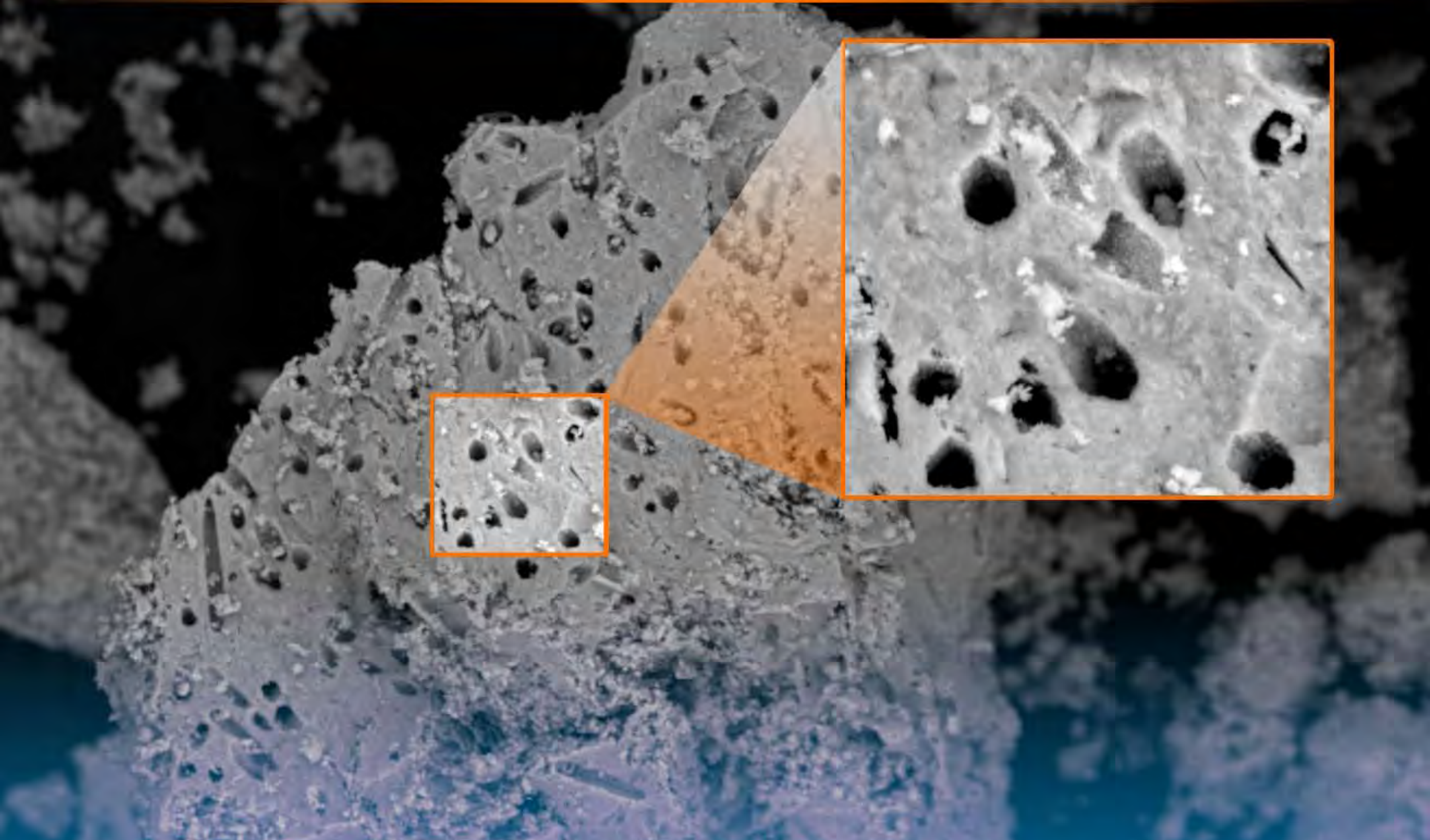
PNNL-16229

Hanford Tanks 241-C-202 and 241-C-203: Residual Waste Contaminant Release Models and Supporting Data



September 2007

Prepared for CH2M HILL Hanford Group, Inc.
and the U. S. Department of Energy
under Contract DE-AC05-76RL01830

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Hanford Tanks 241-C-202 and 241-C-203 Residual Waste Contaminant Release Models and Supporting Data

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Summary

As directed by Congress, the U.S. Department of Energy (DOE) established the Office of River Protection in 1998 to manage DOE's largest, most complex environmental cleanup project – retrieval of radioactive waste from Hanford tanks for treatment and eventual disposal. Sixty percent by volume of the nation's high-level radioactive waste is stored at Hanford in aging deteriorating tanks. If not cleaned up, this waste is a threat to the Columbia River and the Pacific Northwest.

CH2M HILL Hanford Group, Inc. is the Office of River Protection's prime contractor responsible for the storage, retrieval, and disposal of Hanford's tank waste. As part of this effort, CH2M HILL Hanford Group, Inc. contracted with Pacific Northwest National Laboratory (PNNL) to develop release models for key contaminants that are present in residual sludge remaining in Hanford Tanks 241-C-202 (C-202) and 241-C-203 (C-203). The release models were developed from data generated by laboratory characterization and testing of samples from these two tanks. These release models are being developed to support the tank risk assessments performed by CH2M HILL Hanford Group, Inc. for DOE.

The contaminant release models developed for these tanks are based on empirical solubility release models. Sludge testing was not successful in identifying minerals in the solids that may be limiting contaminant release; thus, it was not possible to develop mechanistic release models for the residual sludge in these tanks. The empirical release models apply to two different tank scenarios. In the first scenario the tank is filled with a relatively inert material, such as sand, and the leaching solution that contacts sludge in the future is in equilibrium with calcite ($CaCO_3$). Equilibrium with calcite is the typical condition for Hanford vadose zone porewater and groundwater, and Ca^{2+} and CO_3^{2-}/HCO_3^- are the common major cation and anions in solution. Alternatively, the tanks might be filled with a cementitious material, which would produce a $Ca(OH)_2$ dominated leaching solution while the cement is fresh. As the cement reacts with infiltrating water and ages, it would evolve to resemble the $CaCO_3$ solution of the first scenario. Empirical solubility release models for the primary contaminants of interest (U, Cr, and ^{99}Tc) have been developed from laboratory leaching tests of sludge samples using the $Ca(OH)_2$ and $CaCO_3$ leaching solutions. Results for ^{129}I results were below the detection limit.

Key results from this work are that future release concentrations from these tanks of the primary contaminants of concern in most cases represent less than 10% of the total contaminant concentration in the sludge. That is, the contaminants are not appreciably soluble in the $Ca(OH)_2$ and $CaCO_3$ leaching solutions. For example, the cumulative amount of U leached by the $Ca(OH)_2$ leaching solution during six sequential stages of leaching represented only 0.13% and 0.11% of the total uranium in tanks C-202 and C-203, respectively. The corresponding percentages of U leached by the $CaCO_3$ leaching solution were higher for tank C-202 (9.2%) and tank C-203 (7.4%), but were still a small percentage of the total U present in the residual sludge. The same low cumulative leachable percentages were found for ^{99}Tc, except for a possibly a higher leachable percentage of 26.2% for ^{99}Tc in tank C-203 when leached with the $Ca(OH)_2$ solution. Previously, these contaminants have been considered to be much more leachable from the waste solids. Cr leachability is also less than 10% in all cases except for tank C-203 leached with the $CaCO_3$ solution in which a cumulative amount of 20% of the Cr was leached from the sludge. Note that the six-stage sequential leaching tests represent significant quantities of solution passing through the residual sludge relative to the amount of liquid filling the pores (a pore volume) of the material. For example, one pore volume for a 0.4 g sludge sample with an estimated bulk density of 1.6 g/cc and a porosity of 0.4 would equal 0.1 mL. At each stage of the sequential extractions, 30 mL of

extractant are used with each 0.4 g of sludge sample, thus the extractant solution volume represents 300 sludge sample pore volumes. The amount of time simulated by these leaching tests is a function of the future flow rate into the residual sludge, which is likely to be exceedingly low, and, consequently, the time frame is very long.

The primary product of sludge testing and model development is the measured total contaminant concentrations in the residual sludge and the estimated maximum release concentrations of the key contaminants for the two leaching scenarios. These data are compiled in Table 4.2. They can be used as source term values for the tank performance assessments.

Acknowledgments

The authors wish to acknowledge M. Connelly, J. G. Kristofzski, and F. J. Anderson at CH2M HILL Hanford Group, Inc. (Richland, Washington) for providing project funding and technical guidance. We greatly appreciate the technical reviews provided by F. M. Mann (CH2M HILL), M. I. Wood (Fluor Hanford, Inc., Richland, Washington), and R. J. Serne (PNNL). The authors would also like to thank W. Um, S. R. Baum, Eric Clayton, K. M. Geiszler, I. V. Kutnyakov, and R. D. Orr (all of PNNL) for participating in planning the laboratory tests and completing the chemical and radiochemical analyses of the solution samples from our studies. We are particularly grateful to Launa Morasch (PNNL) for completing the editorial review and Lila Andor and Kathy Neiderhiser (PNNL) for final word processing of this technical report.

Acronyms and Abbreviations

AEA	alpha energy analysis
ASTM	American Society for Testing and Materials
AMU	atomic mass unit
BSE	backscattered electron
$CaCO_3$	calcium carbonate
$Ca(OH)_2$	calcium hydroxide
CCV	continuing calibration verification
DDI	double deionized (water)
DOE	U.S. Department of Energy
DRC	dynamic reaction cell
EDS	energy dispersive spectrometry
EPA	U.S. Environmental Protection Agency
EQL	estimated quantitation limit
GEA	gamma energy analysis
GWB	Geochemist's Workbench®
H_2SO_4	sulfuric acid
HASQARD	Hanford Analytical Services Quality Assurance Requirements Document
IC	ion chromatography (chromatograph)
ICP-MS	inductively coupled plasma-mass spectrometry (spectrometer)
ICP-OES	inductively coupled plasma-optical emission spectroscopy (same as ICP-AES)
ICDD	International Center for Diffraction Data
JCPDS	Joint Committee on Powder Diffraction Standards
KOH	potassium hydroxide
KNO_3	potassium nitrate
$LiBO_2$	lithium metaborate
LSC	liquid scintillation
NDIR	non-dispersive infrared
NIST	National Institute of Standards and Technology
PDF™	powder diffraction file
PNNL	Pacific Northwest National Laboratory
PUREX	plutonium-uranium extraction
QA	quality assurance

R&D	research and development
SEM	scanning electron microscopy (or microscope)
SI	saturation index
SMBS	Standards-Based Management system
TEM	transmission electron microscopy (or microscope)
TC	total carbon
TIC	total inorganic carbon
TOC	total organic carbon
XAS	x-ray absorption spectroscopy
XRD	x-ray powder diffractometry analysis (commonly called x-ray diffraction)

Units of Measure

Å	angstrom
θ	angle of incidence (Bragg angle)
$\Delta_f G_{298}^o$	Gibbs energy of formation from the elements in their reference states at 298.15 K
ºC	temperature in degrees Celsius [T(ºC) = T(K) – 273.15)]
eV	electron volt
g	gram
K	temperature in degrees (without degree symbol) Kelvin [T(K) = T(ºC) + 273.15]
K_{298}^o	equilibrium constant at 298.15 K
kcal	kilocalorie, one calorie equals 4.1840 joules
keV	kilo-electron volt
kJ	kilojoule, one joule equals 4.1840 thermochemical calories
L	liter
µ	micro (prefix, 10^{-6})
µeq	microequivalent
µg	microgram
µm	micrometer
M	molarity, mol/L
mg	milligram
mL	milliliter
mM	molarity, millimol/L
mol	mole
pg	picogram (10^{-12} grams)
rpm	revolution per minute
µmol	micromol
I/I_o	relative intensity of an XRD peak to the most intense peak
λ	wavelength
wt%	weight percent

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1.0 Introduction

This report describes the development of release models for contaminants of concern that are present in residual waste in Hanford tanks 241-C-202 (C-202) and 241-C-203 (C-203) after final waste retrieval. These release models are necessary components of the tank performance assessments. From the perspective of long-term risk to the environment, the primary contaminants of concern are ^{99}Tc, ^{238}U, ^{129}I, and Cr because of their mobility in the environment and, in the case of the radionuclides, their long half-lives. Sludges from tanks C-202 and C-203 were collected after final retrieval activities to characterize the geochemistry of the solids and to quantify the future release of the primary contaminants into water.

The remainder of this section describes the scope of work for laboratory testing and release model development as well as background information on the C-200 series tanks. The sludge samples and laboratory testing procedures for this project are described in Section 2 of this report, and the results are provided in Section 3. Release models are discussed in Section 4 and general conclusions in Section 5. Cited references are listed in Section 6, and supporting material is included in the appendices.

1.1 Scope of Work

Initial (Tier 1) laboratory tests were conducted to characterize the sludge and identify water-leachable constituents. The Tier 1 tests consisted primarily of fusion analysis and acid digestion, which measured elemental concentrations in the solid, and water leaching of contaminants from the sludge to evaluate their mobility in infiltrating water. Water leaching was conducted with double deionized water (DDI), $Ca(OH)_2$-saturated water, and $CaCO_3$-saturated water. The $Ca(OH)_2$ and $CaCO_3$ saturated solutions were used to mimic the initial and final status of a tank chemical system in which the void space above the residual waste is filled with cementitious grout, which is a possible tank fill material. Based on the results of the Tier 1 tests, additional analyses were performed to augment the characterization of the material and elucidate the controlling mechanism(s) for the release of contaminants. Tier 2 tests consisted of x-ray diffraction (XRD) and scanning electron microscopy/energy dispersive spectrometry (SEM/EDS) analyses of the solids to identify reactive phases and uranium mineral solubility measurements to quantify the release of uranium from solid phases in the waste.

The laboratory results of sludge testing were used to develop source term models that describe the release of contaminants as infiltrating water contacts the solids in the future. These models simulate the geochemical system in the tank sludge and take into account interactions between the solution phase and the contaminant-containing solids. The release models are simplifications of the complex geochemical interactions occurring between the phases; however, they adequately represent the release of the key contaminants from the sludge as measured in laboratory tests.

1.2 C-200 Series Tank Description

The C-200 series consists of four single-shell underground waste tanks (C-201 through C-204) in the C Tank Farm in the 200 East Area of the Hanford Site (Figure 1.1). These C-200 series tanks are 6 m (20 ft) in diameter and have a capacity of 208,200 L (55,000 gal) when filled to a depth of 7.3 m (24 ft). Figure 1.2 is a schematic of the configuration of tank C-204.

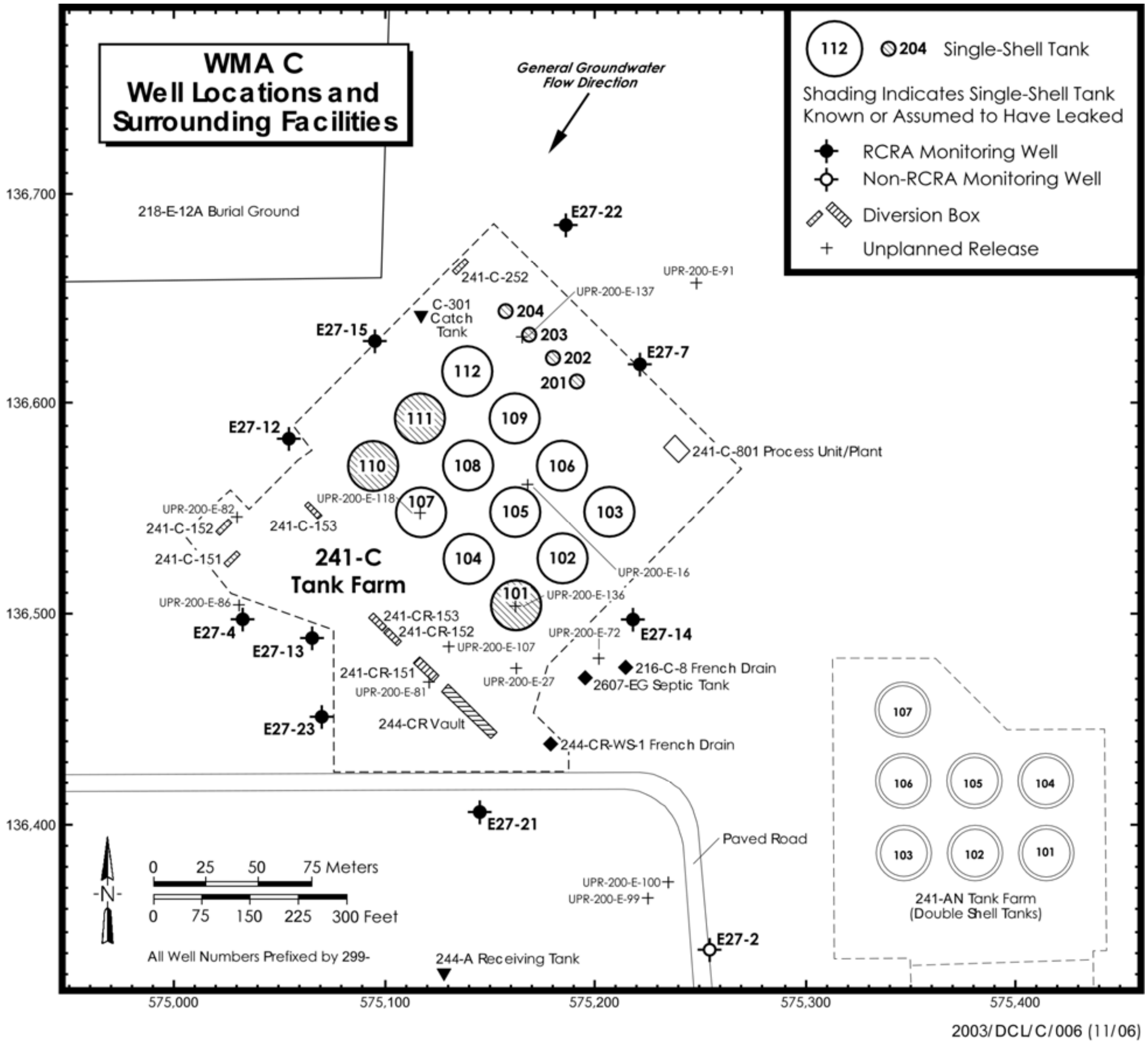

Figure 1.1. Hanford C Tank Farm

The history of waste transfers into and removals from these tanks provides an indication of the types of residual materials that may be present in the tanks. The following information on the C-200 series tank transfers is summarized from Johnson (2003).

- Metal waste transfers
  - November 1947 to January 31, 1948 – four tanks filled with metal waste
    - Measurements on May 27, 1948 showed each tank had about 1.22 m (4 ft) of sludge and 5.5 m (18 ft) of liquid above the sludge
  - February 1952 – metal waste began to be removed from these tanks by pumping and sluicing
  - February 1955 – removal complete; all sludge reportedly removed, as shown by visual inspections through a periscope (undoubtedly some residual waste remained)

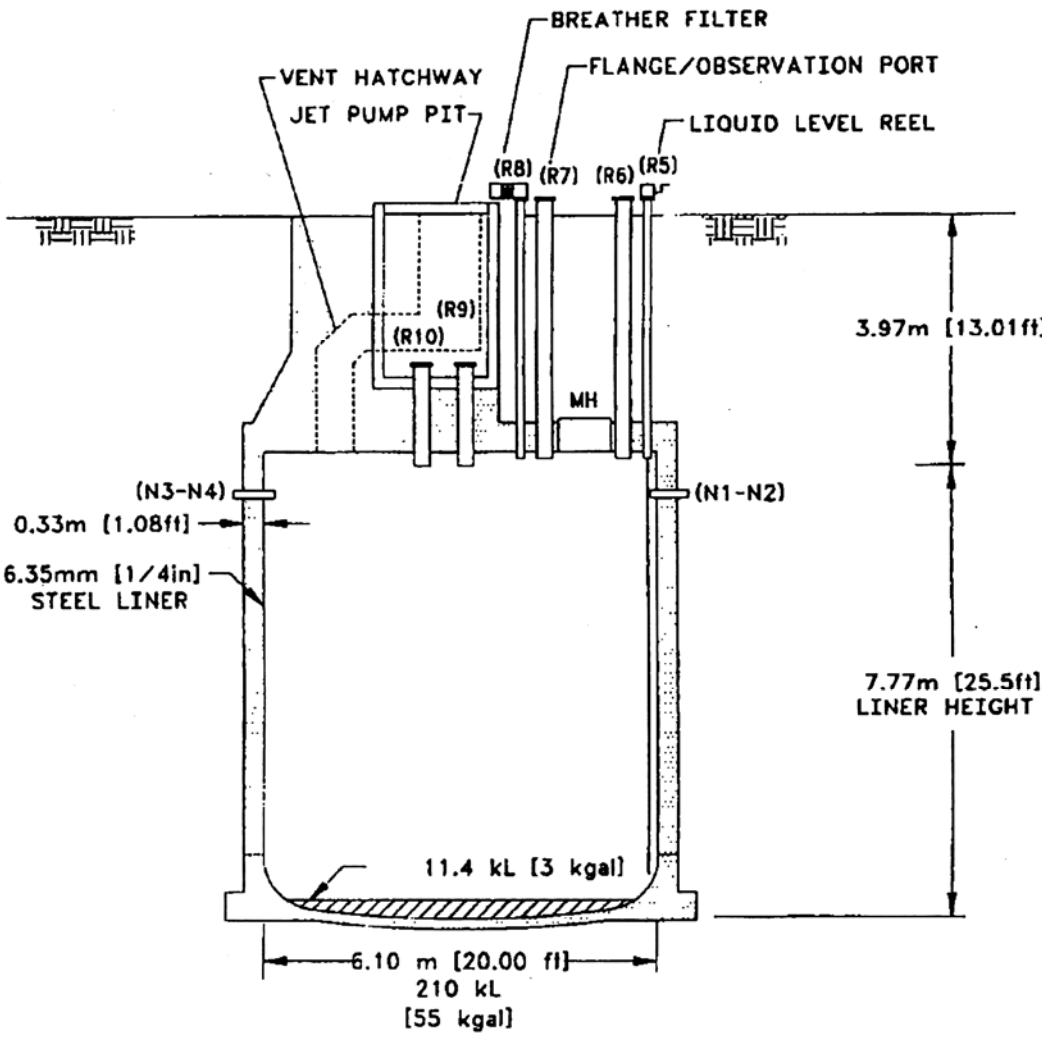

Figure 1.2. Tank C-204 Configuration (Conner 1996)

- Hot Semiworks transfers
  - May 1955 to November 1956 – highly radioactive waste from research and development (R&D) of plutonium-uranium extraction (PUREX) process in the Hot Semiworks facility was concentrated to recover nitric acid, neutralized with sodium hydroxide solution, and transferred to the four tanks.
  - May 1956 – C-201 and C-202 were reported filled with this waste.
  - November 1956 – C-203 and C-204 were reported to contain 130,600 L (34,500 gal) of this waste

- PUREX plant cold uranium run waste
  - November 1955 – C-203 and C-204 received waste from cold uranium runs as part of startup operations at the PUREX Plant

- No additional waste added after November 1956

- Supernatant removal
  - January to March 1970 – C-203: 19,000 gal pumped to C-109
  - April to June 1970 – C-201 through C-204: supernatant pumped to C-104; with the exception of C-204, these tanks contained only a heel of sludge following the transfer of these amounts:
    - C-201: 204,400 L (54,000 gal)
    - C-202: 208,198 L (55,000 gal)
    - C-203: 45,400 L (12,000 gal)
    - C-204: 53,000 L (14,000 gal) (contained 155,000 L [41,000 gal] of supernatant in June 1970)
  - July 10, 1977 – C-204: supernatant pumped out, leaving only 11,400 L (3,000 gal) in this tank
  - October 1980 – C-201 through C-204 supernatant pumped into C-106 using a submersible pump

- Because of the limitations of sludge removal by sluicing and supernatant removal by pumping, some residual material remained in the tanks after the removal campaigns.

Two auger samples of the sludges in tank C-204 were collected in May 1995 (Conner 1996). At that time, it was estimated that the tank contained 11 kL (3 kgal, 1.3 ft) of waste in the form of sludge. The solid samples were analyzed for energetics, moisture, total alpha content, total organic carbon content, and organic compounds. The analytical results (on a wet weight basis) were:

• Percent water	56.95%
• Energetics	813 - >1,234 Joules/g (dry basis)
• Total alpha	0.0322 μCi/g
• Total inorganic carbon	10,500 μgC/g
• Total organic carbon	126,000 μgC/g
• Tributyl phosphate	330,000 μg/g
• Dibutyl phosphate	2,000 μg/g

Tributyl phosphate was used as an organic solvent in several separations processes at the Hanford Site.

Final removal of waste was accomplished by CH2M HILL in August 2005 for tank C-202 and in March 2005 for C-203. A vacuum system was used to remove as much sludge as possible. A high-pressure water spray was used with the vacuum to break up the larger particles of waste that could not be removed solely by vacuum suction because of their size. Following retrieval, samples of the waste were collected for chemical analysis and testing. Samples analyzed and tested by Pacific Northwest National Laboratory (PNNL) are described in Section 2.

2.0 Materials and Laboratory Test Methods

This section provides a description of the sludge samples provided to PNNL and the various tests used to characterize the material, measure contaminant release, and identify controlling solids.

2.1 C-202 and C-203 Sludge Samples

Sludge samples from tanks C-202 and C-203 were collected by CH2M HILL Hanford Group, Inc. during post-retrieval activities in November and May 2005, respectively. The material from tank C-202 (sample 19250) was provided to PNNL on January 24, 2006, and the sludge from tank C-203 (samples 19887 and 19961) were provided on September 15, 2005 (Table 2.1). Figure 2.1 is a photograph of sample 19250 from tank C-202. Figure 2.2 shows sample 19887 from tank C-203 and Figure 2.3 shows sample 19961, also from tank C-203.

Table 2.1. Samples Provided to PNNL by 222-S Laboratory

Tank	Sample #	Sample Size (mL)	Labcore Number	Net Weight of Sample as Received (g)
241-C-202	19250	250	S06T000037	62.4
241-C-203	19887	250	S05T001015	27.9
241-C-203	19961	250	S05T001016	60.6

Figure 2.1. C-202 Tank Sludge (Sample 19250)

Figure 2.2. C-203 Tank Sludge (Sample 19887)

Figure 2.3. C-203 Tank Sludge (Sample 19961)

2.2 Sludge Composition by Fusion Analysis and Acid Digestion

The bulk compositions of the sludge solids were determined using accepted PNNL internal procedure AGG-ESL-001, *Solubilization of Metals from Solids Using a KOH-KNO_3 Fusion*[a] and a modified version of U.S. Environmental Protection Agency (EPA) SW-846 Method 3052 (EPA 1996). These methods were used to measure the elemental composition of the sludge, but are not appropriate for the anion concentrations due to the addition of acids used in the analyses. The anion compositions were measured separately in solutions obtained by water leaching of the solids (see Section 2.5.6).

(a) Unpublished technical procedure. *Solubilization of Metals from Solids Using a KOH-KNO_3 Fusion*. AGG-ESL-001, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.

The potassium hydroxide (KOH)-potassium nitrate (KNO_3) fusion-dissolution procedure is the most commonly used method for solubilization of Hanford tank sludge samples for chemical analysis by inductively coupled plasma-mass spectroscopy (ICP-MS) and other methods (De Lorenzo et al. 1994; Simpson 1994; Fiskum et al. 2000; Smith et al. 2001). Benefits of this procedure include effective metathesizing of insoluble salts such as $SrSO_4$, $PuPO_4$, PuF_3, and ThF_3 into acid soluble hydroxides; completed fusion at relatively low temperature (550°C) compared to other fluxing agents, such as 1100°C for the lithium metaborate ($LiBO_2$) fluxing agent; and use of nickel or zirconium crucibles, as opposed to the more costly platinum crucibles, for the fusion.[(b)]

The KOH-KNO_3 fusion-dissolution procedure consists of chemical analyses of a solution resulting from water and acid dissolutions of a solid that has been fused at a high temperature with the caustic fluxing agent. In this procedure, 300 mg of tank waste sludge material was mixed with 6 mL of a 30% KOH and 3% KNO_3 solution as a fluxing agent in a zirconium crucible. The crucible was then placed in a 95°C oven and allowed to evaporate to dryness, after which it was covered and transferred to a muffle furnace preheated to 550°C. Fusion was accomplished by heating the sample/flux mixture for 60 minutes at 550°C. After 60 minutes, the crucible was removed from the furnace and allowed to cool to room temperature. The fused solid was then dissolved in DDI water. The resulting solution was transferred to a 50-mL centrifuge tube. The crucible was then triple-rinsed with a 1:1 mixture of concentrated sulfuric acid and 1M sodium bisulfite, and these solutions were also added to the centrifuge tube. An additional 5 to 15 mL of the sulfuric acid:sodium bisulfite solution was added to the centrifuge tube to facilitate total sample dissolution. Once sample dissolution was complete, the final solution volume in each centrifuge tube was determined gravimetrically and corrected for solution density.

Chemical analyses of an acid digestion of the sludge solids were also completed to compare the results with the KOH-KNO_3 fusion procedure. The basic procedure described in EPA SW-846 Method 3052 (EPA 1996) was used for acid digestion of the sludge. In this procedure, 300 mg of the sample is placed in a Teflon microwave digestion vessel and 10-mL water, 5-mL 16 M HNO_3, 2-mL 12 M HCl and 1-mL 29 M HF are added to the sample, the vessel is sealed and placed in a microwave-assisted digestion system. The samples are treated at the EPA recommended temperatures and times. The sample is then allowed to cool and 0.45 grams of boric acid is added to the digestate and shaken by hand. Samples are filtered through a 0.45-µm pore-size syringe filter prior to analysis. There were no visible solids when the digestion was complete.

Table 2.2 lists the digestion factors (wet solid-to-solution ratios) for sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) used for the KOH-KNO_3 fusion treatments and EPA acid digestions. These factors were calculated from the wet weight of sludge material divided by the volume of extracting solution. The digestion factors were then multiplied by the percent solids, as determined from moisture content analysis, to convert to a dry weight basis. All EPA acid-digestion and fused-sample solutions were filtered using 0.45-µm pore-size syringe filters prior to analysis. The dissolved metal concentrations and the total beta and total alpha activities for the filtered solutions were then analyzed by a combination of methods, including ICP-MS, inductively coupled plasma-optical emission spectroscopy (ICP-OES), and several radiochemical analytical techniques. These analytical methods are described in Lindberg and Deutsch (2003).

(b) Personal communication with WI Winters (CH2M HILL), December 22, 2003.

Table 2.2. Digestion Factors for Sludge Solids Used for the EPA Acid Digestion and KOH-KNO_3 Fusion Treatments

Treatment	Sample Number	Dry Weight Corrected Digestion Factor (g/L)
KOH-KNO_3 fusion	19250 (202)	5.15
	19250 (202) Dup[(a)]	7.83
	19887 (203)	5.90
	19887 (203) Dup	5.69
	19961 (203)	6.43
	19961 (203) Dup	6.88
EPA Method 3052 acid digestion	19250 (202)	8.89
	19250 (202) Dup	7.57
	19250 (202) Trip[(b)]	7.43
	19887 (203)	9.15
	19887 (203) Dup	5.72
	19961 (203)	8.70
	19961 (203) Dup	10.65

(a) Dup = Duplicate sample.
(b) Trip = Triplicate sample.

2.3 XRD Analysis

Standard bulk powder XRD techniques were used to identify crystalline phases present in the following samples:

- Post-retrieval residual waste from tank C-202
  - Unleached solids
  - One-month single-contact leached DDI water extraction solids
  - One-month single-contact $Ca(OH)_2$ leached solids
  - One-month single-contact $CaCO_3$ leached solids

- Post-retrieval residual waste from tank C-203
  - Unleached brown, yellow, and orange solids separated from Sample 19887
  - Unleached brown, yellow, and orange solids separated from Sample 19961
  - One-month single-contact leached DDI water extraction of solids from Sample 19961
  - Sequential leached DDI water extraction of solids from Sample 19961
  - One-month $Ca(OH)_2$-leached solids from Sample 19961
  - Sequential $Ca(OH)_2$-leached solids from Sample 19961
  - One-month $CaCO_3$-leached solids from Sample 19961
  - Sequential $CaCO_3$-leached solids from Sample 19961

The DDI water extraction, $Ca(OH)_2$, and $CaCO_3$ leach tests are described in Sections 2.5.3 and 2.5.4. Based on visual inspection, samples 19887 and 19961 of unleached C-203 post-retrieval residual waste appeared to contain at least three separate phases based on color. Each sample consisted of a brown matrix that contained particles or aggregates which are approximately 1 to 2 mm in size or smaller and yellow or orange in color. Subsamples of the dominantly brown, yellow, and orange materials were separated from each sample by hand picking, and analyzed separately by XRD.

Because the residual waste samples were highly radioactive dispersible powders, it was necessary to prepare the XRD mounts of these samples inside a fumehood regulated for handling radioactive materials. Residual waste samples were prepared for XRD analysis by placing milligram quantities of each sample into a mixture of water and collodion solution. The collodion solution consists of 2% nitrocellulose dissolved in amyl acetate, and is an x-ray amorphous, viscous binder commonly used to make random powder mounts for XRD when only a limited amount of sample is available. A trace quantity of reference-material corundum powder (α-Al_2O_3, alumina) [National Institute of Standards and Technology Standard Reference Material (NIST SRM) 676] was added to each sample slurry as internal 2θ standard to correct for any observed peak shifts due to slight misalignments of the mounted samples.

Using a pipette, each slurry was transferred onto a circular-shaped platform (1-cm [0.39-in.] diameter) and placed on top of the post located on the base inside a disposable XRD specimen holder (Figure 2.4). This specimen holder was designed specifically for safe handling of dispersible powders containing highly radioactive or hazardous materials (Strachan et al. 2003). After allowing samples to air dry overnight, the holder was assembled and a piece of Kapton® film was placed between the cap and the retainer. The holder was sealed with wicking glue and removed from the fumehood.

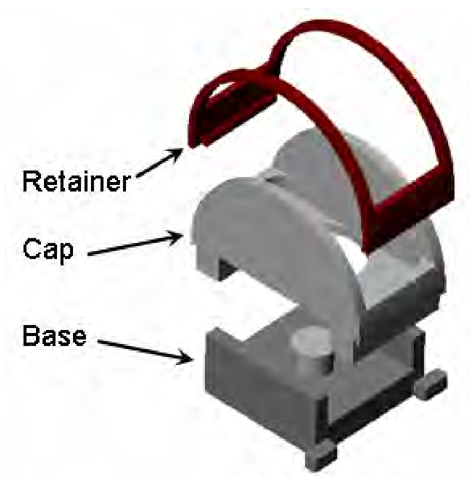

Figure 2.4. Exploded Schematic View of the XRD Sample Holder (Kapton® film not shown) (see Strachan et al. 2003)

Each sample was analyzed using a Scintag XRD unit equipped with a Peltier thermoelectrically-cooled detector and a copper x-ray tube. The diffractometer was operated at 45 kV and 40 mA. Individual scans were obtained from 2 to 65°2θ with a dwell time of 4 and 14 seconds. Scans were collected electronically and processed using the JADE® XRD pattern-processing software.

A sample consisting of only a dry film of the collodion solution was prepared and analyzed by XRD so that its contribution relative to the background signals of the XRD patterns for the residual waste samples could be quantified (Krupka et al. 2004). The resulting XRD pattern for the collodion solution film is shown in Figure 2.5. The most obvious feature of this diffraction pattern is the broad peak positioned between 10° and 30°2θ. The symmetry of this peak is characteristic of those resulting from the XRD of amorphous (noncrystalline) material. Although subtracting the collodion background from residual waste XRD patterns allows for better phase matching, this process may eliminate minor reflections and inconspicuous features of a pattern. Therefore, each as-measured XRD pattern was examined before and after background subtraction to ensure that the integrity of the pattern was maintained. For background subtraction, the JADE® software provides the user with control over the selection of background-subtraction points. This process allows a better fit to 2θ regions under broad reflections, such as those resulting from amorphous materials. On average, 30 to 40 background points were selected from each XRD pattern, and a cubic-spline curve was then fit through each set of points. Adjustments to this curve were made by selecting additional background points in regions of a pattern that were difficult to fit. Once a well-matched curve was fitted to a pattern, the background was subtracted from each as-measured XRD pattern, resulting in a smooth tracing.

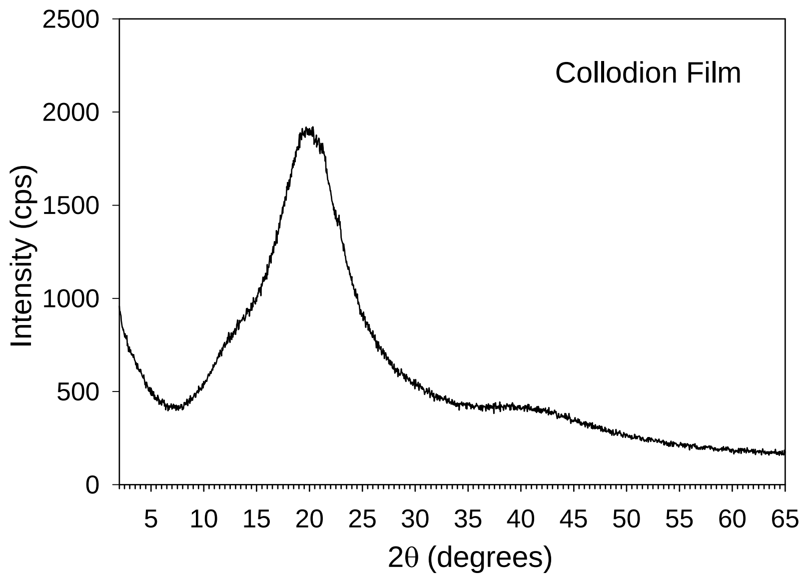

Figure 2.5. XRD Pattern for Collodion Film Measured in the Absence of Any Residual Waste Material (from Krupka et al. 2004)

Identification of the mineral phases in the background-subtracted patterns was based on a comparison of the XRD patterns measured for the residual waste samples with the mineral powder diffraction files (PDF™) published by the Joint Committee on Powder Diffraction Standards (JCPDS) International Center for Diffraction Data (ICDD). As a rule of thumb, a crystalline phase must be present at greater than 5 wt% of the total sample mass (greater than 1 wt% under optimum conditions) to be readily detected by XRD. In general, the measured peak intensities depend on several factors, including the combined mass of each crystalline phase in the sample. Due to the physical characteristics of these residual waste samples such as high radioactivity, high dispersibility, and variable moisture content, the mass of residual waste combined with the collodion solution for each XRD mount could not be controlled or easily determined. Dissimilarities in mineral segregation (settling) resulting from the different densities of minerals mixed with the collodion solution and associated effects on relative peak intensities also influence the overall pattern intensity. The combined effect of these factors could have some effect on the characteristic mineral peak intensities, which precluded quantitative comparisons of peak intensities for equivalent reflections in background-subtracted XRD patterns for different residual waste samples.

2.4 SEM/EDS Analysis

SEM/EDS analyses were used to characterize the morphologies and compositions of solid phases present in the following residual waste samples:

- Tank C-202:
  - Unleached solids
  - One-month single-contact DDI water extraction leached solids
  - One-month single-contact $Ca(OH)_2$ leached solids
  - One-month single-contact $CaCO_3$ leached solids

- Tank C-203:
  - Unleached yellow, brown, and orange solids separated from samples 19887 and 19961
  - One-month single-contact DDI water extraction leached solids from samples 19887 and 19961
  - Sequential DDI water extraction leached solids from samples 19887 and 19961
  - One-month single-contact $Ca(OH)_2$-leached solids from sample 19961
  - Sequential $Ca(OH)_2$-leached solids from sample 19961
  - One-month single-contact $CaCO_3$-leached solids from sample 19961
  - Sequential $CaCO_3$-leached solids from sample 19961

The DDI water extraction, $Ca(OH)_2$, and $CaCO_3$ leach tests are described in Sections 2.5.3 and 2.5.4. As noted in Section 2.3, the unleached C-203 residual waste appeared to contain at least three separate phases based on color. Subsamples of the dominantly brown matrix, and the yellow and orange particles or aggregates in this matrix were separated from each sample by hand and analyzed separately by SEM/EDS.

Multiple mounts were usually prepared of each sample to compensate for the possibility that one or more less-than-optimum mounts of a sample might occur, thus improving the likelihood of obtaining representative SEM images of each sample. The mounts used for SEM/EDS consisted of double-sided carbon tape attached to standard aluminum mounting stubs. For each mount, small aliquots of each sludge sample were placed on the exposed upper surface of the carbon tape using a micro spatula. Each mount was then coated with carbon using a vacuum sputter-coater to improve the conductivity of the samples and thus the quality of the SEM images and EDS signals.

A JEOL JSM-840 SEM was used for high-resolution imaging of micrometer/submicrometer-sized particles in the residual waste samples. The EDS system provided qualitative elemental analysis for scanned areas of particles. The SEM is equipped with an INCA Energy EDS System[c] to automate the collection of EDS spectra over multi-micrometer-sized areas of an SEM-imaged sample. The EDS software was calibrated to a copper reference standard mounted on a specimen holder. Operating

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(c) Oxford Instruments, Concord, Massachusetts.

conditions consisted of 10 to 20 keV for SEM imaging and 20 keV, 100 live seconds[(d)] for the EDS analyses. The EDS analyses are limited to elements with atomic weights heavier than B (boron). Compositions determined by EDS are qualitative and have large uncertainties resulting from alignment artifacts caused by the variable sample and detector configurations that exist when different particles are imaged by SEM.

Photomicrographs of high-resolution secondary electron (SE) images and backscattered electron (BSE) images were obtained as digital images and stored in electronic format. To help identify particles that contain elements with large atomic numbers, such as uranium, the SEM was typically operated in the BSE mode. Secondary electrons are low-energy electrons ejected from the probed specimen as a result of inelastic collisions with beam electrons, whereas backscattered electrons are primary electrons emitted as a result of elastic collisions. Backscattered electron emission intensity is a function of the element's atomic number – the larger the atomic number, the brighter the signal. Backscattered electron images are obtained in exactly the same way as secondary electron images.

The entire area of each SEM mount was examined by SEM at low magnification (typically 50 to 100 times) to identify those particles and surface features that were typical or unusual for the sample. During this examination, SEM micrographs were recorded at low magnification (e.g., 100 times) for two areas of the mount to provide a general perspective of the sizes, types, and distributions of particles that make up each SEM mount. Within these imaged regions, additional SEM micrographs were recorded of several particles at greater magnifications to provide a more detailed representation of the particles' characteristics, and selected points on these particles were then analyzed by EDS. Depending on the perceived importance of such particles, regions on these particles were sometimes analyzed by SEM and EDS at even greater magnifications.

2.5 Tier 1 Tests

Tank waste samples were analyzed in a tiered approach similar to the one developed for investigating contaminant fate and transport issues associated with past single-shell tank leaks in the vadose zone. Such an approach allows for initial (Tier 1) screening of samples using relatively inexpensive analytical techniques. This is followed by an analysis of the data to determine the need for further testing (Tier 2). The Tier 1 tests are described in this section and the Tier 2 tests are described Sections 2.6 to 2.8.

All laboratory activities were conducted in accordance with the requirements of Title 10, Code of Federal Regulations, Part 830.120 "Quality Assurance" (10 FR 830.120) and the Hanford Analytical Services Quality Assurance Requirements Document (HASQARD; DOE 1998). These requirements were implemented using PNNL's online quality assurance (QA) Plan, "Conducting Analytical Work in Support of Regulatory Programs." PNNL's QA Plan is based on the requirements of DOE Order 414.1A as described in PNNL's Standards-Based Management System (SBMS), the HASQARD, relevant elements of NQA-1, as well as recognized industry standards (e.g., EPA, American Society for Testing and Materials [ASTM], American National Standards Institute).

(d) Live time is when (real time less dead time) the EDS system is available to detect incoming x-ray photons. Dead time is the portion of the total analyzing time that is actually spent processing or measuring x-rays. While each x-ray pulse is being measured, the system cannot measure another x-ray that may enter the detector and is, therefore, said to be "dead."

2.5.1 Moisture Content

The moisture contents of the tank waste samples were measured to calculate dry weight concentrations for constituents in the waste. Dry weight concentrations provide a consistent measurement unit for comparison purposes that eliminates the effect of variable water content on sample concentrations.

Gravimetric water content of the waste material was determined using the ASTM procedure D2216-98, *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass* (ASTM 1998) with the following minor exceptions: 1) the volume of sample recommended was decreased due to radiological concerns and 2) the sample was dried at a lower oven temperature, 105°C, for a longer period of time to prevent dehydration of the solids.

Sludge samples were placed in tared containers, weighed, and dried in an oven until a constant weight was achieved, usually 24 to 48 hours. The container was then removed from the oven, sealed, cooled, and weighed. All measurements were performed using a calibrated balance. The gravimetric water content is computed as the percentage change in soil weight before and after oven drying (i.e., [{wet weight - dry weight}/dry weight]).

2.5.2 Carbon Analysis

The analysis of the carbon content of solid and liquid samples is described in this section.

2.5.2.1 Carbon Content of Solids

The carbon content of solid samples is determined by the hot persulfate method.[e] In this method, samples are treated by wet chemical oxidation by heating at 92 to 95°C with a solid potassium persulfate oxidant and liquid silver-ion catalyst. Sulfuric acid (H_2SO_4) is also used to convert carbon to carbon dioxide (CO_2). The CO_2 is swept away by an oxygen carrier gas and measured in a UIC Coulometrics Acid Module.

The method uses a two-step process allowing a separate measurement of total inorganic carbon (TIC) and total organic carbon (TOC) on the same sample. In this process, the sample is first acidified with heated sulfuric acid, converting inorganic carbonates to CO_2 (i.e., TIC analysis), then the persulfate solids and silver-catalyst solution is added and the organic carbon remaining in the sample is converted to CO_2 for TOC measurement. Total carbon (TC) for a solid sample is calculated from the sum of TIC and TOC.

2.5.2.2 Carbon Content of Liquids

The carbon content of liquid samples is determined using PNNL's technical procedure,[f] which is similar to EPA SW-846 Method 9060A (EPA 2004). A Shimadzu Carbon analyzer Model TOC-V CSN with ASI module (auto sampler) is used for the analysis.

(e) Unpublished internal technical procedure: *Carbon Measured in Solids, Sludge, and Liquid Matrices*. RPG-CMC-385, Pacific Northwest National Laboratory, Richland, Washington.

(f) Unpublished internal technical procedure: *Operating of Carbon Analyzer (TOC-V + SSM-5000A + ASI (Shimadzu)*. AGG-TOC-001, Pacific Northwest National Laboratory, Richland, Washington.

Liquid samples are analyzed for TC by introducing a sample aliquot into a combustion chamber with an oxidation catalyst and heated to 680°C. The released carbon from the combustion is converted to CO_2, swept from the combustion chamber by ultra pure oxygen, dehumidified and scrubbed to remove halogens. The carrier gas then delivers the sample combustion products to the cell of a non-dispersive infrared (NDIR) gas analyzer where the carbon dioxide is detected and measured. The amount of CO_2 is proportional the total carbon content of the sample.

Liquid samples are analyzed for total organic carbon by first acidifying a sample aliquot with 3-M HCl to a pH less than 3 with sparging to remove the evolved inorganic carbon dioxide. The remaining acidified sample is introduced into a combustion chamber with an oxidation catalyst and heated to 680°C. The released carbon from the combustion is converted to CO_2, swept from the combustion chamber by ultra pure oxygen, dehumidified and scrubbed to remove halogens. The carrier gas then delivers the sample combustion products to the cell of a NDIR gas analyzer where the carbon dioxide is detected and measured. The amount of CO_2 measured is proportional the TOC content of the sample.

Inorganic carbon for a liquid sample is calculated from the difference of the TC and TOC.

2.5.3 Single Contact Sludge Extraction Tests

Water-soluble inorganic constituents were determined using a DDI water extraction method. The extract was prepared by adding 30 mL of DDI water to 0.200 to 0.600 g of the residual sludge contained in a 50-mL polypropylene centrifuge tube. The centrifuge tube was sealed, briefly shaken by hand, and then placed on a mechanical orbital shaker for 1 month. After shaking for the predetermined time, the tube was placed in a centrifuge and spun at 4,000 rpm for 20 minutes. The supernatant was carefully decanted and filtered through 0.45-µm pore size membrane. More details can be found in ASTM Procedure D3987-85, *Standard Test Method for Shake Extraction of Solid Waste with Water* (ASTM 1999).

To evaluate the leachability of constituents from residual sludge by a leaching solution produced from water contacting cementitious grout filling the tank above the sludge, a $Ca(OH)_2$-saturated solution was prepared to simulate a leachant produced by fresh cement. A sufficient quantity of fresh $Ca(OH)_2$ (~1.4 g/L @ 25°C) was added to deionized water to just saturate the solution. Excess solid $Ca(OH)_2$ is undesirable because it will buffer the pH at a higher than expected value. Because CO_2 in air is very soluble in water at high pH and the resulting dissolved carbonate will precipitate as calcite in the $Ca(OH)_2$-saturated solution, care was taken to minimize contact of the solution with air. When possible, Teflon containers were used because they have low air diffusion coefficients. Air space in the containers was also minimized and the vessel was tightly sealed to limit leakage of air into the vessel. The pH of an aliquot of the $Ca(OH)_2$ solution was measured as well as the dissolved calcium concentration. This solution was used to leach the sludges in the same manner as the DDI water leachant discussed in the previous paragraph.

To evaluate the leachability of constituents from residual sludge by a leaching solution produced from water contacting aged cement filling the tank above the sludge, a $CaCO_3$-saturated solution was prepared to simulate a leachant produced by aged cement. The calcite-saturated solution was prepared by adding excess powdered calcite to deionized water and stirring or shaking the mixture for 24 hours. The temperature during equilibration was a few degrees above room temperature. By preparing the solution at a slightly elevated temperature the possibility of calcite precipitation during the test at room temperature was minimized. (Calcite undergoes retrograde solubility.) There was no need to minimize contact of this solution with the atmosphere. This solution was also used to leach the sludges in the same manner as the DDI water and $Ca(OH)_2$ leachants discussed in the previous paragraphs.

2.5.4 Periodic Replenishment Sludge Extraction Tests

Periodic replenishment tests were conducted on the samples of residual sludges from tanks C-202 and C-203. These tests were conducted with each of the DDI water, $Ca(OH)_2$-saturated, and $CaCO_3$-saturated leachants. In these tests, the leachant was periodically removed and replaced with an equal volume of fresh solution. This test was conducted to evaluate whether solution concentration might be limited by the solubility of one or more solid phases. For these tests, the samples were contacted with the separate leachants for a total of six times. The lengths of time (contact periods) between replenishment of leachant solutions were 1 day for stages 1, 2, 4, and 5; 3 days for stage 3, and 30 days for stage 6. The sludge samples were prepared and handled in the same manner as the single-contact water extracts for each repetitive step.

After these long-term tests, the samples were centrifuged and the supernatant carefully decanted and filtered through 0.45-μm pore size membranes prior to analysis for the same constituents as the shorter-term tests.

2.5.5 pH

The pH of the solutions was measured using a solid-state pH electrode and a pH meter calibrated with buffers bracketing the expected range. This measurement is similar to EPA SW-846, Method 9040C (EPA 2004).

2.5.6 Anion Analysis

Anion analysis was performed using an ion chromatograph. Fluoride, acetate, formate, chloride, nitrite, bromide, nitrate, carbonate, sulfate, oxalate, and phosphate were separated on a Dionex AS17 column with a gradient elution technique from 1-mM to 35-mM NaOH and measured using a conductivity detector. This methodology is similar to EPA SW-846, Method 9056 (EPA 1994) with the exception of using gradient elution with NaOH.

2.5.7 Cations and Trace Metals

Major cation analysis (including aluminum, silicon, calcium, magnesium, sodium, potassium, iron, and manganese) was performed by ICP-OES EPA SW-846 Method 6010B (EPA 1996). Trace metals analysis (including chromium, molybdenum, arsenic, selenium, cadmium, silver, lead, ^{99}Tc, and uranium isotopes) was performed by ICP-MS. This method is similar to EPA Method 6020 (EPA 1996).

For both ICP-OES and ICP-MS, high-purity calibration standards were used to generate calibration curves and to verify continuing calibration during the analysis. Dilutions of 10 times and 5 times were made for each sample and analyzed to investigate and correct for matrix interferences.

2.5.8 ^{237}Np and ^{239}Pu Analysis

ICP-MS is a widely accepted method for the determination of trace metals in solution. The instrument requires user calibration using multi-element standards with concentrations ranging from 5 pg/mL to 20 ng/mL. One area of concern in utilizing ICP-MS to measure actinide elements in tank waste extracts is the proximity in atomic mass of the elements of interest. It can be difficult to measure elements separated by only one atomic mass unit (AMU) when one element is present in trace quantities (^{237}Np and ^{239}Pu) while another element is present in macroscopic concentrations (^{238}U). Under these circumstances, peak tailing from ^{238}U can extend into the regions corresponding to ^{237}Np and ^{239}Pu, resulting in erroneously high reporting of total ^{237}Np and ^{239}Pu. During standard ICP-MS analysis of fusion digests and acid extracts of C-203 residual tank waste material, which contained in excess of 3 mg/L dissolved uranium (after dilution), an interferent was observed at atomic mass unit 239 that impacted the quantitative analysis of ^{239}Pu. If the interferent were dissolved uranium, both ^{237}Np and ^{239}Pu would be affected in the same way. However, because the interferent only affected ^{239}Pu measurements, our hypothesis was that UH formed after ionization of the sample and created a mass interferent at AMU 239. This hypothesis was confirmed by analyzing single-element standards of uranium ranging in concentration from 1 to 500 mg/L while monitoring instrument response (which was a linear increase as a function of uranium solution concentration) at AMU 237 and 239.

A key feature of the Perkin Elmer ELAN DRC II ICP-MS is the ability to inject a reaction gas, such as O_2, CO_2, or N_2O, into the first quadrupole chamber. In the case of uranium, this promotes the formation of uranium oxide species which are filtered out prior to injection into the second (and primary) quadrupole. This creates a significant reduction in the background signal over the key actinide atomic mass range (237-239), resulting in instrument limits of quantification in the range of 7.1 pCi/L for ^{237}Np and 310 pCi/L for ^{239}Pu. Successful analysis of fusions from tank C-106 residual sludge material using conventional ICP-MS analysis has been documented by Deutsch et al. (2005). However, tank C-106 sludge samples contained nearly three orders of magnitude less uranium than sludge samples from tanks C-202 and C-203. Therefore, a specialized ICP-MS technique was developed to facilitate the analysis of transuranics in sludge samples from tanks C-202 and C-203. Initial method development was performed using CO_2 as the reaction gas. Surrogate solutions of tank C-203 acid extracts containing 10 mg/L uranium with 0.1 μg/L of ^{237}Np and ^{239}Pu were successfully analyzed using dynamic reaction cell (DRC) ICP-MS with CO_2 as the reaction gas.

Next, O_2 was tested as a reaction gas to determine its efficiency to react with uranium. The hypothesis was that if the efficiency of the reaction could be increased, more of the uranium could be removed, thereby lowering the limit of quantification for the analysis. This was tested by analyzing single-element standards of uranium ranging in concentration from 1 to 25 mg/L using the DRC-ICP-MS while monitoring instrument response at atomic mass units 238 and 239. With a flow rate of 0.15 mL/min, the uranium intensity at AMU 238 saturated the detector starting with the 1-mg/L uranium standard. Although the DRC was effective at removing a significant portion of the uranium, sufficient uranium persisted to cause detector saturation during the analysis. Ordinarily, AMU 238 would not be monitored during the analysis of ^{239}Pu in the DRC mode; therefore, the fact that detector saturation occurred during analysis of the 1-mg/L uranium solution at this flow rate was not critical. What was more important was the impact at AMU 239. Using O_2 as the reaction gas, the count rate at AMU 239 increased as a function of increasing uranium solution concentration. However, the increase was relatively linear, which enabled a correction factor to be applied to the data. Performing this correction resulted in count rates ranging from 1 to 26 cps at AMU 239 for uranium solutions ranging in concentration from 1 to 25 mg/L, respectively. Unfortunately, the rate of reaction between O_2 and plutonium was also extremely efficient; the plutonium was reacting nearly as quickly as the uranium contained in the sample. Given the large disparity between uranium and plutonium concentrations in these samples, coupled with the similar reaction rates of the two elements, has led us to conclude that O_2 is not a suitable reaction gas for this application.

The final reaction gas tested for its suitability to eliminate uranium interferences at AMU 239 was N_2O. This would hopefully demonstrate that N_2O had a higher affinity to react with uranium than plutonium, thereby leaving sufficient ^{239}Pu post-reaction to make quantitative analysis feasible. While the plutonium did react much more slowly than the uranium using N_2O as the reaction gas, the stability of multiple measurements of a 1-ng/mL solution of ^{239}Pu in 25 mg/L ^{238}U was not sufficient to make quantitative analysis at the desired limit of quantification feasible.

Given the high dissolved uranium load in digests of most tank samples, and particularly the digests of C-202 and C-203 residual tank waste samples, matrix matching the samples was the most appropriate analytical approach. The DRC-ICP-MS analytical method, using CO_2 as the reaction gas, was not fully developed; therefore, the C-202 and C-203 residual tank waste samples were analyzed via conventional ICP-MS analysis using matrix matching to uranium. After reviewing previous work, we did not anticipate analyzing any tank waste fusions or acid extracts containing in excess of 2,500 mg/L dissolved uranium. Typically, dilutions of 100x on the tank waste extracts are performed prior to analyzing them via ICP-MS; therefore, the maximum dissolved uranium concentration anticipated at the time of analysis would be 25 mg/L. Based on this, calibration standards were set up for the ICP-MS with ^{239}Pu concentrations ranging from 0.05 to 0.25 μg/L in the presence of 25-mg/L dissolved uranium. An estimated limit of quantification (EQL) for the analysis was determined using continuing calibration verification (CCV) standards ranging in concentration from 0.01 to 1.0 μg/L ^{239}Pu in the presence of 25 mg/L dissolved uranium. The background corrected data indicate that an instrument EQL for ^{239}Pu using this analysis would be 0.05 μg/L (i.e., the 0.05 CCV standard was the lowest concentration standard accurately measured within 10% of its certified value). Given that this analysis was performed in the presence of 25 mg/L uranium, we have achieved quantitative results in solutions that contain in excess of 5 orders of magnitude more uranium than plutonium. Using this technique, our estimated sample EQL for ^{239}Pu (and ^{237}Np) in the C-202 and C-203 tank waste digests was 5 μg/L.

2.5.9 Alkalinity

The sample alkalinity was measured by standard titration. A volume of standardized sulfuric acid was added to the sample to an endpoint of pH 4.5 to measure total alkalinity. Alkalinity is reported is terms of an equivalent mass of $CaCO_3$. The alkalinity procedure is similar to Standard Method 2320 B (Clesceri et al. 1998).

2.5.10 ^{129}I Extraction and Analysis

From a long-term risk standpoint, ^{129}I is a key potential contaminant in residual Hanford tank waste. For this reason, its presence in the waste material and mobility in infiltrating water is of interest. Although iodine is generally considered mobile as a dissolved constituent in water, small partition coefficients (0.2 to 1 mL/g) are typically calculated when its uptake is measured on Hanford sediments

(Cantrell et al. 2003; Um et al. 2004). Therefore, it is imperative to identify an extraction method that will enable quantitative measurement of total iodine in solid samples such as tank waste.

Previous research (Brown et al. 2005) has shown the potential applicability of water leaches and $KOH:KNO_3$ water fusions for the removal of iodide from solid samples spiked with ^{129}I. The results from Brown et al. (2005) have led to the modification of the accepted PNNL internal procedure,[(g)] to determine the ^{129}I concentration in sludge solids. Using the updated procedure, 300 mg of the tank waste sludge material was mixed with 6 mL of a 30% KOH and 3% KNO_3 solution as a fluxing agent in a zirconium crucible. The crucible was then placed in a 95°C oven and allowed to evaporate to dryness, after which it was covered and transferred to a muffle furnace preheated to 550°C. Fusion was accomplished by heating the sample-flux mixture for 60 minutes at 550°C. After 60 minutes, the crucible was removed from the furnace and allowed to cool to ambient room temperature. The fused solid was then dissolved in DDI water. The resulting solution was transferred to a 50-mL centrifuge tube. The crucible was then triple-rinsed with a 1:1 mixture of concentrated sulfuric acid and 1M sodium bisulfite, and these solutions were also added to the centrifuge tube. An additional 5 to 15 mL of the sulfuric acid:sodium bisulfite mixture was added to the centrifuge tubes to facilitate total sample dissolution. Once sample dissolution was complete, the final solution volume in each centrifuge tube was determined gravimetrically and corrected for solution density. Finally, the samples were diluted using a 1% (by volume) Spectrasol CFA-C solution to ensure the samples were alkaline prior to analysis via ICP-MS.

Table 2.3 lists the digestion factors (wet solid-to-solution ratios) for the samples of C-202 and C-203 sludge solids used for the modified $KOH-KNO_3$ water fusion treatments to measure ^{129}I. These factors were calculated from the wet weight of sludge material divided by the volume of extracting solution. The digestion factors were then multiplied by the percent solids, as determined from moisture content analysis, to convert to a dry weight basis. The fused samples and the samples from the periodic replacement tests (Section 2.5.4) were analyzed for dissolved ^{129}I concentrations using a Perkin Elmer ELAN DRC II ICP-MS in the standard operation mode. Spectrasol CFA-C from Spectrasol, Inc. (Warwick, New York) was diluted in DDI water (18 MΩ-cm) to create a 1% working solution.

Table 2.3. Digestion Factors for Samples of C-202 and C-203 Sludge Solids Used for the Modified $KOH-KNO_3$ Water Fusion Treatment to Measure ^{129}I

	Sample Number	**Dry Weight Corrected Digestion Factor (g/L)**
$KOH-KNO_3$ water fusion	19250 (C-202)	5.79
	19250 (C-202) Dup	6.16
$KOH-KNO_3$ water fusion	19887 (C-203)	5.90
	19887 (C-203) Dup	5.69
$KOH-KNO_3$ water fusion	19961 (C-203)	6.43
	19661 (C-203) Dup	6.88
Dup = Duplicate.		

(g) Unpublished internal technical procedure: *Solubilization of Metals from Solids Using a KOH-KNO3 Fusion*. AGG-ESL-001 Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.

Calibration standards were prepared by diluting a 1 mg/L ^{129}I certified stock standard (NIST, Gaithersburg, Maryland) into appropriate volumes of the 1% Spectrasol CFA-C solution containing 5-ng/mL ^{121}Sb as the internal standard to calibrate the ICP-MS for masses neighboring iodine. An independent calibration check standard was prepared from a 1-mg/L ^{129}I certified stock standard (Amersham, Piscataway, New Jersey) in 1% Spectrasol CFA-C. One percent Spectrasol CFA-C was used to prepare instrument blanks and was used as the rinse solution throughout the run.

2.5.11 Radioanalysis

In addition to the radionuclides ^{99}Tc, ^{129}I, ^{237}Np, ^{238}U, and ^{239}Pu that were analyzed in solution by ICP-MS, short-lived radionuclides were analyzed by conventional counting methods as described below.

2.5.11.1 ^{137}Cs Analysis

^{137}Cs was measured in solution extracts by gamma energy analysis (GEA). The analyses were made using 60% efficient intrinsic-germanium gamma detectors. All germanium counters were efficiency calibrated for distinct geometries using mixed gamma standards traceable to the NIST. Direct solids, acid extracts, and water extracts were analyzed for gamma energy. Spectral analysis was conducted using libraries containing most mixed-fission products, activation products, and natural decay products. Control samples were run throughout the analysis to ensure correct operation of the detectors. The controls contained isotopes with photo peaks spanning the full detector range and were monitored for peak position, counting rate, and full-width half-maximum. Details are found in an internal PNNL procedure.[h]

2.5.11.2 ^{90}Sr Analysis

Aliquots of filtered acid extracts, fusions, and water extracts were diluted in 8 M HNO_3 and submitted for strontium separation and analysis by internal PNNL procedure.[i] A 0.1-5 mL aliquot of sample was spiked with ^{85}Sr tracer and passed through a SrSpec® column (Eichrom Technologies, Chicago) to capture strontium. The columns were washed with 10 column volumes (20 mL) of 8 M nitric acid. The strontium was eluted from the SrSpec column into glass liquid scintillation vials using 15 mL of deionized water. The vials were placed under a heat lamp overnight to evaporate the water to dryness. A 15 mL Optifluor® scintillation cocktail was added to each vial. Gamma spectroscopy was used to determine the chemical yield from the added ^{85}Sr tracer. The samples were then analyzed by liquid scintillation counting (LSC) to determine the amount of ^{90}Sr originally present in the sludge sample. A matrix spike, a blank spike, a duplicate, and blanks were run with each sample set to determine the efficiency of the separation procedure as well as the purity of reagents.

2.5.11.3 Actinide Analysis

Aliquots of filtered acid extracts and fusions are converted to concentrated HCl solutions, and then passed through a strong base anion exchanger. Uranium, plutonium, and neptunium load on to the column. Americium passes through and is collected for later analysis. Plutonium and neptunium are

(h) Unpublished internal technical procedure: *Gamma Energy Analysis, Operation, and Instrument Verification using Genie2000 Support Software*. RRK-001, Pacific Northwest National Laboratory, Richland, Washington.

(i) Unpublished internal technical procedure: T*c99 and Sr90 Analysis Using Eichrom TEVA-Spec and Sr-Spec Resin*. PNL-RRL-003.2, Pacific Northwest National Laboratory, Richland, Washington.

eluted together with 6-M hydrochloric acid, iodide solution. Uranium is eluted last with dilute nitric acid. The separated actinides are co-precipitated with neodymium fluoride, collected on a membrane filter, mounted on a stainless steel disk, and dried, for counting by alpha spectroscopy. A matrix spike, a blank spike, a duplicate, and blanks were run with each sample set to determine the efficiency of the separation procedure as well as the purity of reagents. The separation, co-precipitation and AEA counting were performed using internal PNNL procedures.[j,k,l]

2.6 Uranium Mineral Solubility Measurements

Analysis of **pre-retrieval** C-203 sludge indicated that the majority of uranium is in the form of čejkaite [$Na_4(UO_2)(CO_3)_3$] and a minor fraction in the form of clarkeite [$Na(UO_2)O(OH)(H_2O)_{0\text{-}1}$] or $Na_2U_2O_7{\cdot}xH_2O$ (Deutsch et al. 2004). The retrieval process, which utilized water to enhance sludge removal, may have preferentially removed relatively soluble čejkaite, causing enrichment of clarkeite or $Na_2U_2O_7{\cdot}xH_2O$ in the sludge. Empirical solubility experiments were conducted on post retrieval C-203 sludge in an attempt to verify that the solubility of the residual phase is consistent with clarkeite or $Na_2U_2O_7{\cdot}xH_2O$. In previous work by Yamamura et al. (1998), the solubility of $Na_2U_2O_7{\cdot}xH_2O$ was determined. XRD analysis of the $Na_2U_2O_7{\cdot}xH_2O$ used in their work appears to be identical to the clarkeite or $Na_2U_2O_7{\cdot}xH_2O$ phase identified by XRD in C-203 sludge.

Empirical U solubility experiments were conducted using three different solutions. For each experimental solution used, four sequential contacts (stages) were made. For each contact, the equilibrated solution was removed and fresh solution added. The three solutions used were:

1. 1.0 M $NaNO_3$, 0.01 M NaOH for all four stages
2. 1.0 M NaOH for all four stages
3. 1.0 M NaNO3, 0.01 M NaOH for first three stages
   0.01 M NaOH, 0.001 M Na_2CO_3 for the fourth stage only

The first two stages had durations of 24 hours, stage 3 lasted 1 week, and the duration of the fourth stage was 1 month.

High sodium concentrations were used in an attempt to dissolve any remaining čejkaite in the early stages, while avoiding the possible conversion of clarkeite or $Na_2U_2O_7{\cdot}xH_2O$ to schoepite [$(UO_2)_8O_2(OH)_{12}{\cdot}12(H_2O)$] or metaschoepite [$UO_3{\cdot}n(H_2O)(n<2)$]. Two different NaOH concentrations in the range used by Yamamura et al. (1998) were selected. Na_2CO_3 was only added on the fourth replenishment of the third solution, in case carbonate contamination becomes unavoidable. By adding a known concentration of carbonate, the impact of carbonate complexation can be readily accounted for in the solubility calculations.

Solid:solution ratios of approximately 0.3g to 30 mL were used for all experiments. C-203 sample 19961 was used for most of the experiments. For each of the three experimental solutions, three sludge

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(j) Unpublished internal technical procedure: *Analysis of Environmental Water Samples for Actinides and Strontium-90*. RPG-CMC-4017, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.
(k) Unpublished internal technical procedure: *Coprecipitation Mounting of Actinides for Alpha Spectroscopy*. RPG-CMC-496, Rev. 0, Pacific Northwest National Laboratory, Richland, Washington.
(l) Unpublished internal technical procedure: *Solutions Analysis: Alpha Spectrometry*. RPG-CMC-422, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.

samples were contacted with the sequence of solutions; a primary sample, a duplicate, and a yellow sample. The primary and duplicate samples were made using homogenized composite sample material collected from sample 19961. The third sludge sample used with each of the three experimental solutions was yellow material separated from the sample and then crushed prior to addition to the sample tube. For solutions 1 and 2, the yellow material was collected from sample 19961. Only enough yellow material from sample 19961 was available for solutions 1 and 2. As a result, yellow material collected from sample 19887 was used for solution 3. After completion of the experiments, each solution was analyzed for uranium by ICP-MS, sodium by ICP-OES, and carbonate using ion chromatography (IC) or the carbon analyzer described in Section 2.5.2.2.

3.0 Laboratory Results

This section includes the results of tests conducted on the residual sludge samples from tanks C-202 (sample 19250) and C-203 (samples 19887 and 19961). Section 3.1 includes a description of the sludge composition obtained from fusion and acid digestion methods. A discussion of the extraction of ^{129}I from the sludge and its measurement is provided in Section 3.2. The results of the sludge leaching tests that included batch and sequential leaching with DDI water, and leaching using $Ca(OH)_2$ and $CaCO_3$ solutions are described in Section 3.3.1. Section 3.3.5 describes the results of uranium mineral solubility determined from a set of leaching experiments. Sludge characterization data generated by using analytical methods such as XRD and SEM/EDS are discussed in Sections 3.4 and 3.5, respectively. Section 3.6 includes the results of actinide measurements using DRC ICP-MS methods.

3.1 Sludge Composition

An important component of contaminant release rate calculations is an accurate measurement of the total concentrations of the contaminants in the source material. As described in Section 2.2, the total metals and radionuclide concentrations of the sludges were measured using two methods (fusion analysis and acid digestion). The results of these analyses are described in this section. The anionic (nonmetal) composition of the sludge was estimated by water extraction as part of the Tier 1 analyses (Section 2.5.6). Tier 1 anion results are discussed in Section 3.3.1.

Table 3.1 lists the moisture content [((wet wt – dry wt)/dry wt) x 100%] of the C-202 and C-203 residual sludge samples used for the fusion extractions and EPA acid digestions. These values are used with the digestion factors (Table 2.2) to convert the solution analyses of the extracts from the treatments to dry weight solid concentrations. The moisture contents of the sludge samples ranged from 37.9 to 56.6%, suggesting that the samples were quite fine-grained (had large porosity) and were completely water saturated.

Table 3.1. Moisture Contents of C-202 and C-203 Sludge Samples [(wet wt – dry wt)/dry wt]

Sample Number	Moisture Content
19250 (202)	40.8%
19250 (202) Dup	43.0%
19887 (203)	40.2%
19887 (203) Dup	37.9%
19961 (203)	56.6%
19961 (203) Dup	56.3%
Dup = Duplicate sample.	

Concentrations listed in parentheses in the tables are defined as less than the EQL but greater than a zero instrument signal. These values are reported for informational purposes only. They may reflect actual concentrations that are real but have larger associated uncertainties than values above the EQL or may reflect values that were calculated from the instrument's background signal and are not representative of actual sludge composition. The EQL of an element is determined by analyzing a suite of CCV standards at the beginning and end of each analytical run. The lowest CCV standard that is within ±10% of its certified value is multiplied by the dilution factor for the sample to determine the EQL for the element for the particular analytical run. The EQL may vary with each analysis depending on sample matrix, dilution factors, and instrument performance. Concentrations listed as less-than (<) values in the tables refer to instrument measurements that are less than zero. In these instances, the reported analyte concentration is assigned a value of "<EQL" using the EQL value appropriate for that particular analyte and set of analytical conditions.

The following discussion of element concentrations of the sludge is organized in terms of the analytical method used to measure concentrations in the solution extract. These methods were carbon analyzer, ICP-OES, ICP-MS, IC, GEA (^{137}Cs), and wet chemical separations and liquid scintillation counting (^{90}Sr). For the tables, the solution concentrations have been converted from a per-liter basis to a dry sludge mass basis. Each table provides results from the fusion analysis and EPA acid digestion methods.

Table 3.2 lists the carbon contents on the dry sludge basis for the C-202 and C-203 residual sludge samples. Average total carbon content of 19250 (C-202) was 4.37×10^4 µg/g sludge whereas, in 19887 (C-203) and 19961 (C-203) were the TC were similar and measured to be 1.33×10^4 and 1.18×10^4 µg/g sludge respectively. In 19250 (C-202) the total average organic and inorganic contents were 4.37×10^4 and 9.47×10^3 µg/g sludge, respectively. In the C-202 tank sample, the bulk of the total carbon was mainly in the organic form (~80%). In 19887 (C-203) sample, the organic and inorganic carbon contents were 7.22×10^3 and 6.05×10^3 µg/g sludge respectively each constituting about one half of the total carbon (54 and 46%) in the sludge. In 19961 (C-203) sample, however, the organic and inorganic carbon contents were 7.89×10^3 and 3.94×10^3 µg/g sludge constituting about two-thirds and one-third of the total carbon (67 and 33%) mass, respectively.

The results of elemental analyses by ICP-OES are listed in Table 3.3 through Table 3.5. Because K and sulfur-containing compounds were used as the fluxing agent for the fusion technique, K and S fusion concentrations are not reported in these tables. Also, fusion was conducted in nickel crucibles; therefore, Ni fusion values listed in Table 3.4 are anomalous. Values for Na are not reported for the fusion analysis because sodium bisulfite was used in the fused sample dissolution process. Similarly, B values from acid digestion are not reported because boric acid was used in the process. Among the suite of thirty elements that were analyzed, only eleven elements were present above the instrumental detection limits in all samples. These elements included Ca, Cr, Mg, Mn, Na, Ni, P, Pb, Sr, Ti, and Zn. Additionally, Al, Co, Cu, Si, and Zr were present in detectable concentration in the sludge sample 18250 obtained from tank C-202. The elements that were present in significant concentrations are listed in Table 3.6. Typically, the major element concentrations (present in ≥1% of the dry sludge mass) determined by fusion and acid digestion methods agreed within 1 to 35%. However, in the case of Na, the values obtained by the fusion method for all sludge samples (C-202 and C-203 tank samples) were more than an order of magnitude higher than the values measured by the acid digestion method. Procedure blanks run with the fusion analyses showed the presence of high levels of Na that was likely introduced with the KOH-KNO_3 fluxes. This resulted in the discrepancy between the Na values measured by the fusion method and the acid digestion method. For the metals listed in Table 3.6, there is variability in concentrations between the fusion method and the EPA acid digestion technique, but the acid digestion method generally gives higher concentrations of the major metals by 10 to 40% compared to the concentrations measured by fusion extraction.

Table 3.2. Carbon Contents of Tank C-202 and C-203 Sludge Samples

Sample Number	TC	TOC	TIC	TIC
	----------------------μg C/g Sludge--------------------			μg CO_3/g Sludge
19250 (202)	4.47E+04	3.56E+04	9.12E+03	4.56E+04
19250 (202) Dup	4.27E+04	3.29E+04	9.82E+03	4.91E+04
19250 (202) Avg	4.37E+04	3.43E+04	9.47E+03	4.74E+04
19887 (203)	1.34E+04	7.50E+03	5.94E+03	2.97E+04
19887 (203) Dup	1.31E+04	6.95E+03	6.16E+03	3.08E+04
19961 (203)	1.13E+04	7.40E+03	3.85E+03	1.92E+04
19961 (203) Dup	1.24E+04	8.39E+03	4.04E+03	2.02E+04
19887 (203) Avg	1.33E+04	7.22E+03	6.05E+03	3.02E+04
19961 (203) Avg	1.18E+04	7.89E+03	3.94E+03	1.97E+04

Avg = Average.
Dup = Duplicate.
TC = Total carbon.
TIC = Total inorganic carbon.
TOC = Total organic carbon.
μg C/g = Microgram of C per gram of sludge.
μg CO_3/g = Microgram of CO_3 (carbonate) per gram of sludge.

A comparison of the elemental composition between the sludge samples (Table 3.6) indicated that the sample 19250 (C-202) was significantly enriched in concentrations of Al (1.13×10^4 - 1.36×10^4 μg/g sludge), Ca (9.61×10^3 - 1.45×10^4 μg/g sludge), Cr (1.33×10^4 - 1.32×10^4 μg/g sludge), Fe (1.19×10^5 - 1.22×10^5 μg/g sludge), Mn (2.51×10^4 – 2.54×10^4 μg/g sludge), and Si (5.84×10^3 – 2.50×10^4 μg/g sludge) while being depleted in Na by about half and about two-thirds of P compared to the C-203 tank samples (19867 and 19961).

Major elemental components in sample 19250 (C-202) residual sludge that constituted between 1 to 10% by dry mass were Al, Ca, Cr, Na, Mn, P, and Si. Iron was also abundant (about 12% by dry mass) in this sample. Contrastingly, the major elements in the samples 19887 and 19961 from tank C-203 residual sludge were Fe, Na, and P which constituted about 1% to 10% of the dry sludge mass.

Table 3.3. Sludge Composition Measured by ICP-OES (Al through Cr)

Sample Number	Al	As	B	Ba	Be	Bi	Ca	Cd	Co	Cr
	µg/g-dry Sludge									
KOH-KNO$_3$ Fusions										
19250 (C-202)	1.04E+04	(1.13E+01)	(1.04E+03)	(1.29E+01)	<2.43E+02	<4.85E+03	9.47E+03	<4.85E+01	(9.89E+01)	1.34E+04
19250 (C-202) Dup	1.22E+04	<6.38E+02	(5.88E+02)	<3.19E+01	<1.60E+02	<3.19E+03	9.75E+03	<3.19E+01	1.08E+02	1.32E+04
19887 (C-203)	<2.12E+02	(2.10E+02)	(7.40E+01)	<4.24E+01	<2.12E+01	<4.24E+02	3.87E+03	<2.12E+01	(1.00E+02)	9.14E+03
19887 (C-203) Dup	<2.20E+02	(1.74E+02)	(8.92E+01)	<4.39E+01	<2.20E+01	<4.39E+02	2.26E+03	<2.20E+01	(9.70E+01)	4.67E+03
19961 (C-203)	<1.94E+02	(1.78E+02)	(7.83E+01)	<3.89E+01	<1.94E+01	<3.89E+02	2.93E+03	<1.94E+01	(8.85E+01)	5.12E+03
19961 (C-203) Dup	<1.82E+02	(1.71E+02)	(6.76E+01)	<3.63E+01	<1.82E+01	<3.63E+02	2.58E+03	<1.82E+01	(8.31E+01)	4.72E+03
19250 (C-202) Avg	1.13E+04	(1.13E+01)	(8.15E+02)	(1.29E+01)	<2.01E+02	<4.02E+03	9.61E+03	<4.02E+01	1.04E+02	1.33E+04
19887 (C-203) Avg	<2.16E+02	(1.92E+02)	(8.16E+01)	<4.31E+01	<2.16E+01	<4.31E+02	3.06E+03	<2.16E+01	(9.87E+01)	6.90E+03
19961 (C-203) Avg	<1.88E+02	(1.75E+02)	(7.30E+01)	<3.76E+01	<1.88E+01	<3.76E+02	2.75E+03	<1.88E+01	(8.58E+01)	4.92E+03
EPA Acid Digestion										
19250 (C-202)	1.28E+04	<5.62E+02	N/A	1.98E+02	<1.41E+02	<2.81E+03	1.16E+04	<2.81E+01	1.15E+02	1.41E+04
19250 (C-202) Dup	1.12E+04	(5.76E+01)	N/A	1.93E+02	<1.65E+02	<3.30E+03	1.12E+04	<3.30E+01	1.13E+02	1.35E+04
19250 (C-202) Trip	1.68E+04	<6.73E+02	N/A	2.33E+02	<1.68E+02	<3.37E+03	2.06E+04	<3.37E+01	1.02E+02	1.19E+04
19887 (C-203)	<5.46E+02	(1.78E+02)	N/A	<1.09E+02	<1.09E+02	<1.09E+03	3.40E+03	<1.09E+02	(8.68E+01)	6.16E+03
19887 (C-203) Dup	<8.74E+02	(2.14E+02)	N/A	<1.75E+02	<1.75E+02	<1.75E+03	3.22E+03	<1.75E+02	(9.37E+01)	6.60E+03
19961 (C-203)	<5.75E+02	(1.79E+02)	N/A	<1.15E+02	<1.15E+02	<1.15E+03	3.08E+03	<1.15E+02	(8.50E+01)	5.58E+03
19961 (C-203) Dup	<4.69E+02	(1.75E+02)	N/A	<9.39E+01	<9.39E+01	<9.39E+02	2.86E+03	<9.39E+01	(8.71E+01)	5.28E+03
19250 (C-202) Avg	1.36E+04	(5.76E+01)	N/A	2.08E+02	<1.58E+02	<3.16E+03	1.45E+04	<3.16E+01	1.10E+02	1.32E+04
19887 (C-203) Avg	<7.10E+02	(1.96E+02)	N/A	<1.42E+02	<1.42E+02	<1.42E+03	3.31E+03	<1.42E+02	(9.02E+01)	6.38E+03
19961 (C-203) Avg	<5.22E+02	(1.77E+02)	N/A	<1.04E+02	<1.04E+02	<1.04E+03	2.97E+03	<1.04E+02	(8.60E+01)	5.43E+03

Avg = Average.
Dup = Duplicate.
EQL = Estimated quantitation limit.
N/A = Not analyzed; boric acid used in acid digestion.
Trip = Triplicate.
Concentrations listed in parentheses were <EQL.

Table 3.4. Sludge Composition Measured by ICP-OES (Cu through Pb)

Sample Number	Cu	Fe	K	Li	Mg	Mn	Mo	Ni*	P	Pb
	µg/g-dry Sludge									
$KOH-KNO_3$ Fusions										
19250 (C-202)	3.80E+02	1.16E+05	NR	<2.43E+02	2.41E+03	2.47E+04	(1.20E+01)	4.57E+03	1.34E+04	(1.92E+02)
19250 (C-202) Dup	4.16E+02	1.23E+05	NR	<1.60E+02	2.47E+03	2.54E+04	<1.60E+02	6.28E+03	1.58E+04	(1.63E+02)
19887 (C-203)	(6.07E+01)	1.20E+04	NR	(4.06E+01)	7.18E+02	1.32E+03	(1.07E+00)	1.07E+03	4.38E+04	5.24E+02
19887 (C-203) Dup	(2.98E+01)	3.86E+03	NR	(4.20E+01)	5.86E+02	9.69E+02	<8.79E+01	1.60E+03	5.21E+04	5.80E+02
19961 (C-203)	(8.00E+01)	1.32E+04	NR	(3.07E+01)	6.63E+02	1.29E+03	(4.08E+01)	6.37E+03	3.74E+04	4.10E+02
19961 (C-203) Dup	(4.95E+01)	1.03E+04	NR	(2.81E+01)	6.01E+02	1.27E+03	(5.92E+01)	7.21E+02	3.93E+04	4.57E+02
19250 (C-202) Avg	3.98E+02	1.19E+05	NR	<2.01E+02	2.44E+03	2.51E+04	(1.20E+01)	5.43E+03	1.46E+04	(1.77E+02)
19887 (C-203) Avg	<4.52E+01	7.91E+03	NR	(4.13E+01)	6.52E+02	1.14E+03	(1.07E+00)	1.34E+03	4.80E+04	5.52E+02
19961 (C-203) Avg	<6.47E+01	1.18E+04	NR	(2.94E+01)	6.32E+02	1.28E+03	(5.00E+01)	3.54E+03	3.83E+04	4.34E+02
EPA Acid Digestion										
19250 (C-202)	5.85E+02	1.26E+05	<1.41E+04	<1.41E+02	2.44E+03	2.72E+04	<1.41E+02	9.64E+03	1.53E+04	7.98E+03
19250 (C-202) Dup	5.75E+02	1.24E+05	<1.65E+04	<1.65E+02	2.42E+03	2.52E+04	<1.65E+02	9.29E+03	1.55E+04	8.58E+03
19250 (C-202) Trip	3.93E+02	1.14E+05	<1.68E+04	<1.68E+02	2.82E+03	2.47E+04	<1.68E+02	8.28E+03	1.77E+04	7.36E+03
19887 (C-203)	<1.09E+04	1.14E+04	<2.73E+05	(1.14E+02)	(8.41E+02)	8.12E+02	<5.46E+02	4.50E+02	3.72E+04	5.52E+03
19887 (C-203) Dup	<1.75E+04	2.19E+04	<4.37E+05	(1.44E+02)	(7.76E+02)	8.71E+02	<8.74E+02	4.27E+02	(3.88E+04)	6.38E+03
19961 (C-203)	<1.15E+04	1.74E+04	<2.87E+05	(1.17E+02)	(6.68E+02)	1.11E+03	<5.75E+02	5.97E+02	3.95E+04	5.60E+03
19961 (C-203) Dup	<9.39E+03	1.45E+04	<2.35E+05	(1.07E+02)	(6.30E+02)	1.03E+03	<4.69E+02	5.69E+02	3.84E+04	5.01E+03
19250 (C-202) Avg	5.18E+02	1.22E+05	<1.58E+04	<1.58E+02	2.56E+03	2.57E+04	<1.58E+02	9.07E+03	1.61E+04	7.98E+03
19887 (C-203) Avg	<1.42E+04	1.67E+04	<3.55E+05	(1.29E+02)	(8.09E+02)	8.42E+02	<7.10E+02	4.38E+02	3.80E+04	5.95E+03
19961 (C-203) Avg	<1.04E+04	1.60E+04	<2.61E+05	(1.12E+02)	(6.49E+02)	1.07E+03	<5.22E+02	5.83E+02	3.90E+04	5.30E+03

Avg = Average.
Dup = Duplicate.
EQL = Estimated quantitation limit.
Ni* = Nickel crucible used for fusion.
NR = Not reported – K is a major component of the fluxing agent used in the fusion analysis.
Concentrations listed in parentheses were <EQL.

Table 3.5. Sludge Composition Measured by ICP-OES (Se through Zr)

Sample Number	Se	Sr	Tl	V	Zn	Na	Si	S	Ti	Zr
	µg/g-dry Sludge									
KOH-KNO$_3$ Fusions										
19250 (C-202)	<9.71E+03	1.18E+03	<4.85E+02	<2.43E+02	6.96E+02	NA	8.44E+03	N/A	8.85E+02	9.91E+01
19250 (C-202) Dup	<6.38E+03	1.14E+03	<3.19E+02	<1.60E+02	7.64E+02	NA	3.25E+03	N/A	8.32E+02	9.51E+01
19887 (C-203)	(1.35E+02)	3.16E+02	<4.24E+02	<1.06E+02	5.25E+02	NA	(3.20E+03)	N/A	3.50E+02	<4.24E+01
19887 (C-203) Dup	(1.82E+02)	4.04E+02	<4.39E+02	<1.10E+02	(2.82E+02)	NA	(1.91E+03)	N/A	2.45E+02	<4.39E+01
19961 (C-203)	(9.20E+01)	3.43E+02	<3.89E+02	<9.72E+01	5.49E+02	NA	(2.87E+03)	N/A	2.34E+02	<3.89E+01
19961 (C-203) Dup	(7.23E+01)	3.11E+02	<3.63E+02	<9.08E+01	4.41E+02	NA	(2.62E+03)	N/A	2.26E+02	<3.63E+01
19250 (C-202) Avg	<8.05E+03	1.16E+03	<4.02E+02	<2.01E+02	7.30E+02	NA	5.84E+03	N/A	8.58E+02	9.71E+01
19887 (C-203) Avg	(1.59E+02)	3.60E+02	<4.31E+02	<1.08E+02	4.03E+02	NA	(2.56E+03)	N/A	2.97E+02	<4.31E+01
19961 (C-203) Avg	(8.21E+01)	3.27E+02	<3.76E+02	<9.40E+01	4.95E+02	NA	(2.75E+03)	N/A	2.30E+02	<3.76E+01
EPA Acid Digestion										
19250 (C-202)	<4.59E+02	1.45E+03	<2.81E+02	<7.03E+01	8.43E+02	5.32E+04	2.18E+04	(6.88E+01)	8.91E+02	1.63E+02
19250 (C-202) Dup	<4.13E+02	1.54E+03	<3.30E+02	<8.26E+01	8.21E+02	5.32E+04	1.41E+04	(2.78E+02)	9.05E+02	1.19E+02
19250 (C-202) Trip	<2.18E+02	1.54E+03	<3.37E+02	<8.41E+01	7.20E+02	7.00E+04	3.90E+04	(1.63E+00)	1.03E+03	1.27E+02
19887 (C-203)	<1.09E+03	3.96E+02	<1.09E+03	<2.73E+02	(6.58E+02)	9.77E+04	(4.01E+03)	<4.37E+03	4.01E+02	<1.09E+02
19887 (C-203) Dup	<1.75E+03	3.70E+02	<1.75E+03	<4.37E+02	(7.75E+02)	9.60E+04	(3.75E+03)	<7.00E+03	3.02E+02	<1.75E+02
19961 (C-203)	<1.15E+03	4.42E+02	<1.15E+03	<2.87E+02	(6.09E+02)	9.45E+04	(3.46E+03)	<4.60E+03	2.45E+02	<1.15E+02
19961 (C-203) Dup	<9.39E+02	4.26E+02	<9.39E+02	<2.35E+02	(4.55E+02)	9.49E+04	(2.75E+03)	<3.75E+03	2.37E+02	<9.39E+01
19250 (C-202) Avg	<3.63E+02	1.51E+03	<3.16E+02	<7.90E+01	7.95E+02	5.88E+04	2.50E+04	(1.16E+02)	9.43E+02	1.36E+02
19887 (C-203) Avg	<1.42E+03	3.83E+02	<1.42E+03	<3.55E+02	(7.17E+02)	9.69E+04	(3.88E+03)	<5.68E+03	3.52E+02	<1.42E+02
19961 (C-203) Avg	<1.04E+03	4.34E+02	<1.04E+03	<2.61E+02	(5.32E+02)	9.47E+04	(3.10E+03)	<4.18E+03	2.41E+02	<1.04E+02

Avg = Average.
Dup = Duplicate.
EQL = Estimated quantitation limit.
NA = Not applicable; sodium bisulfite used in the fused sample dissolution process.
Trip = Triplicate.
Concentrations listed in parentheses were <EQL.

Table 3.6. Average Sludge Composition Measured by ICP-OES

Elements	19250 (C-202) Fusion	19250 (C-202) Acid Digestion	19887 (C-203) Fusion	19887 (C-203) Acid Digestion	19961 (C-203) Fusion	19961 (C-203) Acid Digestion
	µg/g-dry Sludge					
Al	11,300	13,600	<216	<710	<188	<522
Ca	9,610	14,522	3,063	3,312	2,446	2,972
Cr	13,300	13,200	6,901	6,380	4,920	5,430
Cu	398	518	<45.2	<14,200	<64.7	<10,400
Fe	119,000	122,000	7,912	16,651	11,751	15,959
Mg	2,440	2,560	652	(809)	632	(649)
Mn	25,100	25,400	1,142	842	1,281	1,069
Na	NA*	58,800	NA*	96,863	NA*	94,672
P	14,600	16,100	47,959	37,991	38,313	38,962
Pb	(177)	7,980	552	5,950	434	5,302
Si	5,840	25,000	(2,650)	(3,880)	(2,750)	(3,100)
Sr	1,160	1,510	360	383	327	434
Ti	858	943	297	352	230	241
Zn	730	795	403	(717)	495	(532)
Zr	97	136	<43.1	<142	<37.6	<104

Concentrations listed in parentheses were <EQL.
< Values were less than instrumental detection limit.
NA* - Not applicable; sodium bisulfite used in the dissolution of the fused sludge.

The elemental concentrations analyzed by ICP-MS are listed in Table 3.7 and Table 3.8. Because ICP-MS uses isotopic measurements, this analytical method for some metals can attain lower detection limits than ICP-OES, and thus allow more accurate measurements of trace metal concentrations in the sludge samples. Among the trace elements listed in the tables, Ag, Cd, Cr, Cu, Mo, Pb, Ru, and Sb were present in concentrations greater than their respective EQLs. The average concentrations of these elements based on isotopic measurements are listed in Table 3.9. The average ICP-MS Cr concentrations

Table 3.7. Sludge Composition Determined from ICP-MS Analysis

Sample Number	Cr – Total[(a)]	Cu - Total[(b)]	As - Total Based on	Se - Total Based on	Mo - Total Based on		
			^{75}As	^{82}Se	^{95}Mo	^{97}Mo	^{98}Mo[(c)]
	µg/g-dry Sludge						
KOH-KNO_3 Fusions							
19250 (C-202)	9.67E+03	3.73E+02	<1.46E+01	<1.46E+02	6.30E+01	6.20E+01	5.82E+01
19250 (C-202) Dup	1.11E+04	4.03E+02	(1.78E+00)	<9.58E+01	3.84E+01	3.65E+01	3.29E+01
19887 (C-203)	4.55E+03	8.48E+01	<1.69E+01	N/A	1.15E+02	N/A	N/A
19887 (C-203) Dup	2.84E+03	(7.03E+01)	<1.76E+01	N/A	7.41E+01	N/A	N/A
19961 (C-203)	2.49E+03	(7.65E+01)	<1.56E+01	N/A	1.15E+02	N/A	N/A
19961 (C-203) Dup	2.37E+03	(6.67E+01)	<1.45E+01	N/A	1.33E+02	N/A	N/A
19250 (C-202) Avg	1.04E+04	3.88E+02	(1.78E+00)	<1.21E+02	5.07E+01	4.93E+01	4.55E+01
19887 (C-203) Avg	3.70E+03	7.75E+01	<1.73E+01		9.45E+01		
19961 (C-203) Avg	2.43E+03	(7.16E+01)	<1.50E+01		1.24E+02		
EPA Acid Digestion							
19250 (C-202)	6.96E+03	2.51E+02	(2.16E+00)	<5.62E+01	1.62E+01	1.54E+01	1.23E+01
19250 (C-202) Dup	6.03E+03	3.07E+02	(1.99E+00)	<6.61E+01	1.56E+01	1.49E+01	1.19E+01
19250 (C-202) Trip	5.05E+03	2.17E+02	(1.22E+00)	<6.73E+01	1.47E+01	1.41E+01	1.11E+01
19887 (C-203)	4.40E+03	7.20E+01	(1.16E+01)	<5.46E+01	<2.73E+01	<2.73E+01	<2.73E+01
19887 (C-203) Dup	4.89E+03	6.57E+01	(9.92E+00)	<8.74E+01	<4.37E+01	<4.37E+01	<4.37E+01
19961 (C-203)	4.14E+03	6.27E+01	(2.98E+00)	<5.75E+01	(4.82E+00)	(2.25E+00)	(2.08E+00)
19961 (C-203) Dup	3.87E+03	5.44E+01	(4.35E+00)	<4.69E+01	(3.04E+00)	(1.10E+00)	(1.74E+00)
19250 (C-202) Avg	6.01E+03	2.58E+02	(1.79E+00)	<6.32E+01	1.55E+01	1.48E+01	1.18E+01
19887 (C-203) Avg	4.64E+03	6.89E+01	(1.08E+01)	<7.10E+01	<3.55E+01	<3.55E+01	<3.55E+01
19961 (C-203) Avg	4.01E+03	5.86E+01	(3.66E+00)	<5.22E+01	(3.93E+00)	(1.68E+00)	(1.91E+00)

(a) Cr results are based on the average of ^{52}Cr and ^{53}Cr for sample 19250 and ^{53}Cr for samples 19887 and 19961.
(b) Cu results are based on the average of ^{63}Cu and ^{65}Cu for sample 19250 and ^{65}Cu for sample 19887 and 19961.
(c) The indicated isotope is the suggested isotope for use to quantify the total concentration of that element.
N/A = Not analyzed.

Table 3.8. Solution Composition Determined from ICP-MS Analysis

Sample Number	Ru – Total Based on		Ag – Total Based on	Cd – Total Based on	Sb – Total Based on	Pb – Total Based on
	^{101}Ru	^{102}Ru	^{107}Ag$^{(a)}$	^{114}Cd$^{(b)}$	^{121}Sb	^{206}Pb$^{(c)}$
	µg/g-dry Sludge					
KOH-KNO$_3$ Fusions						
19250 (C-202)	2.77E+01	1.29E+01	1.15E+00	2.28E+01	4.36E+01	4.50E+01
19250 (C-202) Dup	2.76E+01	1.25E+01	1.06E+00	2.47E+01	2.87E+01	1.90E+01
19887 (C-203)	5.00E+00	2.44E+00	2.08E-01	1.76E+00	7.74E+00	8.56E+01
19887 (C-203) Dup	3.90E+00	1.84E+00	(1.53E-01)	1.35E+00	3.54E+00	1.27E+02
19961 (C-203)	5.68E+00	2.55E+00	3.17E-01	1.63E+00	6.66E+00	6.18E+01
19961 (C-203) Dup	4.30E+00	2.04E+00	2.45E-01	1.51E+00	5.54E+00	9.53E+01
19250 (C-202) Avg	2.77E+01	1.27E+01	1.10E+00	2.37E+01	3.61E+01	3.20E+01
19887 (C-203) Avg	4.45E+00	2.14E+00	1.80E-01	1.56E+00	5.64E+00	1.06E+02
19961 (C-203) Avg	4.99E+00	2.30E+00	2.81E-01	1.57E+00	6.10E+00	7.86E+01
EPA Acid Digestion						
19250 (C-202)	2.19E+01	1.01E+01	1.65E+00	2.28E+01	4.48E+01	7.43E+03
19250 (C-202) Dup	2.18E+01	1.00E+01	1.61E+00	2.14E+01	4.54E+01	7.70E+03
19250 (C-202) Trip	2.12E+01	9.85E+00	1.47E+00	2.15E+01	4.31E+01	6.80E+03
19887 (C-203)	<5.46E+01	<5.46E+01	(1.04E+00)	<1.09E+02	8.91E+00	4.26E+03
19887 (C-203) Dup	<8.74E+01	<8.74E+01	(8.92E-01)	<1.75E+02	9.19E+00	4.97E+03
19961 (C-203)	<5.75E+01	<5.75E+01	(3.68E-01)	<1.15E+02	1.02E+01	4.32E+03
19961 (C-203) Dup	<4.69E+01	<4.69E+01	(1.19E+00)	<9.39E+01	9.52E+00	3.92E+03
19250 (C-202) Avg	2.16E+01	9.98E+00	1.58E+00	2.19E+01	4.44E+01	7.31E+03
19887 (C-203) Avg	<7.10E+01	<7.10E+01	(9.65E-01)	<1.42E+02	9.05E+00	4.62E+03
19961 (C-203) Avg	<5.22E+01	<5.22E+01	(7.80E-01)	<1.04E+02	9.85E+00	4.12E+03

(a) Ag results are based on ^{107}Ag for samples 19887 and 19961 and the average of ^{107}Ag and ^{109}Ag for sample 19250.
(b) Cd results are based on ^{114}Cd for sample 19887 and 19961 and the average of ^{111}Cd and ^{114}Cd for sample 19250.
(c) Pb results are based on ^{206}Pb for sample 19887 and 19961 and the average of ^{206}Pb and ^{208}Pb for sample 19250.

Table 3.9. Average Sludge Composition Measured by ICP-MS

Elements	19250 (C-202)	19250 (C-202)	19887 (C-203)	19887 (C-203)	19961 (C-203)	19961 (C-203)
	Fusion	Acid Digestion	Fusion	Acid Digestion	Fusion	Acid Digestion
	µg/g-dry Sludge					
^{107}Ag	1.1	1.58	0.18	(0.97)	0.28	(0.78)
^{111}Cd	23.7	21.9	1.56	<142	1.57	<104
^{53}Cr	10,400	6,013	3,697	4,643	2,429	4,005
^{65}Cu	388	258	78	69	72	59
^{95}Mo	50.7	15.5	94.5	<35.5	123.9	(3.93)
^{208}Pb	32	7,310	106	4,620	78.6	4,120
^{101}Ru	27.7	21.6	4.5	<71	5.0	<52
^{121}Sb	36.1	44.4	5.6	9.1	6.1	9.85
Concentrations listed in parentheses were <EQL.						

(based on ^{53}Cr) in sample 19250 (C-202) measured by fusion and acid digestion were 10,400 and 6,013 µg/g sludge, respectively. These values based on isotopic measurements were 22% and 55% lower than the values determined by using the ICP-OES (13,300 and 13,200 µg/g sludge) method (Table 3.6). Measurements of Cr concentrations using fused and acid digested sample 19887 (C-203) yielded values of 3,697 and 4,643 µg/g sludge respectively. Similar measurements conducted on sample 19961 (C-203) showed Cr concentrations of 2,429 and 4,005 µg/g sludge, respectively. The average Cr values for sludges 19887 (C-203) and 19961 (C-203) determined by ICP-MS on acid digested samples were 26% and 39% higher than the average values measured on the fused samples. These values measured isotopically by ICP-MS were about 25 to 50% less than corresponding values measured by ICP-OES (Table 3.3 and Table 3.6). The average Pb concentrations in sludge 19250 (C-202) measured by fusion and acid digestion samples were 32 and 7,310 µg/g sludge, respectively. The fusion value is similar to the fusion value determined by ICP-OES (estimated at 177 µg/g sludge) and the acid digestion value is similar to the acid digestion values by ICP-OES (7,980 µg/g sludge). ICP-MS concentrations of Pb in sample 19887 (C-203) analyzed by fusion and acid digestion were 106 and 4,620 µg/g sludge, respectively, whereas in sludge sample 19961 (C-203), the corresponding concentrations were 78.6 and 4,120 µg/g sludge, respectively. These large discrepancies in Pb values determined on fused and acid digested sludge samples were also observed from measurements conducted using ICP-OES methods. Sulfuric acid is used to dissolve the fused sludge samples, and the presence of high concentrations of sulfate in solution probably leads to the precipitation of Pb sulfate from solution thereby lowering the dissolved Pb concentration. For this reason, the Pb concentrations determined from the EPA acid digestion Method 3052 (EPA 1996) are the more reliable values.

The average Cu concentrations in sludge sample 19250 (C-202) measured by fusion and acid digestion were 388 and 258 µg/g sludge, respectively. These values agreed reasonably well with the values generated by the ICP-OES measurements (398 and 518 µg/g of sludge) on fused and acid digested samples, respectively (Table 3.3 and Table 3.6). The Cu concentrations in fused and acid digested sludge sample 19887 from tank C-203 were measured to be 78 and 69 µg/g of sludge, respectively, and in sample 19961, the corresponding Cu concentrations were 72 and 59 µg/g of sludge, respectively. These data showed that the average Cu concentrations in both sludges were very low and similar in magnitude, and confirmed the consistency of values determined using the fusion and acid digestion methods.

The average concentrations of Mo determined on fusion and acid digested samples of all three sludge samples were typically very low and ranged from <EQL to 124 µg/g sludge.

The elements Ru and Sb were also detected in these sludge samples. Ru concentrations in sample 19250 (C-202) measured using fused and acid digested samples were 27.7 and 21.6 µg/g sludge, respectively. Concentrations in fused sludge samples 19887 (C-203) and 19961 (C-203) were 4.5 and 5.0 µg/g sludge, respectively. Concentrations of Sb measured in all three sludges using fused and acid digested samples were relatively consistent [19250 (C-202): 36.1 and 44.4 µg/g sludge; 19887 (C-203): 5.6 and 6.1 µg/g sludge; 19961 (C-203): 9.1 and 9.9 µg/g sludge].

The very low detection limits attainable using the ICP-MS method on appropriately prepared samples were evident in the very low concentrations of Ag and Cd that were measured in these sludge samples. For instance, the average Ag concentrations in fused samples of 19250 (C-202), 19887 (C-203) and 19961 (C-203) sludges were 1.1, 0.18, and 0.28 µg/g sludge, respectively. Similarly, Cd isotope concentrations measured in the same samples were 23.7, 1.56, and 1.57 µg/g sludge, respectively.

The concentrations of ^{99}Tc and ^{238}U measured by ICP-MS are listed in Table 3.10. The ^{99}Tc concentrations measured on fused samples of sludges on average were 0.231 µg/g sludge in 19250 (C-202), 0.0883 µg/g sludge in 19887 (C-203), and 0.073 µg/g sludge in 19961 (C-203). The comparable concentrations in acid digested samples of these sludges were 0.149 µg/g sludge, 0.154 µg/g sludge, and less than EQL of 0.0354 µg/g sludge, respectively.

The ICP-MS analysis indicated that all the three sludge samples [19250 (C-202), 19887 (C-203), and 19961 (C-203)] contained very high concentrations of ^{238}U (Table 3.10). For instance, fused and acid digested samples of 19250 (C-202) sludge on average contained 2.36 x 10^5 µg/g sludge (23.6%) and 2.07 x 10^5 µg/g sludge (20.7%) ^{238}U, respectively. Sludge sample 19887 (C-203) contained on average, 6.37 x 10^5 µg/g sludge (63.7%) and 5.35 x 10^5 µg/g sludge (52.5%) of ^{238}U, respectively from the fusion and acid digestion analysis. Similarly, the fused and digested 19961 (C-203) samples contained average concentrations of 5.35 x 10^5 µg/g sludge (53.5%) and 4.85 x 10^5 µg/g sludge (48.5%) ^{238}U, respectively.

The elemental data from the ICP-OES and ICP-MS analyses indicated that the dominant constituents in 19250 (C-202), in decreasing order, were U, Na, Fe, Mn, and P (Table 3.11). In C-203 tank samples the principal sludge components (>1% by dry mass) were U, Na, P, and Fe (Table 3.11). These elements accounted for about 43 to 68% of the dry masses of these residual sludge samples.

The concentrations of ^{137}Cs and ^{90}Sr in sludges were measured on fused and acid digested samples using GEA and liquid scintillation counting, respectively. The average ^{137}Cs concentrations in fused samples of 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludges were 12.3, 27.5, and 22.1 µCi/g sludge, respectively (Table 3.12). The average concentrations of 13.8, 19.3, and 21.7 µCi/g sludge found in acid digested sludge samples (Table 3.12) were comparable in magnitude to the values obtained from fused samples. The average ^{90}Sr concentrations in acid digested 19250 (C-202), 19887 (C-203) and 19961 (C-203) sludge samples were 756, 338 and 390 µCi/g sludge, respectively (Table 3.13).

Table 3.10. Concentrations of ^{99}Tc and ^{238}U Measured by ICP-MS

Sample Number	^{99}Tc	^{238}U
	µg/g-dry Sludge	
KOH-KNO$_3$ Fusions		
19250 (C-202)	2.38E-01	2.19E+05
19250 (C-202) Dup	2.24E-01	2.52E+05
19887 (C-203)	1.05E-01	6.49E+05
19887 (C-203) Dup	(7.21E-02)	6.26E+05
19961 (C-203)	(7.62E-02)	5.24E+05
19961 (C-203) Dup	(6.97E-02)	5.46E+05
19250 (C-202) Avg	2.31E-01	2.36E+05
19887 (C-203) Avg	8.83E-02	6.37E+05
19961 (C-203) Avg	7.30E-02	5.35E+05
EPA Acid Digestion		
19250 (C-202)	1.36E-01	2.16E+05
19250 (C-202) Dup	1.57E-01	2.28E+05
19250 (C-202) Trip	1.53E-01	1.78E+05
19887 (C-203)	(2.03E-02)	5.30E+05
19887 (C-203) Dup	2.87E-01	5.21E+05
19961 (C-203)	(5.39E-02)	4.95E+05
19961 (C-203) Dup	(1.69E-02)	4.75E+05
19250 (C-202) Avg	1.49E-01	2.07E+05
19887 (C-203) Avg	1.54E-01	5.25E+05
19961 (C-203) Avg	(3.54E-02)	4.85E+05
Avg = average; Dup = duplicate; Trip = triplicate.		

Table 3.11. Dominant Elemental Concentrations in Sludges (% dry weight)

Elements	19250 (C-202)		19887 (C-203)		19961 (C-203)	
	Fusion	Acid Digestion	Fusion	Acid Digestion	Fusion	Acid Digestion
	-----% Dry Mass of Sludge-----					
Fe	11.9	12.2	0.8	1.7	1.2	1.6
Mn	2.5	2.5	0.1	0.1	0.1	0.1
Na	NA*	5.9	NA*	9.7	NA*	9.5
P	1.5	1.6	4.8	3.8	3.8	3.9
U	23.6	20.7	63.7	52.5	53.5	48.5

Concentrations listed in parentheses were <EQL.
NA* = Not applicable; sodium reagent used to dissolve fused sludge.

Table 3.12. ^{137}Cs Concentrations in Sludge

Sample Number	^{137}Cs µCi/g-dry Sludge	^{137}Cs µg/g-dry Sludge
$KOH-KNO_3$ Fusions		
19250 (C-202)	1.05E+01	1.21E-01
19250 (C-202) Dup	1.41E+01	1.62E-01
19887 (C-203)	2.48E+01	2.85E-01
19887 (C-203) Dup	3.02E+01	3.47E-01
19961 (C-203)	2.01E+01	2.31E-01
19961 (C-203) Dup	2.41E+01	2.77E-01
19250 (C-202) Avg	1.23E+01	1.41E-01
19887 (C-203) Avg	2.75E+01	3.16E-01
19961 (C-203) Avg	2.21E+01	2.54E-01
EPA Acid Digestion		
19250 (C-202)	1.37E+01	1.57E-01
19250 (C-202) Dup	1.32E+01	1.51E-01
19250 (C-202) Trip	1.47E+01	1.69E-01
19887 (C-203)	1.79E+01	2.06E-01
19887 (C-203) Dup	2.07E+01	2.38E-01
19961 (C-203)	2.14E+01	2.46E-01
19961 (C-203) Dup	2.19E+01	2.52E-01
19250 (C-202) Avg	1.38E+01	1.59E-01
19887 (C-203) Avg	1.93E+01	2.22E-01
19961 (C-203) Avg	2.17E+01	2.49E-01

Avg = Average.
Dup = Duplicate.
Trip = Triplicate.

The concentrations of actinides in the sludge samples were measured using both fused and acid digested samples using ICP-MS methods unless noted (Table 3.14). The average ^{239}Pu concentration in fusion sample 19250 (C-202) was found to be 55.9 µg/g sludge which was almost an order of magnitude less than the average concentration measured in the acid digested sample of 435 µg/g sludge. The average ^{239}Pu fusion concentration in sample 19887 (C-203) was estimated at 1.78 µg/g sludge and was measured in sample 19961 (C-203) at 4.33 µg/g sludge. These values are up to a factor ten lower than the average ^{239}Pu values (14.9 and 21.4 µg/g sludge) estimated for the acid digested samples. The average ^{237}Np concentrations determined from fused and acid digested samples have similar concentrations. In fusion samples of 19250 (C-202), 19887 (C-203) and 19961 (C-203) sludges, the average ^{237}Np concentrations were measured/estimated to be 0.361, 0.0685, and 0.0445 µg/g sludge, respectively. By comparison, ^{237}Np concentrations in the same sludge samples that were acid digested were 2.16, 0.0485, and 0.0552 µg/g sludge, respectively. The concentrations of ^{241}Am in fused and acid digested fractions of 19250 (C-202) sludge sample were measured to be 0.23 and 0.45 µg/g sludge, respectively. The ^{241}Am concentrations in fused and acid digested fractions of sample 19887 (C-203) were 0.0055 and 0.012 µg/g sludge, respectively. The ^{241}Am concentrations in fused and acid digested fractions of sample 19961 (C-203) were 0.0065 and 0.017 µg/g sludge, respectively.

Table 3.13. ^{90}Sr Concentrations in Sludge

Sample Number	^{90}Sr μCi/g-dry Sludge	^{90}Sr μg/g-dry Sludge
$KOH-KNO_3$ Fusions		
19250 (C-202)	604	4.31
19250 (C-202) Dup	562	4.01
19887 (C-203)	NA	NA
19887 (C-203) Dup	NA	NA
19961 (C-203)	NA	NA
19961 (C-203) Dup	NA	NA
19250 (C-202) Avg	583	4.16
19887 (C-203) Avg	NA	NA
19961 (C-203) Avg	NA	NA
EPA Acid Digestion		
19250 (C-202)	755	5.39
19250 (C-202) Dup	752	5.37
19250 (C-202) Trip	761	5.44
19887 (C-203)	347	2.48
19887 (C-203) Dup	328	2.34
19961 (C-203)	401	2.87
19961 (C-203) Dup	379	2.71
19250 (C-202) Avg	756	5.40
19887 (C-203) Avg	338	2.41
19961 (C-203) Avg	390	2.79

Avg = Average.
Dup = Duplicate.
Trip = Triplicate.
NA = Not analyzed.

3.2 ^{129}I Extraction and Measurement

Table 3.15 contains results of the ^{129}I analysis of the modified $KOH:KNO_3$ fusion/water extraction of sludge material from tanks C-202 and C-203. The data are reported as pCi ^{129}I per gram of sludge (calculated on a dry weight basis). ICP-MS analysis of ^{129}I was better than ±10% of certified reference standards, with a linear operating range extending three orders of magnitude (0.01 to 10 ng/mL).

The ^{129}I concentrations in solutions from the $KOH:KNO_3$ fusion/water extraction method were below the sample EQL for the analysis (see Section 3.1 for a discussion of EQL calculations). The instrument EQLs for these analyses were 4,500 pCi/L for the C-202 and C-203 residual waste samples, respectively. These instrument EQLs resulted in dilution-corrected sample EQLs ranging from 717 to 725 pCi/g sludge for the C-202 tank waste material and 584 to 681 pCi/g sludge for the C-203 tank waste material.

Table 3.14. Actinide Concentrations in Sludge (measured using ICP-MS unless footnoted)

Sample Number	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
KOH-KNO$_3$ Fusions						
19250 (C-202)	2.54E-04	3.57E-01	3.36E+00	5.42E+01	8.95E-01	2.63E-01
19250 (C-202) Dup	2.60E-04	3.66E-01	3.57E+00	5.76E+01	6.86E-01	2.02E-01
19887 (C-203)	<3.61E-04	<5.08E-01	(9.61E-02)	(1.55E+00)	<2.88E+00	<8.47E-01
19887 (C-203) Dup	(4.87E-05)	(6.85E-02)	(1.25E-01)	(2.02E+00)	1.86E-02[a]	5.47E-03[a]
19961 (C-203)	(1.99E-05)	(2.80E-02)	2.45E-01	3.96E+00	2.15E-02[a]	6.32E-03[a]
19961 (C-203) Dup	(4.33E-05)	(6.10E-02)	2.92E-01	4.71E+00	2.24E-02[a]	6.58E-03[a]
19250 (C-202) Avg	2.57E-04	3.61E-01	3.46E+00	5.59E+01	7.91E-01	2.33E-01
19887 (C-203) Avg	(4.87E-05)	(6.85E-02)	(1.11E-01)	(1.78E+00)	1.86E-02[a]	5.47E-03[a]
19961 (C-203) Avg	(3.16E-05)	(4.45E-02)	2.69E-01	4.33E+00	2.19E-02[a]	6.45E-03[a]
EPA Acid Digestion						
19250 (C-202)	1.46E-03	2.05E+00	2.64E+01	4.25E+02	1.48E+00	4.36E-01
19250 (C-202) Dup	1.55E-03	2.18E+00	2.74E+01	4.42E+02	1.58E+00	4.65E-01
19250 (C-202) Trip	1.60E-03	2.26E+00	2.71E+01	4.38E+02	1.52E+00	4.46E-01
19887 (C-203)	(5.03E-05)	(7.09E-02)	9.93E-01	1.60E+01	4.04E-02[a]	1.19E-02[a]
19887 (C-203) Dup	(1.86E-05)	(2.62E-02)	8.58E-01	1.38E+01	3.81E-02[a]	1.12E-02[a]
19961 (C-203)	(5.11E-05)	(7.20E-02)	1.38E+00	2.22E+01	5.79E-02[a]	1.70E-02[a]
19961 (C-203) Dup	(2.73E-05)	(3.85E-02)	1.27E+00	2.05E+01	5.41E-02[a]	1.59E-02[a]
19250 (C-202) Avg	1.54E-03	2.16E+00	2.70E+01	4.35E+02	1.53E+00	4.49E-01
19887 (C-203) Avg	(3.45E-05)	(4.85E-02)	9.25E-01	1.49E+01	3.92E-02[a]	1.15E-02[a]
19961 (C-203) Avg	(3.92E-05)	(5.52E-02)	1.33E+00	2.14E+01	5.60E-02[a]	1.65E-02[a]

(a) Analyzed by Radiochemical Processing Laboratory (RPL) using wet chemical separation and AEA.
Avg = Average.
Dup = Duplicate.
Trip = Triplicate.

Table 3.15. Summary of ^{129}I Concentrations for Modified KOH-KNO$_3$ Water Fusion Extracts for Tanks C-202 and C-203 Sludge Samples

Tank	Sample Number	^{129}I (pCi/g sludge)
C-202	19250	<725
	19250 Duplicate	<717
C-203	19887	<634
	19887 Duplicate	<584
C-203	19961	<681

3.3 Water Leaching Tests

The data obtained from the water leaching tests on the three sludge samples [19250 (202), 19887 (203), and 19961 (203)] are presented and discussed in this section. The concentrations of the constituents in the water extracts tabulated in this section are expressed in units of µCi or µg per gram of dry sludge. Concentrations on per liter basis of dissolved constituents are also listed in Appendix I. Results for ^{129}I in the single-contact and periodic replenishment tests are not included because they were below the detection limit.

3.3.1 Single-Contact Test Results

The single contact water-leach tests were run in duplicate with an equilibration time of one month. DDI water was used as a leachant. The results of these experiments are presented in this section. In addition, the first stage of the sequential extraction tests (Section 3.3.2) represents a 1-day water contact test, and the results of those tests are also provided in the tables in this section.

3.3.1.1 Digestion Factors and Moisture Contents – Single-Contact DDI Water Extracts

In these tests, 30 ml of DDI water was contacted with about 0.5 to 0.8 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to DDI water ratios (Table 3.16). These ratios ranged from about 6.47 to 17.55.

Table 3.16. Sludge to DDI Ratios Used in Water Leaching Tests

Sample Number	Sludge to DDI Water Ratio (g/L)
19250 (C-202)	9.17
19250 (C-202) Dup	6.47
19887 (C-203)	11.60
19887 (C-203) Dup	10.91
19961 (C-203)	13.30
19961 (C-203) Dup	17.55
All concentrations are corrected for the dry sludge basis.	

3.3.1.2 Water Extract pH and Alkalinity – Single-Contact DDI Water Extracts

The average alkalinities and pH values measured in duplicate samples of each sludge DDI water extract are listed in Table 3.17. The pH values of all three sludge water extracts were alkaline in nature with the C-202 samples in the range of 8.18 to 9.00 and the C-203 samples in the range 10.47 to 10.88. The total alkalinities for C-202 sludge DDI water extracts ranged from 25.5 to 38.7 mg $CaCO_3$/g sludge. The values for the C-203 sludge were in the range 42.3 to 48.8 mg $CaCO_3$/g sludge (Table 3.17).

Table 3.17. Water Extract pH and Alkalinity Values

Sample Number	pH	Total Alkalinity as $CaCO_3$ (mg/g sludge)
19250 (C-202) 1 Day	8.18	38.7
19250 (C-202) Dup 1 Day	8.72	32.0
19250 (C-202) 1 Month	8.78	25.5
19250 (C-202) Dup 1 Month	9.00	34.6
19887 (C-203) 1 Day	10.66	42.3
19887 (C-203) Dup 1 Day	10.63	44.2
19887 (C-203) 1 Month	10.56	44.6
19887 (C-203) Dup 1 Month	10.47	48.8
19961 (C-203) 1 Day	10.88	45.3
19961 (C-203) Dup 1 Day	10.88	43.4
19961 (C-203) 1 Month	10.75	43.5
19961 (C-203) Dup 1 Month	10.56	43.1
Dup = Duplicate. All concentrations are corrected for the dry sludge basis.		

3.3.1.3 Extractable ^{99}Tc and ^{238}U – Single-Contact Water Extracts

The radionuclides ^{99}Tc and ^{238}U pose a long-term environmental risk because of their long half lives and high mobility in the dissolved state. The concentrations of these two constituents mobilized in DDI water after 1 day and 1 month of contact with the C-202 and C-203 residual sludge samples are listed in Table 3.18. The concentrations of ^{99}Tc extracted from C-202 sludge in the single contact extracts were extremely low (0.0069 and 0.0093 µg/g sludge). The extracts from the two sludge samples from tank C-203 contained ^{99}Tc concentrations that were estimated at 0.0023 and 0.0037 µg/g sludge for the 1-day contact tests and below instrumental detection limits for the 1-month contact. When compared to the total ^{99}Tc in the sludge as measured by acid digestion of the sludges, these water leachable concentrations represent about 1 to 10% of the ^{99}Tc in the residual sludges (Table 3.19).

Table 3.18. ^{99}Tc and ^{238}U Concentrations Extracted from Sludges from Single-Contact Water Leach Tests

Sample Number	^{99}Tc	^{238}U	^{99}Tc	^{238}U
	µg/g Sludge		µCi/g Sludge	
19250 (202) Dup 1 Day Avg	9.34E-03	4,970	1.59E-04	1.69E-03
19250 (202) 1 Month Avg	6.89E-03	4,380	1.17E-04	1.49E-03
19887 (203) Dup 1 Day Avg	(2.30E-03)	29,800	(3.91E-05)	1.01E-02
19887 (203) 1 Month Avg	<4.45E-02	13,800	<7.56E-04	4.69E-03
19961 (203) Dup 1 Day Avg	(3.69E-03)	50,000	(6.27E-05)	1.70E-02
19961 (203) 1 Month Avg	<3.30E-02	12,100	<5.62E-04	4.13E-03
Avg = Average.				

Table 3.19. Water-Leachable Percentages of ^{99}Tc and ^{238}U Extracted from Sludge Samples

Sample Number	^{99}Tc	^{238}U
	Percent Water Leachable	
19250 (202) Dup 1 Day Avg.	6.3	2.4
19250 (202) 1 Month Avg.	4.6	2.11
19887 (203) Dup 1 Day Avg.	(1.5)	5.7
19887 (203) 1 Month Avg.	N/A	2.63
19961 (203) Dup 1 Day Avg.	(10.4)	10.3
19961 (203) 1 Month Avg.	N/A	2.50
N/A = Technetium was not detected in these samples. Total concentrations from EPA acid digestions.		

The DDI water extracts from these sludges contained significant concentrations of ^{238}U. For instance, the 1-day extract from C-202 sludge contained an average ^{238}U concentration of 4.97 x 10^3 µg/g sludge (4,970 ppm) and the 1-day extracts from the C-203 sludges were found to contain ^{238}U concentrations of 2.98 x 10^4 µg/g sludge (29,800 ppm) and 5.0 x 10^4 µg/g sludge (50,000 ppm), respectively. The 1-month extract ^{238}U concentrations for each sample were slightly lower than the 1-day extracts. The percentages of leachable uranium for the samples have been calculated using the acid digestion concentrations for the total values. The leachable percentages are in the range of 2.1 to 10.3% (Table 3.19) suggesting that ^{238}U, like ^{99}Tc, is present in the sludges in a solid of relatively low solubility.

3.3.1.4 Extractable Metals Concentrations – Single-Contact DDI Water Extracts

Concentrations of a number of metals such as, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the DDI water extracts were measured by ICP-OES. Among these, only about a dozen metals were present in measurable concentrations (Table 3.20). The concentrations listed within parentheses indicate values that are less than EQL. These data showed that the two major DDI water leachable elements in all three sludge samples were Na and P. Extraction concentrations of Na in all three sludge samples were similar in magnitude. For example, the 1-month Na concentrations were 2.96 x 104 µg/g sludge in 19250 (C-202), 2.79 x 104 µg/g sludge in 19887 (C-203), and 2.82 x 104 µg/g sludge in 19961 (C-203). However, 1-month concentrations of P in 19250 (C-202) sludge extract was 2.25 x 103 µg/g sludge, which was about three to four times less than the P concentrations observed in the DDI water extracts of C-203 tank sludge samples (6.5 x 103 µg/g sludge and 7.1 x 103 µg/g sludge in 19887 and 1996, respectively). Other elements with measurable leachability (~50 – 1,000 µg/g sludge) included Al, Ca, Cr, Fe, Mn, and Pb (only in C-203 sludges). Metals with very low leachabilities (<EQL) present in these sludges were Mg, Ni, Sr, and Zn.

Percentages of total metals that were DDI water extractable are listed in Table 3.21. These results were computed on the basis of the total metal concentrations as measured in the acid digestion sludge extractions (Table 3.3 to Table 3.5). The 1-month data show that about a half (50.3%) of the total Na present in 19250 (202) and about a third (28.8 and 29.8%, respectively) of the Na inventory in the 19887 (203) and 19961 (203) residual sludge samples were present in readily leachable forms. Water leachable fractions of P for the 1-month tests constituted 14% of 19250 (C-202), 17.2% of 1987 (C-203), 18.3% of 19961 (203) of the total mass of P present in these residual sludges. Other measurable leachable metal

Table 3.20. DDI Water-Leachable Average Metal Concentrations in Single-Contact Water Extractions

Sample Number	Al	Ca	Cr	Fe	K	Mn	Na	Ni	P	Pb	Si	Sr	Zn
	µg/g-dry Sludge												
19250 (202) 1 Day	211	(214)	207	772	(720)	165	28,000	56.3	2,130	(66.8)	<1,450	15.6	(10.4)
19250 (202) 1 Month	200	(145)	203	132	303	30.3	29,600	(12.3)	2,250	(23.3)	NA	(6.73)	(6.16)
19887 (203) 1 Day	97.2	214	995	704	<4,680	117	29,8004	87	8,450	3.29	(136)	22.4	(46.0)
19887 (203) 1 Month	168	184	560	301	<5,560	49.5	27,900	(41.6)	6,550	152	<4,450	(12.3)	(66.5)
19961 (203) 1 Day	(63.2)	311	1,610	1,640	<46,800	237	33,400	203	10,050	646	(192)	36.7	(70.4)
19961 (203) 1 Month	124	199	977	750	<4,130	119	28,200	(97.4)	7,130	250	<3,300	(13.7)	(67.3)

Table 3.21. Percentages of DDI Water-Leachable Metals in Single-Contact Water Extractions

Sample Number	Al	Ca	Cr	Fe	K	Mn	Na	Ni	P	Pb	Si	Sr	Zn
	Percent Water Leachable												
19250 (C-202) 1 Day	1.5%	(1.5%)	1.6%	0.6%	(4.6%)	0.6%	47.6%	0.6%	13.2%	(0.8%)	N/A	1.0%	(1.3%)
19250 (C-202) 1 Month	1.5%	(1.0%)	1.5%	0.1%	(1.9%)	0.1%	50.3%	(0.1%)	14%	(0.3%)	N/A	(0.4%)	(0.8%)
19887 (C-203) 1 Day	N/A	6.5%	15.6%	4.2%	N/A	13.9%	30.8%	19.9%	22.2%	5.5%	(3.5%)	5.8%	(6.4%)
19887 (C-203) 1 Month	N/A	5.6%	8.8%	1.8%	N/A	5.9%	28.8%	(9.5%)	17.2%	2.6%	N/A	(3.2%)	(9.3%)
19961 (C-203) 1 Day	N/A	10.5%	29.6%	10.3%	N/A	22.1%	35.3%	34.8%	27.0%	12.2%	(6.2%)	8.4%	(13.2%)
19961 (C-203) 1 Month	N/A	6.7%	18.0%	4.7%	N/A	11.1%	29.8%	(16.7%)	18.3%	4.7%	N/A	(3.2%)	(12.6%)

N/A = Not applicable; analytes below detection limits.

fractions were found only in C-203 tank sludge samples. These leachable metals consisted of Ca (5.6 and 6.7%), Cr (8.8 and 18.0%), Fe (1.8 and 4.7%), Mn (5.9 and 11.1%), and Pb (2.6 and 4.7%) in samples 19887 (C-203) and 19961 (C-203), respectively. These data show that Cr, Fe, Mn, and Pb are appreciably more DDI-water leachable from C-203 sludge sample 19887 than 19961. At this time, there are no discernable reasons for this differential leaching of these four elements from these two sludge samples from the same waste tank.

3.3.1.5 Extractable Anion Concentrations – Single-Contact Water Extracts

The concentrations of anions that were present in the DDI water extracts after 1-day and 1-month contact times were measured by ion chromatography (Table 3.22). The results for the 1-day contact are similar to the 1-month, and only the details of the 1-month results are discussed. Among the halides, fluoride in the DDI water extracts of all sludges was present in one and two orders of magnitude higher concentrations than chloride. Average concentrations of F and Cl in the 1-month 19250 (C-202) sample extracts were 4,290 and 165 µg/g sludge, respectively. Extract concentrations of F, and Cl, in C-203 sludge samples were about half of what were measured in the C-202 1-month sludge extract [19887 (C-203), F: 2570 µg/g sludge, Cl: 56µg/g sludge and 19961 (C-203), F: 2760 µg/g sludge, Cl: 83.1 µg/g sludge].

Table 3.22. Average Extractable Anion Concentrations Determined from Single-Contact DDI Water Extractions

Sample Number	Fluoride	Chloride	Nitrite	Nitrate	Carbonate[(a)]	Sulfate	Oxalate[(a)]	Phosphate[(a)]
	µg/g Sludge							
19250 (C-202) 1 Day	3,850	33.5	442	1,250	12,200	233	28,600	5,640
19250 (C-202) 1 Month	4,290	165	474	1,760	13,300	207	27,600	6,260
19887 (C-203) 1 Day	2,480	64.9	478	3,950	29,700	211	1,280	16,200
19887 (C-203) 1 Month	2,570	56	456	3,900	32,300	198	1,270	18,100
19961 (C-203) 1 Day	2,610	73.6	742	5,480	32,400	269	1,330	20,600
19961 (C-203) 1 Month	2,760	83.1	786	5,800	29,700	279	1,400	19,000

(a) Carbonate, oxalate and phosphate results are for information only. The QC standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.

Nitrate concentrations in the extracts were about 4 to 9 times higher than nitrite concentrations. Average nitrate and nitrite concentrations in 19250 (C-202) 1-month extracts were 1,760 and 474 µg/g sludge respectively. Higher concentrations nitrate were found in C-203 tank sludge samples [19887 (203): 3,900 µg/g sludge, and 19961 (C-203): 5,800 µg/g sludge].

The 1-month extract concentration of carbonate in 19250 (C-202) was found to be 13.3 mg/g sludge. This value is about 40% less than the value computed from alkalimetric titrations (30.07 mg/g sludge, Table 3.17). Relatively higher carbonate concentrations were found in the C-203 tank sludge extracts [19887 (203): 32.3 mg/g sludge, and 19961 (C-203): 29.7 mg/g sludge]. These values on average were within 8% of the total alkalinity calculated from the alkalimetric titrations. Part of these differences in the directly measured carbonate concentrations in the extracts and the corresponding calculated total alkalinity values may be attributable to the hydroxide alkalinities of these samples.

Relatively low concentrations of sulfate were found in the DDI water extracts of these sludge samples. The average 1-month contact sulfate concentrations were 207, 198, and 279 µg/g sludge in extracts of 19250 (C-202), 19887 (C-203), and 19961 (C-203) samples, respectively.

Significant concentrations of phosphate were found in the 1-month DDI water extracts of these sludge samples. The phosphate concentrations in DDI water extracts from C-203 sludge samples 19887 and 19961 were 18,100 and 19,000 µg/g sludge, respectively. These phosphate concentrations were about three times higher than what was measured in 19250 (C-202) sample extract (6,260 µg/g sludge). In contrast, the 19250 (C-202) sludge extract contained very high oxalate concentration (27,600 µg/g sludge) that exceeded the oxalate concentrations in C-203 tank sludge sample DDI water extracts by more than an order of magnitude [19887 (C-203): 1,270 µg/g sludge, and 19961 (C-203): 1,400 µg/g sludge].

3.3.1.6 Extractable ^{137}Cs and ^{90}Sr in Single-Contact DDI Water Extracts

The concentrations of ^{137}Cs in the sludge DDI water extracts after 1 month indicated that this radioisotope had extremely low leachabilities that were in the low microcuries per gram of sludge levels (Table 3.23). As an example, the average ^{137}Cs concentration in the 19250 (C-202) sludge DDI water extract was found to be 0.338 µCi/g sludge, whereas, ^{137}Cs concentrations in 19887 (C-203) and 19961 (C-203) sample extracts were measured at 0.385 µCi/g sludge and 0.593 µCi/g sludge, respectively. Therefore, the DDI water leachable fraction of ^{137}Cs in these sludge samples constituted on average 2.4, 2.0, and 2.7% of the total ^{137}Cs present in the 19250 (C-202), 19887 (C-203); and 19961 (C-203) sludge samples, respectively.

Table 3.23. Extractable ^{137}Cs Concentrations Determined from Single-Contact Water Extractions

Sample Number	^{137}Cs µCi/g Sludge	^{137}Cs µg/g Sludge
	Water Extract	
19250 (C-202) 1 Day	0.646	7.42E-03
19250 (C-202) 1 Month	0.338	3.89E-03
19887 (C-203) 1 Day	0.681	7.83E-03
19887 (C-203) 1 Month	0.385	4.42E-03
19961 (C-203) 1 Day	1.58	1.82E-02
19961 (C-203) 1 Month	0.593	6.82E-03

The ^{90}Sr concentrations in the DDI water extracts are provided in Table 3.24. The 1-month C-202 extract of sample 19250 contained 9.93 µCi/g sludge ^{90}Sr, while the extracts of 19887 (C-203) and 19961 (C-203) sludge samples contained concentrations of 16.4 and 15.9 µCi/g sludge, respectively. These concentrations represented 1.3, 4.8, and 4.1% of the total ^{90}Sr present in these sludge samples.

Table 3.24. Extractable ^{90}Sr Concentrations Determined from Single-Contact DDI Water Extractions

Sample Number	^{90}Sr	
	µCi/g Sludge	µg/g Sludge
	Water Extract	
19250 (C-202) 1 Day	20.7	0.148
19250 (C-202) 1 Month	9.93	0.071
19887 (C-203) 1 Day	21.0	0.150
19887 (C-203) 1 Month	16.4	0.117
19961 (C-203) 1 Day	39.4	0.281
19961 (C-203) 1 Month	15.9	0.113

3.3.1.7 Extractable Actinides - Single-Contact DDI Water Extracts

The DDI water leachable extractable actinide concentrations are listed in Table 3.25. The concentrations of actinides in these sludge DDI water extracts were in the order ^{239}Pu > ^{237}Np > ^{241}Am. The concentrations of ^{241}Am in the extracts were in all cases well below the EQL and/or instrument detection limits.

Table 3.25. Extractable Actinide Concentrations Determined from Single-Contact DDI Water Extractions

Sample Number	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
19250 (C-202) 1 Day	9.41E-05	1.33E-01	2.34E-01	3.78E+00	(1.16E-02)	(3.42E-03)
19250 (C-202) 1 Month	(2.16E-05)	(3.04E-02)	6.09E-02	9.83E-01	(2.09E-03)	(6.14E-04)
19887 (C-203) 1 Day	<5.32E-03	<7.49E-01	2.27E-01	3.66E+00	<6.37E-01	<1.87E-01
19887 (C-203) 1 Month	<6.32E-04	<8.90E-01	<2.76E-01	<4.45E+00	<1.51E+01	<4.45E+00
19961 (C-203) 1 Day	<5.56E-03	<7.82E-01	4.78E-01	7.71E+00	<6.65E-01	<1.96E-01
19961 (C-203) 1 Month	<4.69E-04	<6.61E-01	(5.14E-02)	(8.28E-01)	<1.12E+01	<3.30E+00

The ^{239}Pu concentrations in the 1-day DDI water extracts of sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) were 3.78, 3.66, and 7.71 µg/g sludge respectively. These concentrations indicated that 0.87, 24.5, and 36.1% of the total ^{239}Pu contained in these sludge samples were in DDI-water extractable forms (Table 3.26). The 1-month water extract results generally had lower percentages of leachable ^{239}Pu.

The DDI water extracts contained very low concentrations of ^{237}Np. The only measured concentration was the 1-day sample 19250 (C-202) extract that contained 0.133 µg/g sludge ^{237}Np. This represented 6.1% of the total ^{237}Np in this sludge. The non-detect extractable concentration levels for the C-203 sludge samples were greater than the estimated total ^{237}Np concentrations in these samples; therefore, an estimate of maximum leachable ^{237}Np cannot be calculated.

Table 3.26. Water-Leachable Percentage for Actinides in Single-Contact DDI Water Extractions

Sample Number	^{237}Np	^{239}Pu	^{241}Am
	% Water Leachable		
19250 (202) 1 Day	6.1	0.87	(0.8)
19250 (202) 1 Month	(1.40)	0.2	(0.1)
19887 (203) 1 Day	N/A	24.5	N/A
19887 (203) 1 Month	N/A	N/A	N/A
19961 (203) 1 Day	N/A	36.1	N/A
19961 (203) 1 Month	N/A	(0.24)	N/A
N/A = Results below detection limit. Total concentrations from EPA acid digestions.			

The estimated DDI water extractable ^{241}Am concentration for the 1-day water leach of sample 19250 (C-202) was 0.00342 µg/g sludge, which represents 0.8% of the total ^{241}Am in this sludge sample. ^{241}Am was not detected in the water leaches for the C-203 sludge samples.

3.3.2 Water Extraction Periodic Replenishment Test Results

The periodic replenishment tests were conducted by repeatedly equilibrating duplicate sludge samples with 30 mL aliquots of fresh DDI water. Sequential contacts, 1, 2, 4, and 5 were for 1 day each, whereas, sequential contact 3 and 6 lasted 3 and 30 days, respectively (Table 3.27). The goal of the sequential leaching tests was to assess the long-term leaching characteristics of key contaminants and other constituents from these residual sludge samples. The results of these tests are presented in this section.

3.3.2.1 Digestion Factors and Moisture Contents – Periodic Replenishment DDI Water Extractions

In these tests, 30 ml of DDI water was contacted with about 0.3 to 0.6 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to DDI water ratios (Table 3.28). These ratios ranged from about 6.79 to 14.24.

3.3.2.2 Water Extract pH and Alkalinity – Periodic Replenishment Water Extractions

The average alkalinities and pH values measured in duplicate aliquots of DDI water extracts of each sludge sample at the end of each sequential contact are listed in Table 3.27. The pH values at all stages of extraction were alkaline in nature ranging between 7.43 – 8.74, 9.9 – 10.65, and 10.04 – 10.88 for the three sludge samples. The pH values for all sludge samples tended to decrease measurably in a step wise fashion from the initial to the fifth stage of extraction, and then increased slightly during the last extraction stage that lasted 30 days.

Table 3.27. Contact Times, pH Values, and Alkalinities for DDI Water Contact Periodic Replenishment Extractions

Sequential Contacts	Contact Duration (days)	pH	Total Alkalinity as $CaCO_3$ (mg/g sludge)
Sample 19250 (C-202)			
1	1	8.45	35.4
2	1	8.34	10.3
3	3	8.09	7.07
4	1	7.94	4.31
5	1	7.43	3.70
6	30	8.74	8.74
Sample 19887 (C-203)			
1	1	10.65	43.3
2	1	10.50	14.8
3	3	10.27	10.3
4	1	10.55	8.94
5	1	9.90	6.36
6	30	10.49	12.7
Sample 19961 (C-203)			
1	1	10.88	44.4
2	1	10.81	14.1
3	3	10.51	10.8
4	1	10.51	9.66
5	1	10.04	8.17
6	30	10.45	12.7

Table 3.28. Sludge to DDI Ratios Used in Periodic Replenishment Leaching Tests

Sample Number	Sludge to DDI Water Ratio (g/L)
19250 (202)	6.79
19250 (202) Dup	6.99
19887 (203)	14.24
19887 (203) Dup	12.57
19961 (203)	12.26
19961 (203) Dup	13.34
All concentrations are corrected for the dry sludge basis.	

For all samples the initial extraction mobilized the highest total alkalinity then alkalinity decreased with subsequent extraction stages but finally increased slightly during the last stage, a 30-day extraction. Typically, the total alkalinity dropped by about 65 to 70% from the initial extraction to the second extraction. For the 19250 (C-202) sludge, the sum of extractable total alkalinity from all six stages was 69.5 mg $CaCO_3$/g sludge, whereas, the sum of sequentially extracted alkalinities for 19887 (C-203) and 19961 (C-203) sludge samples were 96.4 and 99.8 mg $CaCO_3$/g sludge respectively. These six stages of sequential extractions mobilized more than twice the amount of alkalinity from each sludge sample as compared to the alkalinities released by the single 30-day water extraction (Table 3.17). Also, a rebound in both pH and alkalinity values during the last extraction stage indicated that there are slowly water-releasable alkalinity components in all these sludge samples even after considerable water leaching.

3.3.2.3 Carbon Content – Periodic Replenishment DDI Water Extractions

Table 3.29 lists the carbon contents that were sequentially extractable from the C-202 and C-203 sludge samples. The bulk of the extractable carbon from all the sludge samples was mobilized during the first extraction. Approximately 41, 63, and 64% of the total carbon contents of samples 19250 (C-202), 19887 (C-203) and 19961 (C-203) were extracted during the first stage. The carbon extracted during the first stage consisted of mainly organic carbon that accounted for about 46 to 73% of the total organic carbon contents of these sludges.

Table 3.29. Carbon Content – Periodic Replenishment DDI Water Extractions

Sequential Contact	Duration (Days)	TC	TOC	TIC
		---------------mg C/g Sludge-----------		
19250 (C-202)				
1	1	19.04	12.41	6.63
2	1	5.52	2.52	3.00
3	3	5.94	3.23	2.72
4	1	2.80	1.03	1.77
5	1	2.58	0.87	1.71
6	30	10.31	6.76	3.56
19887 (C-203)				
1	1	8.68	3.99	4.70
2	1	1.63	0.54	1.28
3	3	1.11	0.36	1.11
4	1	0.60	0.36	0.60
5	1	0.52	0.36	0.52
6	30	1.30	0.36	1.30
19961 (C-203)				
1	1	9.39	5.18	4.21
2	1	1.78	0.38	1.78
3	3	1.12	0.38	1.12
4	1	0.68	0.38	0.68
5	1	0.56	0.38	0.56
6	30	1.19	0.38	1.19
All concentrations are corrected for the dry sludge basis.				

The organic and inorganic carbon contents of the DDI water leachates dropped off significantly from the first stage to the last stage of extraction for both C-203 residual sludge samples. During the prolonged final extraction stage, the organic concentration rebounded by a factor of about 8 in the C-202 sludge sample, whereas in the C-203 samples there was no rebound of organic carbon. For all three residual sludge samples, the total inorganic carbon increased by a factor of about 2 between the fifth and sixth stages of contact.

3.3.2.4 ^{99}Tc and ^{238}U – Periodic Replenishment DDI Water Extracts

The concentrations of ^{99}Tc and ^{238}U mobilized in periodic replenishment DDI water extractions of the sludge samples are listed in Table 3.30. The concentration of ^{99}Tc in the first stage extract of sludge 19250 (C-202) was extremely low (0.0093 µg/g sludge). Concentrations of ^{99}Tc for all subsequent stages for this sample were below detection limits. Extracts from all six stages of extraction from the two sludge samples from tank C-203 contained ^{99}Tc concentrations that were below instrumental detection limits. Sample 19250 (C-202) was calculated to have a measurable percentage (8.2%) of its total ^{99}Tc leached during the DDI water replenishment tests (Table 3.31); however, very little (<2%) of the total ^{99}Tc was leachable from sample 19887 (C-203). Approximately 10.4% of the total ^{99}Tc in sample 19961 (C-203) may have been leached from this sludge sample (Table 3.31) using DDI.

In contrast, extracts from these sludges obtained from all six stages contained significant concentrations of ^{238}U (Table 3.30). The initial extract from 19250 (C-202) sludge contained an average ^{238}U concentration of 4,970 µg/g sludge (4,970 ppm) and similarly, the first stage extracts from sludges 19887 (C-203) and 19961 (C-203) samples contained ^{238}U concentrations of 29,800 µg/g sludge and 50,000 µg/g sludge, respectively. The second through fifth stage extracts show a decreasing trend in ^{238}U concentrations. The last (6th) stage of prolonged extractions showed ^{238}U concentrations that had increased to levels

Table 3.30. ^{99}Tc and ^{238}U Concentrations in Periodic Replenishment DDI Water Extractions

Sequential Contact	Contact Duration (days)	^{99}Tc	^{238}U	^{99}Tc	^{238}U
		µg/g Sludge		µCi/g Sludge	
Sample 19250 (C-202)					
1	1	9.34E-03	4,970	1.59E-04	1.69E-03
2	1	(1.89E-03)	1,520	(3.22E-05)	5.17E-04
3	3	(9.49E-04)	1,890	(1.61E-05)	6.42E-04
4	1	<3.72E-03	796	<6.33E-05	2.71E-04
5	1	<7.26E-03	627	<1.23E-04	2.13E-04
6	30	<7.26E-03	5,510	<1.23E-04	1.87E-03
Sample 19887 (C-203)					
1	1	(2.30E-03)	29,800	(3.91E-05)	1.01E-02
2	1	<7.49E-03	11,100	<1.27E-04	3.78E-03
3	3	<7.49E-03	11,700	<1.27E-04	3.99E-03
4	1	<7.49E-03	2,420	<1.27E-04	8.22E-04
5	1	<7.49E-03	2,820	<1.27E-04	9.58E-04
6	30	<3.74E-02	33,400	<6.37E-04	1.14E-02
Sample 19961 (C-203)					
1	1	(3.69E-03)	50,000	(6.27E-05)	1.70E-02
2	1	<7.82E-03	8,870	<1.33E-04	3.02E-03
3	3	<7.82E-03	8,650	<1.33E-04	2.94E-03
4	1	<7.82E-03	1,730	<1.33E-04	5.87E-04
5	1	<7.82E-03	3,090	<1.33E-04	1.05E-03
6	30	<3.91E-02	13,800	<6.65E-04	4.69E-03

Table 3.31. Water Leachable Percentages of ^{99}Tc and ^{238}U in Periodic DDI Water Replenishment Extractions

Contact Stage	Contact Duration (days)	^{99}Tc	^{238}U
		Percent Water Leachable	
C-202 (Sample 19250)			
1	1	6.3	2.4
2	1	(1.3)	0.7
3	3	(0.6)	0.9
4	1	<EQL	0.4
5	1	<EQL	0.3
6	30	<EQL	2.7
C-203 (Sample 19887)			
1	1	(1.5)	5.7
2	1	<EQL	2.1
3	3	<EQL	2.2
4	1	<EQL	0.5
5	1	<EQL	0.5
6	30	<EQL	6.4
C-203 (Sample 19961)			
1	1	(10.4)	10.3
2	1	<EQL	1.8
3	3	<EQL	1.8
4	1	<EQL	0.4
5	1	<EQL	0.6
6	30	<EQL	2.8

<EQL= below the EQL.
Total concentrations from EPA acid digestions.

similar to what was observed during the first stage of extraction for samples 19250 (C-202) and 19887 (C-203), whereas the level in 19961 (C-203) increased significantly in the 6th stage but reached only about 28% of the first stage value. Such dissolution behavior may be indicative of two types of ^{238}U solid phases in these sludges that have differing dissolution kinetics.

The total ^{238}U leachable from all six sequential DDI water extractions constituted 8.0, 17, and 18% of the total ^{238}U present in 19250 (C-202), 19887 (C-203) and 19961 (C-203) residual sludges, respectively (Table 3.31). These data indicate that the sums of ^{238}U leached from all six stages of sequential extraction of these sludges were about 4 to 7 times more than the ^{238}U extracted in the single 30-day contact test (Table 3.19).

3.3.2.5 Selected Metal Concentrations – Periodic Replenishment DDI Water Extractions

Concentrations of a number of metals such as, Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the DDI water extracts were measured by ICP-OES. Among these, only about eleven metals were present in measurable concentrations

Table 3.32). The concentrations listed within parentheses indicate values that are less than the EQL. These data show that the two major leachable elements in all three sludge samples were Na and P. Extractable concentrations of Na in these sludge samples from all six DDI water extraction stages ranged form 1,710 to 33,200 µg/g sludge and P ranged from 237 to 10,400 µg/g sludge. The sequential leaching behaviors of Na and P from these sludges were similar to other constituents in that, following high concentrations in the first stage, significantly lower concentrations were observed in the subsequent four stages of extraction and then concentrations were enhanced noticeably in the final leach stage. Other elements in these sludges with measurable concentrations, such as Cr, Fe, Mn, Ni, and Pb, exhibited sequential leaching behaviors that were similar to that of major leachable elements. Metals with very low leachabilities (<EQL) present in these sludges include Mg, Ni, Sr, and Zn.

Table 3.32. Water-Leachable Average Metals in Periodic Replenishment DDI Water Extractions

Sequential Contact	Al	Ba	Ca	Cr	Fe	Mn	Na	Ni	P	Pb	Sr
	------ µg/g Dry Sludge ------										
Sample 19250 (C-202)											
1	211	(2.8)	(214)	207	773	165	28,000	56	2,130	(66.8)	16
2	241	(1.9)	(162)	(67.0)	468	99	5,500	32	1,420	(40.8)	(8.6)
3	438	(2.2)	(175)	111	796	172	3,900	59	1,100	(66.5)	(10.9)
4	287	(1.7)	(139)	(36.0)	286	64	1,700	(25.8)	426	(24.1)	(4.8)
5	256	(2.8)	(132)	(24.3)	192	43	1,330	(16.5)	237	(23.0)	(4.7)
6	705	27.2	(302)	326	2,510	565	3,870	213	659	175	35
Sample 19887 (C-203)											
1	97.2	(11.1)	214	995	704	116.7	29,800	87.0	8,450	329	22.4
2	(34.9)	(13.4)	(139)	383	312	52.4	7,920	(37.4)	3,730	138	(9.8)
3	(13.9)	(13.1)	(145)	338	271	45.8	5,170	(30.8)	(2,500)	136	(9.7)
4	(18.6)	(6.9)	(88.3)	48	(46.4)	(6.6)	2,440	(6.2)	(1,120)	(19.1)	(2.7)
5	(33.0)	(5.0)	(69.3)	80	(62.0)	(9.4)	1,840	(7.3)	(752)	(30.8)	(3.0)
6	(38.9)	53.9	(185)	351	336	48.0	6,300	(35.3)	3,130	241	22.0
Sample 19961 (C-203)											
1	(66.0)	(19.6)	320.0	1,600	1617	236	33,000	198	10,430	642	37
2	(26.9)	(4.1)	(122.9)	317	375	54	8,050	44	(3,800)	156	(9.6)
3	(21.3)	(10.5)	(120)	236	286	41	5,030	(31)	(2,400)	133	(10.0)
4	(18.1)	(12.9)	(57.3)	38	(49)	(5.9)	2,430	(4.2)	(1,040)	23	(2.3)
5	(18.9)	(13.2)	(82.1)	54	(79)	(9.2)	1,780	(7.4)	(670)	38	(2.8)
6	(72.5)	46.1	(92.0)	159	166	22	4,440	(19)	(2,190)	164	(11.5)

Values within parentheses were <EQL.
Based on duplicate measurements.

The percentages of metals that were cumulatively extractable during the six-stage sequential DDI water leaching are listed in Table 3.33. These results were computed on the basis of the total metal concentrations as measured in the acid digested samples of the residual sludges (Table 3.3 to Table 3.5). The data show that about 75.3% of the total Na present in sample 19250 (C-202) and about 55.2 and 58.0% of the Na inventory in the samples 19887 (C-203) and 19961 (C-203), respectively, were present in readily water leachable forms. These data indicated that the six stage sequential extraction of these sludge samples released about twice the amount of Na that was leached in a single 30-day extraction (Table 3.20). Also the sequential extractions of these sludges released P that constituted 37% of sample

19250 (C-202), 51.8% of 19887 (C-203), and 52.6% of 19961 (C-203) of the total mass of P present in these sludges. The cumulative P released from these sludges by the sequential extractions was about three times the amount of P released from the single 1-month extraction.

Table 3.33. Cumulative Percentages of Leachable Metals – Periodic Replenishment DDI Water Extractions

Element	Sample 19250 (C-202)	Sample 19887 (C-203)	Sample 19961 (C-203)
	-----------Cumulative % - DDI Water Soluble------------		
Al	15.7	--	--
Ca	(7.8)	(25)	26.7
Cr	(5.9)	34.4	44.1
Fe	4.1	10.4	16.1
Mn	4.3	33.1	34.3
Na	75.3	55.2	58.0
Ni	4.4	(47)	(69.5)
P	37.0	51.8	52.6
Pb	5.0	15	21.8
Values within parentheses were less than EQL. Values calculated on the dry sludge basis. Total concentrations from EPA acid digestions.			

Sequential extractions also cumulatively mobilized high percentages other metals, namely Cr, Fe, Mn, and Pb. As compared to a single extraction, the sequential extraction released more than an order of magnitude higher fractions of Fe, Mn, and Pb from the 19250 (C-202) sludge and about 2 to 6 times more of these elements from the C-203 tank sludge samples. The continual leaching of these elements after six stages of sequential extractions indicates that, except for Na and P, the bulk of the elements such as Al, Ca, Fe, and Mn in these residual sludges may be present in less water-soluble forms that are hard to mobilize by repeated leaching with DDI water.

3.3.2.6 Anion Concentrations – Replenishment Water Extractions

The concentrations of anions that were extracted by the DDI water leaches after each stage of sequential extraction were measured by ion chromatography (IC) and are listed in Table 3.34. The initial extraction step mobilized very high concentrations of oxalate, carbonate, fluoride, phosphate and nitrate from the three residual sludge samples. The concentrations of extractable anions from subsequent stages diminished in some cases by more than an order of magnitude. These data indicate that the bulk of the extractable anions in these sludges would be mobilized in the initial stage of water extraction. As compared to the other anions, the slower release rate of phosphate from these sludge samples indicates the presence of phosphatic compounds of more limited solubility. These results indicate that all the major anions, except phosphate, in these sludges are highly water leachable.

Table 3.34. Average Extractable Concentrations of Anions – Periodic Replenishment DDI Water Extractions

Sequential Contact	Fluoride	Chloride	Nitrite	Nitrate	Carbonate	Sulfate	Phosphate	Oxalate
	µg/g Dry Sludge							
Sample 19250 (C-202)								
1	3,850	33.5	442	1,260	12,200	233	5,640	28,600
2	1,020	8.0	<13.6	90	<7260	42	4,070	2,420
3	618	7.8	<13.6	482	<7260	28	3,400	940
4	85	3.9	<13.6	196	<7260	6.5	1,340	85
5	62	8.1	<13.6	230	<7260	4.8	730	52
6	390	99.2	43.1	1,280	<7260	19.2	2,550	267
Sample 19887 (C-203)								
1	2,500	64.9	478	3,950	29,700	211	16,200	1,280
2	135	29.5	<33.8	77.5	7,700	36.0	10,400	<25.8
3	50.4	<18.0	<33.8	<32.4	4,650	<30.6	5,570	44.4
4	10.9	<18.4	<33.8	<32.4	<3,750	<30.6	3,230	<25.8
5	<8.8	20.3	<33.8	<32.4	<3,750	<30.6	1,860	<25.8
6	36.8	<18.0	<33.8	<74.6	8,590	<30.6	3,530	<25.8
Sample 19961 (C-203)								
1	2,610	73.6	742	5,480	32,400	269	20,600	1,330
2	112	169	<35.3	71.4	8,300	58.8	10,350	350
3	39.0	<18.8	<35.3	<33.9	4,300	<32.0	5,010	<27.0
4	<10.4	<18.8	<35.3	<33.9	<3,900	<32.0	3,010	<27.0
5	<9.2	21.4	<35.3	<33.9	<3,900	<32.0	1,680	<27.0
6	30.5	22.4	<35.3	90.9	4,200	<32.0	5,140	<27.0

The carbonate, oxalate and phosphate results are for information only. The QC standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.
< Values were less than instrumental detection limit.
All values based on duplicate measurements.

3.3.2.7 Concentrations ^{137}Cs and ^{90}Sr - Periodic Replenishment DDI Water Extractions

The concentrations of ^{137}Cs in the sludge as determined from all sequential extraction stages using DDI water indicated that this radioisotope had extremely low leachability that was in the low microcuries per gram of sludge (Table 3.35). As an example, the average ^{137}Cs concentration determined from the first stage extract of 19250 (C-202) sludge was found to be 0.646 µCi/g sludge, and ^{137}Cs concentrations in first stage extracts of 19887 (C-203) and 19961 (C-203) samples were measured at 0.681 µCi/g sludge and 1.58 µCi/g sludge, respectively. The cumulative totals released by the subsequent four stages of leaching equaled an amount similar to that of the first stage of leaching. The final leaching stage also released concentrations similar to that of the first stage extractions. The cumulative DDI water leachable fractions of ^{137}Cs in these sludge samples averaged 10.0, 12.4, and 15.8% of the total ^{137}Cs present in the 19250 (C-202), 19887 (C-203); and 19961 (C-203) sludge samples, respectively. The sequential extractions cumulatively leached about 4 to 6 times the amount of ^{137}Cs leached in the single 30-day DDI water extractions.

^{90}Sr data for the periodic replenishment extractions are available for only the first, third, and sixth extractions (Table 3.36). Sample 19250 (C-202) released 20.7 µCi/g sludge of ^{90}Sr during the first contact, while samples 19887 (C-203) and 19961 (C-203) release 21.0 and 39.4 µCi/g sludge. For each sample, the amounts released by the subsequent third and sixth extractions were similar to the first extractions. This indicates that ^{90}Sr in these sludges exists in a continuously leachable form.

Table 3.35. ^{137}Cs Data – Periodic Replenishment DDI Water Extractions

Sequential Contact	Contact Duration (days)	^{137}Cs	
		µCi/g Sludge	µg/g Sludge
Sample 19260 (C-202)			
1	1	0.646	7.42E-03
2	1	0.168	1.93E-03
3	3	0.156	1.79E-03
4	1	0.082	9.43E-04
5	1	0.0505	5.80E-04
6	30	0.278	3.20E-03
Sample 19887 (C-203)			
1	1	0.681	7.83E-03
2	1	0.399	4.58E-03
3	3	0.473	5.44E-03
4	1	0.0708	8.13E-04
5	1	0.0644	7.40E-04
6	30	1.22	1.40E-02
Sample 19961 (C-203)			
1	1	1.58	1.82E-02
2	1	0.437	5.03E-03
3	3	0.341	3.92E-03
4	1	0.0459	5.28E-04
5	1	0.0585	4.85E-04
6	30	0.406	4.67E-03

NA = Not analyzed.

Table 3.36. ^{90}Sr Data – Periodic Replenishment DDI Water Extractions

Sequential Contact	^{90}Sr	
	µCi/g Sludge	µg/g Sludge
Sample 19260 (C-202)		
1	20.7	0.15
3	15.4	0.11
6	40.6	0.29
Sample 19887 (C-203)		
1	21.0	0.15
3	12.9	0.09
6	24.5	0.17
Sample 19961 (C-203)		
1	39.4	0.28
3	12.7	0.09
6	18.5	0.13

3.3.2.8 Actinide Concentrations – Periodic Replenishment DDI Water Extractions

The concentrations of sequentially leachable actinides are listed in Table 3.37. The extractable concentrations of actinides in these sludges were in the order ^{239}Pu > ^{237}Np > ^{241}Am. The concentrations of ^{241}Am in all stages of sequential leaching were below the EQL and/or instrument detection limits.

Table 3.37. Actinide Analysis for C-202 and C-203 Periodic Replenishment DDI Water Extractions

Sequential Contact	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	**µg/g Sludge**	**µCi/g Sludge**	**µg/g Sludge**	**µCi/g Sludge**	**µg/g Sludge**
Sample 19250 (C-202)						
1	9.41E-05	1.33E-01	2.34E-01	3.78E+00	(1.16E-02)	(3.42E-03)
2	5.12E-05	7.21E-02	1.29E-01	2.07E+00	(5.42E-03)	(1.59E-03)
3	5.70E-05	8.02E-02	1.74E-01	2.81E+00	(9.64E-03)	(2.84E-03)
4	(9.81E-06)	(1.38E-02)	6.82E-02	1.10E+00	(2.71E-03)	(7.98E-04)
5	<5.15E-05	<7.26E-02	5.01E-02	8.09E-01	(1.95E-03)	(5.72E-04)
6	(2.06E-05)	(2.91E-02)	6.10E-01	9.83E+00	5.02E-02	1.48E-02
Sample 19887 (C-203)						
1	<5.32E-03	<7.49E-01	2.27E-01	3.66E+00	<6.37E-01	<1.87E-01
2	<5.32E-03	<7.49E-01	(2.04E-01)	(3.29E+00)	<6.37E-01	<1.87E-01
3	<5.32E-03	<7.49E-01	(1.24E-01)	(2.00E+00)	<6.37E-01	<1.87E-01
4	<5.32E-03	<7.49E-01	(1.56E-01)	(2.52E+00)	<6.37E-01	<1.87E-01
5	<5.32E-03	<7.49E-01	(1.68E-01)	(2.72E+00)	<6.37E-01	<1.87E-01
6	<5.32E-03	<7.49E-01	<2.32E-01	<3.74E+00	<1.27E+01	<3.74E+00
Sample 19961 (C-203)						
1	<5.56E-03	<7.82E-01	4.78E-01	7.71E+00	<6.65E-01	<1.96E-01
2	<5.56E-03	<7.82E-01	(1.78E-01)	(2.87E+00)	<6.65E-01	<1.96E-01
3	<5.56E-03	<7.82E-01	(1.85E-01)	(2.99E+00)	<6.65E-01	<1.96E-01
4	<5.56E-03	<7.82E-01	(2.21E-01)	(3.57E+00)	<6.65E-01	<1.96E-01
5	<5.56E-03	<7.82E-01	(1.84E-01)	(2.97E+00)	<6.65E-01	<1.96E-01
6	<5.56E-03	<7.82E-01	<2.43E-01	<3.91E+00	<1.33E+01	<3.91E+00
NA = Not analyzed.						

The ^{239}Pu concentrations in the first stage of leaching from sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) were 3.78, 3.66, and 7.71 µg/g sludge, respectively. The concentrations of ^{239}Pu in the leachates from the second and third stage extractions of 19250 (C-202) sample were about 26–45% of the concentrations encountered in the first stage leachate. For the two C-203 tank sludge samples, the second and third stage extractions yielded estimated concentrations that were also much less than the concentrations of the first stage extracts. The final stage of extraction for sample 19250 (C-202) indicated an increase in concentrations of ^{239}Pu over that observed in the four previous stages of leaching. The cumulative leachable fractions of ^{239}Pu in sludge sample 19250 (C-202) was 4.7% (Table 3.38; therefore, these sequential extractions cumulatively removed about 5 times more ^{239}Pu than the single static extraction (Table 3.26). The cumulative percentage of leachable ^{239}Pu from the C-203 sludge samples is less certain because most of the measurements are estimates; however, the measured amounts leached for the first stage of the extraction equate to 24.5 and 36.1% of the total ^{239}Pu showing that it is much more leachable from these sludge samples than from the C-202 sample.

Table 3.38. Water-Leachable Percentages of Actinides in C-202 and C-203 Periodic Replenishment DDI Water Extractions

Sequential Contact	**^{237}Np**	**^{239}Pu**	**^{241}Am**
Percent Water Leachable			
Sample 19250 (C-202)			
1	6.1	0.87	(0.8)
2	3.3	0.48	(0.4)
3	3.7	0.65	(0.6)
4	(0.6)	0.25	(0.2)
5	<EQL	0.19	(0.1)
6	1.3	2.26	3.3
Sample 19887 (C-203)			
1	<EQL	24.5	<EQL
2	<EQL	(22.0)	<EQL
3	<EQL	(13.4)	<EQL
4	<EQL	(16.9)	<EQL
5	<EQL	(18.2)	<EQL
6	<EQL	<EQL	<EQL
Sample 19961 (C-203)			
1	<EQL	36.1	<EQL
2	<EQL	(13.4)	<EQL
3	<EQL	(14.0)	<EQL
4	<EQL	(16.7)	<EQL
5	<EQL	(13.9)	<EQL
6	<EQL	<EQL	<EQL
Total concentrations from EPA acid digestions.			

Extracts from the various stages of sequential extraction for sample 19250 (C-202) contained very low concentrations of ^{237}Np. The highest concentration of ^{237}Np was observed in the first stage extract of this sample and had a value of 0.133 µg/g sludge (Table 3.37). Extractable ^{237}Np in subsequent sequential extracts was found to be less than the amount measured in the initial extract. The cumulative leachable fraction of ^{237}Np in sludge sample 19250 (C-202) was 15%. As compared to a single static extraction, the six stage sequential extraction cumulatively mobilized about 2.5 times more ^{237}Np from this sludge sample. Detectable quantities of ^{237}Np were not leachable from the C-203 sludge samples.

The ^{241}Am concentrations were estimated values in most cases for the DDI water extracts for sample 19250 (C-202). The only measured concentration was 0.0148 µg/g sludge for the sixth step of the extraction. Assuming the estimated values are correct, the cumulative percentage of ^{241}Am released during the sequential extractions is 5.4% (Table 3.38). Detectable quantities of ^{241}Am were not leachable from the C-203 sludge samples.

3.4 $Ca(OH)_2$ Solution Leaching Tests

The data obtained from the saturated $Ca(OH)_2$ solution leaching tests on the three sludge samples [19250 (C-202), 19887 (C-203), and 19961 (C-203)] are presented and discussed in this section. These tests were designed to evaluate the leaching of residual sludge constituents using a leaching solution derived from infiltrating water contacting fresh cement filling the tank above the sludge. Section 3.4.1 provides the results of single 30-day contacts of the leachant and sludge, and Section 3.4.2 discusses the periodic replenishment tests in which the sludge was contacted 6 times with the leaching solution. The concentrations of the constituents in the $Ca(OH)_2$ extracts tabulated in this section are expressed in units of µCi or µg per gram of dry sludge. Concentrations on a per liter basis of dissolved constituents are also listed in Appendix I. Results for ^{129}I in the single-contact and periodic replenishment tests are not included because they were below the detection limit.

3.4.1 Single Contact $Ca(OH)_2$ Solution Test Results

The single contact water-leach tests were run in duplicate with an equilibration time of 1 month. Saturated $Ca(OH)_2$ solution was used as a leachant. The results of these experiments are presented in this section.

3.4.1.1 Sludge to $Ca(OH)_2$ Solution Ratios Used in Single-Contact Extractions

In these tests, 30 ml of saturated $Ca(OH)_2$ solution was contacted with about 0.5 to 0.8 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to $Ca(OH)_2$ solution ratios (Table 3.39). These ratios ranged from about 11.04 to 19.45.

Table 3.39. Sludge to $Ca(OH)_2$ Solution Used in Leaching Tests

Sample Number	Sludge to $Ca(OH)_2$ Solution Ratio (g/L)
19250 (C-202)	11.32
19250 (C-202) Dup	11.04
19887 (C-203)	17.35
19887 (C-203) Dup	19.13
19961 (C-203)	14.90
19961 (C-203) Dup	19.45
Dup = Duplicate. Sludge mass based on dry weight.	

3.4.1.2 Alkalinity and pH of Single-Contact $Ca(OH)_2$ Solution Extracts

The average alkalinities and pH values measured in duplicate extracts of each residual sludge are listed in Table 3.40. The pH values of leachates from all three sludge samples [19250 (C-202), 19887 (C-203), and 19961 (C-203)] were as expected, highly alkaline in nature (11.48, 11.61, and 11.92, respectively). The average total alkalinity for the 19250 (C-202) sludge was 53.7 mg $CaCO_3$/g sludge. The average total alkalinity for the 19887 (C-203) sludge sample was 70.1 mg $CaCO_3$/g sludge, and the corresponding value for the 19961 (C-203) sludge sample was 52.5 mg $CaCO_3$/g sludge (Table 3.40).

Because of the highly alkaline extractions, the measured alkalinity includes both hydroxide and carbonate alkalinities. There is a direct correlation between the measured alkalinity and the solid to solution ratio shown in Table 3.39 suggesting that the sludges release alkalinity producing soluble species.

Table 3.40. Alkalinity and pH Values after 1 Month of $Ca(OH)_2$ Solution Extraction

Sample Number	pH	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint (mg/L)	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint (mg/g solid)
19250 (C-202)	11.50	591	52.3
19250 (C-202) Dup	11.46	610	55.3
19250 (C-202) Avg	11.48	600	53.7
19887 (C-203)	11.62	772	66.6
19887 (C-203) Dup	11.59	803	73.6
19961 (C-203)	11.89	811	61.0
19961 (C-203) Dup	11.95	772	44.0
19887 (C-203) Avg	11.61	787	70.1
19961 (C-203) Avg	11.92	791	52.5

3.4.1.3 Extractable ^{99}Tc and ^{238}U Determined from Single-Contact $Ca(OH)_2$ Solution Extractions

The concentrations of ^{99}Tc and ^{238}U mobilized in $Ca(OH)_2$ solution after 1 month of contact with the residual sludge samples obtained from tanks C-202 and C-203 are listed in Table 3.41. The extractable concentration of ^{99}Tc for sludge sample 19250 (C-202) was very low (estimated at 0.00518 µg/g sludge), and the extracts from the two sludge samples from tank C-203 did not contain ^{99}Tc above its instrument detection limits. The percentage of total ^{99}Tc leached from tank C-202 sludge is 2.97% (Table 3.42), which is similar to the low percentage of ^{99}Tc leached using DDI water (Table 3.19).

Table 3.41. Extractable ^{99}Tc and ^{238}U after 1 Month of $Ca(OH)_2$ Solution Extraction

Sample Number	^{99}Tc	^{238}U	^{99}Tc	^{238}U
	---------µg/g Sludge-------		-------µCi/g Sludge--------	
19250 (C-202)	(3.95E-03)	5.15E+01	(6.72E-05)	1.75E-05
19250 (C-202) Dup	4.89E-03	6.29E+01	8.32E-05	2.14E-05
19250 (C-202) Avg	4.42E-03	5.72E+01	7.52E-05	1.95E-05
19887 (C-203)	<2.88E-02	1.79E+02	<4.90E-04	6.07E-05
19887 (C-203) Dup	<2.61E-02	1.63E+02	<4.44E-04	5.55E-05
19961 (C-203)	<3.36E-02	2.03E+04	<5.71E-04	6.92E-03
19961 (C-203) Dup	<2.57E-02	3.04E+03	<4.37E-04	1.03E-03
19887 (C-203) Avg	<2.75E-02	1.71E+02	<4.67E-04	5.81E-05
19961 (C-203) Avg	<2.96E-02	1.17E+04	<5.04E-04	3.97E-03
Values within parentheses were less than EQL. < Values were less than instrumental detection limit. All concentrations are corrected for the dry sludge basis.				

Table 3.42. Percentages[(a)] of ^{99}Tc and ^{238}U Leached by $Ca(OH)_2$ Solution

Sample Number	^{99}Tc	^{238}U
	Percent Cement Leachable	
19250 (202)	2.97	0.03
19887 (203)	<EQL	0.03
19961 (203)	<EQL	2.41

<EQL = Below EQL.
(a) Total concentrations in sludges based on acid digestion extractions.

The extracts from these sludges contained significant concentrations of ^{238}U (Table 3.41). For example, the extractable ^{238}U concentration from sample 19250 (C-202) contained an average of 57.2 µg/g sludge (ppm) and sludges 19887 (C-203) and 19961 (C-203) samples were found to contain average extractable ^{238}U concentrations of 171 µg/g sludge (ppm) and 11,700 µg/g sludge (ppm), respectively. These concentrations indicate that the fraction of the ^{238}U leachable in $Ca(OH)_2$ solution after 1 month of contact was on average 0.03, 0.03 and 2.41% of total ^{238}U present in the three samples (Table 3.42).

3.4.1.4 Extractable Metals Concentrations in $Ca(OH)_2$ Solution Water Extractions

Concentrations of a number of metals including Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the $Ca(OH)_2$ solution after extracting for 1 month were measured by ICP-OES. Among these, only a limited number of metals were present in measurable concentrations (Table 3.43). The concentrations listed within parentheses indicate values that are less than their respective EQLs. These data showed that the two major leachable elements in $Ca(OH)_2$ leach solutions in all three sludge samples were Na and P. Average extraction concentrations of Na in all three sludge samples were similar in magnitude namely, 20,900 µg/g sludge in 19250 (C-202), 20,700 µg/g sludge in 19887 (C-203), and 23,500 µg/g sludge in 19961 (C-203). The average concentration of P in 19250 (C-202) sludge extract was 131 µg/g sludge, which was about an order of magnitude less than the P concentrations observed in the extracts of the two C-203 tank sludge samples (1,410 µg/g sludge (sample 19887) and 2,920 µg/g sludge (sample 19961). Other elements with measurable leachability (100 to >1000 µg/g sludge) included Al [only in sample 19250 (C-202)] Ca, Cr, Fe, and Pb.

Percentages of metals that were $Ca(OH)_2$ extractable are listed in Table 3.44. These results were computed on the basis of the total metal concentrations as measured in the acid digested samples (Table 3.3 through Table 3.5). The data show that about a third (35.5%) of the total Na present in sample 19250 (C-202) and 21.3 and 24.8% respectively of the Na inventory in the sample 19887 (C-203) and sample 19961 (C-203) were present in readily leachable forms. Leachable percentages of P in the $Ca(OH)_2$ solution were low constituting 0.8% of 19250 (C-202), 3.7% of 19887 (C-203), 7.5% of 19961 (C-203) of the total mass of P present in these sludges. The leachability of Cr in the three sludge samples was calculated to be 5.7%, 2.8%, and 10.0%, respectively. Other measurable leachable metal fractions were found only in C-203 tank sludge samples. These leachable metals consisted of Fe (0.03 and 2.1%), Mn (1.6 and 8.4%), and Pb (0.1 and 2.9%) in samples 19887 (C-203) and 19961 (C-203), respectively. Although there was no significant difference in the average leachable fractions of Na from the two C-203 sludge samples, sample 19961 (C-203) appeared to leach a greater fraction of Cr, Fe, Mn, P, Pb, and Zn compared to sample 19887 (C-203). At this time, there are no discernable reasons for this differential leaching of these elements from these two sludge samples from the same waste tank (C-203).

Table 3.43. Concentrations Selected Metals after 1 Month of $Ca(OH)_2$ Solution Extractions

Sample Number	Al	Ca	Cr	Fe	Mg	Mn	Na	P	Pb	Zn
	µg/g Dry Sludge									
19250 (C-202)	1,980	(561)	685	<44.2	<110	<11	20,200	123	<110	<55.2
19250 (C-202) Dup	2,050	(543)	827	<45.3	<113	<11.3	21,600	140	<113	<56.6
19250 (C-202) Avg	2,010	(552)	756	<44.7	<112	<11.2	20,900	131	<112	<55.9
19887 (C-203)	(202)	(73)	173	(7.4)	<288	<14.4	21,050	1,360	(7.9)	(69)
19887 (C-203) Dup	(180)	(60)	178	(3.9)	<261	<13.1	20,300	1,450	(2.8)	(41)
19961 (C-203)	(203)	3,190	833	596	(46)	90	28,700	4,180	269	(100)
19961 (C-203) Dup	(145)	725	255	84	<257	<12.9	18,280	1,660	(39)	(111)
19887 (C-203) Avg	(191)	(66)	176	(5.6)	<275	<13.7	20,700	1,410	(5.3)	(55)
19961 (C-203) Avg	(174)	1,956	544	340	(46)	53	23,500	2,920	154	(105)
Values within parentheses were less than EQL.										

Table 3.44. Percentages[(a)] of $Ca(OH)_2$ Solution Extractable Metals after 1 Month Contact

Sample Number	Al	Ca	Cr	Fe	Mg	Mn	Na	P	Pb	Zn
	--Percent Leachable --									
19250 (C-202) Avg	14.8	--	5.7	--	--	--	35.5	0.8	--	--
19887 (C-203) Avg	--	--	2.8	0.03	--	(1.6)	21.3	3.7	(0.1)	(4.2)
19961 (C-203) Avg	--	--	10.0	2.1	(7.1)	(8.4)	24.8	7.5	2.9	(7.7)
(a) Total concentrations based on acid digestion extractions. The numbers within parentheses were calculated on the basis of less than EQL values.										

3.4.1.5 Anion Concentrations in Single-Contact $Ca(OH)_2$ Solution Extractions

The concentrations of anions that were present in $Ca(OH)_2$ solution extracts after 1 month were measured by ion chromatography. The extractable anion concentrations calculated for the sludges are presented in Table 3.45. Among the halides, fluoride in the extracts of all residual sludges was present at 5 to 20 times higher concentrations than chloride. Average extractable concentrations of F and Cl determined for sample 19250 (C-202) were 1,800 and 112 µg/g sludge, respectively. Extractable concentrations of F in C-203 sludge samples were about 35% to 40% lower than what was measured for C-202 sludge extracts [19887 (C-203): 1,200 µg/g sludge, and 19961 (C-203): 1,100 µg/g sludge]. Comparatively, the Cl concentrations in these two sludge samples were below the instrumental detection limits.

Table 3.45. Concentrations Anions from 1 Month of $Ca(OH)_2$ Solution Extractions

Sample Number	Fluoride	Chloride	Nitrite	Nitrate	Carbonate	Sulfate	Phosphate	Oxalate
	µg/g Dry Sludge							
19250 (C-202)	1,900	108	342	1,600	26,600	219	<17.6	952
19250 (C-202) Dup	1,800	116	343	1,500	26,900	216	<18.0	1,050
19250 C-202) Avg	1,800	112	343	1,600	26,800	217	<17.8	1,000
19887 (C-203)	1,100	<136	265	2,400	<28,800	<236	2,700	1,010
19887 (C-203) Dup	1,200	<123	275	2,600	<26,100	<214	3,300	1,030
19961 (C-203)	1,400	<158	536	4,300	<36,700	<275	9,900	1,240
19961 (C-203) Dup	711	<121	303	2,500	<25,700	<210	4,300	738
19887 (C-203) Avg	1,200	<130	270	2,500	<27,500	<225	3,000	1,020
19961 (C-203) Avg	1,100	<140	420	3,400	<36,700	<242	7,100	990

The carbonate, oxalate and phosphate results are for information only. The QC standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.
Avg = Average.
Dup = Duplicate.

Nitrate concentrations in these sludge extracts were on average about 5 to 10 times higher than nitrite concentrations. Average extractable nitrate and nitrite concentrations in 19250 (C-202) sludge were 1,600 and 343 µg/g sludge, respectively. Higher average nitrate concentrations were found in C-203 tank sludge samples [19887 (C-203): 2,500 µg/g sludge and 19961 (C-203): 3,400 µg/g sludge].

The average extractable concentration of carbonate in 19250 (C-202) was found to be 26.8 mg/g sludge. Relatively higher carbonate concentrations (qualitative measurements) may be present in the C-203 tank sludge extracts where the values are below a high detection limit [19887 (C-203): <27.5 mg/g sludge, and 19961 (C-203): <36.7 mg/g sludge].

Compared to the major anions, relatively low concentrations of sulfate were found in the water extracts of these sludge samples. The average extractable sulfate concentrations were 217, <225, and <242 µg/g sludge for the three sludge samples.

Concentrations of extractable phosphate in 19887 (C-203) and 19961 (C-203) sludge sample extracts were 3.0 and 7.1 mg/g sludge, respectively. Contrastingly, the extractable phosphate concentrations from the 19250 (C-202) sample contained phosphate concentrations that were below the instrumental detection limit. The concentrations of oxalate in 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge extracts were determined to be 1,000 µg/g sludge, 1,020 µg/g sludge, and 990 µg/g sludge, respectively.

3.4.1.6 Concentrations ^{137}Cs and ^{90}Sr in Single-Contact $Ca(OH)_2$ Solution Extractions

The concentrations of ^{137}Cs in the $Ca(OH)_2$ solution extracts indicate that this radioisotope had low leachability with concentrations that were in the low microcurie per gram sludge levels (Table 3.46). As an example, the average ^{137}Cs concentration in the 19250 (C-202) sludge extract was found to be 0.904 µCi/g sludge, whereas, ^{137}Cs concentrations in 19887 (C-203) and 19961 (C-203) sample extracts were measured at 0.207 µCi/g sludge and 0.772 µCi/g sludge, respectively. The leachable percentage of ^{137}Cs in these sludge samples constituted on average 6.5, 1.1, and 3.6% of the total ^{137}Cs present in the three sludge samples (Table 3.47).

Table 3.46. Average Extractable Concentrations of ^{137}Cs and ^{90}Sr from 1 Month of $Ca(OH)_2$ Solution Extraction

Sample Number	^{137}Cs		^{90}Sr	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
19250 (C-202) Avg	0.904	1.04E-02	4.74	3.38E-02
19887 (C-203) Avg	0.207	2.38E-03	0.492	3.51E-03
19961 (C-203) Avg	0.772	8.87E-03	15.6	1.11E-01

Avg = Average.
All concentrations are corrected for the dry sludge basis.

Table 3.47. Percentage of Extractable ^{137}Cs and ^{90}Sr from 1 Month of $Ca(OH)_2$ Solution Extraction

Sample Number	^{137}Cs	^{90}Sr
	Percent $Ca(OH)_2$ Leachable	
19250 (C-202) Avg	6.5	0.6
19887 (C-203) Avg	1.1	0.15%
19961 (C-203) Avg	3.6	3.98%

All concentrations are corrected for the dry sludge basis.
Total sludge concentrations from acid digested samples.

^{90}Sr concentrations in the $Ca(OH)_2$ solution extracts were present at slightly higher (3 to 20 times) concentrations than ^{137}Cs. The extractable ^{90}Sr concentrations of sludge samples 19250 (C-202), 19887 (C-203) and 19961 (C-203) contained ^{90}Sr concentrations of 4.74, 0.492, and 15.6 µCi/g sludge, respectively (Table 3.46). These concentrations represent 0.6%, 0.15%, and 3.98 % of the total ^{90}Sr present in these sludge samples (Table 3.47), which shows that ^{90}Sr is not very leachable from sludge in contact with a $Ca(OH)_2$ saturated solution.

3.4.1.7 Extractable Actinides Determined from Single-Contact $Ca(OH)_2$ Solution Extractions

The concentrations of $Ca(OH)_2$ solution leachable actinides are listed in Table 3.48. Only the concentrations of ^{239}Pu in the extracts were present in detectable concentrations. The concentrations of ^{237}Np and ^{241}Am were in all cases well below their respective EQL and/or instrument detection limits.

The 1-month extractable ^{239}Pu concentrations in the extracts of sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) were 7.68 x 10^{-3}, 1.3 x 10^{-2}, and 1.56 µg/g sludge, respectively. These concentrations equate to leachable percentages of total ^{239}Pu in these sludge samples by a $Ca(OH)_2$ solution of 0.002, 0.09, and 7.3%, respectively (Table 3.49). The relatively high leachable percentage of ^{239}Pu of 7.3% for the 1-month leach of sample 19961 (C-203) is noteworthy, but the reason for this leachability is not known.

Table 3.48. Actinide Analysis for Single-Contact $Ca(OH)_2$ Cement Extractions

Sample Number	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
19250 (C-202) 1 Day	<9.55E-07	<1.34E-03	(2.91E-03)	(4.69E-02)	<2.29E-02	<6.72E-03
19250 (C-202) 1 Month	<6.35E-07	<8.95E-04	(4.76E-04)	(7.68E-03)	<1.52E-02	<4.47E-03
19887 (C-203) 1 Day	<6.31E-05	<8.89E-02	(1.73E-03)	(2.79E-02)	<1.51E+01	<4.44E+00
19887 (C-203) 1 Month	<3.90E-05	<5.49E-02	(8.08E-04)	(1.30E-02)	<9.34E+00	<2.75E+00
19961 (C-203) 1 Day	<6.21E-05	<8.75E-02	(1.34E-03)	(2.16E-02)	<1.49E+01	<4.37E+00
19961 (C-203) 1 Month	<4.21E-05	<5.93E-02	9.70E-02	1.56E+00	<1.01E+01	<2.96E+00

Table 3.49. Cement-Leachable Percentages of Actinides in Single-Contact $Ca(OH)_2$ Cement Extractions

Sample Number	^{237}Np	^{239}Pu	^{241}Am
	Percent Cement Leachable		
19250 (C-202) 1 Day	< EQL	(0.01)	< EQL
19250 (C-202) 1 Month	< EQL	(0.002)	< EQL
19887 (C-203) 1 Day	< EQL	(0.19)	< EQL
19887 (C-203) 1 Month	< EQL	(0.09)	< EQL
19961 (C-203) 1 Day	< EQL	(0.14)	< EQL
19961 (C-203) 1 Month	< EQL	7.3	< EQL
Total concentrations from EPA acid digestions.			

3.4.2 Periodic Replenishment $Ca(OH)_2$ Solution Test Results

The periodic replenishment extraction tests were conducted by repeatedly equilibrating duplicate sludge samples with 30 mL aliquots of fresh $Ca(OH)_2$ solution. Sequential contacts 1, 2, 4, and 5 had a duration of 1 day each, whereas, sequential contacts 3 and 6 lasted 3 and 30 days, respectively. The goal of these sequential leaching tests was to assess the long-term leaching characteristics of key contaminants and other constituents from these sludge samples. The results of these tests are presented in this section.

3.4.2.1 Sludge to $Ca(OH)_2$ Solution Ratios used in Periodic Replenishment Extractions

In these tests, 30 ml aliquots of saturated $Ca(OH)_2$ saturated solutions were contacted with about 0.3 to 0.6 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to $Ca(OH)_2$ solution ratios (Table 3.50). These ratios ranged from about 6.84 to 12.4.

3.4.2.2 Alkalinity and pH of $Ca(OH)_2$ Solution Periodic Replenishment Extractions

The average alkalinities and pH values measured in duplicate samples of sludge from each tank at the end of each sequential contact are listed in Table 3.51. As expected from the use of a saturated $Ca(OH)_2$ solution as the leachant, the pH values of all three sludge samples at all stages of extraction were highly alkaline in nature ranging in values between 11.47 to 12.15. The pH values for all sludge samples tended to vary only by about 0.2 pH units between different extraction stages.

Table 3.50. Sludge to Solution Ratios used in Periodic Replenishment $Ca(OH)_2$ Leaching Tests

Sample Number	Dry Sludge to $Ca(OH)_2$ Solution Ratios (g/L)
19250 (202)	8.15
19250 (202) Dup	6.84
19887 (203)	12.4
19887 (203) Dup	10.3
19961 (203)	10.8
19961 (203) Dup	12.1

Table 3.51. Alkalinity and pH Values – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Sequential Contact	Duration (Days)	pH	Total Alkalinity (as $CaCO_3$) @ pH 4.5 Endpoint	Total Alkalinity (as $CaCO_3$) @ pH 4.5 Endpoint
			mg/L	mg/g Solid
19250 (C-202)				
1	1	11.47	666	89.8
2	1	11.54	776	104
3	3	11.57	865	116
4	1	11.68	996	134
5	1	11.70	1,040	141
6	30	11.64	896	120
19887 (C-203)				
1	1	11.67	803	60.0
2	1	11.76	475	35.6
3	3	11.70	440	33.1
4	1	11.70	436	32.6
5	1	11.82	571	43.1
6	30	11.81	429	32.3
19961 (C-203)				
1	1	11.88	838	65.3
2	1	11.98	486	38.2
3	3	11.83	390	30.5
4	1	11.96	490	38.2
5	1	12.15	710	55.3
6	30	11.91	521	41.0

The initial extraction of sample 19250 (C-202) mobilized less total alkalinity than the subsequent stages for this sample, whereas, for samples 19887 (C-203) and 19961 (C-203), the total alkalinity from the initial stage was higher than the values in subsequent extractions. For the 19250 (C-202) sludge, the sum of extractable total alkalinity from all six stages was 705 mg $CaCO_3$/g sludge, whereas, the sum of sequentially extracted alkalinities for samples 19887 (C-203) and 19961 (C-203) were 237 and 269 mg $CaCO_3$/g sludge, respectively. These six stages of sequential extractions cumulatively mobilized more than an order of magnitude more total alkalinity from each sludge sample as compared to the total alkalinity released by a single 30-day extraction (Table 3.40), which suggests that the residual sludges contain some soluble species that titrate as alkalinity. Some of the alkalinity (i.e., hydroxyl) at each stage is due to the $Ca(OH)_2$ solution used as the leachant.

3.4.2.3 Carbon Contents – $Ca(OH)_2$ Solution Sequential Extractions

Table 3.52 lists the carbon contents that were sequentially extractable from the C-202 and C-203 residual sludge samples. The bulk of the extractable carbon from the C-203 sludge samples was mobilized during the first extraction. For instance, about 64 and 78% of the total carbon contents of 19887 (C-203) and 19961 (C-203) sludge samples were extracted during the first stage as compared to only about 20% of the total carbon extracted from 19250 (C-202) sludge sample. Cumulatively, the six sequential extractions leached 47% of the total carbon content of the 19250 (C-202) sludge sample, whereas, the extractions achieved complete removal of all the carbon contained in samples 19887 (C-203) and 19961 (C-203).

Table 3.52. Carbon Contents – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Sequential Contact	Duration (Days)	TC	TOC	TIC
		--------mg C/g Sludge---------		
Sample 19250 (C-202)				
1	1	8.25	4.58	3.67
2	1	3.13	1.52	1.62
3	3	2.72	1.11	1.61
4	1	2.08	0.84	1.24
5	1	2.05	0.72	1.33
6	30	2.66	1.51	1.15
Sample 19887 (C-203)				
1	1	8.49	4.14	4.35
2	1	1.46	0.44	1.25
3	3	1.09	<0.43	1.09
4	1	0.81	<0.43	0.81
5	1	0.47	<0.43	0.47
6	30	1.08	<0.43	1.08
Sample 19961 (C-203)				
1	1	9.21	5.49	3.72
2	1	1.97	0.80	1.17
3	3	1.01	<0.42	1.01
4	1	0.86	<0.42	0.86
5	1	0.73	<0.42	0.73
6	30	1.06	<0.42	1.06
All concentrations are corrected for the dry sludge basis.				

3.4.2.4 Concentrations of ^{99}Tc and ^{238}U in $Ca(OH)_2$ Solution Periodic Replenishment Extractions

The concentrations of ^{99}Tc and ^{238}U mobilized in periodic replenishment $Ca(OH)_2$ solution extractions of residual sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) are listed in Table 3.53. The concentrations of ^{99}Tc in all stages of extraction from all the three sludge samples were below the instrumental detection limits, but estimated values of 5.22 x 10^{-3} µg/g sludge and 4.02 x 10^{-2} µg/g sludge were available for the first stage extraction of samples 19250 (C-202) and 19887 (C-203), respectively. The estimated percentage leachability of ^{99}Tc from the sludges for these two stages is 3.5% and 26.2% (Table 3.54).

Table 3.53. Concentrations of Extractable ^{99}Tc and ^{238}U – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Sequential Contact	Duration (Days)	^{99}Tc	^{238}U	^{99}Tc	^{238}U
		----------µg/g Sludge--------		--------µCi/g Sludge------	
Sample 19250 (C-202)					
1	1	(5.22E-03)	194.	(8.88E-05)	6.61E-05
2	1	<6.72E-03	22.5	<1.14E-04	7.64E-06
3	3	<6.72E-03	16.7	<1.14E-04	5.69E-06
4	1	<6.72E-03	11.4	<1.14E-04	3.88E-06
5	1	<6.72E-03	12.9	<1.14E-04	4.37E-06
6	30	(1.82E-03)	4.95	(3.10E-05)	1.68E-06
Sample 19887 (C-203)					
1	1	(4.02E-02)	331.	(6.84E-04)	1.12E-04
2	1	<4.44E-02	78.8	<7.55E-04	2.68E-05
3	3	<4.44E-02	20.3	<7.55E-04	6.91E-06
4	1	<4.44E-02	12.7	<7.55E-04	4.33E-06
5	1	<4.44E-02	4.67	<7.55E-04	1.59E-06
6	30	<4.44E-02	2.51	<7.55E-04	8.53E-07
Sample 19961 (C-203)					
1	1	<4.37E-02	423.	<7.43E-04	1.44E-04
2	1	<4.37E-02	204.	<7.43E-04	6.92E-05
3	3	<4.37E-02	65.6	<7.43E-04	2.23E-05
4	1	<4.37E-02	10.3	<7.43E-04	3.51E-06
5	1	<3.88E-02	4.97	<6.59E-04	1.69E-06
6	30	<2.57E-02	2.11	<4.37E-04	7.19E-07
All concentrations are corrected for the dry sludge basis. Values within parentheses were less than EQL. < Values were less than instrumental detection limit.					

In contrast to the generally nondetectable concentrations of ^{99}Tc in the $Ca(OH)_2$ solution extracts, all six sequential stages contained measurable concentrations of ^{238}U. For example, the initial extractable ^{238}U concentration from sample 19250 (C-202) contained an average ^{238}U concentration of 1.94 µg/g sludge (194 ppm). Similarly, the first stage extractable ^{238}U concentration from sludges 19887 (C-203) and 19961 (C-203) samples were 331 µg/g sludge and 423 µg/g sludge, respectively. The ^{238}U

extractabilities in the second stage and subsequent stages were typically one to two orders magnitude lower than the initial stage extractability. The first stage extraction from all the sludge samples removed significant fractions of the cumulative leachable ^{238}U. For instance, the initial extractions of 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples mobilized about 74%, 74%, and 60% of the cumulative leachable ^{238}U, respectively. However, the $Ca(OH)_2$ solution sequential extractions cumulatively mobilized only 0.13, 0.09 and 0.15% of the total acid digestable ^{238}U contents of 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples, respectively (Table 3.54). For sludge samples 19250 (C-202) and 19887 (C-203), these are similar leachable concentrations as those measured for the single-contact, 1-month leach tests (Table 3.42); however, for sample 19961 (C-203) the single-contact, 1-month leach test extracted 2.41% of the total ^{238}U in the sludge compared to 0.15% for the total amount removed by the sequential extractions. The total amount of ^{238}U leached by the DDI sequential water extracts was much larger for samples 19250 (C-202, 7.4%), 19887 (C-203, 17.4%) and 19961 (C-203, 17.7%) than for the $Ca(OH)_2$ leached tests.

Table 3.54. $Ca(OH)_2$ Cement-Leachable Percentages of ^{99}Tc and ^{238}U in Periodic Replenishment Extractions

Contact Stage (duration, days)	Contact Duration (days)	^{99}Tc	^{238}U
		% Cement Leachable	
Sample 19250 (C-202)			
1	1	(3.5)	0.09
2	1	< EQL	0.01
3	3	< EQL	0.01
4	1	< EQL	0.01
5	1	< EQL	0.01
6	30	(1.2)	0.002
Sample 19887 (C-203)			
1	1	(26.2)	0.063
2	1	< EQL	0.015
3	3	< EQL	0.0039
4	1	< EQL	0.0024
5	1	< EQL	0.0009
6	30	< EQL	0.0005
Sample 19961 (C-203)			
1	1	< EQL	0.080
2	1	< EQL	0.039
3	3	< EQL	0.012
4	1	< EQL	0.002
5	1	< EQL	0.001
6	30	< EQL	0.0004

< EQL= below the EQL.
Total concentrations based on EPA acid digestions.

3.4.2.5 Extractable Metals Concentrations Determined from $Ca(OH)_2$ Solution Sequential Extractions

Concentrations of a number of metals including Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the extracts of six stage sequential leaching using $Ca(OH)_2$ solution were measured by ICP-OES. Among these, only four elements (Al, Cr, Na, and P) were present in measurable concentrations throughout the majority of the extractions (Table 3.55). The concentrations listed within parentheses indicate values that are less than EQL. These data showed that the major leachable element in all three sludge samples was Na. Initial extraction concentrations of Na from 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples were 36,800, 34,000, and 34,400 ppm, respectively. For all three sludge samples, the initial extraction mobilized the highest concentrations of Al, Cr, Na, and P. The sequential leaching behaviors of Na and P from these sludges were similar to other constituents in that following high concentrations in the first stage, significant reduction in concentrations were observed in the subsequent four stages of extraction and there was a slight enhancement in concentrations in the final stage, which was a 30-day extraction.

Table 3.55. Average Extractable Concentrations of Selected Metals – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Sequential Contact	Al	Cr	Na	P
	-----------µg/g Dry Sludge ----------			
Sample 19250 (C-202)				
1	2,050	214	36,800	223
2	1,260	(109)	6,740	(127)
3	306	200	2,590	(110)
4	148	(131)	677	(89)
5	(49)	(48)	(411)	(72)
6	224	407	1,090	(90)
Sample 19887 (C-203)				
1	(194)	166	34,000	1,630
2	(107)	(10)	16,200	(121)
3	(33)	(34)	11,000	(59)
4	(14)	(17)	11,300	(31)
5	<222	(4)	4,180	(22)
6	<222	151	5,120	(37)
Sample 19961 (C-203)				
1	(147)	236	34,400	1,870
2	(143)	(16)	16,200	(186)
3	(80)	64	12,100	(82)
4	<219	(6)	7,500	(47)
5	<219	(6)	2,300	(30)
6	<219	269	4,700	(8)
Values within parentheses were < EQL. Based on duplicate measurements.				

Percentages of metals that were cumulatively extractable during the six stage sequential leaching with $Ca(OH)_2$ solution are listed in Table 3.56. These results were computed on the basis of the total metal concentrations as measured in the acid digested samples of the sludges (Table 3.3 through Table 3.5). The $Ca(OH)_2$ extractions mobilized about 82% of the total Na present in 19250 (C-202) and about 84 and 82% of the Na inventory in the 19887 (C-203) and 19961 (C-203) sludge samples respectively (Table 3.56). The data indicate that the six stage sequential extraction of these sludge samples released about two to four times the amount of Na that was leached in the single 30-day extraction (Table 3.43). These extractions released P that constituted the following percentages of total mass of P present in these sludges: 3% of 19250 (C-202), 5% of 1987 (C-203), and 6% of 19961 (C-203) (Table 3.56). The cumulative P released from sample 19250 (C-202) by sequential extractions was about four times the amount of P released from the single 1-month extraction, however, there were no significant differences in P extracted by single 30-day vs. cumulative sequential extractions for the C-203 sludge samples. The percentages of Cr mobilized from 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples were 8, 5, and 11% respectively. These data indicated that the sequential extractions cumulatively mobilized Cr in quantities similar to that observed in single 30-day $Ca(OH)_2$ extracts. Sequential extractions of sludge sample 19250 (C-202) cumulatively mobilized a higher fraction of Al (30%) than the single 30-day extraction (15%). The data from sequential leaching of sludge samples with $Ca(OH)_2$ solution indicated that, except for a limited number of metals (Al, Cr, Na, and P), all other metals present in the sludges (Fe, Mn, Ni, Pb, Si, and Sr) were not leachable to any measurable degree.

Table 3.56. Cumulative Fractions of Leachable Metals – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Element	Sample 19250 (C-202)	Sample 19887 (C-203)	Sample 19961 (C-203)
	---Cumulative % $Ca(OH)_2$ Leachable ----		
Al	30	(49)	(71)
Cr	8	6	11
Na	82	84	82
P	4	5	6

Values within parentheses are less than EQL.
Values calculated on the dry sludge basis.

3.4.2.6 Extractable Anions Determined from $Ca(OH)_2$ Solution Periodic Replenishment Extractions

The concentrations of anions that were present in the $Ca(OH)_2$ solution leaches after each stage of sequential extraction were measured by ion chromatography and are listed in Table 3.57.

The initial extraction step mobilized very high concentrations of fluoride, nitrite, nitrate, carbonate, phosphate and oxalate from most of the sludge samples. Extracts from subsequent stages contained concentrations of anions that were significantly lower, in some cases by more than an order of magnitude. These data indicate that the bulk of the extractable anions would be mobilized in the initial stage of extraction with a $Ca(OH)_2$ solution.

Table 3.57. Average Leachable Anion Concentrations – Periodic Replenishment Extraction Tests with $Ca(OH)_2$ Solution

Sequential Contact	Fluoride	Chloride	Nitrite	Nitrate	Carbonate	Sulfate	Phosphate	Oxalate
	----------	----------	----------	µg/g Dry Sludge	----------	----------	----------	----------
Sample 19250 (C-202)								
1	2,920	43	472	1,630	26,020	325	89	2,860
2	195	26	33	1,260	31,040	83	66	155
3	77	24	27	755	32,800	60	54	145
4	87	27	<13	92	38,900	75	31	145
5	32	32	<13	101	39,600	99	29	137
6	53	69	41	237	27,600	87	27	115
Sample 19887 (C-203)								
1	1,260	<210	<401	3,670	<44,000	<363	2,666	1,470
2	111	<210	<401	<385	<44,000	<363	<449	<307
3	<104	<210	<401	<385	<44,000	<363	<449	<307
4	<104	<210	<401	<385	<44,000	<363	<449	<307
5	<104	<210	<401	<385	<44,000	<363	<449	<307
6	<104	<210	<401	<385	<44,000	<363	<449	<307
Sample 19961 (C-203)								
1	668	<206	496	2,700	43,700	<358	808	849
2	834	<206	513	2,800	62,600	<358	2,634	891
3	<102	<206	<394	<379	<43,700	<358	<442	<302
4	<102	<206	<394	<379	<43,700	<358	<442	<302
5	<102	<206	<394	<379	<43,700	<358	<442	<302
6	<102	<206	<394	<379	<43,700	<358	<442	<302

The carbonate, oxalate and phosphate results are for information only. The QC standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.
< Values were less than instrumental detection limit.
All values based on duplicate measurements.

3.4.2.7 Extractable ^{137}Cs and ^{90}Sr Determined from $Ca(OH)_2$ Solution Periodic Replenishment Extractions

The extractable concentrations of ^{137}Cs determined from the $Ca(OH)_2$ solution extracts were at the low microcurie per gram level for all sequential extraction stages (Table 3.58). The extractable ^{137}Cs concentrations of the two C-203 sludges increased with each stage of extraction with the highest concentrations being present in the final stage extracts. For instance, in the initial extracts from the 19250 (C-203), 19887 (C-203) and 19961 (C-203) samples, extractable ^{137}Cs concentrations were measured at 2.71 µCi/g sludge, 0.219 µCi/g sludge and 0.276 µCi/g sludge, respectively; whereas, the final stage extracts from these samples contained extractable ^{137}Cs concentrations of 1.28, 8.98 and 7.19 µCi/g sludge, respectively. The cumulative leachable fractions of ^{137}Cs in these sludge samples were on average 76, 80, 57% of the total ^{137}Cs present in the 19250 (C-202), 19887 (C-203); and 19961 (C-203) sludge samples, respectively. The sequential extractions cumulatively leached more than an order of magnitude greater ^{137}Cs than was leached in the single contact 30-day extraction process (Table 3.46). The DDI water extractable ^{137}Cs was about a factor of 8 to 10 less leachable than that of the $Ca(OH)_2$ solution, and did not show such a large difference in leachability when comparing the single-contact DDI water extraction with the sequential extractions.

Table 3.58. Concentrations of ^{137}Cs and ^{90}Sr – Periodic Replenishment Extractions with $Ca(OH)_2$ Solution

Sequential Contact	Duration (Days)	^{137}Cs		^{90}Sr	
		µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
Sample 19250 (C-202)					
1	1	2.71	3.11E-02	9.71	0.069
2	1	3.51	4.04E-02	NM	NM
3	3	2.25	2.58E-02	94.7	0.68
4	1	0.54	6.23E-03	NM	NM
5	1	0.17	1.98E-03	NM	NM
6	30	1.28	1.48E-02	93.4	0.67
Sample 19887 (C-203)					
1	1	0.219	2.51E-03	<1.18E+00	<8.46E-03
2	1	0.516	5.93E-03	NM	NM
3	3	0.869	9.99E-03	4.32E+00	3.08E-02
4	1	2.36	2.71E-02	NM	NM
5	1	2.52	2.90E-02	NM	NM
6	30	8.98	1.03E-01	1.66E+01	1.18E-01
Sample 19961 (C-203)					
1	1	0.276	3.17E-03	<1.17E+00	<8.33E-03
2	1	0.321	3.68E-03	NM	NM
3	3	0.895	1.03E-02	<1.17E+00	<8.33E-03
4	1	2.30	2.64E-02	NM	NM
5	1	1.94	2.22E-02	NM	NM
6	30	6.69	7.69E-02	2.11E+01	1.50E-01

All concentrations are corrected for the dry sludge basis.
Values within parentheses were less than EQL.
< Values were less than instrumental detection limit.
NM = Not measured.
Values based on duplicate measurements.

The extractable ^{90}Sr concentrations determined from the first, third and sixth stages of the sequential extractions are listed in Table 3.58. For sample 19250 (C-202), the concentrations increase by about an order of magnitude between the first and third extraction. For samples 19887 (C-203) there was a slight increase and for 19961 (C-203) there was no apparent increase. The sixth extraction is similar to the third for sample 19250 (C-202), and increases another factor of 4 for sample 19887 (C-203) and a factor of 21 for samples 19961 (C-203). The leachable concentrations measured for the three extractions represent 26% of the total ^{90}Sr in sludge 19250 (C-202), 6.2% of the sample 19887 (C-203) total, and 5.7% of the total ^{90}Sr in 19961 (C-203). These results indicate that ^{90}Sr is not highly leachable from these sludges by a $Ca(OH)_2$ saturated solution; however, the leachability of both ^{137}Cs and ^{90}Sr appears to increase with leaching stage and contact time.

3.4.2.8 Extractable Actinides Determined from $Ca(OH)_2$ Solution Periodic Replenishment Extractions

The extractable actinide concentrations by the sequential extractions are listed in Table 3.59. The concentrations of ^{237}Np and ^{241}Am in these sludge extracts were all below their respective EQL and/or instrument detection limits during all six stages of extraction indicating that $Ca(OH)_2$ is an ineffective leachant for mobilizing these actinides from these sludge samples. Very small amounts (≤0.01%) of ^{239}Pu appear to be leachable from sample 19250 (C-202) at each sequential extraction stage; however, these concentrations are estimates (Table 3.59 and Table 3.60). Small amounts (≤0.2%) of ^{239}Pu were also measured to be potentially leachable from the two C-203 sludge samples in the first extraction only (Table 3.60).

Table 3.59. Extractable Actinides Determined from Periodic Replenishment $Ca(OH)_2$ Cement Extractions

Sequential Contact	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	**µg/g Sludge**	**µCi/g Sludge**	**µg/g Sludge**	**µCi/g Sludge**	**µg/g Sludge**
Sample 19250 (C-202)						
1	<9.55E-07	<1.34E-03	(2.91E-03)	(4.69E-02)	<2.29E-02	<6.72E-03
2	<9.55E-07	<1.34E-03	(8.21E-04)	(1.32E-02)	<2.29E-02	<6.72E-03
3	<9.55E-07	<1.34E-03	(8.29E-04)	(1.34E-02)	<2.29E-02	<6.72E-03
4	<9.55E-07	<1.34E-03	(6.90E-04)	(1.11E-02)	<2.29E-02	<6.72E-03
5	<9.55E-07	<1.34E-03	(4.46E-04)	(7.19E-03)	<2.29E-02	<6.72E-03
6	<9.55E-07	<1.34E-03	(3.56E-04)	(5.75E-03)	<2.29E-02	<6.72E-03
Sample 19887 (C-203)						
1	<6.31E-05	<8.89E-02	(1.73E-03)	(2.79E-02)	<1.51E+01	<4.44E+00
2	<6.31E-05	<8.89E-02	<2.75E-02	<4.44E-01	<1.51E+01	<4.44E+00
3	<6.31E-05	<8.89E-02	<2.75E-02	<4.44E-01	<1.51E+01	<4.44E+00
4	<6.31E-05	<8.89E-02	<2.75E-02	<4.44E-01	<1.51E+01	<4.44E+00
5	<6.31E-05	<8.89E-02	<2.75E-02	<4.44E-01	<1.51E+01	<4.44E+00
6	<6.31E-05	<8.89E-02	<2.75E-02	<4.44E-01	<1.51E+01	<4.44E+00
Sample 19961 (C-203)						
1	<6.21E-05	<8.75E-02	(1.34E-03)	(2.16E-02)	<1.49E+01	<4.37E+00
2	<6.21E-05	<8.75E-02	<2.71E-02	<4.37E-01	<1.49E+01	<4.37E+00
3	<6.21E-05	<8.75E-02	<2.71E-02	<4.37E-01	<1.49E+01	<4.37E+00
4	<6.21E-05	<8.75E-02	<2.71E-02	<4.37E-01	<1.49E+01	<4.37E+00
5	<6.21E-05	<8.75E-02	<2.71E-02	<4.37E-01	<1.49E+01	<4.37E+00
6	<6.21E-05	<8.75E-02	<2.71E-02	<4.37E-01	<1.49E+01	<4.37E+00

3.5 $CaCO_3$ Solution Leaching Tests

The data obtained from the saturated $CaCO_3$ solution leaching tests on the three residual sludge samples [19250 (C-202), 19887 (C-203), and 19961 (C-203)] are presented and discussed in this section. These tests were designed to evaluate the leaching of sludge constituents by a leaching solution derived from contact of infiltrating water with aged cement filling the tank above the sludge. It is anticipated that calcite ($CaCO_3$) will control the major ion chemistry of water passing through aged cement overlying the sludge and that a Ca/CO_3 saturated leachant will be the appropriate leachant for mobilizing contaminants during this stage of a performance assessment. Section 3.5.1 provides the results of single 30-day contact tests of the solution and sludges, and Section 3.5.2 discusses the periodic replenishment tests in which the sludge was contacted 6 times with the leaching solution. The concentrations of the constituents in the saturated $CaCO_3$ solution extracts tabulated in this section are expressed in units of µCi or µg per gram of dry sludge. Concentrations on a per liter basis of dissolved constituents are listed in Appendix I. Results for ^{129}I in the single-contact and periodic replenishment tests are not included because they were below the detection limit.

Table 3.60. Cement-Leachable Percentage for Actinides in Periodic Replenishment $Ca(OH)_2$ Cement Extracts Compared with Acid Analysis

Sequential Contact	^{237}Np	^{239}Pu	^{241}Am
Percent Cement Leachable			
Sample 19250 (C-202)			
1	< EQL	(0.01)	< EQL
2	< EQL	(0.003)	< EQL
3	< EQL	(0.003)	< EQL
4	< EQL	(0.003)	< EQL
5	< EQL	(0.002)	< EQL
6	< EQL	(0.001)	< EQL
Sample 19887 (C-203)			
1	< EQL	(0.19)	< EQL
2	< EQL	<EQL	< EQL
3	< EQL	<EQL	< EQL
4	< EQL	<EQL	< EQL
5	< EQL	<EQL	< EQL
6	< EQL	<EQL	< EQL
Sample 19961 (C-203)			
1	< EQL	(0.14)	< EQL
2	< EQL	< EQL	< EQL
3	< EQL	< EQL	< EQL
4	< EQL	< EQL	< EQL
5	< EQL	< EQL	< EQL
6	< EQL	< EQL	< EQL
EQL = Estimated quantitation limit.			

3.5.1 Single Contact $CaCO_3$ Solution Contact Test Data

The single contact water-leach tests were run in duplicate with an equilibration time of 1 month. A saturated $CaCO_3$ solution was used as a leachant. The results of these experiments are presented in this section.

3.5.1.1 Sludge to $CaCO_3$ Solution Ratios used in Single-Contact Extractions

In these tests, 30 ml of $CaCO_3$ saturated solution was contacted with about 0.3 to 0.6 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to $CaCO_3$ solution ratios (Table 3.61). These ratios ranged from about 7.76 to 13.30 g/L.

Table 3.61. Sludge to $CaCO_3$ Solution used in Leaching Extractions

Sample Number	Sludge to $CaCO_3$ Solution Ratios (g/L)
19250 (C-202)	7.89
19250 (C-202) Dup	7.76
19887 (C-203)	13.30
19887 (C-203) Dup	12.27
19961 (C-203)	11.31
19961 (C-203) Dup	11.05
DUP = Duplicate. All concentrations are corrected for the dry sludge basis.	

3.5.1.2 Alkalinity and pH of Single Contact $CaCO_3$ Solution Extractions

The average leachable alkalinities and pH values measured in duplicate leachates of each sludge sample are listed in Table 3.47. The pH value of the leachate from sludge sample 19250 (C-202) was slightly alkaline (8.68) whereas, the leachates from C-203 tank sludge samples, [19887 (C-203) and 19961 (C-203)] were more alkaline at pH 10.45 and 10.60, respectively. The total leachable alkalinity for the 19250 (C-202) sludge was 35.8 mg $CaCO_3$/g sludge. The average total leachable alkalinity value for the 19887 (C-203) sludge sample was 64.8 and the corresponding value for 19961 (C-203) sludge sample was 46.4 mg $CaCO_3$/g sludge (Table 3.62).

Table 3.62. Leachable Alkalinity and pH Values after 1 Month of $CaCO_3$ Solution Extraction

Sample Number	pH	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint
		mg/L	mg/g Solid
19250 (C-202)	8.80	278	35.2
19250 (C-202) Dup	8.56	282	36.3
19250 (C-202) Avg	8.68	280	35.8
19887 (C-203)	10.40	757	65.2
19887 (C-203) Dup	10.49	703	64.4
19961 (C-203)	10.51	695	52.3
19961 (C-203) Dup	10.69	710	40.5
19887 (C-203) Avg	10.45	730	64.8
19961 (C-203) Avg	10.60	703	46.4
Avg = Average. Dup = Duplicate.			

3.5.1.3 Extractable ^{99}Tc and ^{238}U Determined from Single-Contact $CaCO_3$ Solution Extractions

The concentrations of ^{99}Tc and ^{238}U mobilized in $CaCO_3$ saturated leachates after a 1-month contact with the residual sludge samples [19250 (C-202), 19887 (C-203), and 19961 (C-203)] are listed in

Table 3.63. The concentrations of ^{99}Tc in each of the leachates of all sludge samples were less than EQL or instrumental detection limit. Where estimated concentrations are available, the calculated percentages of leachable ^{99}Tc from these sludges are 3.48% (19250, C-202) and 31% (19961, C-203) (Table 3.64).

Table 3.63. Extractable ^{99}Tc and ^{238}U after 1 Month of $CaCO_3$ Solution Extraction

Sample Number	^{99}Tc	^{238}U	^{99}Tc	^{238}U
	---------µg/g Sludge-------		--------µCi/g Sludge-------	
19250 (C-202)	(5.07E-03)	6,510	(8.62E-05)	2.21E-03
19250 (C-202) Dup	(5.28E-03)	5,880	(8.98E-05)	2.00E-03
19250 (C-202) Avg	(5.18E-03)	6,190	<8.80E-05	2.11E-03
19887 (C-203)	<3.76E-02	33,800	<6.39E-04	1.15E-02
19887 (C-203) Dup	<4.08E-02	12,200	<6.93E-04	4.15E-03
19961 (C-203)	(1.41E-02)	38,400	(2.40E-04)	1.31E-02
19961 (C-203) Dup	(8.15E-03)	45,700	(1.38E-04)	1.55E-02
19887 (C-203) Avg	<3.92E-02	23,000	<6.66E-04	7.82E-03
19961 (C-203) Avg	(1.11E-02)	42,100	(1.89E-04)	1.43E-02
Values within parentheses were less than EQL. < Values were less than instrumental detection limit. All concentrations are corrected for the dry sludge basis.				

Table 3.64. $CaCO_3$ Solution-Leachable Percentages of ^{99}Tc and ^{238}U

Sample Number	^{99}Tc	^{238}U
	Percent Leachable	
19250 (C-202)	(3.48)	2.99
19887 (C-203)	< EQL	4.4
19961 (C-203)	(31)	8.7
<EQL = Below estimated quantitation limit.		

The extracts from these three sludge samples contained relatively high concentrations of ^{238}U. For example, the $CaCO_3$ leachate of sludge 19250 (C-202) contained an average ^{238}U concentration of 6,190 µg/g sludge and sludges 19887 (C-203) and 19961 (C-203) samples contained extractable ^{238}U concentrations of 23,000 µg/g sludge and 44,100 µg/g sludge, respectively. These concentrations indicate that the percentages of the ^{238}U leachable in $CaCO_3$ solution after 1 month of contact was on average 3, 4.4, and 8.7 % of the total ^{238}U present in 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludges, respectively (Table 3.64). These data suggest that ^{238}U concentrations in leachate from these sludges will be high during the $CaCO_3$ stage of release, but that the U solids in contact with the solution control the water leaching.

The percent leachable by the $CaCO_3$ solution for each sample was similar to that for the DDI water extractant; however, it was over 100 times higher than the amount leachable by the $Ca(OH)_2$ extractant for samples 19250 (C-202) and 19883 (C-203) and 3.6 times higher for sample 19961 (C-203).

3.5.1.4 Extractable Metals Determined from $CaCO_3$ Solution Extractions

Concentrations of a number of metals including Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the $CaCO_3$ solution after extracting for one month were measured by ICP-OES. Among these, only a limited number of metals were present in measurable concentrations (Table 3.65). The concentrations listed within parentheses indicate values that are less than EQL. These data show that the two major leachable elements by the $CaCO_3$ leach solution in all three sludge samples were Na and P. Average extractable concentrations of Na in all three sludge samples were similar in magnitude, namely 28,300 µg/g sludge in 19250 (C-202), 27,800 µg/g sludge in 19887 (C-203), and 32,400 µg/g sludge in 19961 (C-203), respectively. However, the average extractable concentration of P in 19250 (C-202) sludge leachate was 1,980 µg/g sludge, which was about three to four times less than the average extractable P concentrations observed in the leachates of C-203 tank sludge samples (5,590 µg/g sludge and 8,470 µg/g sludge in 19887 (C-203) and 19961 (C-203), respectively). Other elements with measurable leachability (>100 to <1500 µg/g sludge) included Al, Ba, Ca, Cr, Fe, Mg, Mn, Ni, Pb, and Zn.

Percentages of metals that were $CaCO_3$ extractable are listed in Table 3.66. These results were computed on the basis of the total metal concentrations as measured in the acid digested samples (Table 3.3 through Table 3.5). The data show that about half (48.1%) of the total Na present in sample 19250 (C-202) was readily leachable, and 28.7% and 34.2% of the Na inventories in samples 19887 (C-203) and 19961 (C-203) were present in $CaCO_3$ solution leachable forms. Leachable percentages of P in $CaCO_3$ solution were lower, but appreciable, constituting 12.2% of 19250 (C-202), 14.7% of 19887 (C-203), 21.7% of 19961 (C-203) of the total mass of P present in these sludges. The leachability of Cr in 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples were calculated to be 1.5%, 11.6%, and 25.3%, respectively. Other measurable leachable metal percentages were found only in C-203 tank sludge samples. These leachable metals consisted of Fe (2.5% and 8.4%), Mn (8.5% and 18.3%), and Pb (3.2 and 10.4%) in samples 19887 (C-203) and 19961 (C-203), respectively. Although there were no significant differences in the average leachable fractions of Na from the C-203 sludge samples, sample 19961 (C-203) appeared to leach a greater fraction of Cr, Fe, Mn, P, and Pb compare to sample 19887 (C-203). At this time, there are no discernable reasons for this differential leaching of these elements from these two sludge samples from the same waste tank (C-203).

3.5.1.5 Extractable Anions Determined from Single Contact $CaCO_3$ Solution Extractions

The extractable concentrations of anions determined in $CaCO_3$ saturated leachates after 1 month of contact were measured by ion chromatography and the results are provided in Table 3.67. Fluoride extracted from all the sludge samples was present at a concentration at least an order of magnitude higher than chloride. Average concentrations of F and Cl in the 19250 (C-202) sludge leachates were 4,400 and 103 µg/g sludge, respectively. Leachate concentrations of F in C-203 sludge samples were about 30% lower than what was measured in the C-202 sludge extract [19887 (C-203): 3,000 µg/g sludge, and 19961 (C-203): 2,790 µg/g sludge]. The Cl concentrations in the two C-203 sludge $CaCO_3$ leachates were below the instrumental detection limits.

Extractable nitrate concentrations in these sludge samples were on average about 5 to 10 times higher than nitrite concentrations. Average nitrate and nitrite concentrations in sample 19250 (C-202) extracts were 1,830 and 474 µg/g sludge, respectively. Higher average nitrate concentrations were found in C-203 tank sludge samples [19887 (C-203): 4,360 µg/g sludge and 19961 (C-203): 5,140 µg/g sludge].

Table 3.65. Extractable Metals Concentrations After 1 Month of $CaCO_3$ Solution Extraction

Sample Number	Al	Ba	Ca	Cr	Cu	Fe	Mg	Mn	Na	Ni	P	Pb	Zn
	---------- µg/g Dry Sludge ----------												
19250 (C-202)	158	38.7	(219)	208	(7.6)	166	<159	36.3	29,300	(19.2)	2,060	(34.5)	<79.3
19250 (C-202) Dup	139	30.5	(379)	197	(5.7)	144	<161	31.1	27,300	(18.1)	1,890	(20.8)	<80.5
19250 (C-202) Avg	148	34.6	(299)	203	(6.6)	155	<160	33.7	28,300	(18.7)	1,980	(27.6)	<79.9
19887 (C-203)	(106)	(8.10)	(275)	1,030	<7520	639	(57)	110	28,600	(77.2)	6,300	299	(69.2)
19887 (C-203) Dup	(127)	(4.99)	(72.1)	458	<8150	194	<408	32.9	27,100	<408	4,870	78.1	(40.7)
19961 (C-203)	(98.3)	(8.92)	(380)	1,260	<8840	1,200	(71.8)	175	32,000	(146)	8,200	493	(99.5)
19961 (C-203) Dup	(93.6)	(2.98)	(419)	1,490	<9050	1,490	(85.8)	216	32,700	(170)	8,730	605	(111)
19887 (C-203) Avg	(117)	(6.55)	(173)	743	<7840	417	(232)	71.6	27,800	(242)	5,590	189	(54.9)
19961 (C-203) Avg	(96)	(5.95)	(400)	1,380	<8940	1,340	(78.8)	195	32,400	(158)	8,470	549	(105)

Values within parentheses were less than estimated quantitation limit.
< Values were less than instrumental detection limit.

Table 3.66. Percentages of $CaCO_3$ Solution Extractable Metals After 1 Month Contact

Sample Number	Al	Ba	Ca	Cr	Cu	Fe	Mg	Mn	Na	Ni	P	Pb	Zn
	---------- % $CaCO_3$ Solution Leachable ----------												
19250 (C-202) Avg	1.1	16.6	--	1.5	1.3	0.1	--	0.1	48.1	(0.2)	12.2	0.3	--
19887 (C-203) Avg	--	--	--	11.6	--	2.5	(28.7)	8.5	28.7	(55.3)	14.7	3.2	(7.7)
19961 (C-203) Avg	--	--	--	25.3	--	8.4	(12.1)	18.3	34.2	(27.1)	21.7	10.4	(19.8)

The numbers within parentheses were calculated on the basis of less than estimated quantitation limit values.

Table 3.67. Extractable Anion Concentrations After 1 Month of $CaCO_3$ Solution Extraction

Sample Number	Fluoride	Chloride	Nitrite	Nitrate	Carbonate	Sulfate	Phosphate	Oxalate
	µg/g Dry Sludge							
19250 (C-202)	4,600	97	510	1,860	26,200	244	5,500	27,600
19250 (C-202) Dup	4,200	108	438	1,800	25,400	235	5,050	26,800
19250 (C-202) Avg	4,400	103	474	1,830	25,800	240	5,270	27,200
19887 (C-203)	2,930	<178	417	3,880	<37,600	<308	14,640	1,460
19887 (C-203) Dup	3,070	<192	502	4,840	<40,800	<333	15,600	1,730
19961 (C-203)	2,800	<209	636	5,120	<44,200	<362	18,500	1,360
19961 (C-203) Dup	2,780	<214	608	5,160	<45,300	<370	19,400	1,370
19887 (C-203) Avg	3,000	<185	459	4,360	<39,200	<321	15,100	1,600
19961 (C-203) Avg	2,790	<211	622	5,140	<44,700	<366	19,000	1,360

The carbonate, oxalate and phosphate results are for information only. The quality control standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.
Avg = Average.
Dup = Duplicate.

Relatively low concentrations of extractable sulfate were found in these sludge samples. The average concentrations were 240, <321, and <366 µg/g sludge in extracts of samples 19250 (C-202), 19887 (C-203), and 19961 (C-203), respectively.

Significant concentrations of extractable phosphate, namely 15,100 and 19,000 µg/g sludge, were found in the $CaCO_3$ leachates of sludge samples 19887 (C-203) and 19961 (C-203), respectively. Sample 19250 (C-202) contained an extractable phosphate concentration of only 5,270 µg/g sludge. Similar amounts of extractable phosphate were found in these samples extracted with DDI water. Much lower concentrations of extractable phosphate were found in these samples extracted with the $Ca(OH)_2$ solution. The average extractable phosphate concentrations were: <17.8 µg/g sludge for sample 19250 (C-202); 3,000 µg/g sludge for sample 19887 (C-203); and 7,100 µg/g sludge for sample 19961 (C-203). The lower concentrations of phosphate in the $Ca(OH)_2$ extracts may be due to the formation of apatite [$Ca_3(PO_4)_2$] under the high pH and Ca concentrations of these extractions.

The extractable concentrations of oxalate in the 19250 (C-202) sample averaged 27,200 µg/g sludge which was about 20 times higher than oxalate concentrations of 1,600 µg/g sludge and 1,360 µg/g sludge in samples 19887 (C-203) and 19961 (C-203) sludge extracts, respectively. Similar amounts of extractable oxalate were found in these samples extracted with DDI water and with the C-203 samples extracted with the $Ca(OH)_2$ solution. Much lower concentrations of extractable oxalate were found in sample 19250 (C-202) extracted with the $Ca(OH)_2$ solution. The average extractable oxalate concentration for these samples was 1,000 µg/g sludge. The lower concentrations of oxalate in the $Ca(OH)_2$ extraction of sample 19250 (C-202) may be due to the formation of calcium oxalate [CaC_2O_4] under the high pH and Ca concentrations of this extraction.

3.5.1.6 Extractable ^{137}Cs and ^{90}Sr Determined from Single Contact $CaCO_3$ Solution Extractions

The extractable concentrations of ^{137}Cs in the $CaCO_3$ solution leachates indicate that this radioisotope had low leachability at the microcurie per gram level (Table 3.68). As an example, the average ^{137}Cs concentration in the 19250 (C-202) sludge extract was found to be 0.365 µCi/g sludge, and the concentrations in $CaCO_3$ leachates from sludges 19887 (C-203) and 19961 (C-203) were measured at

0.884 µCi/g sludge and 1.85 µCi/g sludge, respectively. The leachable percentage of ^{137}Cs in these sludge samples constituted on average 2.6, 4.6, and 8.5% of the total ^{137}Cs present in the 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples, respectively (Table 3.69).

Table 3.68. Average Extractable Concentrations ^{137}Cs and ^{90}Sr After 1 Month of $CaCO_3$ Solution Extraction

Sample Number	^{137}Cs		^{90}Sr	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
19250 (C-202) Avg	0.365	0.0042	13.0	0.0929
19887 (C-203) Avg	0.884	0.010	23.4	0.167
19961 (C-203) Avg	1.85	0.021	40.5	0.290
Avg = Average. All concentrations are corrected for the dry sludge basis.				

Table 3.69. Extractable ^{137}Cs and ^{90}Sr as a Percentage of Total Sludge Concentration

Sample Number	^{137}Cs	^{90}Sr
	--------% $CaCO_3$ Leachable-----	
19250 (C-202) Avg	2.6	1.7
19887 (C-203) Avg	4.6	6.9%
19961 (C-203) Avg	8.5	10.4%
All concentrations are corrected for the dry sludge basis. Total sludge concentrations from acid digested samples.		

The extractable ^{90}Sr concentrations in the $CaCO_3$ solution were present at levels in the range of 13 to 40 µCi/g sludge. The 19250 (C-202) sample extract measured 13.0 µCi/g sludge and the extractions of 19887 (C-203) and 19961 (C-203) sludge samples contained ^{90}Sr concentrations of 23.4 and 40.5 µCi/g sludge, respectively. These concentrations represented 1.7, 6.9, and 10.4% of the total ^{90}Sr present in these sludge samples (Table 3.69). The extractable percentage of sample 19250 (C-202) was similar to the DDI water extraction, where as the percentages for 19887 (C-203) and 19961 (C-203) were 5 to 10 times higher. The percentages compared to the $Ca(OH)_2$ solution extraction were greater by a factor of 2 to 46 times.

3.5.1.7 Extractable Actinides Determined from Single Contact $CaCO_3$ Solution Extractions

The $CaCO_3$ solution leachable actinides are listed in Table 3.70. The concentrations of ^{239}Pu in the extracts were at measurable levels in all cases whereas the concentrations of ^{237}Np were estimated in all cases and for ^{241}Am they were estimated for the sample from tank C-202 and below detection limit for tank C-203. The extractable ^{239}Pu concentrations in the extracts of sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) were 0.877, 2.16, and 6.08 µg/g sludge, respectively. These concentrations indicated that the ^{239}Pu in these sludge samples had very low leachability (0.2% of the total) for tank C-202 and low leachability (14 and 28% of the total) tank C-203 in $CaCO_3$ solution (Table 3.71). The estimated leachability of ^{237}Np for C-202 is 2.2% of the total and for C-203 it is 0.1 and 0.22%. The estimated leachability of ^{241}Am from C-202 is 0.2% of the total. The extractable percentages are similar to those for the DDI water extractions for all samples. They are also similar to the $Ca(OH)_2$ extractions, except that much less ^{239}Pu was leached by the $Ca(OH)_2$ extractions for the three samples compared to the amount leached by the DDI water or $CaCO_3$ extractants.

Table 3.70. Extractable Actinides Determined from Single-Contact $CaCO_3$ Extractions

Sample Number	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
19250 (202) 1 Month	(3.39E-05)	(4.78E-02)	5.44E-02	8.77E-01	(3.26E-03)	(9.58E-04)
19887 (203) 1 Month	(2.31E-05)	(3.25E-02)	1.34E-01	2.16E+00	<1.33E+01	<3.92E+00
19961 (203) 1 Month	(4.92E-05)	(6.94E-02)	3.77E-01	6.08E+00	<1.52E+01	<4.47E+00

Table 3.71. Percentage of Extractable Actinides Determined from Single-Contact $CaCO_3$ Extractions Compared with Acid Analysis

Sample Number	^{237}Np	^{239}Pu	^{241}Am
	% $CaCO_3$ Leachable		
19250 (202) 1 Month	(2.2)	0.2	(0.2)
19887 (203) 1 Month	(0.10)	14	< EQL
19961 (203) 1 Month	(0.22)	28	< EQL
N/A = Results below detection limit. EQL = Estimated quantitation limit.			

3.5.2 Periodic Replenishment $CaCO_3$ Solution Extraction Data

The sequential extraction tests were conducted by repeatedly equilibrating duplicate sludge samples with 30 mL aliquots of fresh $CaCO_3$-saturated solution. Sequential contacts 1, 2, 4, and 5 had a duration of 1 day each, whereas, sequential contact 3 and 6 lasted 3 and 30 days, respectively. The goal of these sequential leaching tests was to assess the long-term leaching characteristics of key contaminants and other constituents from the sludge samples. The results of these tests are presented in this section.

3.5.2.1 Sludge to $CaCO_3$ Solution Ratios used in Periodic Replenishment Extractions

In these tests, 30 ml aliquots of saturated $CaCO_3$ solution were contacted with about 0.3 to 0.6 g of moist sludge. The moisture contents of these sludge samples ranged from 38 to 57% by mass (Table 3.1). The dry sludge masses calculated from moisture content measurements were used to compute the dry sludge to $CaCO_3$ solution ratios (Table 3.72). These ratios ranged from about 7.34 to 15.12.

3.5.2.2 Alkalinity and pH of $CaCO_3$ Solution Periodic Replenishment Extractions

The average alkalinities and pH values measured in duplicate leachates of each sludge sample at the end of each sequential contact are listed in Table 3.73. The pH values of all three sludge leachates at all stages of extraction were alkaline in nature ranging in values from 7.87 to 10.43. The pH values for all sludge leachates initially tended to be higher and decreased with each succeeding stage of extraction, except during the last stage for the extracts from samples 19250 (C-202) and 19887 (C-203), which showed slight increases in pH values.

Table 3.72. Sludge to Solution Ratios used in Periodic Replenishment $CaCO_3$ Leaching Tests

Sample Number	Sludge to $CaCO_3$ Solution Ratio (g/L)
19250 (C-202)	7.34
19250 (C-202) Dup	7.93
19887 (C-203)	13.71
19887 (C-203) Dup	15.12
19961 (C-203)	10.84
19961 (C-203) Dup	10.56
All concentrations are corrected for the dry sludge basis.	

Table 3.73. Alkalinity and pH Values – Period Replenishment Extraction with $CaCO_3$ Solution

Sequential Contact	Duration (Days)	pH	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint	Total Alkalinity (as $CaCO_3$) at pH 4.5 Endpoint
			mg/L	mg/g solid
Sample 19250 (C-202)				
1	1	8.95	266	34.9
2	1	8.21	102	13.4
3	3	8.46	100	13.2
4	1	7.87	77.2	10.1
5	1	7.96	96.5	12.8
6	30	8.40	118	15.4
Sample 19886 (C-203)				
1	1	10.14	614	45.9
2	1	10.01	228	16.9
3	3	9.59	162	12.1
4	1	9.53	124	9.3
5	1	9.21	124	9.3
6	30	9.50	181	13.5
Sample 19961 (C-203)				
1	1	10.43	560	43.8
2	1	9.98	193	15.1
3	3	9.65	147	11.4
4	1	8.62	112	8.7
5	1	8.64	112	8.8
6	30	8.42	139	10.9

Major fractions of alkalinities from these sludges were mobilized during the first two stages of extraction. For instance, the sum of alkalinities extracted during the two initial extraction stages comprised about 50%, 68%, and 75% of the total cumulative extractable alkalinities in samples 19250 (C-202), 19887 (C-203), and 19961 (C-203), respectively. For the 19250 (C-202) sludge, the sum of extractable total alkalinity from all six stages was 100 mg $CaCO_3$/g sludge, and the sums of extracted alkalinities for samples 19887 (C-203) and 19961 (C-203) were 107 and 99 mg $CaCO_3$/g sludge, respectively. Note that about 50 mg/L of the alkalinity is due to the $CaCO_3$ solution used for the extraction. These six stages of sequential extractions cumulatively mobilized about two to three time more total alkalinities from each sludge sample as compared to the total alkalinities released by the single 30-day extractions with $CaCO_3$ solution (Table 3.62).

3.5.2.3 Carbon Contents – $CaCO_3$ Solution Periodic Replenishment Extractions

Table 3.74 lists the carbon contents that were sequentially extractable from the C-202 and C-203 sludge samples. About 40%, 56%, and 54% of cumulatively extractable TC was extractable from the initial stage of extraction of sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203), respectively. About 46% of the cumulatively extracted carbon from 19250 (C202) sample was inorganic carbon; whereas, inorganic carbon constituted about 77 and 72% of the cumulative TC extracted from samples 19887 (C-203) and 19961 (C-203), respectively. A portion of the inorganic carbon measured in the leachates was due to the carbonate/bicarbonate component of the leachant.

Table 3.74. Extractable Carbon Contents Determined from Periodic Replenishment Extractions with $CaCO_3$ Solution

Sequential Contact	Duration (Days)	TC	TOC	TIC
		--------mg C/g Sludge---------		
Sample 19250 (C-202)				
1	1	19.8	12.6	7.26
2	1	4.94	1.66	3.27
3	3	7.20	3.67	3.53
4	1	3.29	1.10	2.19
5	1	2.21	0.58	1.64
6	30	9.54	5.70	3.84
Sample 19887 (C-203)				
1	1	7.88	2.99	4.89
2	1	1.82	0.40	1.58
3	3	1.28	0.34	1.28
4	1	0.96	0.34	0.96
5	1	0.87	0.34	0.87
6	30	1.21	0.34	1.21
Sample 19961 (C-203)				
1	1	9.33	4.43	4.90
2	1	2.14	0.51	1.86
3	3	1.68	0.45	1.68
4	1	1.25	0.45	1.25
5	1	1.20	0.45	1.20
6	30	1.46	0.45	1.46
All concentrations are corrected for the dry sludge basis.				

3.5.2.4 Extractable ^{99}Tc and ^{238}U Determined from $CaCO_3$ Solution Periodic Replenishment Extractions

The concentrations of ^{99}Tc and ^{238}U mobilized in sequential $CaCO_3$ solution extractions of sludge samples 19250 (C-202), 19887 (C-203), and 19961 (C-203) are listed in Table 3.75. The concentrations of ^{99}Tc in all stages of extraction from all the three sludge samples were below the instrumental detection limits, except for an estimated value of 4.99 x 10^{-3} μg/g sludge for the first extraction of sample 19250 (C-202). If this amount is correct, it represents 3.4% of the total ^{99}Tc in this sludge (Table 3.76). ^{99}Tc in these samples was not leachable to any detectable degree by the $CaCO_3$ solution. Similar low levels of ^{99}Tc leachability were measured or estimated for the DDI water and $Ca(OH)_2$ solution extractions with the exception being an estimated value of 26.2% extractability for the first contact of sample 19887 (C-203) with the $Ca(OH)_2$ extractant.

Table 3.75. Extractable Concentrations of ^{99}Tc and ^{238}U – Periodic Replenishment Extraction with $CaCO_3$ Solution

Sequential Contact	Duration (Days)	^{99}Tc	^{238}U	^{99}Tc	^{238}U
		-------μg/g Sludge-----------		------μCi/g Sludge-------	
Sample 19250 (C-202)					
1	1	(4.99E-03)	7,250	(8.48E-05)	2.47E-03
2	1	<6.56E-03	1,320	<1.11E-04	4.50E-04
3	3	<6.56E-03	3,090	<1.11E-04	1.05E-03
4	1	<6.56E-03	1,240	<1.11E-04	4.23E-04
5	1	<6.56E-03	972	<1.11E-04	3.30E-04
6	30	<6.56E-03	5,260	<1.11E-04	1.79E-03
Sample 19887 (C-203)					
1	1	<3.48E-02	10,300	<5.91E-04	3.52E-03
2	1	<3.48E-02	6,060	<5.91E-04	2.06E-03
3	3	<2.35E-02	2,420	<4.00E-04	8.22E-04
4	1	<3.48E-02	1,930	<5.91E-04	6.58E-04
5	1	<3.48E-02	1,400	<5.91E-04	4.77E-04
6	30	<3.48E-02	14,400	<5.91E-04	4.91E-03
Sample 19961 (C-203)					
1	1	<2.64E-02	19,700	<4.48E-04	6.69E-03
2	1	<4.67E-02	5,320	<7.95E-04	1.81E-03
3	3	<4.67E-02	4,060	<7.95E-04	1.38E-03
4	1	<4.67E-02	1,180	<7.95E-04	4.02E-04
5	1	<4.67E-02	1,410	<7.95E-04	4.80E-04
6	30	<4.67E-02	8,750	<7.95E-04	2.97E-03

All concentrations are corrected for the dry sludge basis.
Values within parentheses were less than EQL.
< Values were less than instrumental detection limit.

Table 3.76. $CaCO_3$ Solution Extractable Percentages of ^{99}Tc and ^{238}U in Periodic Replenishment Extractions

Contact Stage (duration, days)	Contact Duration (days)	^{99}Tc	^{238}U
		% Leachable in $CaCO_3$ Solution	
Sample 19250 (C-202)			
1	1	(3.4)	3.50
2	1	< EQL	0.64
3	3	< EQL	1.49
4	1	< EQL	0.60
5	1	< EQL	0.47
6	30	< EQL	2.54
Sample 19887 (C-203)			
1	1	< EQL	2.0
2	1	< EQL	1.2
3	3	< EQL	0.5
4	1	< EQL	0.4
5	1	< EQL	0.3
6	30	< EQL	2.7
Sample 19961 (C-203)			
1	1	< EQL	3.7
2	1	< EQL	1.0
3	3	< EQL	0.8
4	1	< EQL	0.2
5	1	< EQL	0.3
6	30	< EQL	1.7
<EQL = Below the estimated quantitation limit.			

In contrast, the $CaCO_3$ solution extracts from all six sequential stages contained measurable concentrations of ^{238}U (Table 3.75). For example, the average extractable ^{238}U concentration from the initial extract for 19250 (C-202) sludge contained a ^{238}U concentration of 7,250 µg/g sludge (ppm) and similarly, the first stage extracts from sludges 19887 (C-203) and 19961 (C-203) contained extractable ^{238}U concentrations of 10,300 µg/g sludge and 19,700 µg/g sludge, respectively. The ^{238}U extractabilities in the second and subsequent stages were typically two to six times less than the initial stage extractability. The first stage extraction from all the sludge samples removed about a third to half of the cumulative leachable ^{238}U from all six extraction stages. For instance, the initial extractions of the 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples mobilized about 37%, 28%, and 48% of the cumulative leachable ^{238}U, respectively.

The $CaCO_3$ solution sequential extractions cumulatively mobilized about 9.24, 6.97 and 8.33% of the total acid digestable ^{238}U contents of the 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples, respectively (Table 3.76). These extractable percentages are generally less than those measured for the DDI water extractions and almost 100 time greater than the ^{238}U extractability using the $Ca(OH)_2$ extractant.

3.5.2.5 Extractable Metals Determined from $CaCO_3$ Solution Sequential Extractions

Concentrations of a number of metals including Al, As, B, Ba, Be, Bi, Ca, Cd, Co, Cr, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Se, Si, Sr, Ti, Tl, V, Zn, and Zr in the extracts of the six stage sequential leaching using $CaCO_3$ solution were measured by ICP-OES. Among these, only five elements, namely, Al, Cr, Fe, Na, and P were present in measurable concentrations. The extractable concentrations are shown in (Table 3.77). Concentrations listed within parentheses indicate values that are less than the EQL. These data show that the major leachable element in all three sludge samples was Na. Initial extractable concentrations of Na from 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge leachates were 29,300, 23,600, and 7,540 µg/g sludge, respectively. For all three sludge samples, the initial extraction generally mobilized the highest concentrations of Al, Cr, Fe, Na, and P. The sequential leaching behavior of Na and P from these sludges was similar to other constituents in that, following the high concentrations in the first stage, significant reduction in concentrations were observed in the subsequent four leaching stages with enhanced leaching in the final extraction stage.

Table 3.77. Average Extractable Concentrations Selected Metals – Periodic Replenishment Extraction with $CaCO_3$ Solution

Sequential Contact	Al	Cr	Fe	Na	P
	-----------µg/g Dry Sludge ----------				
Sample 19250 (C-202)					
1	172	255	1,200	29,300	1,990
2	136	(109.2)	387	15,600	1,220
3	196	(52.5)	369	5,120	726
4	216	(76.5)	595	3,520	508
5	(98.7)	(14.9)	(124)	1,920	(159)
6	195	(57.2)	436	2,410	174
Sample 19887 (C-203)					
1	(76.8)	386	218	23,600	5,620
2	(30.1)	329	218	6,280	2,610
3	(15.5)	92.4	(73.8)	3,790	1,370
4	(15.9)	(37.5)	(35.7)	2,560	746
5	<173.9	(20.6)	(22.2)	1,960	453
6	(65.0)	278	199	3,390	1,190
Sample 19961 (C-203)					
1	(73.8)	948	823	7,540	27,700
2	(21.9)	108	143	2,600	6,420
3	(27.6)	(44.2)	(59.6)	1,370	4,200
4	(127.5)	(4.8)	(25.8)	(444)	2,360
5	<233.7	(34.8)	(17.5)	(346)	2,090
6	(80.5)	(76.0)	(89.4)	787	3,070
Values within parentheses were < estimated quantitation limit. Based on duplicate measurements.					

Percentages of metals that were cumulatively extractable during the six-stage sequential leaching with $CaCO_3$ solution are listed in Table 3.78. These results were computed on the basis of the total metal concentrations as measured in the acid digested samples of the sludges (Table 3.3 through Table 3.5). These extractions mobilized about 77% of the total Na present in 19250 (C-202) and about 43 and 49% of the Na inventory in the 19887 (C-203) and 19961 (C-203) sludge samples, respectively. The data indicate that the six-stage sequential extraction of these sludge samples released on average about one and a half times the amount of Na that was leached in the single 30-day $CaCO_3$ extraction (Table 3.66). These extractions released P that constituted 25% of 19250 (C-202), 32% of 19887 (C-203), and 34% of 19961 (C-203) of the total mass of P present in these sludges. The cumulative P released from these sludge samples by sequential extractions were about twice the amount of P released from the single 1-month $CaCO_3$ extraction. The fractions of Cr mobilized from 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples were 5, 18, and 22 %, respectively. These data indicated that the sequential extractions using $CaCO_3$ leachant cumulatively mobilized Cr in quantities similar to that observed in single 30-day $CaCO_3$ extracts.

Table 3.78. Cumulative Percentages of Extractable Metals – Periodic Replenishment Extractions with $CaCO_3$ Solution

Element	19250 (C-202)	19887 (C-203)	19961 (C-203)
	------Cumulative % $CaCO_3$ Leachable ------		
Al	8.8	28.6	(92.8)
Cr	4.7	17.9	22.4
Fe	3.2	(4.6)	7.3
Na	76.9	42.9	48.5
P	25.2	31.6	33.6

Values within parentheses were less than the estimated quantitation limit.
Values calculated on the dry sludge basis.

Sequential extractions of 19250 (C-202), 19887 (C-203), and 19961 (C-203) samples cumulatively mobilized 9, 29, and 93% of the total Al and 3, 5, and 7% of the total Fe present in these sludge samples, respectively. Compared to the single 30-day $CaCO_3$ extraction data (Table 3.66), the sequential extractions mobilized significant fractions of Al but similar fractions of Fe from these sludges samples. These data from sequential leaching of sludge samples with $CaCO_3$ solution indicate that, except for a limited suite of elements (Al, Cr, Fe, Na, and P), all other analyzed metals were not leachable to a measurable degree.

3.5.2.6 Extractable Anions in $CaCO_3$ Solution Periodic Replenishment Extractions

The concentrations of anions that were present in the $CaCO_3$ leachates after each stage of sequential extraction were measured by IC. Extractable concentrations are listed in Table 3.79.

The initial extraction step mobilized very high concentrations of fluoride, nitrate, phosphate and oxalate and high concentrations of nitrite and sulfate from all the three sludge samples. (Approximately 3,000 μg/g sludge of the carbonate concentrations in the leachates are due to the $CaCO_3$ leachant used in the extractions.) Extracts from subsequent stages contained concentrations of anions that were significantly reduced, in some cases by more than an order of magnitude. These data indicated that the bulk of the extractable anions would be mobilized during the initial stage of extraction with $CaCO_3$ solution.

Table 3.79. Average Extractable Concentrations of Anions – Periodic Replenishment Extractions with $CaCO_3$ Solution

Sequential Contact	Fluoride	Chloride	Nitrite	Nitrate	Carbonate	Sulfate	Phosphate	Oxalate
	---------- µg/g Dry Sludge ----------							
Sample 19250 (C-202)								
1	3,430	28	485	1,300	24,400	196	4,490	27,000
2	667	12	<12	96	<6,600	35	2,040	2,300
3	556	7	<12	369	<6,600	28	1,730	1,200
4	103	6	<12	141	<6,600	20	712	93
5	18	6	<12	127	<6,600	34	117	<45
6	286	212	33	1060	<6,600	34	885	463
Sample 19887 (C-203)								
1	2,370	164	354	3,380	<34,800	<284	15,000	1,150
2	169	<164	<314	<301	<34,800	<284	8,000	<240
3	<81	<164	<314	<301	<34,800	<284	4,090	<240
4	<81	<164	<314	<301	<34,800	<284	2,500	<240
5	<81	<164	<314	<301	<34,800	<284	1,440	<240
6	<81	<164	<314	<301	<34,800	<284	2,730	<240
Sample 19961 (C-203)								
1	2,623	<221	632	5,150	<46,700	<382	21,100	1,330
2	<109	<221	<422	<405	<46,700	<382	8,730	<322
3	<109	<221	<422	<405	<46,700	<382	4,410	<322
4	<109	<221	<422	<405	<46,700	<382	1,400	<322
5	<109	<221	<422	<405	<46,700	<382	1,190	<322
6	<109	<221	<422	<405	<46,700	<382	1,940	<322

The carbonate, oxalate and phosphate results are for information only. The QC standard for these three anion analyses was not within the ±10%. Oxalate numbers were background corrected.
< Values were less than instrumental detection limit.
All values based on duplicate measurements.

3.5.2.7 Extractable ^{137}Cs and ^{90}Sr Determined from $CaCO_3$ Solution Periodic Replenishment Extractions

The extractable concentrations of ^{137}Cs in the $CaCO_3$ solution leachates for all three sludge samples were at the low microcurie per gram level (Table 3.80). In all cases, the ^{137}Cs concentrations in the extracts decreased with each stage of extraction with enhanced concentrations in the final 30-day stage extracts, except for sample 19961 (C-203) which continued to decline in concentration. For example, the initial leachate from the 19250 (C-202) sample had an extractable ^{137}Cs concentration of 0.68 µCi/g sludge which decreased to 0.14 µCi/g sludge by the fifth stage and then increased to 0.32 µCi/g sludge for the sixth leaching stage. The cumulative leachable fractions of ^{137}Cs in these sludge samples averaged 11%, 6.6%, and 5.3% of the total ^{137}Cs present in the 19250 (C-202), 19887 (C-203), and 19961 (C-203) sludge samples, respectively (Table 3.81). The sequential extractions cumulatively leached similar fractions of the total ^{137}Cs that were leached in the single 30-day $CaCO_3$ extraction process for the C-203 sludges and about 4 times the amount leached in the single contact leach of sludge C-202 (Table 3.69).

The cumulative amount leached by the DDI water extraction was similar for sample 19250 (C-202) but about twice that for the C-203 samples. The amount of ^{137}Cs leached by the $Ca(OH)_2$ extracts was several times higher than that leached by the $CaCO_3$ solution and DDI water extractants.

Table 3.80. Extractable Concentrations of ^{137}Cs and ^{90}Sr – Periodic Replenishment Extractions with $CaCO_3$ Solution

Sequential Contact	Duration (Days)	^{137}Cs		^{90}Sr	
		µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
Sample 19250 (C-202)					
1	1	0.68	7.82E-03	21.3	0.152
2	1	0.135	1.55E-03	NM	NM
3	3	0.214	2.46E-03	15.4	0.11
4	1	0.088	1.01E-03	NM	NM
5	1	0.14	1.61E-03	NM	NM
6	30	0.323	3.71E-03	24.8	0.177
Sample 19887 (C-203)					
1	1	0.314	3.61E-03	1.03E+01	7.36E-02
2	1	0.261	3.00E-03	NM	NM
3	3	0.139	1.60E-03	5.39E+00	3.85E-02
4	1	0.059	6.72E-04	NM	NM
5	1	0.0597	6.87E-04	NM	NM
6	30	0.444	5.10E-03	1.36E+01	9.72E-02
Sample 19961 (C-203)					
1	1	0.668	7.67E-03	1.68E+01	1.20E-01
2	1	0.209	2.40E-03	NM	NM
3	3	0.129	1.49E-03	5.88E+00	4.20E-02
4	1	0.0373	4.29E-04	NM	NM
5	1	0.0736	8.47E-04	NM	NM
6	30	0.0263	3.03E-04	9.59E+00	6.85E-02
All concentrations are corrected for the dry sludge basis. NM = Not measured. Values based on duplicate measurements.					

Table 3.81. Cumulative Percentages of ^{137}Cs and ^{90}Sr Leached by $CaCO_3$ Solution

Sample Number	^{137}Cs	^{90}Sr
	--------% $CaCO_3$ Leachable-----	
19250 (C-202) Avg	11	8.1
19887 (C-203) Avg	6.6	8.67
19961 (C-203) Avg	5.3	9.56
All concentrations are corrected for the dry sludge basis. Total sludge concentrations from acid digested samples.		

The extractable ^{90}Sr concentrations determined from the first, third and sixth stages of the sequential $CaCO_3$ extractions are listed in Table 3.80. For each sludge leachate, the concentrations decrease between the first and third extractions and then increase for the 30-day (sixth) extraction. The leachable concentrations measured for the three extractions represent 8.1% of the total ^{90}Sr in sludge 19250 (C-202), 8.67% of the sample 19887 (C-203) total, and 9.56% of the total ^{90}Sr in 19961 (C-203). These results indicate that ^{90}Sr is not highly leachable from these sludges by a $CaCO_3$ saturated solution; however, the leachability appears to increase with contact time. The cumulative leachable percentages of ^{90}Sr were similar to the amounts leached in the single 30-day $CaCO_3$ extraction process for the C-203 sludges and was about 5 times greater than the single contact extraction for the C-202 sludge (Table 3.69). The cumulative amount of ^{90}Sr leached by the $CaCO_3$ extractant was similar to the cumulative amount leached by the DDI water extraction for sample 19250 (C-202) and the $Ca(OH)_2$ solution for the C-203 samples.

3.5.2.8 Extractable Actinide Concentrations Determined from $CaCO_3$ Solution Periodic Replenishment Extractions

The $CaCO_3$ leachate concentrations of sequentially leachable actinides are listed in Table 3.82. Extractable concentrations of ^{237}Np were measurable at all stages for sample 19250 (C-202) and estimated for the first and second stages for the C-203 sludge samples. The total extractable percentage of ^{237}Np in the C-202 sample is 8.5% and is less than 1% for the C-203 samples (Table 3.83).

Table 3.82. Extractable Actinide Determined for Periodic Replenishment $CaCO_3$ Extractions

Sequential Contact	^{237}Np		^{239}Pu		^{241}Am	
	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge	µCi/g Sludge	µg/g Sludge
Sample 19250 (C-202)						
1	4.37E-05	6.16E-02	2.30E-01	3.71E+00	<1.13E-02	<3.31E-03
2	1.09E-05	1.53E-02	3.22E-02	5.19E-01	<1.20E-02	<3.53E-03
3	1.88E-05	2.65E-02	1.66E-01	2.68E+00	<9.03E-03	<2.66E-03
4	9.68E-06	1.36E-02	4.78E-02	7.71E-01	<1.54E-03	<4.52E-04
5	1.25E-05	1.76E-02	5.61E-03	9.04E-02	<2.23E-02	<6.56E-03
6	3.41E-05	4.80E-02	3.73E-01	6.02E+00	<2.79E-02	<8.20E-03
Sample 19887 (C-203)						
1	(1.08E-05)	(1.53E-02)	6.89E-02	1.11E+00	<1.18E+01	<3.48E+00
2	(3.15E-05)	(4.44E-02)	4.89E-02	7.89E-01	<1.18E+01	<3.48E+00
3	<2.99E-05	<4.21E-02	(1.95E-02)	(3.15E-01)	<1.18E+01	<3.48E+00
4	<4.94E-05	<6.95E-02	(8.11E-03)	(1.31E-01)	<1.18E+01	<3.48E+00
5	<4.94E-05	<6.95E-02	(5.16E-03)	(8.33E-02)	<1.18E+01	<3.48E+00
6a	(1.73E-05)	(2.44E-02)	7.44E-02	1.20E+00	<1.18E+01	<3.48E+00
Sample 19961 (C-203)						
1	(1.99E-05)	(2.80E-02)	2.24E-01	3.61E+00	<1.59E+01	<4.67E+00
2	(3.72E-05)	(5.24E-02)	4.18E-02	6.75E-01	<1.59E+01	<4.67E+00
3	<6.64E-05	<9.35E-02	(2.31E-02)	(3.73E-01)	<1.59E+01	<4.67E+00
4	<6.64E-05	<9.35E-02	(5.51E-03)	(8.89E-02)	<1.59E+01	<4.67E+00
5	<6.64E-05	<9.35E-02	(5.59E-03)	(9.01E-02)	<1.59E+01	<4.67E+00
6a	<6.64E-05	<9.35E-02	4.62E-02	7.45E-01	<1.59E+01	<4.67E+00

Table 3.83. Extractable Percentages for Actinides Determined from Periodic Replenishment $CaCO_3$ Extractions

Sequential Contact	^{237}Np	^{239}Pu	^{241}Am
% $CaCO_3$ Extractable			
Sample 19250 (C-202)			
1	2.9	0.9	< EQL
2	0.7	0.1	< EQL
3	1.2	0.6	< EQL
4	0.6	0.2	< EQL
5	0.8	0.02	< EQL
6	2.3	1.4	< EQL
Sample 19887 (C-203)			
1	(0.05)	2.1	< EQL
2	(0.13)	1.53	< EQL
3	< EQL	(0.61)	< EQL
4	< EQL	(0.25)	< EQL
5	< EQL	(0.16)	< EQL
6	(0.07)	2.3	< EQL
Sample 19961 (C-203)			
1	(0.08)	7.0	< EQL
2	(0.16)	1.3	< EQL
3	< EQL	(0.72)	< EQL
4	< EQL	(0.17)	< EQL
5	< EQL	(0.17)	< EQL
6	< EQL	1.4	< EQL
EQL = Estimated quantitation limit.			

^{239}Pu was measured in all leachates for samples 19250 (C-202) and samples 19887 and 19961 for C-203, although some of the values are estimated. The cumulative percentages of extractable ^{239}Pu for the 3 sludge samples are 3.2% (19250, C-202), 6.95% (19887, C-203), and 10.8% (19921, C-203) (Table 3.83).

The ^{241}Am concentrations in all the sequential extractions were below the instrument detection limit.

3.6 XRD Results

The as-measured and background-subtracted XRD patterns measured for the characterized samples of C-202 and C-203 post-retrieval residual waste are shown in Appendices A and B, respectively. Each pattern in this section and Appendices A and B is shown as a function of degrees 2θ based on $Cu_{K\alpha}$ radiation (λ=1.5406 Å). The vertical axis in each pattern represents the intensity or relative intensity of the XRD peaks. The XRD patterns show, for comparison purposes, one or more schematic database (PDF) patterns considered for phase identification. The height of each line in the schematic PDF patterns represents the relative intensity of an XRD peak (i.e., the most intense [the highest] peak has a relative intensity [I/I_o] of 100%). Quantitative analyses of the relative masses of individual phases present in each solid sample were not estimated using these XRD patterns due to the factors discussed at the end of Section 2.3. A crystalline phase typically must be present at greater than 5 wt% of the total sample mass (greater than 1 wt% under optimum conditions) to be readily detected by XRD. Phase identification was based on a comparison of the peak reflections and intensities observed in each pattern to the mineral PDF™ published by the JCPDS ICDD. Phase identification from the XRD patterns was done in an iterative fashion by considering phases with particle compositions that were determined by SEM/EDS (see Section 3.7) as present in the unleached and leached residual sludge.

3.6.1 C-202 Post-Retrieval Residual Waste

Samples of unleached, 1-month single-contact leached DDI water extraction, 1-month single-contact $Ca(OH)_2$ leached, and 1-month single-contact $CaCO_3$ leached post-retrieval residual waste from tank C-202 were characterized by bulk XRD. Figure 3.1 shows the as-measured and background-subtracted XRD patterns for a sample of unleached C-202 post-retrieval residual sludge. The XRD results indicate that these samples contain mostly amorphous (non-crystalline) solids. All of the as-measured XRD patterns (e.g., see Figure 3.1) contained a broad diffraction profile (or hump) from approximately 10 to 30°2θ. This feature is indicative of diffraction from amorphous materials, which cannot be identified by XRD methods. Diffraction from the nitrocellulose binder contributed to this broad profile.

The XRD patterns for the other three C-202 residual waste samples (Appendix A) are similar to those shown in Figure 3.1. Except for the possible presence of quartz (SiO_2) in the sample of unleached residual waste (Figure 3.1), no crystalline phases other than corundum (used as a 2θ internal standard) were identified in the samples of unleached, 1-month single-contact leached DDI water extraction, 1-month single-contact $Ca(OH)_2$ leached, and 1-month single-contact $CaCO_3$ leached C-202 post-retrieval residual waste. Only one unidentified reflection was found in the XRD patterns for C-202 residual sludge. This was a low angle reflection at 15.02 °2θ (5.89 Å) noted in the XRD pattern for the 1-month single-contact $Ca(OH)_2$ leached sample. Otherwise, there were no major unassigned reflections in the XRD patterns for the C-202 post-retrieval residual waste samples, which suggests that these samples did not likely contain any major crystalline phases present at more than ~5-10 wt% of the sample mass.

Quartz was also identified in the 2-week DDI water-leached C-204 sludge (Deutsch et al. 2004; Krupka et al. 2006). Based on published tank chemistry and characterization information, quartz is not expected to be a component in these wastes. Because quartz is one of the principal minerals in Hanford sediments, its presence in the C-202 and C-204 samples likely resulted from blowing dust or sediment that fell into the tank during sampling or other tank operation activities.

3.6.2 C-203 Post-Retrieval Residual Sludge

Bulk XRD techniques were used to identify crystalline phases present in the following samples of C-202 post-retrieval residual sludge:

- Unleached brown, yellow, and orange solids separated from sample 19887
- Unleached brown, yellow, and orange solids separated from sample 19961
- One-month single-contact leached water extraction of solids from sample 19961
- Sequential leached water extraction of solids from sample 19961

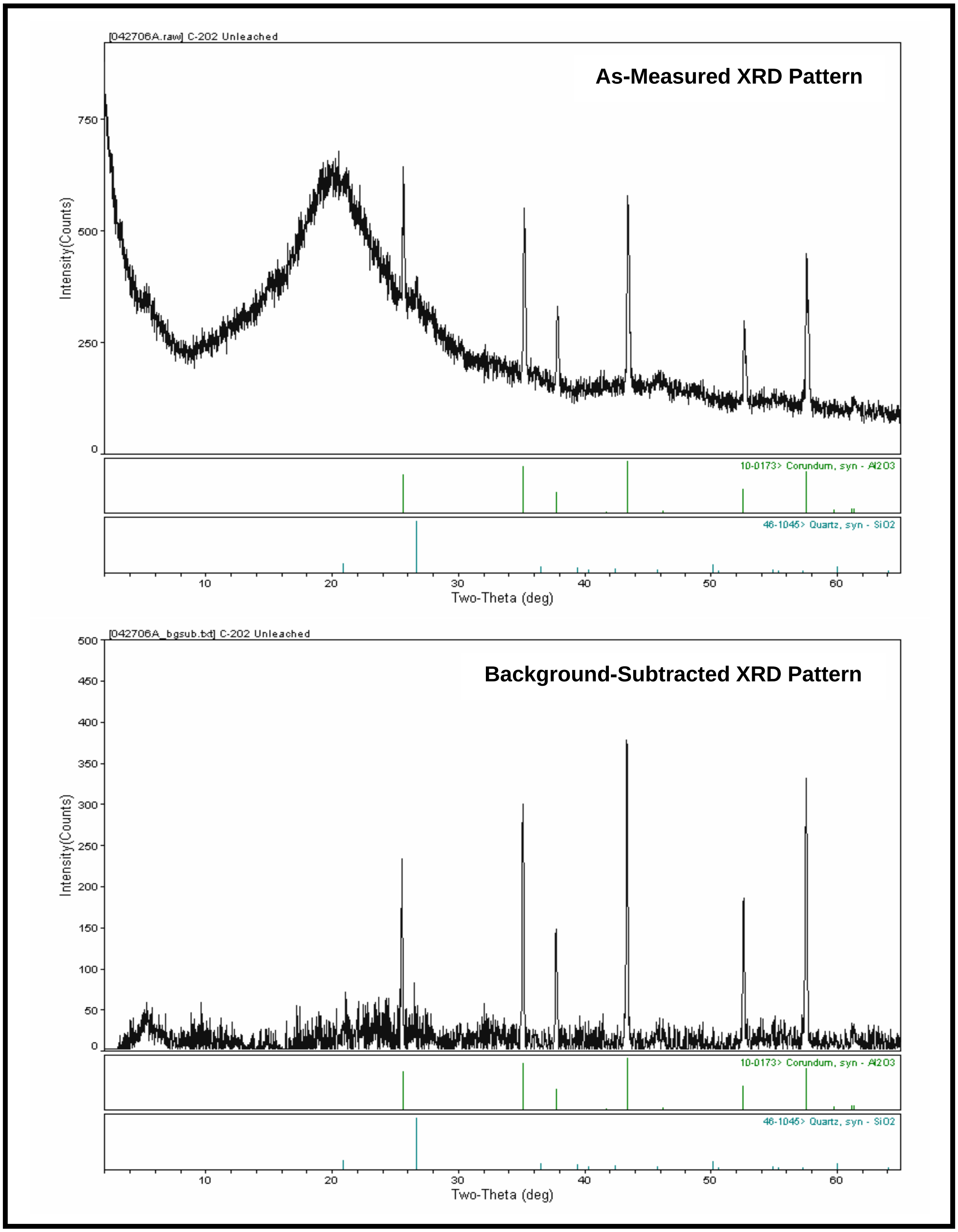


Figure 3.1. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns (based on $Cu_{K\alpha}$ radiation, λ=1.5406 Å) for the Sample of Unleached C-202 Post-Retrieval Residual Sludge

- One-month $Ca(OH)_2$-leached solids from sample 19961
- Sequential $Ca(OH)_2$-leached solids from sample 19961
- One-month $CaCO_3$-leached solids from sample 19961
- Sequential $CaCO_3$-leached solids from sample 19961

Figure 3.2 shows a set of typical as-measured and background-subtracted XRD patterns measured for these six subsamples of C-203 residual sludge. Figure 3.2 contains the XRD patterns for dominantly brown material from sample 19887 of C-203 post-retrieval residual and the schematic database pattern for corundum (PDF #10-0173). Analysis of the XRD patterns for these C-203 samples indicates that these solids consisted of essentially all (~90% or more) amorphous (non-crystalline) material. This conclusion is based on the broad peak positioned between 10 and 30°2θ with symmetry characteristic of XRD amorphous material, and the lack of any reflections that could not be attributed to the corundum (α-Al_2O_3) added to each XRD mount as an internal 2θ standard, the Kapton® polyimide film used in the sample holder, or the nitrocellulose binder. A few of the XRD patterns contained a peak near at 3.0 °2θ. This peak was attributed to an instrument electronic spike, because when the corresponding sample was rerun, the spike was missing from the second diffraction pattern. A few of the XRD patterns did not produce any reflections for the internal standard, corundum. This was likely due to an insufficient amount of corundum being added in the sample mount.

3.6.3 Comparison of XRD Results for C-202 and C-203 Post-Retrieval Residual Sludge to Those for C-203 and C-204 Pre-Retrieval Waste

The XRD results for C-202 and C-203 post-retrieval residual sludges are generally consistent with those for the water-leached pre-retrieval wastes from tanks C-203 and C-204. Like the C-202 and C-203 residual sludges (see Figure 3.1 and Figure 3.2), the C-203 and C-204 water-leached pre-retrieval wastes contained mostly amorphous solids, and no significant quantities of any crystalline phases were detected in their bulk XRD patterns. The C-203 and C-204 water-leached pre-retrieval wastes may contain a small quantity of poorly crystalline clarkeite {ideal end-member formula $Na[(UO_2)O(OH)](H_2O)_{0-1}$} based on the small broad reflections observed at approximately 15, 27, 33, 46, and 49°2θ in the background-subtracted patterns (Deutsch et al. 2004; Krupka et al. 2006). These five reflections correspond to the major reflections for clarkeite (PDF #50-1586). These five small broad reflections however were not detected in the XRD patterns for unleached and leached C-202 and C-203 post-retrieval residual sludges.

Čejkaite [$Na_4(UO_2)(CO_3)_3$] was the primary crystalline phase identified by bulk XRD in the unleached C-203 and C-204 pre-retrieval sludge and the yellow nugget material discovered embedded in the bulk unleached C-203 pre-retrieval sludge sample from sample 19649 (Deutsch et al. 2004; Krupka et al. 2006). The XRD pattern for the unleached yellow nugget material was also consistent with the possible presence of nitratine (soda niter, NaNO3) (PDF #36 1474) at a concentration that was estimated from relative peak heights to be significantly less than 25% of the čejkaite concentration (Deutsch et al. 2004; Krupka et al. 2006). The pre-retrieval yellow nugget material also contained a significant mass of non-crystalline component(s) based on the broad XRD peak observed in the as-measured pattern between 10 and 30º2θ. Neither čejkaite nor nitratine (both highly soluble phases) were identified in the XRD patterns for C-202 and C-203 post-retrieval residual sludges.

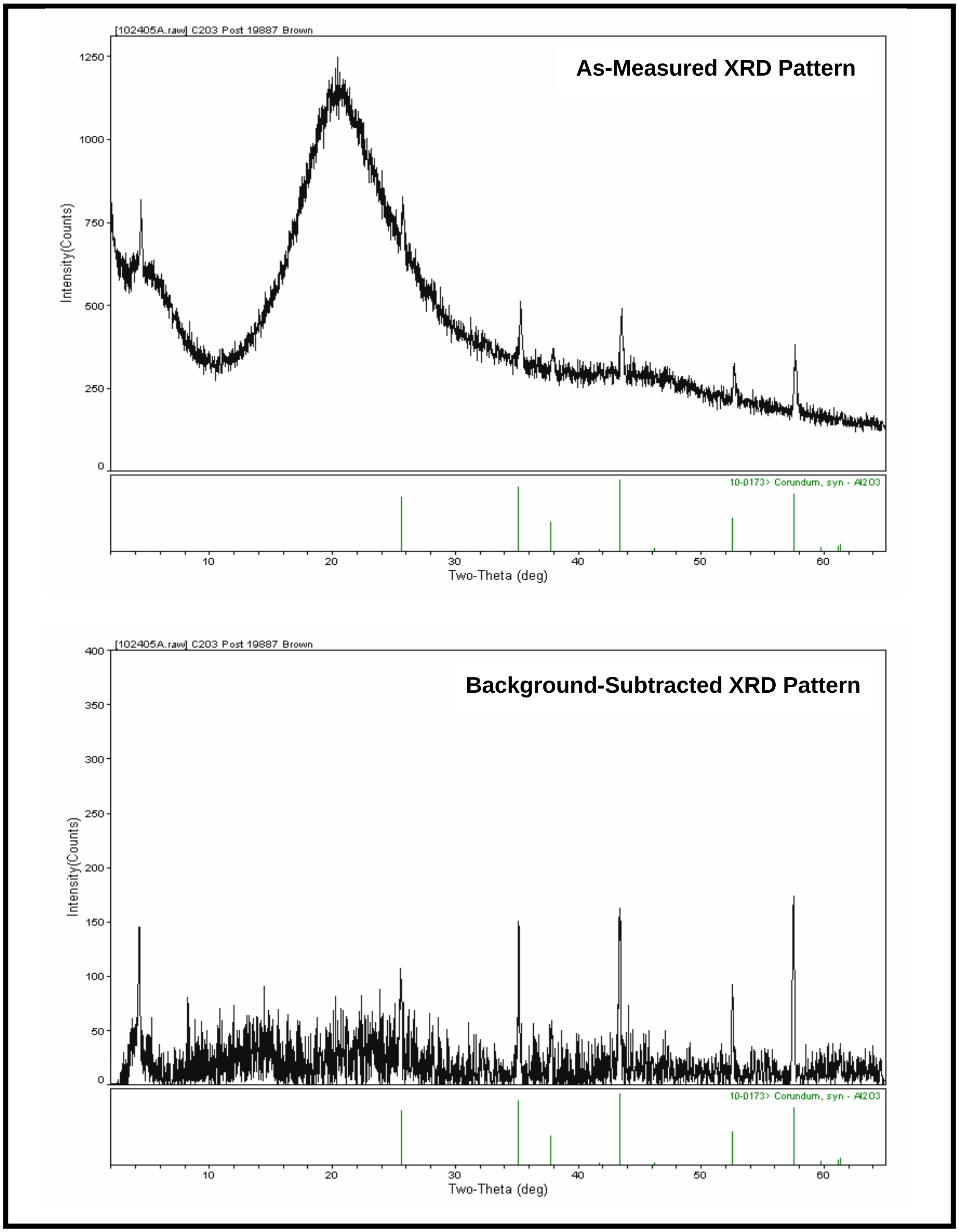


Figure 3.2. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns (based on $Cu_{K\alpha}$ radiation, λ=1.5406 Å) for the Sample of Unleached "Brown" C-203 Post-Retrieval Residual Sludge

Analyses by synchrotron-based μXRD indicated the possible presence of goethite [α-FeO(OH)], maghemite (γ-Fe_2O_3), and the Na uranates clarkeite and/or Na_2U2O_7 in DDI water-leached pre-retrieval waste from tank C-203 (Deutsch et al. 2005). A synchrotron focused x-ray beam was used to collect transmission μXRD patterns on several ~5-μm diameter areas of relatively large (approximately 20 to 100 μm) U- and Fe-rich particles identified by microscanning x-ray fluorescence (μSXRF) in the sample of C-203 pre-retrieval waste. Although Deutsch et al. (2004) did not identify goethite or maghemite in their bulk XRD analyses of this same C-203 pre-retrieval sludge, they did determine the presence of Fe oxides by SEM/EDS. Similarly, the bulk XRD analyses of the post-retrieval (residual) sludge from tanks C-202 and C-203 did not indicate the presence of any crystalline Fe oxide phases. However, Fe-oxide particles often containing trace amounts of Mn, Cr, and sometimes Pb were discovered by SEM/EDS in the C-202 and C-203 post-retrieval (residual) sludges.

3.7 SEM/EDS Results

This section discusses the results of the SEM/EDS analyses for residual waste solids from tanks C-202 and C-203. Unless otherwise noted, the SEM micrographs and EDS information included in this section were selected because they show typical morphologies, sizes, surface textures, and compositions of particles in the mounts of residual sludge from the two tanks. All of the SEM micrographs and EDS analyses collected for the post-retrieval samples from tanks C-202 and C-203 are shown in the appendices listed in Table 3.84. Each appendix contains a series of micrographs of particles imaged by the SEM, EDS spectra and accompanying SEM images showing the locations on particles where the EDS analyses were made, and tables that summarize the elemental compositions (in atomic percent, at.%) derived from EDS analyses of areas of the individual particles.

Table 3.84. List of Appendices Containing the SEM Micrographs and EDS Analyses for the Unleached and Leached C-202 and C-203 Residual Sludge Samples

Tank	Type of Residual Waste Sample	Appendix
Sample 19250 (C-202)	Unleached	C
	1-month single-contact DDI water extraction leached solids	D
	1-month single-contact $Ca(OH)_2$ leached solids	
	1-month single-contact $CaCO_3$ leached solids	
Sample 19887 (C-203)	Unleached – Mounts #1 (yellow solids), #3 (brown solids), and #5 (orange solids)	E
	1-month single-contact DDI water extraction leached solids	F
	Sequential DDI water extraction leached solids	
Sample 19961 (C-203)	Unleached – Mounts #8 (yellow solids), #10 (brown solids), and #11 (orange solids)	G
	1-month single-contact DDI water extraction leached solids	H
	Sequential DDI water extraction leached solids	
	1-month single-contact $Ca(OH)_2$ leached solids	
	Sequential $Ca(OH)_2$ leached solids	
	1-month single-contact $CaCO_3$ leached solids	
	Sequential $CaCO_3$ leached solids	

Readers are cautioned that elemental compositions determined by EDS are qualitative and have large uncertainties resulting from alignment artifacts caused by the variable sample and detector configurations that exist when different particles are imaged by SEM. Moreover, examination of the calculated elemental compositions based on the EDS analyses reported in Appendices C through H suggests that the EDS-determined concentrations of C and possibly O, which are the two lightest elements detected in these waste solids by EDS, are too large. This conclusion is based on comparison of the reported C and O concentrations to the expected C/O molar ratio if C was present in solid phase as carbonate (CO_3) and to the TOC concentrations measured in this study for the bulk unleached residual sludge. Although we believe that U-containing solids in these waste samples likely contain carbonate, the high C concentrations were likely affected by a measurement artifact and do not represent the total C content of these samples, but the reason is not known. There is no indication that this is due to excitation of x-rays from the C coating deposited on the samples or from the double-sided C tape that holds the sample particles to the Al specimen holders. Because of the qualitative nature of the EDS analyses and suspect C concentrations determined by EDS, molar ratios are therefore expected to provide a better way to interpret the EDS results than using the mass concentrations of individual elements. For this reason, the calculated EDS compositions in this report are listed in atomic percent, instead of weight percent, so that molar ratios could be used to make conclusions regarding the compositions of solids in the unleached and leached residual waste samples.

The micrographs presented in this section are typically reproduced at reduced size to conserve page space. To get a more detailed view of these micrographs, the reader is referred to Appendices C through H, where the micrographs are shown at a larger size. The name of each digital image file, sample identification number, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph (excluding those showing the locations of EDS analyses) in this report. Micrographs labeled BSE near the digital image file name indicate that the micrograph was collected with BSE imaging. In the appendices, particles outlined by squares or marked by arrows in a micrograph designate sample material that was imaged at higher magnification and is typically shown in the next figure of the series for that sample.

3.7.1 C-202 Residual Sludge

Figure 3.3 shows BSE SEM micrographs taken at low magnification of typical material present in the sample mounts of unleached and leached C-202 residual sludge. All of the analyzed samples contain a combination of individual and aggregate particles from several hundred to less than a micrometer in size. There were no apparent differences between the SEM/EDS results for the yellow, brown, and orange solids separated from the unleached C-202 residual sludge. The particles were nondescript and appeared to be amorphous due to a general absence of crystal faces. Because XRD analyses did not indicate the presence of any crystalline phases in these samples, it is assumed that the amorphous-looking particles are likely non-crystalline. However, without further studies at higher magnification at the submicrometer scale, such as with transmission electron microscopy (TEM), the non-crystallinity of these particles cannot be verified. The SEM samples of unleached C-202 residual waste also appear similar to the unleached C-203 post retrieval residual waste (see Section 3.7.2).

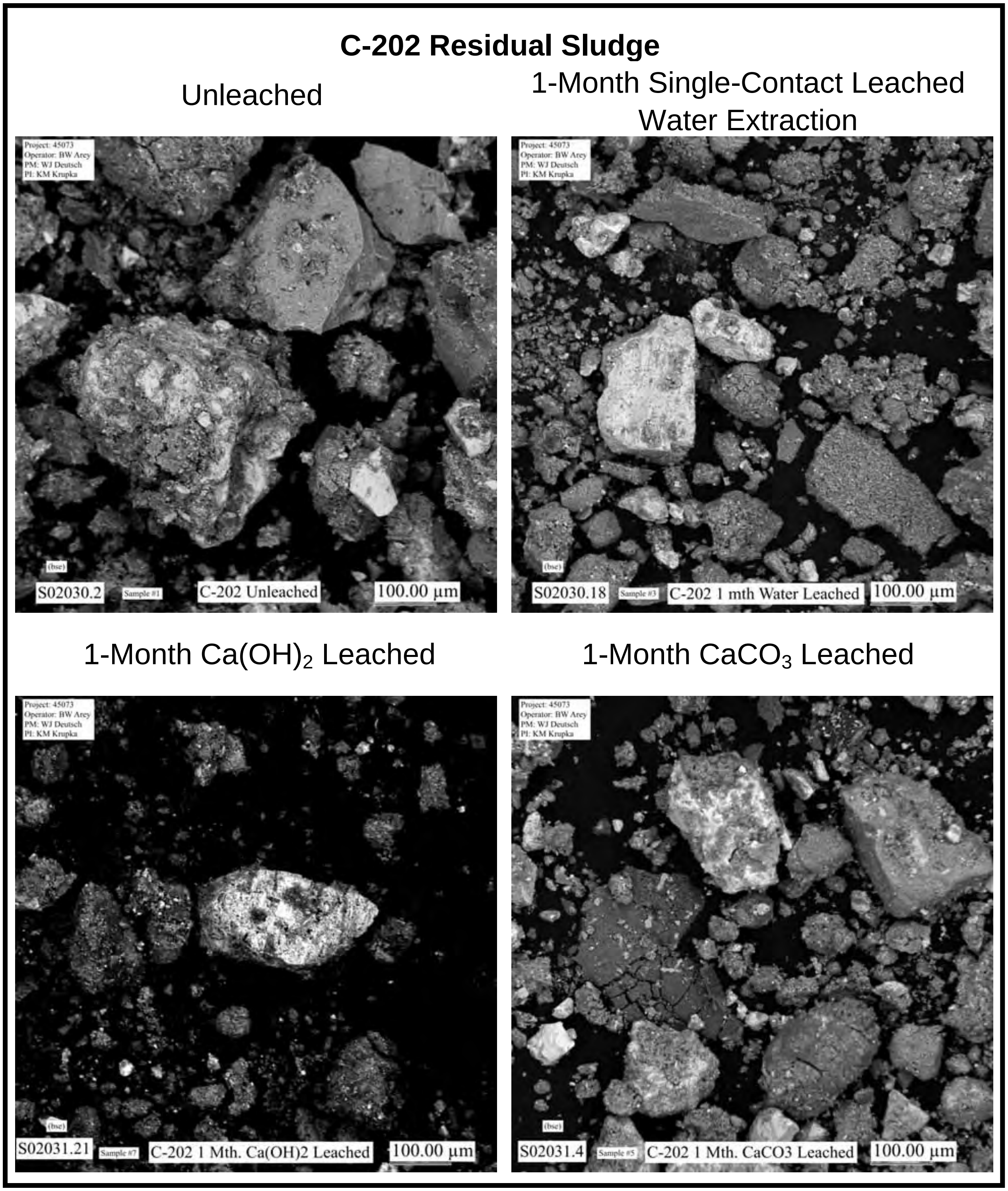


Figure 3.3. Backscattered Electron (BSE) SEM Micrographs for Unleached, 1-Month Single-Contact DDI Water Extraction Leached, 1-Month Single-Contact $Ca(OH)_2$ Leached, and 1-Month Single-Contact $CaCO_3$ Leached Residual Sludge from Tank C-202

The C-202 residual sludge consists of particles generally having one of two common compositions. One composition consists of U, Na, C, O, P, and possibly H (H is not detectable by EDS). These are the bright white particles in Figure 3.3. The other composition is an Fe oxide that often contains trace amounts of Mn, Cr, and sometimes Pb. Particles and aggregates that are gray in Figure 3.3 consist in total or part of this Fe oxide solid (typically, the darker the gray – the greater the Fe oxide content of the aggregate). Because the material in the unleached and leached residual sludge samples contain mostly particle aggregates or individual grains with fine particles adhered to their surface, most EDS analyses indicate the presence of both U and Fe in most particles analyzed by EDS. Figure 3.4 shows typical EDS spectra for particles present in the SEM sample from the 1-month single-contact DDI water extraction leach. The two general compositions of particles present in the C-202 residual sludge are essentially the same as those determined for the unleached and leached C-203 samples discussed in the following section; however, the C-202 residual sludge (after leaching in DDI) appears to contain more Fe oxide particles relative to the U-containing phase than the unleached samples of C-203 residual waste.

Figure 3.5 contains ternary plots for the normalized concentrations (at %) of U, Na, and Fe (i.e., EDS-determined concentrations [at.%] of U, Na, and Fe normalized to a total of 100%) for all C-202 particles (U-Na-C-O-P±H and Fe-O) analyzed by EDS. The compositions used to calculate the ternary plots for unleached and leached samples of C-202 residual waste in Figure 3.5 are listed in Appendices C and D, respectively. The ternary plots do not indicate any clustering of any specific particle compositions within this U-Na-Fe composition range. The U-Na-C-O-P±H and Fe-O phases are believed to have narrow ranges of specific compositions, and the scatter in EDS compositions in Figure 3.5 is believed to be due to the aggregate nature of these solids that resulted in most EDS analyses being composite analyses of both U-Na-C-O-P±H and Fe-O phases. For those analyses of unleached C-202 residual sludge that best reflect the compositions of just the U-Na-C-O-P±H particles (i.e., the normalized at.% values containing little or no Fe [shaded area where <10 normalized at.% Fe] in the left ternary plot in Figure 3.5), the Na/U ratios range approximately from 2:1 to 1:1. For the U-Na-C-O-P±H particles in the leached C-202 residual waste with little or no Fe (shaded area in right ternary plot in Figure 3.5), the Na/U ratios appear to be less than the unleached samples and typically range approximately from 1.5:1 to 0.4:1 with some Na/U ratios as low as 0.1:1. The reader is cautioned to use these ratios only to evaluate possible trends in the compositions of the different unleached and leached waste samples. These ratios must not be compared to those of known phases, because the plotted values are dependent on the elements selected to normalize the atomic percent values to 100%. The results in Figure 3.5 suggest that Na concentrations of the U-Na-C-O-P±H phase decreased as a result of the DDI water extraction, $Ca(OH)_2$, and $CaCO_3$ leaching. If so, these results imply the following:

- The leach product possibly may contain a mixture of the original U-Na-C-O-P±H phase and a new Na-poor or Na–absent U phase where its solubility was exceeded and then precipitated during the course of the leach study.
- The U-Na-C-O-P±H phase may be dissolving incongruently,
- The waste solids may contain a readily soluble Na phase that contains no U.
- The U-Na-C-O-P±H phase may consist of two or more U phases having similar compositions.

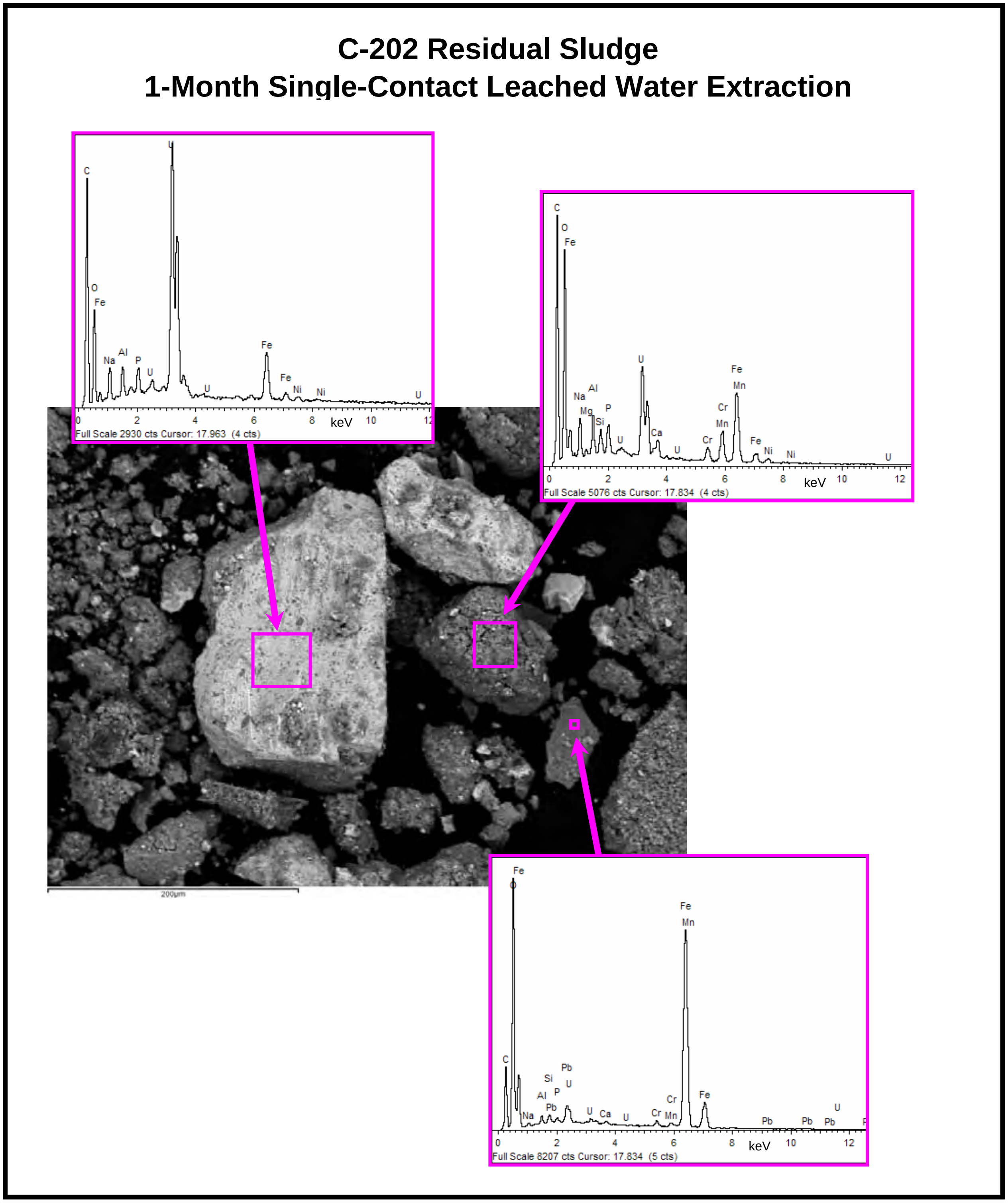


Figure 3.4. Backscattered Electron (BSE) Micrograph and Typical EDS Spectra for Particles Present in the Residual Waste SEM Sample from the 1-Month Single-Contact Leached DDI Water Extraction

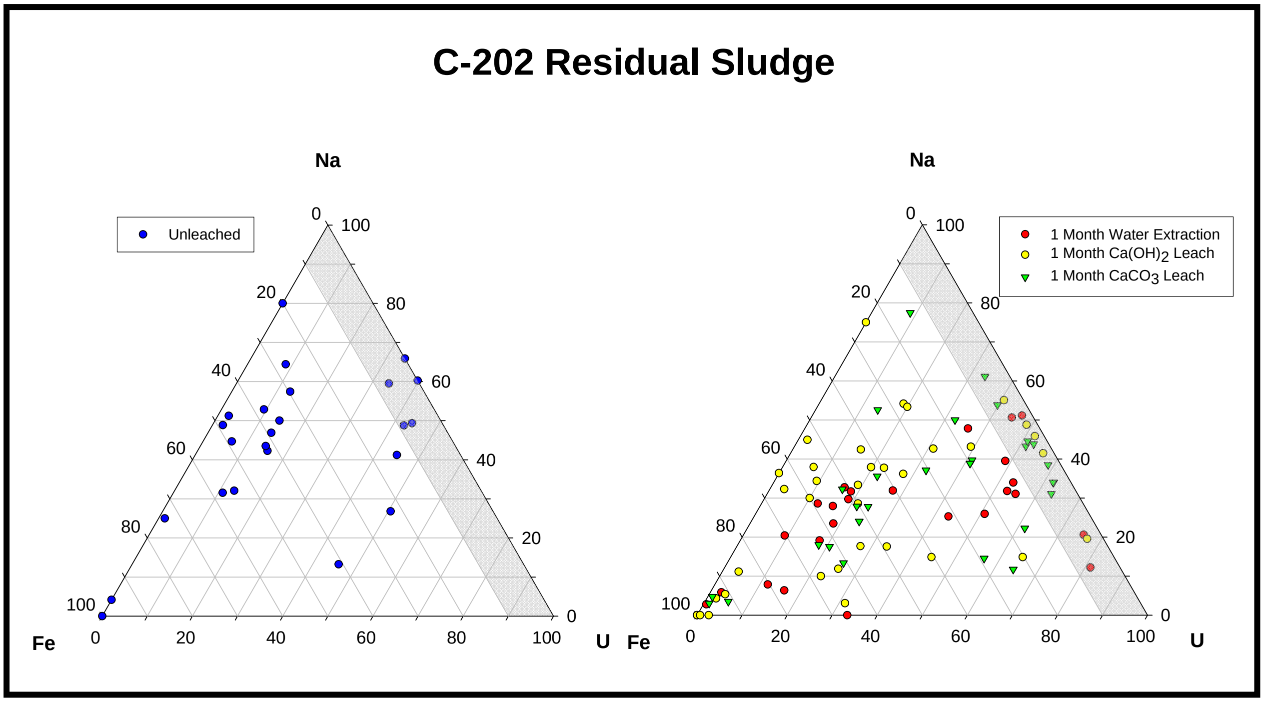


Figure 3.5. Ternary Plots of the EDS-Determined U-Na-Fe Concentrations (at.%) Normalized to 100% for Unleached (left diagram) and Leached (right diagram) Samples of C-202 Residual Waste

The SEM results do not provide any morphological evidence for the precipitation of a new Na-poor U phase. If such a phase exists in small quantity as a coating and/or submicrometer-sized intergranular phase, it would be difficult to discern by SEM and EDS. It is also not possible to use the SEM results to confirm or dispel the possibility that the U-Na-C-O-P±H phase is dissolving incongruently.

The observed decrease in Na concentrations in the residual leached solids could also have resulted from the dissolution of a readily soluble Na phase that contains no U, such as nitratine (soda niter, $NaNO_3$) which was found in the unleached (as-received) C-203 and C-204 pre-retrieval wastes (Deutsch et al. 2004; Krupka et al. 2006). However, there was no evidence from the SEM, EDS, or XRD analyses of such material being present in detectable quantity in post-retrieval sludge from C-202 or C-203. Compared to the BSE images for the U-Na-C-O-P±H particles, any particles and intergranular cement composed of nitratine would have appeared darker in BSE micrographs due to the absence of U. Also, N was not detected in any of the EDS spectra for any of the analyzed particles from the post retrieval sludges.

Some of the SEM micrographs however suggest that the C-202 residual sludge may contain more than one U-containing phase. For example, Figure 3.6 shows a pitted, porous-looking solid (micrograph A) and a large dense-looking particle (micrograph B) both with a U-Na-C-O-P±H composition but different from the standpoint of surface morphology. There are numerous examples of these two solid forms in the micrographs in the appendices for the C-202 unleached and leached samples, and for the C-203 unleached and leached residual waste as will be discussed in the next section. For some conglomerate particles, this porous U-containing solid appears as a coating or an intergrowth with Fe

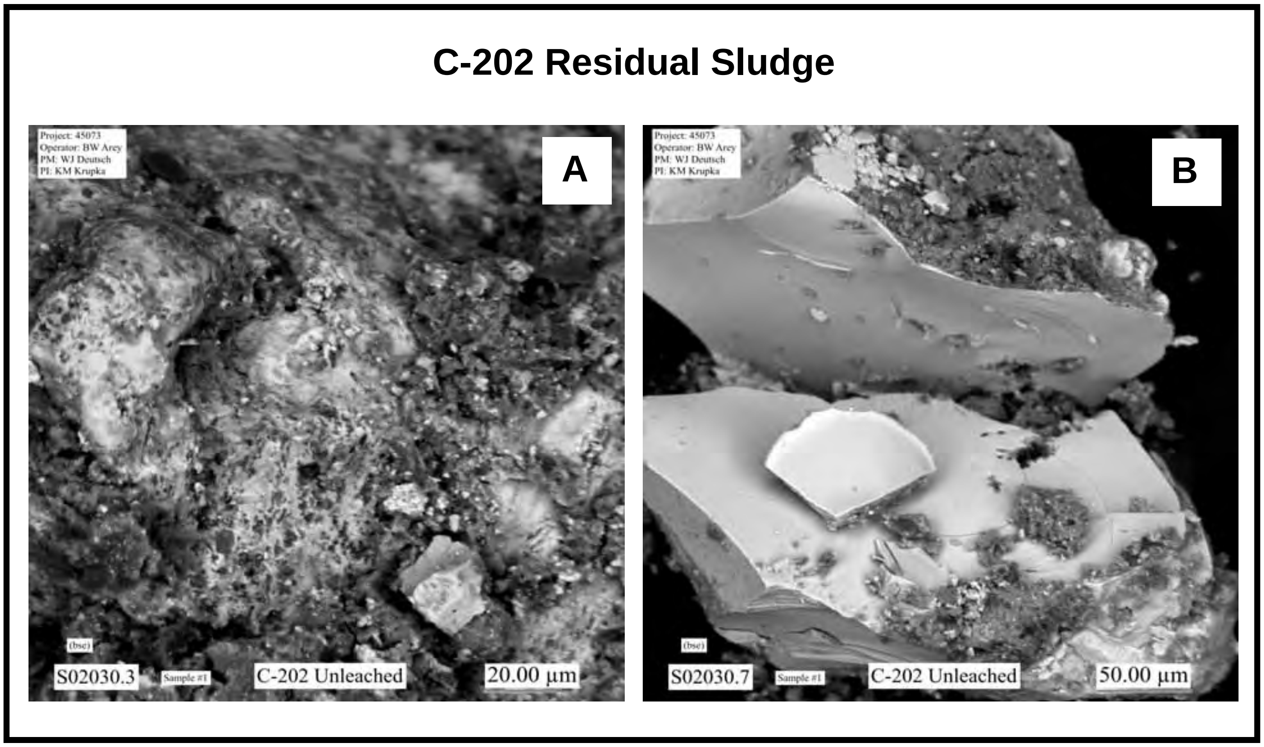


Figure 3.6. Backscattered Electron (BSE) Micrographs Showing the Possible Presence of Two Types of U-Containing Solids – a Pitted or Porous Looking Aggregate (micrograph A) and a Large Dense-Looking Solid (micrograph B) in C-202 Unleached Residual Sludge

oxide (Figure 3.7). If the Fe oxides contain any contaminants of concern, such as Cr or Tc, the release of such contaminants will be delayed until the U-Na-C-O-P±H solid has sufficiently dissolved and the Fe oxide is exposed to infiltrating pore fluid.

The EDS analyses of the leached C-202 residual waste samples also indicate that the Ca content of the U-containing phase present at the end of the $Ca(OH)_2$ and $CaCO_3$ leaches increased relative to that of the unleached and DDI water leached samples. Figure 3.8 contains a ternary plot of the normalized concentrations (at.%) of U, Na, and Ca (i.e., EDS-determined concentrations [at.%] of U, Na, and Fe normalized to a total of 100%) for particles analyzed by EDS. Note that the same colors were used for symbols for the different types of C-202 samples as plotted in Figure 3.5 and Figure 3.8. Figure 3.8 shows that Ca content of the $Ca(OH)_2$ and $CaCO_3$ leached solids has increased with respect to the Na concentrations. This effect is greatest in the $Ca(OH)_2$ leached solids. It is not possible from these SEM/EDS results to ascertain the mechanism, such as a Na/Ca exchange reaction, responsible for this shift in compositions.

The SEM/EDS analyses did not indicate the presence of Tc or I in any of particles present in the unleached or leached samples of residual sludge from tank C-202. Their detection was restricted by their low concentrations in the residual waste samples and their high minimum detection limits by EDS.

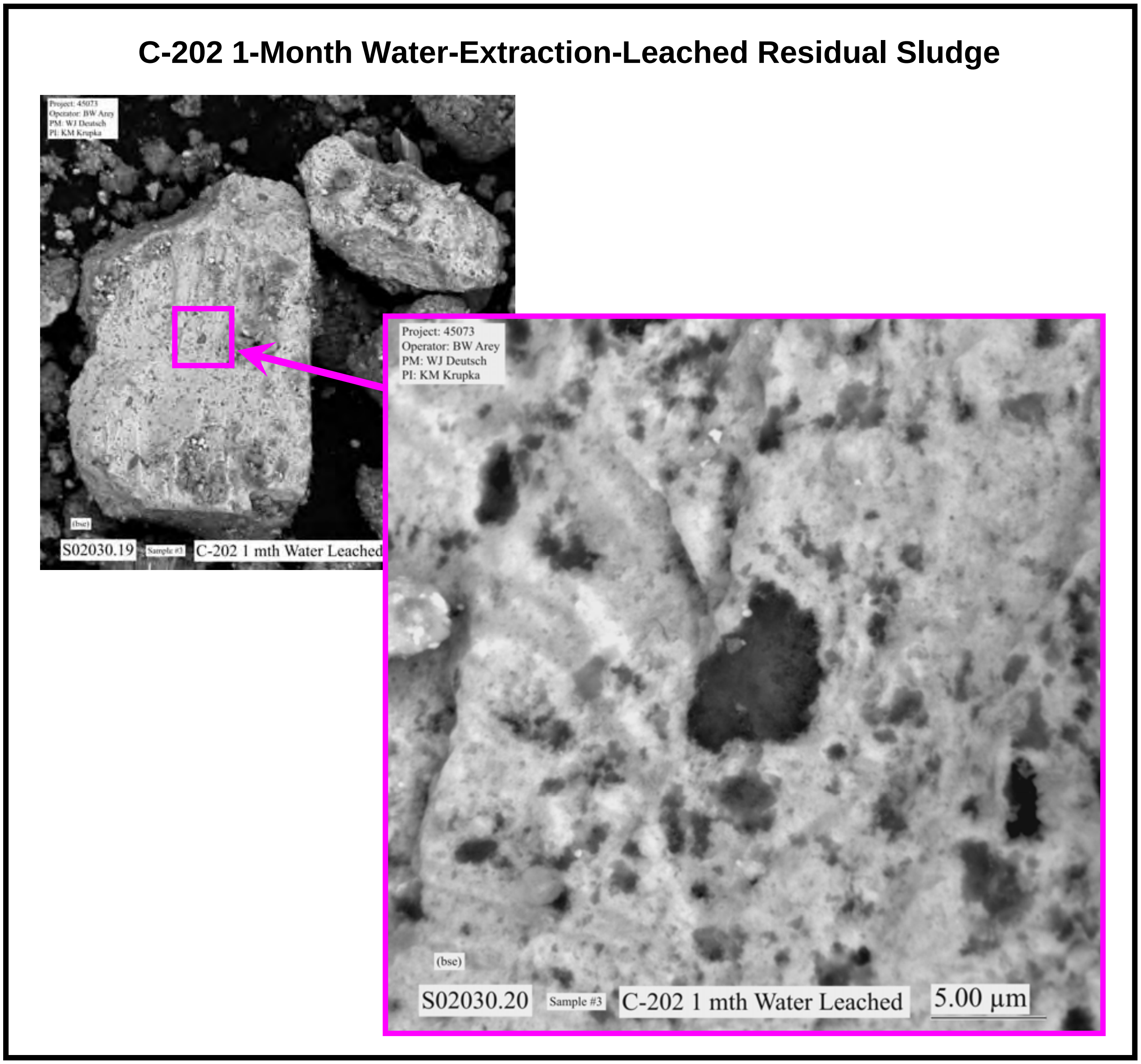


Figure 3.7. Backscattered Electron (BSE) Micrographs Showing Porous U-Containing Solid as a Coating and Intergrowth with Fe Oxide in 1-Month Single-Contact DDI Water Extraction Leached Solid from C-202 Residual Sludge

3.7.2 C-203 Residual Sludge

Figure 3.9 shows BSE SEM micrographs at low magnifications of unleached (micrographs on left side) and sequential-leached DDI water extraction (micrographs on right side) samples of C-203 residual waste from sample 19887. The SEM images and EDS results for the unleached and DDI water extraction samples from sample 19961 (sludge also from post-leached C-203) are similar to those obtained for samples from sample 19887. There were no apparent differences between the SEM/EDS results for the yellow, brown, and orange solids separated from the unleached C-203 residual waste from samples 19887 or 19961. All of the analyzed residual sludge samples contained mostly particle aggregates consisting of

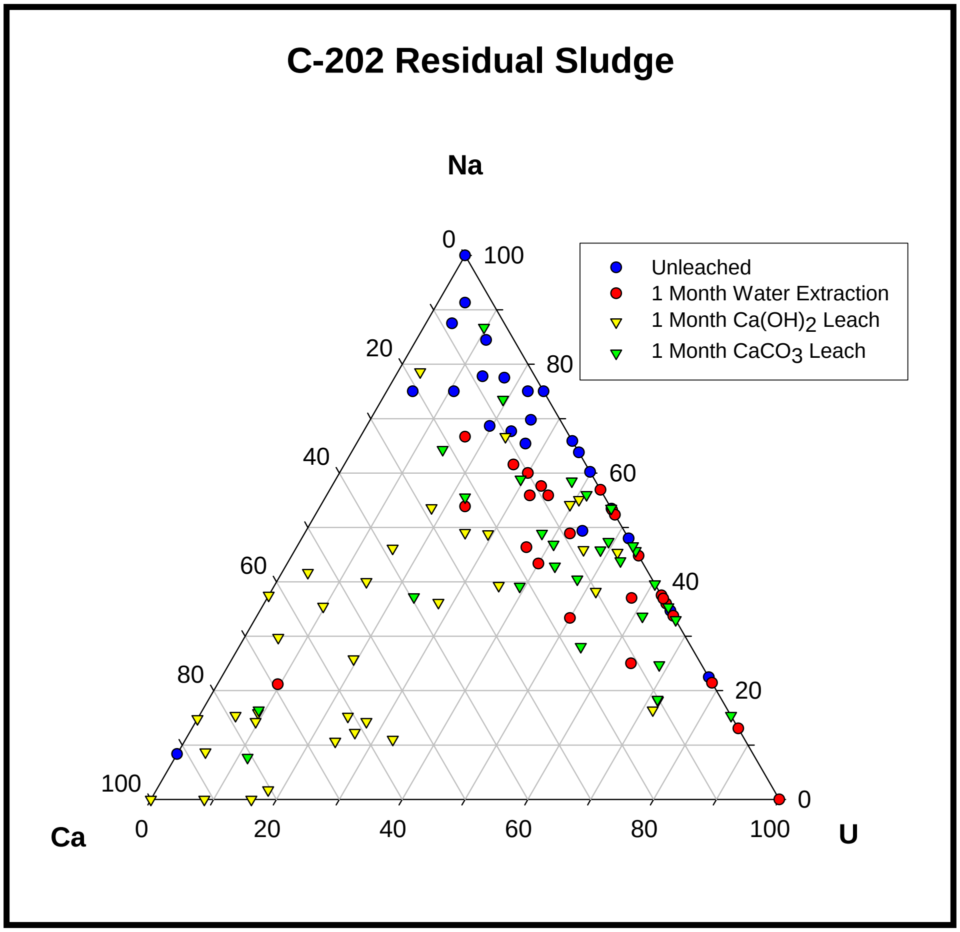


Figure 3.8. Ternary Plot of the EDS-Determined U-Na-Ca Concentrations (at.%) Normalized to 100% for Unleached and Leached Samples of C-202 Residual Sludge

U, Na, C, O, P, sometimes with trace levels of Si and Al, and possibly H (H is not detectable by EDS). The unleached sludge (Figure 3.9) and 1-month single-contact DDI water leached samples (not shown in Figure 3.9) of C-203 residual waste appear to contain more large-particle aggregates than the sequential-leached DDI water extraction samples. Because this difference was observed for sequential DDI water leached samples from both 19887 and 19961 samples, this disaggregation is assumed to occur as a result of dissolution reactions during the sequential-leach testing and/or sample centrifugation at the end of each of the six leach steps, and not from preparation of the SEM mount.

The samples of unleached and DDI water extracted samples also contained a small number of Fe oxide particles (see dark gray Fe-oxide particles indicated in micrograph in lower right of Figure 3.9). These Fe-oxide particles were more apparent in the micrographs of the sequential-leached DDI water extracted samples. The Fe oxides often occur as large individual or conglomerate particles, and often contain low concentrations of Cr, Mn, Pb, and/or Cu. For the unleached and leached samples of C-202 and C-203 residual sludge, the Fe-containing particles (>1 at.% Fe) contained up to 0.8 at.% Mn (typically <0.5 at.%), 4.7 at.% Cr (typically <1.0 at.%), 0.9 at.% Pb (typically <0.5 at.%), and 1.6 at.% Cu (typically <0.5 at.%). Ni ($K_{\alpha 1}$ x-ray emission peak at 7.478 keV) was detected as a trace constituent (less than 1 wt.%) in only a few of all particle regions analyzed by EDS.

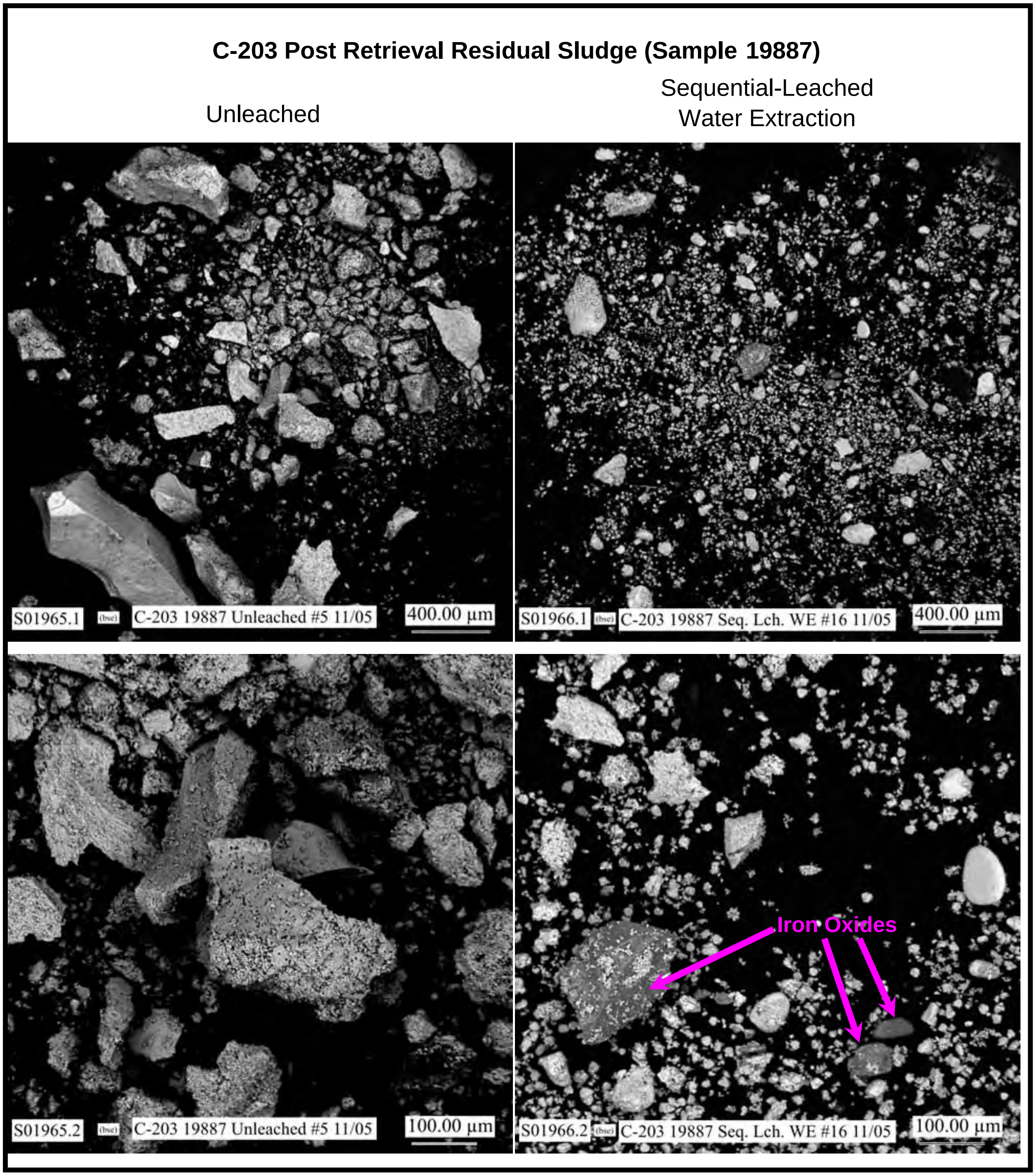


Figure 3.9. Backscattered Electron (BSE) SEM Micrographs of Unleached (left side) and Sequential DDI Water Leached (right side) Samples of C-203 Residual Sludge from Sample 19887. (The bottom row of micrographs show at higher magnification the particles near the center of the corresponding left and right micrographs in the top row.)

Figure 3.10 shows micrographs of U-Na-C-O-P±H (trace Al+Si) particles in the C-203 residual waste samples. The porous aggregates (micrograph A); large, dense, rounded particles (micrograph B) and conglomerates (micrograph C) are common in the unleached and sequential water leached C-203 samples. These porous aggregates and dense, rounded particles have noticeably different surface textures (micrograph D in Figure 3.10), and are similar to those observed in the C-202 residual waste. In some instances, the core material (particle marked by the arrow in micrograph E in Figure 3.10) of the porous aggregates appears to be no different than the dense rounded particles. The smooth concave surfaces on this aggregate represent the locations where large rounded particles were once attached to or pressed against this aggregate. A few particles were also observed (particles marked by the arrows in micrograph F in Figure 3.10) in the C-203 samples to have apparent pyramidal faces. As with the C-202 residual sludge samples, the surface textures and morphologies shown in Figure 3.10 are consistent with the presence of two or more types of U-Na-C-O-P±H phases in the unleached C-203 residual waste. Improved identification/characterization of these phases requires more detailed studies by other techniques such as transmission electron microscopy (TEM) and x-ray absorption spectroscopy (XAS).

Many of these U-Na-C-O-P±H (trace Al+Si) particles appear to contain dissolution pits (micrograph A in Figure 3.11) that at higher magnification (micrographs B and C in Figure 3.11), have internal facet angles of approximately 120°. Some of these cavities (see red arrows in micrograph A in Figure 3.11) also suggest that the dissolved phase might have been rod shaped. The cross sections of these dissolution pits are reminiscent of the hexagonal-like cross sections of the acicular crystals of čejkaite [$Na_4(UO_2)(CO_3)_3$] (see insert from Deutsch et al. [2004] in micrograph B in Figure 3.11) identified in unleached C-203 and C-204 pre-retrieval waste sludge. Because these hexagonal-like dissolution pits were identified in samples of unleached C-203 residual sludge, it is assumed that they exist in the actual residual waste still in the C-200 series tanks. Some of the dissolution pits may also contain remnant material of the phase that originally occurred in these cavities (see red arrows in micrograph C in Figure 3.11). Due to the small particle size of this remnant material, no differences could be detected by EDS in the compositions of this material and the host U-Na-C-O-P±H phase.

The porous aggregates of U-Na-C-O-P±H in the C-203 residual waste (e.g., see micrograph A in Figure 3.10) have complex surface textures. Figure 3.12 shows examples of these surfaces which are porous and have high surface areas.

Some of these U-Na-C-O-P±H (trace Al+Si) particles also coat and/or cement Fe-oxide particle(s). Figure 3.13 and Figure 3.14 show micrographs, EDS spectra, and single- and multi-element EDS maps for one of these conglomerate particles. The single- and multi-element EDS maps in Figure 3.14 clearly show the regions of this coated or cemented particle that consist of Fe oxide. The small gray-white areas within the U-rich (red) areas in Figure 3.14B suggest that P distribution may not be uniform in these U-Na-C-O-P±H solids.

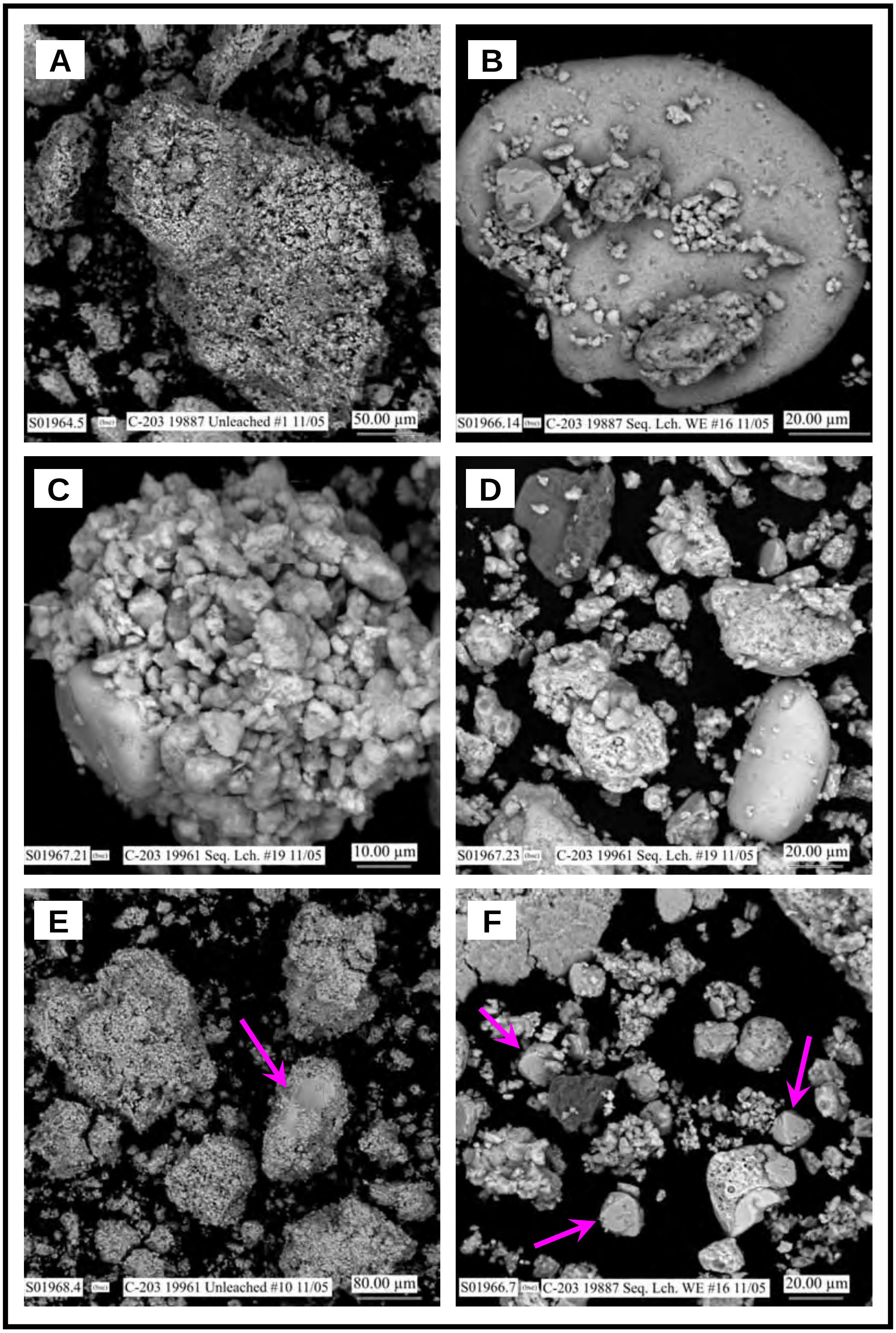


Figure 3.10. Typical Particles of U-Na-C-O-P±H (Trace Al+Si) in Unleached and Sequential DDI Water Leached Samples of C-203 Residual Sludge

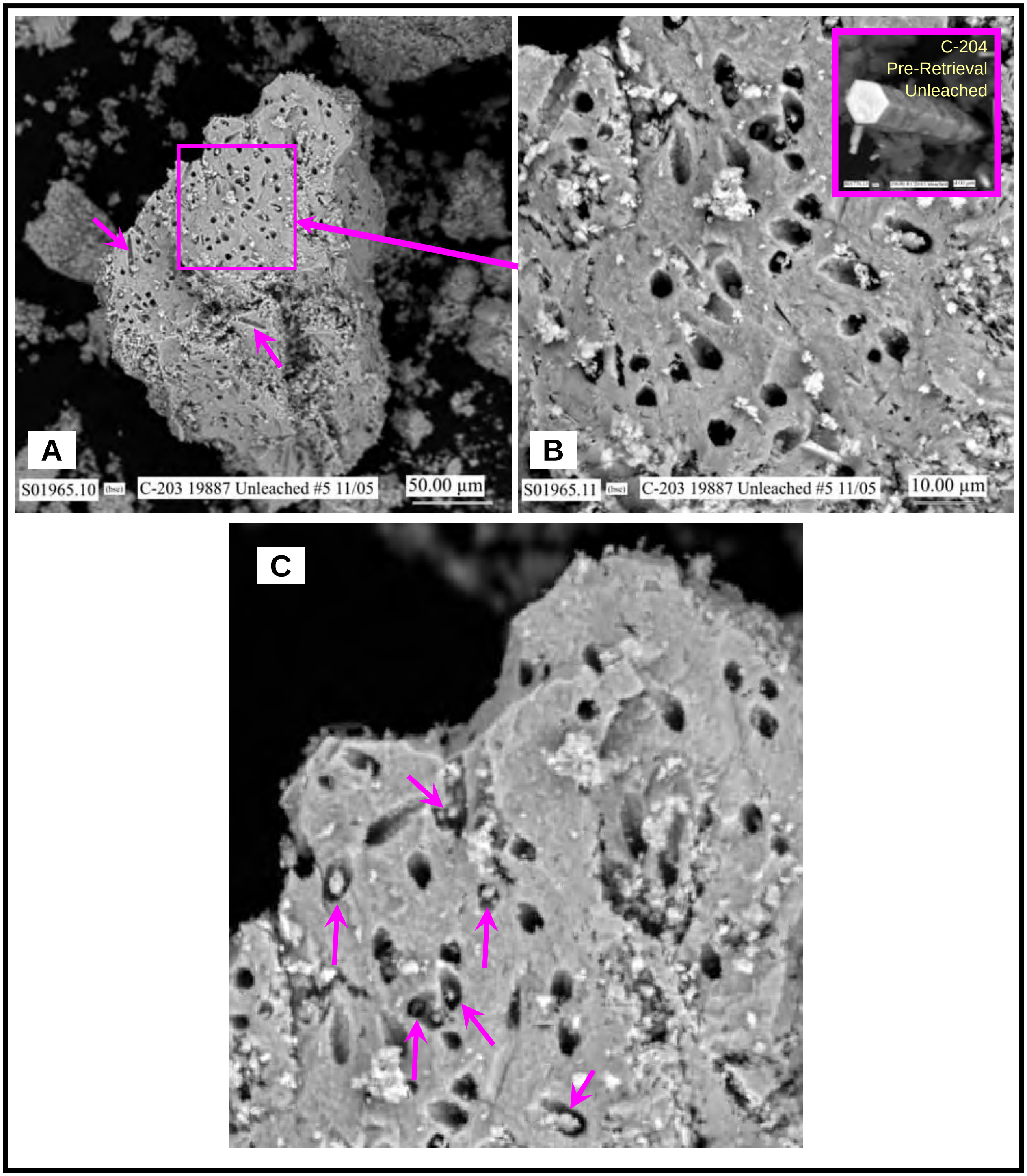


Figure 3.11. Particle of U-Na-C-O-P±H in the Unleached Sample of C-203 Residual Sludge from Sample 19887 Showing Hexagonal, Rod-Like Dissolution Cavities

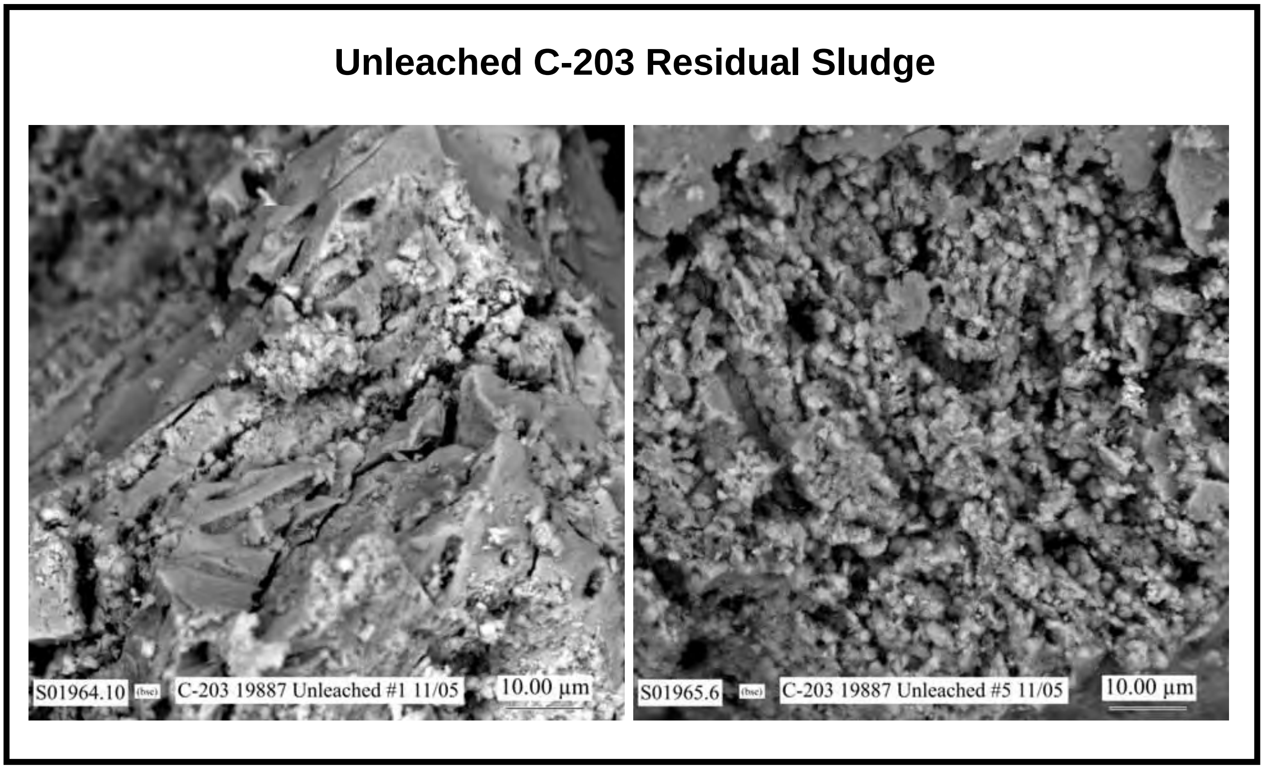


Figure 3.12. Backscattered Electron (BSE) Micrographs Showing Porous, High Surface Area Characteristics of the U-Na-C-O-P±H Aggregate Solids in Unleached C-203 Residual Sludge

Figure 3.15 and Figure 3.16 show BSE micrographs and EDS spectra of typical particles present in the 1-month single-contact $Ca(OH)_2$, sequential $Ca(OH)_2$, 1-month single-contact $CaCO_3$, and sequential $CaCO_3$ leach samples of C-203 residual sludge from sample 19961. These leached solids are similar to those identified in the samples of unleached, 1-month single-contact and six-step sequential DDI water leaches of C-203 residual sludge from samples 19887 and 19961. All of the analyzed samples contained mostly particle aggregates consisting of U, Na, C, O, and P; sometimes with trace levels of Si and Al; and possibly H (H is not detectable by EDS). The samples also contained some Fe oxide particles (see dark gray Fe-oxide particle indicated in micrograph in upper right of Figure 3.15). These Fe-oxide particles occurred as both large individual and conglomerate particles, and often contained low concentrations of Cr, Mn, Pb, and/or Cu.

As in the C-202 residual sludge samples, the particles in unleached and leached C-203 residual sludge samples were generally nondescript and appeared to be amorphous due to a general absence of crystal faces. This is consistent with the bulk XRD results which did not detect any crystalline phases. However, some particles, which typically were Fe oxides, with possible crystalline faces were observed by SEM in the C-203 residual sludge. Examples of such solids with possible crystalline faces are indicated by the arrows in the micrographs in Figure 3.17 for unleached residual sludge.

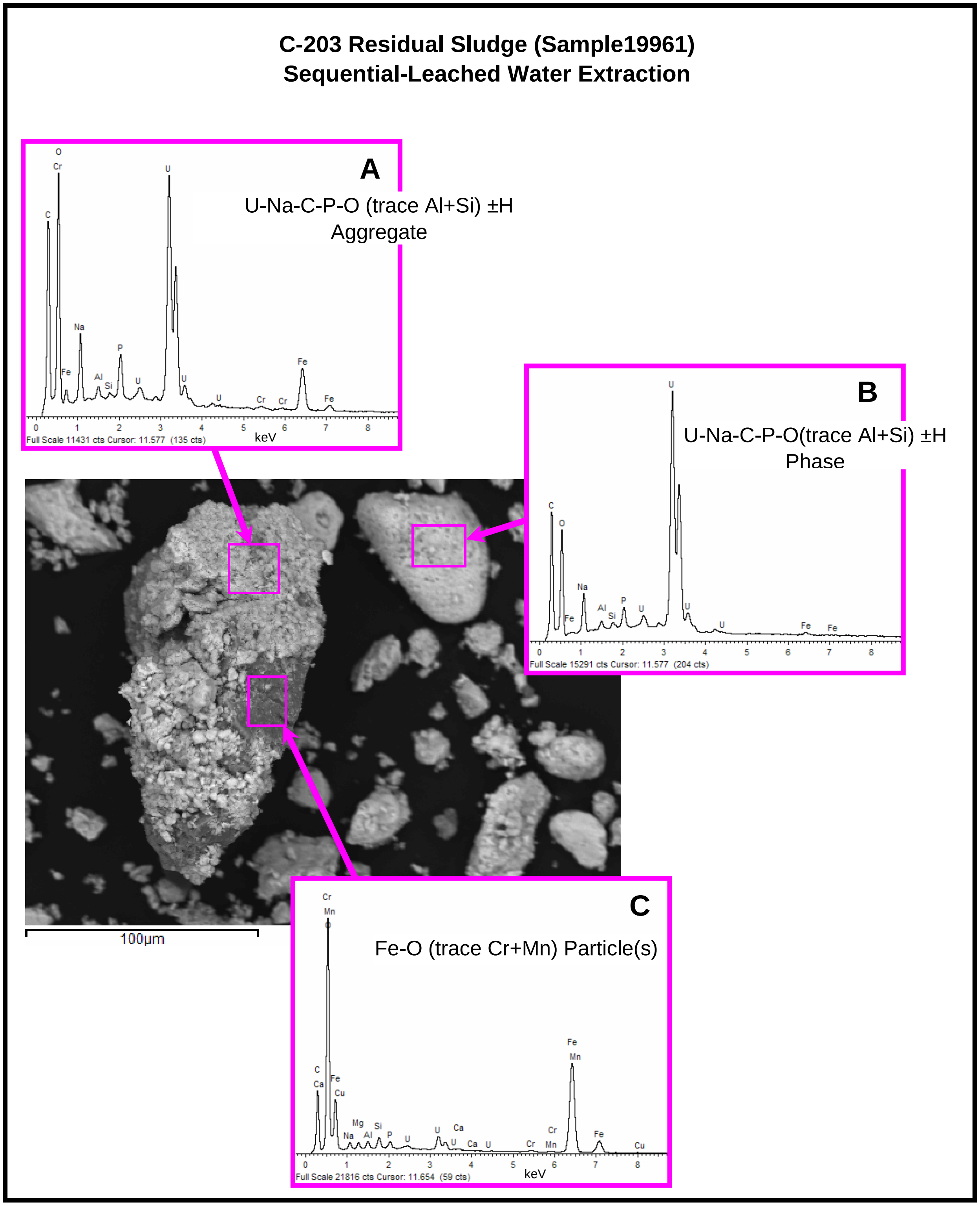


Figure 3.13. BSE Micrograph and EDS Spectra for Sequentially DDI Water Leached Conglomerate of U-Na-C-O-P±H (Trace Al+Si) and Fe-Oxide Particle(s)

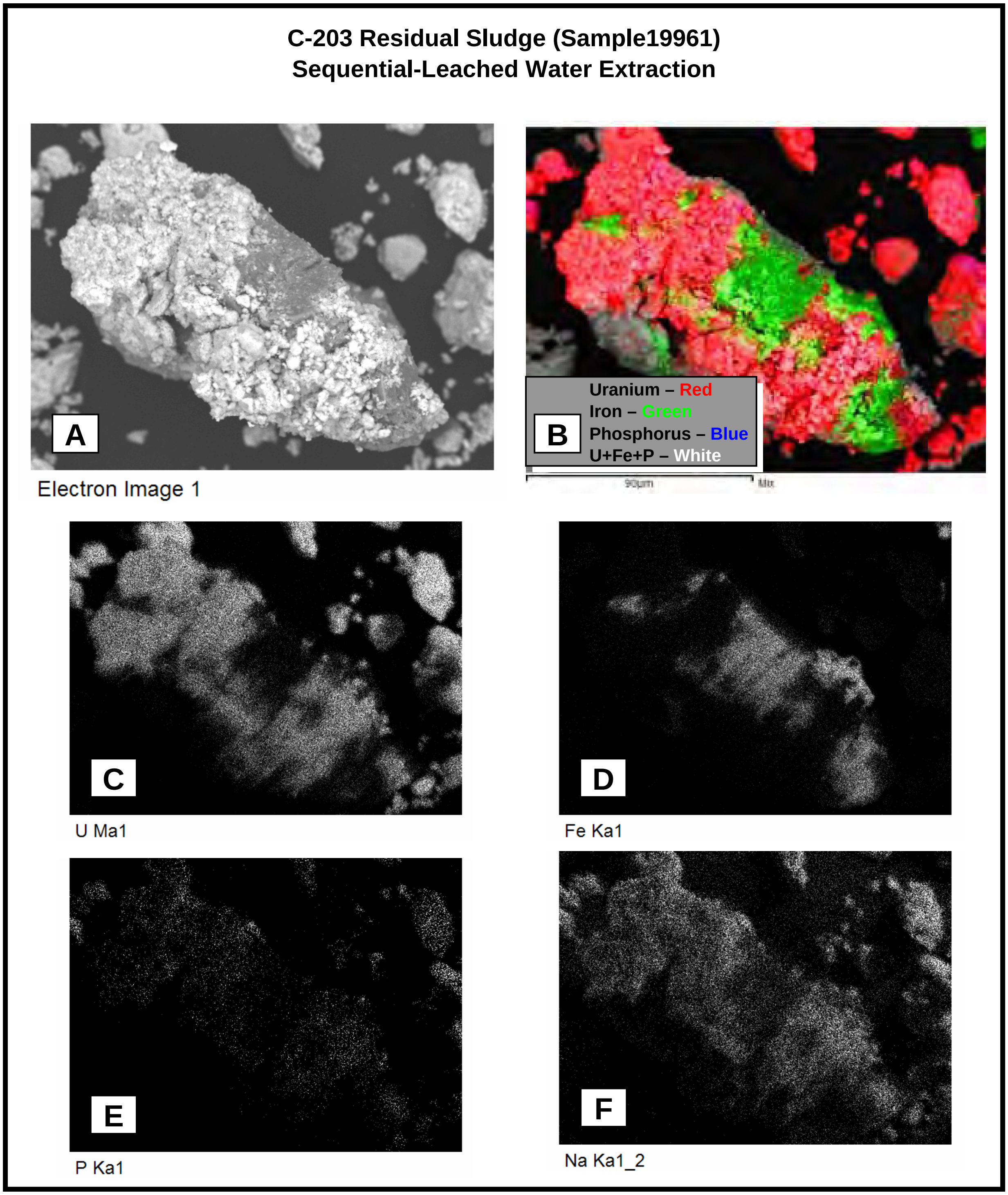


Figure 3.14. BSE Micrograph and Multi- and Single-Element EDS Maps for Conglomerate of U-Na-C-O-P±H (Trace Al+Si) and Fe-Oxide Particle(s). (Particle rotated approximately 45° counter clockwise relative to micrograph of same particle shown in Figure 3.13.)

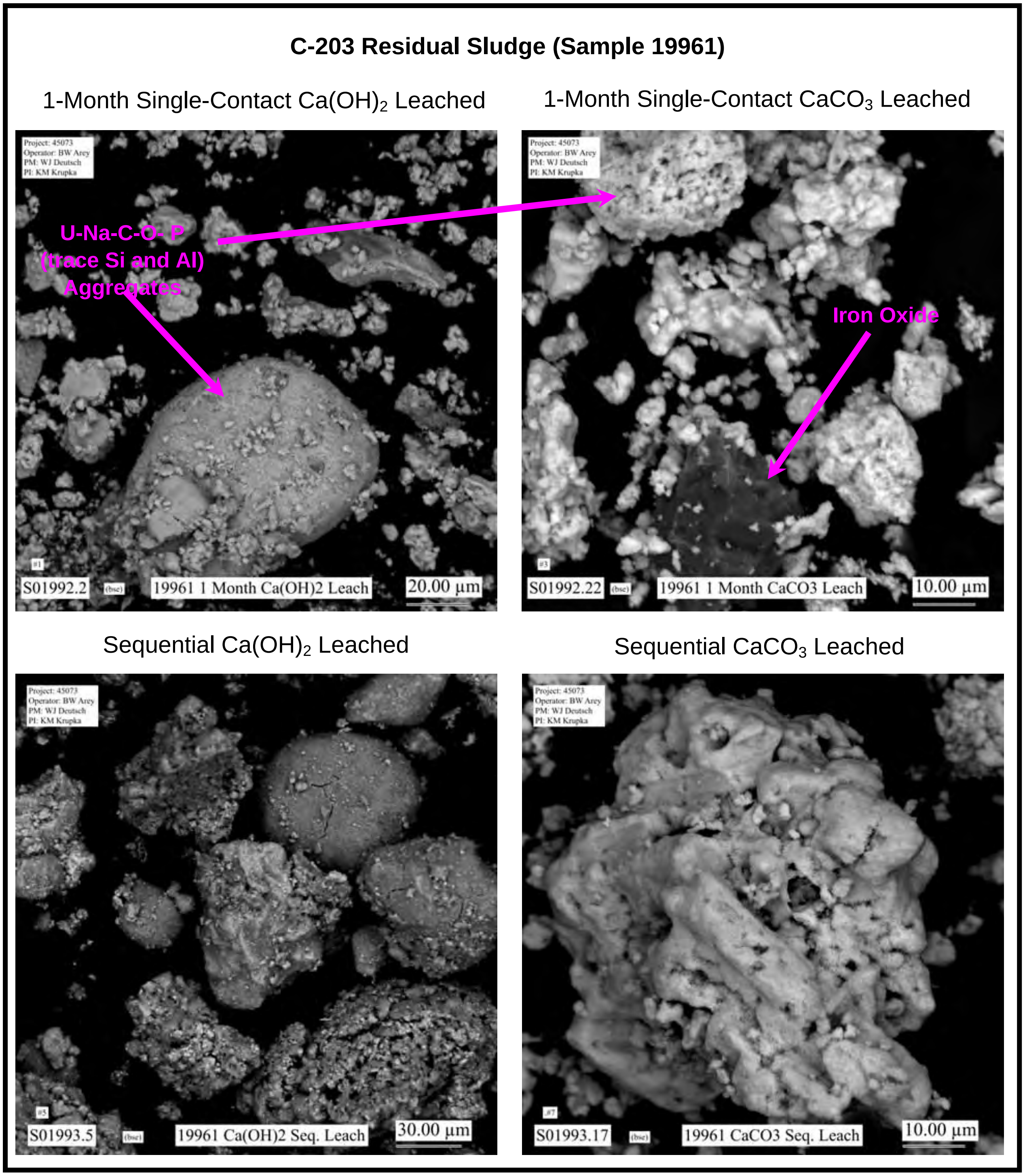


Figure 3.15. BSE SEM Micrographs of 1-Month Single-Contact $Ca(OH)_2$ Leach, Sequential $Ca(OH)_2$ Leach, 1-Month Single-Contact $CaCO_3$ Leach, and Sequential $CaCO_3$ Leach Samples of C-203 Post-Retrieval (Residual) Sludge from Sample 19961

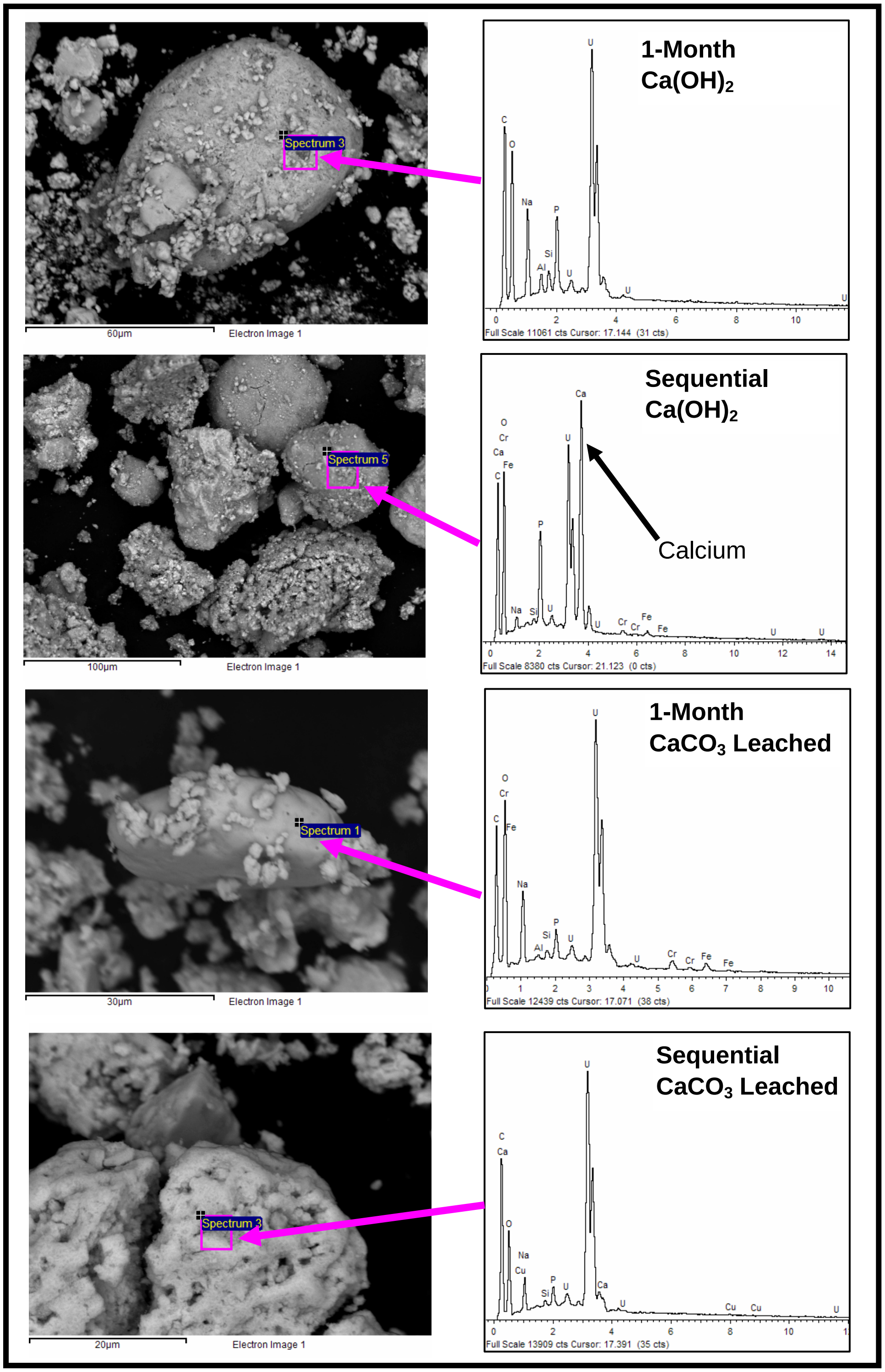


Figure 3.16. BSE SEM Micrographs and EDS Spectra for Typical U-Na-C-O-P Particle Aggregates in 1-Month Single-Contact $Ca(OH)_2$, Sequential $Ca(OH)_2$, 1-Month Single Contact $CaCO_3$, and Sequential $CaCO_3$ Leach Samples of C-203 Residual Sludge from Sample 19961

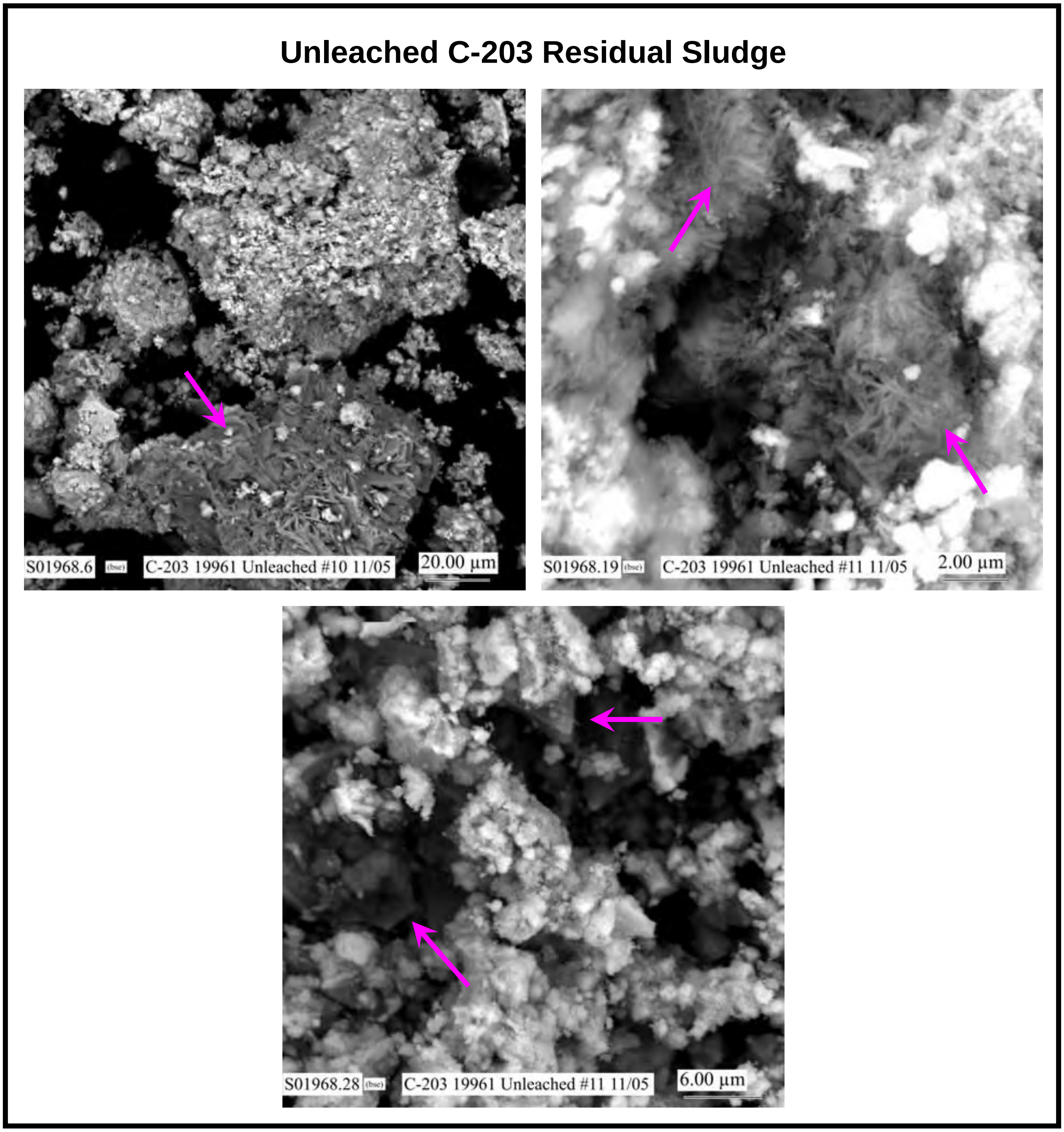


Figure 3.17. BSE Micrographs Showings Solids with Possible Crystal Faces (see arrows) in Unleached C-203 Residual Sludge

Figure 3.18 contains the ternary plots for the normalized concentrations (at.%) of U, Na, and Fe (i.e., EDS-determined concentrations [at.%] of U, Na, and Fe normalized to a total of 100%) for all particles (U-Na-C-O-P±H and Fe-O) analyzed by EDS in C-203 residual sludge from sample 19887. The compositions used to calculate the ternary plots for unleached and leached samples of C-203 residual waste in Figure 3.18 are listed in Appendices E and F, respectively. For those analyses of unleached C-203 residual sludge that contain little or no Fe [e.g., shaded area where <10 normalized at.% Fe] in left ternary plot in Figure 3.18, the Na/U ratios (based on normalized at.%) for the majority of the data points range approximately from 2:1 to 0.9:1 which is essentially the same range as the Na/U values determined for the unleached C-202 residual sludge. The values shown in the left ternary plot in Figure 3.18 also indicate that less Fe oxide particles were observed in the unleached C-203 solids from sample 19887 compared to the solids analyzed from unleached C-202 residual waste and unleached C-203 residual waste from sample 19961 (results discussed below). The Na/U ratios for particles in the DDI water leached C-203 samples with little or no Fe (shaded area in right ternary plot in Figure 3.18), are lower than those for the unleached particles, and range for the majority of the low Fe particles from approximately from 1.5:1 to 0.5:1 which is also consistent with the Na/U normalized at.% ratios for the leached C-202 residual sludge particles. Because the values in these ternary plots are dependent on the elements selected to normalize the atomic percent values to 100%, the reader is cautioned not to compare them to the U-Na-Fe molar ratios for known phases.

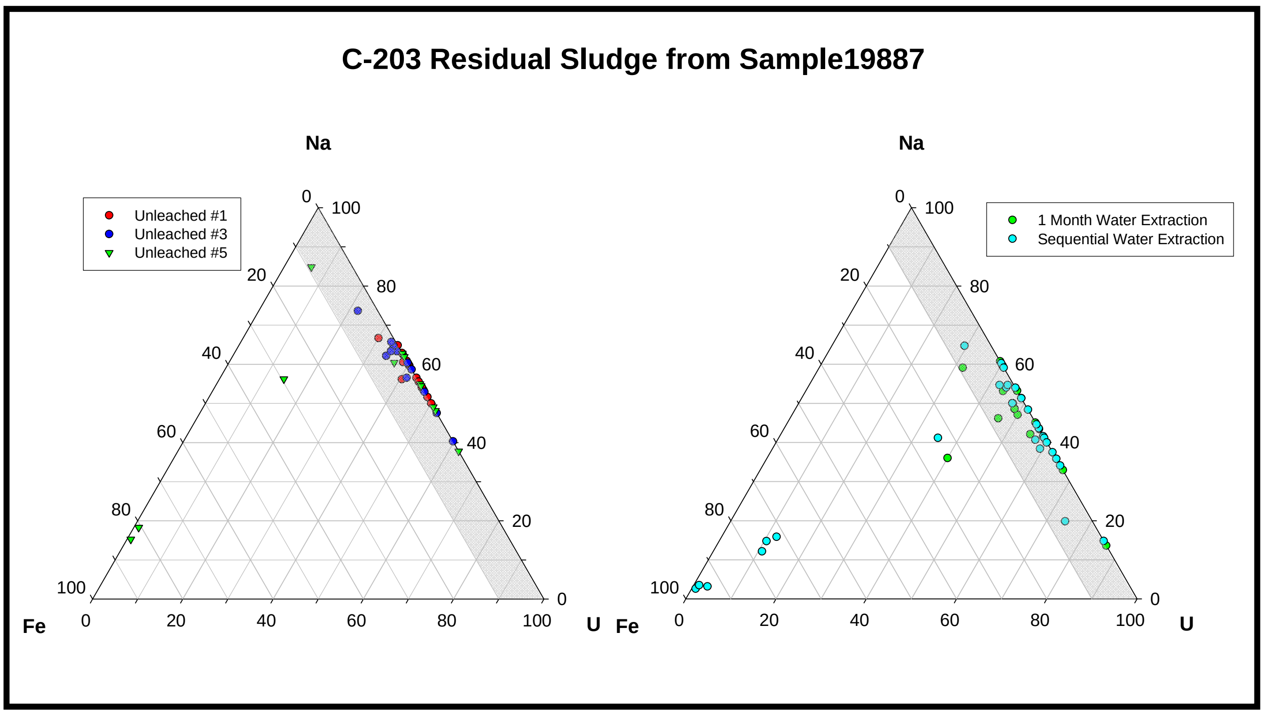


Figure 3.18. Ternary Plots of the EDS-Determined U-Na-Fe Concentrations (at.%) Normalized to 100% for Unleached (left diagram) and DDI Water Extraction Leached (right diagram) Samples of C-203 Residual Sludge from Sample 19887

Figure 3.19 contains the ternary plots for the normalized concentrations (at.%) of U, Na, and Fe for all C-203 residual sludge particles (U-Na-C-O-P±H and Fe-O) analyzed by EDS in unleached (upper left), DDI water extracted leached (upper right), $Ca(OH)_2$ leached (lower left), and $CaCO_3$ leached (lower right) samples from sample 19961. The results in Figure 3.19 suggest that Na concentrations of the U-Na-C-O-P±H phase decreased as a result of the DDI water extraction, $Ca(OH)_2$, and $CaCO_3$ leaches. The EDS values for the $Ca(OH)_2$ and $CaCO_3$ samples also show that for the particles that contain little or no Fe (e.g., shaded areas in lower left and lower right ternary plots in Figure 3.19), the sequential $Ca(OH)_2$ and possibly sequential $CaCO_3$ leaches appear to have removed more Na from the U-Na-C-O-P±H particles than the 1-month single-contact leaches using both leachants. This trend in Na/U ratios may be explained by the same reasons suggested for the results for the leached C-202 residual sludge samples. These include the possibilities that the U-Na-C-O-P±H solid may be dissolving incongruently, the leached sludge contains a mixture of the original U-Na-C-O-P±H phase and a new Na-poor or Na–absent U phase that precipitated during the leaching process, waste solids may contain a readily soluble Na phase that contains no U, and/or the U-Na-C-O-P±H solid consists of two or more U phases having similar compositions. As noted above for the leached C-202 residual sludge samples, the SEM/EDS results only provide some evidence for these possible reaction processes.

The EDS analyses also indicate that the U-Na-C-O-P particle aggregates from the 1-month single-contact and sequential $Ca(OH)_2$ leached and sequential $CaCO_3$ leached sludge samples contain significantly more Ca and less Na (dark blue triangles, light blue triangles, and light red squares, respectively). This is especially apparent for analyses of particles from the sequential $Ca(OH)_2$ leached samples (gray shaded area in Figure 3.20). This increase in Ca concentrations relative to Na is consistent with the results for $Ca(OH)_2$ and $CaCO_3$ leached samples of C-202 residual sludge (Figure 3.8). Unfortunately, the mechanism, such as a Na/Ca exchange reaction, responsible for this shift in compositions could not be determined.

The EDS analyses (see Tables H.5 and H.6 in Appendix H) also suggest that a Ca-containing U-Na-P-O±C phase may also be present in the 1-month single-contact $Ca(OH)_2$ leached samples. The EDS results indicate that for those particles having high Ca and high P concentrations, the U concentrations are also significantly greater (approximately five to ten times in at.%) than the U concentrations for the Ca-poor U-Na-C-O-P particles. Unfortunately, based on the SEM micrographs, there were no apparent differences in the morphologies of the Ca-rich versus Ca-poor U-Na-C-O-P particles.

The SEM/EDS analyses did not indicate the presence of Tc or I in any of particles present in the unleached or leached residual waste from tank C-203.

3.7.3 Comparison of SEM/EDS Results for Residual (Post Retrieval) Sludge to C-203 and C-204 Pre-Retrieval Sludge

The SEM/EDS results for C-202 and C-203 residual sludge are generally consistent with those for the water-leached pre-retrieval wastes from tanks C-203 and C-204. Studies of the C-203 and C-204 pre-retrieval wastes by Deutsch et al. (2004) did not include at that time the $Ca(OH)_2$ and $CaCO_3$ leach measurements used in our current testing methodology. Characterization studies of pre-retrieval wastes from tanks C-203 and C-204 identified the presence of čejkaite [$Na_4(UO_2)(CO_3)_3$] as the primary crystalline phase and the possible presence of nitratine ($NaNO_3$) in the unleached (as-received) C-203 and C-204 pre-retrieval wastes (Deutsch et al. 2004; Krupka et al. 2006). As expected, neither čejkaite nor nitratine were identified in the SEM/EDS analyses of C-202 and C-203 residual sludge because sufficient water was used to retrieve (remove) wastes from the tanks. Because these phases are highly soluble, they likely dissolved during final waste retrieval operations and thus were not present in samples of C-202 and C-203 residual sludge used in the studies reported here. However, the hexagonal, rod-like dissolution pits observed in some of the U-Na-C-O-P±H residual (post-retrieval) particles (see Figure 3.11) are consistent with the possible prior existence of hexagonal, acicular crystals of čejkaite in this post-retrieval residual sludge.

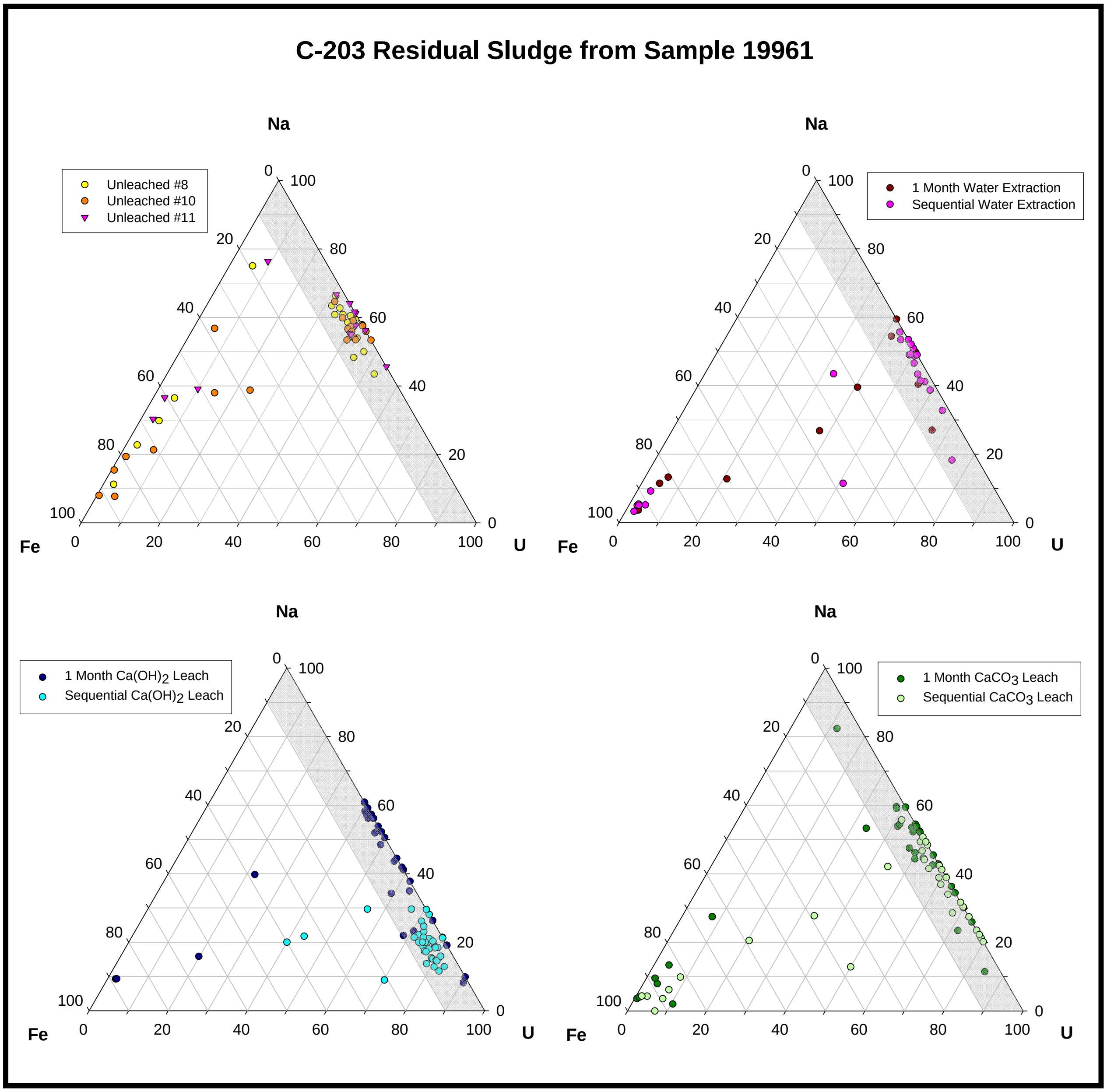


Figure 3.19. Ternary Plots of the EDS-Determined U-Na-Fe Concentrations (at.%) Normalized to 100% for Unleached (upper left), DDI Water Leached (upper right), $Ca(OH)_2$ Leached (lower left), and $CaCO_3$ Leached (lower right) Samples of C-203 Residual Sludge from Sample 19961

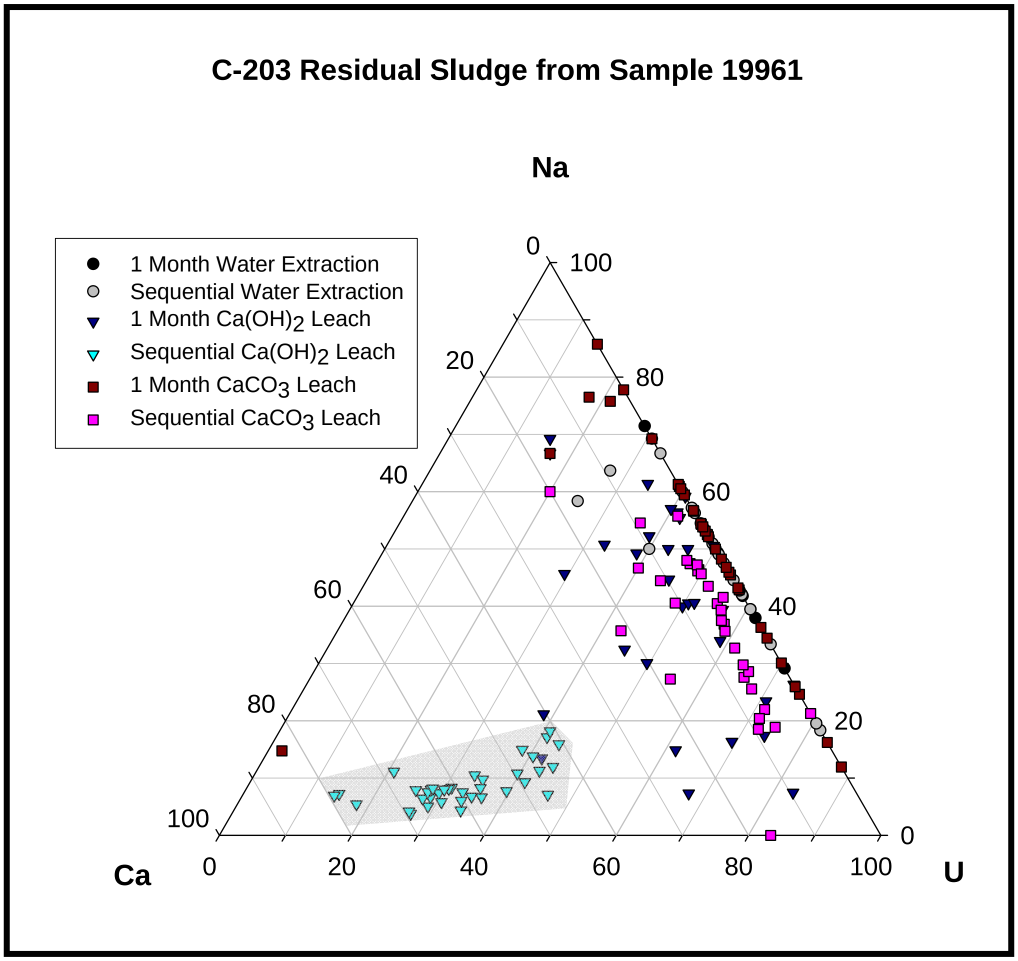


Figure 3.20. Ternary Plots of the EDS-Determined U-Na-Ca Concentrations (at.%) Normalized to 100% for Unleached, DDI Water Leached, $Ca(OH)_2$ Leached, and $CaCO_3$ Leached Samples of C-203 Residual Sludge from Sample 19961

The identification of the possible presence of goethite [α-FeO(OH)], maghemite (γ-Fe_2O_3), and the Na uranates clarkeite $Na[(UO_2)O(OH)](H_2O)_{0\text{-}1}$ and/or $Na_2U_2O_7$ in the water-leached pre-retrieval waste from tank C-203 (Deutsch et al. 2004, 2005) is generally consistent with the Fe oxide and U-Na phases identified by SEM/EDS in the unleached and leached C-202 and C-203 (post retrieval) residual sludges. The pre-retrieval wastes from tanks C-203 and C-204 also contained a significant fraction of amorphous solids (Deutsch et al. 2004) as do the residual waste samples characterized in this study. Smooth, rounded, dense-looking particles, like those shown in micrographs B and D in Figure 3.10, composed of Na, U, O, and possibly C were also present in the unleached and DDI water-leached C-203 pre-retrieval waste, but not in unleached C-204 pre-retrieval waste sludge. The C-204 pre-retrieval waste also contained porous-looking particles or aggregates of sub-micrometer particles containing Al, Cr, Fe, Na, Ni, Si, U, P, O, and C, which are similar to the U-Na-C-O-P±H (trace Al+Si) particle aggregates identified in the C-202 and C-203 (post retrieval) residual sludge.

3.8 Chromium Occurrence and Leaching

Analyses of sludge samples by SEM/EDS (Section 3.7) indicate that chromium in C-202 post retrieval, C-203 pre-retrieval and C-203 post-retrieval samples is generally associated with iron oxides/hydroxides. Because Cr and Fe appear to be associated in the sludge, Cr/Fe ratios in the multiple DDI water extractions for the post-retrieval (residual) samples were calculated and are shown in Table 3.85. The source of the data used for these calculations is provided in Appendix I (ICP-MS values were used for Cr). Note that some of the data used for the calculations are qualified values (below the quantitation limit). The molar Cr/Fe ratios in the DDI water extracts for the two C-203 samples are remarkably constant (1.19 ± 0.27 for 19887 and 0.84 ± 0.16 for 19961). It is also noteworthy that the average Cr/Fe ratios in the DDI water extracts are significantly greater than that ratio in the bulk sludge (0.44 for 19887 and 0.36 for 19961). The Cr/Fe ratios in the DDI water extracts for the C-202 sample (19250) is much more variable (0.31 ± 0.41); however, this sample has an average Cr/Fe ratio that is much higher than that of the sludge (0.13) as was the case for the C-203 samples. The elevated Cr/Fe ratios in water extracts relative to the sludge suggest that chromium is being released through dissolution of iron oxide/hydroxide and desorption of surface complexed chromate from iron oxide/hydroxide in the sludge. The high chromium concentrations measured in the extracts are significantly greater than that expected to be in equilibrium with freshly precipitated $Cr(OH)_3$ (Rai et al. 1987) and are therefore consistent with chromium in the form of chromate [Cr(VI)] and not Cr(III). For example, sample 19887 (C-203) single contact water extracts have Cr concentrations of approximately 2 x 10^{-5} mol/L at pH values of approximately 10.5. The total Cr^{3+} concentration in equilibrium with freshly precipitated $Cr(OH)_3$ at this pH is expected to be <1.4 x 10^{-7} (Rai et al. 1987). This concentration would decrease even further as the crystallinity of the $Cr(OH)_3$ phase increases.

The concentrations of iron in the $Ca(OH)_2$ extracts are significantly lower than in the DDI water extracts (Appendix I). The average Fe concentration in the C-202 $Ca(OH)_2$ extracts is <9 x 10^{-6} mol/L while the average for the DDI extracts is 9.1 x 10^{-6} ± 9.9 x 10^{-6} mol/L; for the C-203 19887 sample, the average Fe concentration is 1.6 x 10^{-6} ± 0.6 x 10^{-6} mol/L ($Ca(OH)_2$ extracts) and 6.8 x 10^{-5} ± 5.2 x 10^{-5} mol/L (DDI extracts); and, for the C-203 19961 sample, the average Fe concentrations are 1.5 x 10^{-5} ± 4.2 x 10^{-5} mol/L ($Ca(OH)_2$ extracts) and 1.1 x 10^{-4} ± 1.3 x 10^{-4} mol/L (DDI extracts). For the $Ca(OH)_2$ extracts, the ratios of released chromium to iron are considerably greater, although much more variable than in the DDI water extracts. For the C-202 sample, the average and standard deviation of the Cr/Fe ratios are >4.4 ± 4.5, and for the C-203 samples the values are 11.8 ± 13.7 (sample 19887) and 13.6 ± 18.4 (sample 19961). In the case of the C-202 $Ca(OH)_2$ extracts, the Fe concentrations were below the detection limit, resulting in Cr/Fe ratios that are prefaced with a > sign. Taken as a whole, the $Ca(OH)_2$ extract results are consistent with greater desorption of adsorbed chromate from the surfaces of the iron oxide/hydroxide due to competitive exchange with hydroxide ions and a decrease in anion adsorption (positively charged) sites under the high pH conditions (>12) of the $Ca(OH)_2$ extractions.

Results of the $CaCO_3$ extractions are similar to the DDI water extracts for the three residual sludge samples. For the C-202 sample, the average and standard deviation of the Cr/Fe ratios are 0.31 ± 0.37, and for the C-203 samples the values are 1.49 ± 0.50 (sample 19887) and 0.77 ± 0.26 (sample 19961). The lower Cr/Fe ratios for the $CaCO_3$ extractions compared to the $Ca(OH)_2$ extractions is likely due to the lower pH conditions (8 to 10.5) of the $CaCO_3$ extractions compared to the pH values (>12) of the $Ca(OH)_2$ extractions. Lower pH values result in less desorption of chromate from the iron solids because of less competition by hydroxide ions and an increase in anion adsorption sites.

Table 3.85. Molar Ratios of Cr/Fe in Multiple Extractions and Sludge for C-202 and C-203 Post Retrieval Sludge Samples

Sample	Extract	1 Mon	1 Mon dup	Stage 1	Stage 1 dup	Stage 2	Stage 2 dup	Stage 3	Stage 3 dup	Stage 4	Stage 4 dup	Stage 5	Stage 5 dup	Stage 6	Stage 6 dup	Average	Std. Dev.
C-202 (19250)	DDI Water	1.26	1.31	0.20	0.23	0.15	0.14	0.13	0.15	0.14	0.17	0.17	0.16	0.11	0.09	0.31	0.41
	$Ca(OH)_2$	>15	>13	>2.9	>3.1	>1.7	>1.9	>3.1	>3.2	>2.0	>2.2	>0.7	>0.9	>5.5	>6.1	>4.4	>4.5
	$CaCO_3$	1.10	1.24	0.18	0.25	0.25	0.21	0.13	0.13	0.16	0.14	0.20	0.21	0.12	0.10	0.31	0.37
	sludge															0.13	
C-203 (19887)	DDI Water	1.82	1.79	1.15	1.16	1.09	1.06	1.01	1.14	1.00	1.02	1.22	1.25	1.05	0.93	1.19	0.27
	$Ca(OH)_2$	24.8	49.0	14.5	21.9	1.20	1.24	5.89	5.19	1.42	3.06	0.49	2.09	16.0	17.9	11.8	13.7
	$CaCO_3$	1.46	2.52	2.42	1.53	1.60	1.31	1.58	1.26	1.39	0.81	1.39	0.65	1.59	1.28	1.49	0.50
	sludge															0.44	
C-203 (19961)	DDI Water	1.03	1.27	0.79	0.77	0.79	0.72	0.75	0.77	0.81	0.75	0.74	0.62	0.95	0.96	0.84	0.16
	$Ca(OH)_2$	1.28	3.24	20.2	55.4	1.19	2.58	9.28	14.4	0.72	0.66	0.61	1.47	45.5	33.4	13.6	18.4
	$CaCO_3$	0.94	0.85	1.12	1.06	0.81	0.82	0.83	0.76	0.45	0.32	0.61	0.32	0.87	1.04	0.77	0.26
	sludge															0.36	

3.9 Mineral Equilibrium

The dissolved concentrations in the leachates produced in the sludge extraction tests were used to calculate mineral saturation indices (SIs) that can identify solid phases in equilibrium with the leachates' compositions. Minerals with SI values near zero (~±0.5) are generally considered to be near equilibrium with the solution composition, more positive values are considered oversaturated and more negative values are considered undersaturated.

Appendix I contains the solution composition data used for the calculations. The React module of Geochemist's Workbench® (GWB) version 6.02 (Bethke 2006) was used to calculate the mineral SIs for these solutions. The thermodynamic database thermo.com.V8.R6+.dat was used with modifications that include solubility data for čejkaite [$Na_4(UO_2)(CO_3)_3$] (Felmy et al. 2005), becquerelite [$Ca(UO_2)_6O_4(OH)_6 \cdot 8H_2O$] (Rai et al. 2002), sodium diuranate hydrate [$Na_2U_2O_7 \cdot xH_2O$] (Yamamura et al. 1998), an estimated value for Ca-autunite [$Ca(UO_2)_2(PO_4)_2$] (Langmuir 1978), and the stability constant for the dissolved species $Ca_2UO_2(CO_3)_3$(aq) (Kalmykov et al. 2000). The poorly crystalline phase [$Na_2U_2O_7 \cdot xH_2O$] (Yamamura et al. 1998) will be referred to as $Na_2U_2O_7$(am).

Results of the saturation index calculations for the three different C-202 sludge leachates are presented in Table 3.86 through Table 3.88. The deionized water [DDI] extract results are shown in Table 3.86, the $Ca(OH)_2$ saturated extracts results are shown in Table 3.87 and the $CaCO_3$ saturated extract results are shown in Table 3.88.

Table 3.86. Calculated Saturation Indices for Significant Phases in Tank C-202 Water Extractions

DDI Water Extracts (Sample 19250)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	<-3	-2.02	<-3	<-3	-1.97	<-3	<-3	-1.15
$Na_2U_2O_7$ (am)	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
becquerelite $Ca(UO_2)_6O_4(OH)_6 \cdot 8H_2O$	<-3	<-3	<-3	<-3	-0.65	<-3	<-3	1.63
schoepite $UO_3 \cdot 2H_2O$	-1.13	-1.33	-1.13	-0.43	-0.11	-0.28	-0.25	0.21
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	2.82	1.27	2.82	4.21	3.90	4.46	4.19	-0.23
$(UO_2)_3(PO_4)_2 \cdot 4H_2O$	-1.83	<-3	-1.83	0.41	-0.53	1.82	1.88	<-3
$Fe(OH)_3$	2.32	1.60	2.32	2.04	2.33	1.78	1.58	2.73
gibbsite $Al(OH)_3$	2.62	2.00	2.62	2.77	2.61	3.29	3.34	2.69
calcite $CaCO_3$	-0.78	-0.50	-0.78	-1.32	-1.02	-2.22	-2.45	-0.76
dawsonite $NaAlCO_3(OH)_2$	1.53	0.93	1.53	0.50	0.01	0.15	-0.02	0.08
rhodochrosite $MnCO_3$	0.71	-0.44	0.71	0.08	0.14	-0.81	-1.16	0.61

Table 3.87. Calculated Saturation Indices for Significant Phases in Tank C-202 $Ca(OH)_2$ Extractions

$Ca(OH)_2$ Extracts (Sample 19250)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	0.53	0.01	0.53	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (am)	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
schoepite $UO_3{\cdot}2H_2O$	-2.74	-2.97	-2.74	<-3	<-3	<-3	<-3	<-3
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$(UO_2)_3(PO_4)_2{\cdot}4H_2O$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Fe(OH)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
gibbsite $Al(OH)_3$	0.31	0.49	0.31	0.02	-0.65	-1.01	-1.55	-0.75
calcite $CaCO_3$	1.50	1.25	1.50	2.81	2.90	2.95	3.01	2.90
dawsonite $NaAlCO_3(OH)_2$	-1.91	-1.83	-1.91	<-3	<-3	<-3	<-3	<-3
rhodochrosite $MnCO_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3

Table 3.88. Calculated Saturation Indices for Significant Phases in Tank C-202 $CaCO_3$ Extractions

$CaCO_3$ Extracts (Sample 19250)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	-1.99	-2.36	-1.99	<-3	-2.60	<-3	<-3	<-3
$Na_2U_2O_7$ (am)	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	<-3	<-3	<-3	-2.16	-1.93	<-3	-2.48
schoepite $UO_3{\cdot}2H_2O$	-1.44	-1.47	-1.44	-0.55	-0.34	-0.15	-0.36	-0.40
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	0.68	1.00	0.68	3.88	3.61	3.91	3.16	2.82
$(UO_2)_3(PO_4)_2{\cdot}4H_2O$	<-3	<-3	<-3	-0.24	-0.89	0.47	-0.28	-1.80
$Fe(OH)_3$	2.41	1.64	2.41	1.45	1.22	1.63	0.62	2.37
gibbsite $Al(OH)_3$	1.77	1.94	1.77	2.55	2.62	2.77	2.54	2.77
calcite $CaCO_3$	0.12	-0.20	0.12	-0.97	-0.68	-1.21	-1.08	-0.53
dawsonite $NaAlCO_3(OH)_2$	0.66	0.90	0.66	0.43	0.42	0.23	-0.32	0.50
rhodochrosite $MnCO_3$	0.17	-0.39	0.17	-0.38	0.41	-0.27	-0.57	0.70

SI results for most of the uranium phases in the deionized water extracts of tank C-202 sludge, shown in Table 3.86, are significantly undersaturated. Schoepite [$UO_3{\cdot}2H_2O$] appears to be near saturation only in the later extracts. Ca-autunite is highly oversaturated. The SI results for $(UO_2)_3(PO_4)_2{\cdot}4H_2O$ are erratic. These results suggest that schoepite or some other unidentified phase is controlling uranium solubility in the later extracts. Although uranium phases make up a substantial portion of the C-202 post-retrieval sludge (C-202 sludge is ≈24 wt.% U), no crystalline phases were identified by XRD (see Section 3.6.1). If schoepite is controlling uranium solubility in the later DDI extracts, it is likely that schoepite formed as a result of incongruent dissolution of other amorphous uranium phases during the sequence of extractions. Precipitation of uranyl phosphates may be kinetically inhibited. For example, Wellman et al. (2005) observed the progressive conversion of uranyl-oxyhydroxides to uranyl-silicates and finally to uranyl-phosphate over a period of 1-2 months in concrete.

The saturation indices calculated for $Fe(OH)_3$ in the DDI water extracts of the tank C-202 post-retrieval sludge sample are relatively high with an average and standard deviation of 2.05 ± 0.43. Gibbsite saturation indices in the C-202 DDI water extracts are also quite high with an average and standard deviation of 2.76 ± 0.45. SI values for dawsonite [$NaAlCO_3(OH)_2$] are closer to equilibrium with an average and standard deviation of 0.45 ± 0.58. SI values for calcite are somewhat undersaturated with an average and standard deviation of -1.29 ± 0.76. Rhodochrosite [$MnCO_3$] appears to be near saturation in these extracts with an average SI and standard deviation of -0.12 ± 0.71.

SI results for uranium phases in the $Ca(OH)_2$ saturated extracts are all very undersaturated with the exception of $Na_2U_2O_7$(c) which is near saturation in the initial extracts. These results indicate that some unidentified phase is controlling the dissolved uranium concentrations in these extracts or that dissolution/ precipitation is kinetically inhibited and the dissolved uranium concentration is not controlled by mineral equilibrium.

$Fe(OH)_3$, dawsonite, and rhodochrosite are all highly undersaturated in the $Ca(OH)_2$ extracts. Gibbsite is initially near saturation, but becomes undersaturated in the later extracts. Calcite is initially oversaturated, becoming increasingly so in the later extracts.

The SI results for čejkaite, $Na_2U_2O_7$(c), $Na_2U_2O_7$(am), and becquerelite in the $CaCO_3$ saturated extracts are all very undersaturated. Schoepite and $(UO_2)_3(PO_4)_2{\cdot}4H_2O$ approach saturation in some of the latter extracts. Ca-autunite is generally highly oversaturated in the $CaCO_3$ extracts. It would appear that schoepite or some other unidentified phase is controlling the dissolved uranium concentration in the $CaCO_3$ extracts.

As was the case for the DDI water extracts, the saturation indices calculated for $Fe(OH)_3$ and gibbsite in the $CaCO_3$ extracts are significantly oversaturated. For $Fe(OH)_3$, the average SI and standard deviation were calculated to be 1.62 ± 0.63. The average and standard deviation of the SI values for gibbsite were calculated to be 2.42 ± 0.40. As was the case for the DDI water extracts SI values for dawsonite are closer to equilibrium with an average and standard deviation of 0.40 ± 0.38. SI values for calcite are slightly undersaturated with an average and standard deviation of -0.65 ± 0.49. Rhodochrosite appears to be near saturation in these extracts with an average SI and standard deviation of -0.47 ± 0.48.

Results of the saturation index calculations for C-203 post retrieval sludge samples 19887 and 19961 are presented in Table 3.89 for the deionized water [DDI] extracts, Table 3.90 for the $Ca(OH)_2$ saturated extracts, and Table 3.91 for the $CaCO_3$ saturated extracts.

Table 3.89. Calculated Saturation Indices for Significant Phases in Tank C-203 Water Extractions

DDI Water Extracts (Sample 19887)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	4.62	2.07	4.62	4.12	3.13	1.97	0.71	4.46
$Na_2U_2O_7$ (am)	2.1	-0.44	2.1	1.61	0.62	-0.54	-1.80	1.95
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	2.48	<-3	2.48	3.95	5.15	1.00	1.34	7.64
schoepite $UO_3{\cdot}2H_2O$	-0.08	-1.13	-0.08	0.19	0.44	-0.31	-0.14	0.74
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	-0.07	-2.12	-0.07	0.16	2.18	-1.34	0.57	1.68
$Fe(OH)_3$	1.47	1.06	1.47	1.09	1.58	0.34	0.99	1.33
gibbsite $Al(OH)_3$	0.08	0.42	0.08	-0.38	-0.42	-0.66	-0.03	0.03
calcite $CaCO_3$	-0.49	-0.59	-0.49	-0.87	-0.40	-0.67	-0.44	-0.23
DDI Water Extracts (Sample 19961)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	6.26	3.67	6.26	3.63	3.19	1.02	-0.25	2.92
$Na_2U_2O_7$ (am)	3.75	1.16	3.75	1.12	0.68	-1.49	-2.76	0.41
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	6.49	-0.74	6.49	2.03	3.72	-0.93	-0.88	4.88
schoepite $UO_3{\cdot}2H_2O$	0.54	-0.61	0.54	-0.14	0.15	-0.59	-0.51	0.42
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	0.70	-1.35	0.70	-1.14	0.14	-1.80	-0.21	1.67
$Fe(OH)_3$	1.52	1.42	1.52	0.80	1.12	0.43	1.07	1.28
gibbsite $Al(OH)_3$	-0.33	0.08	-0.33	-0.64	-0.33	-0.48	0.16	0.47
calcite $CaCO_3$	-0.74	-0.54	-0.74	-1.06	-0.64	-0.67	-0.25	-0.58

Evaluation of the deionized water extract results for uranium minerals indicate that čejkaite is undersaturated throughout all extraction stages. This means that čejkaite, if present in the sludge, is dissolving into the water, but not at a sufficient rate to achieve equilibrium dissolved concentrations of its constituents. $Na_2U_2O_7$(c), $Na_2U_2O_7$(am), and becquerelite are generally oversaturated except for some of the later stages where these phases become undersaturated. Because no crystalline phases containing uranium were identified in the C-203 post-retrieval sludge by XRD, $Na_2U_2O_7$(c) or becquerelite are not expected to occur in occur in the post-retrieval sludge in significant quantities. The high degree of oversaturation with respect to these phases suggests that their formation was kinetically inhibited during the leaching tests. Schoepite is near saturation throughout all DDI leaching stages. Although a number of the SIs calculated for Ca-autunite suggest that this phase could be near equilibrium, many of the autinite SI values are very erratic with some very high values and some very low values. As a result, it does not appear that this phase is able to exert significant control over the solubility of uranium in the C-203 residual sludge. As indicated previously, the formation of uranyl-phosphates appears to be kinetically limited. The average and standard deviation of the saturation indices for schoepite shown in Table 3.89 is -0.07 ± 0.53. For Ca-autunite the average and standard deviation is -0.07 ± 1.35. These results suggest that residual čejkaite in the post-retrieval sludge may be dissolving incongruently to form schoepite. It is also possible that if $Na_2U_2O_7$(am) occurs in these post-retrieval sludge samples, it may also be dissolving incongruently to form schoepite in some of the later stage extracts. Poorly crystalline clarkeite ($Na_2U_2O_7$), was tentatively identified in pre-retrieval C-203 sludge (Deutsch et al. 2004), suggesting the possible occurrence of $Na_2U_2O_7$(am) in C-203 post-retrieval sludge.

Table 3.90. Calculated Saturation Indices for Significant Phases in Tank C-203 $Ca(OH)_2$ Extractions

$Ca(OH)_2$ Extracts (Sample 19887)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	1.40	1.80	1.40	-0.02	-0.35	-1.22	-2.96	<-3
$Na_2U_2O_7$ (am)	-1.11	-0.71	-1.11	-2.53	-2.86	<-3	<-3	<-3
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
schoepite $UO_3{\cdot}2H_2O$	-2.64	-2.38	-2.64	<-3	<-3	<-3	<-3	<-3
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	<-3	<-3	<-3	-	-	-	-	-
$Fe(OH)_3$	-1.36	-1.39	-1.36	-1.60	-1.53	-1.42	-1.41	-1.48
gibbsite $Al(OH)_3$	-0.67	-0.45	-0.67	-1.19	-1.24	-1.85	-2.69	-2.66
calcite $CaCO_3$	-0.63	-0.51	-0.63	1.00	0.63	1.73	2.48	2.21
$Ca(OH)_2$ Extracts (Sample 19961)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5D (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	2.49	6.19	2.49	1.52	0.10	-1.84	<-3	-
$Na_2U_2O_7$ (am)	-0.02	3.68	-0.02	-0.99	-2.41	<-3	<-3	-
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	3.14	<-3	<-3	<-3	<-3	<-3	-
schoepite $UO_3{\cdot}2H_2O$	-2.27	-0.52	-2.27	-2.62	<-3	<-3	<-3	-
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	<-3	<-3	<-3	<-3	-	-	-	-
$Fe(OH)_3$	-1.57	0.18	-1.57	-1.56	-1.73	-1.41	-2.05	-
gibbsite $Al(OH)_3$	-1.03	-0.79	-1.03	-1.16	-1.29	-2.80	<-3	-
calcite	-0.42	0.94	-0.42	-1.23	0.67	<-3	<-3	-

Several non-uranium containing phases that appeared to be near saturation and may be important from a contaminant release perspective are included in Table 3.89 through Table 3.91. These phases include $Fe(OH)_3$, gibbsite, and calcite. In the DDI water extract results for the C-203 sludge samples shown in Table 3.89, $Fe(OH)_3$ is consistently oversaturated with an average SI and standard deviation of 1.11 ± 0.38. It is possible that the complex matrix of the tank waste resulted in an amorphous $Fe(OH)_3$ phase with a solubility constant that is somewhat greater than that used in the thermodynamic database. Despite extensive efforts to characterize $Fe(OH)_3$ solubility, ambiguities remain (Byrne and Luo 2000). Solubility constants for $Fe(OH)_3$ are known to vary over a considerable range. For example, solubility constants available for $Fe(OH)_3$ in GWB vary by as much as 0.8 log units. Non-filterable colloids could also account for the large range in reported solubility constants. Gibbsite appears to be near saturation with an average SI and standard deviation of -0.14 ± 0.37 in the DDI leachates. Calcite is indicated to be somewhat undersaturated with an average SI and standard deviation of -0.58 ± 0.22 in the DDI leachates for residual sludge from Tank C-203.

Table 3.91. Calculated Saturation Indices for Significant Phases in Tank C-203 $CaCO_3$ Extractions

$CaCO_3$ Extracts (Sample 19887)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	-1.73	2.73	-1.73	2.03	-1.84	-0.85	-1.41	1.83
$Na_2U_2O_7$ (am)	<-3	0.22	<-3	-0.48	<-3	<-3	<-3	-0.68
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	-1.52	<-3	0.53	<-3	-3.00	<-3	4.56
schoepite $UO_3{\cdot}2H_2O$	-2.44	-0.71	-2.44	-0.32	-1.25	-0.72	-0.82	0.37
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	-3.0	-0.56	-3.0	0.73	-0.33	0.35	-0.11	2.74
$Fe(OH)_3$	1.33	1.60	1.33	1.60	1.16	1.11	0.96	1.76
gibbsite $Al(OH)_3$	0.74	0.37	0.74	0.13	0.57	0.42	-0.39	0.98
calcite $CaCO_3$	-0.14	-0.12	-0.14	-0.27	-0.57	-0.59	-0.66	0.04
$CaCO_3$ Extracts (Sample 19961)								
Phase	**1 Day**	**1 Month**	**Stage 1 (1 day)**	**Stage 2 (1 day)**	**Stage 3 (3 days)**	**Stage 4 (1 day)**	**Stage 5 (1 day)**	**Stage 6 (30 days)**
čejkaite $Na_4(UO_2)(CO_3)_3$	<-3	<-3	<-3	<-3	<-3	<-3	<-3	<-3
$Na_2U_2O_7$ (c)	2.34	3.65	2.34	0.67	-1.20	<-3	-2.48	-0.42
$Na_2U_2O_7$ (am)	-0.17	1.15	-0.17	-1.83	<-3	<-3	<-3	-2.93
becquerelite $Ca(UO_2)_6O_4(OH)_6{\cdot}8H_2O$	<-3	0.87	<-3	-1.69	<-3	<-3	<-3	2.19
schoepite $UO_3{\cdot}2H_2O$	-0.92	-0.34	-0.92	-0.60	-0.95	-0.45	-0.75	0.26
Ca-autunite $Ca(UO_2)_2(PO_4)_2$	-1.43	-0.03	-1.43	0.42	-0.33	3.29	0.85	4.43
$Fe(OH)_3$	1.51	1.70	1.51	1.42	1.02	0.98	0.92	1.76
gibbsite $Al(OH)_3$	0.03	0.16	0.03	0.10	0.53	0.95	0.14	1.72
calcite $CaCO_3$	-0.54	-0.22	-0.54	-0.48	-0.97	-1.29	-1.04	-0.44

The calculated SI results for the $Ca(OH)_2$ extracts for residual sludge C-203 in Table 3.90 also indicate that čejkaite is undersaturated throughout all extraction stages. With the exception of $Na_2U_2O_7$(c) in some of the initial leaching stages, all other uranium phases were undersaturated throughout each of the extraction stages. Because no uranium-bearing crystalline phases were identified in the C-203 post-retrieval sludge by XRD, $Na_2U_2O_7$(c) is not expected to occur in significant quantities. These results indicate that in the case of the $Ca(OH)_2$ extracts, čejkaite and possibly $Na_2U_2O_7$(am) in the later stages, are dissolving to release uranium. As a result of the high pH of the $Ca(OH)_2$ extracts, schoepite is not stable and cannot limit the dissolved concentration of uranium in this system.

$Fe(OH)_3$, gibbsite, and calcite (in sample 19961) are all generally undersaturated in the C-203 sludge $Ca(OH)_2$ extracts shown in Table 3.90. In the later stages of the $Ca(OH)_2$ extracts of sample 19887, the calcite SI indices indicate significant oversaturation. The reason for these high SI values is unclear, but the measured calcium concentrations in these extracts appear to be anomalously high.

The SI results for the $CaCO_3$ extracts in Table 3.91 are similar to those of the $Ca(OH)_2$ extracts discussed previously, except that some of the $CaCO_3$ extracts appear to be near equilibrium with respect to Ca-autunite. The SI results for Ca-autunite have an average and standard deviation of 0.50 ± 1.91. Although the average is near equilibrium, the high variability of the results indicates that this phase is not likely to exert significant control over the dissolved uranium concentration.

SI results for $Fe(OH)_3$, gibbsite, and calcite in the $CaCO_3$ extracts are similar to those observed for the water extracts. The average SI and standard deviation for $Fe(OH)_3$ is 1.35 ± 0.32. Gibbsite appears to be near saturation with an average SI and standard deviation of 0.46 ± 0.52. Calcite is indicated to be somewhat undersaturated with an average SI and standard deviation of -0.52 ± 0.38.

3.10 Uranium Mineral Solubility Measurements

Empirical solubility experiments were conducted with several C-203 post-retrieval sludge samples in an attempt to determine if $Na_2U_2O_7$(am) occurs in C-203 post-retrieval sludge. The experiments were designed so that, if $Na_2U_2O_7$(am) was the dominant uranium phase in the sludge, it would remain stable and control the dissolved concentration of uranium in the experiments.

The analytical results of the experiments are provided in Appendix I. A summary of the mineral SI calculations conducted with these data for $Na_2U_2O_7$(am) are shown in Table 3.92 and the details are found in the last portion of Appendix J starting on page J.254. Solutions with SI values near zero ($\approx \pm 0.5$) are generally considered to be near equilibrium with the solid, more positive values are considered oversaturated and more negative values are considered undersaturated. The resulting saturation indices indicate significant oversaturation of the experimental solutions with respect to $Na_2U_2O_7$(am) for all the experiments. In experiments 1 and 3, the degree of oversaturation is much higher for the 1 month contact times than for the shorter contact periods.

A number of reasons may account for the high degree of oversaturation with respect to $Na_2U_2O_7$(am) calculated for these experiments. The most likely cause for the oversaturation is the presence of residual, soluble čejkaite in the sludge. It was anticipated that any residual čejkaite that occurred in these sludge samples would readily dissolve in the first 1-day leach. Apparently this did not happen as evidenced by the later contacts.

Another possible reason for the high SI values for $Na_2U_2O_7$(am) includes erroneously low carbonate concentration measurements. Because uranium is strongly complexed by carbonate, increased carbonate concentrations cause an increase in the solubility of uranium minerals. Therefore, erroneously low carbonate concentrations measured in the solutions will result in calculated SI values that are high. The TIC concentrations used to calculate the carbonate concentration in these experiments appear to be suspect (see Appendix I). For example, it is known from the water leach experiments and TIC measurements on the sludge that significant amounts of carbonate occur in C-203 post-retrieval sludge. The results shown in Appendix I for experiment 2 indicate negative values for carbonate. The carbonate concentrations were determined from TIC measurements in the experimental solutions, which were determined by subtracting measured total organic carbon values from measured total carbon values. Because significantly negative values were determined for experiment 2, it seems likely that the carbonate values determined for experiments 1 and 3 are underestimated. Underestimated carbonate concentrations would result in calculated SI values that are erroneously high.

Table 3.92. $Na_2U_2O_7$(am) Saturation Indices for C-203 Solubility Experiments

Experiment #1, 1.0 M $NaNO_3$, 0.01 M NaOH			
Sample	**Stage**	**Leach Period**	**SI $Na_2U_2O_7$(am)**
19661	1	1 Day	1.86
19661	2	1 Day	1.19
19661	3	1 Week	0.99
19661	4	1 Month	2.14
19661 Duplicate	1	1 Day	1.29
19661 Duplicate	2	1 Day	1.13
19661 Duplicate	3	1 Week	0.96
19661 Duplicate	4	1 Month	1.76
19661 Yellow	1	1 Day	1.64
19661 Yellow	2	1 Day	1.19
19661 Yellow	3	1 Week	0.97
19661 Yellow	4	1 Month	2.17
Experiment #2, 1.0 M $NaNO_3$, 0.1 M NaOH			
Sample	**Stage**	**Leach Period**	**SI $Na_2U_2O_7$(am)**
19661	1	1 Day	3.51
19661	2	1 Day	3.01
19661	3	1 Week	2.55
19661	4	1 Month	2.00
19661 Duplicate	1	1 Day	3.49
19661 Duplicate	2	1 Day	3.04
19661 Duplicate	3	1 Week	2.53
19661 Duplicate	4	1 Month	2.21
19661 Yellow	1	1 Day	3.94
19661 Yellow	2	1 Day	3.61
19661 Yellow	3	1 Week	2.76
19661 Yellow	4	1 Month	2.16
Experiment #3, Stage 1-3: 1.0 M $NaNO_3$, 0.01 M NaOH, Stage 4: 1.0 M $NaNO_3$, 0.01 M NaOH, 0.001 M Na_2CO_3			
Sample	**Stage**	**Leach Period**	**SI $Na_2U_2O_7$(am)**
19661	1	1 Day	0.67
19661	2	1 Day	0.97
19661	3	1 Week	0.84
19661	4	1 Month	3.76
19661 Duplicate	1	1 Day	1.12
19661 Duplicate	2	1 Day	0.98
19661 Duplicate	3	1 Week	0.94
19661 Duplicate	4	1 Month	3.90
19887 Yellow	1	1 Day	2.21
19887 Yellow	2	1 Day	2.41
19887 Yellow	3	1 Week	0.97
19887 Yellow	4	1 Month	3.39

The method used to calculate activity coefficients in the thermodynamic model may be another possible reason for the high SI values that were calculated for $Na_2U_2O_7$(am). Because of the relatively high ionic strength of the solutions (~1M), the Pitzer ion-interaction model (Pitzer and Mayorga 1973; Pitzer 1991) is the preferred method to account for ionic strength affects. This approach was not used because measured values for the ion-interaction parameters needed for all the species of interest are not currently available. Instead the "B-dot" method (an extended form of the Debye-Hückel equation) was used to calculate activity coefficients (Helgeson 1969). For the conditions used in the empirical solubility experiments (experiments 1 and 3, in particular), the dominant dissolved uranium species was calculated to be the monovalent $UO_2(OH)_3^-$ species. As a result of the low charge of this species, it is expected that errors due to inaccurate ionic strength corrections were not very significant.

Other possible reasons for the high $Na_2U_2O_7$(am) SI values include the possibility that the K_{sp} value of Yamamura et al. (1998) used for this solid is not correct for the phase in our experiments and the possible formation of colloidal size uranium-bearing particles that could pass through the 0.45 μm filters used to filter the solutions prior to analysis. Other workers measuring the solubility of UO_2^{2+} precipitates have used filters with much smaller pore sizes to avoid this problem (e.g., Rai et al. 2002; Yamamura et al. 1998).

Because of the elevated SI values calculated for $Na_2U_2O_7$(am) in the solubility experiments, no definitive conclusions could be drawn from the results regarding the likely presence or absence of $Na_2U_2O_7$(am) in C-203 post-retrieval sludge.

4.0 Contaminant Release Model

The primary objective of this project is to develop source release models for contaminants of concern present in residual tank waste. As shown in Figure 4.1, this consists of laboratory testing to produce contaminant release data and a conceptual source release model. The release model can then be incorporated into a fate and transport model as part of long-term performance assessment for the tanks. This section describes the conceptual release models developed for the primary contaminants of concern (^{238}U, Cr, and ^{99}Tc) from the laboratory testing of residual sludge from the post-retrieved tanks C-202 and C-203. Results for ^{129}I were below the detection limit.

The contaminant release models for these tanks are based on empirical solubility release models. Post-retrieval sludge testing did not identify minerals in the residual solids that limit contaminant release, thus it was not possible to develop mechanistic release models for these post-retrieved tanks.

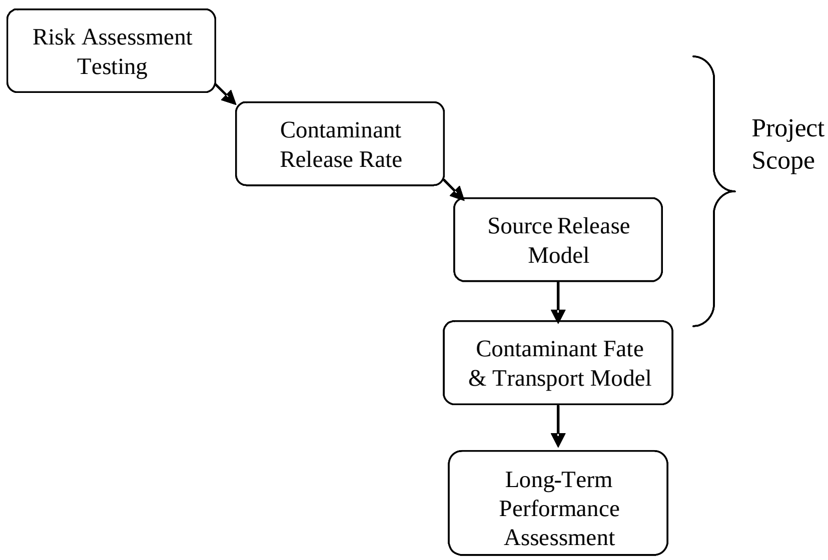


Figure 4.1. Source Release Model Development for Long-Term Performance Assessments

4.1 Uranium, Chromium, and ^{99}Tc Release Models

Two tank scenarios have been considered as part of the development of the contaminant release models for retrieved tanks C-202 and C-203. In the first scenario, it is assumed that the tanks are filled with a relatively inert material such as quartz sand or crushed basalt that does not significantly impact the chemistry of infiltration water that will contact the post-retrieval sludge. In this case, the composition of water contacting the post-retrieval sludge is assumed to be largely controlled by the solubility of $CaCO_3$ (calcite). Calcite is a ubiquitous component of most Hanford vadose zone sediments and future infiltrating water will likely equilibrate with this relatively soluble, reactive mineral.

In the second tank scenario, it is assumed that the tanks are filled with a cementitious grout. CaO is a major component of cement and readily reacts with water to form portlandite [$Ca(OH)_2$]. It is assumed that once the grout sets up some portion of its hydration product, the $Ca(OH)_2$, will remain unreacted in the grout, and it will control the pH of the system. During this timeframe, the pH of the leaching solution generated by the grout is expected to be about 12.

As dissolved CO_2 in water contacts the grout, $Ca(OH)_2$ will react to form $CaCO_3$ (calcite). After all the available $Ca(OH)_2$ has been converted to calcite, the grout will be considered to have been aged. At this point, the characteristics of the leaching solution generated by water contacting grout will be largely controlled by the solubility of calcite and the partial pressure of CO_2 gas in the system. If the CO_2 partial pressure is the same as that in the atmosphere, the pH of the solution will be approximately 8.3.

Because of the high concentrations of uranium in C-202 and C-203 residual sludge and its relatively high leachability from these residual sludges, uranium is expected to be an important risk driver for these tanks. Results of the saturation index calculations, TIC measurements, and XRD results for the samples suggest that the dominant form of uranium in C-202 and C-203 residual sludge could be $Na_2U_2O_7$(am) and that a small but significant percentage of uranium may remain as čejkaite. However, the saturation index calculations and testing of the sludge did not identify a specific phase that controlled the release of uranium, or any of the other primary contaminants of concern, in the $CaCO_3$ or $Ca(OH)_2$ extracts, which are our simplified end member infiltrating waters for aged and fresh grout, respectively.

Because testing of the residual sludge did not identify mineral equilibrium as a control on contaminant release, a mechanistic release model for these residual sludges could not be developed. In place of a mechanistic model, an empirical solubility release model was selected as the most appropriate method to describe contaminant release for residual sludges in tanks C-202 and C-203. $CaCO_3$ extract compositions are expected to provide the most representative release concentrations of contaminants for the first scenario in which the pore water is in equilibrium with calcite. $Ca(OH)_2$ extract compositions are expected to provide the most representative release concentrations of contaminants for the first phase of the second scenario (fresh cement) and the $CaCO_3$ extract compositions are expected to provide the most representative release concentrations of contaminants for the second phase of the second scenario (aged cement/grout in which the $Ca(OH)_2$ has been converted to $CaCO_3$).

The empirical solubility approach is likely to provide the most accurate estimates for the near-term period. It is expected that for longer time periods, this method will significantly overestimate concentrations of released contaminants. This is supported by the results of the sequential extracts, which generally demonstrate that contaminant concentrations leached from the residual sludge drop off significantly with increasing contact number. In most cases, concentrations for measurable contaminants decreased by at least a factor of 10 between stage 1 and stage 5. A concentration rebound was sometimes observed in stage 6, which had a 1- month contact time (compared to 1 or 3 days for stages 1-5).

The maximum dissolved concentrations measured in the multiple extraction experiments and total concentrations present in the residual sludge for the contaminants of concern (U, Cr, and ^{99}Tc) for the $Ca(OH)_2$ and $CaCO_3$ extracts are shown in Table 4.1. The maximum values measured in each extraction experiment usually occurred in stage 1 (1-day contact) or the 1-month single-contact extraction, but in some cases the maximum concentration occurred in stage 6 (30-day contact). Chemical composition data for all the extraction experiments are tabulated in Appendix I. Total sludge concentrations shown in Table 4.1 were determined from either fusion or acid digestion, whichever produced the highest result (Section 3.1 contains the results of the sludge composition measurements).

Table 4.1. Maximum Dissolved Concentrations Measured in Extraction Experiments and Total Sludge Concentrations Measured for U, Cr, ^{99}Tc, and ^{129}I

Tank Sample	Extract Solution	Component	Sludge Conc. µg/g Sludge	Max. Release Conc. µg/L
19250 (C-202)	$CaCO_3$	U	2.4 x 10^5	6.1 x 10^4
	$Ca(OH)_2$	U	2.4 x 10^5	1.7 x 10^3
	$CaCO_3$	Cr	1.0 x 10^4	2.0 x 10^3
	$Ca(OH)_2$	Cr	1.0 x 10^4	7.1 x 10^3
	$CaCO_3$	^{99}Tc	0.23	0.041
	$Ca(OH)_2$	^{99}Tc	0.23	0.054
19887 (C-203)	$CaCO_3$	U	6.4 x 10^5	4.5 x 10^5
	$Ca(OH)_2$	U	6.4 x 10^5	5.3 x 10^3
	$CaCO_3$	Cr	4.6 x 10^3	1.2 x 10^4
	$Ca(OH)_2$	Cr	4.6 x 10^3	3.4 x 10^3
	$CaCO_3$	^{99}Tc	0.15	<0.5
	$Ca(OH)_2$	^{99}Tc	0.15	<0.5
19961 (C-203)	$CaCO_3$	U	5.4 x 10^5	5.1 x 10^5
	$Ca(OH)_2$	U	5.4 x 10^5	3.0 x 10^5
	$CaCO_3$	Cr	4.0 x 10^3	1.3 x 10^4
	$Ca(OH)_2$	Cr	4.0 x 10^3	1.1 x 10^4
	$CaCO_3$	^{99}Tc	0.073	0.16
	$Ca(OH)_2$	^{99}Tc	0.073	0.38

Because two C-203 samples were analyzed, the highest value measured in the respective leachates from these two residual sludge samples was used for the release model. These values along with the C-202 release model values are provided in Table 4.2. Scenario 1 and Phase 2 of scenario 2 are indicated as calcite [$CaCO_3$]. Phase 1 of scenario 2 is indicated as fresh cement [$Ca(OH)_2$]. The uranium concentration in the C-202 sludge (2.4 x 10^5 µg/g sludge, 24%) is about half that of the C-203 sludge (5.9 x 10^5 µg/g sludge, 59%). It is also noteworthy that the calcite stage for both tanks has uranium release concentrations that are greater by factors of 36 (C-202) and 1.7 (C-203) than those of the fresh cement phase. For tank C-202 the maximum uranium release concentration (6.1 x 10^4 µg/L) is nearly ten times less than that for C-203 (5.1 x 10^5 µg/L). The maximum release concentration for the C-202 residual sludge during the fresh cement phase (1.7 x 10^3 µg/L) is more than one hundred times less than that from the C-203 residual sludge (3.0 x 10^5 µg/L) during this phase.

The Cr concentration in the C-202 residual sludge (1.0 x 10^4 µg/g sludge, 1%) is more than double that of the C-203 residual sludge (4.3 x 10^3 µg/g sludge, 0.43%). For tank C-202 residual sludge, Cr release concentrations (2.0 x 10^3 µg/L) for the calcite stage are 28% of those for the fresh cement phase (7.1 x 10^3 µg/L). In the case of tank C-203, the Cr release concentration (1.3 x 10^4 µg/L) for the calcite stage is similar to the fresh cement phase (1.1 x 10^4 µg/L). It had been hypothesized previously in Section 3.8 that the high pH (>12) of the fresh cement solution enhanced Cr release compared to the lower pH (8 to 10.5) of the calcite stage. This would explain the higher Cr release concentrations for residual sludge in tank C-202, but does not explain the similar release concentrations for tank C-203.

Table 4.2. Sludge and Contaminant Release Concentrations for Release Model

Tank	Release Scenario	Component	Sludge Conc. µg/g Sludge	Max. Release Conc. µg/L
C-202	Calcite [$CaCO_3$]	U	2.4×10^5	6.1×10^4
	Fresh cement [$Ca(OH)_2$]	U	2.4×10^5	1.7×10^3
	Calcite [$CaCO_3$]	Cr	1.0×10^4	2.0×10^3
	Fresh cement [$Ca(OH)_2$]	Cr	1.0×10^4	7.1×10^3
	Calcite [$CaCO_3$]	^{99}Tc	0.23	0.041
	Fresh cement [$Ca(OH)_2$]	^{99}Tc	0.23	0.054
C-203	Calcite [$CaCO_3$]	U	5.9×10^5	5.1×10^5
	Fresh cement [$Ca(OH)_2$]	U	5.9×10^5	3.0×10^5
	Calcite [$CaCO_3$]	Cr	4.3×10^3	1.3×10^4
	Fresh cement [$Ca(OH)_2$]	Cr	4.3×10^3	1.1×10^4
	Calcite [$CaCO_3$]	^{99}Tc	0.11	0.16
	Fresh cement [$Ca(OH)_2$]	^{99}Tc	0.11	0.38

The residual sludge concentration of ^{99}Tc in C-202 (2.3×10^{-1} µg/g sludge) is over twice that of C-203 (1.1×10^{-1} µg/g sludge). The ^{99}Tc release concentrations are generally based on estimated solution concentrations because levels were below the EQL. Maximum release concentrations determined for C-202 for the calcite scenario (4.1×10^{-2} µg/L) are similar to the C-202 fresh cement scenario (5.4×10^{-2} µg/L). For C-203, the maximum ^{99}Tc release concentrations are 1.6×10^{-1} µg/L for the calcite scenario and 3.8×10^{-1} µg/L for the fresh cement scenario.

4.2 Integration of the C-202 and C-203 Release Data with Fate and Transport Modeling Codes

Selecting which release concentration data from Table 4.2 to use for scenario 1 in which the tank is filled with relatively inert solids is straightforward because the calcite [$CaCO_3$] values will be used for the entire modeling period. For scenario 2 in which a cementitious material is used to fill the tank, the decision on when to switch the release concentrations from those for fresh cement [$Ca(OH)_2$ stage] to those for aged grout ($CaCO_3$ stage) is somewhat problematic. The primary reason for this is the large uncertainty in how fast the grout will age. The aging process depends upon the rate of water infiltration as well as the surface area of grout that comes in contact with the water. Infiltration will be dependent upon precipitation, evaporation, effectiveness of surface barriers, etc. The surface area of grout will depend upon the size of the grout monolith, the physical integrity of the grout, and the geologic stability of the location where the grout monolith will exist. As cracks develop within the monolith, more surface area will become available to contact infiltrating water and to react with dissolved CO_2. Because the rates of these processes are largely unknown, an estimate of when to switch from the fresh cement to the aged cement scenario cannot be determined with confidence at this time. In the absence of a scientifically defensible method for selecting the time for this transition, a conservative approach is recommended. The most conservative approach would be to use the highest release concentration of the two scenarios for each contaminant listed in Table 4.2 over the entire modeling period.

5.0 Conclusions

This report provides the results of laboratory tests on post-retrieval (residual) sludge samples from Hanford tanks C-202 and C-203 and describes the development of source term release models for the primary contaminants of concern. The major conclusions from this work are discussed in this section.

The contaminant release models for these retrieved tanks are based on empirical solubility release models. Residual sludge testing did not identify minerals in the solids that limit contaminant release; thus, it was not possible to develop mechanistic release models for these retrieved tanks. The empirical release models apply to two different tank filling scenarios. In the first scenario the tank is filled with a relatively inert material, such as sand, and the leaching solution that contacts sludge in the future is in equilibrium with $CaCO_3$. Alternatively, the tanks might be filled with a cementitious material, which would produce a $Ca(OH)_2$ dominated leaching solution while the cement is fresh. As the cement reacts with infiltrating water and ages, it would evolve to resemble the $CaCO_3$ solution of the first scenario. It is not possible to predict the amount of time necessary for the transition from a $Ca(OH)_2$ to a $CaCO_3$ leaching solution for the second scenario, but it is likely to take hundreds if not thousands of years. Empirical solubility release models for the primary contaminants of interest (U, Cr, and ^{99}Tc) have been developed from laboratory leaching tests of residual (post-retrieval) sludge samples using $Ca(OH)_2$ and $CaCO_3$ leaching solutions.

Uranium in the residual sludge of tank C-202 was measured at a concentration of 240,000 μg/g sludge (24%). For this tank, the maximum release concentration in the $CaCO_3$ solution extractions was 61,000 μg/L and in the $Ca(OH)_2$ solution extractions it was 1,700 μg/L. The high pH of the $Ca(OH)_2$ leaching solution (pH ~ 11.5) compared to the $CaCO_3$ solution (pH ~ 8.5) may have produced conditions in which the uranium minerals are less soluble in the $Ca(OH)_2$ leaching environment. The uranium concentration in tank C-203 residual sludge was 590,000 (μg/g sludge) (59%). For this tank, the maximum uranium release concentration in the $CaCO_3$ solution extractions was 510,000 μg/L and in the $Ca(OH)_2$ solution extractions it was 300,000 μg/L. The residual uranium solids in this tank are much more soluble than those in tank C-202 under each of the leaching conditions. The presence of uranium minerals in these residual sludge samples was not identified by XRD or SEM/EDS analyses. In addition, saturation index calculations for the residual sludge leachates did not show equilibrium with any uranium solids.

An association was identified between chromium and iron in the residual sludges from the two tanks (Section 3.8). The analytical data suggest that chromium is present in the residual sludge as the chromate (CrO_4^{2-}) species that is adsorbed onto the surface of the iron oxide/hydroxide solids and also incorporated into the structure of these solids. The release of chromium from the residual sludge would thus be controlled by both the desorption process and the dissolution of the iron oxide solids. Chromium in the residual sludge of tank C-202 was measured at a concentration of 10,000 μg/g sludge (1%). For this tank, the maximum release concentration in the $CaCO_3$ solution extractions was 2,000 μg/L and in the $Ca(OH)_2$ solution extractions it was 7,100 μg/L. The high pH of the $Ca(OH)_2$ leaching solution (pH ~ 11.5) compared to the $CaCO_3$ solution (pH ~ 8.5) may have enhanced the Cr desorption process leading to the higher dissolved Cr concentrations in the $Ca(OH)_2$ leaching environment. The residual chromium concentration in tank C-203 was 4,300 (μg/g sludge) (0.43%). For this tank, the maximum chromium release concentration in the $CaCO_3$ solution extractions was 13,000 μg/L and in the $Ca(OH)_2$ solution extractions it was 11,000 μg/L.

The average ^{99}Tc concentration in the residual sludge from tank C-202 was measured at 0.23 μg/g sludge. The ^{99}Tc concentration in the $CaCO_3$ solution extractions was less than the detection limit for most of the tests; however, an estimated ^{99}Tc concentration was reported for the one-month single contact test. This value was 0.041 μg/L. Most of the ^{99}Tc concentrations in the $Ca(OH)_2$ solution extractions for tank C-202 were below the detection limit; however, one value was measured at 0.054 μg/L for the one-month single contact extraction and it was chosen as the ^{99}Tc release concentration. The average ^{99}Tc concentration in the residual sludge from tank C-203 was measured at 0.11 μg/g sludge. Most of the ^{99}Tc concentration measurements for both the $CaCO_3$ and $Ca(OH)_2$ extractions were less than the detection limit; however, estimated concentrations of 0.16 μg/L for the $CaCO_3$ solution extraction and 0.38 μg/L for the $Ca(OH)_2$ solution extraction were reported. These values represent the ^{99}Tc release concentrations for these stages of the release environment.

6.0 References

10 CFR 830.120. "Quality Assurance Requirements; Scope." *Code of Federal Regulations*, U.S. Department of Energy.

ASTM. 1998. *D2216-98 Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass*. American Society for Testing and Materials, West Conshohocken, Pennsylvania.

ASTM. 1999. *D3987-85 Standard Test Method for Shake Extraction of Solid Waste with Water*. American Society for Testing and Materials, West Conshohocken, Pennsylvania.

Bethke CM. 2006. *The Geochemist's Workbench®*, Release 6.0. Hydrogeology Program, University of Illinois, Urbana, Illinois.

Brown CF, KN Geiszler, and TS Vickerman. 2005. "Extraction and Quantitative Analysis of Iodine in Solid and Solution Matrices." *Analytical Chemistry* 77:7062-7066.

Bushaw RA. 2006. *Final Report for Tank 241-C-202 Post Retrieval Solid Finger Trap Grab Samples.* RPP-RPT-28734, ATL Internation Inc., Richland, Washington.

Byrne RH and Y Luo. 2000. "Direct Observations of Nonintegral Hydrous Ferric Oxide Solubility Products: K*SO = [Fe3+][H+]-2.86." *Geochimica et Cosmochimica Acta* 64:1873-1877.

Cantrell KJ, RJ Serne, and GV Last. 2003. *Hanford Contaminant Distribution Coefficient Database and Users Guide.* PNNL-13895 Rev. 1, Pacific Northwest National Laboratory, Richland, Washington.

Clesceri LS, AE Greenberg, and AD Eaton. 1998. *Standard Methods for the Examination of Water and Wastewater*, 20th Edition. American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

Conner JM. 1996. *Tank Characterization Report for Single-Shell Tank 241-C-204*. WHC-SD-WM-ER-479, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

De Lorenzo DS, AT DiCenso, DB Hiller, KW Johnson, JH Rutherford, DJ Smith, and BC Simpson. 1994. *Tank Characterization Reference Guide*. WHC-SD-WM-TI-648, Rev 0, prepared for Westinghouse Hanford Company by Los Alamos Technical Associates, Kennewick, Washington.

Deutsch WJ, KM Krupka, MJ Lindberg, KJ Cantrell, CF Brown, and HT Schaef. 2004. *Hanford Tanks 241-C-203 and 241-C-204: Residual Waste Contaminant Release Model and Supporting Data*. PNNL-14903, Pacific Northwest National Laboratory, Richland, Washington.

Deutsch WJ, KM Krupka, KJ Cantrell, CF Brown, MJ Lindberg, HT Schaef, SM Heald, BW Arey, and RK Kukkadapu. 2005. *Advances in Geochemical Testing of Key Contaminants in Residual Hanford Tank Waste*. PNNL-15372, Pacific Northwest National Laboratory, Richland, Washington.

DOE. 1998. *Hanford Analytical Services Quality Assurance Requirements Documents*. DOE/RL-96-68, HASQARD, Volumes 1, 2, 3, and 4. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE Order 414.1A. 1999. "Quality Assurance." U.S. Department of Energy, Washington, D.C.

EPA. 1994. "Method 9056, Determination of Inorganic Anions by Ion Chromatography," Rev. 0. In *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* EPA SW-846. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Accessed September 11, 2007, at http://www.epa.gov/sw-846/9_series.htm

EPA. 1996. "Method 3052, Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices," Rev. 0. In *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* EPA SW-846. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Available at: http://www.epa.gov/epaoswer/hazwaste/test/3_series.htm

EPA. 1996. "Method 6010B, Inductively Coupled Plasma – Atomic Emission Spectrometry" Rev. 2. In *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* EPA SW-846, Online. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Accessed September 11, 2007, at http://www.epa.gov/sw-846/6_series.htm

EPA. 1996. "Method 6020, Inductively Coupled Plasma – Mass Spectrometry," Rev. 0. In *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* EPA SW-846. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Accessed September 11, 2007, at http://www.epa.gov/sw-846/6_series.htm

EPA. 2004. "Method 9040C, pH Electrometric Measurement," Rev. 3. In *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* EPA SW-846. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Accessed September 11, 2007, at http://www.epa.gov/sw-846/9_series.htm

EPA. 2004. "Method 9060A. Total Organic Carbon," Rev. 1. In *Test Methods for Evaluating Solid Wastes: Physical/Chemical Methods.* EPA SW-846. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C. Accessed September 11, 2007, at http://www.epa.gov/epaoswer/hazwaste/test/pdfs/9060a.pdf

Felmy AR, Y Xia, and Z Wang. 2005. "The Solubility Product of $NaUO_2PO_4 \cdot xH_2O$ Determined in Phosphate and Carbonate Solutions." *Radiochima Acta* 93(7):401-408.

Fiskum SK, CJ Barinaga, JP Bramson, KJ Carson, and JR DesChane. 2000. *Inorganic and Radio-chemical Analysis of 241-C-104 Tank Waste*. PNNL-13364 (WTP-RPT-007-Rev. 0) (formerly BNFL-RPT-043), Pacific Northwest National Laboratory, Richland, Washington.

Helgeson HC, JM Delany, HW Nesbitt, and DK Bird. 1978. "Summary and Critique of the Thermodynamic Properties of Rock-Forming Minerals." *American Journal of Science* 278-A:1-229.

Johnson ME. 2003. *Origin of Wastes in C-200 Series Single-Shell Tanks*. RPP-15408, CH2M HILL Hanford Group, Richland Washington.

Kalmykov S and GR Choppin. 2000. "Mixed $Ca^{2+}/UO_2^{2+}/CO_3^{2-}$ Complex Formation at Different Ionic Strengths." *Radiochima Acta* 88:603-606.

Krupka KM, WJ Deutsch, MJ Lindberg, KJ Cantrell, NJ Hess, HT Schaef, and BW Arey. 2004. *Hanford Tanks 241-AY-102 and 241-BX-101: Sludge Composition and Contaminant Release Data*. PNNL-14614, Pacific Northwest National Laboratory, Richland, Washington.

Krupka KM, HT Schaef, BW Arey, SM Heald, WJ Deutsch, MJ Lindberg, and KJ Cantrell. 2006. "Residual Waste from Hanford Tanks 241-C-203 and 241-C-204. 1. Solids Characterization." *Environmental Science and Technology* 40(12):3749-3754.

Langmuir D. 1978. "Uranium Solution-Mineral Equilibria at Low Temperatures with Applications to Sedimentary Ore Deposits." *Geochimica et Cosmochimica Acta* 42:547-569.

Lindberg MJ and WJ Deutsch. 2003. *Tank 241-AY-102 Data Report*. PNNL-14344, Pacific Northwest National Laboratory, Richland, Washington.

McKinney SG. 2005. *Final Report for Tank 241-C-203 Post Retrieval Solid Finger Trap Grab Samples*. RPP-RPT-26925, CH2M HILL Hanford Group, Inc., Richland, Washington.

Pitzer KS and G Mayorga. 1973. "Thermodynamics of Electrolytes. II. Activity and Osmotic Coefficients for Strong Electrolytes with One or Both Ions Univalent." *Journal of Physical Chemistry* 77:2300-2308.

Pitzer KS. 1991. "Ion Interaction Approach: Theory and Data Correlation." In *Activity Coefficients in Electrolyte Solutions,* ed. KS Pitzer, Chap. 3, pp. 75-153, CRC Press, Boca Ratan, Florida.

Rai D, BM Sass, and DA Moore. 1987. "Chromium(III) Hydrolysis Constants and Solubility of Chromium(III) Hydroxide." *Inorganic Chemistry* 26:345-349.

Rai D, AR Felmy, NJ Hess, VL LeGore, and DE McCready. 2002. "Thermodynamics of the U(VI)-Ca^{2+}-$Cl^{-}$$OH^{-}$$H_2O$ System: Solubility Product of Becquerelite." *Radiochima Acta* 90:495-503.

Simpson BC. 1994. *Tank 241-T-111 Characterization Report*. WHC-EP-0806, Westinghouse Hanford Company, Richland, Washington.

Smith GL, DJ Bates, RW Goles, LR Greenwood, RC Lettau, GF Piepel, MJ Schweiger, HD Smith, MW Urie, and JJ Wagner. 2001. *Vitrification and Product Testing of C-104 and AZ-102 Pretreated Sludge Mixed with Flowsheet Quantities of Secondary Wastes*. PNNL-13452, Pacific Northwest National Laboratory, Richland, Washington.

Strachan DM, HT Schaef, MJ Schweiger, KL Simmons, LJ Woodcock, and MK Krouse. 2003. "A Versatile and Inexpensive XRD Specimen Holder for Highly Radioactive or Hazardous Specimens." *Powder Diffraction* 18(1):23-28.

Um W, RJ Serne, and KM Krupka. 2004. "Linearity and Reversibility of Iodide Adsorption on Sediments from Hanford, Washington, Under Water-Saturated Conditions." *Water Research* 38:2009-2016.

Wellman DM, SV Mattigod, BW Arey, MI Wood, and SW Forrester. 2005. "In-Situ Identification of Uranium Minerals in Concrete." *Geochimica et Cosmochimica Acta* 69:A468, Suppl. S.

Yamamura T, A Kidtamura, A Fukui, S Nishikawa, T Yamamoto, and H Moriyama. 1998. "Solubility of U(VI) in Highly Basic Solutions." *Radiochima Acta* 83:139-146.

Appendix A

X-Ray Diffraction Patterns for Unleached and Leached Samples of Post-Retrieval Residual Waste from Tank C-202

Appendix A

X-Ray Diffraction Patterns for Unleached and Leached Samples of Post-Retrieval Residual Waste from Tank C-202

For comparison to the background signal in the as-measured XRD patterns included in this appendix and Appendix B, Figure A.1 shows the XRD pattern for collodion film measured in the absence of any sludge material and reported by Krupka et al. (2004).[(a)] This also appendix presents the as-measured and background-subtracted x-ray powder diffraction (XRD) patterns for the following samples of post-retrieval residual waste from tank 241-C-202 (C-202):

- Unleached solids (Figure A.2)
- One month single-contact leached water extraction solids (Figure A.3)
- One month single-contact $Ca(OH)_2$ leached solids (Figure A.4)
- One month single-contact $CaCO_3$ leached solids. (Figure A.5)

The instrumentation and procedures used for measuring, subtracting background, and interpreting the XRD patterns for these materials are described in the main report. The vertical axis in each of the following patterns represents the intensity in counts per second (cps) of the XRD peaks. The horizontal axis is in terms of degrees 2θ based on $Cu_{K\alpha}$ radiation (λ=1.5406 Å), and is related to *d* spacing according to the Bragg law (Cullity 1956).[(b)] The XRD patterns show, for comparison purposes, the schematic database (PDF) pattern for corundum (used as a 2θ internal standard) and any other phases thought to be present in the sample mount. The height of each line in the schematic PDF patterns represents the relative intensity of an XRD peak (i.e., the most intense [the highest] peak has a relative intensity [I/I_o] of 100%).

(a) Krupka KM, WJ Deutsch, MJ Lindberg, KJ Cantrell, NJ Hess, HT Schaef, and BW Arey. 2004. *Hanford Tanks 241-AY-102 and 241-BX-101: Sludge Composition and Contaminant Release Data*. PNNL-14614, Pacific Northwest National Laboratory, Richland, Washington.

(b) Cullity BD. 1967. *Elements of X-Ray Diffraction.* Addison-Wesley Publishing Company, Inc., Reading, Massachusetts.

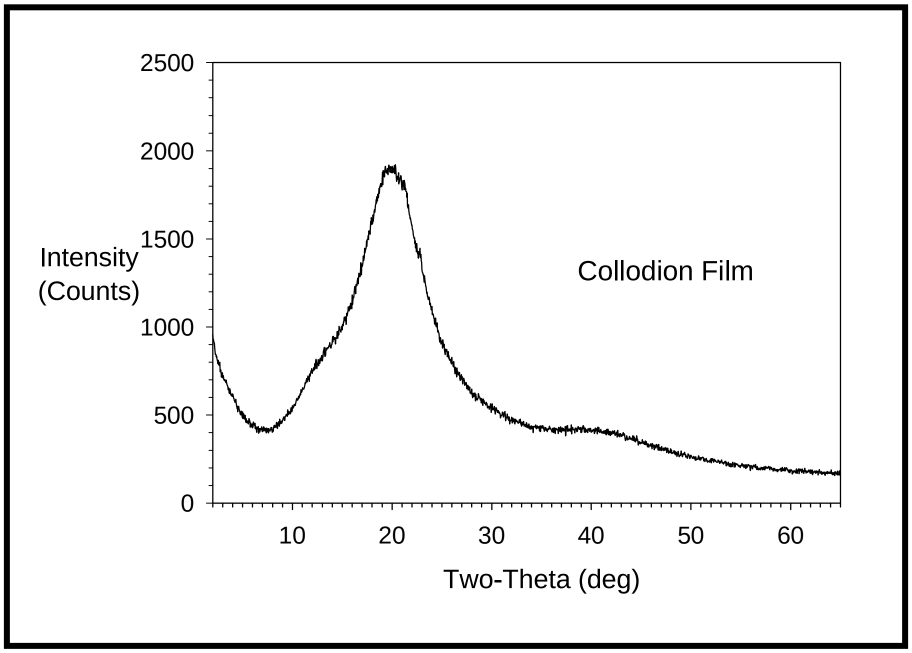


Figure A.1. XRD Pattern for Collodion-Solution Film (from Krupka et al. 2004)

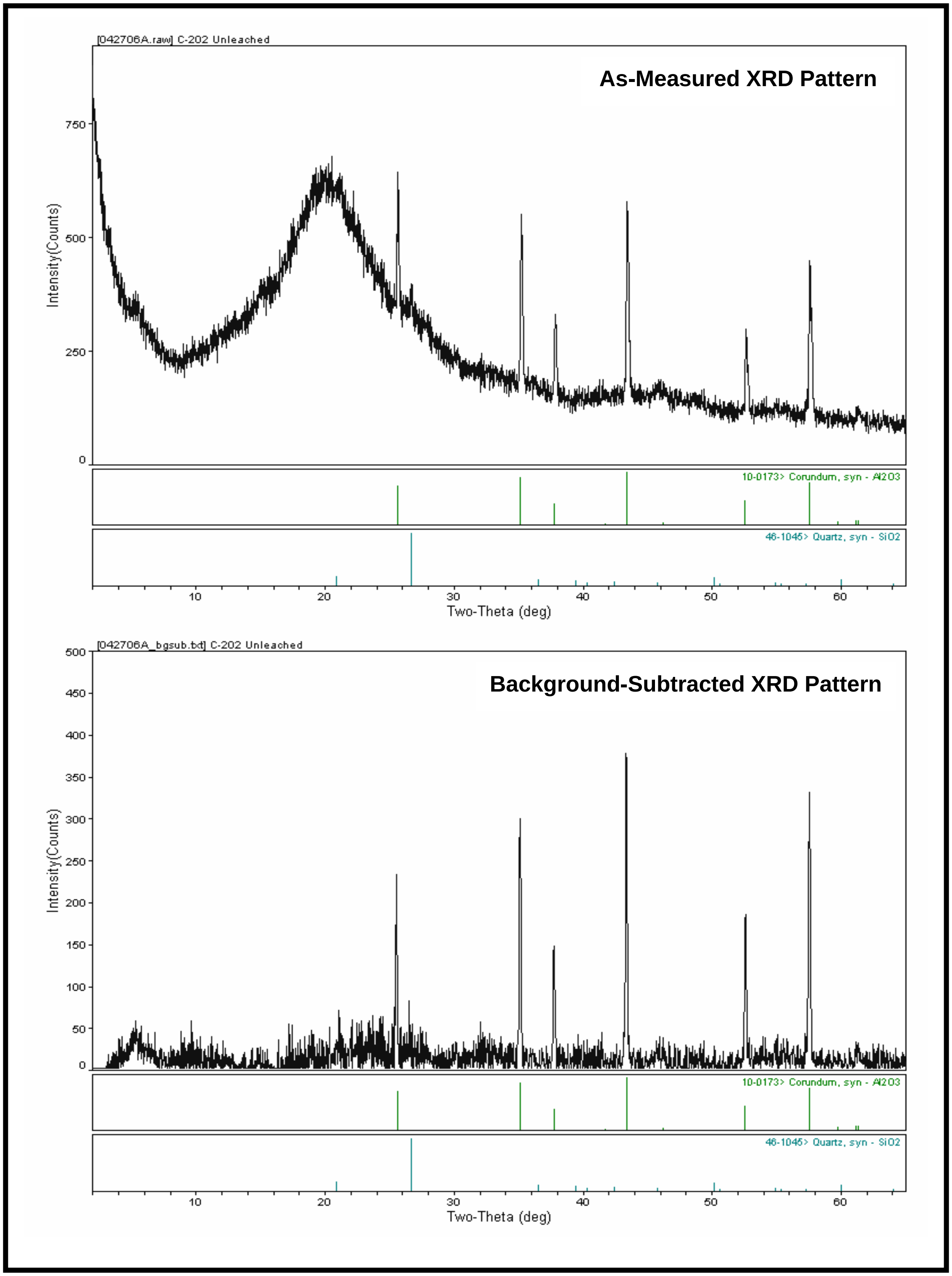


Figure A.2. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for the Sample of Unleached C-202 Post-Retrieval Residual Waste

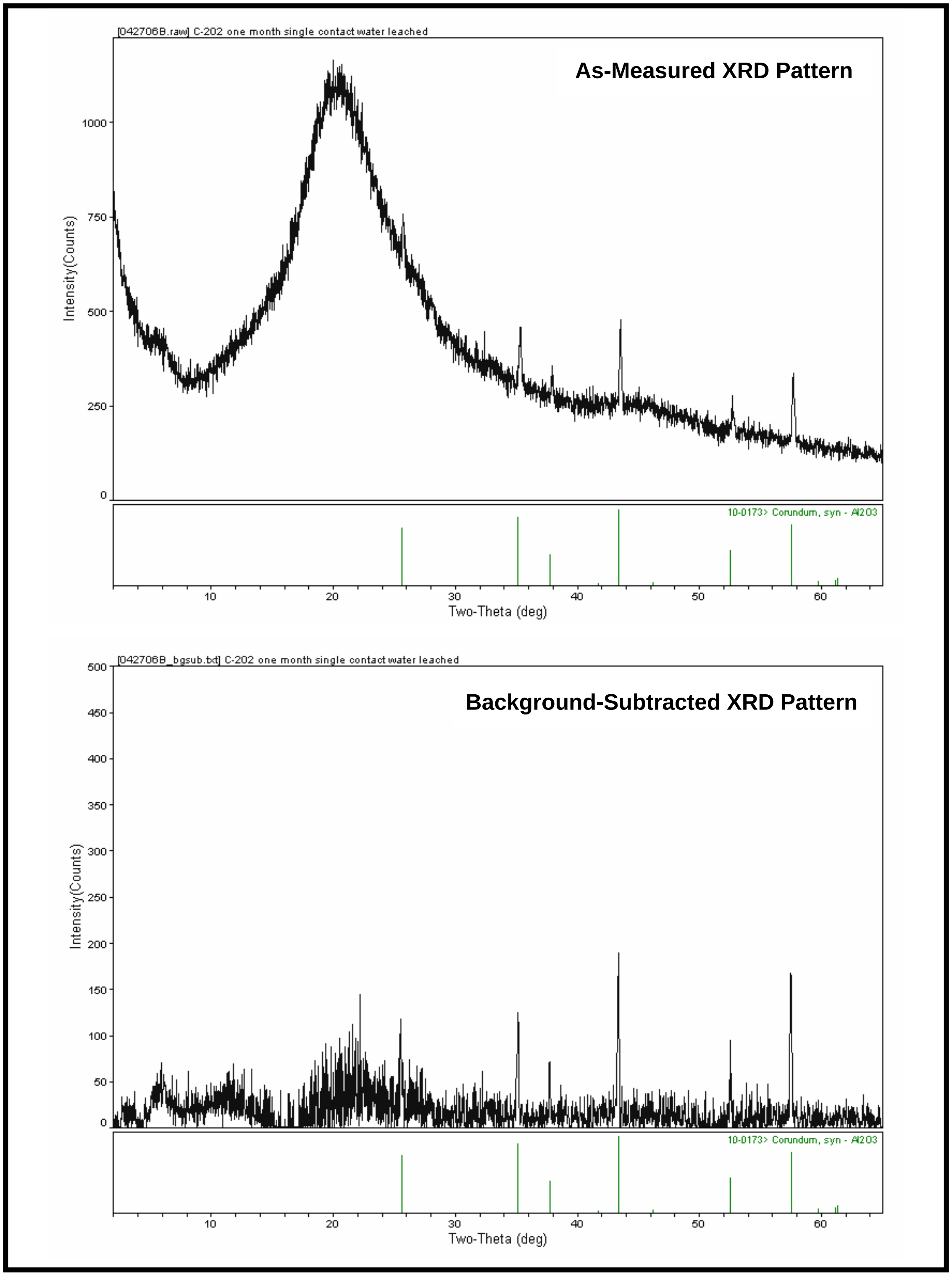


Figure A.3. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for the Sample of One Month Single-Contact Leached Water Extraction C-202 Post-Retrieval Residual Waste

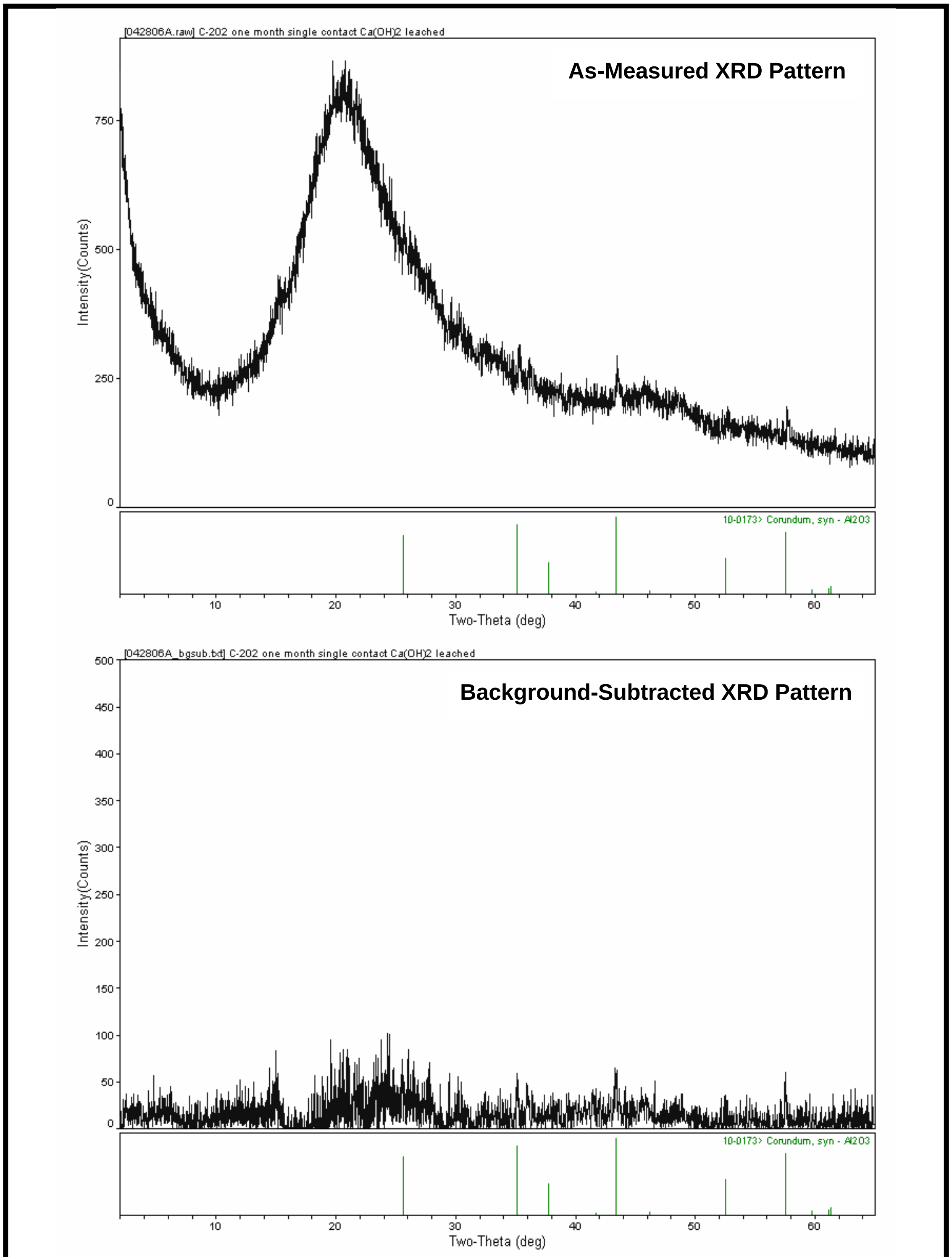


Figure A.4. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for the Sample of One Month Single-Contact $Ca(OH)_2$ Leached C-202 Post-Retrieval Residual Waste

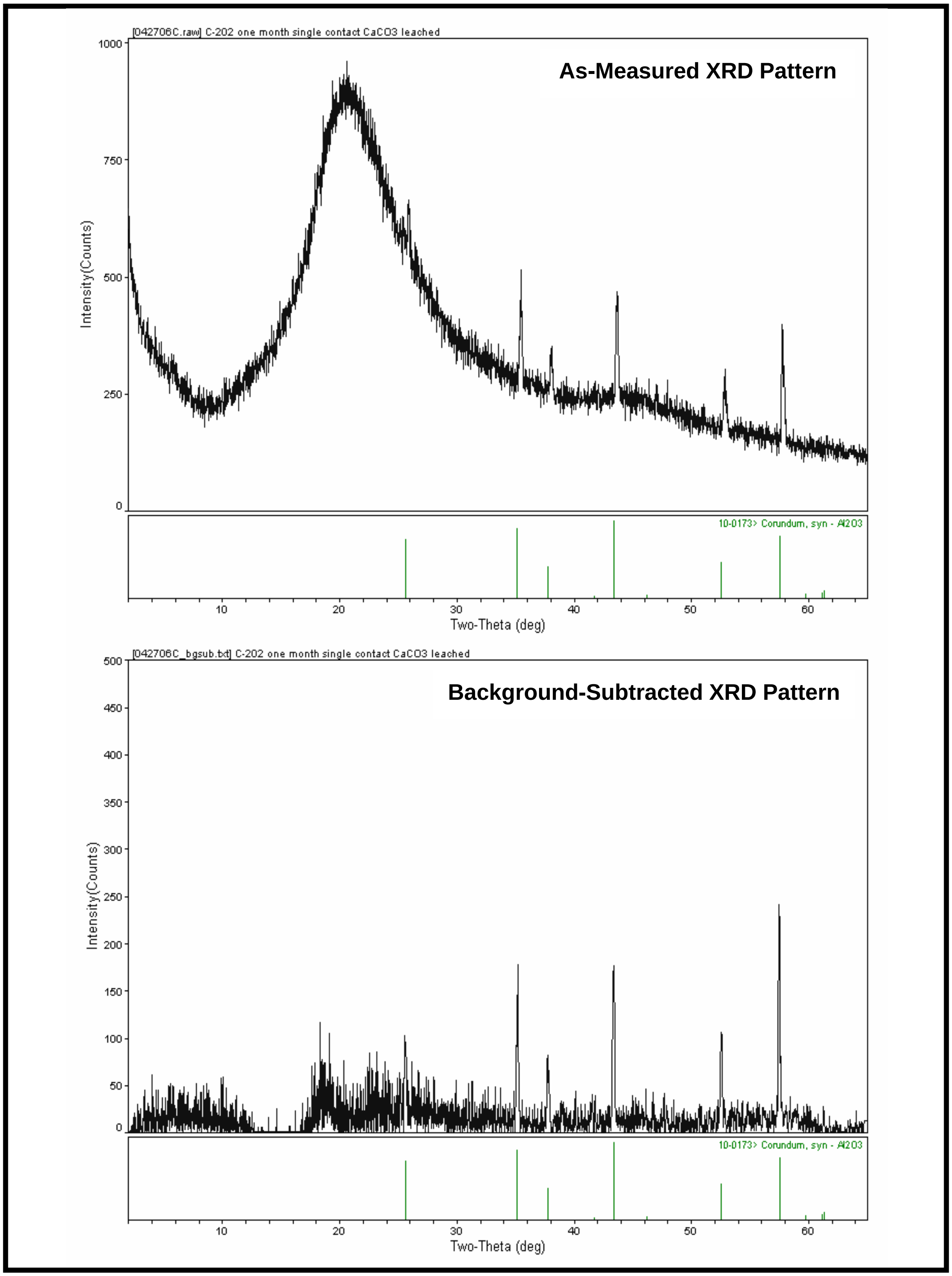


Figure A.5. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for the Sample of One Month Single-Contact $CaCO_3$ Leached C-202 Post-Retrieval Residual Waste

Appendix B

X-Ray Diffraction Patterns for Unleached and Leached Samples of Post-Retrieval Residual Waste from Tank C-203

Appendix B

X-Ray Diffraction Patterns for Unleached and Leached Samples of Post-Retrieval Residual Waste from Tank C-203

This appendix presents the as-measured and background-subtracted x-ray powder diffraction (XRD) patterns for the following samples of C-203 post-retrieval residual waste:

- Unleached brown, yellow, and orange solids separated from sample 19887 (Figures B.1 through B.3, respectively)
- Unleached brown, yellow, and orange solids separated from sample 19961(Figures B.4 through B.6, respectively)
- One month single-contact leached water extraction of solids from sample 19961 (Figure B.7)
- Sequential leached water extraction of solids from sample 19961 (Figure B.8)
- One month $Ca(OH)_2$-leached solids from sample 19961 (Figure B.9)
- Sequential $Ca(OH)_2$-leached solids from sample 19961 (Figure B.10)
- One month $CaCO_3$-leached solids from sample 19961 (Figure B.11)
- Sequential $CaCO_3$-leached solids from sample 19961 (Figure B.12)

The instrumentation and procedures used for measuring, subtracting background, and interpreting the XRD patterns for these materials are described in the main report. The vertical axis in each of the following patterns represents the intensity in counts per second (cps) of the XRD peaks. The horizontal axis is in terms of degrees 2θ based on $Cu_{K\alpha}$ radiation (λ=1.5406 Å), and is related to *d* spacing according to the Bragg law (Cullity 1956).[(a)] The XRD patterns show, for comparison purposes, the schematic database (PDF) pattern for corundum (used as a 2θ internal standard) and any other phases thought to be present in the sample mount. The height of each line in the schematic PDF patterns represents the relative intensity of an XRD peak (i.e., the most intense [the highest] peak has a relative intensity [I/I_o] of 100%).

(a) Cullity BD. 1967. *Elements of X-Ray Diffraction.* Addison-Wesley Publishing Company, Inc., Reading, Massachusetts.

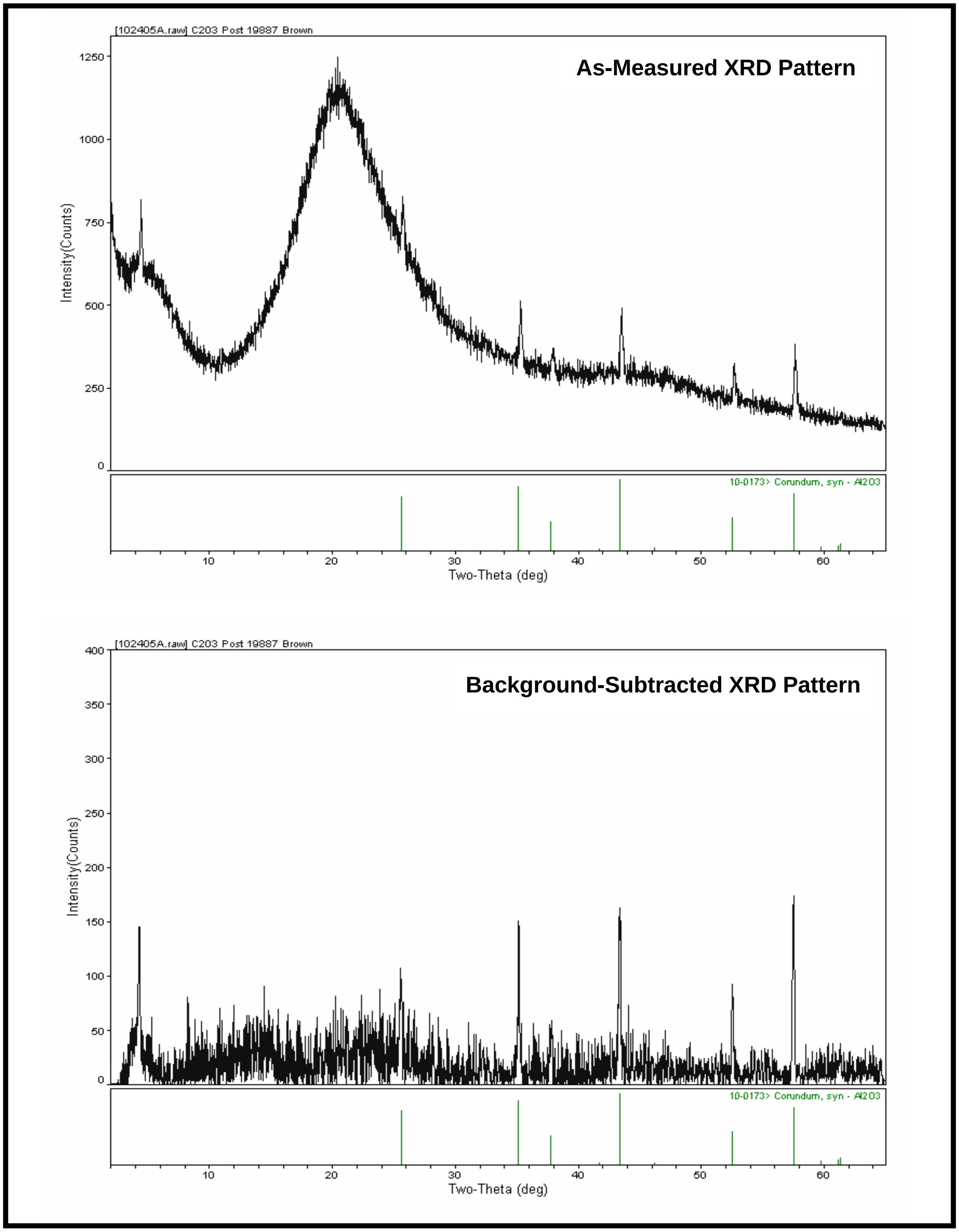


Figure B.1. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Brown Solids Separated from Sample 19887 of C-203 Post-Retrieval Residual Waste

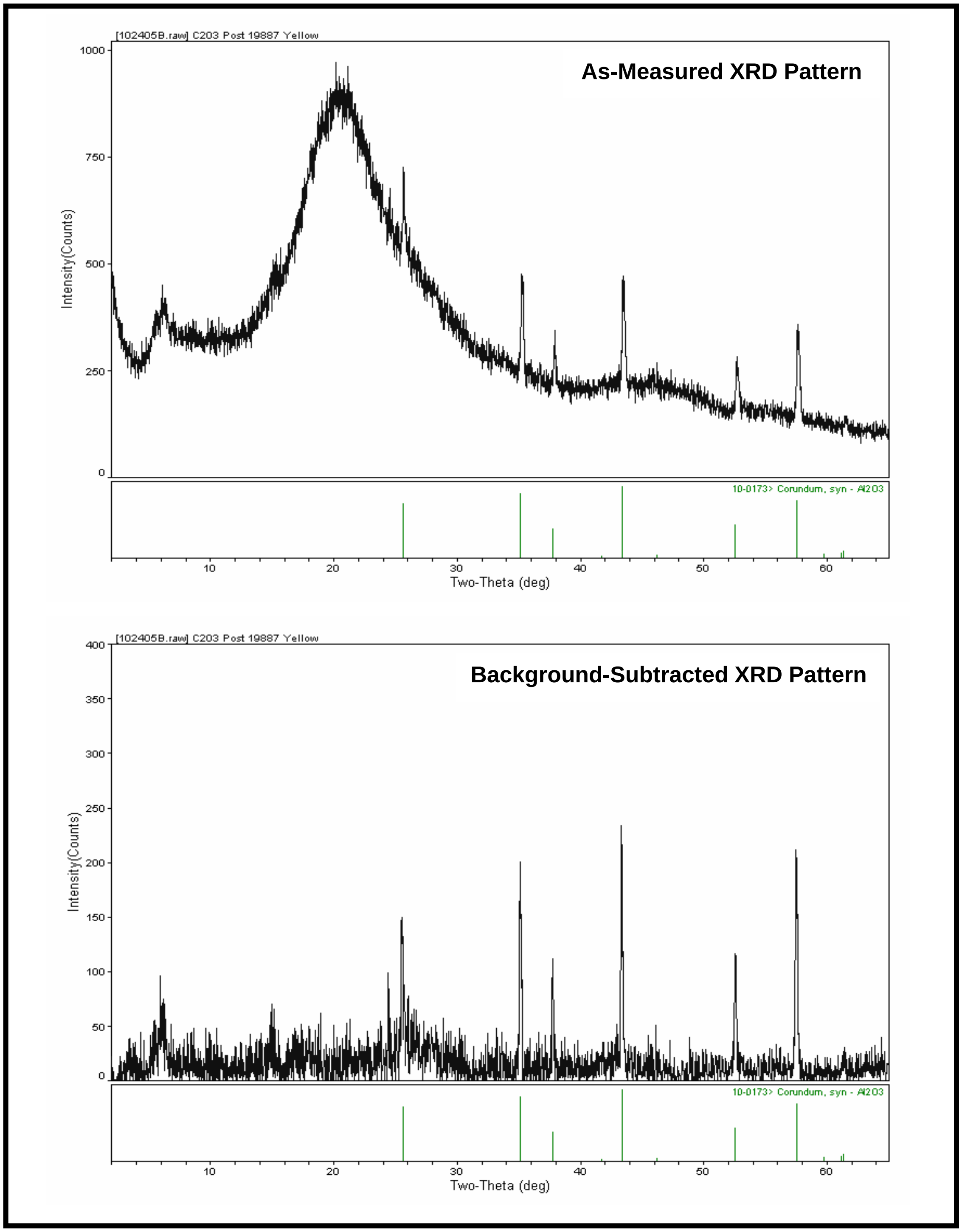


Figure B.2. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Yellow Solids Separated from Sample 19887 of C-203 Post-Retrieval Residual Waste

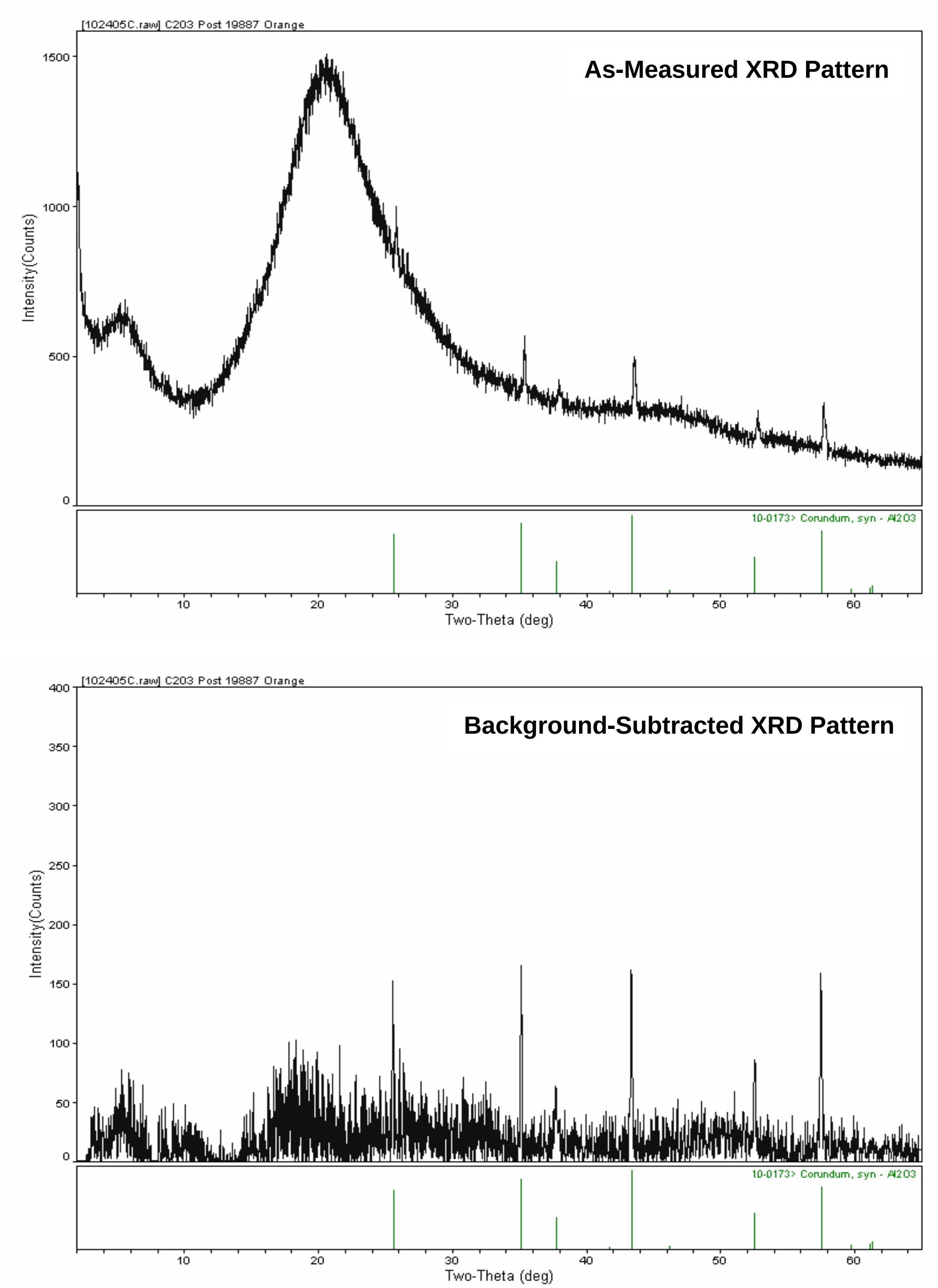


Figure B.3. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Orange Solids Separated from Sample 19887 of C-203 Post-Retrieval Residual Waste

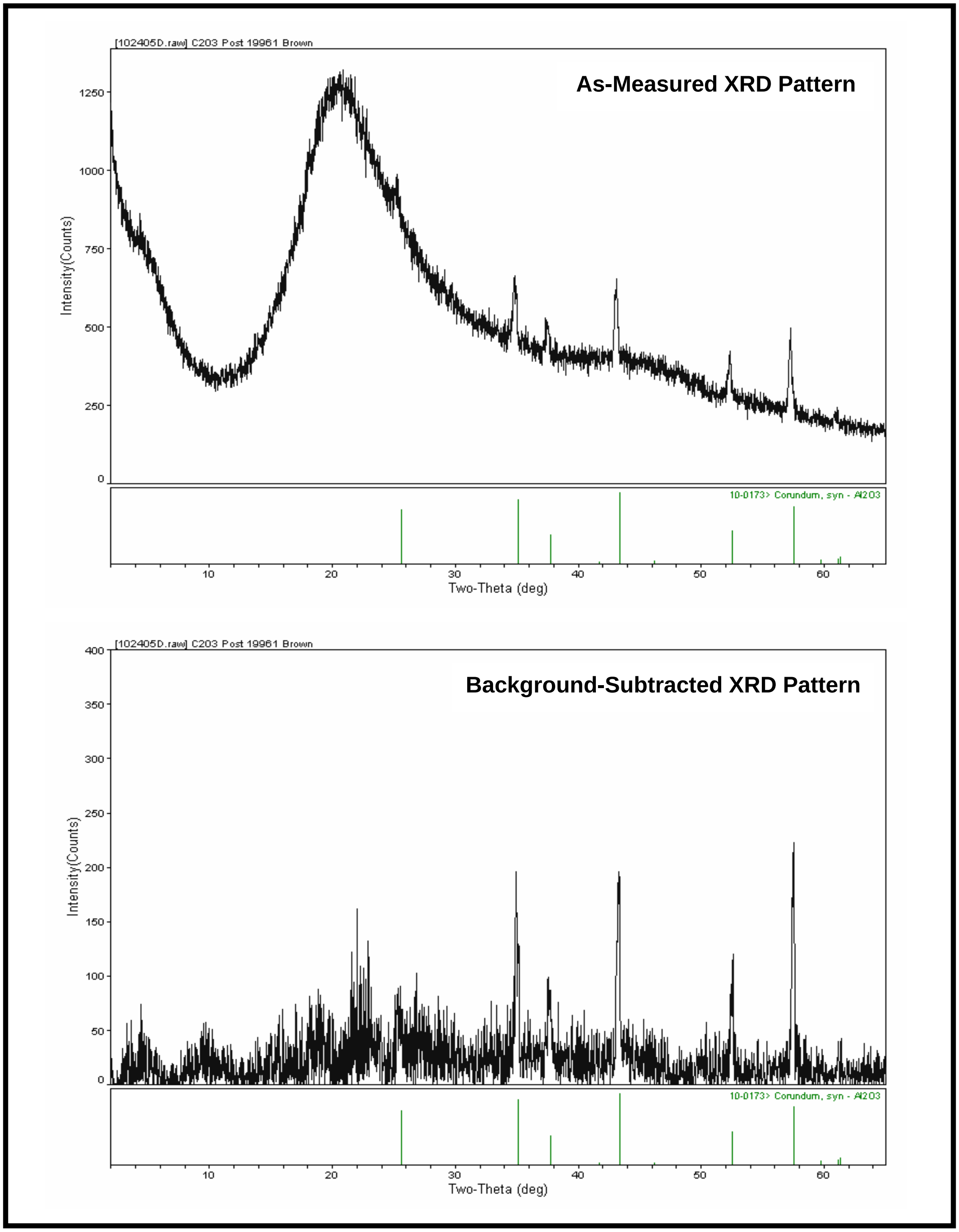


Figure B.4. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Brown Solids Separated from Sample 19887 of C-203 Post-Retrieval Residual Waste

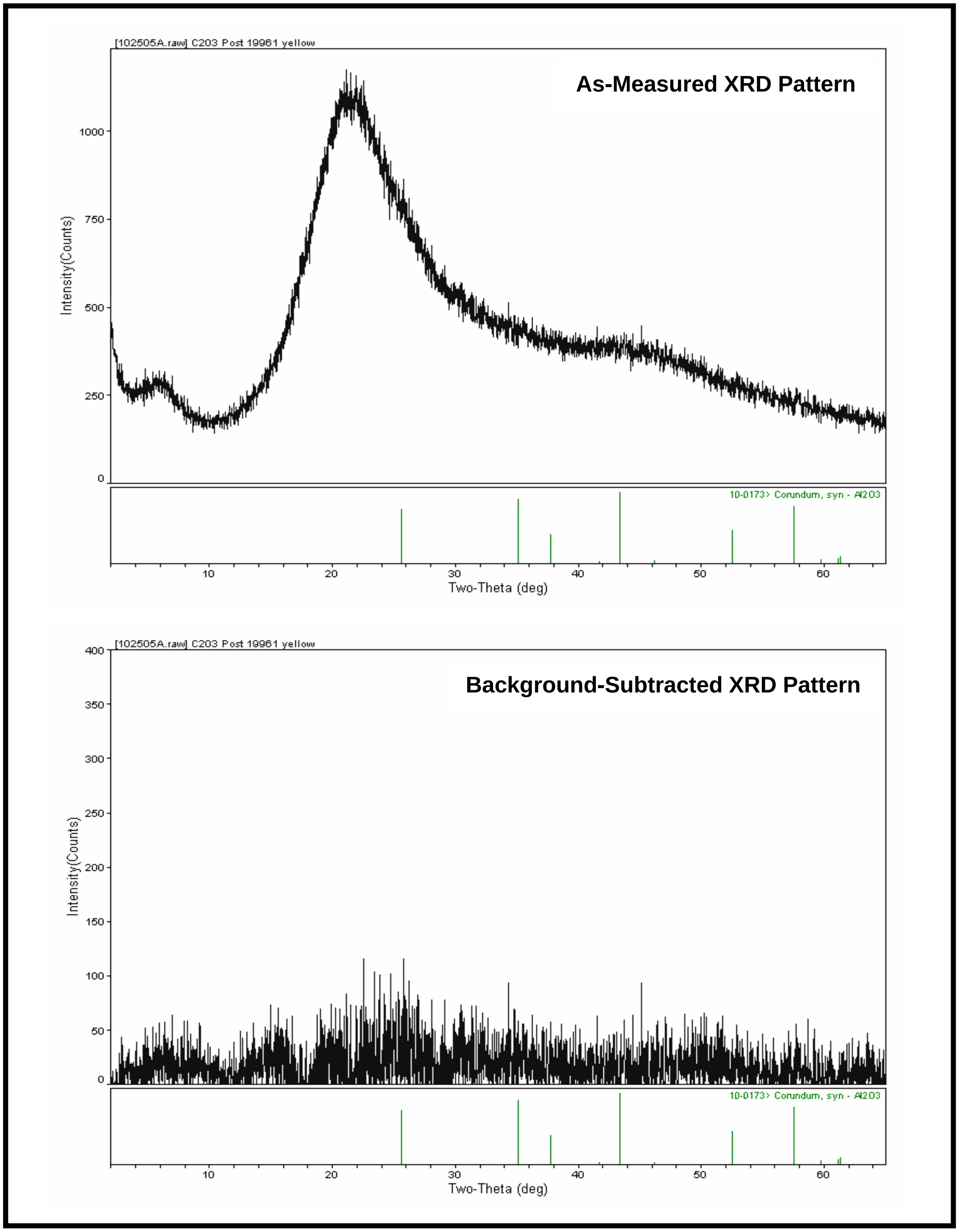


Figure B.5. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Yellow Solids Separated from Sample 19961 of C-203 Post-Retrieval Residual Waste

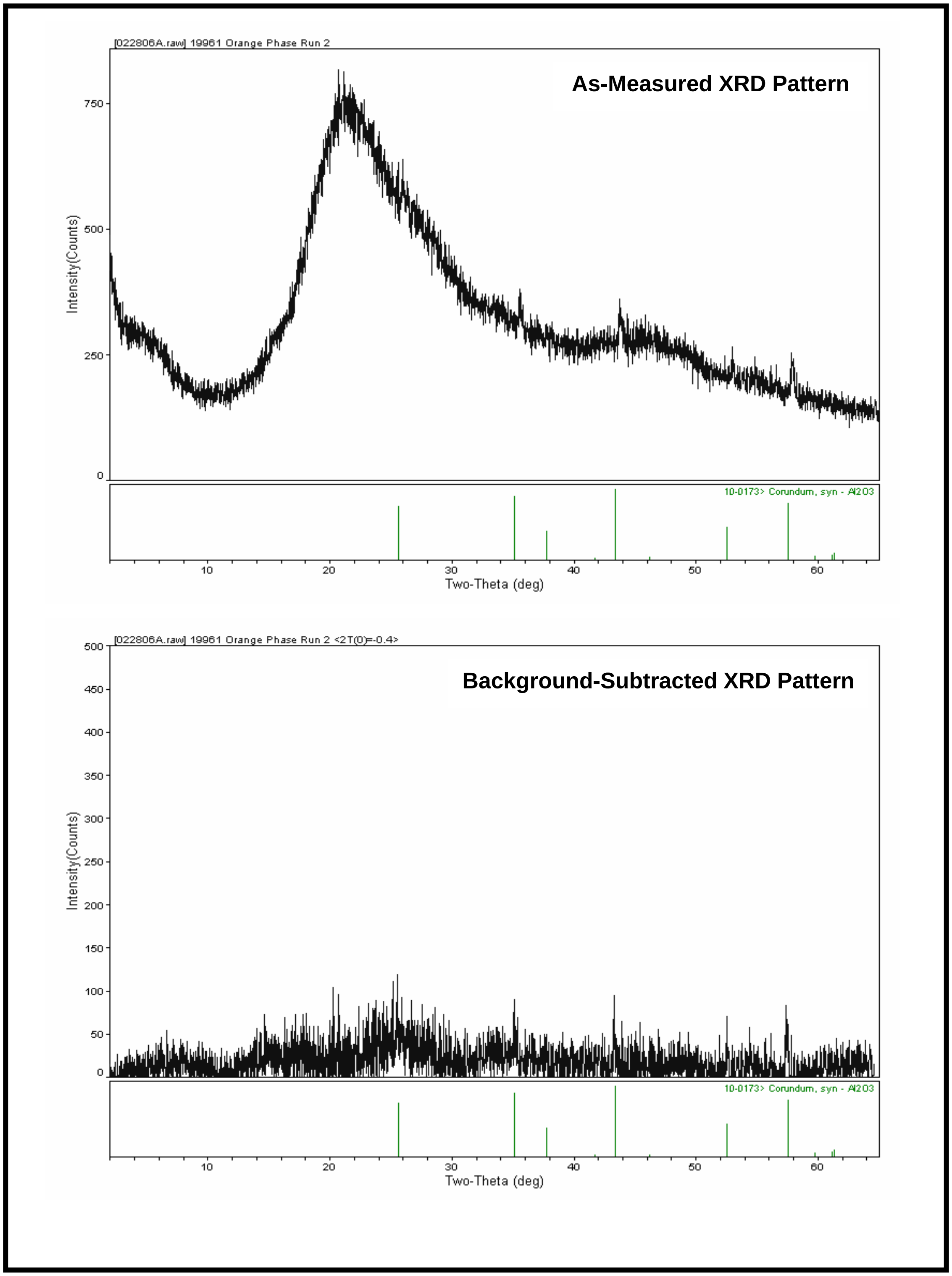


Figure B.6. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Unleached Orange Solids Separated from Sample 19961 of C-203 Post-Retrieval Residual Waste

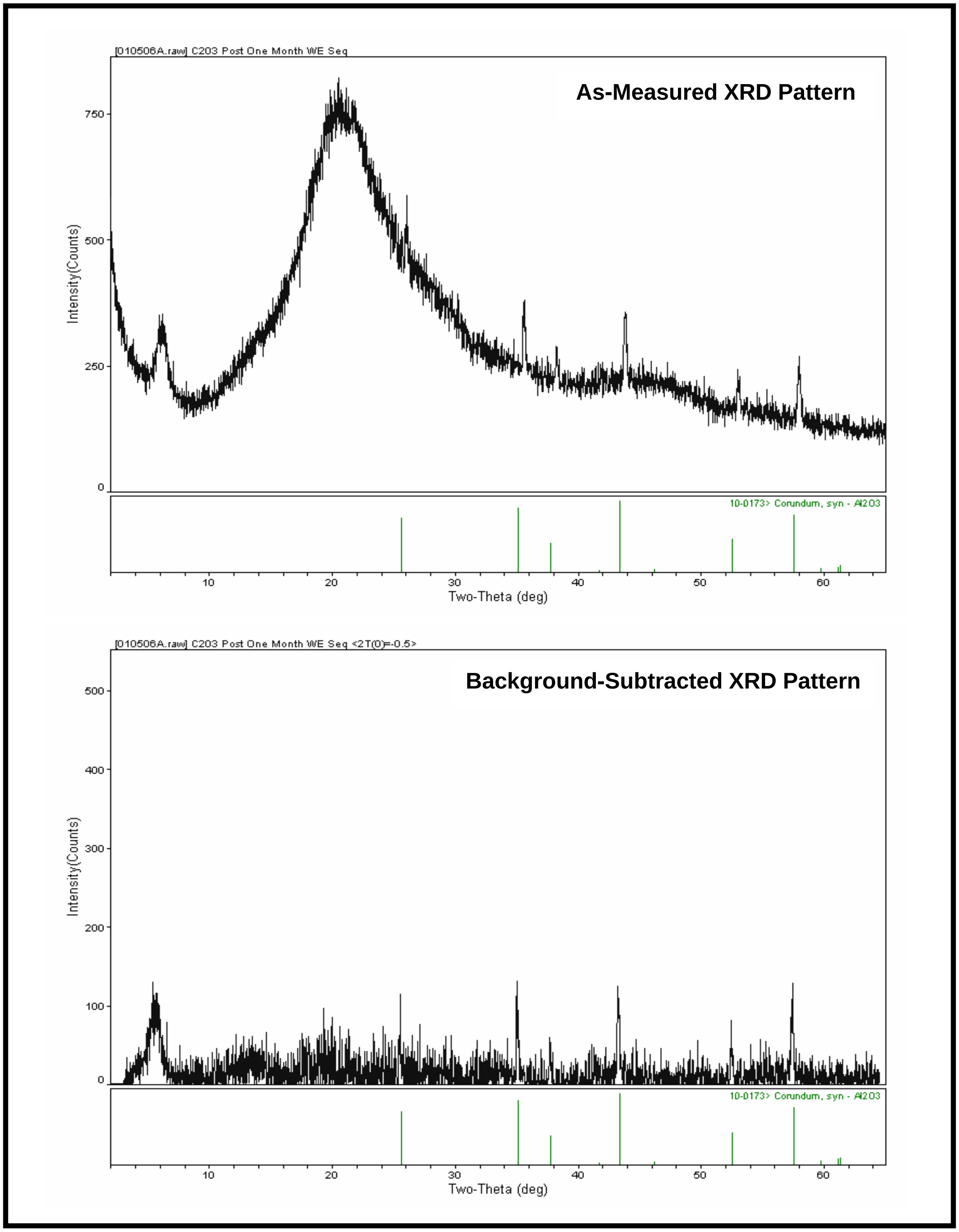


Figure B.7. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for One Month Single-Contact Leached Water Extraction of Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

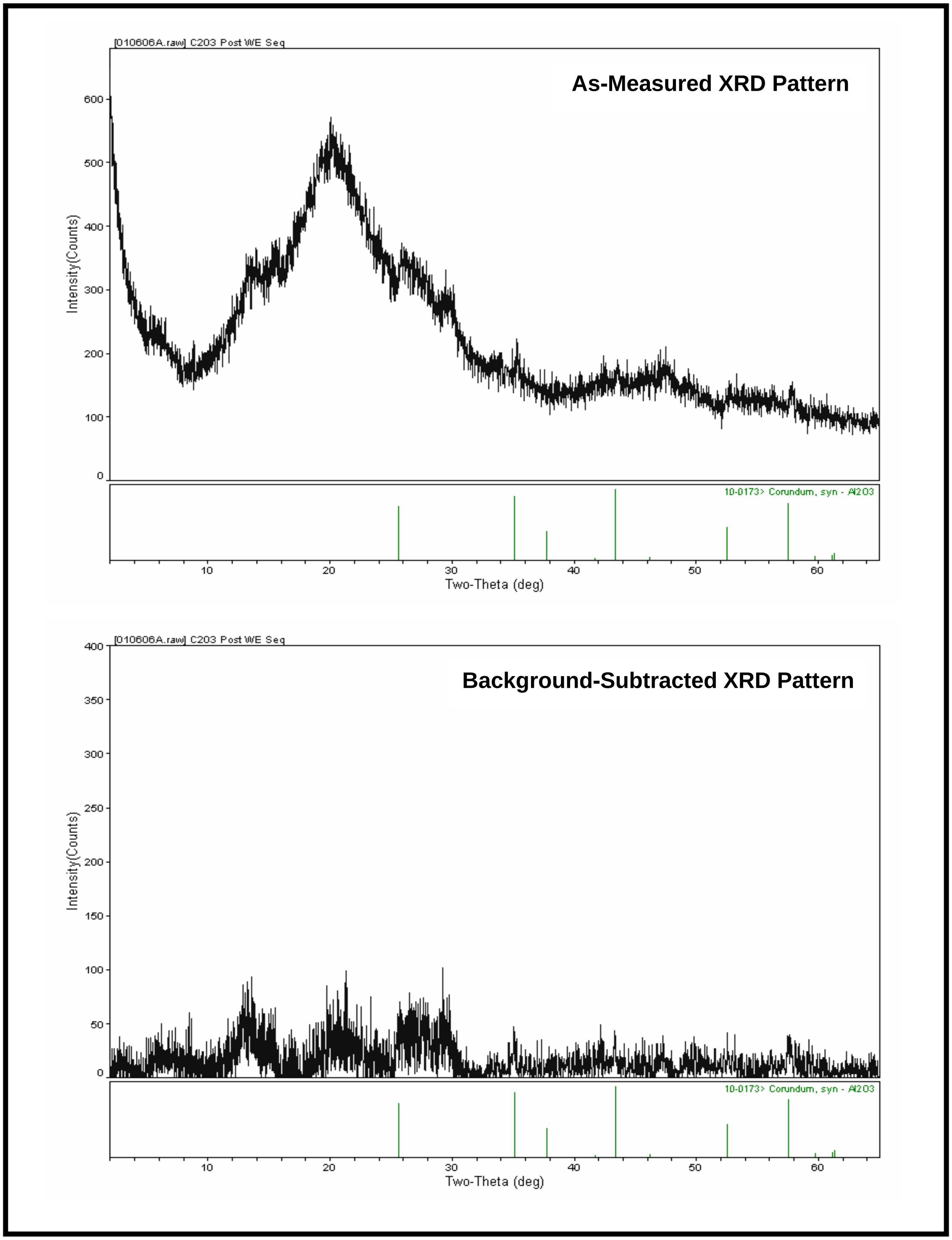


Figure B.8. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Sequential Leached Water Extraction of Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

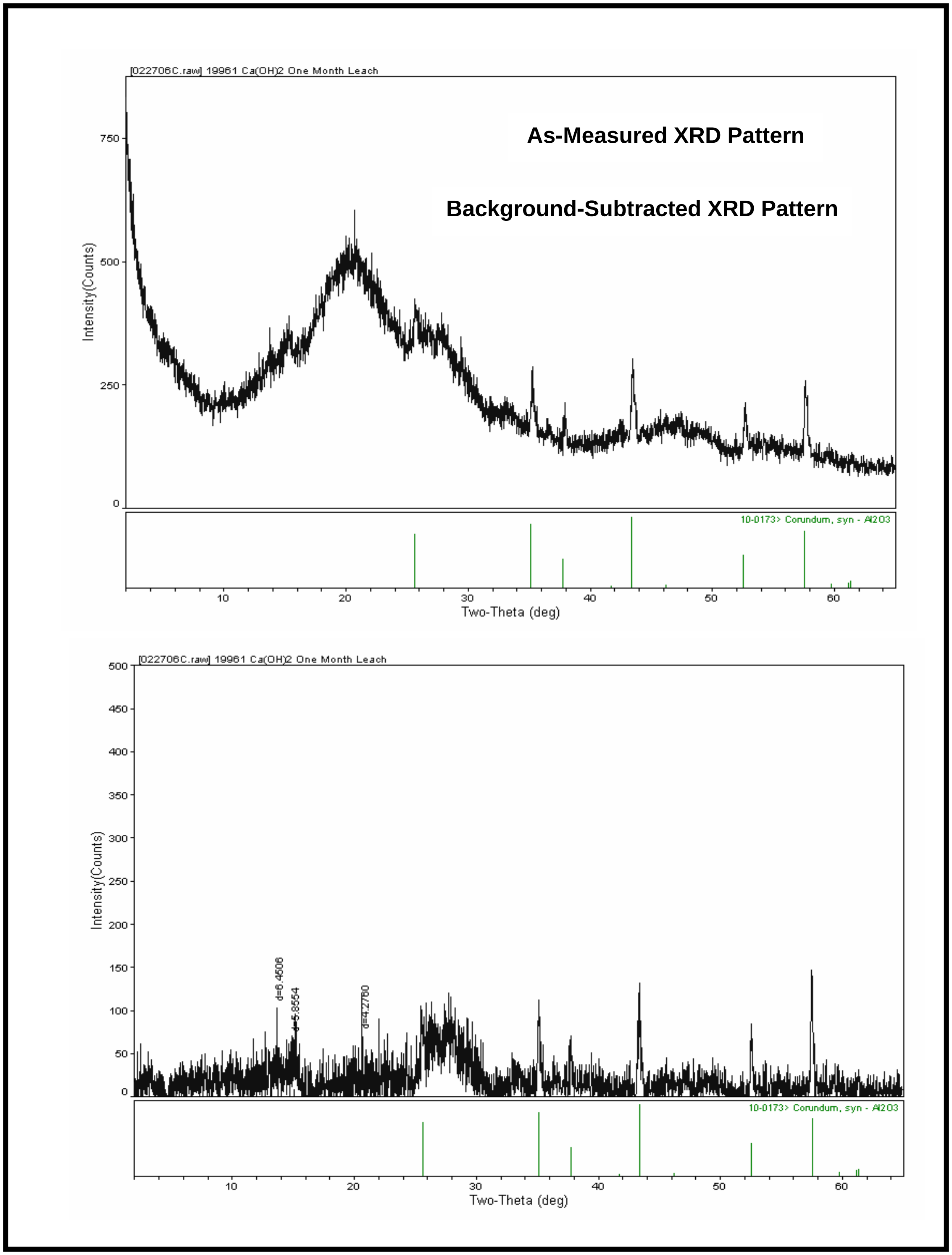


Figure B.9. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for One-Month $Ca(OH)_2$-Leached Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

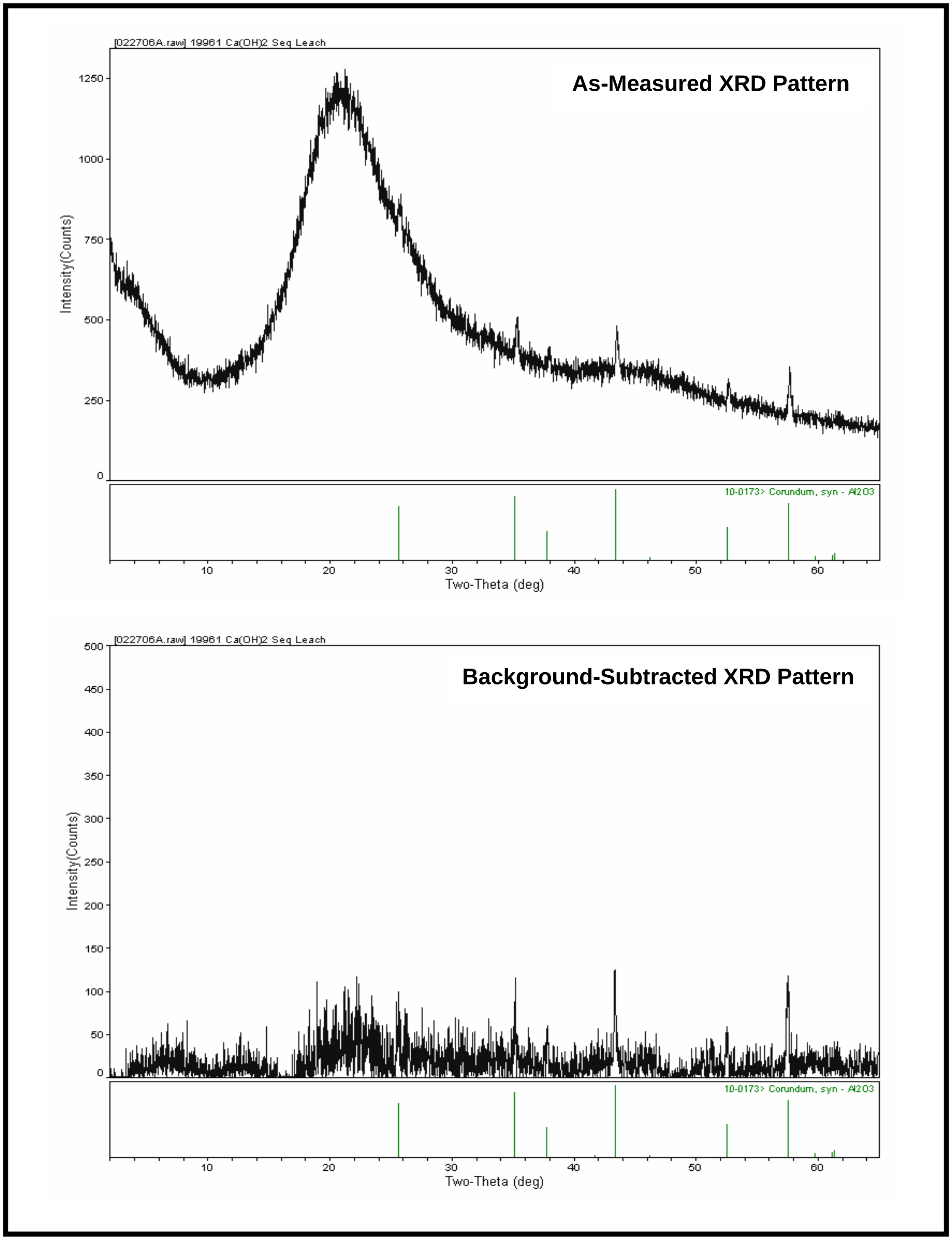


Figure B.10. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Sequential $Ca(OH)_2$-Leached Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

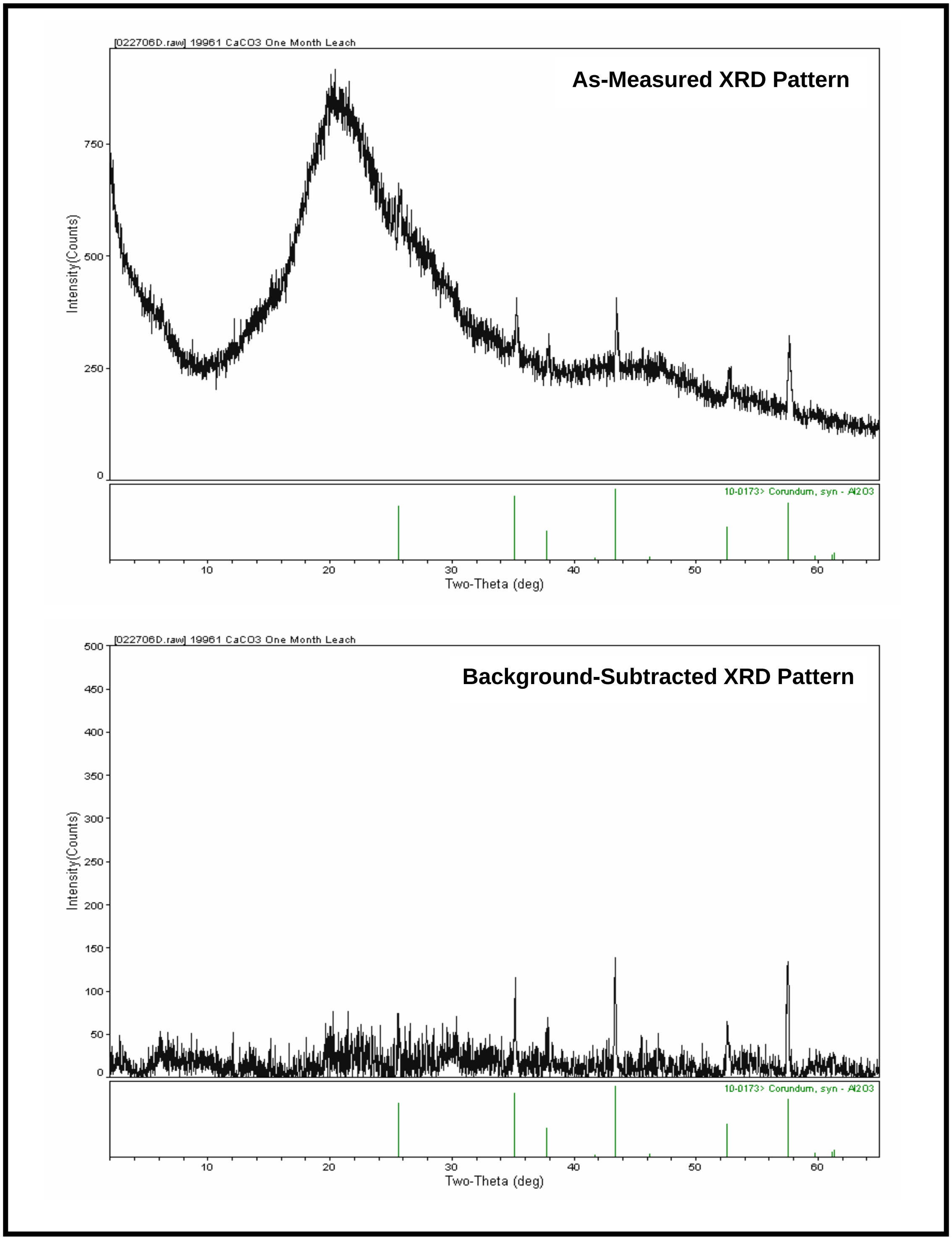


Figure B.11. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for One-Month $CaCO_3$-Leached Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

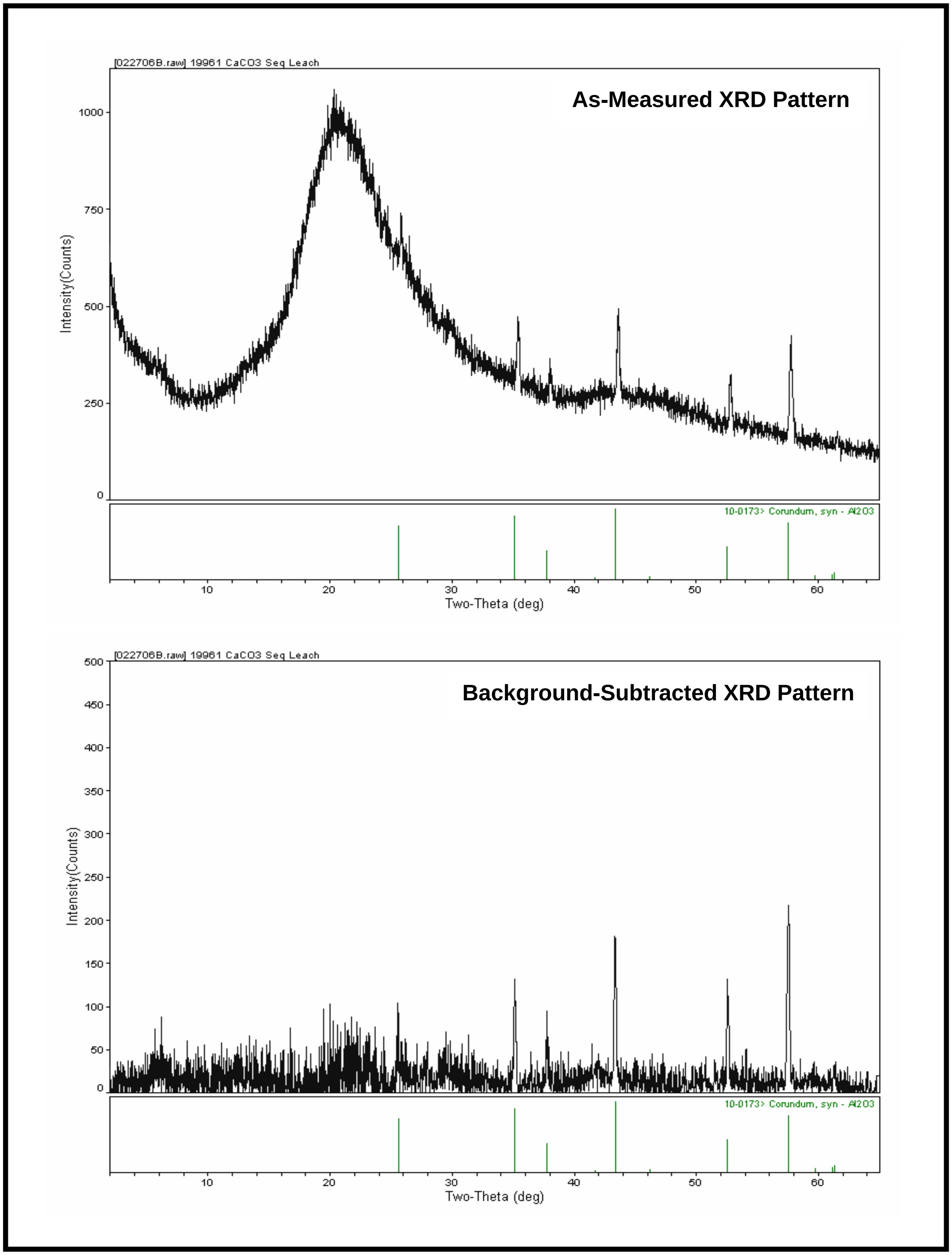


Figure B.12. As-Measured (top) and Background-Subtracted (bottom) XRD Patterns for Sequential $CaCO_3$-Leached Solids from Sample 19961 of C-203 Post-Retrieval Residual Waste

Appendix C

SEM Micrographs and EDS Results for Unleached Residual Waste from Tank C-202

Appendix C

SEM Micrographs and EDS Results for Unleached Residual Waste from Tank C-202

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for samples of unleached residual waste from tank C-202. The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by “BSE” to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample.

The SEM micrographs for this leached material are shown in Figures C.1 through C.11. The EDS spectra and estimated EDS atomic% compositions corresponding to these EDS spectra are given in Figures C.12 through C.17 and Tables C.1 and C.2, respectively.

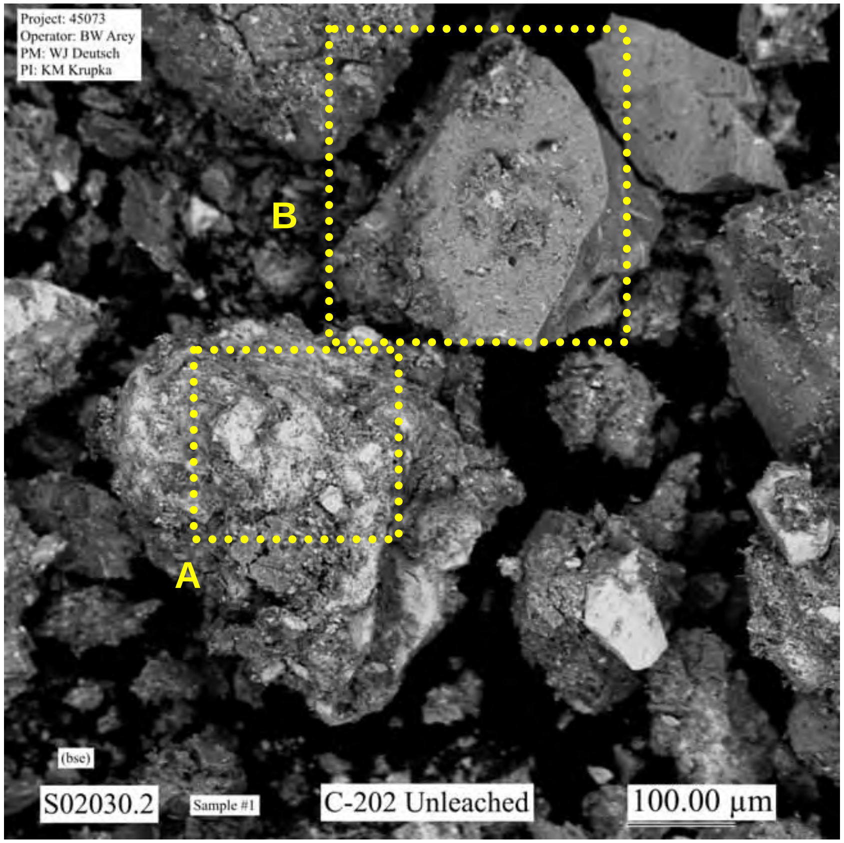


Figure C.1. Low Magnification SEM Micrograph Showing General Morphologies of Particles in the SEM Sample of Unleached Residual Waste from Tank C-202

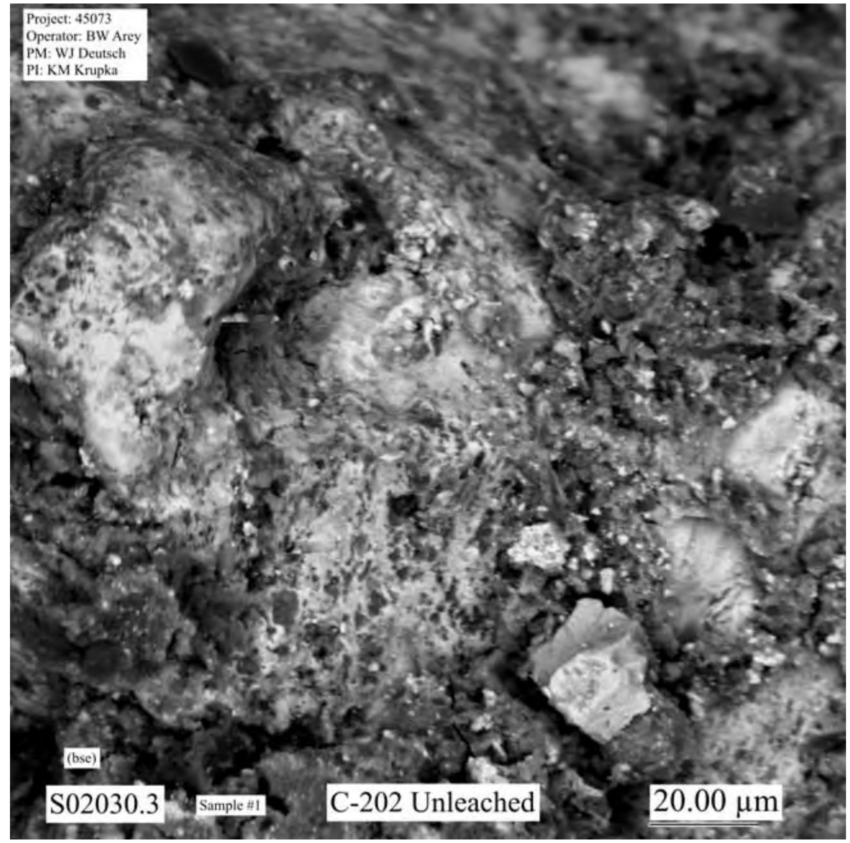


Figure C.2. Micrograph Showing at Higher Magnification the Particle Aggregate in the Area Indicated by the Yellow Dotted-Line Square A in Figure C.1 (Areas where EDS analyses were made are shown in Figure C.12.)

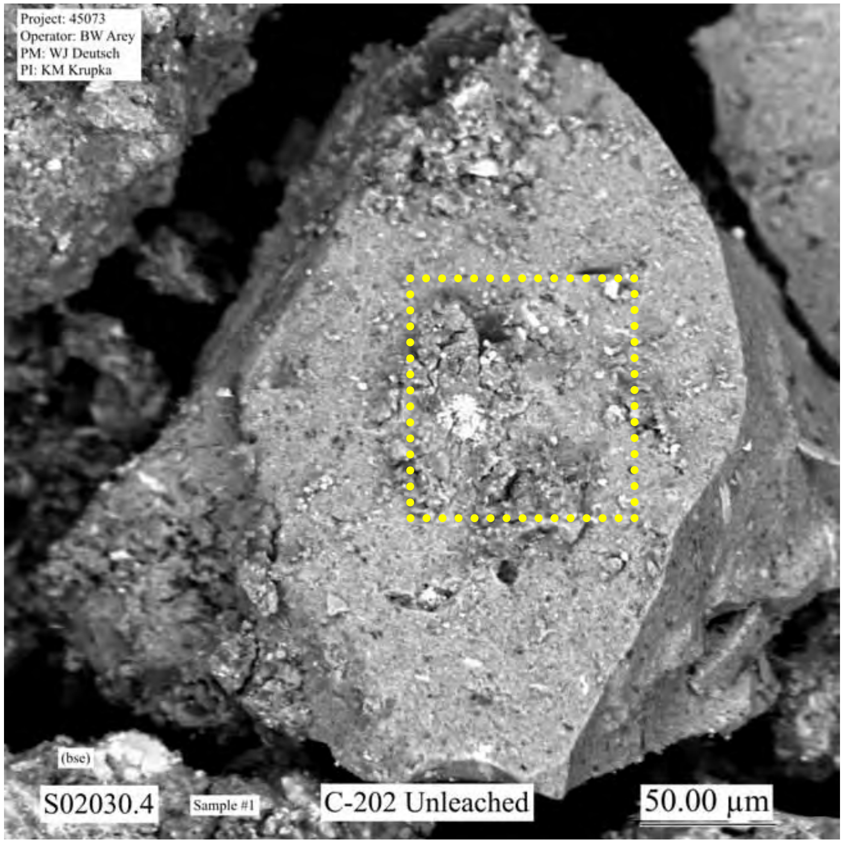


Figure C.3. Micrograph Showing at Higher Magnification the Particle in the Area Indicated by the Yellow Dotted-Line Square B in Figure C.1

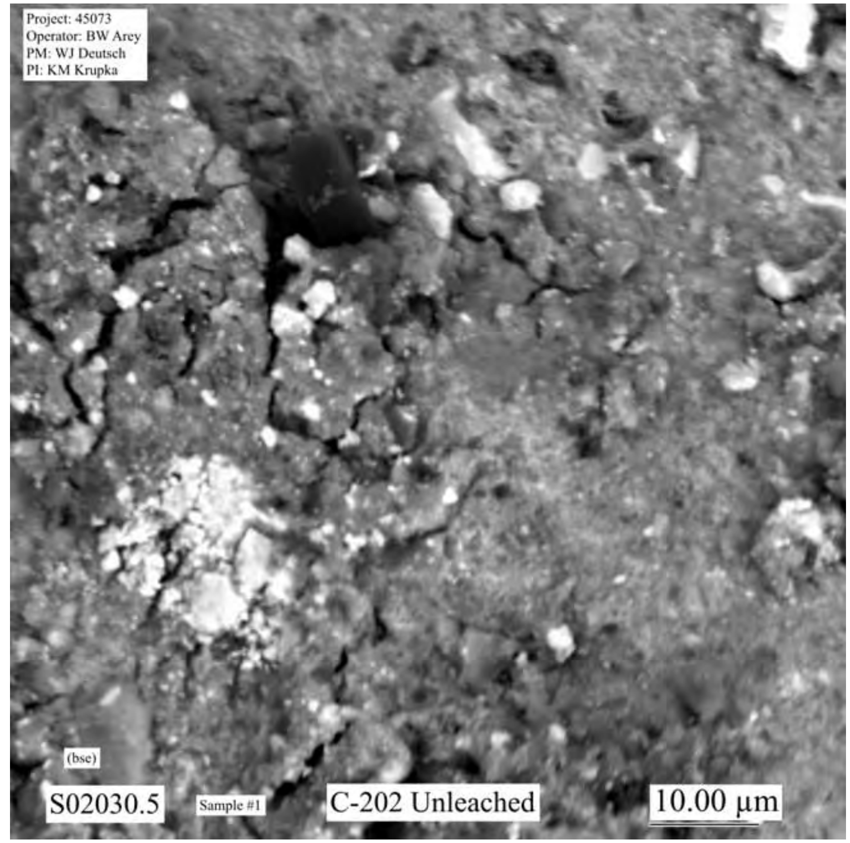


Figure C.4. Micrograph Showing at Higher Magnification the Particle Indicated by the Yellow Dotted-Line Square in Figure C.3 (Areas where EDS analyses were made are shown in Figure C.13.)

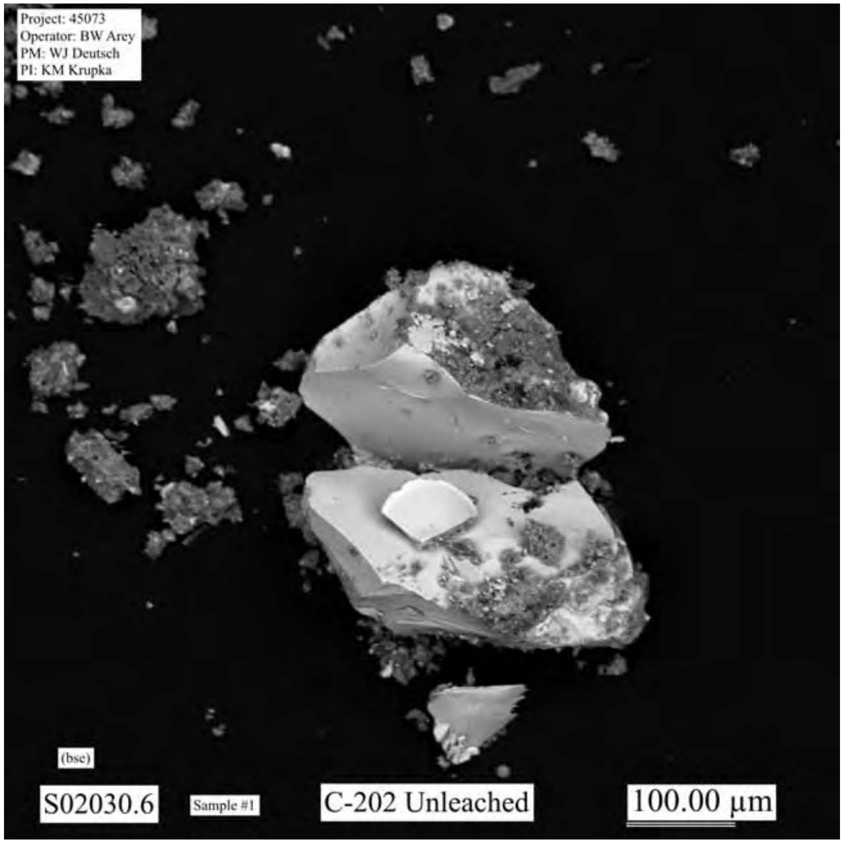


Figure C.5. Micrograph Showing Typical Particles in the SEM Sample of Unleached Residual Waste from Tank C-202

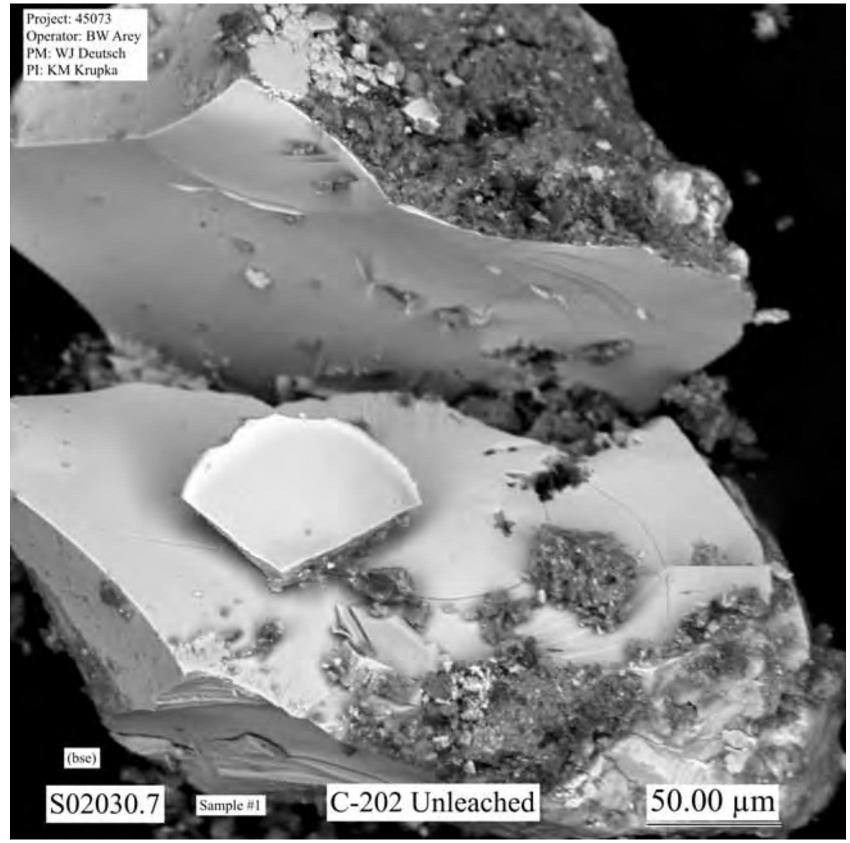


Figure C.6. Micrograph Showing at Higher Magnification the Particle at the center of Figure C.5 (Areas where EDS analyses were made are shown in Figure C.14.)

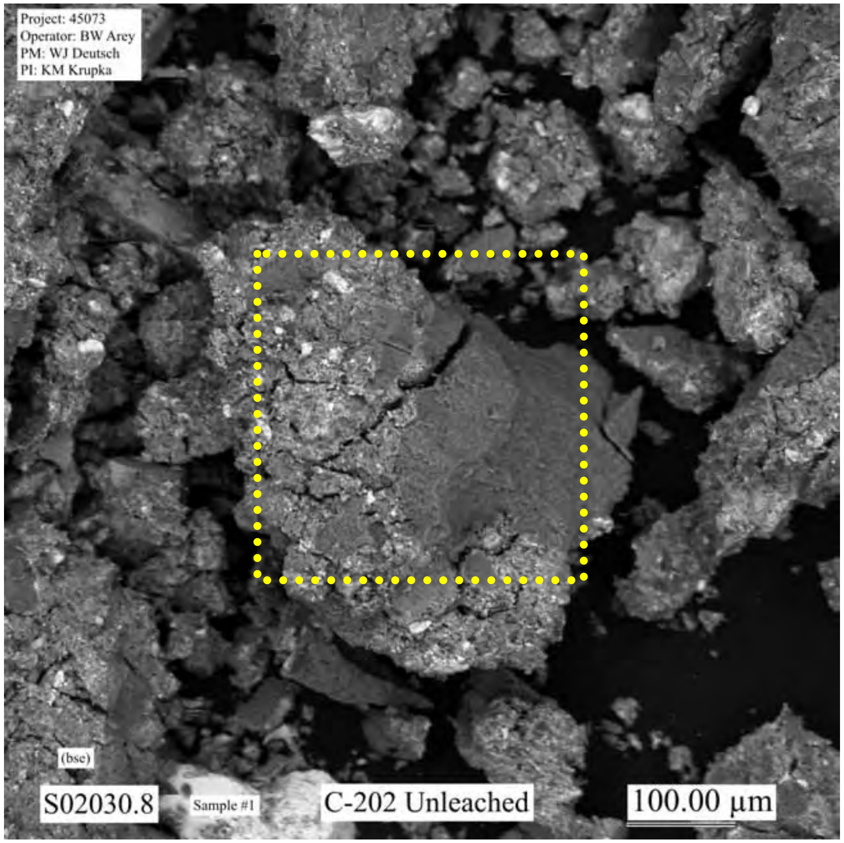


Figure C.7. Micrograph Showing Typical Particles in SEM Sample of Unleached Residual Waste from Tank C-202

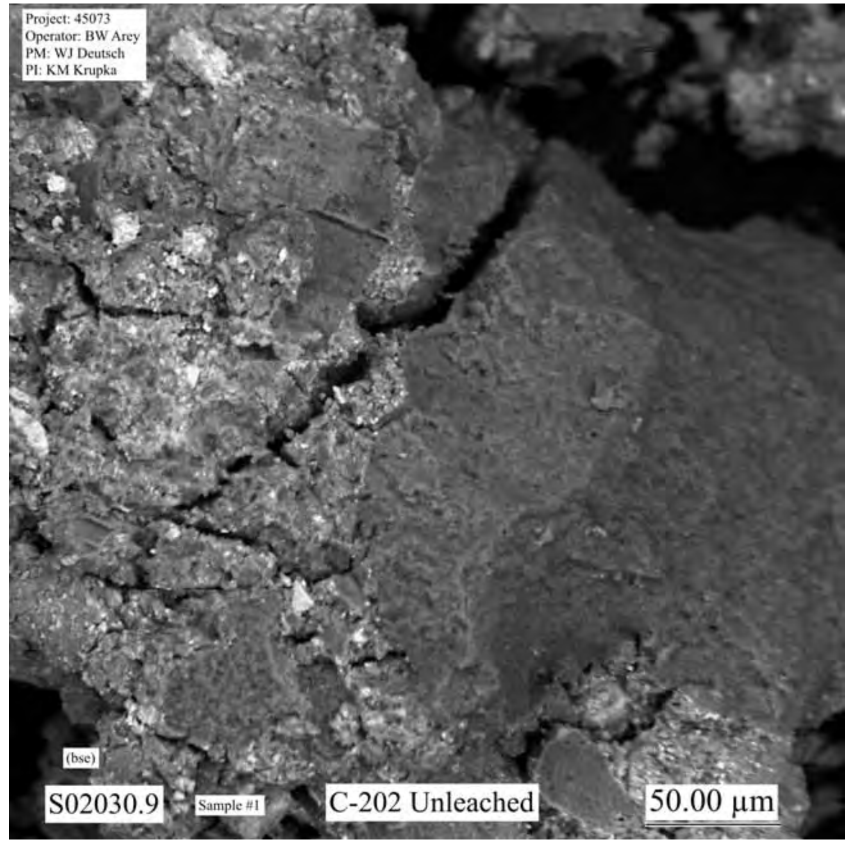


Figure C.8. Micrograph Showing at Higher Magnification the Particle Indicated by the Yellow Dotted-Line Square in Figure C.7 (Areas where EDS analyses were made are shown in Figure C.15.)

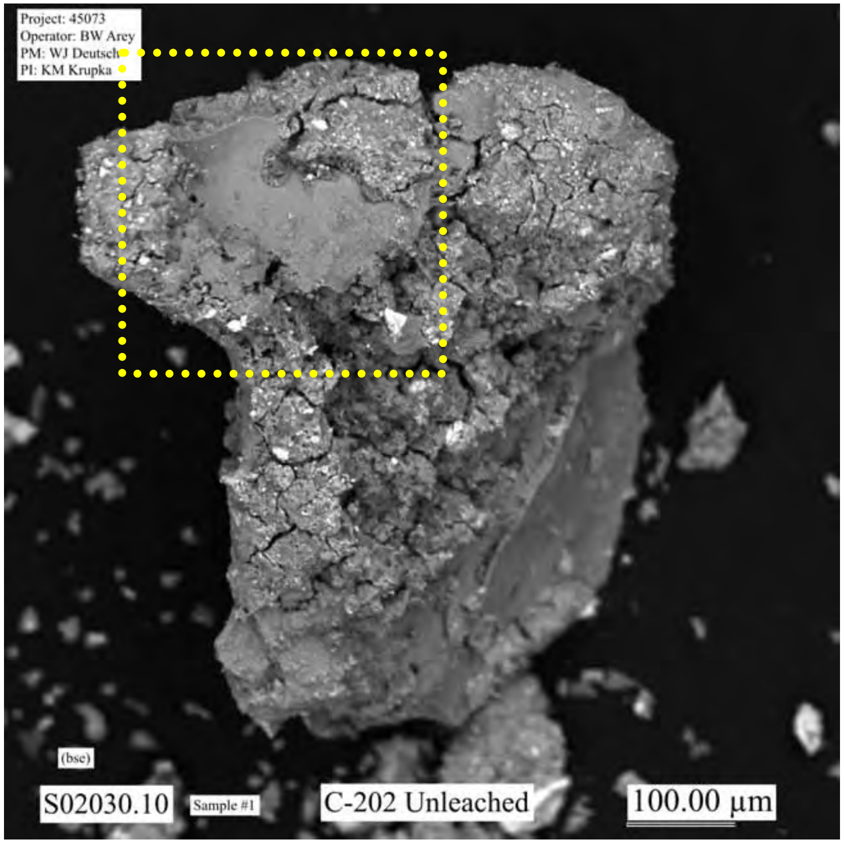


Figure C.9. Micrograph Showing Typical Particles in SEM Sample of Unleached Residual Waste from Tank C-202

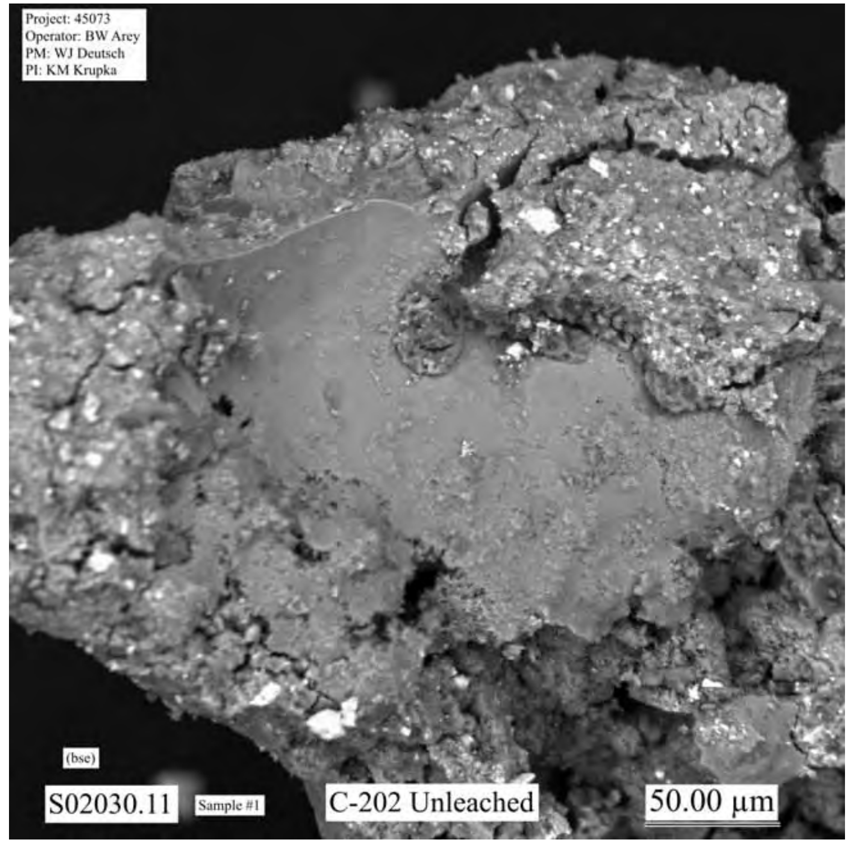


Figure C.10. Micrograph Showing at Higher Magnification the Particle Indicated by the Yellow Dotted-Line Square in Figure C.9 (Areas where EDS analyses were made are shown in Figure C.17.)

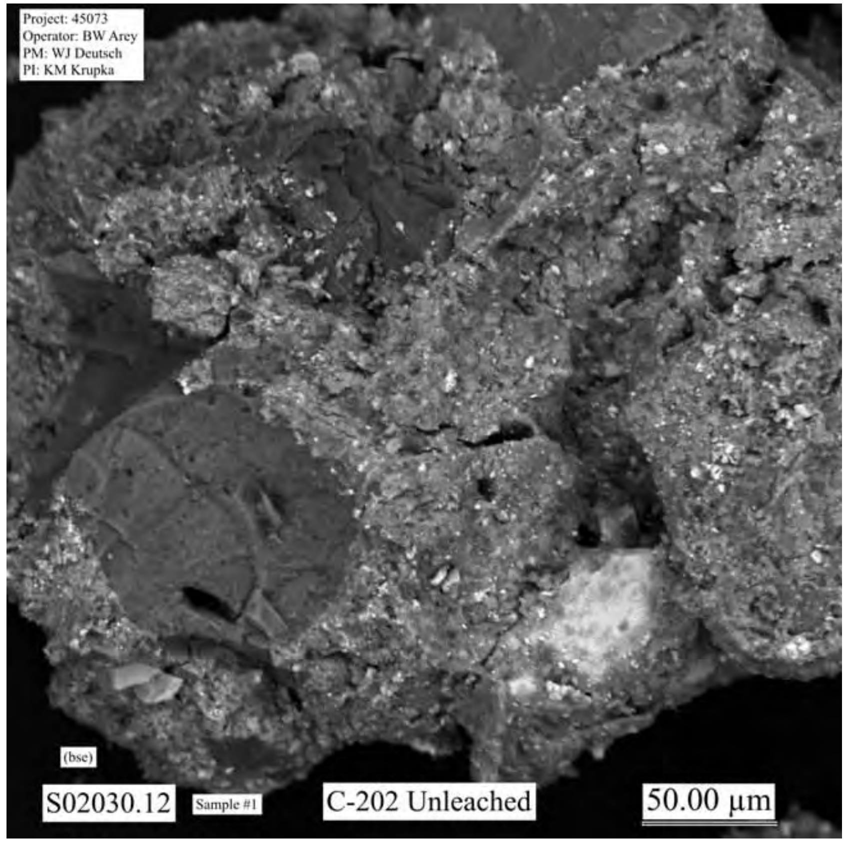


Figure C.11. Micrograph Showing Typical Particles in SEM Sample of Unleached Residual Waste from Tank C-202 (Areas where EDS analyses were made are shown in Figure C.17.)

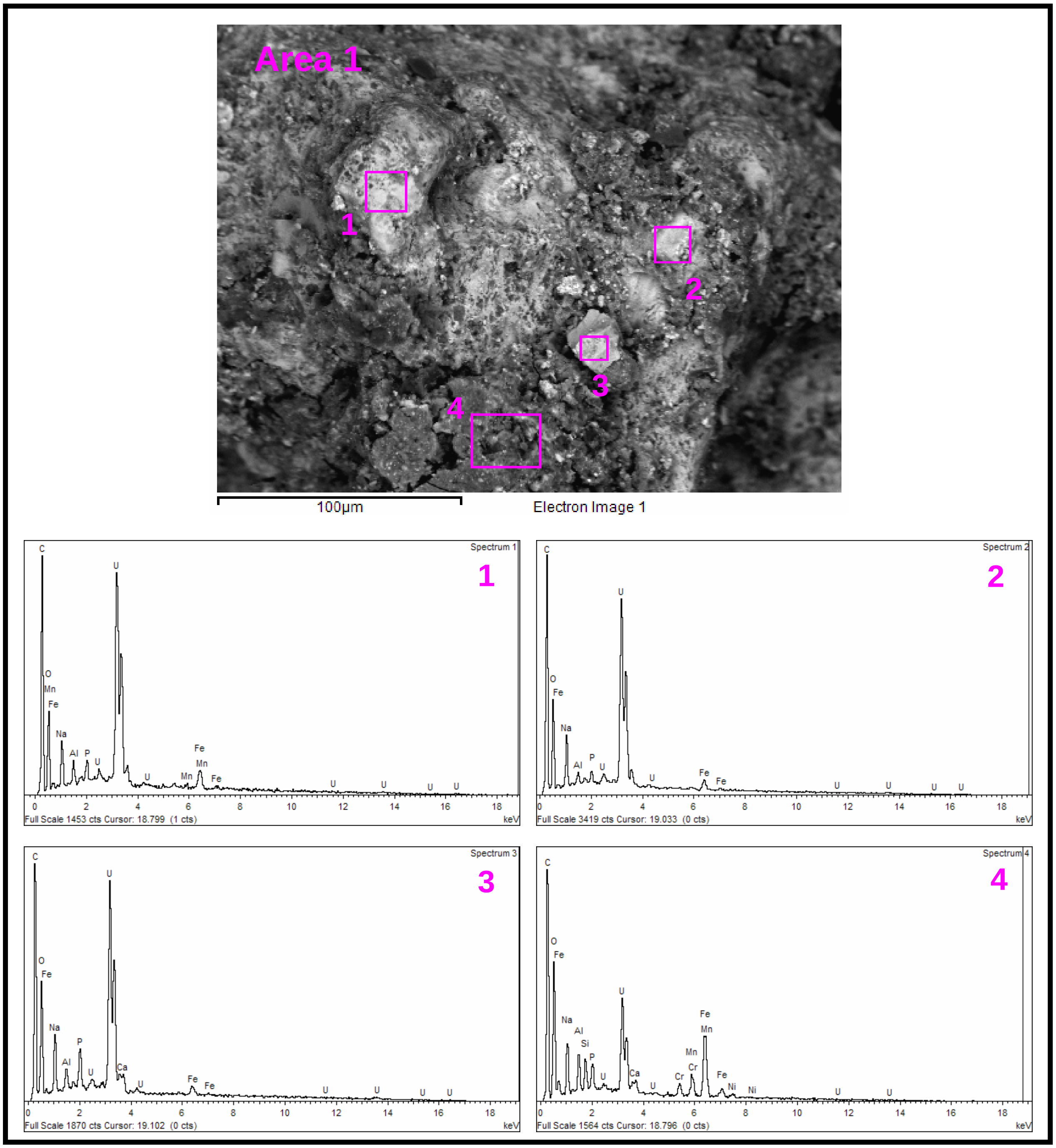


Figure C.12. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

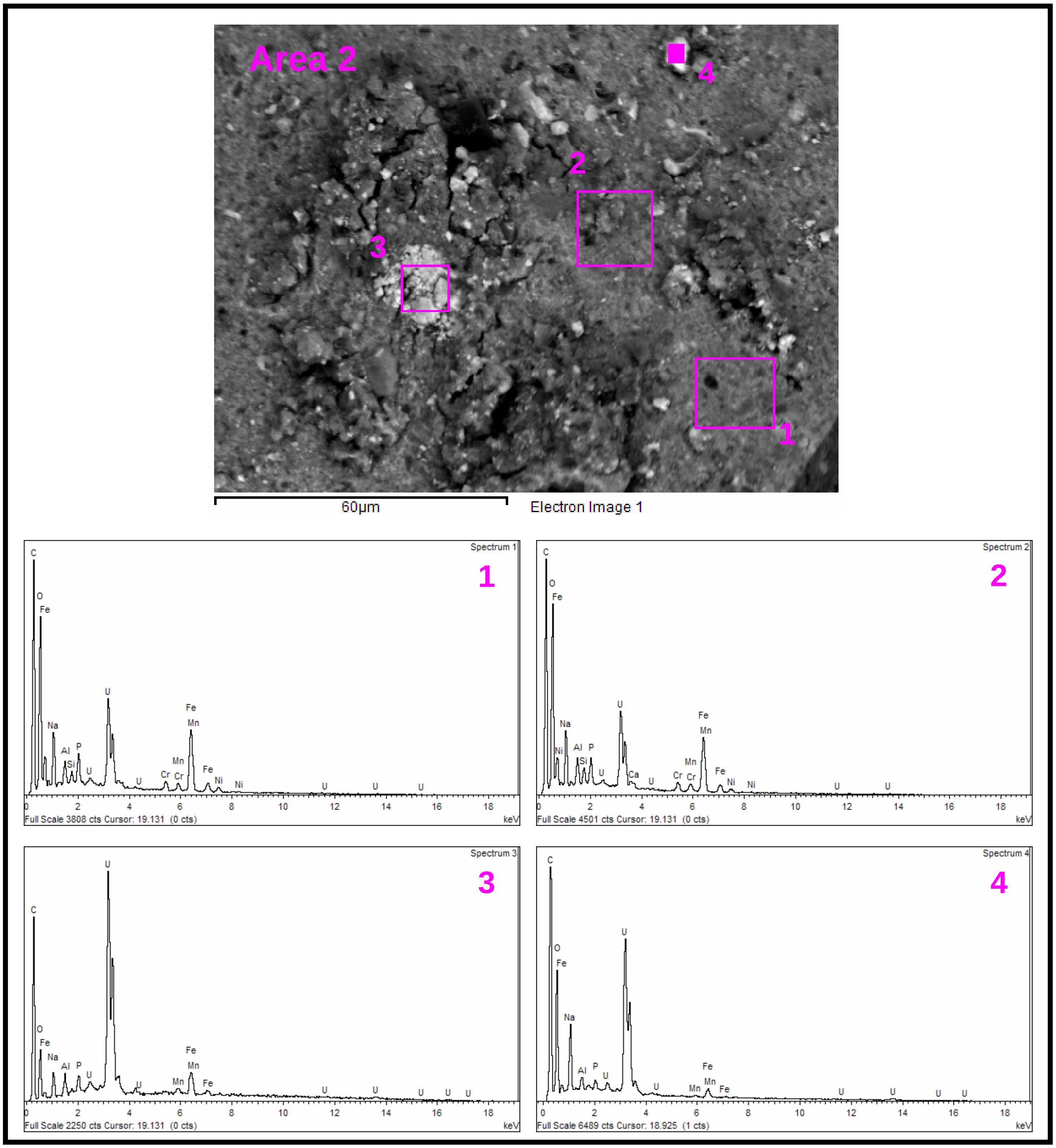


Figure C.13. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

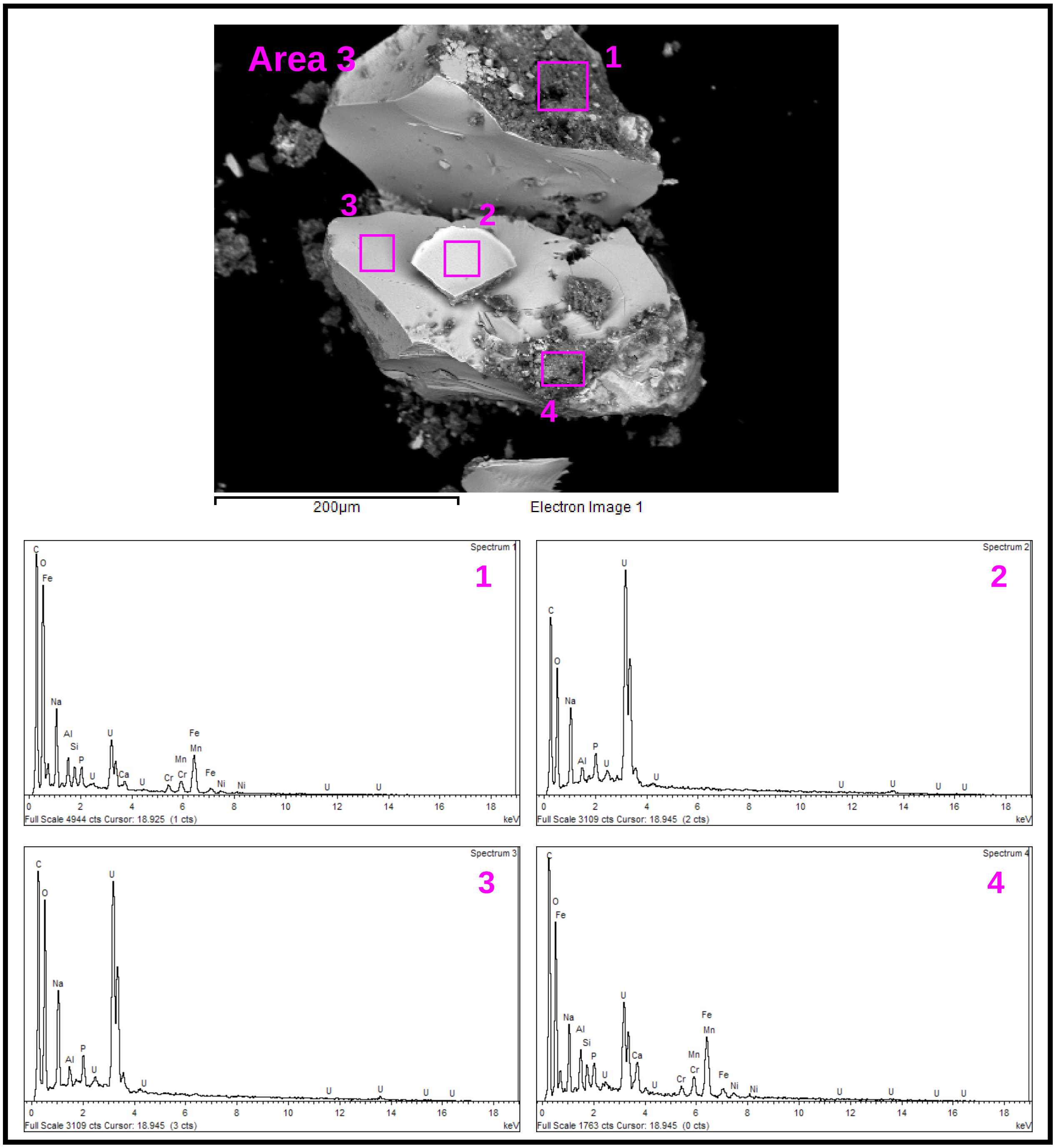


Figure C.14. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

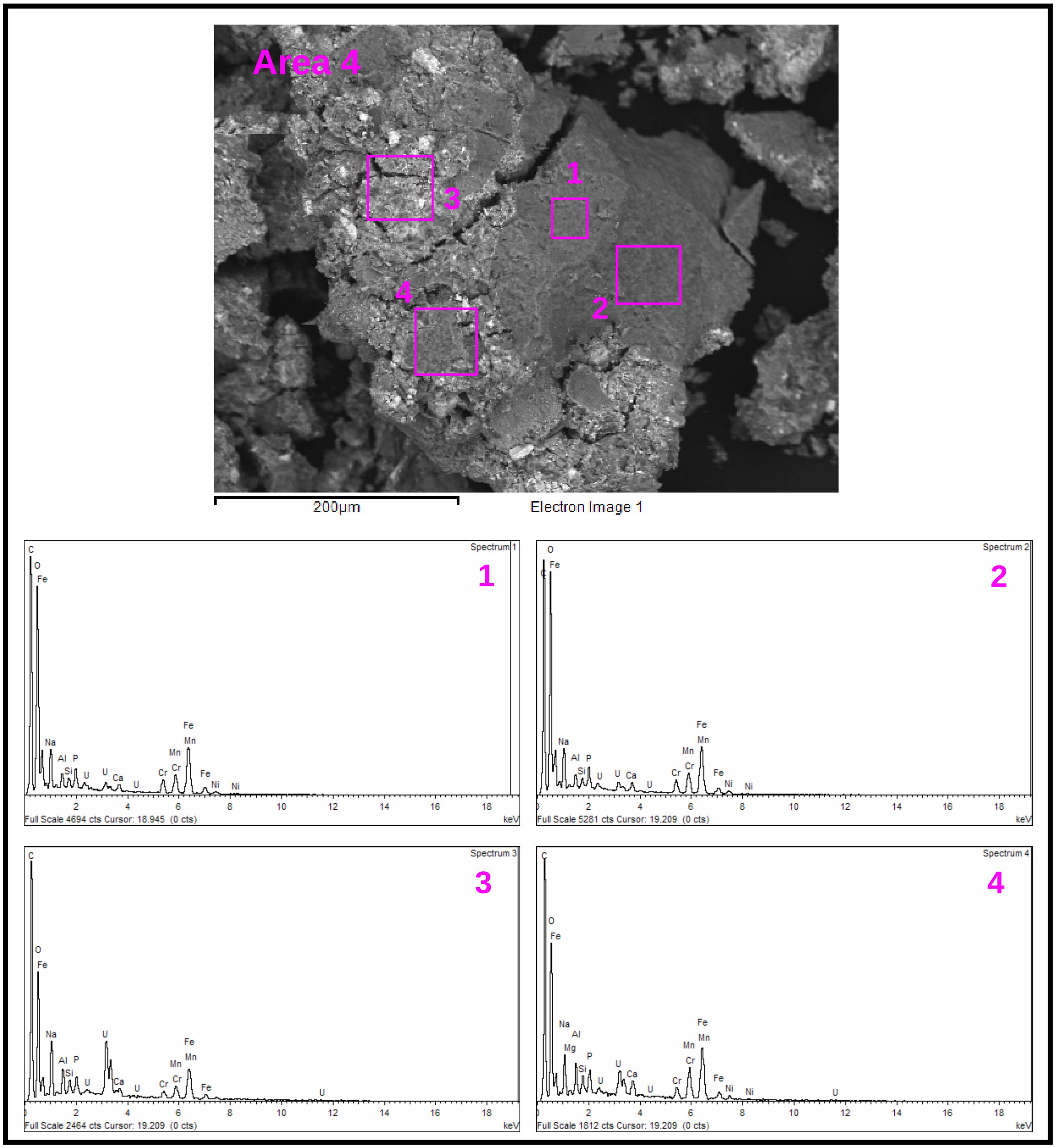


Figure C.15. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

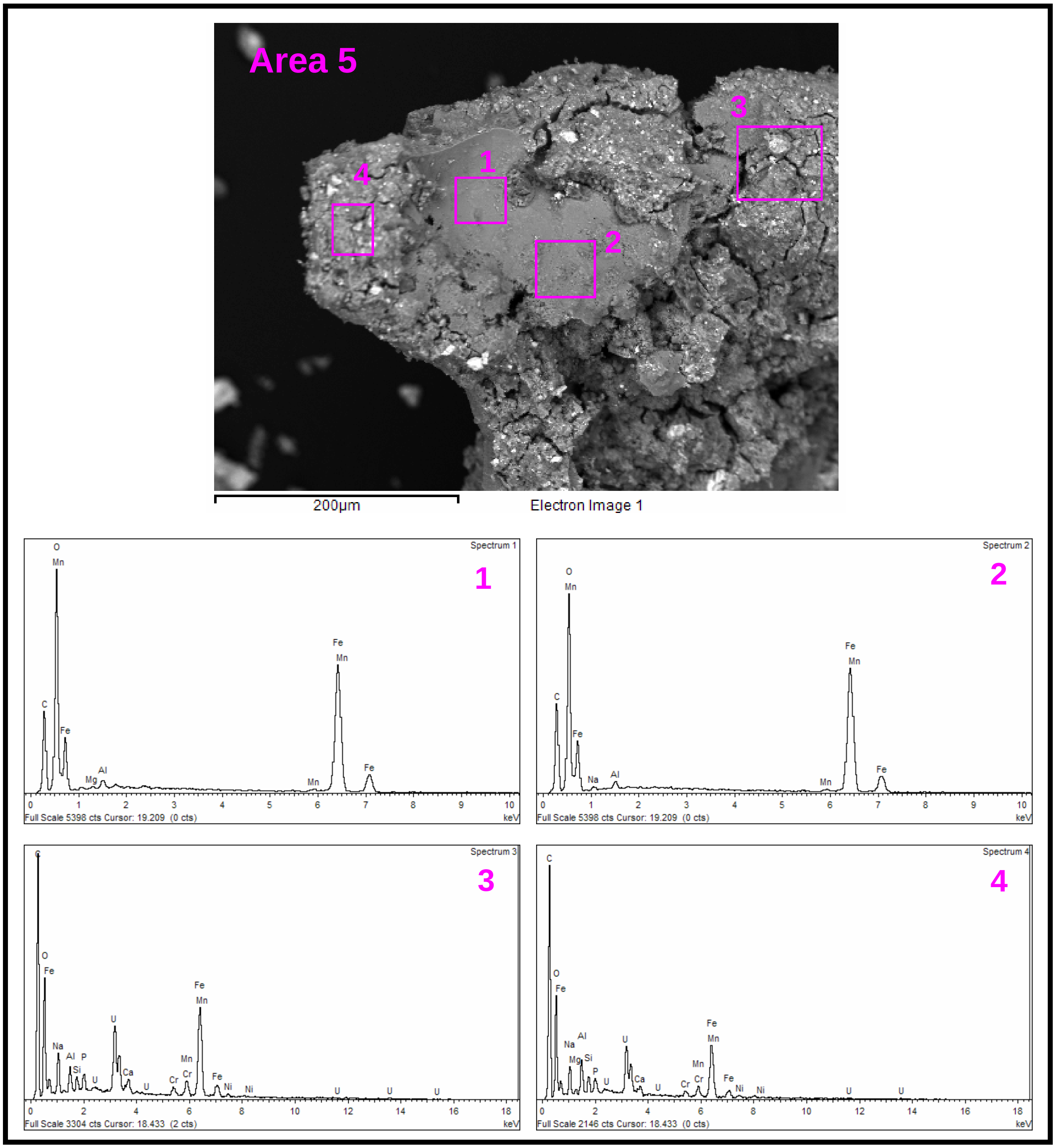


Figure C.16. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

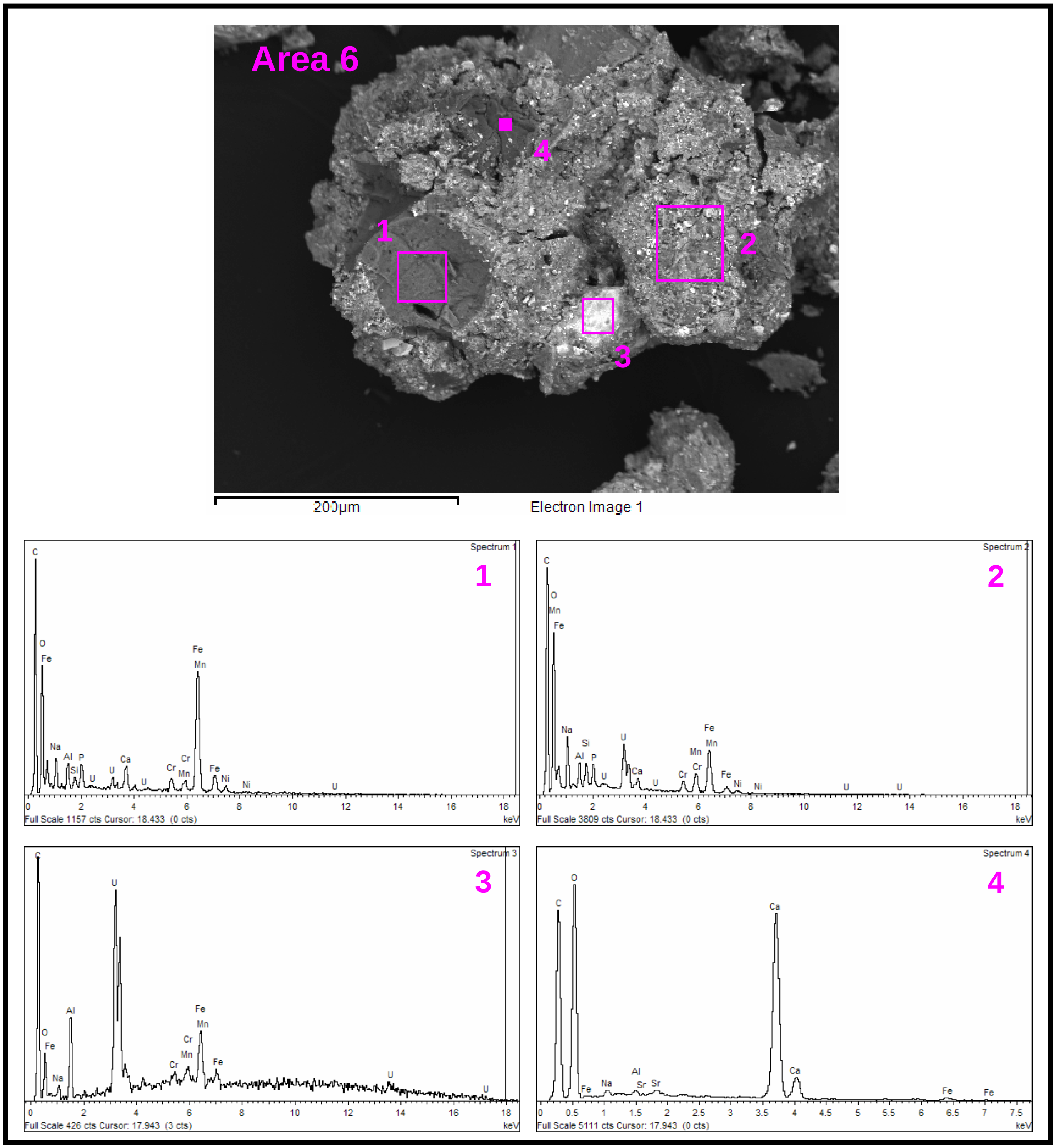


Figure C.17. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Unleached Residual Waste Sample from Tank C-202

Table C.1. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
C.12 / 1	1	3.8	3.5	1.2	0.3				27	*63*	0.8	0.9				
	2	3.4	3.9	0.7					30	*61*	0.4	0.5				
	3	3.3	3.7	0.5				0.5	32	*58*	1.2	0.7				
	4	1.1	3.0	3.0	0.8	0.5	0.2	0.2	30	*59*	0.6	1.0			0.7	
C.13 / 2	1	1.0	3.0	2.9	0.2	0.3	0.3		35	*56*	0.7	0.6			0.2	
	2	0.9	3.0	2.5	0.2	0.3	0.2	0.1	37	*54*	0.6	0.7			0.4	
	3	4.9	2.6	2.2	0.4				22	*66*	0.9	1.1				
	4	2.5	4.4	0.5	0.1				35	*56*	0.3	0.5				
C.14 / 3	1	0.5	3.8	1.6	0.4	0.2	0.1	0.2	38	*54*	0.4	0.7			0.4	
	2	3.9	5.9						38	*51*	1.0	0.6				
	3	2.8	5.4						42	*49*	0.9					
	4	1.0	3.5	2.5	0.6	0.3	0.2	0.6	34	*55*	0.5	1.0			0.5	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table C.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures

Figure No./ Area of Interest	Spectrum	Atomic %[a]														
		Major Cations							Anions[b]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[c]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
C.15/4	1	0.1	2.1	2.1	0.7	0.4	0.1	0.1	39	*55*	0.4	0.3			0.2	
	2	0.1	2.1	1.9	0.7	0.4	0.2	0.2	40	*54*	0.4	0.3			0.2	
	3	0.7	3.1	1.6	0.5	0.2		0.2	32	*60*	0.4	0.7			0.3	
	4	0.3	2.1	2.3	1.0	0.4	0.2	0.4	33	*59*	0.5	0.7		0.2	0.4	
C.16/5	1			9.5	0.1				50	*40*		0.4		0.2		
	2		0.4	9.2	0.1				47	*43*		0.3				
	3	0.8	2.3	4.2	0.6	0.3	0.2	0.3	27	*63*	0.4	0.7			0.3	
	4	0.7	1.7	2.9	0.4	0.2	0.2	0.2	28	*64*	0.4	1.0		0.2	0.5	
C.17/6	1	0.1	1.8	5.3	0.3	0.4	0.4	0.5	27	*62*	0.5	0.7			0.2	
	2	0.5	2.8	2.0	0.7	0.4	0.1	0.3	35	*57*	0.5	0.7			0.5	
	3	3.8	1.1	3.4	0.6	0.5			16	*71*		3.5				
	4		0.4	0.1				4.4	54	*41*		0.1				Sr – 0.1

(a) = Concentrations based on compositions (wt.%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
(b) = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
(c) = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix D

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-202

Appendix D

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-202

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for samples of leached residual waste from tank C-202. These include the following types of samples:

- One month single-contact leached water extraction solids
- One month single-contact $Ca(OH)_2$ leached solids
- One month single-contact $CaCO_3$ leached solids

The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by "BSE" to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample. The figure and table numbers for the SEM micrographs and EDS analyses for the three types of leached C-202 residual waste analyzed by SEM/EDS are listed in Table D.1.

Table D.1. Figures and Tables Containing the SEM Micrographs and EDS Analyses for the Leached C-202 Residual Waste Samples Analyzed by SEM/EDS

Type of Residual Waste Sample	Figures with SEM Micrographs	Figures with EDS Spectra	Tables with EDS Atomic%
1-month single-contact leached water extraction solids	D.1 – D.8	D.9 – D.15	D.2 and D.3
1-month single-contact $Ca(OH)_2$ leached solids	D.16 – D.27	D.28 – D.38	D.4, D.5, and D.6
1-month single-contact $CaCO_3$ leached solids	D.39 – D.52	D.53 – D.60	D.7 and D.8

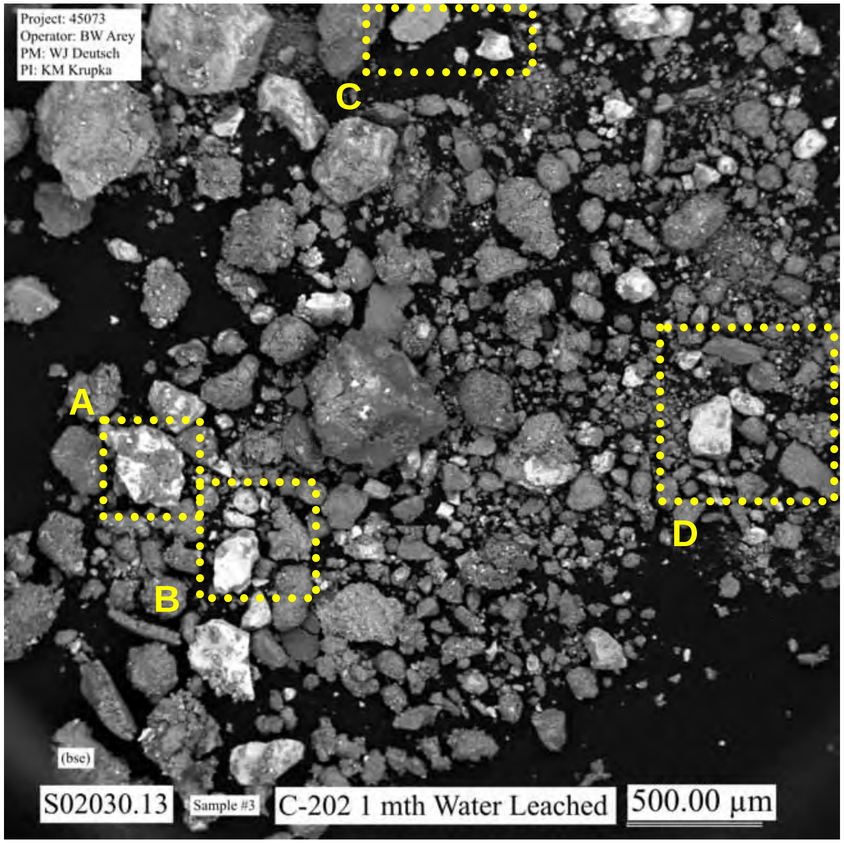


Figure D.1. Micrograph Showing at Low Magnification Typical Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

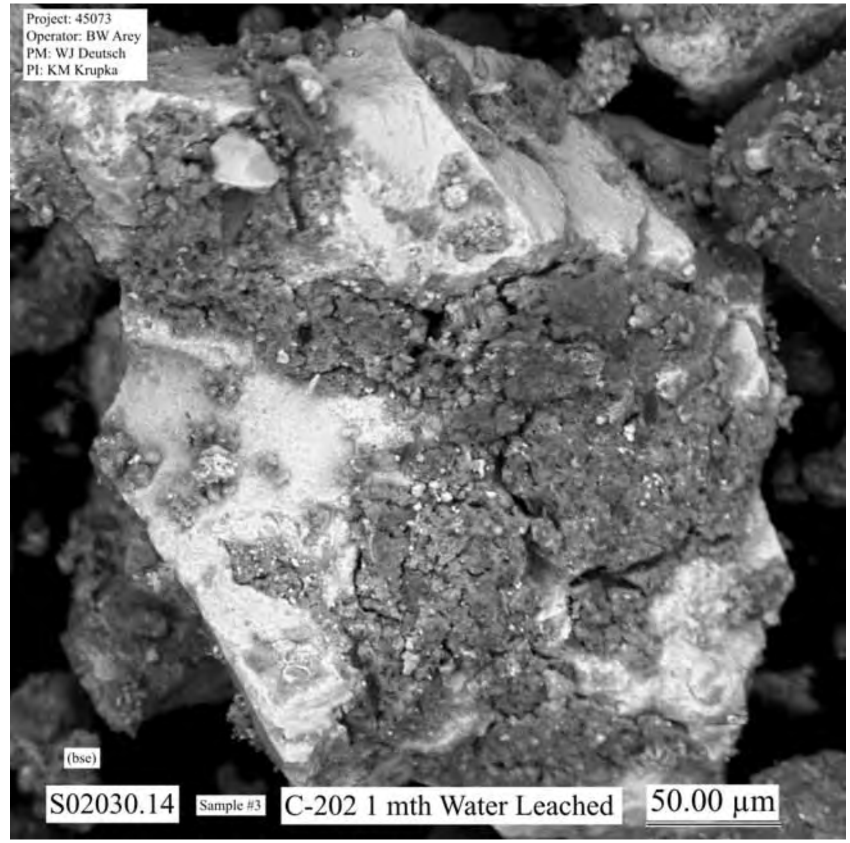


Figure D.2. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square A in Figure D.1 (Areas where EDS analyses were made are shown in Figure D.9.)

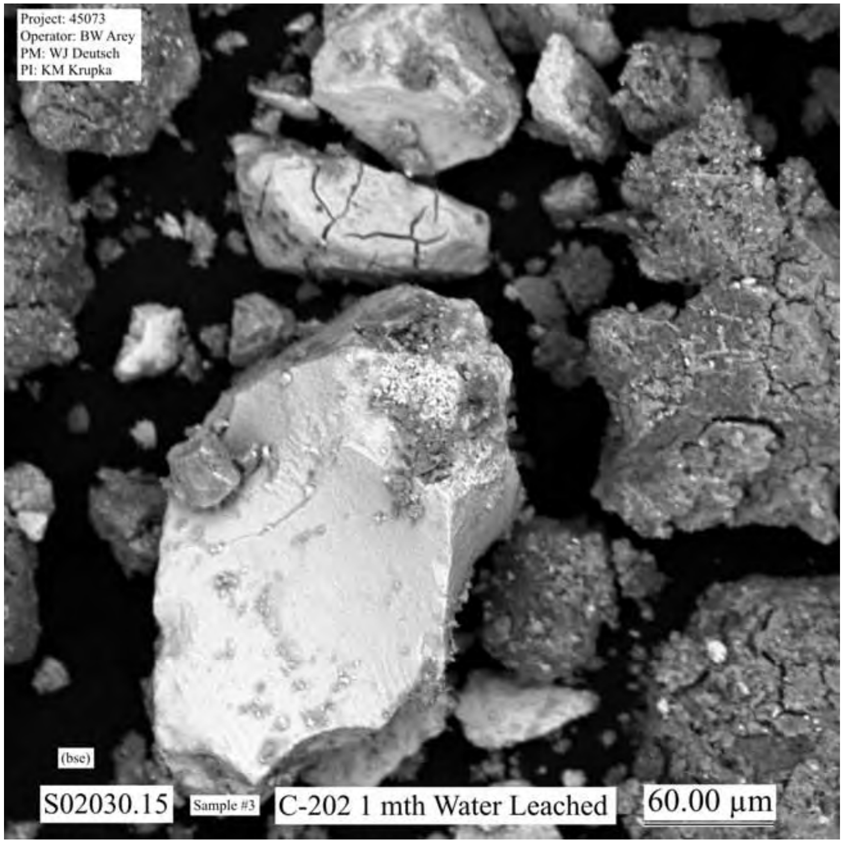


Figure D.3. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square B in Figure D.1 (Areas where EDS analyses were made are shown in Figure D.10.)

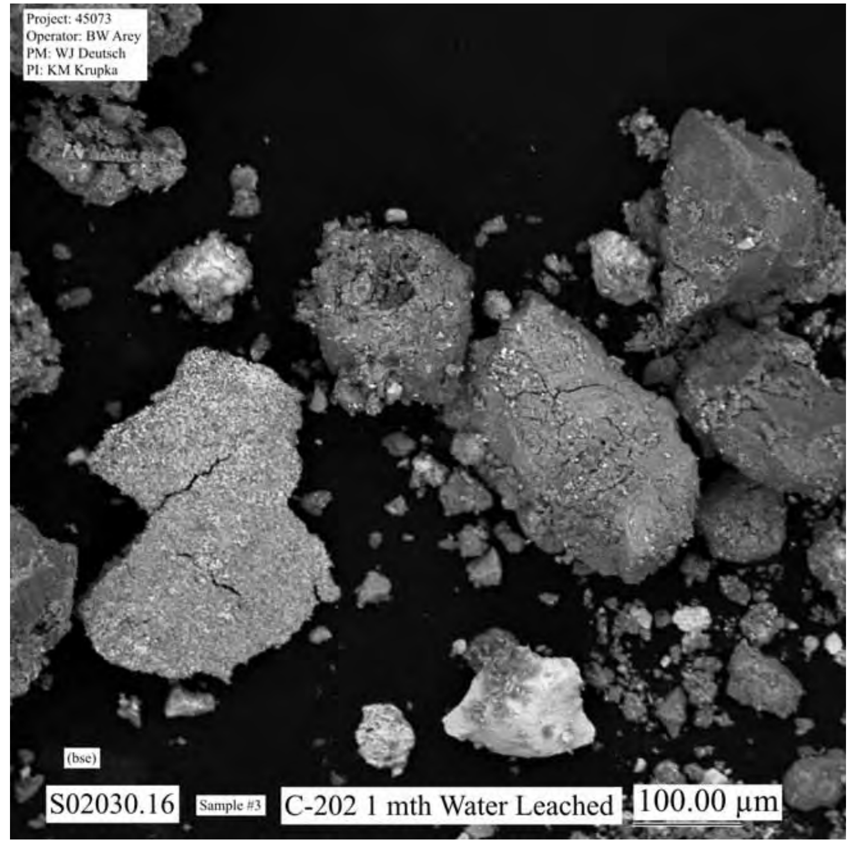


Figure D.4. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square C in Figure D.1 (Areas where EDS analyses were made are shown in Figure D.11.)

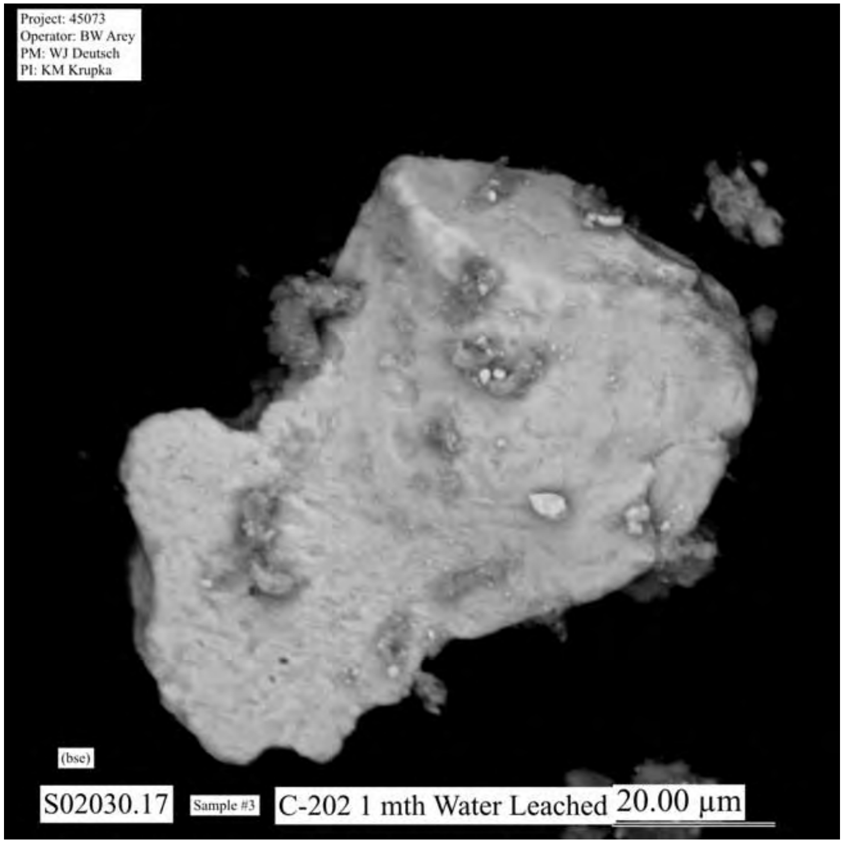


Figure D.5. Micrograph Showing Typical Particles in SEM Sample of SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

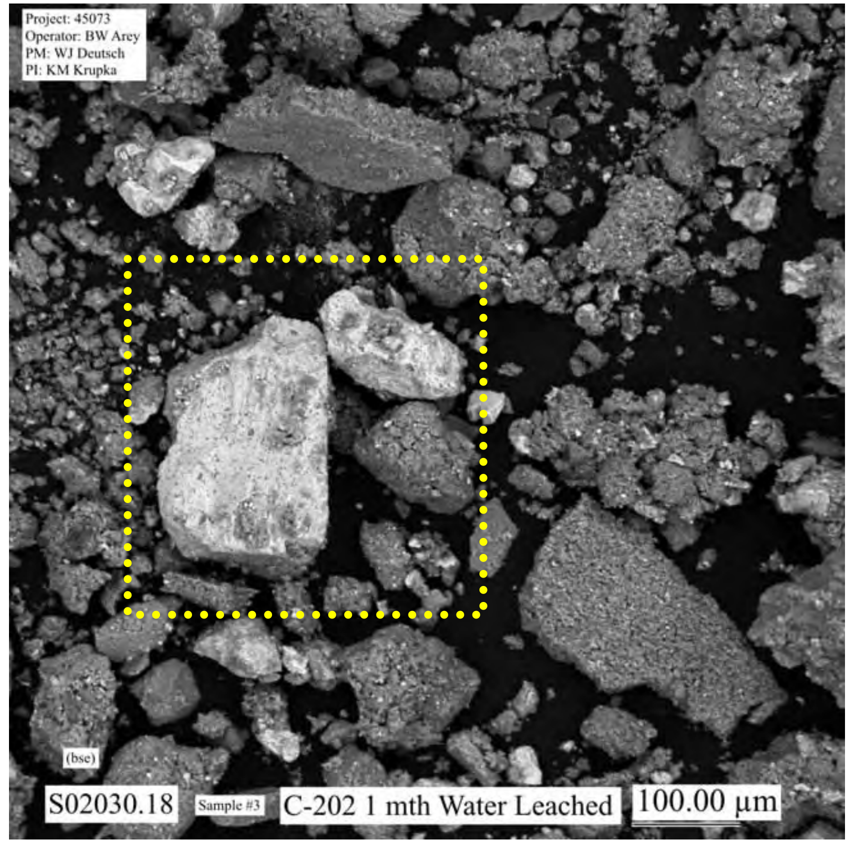


Figure D.6. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square D in Figure D.1

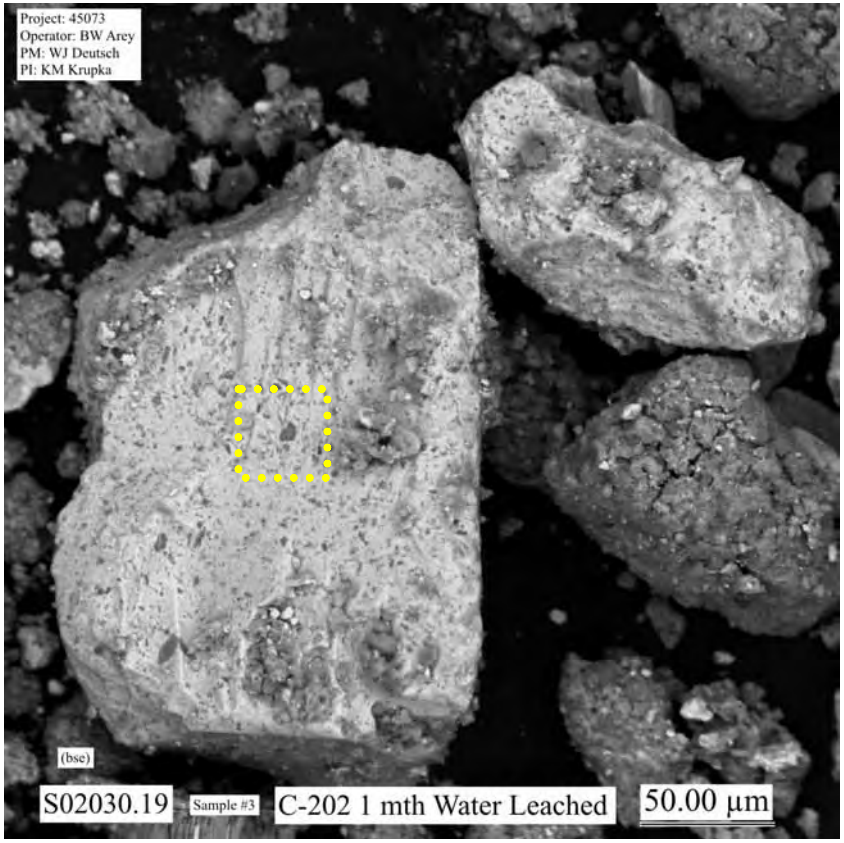


Figure D.7. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure D.6 (Areas where EDS analyses were made are shown in Figure D.13.)

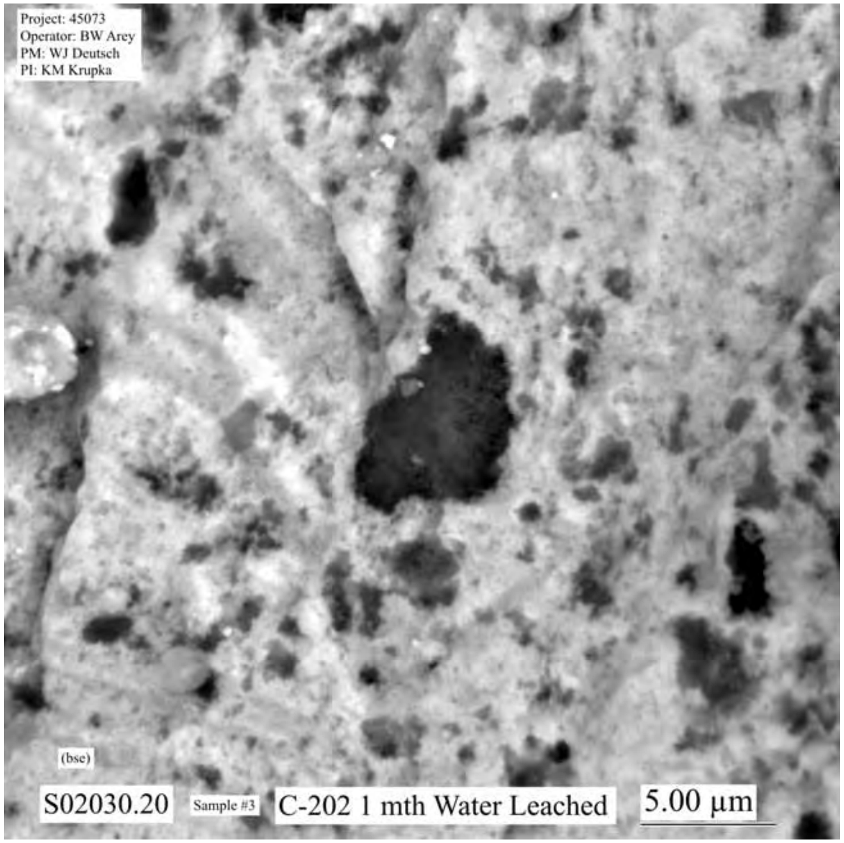


Figure D.8. Micrograph Showing at Higher Magnification the Particle Area Indicated by the Yellow Dotted-Line Square in Figure D.7 (Areas where EDS analyses were made are shown in Figure D.14.)

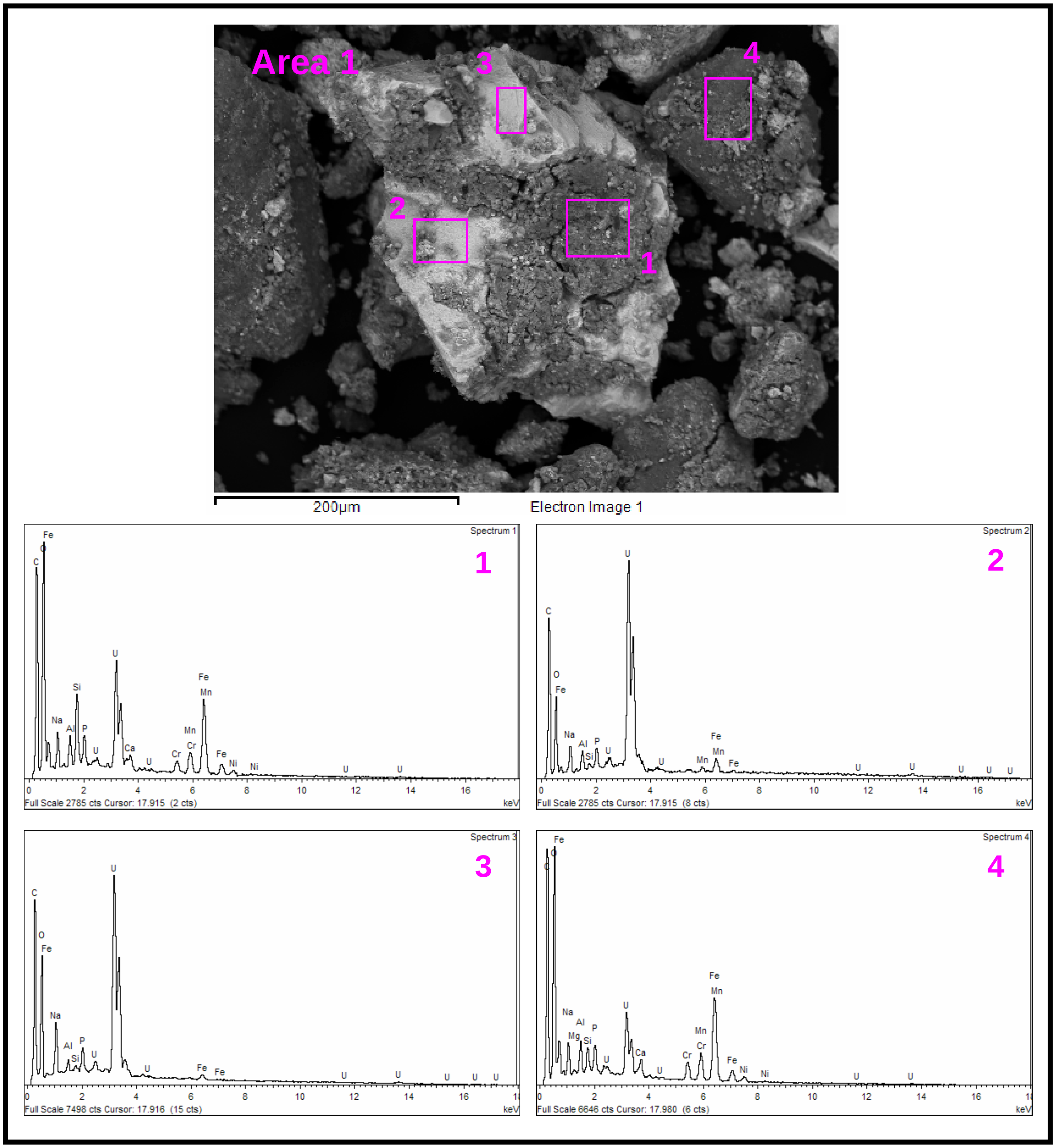


Figure D.9. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

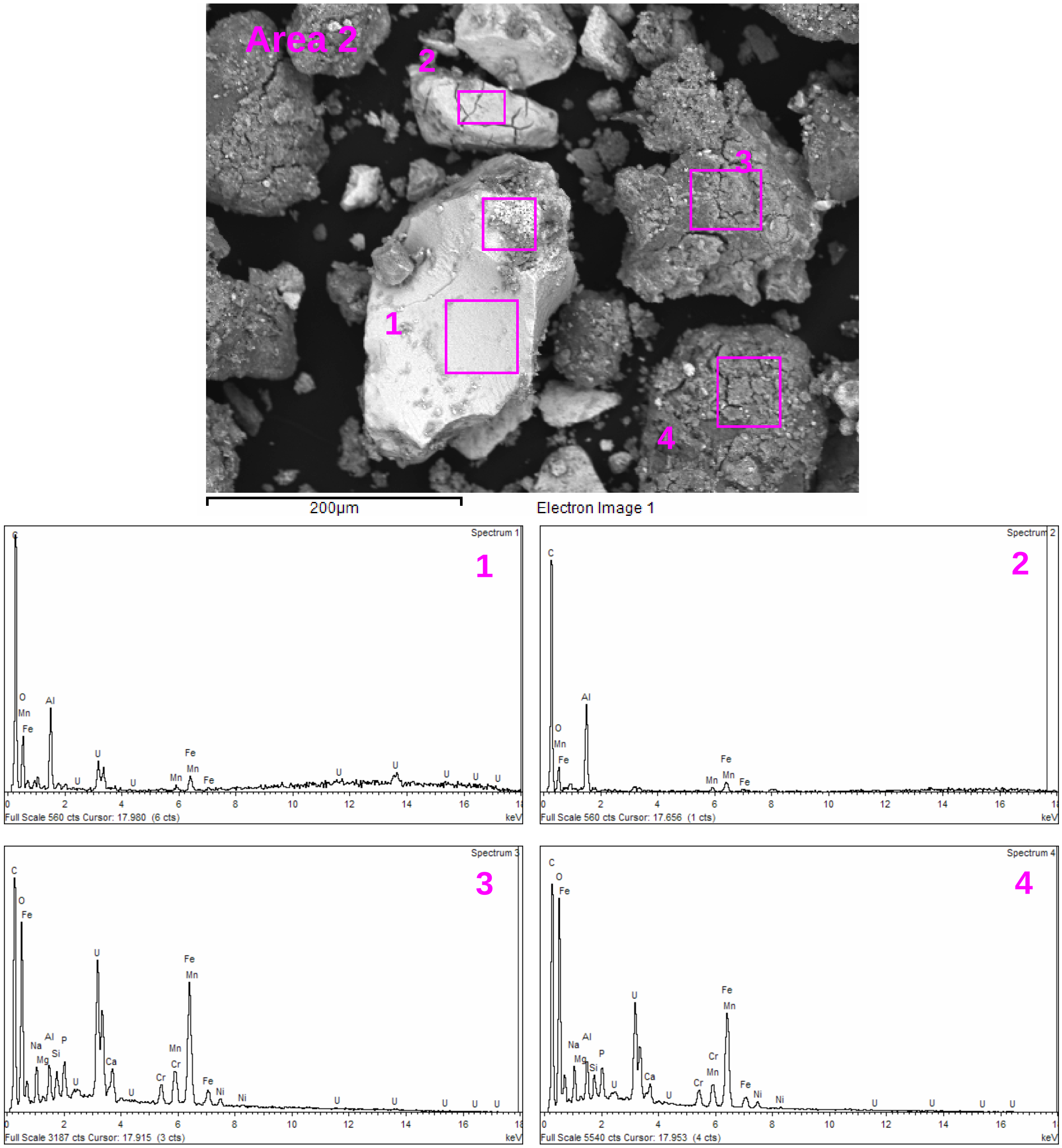


Figure D.10. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202 (EDS spectrum for fifth box shown in above micrograph was not recorded.)

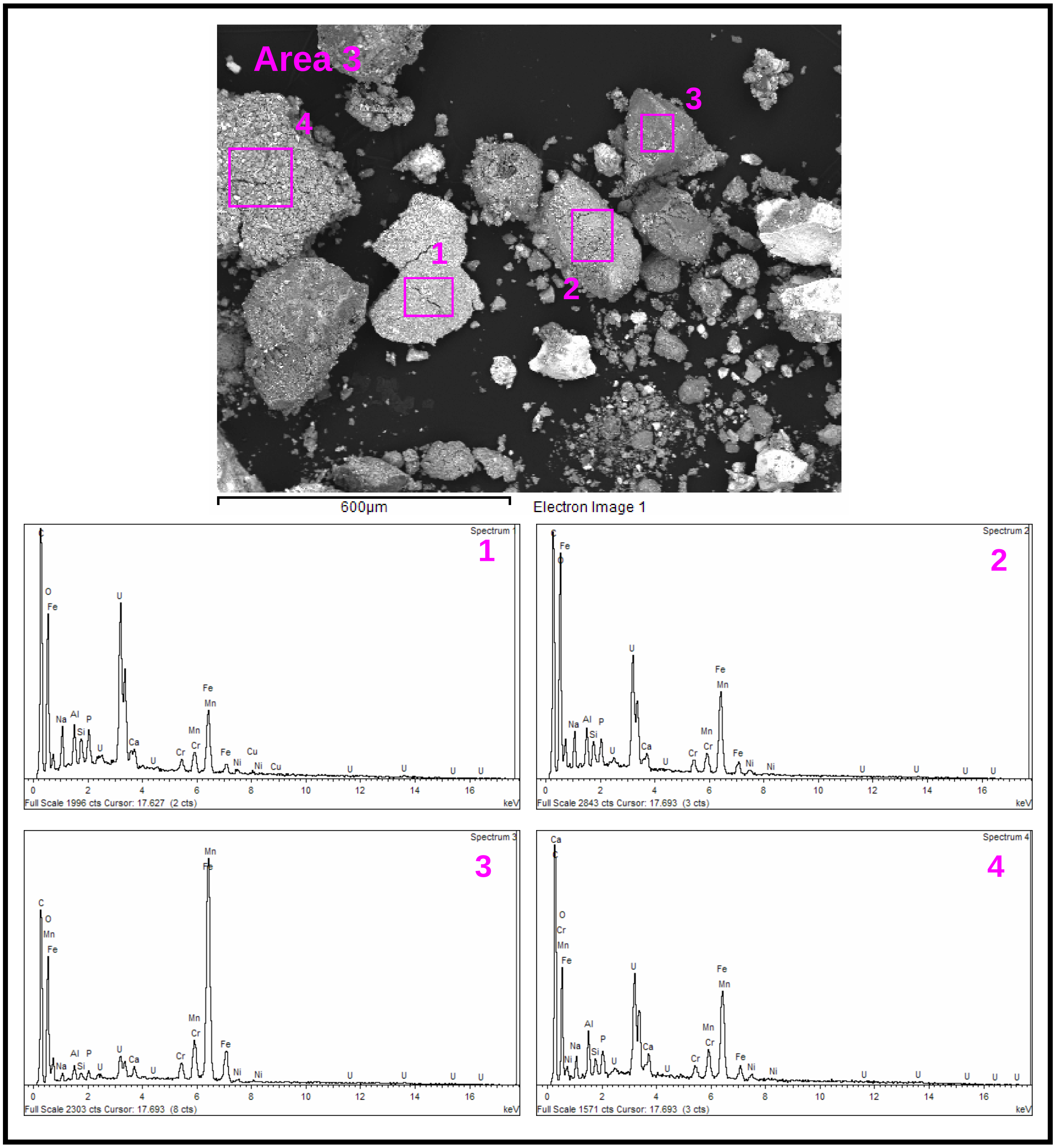


Figure D.11. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

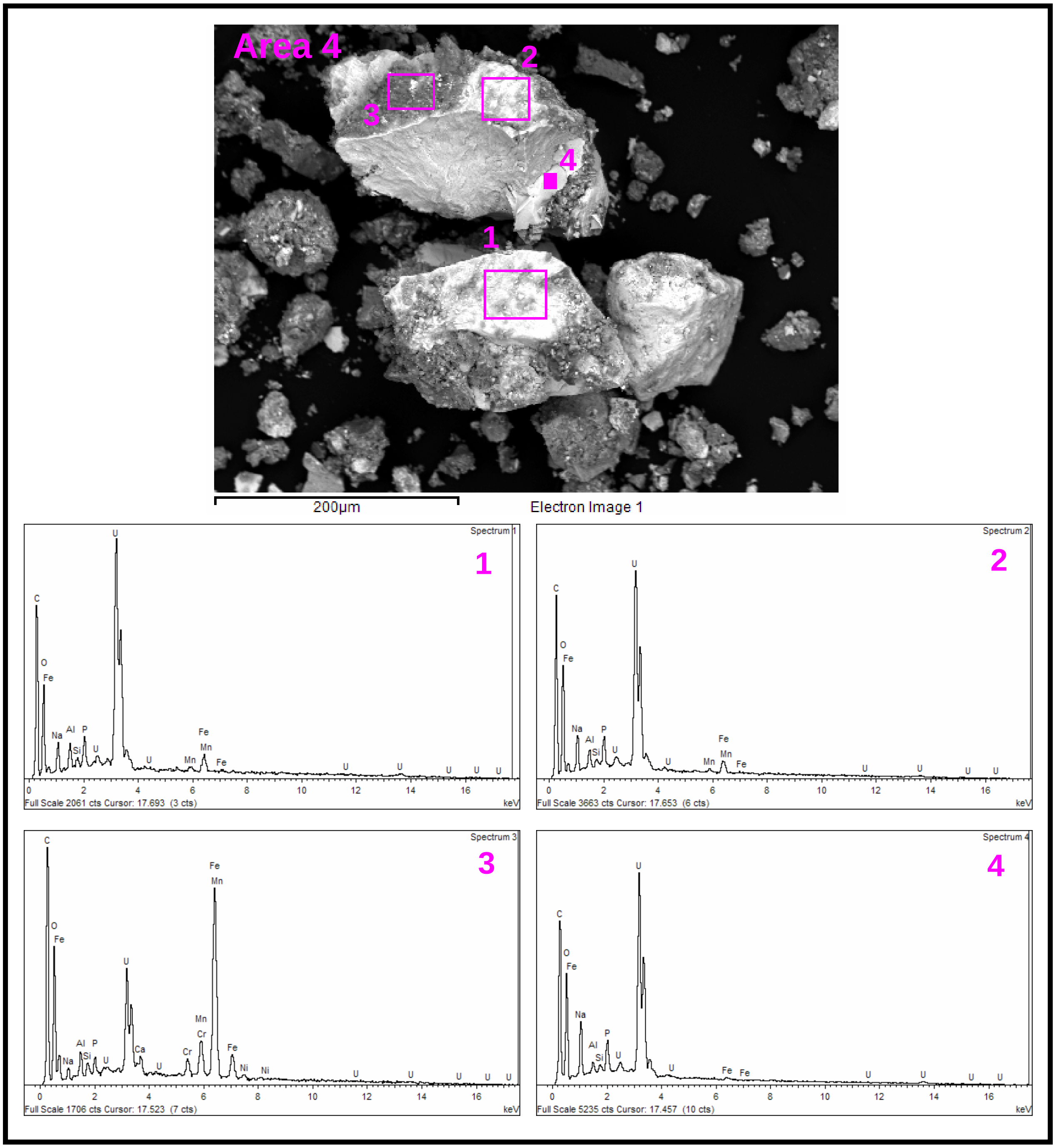


Figure D.12. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

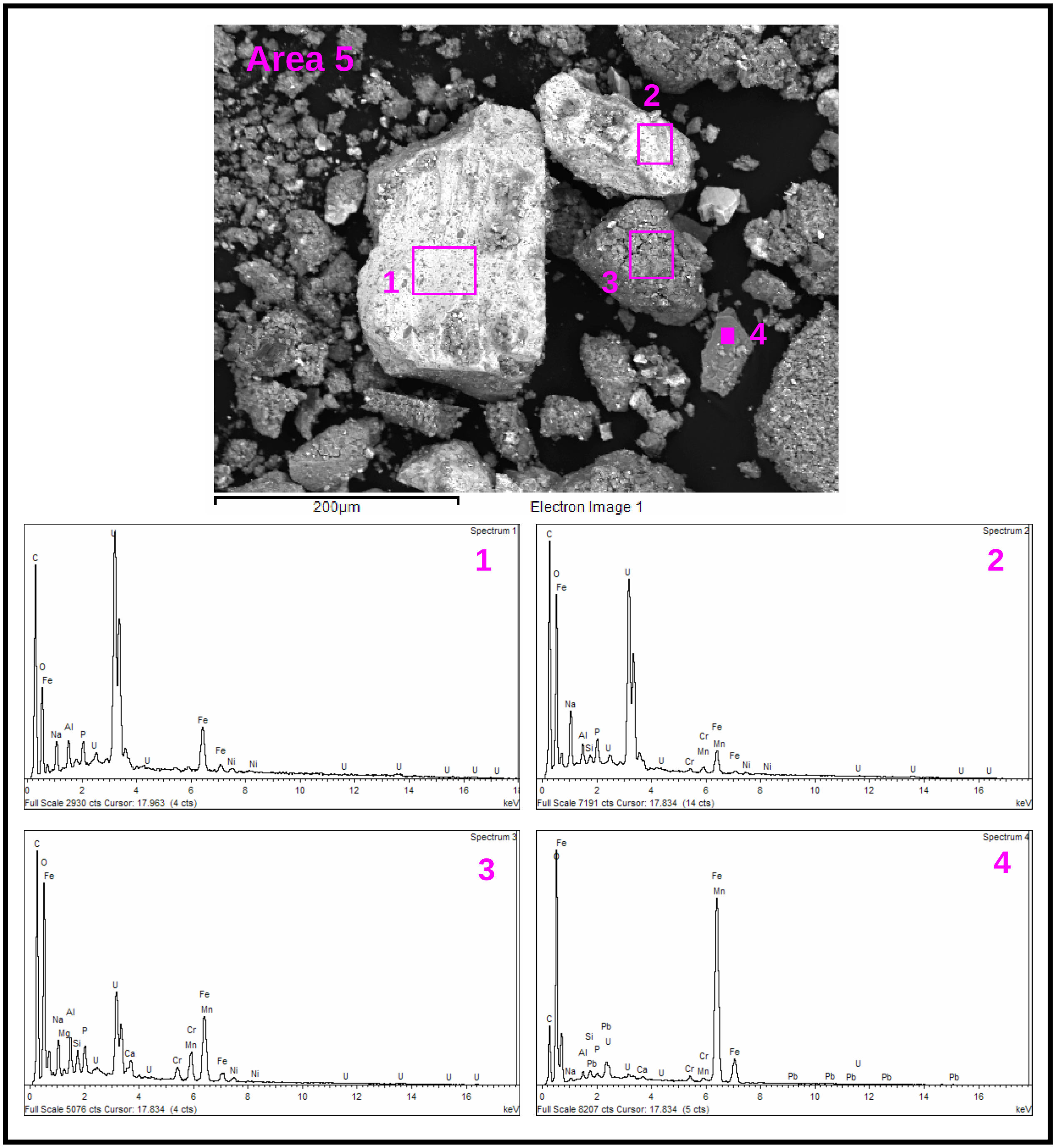


Figure D.13. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

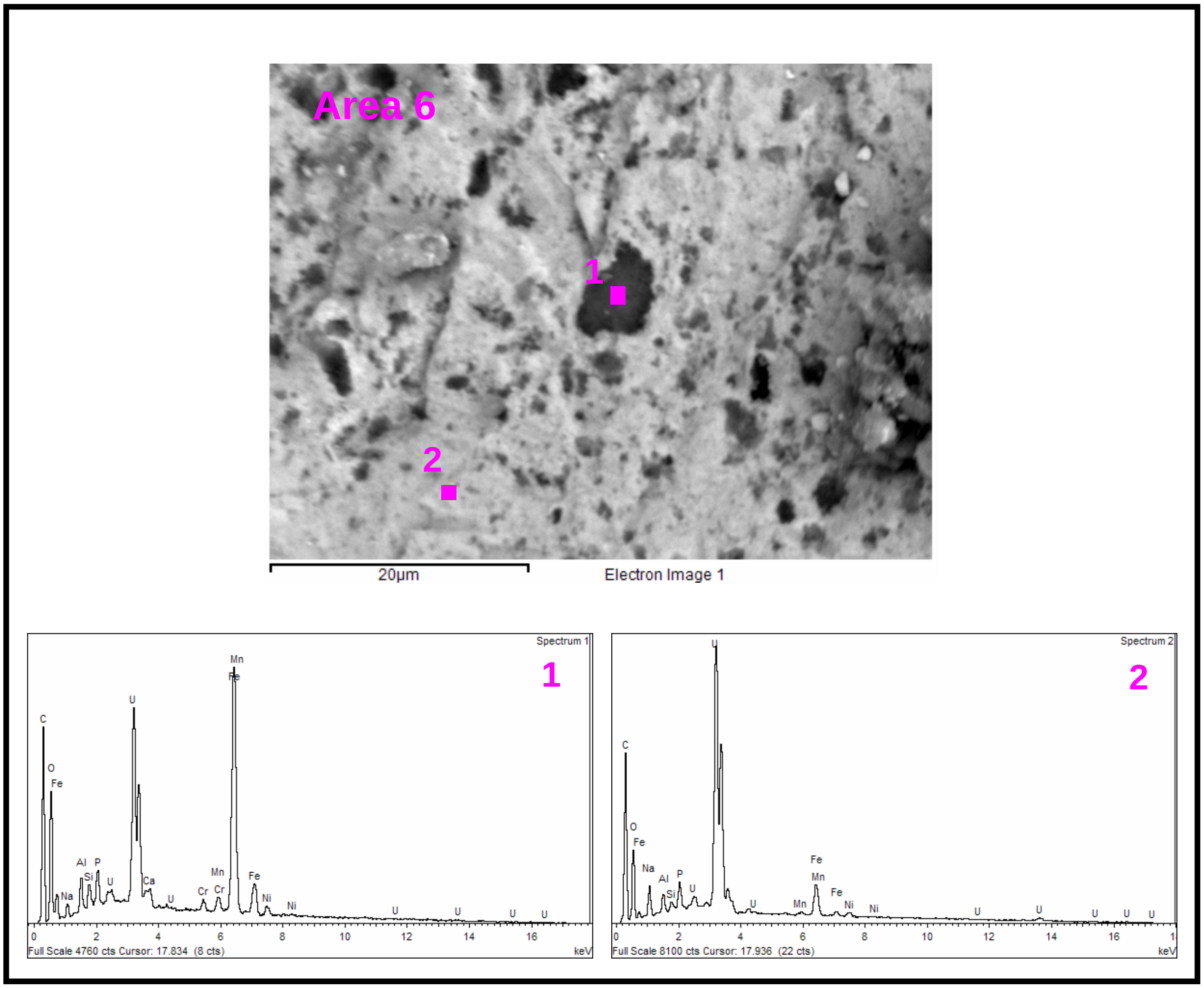


Figure D.14. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

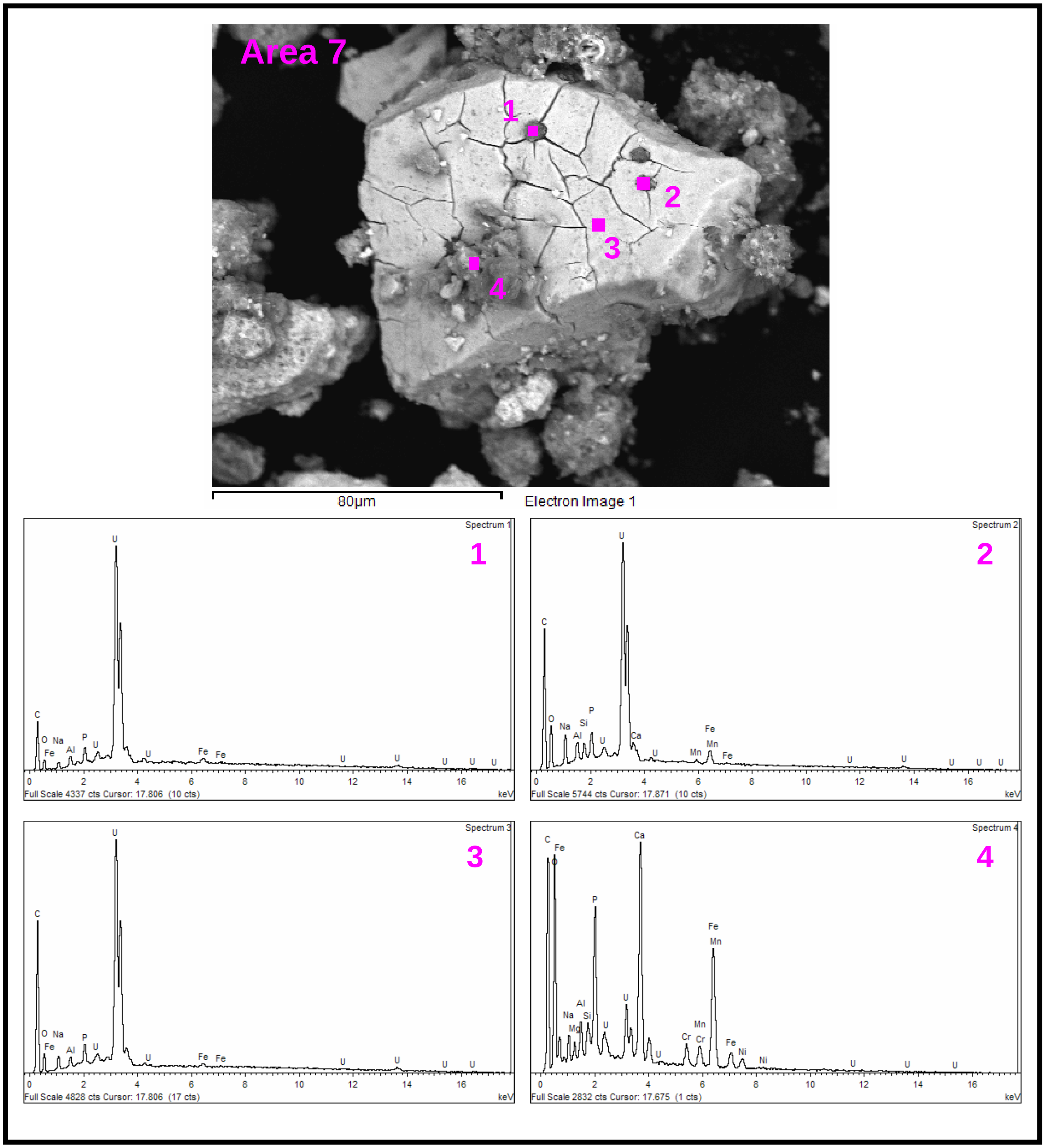


Figure D.15. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in SEM Sample of 1-Month Single-Contact Leached Water Extraction Residual Waste from Tank C-202

Table D.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for One Month Single-Contact Leached Water Extraction Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
D.9 / 1	1	1.1	1.9	3.0	0.8	0.4	0.3	0.3	39	*50*	0.7	0.8			1.5	
	2	4.8	2.7	1.2	0.4				32	*56*	1.0	1.1			0.3	
	3	3.7	4.2	0.4					39	*51*	0.9	0.5			0.1	
	4	0.7	1.6	3.3	0.9	0.5	0.3	0.3	38	*52*	0.6	0.7		0.1	0.5	
D.10 / 2	1	0.5		1.0	0.2				22	*74*		2.6				
	2			0.7	0.3				13	*82*		3.0				
	3	1.5	1.9	4.7	1.2	0.6	0.4	0.7	33	*54*	0.7	0.8		0.2	0.6	
	4	1.1	1.9	3.8	0.8	0.5	0.3	0.4	36	*53*	0.7	1.0		0.1	0.5	
D.11 / 3	1	1.9	2.2	2.8	0.8	0.4	0.3	0.4	32	*57*	0.8	1.1	0.2		0.6	
	2	1.2	1.9	3.3	0.6	0.4	0.3	0.3	38	*53*	0.6	0.9			0.5	
	3	0.3	0.7	11	1.6	0.6	0.2	0.3	26	*59*	0.3	0.5			0.2	
	4	1.2	1.3	4.3	1.1	0.4	0.3	0.5	27	*62*	0.6	1.2			0.4	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table D.3. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for One Month Single-Contact Leached Water Extraction Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
D.12 / 4	1	4.5	2.7	1.3	0.3				32	*57*	1.2	1.3			0.3	
	2	3.7	3.0	0.9	0.2				35	*55*	1.1	0.8			0.3	
	3	1.2	0.8	8.2	1.3	0.6	0.3	0.4	26	*60*	0.4	0.6			0.3	
	4	4.1	4.5	0.2					37	*52*	1.3	0.5			0.3	
D.13 / 5	1	4.1	2.4	3.0			0.4		28	*60*	0.9	1.2				
	2	2.5	3.3	1.1	0.2	0.1	0.1		39	*52*	0.7	0.6			0.2	W – 0.1
	3	0.9	1.8	2.8	1.0	0.4	0.2	0.3	37	*54*	0.6	0.9		0.2	0.5	
	4	0.1	0.4	14	0.2	0.2		0.1	50	*34*	0.2	0.4			0.3	Pb – 0.3
D.14 / 6	1	2.3	0.9	11	0.6	0.4	0.6	0.4	25	*56*	0.9	1.0			0.6	
	2	5.7	2.9	2.6	0.2		0.5		26	*59*	1.2	0.9			0.4	
D.15 / 7	1	16	2.4	1.3					16	*59*	2.7	2.1				
	2	5.8	3.7	1.4	0.3			0.5	22	*63*	1.5	1.2			0.9	
	3	7.7	2.1	0.4					13	*75*	1.4	0.9				
	4	0.5	1.1	3.8	0.5	0.5	0.5	3.6	36	*50*	2.4	0.7		0.5	0.4	Pb – 0.2, W – 0.1

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as “<0.1” indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.

2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.

3 = Carbon concentrations (in italics) are suspect, and are likely too large.

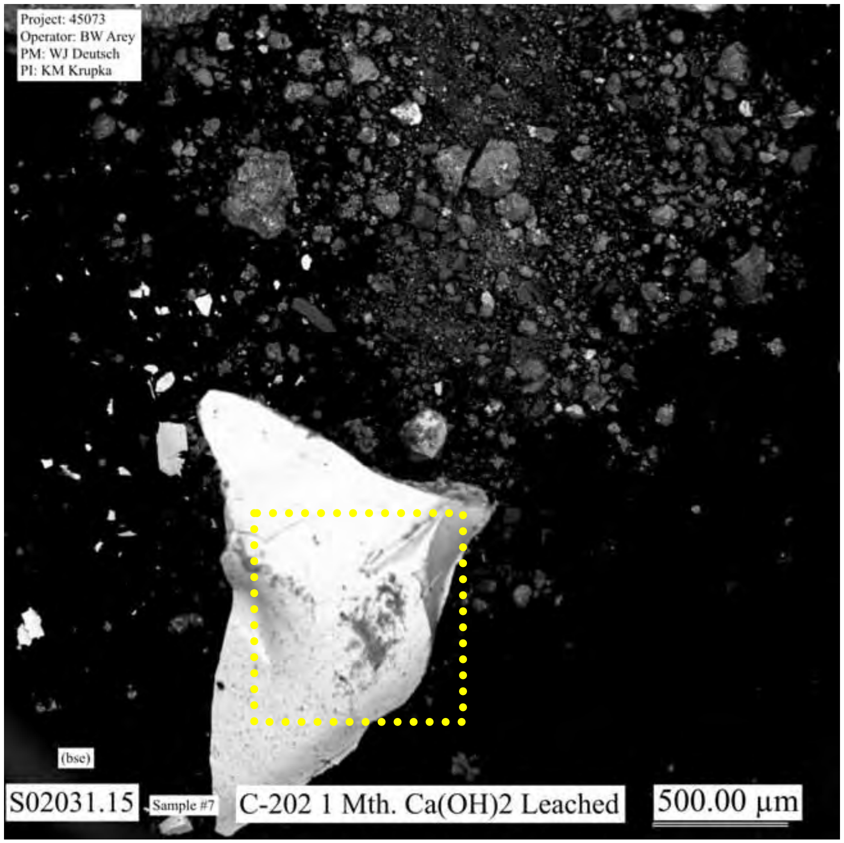


Figure D.16. Micrograph Showing at Low Magnification Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

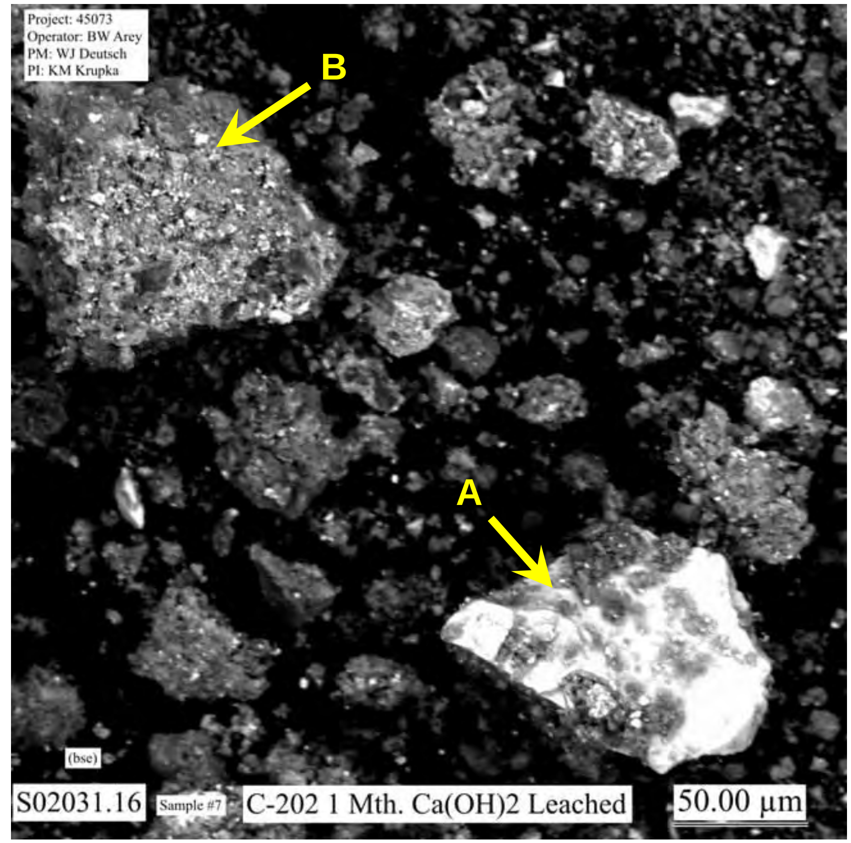


Figure D.17. Micrograph Showing Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

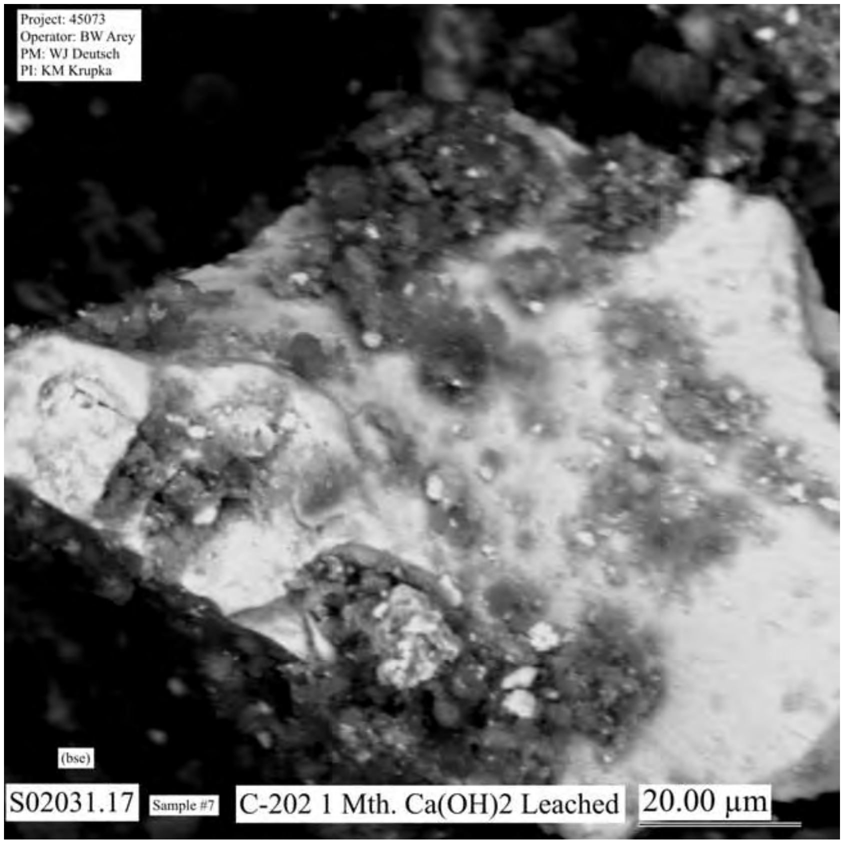


Figure D.18. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure D.17 (Areas where EDS analyses were made are shown in Figure D.28.)

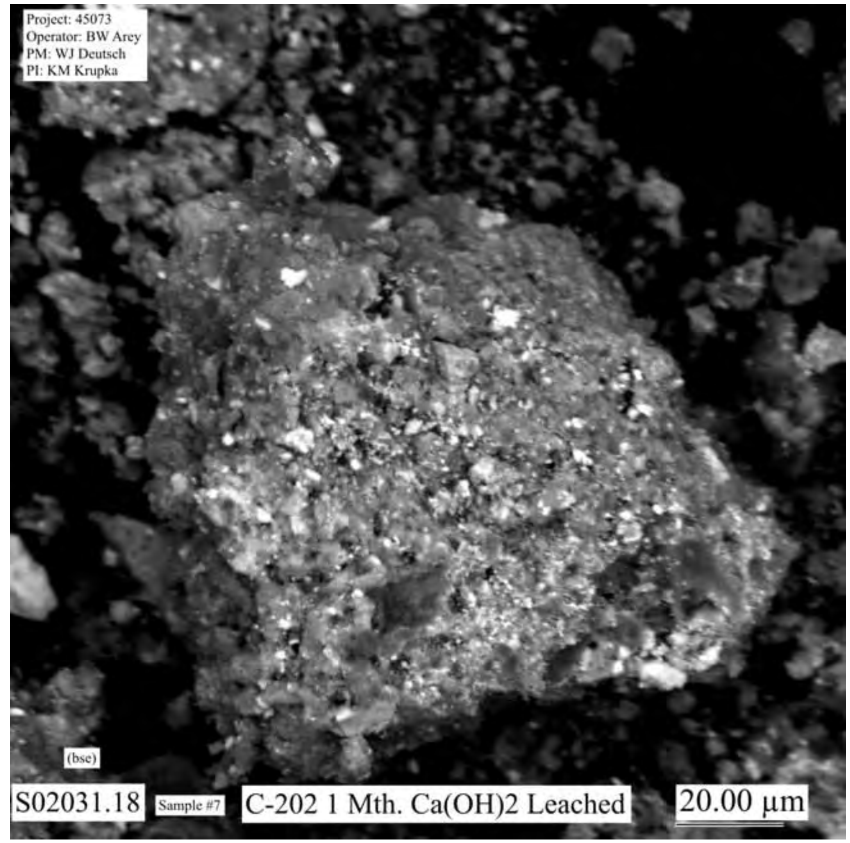


Figure D.19. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled B in Figure D.17 (Areas where EDS analyses were made are shown in Figure D.29.)

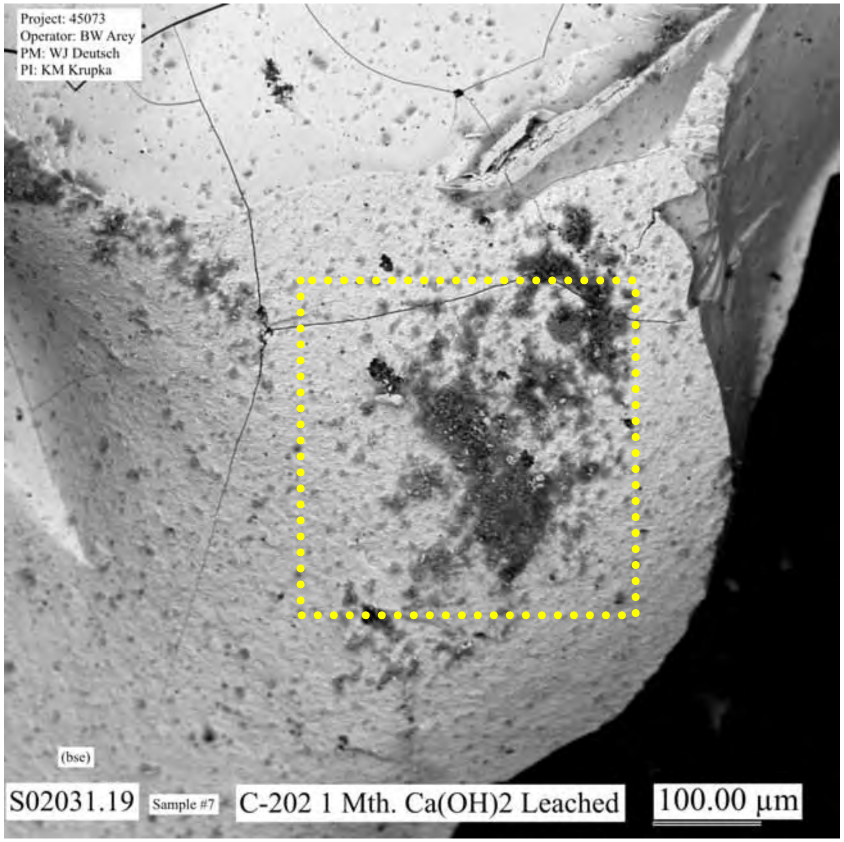


Figure D.20. Micrograph Showing at Higher Magnification the Particle Area Indicated by the Yellow Dotted-Line Square in Figure D.16

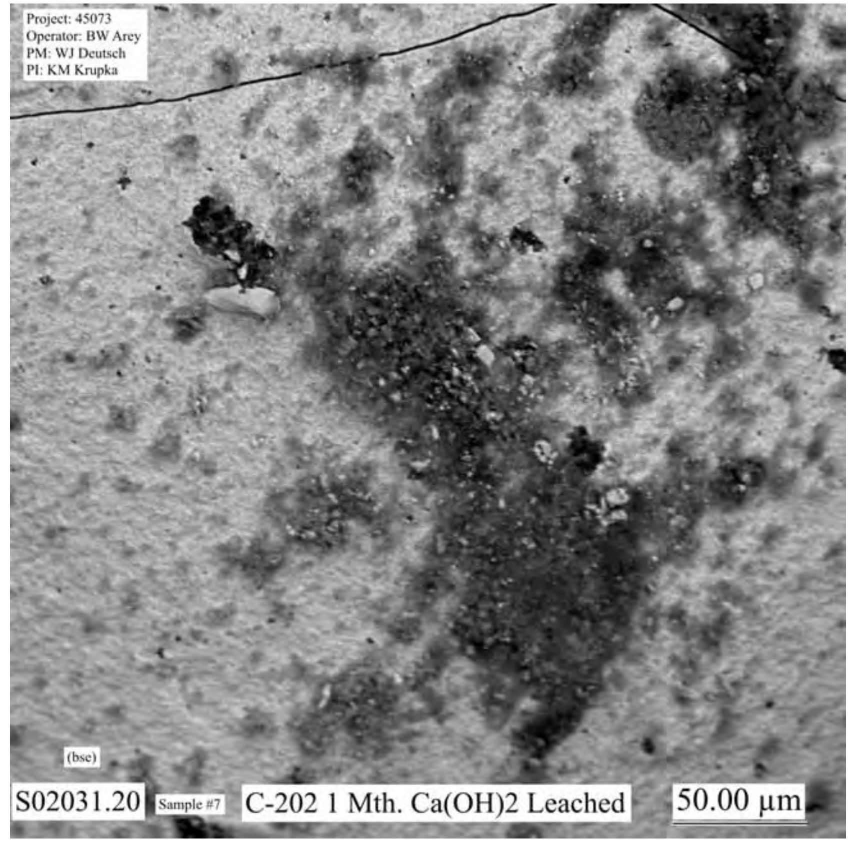
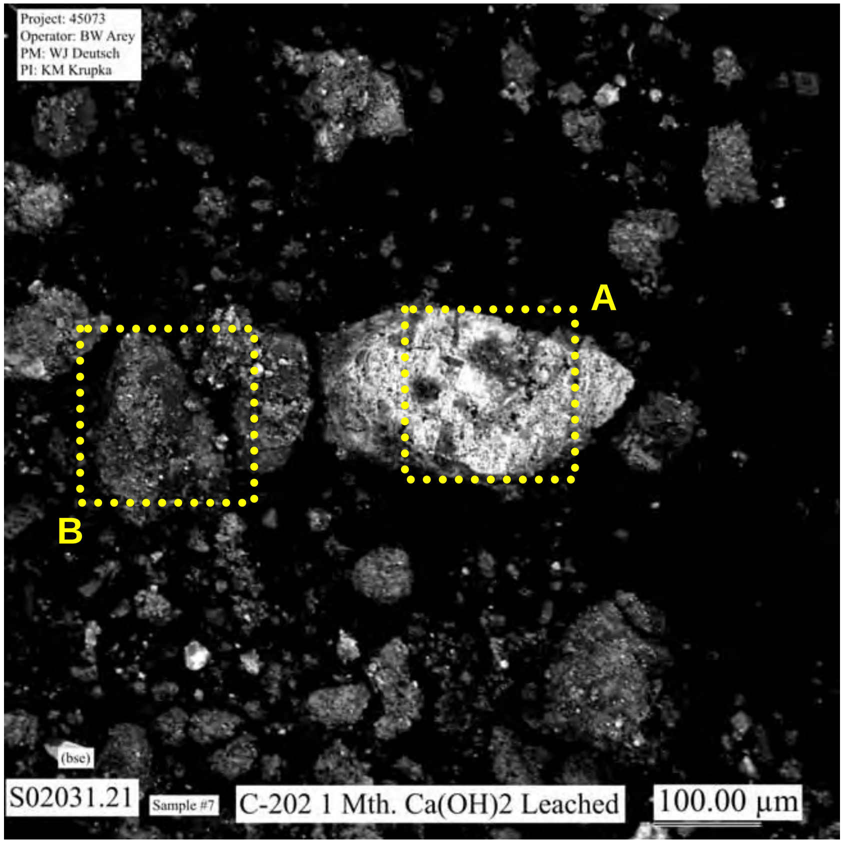


Figure D.21. Micrograph Showing at Higher Magnification the Particle Area Indicated by the Yellow Dotted-Line Square in Figure D.20 (Areas where EDS analyses were made are shown in Figure D.30.)



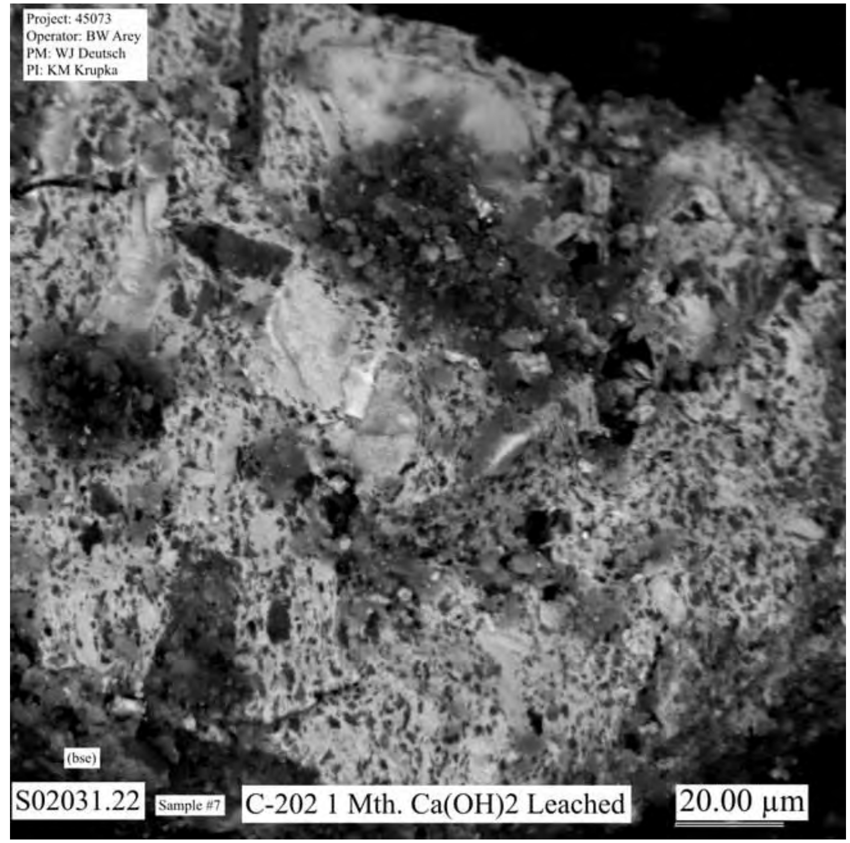


Figure D.22. Micrograph Showing at Low Magnification Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

Figure D.23. Micrograph Showing at Higher Magnification the Particle Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure D.22 (Areas where EDS analyses were made are shown in Figures D.31 and D.32.)

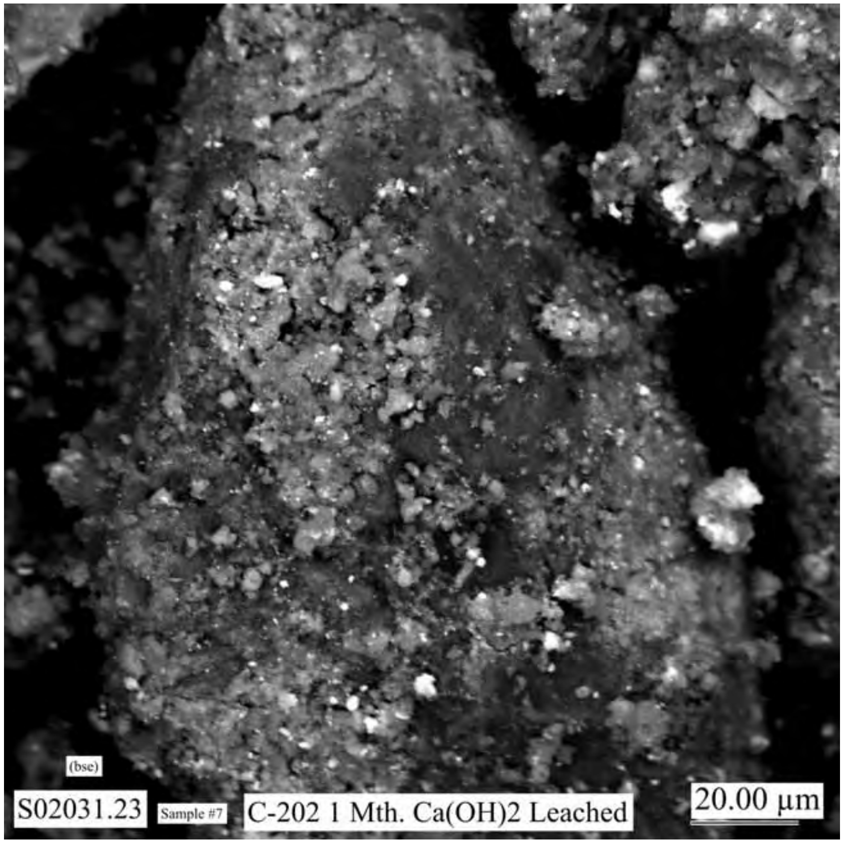


Figure D.24. Micrograph Showing at Higher Magnification the Particle Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure D.22 (Areas where EDS analyses were made are shown in Figures D.33 and D.34.)

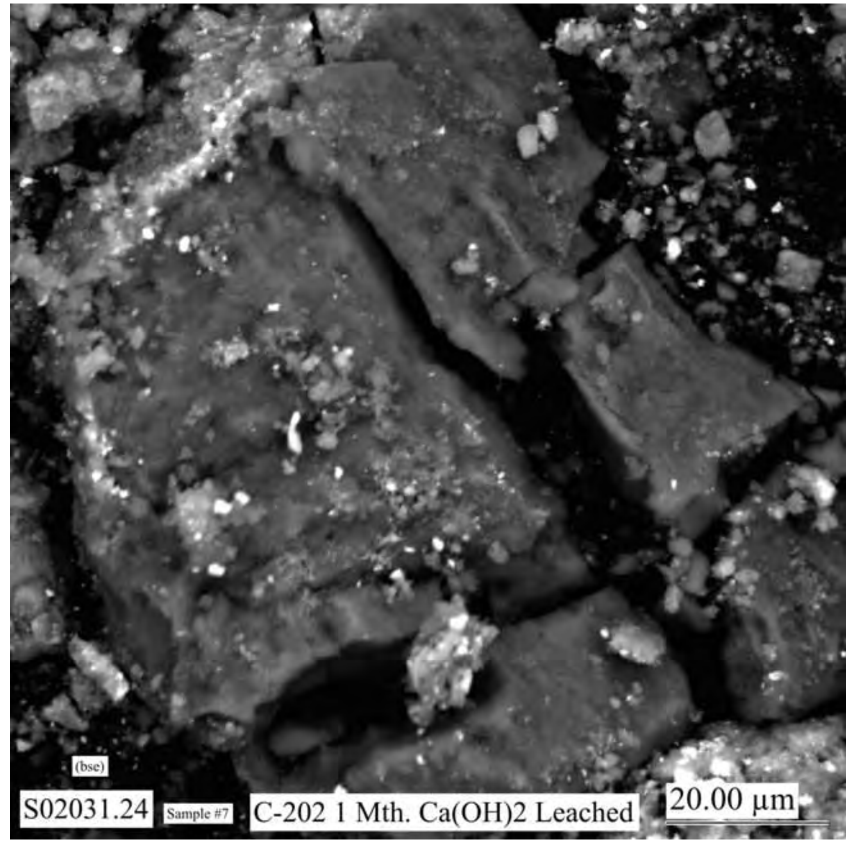
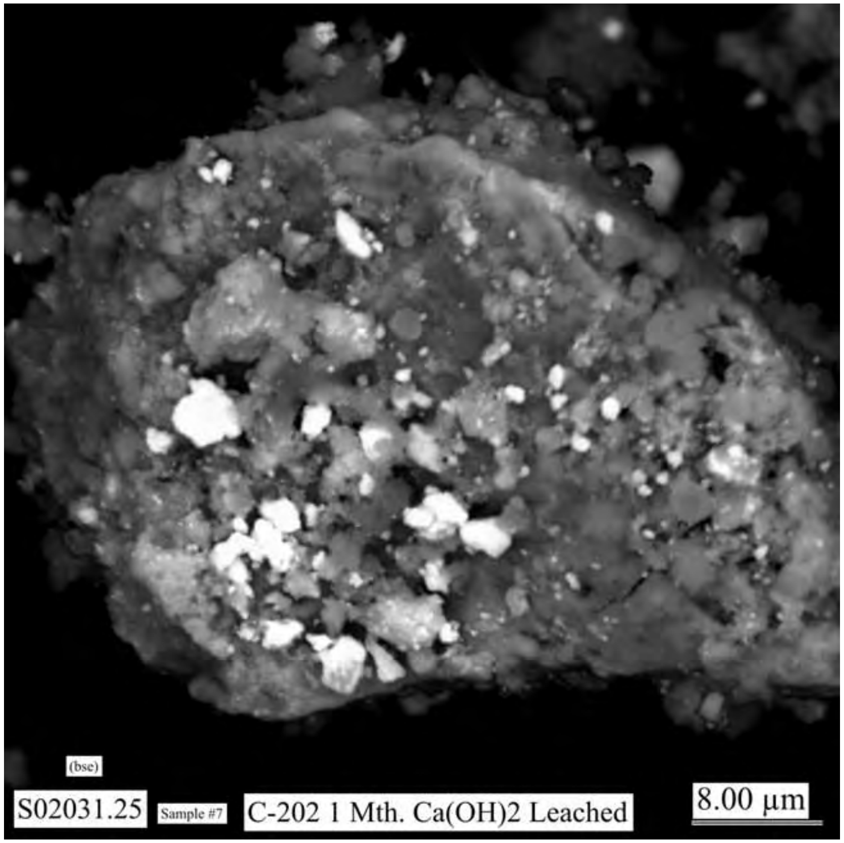


Figure D.25. Micrograph Showing Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202 (Areas where EDS analyses were made are shown in Figure D.35.)



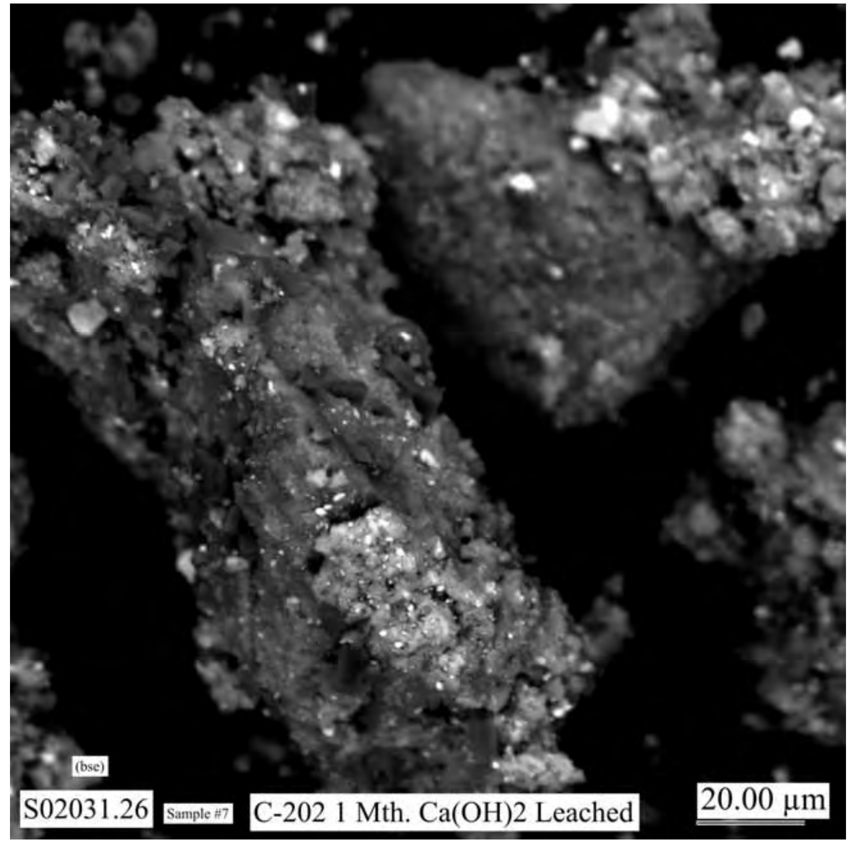


Figure D.26. Micrograph Showing Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202 (Areas where EDS analyses were made are shown in Figure D.36.)

Figure D.27. Micrograph Showing Typical Particles in SEM Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202 (Areas where EDS analyses were made are shown in Figures D.37 and D.38.)

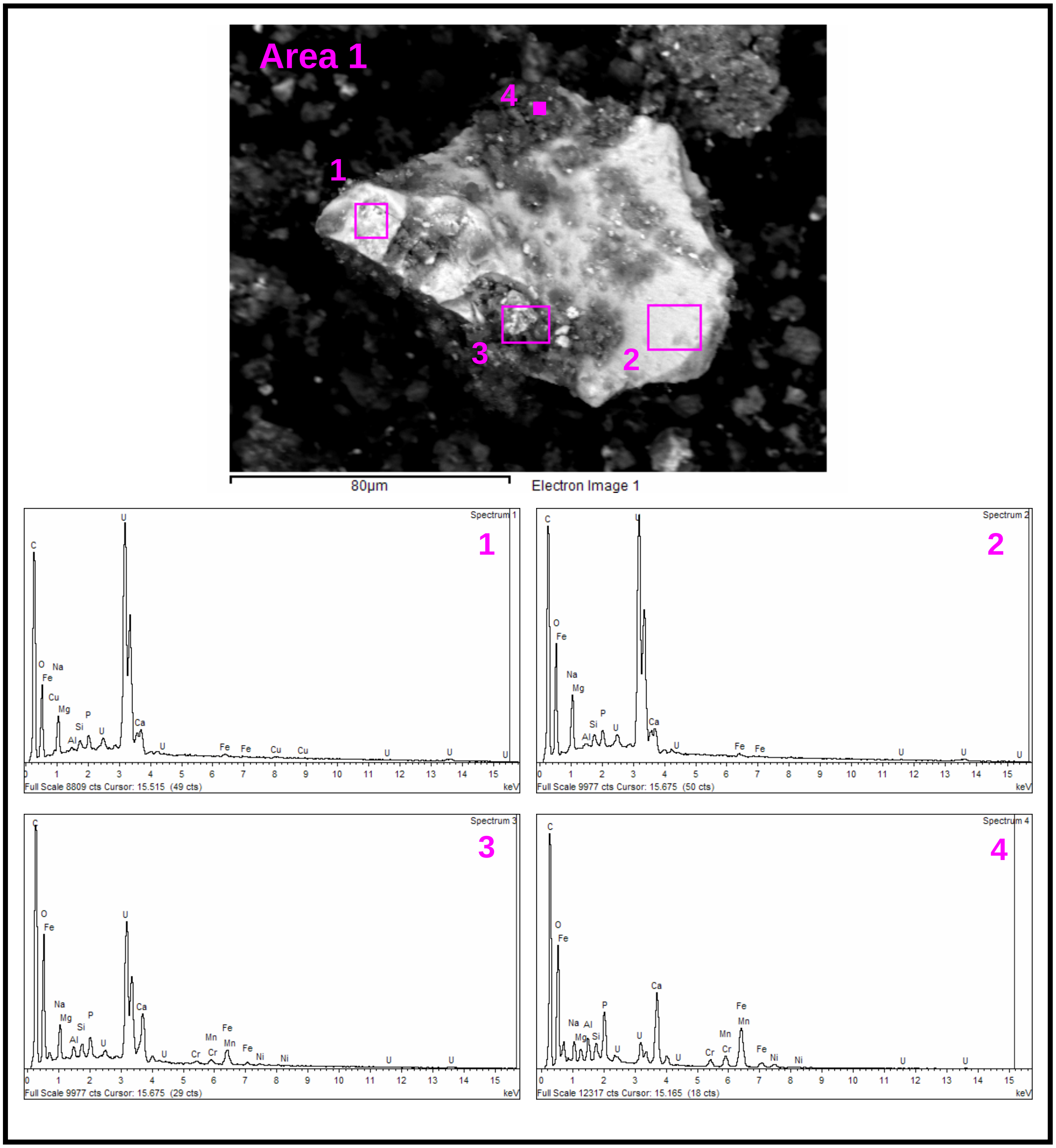


Figure D.28. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

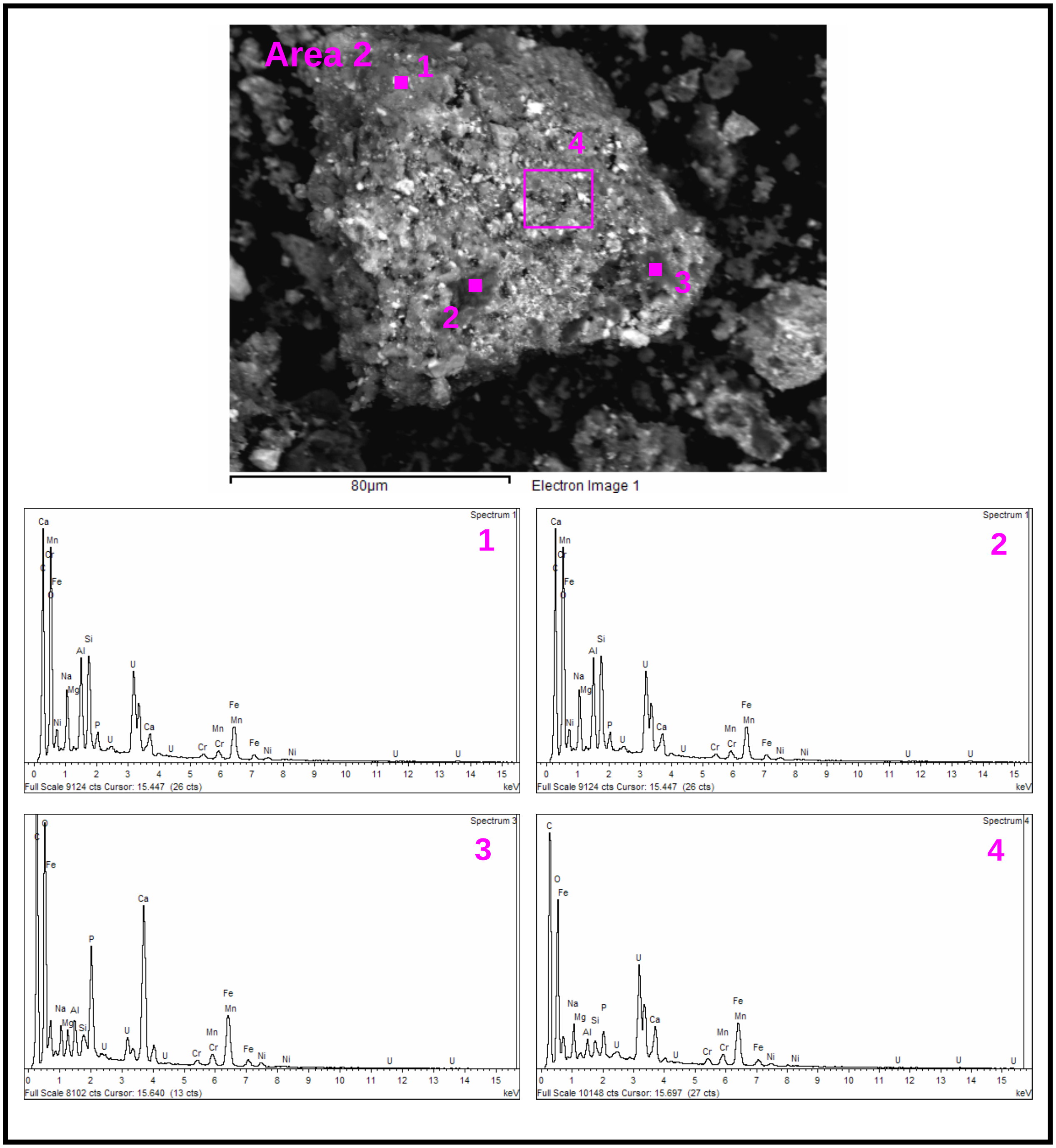


Figure D.29. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

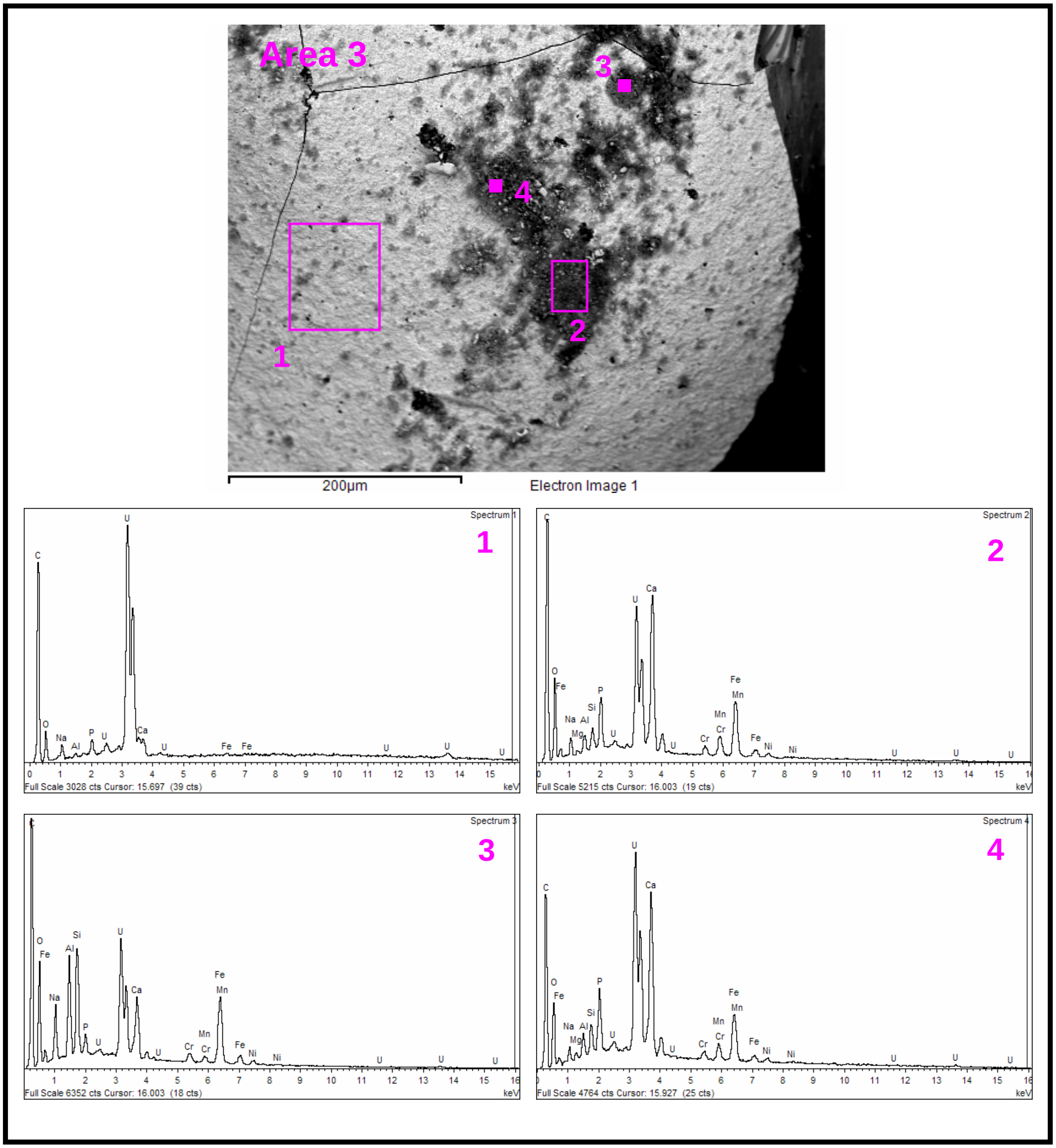


Figure D.30. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

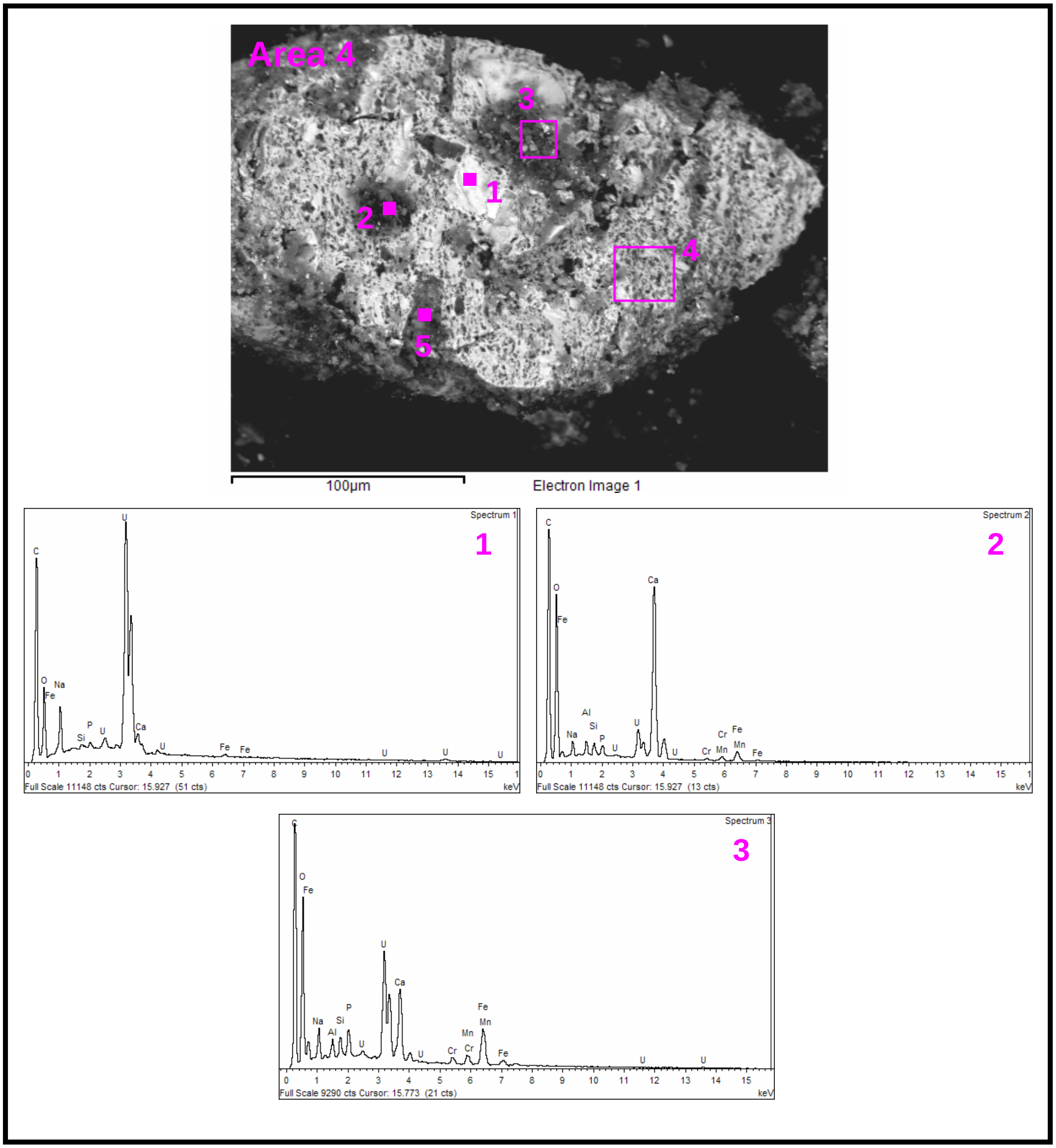


Figure D.31. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

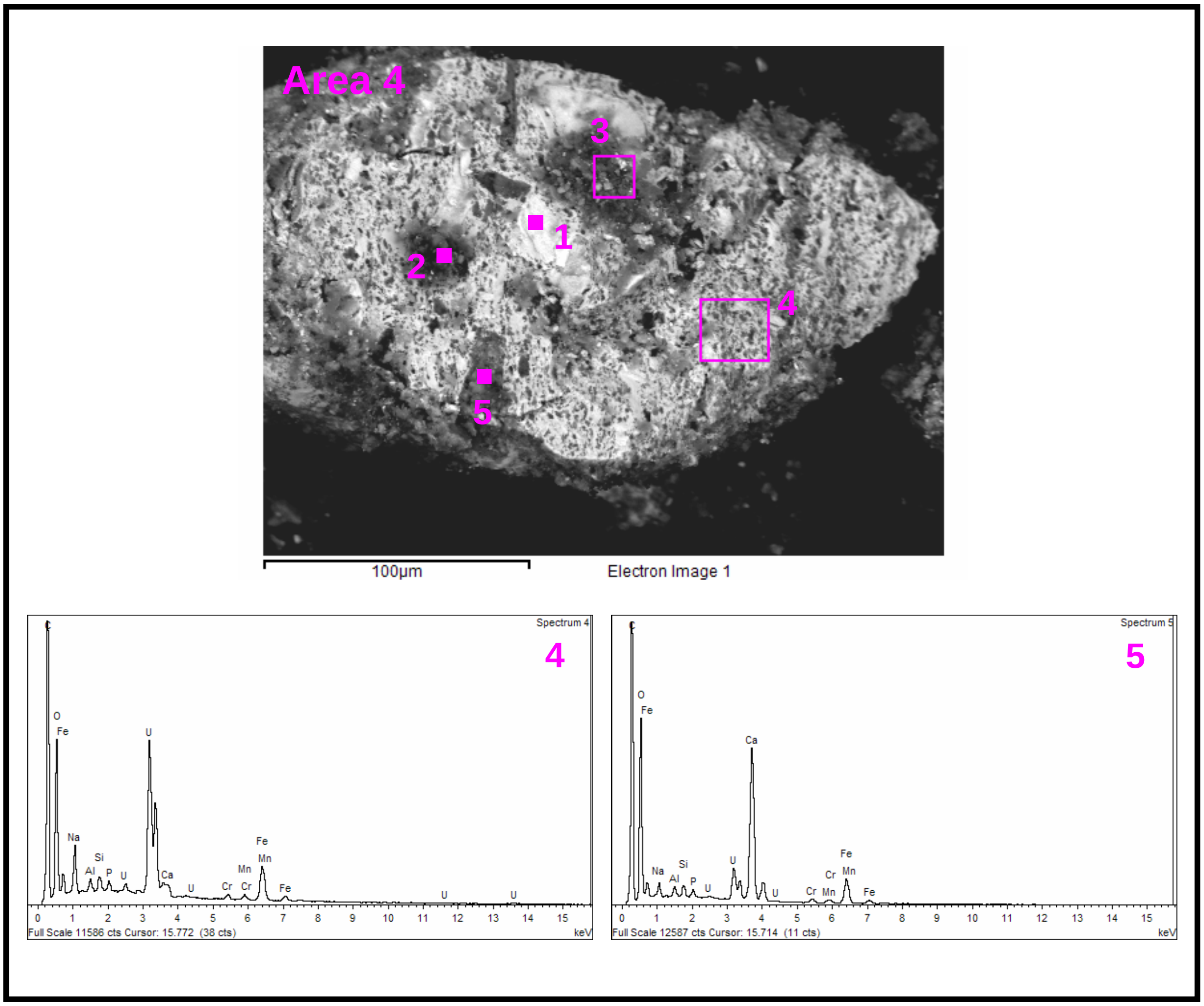


Figure D.32. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

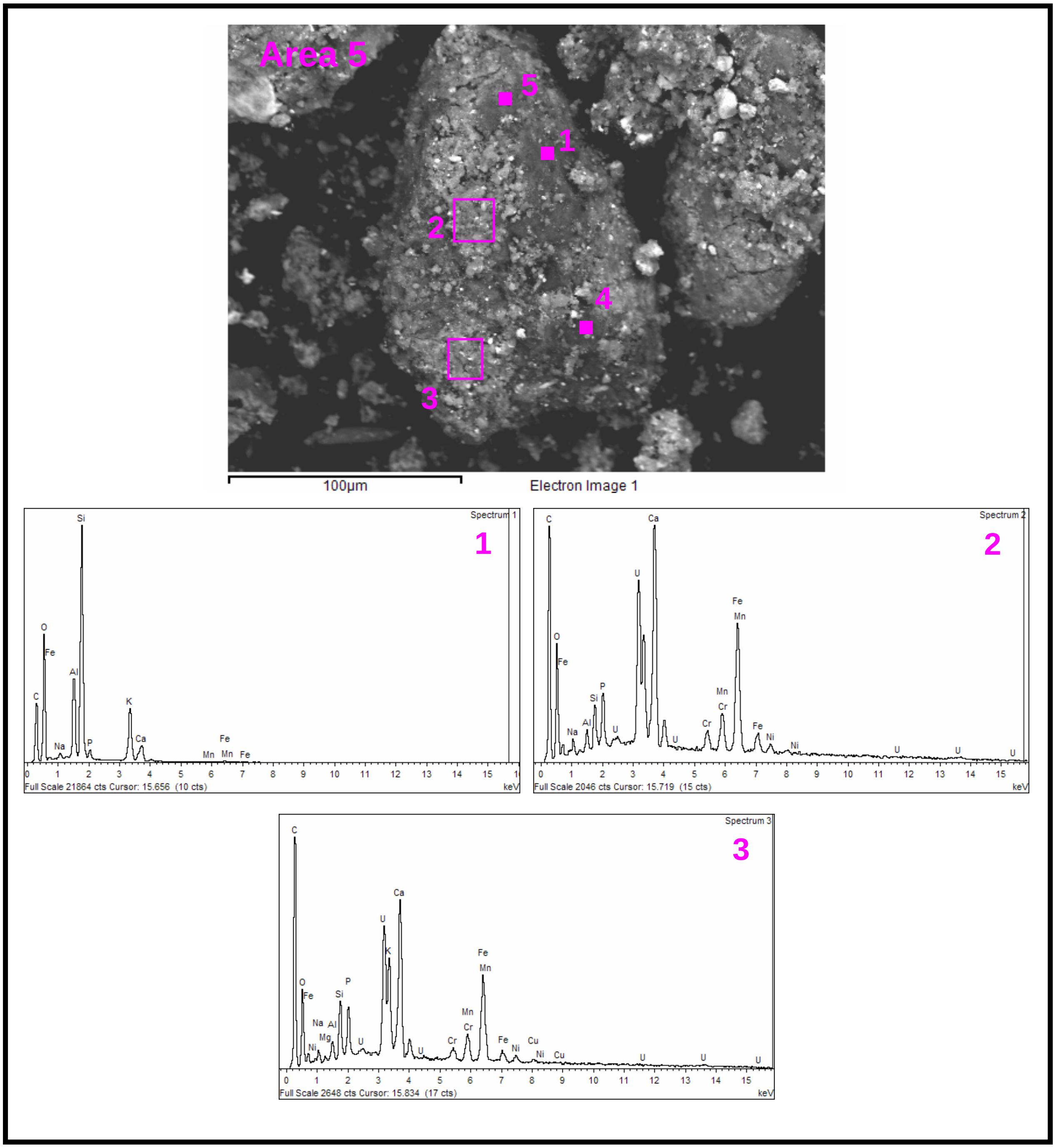


Figure D.33. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

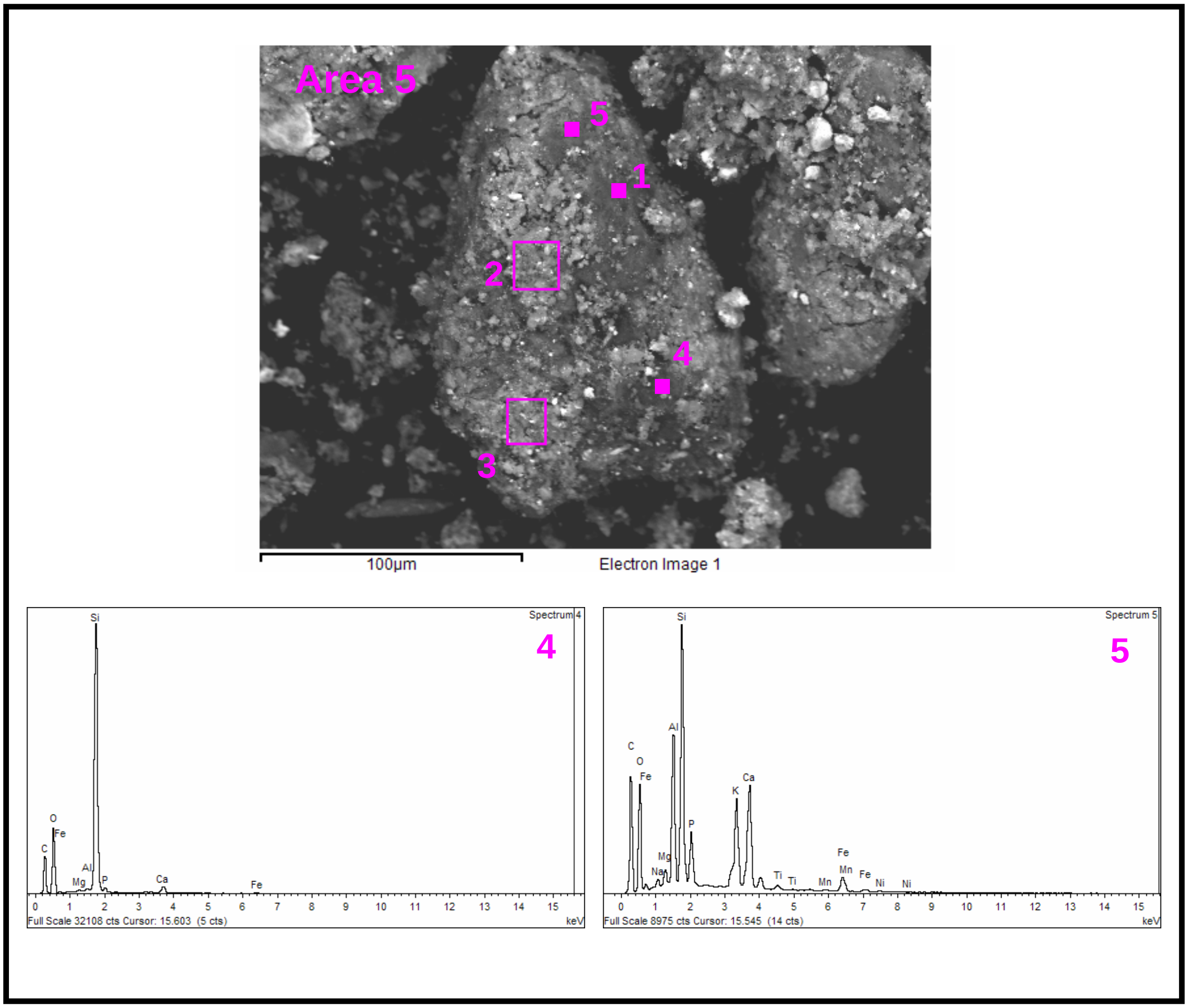


Figure D.34. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

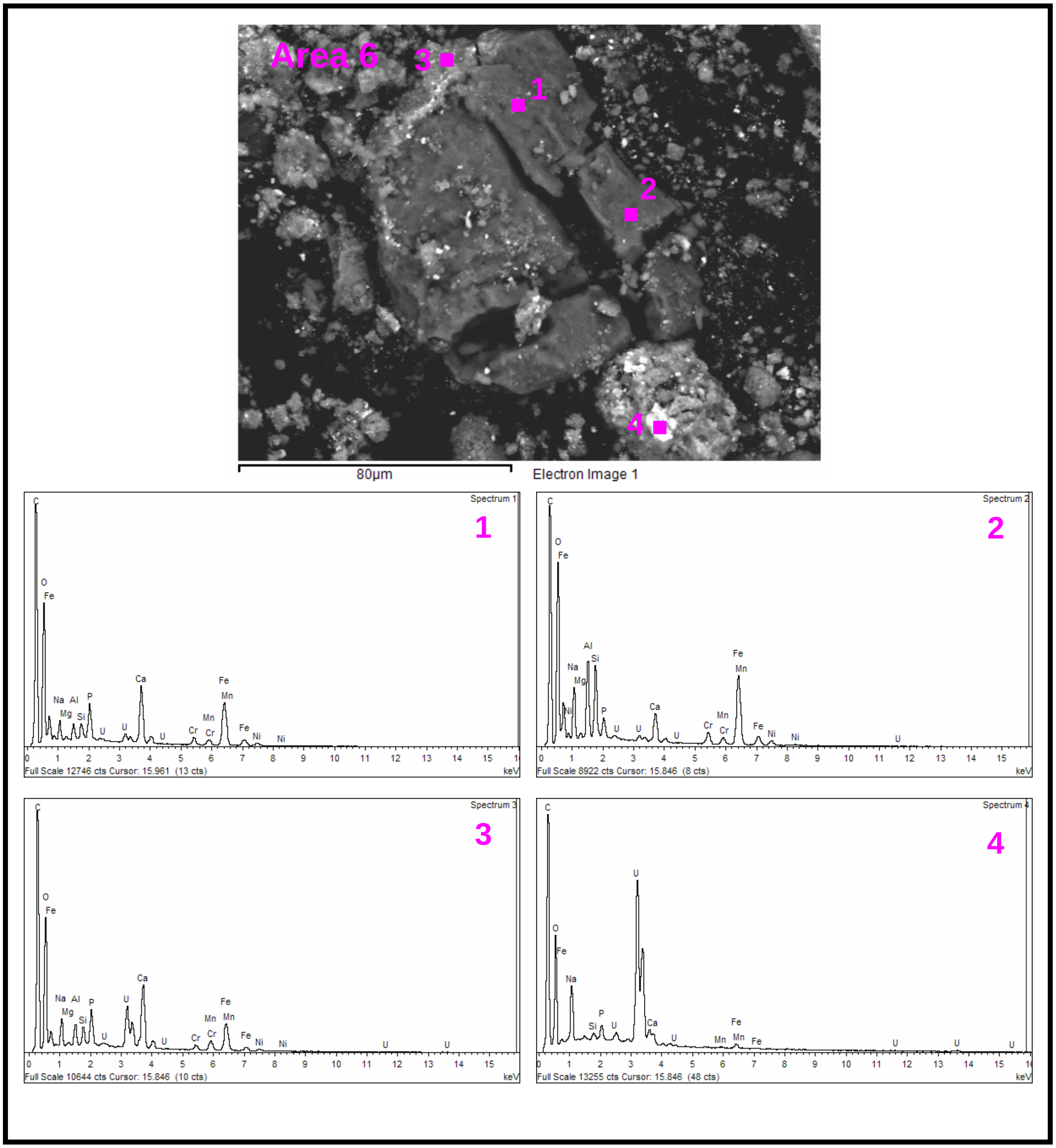


Figure D.35. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

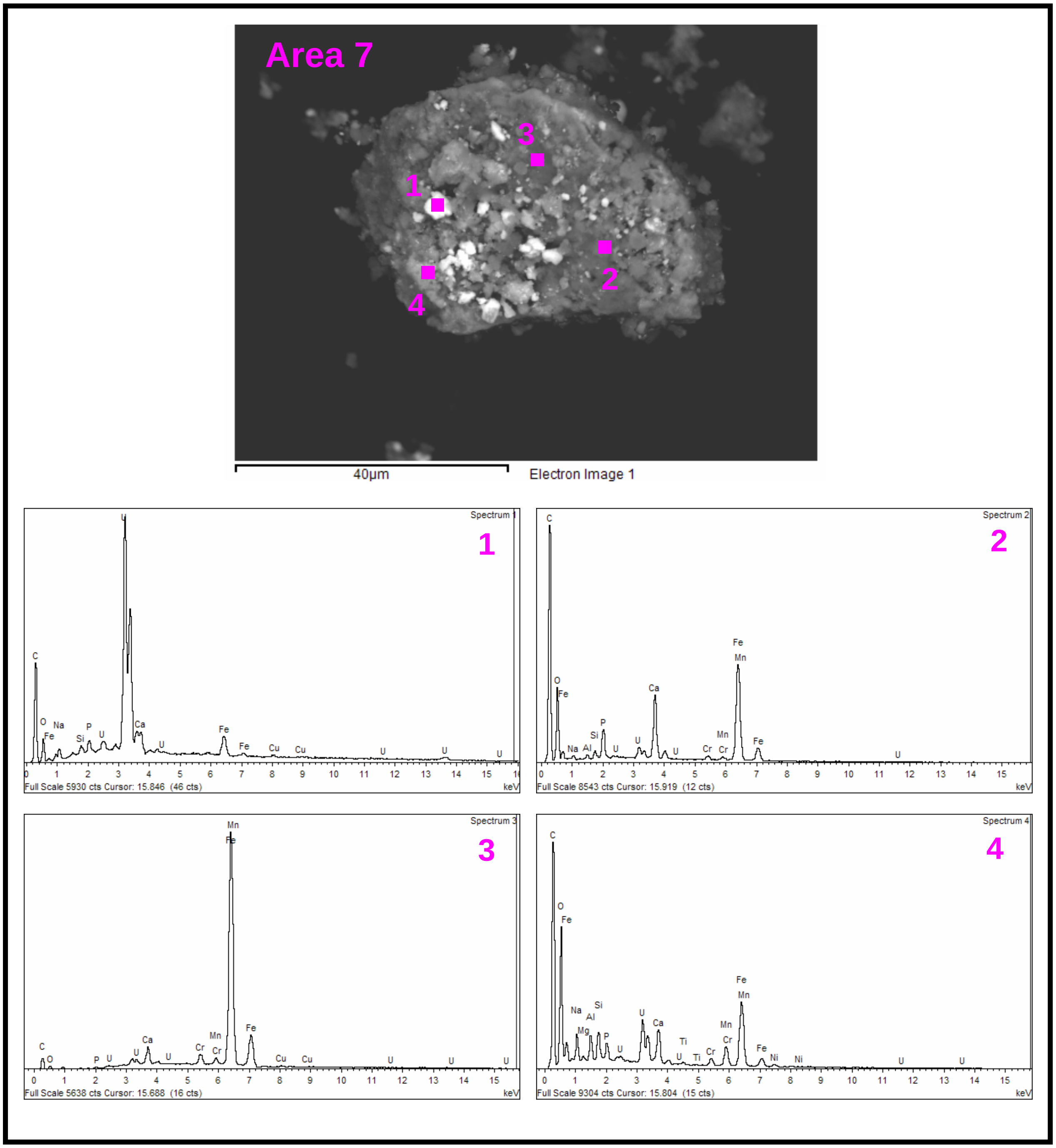


Figure D.36. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

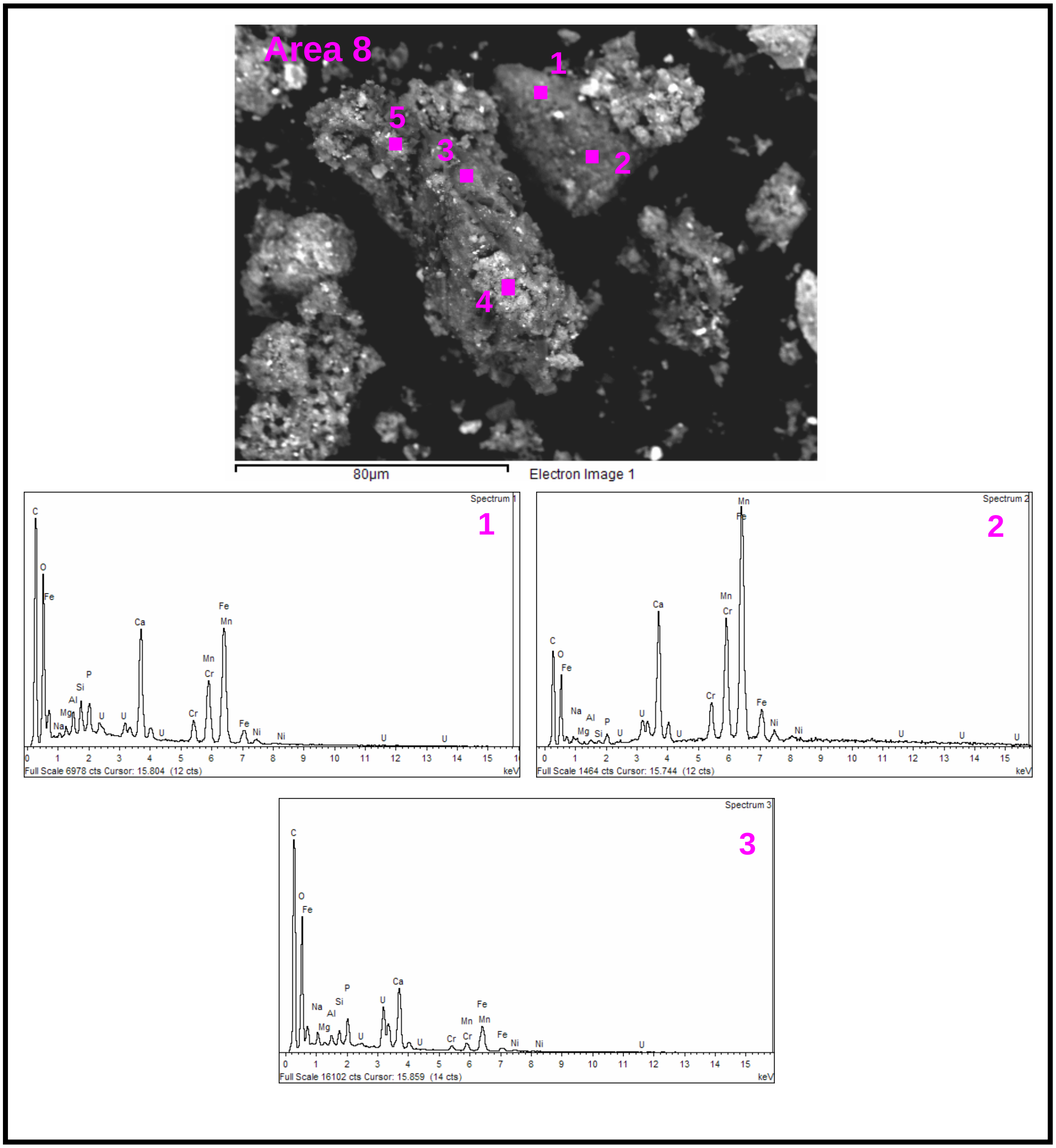


Figure D.37. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

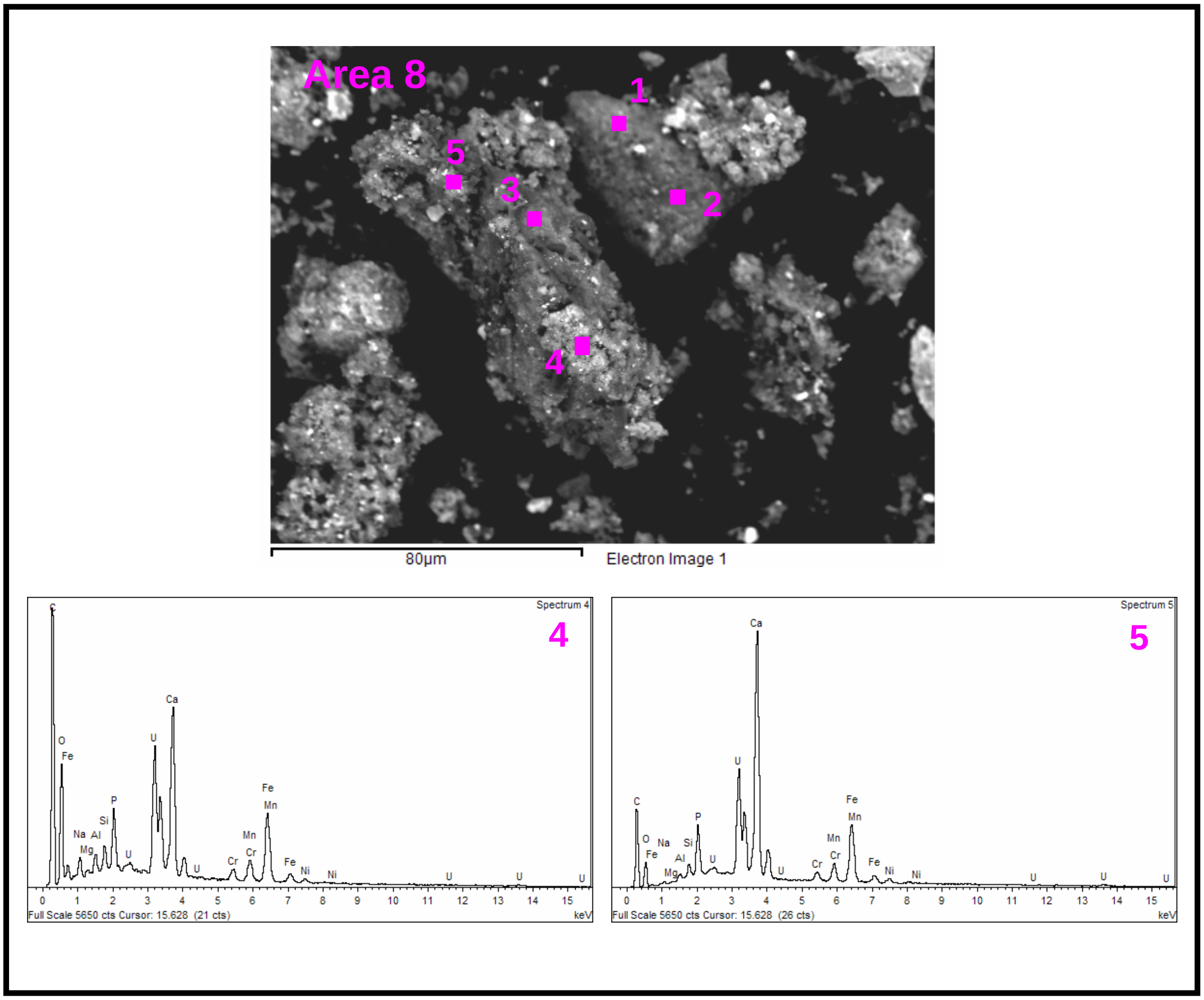


Figure D.38. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Residual Waste from Tank C-202

Table D.4. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]													
		Major Cations							Anions[2]			Others			
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**
D.28 / 1	1	4.6	3.4	0.2				0.9	29	*61*	0.6		0.2		0.4
	2	3.9	3.9	0.2				0.7	34	*56*	0.6				0.4
	3	2.0	2.2	0.9	2.2	0.1	0.1	1.4	35	*57*	0.6	0.3	0.1		0.4
	4	0.3	1.1	1.8	0.4	0.2	0.2	1.7	31	*61*	1.1	0.5		0.4	0.3
D.29 / 2	1	0.9	2.6	1.3	0.3	0.1	0.1	0.4	37	*53*	0.4	1.9		0.1	1.8
	2	0.2	0.6	4.6	0.8	0.9	0.5	0.5	33	*58*	0.3	0.3		0.1	0.3
	3	0.2	1.1	1.6	0.3	0.1	0.2	2.4	39	*52*	1.7	0.6		0.6	0.2
	4	1.2	2.0	2.1	0.5	0.2	0.2	0.9	36	*55*	0.6	0.5	0.1	0.2	0.4
D.30 / 3	1	6.3	1.6	0.3				0.9	17	*73*	0.8	0.3			
	2	1.9	1.0	2.8	0.8	0.4	0.2	4.1	24	*62*	1.4	0.5		0.1	0.6
	3	1.3	2.5	2.8	0.2	0.3	0.3	1.3	23	*63*	0.4	2.4			2.3
	4	3.3	1.1	3.0	0.9	0.4	0.3	5.6	23	*58*	2.1	0.9		0.4	1.0

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table D.5. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
D.31 & D.32 / 4	1	5.0	4.4	0.2				0.3	29	*61*	0.3				0.2	
	2	0.3	0.8	0.4	0.2	0.1		4.1	44	*50*	0.2	0.3			0.3	
	3	1.3	1.7	1.7	0.4	0.3	0.1	1.7	37	*54*	0.6	0.5		0.1	0.4	
	4	1.9	2.6	1.6	0.2	0.2	0.1	0.3	35	*57*	0.2	0.3			0.3	
	5	0.4	0.7	1.0	0.1	0.1	0.1	3.3	42	*52*	0.1	0.2			0.2	
D.33 & D.34 / 5	1		0.3	0.1	<0.1			0.5	44	*44*	0.3	2.5			7.2	K – 1.7
	2	1.8	0.8	5.4	1.3	0.6	0.5	4.9	26	*56*	1.2	0.5			0.9	
	3	1.5	0.7	3.7	1.0	0.3	0.4	3.5	20	*65*	1.1	0.4	0.2	0.2	1.3	K – 0.4
	4			0.1				0.4	38	*49*	0.3	0.1		0.1	12	
	5		0.4	0.7	<0.1		0.1	2.3	32	*52*	1.3	3.1		0.4	5.4	K – 1.7, Ti – 0.1
D.35 / 6	1	0.1	1.0	2.0	0.2	0.3	0.2	1.3	34	*59*	0.8	0.4		0.1	0.3	
	2	0.1	2.2	2.6	0.2	0.3	0.2	0.5	33	*58*	0.4	1.5		0.1	1.3	Pb - <0.1
	3	0.5	1.4	1.4	0.4	0.2	0.1	1.6	34	*59*	0.8	0.5		0.1	0.4	
	4	2.8	3.8	0.3	0.1			0.3	34	*58*	0.5				0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table D.6. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
D.36 / 7	1	9.6	2.2	3.0				1.6	19	*63*	1.0		0.3		0.7	
	2	0.2	0.3	5.1	0.1	0.1		1.6	23	*68*	0.8	0.1			0.2	
	3	0.4		59	1.0	1.7		2.1	2.6	*32*	0.3	0.2	0.5			
	4	0.5	1.5	3.0	0.7	0.3	0.1	0.8	33	*58*	0.4	0.7		0.2	0.7	Ti – 0.1
D.37 & D.38 / 8	1	0.1	0.2	4.4	2.0	0.6	0.2	2.0	32	*56*	0.6	0.5		0.3	0.6	
	2	0.4		15	6.8	1.7	0.9	4.3	20	*50*	0.3					
	3	0.6	0.8	1.4	0.4	0.2	0.1	1.7	37	*56*	0.7	0.3	0.1	0.1	0.4	
	4	1.4	0.9	2.8	0.7	0.4	0.2	3.6	28	*60*	1.3	0.4		0.2	0.5	
	5	3.1	0.3	6.5	1.7	0.7	0.5	14	18	*51*	3.0	0.4			0.7	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

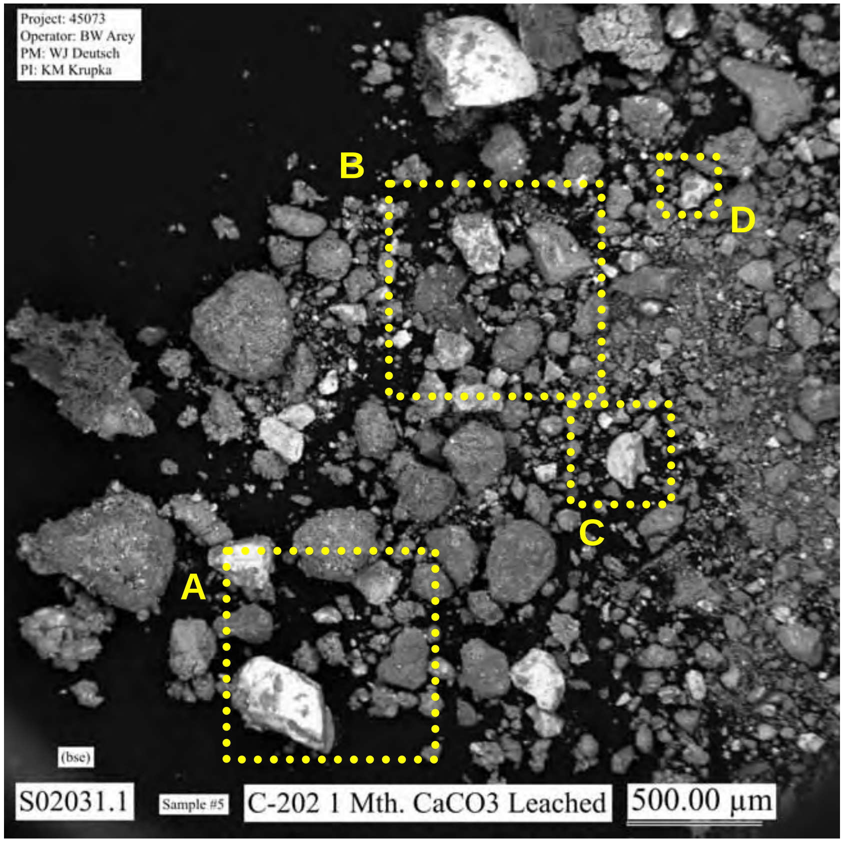


Figure D.39. Micrograph Showing at Low Magnification Typical Particles in SEM Sample of 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

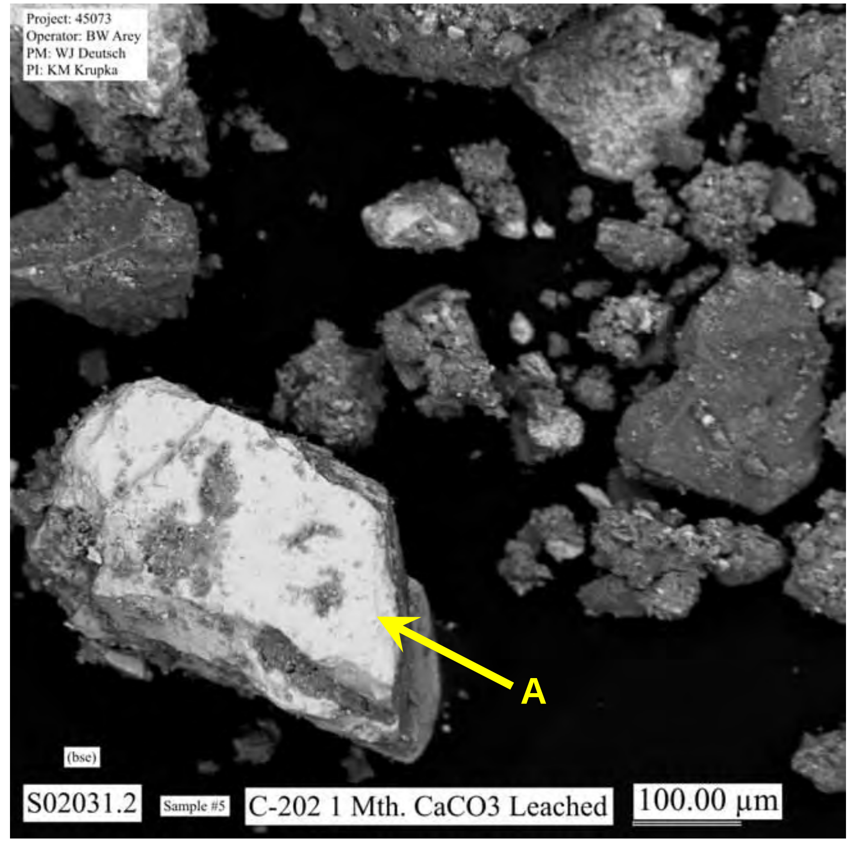


Figure D.40. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure D.39

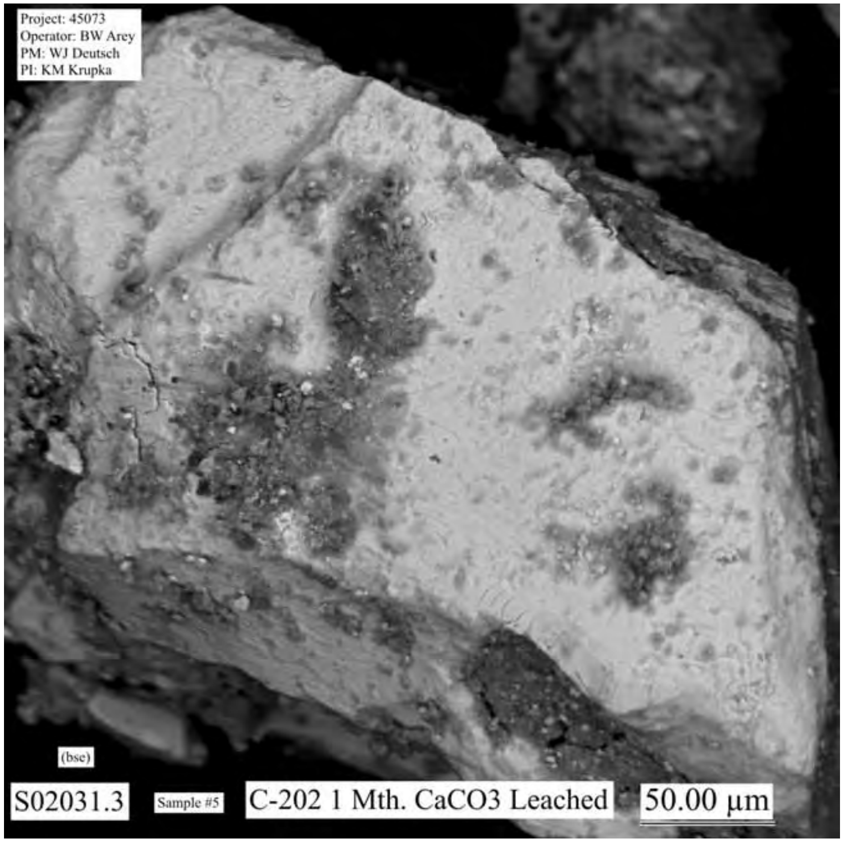


Figure D.41. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure D.40 (Areas where EDS analyses were made are shown in Figure D.53.)

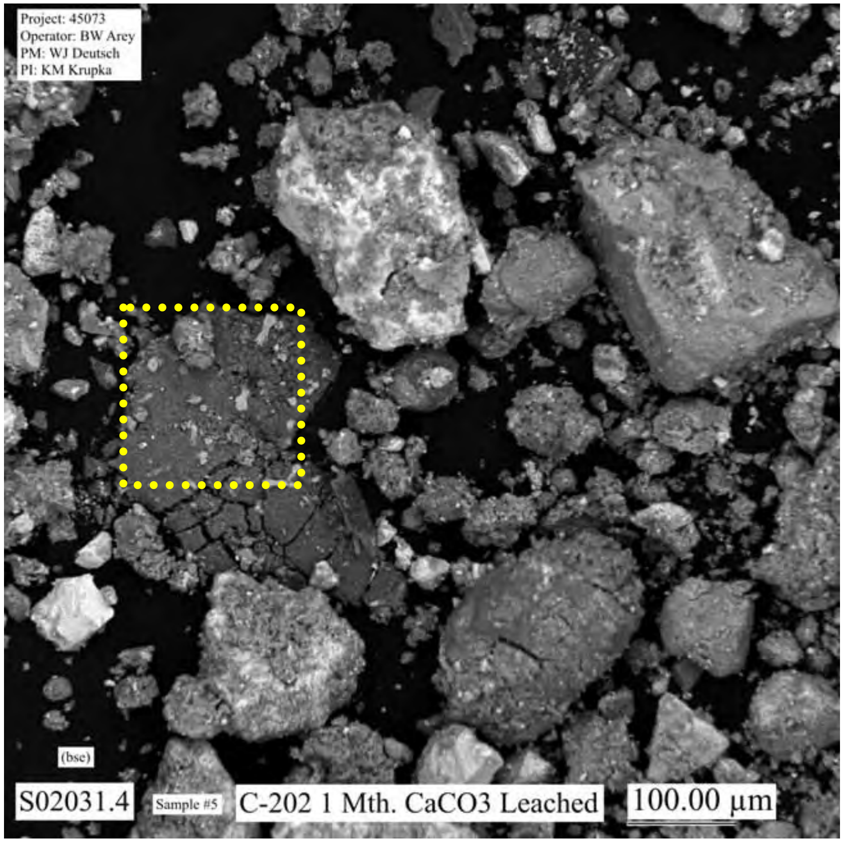
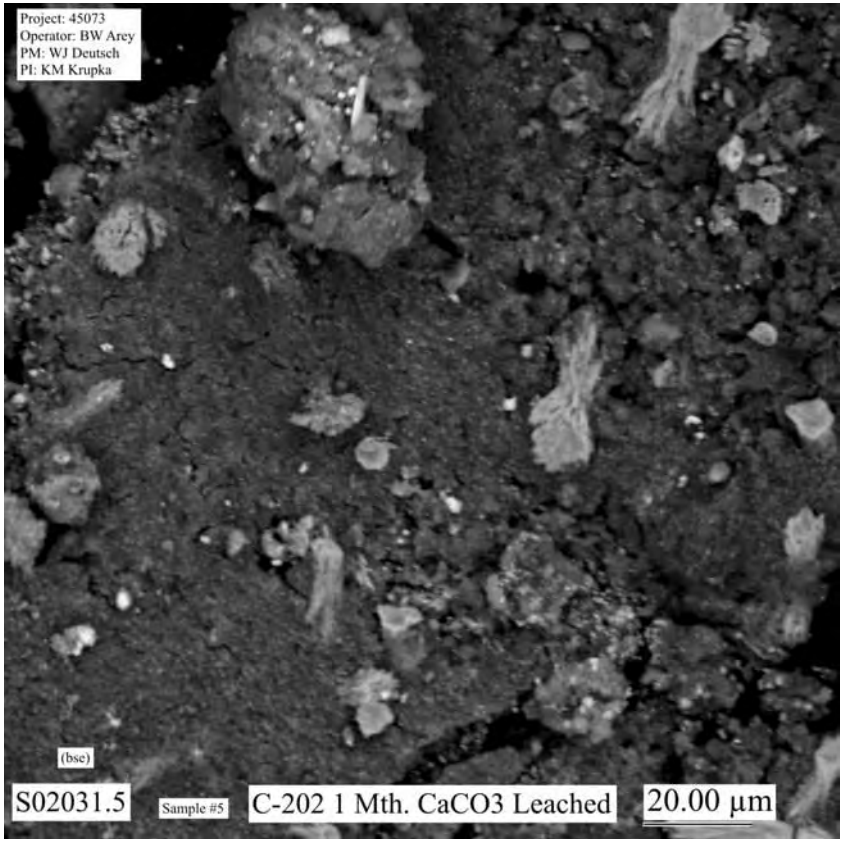


Figure D.42. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure D.39



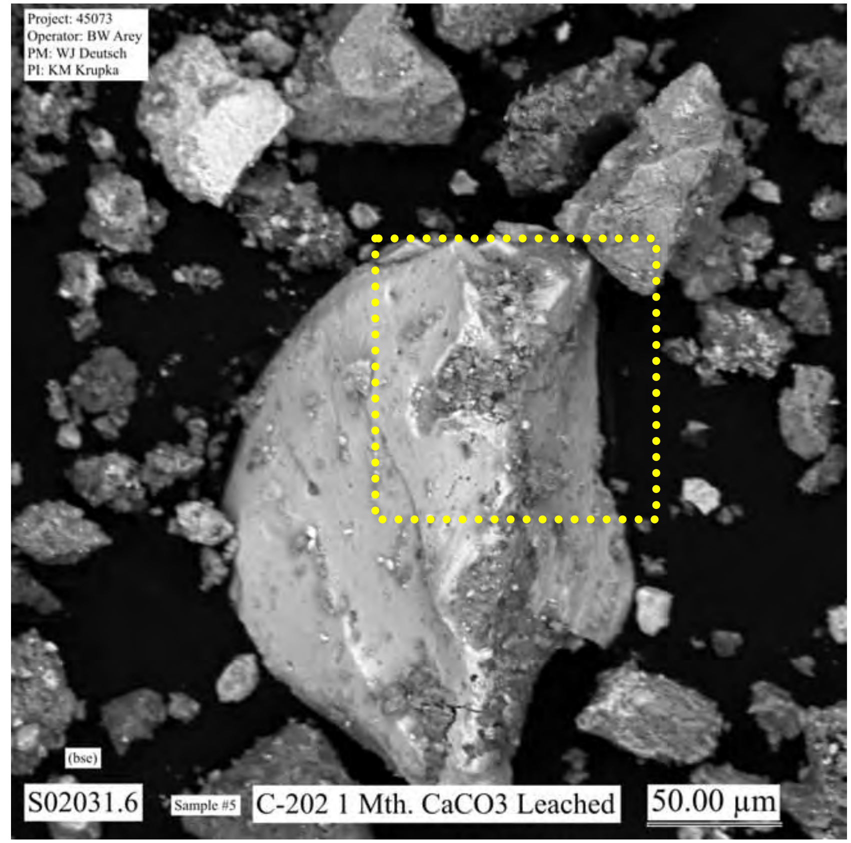


Figure D.43. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure D.42 (Areas where EDS analyses were made are shown in Figure D.54.)

Figure D.44. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure D.39

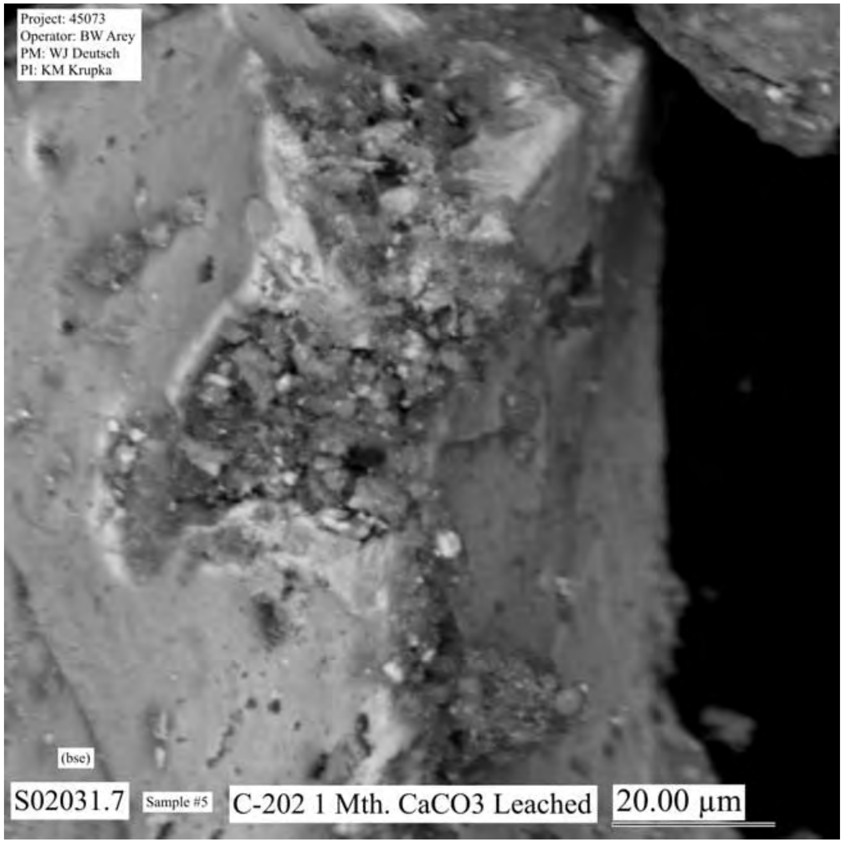


Figure D.45. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square in Figure D.44 (Areas where EDS analyses were made are shown in Figure D.55.)

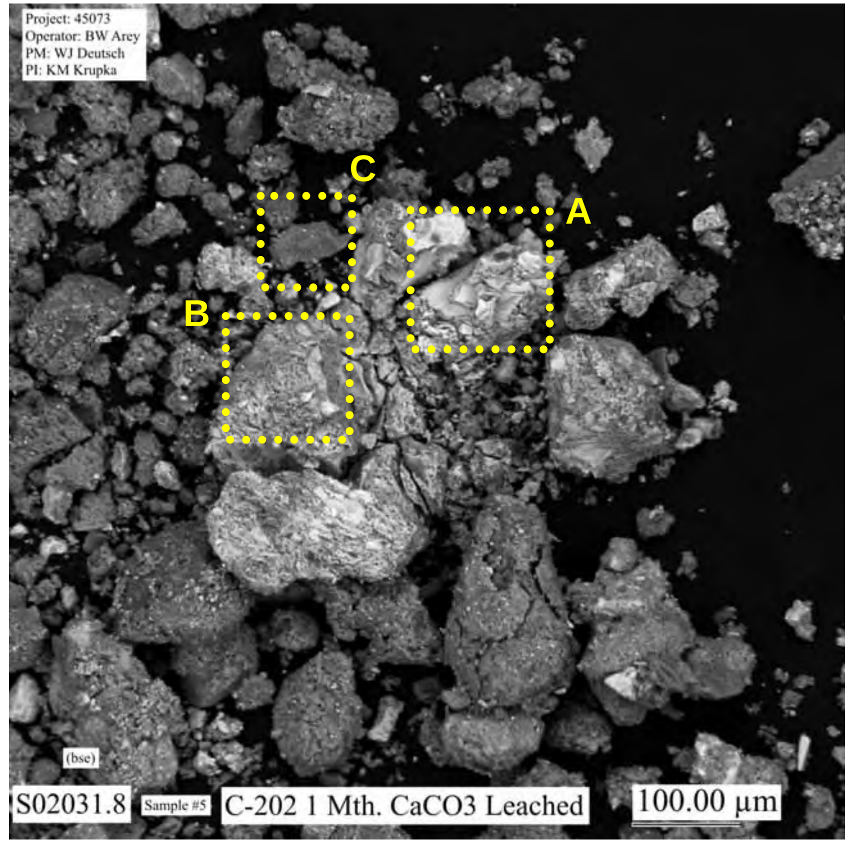


Figure D.46. Micrograph Showing Typical Particles in SEM Sample of 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

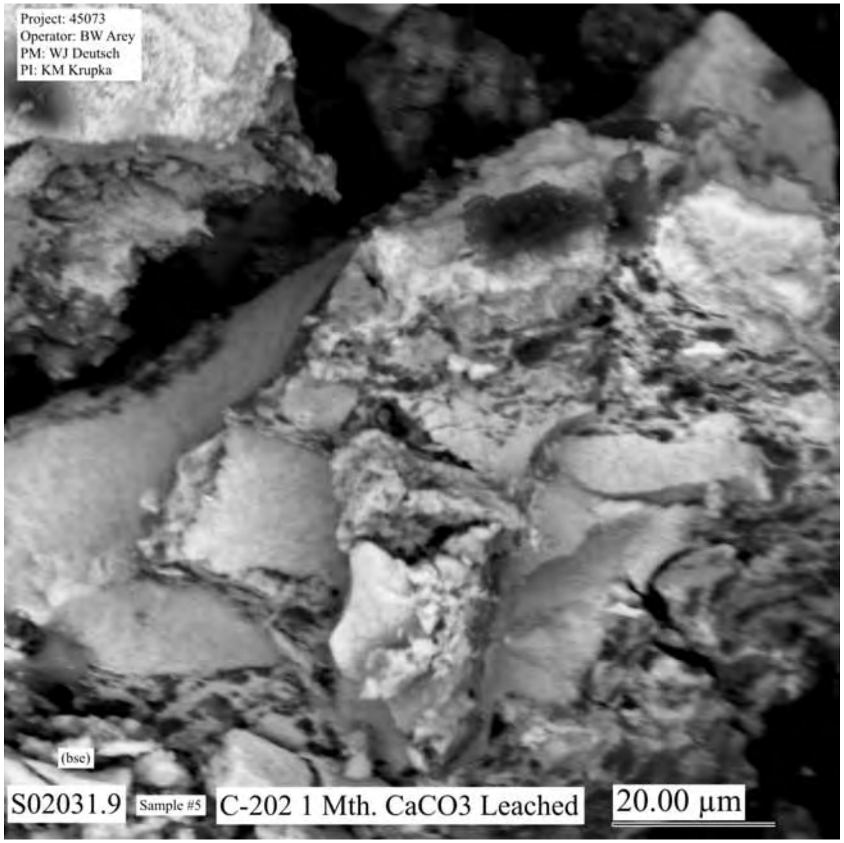


Figure D.47. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled A in Figure D.46 (Areas where EDS analyses were made are shown in Figure D.56.)

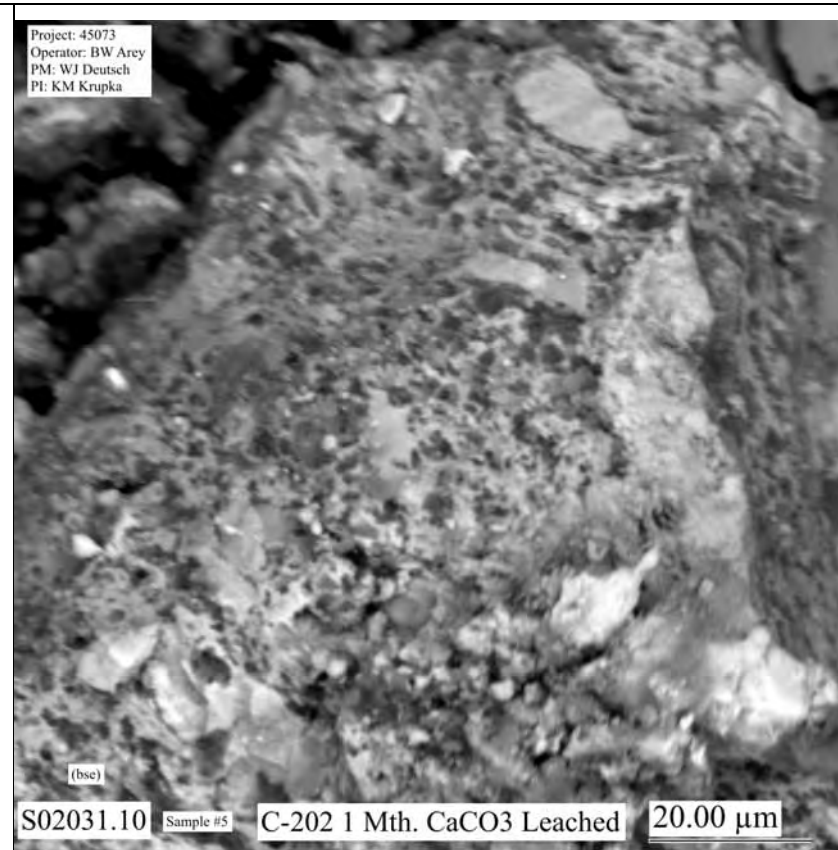


Figure D.48. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled B in Figure D.46 (Areas where EDS analyses were made are shown in Figure D.57.)

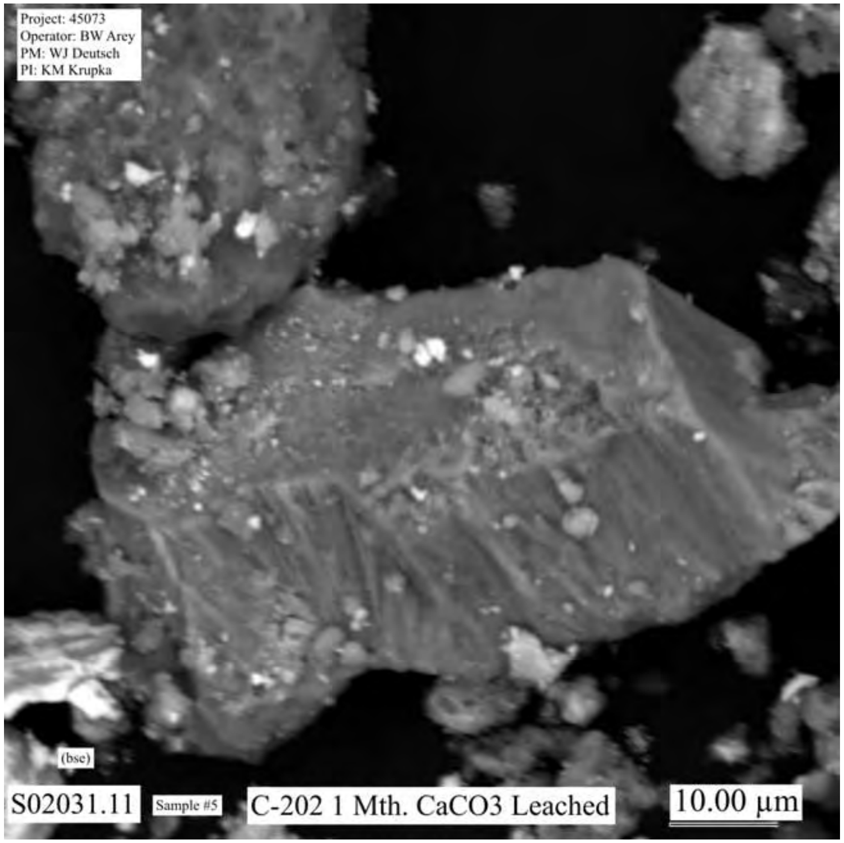


Figure D.49. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled C (Areas where EDS analyses were made are shown in Figure D.58.)

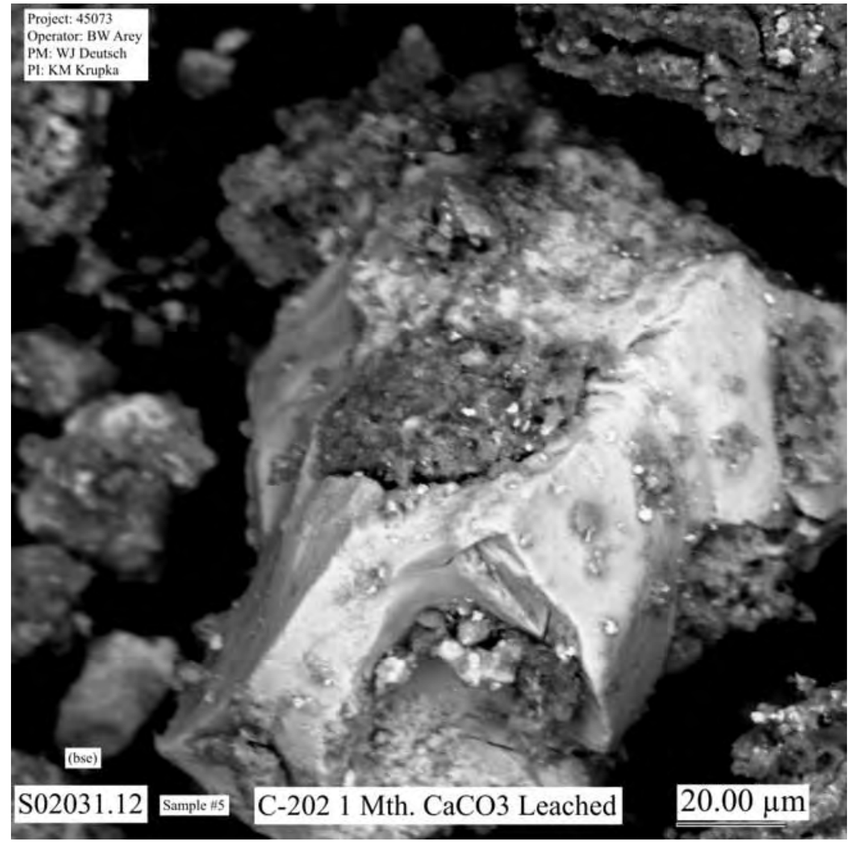


Figure D.50. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled D in Figure D.39 (Areas where EDS analyses were made are shown in Figure D.59.)

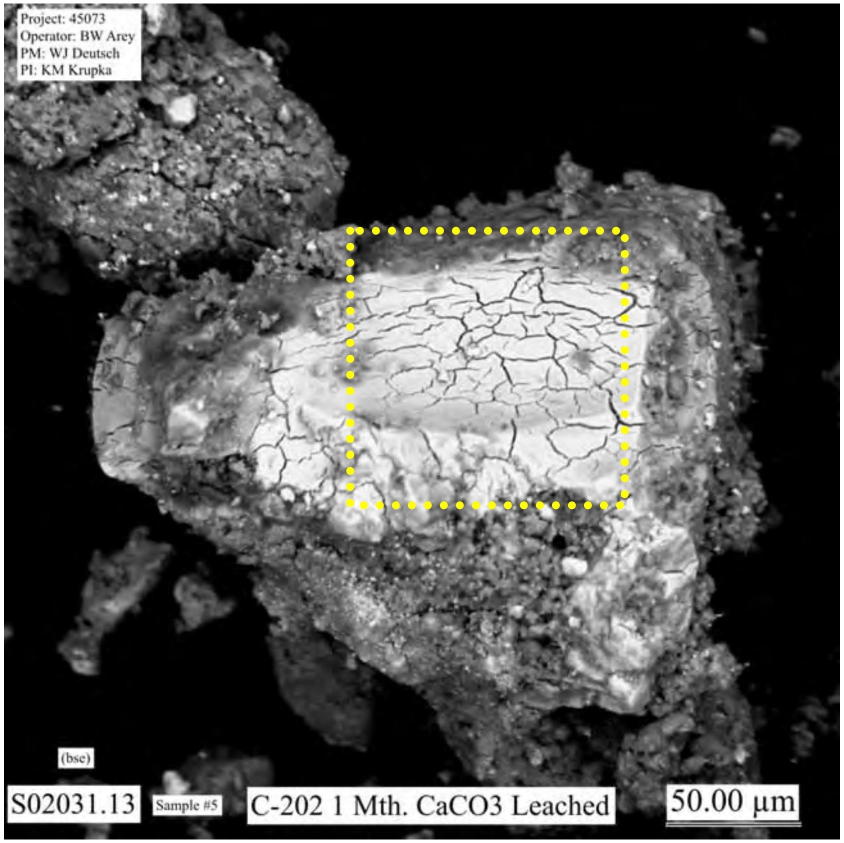


Figure D.51. Micrograph Showing Particles in SEM Sample of 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

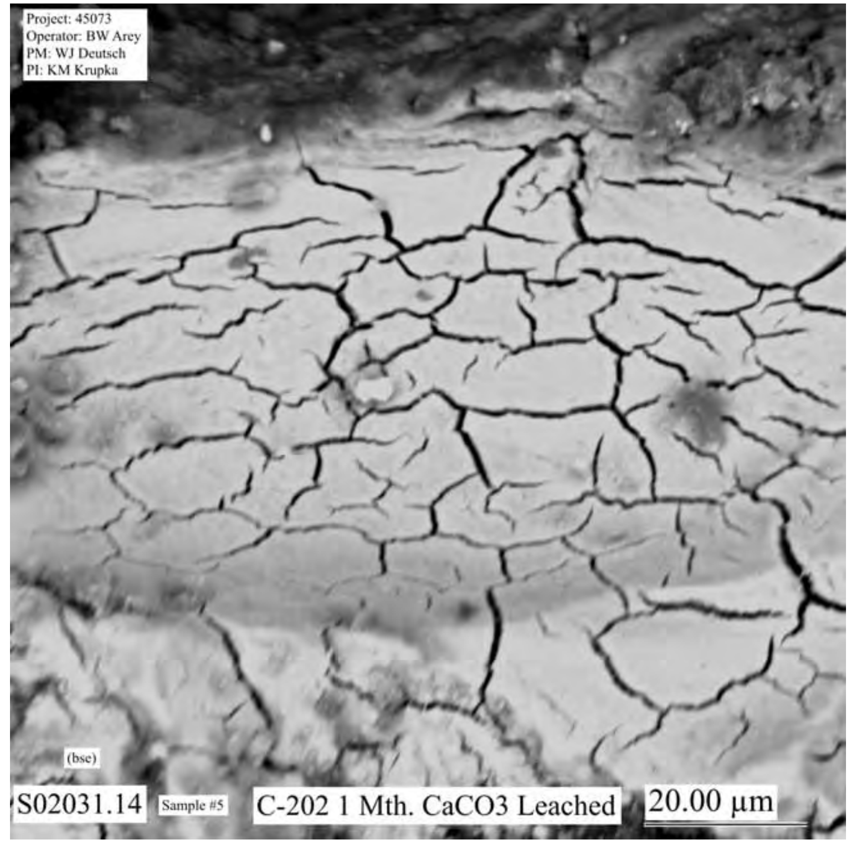


Figure D.52. Micrograph Showing at Higher Magnification the Particle Surface Indicated by the Yellow Dotted-Line Square in Figure D.51 (Areas where EDS analyses were made are shown in Figure D.60.)

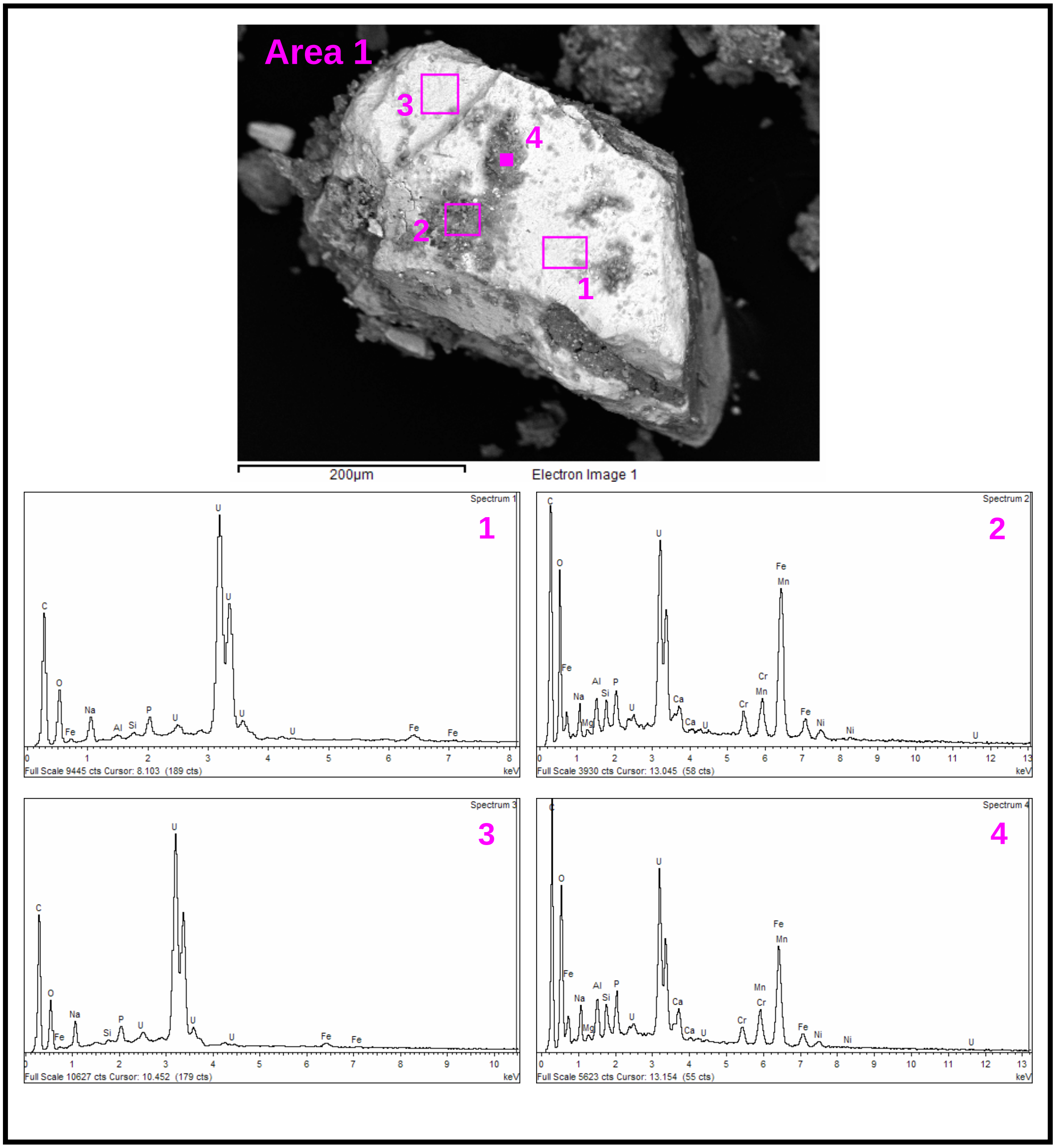


Figure D.53. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

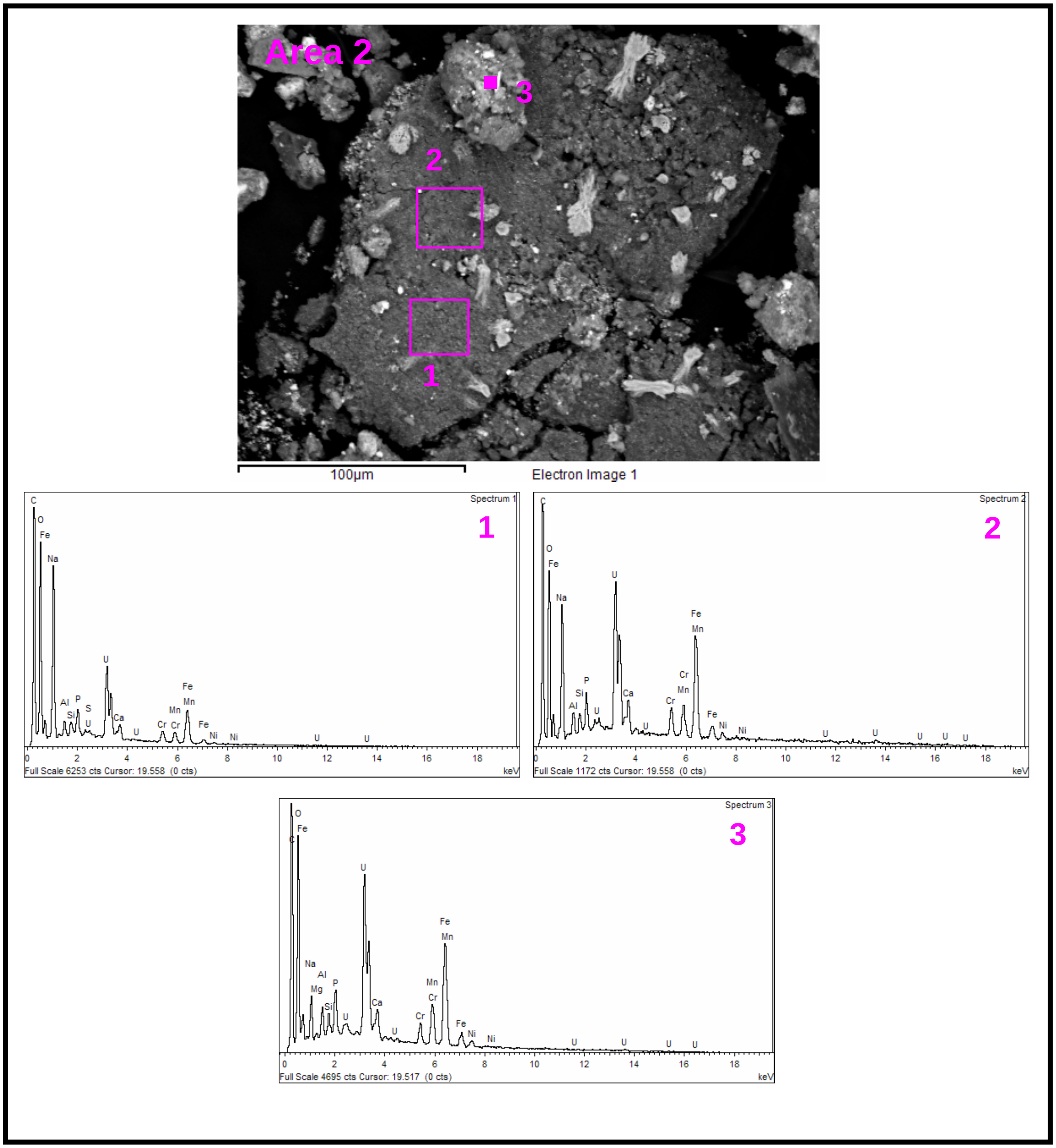


Figure D.54. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

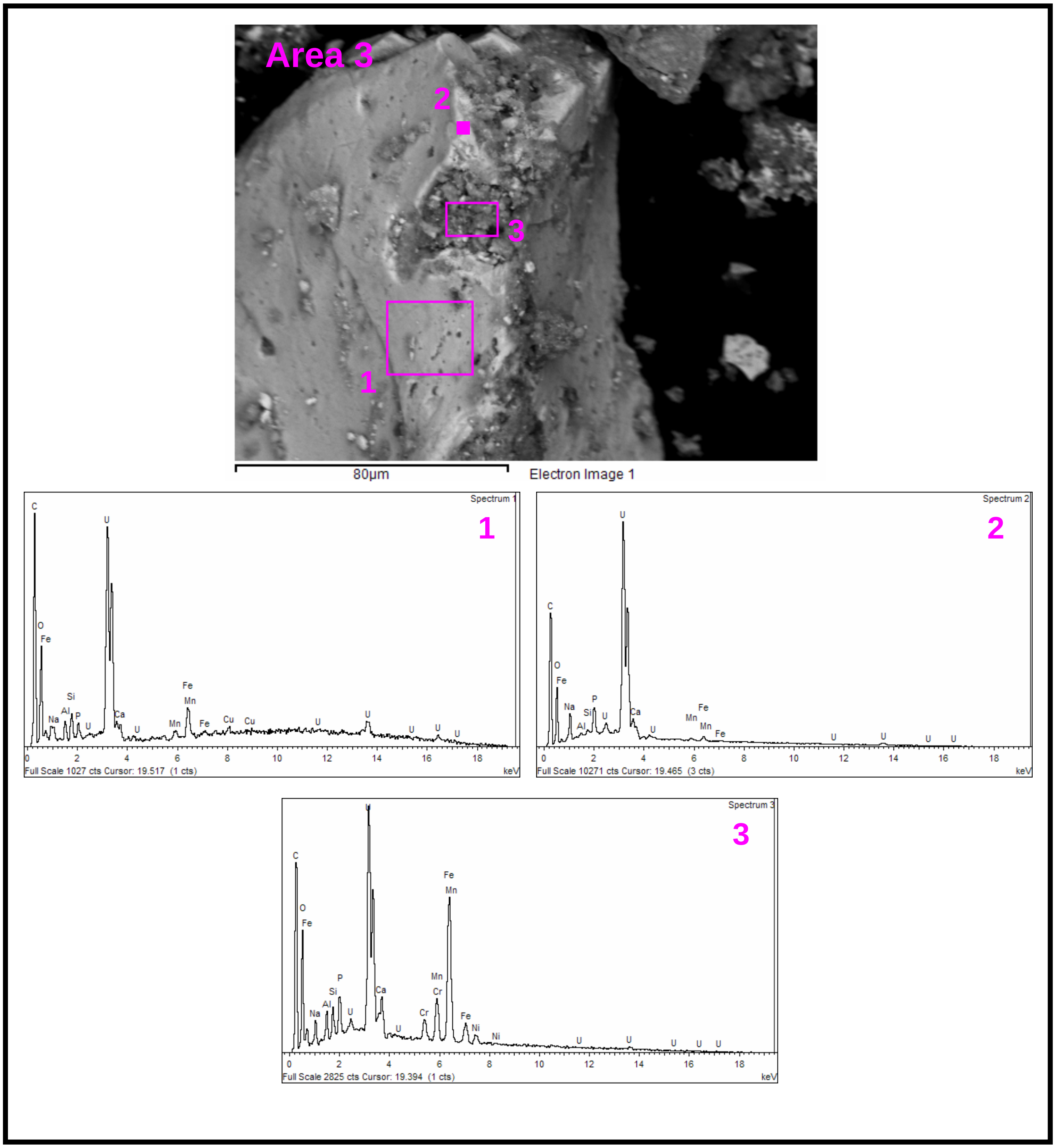


Figure D.55. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

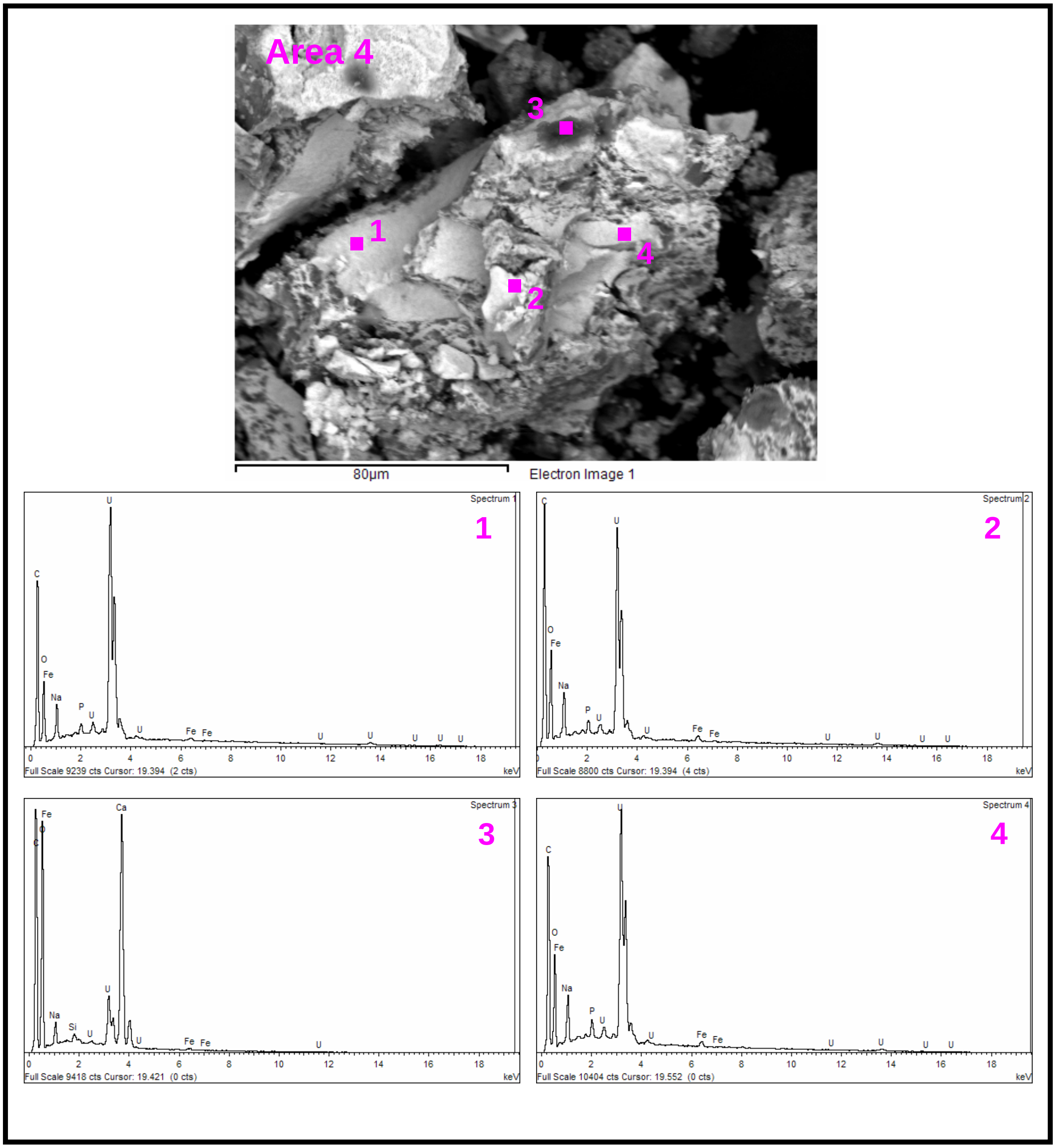


Figure D.56. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

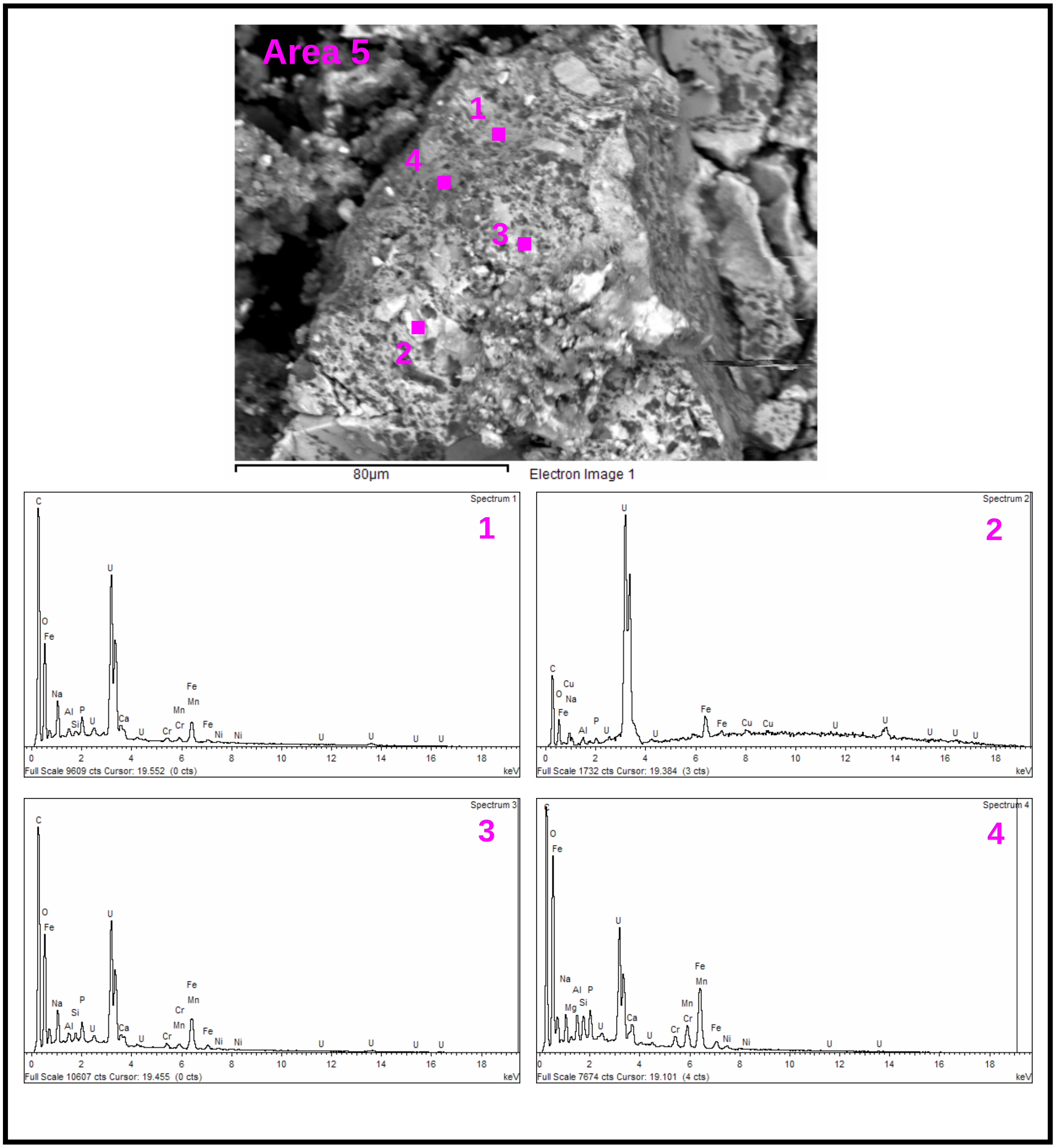


Figure D.57. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

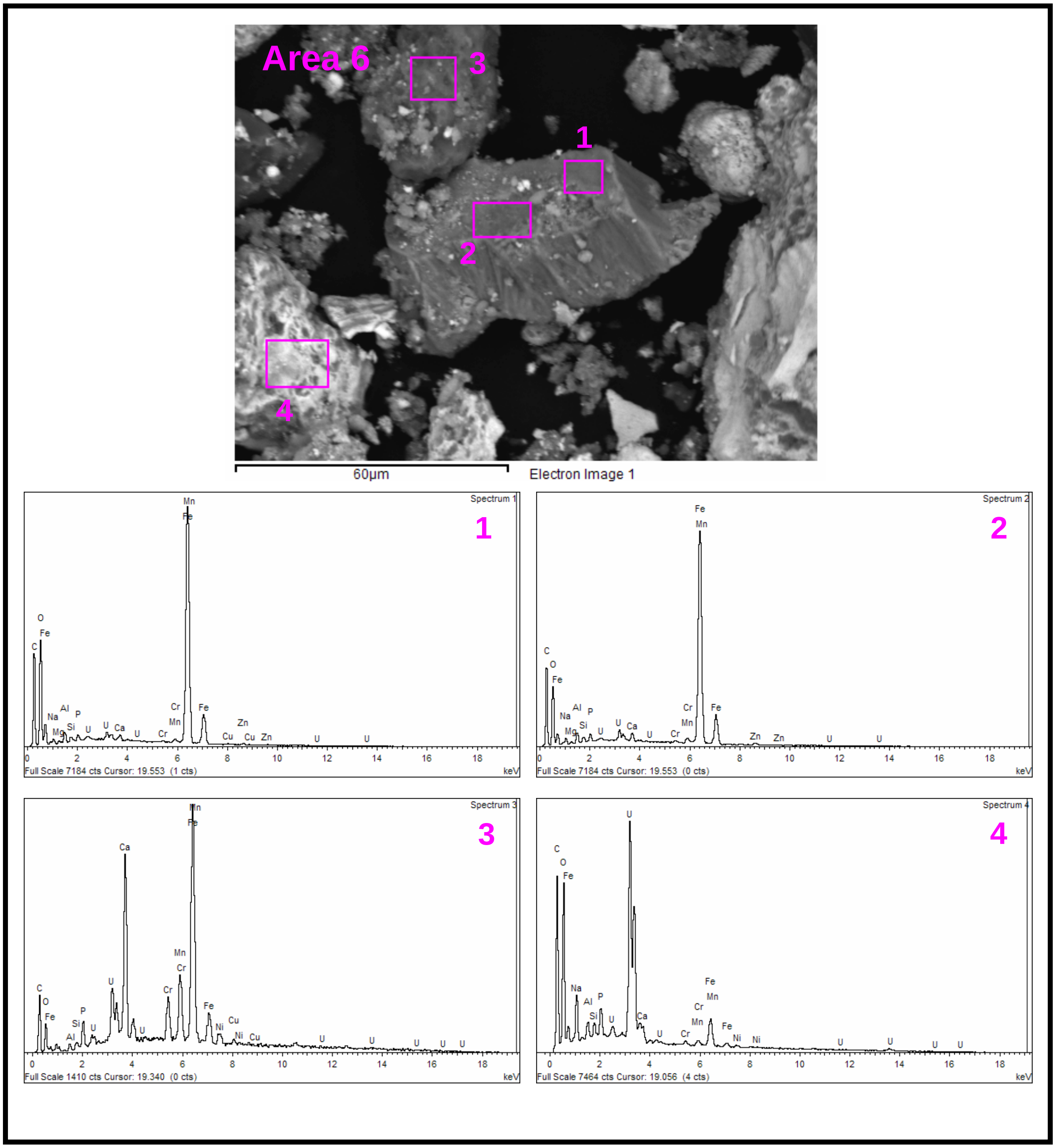


Figure D.58. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

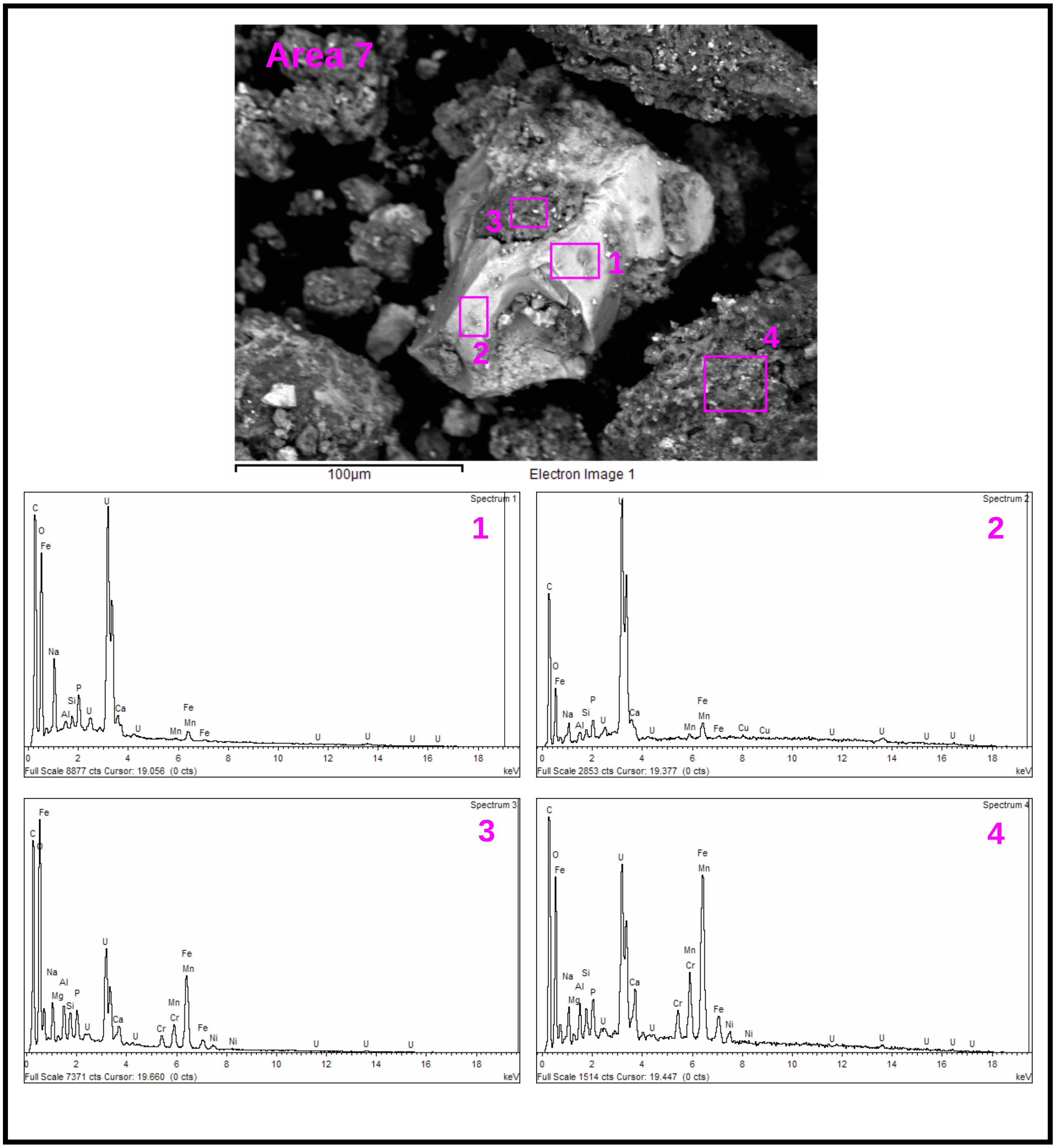


Figure D.59. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

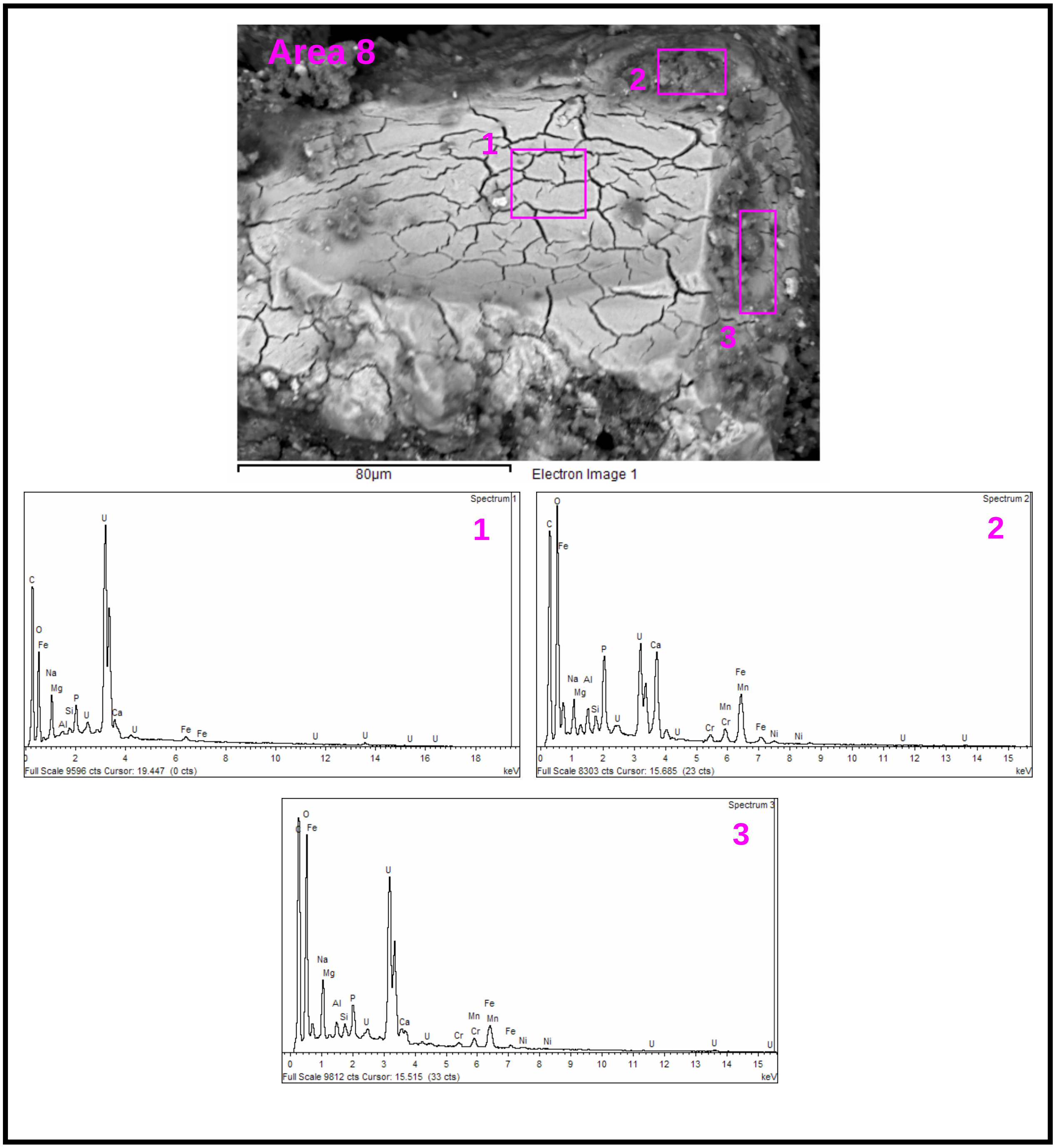


Figure D.60. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Residual Waste from Tank C-202

Table D.7. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
D.53 / 1	1	6.5	3.2	0.6					30	58	1.2	0.2			0.3	
	2	2.0	1.7	6.0	1.2	0.8	0.5	0.5	30	55	0.8	0.8		0.2	0.7	
	3	6.4	3.5	0.4					28	60	1.0				0.2	
	4	1.8	1.8	3.9	1.2	0.6	0.3	0.6	30	57	0.9	0.9		0.2	0.6	
D.54 / 2	1	0.8	7.2	1.3	0.3	0.4	0.1	0.3	36	*53*	0.5	0.4			0.2	S – 0.1
	2	1.6	6.1	3.9	1.0	0.8	0.4	0.6	30	*54*	0.8	0.5			0.4	
	3	1.7	2.2	4.0	1.4	0.6	0.3	0.6	35	*52*	0.9	0.7		0.2	0.4	
D.55 / 3	1	3.5	0.9	1.8	0.4			0.5	28	*62*	0.5	0.7	0.6		0.9	
	2	6.2	3.4	0.4	0.2			0.5	30	*58*	1.6	0.2			0.2	
	3	3.1	1.6	7.3	1.9	0.8	0.7	1.0	26	*55*	1.1	1.0			0.8	
D.56 / 4	1	6.1	4.0	0.3					30	*59*	0.6					
	2	3.8	3.2	0.4					30	*62*	0.5				<0.1	W – 0.1
	3	0.6	1.1	0.1				5.0	51	*42*						
	4	4.7	4.1	0.4					34	*56*	0.8					

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table D.8. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C**[3]	**P**	**Al**	**Cu**	**Mg**	**Si**	
D.57 / 5	1	2.8	2.7	1.3	0.2	0.2	0.1	0.2	30	*61*	0.6	0.3			0.1	
	2	11	2.0	4.1					24	*56*	0.6	0.8	1.3			
	3	2.0	2.3	1.9	0.2	0.2	0.1		32	*59*	0.6	0.3			0.3	
	4	1.3	1.5	2.6	0.8	0.4	0.2	0.4	36	*54*	0.7	0.6		0.2	0.5	
D.58 / 6	1	0.2	0.5	16	0.2	0.1		0.2	28	*53*	0.2	0.5	0.1	0.2	0.2	Zn – 0.2
	2	0.2	0.9	18	0.3	0.1		0.3	20	*58*	0.4	0.7		0.2	0.3	Zn – 0.3
	3	1.2	0.8	21	5.0	2.9	1.6	8.4	12	*45*	1.5	0.5	0.6		0.3	
	4	3.5	3.3	1.7	0.3	0.1	0.1	0.4	42	*47*	0.9	0.6			0.5	
D.59 / 7	1	3.1	4.2	0.5	0.1			0.2	41	*50*	1.0	0.2			0.3	
	2	6.1	2.2	1.6	0.5			0.6	26	*60*	1.0	0.6	0.3		0.5	
	3	1.0	2.0	3.2	0.8	0.4	0.2	0.4	40	*50*	0.7	0.9		0.2	0.5	W - <0.1
	4	1.8	1.8	6.4	2.1	0.8	0.5	1.0	28	*55*	0.8	0.9		0.3	0.6	
D.60 / 8	1	4.7	3.9	0.3				0.3	35	*54*	1.3	0.2			0.2	W - <0.1
	2	1.0	1.6	1.9	0.4	0.2	0.1	1.7	42	*48*	1.5	0.6		0.3	0.3	Zn – 0.1
	3	2.0	3.1	1.1	0.4	0.1	0.1	0.2	43	*49*	0.8	0.4		0.1	0.3	Ti – 0.1

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix E

SEM Micrographs and EDS Results for Unleached Residual Waste from Sample 19887 Tank C-203

Appendix E

SEM Micrographs and EDS Results for Unleached Residual Waste from Sample 19887 Tank C-203

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for three sample mounts (#1, #3, and #5) of unleached residual waste from tank C-203 (sample 19887). The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by “BSE” to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample. The figure and table numbers for the SEM micrographs and EDS analyses for the three sample mounts of unleached C-203 (sample 19887) residual waste analyzed by SEM/EDS are listed in Table E.1.

Table E.1. Figures and Tables Containing the SEM Micrographs and EDS Analyses for Three Mounts of Unleached Residual Waste from Tank C-203 (Sample 19887)

Sample Mount Number	Figures with SEM Micrographs	Figures with EDS Spectra	Tables with EDS Atomic%
1 (Yellow Solids)	E.1 – E.16	E.17 – E.22	E.2 and E.3
3 (Brown Solids)	E.23 – E.34	E.35 – E.38	E.4
5 (Orange Solids)	E.39 – E.54	E.55 – E.58	E.5

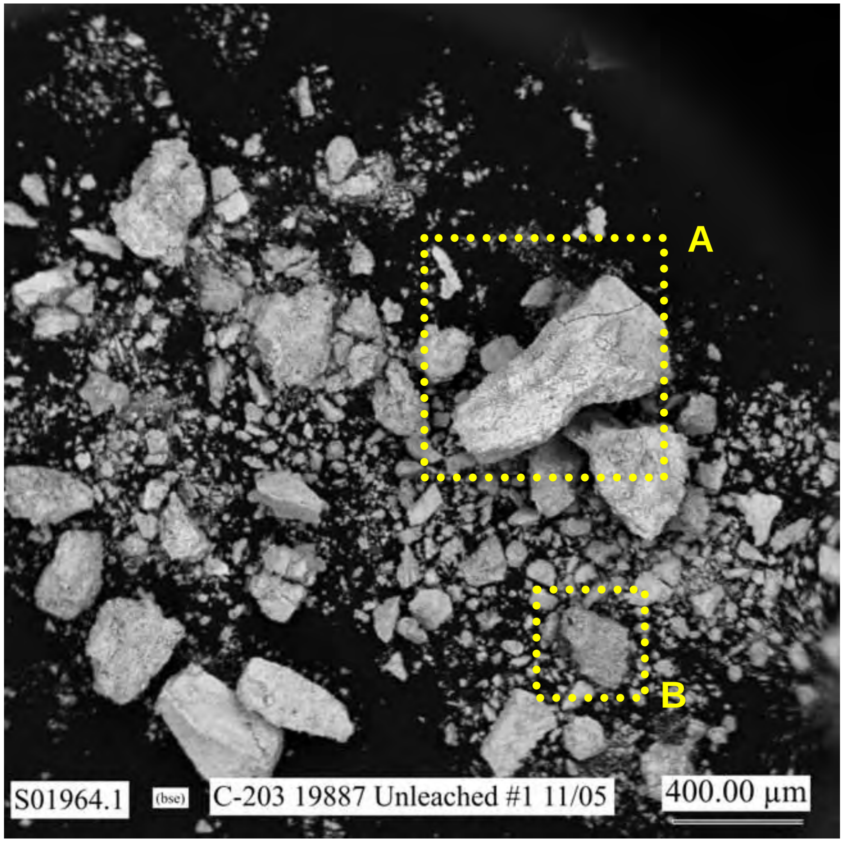


Figure E.1. Low Magnification SEM Micrograph Showing Typical Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

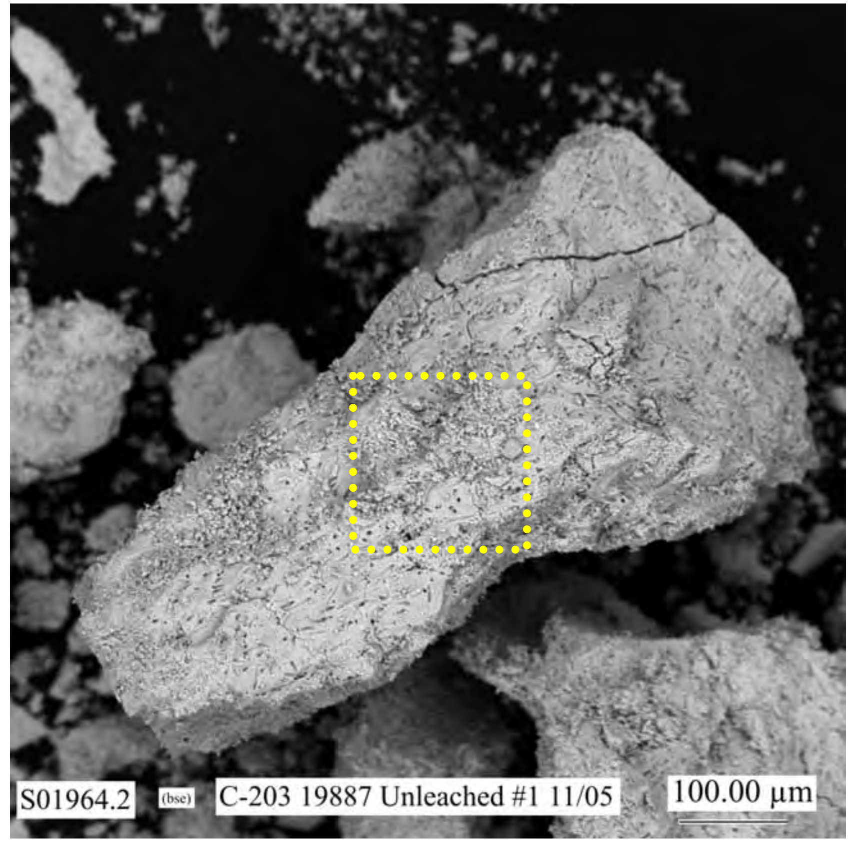


Figure E.2. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.1

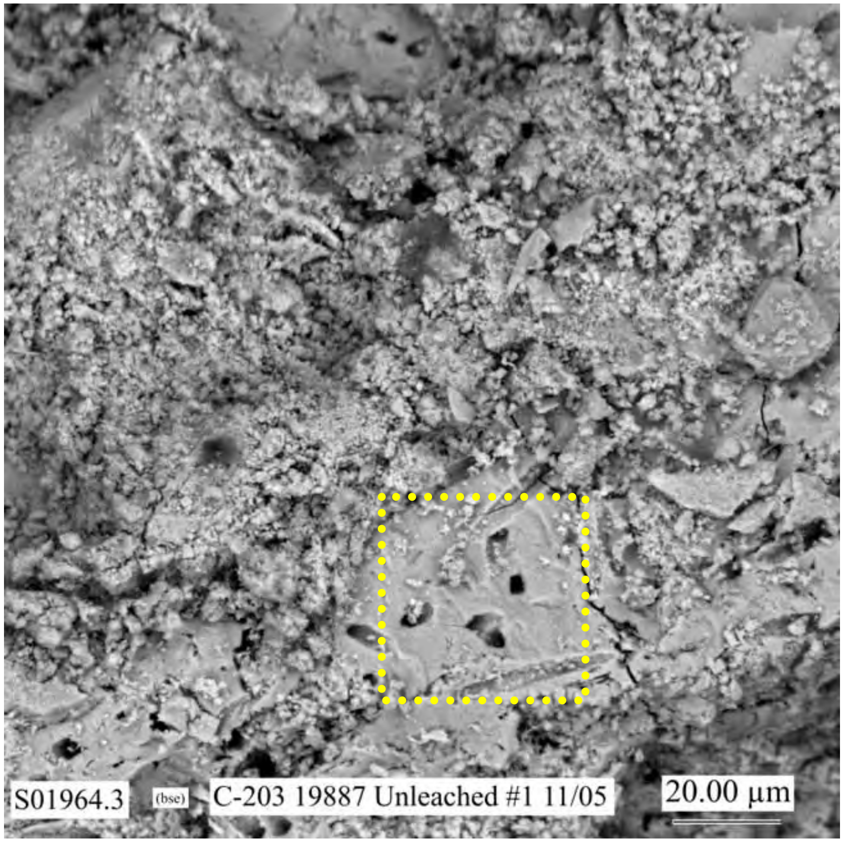


Figure E.3. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.2

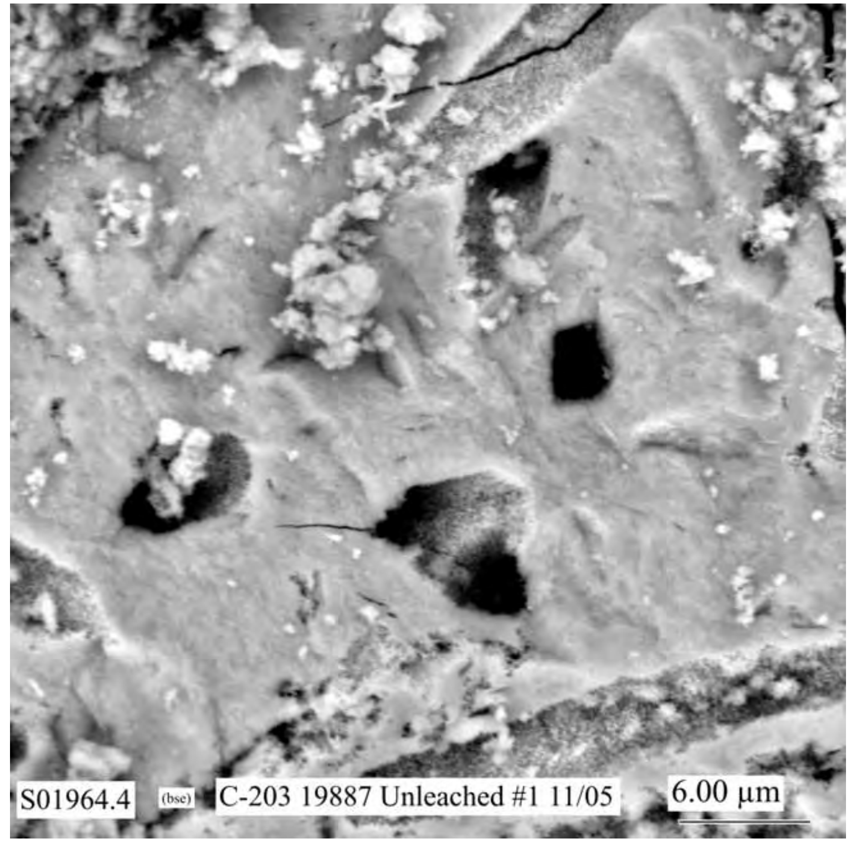


Figure E.4. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.3 (Areas where EDS analyses were made are shown in Figure E.17.)

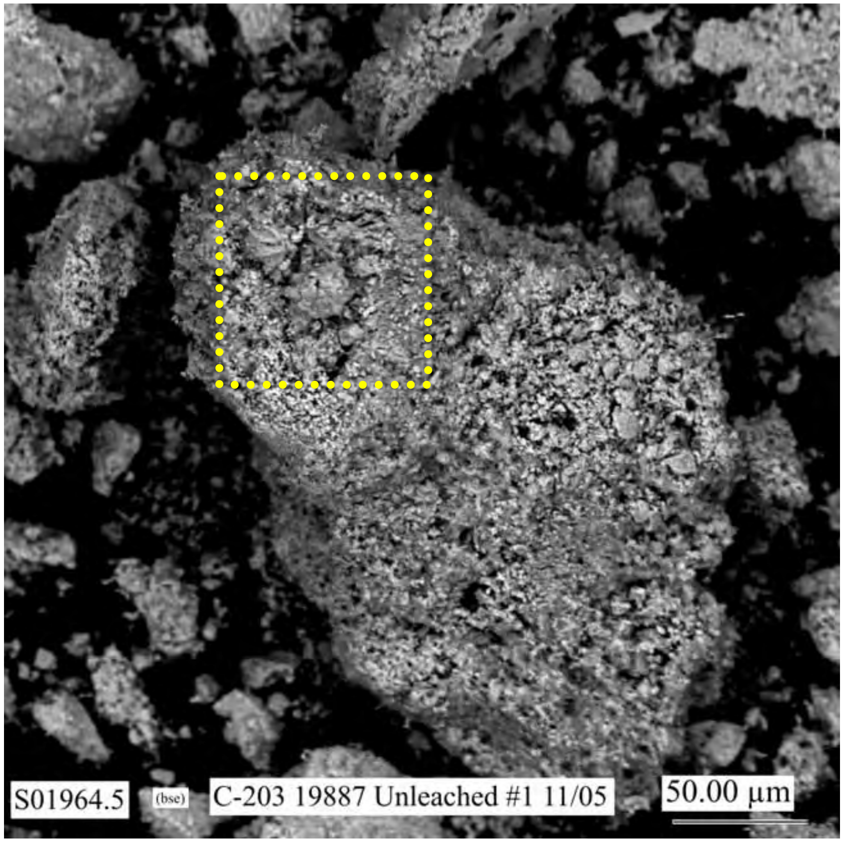


Figure E.5. Micrograph Showing Typical Particle Aggregates in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

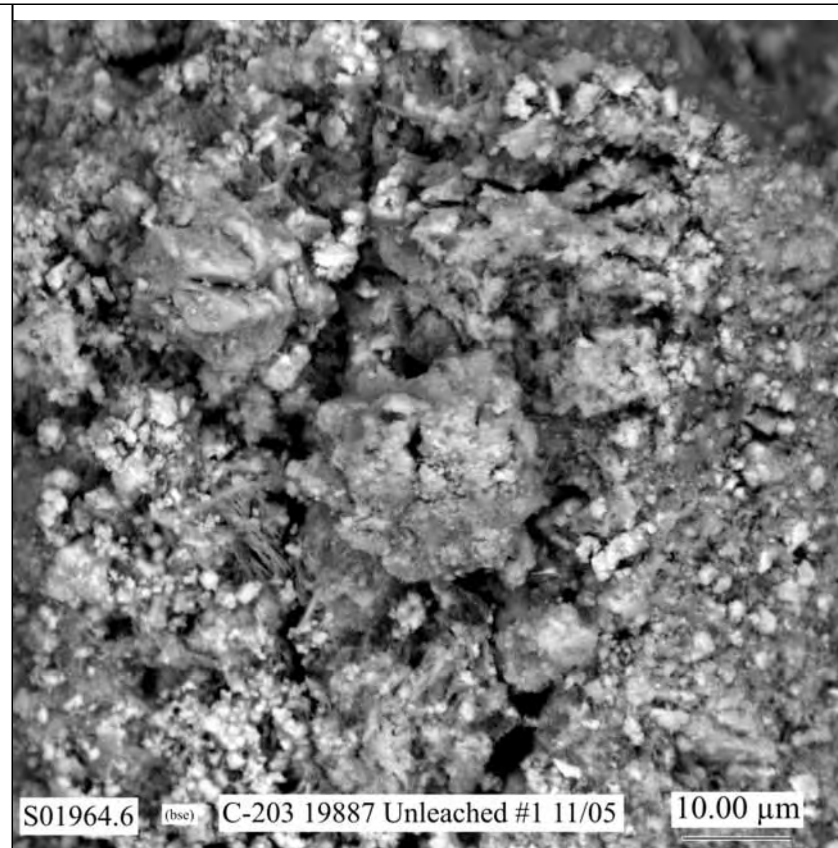


Figure E.6. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.5 (Areas where EDS analyses were made are shown in Figure E.18.)

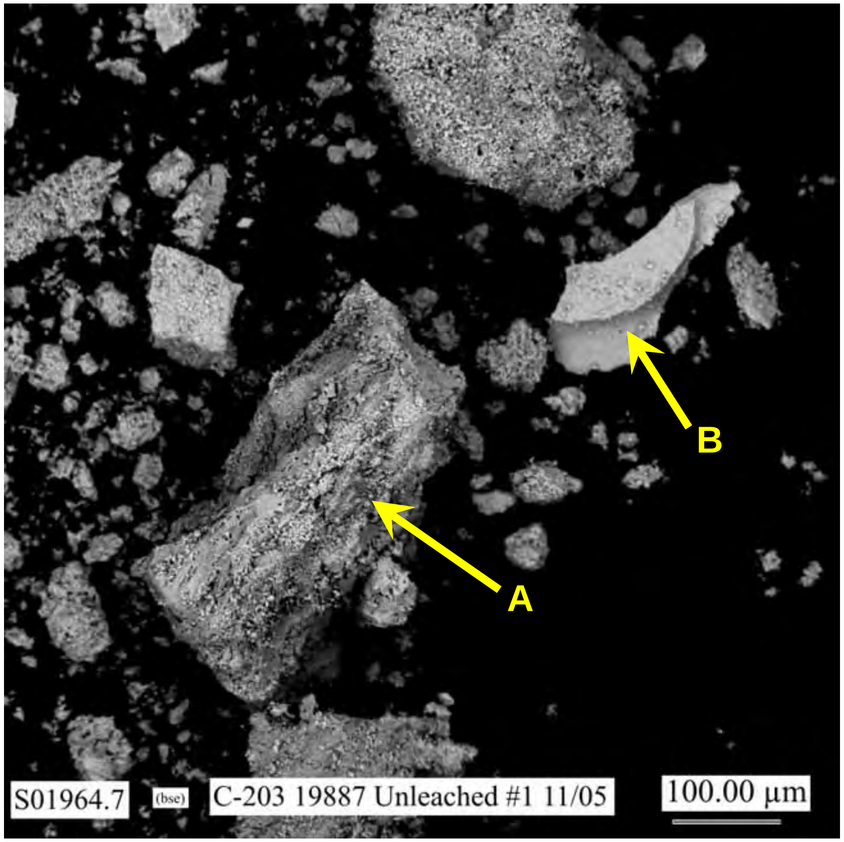


Figure E.7. Micrograph Showing Typical Particle Aggregates in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

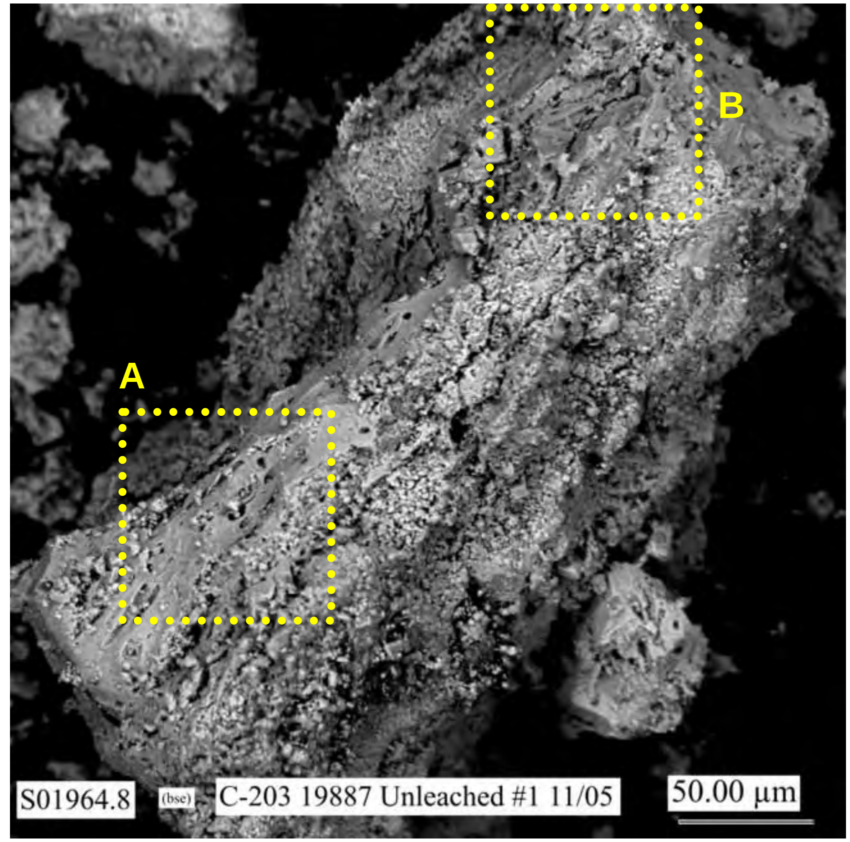


Figure E.8. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure E.7

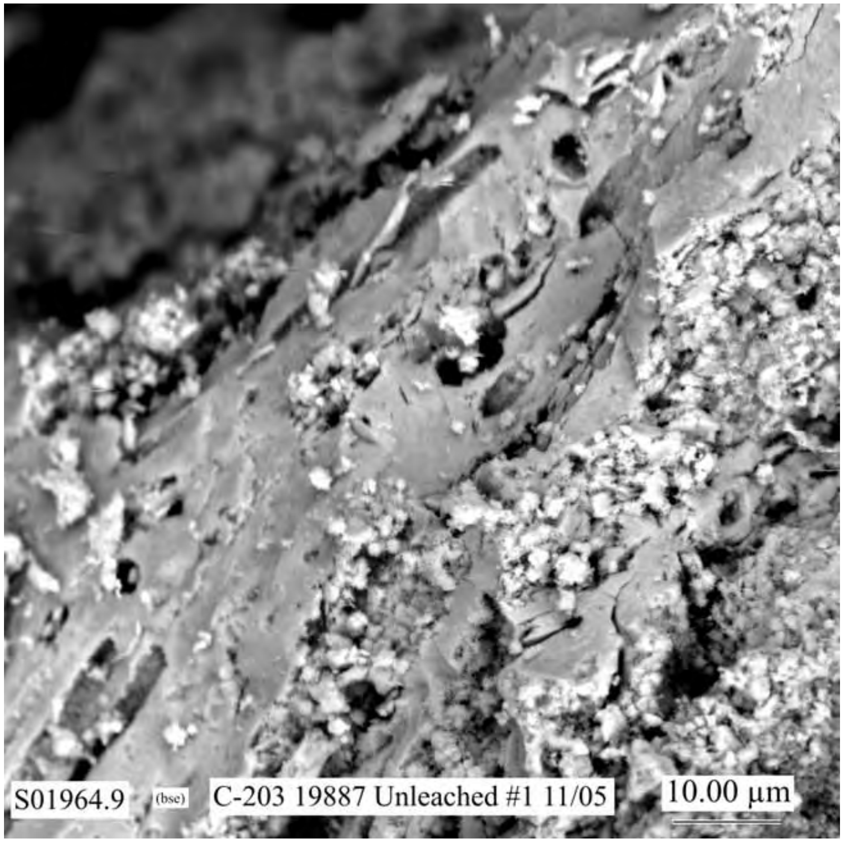


Figure E.9. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.8

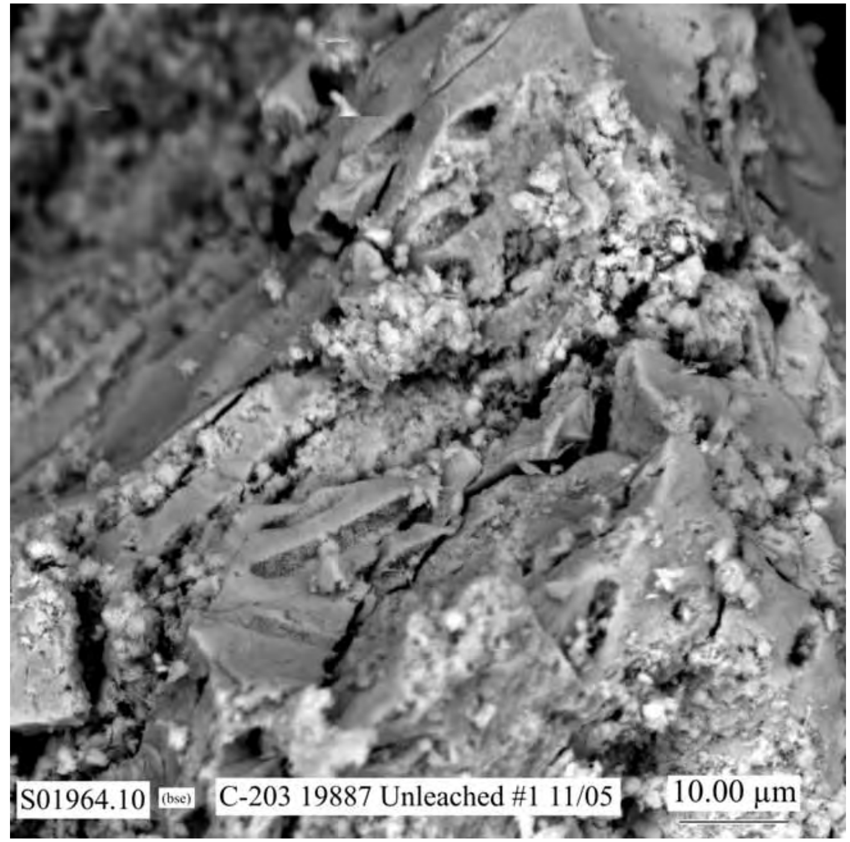


Figure E.10. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure E.8 (Areas where EDS analyses were made are shown in Figure E.19.)

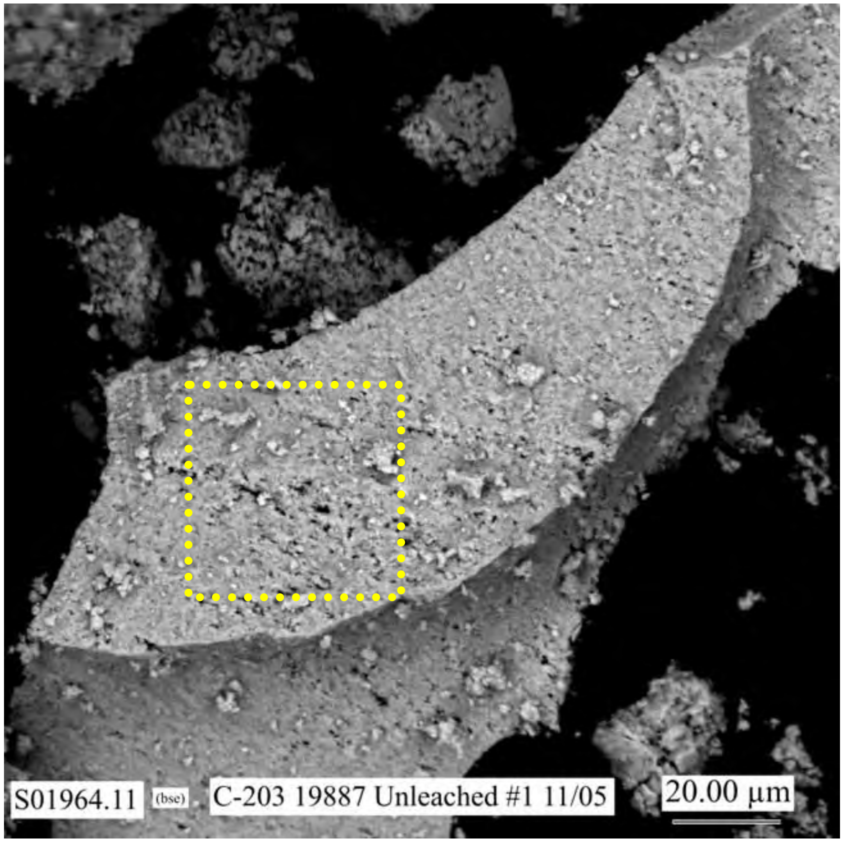


Figure E.11. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled B in Figure E.7 (Areas where EDS analyses were made are shown in Figure E.20.)

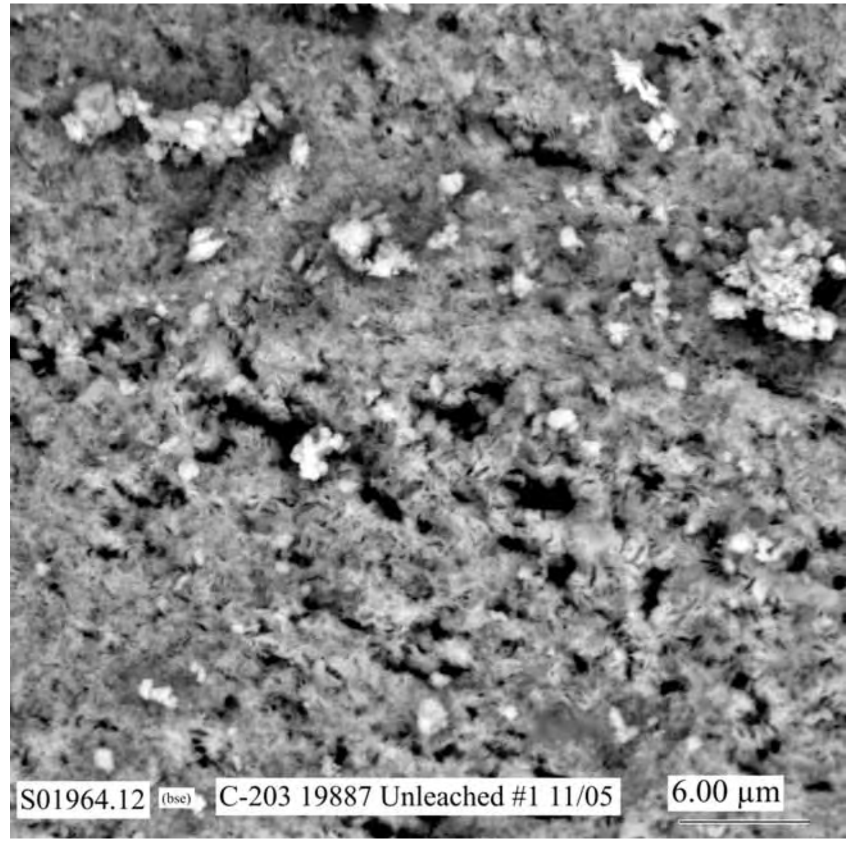


Figure E.12. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.11

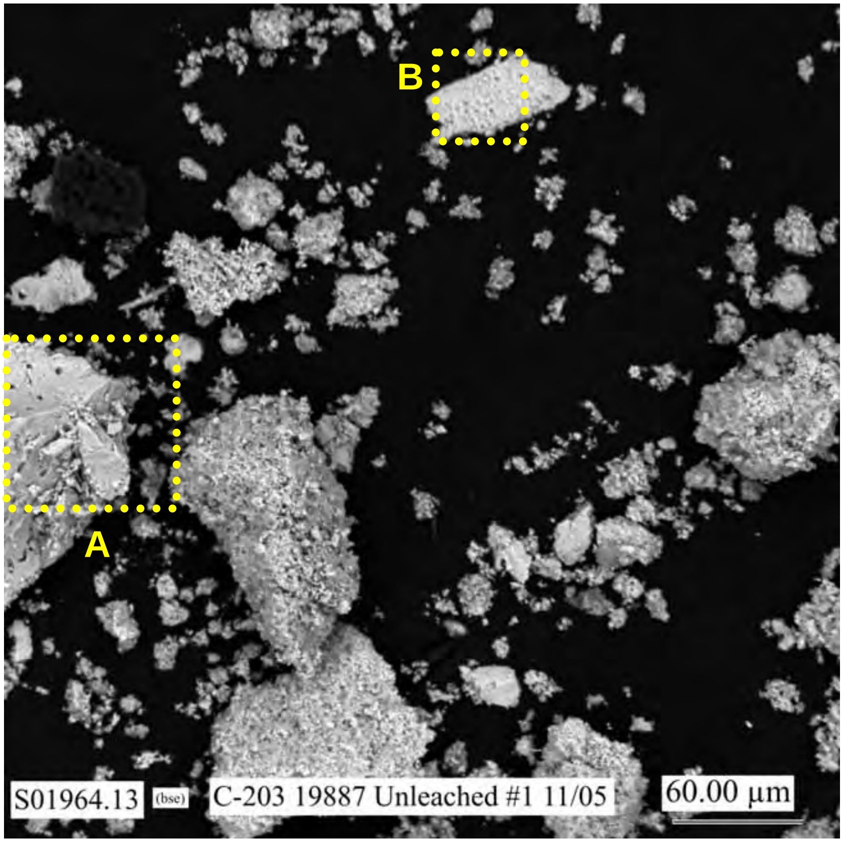


Figure E.13. Micrograph Showing Typical Particle Aggregates in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887) (Areas where EDS analyses were made are shown in Figures E.21 and E.22.)

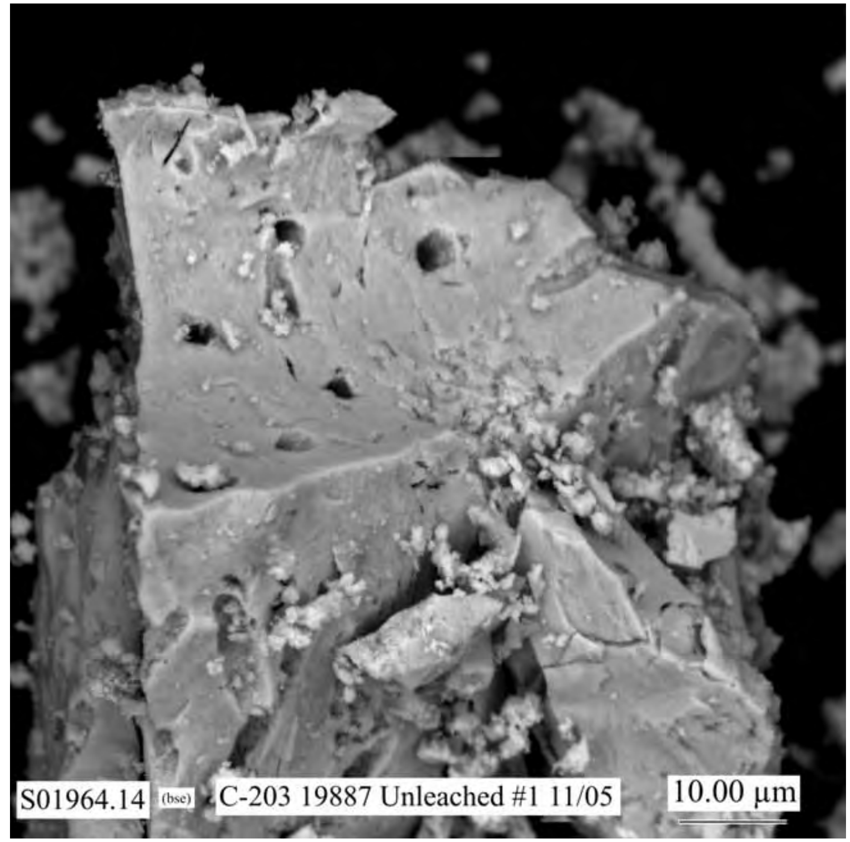


Figure E.14. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.13

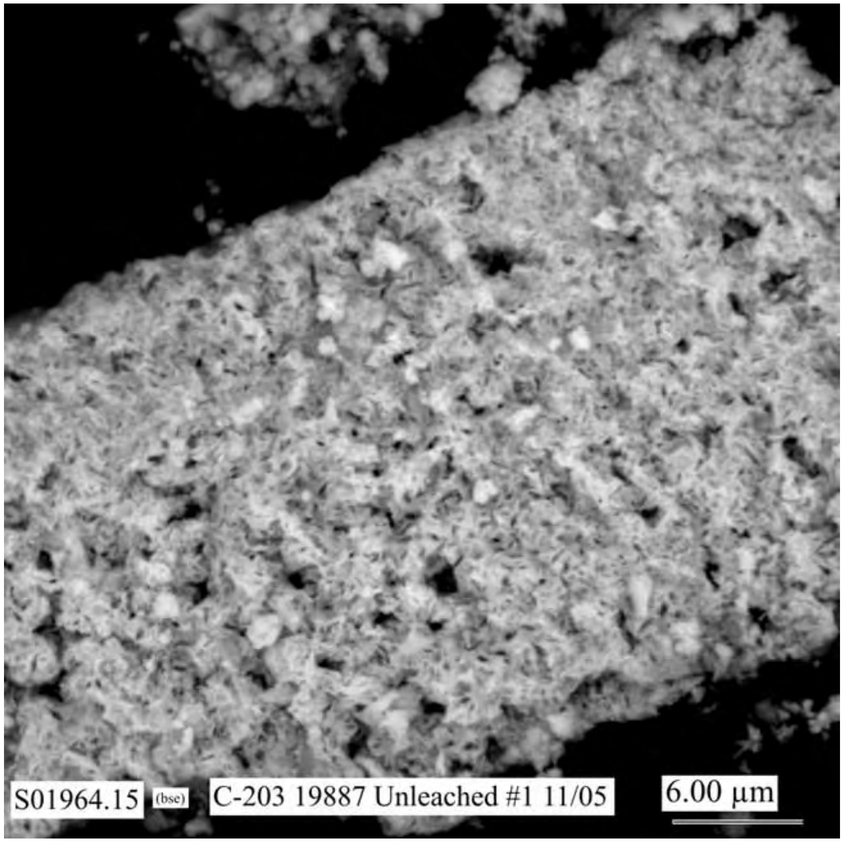


Figure E.15. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure E.13

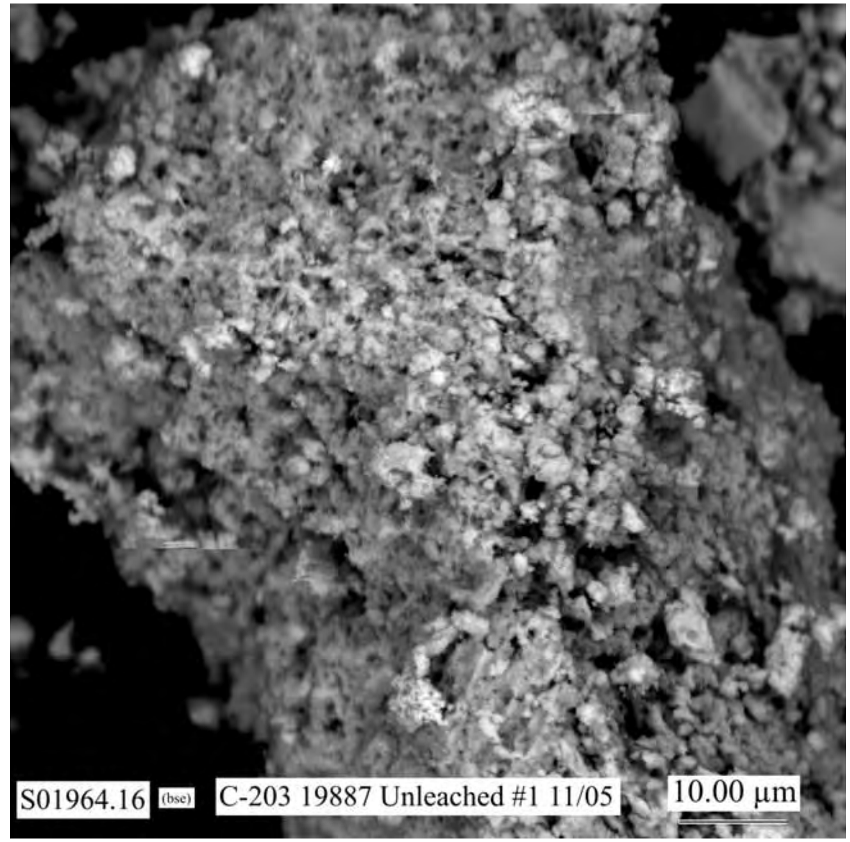


Figure E.16. Micrograph Showing Typical Particle Aggregate in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

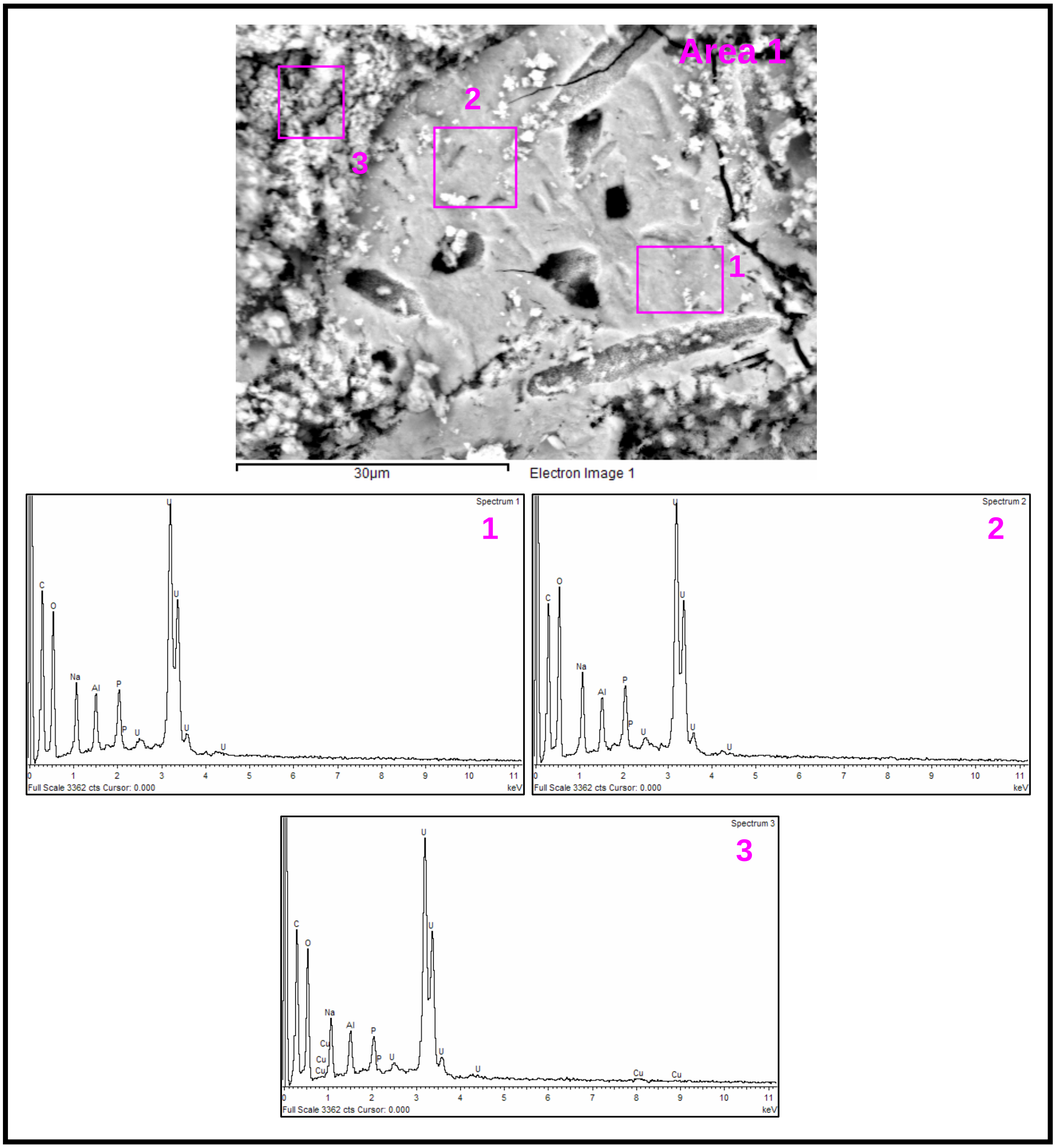


Figure E.17. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

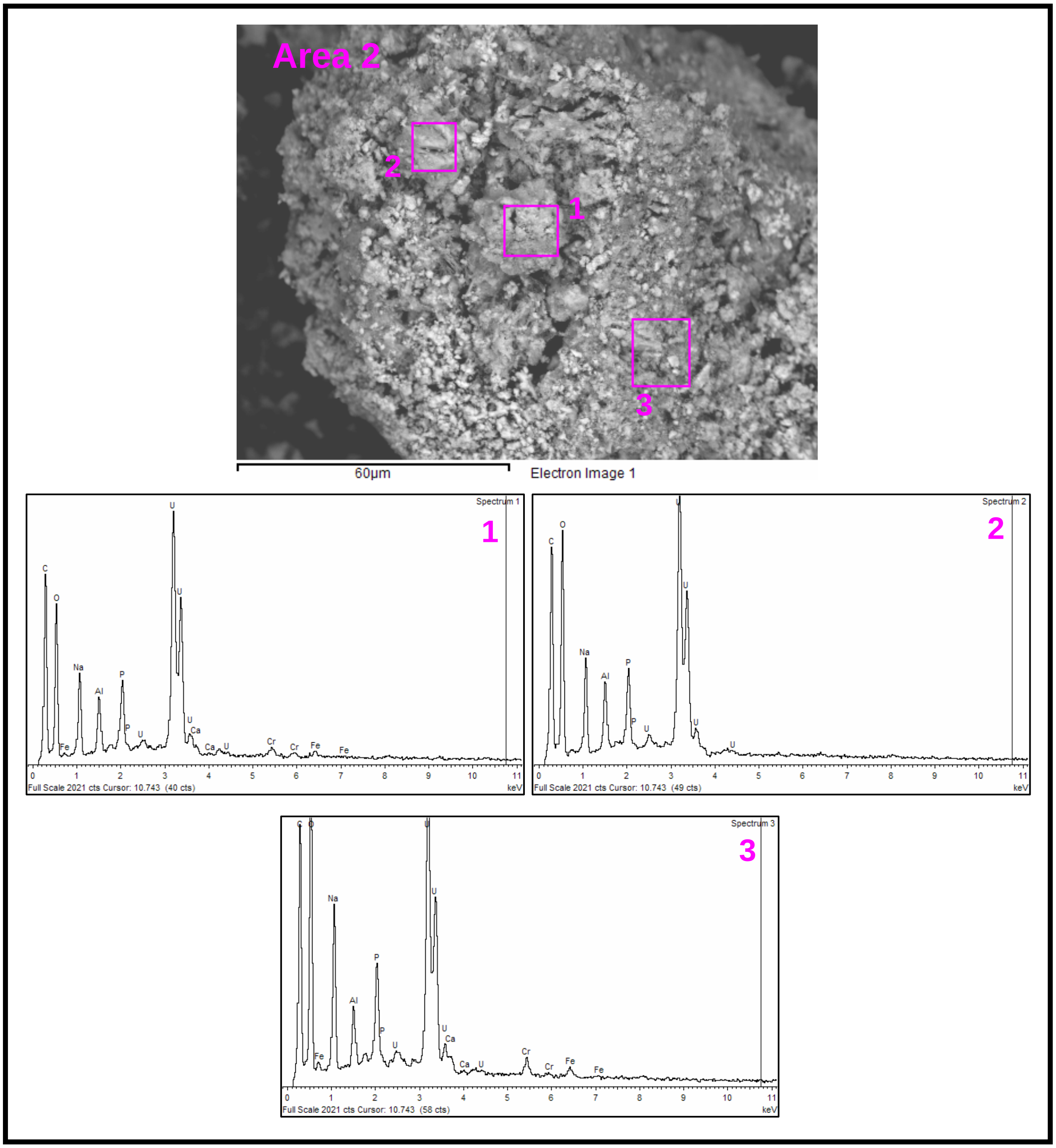


Figure E.18. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

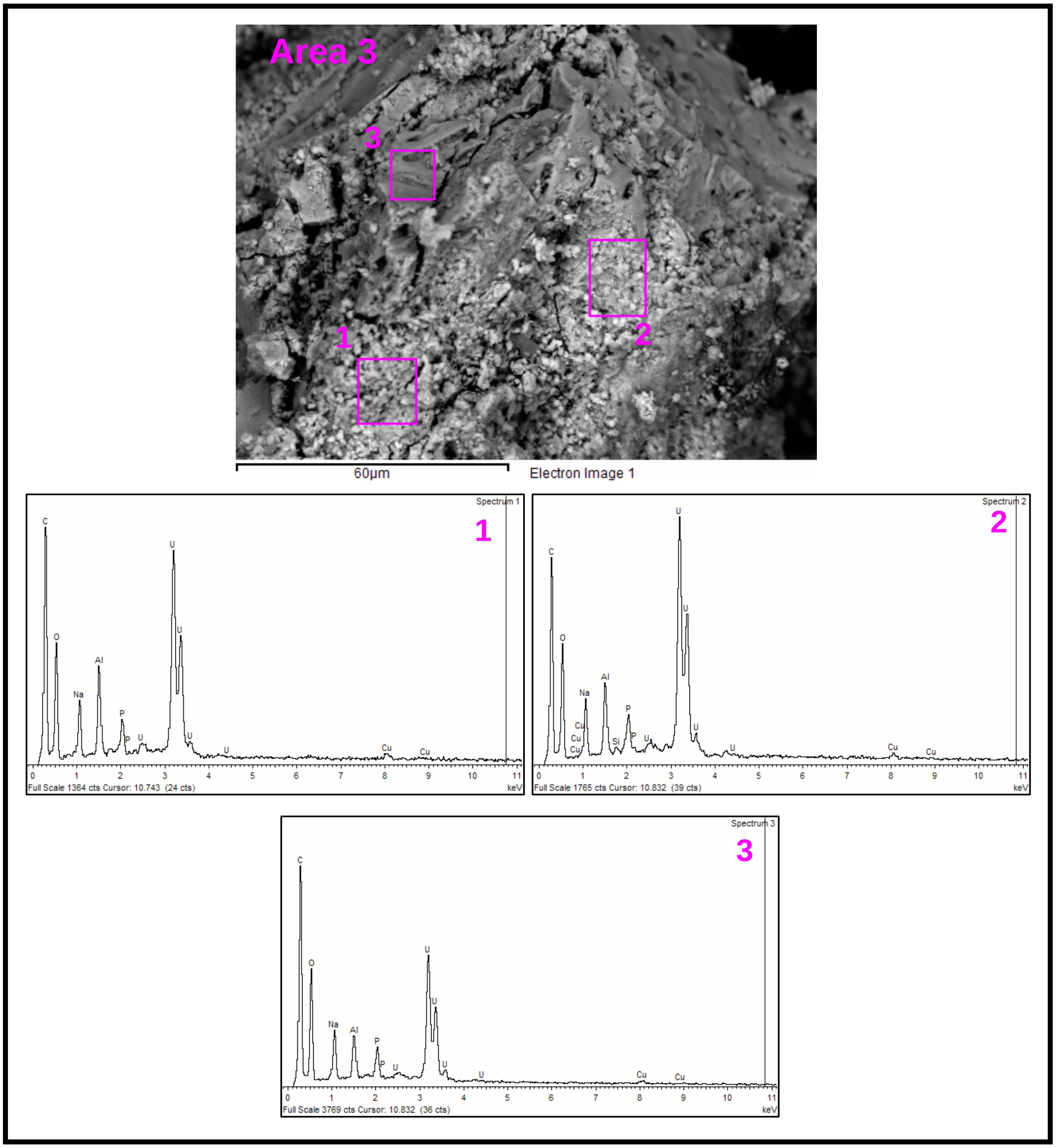


Figure E.19. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

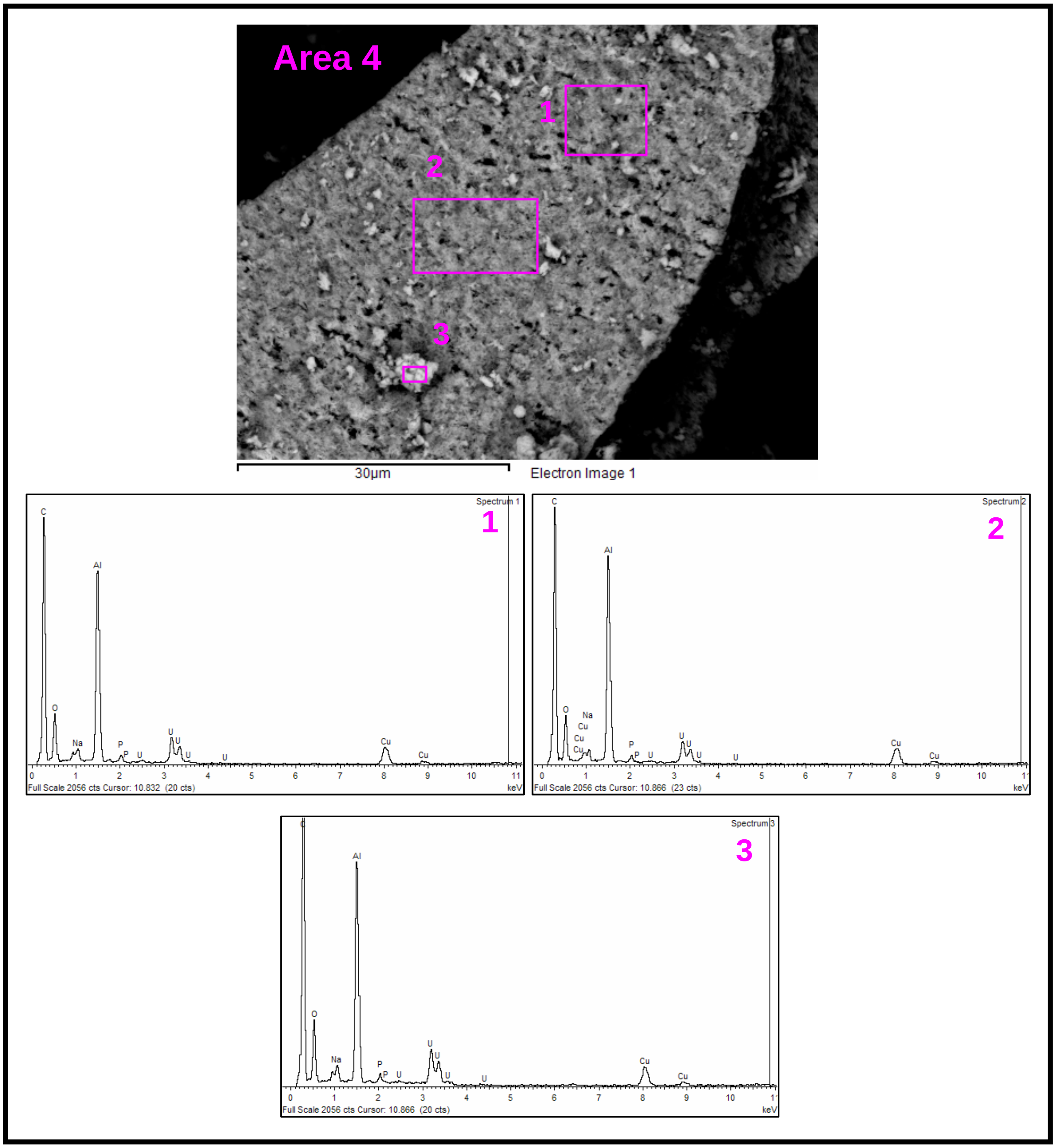


Figure E.20. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

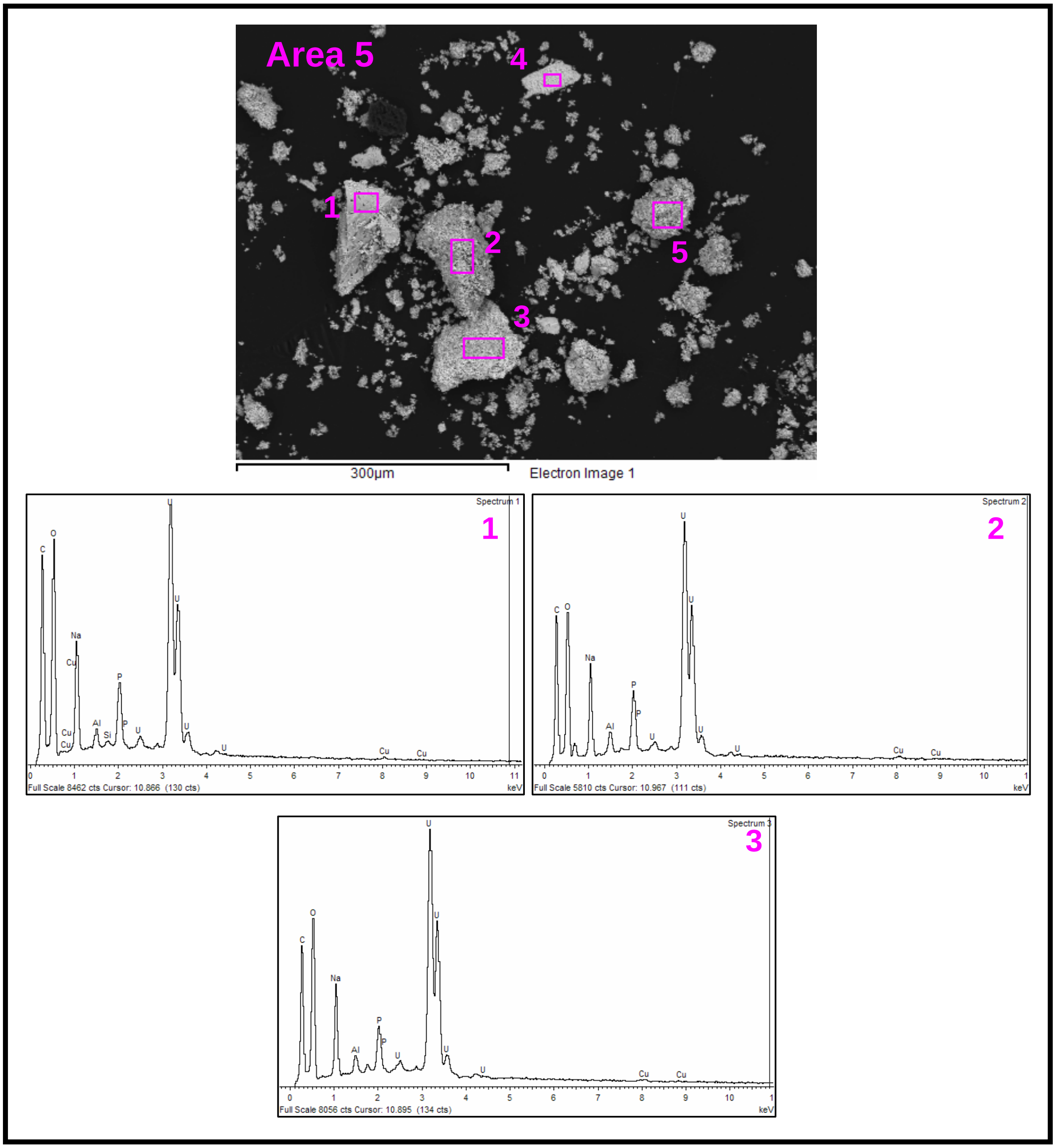


Figure E.21. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

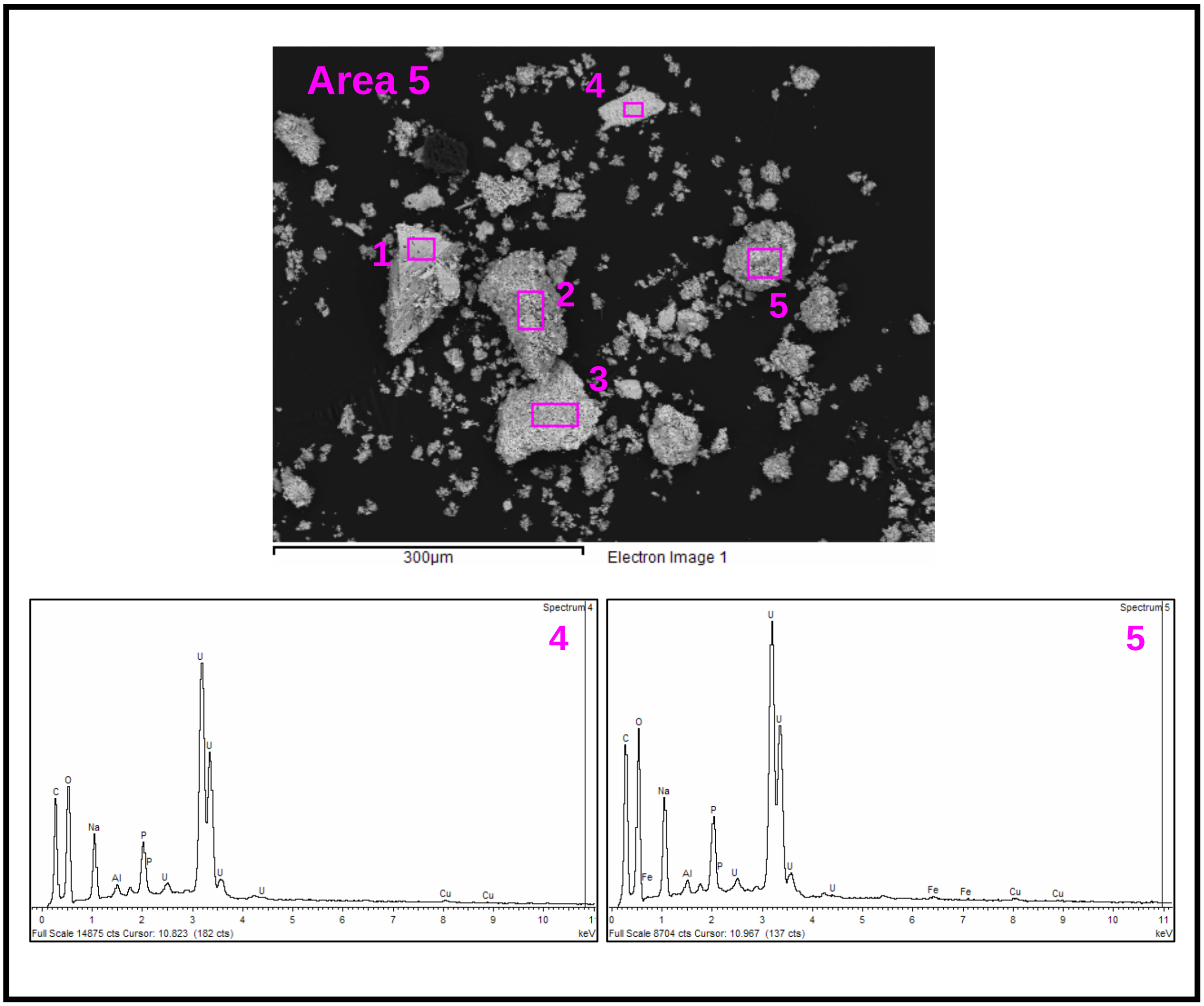


Figure E.22. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #1 of Unleached Residual Waste from Tank C-203 (Sample 19887)

Table E.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount #1

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
E.17 / 1	1	4.1	4.7						39	*48*	2.0	2.2				
	2	4.0	5.2						43	*44*	2.1	2.1				
	3	4.5	4.8						40	*46*	1.4	2.0	0.3			
E.18 / 2	1	2.9	3.4						30	*59*	1.0	2.9	0.5			
	2	3.8	3.8						32	*56*	1.1	2.7	0.4		0.3	
	3	2.1	3.1						33	*59*	1.0	1.6	0.3			
E.19 / 3	1	3.6	5.0	0.3		0.4			38	*49*	2.0	1.9				
	2	3.1	4.7						43	*46*	1.9	1.8				
	3	2.7	6.0	0.3		0.5		0.2	45	*42*	1.8	1.2			0.2	
E.20 / 4	1	0.4	0.5						16	*76*	0.2	5.0	1.5			
	2	0.3	0.5						15	*77*	0.2	5.0	1.4			
	3	0.4	0.6						17	*76*	0.2	4.7	1.3			

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table E.3. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount #1

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
E.21 & E.22 / 5	1	3.2	5.9						43	*45*	1.7	0.6	0.2		0.1	
	2	3.9	6.6						38	*44*	2.1	0.8	0.3			F – 4.5
	3	4.5	7.0						44	*41*	1.7	0.7	0.2		0.3	
	4	5.5	6.5						43	*41*	2.5	0.6	0.2		0.3	
	5	4.2	6.6	0.1		0.1			42	*43*	2.4	0.5	0.2		0.3	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

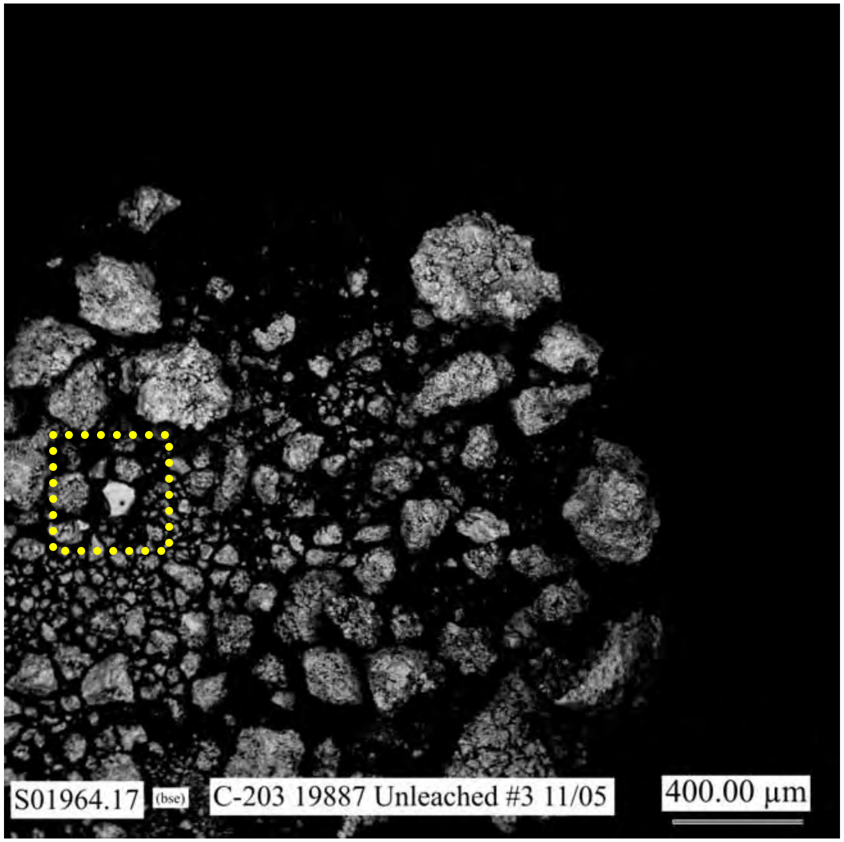
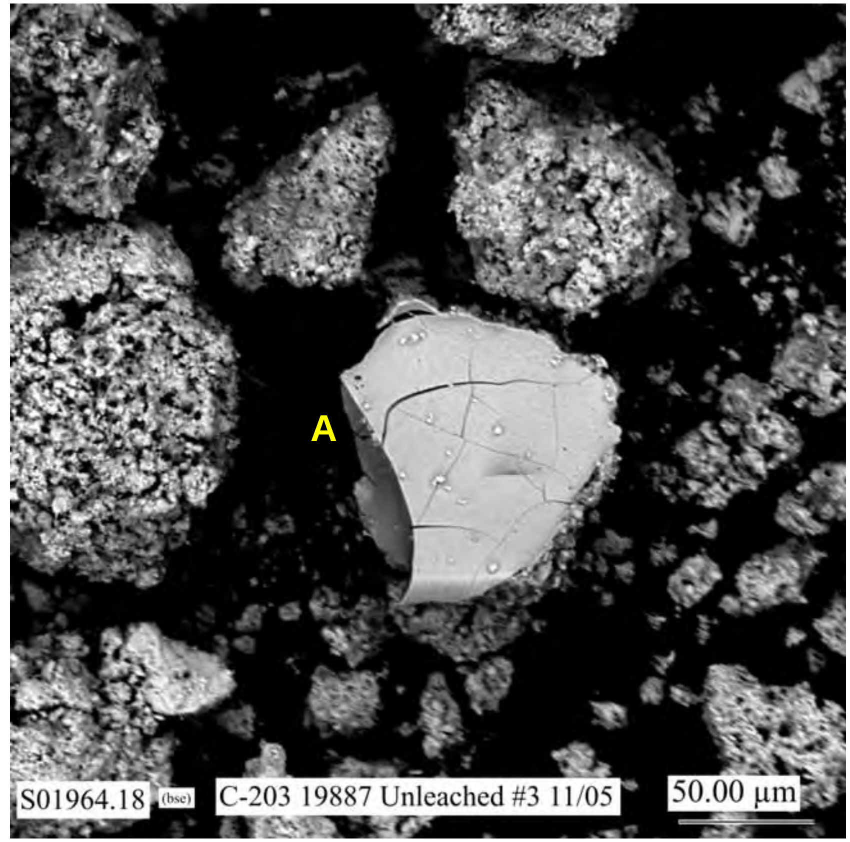
	

Figure E.23. Low Magnification Micrograph Showing Typical Particle Aggregates in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)	**Figure E.24**. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.23 (Areas where EDS analyses were made are shown in Figure E.35.)

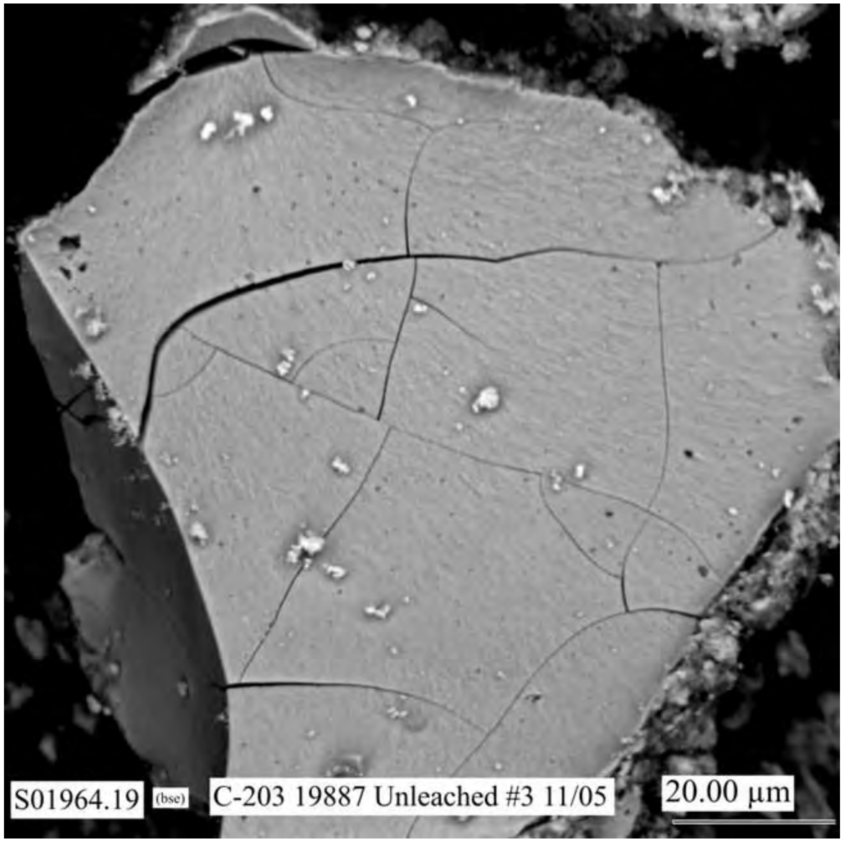


Figure E.25. Micrograph Showing at Higher Magnification the Large Particle Labeled A in Figure E.22.)

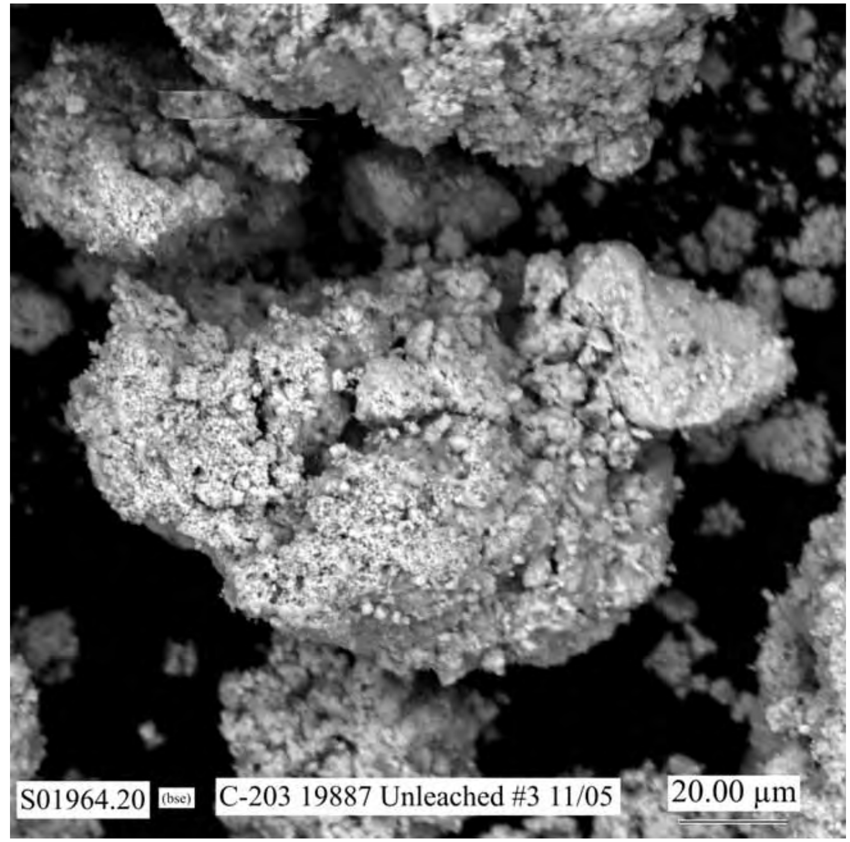


Figure E.26. Micrograph Showing Typical Particle Aggregates in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

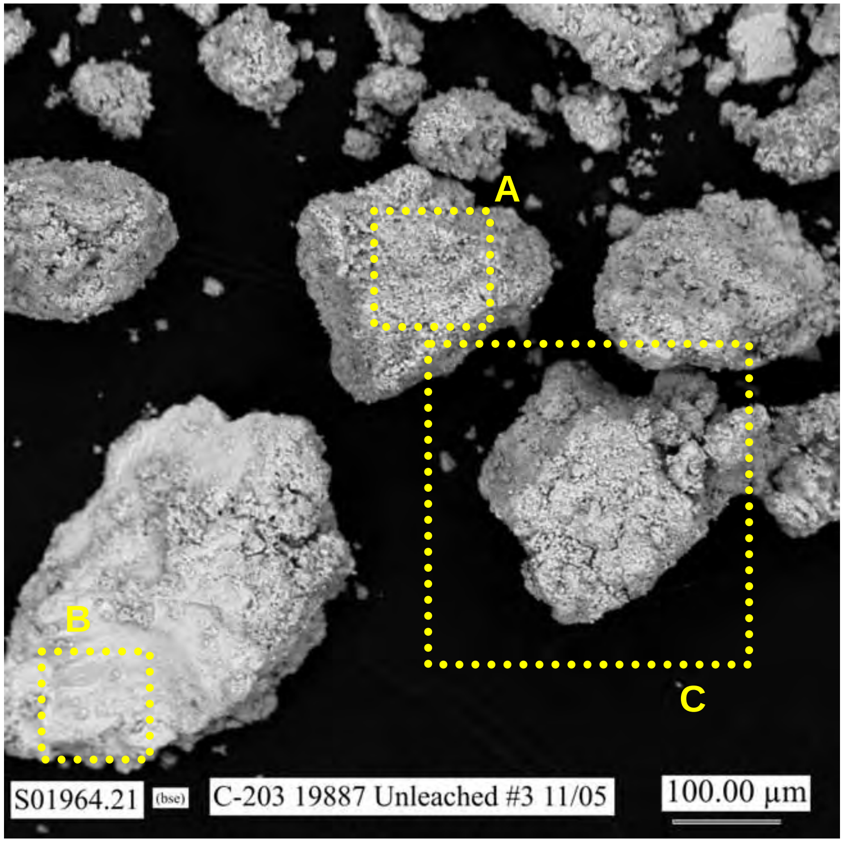


Figure E.27. Micrograph Showing Typical Particle Aggregates in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887) (Areas where EDS analyses were made are shown in Figures E.36 and E.37.)

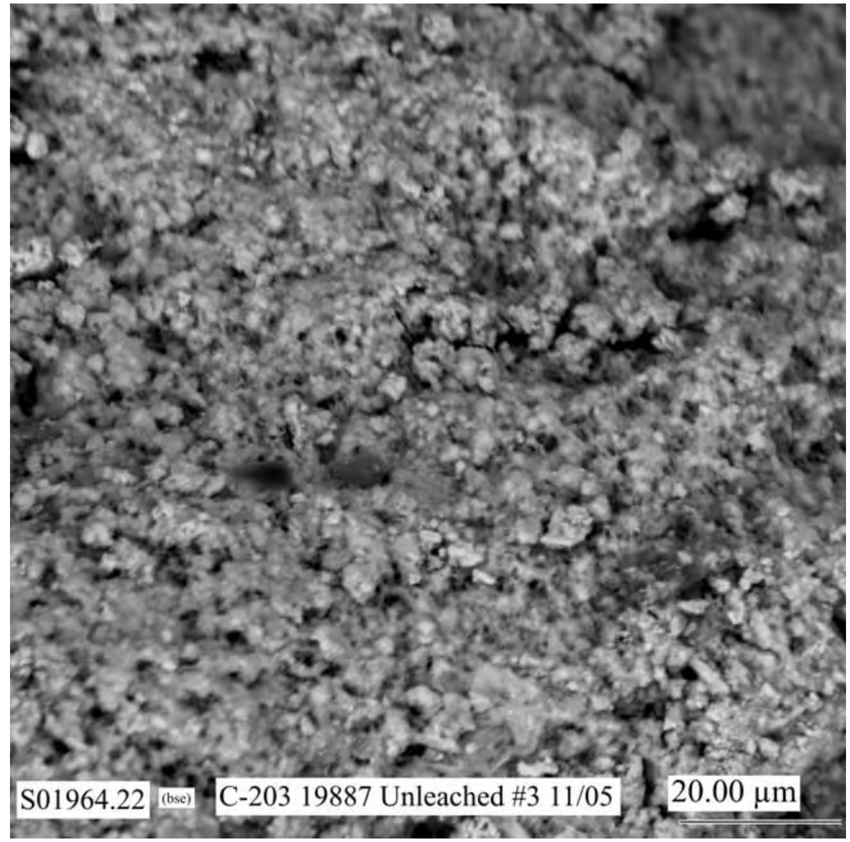
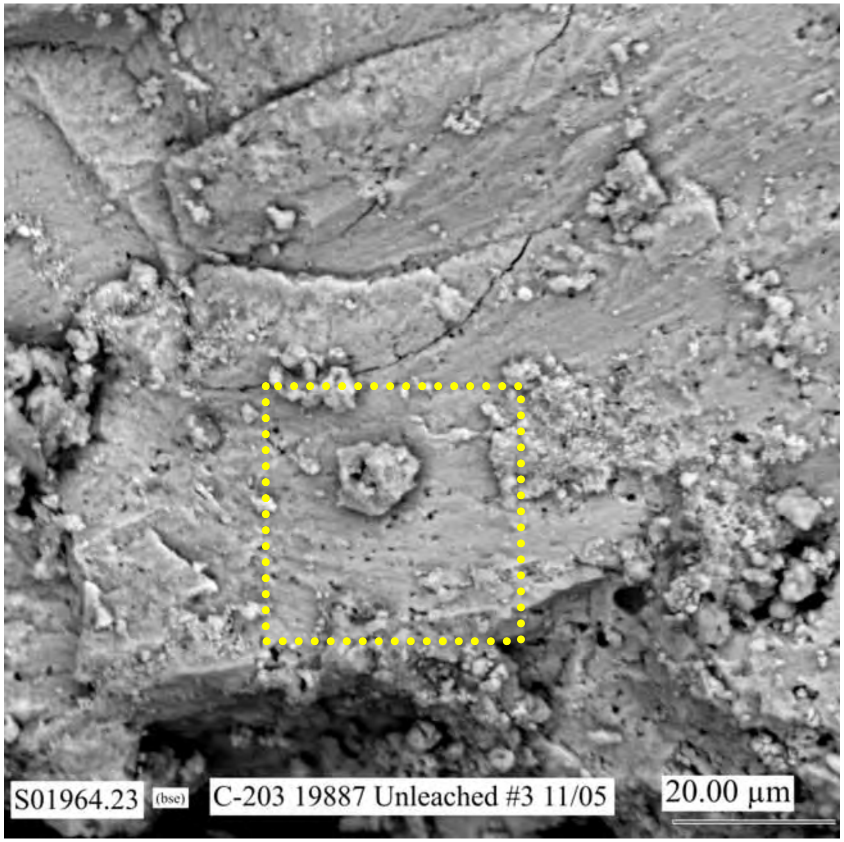


Figure E.28. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.27



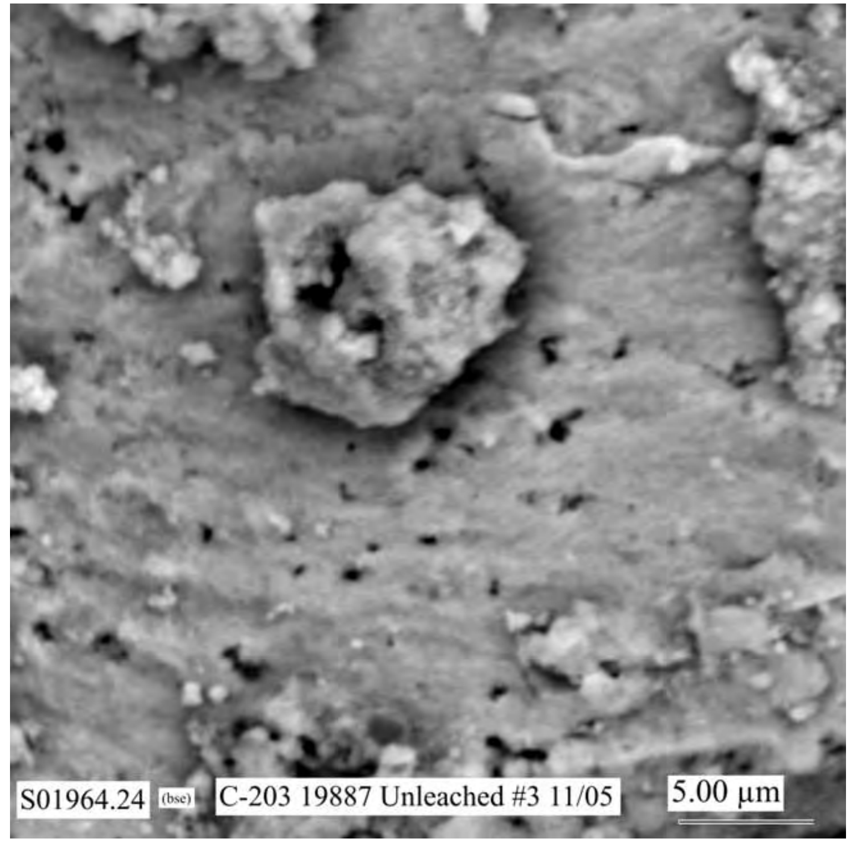


Figure E.29. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure E.27

Figure E.30. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.29

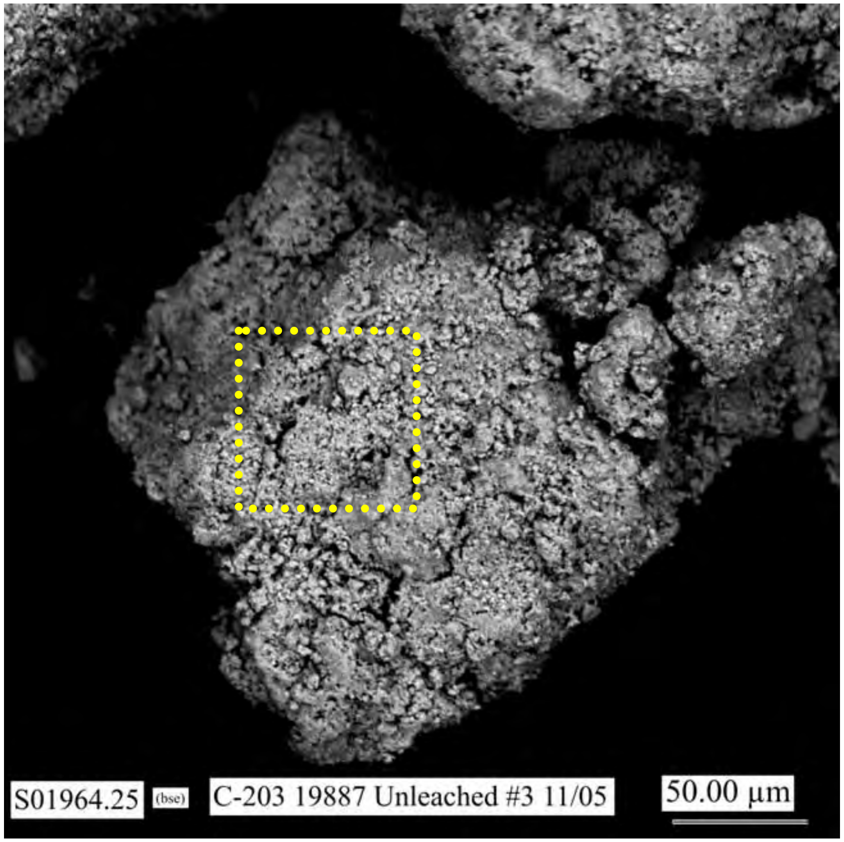


Figure E.31. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled C in Figure E.27

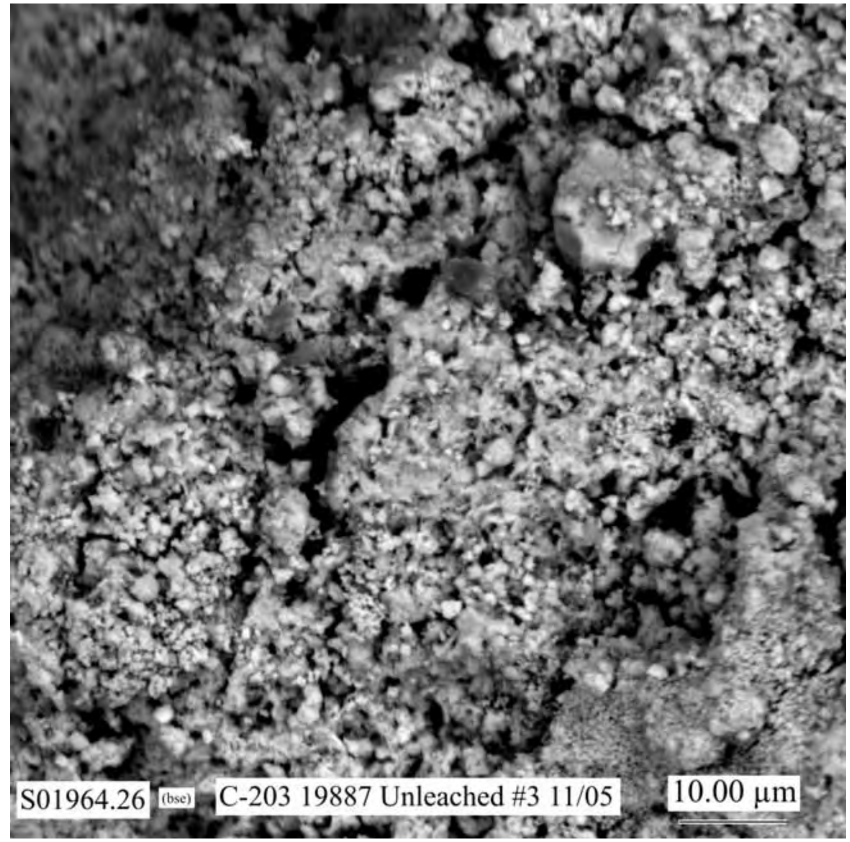


Figure E.32. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.31

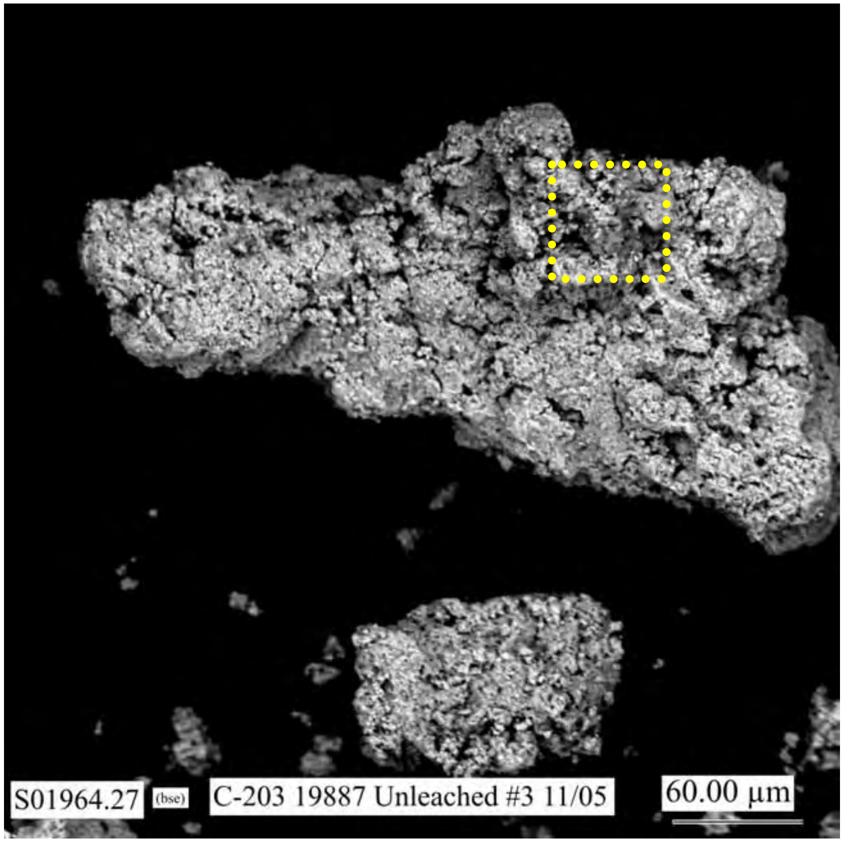


Figure E.33. Micrograph Showing Typical Particle Aggregates in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

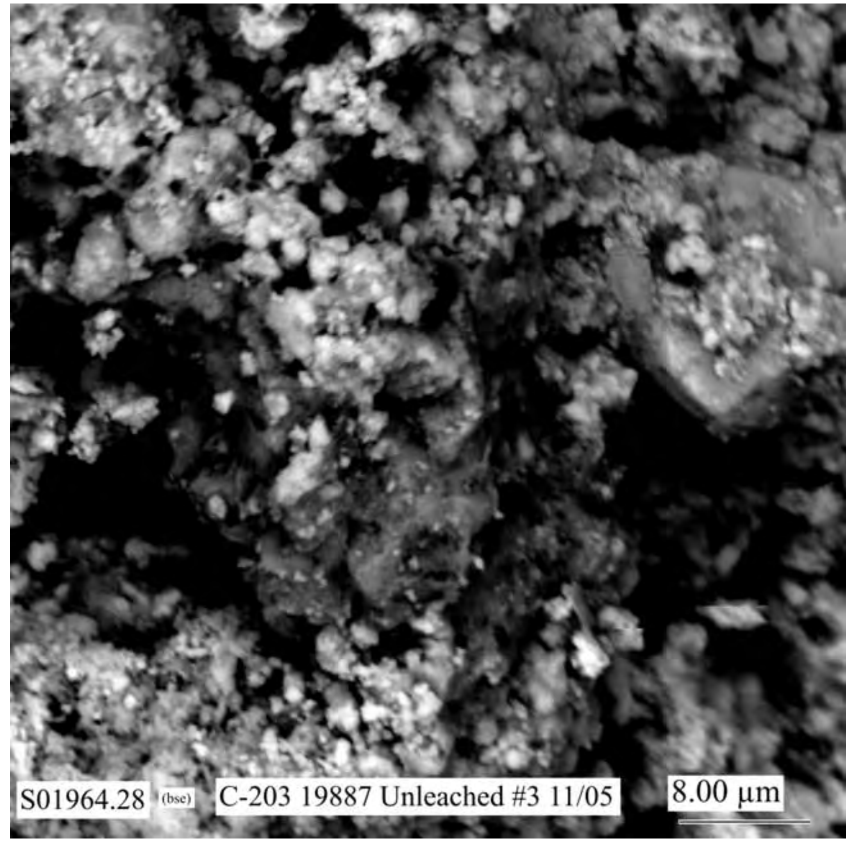


Figure E.34. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.33 (Areas where EDS analyses were made are shown in Figure E.38.)

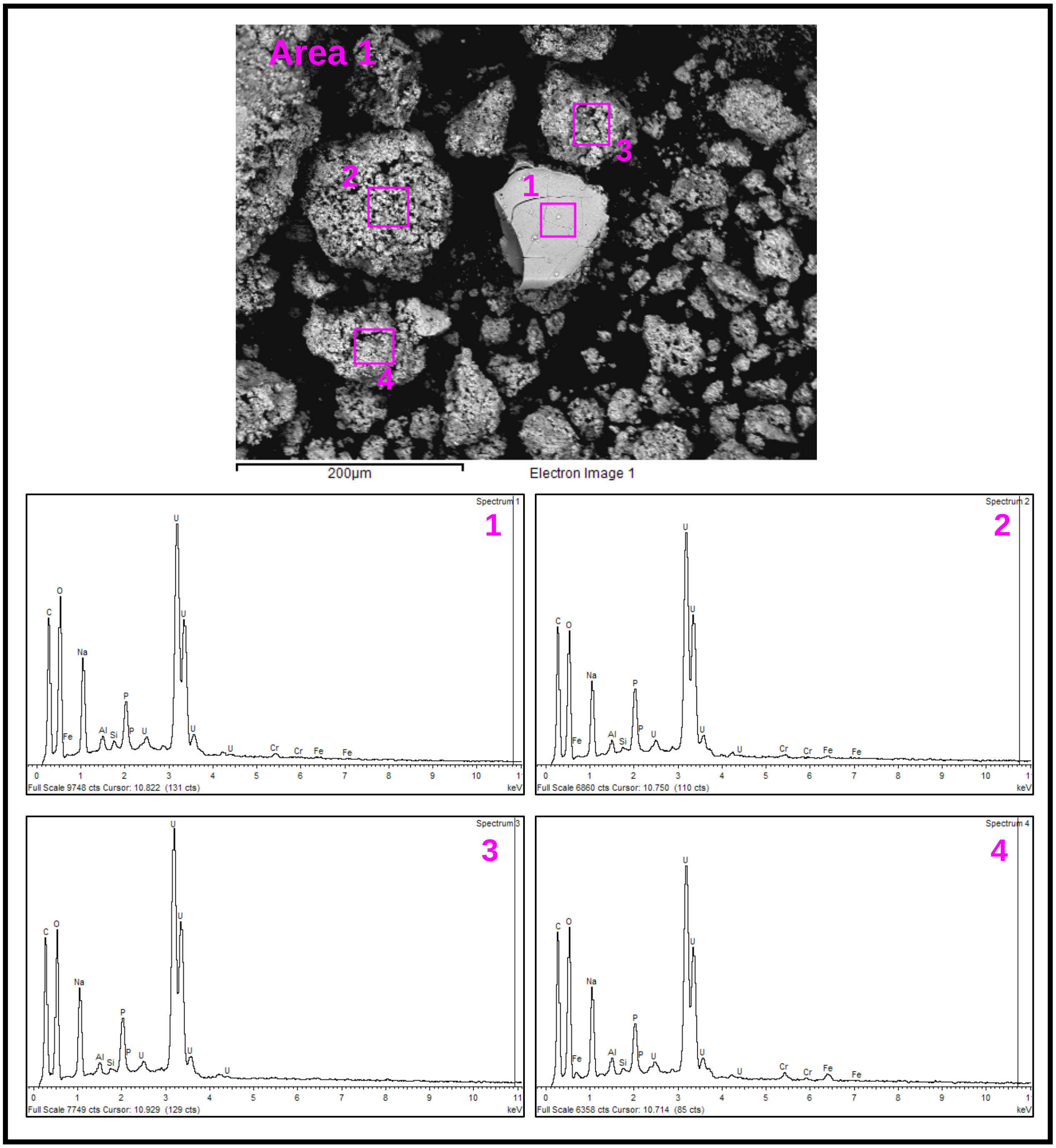


Figure E.35. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

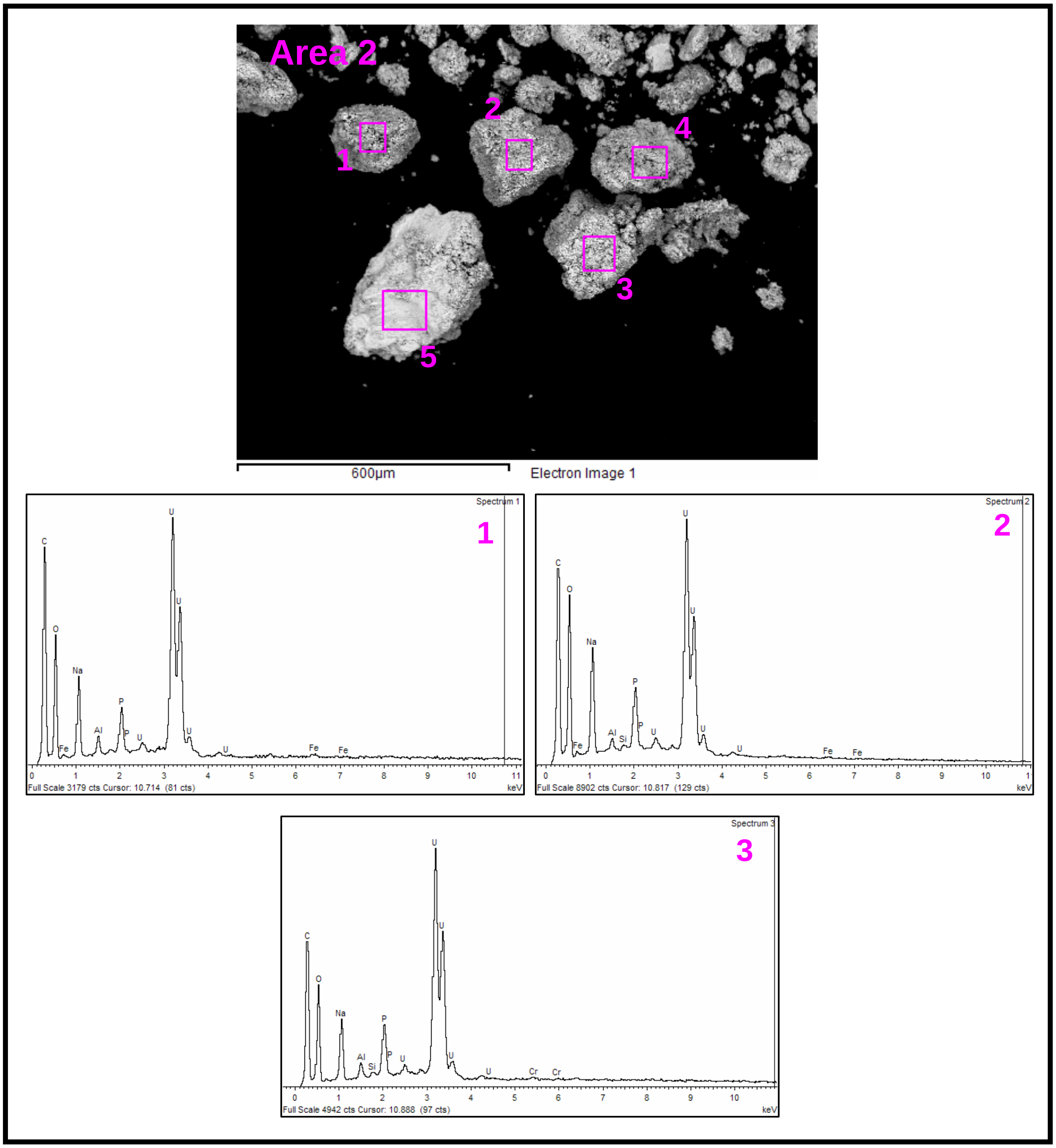


Figure E.36. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

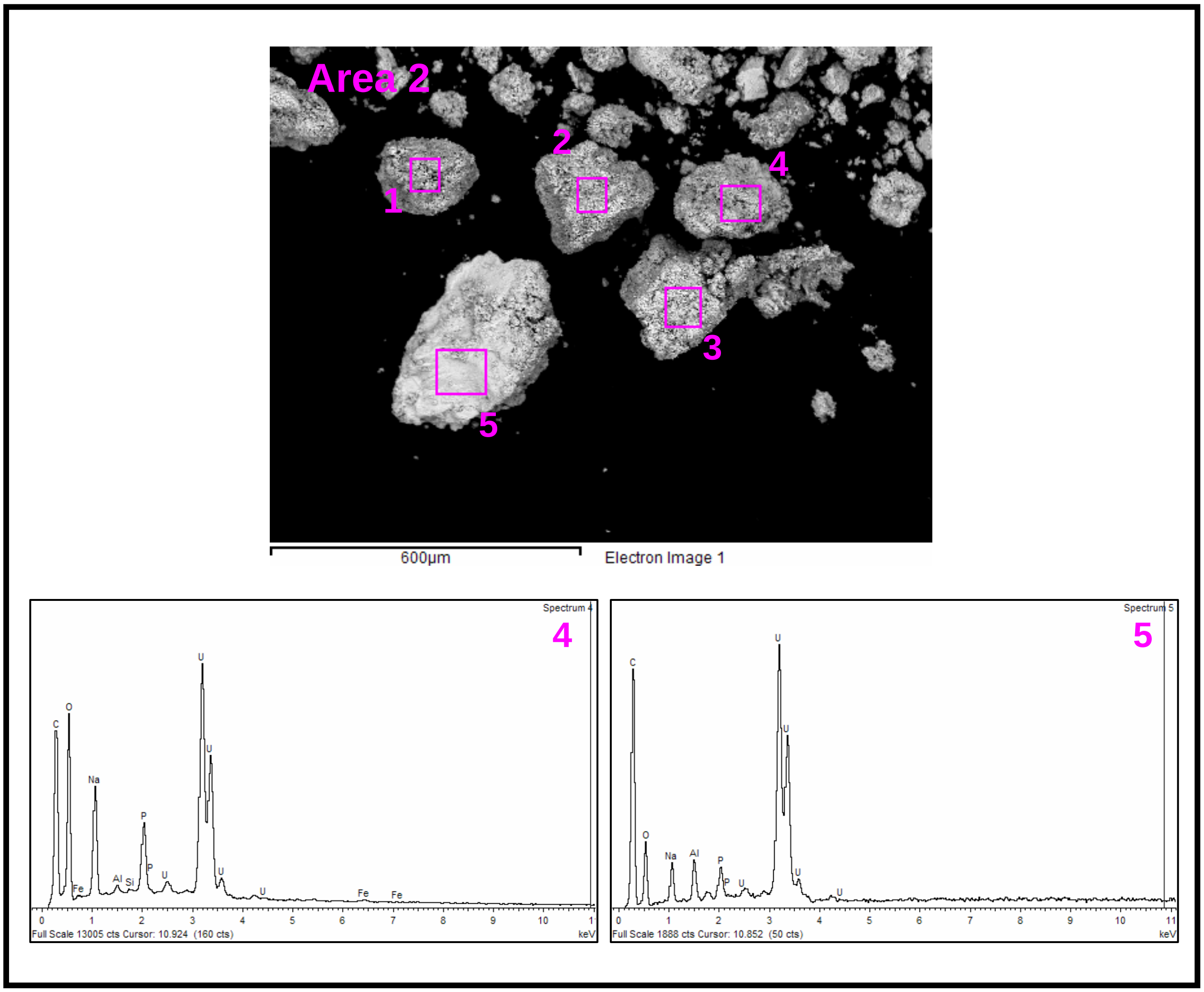


Figure E.37. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

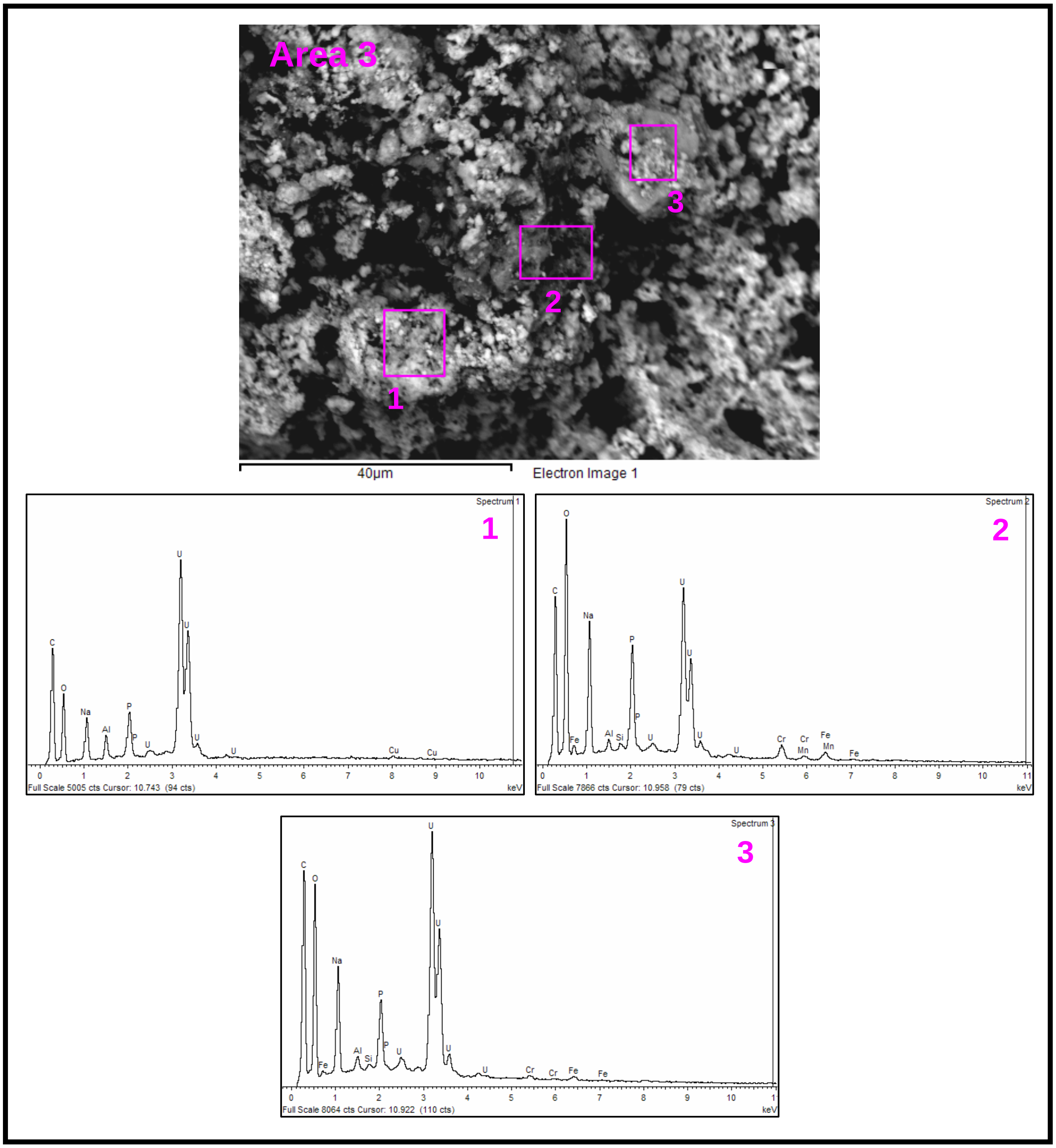


Figure E.38. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #3 of Unleached Residual Waste from Tank C-203 (Sample 19887)

Table E.4. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount #3

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
E. 35 / 1	1	3.9	6.9	0.1		0.2			44	*43*	1.6	0.6			0.3	
	2	4.3	6.1			0.2			40	*46*	2.5	0.6			0.1	
	3	4.4	6.7						43	*44*	2.0	0.5			0.2	
	4	3.5	6.4	0.4		0.3			41	*45*	1.7	0.6			0.2	F – 1.1
E.36 & E.37 / 2	1	3.8	5.2	0.2					34	*55*	1.4	0.7				
	2	3.4	6.4	0.1					39	*49*	1.8	0.4			0.1	F – 0.8
	3	4.8	5.4			0.2			36	*51*	2.3	0.7			0.2	
	4	3.4	6.7	0.1					43	*45*	2.1	0.2			0.1	
	5	4.6	3.1						23	*67*	1.2	1.8				
E.38 / 3	1	5.3	4.8						32	*53*	2.5	1.5	0.3			
	2	2.0	6.7	0.4	0.1	0.5			45	*43*	2.6	0.3			0.1	
	3	3.1	5.7	0.2		0.1			41	*48*	1.8	0.4			0.1	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

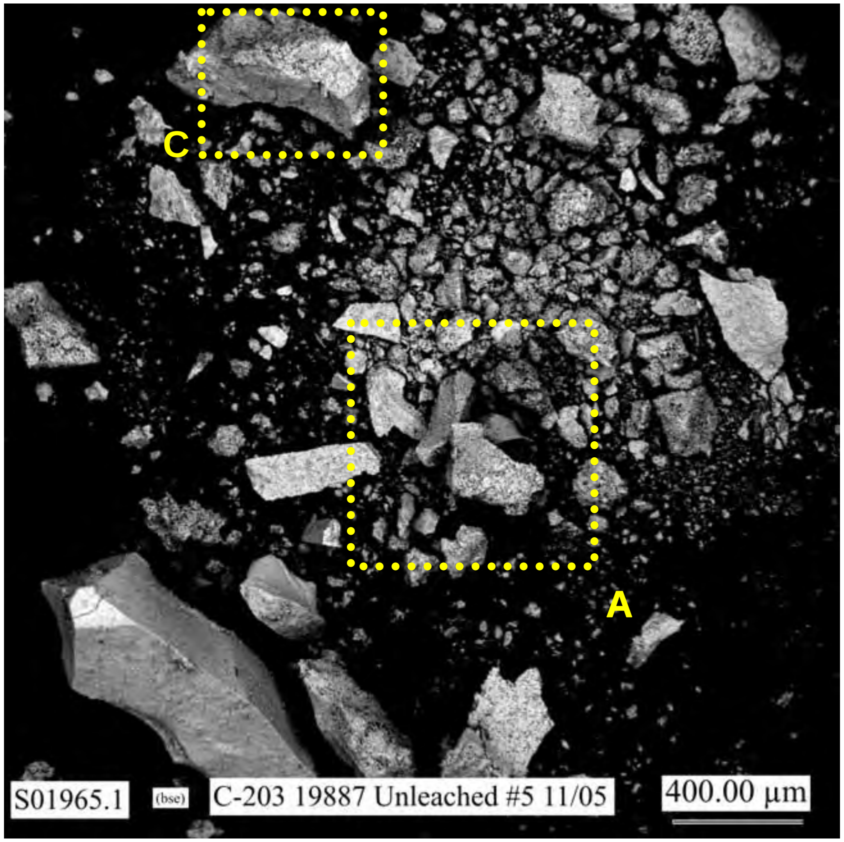


Figure E.39. Low Magnification Micrograph Showing Typical Particle Aggregates in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

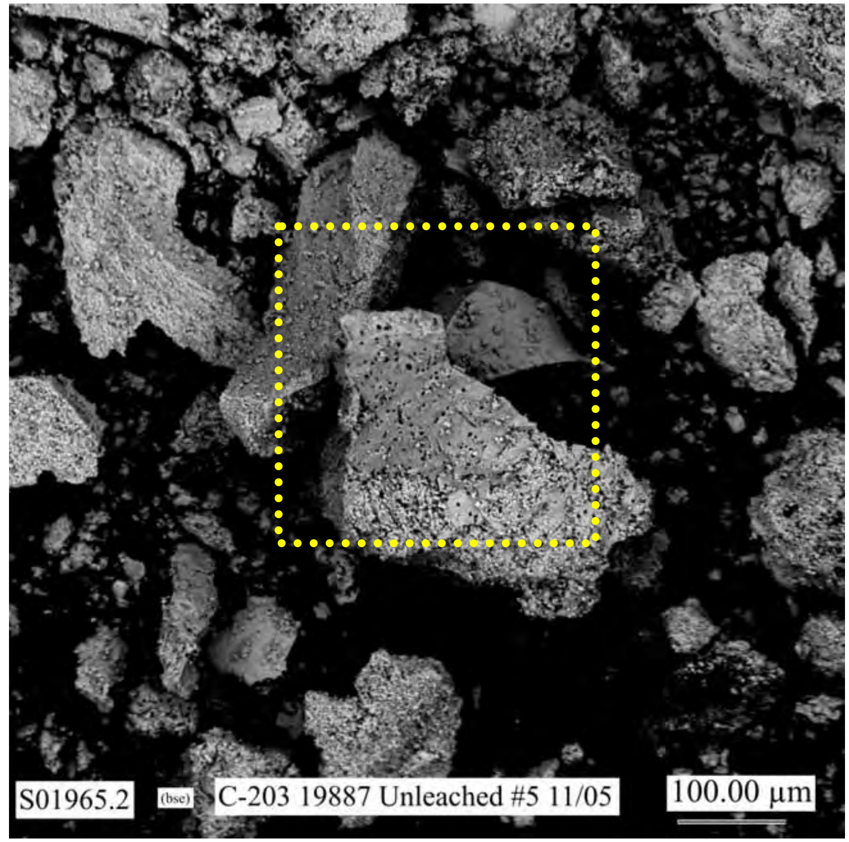


Figure E.40. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.39

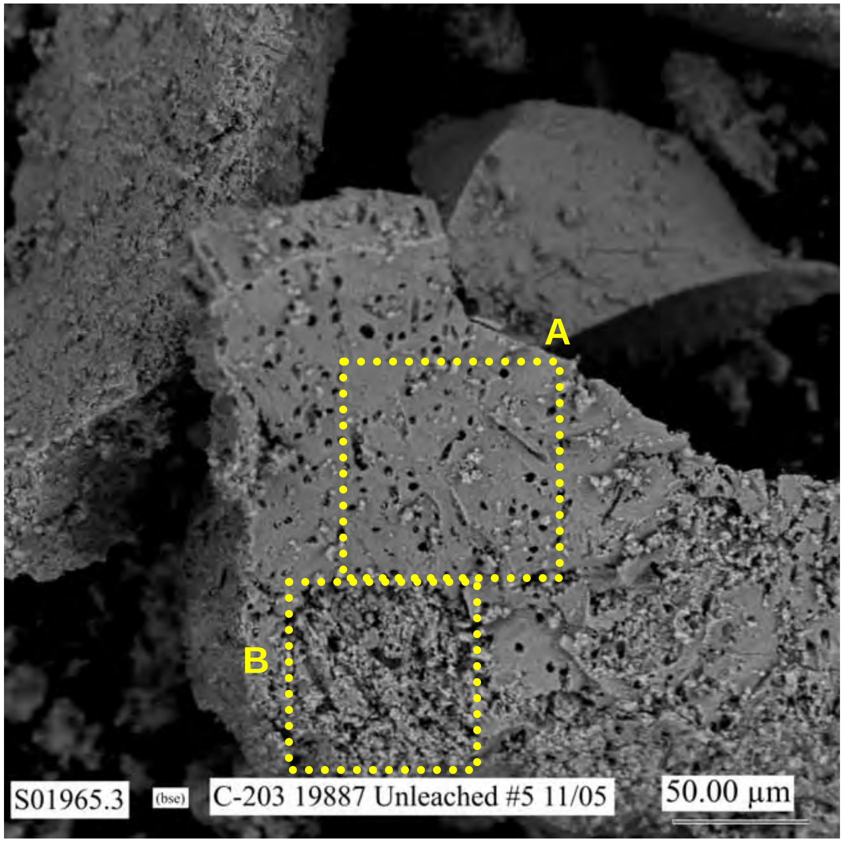


Figure E.41. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.40 (Areas where EDS analyses were made are shown in Figure E.55.)

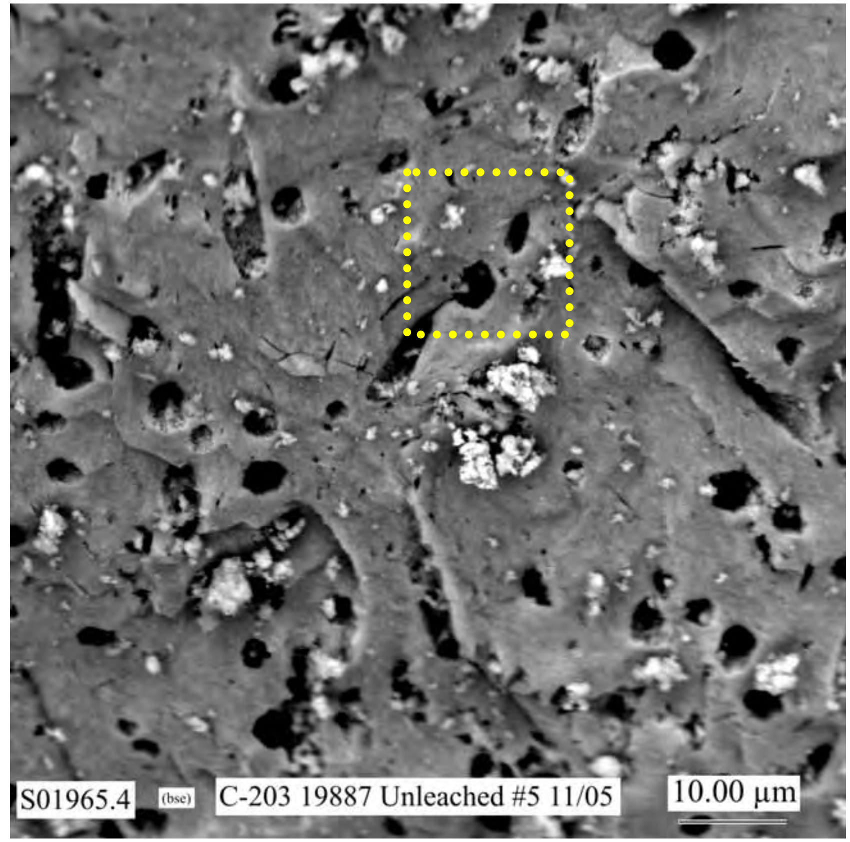


Figure E.42. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure E.41

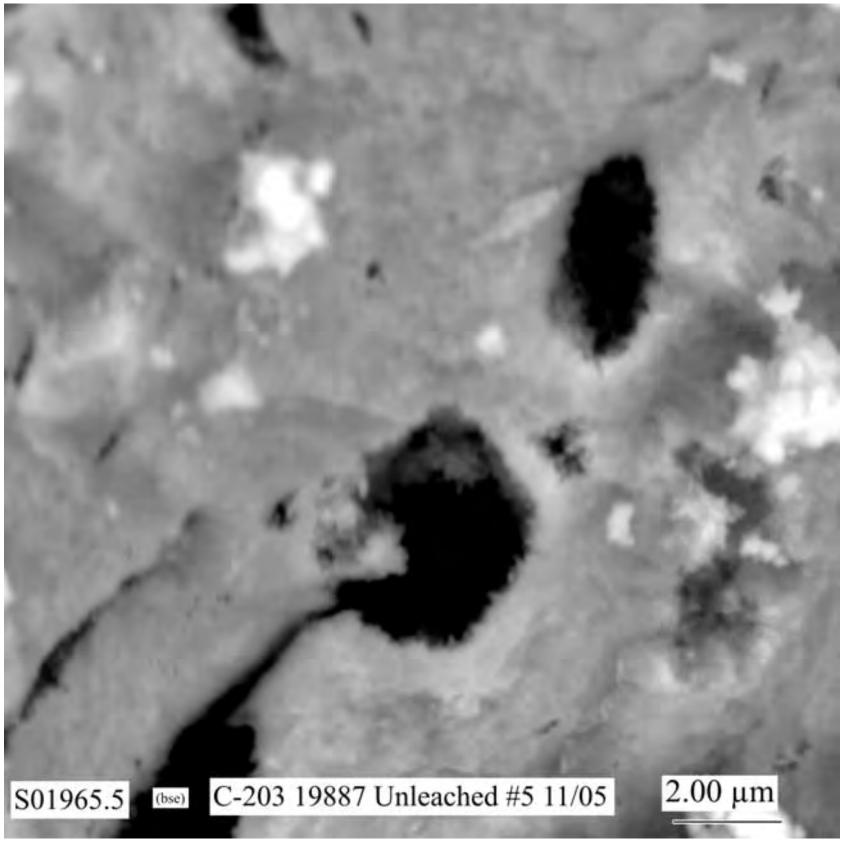


Figure E.43. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.42

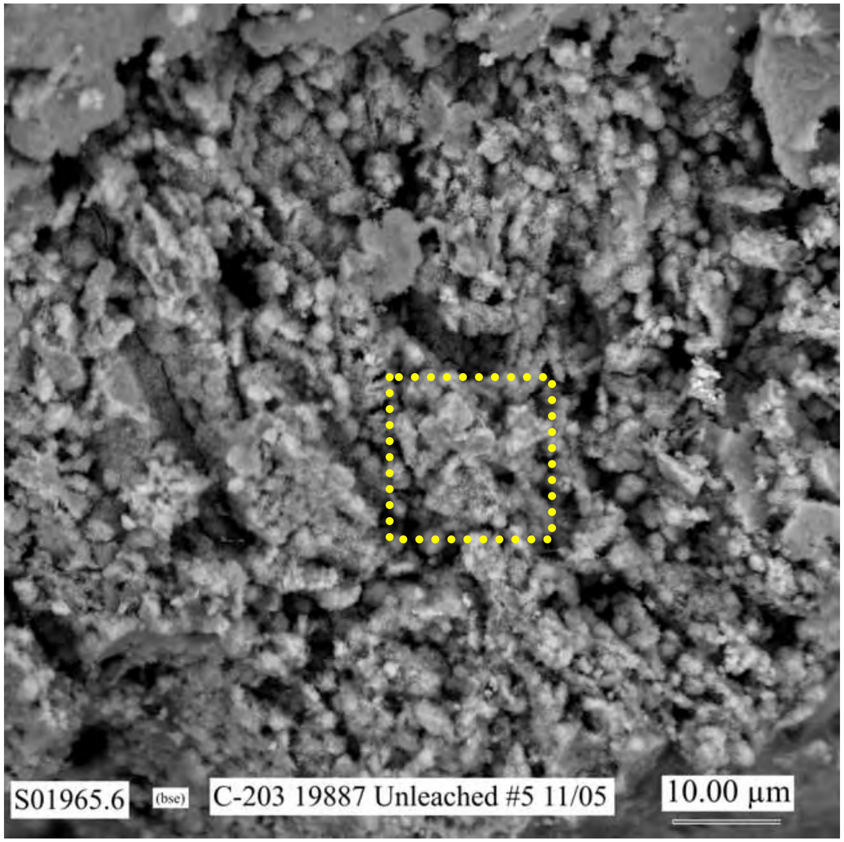


Figure E.44. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure E.41

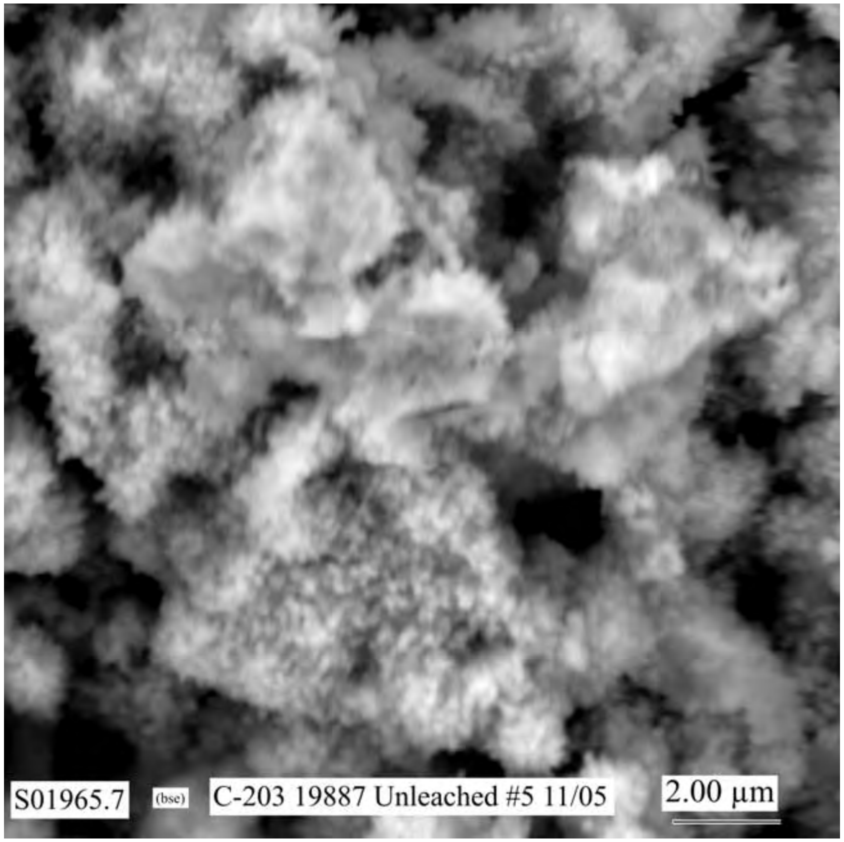


Figure E.45. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.44

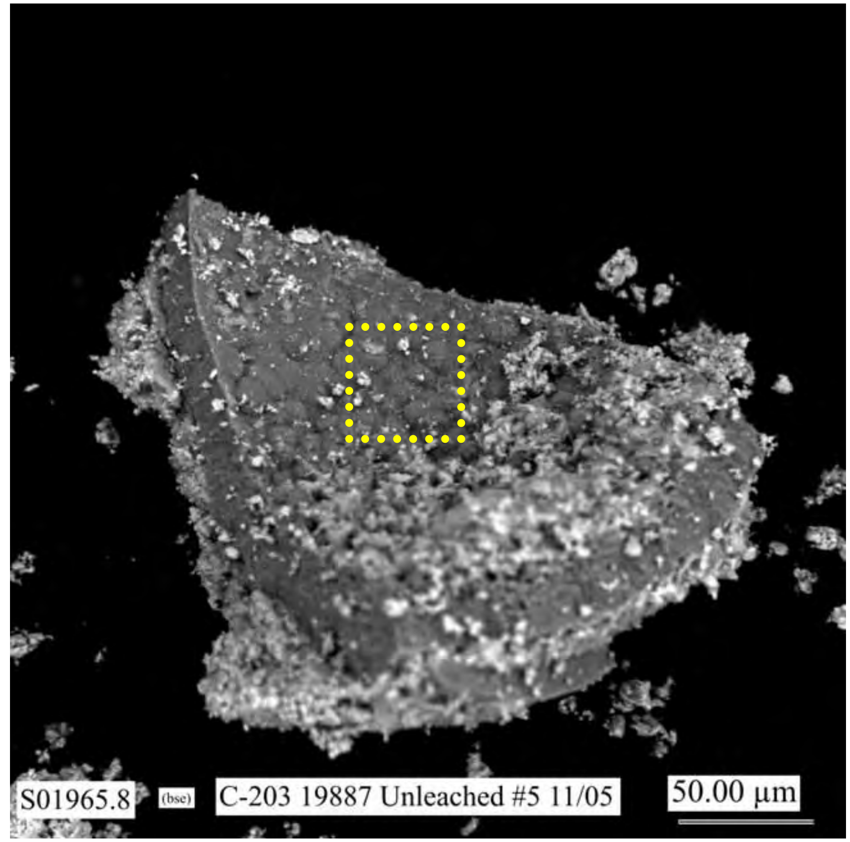


Figure E.46. Micrograph Showing Typical Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887) (Areas where EDS analyses were made are shown in Figure E.56.)

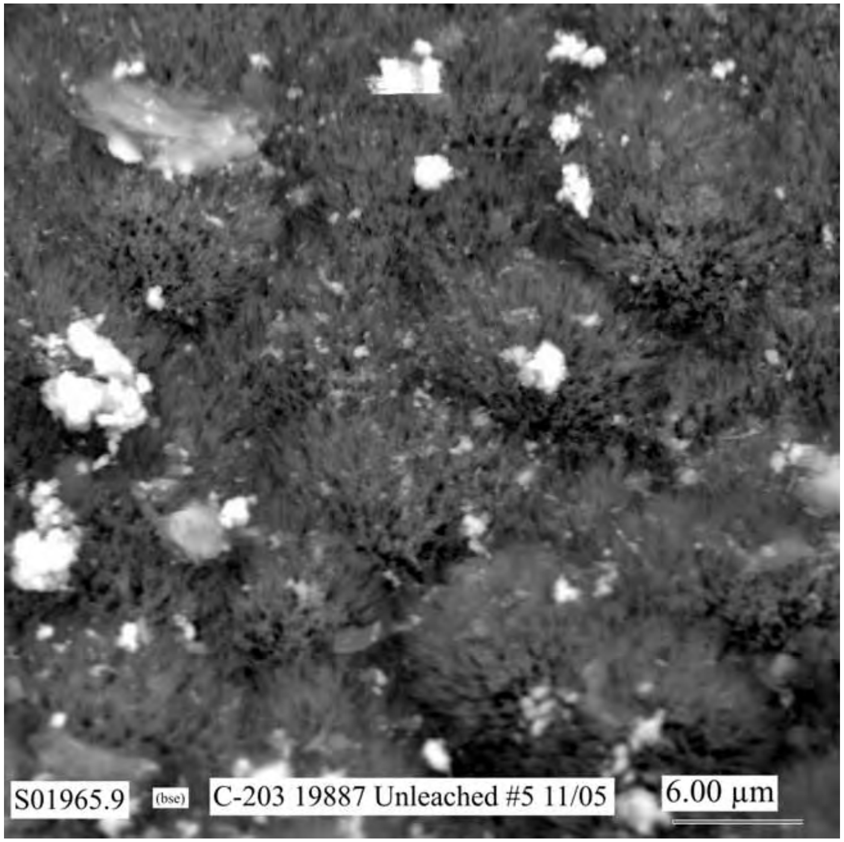


Figure E.47. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.46

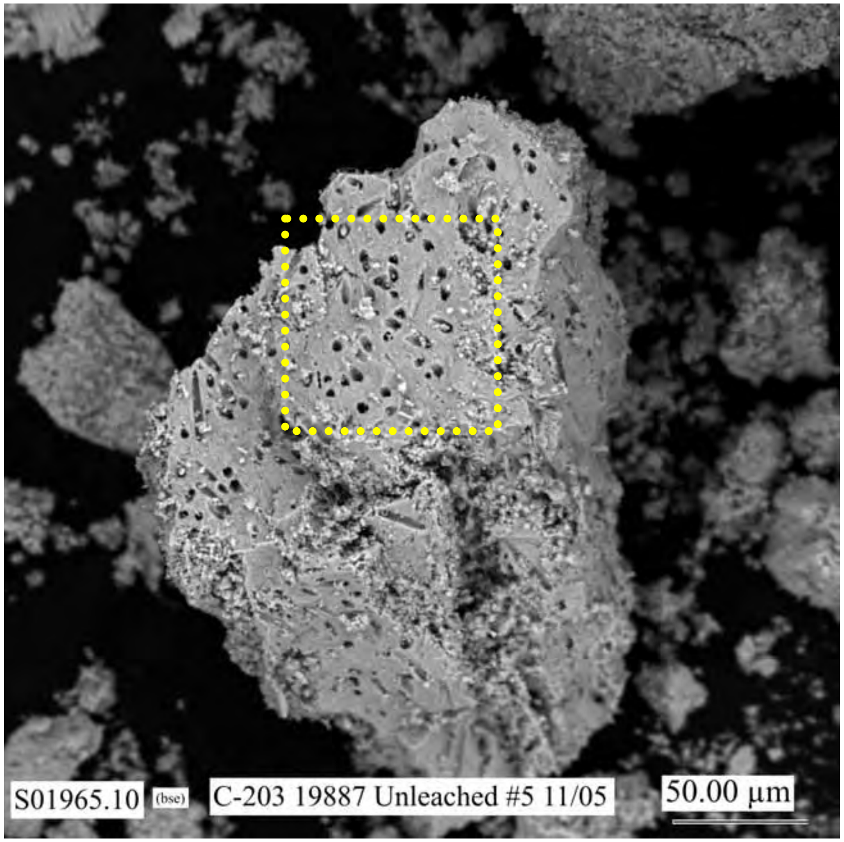


Figure E.48. Micrograph Showing Typical Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

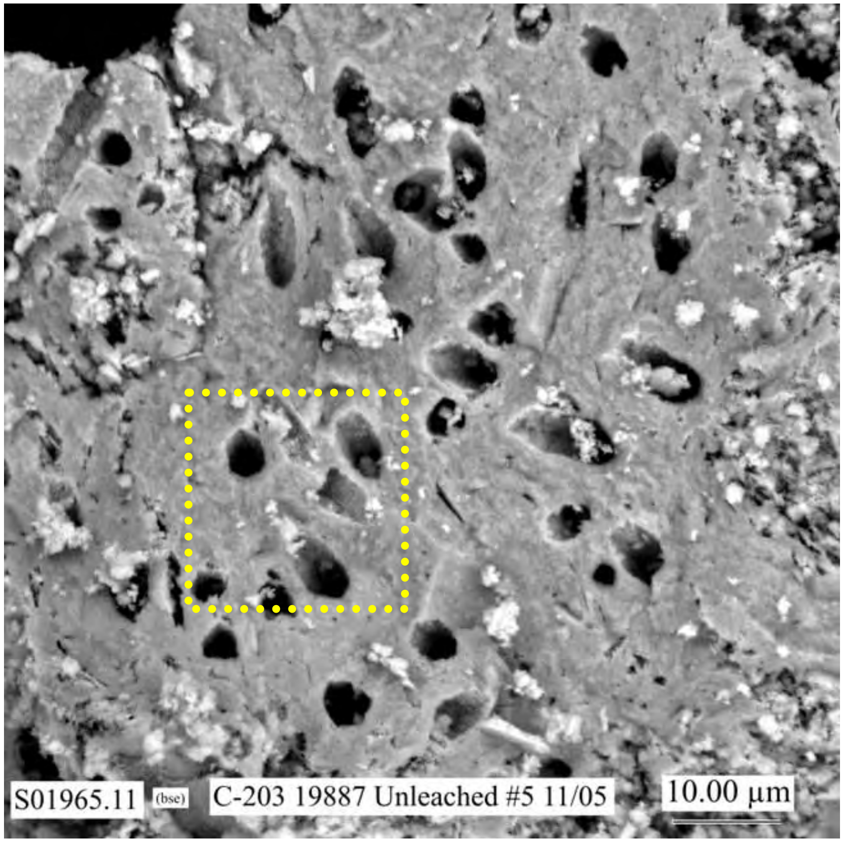


Figure E.49. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.48

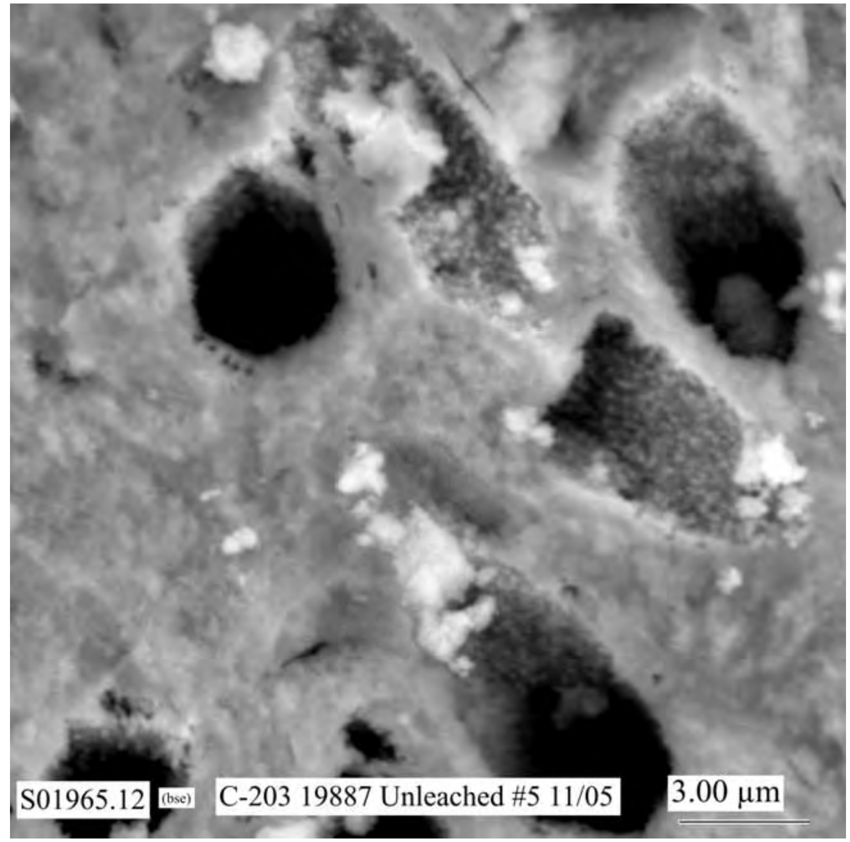


Figure E.50. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.49

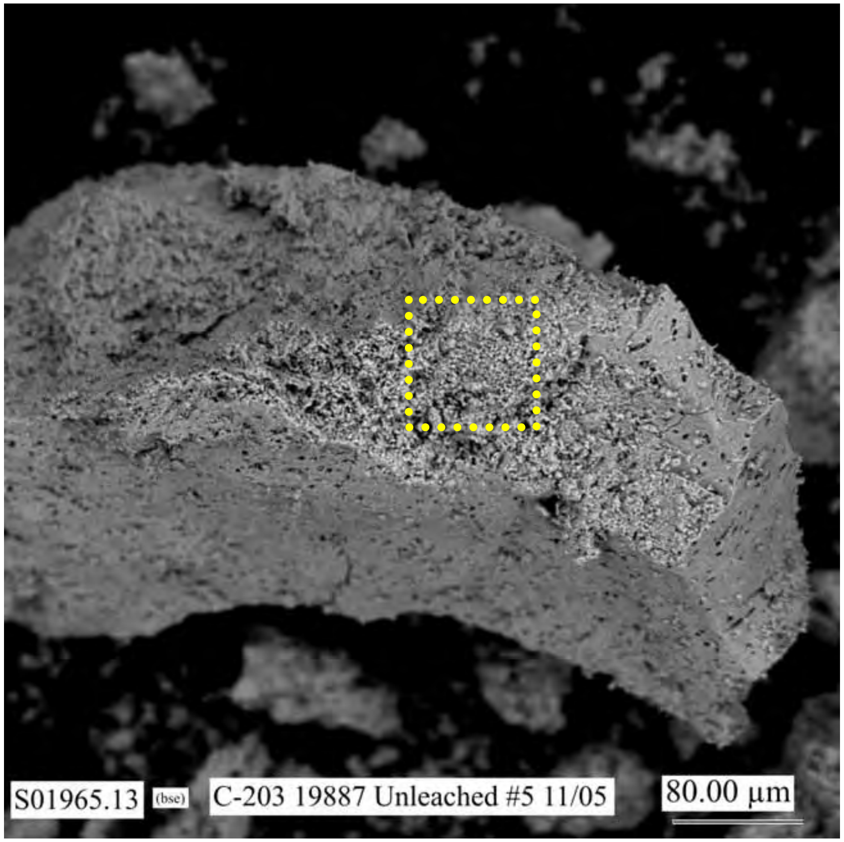


Figure E.51. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure E.39

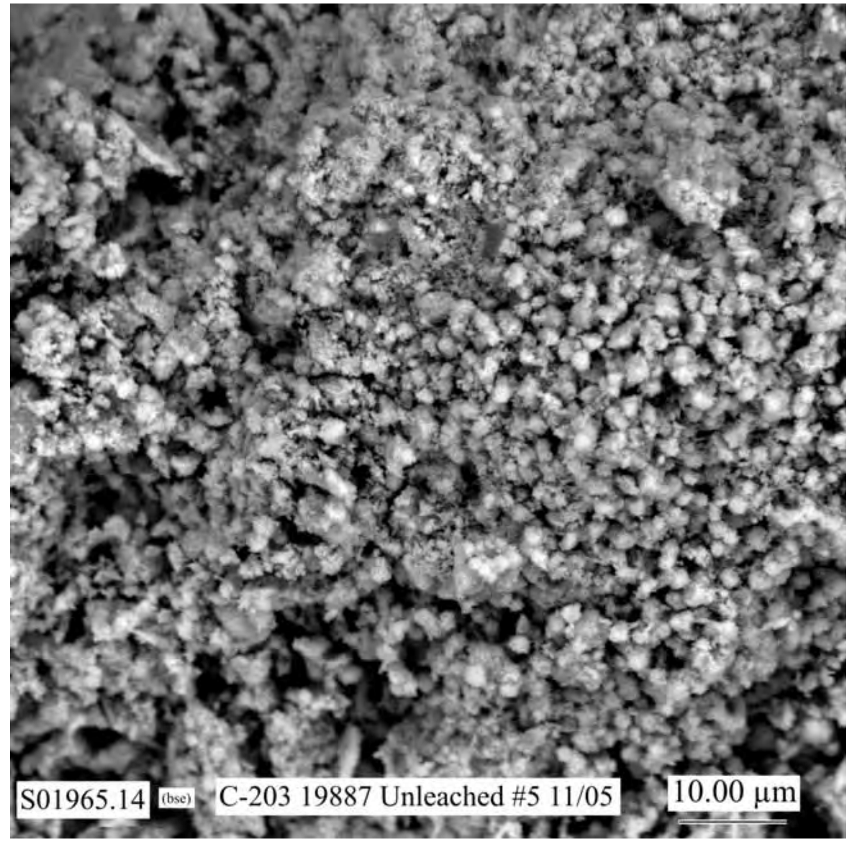


Figure E.52. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.51

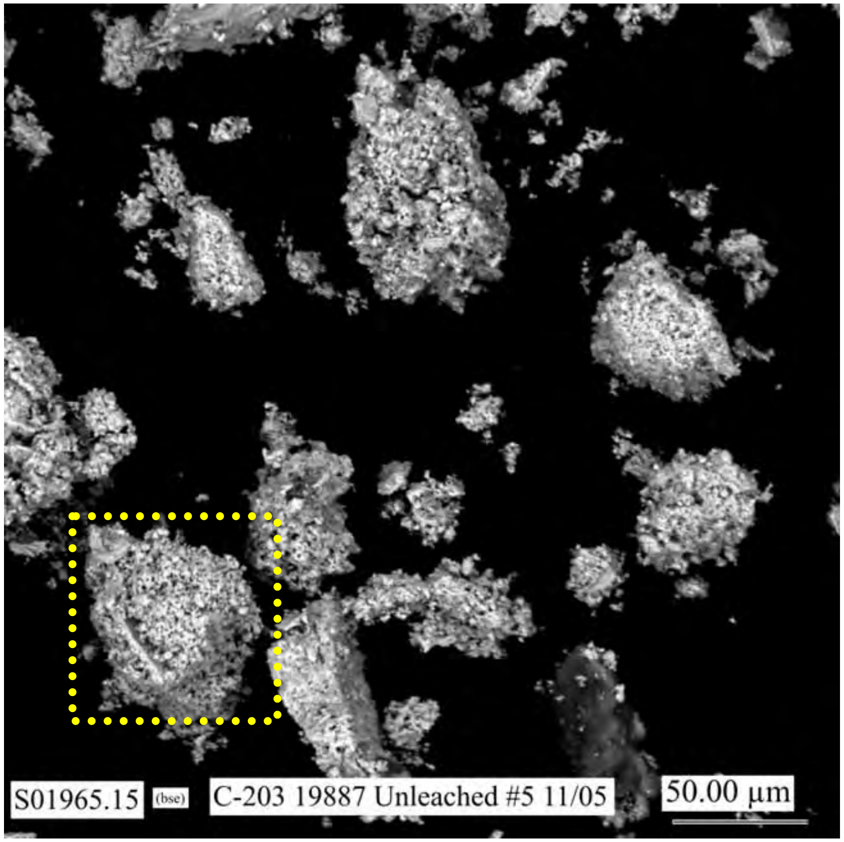


Figure E.53. Micrograph Showing Typical Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887) (Areas where EDS analyses were made are shown in Figures E.57 and E.58.)

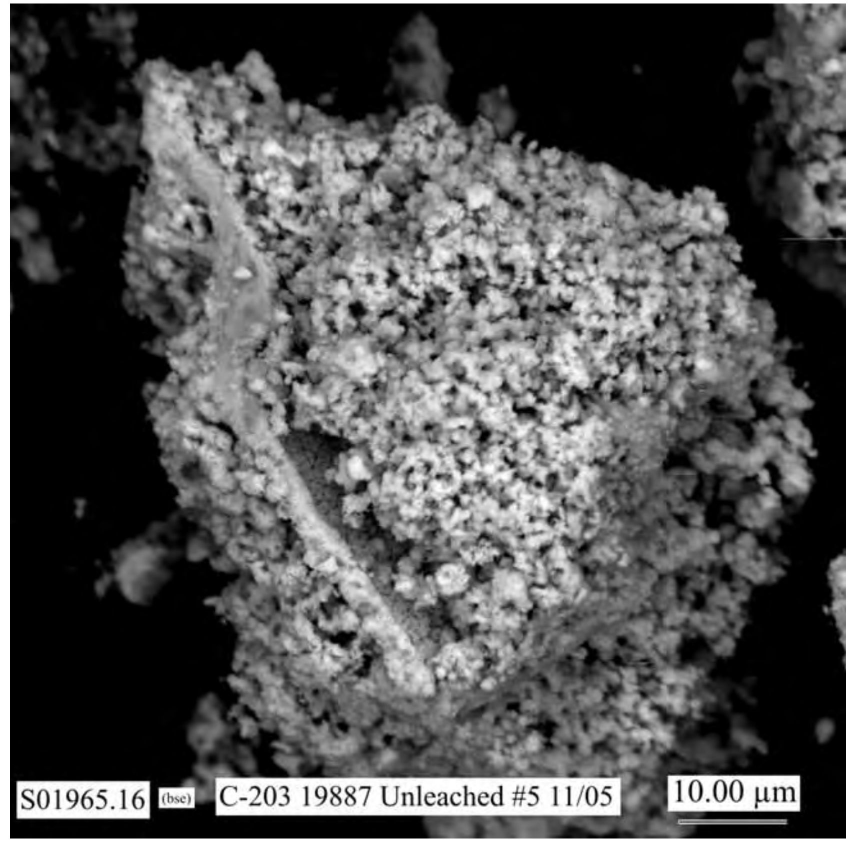


Figure E.54. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure E.53

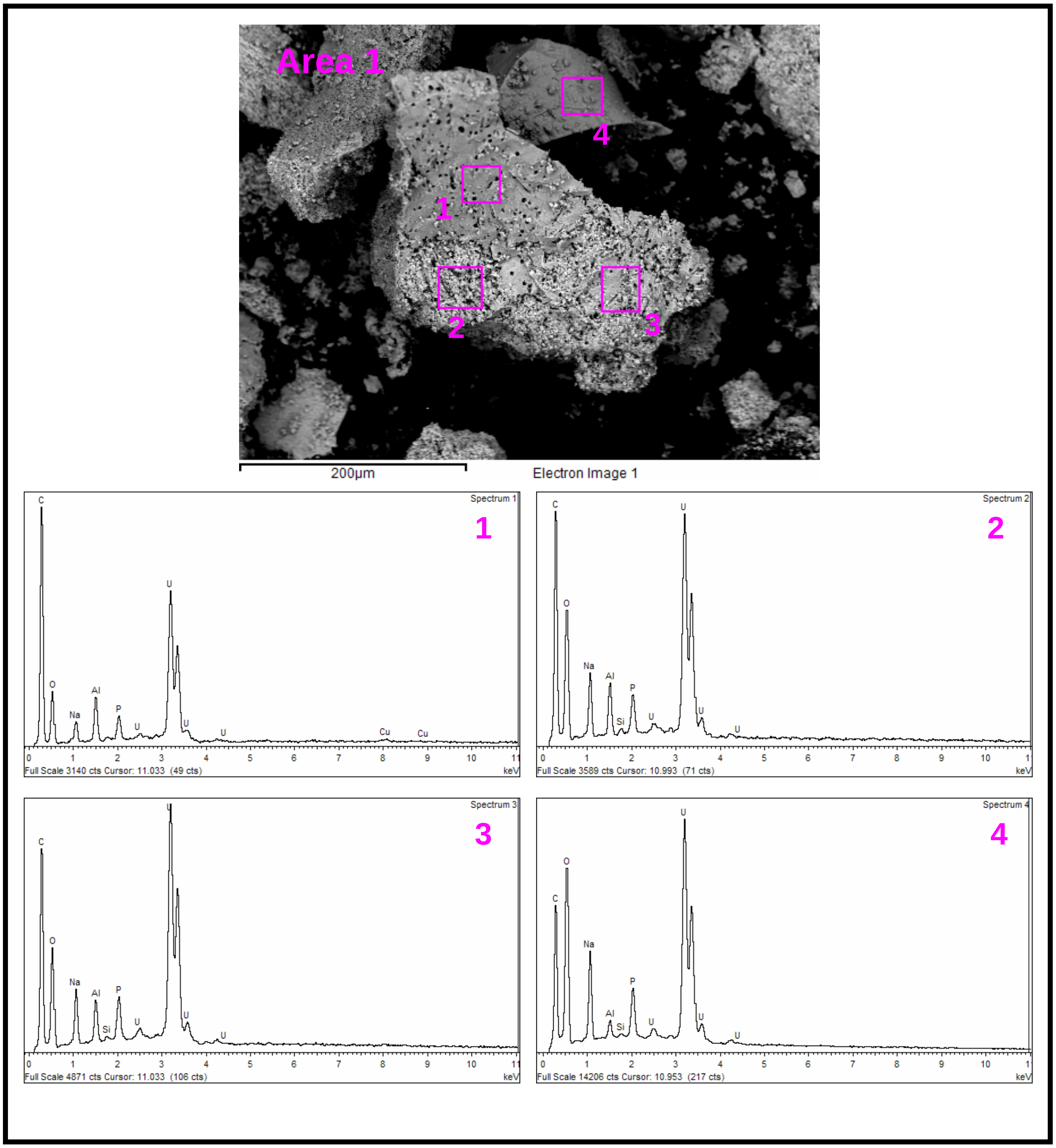


Figure E.55. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

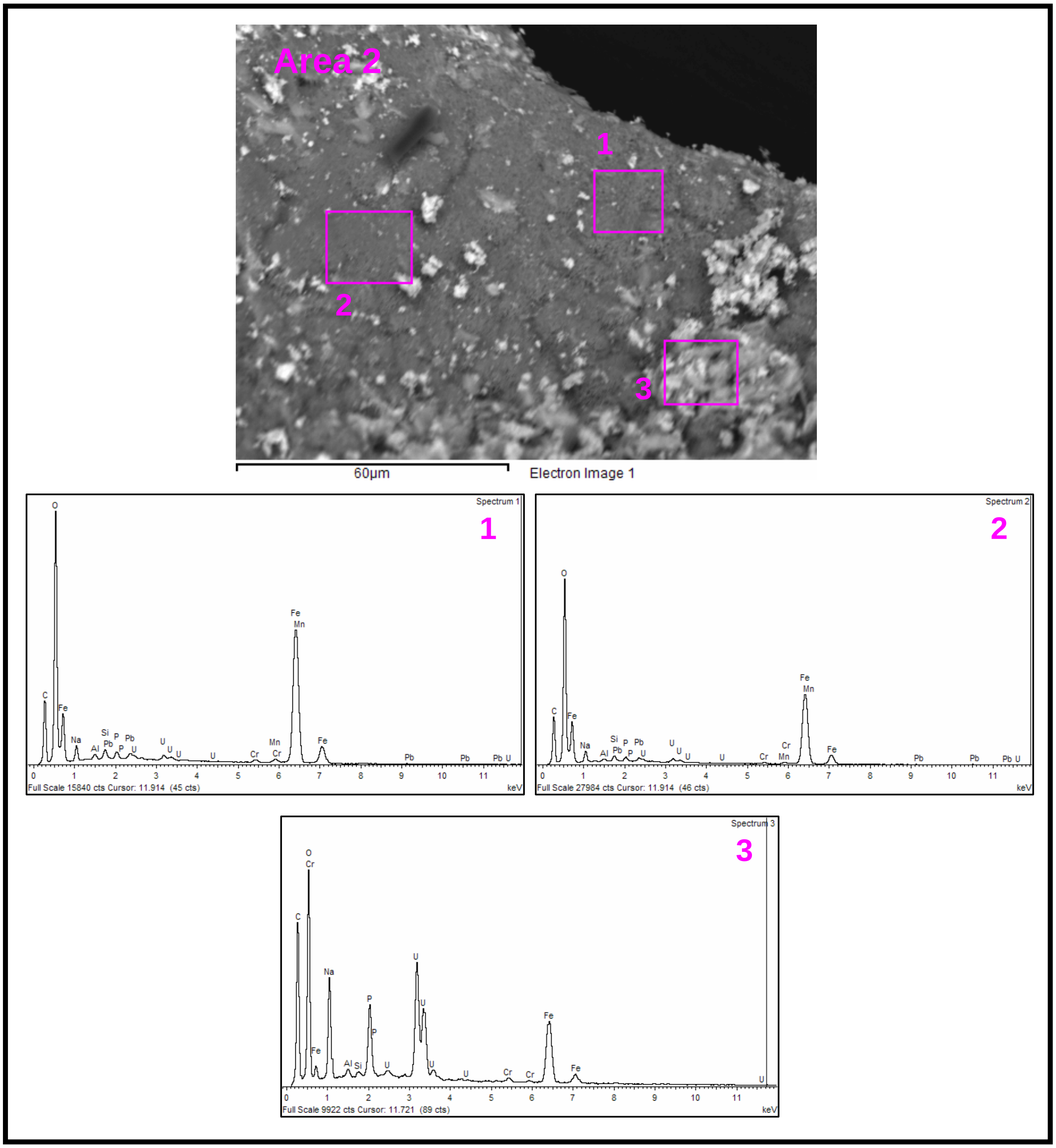


Figure E.56. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

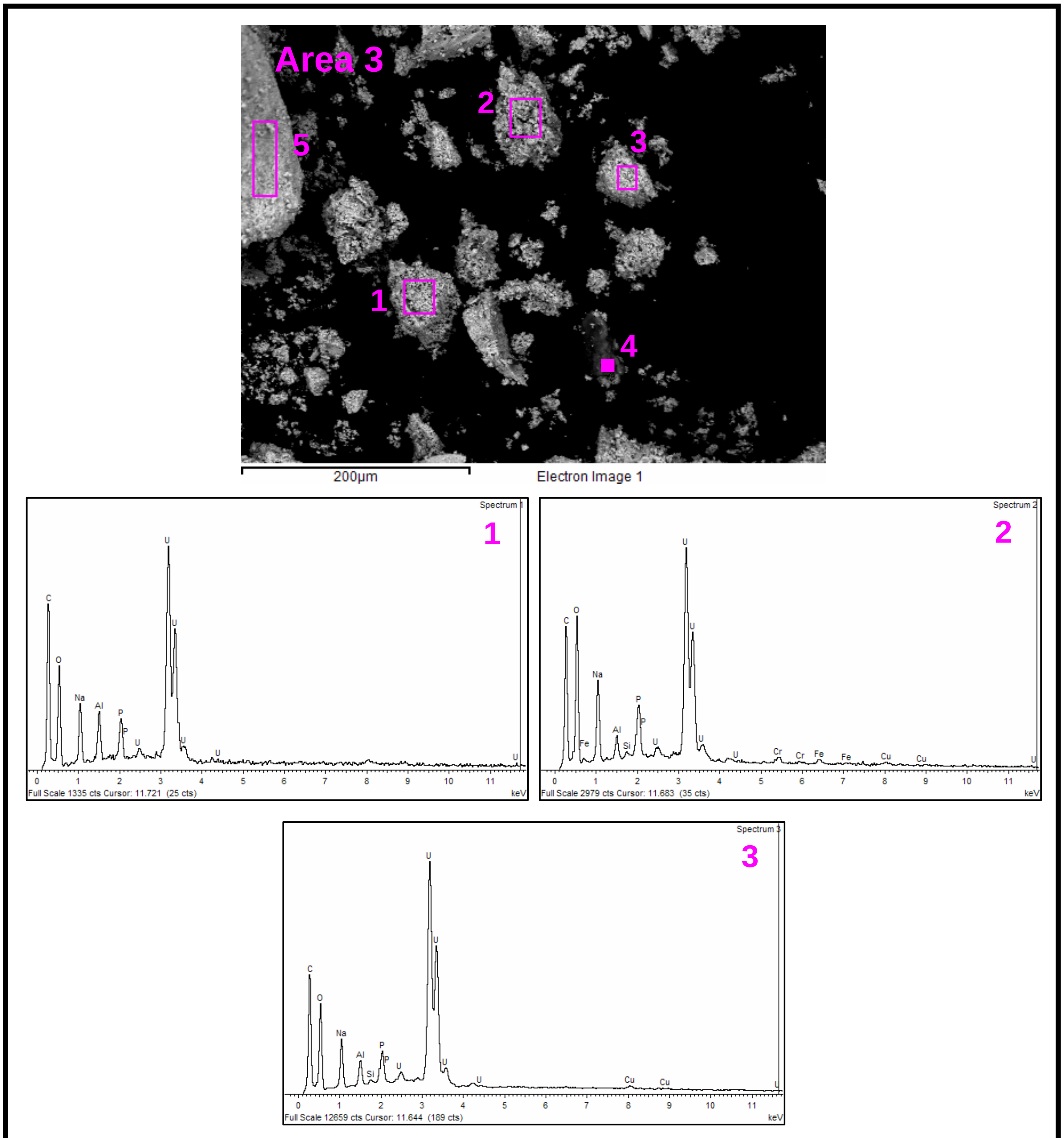


Figure E.57. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

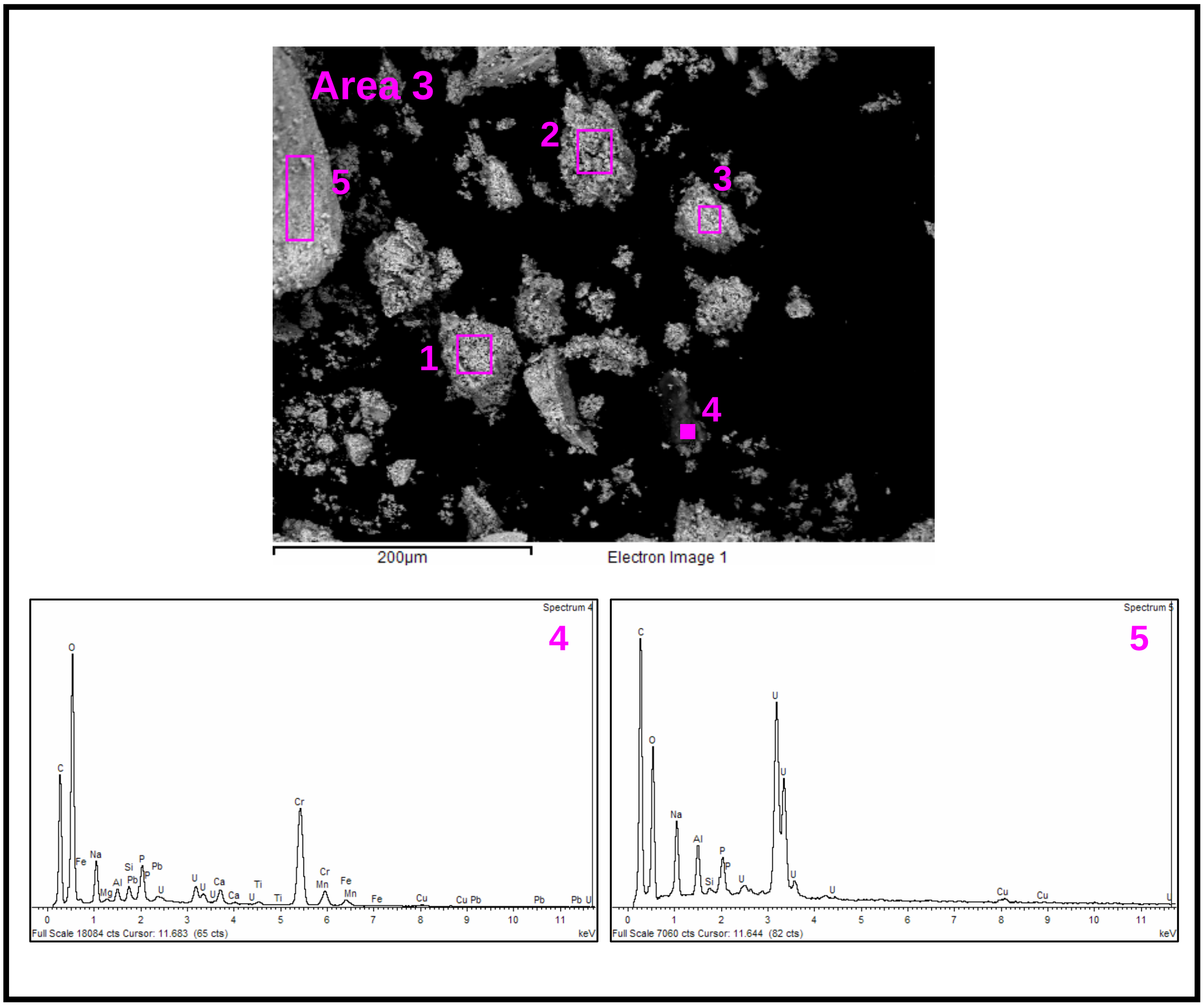


Figure E.58. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount #5 of Unleached Residual Waste from Tank C-203 (Sample 19887)

Table E.5. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount #5

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
E.55 / 1	1	2.8	1.7						21	*71*	0.9	1.9	0.2			
	2	3.2	3.9						34	*56*	1.2	1.8			0.2	
	3	4.1	3.8						31	*57*	1.5	1.7			0.2	
	4	3.8	6.4						46	*41*	1.7	0.7			0.1	
E.56 / 2	1	0.1	1.8	9.9	0.2	0.1			53	*34*	0.3	0.2			0.4	Pb – 0.9
	2	0.1	1.7	7.5	0.1	0.1			55	*34*	0.2	0.2			0.3	Pb – 0.1
	3	1.5	5.9	3.1		0.2			41	*46*	1.9	0.2			0.1	
E.57 & E.58 / 3	1	4.1	4.9						34	*54*	1.7	2.2				
	2	3.7	6.1	0.3		0.3			42	*45*	2.0	0.9	0.3		0.2	
	3	5.5	5.3						37	*49*	1.7	1.5	0.4		0.2	
	4	0.2	2.8	0.3	0.1	4.1		0.4	47	*43*	1.0	0.4	0.1	0.1	0.4	Pb – 0.1, Ti – 0.1
	5	2.4	3.9						35	*56*	0.9	1.4	0.3		0.1	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix F

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-203 (Sample 19887)

Appendix F

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-203 (Sample 19887)

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for samples of leached water extraction residual waste from tank C-203 (sample 19887). These include the following types of samples:

- One month single-contact leached water extraction solids
- Sequential leached water extraction solids

The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by "BSE" to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample. The figure and table numbers for the SEM micrographs and EDS analyses for the leached water extraction solids of C-203 residual waste (sample 19887) analyzed by SEM/EDS are listed in Table F.1.

Table F.1. Figures and Tables Containing the SEM Micrographs and EDS Analyses for the Leached Water Extraction Solids of C-203 Residual Waste Analyzed by SEM/EDS

Type of Residual Waste Sample	Figures with SEM Micrographs	Figures with EDS Spectra	Tables with EDS Atomic%
One month single-contact leached water extraction solids	F.1 – F.11	F.12 – F.17	F.2
Sequential leached water extraction solids	F.18 – F.33	F.34 – F.45	F.3, F.4, and F.5

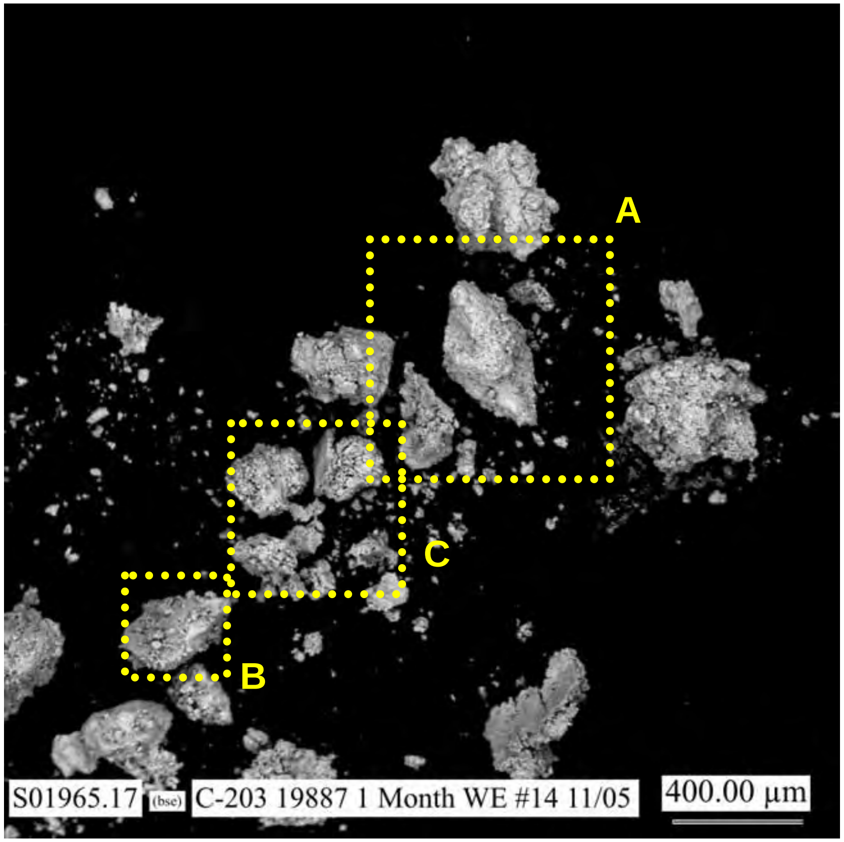


Figure F.1. Low Magnification Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact Water Extraction Solid from C-203 Residual Waste (Sample 19887)

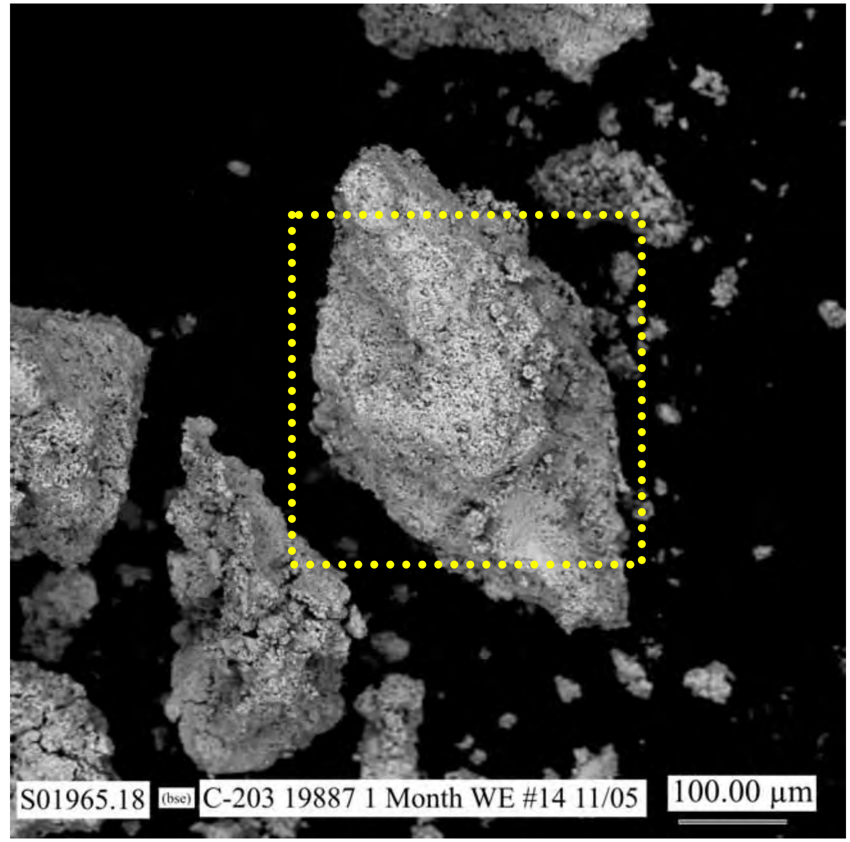


Figure F.2. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure F.1

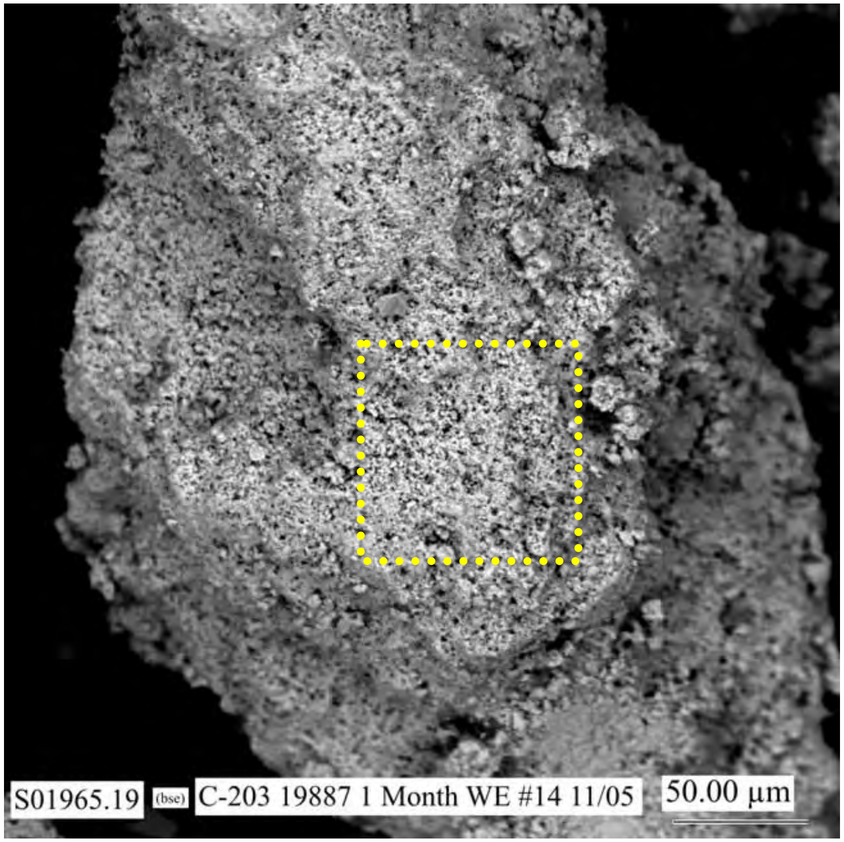


Figure F.3. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure F.2

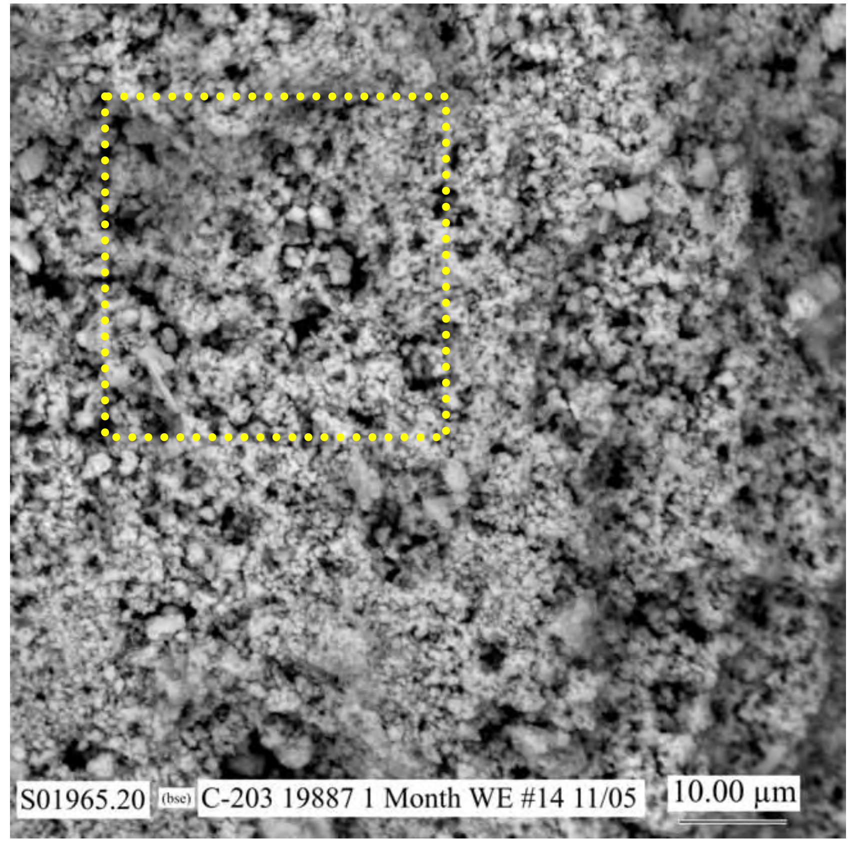


Figure F.4. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure F.3

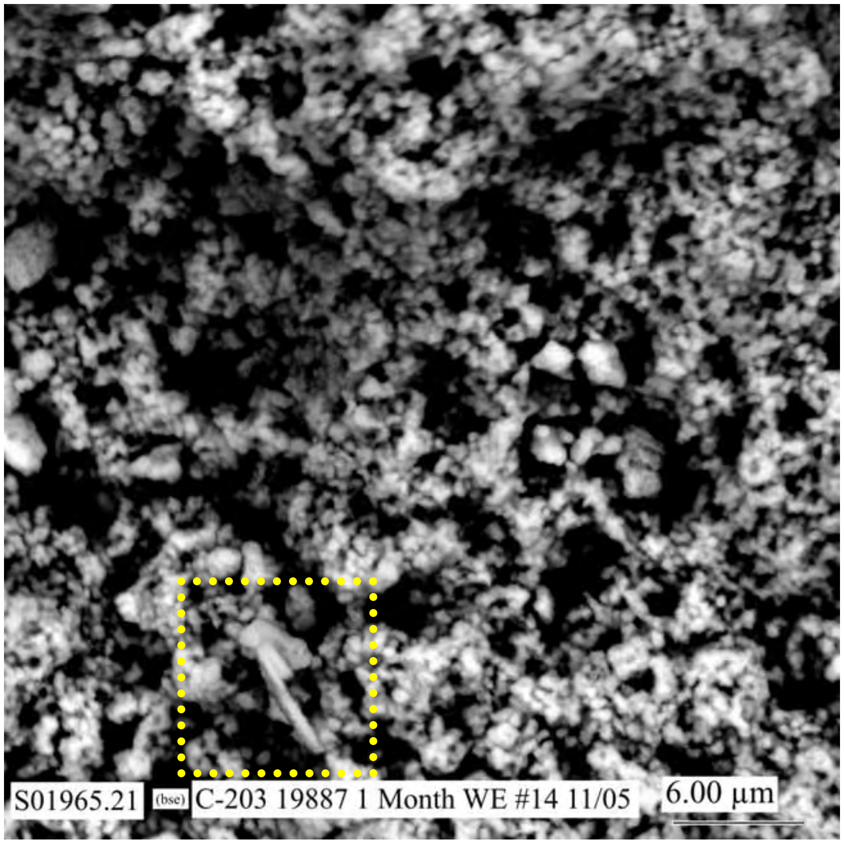


Figure F.5. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure F.4

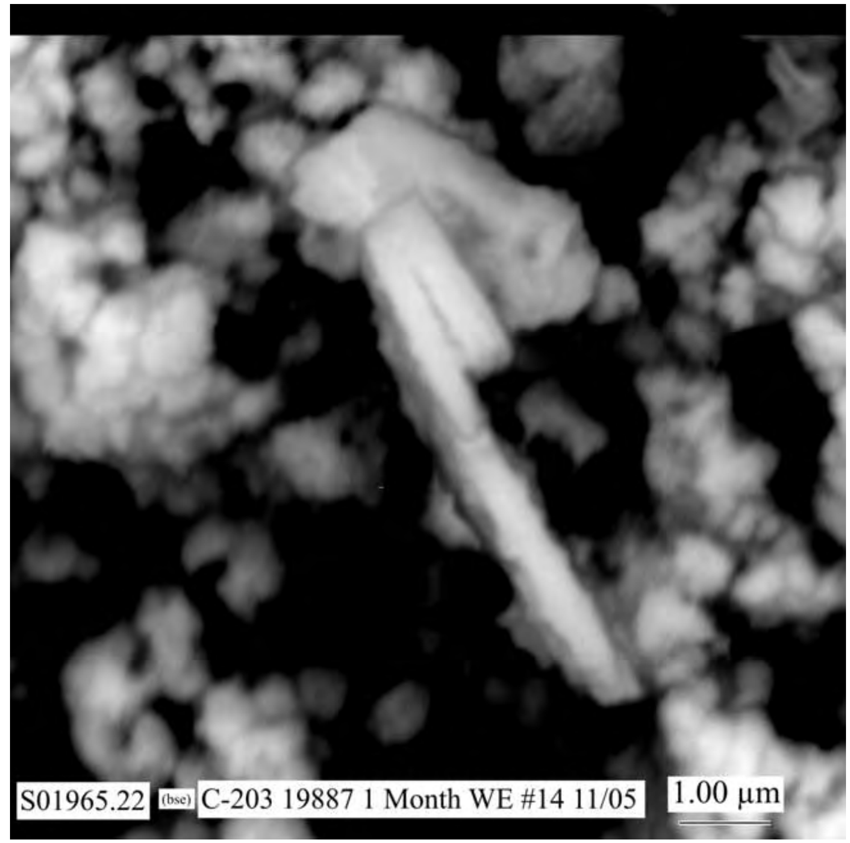


Figure F.6. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure F.5 (Areas where EDS analyses were made are shown in Figure F.12.)

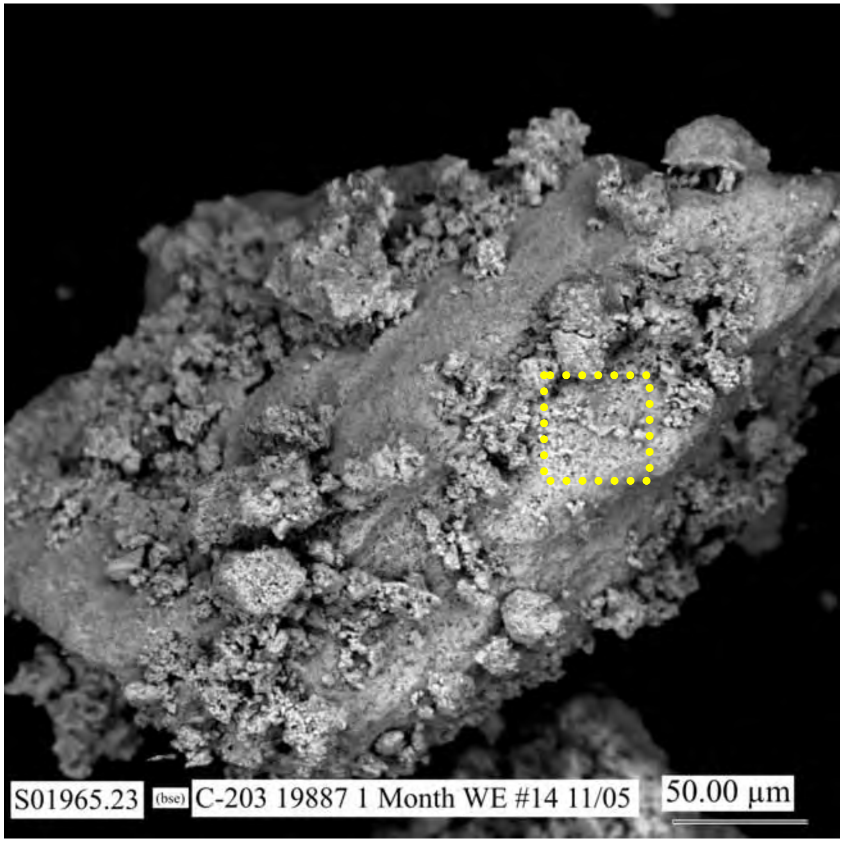


Figure F.7. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled B in Figure F.1

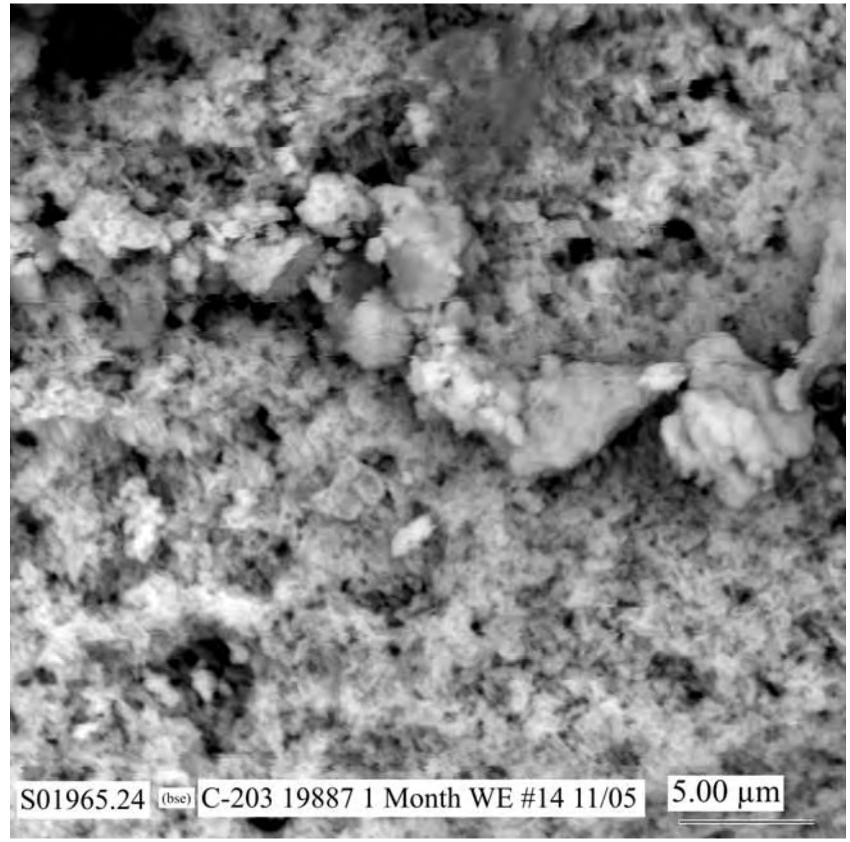
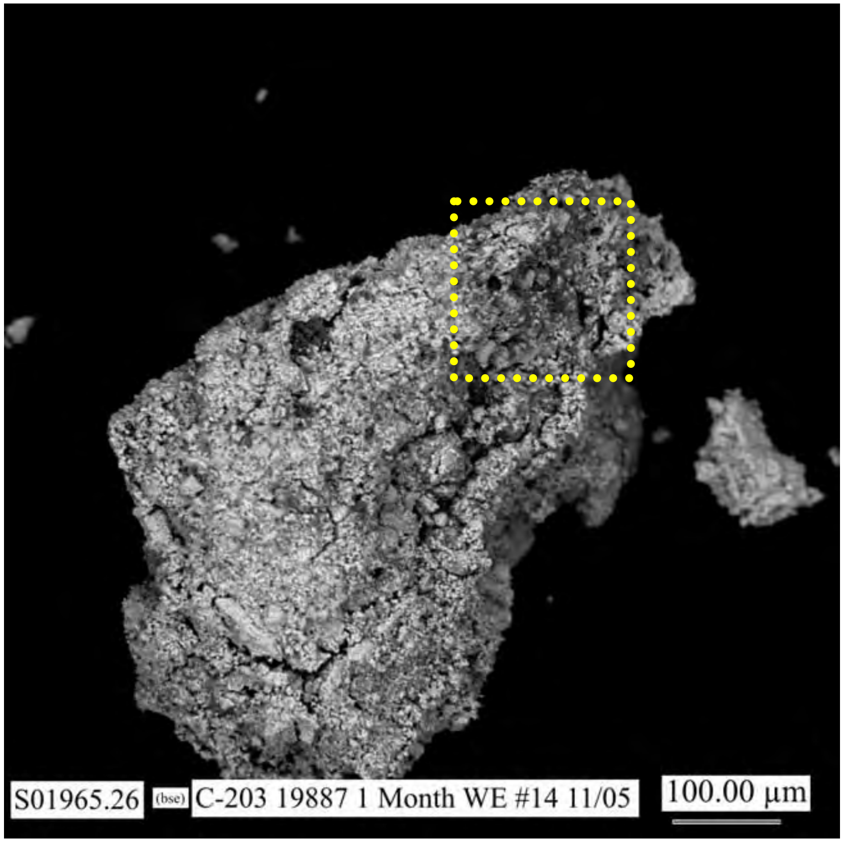


Figure F.8. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure F.7 (Areas where EDS analyses were made are shown in Figure F.13.)



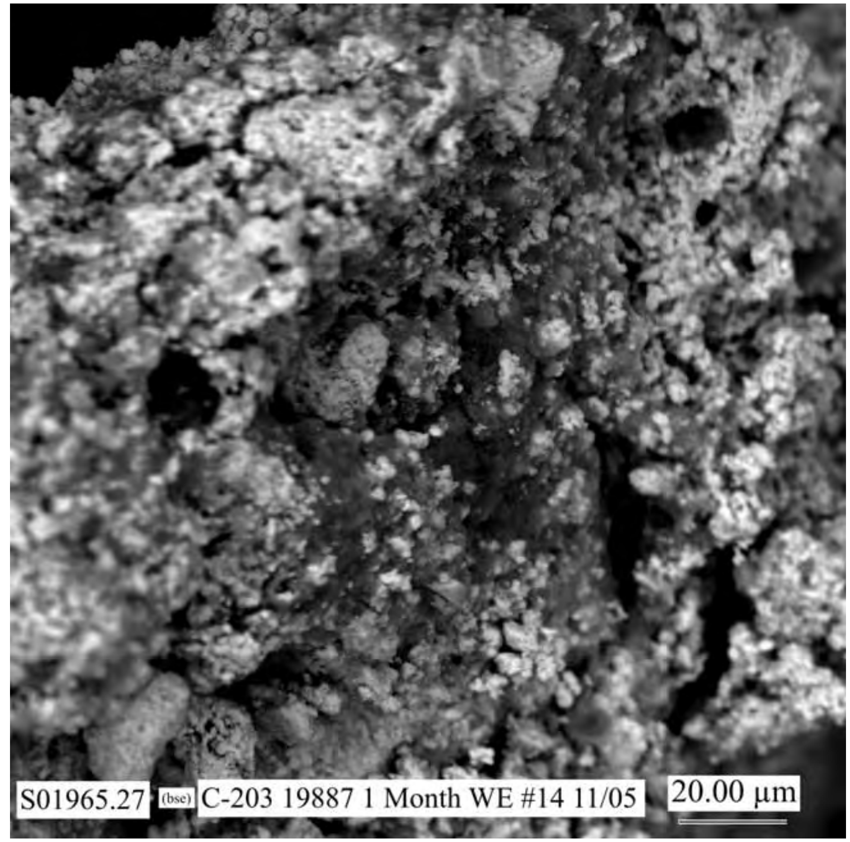


Figure F.9. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact Water Extraction Solid from C-203 Residual Waste (Sample 19888)

Figure F.10. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure F.9 (Areas where EDS analyses were made are shown in Figure F.15.)

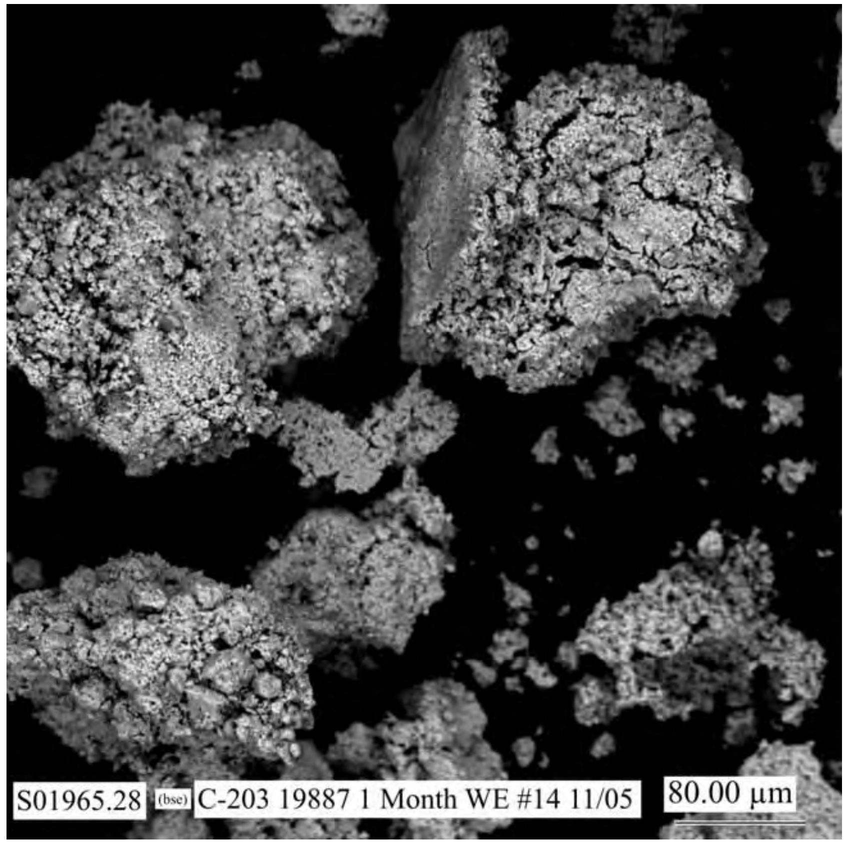


Figure F.11. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure F.1 (Areas where EDS analyses were made are shown in Figures F.16 and F.17.)

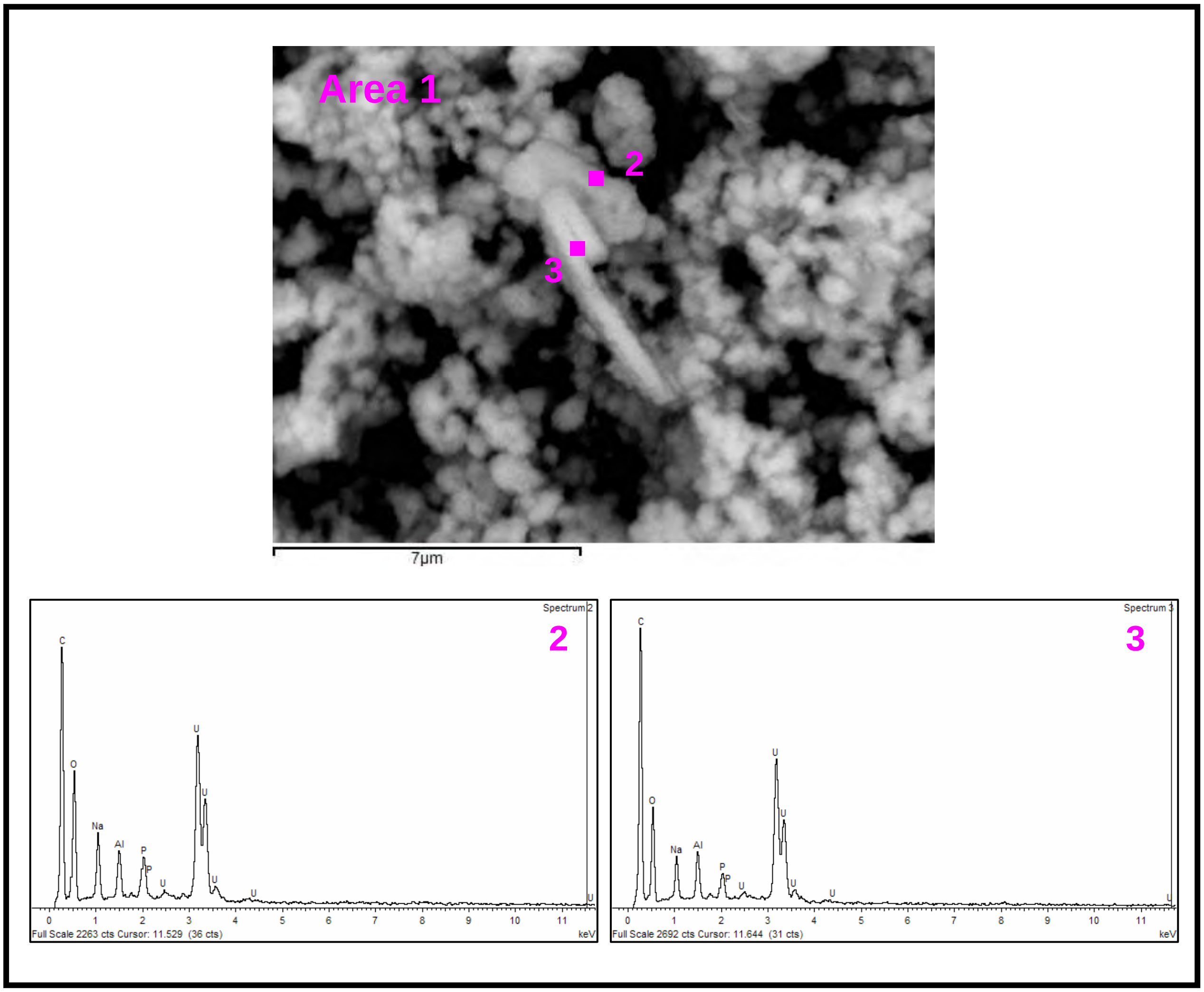


Figure F.12. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

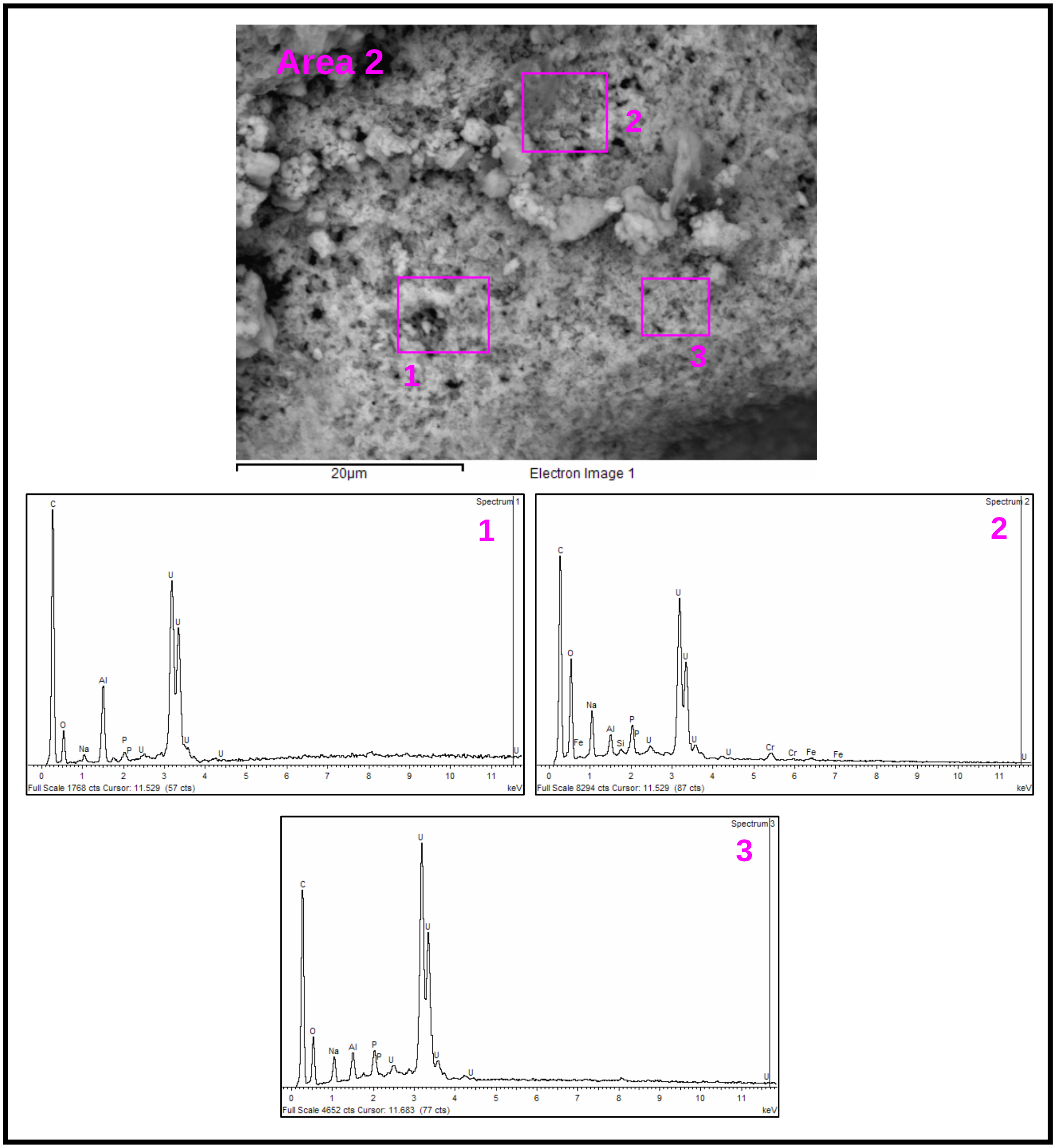


Figure F.13. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

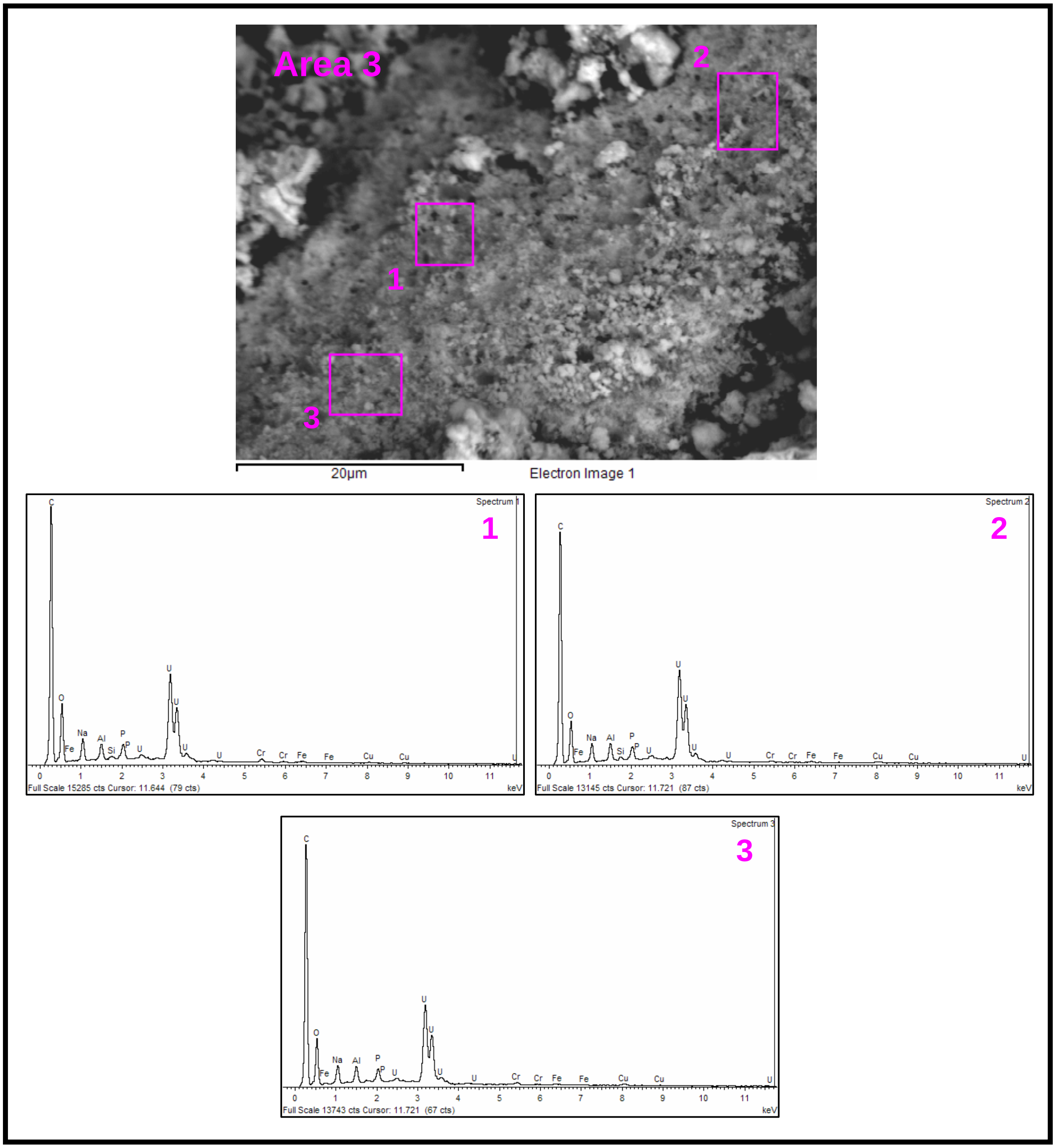


Figure F.14. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

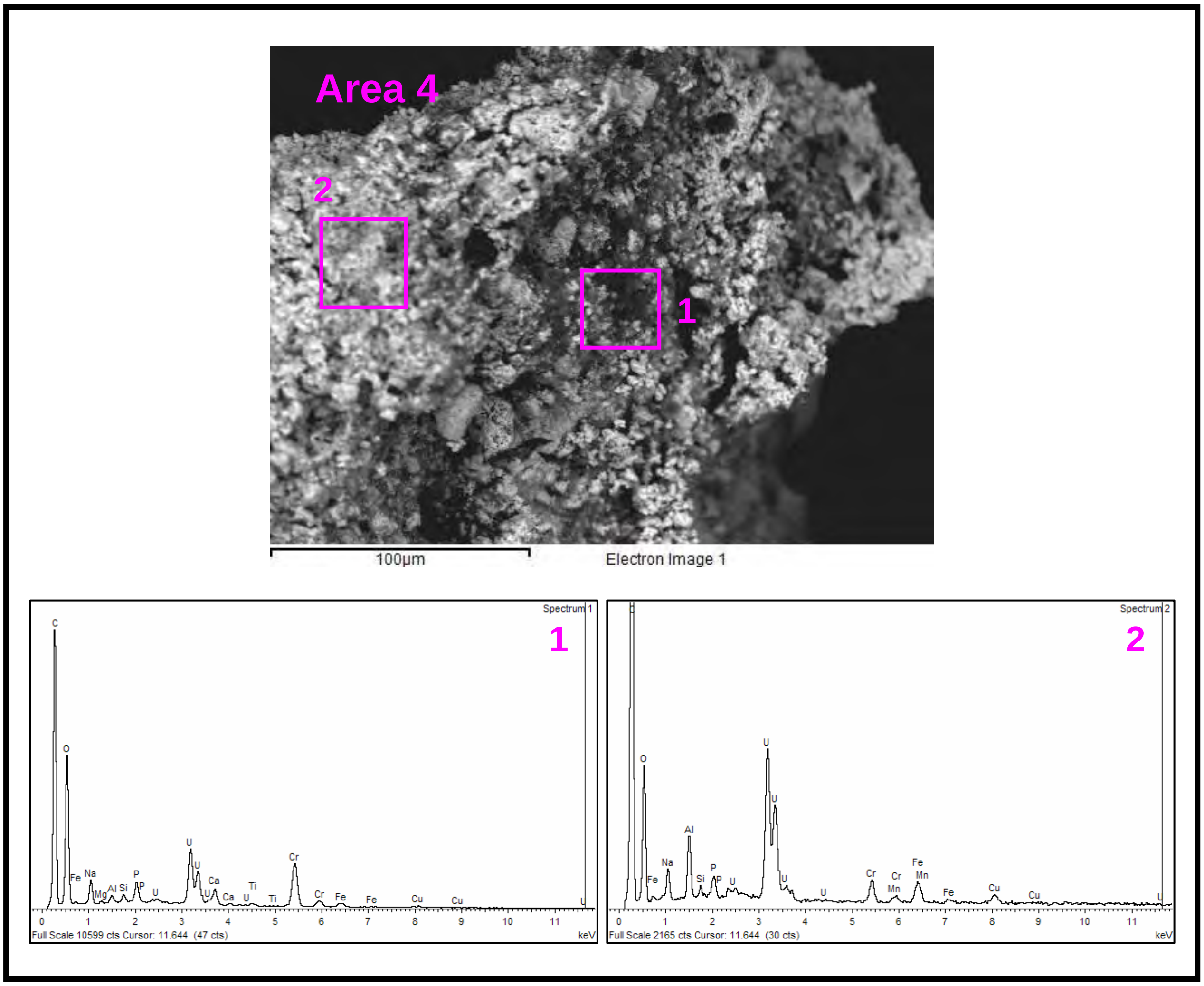


Figure F.15. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

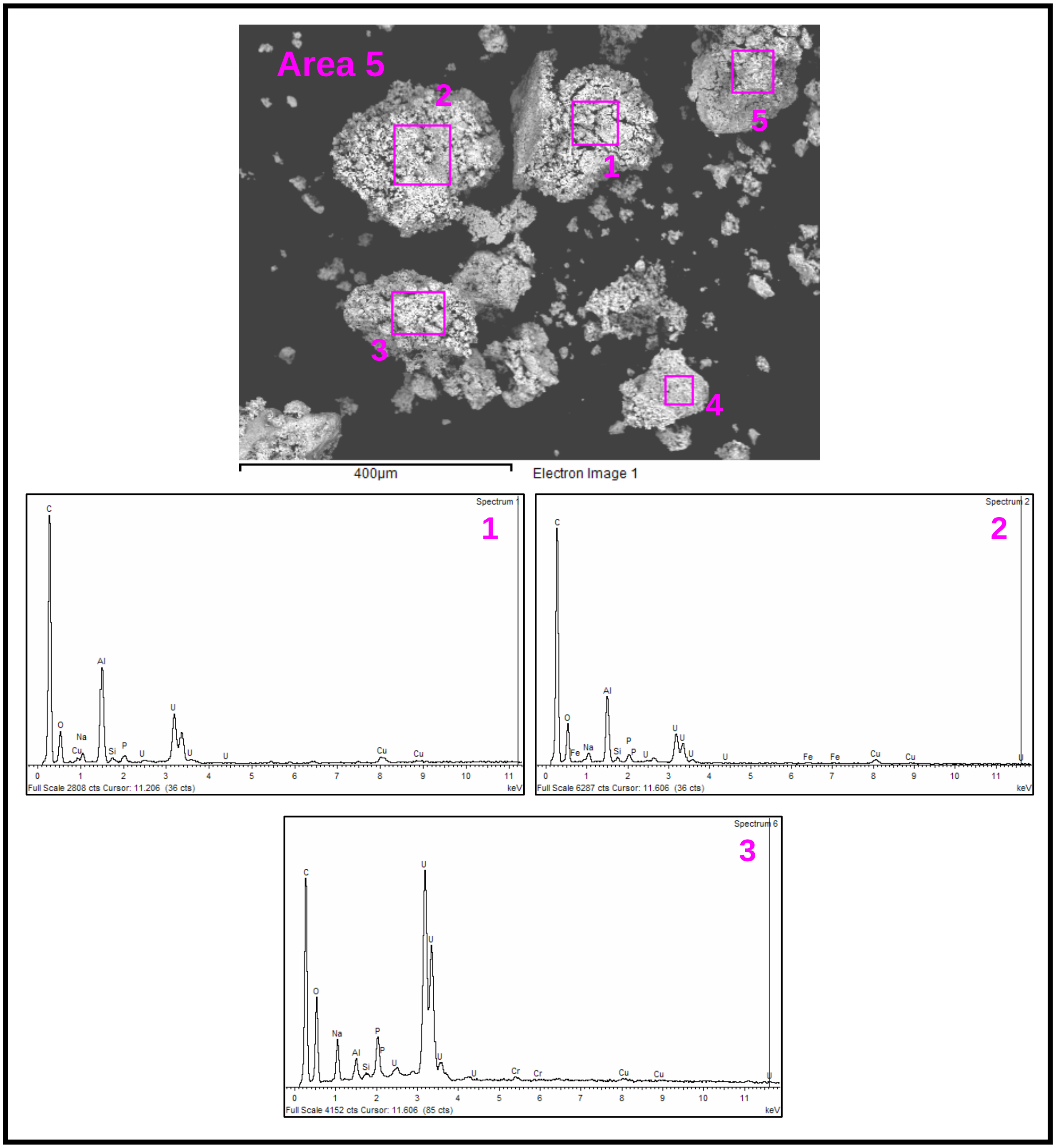


Figure F.16. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

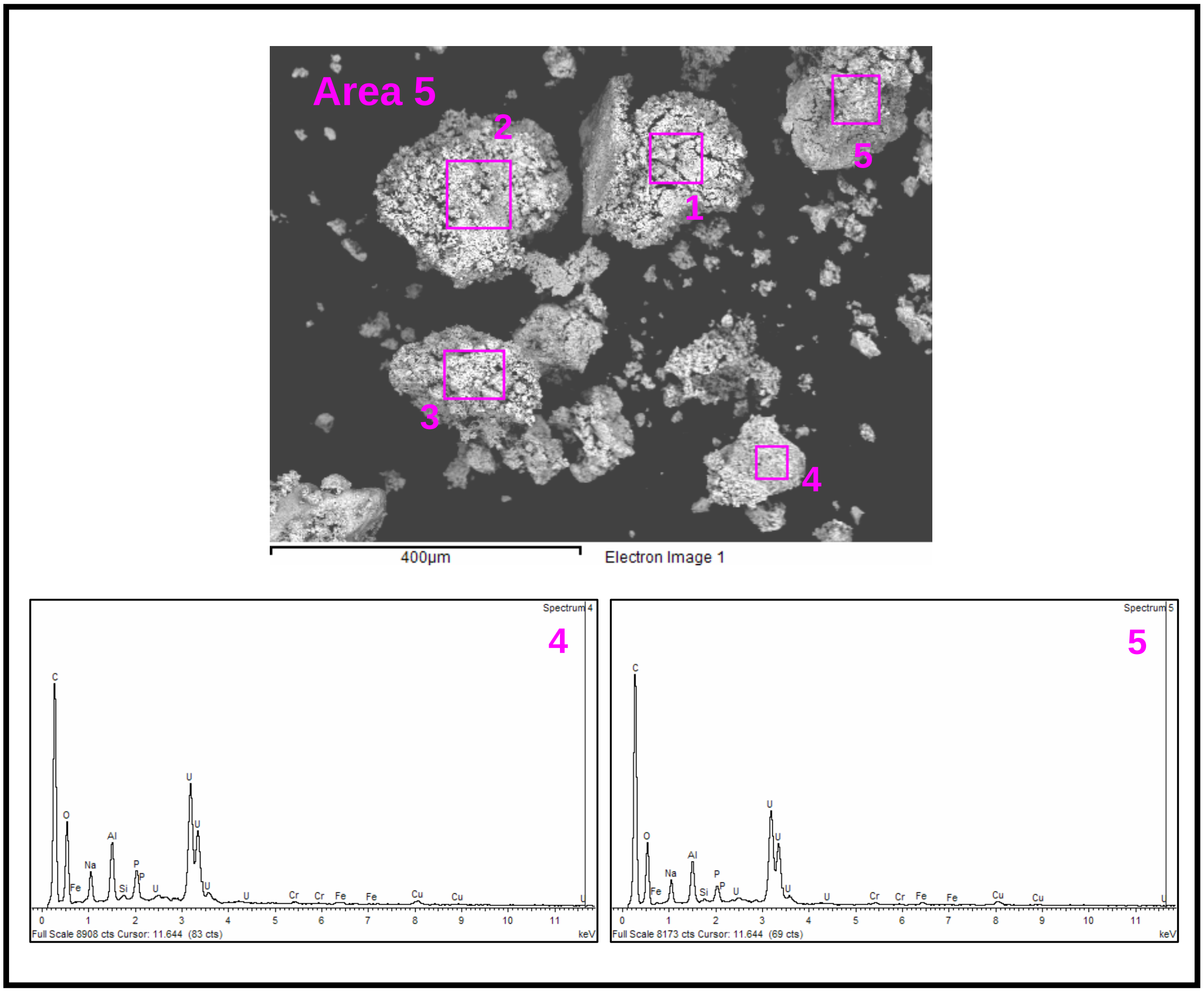


Figure F.17. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

Table F.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact Water Extraction Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
F.12 / 1	1	2.2	3.4						32	*60*	1.2	1.2				
	2	2.3	3.4						33	*59*	1.1	1.4				
	3	2.2	2.5						28	*65*	0.8	1.6				
F.13 / 2	1	3.8	0.6						15	*77*	0.4	3.6				
	2	2.8	3.4	0.2		0.4			33	*59*	1.1	0.8			0.2	
	3	5.3	2.6						22	*67*	1.3	1.5				
F.14 / 3	1	1.7	1.7	0.1		0.2			24	*71*	0.6	0.6	0.1		0.1	
	2	2.1	1.6	0.1		0.1			21	*74*	0.6	0.8	0.1		0.1	
	3	1.7	1.6	0.1		0.1			22	*73*	0.6	0.7	0.2			
F.15 / 4	1	0.7	1.3	0.2		1.7		0.4	35	*59*	0.5	0.2	0.1	0.1	0.2	Ti – 0.1
	2	1.0	0.9	0.6	0.1	0.5			21	*74*	0.3	0.9	0.4		0.1	
F.16 & F.17 / 5	1	0.9	0.6						15	*79*	0.2	3.4	0.6		0.1	
	2	0.6	0.6	0.1					18	*77*	0.3	2.3	0.5		0.2	Cl – 0.1
	3	3.9	3.2			0.2			29	*61*	1.5	0.8	0.2		0.2	
	4	1.9	2.0	0.1		0.1			27	*66*	1.0	2.0	0.4		0.1	Cl – 0.1
	5	1.7	1.7	0.1		0.1			24	*69*	0.6	1.6	0.4		0.1	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

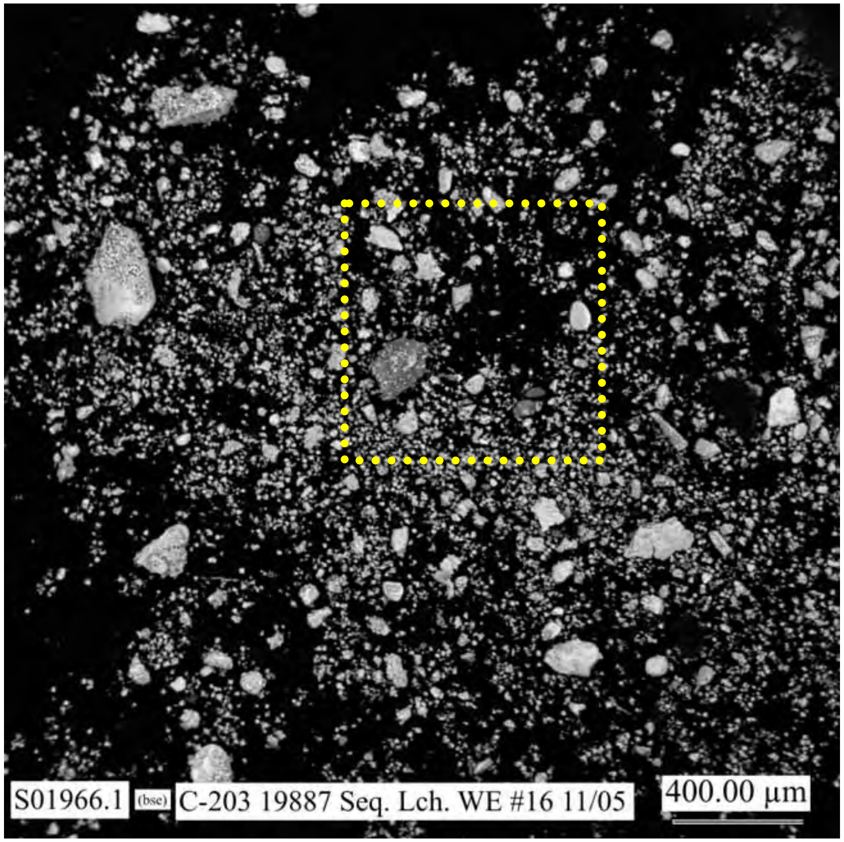


Figure F.18. Low Magnification Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887)

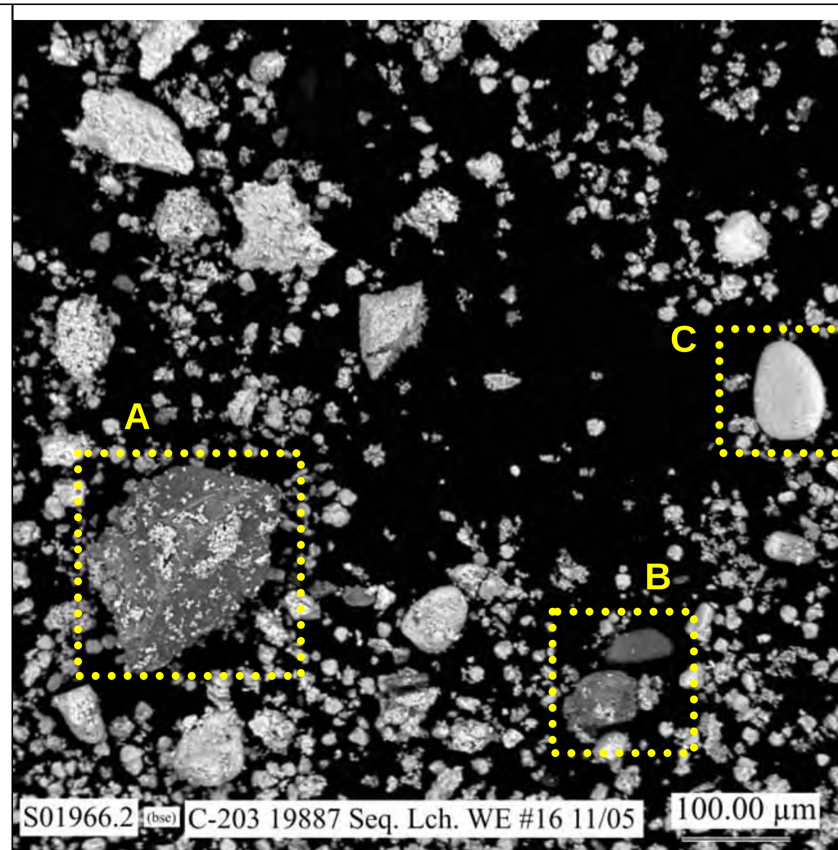


Figure F.19. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure F.18

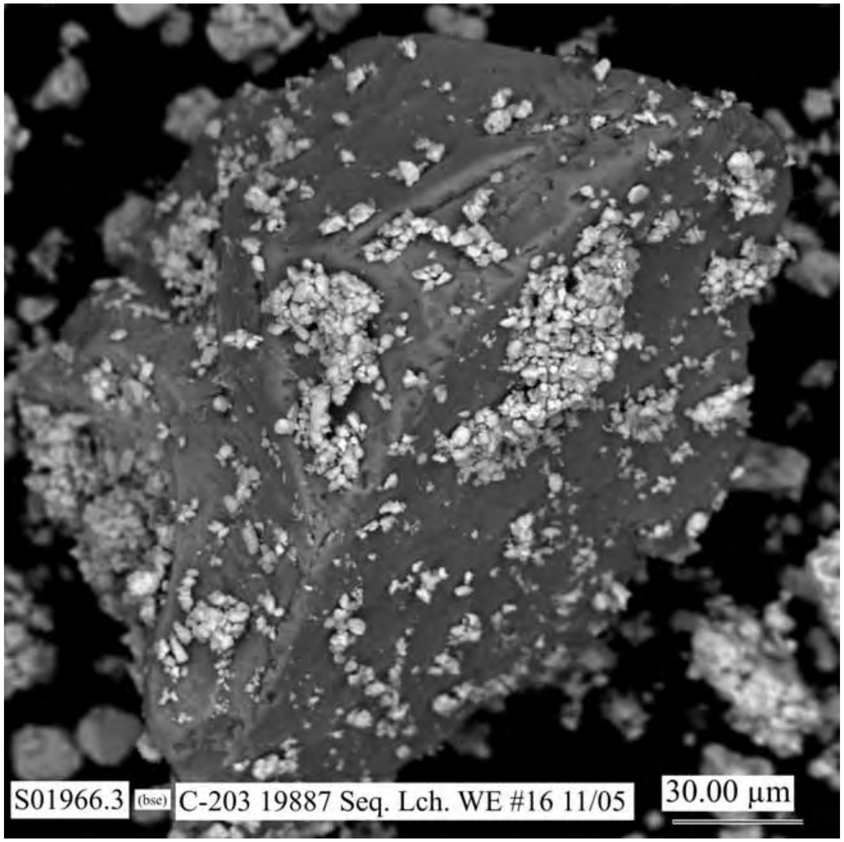


Figure F.20. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure F.19 (Areas where EDS analyses were made are shown in Figure F.34.)

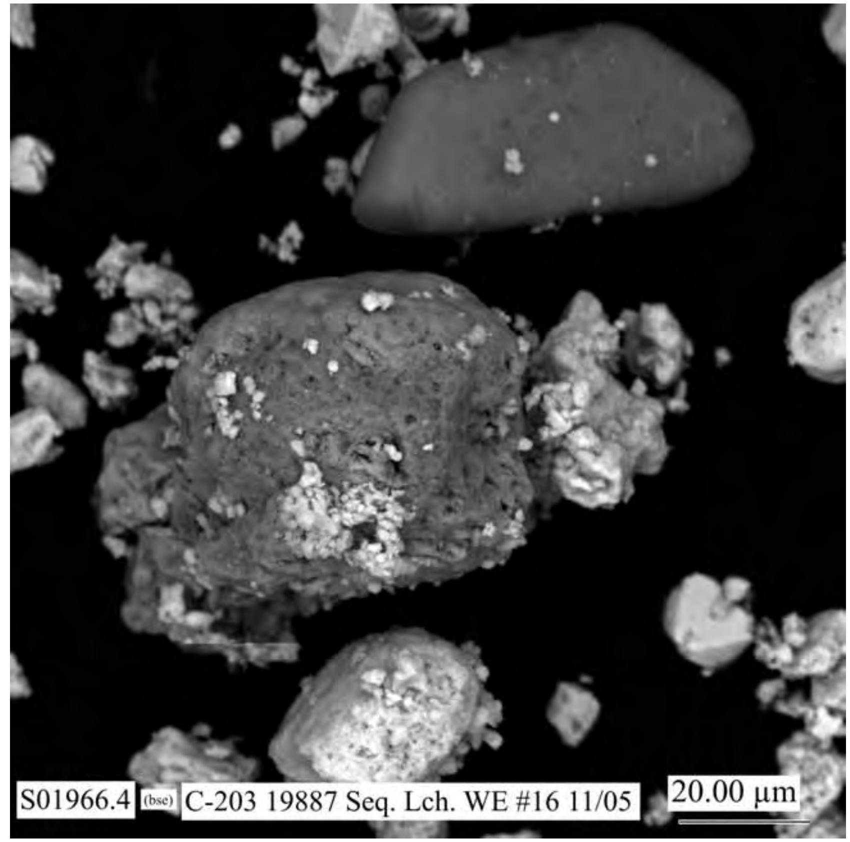


Figure F.21. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure F.19 (Areas where EDS analyses were made are shown in Figures F.35 and F.36.)

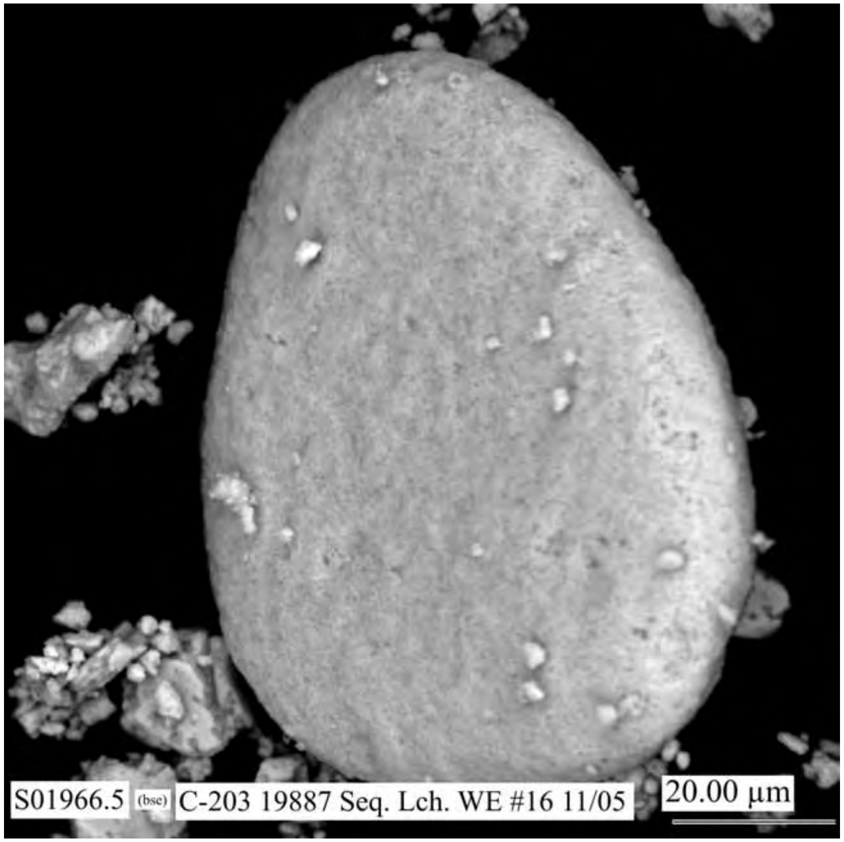


Figure F.22. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure F.19 (Areas where EDS analyses were made are shown in Figure F.37.)

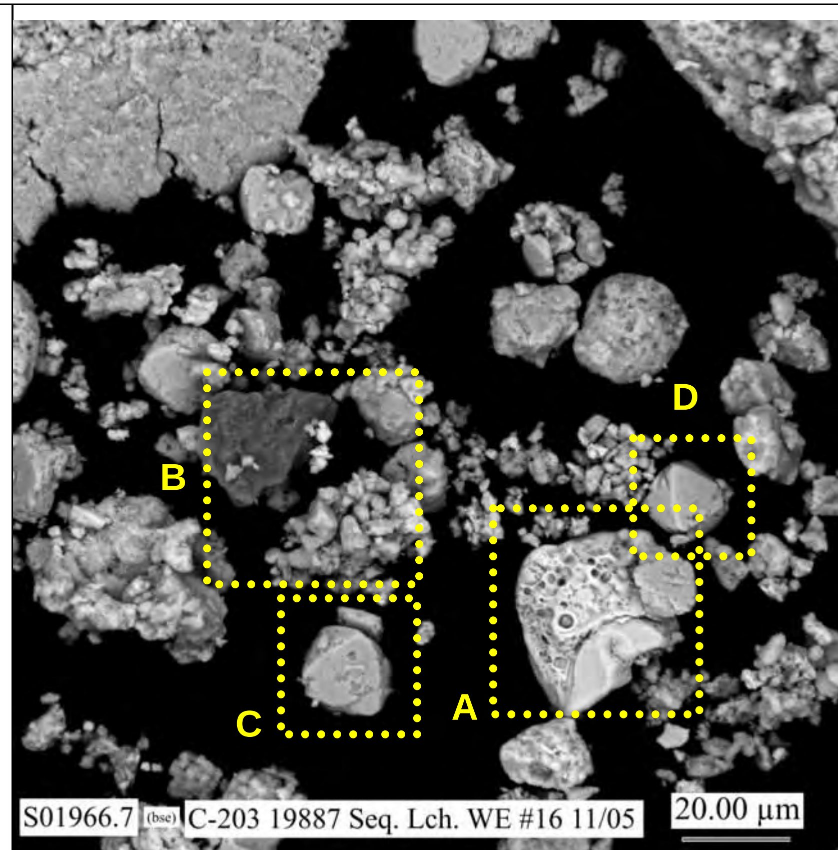


Figure F.23. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887)

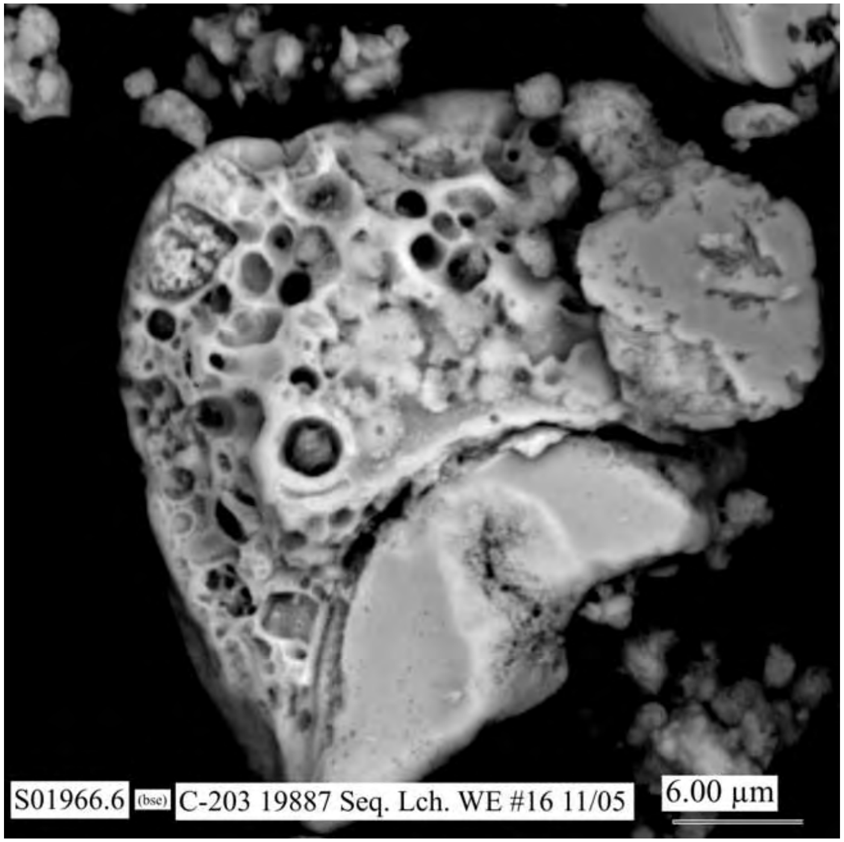


Figure F.24. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure F.23

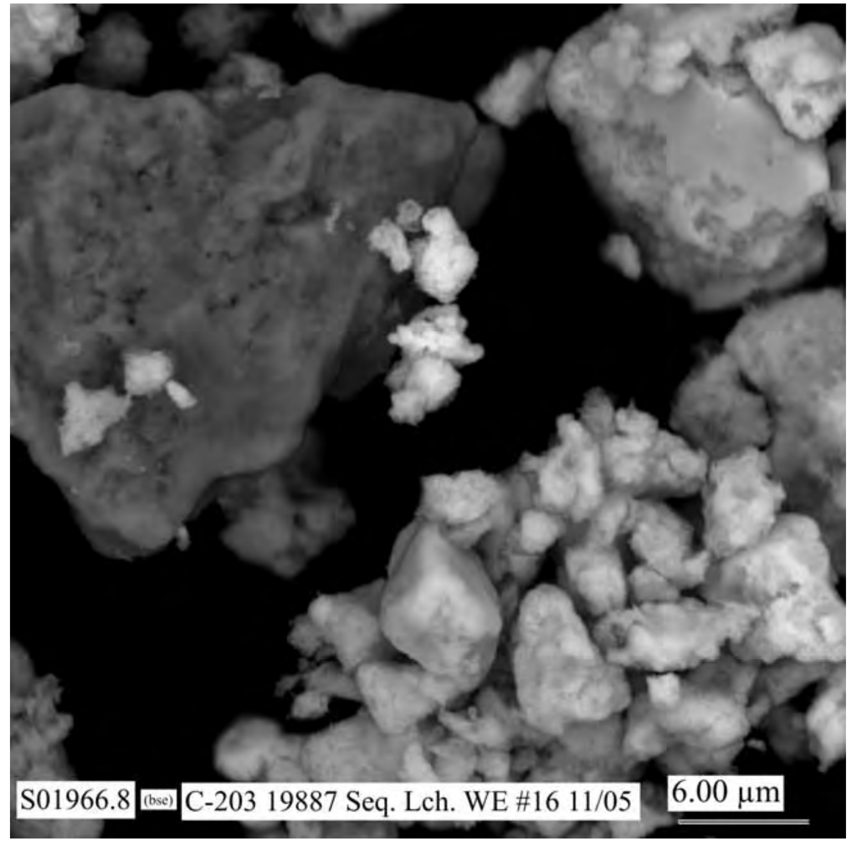


Figure F.25. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure F.23 (Areas where EDS analyses were made are shown in Figures F.38 and F.39.)

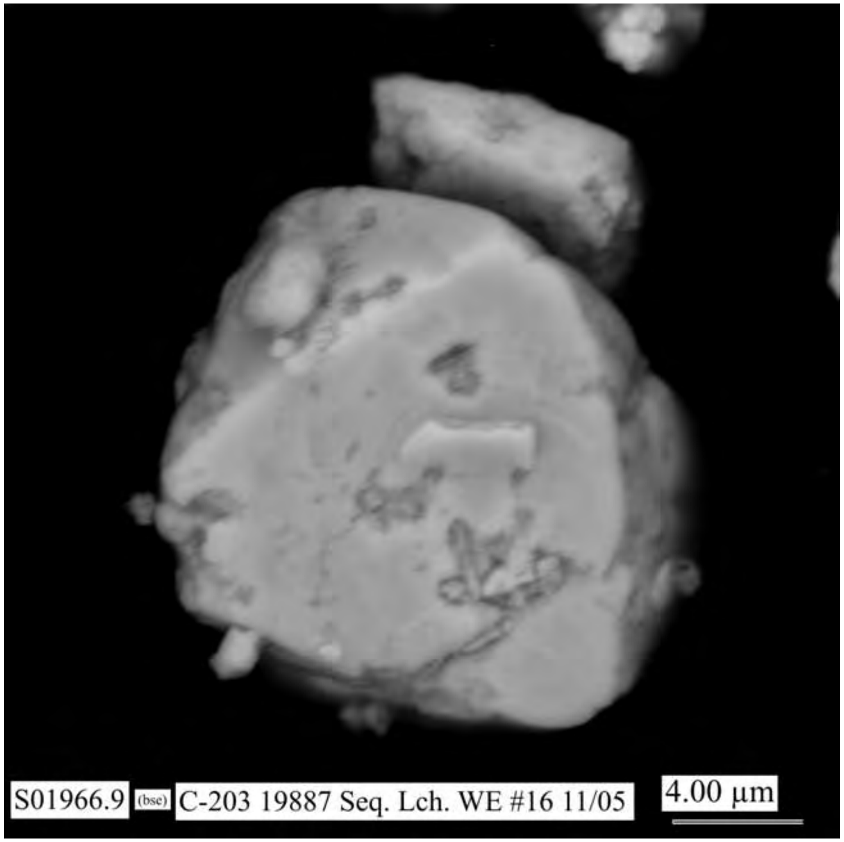


Figure F.26. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure F.23

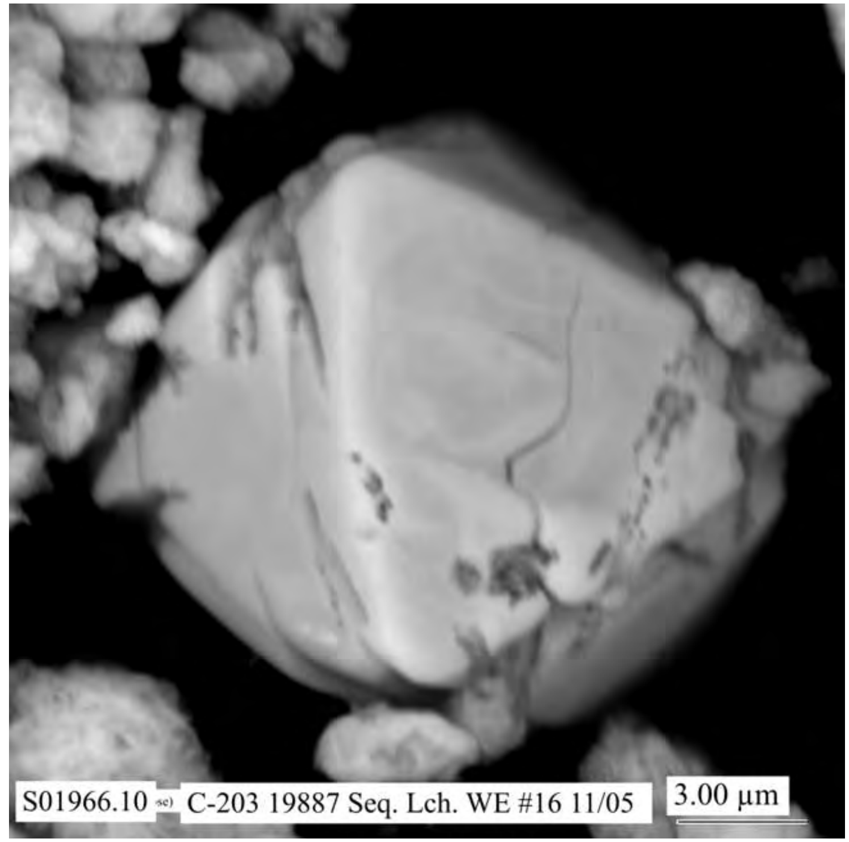


Figure F.27. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure F.23

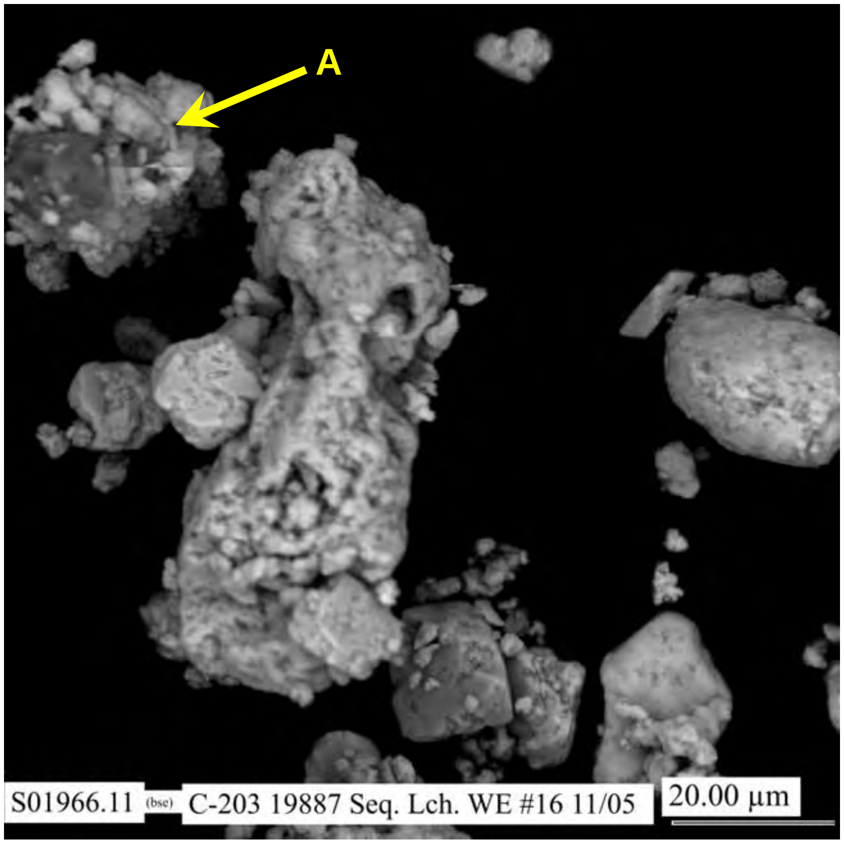


Figure F.28. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887) (Areas where EDS analyses were made are shown in Figure F.40.)

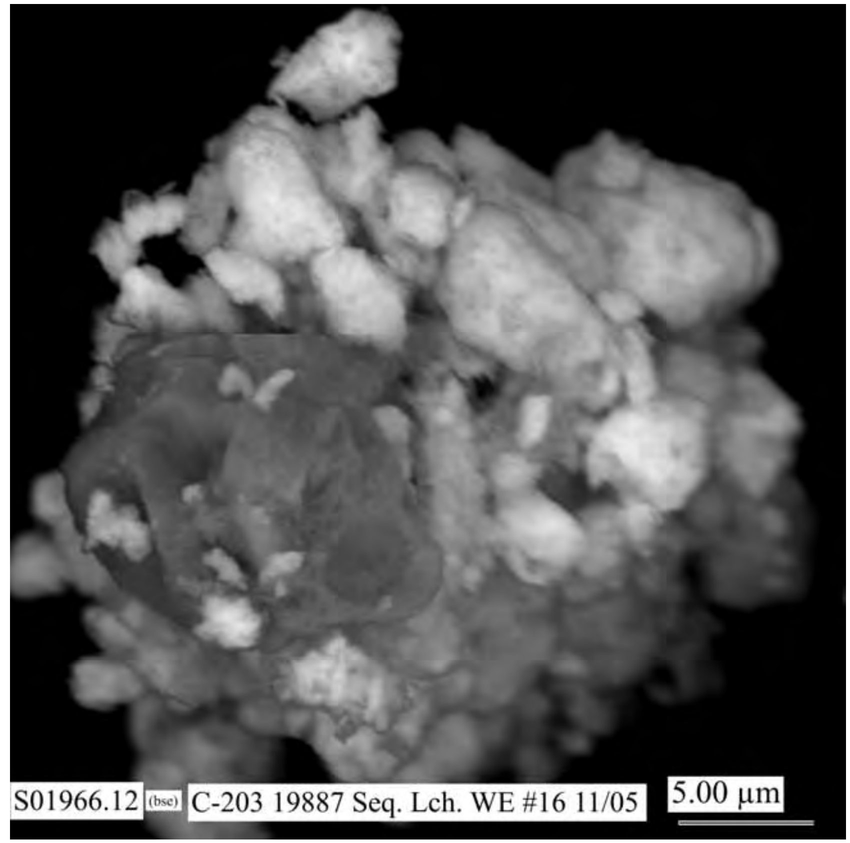


Figure F.29. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure F.28 (Areas where EDS analyses were made are shown in Figure F.41.)

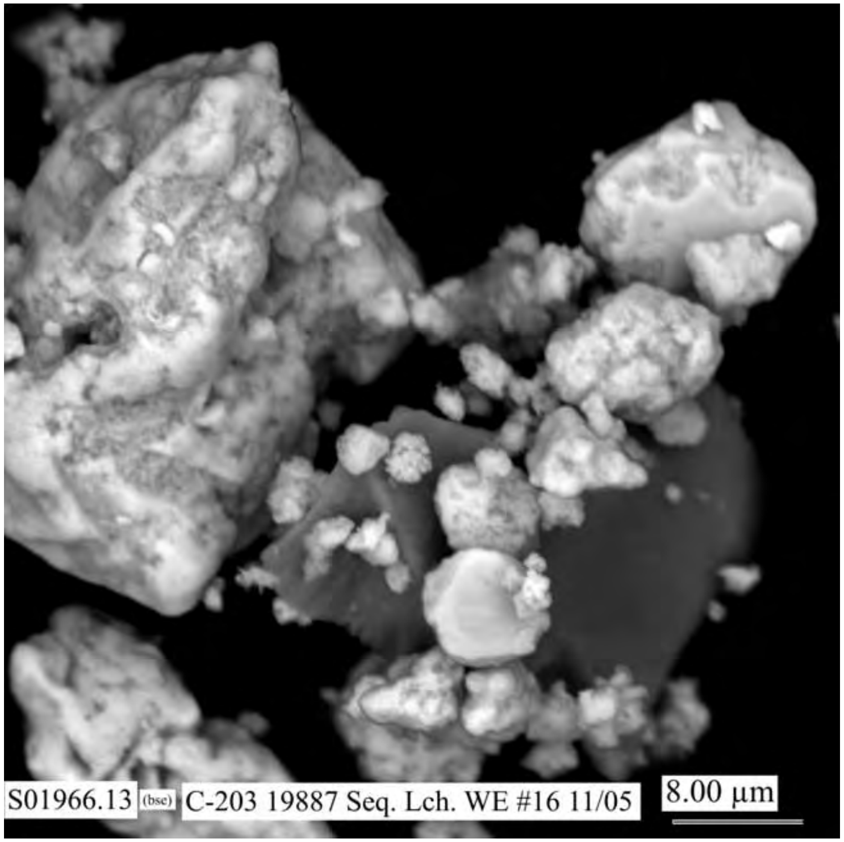


Figure F.30. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887) (Areas where EDS analyses were made are shown in Figure F.42.)

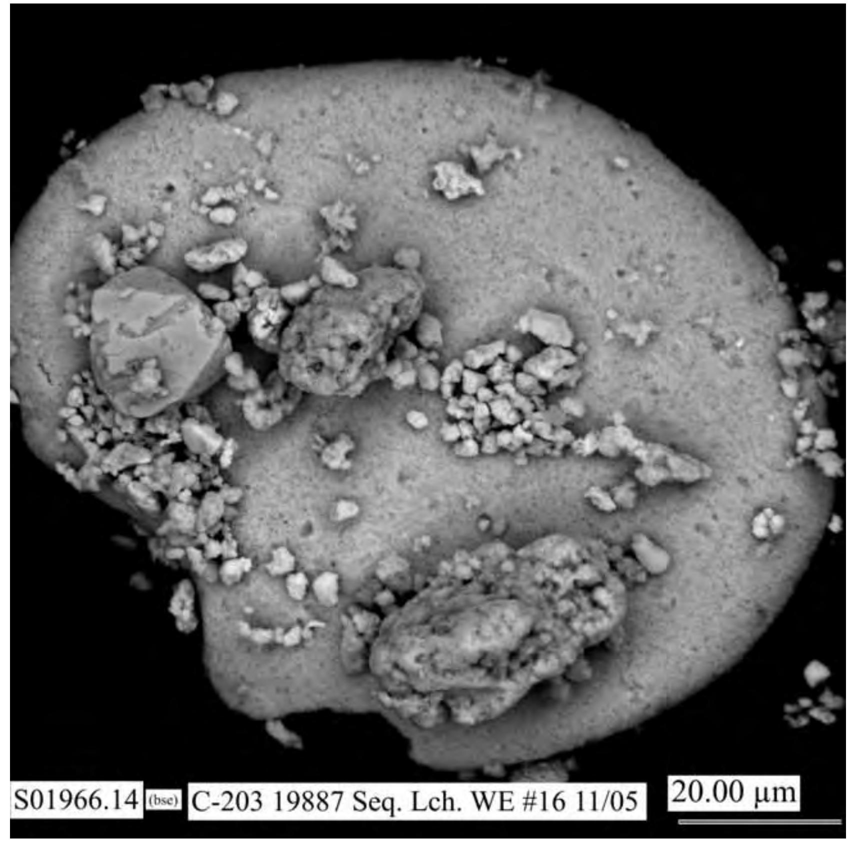


Figure F.31. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887) (Areas where EDS analyses were made are shown in Figure F.43.)

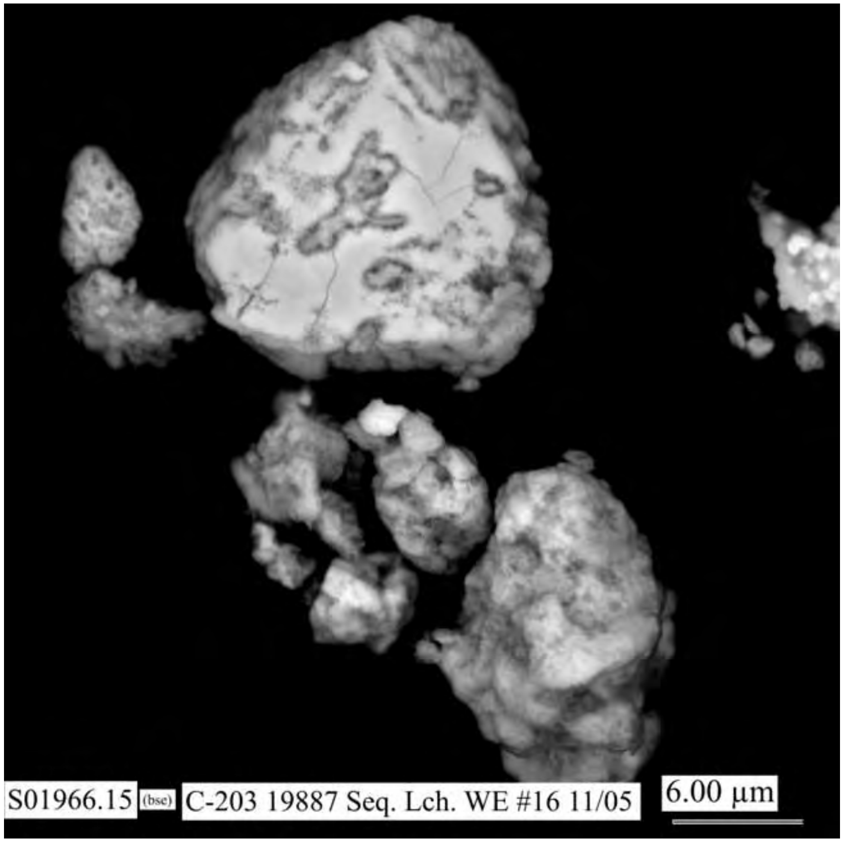


Figure F.32. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887) (Areas where EDS analyses were made are shown in Figure F.44.)

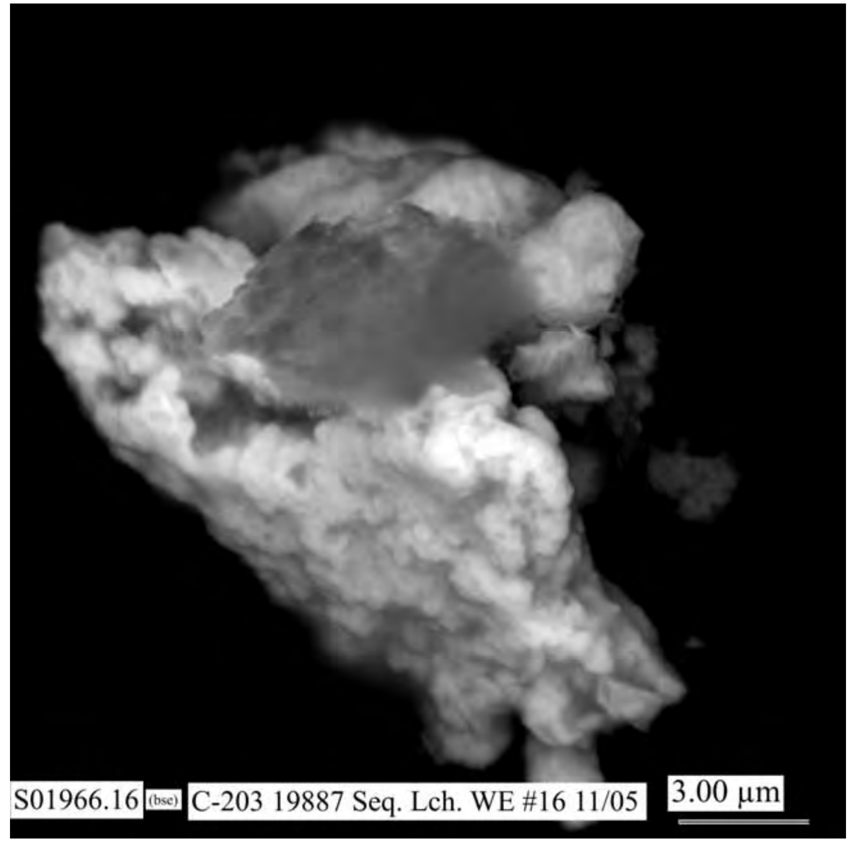


Figure F.33. Micrograph Showing Typical Particles in Sample of Sequential Water Extraction Solid from C-203 Residual Waste (Sample 19887) (Areas where EDS analyses were made are shown in Figure F.45.)

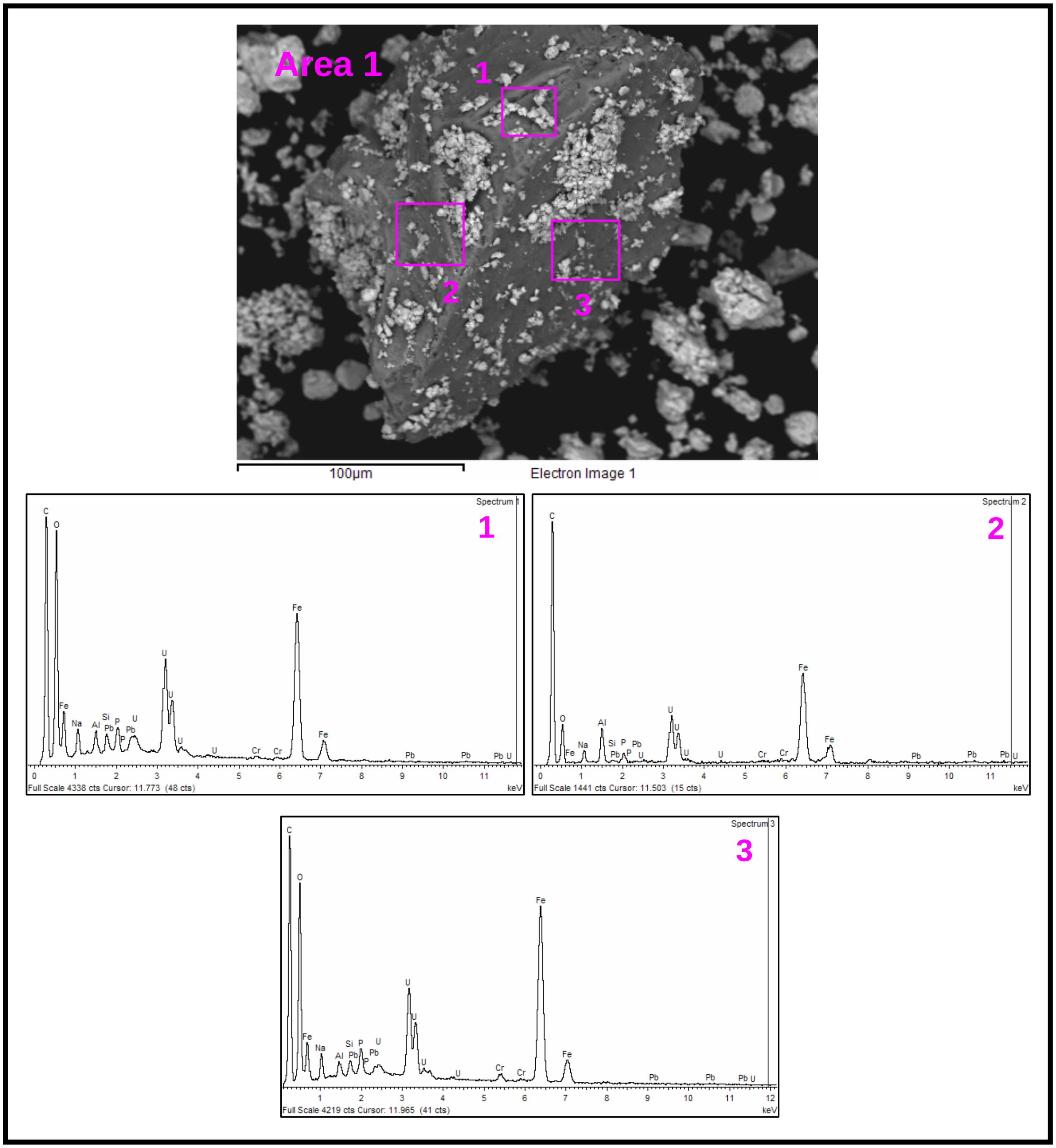


Figure F.34. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

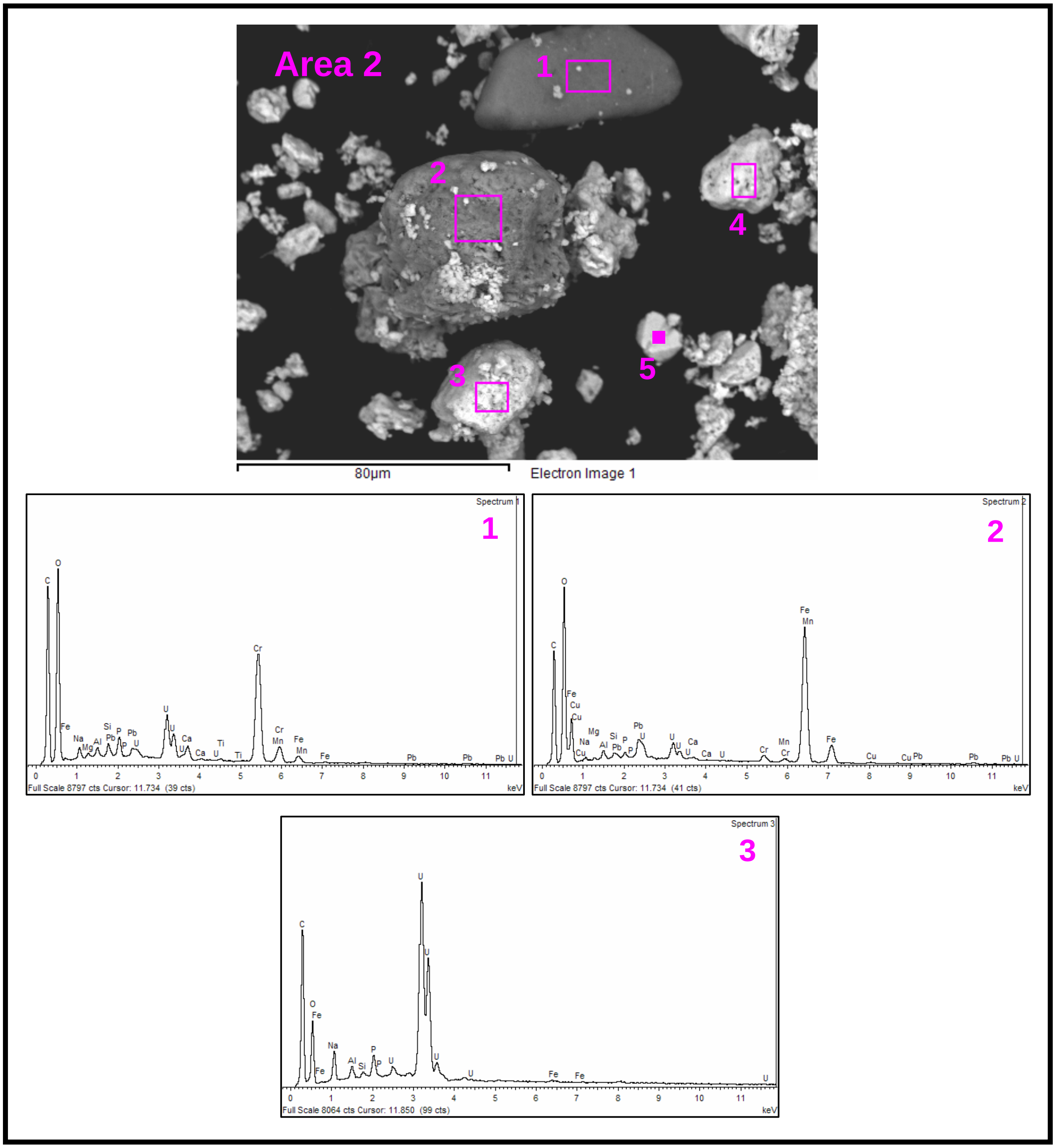


Figure F.35. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

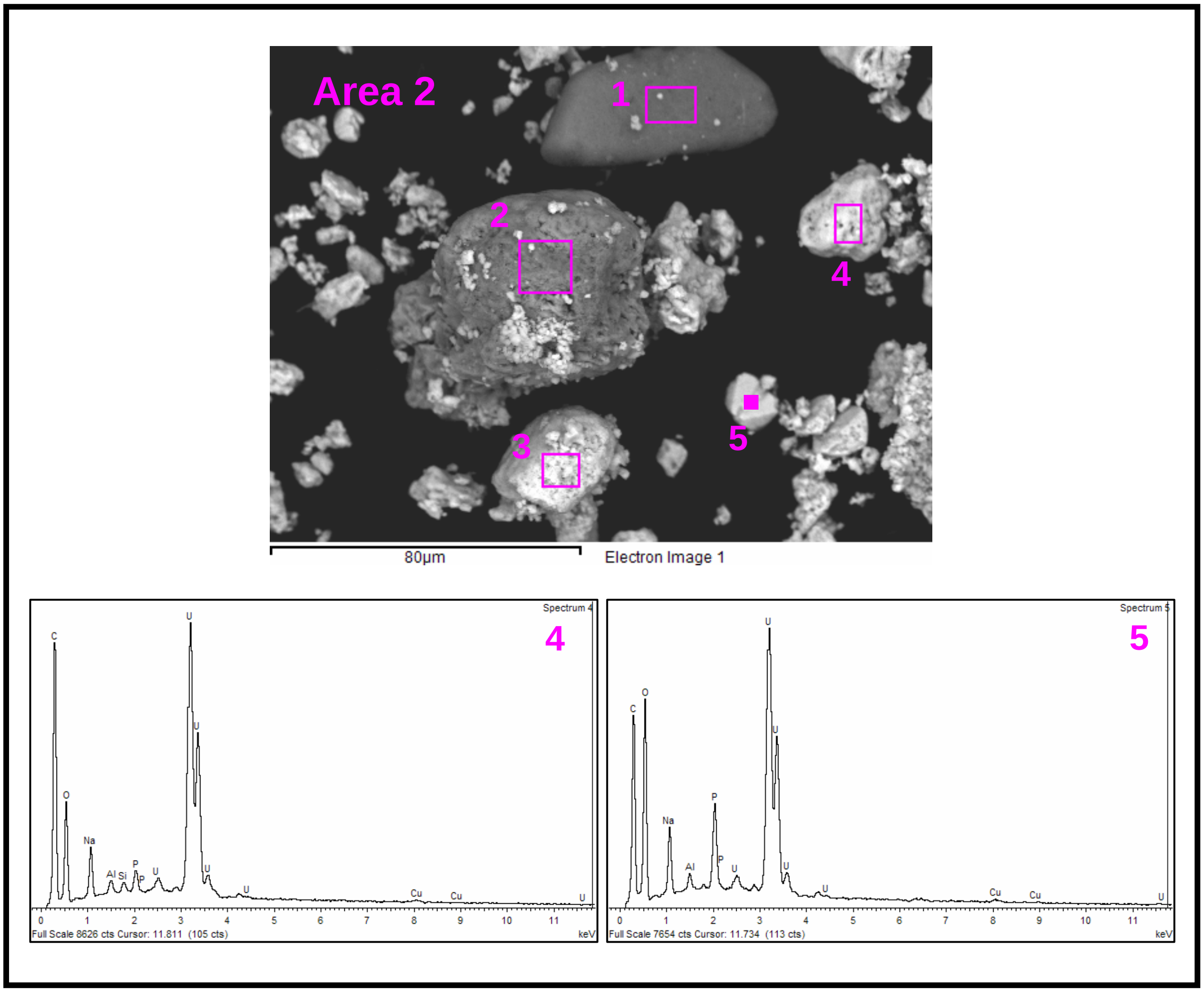


Figure F.36. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

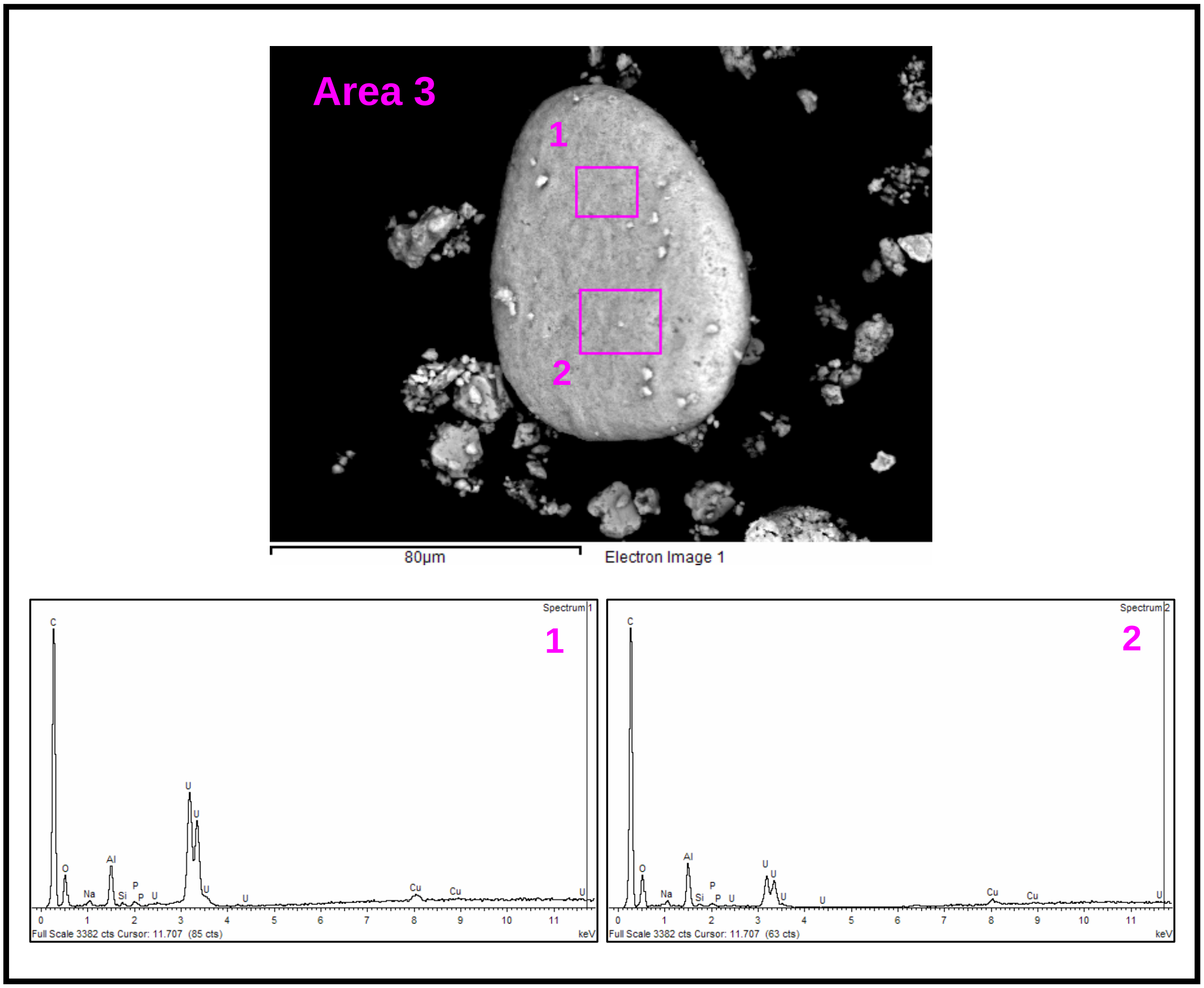


Figure F.37. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

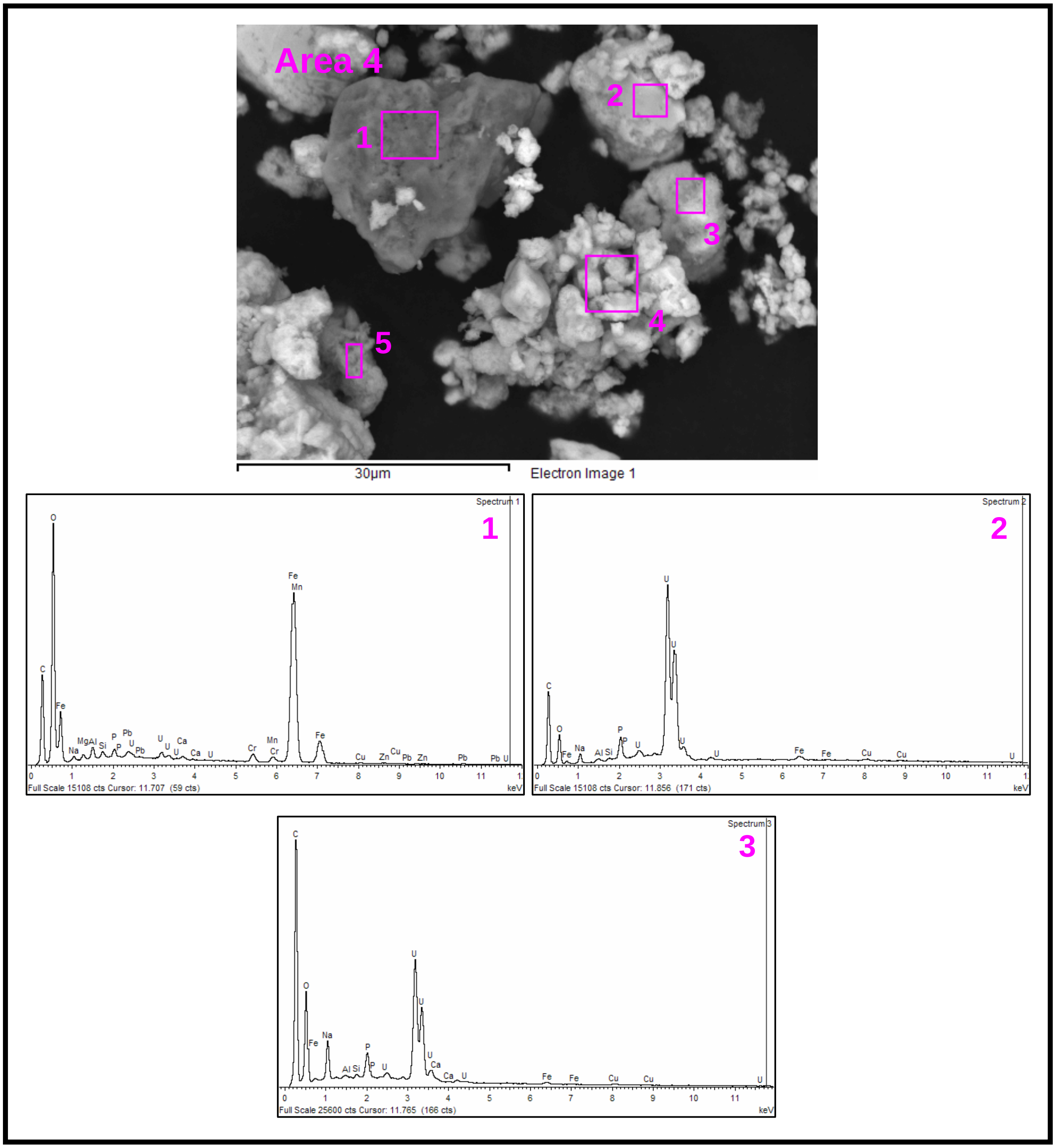


Figure F.38. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

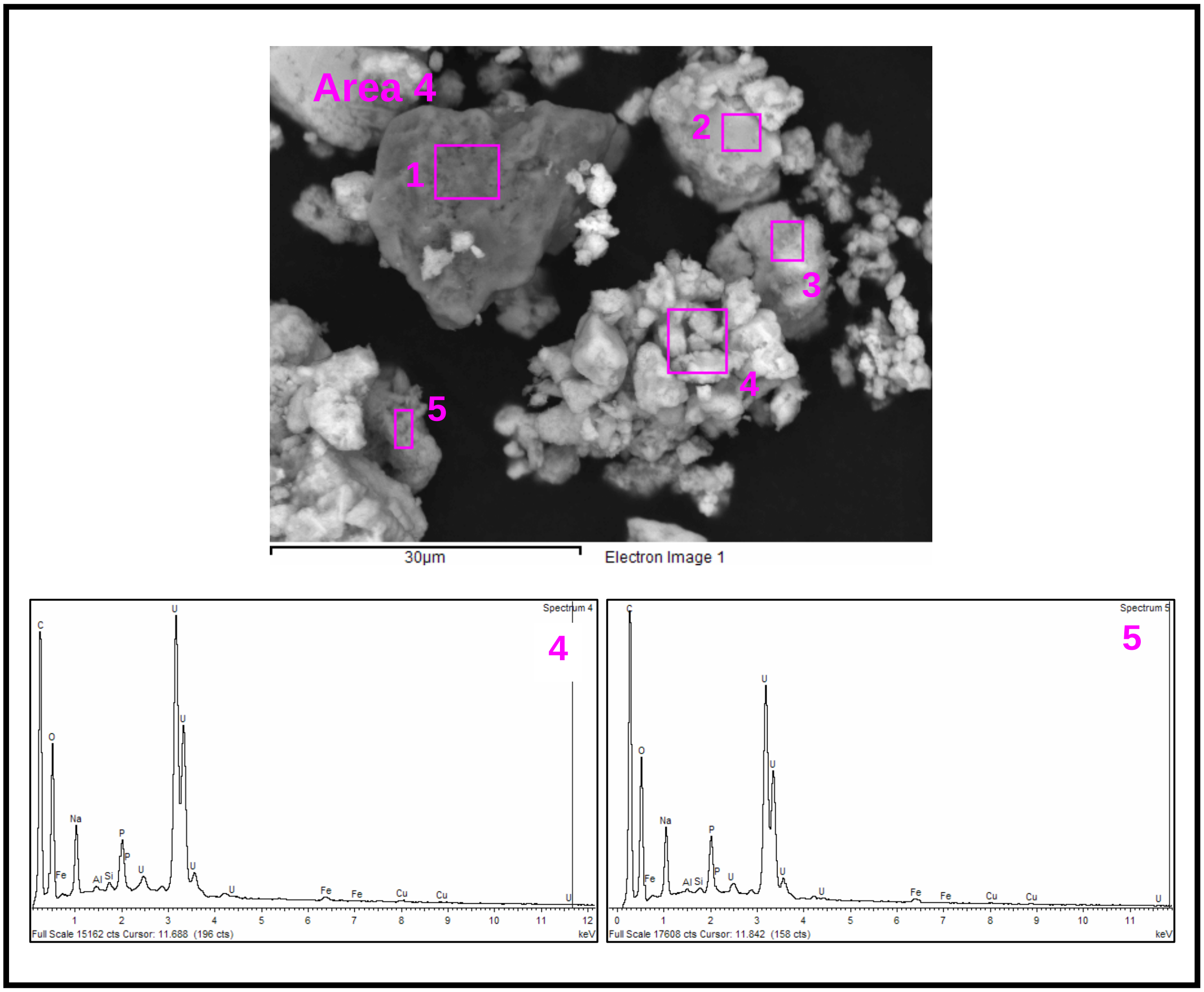


Figure F.39. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

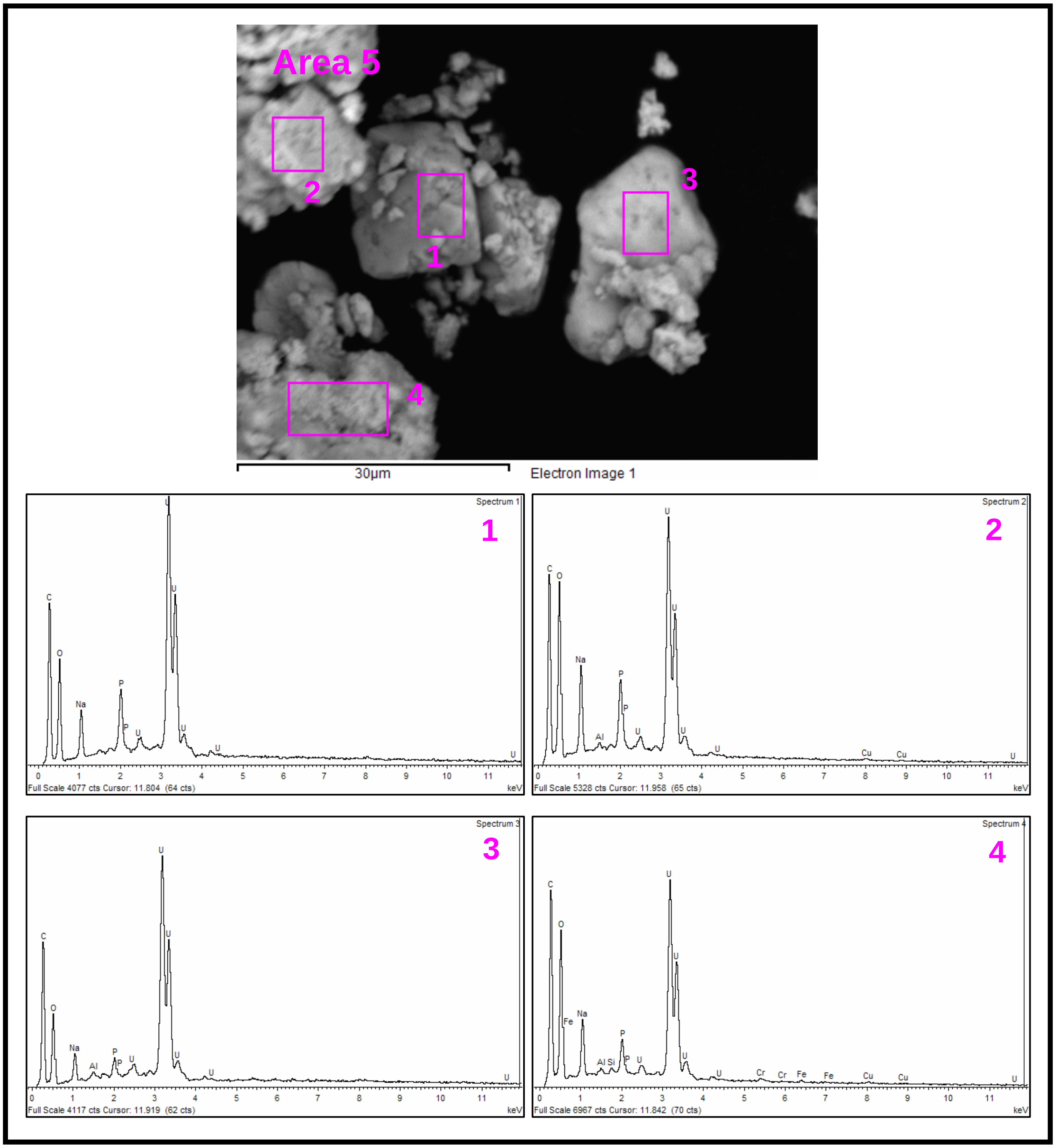


Figure F.40. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

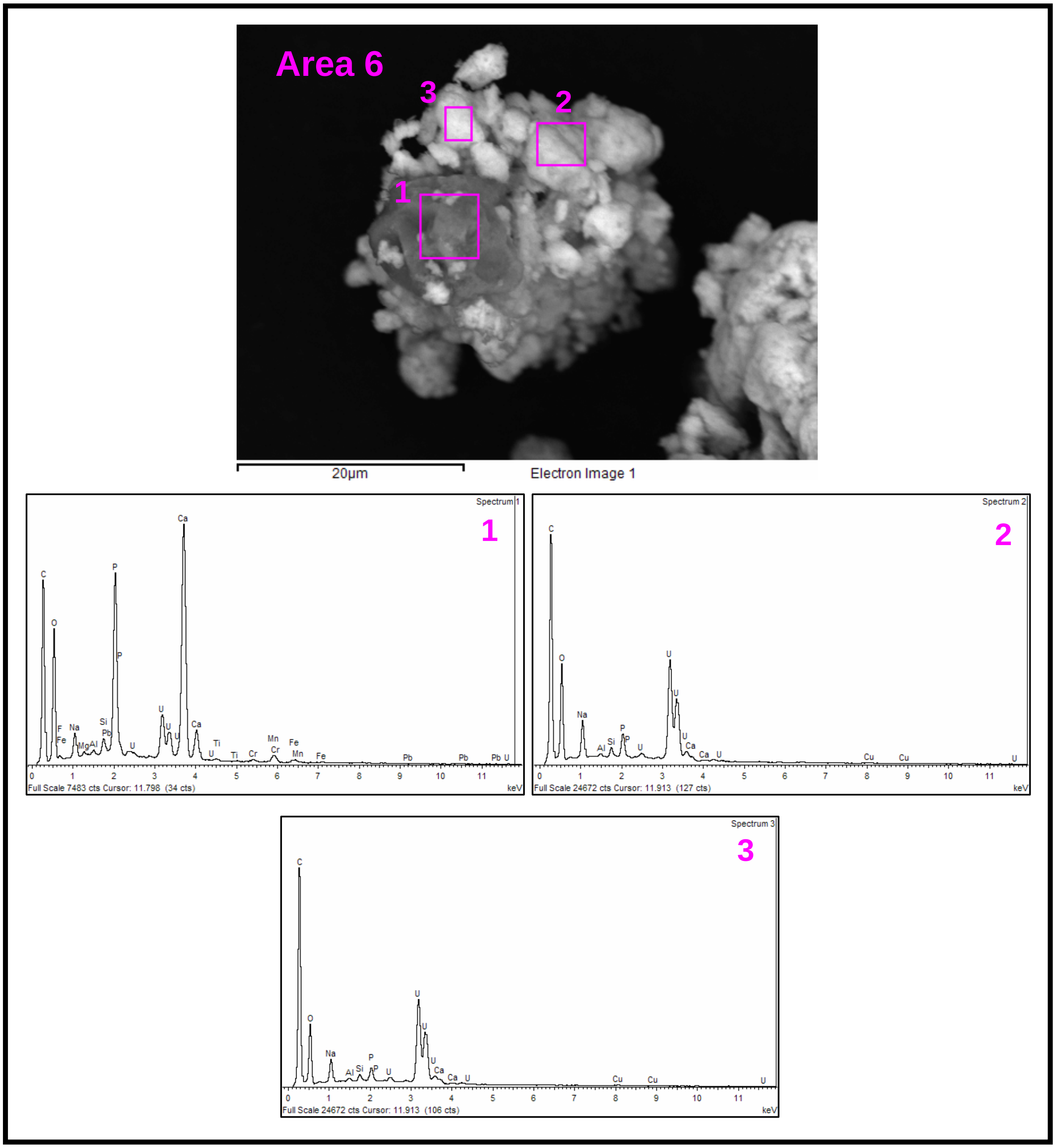


Figure F.41. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

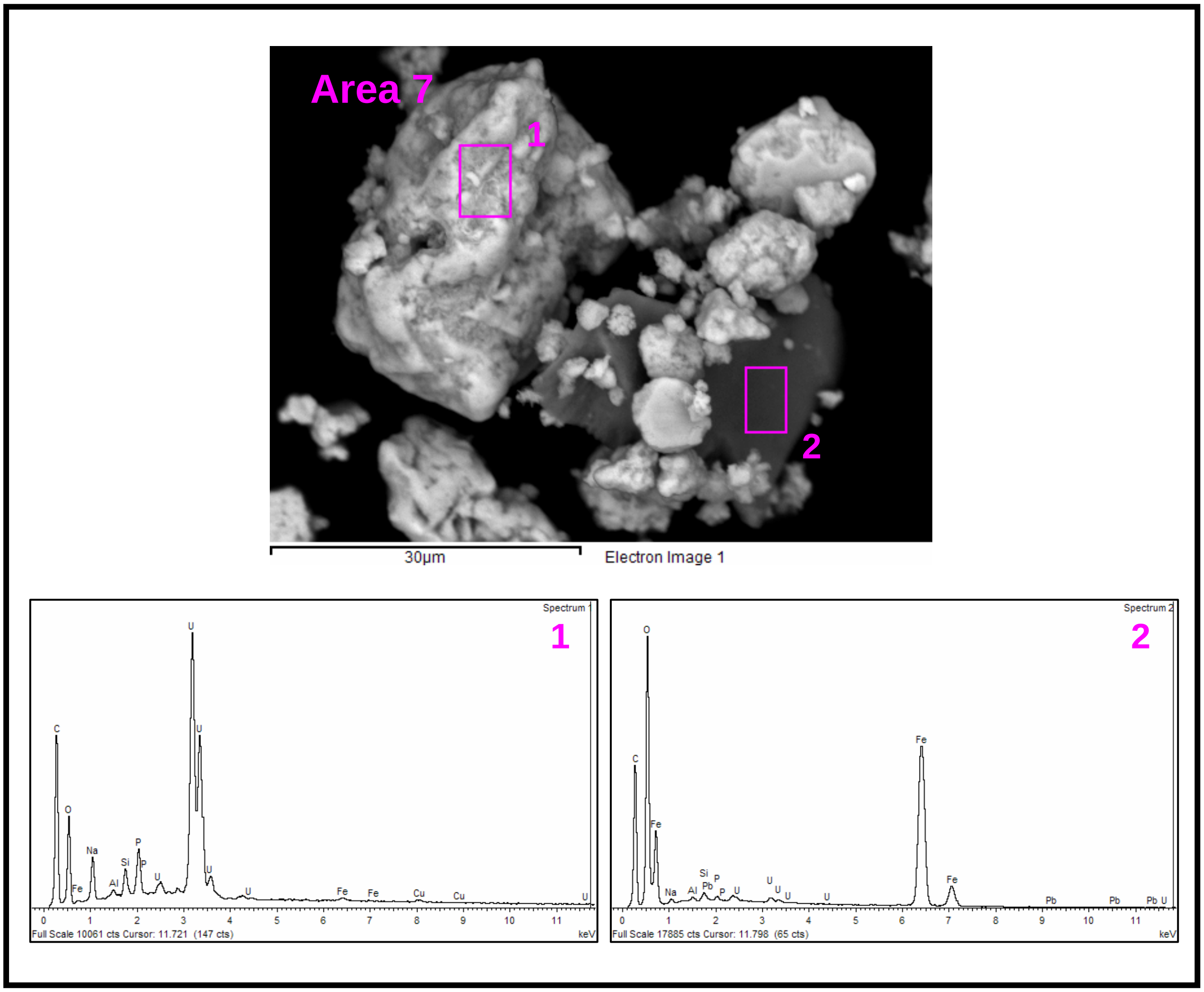


Figure F.42. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

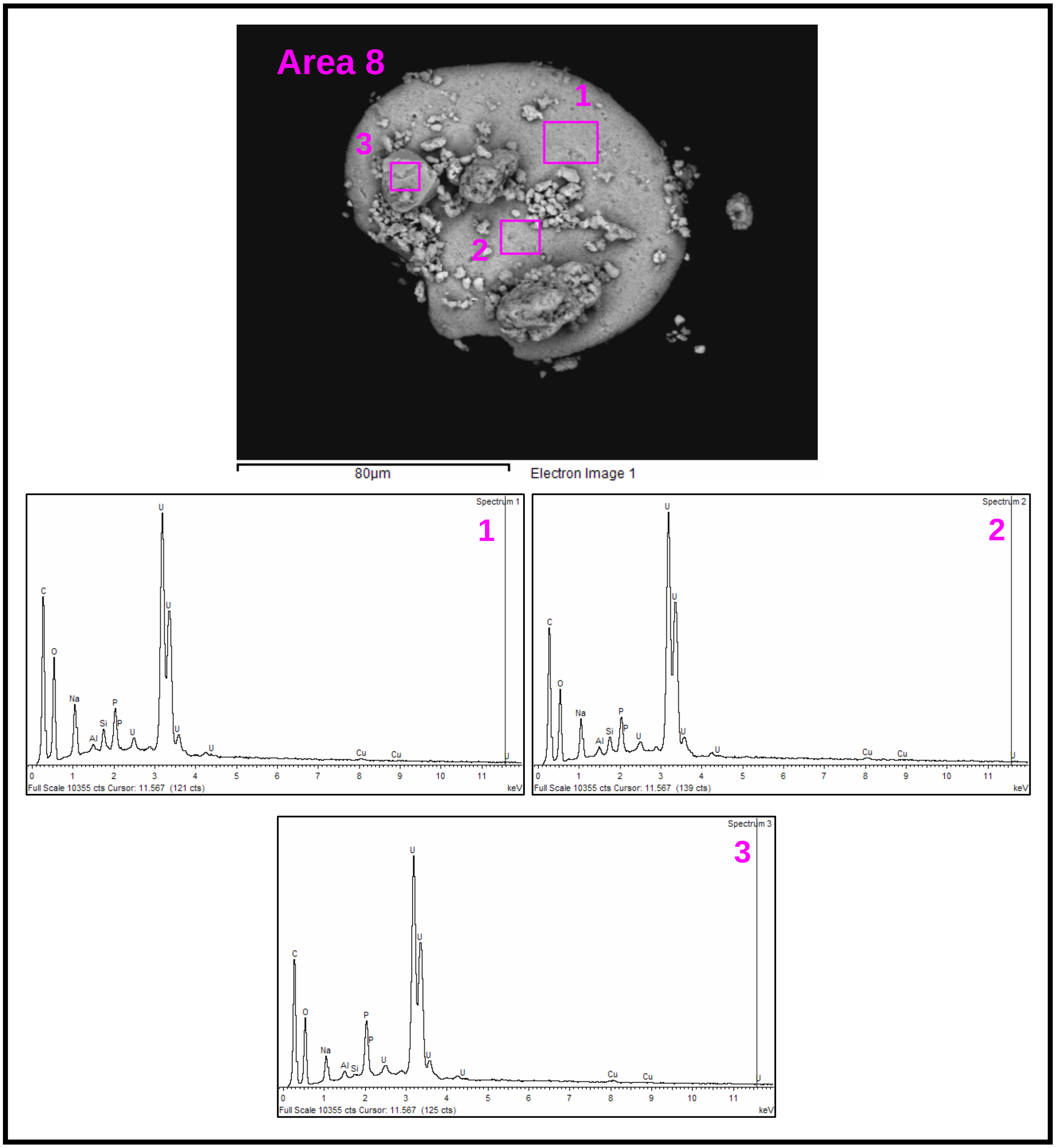


Figure F.43. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

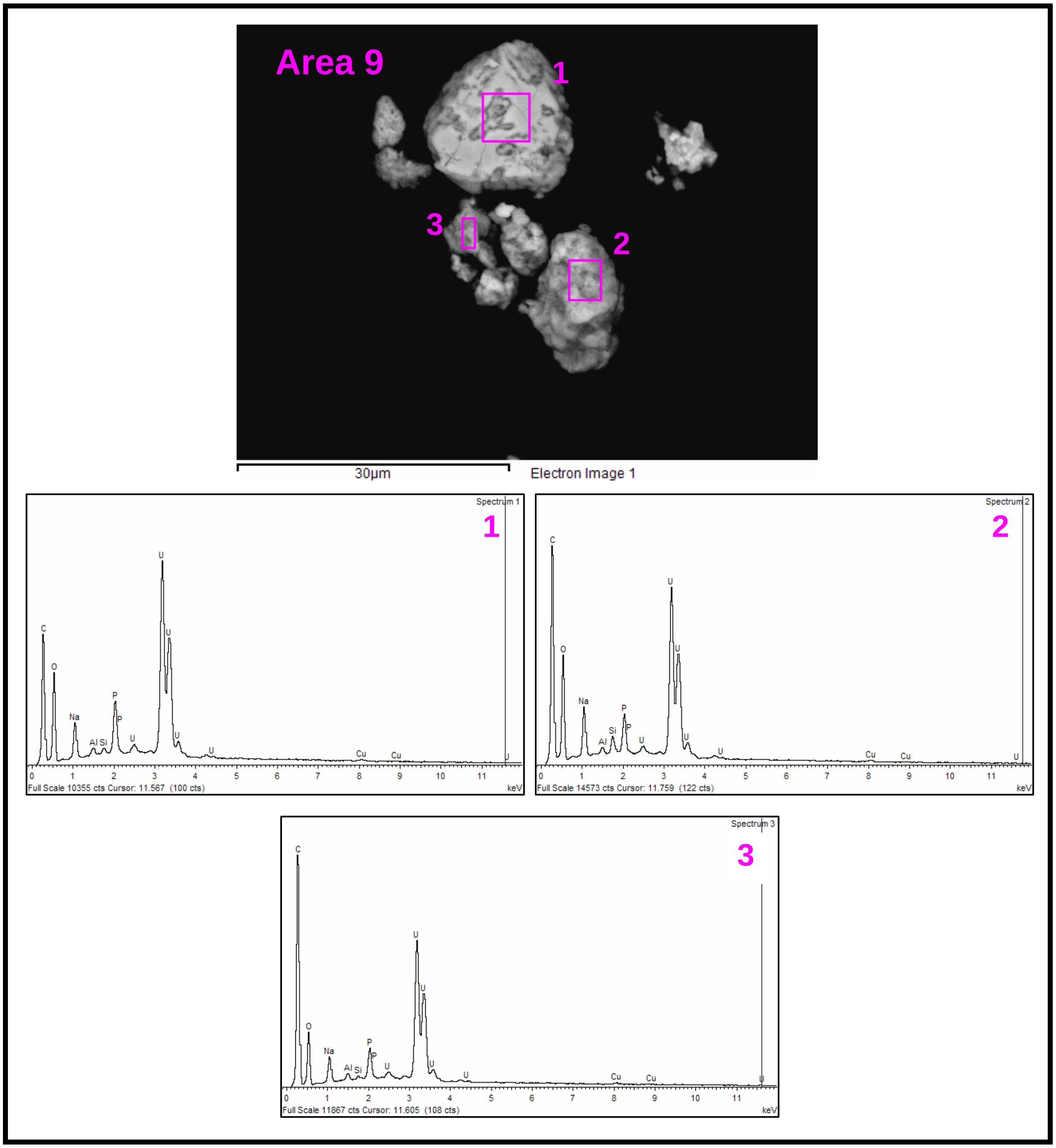


Figure F.44. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

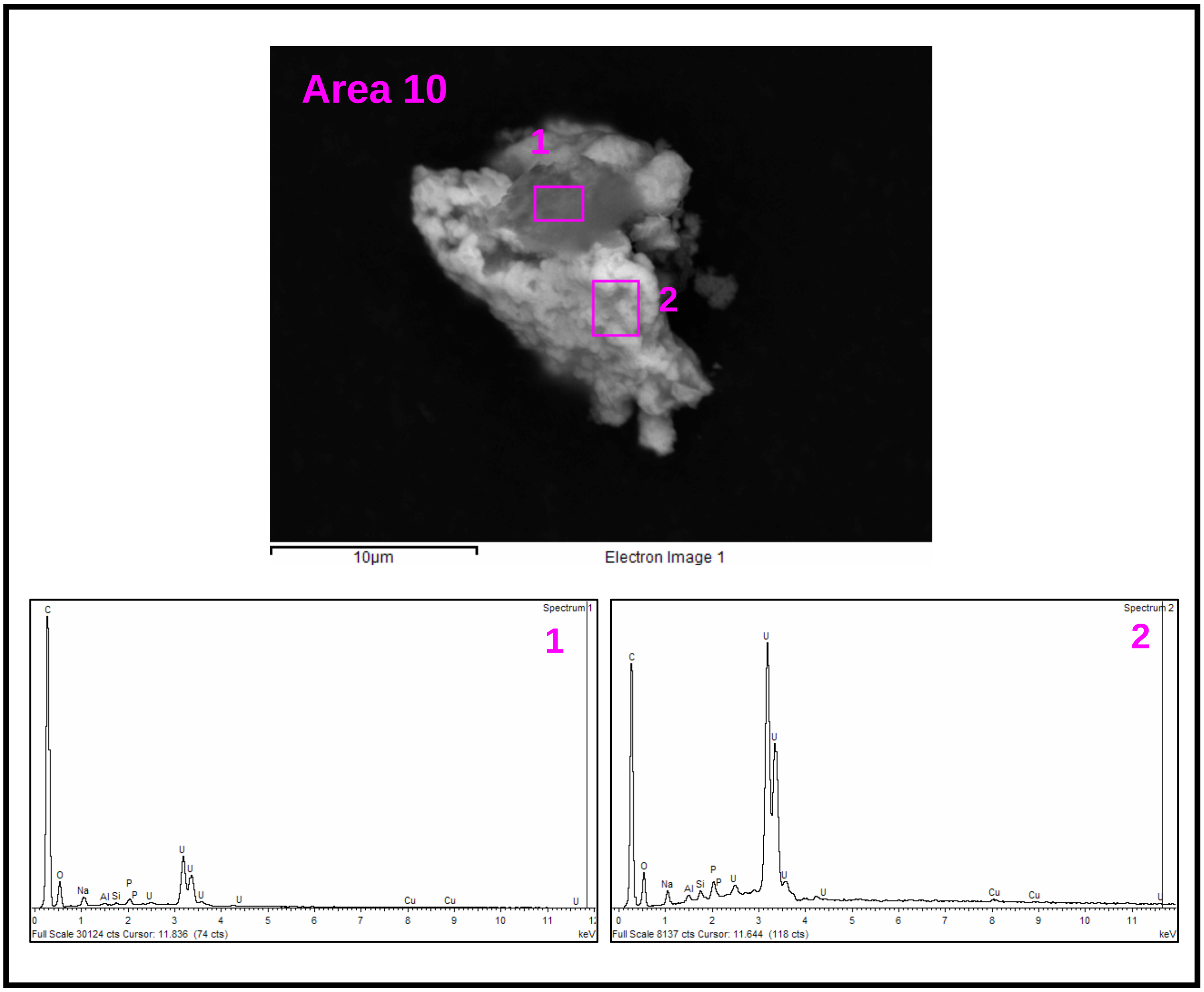


Figure F.45. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19887)

Table F.3. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential Water Extraction Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
F.34 / 1	1	1.0	1.3	5.9		0.1			37	*53*	0.5	0.5			0.4	Pb – 0.1
	2	0.8	0.9	5.7					14	*77*	0.3	1.2	0.3			
	3	1.0	1.4	7.1		0.2		0.1	33	*56*	0.6	0.3			0.3	
F.35 & F.36 / 2	1	0.6	0.7	0.4	0.2	4.7		0.4	41	*50*	0.6	0.3		0.2	0.3	Pb – 0.1, Ti – 0.1
	2	0.3	0.3	8.8	0.1	0.3		0.1	41	*48*	0.2	0.3	0.1	0.1	0.2	Pb – 0.3
	3	5.1	3.3	0.2					29	*60*	1.1	0.7			0.3	
	4	4.3	3.3						29	*61*	0.7	0.5	0.2		0.3	
	5	3.7	3.9						44	*45*	2.4	0.5	0.2			W – 0.1
F.37 / 3	1	2.3	0.4						15	*80*	0.2	1.8	0.8		0.1	
	2	0.5	0.3						16	*81*	0.1	1.4	0.5		0.1	K – 0.2

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table F.4. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential Water Extraction Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
F.38 & F.39 / 4	1	0.1	0.3	11	0.2	0.3		0.1	47	*40*	0.3	0.5	0.1	0.3	0.2	Pb – 0.1, Zn – 0.1
	2	8.6	2.3	0.7					28	*57*	2.4	0.3	0.5		0.2	
	3	2.2	2.7	0.1					30	*64*	0.9	0.1	0.1		0.1	
	4	3.6	3.8	0.2					35	*55*	1.3	0.1	0.1		0.2	
	5	2.7	3.5	0.2					33	*59*	1.4	0.1	0.1		0.1	
F.40 / 5	1	5.3	4.1						36	*52*	2.5					
	2	3.5	5.3						42	*47*	2.1	0.2	0.2			
	3	6.1	3.4						34	*55*	1.1	0.3				
	4	3.3	4.1	0.1		0.1			41	*50*	1.1	0.2	0.2		0.2	
F.41 / 6	1	0.5	1.1	0.1	0.3	0.1		5.2	36	*51*	3.7	0.1		0.1	0.3	F – 0.9, Pb - <0.1, Ti – 0.1
	2	1.8	2.6					0.1	32	*62*	0.8	0.1	0.1		0.3	
	3	1.9	2.0					0.1	27	*68*	0.6	0.1	0.1		0.3	
F.42 / 7	1	5.2	3.7	0.2					31	*56*	1.9	0.2	0.3		1.1	
	2	0.1	0.3	8.1					46	*45*	0.1	0.1			0.2	Pb – 0.1

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table F.5. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential Water Extraction Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
F.43 / 8	1	4.7	4.4						35	*53*	1.7	0.3	0.2		0.9	
	2	5.9	4.2						32	*55*	1.9	0.4	0.3		0.9	
	3	5.8	3.0						32	*56*	3.0	0.5	0.3			
F.44 /9	1	4.6	3.7						36	*52*	2.6	0.4	0.2		0.3	
	2	2.9	3.4						32	*59*	1.3	0.3	0.1		0.6	
	3	3.0	2.1						22	*71*	1.2	0.3	0.2		0.1	
F.45 / 10	1	1.2	0.8						15	*82*	0.3	0.1	0.1		0.1	
	2	5.7	1.4						16	*75*	0.8	0.3	0.3		0.4	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix G

SEM Micrographs and EDS Results for Unleached Residual Waste from Tank C-203 (Sample 19961)

Appendix G

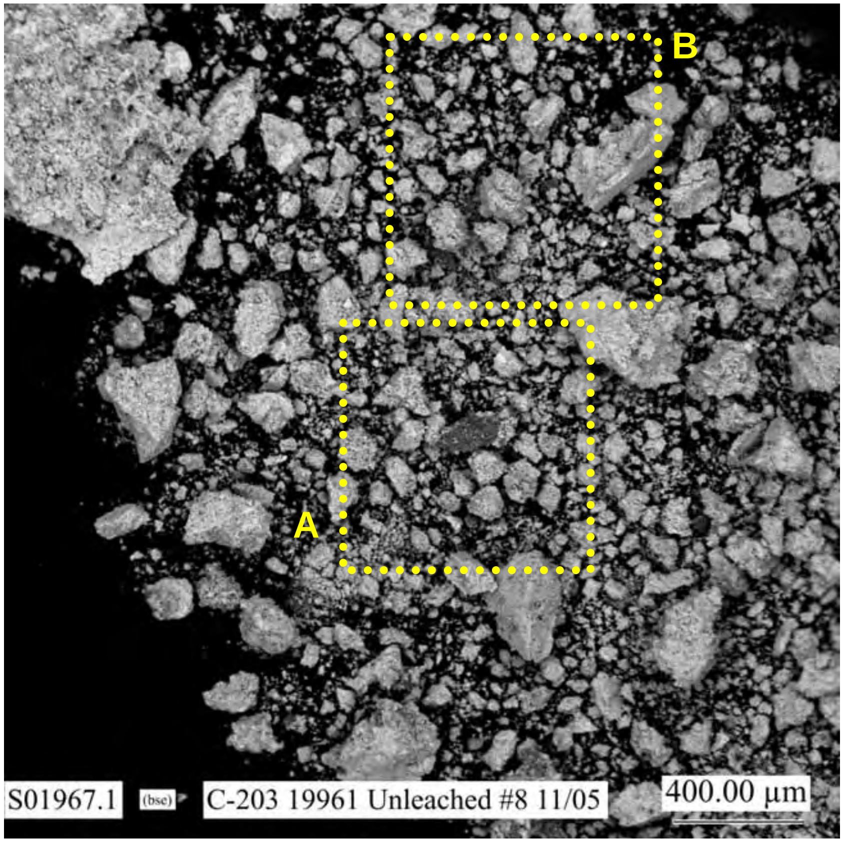
SEM Micrographs and EDS Results for Unleached Residual Waste from Tank C-203 (Sample 19961)

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for three sample mounts (8, 10, and11) of unleached residual waste from tank C-203 (sample 19961). The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by "BSE" to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample. The figure and table numbers for the SEM micrographs and EDS analyses for the three sample mounts of unleached C-203 (sample 19961) residual waste analyzed by SEM/EDS are listed in Table G.1.

Table G.1. Figures and Tables Containing the SEM Micrographs and EDS Analyses for Three Mounts of Unleached Residual Waste from Tank C-203 (Sample 19961)

Sample Mount Number	Figures with SEM Micrographs	Figures with EDS Spectra	Tables with EDS Atomic%
8 (Yellow Solids)	G.1 – G.12	G.13 – G.19	G.2 and G.3
10 (Brown Solids)	G.20 – G.30	G.31 – G.38	G.4 and G.5
11 (Orange Solids)	G.39 – G.54	G.55 – G.58	G.6



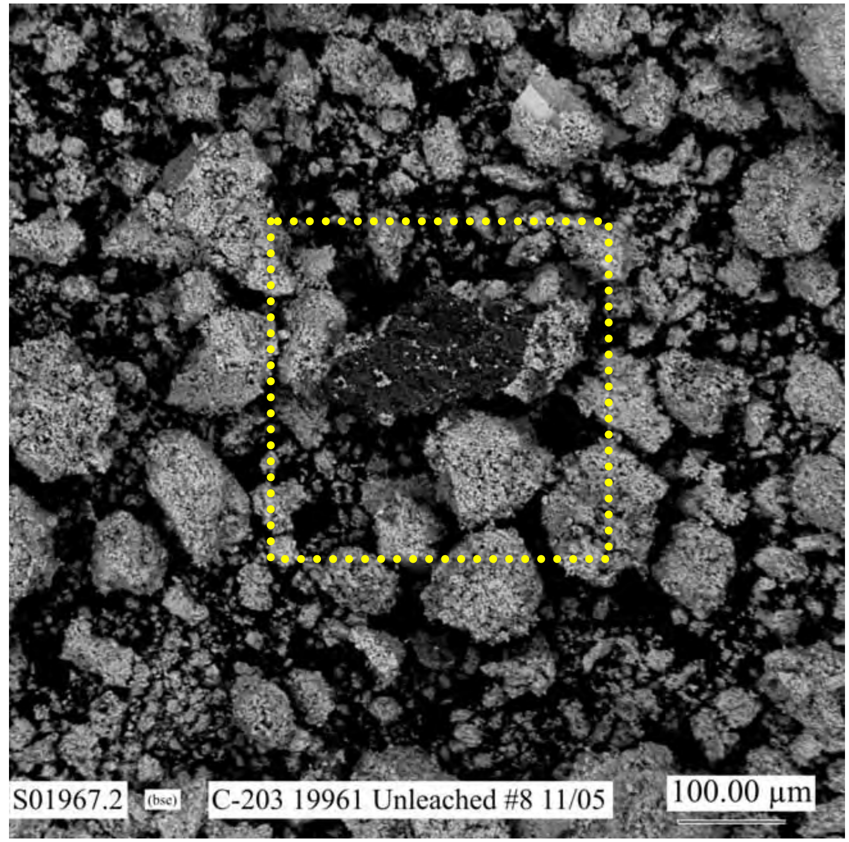


Figure G.1. Low Magnification Micrograph Showing Typical Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

Figure G.2. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure G.1 (Areas where EDS analyses were made are shown in Figures G.13 and G.14.)

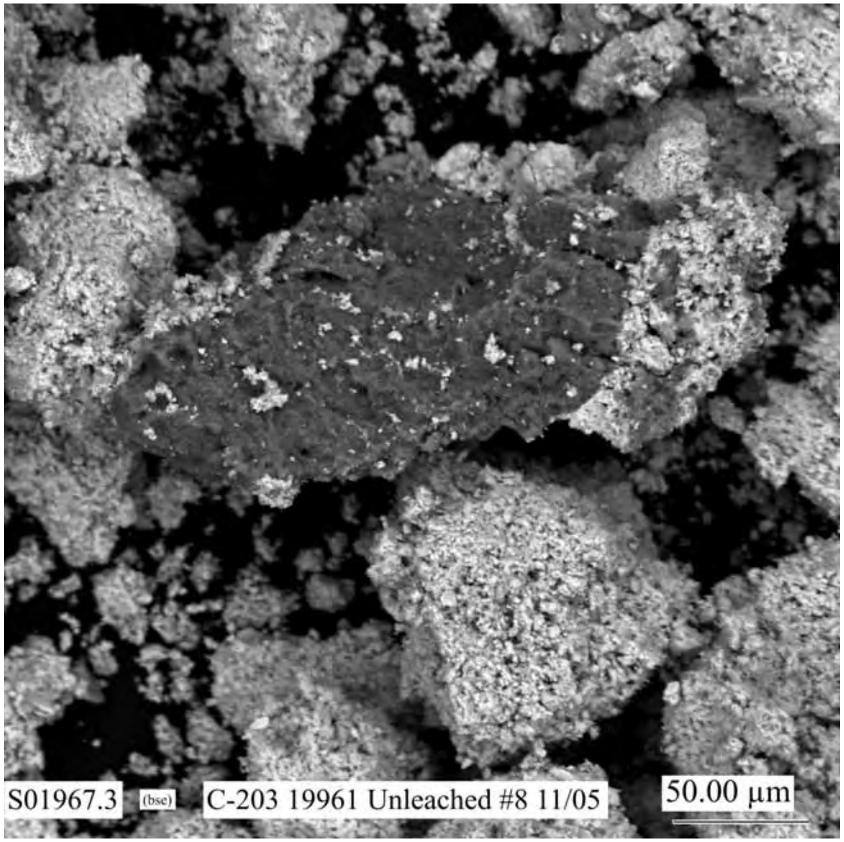


Figure G.3. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure G.2

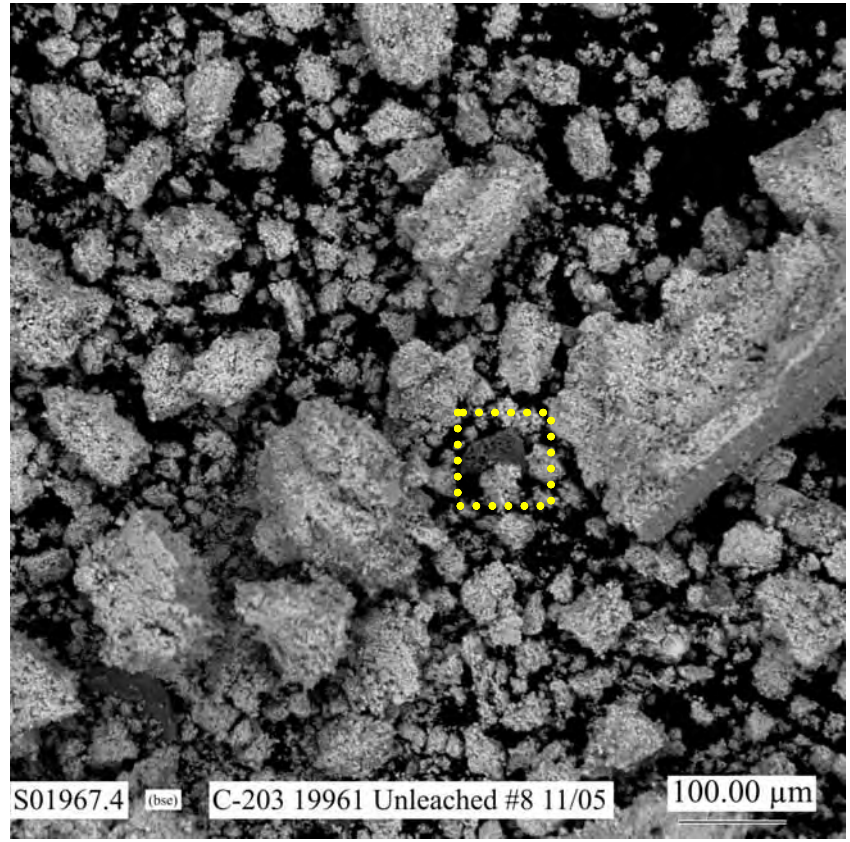


Figure G.4. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure G.1

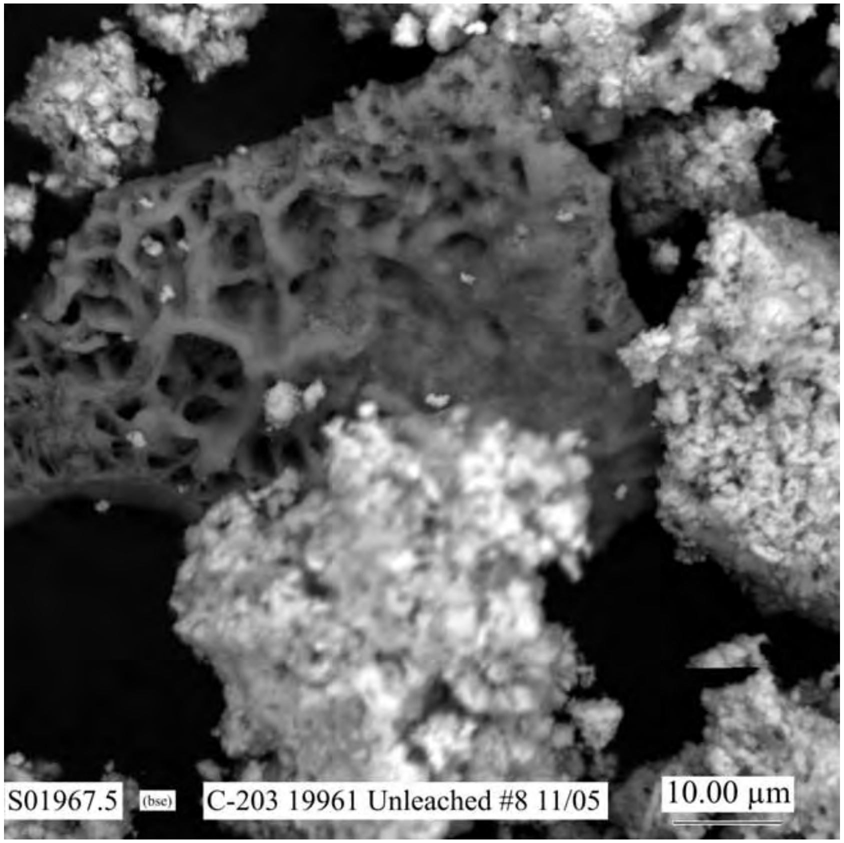


Figure G.5. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure G.4 (Focus set on large dark particle; compare to image in Figure G.6.) (Areas where EDS analyses were made are shown in Figure G.15.)

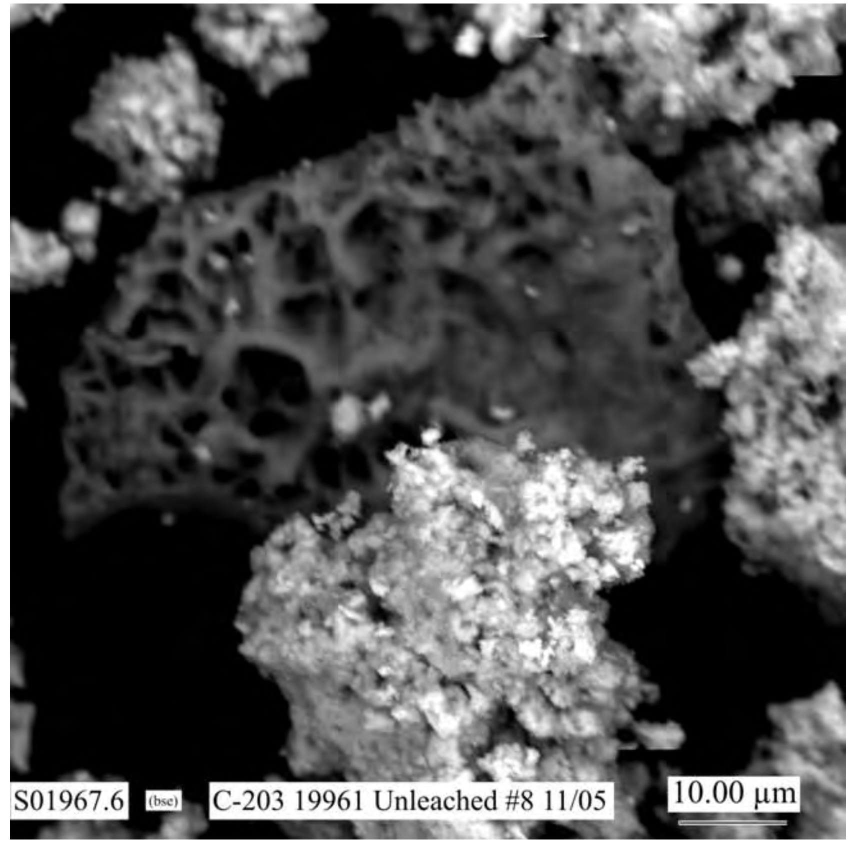


Figure G.6. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure G.4 (Focus changed to bright particle at bottom of micrograph relative to image in Figure G.5.)

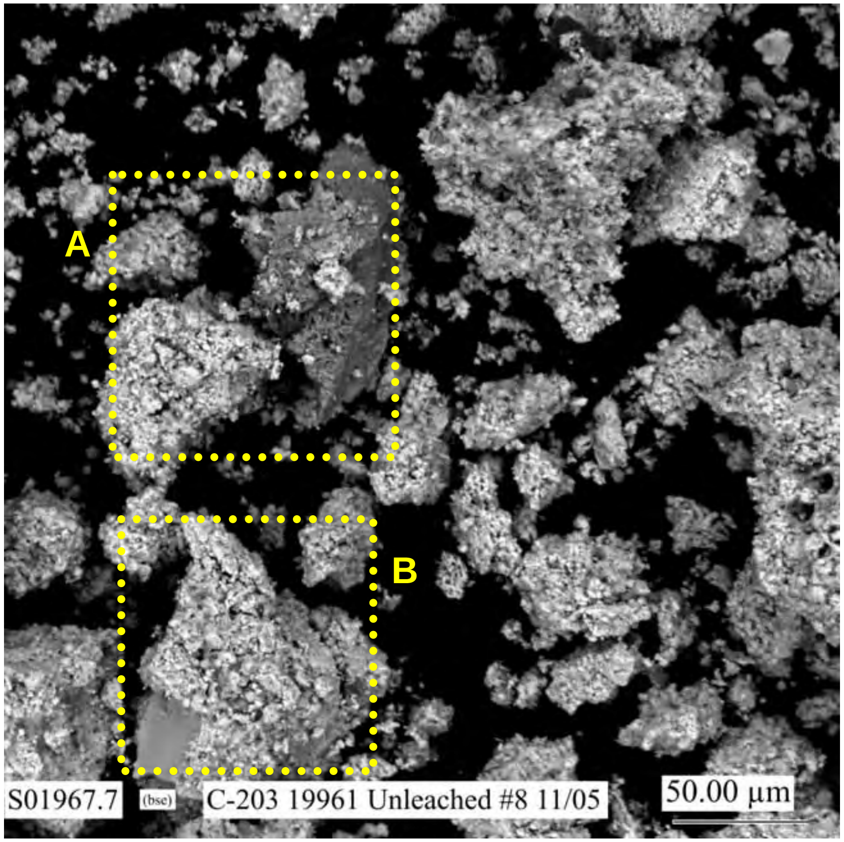


Figure G.7. Micrograph Showing at Higher Magnification Typical Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

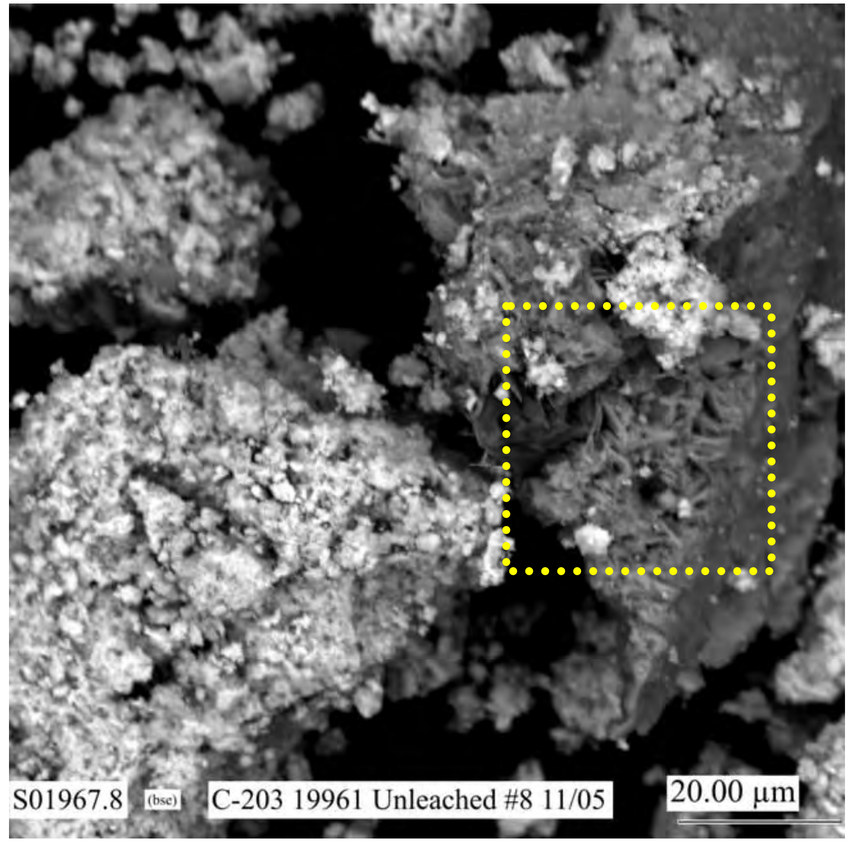


Figure G.8. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure G.7 (Areas where EDS analyses were made are shown in Figure G.16.)

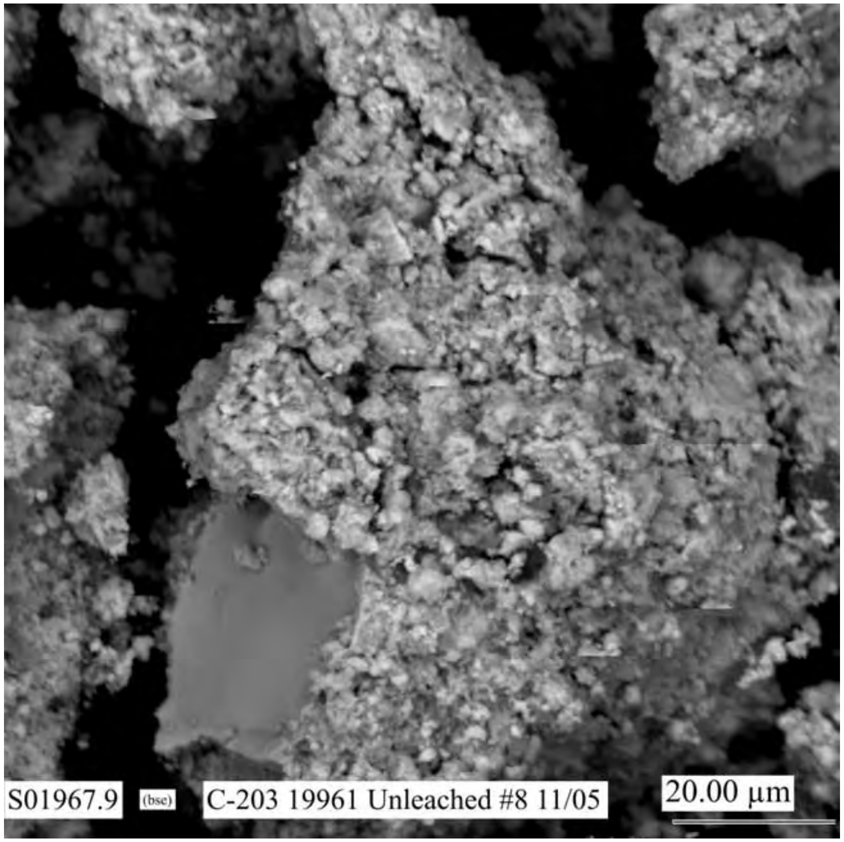


Figure G.9. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure G.7 (Areas where EDS analyses were made are shown in Figure G.17.)

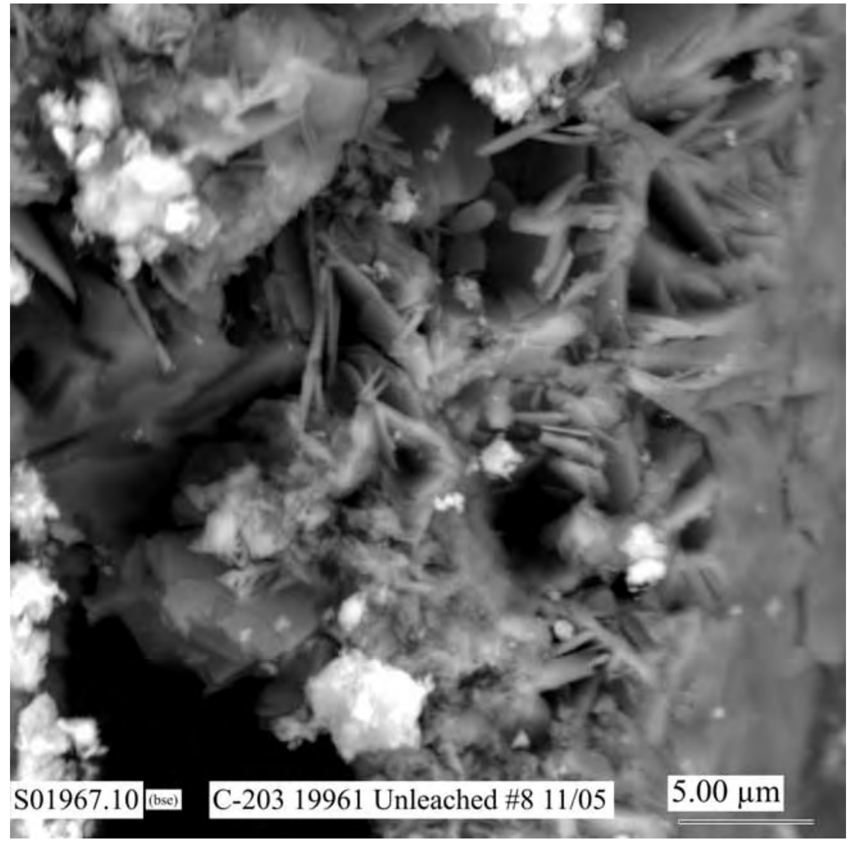


Figure G.10. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.8

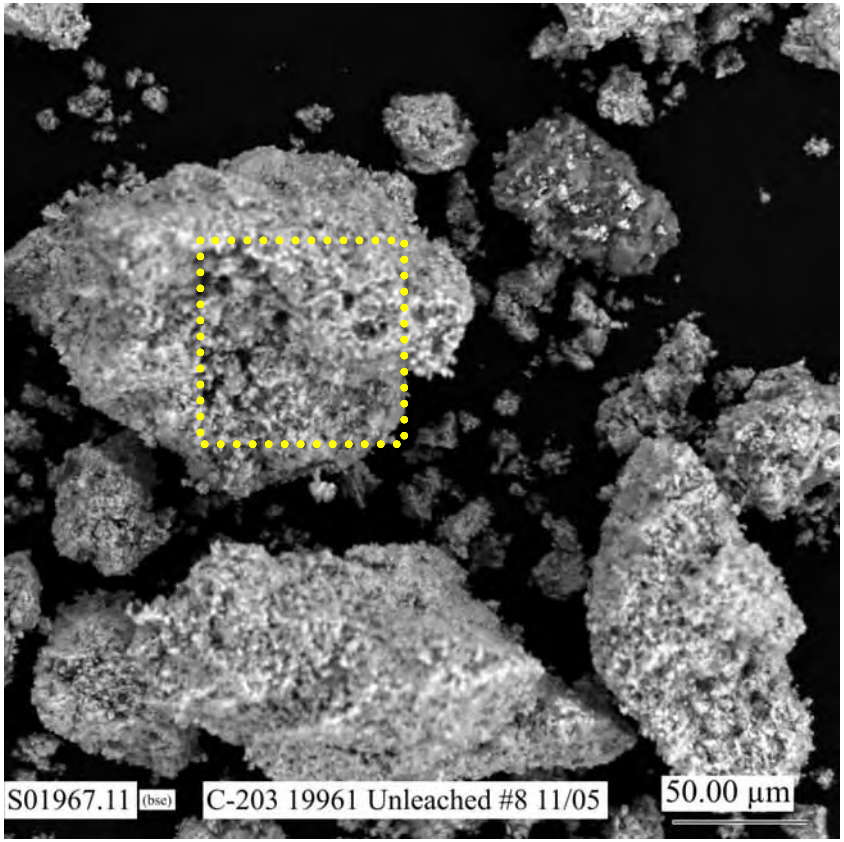


Figure G.11. Micrograph Showing Typical Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961) (Areas where EDS analyses were made are shown in Figures G.18 and G.19.)

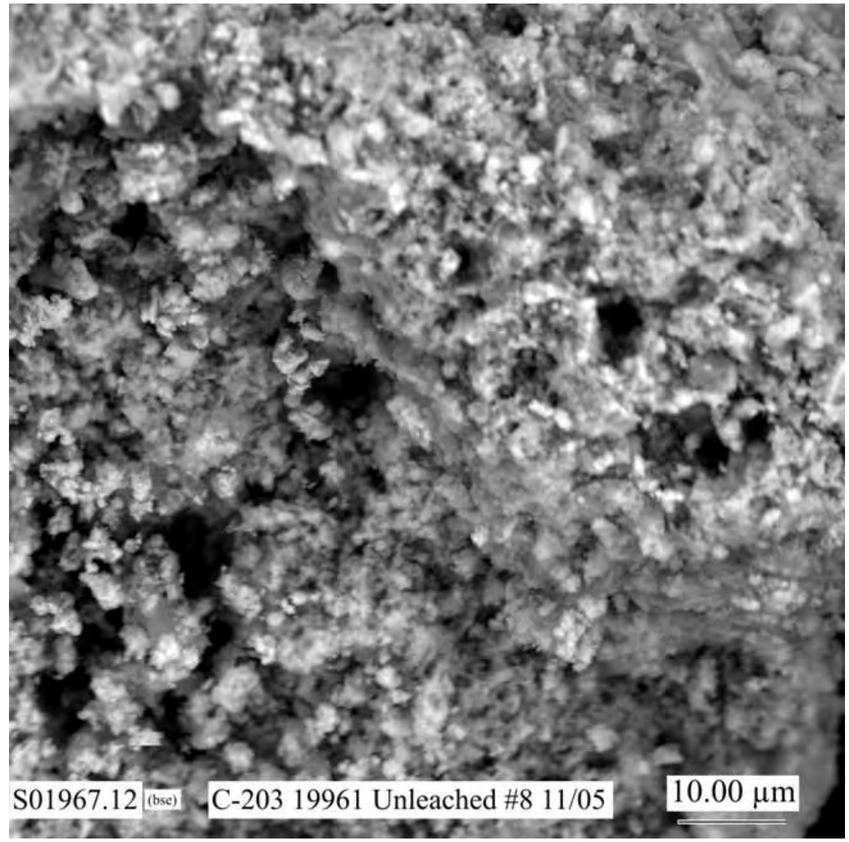


Figure G.12. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square in Figure G.11

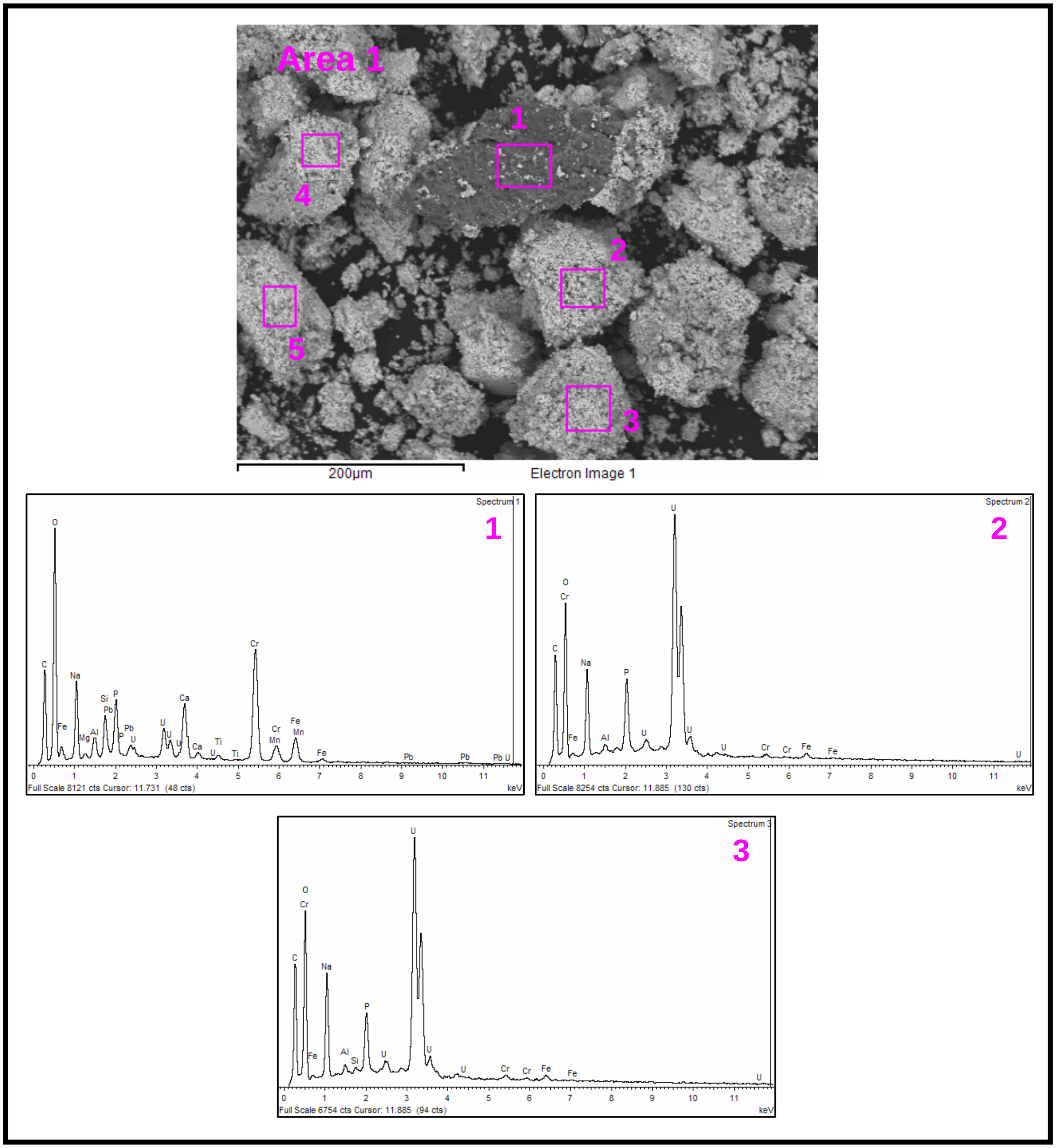


Figure G.13. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

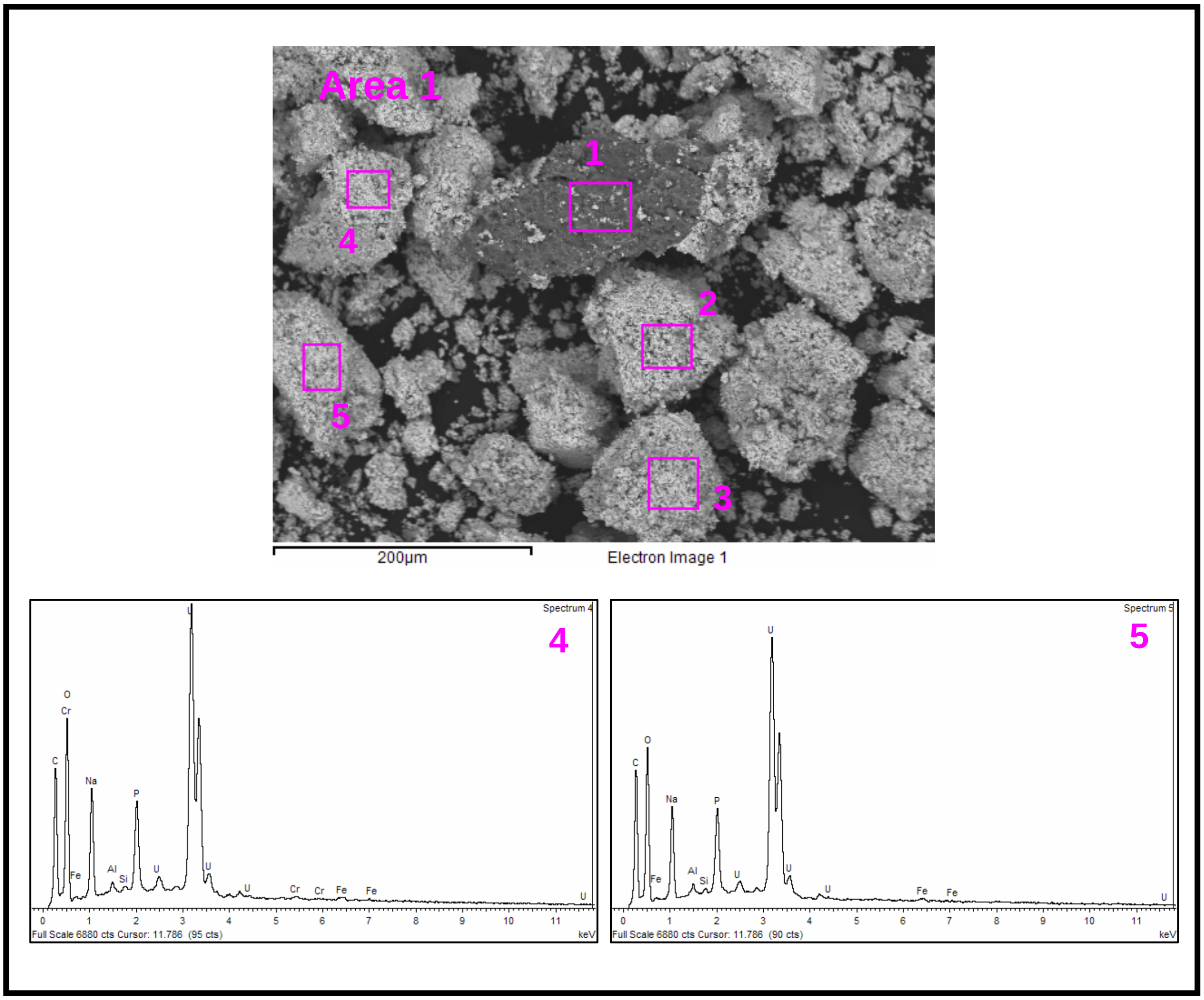


Figure G.14. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

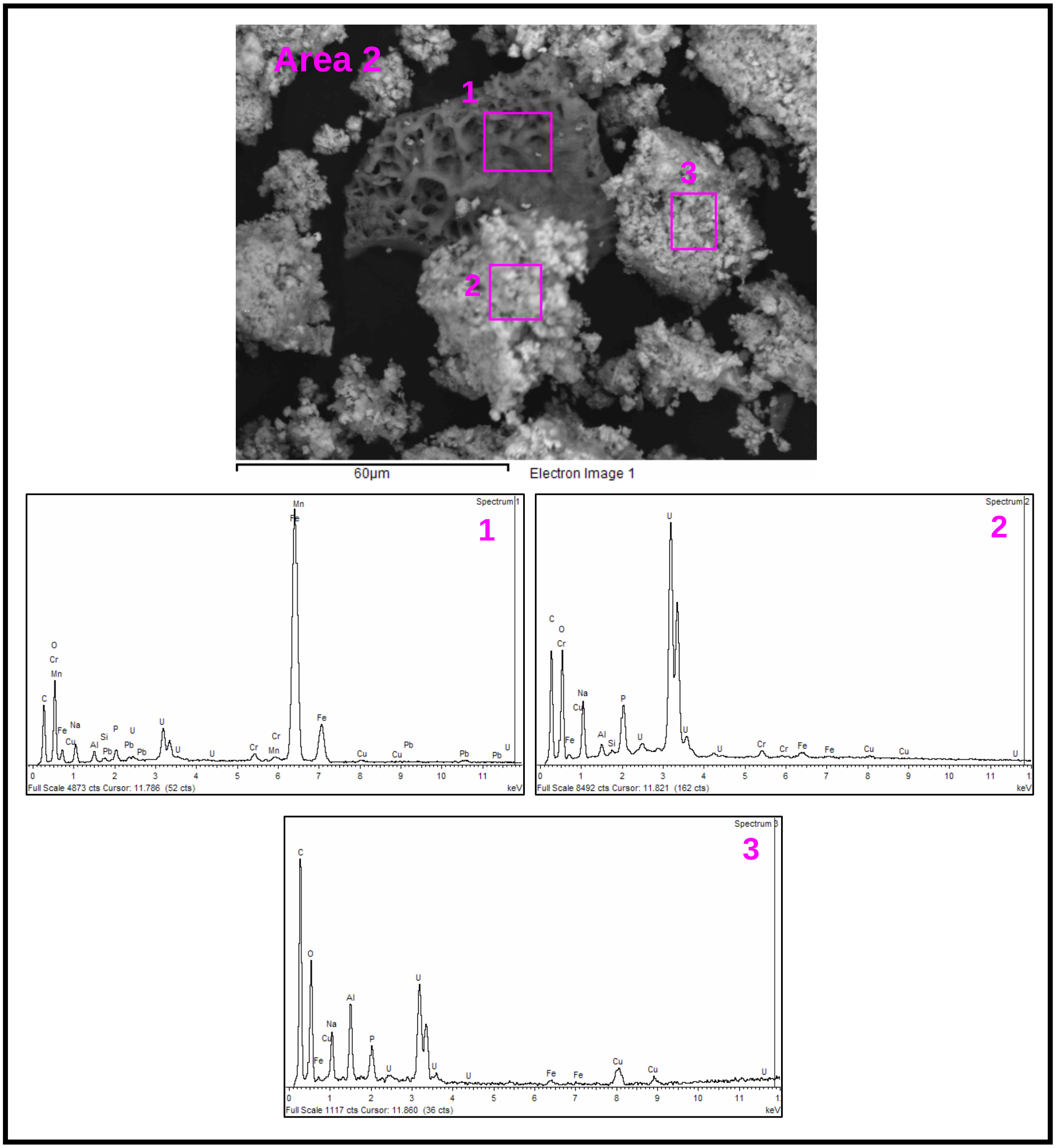


Figure G.15. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

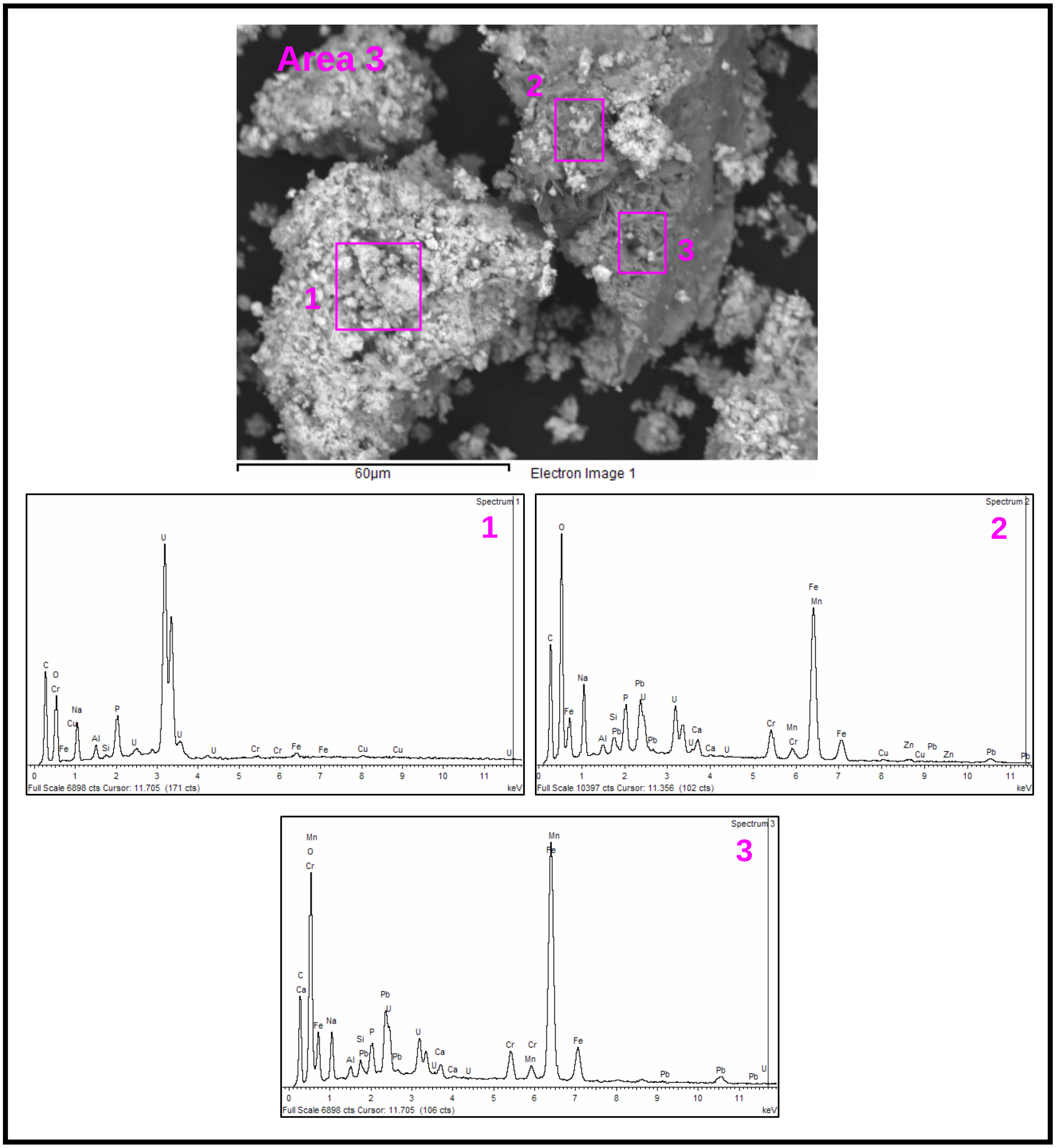


Figure G.16. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

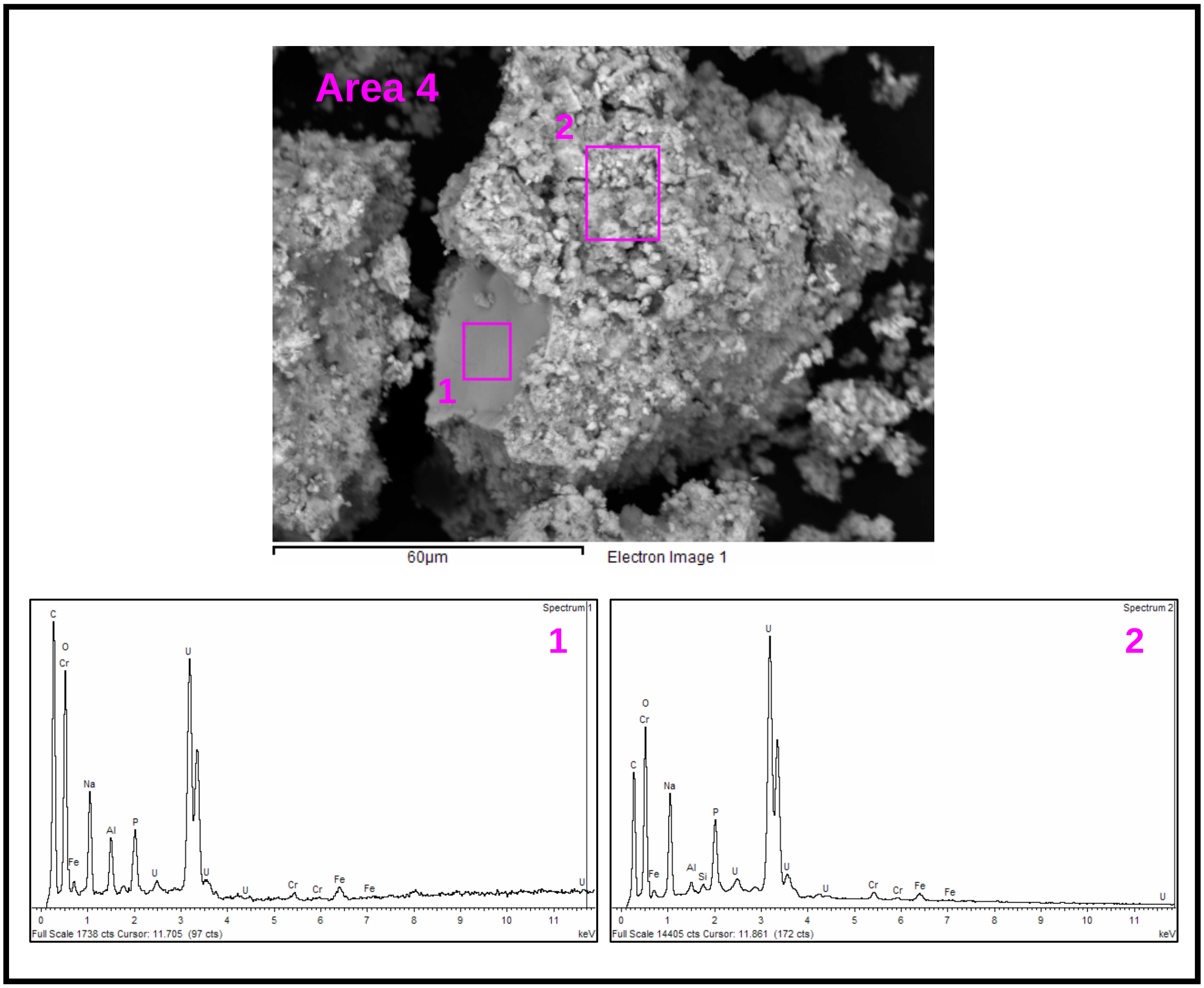


Figure G.17. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

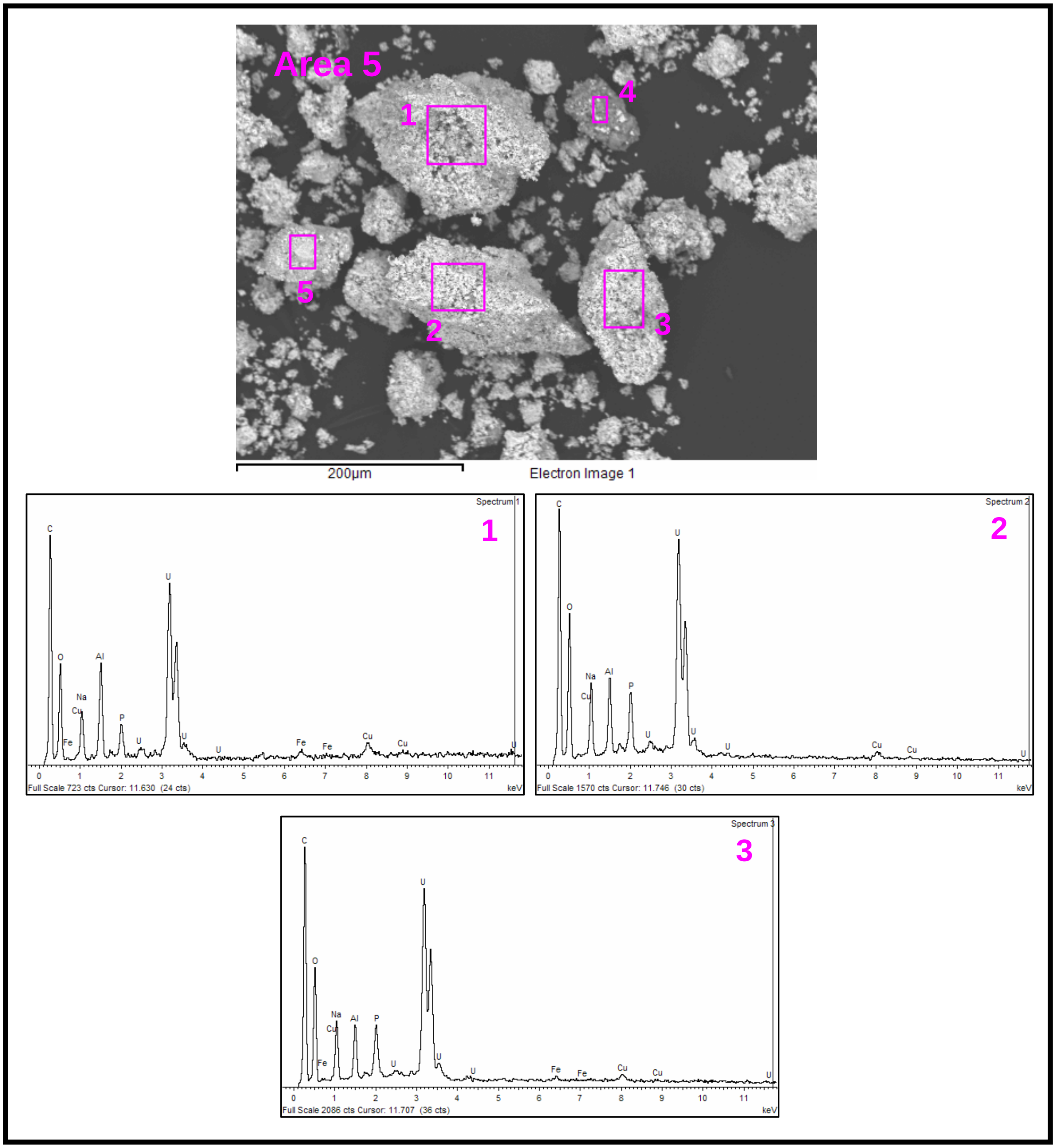


Figure G.18. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

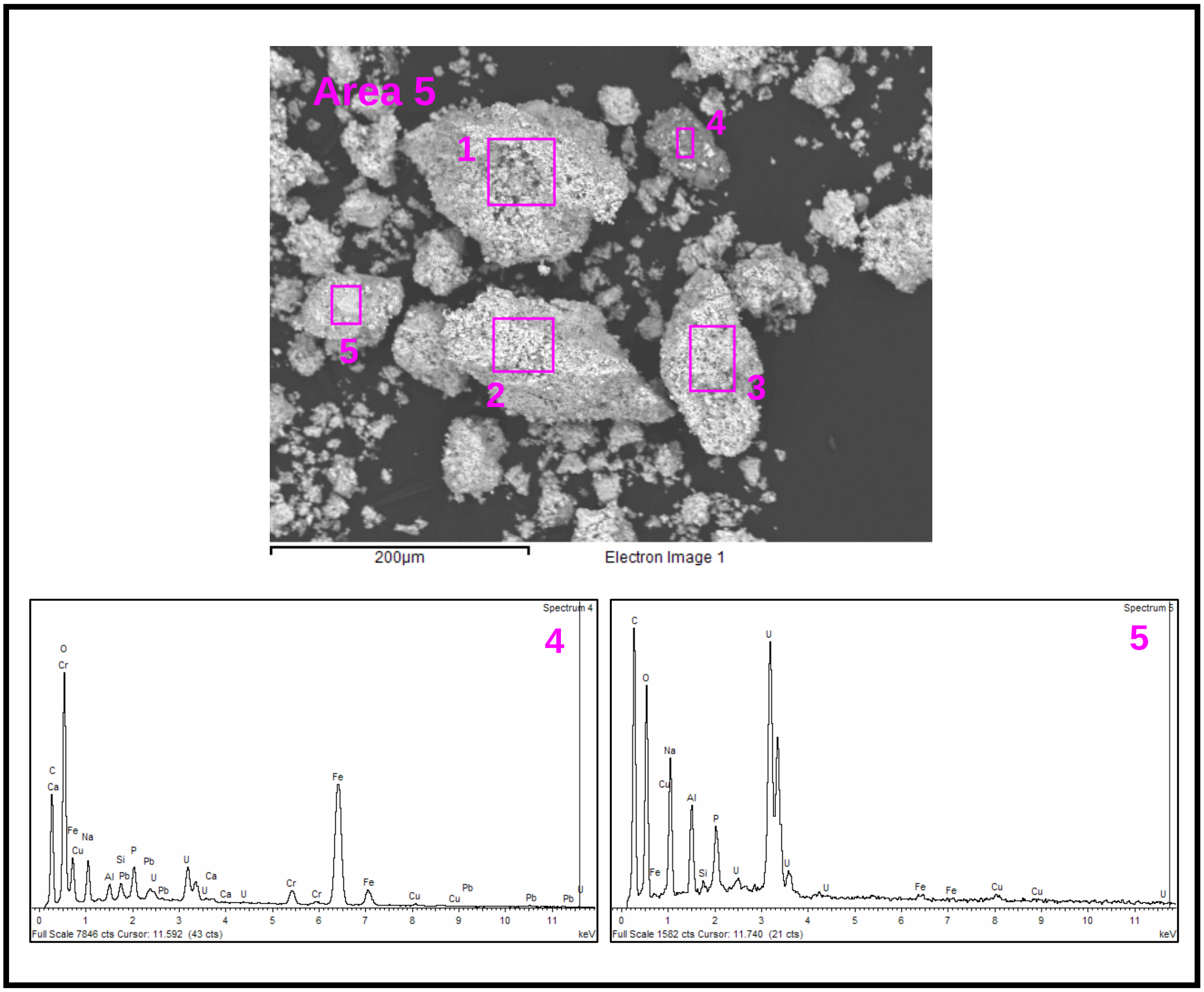


Figure G.19. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 8 of Unleached Residual Waste from Tank C-203 (Sample 19961)

Table G.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount 8

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
G.13 & G.14 / 1	1	0.4	5.1	1.3	0.1	4.7		1.5	47	*37*	1.6	0.6		0.2	1.1	Pb – 0.1, Ti – 0.1
	2	4.7	7.2	0.4		0.2			47	*38*	2.9	0.3				
	3	4.3	7.9	0.4		0.3			46	*38*	2.2	0.3			0.2	
	4	4.7	7.5	0.2		0.1			45	*39*	2.9	0.4			0.2	
	5	4.5	6.7	0.1					43	*42*	3.0	0.4			0.2	
G.14 / 2	1	0.7	3.0	23	0.2	0.4			25	*45*	0.6	0.7	0.3		0.2	Pb – 0.1
	2	5.4	5.8	0.4		0.5			41	*44*	2.3	0.7	0.2		0.2	
	3	1.3	2.6	0.2					30	*61*	0.9	2.2	1.5			
G.16 / 3	1	6.4	5.3	0.5		0.2			35	*48*	2.6	1.0	0.4		0.2	
	2	0.7	4.7	7.5	0.3	1.0		0.4	41	*42*	1.2	0.3	0.1		0.4	Pb – 0.5, Zn – 0.2
	3	0.5	4.0	13.1	0.5	1.2		0.4	39	*39*	1.0	0.4			0.5	Pb – 0.8
G.17 / 4	1	2.5	4.5	0.4		0.2			39	*51*	1.3	1.3				
	2	4.3	7.3	0.4		0.4			45	*40*	2.4	0.4			0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.

2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.

3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table G.3. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount 8

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
G.18 & G.19 / 5	1	2.6	2.8	0.4					27	*63*	1.0	3.1	1.0			
	2	2.7	3.7						33	*57*	1.6	2.2	0.5			
	3	2.7	3.4	0.2					30	*60*	1.4	1.8	0.5			
	4	0.5	3.1	6.8		0.6		0.1	45	*42*	1.0	0.6	0.1		0.5	Pb – 0.1
	5	2.6	5.5	0.2					36	*52*	1.2	2.1	0.3		0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

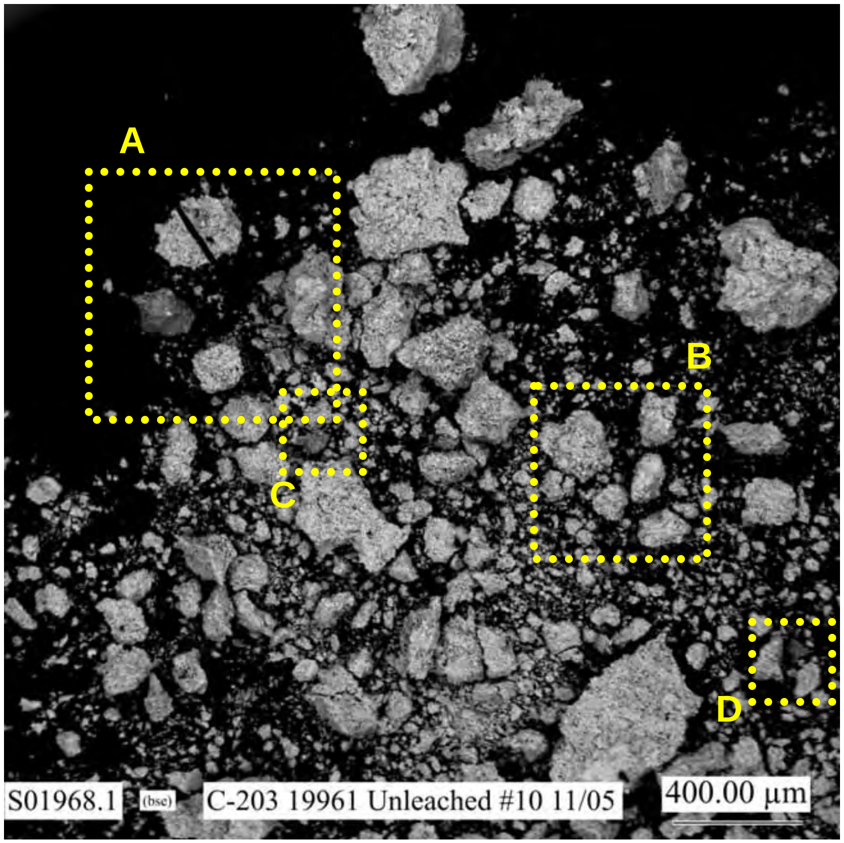


Figure G.20. Low Magnification Micrograph Showing Typical Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

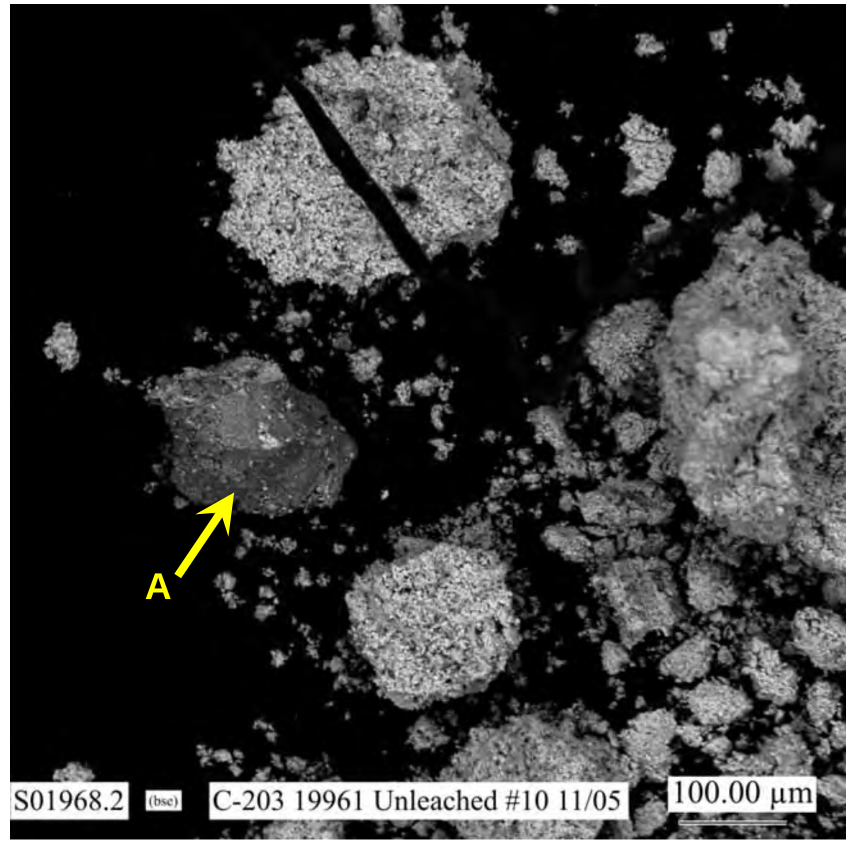


Figure G.21. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure G.20

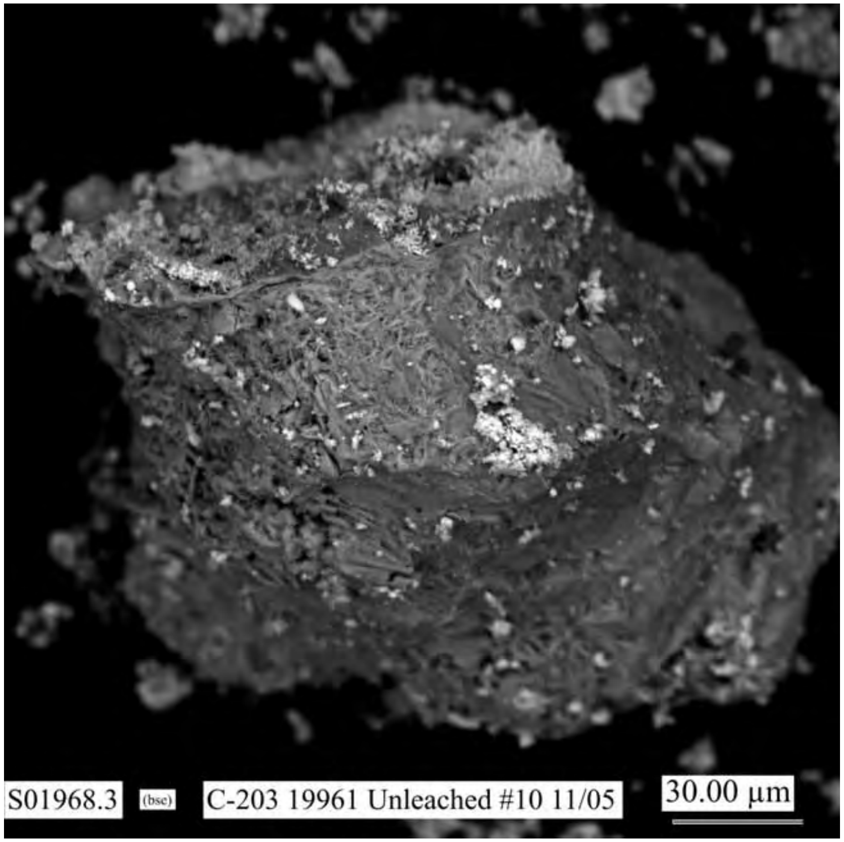


Figure G.22. Micrograph Showing at Higher Magnification the Large Particle Labeled A in Figure G.21 (Areas where EDS analyses were made are shown in Figure G.31.)

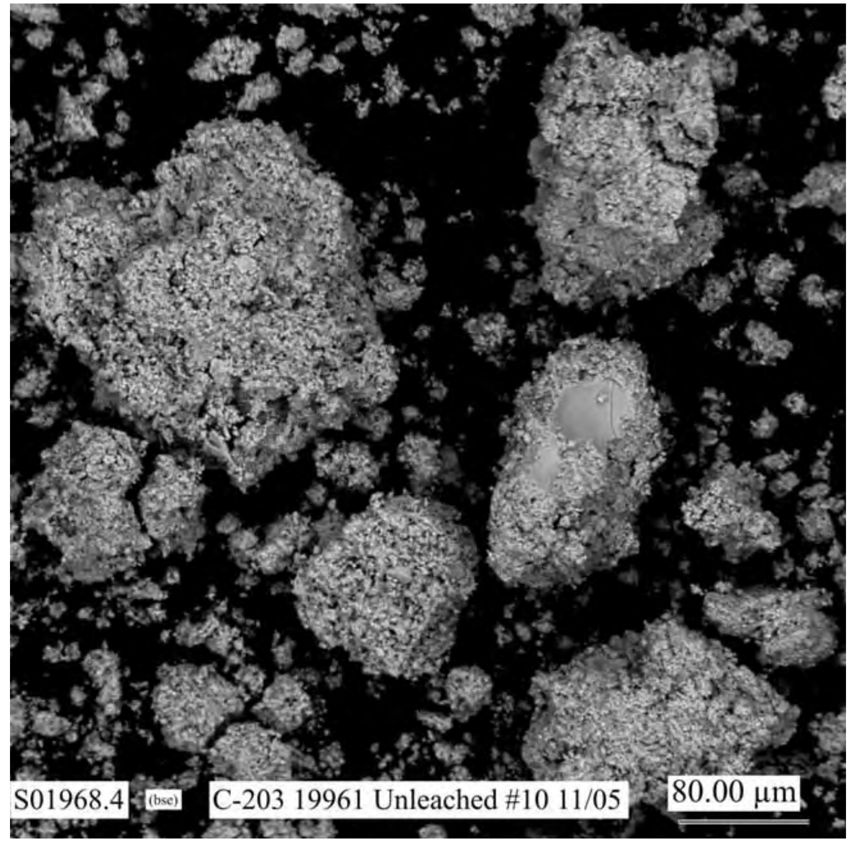


Figure G.23. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled B in Figure G.20 (Areas where EDS analyses were made are shown in Figures G.32 and G.33.)

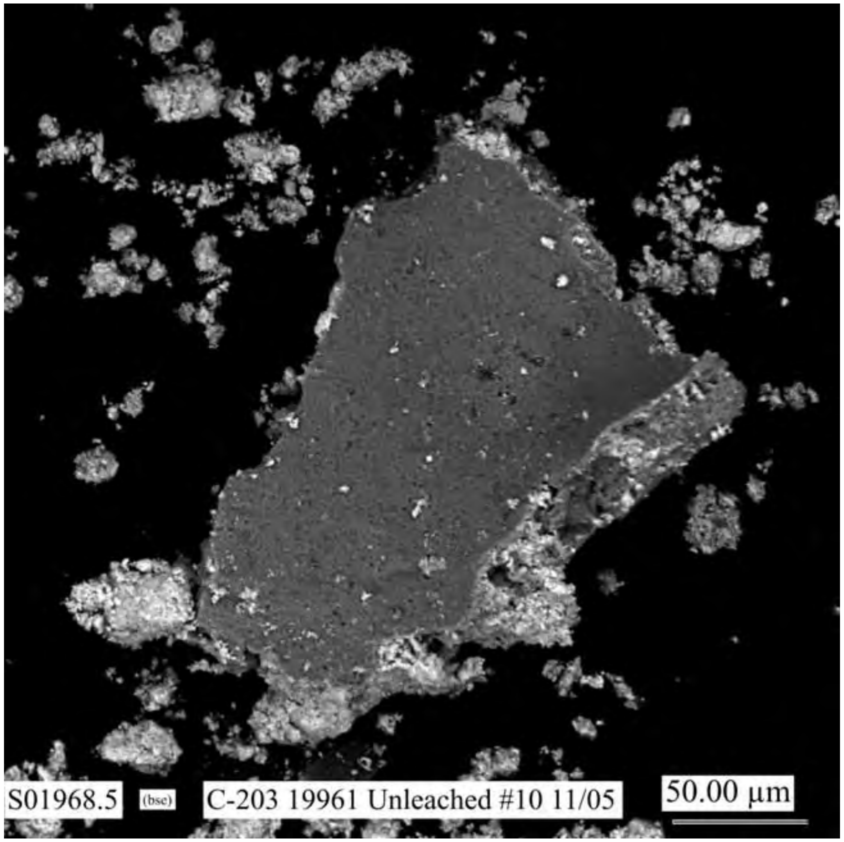


Figure G.24. Micrograph Showing Typical Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961) (Areas where EDS analyses were made are shown in Figure G.34.)

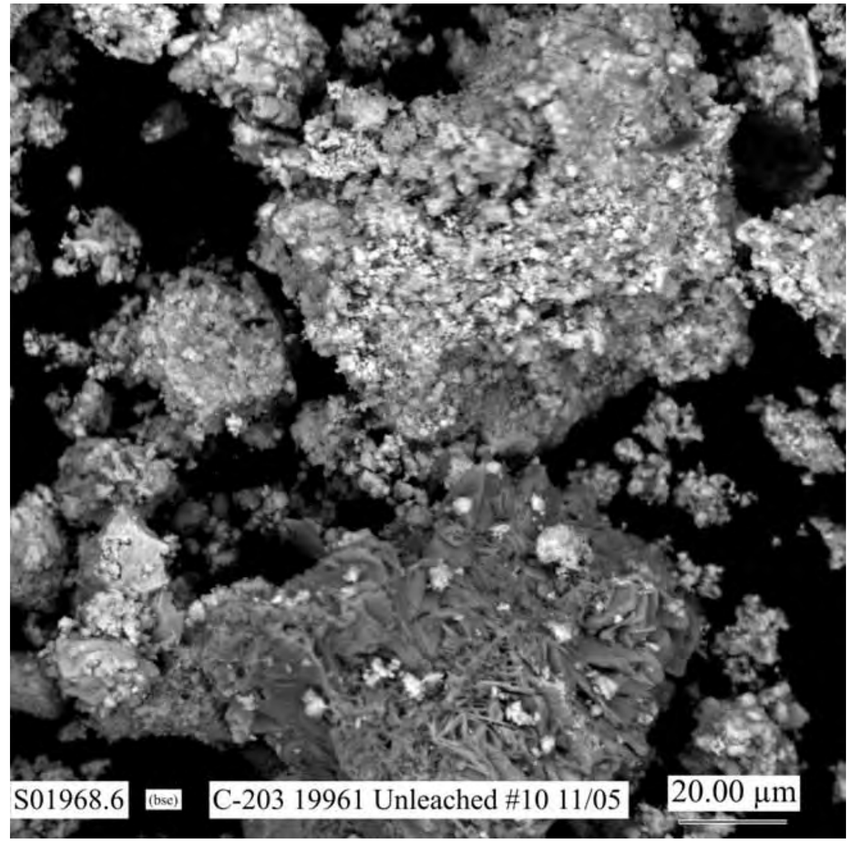


Figure G.25. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled C in Figure G.20 (Areas where EDS analyses were made are shown in Figure G.35.)

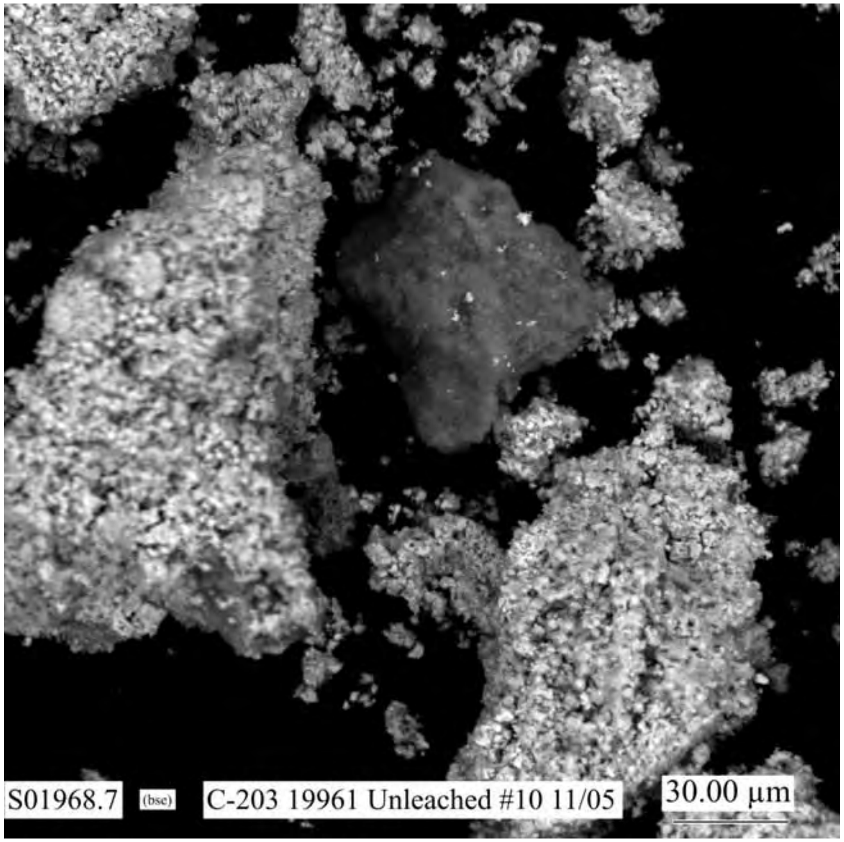


Figure G.26. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled D in Figure G.20 (Areas where EDS analyses were made are shown in Figure G.36.)

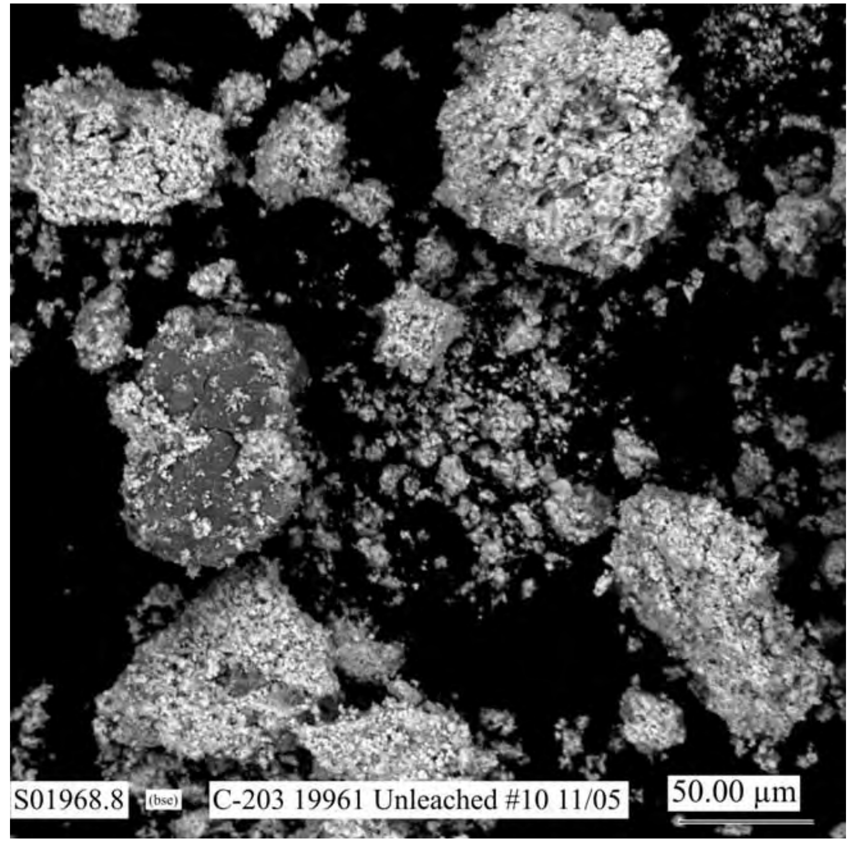


Figure G.27. Micrograph Showing Typical Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961) (Areas where EDS analyses were made are shown in Figures G.37 and G.38.)

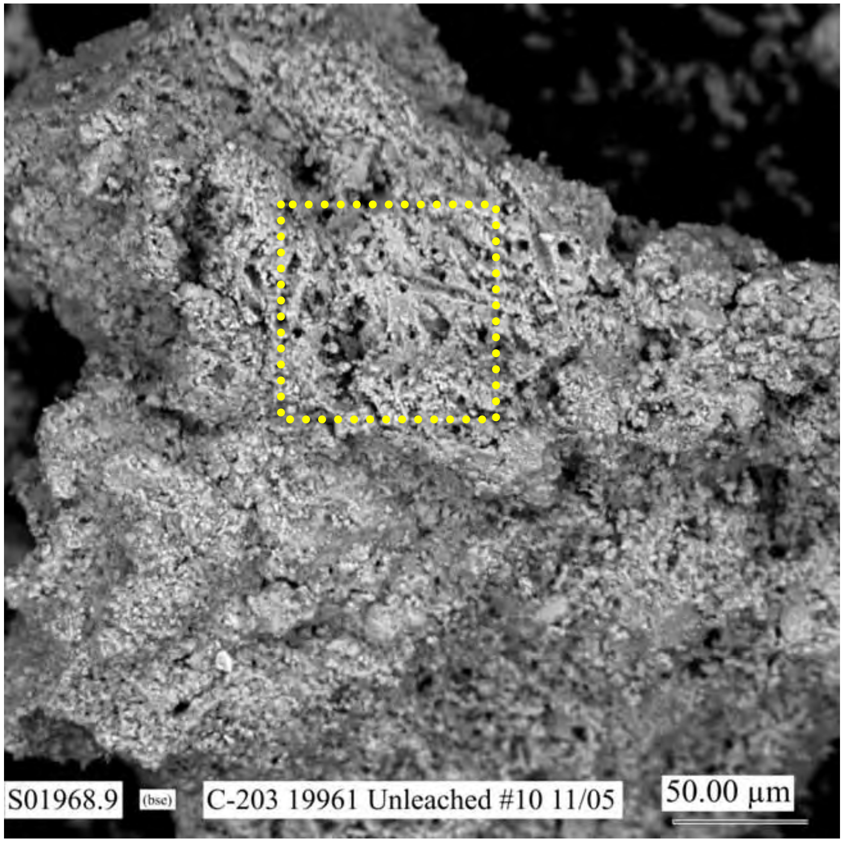


Figure G.28. Micrograph Showing Typical Particle Aggregate in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

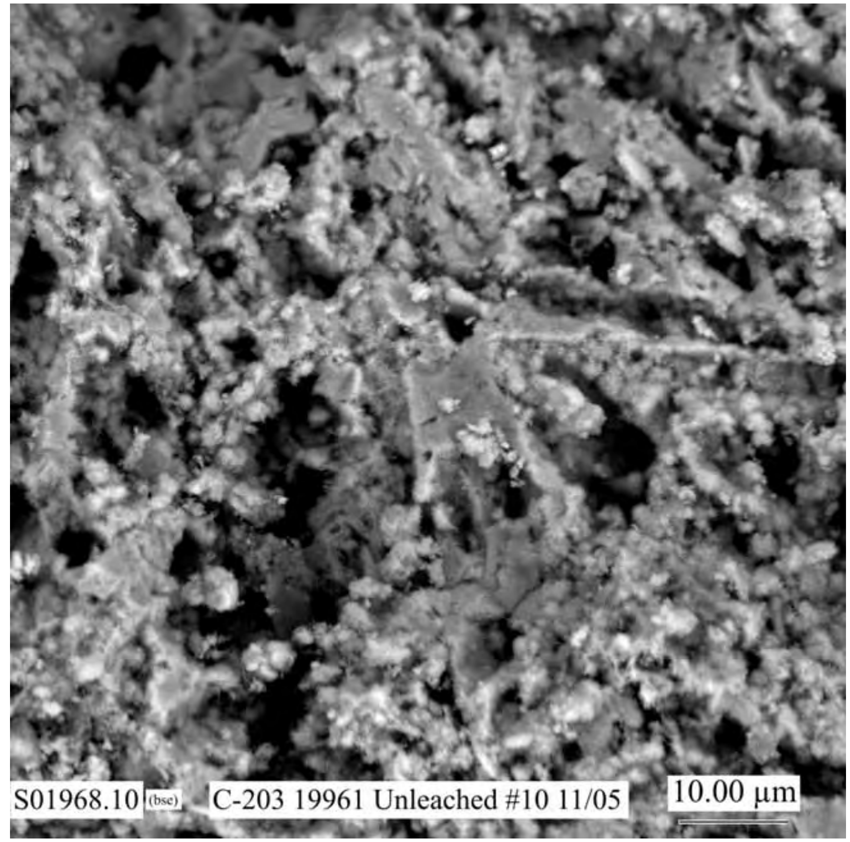


Figure G.29. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.28

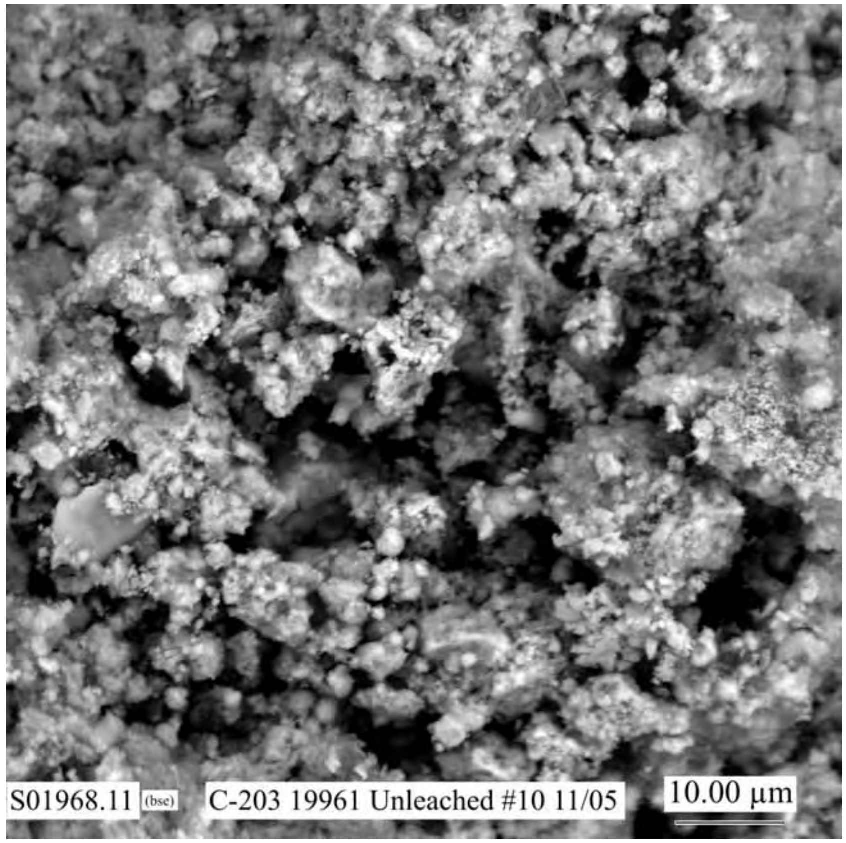


Figure G.30. Micrograph Showing Typical Particle Aggregate in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

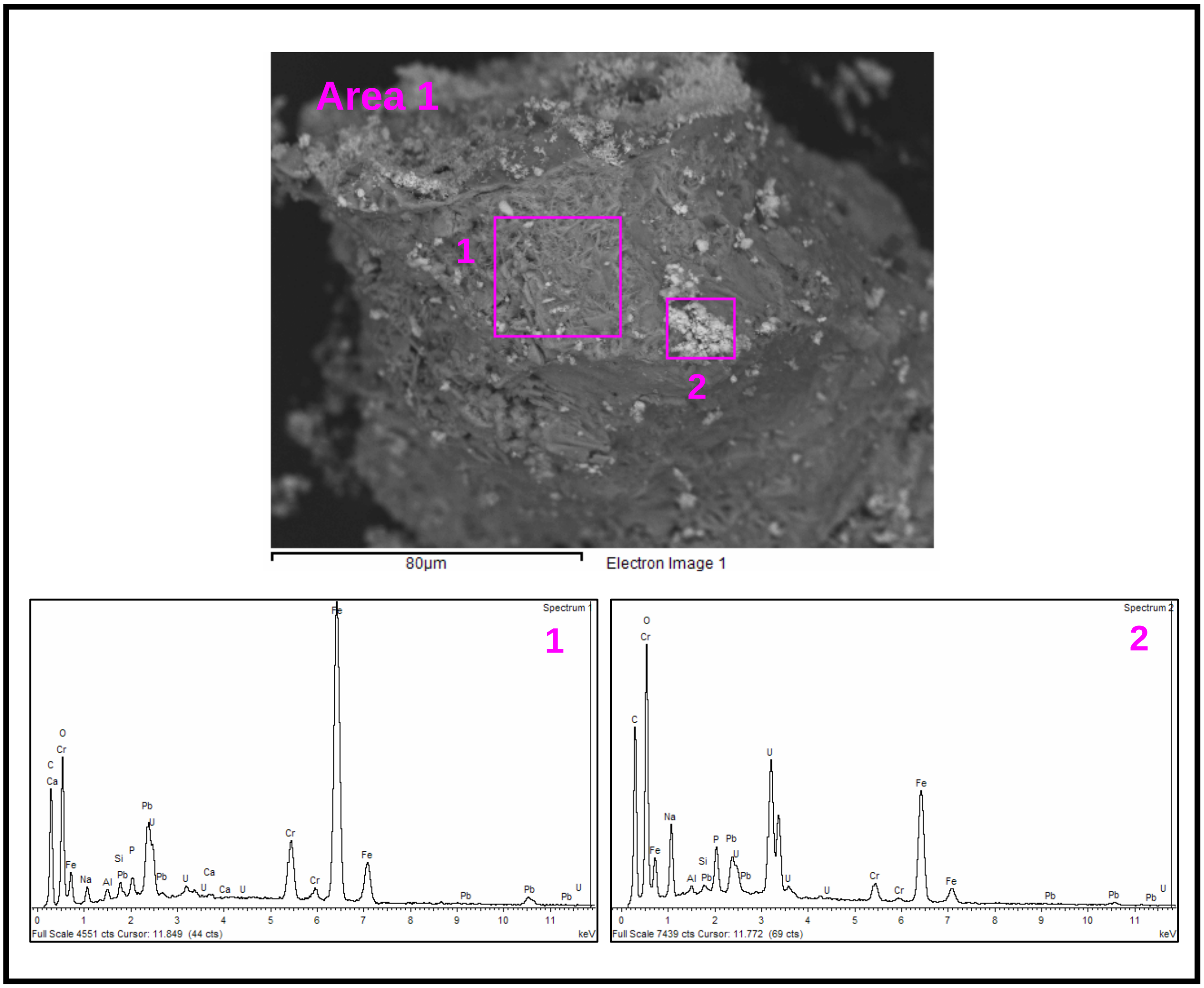


Figure G.31. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

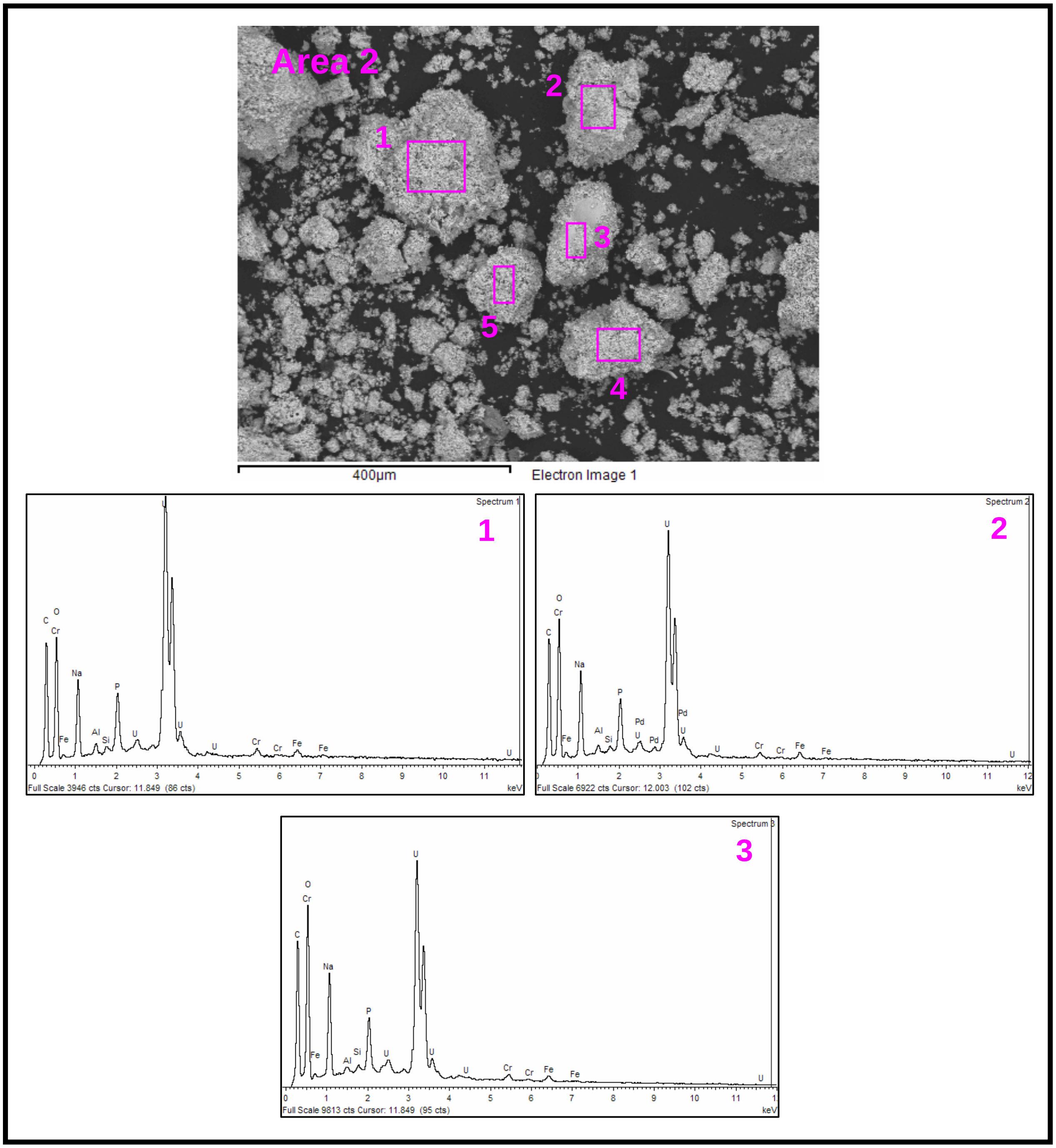


Figure G.32. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

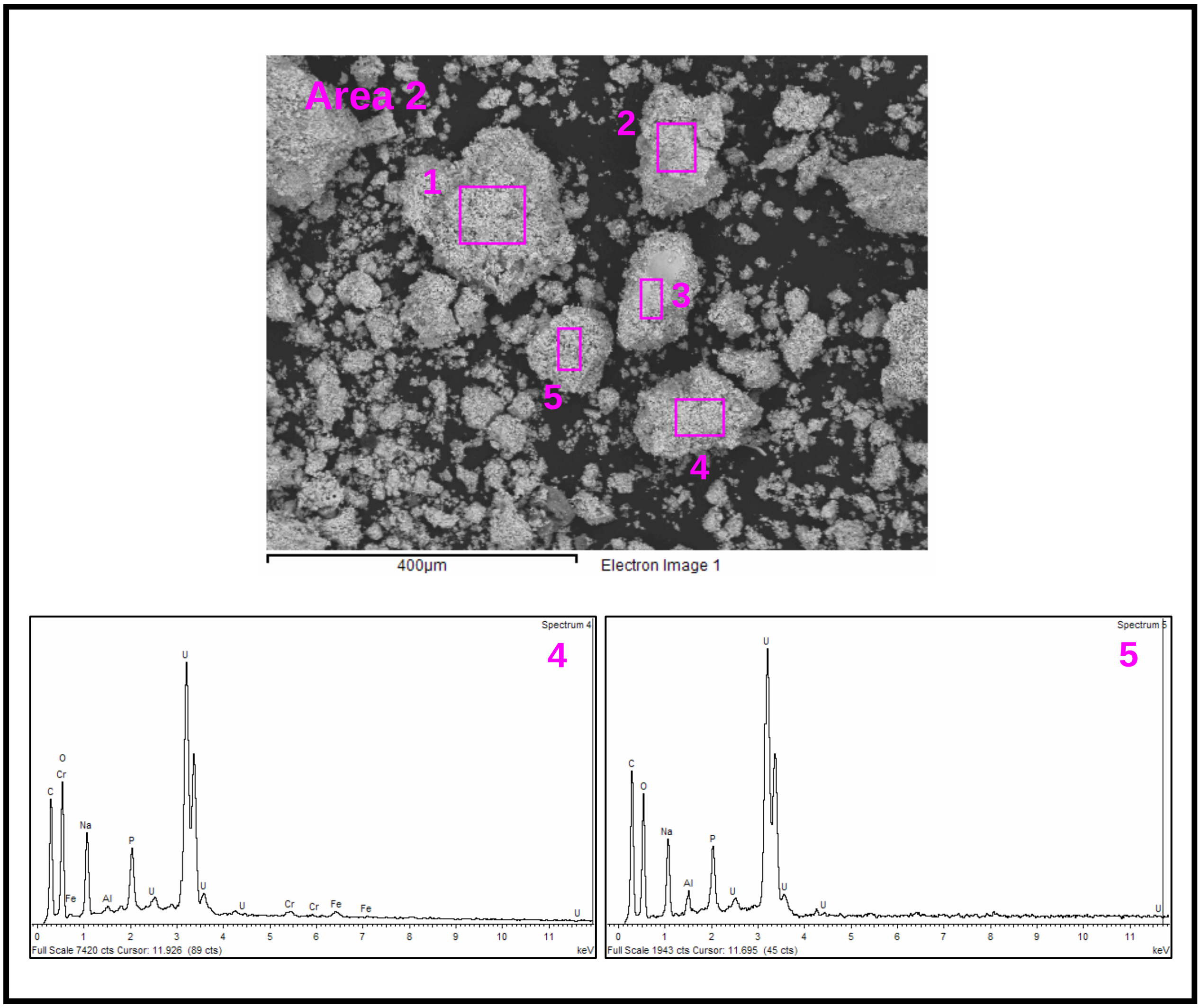


Figure G.33. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

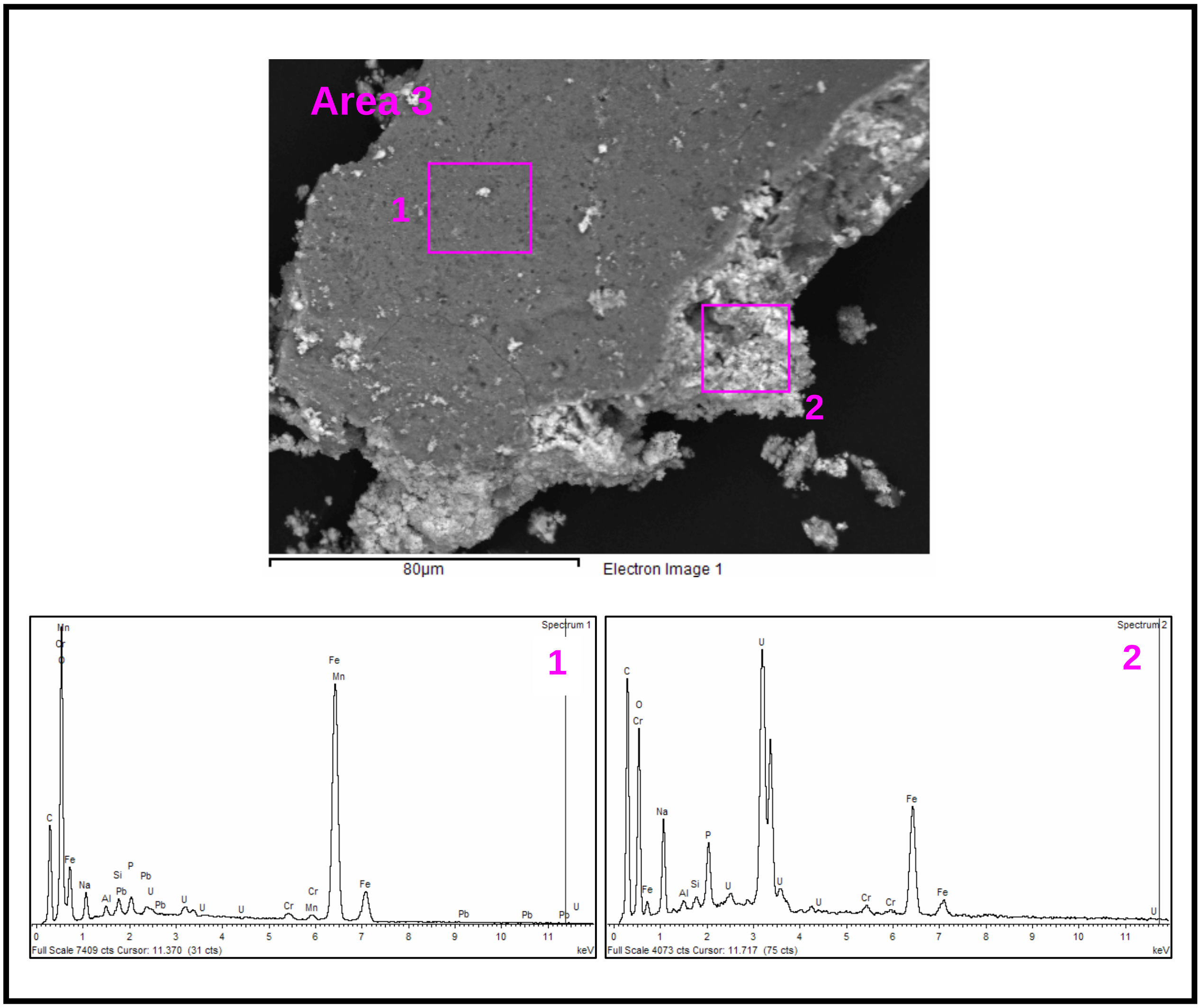


Figure G.34. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

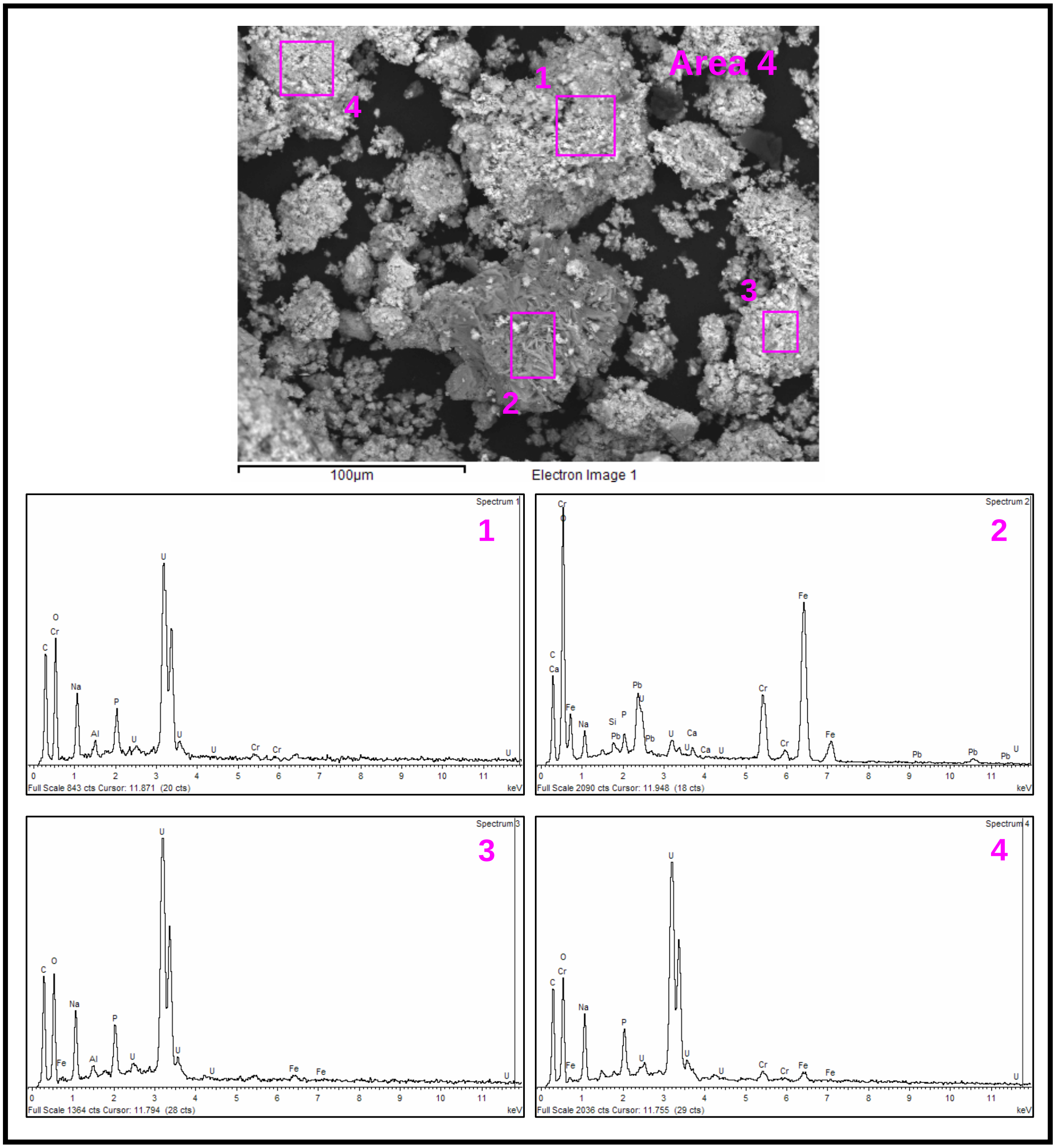


Figure G.35. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

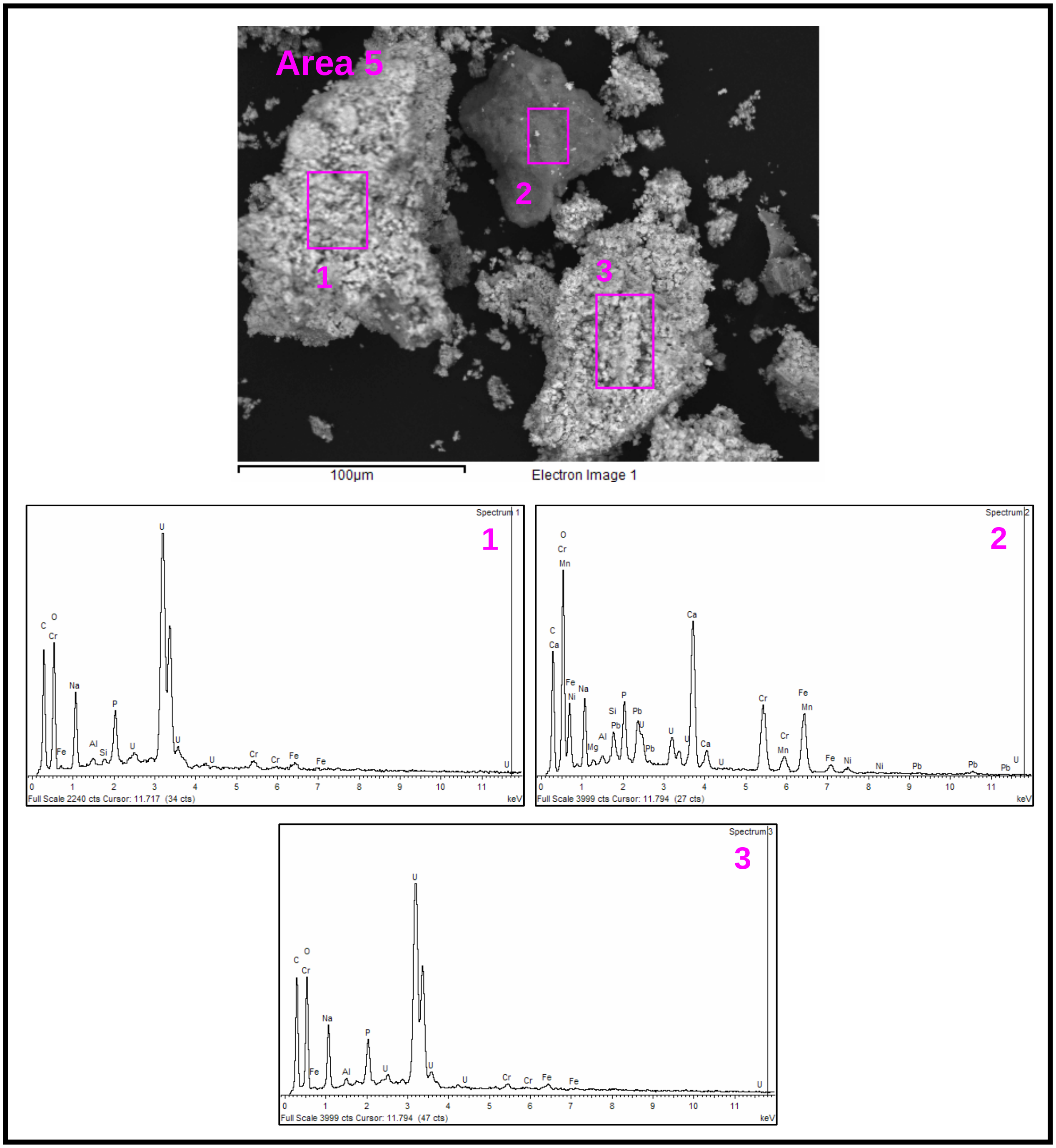
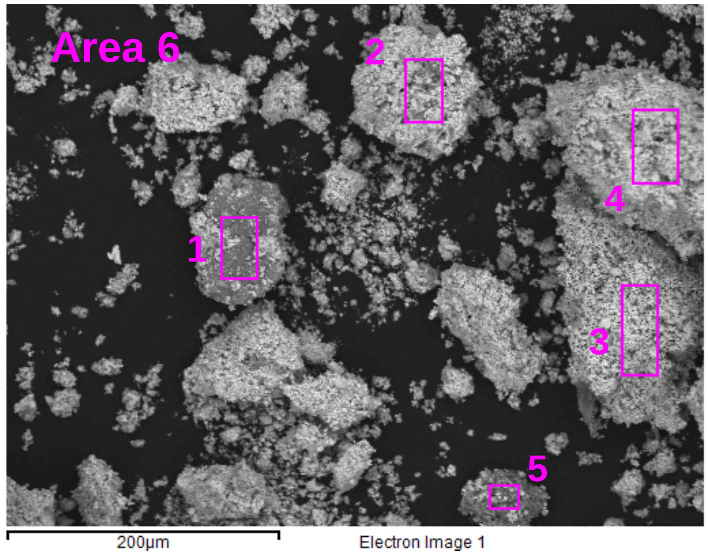


Figure G.36. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)



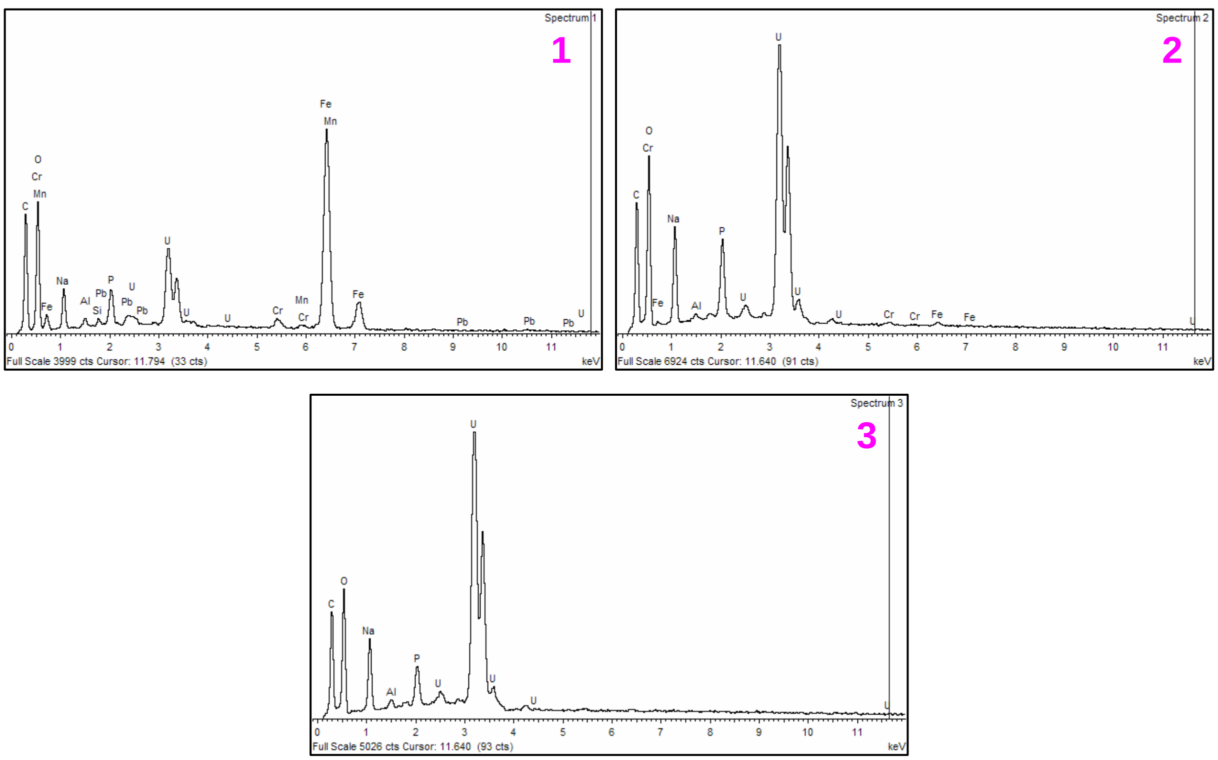


Figure G.37. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

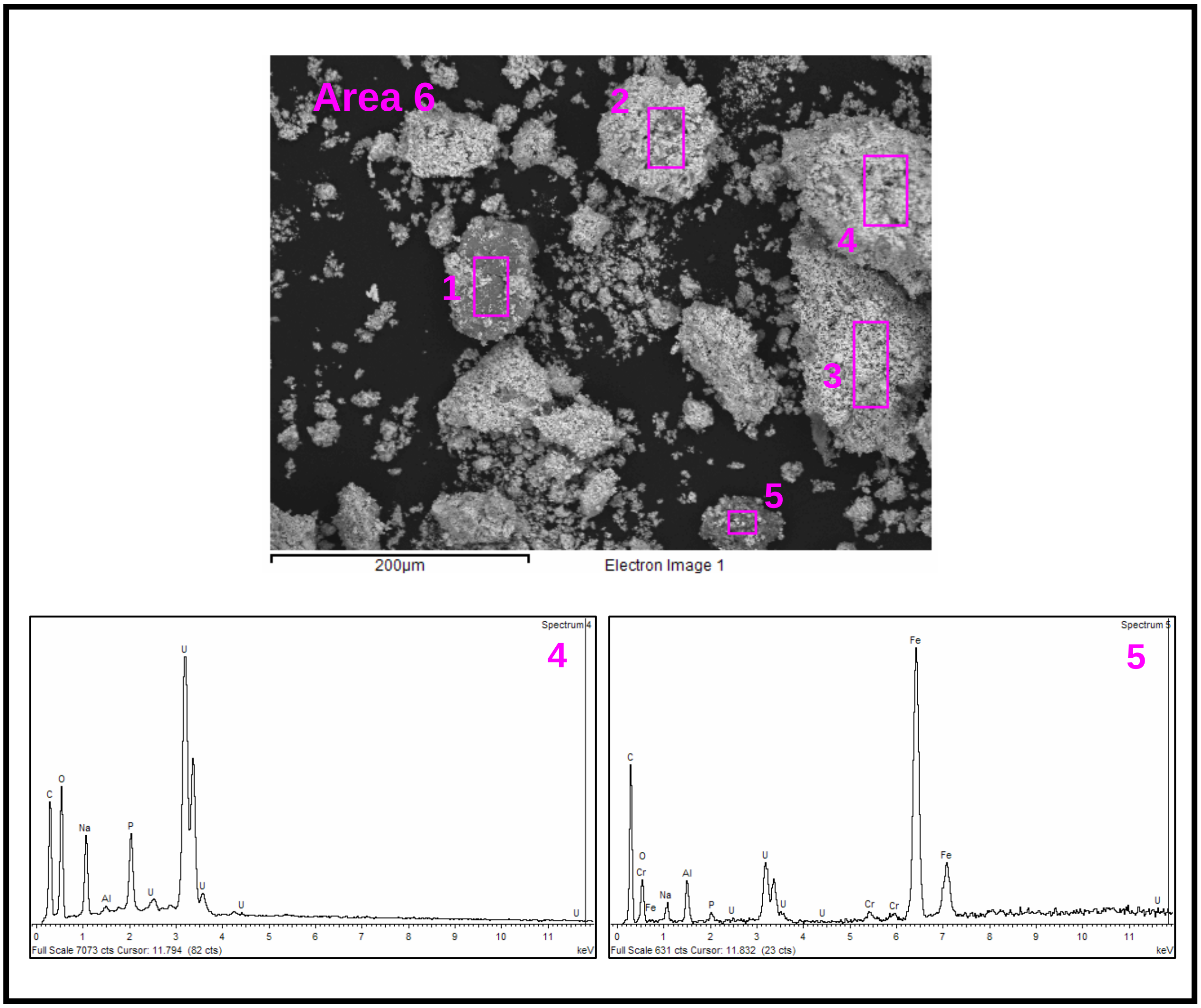


Figure G.38. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 10 of Unleached Residual Waste from Tank C-203 (Sample 19961)

Table G.4. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount 10

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
G.31 / 1	1	0.1	1.4	16		2.3		0.1	28	*50*	0.6	0.4			0.5	Pb – 0.8
	2	1.6	4.1	5.1		0.6			43	*44*	1.1	0.2			0.2	Pb – 0.3
G.32 & G.33 / 2	1	5.4	6.9	0.5		0.4			40	*43*	2.4	0.5			0.3	
	2	4.6	7.6	0.5		0.3			45	*39*	2.3	0.4			0.2	Pd – 0.1
	3	3.6	7.3	0.4		0.3			45	*42*	1.8	0.2			0.2	
	4	4.9	7.1	0.4		0.3			43	*42*	2.5	0.3				
	5	4.9	6.2						38	*47*	2.4	0.9				
G.34 / 3	1	0.1	2.2	12	0.2	0.2			45	*39*	0.5	0.3			0.5	Pb – 0.1
	2	2.9	4.8	4.7		0.3			34	*52*	1.5	0.3			0.3	
G.35 / 4	1	4.5	6.1			0.4			44	*42*	1.9	0.8				
	2	0.2	2.3	9.4		2.8		0.3	47	*37*	0.6				0.3	Pb – 0.7
	3	5.6	7.0	0.5					41	*43*	2.5	0.6				
	4	5.4	7.1	0.8		0.7			42	*42*	2.4					

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.

2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.

3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table G.5. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount 10

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
G.36 / 5	1	4.7	6.8	0.5		0.5			42	*43*	2.2	0.3			0.3	
	2	0.4	4.2	2.8	0.3	2.3	0.3	3.6	44	*39*	1.5	0.2		0.2	0.7	Pb – 0.4
	3	4.5	6.2	0.4		0.3			42	*45*	2.1	0.4				
G.37 & G.38 / 6	1	4.8	7.2	0.2		0.1			46	*39*	2.8	0.2				
	2	6.3	7.2						45	*39*	2.0	0.5				
	3	5.1	6.9						43	*42*	3.1	0.2				
	4	0.9	1.5	17		0.4			11	*67*	0.3	1.7				
	5	1.3	3.6	12	0.2	0.4			31	*50*	1.3	0.3			0.2	Pb – 0.1

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

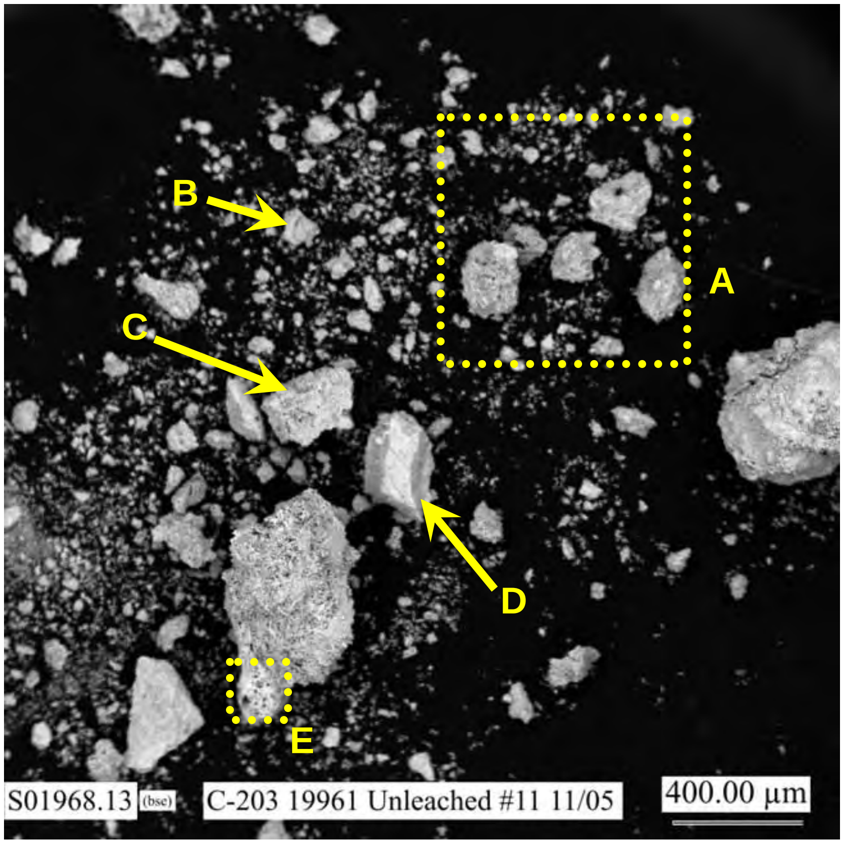


Figure G.39. Low Magnification Micrograph Showing Typical Particles in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

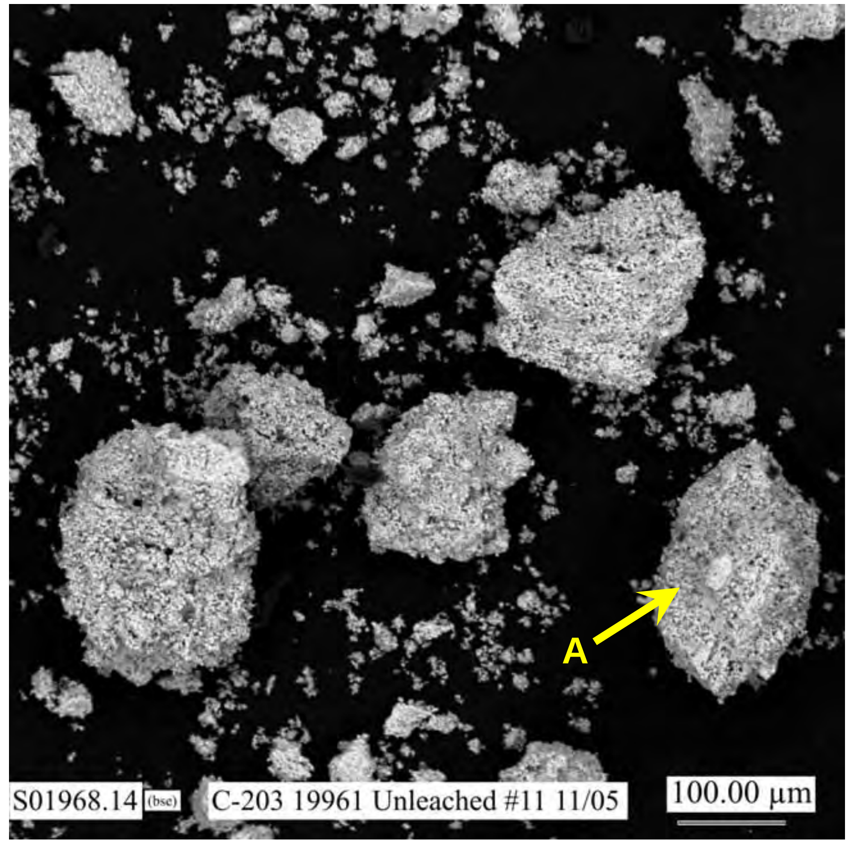


Figure G.40. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure G.39

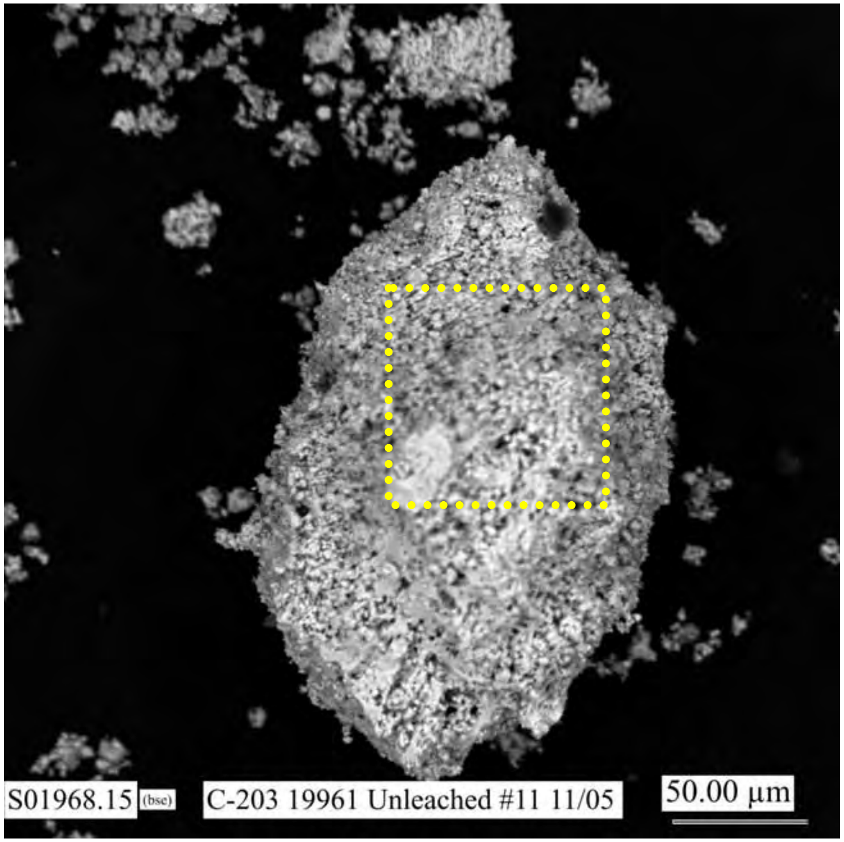


Figure G.41. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure G.40

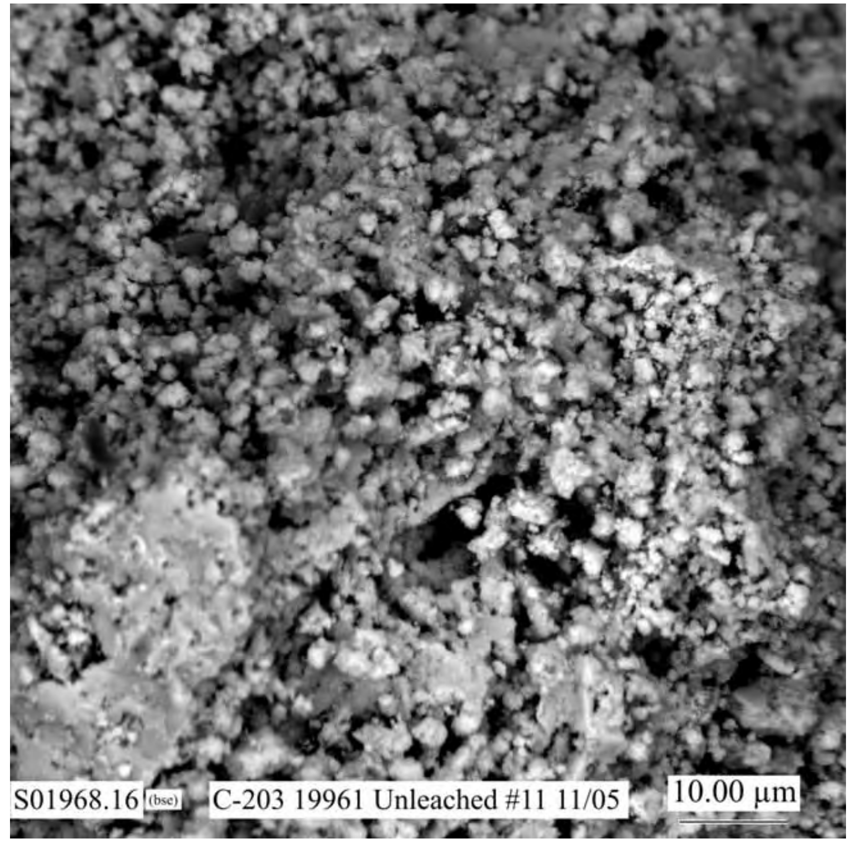


Figure G.42. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.41 (Areas where EDS analyses were made are shown in Figure G.55.)

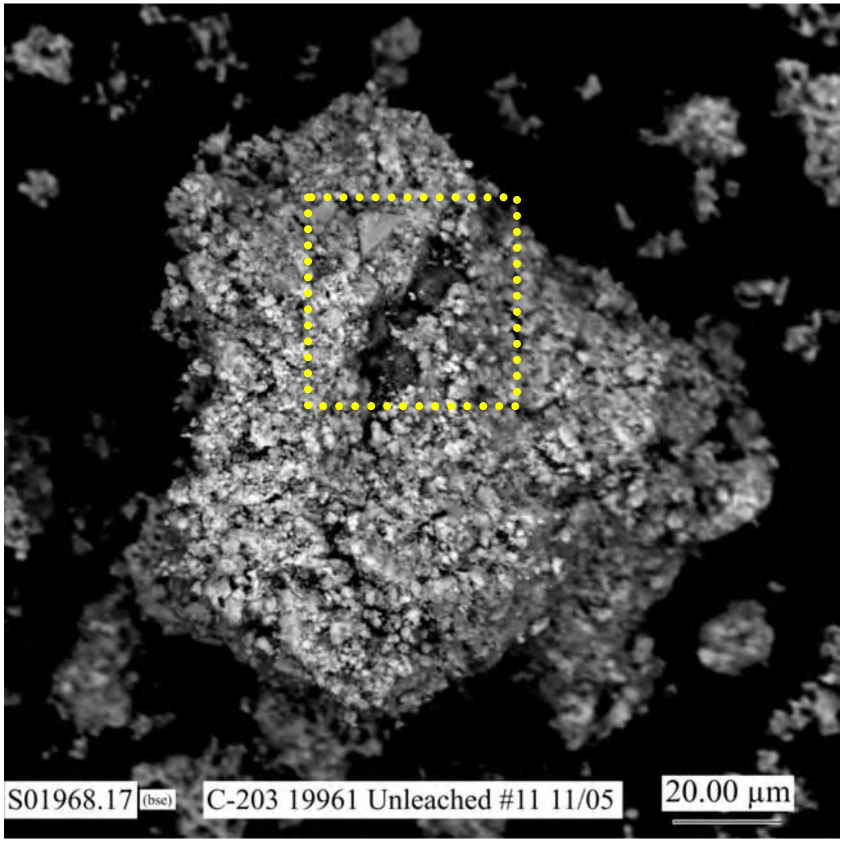


Figure G.43. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled B in Figure G.39

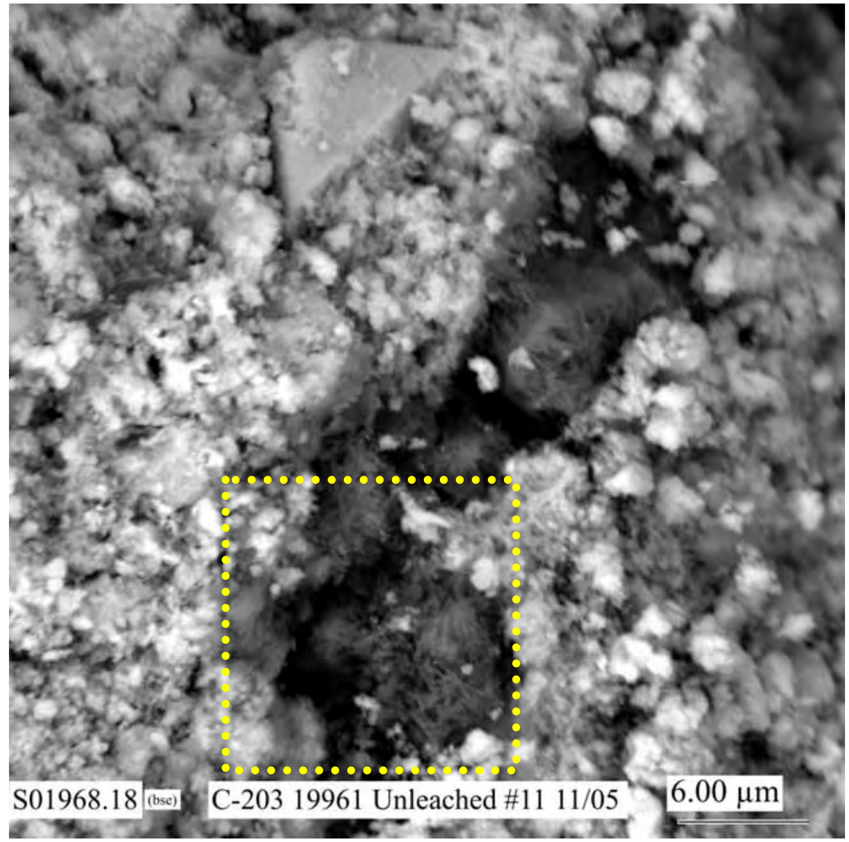


Figure G.44. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.43 (Areas where EDS analyses were made are shown in Figure G.56.)

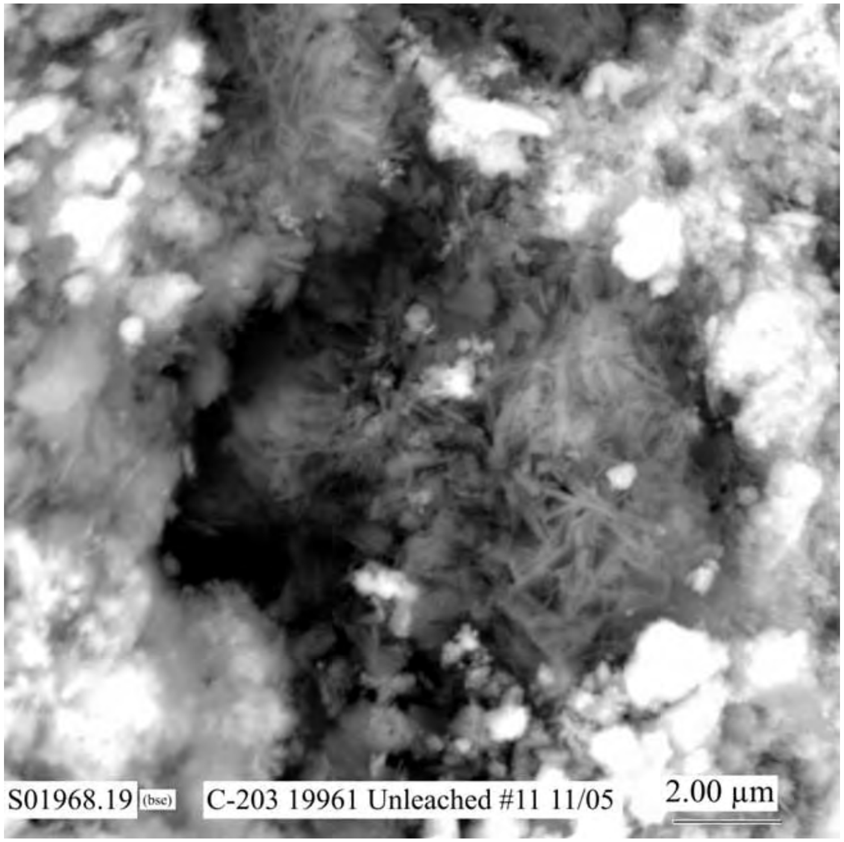
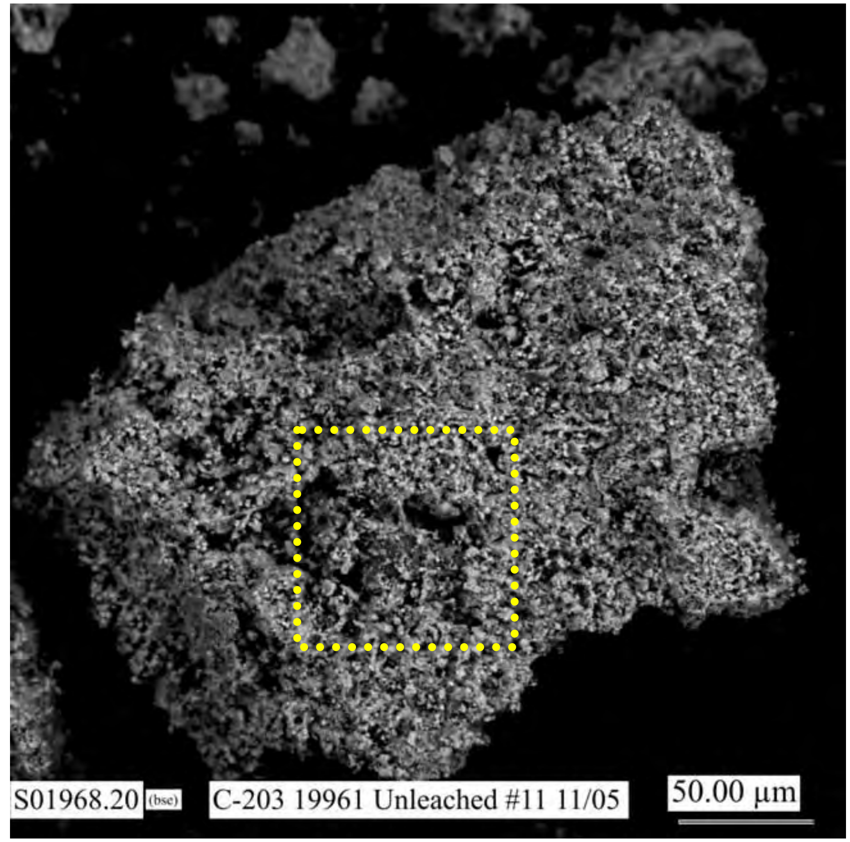
	

Figure G.45. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.44	**Figure G.46**. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled C in Figure G.39

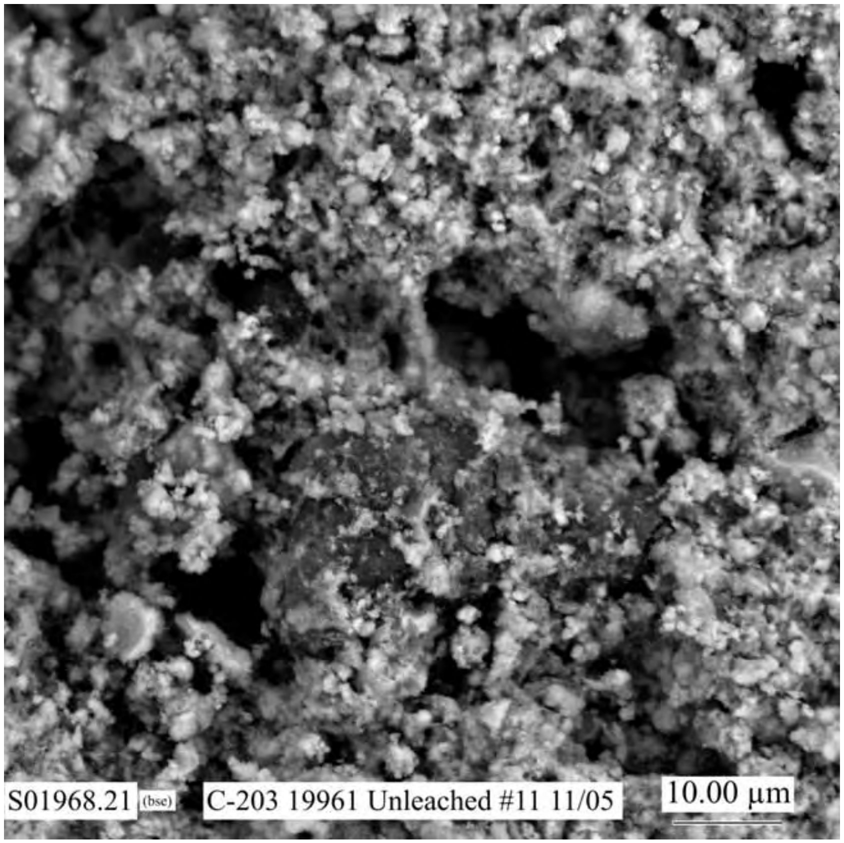


Figure G.47. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure G.46 (Areas where EDS analyses were made are shown in Figure G.57.)

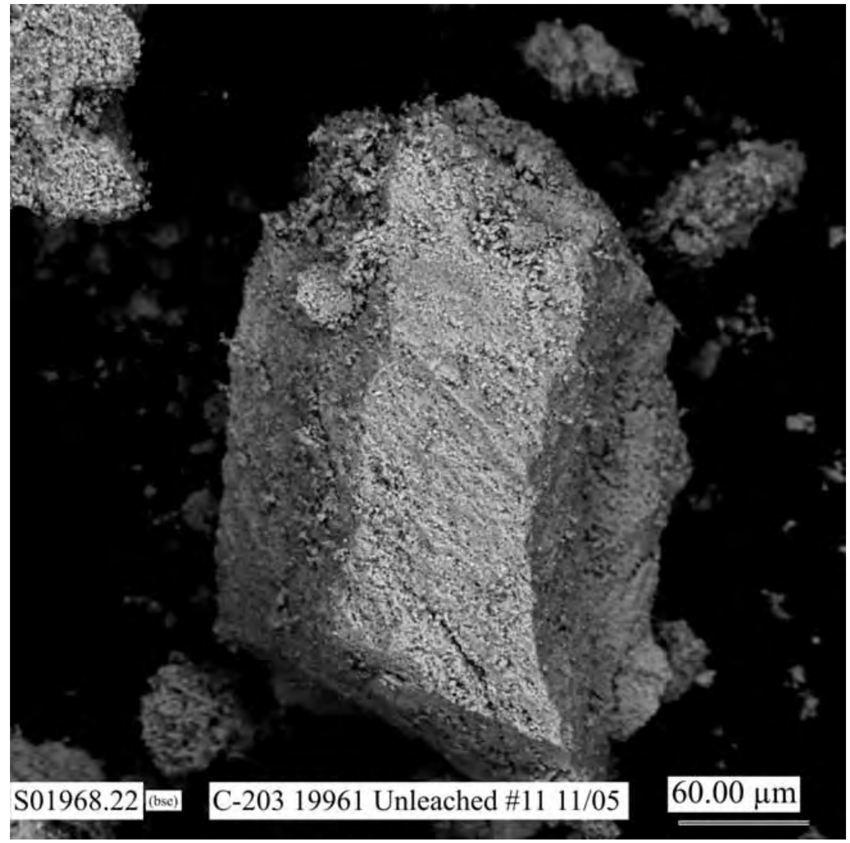


Figure G.48. Micrograph Showing at Higher Magnification the Particle Labeled D in Figure G.39

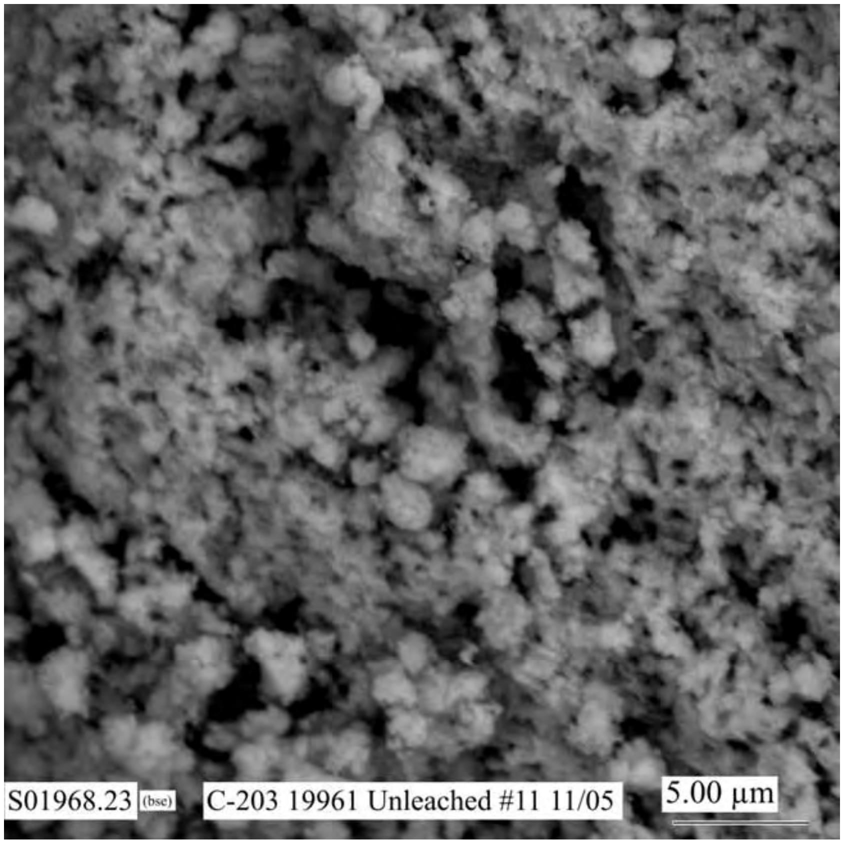


Figure G.49. Micrograph Showing at High Magnification Typical Particle Aggregate in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

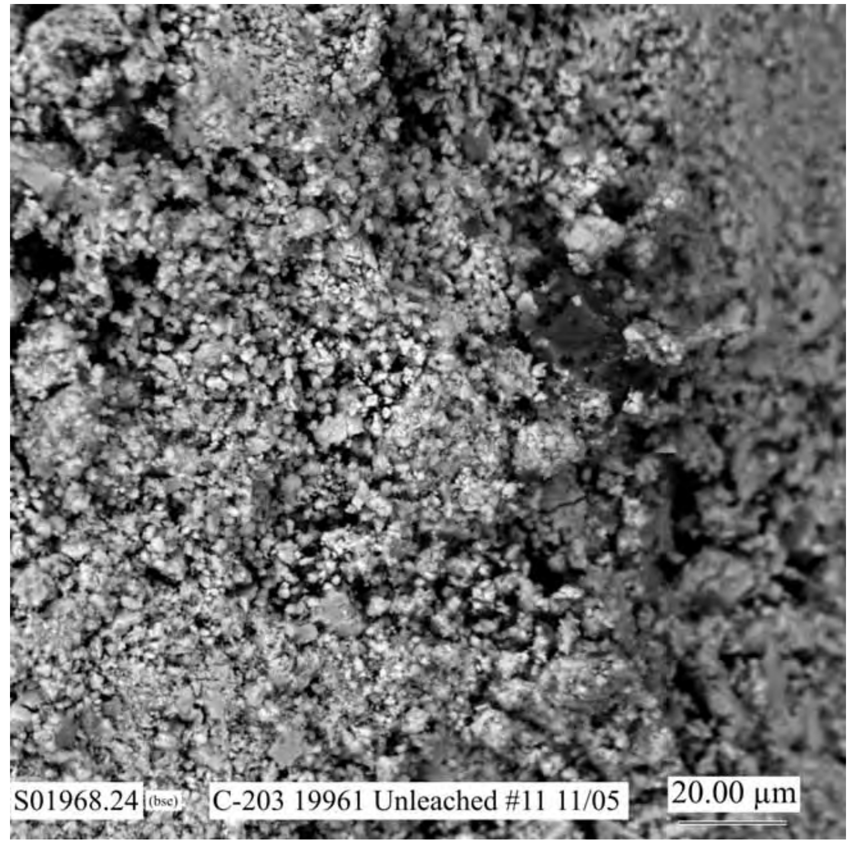


Figure G.50. Micrograph Showing Typical Particle Aggregate in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961) (Areas where EDS analyses were made are shown in Figure G.58.)

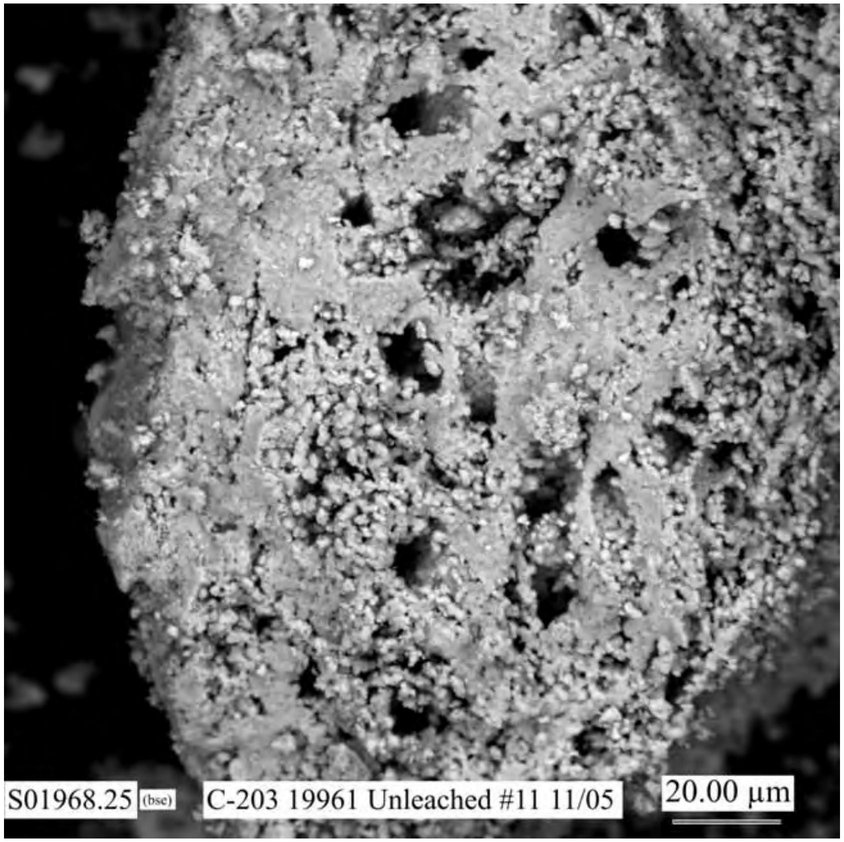


Figure G.51. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled E in Figure G.39

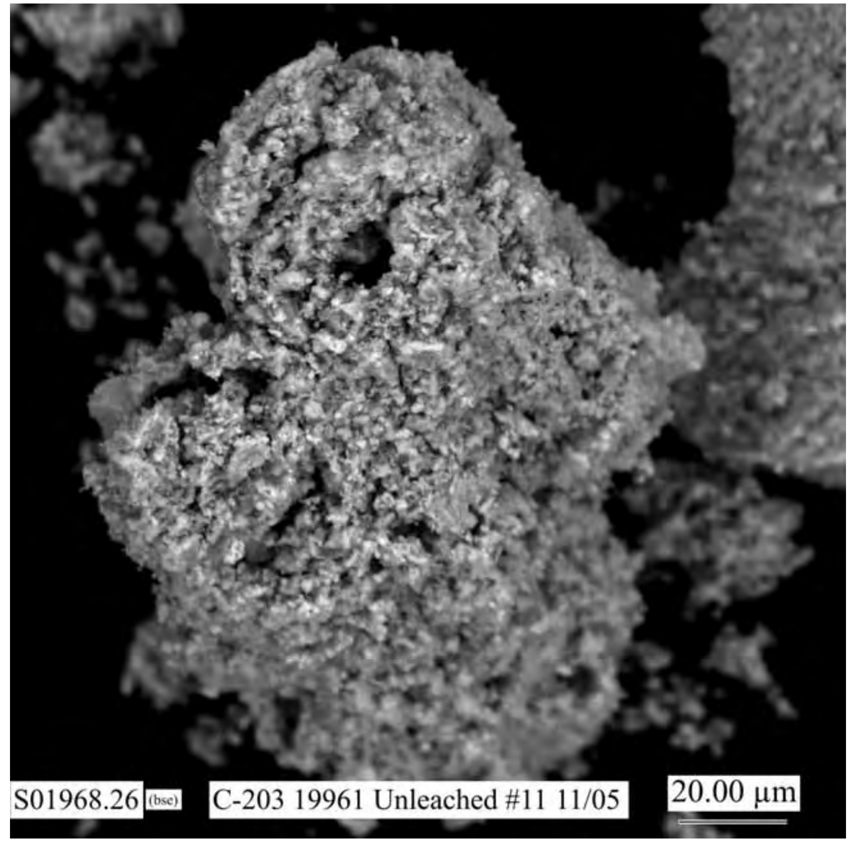


Figure G.52. Micrograph Showing Typical Particle Aggregate in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

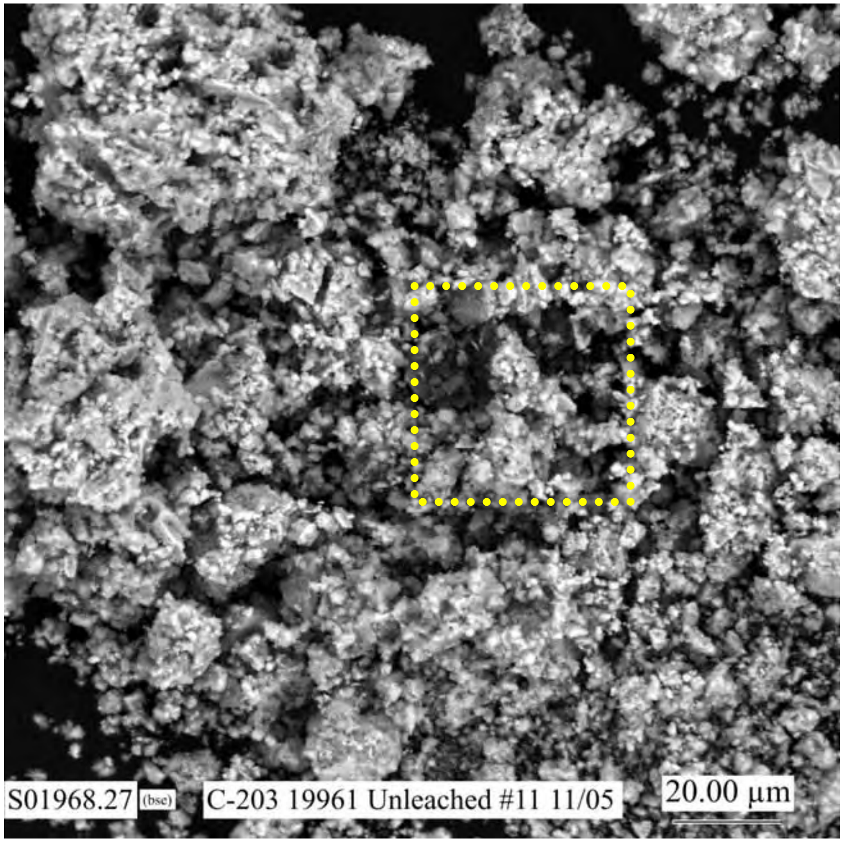


Figure G.53. Micrograph Showing Typical Particle Aggregate in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

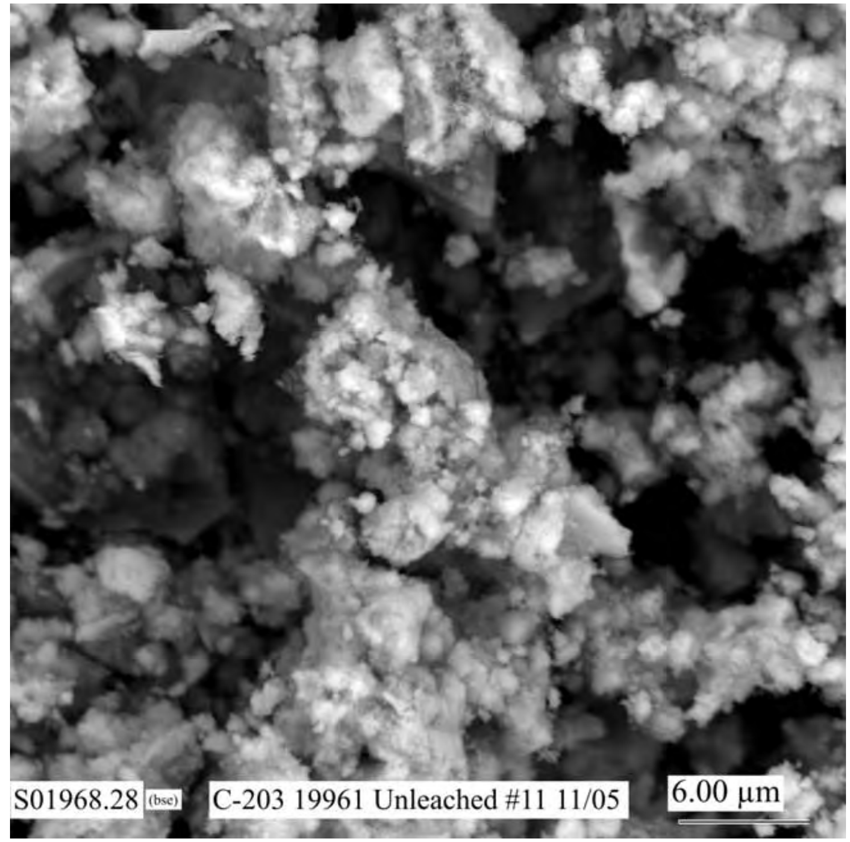


Figure G.54. Micrograph Showing at Higher Magnification the Particle Aggregate Indicated by the Yellow Dotted-Line Square in Figure G.53

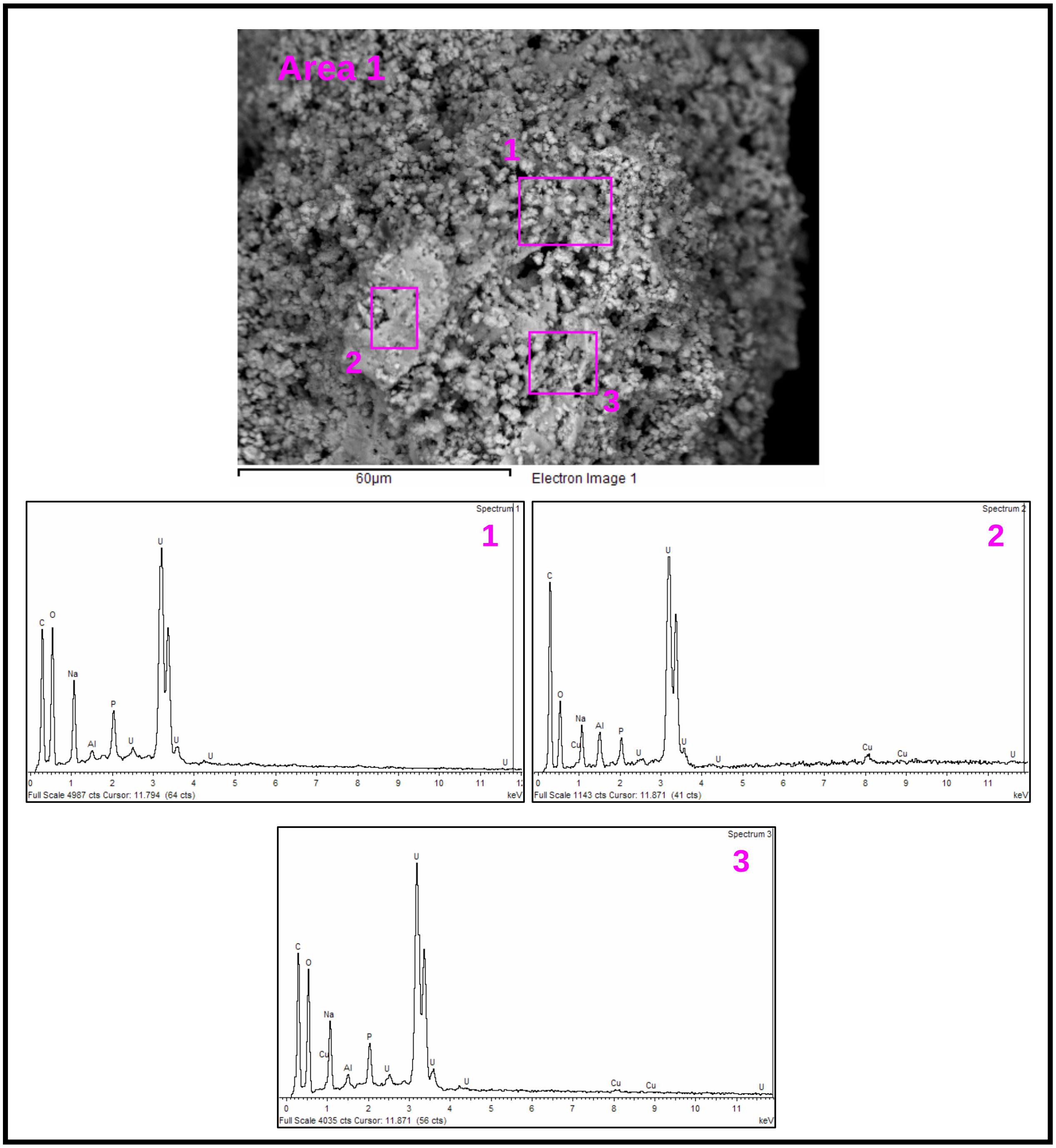


Figure G.55. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

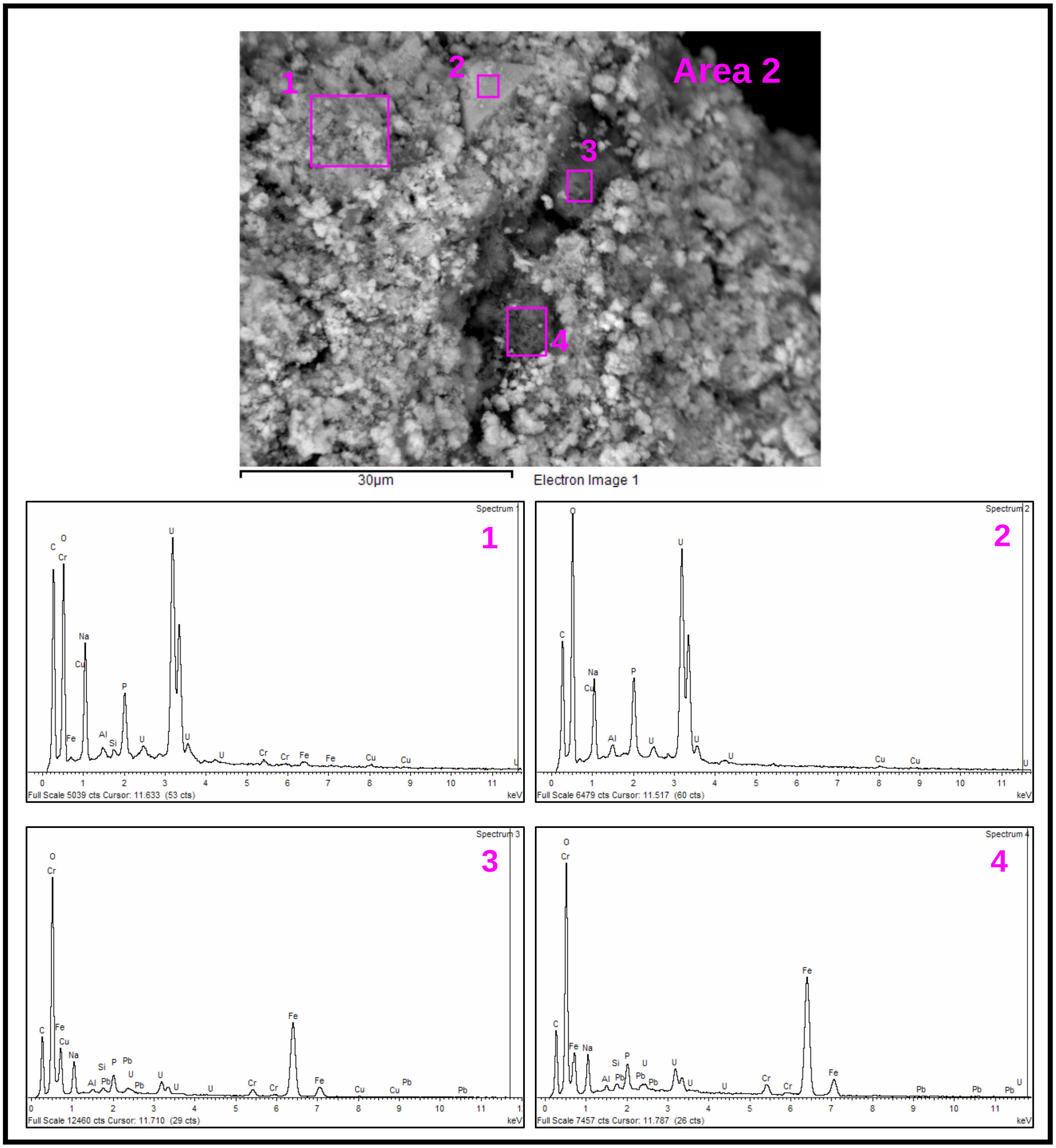


Figure G.56. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

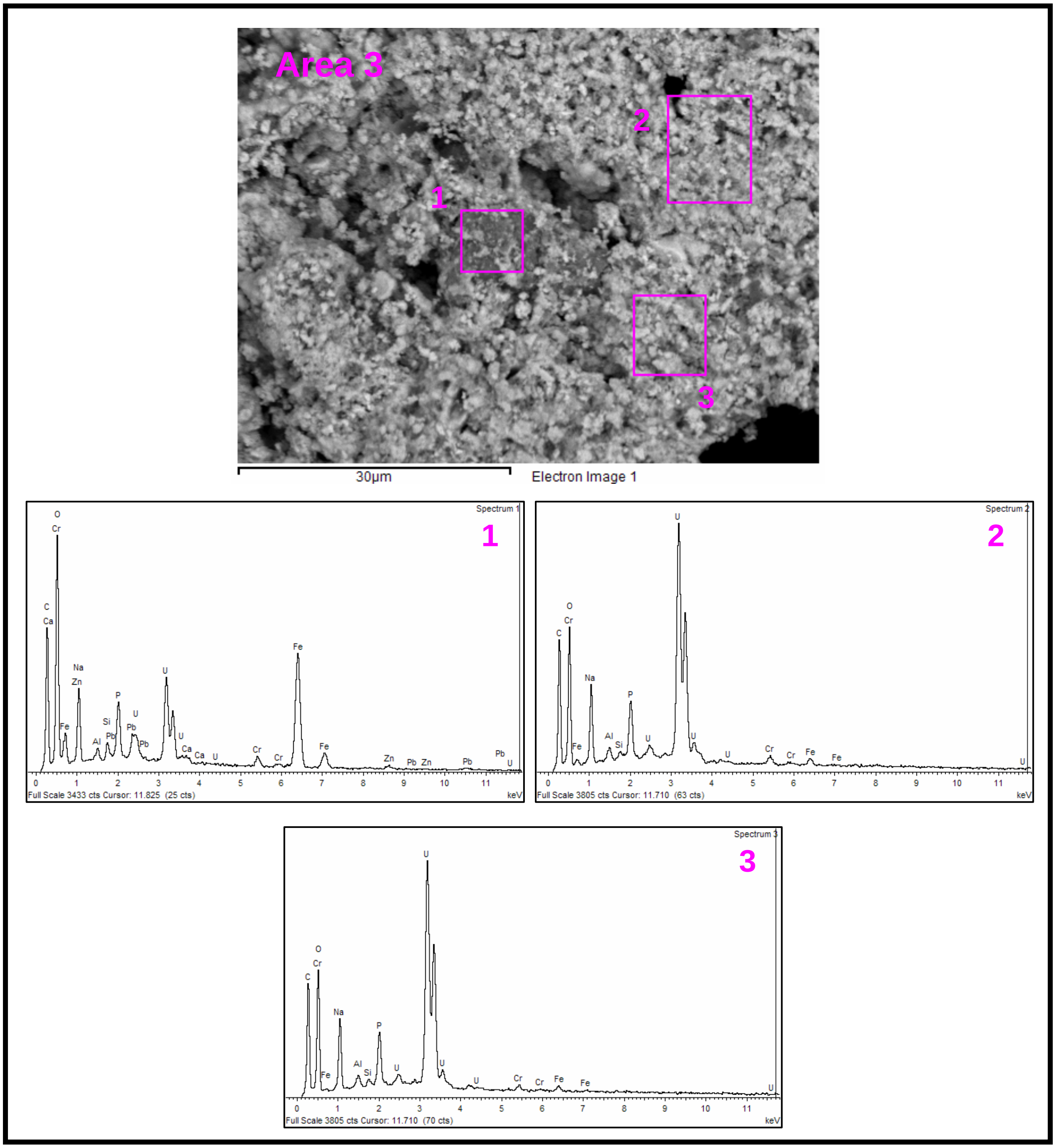


Figure G.57. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

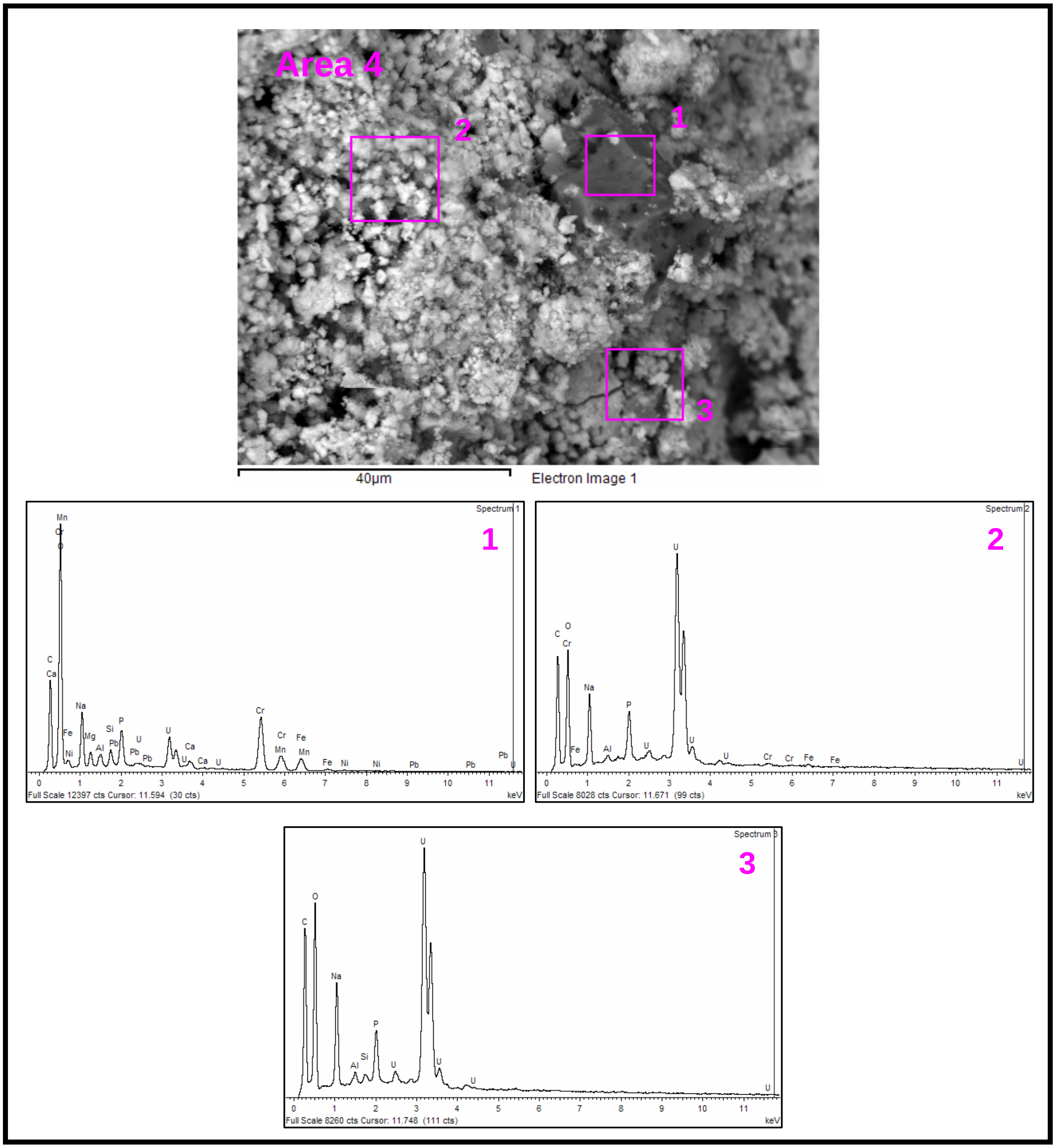


Figure G.58. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sample Mount 11 of Unleached Residual Waste from Tank C-203 (Sample 19961)

Table G.6. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Unleached Solids in Sample Mount 11

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
G.55 / 1	1	4.2	6.6						43	*44*	1.9	0.4				
	2	4.3	3.6						26	*63*	1.1	1.7	0.9			
	3	4.6	5.9						40	*47*	1.8	0.5	0.3			
G.56 /2	1	3.0	6.4	0.2		0.2			42	*46*	1.7	0.2	0.2		0.2	
	2	3.3	5.3						54	*35*	2.4	0.4	0.2			
	3	0.3	3.8	6.3		0.4			54	*34*	0.8	0.2	0.1		0.2	Pb – 0.1
	4	0.4	4.0	8.8		0.5			50	*34*	1.0	0.3			0.2	Pb – 0.1
G.57 / 3	1	1.1	4.3	5.6		0.4		0.2	42	*44*	1.5	0.3			0.5	Pb – 0.2, Zn – 0.3
	2	4.5	6.2	0.5		0.5			42	*44*	2.3	0.6			0.2	
	3	4.9	6.6	0.5		0.4			43	*42*	2.4	0.5			0.3	
G.58 / 4	1	0.5	4.2	0.8	0.5	2.6	0.1	0.2	51	*37*	1.2	0.5		0.8	0.5	Pb - <0.1
	2	4.8	6.8	0.2		0.2			42	*43*	2.3	0.3				
	3	3.7	6.6						44	*43*	1.6	0.4			0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix H

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-203 (Sample 19961)

Appendix H

SEM Micrographs and EDS Results for Leached Residual Waste from Tank C-203 (Sample 19961)

This appendix includes the scanning electron microscope (SEM) micrographs and the energy-dispersive spectroscopy (EDS) spectra for samples of leached residual waste from tank C-203 (sample 19961). These include the following types of samples:

- One month single-contact leached water extraction solids
- Sequential leached water extraction solids
- One month single-contact $Ca(OH)_2$ leached solids
- Sequential $Ca(OH)_2$ leached solids
- One month single-contact $CaCO_3$ leached solids
- Sequential $CaCO_3$ leached solids

The operating conditions for the SEM and procedures used for mounting the SEM samples are described in Section 3.7 of the main report.

The identification number for the digital micrograph image file, descriptor for the type of sample, and a size scale bar are given, respectively, at the bottom left, center, and right of each SEM micrograph in this appendix. Micrographs labeled by "BSE" to the immediate right of the digital image file number indicate that the micrograph was collected with backscattered electrons. Sample areas or particles identified by a yellow letter or arrow, and/or outlined by a yellow dotted-line square in a micrograph designate sample material that was imaged at higher magnification, which is typically shown in figure(s) that immediately follow in the series for that sample. The figure and table numbers for the SEM micrographs and EDS analyses for leached C-203 (sample 19961) residual waste analyzed by SEM/EDS are listed in Table H.1.

Table H.1. Figures and Tables Containing the SEM Micrographs and EDS Analyses for the Leached C-203 Residual Waste Samples (Sample 19961) Analyzed by SEM/EDS

Type of Residual Waste Sample	Figures with SEM Micrographs	Figures with EDS Spectra	Tables with EDS Atomic%
1-month single-contact leached water extraction solids	H.1 – H.12	H.13 – H.15	H.2
Sequential leached water extraction solids	H.16 – H.27	H.28 – H.35	H.3 and H.4
1-month single-contact $Ca(OH)_2$ leached solids	H.36 – H.50	H.51 – H.61	H.5, H.6, and H.7
Sequential $Ca(OH)_2$ leached solids	H.62 – H.73	H.74 – H.85	H.8, H.9, and H.10
1-month single-contact $CaCO_3$ leached solids	H.86 – H.97	H.98 – H.107	H.11, H.12, and H.13
Sequential $CaCO_3$ leached solids	H.108 – H.119	H.120 – H.129	H.14, H.15, and H.16

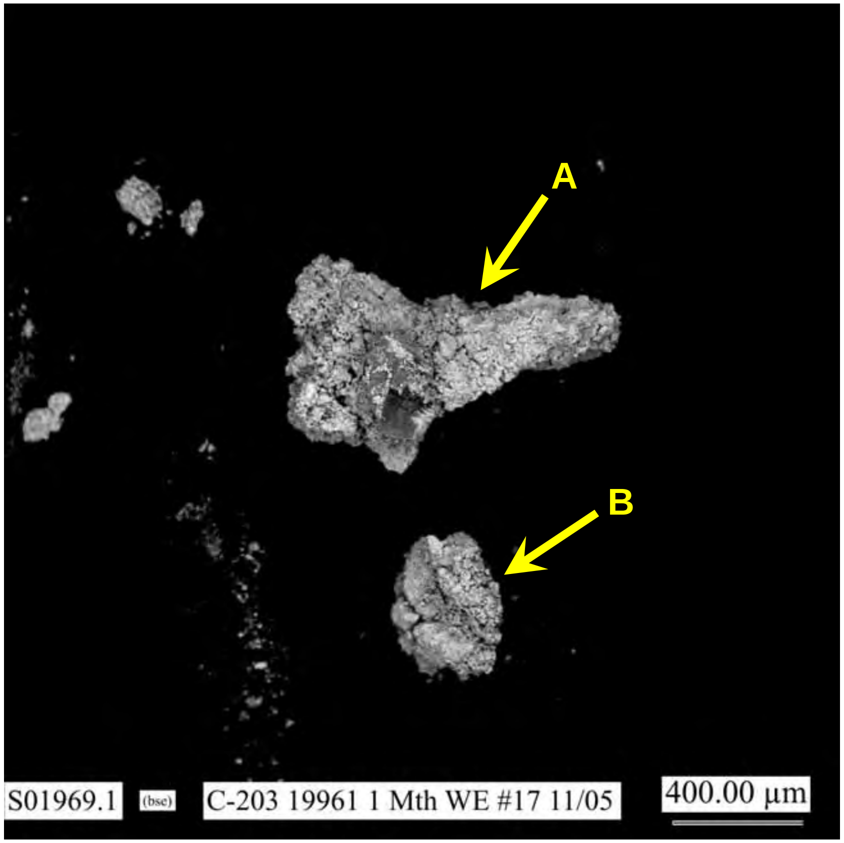


Figure H.1. Low Magnification Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact Leached Water Extraction Solid from C-203 Residual Waste (Sample 19961)

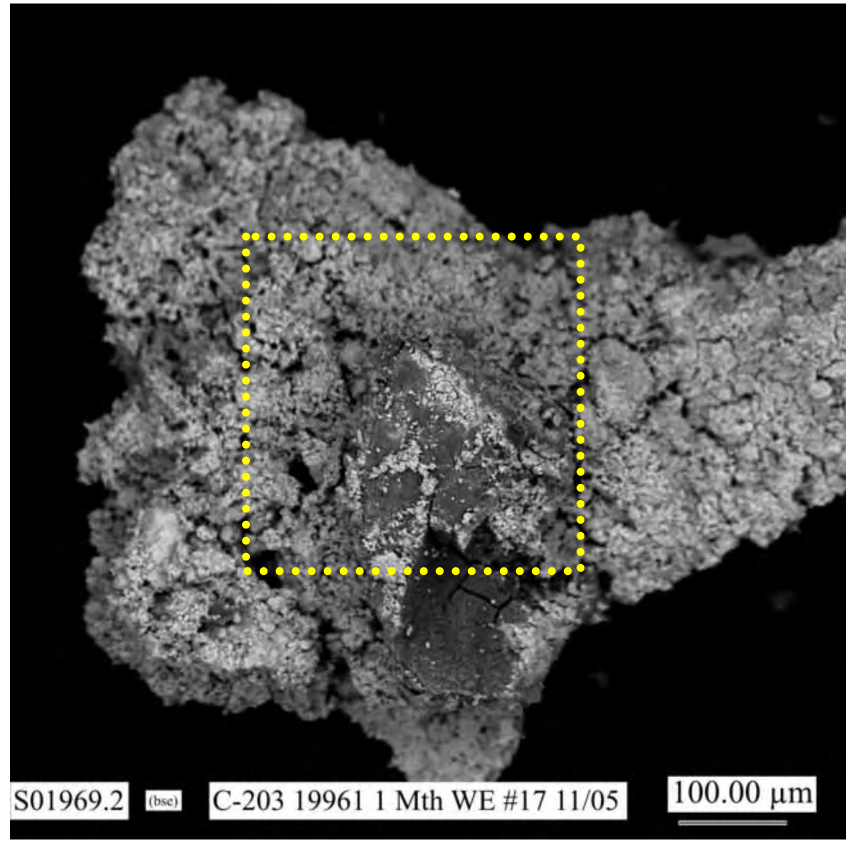


Figure H.2. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure H.1

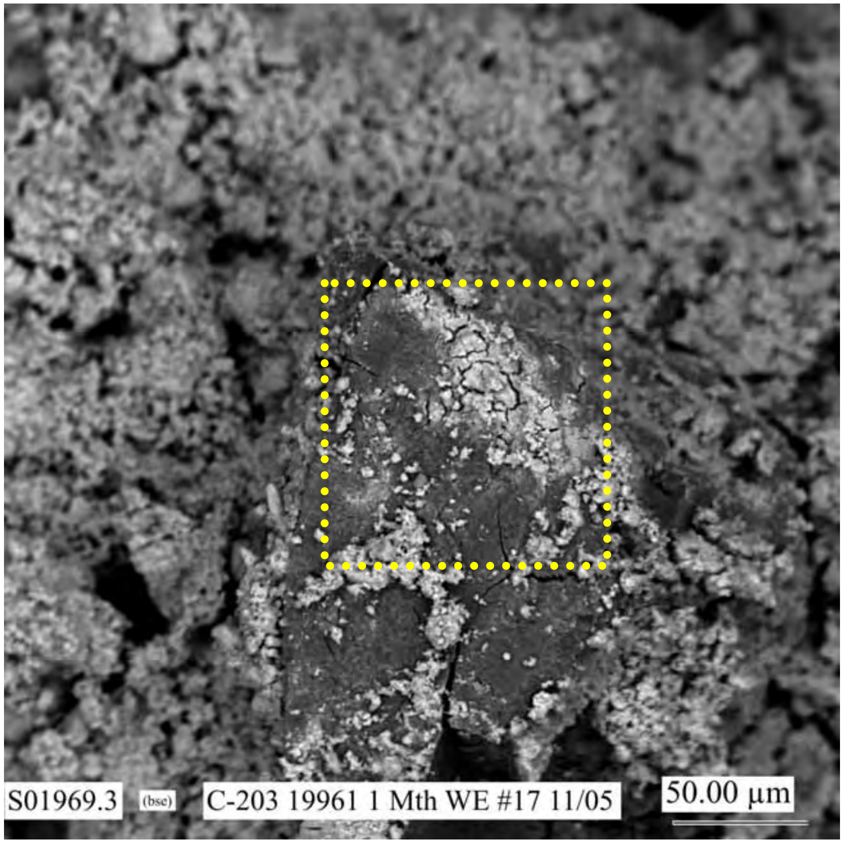


Figure H.3. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.2 (Areas where EDS analyses were made are shown in Figure H.13.)

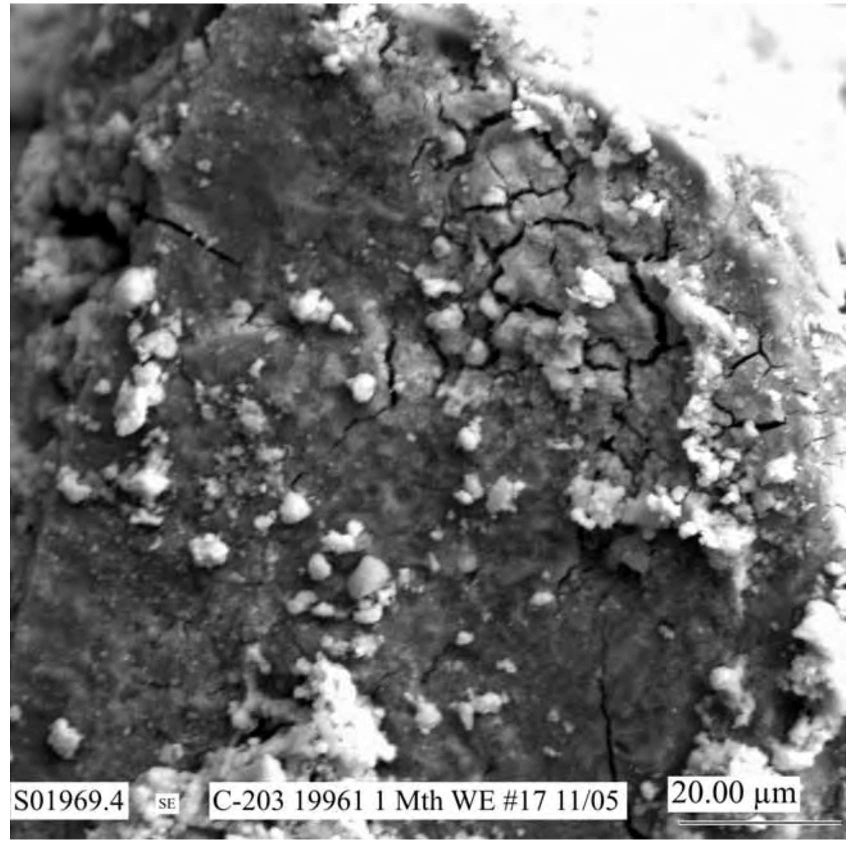


Figure H.4. Secondary Electron (SE) Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.3

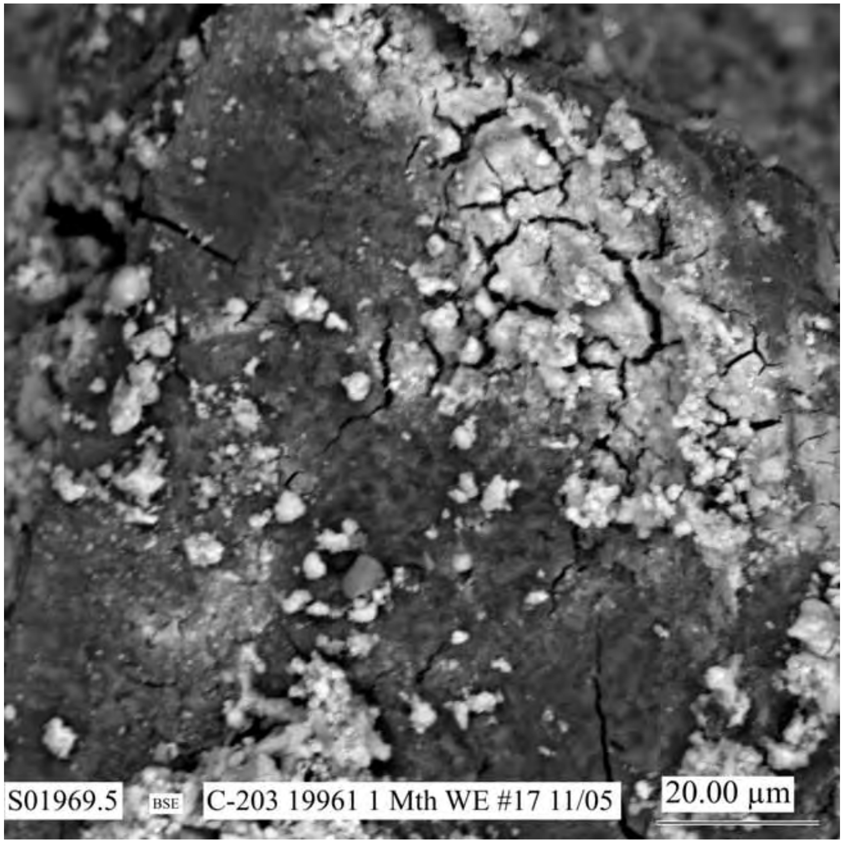


Figure H.5. Backscattered Electron (BSE) Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.3

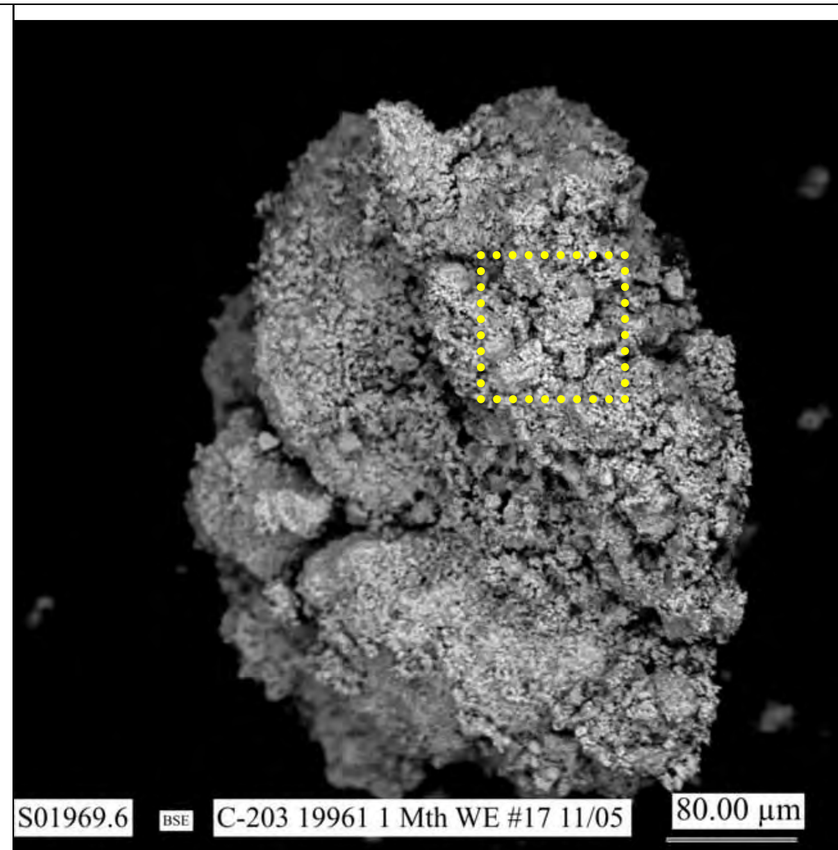


Figure H.6. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled B in Figure H.1

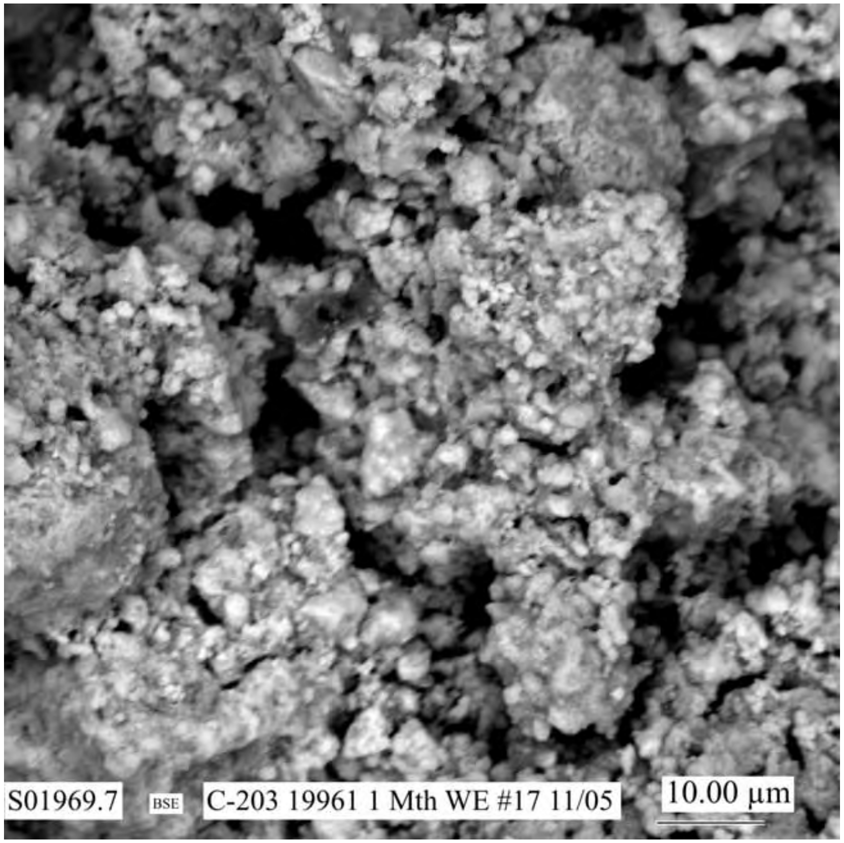


Figure H.7. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.6 (Areas where EDS analyses were made are shown in Figure H.14.)

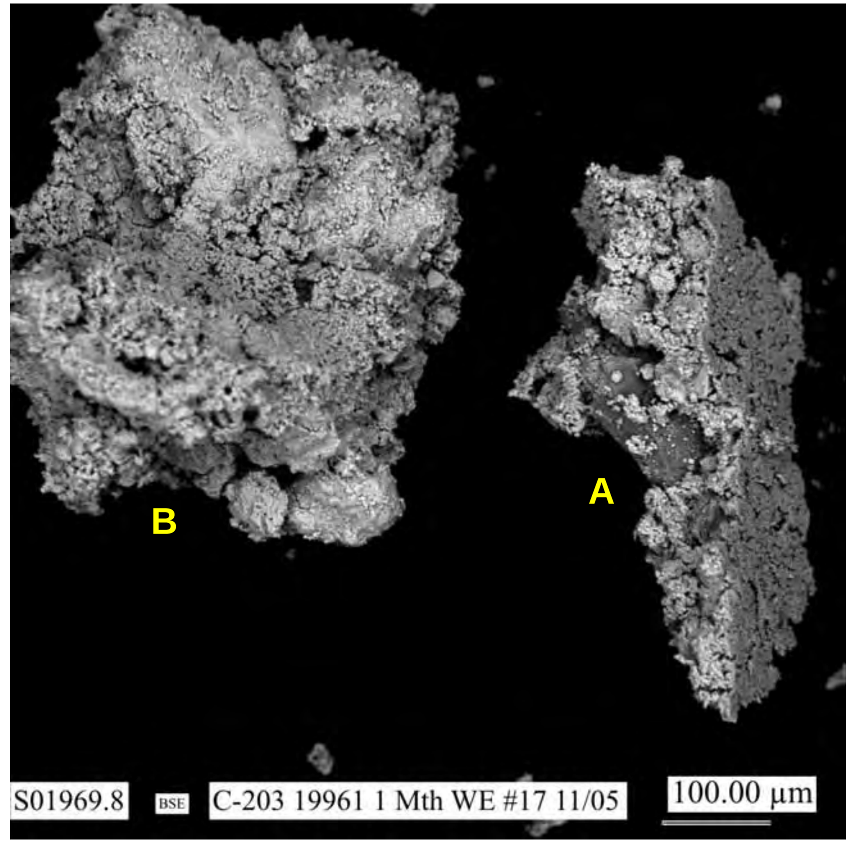


Figure H.8. Micrograph Showing Typical Particle Aggregates in Sample of 1-Month Single-Contact Leached Water Extraction Solid from C-203 Residual Waste (Sample 19961)

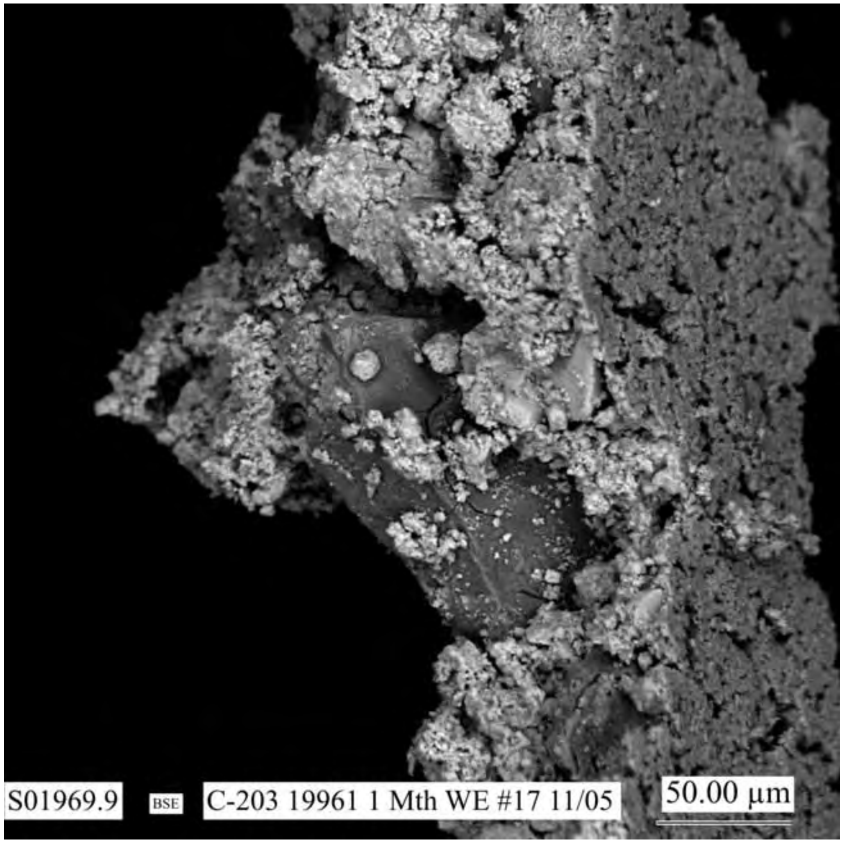


Figure H.9. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure H.8 (Areas where EDS analyses were made are shown in Figure H.15.)

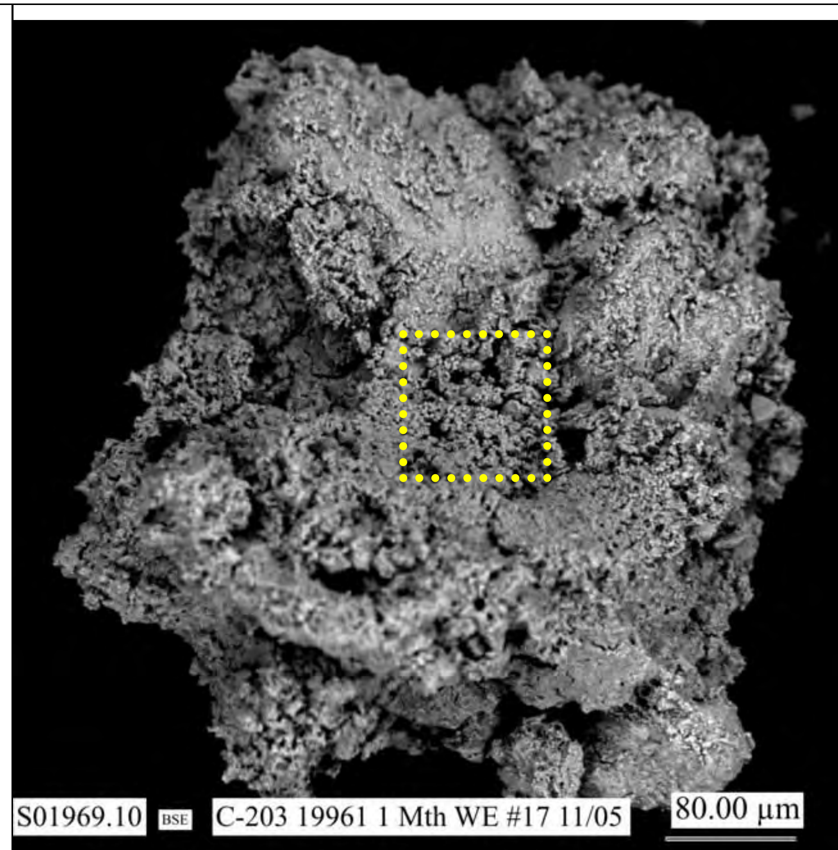


Figure H.10. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled B in Figure H.8

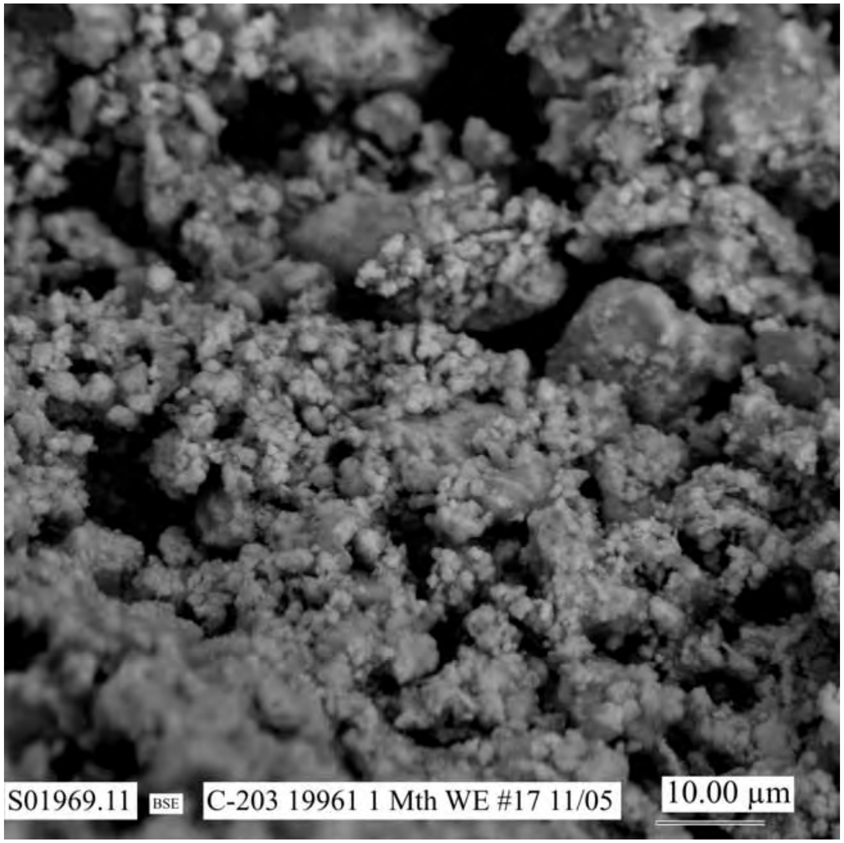


Figure H.11. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.6

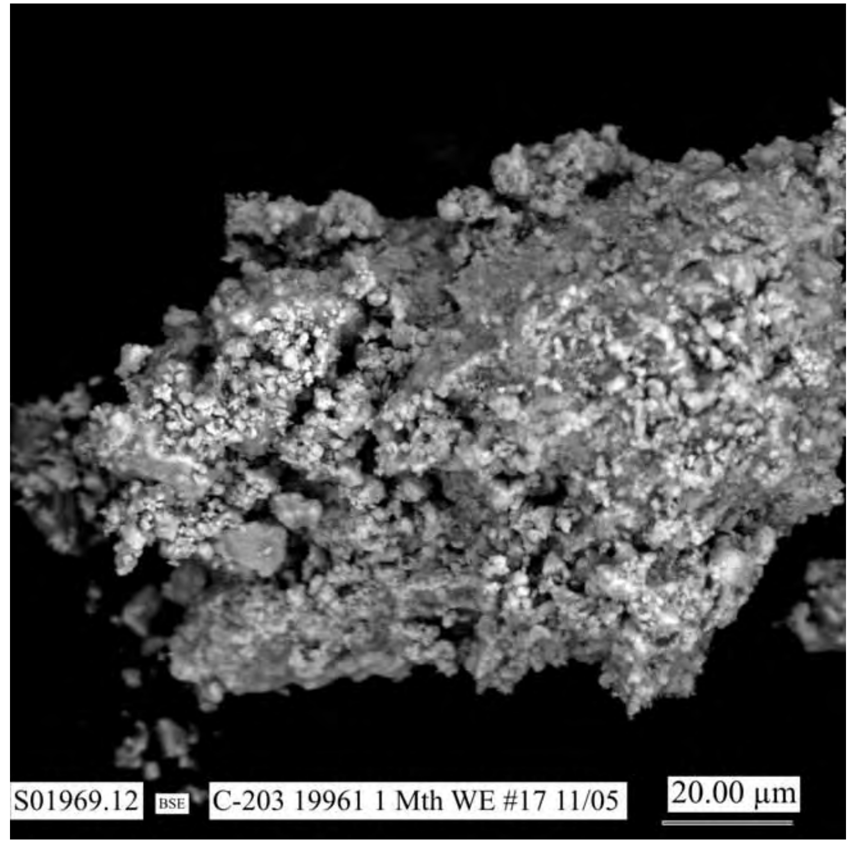


Figure H.12. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact Leached Water Extraction Solid from C-203 Residual Waste (Sample 19961)

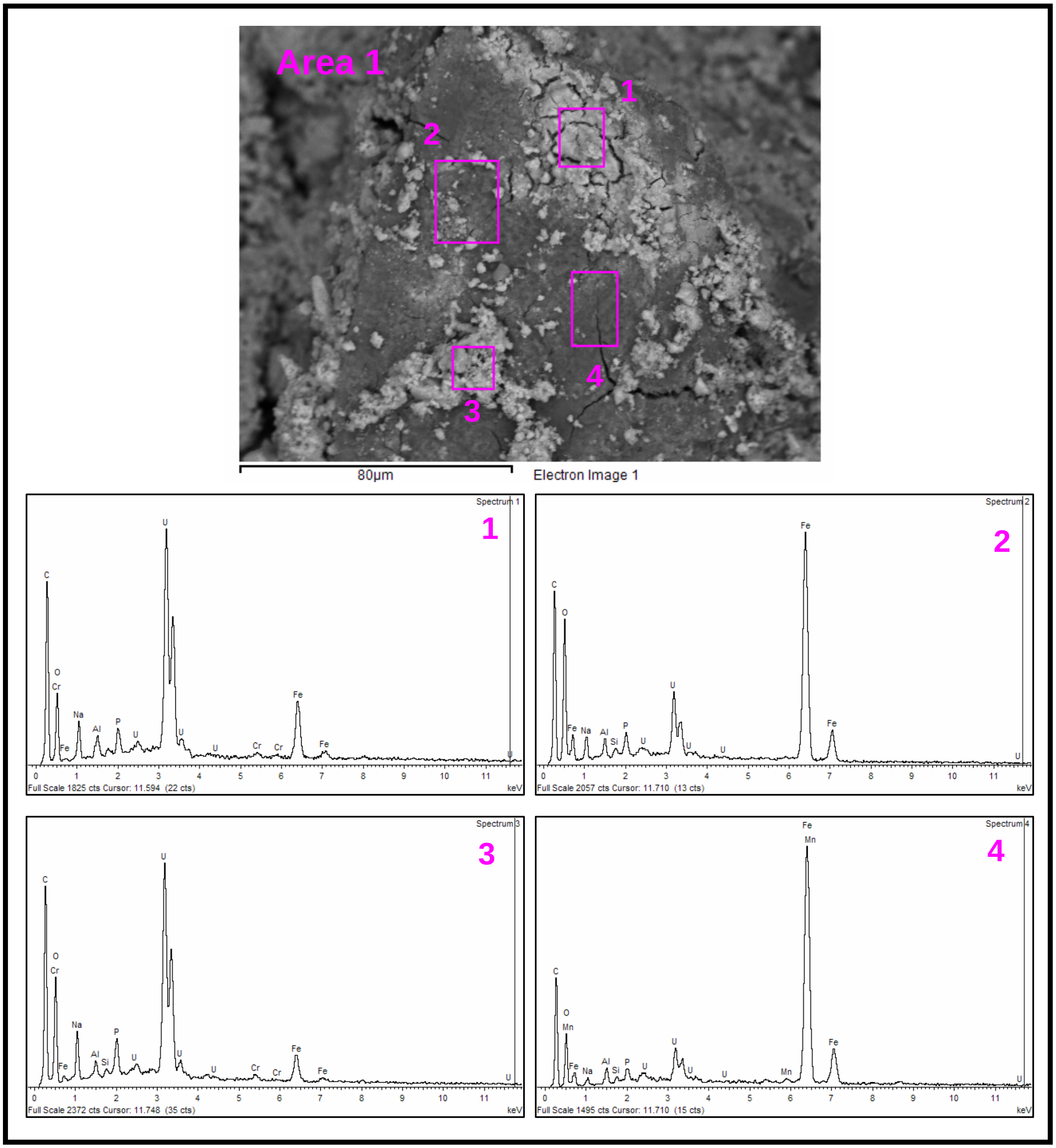


Figure H.13. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

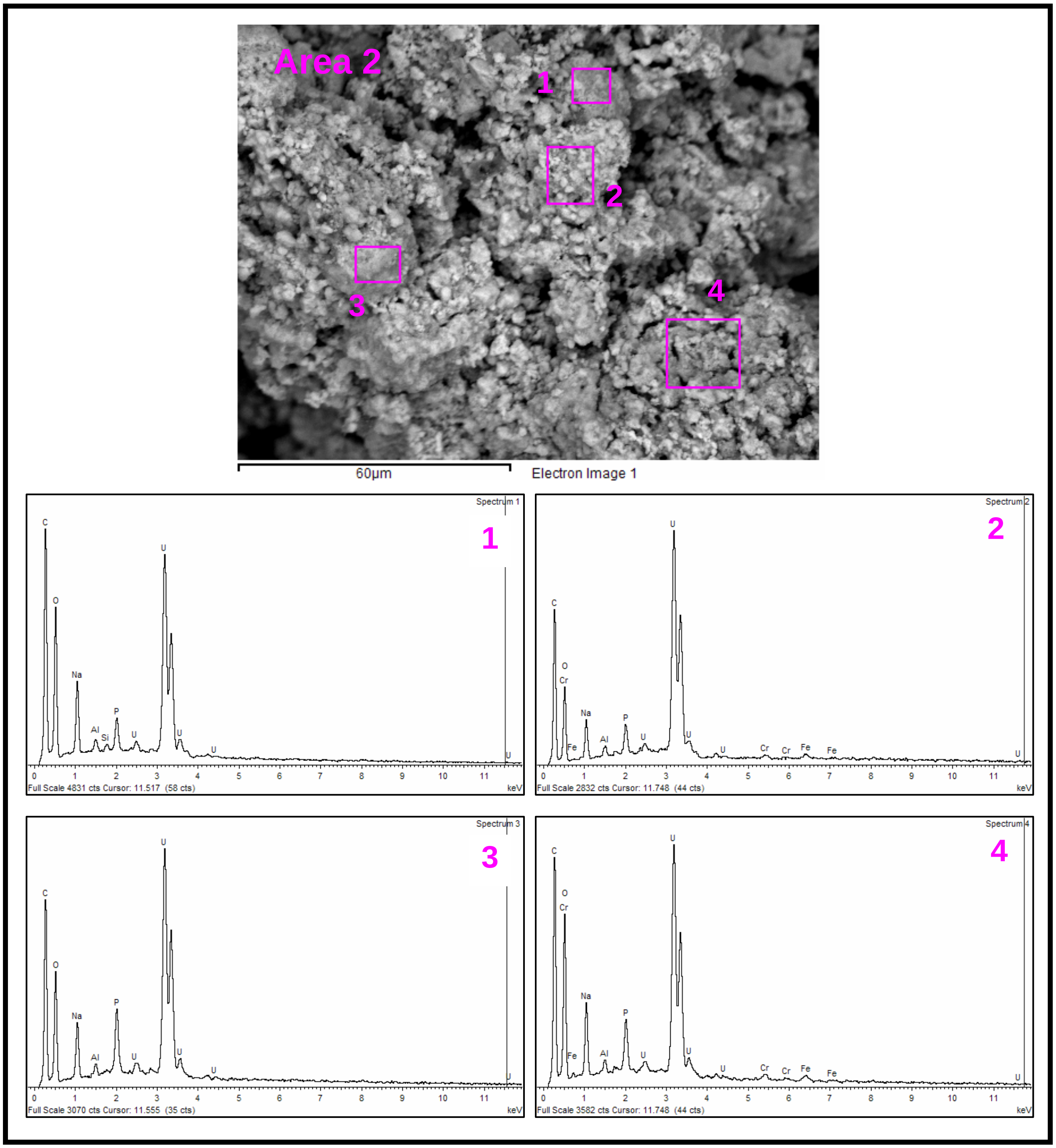


Figure H.14. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

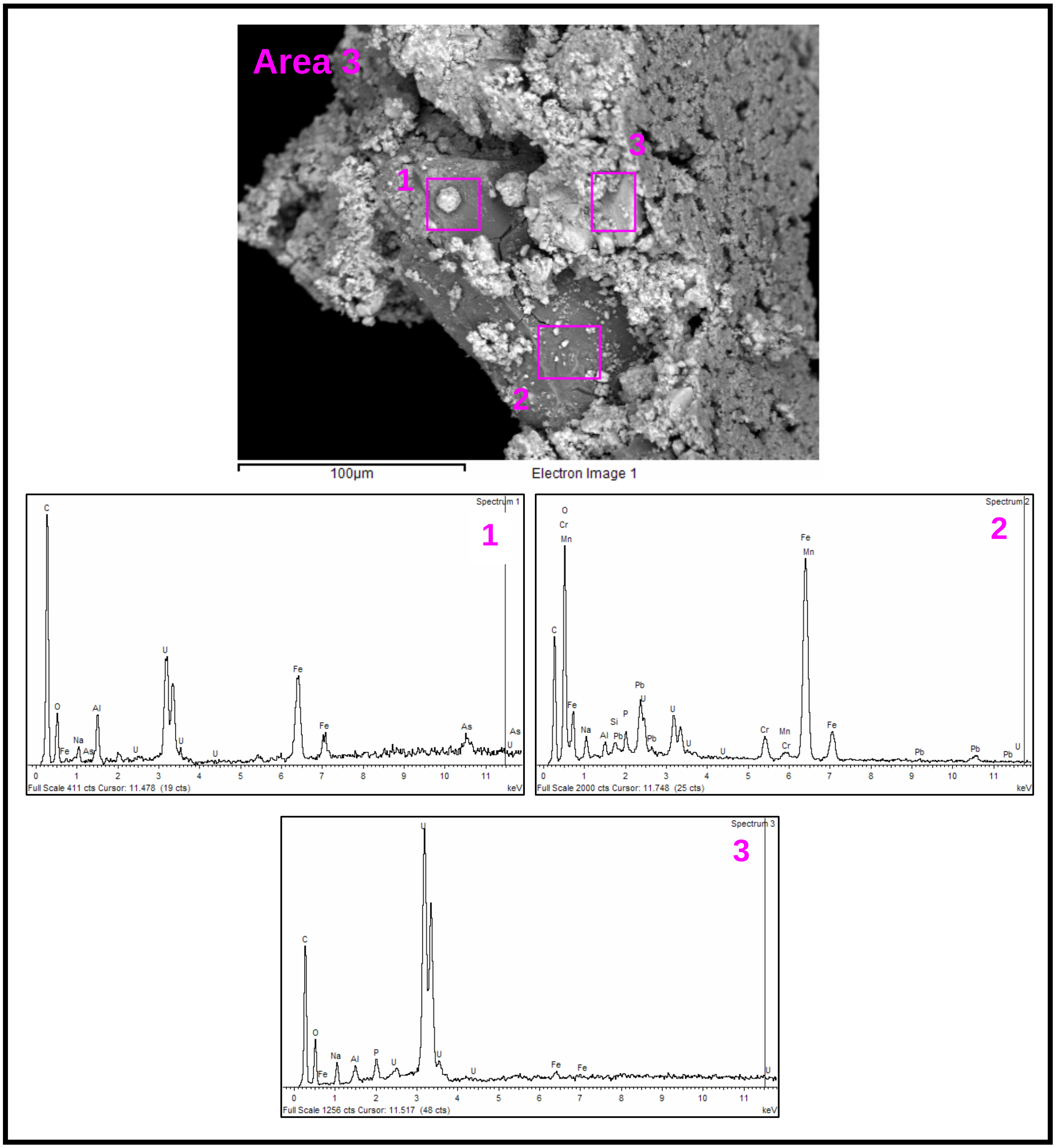


Figure H.15. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.2. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact Water Extraction Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H.13 / 1	1	4.6	3.3	4.4		0.3			24	*61*	1.1	1.0				
	2	0.8	1.8	11					29	*56*	0.6	0.6			0.2	
	3	3.7	3.6	1.8		0.3			32	*57*	1.3	0.6			0.3	
	4	0.6	0.7	18	0.3				16	*63*	0.6	0.8			0.2	
H.14 / 2	1	3.0	4.4						38	*53*	1.0	0.4			0.2	
	2	5.5	4.0	0.4		0.3			32	*56*	1.5	0.6				
	3	4.1	4.1						34	*55*	2.3	0.5				
	4	3.3	4.3	0.3		0.3			38	*52*	1.5	0.4				
H.15 / 3	1	1.8	1.1	5.7					17	*73*		1.8				As - <0.1
	2	0.6	1.5	11	0.2	0.8			39	*45*	0.6	0.5			0.3	Pb – 0.6
	3	7.3	3.0	0.8					25	*62*	1.3	1.0				

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

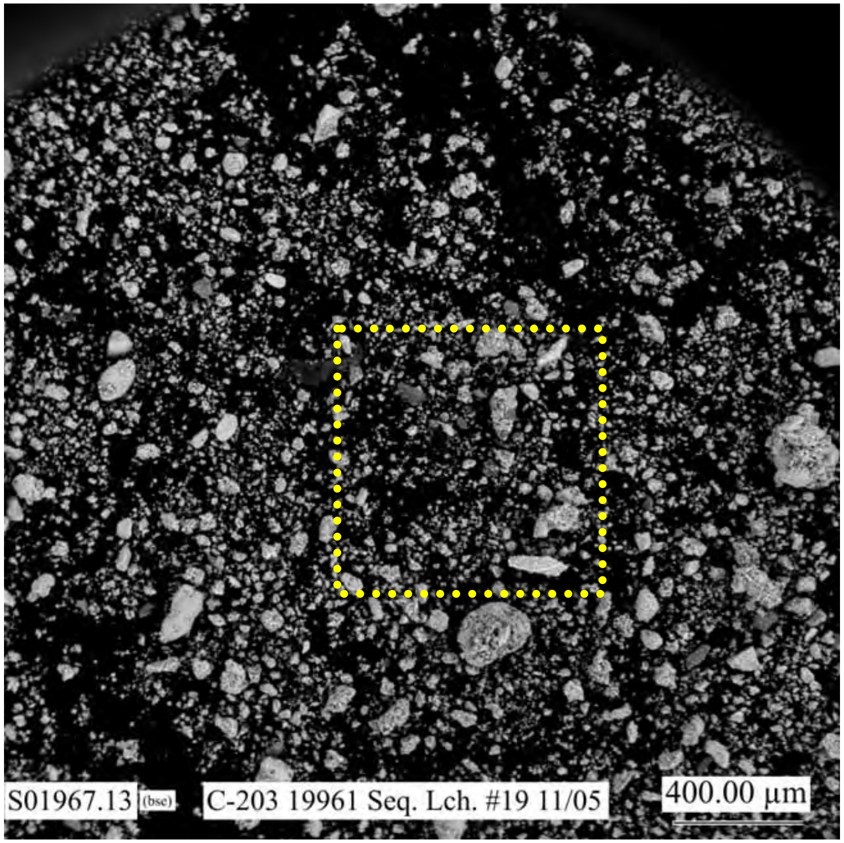


Figure H.16. Low Magnification Micrograph Showing Typical Particles in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961)

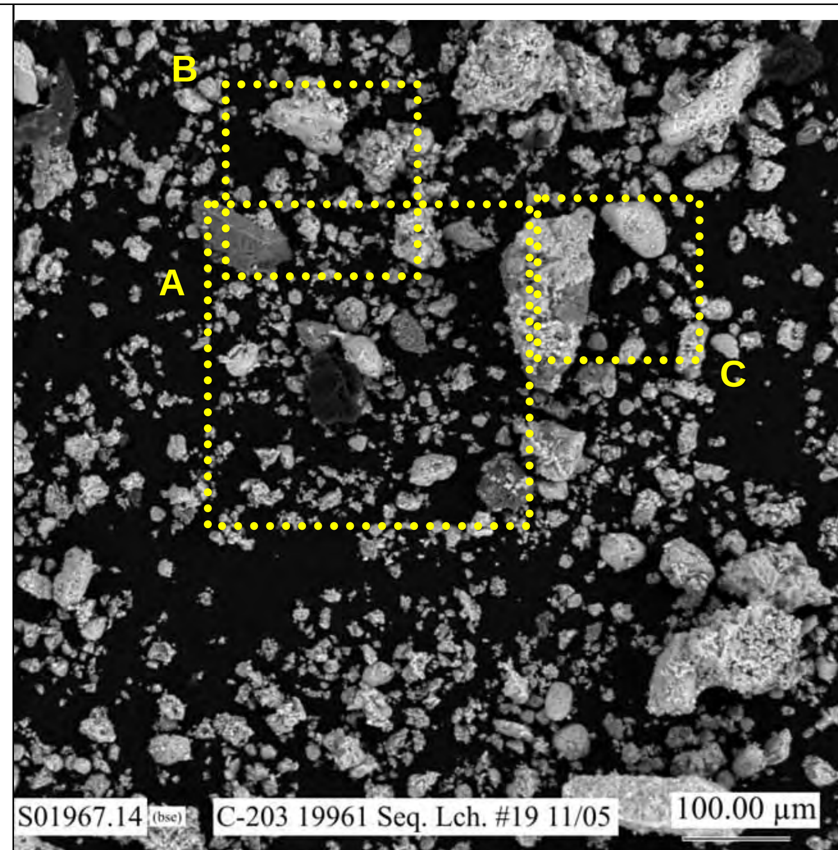


Figure H.17. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.16

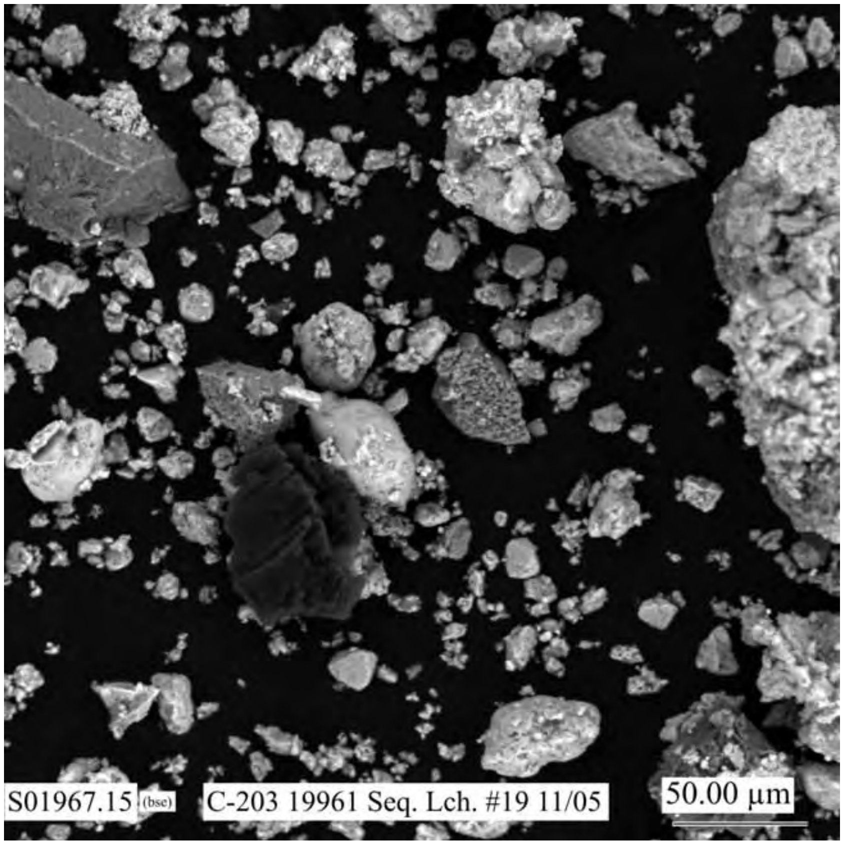


Figure H.18. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure H.17

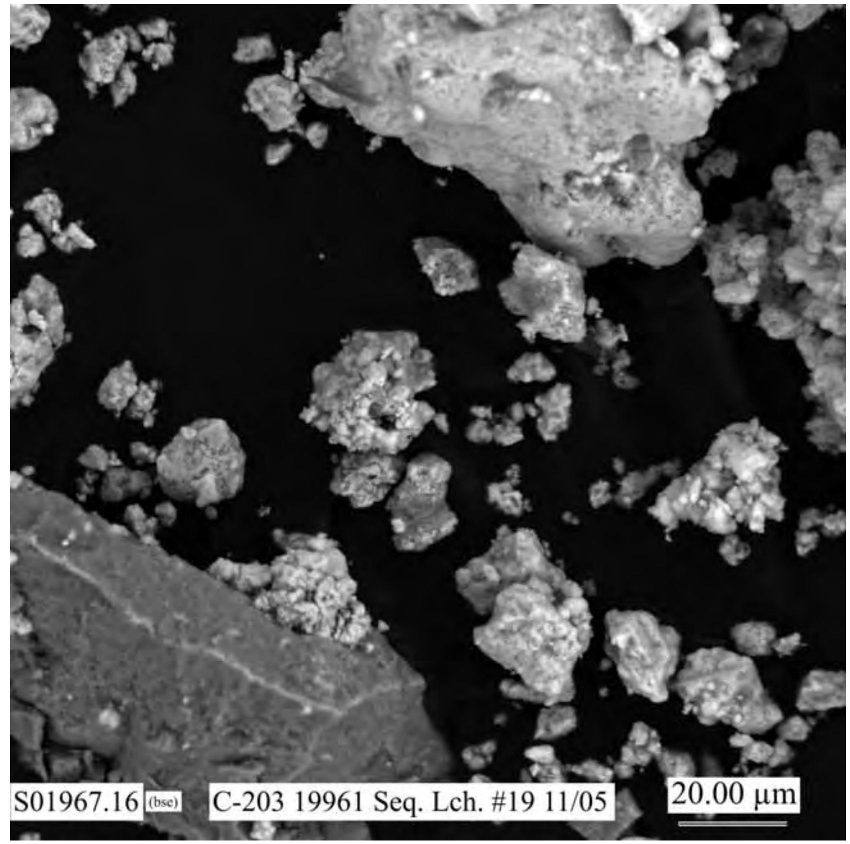


Figure H.19. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure H.17 (Areas where EDS analyses were made are shown in Figure H.28.)

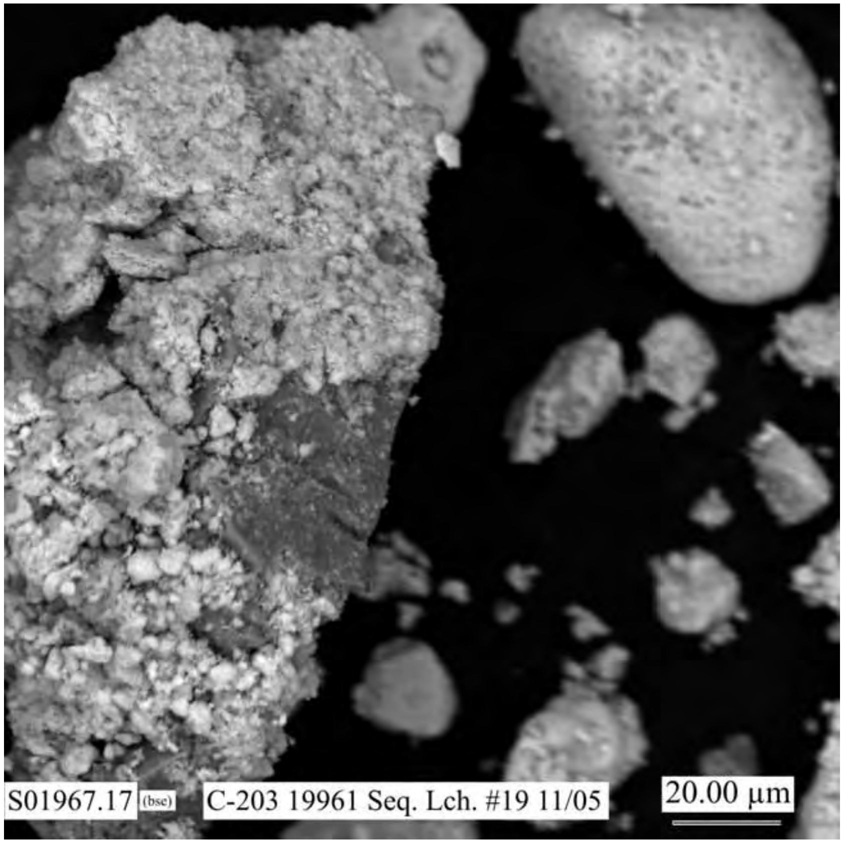


Figure H.20. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled C in Figure H.17 (Areas where EDS analyses were made are shown in Figure H.29.)

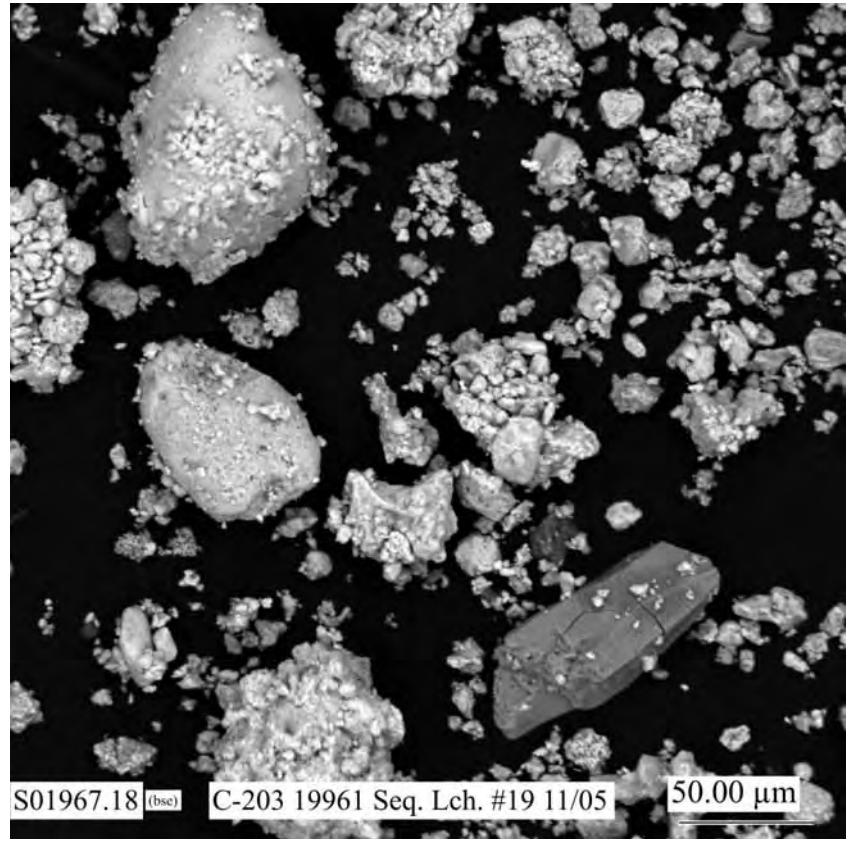


Figure H.21. Micrograph Showing Typical Particles in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.30.)

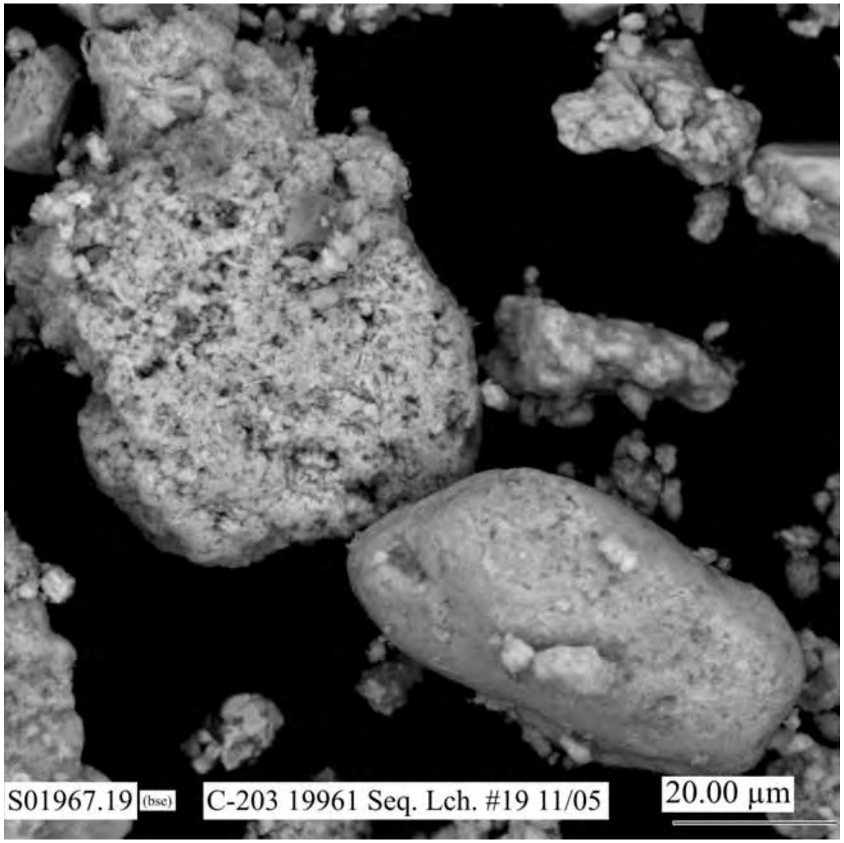


Figure H.22. Micrograph Showing Typical Particles in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.31.)

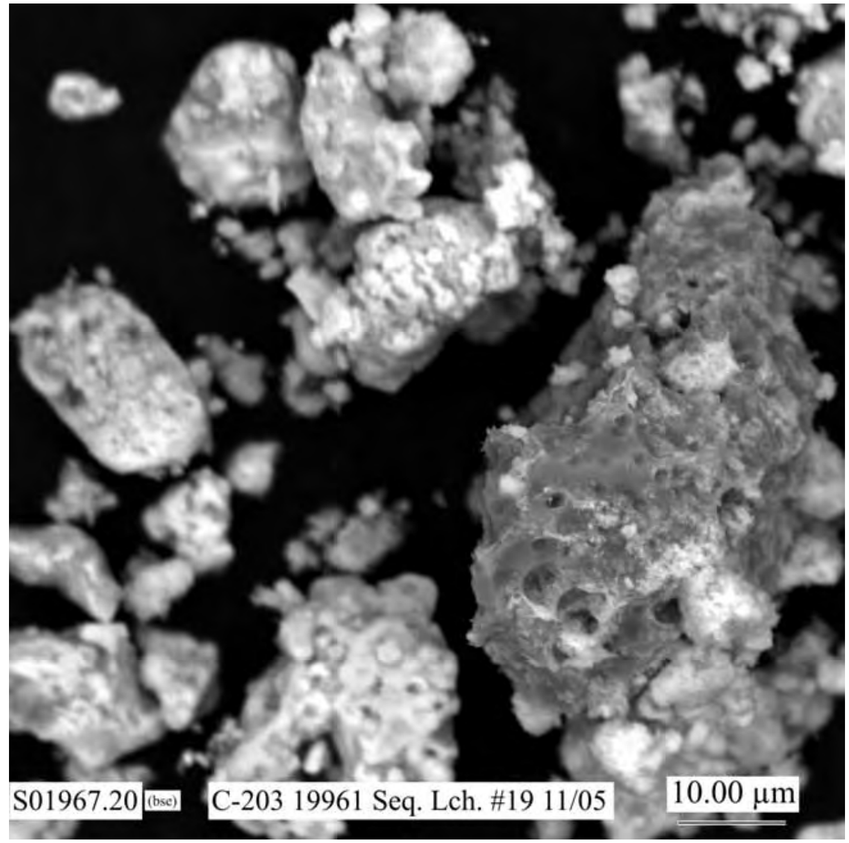


Figure H.23. Micrograph Showing Typical Particles in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.32.)

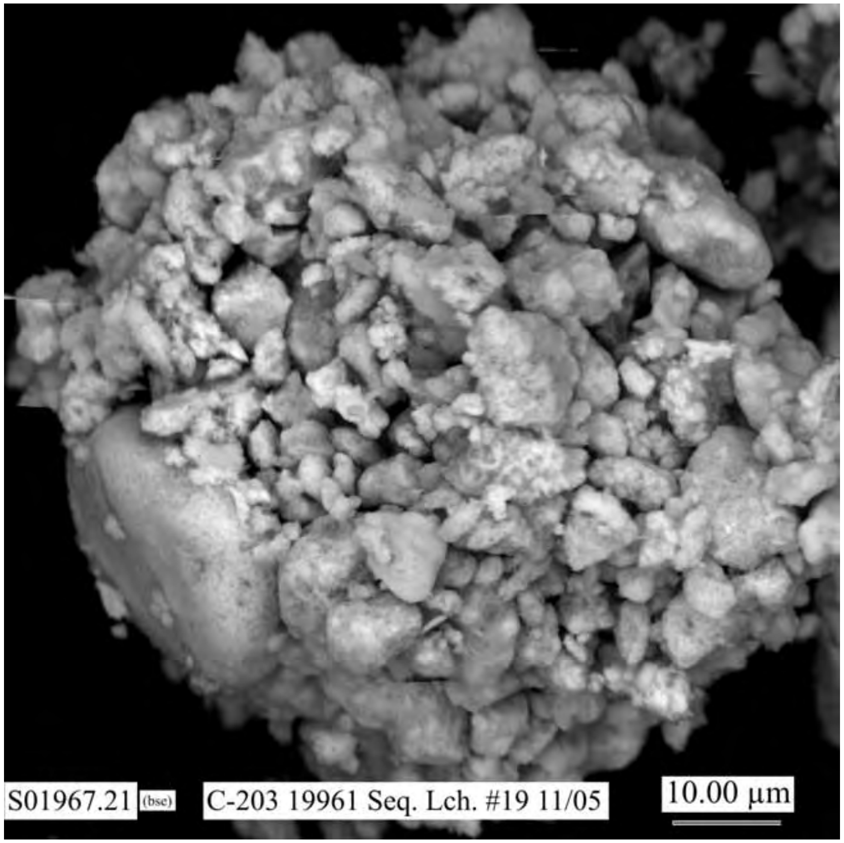
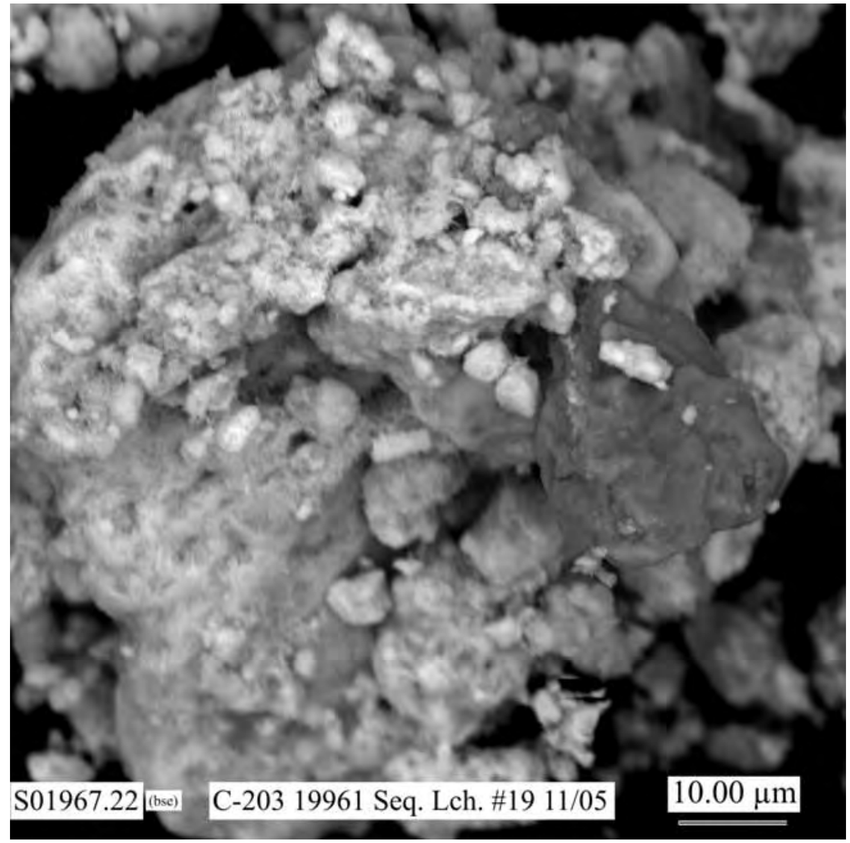
	

Figure H.24. Micrograph Showing Typical Particle Aggregates in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961)	**Figure H.25**. Micrograph Showing Typical Particle Aggregates in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.33.)

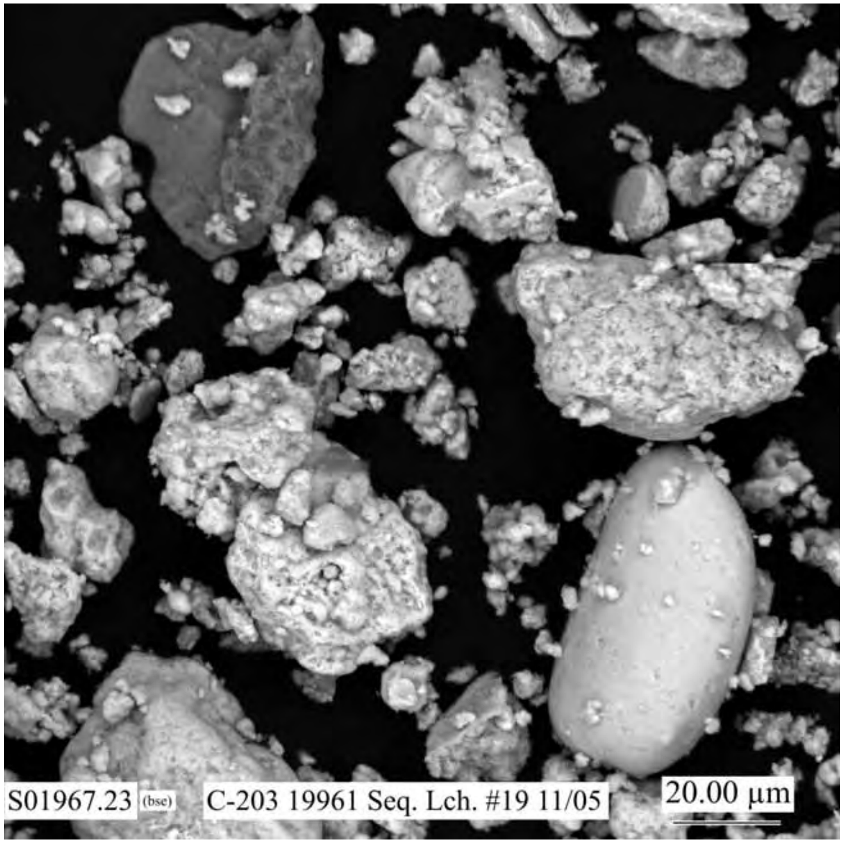


Figure H.26. Micrograph Showing Typical Particles in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.34 and H.35.)

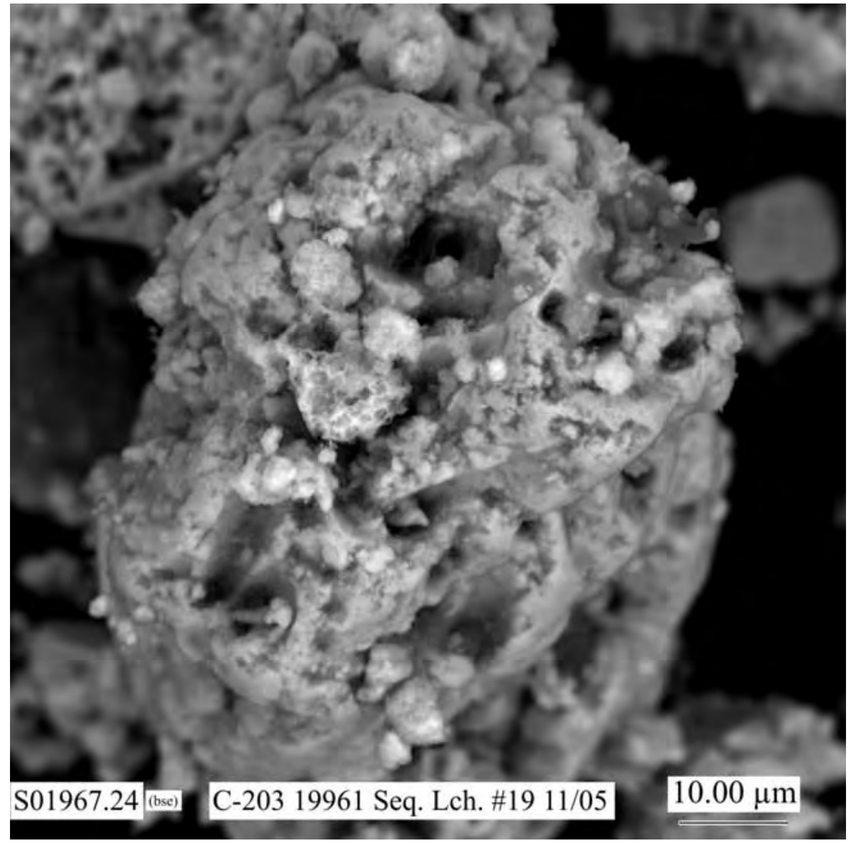


Figure H.27. Micrograph Showing Typical Particle Aggregate in Sample of Sequential Leached Water Extraction Solids from C-203 Residual Waste (Sample 19961)

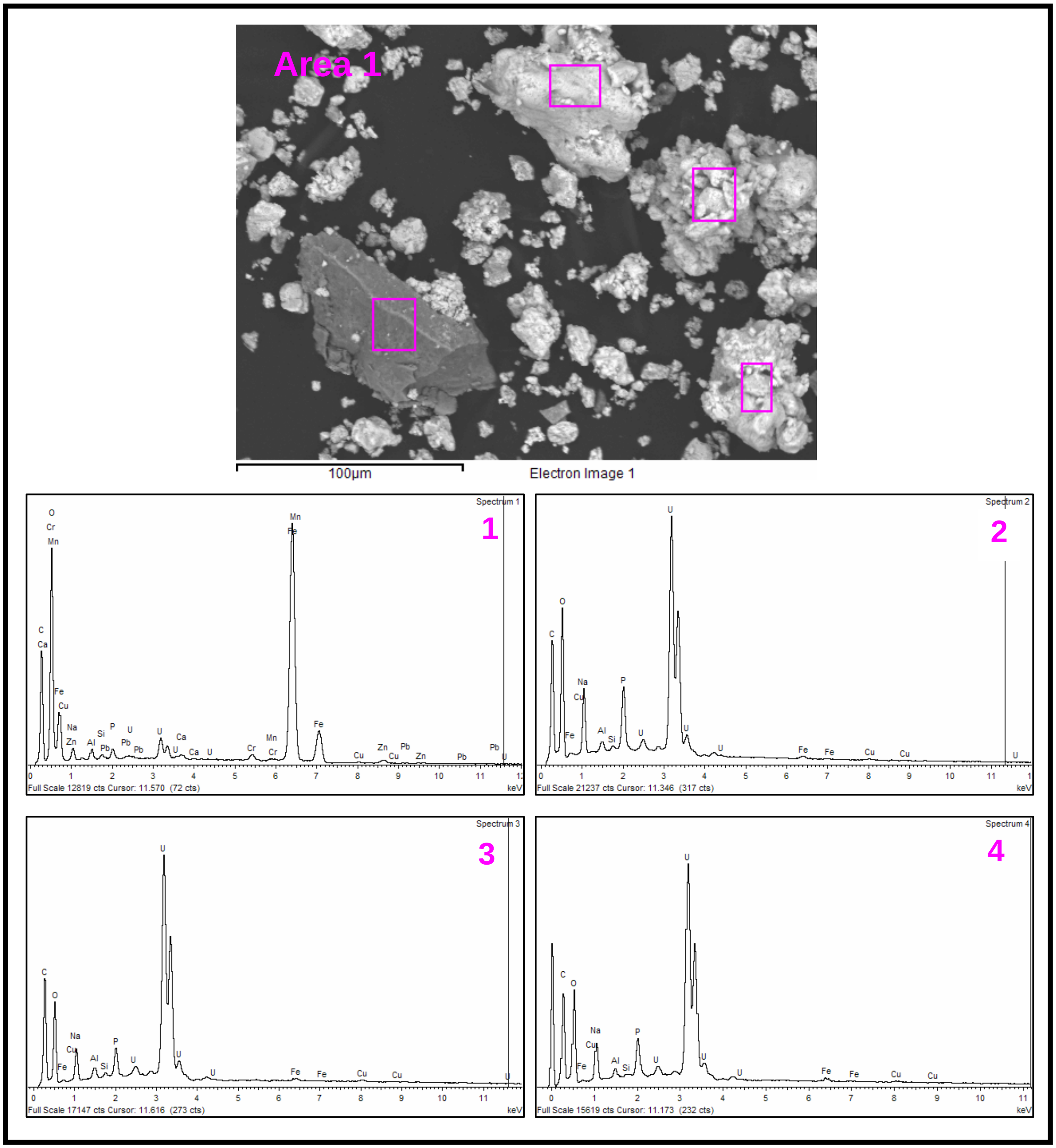


Figure H.28. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

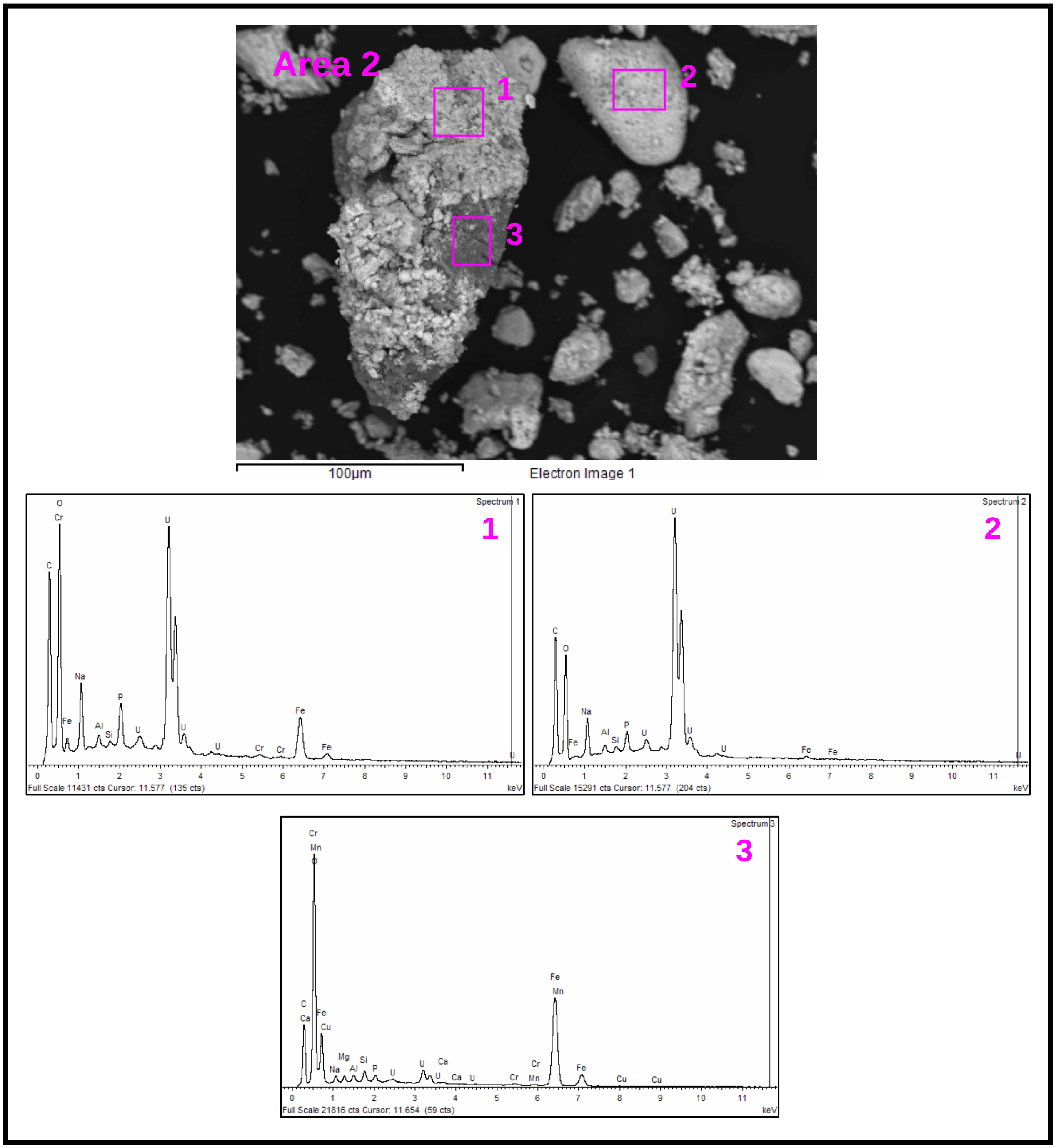


Figure H.29. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

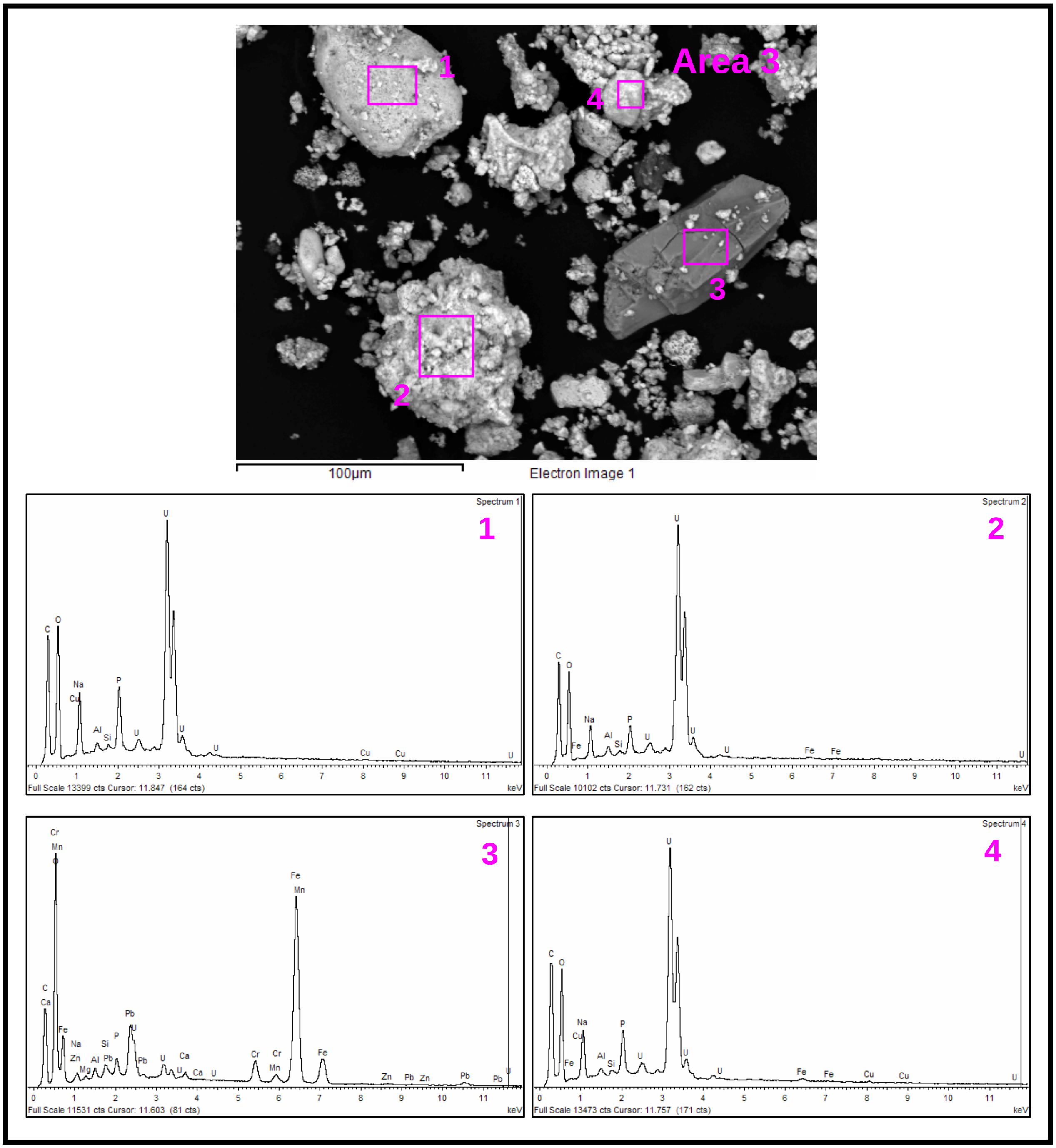


Figure H.30. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

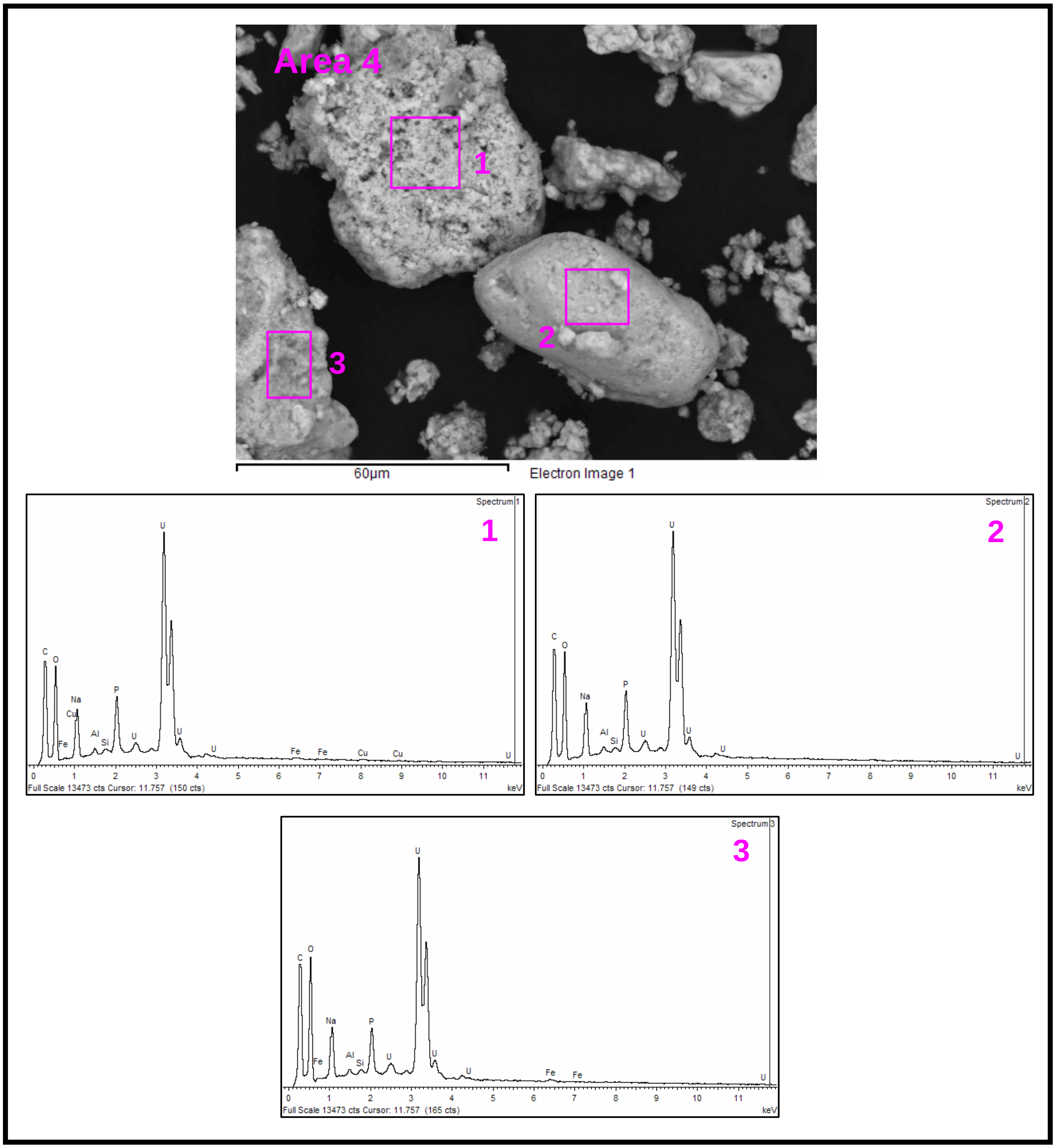


Figure H.31. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

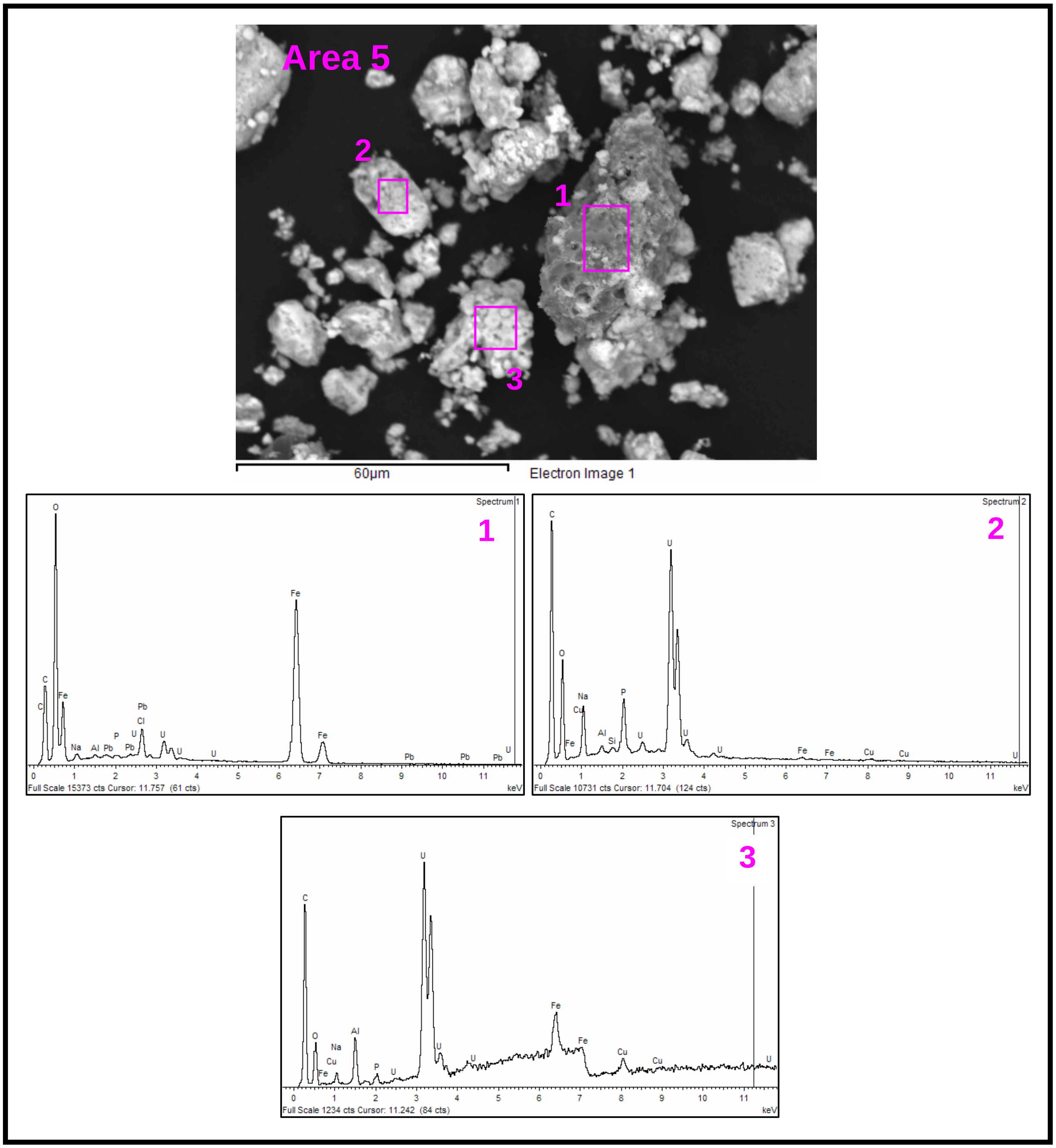


Figure H.32. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

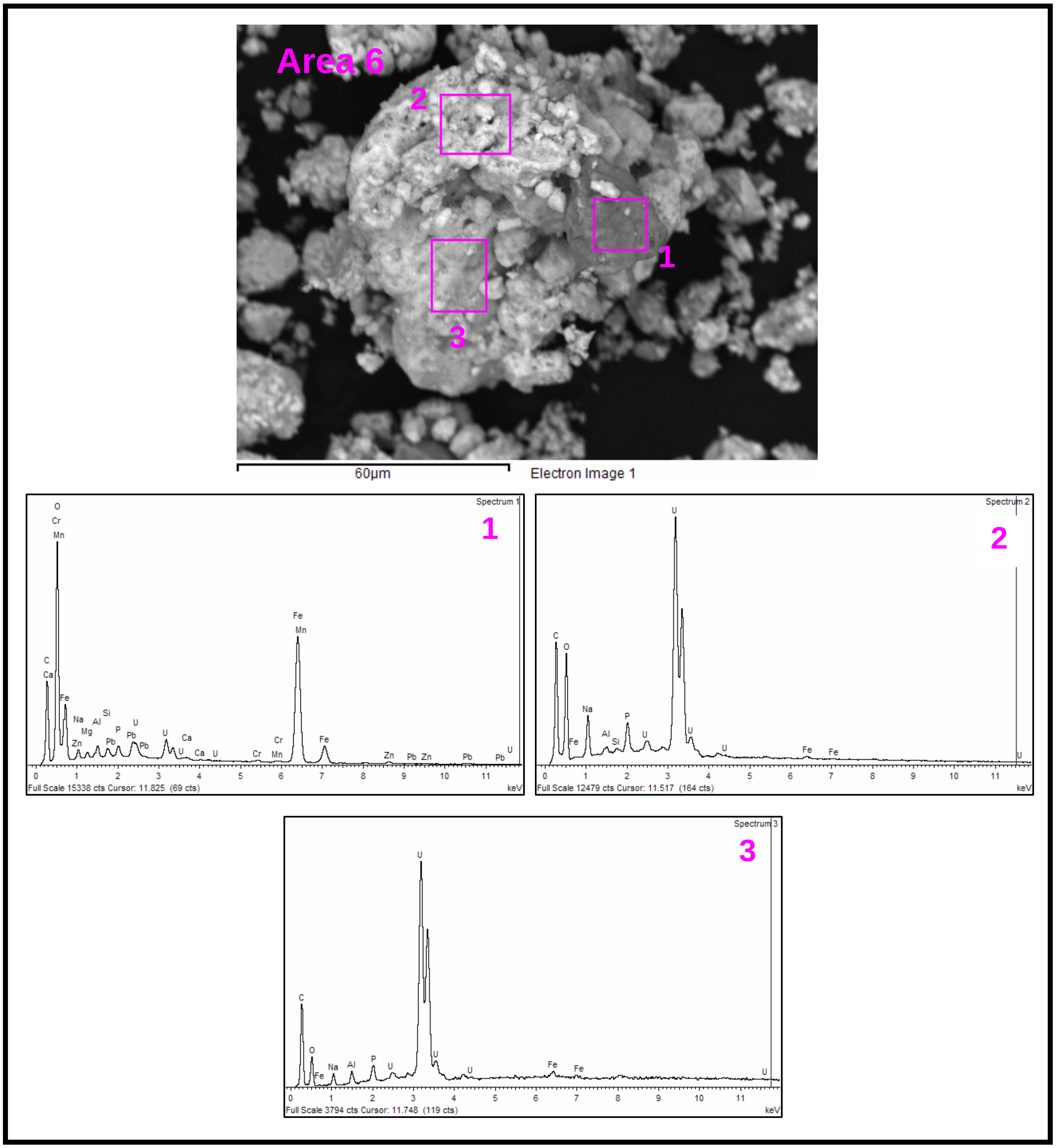


Figure H.33. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

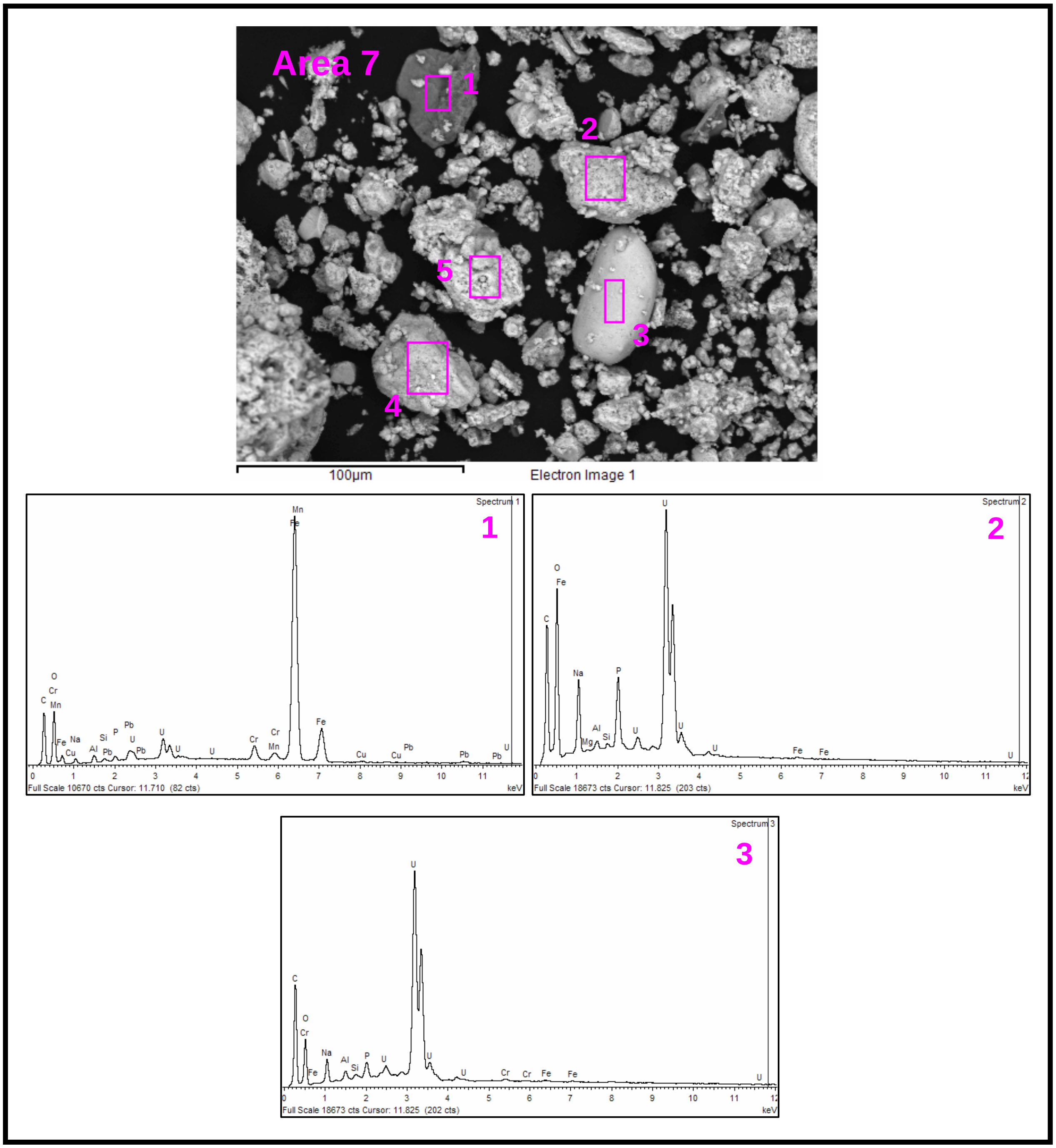


Figure H.34. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

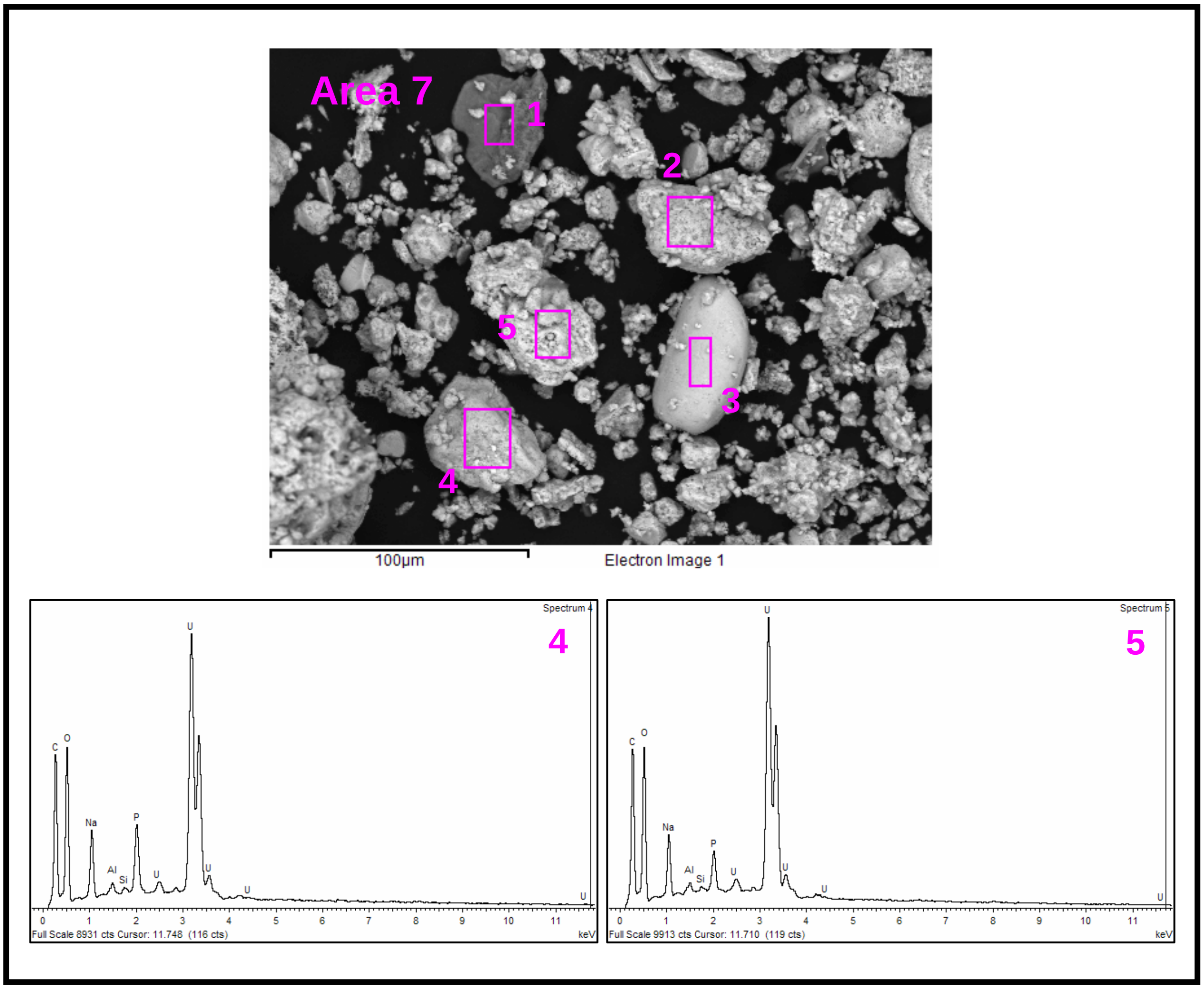


Figure H.35. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.3. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential Water Extraction Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H. 28 / 1	1	0.3	0.7	13	0.1	0.2		0.1	39	*45*	0.3	0.4	0.1		0.1	Pb - <0.1, Zn – 0.4
	2	4.6	5.5	0.2					46	*41*	2.5	0.4	0.1		0.2	
	3	6.3	4.1	0.2					39	*48*	1.7	0.7	0.2		0.2	
	4	6.1	4.9	0.3					43	*42*	2.3	0.6	0.2		0.1	
H.29 /2	1	3.0	4.0	2.2		0.1			46	*43*	1.2	0.4			0.1	
	2	5.8	4.2	0.2					43	*45*	1.0	0.4			0.3	
	3	0.3	0.8	7.6	0.1	0.1		<0.1	56	*33*	0.3	0.4	0.1	0.5	0.5	
H.30 / 3	1	4.7	5.4						43	*44*	2.7	0.4	0.1		0.2	
	2	6.6	4.3	0.2					42	*44*	1.7	0.6			0.2	
	3	0.3	0.7	12	0.3	1.0		0.2	47	*37*	0.6	0.4		0.2	0.4	Pb – 0.7, Zn – 0.1
	4	5.3	4.8	0.2					42	*45*	2.1	0.3	0.2		0.2	
H.31 /4	1	5.7	5.5	0.1					40	*45*	3.0	0.4	0.2		0.2	
	2	5.2	5.4						41	*45*	2.9	0.3			0.2	
	3	4.9	4.9	0.2					45	*43*	2.1	0.3			0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.4. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential Water Extraction Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H.32 / 5	1	0.3	0.6	11					50	*38*	0.1	0.1				Cl – 0.9, Pb - <0.1
	2	3.3	3.3	0.1					29	*62*	1.7	0.3	0.2		0.1	
	3	4.9	1.1	3.6					18	*68*	0.5	2.6	1.6			
H.33 / 6	1	0.4	0.5	8.8	0.1	0.1		0.1	49	*39*	0.4	0.5		0.4	0.3	Pb – 0.2, Zn – 0.3
	2	5.9	4.4	0.3					43	*44*	1.5	0.4			0.2	
	3	10.3	2.5	0.9					26	*58*	1.6	1.5				
H.34 and H.35 / 7	1	0.6	0.9	26	0.5	1.0			20	*49*	0.3	0.6	0.2		0.2	Pb – 0.2
	2	4.2	5.4	0.1					46	*41*	2.5	0.3		0.1	0.2	
	3	7.6	3.8	0.2		0.2			31	*55*	1.2	0.8			0.3	
	4	4.6	5.0						44	*44*	2.5	0.4			0.2	
	5	5.1	4.9						45	*43*	1.5	0.4			0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

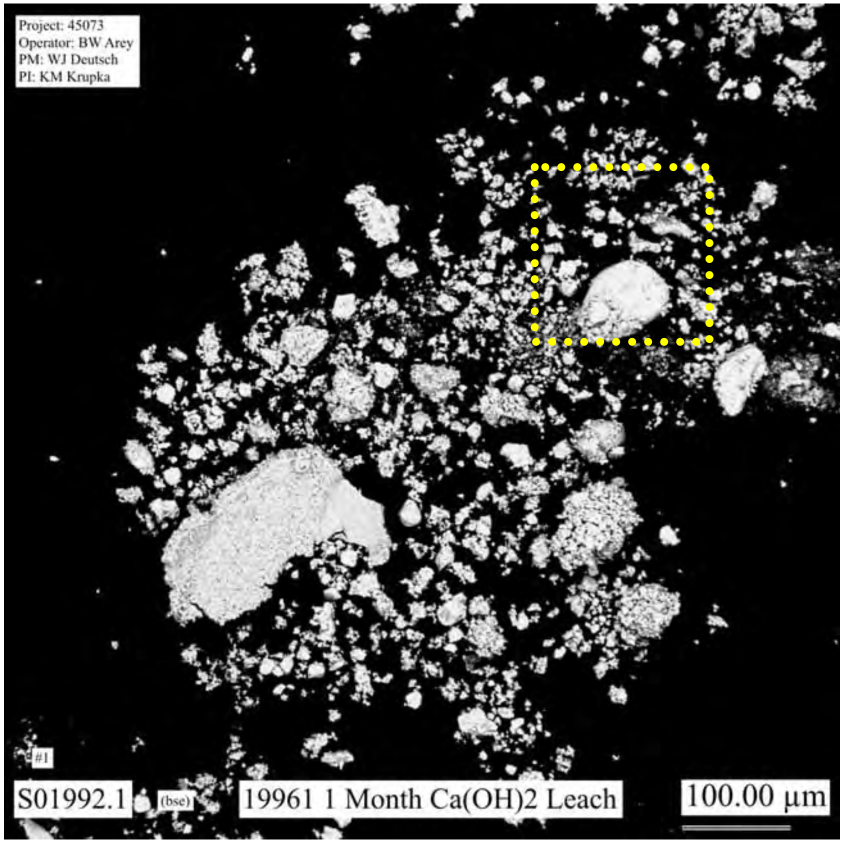


Figure H.36. Low Magnification Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

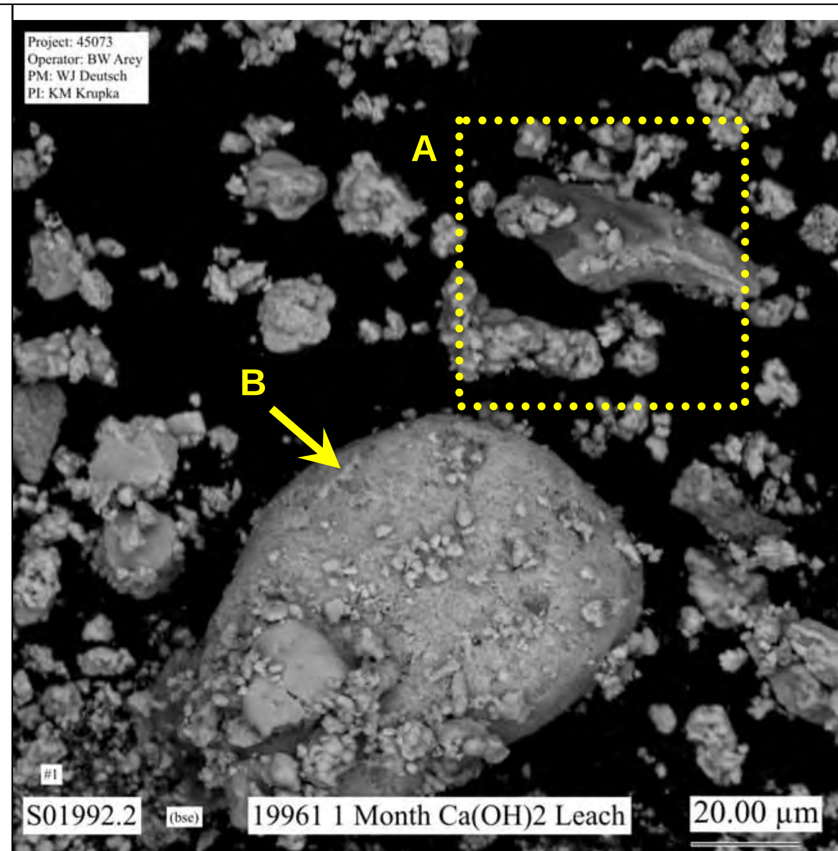


Figure H.37. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.36

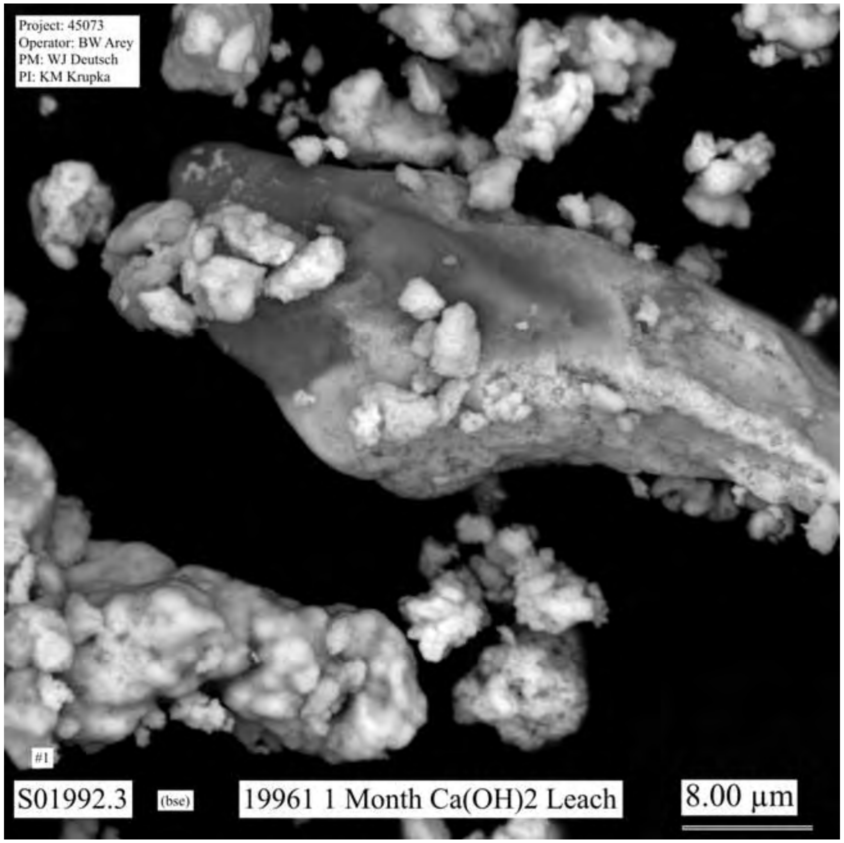


Figure H.38. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square Labeled A in Figure H.37 (Areas where EDS analyses were made are shown in Figure H.51.)

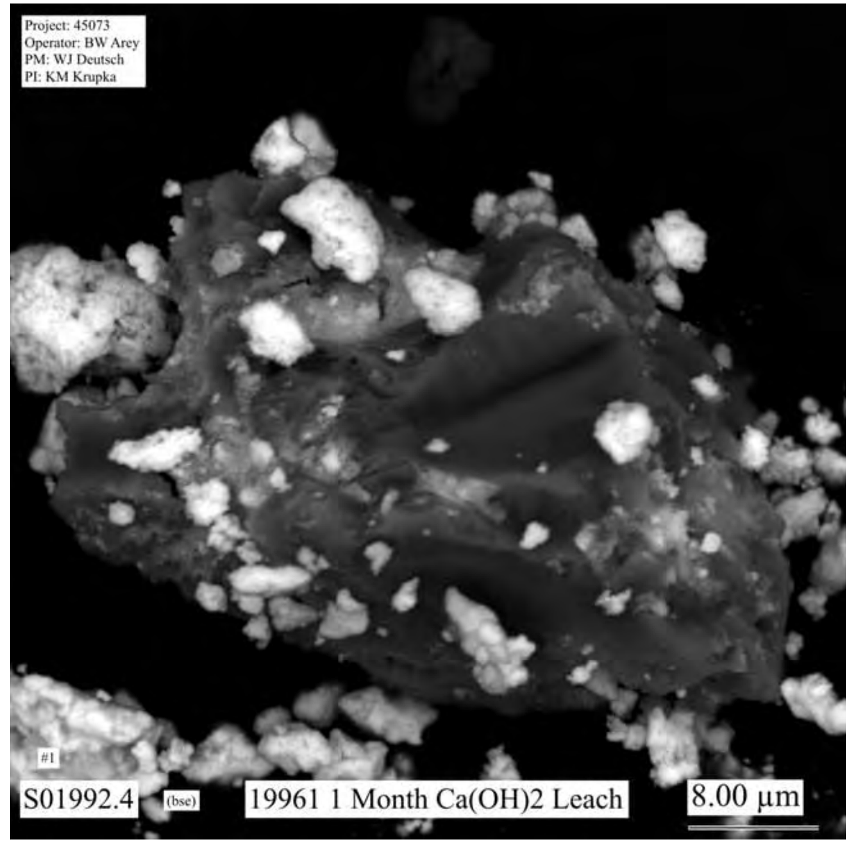


Figure H.39. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.52.)

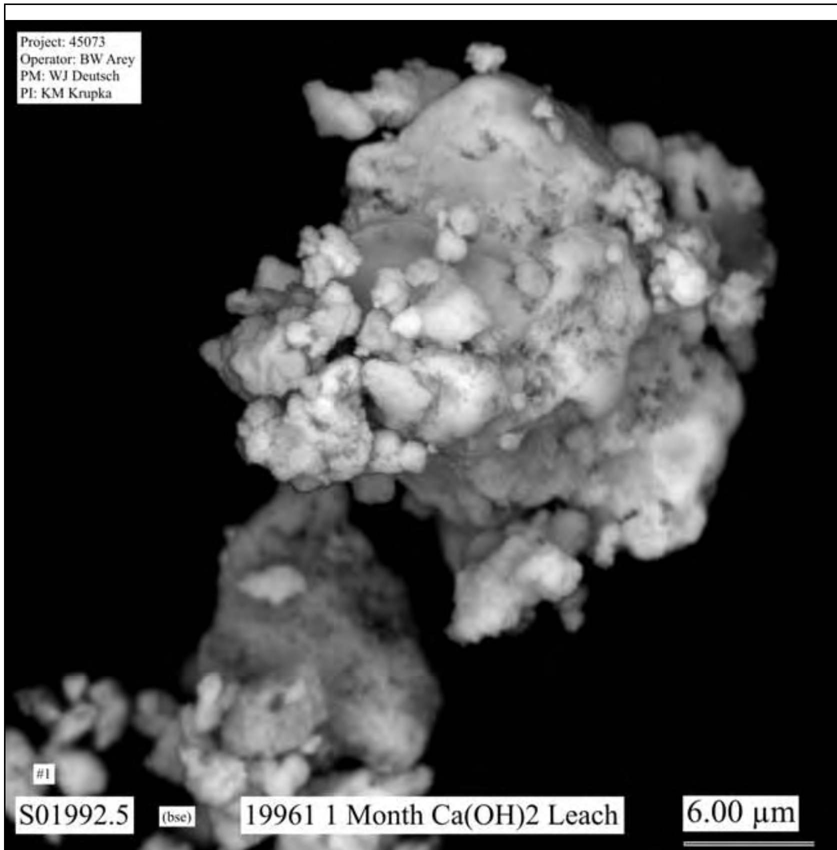


Figure H.40. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.53.)

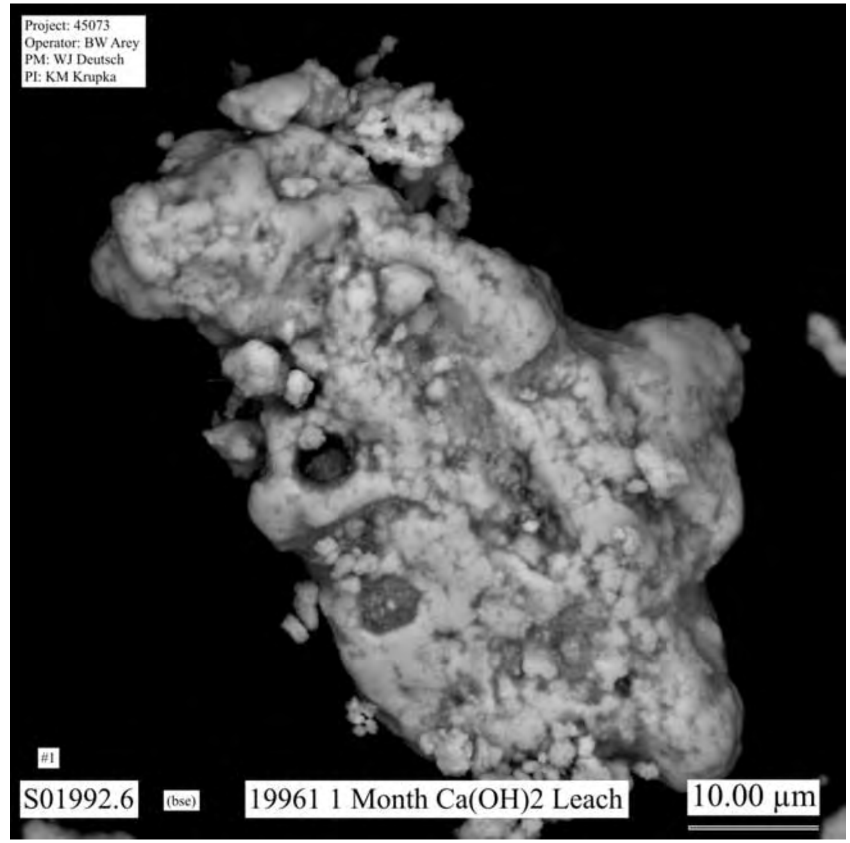


Figure H.41. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.54 and H.55.)

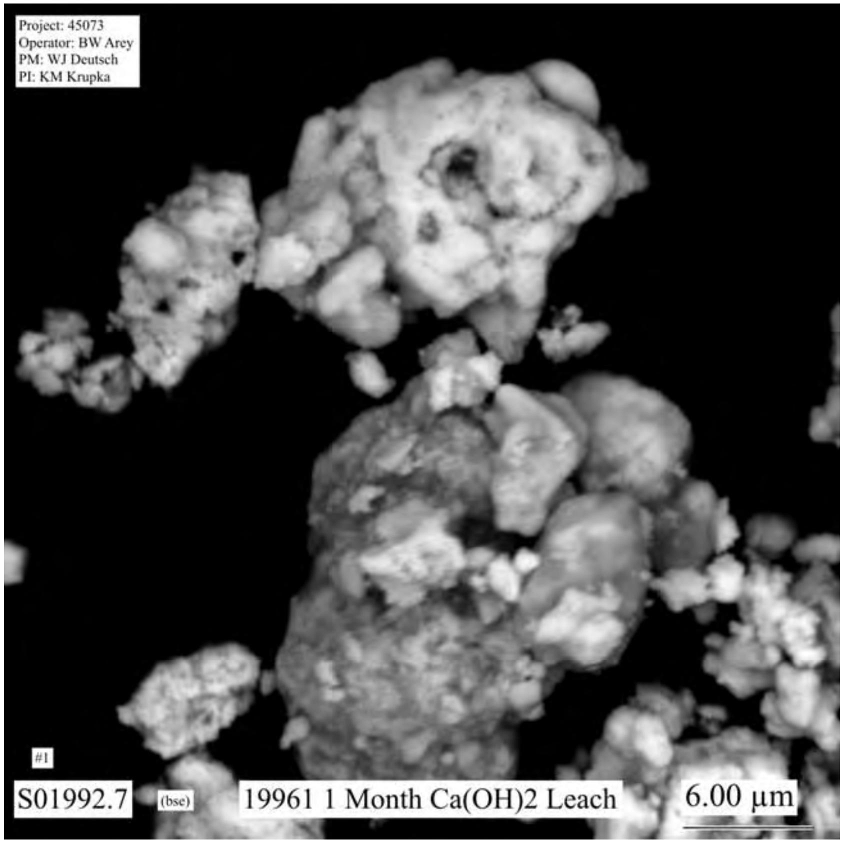


Figure H.42. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.56 and H.57.)

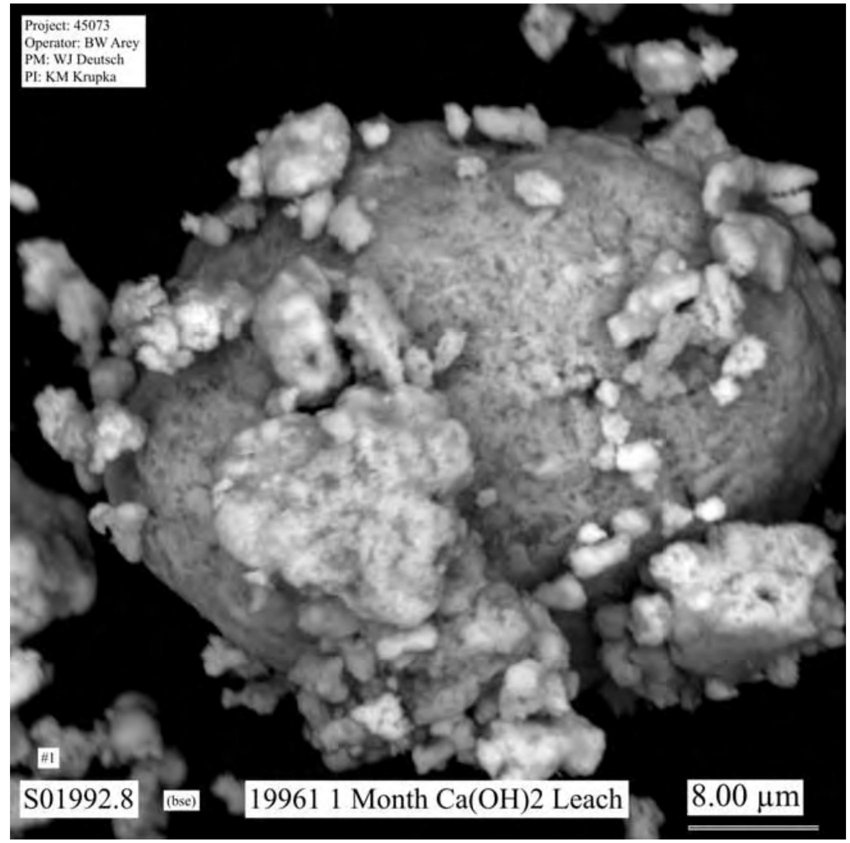
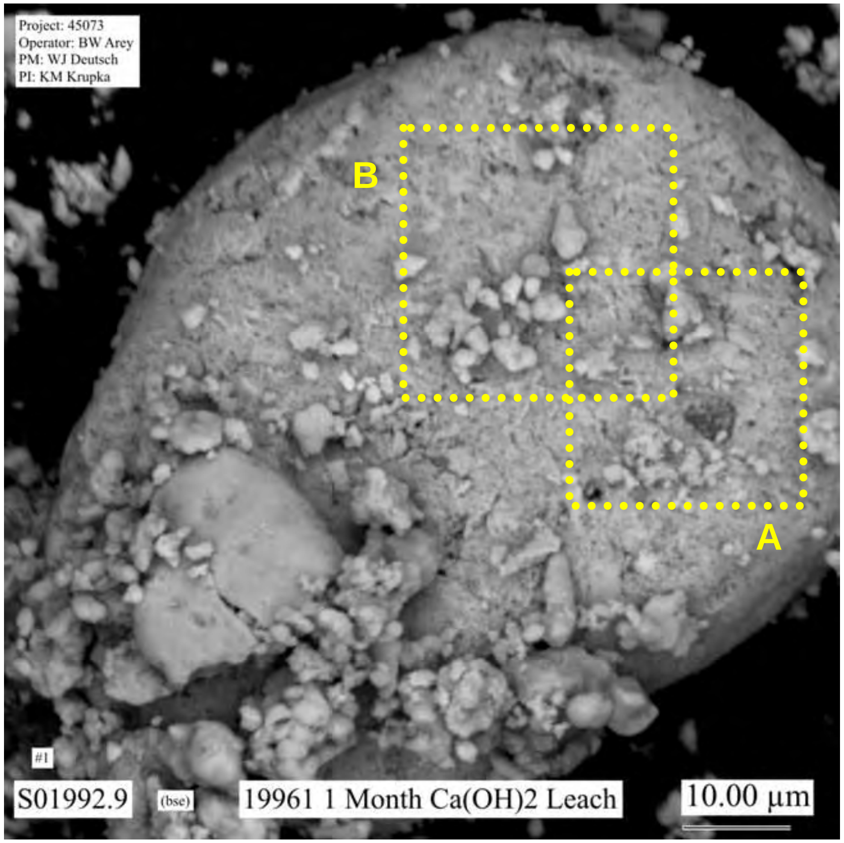


Figure H.43. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.58.)



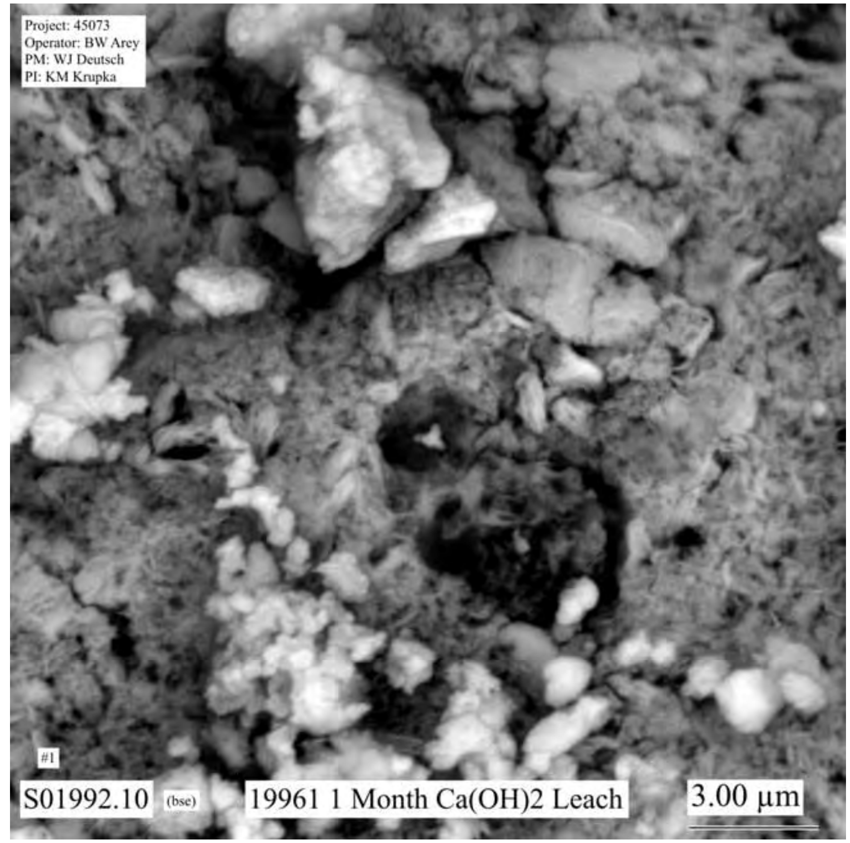


Figure H.44. Micrograph Showing at Higher Magnification the Large Particle Aggregate Labeled B in Figure H.36 (Areas where EDS analyses were made are shown in Figure H.59.)

Figure H.45. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure H.44

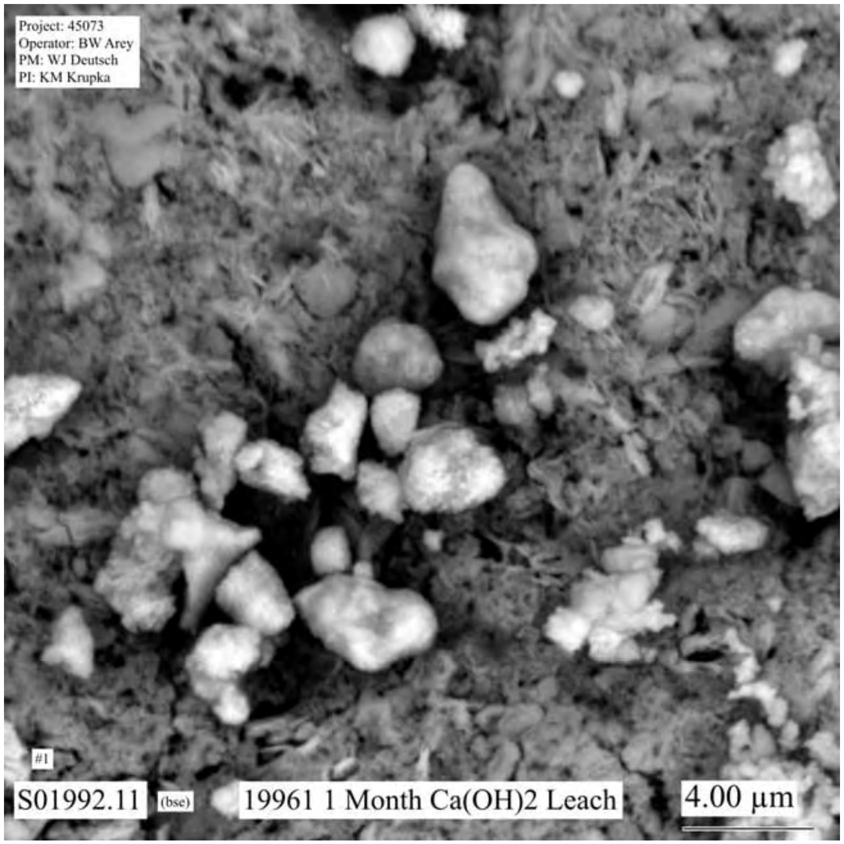


Figure H.46. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled B in Figure H.44

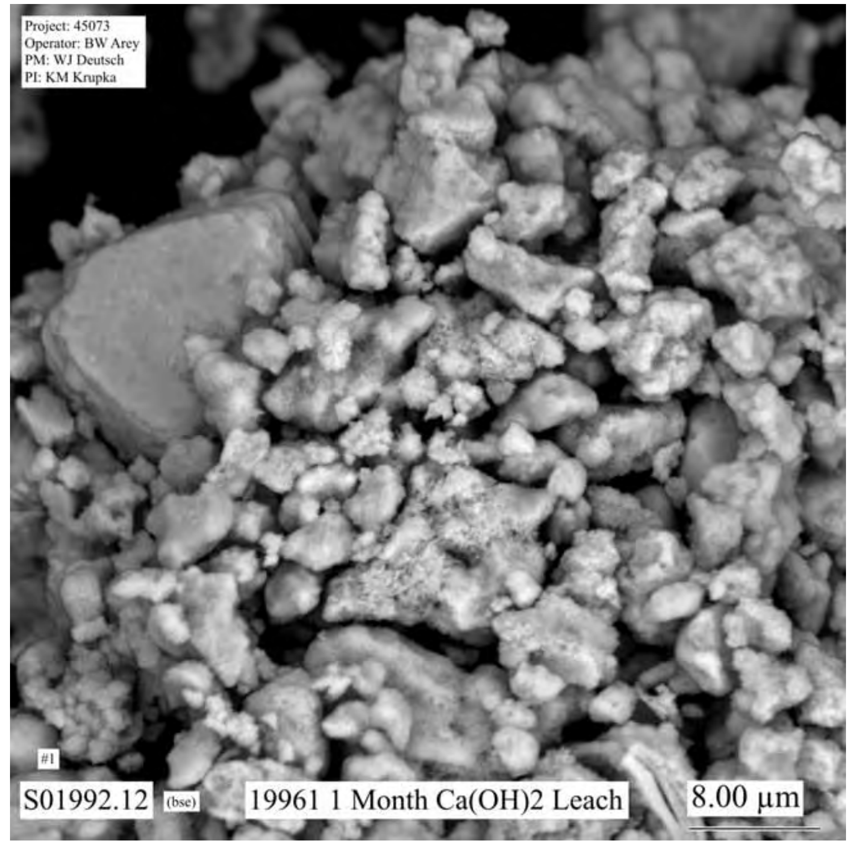


Figure H.47. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

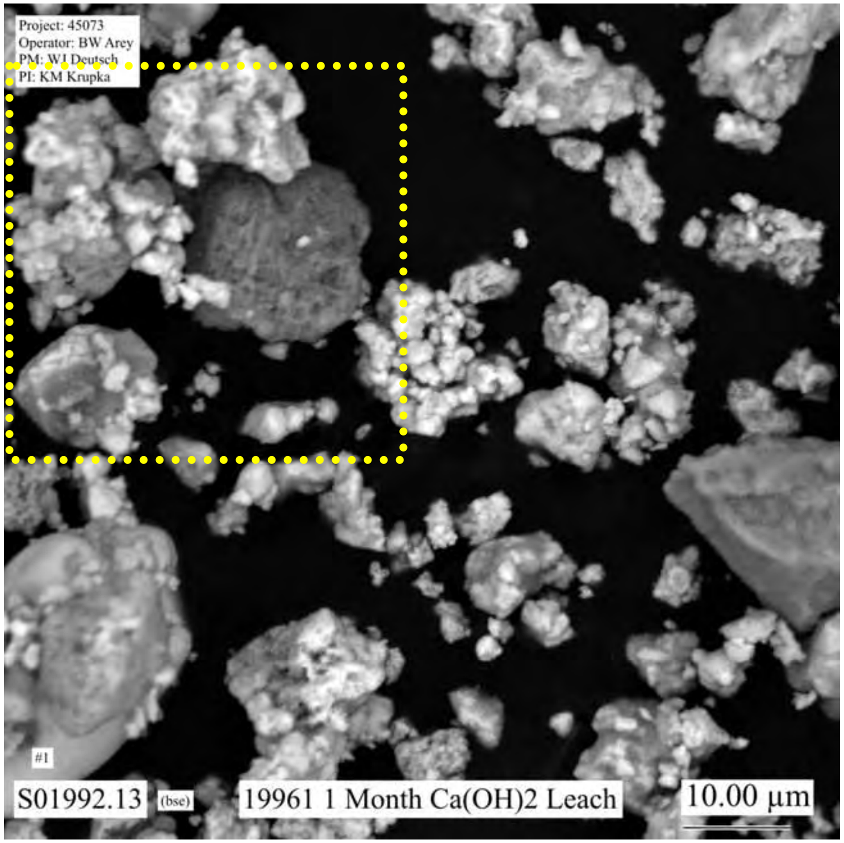


Figure H.48. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.60 and H.61.)

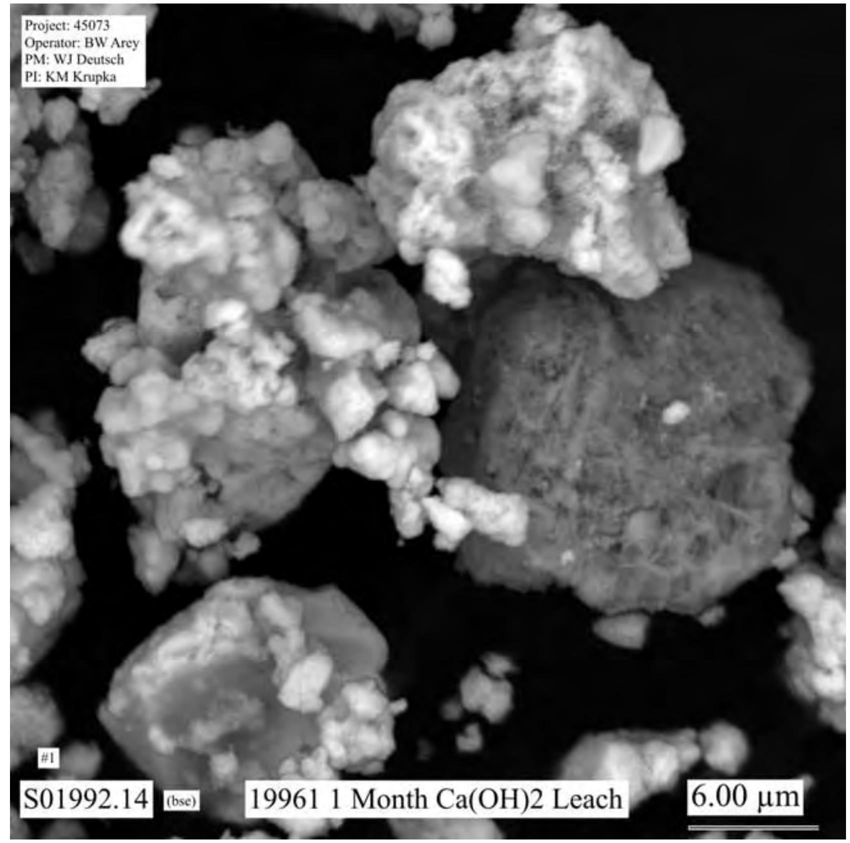


Figure H.49. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.48

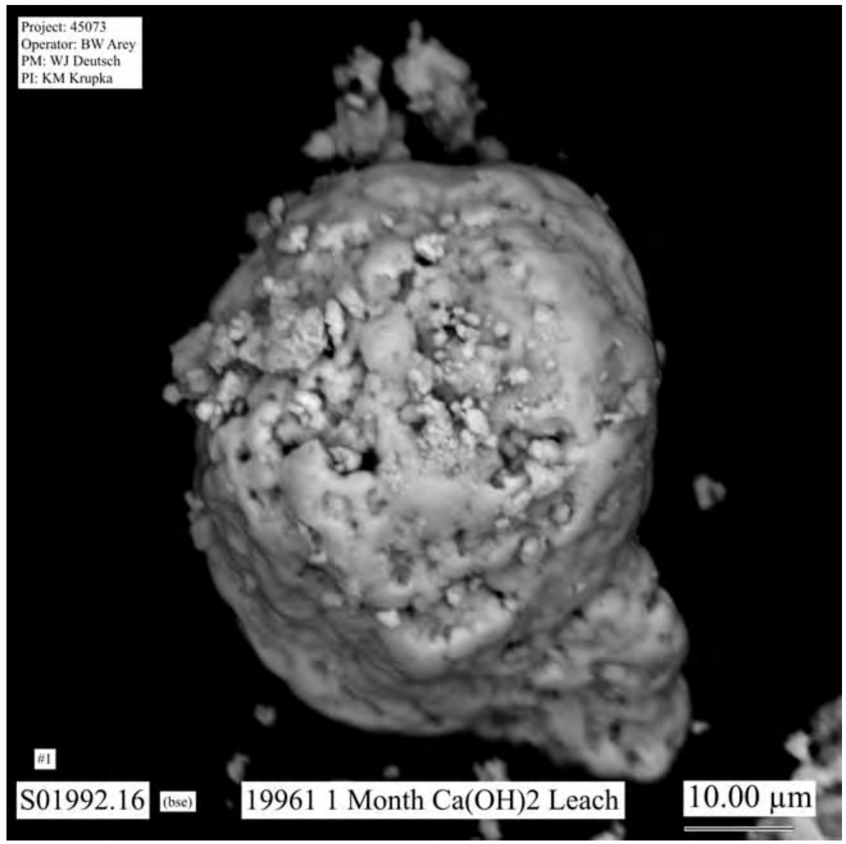


Figure H.50. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

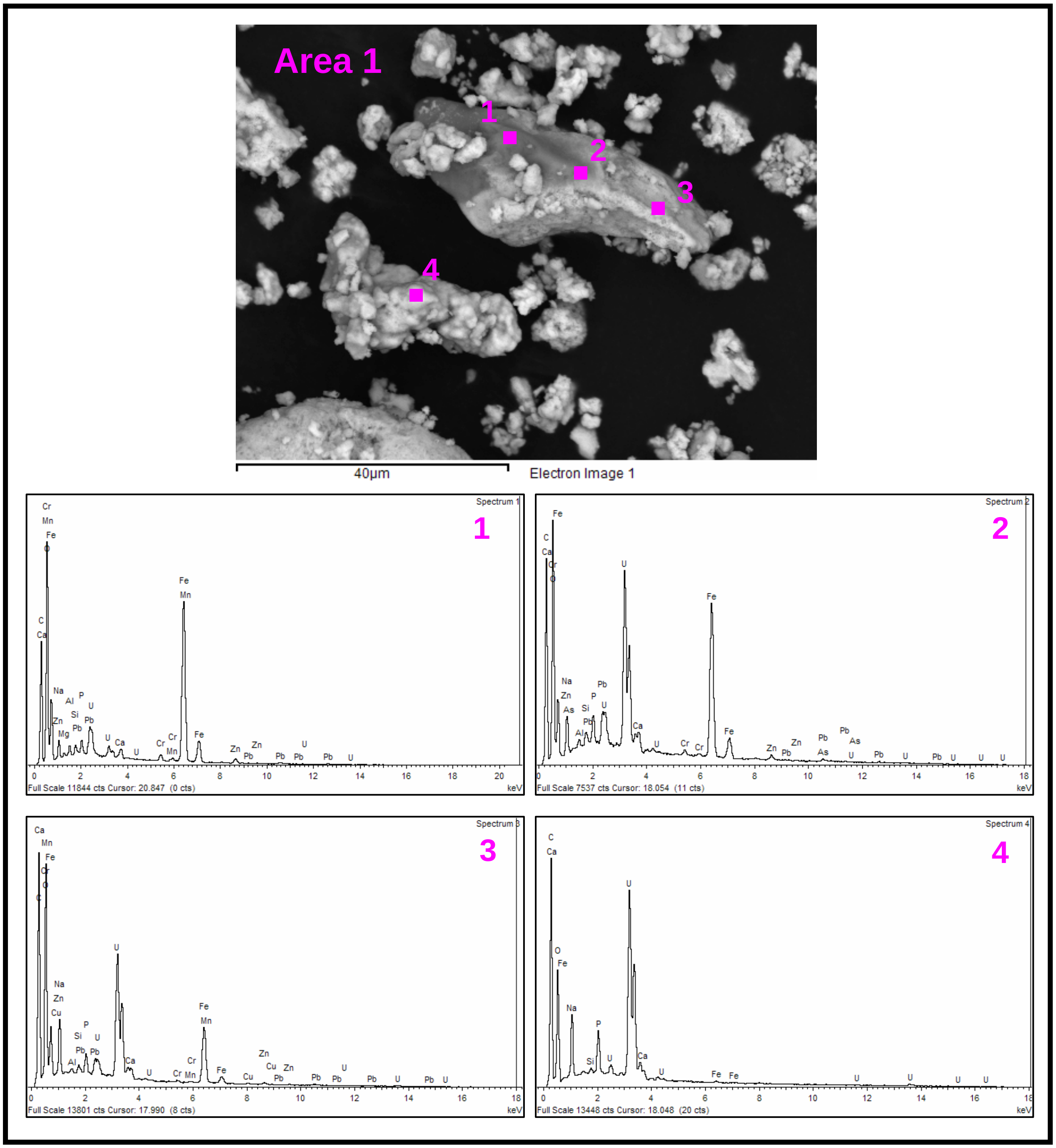


Figure H.51. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

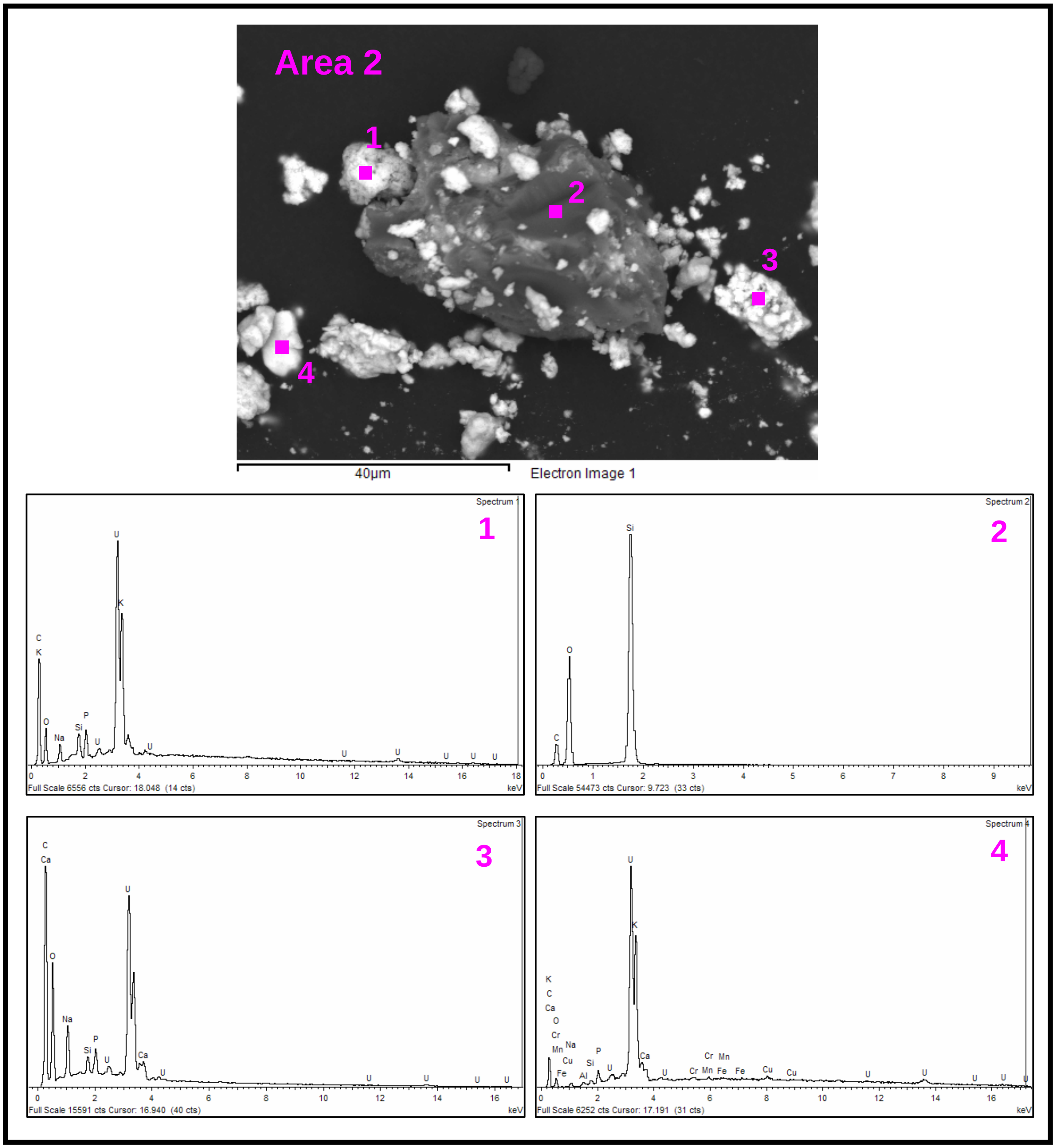


Figure H.52. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

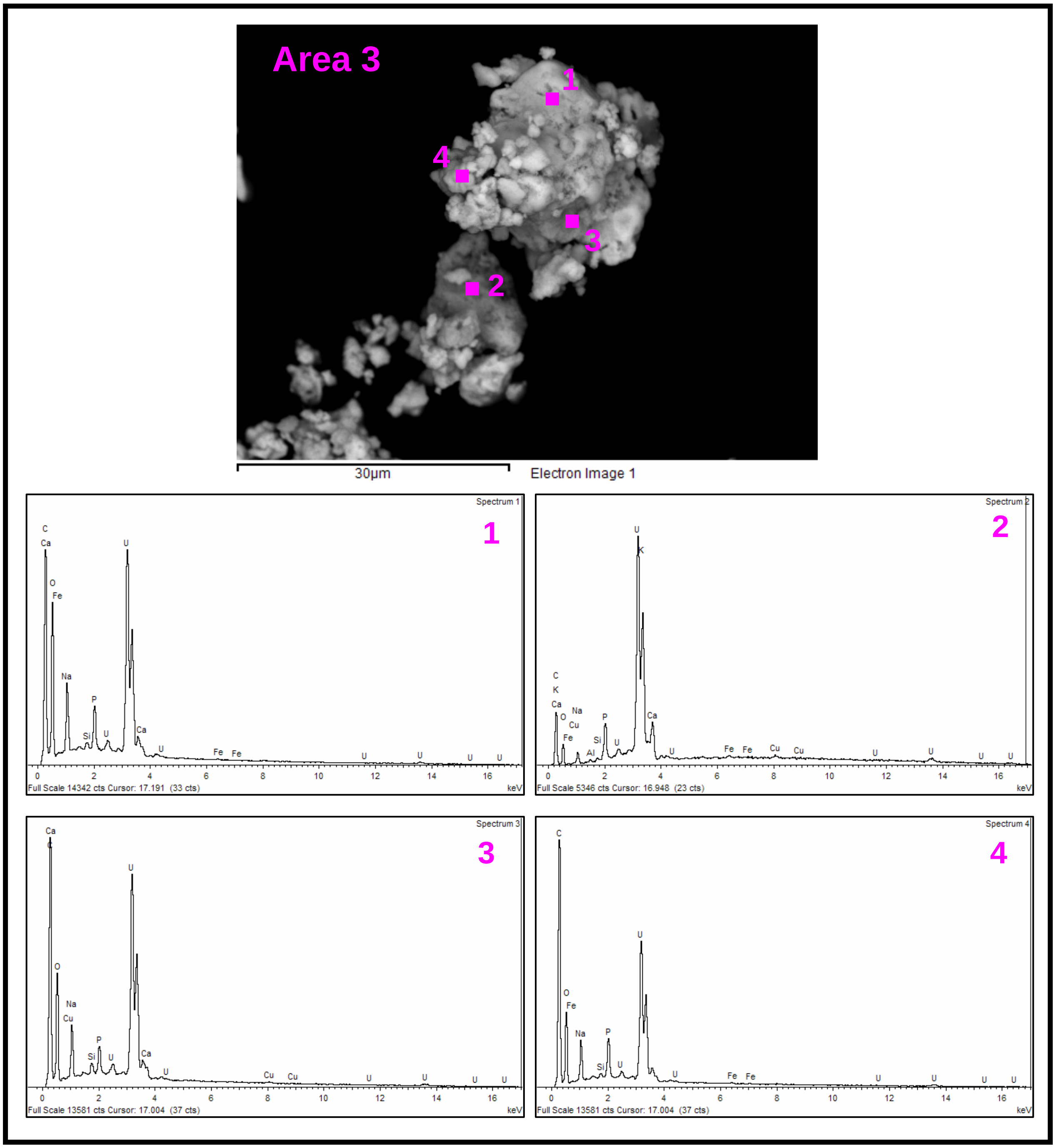


Figure H.53. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

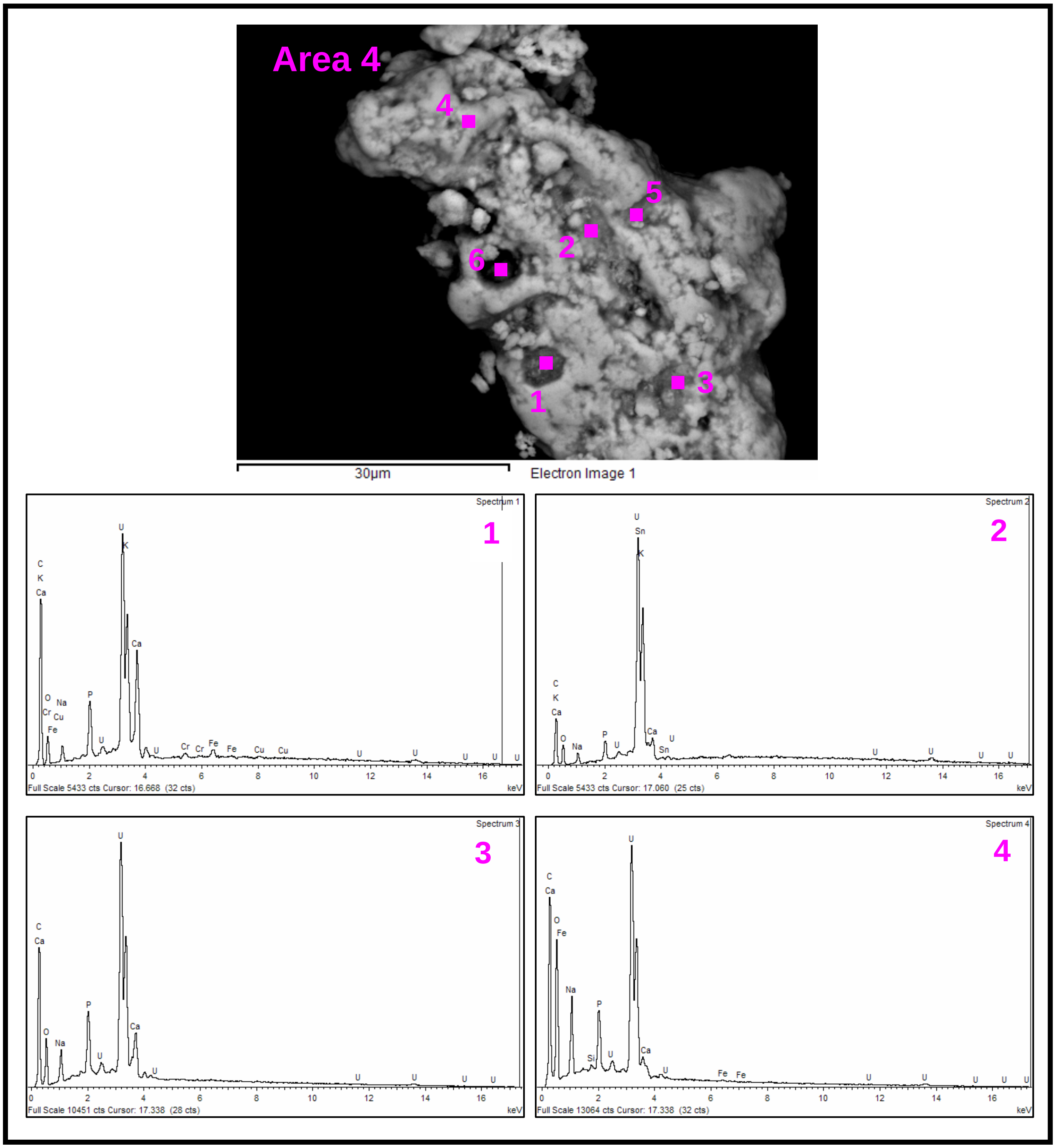


Figure H.54. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

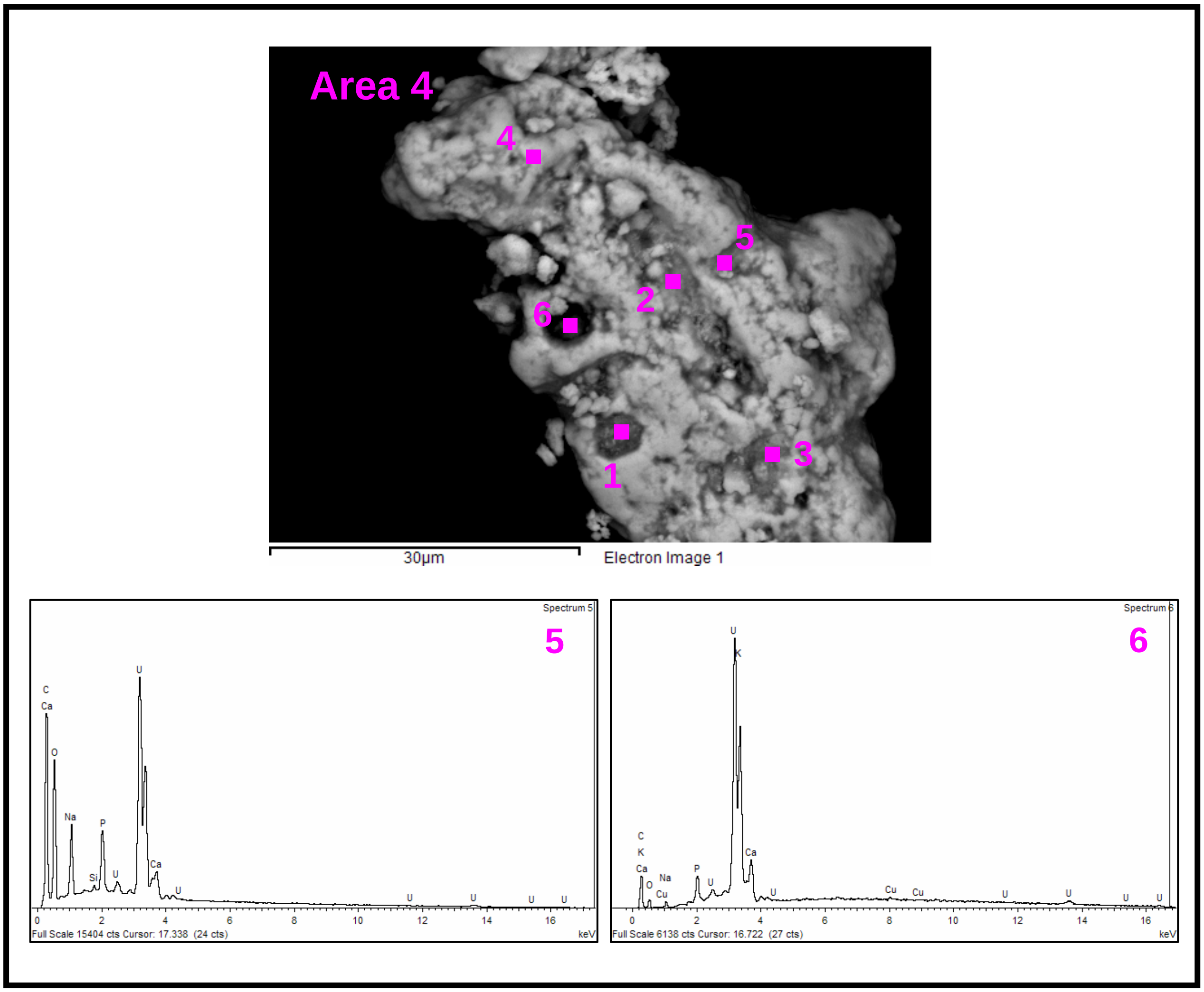


Figure H.55. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

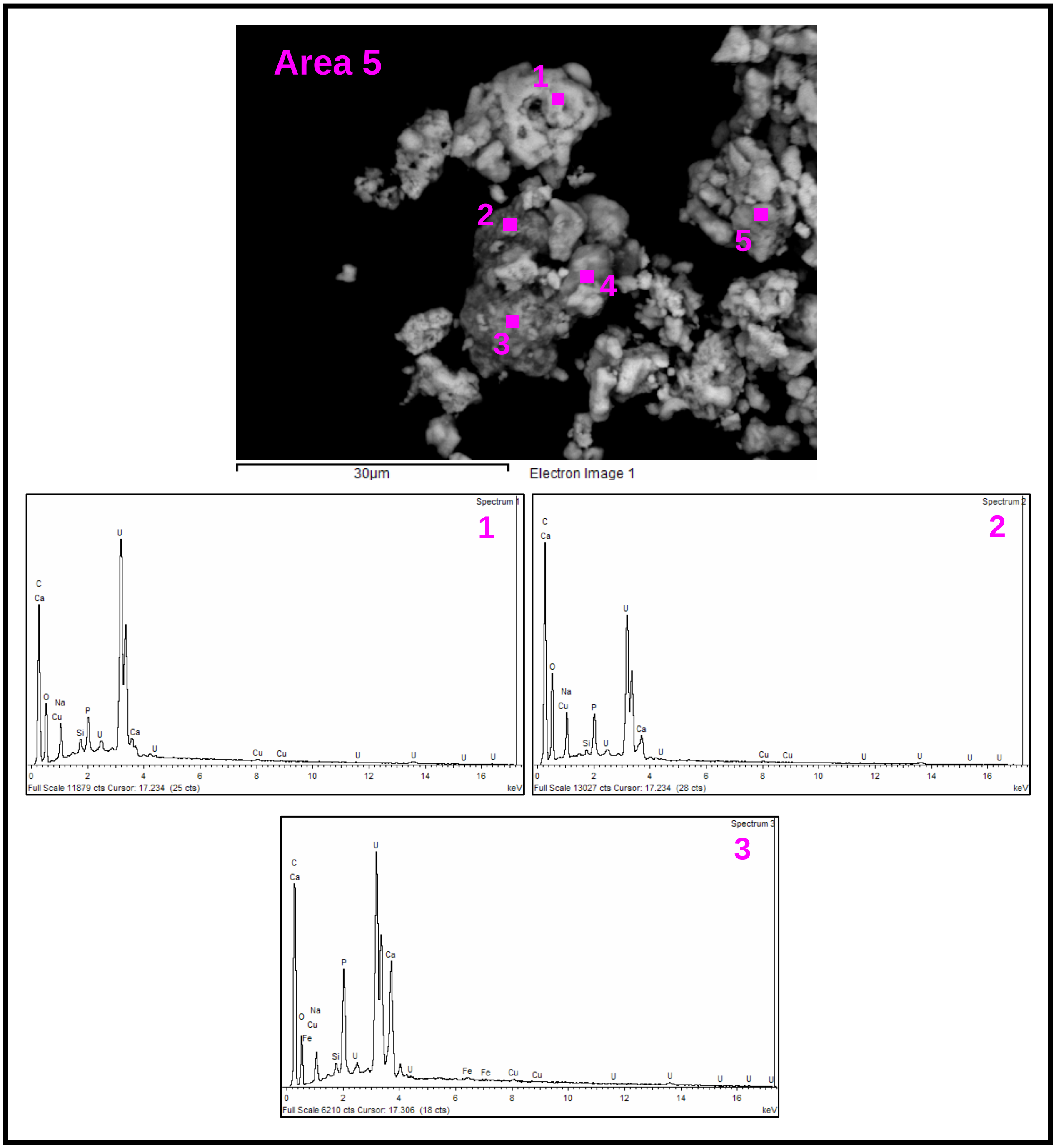


Figure H.56. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

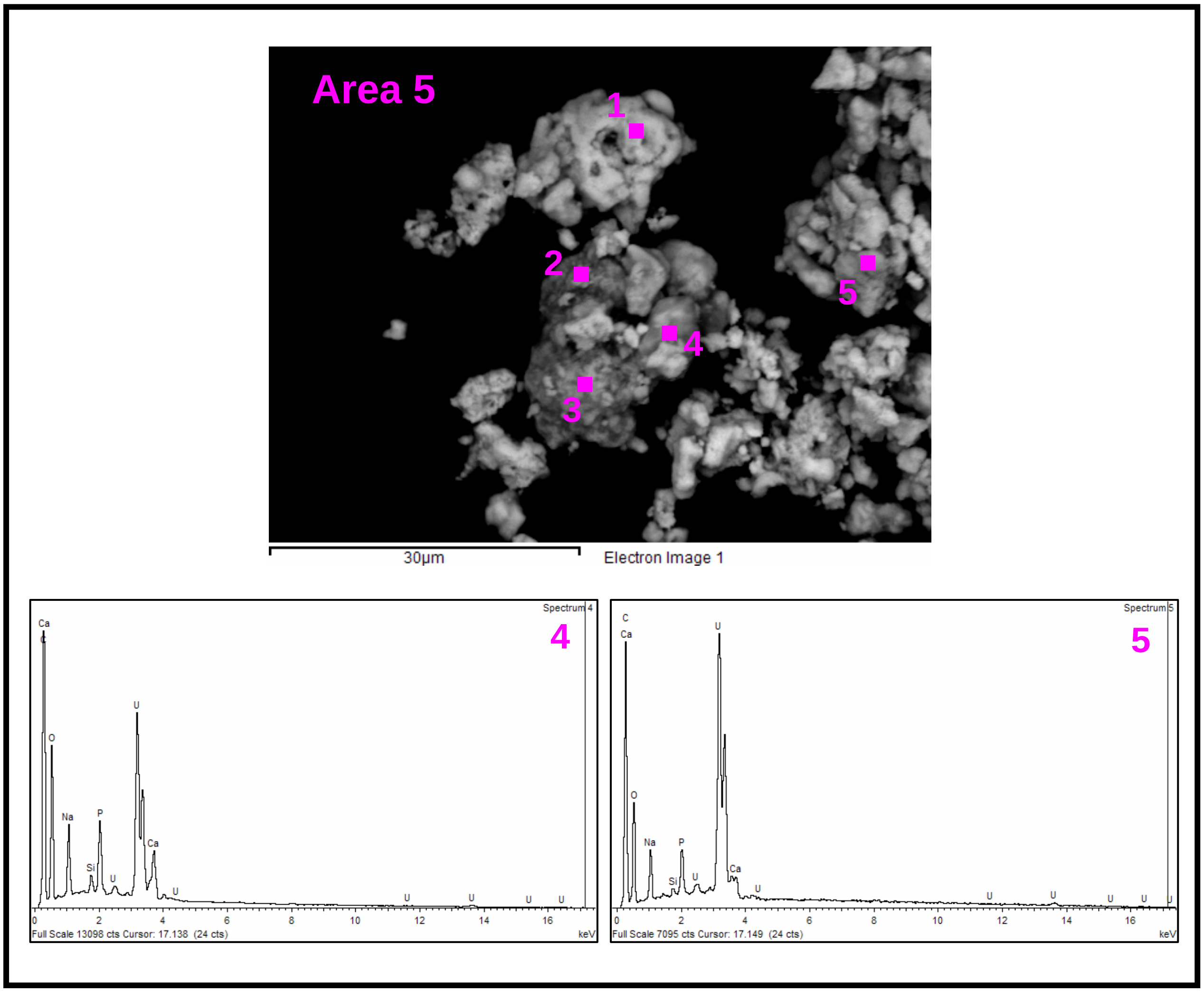


Figure H.57. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

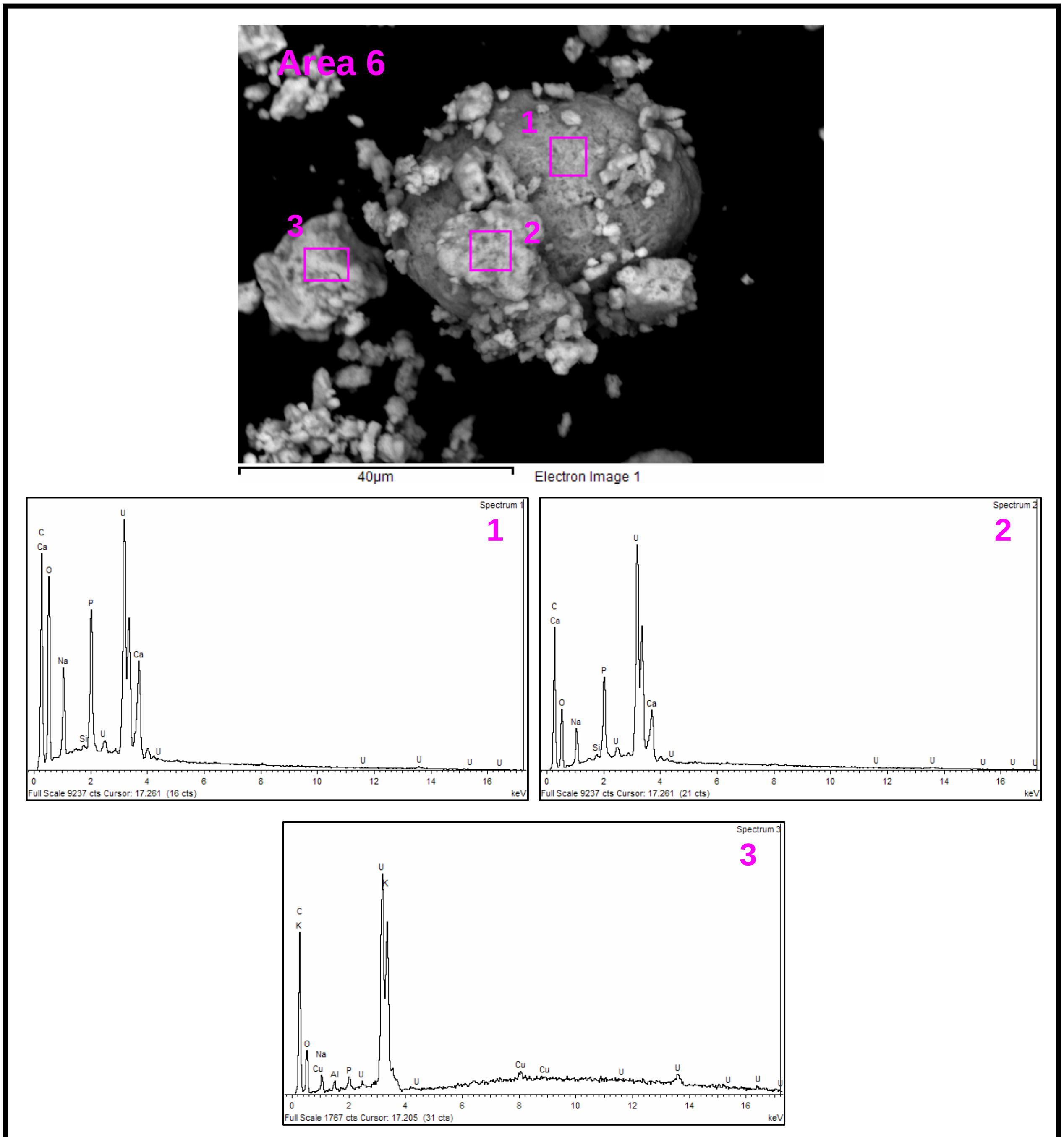


Figure H.58. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

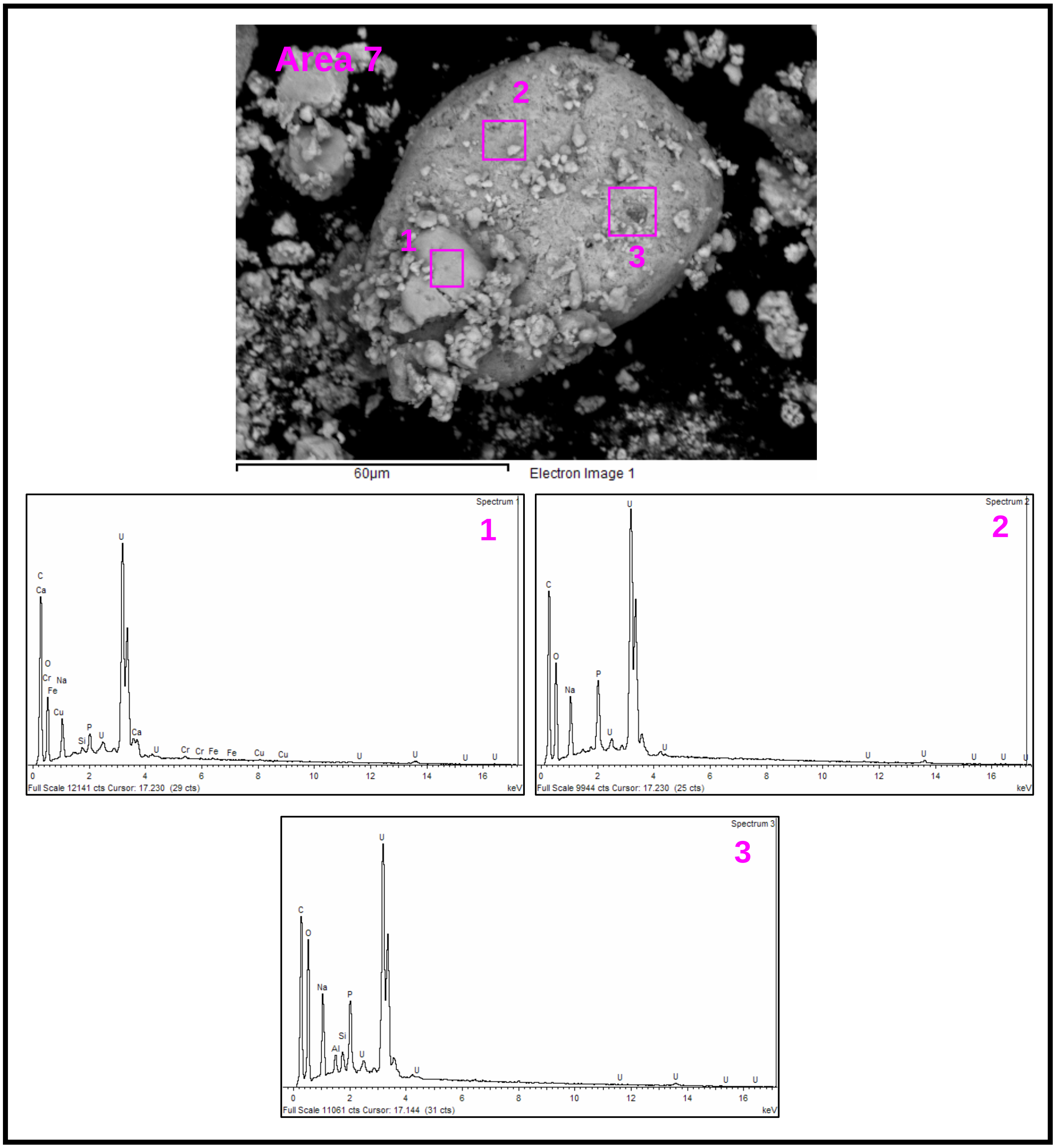


Figure H.59. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

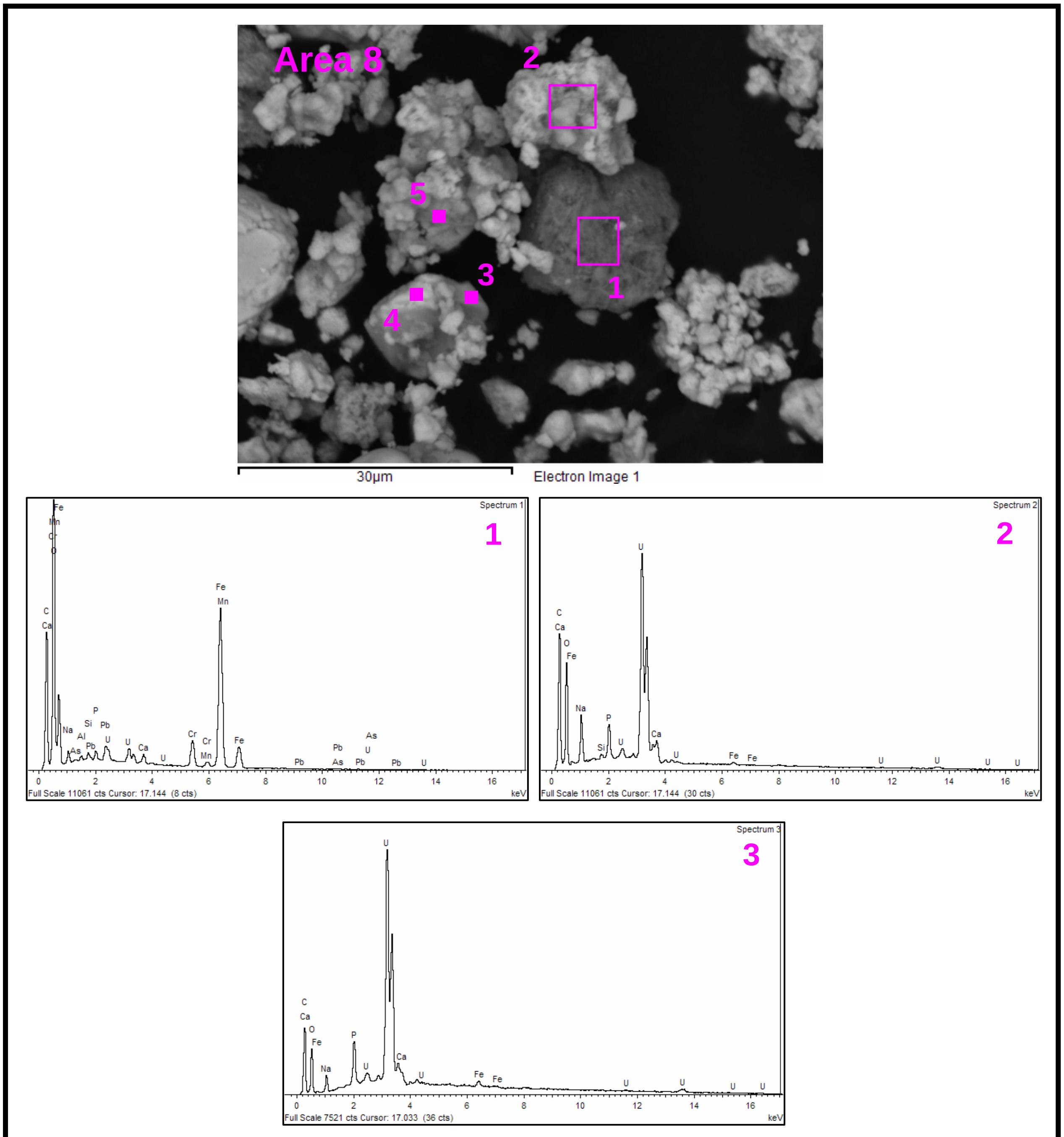


Figure H.60. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

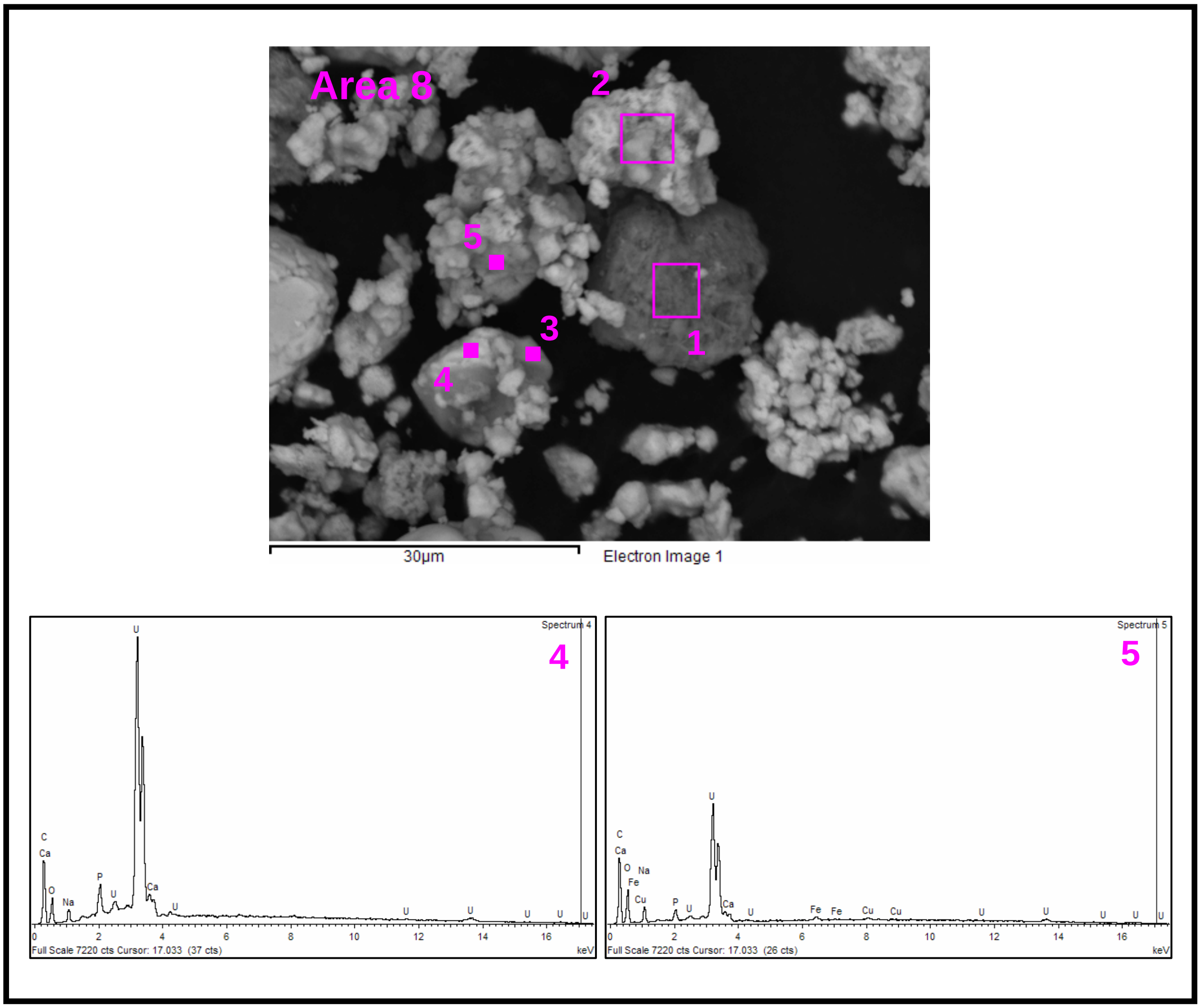


Figure H.61. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.5. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C**[3]	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.51 / 1	1	0.2	0.9	8.6	0.1	0.2		0.2	42	*46*	0.4	0.3		0.2	0.3	Pb – 0.3, Zn – 0.5
	2	2.0	1.6	6.5		0.2		0.4	40	*47*	0.6	0.2			0.3	As - <0.1, Pb – 0.3, Zn – 0.4
	3	1.5	2.7	2.6	<0.1	0.1		0.2	41	*51*	0.5	0.1	0.1		0.2	Pb – 0.1, Zn – 0.2
	4	3.1	4.1	0.1				0.2	33	*58*	1.4				0.2	
H.52 / 2	1	7.3	2.6						23	*63*	2.1				1.5	K – 0.5
	2								54	*33*					13	
	3	3.0	3.5					0.5	36	*56*	0.9				0.6	
	4	20	1.8	0.3	0.6	0.5		2.3	18	*50*	2.6	0.6	1.4		0.8	K – 1.5
H.53 / 3	1	3.2	4.4	0.1				0.2	39	*51*	1.4				0.2	
	2	12	2.9	0.5				4.6	23	*51*	4.3	0.3	0.8		0.3	K – 0.4
	3	3.3	3.6					0.3	32	*59*	0.9		0.1		0.4	
	4	2.5	2.8	0.1					26	*67*	1.4				0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.6. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H.54 & H.55 /4	1	5.0	1.6	0.7		0.3		5.3	15	*70*	2.6		0.3			K – 0.1
	2	14	3.3					2.9	27	*47*	2.9					K – 1.5, Sn – 0.9
	3	6.1	3.7					2.5	24	*60*	3.4					
	4	3.7	5.3	0.1				0.3	38	*50*	2.0				0.2	
	5	3.5	4.7					0.8	39	*50*	1.9				0.2	
	6	22	2.4					8.3	15	*46*	5.0		0.8			K – 0.6
H.56 & H.57 / 5	1	5.3	3.7					0.4	27	*61*	1.8		0.2		0.7	
	2	2.5	3.2					0.8	30	*62*	1.5		0.1		0.2	
	3	4.0	2.2	0.1				4.2	20	*66*	3.7		0.2		0.5	
	4	2.2	3.4					1.1	35	*56*	1.7				0.4	
	5	4.0	3.2					0.7	29	*61*	1.4				0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.

2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.

3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.7. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic% [1]														
		Major Cations							Anions [2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C** [3]	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.58 / 6	1	2.7	4.2					2.3	40	*48*	3.2				0.1	
	2	5.0	3.6					2.5	27	*58*	3.8				0.2	
	3	5.6	2.0						22	*68*	0.7	0.6	1.1			K – 0.9
H.59 / 7	1	5.2	4.1	0.1		0.2		0.8	29	*59*	1.0		0.1		0.2	
	2	4.7	4.8						33	*55*	2.7					
	3	3.8	5.5						38	*49*	2.3	0.7			0.7	
H.60 & H.61 / 8	1	0.2	0.8	7.6	0.1	0.9		0.2	48	*41*	0.2	0.1			0.1	As - <0.1, Pb – 0.1
	2	4.7	4.6	0.2				1.0	40	*48*	1.6				0.2	
	3	10	3.3	0.9				0.8	34	*46*	4.1					
	4	14	3.3					1.7	25	*52*	3.5					
	5	6.4	3.7	0.7				0.8	33	*54*	1.2		0.5			

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

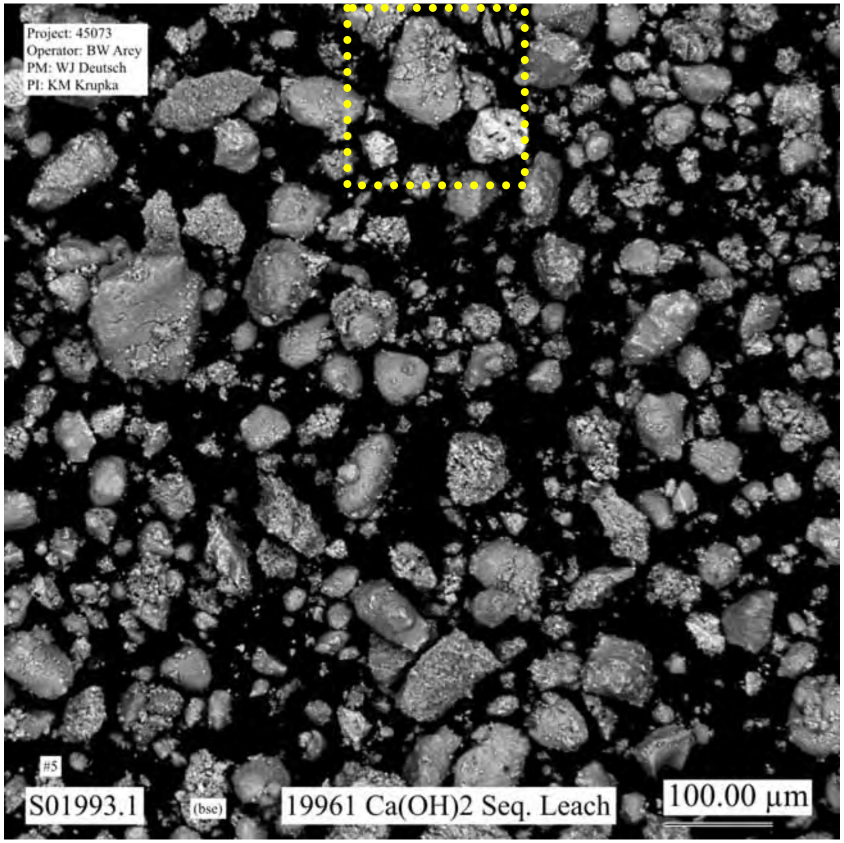


Figure H.62. Low Magnification Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

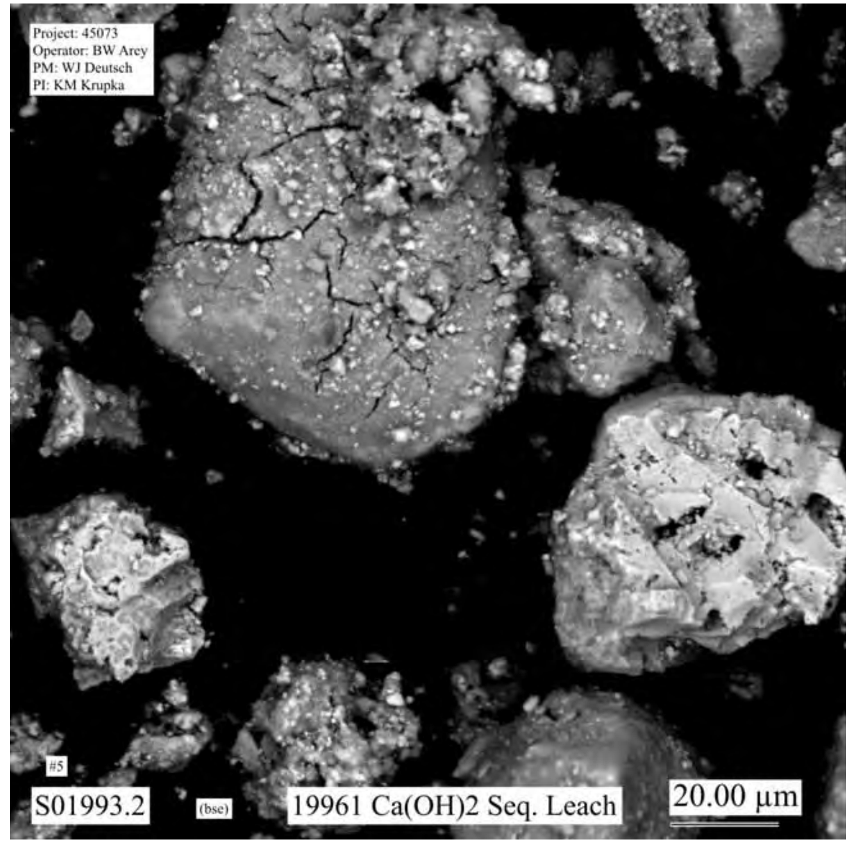


Figure H.63. Micrograph Showing at Higher Magnification the Particles Indicated by the Yellow Dotted-Line Square in Figure H.36 (Areas where EDS analyses were made are shown in Figure H.74.)

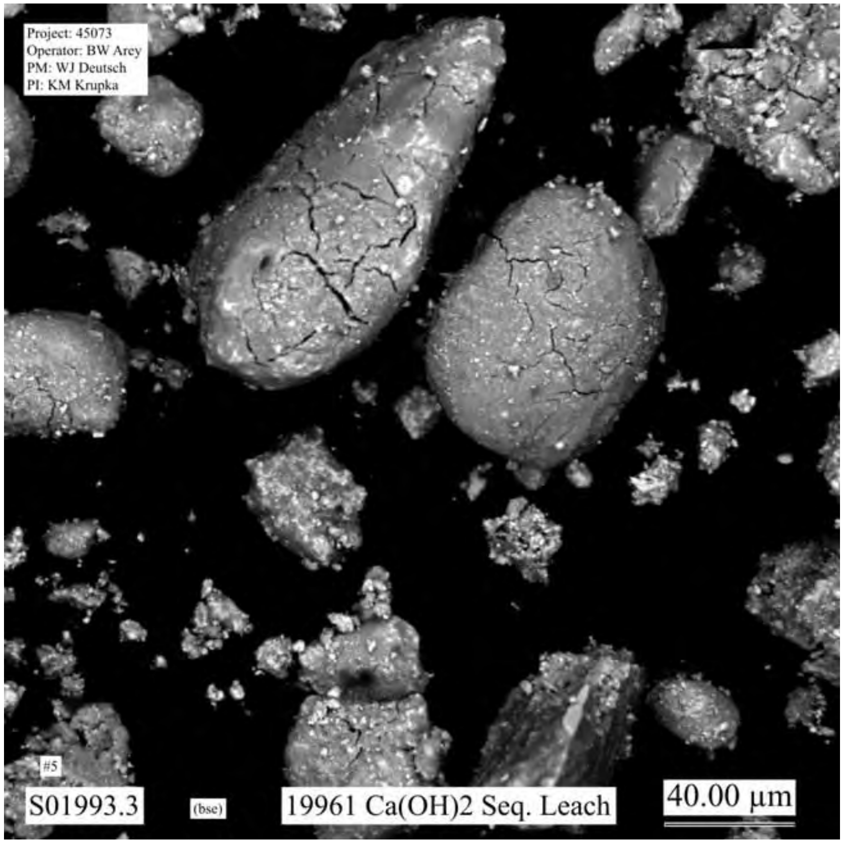


Figure H.64. Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

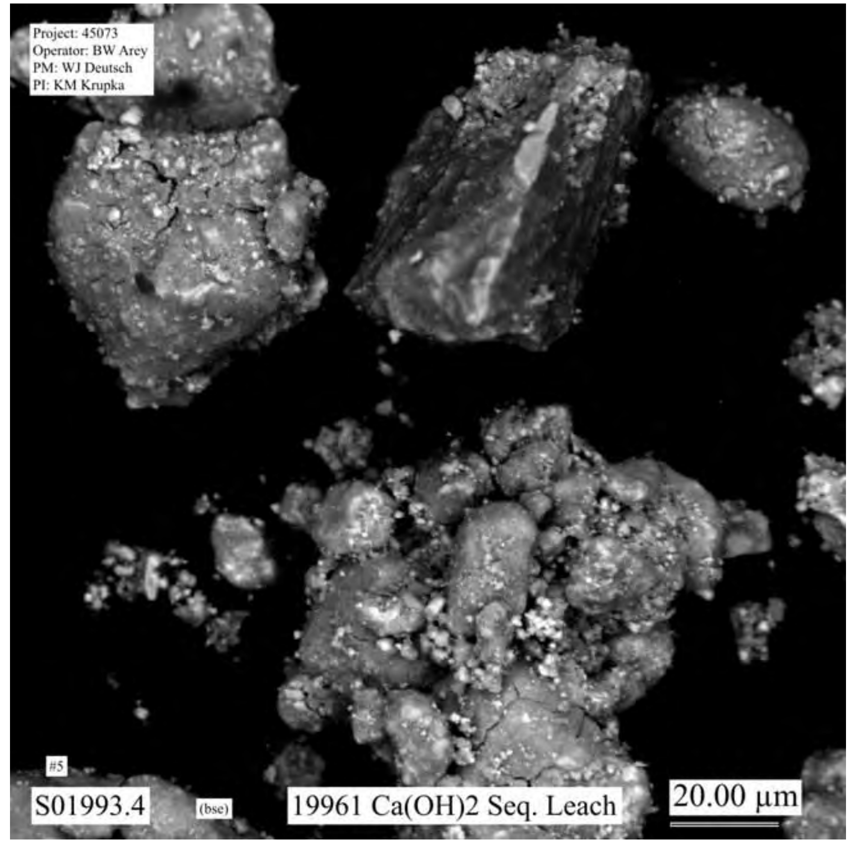


Figure H.65. Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.75.)

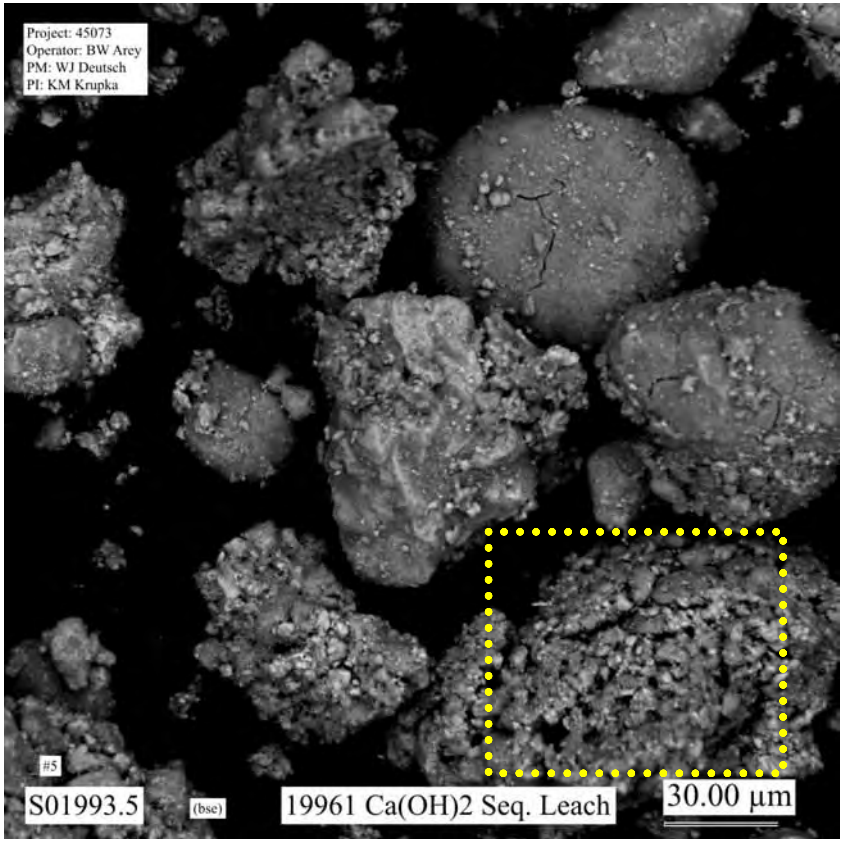


Figure H.66. Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.76 and H.77.)

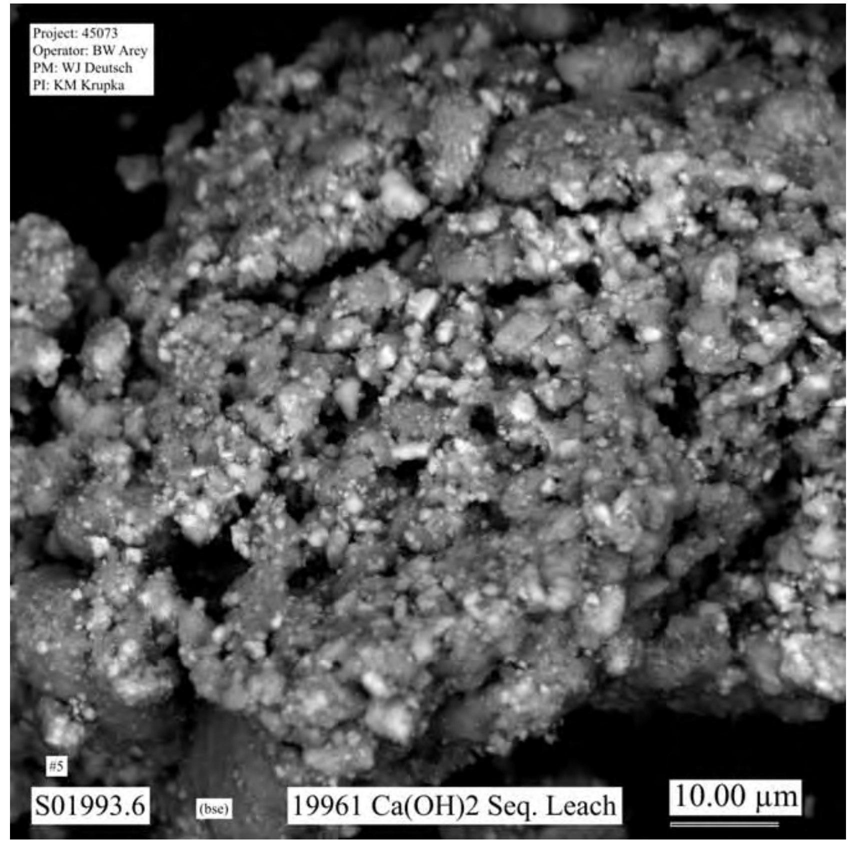


Figure H.67. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.66

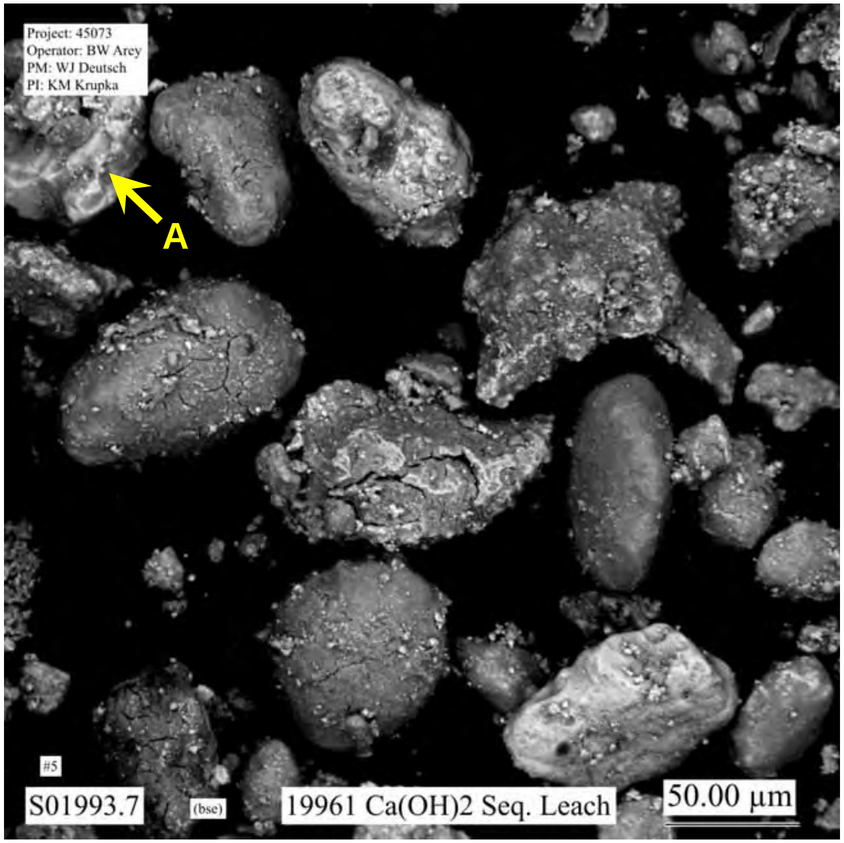


Figure H.68. Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.78 and H.79.)

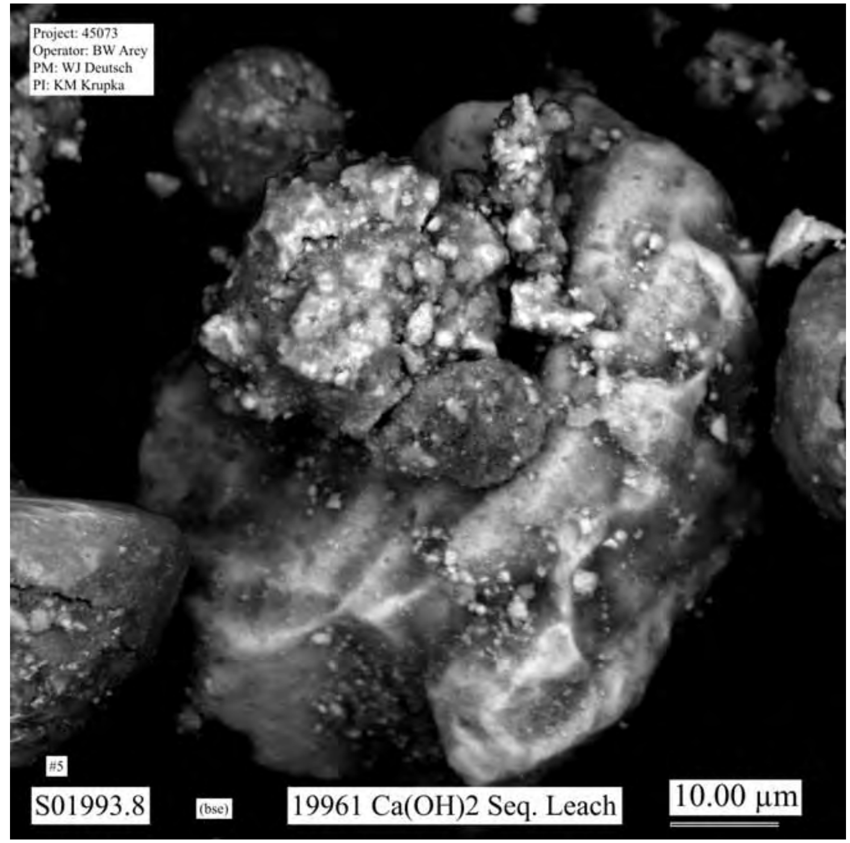


Figure H.69. Micrograph Showing at Higher Magnification the Particle Aggregate Labeled A in Figure H.68 (Areas where EDS analyses were made are shown in Figures H.80 and H.81.)

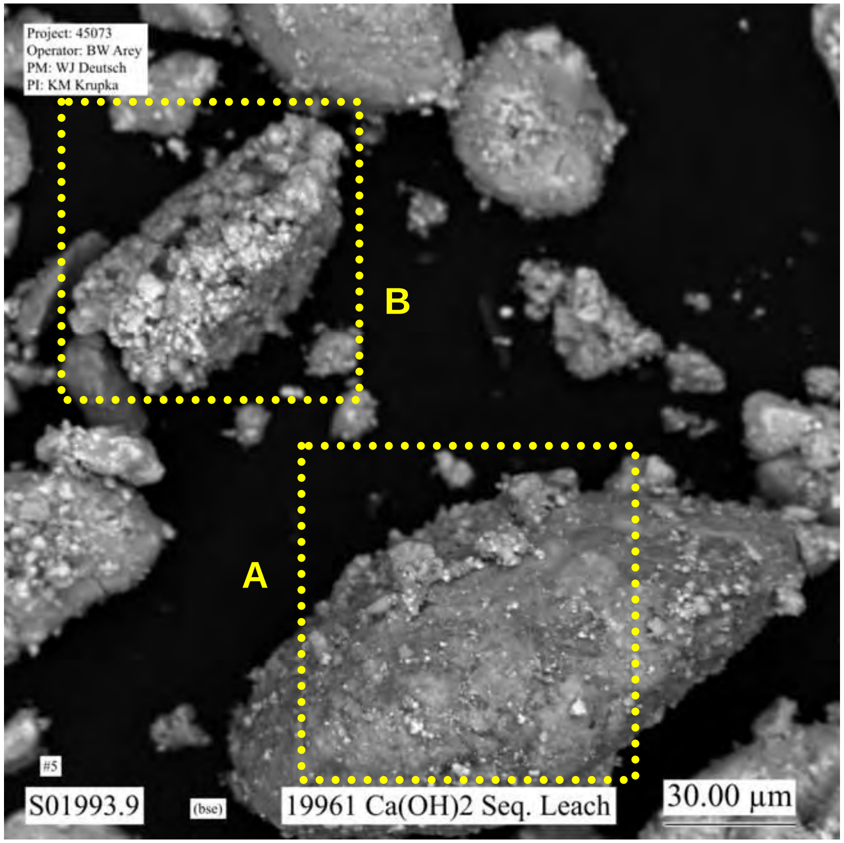


Figure H.70. Micrograph Showing Typical Particles in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961)

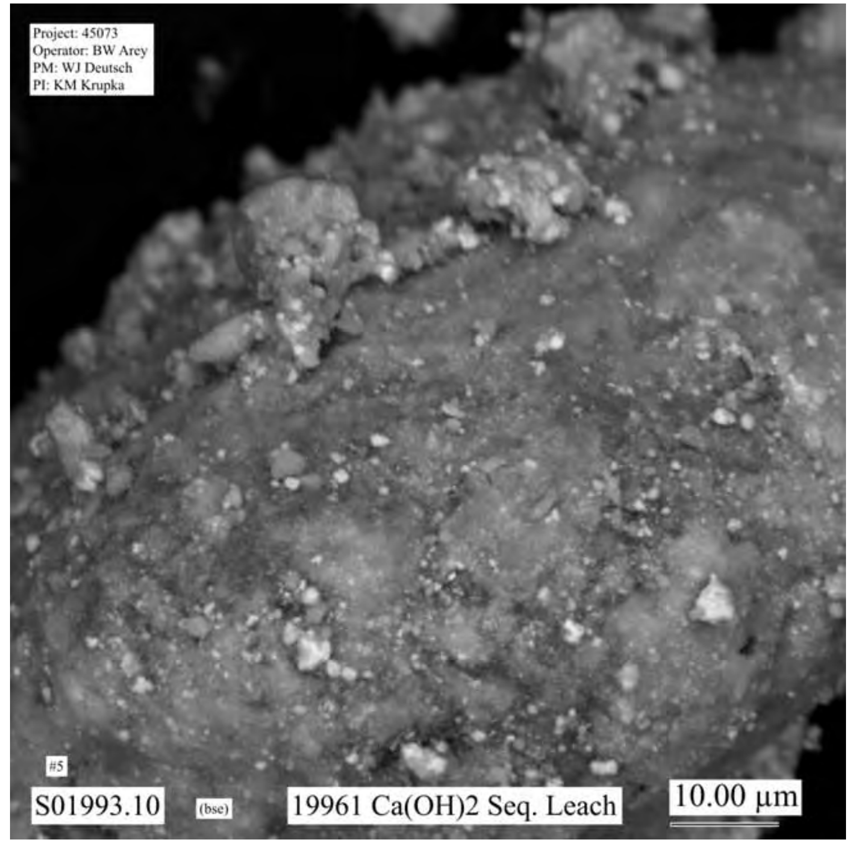


Figure H.71. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square Labeled A in Figure H.70 (Areas where EDS analyses were made are shown in Figure H.82.)

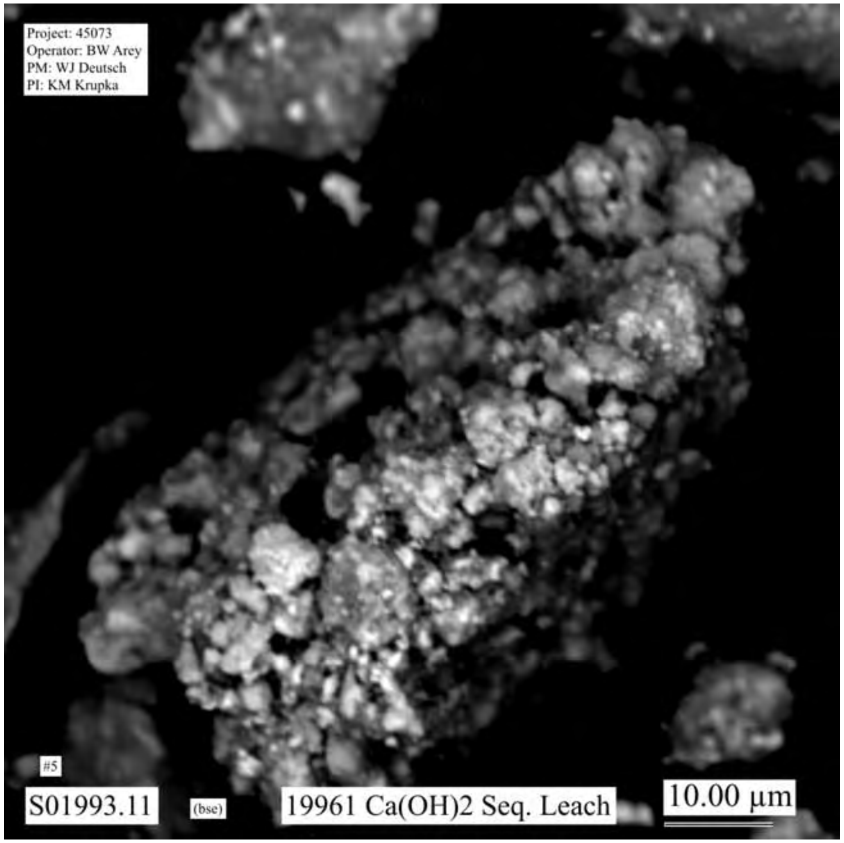
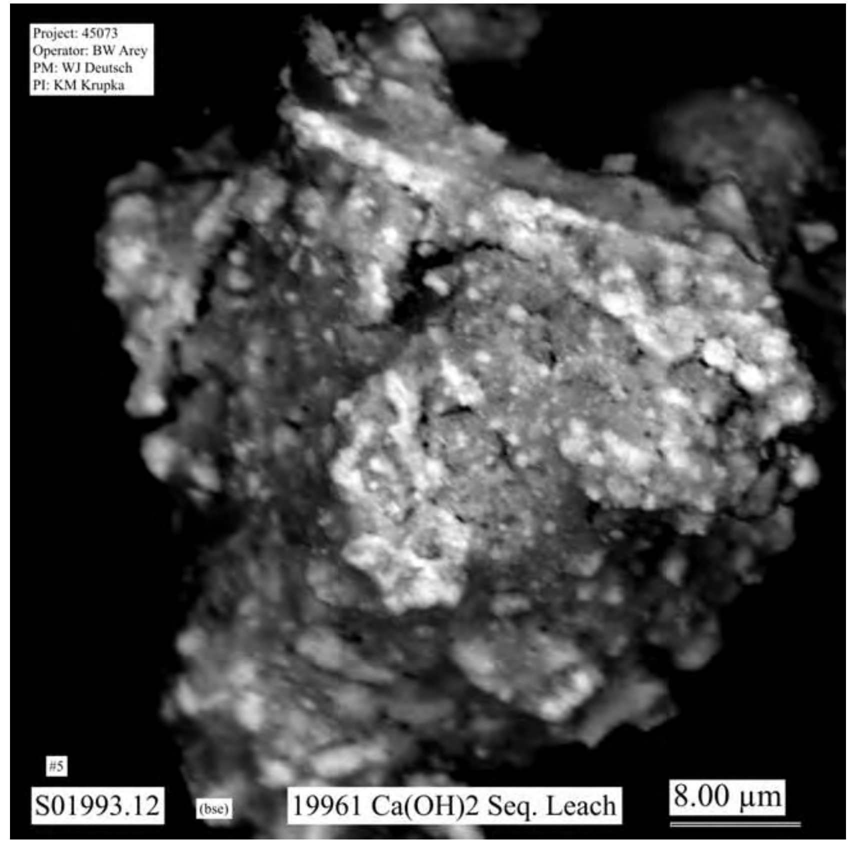
	

Figure H.72. Micrograph Showing at Higher Magnification Particle Aggregate Indicated by the Yellow Dotted-Line Square Labeled B in Figure H.70 (Areas where EDS analyses were made are shown in Figure H.83.)	**Figure H.73**. Micrograph Showing Typical Particle Aggregate in Sample of Sequential $Ca(OH)_2$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.84 and H.85.)

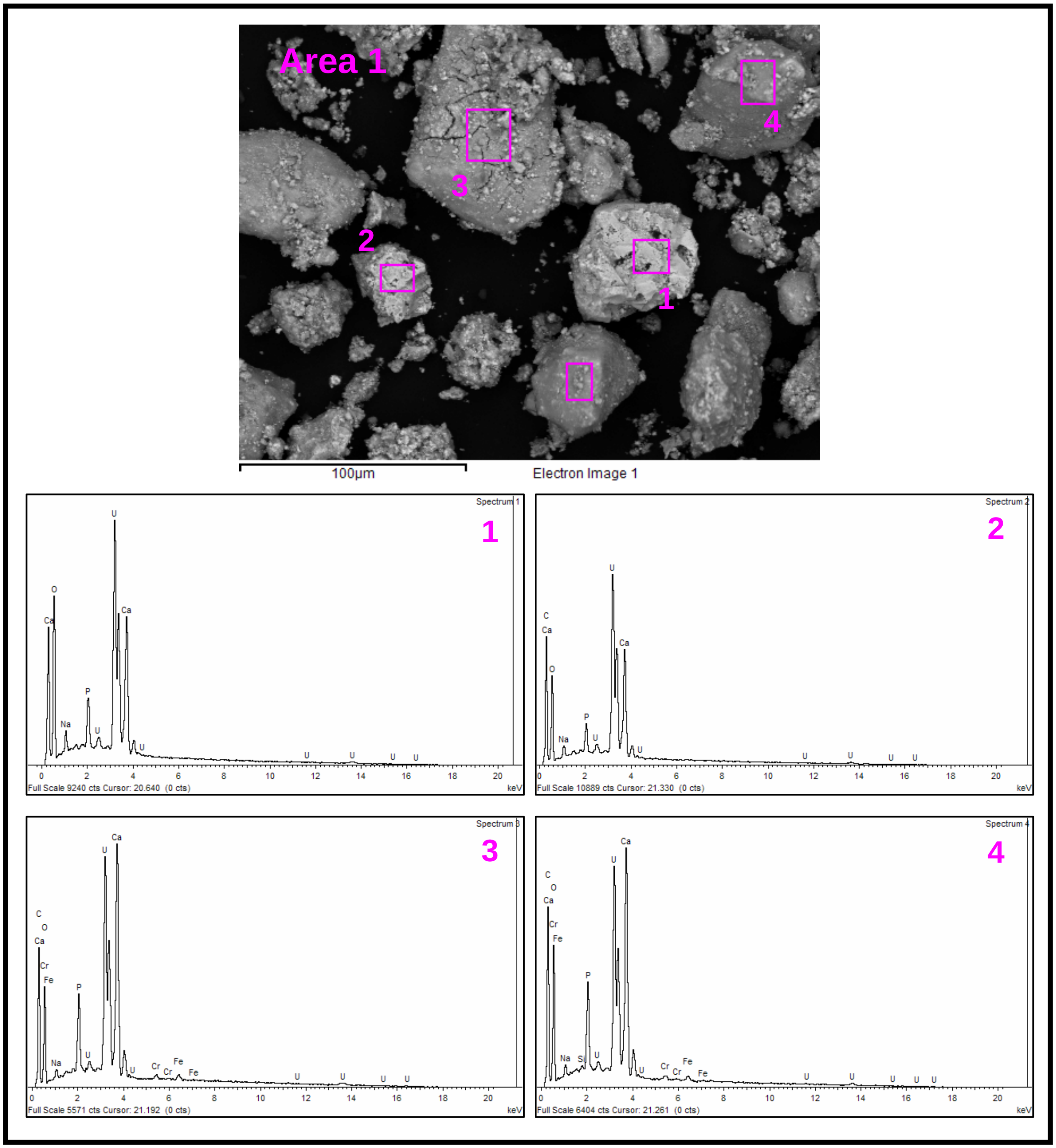


Figure H.74. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

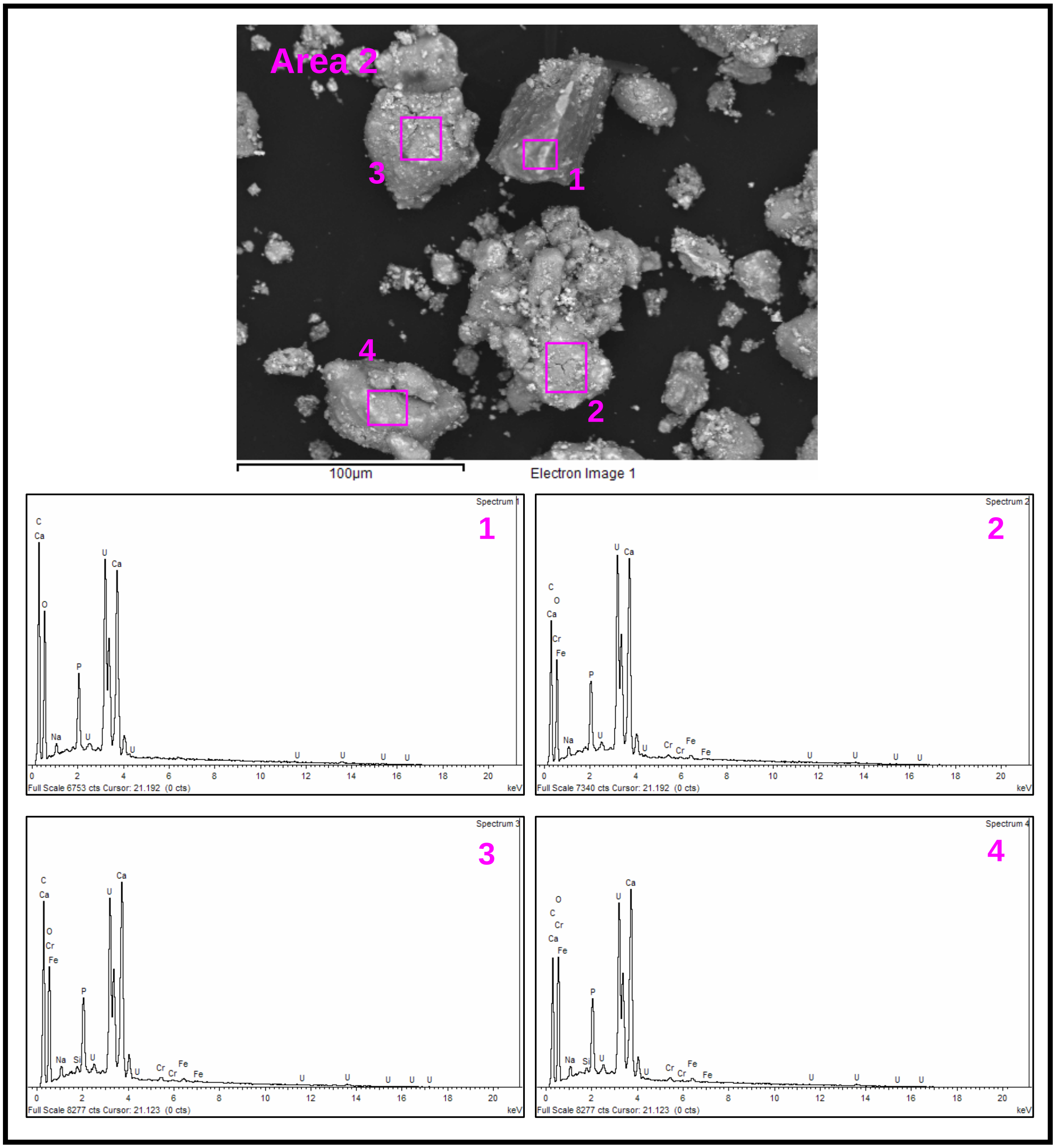


Figure H.75. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

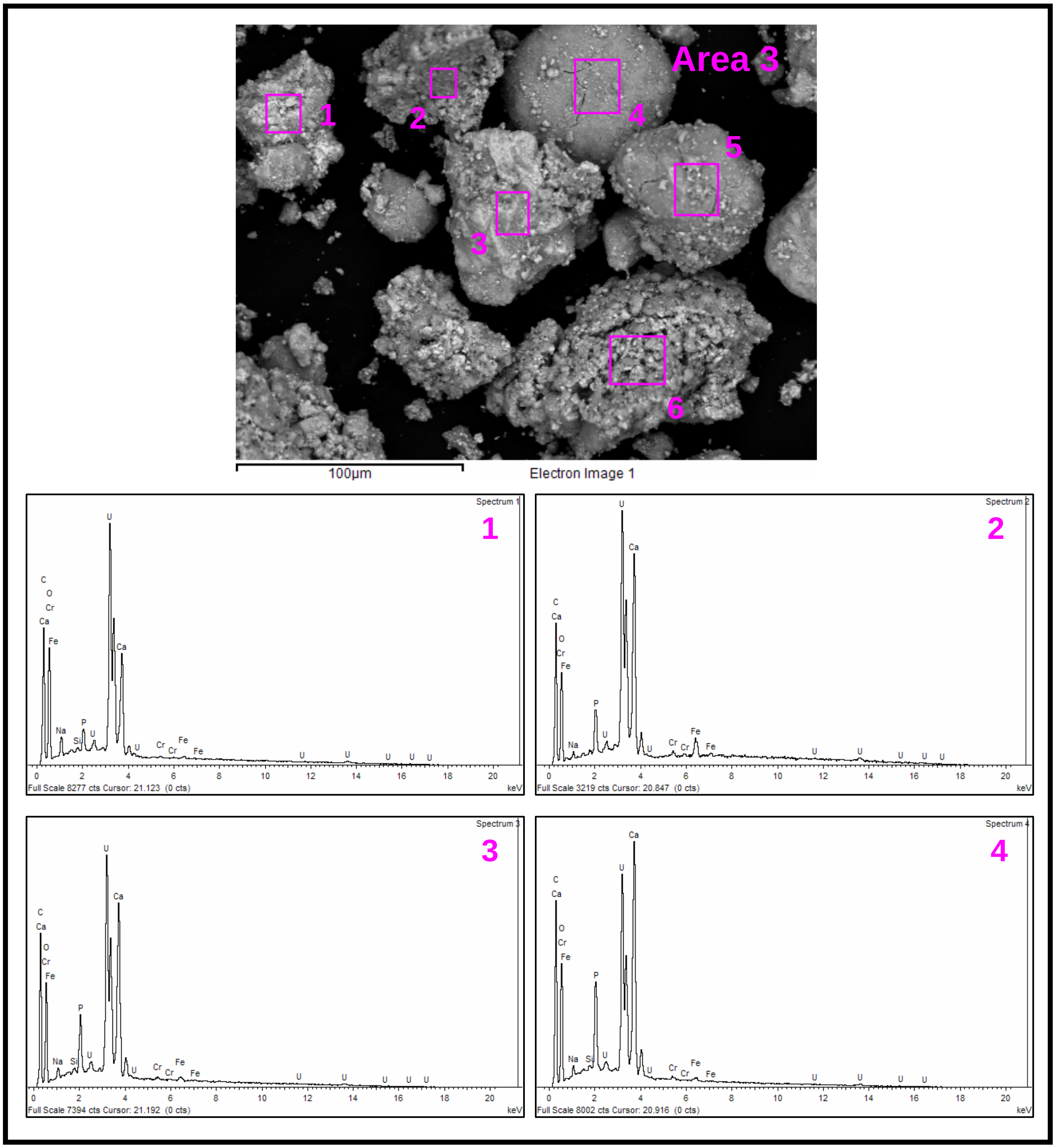


Figure H.76. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

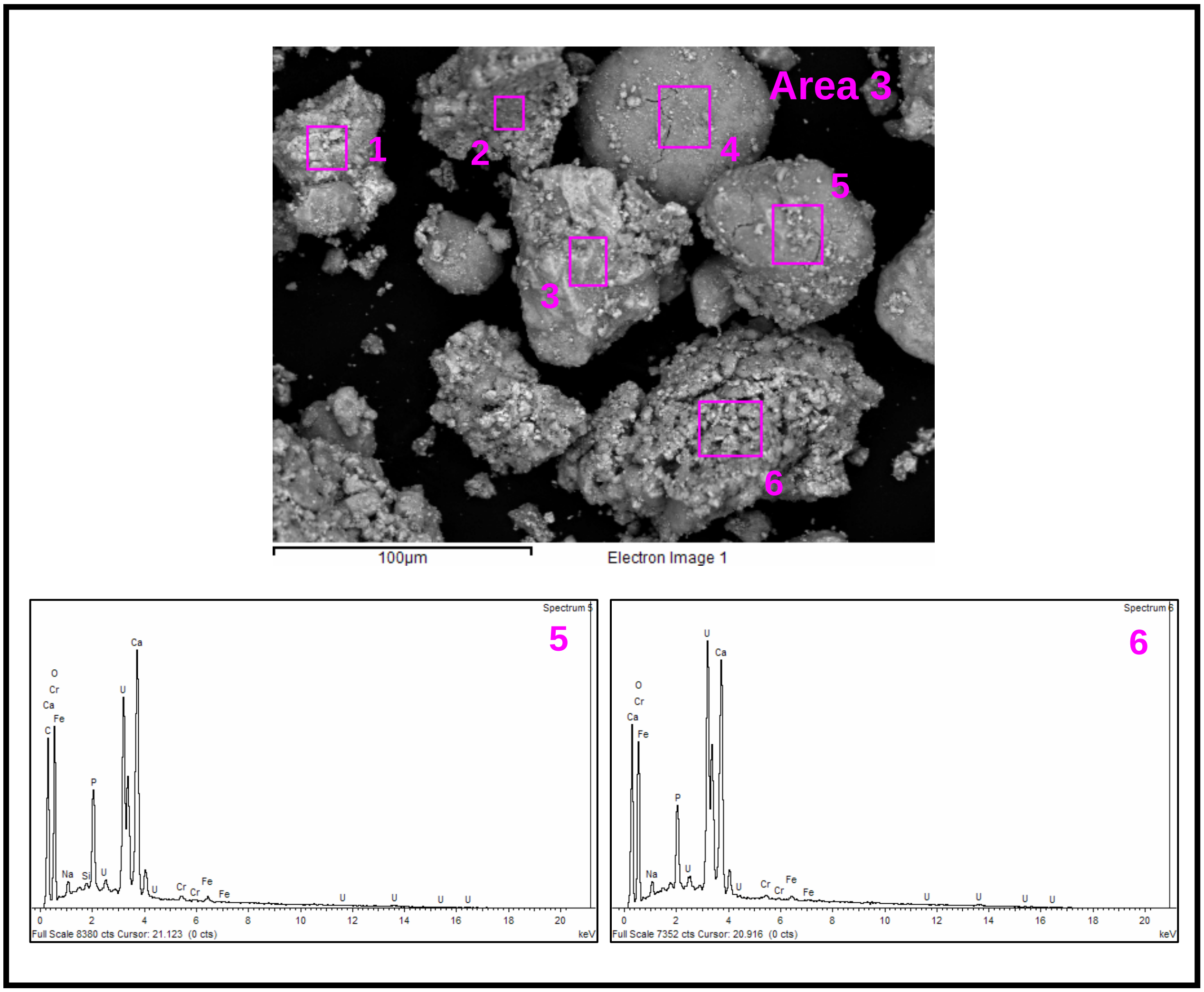


Figure H.77. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

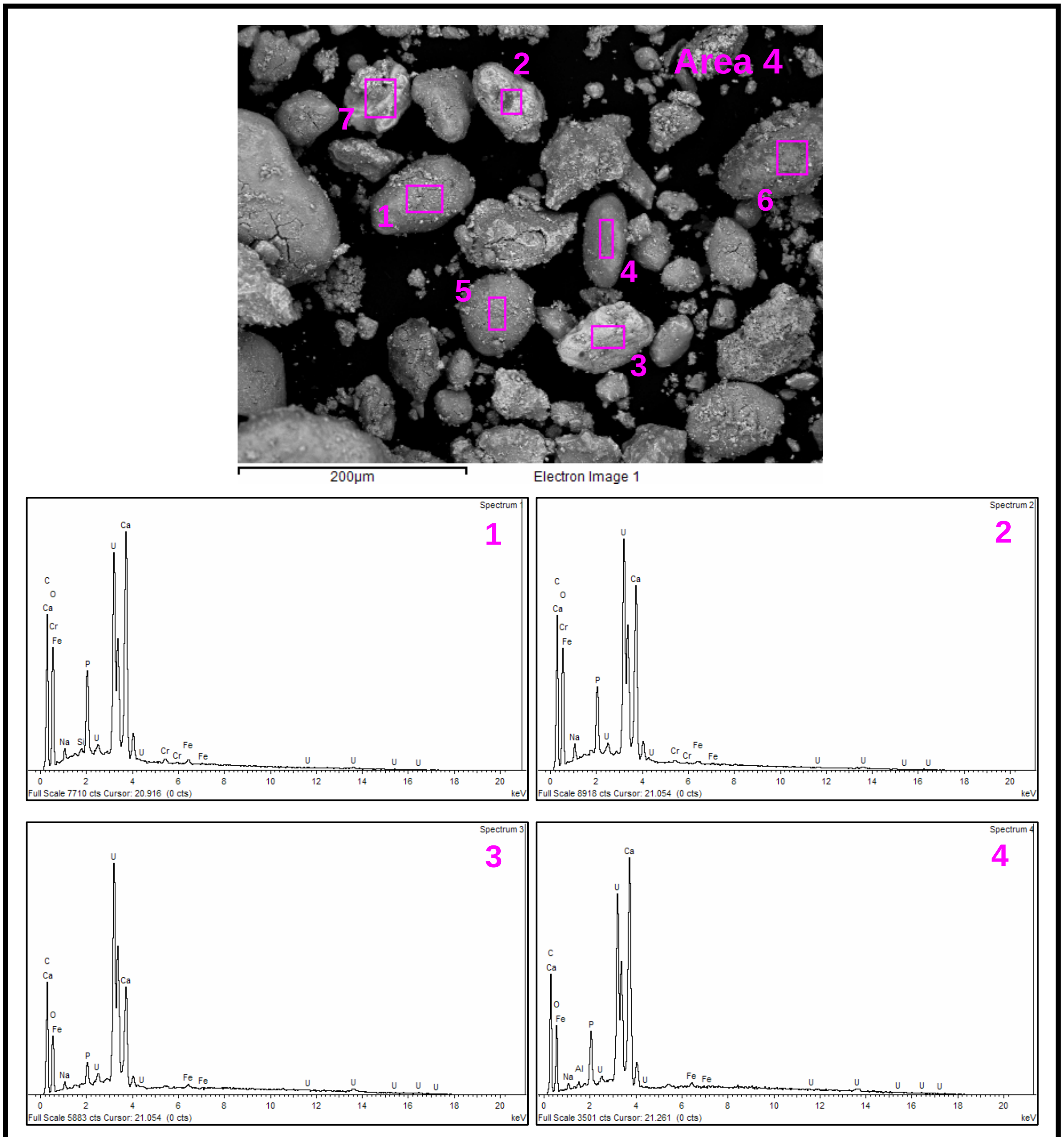


Figure H.78. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

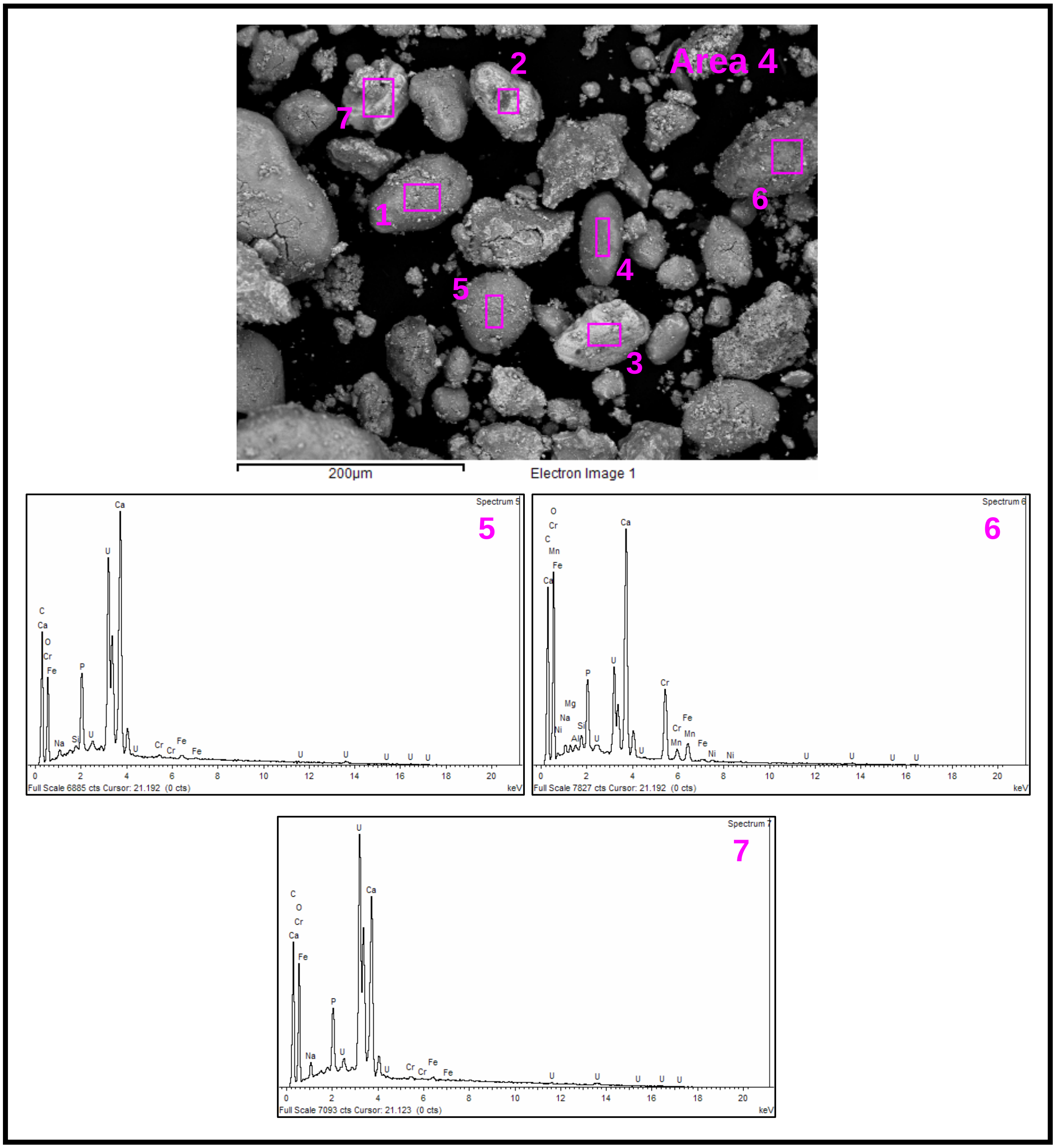


Figure H.79. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

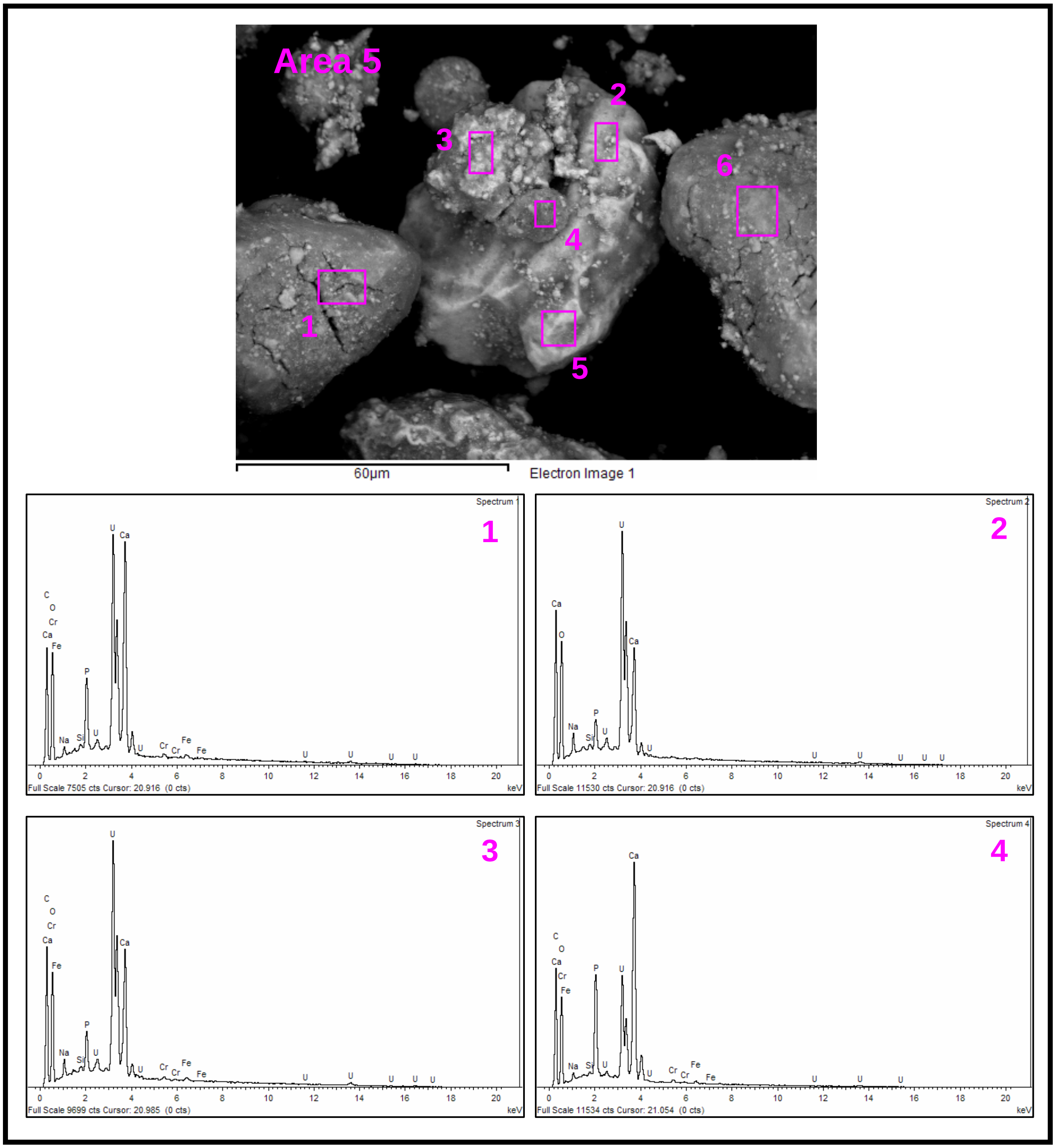


Figure H.80. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

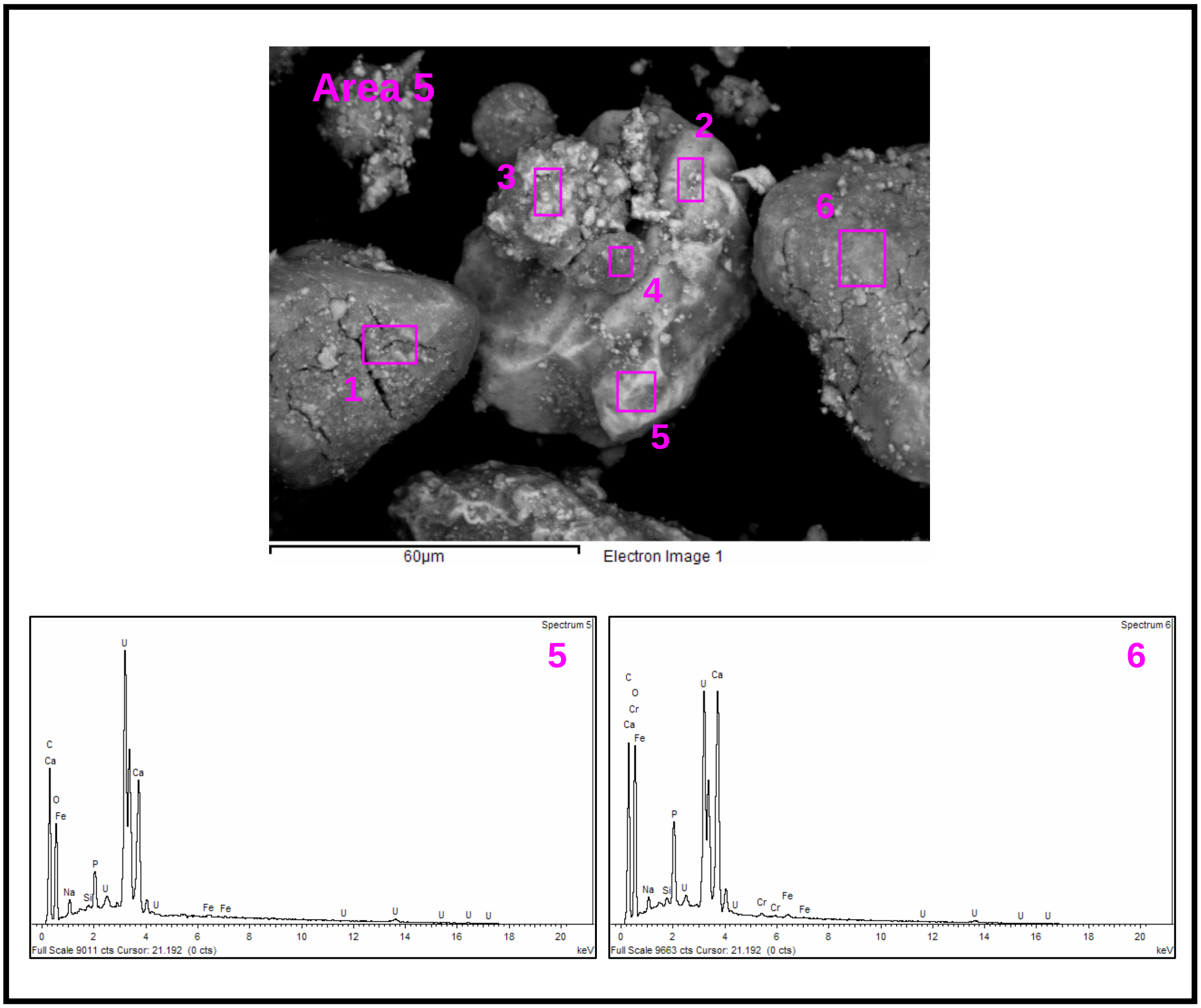


Figure H.81. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

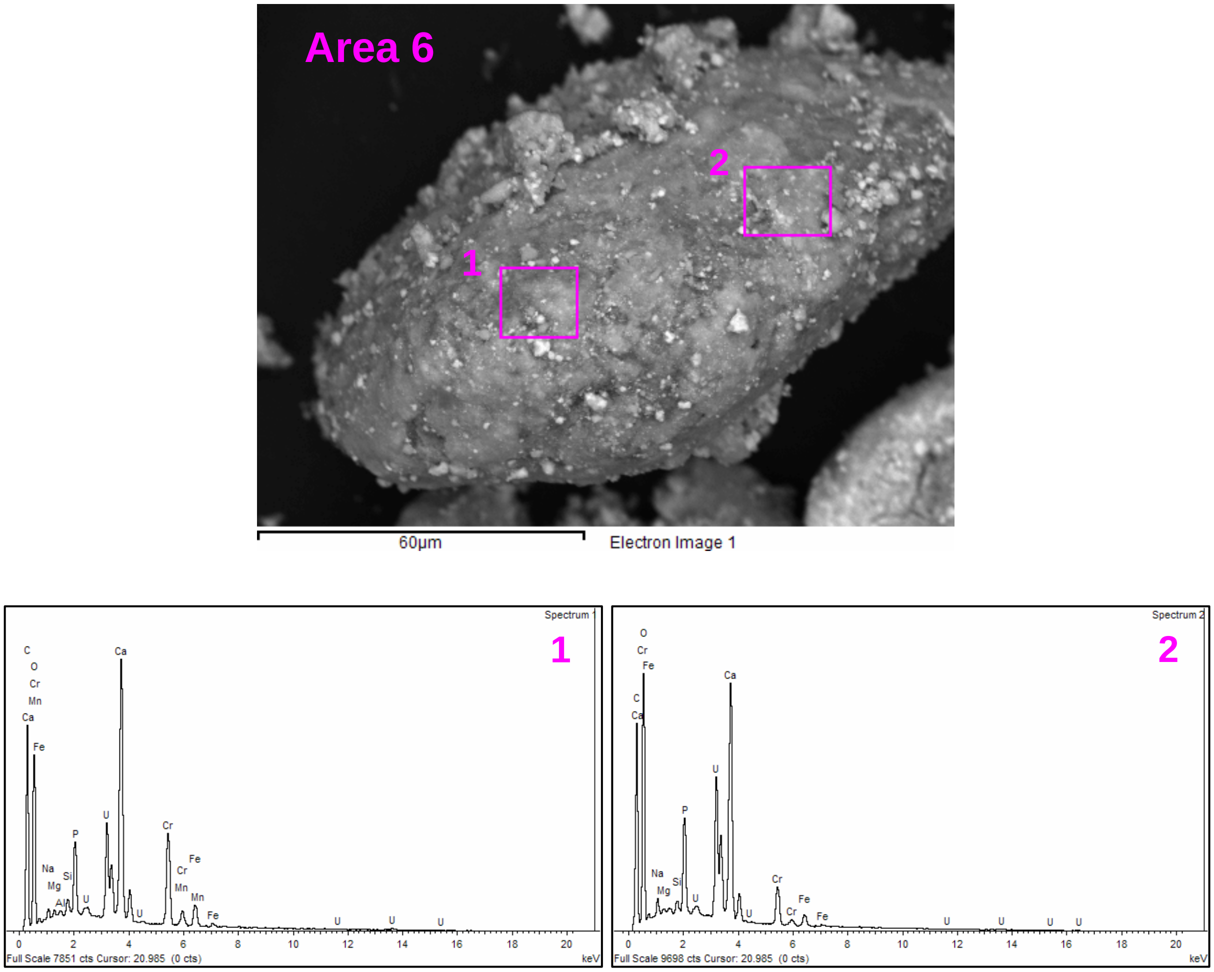


Figure H.82. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

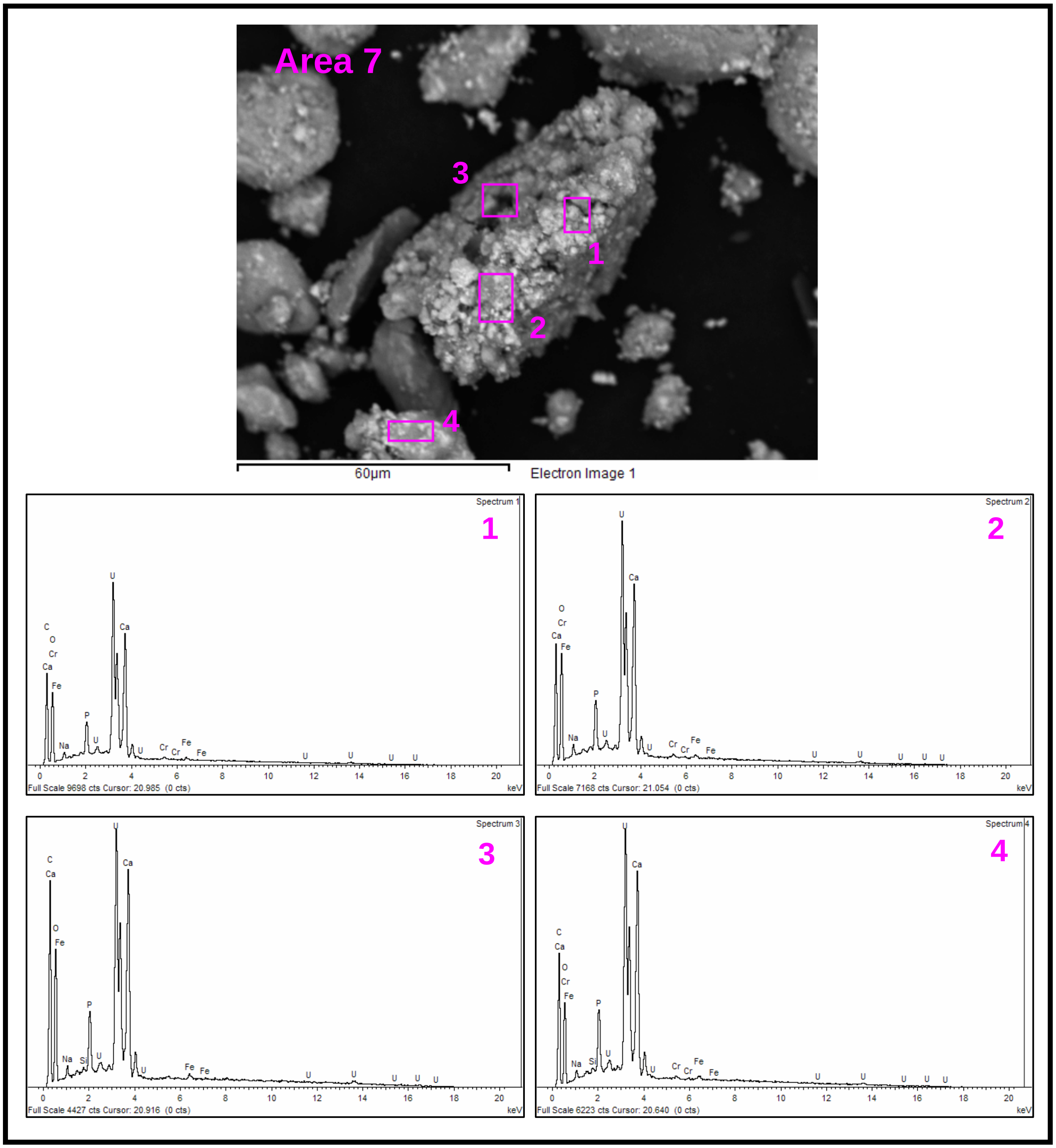


Figure H.83. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

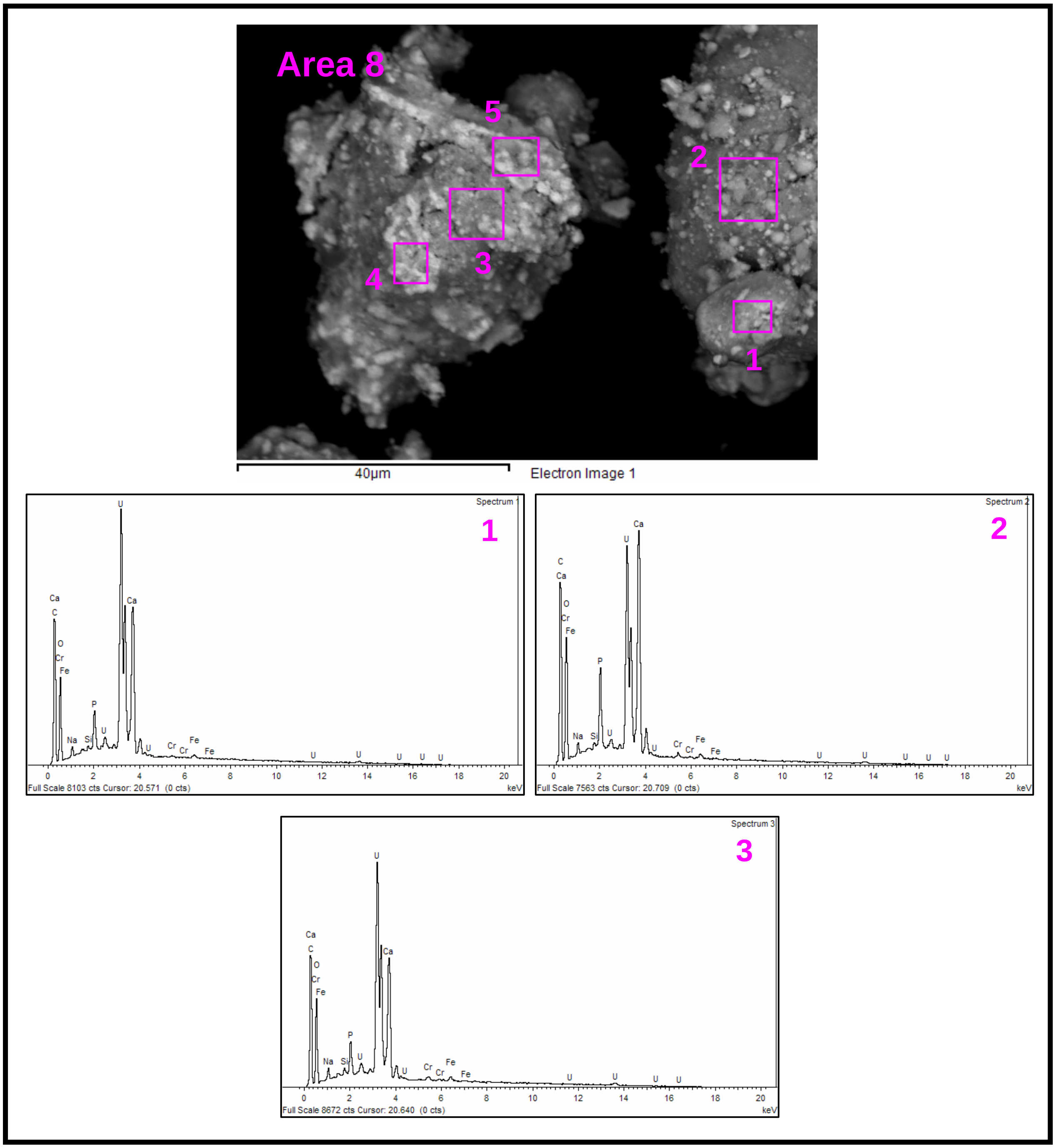


Figure H.84. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

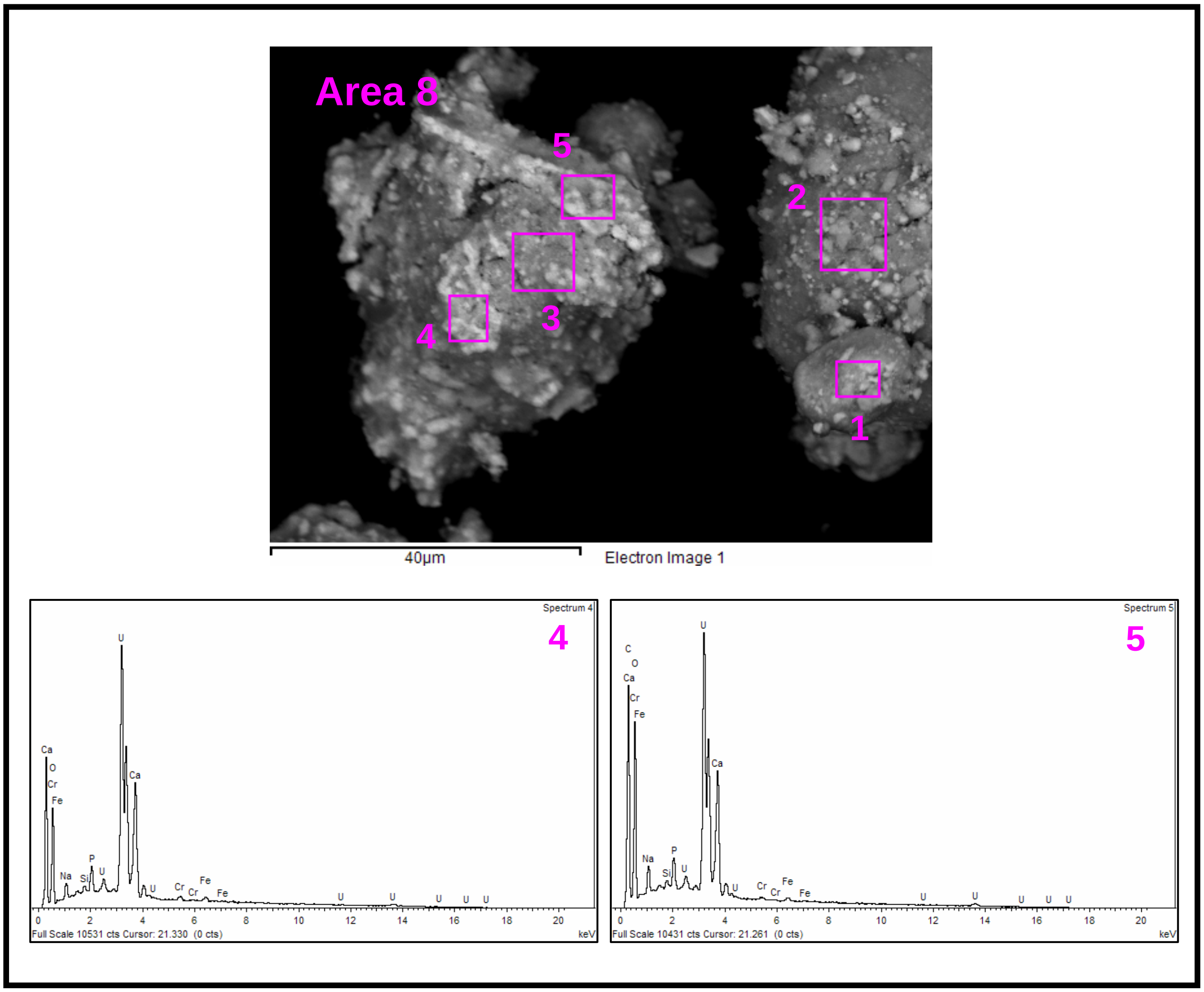


Figure H.85. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $Ca(OH)_2$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.8. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic% [1]														
		Major Cations							Anions [2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C [3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.74 / 1	1	4.1	1.6					5.0	51	*36*	1.8					
	2	4.4	1.2					5.5	42	*46*	1.5					
	3	4.0	0.7	0.4		0.2		9.1	39	*43*	2.8					
	4	3.0	0.7	0.2		0.2		6.8	42	*45*	2.5				0.2	
H.75 / 2	1	2.6	0.7					5.1	41	*49*	2.0					
	2	3.6	0.9	0.3		0.2		7.7	41	*44*	2.6					
	3	2.8	0.8	0.2		0.2		6.4	39	*49*	2.2				0.2	
	4	3.1	0.9	0.2		0.2		7.0	46	*40*	2.6				0.2	
H.76 & H.77 / 3	1	4.9	1.8	0.2		0.1		4.6	46	*42*	1.0				0.2	
	2	4.7	0.6	1.4		0.3		8.4	38	*45*	1.9					
	3	4.1	0.8	0.3		0.2		6.9	40	*46*	2.1				0.2	
	4	3.0	0.7	0.1		0.1		7.2	39	*47*	2.6				0.1	
	5	2.6	0.8	0.2		0.2		6.7	47	*39*	2.6				0.2	
	6	3.4	0.9	0.2		0.2		6.8	45	*41*	2.3					

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.9. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H.78 & H.79 / 4	1	3.3	0.9	0.3		0.2		7.7	41	*44*	2.6				0.2	
	2	3.8	1.2	0.2		0.1		6.4	41	*44*	2.4					
	3	6.5	1.0	0.3				6.6	35	*49*	1.3					
	4	4.3	0.6	0.3				11	36	*45*	2.5	0.3				
	5	3.8	0.6	0.3		0.2		9.9	38	*45*	3.0				0.2	
	6	1.0	0.5	0.8	0.1	2.6	0.1	5.4	44	*43*	1.6	0.1		0.3	0.3	
	7	4.3	1.2	0.2		0.2		6.8	43	*42*	2.3					
H.80 & H.81 / 5	1	4.2	0.8	0.3		0.3		8.7	44	*39*	2.8				0.2	
	2	4.3	1.8					4.4	44	*44*	1.1				0.2	
	3	4.7	1.6	0.2		0.2		5.3	44	*43*	1.6				0.2	
	4	2.0	0.6	0.2		0.2		8.5	40	*45*	3.7				0.1	
	5	5.3	1.4	0.2				5.7	39	*47*	1.6				0.2	
	6	3.0	0.8	0.2		0.1		6.2	46	*41*	2.2				0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.10. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $Ca(OH)_2$ Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.82 / 6	1	1.0	0.5	1.0	0.1	3.2		5.7	40	*47*	1.6	0.1		0.2	0.3	
	2	1.5	0.8	0.4		1.3		4.9	49	*40*	1.9			0.2	0.2	
H.83 / 7	1	4.9	0.9	0.3		0.2		7.7	42	*42*	2.0					
	2	4.7	1.1	0.2		0.2		7.5	45	*39*	2.1					
	3	3.5	0.8	0.3				6.3	40	*47*	1.7				0.2	
	4	5.0	0.9	0.3		0.1		9.0	37	*45*	2.6				0.2	
H.84 & H.85 / 8	1	5.1	1.0	0.2		0.1		6.8	37	*47*	1.7				0.2	
	2	3.1	0.9	0.2		0.2		7.0	40	*47*	2.3				0.2	
	3	4.9	1.1	0.4		0.3		5.8	39	*47*	1.6				0.3	
	4	5.2	1.4	0.4		0.3		5.1	40	*46*	1.2				0.3	
	5	3.6	1.6	0.2		0.1		3.6	45	*45*	0.8				0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

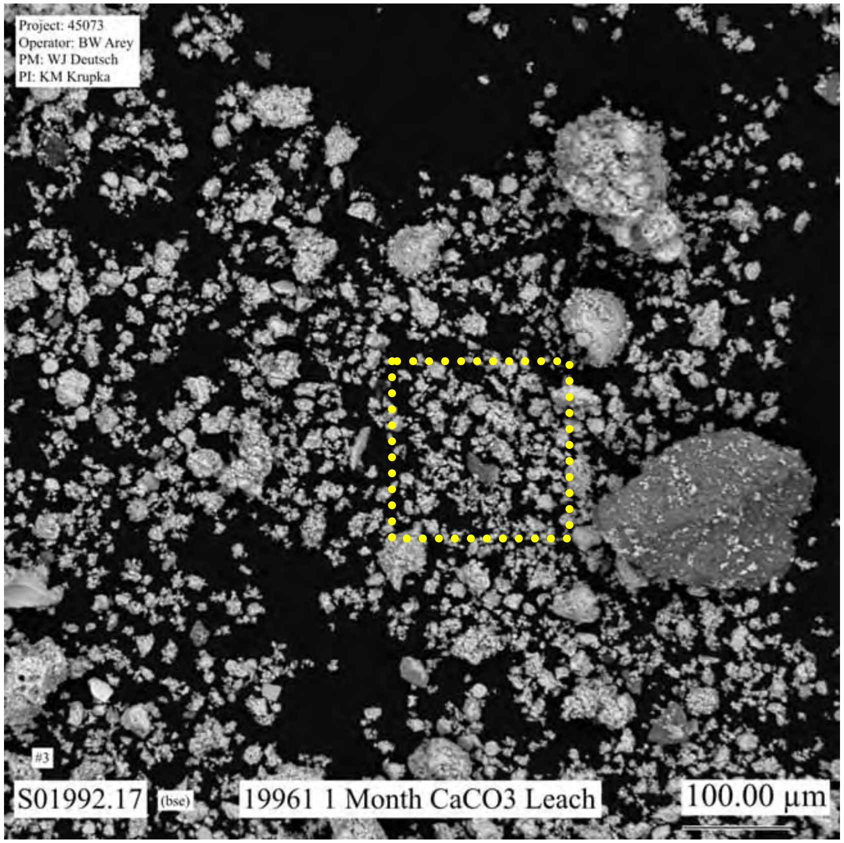


Figure H.86. Low Magnification Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

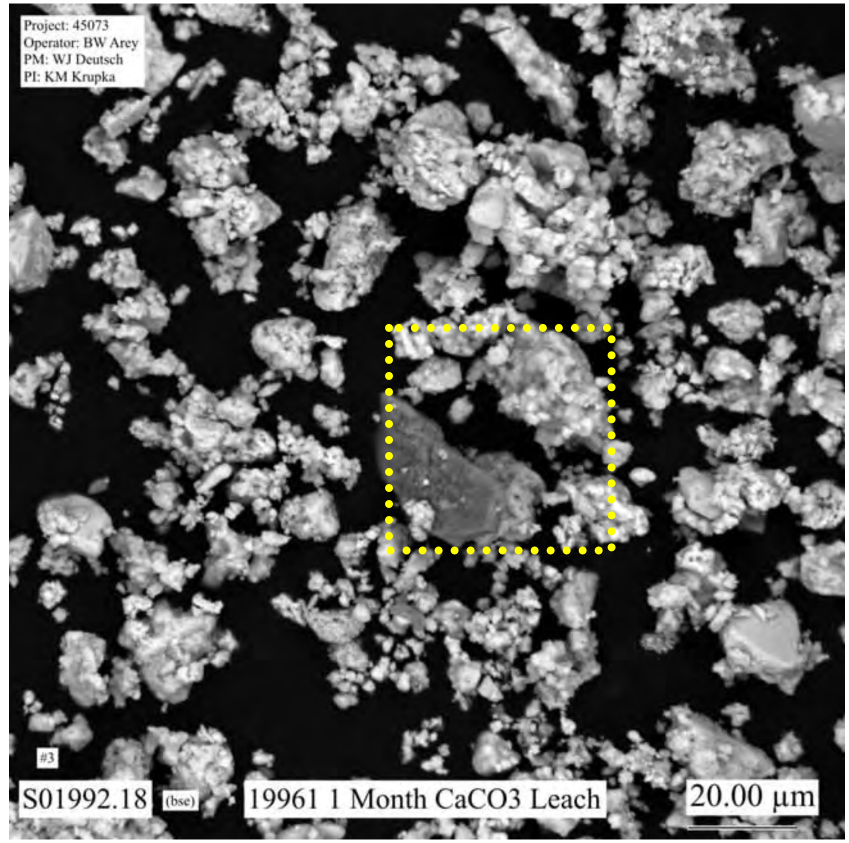


Figure H.87. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.86

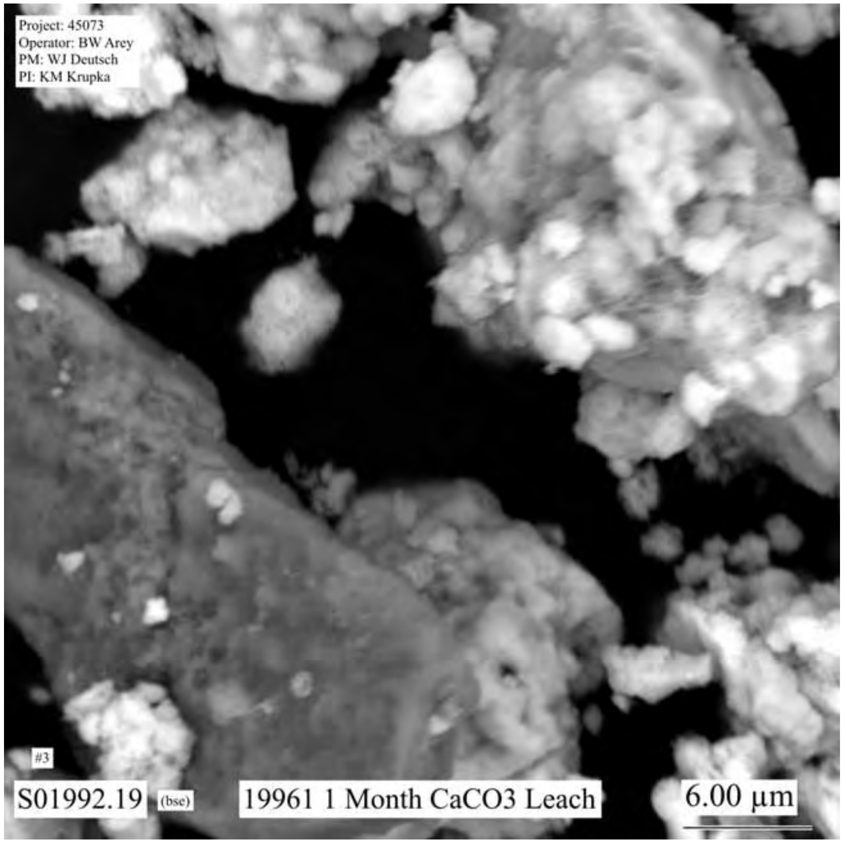


Figure H.88. Micrograph Showing at Higher Magnification the Area Indicated by the Yellow Dotted-Line Square in Figure H.87 (Areas where EDS analyses were made are shown in Figure H.98.)

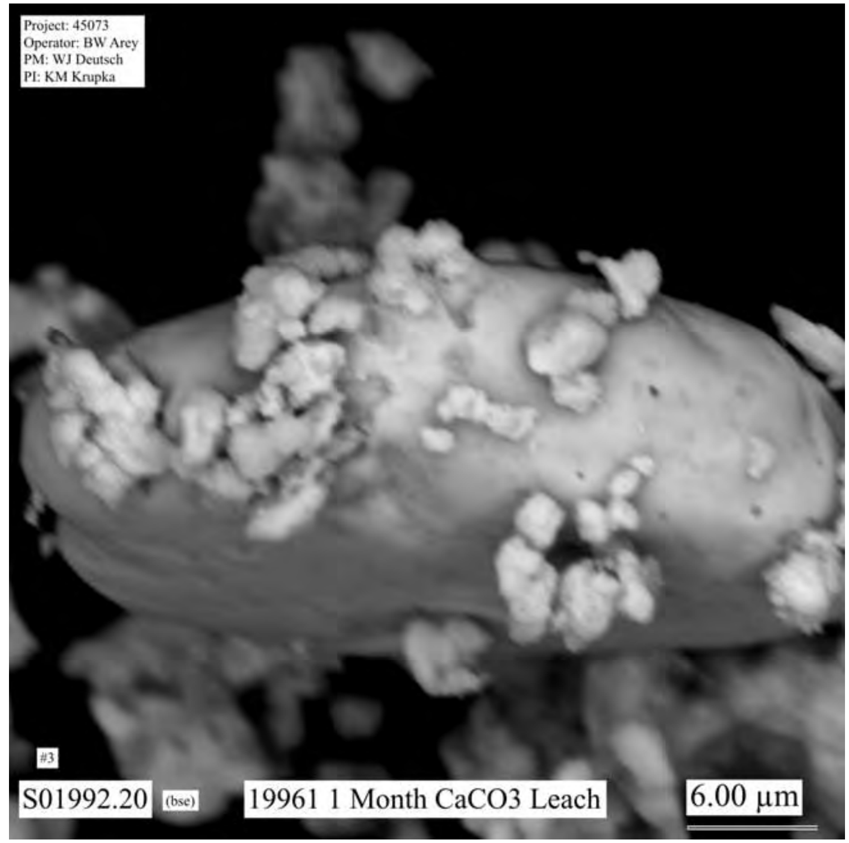
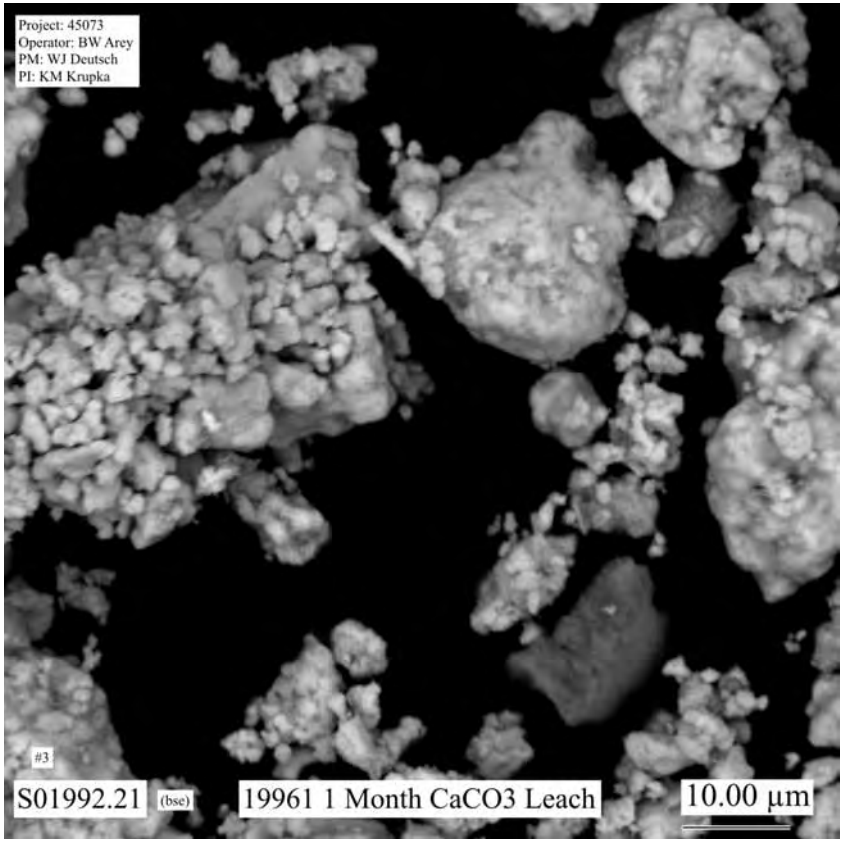


Figure H.89. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.99.)



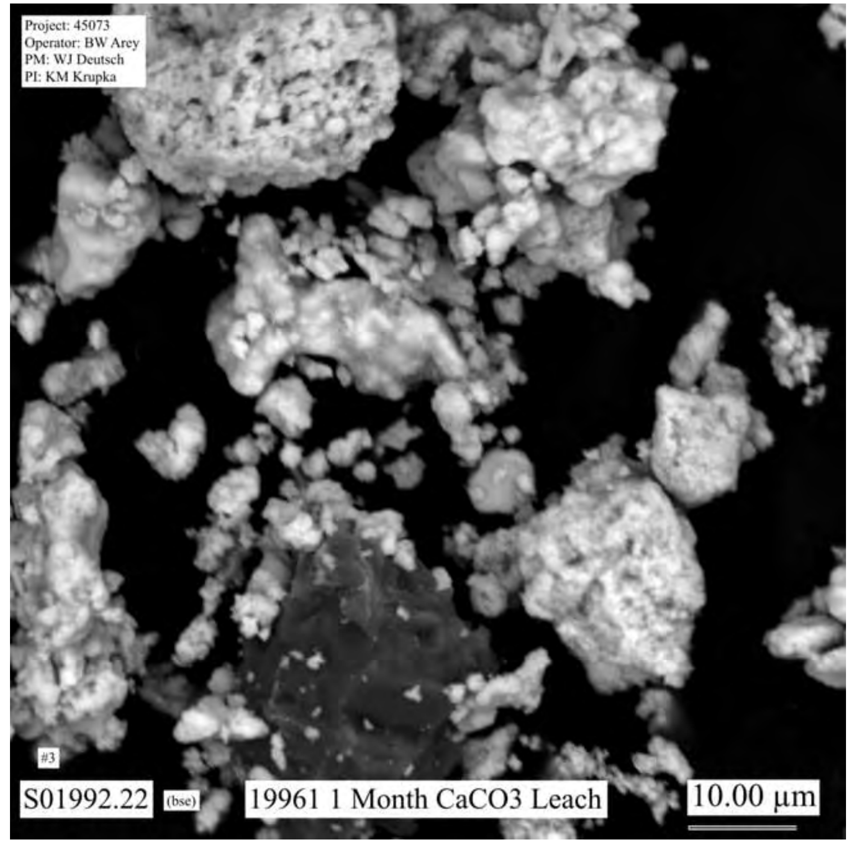


Figure H.90. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.100 and H.101.)

Figure H.91. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.102 and H.103.)

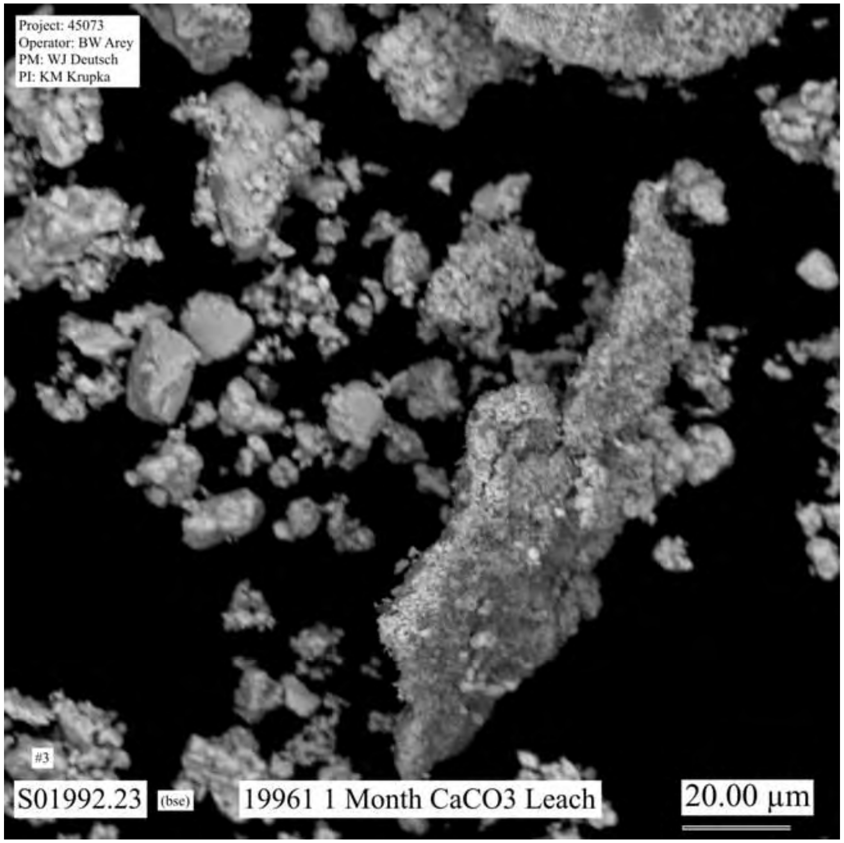


Figure H.92. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.104 and H.105.)

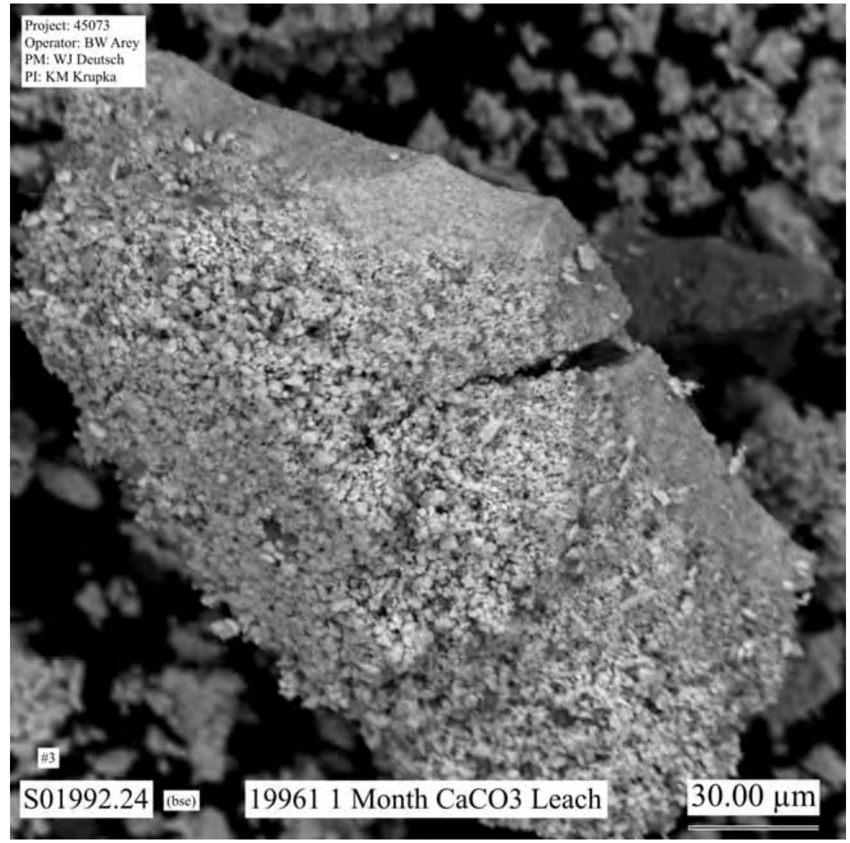


Figure H.93. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.106.)

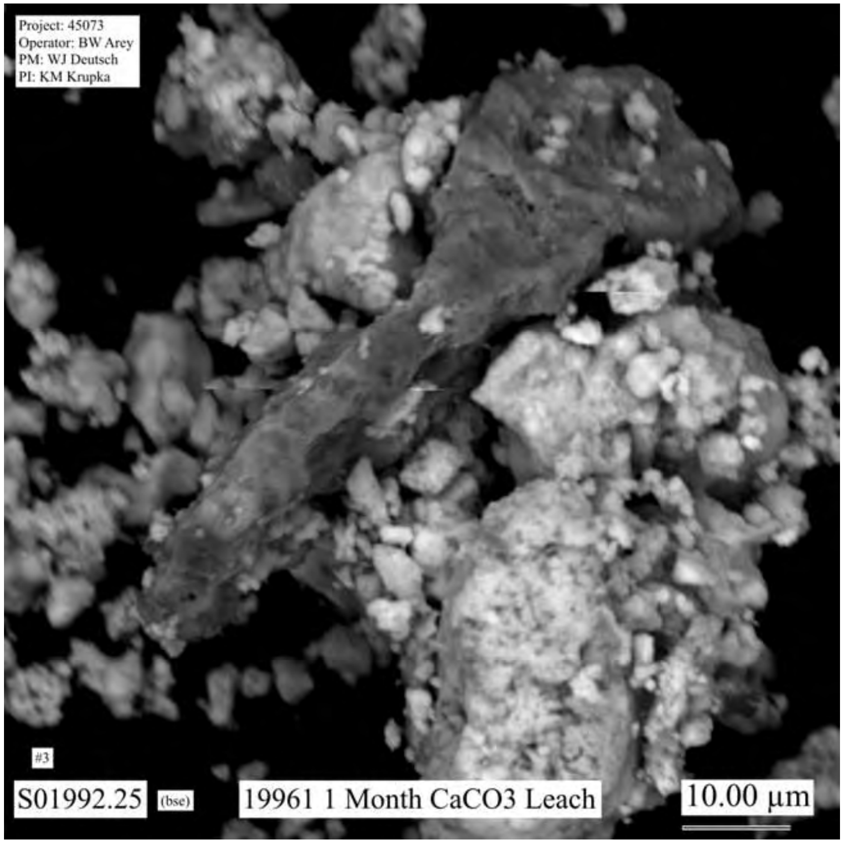


Figure H.94. Micrograph Showing Typical Particles in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.107.)

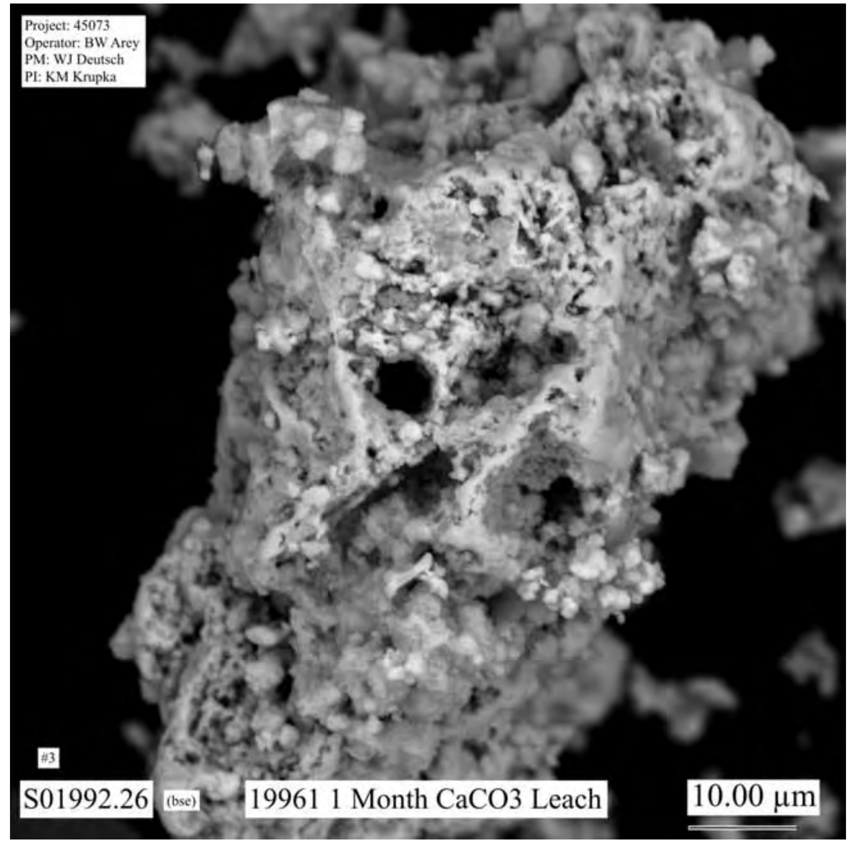


Figure H.95. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

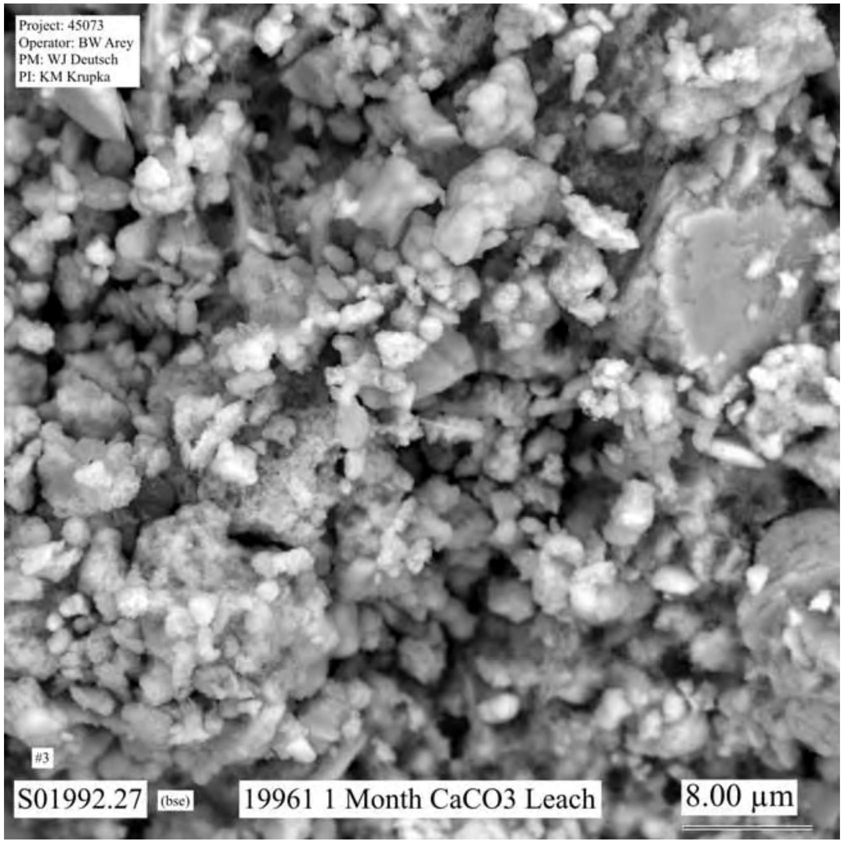


Figure H.96. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

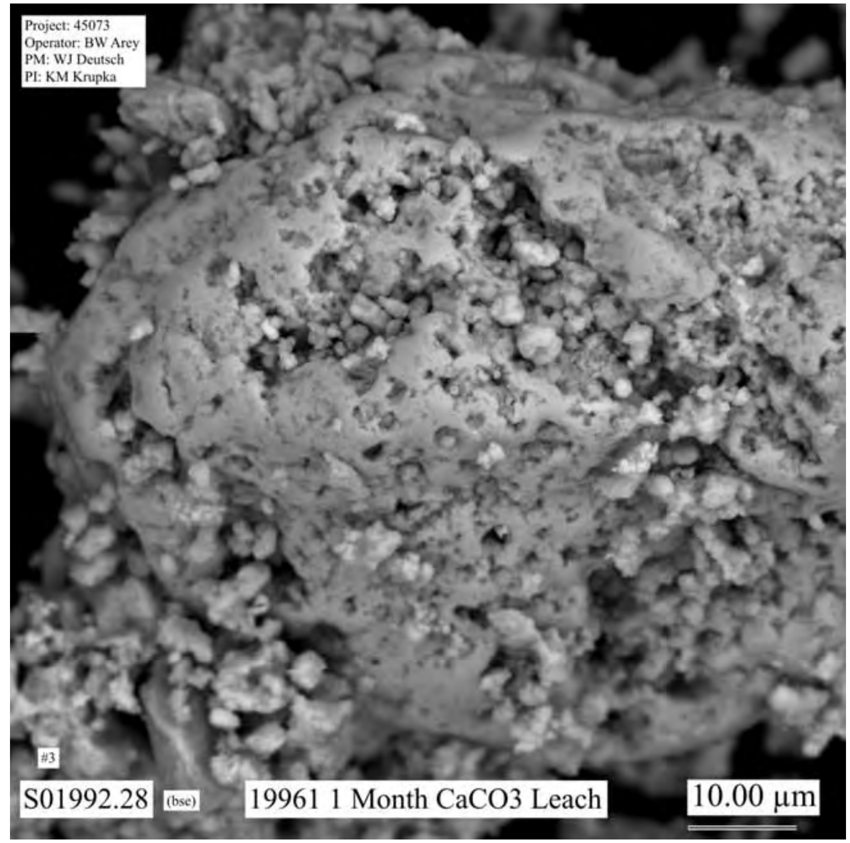


Figure H.97. Micrograph Showing Typical Particle Aggregate in Sample of 1-Month Single-Contact $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

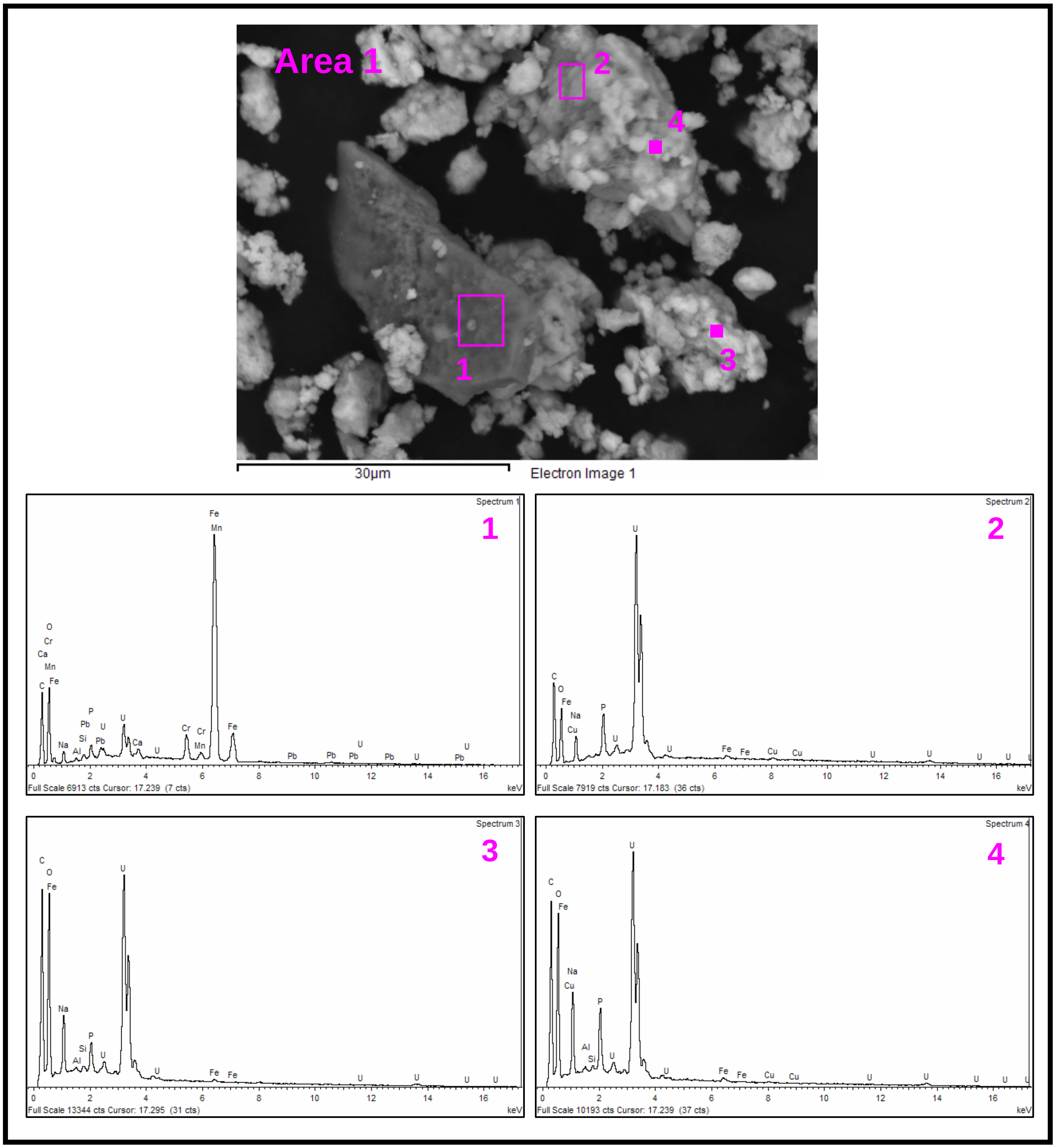


Figure H.98. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

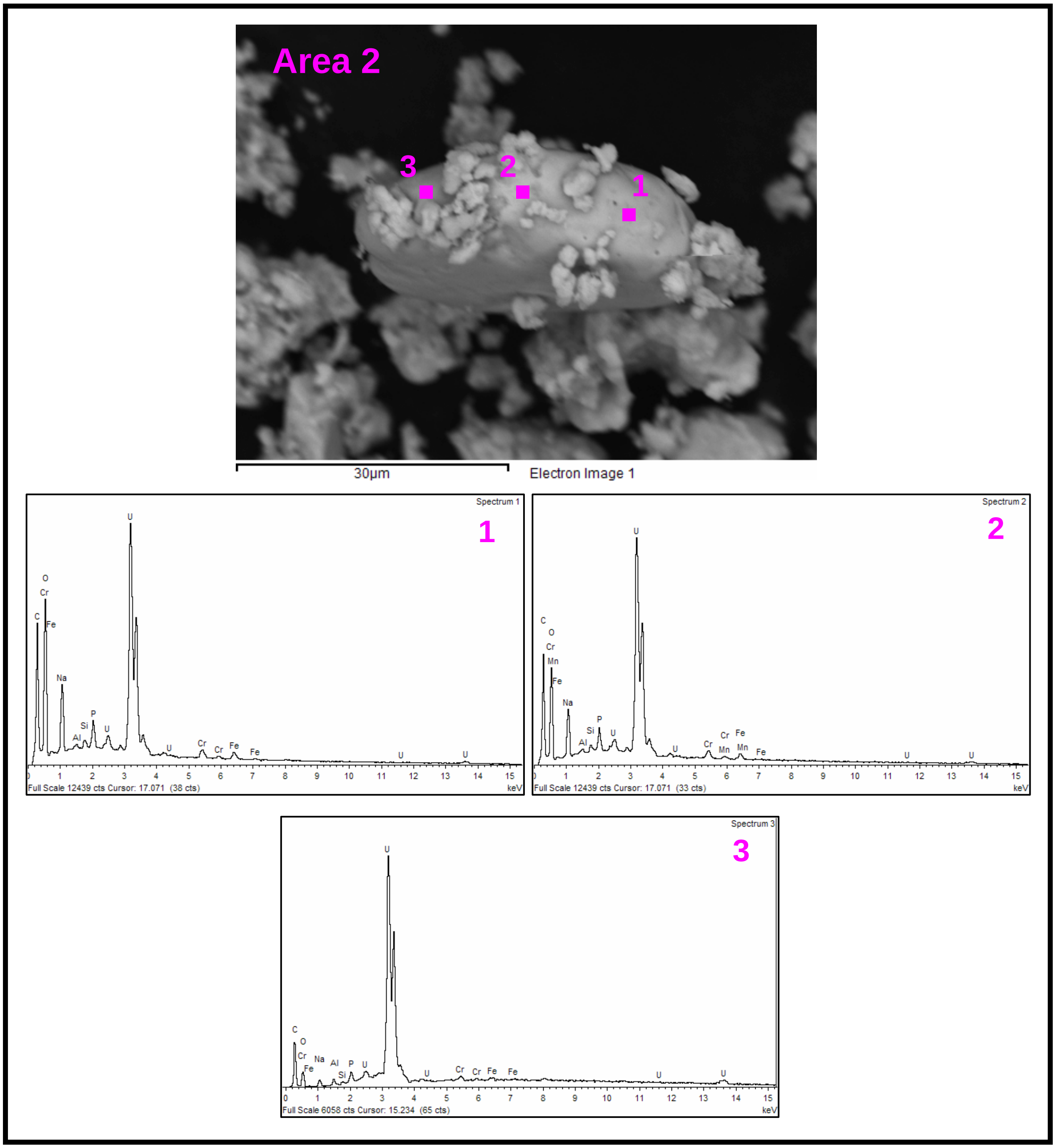


Figure H.99. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

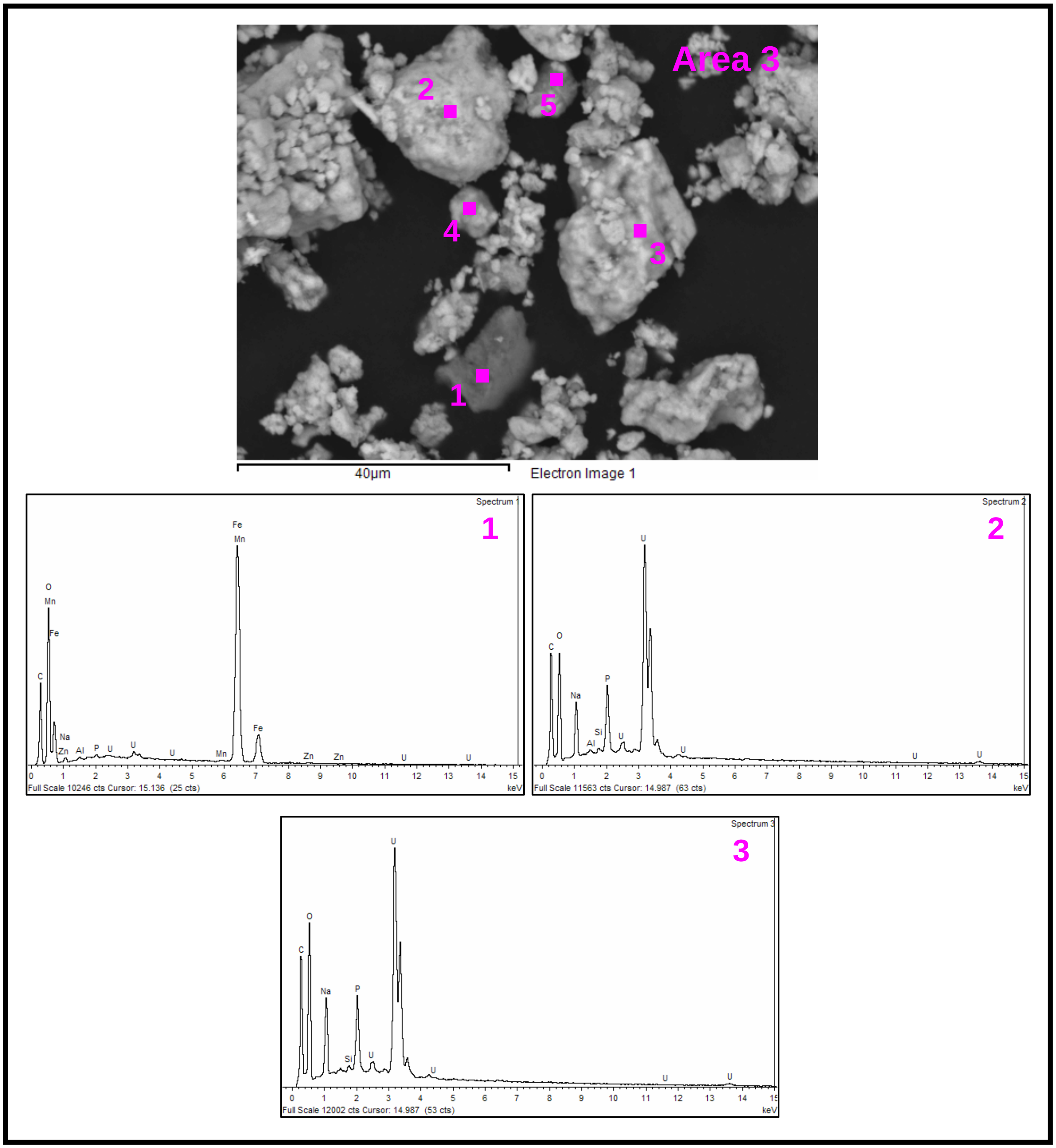


Figure H.100. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

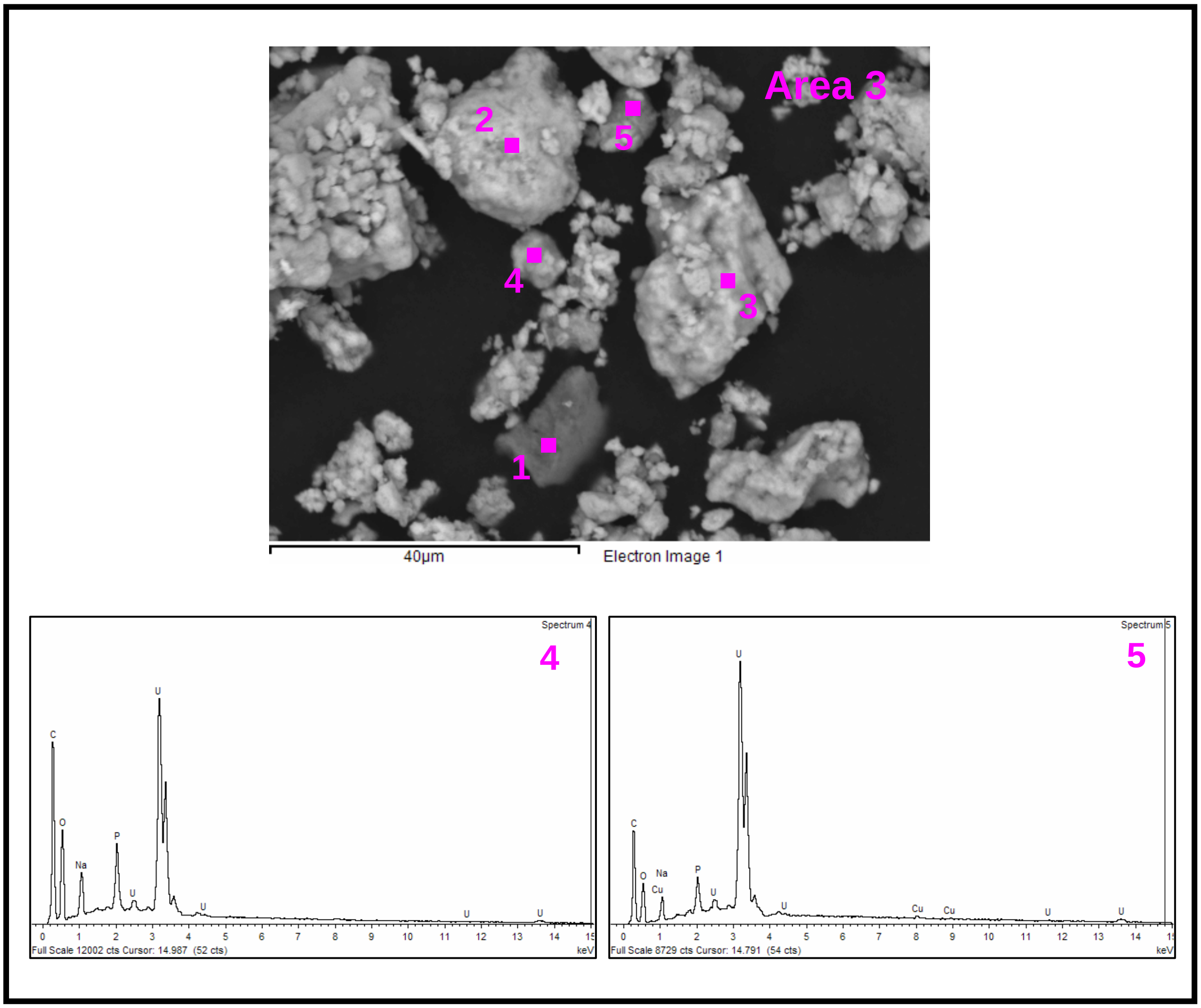


Figure H.101. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

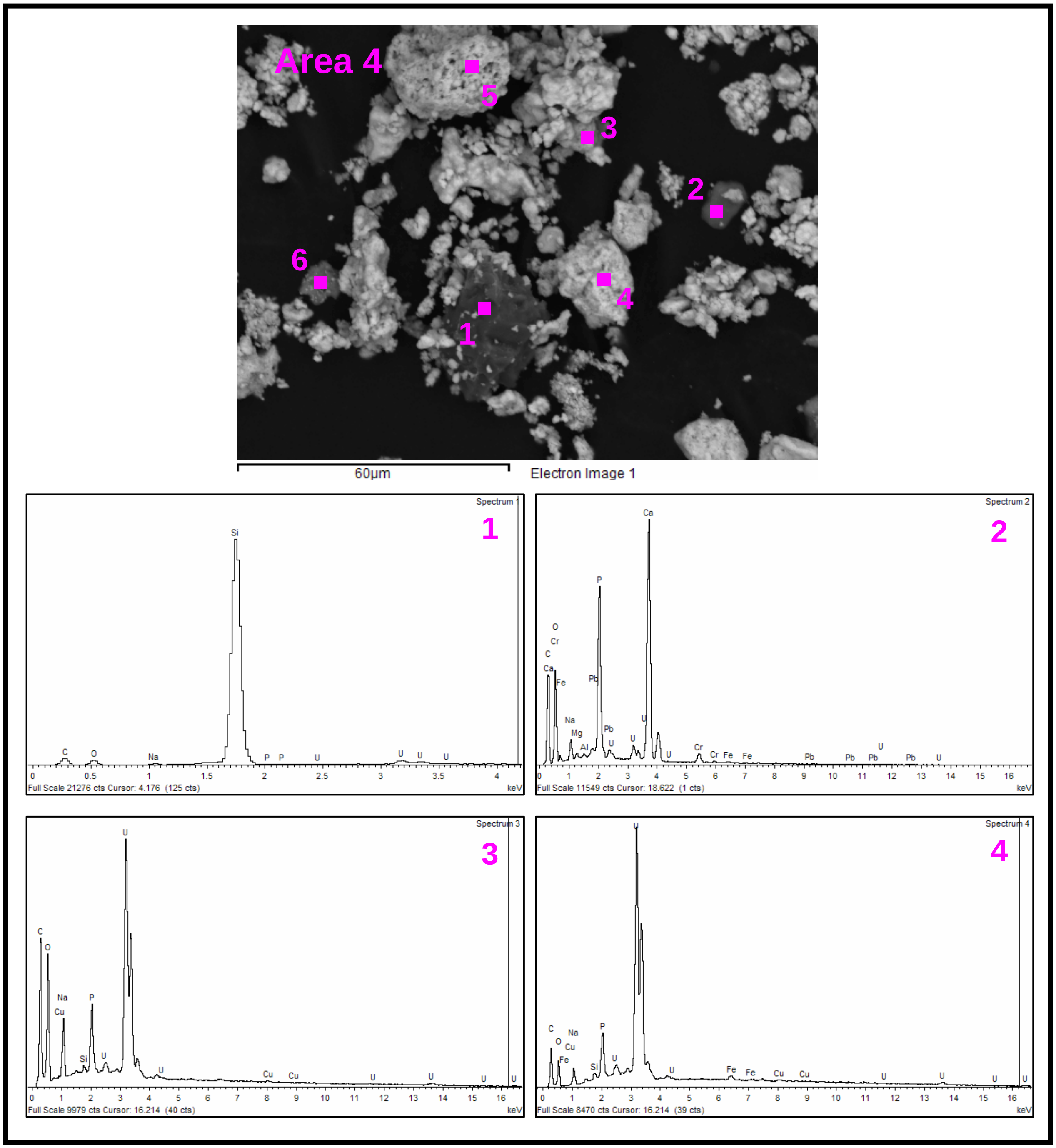


Figure H.102. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

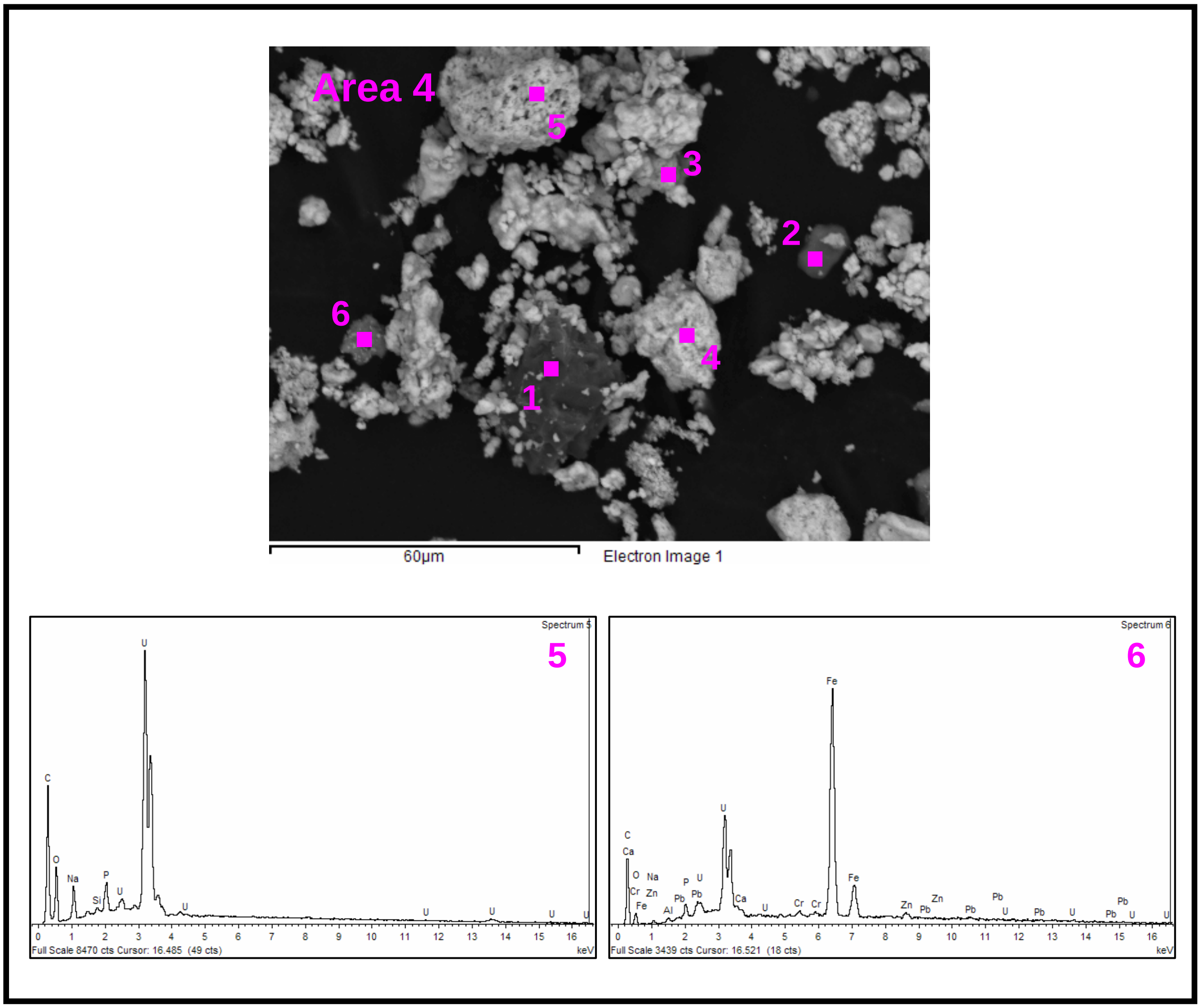


Figure H.103. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

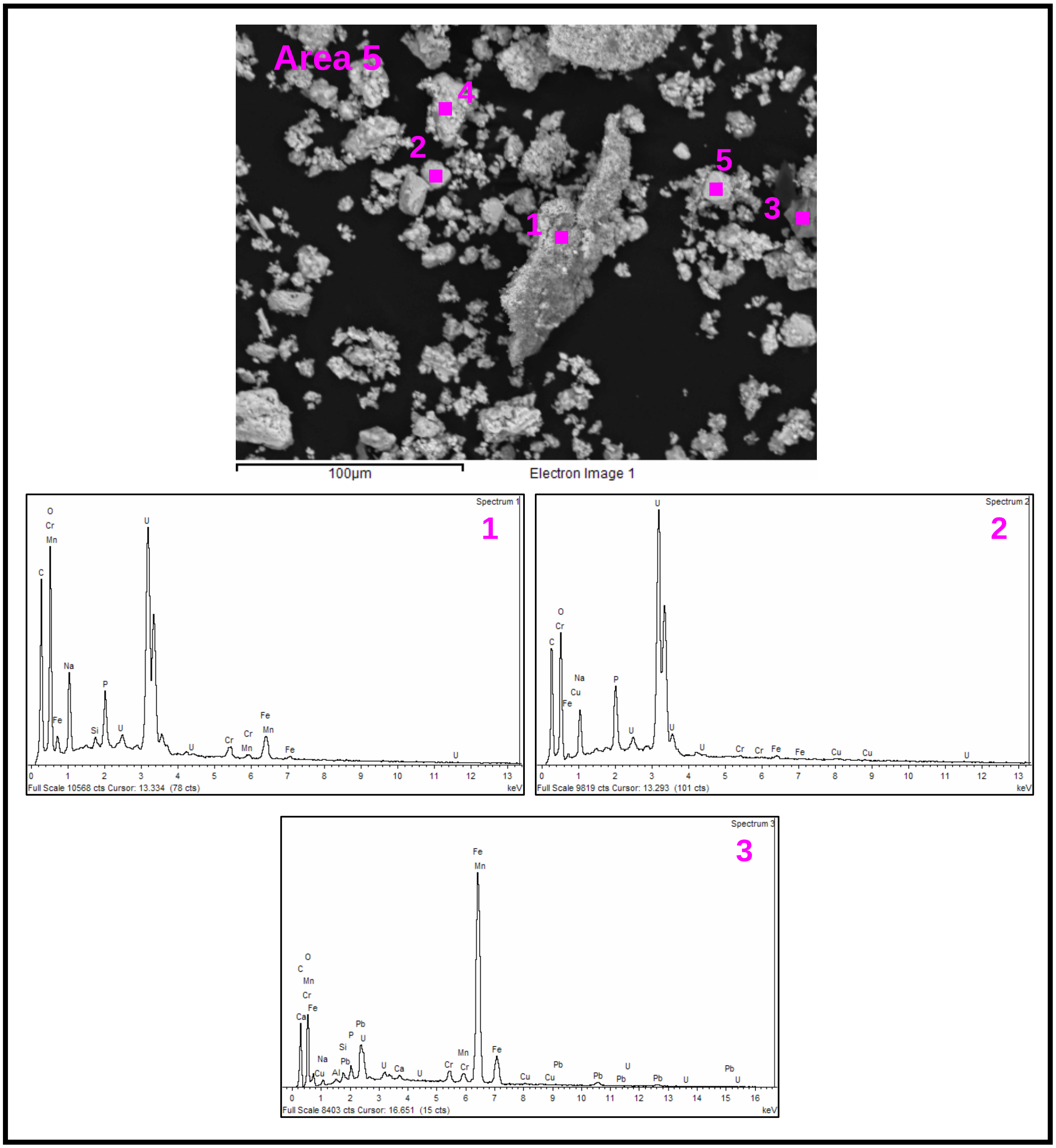


Figure H.104. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

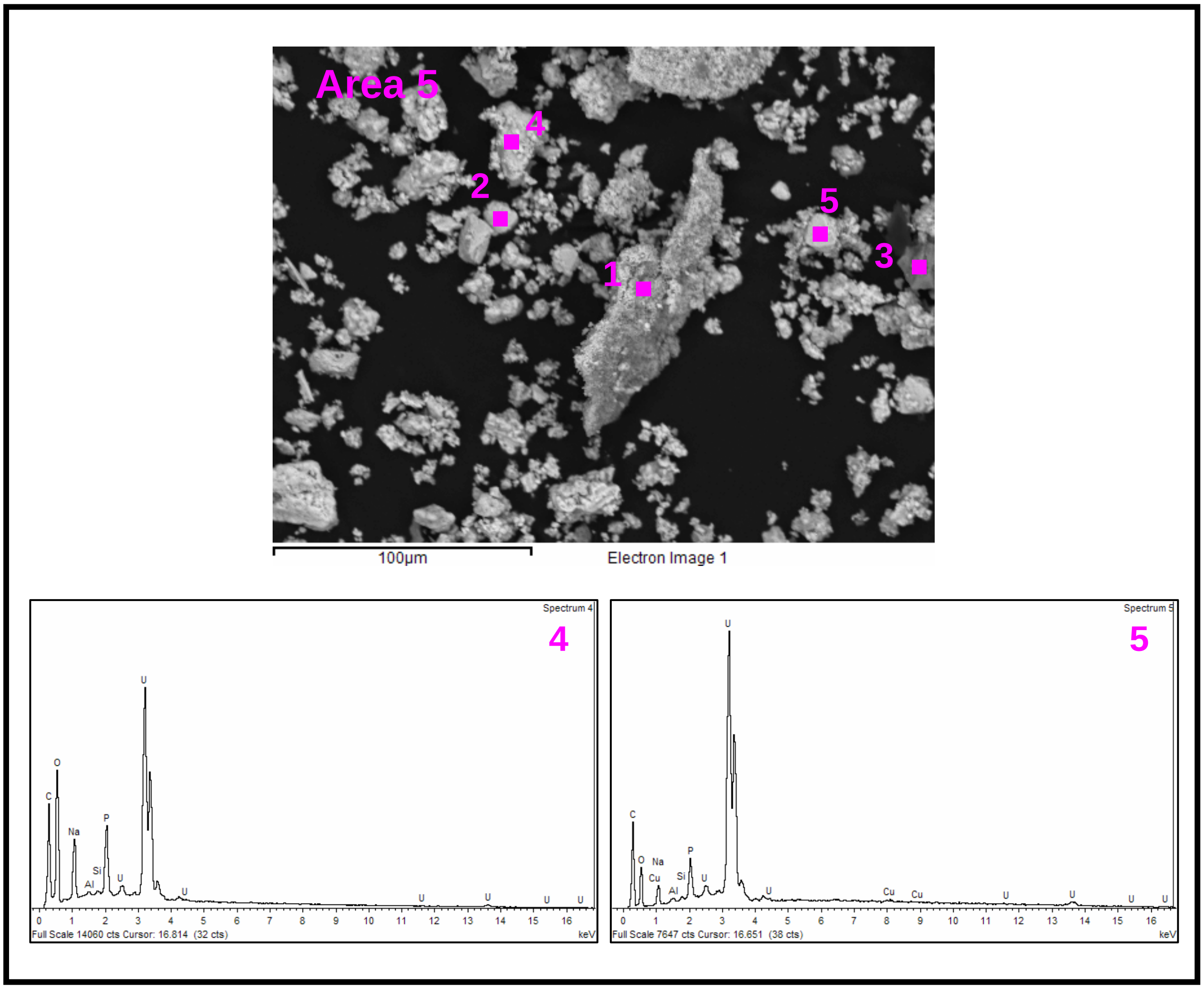


Figure H.105. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

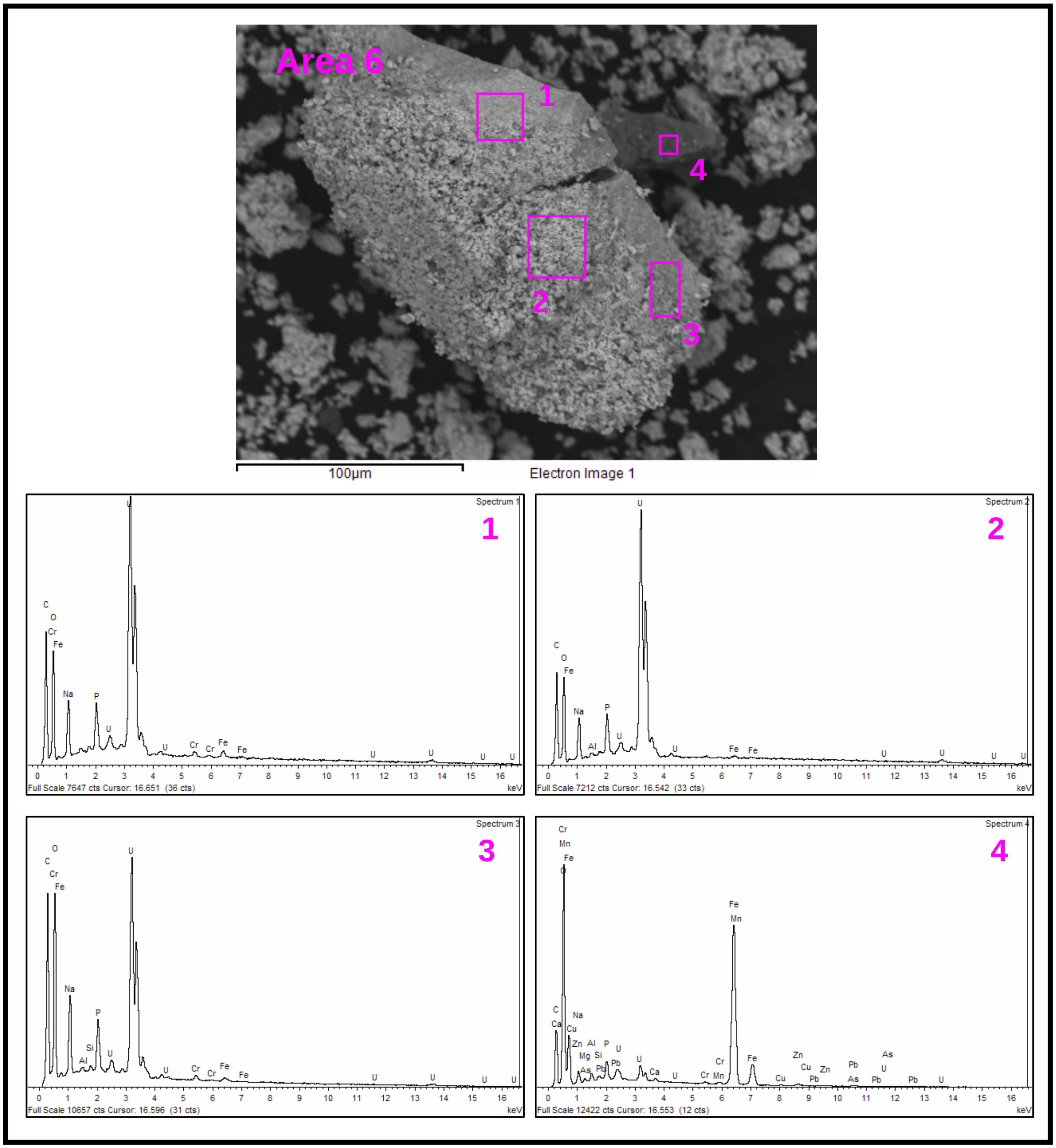


Figure H.106. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

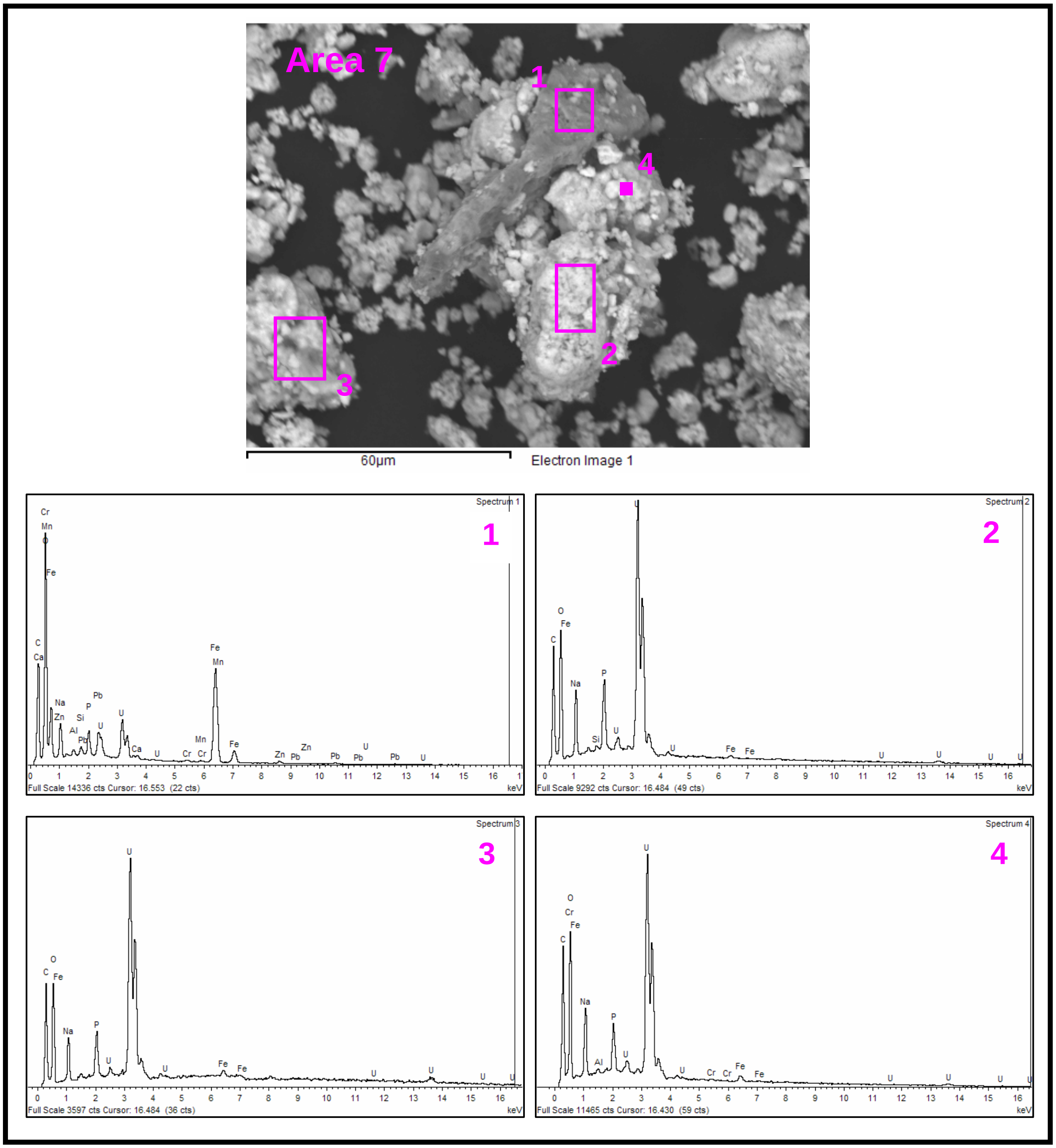


Figure H.107. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in 1-Month Single-Contact $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.11. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	Na	Fe	Mn	Cr	Ni	Ca	O	C[3]	P	Al	Cu	Mg	Si	
H.98 / 1	1	0.8	1.8	20	0.3	1.5			24	*51*	0.7	0.2	0.1		0.3	Pb – 0.2
	2	8.0	4.2						35	*49*	3.2		0.4			
	3	3.2	3.8	0.1					46	*46*	1.0	0.1			0.2	
	4	3.4	5.3	0.2					41	*48*	2.0	0.1	0.1		0.2	
H.99 / 2	1	4.3	5.6	0.5		0.5			46	*42*	1.2	0.2			0.3	
	2	5.7	5.7	0.6	0.1	0.7			40	*46*	1.3	0.2			0.3	
	3	17	2.3	0.8		1.0			23	*53*	1.8	1.1			0.4	
H.100 & H.101 / 3	1	0.1	0.6	16	0.1				37	*46*	0.1	0.2				Zn – 0.1
	2	4.8	5.3						41	*45*	3.2	0.1			0.2	
	3	4.1	6.0						45	*42*	2.8				0.2	
	4	4.2	3.5						32	*58*	2.6					
	5	9.3	4.0						28	*56*	2.9		0.3			

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as “<0.1” indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.12. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.102 & H.103 / 4	1	0.4	0.3						13	*54*	0.2				33	
	2	0.2	1.4	0.1		0.4		7.9	40	*44*	5.0	0.1		0.2		Pb – 0.1
	3	4.5	4.9						40	*48*	2.6		0.1		0.3	
	4	15	4.9	1.0					29	*43*	5.8		0.5		0.8	
	5	7.2	4.1						29	*58*	1.7				0.3	
	6	3.1	0.6	26		0.4			5.3	*61*	1.0	0.4				Pb – 0.3, Zn – 1.4
	7	0.6	2.1	13					44	*41*	0.5					
H.104 & H.105 / 5	1	3.1	4.9	1.2	0.1	0.5			44	*44*	1.6				0.3	
	2	5.3	4.5	0.3		0.1			45	*42*	2.9		0.2			
	3	0.2	0.8	19	0.7	0.7		0.2	25	*51*	0.7	0.2	0.1		0.5	Pb – 0.7
	4	4.6	5.5						46	*40*	3.2	0.2			0.2	
	5	10	3.5						28	*54*	3.3	0.3	0.4		0.3	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.13. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for 1-Month Single-Contact $CaCO_3$ Leached Solids

Figure No./ Area of Interest	**Spectrum**	**Atomic%[1]**														
		Major Cations							**Anions[2]**			**Others**				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.106 / 6	1	5.8	5.4	0.5		0.4			40	*46*	2.2					
	2	7.1	5.4	0.2					41	*43*	2.5	0.3				
	3	3.2	4.9	0.2		0.2			43	*47*	1.5	0.1			0.1	
	4	0.3	1.3	12	0.1	0.1		0.1	50	*33*	0.8	0.4	0.1	0.2	0.2	Pb – 0.2, Zn – 0.3
H.107 / 7	1	0.7	2.5	5.9	0.1	0.1		0.1	49	*40*	0.8	0.2			0.3	Pb – 0.3, Zn – 0.3
	2	5.3	6.0	0.2					43	*42*	3.0				0.2	
	3	5.8	5.1	0.6					42	*44*	2.4					
	4	4.2	5.5	0.4		0.1			44	*44*	1.9	0.2				
	5	0.6	0.7						18	*77*	0.7		0.5		0.7	Ce – 0.2, Y – 1.4

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

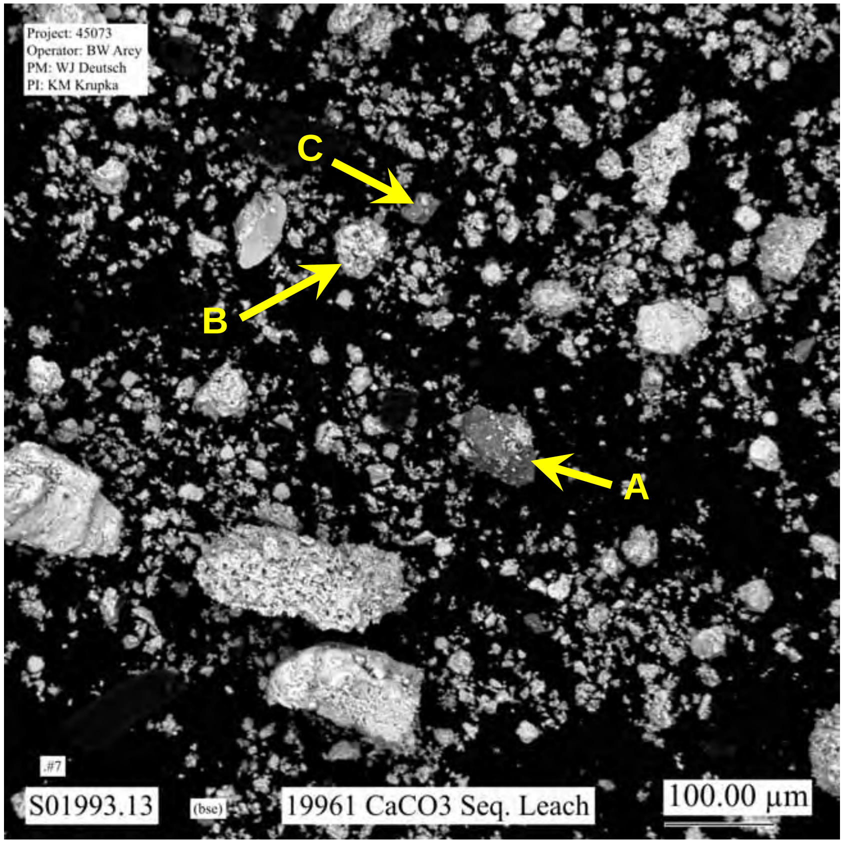


Figure H.108. Low Magnification Micrograph Showing Typical Particles in Sample of Sequential $CaCO_3$ Leached Solids from C 203 Residual Waste (Sample 19961)

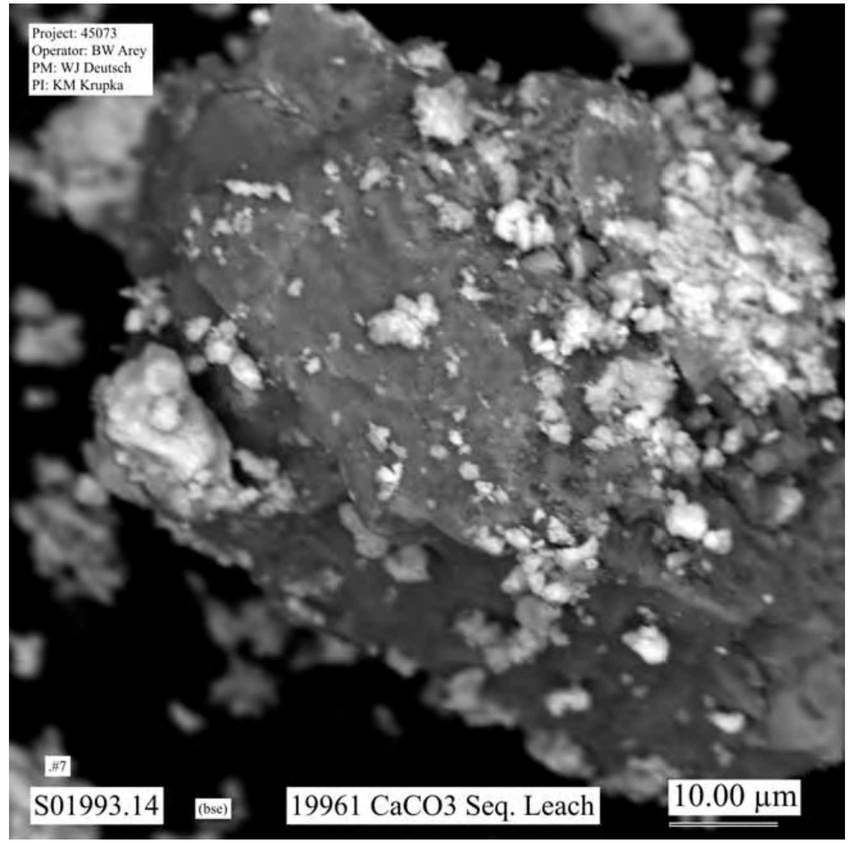


Figure H.109. Micrograph Showing at Higher Magnification the Particle Labeled A in Figure H.108 (Areas where EDS analyses were made are shown in Figure H.120.)

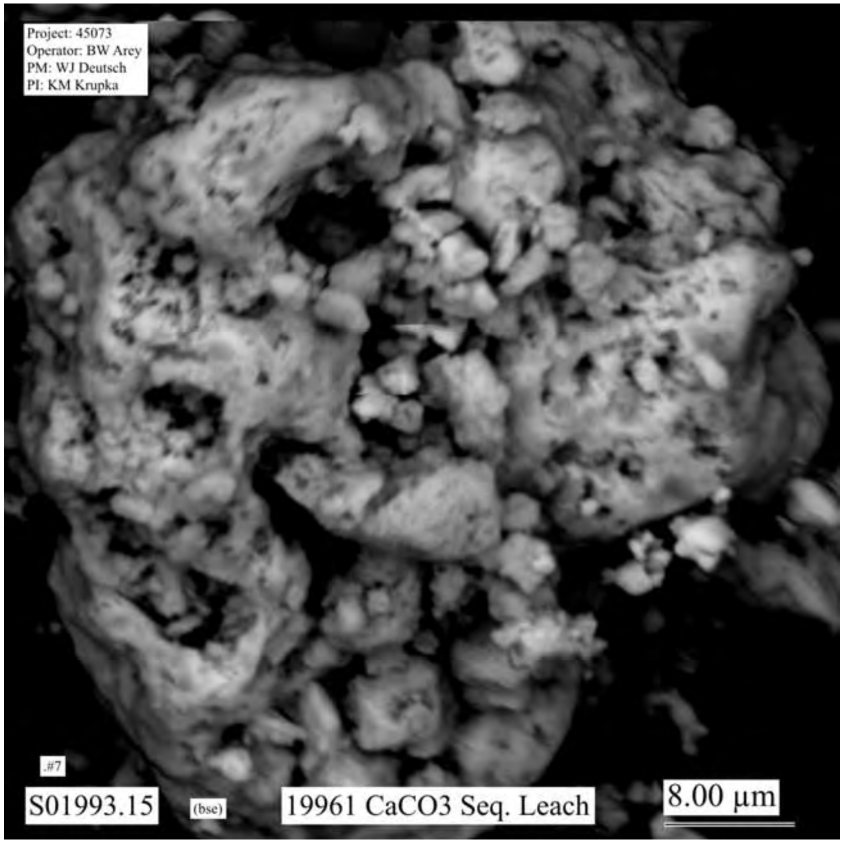


Figure H.110. Micrograph Showing at Higher Magnification the Particle Labeled B in Figure H.108 (Areas where EDS analyses were made are shown in Figure H.121.)

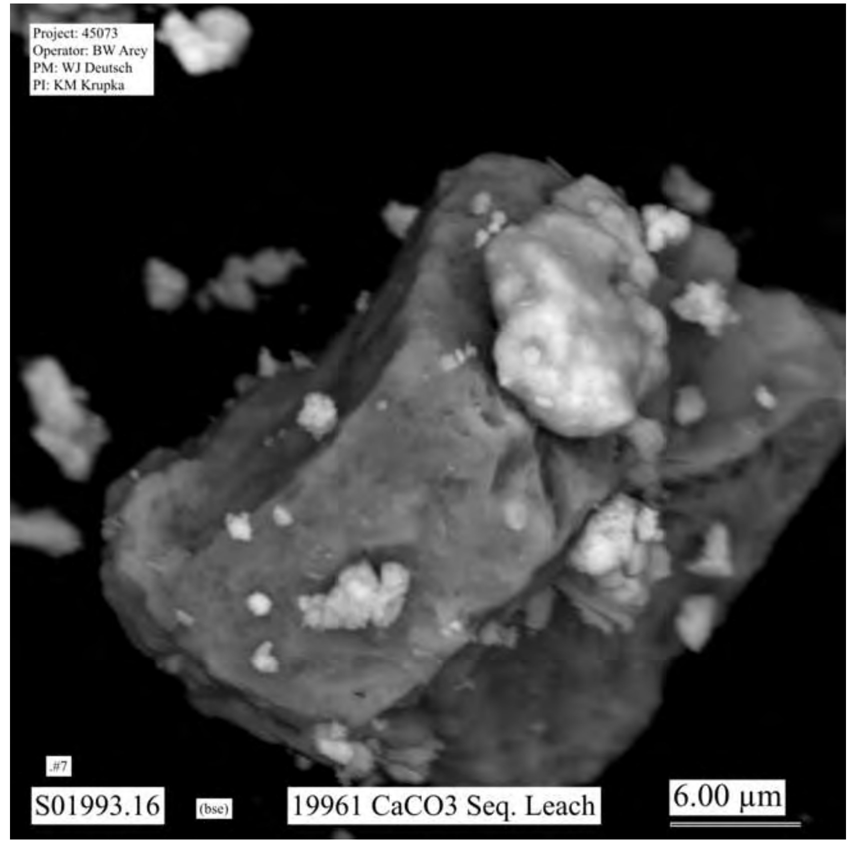


Figure H.111. Micrograph Showing at Higher Magnification the Particle Labeled C in Figure H.108 (Areas where EDS analyses were made are shown in Figure H.122.)

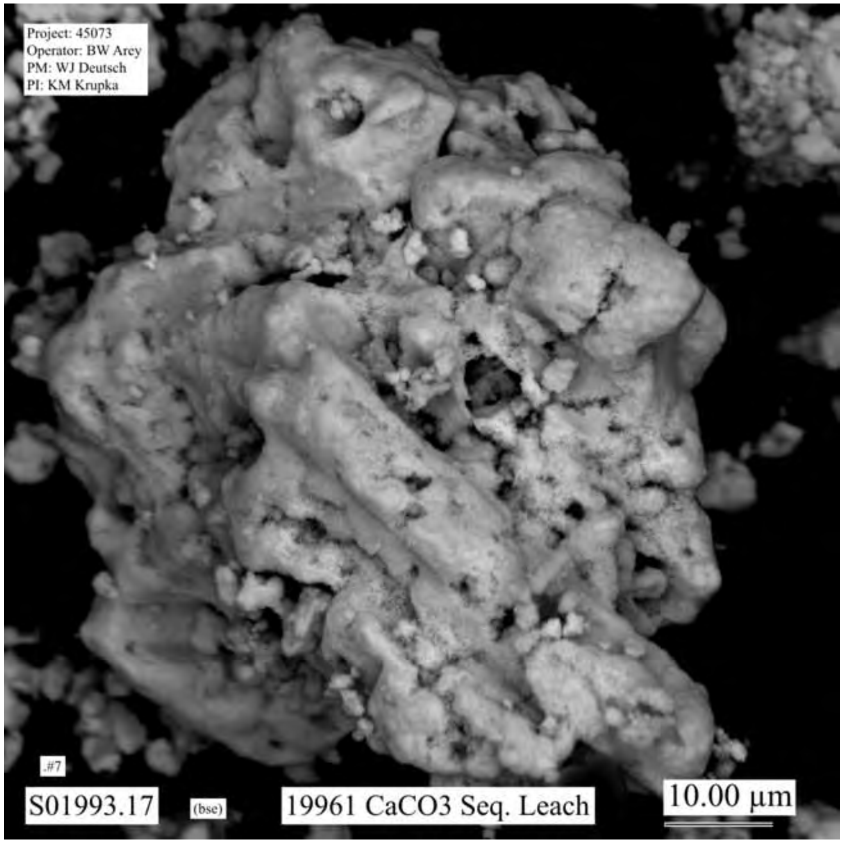


Figure H.112. Micrograph Showing Typical Particle Aggregate in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.123.)

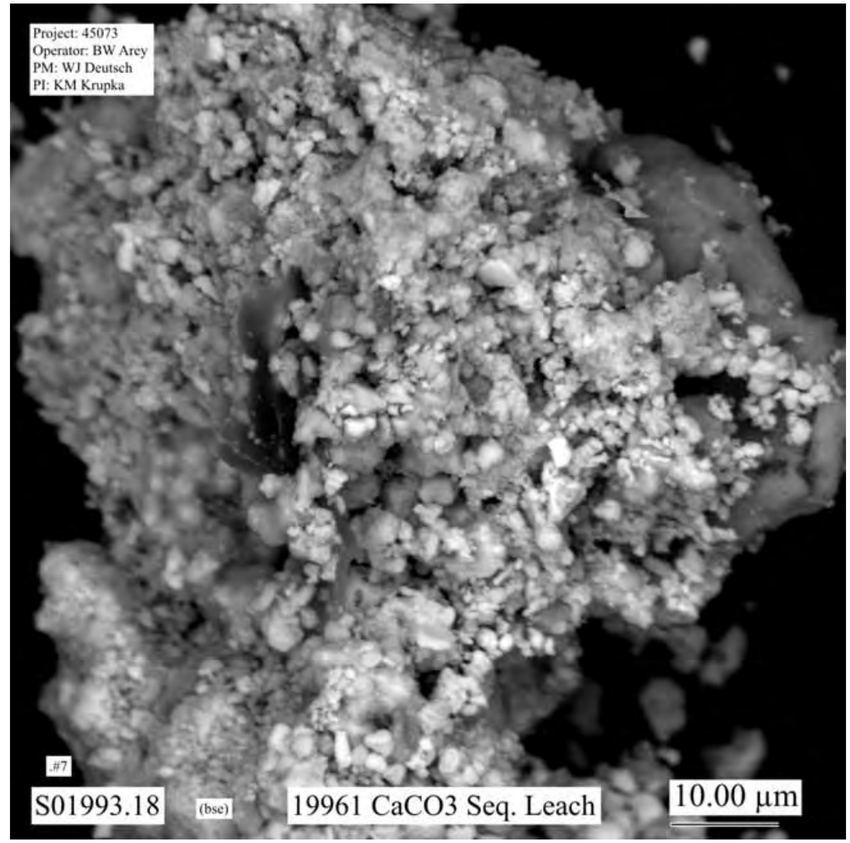


Figure H.113. Micrograph Showing Typical Particle Aggregate in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.124 and H.125.)

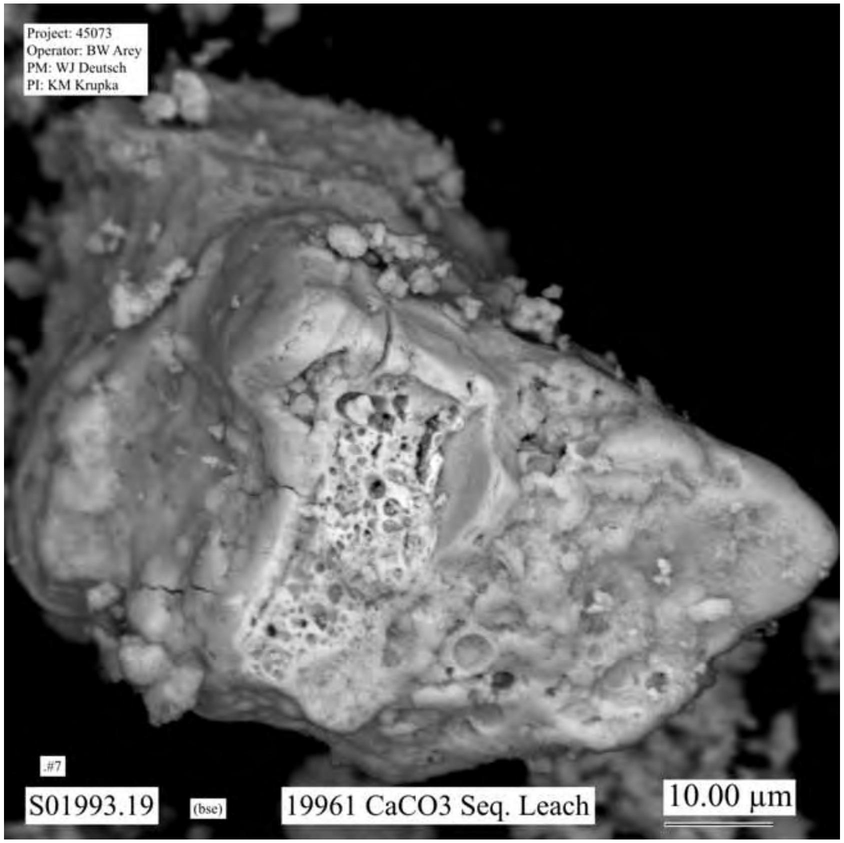


Figure H.114. Micrograph Showing Typical Particle in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

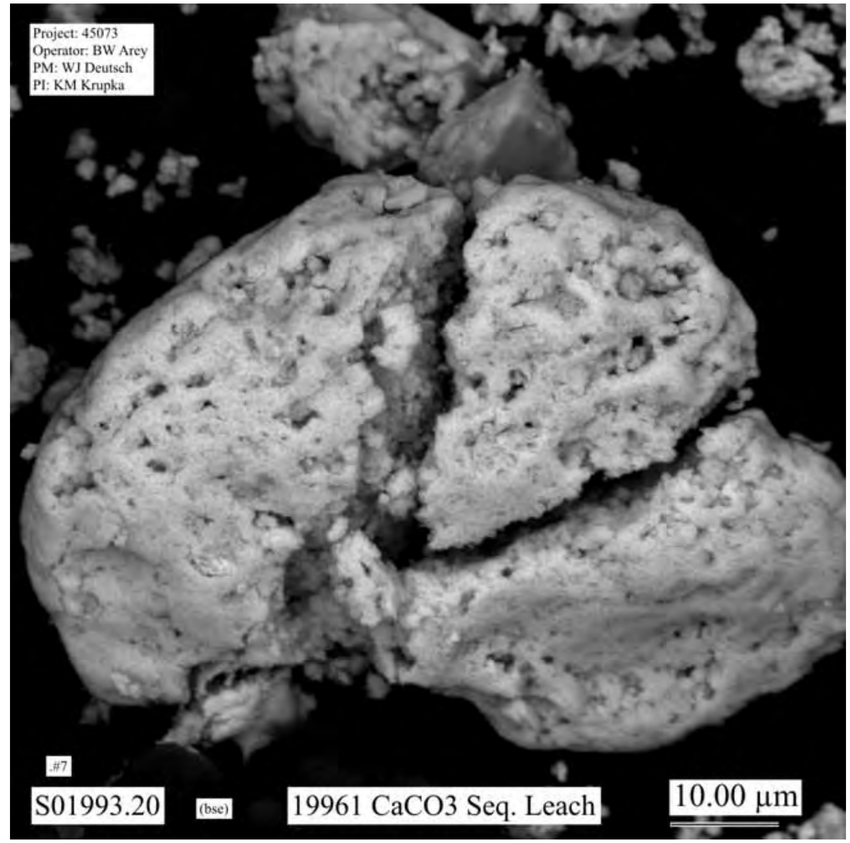


Figure H.115. Micrograph Showing Typical Particle in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.126.)

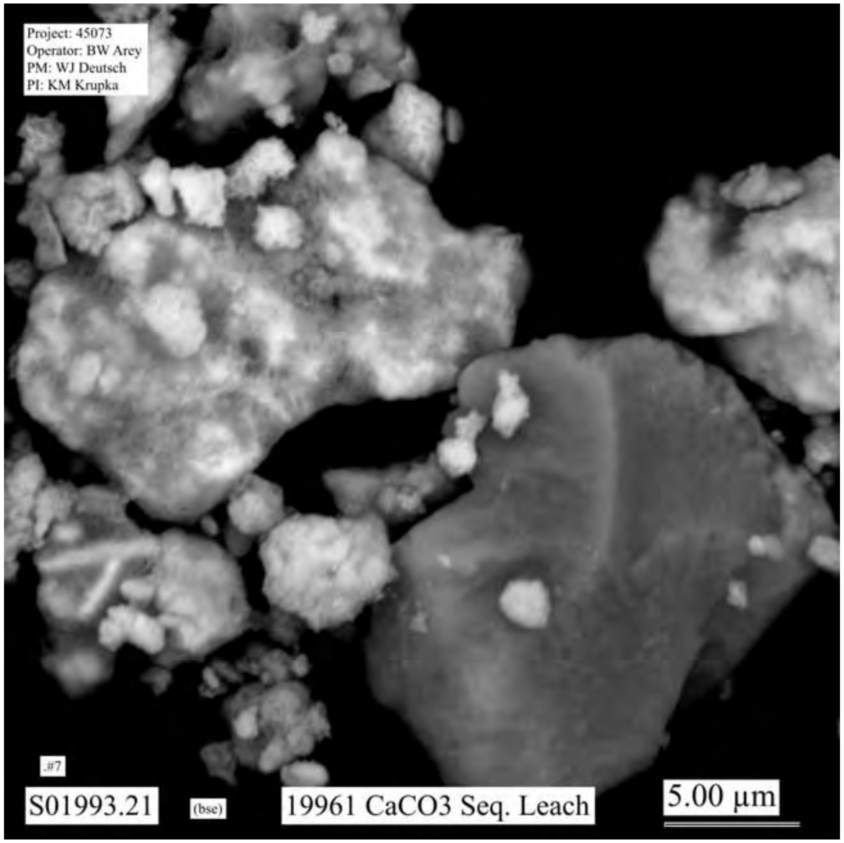


Figure H.116. Micrograph Showing Typical Particles in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figure H.127.)

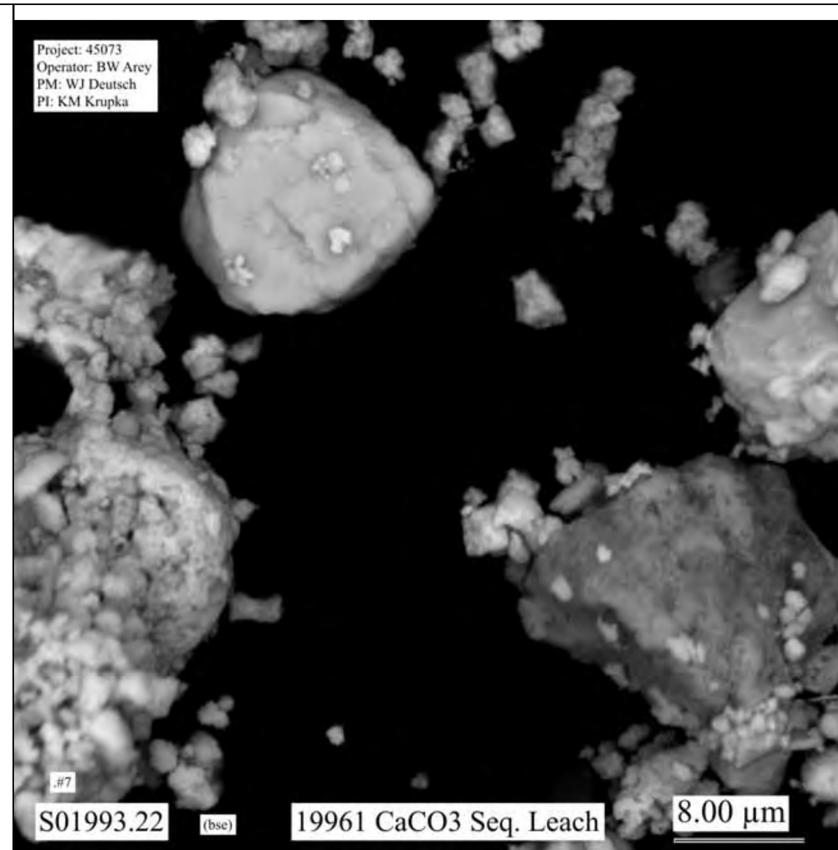


Figure H.117. Micrograph Showing Typical Particles in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961) (Areas where EDS analyses were made are shown in Figures H.128 and H.129.)

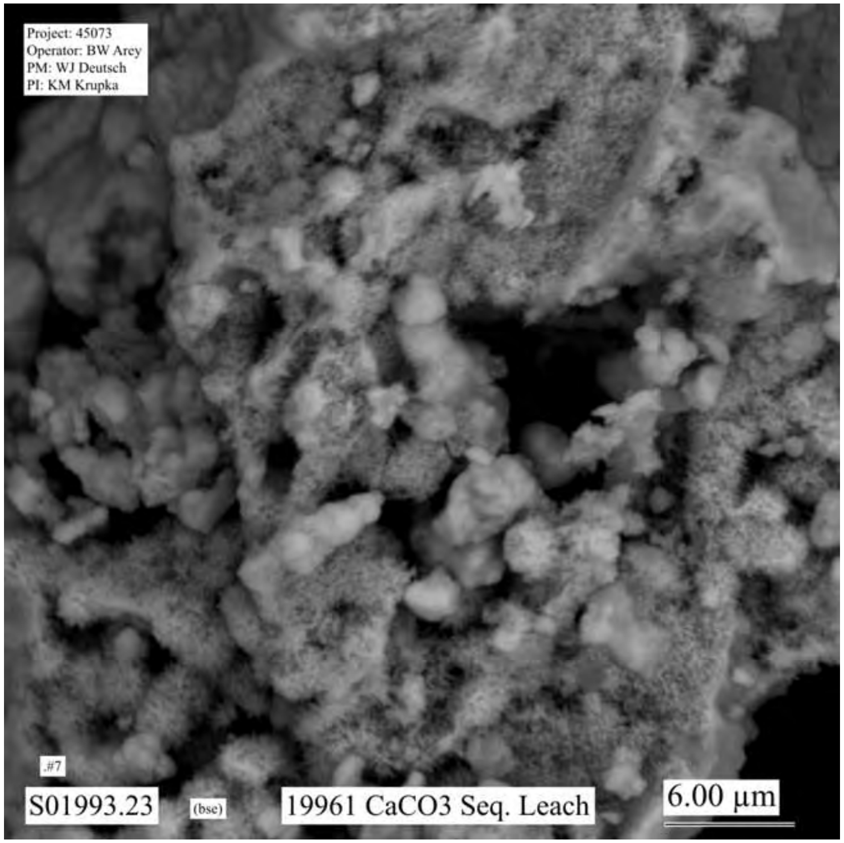


Figure H.118. Micrograph Showing Typical Particle Aggregate in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

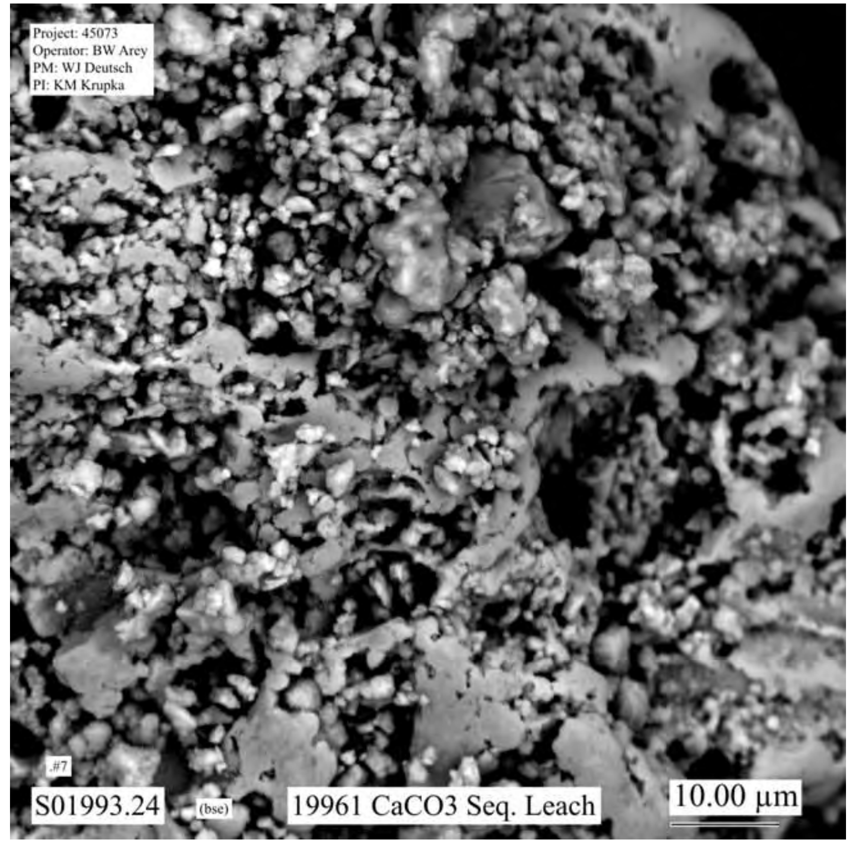


Figure H.119. Micrograph Showing Typical Particle Aggregate in Sample of Sequential $CaCO_3$ Leached Solids from C-203 Residual Waste (Sample 19961)

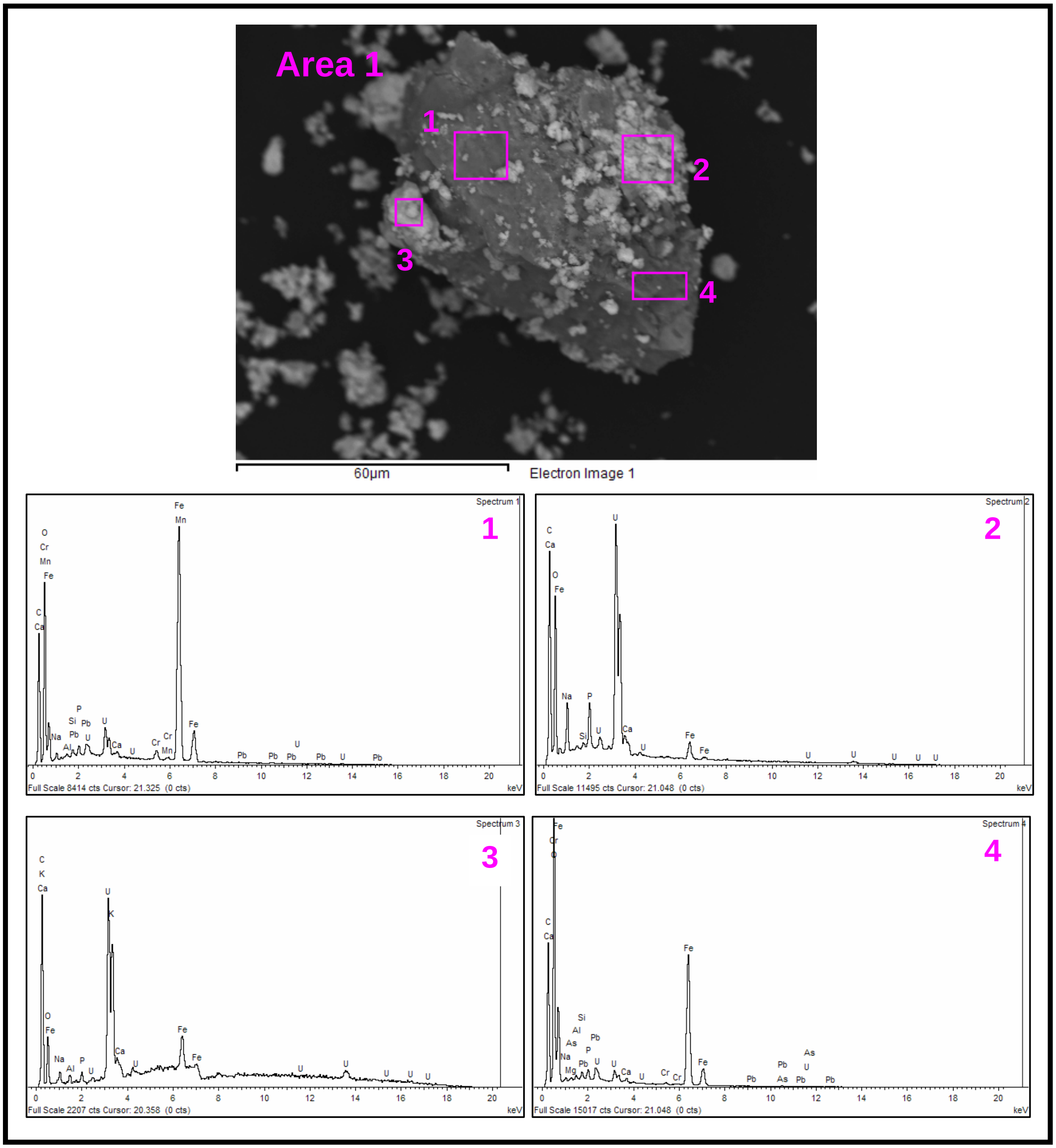


Figure H.120. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

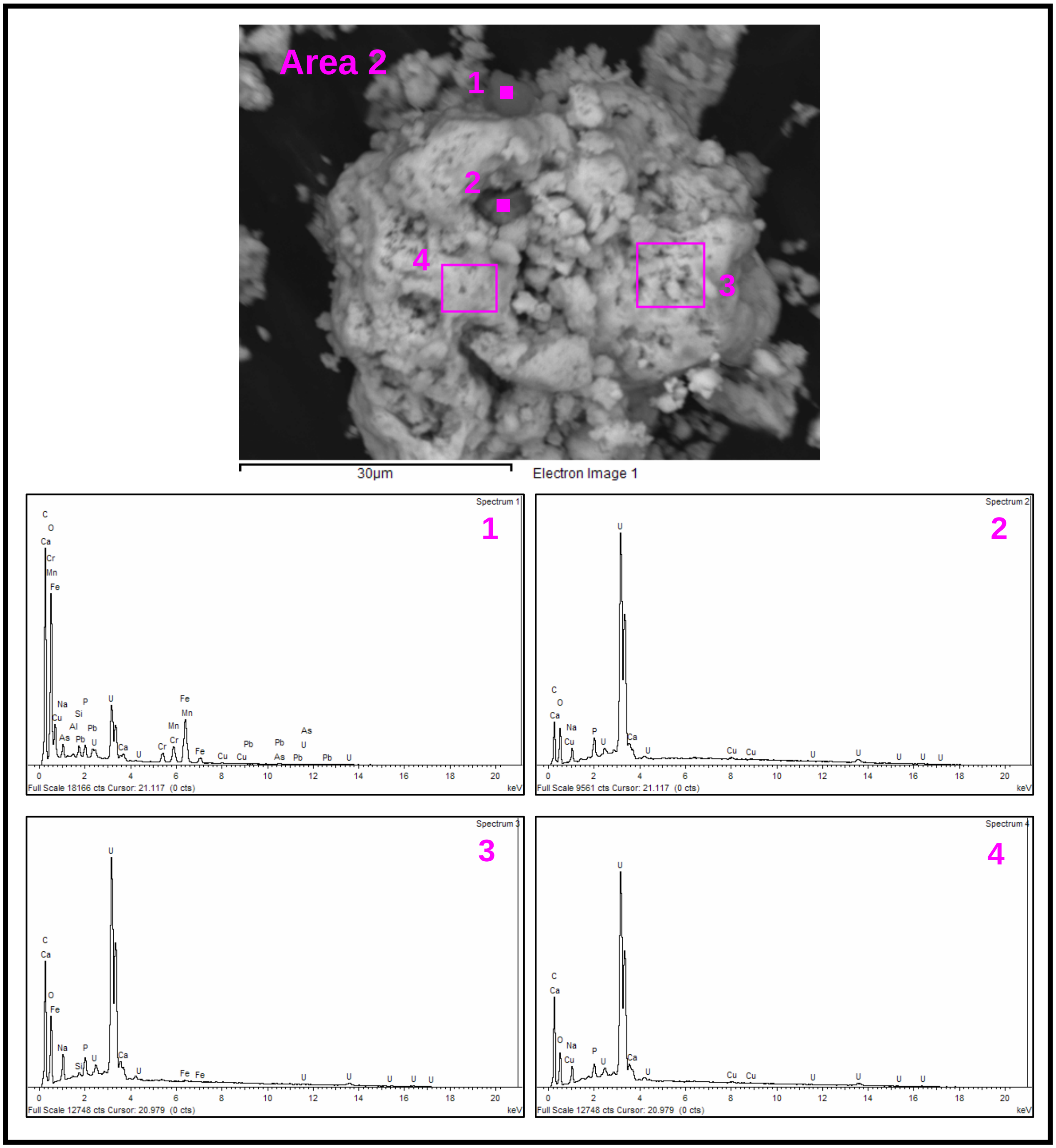


Figure H.121. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

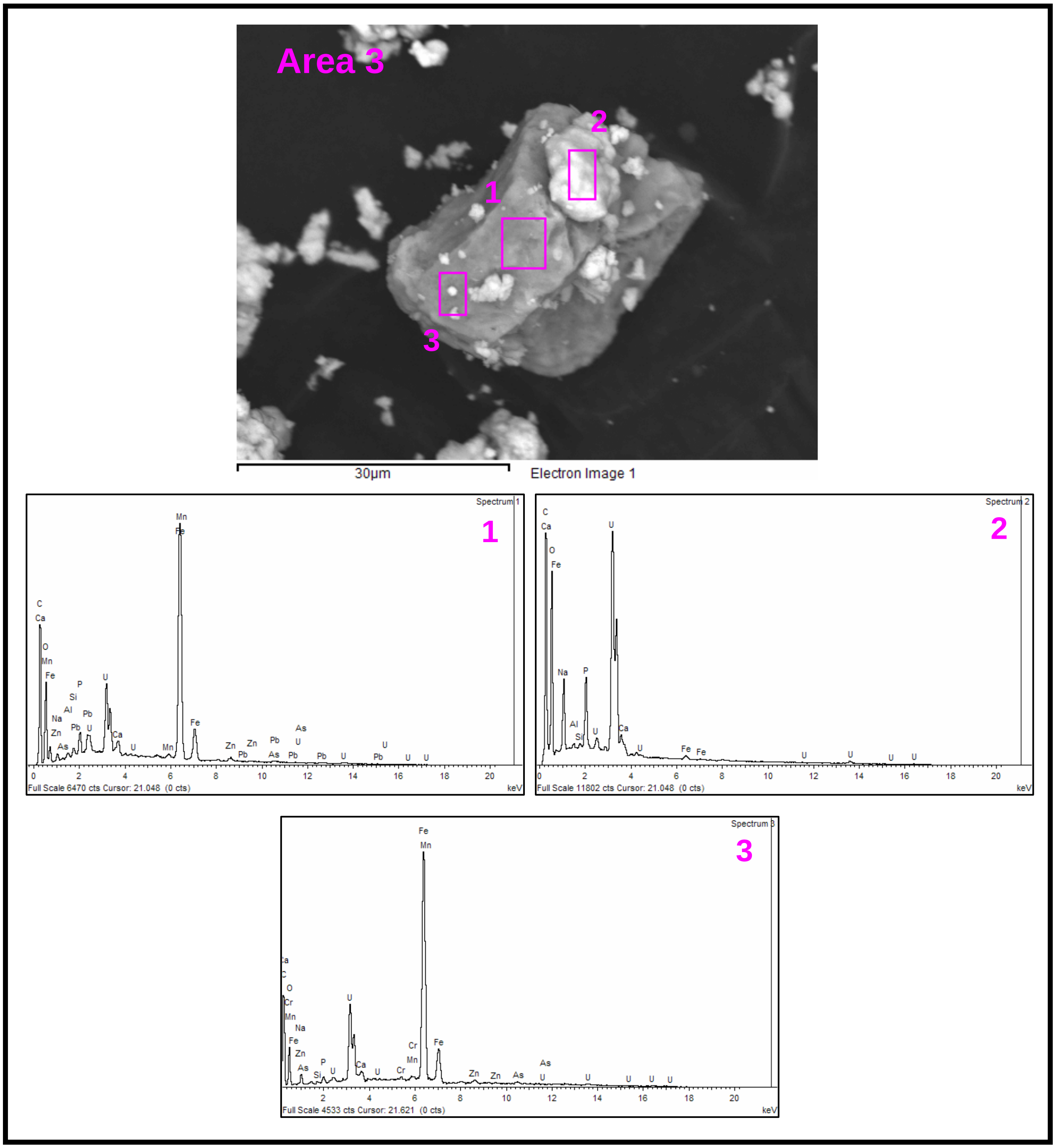


Figure H.122. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

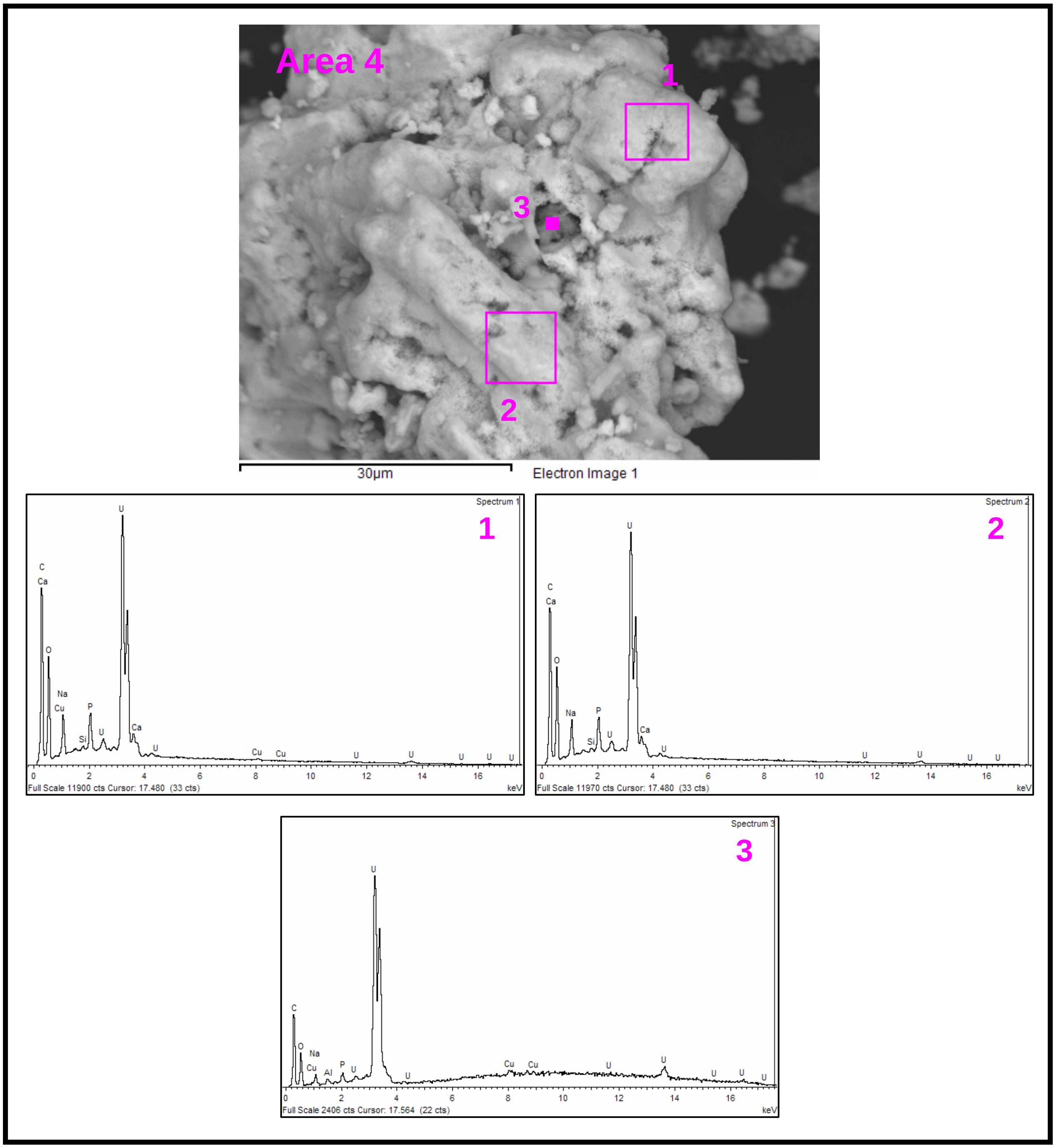


Figure H.123. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

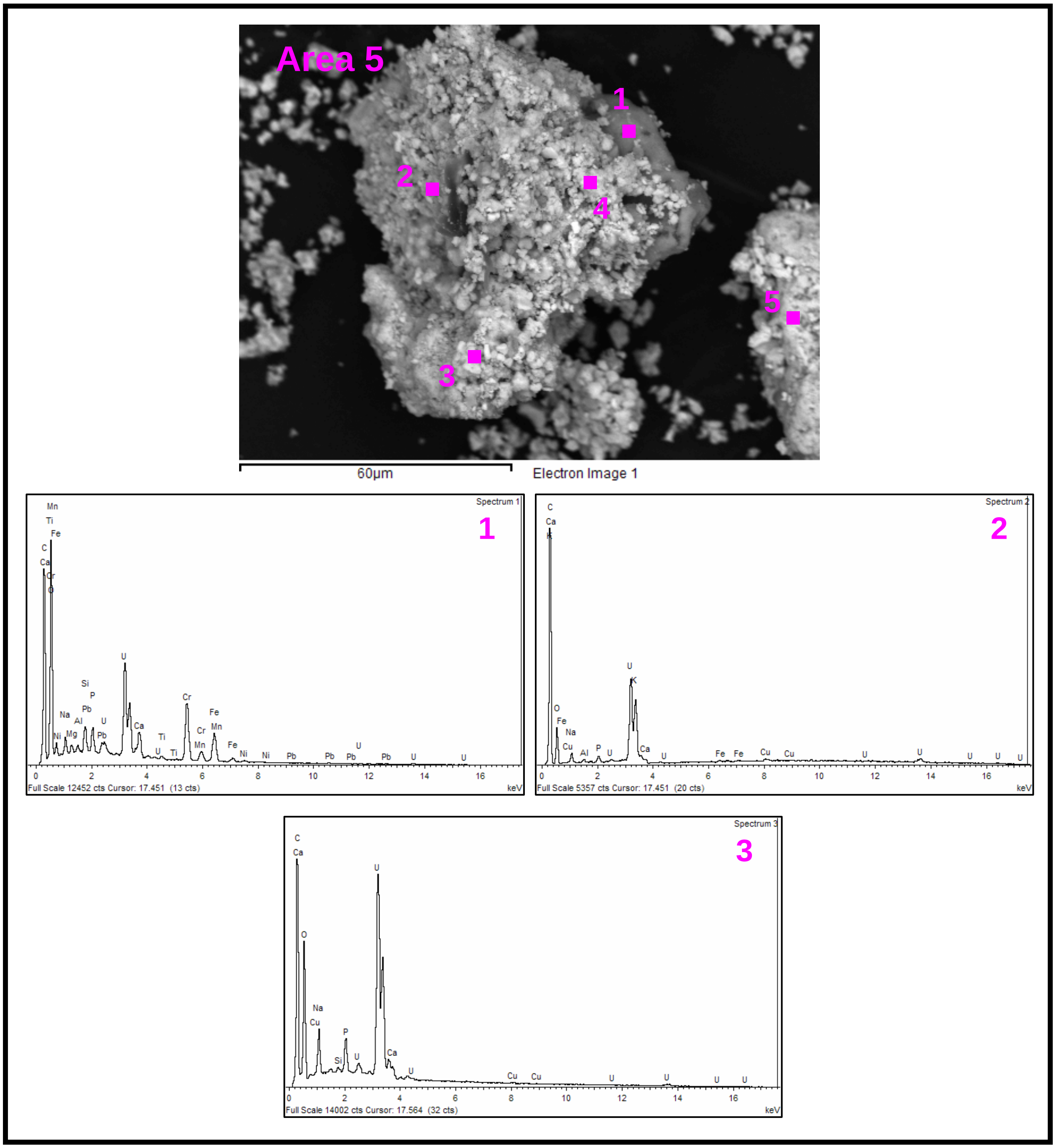


Figure H.124. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

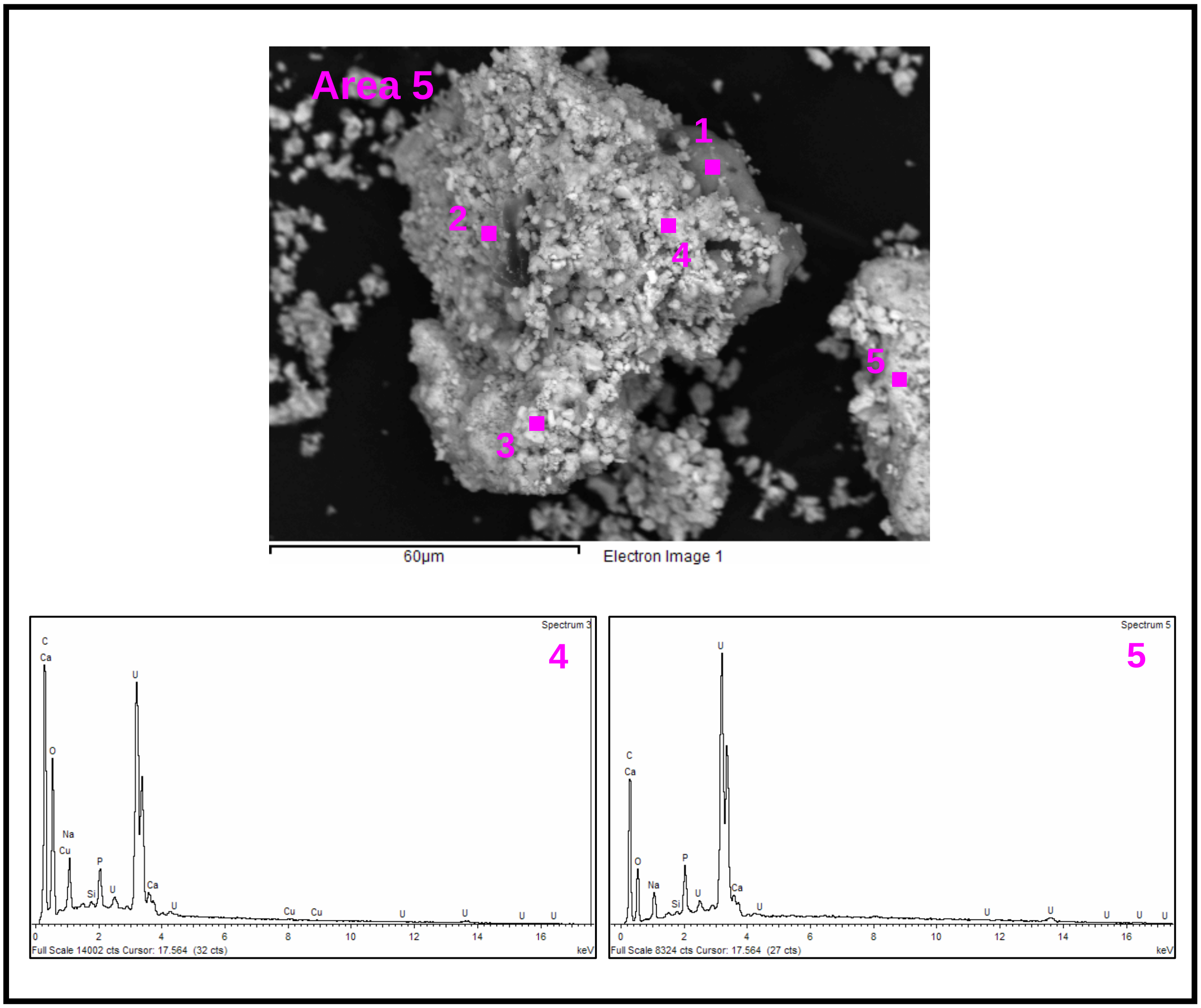


Figure H.125. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

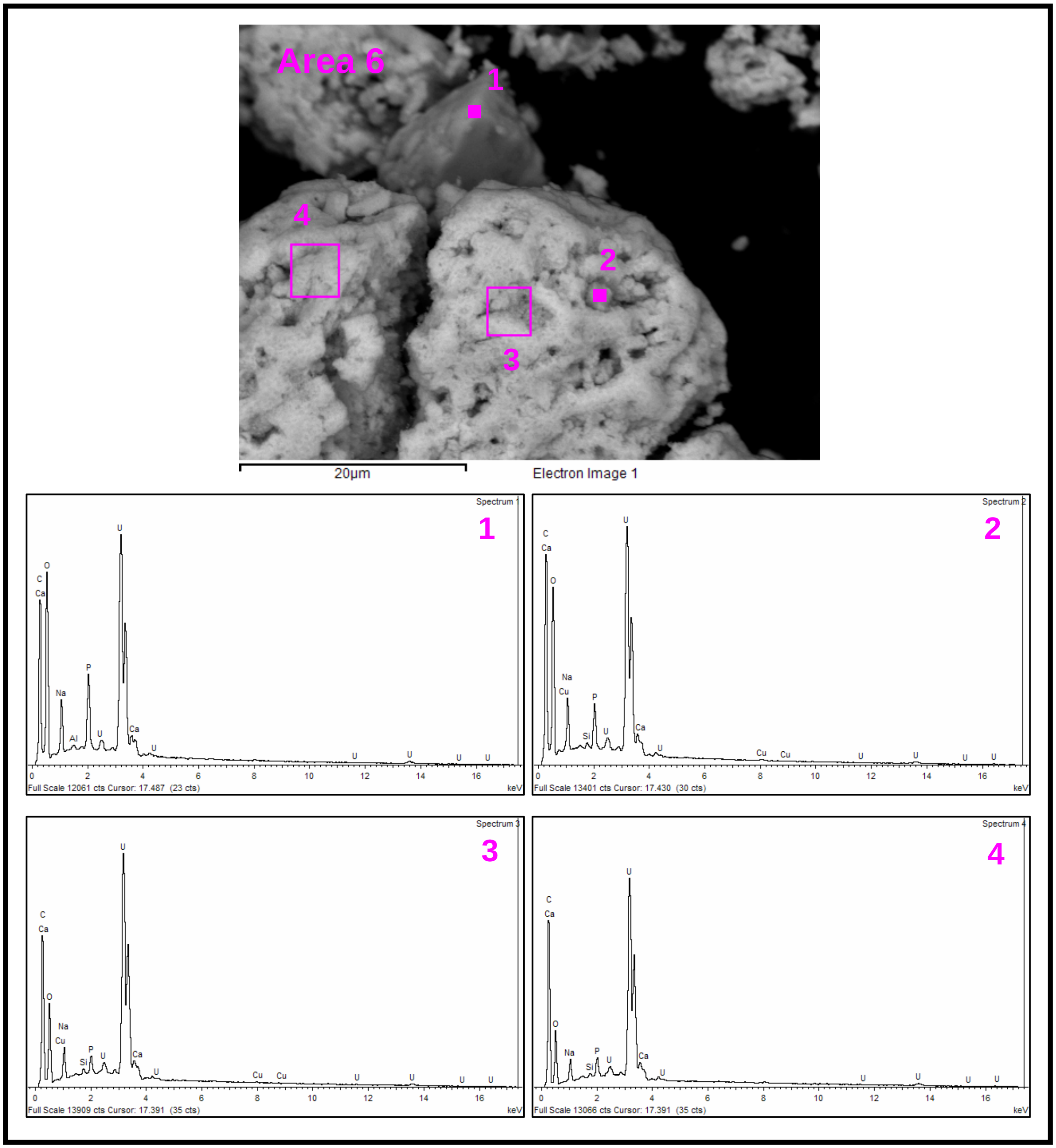


Figure H.126. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

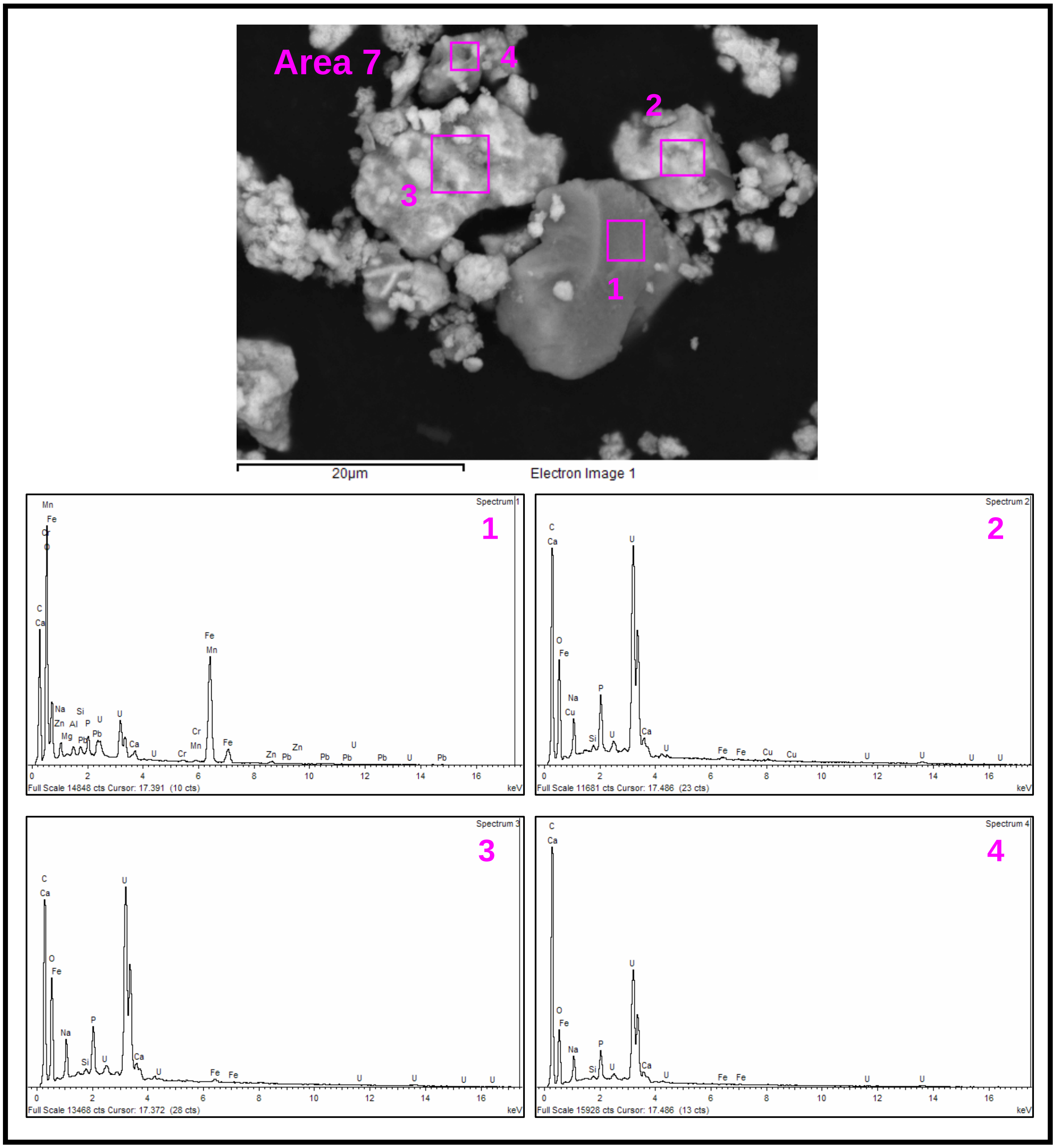


Figure H.127. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

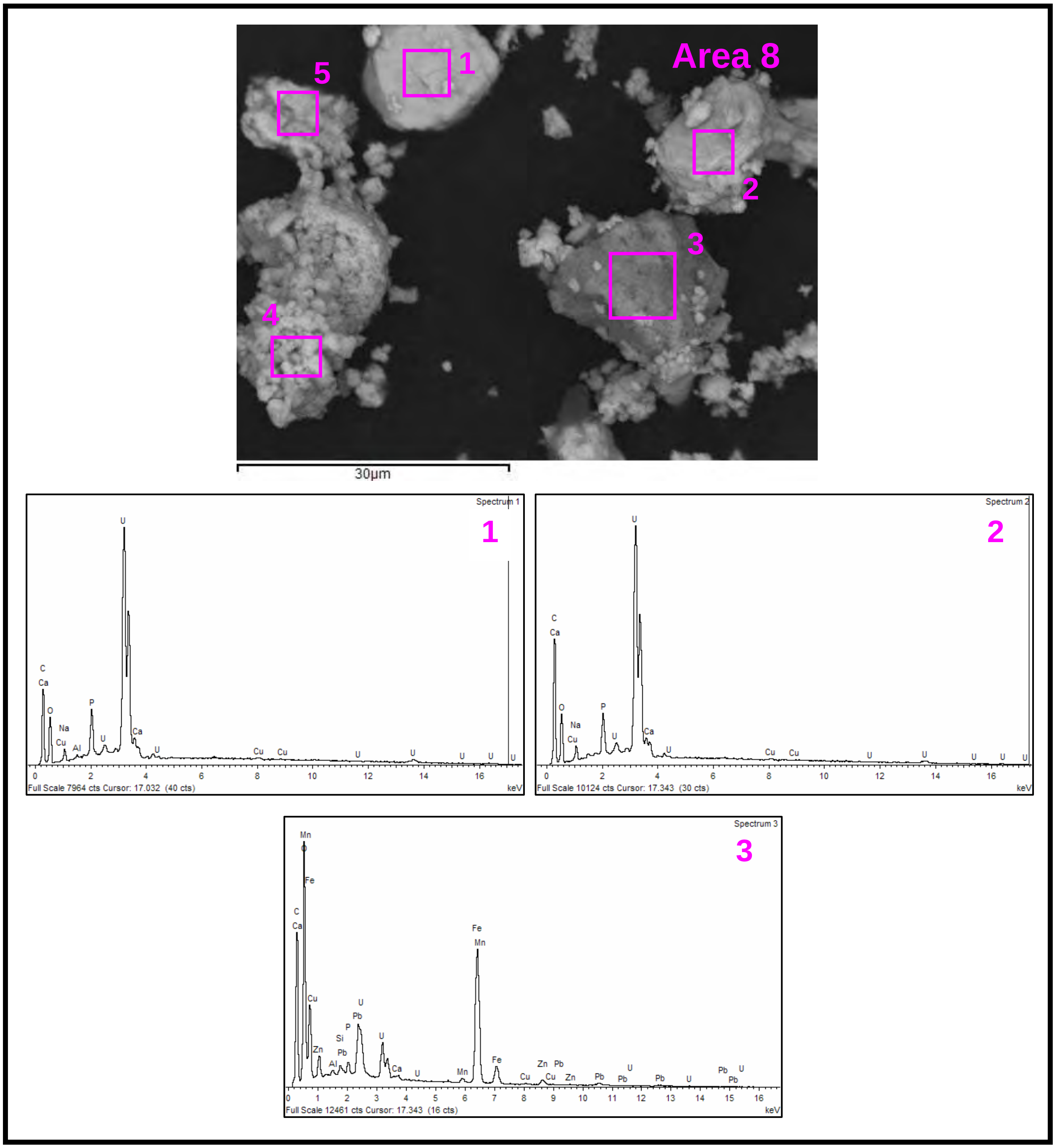


Figure H.128. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

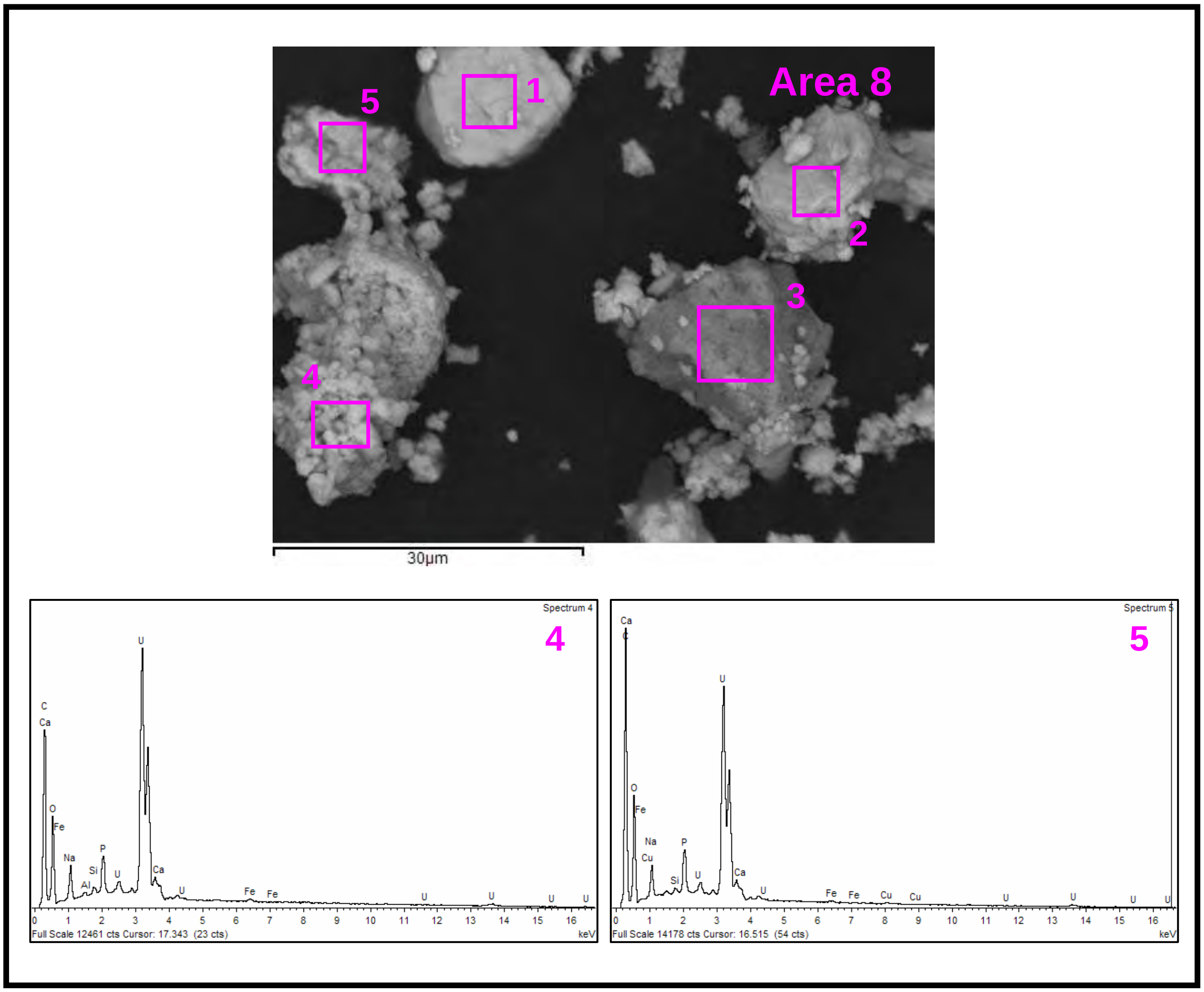


Figure H.129. EDS Spectra for Numbered Areas Marked in Pink in Top SEM Micrograph of Particles in Sequential $CaCO_3$ Leached Water Extraction Solids of C-203 Residual Waste (Sample 19961)

Table H.14. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C**[3]	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.120 / 1	1	0.4	0.6	13	0.1	0.3		0.1	36	*49*	0.3	0.1			0.2	Pb – 0.1
	2	3.4	3.2	1.0				0.3	40	*50*	1.4				0.2	
	3	3.9	1.0	2.9				0.5	21	*69*	0.4	0.4				K – 0.7
	4	0.1	0.3	6.5		0.1		0.1	48	*44*	0.3	0.1		0.1	0.2	As - <0.1, Pb – 0.1
H.121 / 2	1	0.8	0.8	2.3	0.8	0.4		0.2	39	*55*	0.3	0.1	0.6		0.3	Pb – 0.1
	2	13	4.0					1.2	39	*39*	2.7		0.7			
	3	6.4	3.4	0.2				0.6	35	*53*	1.1				0.2	
	4	9.0	3.4					0.9	27	*58*	1.4		0.3			
H.122 / 3	1	1.2	0.6	15	0.2			0.4	21	*60*	0.8	0.2			0.3	As - <0.1, Pb – 0.2, Zn – 0.4
	2	2.9	3.9	0.2				0.2	41	*50*	1.8	0.1			0.1	
	3	1.8	1.5	21	0.2	0.2		0.4	14	*60*	0.4				0.1	Zn – 0.5
H.123 / 4	1	4.9	3.6					0.4	36	*53*	1.6		0.1		0.2	
	2	5.0	3.5					0.4	37	*52*	1.6				0.2	
	3	10	2.7						31	*53*	1.0	0.5	1.4			

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.15. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C[3]**	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.124 & H.125 / 5	1	1.2	1.0	1.4	0.1	2.2	0.1	0.6	44	*48*	0.6	0.2		0.3	0.6	Pb – 0.1, Ti – 0.1
	2	1.9	0.8	0.1				0.2	19	*77*	0.3	0.2	0.3			K – 0.3
	3	3.2	3.0					0.3	38	*54*	1.1		0.1		0.1	
	4	3.7	3.7	0.1				0.4	35	*55*	2.0		0.1			
	5	6.9	3.0					0.6	27	*60*	2.6				0.2	
H.126 / 6	1	3.5	3.6					0.4	47	*43*	2.4	0.1				
	2	3.5	3.4					0.3	43	*48*	1.4		0.1		0.2	
	3	5.5	3.5					0.5	35	*54*	1.0		0.1		0.3	
	4	5.4	2.5					0.5	28	*63*	1.1				0.2	
H.127 / 7	1	0.6	0.7	5.8	0.1	0.1		0.2	47	*44*	0.5	0.3		0.1	0.2	Pb – 0.2, Zn – 0.2
	2	3.6	2.7	0.2				0.2	32	*59*	2.0		0.1		0.2	
	3	3.6	3.0	0.2				0.3	35	*56*	1.8				0.2	
	4	2.3	2.1	0.1				0.2	23	*71*	1.1				0.1	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Table H.16. Estimated EDS Compositions (atomic%) Corresponding to the EDS Spectra Shown in Previous Figures for Sequential $CaCO_3$ Leached Solids

Figure No./ Area of Interest	Spectrum	Atomic%[1]														
		Major Cations							Anions[2]			Others				
		U	**Na**	**Fe**	**Mn**	**Cr**	**Ni**	**Ca**	**O**	**C**[3]	**P**	**Al**	**Cu**	**Mg**	**Si**	
H.128 & H.129 / 8	1	9.1	2.3					0.8	34	*49*	3.9	0.3	0.4			
	2	7.0	2.0					0.8	28	*59*	2.6		0.2			
	3	0.5		6.7	0.2			0.1	44	*46*	0.3	0.2	0.1		0.2	Pb – 0.5, Zn – 0.5
	4	5.1	3.1	0.2				0.5	33	*56*	1.6	0.2			0.3	
	5	3.2	2.1	0.1				0.3	31	*62*	1.3		0.1		0.2	

1 = Concentrations based on compositions (wt%) normalized to 100%. Concentrations listed as "<0.1" indicate that the corresponding element was detected based on close inspection of an expanded view of the EDS spectrum, but that the calculated concentration was less than 0.05 at.%. Empty cells indicate that the corresponding element was not detected by EDS.
2 = EDS cannot detect hydrogen (H) or other elements with atomic numbers less than that of boron.
3 = Carbon concentrations (in italics) are suspect, and are likely too large.

Appendix I

Solution Concentrations in the Three Leachates Used on the Residual Sludge fromTanks C-202 and C-203 Water Contact Tests

Tank C-202 (19250) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	8.18	8.72	8.78	9.00	8.18	8.72	8.11	8.57	8.56	7.62	8.28	7.59	7.43	7.43	8.65	8.82
Alkalinity	mg/L as CaCO3	2.62E+02	2.24E+02	2.34E+02	2.24E+02	2.62E+02	2.24E+02	8.11E+01	6.02E+01	5.40E+01	4.32E+01	INS	3.01E+01	2.47E+01	2.62E+01	5.94E+01	6.10E+01
TIC	mg C/L	4.64E+01	4.49E+01	5.04E+01	4.34E+01	4.64E+01	4.49E+01	2.07E+01	2.07E+01	1.82E+01	1.93E+01	1.22E+01	1.23E+01	1.04E+01	1.32E+01	2.58E+01	2.32E+01
TOC	mg C/L	8.46E+01	8.63E+01	1.03E+02	7.85E+01	8.46E+01	8.63E+01	1.60E+01	1.87E+01	2.52E+01	1.92E+01	7.38E+00	6.77E+00	5.27E+00	6.72E+00	4.36E+01	4.95E+01
TC	mg C/L	1.31E+02	1.31E+02	1.54E+02	1.22E+02	1.31E+02	1.31E+02	3.67E+01	3.94E+01	4.34E+01	3.84E+01	1.95E+01	1.91E+01	1.57E+01	1.99E+01	6.94E+01	7.27E+01
Radionuclides																	
^{90}Sr	µCi/L	1.41E+02	1.44E+02	8.62E+01	6.76E+01	1.41E+02	1.44E+02			1.12E+02	9.94E+01					2.64E+02	2.96E+02
^{99}Tc	mg/L	5.20E-05	7.70E-05	6.83E-05	(4.10E-05)	5.20E-05	7.70E-05	(1.60E-05)	(1.00E-05)	(9.00E-06)	(4.00E-06)	(2.00E-06)	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05
^{238}U	mg/L	3.32E+01	3.53E+01	4.20E+01	2.70E+01	3.32E+01	3.53E+01	9.38E+00	1.16E+01	1.45E+01	1.15E+01	6.12E+00	4.84E+00	4.08E+00	4.56E+00	4.66E+01	2.91E+01
^{239}Pu*	µCi/L	1.35E+00	1.38E+00	6.08E-01	4.58E-01	1.35E+00	1.38E+00	6.51E-01	7.59E-01	1.17E+00	9.28E-01	4.64E-01	3.56E-01	2.30E-01	3.40E-01	3.85E+00	5.43E+00
^{237}Np*	µCi/L	2.59E-04	2.50E-04	2.68E-04	2.27E-04	2.59E-04	2.50E-04	6.60E-05	7.74E-05	8.48E-05	7.53E-05	3.34E-05	2.49E-05	1.85E-05	2.49E-05	2.31E-04	2.97E-04
^{241}Am	µCi/L	(8.84E-02)	(7.14E-02)	(2.38E-02)	(1.02E-02)	(8.84E-02)	(7.14E-02)	(3.06E-02)	(4.42E-02)	(7.48E-02)	(5.78E-02)	(1.70E-02)	(2.04E-02)	<1.70E-01	(1.36E-02)	2.72E-01	4.22E-01
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mg/L	2.93E-04	2.60E-04	3.21E-04	2.61E-04	2.93E-04	2.60E-04	(7.45E-05)	(8.20E-05)	(1.06E-04)	(9.35E-05)	(3.95E-05)	(4.50E-05)	(2.80E-05)	(4.20E-05)	3.25E-04	3.10E-04
Al	mg/L	1.45E+00	1.45E+00	1.35E+00	1.64E+00	1.45E+00	1.45E+00	1.65E+00	1.67E+00	3.12E+00	2.91E+00	2.25E+00	1.70E+00	1.80E+00	1.72E+00	4.72E+00	4.99E+00
As	mg/L	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00	<2.00E+00
As 75	mg/L	(1.93E-03)	(1.89E-03)	(2.52E-03)	(2.42E-03)	(1.93E-03)	(1.89E-03)	(1.40E-03)	(2.23E-04)	(1.11E-03)	(5.51E-04)	(4.03E-04)	<5.00E-03	(1.23E-04)	(2.98E-04)	(6.02E-04)	(5.07E-04)
B	mg/L	(8.28E+00)	(4.79E+00)	(1.73E+00)	(1.65E+00)	(8.28E+00)	(4.79E+00)	(3.47E+00)	(2.80E+00)	(2.45E+00)	(2.21E+00)	(2.15E+00)	(2.10E+00)	(1.99E+00)	(1.95E+00)	(1.77E+00)	(1.75E+00)
Ba	mg/L	(2.44E-02)	(1.41E-02)	2.24E-01	1.81E-01	(2.44E-02)	(1.41E-02)	(1.26E-02)	(1.33E-02)	(1.59E-02)	(1.43E-02)	(1.16E-02)	(1.23E-02)	(1.15E-02)	(2.74E-02)	1.71E-01	2.04E-01
Be	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Bi	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Ca	mg/L	(1.39E+00)	(1.55E+00)	(1.02E+00)	(1.16E+00)	(1.39E+00)	(1.55E+00)	(1.06E+00)	(1.18E+00)	(1.21E+00)	(1.19E+00)	(9.98E-01)	(9.20E-01)	(9.14E-01)	(9.07E-01)	(1.93E+00)	(2.24E+00)
Cd ICP-MS	mg/L	1.19E-03	1.20E-03	5.04E-04	4.01E-04	1.19E-03	1.20E-03	6.26E-04	7.81E-04	1.21E-03	1.01E-03	5.02E-04	6.28E-04	2.70E-04	4.60E-04	3.89E-03	4.42E-03
Cd ICP-OES	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
Co	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cr ICP-MS	mg/L	1.06E+00	1.05E+00	1.38E+00	1.07E+00	1.06E+00	1.05E+00	4.23E-01	4.71E-01	7.52E-01	7.14E-01	2.95E-01	2.53E-01	1.62E-01	2.38E-01	1.50E+00	1.59E+00
Cr ICP-OES	mg/L	1.47E+00	1.38E+00	1.86E+00	1.31E+00	1.47E+00	1.38E+00	(4.42E-01)	(4.82E-01)	8.40E-01	6.84E-01	(2.88E-01)	(2.06E-01)	(1.43E-01)	(1.93E-01)	2.08E+00	2.42E+00
Cu ICP-MS	mg/L	2.67E-02	2.54E-02	1.51E-01	1.77E-02	2.67E-02	2.54E-02	1.13E-02	1.31E-02	1.77E-02	1.65E-02	7.77E-03	7.98E-03	5.03E-03	7.26E-03	3.77E-02	4.29E-02
Cu ICP-OES	mg/L	(5.65E-02)	(5.91E-02)	(5.04E-02)	(4.75E-02)	(5.65E-02)	(5.91E-02)	(3.63E-02)	(3.24E-02)	(3.84E-02)	(3.47E-02)	(2.43E-02)	(2.19E-02)	(2.68E-02)	(3.13E-02)	(7.79E-02)	(9.15E-02)
Fe	mg/L	5.62E+00	5.01E+00	1.18E+00	8.76E-01	5.62E+00	5.01E+00	2.94E+00	3.51E+00	6.00E+00	4.96E+00	2.31E+00	1.63E+00	1.04E+00	1.61E+00	1.52E+01	1.94E+01
K	mg/L	(5.06E+00)	(4.86E+00)	(2.16E+00)	(2.39E+00)	(5.06E+00)	(4.86E+00)	(6.34E+00)	(7.41E+00)	(5.45E+00)	(5.80E+00)	(3.73E+00)	(4.68E+00)	(2.42E+00)	(4.17E+00)	(5.80E+00)	(4.58E+00)
Li	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Mg	mg/L	(1.12E-01)	(1.29E-01)	(5.32E-02)	(5.42E-02)	(1.12E-01)	(1.29E-01)	(7.15E-02)	(6.38E-02)	(1.13E-01)	(9.73E-02)	(6.71E-02)	(6.57E-02)	(3.93E-02)	(5.30E-02)	(3.38E-01)	(4.97E-01)
Mn	mg/L	1.19E+00	1.08E+00	2.78E-01	1.96E-01	1.19E+00	1.08E+00	6.41E-01	7.29E-01	1.33E+00	1.03E+00	5.22E-01	3.53E-01	2.42E-01	3.46E-01	3.38E+00	4.41E+00
Mo	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Mo 95	mg/L	1.11E-02	1.14E-02	2.04E-02	1.48E-02	1.11E-02	1.14E-02	2.80E-03	2.84E-03	3.01E-03	3.31E-03	9.49E-04	1.29E-03	1.04E-03	9.46E-04	4.28E-03	3.42E-03
Mo 97	mg/L	1.01E-02	1.03E-02	1.78E-02	1.27E-02	1.01E-02	1.03E-02	(2.01E-03)	(2.04E-03)	(2.22E-03)	(2.18E-03)	(6.40E-04)	(9.05E-04)	(6.35E-04)	(5.56E-04)	3.59E-03	2.74E-03
Mo 98	mg/L	6.62E-03	6.88E-03	1.18E-02	8.24E-03	6.62E-03	6.88E-03	1.31E-03	1.31E-03	1.37E-03	1.42E-03	(3.79E-04)	(7.12E-04)	(4.72E-04)	(3.74E-04)	2.58E-03	1.88E-03
Na	mg/L	1.92E+02	1.94E+02	2.57E+02	2.01E+02	1.92E+02	1.94E+02	3.54E+01	3.97E+01	2.60E+01	2.75E+01	1.18E+01	1.17E+01	8.52E+00	9.78E+00	2.60E+01	2.74E+01
Ni	mg/L	4.08E-01	3.67E-01	(1.21E-01)	(7.44E-02)	4.08E-01	3.67E-01	2.14E-01	2.22E-01	4.68E-01	3.40E-01	(1.87E-01)	(1.68E-01)	(9.08E-02)	(1.37E-01)	1.33E+00	1.60E+00
P	mg/L	1.44E+01	1.49E+01	1.86E+01	1.60E+01	1.44E+01	1.49E+01	9.55E+00	1.00E+01	7.57E+00	7.61E+00	2.97E+00	2.90E+00	1.59E+00	1.69E+00	5.92E+00	3.11E+00
Pb ICP-MS	mg/L	3.68E-01	3.36E-01	1.29E-01	1.01E-01	3.68E-01	3.36E-01	2.03E-01	2.37E-01	3.62E-01	2.81E-01	1.44E-01	1.38E-01	8.77E-02	1.33E-01	1.17E+00	1.33E+00
Pb ICP-OES	mg/L	(4.76E-01)	(4.43E-01)	(1.80E-01)	(1.74E-01)	(4.76E-01)	(4.43E-01)	(2.17E-01)	(3.47E-01)	(5.17E-01)	(3.96E-01)	(2.09E-01)	(1.23E-01)	(1.43E-01)	(1.75E-01)	1.07E+00	1.35E+00
Ru 101	mg/L	3.97E-03	3.77E-03	4.82E-03	3.39E-03	3.97E-03	3.77E-03	6.57E-04	7.67E-04	1.13E-03	9.69E-04	4.32E-04	4.08E-04	2.46E-04	3.69E-04	3.81E-03	3.88E-03
Ru 102	mg/L	1.80E-03	1.79E-03	2.25E-03	1.51E-03	1.80E-03	1.79E-03	2.74E-04	3.34E-04	4.97E-04	4.43E-04	1.78E-04	1.65E-04	9.10E-05	1.57E-04	1.70E-03	1.81E-03
S	mg/L	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01	<4.00E+01
Sb 121	mg/L	2.79E-02	2.70E-02	3.91E-02	3.50E-02	2.79E-02	2.70E-02	2.44E-02	2.64E-02	2.43E-02	2.48E-02	(9.16E-03)	(9.46E-03)	(6.05E-03)	(7.04E-03)	2.63E-02	2.16E-02
Se	mg/L	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01	<2.00E+01
Se 82	mg/L	<5.00E-02	<5.00E-02	(2.80E-04)	(1.65E-03)	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02
Si	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Sr	mg/L	1.12E-01	1.04E-01	(5.25E-02)	(5.00E-02)	1.12E-01	1.04E-01	(5.55E-02)	(6.25E-02)	(8.18E-02)	(6.84E-02)	(3.82E-02)	(2.73E-02)	(2.83E-02)	(3.69E-02)	2.21E-01	2.65E-01
Ti	mg/L	(1.63E-02)	(1.59E-02)	(6.40E-03)	(4.23E-03)	(1.63E-02)	(1.59E-02)	(7.76E-03)	(8.38E-03)	(1.32E-02)	(9.12E-03)	(5.75E-03)	(4.68E-03)	(3.11E-03)	(6.38E-03)	(3.26E-02)	(4.46E-02)
Tl	mg/L	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00	<1.00E+00
V	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Zn	mg/L	(4.42E-02)	(1.00E-01)	(4.58E-02)	(4.73E-02)	(4.42E-02)	(1.00E-01)	(2.02E-02)	(2.33E-02)	(4.27E-02)	(2.59E-02)	(1.22E-02)	(3.19E-02)	(9.35E-04)	(2.56E-02)	(1.20E-01)	(1.63E-01)
Zr	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
Anions																	
NO_2^- as NO2-	mg/L	3.11E+00	2.97E+00	4.57E+00	2.90E+00	3.11E+00	2.97E+00	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	2.86E-01	3.08E-01
NO_3^- as NO3-	mg/L	8.81E+00	8.47E+00	1.54E+01	1.19E+01	8.81E+00	8.47E+00	6.40E-01	6.04E-01	3.26E+00	3.38E+00	1.39E+00	1.32E+00	1.58E+00	1.59E+00	8.45E+00	9.13E+00
CO_3^{2-}	mg/L	1.09E+02	5.81E+01	1.29E+02	8.11E+01	1.09E+02	5.81E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
SO_4^{2-}	mg/L	1.66E+00	1.54E+00	2.05E+00	1.23E+00	1.66E+00	1.54E+00	2.28E-01	3.45E-01	1.82E-01	2.04E-01	3.52E-02	5.40E-02	3.24E-02	3.33E-02	1.68E-01	9.53E-02
PO_4^{3-} as PO_4^{3-}	mg/L	3.86E+01	3.92E+01	5.23E+01	4.41E+01	3.86E+01	3.92E+01	2.78E+01	2.82E+01	2.31E+01	2.39E+01	9.46E+00	8.97E+00	4.78E+00	5.28E+00	1.72E+01	1.79E+01
Cl^-	mg/L	2.57E-01	2.04E-01	1.51E+00	1.08E+00	2.57E-01	2.04E-01	4.94E-02	6.04E-02	5.62E-02	5.11E-02	2.33E-02	3.10E-02	4.81E-02	6.38E-02	6.16E-01	7.53E-01
F^-	mg/L	2.73E+01	2.57E+01	3.97E+01	2.75E+01	2.73E+01	2.57E+01	6.09E+00	7.92E+00	4.07E+00	4.46E+00	5.91E-01	6.20E-01	4.05E-01	4.49E-01	2.79E+00	2.57E+00
Oxalate*	mg/L	2.05E+02	1.89E+02	2.43E+02	1.85E+02	2.05E+02	1.89E+02	1.40E+01	1.94E+01	4.69E+00	8.31E+00	5.25E-01	6.53E-01	<3.45E-01	3.67E-01	1.95E+00	1.72E+00

* Oxalate results are for information only

Tank C-202 (19250) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	2.62E+00	2.24E+00	2.34E+00	2.24E+00	2.62E+00	2.24E+00	8.10E-01	6.02E-01	5.40E-01	4.32E-01	#VALUE!	3.01E-01	2.47E-01	2.62E-01	5.94E-01	6.09E-01
TIC	mM C	3.87E+00	3.74E+00	4.20E+00	3.61E+00	3.87E+00	3.74E+00	1.73E+00	1.72E+00	1.51E+00	1.60E+00	1.01E+00	1.02E+00	8.66E-01	1.10E+00		
TOC	mM C	7.05E+00	7.19E+00	8.61E+00	6.54E+00	7.05E+00	7.19E+00	1.33E+00	1.56E+00	2.10E+00	1.60E+00	6.15E-01	5.64E-01	4.39E-01	5.60E-01		
TC	mM C	1.09E+01	1.09E+01	1.28E+01	1.02E+01	1.09E+01	1.09E+01	3.06E+00	3.28E+00	3.61E+00	3.20E+00	1.63E+00	1.59E+00	1.31E+00	1.66E+00		
Radionuclides																	
^{90}Sr	mM	1.12E-05	1.15E-05	6.84E-06	5.37E-06	1.12E-05	1.15E-05			8.92E-06	7.89E-06					2.10E-05	2.35E-05
^{99}Tc	mM	5.26E-07	7.78E-07	6.89E-07	(4.14E-07)	5.26E-07	7.78E-07	(1.62E-07)	(1.01E-07)	(9.09E-08)	(4.04E-08)	(2.02E-08)	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07
^{238}U	mM	1.39E-01	1.48E-01	1.77E-01	1.13E-01	1.39E-01	1.48E-01	3.94E-02	4.88E-02	6.09E-02	4.82E-02	2.57E-02	2.03E-02	1.72E-02	1.92E-02	1.96E-01	1.22E-01
^{239}Pu*	mM	9.14E-04	9.28E-04	4.10E-04	3.09E-04	9.14E-04	9.28E-04	4.39E-04	5.12E-04	7.87E-04	6.27E-04	3.13E-04	2.40E-04	1.55E-04	2.30E-04	2.60E-03	3.67E-03
^{237}Np*	mM	1.54E-06	1.49E-06	1.59E-06	1.35E-06	1.54E-06	1.49E-06	3.92E-07	4.60E-07	5.04E-07	4.47E-07	1.98E-07	1.48E-07	1.10E-07	1.48E-07	1.38E-06	1.76E-06
^{241}Am	mM	(1.08E-07)	(8.71E-08)	(2.90E-08)	(1.24E-08)	(1.08E-07)	(8.71E-08)	(3.73E-08)	(5.39E-08)	(9.13E-08)	(7.05E-08)	(2.07E-08)	(2.49E-08)	<2.07E-07	(1.66E-08)	3.32E-07	5.15E-07
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mM	2.72E-06	2.41E-06	2.98E-06	2.42E-06	2.72E-06	2.41E-06	(6.91E-07)	(7.60E-07)	(9.83E-07)	(8.67E-07)	(3.66E-07)	(4.17E-07)	(2.60E-07)	(3.89E-07)	3.01E-06	2.87E-06
Al	mM	5.36E-02	5.39E-02	4.99E-02	6.07E-02	5.36E-02	5.39E-02	6.12E-02	6.17E-02	1.16E-01	1.08E-01	8.33E-02	6.31E-02	6.68E-02	6.39E-02	1.75E-01	1.85E-01
As	mM	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02	<2.67E-02
As 75	mM	(2.57E-05)	(2.53E-05)	(3.36E-05)	(3.23E-05)	(2.57E-05)	(2.53E-05)	(1.87E-05)	(2.97E-06)	(1.48E-05)	(7.35E-06)	(5.37E-06)	<6.67E-05	(1.64E-06)	(3.97E-06)	(8.03E-06)	(6.76E-06)
B	mM	(7.66E-01)	(4.43E-01)	(1.60E-01)	(1.53E-01)	(7.66E-01)	(4.43E-01)	(3.21E-01)	(2.59E-01)	(2.27E-01)	(2.05E-01)	(1.99E-01)	(1.95E-01)	(1.84E-01)	(1.80E-01)	(1.64E-01)	(1.62E-01)
Ba	mM	(1.77E-04)	(1.03E-04)	1.63E-03	1.32E-03	(1.77E-04)	(1.03E-04)	(9.17E-05)	(9.68E-05)	(1.16E-04)	(1.04E-04)	(8.46E-05)	(8.94E-05)	(8.39E-05)	(1.99E-04)	1.25E-03	1.49E-03
Be	mM	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02
Bi	mM	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02	<4.79E-02
Ca	mM	(3.47E-02)	(3.87E-02)	(2.55E-02)	(2.90E-02)	(3.47E-02)	(3.87E-02)	(2.64E-02)	(2.94E-02)	(3.02E-02)	(2.98E-02)	(2.49E-02)	(2.30E-02)	(2.28E-02)	(2.26E-02)	(4.83E-02)	(5.58E-02)
Cd ICP-MS	mM	1.06E-05	1.06E-05	4.48E-06	3.57E-06	1.06E-05	1.06E-05	5.56E-06	6.95E-06	1.08E-05	8.95E-06	4.47E-06	5.59E-06	2.40E-06	4.09E-06	3.46E-05	3.93E-05
Cd ICP-OES	mM	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04	<8.90E-04
Co	mM	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03	<4.24E-03
Cr ICP-MS	mM	2.04E-02	2.02E-02	2.66E-02	2.05E-02	2.04E-02	2.02E-02	8.14E-03	9.06E-03	1.45E-02	1.37E-02	5.67E-03	4.86E-03	3.11E-03	4.58E-03	2.88E-02	3.05E-02
Cr ICP-OES	mM	2.82E-02	2.65E-02	3.58E-02	2.52E-02	2.82E-02	2.65E-02	(8.49E-03)	(9.28E-03)	1.62E-02	1.32E-02	(5.54E-03)	(3.96E-03)	(2.75E-03)	(3.71E-03)	4.01E-02	4.65E-02
Cu ICP-MS	mM	4.20E-04	4.00E-04	2.38E-03	2.78E-04	4.20E-04	4.00E-04	1.78E-04	2.07E-04	2.78E-04	2.60E-04	1.22E-04	1.26E-04	7.91E-05	1.14E-04	5.93E-04	6.75E-04
Cu ICP-OES	mM	(8.89E-04)	(9.29E-04)	(7.92E-04)	(7.47E-04)	(8.89E-04)	(9.29E-04)	(5.71E-04)	(5.10E-04)	(6.04E-04)	(5.46E-04)	(3.83E-04)	(3.45E-04)	(4.22E-04)	(4.92E-04)	(1.23E-03)	(1.44E-03)
Fe	mM	1.01E-01	8.97E-02	2.11E-02	1.57E-02	1.01E-01	8.97E-02	5.27E-02	6.28E-02	1.07E-01	8.87E-02	4.13E-02	2.92E-02	1.87E-02	2.89E-02	2.73E-01	3.47E-01
K	mM	(1.30E-01)	(1.24E-01)	(5.53E-02)	(6.11E-02)	(1.30E-01)	(1.24E-01)	(1.62E-01)	(1.90E-01)	(1.39E-01)	(1.48E-01)	(9.54E-02)	(1.20E-01)	(6.20E-02)	(1.07E-01)	(1.48E-01)	(1.17E-01)
Li	mM	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02	<7.20E-02
Mg	mM	(4.62E-03)	(5.31E-03)	(2.19E-03)	(2.23E-03)	(4.62E-03)	(5.31E-03)	(2.94E-03)	(2.63E-03)	(4.63E-03)	(4.01E-03)	(2.76E-03)	(2.70E-03)	(1.62E-03)	(2.18E-03)	(1.39E-02)	(2.04E-02)
Mn	mM	2.17E-02	1.96E-02	5.05E-03	3.56E-03	2.17E-02	1.96E-02	1.17E-02	1.33E-02	2.43E-02	1.87E-02	9.51E-03	6.42E-03	4.41E-03	6.31E-03	6.15E-02	8.03E-02
Mo	mM	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03	<5.21E-03
Mo 95	mM	1.17E-04	1.20E-04	2.15E-04	1.56E-04	1.17E-04	1.20E-04	2.95E-05	2.99E-05	3.17E-05	3.49E-05	9.99E-06	1.36E-05	1.09E-05	9.96E-06	4.50E-05	3.60E-05
Mo 97	mM	1.04E-04	1.06E-04	1.84E-04	1.31E-04	1.04E-04	1.06E-04	(2.07E-05)	(2.10E-05)	(2.29E-05)	(2.24E-05)	(6.60E-06)	(9.33E-06)	(6.55E-06)	(5.73E-06)	3.70E-05	2.83E-05
Mo 98	mM	6.75E-05	7.02E-05	1.20E-04	8.40E-05	6.75E-05	7.02E-05	1.33E-05	1.34E-05	1.40E-05	1.44E-05	(3.87E-06)	(7.27E-06)	(4.82E-06)	(3.82E-06)	2.63E-05	1.92E-05
Na	mM	8.34E+00	8.45E+00	1.12E+01	8.76E+00	8.34E+00	8.45E+00	1.54E+00	1.72E+00	1.13E+00	1.20E+00	5.15E-01	5.10E-01	3.71E-01	4.26E-01	1.13E+00	1.19E+00
Ni	mM	6.96E-03	6.25E-03	(2.06E-03)	(1.27E-03)	6.96E-03	6.25E-03	3.64E-03	3.78E-03	7.98E-03	5.80E-03	(3.18E-03)	(2.86E-03)	(1.55E-03)	(2.34E-03)	2.27E-02	2.73E-02
P	mM	4.66E-01	4.81E-01	6.01E-01	5.16E-01	4.66E-01	4.81E-01	3.08E-01	3.23E-01	2.45E-01	2.46E-01	9.59E-02	9.37E-02	5.12E-02	5.45E-02	1.91E-01	1.00E-01
Pb	mM	1.78E-03	1.62E-03	6.22E-04	4.89E-04	1.78E-03	1.62E-03	9.81E-04	1.14E-03	1.75E-03	1.36E-03	6.96E-04	6.68E-04	4.23E-04	6.43E-04	5.67E-03	6.43E-03
Pb	mM	(2.30E-03)	(2.14E-03)	(8.67E-04)	(8.40E-04)	(2.30E-03)	(2.14E-03)	(1.05E-03)	(1.68E-03)	(2.50E-03)	(1.91E-03)	(1.01E-03)	(5.92E-04)	(6.88E-04)	(8.45E-04)	5.18E-03	6.49E-03
Ru 101	mM	3.93E-05	3.73E-05	4.77E-05	3.36E-05	3.93E-05	3.73E-05	6.50E-06	7.59E-06	1.11E-05	9.59E-06	4.28E-06	4.04E-06	2.44E-06	3.65E-06	3.77E-05	3.85E-05
Ru 102	mM	1.77E-05	1.75E-05	2.20E-05	1.48E-05	1.77E-05	1.75E-05	2.69E-06	3.27E-06	4.87E-06	4.34E-06	1.75E-06	1.62E-06	8.92E-07	1.54E-06	1.66E-05	1.77E-05
S	mM	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Sb 121	mM	2.31E-04	2.23E-04	3.23E-04	2.89E-04	2.31E-04	2.23E-04	2.02E-04	2.18E-04	2.01E-04	2.05E-04	(7.57E-05)	(7.82E-05)	(5.00E-05)	(5.82E-05)	2.17E-04	1.79E-04
Se	mM	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01	<2.53E-01
Se 82	mM	<6.10E-04	<6.10E-04	(3.41E-06)	(2.02E-05)	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04
Si	mM	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01	<3.56E-01
Sr	mM	1.27E-03	1.18E-03	(5.99E-04)	(5.71E-04)	1.27E-03	1.18E-03	(6.34E-04)	(7.14E-04)	(9.34E-04)	(7.80E-04)	(4.36E-04)	(3.12E-04)	(3.22E-04)	(4.21E-04)	2.52E-03	3.03E-03
Ti	mM	(3.41E-04)	(3.32E-04)	(1.34E-04)	(8.84E-05)	(3.41E-04)	(3.32E-04)	(1.62E-04)	(1.75E-04)	(2.77E-04)	(1.91E-04)	(1.20E-04)	(9.78E-05)	(6.50E-05)	(1.33E-04)	(6.81E-04)	(9.32E-04)
Tl	mM	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03	<4.89E-03
V	mM	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03	<4.91E-03
Zn	mM	(6.75E-04)	(1.53E-03)	(7.01E-04)	(7.23E-04)	(6.75E-04)	(1.53E-03)	(3.09E-04)	(3.56E-04)	(6.52E-04)	(3.97E-04)	(1.87E-04)	(4.87E-04)	(1.43E-05)	(3.92E-04)	(1.84E-03)	(2.49E-03)
Zr	mM	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03	<1.10E-03
Anions																	
NO_2^- as NO2-	mM	6.76E-02	6.45E-02	9.92E-02	6.31E-02	6.76E-02	6.45E-02	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	6.22E-03	6.70E-03
NO_3^- as NO3-	mM	1.42E-01	1.37E-01	2.48E-01	1.92E-01	1.42E-01	1.37E-01	1.03E-02	9.74E-03	5.25E-02	5.45E-02	2.24E-02	2.12E-02	2.55E-02	2.56E-02	1.36E-01	1.47E-01
CO_3^{2-}	mM	1.82E+00	9.68E-01	2.15E+00	1.35E+00	1.82E+00	9.68E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01
SO_4^{2-}	mM	1.73E-02	1.60E-02	2.14E-02	1.28E-02	1.73E-02	1.60E-02	2.38E-03	3.59E-03	1.90E-03	2.12E-03	3.67E-04	5.62E-04	3.37E-04	3.46E-04	1.74E-03	9.92E-04
PO_4^{3-} as PO_4^{3-}	mM	4.06E-01	4.12E-01	5.51E-01	4.64E-01	4.06E-01	4.12E-01	2.93E-01	2.96E-01	2.43E-01	2.51E-01	9.96E-02	9.45E-02	5.04E-02	5.56E-02	1.81E-01	1.89E-01
Cl^-	mM	7.24E-03	5.77E-03	4.25E-02	3.04E-02	7.24E-03	5.77E-03	1.40E-03	1.70E-03	1.59E-03	1.44E-03	6.58E-04	8.74E-04	1.36E-03	1.80E-03	1.74E-02	2.12E-02
F^-	mM	1.43E+00	1.35E+00	2.09E+00	1.45E+00	1.43E+00	1.35E+00	3.20E-01	4.17E-01	2.14E-01	2.34E-01	3.11E-02	3.26E-02	2.13E-02	2.37E-02	1.47E-01	1.35E-01
Oxalate*	mM	2.33E+00	2.14E+00	2.76E+00	2.10E+00	2.33E+00	2.14E+00	1.59E-01	2.20E-01	5.33E-02	9.44E-02	5.97E-03	7.42E-03	<3.92E-03	4.17E-03	2.22E-02	1.96E-02

* Oxalate results are for information only

Tank C-203 (19887) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	10.66	10.63	10.56	10.47	10.66	10.63	10.70	10.29	10.11	10.43	10.61	10.49	9.94	9.85	10.41	10.56
Alkalinity	mg/L as CaCO3	6.02E+02	5.56E+02	5.17E+02	5.33E+02	6.02E+02	5.56E+02	1.93E+02	2.01E+02	1.54E+02	1.24E+02	1.24E+02	1.16E+02	8.49E+01	8.49E+01	1.78E+02	1.62E+02
TIC	mg C/L	6.76E+01	5.84E+01	5.63E+01	5.76E+01	6.76E+01	5.84E+01	9.42E+00	2.38E+01	1.77E+01	1.23E+01	8.84E+00	7.33E+00	7.31E+00	6.60E+00	2.00E+01	1.52E+01
TOC	mg C/L	5.56E+01	5.11E+01	3.71E+01	3.66E+01	5.56E+01	5.11E+01	1.00E+01	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	1.23E+02	1.10E+02	9.33E+01	9.42E+01	1.23E+02	1.10E+02	1.95E+01	2.38E+01	1.77E+01	1.23E+01	8.84E+00	7.33E+00	7.31E+00	6.60E+00	2.00E+01	1.52E+01
Radionuclides																	
^{90}Sr	µCi/L	3.08E+02	2.55E+02	1.75E+02	1.92E+02	3.08E+02	2.55E+02			1.93E+02	1.53E+02					3.48E+02	3.07E+02
^{99}Tc	mg/L	(3.12E-05)	(3.03E-05)	<5.00E-04	<5.00E-04	(3.12E-05)	(3.03E-05)	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<5.00E-04
^{238}U	mg/L	3.85E+02	4.08E+02	1.55E+02	1.55E+02	3.85E+02	4.08E+02	1.63E+02	1.36E+02	1.87E+02	1.30E+02	3.86E+01	2.67E+01	3.56E+01	3.94E+01	4.70E+02	4.25E+02
^{239}Pu*	µCi/L	3.94E+00	2.79E+00	9.45E-01	9.32E-01	3.94E+00	2.79E+00	1.37E+00	1.19E+00	1.49E+00	1.02E+00	3.13E-01	2.19E-01	2.98E-01	3.57E-01	1.77E+00	1.68E+00
^{237}Np*	µCi/L	1.44E-02	1.29E-02	(1.44E-04)	(1.40E-04)	1.44E-02	1.29E-02	6.21E-03	5.80E-03	8.41E-03	5.60E-03	1.60E-03	7.31E-04	1.54E-03	1.73E-03	5.59E-04	4.92E-04
^{241}Am	µCi/L	<8.50E+00	<8.50E+00	<1.70E+02	<1.70E+02	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	1.70E+02	1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	(1.02E-03)	(6.13E-04)	(2.00E-04)	(1.80E-04)	(1.02E-03)	(6.13E-04)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	(2.70E-04)	(1.70E-04)
Al	mg/L	1.30E+00	1.30E+00	2.25E+00	1.54E+00	1.30E+00	1.30E+00	(4.69E-01)	(4.63E-01)	(1.09E-01)	(2.54E-01)	(1.95E-01)	(2.96E-01)	(1.74E-01)	(6.77E-01)	(6.09E-01)	(4.40E-01)
As	mg/L	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00
As 75	mg/L	(9.81E-03)	(9.19E-03)	<1.00E-01	<1.00E-01	(9.81E-03)	(9.19E-03)	(6.15E-03)	(5.25E-03)	(6.85E-03)	(1.71E-03)	(5.37E-03)	(2.25E-03)	(6.73E-03)	(2.50E-03)	<1.00E-01	<1.00E-01
B	mg/L	(3.37E-01)	<2.50E+00	<2.50E+00	<2.50E+00	(3.37E-01)	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ba	mg/L	(3.33E-02)	<2.50E-01	(1.55E-01)	4.79E-01	(3.33E-02)	<2.50E-01	<2.50E-01	(1.16E-01)	2.83E-01	(7.92E-02)	(1.34E-01)	(5.48E-02)	(5.93E-02)	(7.25E-02)	5.80E-01	8.42E-01
Be	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00
Ca	mg/L	3.22E+00	2.55E+00	(1.54E+00)	2.57E+00	3.22E+00	2.55E+00	(1.98E+00)	(1.75E+00)	(2.34E+00)	(1.59E+00)	(9.89E-01)	(1.35E+00)	(8.69E-01)	(9.76E-01)	2.86E+00	(2.13E+00)
Cd	mg/L	<2.50E-01	<2.50E-01	<1.25E-01	<1.25E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<1.25E-01	<1.25E-01
Cd 114	mg/L	<1.00E-01	<1.00E-01	(7.20E-04)	(5.00E-04)	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	(1.08E-03)	(9.70E-04)
Co	mg/L	(1.09E-01)	(1.04E-01)	(5.60E-02)	(3.66E-02)	(1.09E-01)	(1.04E-01)	(5.31E-02)	(5.41E-02)	(4.87E-02)	(3.57E-02)	(3.34E-02)	(2.82E-02)	(2.02E-02)	(3.42E-02)	(9.81E-02)	(1.00E-01)
Cr	mg/L	1.55E+01	1.13E+01	6.34E+00	6.25E+00	1.55E+01	1.13E+01	5.91E+00	4.42E+00	5.31E+00	3.82E+00	6.82E-01	5.99E-01	1.05E+00	1.08E+00	4.95E+00	4.46E+00
Cr 53	mg/L	1.18E+01	8.91E+00	5.83E+00	5.75E+00	1.18E+01	8.91E+00	4.86E+00	3.72E+00	4.24E+00	3.15E+00	6.37E-01	5.53E-01	9.46E-01	9.91E-01	4.39E+00	4.00E+00
Cu	mg/L	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01
Cu 65	mg/L	7.44E-02	5.78E-02	3.10E-02	2.72E-02	7.44E-02	5.78E-02	3.81E-02	3.60E-02	3.43E-02	2.44E-02	(4.50E-03)	(2.88E-03)	(7.64E-03)	(5.98E-03)	5.95E-02	4.10E-02
Fe	mg/L	1.09E+01	8.11E+00	3.38E+00	3.39E+00	1.09E+01	8.11E+00	4.70E+00	3.71E+00	4.41E+00	2.92E+00	(6.72E-01)	(5.74E-01)	(8.19E-01)	(8.37E-01)	4.39E+00	4.55E+00
K	mg/L	<6.25E+02	<6.25E+02	<6.25E+01	<6.25E+01	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+01	<6.25E+01
Li	mg/L	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00
Mg	mg/L	(8.00E-01)	(5.98E-01)	(3.86E-01)	(3.99E-01)	(8.00E-01)	(5.98E-01)	(3.43E-01)	(3.32E-01)	(3.61E-01)	(2.76E-01)	(1.15E-01)	(1.77E-01)	(1.04E-01)	(1.06E-01)	(6.12E-01)	(5.41E-01)
Mn	mg/L	1.85E+00	1.30E+00	5.55E-01	5.57E-01	1.85E+00	1.30E+00	8.37E-01	5.78E-01	7.76E-01	4.65E-01	(9.93E-02)	(7.92E-02)	(1.27E-01)	(1.24E-01)	6.87E-01	6.00E-01
Mo	mg/L	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00
Mo 95	mg/L	(6.55E-03)	(4.06E-03)	(3.76E-03)	(4.63E-03)	(6.55E-03)	(4.06E-03)	(9.40E-04)	(1.52E-03)	(1.33E-03)	(1.02E-03)	(9.50E-04)	<2.50E-02	(5.30E-04)	<2.50E-02	(1.72E-03)	(1.72E-03)
Mo 97	mg/L	(5.99E-03)	(3.74E-03)	(3.48E-03)	(3.94E-03)	(5.99E-03)	(3.74E-03)	(6.10E-03)	(6.87E-03)	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	(1.26E-03)	(1.13E-03)
Mo 98	mg/L	(5.10E-03)	(2.56E-03)	(3.29E-03)	(3.03E-03)	(5.10E-03)	(2.56E-03)	(5.14E-03)	(5.66E-03)	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	(1.27E-03)	(1.21E-03)
Na	mg/L	4.26E+02	3.73E+02	3.21E+02	3.07E+02	4.26E+02	3.73E+02	1.11E+02	1.01E+02	7.54E+01	6.35E+01	3.50E+01	3.04E+01	2.53E+01	2.39E+01	8.75E+01	8.12E+01
Ni	mg/L	1.42E+00	9.38E-01	(4.70E-01)	(4.65E-01)	1.42E+00	9.38E-01	6.07E-01	(4.05E-01)	5.51E-01	(2.87E-01)	(1.01E-01)	(6.71E-02)	(1.07E-01)	(8.83E-02)	(5.23E-01)	(4.26E-01)
P	mg/L	1.19E+02	1.07E+02	7.89E+01	6.86E+01	1.19E+02	1.07E+02	(5.33E+01)	(4.66E+01)	(3.73E+01)	(3.03E+01)	(1.64E+01)	(1.35E+01)	(1.05E+01)	(9.61E+00)	4.37E+01	4.01E+01
Pb	mg/L	5.28E+00	3.61E+00	1.70E+00	1.71E+00	5.28E+00	3.61E+00	2.02E+00	1.69E+00	2.16E+00	1.50E+00	(2.94E-01)	(2.21E-01)	(3.80E-01)	(4.39E-01)	3.40E+00	3.06E+00
Pb 206	mg/L	4.13E+00	2.92E+00	1.61E+00	1.53E+00	4.13E+00	2.92E+00	1.77E+00	1.41E+00	1.80E+00	1.24E+00	3.03E-01	2.51E-01	4.00E-01	4.12E-01	2.98E+00	2.62E+00
Ru 101	mg/L	(1.21E-02)	(5.41E-03)	(1.78E-03)	(2.30E-03)	(1.21E-02)	(5.41E-03)	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	(3.13E-03)	(3.24E-03)
Ru 102	mg/L	(9.20E-03)	(2.54E-03)	(9.20E-04)	(1.01E-03)	(9.20E-03)	(2.54E-03)	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	(1.56E-03)	(1.55E-03)
S	mg/L	(1.65E+00)	(1.35E+00)	<1.00E+02	<1.00E+02	(1.65E+00)	(1.35E+00)	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+02	<1.00E+02
Sb 121	mg/L	1.98E-02	1.59E-02	7.34E-03	7.31E-03	1.98E-02	1.59E-02	1.06E-02	9.35E-03	8.58E-03	7.68E-03	(4.85E-03)	(4.21E-03)	(4.54E-03)	(3.44E-03)	8.98E-03	9.18E-03
Se	mg/L	<2.50E+00	<2.50E+00	<2.50E+01	<2.50E+01	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+01	<2.50E+01
Se 82	mg/L	<5.00E-02	<5.00E-02			<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02		
Si	mg/L	(2.34E+00)	(1.34E+00)	<5.00E+01	<5.00E+01	(2.34E+00)	(1.34E+00)	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01
Sr	mg/L	3.43E-01	2.60E-01	(1.31E-01)	(1.45E-01)	3.43E-01	2.60E-01	(1.39E-01)	(1.23E-01)	(1.53E-01)	(1.08E-01)	(4.02E-02)	(3.27E-02)	(3.81E-02)	(4.25E-02)	(3.09E-01)	(2.79E-01)
Ti	mg/L	(1.91E-01)	(1.39E-01)	(6.81E-02)	(6.42E-02)	(1.91E-01)	(1.39E-01)	(7.57E-02)	(6.60E-02)	(8.41E-02)	(5.84E-02)	(2.49E-02)	(2.32E-02)	(2.26E-02)	(2.18E-02)	(1.40E-01)	(1.26E-01)
Tl	mg/L	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00
V	mg/L	<6.25E-01	<6.25E-01	<2.50E+00	<2.50E+00	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<2.50E+00	<2.50E+00
Zn	mg/L	(6.83E-01)	(5.54E-01)	(6.85E-01)	(8.06E-01)	(6.83E-01)	(5.54E-01)	(3.78E-01)	(5.78E-01)	(5.45E-01)	(1.48E+00)	(3.70E-01)	(2.74E-01)	(2.02E-01)	(2.73E-01)	(9.80E-01)	(9.68E-01)
Zr	mg/L	<2.50E-01	<2.50E-01	<6.25E-01	<6.25E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<6.25E-01	<6.25E-01
* Cr 53 and Pb 206 concentration are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	6.89E+00	5.94E+00	4.82E+00	5.41E+00	6.89E+00	5.94E+00	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01
NO_3^- as NO3-	mg/L	5.66E+01	4.93E+01	4.16E+01	4.60E+01	5.66E+01	4.93E+01	1.60E+00	5.39E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	1.09E+00	9.16E-01
CO_3^{2-}*	mg/L	4.18E+02	3.77E+02	3.61E+02	3.66E+02	4.18E+02	3.77E+02	1.15E+02	9.20E+01	7.35E+01	5.20E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	1.18E+02	1.11E+02
SO_4^{2-}	mg/L	3.16E+00	2.52E+00	2.07E+00	2.38E+00	3.16E+00	2.52E+00	5.62E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01
PO_4^{3-} as PO_4^{3-}*	mg/L	2.09E+02	2.24E+02	2.21E+02	1.87E+02	2.09E+02	2.24E+02	1.51E+02	1.29E+02	7.70E+01	7.20E+01	4.59E+01	4.07E+01	2.65E+01	2.35E+01	4.51E+01	4.90E+01
Cl^-	mg/L	1.06E+00	6.98E-01	6.10E-01	6.49E-01	1.06E+00	6.98E-01	5.69E-01	<2.40E-01	<2.40E-01	<2.40E-01	2.52E-01	<2.40E-01	<2.40E-01	2.99E-01	<2.40E-01	<2.40E-01
F^-	mg/L	3.55E+01	3.10E+01	2.84E+01	2.93E+01	3.55E+01	3.10E+01	1.99E+00	1.62E+00	7.59E-01	5.96E-01	1.63E-01	1.30E-01	<1.17E-01	<1.17E-01	5.00E-01	4.82E-01
Oxalate*	mg/L	1.83E+01	1.61E+01	1.37E+01	1.48E+01	1.83E+01	1.61E+01	<3.45E-01	<3.45E-01	<3.45E-01	8.12E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19887) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	6.02E+00	5.55E+00	5.17E+00	5.32E+00	6.02E+00	5.55E+00	1.93E+00	2.01E+00	1.54E+00	1.23E+00	1.23E+00	1.16E+00	8.48E-01	8.48E-01	1.77E+00	1.62E+00
TIC	mM C	5.63E+00	4.87E+00	4.69E+00	4.80E+00	5.63E+00	4.87E+00	7.85E-01	1.98E+00	1.48E+00	1.02E+00	7.37E-01	6.11E-01	6.09E-01	5.50E-01		
TOC	mM C	4.63E+00	4.26E+00	3.09E+00	3.05E+00	4.63E+00	4.26E+00	8.37E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	1.03E+01	9.13E+00	7.78E+00	7.85E+00	1.03E+01	9.13E+00	1.62E+00	1.98E+00	1.48E+00	1.02E+00	7.37E-01	6.11E-01	6.09E-01	5.50E-01		
Radionuclides																	
^{90}Sr	mM	2.44E-05	2.03E-05	1.39E-05	1.52E-05	2.44E-05	2.03E-05			1.53E-05	1.21E-05					2.76E-05	2.44E-05
^{99}Tc	mM	(3.15E-07)	(3.06E-07)	<5.05E-06	<5.05E-06	(3.15E-07)	(3.06E-07)	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<5.05E-06	<5.05E-06
^{238}U	mM	1.62E+00	1.71E+00	6.51E-01	6.52E-01	1.62E+00	1.71E+00	6.83E-01	5.70E-01	7.84E-01	5.46E-01	1.62E-01	1.12E-01	1.50E-01	1.66E-01	1.97E+00	1.78E+00
^{239}Pu*	mM	2.66E-03	1.88E-03	6.38E-04	6.29E-04	2.66E-03	1.88E-03	9.25E-04	8.02E-04	1.00E-03	6.88E-04	2.11E-04	1.48E-04	2.01E-04	2.41E-04	1.20E-03	1.13E-03
^{237}Np*	mM	8.56E-05	7.64E-05	(8.54E-07)	(8.33E-07)	8.56E-05	7.64E-05	3.69E-05	3.45E-05	5.00E-05	3.33E-05	9.49E-06	4.35E-06	9.16E-06	1.03E-05	3.32E-06	2.92E-06
^{241}Am	mM	<1.04E-05	<1.04E-05	<2.07E-04	<2.07E-04	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	2.07E-04	2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	(9.53E-06)	(5.72E-06)	(1.87E-06)	(1.68E-06)	(9.53E-06)	(5.72E-06)	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	(2.52E-06)	(1.59E-06)
Al	mM	4.81E-02	4.80E-02	8.34E-02	5.72E-02	4.81E-02	4.80E-02	(1.74E-02)	(1.71E-02)	(4.03E-03)	(9.42E-03)	(7.23E-03)	(1.10E-02)	(6.47E-03)	(2.51E-02)	(2.26E-02)	(1.63E-02)
As	mM	<3.34E-02	<3.34E-02	<1.67E-02	<1.67E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<1.67E-02	<1.67E-02
As 75	mM	(1.31E-04)	(1.22E-04)	<1.33E-03	<1.33E-03	(1.31E-04)	(1.22E-04)	(8.20E-05)	(7.00E-05)	(9.13E-05)	(2.28E-05)	(7.16E-05)	(3.00E-05)	(8.97E-05)	(3.33E-05)	<1.33E-03	<1.33E-03
B	mM	(3.12E-02)	<2.31E-01	<2.31E-01	<2.31E-01	(3.12E-02)	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01
Ba	mM	(2.42E-04)	<1.82E-03	(1.13E-03)	3.49E-03	(2.42E-04)	<1.82E-03	<1.82E-03	(8.47E-04)	2.06E-03	(5.77E-04)	(9.78E-04)	(3.99E-04)	(4.32E-04)	(5.28E-04)	4.23E-03	6.13E-03
Be	mM	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02
Bi	mM	<1.20E-02	<1.20E-02	<5.98E-03	<5.98E-03	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<5.98E-03	<5.98E-03
Ca	mM	8.02E-02	6.36E-02	(3.84E-02)	6.40E-02	8.02E-02	6.36E-02	(4.93E-02)	(4.38E-02)	(5.84E-02)	(3.96E-02)	(2.47E-02)	(3.36E-02)	(2.17E-02)	(2.43E-02)	7.12E-02	(5.31E-02)
Cd	mM	<2.22E-03	<2.22E-03	<1.11E-03	<1.11E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<1.11E-03	<1.11E-03
Cd 114	mM	<8.77E-04	<8.77E-04	(6.32E-06)	(4.39E-06)	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	(9.47E-06)	(8.51E-06)
Co	mM	(1.84E-03)	(1.76E-03)	(9.49E-04)	(6.22E-04)	(1.84E-03)	(1.76E-03)	(9.00E-04)	(9.18E-04)	(8.26E-04)	(6.05E-04)	(5.66E-04)	(4.79E-04)	(3.43E-04)	(5.80E-04)	(1.66E-03)	(1.70E-03)
Cr	mM	2.98E-01	2.18E-01	1.22E-01	1.20E-01	2.98E-01	2.18E-01	1.14E-01	8.49E-02	1.02E-01	7.34E-02	1.31E-02	1.15E-02	2.02E-02	2.07E-02	9.52E-02	8.58E-02
Cr 53 *	mM	2.23E-01	1.68E-01	1.10E-01	1.09E-01	2.23E-01	1.68E-01	9.18E-02	7.01E-02	8.01E-02	5.95E-02	1.20E-02	1.04E-02	1.78E-02	1.87E-02	8.28E-02	7.54E-02
Cu	mM	<3.93E-01	<3.93E-01	<7.87E-01	<7.87E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<7.87E-01	<7.87E-01
Cu 65	mM	1.14E-03	8.90E-04	<4.77E-04	<4.19E-04	1.14E-03	8.90E-04	5.86E-04	5.53E-04	5.27E-04	3.76E-04	(6.92E-05)	(4.43E-05)	(1.18E-04)	(9.20E-05)	(9.16E-04)	<6.31E-04
Fe	mM	1.94E-01	1.45E-01	6.05E-02	6.07E-02	1.94E-01	1.45E-01	8.41E-02	6.64E-02	7.90E-02	5.23E-02	(1.20E-02)	(1.03E-02)	(1.47E-02)	(1.50E-02)	7.87E-02	8.16E-02
K	mM	<1.60E+01	<1.60E+01	<1.60E+00	<1.60E+00	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+00	<1.60E+00
Li	mM	<3.60E-01	<3.60E-01	<7.20E-01	<7.20E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<7.20E-01	<7.20E-01
Mg	mM	(3.29E-02)	(2.46E-02)	(1.59E-02)	(1.64E-02)	(3.29E-02)	(2.46E-02)	(1.41E-02)	(1.37E-02)	(1.48E-02)	(1.13E-02)	(4.74E-03)	(7.27E-03)	(4.30E-03)	(4.37E-03)	(2.52E-02)	(2.23E-02)
Mn	mM	3.37E-02	2.36E-02	1.01E-02	1.01E-02	3.37E-02	2.36E-02	1.52E-02	1.05E-02	1.41E-02	8.47E-03	(1.81E-03)	(1.44E-03)	(2.32E-03)	(2.26E-03)	1.25E-02	1.09E-02
Mo	mM	<1.30E-02	<1.30E-02	<2.61E-02	<2.61E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<2.61E-02	<2.61E-02
Mo 95	mM	(6.55E-05)	(4.06E-05)	(3.76E-05)	(4.63E-05)	(6.55E-05)	(4.06E-05)	(9.40E-06)	(1.52E-05)	(1.33E-05)	(1.02E-05)	(9.50E-06)	<2.50E-04	(5.30E-06)	<2.50E-04	(1.72E-05)	(1.72E-05)
Mo 97	mM	(6.31E-05)	(3.93E-05)	(3.66E-05)	(4.15E-05)	(6.31E-05)	(3.93E-05)	(6.42E-05)	(7.23E-05)	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	(1.33E-05)	(1.19E-05)
Mo 98	mM	(5.20E-05)	(2.61E-05)	(3.35E-05)	(3.09E-05)	(5.20E-05)	(2.61E-05)	(5.24E-05)	(5.78E-05)	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	(1.30E-05)	(1.23E-05)
Na	mM	1.85E+01	1.62E+01	1.39E+01	1.34E+01	1.85E+01	1.62E+01	4.84E+00	4.38E+00	3.28E+00	2.76E+00	1.52E+00	1.32E+00	1.10E+00	1.04E+00	3.81E+00	3.53E+00
Ni	mM	2.41E-02	1.60E-02	(8.01E-03)	(7.92E-03)	2.41E-02	1.60E-02	1.03E-02	(6.90E-03)	9.40E-03	(4.90E-03)	(1.72E-03)	(1.14E-03)	(1.82E-03)	(1.50E-03)	(8.91E-03)	(7.25E-03)
P	mM	3.86E+00	3.46E+00	2.55E+00	2.22E+00	3.86E+00	3.46E+00	(1.72E+00)	(1.50E+00)	(1.20E+00)	(9.78E-01)	(5.31E-01)	(4.37E-01)	(3.41E-01)	(3.10E-01)	1.41E+00	1.30E+00
Pb	mM	2.55E-02	1.74E-02	8.23E-03	8.26E-03	2.55E-02	1.74E-02	9.75E-03	8.15E-03	1.04E-02	7.23E-03	(1.42E-03)	(1.07E-03)	(1.84E-03)	(2.12E-03)	1.64E-02	1.48E-02
Pb 206 *	mM	2.00E-02	1.42E-02	7.80E-03	7.42E-03	2.00E-02	1.42E-02	8.61E-03	6.84E-03	8.72E-03	6.00E-03	1.47E-03	1.22E-03	1.94E-03	2.00E-03	1.45E-02	1.27E-02
Ru 101	mM	(1.20E-04)	(5.36E-05)	(1.76E-05)	(2.28E-05)	(1.20E-04)	(5.36E-05)	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	(3.10E-05)	(3.21E-05)
Ru 102	mM	(9.02E-05)	(2.49E-05)	(9.02E-06)	(9.90E-06)	(9.02E-05)	(2.49E-05)	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	(1.53E-05)	(1.52E-05)
S	mM	(5.15E-02)	(4.22E-02)	<3.12E+00	<3.12E+00	(5.15E-02)	(4.22E-02)	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E+00	<3.12E+00
Sb 121	mM	1.64E-04	1.31E-04	6.07E-05	6.04E-05	1.64E-04	1.31E-04	8.74E-05	7.73E-05	7.09E-05	6.35E-05	(4.01E-05)	(3.48E-05)	(3.75E-05)	(2.84E-05)	7.42E-05	7.59E-05
Se	mM	<3.17E-02	<3.17E-02	<3.17E-01	<3.17E-01	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-01	<3.17E-01
Se 82	mM	<6.10E-04	<6.10E-04			<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04		
Si	mM	(8.34E-02)	(4.78E-02)	<1.78E+00	<1.78E+00	(8.34E-02)	(4.78E-02)	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<1.78E+00	<1.78E+00
Sr	mM	3.91E-03	2.97E-03	(1.49E-03)	(1.65E-03)	3.91E-03	2.97E-03	(1.58E-03)	(1.40E-03)	(1.74E-03)	(1.23E-03)	(4.59E-04)	(3.74E-04)	(4.35E-04)	(4.85E-04)	(3.52E-03)	(3.19E-03)
Ti	mM	(3.98E-03)	(2.89E-03)	(1.42E-03)	(1.34E-03)	(3.98E-03)	(2.89E-03)	(1.58E-03)	(1.38E-03)	(1.76E-03)	(1.22E-03)	(5.20E-04)	(4.85E-04)	(4.72E-04)	(4.56E-04)	(2.92E-03)	(2.63E-03)
Tl	mM	<1.22E-02	<1.22E-02	<2.45E-02	<2.45E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<2.45E-02	<2.45E-02
V	mM	<1.23E-02	<1.23E-02	<4.91E-02	<4.91E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<4.91E-02	<4.91E-02
Zn	mM	(1.04E-02)	(8.47E-03)	(1.05E-02)	(1.23E-02)	(1.04E-02)	(8.47E-03)	(5.78E-03)	(8.83E-03)	(8.33E-03)	(2.26E-02)	(5.66E-03)	(4.19E-03)	(3.09E-03)	(4.18E-03)	(1.50E-02)	(1.48E-02)
Zr	mM	<2.74E-03	<2.74E-03	<6.85E-03	<6.85E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<6.85E-03	<6.85E-03
* Cr 53 and Pb 206 concentration are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	1.50E-01	1.29E-01	1.05E-01	1.18E-01	1.50E-01	1.29E-01	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03
NO_3^- as NO3-	mM	9.13E-01	7.95E-01	6.71E-01	7.42E-01	9.13E-01	7.95E-01	2.58E-02	8.68E-03	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	1.75E-02	1.48E-02
CO_3^{2-} *	mM	6.96E+00	6.28E+00	6.02E+00	6.09E+00	6.96E+00	6.28E+00	1.91E+00	1.53E+00	1.22E+00	8.67E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	1.97E+00	1.86E+00
SO_4^{2-}	mM	3.29E-02	2.62E-02	2.16E-02	2.48E-02	3.29E-02	2.62E-02	5.85E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03
PO_4^{3-} as PO_4^{3-} *	mM	2.20E+00	2.36E+00	2.33E+00	1.97E+00	2.20E+00	2.36E+00	1.59E+00	1.36E+00	8.11E-01	7.58E-01	4.84E-01	4.29E-01	2.79E-01	2.47E-01	4.75E-01	5.16E-01
Cl^-	mM	2.98E-02	1.97E-02	1.72E-02	1.83E-02	2.98E-02	1.97E-02	1.61E-02	<6.77E-03	<6.77E-03	<6.77E-03	7.12E-03	<6.77E-03	<6.77E-03	8.44E-03	<6.77E-03	<6.77E-03
F^-	mM	1.87E+00	1.63E+00	1.49E+00	1.54E+00	1.87E+00	1.63E+00	1.05E-01	8.55E-02	4.00E-02	3.14E-02	8.57E-03	6.83E-03	<6.16E-03	<6.16E-03	2.63E-02	2.54E-02
Oxalate*	mM	2.08E-01	1.83E-01	1.56E-01	1.68E-01	2.08E-01	1.83E-01	<3.92E-03	<3.92E-03	<3.92E-03	9.23E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19961) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	10.88	10.88	10.75	10.56	10.88	10.88	10.85	10.76	10.52	10.50	10.48	10.53	9.89	10.18	10.15	10.75
Alkalinity	mg/L as CaCO3	5.56E+02	5.79E+02	5.79E+02	7.57E+02	5.56E+02	5.79E+02	1.62E+02	2.01E+02	1.24E+02	1.54E+02	1.24E+02	1.24E+02	1.08E+02	1.00E+02	1.62E+02	1.62E+02
TIC	mg C/L	5.06E+01	5.74E+01	6.15E+01	6.37E+01	5.06E+01	5.74E+01	2.32E+01	2.22E+01	1.49E+01	1.37E+01	8.40E+00	8.92E+00	7.62E+00	6.76E+00	1.52E+01	1.53E+01
TOC	mg C/L	6.55E+01	6.69E+01	6.45E+01	7.78E+01	6.55E+01	6.69E+01	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	1.16E+02	1.24E+02	1.26E+02	1.42E+02	1.16E+02	1.24E+02	2.32E+01	2.22E+01	1.49E+01	1.37E+01	8.40E+00	8.92E+00	7.62E+00	6.76E+00	1.52E+01	1.53E+01
Radionuclides																	
^{90}Sr	µCi/L	4.90E+02	5.17E+02	2.72E+02	1.98E+02	4.90E+02	5.17E+02			1.36E+02	1.92E+02					2.72E+02	1.98E+02
^{99}Tc	mg/L	(3.48E-05)	(6.05E-05)	<5.00E-04	<5.00E-04	(3.48E-05)	(6.05E-05)	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<5.00E-04	<5.00E-04
^{238}U	mg/L	7.46E+02	5.24E+02	2.35E+02	1.16E+02	7.46E+02	5.24E+02	8.16E+01	1.48E+02	9.59E+01	1.27E+02	2.24E+01	2.16E+01	3.00E+01	4.97E+01	1.87E+02	1.65E+02
^{239}Pu*	µCi/L	6.02E+00	6.54E+00	2.51E+00	1.71E+00	6.02E+00	6.54E+00	1.01E+00	1.84E+00	9.25E-01	1.47E+00	2.14E-01	2.13E-01	2.62E-01	2.46E-01	1.31E+00	9.95E-01
^{237}Np*	µCi/L	1.96E-02	2.03E-02	(2.68E-04)	(1.42E-04)	1.96E-02	2.03E-02	3.42E-03	6.72E-03	3.27E-03	6.72E-03	7.38E-04	6.39E-04	7.67E-04	1.58E-03	2.18E-04	1.78E-04
^{241}Am	µCi/L	<8.50E+00	<8.50E+00	<1.70E+02	<1.70E+02	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<8.50E+00	<1.70E+02	<1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	(8.30E-04)	(1.06E-03)	(5.30E-04)	(5.20E-04)	(8.30E-04)	(1.06E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	(1.60E-04)	(2.00E-04)
Al	mg/L	(8.43E-01)	(8.44E-01)	1.60E+00	2.25E+00	(8.43E-01)	(8.44E-01)	(3.58E-01)	(3.28E-01)	(3.33E-01)	(2.07E-01)	(2.14E-01)	(2.51E-01)	(2.40E-01)	(2.44E-01)	(9.23E-01)	(9.31E-01)
As	mg/L	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00
As 75	mg/L	(1.55E-02)	(1.71E-02)	<1.00E-01	<1.00E-01	(1.55E-02)	(1.71E-02)	(1.97E-03)	(8.01E-03)	(1.71E-03)	(6.25E-03)	(1.38E-03)	(5.56E-03)	(2.47E-03)	(5.89E-03)	<1.00E-01	<1.00E-01
B	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ba	mg/L	<2.50E-01	<2.50E-01	2.71E-01	4.19E-01	<2.50E-01	<2.50E-01	(2.85E-02)	(7.81E-02)	(6.69E-02)	(2.06E-01)	(9.72E-02)	(2.39E-01)	(1.99E-01)	(1.36E-01)	5.89E-01	5.88E-01
Be	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00
Ca	mg/L	4.03E+00	4.15E+00	2.83E+00	3.25E+00	4.03E+00	4.15E+00	(1.34E+00)	(1.82E+00)	(1.47E+00)	(1.61E+00)	(6.55E-01)	(8.17E-01)	(9.13E-01)	(1.20E+00)	(1.30E+00)	(1.04E+00)
Cd	mg/L	<2.50E-01	<2.50E-01	<1.25E-01	<1.25E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<1.25E-01	<1.25E-01
Cd 114	mg/L	<1.00E-01	<1.00E-01	(2.19E-03)	(2.24E-03)	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	(7.80E-04)	(5.70E-04)
Co	mg/L	(1.35E-01)	(1.31E-01)	(5.10E-02)	(5.67E-02)	(1.35E-01)	(1.31E-01)	(3.82E-02)	(5.42E-02)	(5.34E-02)	(3.66E-02)	(2.95E-02)	(2.39E-02)	(2.32E-02)	(2.79E-02)	(7.41E-02)	(6.48E-02)
Cr	mg/L	1.93E+01	2.15E+01	1.42E+01	1.56E+01	1.93E+01	2.15E+01	2.77E+00	5.45E+00	2.67E+00	3.40E+00	5.07E-01	4.71E-01	6.84E-01	6.99E-01	2.24E+00	1.79E+00
Cr 53 *	mg/L	1.44E+01	1.56E+01	1.13E+01	1.27E+01	1.44E+01	1.56E+01	2.43E+00	4.29E+00	2.31E+00	2.88E+00	4.71E-01	4.31E-01	6.32E-01	6.35E-01	2.08E+00	1.67E+00
Cu	mg/L	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01
Cu 65	mg/L	9.81E-02	1.10E-01	6.73E-02	7.23E-02	9.81E-02	1.10E-01	2.34E-02	5.22E-02	2.09E-02	2.58E-02	(2.91E-03)	(2.60E-03)	(5.99E-03)	(4.75E-03)	(2.29E-02)	(1.96E-02)
Fe	mg/L	1.95E+01	2.19E+01	1.18E+01	1.08E+01	1.95E+01	2.19E+01	3.31E+00	6.41E+00	3.31E+00	4.02E+00	(6.25E-01)	(6.20E-01)	(9.22E-01)	(1.11E+00)	2.36E+00	1.87E+00
K	mg/L	<6.25E+02	<6.25E+02	<6.25E+01	<6.25E+01	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+02	<6.25E+01	<6.25E+01
Li	mg/L	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00
Mg	mg/L	(1.00E+00)	(1.11E+00)	(6.85E-01)	(6.38E-01)	(1.00E+00)	(1.11E+00)	(2.24E-01)	(3.56E-01)	(2.28E-01)	(2.92E-01)	(7.64E-02)	(8.20E-02)	(9.52E-02)	(1.09E-01)	(3.30E-01)	(2.82E-01)
Mn	mg/L	2.88E+00	3.16E+00	1.83E+00	1.75E+00	2.88E+00	3.16E+00	4.70E-01	9.27E-01	4.68E-01	5.87E-01	(7.83E-02)	(7.17E-02)	(1.15E-01)	(1.21E-01)	3.10E-01	2.35E-01
Mo	mg/L	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<2.50E+00	<2.50E+00
Mo 95	mg/L	(6.04E-03)	(7.52E-03)	6.72E-03	9.23E-03	(6.04E-03)	(7.52E-03)	(1.90E-03)	(1.80E-03)	(2.41E-03)	(5.90E-04)	<2.50E-02	(1.00E-03)	<2.50E-02	(2.20E-04)	(1.97E-03)	(1.35E-03)
Mo 97	mg/L	<2.50E-02	<2.50E-02	(7.07E-03)	(8.99E-03)	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	(1.51E-03)	(7.70E-04)
Mo 98	mg/L	<2.50E-02	<2.50E-02	5.38E-03	6.78E-03	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	<2.50E-02	(1.39E-03)	(7.20E-04)
Na	mg/L	4.04E+02	4.46E+02	3.92E+02	4.71E+02	4.04E+02	4.46E+02	9.41E+01	1.13E+02	6.14E+01	6.73E+01	3.00E+01	3.22E+01	2.20E+01	2.35E+01	5.67E+01	5.67E+01
Ni	mg/L	2.38E+00	2.70E+00	(1.51E+00)	(1.42E+00)	2.38E+00	2.70E+00	(4.11E-01)	7.38E-01	(3.57E-01)	(4.41E-01)	(5.23E-02)	(5.41E-02)	(9.46E-02)	(9.36E-02)	(2.55E-01)	(2.29E-01)
P	mg/L	1.27E+02	1.40E+02	1.01E+02	1.17E+02	1.27E+02	1.40E+02	(4.50E+01)	(5.23E+01)	(2.87E+01)	(3.19E+01)	(1.27E+01)	(1.39E+01)	(7.99E+00)	(9.18E+00)	2.80E+01	2.78E+01
Pb	mg/L	7.81E+00	8.63E+00	4.20E+00	3.24E+00	7.81E+00	8.63E+00	1.37E+00	2.68E+00	1.38E+00	2.03E+00	3.14E-01	2.68E-01	4.16E-01	5.61E-01	2.41E+00	1.75E+00
Pb 206 *	mg/L	6.27E+00	6.76E+00	3.59E+00	2.94E+00	6.27E+00	6.76E+00	1.19E+00	2.17E+00	1.19E+00	1.61E+00	2.89E-01	2.54E-01	4.07E-01	4.32E-01	2.16E+00	1.63E+00
Ru 101	mg/L	(4.23E-03)	(4.04E-03)	(3.24E-03)	(3.64E-03)	(4.23E-03)	(4.04E-03)	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	(2.08E-03)	(1.57E-03)
Ru 102	mg/L	(2.32E-03)	(1.62E-03)	(1.61E-03)	(1.67E-03)	(2.32E-03)	(1.62E-03)	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	(9.70E-04)	(9.60E-04)
S	mg/L	(1.40E+00)	(1.06E+00)	<1.00E+02	(1.61E+00)	(1.40E+00)	(1.06E+00)	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+02	<1.00E+02
Sb 121	mg/L	2.48E-02	2.69E-02	1.26E-02	1.01E-02	2.48E-02	2.69E-02	9.63E-03	1.17E-02	6.95E-03	7.59E-03	(4.37E-03)	(5.06E-03)	(4.14E-03)	5.01E-03	7.56E-03	6.60E-03
Se	mg/L	<2.50E+00	<2.50E+00	<2.50E+01	<2.50E+01	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+01	<2.50E+01
Se 82	mg/L	<5.00E-02	<5.00E-02			<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02		
Si	mg/L	(2.44E+00)	(2.56E+00)	<5.00E+01	<5.00E+01	(2.44E+00)	(2.56E+00)	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<5.00E+01	<5.00E+01
Sr	mg/L	4.59E-01	4.89E-01	(2.47E-01)	(1.55E-01)	4.59E-01	4.89E-01	(8.62E-02)	(1.63E-01)	(1.10E-01)	(1.48E-01)	(3.16E-02)	(2.70E-02)	(3.48E-02)	(3.62E-02)	(1.60E-01)	(1.32E-01)
Ti	mg/L	(2.21E-01)	(2.38E-01)	(1.22E-01)	(9.55E-02)	(2.21E-01)	(2.38E-01)	(4.23E-02)	(7.85E-02)	(6.49E-02)	(7.01E-02)	(1.77E-02)	(1.48E-02)	(1.75E-02)	(2.01E-02)	(6.25E-02)	(5.24E-02)
Tl	mg/L	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<5.00E+00	<5.00E+00
V	mg/L	<6.25E-01	<6.25E-01	<2.50E+00	<2.50E+00	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<2.50E+00	<2.50E+00
Zn	mg/L	(9.02E-01)	(9.39E-01)	(1.01E+00)	(1.03E+00)	(9.02E-01)	(9.39E-01)	(3.97E-01)	(5.08E-01)	(5.39E-01)	(5.22E-01)	(2.20E-01)	(2.06E-01)	(4.11E-01)	(4.38E-01)	(8.05E-01)	(6.91E-01)
Zr	mg/L	<2.50E-01	<2.50E-01	<6.25E-01	<6.25E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<6.25E-01	<6.25E-01
* Cr 53 and Pb 206 concentration are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	8.92E+00	1.01E+01	1.05E+01	1.38E+01	8.92E+00	1.01E+01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01	<4.51E-01
NO_3^- as NO3-	mg/L	6.59E+01	7.44E+01	7.77E+01	1.01E+02	6.59E+01	7.44E+01	1.07E+00	7.45E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	<4.33E-01	1.22E+00	1.10E+00
CO_3^{2-} *	mg/L	3.93E+02	4.38E+02	4.11E+02	4.99E+02	3.93E+02	4.38E+02	8.74E+01	1.26E+02	<5.00E+01	6.12E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	5.64E+01	<5.00E+01
SO_4^{2-}	mg/L	3.10E+00	3.80E+00	3.75E+00	4.83E+00	3.10E+00	3.80E+00	5.17E-01	1.01E+00	<4.09E-01	<4.09E-01	4.31E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01	<4.09E-01
PO_4^{3-} as PO_4^{3-} *	mg/L	2.51E+02	2.76E+02	2.52E+02	3.35E+02	2.51E+02	2.76E+02	1.33E+02	1.31E+02	6.33E+01	6.49E+01	3.67E+01	4.03E+01	2.03E+01	2.27E+01	6.21E+01	6.97E+01
Cl^-	mg/L	9.09E-01	9.76E-01	1.02E+00	1.58E+00	9.09E-01	9.76E-01	3.92E+00	<2.40E-01	<2.40E-01	<2.40E-01	<2.40E-01	<2.40E-01	3.04E-01	<2.40E-01	3.30E-01	<2.40E-01
F^-	mg/L	3.20E+01	3.47E+01	3.61E+01	4.91E+01	3.20E+01	3.47E+01	1.31E+00	1.55E+00	4.72E-01	5.28E-01	1.48E-01	<1.17E-01	<1.17E-01	<1.17E-01	3.76E-01	4.06E-01
Oxalate*	mg/L	1.60E+01	1.80E+01	1.84E+01	2.48E+01	1.60E+01	1.80E+01	<3.45E-01	8.97E+00	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01	<3.45E-01

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19961) DDI Water Leach Result																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	5.55E+00	5.78E+00	5.78E+00	7.56E+00	5.55E+00	5.78E+00	1.62E+00	2.01E+00	1.23E+00	1.54E+00	1.23E+00	1.23E+00	1.08E+00	1.00E+00	1.62E+00	1.62E+00
TIC	mM C	4.21E+00	4.79E+00	5.12E+00	5.31E+00	4.21E+00	4.79E+00	1.93E+00	1.85E+00	1.24E+00	1.15E+00	7.00E-01	7.43E-01	6.35E-01	5.63E-01		
TOC	mM C	5.46E+00	5.57E+00	5.37E+00	6.48E+00	5.46E+00	5.57E+00	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	9.68E+00	1.04E+01	1.05E+01	1.18E+01	9.68E+00	1.04E+01	1.93E+00	1.85E+00	1.24E+00	1.15E+00	7.00E-01	7.43E-01	6.35E-01	5.63E-01		
Radionuclides																	
^{90}Sr	mM	3.89E-05	4.11E-05	2.16E-05	1.57E-05	3.89E-05	4.11E-05			1.08E-05	1.52E-05					2.16E-05	1.57E-05
^{99}Tc	mM	(3.51E-07)	(6.11E-07)	<5.05E-06	<5.05E-06	(3.51E-07)	(6.11E-07)	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<1.01E-06	<5.05E-06	<5.05E-06
^{238}U	mM	3.13E+00	2.20E+00	9.88E-01	4.85E-01	3.13E+00	2.20E+00	3.43E-01	6.22E-01	4.03E-01	5.32E-01	9.43E-02	9.09E-02	1.26E-01	2.09E-01	7.85E-01	6.92E-01
^{239}Pu*	mM	4.06E-03	4.42E-03	1.70E-03	1.16E-03	4.06E-03	4.42E-03	6.80E-04	1.24E-03	6.24E-04	9.92E-04	1.44E-04	1.44E-04	1.77E-04	1.66E-04	8.81E-04	6.71E-04
^{237}Np*	mM	1.16E-04	1.21E-04	(1.59E-06)	(8.44E-07)	1.16E-04	1.21E-04	2.03E-05	3.99E-05	1.95E-05	3.99E-05	4.39E-06	3.80E-06	4.56E-06	9.37E-06	1.30E-06	1.05E-06
^{241}Am	mM	<1.04E-05	<1.04E-05	<2.07E-04	<2.07E-04	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<1.04E-05	<2.07E-04	<2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	(7.76E-06)	(9.86E-06)	(4.95E-06)	(4.86E-06)	(7.76E-06)	(9.86E-06)	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	<4.67E-05	(1.50E-06)	(1.87E-06)
Al	mM	(3.12E-02)	(3.13E-02)	5.93E-02	8.34E-02	(3.12E-02)	(3.13E-02)	(1.33E-02)	(1.22E-02)	(1.24E-02)	(7.67E-03)	(7.92E-03)	(9.30E-03)	(8.88E-03)	(9.06E-03)	(3.42E-02)	(3.45E-02)
As	mM	<3.34E-02	<3.34E-02	<1.67E-02	<1.67E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<1.67E-02	<1.67E-02
As 75	mM	(2.07E-04)	(2.28E-04)	<1.33E-03	<1.33E-03	(2.07E-04)	(2.28E-04)	(2.63E-05)	(1.07E-04)	(2.28E-05)	(8.33E-05)	(1.84E-05)	(7.41E-05)	(3.29E-05)	(7.85E-05)	<1.33E-03	<1.33E-03
B	mM	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01	<2.31E-01
Ba	mM	<1.82E-03	<1.82E-03	1.97E-03	3.05E-03	<1.82E-03	<1.82E-03	(2.07E-04)	(5.69E-04)	(4.87E-04)	(1.50E-03)	(7.08E-04)	(1.74E-03)	(1.45E-03)	(9.88E-04)	4.29E-03	4.28E-03
Be	mM	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02	<2.77E-02
Bi	mM	<1.20E-02	<1.20E-02	<5.98E-03	<5.98E-03	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<5.98E-03	<5.98E-03
Ca	mM	1.01E-01	1.04E-01	7.07E-02	8.10E-02	1.01E-01	1.04E-01	(3.35E-02)	(4.54E-02)	(3.67E-02)	(4.02E-02)	(1.63E-02)	(2.04E-02)	(2.28E-02)	(2.99E-02)	(3.25E-02)	(2.59E-02)
Cd	mM	<2.22E-03	<2.22E-03	<1.11E-03	<1.11E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<1.11E-03	<1.11E-03
Cd 114	mM	<8.77E-04	<8.77E-04	(1.92E-05)	(1.96E-05)	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	<8.77E-04	(6.84E-06)	(5.00E-06)
Co	mM	(2.29E-03)	(2.22E-03)	(8.65E-04)	(9.63E-04)	(2.29E-03)	(2.22E-03)	(6.49E-04)	(9.20E-04)	(9.06E-04)	(6.21E-04)	(5.01E-04)	(4.05E-04)	(3.94E-04)	(4.74E-04)	(1.26E-03)	(1.10E-03)
Cr	mM	3.71E-01	4.13E-01	2.72E-01	3.00E-01	3.71E-01	4.13E-01	5.33E-02	1.05E-01	5.13E-02	6.55E-02	9.76E-03	9.06E-03	1.32E-02	1.34E-02	4.32E-02	3.45E-02
Cr 53 *	mM	2.71E-01	2.94E-01	2.13E-01	2.40E-01	2.71E-01	2.94E-01	4.59E-02	8.09E-02	4.36E-02	5.44E-02	8.89E-03	8.13E-03	1.19E-02	1.20E-02	3.93E-02	3.16E-02
Cu	mM	<3.93E-01	<3.93E-01	<7.87E-01	<7.87E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<3.93E-01	<7.87E-01	<7.87E-01
Cu 65	mM	1.51E-03	1.69E-03	(1.04E-03)	(1.11E-03)	1.51E-03	1.69E-03	3.60E-04	8.03E-04	3.22E-04	3.97E-04	(4.48E-05)	(4.00E-05)	(9.22E-05)	(7.31E-05)	<3.52E-04	<3.01E-04
Fe	mM	3.50E-01	3.92E-01	2.11E-01	1.93E-01	3.50E-01	3.92E-01	5.93E-02	1.15E-01	5.93E-02	7.20E-02	(1.12E-02)	(1.11E-02)	(1.65E-02)	(1.99E-02)	4.22E-02	3.34E-02
K	mM	<1.60E+01	<1.60E+01	<1.60E+00	<1.60E+00	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+01	<1.60E+00	<1.60E+00
Li	mM	<3.60E-01	<3.60E-01	<7.20E-01	<7.20E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<3.60E-01	<7.20E-01	<7.20E-01
Mg	mM	(4.13E-02)	(4.56E-02)	(2.82E-02)	(2.62E-02)	(4.13E-02)	(4.56E-02)	(9.21E-03)	(1.47E-02)	(9.40E-03)	(1.20E-02)	(3.15E-03)	(3.37E-03)	(3.92E-03)	(4.50E-03)	(1.36E-02)	(1.16E-02)
Mn	mM	5.23E-02	5.74E-02	3.33E-02	3.19E-02	5.23E-02	5.74E-02	8.56E-03	1.69E-02	8.51E-03	1.07E-02	(1.43E-03)	(1.30E-03)	(2.10E-03)	(2.20E-03)	5.65E-03	4.28E-03
Mo	mM	<1.30E-02	<1.30E-02	<2.61E-02	<2.61E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<2.61E-02	<2.61E-02
Mo 95	mM	(6.04E-05)	(7.52E-05)	6.72E-05	9.23E-05	(6.04E-05)	(7.52E-05)	(1.90E-05)	(1.80E-05)	(2.41E-05)	(5.90E-06)	<2.50E-04	(1.00E-05)	<2.50E-04	(2.20E-06)	(1.97E-05)	(1.35E-05)
Mo 97	mM	<2.63E-04	<2.63E-04	(7.44E-05)	(9.46E-05)	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	<2.63E-04	(1.59E-05)	(8.11E-06)
Mo 98	mM	<2.55E-04	<2.55E-04	5.49E-05	6.92E-05	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	<2.55E-04	(1.42E-05)	(7.35E-06)
Na	mM	1.76E+01	1.94E+01	1.70E+01	2.05E+01	1.76E+01	1.94E+01	4.09E+00	4.90E+00	2.67E+00	2.93E+00	1.30E+00	1.40E+00	9.55E-01	1.02E+00	2.47E+00	2.47E+00
Ni	mM	4.06E-02	4.61E-02	(2.58E-02)	(2.43E-02)	4.06E-02	4.61E-02	(7.00E-03)	1.26E-02	(6.09E-03)	(7.52E-03)	(8.91E-04)	(9.21E-04)	(1.61E-03)	(1.59E-03)	(4.35E-03)	(3.90E-03)
P	mM	4.10E+00	4.53E+00	3.26E+00	3.77E+00	4.10E+00	4.53E+00	(1.45E+00)	(1.69E+00)	(9.26E-01)	(1.03E+00)	(4.10E-01)	(4.49E-01)	(2.58E-01)	(2.97E-01)	9.04E-01	8.99E-01
Pb	mM	3.77E-02	4.16E-02	2.03E-02	1.56E-02	3.77E-02	4.16E-02	6.62E-03	1.29E-02	6.66E-03	9.82E-03	1.51E-03	1.29E-03	2.01E-03	2.71E-03	1.16E-02	8.45E-03
Pb 206 *	mM	3.04E-02	3.28E-02	1.74E-02	1.43E-02	3.04E-02	3.28E-02	5.76E-03	1.05E-02	5.76E-03	7.84E-03	1.40E-03	1.23E-03	1.98E-03	2.10E-03	1.05E-02	7.92E-03
Ru 101	mM	(4.19E-05)	(4.00E-05)	(3.21E-05)	(3.60E-05)	(4.19E-05)	(4.00E-05)	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	<4.95E-04	(2.06E-05)	(1.55E-05)
Ru 102	mM	(2.27E-05)	(1.59E-05)	(1.58E-05)	(1.64E-05)	(2.27E-05)	(1.59E-05)	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	<4.90E-04	(9.51E-06)	(9.41E-06)
S	mM	(4.36E-02)	(3.32E-02)	<3.12E+00	(5.03E-02)	(4.36E-02)	(3.32E-02)	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E-01	<3.12E+00	<3.12E+00
Sb 121	mM	2.05E-04	2.22E-04	1.04E-04	8.36E-05	2.05E-04	2.22E-04	7.96E-05	9.64E-05	5.74E-05	6.27E-05	(3.61E-05)	(4.18E-05)	(3.42E-05)	4.14E-05	6.25E-05	5.45E-05
Se	mM	<3.17E-02	<3.17E-02	<3.17E-01	<3.17E-01	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-02	<3.17E-01	<3.17E-01
Se 82	mM	<6.10E-04	<6.10E-04			<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04		
Si	mM	(8.67E-02)	(9.10E-02)	<1.78E+00	<1.78E+00	(8.67E-02)	(9.10E-02)	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<1.78E+00	<1.78E+00
Sr	mM	5.23E-03	5.58E-03	(2.82E-03)	(1.77E-03)	5.23E-03	5.58E-03	(9.84E-04)	(1.86E-03)	(1.26E-03)	(1.69E-03)	(3.60E-04)	(3.08E-04)	(3.97E-04)	(4.13E-04)	(1.83E-03)	(1.51E-03)
Ti	mM	(4.63E-03)	(4.97E-03)	(2.54E-03)	(1.99E-03)	(4.63E-03)	(4.97E-03)	(8.84E-04)	(1.64E-03)	(1.35E-03)	(1.46E-03)	(3.69E-04)	(3.09E-04)	(3.66E-04)	(4.21E-04)	(1.31E-03)	(1.09E-03)
Tl	mM	<1.22E-02	<1.22E-02	<2.45E-02	<2.45E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<2.45E-02	<2.45E-02
V	mM	<1.23E-02	<1.23E-02	<4.91E-02	<4.91E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<4.91E-02	<4.91E-02
Zn	mM	(1.38E-02)	(1.44E-02)	(1.54E-02)	(1.58E-02)	(1.38E-02)	(1.44E-02)	(6.06E-03)	(7.76E-03)	(8.25E-03)	(7.98E-03)	(3.37E-03)	(3.16E-03)	(6.29E-03)	(6.71E-03)	(1.23E-02)	(1.06E-02)
Zr	mM	<2.74E-03	<2.74E-03	<6.85E-03	<6.85E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<6.85E-03	<6.85E-03
* Cr 53 and Pb 206 concentration are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	1.94E-01	2.19E-01	2.28E-01	2.99E-01	1.94E-01	2.19E-01	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03	<9.80E-03
NO_3^- as NO3-	mM	1.06E+00	1.20E+00	1.25E+00	1.63E+00	1.06E+00	1.20E+00	1.72E-02	1.20E-02	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	<6.98E-03	1.97E-02	1.77E-02
CO_3^{2-} *	mM	6.55E+00	7.30E+00	6.85E+00	8.31E+00	6.55E+00	7.30E+00	1.46E+00	2.10E+00	<8.33E-01	1.02E+00	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	9.39E-01	<8.33E-01
SO_4^{2-}	mM	3.23E-02	3.95E-02	3.90E-02	5.03E-02	3.23E-02	3.95E-02	5.38E-03	1.05E-02	<4.26E-03	<4.26E-03	4.48E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03	<4.26E-03
PO_4^{3-} as PO_4^{3-} *	mM	2.65E+00	2.90E+00	2.65E+00	3.52E+00	2.65E+00	2.90E+00	1.40E+00	1.38E+00	6.66E-01	6.83E-01	3.86E-01	4.25E-01	2.14E-01	2.39E-01	6.54E-01	7.33E-01
Cl^-	mM	2.57E-02	2.76E-02	2.87E-02	4.45E-02	2.57E-02	2.76E-02	1.11E-01	<6.77E-03	<6.77E-03	<6.77E-03	<6.77E-03	<6.77E-03	8.57E-03	<6.77E-03	9.30E-03	<6.77E-03
F^-	mM	1.69E+00	1.83E+00	1.90E+00	2.58E+00	1.69E+00	1.83E+00	6.89E-02	8.16E-02	2.48E-02	2.78E-02	7.81E-03	<6.16E-03	<6.16E-03	<6.16E-03	1.98E-02	2.14E-02
Oxalate *	mM	1.81E-01	2.05E-01	2.09E-01	2.82E-01	1.81E-01	2.05E-01	<3.92E-03	1.02E-01	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03	<3.92E-03

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-202 (19250) $Ca(OH)_2$ Leach Results																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	11.48	11.45	11.50	11.46	11.48	11.45	11.56	11.51	11.60	11.53	11.66	11.70	11.74	11.77	11.63	11.65
Alkalinity	mg/L as CaCO3	6.48E+02	6.83E+02	5.91E+02	6.10E+02	6.48E+02	6.83E+02	8.11E+02	7.41E+02	8.96E+02	8.34E+02	9.84E+02	1.01E+03	1.15E+03	1.16E+03	9.15E+02	8.76E+02
TIC	mg C/L	2.43E+01	2.98E+01	2.05E+01	2.03E+01	2.43E+01	2.98E+01	1.14E+01	1.25E+01	1.19E+01	1.21E+01	9.76E+00	8.81E+00	1.06E+01	9.32E+00	8.61E+00	8.44E+00
TOC	mg C/L	2.94E+01	3.79E+01	3.52E+01	3.76E+01	2.94E+01	3.79E+01	1.22E+01	1.05E+01	8.13E+00	8.34E+00	6.16E+00	6.31E+00	5.51E+00	5.27E+00	1.02E+01	1.22E+01
TC	mg C/L	5.37E+01	6.77E+01	5.57E+01	5.78E+01	5.37E+01	6.77E+01	2.37E+01	2.30E+01	2.00E+01	2.04E+01	1.59E+01	1.51E+01	1.61E+01	1.46E+01	1.88E+01	2.06E+01
Radionuclides																	
^{90}Sr	µCi/L	9.79E+01	5.06E+01	4.993E+01	5.588E+01	9.79E+01	5.06E+01			6.85E+02	7.20E+02					6.43E+02	7.37E+02
^{99}Tc	mg/L	(3.15E-05)	(4.50E-05)	(4.48E-05)	5.40E-05	(3.15E-05)	(4.50E-05)	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	(1.30E-05)	(1.40E-05)
^{238}U	mg/L	1.09E+00	1.74E+00	5.83E-01	6.95E-01	1.09E+00	1.74E+00	1.69E-01	1.66E-01	1.27E-01	1.22E-01	4.52E-02	1.18E-01	8.87E-02	1.01E-01	6.51E-02	1.31E-02
^{239}Pu*	µCi/L	(2.12E-02)	(2.20E-02)	(6.01E-03)	(4.65E-03)	(2.12E-02)	(2.20E-02)	(6.94E-03)	(5.39E-03)	(4.34E-03)	(7.69E-03)	(5.70E-03)	(4.65E-03)	(3.35E-03)	(3.29E-03)	(2.85E-03)	(2.48E-03)
^{237}Np*	µCi/L	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06	<7.10E-06
^{241}Am	µCi/L	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01	<1.70E-01
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mg/L	1.13E-03	1.30E-03	2.14E-03	2.60E-03	1.13E-03	1.30E-03	(5.35E-05)	2.55E-04	3.05E-04	3.56E-04	(3.65E-05)	(2.50E-05)	<1.00E-04	<1.00E-04	9.26E-04	1.14E-03
Al	mg/L	1.44E+01	1.59E+01	2.24E+01	2.26E+01	1.44E+01	1.59E+01	8.60E+00	1.01E+01	2.04E+00	2.47E+00	1.00E+00	1.18E+00	(3.54E-01)	(3.70E-01)	1.73E+00	1.61E+00
As	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
As 75	mg/L	<5.00E-03	<5.00E-03	(3.46E-04)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
B	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Ba	mg/L	(1.99E-02)	(1.82E-02)	(1.07E-01)	(9.04E-02)	(1.99E-02)	(1.82E-02)	(2.84E-02)	(2.53E-02)	(3.51E-02)	(3.40E-02)	(6.13E-02)	(5.11E-02)	(1.30E-01)	(1.13E-01)	(5.18E-02)	(4.32E-02)
Be	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Bi	mg/L	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01
Ca	mg/L	(1.12E+01)	(5.61E+00)	(6.35E+00)	(5.99E+00)	(1.12E+01)	(5.61E+00)	2.44E+02	1.86E+02	3.00E+02	2.76E+02	3.38E+02	3.89E+02	3.83E+02	4.14E+02	3.00E+02	3.04E+02
Cd	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cd 111	mg/L	(2.30E-05)	(2.20E-05)	(2.90E-05)	(2.40E-05)	(2.30E-05)	(2.20E-05)	<1.00E-04	<1.00E-04	<1.00E-04	(1.50E-05)	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04	<1.00E-04
Co	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Cr ICP-MS	mg/L	1.35E+00	1.42E+00	7.07E+00	6.22E+00	1.35E+00	1.42E+00	7.88E-01	8.65E-01	1.44E+00	1.47E+00	9.39E-01	1.01E+00	3.45E-01	4.15E-01	2.56E+00	2.83E+00
Cr ICP-OES	mg/L	1.54E+00	1.63E+00	7.76E+00	9.13E+00	1.54E+00	1.63E+00	(7.66E-01)	(8.46E-01)	1.49E+00	1.48E+00	(9.23E-01)	(1.01E+00)	(3.14E-01)	(3.89E-01)	2.95E+00	3.10E+00
Cu	mg/L	(4.77E-02)	(5.75E-02)	(4.08E-02)	(3.76E-02)	(4.77E-02)	(5.75E-02)	(5.70E-02)	(5.56E-02)	(5.16E-02)	(4.52E-02)	(3.63E-02)	(3.75E-02)	(3.64E-02)	(2.69E-02)	(3.28E-02)	(3.47E-02)
Cu 63	mg/L	6.05E-03	7.88E-03	4.58E-03	4.95E-03	6.05E-03	7.88E-03	(1.94E-03)	(1.79E-03)	(1.08E-03)	(9.00E-04)	(6.20E-04)	(7.71E-04)	(1.26E-03)	(1.77E-03)	(1.02E-03)	(9.96E-04)
Fe	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mg	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mn	mg/L	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01	<1.25E-01
Mo	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mo 95	mg/L	1.21E-02	1.39E-02	1.97E-02	1.95E-02	1.21E-02	1.39E-02	1.76E-03	1.78E-03	1.65E-03	1.74E-03	8.06E-04	8.99E-04	(3.21E-04)	(3.60E-04)	1.99E-03	2.33E-03
Mo 97	mg/L	1.10E-02	1.31E-02	1.80E-02	1.80E-02	1.10E-02	1.31E-02	(1.44E-03)	(1.52E-03)	(1.41E-03)	(1.56E-03)	(7.01E-04)	(7.33E-04)	(3.07E-04)	(2.95E-04)	(1.92E-03)	(2.20E-03)
Mo 98	mg/L	7.12E-03	8.47E-03	1.18E-02	1.18E-02	7.12E-03	8.47E-03	(9.62E-04)	1.01E-03	(9.39E-04)	1.06E-03	(4.80E-04)	(5.40E-04)	(2.10E-04)	(2.43E-04)	1.30E-03	1.46E-03
Na	mg/L	2.58E+02	2.87E+02	2.29E+02	2.38E+02	2.58E+02	2.87E+02	4.07E+01	5.80E+01	1.81E+01	2.02E+01	(4.34E+00)	5.61E+00	(3.87E+00)	(2.38E+00)	6.83E+00	9.22E+00
Ni	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
P	mg/L	1.69E+00	1.63E+00	1.39E+00	1.55E+00	1.69E+00	1.63E+00	(1.02E+00)	(8.77E-01)	(9.04E-01)	(7.53E-01)	(5.98E-01)	(7.20E-01)	(4.23E-01)	(6.36E-01)	(7.78E-01)	(5.78E-01)
Pb ICP-MS	mg/L	(3.66E-03)	(2.60E-03)	(2.90E-05)	(1.35E-04)	(3.66E-03)	(2.60E-03)	1.87E-02	1.30E-02	2.34E-02	2.08E-02	3.36E-02	3.79E-02	3.69E-02	3.86E-02	2.78E-02	2.72E-02
Pb ICP-OES	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Ru 101	mg/L	1.74E-03	3.38E-03	2.43E-03	2.67E-03	1.74E-03	3.38E-03	(2.10E-04)	(2.16E-04)	(1.89E-04)	(1.92E-04)	(1.22E-04)	(1.34E-04)	(6.70E-05)	(8.30E-05)	(2.04E-04)	(2.40E-04)
Ru 102	mg/L	7.55E-04	1.46E-03	1.07E-03	1.21E-03	7.55E-04	1.46E-03	3.56E-04	3.08E-04	3.50E-04	3.32E-04	3.12E-04	3.51E-04	3.20E-04	3.52E-04	3.17E-04	3.22E-04
S	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sb 121	mg/L	(5.12E-04)	(9.08E-04)	(5.85E-04)	(7.37E-04)	(5.12E-04)	(9.08E-04)	(9.80E-05)	(9.40E-05)	(7.80E-05)	(1.47E-04)	(1.13E-04)	(1.05E-04)	(9.60E-05)	(7.70E-05)	(7.70E-05)	(7.60E-05)
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Se 82	mg/L	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02
Si	mg/L	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01
Sr	mg/L	(9.76E-02)	(4.52E-02)	(6.53E-02)	(5.64E-02)	(9.76E-02)	(4.52E-02)	1.90E+00	1.73E+00	2.01E+00	1.97E+00	1.60E+00	1.96E+00	1.23E+00	1.30E+00	2.06E+00	2.34E+00
Ti	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Tl	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
V	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Zn	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Zr	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Anions																	
NO_2^- as NO2-	mg/L	3.32E+00	3.67E+00	3.88E+00	3.78E+00	3.32E+00	3.67E+00	2.10E-01	2.72E-01	1.73E-01	2.28E-01	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	2.68E-01	3.36E-01
NO_3^- as NO3-	mg/L	1.21E+01	1.21E+01	1.79E+01	1.69E+01	1.21E+01	1.21E+01	8.50E+00	1.01E+01	4.58E+00	6.48E+00	5.63E-01	7.82E-01	6.40E-01	8.51E-01	1.61E+00	1.89E+00
CO_3^{2-}	mg/L	1.69E+02	2.14E+02	3.02E+02	2.97E+02	1.69E+02	2.14E+02	1.99E+02	2.57E+02	2.52E+02	2.38E+02	2.67E+02	3.08E+02	2.93E+02	2.95E+02	1.97E+02	2.13E+02
SO_4^{2-}	mg/L	2.39E+00	2.45E+00	2.48E+00	2.38E+00	2.39E+00	2.45E+00	8.22E-01	4.48E-01	5.31E-01	3.74E-01	6.29E-01	4.96E-01	7.33E-01	7.34E-01	7.63E-01	5.46E-01
PO_4^{3-} as PO_4^{3-}	mg/L	6.98E-01	6.28E-01	<1.99E-01	<1.99E-01	6.98E-01	6.28E-01	5.42E-01	4.49E-01	4.27E-01	3.87E-01	2.20E-01	2.41E-01	2.16E-01	2.18E-01	2.03E-01	<1.99E-01
Cl^-	mg/L	3.15E-01	3.30E-01	1.22E+00	1.28E+00	3.15E-01	3.30E-01	1.94E-01	1.93E-01	1.73E-01	1.77E-01	2.09E-01	1.89E-01	1.59E-01	2.98E-01	8.29E-01	2.47E-01
F^-	mg/L	1.82E+01	2.47E+01	2.08E+01	1.97E+01	1.82E+01	2.47E+01	1.51E+00	1.39E+00	6.12E-01	5.43E-01	6.52E-01	6.42E-01	2.42E-01	2.36E-01	4.25E-01	3.62E-01
Oxalate*	mg/L	1.06E+01	3.02E+01	1.08E+01	1.16E+01	1.06E+01	3.02E+01	1.14E+00	1.17E+00	1.05E+00	1.10E+00	1.06E+00	1.10E+00	9.56E-01	1.07E+00	8.53E-01	8.52E-01

* Oxalate results are for information only

Tank C-202 (19250) $Ca(OH)_2$ Leach Results																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	6.48E+00	6.83E+00	5.90E+00	6.09E+00	6.48E+00	6.83E+00	8.10E+00	7.40E+00	8.95E+00	8.33E+00	9.83E+00	1.01E+01	1.15E+01	1.16E+01	9.14E+00	8.75E+00
TIC	mM C	2.03E+00	2.49E+00	1.71E+00	1.69E+00	2.03E+00	2.49E+00	9.53E-01	1.04E+00	9.89E-01	1.01E+00	8.13E-01	7.34E-01	8.82E-01	7.77E-01		
TOC	mM C	2.45E+00	3.16E+00	2.93E+00	3.13E+00	2.45E+00	3.16E+00	1.02E+00	8.74E-01	6.78E-01	6.95E-01	5.14E-01	5.26E-01	4.59E-01	4.39E-01		
TC	mM C	4.48E+00	5.64E+00	4.64E+00	4.82E+00	4.48E+00	5.64E+00	1.97E+00	1.92E+00	1.67E+00	1.70E+00	1.33E+00	1.26E+00	1.34E+00	1.22E+00		
Radionuclides																	
^{90}Sr	mM	7.77E-06	4.01E-06	3.96E-06	4.43E-06	7.77E-06	4.01E-06			5.44E-05	5.71E-05					5.11E-05	5.85E-05
^{99}Tc	mM	(3.18E-07)	(4.55E-07)	(4.52E-07)	5.45E-07	(3.18E-07)	(4.55E-07)	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	(1.31E-07)	(1.41E-07)
^{238}U	mM	4.58E-03	7.32E-03	2.45E-03	2.92E-03	4.58E-03	7.32E-03	7.09E-04	6.97E-04	5.35E-04	5.12E-04	1.90E-04	4.96E-04	3.73E-04	4.26E-04	2.74E-04	5.50E-05
^{239}Pu*	mM	(1.43E-05)	(1.49E-05)	(4.06E-06)	(3.14E-06)	(1.43E-05)	(1.49E-05)	(4.69E-06)	(3.64E-06)	(2.93E-06)	(5.19E-06)	(3.85E-06)	(3.14E-06)	(2.26E-06)	(2.22E-06)	(1.92E-06)	(1.67E-06)
^{237}Np*	mM	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08	<4.22E-08
^{241}Am	mM	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07	<2.07E-07
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mM	1.05E-05	1.21E-05	1.99E-05	2.41E-05	1.05E-05	1.21E-05	(4.96E-07)	2.36E-06	2.82E-06	3.30E-06	(3.38E-07)	(2.32E-07)	<9.27E-07	<9.27E-07	8.59E-06	1.06E-05
Al	mM	5.35E-01	5.88E-01	8.30E-01	8.38E-01	5.35E-01	5.88E-01	3.19E-01	3.73E-01	7.56E-02	9.17E-02	3.72E-02	4.39E-02	(1.31E-02)	(1.37E-02)	6.42E-02	5.96E-02
As	mM	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02
As 75	mM	<6.67E-05	<6.67E-05	(4.61E-06)	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05	<6.67E-05
B	mM	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00
Ba	mM	(1.45E-04)	(1.32E-04)	(7.77E-04)	(6.59E-04)	(1.45E-04)	(1.32E-04)	(2.07E-04)	(1.84E-04)	(2.55E-04)	(2.48E-04)	(4.46E-04)	(3.72E-04)	(9.50E-04)	(8.22E-04)	(3.77E-04)	(3.14E-04)
Be	mM	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01
Bi	mM	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01
Ca	mM	(2.79E-01)	(1.40E-01)	(1.58E-01)	(1.50E-01)	(2.79E-01)	(1.40E-01)	6.08E+00	4.63E+00	7.49E+00	6.90E+00	8.43E+00	9.72E+00	9.55E+00	1.03E+01	7.48E+00	7.58E+00
Cd	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Cd 111	mM	(2.05E-07)	(1.96E-07)	(2.58E-07)	(2.14E-07)	(2.05E-07)	(1.96E-07)	<8.90E-07	<8.90E-07	<8.90E-07	(1.33E-07)	<8.90E-07	<8.90E-07	<8.90E-07	<8.90E-07	<8.90E-07	<8.90E-07
Co	mM	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02
Cr ICP-MS	mM	2.59E-02	2.74E-02	1.36E-01	1.20E-01	2.59E-02	2.74E-02	1.52E-02	1.66E-02	2.78E-02	2.83E-02	1.81E-02	1.94E-02	6.63E-03	7.97E-03	4.92E-02	5.45E-02
Cr ICP-OES	mM	2.97E-02	3.13E-02	1.49E-01	1.76E-01	2.97E-02	3.13E-02	(1.47E-02)	(1.63E-02)	2.87E-02	2.85E-02	(1.77E-02)	(1.95E-02)	(6.04E-03)	(7.48E-03)	5.67E-02	5.95E-02
Cu	mM	(7.50E-04)	(9.05E-04)	(6.41E-04)	(5.91E-04)	(7.50E-04)	(9.05E-04)	(8.98E-04)	(8.75E-04)	(8.12E-04)	(7.11E-04)	(5.71E-04)	(5.90E-04)	(5.73E-04)	(4.24E-04)	(5.17E-04)	(5.47E-04)
Cu 63	mM	9.52E-05	1.24E-04	7.21E-05	7.80E-05	9.52E-05	1.24E-04	(3.05E-05)	(2.82E-05)	(1.70E-05)	(1.42E-05)	(9.76E-06)	(1.21E-05)	(1.99E-05)	(2.79E-05)	(1.60E-05)	(1.57E-05)
Fe	mM	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03	<8.95E-03
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01
Mg	mM	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02
Mn	mM	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03	<2.28E-03
Mo	mM	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02
Mo 95	mM	1.27E-04	1.46E-04	2.07E-04	2.05E-04	1.27E-04	1.46E-04	1.85E-05	1.88E-05	1.73E-05	1.83E-05	8.48E-06	9.46E-06	(3.38E-06)	(3.79E-06)	2.10E-05	2.45E-05
Mo 97	mM	1.13E-04	1.35E-04	1.85E-04	1.85E-04	1.13E-04	1.35E-04	(1.48E-05)	(1.57E-05)	(1.45E-05)	(1.60E-05)	(7.23E-06)	(7.56E-06)	(3.16E-06)	(3.04E-06)	(1.98E-05)	(2.27E-05)
Mo 98	mM	7.27E-05	8.65E-05	1.21E-04	1.20E-04	7.27E-05	8.65E-05	(9.82E-06)	1.03E-05	(9.58E-06)	1.08E-05	(4.90E-06)	(5.51E-06)	(2.14E-06)	(2.48E-06)	1.33E-05	1.49E-05
Na	mM	1.12E+01	1.25E+01	9.95E+00	1.03E+01	1.12E+01	1.25E+01	1.77E+00	2.52E+00	7.89E-01	8.77E-01	(1.89E-01)	2.44E-01	(1.68E-01)	(1.03E-01)	2.97E-01	4.01E-01
Ni	mM	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03	<8.52E-03
P	mM	5.47E-02	5.26E-02	4.48E-02	4.99E-02	5.47E-02	5.26E-02	(3.30E-02)	(2.83E-02)	(2.92E-02)	(2.43E-02)	(1.93E-02)	(2.32E-02)	(1.36E-02)	(2.05E-02)	(2.51E-02)	(1.87E-02)
Pb ICP-MS	mM	(1.77E-05)	(1.26E-05)	(1.40E-07)	(6.49E-07)	(1.77E-05)	(1.26E-05)	9.03E-05	6.29E-05	1.13E-04	1.01E-04	1.62E-04	1.83E-04	1.78E-04	1.86E-04	1.34E-04	1.31E-04
Pb ICP-OES	mM	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03	<6.03E-03
Ru 101	mM	1.72E-05	3.35E-05	2.41E-05	2.64E-05	1.72E-05	3.35E-05	(2.08E-06)	(2.14E-06)	(1.87E-06)	(1.90E-06)	(1.21E-06)	(1.33E-06)	(6.63E-07)	(8.22E-07)	(2.02E-06)	(2.37E-06)
Ru 102	mM	7.40E-06	1.43E-05	1.05E-05	1.19E-05	7.40E-06	1.43E-05	3.49E-06	3.02E-06	3.43E-06	3.25E-06	3.06E-06	3.44E-06	3.14E-06	3.45E-06	3.11E-06	3.16E-06
S	mM	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00
Sb 121	mM	(4.23E-06)	(7.50E-06)	(4.83E-06)	(6.09E-06)	(4.23E-06)	(7.50E-06)	(8.10E-07)	(7.77E-07)	(6.45E-07)	(1.21E-06)	(9.34E-07)	(8.68E-07)	(7.93E-07)	(6.36E-07)	(6.36E-07)	(6.28E-07)
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Se 82	mM	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04
Si	mM	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01
Sr	mM	(1.11E-03)	(5.16E-04)	(7.45E-04)	(6.44E-04)	(1.11E-03)	(5.16E-04)	2.16E-02	1.98E-02	2.29E-02	2.25E-02	1.82E-02	2.24E-02	1.40E-02	1.48E-02	2.35E-02	2.67E-02
Ti	mM	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03
Tl	mM	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02
V	mM	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02
Zn	mM	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03
Zr	mM	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03
Anions																	
NO_2^- as NO2-	mM	7.22E-02	7.97E-02	8.43E-02	8.23E-02	7.22E-02	7.97E-02	4.56E-03	5.92E-03	3.75E-03	4.96E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	5.82E-03	7.30E-03
NO_3^- as NO3-	mM	1.95E-01	1.96E-01	2.89E-01	2.72E-01	1.95E-01	1.96E-01	1.37E-01	1.63E-01	7.39E-02	1.05E-01	9.09E-03	1.26E-02	1.03E-02	1.37E-02	2.60E-02	3.05E-02
CO_3^{2-}	mM	2.81E+00	3.57E+00	5.02E+00	4.94E+00	2.81E+00	3.57E+00	3.32E+00	4.29E+00	4.20E+00	3.96E+00	4.45E+00	5.13E+00	4.89E+00	4.92E+00	3.27E+00	3.55E+00
SO_4^{2-}	mM	2.48E-02	2.55E-02	2.58E-02	2.48E-02	2.48E-02	2.55E-02	8.56E-03	4.67E-03	5.53E-03	3.89E-03	6.54E-03	5.17E-03	7.63E-03	7.64E-03	7.94E-03	5.69E-03
PO_4^{3-} as PO_4^{3-}	mM	7.35E-03	6.61E-03	<2.10E-03	<2.10E-03	7.35E-03	6.61E-03	5.70E-03	4.73E-03	4.50E-03	4.07E-03	2.31E-03	2.53E-03	2.28E-03	2.29E-03	2.13E-03	<2.10E-03
Cl^-	mM	8.89E-03	9.32E-03	3.45E-02	3.60E-02	8.89E-03	9.32E-03	5.47E-03	5.44E-03	4.89E-03	5.00E-03	5.90E-03	5.33E-03	4.49E-03	8.42E-03	2.34E-02	6.97E-03
F^-	mM	9.56E-01	1.30E+00	1.09E+00	1.04E+00	9.56E-01	1.30E+00	7.97E-02	7.34E-02	3.22E-02	2.86E-02	3.43E-02	3.38E-02	1.28E-02	1.24E-02	2.24E-02	1.90E-02
Oxalate*	mM	1.20E-01	3.43E-01	1.22E-01	1.32E-01	1.20E-01	3.43E-01	1.30E-02	1.33E-02	1.20E-02	1.25E-02	1.20E-02	1.25E-02	1.09E-02	1.21E-02	9.69E-03	9.68E-03

* Oxalate results are for information only

Tank C-203 (19887) $Ca(OH)_2$ Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
		1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	11.64	11.69	11.62	11.59	11.64	11.69	11.85	11.67	11.67	11.73	11.67	11.73	11.76	11.88	11.74	11.88
Alkalinity	mg/L as CaCO3	8.34E+02	7.72E+02	7.72E+02	8.03E+02	8.34E+02	7.72E+02	4.71E+02	4.79E+02	4.17E+02	4.63E+02	4.48E+02	4.25E+02	5.10E+02	6.33E+02	3.94E+02	4.63E+02
TIC	mg C/L	5.53E+01	4.36E+01	5.20E+01	6.07E+01	5.53E+01	4.36E+01	1.31E+01	1.49E+01	1.15E+01	1.29E+01	8.26E+00	9.79E+00	7.70E+00	3.34E+00	1.54E+01	9.36E+00
TOC	mg C/L	4.72E+01	4.61E+01	4.62E+01	4.70E+01	4.72E+01	4.61E+01	5.18E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	1.03E+02	8.98E+01	9.82E+01	1.08E+02	1.03E+02	8.98E+01	1.83E+01	1.49E+01	1.15E+01	1.29E+01	8.26E+00	9.79E+00	7.70E+00	3.34E+00	1.54E+01	9.36E+00
Radionuclides																	
^{90}Sr	µCi/L	<8.89E-01	<8.89E-01	4.52E-01	7.56E-01	<8.89E-01	<8.89E-01			4.58E-01	5.54E+00					9.29E+00	1.51E+01
^{99}Tc	mg/L	(5.00E-04)	<5.00E-04	<5.00E-04	<5.00E-04	(5.00E-04)	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04
^{238}U	mg/L	1.87E+00	5.25E+00	3.10E+00	3.12E+00	1.87E+00	5.25E+00	4.65E-01	1.24E+00	3.91E-01	9.44E-02	1.59E-01	1.31E-01	4.97E-02	5.50E-02	3.54E-02	2.23E-02
^{239}Pu*	µCi/L	(2.65E-02)	<1.36E-02	(1.74E-02)	(1.18E-02)	(2.65E-02)	<1.36E-02	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01
^{237} Np*	µCi/L	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04
^{241}Am	µCi/L	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-03	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Al	mg/L	(2.20E+00)	(2.17E+00)	3.50E+00	3.44E+00	(2.20E+00)	(2.17E+00)	(1.06E+00)	(1.32E+00)	(6.15E-01)	(1.61E-01)	(1.51E-01)	(1.63E-01)	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As 75	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
B	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Ba	mg/L	(1.15E-01)	(5.38E-02)	(6.98E-02)	(1.14E-01)	(1.15E-01)	(5.38E-02)	(1.27E-02)	(3.90E-01)	(7.45E-02)	(3.29E-02)	(4.42E-02)	(1.12E-01)	(8.63E-02)	(2.88E-02)	(8.01E-02)	(1.22E-01)
Be	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ca	mg/L	(5.83E-01)	(6.25E-01)	(1.27E+00)	(1.14E+00)	(5.83E-01)	(6.25E-01)	(4.04E+00)	(1.75E+00)	(1.83E+00)	7.35E+01	2.03E+01	4.12E+01	1.11E+02	1.98E+02	6.40E+01	1.21E+02
Cd	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cd 114	mg/L	<1.00E-05	<2.50E-03	<2.50E-03	<2.50E-03	<1.00E-05	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03
Co	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Cr	mg/L	2.05E+00	1.72E+00	3.01E+00	3.40E+00	2.05E+00	1.72E+00	(1.28E-01)	(1.08E-01)	(4.83E-01)	(2.94E-01)	(1.38E-01)	(2.28E-01)	(2.12E-02)	(6.62E-02)	1.97E+00	1.48E+00
Cr 53*	mg/L	1.97E+00	1.76E+00	3.01E+00	3.44E+00	1.97E+00	1.76E+00	1.46E-01	1.32E-01	5.55E-01	3.30E-01	1.72E-01	2.68E-01	7.46E-02	1.01E-01	1.97E+00	1.50E+00
Cu	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Cu 65	mg/L	(1.75E-02)	(1.72E-02)	4.11E-02	(1.28E-02)	(1.75E-02)	(1.72E-02)	(4.47E-03)	<2.50E-02	(2.43E-02)	3.51E-02	4.28E-02	(1.61E-02)	(2.49E-02)	(2.45E-03)	(1.46E-02)	(2.16E-02)
Fe	mg/L	(1.43E-01)	(8.45E-02)	(1.28E-01)	(7.39E-02)	(1.43E-01)	(8.45E-02)	(1.28E-01)	(1.13E-01)	(9.92E-02)	(6.69E-02)	(1.28E-01)	(9.24E-02)	(1.61E-01)	(5.09E-02)	(1.30E-01)	(8.87E-02)
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Mg	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mn	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Mo	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mo 95	mg/L	(3.11E-03)	(2.72E-03)	(4.16E-03)	(4.90E-03)	(3.11E-03)	(2.72E-03)	(7.50E-04)	(8.10E-04)	(7.70E-04)	(4.10E-04)	(8.00E-05)	(2.40E-04)	(6.00E-05)	(1.90E-04)	(9.00E-05)	(2.20E-04)
Mo 97	mg/L	(2.56E-03)	(2.67E-03)	(3.64E-03)	(3.93E-03)	(2.56E-03)	(2.67E-03)	(1.80E-04)	(6.00E-05)	<1.00E-02	(1.50E-04)	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Mo 98	mg/L	(2.58E-03)	(2.18E-03)	(2.82E-03)	(3.05E-03)	(2.58E-03)	(2.18E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Na	mg/L	3.97E+02	3.70E+02	3.65E+02	3.88E+02	3.97E+02	3.70E+02	1.87E+02	1.79E+02	1.52E+02	1.00E+02	1.38E+02	1.19E+02	6.47E+01	3.25E+01	7.22E+01	4.56E+01
Ni	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
P	mg/L	1.80E+01	1.87E+01	2.36E+01	2.78E+01	1.80E+01	1.87E+01	(1.83E+00)	(9.74E-01)	(8.56E-01)	(5.01E-01)	(3.32E-01)	(3.65E-01)	(4.02E-01)	(1.28E-01)	(7.11E-01)	(1.81E-01)
Pb	mg/L	(2.05E-01)	(6.52E-02)	(1.37E-01)	(5.28E-02)	(2.05E-01)	(6.52E-02)	(6.70E-02)	(1.76E-01)	(3.15E-01)	(1.00E-01)	(1.36E-01)	(3.72E-02)	(2.10E-01)	(1.01E-01)	(1.07E-02)	(1.66E-01)
Pb 206	mg/L	(3.60E-04)	(1.40E-03)	1.59E-02	1.75E-02	(3.60E-04)	(1.40E-03)	(1.15E-03)	(8.40E-04)	(6.00E-04)	(2.11E-03)	(6.90E-04)	(1.13E-03)	(2.49E-03)	5.62E-03	(1.18E-03)	(2.52E-03)
Ru 101	mg/L	(1.09E-03)	(9.40E-04)	(1.35E-03)	(1.99E-03)	(1.09E-03)	(9.40E-04)	<5.00E-03	(9.00E-05)	(7.00E-05)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Ru 102	mg/L	(5.00E-04)	(5.00E-04)	(7.80E-04)	(8.10E-04)	(5.00E-04)	(5.00E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03
S	mg/L	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02
Sb 121	mg/L	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Si	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sr	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ti	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Tl	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
V	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Zn	mg/L	(4.50E-01)	(5.59E-01)	(5.27E-01)	(5.59E-01)	(4.50E-01)	(5.59E-01)	(4.71E-01)	(4.62E-01)	(5.63E-01)	(4.91E-01)	(4.69E-01)	(7.17E-01)	(6.48E-01)	(4.94E-01)	(5.44E-01)	(6.17E-01)
Zr	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
* Cr 53 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	<4.51E+00	<4.51E+00	4.59E+00	5.26E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00
NO_3^- as NO3-	mg/L	4.63E+01	3.72E+01	4.23E+01	4.92E+01	4.63E+01	3.72E+01	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00
CO_3^{2-} *	mg/L	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02
SO_4^{2-}	mg/L	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00
PO_4^{3-} as PO_4^{3-}	mg/L	2.86E+01	3.11E+01	4.76E+01	6.21E+01	2.86E+01	3.11E+01	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00
Cl^-	mg/L	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00
F^- *	mg/L	1.51E+01	1.33E+01	1.96E+01	2.29E+01	1.51E+01	1.33E+01	<1.17E+00	1.31E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00
Oxalate*	mg/L	1.80E+01	1.54E+01	1.75E+01	1.97E+01	1.80E+01	1.54E+01	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00

* The fluoride, carbonate,and oxalate results are for information only. The QC not within procedural limits..

Tank C-203 (19887) $Ca(OH)_2$ Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
		1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	8.33E+00	7.71E+00	7.71E+00	8.02E+00	8.33E+00	7.71E+00	4.70E+00	4.78E+00	4.17E+00	4.63E+00	4.47E+00	4.24E+00	5.09E+00	6.32E+00	3.93E+00	4.63E+00
TIC	mM C	4.61E+00	3.64E+00	4.33E+00	5.06E+00	4.61E+00	3.64E+00	1.09E+00	1.24E+00	9.54E-01	1.07E+00	6.88E-01	8.16E-01	6.42E-01	2.78E-01		
TOC	mM C	3.94E+00	3.84E+00	3.85E+00	3.91E+00	3.94E+00	3.84E+00	4.31E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	8.54E+00	7.48E+00	8.19E+00	8.98E+00	8.54E+00	7.48E+00	1.52E+00	1.24E+00	9.54E-01	1.07E+00	6.88E-01	8.16E-01	6.42E-01	2.78E-01		
Radionuclides																	
^{90}Sr	mM	<7.05E-08	<7.05E-08	3.59E-08	6.00E-08	<7.05E-08	<7.05E-08			3.64E-08	4.40E-07					7.37E-07	1.19E-06
^{99}Tc	mM	(5.05E-06)	<5.05E-06	<5.05E-06	<5.05E-06	(5.05E-06)	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06
^{238}U	mM	7.87E-03	2.21E-02	1.30E-02	1.31E-02	7.87E-03	2.21E-02	1.95E-03	5.19E-03	1.64E-03	3.97E-04	6.67E-04	5.49E-04	2.09E-04	2.31E-04	1.49E-04	9.37E-05
^{239}Pu*	mM	(1.79E-05)	<9.21E-06	(1.17E-05)	(7.95E-06)	(1.79E-05)	<9.21E-06	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04
^{237}Np*	mM	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06
^{241}Am	mM	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-06	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05
Al	mM	(8.16E-02)	(8.06E-02)	1.30E-01	1.28E-01	(8.16E-02)	(8.06E-02)	(3.93E-02)	(4.90E-02)	(2.28E-02)	(5.96E-03)	(5.61E-03)	(6.05E-03)	<9.27E-02	<9.27E-02	<9.27E-02	<9.27E-02
As	mM	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02
As 75	mM	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03
B	mM	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01
Ba	mM	(8.36E-04)	(3.92E-04)	(5.08E-04)	(8.30E-04)	(8.36E-04)	(3.92E-04)	(9.25E-05)	(2.84E-03)	(5.43E-04)	(2.39E-04)	(3.22E-04)	(8.12E-04)	(6.28E-04)	(2.10E-04)	(5.83E-04)	(8.92E-04)
Be	mM	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02
Bi	mM	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02
Ca	mM	(1.45E-02)	(1.56E-02)	(3.16E-02)	(2.84E-02)	(1.45E-02)	(1.56E-02)	(1.01E-01)	(4.36E-02)	(4.57E-02)	1.83E+00	5.06E-01	1.03E+00	2.77E+00	4.95E+00	1.60E+00	3.03E+00
Cd	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Cd 114	mM	<8.77E-08	<2.19E-05	<2.19E-05	<2.19E-05	<8.77E-08	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05
Co	mM	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02
Cr	mM	3.95E-02	3.30E-02	5.79E-02	6.55E-02	3.95E-02	3.30E-02	(2.47E-03)	(2.08E-03)	(9.29E-03)	(5.66E-03)	(2.65E-03)	(4.39E-03)	(4.08E-04)	(1.27E-03)	3.80E-02	2.85E-02
Cr 53 *	mM	3.71E-02	3.32E-02	5.69E-02	6.49E-02	3.71E-02	3.32E-02	2.76E-03	2.50E-03	1.05E-02	6.22E-03	3.25E-03	5.06E-03	1.41E-03	1.90E-03	3.72E-02	2.83E-02
Cu	mM	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00
Cu 65	mM	(2.70E-04)	(2.65E-04)	6.32E-04	(1.97E-04)	(2.70E-04)	(2.65E-04)	(6.88E-05)	<3.85E-04	(3.73E-04)	5.40E-04	6.58E-04	(2.47E-04)	(3.83E-04)	(3.77E-05)	(2.25E-04)	(3.32E-04)
Fe	mM	(2.56E-03)	(1.51E-03)	(2.29E-03)	(1.32E-03)	(2.56E-03)	(1.51E-03)	(2.29E-03)	(2.02E-03)	(1.78E-03)	(1.20E-03)	(2.28E-03)	(1.65E-03)	(2.88E-03)	(9.12E-04)	(2.32E-03)	(1.59E-03)
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00
Mg	mM	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01
Mn	mM	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03
Mo	mM	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02
Mo 95	mM	(3.11E-05)	(2.72E-05)	(4.16E-05)	(4.90E-05)	(3.11E-05)	(2.72E-05)	(7.50E-06)	(8.10E-06)	(7.70E-06)	(4.10E-06)	(8.00E-07)	(2.40E-06)	(6.00E-07)	(1.90E-06)	(9.00E-07)	(2.20E-06)
Mo 97	mM	(2.69E-05)	(2.81E-05)	(3.83E-05)	(4.14E-05)	(2.69E-05)	(2.81E-05)	(1.89E-06)	(6.32E-07)	<1.05E-04	(1.58E-06)	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04
Mo 98	mM	(2.63E-05)	(2.22E-05)	(2.88E-05)	(3.11E-05)	(2.63E-05)	(2.22E-05)	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05
Na	mM	1.73E+01	1.61E+01	1.59E+01	1.69E+01	1.73E+01	1.61E+01	8.14E+00	7.78E+00	6.59E+00	4.37E+00	5.99E+00	5.16E+00	2.81E+00	1.42E+00	3.14E+00	1.99E+00
Ni	mM	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02
P	mM	5.80E-01	6.05E-01	7.61E-01	8.97E-01	5.80E-01	6.05E-01	(5.89E-02)	(3.15E-02)	(2.77E-02)	(1.62E-02)	(1.07E-02)	(1.18E-02)	(1.30E-02)	(4.12E-03)	(2.30E-02)	(5.83E-03)
Pb	mM	(9.89E-04)	(3.15E-04)	(6.61E-04)	(2.55E-04)	(9.89E-04)	(3.15E-04)	(3.23E-04)	(8.52E-04)	(1.52E-03)	(4.84E-04)	(6.57E-04)	(1.80E-04)	(1.01E-03)	(4.89E-04)	(5.16E-05)	(8.00E-04)
Pb 206	mM	(1.75E-06)	(6.80E-06)	7.72E-05	8.51E-05	(1.75E-06)	(6.80E-06)	(5.58E-06)	(4.08E-06)	(2.91E-06)	(1.02E-05)	(3.35E-06)	(5.49E-06)	(1.21E-05)	2.73E-05	(5.73E-06)	(1.22E-05)
Ru 101	mM	(1.08E-05)	(9.31E-06)	(1.34E-05)	(1.97E-05)	(1.08E-05)	(9.31E-06)	<4.95E-05	(8.91E-07)	(6.93E-07)	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05
Ru 102	mM	(4.90E-06)	(4.90E-06)	(7.65E-06)	(7.94E-06)	(4.90E-06)	(4.90E-06)	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05
S	mM	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00
Sb 121	mM	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Si	mM	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00
Sr	mM	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02
Ti	mM	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02
Tl	mM	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02
V	mM	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02
Zn	mM	(6.88E-03)	(8.55E-03)	(8.06E-03)	(8.55E-03)	(6.88E-03)	(8.55E-03)	(7.21E-03)	(7.06E-03)	(8.61E-03)	(7.51E-03)	(7.17E-03)	(1.10E-02)	(9.91E-03)	(7.55E-03)	(8.32E-03)	(9.44E-03)
Zr	mM	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02
* Cr 53 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	<9.80E-02	<9.80E-02	9.98E-02	1.14E-01	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02
NO_3^- as NO3-	mM	7.47E-01	5.99E-01	6.82E-01	7.94E-01	7.47E-01	5.99E-01	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02
CO_3^{2-} *	mM	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00
SO_4^{2-}	mM	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02
PO_4^{3-} as PO_4^{3-}	mM	3.02E-01	3.28E-01	5.01E-01	6.54E-01	3.02E-01	3.28E-01	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02
Cl^-	mM	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02
F^- *	mM	7.94E-01	7.01E-01	1.03E+00	1.20E+00	7.94E-01	7.01E-01	<6.16E-02	6.91E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02
Oxalate*	mM	2.04E-01	1.75E-01	1.99E-01	2.24E-01	2.04E-01	1.75E-01	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02

* The fluoride, carbonate,and oxalate results are for information only. The QC not within procedural limits..

Tank C-203 (19961) $Ca(OH)_2$ Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
		1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	11.86	11.89	11.89	11.95	11.86	11.89	11.99	11.96	11.83	11.83	11.88	12.03	12.10	12.20	11.92	11.89
Alkalinity	mg/L as CaCO3	7.80E+02	8.96E+02	8.11E+02	7.72E+02	7.80E+02	8.96E+02	5.17E+02	4.55E+02	3.94E+02	3.86E+02	4.40E+02	5.40E+02	6.33E+02	7.87E+02	5.94E+02	4.48E+02
TIC	mg C/L	3.80E+01	4.77E+01	4.83E+01	4.14E+01	3.80E+01	4.77E+01	1.33E+01	1.34E+01	1.26E+01	1.04E+01	1.02E+01	9.53E+00	6.42E+00	1.05E+01	1.29E+01	1.12E+01
TOC	mg C/L	5.68E+01	6.94E+01	5.49E+01	3.31E+01	5.68E+01	6.94E+01	1.26E+01	5.25E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	9.48E+01	1.17E+02	1.03E+02	7.45E+01	9.48E+01	1.17E+02	2.59E+01	1.87E+01	1.26E+01	1.04E+01	1.02E+01	9.53E+00	6.42E+00	1.05E+01	1.29E+01	1.12E+01
Radionuclides																	
^{90}Sr	µCi/L	<8.89E-01	<8.89E-01	2.52E+01	7.49E+00	<8.89E-01	<8.89E-01			6.23E-01	<8.89E-01					2.10E+01	1.05E+01
^{99}Tc	mg/L	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	(3.80E-04)	(1.10E-04)	<5.00E-04
^{238}U	mg/L	5.00E+00	4.65E+00	3.03E+02	5.90E+01	5.00E+00	4.65E+00	2.76E+00	1.85E+00	6.94E-01	8.13E-01	1.10E-01	1.27E-01	5.26E-02	6.15E-02	2.13E-02	2.74E-02
^{239}Pu*	µCi/L	(2.12E-02)	(8.68E-03)	2.54E+00	4.57E-01	(2.12E-02)	(8.68E-03)	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01	<3.10E-01
^{237}Np*	µCi/L	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04
^{241}Am	µCi/L	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	(2.50E-04)	<1.00E-03	(3.50E-04)	<1.00E-03	(2.50E-04)	<1.00E-03	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-03	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Al	mg/L	(1.58E+00)	(1.78E+00)	3.03E+00	2.81E+00	(1.58E+00)	(1.78E+00)	(1.57E+00)	(1.70E+00)	(7.96E-01)	(1.04E+00)	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As 75	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
B	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Ba	mg/L	(1.11E-01)	(4.10E-02)	2.67E-01	(1.05E-01)	(1.11E-01)	(4.10E-02)	(7.64E-02)	(4.22E-02)	(5.18E-02)	(1.11E-01)	(6.26E-02)	(4.14E-02)	(4.43E-02)	(3.37E-02)	(6.28E-02)	(1.58E-01)
Be	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ca	mg/L	(6.45E-01)	(6.09E-01)	4.75E+01	1.41E+01	(6.45E-01)	(6.09E-01)	(6.58E-01)	(5.22E-01)	(1.78E+00)	(9.27E-01)	5.46E+01	1.18E+02	1.93E+02	2.45E+02	1.62E+02	6.68E+01
Cd	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cd 114	mg/L	<2.50E-03	<2.50E-03	(1.95E-03)	(4.40E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<1.00E-05	<2.50E-03	<2.50E-03	<2.00E-05
Co	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Cr	mg/L	2.58E+00	2.82E+00	1.24E+01	4.97E+00	2.58E+00	2.82E+00	(1.72E-01)	(2.04E-01)	7.41E-01	7.24E-01	(9.97E-02)	(4.41E-02)	(4.06E-02)	(1.03E-01)	2.17E+00	4.09E+00
Cr 53	mg/L	2.72E+00	2.85E+00	1.06E+01	4.91E+00	2.72E+00	2.85E+00	2.21E-01	2.47E-01	7.89E-01	7.72E-01	1.43E-01	9.47E-02	8.67E-02	1.40E-01	2.22E+00	4.09E+00
Cu	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Cu 65	mg/L	(6.96E-03)	(1.26E-02)	9.76E-02	4.56E-02	(6.96E-03)	(1.26E-02)	4.58E-02	2.76E-02	(2.48E-02)	(2.49E-02)	0.00E+00	(9.19E-03)	3.66E-02	2.51E-02	5.04E-02	(2.18E-02)
Fe	mg/L	(1.45E-01)	(5.52E-02)	8.88E+00	1.63E+00	(1.45E-01)	(5.52E-02)	(1.99E-01)	(1.03E-01)	(9.13E-02)	(5.76E-02)	(2.11E-01)	(1.54E-01)	(1.52E-01)	(1.02E-01)	(5.23E-02)	(1.32E-01)
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Mg	mg/L	<5.00E+00	<5.00E+00	(6.87E-01)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mn	mg/L	<2.50E-01	<2.50E-01	1.34E+00	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Mo	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mo 95	mg/L	(4.48E-03)	5.54E-03	6.92E-03	5.32E-03	(4.48E-03)	5.54E-03	(1.00E-03)	(1.07E-03)	(7.60E-04)	(9.00E-04)	(2.30E-04)	(1.50E-04)	(1.00E-04)	(1.10E-04)	(3.30E-04)	(3.00E-04)
Mo 97	mg/L	(4.17E-03)	(4.54E-03)	(5.52E-03)	(4.61E-03)	(4.17E-03)	(4.54E-03)	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Mo 98	mg/L	(3.64E-03)	(3.78E-03)	5.12E-03	(3.96E-03)	(3.64E-03)	(3.78E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Na	mg/L	3.61E+02	4.29E+02	4.28E+02	3.55E+02	3.61E+02	4.29E+02	1.91E+02	1.79E+02	1.38E+02	1.39E+02	9.40E+01	7.55E+01	2.50E+01	2.83E+01	3.56E+01	7.47E+01
Ni	mg/L	<5.00E+00	<5.00E+00	(1.07E+00)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
P	mg/L	1.35E+01	3.03E+01	6.22E+01	3.22E+01	1.35E+01	3.03E+01	(3.02E+00)	(1.13E+00)	(8.71E-01)	(1.01E+00)	(4.59E-01)	(6.30E-01)	(6.19E-01)	(4.51E-02)	(1.53E-02)	(1.81E-01)
Pb	mg/L	(2.25E-01)	(1.46E-01)	4.01E+00	(7.66E-01)	(2.25E-01)	(1.46E-01)	(1.44E-01)	(4.48E-03)	(1.96E-02)	(1.07E-01)	<1.00E+00	(4.37E-02)	(8.73E-02)	(1.09E-01)	(5.71E-02)	(1.31E-01)
Pb 206	mg/L	2.66E-02	(1.77E-03)	3.57E+00	7.14E-01	2.66E-02	(1.77E-03)	(2.05E-03)	(3.35E-04)	(4.40E-04)	(6.80E-04)	2.87E-02	(3.35E-03)	6.92E-03	1.05E-02	7.40E-03	(2.00E-03)
Ru 101	mg/L	(1.08E-03)	(1.50E-03)	(4.64E-03)	(2.09E-03)	(1.08E-03)	(1.50E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Ru 102	mg/L	(6.50E-04)	(7.80E-04)	(2.23E-03)	(1.00E-03)	(6.50E-04)	(7.80E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	(3.50E-04)	(5.10E-04)	(6.60E-04)	(4.90E-04)	(1.90E-04)
S	mg/L	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02
Sb 121	mg/L	<5.00E-03	<5.00E-03	8.25E-03	(1.56E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Si	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sr	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ti	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Tl	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
V	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Zn	mg/L	(5.06E-01)	(5.90E-01)	(8.48E-01)	(4.77E-01)	(5.06E-01)	(5.90E-01)	(5.47E-01)	(5.37E-01)	(5.50E-01)	(5.88E-01)	(1.03E+00)	(5.98E-01)	(6.25E-01)	(6.69E-01)	(4.60E-01)	(5.12E-01)
Zr	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
* Cr 53 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	6.70E+00		7.99E+00	5.89E+00	6.70E+00		7.07E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00
NO_3^- as NO3-	mg/L	5.45E+01		6.43E+01	4.83E+01	5.45E+01		5.77E+01	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00
CO_3^{2-} *	mg/L	<5.00E+02		5.47E+02	<5.00E+02	<5.00E+02		9.09E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02
SO_4^{2-}	mg/L	<4.09E+00		<4.09E+00	<4.09E+00	<4.09E+00		<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00
PO_4^{3-} as PO_4^{3-} *	mg/L	1.30E+01		1.47E+02	8.29E+01	1.30E+01		5.25E+01	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00	<5.05E+00
Cl^-	mg/L	<2.36E+00		<2.36E+00	<2.36E+00	<2.36E+00		<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00
F^-	mg/L	1.34E+01		2.15E+01	1.38E+01	1.34E+01		1.61E+01	2.24E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00
Oxalate*	mg/L	1.53E+01		1.85E+01	1.44E+01	1.53E+01		1.62E+01	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19961) $Ca(OH)_2$ Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	7.79E+00	8.95E+00	8.10E+00	7.71E+00	7.79E+00	8.95E+00	5.17E+00	4.55E+00	3.93E+00	3.86E+00	4.40E+00	5.40E+00	6.32E+00	7.87E+00	5.94E+00	4.47E+00
TIC	mM C	3.17E+00	3.97E+00	4.03E+00	3.45E+00	3.17E+00	3.97E+00	1.11E+00	1.12E+00	1.05E+00	8.64E-01	8.48E-01	7.94E-01	5.35E-01	8.78E-01		
TOC	mM C	4.73E+00	5.78E+00	4.58E+00	2.76E+00	4.73E+00	5.78E+00	1.05E+00	4.37E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	7.90E+00	9.75E+00	8.60E+00	6.21E+00	7.90E+00	9.75E+00	2.16E+00	1.56E+00	1.05E+00	8.64E-01	8.48E-01	7.94E-01	5.35E-01	8.78E-01		
Radionuclides																	
^{90}Sr	mM	<7.05E-08	<7.05E-08	2.00E-06	5.94E-07	<7.05E-08	<7.05E-08			4.94E-08	<7.05E-08					1.67E-06	8.32E-07
^{99}Tc	mM	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	(3.84E-06)	(1.11E-06)	<5.05E-06
^{238}U	mM	2.10E-02	1.95E-02	1.27E+00	2.48E-01	2.10E-02	1.95E-02	1.16E-02	7.76E-03	2.92E-03	3.42E-03	4.62E-04	5.34E-04	2.21E-04	2.58E-04	8.95E-05	1.15E-04
^{239}Pu*	mM	(1.43E-05)	(5.86E-06)	1.71E-03	3.08E-04	(1.43E-05)	(5.86E-06)	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04	<2.09E-04
^{237} Np*	mM	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06
^{241}Am	mM	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	(2.34E-06)	<9.35E-06	(3.27E-06)	<9.35E-06	(2.34E-06)	<9.35E-06	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-06	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05
Al	mM	(5.87E-02)	(6.59E-02)	1.12E-01	1.04E-01	(5.87E-02)	(6.59E-02)	(5.81E-02)	(6.29E-02)	(2.95E-02)	(3.85E-02)	<9.27E-02	<9.27E-02	<9.27E-02	<9.27E-02	<9.27E-02	<9.27E-02
As	mM	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02
As 75	mM	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03
B	mM	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01
Ba	mM	(8.09E-04)	(2.99E-04)	1.94E-03	(7.67E-04)	(8.09E-04)	(2.99E-04)	(5.57E-04)	(3.07E-04)	(3.78E-04)	(8.11E-04)	(4.56E-04)	(3.02E-04)	(3.22E-04)	(2.45E-04)	(4.57E-04)	(1.15E-03)
Be	mM	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02
Bi	mM	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02
Ca	mM	(1.61E-02)	(1.52E-02)	1.18E+00	3.52E-01	(1.61E-02)	(1.52E-02)	(1.64E-02)	(1.30E-02)	(4.44E-02)	(2.31E-02)	1.36E+00	2.93E+00	4.81E+00	6.12E+00	4.04E+00	1.67E+00
Cd	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Cd 114	mM	<2.19E-05	<2.19E-05	(1.71E-05)	(3.86E-06)	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<2.19E-05	<8.77E-08	<2.19E-05	<2.19E-05	<1.75E-07
Co	mM	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02
Cr	mM	4.96E-02	5.43E-02	2.39E-01	9.55E-02	4.96E-02	5.43E-02	(3.30E-03)	(3.93E-03)	1.43E-02	1.39E-02	(1.92E-03)	(8.48E-04)	(7.81E-04)	(1.98E-03)	4.18E-02	7.87E-02
Cr 53	mM	5.14E-02	5.37E-02	2.00E-01	9.27E-02	5.14E-02	5.37E-02	4.17E-03	4.66E-03	1.49E-02	1.46E-02	2.69E-03	1.79E-03	1.64E-03	2.65E-03	4.18E-02	7.72E-02
Cu	mM	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00
Cu 65	mM	(1.07E-04)	(1.94E-04)	1.50E-03	7.01E-04	(1.07E-04)	(1.94E-04)	7.04E-04	4.25E-04	(3.82E-04)	(3.83E-04)	0.00E+00	(1.41E-04)	5.63E-04	3.87E-04	7.76E-04	(3.36E-04)
Fe	mM	(2.60E-03)	(9.88E-04)	1.59E-01	2.92E-02	(2.60E-03)	(9.88E-04)	(3.56E-03)	(1.84E-03)	(1.63E-03)	(1.03E-03)	(3.79E-03)	(2.75E-03)	(2.72E-03)	(1.83E-03)	(9.37E-04)	(2.36E-03)
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00
Mg	mM	<2.06E-01	<2.06E-01	(2.83E-02)	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01
Mn	mM	<4.55E-03	<4.55E-03	2.44E-02	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03	<4.55E-03
Mo	mM	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02
Mo 95	mM	(4.48E-05)	5.54E-05	6.92E-05	5.32E-05	(4.48E-05)	5.54E-05	(1.00E-05)	(1.07E-05)	(7.60E-06)	(9.00E-06)	(2.30E-06)	(1.50E-06)	(1.00E-06)	(1.10E-06)	(3.30E-06)	(3.00E-06)
Mo 97	mM	(4.39E-05)	(4.78E-05)	(5.81E-05)	(4.85E-05)	(4.39E-05)	(4.78E-05)	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04
Mo 98	mM	(3.71E-05)	(3.86E-05)	5.22E-05	(4.04E-05)	(3.71E-05)	(3.86E-05)	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05
Na	mM	1.57E+01	1.87E+01	1.86E+01	1.55E+01	1.57E+01	1.87E+01	8.29E+00	7.78E+00	6.02E+00	6.04E+00	4.09E+00	3.28E+00	1.09E+00	1.23E+00	1.55E+00	3.25E+00
Ni	mM	<8.52E-02	<8.52E-02	(1.83E-02)	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02
P	mM	4.37E-01	9.77E-01	2.01E+00	1.04E+00	4.37E-01	9.77E-01	(9.76E-02)	(3.66E-02)	(2.81E-02)	(3.27E-02)	(1.48E-02)	(2.03E-02)	(2.00E-02)	(1.46E-03)	(4.93E-04)	(5.83E-03)
Pb	mM	(1.08E-03)	(7.06E-04)	1.93E-02	(3.70E-03)	(1.08E-03)	(7.06E-04)	(6.94E-04)	(2.16E-05)	(9.44E-05)	(5.18E-04)	<4.83E-03	(2.11E-04)	(4.21E-04)	(5.27E-04)	(2.76E-04)	(6.33E-04)
Pb 206	mM	1.29E-04	(8.59E-06)	1.73E-02	3.47E-03	1.29E-04	(8.59E-06)	(9.95E-06)	(1.63E-06)	(2.14E-06)	(3.30E-06)	1.40E-04	(1.63E-05)	3.36E-05	5.10E-05	3.59E-05	(9.71E-06)
Ru 101	mM	(1.07E-05)	(1.49E-05)	(4.59E-05)	(2.07E-05)	(1.07E-05)	(1.49E-05)	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05
Ru 102	mM	(6.37E-06)	(7.65E-06)	(2.19E-05)	(9.80E-06)	(6.37E-06)	(7.65E-06)	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	(3.43E-06)	(5.00E-06)	(6.47E-06)	(4.80E-06)	(1.86E-06)
S	mM	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00
Sb 121	mM	<4.13E-05	<4.13E-05	6.82E-05	(1.29E-05)	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05	<4.13E-05
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Si	mM	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00
Sr	mM	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02
Ti	mM	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02
Tl	mM	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02
V	mM	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02
Zn	mM	(7.73E-03)	(9.02E-03)	(1.30E-02)	(7.29E-03)	(7.73E-03)	(9.02E-03)	(8.37E-03)	(8.22E-03)	(8.41E-03)	(8.99E-03)	(1.57E-02)	(9.14E-03)	(9.56E-03)	(1.02E-02)	(7.03E-03)	(7.83E-03)
Zr	mM	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02
* Cr 53 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	1.46E-01		1.74E-01	1.28E-01	1.46E-01	<0.00E+00	1.54E-01	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02
NO_3^- as NO3-	mM	8.80E-01		1.04E+00	7.78E-01	8.80E-01	<0.00E+00	9.31E-01	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02
CO_3^{2-} *	mM	<8.33E+00		9.11E+00	<8.33E+00	<8.33E+00	<0.00E+00	1.51E+01	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00
SO_4^{2-}	mM	<4.26E-02		<4.26E-02	<4.26E-02	<4.26E-02	<0.00E+00	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02
PO_4^{3-} as PO_4^{3-} *	mM	1.37E-01		1.55E+00	8.73E-01	1.37E-01	<0.00E+00	5.53E-01	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02	<5.32E-02
Cl^-	mM	<6.66E-02		<6.66E-02	<6.66E-02	<6.66E-02	<0.00E+00	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02
F^-	mM	7.06E-01		1.13E+00	7.28E-01	7.06E-01	<0.00E+00	8.45E-01	1.18E-01	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02
Oxalate *	mM	1.74E-01		2.10E-01	1.63E-01	1.74E-01	<0.00E+00	1.84E-01	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-202 (19250) $CaCO_3$ Leach Results

		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	8.98	8.91	8.80	8.56	8.98	8.91	8.06	8.35	8.34	8.58	7.92	7.81	7.55	7.61	8.30	8.50
Alkalinity	mg/L as CaCO3	2.66E+02	2.66E+02	2.78E+02	2.82E+02	2.66E+02	2.66E+02	1.04E+02	1.00E+02	1.00E+02	1.00E+02	8.11E+01	7.33E+01	7.33E+01	7.72E+01	1.16E+02	1.20E+02
TIC	mg C/L	5.72E+01	5.33E+01	3.48E+01	4.16E+01	5.72E+01	5.33E+01	2.48E+01	2.51E+01	2.69E+01	2.69E+01	1.60E+01	1.74E+01	1.27E+01	1.22E+01	2.46E+01	3.43E+01
TOC	mg C/L	1.03E+02	8.82E+01	9.51E+01	8.79E+01	1.03E+02	8.82E+01	1.14E+01	1.41E+01	2.77E+01	2.83E+01	8.65E+00	8.06E+00	4.26E+00	4.51E+00	2.85E+01	5.96E+01
TC	mg C/L	1.60E+02	1.42E+02	1.30E+02	1.30E+02	1.60E+02	1.42E+02	3.62E+01	3.92E+01	5.46E+01	5.52E+01	2.47E+01	2.55E+01	1.70E+01	1.68E+01	5.31E+01	9.39E+01
Radionuclides																	
^{90}Sr	µCi/L	1.84E+02	1.39E+02	1.026E+02	1.010E+02	1.84E+02	1.39E+02			1.04E+02	1.32E+02					1.26E+02	2.58E+02
^{99}Tc	mg/L	(3.90E-05)	(3.70E-05)	(4.00E-05)	(4.10E-05)	(3.90E-05)	(3.70E-05)	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05	<5.00E-05
^{238}U	mg/L	5.79E+01	5.24E+01	5.13E+01	4.56E+01	5.79E+01	5.24E+01	9.88E+00	1.03E+01	1.85E+01	2.90E+01	8.79E+00	1.02E+01	7.90E+00	6.88E+00	2.07E+01	6.11E+01
^{239}Pu*	µCi/L	1.98E+00	1.27E+00	5.92E-01	4.76E-01	1.98E+00	1.27E+00	1.99E-01	2.48E-01	9.42E-01	1.57E+00	3.07E-01	3.85E-01	4.61E-02	4.49E-02	1.54E+00	5.09E+00
^{237}Np*	µCi/L	3.81E-04	2.82E-04	2.66E-04	2.68E-04	3.81E-04	2.82E-04	8.24E-05	8.38E-05	1.14E-04	1.76E-04	7.31E-05	7.46E-05	9.59E-05	9.44E-05	1.48E-04	3.80E-04
^{241}Am	µCi/L	<1.09E-01	<6.12E-02	(2.72E-02)	(2.38E-02)	<1.09E-01	<6.12E-02	<1.70E-01	<6.80E-03	<4.76E-02	<9.18E-02	<6.80E-03	<1.70E-02	<1.70E-01	<1.70E-01	<8.84E-02	<3.47E-01
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mg/L	2.22E-04	1.87E-04	2.57E-04	2.34E-04	2.22E-04	1.87E-04	(1.55E-05)	(1.60E-05)	(6.85E-05)	1.51E-04	(1.30E-05)	(2.45E-05)	<1.00E-04	<1.00E-04	(9.25E-05)	4.10E-04
Al	mg/L	1.26E+00	1.20E+00	1.25E+00	1.08E+00	1.26E+00	1.20E+00	8.82E-01	9.68E-01	1.98E+00	2.27E+00	1.07E+00	1.26E+00	(2.78E-01)	(3.44E-01)	2.54E+00	4.27E+00
As	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
As 75	mg/L	(1.20E-03)	(1.26E-03)	(2.04E-03)	(1.55E-03)	(1.20E-03)	(1.26E-03)	<5.00E-03	<5.00E-03	(5.18E-04)	(5.50E-04)	(2.84E-04)	<5.00E-03	<5.00E-03	(3.07E-04)	(4.30E-04)	(7.51E-04)
B	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Ba	mg/L	(2.95E-02)	(2.78E-02)	3.05E-01	2.37E-01	(2.95E-02)	(2.78E-02)	(2.13E-02)	(4.35E-02)	(2.58E-02)	(3.18E-02)	(2.30E-02)	(2.26E-02)	(2.03E-02)	(2.09E-02)	(3.22E-02)	(5.52E-02)
Be	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Bi	mg/L	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01
Ca	mg/L	(2.93E+00)	(2.91E+00)	(1.72E+00)	(2.94E+00)	(2.93E+00)	(2.91E+00)	(2.03E+00)	(2.21E+00)	(2.42E+00)	(2.24E+00)	(1.85E+00)	(1.79E+00)	(6.05E+00)	(4.59E+00)	(3.41E+00)	(4.83E+00)
Cd ICP-MS	mg/L	1.86E-03	1.03E-03	3.51E-04	3.45E-04	1.86E-03	1.03E-03	1.77E-04	2.34E-04	9.48E-04	1.75E-03	2.58E-04	4.23E-04	(2.00E-05)	(3.50E-05)	1.47E-03	5.16E-03
Cd ICP-OES	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Co	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Cr ICP-MS	mg/L	1.34E+00	1.23E+00	1.34E+00	1.29E+00	1.34E+00	1.23E+00	1.75E-01	2.08E-01	5.29E-01	9.97E-01	1.66E-01	2.46E-01	(2.08E-02)	(2.36E-02)	7.07E-01	2.00E+00
Cr ICP-OES	mg/L	1.87E+00	1.58E+00	1.64E+00	1.53E+00	1.87E+00	1.58E+00	(1.43E-01)	(1.79E-01)	(6.06E-01)	(1.06E+00)	(1.38E-01)	(2.31E-01)	(4.22E-03)	(1.10E-02)	(8.30E-01)	2.87E+00
Cu ICP-MS	mg/L	3.04E-02	2.28E-02	2.46E-02	1.83E-02	3.04E-02	2.28E-02	(4.53E-03)	5.58E-03	1.43E-02	2.44E-02	(4.63E-03)	6.53E-03	(4.89E-04)	(5.34E-04)	1.94E-02	4.06E-02
Cu ICP-OES	mg/L	(8.67E-02)	(6.94E-02)	(6.00E-02)	(4.39E-02)	(8.67E-02)	(6.94E-02)	(2.86E-02)	(2.57E-02)	(4.98E-02)	(4.91E-02)	(2.51E-02)	(3.62E-02)	(1.97E-02)	(2.37E-02)	(4.70E-02)	(1.03E-01)
Fe	mg/L	8.20E+00	5.33E+00	1.31E+00	1.12E+00	8.20E+00	5.33E+00	7.49E-01	1.04E+00	4.46E+00	8.20E+00	1.14E+00	1.84E+00	(1.12E-01)	(1.22E-01)	6.29E+00	2.22E+01
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mg	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mn	mg/L	1.69E+00	1.09E+00	2.86E-01	2.41E-01	1.69E+00	1.09E+00	1.65E-01	2.21E-01	9.70E-01	1.79E+00	2.55E-01	4.16E-01	<1.25E-01	<1.25E-01	1.43E+00	5.02E+00
Mo	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Mo 95	mg/L	1.20E-02	1.16E-02	1.77E-02	1.68E-02	1.20E-02	1.16E-02	2.36E-03	2.38E-03	3.00E-03	3.21E-03	9.19E-04	9.07E-04	6.49E-04	6.68E-04	3.05E-03	3.53E-03
Mo 97	mg/L	1.08E-02	1.06E-02	1.56E-02	1.48E-02	1.08E-02	1.06E-02	(1.68E-03)	(1.68E-03)	(2.17E-03)	(2.38E-03)	(5.99E-04)	(5.93E-04)	(4.26E-04)	(4.34E-04)	(2.31E-03)	2.99E-03
Mo 98	mg/L	7.14E-03	6.93E-03	1.01E-02	9.55E-03	7.14E-03	6.93E-03	1.02E-03	1.04E-03	1.35E-03	1.56E-03	(3.81E-04)	(3.82E-04)	(2.89E-04)	(2.51E-04)	1.48E-03	2.00E-03
Na	mg/L	2.15E+02	2.06E+02	2.31E+02	2.12E+02	2.15E+02	2.06E+02	3.85E+01	4.31E+01	3.53E+01	3.55E+01	1.87E+01	2.02E+01	9.48E+00	9.90E+00	2.62E+01	3.19E+01
Ni	mg/L	6.11E-01	(4.35E-01)	(1.52E-01)	(1.41E-01)	6.11E-01	(4.35E-01)	(1.09E-01)	(8.68E-02)	(4.10E-01)	7.23E-01	(1.14E-01)	(1.84E-01)	(1.14E-02)	(3.03E-03)	5.46E-01	2.06E+00
P	mg/L	1.46E+01	1.37E+01	1.62E+01	1.47E+01	1.46E+01	1.37E+01	5.15E+00	5.88E+00	5.22E+00	6.01E+00	1.89E+00	2.05E+00	(4.42E-01)	(5.07E-01)	2.09E+00	4.54E+00
Pb ICP-MS	mg/L	4.67E-01	3.61E-01	1.28E-01	1.17E-01	4.67E-01	3.61E-01	6.17E-02	8.40E-02	2.81E-01	5.84E-01	8.75E-02	1.24E-01	5.95E-03	9.21E-03	3.88E-01	1.60E+00
Pb ICP-OES	mg/L	(8.22E-01)	(4.85E-01)	(2.72E-01)	(1.61E-01)	(8.22E-01)	(4.85E-01)	(1.54E-01)	(1.90E-01)	(4.26E-01)	(5.49E-01)	(2.08E-01)	(2.62E-01)	(1.88E-01)	(2.21E-01)	(4.16E-01)	1.40E+00
Ru 101	mg/L	4.93E-03	4.43E-03	4.16E-03	3.81E-03	4.93E-03	4.43E-03	3.23E-04	3.81E-04	1.07E-03	1.76E-03	2.80E-04	3.95E-04	(3.00E-05)	(4.10E-05)	1.52E-03	4.90E-03
Ru 102	mg/L	2.26E-03	2.02E-03	1.93E-03	1.79E-03	2.26E-03	2.02E-03	1.51E-04	1.69E-04	4.82E-04	8.29E-04	1.19E-04	1.76E-04	(1.40E-05)	(1.80E-05)	7.05E-04	2.22E-03
S	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sb 121	mg/L	3.28E-02	2.65E-02	3.58E-02	3.58E-02	3.28E-02	2.65E-02	1.78E-02	1.88E-02	2.27E-02	2.55E-02	(9.02E-03)	(9.97E-03)	(2.88E-03)	(2.69E-03)	1.45E-02	2.34E-02
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Se 82	mg/L	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02	<5.00E-02
Si	mg/L	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01	<2.50E+01
Sr	mg/L	(1.68E-01)	(1.31E-01)	(7.86E-02)	(7.18E-02)	(1.68E-01)	(1.31E-01)	(4.51E-02)	(5.30E-02)	(8.96E-02)	(1.34E-01)	(3.76E-02)	(4.76E-02)	(6.73E-02)	(5.27E-02)	(1.14E-01)	(2.77E-01)
Ti	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Tl	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
V	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Zn	mg/L	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01	<6.25E-01
Zr	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Anions																	
NO_2^- as NO2-	mg/L	3.59E+00	3.81E+00	4.02E+00	3.40E+00	3.59E+00	3.81E+00	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	<9.40E-02	2.47E-01	2.49E-01
NO_3^- as NO3-	mg/L	9.80E+00	1.01E+01	1.46E+01	1.40E+01	9.80E+00	1.01E+01	7.84E-01	6.82E-01	2.95E+00	2.67E+00	1.07E+00	1.08E+00	9.91E-01	9.40E-01	7.92E+00	8.25E+00
CO_3^{2-}	mg/L	1.82E+02	1.91E+02	2.07E+02	1.97E+02	1.82E+02	1.91E+02	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
SO_4^{2-}	mg/L	1.55E+00	1.43E+00	1.93E+00	1.83E+00	1.55E+00	1.43E+00	2.80E-01	2.56E-01	1.41E-01	2.90E-01	1.65E-01	1.33E-01	1.86E-01	3.35E-01	2.73E-01	2.46E-01
PO_4^{3-} as PO_4^{3-}	mg/L	3.39E+01	3.45E+01	4.33E+01	3.92E+01	3.39E+01	3.45E+01	1.58E+01	1.54E+01	1.27E+01	1.36E+01	4.97E+00	5.92E+00	9.41E-01	8.40E-01	4.71E+00	8.95E+00
Cl^-	mg/L	2.14E-01	2.09E-01	7.67E-01	8.38E-01	2.14E-01	2.09E-01	6.43E-02	1.26E-01	5.67E-02	5.34E-02	4.56E-02	4.43E-02	4.03E-02	5.21E-02	2.10E+00	1.11E+00
F^-	mg/L	2.77E+01	2.45E+01	3.62E+01	3.24E+01	2.77E+01	2.45E+01	4.28E+00	5.96E+00	3.75E+00	4.76E+00	6.86E-01	8.97E-01	1.42E-01	1.35E-01	1.98E+00	2.39E+00
Oxalate*	mg/L	2.12E+02	2.00E+02	2.18E+02	2.08E+02	2.12E+02	2.00E+02	1.50E+01	2.03E+01	8.27E+00	1.00E+01	5.38E-01	8.90E-01	<3.45E-01	<3.45E-01	1.85E+00	5.34E+00

* Oxalate results are for information only

Tank C-202 (19250) CaCO3 Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	2.66E+00	2.66E+00	2.78E+00	2.82E+00	2.66E+00	2.66E+00	1.04E+00	1.00E+00	1.00E+00	1.00E+00	8.10E-01	7.33E-01	7.33E-01	7.71E-01	1.16E+00	1.20E+00
TIC	mM C	4.77E+00	4.44E+00	2.90E+00	3.47E+00	4.77E+00	4.44E+00	2.07E+00	2.09E+00	2.24E+00	2.24E+00	1.33E+00	1.45E+00	1.06E+00	1.02E+00		
TOC	mM C	8.58E+00	7.35E+00	7.93E+00	7.32E+00	8.58E+00	7.35E+00	9.51E-01	1.17E+00	2.31E+00	2.36E+00	7.21E-01	6.72E-01	3.55E-01	3.76E-01		
TC	mM C	1.34E+01	1.18E+01	1.08E+01	1.08E+01	1.34E+01	1.18E+01	3.02E+00	3.26E+00	4.55E+00	4.60E+00	2.06E+00	2.13E+00	1.42E+00	1.40E+00		
Radionuclides																	
^{90}Sr	mM	1.46E-05	1.10E-05	8.14E-06	8.02E-06	1.46E-05	1.10E-05			8.28E-06	1.05E-05					9.99E-06	2.04E-05
^{99}Tc	mM	(3.94E-07)	(3.74E-07)	(4.04E-07)	(4.14E-07)	(3.94E-07)	(3.74E-07)	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07	<5.05E-07
^{238}U	mM	2.43E-01	2.20E-01	2.16E-01	1.92E-01	2.43E-01	2.20E-01	4.15E-02	4.33E-02	7.79E-02	1.22E-01	3.69E-02	4.30E-02	3.32E-02	2.89E-02	8.70E-02	2.57E-01
^{239}Pu*	mM	1.33E-03	8.56E-04	4.00E-04	3.21E-04	1.33E-03	8.56E-04	1.35E-04	1.67E-04	6.36E-04	1.06E-03	2.07E-04	2.60E-04	3.11E-05	3.03E-05	1.04E-03	3.44E-03
^{237}Np*	mM	2.26E-06	1.68E-06	1.58E-06	1.59E-06	2.26E-06	1.68E-06	4.89E-07	4.98E-07	6.75E-07	1.04E-06	4.35E-07	4.43E-07	5.70E-07	5.61E-07	8.82E-07	2.26E-06
^{241}Am	mM	<1.33E-07	<7.47E-08	(3.32E-08)	(2.90E-08)	<1.33E-07	<7.47E-08	<2.07E-07	<8.30E-09	<5.81E-08	<1.12E-07	<8.30E-09	<2.07E-08	<2.07E-07	<2.07E-07	<1.08E-07	<4.23E-07
*Pu and Np results may be biased due to High Uranium Concentration.																	
Metals																	
Ag	mM	2.06E-06	1.73E-06	2.38E-06	2.16E-06	2.06E-06	1.73E-06	(1.44E-07)	(1.48E-07)	(6.35E-07)	1.40E-06	(1.21E-07)	(2.27E-07)	<9.27E-07	<9.27E-07	(8.58E-07)	3.80E-06
Al	mM	4.69E-02	4.44E-02	4.62E-02	3.99E-02	4.69E-02	4.44E-02	3.27E-02	3.59E-02	7.33E-02	8.41E-02	3.97E-02	4.69E-02	(1.03E-02)	(1.27E-02)	9.40E-02	1.58E-01
As	mM	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02	<6.67E-02
As 75	mM	(1.60E-05)	(1.68E-05)	(2.72E-05)	(2.07E-05)	(1.60E-05)	(1.68E-05)	<6.67E-05	<6.67E-05	(6.91E-06)	(7.33E-06)	(3.79E-06)	<6.67E-05	<6.67E-05	(4.09E-06)	(5.73E-06)	(1.00E-05)
B	mM	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00	<4.63E+00
Ba	mM	(2.15E-04)	(2.02E-04)	2.22E-03	1.72E-03	(2.15E-04)	(2.02E-04)	(1.55E-04)	(3.17E-04)	(1.88E-04)	(2.32E-04)	(1.68E-04)	(1.64E-04)	(1.48E-04)	(1.52E-04)	(2.35E-04)	(4.02E-04)
Be	mM	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01	<1.39E-01
Bi	mM	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01	<1.20E-01
Ca	mM	(7.30E-02)	(7.25E-02)	(4.30E-02)	(7.33E-02)	(7.30E-02)	(7.25E-02)	(5.08E-02)	(5.51E-02)	(6.03E-02)	(5.59E-02)	(4.63E-02)	(4.45E-02)	(1.51E-01)	(1.14E-01)	(8.51E-02)	(1.21E-01)
Cd ICP-MS	mM	1.65E-05	9.18E-06	3.12E-06	3.07E-06	1.65E-05	9.18E-06	1.57E-06	2.08E-06	8.43E-06	1.56E-05	2.29E-06	3.76E-06	(1.78E-07)	(3.11E-07)	1.31E-05	4.59E-05
Cd ICP-OES	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Co	mM	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02	<1.06E-02
Cr ICP-MS	mM	2.57E-02	2.36E-02	2.57E-02	2.47E-02	2.57E-02	2.36E-02	3.36E-03	4.00E-03	1.02E-02	1.92E-02	3.19E-03	4.72E-03	(4.01E-04)	(4.54E-04)	1.36E-02	3.85E-02
Cr ICP-OES	mM	3.60E-02	3.03E-02	3.16E-02	2.94E-02	3.60E-02	3.03E-02	(2.75E-03)	(3.43E-03)	(1.17E-02)	(2.05E-02)	(2.66E-03)	(4.44E-03)	(8.11E-05)	(2.11E-04)	(1.60E-02)	5.51E-02
Cu ICP-MS	mM	4.79E-04	3.59E-04	3.87E-04	2.87E-04	4.79E-04	3.59E-04	(7.13E-05)	8.78E-05	2.24E-04	3.85E-04	(7.29E-05)	1.03E-04	(7.69E-06)	(8.39E-06)	3.05E-04	6.39E-04
Cu ICP-OES	mM	(1.36E-03)	(1.09E-03)	(9.45E-04)	(6.90E-04)	(1.36E-03)	(1.09E-03)	(4.49E-04)	(4.04E-04)	(7.83E-04)	(7.72E-04)	(3.95E-04)	(5.70E-04)	(3.11E-04)	(3.73E-04)	(7.40E-04)	(1.62E-03)
Fe	mM	1.47E-01	9.54E-02	2.34E-02	2.00E-02	1.47E-01	9.54E-02	1.34E-02	1.86E-02	7.98E-02	1.47E-01	2.04E-02	3.30E-02	(2.00E-03)	(2.18E-03)	1.13E-01	3.98E-01
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01	<1.80E-01
Mg	mM	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02	<5.14E-02
Mn	mM	3.07E-02	1.99E-02	5.21E-03	4.39E-03	3.07E-02	1.99E-02	3.00E-03	4.02E-03	1.77E-02	3.25E-02	4.64E-03	7.57E-03	<2.28E-03	<2.28E-03	2.60E-02	9.15E-02
Mo	mM	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02	<1.30E-02
Mo 95	mM	1.26E-04	1.22E-04	1.87E-04	1.77E-04	1.26E-04	1.22E-04	2.48E-05	2.50E-05	3.15E-05	3.38E-05	9.67E-06	9.55E-06	6.83E-06	7.03E-06	3.21E-05	3.72E-05
Mo 97	mM	1.11E-04	1.09E-04	1.61E-04	1.52E-04	1.11E-04	1.09E-04	(1.73E-05)	(1.73E-05)	(2.23E-05)	(2.45E-05)	(6.18E-06)	(6.11E-06)	(4.39E-06)	(4.47E-06)	(2.38E-05)	3.08E-05
Mo 98	mM	7.28E-05	7.07E-05	1.03E-04	9.75E-05	7.28E-05	7.07E-05	1.04E-05	1.06E-05	1.38E-05	1.59E-05	(3.89E-06)	(3.90E-06)	(2.95E-06)	(2.56E-06)	1.51E-05	2.04E-05
Na	mM	9.36E+00	8.94E+00	1.00E+01	9.21E+00	9.36E+00	8.94E+00	1.67E+00	1.87E+00	1.54E+00	1.54E+00	8.15E-01	8.79E-01	4.13E-01	4.30E-01	1.14E+00	1.39E+00
Ni	mM	1.04E-02	(7.41E-03)	(2.59E-03)	(2.40E-03)	1.04E-02	(7.41E-03)	(1.85E-03)	(1.48E-03)	(6.99E-03)	1.23E-02	(1.95E-03)	(3.13E-03)	(1.95E-04)	(5.15E-05)	9.30E-03	3.51E-02
P	mM	4.71E-01	4.42E-01	5.25E-01	4.74E-01	4.71E-01	4.42E-01	1.66E-01	1.90E-01	1.69E-01	1.94E-01	6.12E-02	6.61E-02	(1.43E-02)	(1.64E-02)	6.73E-02	1.46E-01
Pb	mM	2.26E-03	1.74E-03	6.19E-04	5.66E-04	2.26E-03	1.74E-03	2.98E-04	4.06E-04	1.36E-03	2.82E-03	4.22E-04	6.00E-04	2.87E-05	4.45E-05	1.87E-03	7.71E-03
Pb	mM	(3.97E-03)	(2.34E-03)	(1.31E-03)	(7.78E-04)	(3.97E-03)	(2.34E-03)	(7.45E-04)	(9.16E-04)	(2.06E-03)	(2.65E-03)	(1.00E-03)	(1.26E-03)	(9.06E-04)	(1.07E-03)	(2.01E-03)	6.74E-03
Ru 101	mM	4.88E-05	4.39E-05	4.12E-05	3.77E-05	4.88E-05	4.39E-05	3.20E-06	3.77E-06	1.06E-05	1.75E-05	2.77E-06	3.91E-06	(2.97E-07)	(4.06E-07)	1.51E-05	4.85E-05
Ru 102	mM	2.22E-05	1.98E-05	1.89E-05	1.75E-05	2.22E-05	1.98E-05	1.48E-06	1.66E-06	4.73E-06	8.13E-06	1.17E-06	1.73E-06	(1.37E-07)	(1.76E-07)	6.91E-06	2.17E-05
S	mM	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00	<3.12E+00
Sb 121	mM	2.71E-04	2.19E-04	2.96E-04	2.96E-04	2.71E-04	2.19E-04	1.47E-04	1.55E-04	1.87E-04	2.10E-04	(7.45E-05)	(8.24E-05)	(2.38E-05)	(2.22E-05)	1.20E-04	1.93E-04
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Se 82	mM	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04	<6.10E-04
Si	mM	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01	<8.90E-01
Sr	mM	(1.92E-03)	(1.49E-03)	(8.97E-04)	(8.19E-04)	(1.92E-03)	(1.49E-03)	(5.15E-04)	(6.05E-04)	(1.02E-03)	(1.53E-03)	(4.29E-04)	(5.44E-04)	(7.68E-04)	(6.01E-04)	(1.30E-03)	(3.16E-03)
Ti	mM	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03	<5.22E-03
Tl	mM	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02	<1.22E-02
V	mM	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02	<1.23E-02
Zn	mM	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03	<9.56E-03
Zr	mM	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03	<2.74E-03
Anions																	
NO_2^- as NO2-	mM	7.81E-02	8.27E-02	8.74E-02	7.39E-02	7.81E-02	8.27E-02	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	<2.04E-03	5.37E-03	5.41E-03
NO_3^- as NO3-	mM	1.58E-01	1.62E-01	2.36E-01	2.25E-01	1.58E-01	1.62E-01	1.26E-02	1.10E-02	4.76E-02	4.30E-02	1.72E-02	1.74E-02	1.60E-02	1.52E-02	1.28E-01	1.33E-01
CO_3^{2-}	mM	3.03E+00	3.18E+00	3.45E+00	3.28E+00	3.03E+00	3.18E+00	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01	<8.33E-01
SO_4^{2-}	mM	1.62E-02	1.49E-02	2.01E-02	1.90E-02	1.62E-02	1.49E-02	2.92E-03	2.66E-03	1.47E-03	3.02E-03	1.72E-03	1.38E-03	1.94E-03	3.49E-03	2.84E-03	2.56E-03
PO_4^{3-} as PO_4^{3-}	mM	3.57E-01	3.64E-01	4.56E-01	4.13E-01	3.57E-01	3.64E-01	1.66E-01	1.62E-01	1.34E-01	1.44E-01	5.23E-02	6.23E-02	9.91E-03	8.85E-03	4.96E-02	9.42E-02
Cl^-	mM	6.05E-03	5.91E-03	2.16E-02	2.36E-02	6.05E-03	5.91E-03	1.81E-03	3.55E-03	1.60E-03	1.51E-03	1.29E-03	1.25E-03	1.14E-03	1.47E-03	5.92E-02	3.12E-02
F^-	mM	1.46E+00	1.29E+00	1.91E+00	1.71E+00	1.46E+00	1.29E+00	2.25E-01	3.14E-01	1.97E-01	2.51E-01	3.61E-02	4.72E-02	7.45E-03	7.11E-03	1.04E-01	1.26E-01
Oxalate*	mM	2.41E+00	2.27E+00	2.47E+00	2.37E+00	2.41E+00	2.27E+00	1.70E-01	2.31E-01	9.39E-02	1.14E-01	6.12E-03	1.01E-02	<3.92E-03	<3.92E-03	2.10E-02	6.07E-02

* Oxalate results are for information only

Tank C-203 (19887) $CaCO_3$ Leach Results

Parameter	Units	Single Contact 1 day	1 day (dup)	1 month	1 month (dup)	Periodic Replenishment Tests Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	9.93	10.34	10.40	10.49	9.93	10.34	10.19	9.82	9.49	9.68	9.57	9.49	9.49	8.92	9.71	9.28
Alkalinity	mg/L as CaCO3	6.25E+02	6.02E+02	7.57E+02	7.03E+02	6.25E+02	6.02E+02	2.55E+02	2.01E+02	1.62E+02	1.62E+02	1.24E+02	1.24E+02	1.24E+02	1.24E+02	2.01E+02	1.62E+02
TIC	mg C/L	7.54E+01	6.48E+01	7.80E+01	7.75E+01	7.54E+01	6.48E+01	2.36E+01	2.18E+01	1.84E+01	1.83E+01	1.45E+01	1.31E+01	1.29E+01	1.22E+01	1.72E+01	1.77E+01
TOC	mg C/L	4.16E+01	4.46E+01	3.61E+01	3.74E+01	4.16E+01	4.46E+01	6.61E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	1.17E+02	1.09E+02	1.14E+02	1.15E+02	1.17E+02	1.09E+02	3.02E+01	2.18E+01	1.84E+01	1.83E+01	1.45E+01	1.31E+01	1.29E+01	1.22E+01	1.72E+01	1.77E+01
Radionuclides																	
^{90}Sr	µCi/L	7.55E+00	1.24E+01	2.20E+01	1.80E+01	7.55E+00	1.24E+01			3.33E+00	7.18E+00					1.39E+01	1.21E+01
^{99}Tc	mg/L	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	(1.60E-04)	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04
^{238}U	mg/L	1.26E+02	1.73E+02	4.49E+02	1.50E+02	1.26E+02	1.73E+02	1.39E+02	2.99E+01	2.66E+01	4.37E+01	3.32E+01	2.19E+01	2.67E+01	1.30E+01	2.37E+02	1.75E+02
^{239}Pu*	µCi/L	6.42E-01	1.37E+00	2.80E+00	6.96E-01	6.42E-01	1.37E+00	1.21E+00	(1.46E-01)	(1.48E-01)	4.27E-01	(1.55E-01)	(7.44E-02)	(1.07E-01)	(3.78E-02)	1.31E+00	8.08E-01
^{237}Np*	µCi/L	(1.17E-04)	(1.99E-04)	(4.83E-04)	(1.21E-04)	(1.17E-04)	(1.99E-04)	(2.20E-04)	<7.10E-04	<7.10E-04	(1.21E-04)	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	(2.63E-04)	(2.34E-04)
^{241}Am	µCi/L	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	<1.00E-03	<1.00E-03	(3.70E-04)	(1.90E-04)	<1.00E-03	<1.00E-03	<1.00E-03	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-03	<1.00E-02
Al	mg/L	(1.09E+00)	(1.12E+00)	(1.41E+00)	(1.56E+00)	(1.09E+00)	(1.12E+00)	(4.71E-01)	(3.91E-01)	(2.48E-01)	(1.96E-01)	(2.09E-01)	(2.50E-01)	<2.50E+00	<2.50E+00	(1.09E+00)	(7.59E-01)
As	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As 75	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
B	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Ba	mg/L	(6.91E-02)	(9.14E-02)	(1.08E-01)	(6.12E-02)	(6.91E-02)	(9.14E-02)	(1.31E-01)	(1.63E-01)	(7.06E-02)	(1.25E-01)	(1.33E-02)	(5.36E-02)	(4.50E-02)	(2.39E-02)	(4.73E-01)	(7.79E-02)
Be	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ca	mg/L	(1.34E+00)	(1.54E+00)	(3.65E+00)	(8.84E-01)	(1.34E+00)	(1.54E+00)	(2.89E+00)	(5.09E-01)	(5.21E-01)	(1.38E+00)	(5.42E-01)	(5.43E-01)	(3.76E-01)	(1.20E+00)	(3.62E+00)	(2.90E+00)
Cd	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cd 114	mg/L	(5.80E-04)	(8.30E-04)	(2.02E-03)	(4.30E-04)	(5.80E-04)	(8.30E-04)	(1.31E-03)	<2.50E-03	(1.90E-04)	(3.40E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<1.00E-05	(8.80E-04)	(4.90E-04)
Co	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Cr	mg/L	4.39E+00	6.82E+00	1.37E+01	5.61E+00	4.39E+00	6.82E+00	8.30E+00	8.00E-01	9.01E-01	1.80E+00	8.04E-01	(2.47E-01)	(4.88E-01)	(8.44E-02)	5.19E+00	2.67E+00
Cr 53 *	mg/L	4.32E+00	6.55E+00	1.18E+01	5.69E+00	4.32E+00	6.55E+00	8.12E+00	8.47E-01	9.94E-01	1.79E+00	8.66E-01	2.75E-01	5.58E-01	1.28E-01	5.28E+00	2.60E+00
Cu	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Cu 65	mg/L	4.53E-02	5.17E-02	7.69E-02	2.85E-02	4.53E-02	5.17E-02	6.55E-02	2.96E-02	(1.38E-02)	4.38E-02	2.68E-02	2.61E-02	(1.61E-02)	(2.35E-02)	6.61E-02	5.64E-02
Fe	mg/L	1.88E+00	4.52E+00	8.50E+00	2.38E+00	1.88E+00	4.52E+00	5.36E+00	(6.79E-01)	(6.63E-01)	1.50E+00	(6.56E-01)	(3.56E-01)	(4.22E-01)	(2.06E-01)	3.49E+00	2.15E+00
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Mg	mg/L	<5.00E+00	<5.00E+00	(7.58E-01)	<5.00E+00	<5.00E+00	<5.00E+00	(5.41E-01)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mn	mg/L	3.29E-01	7.41E-01	1.47E+00	4.03E-01	3.29E-01	7.41E-01	1.01E+00	(9.77E-02)	(9.53E-02)	(2.30E-01)	(8.78E-02)	(2.60E-02)	(5.59E-02)	<2.50E-01	5.98E-01	3.38E-01
Mo	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mo 95	mg/L	(4.64E-03)	(4.07E-03)	5.07E-03	(4.98E-03)	(4.64E-03)	(4.07E-03)	(8.30E-04)	(7.40E-04)	(4.80E-04)	(5.60E-04)	(1.70E-04)	(1.50E-04)	(2.10E-04)	(1.90E-04)	(8.90E-04)	(6.50E-04)
Mo 97	mg/L	(3.65E-03)	(3.49E-03)	(4.67E-03)	(4.37E-03)	(3.65E-03)	(3.49E-03)	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Mo 98	mg/L	(3.42E-03)	(3.09E-03)	<5.00E-03	<5.00E-03	(3.42E-03)	(3.09E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Na	mg/L	3.50E+02	3.27E+02	3.80E+02	3.32E+02	3.50E+02	3.27E+02	1.06E+02	7.26E+01	5.00E+01	5.94E+01	3.82E+01	3.53E+01	3.03E+01	2.56E+01	5.00E+01	4.74E+01
Ni	mg/L	<5.00E+00	(7.15E-01)	(1.03E+00)	<5.00E+00	<5.00E+00	(7.15E-01)	(7.14E-01)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	(6.15E-01)	<5.00E+00
P	mg/L	8.10E+01	8.08E+01	8.38E+01	5.97E+01	8.10E+01	8.08E+01	4.60E+01	2.81E+01	1.69E+01	2.28E+01	1.17E+01	9.63E+00	7.71E+00	(5.18E+00)	1.74E+01	1.66E+01
Pb	mg/L	1.13E+00	1.84E+00	3.98E+00	(9.58E-01)	1.13E+00	1.84E+00	2.63E+00	(4.81E-01)	(4.46E-01)	(9.43E-01)	(4.40E-01)	(1.29E-01)	(2.81E-01)	(1.53E-01)	2.10E+00	1.25E+00
Pb 206 *	mg/L	8.35E-01	1.88E+00	3.50E+00	9.63E-01	8.35E-01	1.88E+00	2.50E+00	3.02E-01	2.99E-01	7.58E-01	2.85E-01	1.25E-01	1.87E-01	5.77E-02	1.86E+00	1.14E+00
Ru 101	mg/L	(2.28E-03)	(2.54E-03)	(4.49E-03)	(2.86E-03)	(2.28E-03)	(2.54E-03)	(1.67E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	(1.53E-03)	(1.15E-03)
Ru 102	mg/L	(1.01E-03)	(1.26E-03)	(2.17E-03)	(1.21E-03)	(1.01E-03)	(1.26E-03)	(7.60E-04)	(2.20E-04)	(2.80E-04)	(3.80E-04)	(2.60E-04)	<2.50E-03	<2.50E-03	<2.50E-03	(8.60E-04)	(6.75E-04)
S	mg/L	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02
Sb 121	mg/L	9.22E-03	1.31E-02	1.91E-02	9.20E-03	9.22E-03	1.31E-02	1.28E-02	5.84E-03	5.42E-03	6.76E-03	(5.13E-03)	(3.52E-03)	(3.91E-03)	(2.39E-03)	7.76E-03	6.04E-03
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Si	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sr	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ti	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Tl	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
V	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Zn	mg/L	(5.09E-01)	(5.28E-01)	(9.20E-01)	(4.99E-01)	(5.09E-01)	(5.28E-01)	(6.35E-01)	(5.27E-01)	(6.21E-01)	(6.92E-01)	(5.21E-01)	(6.20E-01)	(5.25E-01)	(5.29E-01)	(5.99E-01)	(5.11E-01)
Zr	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
* Cr 53 and Pb206 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	5.62E+00	<4.51E+00	5.55E+00	6.16E+00	5.62E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00
NO_3^- as NO3-	mg/L	5.32E+01	4.35E+01	5.16E+01	5.94E+01	5.32E+01	4.35E+01	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	5.47E+01	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00
CO_3^{2-} *	mg/L	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02
SO_4^{2-}	mg/L	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00
PO_4^{3-} as PO_4^{3-} *	mg/L	2.19E+02	2.12E+02	1.95E+02	1.91E+02	2.19E+02	2.12E+02	1.36E+02	9.17E+01	5.50E+01	6.31E+01	3.86E+01	3.28E+01	2.45E+01	1.66E+01	3.52E+01	4.38E+01
Cl^-	mg/L	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00
F^-	mg/L	3.60E+01	3.19E+01	3.89E+01	3.76E+01	3.60E+01	3.19E+01	3.58E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00
Oxalate*	mg/L	1.66E+01	1.63E+01	1.94E+01	2.12E+01	1.66E+01	1.63E+01	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19887) $CaCO_3$ Leach Results																	
		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	6.25E+00	6.02E+00	7.56E+00	7.02E+00	6.25E+00	6.02E+00	2.55E+00	2.01E+00	1.62E+00	1.62E+00	1.23E+00	1.23E+00	1.23E+00	1.23E+00	2.01E+00	1.62E+00
TIC	mM C	6.28E+00	5.40E+00	6.50E+00	6.45E+00	6.28E+00	5.40E+00	1.96E+00	1.82E+00	1.53E+00	1.53E+00	1.21E+00	1.09E+00	1.07E+00	1.01E+00		
TOC	mM C	3.47E+00	3.71E+00	3.01E+00	3.11E+00	3.47E+00	3.71E+00	5.51E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	9.75E+00	9.11E+00	9.50E+00	9.57E+00	9.75E+00	9.11E+00	2.52E+00	1.82E+00	1.53E+00	1.53E+00	1.21E+00	1.09E+00	1.07E+00	1.01E+00		
Radionuclides																	
^{90}Sr	mM	5.99E-07	9.87E-07	1.75E-06	1.43E-06	5.99E-07	9.87E-07			2.65E-07	5.70E-07					1.11E-06	9.57E-07
^{99}Tc	mM	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	(1.62E-06)	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06
^{238}U	mM	5.31E-01	7.29E-01	1.89E+00	6.29E-01	5.31E-01	7.29E-01	5.84E-01	1.26E-01	1.12E-01	1.84E-01	1.39E-01	9.21E-02	1.12E-01	5.44E-02	9.97E-01	7.35E-01
^{239}Pu*	mM	4.33E-04	9.28E-04	1.89E-03	4.70E-04	4.33E-04	9.28E-04	8.16E-04	(9.87E-05)	(1.00E-04)	2.88E-04	(1.05E-04)	(5.02E-05)	(7.24E-05)	(2.55E-05)	8.83E-04	5.45E-04
^{237} Np*	mM	(6.96E-07)	(1.18E-06)	(2.87E-06)	(7.17E-07)	(6.96E-07)	(1.18E-06)	(1.31E-06)	<4.22E-06	<4.22E-06	(7.17E-07)	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	(1.56E-06)	(1.39E-06)
^{241}Am	mM	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	<9.35E-06	<9.35E-06	(3.46E-06)	(1.78E-06)	<9.35E-06	<9.35E-06	<9.35E-06	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-06	<9.35E-05
Al	mM	(4.04E-02)	(4.15E-02)	(5.22E-02)	(5.79E-02)	(4.04E-02)	(4.15E-02)	(1.75E-02)	(1.45E-02)	(9.18E-03)	(7.26E-03)	(7.76E-03)	(9.26E-03)	<9.27E-02	<9.27E-02	(4.06E-02)	(2.81E-02)
As	mM	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02
As 75	mM	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03
B	mM	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01
Ba	mM	(5.03E-04)	(6.66E-04)	(7.85E-04)	(4.45E-04)	(5.03E-04)	(6.66E-04)	(9.52E-04)	(1.19E-03)	(5.14E-04)	(9.13E-04)	(9.67E-05)	(3.90E-04)	(3.28E-04)	(1.74E-04)	(3.45E-03)	(5.68E-04)
Be	mM	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02
Bi	mM	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02
Ca	mM	(3.35E-02)	(3.85E-02)	(9.11E-02)	(2.21E-02)	(3.35E-02)	(3.85E-02)	(7.22E-02)	(1.27E-02)	(1.30E-02)	(3.44E-02)	(1.35E-02)	(1.35E-02)	(9.38E-03)	(2.98E-02)	(9.03E-02)	(7.23E-02)
Cd	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Cd 114	mM	(5.09E-06)	(7.28E-06)	(1.77E-05)	(3.77E-06)	(5.09E-06)	(7.28E-06)	(1.15E-05)	<2.19E-05	(1.67E-06)	(2.98E-06)	<2.19E-05	<2.19E-05	<2.19E-05	<8.77E-08	(7.72E-06)	(4.30E-06)
Co	mM	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02
Cr	mM	8.45E-02	1.31E-01	2.63E-01	1.08E-01	8.45E-02	1.31E-01	1.60E-01	1.54E-02	1.73E-02	3.46E-02	1.55E-02	(4.75E-03)	(9.38E-03)	(1.62E-03)	9.99E-02	5.13E-02
Cr 53 *	mM	8.14E-02	1.24E-01	2.23E-01	1.07E-01	8.14E-02	1.24E-01	1.53E-01	1.60E-02	1.87E-02	3.39E-02	1.63E-02	5.19E-03	1.05E-02	2.42E-03	9.96E-02	4.91E-02
Cu	mM	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00
Cu 65	mM	6.97E-04	7.96E-04	1.18E-03	4.39E-04	6.97E-04	7.96E-04	1.01E-03	4.55E-04	(2.13E-04)	6.73E-04	4.12E-04	4.01E-04	(2.47E-04)	(3.62E-04)	1.02E-03	8.68E-04
Fe	mM	3.36E-02	8.09E-02	1.52E-01	4.26E-02	3.36E-02	8.09E-02	9.60E-02	(1.21E-02)	(1.19E-02)	2.69E-02	(1.17E-02)	(6.37E-03)	(7.56E-03)	(3.69E-03)	6.26E-02	3.85E-02
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00
Mg	mM	<2.06E-01	<2.06E-01	(3.12E-02)	<2.06E-01	<2.06E-01	<2.06E-01	(2.23E-02)	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01
Mn	mM	5.99E-03	1.35E-02	2.67E-02	7.34E-03	5.99E-03	1.35E-02	1.83E-02	(1.78E-03)	(1.73E-03)	(4.19E-03)	(1.60E-03)	(4.73E-04)	(1.02E-03)	<4.55E-03	1.09E-02	6.15E-03
Mo	mM	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02
Mo 95	mM	(4.64E-05)	(4.07E-05)	5.07E-05	(4.98E-05)	(4.64E-05)	(4.07E-05)	(8.30E-06)	(7.40E-06)	(4.80E-06)	(5.60E-06)	(1.70E-06)	(1.50E-06)	(2.10E-06)	(1.90E-06)	(8.90E-06)	(6.50E-06)
Mo 97	mM	(3.84E-05)	(3.67E-05)	(4.92E-05)	(4.60E-05)	(3.84E-05)	(3.67E-05)	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04
Mo 98	mM	(3.48E-05)	(3.15E-05)	<5.10E-05	<5.10E-05	(3.48E-05)	(3.15E-05)	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05
Na	mM	1.52E+01	1.42E+01	1.65E+01	1.45E+01	1.52E+01	1.42E+01	4.63E+00	3.16E+00	2.18E+00	2.58E+00	1.66E+00	1.54E+00	1.32E+00	1.12E+00	2.17E+00	2.06E+00
Ni	mM	<8.52E-02	(1.22E-02)	(1.75E-02)	<8.52E-02	<8.52E-02	(1.22E-02)	(1.22E-02)	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	(1.05E-02)	<8.52E-02
P	mM	2.61E+00	2.61E+00	2.71E+00	1.93E+00	2.61E+00	2.61E+00	1.48E+00	9.07E-01	5.47E-01	7.36E-01	3.79E-01	3.11E-01	2.49E-01	(1.67E-01)	5.62E-01	5.37E-01
Pb	mM	5.46E-03	8.90E-03	1.92E-02	(4.62E-03)	5.46E-03	8.90E-03	1.27E-02	(2.32E-03)	(2.15E-03)	(4.55E-03)	(2.12E-03)	(6.24E-04)	(1.36E-03)	(7.37E-04)	1.01E-02	6.03E-03
Pb 206 *	mM	4.05E-03	9.15E-03	1.70E-02	4.68E-03	4.05E-03	9.15E-03	1.21E-02	1.47E-03	1.45E-03	3.68E-03	1.38E-03	6.07E-04	9.10E-04	2.80E-04	9.01E-03	5.52E-03
Ru 101	mM	(2.26E-05)	(2.51E-05)	(4.45E-05)	(2.83E-05)	(2.26E-05)	(2.51E-05)	(1.65E-05)	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	(1.51E-05)	(1.14E-05)
Ru 102	mM	(9.90E-06)	(1.24E-05)	(2.13E-05)	(1.19E-05)	(9.90E-06)	(1.24E-05)	(7.45E-06)	(2.16E-06)	(2.75E-06)	(3.73E-06)	(2.55E-06)	<2.45E-05	<2.45E-05	<2.45E-05	(8.43E-06)	(6.62E-06)
S	mM	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00
Sb 121	mM	7.62E-05	1.08E-04	1.58E-04	7.60E-05	7.62E-05	1.08E-04	1.06E-04	4.83E-05	4.48E-05	5.58E-05	(4.24E-05)	(2.91E-05)	(3.23E-05)	(1.98E-05)	6.41E-05	4.99E-05
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Si	mM	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00
Sr	mM	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02
Ti	mM	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02
Tl	mM	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02
V	mM	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02
Zn	mM	(7.79E-03)	(8.08E-03)	(1.41E-02)	(7.63E-03)	(7.79E-03)	(8.08E-03)	(9.71E-03)	(8.06E-03)	(9.49E-03)	(1.06E-02)	(7.96E-03)	(9.48E-03)	(8.03E-03)	(8.09E-03)	(9.16E-03)	(7.81E-03)
Zr	mM	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02
* Cr 53 and Pb206 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	1.22E-01	<9.80E-02	1.21E-01	1.34E-01	1.22E-01	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02
NO_3^- as NO3-	mM	8.58E-01	7.02E-01	8.33E-01	9.57E-01	8.58E-01	7.02E-01	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	8.81E-01	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02
CO_3^{2-} *	mM	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00
SO_4^{2-}	mM	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02
PO_4^{3-} as PO_4^{3-} *	mM	2.30E+00	2.23E+00	2.05E+00	2.01E+00	2.30E+00	2.23E+00	1.43E+00	9.65E-01	5.79E-01	6.64E-01	4.07E-01	3.45E-01	2.58E-01	1.75E-01	3.70E-01	4.61E-01
Cl^-	mM	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02
F^-	mM	1.89E+00	1.68E+00	2.05E+00	1.98E+00	1.89E+00	1.68E+00	1.88E-01	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02
Oxalate*	mM	1.89E-01	1.86E-01	2.20E-01	2.41E-01	1.89E-01	1.86E-01	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19961) $CaCO_3$ Leach Results

Parameter	Units	Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units	10.52	10.33	10.51	10.69	10.52	10.33	9.94	10.02	9.58	9.72	8.15	9.09	8.96	8.31	8.80	8.04
Alkalinity	mg/L as CaCO3	5.64E+02	5.56E+02	6.95E+02	7.10E+02	5.64E+02	5.56E+02	1.85E+02	2.01E+02	1.31E+02	1.62E+02	1.00E+02	1.24E+02	1.24E+02	1.00E+02	1.54E+02	1.24E+02
TIC	mg C/L	5.12E+01	5.37E+01	5.76E+01	5.16E+01	5.12E+01	5.37E+01	2.05E+01	1.92E+01	1.96E+01	1.64E+01	1.30E+01	1.37E+01	1.38E+01	1.20E+01	1.79E+01	1.34E+01
TOC	mg C/L	4.68E+01	4.79E+01	4.08E+01	4.16E+01	4.68E+01	4.79E+01	6.16E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00	<4.82E+00
TC	mg C/L	9.80E+01	1.02E+02	9.84E+01	9.32E+01	9.80E+01	1.02E+02	2.66E+01	1.92E+01	1.96E+01	1.64E+01	1.30E+01	1.37E+01	1.38E+01	1.20E+01	1.79E+01	1.34E+01
Radionuclides																	
^{90}Sr	µCi/L	8.46E+00	1.65E+01	2.90E+01	3.14E+01	8.46E+00	1.65E+01			2.97E+00	5.76E+00					1.23E+01	2.10E+00
^{99}Tc	mg/L	<5.00E-04	(7.00E-05)	(1.60E-04)	(9.00E-05)	<5.00E-04	(7.00E-05)	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04	<5.00E-04
^{238}U	mg/L	2.29E+02	1.93E+02	4.35E+02	5.05E+02	2.29E+02	1.93E+02	7.71E+01	3.73E+01	2.59E+01	6.05E+01	1.18E+01	1.35E+01	2.08E+01	9.55E+00	1.70E+02	1.92E+01
^{239}Pu*	µCi/L	2.56E+00	2.23E+00	3.80E+00	4.62E+00	2.56E+00	2.23E+00	6.24E-01	(2.75E-01)	(1.85E-01)	(3.09E-01)	(5.58E-02)	(6.20E-02)	(8.87E-02)	(3.16E-02)	8.26E-01	(1.71E-01)
^{237}Np*	µCi/L	(2.34E-04)	(1.92E-04)	(5.25E-04)	(5.75E-04)	(2.34E-04)	(1.92E-04)	(7.81E-05)	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04	<7.10E-04
^{241}Am	µCi/L	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02	<1.70E+02
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mg/L	(4.40E-04)	(3.90E-04)	(7.80E-04)	(6.20E-04)	(4.40E-04)	(3.90E-04)	(1.30E-04)	(3.00E-05)	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Al	mg/L	(8.43E-01)	(7.38E-01)	(1.11E+00)	(1.03E+00)	(8.43E-01)	(7.38E-01)	(2.45E-01)	(2.24E-01)	(2.79E-01)	(3.10E-01)	<2.50E+00	(2.59E-01)	<2.50E+00	<2.50E+00	(7.29E-01)	(9.90E-01)
As	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
As 75	mg/L	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01	<1.00E-01
B	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Ba	mg/L	(1.58E-01)	(1.63E-01)	(1.01E-01)	(3.29E-02)	(1.58E-01)	(1.63E-01)	(1.76E-01)	(2.96E-02)	(2.00E-01)	(8.73E-02)	(3.80E-02)	(5.48E-02)	(1.30E-01)	(3.42E-02)	(4.65E-02)	(1.57E-01)
Be	mg/L	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01	<5.00E-01
Bi	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ca	mg/L	(1.97E+00)	(2.54E+00)	(4.30E+00)	(4.63E+00)	(1.97E+00)	(2.54E+00)	(1.19E+00)	(2.33E-01)	(2.36E-01)	(5.24E-01)	(7.83E-01)	(6.10E-01)	(2.59E-01)	(1.83E-01)	(2.81E+00)	(5.15E-01)
Cd	mg/L	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01	<2.50E-01
Cd 114	mg/L	(2.10E-03)	(1.67E-03)	2.74E-03	3.53E-03	(2.10E-03)	(1.67E-03)	(7.70E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<5.00E-05	<2.50E-03	<4.00E-05	<5.00E-05	<2.50E-03	<1.00E-05
Co	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Cr	mg/L	9.98E+00	1.03E+01	1.43E+01	1.64E+01	9.98E+00	1.03E+01	1.75E+00	(5.61E-01)	(4.01E-01)	(5.42E-01)	(5.48E-02)	(4.78E-02)	(1.12E-01)	<6.25E-01	1.48E+00	(1.66E-01)
Cr 53 *	mg/L	9.08E+00	8.78E+00	1.18E+01	1.31E+01	9.08E+00	8.78E+00	1.69E+00	6.43E-01	4.19E-01	5.17E-01	1.07E-01	8.76E-02	1.47E-01	(3.51E-02)	1.40E+00	2.01E-01
Cu	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Cu 65	mg/L	6.97E-02	7.48E-02	1.27E-01	1.09E-01	6.97E-02	7.48E-02	7.32E-02	(2.29E-02)	4.54E-02	8.00E-02	(1.86E-02)	2.59E-02	3.32E-02	3.58E-02	8.14E-02	(1.96E-02)
Fe	mg/L	8.69E+00	8.91E+00	1.35E+01	1.65E+01	8.69E+00	8.91E+00	2.24E+00	(8.39E-01)	(5.41E-01)	(7.32E-01)	(2.55E-01)	(2.97E-01)	(2.61E-01)	(1.16E-01)	1.73E+00	(2.07E-01)
K	mg/L	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02	<1.25E+02
Li	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
Mg	mg/L	(5.66E-01)	(5.90E-01)	(8.12E-01)	(9.48E-01)	(5.66E-01)	(5.90E-01)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	(2.78E+00)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mn	mg/L	1.36E+00	1.39E+00	1.98E+00	2.39E+00	1.36E+00	1.39E+00	3.09E-01	(9.69E-02)	(5.89E-02)	(8.15E-02)	(2.29E-02)	(1.44E-02)	(2.44E-02)	<2.50E-01	(2.31E-01)	<2.50E-01
Mo	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Mo 95	mg/L	(4.95E-03)	5.24E-03	6.33E-03	6.16E-03	(4.95E-03)	5.24E-03	(6.50E-04)	(5.20E-04)	(4.50E-04)	(4.20E-04)	(9.00E-05)	(1.80E-04)	(1.50E-04)	(1.20E-04)	(6.20E-04)	(4.10E-04)
Mo 97	mg/L	(4.79E-03)	(4.69E-03)	(5.70E-03)	(5.93E-03)	(4.79E-03)	(4.69E-03)	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02	<1.00E-02
Mo 98	mg/L	<5.00E-03	<5.00E-03	5.09E-03	5.04E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03
Na	mg/L	2.96E+02	2.97E+02	3.62E+02	3.61E+02	2.96E+02	2.97E+02	7.28E+01	6.47E+01	4.27E+01	4.71E+01	2.37E+01	2.68E+01	2.52E+01	1.96E+01	3.89E+01	2.69E+01
Ni	mg/L	(1.19E+00)	(1.15E+00)	(1.66E+00)	(1.88E+00)	(1.19E+00)	(1.15E+00)	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
P	mg/L	7.97E+01	8.17E+01	9.29E+01	9.64E+01	7.97E+01	8.17E+01	3.03E+01	2.53E+01	1.47E+01	1.46E+01	(4.02E+00)	(5.47E+00)	(5.11E+00)	(2.32E+00)	1.23E+01	(4.68E+00)
Pb	mg/L	3.41E+00	3.51E+00	5.58E+00	6.68E+00	3.41E+00	3.51E+00	1.16E+00	(6.43E-01)	(2.35E-01)	(6.49E-01)	(1.34E-01)	(1.63E-01)	(8.55E-02)	(1.69E-01)	1.26E+00	(3.51E-01)
Pb 206 *	mg/L	3.32E+00	3.03E+00	4.48E+00	5.07E+00	3.32E+00	3.03E+00	9.53E-01	4.04E-01	2.65E-01	4.71E-01	7.38E-02	8.06E-02	1.24E-01	2.64E-02	1.20E+00	1.23E-01
Ru 101	mg/L	(3.16E-03)	(2.64E-03)	5.05E-03	5.63E-03	(3.16E-03)	(2.64E-03)	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	<5.00E-03	(1.24E-03)	<5.00E-03
Ru 102	mg/L	(1.53E-03)	(1.14E-03)	2.64E-03	2.98E-03	(1.53E-03)	(1.14E-03)	(5.90E-04)	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03	<2.50E-03
S	mg/L	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02	<2.00E+02
Sb 121	mg/L	1.71E-02	1.40E-02	1.67E-02	1.90E-02	1.71E-02	1.40E-02	7.87E-03	6.95E-03	(5.11E-03)	(5.33E-03)	(1.61E-03)	(3.19E-03)	(3.20E-03)	(1.93E-03)	(4.48E-03)	(2.95E-03)
Se	mg/L	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01	<5.00E+01
Si	mg/L	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02	<1.00E+02
Sr	mg/L	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00	<2.50E+00
Ti	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
Tl	mg/L	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01	<1.00E+01
V	mg/L	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00	<5.00E+00
Zn	mg/L	(7.82E-01)	(8.88E-01)	(1.13E+00)	(1.22E+00)	(7.82E-01)	(8.88E-01)	(5.10E-01)	(4.74E-01)	(4.72E-01)	(6.21E-01)	(4.34E-01)	(4.78E-01)	(4.17E-01)	(3.67E-01)	(5.89E-01)	(5.30E-01)
Zr	mg/L	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00	<1.25E+00
* Cr 53 and Pb206 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mg/L	6.74E+00	6.78E+00	7.20E+00	6.72E+00	6.74E+00	6.78E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00	<4.51E+00
NO_3^- as NO3-	mg/L	5.45E+01	5.57E+01	5.80E+01	5.70E+01	5.45E+01	5.57E+01	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00	<4.33E+00
CO_3^{2-} *	mg/L	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02	<5.00E+02
SO_4^{2-}	mg/L	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00	<4.09E+00
PO_4^{3-} as PO_4^{3-} *	mg/L	2.34E+02	2.19E+02	2.10E+02	2.15E+02	2.34E+02	2.19E+02	9.80E+01	8.90E+01	4.95E+01	4.49E+01	1.17E+01	1.81E+01	1.68E+01	8.69E+00	2.34E+01	1.83E+01
Cl^-	mg/L	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00	<2.36E+00
F^-	mg/L	2.92E+01	2.69E+01	3.17E+01	3.07E+01	2.92E+01	2.69E+01	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00	<1.17E+00
Oxalate*	mg/L	1.42E+01	1.43E+01	1.54E+01	1.51E+01	1.42E+01	1.43E+01	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00	<3.45E+00

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Tank C-203 (19961) $CaCO_3$ Leach Results

		Single Contact				Periodic Replenishment Tests											
Parameter	Units	1 day	1 day (dup)	1 month	1 month (dup)	Stage 1	Stage 1 (dup)	Stage 2	Stage 2 (dup)	Stage 3	Stage 3 (dup)	Stage 4	Stage 4 (dup)	Stage 5	Stage 5 (dup)	Stage 6	Stage 6 (dup)
pH	std units																
Alkalinity	mM as CaCO3	5.63E+00	5.55E+00	6.94E+00	7.10E+00	5.63E+00	5.55E+00	1.85E+00	2.01E+00	1.31E+00	1.62E+00	1.00E+00	1.23E+00	1.23E+00	1.00E+00	1.54E+00	1.23E+00
TIC	mM C	4.27E+00	4.47E+00	4.80E+00	4.30E+00	4.27E+00	4.47E+00	1.71E+00	1.60E+00	1.64E+00	1.37E+00	1.08E+00	1.14E+00	1.15E+00	9.99E-01		
TOC	mM C	3.90E+00	3.99E+00	3.40E+00	3.47E+00	3.90E+00	3.99E+00	5.13E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01	<4.02E-01		
TC	mM C	8.17E+00	8.46E+00	8.20E+00	7.77E+00	8.17E+00	8.46E+00	2.22E+00	1.60E+00	1.64E+00	1.37E+00	1.08E+00	1.14E+00	1.15E+00	9.99E-01		
Radionuclides																	
^{90}Sr	mM	6.71E-07	1.31E-06	2.30E-06	2.49E-06	6.71E-07	1.31E-06			2.36E-07	4.57E-07					9.77E-07	1.66E-07
^{99}Tc	mM	<5.05E-06	(7.07E-07)	(1.62E-06)	(9.09E-07)	<5.05E-06	(7.07E-07)	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06	<5.05E-06
^{238}U	mM	9.62E-01	8.10E-01	1.83E+00	2.12E+00	9.62E-01	8.10E-01	3.24E-01	1.57E-01	1.09E-01	2.54E-01	4.95E-02	5.67E-02	8.75E-02	4.01E-02	7.14E-01	8.08E-02
^{239}Pu*	mM	1.73E-03	1.50E-03	2.56E-03	3.12E-03	1.73E-03	1.50E-03	4.21E-04	(1.86E-04)	(1.25E-04)	(2.08E-04)	(3.77E-05)	(4.18E-05)	(5.98E-05)	(2.13E-05)	5.57E-04	(1.15E-04)
^{237}Np*	mM	(1.39E-06)	(1.14E-06)	(3.12E-06)	(3.42E-06)	(1.39E-06)	(1.14E-06)	(4.64E-07)	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06	<4.22E-06
^{241}Am	mM	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04	<2.07E-04
* Pu and Np Results may be biased high due to U concentration.																	
Metals																	
Ag 107	mM	(4.11E-06)	(3.64E-06)	(7.29E-06)	(5.79E-06)	(4.11E-06)	(3.64E-06)	(1.21E-06)	(2.80E-07)	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05	<9.35E-05
Al	mM	(3.12E-02)	(2.74E-02)	(4.12E-02)	(3.84E-02)	(3.12E-02)	(2.74E-02)	(9.06E-03)	(8.29E-03)	(1.04E-02)	(1.15E-02)	<9.27E-02	(9.59E-03)	<9.27E-02	<9.27E-02	(2.70E-02)	(3.67E-02)
As	mM	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02	<3.34E-02
As 75	mM	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03	<1.33E-03
B	mM	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01	<4.63E-01
Ba	mM	(1.15E-03)	(1.19E-03)	(7.35E-04)	(2.39E-04)	(1.15E-03)	(1.19E-03)	(1.28E-03)	(2.15E-04)	(1.46E-03)	(6.35E-04)	(2.77E-04)	(3.99E-04)	(9.49E-04)	(2.49E-04)	(3.39E-04)	(1.14E-03)
Be	mM	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02	<5.55E-02
Bi	mM	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02	<1.20E-02
Ca	mM	(4.92E-02)	(6.33E-02)	(1.07E-01)	(1.16E-01)	(4.92E-02)	(6.33E-02)	(2.97E-02)	(5.80E-03)	(5.89E-03)	(1.31E-02)	(1.95E-02)	(1.52E-02)	(6.46E-03)	(4.56E-03)	(7.02E-02)	(1.29E-02)
Cd	mM	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03	<2.22E-03
Cd 114	mM	(1.84E-05)	(1.46E-05)	2.40E-05	3.10E-05	(1.84E-05)	(1.46E-05)	(6.75E-06)	<2.19E-05	<2.19E-05	<2.19E-05	<4.39E-07	<2.19E-05	<3.51E-07	<4.39E-07	<2.19E-05	<8.77E-08
Co	mM	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02	<2.12E-02
Cr	mM	1.92E-01	1.98E-01	2.75E-01	3.16E-01	1.92E-01	1.98E-01	3.37E-02	(1.08E-02)	(7.71E-03)	(1.04E-02)	(1.05E-03)	(9.20E-04)	(2.16E-03)	<1.20E-02	2.84E-02	(3.20E-03)
Cr 53 *	mM	1.71E-01	1.66E-01	2.22E-01	2.47E-01	1.71E-01	1.66E-01	3.18E-02	1.21E-02	7.91E-03	9.75E-03	2.02E-03	1.65E-03	2.78E-03	(6.62E-04)	2.64E-02	3.79E-03
Cu	mM	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00	<1.57E+00
Cu 65	mM	1.07E-03	1.15E-03	1.95E-03	1.67E-03	1.07E-03	1.15E-03	1.13E-03	(3.53E-04)	6.99E-04	1.23E-03	(2.85E-04)	3.98E-04	5.10E-04	5.51E-04	1.25E-03	(3.01E-04)
Fe	mM	1.56E-01	1.60E-01	2.42E-01	2.96E-01	1.56E-01	1.60E-01	4.01E-02	(1.50E-02)	(9.68E-03)	(1.31E-02)	(4.57E-03)	(5.31E-03)	(4.67E-03)	(2.08E-03)	3.09E-02	(3.70E-03)
K	mM	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00	<3.20E+00
Li	mM	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00	<1.44E+00
Mg	mM	(2.33E-02)	(2.43E-02)	(3.34E-02)	(3.90E-02)	(2.33E-02)	(2.43E-02)	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01	(1.15E-01)	<2.06E-01	<2.06E-01	<2.06E-01	<2.06E-01
Mn	mM	2.48E-02	2.53E-02	3.60E-02	4.34E-02	2.48E-02	2.53E-02	5.63E-03	(1.76E-03)	(1.07E-03)	(1.48E-03)	(4.16E-04)	(2.63E-04)	(4.44E-04)	<4.55E-03	(4.20E-03)	<4.55E-03
Mo	mM	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02	<5.21E-02
Mo 95	mM	(4.95E-05)	5.24E-05	6.33E-05	6.16E-05	(4.95E-05)	5.24E-05	(6.50E-06)	(5.20E-06)	(4.50E-06)	(4.20E-06)	(9.00E-07)	(1.80E-06)	(1.50E-06)	(1.20E-06)	(6.20E-06)	(4.10E-06)
Mo 97	mM	(5.04E-05)	(4.94E-05)	(6.00E-05)	(6.24E-05)	(5.04E-05)	(4.94E-05)	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04	<1.05E-04
Mo 98	mM	<5.10E-05	<5.10E-05	5.19E-05	5.14E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05	<5.10E-05
Na	mM	1.29E+01	1.29E+01	1.58E+01	1.57E+01	1.29E+01	1.29E+01	3.17E+00	2.82E+00	1.86E+00	2.05E+00	1.03E+00	1.17E+00	1.09E+00	8.53E-01	1.69E+00	1.17E+00
Ni	mM	(2.03E-02)	(1.95E-02)	(2.82E-02)	(3.19E-02)	(2.03E-02)	(1.95E-02)	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02	<8.52E-02
P	mM	2.57E+00	2.64E+00	3.00E+00	3.11E+00	2.57E+00	2.64E+00	9.80E-01	8.18E-01	4.76E-01	4.73E-01	(1.30E-01)	(1.77E-01)	(1.65E-01)	(7.49E-02)	3.96E-01	(1.51E-01)
Pb	mM	1.64E-02	1.69E-02	2.69E-02	3.23E-02	1.64E-02	1.69E-02	5.61E-03	(3.11E-03)	(1.14E-03)	(3.13E-03)	(6.48E-04)	(7.87E-04)	(4.13E-04)	(8.13E-04)	6.10E-03	(1.69E-03)
Pb 206 *	mM	1.61E-02	1.47E-02	2.17E-02	2.46E-02	1.61E-02	1.47E-02	4.63E-03	1.96E-03	1.29E-03	2.29E-03	3.58E-04	3.91E-04	6.01E-04	1.28E-04	5.81E-03	5.98E-04
Ru 101	mM	(3.13E-05)	(2.61E-05)	5.00E-05	5.57E-05	(3.13E-05)	(2.61E-05)	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	<4.95E-05	(1.23E-05)	<4.95E-05
Ru 102	mM	(1.50E-05)	(1.12E-05)	2.59E-05	2.92E-05	(1.50E-05)	(1.12E-05)	(5.78E-06)	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05	<2.45E-05
S	mM	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00	<6.24E+00
Sb 121	mM	1.41E-04	1.16E-04	1.38E-04	1.57E-04	1.41E-04	1.16E-04	6.50E-05	5.74E-05	(4.22E-05)	(4.40E-05)	(1.33E-05)	(2.64E-05)	(2.64E-05)	(1.60E-05)	(3.70E-05)	(2.44E-05)
Se	mM	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01	<6.33E-01
Si	mM	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00	<3.56E+00
Sr	mM	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02	<2.85E-02
Ti	mM	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02	<2.61E-02
Tl	mM	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02	<4.89E-02
V	mM	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02	<9.82E-02
Zn	mM	(1.20E-02)	(1.36E-02)	(1.72E-02)	(1.87E-02)	(1.20E-02)	(1.36E-02)	(7.79E-03)	(7.25E-03)	(7.22E-03)	(9.50E-03)	(6.64E-03)	(7.32E-03)	(6.37E-03)	(5.62E-03)	(9.02E-03)	(8.11E-03)
Zr	mM	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02	<1.37E-02
* Cr 53 and Pb206 concentrations are above highest check standard.																	
Anions																	
NO_2^- as NO2-	mM	1.46E-01	1.47E-01	1.57E-01	1.46E-01	1.46E-01	1.47E-01	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02	<9.80E-02
NO_3^- as NO3-	mM	8.79E-01	8.98E-01	9.35E-01	9.19E-01	8.79E-01	8.98E-01	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02	<6.98E-02
CO_3^{2-} *	mM	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00	<8.33E+00
SO_4^{2-}	mM	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02	<4.26E-02
PO_4^{3-} as PO_4^{3-} *	mM	2.46E+00	2.31E+00	2.21E+00	2.26E+00	2.46E+00	2.31E+00	1.03E+00	9.37E-01	5.21E-01	4.73E-01	1.23E-01	1.91E-01	1.77E-01	9.15E-02	2.46E-01	1.92E-01
Cl^-	mM	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02	<6.66E-02
F^-	mM	1.54E+00	1.42E+00	1.67E+00	1.62E+00	1.54E+00	1.42E+00	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02	<6.16E-02
Oxalate *	mM	1.62E-01	1.63E-01	1.75E-01	1.72E-01	1.62E-01	1.63E-01	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02	<3.92E-02

* The carbonate,oxalate and phosphate results are for information only. QC was not within procedural limits. Oxalate number were background corrected.

Uranium Mineral Solublity Experimental Data

Experiment #1 19961 Composite (1.0M NaNO3, 0.01M NaOH)									
Parameters	Units	Stage 1	Stage 1 Dup	Stage 2	Stage 2 DUP	Stage 3	Stage 3 Dup	Stage 4	Stage 4 DUP
		1 Day	1 Day	1 Day	1 Day	1 week	1 week	1 month	1 month
U238	mg/L	1.15E+00	6.01E-01	5.07E-01	4.82E-01	4.21E-01	4.09E-01	1.47E+00	9.92E-01
Na	mg/L	2.39E+04	2.38E+04	2.45E+04	2.44E+04	2.34E+04	2.33E+04	2.53E+04	2.43E+04
TC	mg/L	9.27E+01	7.88E+01	3.45E+01	3.32E+01	2.47E+01	1.82E+01	2.92E+01	3.01E+01
TOC	mg/L	5.40E+01	4.20E+01	9.19E+00	8.51E+00	9.85E+00	6.66E+00	7.76E+00	9.28E+00
TIC	mg/L	3.87E+01	3.68E+01	2.53E+01	2.47E+01	1.48E+01	1.16E+01	2.14E+01	2.08E+01

Experiment #1 19961 Yellow (1.0M NaNO3, 0.01M NaOH)					
Parameters	Units	Stage 1	Stage 2	Stage 3	Stage 4
		1 Day	1 Day	1 week	1 month
U238	mg/L	9.08E-01	5.06E-01	4.15E-01	1.33E+00
Na	mg/L	2.35E+04	2.47E+04	2.33E+04	2.91E+04
TC	mg/L	5.82E+01	2.90E+01	1.79E+01	3.60E+01
TOC	mg/L	2.27E+01	8.92E+00	6.81E+00	8.46E+00
TIC	mg/L	3.55E+01	2.00E+01	1.11E+01	2.75E+01

Experiment #2 19961 Composite (1.0M NaOH)									
Parameters	Units	Stage 1	Stage 1 Dup	Stage 2	Stage 2 DUP	Stage 3	Stage 3 Dup	Stage 4	Stage 4 DUP
		1 Day	1 Day	1 Day	1 Day	1 week	1 week	1 month	1 month
U238	mg/L	3.92E+01	3.82E+01	2.10E+01	2.21E+01	1.22E+01	1.22E+01	6.87E+00	8.56E+00
Na	mg/L	2.41E+04	2.40E+04	2.53E+04	2.51E+04	2.58E+04	2.54E+04	2.43E+04	2.48E+04
TC	mg/L	7.07E+01	6.68E+01	2.43E+02	2.45E+02	2.69E+02	2.80E+02	1.66E+02	2.97E+02
TOC	mg/L	8.06E+01	7.64E+01	2.81E+02	2.88E+02	3.13E+02	3.31E+02	2.13E+02	3.53E+02
TIC	mg/L	ND	ND	ND	ND	ND	ND	ND	ND
ND = Not Detected									

Experiment #2 19961 Yellow (1.0M NaOH)					
Parameters	Units	Stage 1	Stage 2	Stage 3	Stage 4
		1 Day	1 Day	1 week	1 month
U238	mg/L	6.44E+01	4.06E+01	1.59E+01	7.67E+00
Na	mg/L	2.42E+04	2.62E+04	2.53E+04	2.63E+04
TC	mg/L	7.51E+01	2.51E+02	2.51E+02	4.68E+02
TOC	mg/L	9.22E+01	2.97E+02	2.89E+02	5.42E+02
TIC	mg/L	ND	ND	ND	ND
ND = Not Detected					

Experiment #3 19961 Composite Stage 1,2,3 (1.0M NaNO3, 0.01M NaOH) Stage 4 (0.01M NaOH, 0.001M Na2CO3)									
Parameters	Units	Stage 1	Stage 1 Dup	Stage 2	Stage 2 DUP	Stage 3	Stage 3 Dup	Stage 4	Stage 4 DUP
		1 Day	1 Day	1 Day	1 Day	1 week	1 week	1 month	1 month
U238	mg/L	5.60E-01	5.48E-01	4.33E-01	4.13E-01	3.43E-01	3.86E-01	2.47E+02	2.61E+02
Na	mg/L	2.36E+04	2.39E+04	2.49E+04	2.47E+04	2.43E+04	2.44E+04	5.38E+02	6.09E+02
TC	mg/L	2.19E+02	1.36E+02	8.04E+01	5.94E+01	3.61E+01	3.26E+01	2.34E+01	2.59E+01
TOC	mg/L	8.56E+01	6.54E+01	1.50E+01	1.32E+01	8.56E+00	1.27E+01	9.10E+00	1.07E+01
TIC	mg/L	1.33E+02	7.09E+01	6.55E+01	4.63E+01	2.75E+01	1.99E+01	1.43E+01	1.52E+01

Experiment #2 19887 Yellow Stage 1,2,3 (1.0M NaNO3, 0.01M NaOH) Stage 4 (0.01M NaOH, 0.001M Na2CO3)					
Parameters	Units	Stage 1	Stage 2	Stage 3	Stage 4
		1 Day	1 Day	1 week	1 month
U238	mg/L	2.06E+00	5.16E-01	3.87E-01	1.51E+02
Na	mg/L	2.41E+04	2.52E+04	2.49E+04	5.80E+02
TC	mg/L	1.31E+02	4.52E+01	3.43E+01	2.54E+01
TOC	mg/L	4.73E+01	8.50E+00	1.02E+01	1.17E+01
TIC	mg/L	8.39E+01	3.67E+01	2.41E+01	1.38E+01

Appendix J

Chemical Equilibrium Modeling Calculations

Appendix J

Chemical Equilibrium Modeling Calculations

Sample 19887 water leach, 1 day (Stage 1).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 10.660              log fO2 =   -0.892
Eh =   0.5853 volts      pe =   9.8935
Ionic strength      =    0.031371
Activity of water   =    0.999999
Solvent mass        =    0.999963 kg
Solution mass       =    1.001648 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000030 molal
Dissolved solids    =        1682 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      603.01 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01828	419.6	0.8469	-1.8102
CO3--	0.001906	114.2	0.5179	-3.0057
F-	0.001868	35.42	0.8434	-2.8027
HPO4--	0.001854	177.6	0.5098	-3.0246
UO2(CO3)3----	0.001405	631.3	0.0670	-4.0265
NO3-	0.0009130	56.52	0.8398	-3.1153
OH-	0.0005481	9.306	0.8434	-3.3351
HCO3-	0.0005435	33.11	0.8469	-3.3369
CrO4--	0.0002980	34.51	0.5098	-3.8184
UO2(OH)3-	0.0001840	58.99	0.8469	-3.8073
Fe(OH)4-	0.0001807	22.34	0.8469	-3.8153
O2(aq)	0.0001622	5.183	1.0000	-3.7898
NaHPO4-	0.0001437	17.07	0.8469	-3.9147
PO4---	9.409e-005	8.921	0.2188	-4.6864
CaPO4-	7.534e-005	10.16	0.8469	-4.1952
NaCO3-	5.898e-005	4.887	0.8469	-4.3015
AlO2-	4.799e-005	2.825	0.8469	-4.3911
MgPO4-	3.172e-005	3.777	0.8469	-4.5709
SO4--	3.098e-005	2.971	0.5098	-4.8014
Cl-	2.974e-005	1.052	0.8398	-4.6025
MnO4-	2.231e-005	2.650	0.8434	-4.7254
Ni(OH)2(aq)	1.475e-005	1.365	1.0000	-4.8311
Fe(OH)3(aq)	1.333e-005	1.422	1.0000	-4.8753
Pb(OH)2(aq)	1.204e-005	2.900	1.0000	-4.9193
MnO4--	1.139e-005	1.352	0.5098	-5.2362

(UO2)2CO3(OH)3-	1.051e-005	6.829	0.8469	-5.0508
NaHCO3(aq)	1.016e-005	0.8523	1.0000	-4.9930
Ni(OH)3-	8.055e-006	0.8823	0.8469	-5.1661
Pb(OH)3-	6.575e-006	1.695	0.8469	-5.2543
UO2(CO3)2--	4.232e-006	1.648	0.5098	-5.6660
Pb(CO3)2--	3.404e-006	1.112	0.5098	-5.7606
UO2(OH)2(aq)	2.754e-006	0.8359	1.0000	-5.5601
Sr++	2.706e-006	0.2367	0.5256	-5.8470
PbCO3(aq)	2.662e-006	0.7100	1.0000	-5.5748
NaF(aq)	2.452e-006	0.1028	1.0000	-5.6104
CaCO3(aq)	2.252e-006	0.2250	1.0000	-5.6475
Ca++	1.988e-006	0.07954	0.5405	-5.9688
NaSO4-	1.908e-006	0.2268	0.8469	-5.7916
Ni++	1.277e-006	0.07484	0.5405	-6.1609
NaOH(aq)	1.135e-006	0.04533	1.0000	-5.9450
SrCO3(aq)	1.029e-006	0.1517	1.0000	-5.9874
(UO2)3(OH)7-	8.811e-007	0.8173	0.8469	-6.1272
PbOH+	7.726e-007	0.1729	0.8469	-6.1842
Mg++	5.920e-007	0.01436	0.5677	-6.4735
CaHPO4(aq)	5.580e-007	0.07579	1.0000	-6.2534
H2PO4-	3.918e-007	0.03793	0.8469	-6.4792
MgCO3(aq)	3.159e-007	0.02659	1.0000	-6.5004
MgHPO4(aq)	2.582e-007	0.03100	1.0000	-6.5881
UO2(OH)4--	2.178e-007	0.07350	0.5098	-6.9546
UO2PO4-	1.667e-007	0.06075	0.8469	-6.8502
SrHPO4(aq)	1.543e-007	0.02829	1.0000	-6.8115
NaAlO2(aq)	1.136e-007	0.009298	1.0000	-6.9445
NaCl(aq)	6.461e-008	0.003770	1.0000	-7.1897
PbP2O7--	3.221e-008	0.01226	0.5098	-7.7846
CO2(aq)	2.227e-008	0.0009785	1.0000	-7.6522
Ca2UO2(CO3)3	1.722e-008	0.009116	1.0000	-7.7639
MgF+	1.407e-008	0.0006083	0.8469	-7.9238
HCrO4-	1.225e-008	0.001431	0.8469	-7.9840

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	54.1189s/sat	PbCO3.PbO	0.6737s/sat
Todorokite	46.9860s/sat	Diaspore	0.6719s/sat
Pyromorphite	20.4537s/sat	Boehmite	0.2680s/sat
Trevorite	19.6210s/sat	Gibbsite	0.0762s/sat
Fluorapatite	15.2536s/sat	Ca-Autunite	-0.0668
Hematite	14.1409s/sat	Schoepite	-0.0788
Pyromorphite-OH	14.0861s/sat	UO3:2H2O	-0.0788
Pb4O(PO4)2	12.5672s/sat	Ice	-0.1387
Bixbyite	10.2049s/sat	UO2(OH)2(beta)	-0.1912
Pyrolusite	9.1899s/sat	Pb3SO6	-0.2069
Hausmannite	8.7278s/sat	Crocoite	-0.2498
Parsonsite	8.1983s/sat	Schoepite-dehy(.	-0.2622
Ferrite-Ca	8.0789s/sat	UO3:.9H2O(alpha)	-0.2622
Ferrite-Mg	8.0408s/sat	Dolomite	-0.3097
Pb3(PO4)2	7.7980s/sat	Dolomite-ord	-0.3097
MnO2(gamma)	7.6721s/sat	Schoepite-dehy(.	-0.3425
Hydroxylapatite	6.7969s/sat	Schoepite-dehy(1	-0.3486
Hydrocerussite	6.6711s/sat	Litharge	-0.4679
Goethite	6.5902s/sat	Calcite	-0.4945

Manganite	4.7843s/sat	Aragonite	-0.6389
Na2U2O7(c)	4.6171s/sat	Massicot	-0.6501
Minium	4.1791s/sat	Lanarkite	-1.3105
CaUO4	4.1637s/sat	Monohydrocalcite	-1.3282
Plattnerite	4.0619s/sat	Magnesite	-1.4441
PbHPO4	3.5538s/sat	Brucite	-1.4515
Ni3(PO4)2	3.4296s/sat	Schoepite-dehy(.	-1.4518
Magnetite	3.3594s/sat	Fluorite	-1.5372
Bunsenite	2.6872s/sat	Dawsonite	-1.6613
Becquerelite	2.4784s/sat	Mn(OH)3	-1.7215
Ni(OH)2	2.4106s/sat	MnHPO4	-1.7493
Na2U2O7(am)	2.1088s/sat	Dolomite-dis	-1.8541
Strontianite	1.7898s/sat	Schoepite-dehy(.	-1.9698
Whitlockite	1.5893s/sat	NiCO3	-2.3496
Fe(OH)3(ppd)	1.4691s/sat	SrHPO4	-2.6299
Cerussite	1.3831s/sat	Corundum	-2.6476
SrUO4(alpha)	1.0626s/sat	Sellaite	-2.6946
Pb4Cl2(OH)6	0.8792s/sat	SrF2	-2.9123
Pb4SO7	0.8267s/sat	UO3(gamma)	-2.9528

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1284	-0.892
H2O(g)	0.02598	-1.585
CO2(g)	6.556e-007	-6.183
HF(g)	2.659e-015	-14.575
NO2(g)	6.380e-022	-21.195
HCl(g)	2.704e-022	-21.568
N2(g)	2.350e-023	-22.629
NO(g)	1.194e-027	-26.923
Cl2(g)	3.799e-036	-35.420
H2(g)	7.822e-042	-41.107
CO(g)	1.602e-051	-50.795
UO2F2(g)	1.451e-057	-56.838
Pb(g)	2.863e-062	-61.543
SO2(g)	1.108e-062	-61.955
UO3(g)	6.405e-067	-66.193
NH3(g)	8.085e-071	-70.092
Na(g)	8.577e-072	-71.067
UOF4(g)	4.160e-074	-73.381
UO2Cl2(g)	1.847e-074	-73.734
F2(g)	2.884e-085	-84.540
UF5(g)	9.809e-089	-88.008
UF6(g)	5.308e-095	-94.275
UF4(g)	1.785e-096	-95.748
UO2(g)	1.114e-119	-118.953
Mg(g)	3.104e-126	-125.508
UCl4(g)	1.784e-135	-134.749
UF3(g)	1.488e-145	-144.827
UCl5(g)	6.940e-146	-145.159
CH4(g)	1.958e-148	-147.708
Ca(g)	1.473e-148	-147.832
H2S(g)	1.310e-149	-148.883
UCl6(g)	5.015e-151	-150.300
U2F10(g)	1.077e-151	-150.968
UCl3(g)	2.361e-162	-161.627

Al(g)	1.119e-190	-189.951
UF2(g)	1.831e-191	-190.737
C(g)	1.049e-192	-191.979
UO(g)	7.689e-204	-203.114
UCl2(g)	1.691e-206	-205.772
UF(g)	5.545e-231	-230.256
S2(g)	6.255e-242	-241.204
C2H4(g)	1.236e-243	-242.908
UCl(g)	2.653e-248	-247.576
U2Cl8(g)	7.845e-260	-259.105
U2Cl10(g)	9.612e-265	-264.017
U(g)	1.245e-288	-287.905

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	4.81e-005	4.81e-005	1.30			
Ca++	8.02e-005	8.02e-005	3.21			
Cl-	2.98e-005	2.98e-005	1.05			
CrO4--	0.000298	0.000298	34.5			
F-	0.00187	0.00187	35.5			
Fe++	0.000194	0.000194	10.8			
H+	-0.00944	-0.00944	-9.50			
H2O	55.5	55.5	9.98e+005			
HCO3-	0.00677	0.00677	412.			
HPO4--	0.00220	0.00220	211.			
Mg++	3.29e-005	3.29e-005	0.798			
Mn++	3.37e-005	3.37e-005	1.85			
NH3(aq)	0.000913	0.000913	15.5			
Na+	0.0185	0.0185	425.			
Ni++	2.41e-005	2.41e-005	1.41			
O2(aq)	0.00208	0.00208	66.3			
Pb++	2.55e-005	2.55e-005	5.27			
SO4--	3.29e-005	3.29e-005	3.16			
Sr++	3.91e-006	3.91e-006	0.342			
UO2++	0.00162	0.00162	437.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	4.810e-005	4.810e-005	1.296		
Calcium	8.020e-005	8.020e-005	3.209		
Carbon	0.006765	0.006765	81.12		
Chlorine	2.980e-005	2.980e-005	1.055		
Chromium	0.0002980	0.0002980	15.47		
Fluorine	0.001870	0.001870	35.47		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0001940	0.0001940	10.82		
Lead	2.550e-005	2.550e-005	5.275		
Magnesium	3.290e-005	3.290e-005	0.7983		
Manganese	3.370e-005	3.370e-005	1.848		
Nickel	2.410e-005	2.410e-005	1.412		
Nitrogen	0.0009130	0.0009130	12.77		
Oxygen	55.55	55.55	8.872e+005		
Phosphorus	0.002200	0.002200	68.03		
Sodium	0.01850	0.01850	424.6		
Strontium	3.910e-006	3.910e-006	0.3420		

Sulfur	3.290e-005	3.290e-005	1.053
Uranium	0.001620	0.001620	385.0

Sample 19887 water leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.560               log fO2 =   -0.754
Eh =   0.5932 volts       pe =  10.0280
Ionic strength      =     0.024558
Activity of water   =     0.999999
Solvent mass        =     0.999984 kg
Solution mass       =     1.001189 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000017 molal
Dissolved solids    =         1203 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       517.62 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01368	314.2	0.8601	-1.9293
CO3--	0.002889	173.1	0.5505	-2.7985
HPO4--	0.002073	198.7	0.5435	-2.9482
F-	0.001489	28.25	0.8573	-2.8941
HCO3-	0.001086	66.17	0.8601	-3.0297
NO3-	0.0006710	41.56	0.8543	-3.2417
UO2(CO3)3----	0.0006362	286.0	0.0867	-4.2585
OH-	0.0004283	7.276	0.8573	-3.4351
O2(aq)	0.0002229	7.125	1.0000	-3.6518
NaHPO4-	0.0001282	15.24	0.8601	-3.9575
CrO4--	0.0001220	14.13	0.5435	-4.1784
AlO2-	8.324e-005	4.904	0.8601	-4.1451
PO4---	7.710e-005	7.313	0.2529	-4.7100
NaCO3-	7.112e-005	5.896	0.8601	-4.2134
Fe(OH)4-	5.529e-005	6.840	0.8601	-4.3228
CaPO4-	3.528e-005	4.758	0.8601	-4.5180
SO4--	2.059e-005	1.975	0.5435	-4.9512
Cl-	1.717e-005	0.6080	0.8543	-4.8336
NaHCO3(aq)	1.567e-005	1.315	1.0000	-4.8049
MgPO4-	1.518e-005	1.809	0.8601	-4.8841
UO2(OH)3-	1.272e-005	4.079	0.8601	-4.9609
MnO4-	7.443e-006	0.8842	0.8573	-5.1951
Fe(OH)3(aq)	5.214e-006	0.5566	1.0000	-5.2828
Ni(OH)2(aq)	5.143e-006	0.4762	1.0000	-5.2888
Pb(CO3)2--	2.835e-006	0.9264	0.5435	-5.8123
MnO4--	2.657e-006	0.3156	0.5435	-5.8405
Pb(OH)2(aq)	2.598e-006	0.6258	1.0000	-5.5854
Ni(OH)3-	2.196e-006	0.2406	0.8601	-5.7238
CaCO3(aq)	1.822e-006	0.1821	1.0000	-5.7394
NaF(aq)	1.510e-006	0.06332	1.0000	-5.8210
PbCO3(aq)	1.466e-006	0.3914	1.0000	-5.8338

UO2(CO3)2--	1.444e-006	0.5625	0.5435	-6.1053
Pb(OH)3-	1.109e-006	0.2861	0.8601	-6.0204
NaSO4-	1.011e-006	0.1203	0.8601	-6.0605
Ca++	9.459e-007	0.03787	0.5704	-6.2680
Sr++	8.623e-007	0.07546	0.5573	-6.3182
NaOH(aq)	6.853e-007	0.02738	1.0000	-6.1641
Ni++	6.687e-007	0.03920	0.5704	-6.4186
H2PO4-	5.790e-007	0.05609	0.8601	-6.3028
SrCO3(aq)	5.604e-007	0.08263	1.0000	-6.2515
CaHPO4(aq)	3.341e-007	0.04540	1.0000	-6.4762
Mg++	2.903e-007	0.007047	0.5943	-6.7632
MgCO3(aq)	2.613e-007	0.02201	1.0000	-6.5828
UO2(OH)2(aq)	2.434e-007	0.07391	1.0000	-6.6137
PbOH+	2.066e-007	0.04627	0.8601	-6.7503
(UO2)2CO3(OH)3-	1.639e-007	0.1066	0.8601	-6.8508
MgHPO4(aq)	1.580e-007	0.01898	1.0000	-6.8013
NaAlO2(aq)	1.522e-007	0.01246	1.0000	-6.8177
SrHPO4(aq)	6.217e-008	0.01140	1.0000	-7.2064
CO2(aq)	5.688e-008	0.002500	1.0000	-7.2450
NaCl(aq)	2.885e-008	0.001684	1.0000	-7.5399
UO2PO4-	2.178e-008	0.007939	0.8601	-7.7275
PbP2O7--	1.468e-008	0.005590	0.5435	-8.0980
UO2(OH)4--	1.139e-008	0.003846	0.5435	-8.2082

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	50.1947s/sat	Gibbsite	0.4222s/sat
Todorokite	43.5351s/sat	Ice	-0.1387
Trevorite	18.3482s/sat	PbCO3.PbO	-0.2513
Pyromorphite	17.8212s/sat	Na2U2O7(am)	-0.4368
Fluorapatite	13.5954s/sat	Dolomite	-0.4841
Hematite	13.3258s/sat	Dolomite-ord	-0.4841
Pyromorphite-OH	11.5847s/sat	Calcite	-0.5864
Pb4O(PO4)2	10.4555s/sat	SrUO4(alpha)	-0.6623
Bixbyite	9.1893s/sat	Aragonite	-0.7308
Pyrolusite	8.7167s/sat	Crocoite	-1.0759
MnO2(gamma)	7.1989s/sat	Dawsonite	-1.1272
Hausmannite	7.1700s/sat	Schoepite	-1.1324
Ferrite-Ca	6.7647s/sat	UO3:2H2O	-1.1324
Ferrite-Mg	6.7361s/sat	Litharge	-1.1340
Parsonsite	6.3652s/sat	UO2(OH)2(beta)	-1.2448
Pb3(PO4)2	6.3524s/sat	Schoepite-dehy(.	-1.3158
Goethite	6.1827s/sat	UO3:.9H2O(alpha)	-1.3158
Hydrocerussite	5.4872s/sat	Massicot	-1.3162
Hydroxylapatite	5.1301s/sat	Schoepite-dehy(.	-1.3961
Manganite	4.2765s/sat	Schoepite-dehy(1	-1.4022
Plattnerite	3.4648s/sat	Monohydrocalcite	-1.4201
PbHPO4	3.1641s/sat	Magnesite	-1.5265
CaUO4	2.6109s/sat	Pb4SO7	-1.7875
Ni3(PO4)2	2.6092s/sat	Brucite	-1.9412
Minium	2.2497s/sat	Corundum	-1.9557
Bunsenite	2.2295s/sat	MnHPO4	-2.0152
Magnetite	2.1022s/sat	Fluorite	-2.0193
Na2U2O7(c)	2.0715s/sat	Dolomite-dis	-2.0285
Ni(OH)2	1.9529s/sat	Pb4Cl2(OH)6	-2.0474

Strontianite	1.5257s/sat	Ca-Autunite	-2.1205
Cerussite	1.1241s/sat	Pb3SO6	-2.1549
Fe(OH)3(ppd)	1.0616s/sat	Mn(OH)3	-2.2293
Diaspore	1.0179s/sat	NiCO3	-2.4001
Whitlockite	0.6446s/sat	Schoepite-dehy(.	-2.5054
Boehmite	0.6140s/sat	Lanarkite	-2.5924

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1764	-0.754
H2O(g)	0.02598	-1.585
CO2(g)	1.674e-006	-5.776
HF(g)	2.712e-015	-14.567
NO2(g)	5.546e-022	-21.256
HCl(g)	1.999e-022	-21.699
N2(g)	9.404e-024	-23.027
NO(g)	8.851e-028	-27.053
Cl2(g)	2.435e-036	-35.614
H2(g)	6.673e-042	-41.176
CO(g)	3.490e-051	-50.457
UO2F2(g)	1.334e-058	-57.875
SO2(g)	1.061e-062	-61.974
Pb(g)	5.269e-063	-62.278
UO3(g)	5.661e-068	-67.247
NH3(g)	4.030e-071	-70.395
Na(g)	4.783e-072	-71.320
UOF4(g)	3.977e-075	-74.400
UO2Cl2(g)	8.927e-076	-75.049
F2(g)	3.516e-085	-84.454
UF5(g)	8.834e-090	-89.054
UF6(g)	5.278e-096	-95.278
UF4(g)	1.456e-097	-96.837
UO2(g)	8.397e-121	-120.076
Mg(g)	8.577e-127	-126.067
UCl4(g)	4.023e-137	-136.395
UF3(g)	1.099e-146	-145.959
UCl5(g)	1.253e-147	-146.902
CH4(g)	2.648e-148	-147.577
Ca(g)	3.982e-149	-148.400
H2S(g)	7.789e-150	-149.109
UCl6(g)	7.248e-153	-152.140
U2F10(g)	8.736e-154	-153.059
UCl3(g)	6.648e-164	-163.177
Al(g)	1.956e-190	-189.709
C(g)	1.949e-192	-191.710
UF2(g)	1.225e-192	-191.912
UO(g)	4.946e-205	-204.306
UCl2(g)	5.948e-208	-207.226
UF(g)	3.359e-232	-231.474
S2(g)	3.038e-242	-241.517
C2H4(g)	3.108e-243	-242.508
UCl(g)	1.165e-249	-248.934
U2Cl8(g)	3.988e-263	-262.399
U2Cl10(g)	3.132e-268	-267.504
U(g)	6.832e-290	-289.165

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	8.34e-005	8.34e-005	2.25			
Ca++	3.84e-005	3.84e-005	1.54			
Cl-	1.72e-005	1.72e-005	0.609			
CrO4--	0.000122	0.000122	14.1			
F-	0.00149	0.00149	28.3			
Fe++	6.05e-005	6.05e-005	3.37			
H+	-0.00672	-0.00672	-6.76			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00598	0.00598	365.			
HPO4--	0.00233	0.00233	223.			
Mg++	1.59e-005	1.59e-005	0.386			
Mn++	1.01e-005	1.01e-005	0.554			
NH3(aq)	0.000671	0.000671	11.4			
Na+	0.0139	0.0139	319.			
Ni++	8.01e-006	8.01e-006	0.470			
O2(aq)	0.00159	0.00159	50.9			
Pb++	8.23e-006	8.23e-006	1.70			
SO4--	2.16e-005	2.16e-005	2.07			
Sr++	1.49e-006	1.49e-006	0.130			
UO2++	0.000651	0.000651	176.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	8.340e-005	8.340e-005	2.248		
Calcium	3.840e-005	3.840e-005	1.537		
Carbon	0.005983	0.005983	71.77		
Chlorine	1.720e-005	1.720e-005	0.6091		
Chromium	0.0001220	0.0001220	6.336		
Fluorine	0.001490	0.001490	28.27		
Hydrogen	111.0	111.0	1.118e+005		
Iron	6.050e-005	6.050e-005	3.375		
Lead	8.230e-006	8.230e-006	1.703		
Magnesium	1.590e-005	1.590e-005	0.3860		
Manganese	1.010e-005	1.010e-005	0.5542		
Nickel	8.010e-006	8.010e-006	0.4695		
Nitrogen	0.0006710	0.0006710	9.387		
Oxygen	55.54	55.54	8.876e+005		
Phosphorus	0.002330	0.002330	72.08		
Sodium	0.01390	0.01390	319.2		
Strontium	1.490e-006	1.490e-006	0.1304		
Sulfur	2.160e-005	2.160e-005	0.6918		
Uranium	0.0006510	0.0006510	154.8		

Sample 19887 water leach, Stage 2.

```
Step #     0               Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.700               log fO2 =   -0.777
Eh =   0.5846 volts       pe =   9.8821
Ionic strength      =     0.010776
Activity of water   =     0.999999
Solvent mass        =     0.999962 kg
Solution mass       =     1.000620 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000016 molal
Dissolved solids    =          658 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=      193.13 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.004790	110.1	0.8989	-2.3659
HPO4--	0.001432	137.4	0.6510	-3.0303
CO3--	0.001036	62.10	0.6552	-3.1684
OH-	0.0005648	9.599	0.8975	-3.2951
UO2(OH)3-	0.0003520	112.9	0.8989	-3.4997
HCO3-	0.0003211	19.58	0.8989	-3.5396
UO2(CO3)3----	0.0002630	118.3	0.1791	-4.3270
O2(aq)	0.0002111	6.752	1.0000	-3.6754
CrO4--	0.0001140	13.21	0.6510	-4.1295
F-	0.0001050	1.993	0.8975	-4.0259
Fe(OH)4-	7.850e-005	9.718	0.8989	-4.1514
PO4---	5.859e-005	5.561	0.3802	-4.6521
CaPO4-	4.702e-005	6.345	0.8989	-4.3740
NaHPO4-	3.716e-005	4.417	0.8989	-4.4762
NO3-	2.580e-005	1.599	0.8960	-4.6361
(UO2)2CO3(OH)3-	2.128e-005	13.84	0.8989	-4.7184
AlO2-	1.739e-005	1.025	0.8989	-4.8060
Cl-	1.609e-005	0.5701	0.8960	-4.8412
MgPO4-	1.369e-005	1.632	0.8989	-4.9099
NaCO3-	1.062e-005	0.8812	0.8989	-5.0200
MnO4-	1.058e-005	1.258	0.8975	-5.0224
Ni(OH)2(aq)	6.349e-006	0.5882	1.0000	-5.1973
(UO2)3(OH)7-	5.778e-006	5.365	0.8989	-5.2845
SO4--	5.731e-006	0.5502	0.6510	-5.4282
Fe(OH)3(aq)	5.605e-006	0.5986	1.0000	-5.2514
Pb(OH)2(aq)	5.315e-006	1.281	1.0000	-5.2745
UO2(OH)2(aq)	5.099e-006	1.549	1.0000	-5.2925
MnO4--	4.619e-006	0.5490	0.6510	-5.5219
Ni(OH)3-	3.581e-006	0.3926	0.8989	-5.4923
Pb(OH)3-	2.998e-006	0.7735	0.8989	-5.5695

UO2(CO3)2--	2.413e-006	0.9405	0.6510	-5.8039
NaHCO3(aq)	1.772e-006	0.1488	1.0000	-5.7515
Sr++	1.128e-006	0.09874	0.6592	-6.1288
Ca++	9.861e-007	0.03949	0.6671	-6.1819
CaCO3(aq)	9.479e-007	0.09481	1.0000	-6.0233
PbCO3(aq)	6.718e-007	0.1794	1.0000	-6.1727
Pb(CO3)2--	4.626e-007	0.1513	0.6510	-6.5212
UO2(OH)4--	3.797e-007	0.1283	0.6510	-6.6070
Ni++	3.704e-007	0.02173	0.6671	-6.6071
SrCO3(aq)	3.699e-007	0.05457	1.0000	-6.4319
NaOH(aq)	3.462e-007	0.01384	1.0000	-6.4607
CaHPO4(aq)	3.371e-007	0.04584	1.0000	-6.4722
H2PO4-	3.322e-007	0.03219	0.8989	-6.5249
PbOH+	2.930e-007	0.06565	0.8989	-6.5794
UO2PO4-	2.617e-007	0.09547	0.8989	-6.6284
Mg++	2.088e-007	0.005070	0.6818	-6.8467
NaSO4-	1.181e-007	0.01405	0.8989	-6.9741
MgHPO4(aq)	1.079e-007	0.01297	1.0000	-6.9671
MgCO3(aq)	9.199e-008	0.007751	1.0000	-7.0363
SrHPO4(aq)	7.960e-008	0.01460	1.0000	-7.0991
NaF(aq)	4.079e-008	0.001711	1.0000	-7.3895
CO2(aq)	1.274e-008	0.0005602	1.0000	-7.8949
NaAlO2(aq)	1.215e-008	0.0009957	1.0000	-7.9153
NaCl(aq)	1.037e-008	0.0006059	1.0000	-7.9841

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	50.6214s/sat	Diaspore	0.2170s/sat
Todorokite	43.9113s/sat	Schoepite	0.1888s/sat
Trevorite	18.5025s/sat	UO3:2H2O	0.1888s/sat
Pyromorphite	18.1418s/sat	Ca-Autunite	0.1636s/sat
Hematite	13.3886s/sat	UO2(OH)2(beta)	0.0764s/sat
Fluorapatite	13.0675s/sat	Schoepite-dehy(.	0.0054s/sat
Pyromorphite-OH	12.0529s/sat	UO3:.9H2O(alpha)	0.0054s/sat
Pb4O(PO4)2	10.9749s/sat	Schoepite-dehy(.	-0.0749
Bixbyite	9.3019s/sat	Schoepite-dehy(1	-0.0810
Pyrolusite	8.7670s/sat	Ice	-0.1387
Parsonsite	7.5840s/sat	Boehmite	-0.1869
Hausmannite	7.3447s/sat	PbCO3.PbO	-0.2793
MnO2(gamma)	7.2492s/sat	Gibbsite	-0.3787
Ferrite-Ca	7.1936s/sat	Litharge	-0.8231
Ferrite-Mg	6.9953s/sat	Calcite	-0.8703
Pb3(PO4)2	6.5609s/sat	Crocoite	-0.9961
Goethite	6.2141s/sat	Massicot	-1.0053
Hydroxylapatite	5.8741s/sat	Aragonite	-1.0147
Hydrocerussite	5.1201s/sat	Pb4Cl2(OH)6	-1.0988
Manganite	4.3328s/sat	Schoepite-dehy(.	-1.1842
CaUO4	4.2982s/sat	Dolomite	-1.2214
Na2U2O7(c)	4.1206s/sat	Dolomite-ord	-1.2214
Becquerelite	3.9507s/sat	Pb4SO7	-1.3008
Plattnerite	3.7639s/sat	Schoepite-dehy(.	-1.7022
Minium	3.1707s/sat	Monohydrocalcite	-1.7040
PbHPO4	3.1129s/sat	Brucite	-1.7447
Bunsenite	2.3210s/sat	Pb3SO6	-1.9792
Magnetite	2.2023s/sat	Magnesite	-1.9800

Ni3(PO4)2	2.1594s/sat	Mn(OH)3	-2.1730
Ni(OH)2	2.0444s/sat	MnHPO4	-2.3152
Na2U2O7(am)	1.6123s/sat	UO3(gamma)	-2.6852
Strontianite	1.3453s/sat	Lanarkite	-2.7276
SrUO4(alpha)	1.1283s/sat	Dolomite-dis	-2.7658
Fe(OH)3(ppd)	1.0930s/sat	Dawsonite	-2.8747
Whitlockite	1.0185s/sat	SrHPO4	-2.9175
Cerussite	0.7852s/sat	NiCO3	-2.9586

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1671	-0.777
H2O(g)	0.02598	-1.585
CO2(g)	3.749e-007	-6.426
HF(g)	1.450e-016	-15.839
HCl(g)	1.423e-022	-21.847
NO2(g)	1.642e-023	-22.785
N2(g)	9.193e-027	-26.037
NO(g)	2.693e-029	-28.570
Cl2(g)	1.201e-036	-35.920
H2(g)	6.857e-042	-41.164
CO(g)	8.029e-052	-51.095
UO2F2(g)	7.993e-060	-59.097
Pb(g)	1.108e-062	-61.956
SO2(g)	1.909e-063	-62.719
UO3(g)	1.186e-066	-65.926
Na(g)	2.449e-072	-71.611
NH3(g)	1.312e-072	-71.882
UO2Cl2(g)	9.480e-075	-74.023
UOF4(g)	6.816e-079	-78.166
F2(g)	9.788e-088	-87.009
UF5(g)	8.208e-095	-94.086
UF4(g)	2.564e-101	-100.591
UF6(g)	2.587e-102	-101.587
UO2(g)	1.808e-119	-118.743
Mg(g)	1.385e-126	-125.858
UCl4(g)	2.225e-136	-135.653
UCl5(g)	4.866e-147	-146.313
Ca(g)	9.506e-149	-148.022
CH4(g)	6.610e-149	-148.180
UF3(g)	3.670e-149	-148.435
H2S(g)	1.519e-150	-149.818
UCl6(g)	1.977e-152	-151.704
UCl3(g)	5.235e-163	-162.281
U2F10(g)	7.541e-164	-163.123
Al(g)	3.221e-191	-190.492
C(g)	4.608e-193	-192.337
UF2(g)	7.750e-194	-193.111
UO(g)	1.094e-203	-202.961
UCl2(g)	6.668e-207	-206.176
UF(g)	4.028e-232	-231.395
S2(g)	1.095e-243	-242.961
C2H4(g)	1.834e-244	-243.737
UCl(g)	1.860e-248	-247.730
U2Cl8(g)	1.220e-261	-260.914
U2Cl10(g)	4.726e-267	-266.326

U(g)	1.553e-288	-287.809

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.74e-005	1.74e-005	0.469			
Ca++	4.93e-005	4.93e-005	1.97			
Cl-	1.61e-005	1.61e-005	0.570			
CrO4--	0.000114	0.000114	13.2			
F-	0.000105	0.000105	1.99			
Fe++	8.41e-005	8.41e-005	4.69			
H+	-0.00416	-0.00416	-4.19			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00219	0.00219	133.			
HPO4--	0.00159	0.00159	153.			
Mg++	1.41e-005	1.41e-005	0.342			
Mn++	1.52e-005	1.52e-005	0.835			
NH3(aq)	2.58e-005	2.58e-005	0.439			
Na+	0.00484	0.00484	111.			
Ni++	1.03e-005	1.03e-005	0.604			
O2(aq)	0.000302	0.000302	9.65			
Pb++	9.75e-006	9.75e-006	2.02			
SO4--	5.85e-006	5.85e-006	0.562			
Sr++	1.58e-006	1.58e-006	0.138			
UO2++	0.000683	0.000683	184.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	1.740e-005	1.740e-005	0.4692		
Calcium	4.930e-005	4.930e-005	1.975		
Carbon	0.002187	0.002187	26.25		
Chlorine	1.610e-005	1.610e-005	0.5704		
Chromium	0.0001140	0.0001140	5.924		
Fluorine	0.0001050	0.0001050	1.994		
Hydrogen	111.0	111.0	1.118e+005		
Iron	8.410e-005	8.410e-005	4.694		
Lead	9.750e-006	9.750e-006	2.019		
Magnesium	1.410e-005	1.410e-005	0.3425		
Manganese	1.520e-005	1.520e-005	0.8345		
Nickel	1.030e-005	1.030e-005	0.6041		
Nitrogen	2.580e-005	2.580e-005	0.3611		
Oxygen	55.52	55.52	8.878e+005		
Phosphorus	0.001590	0.001590	49.22		
Sodium	0.004840	0.004840	111.2		
Strontium	1.580e-006	1.580e-006	0.1384		
Sulfur	5.850e-006	5.850e-006	0.1875		
Uranium	0.0006830	0.0006830	162.5		

Sample 19887 water leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.110               log fO2 =   -0.773
Eh =   0.6195 volts       pe =  10.4731
Ionic strength      =     0.007674
Activity of water   =     1.000000
Solvent mass        =     0.999976 kg
Solution mass       =     1.000530 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000007 molal
Dissolved solids    =          554 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       154.09 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.003261	74.94	0.9123	-2.5264
HPO4--	0.0007272	69.76	0.6912	-3.2987
HCO3-	0.0004965	30.28	0.9123	-3.3440
CO3--	0.0003941	23.63	0.6945	-3.5628
UO2(CO3)3----	0.0003677	165.4	0.2278	-4.0769
O2(aq)	0.0002130	6.811	1.0000	-3.6717
UO2(OH)3-	0.0001597	51.23	0.9123	-3.8367
OH-	0.0001430	2.430	0.9112	-3.8851
(UO2)2CO3(OH)3-	0.0001055	68.65	0.9123	-4.0166
CrO4--	0.0001020	11.82	0.6912	-4.1518
Fe(OH)4-	6.162e-005	7.630	0.9123	-4.2501
CaPO4-	4.682e-005	6.319	0.9123	-4.3694
F-	3.999e-005	0.7593	0.9112	-4.4384
Fe(OH)3(aq)	1.737e-005	1.856	1.0000	-4.7601
NaHPO4-	1.364e-005	1.621	0.9123	-4.9052
MgPO4-	1.278e-005	1.524	0.9123	-4.9333
MnO4-	1.273e-005	1.514	0.9112	-4.9354
UO2(CO3)2--	1.002e-005	3.906	0.6912	-5.1595
UO2(OH)2(aq)	9.131e-006	2.775	1.0000	-5.0395
(UO2)3(OH)7-	8.403e-006	7.803	0.9123	-5.1154
PO4---	7.091e-006	0.6730	0.4353	-5.5105
NO3-	6.980e-006	0.4325	0.9101	-5.1971
Ca++	6.816e-006	0.2730	0.7039	-5.3189
Cl-	6.767e-006	0.2398	0.9101	-5.2105
Ni(OH)2(aq)	4.744e-006	0.4396	1.0000	-5.3239
Pb(OH)2(aq)	4.449e-006	1.073	1.0000	-5.3517
SO4--	4.193e-006	0.4026	0.6912	-5.5378
AlO2-	4.027e-006	0.2374	0.9123	-5.4348
Ni++	3.970e-006	0.2329	0.7039	-5.5537
PbCO3(aq)	3.433e-006	0.9169	1.0000	-5.4643
NaCO3-	2.918e-006	0.2420	0.9123	-5.5748
CaCO3(aq)	2.789e-006	0.2790	1.0000	-5.5546

NaHCO3(aq)	1.922e-006	0.1614	1.0000	-5.7163
Sr++	1.473e-006	0.1290	0.6977	-5.9881
MnO4--	1.363e-006	0.1620	0.6912	-6.0258
Mg++	1.360e-006	0.03304	0.7156	-6.0118
CaHPO4(aq)	1.325e-006	0.1802	1.0000	-5.8776
UO2PO4-	9.684e-007	0.3533	0.9123	-6.0538
PbOH+	9.402e-007	0.2107	0.9123	-6.0666
Pb(CO3)2--	8.981e-007	0.2937	0.6912	-6.2070
H2PO4-	6.863e-007	0.06653	0.9123	-6.2033
Ni(OH)3-	6.776e-007	0.07430	0.9123	-6.2089
Pb(OH)3-	6.355e-007	0.1640	0.9123	-6.2367
MgHPO4(aq)	3.977e-007	0.04781	1.0000	-6.4005
Ca2UO2(CO3)3	3.058e-007	0.1620	1.0000	-6.5146
MgCO3(aq)	2.537e-007	0.02138	1.0000	-6.5956
SrCO3(aq)	2.063e-007	0.03043	1.0000	-6.6856
CO2(aq)	7.776e-008	0.003420	1.0000	-7.1093
NaSO4-	6.246e-008	0.007432	0.9123	-7.2442
NaOH(aq)	6.148e-008	0.002458	1.0000	-7.2112
SrHPO4(aq)	5.931e-008	0.01088	1.0000	-7.2268
UO2(OH)4--	4.231e-008	0.01429	0.6912	-7.5340
PbP2O7--	3.126e-008	0.01191	0.6912	-7.6654
CaHCO3+	2.653e-008	0.002680	0.9123	-7.6162
HCrO4-	1.872e-008	0.002190	0.9123	-7.7674
NaF(aq)	1.090e-008	0.0004575	1.0000	-7.9625

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	56.0112s/sat	Schoepite	0.4418s/sat
Todorokite	48.6270s/sat	UO3:2H2O	0.4418s/sat
Pyromorphite	20.7111s/sat	PbCO3.PbO	0.3519s/sat
Trevorite	19.3585s/sat	SrUO4(alpha)	0.3420s/sat
Pyromorphite-OH	14.4015s/sat	UO2(OH)2(beta)	0.3294s/sat
Fluorapatite	14.3948s/sat	Schoepite-dehy(.	0.2584s/sat
Hematite	14.3712s/sat	UO3:.9H2O(alpha)	0.2584s/sat
Pb4O(PO4)2	12.4892s/sat	Diaspore	0.1782s/sat
Bixbyite	10.6484s/sat	Schoepite-dehy(.	0.1781s/sat
Parsonsite	9.5057s/sat	Schoepite-dehy(1	0.1720s/sat
Pyrolusite	9.4412s/sat	Crocoite	0.0843s/sat
Hausmannite	9.3636s/sat	Ice	-0.1387
Pb3(PO4)2	8.1524s/sat	Boehmite	-0.2257
MnO2(gamma)	7.9234s/sat	Dolomite	-0.3121
Ferrite-Ca	7.8592s/sat	Dolomite-ord	-0.3121
Ferrite-Mg	7.6329s/sat	Calcite	-0.4016
Hydroxylapatite	7.0238s/sat	Gibbsite	-0.4175
Goethite	6.7054s/sat	Pb4SO7	-0.5393
Hydrocerussite	6.4598s/sat	Aragonite	-0.5460
Becquerelite	5.1518s/sat	MnHPO4	-0.7313
Manganite	5.0061s/sat	Litharge	-0.9003
CaUO4	4.2342s/sat	Schoepite-dehy(.	-0.9312
PbHPO4	3.9473s/sat	Pb4Cl2(OH)6	-0.9664
Plattnerite	3.6886s/sat	Massicot	-1.0825
Magnetite	3.6753s/sat	Pb3SO6	-1.1405
Ni3(PO4)2	3.6030s/sat	Monohydrocalcite	-1.2353
Na2U2O7(c)	3.1257s/sat	Schoepite-dehy(.	-1.4492
Minium	2.9409s/sat	Mn(OH)3	-1.4998

Bunsenite	2.1944s/sat	Magnesite	-1.5393
Ca-Autunite	2.1759s/sat	Lanarkite	-1.8116
Ni(OH)2	1.9178s/sat	Dolomite-dis	-1.8565
Whitlockite	1.8907s/sat	Brucite	-2.0898
Fe(OH)3(ppd)	1.5843s/sat	NiCO3	-2.2994
Cerussite	1.4936s/sat	UO3(gamma)	-2.4322
Strontianite	1.0916s/sat	Saleeite	-2.8215
Na2U2O7(am)	0.6174s/sat	Dawsonite	-2.8783

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1685	-0.773
H2O(g)	0.02598	-1.585
CO2(g)	2.289e-006	-5.640
HF(g)	2.182e-016	-15.661
HCl(g)	2.366e-022	-21.626
NO2(g)	1.752e-023	-22.756
N2(g)	1.028e-026	-25.988
NO(g)	2.861e-029	-28.544
Cl2(g)	3.332e-036	-35.477
H2(g)	6.827e-042	-41.166
CO(g)	4.881e-051	-50.312
UO2F2(g)	3.241e-059	-58.489
SO2(g)	2.235e-062	-61.651
Pb(g)	9.232e-063	-62.035
UO3(g)	2.124e-066	-65.673
NH3(g)	1.379e-072	-71.860
Na(g)	4.340e-073	-72.363
UO2Cl2(g)	4.689e-074	-73.329
UOF4(g)	6.259e-078	-77.203
F2(g)	2.226e-087	-86.652
UF5(g)	1.132e-093	-92.946
UF4(g)	2.345e-100	-99.630
UF6(g)	5.381e-101	-100.269
UO2(g)	3.223e-119	-118.492
Mg(g)	6.232e-127	-126.205
UCl4(g)	3.027e-135	-134.519
UCl5(g)	1.103e-145	-144.958
CH4(g)	3.966e-148	-147.402
UF3(g)	2.225e-148	-147.653
Ca(g)	4.562e-149	-148.341
H2S(g)	1.756e-149	-148.755
UCl6(g)	7.463e-151	-150.127
U2F10(g)	1.434e-161	-160.843
UCl3(g)	4.276e-162	-161.369
Al(g)	2.927e-191	-190.534
C(g)	2.789e-192	-191.555
UF2(g)	3.116e-193	-192.506
UO(g)	1.942e-203	-202.712
UCl2(g)	3.270e-206	-205.485
UF(g)	1.074e-231	-230.969
S2(g)	1.475e-241	-240.831
C2H4(g)	6.660e-243	-242.177
UCl(g)	5.477e-248	-247.261
U2Cl8(g)	2.258e-259	-258.646
U2Cl10(g)	2.427e-264	-263.615

U(g) 2.745e-288 -287.561

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	4.03e-006	4.03e-006	0.109			
Ca++	5.84e-005	5.84e-005	2.34			
Cl-	6.77e-006	6.77e-006	0.240			
CrO4--	0.000102	0.000102	11.8			
F-	4.00e-005	4.00e-005	0.760			
Fe++	7.90e-005	7.90e-005	4.41			
H+	-0.00303	-0.00303	-3.05			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00213	0.00213	130.			
HPO4--	0.000811	0.000811	77.8			
Mg++	1.48e-005	1.48e-005	0.360			
Mn++	1.41e-005	1.41e-005	0.774			
NH3(aq)	6.98e-006	6.98e-006	0.119			
Na+	0.00328	0.00328	75.4			
Ni++	9.40e-006	9.40e-006	0.551			
O2(aq)	0.000264	0.000264	8.44			
Pb++	1.04e-005	1.04e-005	2.15			
SO4--	4.26e-006	4.26e-006	0.409			
Sr++	1.74e-006	1.74e-006	0.152			
UO2++	0.000784	0.000784	212.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	4.030e-006	4.030e-006	0.1087		
Calcium	5.840e-005	5.840e-005	2.339		
Carbon	0.002133	0.002133	25.61		
Chlorine	6.770e-006	6.770e-006	0.2399		
Chromium	0.0001020	0.0001020	5.301		
Fluorine	4.000e-005	4.000e-005	0.7595		
Hydrogen	111.0	111.0	1.118e+005		
Iron	7.900e-005	7.900e-005	4.410		
Lead	1.040e-005	1.040e-005	2.154		
Magnesium	1.480e-005	1.480e-005	0.3595		
Manganese	1.410e-005	1.410e-005	0.7742		
Nickel	9.400e-006	9.400e-006	0.5514		
Nitrogen	6.980e-006	6.980e-006	0.09771		
Oxygen	55.52	55.52	8.878e+005		
Phosphorus	0.0008110	0.0008110	25.11		
Sodium	0.003280	0.003280	75.37		
Strontium	1.740e-006	1.740e-006	0.1524		
Sulfur	4.260e-006	4.260e-006	0.1365		
Uranium	0.0007840	0.0007840	186.5		

Sample 19887 water leach, Stage 4.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.610               log fO2 =   -0.749
Eh =   0.5903 volts       pe =   9.9792
Ionic strength      =    0.004757
Activity of water   =    1.000000
Solvent mass        =    0.999985 kg
Solution mass       =    1.000248 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000007 molal
Dissolved solids    =         263 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      124.03 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001512	34.75	0.9287	-2.8526
CO3--	0.0008751	52.50	0.7450	-3.1858
OH-	0.0004440	7.549	0.9279	-3.3851
HPO4--	0.0004411	42.33	0.7427	-3.4846
HCO3-	0.0003674	22.41	0.9287	-3.4670
O2(aq)	0.0002255	7.213	1.0000	-3.6469
CrO4--	0.0001310	15.19	0.7427	-4.0119
UO2(OH)3-	8.793e-005	28.22	0.9287	-4.0880
UO2(CO3)3----	6.606e-005	29.72	0.3039	-4.6973
CaPO4-	2.153e-005	2.906	0.9287	-4.6992
MnO4-	1.375e-005	1.635	0.9279	-4.8942
PO4---	1.243e-005	1.180	0.5119	-5.1964
Fe(OH)4-	1.100e-005	1.362	0.9287	-4.9907
F-	8.569e-006	0.1628	0.9279	-5.0996
Pb(OH)2(aq)	7.886e-006	1.902	1.0000	-5.1031
AlO2-	7.228e-006	0.4262	0.9287	-5.1731
Cl-	7.119e-006	0.2523	0.9272	-5.1804
NO3-	6.980e-006	0.4327	0.9272	-5.1890
MgPO4-	4.377e-006	0.5219	0.9287	-5.3910
MnO4--	4.349e-006	0.5172	0.7427	-5.4907
SO4--	4.228e-006	0.4060	0.7427	-5.5030
NaHPO4-	4.120e-006	0.4900	0.9287	-5.4172
Pb(OH)3-	3.500e-006	0.9034	0.9287	-5.4881
NaCO3-	3.222e-006	0.2674	0.9287	-5.5240
(UO2)2CO3(OH)3-	2.454e-006	1.597	0.9287	-5.6423
UO2(OH)2(aq)	1.619e-006	0.4921	1.0000	-5.7908
CaCO3(aq)	1.509e-006	0.1510	1.0000	-5.8214
PbCO3(aq)	1.450e-006	0.3873	1.0000	-5.8387
Ca++	1.450e-006	0.05808	0.7516	-5.9628
Ni(OH)2(aq)	1.130e-006	0.1047	1.0000	-5.9469
Fe(OH)3(aq)	9.984e-007	0.1067	1.0000	-6.0007

UO2(CO3)2--	9.383e-007	0.3659	0.7427	-6.1568
Pb(CO3)2--	8.408e-007	0.2751	0.7427	-6.2045
NaHCO3(aq)	6.831e-007	0.05737	1.0000	-6.1655
PbOH+	5.177e-007	0.1161	0.9287	-6.3180
Ni(OH)3-	5.014e-007	0.05500	0.9287	-6.3319
Sr++	3.308e-007	0.02898	0.7473	-6.6070
Mg++	2.166e-007	0.005263	0.7599	-6.7836
CaHPO4(aq)	1.962e-007	0.02668	1.0000	-6.7074
(UO2)3(OH)7-	1.455e-007	0.1351	0.9287	-6.8694
H2PO4-	1.390e-007	0.01348	0.9287	-6.8892
SrCO3(aq)	1.182e-007	0.01744	1.0000	-6.9274
MgCO3(aq)	1.022e-007	0.008616	1.0000	-6.9905
NaOH(aq)	9.174e-008	0.003668	1.0000	-7.0374
Ni++	8.857e-008	0.005197	0.7516	-7.1767
UO2(OH)4--	6.980e-008	0.02359	0.7427	-7.2853
MgHPO4(aq)	4.383e-008	0.005271	1.0000	-7.3582
UO2PO4-	3.477e-008	0.01269	0.9287	-7.4910
NaSO4-	3.137e-008	0.003733	0.9287	-7.5357
CO2(aq)	1.852e-008	0.0008150	1.0000	-7.7323

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	52.1679s/sat	Magnetite	-0.0526
Todorokite	45.2610s/sat	Diaspore	-0.0601
Pyromorphite	17.9265s/sat	Ice	-0.1387
Trevorite	16.2543s/sat	Schoepite	-0.3095
Pyromorphite-OH	12.0868s/sat	UO3:2H2O	-0.3095
Hematite	11.8900s/sat	UO2(OH)2(beta)	-0.4219
Fluorapatite	11.4568s/sat	Boehmite	-0.4640
Pb4O(PO4)2	11.1118s/sat	Schoepite-dehy(.	-0.4929
Bixbyite	9.6814s/sat	UO3:.9H2O(alpha)	-0.4929
Pyrolusite	8.9639s/sat	Pb4SO7	-0.5102
Hausmannite	7.9069s/sat	Crocoite	-0.5271
MnO2(gamma)	7.4461s/sat	Na2U2O7(am)	-0.5377
Parsonsite	6.8798s/sat	Schoepite-dehy(.	-0.5732
Pb3(PO4)2	6.5264s/sat	Schoepite-dehy(1	-0.5793
Hydrocerussite	5.9596s/sat	Ni3(PO4)2	-0.6380
Ferrite-Ca	5.7342s/sat	Litharge	-0.6517
Goethite	5.4648s/sat	Gibbsite	-0.6558
Ferrite-Mg	5.3799s/sat	Calcite	-0.6684
Hydroxylapatite	5.2470s/sat	Aragonite	-0.8128
Manganite	4.5225s/sat	Massicot	-0.8339
Plattnerite	3.9495s/sat	Pb4Cl2(OH)6	-0.9119
CaUO4	3.8390s/sat	Dolomite-ord	-0.9738
Minium	3.6990s/sat	Dolomite	-0.9738
PbHPO4	3.0100s/sat	Ca-Autunite	-1.3424
Na2U2O7(c)	1.9706s/sat	Pb3SO6	-1.3599
Bunsenite	1.5714s/sat	Monohydrocalcite	-1.5021
Ni(OH)2	1.2948s/sat	Schoepite-dehy(.	-1.6825
Cerussite	1.1192s/sat	Brucite	-1.8616
Becquerelite	1.0000s/sat	Magnesite	-1.9342
Strontianite	0.8498s/sat	Mn(OH)3	-1.9833
Whitlockite	0.5874s/sat	Schoepite-dehy(.	-2.2005
Fe(OH)3(ppd)	0.3437s/sat	Lanarkite	-2.2797
PbCO3.PbO	0.2261s/sat	MnHPO4	-2.4068

SrUO4(alpha)	-0.0282	Dolomite-dis	-2.5182

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1784	-0.749
H2O(g)	0.02598	-1.585
CO2(g)	5.453e-007	-6.263
HF(g)	1.506e-017	-16.822
HCl(g)	8.018e-023	-22.096
NO2(g)	5.565e-024	-23.255
N2(g)	9.256e-028	-27.034
NO(g)	8.831e-030	-29.054
Cl2(g)	3.938e-037	-36.405
H2(g)	6.635e-042	-41.178
CO(g)	1.130e-051	-50.947
UO2F2(g)	2.736e-062	-61.563
Pb(g)	1.590e-062	-61.798
SO2(g)	2.353e-063	-62.628
UO3(g)	3.765e-067	-66.424
Na(g)	6.384e-073	-72.195
NH3(g)	3.964e-073	-72.402
UO2Cl2(g)	9.548e-076	-75.020
UOF4(g)	2.516e-083	-82.599
F2(g)	1.091e-089	-88.962
UF5(g)	3.096e-100	-99.509
UF4(g)	9.161e-106	-105.038
UF6(g)	1.030e-108	-107.987
UO2(g)	5.553e-120	-119.255
Mg(g)	1.024e-126	-125.990
UCl4(g)	6.880e-138	-137.162
Ca(g)	1.007e-148	-147.997
UCl5(g)	8.616e-149	-148.065
CH4(g)	8.430e-149	-148.074
H2S(g)	1.697e-150	-149.770
UF3(g)	1.242e-152	-151.906
UCl6(g)	2.005e-154	-153.698
UCl3(g)	2.827e-164	-163.549
U2F10(g)	1.073e-174	-173.970
Al(g)	1.620e-191	-190.790
C(g)	6.275e-193	-192.202
UF2(g)	2.485e-196	-195.605
UO(g)	3.252e-204	-203.488
UCl2(g)	6.290e-208	-207.201
UF(g)	1.223e-233	-232.912
S2(g)	1.459e-243	-242.836
C2H4(g)	3.186e-244	-243.497
UCl(g)	3.065e-249	-248.514
U2Cl8(g)	1.167e-264	-263.933
U2Cl10(g)	1.482e-270	-269.829
U(g)	4.467e-289	-288.350

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	7.23e-006	7.23e-006	0.195			
Ca++	2.47e-005	2.47e-005	0.990			

Cl-	7.12e-006	7.12e-006	0.252
CrO4--	0.000131	0.000131	15.2
F-	8.57e-006	8.57e-006	0.163
Fe++	1.20e-005	1.20e-005	0.670
H+	-0.00200	-0.00200	-2.02
H2O	55.5	55.5	1.00e+006
HCO3-	0.00145	0.00145	88.7
HPO4--	0.000484	0.000484	46.4
Mg++	4.74e-006	4.74e-006	0.115
Mn++	1.81e-005	1.81e-005	0.994
NH3(aq)	6.98e-006	6.98e-006	0.119
Na+	0.00152	0.00152	34.9
Ni++	1.72e-006	1.72e-006	0.101
O2(aq)	0.000264	0.000264	8.44
Pb++	1.42e-005	1.42e-005	2.94
SO4--	4.26e-006	4.26e-006	0.409
Sr++	4.59e-007	4.59e-007	0.0402
UO2++	0.000162	0.000162	43.7

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	7.230e-006	7.230e-006	0.1950		
Calcium	2.470e-005	2.470e-005	0.9897		
Carbon	0.001454	0.001454	17.46		
Chlorine	7.120e-006	7.120e-006	0.2524		
Chromium	0.0001310	0.0001310	6.810		
Fluorine	8.570e-006	8.570e-006	0.1628		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.200e-005	1.200e-005	0.6700		
Lead	1.420e-005	1.420e-005	2.942		
Magnesium	4.740e-006	4.740e-006	0.1152		
Manganese	1.810e-005	1.810e-005	0.9941		
Nickel	1.720e-006	1.720e-006	0.1009		
Nitrogen	6.980e-006	6.980e-006	0.09774		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0004840	0.0004840	14.99		
Sodium	0.001520	0.001520	34.94		
Strontium	4.590e-007	4.590e-007	0.04021		
Sulfur	4.260e-006	4.260e-006	0.1366		
Uranium	0.0001620	0.0001620	38.55		

Sample 19887 water leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  9.940               log fO2 =   -0.715
Eh =   0.6305 volts       pe =  10.6576
Ionic strength      =     0.002967
Activity of water   =     1.000000
Solvent mass        =     0.999995 kg
Solution mass       =     1.000189 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000007 molal
Dissolved solids    =          194 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=        84.92 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001096	25.20	0.9422	-2.9859
HCO3-	0.0006490	39.59	0.9422	-3.2136
CO3--	0.0003166	19.00	0.7889	-3.6024
HPO4--	0.0002592	24.87	0.7873	-3.6902
O2(aq)	0.0002435	7.789	1.0000	-3.6136
UO2(CO3)3----	9.589e-005	43.15	0.3839	-4.4340
OH-	9.354e-005	1.591	0.9417	-4.0551
UO2(OH)3-	2.762e-005	8.865	0.9422	-4.5847
CrO4--	2.019e-005	2.342	0.7873	-4.7986
CaPO4-	1.234e-005	1.666	0.9422	-4.9346
Fe(OH)4-	1.027e-005	1.272	0.9422	-5.0141
(UO2)2CO3(OH)3-	9.628e-006	6.267	0.9422	-5.0423
NO3-	6.980e-006	0.4327	0.9412	-5.1825
Cl-	6.769e-006	0.2399	0.9412	-5.1958
AlO2-	6.467e-006	0.3813	0.9422	-5.2152
F-	6.159e-006	0.1170	0.9417	-5.2366
Ca++	5.997e-006	0.2403	0.7934	-5.3226
Fe(OH)3(aq)	4.425e-006	0.4728	1.0000	-5.3541
UO2(CO3)2--	4.236e-006	1.652	0.7873	-5.4769
SO4--	4.233e-006	0.4065	0.7873	-5.4773
MgPO4-	2.912e-006	0.3473	0.9422	-5.5616
CaCO3(aq)	2.524e-006	0.2526	1.0000	-5.5979
UO2(OH)2(aq)	2.413e-006	0.7334	1.0000	-5.6175
MnO4-	2.181e-006	0.2593	0.9417	-5.6874
NaHPO4-	1.861e-006	0.2213	0.9422	-5.7562
PO4---	1.452e-006	0.1378	0.5837	-6.0720
Ni++	1.087e-006	0.06381	0.7934	-6.0641
Mg++	1.044e-006	0.02537	0.7992	-6.0786
NaHCO3(aq)	9.006e-007	0.07564	1.0000	-6.0455
NaCO3-	8.951e-007	0.07428	0.9422	-6.0740
PbCO3(aq)	8.684e-007	0.2320	1.0000	-6.0613

Ni(OH)2(aq)	6.695e-007	0.06205	1.0000	-6.1743
Pb(OH)2(aq)	5.636e-007	0.1359	1.0000	-6.2490
CaHPO4(aq)	5.336e-007	0.07258	1.0000	-6.2728
H2PO4-	3.991e-007	0.03870	0.9422	-6.4248
Sr++	3.736e-007	0.03273	0.7904	-6.5297
MgCO3(aq)	1.985e-007	0.01674	1.0000	-6.7022
Pb(CO3)2--	1.820e-007	0.05955	0.7873	-6.8437
PbOH+	1.706e-007	0.03824	0.9422	-6.7939
CO2(aq)	1.553e-007	0.006832	1.0000	-6.8089
UO2PO4-	1.488e-007	0.05430	0.9422	-6.8533
MnO4--	1.385e-007	0.01647	0.7873	-6.9623
MgHPO4(aq)	1.384e-007	0.01664	1.0000	-6.8588
Ca2UO2(CO3)3	1.321e-007	0.07004	1.0000	-6.8790
(UO2)3(OH)7-	1.015e-007	0.09427	0.9422	-7.0195
Ni(OH)3-	6.260e-008	0.006867	0.9422	-7.2293
SrCO3(aq)	5.409e-008	0.007984	1.0000	-7.2668
Pb(OH)3-	5.270e-008	0.01361	0.9422	-7.3040
CaHCO3+	3.438e-008	0.003475	0.9422	-7.4895
NaSO4-	2.414e-008	0.002873	0.9422	-7.6432
NaOH(aq)	1.443e-008	0.0005770	1.0000	-7.8407

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	50.9483s/sat	Strontianite	0.5104s/sat
Todorokite	44.1896s/sat	Minium	0.2780s/sat
Trevorite	17.3201s/sat	Boehmite	0.1639s/sat
Pyromorphite	16.2548s/sat	Gibbsite	-0.0279
Hematite	13.1832s/sat	Schoepite	-0.1362
Fluorapatite	11.8938s/sat	UO3:2H2O	-0.1362
Pyromorphite-OH	9.7605s/sat	Ice	-0.1387
Bixbyite	9.3681s/sat	UO2(OH)2(beta)	-0.2486
Pyrolusite	8.8156s/sat	Schoepite-dehy(.	-0.3196
Pb4O(PO4)2	8.7970s/sat	UO3:.9H2O(alpha)	-0.3196
Hausmannite	7.4286s/sat	Schoepite-dehy(.	-0.3999
MnO2(gamma)	7.2978s/sat	Schoepite-dehy(1	-0.4060
Parsonsite	7.0301s/sat	Calcite	-0.4449
Ferrite-Ca	6.3275s/sat	Dolomite	-0.4620
Goethite	6.1114s/sat	Dolomite-ord	-0.4620
Ferrite-Mg	6.0380s/sat	Aragonite	-0.5893
Pb3(PO4)2	5.3575s/sat	SrUO4(alpha)	-1.1176
Hydroxylapatite	5.1510s/sat	Crocoite	-1.1198
Hydrocerussite	4.3685s/sat	PbCO3.PbO	-1.1424
Manganite	4.3659s/sat	Monohydrocalcite	-1.2786
CaUO4	3.3125s/sat	MnHPO4	-1.4374
PbHPO4	2.9985s/sat	Schoepite-dehy(.	-1.5092
Plattnerite	2.8203s/sat	Magnesite	-1.6459
Magnetite	1.8787s/sat	Litharge	-1.7976
Bunsenite	1.3440s/sat	Na2U2O7(am)	-1.7977
Becquerelite	1.3400s/sat	Massicot	-1.9798
Ni(OH)2	1.0674s/sat	Dolomite-dis	-2.0064
Fe(OH)3(ppd)	0.9903s/sat	Schoepite-dehy(.	-2.0272
Ni3(PO4)2	0.9488s/sat	Mn(OH)3	-2.1399
Cerussite	0.8966s/sat	Brucite	-2.4966
Whitlockite	0.7567s/sat	Dawsonite	-2.8179
Na2U2O7(c)	0.7106s/sat	NiCO3	-2.8495

Ca-Autunite	0.5732s/sat	Corundum	-2.8559
Diaspore	0.5678s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1926	-0.715
H2O(g)	0.02598	-1.585
CO2(g)	4.570e-006	-5.340
HF(g)	5.138e-017	-16.289
HCl(g)	3.620e-022	-21.441
NO2(g)	2.592e-023	-22.586
N2(g)	1.722e-026	-25.764
NO(g)	3.958e-029	-28.403
Cl2(g)	8.341e-036	-35.079
H2(g)	6.385e-042	-41.195
CO(g)	9.115e-051	-50.040
UO2F2(g)	4.747e-061	-60.324
SO2(g)	5.257e-062	-61.279
Pb(g)	1.094e-063	-62.961
UO3(g)	5.612e-067	-66.251
NH3(g)	1.614e-072	-71.792
Na(g)	9.850e-074	-73.007
UO2Cl2(g)	2.901e-074	-73.537
UOF4(g)	5.082e-081	-80.294
F2(g)	1.319e-088	-87.880
UF5(g)	2.092e-097	-96.679
UF4(g)	1.780e-103	-102.750
UF6(g)	2.421e-105	-104.616
UO2(g)	7.965e-120	-119.099
Mg(g)	2.284e-127	-126.641
UCl4(g)	4.100e-135	-134.387
UCl5(g)	2.363e-145	-144.626
CH4(g)	6.060e-148	-147.218
H2S(g)	3.379e-149	-148.471
Ca(g)	1.934e-149	-148.714
UCl6(g)	2.531e-150	-149.597
UF3(g)	6.940e-151	-150.159
UCl3(g)	3.661e-162	-161.436
U2F10(g)	4.901e-169	-168.310
Al(g)	6.494e-191	-190.188
C(g)	4.871e-192	-191.312
UF2(g)	3.992e-195	-194.399
UO(g)	4.489e-204	-203.348
UCl2(g)	1.770e-206	-205.752
UF(g)	5.652e-233	-232.248
S2(g)	6.247e-241	-240.204
C2H4(g)	1.777e-242	-241.750
UCl(g)	1.873e-248	-247.727
U2Cl8(g)	4.143e-259	-258.383
U2Cl10(g)	1.115e-263	-262.953
U(g)	5.934e-289	-288.227

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	6.47e-006	6.47e-006	0.175			

Ca++	2.17e-005	2.17e-005	0.870
Cl-	6.77e-006	6.77e-006	0.240
CrO4--	2.02e-005	2.02e-005	2.34
F-	6.16e-006	6.16e-006	0.117
Fe++	1.47e-005	1.47e-005	0.821
H+	-0.000937	-0.000937	-0.945
H2O	55.5	55.5	1.00e+006
HCO3-	0.00128	0.00128	78.0
HPO4--	0.000279	0.000279	26.8
Mg++	4.30e-006	4.30e-006	0.104
Mn++	2.32e-006	2.32e-006	0.127
NH3(aq)	6.98e-006	6.98e-006	0.119
Na+	0.00110	0.00110	25.3
Ni++	1.82e-006	1.82e-006	0.107
O2(aq)	0.000264	0.000264	8.45
Pb++	1.84e-006	1.84e-006	0.381
SO4--	4.26e-006	4.26e-006	0.409
Sr++	4.35e-007	4.35e-007	0.0381
UO2++	0.000150	0.000150	40.5

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	6.470e-006	6.470e-006	0.1745		
Calcium	2.170e-005	2.170e-005	0.8695		
Carbon	0.001278	0.001278	15.34		
Chlorine	6.770e-006	6.770e-006	0.2400		
Chromium	2.020e-005	2.020e-005	1.050		
Fluorine	6.160e-006	6.160e-006	0.1170		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.470e-005	1.470e-005	0.8208		
Lead	1.840e-006	1.840e-006	0.3812		
Magnesium	4.300e-006	4.300e-006	0.1045		
Manganese	2.320e-006	2.320e-006	0.1274		
Nickel	1.820e-006	1.820e-006	0.1068		
Nitrogen	6.980e-006	6.980e-006	0.09775		
Oxygen	55.51	55.51	8.880e+005		
Phosphorus	0.0002790	0.0002790	8.640		
Sodium	0.001100	0.001100	25.28		
Strontium	4.350e-007	4.350e-007	0.03811		
Sulfur	4.260e-006	4.260e-006	0.1366		
Uranium	0.0001500	0.0001500	35.70		

Sample 19887 water leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.410               log fO2 =   -0.769
Eh =   0.6019 volts       pe =  10.1742
Ionic strength      =     0.007806
Activity of water   =     1.000000
Solvent mass        =     0.999921 kg
Solution mass       =     1.000833 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000007 molal
Dissolved solids    =          911 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       178.16 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.003796	87.19	0.9117	-2.4608
UO2(OH)3-	0.0006388	204.9	0.9117	-3.2348
CO3--	0.0004945	29.65	0.6926	-3.4653
HPO4--	0.0003782	36.26	0.6893	-3.5839
UO2(CO3)3----	0.0003669	165.0	0.2252	-4.0828
HCO3-	0.0003116	19.00	0.9117	-3.5465
OH-	0.0002855	4.851	0.9106	-3.5851
(UO2)2CO3(OH)3-	0.0002659	173.0	0.9117	-3.6154
O2(aq)	0.0002153	6.882	1.0000	-3.6670
(UO2)3(OH)7-	0.0001350	125.3	0.9117	-3.9097
CrO4--	9.520e-005	11.03	0.6893	-4.1830
Fe(OH)4-	6.897e-005	8.536	0.9117	-4.2015
CaPO4-	5.730e-005	7.731	0.9117	-4.2820
F-	2.629e-005	0.4991	0.9106	-4.6209
AlO2-	2.259e-005	1.331	0.9117	-4.6863
MgPO4-	2.205e-005	2.628	0.9117	-4.6968
UO2(OH)2(aq)	1.830e-005	5.559	1.0000	-4.7376
NO3-	1.750e-005	1.084	0.9094	-4.7982
MnO4-	1.030e-005	1.224	0.9106	-5.0278
Fe(OH)3(aq)	9.738e-006	1.040	1.0000	-5.0115
Pb(OH)2(aq)	9.560e-006	2.304	1.0000	-5.0196
NaHPO4-	8.230e-006	0.9783	0.9117	-5.1247
Ca++	8.078e-006	0.3235	0.7021	-5.2463
UO2(CO3)2--	7.922e-006	3.087	0.6893	-5.2628
PO4---	7.384e-006	0.7006	0.4325	-5.4957
Cl-	6.767e-006	0.2397	0.9094	-5.2108
Ni(OH)2(aq)	5.956e-006	0.5516	1.0000	-5.2251
NaCO3-	4.250e-006	0.3524	0.9117	-5.4118
SO4--	4.183e-006	0.4015	0.6893	-5.5401
CaCO3(aq)	4.126e-006	0.4125	1.0000	-5.3845
Sr++	2.941e-006	0.2574	0.6958	-5.6890
Pb(OH)3-	2.726e-006	0.7034	0.9117	-5.6046

PbCO3(aq)	2.319e-006	0.6191	1.0000	-5.6347
Mg++	2.271e-006	0.05516	0.7140	-5.7900
MnO4--	2.199e-006	0.2613	0.6893	-5.8193
Ni(OH)3-	1.699e-006	0.1862	0.9117	-5.8101
NaHCO3(aq)	1.402e-006	0.1177	1.0000	-5.8533
Ni++	1.255e-006	0.07360	0.7021	-6.0549
PbOH+	1.013e-006	0.2270	0.9117	-6.0345
CaHPO4(aq)	8.125e-007	0.1104	1.0000	-6.0902
Pb(CO3)2--	7.613e-007	0.2489	0.6893	-6.2800
MgCO3(aq)	5.291e-007	0.04457	1.0000	-6.2765
SrCO3(aq)	5.139e-007	0.07580	1.0000	-6.2891
UO2PO4-	5.047e-007	0.1841	0.9117	-6.3371
Ca2UO2(CO3)3	4.215e-007	0.2233	1.0000	-6.3752
MgHPO4(aq)	3.436e-007	0.04129	1.0000	-6.4640
UO2(OH)4--	3.385e-007	0.1143	0.6893	-6.6321
H2PO4-	1.785e-007	0.01730	0.9117	-6.7885
NaOH(aq)	1.427e-007	0.005702	1.0000	-6.8456
NaSO4-	7.232e-008	0.008602	0.9117	-7.1809
SrHPO4(aq)	6.124e-008	0.01123	1.0000	-7.2130
CO2(aq)	2.444e-008	0.001075	1.0000	-7.6118
CaOH+	2.259e-008	0.001288	0.9117	-7.6863
CaHCO3+	1.968e-008	0.001988	0.9117	-7.7461
NaAlO2(aq)	1.287e-008	0.001054	1.0000	-7.8904

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	52.8396s/sat	Schoepite	0.7437s/sat
Todorokite	45.8512s/sat	UO3:2H2O	0.7437s/sat
Pyromorphite	19.4160s/sat	UO2(OH)2(beta)	0.6313s/sat
Trevorite	18.9545s/sat	Diaspore	0.6267s/sat
Fluorapatite	14.6200s/sat	Schoepite-dehy(.	0.5603s/sat
Hematite	13.8684s/sat	UO3:.9H2O(alpha)	0.5603s/sat
Pyromorphite-OH	13.4067s/sat	PbCO3.PbO	0.5136s/sat
Pb4O(PO4)2	12.0474s/sat	Schoepite-dehy(.	0.4800s/sat
Bixbyite	9.8543s/sat	Schoepite-dehy(1	0.4739s/sat
Pyrolusite	9.0454s/sat	Boehmite	0.2228s/sat
Parsonsite	8.7016s/sat	Pb4SO7	0.1871s/sat
Hausmannite	8.1713s/sat	Dolomite	0.1771s/sat
Ferrite-Ca	8.0290s/sat	Dolomite-ord	0.1771s/sat
Ferrite-Mg	7.9518s/sat	Gibbsite	0.0310s/sat
Hydroxylapatite	7.7314s/sat	Ice	-0.1387
Becquerelite	7.6359s/sat	Crocoite	-0.2146
MnO2(gamma)	7.5276s/sat	Calcite	-0.2315
Pb3(PO4)2	7.3785s/sat	Pb4Cl2(OH)6	-0.2384
Goethite	6.4540s/sat	Aragonite	-0.3759
Hydrocerussite	6.4511s/sat	Litharge	-0.5682
CaUO4	5.2087s/sat	Schoepite-dehy(.	-0.6293
Manganite	4.6090s/sat	Pb3SO6	-0.7463
Na2U2O7(c)	4.4607s/sat	Massicot	-0.7504
Plattnerite	4.0230s/sat	Monohydrocalcite	-1.0652
Minium	3.9397s/sat	Schoepite-dehy(.	-1.1473
PbHPO4	3.3942s/sat	Magnesite	-1.2202
Magnetite	2.9199s/sat	Brucite	-1.2680
Bunsenite	2.2932s/sat	Dolomite-dis	-1.3673
Whitlockite	2.1382s/sat	Lanarkite	-1.7496

Ni3(PO4)2	2.1289s/sat	Mn(OH)3	-1.8968
Ni(OH)2	2.0166s/sat	MnHPO4	-2.0147
Na2U2O7(am)	1.9524s/sat	UO3(gamma)	-2.1303
Ca-Autunite	1.6819s/sat	MgUO4	-2.3953
SrUO4(alpha)	1.5430s/sat	Dawsonite	-2.5668
Strontianite	1.4881s/sat	NiCO3	-2.7032
Fe(OH)3(ppd)	1.3329s/sat	UO3(beta)	-2.7325
Cerussite	1.3232s/sat	Corundum	-2.7381

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1703	-0.769
H2O(g)	0.02598	-1.585
CO2(g)	7.195e-007	-6.143
HF(g)	7.187e-017	-16.143
HCl(g)	1.185e-022	-21.926
NO2(g)	2.194e-023	-22.659
N2(g)	1.578e-026	-25.802
NO(g)	3.563e-029	-28.448
Cl2(g)	8.402e-037	-36.076
H2(g)	6.790e-042	-41.168
CO(g)	1.526e-051	-50.816
UO2F2(g)	7.043e-060	-59.152
Pb(g)	1.973e-062	-61.705
SO2(g)	5.554e-063	-62.255
UO3(g)	4.256e-066	-65.371
NH3(g)	1.695e-072	-71.771
Na(g)	1.004e-072	-71.998
UO2Cl2(g)	2.357e-074	-73.628
UOF4(g)	1.475e-079	-78.831
F2(g)	2.427e-088	-87.615
UF5(g)	8.758e-096	-95.058
UF4(g)	5.495e-102	-101.260
UF6(g)	1.375e-103	-102.862
UO2(g)	6.424e-119	-118.192
Mg(g)	4.112e-126	-125.386
UCl4(g)	3.795e-136	-135.421
UCl5(g)	6.943e-147	-146.158
Ca(g)	2.135e-148	-147.671
CH4(g)	1.220e-148	-147.914
UF3(g)	1.579e-149	-148.802
H2S(g)	4.295e-150	-149.367
UCl6(g)	2.360e-152	-151.627
UCl3(g)	1.068e-162	-161.972
U2F10(g)	8.587e-166	-165.066
Al(g)	8.155e-191	-190.089
C(g)	8.673e-193	-192.062
UF2(g)	6.699e-194	-193.174
UO(g)	3.851e-203	-202.414
UCl2(g)	1.626e-206	-205.789
UF(g)	6.992e-232	-231.155
S2(g)	8.920e-243	-242.050
C2H4(g)	6.373e-244	-243.196
UCl(g)	5.424e-248	-247.266
U2Cl8(g)	3.550e-261	-260.450
U2Cl10(g)	9.620e-267	-266.017

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 U(g)                5.413e-288    -287.267
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Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	2.26e-005	2.26e-005	0.609			
Ca++	7.12e-005	7.12e-005	2.85			
Cl-	6.77e-006	6.77e-006	0.240			
CrO4--	9.52e-005	9.52e-005	11.0			
F-	2.63e-005	2.63e-005	0.499			
Fe++	7.87e-005	7.87e-005	4.39			
H+	-0.00638	-0.00638	-6.43			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00220	0.00220	134.			
HPO4--	0.000475	0.000475	45.6			
Mg++	2.52e-005	2.52e-005	0.612			
Mn++	1.25e-005	1.25e-005	0.686			
NH3(aq)	1.75e-005	1.75e-005	0.298			
Na+	0.00381	0.00381	87.5			
Ni++	8.91e-006	8.91e-006	0.522			
O2(aq)	0.000285	0.000285	9.11			
Pb++	1.64e-005	1.64e-005	3.40			
SO4--	4.26e-006	4.26e-006	0.409			
Sr++	3.52e-006	3.52e-006	0.308			
UO2++	0.00197	0.00197	532.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	2.260e-005	2.260e-005	0.6093		
Calcium	7.120e-005	7.120e-005	2.851		
Carbon	0.002204	0.002204	26.45		
Chlorine	6.770e-006	6.770e-006	0.2398		
Chromium	9.520e-005	9.520e-005	4.946		
Fluorine	2.630e-005	2.630e-005	0.4992		
Hydrogen	111.0	111.0	1.118e+005		
Iron	7.870e-005	7.870e-005	4.391		
Lead	1.640e-005	1.640e-005	3.395		
Magnesium	2.520e-005	2.520e-005	0.6120		
Manganese	1.250e-005	1.250e-005	0.6862		
Nickel	8.910e-006	8.910e-006	0.5225		
Nitrogen	1.750e-005	1.750e-005	0.2449		
Oxygen	55.52	55.52	8.876e+005		
Phosphorus	0.0004750	0.0004750	14.70		
Sodium	0.003810	0.003810	87.52		
Strontium	3.520e-006	3.520e-006	0.3082		
Sulfur	4.260e-006	4.260e-006	0.1365		
Uranium	0.001970	0.001970	468.5		

Sample 19887 $Ca(OH)_2$ leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.640               log fO2 =   -0.707
Eh =   0.5300 volts       pe =   8.9597
Ionic strength      =     0.029020
Activity of water   =     1.000000
Solvent mass        =     0.999903 kg
Solution mass       =     1.001015 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =         1111 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       834.93 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01704	391.3	0.8512	-1.8386
CO3--	0.007966	477.5	0.5283	-2.3759
OH-	0.005207	88.45	0.8479	-2.3551
F-	0.0007931	15.05	0.8479	-3.1723
NO3-	0.0007471	46.27	0.8445	-3.2000
O2(aq)	0.0002483	7.938	1.0000	-3.6049
HCO3-	0.0002415	14.72	0.8512	-3.6871
NaCO3-	0.0002344	19.43	0.8512	-3.7001
HPO4--	0.0001867	17.90	0.5206	-4.0124
PO4---	8.813e-005	8.360	0.2294	-4.6942
AlO2-	8.143e-005	4.797	0.8512	-4.1592
CrO4--	3.950e-005	4.577	0.5206	-4.6869
NaHPO4-	1.377e-005	1.636	0.8512	-4.9310
CaPO4-	1.251e-005	1.688	0.8512	-4.9727
NaOH(aq)	1.015e-005	0.4057	1.0000	-4.9934
Cl-	9.981e-006	0.3534	0.8445	-5.0742
SO4--	9.447e-006	0.9065	0.5206	-5.3082
UO2(OH)3-	4.796e-006	1.538	0.8512	-5.3891
NaHCO3(aq)	4.250e-006	0.3566	1.0000	-5.3716
UO2(CO3)3----	3.011e-006	1.354	0.0728	-6.6588
Fe(OH)4-	2.541e-006	0.3144	0.8512	-5.6651
CaCO3(aq)	1.632e-006	0.1632	1.0000	-5.7872
NaF(aq)	9.806e-007	0.04113	1.0000	-6.0085
MgPO4-	9.405e-007	0.1121	0.8512	-6.0966
Ni(OH)3-	8.383e-007	0.09187	0.8512	-6.1466
Pb(OH)3-	8.197e-007	0.2114	0.8512	-6.1563
MnO4--	8.119e-007	0.09645	0.5206	-6.3740
SrCO3(aq)	6.177e-007	0.09108	1.0000	-6.2093
NaSO4-	5.536e-007	0.06584	0.8512	-6.3268
Sr++	3.736e-007	0.03270	0.5357	-6.6986
Ca++	3.321e-007	0.01329	0.5500	-6.7384

MnO4-	1.882e-007	0.02236	0.8479	-6.7970
NaAlO2(aq)	1.815e-007	0.01486	1.0000	-6.7411
Ni(OH)2(aq)	1.616e-007	0.01496	1.0000	-6.7916
Pb(OH)2(aq)	1.580e-007	0.03807	1.0000	-6.8013
UO2(OH)4--	5.335e-008	0.01801	0.5206	-7.5564
MgCO3(aq)	4.089e-008	0.003444	1.0000	-7.3884
NaCl(aq)	2.043e-008	0.001192	1.0000	-7.6898
Fe(OH)3(aq)	1.972e-008	0.002105	1.0000	-7.7051
Mg++	1.770e-008	0.0004298	0.5762	-7.9914
CaOH+	1.323e-008	0.0007544	0.8512	-7.9484

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	28.4119s/sat	Whitlockite	-0.7352
Todorokite	24.4692s/sat	Aragonite	-0.7786
Trevorite	12.0009s/sat	Pb4O(PO4)2	-0.8567
Fluorapatite	11.0123s/sat	Brucite	-1.0094
Hematite	8.4813s/sat	Hausmannite	-1.0279
Pyrolusite	5.9997s/sat	Na2U2O7(am)	-1.1117
MnO2(gamma)	4.4819s/sat	PbHPO4	-1.2761
Hydroxylapatite	3.9052s/sat	Dolomite-ord	-1.3375
Goethite	3.7604s/sat	Dolomite	-1.3375
Bixbyite	3.7319s/sat	Fe(OH)3(ppd)	-1.3607
Ferrite-Ca	3.6098s/sat	Minium	-1.3746
Ferrite-Mg	2.8234s/sat	Monohydrocalcite	-1.4679
CaUO4	2.7923s/sat	Hydrocerussite	-1.6353
Plattnerite	2.2723s/sat	Cerussite	-1.8292
Strontianite	1.5679s/sat	Magnesite	-2.3321
Manganite	1.5478s/sat	Litharge	-2.3499
Na2U2O7(c)	1.3966s/sat	Massicot	-2.5321
Pyromorphite	0.7481s/sat	UO3:2H2O	-2.6406
Bunsenite	0.7267s/sat	Schoepite	-2.6406
Ni(OH)2	0.4501s/sat	UO2(OH)2(beta)	-2.7530
Diaspore	-0.0762	Dawsonite	-2.7880
Ice	-0.1387	UO3:.9H2O(alpha)	-2.8240
SrUO4(alpha)	-0.3909	Schoepite-dehy(.	-2.8240
Boehmite	-0.4801	Dolomite-dis	-2.8819
Calcite	-0.6342	Schoepite-dehy(.	-2.9043
Gibbsite	-0.6719	Schoepite-dehy(1	-2.9104

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1965	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	3.065e-008	-7.514
HF(g)	1.189e-016	-15.925
NO2(g)	4.942e-023	-22.306
HCl(g)	9.556e-024	-23.020
N2(g)	6.017e-026	-25.221
NO(g)	7.473e-029	-28.127
Cl2(g)	5.870e-039	-38.231
H2(g)	6.322e-042	-41.199
CO(g)	6.053e-053	-52.218
UO2F2(g)	7.954e-063	-62.099

Pb(g)	3.036e-064	-63.518
SO2(g)	3.058e-065	-64.515
UO3(g)	1.757e-069	-68.755
Na(g)	6.897e-071	-70.161
NH3(g)	2.973e-072	-71.527
UO2Cl2(g)	6.328e-080	-79.199
UOF4(g)	4.556e-082	-81.341
F2(g)	7.132e-088	-87.147
UF5(g)	4.319e-098	-97.365
UF4(g)	1.581e-104	-103.801
UF6(g)	1.162e-105	-104.935
UO2(g)	2.469e-122	-121.608
Mg(g)	6.945e-126	-125.158
UCl4(g)	6.171e-144	-143.210
Ca(g)	1.846e-147	-146.734
CH4(g)	3.906e-150	-149.408
UF3(g)	2.650e-152	-151.577
H2S(g)	1.908e-152	-151.719
UCl5(g)	9.435e-156	-155.025
UCl6(g)	2.680e-162	-161.572
UCl3(g)	2.077e-169	-168.683
U2F10(g)	2.088e-170	-169.680
Al(g)	1.452e-191	-190.838
C(g)	3.203e-194	-193.494
UF2(g)	6.557e-197	-196.183
UO(g)	1.378e-206	-205.861
UCl2(g)	3.784e-212	-211.422
UF(g)	3.993e-235	-234.399
C2H4(g)	7.533e-247	-246.123
S2(g)	2.032e-247	-246.692
UCl(g)	1.510e-252	-251.821
U2Cl8(g)	9.383e-277	-276.028
U2Cl10(g)	1.777e-284	-283.750
U(g)	1.803e-291	-290.744

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	8.16e-005	8.16e-005	2.20			
Ca++	1.45e-005	1.45e-005	0.581			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	3.95e-005	3.95e-005	4.58			
F-	0.000794	0.000794	15.1			
Fe++	2.56e-006	2.56e-006	0.143			
H+	-0.0146	-0.0146	-14.7			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00846	0.00846	515.			
HPO4--	0.000302	0.000302	29.0			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	0.000747	0.000747	12.7			
Na+	0.0173	0.0173	397.			
Ni++	1.00e-006	1.00e-006	0.0586			
O2(aq)	0.00174	0.00174	55.7			
Pb++	9.89e-007	9.89e-007	0.205			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0875			

UO2++	7.87e-006	7.87e-006	2.12

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	8.160e-005	8.160e-005	2.199		
Calcium	1.450e-005	1.450e-005	0.5805		
Carbon	0.008456	0.008456	101.5		
Chlorine	1.000e-005	1.000e-005	0.3542		
Chromium	3.950e-005	3.950e-005	2.052		
Fluorine	0.0007940	0.0007940	15.07		
Hydrogen	111.0	111.0	1.118e+005		
Iron	2.560e-006	2.560e-006	0.1428		
Lead	9.890e-007	9.890e-007	0.2047		
Magnesium	1.000e-006	1.000e-006	0.02428		
Manganese	1.000e-006	1.000e-006	0.05488		
Nickel	1.000e-006	1.000e-006	0.05863		
Nitrogen	0.0007470	0.0007470	10.45		
Oxygen	55.54	55.54	8.877e+005		
Phosphorus	0.0003020	0.0003020	9.345		
Sodium	0.01730	0.01730	397.3		
Strontium	1.000e-006	1.000e-006	0.08753		
Sulfur	1.000e-005	1.000e-005	0.3203		
Uranium	7.870e-006	7.870e-006	1.871		

Sample 19887 $Ca(OH)_2$ leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.620              log fO2 =   -0.707
Eh =   0.5312 volts      pe =   8.9798
Ionic strength      =    0.027659
Activity of water   =    1.000000
Solvent mass        =    0.999905 kg
Solution mass       =    1.000970 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =        1064 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      772.82 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01566	359.7	0.8538	-1.8738
CO3--	0.007376	442.1	0.5347	-2.4041
OH-	0.004956	84.20	0.8506	-2.3751
F-	0.001029	19.53	0.8506	-3.0579
NO3-	0.0006821	42.25	0.8474	-3.2381
HPO4--	0.0003115	29.87	0.5272	-3.7845
O2(aq)	0.0002484	7.940	1.0000	-3.6048
HCO3-	0.0002363	14.40	0.8538	-3.6953
NaCO3-	0.0002019	16.74	0.8538	-3.7634
PO4---	0.0001382	13.11	0.2361	-4.4863
AlO2-	0.0001297	7.644	0.8538	-3.9556
CrO4--	5.791e-005	6.709	0.5272	-4.5153
CaPO4-	2.889e-005	3.898	0.8538	-4.6079
NaHPO4-	2.140e-005	2.543	0.8538	-4.7383
Cl-	9.982e-006	0.3535	0.8474	-5.0727
SO4--	9.483e-006	0.9100	0.5272	-5.3011
NaOH(aq)	8.942e-006	0.3573	1.0000	-5.0486
UO2(OH)3-	8.237e-006	2.642	0.8538	-5.1529
UO2(CO3)3----	4.660e-006	2.095	0.0767	-6.4471
NaHCO3(aq)	3.846e-006	0.3228	1.0000	-5.4149
Fe(OH)4-	2.272e-006	0.2811	0.8538	-5.7123
CaCO3(aq)	2.195e-006	0.2195	1.0000	-5.6585
NaF(aq)	1.177e-006	0.04937	1.0000	-5.9292
MgPO4-	9.635e-007	0.1148	0.8538	-6.0848
Ni(OH)3-	8.316e-007	0.09114	0.8538	-6.1488
MnO4--	8.032e-007	0.09543	0.5272	-6.3732
SrCO3(aq)	6.041e-007	0.08909	1.0000	-6.2189
Pb(OH)3-	5.433e-007	0.1402	0.8538	-6.3336
NaSO4-	5.174e-007	0.06153	0.8538	-6.3548
Ca++	4.715e-007	0.01888	0.5559	-6.5816
Sr++	3.854e-007	0.03373	0.5420	-6.6801

NaAlO2(aq)	2.675e-007	0.02191	1.0000	-6.5726
MnO4-	1.969e-007	0.02339	0.8506	-6.7761
Ni(OH)2(aq)	1.684e-007	0.01559	1.0000	-6.7738
Pb(OH)2(aq)	1.100e-007	0.02651	1.0000	-6.9586
UO2(OH)4--	8.666e-008	0.02927	0.5272	-7.3402
MgCO3(aq)	2.440e-008	0.002055	1.0000	-7.6127
CaHPO4(aq)	2.365e-008	0.003215	1.0000	-7.6261
NaCl(aq)	1.890e-008	0.001104	1.0000	-7.7235
Fe(OH)3(aq)	1.852e-008	0.001977	1.0000	-7.7323
CaOH+	1.808e-008	0.001031	0.8538	-7.8116
UO2(OH)2(aq)	1.362e-008	0.004138	1.0000	-7.8657
Mg++	1.117e-008	0.0002712	0.5814	-8.1875

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	28.7381s/sat	Aragonite	-0.6499
Todorokite	24.7546s/sat	Na2U2O7(am)	-0.7097
Fluorapatite	12.5348s/sat	Hausmannite	-0.9056
Trevorite	11.9642s/sat	Pb4O(PO4)2	-0.9498
Hematite	8.4268s/sat	PbHPO4	-1.1654
Pyrolusite	6.0404s/sat	Brucite	-1.2455
Hydroxylapatite	5.2932s/sat	Monohydrocalcite	-1.3392
MnO2(gamma)	4.5226s/sat	Fe(OH)3(ppd)	-1.3879
Bixbyite	3.8134s/sat	Dolomite-ord	-1.4331
Goethite	3.7332s/sat	Dolomite	-1.4331
Ferrite-Ca	3.6721s/sat	Minium	-1.8462
CaUO4	3.1654s/sat	Cerussite	-1.9745
Ferrite-Mg	2.5328s/sat	Hydrocerussite	-2.0834
Plattnerite	2.1151s/sat	UO3:2H2O	-2.3844
Na2U2O7(c)	1.7986s/sat	Schoepite	-2.3844
Manganite	1.5885s/sat	UO2(OH)2(beta)	-2.4968
Strontianite	1.5583s/sat	Litharge	-2.5072
Pyromorphite	0.7872s/sat	Magnesite	-2.5564
Bunsenite	0.7445s/sat	UO3:.9H2O(alpha)	-2.5678
Ni(OH)2	0.4679s/sat	Schoepite-dehy(.	-2.5678
Whitlockite	0.1512s/sat	Dawsonite	-2.6077
Diaspore	0.1474s/sat	Schoepite-dehy(.	-2.6481
Ice	-0.1387	Schoepite-dehy(1	-2.6542
SrUO4(alpha)	-0.1562	Fluorite	-2.6603
Boehmite	-0.2565	Massicot	-2.6894
Gibbsite	-0.4483	Dolomite-dis	-2.9775
Calcite	-0.5055		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1965	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	3.150e-008	-7.502
HF(g)	1.620e-016	-15.790
NO2(g)	4.740e-023	-22.324
HCl(g)	1.004e-023	-22.998
N2(g)	5.533e-026	-25.257
NO(g)	7.167e-029	-28.145
Cl2(g)	6.483e-039	-38.188

H2(g)	6.321e-042	-41.199
CO(g)	6.219e-053	-52.206
UO2F2(g)	2.665e-062	-61.574
Pb(g)	2.114e-064	-63.675
SO2(g)	3.408e-065	-64.467
UO3(g)	3.169e-069	-68.499
Na(g)	6.074e-071	-70.217
NH3(g)	2.850e-072	-71.545
UO2Cl2(g)	1.260e-079	-78.899
UOF4(g)	2.836e-081	-80.547
F2(g)	1.325e-087	-86.878
UF5(g)	3.662e-097	-96.436
UF4(g)	9.834e-104	-103.007
UF6(g)	1.343e-104	-103.872
UO2(g)	4.453e-122	-121.351
Mg(g)	4.032e-126	-125.394
UCl4(g)	1.357e-143	-142.867
Ca(g)	2.416e-147	-146.617
CH4(g)	4.012e-150	-149.397
UF3(g)	1.210e-151	-150.917
H2S(g)	2.126e-152	-151.672
UCl5(g)	2.181e-155	-154.661
UCl6(g)	6.510e-162	-161.186
U2F10(g)	1.502e-168	-167.823
UCl3(g)	4.346e-169	-168.362
Al(g)	2.430e-191	-190.614
C(g)	3.290e-194	-193.483
UF2(g)	2.196e-196	-195.658
UO(g)	2.485e-206	-205.605
UCl2(g)	7.536e-212	-211.123
UF(g)	9.813e-235	-234.008
C2H4(g)	7.950e-247	-246.100
S2(g)	2.523e-247	-246.598
UCl(g)	2.862e-252	-251.543
U2Cl8(g)	4.538e-276	-275.343
U2Cl10(g)	9.490e-284	-283.023
U(g)	3.251e-291	-290.488

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	0.000130	0.000130	3.50			
Ca++	3.16e-005	3.16e-005	1.27			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	5.79e-005	5.79e-005	6.71			
F-	0.00103	0.00103	19.5			
Fe++	2.29e-006	2.29e-006	0.128			
H+	-0.0140	-0.0140	-14.1			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00783	0.00783	478.			
HPO4--	0.000501	0.000501	48.0			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	0.000682	0.000682	11.6			
Na+	0.0159	0.0159	365.			
Ni++	1.00e-006	1.00e-006	0.0586			
O2(aq)	0.00161	0.00161	51.6			

Pb++	6.61e-007	6.61e-007	0.137
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0875
UO2++	1.30e-005	1.30e-005	3.51

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	0.0001300	0.0001300	3.504		
Calcium	3.160e-005	3.160e-005	1.265		
Carbon	0.007834	0.007834	94.00		
Chlorine	1.000e-005	1.000e-005	0.3542		
Chromium	5.790e-005	5.790e-005	3.008		
Fluorine	0.001030	0.001030	19.55		
Hydrogen	111.0	111.0	1.118e+005		
Iron	2.290e-006	2.290e-006	0.1278		
Lead	6.610e-007	6.610e-007	0.1368		
Magnesium	1.000e-006	1.000e-006	0.02428		
Manganese	1.000e-006	1.000e-006	0.05488		
Nickel	1.000e-006	1.000e-006	0.05863		
Nitrogen	0.0006820	0.0006820	9.543		
Oxygen	55.54	55.54	8.877e+005		
Phosphorus	0.0005010	0.0005010	15.50		
Sodium	0.01590	0.01590	365.2		
Strontium	1.000e-006	1.000e-006	0.08754		
Sulfur	1.000e-005	1.000e-005	0.3203		
Uranium	1.300e-005	1.300e-005	3.091		

Sample 19887 $Ca(OH)_2$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.850              log fO2 =   -0.706
Eh =   0.5176 volts      pe =   8.7498
Ionic strength      =    0.017382
Activity of water   =    1.000000
Solvent mass        =    0.999851 kg
Solution mass       =    1.000491 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         640 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      471.30 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.008180	139.0	0.8753	-2.1451
Na+	0.008061	185.2	0.8775	-2.1504
CO3--	0.004517	270.9	0.5957	-2.5701
O2(aq)	0.0002484	7.945	1.0000	-3.6048
HCO3-	9.235e-005	5.631	0.8775	-4.0913
CaCO3(aq)	7.110e-005	7.112	1.0000	-4.1481
NaCO3-	7.091e-005	5.881	0.8775	-4.2061
NO3-	6.981e-005	4.326	0.8731	-4.2151
AlO2-	3.926e-005	2.314	0.8775	-4.4628
Ca++	2.033e-005	0.8144	0.6119	-4.9051
F-	9.995e-006	0.1898	0.8753	-5.0581
Cl-	9.991e-006	0.3540	0.8731	-5.0593
SO4--	9.687e-006	0.9300	0.5900	-5.2429
CaPO4-	8.131e-006	1.097	0.8775	-5.1466
NaOH(aq)	8.032e-006	0.3211	1.0000	-5.0952
CrO4--	2.470e-006	0.2864	0.5900	-5.8364
Fe(OH)4-	2.279e-006	0.2821	0.8775	-5.6990
UO2(OH)3-	1.873e-006	0.6008	0.8775	-5.7843
CaOH+	1.418e-006	0.08089	0.8775	-5.9051
HPO4--	9.987e-007	0.09580	0.5900	-6.2297
Ni(OH)3-	8.909e-007	0.09768	0.8775	-6.1069
MnO4--	8.645e-007	0.1027	0.5900	-6.2924
NaHCO3(aq)	8.174e-007	0.06862	1.0000	-6.0876
PO4---	6.530e-007	0.06198	0.3045	-6.7015
SrCO3(aq)	5.364e-007	0.07913	1.0000	-6.2705
MgCO3(aq)	5.098e-007	0.04295	1.0000	-6.2926
Sr++	4.521e-007	0.03959	0.6013	-6.5657
Mg++	3.148e-007	0.007647	0.6316	-6.7014
NaSO4-	3.044e-007	0.03622	0.8775	-6.5733
Pb(OH)3-	2.873e-007	0.07415	0.8775	-6.5983
MgPO4-	1.749e-007	0.02085	0.8775	-6.8139

MnO4-	1.357e-007	0.01613	0.8753	-6.9253
Ni(OH)2(aq)	1.092e-007	0.01011	1.0000	-6.9619
UO2(CO3)3----	4.488e-008	0.02018	0.1206	-8.2666
NaAlO2(aq)	4.401e-008	0.003605	1.0000	-7.3564
NaHPO4-	3.951e-008	0.004698	0.8775	-7.4600
Pb(OH)2(aq)	3.521e-008	0.008488	1.0000	-7.4533
UO2(OH)4--	3.073e-008	0.01038	0.5900	-7.7416
CaHCO3+	1.279e-008	0.001293	0.8775	-7.9497
SrOH+	1.125e-008	0.001176	0.8775	-8.0057
Fe(OH)3(aq)	1.125e-008	0.001201	1.0000	-7.9490
NaCl(aq)	1.031e-008	0.0006022	1.0000	-7.9867

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	25.7041s/sat	Aragonite	0.8605s/sat
Todorokite	22.0999s/sat	Whitlockite	0.7502s/sat
Fluorapatite	12.2713s/sat	Brucite	0.7006s/sat
Trevorite	11.3427s/sat	Bunsenite	0.5564s/sat
Hematite	7.9934s/sat	Ni(OH)2	0.2798s/sat
Hydroxylapatite	7.2600s/sat	Monohydrocalcite	0.1712s/sat
Pyrolusite	5.6612s/sat	Na2U2O7(c)	-0.0174
Ferrite-Ca	5.3752s/sat	Ice	-0.1387
CaUO4	4.4404s/sat	Dolomite-dis	-0.1471
MnO2(gamma)	4.1434s/sat	SrUO4(alpha)	-0.4432
Ferrite-Mg	4.0455s/sat	Diaspore	-0.5898
Goethite	3.5165s/sat	Boehmite	-0.9937
Bixbyite	3.0549s/sat	Gibbsite	-1.1855
Plattnerite	1.6204s/sat	Magnesite	-1.2363
Strontianite	1.5067s/sat	Artinite	-1.6002
Dolomite-ord	1.3973s/sat	Fe(OH)3(ppd)	-1.6046
Dolomite	1.3973s/sat	Hausmannite	-2.0434
Manganite	1.2093s/sat	Na2U2O7(am)	-2.5257
Calcite	1.0049s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1966	-0.706
H2O(g)	0.02598	-1.585
CO2(g)	7.452e-009	-8.128
HF(g)	9.535e-019	-18.021
HCl(g)	6.098e-024	-23.215
NO2(g)	2.943e-024	-23.531
N2(g)	2.133e-028	-27.671
NO(g)	4.450e-030	-29.352
Cl2(g)	2.391e-039	-38.621
H2(g)	6.321e-042	-41.199
CO(g)	1.471e-053	-52.832
Pb(g)	6.765e-065	-64.170
SO2(g)	1.351e-065	-64.869
UO2F2(g)	1.270e-067	-66.896
UO3(g)	4.360e-070	-69.361
Na(g)	5.456e-071	-70.263
NH3(g)	1.769e-073	-72.752
UO2Cl2(g)	6.395e-081	-80.194

UOF4(g)	4.682e-091	-90.330
F2(g)	4.590e-092	-91.338
UF5(g)	3.559e-109	-108.449
UF4(g)	1.624e-113	-112.789
UF6(g)	7.683e-119	-118.114
UO2(g)	6.126e-123	-122.213
Mg(g)	3.561e-124	-123.448
Ca(g)	3.307e-145	-144.481
UCl4(g)	2.539e-145	-144.595
CH4(g)	9.490e-151	-150.023
H2S(g)	8.426e-153	-152.074
UCl5(g)	2.478e-157	-156.606
UF3(g)	3.394e-159	-158.469
UCl6(g)	4.491e-164	-163.348
UCl3(g)	1.339e-170	-169.873
Al(g)	4.449e-192	-191.352
U2F10(g)	1.418e-192	-191.848
C(g)	7.784e-195	-194.109
UF2(g)	1.047e-201	-200.980
UO(g)	3.418e-207	-206.466
UCl2(g)	3.823e-213	-212.418
UF(g)	7.945e-238	-237.100
C2H4(g)	4.448e-248	-247.352
S2(g)	3.963e-248	-247.402
UCl(g)	2.391e-253	-252.621
U2Cl8(g)	1.589e-279	-278.799
U2Cl10(g)	1.225e-287	-286.912
U(g)	4.473e-292	-291.349

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	3.93e-005	3.93e-005	1.06			
Ca++	0.000101	0.000101	4.05			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	2.47e-006	2.47e-006	0.286			
F-	1.00e-005	1.00e-005	0.190			
Fe++	2.29e-006	2.29e-006	0.128			
H+	-0.0131	-0.0131	-13.2			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00475	0.00475	290.			
HPO4--	1.00e-005	1.00e-005	0.959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00814	0.00814	187.			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	3.23e-007	3.23e-007	0.0669			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	1.95e-006	1.95e-006	0.526			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	3.930e-005	3.930e-005	1.060		

Calcium	0.0001010	0.0001010	4.046
Carbon	0.004753	0.004753	57.06
Chlorine	1.000e-005	1.000e-005	0.3544
Chromium	2.470e-006	2.470e-006	0.1284
Fluorine	1.000e-005	1.000e-005	0.1899
Hydrogen	111.0	111.0	1.118e+005
Iron	2.290e-006	2.290e-006	0.1278
Lead	3.230e-007	3.230e-007	0.06689
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05491
Nickel	1.000e-006	1.000e-006	0.05866
Nitrogen	6.980e-005	6.980e-005	0.9772
Oxygen	55.52	55.52	8.879e+005
Phosphorus	1.000e-005	1.000e-005	0.3096
Sodium	0.008140	0.008140	187.0
Strontium	1.000e-006	1.000e-006	0.08758
Sulfur	1.000e-005	1.000e-005	0.3205
Uranium	1.950e-006	1.950e-006	0.4639

Sample 19887 $Ca(OH)_2$ leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.670               log fO2 =   -0.706
Eh =   0.5282 volts       pe =   8.9298
Ionic strength      =    0.014196
Activity of water   =    1.000000
Solvent mass        =    0.999902 kg
Solution mass       =    1.000425 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         522 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      417.22 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.006532	150.1	0.8870	-2.2371
OH-	0.005344	90.85	0.8851	-2.3251
CO3--	0.004018	241.0	0.6214	-2.6026
O2(aq)	0.0002485	7.949	1.0000	-3.6046
HCO3-	0.0001283	7.825	0.8870	-3.9438
NO3-	6.980e-005	4.326	0.8832	-4.2101
NaCO3-	5.331e-005	4.422	0.8870	-4.3253
CaCO3(aq)	3.012e-005	3.013	1.0000	-4.5211
AlO2-	2.278e-005	1.343	0.8870	-4.6945
F-	9.996e-006	0.1898	0.8851	-5.0532
Cl-	9.992e-006	0.3541	0.8832	-5.0543
SO4--	9.737e-006	0.9349	0.6164	-5.2217
CrO4--	9.291e-006	1.077	0.6164	-5.2421
Ca++	8.937e-006	0.3580	0.6357	-5.2456
CaPO4-	6.200e-006	0.8369	0.8870	-5.2597
NaOH(aq)	4.346e-006	0.1738	1.0000	-5.3619
HPO4--	2.442e-006	0.2343	0.6164	-5.8223
Fe(OH)4-	1.767e-006	0.2188	0.8870	-5.8049
UO2(OH)3-	1.535e-006	0.4926	0.8870	-5.8660
Pb(OH)3-	1.275e-006	0.3291	0.8870	-5.9466
PO4---	9.986e-007	0.09479	0.3361	-6.4741
NaHCO3(aq)	9.402e-007	0.07894	1.0000	-6.0268
Ni(OH)3-	8.421e-007	0.09234	0.8870	-6.1267
MnO4--	8.030e-007	0.09545	0.6164	-6.3054
SrCO3(aq)	5.298e-007	0.07817	1.0000	-6.2759
Sr++	4.620e-007	0.04046	0.6263	-6.5386
MgCO3(aq)	4.419e-007	0.03724	1.0000	-6.3547
CaOH+	4.232e-007	0.02415	0.8870	-6.4256
Mg++	2.845e-007	0.006910	0.6531	-6.7310
MgPO4-	2.729e-007	0.03253	0.8870	-6.6161
NaSO4-	2.590e-007	0.03082	0.8870	-6.6388

```
 Pb(OH)2(aq)         2.390e-007       0.05762      1.0000       -6.6216
 MnO4-               1.971e-007       0.02343      0.8851       -6.7583
 Ni(OH)2(aq)         1.579e-007       0.01463      1.0000       -6.8017
 UO2(CO3)3----       8.638e-008       0.03886      0.1438       -7.9058
 NaHPO4-             8.179e-008      0.009725      0.8870       -7.1394
 NaAlO2(aq)          2.114e-008      0.001732      1.0000       -7.6749
 UO2(OH)4--          1.610e-008      0.005440      0.6164       -8.0033
 Fe(OH)3(aq)         1.334e-008      0.001425      1.0000       -7.8749
  (only species > 1e-8 molal listed)

Mineral saturation states
                   log Q/K                            log Q/K
----------------------------------------------------------------
 Birnessite        28.4789s/sat   Brucite              0.3110s/sat
 Todorokite        24.5278s/sat   Whitlockite          0.1836s/sat
 Trevorite         11.6511s/sat   Ice                 -0.1387
 Fluorapatite      11.2560s/sat   Monohydrocalcite    -0.2018
 Hematite           8.1416s/sat   Na2U2O7(c)          -0.3542
 Hydroxylapatite    6.0598s/sat   Dolomite-dis        -0.5821
 Pyrolusite         6.0081s/sat   Diaspore            -0.6415
 Ferrite-Ca         4.8229s/sat   SrUO4(alpha)        -0.6778
 MnO2(gamma)        4.4903s/sat   Minium              -0.8351
 CaUO4              3.8383s/sat   Hausmannite         -1.0030
 Ferrite-Mg         3.8042s/sat   Boehmite            -1.0454
 Bixbyite           3.7486s/sat   Gibbsite            -1.2372
 Goethite           3.5906s/sat   Magnesite           -1.2984
 Plattnerite        2.4522s/sat   Fe(OH)3(ppd)        -1.5305
 Manganite          1.5561s/sat   Hydrocerussite      -1.6695
 Strontianite       1.5013s/sat   Cerussite           -1.9361
 Dolomite-ord       0.9623s/sat   Artinite            -2.0517
 Dolomite           0.9623s/sat   Litharge            -2.1702
 Bunsenite          0.7166s/sat   Massicot            -2.3524
 Calcite            0.6319s/sat   Na2U2O7(am)         -2.8625
 Aragonite          0.4875s/sat   PbHPO4              -2.9662
 Ni(OH)2            0.4400s/sat
  (only minerals with log Q/K > -3 listed)

Gases                   fugacity      log fug.
-----------------------------------------------
 O2(g)                    0.1967      -0.706
 H2O(g)                  0.02598      -1.585
 CO2(g)              1.584e-008       -7.800
 HF(g)               1.459e-018      -17.836
 HCl(g)              9.337e-024      -23.030
 NO2(g)              4.506e-024      -23.346
 N2(g)               4.995e-028      -27.302
 NO(g)               6.811e-030      -29.167
 Cl2(g)              5.607e-039      -38.251
 H2(g)               6.320e-042      -41.199
 CO(g)               3.127e-053      -52.505
 Pb(g)               4.591e-064      -63.338
 SO2(g)              3.249e-065      -64.488
 UO2F2(g)            3.732e-067      -66.428
 UO3(g)              5.468e-070      -69.262
 Na(g)               2.952e-071      -70.530
 NH3(g)              2.707e-073      -72.568
 UO2Cl2(g)           1.881e-080      -79.726
```

UOF4(g)	3.223e-090	-89.492
F2(g)	1.075e-091	-90.968
UF5(g)	3.750e-108	-107.426
UF4(g)	1.117e-112	-111.952
UF6(g)	1.239e-117	-116.907
UO2(g)	7.681e-123	-122.115
Mg(g)	1.452e-124	-123.838
UCl4(g)	1.750e-144	-143.757
Ca(g)	6.591e-146	-145.181
CH4(g)	2.015e-150	-149.696
H2S(g)	2.025e-152	-151.693
UCl5(g)	2.616e-156	-155.582
UF3(g)	1.526e-158	-157.817
UCl6(g)	7.263e-163	-162.139
UCl3(g)	6.028e-170	-169.220
U2F10(g)	1.574e-190	-189.803
Al(g)	3.948e-192	-191.404
C(g)	1.654e-194	-193.782
UF2(g)	3.074e-201	-200.512
UO(g)	4.285e-207	-206.368
UCl2(g)	1.124e-212	-211.949
UF(g)	1.524e-237	-236.817
S2(g)	2.291e-247	-246.640
C2H4(g)	2.007e-247	-246.697
UCl(g)	4.589e-253	-252.338
U2Cl8(g)	7.551e-278	-277.122
U2Cl10(g)	1.366e-285	-284.865
U(g)	5.606e-292	-291.251

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	2.28e-005	2.28e-005	0.615			
Ca++	4.57e-005	4.57e-005	1.83			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	9.29e-006	9.29e-006	1.08			
F-	1.00e-005	1.00e-005	0.190			
Fe++	1.78e-006	1.78e-006	0.0994			
H+	-0.00964	-0.00964	-9.71			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00423	0.00423	258.			
HPO4--	1.00e-005	1.00e-005	0.959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00659	0.00659	151.			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	1.52e-006	1.52e-006	0.315			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	1.64e-006	1.64e-006	0.443			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	2.280e-005	2.280e-005	0.6149		

Calcium	4.570e-005	4.570e-005	1.831
Carbon	0.004231	0.004231	50.80
Chlorine	1.000e-005	1.000e-005	0.3544
Chromium	9.290e-006	9.290e-006	0.4828
Fluorine	1.000e-005	1.000e-005	0.1899
Hydrogen	111.0	111.0	1.118e+005
Iron	1.780e-006	1.780e-006	0.09937
Lead	1.520e-006	1.520e-006	0.3148
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05491
Nickel	1.000e-006	1.000e-006	0.05867
Nitrogen	6.980e-005	6.980e-005	0.9773
Oxygen	55.52	55.52	8.879e+005
Phosphorus	1.000e-005	1.000e-005	0.3096
Sodium	0.006590	0.006590	151.4
Strontium	1.000e-006	1.000e-006	0.08758
Sulfur	1.000e-005	1.000e-005	0.3205
Uranium	1.640e-006	1.640e-006	0.3902

Sample 19887 $Ca(OH)_2$ leach, Stage 4.

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.670              log fO2 =   -0.707
Eh =   0.5282 volts      pe =   8.9298
Ionic strength      =    0.014019
Activity of water   =    1.000000
Solvent mass        =    0.999903 kg
Solution mass       =    1.000447 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         544 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      448.24 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.005937	136.4	0.8875	-2.2782
OH-	0.005341	90.78	0.8857	-2.3251
CO3--	0.003990	239.3	0.6230	-2.6046
CaCO3(aq)	0.0003785	37.86	1.0000	-3.4220
O2(aq)	0.0002484	7.945	1.0000	-3.6048
HCO3-	0.0001277	7.785	0.8875	-3.9458
Ca++	0.0001125	4.507	0.6371	-4.1445
NO3-	6.978e-005	4.324	0.8838	-4.2099
NaCO3-	4.824e-005	4.002	0.8875	-4.3684
Cl-	9.993e-006	0.3541	0.8838	-5.0539
F-	9.993e-006	0.1897	0.8857	-5.0530
SO4--	9.709e-006	0.9322	0.6180	-5.2218
CaPO4-	9.523e-006	1.285	0.8875	-5.0730
AlO2-	5.606e-006	0.3305	0.8875	-5.3032
CaOH+	5.337e-006	0.3045	0.8875	-5.3245
NaOH(aq)	3.953e-006	0.1580	1.0000	-5.4030
CrO4--	2.650e-006	0.3072	0.6180	-5.7857
Fe(OH)4-	2.263e-006	0.2802	0.8875	-5.6971
NaHCO3(aq)	8.514e-007	0.07148	1.0000	-6.0699
Ni(OH)3-	8.420e-007	0.09233	0.8875	-6.1265
MnO4--	8.027e-007	0.09542	0.6180	-6.3044
UO2(OH)3-	6.213e-007	0.1994	0.8875	-6.2585
MgCO3(aq)	5.807e-007	0.04894	1.0000	-6.2360
Pb(OH)3-	5.511e-007	0.1422	0.8875	-6.3106
SrCO3(aq)	5.293e-007	0.07809	1.0000	-6.2763
Sr++	4.625e-007	0.04050	0.6278	-6.5371
Mg++	3.747e-007	0.009103	0.6545	-6.6104
HPO4--	2.967e-007	0.02846	0.6180	-6.7367
NaSO4-	2.354e-007	0.02801	0.8875	-6.6800
MnO4-	1.974e-007	0.02347	0.8857	-6.7574
Ni(OH)2(aq)	1.579e-007	0.01463	1.0000	-6.8015

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  PO4---              1.209e-007       0.01148      0.3381       -7.3885
  Pb(OH)2(aq)         1.034e-007       0.02492      1.0000       -6.9856
  CaHCO3+             1.019e-007       0.01030      0.8875       -7.0436
  CaSO4(aq)           5.556e-008      0.007560      1.0000       -7.2552
  MgPO4-              4.384e-008      0.005227      0.8875       -7.4099
  UO2(CO3)3----       3.416e-008       0.01537      0.1453       -8.3042
  CaNO3+              2.497e-008      0.002547      0.8875       -7.6544
  Fe(OH)3(aq)         1.710e-008      0.001826      1.0000       -7.7671
   (only species > 1e-8 molal listed)

 Mineral saturation states
                    log Q/K                           log Q/K
----------------------------------------------------------------
  Birnessite        28.4879s/sat   Monohydrocalcite   0.8973s/sat
  Todorokite        24.5357s/sat   Bunsenite          0.7168s/sat
  Fluorapatite      14.0182s/sat   Dolomite-dis       0.6357s/sat
  Trevorite         11.8669s/sat   Ni(OH)2            0.4402s/sat
  Hydroxylapatite    8.8219s/sat   Brucite            0.4316s/sat
  Hematite           8.3572s/sat   Ice               -0.1387
  Ferrite-Ca         6.1396s/sat   Hausmannite       -0.9995
  Pyrolusite         6.0092s/sat   SrUO4(alpha)      -1.0688
  CaUO4              4.5468s/sat   Magnesite         -1.1797
  MnO2(gamma)        4.4914s/sat   Na2U2O7(c)        -1.2216
  Ferrite-Mg         4.1403s/sat   Diaspore          -1.2502
  Bixbyite           3.7508s/sat   Fe(OH)3(ppd)      -1.4227
  Goethite           3.6984s/sat   Boehmite          -1.6541
  Dolomite           2.1801s/sat   Artinite          -1.8125
  Dolomite-ord       2.1801s/sat   Gibbsite          -1.8459
  Plattnerite        2.0881s/sat   Minium            -1.9273
  Calcite            1.7310s/sat   Cerussite         -2.3021
  Whitlockite        1.6579s/sat   Litharge          -2.5342
  Aragonite          1.5866s/sat   Massicot          -2.7164
  Manganite          1.5573s/sat   Hydrocerussite    -2.7654
  Strontianite       1.5009s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                  fugacity      log fug.
-----------------------------------------------
  O2(g)                   0.1966       -0.707
  H2O(g)                 0.02598       -1.585
  CO2(g)              1.577e-008       -7.802
  HF(g)               1.460e-018      -17.836
  HCl(g)              9.344e-024      -23.029
  NO2(g)              4.508e-024      -23.346
  N2(g)               5.004e-028      -27.301
  NO(g)               6.816e-030      -29.166
  Cl2(g)              5.614e-039      -38.251
  H2(g)               6.321e-042      -41.199
  CO(g)               3.114e-053      -52.507
  Pb(g)               1.986e-064      -63.702
  SO2(g)              3.249e-065      -64.488
  UO2F2(g)            1.513e-067      -66.820
  UO3(g)              2.215e-070      -69.655
  Na(g)               2.685e-071      -70.571
  NH3(g)              2.710e-073      -72.567
  UO2Cl2(g)           7.628e-081      -80.118
  UOF4(g)             1.307e-090      -89.884
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F2(g)	1.076e-091	-90.968
UF5(g)	1.522e-108	-107.818
UF4(g)	4.534e-113	-112.343
UF6(g)	5.030e-118	-117.298
UO2(g)	3.112e-123	-122.507
Mg(g)	1.917e-124	-123.717
Ca(g)	8.319e-145	-144.080
UCl4(g)	7.113e-145	-144.148
CH4(g)	2.009e-150	-149.697
H2S(g)	2.027e-152	-151.693
UCl5(g)	1.064e-156	-155.973
UF3(g)	6.189e-159	-158.208
UCl6(g)	2.955e-163	-162.529
UCl3(g)	2.448e-170	-169.611
U2F10(g)	2.593e-191	-190.586
Al(g)	9.726e-193	-192.012
C(g)	1.647e-194	-193.783
UF2(g)	1.247e-201	-200.904
UO(g)	1.736e-207	-206.760
UCl2(g)	4.561e-213	-212.341
UF(g)	6.180e-238	-237.209
S2(g)	2.293e-247	-246.640
C2H4(g)	1.992e-247	-246.701
UCl(g)	1.861e-253	-252.730
U2Cl8(g)	1.247e-278	-277.904
U2Cl10(g)	2.258e-286	-285.646
U(g)	2.272e-292	-291.644

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	5.61e-006	5.61e-006	0.151			
Ca++	0.000506	0.000506	20.3			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	2.65e-006	2.65e-006	0.307			
F-	1.00e-005	1.00e-005	0.190			
Fe++	2.28e-006	2.28e-006	0.127			
H+	-0.00989	-0.00989	-9.96			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00455	0.00455	277.			
HPO4--	1.00e-005	1.00e-005	0.959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00599	0.00599	138.			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	6.57e-007	6.57e-007	0.136			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	6.67e-007	6.67e-007	0.180			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	5.610e-006	5.610e-006	0.1513		
Calcium	0.0005060	0.0005060	20.27		

Carbon	0.004546	0.004546	54.58
Chlorine	1.000e-005	1.000e-005	0.3544
Chromium	2.650e-006	2.650e-006	0.1377
Fluorine	1.000e-005	1.000e-005	0.1899
Hydrogen	111.0	111.0	1.118e+005
Iron	2.280e-006	2.280e-006	0.1273
Lead	6.570e-007	6.570e-007	0.1361
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05491
Nickel	1.000e-006	1.000e-006	0.05866
Nitrogen	6.980e-005	6.980e-005	0.9772
Oxygen	55.52	55.52	8.879e+005
Phosphorus	1.000e-005	1.000e-005	0.3096
Sodium	0.005990	0.005990	137.6
Strontium	1.000e-006	1.000e-006	0.08758
Sulfur	1.000e-005	1.000e-005	0.3205
Uranium	6.670e-007	6.670e-007	0.1587

Sample 19887 $Ca(OH)_2$ leach, Stage 5.

```
Step #     0               Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.760                log fO2 =   -0.707
Eh =   0.5229 volts       pe =   8.8397
Ionic strength      =    0.014375
Activity of water   =    1.000000
Solvent mass        =    0.999880 kg
Solution mass       =    1.000574 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         694 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      633.44 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.006579	111.8	0.8845	-2.2351
CO3--	0.004157	249.3	0.6198	-2.5889
Na+	0.002784	63.96	0.8864	-2.6077
CaCO3(aq)	0.002115	211.5	1.0000	-2.6747
Ca++	0.0006093	24.40	0.6342	-3.4129
O2(aq)	0.0002483	7.939	1.0000	-3.6051
HCO3-	0.0001077	6.568	0.8864	-4.0201
NO3-	6.967e-005	4.317	0.8826	-4.2112
CaOH+	3.544e-005	2.021	0.8864	-4.5029
NaCO3-	2.345e-005	1.945	0.8864	-4.6822
Cl-	9.997e-006	0.3542	0.8826	-5.0544
F-	9.980e-006	0.1895	0.8845	-5.0541
CaPO4-	9.915e-006	1.338	0.8864	-5.0561
SO4--	9.597e-006	0.9213	0.6148	-5.2291
Fe(OH)4-	2.863e-006	0.3544	0.8864	-5.5956
NaOH(aq)	2.278e-006	0.09104	1.0000	-5.6425
AlO2-	9.997e-007	0.05892	0.8864	-6.0525
Pb(OH)3-	8.745e-007	0.2257	0.8864	-6.1106
Ni(OH)3-	8.679e-007	0.09515	0.8864	-6.1139
MnO4--	8.341e-007	0.09913	0.6148	-6.2901
MgCO3(aq)	6.097e-007	0.05137	1.0000	-6.2149
SrCO3(aq)	5.361e-007	0.07909	1.0000	-6.2707
CaHCO3+	4.635e-007	0.04682	0.8864	-6.3863
Sr++	4.541e-007	0.03976	0.6248	-6.5471
CrO4--	4.080e-007	0.04730	0.6148	-6.6006
Mg++	3.811e-007	0.009256	0.6518	-6.6049
NaHCO3(aq)	3.360e-007	0.02821	1.0000	-6.4737
CaSO4(aq)	2.945e-007	0.04006	1.0000	-6.5309
UO2(OH)3-	1.801e-007	0.05777	0.8864	-6.7969
MnO4-	1.661e-007	0.01974	0.8845	-6.8330
CaNO3+	1.344e-007	0.01371	0.8864	-6.9241

Pb(OH)2(aq)	1.332e-007	0.03210	1.0000	-6.8756
Ni(OH)2(aq)	1.322e-007	0.01224	1.0000	-6.8789
NaSO4-	1.085e-007	0.01291	0.8864	-7.0168
HPO4--	4.677e-008	0.004486	0.6148	-7.5413
PO4---	2.360e-008	0.002240	0.3341	-8.1031
Ca2UO2(CO3)3	2.035e-008	0.01078	1.0000	-7.6913
CaF+	1.849e-008	0.001092	0.8864	-7.7854
Fe(OH)3(aq)	1.756e-008	0.001875	1.0000	-7.7556

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	27.1641s/sat	Manganite	1.3918s/sat
Todorokite	23.3774s/sat	Bunsenite	0.6394s/sat
Fluorapatite	15.5312s/sat	Brucite	0.6171s/sat
Trevorite	11.8125s/sat	Ni(OH)2	0.3628s/sat
Hydroxylapatite	10.4259s/sat	Ice	-0.1387
Hematite	8.3802s/sat	Magnesite	-1.1586
Ferrite-Ca	7.0742s/sat	Fe(OH)3(ppd)	-1.4112
Pyrolusite	5.8437s/sat	Hausmannite	-1.4957
CaUO4	4.8299s/sat	SrUO4(alpha)	-1.5273
Ferrite-Mg	4.3489s/sat	Minium	-1.5975
MnO2(gamma)	4.3259s/sat	Artinite	-1.6058
Goethite	3.7099s/sat	Diaspore	-2.0895
Bixbyite	3.4200s/sat	Cerussite	-2.3564
Dolomite-ord	2.9485s/sat	Litharge	-2.4242
Dolomite	2.9485s/sat	Portlandite	-2.4481
Calcite	2.4783s/sat	Boehmite	-2.4934
Whitlockite	2.4234s/sat	Huntite	-2.5689
Aragonite	2.3339s/sat	Massicot	-2.6064
Plattnerite	2.1979s/sat	Gibbsite	-2.6852
Monohydrocalcite	1.6446s/sat	Hydrocerussite	-2.7642
Strontianite	1.5065s/sat	Na2U2O7(c)	-2.9574
Dolomite-dis	1.4041s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1964	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	1.080e-008	-7.967
HF(g)	1.184e-018	-17.927
HCl(g)	7.588e-024	-23.120
NO2(g)	3.654e-024	-23.437
N2(g)	3.292e-028	-27.483
NO(g)	5.526e-030	-29.258
Cl2(g)	3.701e-039	-38.432
H2(g)	6.323e-042	-41.199
CO(g)	2.133e-053	-52.671
Pb(g)	2.559e-064	-63.592
SO2(g)	2.112e-065	-64.675
UO2F2(g)	2.339e-068	-67.631
UO3(g)	5.210e-071	-70.283
Na(g)	1.547e-071	-70.810
NH3(g)	2.199e-073	-72.658
UO2Cl2(g)	1.183e-081	-80.927

UOF4(g)	1.329e-091	-90.877
F2(g)	7.071e-092	-91.151
UF5(g)	1.254e-109	-108.902
UF4(g)	4.610e-114	-113.336
UF6(g)	3.361e-119	-118.474
UO2(g)	7.323e-124	-123.135
Mg(g)	2.940e-124	-123.532
Ca(g)	6.789e-144	-143.168
UCl4(g)	7.277e-146	-145.138
CH4(g)	1.377e-150	-149.861
H2S(g)	1.318e-152	-151.880
UCl5(g)	8.835e-158	-157.054
UF3(g)	7.763e-160	-159.110
UCl6(g)	1.993e-164	-163.701
UCl3(g)	3.085e-171	-170.511
U2F10(g)	1.761e-193	-192.754
Al(g)	1.409e-193	-192.851
C(g)	1.129e-194	-193.947
UF2(g)	1.929e-202	-201.715
UO(g)	4.087e-208	-207.389
UCl2(g)	7.079e-214	-213.150
UF(g)	1.180e-238	-237.928
S2(g)	9.694e-248	-247.013
C2H4(g)	9.362e-248	-247.029
UCl(g)	3.558e-254	-253.449
U2Cl8(g)	1.305e-280	-279.884
U2Cl10(g)	1.558e-288	-287.807
U(g)	5.350e-293	-292.272

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	0.00277	0.00277	111.			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	4.08e-007	4.08e-007	0.0473			
F-	1.00e-005	1.00e-005	0.190			
Fe++	2.88e-006	2.88e-006	0.161			
H+	-0.0130	-0.0130	-13.1			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00640	0.00640	391.			
HPO4--	1.00e-005	1.00e-005	0.959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00281	0.00281	64.6			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	1.01e-006	1.01e-006	0.209			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	2.09e-007	2.09e-007	0.0564			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.000e-006	1.000e-006	0.02697		

Calcium	0.002770	0.002770	111.0
Carbon	0.006404	0.006404	76.88
Chlorine	1.000e-005	1.000e-005	0.3543
Chromium	4.080e-007	4.080e-007	0.02120
Fluorine	1.000e-005	1.000e-005	0.1899
Hydrogen	111.0	111.0	1.118e+005
Iron	2.880e-006	2.880e-006	0.1607
Lead	1.010e-006	1.010e-006	0.2092
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05491
Nickel	1.000e-006	1.000e-006	0.05866
Nitrogen	6.980e-005	6.980e-005	0.9771
Oxygen	55.53	55.53	8.879e+005
Phosphorus	1.000e-005	1.000e-005	0.3096
Sodium	0.002810	0.002810	64.56
Strontium	1.000e-006	1.000e-006	0.08757
Sulfur	1.000e-005	1.000e-005	0.3205
Uranium	2.090e-007	2.090e-007	0.04972

Sample 19887 $Ca(OH)_2$ leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.740               log fO2 =   -0.707
Eh =   0.5241 volts       pe =   8.8598
Ionic strength      =     0.011306
Activity of water   =     1.000000
Solvent mass        =     0.999887 kg
Solution mass       =     1.000395 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =          507 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       394.20 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.006207	105.5	0.8954	-2.2551
Na+	0.003119	71.67	0.8969	-2.5532
CO3--	0.002772	166.3	0.6494	-2.7447
CaCO3(aq)	0.001121	112.2	1.0000	-2.9503
Ca++	0.0004432	17.75	0.6617	-3.5328
O2(aq)	0.0002484	7.945	1.0000	-3.6048
HCO3-	7.787e-005	4.749	0.8969	-4.1559
NO3-	6.971e-005	4.320	0.8938	-4.2055
CrO4--	3.800e-005	4.406	0.6451	-4.6105
CaOH+	2.538e-005	1.448	0.8969	-4.6428
NaCO3-	1.836e-005	1.523	0.8969	-4.7835
Cl-	9.996e-006	0.3542	0.8938	-5.0489
F-	9.984e-006	0.1896	0.8954	-5.0487
CaPO4-	9.889e-006	1.335	0.8969	-5.0521
SO4--	9.637e-006	0.9253	0.6451	-5.2064
NaOH(aq)	2.466e-006	0.09858	1.0000	-5.6080
Fe(OH)4-	2.305e-006	0.2854	0.8969	-5.6845
AlO2-	9.997e-007	0.05893	0.8969	-6.0474
Ni(OH)3-	8.611e-007	0.09443	0.8969	-6.1122
MnO4--	8.224e-007	0.09776	0.6451	-6.2753
Sr++	5.307e-007	0.04648	0.6536	-6.4598
MgCO3(aq)	5.293e-007	0.04460	1.0000	-6.2763
SrCO3(aq)	4.579e-007	0.06757	1.0000	-6.3392
Mg++	4.560e-007	0.01108	0.6769	-6.5106
NaHCO3(aq)	2.786e-007	0.02339	1.0000	-6.5550
CaHCO3+	2.543e-007	0.02569	0.8969	-6.6419
CaSO4(aq)	2.354e-007	0.03204	1.0000	-6.6281
MnO4-	1.777e-007	0.02113	0.8954	-6.7982
UO2(OH)3-	1.419e-007	0.04554	0.8969	-6.8952
Ni(OH)2(aq)	1.389e-007	0.01287	1.0000	-6.8572
NaSO4-	1.281e-007	0.01524	0.8969	-6.9396

CaNO3+	1.021e-007	0.01042	0.8969	-7.0383
HPO4--	6.207e-008	0.005954	0.6451	-7.3975
Pb(OH)3-	4.436e-008	0.01145	0.8969	-7.4003
PO4---	2.816e-008	0.002673	0.3725	-7.9793
Fe(OH)3(aq)	1.498e-008	0.001600	1.0000	-7.8245
CaF+	1.404e-008	0.0008293	0.8969	-7.8997
MgPO4-	1.401e-008	0.001670	0.8969	-7.9008
SrOH+	1.090e-008	0.001140	0.8969	-8.0098

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	27.6011s/sat	Manganite	1.4464s/sat
Todorokite	23.7598s/sat	Strontianite	1.4380s/sat
Fluorapatite	15.3090s/sat	Monohydrocalcite	1.3690s/sat
Trevorite	11.6964s/sat	Dolomite-dis	1.0670s/sat
Hydroxylapatite	10.1782s/sat	Plattnerite	0.9284s/sat
Hematite	8.2424s/sat	Brucite	0.6714s/sat
Ferrite-Ca	6.7765s/sat	Bunsenite	0.6611s/sat
Pyrolusite	5.8983s/sat	Ni(OH)2	0.3845s/sat
CaUO4	4.5918s/sat	Ice	-0.1387
MnO2(gamma)	4.3805s/sat	Magnesite	-1.2200
Ferrite-Mg	4.2653s/sat	Hausmannite	-1.3320
Goethite	3.6410s/sat	Fe(OH)3(ppd)	-1.4801
Bixbyite	3.5292s/sat	SrUO4(alpha)	-1.5582
Dolomite-ord	2.6114s/sat	Artinite	-1.6130
Dolomite	2.6114s/sat	Diaspore	-2.0644
Whitlockite	2.3116s/sat	Boehmite	-2.4683
Calcite	2.2027s/sat	Portlandite	-2.6080
Aragonite	2.0583s/sat	Gibbsite	-2.6601

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1966	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	8.274e-009	-8.082
HF(g)	1.255e-018	-17.901
HCl(g)	8.046e-024	-23.094
NO2(g)	3.876e-024	-23.412
N2(g)	3.700e-028	-27.432
NO(g)	5.861e-030	-29.232
Cl2(g)	4.163e-039	-38.381
H2(g)	6.321e-042	-41.199
CO(g)	1.634e-053	-52.787
SO2(g)	2.439e-065	-64.613
Pb(g)	1.375e-065	-64.862
UO2F2(g)	2.197e-068	-67.658
UO3(g)	4.351e-071	-70.361
Na(g)	1.675e-071	-70.776
NH3(g)	2.331e-073	-72.633
UO2Cl2(g)	1.111e-081	-80.954
UOF4(g)	1.403e-091	-90.853
F2(g)	7.954e-092	-91.099
UF5(g)	1.404e-109	-108.852
UF4(g)	4.867e-114	-113.313

UF6(g)	3.991e-119	-118.399
UO2(g)	6.114e-124	-123.214
Mg(g)	3.330e-124	-123.478
Ca(g)	4.697e-144	-143.328
UCl4(g)	7.682e-146	-145.115
CH4(g)	1.054e-150	-149.977
H2S(g)	1.521e-152	-151.818
UCl5(g)	9.891e-158	-157.005
UF3(g)	7.728e-160	-159.112
UCl6(g)	2.366e-164	-163.626
UCl3(g)	3.070e-171	-170.513
U2F10(g)	2.208e-193	-192.656
Al(g)	1.492e-193	-192.826
C(g)	8.643e-195	-194.063
UF2(g)	1.811e-202	-201.742
UO(g)	3.411e-208	-207.467
UCl2(g)	6.644e-214	-213.178
UF(g)	1.044e-238	-237.981
S2(g)	1.292e-247	-246.889
C2H4(g)	5.485e-248	-247.261
UCl(g)	3.149e-254	-253.502
U2Cl8(g)	1.454e-280	-279.837
U2Cl10(g)	1.953e-288	-287.709
U(g)	4.464e-293	-292.350

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	0.00160	0.00160	64.1			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	3.80e-005	3.80e-005	4.41			
F-	1.00e-005	1.00e-005	0.190			
Fe++	2.32e-006	2.32e-006	0.130			
H+	-0.0102	-0.0102	-10.3			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00399	0.00399	243.			
HPO4--	1.00e-005	1.00e-005	0.959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00314	0.00314	72.2			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	5.16e-008	5.16e-008	0.0107			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	1.49e-007	1.49e-007	0.0402			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	1.000e-006	1.000e-006	0.02697		
Calcium	0.001600	0.001600	64.10		
Carbon	0.003991	0.003991	47.91		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	3.800e-005	3.800e-005	1.975		

Fluorine	1.000e-005	1.000e-005	0.1899
Hydrogen	111.0	111.0	1.118e+005
Iron	2.320e-006	2.320e-006	0.1295
Lead	5.160e-008	5.160e-008	0.01069
Magnesium	1.000e-006	1.000e-006	0.02430
Manganese	1.000e-006	1.000e-006	0.05492
Nickel	1.000e-006	1.000e-006	0.05867
Nitrogen	6.980e-005	6.980e-005	0.9773
Oxygen	55.52	55.52	8.880e+005
Phosphorus	1.000e-005	1.000e-005	0.3096
Sodium	0.003140	0.003140	72.16
Strontium	1.000e-006	1.000e-006	0.08759
Sulfur	1.000e-005	1.000e-005	0.3205
Uranium	1.490e-007	1.490e-007	0.03545

Sample 19887 $CaCO_3$ leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  9.930               log fO2 =   -0.732
Eh =   0.6308 volts       pe =  10.6634
Ionic strength      =    0.025626
Activity of water   =    1.000000
Solvent mass        =    0.999995 kg
Solution mass       =    1.001378 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =        1382 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      625.86 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01491	342.4	0.8579	-1.8930
HCO3-	0.004459	271.7	0.8579	-2.4173
CO3--	0.002803	168.0	0.5449	-2.8161
HPO4--	0.002112	202.4	0.5377	-2.9449
F-	0.001888	35.82	0.8549	-2.7921
NO3-	0.0008580	53.13	0.8518	-3.1362
UO2(CO3)3----	0.0005296	238.0	0.0830	-4.3570
O2(aq)	0.0002342	7.485	1.0000	-3.6303
NaHPO4-	0.0001408	16.73	0.8579	-3.9179
OH-	0.0001007	1.710	0.8549	-4.0651
CrO4--	8.448e-005	9.786	0.5377	-4.3427
NaCO3-	7.444e-005	6.170	0.8579	-4.1948
NaHCO3(aq)	6.978e-005	5.854	1.0000	-4.1563
AlO2-	4.031e-005	2.374	0.8579	-4.4612
CaPO4-	2.446e-005	3.298	0.8579	-4.6782
Fe(OH)4-	2.398e-005	2.966	0.8579	-4.6868
PO4---	1.866e-005	1.770	0.2468	-5.3367
Cl-	9.982e-006	0.3534	0.8518	-5.0704
Fe(OH)3(aq)	9.621e-006	1.027	1.0000	-5.0168
SO4--	9.495e-006	0.9109	0.5377	-5.2920
MnO4-	5.523e-006	0.6559	0.8549	-5.3259
CaCO3(aq)	5.122e-006	0.5119	1.0000	-5.2906
Pb(CO3)2--	3.377e-006	1.104	0.5377	-5.7409
Ca++	2.794e-006	0.1118	0.5652	-5.8015
H2PO4-	2.495e-006	0.2417	0.8579	-5.6695
NaF(aq)	2.076e-006	0.08705	1.0000	-5.6827
PbCO3(aq)	1.800e-006	0.4803	1.0000	-5.7448
UO2(CO3)2--	1.211e-006	0.4718	0.5377	-6.1862
CO2(aq)	9.939e-007	0.04368	1.0000	-6.0026
CaHPO4(aq)	9.854e-007	0.1339	1.0000	-6.0064
MgPO4-	8.332e-007	0.09924	0.8579	-6.1458

Ni++	6.830e-007	0.04003	0.5652	-6.4134
Sr++	5.899e-007	0.05162	0.5518	-6.4874
NaSO4-	5.030e-007	0.05980	0.8579	-6.3650
MnO4--	4.601e-007	0.05464	0.5377	-6.6067
SrCO3(aq)	3.645e-007	0.05374	1.0000	-6.4383
Ni(OH)2(aq)	2.860e-007	0.02648	1.0000	-6.5436
Pb(OH)2(aq)	1.825e-007	0.04395	1.0000	-6.7388
NaOH(aq)	1.746e-007	0.006976	1.0000	-6.7578
UO2(OH)3-	1.479e-007	0.04742	0.8579	-6.8966
NaAlO2(aq)	7.989e-008	0.006539	1.0000	-7.0975
CaHCO3+	7.842e-008	0.007917	0.8579	-7.1722
Mg++	6.780e-008	0.001645	0.5897	-7.3982
PbOH+	6.206e-008	0.01390	0.8579	-7.2737
MgCO3(aq)	5.815e-008	0.004896	1.0000	-7.2354
SrHPO4(aq)	4.244e-008	0.007781	1.0000	-7.3723
MgHPO4(aq)	3.690e-008	0.004432	1.0000	-7.4330
Ni(OH)3-	2.871e-008	0.003145	0.8579	-7.6086
HCrO4-	1.942e-008	0.002269	0.8579	-7.7783
PbP2O7--	1.926e-008	0.007332	0.5377	-7.9847
Pb(OH)3-	1.831e-008	0.004722	0.8579	-7.8038
NaCl(aq)	1.818e-008	0.001061	1.0000	-7.7405
Ca2UO2(CO3)3	1.738e-008	0.009204	1.0000	-7.7599
CaF+	1.428e-008	0.0008423	0.8579	-7.9119
UO2(OH)2(aq)	1.204e-008	0.003655	1.0000	-7.9194
HAlO2(aq)	1.146e-008	0.0006866	1.0000	-7.9408

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	54.0377s/sat	Ni(OH)2	0.6981s/sat
Todorokite	46.8950s/sat	CaUO4	0.5117s/sat
Trevorite	17.6254s/sat	Calcite	-0.1376
Pyromorphite	16.2372s/sat	Ice	-0.1387
Fluorapatite	14.1497s/sat	Dawsonite	-0.1647
Hematite	13.8578s/sat	MnHPO4	-0.2796
Bixbyite	10.1447s/sat	Aragonite	-0.2820
Pyromorphite-OH	9.6076s/sat	Dolomite-ord	-0.6879
Pyrolusite	9.1997s/sat	Dolomite	-0.6879
Hausmannite	8.5977s/sat	Monohydrocalcite	-0.9713
Pb4O(PO4)2	8.3685s/sat	Crocoite	-1.1336
MnO2(gamma)	7.6819s/sat	Minium	-1.1998
Ferrite-Ca	6.5032s/sat	PbCO3.PbO	-1.3157
Goethite	6.4487s/sat	Corundum	-1.3279
Pb3(PO4)2	5.4188s/sat	Fluorite	-1.3487
Ferrite-Mg	5.3731s/sat	Plumbogummite	-1.6357
Parsonsite	5.2793s/sat	Na2U2O7(c)	-1.7274
Hydroxylapatite	4.9524s/sat	Mn(OH)3	-1.7516
Manganite	4.7542s/sat	Magnesite	-2.1791
Hydrocerussite	4.5117s/sat	Dolomite-dis	-2.2323
PbHPO4	3.2740s/sat	Litharge	-2.2874
Magnetite	2.8949s/sat	NiCO3	-2.4125
Plattnerite	2.3221s/sat	UO3:2H2O	-2.4381
Ni3(PO4)2	1.3715s/sat	Schoepite	-2.4381
Strontianite	1.3389s/sat	Massicot	-2.4696
Diaspore	1.3318s/sat	UO2(OH)2(beta)	-2.5505
Fe(OH)3(ppd)	1.3276s/sat	Rhodochrosite	-2.5763

Cerussite	1.2131s/sat	UO3:.9H2O(alpha)	-2.6215
Bunsenite	0.9747s/sat	Schoepite-dehy(.	-2.6215
Boehmite	0.9279s/sat	Schoepite-dehy(.	-2.7018
Whitlockite	0.7906s/sat	Schoepite-dehy(1	-2.7079
Gibbsite	0.7361s/sat	Ca-Autunite	-2.9989

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1853	-0.732
H2O(g)	0.02598	-1.585
CO2(g)	2.926e-005	-4.534
HF(g)	1.463e-014	-13.835
NO2(g)	2.979e-021	-20.526
HCl(g)	4.944e-022	-21.306
N2(g)	2.458e-022	-21.609
NO(g)	4.639e-027	-26.334
Cl2(g)	1.526e-035	-34.816
H2(g)	6.510e-042	-41.186
CO(g)	5.949e-050	-49.226
UO2F2(g)	1.921e-058	-57.717
SO2(g)	8.598e-062	-61.066
Pb(g)	3.610e-064	-63.442
UO3(g)	2.800e-069	-68.553
NH3(g)	1.985e-070	-69.702
Na(g)	1.204e-072	-71.919
UOF4(g)	1.667e-073	-72.778
UO2Cl2(g)	2.700e-076	-75.569
F2(g)	1.049e-083	-82.979
UF5(g)	1.974e-087	-86.705
UF6(g)	6.442e-093	-92.191
UF4(g)	5.955e-096	-95.225
UO2(g)	4.052e-122	-121.392
Mg(g)	1.066e-128	-127.972
UCl4(g)	7.256e-137	-136.139
UF3(g)	8.231e-146	-145.085
UCl5(g)	5.657e-147	-146.247
CH4(g)	4.191e-147	-146.378
H2S(g)	5.857e-149	-148.232
U2F10(g)	4.361e-149	-148.360
Ca(g)	6.249e-150	-149.204
UCl6(g)	8.193e-152	-151.087
UCl3(g)	4.790e-164	-163.320
Al(g)	3.882e-190	-189.411
C(g)	3.241e-191	-190.489
UF2(g)	1.679e-192	-191.775
UO(g)	2.328e-206	-205.633
UCl2(g)	1.712e-208	-207.767
UF(g)	8.427e-233	-232.074
S2(g)	1.806e-240	-239.743
C2H4(g)	8.179e-241	-240.087
UCl(g)	1.340e-250	-249.873
U2Cl8(g)	1.297e-262	-261.887
U2Cl10(g)	6.386e-267	-266.195
U(g)	3.137e-291	-290.503

	In fluid	Sorbed	Kd

Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	4.04e-005	4.04e-005	1.09			
Ca++	3.35e-005	3.35e-005	1.34			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	8.45e-005	8.45e-005	9.79			
F-	0.00189	0.00189	35.9			
Fe++	3.36e-005	3.36e-005	1.87			
H+	-0.00575	-0.00575	-5.79			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00901	0.00901	549.			
HPO4--	0.00230	0.00230	220.			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	5.99e-006	5.99e-006	0.329			
NH3(aq)	0.000858	0.000858	14.6			
Na+	0.0152	0.0152	349.			
Ni++	1.00e-006	1.00e-006	0.0586			
O2(aq)	0.00197	0.00197	62.8			
Pb++	5.46e-006	5.46e-006	1.13			
SO4--	1.00e-005	1.00e-005	0.959			
Sr++	1.00e-006	1.00e-006	0.0875			
UO2++	0.000531	0.000531	143.			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	4.040e-005	4.040e-005	1.089		
Calcium	3.350e-005	3.350e-005	1.341		
Carbon	0.009012	0.009012	108.1		
Chlorine	1.000e-005	1.000e-005	0.3540		
Chromium	8.450e-005	8.450e-005	4.388		
Fluorine	0.001890	0.001890	35.86		
Hydrogen	111.0	111.0	1.117e+005		
Iron	3.360e-005	3.360e-005	1.874		
Lead	5.460e-006	5.460e-006	1.130		
Magnesium	1.000e-006	1.000e-006	0.02427		
Manganese	5.990e-006	5.990e-006	0.3286		
Nickel	1.000e-006	1.000e-006	0.05861		
Nitrogen	0.0008580	0.0008580	12.00		
Oxygen	55.55	55.55	8.875e+005		
Phosphorus	0.002300	0.002300	71.14		
Sodium	0.01520	0.01520	349.0		
Strontium	1.000e-006	1.000e-006	0.08750		
Sulfur	1.000e-005	1.000e-005	0.3202		
Uranium	0.0005310	0.0005310	126.2		

Sample 19887 $CaCO_3$ leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 10.400              log fO2 =   -0.846
Eh =   0.6013 volts      pe =  10.1648
Ionic strength      =    0.034333
Activity of water   =    1.000000
Solvent mass        =    0.999980 kg
Solution mass       =    1.001789 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =        1806 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      758.37 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01630	374.0	0.8418	-1.8627
CO3--	0.002258	135.3	0.5057	-2.9424
F-	0.002048	38.83	0.8381	-2.7654
UO2(CO3)3----	0.001859	834.9	0.0606	-3.9485
HPO4--	0.001768	169.4	0.4973	-3.0558
HCO3-	0.001151	70.13	0.8418	-3.0136
NO3-	0.0008330	51.56	0.8342	-3.1581
OH-	0.0003031	5.146	0.8381	-3.5951
CrO4--	0.0002630	30.45	0.4973	-3.8834
O2(aq)	0.0001801	5.752	1.0000	-3.7445
Fe(OH)4-	0.0001341	16.58	0.8418	-3.9473
NaHPO4-	0.0001192	14.16	0.8418	-3.9984
CaPO4-	8.019e-005	10.81	0.8418	-4.1707
NaCO3-	6.084e-005	5.040	0.8418	-4.2906
AlO2-	5.209e-005	3.067	0.8418	-4.3581
PO4---	5.090e-005	4.825	0.2069	-4.9776
MgPO4-	2.901e-005	3.454	0.8418	-4.6122
UO2(OH)3-	2.374e-005	7.607	0.8418	-4.6994
MnO4-	2.089e-005	2.480	0.8381	-4.7568
NaHCO3(aq)	1.896e-005	1.590	1.0000	-4.7221
Fe(OH)3(aq)	1.789e-005	1.909	1.0000	-4.7473
Ni(OH)2(aq)	1.095e-005	1.013	1.0000	-4.9607
Cl-	9.981e-006	0.3532	0.8342	-5.0795
SO4--	9.489e-006	0.9099	0.4973	-5.3262
Pb(CO3)2--	6.929e-006	2.263	0.4973	-5.4627
MnO4--	5.812e-006	0.6900	0.4973	-5.5390
Pb(OH)2(aq)	5.393e-006	1.299	1.0000	-5.2682
CaCO3(aq)	5.391e-006	0.5386	1.0000	-5.2683
PbCO3(aq)	4.568e-006	1.218	1.0000	-5.3403
UO2(CO3)2--	4.487e-006	1.747	0.4973	-5.6514
Ca++	4.198e-006	0.1680	0.5295	-5.6531

Ni(OH)3-	3.304e-006	0.3619	0.8418	-5.5557
Ni++	3.204e-006	0.1877	0.5295	-5.7705
NaF(aq)	2.368e-006	0.09923	1.0000	-5.6257
Pb(OH)3-	1.628e-006	0.4196	0.8418	-5.8632
(UO2)2CO3(OH)3-	1.211e-006	0.7871	0.8418	-5.9916
CaHPO4(aq)	1.074e-006	0.1459	1.0000	-5.9689
Mg++	1.071e-006	0.02599	0.5579	-6.2236
Sr++	6.722e-007	0.05879	0.5139	-6.4616
H2PO4-	6.674e-007	0.06461	0.8418	-6.2504
MgCO3(aq)	6.501e-007	0.05471	1.0000	-6.1870
UO2(OH)2(aq)	6.424e-007	0.1950	1.0000	-6.1922
PbOH+	6.335e-007	0.1418	0.8418	-6.2731
NaOH(aq)	5.528e-007	0.02207	1.0000	-6.2575
NaSO4-	5.081e-007	0.06039	0.8418	-6.3688
MgHPO4(aq)	4.272e-007	0.05129	1.0000	-6.3694
SrCO3(aq)	2.893e-007	0.04263	1.0000	-6.5387
NaAlO2(aq)	1.086e-007	0.008889	1.0000	-6.9640
Ca2UO2(CO3)3	8.822e-008	0.04669	1.0000	-7.0544
CO2(aq)	8.534e-008	0.003749	1.0000	-7.0689
UO2PO4-	6.625e-008	0.02414	0.8418	-7.2536
PbP2O7--	4.240e-008	0.01613	0.4973	-7.6759
SrHPO4(aq)	3.488e-008	0.006393	1.0000	-7.4574
CaHCO3+	2.850e-008	0.002876	0.8418	-7.6199
MgF+	2.743e-008	0.001185	0.8418	-7.6366
CaF+	2.177e-008	0.001284	0.8418	-7.7368
HCrO4-	1.931e-008	0.002255	0.8418	-7.7890
NaCl(aq)	1.909e-008	0.001114	1.0000	-7.7192
UO2(OH)4--	1.573e-008	0.005307	0.4973	-8.1067

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	55.6297s/sat	Dolomite-ord	0.3827s/sat
Todorokite	48.3022s/sat	Gibbsite	0.3692s/sat
Pyromorphite	19.9587s/sat	Na2U2O7(am)	0.2195s/sat
Trevorite	19.7472s/sat	Calcite	-0.1153
Fluorapatite	15.9958s/sat	Ice	-0.1387
Hematite	14.3967s/sat	Crocoite	-0.1437
Pyromorphite-OH	13.8081s/sat	Aragonite	-0.2597
Pb4O(PO4)2	12.1493s/sat	Ca-Autunite	-0.5578
Bixbyite	10.5712s/sat	Pb4SO7	-0.5734
Pyrolusite	9.3844s/sat	SrUO4(alpha)	-0.7042
Hausmannite	9.2660s/sat	Schoepite	-0.7109
Ferrite-Ca	8.1306s/sat	UO3:2H2O	-0.7109
Ferrite-Mg	8.0267s/sat	Litharge	-0.8168
MnO2(gamma)	7.8666s/sat	UO2(OH)2(beta)	-0.8233
Parsonsite	7.8460s/sat	Schoepite-dehy(.	-0.8943
Pb3(PO4)2	7.7289s/sat	UO3:.9H2O(alpha)	-0.8943
Hydroxylapatite	7.2418s/sat	Monohydrocalcite	-0.9490
Hydrocerussite	6.7913s/sat	Pb4Cl2(OH)6	-0.9502
Goethite	6.7182s/sat	Schoepite-dehy(.	-0.9746
Manganite	4.9675s/sat	Schoepite-dehy(1	-0.9807
Ni3(PO4)2	4.0183s/sat	Massicot	-0.9990
Plattnerite	3.7357s/sat	MnHPO4	-1.0887
Magnetite	3.7318s/sat	Dawsonite	-1.0974
PbHPO4	3.6938s/sat	Magnesite	-1.1307

CaUO4	3.3273s/sat	Fluorite	-1.1470
Minium	3.1552s/sat	Dolomite-dis	-1.1617
Na2U2O7(c)	2.7278s/sat	Pb3SO6	-1.2581
Bunsenite	2.5576s/sat	Becquerelite	-1.5186
Ni(OH)2	2.2810s/sat	Mn(OH)3	-1.5383
Whitlockite	1.9541s/sat	Brucite	-1.7216
Cerussite	1.6176s/sat	NiCO3	-1.8959
Fe(OH)3(ppd)	1.5971s/sat	Lanarkite	-2.0129
Strontianite	1.2385s/sat	Corundum	-2.0616
Diaspore	0.9649s/sat	Schoepite-dehy(.	-2.0839
Boehmite	0.5610s/sat	Sellaite	-2.3702
PbCO3.PbO	0.5594s/sat	Schoepite-dehy(.	-2.6019
Dolomite	0.3827s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1425	-0.846
H2O(g)	0.02598	-1.585
CO2(g)	2.512e-006	-5.600
HF(g)	5.272e-015	-14.278
NO2(g)	1.025e-021	-20.989
HCl(g)	1.640e-022	-21.785
N2(g)	4.923e-023	-22.308
NO(g)	1.820e-027	-26.740
Cl2(g)	1.473e-036	-35.832
H2(g)	7.424e-042	-41.129
CO(g)	5.825e-051	-50.235
UO2F2(g)	1.331e-057	-56.876
Pb(g)	1.217e-062	-61.915
SO2(g)	1.041e-062	-61.983
UO3(g)	1.494e-067	-66.826
NH3(g)	1.082e-070	-69.966
Na(g)	4.069e-072	-71.391
UOF4(g)	1.499e-073	-72.824
UO2Cl2(g)	1.586e-075	-74.800
F2(g)	1.194e-084	-83.923
UF5(g)	6.828e-088	-87.166
UF6(g)	7.519e-094	-93.124
UF4(g)	6.106e-096	-95.214
UO2(g)	2.466e-120	-119.608
Mg(g)	1.582e-126	-125.801
UCl4(g)	5.354e-137	-136.271
UF3(g)	2.502e-145	-144.602
UCl5(g)	1.297e-147	-146.887
CH4(g)	6.087e-148	-147.216
Ca(g)	8.737e-149	-148.059
H2S(g)	1.052e-149	-148.978
U2F10(g)	5.219e-150	-149.282
UCl6(g)	5.836e-153	-152.234
UCl3(g)	1.137e-163	-162.944
Al(g)	2.032e-190	-189.692
UF2(g)	1.513e-191	-190.820
C(g)	3.619e-192	-191.441
UO(g)	1.616e-204	-203.792
UCl2(g)	1.308e-207	-206.883
UF(g)	2.251e-231	-230.648

S2(g)	4.474e-242	-241.349
C2H4(g)	1.327e-242	-241.877
UCl(g)	3.295e-249	-248.482
U2Cl8(g)	7.063e-263	-262.151
U2Cl10(g)	3.357e-268	-267.474
U(g)	2.484e-289	-288.605

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	5.22e-005	5.22e-005	1.41			
Ca++	9.11e-005	9.11e-005	3.64			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	0.000263	0.000263	30.5			
F-	0.00205	0.00205	38.9			
Fe++	0.000152	0.000152	8.47			
H+	-0.0101	-0.0101	-10.1			
H2O	55.5	55.5	9.98e+005			
HCO3-	0.00910	0.00910	554.			
HPO4--	0.00205	0.00205	196.			
Mg++	3.12e-005	3.12e-005	0.757			
Mn++	2.67e-005	2.67e-005	1.46			
NH3(aq)	0.000833	0.000833	14.2			
Na+	0.0165	0.0165	379.			
Ni++	1.75e-005	1.75e-005	1.03			
O2(aq)	0.00192	0.00192	61.2			
Pb++	1.92e-005	1.92e-005	3.97			
SO4--	1.00e-005	1.00e-005	0.959			
Sr++	1.00e-006	1.00e-006	0.0875			
UO2++	0.00189	0.00189	509.			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	5.220e-005	5.220e-005	1.406		
Calcium	9.110e-005	9.110e-005	3.645		
Carbon	0.009100	0.009100	109.1		
Chlorine	1.000e-005	1.000e-005	0.3539		
Chromium	0.0002630	0.0002630	13.65		
Fluorine	0.002050	0.002050	38.88		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0001520	0.0001520	8.474		
Lead	1.920e-005	1.920e-005	3.971		
Magnesium	3.120e-005	3.120e-005	0.7570		
Manganese	2.670e-005	2.670e-005	1.464		
Nickel	1.750e-005	1.750e-005	1.025		
Nitrogen	0.0008330	0.0008330	11.65		
Oxygen	55.55	55.55	8.872e+005		
Phosphorus	0.002050	0.002050	63.38		
Sodium	0.01650	0.01650	378.7		
Strontium	1.000e-006	1.000e-006	0.08746		
Sulfur	1.000e-005	1.000e-005	0.3201		
Uranium	0.001890	0.001890	449.1		

Sample 19887 $CaCO_3$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.190               log fO2 =   -0.793
Eh =   0.6145 volts       pe =  10.3882
Ionic strength      =     0.012156
Activity of water   =     1.000000
Solvent mass        =     0.999987 kg
Solution mass       =     1.000660 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =          672 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       255.17 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.004585	105.3	0.8938	-2.3874
HPO4--	0.001296	124.3	0.6361	-3.0838
CO3--	0.0008805	52.80	0.6406	-3.2487
HCO3-	0.0008687	52.97	0.8938	-3.1099
UO2(CO3)3----	0.0005321	239.3	0.1632	-4.0614
O2(aq)	0.0002037	6.514	1.0000	-3.6910
F-	0.0001879	3.568	0.8922	-3.7755
OH-	0.0001756	2.984	0.8922	-3.8051
CrO4--	0.0001600	18.54	0.6361	-3.9924
Fe(OH)4-	7.806e-005	9.664	0.8938	-4.1563
NO3-	6.980e-005	4.325	0.8905	-4.2065
CaPO4-	6.186e-005	8.349	0.8938	-4.2573
UO2(OH)3-	3.352e-005	10.76	0.8938	-4.5234
NaHPO4-	3.145e-005	3.739	0.8938	-4.5511
MgPO4-	2.022e-005	2.410	0.8938	-4.7430
Fe(OH)3(aq)	1.794e-005	1.915	1.0000	-4.7463
AlO2-	1.749e-005	1.031	0.8938	-4.8061
PO4---	1.687e-005	1.601	0.3608	-5.2156
MnO4-	1.607e-005	1.910	0.8922	-4.8435
Cl-	9.994e-006	0.3541	0.8905	-5.0506
SO4--	9.805e-006	0.9412	0.6361	-5.2050
NaCO3-	8.455e-006	0.7013	0.8938	-5.1216
Ni(OH)2(aq)	6.770e-006	0.6271	1.0000	-5.1694
UO2(CO3)2--	5.476e-006	2.134	0.6361	-5.4580
(UO2)2CO3(OH)3-	5.405e-006	3.517	0.8938	-5.3160
Ca++	4.819e-006	0.1930	0.6535	-5.5018
NaHCO3(aq)	4.538e-006	0.3810	1.0000	-5.3431
PbCO3(aq)	4.485e-006	1.198	1.0000	-5.3483
Ni++	4.222e-006	0.2476	0.6535	-5.5592
Pb(OH)2(aq)	4.076e-006	0.9825	1.0000	-5.3898
CaCO3(aq)	3.773e-006	0.3774	1.0000	-5.4233

Pb(CO3)2--	2.627e-006	0.8592	0.6361	-5.7769
MnO4--	2.225e-006	0.2645	0.6361	-5.8490
UO2(OH)2(aq)	1.562e-006	0.4747	1.0000	-5.8062
CaHPO4(aq)	1.427e-006	0.1940	1.0000	-5.8455
Ni(OH)3-	1.187e-006	0.1301	0.8938	-5.9744
Mg++	1.143e-006	0.02775	0.6694	-6.1164
H2PO4-	9.558e-007	0.09264	0.8938	-6.0684
Sr++	7.520e-007	0.06585	0.6450	-6.3142
PbOH+	7.312e-007	0.1638	0.8938	-6.1847
Pb(OH)3-	7.144e-007	0.1844	0.8938	-6.1948
MgHPO4(aq)	5.127e-007	0.06162	1.0000	-6.2902
MgCO3(aq)	4.110e-007	0.03463	1.0000	-6.3862
UO2PO4-	2.308e-007	0.08418	0.8938	-6.6856
SrCO3(aq)	2.007e-007	0.02960	1.0000	-6.6976
NaSO4-	1.889e-007	0.02248	0.8938	-6.7724
Ca2UO2(CO3)3	1.365e-007	0.07235	1.0000	-6.8647
CO2(aq)	1.109e-007	0.004876	1.0000	-6.9552
NaOH(aq)	1.018e-007	0.004070	1.0000	-6.9922
NaF(aq)	6.910e-008	0.002899	1.0000	-7.1605
PbP2O7--	5.794e-008	0.02207	0.6361	-7.4335
(UO2)3(OH)7-	5.166e-008	0.04797	0.8938	-7.3356
SrHPO4(aq)	4.592e-008	0.008426	1.0000	-7.3380
CaHCO3+	3.047e-008	0.003078	0.8938	-7.5649
HCrO4-	2.295e-008	0.002683	0.8938	-7.6880
NaAlO2(aq)	1.157e-008	0.0009476	1.0000	-7.9367
UO2(OH)4--	1.137e-008	0.003841	0.6361	-8.1407

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	56.2420s/sat	PbCO3.PbO	0.4298s/sat
Todorokite	48.8313s/sat	Boehmite	0.3230s/sat
Pyromorphite	20.7655s/sat	Gibbsite	0.1312s/sat
Trevorite	19.5406s/sat	Crocoite	0.0457s/sat
Fluorapatite	15.0283s/sat	Dolomite	0.0286s/sat
Hematite	14.3988s/sat	Dolomite-ord	0.0286s/sat
Pyromorphite-OH	14.3760s/sat	Ice	-0.1387
Pb4O(PO4)2	12.4468s/sat	Calcite	-0.2703
Bixbyite	10.7109s/sat	Schoepite	-0.3249
Pyrolusite	9.4677s/sat	UO3:2H2O	-0.3249
Hausmannite	9.4622s/sat	Aragonite	-0.4147
Parsonsite	8.7728s/sat	UO2(OH)2(beta)	-0.4373
Pb3(PO4)2	8.1481s/sat	Na2U2O7(am)	-0.4780
MnO2(gamma)	7.9499s/sat	Schoepite-dehy(.	-0.5083
Ferrite-Ca	7.8639s/sat	UO3:.9H2O(alpha)	-0.5083
Ferrite-Mg	7.7159s/sat	Pb4SO7	-0.5188
Hydroxylapatite	7.0745s/sat	Schoepite-dehy(.	-0.5886
Goethite	6.7192s/sat	SrUO4(alpha)	-0.5908
Hydrocerussite	6.6538s/sat	Schoepite-dehy(1	-0.5947
Manganite	5.0373s/sat	MnHPO4	-0.6402
Ni3(PO4)2	4.1761s/sat	Litharge	-0.9384
PbHPO4	3.9641s/sat	Pb4Cl2(OH)6	-0.9589
Magnetite	3.7216s/sat	Pb3SO6	-1.0819
Plattnerite	3.6408s/sat	Monohydrocalcite	-1.1040
CaUO4	3.4446s/sat	Massicot	-1.1206
Minium	2.8170s/sat	Magnesite	-1.3299

Bunsenite	2.3489s/sat	Mn(OH)3	-1.4685
Ni(OH)2	2.0723s/sat	Dolomite-dis	-1.5158
Na2U2O7(c)	2.0303s/sat	Schoepite-dehy(.	-1.6979
Whitlockite	1.9321s/sat	Lanarkite	-1.7150
Cerussite	1.6096s/sat	Dawsonite	-1.9564
Fe(OH)3(ppd)	1.5981s/sat	NiCO3	-1.9909
Strontianite	1.0796s/sat	Brucite	-2.0344
Ca-Autunite	0.7295s/sat	Schoepite-dehy(.	-2.2159
Diaspore	0.7269s/sat	Corundum	-2.5376
Becquerelite	0.5287s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1612	-0.793
H2O(g)	0.02598	-1.585
CO2(g)	3.264e-006	-5.486
HF(g)	8.353e-016	-15.078
HCl(g)	2.844e-022	-21.546
NO2(g)	1.442e-022	-21.841
N2(g)	7.614e-025	-24.118
NO(g)	2.407e-028	-27.618
Cl2(g)	4.708e-036	-35.327
H2(g)	6.981e-042	-41.156
CO(g)	7.116e-051	-50.148
UO2F2(g)	8.125e-059	-58.090
SO2(g)	3.401e-062	-61.468
Pb(g)	8.648e-063	-62.063
UO3(g)	3.634e-067	-66.440
NH3(g)	1.227e-071	-70.911
Na(g)	7.267e-073	-72.139
UO2Cl2(g)	1.159e-074	-73.936
UOF4(g)	2.298e-076	-75.639
F2(g)	3.189e-086	-85.496
UF5(g)	1.609e-091	-90.794
UF6(g)	2.894e-098	-97.538
UF4(g)	8.803e-099	-98.055
UO2(g)	5.639e-120	-119.249
Mg(g)	7.239e-127	-126.140
UCl4(g)	1.105e-135	-134.956
UCl5(g)	4.787e-146	-145.320
UF3(g)	2.207e-147	-146.656
CH4(g)	6.182e-148	-147.209
Ca(g)	4.425e-149	-148.354
H2S(g)	2.857e-149	-148.544
UCl6(g)	3.851e-151	-150.414
U2F10(g)	2.896e-157	-156.538
UCl3(g)	1.314e-162	-161.881
Al(g)	1.071e-190	-189.970
C(g)	4.158e-192	-191.381
UF2(g)	8.166e-193	-192.088
UO(g)	3.475e-204	-203.459
UCl2(g)	8.453e-207	-206.073
UF(g)	7.436e-232	-231.129
S2(g)	3.737e-241	-240.428
C2H4(g)	1.548e-242	-241.810
UCl(g)	1.191e-248	-247.924

U2Cl8(g)	3.012e-260	-259.521
U2Cl10(g)	4.574e-265	-264.340
U(g)	5.021e-289	-288.299

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.75e-005	1.75e-005	0.472			
Ca++	7.22e-005	7.22e-005	2.89			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	0.000160	0.000160	18.5			
F-	0.000188	0.000188	3.57			
Fe++	9.60e-005	9.60e-005	5.36			
H+	-0.00341	-0.00341	-3.43			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00339	0.00339	207.			
HPO4--	0.00143	0.00143	137.			
Mg++	2.23e-005	2.23e-005	0.542			
Mn++	1.83e-005	1.83e-005	1.00			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00463	0.00463	106.			
Ni++	1.22e-005	1.22e-005	0.716			
O2(aq)	0.000390	0.000390	12.5			
Pb++	1.27e-005	1.27e-005	2.63			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	0.000584	0.000584	158.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	1.750e-005	1.750e-005	0.4719		
Calcium	7.220e-005	7.220e-005	2.892		
Carbon	0.003390	0.003390	40.68		
Chlorine	1.000e-005	1.000e-005	0.3543		
Chromium	0.0001600	0.0001600	8.314		
Fluorine	0.0001880	0.0001880	3.569		
Hydrogen	111.0	111.0	1.118e+005		
Iron	9.600e-005	9.600e-005	5.358		
Lead	1.270e-005	1.270e-005	2.630		
Magnesium	2.230e-005	2.230e-005	0.5416		
Manganese	1.830e-005	1.830e-005	1.005		
Nickel	1.220e-005	1.220e-005	0.7155		
Nitrogen	6.980e-005	6.980e-005	0.9770		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	0.001430	0.001430	44.26		
Sodium	0.004630	0.004630	106.4		
Strontium	1.000e-006	1.000e-006	0.08756		
Sulfur	1.000e-005	1.000e-005	0.3204		
Uranium	0.0005840	0.0005840	138.9		

Sample 19887 $CaCO_3$ leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  9.490               log fO2 =   -0.713
Eh =   0.6571 volts       pe =  11.1082
Ionic strength      =    0.005018
Activity of water   =    1.000000
Solvent mass        =    0.999998 kg
Solution mass       =    1.000330 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         332 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      162.05 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.002165	49.76	0.9270	-2.6975
HCO3-	0.002086	127.2	0.9270	-2.7136
HPO4--	0.0005550	53.25	0.7373	-3.3881
CO3--	0.0003789	22.73	0.7397	-3.5524
O2(aq)	0.0002449	7.834	1.0000	-3.6110
UO2(CO3)3----	0.0001071	48.19	0.2951	-4.5002
NO3-	6.980e-005	4.326	0.9254	-4.1898
OH-	3.374e-005	0.5737	0.9262	-4.5051
CrO4--	1.729e-005	2.004	0.7373	-4.8947
F-	9.997e-006	0.1899	0.9262	-5.0334
Cl-	9.997e-006	0.3543	0.9254	-5.0338
SO4--	9.887e-006	0.9495	0.7373	-5.1373
AlO2-	9.169e-006	0.5406	0.9270	-5.0706
NaHPO4-	7.368e-006	0.8763	0.9270	-5.1656
Fe(OH)3(aq)	6.474e-006	0.6916	1.0000	-5.1888
CaPO4-	5.958e-006	0.8043	0.9270	-5.2579
MgPO4-	5.642e-006	0.6728	0.9270	-5.2815
NaHCO3(aq)	5.533e-006	0.4647	1.0000	-5.2570
Fe(OH)4-	5.421e-006	0.6713	0.9270	-5.2988
Ca++	4.256e-006	0.1705	0.7466	-5.4980
UO2(CO3)2--	3.462e-006	1.350	0.7373	-5.5930
Mg++	2.960e-006	0.07193	0.7552	-5.6506
H2PO4-	2.292e-006	0.2222	0.9270	-5.6727
NaCO3-	1.983e-006	0.1646	0.9270	-5.7355
CaCO3(aq)	1.891e-006	0.1892	1.0000	-5.7233
MnO4-	1.683e-006	0.2001	0.9262	-5.8073
PbCO3(aq)	1.539e-006	0.4112	1.0000	-5.8127
CO2(aq)	1.384e-006	0.06088	1.0000	-5.8589
PO4---	1.197e-006	0.1137	0.5035	-6.2199
Ni++	9.290e-007	0.05450	0.7466	-6.1589
Sr++	8.411e-007	0.07367	0.7420	-6.2047

UO2(OH)3-	7.622e-007	0.2446	0.9270	-6.1509
MgHPO4(aq)	7.436e-007	0.08941	1.0000	-6.1287
CaHPO4(aq)	7.144e-007	0.09717	1.0000	-6.1461
MgCO3(aq)	5.969e-007	0.05031	1.0000	-6.2241
Pb(CO3)2--	3.866e-007	0.1264	0.7373	-6.5451
UO2(OH)2(aq)	1.846e-007	0.05612	1.0000	-6.7337
(UO2)2CO3(OH)3-	1.812e-007	0.1180	0.9270	-6.7747
SrCO3(aq)	1.283e-007	0.01893	1.0000	-6.8919
Pb(OH)2(aq)	1.121e-007	0.02703	1.0000	-6.9505
NaSO4-	1.043e-007	0.01241	0.9270	-7.0148
PbOH+	9.718e-008	0.02178	0.9270	-7.0454
CaHCO3+	7.379e-008	0.007458	0.9270	-7.1649
Ni(OH)2(aq)	6.774e-008	0.006278	1.0000	-7.1691
UO2PO4-	6.540e-008	0.02386	0.9270	-7.2174
MgHCO3+	5.063e-008	0.004318	0.9270	-7.3285
Ca2UO2(CO3)3	5.059e-008	0.02682	1.0000	-7.2959
MnO4--	3.976e-008	0.004728	0.7373	-7.5328
SrHPO4(aq)	2.932e-008	0.005382	1.0000	-7.5328
HCrO4-	1.389e-008	0.001625	0.9270	-7.8903

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	53.5716s/sat	Ni(OH)2	0.0726s/sat
Todorokite	46.4848s/sat	Whitlockite	-0.0652
Pyromorphite	16.9660s/sat	Dolomite	-0.1093
Trevorite	16.6558s/sat	Dolomite-ord	-0.1093
Hematite	13.5137s/sat	Ice	-0.1387
Fluorapatite	10.7765s/sat	Ca-Autunite	-0.3303
Bixbyite	10.0233s/sat	Calcite	-0.5703
Pyromorphite-OH	9.8597s/sat	Aragonite	-0.7147
Pyrolusite	9.1439s/sat	Crocoite	-1.0172
Hausmannite	8.4108s/sat	Magnesite	-1.1678
Pb4O(PO4)2	8.3954s/sat	Schoepite	-1.2524
MnO2(gamma)	7.6261s/sat	UO3:2H2O	-1.2524
Parsonsite	6.9153s/sat	UO2(OH)2(beta)	-1.3648
Goethite	6.2767s/sat	Monohydrocalcite	-1.4040
Ferrite-Mg	5.8966s/sat	Dawsonite	-1.4348
Pb3(PO4)2	5.6574s/sat	UO3:.9H2O(alpha)	-1.4358
Ferrite-Ca	5.5827s/sat	Schoepite-dehy(.	-1.4358
Manganite	4.6935s/sat	Plumbogummite	-1.4820
Hydrocerussite	4.1642s/sat	Schoepite-dehy(.	-1.5161
PbHPO4	3.4991s/sat	Schoepite-dehy(1	-1.5222
Hydroxylapatite	3.3805s/sat	PbCO3.PbO	-1.5953
Magnetite	2.3740s/sat	Dolomite-dis	-1.6537
Plattnerite	2.1201s/sat	Corundum	-1.6667
Diaspore	1.1624s/sat	Mn(OH)3	-1.8123
Fe(OH)3(ppd)	1.1556s/sat	Minium	-1.8250
Cerussite	1.1452s/sat	Na2U2O7(c)	-1.8448
CaUO4	1.1209s/sat	Rhodochrosite	-2.4981
Strontianite	0.8853s/sat	Litharge	-2.4991
Boehmite	0.7585s/sat	Schoepite-dehy(.	-2.6254
Gibbsite	0.5667s/sat	Massicot	-2.6813
Ni3(PO4)2	0.3685s/sat	SrUO4(alpha)	-2.8088
Bunsenite	0.3492s/sat	NiCO3	-2.8944
MnHPO4	0.0917s/sat	Brucite	-2.9686

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1938	-0.713
H2O(g)	0.02598	-1.585
CO2(g)	4.074e-005	-4.390
HF(g)	2.312e-016	-15.636
HCl(g)	1.482e-021	-20.829
NO2(g)	7.172e-022	-21.144
N2(g)	1.303e-023	-22.885
NO(g)	1.092e-027	-26.962
Cl2(g)	1.401e-034	-33.853
H2(g)	6.367e-042	-41.196
CO(g)	8.100e-050	-49.092
SO2(g)	9.108e-061	-60.041
UO2F2(g)	7.356e-061	-60.133
Pb(g)	2.169e-064	-63.664
UO3(g)	4.295e-068	-67.367
NH3(g)	4.421e-071	-70.354
Na(g)	6.781e-074	-73.169
UO2Cl2(g)	3.718e-074	-73.430
UOF4(g)	1.594e-079	-78.797
F2(g)	2.679e-087	-86.572
UF5(g)	2.949e-095	-94.530
UF4(g)	5.568e-102	-101.254
UF6(g)	1.538e-102	-101.813
UO2(g)	6.078e-121	-120.216
Mg(g)	7.683e-128	-127.114
UCl4(g)	8.778e-134	-133.057
UCl5(g)	2.074e-143	-142.683
CH4(g)	5.339e-147	-146.273
UCl6(g)	9.101e-148	-147.041
H2S(g)	5.805e-148	-147.236
UF3(g)	4.817e-150	-149.317
Ca(g)	1.621e-150	-149.790
UCl3(g)	1.912e-161	-160.718
U2F10(g)	9.736e-165	-164.012
Al(g)	2.542e-190	-189.595
C(g)	4.316e-191	-190.365
UF2(g)	6.150e-195	-194.211
UO(g)	3.415e-205	-204.467
UCl2(g)	2.255e-206	-205.647
UF(g)	1.932e-233	-232.714
S2(g)	1.854e-238	-237.732
C2H4(g)	1.387e-240	-239.858
UCl(g)	5.825e-249	-248.235
U2Cl8(g)	1.899e-256	-255.722
U2Cl10(g)	8.582e-260	-259.066
U(g)	4.502e-290	-289.347

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	9.18e-006	9.18e-006	0.248			
Ca++	1.30e-005	1.30e-005	0.521			
Cl-	1.00e-005	1.00e-005	0.354			

CrO4--	1.73e-005	1.73e-005	2.01
F-	1.00e-005	1.00e-005	0.190
Fe++	1.19e-005	1.19e-005	0.664
H+	-0.000902	-0.000902	-0.909
H2O	55.5	55.5	1.00e+006
HCO3-	0.00281	0.00281	171.
HPO4--	0.000579	0.000579	55.6
Mg++	1.00e-005	1.00e-005	0.243
Mn++	1.73e-006	1.73e-006	0.0950
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00218	0.00218	50.1
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	2.15e-006	2.15e-006	0.445
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	0.000112	0.000112	30.2

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	9.180e-006	9.180e-006	0.2476		
Calcium	1.300e-005	1.300e-005	0.5208		
Carbon	0.002807	0.002807	33.71		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	1.730e-005	1.730e-005	0.8992		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.190e-005	1.190e-005	0.6644		
Lead	2.150e-006	2.150e-006	0.4453		
Magnesium	1.000e-005	1.000e-005	0.2430		
Manganese	1.730e-006	1.730e-006	0.09501		
Nickel	1.000e-006	1.000e-006	0.05867		
Nitrogen	6.980e-005	6.980e-005	0.9773		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0005790	0.0005790	17.93		
Sodium	0.002180	0.002180	50.10		
Strontium	1.000e-006	1.000e-006	0.08759		
Sulfur	1.000e-005	1.000e-005	0.3206		
Uranium	0.0001120	0.0001120	26.65		

Sample 19887 $CaCO_3$ leach, Stage 4.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  9.570              log fO2 =   -0.712
Eh =   0.6524 volts      pe =  11.0283
Ionic strength      =    0.004498
Activity of water   =    1.000000
Solvent mass        =    0.999998 kg
Solution mass       =    1.000316 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         318 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      124.04 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001652	37.96	0.9304	-2.8134
HCO3-	0.001400	85.40	0.9304	-2.8852
NO3-	0.0008810	54.61	0.9290	-3.0870
HPO4--	0.0003879	37.22	0.7484	-3.5372
CO3--	0.0003025	18.14	0.7505	-3.6440
O2(aq)	0.0002451	7.840	1.0000	-3.6107
UO2(CO3)3----	0.0001269	57.09	0.3132	-4.4007
OH-	4.042e-005	0.6872	0.9297	-4.4251
CrO4--	1.549e-005	1.796	0.7484	-4.9359
F-	9.998e-006	0.1899	0.9297	-5.0318
Cl-	9.998e-006	0.3543	0.9290	-5.0321
SO4--	9.909e-006	0.9516	0.7484	-5.1299
AlO2-	7.753e-006	0.4571	0.9304	-5.1419
CaPO4-	5.935e-006	0.8012	0.9304	-5.2579
Fe(OH)4-	5.857e-006	0.7253	0.9304	-5.2636
Fe(OH)3(aq)	5.839e-006	0.6238	1.0000	-5.2336
MgPO4-	5.468e-006	0.6520	0.9304	-5.2935
UO2(CO3)2--	5.295e-006	2.065	0.7484	-5.4020
Ca++	4.920e-006	0.1971	0.7569	-5.4290
NaHPO4-	3.988e-006	0.4744	0.9304	-5.4305
Mg++	3.334e-006	0.08100	0.7648	-5.5935
UO2(OH)3-	3.123e-006	1.002	0.9304	-5.5368
NaHCO3(aq)	2.855e-006	0.2397	1.0000	-5.5444
CaCO3(aq)	1.795e-006	0.1796	1.0000	-5.7458
MnO4-	1.553e-006	0.1846	0.9297	-5.8405
PbCO3(aq)	1.478e-006	0.3948	1.0000	-5.8303
(UO2)2CO3(OH)3-	1.423e-006	0.9263	0.9304	-5.8781
H2PO4-	1.348e-006	0.1307	0.9304	-5.9018
NaCO3-	1.226e-006	0.1017	0.9304	-5.9429
PO4---	9.875e-007	0.09375	0.5206	-6.2890
Ni++	8.979e-007	0.05268	0.7569	-6.1677

Sr++	8.652e-007	0.07578	0.7527	-6.1863
CO2(aq)	7.754e-007	0.03412	1.0000	-6.1105
UO2(OH)2(aq)	6.315e-007	0.1919	1.0000	-6.1996
MgHPO4(aq)	6.016e-007	0.07234	1.0000	-6.2207
CaHPO4(aq)	5.941e-007	0.08081	1.0000	-6.2261
MgCO3(aq)	5.513e-007	0.04647	1.0000	-6.2586
Pb(CO3)2--	2.962e-007	0.09690	0.7484	-6.6543
Pb(OH)2(aq)	1.921e-007	0.04631	1.0000	-6.7166
PbOH+	1.380e-007	0.03093	0.9304	-6.8915
UO2PO4-	1.315e-007	0.04799	0.9304	-6.9124
SrCO3(aq)	1.084e-007	0.01600	1.0000	-6.9650
Ni(OH)2(aq)	9.595e-008	0.008892	1.0000	-7.0180
Ca2UO2(CO3)3	8.740e-008	0.04633	1.0000	-7.0585
NaSO4-	8.093e-008	0.009632	0.9304	-7.1232
CaHCO3+	5.806e-008	0.005868	0.9304	-7.2674
MnO4--	4.363e-008	0.005187	0.7484	-7.4861
MgHCO3+	3.876e-008	0.003306	0.9304	-7.4430
SrHPO4(aq)	2.170e-008	0.003984	1.0000	-7.6634
CaNO3+	1.642e-008	0.001676	0.9304	-7.8160
HCrO4-	1.047e-008	0.001224	0.9304	-8.0115

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	52.6636s/sat	Whitlockite	0.0036s/sat
Todorokite	45.6902s/sat	Ice	-0.1387
Pyromorphite	17.1301s/sat	Dolomite	-0.1663
Trevorite	16.7174s/sat	Dolomite-ord	-0.1663
Hematite	13.4241s/sat	MnHPO4	-0.3310
Fluorapatite	10.9159s/sat	Calcite	-0.5928
Pyromorphite-OH	10.1021s/sat	Schoepite	-0.7183
Bixbyite	9.7962s/sat	UO3:2H2O	-0.7183
Pyrolusite	9.0304s/sat	Aragonite	-0.7372
Pb4O(PO4)2	8.7130s/sat	UO2(OH)2(beta)	-0.8307
Hausmannite	8.0701s/sat	Na2U2O7(c)	-0.8485
MnO2(gamma)	7.5126s/sat	Schoepite-dehy(.	-0.9017
Parsonsite	7.2991s/sat	UO3:.9H2O(alpha)	-0.9017
Goethite	6.2319s/sat	Schoepite-dehy(.	-0.9820
Ferrite-Mg	6.0241s/sat	Crocoite	-0.9845
Pb3(PO4)2	5.7410s/sat	Schoepite-dehy(1	-0.9881
Ferrite-Ca	5.7220s/sat	Minium	-1.1231
Manganite	4.5800s/sat	Magnesite	-1.2023
Hydrocerussite	4.3629s/sat	PbCO3.PbO	-1.3790
Hydroxylapatite	3.5982s/sat	Monohydrocalcite	-1.4265
PbHPO4	3.4240s/sat	Dolomite-dis	-1.7107
Plattnerite	2.3542s/sat	Dawsonite	-1.8735
Magnetite	2.2394s/sat	Mn(OH)3	-1.9258
CaUO4	1.8840s/sat	Corundum	-1.9693
Cerussite	1.1276s/sat	Schoepite-dehy(.	-2.0913
Fe(OH)3(ppd)	1.1108s/sat	SrUO4(alpha)	-2.0963
Diaspore	1.0111s/sat	Litharge	-2.2652
Strontianite	0.8122s/sat	Plumbogummite	-2.3201
Boehmite	0.6072s/sat	Massicot	-2.4474
Bunsenite	0.5004s/sat	Schoepite-dehy(.	-2.6093
Gibbsite	0.4154s/sat	Brucite	-2.7515
Ca-Autunite	0.3487s/sat	Rhodochrosite	-2.8632

Ni(OH)2	0.2237s/sat	NiCO3	-2.9947
Ni3(PO4)2	0.2038s/sat	Becquerelite	-2.9990

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1939	-0.712
H2O(g)	0.02598	-1.585
CO2(g)	2.283e-005	-4.642
HF(g)	1.930e-016	-15.714
NO2(g)	7.557e-021	-20.122
N2(g)	1.444e-021	-20.840
HCl(g)	1.237e-021	-20.908
NO(g)	1.150e-026	-25.939
Cl2(g)	9.774e-035	-34.010
H2(g)	6.364e-042	-41.196
CO(g)	4.537e-050	-49.343
UO2F2(g)	1.754e-060	-59.756
SO2(g)	6.407e-061	-60.193
Pb(g)	3.715e-064	-63.430
UO3(g)	1.469e-067	-66.833
NH3(g)	4.652e-070	-69.332
UO2Cl2(g)	8.868e-074	-73.052
Na(g)	6.242e-074	-73.205
UOF4(g)	2.650e-079	-78.577
F2(g)	1.868e-087	-86.729
UF5(g)	4.092e-095	-94.388
UF4(g)	9.251e-102	-101.034
UF6(g)	1.782e-102	-101.749
UO2(g)	2.078e-120	-119.682
Mg(g)	1.266e-127	-126.898
UCl4(g)	1.459e-133	-132.836
UCl5(g)	2.879e-143	-142.541
CH4(g)	2.986e-147	-146.525
UCl6(g)	1.055e-147	-146.977
H2S(g)	4.078e-148	-147.390
UF3(g)	9.584e-150	-149.018
Ca(g)	2.745e-150	-149.561
UCl3(g)	3.806e-161	-160.420
U2F10(g)	1.874e-164	-163.727
Al(g)	1.793e-190	-189.746
C(g)	2.417e-191	-190.617
UF2(g)	1.465e-194	-193.834
UO(g)	1.167e-204	-203.933
UCl2(g)	5.374e-206	-205.270
UF(g)	5.511e-233	-232.259
S2(g)	9.158e-239	-238.038
C2H4(g)	4.345e-241	-240.362
UCl(g)	1.662e-248	-247.779
U2Cl8(g)	5.246e-256	-255.280
U2Cl10(g)	1.654e-259	-258.781
U(g)	1.538e-289	-288.813

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	7.76e-006	7.76e-006	0.209			

Ca++	1.35e-005	1.35e-005	0.541
Cl-	1.00e-005	1.00e-005	0.354
CrO4--	1.55e-005	1.55e-005	1.80
F-	1.00e-005	1.00e-005	0.190
Fe++	1.17e-005	1.17e-005	0.653
H+	-0.00171	-0.00171	-1.73
H2O	55.5	55.5	1.00e+006
HCO3-	0.00210	0.00210	128.
HPO4--	0.000407	0.000407	39.1
Mg++	1.00e-005	1.00e-005	0.243
Mn++	1.60e-006	1.60e-006	0.0879
NH3(aq)	0.000881	0.000881	15.0
Na+	0.00166	0.00166	38.2
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.00201	0.00201	64.4
Pb++	2.12e-006	2.12e-006	0.439
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	0.000139	0.000139	37.5

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	7.760e-006	7.760e-006	0.2093		
Calcium	1.350e-005	1.350e-005	0.5409		
Carbon	0.002105	0.002105	25.27		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	1.550e-005	1.550e-005	0.8057		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.170e-005	1.170e-005	0.6532		
Lead	2.120e-006	2.120e-006	0.4391		
Magnesium	1.000e-005	1.000e-005	0.2430		
Manganese	1.600e-006	1.600e-006	0.08787		
Nickel	1.000e-006	1.000e-006	0.05867		
Nitrogen	0.0008810	0.0008810	12.34		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0004070	0.0004070	12.60		
Sodium	0.001660	0.001660	38.15		
Strontium	1.000e-006	1.000e-006	0.08759		
Sulfur	1.000e-005	1.000e-005	0.3206		
Uranium	0.0001390	0.0001390	33.08		

Sample 19887 $CaCO_3$ leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  9.490              log fO2 =   -0.709
Eh =   0.6572 volts      pe =  11.1091
Ionic strength      =    0.003437
Activity of water   =    1.000000
Solvent mass        =    0.999999 kg
Solution mass       =    1.000238 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         240 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      124.03 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001558	95.03	0.9382	-2.8352
Na+	0.001314	30.21	0.9382	-2.9090
CO3--	0.0002730	16.38	0.7759	-3.6740
O2(aq)	0.0002469	7.897	1.0000	-3.6076
HPO4--	0.0002463	23.63	0.7741	-3.7198
UO2(CO3)3----	0.0001023	46.03	0.3587	-4.4353
NO3-	6.980e-005	4.327	0.9371	-4.1844
OH-	3.333e-005	0.5667	0.9377	-4.5051
Cl-	9.998e-006	0.3544	0.9371	-5.0283
F-	9.998e-006	0.1899	0.9377	-5.0280
SO4--	9.921e-006	0.9528	0.7741	-5.1146
CrO4--	9.372e-006	1.087	0.7741	-5.1394
UO2(CO3)2--	5.065e-006	1.975	0.7741	-5.4067
Mg++	4.523e-006	0.1099	0.7875	-5.4483
Ca++	4.356e-006	0.1745	0.7810	-5.4683
MgPO4-	4.138e-006	0.4934	0.9382	-5.4109
Fe(OH)3(aq)	4.135e-006	0.4418	1.0000	-5.3835
Fe(OH)4-	3.422e-006	0.4237	0.9382	-5.4935
CaPO4-	2.937e-006	0.3965	0.9382	-5.5598
NaHCO3(aq)	2.570e-006	0.2158	1.0000	-5.5901
NaHPO4-	2.084e-006	0.2479	0.9382	-5.7088
UO2(OH)3-	2.024e-006	0.6498	0.9382	-5.7214
CaCO3(aq)	1.531e-006	0.1532	1.0000	-5.8151
H2PO4-	1.055e-006	0.1023	0.9382	-6.0044
CO2(aq)	1.046e-006	0.04602	1.0000	-5.9805
AlO2-	9.989e-007	0.05890	0.9382	-6.0282
PbCO3(aq)	9.954e-007	0.2659	1.0000	-6.0020
MnO4-	9.946e-007	0.1183	0.9377	-6.0303
(UO2)2CO3(OH)3-	9.782e-007	0.6367	0.9382	-6.0373
Ni++	9.261e-007	0.05434	0.7810	-6.1407
NaCO3-	9.102e-007	0.07553	0.9382	-6.0686

```
 Sr++               8.776e-007       0.07687      0.7776       -6.1660
 MgCO3(aq)          7.187e-007       0.06059      1.0000       -6.1434
 MgHPO4(aq)         5.519e-007       0.06637      1.0000       -6.2581
 PO4---             4.998e-007       0.04746      0.5618       -6.5516
 UO2(OH)2(aq)       4.964e-007        0.1509      1.0000       -6.3042
 CaHPO4(aq)         3.564e-007       0.04848      1.0000       -6.4480
 Pb(CO3)2--         1.800e-007       0.05888      0.7741       -6.8560
 SrCO3(aq)          1.060e-007       0.01565      1.0000       -6.9746
 Pb(OH)2(aq)        9.589e-008       0.02312      1.0000       -7.0182
 PbOH+              8.214e-008       0.01841      0.9382       -7.1131
 UO2PO4-            8.093e-008       0.02953      0.9382       -7.1196
 Ni(OH)2(aq)        7.065e-008      0.006548      1.0000       -7.1509
 Ca2UO2(CO3)3       6.735e-008       0.03570      1.0000       -7.1717
 NaSO4-             6.669e-008      0.007938      0.9382       -7.2036
 MgHCO3+            6.024e-008      0.005138      0.9382       -7.2478
 CaHCO3+            5.901e-008      0.005965      0.9382       -7.2567
 MnO4--             2.262e-008      0.002690      0.7741       -7.7567
 SrHPO4(aq)         1.494e-008      0.002742      1.0000       -7.8257
  (only species > 1e-8 molal listed)

Mineral saturation states
                   log Q/K                          log Q/K
----------------------------------------------------------------
 Birnessite        51.7634s/sat   Ice                -0.1387
 Todorokite        44.9022s/sat   Boehmite           -0.1991
 Trevorite         16.2847s/sat   Ni3(PO4)2          -0.2403
 Pyromorphite      15.6376s/sat   Gibbsite           -0.3909
 Hematite          13.1244s/sat   MnHPO4             -0.4673
 Fluorapatite       9.9353s/sat   Whitlockite        -0.6394
 Bixbyite           9.5704s/sat   Calcite            -0.6621
 Pyrolusite         8.9183s/sat   Aragonite          -0.8065
 Pyromorphite-OH    8.5258s/sat   UO3:2H2O           -0.8229
 Hausmannite        7.7306s/sat   Schoepite          -0.8229
 Pb4O(PO4)2         7.4610s/sat   UO2(OH)2(beta)     -0.9353
 MnO2(gamma)        7.4005s/sat   UO3:.9H2O(alpha)   -1.0063
 Parsonsite         6.5459s/sat   Schoepite-dehy(.   -1.0063
 Goethite           6.0820s/sat   Schoepite-dehy(.   -1.0866
 Ferrite-Mg         5.7096s/sat   Magnesite          -1.0871
 Ferrite-Ca         5.2231s/sat   Schoepite-dehy(1   -1.0927
 Pb3(PO4)2          4.7908s/sat   Crocoite           -1.3297
 Manganite          4.4671s/sat   Na2U2O7(c)         -1.4089
 Hydrocerussite     3.7179s/sat   Monohydrocalcite   -1.4958
 PbHPO4             3.0997s/sat   Dolomite-dis       -1.6649
 Hydroxylapatite    2.5340s/sat   PbCO3.PbO          -1.8523
 Plattnerite        2.0541s/sat   Minium             -2.0266
 Magnetite          1.7892s/sat   Mn(OH)3            -2.0387
 CaUO4              1.5801s/sat   Schoepite-dehy(.   -2.1959
 Fe(OH)3(ppd)       0.9609s/sat   SrUO4(alpha)       -2.3406
 Cerussite          0.9559s/sat   Litharge           -2.5668
 Strontianite       0.8026s/sat   Schoepite-dehy(.   -2.7139
 Bunsenite          0.3674s/sat   Dawsonite          -2.7254
 Diaspore           0.2048s/sat   Massicot           -2.7490
 Ni(OH)2            0.0908s/sat   Brucite            -2.7663
 Ca-Autunite       -0.1050        Rhodochrosite      -2.8469
 Dolomite-ord      -0.1205        NiCO3              -2.9977
 Dolomite          -0.1205
  (only minerals with log Q/K > -3 listed)
```

Gases	fugacity	log fug.
O2(g)	0.1953	-0.709
H2O(g)	0.02598	-1.585
CO2(g)	3.079e-005	-4.512
HF(g)	2.341e-016	-15.631
HCl(g)	1.500e-021	-20.824
NO2(g)	7.248e-022	-21.140
N2(g)	1.310e-023	-22.883
NO(g)	1.099e-027	-26.959
Cl2(g)	1.443e-034	-33.841
H2(g)	6.341e-042	-41.198
CO(g)	6.098e-050	-49.215
UO2F2(g)	2.027e-060	-59.693
SO2(g)	9.557e-061	-60.020
Pb(g)	1.848e-064	-63.733
UO3(g)	1.155e-067	-66.938
NH3(g)	4.406e-071	-70.356
UO2Cl2(g)	1.025e-073	-72.989
Na(g)	4.158e-074	-73.381
UOF4(g)	4.502e-079	-78.347
F2(g)	2.757e-087	-86.560
UF5(g)	8.416e-095	-94.075
UF4(g)	1.566e-101	-100.805
UF6(g)	4.452e-102	-101.351
UO2(g)	1.627e-120	-119.789
Mg(g)	1.219e-127	-126.914
UCl4(g)	2.472e-133	-132.607
UCl5(g)	5.927e-143	-142.227
CH4(g)	3.971e-147	-146.401
UCl6(g)	2.640e-147	-146.578
H2S(g)	6.018e-148	-147.221
UF3(g)	1.336e-149	-148.874
Ca(g)	1.729e-150	-149.762
UCl3(g)	5.308e-161	-160.275
U2F10(g)	7.928e-164	-163.101
C(g)	3.237e-191	-190.490
Al(g)	2.786e-191	-190.555
UF2(g)	1.681e-194	-193.774
UO(g)	9.109e-205	-204.041
UCl2(g)	6.169e-206	-205.210
UF(g)	5.206e-233	-232.283
S2(g)	2.009e-238	-237.697
C2H4(g)	7.740e-241	-240.111
UCl(g)	1.570e-248	-247.804
U2Cl8(g)	1.506e-255	-254.822
U2Cl10(g)	7.011e-259	-258.154
U(g)	1.196e-289	-288.922

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	9.38e-006	9.38e-006	0.376			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	9.38e-006	9.38e-006	1.09			

F-	1.00e-005	1.00e-005	0.190
Fe++	7.56e-006	7.56e-006	0.422
H+	-0.000741	-0.000741	-0.746
H2O	55.5	55.5	1.00e+006
HCO3-	0.00216	0.00216	132.
HPO4--	0.000258	0.000258	24.8
Mg++	1.00e-005	1.00e-005	0.243
Mn++	1.02e-006	1.02e-006	0.0560
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00132	0.00132	30.3
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	1.36e-006	1.36e-006	0.282
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	0.000112	0.000112	30.2

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.000e-006	1.000e-006	0.02698		
Calcium	9.380e-006	9.380e-006	0.3758		
Carbon	0.002157	0.002157	25.91		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	9.380e-006	9.380e-006	0.4876		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	7.560e-006	7.560e-006	0.4221		
Lead	1.360e-006	1.360e-006	0.2817		
Magnesium	1.000e-005	1.000e-005	0.2430		
Manganese	1.020e-006	1.020e-006	0.05602		
Nickel	1.000e-006	1.000e-006	0.05868		
Nitrogen	6.980e-005	6.980e-005	0.9774		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0002580	0.0002580	7.989		
Sodium	0.001320	0.001320	30.34		
Strontium	1.000e-006	1.000e-006	0.08760		
Sulfur	1.000e-005	1.000e-005	0.3206		
Uranium	0.0001120	0.0001120	26.65		

Sample 19887 $CaCO_3$ leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  9.710               log fO2 =   -0.734
Eh =   0.6438 volts       pe =  10.8828
Ionic strength      =    0.008339
Activity of water   =    1.000000
Solvent mass        =    0.999983 kg
Solution mass       =    1.000591 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         607 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      201.12 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.002163	49.69	0.9092	-2.7064
HCO3-	0.0008398	51.21	0.9092	-3.1172
UO2(CO3)3----	0.0006336	285.0	0.2154	-3.8649
HPO4--	0.0003208	30.77	0.6817	-3.6602
CO3--	0.0002681	16.08	0.6851	-3.7360
O2(aq)	0.0002330	7.452	1.0000	-3.6326
(UO2)2CO3(OH)3-	0.0001303	84.77	0.9092	-3.9265
CrO4--	9.986e-005	11.58	0.6817	-4.1671
NO3-	6.979e-005	4.325	0.9068	-4.1987
OH-	5.712e-005	0.9709	0.9080	-4.2851
UO2(OH)3-	5.449e-005	17.48	0.9092	-4.3050
AlO2-	4.057e-005	2.391	0.9092	-4.4332
Fe(OH)4-	3.669e-005	4.543	0.9092	-4.4768
CaPO4-	3.387e-005	4.571	0.9092	-4.5115
Ca++	2.874e-005	1.151	0.6951	-4.6995
Fe(OH)3(aq)	2.590e-005	2.766	1.0000	-4.5868
UO2(CO3)2--	2.467e-005	9.617	0.6817	-4.7742
Cl-	9.997e-006	0.3542	0.9068	-5.0426
F-	9.997e-006	0.1898	0.9080	-5.0421
SO4--	9.876e-006	0.9482	0.6817	-5.1718
Ni++	8.758e-006	0.5137	0.6951	-5.2155
Ca2UO2(CO3)3	8.636e-006	4.576	1.0000	-5.0637
UO2(OH)2(aq)	7.802e-006	2.371	1.0000	-5.1078
CaCO3(aq)	7.792e-006	0.7794	1.0000	-5.1084
PbCO3(aq)	6.048e-006	1.615	1.0000	-5.2184
MgPO4-	5.622e-006	0.6701	0.9092	-5.2915
NaHPO4-	3.933e-006	0.4676	0.9092	-5.4466
Mg++	3.482e-006	0.08458	0.7075	-5.6085
CaHPO4(aq)	2.400e-006	0.3264	1.0000	-5.6197
NaHCO3(aq)	2.141e-006	0.1797	1.0000	-5.6694
(UO2)3(OH)7-	2.094e-006	1.944	0.9092	-5.7204

Pb(OH)2(aq)	1.851e-006	0.4462	1.0000	-5.7326
Ni(OH)2(aq)	1.638e-006	0.1517	1.0000	-5.7857
NaCO3-	1.298e-006	0.1077	0.9092	-5.9279
PO4---	1.267e-006	0.1203	0.4218	-6.2720
Pb(CO3)2--	1.077e-006	0.3521	0.6817	-6.1344
MnO4-	1.045e-006	0.1242	0.9080	-6.0227
PbOH+	9.859e-007	0.2209	0.9092	-6.0475
UO2PO4-	9.072e-007	0.3309	0.9092	-6.0836
Sr++	8.997e-007	0.07879	0.6885	-6.2080
H2PO4-	7.525e-007	0.07294	0.9092	-6.1648
MgHPO4(aq)	4.378e-007	0.05263	1.0000	-6.3587
MgCO3(aq)	4.310e-007	0.03632	1.0000	-6.3655
CO2(aq)	3.293e-007	0.01448	1.0000	-6.4825
CaHCO3+	1.868e-007	0.01887	0.9092	-6.7700
Pb(OH)3-	1.056e-007	0.02725	0.9092	-7.0176
NaSO4-	9.619e-008	0.01144	0.9092	-7.0582
Ni(OH)3-	9.346e-008	0.01025	0.9092	-7.0707
SrCO3(aq)	8.344e-008	0.01231	1.0000	-7.0786
HCrO4-	4.557e-008	0.005329	0.9092	-7.3827
MnO4--	4.401e-008	0.005231	0.6817	-7.5229
MgHCO3+	2.246e-008	0.001915	0.9092	-7.6899
HAlO2(aq)	2.029e-008	0.001216	1.0000	-7.6928
CaSO4(aq)	1.737e-008	0.002363	1.0000	-7.7602
NaOH(aq)	1.617e-008	0.0006465	1.0000	-7.7912
CaOH+	1.592e-008	0.0009081	0.9092	-7.8395
PbP2O7--	1.574e-008	0.005997	0.6817	-7.9693
SrHPO4(aq)	1.555e-008	0.002854	1.0000	-7.8082
NaAlO2(aq)	1.310e-008	0.001073	1.0000	-7.8829
Pb++	1.264e-008	0.002618	0.6851	-8.0624
Fe(OH)2+	1.187e-008	0.001066	0.9092	-7.9668

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	50.2394s/sat	Strontianite	0.6986s/sat
Todorokite	43.5717s/sat	Crocoite	0.4882s/sat
Pyromorphite	20.6899s/sat	Schoepite	0.3735s/sat
Trevorite	19.2433s/sat	UO3:2H2O	0.3735s/sat
Hematite	14.7179s/sat	Dolomite	0.3642s/sat
Fluorapatite	14.6037s/sat	Dolomite-ord	0.3642s/sat
Pyromorphite-OH	13.8124s/sat	UO2(OH)2(beta)	0.2611s/sat
Pb4O(PO4)2	11.8425s/sat	PbCO3.PbO	0.2169s/sat
Parsonsite	9.5525s/sat	Schoepite-dehy(.	0.1901s/sat
Bixbyite	9.1957s/sat	UO3:.9H2O(alpha)	0.1901s/sat
Pyrolusite	8.7246s/sat	Schoepite-dehy(.	0.1098s/sat
Ferrite-Ca	8.0253s/sat	Schoepite-dehy(1	0.1037s/sat
Pb3(PO4)2	7.8866s/sat	Calcite	0.0446s/sat
Ferrite-Mg	7.5829s/sat	Aragonite	-0.0998
Hydroxylapatite	7.4364s/sat	Ice	-0.1387
MnO2(gamma)	7.2068s/sat	Plumbogummite	-0.4362
Hausmannite	7.1747s/sat	Na2U2O7(am)	-0.6792
Goethite	6.8787s/sat	SrUO4(alpha)	-0.7462
Hydrocerussite	6.5707s/sat	Monohydrocalcite	-0.7891
Becquerelite	4.5613s/sat	Corundum	-0.8318
Manganite	4.2797s/sat	Pb4SO7	-0.8970
Magnetite	4.1856s/sat	Schoepite-dehy(.	-0.9995

PbHPO4	4.0048s/sat	MnHPO4	-1.0289
CaUO4	3.9853s/sat	Pb3SO6	-1.1173
Plattnerite	3.3272s/sat	Dolomite-dis	-1.1802
Ni3(PO4)2	3.0943s/sat	Litharge	-1.2812
Ca-Autunite	2.7356s/sat	Magnesite	-1.3092
Whitlockite	2.2259s/sat	Pb4Cl2(OH)6	-1.3543
Na2U2O7(c)	1.8291s/sat	Lanarkite	-1.4075
Minium	1.8177s/sat	Dawsonite	-1.4298
Fe(OH)3(ppd)	1.7576s/sat	Massicot	-1.4634
Cerussite	1.7395s/sat	Schoepite-dehy(.	-1.5175
Bunsenite	1.7326s/sat	NiCO3	-2.1345
Diaspore	1.5798s/sat	Mn(OH)3	-2.2261
Ni(OH)2	1.4560s/sat	Saleeite	-2.4778
Boehmite	1.1759s/sat	Brucite	-2.4865
Gibbsite	0.9841s/sat	UO3(gamma)	-2.5005

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1844	-0.734
H2O(g)	0.02598	-1.585
CO2(g)	9.693e-006	-5.014
HF(g)	1.366e-016	-15.865
HCl(g)	8.747e-022	-21.058
NO2(g)	4.287e-022	-21.368
N2(g)	5.144e-024	-23.289
NO(g)	6.692e-028	-27.174
Cl2(g)	4.765e-035	-34.322
H2(g)	6.527e-042	-41.185
CO(g)	1.976e-050	-49.704
UO2F2(g)	1.084e-059	-58.965
SO2(g)	3.131e-061	-60.504
Pb(g)	3.672e-063	-62.435
UO3(g)	1.815e-066	-65.741
NH3(g)	2.883e-071	-70.540
UO2Cl2(g)	5.477e-073	-72.261
Na(g)	1.116e-073	-72.952
UOF4(g)	8.199e-079	-78.086
F2(g)	9.118e-088	-87.040
UF5(g)	9.072e-095	-94.042
UF4(g)	2.936e-101	-100.532
UF6(g)	2.760e-102	-101.559
UO2(g)	2.633e-119	-118.580
Mg(g)	2.390e-127	-126.622
UCl4(g)	4.621e-133	-132.335
UCl5(g)	6.366e-143	-142.196
UCl6(g)	1.629e-147	-146.788
CH4(g)	1.403e-147	-146.853
H2S(g)	2.150e-148	-147.668
UF3(g)	4.354e-149	-148.361
Ca(g)	2.877e-149	-148.541
UCl3(g)	1.726e-160	-159.763
U2F10(g)	9.212e-164	-163.036
Al(g)	6.899e-190	-189.161
C(g)	1.079e-191	-190.967
UF2(g)	9.528e-194	-193.021
UO(g)	1.517e-203	-202.819

UCl2(g)	3.491e-205	-204.457
UF(g)	5.131e-232	-231.290
S2(g)	2.419e-239	-238.616
C2H4(g)	9.119e-242	-241.040
UCl(g)	1.546e-247	-246.811
U2Cl8(g)	5.262e-255	-254.279
U2Cl10(g)	8.087e-259	-258.092
U(g)	2.049e-288	-287.688

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	4.06e-005	4.06e-005	1.09			
Ca++	9.03e-005	9.03e-005	3.62			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	9.99e-005	9.99e-005	11.6			
F-	1.00e-005	1.00e-005	0.190			
Fe++	6.26e-005	6.26e-005	3.49			
H+	-0.00348	-0.00348	-3.51			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00323	0.00323	197.			
HPO4--	0.000370	0.000370	35.5			
Mg++	1.00e-005	1.00e-005	0.243			
Mn++	1.09e-006	1.09e-006	0.0598			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00217	0.00217	49.9			
Ni++	1.05e-005	1.05e-005	0.616			
O2(aq)	0.000390	0.000390	12.5			
Pb++	1.01e-005	1.01e-005	2.09			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	0.000997	0.000997	269.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	4.060e-005	4.060e-005	1.095		
Calcium	9.030e-005	9.030e-005	3.617		
Carbon	0.003235	0.003235	38.83		
Chlorine	1.000e-005	1.000e-005	0.3543		
Chromium	9.990e-005	9.990e-005	5.191		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.118e+005		
Iron	6.260e-005	6.260e-005	3.494		
Lead	1.010e-005	1.010e-005	2.091		
Magnesium	1.000e-005	1.000e-005	0.2429		
Manganese	1.090e-006	1.090e-006	0.05985		
Nickel	1.050e-005	1.050e-005	0.6159		
Nitrogen	6.980e-005	6.980e-005	0.9771		
Oxygen	55.52	55.52	8.878e+005		
Phosphorus	0.0003700	0.0003700	11.45		
Sodium	0.002170	0.002170	49.86		
Strontium	1.000e-006	1.000e-006	0.08757		
Sulfur	1.000e-005	1.000e-005	0.3205		
Uranium	0.0009970	0.0009970	237.2		

Sample 19961 water leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.880               log fO2 =   -1.087
Eh =   0.5694 volts       pe =   9.6247
Ionic strength       =    0.031579
Activity of water    =    0.999999
Solvent mass         =    0.999867 kg
Solution mass        =    1.002054 kg
Solution density     =    1.013    g/cm3
Chlorinity           =    0.000026 molal
Dissolved solids     =        2182 mg/kg sol'n
Rock mass            =    0.000000 kg
Carbonate alkalinity=       557.22 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01738	398.8	0.8465	-1.8322
HPO4--	0.002168	207.6	0.5089	-2.9574
F-	0.001688	32.00	0.8430	-2.8468
CO3--	0.001617	96.82	0.5170	-3.0778
UO2(CO3)3----	0.001312	589.3	0.0665	-4.0593
UO2(OH)3-	0.001284	411.3	0.8465	-2.9638
NO3-	0.001060	65.59	0.8394	-3.0507
OH-	0.0009100	15.44	0.8430	-3.1151
CrO4--	0.0003710	42.94	0.5089	-3.7239
Fe(OH)4-	0.0003352	41.43	0.8465	-3.5471
HCO3-	0.0002775	16.90	0.8465	-3.6290
PO4---	0.0001830	17.34	0.2179	-4.3992
NaHPO4-	0.0001595	18.94	0.8465	-3.8696
(UO2)3(OH)7-	0.0001085	100.6	0.8465	-4.0368
O2(aq)	0.0001035	3.305	1.0000	-3.9850
CaPO4-	9.792e-005	13.20	0.8465	-4.0815
(UO2)2CO3(OH)3-	9.471e-005	61.53	0.8465	-4.0960
NaCO3-	4.750e-005	3.934	0.8465	-4.3956
MgPO4-	4.053e-005	4.823	0.8465	-4.4646
AlO2-	3.113e-005	1.832	0.8465	-4.5791
SO4--	3.051e-005	2.925	0.5089	-4.8089
MnO4-	2.684e-005	3.185	0.8430	-4.6454
Cl-	2.565e-005	0.9074	0.8394	-4.6669
MnO4--	2.547e-005	3.022	0.5089	-4.8874
Ni(OH)2(aq)	2.095e-005	1.938	1.0000	-4.6789
Ni(OH)3-	1.899e-005	2.079	0.8465	-4.7939
Pb(OH)2(aq)	1.805e-005	4.344	1.0000	-4.7436
Pb(OH)3-	1.636e-005	4.215	0.8465	-4.8586
Fe(OH)3(aq)	1.489e-005	1.588	1.0000	-4.8271
UO2(OH)2(aq)	1.157e-005	3.511	1.0000	-4.9366
NaHCO3(aq)	4.930e-006	0.4133	1.0000	-5.3071

UO2(CO3)2--	4.641e-006	1.806	0.5089	-5.6268
Sr++	3.744e-006	0.3274	0.5248	-5.7067
UO2(OH)4--	2.525e-006	0.8517	0.5089	-5.8911
NaF(aq)	2.106e-006	0.08823	1.0000	-5.6766
NaOH(aq)	1.791e-006	0.07146	1.0000	-5.7470
NaSO4-	1.784e-006	0.2119	0.8465	-5.8211
Ca++	1.335e-006	0.05340	0.5397	-6.1423
Pb(CO3)2--	1.331e-006	0.4347	0.5089	-6.1690
CaCO3(aq)	1.279e-006	0.1278	1.0000	-5.8930
PbCO3(aq)	1.227e-006	0.3271	1.0000	-5.9112
SrCO3(aq)	1.205e-006	0.1774	1.0000	-5.9192
PbOH+	6.981e-007	0.1562	0.8465	-6.2285
Ni++	6.595e-007	0.03862	0.5397	-6.4487
UO2PO4-	4.929e-007	0.1795	0.8465	-6.3796
CaHPO4(aq)	4.368e-007	0.05931	1.0000	-6.3597
Mg++	3.908e-007	0.009478	0.5670	-6.6544
H2PO4-	2.757e-007	0.02668	0.8465	-6.6320
SrHPO4(aq)	2.489e-007	0.04559	1.0000	-6.6040
MgHPO4(aq)	1.987e-007	0.02385	1.0000	-6.7018
MgCO3(aq)	1.765e-007	0.01484	1.0000	-6.7534
NaAlO2(aq)	7.004e-008	0.005729	1.0000	-7.1546
NaCl(aq)	5.295e-008	0.003088	1.0000	-7.2761
PbP2O7--	2.393e-008	0.009099	0.5089	-7.9145
SrNO3+	1.303e-008	0.001946	0.8465	-7.9573

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	54.3650s/sat	Schoepite	0.5447s/sat
Todorokite	47.2258s/sat	UO3:2H2O	0.5447s/sat
Pyromorphite	19.9295s/sat	PbCO3.PbO	0.5131s/sat
Trevorite	19.8695s/sat	UO2(OH)2(beta)	0.4323s/sat
Fluorapatite	15.2036s/sat	Schoepite-dehy(.	0.3613s/sat
Hematite	14.2372s/sat	UO3:.9H2O(alpha)	0.3613s/sat
Pyromorphite-OH	13.8464s/sat	Schoepite-dehy(.	0.2810s/sat
Pb4O(PO4)2	12.5245s/sat	Schoepite-dehy(1	0.2749s/sat
Bixbyite	10.3152s/sat	Diaspore	0.2639s/sat
Pyrolusite	9.1963s/sat	Pb3SO6	-0.1271
Hausmannite	8.9421s/sat	Ice	-0.1387
Ferrite-Ca	8.4417s/sat	Boehmite	-0.1400
Parsonsite	8.4276s/sat	Litharge	-0.2922
Ferrite-Mg	8.3962s/sat	Gibbsite	-0.3318
MnO2(gamma)	7.6785s/sat	Crocoite	-0.4196
Pb3(PO4)2	7.5796s/sat	Massicot	-0.4744
Hydroxylapatite	7.0109s/sat	Calcite	-0.7400
Goethite	6.6384s/sat	Dolomite	-0.8083
Becquerelite	6.4856s/sat	Dolomite-ord	-0.8083
Na2U2O7(c)	6.2599s/sat	Schoepite-dehy(.	-0.8283
Hydrocerussite	6.1741s/sat	Aragonite	-0.8844
CaUO4	5.0537s/sat	Brucite	-1.1924
Manganite	4.8394s/sat	Schoepite-dehy(.	-1.3463
Minium	4.6087s/sat	Lanarkite	-1.4064
Plattnerite	4.1400s/sat	Monohydrocalcite	-1.5737
Na2U2O7(am)	3.7516s/sat	Mn(OH)3	-1.6664
Magnetite	3.5526s/sat	Magnesite	-1.6971
PbHPO4	3.3568s/sat	Fluorite	-1.7988

Ni3(PO4)2	3.1407s/sat	MnHPO4	-2.0182
Bunsenite	2.8394s/sat	UO3(gamma)	-2.3293
Ni(OH)2	2.5628s/sat	Dolomite-dis	-2.3527
SrUO4(alpha)	2.2663s/sat	Dawsonite	-2.3835
Strontianite	1.8580s/sat	SrHPO4	-2.4224
Whitlockite	1.6432s/sat	MgUO4	-2.5188
Fe(OH)3(ppd)	1.5173s/sat	NiCO3	-2.7095
Pb4SO7	1.0822s/sat	SrF2	-2.8602
Cerussite	1.0467s/sat	UO3(beta)	-2.9315
Pb4Cl2(OH)6	1.0134s/sat	Sellaite	-2.9637
Ca-Autunite	0.7009s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.08190	-1.087
H2O(g)	0.02598	-1.585
CO2(g)	2.016e-007	-6.695
HF(g)	1.448e-015	-14.839
NO2(g)	4.992e-022	-21.302
HCl(g)	1.405e-022	-21.852
N2(g)	3.534e-023	-22.452
NO(g)	1.169e-027	-26.932
Cl2(g)	8.189e-037	-36.087
H2(g)	9.793e-042	-41.009
CO(g)	6.167e-052	-51.210
UO2F2(g)	1.807e-057	-56.743
Pb(g)	5.372e-062	-61.270
SO2(g)	4.952e-063	-62.305
UO3(g)	2.691e-066	-65.570
NH3(g)	1.389e-070	-69.857
Na(g)	1.514e-071	-70.820
UO2Cl2(g)	2.095e-074	-73.679
UOF4(g)	1.535e-074	-73.814
F2(g)	6.828e-086	-85.166
UF5(g)	2.205e-089	-88.657
UF6(g)	5.806e-096	-95.236
UF4(g)	8.248e-097	-96.084
UO2(g)	5.859e-119	-118.232
Mg(g)	7.058e-126	-125.151
UCl4(g)	6.837e-136	-135.165
UF3(g)	1.413e-145	-144.850
UCl5(g)	1.235e-146	-145.908
Ca(g)	3.407e-148	-147.468
CH4(g)	1.479e-148	-147.830
H2S(g)	1.148e-149	-148.940
UCl6(g)	4.143e-152	-151.383
U2F10(g)	5.444e-153	-152.264
UCl3(g)	1.948e-162	-161.710
Al(g)	6.125e-191	-190.213
UF2(g)	3.574e-191	-190.447
C(g)	5.054e-193	-192.296
UO(g)	5.064e-203	-202.296
UCl2(g)	3.006e-206	-205.522
UF(g)	2.224e-230	-229.653
S2(g)	3.067e-242	-241.513
C2H4(g)	4.501e-244	-243.347

UCl(g)	1.016e-247	-246.993
U2Cl8(g)	1.152e-260	-259.939
U2Cl10(g)	3.043e-266	-265.517
U(g)	1.027e-287	-286.989

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	3.12e-005	3.12e-005	0.840			
Ca++	0.000101	0.000101	4.04			
Cl-	2.57e-005	2.57e-005	0.909			
CrO4--	0.000371	0.000371	42.9			
F-	0.00169	0.00169	32.0			
Fe++	0.000350	0.000350	19.5			
H+	-0.0145	-0.0145	-14.5			
H2O	55.5	55.5	9.98e+005			
HCO3-	0.00599	0.00599	365.			
HPO4--	0.00265	0.00265	254.			
Mg++	4.13e-005	4.13e-005	1.00			
Mn++	5.23e-005	5.23e-005	2.87			
NH3(aq)	0.00106	0.00106	18.0			
Na+	0.0176	0.0176	404.			
Ni++	4.06e-005	4.06e-005	2.38			
O2(aq)	0.00237	0.00237	75.7			
Pb++	3.77e-005	3.77e-005	7.80			
SO4--	3.23e-005	3.23e-005	3.10			
Sr++	5.23e-006	5.23e-006	0.457			
UO2++	0.00313	0.00313	843.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	3.120e-005	3.120e-005	0.8401		
Calcium	0.0001010	0.0001010	4.040		
Carbon	0.005993	0.005993	71.84		
Chlorine	2.570e-005	2.570e-005	0.9093		
Chromium	0.0003710	0.0003710	19.25		
Fluorine	0.001690	0.001690	32.04		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0003500	0.0003500	19.51		
Lead	3.770e-005	3.770e-005	7.795		
Magnesium	4.130e-005	4.130e-005	1.002		
Manganese	5.230e-005	5.230e-005	2.867		
Nickel	4.060e-005	4.060e-005	2.378		
Nitrogen	0.001060	0.001060	14.82		
Oxygen	55.55	55.55	8.869e+005		
Phosphorus	0.002650	0.002650	81.91		
Sodium	0.01760	0.01760	403.8		
Strontium	5.230e-006	5.230e-006	0.4573		
Sulfur	3.230e-005	3.230e-005	1.034		
Uranium	0.003130	0.003130	743.5		

Sample 19961 water leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.750               log fO2 =   -0.901
Eh =   0.5798 volts       pe =   9.8012
Ionic strength      =     0.029826
Activity of water   =     0.999999
Solvent mass        =     0.999966 kg
Solution mass       =     1.001482 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000029 molal
Dissolved solids    =         1514 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       579.88 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01674	384.2	0.8497	-1.8470
CO3--	0.002862	171.5	0.5246	-2.8235
HPO4--	0.002254	216.0	0.5168	-2.9337
F-	0.001898	36.00	0.8463	-2.7942
NO3-	0.001250	77.39	0.8429	-2.9773
UO2(CO3)3----	0.0009160	411.6	0.0707	-4.1884
OH-	0.0006720	11.41	0.8463	-3.2451
HCO3-	0.0006700	40.82	0.8497	-3.2447
CrO4--	0.0002720	31.50	0.5168	-3.8521
Fe(OH)4-	0.0001990	24.62	0.8497	-3.7718
NaHPO4-	0.0001622	19.26	0.8497	-3.8608
O2(aq)	0.0001588	5.075	1.0000	-3.7990
PO4---	0.0001384	13.12	0.2257	-4.5055
NaCO3-	8.215e-005	6.808	0.8497	-4.1561
CaPO4-	6.709e-005	9.047	0.8497	-4.2441
UO2(OH)3-	6.681e-005	21.42	0.8497	-4.2459
AlO2-	5.917e-005	3.485	0.8497	-4.2986
SO4--	3.689e-005	3.538	0.5168	-4.7198
Cl-	2.864e-005	1.014	0.8429	-4.6172
MgPO4-	2.740e-005	3.263	0.8497	-4.6330
MnO4-	2.050e-005	2.434	0.8463	-4.7608
Ni(OH)2(aq)	1.494e-005	1.383	1.0000	-4.8256
MnO4--	1.280e-005	1.521	0.5168	-5.1793
Fe(OH)3(aq)	1.197e-005	1.278	1.0000	-4.9218
NaHCO3(aq)	1.154e-005	0.9684	1.0000	-4.9376
Ni(OH)3-	1.000e-005	1.096	0.8497	-5.0706
Pb(OH)2(aq)	8.554e-006	2.060	1.0000	-5.0678
Pb(OH)3-	5.727e-006	1.477	0.8497	-5.3128
Pb(CO3)2--	3.648e-006	1.192	0.5168	-5.7246
NaF(aq)	2.297e-006	0.09630	1.0000	-5.6388
NaSO4-	2.108e-006	0.2506	0.8497	-5.7468
CaCO3(aq)	2.019e-006	0.2017	1.0000	-5.6950

PbCO3(aq)	1.901e-006	0.5071	1.0000	-5.7211
UO2(CO3)2--	1.890e-006	0.7360	0.5168	-6.0102
Sr++	1.692e-006	0.1480	0.5322	-6.0455
NaOH(aq)	1.283e-006	0.05123	1.0000	-5.8918
Ca++	1.158e-006	0.04634	0.5467	-6.1986
(UO2)2CO3(OH)3-	1.135e-006	0.7377	0.8497	-6.0159
SrCO3(aq)	9.915e-007	0.1462	1.0000	-6.0037
Ni++	8.451e-007	0.04952	0.5467	-6.3354
UO2(OH)2(aq)	8.152e-007	0.2475	1.0000	-6.0887
PbOH+	4.447e-007	0.09954	0.8497	-6.4227
CaHPO4(aq)	4.052e-007	0.05505	1.0000	-6.3923
H2PO4-	3.912e-007	0.03788	0.8497	-6.4783
Mg++	3.351e-007	0.008133	0.5732	-6.7165
MgCO3(aq)	2.747e-007	0.02313	1.0000	-6.5611
MgHPO4(aq)	1.819e-007	0.02184	1.0000	-6.7402
NaAlO2(aq)	1.291e-007	0.01057	1.0000	-6.8890
SrHPO4(aq)	1.204e-007	0.02208	1.0000	-6.9192
UO2(OH)4--	9.626e-008	0.03249	0.5168	-7.3032
NaCl(aq)	5.738e-008	0.003348	1.0000	-7.2412
UO2PO4-	4.928e-008	0.01796	0.8497	-7.3781
(UO2)3(OH)7-	2.803e-008	0.02600	0.8497	-7.6232
PbP2O7--	2.265e-008	0.008622	0.5168	-7.9315
CO2(aq)	2.239e-008	0.0009838	1.0000	-7.6500

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	53.1799s/sat	Boehmite	0.2705s/sat
Todorokite	46.1655s/sat	Pb4SO7	0.1343s/sat
Trevorite	19.5334s/sat	Gibbsite	0.0787s/sat
Pyromorphite	19.3388s/sat	Pb4Cl2(OH)6	0.0758s/sat
Fluorapatite	14.6558s/sat	Ice	-0.1387
Hematite	14.0478s/sat	Dolomite-ord	-0.4180
Pyromorphite-OH	13.0760s/sat	Dolomite	-0.4180
Pb4O(PO4)2	11.7947s/sat	Calcite	-0.5420
Bixbyite	9.9724s/sat	Schoepite	-0.6074
Pyrolusite	9.0714s/sat	UO3:2H2O	-0.6074
Hausmannite	8.3814s/sat	Crocoite	-0.6120
Ferrite-Ca	7.9361s/sat	Litharge	-0.6164
Ferrite-Mg	7.8848s/sat	Aragonite	-0.6864
MnO2(gamma)	7.5536s/sat	UO2(OH)2(beta)	-0.7198
Parsonsite	7.1942s/sat	Becquerelite	-0.7433
Pb3(PO4)2	7.1740s/sat	Pb3SO6	-0.7508
Goethite	6.5437s/sat	Schoepite-dehy(.	-0.7908
Hydroxylapatite	6.2806s/sat	UO3:.9H2O(alpha)	-0.7908
Hydrocerussite	6.2300s/sat	Massicot	-0.7986
Manganite	4.6681s/sat	Schoepite-dehy(.	-0.8711
Plattnerite	3.9088s/sat	Schoepite-dehy(1	-0.8772
Minium	3.7289s/sat	Ca-Autunite	-1.3523
Na2U2O7(c)	3.6660s/sat	Monohydrocalcite	-1.3757
CaUO4	3.5853s/sat	Magnesite	-1.5048
PbHPO4	3.3161s/sat	Brucite	-1.5145
Ni3(PO4)2	3.2678s/sat	Dawsonite	-1.6035
Magnetite	3.2220s/sat	Lanarkite	-1.7059
Bunsenite	2.6927s/sat	Fluorite	-1.7500
Ni(OH)2	2.4161s/sat	Mn(OH)3	-1.8377

Strontianite	1.7735s/sat	MnHPO4	-1.9524
Fe(OH)3(ppd)	1.4226s/sat	Dolomite-dis	-1.9624
Whitlockite	1.2617s/sat	Schoepite-dehy(.	-1.9804
Cerussite	1.2368s/sat	NiCO3	-2.3419
Na2U2O7(am)	1.1577s/sat	Schoepite-dehy(.	-2.4984
Diaspore	0.6744s/sat	Corundum	-2.6428
SrUO4(alpha)	0.5154s/sat	SrHPO4	-2.7376
PbCO3.PbO	0.3790s/sat	Sellaite	-2.9206

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1257	-0.901
H2O(g)	0.02598	-1.585
CO2(g)	6.590e-007	-6.181
HF(g)	2.204e-015	-14.657
NO2(g)	7.164e-022	-21.145
HCl(g)	2.125e-022	-21.673
N2(g)	3.091e-023	-22.510
NO(g)	1.354e-027	-26.868
Cl2(g)	2.321e-036	-35.634
H2(g)	7.905e-042	-41.102
CO(g)	1.627e-051	-50.789
UO2F2(g)	2.951e-058	-57.530
Pb(g)	2.055e-062	-61.687
SO2(g)	8.931e-063	-62.049
UO3(g)	1.896e-067	-66.722
NH3(g)	9.420e-071	-70.026
Na(g)	9.744e-072	-71.011
UOF4(g)	5.811e-075	-74.236
UO2Cl2(g)	3.376e-075	-74.472
F2(g)	1.960e-085	-84.708
UF5(g)	1.142e-089	-88.942
UF6(g)	5.093e-096	-95.293
UF4(g)	2.520e-097	-96.599
UO2(g)	3.332e-120	-119.477
Mg(g)	2.714e-126	-125.566
UCl4(g)	2.035e-136	-135.691
UF3(g)	2.549e-146	-145.594
UCl5(g)	6.188e-147	-146.208
CH4(g)	2.053e-148	-147.688
Ca(g)	1.328e-148	-147.877
H2S(g)	1.090e-149	-148.963
UCl6(g)	3.495e-152	-151.457
U2F10(g)	1.459e-153	-152.836
UCl3(g)	3.445e-163	-162.463
Al(g)	1.143e-190	-189.942
UF2(g)	3.803e-192	-191.420
C(g)	1.077e-192	-191.968
UO(g)	2.325e-204	-203.634
UCl2(g)	3.157e-207	-206.501
UF(g)	1.397e-231	-230.855
S2(g)	4.237e-242	-241.373
C2H4(g)	1.331e-243	-242.876
UCl(g)	6.337e-249	-248.198
U2Cl8(g)	1.021e-261	-260.991
U2Cl10(g)	7.642e-267	-266.117

U(g)	3.805e-289	-288.420

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	5.93e-005	5.93e-005	1.60			
Ca++	7.07e-005	7.07e-005	2.83			
Cl-	2.87e-005	2.87e-005	1.02			
CrO4--	0.000272	0.000272	31.5			
F-	0.00190	0.00190	36.0			
Fe++	0.000211	0.000211	11.8			
H+	-0.00914	-0.00914	-9.20			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00639	0.00639	389.			
HPO4--	0.00265	0.00265	254.			
Mg++	2.82e-005	2.82e-005	0.684			
Mn++	3.33e-005	3.33e-005	1.83			
NH3(aq)	0.00125	0.00125	21.3			
Na+	0.0170	0.0170	390.			
Ni++	2.58e-005	2.58e-005	1.51			
O2(aq)	0.00275	0.00275	87.9			
Pb++	2.03e-005	2.03e-005	4.20			
SO4--	3.90e-005	3.90e-005	3.74			
Sr++	2.82e-006	2.82e-006	0.247			
UO2++	0.000988	0.000988	266.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	5.930e-005	5.930e-005	1.598		
Calcium	7.070e-005	7.070e-005	2.829		
Carbon	0.006391	0.006391	76.65		
Chlorine	2.870e-005	2.870e-005	1.016		
Chromium	0.0002720	0.0002720	14.12		
Fluorine	0.001900	0.001900	36.04		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0002110	0.0002110	11.77		
Lead	2.030e-005	2.030e-005	4.200		
Magnesium	2.820e-005	2.820e-005	0.6844		
Manganese	3.330e-005	3.330e-005	1.827		
Nickel	2.580e-005	2.580e-005	1.512		
Nitrogen	0.001250	0.001250	17.48		
Oxygen	55.55	55.55	8.874e+005		
Phosphorus	0.002650	0.002650	81.96		
Sodium	0.01700	0.01700	390.2		
Strontium	2.820e-006	2.820e-006	0.2467		
Sulfur	3.900e-005	3.900e-005	1.249		
Uranium	0.0009880	0.0009880	234.8		

Sample 19961 water leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.850               log fO2 =   -0.749
Eh =   0.5761 volts       pe =   9.7392
Ionic strength      =     0.008991
Activity of water   =     0.999996
Solvent mass        =     0.999968 kg
Solution mass       =     1.000460 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000111 molal
Dissolved solids    =          493 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       162.08 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.004049	93.04	0.9063	-2.4354
HPO4--	0.001260	120.9	0.6728	-3.0718
CO3--	0.001206	72.35	0.6765	-3.0883
OH-	0.0007911	13.45	0.9050	-3.1451
HCO3-	0.0002712	16.54	0.9063	-3.6095
UO2(OH)3-	0.0002336	74.96	0.9063	-3.6743
O2(aq)	0.0002253	7.205	1.0000	-3.6473
Cl-	0.0001109	3.931	0.9037	-3.9989
UO2(CO3)3----	9.512e-005	42.79	0.2044	-4.7112
PO4---	6.984e-005	6.630	0.4096	-4.5436
F-	6.888e-005	1.308	0.9050	-4.2053
Fe(OH)4-	5.643e-005	6.986	0.9063	-4.2913
CrO4--	5.330e-005	6.179	0.6728	-4.4454
CaPO4-	3.220e-005	4.347	0.9063	-4.5349
NaHPO4-	2.855e-005	3.395	0.9063	-4.5872
NO3-	1.720e-005	1.066	0.9037	-4.8084
AlO2-	1.329e-005	0.7836	0.9063	-4.9192
NaCO3-	1.080e-005	0.8960	0.9063	-5.0093
MgPO4-	8.997e-006	1.073	0.9063	-5.0886
MnO4-	5.377e-006	0.6392	0.9050	-5.3128
SO4--	5.284e-006	0.5074	0.6728	-5.4491
(UO2)2CO3(OH)3-	4.031e-006	2.623	0.9063	-5.4373
Ni(OH)2(aq)	3.849e-006	0.3567	1.0000	-5.4146
Pb(OH)2(aq)	3.366e-006	0.8115	1.0000	-5.4729
MnO4--	3.183e-006	0.3784	0.6728	-5.6693
Ni(OH)3-	3.042e-006	0.3335	0.9063	-5.5596
Fe(OH)3(aq)	2.876e-006	0.3072	1.0000	-5.5413
Pb(OH)3-	2.660e-006	0.6864	0.9063	-5.6179
UO2(OH)2(aq)	2.415e-006	0.7339	1.0000	-5.6171
NaHCO3(aq)	1.286e-006	0.1080	1.0000	-5.8908
(UO2)3(OH)7-	8.601e-007	0.7987	0.9063	-6.1082

UO2(CO3)2--	8.015e-007	0.3125	0.6728	-6.2682
Sr++	6.664e-007	0.05836	0.6801	-6.3437
CaCO3(aq)	6.130e-007	0.06133	1.0000	-6.2125
Ca++	5.149e-007	0.02063	0.6870	-6.4513
NaOH(aq)	4.167e-007	0.01666	1.0000	-6.3802
UO2(OH)4--	3.471e-007	0.1173	0.6728	-6.6316
SrCO3(aq)	2.712e-007	0.04002	1.0000	-6.5667
PbCO3(aq)	2.564e-007	0.06849	1.0000	-6.5910
H2PO4-	2.120e-007	0.02055	0.9063	-6.7164
Pb(CO3)2--	2.055e-007	0.06720	0.6728	-6.8593
CaHPO4(aq)	1.648e-007	0.02241	1.0000	-6.7831
PbOH+	1.303e-007	0.02920	0.9063	-6.9278
Ni++	1.093e-007	0.006411	0.6870	-7.1244
Mg++	1.049e-007	0.002548	0.7000	-7.1341
NaSO4-	9.511e-008	0.01132	0.9063	-7.0645
UO2PO4-	7.913e-008	0.02887	0.9063	-7.1444
NaCl(aq)	6.148e-008	0.003591	1.0000	-7.2113
MgCO3(aq)	5.708e-008	0.004811	1.0000	-7.2435
MgHPO4(aq)	5.060e-008	0.006083	1.0000	-7.2958
SrHPO4(aq)	4.411e-008	0.008095	1.0000	-7.3554
NaF(aq)	2.300e-008	0.0009652	1.0000	-7.6383

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	46.9015s/sat	Fe(OH)3(ppd)	0.8031s/sat
Todorokite	40.6529s/sat	Whitlockite	0.4275s/sat
Trevorite	17.7054s/sat	Cerussite	0.3669s/sat
Pyromorphite	16.8177s/sat	Diaspore	-0.0462
Hematite	12.8089s/sat	UO3:2H2O	-0.1358
Fluorapatite	11.8669s/sat	Schoepite	-0.1358
Pyromorphite-OH	10.0365s/sat	Ice	-0.1387
Pb4O(PO4)2	9.4983s/sat	UO2(OH)2(beta)	-0.2482
Bixbyite	8.3649s/sat	UO3:.9H2O(alpha)	-0.3192
Pyrolusite	8.3056s/sat	Schoepite-dehy(.	-0.3192
MnO2(gamma)	6.7878s/sat	Schoepite-dehy(.	-0.3995
Ferrite-Ca	6.6445s/sat	Schoepite-dehy(1	-0.4056
Ferrite-Mg	6.4283s/sat	Boehmite	-0.4501
Parsonsite	6.1797s/sat	Pb4Cl2(OH)6	-0.5079
Hausmannite	5.9322s/sat	Gibbsite	-0.6419
Goethite	5.9242s/sat	PbCO3.PbO	-0.8960
Pb3(PO4)2	5.2828s/sat	Litharge	-1.0215
Hydroxylapatite	5.0028s/sat	Calcite	-1.0595
Hydrocerussite	4.0852s/sat	Ca-Autunite	-1.1378
CaUO4	4.0042s/sat	Massicot	-1.2037
Manganite	3.8643s/sat	Aragonite	-1.2039
Na2U2O7(c)	3.6325s/sat	Schoepite-dehy(.	-1.5088
Plattnerite	3.5796s/sat	Dolomite-ord	-1.6179
Minium	2.5895s/sat	Dolomite	-1.6179
PbHPO4	2.5730s/sat	Brucite	-1.7321
Bunsenite	2.1037s/sat	Crocoite	-1.8104
Becquerelite	2.0339s/sat	Monohydrocalcite	-1.8932
Ni(OH)2	1.8271s/sat	Schoepite-dehy(.	-2.0268
Magnetite	1.3257s/sat	Magnesite	-2.1872
Strontianite	1.2105s/sat	Pb4SO7	-2.4153
Na2U2O7(am)	1.1242s/sat	Mn(OH)3	-2.6415

SrUO4(alpha)	0.8888s/sat	Pb3SO6	-2.8953
Ni3(PO4)2	0.8246s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1783	-0.749
H2O(g)	0.02598	-1.585
CO2(g)	2.260e-007	-6.646
HF(g)	6.794e-017	-16.168
HCl(g)	7.008e-022	-21.154
NO2(g)	7.693e-024	-23.114
N2(g)	1.772e-027	-26.752
NO(g)	1.221e-029	-28.913
Cl2(g)	3.008e-035	-34.522
H2(g)	6.638e-042	-41.178
CO(g)	4.685e-052	-51.329
UO2F2(g)	8.308e-061	-60.080
Pb(g)	6.791e-063	-62.168
SO2(g)	8.826e-064	-63.054
UO3(g)	5.617e-067	-66.250
Na(g)	2.900e-072	-71.538
NH3(g)	5.488e-073	-72.261
UO2Cl2(g)	1.088e-073	-72.963
UOF4(g)	1.555e-080	-79.808
F2(g)	2.219e-088	-87.654
UF5(g)	8.630e-097	-96.064
UF4(g)	5.662e-103	-102.247
UF6(g)	1.295e-104	-103.888
UO2(g)	8.288e-120	-119.082
Mg(g)	1.381e-126	-125.860
UCl4(g)	5.994e-134	-133.222
UCl5(g)	6.561e-144	-143.183
UCl6(g)	1.334e-148	-147.875
Ca(g)	9.875e-149	-148.005
CH4(g)	3.500e-149	-148.456
UF3(g)	1.702e-150	-149.769
H2S(g)	6.374e-151	-150.196
UCl3(g)	2.819e-161	-160.550
U2F10(g)	8.338e-168	-167.079
Al(g)	1.674e-191	-190.776
C(g)	2.603e-193	-192.585
UF2(g)	7.550e-195	-194.122
UO(g)	4.856e-204	-203.314
UCl2(g)	7.175e-206	-205.144
UF(g)	8.242e-233	-232.084
S2(g)	2.057e-244	-243.687
C2H4(g)	5.485e-245	-244.261
UCl(g)	4.001e-248	-247.398
U2Cl8(g)	8.855e-257	-256.053
U2Cl10(g)	8.590e-261	-260.066
U(g)	6.673e-289	-288.176

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.33e-005	1.33e-005	0.359			

Ca++	3.35e-005	3.35e-005	1.34
Cl-	0.000111	0.000111	3.93
CrO4--	5.33e-005	5.33e-005	6.18
F-	6.89e-005	6.89e-005	1.31
Fe++	5.93e-005	5.93e-005	3.31
H+	-0.00344	-0.00344	-3.47
H2O	55.5	55.5	1.00e+006
HCO3-	0.00178	0.00178	109.
HPO4--	0.00140	0.00140	134.
Mg++	9.21e-006	9.21e-006	0.224
Mn++	8.56e-006	8.56e-006	0.470
NH3(aq)	1.72e-005	1.72e-005	0.293
Na+	0.00409	0.00409	94.0
Ni++	7.00e-006	7.00e-006	0.411
O2(aq)	0.000284	0.000284	9.10
Pb++	6.62e-006	6.62e-006	1.37
SO4--	5.38e-006	5.38e-006	0.517
Sr++	9.84e-007	9.84e-007	0.0862
UO2++	0.000343	0.000343	92.6

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.330e-005	1.330e-005	0.3587		
Calcium	3.350e-005	3.350e-005	1.342		
Carbon	0.001782	0.001782	21.39		
Chlorine	0.0001110	0.0001110	3.933		
Chromium	5.330e-005	5.330e-005	2.770		
Fluorine	6.890e-005	6.890e-005	1.308		
Hydrogen	111.0	111.0	1.118e+005		
Iron	5.930e-005	5.930e-005	3.310		
Lead	6.620e-006	6.620e-006	1.371		
Magnesium	9.210e-006	9.210e-006	0.2237		
Manganese	8.560e-006	8.560e-006	0.4701		
Nickel	7.000e-006	7.000e-006	0.4106		
Nitrogen	1.720e-005	1.720e-005	0.2408		
Oxygen	55.52	55.52	8.879e+005		
Phosphorus	0.001400	0.001400	43.34		
Sodium	0.004090	0.004090	93.99		
Strontium	9.840e-007	9.840e-007	0.08618		
Sulfur	5.380e-006	5.380e-006	0.1724		
Uranium	0.0003430	0.0003430	81.61		

Sample 19961 water leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.520               log fO2 =   -0.750
Eh =   0.5956 volts       pe =  10.0690
Ionic strength      =     0.005772
Activity of water   =     1.000000
Solvent mass        =     0.999976 kg
Solution mass       =     1.000351 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =          375 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       124.05 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.002655	61.01	0.9224	-2.6110
CO3--	0.0006844	41.06	0.7253	-3.3042
HPO4--	0.0006000	57.56	0.7227	-3.3629
OH-	0.0003634	6.178	0.9215	-3.4751
HCO3-	0.0003465	21.14	0.9224	-3.4954
O2(aq)	0.0002250	7.197	1.0000	-3.6478
UO2(OH)3-	0.0002070	66.45	0.9224	-3.7190
UO2(CO3)3----	0.0001417	63.76	0.2723	-4.4135
Fe(OH)4-	5.338e-005	6.610	0.9224	-4.3077
CrO4--	5.130e-005	5.948	0.7227	-4.4310
CaPO4-	3.261e-005	4.402	0.9224	-4.5217
F-	2.479e-005	0.4709	0.9215	-4.6411
(UO2)2CO3(OH)3-	1.916e-005	12.47	0.9224	-4.7527
PO4---	1.422e-005	1.350	0.4812	-5.1647
AlO2-	1.239e-005	0.7307	0.9224	-4.9419
Cl-	9.996e-006	0.3543	0.9206	-5.0361
NaHPO4-	9.575e-006	1.139	0.9224	-5.0540
MgPO4-	8.739e-006	1.042	0.9224	-5.0936
NO3-	7.000e-006	0.4339	0.9206	-5.1908
MnO4-	6.740e-006	0.8014	0.9215	-5.2068
Fe(OH)3(aq)	5.920e-006	0.6324	1.0000	-5.2277
UO2(OH)2(aq)	4.658e-006	1.416	1.0000	-5.3318
NaCO3-	4.308e-006	0.3574	0.9224	-5.4008
Ni(OH)2(aq)	4.102e-006	0.3801	1.0000	-5.3871
Pb(OH)2(aq)	3.798e-006	0.9158	1.0000	-5.4204
(UO2)3(OH)7-	2.835e-006	2.634	0.9224	-5.5825
UO2(CO3)2--	2.435e-006	0.9493	0.7227	-5.7546
Ca++	2.079e-006	0.08330	0.7330	-5.8170
MnO4--	1.770e-006	0.2104	0.7227	-5.8932
CaCO3(aq)	1.607e-006	0.1607	1.0000	-5.7941
Ni(OH)3-	1.489e-006	0.1634	0.9224	-5.8621

Pb(OH)3-	1.379e-006	0.3560	0.9224	-5.8954
NaHCO3(aq)	1.116e-006	0.09373	1.0000	-5.9523
SO4--	9.872e-007	0.09480	0.7227	-6.1467
Sr++	9.672e-007	0.08472	0.7279	-6.1524
PbCO3(aq)	8.047e-007	0.2149	1.0000	-6.0944
Ni++	4.990e-007	0.02927	0.7330	-6.4369
Mg++	4.087e-007	0.009930	0.7425	-6.5179
Pb(CO3)2--	3.652e-007	0.1195	0.7227	-6.5785
CaHPO4(aq)	3.631e-007	0.04939	1.0000	-6.4399
PbOH+	3.088e-007	0.06922	0.9224	-6.5453
SrCO3(aq)	2.563e-007	0.03782	1.0000	-6.5912
H2PO4-	2.278e-007	0.02209	0.9224	-6.6775
UO2PO4-	1.640e-007	0.05982	0.9224	-6.8204
MgCO3(aq)	1.435e-007	0.01210	1.0000	-6.8431
UO2(OH)4--	1.364e-007	0.04609	0.7227	-7.0063
NaOH(aq)	1.301e-007	0.005200	1.0000	-6.8858
MgHPO4(aq)	1.070e-007	0.01286	1.0000	-6.9708
SrHPO4(aq)	3.505e-008	0.006433	1.0000	-7.4553
CO2(aq)	2.135e-008	0.0009392	1.0000	-7.6707
Ca2UO2(CO3)3	1.421e-008	0.007533	1.0000	-7.8473
NaSO4-	1.251e-008	0.001489	0.9224	-7.9377

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	50.3932s/sat	Na2U2O7(am)	0.6835s/sat
Todorokite	43.7082s/sat	Diaspore	0.2611s/sat
Trevorite	18.3601s/sat	UO3:2H2O	0.1495s/sat
Pyromorphite	17.4793s/sat	Schoepite	0.1495s/sat
Hematite	13.4360s/sat	Ca-Autunite	0.1447s/sat
Fluorapatite	12.7390s/sat	UO2(OH)2(beta)	0.0371s/sat
Pyromorphite-OH	11.4053s/sat	Schoepite-dehy(.	-0.0339
Pb4O(PO4)2	10.4459s/sat	UO3:.9H2O(alpha)	-0.0339
Bixbyite	9.2379s/sat	Schoepite-dehy(.	-0.1142
Pyrolusite	8.7420s/sat	Schoepite-dehy(1	-0.1203
Parsonsite	7.3075s/sat	Ice	-0.1387
Ferrite-Ca	7.2459s/sat	Boehmite	-0.1428
Hausmannite	7.2419s/sat	Gibbsite	-0.3346
MnO2(gamma)	7.2242s/sat	PbCO3.PbO	-0.3469
Ferrite-Mg	7.0116s/sat	Calcite	-0.6411
Goethite	6.2378s/sat	Aragonite	-0.7855
Pb3(PO4)2	6.1778s/sat	Dolomite-ord	-0.7991
Hydroxylapatite	5.9807s/sat	Dolomite	-0.7991
Hydrocerussite	5.1309s/sat	Litharge	-0.9690
Manganite	4.3008s/sat	Crocoite	-1.0835
CaUO4	4.2638s/sat	Massicot	-1.1512
Becquerelite	3.7196s/sat	Schoepite-dehy(.	-1.2235
Plattnerite	3.6317s/sat	Monohydrocalcite	-1.4748
Na2U2O7(c)	3.1918s/sat	Pb4Cl2(OH)6	-1.7124
PbHPO4	2.9943s/sat	Schoepite-dehy(.	-1.7415
Minium	2.7467s/sat	Brucite	-1.7759
Magnetite	2.2666s/sat	Magnesite	-1.7868
Bunsenite	2.1312s/sat	Mn(OH)3	-2.2050
Ni(OH)2	1.8546s/sat	Pb4SO7	-2.2430
Ni3(PO4)2	1.6450s/sat	MnHPO4	-2.3267
Strontianite	1.1860s/sat	Dolomite-dis	-2.3435

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 Fe(OH)3(ppd)       1.1167s/sat   UO3(gamma)        -2.7245
 Whitlockite        1.0880s/sat   Pb3SO6            -2.7755
 Cerussite          0.8635s/sat   NiCO3             -2.9240
 SrUO4(alpha)       0.7054s/sat
  (only minerals with log Q/K > -3 listed)

Gases                    fugacity      log fug.
-----------------------------------------------
 O2(g)                     0.1780       -0.750
 H2O(g)                   0.02598       -1.585
 CO2(g)                 6.284e-007      -6.202
 HF(g)                  5.324e-017     -16.274
 HCl(g)                 1.375e-022     -21.862
 NO2(g)                 6.821e-024     -23.166
 N2(g)                  1.397e-027     -26.855
 NO(g)                  1.084e-029     -28.965
 Cl2(g)                 1.158e-036     -35.936
 H2(g)                  6.642e-042     -41.178
 CO(g)                  1.304e-051     -50.885
 UO2F2(g)               9.840e-061     -60.007
 Pb(g)                  7.668e-063     -62.115
 SO2(g)                 8.099e-064     -63.092
 UO3(g)                 1.083e-066     -65.965
 Na(g)                  9.056e-073     -72.043
 NH3(g)                 4.877e-073     -72.312
 UO2Cl2(g)              8.085e-075     -74.092
 UOF4(g)                1.131e-080     -79.947
 F2(g)                  1.362e-088     -87.866
 UF5(g)                 4.921e-097     -96.308
 UF4(g)                 4.121e-103    -102.385
 UF6(g)                 5.786e-105    -104.238
 UO2(g)                 1.600e-119    -118.796
 Mg(g)                  1.249e-126    -125.903
 UCl4(g)                1.716e-136    -135.765
 UCl5(g)                3.685e-147    -146.434
 CH4(g)                 9.757e-149    -148.011
 Ca(g)                  9.313e-149    -148.031
 UF3(g)                 1.581e-150    -149.801
 H2S(g)                 5.861e-151    -150.232
 UCl6(g)                1.470e-152    -151.833
 UCl3(g)                4.113e-163    -162.386
 U2F10(g)               2.711e-168    -167.567
 Al(g)                  3.400e-191    -190.468
 C(g)                   7.247e-193    -192.140
 UF2(g)                 8.954e-195    -194.048
 UO(g)                  9.378e-204    -203.028
 UCl2(g)                5.337e-207    -206.273
 UF(g)                  1.248e-232    -231.904
 C2H4(g)                4.258e-244    -243.371
 S2(g)                  1.737e-244    -243.760
 UCl(g)                 1.517e-248    -247.819
 U2Cl8(g)               7.258e-262    -261.139
 U2Cl10(g)              2.710e-267    -266.567
 U(g)                   1.289e-288    -287.890

                                  In fluid              Sorbed              Kd
Original basis total moles   moles      mg/kg      moles      mg/kg       L/kg
```

Al+++	1.24e-005	1.24e-005	0.334
Ca++	3.67e-005	3.67e-005	1.47
Cl-	1.00e-005	1.00e-005	0.354
CrO4--	5.13e-005	5.13e-005	5.95
F-	2.48e-005	2.48e-005	0.471
Fe++	5.93e-005	5.93e-005	3.31
H+	-0.00255	-0.00255	-2.57
H2O	55.5	55.5	1.00e+006
HCO3-	0.00149	0.00149	90.8
HPO4--	0.000666	0.000666	63.9
Mg++	9.40e-006	9.40e-006	0.228
Mn++	8.51e-006	8.51e-006	0.467
NH3(aq)	7.00e-006	7.00e-006	0.119
Na+	0.00267	0.00267	61.4
Ni++	6.09e-006	6.09e-006	0.357
O2(aq)	0.000264	0.000264	8.45
Pb++	6.66e-006	6.66e-006	1.38
SO4--	1.00e-006	1.00e-006	0.0960
Sr++	1.26e-006	1.26e-006	0.110
UO2++	0.000403	0.000403	109.

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.240e-005	1.240e-005	0.3345		
Calcium	3.670e-005	3.670e-005	1.470		
Carbon	0.001489	0.001489	17.88		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	5.130e-005	5.130e-005	2.666		
Fluorine	2.480e-005	2.480e-005	0.4710		
Hydrogen	111.0	111.0	1.119e+005		
Iron	5.930e-005	5.930e-005	3.311		
Lead	6.660e-006	6.660e-006	1.379		
Magnesium	9.400e-006	9.400e-006	0.2284		
Manganese	8.510e-006	8.510e-006	0.4674		
Nickel	6.090e-006	6.090e-006	0.3573		
Nitrogen	7.000e-006	7.000e-006	0.09801		
Oxygen	55.52	55.52	8.879e+005		
Phosphorus	0.0006660	0.0006660	20.62		
Sodium	0.002670	0.002670	61.36		
Strontium	1.260e-006	1.260e-006	0.1104		
Sulfur	1.000e-006	1.000e-006	0.03205		
Uranium	0.0004030	0.0004030	95.89		

Sample 19961 water leach, Stage 4.

```
Step #     0               Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH = 10.480                log fO2 =   -0.712
Eh =   0.5986 volts        pe =  10.1185
Ionic strength      =    0.004043
Activity of water   =    1.000000
Solvent mass        =    0.999991 kg
Solution mass       =    1.000201 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =         210 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      124.03 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001293	29.73	0.9336	-2.9181
CO3--	0.0008491	50.94	0.7608	-3.1897
HCO3-	0.0004885	29.80	0.9336	-3.3409
HPO4--	0.0003594	34.49	0.7588	-3.5643
OH-	0.0003274	5.566	0.9330	-3.5151
O2(aq)	0.0002455	7.854	1.0000	-3.6100
UO2(CO3)3----	5.653e-005	25.44	0.3312	-4.7276
UO2(OH)3-	3.415e-005	10.96	0.9336	-4.4964
CaPO4-	1.320e-005	1.783	0.9336	-4.9091
Cl-	9.998e-006	0.3544	0.9323	-5.0305
Fe(OH)4-	9.973e-006	1.235	0.9336	-5.0310
CrO4--	9.759e-006	1.132	0.7588	-5.1304
AlO2-	7.918e-006	0.4669	0.9336	-5.1312
F-	7.809e-006	0.1483	0.9330	-5.1375
PO4---	7.308e-006	0.6939	0.5372	-5.4061
NO3-	7.000e-006	0.4339	0.9323	-5.1853
SO4--	4.450e-006	0.4274	0.7588	-5.4715
NaHPO4-	2.934e-006	0.3490	0.9336	-5.5624
MgPO4-	2.786e-006	0.3322	0.9336	-5.5849
NaCO3-	2.732e-006	0.2267	0.9336	-5.5934
CaCO3(aq)	1.494e-006	0.1495	1.0000	-5.8257
Ca++	1.420e-006	0.05691	0.7667	-5.9630
Fe(OH)3(aq)	1.227e-006	0.1311	1.0000	-5.9110
MnO4-	1.166e-006	0.1387	0.9330	-5.9633
(UO2)2CO3(OH)3-	9.052e-007	0.5892	0.9336	-6.0731
UO2(CO3)2--	8.643e-007	0.3370	0.7588	-6.1832
UO2(OH)2(aq)	8.526e-007	0.2592	1.0000	-6.0692
NaHCO3(aq)	7.854e-007	0.06596	1.0000	-6.1049
Pb(OH)2(aq)	7.808e-007	0.1883	1.0000	-6.1074
Ni(OH)2(aq)	6.073e-007	0.05629	1.0000	-6.2166
MnO4--	2.635e-007	0.03133	0.7588	-6.6991

Sr++	2.595e-007	0.02274	0.7628	-6.7034
PbCO3(aq)	2.588e-007	0.06915	1.0000	-6.5870
Pb(OH)3-	2.555e-007	0.06596	0.9336	-6.6224
Mg++	2.205e-007	0.005358	0.7740	-6.7678
Ni(OH)3-	1.987e-007	0.02180	0.9336	-6.7316
CaHPO4(aq)	1.632e-007	0.02220	1.0000	-6.7873
H2PO4-	1.552e-007	0.01505	0.9336	-6.8389
Pb(CO3)2--	1.456e-007	0.04763	0.7588	-6.9567
MgCO3(aq)	1.050e-007	0.008854	1.0000	-6.9787
SrCO3(aq)	9.379e-008	0.01384	1.0000	-7.0278
Ni++	8.492e-008	0.004983	0.7667	-7.1864
PbOH+	6.879e-008	0.01542	0.9336	-7.1923
NaOH(aq)	5.849e-008	0.002339	1.0000	-7.2329
MgHPO4(aq)	3.783e-008	0.004550	1.0000	-7.4221
CO2(aq)	3.340e-008	0.001470	1.0000	-7.4762
NaSO4-	2.886e-008	0.003435	0.9336	-7.5695
UO2PO4-	2.045e-008	0.007463	0.9336	-7.7191
UO2(OH)4--	1.978e-008	0.006684	0.7588	-7.8237
(UO2)3(OH)7-	1.567e-008	0.01456	0.9336	-7.8347

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	44.3966s/sat	Diaspore	0.1118s/sat
Todorokite	38.4565s/sat	Ice	-0.1387
Trevorite	16.1640s/sat	Boehmite	-0.2921
Pyromorphite	13.7258s/sat	Gibbsite	-0.4839
Hematite	12.0693s/sat	Schoepite	-0.5879
Fluorapatite	10.7884s/sat	UO3:2H2O	-0.5879
Pyrolusite	7.9971s/sat	SrUO4(alpha)	-0.6630
Bixbyite	7.7293s/sat	Calcite	-0.6727
Pyromorphite-OH	7.6062s/sat	UO2(OH)2(beta)	-0.7003
Pb4O(PO4)2	7.4552s/sat	UO3:.9H2O(alpha)	-0.7713
MnO2(gamma)	6.4793s/sat	Schoepite-dehy(.	-0.7713
Ferrite-Ca	5.6532s/sat	Aragonite	-0.8171
Goethite	5.5545s/sat	Schoepite-dehy(.	-0.8516
Ferrite-Mg	5.3150s/sat	Schoepite-dehy(1	-0.8577
Hausmannite	4.9695s/sat	Becquerelite	-0.9308
Parsonsite	4.9534s/sat	Dolomite-ord	-0.9662
Hydroxylapatite	4.4865s/sat	Dolomite	-0.9662
Pb3(PO4)2	3.8741s/sat	Ni3(PO4)2	-1.0863
Manganite	3.5465s/sat	Na2U2O7(am)	-1.4854
Hydrocerussite	3.4587s/sat	Monohydrocalcite	-1.5064
CaUO4	3.3003s/sat	PbCO3.PbO	-1.5265
Plattnerite	2.9637s/sat	Litharge	-1.6560
PbHPO4	2.1860s/sat	Ca-Autunite	-1.7989
Bunsenite	1.3017s/sat	Massicot	-1.8382
Ni(OH)2	1.0251s/sat	Magnesite	-1.9224
Na2U2O7(c)	1.0229s/sat	Schoepite-dehy(.	-1.9609
Strontianite	0.7494s/sat	Brucite	-2.1058
Minium	0.7046s/sat	Crocoite	-2.3900
Fe(OH)3(ppd)	0.4334s/sat	Schoepite-dehy(.	-2.4789
Cerussite	0.3709s/sat	Dolomite-dis	-2.5106
Magnetite	0.2071s/sat	Mn(OH)3	-2.9593
Whitlockite	0.1672s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1942	-0.712
H2O(g)	0.02598	-1.585
CO2(g)	9.832e-007	-6.007
HF(g)	1.862e-017	-16.730
HCl(g)	1.528e-022	-21.816
NO2(g)	7.411e-024	-23.130
N2(g)	1.385e-027	-26.859
NO(g)	1.127e-029	-28.948
Cl2(g)	1.491e-036	-35.826
H2(g)	6.359e-042	-41.197
CO(g)	1.953e-051	-50.709
UO2F2(g)	2.202e-062	-61.657
SO2(g)	4.413e-063	-62.355
Pb(g)	1.509e-063	-62.821
UO3(g)	1.983e-067	-66.703
NH3(g)	4.549e-073	-72.342
Na(g)	3.985e-073	-72.400
UO2Cl2(g)	1.825e-075	-74.739
UOF4(g)	3.093e-083	-82.510
F2(g)	1.739e-089	-88.760
UF5(g)	4.605e-100	-99.337
UF4(g)	1.079e-105	-104.967
UF6(g)	1.935e-108	-107.713
UO2(g)	2.803e-120	-119.552
Mg(g)	5.594e-127	-126.252
UCl4(g)	4.575e-137	-136.340
UCl5(g)	1.115e-147	-146.953
CH4(g)	1.282e-148	-147.892
Ca(g)	5.298e-149	-148.276
H2S(g)	2.802e-150	-149.553
UF3(g)	1.159e-152	-151.936
UCl6(g)	5.049e-153	-152.297
UCl3(g)	9.661e-164	-163.015
U2F10(g)	2.374e-174	-173.625
Al(g)	2.258e-191	-190.646
C(g)	1.039e-192	-191.983
UF2(g)	1.836e-196	-195.736
UO(g)	1.573e-204	-203.803
UCl2(g)	1.104e-207	-206.957
UF(g)	7.161e-234	-233.145
S2(g)	4.330e-243	-242.363
C2H4(g)	8.025e-244	-243.096
UCl(g)	2.765e-249	-248.558
U2Cl8(g)	5.159e-263	-262.287
U2Cl10(g)	2.482e-268	-267.605
U(g)	2.071e-289	-288.684

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	7.92e-006	7.92e-006	0.214			
Ca++	1.63e-005	1.63e-005	0.653			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	9.76e-006	9.76e-006	1.13			

F-	7.81e-006	7.81e-006	0.148
Fe++	1.12e-005	1.12e-005	0.625
H+	-0.00156	-0.00156	-1.58
H2O	55.5	55.5	1.00e+006
HCO3-	0.00152	0.00152	92.5
HPO4--	0.000386	0.000386	37.0
Mg++	3.15e-006	3.15e-006	0.0765
Mn++	1.43e-006	1.43e-006	0.0785
NH3(aq)	7.00e-006	7.00e-006	0.119
Na+	0.00130	0.00130	29.9
Ni++	8.91e-007	8.91e-007	0.0523
O2(aq)	0.000264	0.000264	8.45
Pb++	1.51e-006	1.51e-006	0.313
SO4--	4.48e-006	4.48e-006	0.430
Sr++	3.60e-007	3.60e-007	0.0315
UO2++	9.43e-005	9.43e-005	25.5

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	7.920e-006	7.920e-006	0.2137		
Calcium	1.630e-005	1.630e-005	0.6531		
Carbon	0.001516	0.001516	18.20		
Chlorine	1.000e-005	1.000e-005	0.3545		
Chromium	9.760e-006	9.760e-006	0.5074		
Fluorine	7.810e-006	7.810e-006	0.1483		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.120e-005	1.120e-005	0.6254		
Lead	1.510e-006	1.510e-006	0.3128		
Magnesium	3.150e-006	3.150e-006	0.07655		
Manganese	1.430e-006	1.430e-006	0.07855		
Nickel	8.910e-007	8.910e-007	0.05228		
Nitrogen	7.000e-006	7.000e-006	0.09803		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0003860	0.0003860	11.95		
Sodium	0.001300	0.001300	29.88		
Strontium	3.600e-007	3.600e-007	0.03154		
Sulfur	4.480e-006	4.480e-006	0.1436		
Uranium	9.430e-005	9.430e-005	22.44		

Sample 19961 water leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  9.890               log fO2 =   -0.716
Eh =   0.6334 volts       pe =  10.7075
Ionic strength      =     0.003114
Activity of water   =     1.000000
Solvent mass        =     0.999996 kg
Solution mass       =     1.000195 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000009 molal
Dissolved solids    =          199 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       108.02 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.0009517	21.87	0.9409	-3.0480
HCO3-	0.0009189	56.06	0.9409	-3.0632
CO3--	0.0004012	24.07	0.7847	-3.5020
O2(aq)	0.0002433	7.783	1.0000	-3.6139
HPO4--	0.0001981	19.01	0.7830	-3.8094
UO2(CO3)3----	0.0001055	47.48	0.3756	-4.4019
OH-	8.348e-005	1.420	0.9404	-4.1051
CrO4--	1.320e-005	1.530	0.7830	-4.9858
Fe(OH)4-	1.113e-005	1.378	0.9409	-4.9800
UO2(OH)3-	1.053e-005	3.381	0.9409	-5.0039
CaPO4-	1.038e-005	1.401	0.9409	-5.0104
AlO2-	8.876e-006	0.5234	0.9409	-5.0783
Cl-	8.569e-006	0.3037	0.9399	-5.0940
Ca++	7.472e-006	0.2994	0.7894	-5.2293
NO3-	7.000e-006	0.4339	0.9399	-5.1818
Fe(OH)3(aq)	5.370e-006	0.5738	1.0000	-5.2700
CaCO3(aq)	3.943e-006	0.3946	1.0000	-5.4042
UO2(CO3)2--	3.639e-006	1.419	0.7830	-5.5452
(UO2)2CO3(OH)3-	2.489e-006	1.620	0.9409	-5.6304
MgPO4-	2.285e-006	0.2725	0.9409	-5.6675
MnO4-	1.987e-006	0.2362	0.9404	-5.7286
NaHPO4-	1.228e-006	0.1460	0.9409	-5.9373
Mg++	1.214e-006	0.02949	0.7954	-6.0153
NaHCO3(aq)	1.104e-006	0.09272	1.0000	-5.9571
PbCO3(aq)	1.087e-006	0.2903	1.0000	-5.9639
Ni++	1.054e-006	0.06186	0.7894	-6.0798
UO2(OH)2(aq)	1.031e-006	0.3134	1.0000	-5.9867
F-	9.999e-007	0.01899	0.9404	-6.0267
PO4---	9.954e-007	0.09452	0.5765	-6.2412
SO4--	9.942e-007	0.09549	0.7830	-6.1088
NaCO3-	9.792e-007	0.08126	0.9409	-6.0356

Ni(OH)2(aq)	5.129e-007	0.04754	1.0000	-6.2900
CaHPO4(aq)	5.028e-007	0.06839	1.0000	-6.2986
Pb(OH)2(aq)	4.445e-007	0.1072	1.0000	-6.3521
H2PO4-	3.408e-007	0.03305	0.9409	-6.4940
Sr++	3.319e-007	0.02908	0.7863	-6.5834
MgCO3(aq)	2.894e-007	0.02440	1.0000	-6.5384
Pb(CO3)2--	2.886e-007	0.09442	0.7830	-6.6459
CO2(aq)	2.463e-007	0.01084	1.0000	-6.6085
Ca2UO2(CO3)3	2.187e-007	0.1159	1.0000	-6.6602
PbOH+	1.512e-007	0.03388	0.9409	-6.8470
MgHPO4(aq)	1.217e-007	0.01464	1.0000	-6.9147
MnO4--	1.129e-007	0.01343	0.7830	-7.0534
CaHCO3+	6.035e-008	0.006100	0.9409	-7.2458
SrCO3(aq)	6.025e-008	0.008892	1.0000	-7.2201
UO2PO4-	5.429e-008	0.01981	0.9409	-7.2917
Ni(OH)3-	4.280e-008	0.004695	0.9409	-7.3950
Pb(OH)3-	3.710e-008	0.009577	0.9409	-7.4571
NaOH(aq)	1.115e-008	0.0004458	1.0000	-7.9528

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	51.0213s/sat	Minium	-0.0314
Todorokite	44.2535s/sat	Dolomite	-0.1045
Trevorite	17.3726s/sat	Dolomite-ord	-0.1045
Pyromorphite	15.8336s/sat	Ice	-0.1387
Hematite	13.3514s/sat	Ca-Autunite	-0.2103
Fluorapatite	11.0629s/sat	Calcite	-0.2512
Bixbyite	9.3865s/sat	Na2U2O7(c)	-0.2519
Pyromorphite-OH	9.1875s/sat	Aragonite	-0.3956
Pyrolusite	8.8247s/sat	Schoepite	-0.5054
Pb4O(PO4)2	8.3462s/sat	UO3:2H2O	-0.5054
Hausmannite	7.4562s/sat	UO2(OH)2(beta)	-0.6178
MnO2(gamma)	7.3069s/sat	Schoepite-dehy(.	-0.6888
Ferrite-Ca	6.4890s/sat	UO3:.9H2O(alpha)	-0.6888
Parsonsite	6.4164s/sat	Schoepite-dehy(.	-0.7691
Goethite	6.1955s/sat	Schoepite-dehy(1	-0.7752
Ferrite-Mg	6.1695s/sat	Becquerelite	-0.8821
Hydroxylapatite	5.0602s/sat	Monohydrocalcite	-1.0849
Pb3(PO4)2	5.0099s/sat	PbCO3.PbO	-1.1482
Hydrocerussite	4.4601s/sat	Crocoite	-1.3100
Manganite	4.3751s/sat	MnHPO4	-1.4473
CaUO4	2.9366s/sat	Magnesite	-1.4821
PbHPO4	2.8762s/sat	SrUO4(alpha)	-1.6405
Plattnerite	2.7170s/sat	Dolomite-dis	-1.6489
Magnetite	2.1311s/sat	Schoepite-dehy(.	-1.8784
Bunsenite	1.2283s/sat	Litharge	-1.9007
Fe(OH)3(ppd)	1.0744s/sat	Massicot	-2.0829
Cerussite	0.9940s/sat	Mn(OH)3	-2.1307
Ni(OH)2	0.9517s/sat	Schoepite-dehy(.	-2.3964
Diaspore	0.7547s/sat	Corundum	-2.4820
Whitlockite	0.6984s/sat	Brucite	-2.5333
Ni3(PO4)2	0.5633s/sat	Dawsonite	-2.5425
Strontianite	0.5571s/sat	Na2U2O7(am)	-2.7602
Boehmite	0.3508s/sat	NiCO3	-2.7648
Gibbsite	0.1590s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1925	-0.716
H2O(g)	0.02598	-1.585
CO2(g)	7.251e-006	-5.140
HF(g)	9.347e-018	-17.029
HCl(g)	5.134e-022	-21.290
NO2(g)	2.913e-023	-22.536
N2(g)	2.178e-026	-25.662
NO(g)	4.450e-029	-28.352
Cl2(g)	1.677e-035	-34.775
H2(g)	6.388e-042	-41.195
CO(g)	1.447e-050	-49.840
SO2(g)	1.547e-062	-61.811
UO2F2(g)	6.712e-063	-62.173
Pb(g)	8.630e-064	-63.064
UO3(g)	2.398e-067	-66.620
NH3(g)	1.816e-072	-71.741
Na(g)	7.612e-074	-73.119
UO2Cl2(g)	2.494e-074	-73.603
UOF4(g)	2.377e-084	-83.624
F2(g)	4.364e-090	-89.360
UF5(g)	1.781e-101	-100.749
UF4(g)	8.331e-107	-106.079
UF6(g)	3.748e-110	-109.426
UO2(g)	3.405e-120	-119.468
Mg(g)	2.100e-127	-126.678
UCl4(g)	7.094e-135	-134.149
UCl5(g)	5.799e-145	-144.237
CH4(g)	9.628e-148	-147.016
Ca(g)	1.905e-149	-148.720
H2S(g)	9.954e-150	-149.002
UCl6(g)	8.805e-150	-149.055
UF3(g)	1.786e-153	-152.748
UCl3(g)	4.466e-162	-161.350
U2F10(g)	3.550e-177	-176.450
Al(g)	9.992e-191	-190.000
C(g)	7.734e-192	-191.112
UF2(g)	5.649e-197	-196.248
UO(g)	1.920e-204	-203.717
UCl2(g)	1.522e-206	-205.817
UF(g)	4.397e-234	-233.357
S2(g)	5.416e-242	-241.266
C2H4(g)	4.484e-242	-241.348
UCl(g)	1.137e-248	-247.944
U2Cl8(g)	1.240e-258	-257.907
U2Cl10(g)	6.710e-263	-262.173
U(g)	2.539e-289	-288.595

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	8.88e-006	8.88e-006	0.240			
Ca++	2.28e-005	2.28e-005	0.914			
Cl-	8.57e-006	8.57e-006	0.304			

CrO4--	1.32e-005	1.32e-005	1.53
F-	1.00e-006	1.00e-006	0.0190
Fe++	1.65e-005	1.65e-005	0.921
H+	-0.000968	-0.000968	-0.976
H2O	55.5	55.5	1.00e+006
HCO3-	0.00166	0.00166	101.
HPO4--	0.000214	0.000214	20.5
Mg++	3.92e-006	3.92e-006	0.0953
Mn++	2.10e-006	2.10e-006	0.115
NH3(aq)	7.00e-006	7.00e-006	0.119
Na+	0.000955	0.000955	22.0
Ni++	1.61e-006	1.61e-006	0.0945
O2(aq)	0.000264	0.000264	8.45
Pb++	2.01e-006	2.01e-006	0.416
SO4--	1.00e-006	1.00e-006	0.0960
Sr++	3.97e-007	3.97e-007	0.0348
UO2++	0.000126	0.000126	34.0

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	8.880e-006	8.880e-006	0.2395		
Calcium	2.280e-005	2.280e-005	0.9136		
Carbon	0.001655	0.001655	19.88		
Chlorine	8.570e-006	8.570e-006	0.3038		
Chromium	1.320e-005	1.320e-005	0.6862		
Fluorine	1.000e-006	1.000e-006	0.01899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.650e-005	1.650e-005	0.9213		
Lead	2.010e-006	2.010e-006	0.4164		
Magnesium	3.920e-006	3.920e-006	0.09526		
Manganese	2.100e-006	2.100e-006	0.1153		
Nickel	1.610e-006	1.610e-006	0.09447		
Nitrogen	7.000e-006	7.000e-006	0.09803		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0002140	0.0002140	6.627		
Sodium	0.0009550	0.0009550	21.95		
Strontium	3.970e-007	3.970e-007	0.03478		
Sulfur	1.000e-006	1.000e-006	0.03206		
Uranium	0.0001260	0.0001260	29.99		

Sample 19961 water leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 10.150               log fO2 =   -0.735
Eh =   0.6177 volts       pe =  10.4426
Ionic strength      =     0.007063
Activity of water   =     1.000000
Solvent mass        =     0.999977 kg
Solution mass       =     1.000492 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000009 molal
Dissolved solids    =          514 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       162.08 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.002457	56.47	0.9154	-2.6479
HPO4--	0.0005995	57.51	0.7006	-3.3767
HCO3-	0.0005033	30.69	0.9154	-3.3366
CO3--	0.0004337	26.02	0.7037	-3.5154
UO2(CO3)3----	0.0003824	172.0	0.2405	-4.0364
O2(aq)	0.0002325	7.437	1.0000	-3.6335
UO2(OH)3-	0.0001660	53.27	0.9154	-3.8183
OH-	0.0001562	2.656	0.9143	-3.8451
(UO2)2CO3(OH)3-	9.681e-005	63.00	0.9154	-4.0525
CrO4--	4.319e-005	5.008	0.7006	-4.5191
AlO2-	3.418e-005	2.015	0.9154	-4.5046
Fe(OH)4-	3.355e-005	4.153	0.9154	-4.5128
CaPO4-	2.566e-005	3.464	0.9154	-4.6291
F-	1.980e-005	0.3759	0.9143	-4.7423
NO3-	1.970e-005	1.221	0.9133	-4.7449
MgPO4-	1.164e-005	1.388	0.9154	-4.9725
UO2(CO3)2--	9.731e-006	3.794	0.7006	-5.1664
Cl-	9.297e-006	0.3294	0.9133	-5.0711
UO2(OH)2(aq)	8.687e-006	2.640	1.0000	-5.0611
Fe(OH)3(aq)	8.654e-006	0.9244	1.0000	-5.0628
NaHPO4-	8.586e-006	1.021	0.9154	-5.1046
(UO2)3(OH)7-	7.908e-006	7.344	0.9154	-5.1403
PO4---	6.302e-006	0.5982	0.4487	-5.5485
Pb(OH)2(aq)	5.095e-006	1.228	1.0000	-5.2928
MnO4-	5.073e-006	0.6030	0.9143	-5.3337
Ca++	4.042e-006	0.1619	0.7126	-5.5406
PbCO3(aq)	3.647e-006	0.9741	1.0000	-5.4380
NaCO3-	2.452e-006	0.2034	0.9154	-5.6489
Ni(OH)2(aq)	2.359e-006	0.2186	1.0000	-5.6273
CaCO3(aq)	1.867e-006	0.1868	1.0000	-5.7289
Ni++	1.622e-006	0.09516	0.7126	-5.9371
Sr++	1.534e-006	0.1343	0.7067	-5.9650

NaHCO3(aq)	1.478e-006	0.1241	1.0000	-5.8304
Mg++	1.341e-006	0.03258	0.7236	-6.0130
Pb(CO3)2--	1.050e-006	0.3434	0.7006	-6.1334
SO4--	9.881e-007	0.09487	0.7006	-6.1597
PbOH+	9.788e-007	0.2193	0.9154	-6.0477
Pb(OH)3-	7.954e-007	0.2053	0.9154	-6.1378
UO2PO4-	6.998e-007	0.2553	0.9154	-6.1934
CaHPO4(aq)	6.648e-007	0.09040	1.0000	-6.1773
MnO4--	5.767e-007	0.06855	0.7006	-6.3936
H2PO4-	5.213e-007	0.05053	0.9154	-6.3213
Ni(OH)3-	3.682e-007	0.04038	0.9154	-6.4723
MgHPO4(aq)	3.314e-007	0.03984	1.0000	-6.4797
MgCO3(aq)	2.822e-007	0.02378	1.0000	-6.5495
SrCO3(aq)	2.426e-007	0.03580	1.0000	-6.6150
Ca2UO2(CO3)3	1.209e-007	0.06409	1.0000	-6.9174
CO2(aq)	7.213e-008	0.003173	1.0000	-7.1419
SrHPO4(aq)	5.228e-008	0.009594	1.0000	-7.2817
NaOH(aq)	5.097e-008	0.002037	1.0000	-7.2927
UO2(OH)4--	4.774e-008	0.01613	0.7006	-7.4756
PbP2O7--	2.051e-008	0.007815	0.7006	-7.8425
CaHCO3+	1.614e-008	0.001631	0.9154	-7.8305
NaAlO2(aq)	1.271e-008	0.001041	1.0000	-7.8958
NaSO4-	1.124e-008	0.001337	0.9154	-7.9876

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	52.2381s/sat	Gibbsite	0.4727s/sat
Todorokite	45.3207s/sat	PbCO3.PbO	0.4371s/sat
Pyromorphite	20.6310s/sat	SrUO4(alpha)	0.4235s/sat
Trevorite	18.4498s/sat	Schoepite	0.4202s/sat
Pyromorphite-OH	14.2220s/sat	UO3:2H2O	0.4202s/sat
Hematite	13.7658s/sat	Na2U2O7(am)	0.4111s/sat
Fluorapatite	12.8685s/sat	UO2(OH)2(beta)	0.3078s/sat
Pb4O(PO4)2	12.4087s/sat	UO3:.9H2O(alpha)	0.2368s/sat
Bixbyite	9.6956s/sat	Schoepite-dehy(.	0.2368s/sat
Parsonsite	9.2859s/sat	Schoepite-dehy(.	0.1565s/sat
Pyrolusite	8.9744s/sat	Schoepite-dehy(1	0.1504s/sat
Pb3(PO4)2	8.0131s/sat	Ice	-0.1387
Hausmannite	7.9248s/sat	Crocoite	-0.3040
MnO2(gamma)	7.4566s/sat	Dolomite	-0.4402
Ferrite-Ca	7.1121s/sat	Dolomite-ord	-0.4402
Ferrite-Mg	7.1064s/sat	Pb4Cl2(OH)6	-0.5320
Hydrocerussite	6.5712s/sat	Calcite	-0.5759
Goethite	6.4027s/sat	Aragonite	-0.7203
Hydroxylapatite	5.8414s/sat	Litharge	-0.8414
Becquerelite	4.8803s/sat	Schoepite-dehy(.	-0.9528
Manganite	4.5296s/sat	Pb4SO7	-1.0057
CaUO4	4.0709s/sat	Massicot	-1.0236
PbHPO4	3.8481s/sat	MnHPO4	-1.3752
Plattnerite	3.7665s/sat	Monohydrocalcite	-1.4096
Minium	3.1366s/sat	Schoepite-dehy(.	-1.4708
Na2U2O7(c)	2.9194s/sat	Magnesite	-1.4932
Magnetite	2.7577s/sat	Pb3SO6	-1.6657
Ni3(PO4)2	2.3767s/sat	Corundum	-1.8547
Bunsenite	1.8910s/sat	Mn(OH)3	-1.9762

Ca-Autunite	1.6749s/sat	Dolomite-dis	-1.9846
Ni(OH)2	1.6144s/sat	Brucite	-2.0110
Cerussite	1.5199s/sat	Dawsonite	-2.1022
Fe(OH)3(ppd)	1.2816s/sat	Lanarkite	-2.3958
Strontianite	1.1622s/sat	UO3(gamma)	-2.4538
Whitlockite	1.1496s/sat	NiCO3	-2.6355
Diaspore	1.0684s/sat	Plumbogummite	-2.7237
Boehmite	0.6645s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1840	-0.735
H2O(g)	0.02598	-1.585
CO2(g)	2.123e-006	-5.673
HF(g)	9.887e-017	-16.005
HCl(g)	2.975e-022	-21.527
NO2(g)	4.427e-023	-22.354
N2(g)	5.508e-026	-25.259
NO(g)	6.918e-029	-28.160
Cl2(g)	5.505e-036	-35.259
H2(g)	6.533e-042	-41.185
CO(g)	4.333e-051	-50.363
UO2F2(g)	6.329e-060	-59.199
Pb(g)	1.012e-062	-61.995
SO2(g)	4.248e-063	-62.372
UO3(g)	2.021e-066	-65.695
NH3(g)	2.988e-072	-71.525
Na(g)	3.519e-073	-72.454
UO2Cl2(g)	7.053e-074	-73.152
UOF4(g)	2.508e-079	-78.601
F2(g)	4.774e-088	-87.321
UF5(g)	2.010e-095	-94.697
UF4(g)	8.991e-102	-101.046
UF6(g)	4.425e-103	-102.354
UO2(g)	2.935e-119	-118.532
Mg(g)	7.151e-127	-126.146
UCl4(g)	6.888e-135	-134.162
UCl5(g)	3.225e-145	-144.491
CH4(g)	3.086e-148	-147.511
Ca(g)	3.150e-149	-148.502
UF3(g)	1.843e-149	-148.735
H2S(g)	2.926e-150	-149.534
UCl6(g)	2.806e-150	-149.552
UCl3(g)	7.571e-162	-161.121
U2F10(g)	4.523e-165	-164.345
Al(g)	2.128e-190	-189.672
C(g)	2.369e-192	-191.625
UF2(g)	5.572e-194	-193.254
UO(g)	1.692e-203	-202.772
UCl2(g)	4.505e-206	-205.346
UF(g)	4.147e-232	-231.382
S2(g)	4.473e-243	-242.349
C2H4(g)	4.403e-243	-242.356
UCl(g)	5.871e-248	-247.231
U2Cl8(g)	1.169e-258	-257.932
U2Cl10(g)	2.076e-263	-262.683

U(g) 2.289e-288 -287.640

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	3.42e-005	3.42e-005	0.922			
Ca++	3.25e-005	3.25e-005	1.30			
Cl-	9.30e-006	9.30e-006	0.330			
CrO4--	4.32e-005	4.32e-005	5.01			
F-	1.98e-005	1.98e-005	0.376			
Fe++	4.22e-005	4.22e-005	2.36			
H+	-0.00308	-0.00308	-3.10			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00221	0.00221	135.			
HPO4--	0.000654	0.000654	62.7			
Mg++	1.36e-005	1.36e-005	0.330			
Mn++	5.65e-006	5.65e-006	0.310			
NH3(aq)	1.97e-005	1.97e-005	0.335			
Na+	0.00247	0.00247	56.8			
Ni++	4.35e-006	4.35e-006	0.255			
O2(aq)	0.000289	0.000289	9.26			
Pb++	1.16e-005	1.16e-005	2.40			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.83e-006	1.83e-006	0.160			
UO2++	0.000785	0.000785	212.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	3.420e-005	3.420e-005	0.9223		
Calcium	3.250e-005	3.250e-005	1.302		
Carbon	0.002213	0.002213	26.57		
Chlorine	9.300e-006	9.300e-006	0.3295		
Chromium	4.320e-005	4.320e-005	2.245		
Fluorine	1.980e-005	1.980e-005	0.3760		
Hydrogen	111.0	111.0	1.118e+005		
Iron	4.220e-005	4.220e-005	2.356		
Lead	1.160e-005	1.160e-005	2.402		
Magnesium	1.360e-005	1.360e-005	0.3304		
Manganese	5.650e-006	5.650e-006	0.3102		
Nickel	4.350e-006	4.350e-006	0.2552		
Nitrogen	1.970e-005	1.970e-005	0.2758		
Oxygen	55.52	55.52	8.879e+005		
Phosphorus	0.0006540	0.0006540	20.25		
Sodium	0.002470	0.002470	56.76		
Strontium	1.830e-006	1.830e-006	0.1603		
Sulfur	1.000e-006	1.000e-006	0.03205		
Uranium	0.0007850	0.0007850	186.8		

Sample 19961 $Ca(OH)_2$ leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.860               log fO2 =   -0.707
Eh =   0.5170 volts       pe =   8.7397
Ionic strength      =     0.028605
Activity of water   =     1.000000
Solvent mass        =     0.999841 kg
Solution mass       =     1.000934 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =         1092 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       780.85 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01548	355.4	0.8520	-1.8799
OH-	0.008632	146.7	0.8487	-2.1351
CO3--	0.007513	450.3	0.5302	-2.3998
NO3-	0.0008801	54.51	0.8454	-3.1284
F-	0.0007053	13.39	0.8487	-3.2228
O2(aq)	0.0002484	7.939	1.0000	-3.6049
NaCO3-	0.0002015	16.71	0.8520	-3.7652
HCO3-	0.0001376	8.387	0.8520	-3.9310
HPO4--	6.674e-005	6.399	0.5226	-4.4574
AlO2-	5.859e-005	3.452	0.8520	-4.3018
PO4---	5.205e-005	4.938	0.2314	-4.9192
CrO4--	4.961e-005	5.748	0.5226	-4.5863
UO2(OH)3-	1.852e-005	5.938	0.8520	-4.8020
NaOH(aq)	1.532e-005	0.6122	1.0000	-4.8147
CaPO4-	1.282e-005	1.730	0.8520	-4.9615
Cl-	9.983e-006	0.3535	0.8454	-5.0737
SO4--	9.494e-006	0.9110	0.5226	-5.3044
NaHPO4-	4.490e-006	0.5336	0.8520	-5.4173
CaCO3(aq)	2.661e-006	0.2660	1.0000	-5.5750
Fe(OH)4-	2.588e-006	0.3203	0.8520	-5.6566
NaHCO3(aq)	2.204e-006	0.1850	1.0000	-5.6567
UO2(CO3)3----	2.126e-006	0.9559	0.0740	-6.8033
Pb(OH)3-	9.651e-007	0.2489	0.8520	-6.0850
MgPO4-	9.080e-007	0.1082	0.8520	-6.1115
Ni(OH)3-	8.960e-007	0.09819	0.8520	-6.1173
MnO4--	8.773e-007	0.1042	0.5226	-6.3387
NaF(aq)	7.937e-007	0.03329	1.0000	-6.1003
SrCO3(aq)	6.041e-007	0.08908	1.0000	-6.2189
Ca++	5.701e-007	0.02282	0.5518	-6.5023
NaSO4-	5.073e-007	0.06033	0.8520	-6.3643
Sr++	3.847e-007	0.03367	0.5376	-6.6844

UO2(OH)4--	3.408e-007	0.1151	0.5226	-6.7493
MnO4-	1.229e-007	0.01460	0.8487	-6.9816
NaAlO2(aq)	1.189e-007	0.009733	1.0000	-6.9249
Pb(OH)2(aq)	1.122e-007	0.02703	1.0000	-6.9500
Ni(OH)2(aq)	1.042e-007	0.009646	1.0000	-6.9823
MgCO3(aq)	6.279e-008	0.005288	1.0000	-7.2021
CaOH+	3.778e-008	0.002154	0.8520	-7.4923
Mg++	2.864e-008	0.0006954	0.5777	-7.7813
NaCl(aq)	1.860e-008	0.001086	1.0000	-7.7306
UO2(OH)2(aq)	1.759e-008	0.005341	1.0000	-7.7548
Fe(OH)3(aq)	1.212e-008	0.001294	1.0000	-7.9166

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	25.1740s/sat	Whitlockite	-0.4769
Todorokite	21.6361s/sat	Aragonite	-0.5664
Fluorapatite	11.4673s/sat	Boehmite	-0.8427
Trevorite	11.3872s/sat	Dolomite-ord	-0.9390
Hematite	8.0583s/sat	Dolomite	-0.9390
Pyrolusite	5.5949s/sat	Gibbsite	-1.0345
Hydroxylapatite	4.6308s/sat	Monohydrocalcite	-1.2557
MnO2(gamma)	4.0771s/sat	Fe(OH)3(ppd)	-1.5722
Ferrite-Ca	3.8629s/sat	Minium	-1.8206
CaUO4	3.8355s/sat	Magnesite	-2.1458
Goethite	3.5489s/sat	Hausmannite	-2.2421
Ferrite-Mg	3.0505s/sat	UO3:2H2O	-2.2735
Bixbyite	2.9224s/sat	Schoepite	-2.2735
Na2U2O7(c)	2.4881s/sat	PbHPO4	-2.3097
Plattnerite	2.1236s/sat	UO2(OH)2(beta)	-2.3859
Strontianite	1.5583s/sat	Cerussite	-2.4417
Manganite	1.1431s/sat	UO3:.9H2O(alpha)	-2.4569
Bunsenite	0.5360s/sat	Schoepite-dehy(.	-2.4569
SrUO4(alpha)	0.4303s/sat	Dolomite-dis	-2.4834
Ni(OH)2	0.2594s/sat	Litharge	-2.4986
Na2U2O7(am)	-0.0202	Schoepite-dehy(.	-2.5372
Ice	-0.1387	Schoepite-dehy(1	-2.5433
Brucite	-0.3593	Massicot	-2.6808
Calcite	-0.4220	Pyromorphite	-2.8696
Diaspore	-0.4388	Fluorite	-2.9110

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1965	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	1.054e-008	-7.977
HF(g)	6.376e-017	-16.195
NO2(g)	3.512e-023	-22.454
HCl(g)	5.765e-024	-23.239
N2(g)	3.038e-026	-25.517
NO(g)	5.310e-029	-28.275
Cl2(g)	2.137e-039	-38.670
H2(g)	6.322e-042	-41.199
CO(g)	2.080e-053	-52.682
UO2F2(g)	5.328e-063	-62.273

Pb(g)	2.156e-064	-63.666
SO2(g)	1.120e-065	-64.951
UO3(g)	4.091e-069	-68.388
Na(g)	1.041e-070	-69.983
NH3(g)	2.112e-072	-71.675
UO2Cl2(g)	5.363e-080	-79.271
UOF4(g)	8.782e-083	-82.056
F2(g)	2.052e-088	-87.688
UF5(g)	4.465e-099	-98.350
UF4(g)	3.046e-105	-104.516
UF6(g)	6.443e-107	-106.191
UO2(g)	5.748e-122	-121.240
Mg(g)	3.103e-125	-124.508
UCl4(g)	1.904e-144	-143.720
Ca(g)	8.757e-147	-146.058
CH4(g)	1.342e-150	-149.872
UF3(g)	9.522e-153	-152.021
H2S(g)	6.989e-153	-152.156
UCl5(g)	1.756e-156	-155.755
UCl6(g)	3.010e-163	-162.521
UCl3(g)	1.062e-169	-168.974
U2F10(g)	2.231e-172	-171.651
Al(g)	6.301e-192	-191.201
C(g)	1.101e-194	-193.958
UF2(g)	4.392e-197	-196.357
UO(g)	3.208e-206	-205.494
UCl2(g)	3.207e-212	-211.494
UF(g)	4.986e-235	-234.302
C2H4(g)	8.896e-248	-247.051
S2(g)	2.726e-248	-247.565
UCl(g)	2.121e-252	-251.673
U2Cl8(g)	8.929e-278	-277.049
U2Cl10(g)	6.154e-286	-285.211
U(g)	4.198e-291	-290.377

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	5.87e-005	5.87e-005	1.58			
Ca++	1.61e-005	1.61e-005	0.645			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	4.96e-005	4.96e-005	5.75			
F-	0.000706	0.000706	13.4			
Fe++	2.60e-006	2.60e-006	0.145			
H+	-0.0176	-0.0176	-17.7			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00786	0.00786	479.			
HPO4--	0.000137	0.000137	13.1			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	0.000880	0.000880	15.0			
Na+	0.0157	0.0157	361.			
Ni++	1.00e-006	1.00e-006	0.0586			
O2(aq)	0.00201	0.00201	64.3			
Pb++	1.08e-006	1.08e-006	0.224			
SO4--	1.00e-005	1.00e-005	0.960			
Sr++	1.00e-006	1.00e-006	0.0875			

UO2++	2.10e-005	2.10e-005	5.67

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	5.870e-005	5.870e-005	1.582		
Calcium	1.610e-005	1.610e-005	0.6447		
Carbon	0.007863	0.007863	94.35		
Chlorine	1.000e-005	1.000e-005	0.3542		
Chromium	4.960e-005	4.960e-005	2.577		
Fluorine	0.0007060	0.0007060	13.40		
Hydrogen	111.0	111.0	1.118e+005		
Iron	2.600e-006	2.600e-006	0.1451		
Lead	1.080e-006	1.080e-006	0.2236		
Magnesium	1.000e-006	1.000e-006	0.02428		
Manganese	1.000e-006	1.000e-006	0.05489		
Nickel	1.000e-006	1.000e-006	0.05864		
Nitrogen	0.0008800	0.0008800	12.31		
Oxygen	55.54	55.54	8.877e+005		
Phosphorus	0.0001370	0.0001370	4.239		
Sodium	0.01570	0.01570	360.6		
Strontium	1.000e-006	1.000e-006	0.08754		
Sulfur	1.000e-005	1.000e-005	0.3204		
Uranium	2.100e-005	2.100e-005	4.994		

Sample 19961 $Ca(OH)_2$ leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.890               log fO2 =   -0.834
Eh =   0.5133 volts       pe =   8.6779
Ionic strength      =     0.034076
Activity of water   =     1.000000
Solvent mass        =     0.999751 kg
Solution mass       =     1.001587 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000001 molal
Dissolved solids    =         1833 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       812.49 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01834	420.8	0.8422	-1.8112
OH-	0.009362	158.9	0.8386	-2.1051
CO3--	0.007433	445.2	0.5068	-2.4240
UO2(OH)3-	0.001136	364.0	0.8422	-3.0192
F-	0.001129	21.41	0.8386	-3.0239
CaPO4-	0.001102	148.6	0.8422	-3.0322
NO3-	0.001040	64.38	0.8347	-3.0613
CrO4--	0.0002391	27.68	0.4984	-3.9239
HPO4--	0.0002265	21.70	0.4984	-3.9473
NaCO3-	0.0002258	18.71	0.8422	-3.7208
PO4---	0.0002010	19.05	0.2078	-4.3791
O2(aq)	0.0001853	5.917	1.0000	-3.7322
Fe(OH)4-	0.0001584	19.58	0.8422	-3.8749
HCO3-	0.0001228	7.482	0.8422	-3.9852
AlO2-	0.0001118	6.580	0.8422	-4.0263
UO2(CO3)3----	0.0001073	48.21	0.0611	-5.1833
CaCO3(aq)	6.165e-005	6.159	1.0000	-4.2100
UO2(OH)4--	2.322e-005	7.836	0.4984	-4.9365
MnO4--	2.184e-005	2.593	0.4984	-4.9631
NaOH(aq)	1.923e-005	0.7678	1.0000	-4.7160
Pb(OH)3-	1.740e-005	4.485	0.8422	-4.8340
NaHPO4-	1.722e-005	2.045	0.8422	-4.8385
Ni(OH)3-	1.653e-005	1.810	0.8422	-4.8563
Ca++	1.453e-005	0.5813	0.5304	-5.1131
MgPO4-	2.752e-006	0.3277	0.8422	-5.6349
MnO4-	2.562e-006	0.3042	0.8386	-5.6679
NaHCO3(aq)	2.279e-006	0.1911	1.0000	-5.6423
Pb(OH)2(aq)	1.866e-006	0.4493	1.0000	-5.7290
Ni(OH)2(aq)	1.773e-006	0.1641	1.0000	-5.7513
NaF(aq)	1.470e-006	0.06161	1.0000	-5.8327
CaOH+	1.003e-006	0.05717	0.8422	-6.0731

Cl-	9.981e-007	0.03532	0.8347	-6.0793
UO2(OH)2(aq)	9.953e-007	0.3021	1.0000	-6.0020
SO4--	9.428e-007	0.09041	0.4984	-6.3280
(UO2)3(OH)7-	7.104e-007	0.6588	0.8422	-6.2231
Fe(OH)3(aq)	6.840e-007	0.07297	1.0000	-6.1649
SrCO3(aq)	5.789e-007	0.08531	1.0000	-6.2374
CaHPO4(aq)	4.782e-007	0.06494	1.0000	-6.3204
Sr++	4.070e-007	0.03560	0.5149	-6.6787
(UO2)2CO3(OH)3-	3.102e-007	0.2016	0.8422	-6.5830
NaAlO2(aq)	2.626e-007	0.02148	1.0000	-6.5808
UO2(CO3)2--	7.904e-008	0.03077	0.4984	-7.4046
Ca2UO2(CO3)3	6.176e-008	0.03268	1.0000	-7.2093
NaSO4-	5.693e-008	0.006765	0.8422	-7.3192
MgCO3(aq)	5.130e-008	0.004317	1.0000	-7.2899
CaF+	4.162e-008	0.002454	0.8422	-7.4553
CaNO3+	3.982e-008	0.004058	0.8422	-7.4745
Pb(CO3)2--	2.726e-008	0.008904	0.4984	-7.8669
Mg++	2.559e-008	0.0006207	0.5587	-7.8448
CaHCO3+	1.054e-008	0.001064	0.8422	-8.0516

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	36.3354s/sat	Dolomite	0.3381s/sat
Todorokite	31.4182s/sat	Fe(OH)3(ppd)	0.1795s/sat
Fluorapatite	20.2326s/sat	Monohydrocalcite	0.1093s/sat
Trevorite	16.1215s/sat	Pyromorphite-OH	-0.1108
Hydroxylapatite	13.2271s/sat	Ice	-0.1387
Hematite	11.5615s/sat	Diaspore	-0.1933
Ferrite-Ca	8.8153s/sat	Brucite	-0.3628
CaUO4	7.0375s/sat	UO3:2H2O	-0.5207
Pyrolusite	6.9742s/sat	Schoepite	-0.5207
Ferrite-Mg	6.5502s/sat	Magnetite	-0.5240
Na2U2O7(c)	6.1910s/sat	Boehmite	-0.5972
Bixbyite	5.7446s/sat	Parsonsite	-0.6286
MnO2(gamma)	5.4564s/sat	UO2(OH)2(beta)	-0.6331
Goethite	5.3006s/sat	PbHPO4	-0.6386
Whitlockite	4.7709s/sat	UO3:.9H2O(alpha)	-0.7041
Na2U2O7(am)	3.6827s/sat	Schoepite-dehy(.	-0.7041
Pyromorphite	3.5500s/sat	Schoepite-dehy(.	-0.7844
Plattnerite	3.2810s/sat	Gibbsite	-0.7890
Becquerelite	3.1423s/sat	Schoepite-dehy(1	-0.7905
Pb4O(PO4)2	2.5627s/sat	Fluorite	-1.1238
Manganite	2.5541s/sat	Dolomite-dis	-1.2063
SrUO4(alpha)	2.2489s/sat	Litharge	-1.2776
Hausmannite	2.0230s/sat	Cerussite	-1.3050
Minium	1.7787s/sat	Pb3(PO4)2	-1.3967
Bunsenite	1.7670s/sat	Massicot	-1.4598
Strontianite	1.5398s/sat	Schoepite-dehy(.	-1.8937
Ni(OH)2	1.4904s/sat	Magnesite	-2.2336
Calcite	0.9430s/sat	Schoepite-dehy(.	-2.4117
Aragonite	0.7986s/sat	MgUO4	-2.7545
Hydrocerussite	0.4853s/sat	PbCO3.PbO	-2.8240
Dolomite-ord	0.3381s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1466	-0.834
H2O(g)	0.02598	-1.585
CO2(g)	8.677e-009	-8.062
HF(g)	9.409e-017	-16.026
NO2(g)	4.115e-023	-22.386
HCl(g)	5.311e-025	-24.275
N2(g)	7.498e-026	-25.125
NO(g)	7.205e-029	-28.142
Cl2(g)	1.566e-041	-40.805
H2(g)	7.320e-042	-41.135
CO(g)	1.984e-053	-52.703
UO2F2(g)	6.567e-061	-60.183
Pb(g)	4.152e-063	-62.382
SO2(g)	1.070e-066	-65.971
UO3(g)	2.315e-067	-66.635
Na(g)	1.406e-070	-69.852
NH3(g)	4.134e-072	-71.384
UO2Cl2(g)	2.576e-080	-79.589
UOF4(g)	2.357e-080	-79.628
F2(g)	3.859e-088	-87.414
UF5(g)	1.902e-096	-95.721
UF4(g)	9.465e-103	-102.024
UF6(g)	3.765e-104	-103.424
UO2(g)	3.767e-120	-119.424
Mg(g)	3.564e-125	-124.448
Ca(g)	2.852e-145	-144.545
UCl4(g)	8.987e-147	-146.046
UF3(g)	2.157e-150	-149.666
CH4(g)	1.987e-150	-149.702
H2S(g)	1.036e-153	-152.985
UCl5(g)	7.099e-160	-159.149
U2F10(g)	4.052e-167	-166.392
UCl6(g)	1.042e-167	-166.982
UCl3(g)	5.855e-171	-170.232
Al(g)	1.382e-191	-190.860
C(g)	1.215e-194	-193.915
UF2(g)	7.257e-195	-194.139
UO(g)	2.434e-204	-203.614
UCl2(g)	2.065e-212	-211.685
UF(g)	6.007e-233	-232.221
C2H4(g)	1.454e-247	-246.837
S2(g)	4.468e-250	-249.350
UCl(g)	1.596e-251	-250.797
U2Cl8(g)	1.990e-282	-281.701
U(g)	3.688e-289	-288.433
U2Cl10(g)	1.006e-292	-291.998

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	0.000112	0.000112	3.02			
Ca++	0.00118	0.00118	47.2			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	0.000239	0.000239	27.7			
F-	0.00113	0.00113	21.4			

Fe++	0.000159	0.000159	8.87
H+	-0.0244	-0.0244	-24.6
H2O	55.5	55.5	9.98e+005
HCO3-	0.00817	0.00817	498.
HPO4--	0.00155	0.00155	149.
Mg++	2.83e-006	2.83e-006	0.0687
Mn++	2.44e-005	2.44e-005	1.34
NH3(aq)	0.00104	0.00104	17.7
Na+	0.0186	0.0186	427.
Ni++	1.83e-005	1.83e-005	1.07
O2(aq)	0.00233	0.00233	74.4
Pb++	1.93e-005	1.93e-005	3.99
SO4--	1.00e-006	1.00e-006	0.0959
Sr++	1.00e-006	1.00e-006	0.0875
UO2++	0.00127	0.00127	342.

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	0.0001120	0.0001120	3.017		
Calcium	0.001180	0.001180	47.22		
Carbon	0.008167	0.008167	97.94		
Chlorine	1.000e-006	1.000e-006	0.03540		
Chromium	0.0002390	0.0002390	12.41		
Fluorine	0.001130	0.001130	21.43		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0001590	0.0001590	8.866		
Lead	1.930e-005	1.930e-005	3.993		
Magnesium	2.830e-006	2.830e-006	0.06867		
Manganese	2.440e-005	2.440e-005	1.338		
Nickel	1.830e-005	1.830e-005	1.072		
Nitrogen	0.001040	0.001040	14.54		
Oxygen	55.55	55.55	8.873e+005		
Phosphorus	0.001550	0.001550	47.93		
Sodium	0.01860	0.01860	426.9		
Strontium	1.000e-006	1.000e-006	0.08748		
Sulfur	1.000e-006	1.000e-006	0.03202		
Uranium	0.001270	0.001270	301.8		

Sample 19961 $Ca(OH)_2$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.990               log fO2 =   -0.707
Eh =   0.5093 volts       pe =   8.6097
Ionic strength      =     0.022665
Activity of water   =     1.000000
Solvent mass        =     0.999790 kg
Solution mass       =     1.000637 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000001 molal
Dissolved solids    =          847 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       517.44 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.01147	194.9	0.8616	-2.0051
Na+	0.008193	188.2	0.8643	-2.1499
CO3--	0.005052	302.9	0.5611	-2.5474
NO3-	0.0009312	57.69	0.8588	-3.0971
F-	0.0008447	16.03	0.8616	-3.1380
HPO4--	0.0002663	25.54	0.5545	-3.8308
PO4---	0.0002599	24.67	0.2646	-4.1626
O2(aq)	0.0002481	7.934	1.0000	-3.6053
NaCO3-	7.593e-005	6.297	0.8643	-4.1829
HCO3-	7.156e-005	4.363	0.8643	-4.2086
AlO2-	5.805e-005	3.421	0.8643	-4.2996
CaPO4-	1.585e-005	2.139	0.8643	-4.8633
UO2(OH)3-	1.118e-005	3.586	0.8643	-5.0150
NaOH(aq)	1.110e-005	0.4436	1.0000	-4.9547
NaHPO4-	1.006e-005	1.196	0.8643	-5.0607
Fe(OH)4-	3.548e-006	0.4392	0.8643	-5.5133
CrO4--	3.301e-006	0.3825	0.5545	-5.7375
Cl-	9.992e-007	0.03539	0.8588	-6.0665
MgPO4-	9.858e-007	0.1175	0.8643	-6.0695
SO4--	9.710e-007	0.09320	0.5545	-6.2689
Ni(OH)3-	9.198e-007	0.1008	0.8643	-6.0997
MnO4--	9.023e-007	0.1072	0.5545	-6.3008
Pb(OH)3-	6.379e-007	0.1646	0.8643	-6.2586
NaHCO3(aq)	6.246e-007	0.05242	1.0000	-6.2044
SrCO3(aq)	5.301e-007	0.07819	1.0000	-6.2756
NaF(aq)	5.182e-007	0.02174	1.0000	-6.2855
Sr++	4.492e-007	0.03933	0.5676	-6.5935
CaCO3(aq)	4.159e-007	0.04159	1.0000	-6.3810
UO2(OH)4--	2.654e-007	0.08964	0.5545	-6.8323
UO2(CO3)3----	1.507e-007	0.06775	0.0939	-7.8493
Ca++	1.191e-007	0.004768	0.5801	-7.1607

MnO4-	9.792e-008	0.01164	0.8616	-7.0738
Ni(OH)2(aq)	8.042e-008	0.007449	1.0000	-7.0947
NaAlO2(aq)	6.416e-008	0.005255	1.0000	-7.1927
Pb(OH)2(aq)	5.577e-008	0.01344	1.0000	-7.2536
NaSO4-	2.915e-008	0.003467	0.8643	-7.5988
SrOH+	1.479e-008	0.001546	0.8643	-7.8935
Fe(OH)3(aq)	1.249e-008	0.001334	1.0000	-7.9033
CaOH+	1.103e-008	0.0006292	0.8643	-8.0207

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	23.3994s/sat	Whitlockite	-0.9387
Todorokite	20.0834s/sat	Boehmite	-0.9705
Trevorite	11.3013s/sat	Na2U2O7(am)	-0.9861
Fluorapatite	10.5302s/sat	Gibbsite	-1.1623
Hematite	8.0848s/sat	Calcite	-1.2280
Pyrolusite	5.3731s/sat	Aragonite	-1.3724
MnO2(gamma)	3.8553s/sat	Fe(OH)3(ppd)	-1.5589
Hydroxylapatite	3.7388s/sat	Monohydrocalcite	-2.0617
Goethite	3.5622s/sat	PbHPO4	-2.2467
Ferrite-Ca	3.4910s/sat	Dolomite	-2.6074
CaUO4	3.0942s/sat	Dolomite-ord	-2.6074
Ferrite-Mg	2.6223s/sat	UO3:2H2O	-2.6165
Bixbyite	2.4789s/sat	Schoepite	-2.6165
Plattnerite	1.8199s/sat	UO2(OH)2(beta)	-2.7289
Na2U2O7(c)	1.5222s/sat	Minium	-2.7316
Strontianite	1.5016s/sat	UO3:.9H2O(alpha)	-2.7999
Manganite	0.9213s/sat	Schoepite-dehy(.	-2.7999
SrUO4(alpha)	0.4383s/sat	Litharge	-2.8022
Bunsenite	0.4236s/sat	Schoepite-dehy(.	-2.8802
Ni(OH)2	0.1470s/sat	Schoepite-dehy(1	-2.8863
Ice	-0.1387	Hausmannite	-2.9073
Diaspore	-0.5666	Massicot	-2.9844
Brucite	-0.8139		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1963	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	4.121e-009	-8.385
HF(g)	5.746e-017	-16.241
NO2(g)	2.799e-023	-22.553
HCl(g)	4.346e-025	-24.362
N2(g)	1.933e-026	-25.714
NO(g)	4.234e-029	-28.373
Cl2(g)	1.214e-041	-40.916
H2(g)	6.325e-042	-41.199
CO(g)	8.139e-054	-53.089
UO2F2(g)	1.965e-063	-62.707
Pb(g)	1.072e-064	-63.970
SO2(g)	6.683e-067	-66.175
UO3(g)	1.857e-069	-68.731
Na(g)	7.541e-071	-70.123
NH3(g)	1.686e-072	-71.773

UO2Cl2(g)	1.383e-082	-81.859
UOF4(g)	2.630e-083	-82.580
F2(g)	1.666e-088	-87.778
UF5(g)	1.205e-099	-98.919
UF4(g)	9.127e-106	-105.040
UF6(g)	1.567e-107	-106.805
UO2(g)	2.611e-122	-121.583
Mg(g)	1.090e-125	-124.963
Ca(g)	3.501e-147	-146.456
UCl4(g)	2.791e-149	-148.554
CH4(g)	5.259e-151	-150.279
UF3(g)	3.166e-153	-152.499
H2S(g)	4.175e-154	-153.379
UCl5(g)	1.940e-162	-161.712
UCl6(g)	2.506e-170	-169.601
UCl3(g)	2.066e-173	-172.685
U2F10(g)	1.626e-173	-172.789
Al(g)	4.698e-192	-191.328
C(g)	4.309e-195	-194.366
UF2(g)	1.621e-197	-196.790
UO(g)	1.458e-206	-205.836
UCl2(g)	8.280e-215	-214.082
UF(g)	2.042e-235	-234.690
C2H4(g)	1.365e-248	-247.865
S2(g)	9.719e-251	-250.012
UCl(g)	7.268e-254	-253.139
U2Cl8(g)	1.920e-287	-286.717
U(g)	1.908e-291	-290.719
U2Cl10(g)	7.514e-298	-297.124

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	5.81e-005	5.81e-005	1.57			
Ca++	1.64e-005	1.64e-005	0.657			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	3.30e-006	3.30e-006	0.383			
F-	0.000845	0.000845	16.0			
Fe++	3.56e-006	3.56e-006	0.199			
H+	-0.0181	-0.0181	-18.2			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00520	0.00520	317.			
HPO4--	0.000553	0.000553	53.0			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	0.000931	0.000931	15.8			
Na+	0.00829	0.00829	190.			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.00211	0.00211	67.5			
Pb++	6.94e-007	6.94e-007	0.144			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	1.16e-005	1.16e-005	3.13			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg

Aluminum	5.810e-005	5.810e-005	1.567
Calcium	1.640e-005	1.640e-005	0.6569
Carbon	0.005201	0.005201	62.43
Chlorine	1.000e-006	1.000e-006	0.03543
Chromium	3.300e-006	3.300e-006	0.1715
Fluorine	0.0008450	0.0008450	16.04
Hydrogen	111.0	111.0	1.118e+005
Iron	3.560e-006	3.560e-006	0.1987
Lead	6.940e-007	6.940e-007	0.1437
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05490
Nickel	1.000e-006	1.000e-006	0.05865
Nitrogen	0.0009310	0.0009310	13.03
Oxygen	55.53	55.53	8.879e+005
Phosphorus	0.0005530	0.0005530	17.12
Sodium	0.008290	0.008290	190.5
Strontium	1.000e-006	1.000e-006	0.08756
Sulfur	1.000e-006	1.000e-006	0.03205
Uranium	1.160e-005	1.160e-005	2.759

Sample 19961 $Ca(OH)_2$ leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.830               log fO2 =   -0.706
Eh =   0.5188 volts       pe =   8.7699
Ionic strength      =     0.014659
Activity of water   =     1.000000
Solvent mass        =     0.999859 kg
Solution mass       =     1.000393 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000001 molal
Dissolved solids    =          534 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       394.21 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.007738	131.5	0.8836	-2.1651
Na+	0.005969	137.1	0.8855	-2.2769
CO3--	0.003815	228.8	0.6174	-2.6279
O2(aq)	0.0002486	7.951	1.0000	-3.6045
HCO3-	8.388e-005	5.115	0.8855	-4.1291
NO3-	7.001e-005	4.338	0.8816	-4.2096
NaCO3-	4.595e-005	3.812	0.8855	-4.3905
CaCO3(aq)	3.267e-005	3.268	1.0000	-4.4859
AlO2-	2.948e-005	1.738	0.8855	-4.5833
CrO4--	1.430e-005	1.658	0.6123	-5.0576
Ca++	1.033e-005	0.4139	0.6320	-5.1851
NaOH(aq)	5.731e-006	0.2291	1.0000	-5.2417
UO2(OH)3-	2.838e-006	0.9108	0.8855	-5.5997
Fe(OH)4-	1.622e-006	0.2008	0.8855	-5.8428
F-	9.996e-007	0.01898	0.8836	-6.0539
Cl-	9.994e-007	0.03541	0.8816	-6.0550
SO4--	9.760e-007	0.09371	0.6123	-6.2236
Ni(OH)3-	8.855e-007	0.09709	0.8855	-6.1056
MnO4--	8.556e-007	0.1017	0.6123	-6.2808
CaOH+	7.043e-007	0.04018	0.8855	-6.2051
CaPO4-	6.942e-007	0.09371	0.8855	-6.2113
MgCO3(aq)	5.714e-007	0.04815	1.0000	-6.2430
NaHCO3(aq)	5.598e-007	0.04700	1.0000	-6.2520
SrCO3(aq)	5.120e-007	0.07555	1.0000	-6.2907
Sr++	4.763e-007	0.04171	0.6224	-6.5281
Mg++	3.920e-007	0.009522	0.6498	-6.5940
HPO4--	1.654e-007	0.01587	0.6123	-6.9944
MnO4-	1.446e-007	0.01719	0.8836	-6.8936
Ni(OH)2(aq)	1.146e-007	0.01062	1.0000	-6.9406
PO4---	9.860e-008	0.009359	0.3311	-7.4862
Pb(OH)3-	8.347e-008	0.02154	0.8855	-7.1313

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  UO2(CO3)3----      4.554e-008      0.02049     0.1400       -8.1956
  UO2(OH)4--         4.325e-008      0.01461     0.6123       -7.5770
  MgPO4-             3.644e-008     0.004344     0.8855       -7.4912
  NaAlO2(aq)         2.492e-008     0.002041     1.0000       -7.6035
  NaSO4-             2.357e-008     0.002804     0.8855       -7.6805
  SrOH+              1.161e-008     0.001214     0.8855       -7.9881
  Pb(OH)2(aq)        1.081e-008     0.002605     1.0000       -7.9663
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                          log Q/K
----------------------------------------------------------------
  Birnessite       26.1154s/sat   Calcite            0.6671s/sat
  Todorokite       22.4598s/sat   Bunsenite          0.5777s/sat
  Trevorite        11.1163s/sat   Aragonite          0.5227s/sat
  Hematite          7.7458s/sat   Ni(OH)2            0.3011s/sat
  Fluorapatite      7.5215s/sat   Na2U2O7(c)         0.0986s/sat
  Pyrolusite        5.7127s/sat   Ice               -0.1387
  Ferrite-Ca        4.8076s/sat   Monohydrocalcite  -0.1666
  CaUO4             4.3250s/sat   SrUO4(alpha)      -0.2410
  MnO2(gamma)       4.1949s/sat   Dolomite-dis      -0.4353
  Ferrite-Mg        3.8653s/sat   Diaspore          -0.6903
  Hydroxylapatite   3.4860s/sat   Boehmite          -1.0942
  Goethite          3.3927s/sat   Magnesite         -1.1867
  Bixbyite          3.1577s/sat   Gibbsite          -1.2860
  Strontianite      1.4865s/sat   Artinite          -1.4831
  Manganite         1.2607s/sat   Whitlockite       -1.6592
  Dolomite-ord      1.1091s/sat   Fe(OH)3(ppd)      -1.7284
  Dolomite          1.1091s/sat   Hausmannite       -1.8893
  Plattnerite       1.1076s/sat   Na2U2O7(am)       -2.4097
  Brucite           0.7680s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                 fugacity      log fug.
-----------------------------------------------
  O2(g)                  0.1967       -0.706
  H2O(g)                0.02598       -1.585
  CO2(g)             7.152e-009       -8.146
  HF(g)              1.008e-019      -18.997
  NO2(g)             3.121e-024      -23.506
  HCl(g)             6.449e-025      -24.190
  N2(g)              2.394e-028      -27.621
  NO(g)              4.716e-030      -29.326
  Cl2(g)             2.675e-041      -40.573
  H2(g)              6.319e-042      -41.199
  CO(g)              1.412e-053      -52.850
  Pb(g)              2.076e-065      -64.683
  SO2(g)             1.548e-066      -65.810
  UO2F2(g)           2.274e-069      -68.643
  UO3(g)             6.984e-070      -69.156
  Na(g)              3.892e-071      -70.410
  NH3(g)             1.874e-073      -72.727
  UO2Cl2(g)          1.146e-082      -81.941
  F2(g)              5.132e-094      -93.290
  UOF4(g)            9.368e-095      -94.028
  UF5(g)             7.528e-114     -113.123
  UF4(g)             3.248e-117     -116.488
```

UO2(g)	9.809e-123	-122.008
Mg(g)	4.158e-124	-123.381
UF6(g)	1.718e-124	-123.765
Ca(g)	1.583e-145	-144.801
UCl4(g)	5.087e-149	-148.294
CH4(g)	9.096e-151	-150.041
H2S(g)	9.647e-154	-153.016
UF3(g)	6.420e-162	-161.192
UCl5(g)	5.251e-162	-161.280
UCl6(g)	1.007e-169	-168.997
UCl3(g)	2.536e-173	-172.596
Al(g)	3.528e-192	-191.452
C(g)	7.465e-195	-194.127
U2F10(g)	6.344e-202	-201.198
UF2(g)	1.873e-203	-202.728
UO(g)	5.471e-207	-206.262
UCl2(g)	6.845e-215	-214.165
UF(g)	1.344e-238	-237.872
C2H4(g)	4.089e-248	-247.388
S2(g)	5.198e-250	-249.284
UCl(g)	4.047e-254	-253.393
U2Cl8(g)	6.377e-287	-286.195
U(g)	7.157e-292	-291.145
U2Cl10(g)	5.503e-297	-296.259

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	2.95e-005	2.95e-005	0.796			
Ca++	4.44e-005	4.44e-005	1.78			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	1.43e-005	1.43e-005	1.66			
F-	1.00e-006	1.00e-006	0.0190			
Fe++	1.63e-006	1.63e-006	0.0910			
H+	-0.0118	-0.0118	-11.9			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00398	0.00398	243.			
HPO4--	1.00e-006	1.00e-006	0.0959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	7.00e-005	7.00e-005	1.19			
Na+	0.00602	0.00602	138.			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	9.44e-008	9.44e-008	0.0196			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	2.93e-006	2.93e-006	0.791			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	2.950e-005	2.950e-005	0.7956		
Calcium	4.440e-005	4.440e-005	1.779		
Carbon	0.003979	0.003979	47.77		
Chlorine	1.000e-006	1.000e-006	0.03544		
Chromium	1.430e-005	1.430e-005	0.7433		

Fluorine	1.000e-006	1.000e-006	0.01899
Hydrogen	111.0	111.0	1.118e+005
Iron	1.630e-006	1.630e-006	0.09099
Lead	9.440e-008	9.440e-008	0.01955
Magnesium	1.000e-006	1.000e-006	0.02430
Manganese	1.000e-006	1.000e-006	0.05492
Nickel	1.000e-006	1.000e-006	0.05867
Nitrogen	7.000e-005	7.000e-005	0.9801
Oxygen	55.52	55.52	8.880e+005
Phosphorus	1.000e-006	1.000e-006	0.03096
Sodium	0.006020	0.006020	138.3
Strontium	1.000e-006	1.000e-006	0.08759
Sulfur	1.000e-006	1.000e-006	0.03205
Uranium	2.930e-006	2.930e-006	0.6972

Sample 19961 $Ca(OH)_2$ leach, Stage 4.

```
Step #     0               Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH = 11.880                log fO2 =   -0.707
Eh =   0.5158 volts        pe =   8.7196
Ionic strength       =     0.013877
Activity of water    =     1.000000
Solvent mass         =     0.999843 kg
Solution mass        =     1.000425 kg
Solution density     =     1.013    g/cm3
Chlorinity           =     0.000001 molal
Dissolved solids     =          582 mg/kg sol'n
Rock mass            =     0.000000 kg
Carbonate alkalinity=        440.26 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.008657	147.2	0.8862	-2.1151
Na+	0.004058	93.24	0.8880	-2.4433
CO3--	0.003358	201.4	0.6243	-2.6786
CaCO3(aq)	0.0009855	98.57	1.0000	-3.0064
Ca++	0.0003468	13.89	0.6383	-3.6549
O2(aq)	0.0002481	7.933	1.0000	-3.6054
NO3-	6.993e-005	4.334	0.8843	-4.2087
HCO3-	6.635e-005	4.046	0.8880	-4.2298
NaCO3-	2.781e-005	2.307	0.8880	-4.6074
CaOH+	2.671e-005	1.524	0.8880	-4.6249
NaOH(aq)	4.385e-006	0.1753	1.0000	-5.3581
Fe(OH)4-	3.773e-006	0.4671	0.8880	-5.4749
CrO4--	1.920e-006	0.2226	0.6193	-5.9247
Cl-	9.996e-007	0.03542	0.8843	-6.0536
AlO2-	9.996e-007	0.05892	0.8880	-6.0518
F-	9.988e-007	0.01896	0.8862	-6.0530
CaPO4-	9.877e-007	0.1333	0.8880	-6.0570
SO4--	9.669e-007	0.09283	0.6193	-6.2227
Ni(OH)3-	8.964e-007	0.09829	0.8880	-6.0991
MnO4--	8.683e-007	0.1032	0.6193	-6.2694
MgCO3(aq)	5.659e-007	0.04768	1.0000	-6.2473
Sr++	5.014e-007	0.04390	0.6291	-6.5012
SrCO3(aq)	4.848e-007	0.07153	1.0000	-6.3144
UO2(OH)3-	4.467e-007	0.1433	0.8880	-6.4015
Mg++	4.323e-007	0.01050	0.6555	-6.5476
NaHCO3(aq)	3.027e-007	0.02542	1.0000	-6.5189
CaHCO3+	1.635e-007	0.01652	0.8880	-6.8380
MnO4-	1.318e-007	0.01567	0.8862	-6.9325
Ni(OH)2(aq)	1.037e-007	0.009611	1.0000	-6.9841
Pb(OH)3-	8.454e-008	0.02182	0.8880	-7.1245
CaNO3+	7.726e-008	0.007883	0.8880	-7.1636

Fe(OH)3(aq)	1.758e-008	0.001878	1.0000	-7.7549
CaSO4(aq)	1.712e-008	0.002329	1.0000	-7.7665
NaSO4-	1.606e-008	0.001910	0.8880	-7.8460
SrOH+	1.382e-008	0.001445	0.8880	-7.9112

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	25.4113s/sat	Manganite	1.1728s/sat
Todorokite	21.8438s/sat	Plattnerite	1.0639s/sat
Trevorite	11.7087s/sat	Dolomite-dis	1.0401s/sat
Fluorapatite	11.0457s/sat	Brucite	0.9144s/sat
Hematite	8.3816s/sat	Bunsenite	0.5342s/sat
Ferrite-Ca	7.0736s/sat	Ni(OH)2	0.2576s/sat
Hydroxylapatite	7.0593s/sat	Whitlockite	0.1797s/sat
Pyrolusite	5.6245s/sat	Ice	-0.1387
CaUO4	5.1034s/sat	SrUO4(alpha)	-0.9659
Ferrite-Mg	4.6475s/sat	Magnesite	-1.1910
MnO2(gamma)	4.1067s/sat	Artinite	-1.3410
Goethite	3.7106s/sat	Fe(OH)3(ppd)	-1.4105
Bixbyite	2.9819s/sat	Na2U2O7(c)	-1.8377
Dolomite-ord	2.5845s/sat	Hausmannite	-2.1528
Dolomite	2.5845s/sat	Diaspore	-2.2088
Calcite	2.1466s/sat	Portlandite	-2.4501
Aragonite	2.0022s/sat	Boehmite	-2.6127
Strontianite	1.4628s/sat	Gibbsite	-2.8045
Monohydrocalcite	1.3129s/sat	Huntite	-2.9978

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1963	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	5.056e-009	-8.296
HF(g)	9.003e-020	-19.046
NO2(g)	2.788e-024	-23.555
HCl(g)	5.767e-025	-24.239
N2(g)	1.920e-028	-27.717
NO(g)	4.218e-030	-29.375
Cl2(g)	2.137e-041	-40.670
H2(g)	6.326e-042	-41.199
CO(g)	9.990e-054	-53.000
Pb(g)	1.881e-065	-64.726
SO2(g)	1.234e-066	-65.909
UO2F2(g)	2.551e-070	-69.593
UO3(g)	9.823e-071	-70.008
Na(g)	2.979e-071	-70.526
NH3(g)	1.681e-073	-72.775
UO2Cl2(g)	1.289e-083	-82.890
F2(g)	4.088e-094	-93.388
UOF4(g)	8.383e-096	-95.077
UF5(g)	6.019e-115	-114.220
UF4(g)	2.909e-118	-117.536
UO2(g)	1.381e-123	-122.860
Mg(g)	5.831e-124	-123.234
UF6(g)	1.226e-125	-124.911

Ca(g)	6.761e-144	-143.170
UCl4(g)	4.579e-150	-149.339
CH4(g)	6.458e-151	-150.190
H2S(g)	7.712e-154	-153.113
UF3(g)	6.443e-163	-162.191
UCl5(g)	4.224e-163	-162.374
UCl6(g)	7.239e-171	-170.140
UCl3(g)	2.554e-174	-173.593
Al(g)	1.071e-193	-192.970
C(g)	5.289e-195	-194.277
U2F10(g)	4.056e-204	-203.392
UF2(g)	2.106e-204	-203.677
UO(g)	7.712e-208	-207.113
UCl2(g)	7.715e-216	-215.113
UF(g)	1.693e-239	-238.771
C2H4(g)	2.057e-248	-247.687
S2(g)	3.315e-250	-249.480
UCl(g)	5.103e-255	-254.292
U2Cl8(g)	5.166e-289	-288.287
U(g)	1.010e-292	-291.996
U2Cl10(g)	3.560e-299	-298.449

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	0.00136	0.00136	54.5			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	1.92e-006	1.92e-006	0.223			
F-	1.00e-006	1.00e-006	0.0190			
Fe++	3.79e-006	3.79e-006	0.212			
H+	-0.0132	-0.0132	-13.3			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00444	0.00444	271.			
HPO4--	1.00e-006	1.00e-006	0.0959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	7.00e-005	7.00e-005	1.19			
Na+	0.00409	0.00409	94.0			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	9.44e-008	9.44e-008	0.0196			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	4.62e-007	4.62e-007	0.125			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.000e-006	1.000e-006	0.02697		
Calcium	0.001360	0.001360	54.48		
Carbon	0.004438	0.004438	53.29		
Chlorine	1.000e-006	1.000e-006	0.03544		
Chromium	1.920e-006	1.920e-006	0.09979		
Fluorine	1.000e-006	1.000e-006	0.01899		
Hydrogen	111.0	111.0	1.118e+005		
Iron	3.790e-006	3.790e-006	0.2116		

Lead	9.440e-008	9.440e-008	0.01955
Magnesium	1.000e-006	1.000e-006	0.02429
Manganese	1.000e-006	1.000e-006	0.05491
Nickel	1.000e-006	1.000e-006	0.05867
Nitrogen	7.000e-005	7.000e-005	0.9801
Oxygen	55.52	55.52	8.880e+005
Phosphorus	1.000e-006	1.000e-006	0.03096
Sodium	0.004090	0.004090	93.99
Strontium	1.000e-006	1.000e-006	0.08758
Sulfur	1.000e-006	1.000e-006	0.03205
Uranium	4.620e-007	4.620e-007	0.1099

Sample 19961 $Ca(OH)_2$ leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 12.200               log fO2 =   -0.706
Eh =   0.4969 volts       pe =   8.3999
Ionic strength      =    0.020527
Activity of water   =    1.000000
Solvent mass        =    0.999662 kg
Solution mass       =    1.000747 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000001 molal
Dissolved solids    =        1084 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      787.85 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
OH-	0.01849	314.1	0.8668	-1.7951
CaCO3(aq)	0.004244	424.3	1.0000	-2.3722
CO3--	0.003612	216.5	0.5741	-2.6833
Ca++	0.001628	65.17	0.5920	-3.0160
Na+	0.001219	28.00	0.8693	-2.9747
O2(aq)	0.0002486	7.947	1.0000	-3.6045
CaOH+	0.0002482	14.15	0.8693	-3.6660
NO3-	6.969e-005	4.316	0.8643	-4.2202
HCO3-	3.209e-005	1.956	0.8693	-4.5545
NaCO3-	8.266e-006	0.6853	0.8693	-5.1435
NaOH(aq)	2.695e-006	0.1077	1.0000	-5.5695
CrO4--	1.981e-006	0.2295	0.5678	-5.9490
Fe(OH)4-	1.827e-006	0.2260	0.8693	-5.7992
AlO2-	1.000e-006	0.05893	0.8693	-6.0607
Cl-	1.000e-006	0.03541	0.8643	-6.0634
CaPO4-	9.979e-007	0.1346	0.8693	-6.0617
F-	9.956e-007	0.01890	0.8668	-6.0640
Ni(OH)3-	9.489e-007	0.1040	0.8693	-6.0836
MnO4--	9.365e-007	0.1113	0.5678	-6.2743
SO4--	9.303e-007	0.08927	0.5678	-6.2772
MgCO3(aq)	5.479e-007	0.04614	1.0000	-6.2613
Sr++	5.164e-007	0.04520	0.5803	-6.5233
Pb(OH)3-	5.000e-007	0.1290	0.8693	-6.3619
SrCO3(aq)	4.557e-007	0.06720	1.0000	-6.3413
Mg++	4.519e-007	0.01097	0.6137	-6.5570
CaHCO3+	3.444e-007	0.03478	0.8693	-6.5238
CaNO3+	3.346e-007	0.03412	0.8693	-6.5362
UO2(OH)3-	2.443e-007	0.07834	0.8693	-6.6730
CaSO4(aq)	6.575e-008	0.008942	1.0000	-7.1821
MnO4-	6.382e-008	0.007583	0.8668	-7.2571
Ni(OH)2(aq)	5.145e-008	0.004765	1.0000	-7.2886

NaHCO3(aq)	4.217e-008	0.003539	1.0000	-7.3750
SrOH+	2.802e-008	0.002928	0.8693	-7.6133
Pb(OH)2(aq)	2.711e-008	0.006532	1.0000	-7.5669

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	20.2476s/sat	Dolomite-dis	1.6602s/sat
Todorokite	17.3254s/sat	Brucite	1.5450s/sat
Fluorapatite	12.2982s/sat	Plattnerite	1.5070s/sat
Trevorite	10.1157s/sat	Strontianite	1.4359s/sat
Hydroxylapatite	8.6427s/sat	Whitlockite	0.8090s/sat
Hematite	7.0931s/sat	Manganite	0.5272s/sat
Ferrite-Ca	7.0639s/sat	Bunsenite	0.2297s/sat
CaUO4	5.7908s/sat	Ni(OH)2	-0.0469
Pyrolusite	4.9792s/sat	Ice	-0.1387
Ferrite-Mg	3.9896s/sat	Artinite	-0.7244
MnO2(gamma)	3.4614s/sat	SrUO4(alpha)	-0.9395
Dolomite	3.2046s/sat	Portlandite	-1.1712
Dolomite-ord	3.2046s/sat	Magnesite	-1.2050
Goethite	3.0663s/sat	Fe(OH)3(ppd)	-2.0548
Calcite	2.7808s/sat	Huntite	-2.4057
Aragonite	2.6364s/sat	Diaspore	-2.5377
Monohydrocalcite	1.9471s/sat	Boehmite	-2.9416
Bixbyite	1.6907s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1967	-0.706
H2O(g)	0.02598	-1.585
CO2(g)	1.146e-009	-8.941
HF(g)	4.202e-020	-19.377
NO2(g)	1.299e-024	-23.886
HCl(g)	2.699e-025	-24.569
N2(g)	4.148e-029	-28.382
NO(g)	1.963e-030	-29.707
H2(g)	6.319e-042	-41.199
Cl2(g)	4.684e-042	-41.329
CO(g)	2.261e-054	-53.646
Pb(g)	5.207e-065	-64.283
SO2(g)	2.490e-067	-66.604
UO3(g)	2.517e-071	-70.599
Na(g)	1.830e-071	-70.738
UO2F2(g)	1.424e-071	-70.847
NH3(g)	7.799e-074	-73.108
UO2Cl2(g)	7.230e-085	-84.141
F2(g)	8.916e-095	-94.050
UOF4(g)	1.019e-097	-96.992
UF5(g)	3.413e-117	-116.467
UF4(g)	3.533e-120	-119.452
Mg(g)	2.488e-123	-122.604
UO2(g)	3.535e-124	-123.452
UF6(g)	3.247e-128	-127.488
Ca(g)	1.283e-142	-141.892
CH4(g)	1.457e-151	-150.837

UCl4(g)	5.620e-152	-151.250
H2S(g)	1.552e-154	-153.809
UF3(g)	1.675e-164	-163.776
UCl5(g)	2.428e-165	-164.615
UCl6(g)	1.948e-173	-172.710
UCl3(g)	6.696e-176	-175.174
Al(g)	5.013e-194	-193.300
C(g)	1.196e-195	-194.922
UF2(g)	1.172e-205	-204.931
UO(g)	1.972e-208	-207.705
U2F10(g)	1.304e-208	-207.885
UCl2(g)	4.319e-217	-216.365
UF(g)	2.019e-240	-239.695
C2H4(g)	1.049e-249	-248.979
S2(g)	1.345e-251	-250.871
UCl(g)	6.102e-256	-255.215
U2Cl8(g)	7.784e-293	-292.109
U(g)	2.579e-293	-292.589
U2Cl10(g)	1.176e-303	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	0.00612	0.00612	245.			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	1.98e-006	1.98e-006	0.229			
F-	1.00e-006	1.00e-006	0.0190			
Fe++	1.83e-006	1.83e-006	0.102			
H+	-0.0267	-0.0267	-26.9			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00790	0.00790	481.			
HPO4--	1.00e-006	1.00e-006	0.0959			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	1.00e-006	1.00e-006	0.0549			
NH3(aq)	7.00e-005	7.00e-005	1.19			
Na+	0.00123	0.00123	28.3			
Ni++	1.00e-006	1.00e-006	0.0586			
O2(aq)	0.000390	0.000390	12.5			
Pb++	5.27e-007	5.27e-007	0.109			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	2.58e-007	2.58e-007	0.0696			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	1.000e-006	1.000e-006	0.02696		
Calcium	0.006120	0.006120	245.1		
Carbon	0.007895	0.007895	94.76		
Chlorine	1.000e-006	1.000e-006	0.03543		
Chromium	1.980e-006	1.980e-006	0.1029		
Fluorine	1.000e-006	1.000e-006	0.01898		
Hydrogen	111.0	111.0	1.118e+005		
Iron	1.830e-006	1.830e-006	0.1021		
Lead	5.270e-007	5.270e-007	0.1091		
Magnesium	1.000e-006	1.000e-006	0.02429		

Manganese	1.000e-006	1.000e-006	0.05490
Nickel	1.000e-006	1.000e-006	0.05865
Nitrogen	7.000e-005	7.000e-005	0.9797
Oxygen	55.53	55.53	8.878e+005
Phosphorus	1.000e-006	1.000e-006	0.03095
Sodium	0.001230	0.001230	28.26
Strontium	1.000e-006	1.000e-006	0.08755
Sulfur	1.000e-006	1.000e-006	0.03204
Uranium	2.580e-007	2.580e-007	0.06137

Sample 19961 $CaCO_3$ leach, 1 day (Stage 1).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 10.520              log fO2 =   -0.843
Eh =   0.5943 volts      pe =  10.0458
Ionic strength      =    0.026790
Activity of water   =    1.000000
Solvent mass        =    0.999979 kg
Solution mass       =    1.001344 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =        1362 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      564.77 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01269	291.4	0.8555	-1.9642
CO3--	0.002612	156.6	0.5390	-2.8514
HPO4--	0.002356	225.8	0.5316	-2.9022
F-	0.001539	29.19	0.8524	-2.8822
HCO3-	0.001060	64.57	0.8555	-3.0426
UO2(CO3)3----	0.0009396	422.3	0.0793	-4.1280
NO3-	0.0008790	54.43	0.8492	-3.1270
OH-	0.0003929	6.672	0.8524	-3.4751
CrO4--	0.0001920	22.24	0.5316	-3.9911
O2(aq)	0.0001816	5.804	1.0000	-3.7408
Fe(OH)4-	0.0001415	17.50	0.8555	-3.9172
NaHPO4-	0.0001322	15.71	0.8555	-3.9464
PO4---	8.219e-005	7.795	0.2406	-4.7040
NaCO3-	5.842e-005	4.842	0.8555	-4.3012
CaPO4-	4.544e-005	6.128	0.8555	-4.4103
AlO2-	3.115e-005	1.835	0.8555	-4.5744
MgPO4-	2.228e-005	2.653	0.8555	-4.7199
UO2(OH)3-	1.888e-005	6.052	0.8555	-4.7918
MnO4-	1.839e-005	2.185	0.8524	-4.8047
Fe(OH)3(aq)	1.455e-005	1.553	1.0000	-4.8372
NaHCO3(aq)	1.404e-005	1.178	1.0000	-4.8527
Ni(OH)2(aq)	1.307e-005	1.210	1.0000	-4.8837
Cl-	9.985e-006	0.3535	0.8492	-5.0716
SO4--	9.572e-006	0.9182	0.5316	-5.2934
MnO4--	6.406e-006	0.7609	0.5316	-5.4678
Pb(CO3)2--	5.491e-006	1.794	0.5316	-5.5348
Pb(OH)2(aq)	5.221e-006	1.258	1.0000	-5.2822
Ni(OH)3-	5.118e-006	0.5608	0.8555	-5.3587
PbCO3(aq)	3.138e-006	0.8373	1.0000	-5.5034
UO2(CO3)2--	2.252e-006	0.8771	0.5316	-5.9219
Ni++	2.082e-006	0.1220	0.5598	-5.9335
Pb(OH)3-	2.044e-006	0.5272	0.8555	-5.7572

CaCO3(aq)	2.039e-006	0.2038	1.0000	-5.6906
NaF(aq)	1.432e-006	0.06005	1.0000	-5.8440
Ca++	1.218e-006	0.04875	0.5598	-6.1663
H2PO4-	7.096e-007	0.06872	0.8555	-6.2168
Sr++	6.067e-007	0.05309	0.5461	-6.4798
NaOH(aq)	5.767e-007	0.02304	1.0000	-6.2390
CaHPO4(aq)	4.693e-007	0.06377	1.0000	-6.3285
PbOH+	4.578e-007	0.1025	0.8555	-6.4071
NaSO4-	4.267e-007	0.05073	0.8555	-6.4376
Mg++	4.246e-007	0.01031	0.5849	-6.6050
(UO2)2CO3(OH)3-	4.190e-007	0.2724	0.8555	-6.4455
UO2(OH)2(aq)	3.939e-007	0.1196	1.0000	-6.4046
SrCO3(aq)	3.421e-007	0.05044	1.0000	-6.4658
MgCO3(aq)	3.331e-007	0.02805	1.0000	-6.4774
MgHPO4(aq)	2.528e-007	0.03037	1.0000	-6.5971
CO2(aq)	6.055e-008	0.002661	1.0000	-7.2179
NaAlO2(aq)	5.225e-008	0.004277	1.0000	-7.2819
SrHPO4(aq)	4.765e-008	0.008737	1.0000	-7.3219
PbP2O7--	4.484e-008	0.01707	0.5316	-7.6228
UO2PO4-	4.319e-008	0.01574	0.8555	-7.4324
UO2(OH)4--	1.568e-008	0.005293	0.5316	-8.0791
NaCl(aq)	1.539e-008	0.0008980	1.0000	-7.8128
HCrO4-	1.125e-008	0.001314	0.8555	-8.0167

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	54.2612s/sat	Gibbsite	0.0329s/sat
Todorokite	47.1044s/sat	Ice	-0.1387
Trevorite	19.6446s/sat	Na2U2O7(am)	-0.1685
Pyromorphite	19.5171s/sat	Dolomite	-0.3300
Hematite	14.2171s/sat	Dolomite-ord	-0.3300
Fluorapatite	14.1335s/sat	Crocoite	-0.5054
Pyromorphite-OH	13.4787s/sat	Calcite	-0.5376
Pb4O(PO4)2	11.9203s/sat	Aragonite	-0.6820
Bixbyite	10.2282s/sat	SrUO4(alpha)	-0.6948
Pyrolusite	9.2138s/sat	Litharge	-0.8308
Hausmannite	8.7505s/sat	Pb4SO7	-0.8369
Ferrite-Mg	7.7056s/sat	Schoepite	-0.9233
MnO2(gamma)	7.6960s/sat	UO3:2H2O	-0.9233
Ferrite-Ca	7.6776s/sat	Massicot	-1.0130
Pb3(PO4)2	7.5140s/sat	UO2(OH)2(beta)	-1.0357
Parsonsite	7.4327s/sat	Schoepite-dehy(.	-1.1067
Goethite	6.6283s/sat	UO3:.9H2O(alpha)	-1.1067
Hydrocerussite	6.4511s/sat	Schoepite-dehy(.	-1.1870
Hydroxylapatite	5.6163s/sat	Schoepite-dehy(1	-1.1931
Manganite	4.7959s/sat	Pb4Cl2(OH)6	-1.2306
Ni3(PO4)2	4.0767s/sat	MnHPO4	-1.3475
Plattnerite	3.7235s/sat	Monohydrocalcite	-1.3713
PbHPO4	3.5933s/sat	Magnesite	-1.4211
Magnetite	3.4614s/sat	Ca-Autunite	-1.4288
Minium	3.1148s/sat	Pb3SO6	-1.5076
CaUO4	2.8416s/sat	Dawsonite	-1.5643
Bunsenite	2.6346s/sat	Mn(OH)3	-1.7099
Ni(OH)2	2.3580s/sat	Brucite	-1.8630
Na2U2O7(c)	2.3398s/sat	Dolomite-dis	-1.8744

Fe(OH)3(ppd)	1.5072s/sat	Fluorite	-1.8938
Cerussite	1.4545s/sat	NiCO3	-1.9678
Strontianite	1.3114s/sat	Lanarkite	-2.2483
Whitlockite	0.9615s/sat	Schoepite-dehy(.	-2.2963
Diaspore	0.6286s/sat	Corundum	-2.7342
PbCO3.PbO	0.3823s/sat	Schoepite-dehy(.	-2.8143
Boehmite	0.2247s/sat	Sellaite	-2.9851

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1437	-0.843
H2O(g)	0.02598	-1.585
CO2(g)	1.782e-006	-5.749
HF(g)	3.056e-015	-14.515
NO2(g)	8.336e-022	-21.079
HCl(g)	1.267e-022	-21.897
N2(g)	3.201e-023	-22.495
NO(g)	1.474e-027	-26.832
Cl2(g)	8.829e-037	-36.054
H2(g)	7.393e-042	-41.131
CO(g)	4.116e-051	-50.386
UO2F2(g)	2.742e-058	-57.562
Pb(g)	1.173e-062	-61.931
SO2(g)	6.430e-063	-62.192
UO3(g)	9.162e-068	-67.038
NH3(g)	8.670e-071	-70.062
Na(g)	4.236e-072	-71.373
UOF4(g)	1.038e-074	-73.984
UO2Cl2(g)	5.804e-076	-75.236
F2(g)	4.031e-085	-84.395
UF5(g)	2.736e-089	-88.563
UF6(g)	1.750e-095	-94.757
UF4(g)	4.211e-097	-96.376
UO2(g)	1.506e-120	-119.822
Mg(g)	1.138e-126	-125.944
UCl4(g)	1.164e-137	-136.934
UF3(g)	2.970e-146	-145.527
CH4(g)	4.247e-148	-147.372
UCl5(g)	2.183e-148	-147.661
Ca(g)	4.637e-149	-148.334
H2S(g)	6.416e-150	-149.193
U2F10(g)	8.379e-153	-152.077
UCl6(g)	7.605e-154	-153.119
UCl3(g)	3.195e-164	-163.496
Al(g)	9.306e-191	-190.031
UF2(g)	3.091e-192	-191.510
C(g)	2.547e-192	-191.594
UO(g)	9.825e-205	-204.008
UCl2(g)	4.746e-208	-207.324
UF(g)	7.916e-232	-231.101
S2(g)	1.680e-242	-241.775
C2H4(g)	6.513e-243	-242.186
UCl(g)	1.545e-249	-248.811
U2Cl8(g)	3.339e-264	-263.476
U2Cl10(g)	9.510e-270	-269.022
U(g)	1.504e-289	-288.823

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	3.12e-005	3.12e-005	0.841			
Ca++	4.92e-005	4.92e-005	1.97			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	0.000192	0.000192	22.2			
F-	0.00154	0.00154	29.2			
Fe++	0.000156	0.000156	8.70			
H+	-0.00771	-0.00771	-7.76			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00659	0.00659	401.			
HPO4--	0.00264	0.00264	253.			
Mg++	2.33e-005	2.33e-005	0.566			
Mn++	2.48e-005	2.48e-005	1.36			
NH3(aq)	0.000879	0.000879	14.9			
Na+	0.0129	0.0129	296.			
Ni++	2.03e-005	2.03e-005	1.19			
O2(aq)	0.00201	0.00201	64.2			
Pb++	1.64e-005	1.64e-005	3.39			
SO4--	1.00e-005	1.00e-005	0.959			
Sr++	1.00e-006	1.00e-006	0.0875			
UO2++	0.000962	0.000962	259.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	3.120e-005	3.120e-005	0.8407		
Calcium	4.920e-005	4.920e-005	1.969		
Carbon	0.006585	0.006585	78.99		
Chlorine	1.000e-005	1.000e-005	0.3541		
Chromium	0.0001920	0.0001920	9.970		
Fluorine	0.001540	0.001540	29.22		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0001560	0.0001560	8.700		
Lead	1.640e-005	1.640e-005	3.394		
Magnesium	2.330e-005	2.330e-005	0.5655		
Manganese	2.480e-005	2.480e-005	1.361		
Nickel	2.030e-005	2.030e-005	1.190		
Nitrogen	0.0008790	0.0008790	12.30		
Oxygen	55.54	55.54	8.875e+005		
Phosphorus	0.002640	0.002640	81.66		
Sodium	0.01290	0.01290	296.2		
Strontium	1.000e-006	1.000e-006	0.08750		
Sulfur	1.000e-005	1.000e-005	0.3202		
Uranium	0.0009620	0.0009620	228.7		

Sample 19961 $CaCO_3$ leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 10.510              log fO2 =   -0.934
Eh =   0.5935 volts      pe =  10.0328
Ionic strength      =    0.032651
Activity of water   =    1.000000
Solvent mass        =    0.999970 kg
Solution mass       =    1.001720 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000010 molal
Dissolved solids    =        1747 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      696.22 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01561	358.2	0.8446	-1.8799
CO3--	0.001980	118.6	0.5125	-2.9936
HPO4--	0.001886	180.7	0.5043	-3.0218
UO2(CO3)3----	0.001742	782.8	0.0641	-3.9521
F-	0.001668	31.64	0.8411	-2.8529
NO3-	0.0009350	57.87	0.8374	-3.1063
HCO3-	0.0007916	48.22	0.8446	-3.1748
OH-	0.0003891	6.606	0.8411	-3.4851
CrO4--	0.0002750	31.84	0.5043	-3.8580
Fe(OH)4-	0.0002192	27.11	0.8446	-3.7324
O2(aq)	0.0001470	4.694	1.0000	-3.8328
NaHPO4-	0.0001235	14.66	0.8446	-3.9817
CaPO4-	9.792e-005	13.20	0.8446	-4.0824
UO2(OH)3-	7.145e-005	22.90	0.8446	-4.2193
PO4---	6.872e-005	6.515	0.2135	-4.8336
NaCO3-	5.178e-005	4.290	0.8446	-4.3591
AlO2-	4.112e-005	2.421	0.8446	-4.4593
MgPO4-	3.172e-005	3.777	0.8446	-4.5720
MnO4-	2.621e-005	3.112	0.8411	-4.6566
Fe(OH)3(aq)	2.278e-005	2.430	1.0000	-4.6424
Ni(OH)2(aq)	1.799e-005	1.665	1.0000	-4.7450
NaHCO3(aq)	1.257e-005	1.054	1.0000	-4.9006
Pb(OH)2(aq)	1.058e-005	2.548	1.0000	-4.9755
Cl-	9.982e-006	0.3533	0.8374	-5.0779
MnO4--	9.785e-006	1.162	0.5043	-5.3067
SO4--	9.503e-006	0.9113	0.5043	-5.3195
Ni(OH)3-	6.972e-006	0.7636	0.8446	-5.2300
Pb(CO3)2--	6.380e-006	2.084	0.5043	-5.4925
UO2(CO3)2--	4.937e-006	1.922	0.5043	-5.6038
PbCO3(aq)	4.799e-006	1.280	1.0000	-5.3189
(UO2)2CO3(OH)3-	4.577e-006	2.975	0.8446	-5.4127

CaCO3(aq)	4.214e-006	0.4210	1.0000	-5.3754
Pb(OH)3-	4.101e-006	1.057	0.8446	-5.4605
Ca++	3.650e-006	0.1460	0.5356	-5.7088
Ni++	3.136e-006	0.1837	0.5356	-5.7748
NaF(aq)	1.860e-006	0.07797	1.0000	-5.7305
UO2(OH)2(aq)	1.506e-006	0.4572	1.0000	-5.8221
CaHPO4(aq)	1.022e-006	0.1388	1.0000	-5.9906
PbOH+	9.615e-007	0.2152	0.8446	-6.0904
Mg++	8.353e-007	0.02027	0.5634	-6.3274
Sr++	6.897e-007	0.06033	0.5204	-6.4450
NaOH(aq)	6.843e-007	0.02732	1.0000	-6.1647
H2PO4-	5.584e-007	0.05406	0.8446	-6.3264
NaSO4-	4.942e-007	0.05874	0.8446	-6.3794
MgCO3(aq)	4.549e-007	0.03829	1.0000	-6.3421
MgHPO4(aq)	3.638e-007	0.04368	1.0000	-6.4392
SrCO3(aq)	2.671e-007	0.03937	1.0000	-6.5733
UO2PO4-	1.300e-007	0.04736	0.8446	-6.9595
(UO2)3(OH)7-	1.023e-007	0.09492	0.8446	-7.0633
NaAlO2(aq)	8.269e-008	0.006766	1.0000	-7.0826
Ca2UO2(CO3)3	6.767e-008	0.03582	1.0000	-7.1696
UO2(OH)4--	6.036e-008	0.02037	0.5043	-7.5166
PbP2O7--	5.782e-008	0.02200	0.5043	-7.5352
CO2(aq)	4.570e-008	0.002008	1.0000	-7.3401
SrHPO4(aq)	3.920e-008	0.007184	1.0000	-7.4068
Ni4(OH)4++++	2.364e-008	0.007145	0.0771	-8.7394
NaCl(aq)	1.842e-008	0.001074	1.0000	-7.7348
MgF+	1.760e-008	0.0007607	0.8446	-7.8279
CaHCO3+	1.723e-008	0.001739	0.8446	-7.8370
HCrO4-	1.584e-008	0.001850	0.8446	-7.8736
CaF+	1.560e-008	0.0009203	0.8446	-7.8801
CaOH+	1.058e-008	0.0006029	0.8446	-8.0488

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	56.1693s/sat	Pb4SO7	0.3841s/sat
Todorokite	48.7855s/sat	Boehmite	0.3498s/sat
Pyromorphite	20.7559s/sat	Gibbsite	0.1580s/sat
Trevorite	20.1728s/sat	Dolomite-ord	0.1207s/sat
Fluorapatite	16.0615s/sat	Dolomite	0.1207s/sat
Pyromorphite-OH	14.7137s/sat	Pb4Cl2(OH)6	0.0039s/sat
Hematite	14.6065s/sat	Ca-Autunite	-0.0254
Pb4O(PO4)2	12.9481s/sat	Crocoite	-0.0456
Bixbyite	10.7282s/sat	SrUO4(alpha)	-0.0975
Hausmannite	9.5236s/sat	Ice	-0.1387
Pyrolusite	9.4409s/sat	Calcite	-0.2224
Ferrite-Ca	8.5046s/sat	Schoepite	-0.3408
Parsonsite	8.4295s/sat	UO3:2H2O	-0.3408
Ferrite-Mg	8.3527s/sat	Aragonite	-0.3668
Pb3(PO4)2	8.2351s/sat	UO2(OH)2(beta)	-0.4532
MnO2(gamma)	7.9231s/sat	Litharge	-0.5241
Hydroxylapatite	7.5050s/sat	Schoepite-dehy(.	-0.5242
Hydrocerussite	7.1269s/sat	UO3:.9H2O(alpha)	-0.5242
Goethite	6.8231s/sat	Pb3SO6	-0.5933
Manganite	5.0460s/sat	Schoepite-dehy(.	-0.6045
Ni3(PO4)2	4.2935s/sat	Schoepite-dehy(1	-0.6106

Magnetite	4.0686s/sat	Massicot	-0.7063
Minium	3.9891s/sat	Monohydrocalcite	-1.0561
Plattnerite	3.9842s/sat	MnHPO4	-1.1741
CaUO4	3.8617s/sat	Magnesite	-1.2858
PbHPO4	3.8005s/sat	Fluorite	-1.3777
Na2U2O7(c)	3.6534s/sat	Dolomite-dis	-1.4237
Bunsenite	2.7733s/sat	Mn(OH)3	-1.4598
Ni(OH)2	2.4967s/sat	Dawsonite	-1.4872
Whitlockite	2.0748s/sat	Brucite	-1.6054
Fe(OH)3(ppd)	1.7020s/sat	Lanarkite	-1.6408
Cerussite	1.6390s/sat	Schoepite-dehy(.	-1.7138
Strontianite	1.2039s/sat	NiCO3	-1.9514
Na2U2O7(am)	1.1451s/sat	Schoepite-dehy(.	-2.2318
PbCO3.PbO	0.8736s/sat	Corundum	-2.4841
Becquerelite	0.8661s/sat	Sellaite	-2.6489
Diaspore	0.7537s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1163	-0.934
H2O(g)	0.02598	-1.585
CO2(g)	1.345e-006	-5.871
HF(g)	3.346e-015	-14.476
NO2(g)	9.432e-022	-21.025
HCl(g)	1.278e-022	-21.893
N2(g)	6.259e-023	-22.203
NO(g)	1.854e-027	-26.732
Cl2(g)	8.081e-037	-36.093
H2(g)	8.219e-042	-41.085
CO(g)	3.453e-051	-50.462
UO2F2(g)	1.256e-057	-56.901
Pb(g)	2.643e-062	-61.578
SO2(g)	7.049e-063	-62.152
UO3(g)	3.503e-067	-66.456
NH3(g)	1.421e-070	-69.847
Na(g)	5.300e-072	-71.276
UOF4(g)	5.702e-074	-73.244
UO2Cl2(g)	2.258e-075	-74.646
F2(g)	4.346e-085	-84.362
UF5(g)	1.734e-088	-87.761
UF6(g)	1.152e-094	-93.939
UF4(g)	2.571e-096	-95.590
UO2(g)	6.400e-120	-119.194
Mg(g)	2.289e-126	-125.640
UCl4(g)	5.122e-137	-136.291
UF3(g)	1.746e-145	-144.758
UCl5(g)	9.190e-148	-147.037
CH4(g)	4.895e-148	-147.310
Ca(g)	1.412e-148	-147.850
H2S(g)	9.663e-150	-149.015
U2F10(g)	3.366e-151	-150.473
UCl6(g)	3.063e-153	-152.514
UCl3(g)	1.469e-163	-162.833
Al(g)	1.455e-190	-189.837
UF2(g)	1.750e-191	-190.757
C(g)	2.375e-192	-191.624

UO(g)	4.643e-204	-203.333
UCl2(g)	2.282e-207	-206.642
UF(g)	4.318e-231	-230.365
S2(g)	3.083e-242	-241.511
C2H4(g)	7.001e-243	-242.155
UCl(g)	7.763e-249	-248.110
U2Cl8(g)	6.466e-263	-262.189
U2Cl10(g)	1.685e-268	-267.773
U(g)	7.899e-289	-288.102

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	4.12e-005	4.12e-005	1.11			
Ca++	0.000107	0.000107	4.28			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	0.000275	0.000275	31.8			
F-	0.00167	0.00167	31.7			
Fe++	0.000242	0.000242	13.5			
H+	-0.0101	-0.0101	-10.2			
H2O	55.5	55.5	9.98e+005			
HCO3-	0.00810	0.00810	493.			
HPO4--	0.00221	0.00221	212.			
Mg++	3.34e-005	3.34e-005	0.810			
Mn++	3.60e-005	3.60e-005	1.97			
NH3(aq)	0.000935	0.000935	15.9			
Na+	0.0158	0.0158	363.			
Ni++	2.82e-005	2.82e-005	1.65			
O2(aq)	0.00212	0.00212	67.7			
Pb++	2.69e-005	2.69e-005	5.56			
SO4--	1.00e-005	1.00e-005	0.959			
Sr++	1.00e-006	1.00e-006	0.0875			
UO2++	0.00183	0.00183	493.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	4.120e-005	4.120e-005	1.110		
Calcium	0.0001070	0.0001070	4.281		
Carbon	0.008100	0.008100	97.13		
Chlorine	1.000e-005	1.000e-005	0.3539		
Chromium	0.0002750	0.0002750	14.27		
Fluorine	0.001670	0.001670	31.67		
Hydrogen	111.0	111.0	1.117e+005		
Iron	0.0002420	0.0002420	13.49		
Lead	2.690e-005	2.690e-005	5.564		
Magnesium	3.340e-005	3.340e-005	0.8104		
Manganese	3.600e-005	3.600e-005	1.974		
Nickel	2.820e-005	2.820e-005	1.652		
Nitrogen	0.0009350	0.0009350	13.07		
Oxygen	55.55	55.55	8.872e+005		
Phosphorus	0.002210	0.002210	68.33		
Sodium	0.01580	0.01580	362.6		
Strontium	1.000e-006	1.000e-006	0.08747		
Sulfur	1.000e-005	1.000e-005	0.3201		
Uranium	0.001830	0.001830	434.8		

Sample 19961 $CaCO_3$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  9.940               log fO2 =   -0.734
Eh =   0.6302 volts       pe =  10.6528
Ionic strength       =    0.008090
Activity of water    =    1.000000
Solvent mass         =    0.999995 kg
Solution mass        =    1.000453 kg
Solution density     =    1.013    g/cm3
Chlorinity           =    0.000010 molal
Dissolved solids     =         458 mg/kg sol'n
Rock mass            =    0.000000 kg
Carbonate alkalinity=       185.08 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.003143	72.23	0.9103	-2.5434
HCO3-	0.001167	71.15	0.9103	-2.9739
HPO4--	0.0009799	94.01	0.6852	-3.1730
CO3--	0.0006300	37.79	0.6886	-3.3627
UO2(CO3)3----	0.0003038	136.7	0.2199	-4.1752
O2(aq)	0.0002330	7.454	1.0000	-3.6326
OH-	9.688e-005	1.647	0.9092	-4.0551
NO3-	6.980e-005	4.326	0.9080	-4.1981
CrO4--	3.369e-005	3.906	0.6852	-4.6367
Fe(OH)4-	2.832e-005	3.506	0.9103	-4.5888
CaPO4-	2.256e-005	3.046	0.9103	-4.6874
NaHPO4-	1.755e-005	2.088	0.9103	-4.7964
Fe(OH)3(aq)	1.178e-005	1.259	1.0000	-4.9288
F-	9.997e-006	0.1898	0.9092	-5.0415
Cl-	9.996e-006	0.3542	0.9080	-5.0421
UO2(OH)3-	9.899e-006	3.177	0.9103	-5.0452
SO4--	9.856e-006	0.9464	0.6852	-5.1705
AlO2-	9.053e-006	0.5337	0.9103	-5.0840
PO4---	6.532e-006	0.6201	0.4267	-5.5548
MnO4-	5.253e-006	0.6244	0.9092	-5.3210
UO2(CO3)2--	5.086e-006	1.983	0.6852	-5.4579
NaCO3-	4.458e-006	0.3698	0.9103	-5.3917
NaHCO3(aq)	4.333e-006	0.3639	1.0000	-5.3632
Ca++	3.659e-006	0.1466	0.6983	-5.5926
PbCO3(aq)	2.867e-006	0.7656	1.0000	-5.5426
CaCO3(aq)	2.354e-006	0.2355	1.0000	-5.6281
(UO2)2CO3(OH)3-	2.076e-006	1.351	0.9103	-5.7236
H2PO4-	1.359e-006	0.1317	0.9103	-5.9076
Pb(CO3)2--	1.199e-006	0.3922	0.6852	-6.0853
Pb(OH)2(aq)	1.071e-006	0.2583	1.0000	-5.9702
CaHPO4(aq)	9.428e-007	0.1282	1.0000	-6.0256

UO2(OH)2(aq)	8.356e-007	0.2539	1.0000	-6.0780
MgPO4-	8.330e-007	0.09931	0.9103	-6.1202
Sr++	7.843e-007	0.06869	0.6919	-6.2655
Ni++	6.267e-007	0.03677	0.6983	-6.3589
MnO4--	3.742e-007	0.04448	0.6852	-6.5911
Ni(OH)2(aq)	3.396e-007	0.03147	1.0000	-6.4691
PbOH+	3.355e-007	0.07520	0.9103	-6.5151
CO2(aq)	2.697e-007	0.01186	1.0000	-6.5692
UO2PO4-	1.755e-007	0.06401	0.9103	-6.7966
SrCO3(aq)	1.726e-007	0.02547	1.0000	-6.7629
NaSO4-	1.403e-007	0.01669	0.9103	-6.8939
Pb(OH)3-	1.037e-007	0.02676	0.9103	-7.0252
Mg++	9.865e-008	0.002397	0.7105	-7.1544
Ca2UO2(CO3)3	6.916e-008	0.03665	1.0000	-7.1602
SrHPO4(aq)	4.183e-008	0.007677	1.0000	-7.3785
NaOH(aq)	3.998e-008	0.001598	1.0000	-7.3982
MgHPO4(aq)	3.825e-008	0.004599	1.0000	-7.4174
CaHCO3+	3.319e-008	0.003354	0.9103	-7.5197
Ni(OH)3-	3.287e-008	0.003604	0.9103	-7.5241
PbP2O7--	2.964e-008	0.01129	0.6852	-7.6924
MgCO3(aq)	2.897e-008	0.002441	1.0000	-7.5381

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	54.0130s/sat	Boehmite	0.2951s/sat
Todorokite	46.8737s/sat	Gibbsite	0.1033s/sat
Pyromorphite	19.3545s/sat	Ice	-0.1387
Trevorite	17.8760s/sat	PbCO3.PbO	-0.3449
Hematite	14.0338s/sat	Calcite	-0.4751
Pyromorphite-OH	12.7065s/sat	MnHPO4	-0.5300
Fluorapatite	12.2906s/sat	Schoepite	-0.5967
Pb4O(PO4)2	10.9469s/sat	UO3:2H2O	-0.5967
Bixbyite	10.1391s/sat	Aragonite	-0.6195
Pyrolusite	9.1963s/sat	Crocoite	-0.6789
Hausmannite	8.5898s/sat	UO2(OH)2(beta)	-0.7091
Parsonsite	8.1618s/sat	UO3:.9H2O(alpha)	-0.7801
MnO2(gamma)	7.6785s/sat	Schoepite-dehy(.	-0.7801
Pb3(PO4)2	7.2285s/sat	Schoepite-dehy(.	-0.8604
Ferrite-Ca	6.9082s/sat	Schoepite-dehy(1	-0.8665
Goethite	6.5367s/sat	Monohydrocalcite	-1.3088
Ferrite-Mg	5.8130s/sat	SrUO4(alpha)	-1.3139
Hydrocerussite	5.6847s/sat	Dolomite	-1.3282
Hydroxylapatite	5.3527s/sat	Dolomite-ord	-1.3282
Manganite	4.7514s/sat	Litharge	-1.5188
PbHPO4	3.7945s/sat	Becquerelite	-1.6930
Magnetite	3.1595s/sat	Massicot	-1.7010
Plattnerite	3.0897s/sat	Mn(OH)3	-1.7544
CaUO4	2.5820s/sat	Na2U2O7(am)	-1.8336
Fe(OH)3(ppd)	1.4156s/sat	Schoepite-dehy(.	-1.9697
Cerussite	1.4153s/sat	Dawsonite	-2.0044
Minium	1.1052s/sat	Pb3SO6	-2.2884
Ni3(PO4)2	1.0988s/sat	Pb4SO7	-2.3057
Bunsenite	1.0492s/sat	Lanarkite	-2.3412
Strontianite	1.0143s/sat	Magnesite	-2.4818
Whitlockite	0.9812s/sat	Schoepite-dehy(.	-2.4877

Ni(OH)2	0.7726s/sat	Corundum	-2.5935
Diaspore	0.6990s/sat	Pb4Cl2(OH)6	-2.7633
Na2U2O7(c)	0.6747s/sat	Dolomite-dis	-2.8726
Ca-Autunite	0.4166s/sat	NiCO3	-2.9045

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1844	-0.734
H2O(g)	0.02598	-1.585
CO2(g)	7.938e-006	-5.100
HF(g)	8.053e-017	-16.094
HCl(g)	5.157e-022	-21.288
NO2(g)	2.528e-022	-21.597
N2(g)	1.788e-024	-23.748
NO(g)	3.946e-028	-27.404
Cl2(g)	1.656e-035	-34.781
H2(g)	6.526e-042	-41.185
CO(g)	1.618e-050	-49.791
UO2F2(g)	4.038e-061	-60.394
SO2(g)	1.089e-061	-60.963
Pb(g)	2.125e-063	-62.673
UO3(g)	1.944e-067	-66.711
NH3(g)	1.700e-071	-70.770
Na(g)	2.759e-073	-72.559
UO2Cl2(g)	2.039e-074	-73.691
UOF4(g)	1.061e-080	-79.974
F2(g)	3.170e-088	-87.499
UF5(g)	6.924e-097	-96.160
UF4(g)	3.801e-103	-102.420
UF6(g)	1.242e-104	-103.906
UO2(g)	2.820e-120	-119.550
Mg(g)	1.961e-128	-127.707
UCl4(g)	5.978e-135	-134.223
UCl5(g)	4.855e-145	-144.314
CH4(g)	1.149e-147	-146.940
H2S(g)	7.475e-149	-148.126
Ca(g)	1.061e-149	-148.974
UCl6(g)	7.326e-150	-149.135
UF3(g)	9.559e-151	-150.020
UCl3(g)	3.788e-162	-161.422
U2F10(g)	5.368e-168	-167.270
Al(g)	9.076e-191	-190.042
C(g)	8.839e-192	-191.054
UF2(g)	3.547e-195	-194.450
UO(g)	1.624e-204	-203.789
UCl2(g)	1.299e-206	-205.886
UF(g)	3.240e-233	-232.489
S2(g)	2.926e-240	-239.534
C2H4(g)	6.114e-242	-241.214
UCl(g)	9.763e-249	-248.010
U2Cl8(g)	8.807e-259	-258.055
U2Cl10(g)	4.705e-263	-262.327
U(g)	2.194e-289	-288.659

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg

Al+++	9.06e-006	9.06e-006	0.244
Ca++	2.97e-005	2.97e-005	1.19
Cl-	1.00e-005	1.00e-005	0.354
CrO4--	3.37e-005	3.37e-005	3.91
F-	1.00e-005	1.00e-005	0.190
Fe++	4.01e-005	4.01e-005	2.24
H+	-0.00196	-0.00196	-1.98
H2O	55.5	55.5	1.00e+006
HCO3-	0.00274	0.00274	167.
HPO4--	0.00103	0.00103	98.8
Mg++	1.00e-006	1.00e-006	0.0243
Mn++	5.63e-006	5.63e-006	0.309
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00317	0.00317	72.8
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	5.61e-006	5.61e-006	1.16
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	0.000324	0.000324	87.4

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	9.060e-006	9.060e-006	0.2443		
Calcium	2.970e-005	2.970e-005	1.190		
Carbon	0.002737	0.002737	32.86		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	3.370e-005	3.370e-005	1.751		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.118e+005		
Iron	4.010e-005	4.010e-005	2.238		
Lead	5.610e-006	5.610e-006	1.162		
Magnesium	1.000e-006	1.000e-006	0.02429		
Manganese	5.630e-006	5.630e-006	0.3092		
Nickel	1.000e-006	1.000e-006	0.05866		
Nitrogen	6.980e-005	6.980e-005	0.9772		
Oxygen	55.52	55.52	8.879e+005		
Phosphorus	0.001030	0.001030	31.89		
Sodium	0.003170	0.003170	72.84		
Strontium	1.000e-006	1.000e-006	0.08758		
Sulfur	1.000e-005	1.000e-005	0.3205		
Uranium	0.0003240	0.0003240	77.09		

Sample 19961 $CaCO_3$ leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  9.580               log fO2 =   -0.710
Eh =   0.6518 volts       pe =  11.0188
Ionic strength      =     0.004355
Activity of water   =     1.000000
Solvent mass        =     0.999998 kg
Solution mass       =     1.000279 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000010 molal
Dissolved solids    =          280 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       131.04 mg/kg as CaCO3
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Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001849	42.49	0.9314	-2.7640
HCO3-	0.001554	94.80	0.9314	-2.8394
HPO4--	0.0005080	48.75	0.7516	-3.4182
CO3--	0.0003425	20.55	0.7537	-3.5882
O2(aq)	0.0002463	7.878	1.0000	-3.6086
UO2(CO3)3----	0.0001018	45.81	0.3186	-4.4889
NO3-	6.980e-005	4.327	0.9300	-4.1877
OH-	4.131e-005	0.7024	0.9307	-4.4151
AlO2-	1.039e-005	0.6126	0.9314	-5.0143
F-	9.998e-006	0.1899	0.9307	-5.0313
Cl-	9.997e-006	0.3543	0.9300	-5.0316
SO4--	9.906e-006	0.9513	0.7516	-5.1282
CrO4--	7.705e-006	0.8935	0.7516	-5.2373
NaHPO4-	5.872e-006	0.6983	0.9314	-5.2621
Fe(OH)4-	4.899e-006	0.6067	0.9314	-5.3408
Fe(OH)3(aq)	4.778e-006	0.5105	1.0000	-5.3208
UO2(CO3)2--	3.785e-006	1.476	0.7516	-5.5460
NaHCO3(aq)	3.554e-006	0.2985	1.0000	-5.4492
CaPO4-	2.969e-006	0.4009	0.9314	-5.5583
UO2(OH)3-	1.856e-006	0.5957	0.9314	-5.7623
Ca++	1.824e-006	0.07307	0.7599	-5.8583
H2PO4-	1.730e-006	0.1678	0.9314	-5.7928
NaCO3-	1.560e-006	0.1294	0.9314	-5.8377
PO4---	1.316e-006	0.1250	0.5256	-6.1600
MnO4-	1.038e-006	0.1234	0.9307	-6.0151
Ni++	8.944e-007	0.05248	0.7599	-6.1677
Sr++	8.490e-007	0.07437	0.7558	-6.1927
CO2(aq)	8.420e-007	0.03705	1.0000	-6.0747
PbCO3(aq)	7.903e-007	0.2111	1.0000	-6.1022
CaCO3(aq)	7.597e-007	0.07601	1.0000	-6.1194
MgPO4-	6.055e-007	0.07220	0.9314	-6.2488

(UO2)2CO3(OH)3-	5.340e-007	0.3476	0.9314	-6.3034
UO2(OH)2(aq)	3.672e-007	0.1116	1.0000	-6.4351
CaHPO4(aq)	2.908e-007	0.03955	1.0000	-6.5365
Mg++	2.736e-007	0.006647	0.7676	-6.6778
Pb(CO3)2--	1.793e-007	0.05867	0.7516	-6.8704
SrCO3(aq)	1.215e-007	0.01793	1.0000	-6.9156
Ni(OH)2(aq)	1.005e-007	0.009312	1.0000	-6.9979
UO2PO4-	9.817e-008	0.03582	0.9314	-7.0389
Pb(OH)2(aq)	9.458e-008	0.02281	1.0000	-7.0242
NaSO4-	9.094e-008	0.01082	0.9314	-7.0721
PbOH+	6.634e-008	0.01487	0.9314	-7.2091
MgHPO4(aq)	6.517e-008	0.007837	1.0000	-7.1860
MgCO3(aq)	5.163e-008	0.004352	1.0000	-7.2871
MnO4--	2.970e-008	0.003532	0.7516	-7.6513
SrHPO4(aq)	2.813e-008	0.005163	1.0000	-7.5508
CaHCO3+	2.398e-008	0.002424	0.9314	-7.6510
NaOH(aq)	1.050e-008	0.0004199	1.0000	-7.9788

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	51.1722s/sat	Ni(OH)2	0.2438s/sat
Todorokite	44.3850s/sat	Ice	-0.1387
Trevorite	16.5632s/sat	Ca-Autunite	-0.3337
Pyromorphite	15.8793s/sat	MnHPO4	-0.4192
Hematite	13.2499s/sat	UO3:2H2O	-0.9538
Bixbyite	9.4229s/sat	Schoepite	-0.9538
Fluorapatite	9.1568s/sat	Calcite	-0.9664
Pyromorphite-OH	8.8608s/sat	Whitlockite	-1.0263
Pyrolusite	8.8442s/sat	UO2(OH)2(beta)	-1.0662
Pb4O(PO4)2	7.6803s/sat	Aragonite	-1.1108
Hausmannite	7.5095s/sat	UO3:.9H2O(alpha)	-1.1372
MnO2(gamma)	7.3264s/sat	Schoepite-dehy(.	-1.1372
Parsonsite	6.6462s/sat	Na2U2O7(c)	-1.2007
Goethite	6.1447s/sat	Schoepite-dehy(.	-1.2175
Ferrite-Ca	5.1385s/sat	Schoepite-dehy(1	-1.2236
Pb3(PO4)2	5.0161s/sat	Dolomite-ord	-1.5683
Ferrite-Mg	4.7856s/sat	Dolomite	-1.5683
Manganite	4.3933s/sat	Crocoite	-1.6136
Hydrocerussite	3.5115s/sat	Dawsonite	-1.6607
PbHPO4	3.2153s/sat	Corundum	-1.7340
Plattnerite	2.0476s/sat	Monohydrocalcite	-1.8001
Magnetite	1.9776s/sat	PbCO3.PbO	-1.9585
Hydroxylapatite	1.8486s/sat	Minium	-2.0450
CaUO4	1.2392s/sat	Plumbogummite	-2.0769
Diaspore	1.1287s/sat	Mn(OH)3	-2.1125
Fe(OH)3(ppd)	1.0236s/sat	Magnesite	-2.2308
Strontianite	0.8616s/sat	SrUO4(alpha)	-2.3182
Cerussite	0.8557s/sat	Schoepite-dehy(.	-2.3268
Boehmite	0.7248s/sat	Litharge	-2.5728
Gibbsite	0.5330s/sat	Massicot	-2.7550
Bunsenite	0.5204s/sat	Schoepite-dehy(.	-2.8448
Ni3(PO4)2	0.4619s/sat	NiCO3	-2.9389

(only minerals with log Q/K > -3 listed)

Gases fugacity log fug.

O2(g)	0.1948	-0.710
H2O(g)	0.02598	-1.585
CO2(g)	2.479e-005	-4.606
HF(g)	1.889e-016	-15.724
HCl(g)	1.210e-021	-20.917
NO2(g)	5.850e-022	-21.233
N2(g)	8.576e-024	-23.067
NO(g)	8.884e-028	-27.051
Cl2(g)	9.377e-035	-34.028
H2(g)	6.349e-042	-41.197
CO(g)	4.915e-050	-49.308
UO2F2(g)	9.760e-061	-60.011
SO2(g)	6.128e-061	-60.213
Pb(g)	1.825e-064	-63.739
UO3(g)	8.540e-068	-67.069
NH3(g)	3.571e-071	-70.447
Na(g)	7.148e-074	-73.146
UO2Cl2(g)	4.934e-074	-73.307
UOF4(g)	1.411e-079	-78.850
F2(g)	1.793e-087	-86.747
UF5(g)	2.130e-095	-94.672
UF4(g)	4.916e-102	-101.308
UF6(g)	9.084e-103	-102.042
UO2(g)	1.205e-120	-119.919
Mg(g)	1.089e-128	-127.963
UCl4(g)	7.751e-134	-133.111
UCl5(g)	1.498e-143	-142.825
CH4(g)	3.212e-147	-146.493
UCl6(g)	5.378e-148	-147.269
H2S(g)	3.873e-148	-147.412
UF3(g)	5.199e-150	-149.284
Ca(g)	1.067e-150	-149.972
UCl3(g)	2.064e-161	-160.685
U2F10(g)	5.077e-165	-164.294
Al(g)	2.343e-190	-189.630
C(g)	2.612e-191	-190.583
UF2(g)	8.114e-195	-194.091
UO(g)	6.754e-205	-204.170
UCl2(g)	2.976e-206	-205.526
UF(g)	3.116e-233	-232.506
S2(g)	8.299e-239	-238.081
C2H4(g)	5.052e-241	-240.297
UCl(g)	9.397e-249	-248.027
U2Cl8(g)	1.481e-256	-255.830
U2Cl10(g)	4.478e-260	-259.349
U(g)	8.877e-290	-289.052

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.04e-005	1.04e-005	0.281			
Ca++	5.89e-006	5.89e-006	0.236			
Cl-	1.00e-005	1.00e-005	0.354			
CrO4--	7.71e-006	7.71e-006	0.894			
F-	1.00e-005	1.00e-005	0.190			
Fe++	9.68e-006	9.68e-006	0.540			

H+	-0.000851	-0.000851	-0.857
H2O	55.5	55.5	1.00e+006
HCO3-	0.00222	0.00222	135.
HPO4--	0.000521	0.000521	50.0
Mg++	1.00e-006	1.00e-006	0.0243
Mn++	1.07e-006	1.07e-006	0.0588
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00186	0.00186	42.7
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	1.14e-006	1.14e-006	0.236
SO4--	1.00e-005	1.00e-005	0.960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	0.000109	0.000109	29.4

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.040e-005	1.040e-005	0.2805		
Calcium	5.890e-006	5.890e-006	0.2360		
Carbon	0.002218	0.002218	26.64		
Chlorine	1.000e-005	1.000e-005	0.3544		
Chromium	7.710e-006	7.710e-006	0.4008		
Fluorine	1.000e-005	1.000e-005	0.1899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	9.680e-006	9.680e-006	0.5404		
Lead	1.140e-006	1.140e-006	0.2361		
Magnesium	1.000e-006	1.000e-006	0.02430		
Manganese	1.070e-006	1.070e-006	0.05877		
Nickel	1.000e-006	1.000e-006	0.05867		
Nitrogen	6.980e-005	6.980e-005	0.9774		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0005210	0.0005210	16.13		
Sodium	0.001860	0.001860	42.75		
Strontium	1.000e-006	1.000e-006	0.08760		
Sulfur	1.000e-005	1.000e-005	0.3206		
Uranium	0.0001090	0.0001090	25.94		

Sample 19961 $CaCO_3$ leach, Stage 4.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  8.150              log fO2 =   -0.706
Eh =   0.7365 volts      pe =  12.4499
Ionic strength      =    0.001952
Activity of water   =    1.000000
Solvent mass        =    1.000000 kg
Solution mass       =    1.000191 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000001 molal
Dissolved solids    =         191 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      100.02 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001877	114.5	0.9522	-2.7477
Na+	0.001027	23.60	0.9522	-3.0098
O2(aq)	0.0002488	7.959	1.0000	-3.6042
HPO4--	0.0001085	10.41	0.8216	-4.0498
NO3-	6.979e-005	4.327	0.9515	-4.1777
CO2(aq)	2.799e-005	1.232	1.0000	-4.5530
Ca++	1.739e-005	0.6969	0.8260	-4.8427
UO2(CO3)2--	1.684e-005	6.567	0.8216	-4.8590
UO2(CO3)3----	1.590e-005	7.154	0.4555	-5.1402
CO3--	1.440e-005	0.8637	0.8227	-4.9265
H2PO4-	1.064e-005	1.031	0.9522	-4.9944
(UO2)2CO3(OH)3-	6.559e-006	4.270	0.9522	-5.2044
Fe(OH)3(aq)	4.339e-006	0.4637	1.0000	-5.3626
NaHCO3(aq)	2.492e-006	0.2093	1.0000	-5.6034
UO2PO4-	1.924e-006	0.7023	0.9522	-5.7370
OH-	1.501e-006	0.02552	0.9519	-5.8451
UO2(OH)2(aq)	1.171e-006	0.3559	1.0000	-5.9315
CrO4--	1.030e-006	0.1195	0.8216	-6.0723
Cl-	9.998e-007	0.03544	0.9515	-6.0216
F-	9.998e-007	0.01899	0.9519	-6.0215
Ni++	9.996e-007	0.05865	0.8260	-6.0832
SO4--	9.925e-007	0.09533	0.8216	-6.0886
Sr++	9.842e-007	0.08622	0.8238	-6.0911
AlO2-	9.811e-007	0.05785	0.9522	-6.0296
Mg++	9.034e-007	0.02195	0.8301	-6.1250
NaHPO4-	7.614e-007	0.09056	0.9522	-6.1397
CaHPO4(aq)	7.038e-007	0.09574	1.0000	-6.1525
PbCO3(aq)	5.813e-007	0.1553	1.0000	-6.2356
CaCO3(aq)	3.613e-007	0.03616	1.0000	-6.4421
CaHCO3+	3.003e-007	0.03036	0.9522	-6.5437
CaPO4-	2.612e-007	0.03527	0.9522	-6.6043

Ca2UO2(CO3)3	2.369e-007	0.1256	1.0000	-6.6254
UO2(OH)3-	2.151e-007	0.06903	0.9522	-6.6887
Mn++	1.994e-007	0.01095	0.8260	-6.7834
Fe(OH)4-	1.617e-007	0.02003	0.9522	-6.8126
MnO4-	7.700e-008	0.009156	0.9519	-7.1349
Fe(OH)2+	6.898e-008	0.006197	0.9522	-7.1826
UO2CO3(aq)	6.637e-008	0.02190	1.0000	-7.1780
MnCO3(aq)	6.458e-008	0.007422	1.0000	-7.1899
MnHPO4(aq)	5.582e-008	0.008422	1.0000	-7.2532
MgHPO4(aq)	5.434e-008	0.006535	1.0000	-7.2649
NaCO3-	3.975e-008	0.003299	0.9522	-7.4219
PbOH+	3.864e-008	0.008663	0.9522	-7.4342
UO2HPO4(aq)	2.972e-008	0.01088	1.0000	-7.5270
HCrO4-	1.965e-008	0.002298	0.9522	-7.7279
HAlO2(aq)	1.866e-008	0.001119	1.0000	-7.7292
MgPO4-	1.835e-008	0.002188	0.9522	-7.7577
MnPO4-	1.608e-008	0.002410	0.9522	-7.8150
Pb++	1.569e-008	0.003251	0.8227	-7.8891
MgHCO3+	1.528e-008	0.001304	0.9522	-7.8370

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	53.6228s/sat	Ice	-0.1387
Todorokite	46.5287s/sat	Strontianite	-0.3751
Pyromorphite	14.7288s/sat	UO3:2H2O	-0.4502
Trevorite	13.7040s/sat	Schoepite	-0.4502
Hematite	13.1662s/sat	(UO2)3(PO4)2:4H2	-0.5156
Bixbyite	10.0344s/sat	UO2(OH)2(beta)	-0.5626
Pyrolusite	9.1511s/sat	UO3:.9H2O(alpha)	-0.6336
Hausmannite	8.4258s/sat	Schoepite-dehy(.	-0.6336
Parsonsite	8.2963s/sat	Hydroxylapatite	-0.6884
MnO2(gamma)	7.6333s/sat	Schoepite-dehy(.	-0.7139
Pyromorphite-OH	7.2703s/sat	Schoepite-dehy(1	-0.7200
Fluorapatite	7.0595s/sat	Corundum	-0.9046
Goethite	6.1029s/sat	Rhodochrosite	-1.1883
Pb4O(PO4)2	5.5167s/sat	Crocoite	-1.2437
Manganite	4.6991s/sat	Calcite	-1.2891
Pb3(PO4)2	4.5075s/sat	Dawsonite	-1.4002
PbHPO4	3.7886s/sat	Aragonite	-1.4335
Ca-Autunite	3.2858s/sat	Mn(OH)3	-1.8067
Ferrite-Ca	3.2105s/sat	Schoepite-dehy(.	-1.8232
Ferrite-Mg	2.3947s/sat	Whitlockite	-2.1029
MnHPO4	2.1138s/sat	Monohydrocalcite	-2.1228
Plumbogummite	1.9687s/sat	Bunsenite	-2.2551
Magnetite	1.8510s/sat	Saleeite	-2.3011
Hydrocerussite	1.5897s/sat	Schoepite-dehy(.	-2.3412
Diaspore	1.5434s/sat	Strengite	-2.3695
Boehmite	1.1395s/sat	UO2CO3	-2.3879
Fe(OH)3(ppd)	0.9818s/sat	Rutherfordine	-2.4082
Gibbsite	0.9477s/sat	Ni(OH)2	-2.5317
Cerussite	0.7223s/sat	Dolomite-ord	-2.6766
Plattnerite	0.3947s/sat	Dolomite	-2.6766
CaUO4	-0.1016	UO2HPO4:4H2O	-2.9437

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1968	-0.706
H2O(g)	0.02598	-1.585
CO2(g)	0.0008240	-3.084
HF(g)	5.199e-016	-15.284
NO2(g)	1.607e-020	-19.794
N2(g)	6.340e-021	-20.198
HCl(g)	3.333e-021	-20.477
NO(g)	2.428e-026	-25.615
Cl2(g)	7.149e-034	-33.146
H2(g)	6.317e-042	-41.199
CO(g)	1.626e-048	-47.789
SO2(g)	4.839e-059	-58.315
UO2F2(g)	2.358e-059	-58.627
Pb(g)	4.018e-066	-65.396
UO3(g)	2.723e-067	-66.565
NH3(g)	9.637e-070	-69.016
UO2Cl2(g)	1.193e-072	-71.923
Na(g)	1.504e-075	-74.823
UOF4(g)	2.584e-077	-76.588
F2(g)	1.365e-086	-85.865
UF5(g)	1.070e-092	-91.970
UF6(g)	1.260e-099	-98.900
UF4(g)	8.955e-100	-99.048
UO2(g)	3.824e-120	-119.418
Mg(g)	5.342e-131	-130.272
UCl4(g)	1.415e-131	-130.849
UCl5(g)	7.550e-141	-140.122
UCl6(g)	7.484e-145	-144.126
CH4(g)	1.046e-145	-144.980
H2S(g)	3.012e-146	-145.521
UF3(g)	3.432e-148	-147.464
Ca(g)	1.519e-152	-151.818
UCl3(g)	1.365e-159	-158.865
U2F10(g)	1.283e-159	-158.892
C(g)	8.594e-190	-189.066
Al(g)	6.041e-190	-189.219
UF2(g)	1.941e-193	-192.712
UO(g)	2.132e-204	-203.671
UCl2(g)	7.125e-205	-204.147
UF(g)	2.701e-232	-231.568
S2(g)	5.070e-235	-234.295
C2H4(g)	5.415e-238	-237.266
UCl(g)	8.149e-248	-247.089
U2Cl8(g)	4.933e-252	-251.307
U2Cl10(g)	1.138e-254	-253.944
U(g)	2.788e-289	-288.555

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	1.95e-005	1.95e-005	0.781			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	1.05e-006	1.05e-006	0.122			
F-	1.00e-006	1.00e-006	0.0190			

Fe++	4.57e-006	4.57e-006	0.255
H+	-0.000175	-0.000175	-0.177
H2O	55.5	55.5	1.00e+006
HCO3-	0.00201	0.00201	123.
HPO4--	0.000123	0.000123	11.8
Mg++	1.00e-006	1.00e-006	0.0243
Mn++	4.16e-007	4.16e-007	0.0228
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00103	0.00103	23.7
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	6.48e-007	6.48e-007	0.134
SO4--	1.00e-006	1.00e-006	0.0960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	4.95e-005	4.95e-005	13.4

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.000e-006	1.000e-006	0.02698		
Calcium	1.950e-005	1.950e-005	0.7814		
Carbon	0.002012	0.002012	24.17		
Chlorine	1.000e-006	1.000e-006	0.03545		
Chromium	1.050e-006	1.050e-006	0.05459		
Fluorine	1.000e-006	1.000e-006	0.01899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	4.570e-006	4.570e-006	0.2552		
Lead	6.480e-007	6.480e-007	0.1342		
Magnesium	1.000e-006	1.000e-006	0.02430		
Manganese	4.160e-007	4.160e-007	0.02285		
Nickel	1.000e-006	1.000e-006	0.05868		
Nitrogen	6.980e-005	6.980e-005	0.9775		
Oxygen	55.52	55.52	8.881e+005		
Phosphorus	0.0001230	0.0001230	3.809		
Sodium	0.001030	0.001030	23.67		
Strontium	1.000e-006	1.000e-006	0.08760		
Sulfur	1.000e-006	1.000e-006	0.03206		
Uranium	4.950e-005	4.950e-005	11.78		

Sample 19961 $CaCO_3$ leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  8.960              log fO2 =   -0.707
Eh =   0.6886 volts      pe =  11.6397
Ionic strength      =    0.002766
Activity of water   =    1.000000
Solvent mass        =    0.999999 kg
Solution mass       =    1.000229 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000001 molal
Dissolved solids    =         229 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      124.03 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.002018	123.1	0.9440	-2.7200
Na+	0.001086	24.95	0.9440	-2.9893
O2(aq)	0.0002483	7.944	1.0000	-3.6050
HPO4--	0.0001717	16.48	0.7934	-3.8657
CO3--	0.0001025	6.151	0.7949	-4.0888
UO2(CO3)3----	7.228e-005	32.52	0.3959	-4.5434
NO3-	6.980e-005	4.327	0.9431	-4.1816
UO2(CO3)2--	1.002e-005	3.906	0.7934	-5.0998
OH-	9.776e-006	0.1662	0.9435	-5.0351
Ca++	4.654e-006	0.1865	0.7992	-5.4296
CO2(aq)	4.620e-006	0.2033	1.0000	-5.3353
Fe(OH)3(aq)	3.750e-006	0.4007	1.0000	-5.4259
NaHCO3(aq)	2.784e-006	0.2338	1.0000	-5.5553
H2PO4-	2.540e-006	0.2462	0.9440	-5.6203
CrO4--	2.154e-006	0.2498	0.7934	-5.7673
(UO2)2CO3(OH)3-	1.803e-006	1.174	0.9440	-5.7690
NaHPO4-	1.230e-006	0.1463	0.9440	-5.9350
F-	9.999e-007	0.01899	0.9435	-6.0253
Cl-	9.998e-007	0.03544	0.9431	-6.0255
AlO2-	9.969e-007	0.05878	0.9440	-6.0264
SO4--	9.936e-007	0.09543	0.7934	-6.1033
Ni++	9.929e-007	0.05826	0.7992	-6.1004
Sr++	9.429e-007	0.08260	0.7963	-6.1244
Fe(OH)4-	9.102e-007	0.1127	0.9440	-6.0659
Mg++	7.324e-007	0.01780	0.8046	-6.2297
UO2(OH)3-	7.083e-007	0.2273	0.9440	-6.1749
CaPO4-	6.729e-007	0.09086	0.9440	-6.1971
CaCO3(aq)	6.437e-007	0.06441	1.0000	-6.1913
UO2(OH)2(aq)	5.920e-007	0.1800	1.0000	-6.2277
MnO4-	4.229e-007	0.05029	0.9435	-6.3990
PbCO3(aq)	3.562e-007	0.09516	1.0000	-6.4483

NaCO3-	2.892e-007	0.02400	0.9440	-6.5638
CaHPO4(aq)	2.784e-007	0.03788	1.0000	-6.5553
UO2PO4-	2.323e-007	0.08478	0.9440	-6.6589
MgPO4-	1.435e-007	0.01711	0.9440	-6.8681
PO4---	9.972e-008	0.009469	0.5939	-7.2275
CaHCO3+	8.358e-008	0.008448	0.9440	-7.1029
MgHPO4(aq)	6.526e-008	0.007848	1.0000	-7.1853
Ca2UO2(CO3)3	6.276e-008	0.03327	1.0000	-7.2023
MgCO3(aq)	4.575e-008	0.003857	1.0000	-7.3396
SrCO3(aq)	4.488e-008	0.006623	1.0000	-7.3480
Pb(CO3)2--	2.418e-008	0.007909	0.7934	-7.7171
PbOH+	2.241e-008	0.005024	0.9440	-7.6745
MgHCO3+	1.291e-008	0.001102	0.9440	-7.9140
SrHPO4(aq)	1.175e-008	0.002156	1.0000	-7.9301

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	53.0360s/sat	Hydroxylapatite	0.1696s/sat
Todorokite	46.0154s/sat	Gibbsite	0.1409s/sat
Trevorite	15.1801s/sat	Ice	-0.1387
Hematite	13.0396s/sat	Bunsenite	-0.6523
Pyromorphite	12.4556s/sat	Schoepite	-0.7464
Bixbyite	9.8879s/sat	UO3:2H2O	-0.7464
Pyrolusite	9.0777s/sat	UO2(OH)2(beta)	-0.8588
Hausmannite	8.2062s/sat	Ni(OH)2	-0.9289
MnO2(gamma)	7.5599s/sat	UO3:.9H2O(alpha)	-0.9298
Fluorapatite	7.1037s/sat	Schoepite-dehy(.	-0.9298
Parsonsite	6.2678s/sat	Schoepite-dehy(.	-1.0101
Goethite	6.0396s/sat	Schoepite-dehy(1	-1.0162
Pyromorphite-OH	5.8111s/sat	Calcite	-1.0383
Pb4O(PO4)2	4.9236s/sat	Aragonite	-1.1827
Manganite	4.6258s/sat	Ni3(PO4)2	-1.4713
Ferrite-Ca	4.1169s/sat	Dolomite-ord	-1.6928
Ferrite-Mg	3.7834s/sat	Dolomite	-1.6928
Pb3(PO4)2	3.3447s/sat	Monohydrocalcite	-1.8720
PbHPO4	2.9224s/sat	Whitlockite	-1.8752
Hydrocerussite	1.7339s/sat	Mn(OH)3	-1.8800
Magnetite	1.6612s/sat	Crocoite	-1.9890
Plattnerite	0.9640s/sat	Rhodochrosite	-2.0437
Fe(OH)3(ppd)	0.9185s/sat	Schoepite-dehy(.	-2.1194
Ca-Autunite	0.8549s/sat	Dawsonite	-2.1589
Diaspore	0.7366s/sat	Magnesite	-2.2833
CaUO4	0.6354s/sat	Na2U2O7(c)	-2.4765
MnHPO4	0.6049s/sat	Corundum	-2.5183
Cerussite	0.5096s/sat	Schoepite-dehy(.	-2.6374
Strontianite	0.4292s/sat	Plumbogummite	-2.7538
Boehmite	0.3327s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1965	-0.707
H2O(g)	0.02598	-1.585
CO2(g)	0.0001360	-3.866
HF(g)	7.982e-017	-16.098

NO2(g)	2.468e-021	-20.608
HCl(g)	5.117e-022	-21.291
N2(g)	1.501e-022	-21.824
NO(g)	3.732e-027	-26.428
Cl2(g)	1.683e-035	-34.774
H2(g)	6.323e-042	-41.199
CO(g)	2.686e-049	-48.571
SO2(g)	1.123e-060	-59.950
UO2F2(g)	2.811e-061	-60.551
Pb(g)	1.493e-065	-64.826
UO3(g)	1.377e-067	-66.861
NH3(g)	1.485e-070	-69.828
UO2Cl2(g)	1.422e-074	-73.847
Na(g)	1.018e-074	-73.992
UOF4(g)	7.260e-081	-80.139
F2(g)	3.215e-088	-87.493
UF5(g)	4.620e-097	-96.335
UF4(g)	2.518e-103	-102.599
UF6(g)	8.347e-105	-104.078
UO2(g)	1.935e-120	-119.713
Mg(g)	1.752e-129	-128.757
UCl4(g)	3.976e-135	-134.401
UCl5(g)	3.255e-145	-144.487
CH4(g)	1.734e-146	-145.761
H2S(g)	7.010e-148	-147.154
UCl6(g)	4.951e-150	-149.305
UF3(g)	6.289e-151	-150.201
Ca(g)	1.641e-151	-150.785
UCl3(g)	2.499e-162	-161.602
U2F10(g)	2.390e-168	-167.622
C(g)	1.421e-190	-189.847
Al(g)	9.438e-191	-190.025
UF2(g)	2.318e-195	-194.635
UO(g)	1.080e-204	-203.967
UCl2(g)	8.505e-207	-206.070
UF(g)	2.102e-233	-232.677
S2(g)	2.742e-238	-237.562
C2H4(g)	1.484e-239	-238.829
UCl(g)	6.340e-249	-248.198
U2Cl8(g)	3.896e-259	-258.409
U2Cl10(g)	2.115e-263	-262.675
U(g)	1.414e-289	-288.850

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.00e-006	1.00e-006	0.0270			
Ca++	6.46e-006	6.46e-006	0.259			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	2.16e-006	2.16e-006	0.250			
F-	1.00e-006	1.00e-006	0.0190			
Fe++	4.67e-006	4.67e-006	0.261			
H+	-0.000441	-0.000441	-0.444			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00237	0.00237	144.			
HPO4--	0.000177	0.000177	17.0			
Mg++	1.00e-006	1.00e-006	0.0243			

Mn++	4.44e-007	4.44e-007	0.0244
NH3(aq)	6.98e-005	6.98e-005	1.19
Na+	0.00109	0.00109	25.1
Ni++	1.00e-006	1.00e-006	0.0587
O2(aq)	0.000390	0.000390	12.5
Pb++	4.13e-007	4.13e-007	0.0856
SO4--	1.00e-006	1.00e-006	0.0960
Sr++	1.00e-006	1.00e-006	0.0876
UO2++	8.75e-005	8.75e-005	23.6

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.000e-006	1.000e-006	0.02698		
Calcium	6.460e-006	6.460e-006	0.2588		
Carbon	0.002369	0.002369	28.44		
Chlorine	1.000e-006	1.000e-006	0.03544		
Chromium	2.160e-006	2.160e-006	0.1123		
Fluorine	1.000e-006	1.000e-006	0.01899		
Hydrogen	111.0	111.0	1.119e+005		
Iron	4.670e-006	4.670e-006	0.2607		
Lead	4.130e-007	4.130e-007	0.08555		
Magnesium	1.000e-006	1.000e-006	0.02430		
Manganese	4.440e-007	4.440e-007	0.02439		
Nickel	1.000e-006	1.000e-006	0.05868		
Nitrogen	6.980e-005	6.980e-005	0.9774		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0001770	0.0001770	5.481		
Sodium	0.001090	0.001090	25.05		
Strontium	1.000e-006	1.000e-006	0.08760		
Sulfur	1.000e-006	1.000e-006	0.03206		
Uranium	8.750e-005	8.750e-005	20.82		

Sample 19961 $CaCO_3$ leach, Stage 6.

```
Step #      0              Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH =  8.800                log fO2 =   -0.726
Eh =   0.6977 volts        pe =  11.7949
Ionic strength      =      0.005260
Activity of water   =      1.000000
Solvent mass        =      0.999989 kg
Solution mass       =      1.000463 kg
Solution density    =      1.013    g/cm3
Chlorinity          =      0.000001 molal
Dissolved solids    =           474 mg/kg sol'n
Rock mass           =      0.000000 kg
Carbonate alkalinity=        154.07 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001684	38.70	0.9255	-2.8073
HCO3-	0.001603	97.79	0.9255	-2.8286
UO2(CO3)3----	0.0003285	147.8	0.2874	-4.0250
O2(aq)	0.0002375	7.598	1.0000	-3.6243
HPO4--	0.0002275	21.82	0.7324	-3.7783
(UO2)2CO3(OH)3-	0.0001459	94.97	0.9255	-3.8695
NO3-	6.979e-005	4.325	0.9238	-4.1906
UO2(CO3)2--	6.643e-005	25.90	0.7324	-4.3129
CO3--	5.976e-005	3.584	0.7349	-4.3574
Ca++	3.731e-005	1.494	0.7420	-4.5578
CrO4--	2.829e-005	3.280	0.7324	-4.6836
AlO2-	2.688e-005	1.585	0.9255	-4.6042
Fe(OH)3(aq)	2.630e-005	2.809	1.0000	-4.5800
Ca2UO2(CO3)3	1.147e-005	6.080	1.0000	-4.9404
OH-	6.901e-006	0.1173	0.9247	-5.1951
UO2(OH)2(aq)	5.976e-006	1.816	1.0000	-5.2236
PbCO3(aq)	5.273e-006	1.408	1.0000	-5.2779
CO2(aq)	5.201e-006	0.2288	1.0000	-5.2839
UO2(OH)3-	5.045e-006	1.619	0.9255	-5.3308
H2PO4-	4.579e-006	0.4439	0.9255	-5.3729
Fe(OH)4-	4.504e-006	0.5577	0.9255	-5.3800
CaPO4-	4.323e-006	0.5835	0.9255	-5.3979
UO2PO4-	4.228e-006	1.543	0.9255	-5.4075
MnO4-	3.780e-006	0.4493	0.9247	-5.4565
NaHCO3(aq)	3.298e-006	0.2769	1.0000	-5.4818
CaCO3(aq)	2.582e-006	0.2583	1.0000	-5.5881
CaHPO4(aq)	2.535e-006	0.3447	1.0000	-5.5961
NaHPO4-	2.334e-006	0.2775	0.9255	-5.6656
Cl-	9.998e-007	0.03543	0.9238	-6.0345
F-	9.997e-007	0.01898	0.9247	-6.0341
Ni++	9.967e-007	0.05847	0.7420	-6.1310

SO4--	9.891e-007	0.09497	0.7324	-6.1400
Sr++	9.631e-007	0.08435	0.7373	-6.1487
Mg++	7.667e-007	0.01863	0.7510	-6.2397
CaHCO3+	4.943e-007	0.04994	0.9255	-6.3397
PbOH+	4.345e-007	0.09738	0.9255	-6.3956
NaCO3-	2.418e-007	0.02006	0.9255	-6.6503
Pb(CO3)2--	2.089e-007	0.06832	0.7324	-6.8153
MnCO3(aq)	1.357e-007	0.01559	1.0000	-6.8673
Mn++	1.258e-007	0.006907	0.7420	-7.0299
MgPO4-	1.210e-007	0.01443	0.9255	-6.9508
(UO2)3(OH)7-	1.137e-007	0.1056	0.9255	-6.9778
HAlO2(aq)	1.112e-007	0.006669	1.0000	-6.9538
HCrO4-	1.108e-007	0.01295	0.9255	-6.9892
Pb(OH)2(aq)	1.022e-007	0.02463	1.0000	-6.9907
PO4---	1.010e-007	0.009590	0.4960	-7.3001
Fe(OH)2+	9.629e-008	0.008649	0.9255	-7.0500
MnPO4-	7.827e-008	0.01173	0.9255	-7.1400
MgHPO4(aq)	7.798e-008	0.009375	1.0000	-7.1080
UO2CO3(aq)	6.295e-008	0.02077	1.0000	-7.2010
MnHPO4(aq)	5.912e-008	0.008919	1.0000	-7.2282
Pb++	4.298e-008	0.008901	0.7349	-7.5005
PbP2O7--	3.102e-008	0.01182	0.7324	-7.6436
MgCO3(aq)	2.409e-008	0.002030	1.0000	-7.6182
SrCO3(aq)	2.287e-008	0.003374	1.0000	-7.6408
MnO4--	1.847e-008	0.002196	0.7324	-7.8688
UO2HPO4(aq)	1.421e-008	0.005197	1.0000	-7.8475
SrHPO4(aq)	1.358e-008	0.002493	1.0000	-7.8670
MgHCO3+	1.002e-008	0.0008548	0.9255	-8.0326

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	61.9903s/sat	UO2(OH)2(beta)	0.1453s/sat
Todorokite	53.8528s/sat	Strontianite	0.1364s/sat
Pyromorphite	19.4233s/sat	Schoepite-dehy(.	0.0743s/sat
Trevorite	16.5213s/sat	UO3:.9H2O(alpha)	0.0743s/sat
Hematite	14.7313s/sat	Schoepite-dehy(.	-0.0060
Pyromorphite-OH	12.6277s/sat	Schoepite-dehy(1	-0.0121
Bixbyite	12.1313s/sat	Ice	-0.1387
Hausmannite	11.5761s/sat	Na2U2O7(c)	-0.4242
Fluorapatite	11.2360s/sat	Calcite	-0.4351
Parsonsite	10.3244s/sat	(UO2)3(PO4)2:4H2	-0.4487
Pb4O(PO4)2	10.2139s/sat	Dawsonite	-0.5031
Pyrolusite	10.1945s/sat	Aragonite	-0.5795
MnO2(gamma)	8.6767s/sat	Mn(OH)3	-0.7583
Pb3(PO4)2	7.5162s/sat	Rhodochrosite	-0.8657
Goethite	6.8855s/sat	Bunsenite	-1.0029
Ferrite-Ca	6.3604s/sat	PbCO3.PbO	-1.1008
Manganite	5.7475s/sat	Schoepite-dehy(.	-1.1153
Hydrocerussite	5.1935s/sat	Monohydrocalcite	-1.2688
Ferrite-Mg	5.1451s/sat	Ni(OH)2	-1.2795
PbHPO4	4.4487s/sat	Dolomite-ord	-1.3682
Ca-Autunite	4.2296s/sat	Dolomite	-1.3682
Magnetite	4.2036s/sat	Schoepite-dehy(.	-1.6333
Hydroxylapatite	4.1507s/sat	Ni3(PO4)2	-1.7082
Plumbogummite	3.9265s/sat	Saleeite	-1.7568

Diaspore	2.3188s/sat	Minium	-1.9524
CaUO4	2.1912s/sat	UO2CO3	-2.4109
Becquerelite	2.1883s/sat	Rutherfordine	-2.4312
MnHPO4	2.1388s/sat	Przhevalskite	-2.4348
Plattnerite	2.0732s/sat	Litharge	-2.5393
Boehmite	1.9149s/sat	Magnesite	-2.5619
Fe(OH)3(ppd)	1.7644s/sat	Strengite	-2.6155
Gibbsite	1.7231s/sat	UO3(gamma)	-2.6163
Cerussite	1.6800s/sat	SrUO4(alpha)	-2.6227
Corundum	0.6461s/sat	Massicot	-2.7215
Whitlockite	0.5949s/sat	Dolomite-dis	-2.9126
Crocoite	0.5336s/sat	Na2U2O7(am)	-2.9325
Schoepite	0.2577s/sat	Corkite	-2.9639
UO3:2H2O	0.2577s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1880	-0.726
H2O(g)	0.02598	-1.585
CO2(g)	0.0001531	-3.815
HF(g)	1.130e-016	-15.947
NO2(g)	3.533e-021	-20.452
HCl(g)	7.244e-022	-21.140
N2(g)	3.362e-022	-21.473
NO(g)	5.462e-027	-26.263
Cl2(g)	3.300e-035	-34.482
H2(g)	6.464e-042	-41.189
CO(g)	3.091e-049	-48.510
UO2F2(g)	5.691e-060	-59.245
SO2(g)	2.205e-060	-59.657
Pb(g)	2.007e-064	-63.697
UO3(g)	1.390e-066	-65.857
NH3(g)	2.297e-070	-69.639
UO2Cl2(g)	2.877e-073	-72.541
Na(g)	1.083e-074	-73.965
UOF4(g)	2.949e-079	-78.530
F2(g)	6.308e-088	-87.200
UF5(g)	2.688e-095	-94.571
UF4(g)	1.046e-101	-100.981
UF6(g)	6.801e-103	-102.167
UO2(g)	1.997e-119	-118.700
Mg(g)	8.375e-130	-129.077
UCl4(g)	1.649e-133	-132.783
UCl5(g)	1.890e-143	-142.723
CH4(g)	2.133e-146	-145.671
H2S(g)	1.471e-147	-146.832
UCl6(g)	4.026e-148	-147.395
UF3(g)	1.865e-149	-148.729
Ca(g)	5.978e-151	-150.223
UCl3(g)	7.403e-161	-160.131
U2F10(g)	8.085e-165	-164.092
Al(g)	3.728e-189	-188.428
C(g)	1.672e-190	-189.777
UF2(g)	4.905e-194	-193.309
UO(g)	1.140e-203	-202.943
UCl2(g)	1.799e-205	-204.745

UF(g)	3.176e-232	-231.498
S2(g)	1.154e-237	-236.938
C2H4(g)	2.148e-239	-238.668
UCl(g)	9.577e-248	-247.019
U2Cl8(g)	6.701e-256	-255.174
U2Cl10(g)	7.132e-260	-259.147
U(g)	1.525e-288	-287.817

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	2.70e-005	2.70e-005	0.728			
Ca++	7.02e-005	7.02e-005	2.81			
Cl-	1.00e-006	1.00e-006	0.0354			
CrO4--	2.84e-005	2.84e-005	3.29			
F-	1.00e-006	1.00e-006	0.0190			
Fe++	3.09e-005	3.09e-005	1.72			
H+	-0.00209	-0.00209	-2.11			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00298	0.00298	182.			
HPO4--	0.000246	0.000246	23.6			
Mg++	1.00e-006	1.00e-006	0.0243			
Mn++	4.20e-006	4.20e-006	0.231			
NH3(aq)	6.98e-005	6.98e-005	1.19			
Na+	0.00169	0.00169	38.8			
Ni++	1.00e-006	1.00e-006	0.0587			
O2(aq)	0.000390	0.000390	12.5			
Pb++	6.10e-006	6.10e-006	1.26			
SO4--	1.00e-006	1.00e-006	0.0960			
Sr++	1.00e-006	1.00e-006	0.0876			
UO2++	0.000714	0.000714	193.			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	2.700e-005	2.700e-005	0.7282		
Calcium	7.020e-005	7.020e-005	2.812		
Carbon	0.002980	0.002980	35.77		
Chlorine	1.000e-006	1.000e-006	0.03544		
Chromium	2.840e-005	2.840e-005	1.476		
Fluorine	1.000e-006	1.000e-006	0.01899		
Hydrogen	111.0	111.0	1.118e+005		
Iron	3.090e-005	3.090e-005	1.725		
Lead	6.100e-006	6.100e-006	1.263		
Magnesium	1.000e-006	1.000e-006	0.02429		
Manganese	4.200e-006	4.200e-006	0.2306		
Nickel	1.000e-006	1.000e-006	0.05866		
Nitrogen	6.980e-005	6.980e-005	0.9772		
Oxygen	55.52	55.52	8.879e+005		
Phosphorus	0.0002460	0.0002460	7.616		
Sodium	0.001690	0.001690	38.83		
Strontium	1.000e-006	1.000e-006	0.08758		
Sulfur	1.000e-006	1.000e-006	0.03205		
Uranium	0.0007140	0.0007140	169.9		

Sample 19250 water leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.180               log fO2 =   -0.756
Eh =   0.7340 volts       pe =  12.4073
Ionic strength      =     0.009287
Activity of water   =     1.000000
Solvent mass        =     0.999994 kg
Solution mass       =     1.000657 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000007 molal
Dissolved solids    =          663 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       262.17 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.008276	190.1	0.9050	-2.1255
HCO3-	0.004707	287.0	0.9050	-2.3706
F-	0.001425	27.06	0.9037	-2.8901
HPO4--	0.0003509	33.66	0.6690	-3.6294
O2(aq)	0.0002214	7.080	1.0000	-3.6548
NO3-	0.0001420	8.798	0.9023	-3.8924
K+	0.0001298	5.072	0.9023	-3.9313
UO2(CO3)3----	0.0001103	49.62	0.1998	-4.6567
Fe(OH)3(aq)	9.550e-005	10.20	1.0000	-4.0200
CO2(aq)	6.224e-005	2.737	1.0000	-4.2059
AlO2-	5.162e-005	3.043	0.9050	-4.3305
NaHCO3(aq)	4.549e-005	3.819	1.0000	-4.3421
CO3--	4.495e-005	2.696	0.6727	-4.5194
H2PO4-	2.750e-005	2.665	0.9050	-4.6040
Ca++	2.673e-005	1.070	0.6835	-4.7383
UO2(CO3)2--	2.466e-005	9.612	0.6690	-4.7826
CrO4--	2.009e-005	2.329	0.6690	-4.8715
SO4--	1.653e-005	1.587	0.6690	-4.9563
NaHPO4-	1.616e-005	1.921	0.9050	-4.8350
Mn++	7.465e-006	0.4098	0.6835	-5.2922
Cl-	7.232e-006	0.2562	0.9023	-5.1854
Ni++	6.950e-006	0.4076	0.6835	-5.3233
MnCO3(aq)	5.109e-006	0.5869	1.0000	-5.2917
MnHPO4(aq)	4.554e-006	0.6868	1.0000	-5.3416
Fe(OH)4-	4.012e-006	0.4967	0.9050	-5.4400
Mg++	3.656e-006	0.08880	0.6968	-5.5939
MnO4-	2.673e-006	0.3177	0.9037	-5.6170
CaHPO4(aq)	2.357e-006	0.3204	1.0000	-5.6277
OH-	1.694e-006	0.02879	0.9037	-5.8151
PbCO3(aq)	1.626e-006	0.4341	1.0000	-5.7890
Fe(OH)2+	1.491e-006	0.1339	0.9050	-5.8700

MnPO4-	1.479e-006	0.2215	0.9050	-5.8734
CaCO3(aq)	1.173e-006	0.1173	1.0000	-5.9306
Ca2UO2(CO3)3	1.166e-006	0.6181	1.0000	-5.9331
UO2PO4-	1.045e-006	0.3812	0.9050	-6.0242
CaPO4-	9.859e-007	0.1331	0.9050	-6.0495
NaF(aq)	9.700e-007	0.04070	1.0000	-6.0132
CaHCO3+	9.575e-007	0.09673	0.9050	-6.0622
HAlO2(aq)	8.707e-007	0.05220	1.0000	-6.0601
NaCO3-	8.181e-007	0.06785	0.9050	-6.1306
AlF3(aq)	7.286e-007	0.06115	1.0000	-6.1375
(UO2)2CO3(OH)3-	7.254e-007	0.4720	0.9050	-6.1828
NaSO4-	6.047e-007	0.07195	0.9050	-6.2618
MgHPO4(aq)	4.861e-007	0.05843	1.0000	-6.3133
HCrO4-	3.064e-007	0.03582	0.9050	-6.5571
AlF4-	2.605e-007	0.02681	0.9050	-6.6276
UO2(OH)2(aq)	2.459e-007	0.07472	1.0000	-6.6092
MnF+	1.954e-007	0.01444	0.9050	-6.7523
MgPO4-	1.850e-007	0.02206	0.9050	-6.7761
KHPO4-	1.831e-007	0.02471	0.9050	-6.7807
MnHCO3+	1.828e-007	0.02119	0.9050	-6.7813
MgHCO3+	1.302e-007	0.01110	0.9050	-6.9288
CaF+	1.249e-007	0.007376	0.9050	-6.9467
MgF+	8.161e-008	0.003532	0.9050	-7.1316
MgCO3(aq)	7.338e-008	0.006183	1.0000	-7.1344
NaAlO2(aq)	6.319e-008	0.005176	1.0000	-7.1994
UO2(OH)3-	5.092e-008	0.01634	0.9050	-7.3364
AlF2+	4.965e-008	0.003224	0.9050	-7.3474
Pb(CO3)2--	4.855e-008	0.01587	0.6690	-7.4884
PbOH+	4.772e-008	0.01069	0.9050	-7.3647
PO3F--	4.725e-008	0.004626	0.6690	-7.5002
PO4---	4.189e-008	0.003975	0.4043	-7.7712
UO2CO3(aq)	3.100e-008	0.01022	1.0000	-7.5087
PbP2O7--	3.019e-008	0.01150	0.6690	-7.6948
CaSO4(aq)	2.609e-008	0.003550	1.0000	-7.5835
MnOH+	2.193e-008	0.001577	0.9050	-7.7022
Pb++	2.102e-008	0.004352	0.6727	-7.8496
UO2HPO4(aq)	1.431e-008	0.005235	1.0000	-7.8442
CaNO3+	1.296e-008	0.001322	0.9050	-7.9307
MnSO4(aq)	1.272e-008	0.001919	1.0000	-7.8956
HF(aq)	1.253e-008	0.0002505	1.0000	-7.9020
KSO4-	1.085e-008	0.001465	0.9050	-8.0080

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	65.8803s/sat	Rhodochrosite	0.7099s/sat
Todorokite	57.2603s/sat	Plattnerite	0.4689s/sat
Trevorite	17.2091s/sat	Crocoite	-0.0034
Pyromorphite	17.1140s/sat	Ice	-0.1387
Hematite	15.8514s/sat	Ni3(PO4)2	-0.2273
Bixbyite	13.1114s/sat	Mn(OH)3	-0.2682
Hausmannite	13.0539s/sat	Fluorite	-0.4815
Fluorapatite	12.0642s/sat	CaUO4	-0.6149
Pyrolusite	10.6770s/sat	Strengite	-0.6665
MnO2(gamma)	9.1592s/sat	Calcite	-0.7776
Pyromorphite-OH	8.8493s/sat	Whitlockite	-0.8888

Parsonsite	8.5385s/sat	Aragonite	-0.9220
Plumbogummite	7.7963s/sat	Schoepite	-1.1279
Goethite	7.4455s/sat	UO3:2H2O	-1.1279
Pb4O(PO4)2	6.6356s/sat	Dolomite-ord	-1.2270
Manganite	6.2376s/sat	Dolomite	-1.2270
Ferrite-Ca	6.0600s/sat	UO2(OH)2(beta)	-1.2403
Magnetite	5.8914s/sat	UO3:.9H2O(alpha)	-1.3113
Ferrite-Mg	5.6710s/sat	Schoepite-dehy(.	-1.3113
Pb3(PO4)2	5.5269s/sat	Schoepite-dehy(.	-1.3916
PbHPO4	4.2485s/sat	Schoepite-dehy(1	-1.3977
MnHPO4	4.0254s/sat	Bunsenite	-1.4352
Diaspore	3.2125s/sat	Monohydrocalcite	-1.6113
Ca-Autunite	2.8156s/sat	Ni(OH)2	-1.7118
Boehmite	2.8086s/sat	(UO2)3(PO4)2:4H2	-1.8278
Gibbsite	2.6168s/sat	Sellaite	-1.9898
Hydrocerussite	2.5823s/sat	Magnesite	-2.0781
Corundum	2.4335s/sat	Saleeite	-2.3445
Fe(OH)3(ppd)	2.3244s/sat	Berlinite	-2.4079
Dawsonite	1.5302s/sat	Schoepite-dehy(.	-2.5009
Hydroxylapatite	1.2149s/sat	UO2CO3	-2.7186
Cerussite	1.1689s/sat	Rutherfordine	-2.7389
Corkite	0.9398s/sat	Dolomite-dis	-2.7714

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1752	-0.756
H2O(g)	0.02598	-1.585
CO2(g)	0.001832	-2.737
HF(g)	6.566e-013	-12.183
NO2(g)	2.979e-020	-19.526
N2(g)	2.750e-020	-19.561
HCl(g)	2.134e-020	-19.671
NO(g)	4.770e-026	-25.321
Cl2(g)	2.763e-032	-31.559
H2(g)	6.696e-042	-41.174
CO(g)	3.831e-048	-47.417
UO2F2(g)	7.901e-054	-53.102
SO2(g)	6.058e-058	-57.218
UOF4(g)	1.381e-065	-64.860
Pb(g)	5.356e-066	-65.271
UO3(g)	5.720e-068	-67.243
NH3(g)	2.190e-069	-68.660
UO2Cl2(g)	1.027e-071	-70.988
Na(g)	1.271e-074	-73.896
K(g)	3.810e-077	-76.419
UF5(g)	7.440e-078	-77.128
F2(g)	2.055e-080	-79.687
UF6(g)	1.075e-081	-80.969
UF4(g)	5.073e-088	-87.295
UO2(g)	8.513e-121	-120.070
UCl4(g)	5.288e-129	-128.277
U2F10(g)	6.197e-130	-129.208
Mg(g)	2.208e-130	-129.656
UCl5(g)	1.754e-137	-136.756
UF3(g)	1.585e-139	-138.800
UCl6(g)	1.081e-140	-139.966

H2S(g)	4.491e-145	-144.348
CH4(g)	2.937e-145	-144.532
Ca(g)	2.351e-152	-151.629
UCl3(g)	8.204e-158	-157.086
UF2(g)	7.306e-188	-187.136
Al(g)	3.077e-188	-187.512
C(g)	2.147e-189	-188.668
UCl2(g)	6.890e-204	-203.162
UO(g)	5.031e-205	-204.298
UF(g)	8.288e-230	-229.082
S2(g)	1.003e-232	-231.999
C2H4(g)	3.798e-237	-236.420
U2Cl8(g)	6.892e-247	-246.162
UCl(g)	1.267e-247	-246.897
U2Cl10(g)	6.143e-248	-247.212
U(g)	6.973e-290	-289.157

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	5.36e-005	5.36e-005	1.45			
Ca++	3.47e-005	3.47e-005	1.39			
Cl-	7.24e-006	7.24e-006	0.257			
CrO4--	2.04e-005	2.04e-005	2.36			
F-	0.00143	0.00143	27.1			
Fe++	0.000101	0.000101	5.64			
H+	-0.000921	-0.000921	-0.927			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00525	0.00525	320.			
HPO4--	0.000406	0.000406	38.9			
K+	0.000130	0.000130	5.08			
Mg++	4.62e-006	4.62e-006	0.112			
Mn++	2.17e-005	2.17e-005	1.19			
NH3(aq)	0.000142	0.000142	2.42			
Na+	0.00834	0.00834	192.			
Ni++	6.96e-006	6.96e-006	0.408			
O2(aq)	0.000534	0.000534	17.1			
Pb++	1.78e-006	1.78e-006	0.369			
SO4--	1.72e-005	1.72e-005	1.65			
UO2++	0.000139	0.000139	37.5			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	5.360e-005	5.360e-005	1.445		
Calcium	3.470e-005	3.470e-005	1.390		
Carbon	0.005254	0.005254	63.07		
Chlorine	7.240e-006	7.240e-006	0.2565		
Chromium	2.040e-005	2.040e-005	1.060		
Fluorine	0.001430	0.001430	27.15		
Hydrogen	111.0	111.0	1.118e+005		
Iron	0.0001010	0.0001010	5.637		
Lead	1.780e-006	1.780e-006	0.3686		
Magnesium	4.620e-006	4.620e-006	0.1122		
Manganese	2.170e-005	2.170e-005	1.191		
Nickel	6.960e-006	6.960e-006	0.4082		
Nitrogen	0.0001420	0.0001420	1.988		

Oxygen	55.53	55.53	8.878e+005
Phosphorus	0.0004060	0.0004060	12.57
Potassium	0.0001300	0.0001300	5.079
Sodium	0.008340	0.008340	191.6
Sulfur	1.720e-005	1.720e-005	0.5512
Uranium	0.0001390	0.0001390	33.06

Sample 19250 water leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  8.780               log fO2 =   -0.722
Eh =   0.6990 volts      pe =  11.8158
Ionic strength      =    0.011507
Activity of water   =    0.999998
Solvent mass        =    0.999997 kg
Solution mass       =    1.000715 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000043 molal
Dissolved solids    =         717 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      234.17 mg/kg as CaCO3
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Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01112	255.4	0.8962	-2.0017
HCO3-	0.003786	230.9	0.8962	-2.4694
F-	0.002088	39.64	0.8946	-2.7286
HPO4--	0.0005046	48.40	0.6429	-3.4889
NO3-	0.0002480	15.37	0.8930	-3.6547
O2(aq)	0.0002395	7.658	1.0000	-3.6207
UO2(CO3)3----	0.0001652	74.28	0.1703	-4.5508
CO3--	0.0001482	8.884	0.6473	-4.0182
K+	5.519e-005	2.156	0.8930	-4.3073
AlO2-	4.960e-005	2.923	0.8962	-4.3521
NaHCO3(aq)	4.820e-005	4.046	1.0000	-4.3170
Cl-	4.244e-005	1.503	0.8930	-4.4214
NaHPO4-	2.999e-005	3.566	0.8962	-4.5706
CrO4--	2.650e-005	3.072	0.6429	-4.7686
SO4--	2.041e-005	1.959	0.6429	-4.8821
Fe(OH)3(aq)	1.799e-005	1.921	1.0000	-4.7450
Ca++	1.645e-005	0.6588	0.6597	-4.9645
CO2(aq)	1.245e-005	0.5477	1.0000	-4.9047
UO2(CO3)2--	1.032e-005	4.024	0.6429	-5.1780
H2PO4-	9.641e-006	0.9344	0.8962	-5.0635
OH-	6.812e-006	0.1158	0.8946	-5.2151
MnO4-	4.165e-006	0.4950	0.8946	-5.4288
NaCO3-	3.485e-006	0.2890	0.8962	-5.5055
CaPO4-	3.254e-006	0.4391	0.8962	-5.5352
Fe(OH)4-	3.038e-006	0.3761	0.8962	-5.5650
CaCO3(aq)	2.210e-006	0.2211	1.0000	-5.6556
Ni++	2.051e-006	0.1203	0.6597	-5.8686
CaHPO4(aq)	1.935e-006	0.2630	1.0000	-5.7134
NaF(aq)	1.871e-006	0.07850	1.0000	-5.7279
Mg++	1.391e-006	0.03379	0.6750	-6.0273
NaSO4-	9.635e-007	0.1146	0.8962	-6.0637

PbCO3(aq)	5.358e-007	0.1431	1.0000	-6.2710
Ca2UO2(CO3)3	5.253e-007	0.2783	1.0000	-6.2796
CaHCO3+	4.575e-007	0.04622	0.8962	-6.3872
MgPO4-	3.790e-007	0.04517	0.8962	-6.4690
MnCO3(aq)	3.591e-007	0.04125	1.0000	-6.4448
PO4---	2.521e-007	0.02392	0.3697	-7.0307
MgHPO4(aq)	2.477e-007	0.02977	1.0000	-6.6062
(UO2)2CO3(OH)3-	2.346e-007	0.1526	0.8962	-6.6773
UO2PO4-	2.323e-007	0.08472	0.8962	-6.6816
HAlO2(aq)	2.081e-007	0.01247	1.0000	-6.6817
MnPO4-	1.821e-007	0.02728	0.8962	-6.7873
Mn++	1.714e-007	0.009409	0.6597	-6.9466
UO2(OH)2(aq)	1.559e-007	0.04737	1.0000	-6.8071
MnHPO4(aq)	1.395e-007	0.02103	1.0000	-6.8555
UO2(OH)3-	1.298e-007	0.04165	0.8962	-6.9343
CaF+	1.087e-007	0.006416	0.8962	-7.0114
KHPO4-	1.075e-007	0.01451	0.8962	-7.0162
HCrO4-	9.850e-008	0.01152	0.8962	-7.0542
MgCO3(aq)	8.579e-008	0.007228	1.0000	-7.0666
NaAlO2(aq)	7.996e-008	0.006550	1.0000	-7.0971
Fe(OH)2+	7.123e-008	0.006396	0.8962	-7.1950
NaCl(aq)	6.309e-008	0.003684	1.0000	-7.2001
Pb(CO3)2--	5.280e-008	0.01726	0.6429	-7.4692
MgF+	4.406e-008	0.001907	0.8962	-7.4035
MgHCO3+	3.861e-008	0.003292	0.8962	-7.4610
PO3F--	2.475e-008	0.002423	0.6429	-7.7982
MnO4--	2.138e-008	0.002540	0.6429	-7.8619
PbOH+	1.994e-008	0.004467	0.8962	-7.7479
CaSO4(aq)	1.839e-008	0.002502	1.0000	-7.7354
CaNO3+	1.344e-008	0.001371	0.8962	-7.9192

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	62.3474s/sat	Plattnerite	0.7027s/sat
Todorokite	54.1648s/sat	Cerussite	0.6869s/sat
Trevorite	16.4139s/sat	CaUO4	0.1610s/sat
Pyromorphite	15.1831s/sat	Whitlockite	-0.0863
Hematite	14.4015s/sat	Ice	-0.1387
Fluorapatite	13.3162s/sat	Ni3(PO4)2	-0.3821
Bixbyite	12.2197s/sat	Fluorite	-0.3848
Hausmannite	11.7078s/sat	Rhodochrosite	-0.4432
Pyrolusite	10.2396s/sat	Calcite	-0.5026
MnO2(gamma)	8.7218s/sat	Aragonite	-0.6470
Pyromorphite-OH	6.7544s/sat	Mn(OH)3	-0.7141
Goethite	6.7205s/sat	Bunsenite	-0.7805
Parsonsite	6.6551s/sat	Crocoite	-0.8837
Manganite	5.7917s/sat	Dolomite-ord	-0.8840
Ferrite-Ca	5.5839s/sat	Dolomite	-0.8840
Pb4O(PO4)2	5.3835s/sat	Ni(OH)2	-1.0571
Ferrite-Mg	4.9877s/sat	UO3:2H2O	-1.3258
Pb3(PO4)2	4.0581s/sat	Schoepite	-1.3258
Plumbogummite	4.0292s/sat	Monohydrocalcite	-1.3363
Magnetite	3.7080s/sat	UO2(OH)2(beta)	-1.4382
PbHPO4	3.4058s/sat	UO3:.9H2O(alpha)	-1.5092
Hydroxylapatite	2.9055s/sat	Schoepite-dehy(.	-1.5092

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  Diaspore           2.5909s/sat   Schoepite-dehy(.  -1.5895
  MnHPO4             2.5115s/sat   Schoepite-dehy(1  -1.5956
  Boehmite           2.1870s/sat   Magnesite         -2.0103
  Gibbsite           1.9952s/sat   Na2U2O7(c)        -2.0201
  Hydrocerussite     1.8350s/sat   Sellaite          -2.1003
  Fe(OH)3(ppd)       1.5994s/sat   Dolomite-dis      -2.4284
  Ca-Autunite        1.2747s/sat   Strengite         -2.4509
  Corundum           1.1902s/sat   Schoepite-dehy(.  -2.6988
  Dawsonite          0.9337s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                fugacity      log fug.
-----------------------------------------------
  O2(g)                   0.1895      -0.722
  H2O(g)                 0.02598      -1.585
  CO2(g)               0.0003666      -3.436
  HF(g)                2.392e-013    -12.621
  HCl(g)               3.112e-020    -19.507
  NO2(g)               1.268e-020    -19.897
  N2(g)                4.260e-021    -20.371
  NO(g)                1.953e-026    -25.709
  Cl2(g)               6.116e-032    -31.214
  H2(g)                6.438e-042    -41.191
  CO(g)                7.372e-049    -48.132
  UO2F2(g)             6.648e-055    -54.177
  SO2(g)               4.360e-059    -58.361
  Pb(g)                8.482e-066    -65.072
  UOF4(g)              1.542e-067    -66.812
  UO3(g)               3.627e-068    -67.440
  NH3(g)               8.127e-070    -69.090
  UO2Cl2(g)            1.386e-071    -70.858
  Na(g)                6.599e-074    -73.181
  K(g)                 6.257e-077    -76.204
  UF5(g)               2.968e-080    -79.528
  F2(g)                2.836e-081    -80.547
  UF6(g)               1.592e-084    -83.798
  UF4(g)               5.447e-090    -89.264
  UO2(g)               5.190e-121   -120.285
  UCl4(g)              1.460e-128   -127.836
  Mg(g)                1.241e-129   -128.906
  U2F10(g)             9.860e-135   -134.006
  UCl5(g)              7.206e-137   -136.142
  UCl6(g)              6.608e-140   -139.180
  UF3(g)               4.580e-141   -140.339
  CH4(g)               5.023e-146   -145.299
  H2S(g)               2.873e-146   -145.542
  Ca(g)                2.128e-151   -150.672
  UCl3(g)              1.522e-157   -156.817
  Al(g)                6.932e-189   -188.159
  UF2(g)               5.683e-189   -188.245
  C(g)                 3.972e-190   -189.401
  UCl2(g)              8.594e-204   -203.066
  UO(g)                2.949e-205   -204.530
  UF(g)                1.735e-230   -229.761
  S2(g)                4.441e-235   -234.353
  C2H4(g)              1.201e-238   -237.920
  U2Cl8(g)             5.253e-246   -245.280
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U2Cl10(g)	1.036e-246	-245.984
UCl(g)	1.063e-247	-246.974
U(g)	3.930e-290	-289.406

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	4.99e-005	4.99e-005	1.35			
Ca++	2.55e-005	2.55e-005	1.02			
Cl-	4.25e-005	4.25e-005	1.51			
CrO4--	2.66e-005	2.66e-005	3.08			
F-	0.00209	0.00209	39.7			
Fe++	2.11e-005	2.11e-005	1.18			
H+	-0.00117	-0.00117	-1.18			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00452	0.00452	276.			
HPO4--	0.000551	0.000551	52.8			
K+	5.53e-005	5.53e-005	2.16			
Mg++	2.19e-006	2.19e-006	0.0532			
Mn++	5.05e-006	5.05e-006	0.277			
NH3(aq)	0.000248	0.000248	4.22			
Na+	0.0112	0.0112	257.			
Ni++	2.06e-006	2.06e-006	0.121			
O2(aq)	0.000746	0.000746	23.9			
Pb++	6.22e-007	6.22e-007	0.129			
SO4--	2.14e-005	2.14e-005	2.05			
UO2++	0.000177	0.000177	47.8			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	4.990e-005	4.990e-005	1.345		
Calcium	2.550e-005	2.550e-005	1.021		
Carbon	0.004520	0.004520	54.26		
Chlorine	4.250e-005	4.250e-005	1.506		
Chromium	2.660e-005	2.660e-005	1.382		
Fluorine	0.002090	0.002090	39.68		
Hydrogen	111.0	111.0	1.118e+005		
Iron	2.110e-005	2.110e-005	1.178		
Lead	6.220e-007	6.220e-007	0.1288		
Magnesium	2.190e-006	2.190e-006	0.05319		
Manganese	5.050e-006	5.050e-006	0.2772		
Nickel	2.060e-006	2.060e-006	0.1208		
Nitrogen	0.0002480	0.0002480	3.471		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	0.0005510	0.0005510	17.05		
Potassium	5.530e-005	5.530e-005	2.161		
Sodium	0.01120	0.01120	257.3		
Sulfur	2.140e-005	2.140e-005	0.6857		
Uranium	0.0001770	0.0001770	42.10		

Sample 19250 water leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.110               log fO2 =   -0.730
Eh =   0.7385 volts       pe =  12.4838
Ionic strength       =    0.002545
Activity of water    =    1.000000
Solvent mass         =    0.999995 kg
Solution mass        =    1.000208 kg
Solution density     =    1.013    g/cm3
Chlorinity           =    0.000001 molal
Dissolved solids     =         213 mg/kg sol'n
Rock mass            =    0.000000 kg
Carbonate alkalinity=       81.12 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001536	93.70	0.9460	-2.8377
Na+	0.001534	35.27	0.9460	-2.8382
F-	0.0003198	6.074	0.9456	-3.5194
HPO4--	0.0002514	24.13	0.8004	-3.6962
O2(aq)	0.0002351	7.522	1.0000	-3.6287
K+	0.0001618	6.325	0.9452	-3.8155
AlO2-	5.991e-005	3.533	0.9460	-4.2466
Fe(OH)3(aq)	5.011e-005	5.354	1.0000	-4.3001
H2PO4-	2.650e-005	2.570	0.9460	-4.6008
CO2(aq)	2.495e-005	1.098	1.0000	-4.6030
Ca++	2.262e-005	0.9064	0.8058	-4.7392
UO2(CO3)2--	1.192e-005	4.647	0.8004	-5.0205
CO3--	1.095e-005	0.6570	0.8018	-5.0565
NO3-	1.030e-005	0.6385	0.9452	-5.0117
UO2(CO3)3----	9.022e-006	4.059	0.4102	-5.4317
CrO4--	7.976e-006	0.9250	0.8004	-5.1949
(UO2)2CO3(OH)3-	5.844e-006	3.804	0.9460	-5.2574
Mn++	5.082e-006	0.2791	0.8058	-5.3877
UO2PO4-	5.003e-006	1.826	0.9460	-5.3248
Ni++	3.639e-006	0.2135	0.8058	-5.5328
MnHPO4(aq)	3.134e-006	0.4728	1.0000	-5.5040
NaHCO3(aq)	3.008e-006	0.2526	1.0000	-5.5218
NaHPO4-	2.569e-006	0.3055	0.9460	-5.6144
Mg++	2.449e-006	0.05951	0.8110	-5.7020
SO4--	2.351e-006	0.2258	0.8004	-5.7255
CaHPO4(aq)	2.016e-006	0.2743	1.0000	-5.6955
Fe(OH)4-	1.714e-006	0.2123	0.9460	-5.7901
Cl-	1.400e-006	0.04961	0.9452	-5.8784
OH-	1.378e-006	0.02343	0.9456	-5.8851
MnO4-	1.363e-006	0.1620	0.9456	-5.8899
HAlO2(aq)	1.241e-006	0.07443	1.0000	-5.9062

UO2(OH)2(aq)	1.222e-006	0.3714	1.0000	-5.9130
MnCO3(aq)	1.191e-006	0.1368	1.0000	-5.9242
Fe(OH)2+	8.790e-007	0.07897	0.9460	-6.0801
PbCO3(aq)	8.328e-007	0.2225	1.0000	-6.0794
MnPO4-	8.286e-007	0.1242	0.9460	-6.1058
CaPO4-	6.868e-007	0.09273	0.9460	-6.1873
CaCO3(aq)	3.399e-007	0.03401	1.0000	-6.4686
MgHPO4(aq)	3.249e-007	0.03907	1.0000	-6.4882
CaHCO3+	3.118e-007	0.03151	0.9460	-6.5302
UO2(OH)3-	2.060e-007	0.06612	0.9460	-6.7102
KHPO4-	1.961e-007	0.02648	0.9460	-6.7317
Ca2UO2(CO3)3	1.950e-007	0.1034	1.0000	-6.7100
HCrO4-	1.635e-007	0.01913	0.9460	-6.8105
MgPO4-	1.007e-007	0.01201	0.9460	-7.0210
UO2HPO4(aq)	8.417e-008	0.03080	1.0000	-7.0748
PbOH+	6.856e-008	0.01537	0.9460	-7.1880
UO2CO3(aq)	6.173e-008	0.02037	1.0000	-7.2095
MnHCO3+	4.789e-008	0.005552	0.9460	-7.3438
NaF(aq)	4.414e-008	0.001853	1.0000	-7.3552
NaCO3-	4.404e-008	0.003654	0.9460	-7.3803
MnF+	3.523e-008	0.002604	0.9460	-7.4772
MgHCO3+	3.312e-008	0.002825	0.9460	-7.5040
PbP2O7--	3.273e-008	0.01247	0.8004	-7.5818
Pb++	3.112e-008	0.006446	0.8018	-7.6029
CaF+	2.800e-008	0.001654	0.9460	-7.5770
AlF3(aq)	2.180e-008	0.001830	1.0000	-7.6616
PO4---	2.040e-008	0.001937	0.6058	-7.9080
NaSO4-	1.907e-008	0.002270	0.9460	-7.7436
MgCO3(aq)	1.661e-008	0.001400	1.0000	-7.7796
NaAlO2(aq)	1.486e-008	0.001218	1.0000	-7.8281
MnOH+	1.433e-008	0.001031	0.9460	-7.8677
MgF+	1.429e-008	0.0006187	0.9460	-7.8690

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	64.0745s/sat	Rhodochrosite	0.0774s/sat
Todorokite	55.6770s/sat	CaUO4	-0.0597
Pyromorphite	17.2436s/sat	Crocoite	-0.0801
Trevorite	16.2994s/sat	Ice	-0.1387
Hematite	15.2912s/sat	Corkite	-0.3498
Bixbyite	12.6535s/sat	UO3:2H2O	-0.4317
Hausmannite	12.3604s/sat	Schoepite	-0.4317
Fluorapatite	11.0197s/sat	Mn(OH)3	-0.4972
Pyrolusite	10.4545s/sat	UO2(OH)2(beta)	-0.5441
Pyromorphite-OH	9.6019s/sat	Schoepite-dehy(.	-0.6151
Parsonsite	9.5944s/sat	UO3:.9H2O(alpha)	-0.6151
MnO2(gamma)	8.9367s/sat	Schoepite-dehy(.	-0.6954
Plumbogummite	8.5110s/sat	Schoepite-dehy(1	-0.7015
Pb4O(PO4)2	7.2085s/sat	Strengite	-0.8734
Goethite	7.1654s/sat	Saleeite	-1.0538
Manganite	6.0086s/sat	Ni3(PO4)2	-1.1295
Pb3(PO4)2	5.9931s/sat	Whitlockite	-1.1653
Ferrite-Ca	5.3589s/sat	Calcite	-1.3156
Magnetite	5.0446s/sat	Aragonite	-1.4600
Ferrite-Mg	4.8627s/sat	Fluorite	-1.7411

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  PbHPO4              4.4283s/sat   Bunsenite          -1.7847
  Ca-Autunite         4.2135s/sat   Schoepite-dehy(.   -1.8047
  MnHPO4              3.8630s/sat   Ni(OH)2            -2.0613
  Diaspore            3.3664s/sat   Monohydrocalcite   -2.1493
  Boehmite            2.9625s/sat   Berlinite          -2.1808
  Gibbsite            2.7707s/sat   Schoepite-dehy(.   -2.3227
  Corundum            2.7413s/sat   Przhevalskite      -2.3719
  Hydrocerussite      2.1081s/sat   Dolomite-ord       -2.4101
  Fe(OH)3(ppd)        2.0443s/sat   Dolomite           -2.4101
  Cerussite           0.8785s/sat   UO2CO3             -2.4194
  Hydroxylapatite     0.7297s/sat   Rutherfordine      -2.4397
  Plattnerite         0.5886s/sat   UO2HPO4:4H2O       -2.4915
  Dawsonite           0.5044s/sat   Magnesite          -2.7233
  (UO2)3(PO4)2:4H2    0.4072s/sat   UO2HPO4            -2.8364
   (only minerals with log Q/K > -3 listed)

 Gases                   fugacity      log fug.
-----------------------------------------------
  O2(g)                    0.1860      -0.730
  H2O(g)                  0.02598      -1.585
  CO2(g)                0.0007343      -3.134
  HF(g)                 1.811e-013    -12.742
  HCl(g)                5.082e-021    -20.294
  NO2(g)                2.619e-021    -20.582
  N2(g)                 1.886e-022    -21.725
  NO(g)                 4.070e-027    -26.390
  Cl2(g)                1.616e-033    -32.792
  H2(g)                 6.497e-042    -41.187
  CO(g)                 1.490e-048    -47.827
  UO2F2(g)              2.987e-054    -53.525
  SO2(g)                1.381e-058    -57.860
  Pb(g)                 6.644e-066    -65.178
  UOF4(g)               3.973e-067    -66.401
  UO3(g)                2.842e-067    -66.546
  NH3(g)                1.734e-070    -69.761
  UO2Cl2(g)             2.895e-072    -71.538
  Na(g)                 2.065e-075    -74.685
  K(g)                  4.170e-077    -76.380
  UF5(g)                5.816e-080    -79.235
  F2(g)                 1.611e-081    -80.793
  UF6(g)                2.352e-084    -83.629
  UF4(g)                1.416e-089    -88.849
  UO2(g)                4.104e-120   -119.387
  Mg(g)                 1.210e-130   -129.917
  UCl4(g)               8.208e-131   -130.086
  U2F10(g)              3.787e-134   -133.422
  UCl5(g)               6.584e-140   -139.181
  UF3(g)                1.580e-140   -139.801
  UCl6(g)               9.813e-144   -143.008
  CH4(g)                1.044e-145   -144.981
  H2S(g)                9.352e-146   -145.029
  Ca(g)                 1.649e-152   -151.783
  UCl3(g)               5.266e-159   -158.279
  Al(g)                 4.192e-188   -187.378
  UF2(g)                2.601e-188   -187.585
  C(g)                  8.104e-190   -189.091
  UO(g)                 2.354e-204   -203.628
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UCl2(g)	1.829e-204	-203.738
UF(g)	1.054e-229	-228.977
S2(g)	4.621e-234	-233.335
C2H4(g)	5.094e-238	-237.293
UCl(g)	1.391e-247	-246.857
U2Cl8(g)	1.660e-250	-249.780
U2Cl10(g)	8.652e-253	-252.063
U(g)	3.166e-289	-288.499

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	6.12e-005	6.12e-005	1.65			
Ca++	2.64e-005	2.64e-005	1.06			
Cl-	1.40e-006	1.40e-006	0.0496			
CrO4--	8.14e-006	8.14e-006	0.944			
F-	0.000320	0.000320	6.08			
Fe++	5.27e-005	5.27e-005	2.94			
H+	-0.000412	-0.000412	-0.415			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00164	0.00164	99.7			
HPO4--	0.000293	0.000293	28.1			
K+	0.000162	0.000162	6.33			
Mg++	2.94e-006	2.94e-006	0.0714			
Mn++	1.17e-005	1.17e-005	0.643			
NH3(aq)	1.03e-005	1.03e-005	0.175			
Na+	0.00154	0.00154	35.4			
Ni++	3.64e-006	3.64e-006	0.214			
O2(aq)	0.000271	0.000271	8.66			
Pb++	9.81e-007	9.81e-007	0.203			
SO4--	2.38e-006	2.38e-006	0.229			
UO2++	3.94e-005	3.94e-005	10.6			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	6.120e-005	6.120e-005	1.651		
Calcium	2.640e-005	2.640e-005	1.058		
Carbon	0.001635	0.001635	19.64		
Chlorine	1.400e-006	1.400e-006	0.04962		
Chromium	8.140e-006	8.140e-006	0.4232		
Fluorine	0.0003200	0.0003200	6.078		
Hydrogen	111.0	111.0	1.119e+005		
Iron	5.270e-005	5.270e-005	2.943		
Lead	9.810e-007	9.810e-007	0.2032		
Magnesium	2.940e-006	2.940e-006	0.07144		
Manganese	1.170e-005	1.170e-005	0.6426		
Nickel	3.640e-006	3.640e-006	0.2136		
Nitrogen	1.030e-005	1.030e-005	0.1442		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0002930	0.0002930	9.073		
Potassium	0.0001620	0.0001620	6.333		
Sodium	0.001540	0.001540	35.40		
Sulfur	2.380e-006	2.380e-006	0.07630		
Uranium	3.940e-005	3.940e-005	9.376		

Sample 19250 water leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.560               log fO2 =   -0.795
Eh =   0.7109 volts       pe =  12.0177
Ionic strength      =     0.002047
Activity of water   =     1.000000
Solvent mass        =     0.999989 kg
Solution mass       =     1.000171 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000002 molal
Dissolved solids    =          181 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=        54.01 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001127	25.90	0.9511	-2.9699
HCO3-	0.0009621	58.69	0.9511	-3.0385
HPO4--	0.0002213	21.24	0.8180	-3.7422
F-	0.0002139	4.064	0.9508	-3.6916
O2(aq)	0.0002027	6.486	1.0000	-3.6931
K+	0.0001388	5.428	0.9505	-3.8795
AlO2-	0.0001151	6.789	0.9511	-3.9606
Fe(OH)3(aq)	9.709e-005	10.37	1.0000	-4.0128
NO3-	5.249e-005	3.254	0.9505	-4.3020
Ca++	2.463e-005	0.9871	0.8225	-4.6933
CO3--	1.902e-005	1.141	0.8191	-4.8073
MnO4-	1.639e-005	1.949	0.9508	-4.8073
(UO2)2CO3(OH)3-	1.585e-005	10.32	0.9511	-4.8218
CrO4--	1.439e-005	1.669	0.8180	-4.9291
UO2(CO3)3----	1.212e-005	5.452	0.4474	-5.2660
UO2(CO3)2--	9.623e-006	3.753	0.8180	-5.1039
Fe(OH)4-	9.310e-006	1.153	0.9511	-5.0528
H2PO4-	8.413e-006	0.8158	0.9511	-5.0968
Ni++	7.969e-006	0.4676	0.8225	-5.1835
CO2(aq)	5.574e-006	0.2453	1.0000	-5.2538
OH-	3.862e-006	0.06567	0.9508	-5.4351
Mg++	3.696e-006	0.08982	0.8268	-5.5149
UO2PO4-	3.305e-006	1.206	0.9511	-5.5026
Mn++	3.237e-006	0.1778	0.8225	-5.5747
UO2(OH)2(aq)	2.542e-006	0.7728	1.0000	-5.5948
CaHPO4(aq)	2.016e-006	0.2742	1.0000	-5.6956
CaPO4-	1.925e-006	0.2599	0.9511	-5.7374
SO4--	1.879e-006	0.1805	0.8180	-5.8132
MnHPO4(aq)	1.833e-006	0.2765	1.0000	-5.7369
NaHPO4-	1.697e-006	0.2018	0.9511	-5.7921
Cl-	1.590e-006	0.05635	0.9505	-5.8207

PbCO3(aq)	1.455e-006	0.3887	1.0000	-5.8371
NaHCO3(aq)	1.398e-006	0.1175	1.0000	-5.8543
MnCO3(aq)	1.374e-006	0.1579	1.0000	-5.8620
MnPO4-	1.358e-006	0.2036	0.9511	-5.8887
UO2(OH)3-	1.202e-006	0.3857	0.9511	-5.9420
HAlO2(aq)	8.508e-007	0.05103	1.0000	-6.0702
CaCO3(aq)	6.705e-007	0.06710	1.0000	-6.1736
Fe(OH)2+	6.011e-007	0.05400	0.9511	-6.2428
MgHPO4(aq)	4.497e-007	0.05408	1.0000	-6.3471
MgPO4-	3.907e-007	0.04659	0.9511	-6.4299
Ca2UO2(CO3)3	3.528e-007	0.1870	1.0000	-6.4525
CaHCO3+	2.171e-007	0.02194	0.9511	-6.6852
PbOH+	1.892e-007	0.04241	0.9511	-6.7449
KHPO4-	1.514e-007	0.02044	0.9511	-6.8417
HCrO4-	1.064e-007	0.01245	0.9511	-6.9947
NaCO3-	5.740e-008	0.004763	0.9511	-7.2628
PO4---	4.925e-008	0.004677	0.6361	-7.5040
MgCO3(aq)	4.536e-008	0.003824	1.0000	-7.3433
MnO4--	4.415e-008	0.005250	0.8180	-7.4424
MgHCO3+	3.192e-008	0.002723	0.9511	-7.5177
Pb++	2.998e-008	0.006211	0.8191	-7.6098
UO2CO3(aq)	2.870e-008	0.009471	1.0000	-7.5421
Pb(OH)2(aq)	2.630e-008	0.006343	1.0000	-7.5800
MnOH+	2.613e-008	0.001879	0.9511	-7.6047
PbP2O7--	2.550e-008	0.009719	0.8180	-7.6806
NaF(aq)	2.192e-008	0.0009202	1.0000	-7.6592
NaAlO2(aq)	2.119e-008	0.001737	1.0000	-7.6738
CaF+	2.082e-008	0.001230	0.9511	-7.7033
UO2HPO4(aq)	1.983e-008	0.007258	1.0000	-7.7026
MnHCO3+	1.950e-008	0.002261	0.9511	-7.7316
Pb(CO3)2--	1.831e-008	0.005992	0.8180	-7.8245
MnF+	1.533e-008	0.001133	0.9511	-7.8363
MgF+	1.471e-008	0.0006369	0.9511	-7.8541
NaSO4-	1.144e-008	0.001362	0.9511	-7.9631

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	69.5858s/sat	Crocoite	0.1788s/sat
Todorokite	60.5074s/sat	Rhodochrosite	0.1396s/sat
Pyromorphite	18.4790s/sat	Dawsonite	0.0079s/sat
Trevorite	18.1233s/sat	Schoepite	-0.1135
Hematite	15.8658s/sat	UO3:2H2O	-0.1135
Hausmannite	14.4674s/sat	Ice	-0.1387
Bixbyite	14.0474s/sat	Whitlockite	-0.2196
Fluorapatite	12.2890s/sat	UO2(OH)2(beta)	-0.2259
Pyromorphite-OH	11.2296s/sat	Schoepite-dehy(.	-0.2969
Pyrolusite	11.1354s/sat	UO3:.9H2O(alpha)	-0.2969
Parsonsite	9.8069s/sat	Schoepite-dehy(.	-0.3772
MnO2(gamma)	9.6176s/sat	Schoepite-dehy(1	-0.3833
Pb4O(PO4)2	8.8890s/sat	Corkite	-0.5286
Goethite	7.4527s/sat	(UO2)3(PO4)2:4H2	-0.5301
Plumbogummite	7.0202s/sat	Bunsenite	-0.5354
Ferrite-Ca	6.8793s/sat	Becquerelite	-0.6544
Pb3(PO4)2	6.7805s/sat	Ni(OH)2	-0.8120
Manganite	6.7055s/sat	Calcite	-1.0206

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  Ferrite-Mg         6.5244s/sat   Aragonite          -1.1650
  Magnetite          5.9225s/sat   Saleeite           -1.2222
  PbHPO4             4.3755s/sat   Schoepite-dehy(.   -1.4865
  Ca-Autunite        3.9039s/sat   Strengite          -1.5321
  MnHPO4             3.6301s/sat   Dolomite-ord       -1.6788
  Hydrocerussite     3.4858s/sat   Dolomite           -1.6788
  Diaspore           3.2024s/sat   Monohydrocalcite   -1.8543
  Boehmite           2.7985s/sat   Na2U2O7(c)         -1.9719
  Hydroxylapatite    2.6212s/sat   Schoepite-dehy(.   -2.0045
  Gibbsite           2.6067s/sat   Fluorite           -2.0396
  Corundum           2.4133s/sat   PbCO3.PbO          -2.2492
  Fe(OH)3(ppd)       2.3316s/sat   Magnesite          -2.2870
  Plattnerite        1.4496s/sat   Przhevalskite      -2.7343
  CaUO4              1.2045s/sat   UO2CO3             -2.7520
  Cerussite          1.1208s/sat   Rutherfordine      -2.7723
  Ni3(PO4)2          0.7265s/sat   UO3(gamma)         -2.9875
  Mn(OH)3            0.1997s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                  fugacity      log fug.
-----------------------------------------------
  O2(g)                   0.1604       -0.795
  H2O(g)                 0.02598       -1.585
  CO2(g)               0.0001641       -3.785
  HF(g)                4.323e-014     -13.364
  NO2(g)               4.943e-021     -20.306
  HCl(g)               2.059e-021     -20.686
  N2(g)                9.034e-022     -21.044
  NO(g)                8.273e-027     -26.082
  Cl2(g)               2.464e-034     -33.608
  H2(g)                6.997e-042     -41.155
  CO(g)                3.586e-049     -48.445
  UO2F2(g)             3.540e-055     -54.451
  SO2(g)               1.529e-059     -58.815
  Pb(g)                5.594e-065     -64.252
  UO3(g)               5.913e-067     -66.228
  UOF4(g)              2.682e-069     -68.572
  NH3(g)               4.241e-070     -69.372
  UO2Cl2(g)            9.893e-073     -72.005
  Na(g)                4.460e-075     -74.351
  K(g)                 1.053e-076     -75.978
  UF5(g)               9.725e-083     -82.012
  F2(g)                8.521e-083     -82.070
  UF6(g)               9.044e-088     -87.044
  UF4(g)               1.030e-091     -90.987
  UO2(g)               9.197e-120    -119.036
  Mg(g)                1.593e-129    -128.798
  UCl4(g)              4.960e-132    -131.305
  U2F10(g)             1.059e-139    -138.975
  UCl5(g)              1.554e-141    -140.809
  UF3(g)               4.995e-142    -141.301
  UCl6(g)              9.042e-146    -145.044
  CH4(g)               3.138e-146    -145.503
  H2S(g)               1.294e-146    -145.888
  Ca(g)                1.568e-151    -150.805
  UCl3(g)              8.149e-160    -159.089
  Al(g)                3.212e-188    -187.493
```

UF2(g)	3.575e-189	-188.447
C(g)	2.100e-190	-189.678
UO(g)	5.681e-204	-203.246
UCl2(g)	7.248e-205	-204.140
UF(g)	6.298e-230	-229.201
S2(g)	7.626e-236	-235.118
C2H4(g)	3.968e-239	-238.401
UCl(g)	1.412e-247	-246.850
U2Cl8(g)	6.063e-253	-252.217
U2Cl10(g)	4.818e-256	-255.317
U(g)	8.229e-289	-288.085

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	0.000116	0.000116	3.13			
Ca++	3.02e-005	3.02e-005	1.21			
Cl-	1.59e-006	1.59e-006	0.0564			
CrO4--	1.45e-005	1.45e-005	1.68			
F-	0.000214	0.000214	4.06			
Fe++	0.000107	0.000107	5.97			
H+	-0.000936	-0.000936	-0.943			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00106	0.00106	64.9			
HPO4--	0.000243	0.000243	23.3			
K+	0.000139	0.000139	5.43			
Mg++	4.63e-006	4.63e-006	0.113			
Mn++	2.43e-005	2.43e-005	1.33			
NH3(aq)	5.25e-005	5.25e-005	0.894			
Na+	0.00113	0.00113	26.0			
Ni++	7.98e-006	7.98e-006	0.468			
O2(aq)	0.000355	0.000355	11.4			
Pb++	1.75e-006	1.75e-006	0.363			
SO4--	1.90e-006	1.90e-006	0.182			
UO2++	6.09e-005	6.09e-005	16.4			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	0.0001160	0.0001160	3.129		
Calcium	3.020e-005	3.020e-005	1.210		
Carbon	0.001065	0.001065	12.78		
Chlorine	1.590e-006	1.590e-006	0.05636		
Chromium	1.450e-005	1.450e-005	0.7538		
Fluorine	0.0002140	0.0002140	4.065		
Hydrogen	111.0	111.0	1.119e+005		
Iron	0.0001070	0.0001070	5.975		
Lead	1.750e-006	1.750e-006	0.3625		
Magnesium	4.630e-006	4.630e-006	0.1125		
Manganese	2.430e-005	2.430e-005	1.335		
Nickel	7.980e-006	7.980e-006	0.4683		
Nitrogen	5.250e-005	5.250e-005	0.7352		
Oxygen	55.51	55.51	8.880e+005		
Phosphorus	0.0002430	0.0002430	7.525		
Potassium	0.0001390	0.0001390	5.434		
Sodium	0.001130	0.001130	25.97		
Sulfur	1.900e-006	1.900e-006	0.06092		

Uranium	6.090e-005	6.090e-005	14.49

Sample 19250 water leach, Stage 4.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  7.590               log fO2 =   -0.717
Eh =   0.7694 volts       pe =  13.0072
Ionic strength      =     0.000894
Activity of water   =     1.000000
Solvent mass        =     0.999997 kg
Solution mass       =     1.000090 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000001 molal
Dissolved solids    =           94 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=        30.10 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.0005885	35.90	0.9668	-3.2450
Na+	0.0005094	11.71	0.9668	-3.3077
O2(aq)	0.0002427	7.764	1.0000	-3.6150
K+	0.0001200	4.690	0.9665	-3.9358
HPO4--	6.250e-005	5.998	0.8733	-4.2629
AlO2-	5.854e-005	3.452	0.9668	-4.2472
F-	3.256e-005	0.6186	0.9666	-4.5020
CO2(aq)	3.234e-005	1.423	1.0000	-4.4903
Fe(OH)3(aq)	2.737e-005	2.924	1.0000	-4.5628
H2PO4-	2.329e-005	2.258	0.9668	-4.6475
Ca++	2.217e-005	0.8885	0.8755	-4.7119
NO3-	2.120e-005	1.314	0.9665	-4.6885
UO2PO4-	6.283e-006	2.293	0.9668	-5.2165
Mn++	5.176e-006	0.2843	0.8755	-5.3437
(UO2)2CO3(OH)3-	4.571e-006	2.976	0.9668	-5.3547
CrO4--	4.532e-006	0.5256	0.8733	-5.4026
HAlO2(aq)	4.104e-006	0.2461	1.0000	-5.3868
Ni++	2.860e-006	0.1678	0.8755	-5.6014
Mg++	2.572e-006	0.06251	0.8776	-5.6464
UO2(CO3)2--	2.392e-006	0.9330	0.8733	-5.6800
UO2(OH)2(aq)	1.746e-006	0.5308	1.0000	-5.7580
Fe(OH)2+	1.556e-006	0.1398	0.9668	-5.8228
CO3--	1.188e-006	0.07128	0.8739	-5.9838
MnHPO4(aq)	9.404e-007	0.1419	1.0000	-6.0267
Cl-	8.739e-007	0.03098	0.9665	-6.0734
CaHPO4(aq)	5.823e-007	0.07921	1.0000	-6.2349
SO4--	5.578e-007	0.05357	0.8733	-6.3124
PbCO3(aq)	4.339e-007	0.1159	1.0000	-6.3626
OH-	4.071e-007	0.006922	0.9666	-6.4051
NaHCO3(aq)	3.995e-007	0.03356	1.0000	-6.3985
UO2HPO4(aq)	3.577e-007	0.1309	1.0000	-6.4465

HCrO4-	3.285e-007	0.03843	0.9668	-6.4982
Fe(OH)4-	2.766e-007	0.03427	0.9668	-6.5728
NaHPO4-	2.313e-007	0.02751	0.9668	-6.6506
UO2(CO3)3----	1.648e-007	0.07416	0.5815	-7.0185
MnCO3(aq)	1.558e-007	0.01790	1.0000	-6.8075
CaHCO3+	1.272e-007	0.01286	0.9668	-6.9102
Pb++	1.258e-007	0.02606	0.8739	-6.9589
UO2CO3(aq)	1.144e-007	0.03774	1.0000	-6.9418
MgHPO4(aq)	1.002e-007	0.01205	1.0000	-6.9993
PbOH+	8.927e-008	0.02001	0.9668	-7.0640
UO2(OH)3-	8.699e-008	0.02793	0.9668	-7.0752
Al(OH)2+	7.520e-008	0.004587	0.9668	-7.1384
MnPO4-	7.349e-008	0.01102	0.9668	-7.1485
CaPO4-	5.861e-008	0.007915	0.9668	-7.2467
CaCO3(aq)	4.280e-008	0.004283	1.0000	-7.3686
MnO4-	4.226e-008	0.005026	0.9666	-7.3888
KHPO4-	3.944e-008	0.005327	0.9668	-7.4187
Al13O4(OH)24(7+)	2.795e-008	0.02300	0.1960	-8.2612
H+	2.655e-008	2.675e-005	0.9682	-7.5900
MnHCO3+	2.030e-008	0.002354	0.9668	-7.7071
MgHCO3+	1.442e-008	0.001230	0.9668	-7.8557

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	56.1476s/sat	Cerussite	0.5953s/sat
Todorokite	48.7392s/sat	Crocoite	0.3563s/sat
Pyromorphite	17.0089s/sat	Plattnerite	0.1995s/sat
Hematite	14.7659s/sat	Dawsonite	0.1470s/sat
Trevorite	14.6654s/sat	Ice	-0.1387
Bixbyite	10.6683s/sat	Schoepite	-0.2767
Plumbogummite	10.6197s/sat	UO3:2H2O	-0.2767
Parsonsite	9.9041s/sat	UO2(OH)2(beta)	-0.3891
Pyrolusite	9.4654s/sat	UO3:.9H2O(alpha)	-0.4601
Hausmannite	9.3793s/sat	Schoepite-dehy(.	-0.4601
Pyromorphite-OH	9.0422s/sat	Schoepite-dehy(.	-0.5404
MnO2(gamma)	7.9476s/sat	Schoepite-dehy(1	-0.5465
Fluorapatite	6.9134s/sat	Corkite	-0.6074
Goethite	6.9027s/sat	Strengite	-0.6628
Pb4O(PO4)2	6.5714s/sat	Saleeite	-0.7816
Pb3(PO4)2	5.7519s/sat	Rhodochrosite	-0.8059
Manganite	5.0160s/sat	CaUO4	-0.9173
PbHPO4	4.5057s/sat	Berlinite	-1.1882
Ca-Autunite	4.4574s/sat	Mn(OH)3	-1.4898
Magnetite	4.2531s/sat	Przhevalskite	-1.5112
Diaspore	3.8858s/sat	Schoepite-dehy(.	-1.6497
Ferrite-Ca	3.8208s/sat	UO2HPO4:4H2O	-1.8632
Corundum	3.7800s/sat	UO2CO3	-2.1517
Boehmite	3.4819s/sat	Schoepite-dehy(.	-2.1677
Ferrite-Mg	3.3530s/sat	Rutherfordine	-2.1720
MnHPO4	3.3403s/sat	UO2HPO4	-2.2081
Gibbsite	3.2901s/sat	Calcite	-2.2156
(UO2)3(PO4)2:4H2	1.8188s/sat	Aragonite	-2.3600
Fe(OH)3(ppd)	1.7816s/sat	Bunsenite	-2.8933
Hydrocerussite	1.1458s/sat	Hydroxylapatite	-2.9139

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1920	-0.717
H2O(g)	0.02598	-1.585
CO2(g)	0.0009520	-3.021
HF(g)	6.243e-014	-13.205
NO2(g)	1.811e-020	-19.742
HCl(g)	1.074e-020	-19.969
N2(g)	8.464e-021	-20.072
NO(g)	2.770e-026	-25.557
Cl2(g)	7.335e-033	-32.135
H2(g)	6.396e-042	-41.194
CO(g)	1.902e-048	-47.721
UO2F2(g)	5.070e-055	-54.295
SO2(g)	3.858e-058	-57.414
Pb(g)	2.628e-066	-65.580
UO3(g)	4.061e-067	-66.391
UOF4(g)	8.011e-069	-68.096
NH3(g)	1.134e-069	-68.945
UO2Cl2(g)	1.849e-071	-70.733
Na(g)	2.099e-076	-75.678
K(g)	9.473e-078	-77.024
UF5(g)	4.011e-082	-81.397
F2(g)	1.944e-082	-81.711
UF6(g)	5.634e-087	-86.249
UF4(g)	2.811e-091	-90.551
UO2(g)	5.773e-120	-119.239
UCl4(g)	2.306e-129	-128.637
Mg(g)	1.235e-131	-130.908
UCl5(g)	3.941e-138	-137.404
U2F10(g)	1.801e-138	-137.745
UCl6(g)	1.251e-141	-140.903
UF3(g)	9.028e-142	-141.044
H2S(g)	2.492e-145	-144.603
CH4(g)	1.271e-145	-144.896
Ca(g)	1.577e-153	-152.802
UCl3(g)	6.942e-158	-157.158
Al(g)	1.354e-187	-186.868
UF2(g)	4.278e-189	-188.369
C(g)	1.018e-189	-188.992
UCl2(g)	1.132e-203	-202.946
UO(g)	3.259e-204	-203.487
UF(g)	4.989e-230	-229.302
S2(g)	3.387e-233	-232.470
C2H4(g)	7.789e-238	-237.108
UCl(g)	4.040e-247	-246.394
U2Cl8(g)	1.310e-247	-246.883
U2Cl10(g)	3.099e-249	-248.509
U(g)	4.315e-289	-288.365

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	6.31e-005	6.31e-005	1.70			
Ca++	2.30e-005	2.30e-005	0.922			
Cl-	8.74e-007	8.74e-007	0.0310			

CrO4--	4.86e-006	4.86e-006	0.564
F-	3.26e-005	3.26e-005	0.619
Fe++	2.92e-005	2.92e-005	1.63
H+	-0.000306	-0.000306	-0.309
H2O	55.5	55.5	1.00e+006
HCO3-	0.000633	0.000633	38.6
HPO4--	9.45e-005	9.45e-005	9.07
K+	0.000120	0.000120	4.69
Mg++	2.70e-006	2.70e-006	0.0656
Mn++	6.42e-006	6.42e-006	0.353
NH3(aq)	2.12e-005	2.12e-005	0.361
Na+	0.000510	0.000510	11.7
Ni++	2.86e-006	2.86e-006	0.168
O2(aq)	0.000292	0.000292	9.36
Pb++	6.68e-007	6.68e-007	0.138
SO4--	5.62e-007	5.62e-007	0.0540
UO2++	2.03e-005	2.03e-005	5.48

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	6.310e-005	6.310e-005	1.702		
Calcium	2.300e-005	2.300e-005	0.9217		
Carbon	0.0006332	0.0006332	7.604		
Chlorine	8.740e-007	8.740e-007	0.03098		
Chromium	4.860e-006	4.860e-006	0.2527		
Fluorine	3.260e-005	3.260e-005	0.6193		
Hydrogen	111.0	111.0	1.119e+005		
Iron	2.920e-005	2.920e-005	1.631		
Lead	6.680e-007	6.680e-007	0.1384		
Magnesium	2.700e-006	2.700e-006	0.06562		
Manganese	6.420e-006	6.420e-006	0.3527		
Nickel	2.860e-006	2.860e-006	0.1678		
Nitrogen	2.120e-005	2.120e-005	0.2969		
Oxygen	55.51	55.51	8.881e+005		
Phosphorus	9.450e-005	9.450e-005	2.927		
Potassium	0.0001200	0.0001200	4.691		
Sodium	0.0005100	0.0005100	11.72		
Sulfur	5.620e-007	5.620e-007	0.01802		
Uranium	2.030e-005	2.030e-005	4.832		

Sample 19250 water leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  7.430              log fO2 =   -0.712
Eh =   0.7790 volts      pe =  13.1684
Ionic strength      =    0.000679
Activity of water   =    1.000000
Solvent mass        =    0.999997 kg
Solution mass       =    1.000073 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000001 molal
Dissolved solids    =          76 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=       24.70 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.0004842	29.54	0.9708	-3.3279
Na+	0.0003707	8.521	0.9708	-3.4439
O2(aq)	0.0002453	7.849	1.0000	-3.6103
K+	6.199e-005	2.424	0.9706	-4.2206
AlO2-	4.513e-005	2.662	0.9708	-4.3584
CO2(aq)	3.862e-005	1.700	1.0000	-4.4132
HPO4--	2.893e-005	2.777	0.8882	-4.5901
NO3-	2.550e-005	1.581	0.9706	-4.6065
Ca++	2.236e-005	0.8960	0.8899	-4.7013
F-	2.126e-005	0.4039	0.9707	-4.6853
Fe(OH)3(aq)	1.717e-005	1.835	1.0000	-4.7651
H2PO4-	1.578e-005	1.530	0.9708	-4.8147
HAlO2(aq)	4.592e-006	0.2754	1.0000	-5.3380
UO2PO4-	4.517e-006	1.649	0.9708	-5.3580
(UO2)2CO3(OH)3-	4.234e-006	2.756	0.9708	-5.3861
Mn++	3.949e-006	0.2169	0.8899	-5.4542
CrO4--	2.812e-006	0.3261	0.8882	-5.6025
UO2(OH)2(aq)	1.852e-006	0.5631	1.0000	-5.7323
UO2(CO3)2--	1.704e-006	0.6645	0.8882	-5.8201
Mg++	1.580e-006	0.03839	0.8915	-5.8513
Ni++	1.550e-006	0.09095	0.8899	-5.8604
Fe(OH)2+	1.405e-006	0.1263	0.9708	-5.8651
Cl-	1.360e-006	0.04821	0.9706	-5.8795
Al13O4(OH)24(7+)	1.303e-006	1.072	0.2393	-6.5063
CO3--	6.678e-007	0.04007	0.8886	-6.2267
UO2HPO4(aq)	3.732e-007	0.1366	1.0000	-6.4280
MnHPO4(aq)	3.433e-007	0.05181	1.0000	-6.4643
SO4--	3.350e-007	0.03218	0.8882	-6.5265
HCrO4-	2.983e-007	0.03490	0.9708	-6.5381
CaHPO4(aq)	2.809e-007	0.03822	1.0000	-6.5514
OH-	2.804e-007	0.004769	0.9707	-6.5651

NaHCO3(aq)	2.412e-007	0.02026	1.0000	-6.6176
PbCO3(aq)	2.386e-007	0.06374	1.0000	-6.6224
UO2CO3(aq)	1.449e-007	0.04782	1.0000	-6.8389
Al(OH)2+	1.211e-007	0.007388	0.9708	-6.9296
Fe(OH)4-	1.196e-007	0.01482	0.9708	-6.9351
Pb++	1.190e-007	0.02466	0.8886	-6.9757
CaHCO3+	1.073e-007	0.01084	0.9708	-6.9824
NaHPO4-	7.923e-008	0.009425	0.9708	-7.1140
MnCO3(aq)	6.905e-008	0.007936	1.0000	-7.1608
UO2(CO3)3----	6.378e-008	0.02870	0.6221	-7.4015
UO2(OH)3-	6.359e-008	0.02041	0.9708	-7.2095
PbOH+	5.916e-008	0.01326	0.9708	-7.2408
H+	3.822e-008	3.852e-005	0.9720	-7.4300
MgHPO4(aq)	2.942e-008	0.003538	1.0000	-7.5314
CaCO3(aq)	2.507e-008	0.002509	1.0000	-7.6008
CaPO4-	1.948e-008	0.002631	0.9708	-7.7232
MnPO4-	1.848e-008	0.002770	0.9708	-7.7461
MnHCO3+	1.295e-008	0.001502	0.9708	-7.9004
AlF2+	1.115e-008	0.0007241	0.9708	-7.9658
MnO4-	1.095e-008	0.001303	0.9707	-7.9733

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	52.7183s/sat	Cerussite	0.3355s/sat
Todorokite	45.7380s/sat	Hydrocerussite	0.2894s/sat
Pyromorphite	15.6570s/sat	Crocoite	0.1394s/sat
Hematite	14.3612s/sat	Dawsonite	-0.0232
Trevorite	13.6818s/sat	Plattnerite	-0.1349
Plumbogummite	10.4150s/sat	Ice	-0.1387
Bixbyite	9.8098s/sat	UO3:2H2O	-0.2510
Parsonsite	9.2417s/sat	Schoepite	-0.2510
Pyrolusite	9.0373s/sat	UO2(OH)2(beta)	-0.3634
Hausmannite	8.0903s/sat	UO3:.9H2O(alpha)	-0.4344
MnO2(gamma)	7.5195s/sat	Schoepite-dehy(.	-0.4344
Pyromorphite-OH	7.3364s/sat	Schoepite-dehy(.	-0.5147
Goethite	6.7004s/sat	Schoepite-dehy(1	-0.5208
Fluorapatite	5.3220s/sat	Strengite	-0.8723
Pb4O(PO4)2	5.2096s/sat	Berlinite	-1.1465
Pb3(PO4)2	4.7270s/sat	Rhodochrosite	-1.1592
Manganite	4.5868s/sat	CaUO4	-1.2009
Ca-Autunite	4.1851s/sat	Saleeite	-1.2694
PbHPO4	4.1617s/sat	Corkite	-1.4526
Diaspore	3.9346s/sat	Schoepite-dehy(.	-1.6240
Corundum	3.8777s/sat	Przhevalskite	-1.8110
Magnetite	3.6449s/sat	UO2HPO4:4H2O	-1.8447
Boehmite	3.5307s/sat	Mn(OH)3	-1.9190
Gibbsite	3.3389s/sat	UO2CO3	-2.0488
Ferrite-Ca	3.1068s/sat	Rutherfordine	-2.0691
MnHPO4	2.9027s/sat	Schoepite-dehy(.	-2.1420
Ferrite-Mg	2.4234s/sat	UO2HPO4	-2.1896
(UO2)3(PO4)2:4H2	1.8816s/sat	Calcite	-2.4478
Fe(OH)3(ppd)	1.5793s/sat	Aragonite	-2.5922

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.

O2(g)	0.1941	-0.712
H2O(g)	0.02598	-1.585
CO2(g)	0.001137	-2.944
HF(g)	5.917e-014	-13.228
NO2(g)	3.154e-020	-19.501
N2(g)	2.511e-020	-19.600
HCl(g)	2.427e-020	-19.615
NO(g)	4.798e-026	-25.319
Cl2(g)	3.763e-032	-31.424
H2(g)	6.361e-042	-41.196
CO(g)	2.259e-048	-47.646
UO2F2(g)	4.832e-055	-54.316
SO2(g)	4.896e-058	-57.310
Pb(g)	1.203e-066	-65.920
UO3(g)	4.308e-067	-66.366
UOF4(g)	6.858e-069	-68.164
NH3(g)	1.938e-069	-68.713
UO2Cl2(g)	1.001e-070	-70.000
Na(g)	1.059e-076	-75.975
K(g)	3.392e-078	-77.470
UF5(g)	3.245e-082	-81.489
F2(g)	1.756e-082	-81.755
UF6(g)	4.332e-087	-86.363
UF4(g)	2.393e-091	-90.621
UO2(g)	6.092e-120	-119.215
UCl4(g)	6.335e-128	-127.198
Mg(g)	3.668e-132	-131.436
UCl5(g)	2.452e-136	-135.610
U2F10(g)	1.179e-138	-137.929
UCl6(g)	1.764e-139	-138.754
UF3(g)	8.088e-142	-141.092
H2S(g)	3.112e-145	-144.507
CH4(g)	1.485e-145	-144.828
Ca(g)	7.693e-154	-153.114
UCl3(g)	8.421e-157	-156.075
Al(g)	1.502e-187	-186.823
UF2(g)	4.033e-189	-188.394
C(g)	1.203e-189	-188.920
UCl2(g)	6.060e-203	-202.218
UO(g)	3.420e-204	-203.466
UF(g)	4.949e-230	-229.305
S2(g)	5.337e-233	-232.273
C2H4(g)	1.075e-237	-236.969
U2Cl8(g)	9.889e-245	-244.005
U2Cl10(g)	1.200e-245	-244.921
UCl(g)	9.552e-247	-246.020
U(g)	4.504e-289	-288.346

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	6.68e-005	6.68e-005	1.80			
Ca++	2.28e-005	2.28e-005	0.914			
Cl-	1.36e-006	1.36e-006	0.0482			
CrO4--	3.11e-006	3.11e-006	0.361			
F-	2.13e-005	2.13e-005	0.405			

Fe++	1.87e-005	1.87e-005	1.04
H+	-0.000274	-0.000274	-0.276
H2O	55.5	55.5	1.00e+006
HCO3-	0.000532	0.000532	32.5
HPO4--	5.04e-005	5.04e-005	4.84
K+	6.20e-005	6.20e-005	2.42
Mg++	1.62e-006	1.62e-006	0.0394
Mn++	4.41e-006	4.41e-006	0.242
NH3(aq)	2.55e-005	2.55e-005	0.434
Na+	0.000371	0.000371	8.53
Ni++	1.55e-006	1.55e-006	0.0910
O2(aq)	0.000301	0.000301	9.63
Pb++	4.23e-007	4.23e-007	0.0876
SO4--	3.37e-007	3.37e-007	0.0324
UO2++	1.72e-005	1.72e-005	4.64

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	6.680e-005	6.680e-005	1.802		
Calcium	2.280e-005	2.280e-005	0.9137		
Carbon	0.0005321	0.0005321	6.391		
Chlorine	1.360e-006	1.360e-006	0.04821		
Chromium	3.110e-006	3.110e-006	0.1617		
Fluorine	2.130e-005	2.130e-005	0.4046		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.870e-005	1.870e-005	1.044		
Lead	4.230e-007	4.230e-007	0.08764		
Magnesium	1.620e-006	1.620e-006	0.03937		
Manganese	4.410e-006	4.410e-006	0.2423		
Nickel	1.550e-006	1.550e-006	0.09096		
Nitrogen	2.550e-005	2.550e-005	0.3571		
Oxygen	55.51	55.51	8.881e+005		
Phosphorus	5.040e-005	5.040e-005	1.561		
Potassium	6.200e-005	6.200e-005	2.424		
Sodium	0.0003710	0.0003710	8.529		
Sulfur	3.370e-007	3.370e-007	0.01081		
Uranium	1.720e-005	1.720e-005	4.094		

Sample 19250 water leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.650               log fO2 =   -0.994
Eh =   0.7026 volts       pe =  11.8778
Ionic strength      =     0.002275
Activity of water   =     0.999999
Solvent mass        =     0.999976 kg
Solution mass       =     1.000228 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000017 molal
Dissolved solids    =          252 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=        59.42 mg/kg as CaCO3
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Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.001127	25.91	0.9487	-2.9708
HCO3-	0.0009282	56.62	0.9487	-3.0552
Fe(OH)3(aq)	0.0002430	25.97	1.0000	-3.6143
AlO2-	0.0001739	10.26	0.9487	-3.7825
HPO4--	0.0001578	15.14	0.8096	-3.8936
K+	0.0001479	5.781	0.9480	-3.8533
F-	0.0001469	2.790	0.9484	-3.8560
NO3-	0.0001360	8.429	0.9480	-3.8897
O2(aq)	0.0001280	4.096	1.0000	-3.8926
(UO2)2CO3(OH)3-	6.686e-005	43.52	0.9487	-4.1977
MnO4-	4.284e-005	5.094	0.9484	-4.3911
Ca++	3.815e-005	1.529	0.8146	-4.5075
UO2(CO3)3----	2.894e-005	13.02	0.4294	-4.9057
Fe(OH)4-	2.874e-005	3.560	0.9487	-4.5643
CrO4--	2.863e-005	3.320	0.8096	-4.6349
CO3--	2.275e-005	1.365	0.8109	-4.7340
Ni++	2.265e-005	1.329	0.8146	-4.7340
UO2(CO3)2--	1.883e-005	7.341	0.8096	-4.8169
Cl-	1.740e-005	0.6166	0.9480	-4.7827
Mg++	1.156e-005	0.2810	0.8192	-5.0235
Mn++	8.129e-006	0.4465	0.8146	-5.1791
UO2(OH)2(aq)	5.316e-006	1.616	1.0000	-5.2744
H2PO4-	4.837e-006	0.4691	0.9487	-5.3382
OH-	4.764e-006	0.08099	0.9484	-5.3451
PbCO3(aq)	4.721e-006	1.261	1.0000	-5.3260
CO2(aq)	4.360e-006	0.1918	1.0000	-5.3605
MnCO3(aq)	4.045e-006	0.4648	1.0000	-5.3931
UO2PO4-	3.974e-006	1.450	0.9487	-5.4236
MnHPO4(aq)	3.216e-006	0.4852	1.0000	-5.4927
UO2(OH)3-	3.099e-006	0.9948	0.9487	-5.5316
MnPO4-	2.940e-006	0.4406	0.9487	-5.5545

CaPO4-	2.570e-006	0.3469	0.9487	-5.6130
CaHPO4(aq)	2.182e-006	0.2968	1.0000	-5.6612
Ca2UO2(CO3)3	1.903e-006	1.009	1.0000	-5.7206
SO4--	1.714e-006	0.1646	0.8096	-5.8578
NaHCO3(aq)	1.343e-006	0.1128	1.0000	-5.8719
Fe(OH)2+	1.226e-006	0.1102	0.9487	-5.9343
CaCO3(aq)	1.218e-006	0.1218	1.0000	-5.9145
NaHPO4-	1.198e-006	0.1425	0.9487	-5.9444
MgPO4-	1.054e-006	0.1257	0.9487	-5.9999
HAlO2(aq)	1.042e-006	0.06250	1.0000	-5.9821
MgHPO4(aq)	9.838e-007	0.1183	1.0000	-6.0071
PbOH+	6.394e-007	0.1433	0.9487	-6.2171
CaHCO3+	3.212e-007	0.03246	0.9487	-6.5161
HCrO4-	1.708e-007	0.01997	0.9487	-6.7905
MgCO3(aq)	1.665e-007	0.01403	1.0000	-6.7786
MnO4--	1.605e-007	0.01908	0.8096	-6.8863
KHPO4-	1.137e-007	0.01536	0.9487	-6.9669
Pb(OH)2(aq)	1.091e-007	0.02631	1.0000	-6.9622
MgHCO3+	9.547e-008	0.008144	0.9487	-7.0430
Pb++	8.300e-008	0.01719	0.8109	-7.1720
MnOH+	8.013e-008	0.005764	0.9487	-7.1191
Pb(CO3)2--	7.107e-008	0.02325	0.8096	-7.2400
NaCO3-	6.799e-008	0.005642	0.9487	-7.1904
(UO2)3(OH)7-	5.529e-008	0.05136	0.9487	-7.2802
UO2CO3(aq)	4.694e-008	0.01549	1.0000	-7.3284
MnHCO3+	4.679e-008	0.005424	0.9487	-7.3527
PO4---	4.375e-008	0.004154	0.6216	-7.5654
Ni(OH)2(aq)	3.766e-008	0.003490	1.0000	-7.4242
PbP2O7--	3.516e-008	0.01340	0.8096	-7.5456
NaAlO2(aq)	3.187e-008	0.002612	1.0000	-7.4966
MgF+	3.132e-008	0.001356	0.9487	-7.5270
MnF+	2.617e-008	0.001934	0.9487	-7.6050
CaF+	2.193e-008	0.001295	0.9487	-7.6818
CaNO3+	2.116e-008	0.002160	0.9487	-7.6973
UO2HPO4(aq)	1.934e-008	0.007075	1.0000	-7.7136
NaF(aq)	1.498e-008	0.0006290	1.0000	-7.8244
PbHPO4(aq)	1.082e-008	0.003281	1.0000	-7.9656
NaSO4-	1.033e-008	0.001230	0.9487	-8.0086

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	73.5921s/sat	Rhodochrosite	0.6085s/sat
Todorokite	64.0379s/sat	Whitlockite	0.2150s/sat
Pyromorphite	21.5219s/sat	Schoepite	0.2069s/sat
Trevorite	19.5498s/sat	UO3:2H2O	0.2069s/sat
Hematite	16.6627s/sat	UO2(OH)2(beta)	0.0945s/sat
Hausmannite	16.0945s/sat	Bunsenite	0.0941s/sat
Bixbyite	15.0989s/sat	Dawsonite	0.0784s/sat
Pyromorphite-OH	13.3246s/sat	UO3:.9H2O(alpha)	0.0235s/sat
Fluorapatite	12.8694s/sat	Schoepite-dehy(.	0.0235s/sat
Pyrolusite	11.6112s/sat	Schoepite-dehy(.	-0.0568
Parsonsite	10.7001s/sat	Schoepite-dehy(1	-0.0629
Pb4O(PO4)2	10.6976s/sat	Ice	-0.1387
MnO2(gamma)	10.0934s/sat	Ni(OH)2	-0.1825
Ferrite-Ca	8.0421s/sat	(UO2)3(PO4)2:4H2	-0.2318

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  Ferrite-Mg          7.9928s/sat   Saleeite          -0.5728
  Pb3(PO4)2           7.9712s/sat   Calcite           -0.7615
  Goethite            7.8512s/sat   Dolomite-ord      -0.8550
  Plumbogummite       7.2395s/sat   Dolomite          -0.8550
  Manganite           7.2313s/sat   Aragonite         -0.9059
  Magnetite           7.1679s/sat   PbCO3.PbO         -1.1203
  Hydrocerussite      5.1260s/sat   Na2U2O7(c)        -1.1529
  PbHPO4              4.6619s/sat   Schoepite-dehy(.  -1.1661
  Ca-Autunite         4.2476s/sat   Strengite         -1.4651
  MnHPO4              3.8743s/sat   Monohydrocalcite  -1.5952
  Hydroxylapatite     3.4560s/sat   Schoepite-dehy(.  -1.6841
  Diaspore            3.2905s/sat   Magnesite         -1.7223
  Boehmite            2.8866s/sat   Minium            -2.0009
  Fe(OH)3(ppd)        2.7301s/sat   Przhevalskite     -2.1385
  Gibbsite            2.6948s/sat   Fluorite          -2.1825
  Corundum            2.5895s/sat   Dolomite-dis      -2.3994
  Plattnerite         1.9676s/sat   Lanarkite         -2.4325
  Ni3(PO4)2           1.9522s/sat   Litharge          -2.5108
  CaUO4               1.8907s/sat   UO2CO3            -2.5383
  Becquerelite        1.6337s/sat   Rutherfordine     -2.5586
  Cerussite           1.6319s/sat   NiCO3             -2.6510
  Crocoite            0.9108s/sat   UO3(gamma)        -2.6671
  Corkite             0.7287s/sat   Massicot          -2.6930
  Mn(OH)3             0.7255s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                    fugacity      log fug.
-----------------------------------------------
  O2(g)                     0.1013        -0.994
  H2O(g)                   0.02598        -1.585
  CO2(g)                 0.0001283        -3.892
  HF(g)                  2.407e-014      -13.619
  HCl(g)                 1.827e-020      -19.738
  N2(g)                  1.257e-020      -19.901
  NO2(g)                 1.164e-020      -19.934
  NO(g)                  2.452e-026      -25.610
  Cl2(g)                 1.541e-032      -31.812
  H2(g)                  8.805e-042      -41.055
  CO(g)                  3.529e-049      -48.452
  UO2F2(g)               2.295e-055      -54.639
  SO2(g)                 1.147e-059      -58.940
  Pb(g)                  2.920e-064      -63.535
  UO3(g)                 1.237e-066      -65.908
  NH3(g)                 2.233e-069      -68.651
  UOF4(g)                5.389e-070      -69.269
  UO2Cl2(g)              1.628e-070      -69.788
  Na(g)                  6.143e-075      -74.212
  K(g)                   1.543e-076      -75.812
  F2(g)                  2.099e-083      -82.678
  UF5(g)                 1.220e-083      -82.914
  UF6(g)                 5.633e-089      -88.249
  UF4(g)                 2.603e-092      -91.585
  UO2(g)                 2.420e-119     -118.616
  UCl4(g)                8.085e-128     -127.092
  Mg(g)                  9.407e-129     -128.027
  UCl5(g)                2.003e-136     -135.698
  UCl6(g)                9.220e-140     -139.035
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U2F10(g)	1.667e-141	-140.778
UF3(g)	2.544e-142	-141.594
CH4(g)	6.152e-146	-145.211
H2S(g)	1.934e-146	-145.714
Ca(g)	4.581e-151	-150.339
UCl3(g)	1.680e-156	-155.775
Al(g)	5.552e-188	-187.256
UF2(g)	3.669e-189	-188.435
C(g)	2.601e-190	-189.585
UCl2(g)	1.889e-202	-201.724
UO(g)	1.881e-203	-202.726
UF(g)	1.302e-229	-228.885
S2(g)	1.076e-235	-234.968
C2H4(g)	9.634e-239	-238.016
U2Cl8(g)	1.611e-244	-243.793
U2Cl10(g)	8.008e-246	-245.096
UCl(g)	4.652e-246	-245.332
U(g)	3.428e-288	-287.465

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	0.000175	0.000175	4.72			
Ca++	4.83e-005	4.83e-005	1.94			
Cl-	1.74e-005	1.74e-005	0.617			
CrO4--	2.88e-005	2.88e-005	3.34			
F-	0.000147	0.000147	2.79			
Fe++	0.000273	0.000273	15.2			
H+	-0.00200	-0.00200	-2.01			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00116	0.00116	71.0			
HPO4--	0.000181	0.000181	17.4			
K+	0.000148	0.000148	5.79			
Mg++	1.39e-005	1.39e-005	0.338			
Mn++	6.15e-005	6.15e-005	3.38			
NH3(aq)	0.000136	0.000136	2.32			
Na+	0.00113	0.00113	26.0			
Ni++	2.27e-005	2.27e-005	1.33			
O2(aq)	0.000522	0.000522	16.7			
Pb++	5.67e-006	5.67e-006	1.17			
SO4--	1.74e-006	1.74e-006	0.167			
UO2++	0.000196	0.000196	52.9			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	0.0001750	0.0001750	4.721		
Calcium	4.830e-005	4.830e-005	1.935		
Carbon	0.001164	0.001164	13.98		
Chlorine	1.740e-005	1.740e-005	0.6167		
Chromium	2.880e-005	2.880e-005	1.497		
Fluorine	0.0001470	0.0001470	2.792		
Hydrogen	111.0	111.0	1.119e+005		
Iron	0.0002730	0.0002730	15.24		
Lead	5.670e-006	5.670e-006	1.175		
Magnesium	1.390e-005	1.390e-005	0.3378		
Manganese	6.150e-005	6.150e-005	3.378		

Nickel	2.270e-005	2.270e-005	1.332
Nitrogen	0.0001360	0.0001360	1.904
Oxygen	55.51	55.51	8.880e+005
Phosphorus	0.0001810	0.0001810	5.605
Potassium	0.0001480	0.0001480	5.785
Sodium	0.001130	0.001130	25.97
Sulfur	1.740e-006	1.740e-006	0.05578
Uranium	0.0001960	0.0001960	46.64

Sample 19250 $Ca(OH)_2$ leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.480              log fO2 =   -0.704
Eh =   0.5395 volts      pe =   9.1205
Ionic strength      =    0.020137
Activity of water   =    1.000000
Solvent mass        =    0.999917 kg
Solution mass       =    1.000711 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000009 molal
Dissolved solids    =         793 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      648.51 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.01107	254.2	0.8703	-2.0163
CO3--	0.005988	359.0	0.5767	-2.4618
OH-	0.003519	59.81	0.8678	-2.5151
AlO2-	0.0005342	31.48	0.8703	-3.3326
HCO3-	0.0002801	17.08	0.8703	-3.6130
O2(aq)	0.0002500	7.994	1.0000	-3.6020
CaCO3(aq)	0.0002204	22.04	1.0000	-3.6568
NO3-	0.0001950	12.08	0.8653	-3.7728
F-	0.0001469	2.788	0.8678	-3.8946
NaCO3-	0.0001249	10.36	0.8703	-3.9638
Ca++	5.057e-005	2.025	0.5943	-4.5220
CrO4--	2.590e-005	3.002	0.5704	-4.8305
SO4--	2.376e-005	2.281	0.5704	-4.8680
Cl-	8.878e-006	0.3145	0.8653	-5.1145
CaPO4-	6.307e-006	0.8511	0.8703	-5.2605
NaOH(aq)	4.665e-006	0.1864	1.0000	-5.3311
NaHCO3(aq)	3.348e-006	0.2810	1.0000	-5.4753
UO2(OH)3-	2.599e-006	0.8336	0.8703	-5.6456
UO2(CO3)3----	1.926e-006	0.8660	0.1053	-6.6931
CaOH+	1.473e-006	0.08404	0.8703	-5.8920
NaSO4-	9.909e-007	0.1179	0.8703	-6.0643
NaAlO2(aq)	8.086e-007	0.06623	1.0000	-6.0922
HPO4--	7.712e-007	0.07396	0.5704	-6.3567
PO4---	2.245e-007	0.02130	0.2821	-7.1985
NaF(aq)	1.234e-007	0.005179	1.0000	-6.9086
CaHCO3+	9.375e-008	0.009470	0.8703	-7.0884
CaSO4(aq)	5.261e-008	0.007157	1.0000	-7.2789
NaHPO4-	4.049e-008	0.004813	0.8703	-7.4530
CaNO3+	2.921e-008	0.002979	0.8703	-7.5949
Ca2UO2(CO3)3	2.904e-008	0.01539	1.0000	-7.5370
CaF+	2.115e-008	0.001249	0.8703	-7.7350

UO2(OH)4--	1.866e-008	0.006303	0.5704	-7.9729
Pb(OH)3-	1.371e-008	0.003538	0.8703	-7.9232
NaCl(aq)	1.236e-008	0.0007220	1.0000	-7.9078

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Fluorapatite	13.8592s/sat	Gibbsite	0.3147s/sat
Hydroxylapatite	7.3144s/sat	Ice	-0.1387
CaUO4	4.5922s/sat	Dawsonite	-1.9051
Calcite	1.4962s/sat	Na2U2O7(am)	-1.9803
Aragonite	1.3518s/sat	Corundum	-2.1707
Diaspore	0.9104s/sat	Fluorite	-2.2743
Whitlockite	0.9055s/sat	UO3:2H2O	-2.7371
Plattnerite	0.6669s/sat	Schoepite	-2.7371
Monohydrocalcite	0.6625s/sat	UO2(OH)2(beta)	-2.8495
Na2U2O7(c)	0.5280s/sat	UO3:.9H2O(alpha)	-2.9205
Boehmite	0.5065s/sat	Schoepite-dehy(.	-2.9205

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	5.255e-008	-7.279
HF(g)	3.257e-017	-16.487
NO2(g)	1.907e-023	-22.720
HCl(g)	1.259e-023	-22.900
N2(g)	8.840e-027	-26.054
NO(g)	2.874e-029	-28.542
Cl2(g)	1.022e-038	-37.990
H2(g)	6.301e-042	-41.201
CO(g)	1.034e-052	-51.985
UO2F2(g)	4.780e-064	-63.321
SO2(g)	1.755e-064	-63.756
Pb(g)	7.481e-066	-65.126
UO3(g)	1.407e-069	-68.852
Na(g)	3.163e-071	-70.500
NH3(g)	1.134e-072	-71.946
UO2Cl2(g)	8.794e-080	-79.056
UOF4(g)	2.055e-084	-83.687
F2(g)	5.371e-089	-88.270
UF5(g)	5.328e-101	-100.273
UF4(g)	7.105e-107	-106.148
UF6(g)	3.934e-109	-108.405
UO2(g)	1.970e-122	-121.705
UCl4(g)	1.484e-143	-142.829
Ca(g)	1.449e-145	-144.839
CH4(g)	6.607e-150	-149.180
H2S(g)	1.084e-151	-150.965
UF3(g)	4.341e-154	-153.362
UCl5(g)	2.994e-155	-154.524
UCl6(g)	1.122e-161	-160.950
UCl3(g)	3.784e-169	-168.422
U2F10(g)	3.178e-176	-175.498
Al(g)	1.401e-190	-189.854

C(g)	5.453e-194	-193.263
UF2(g)	3.914e-198	-197.407
UO(g)	1.096e-206	-205.960
UCl2(g)	5.224e-212	-211.282
UF(g)	8.685e-236	-235.061
S2(g)	6.601e-246	-245.180
C2H4(g)	2.169e-246	-245.664
UCl(g)	1.580e-252	-251.801
U2Cl8(g)	5.424e-276	-275.266
U2Cl10(g)	1.789e-283	-282.748
U(g)	1.429e-291	-290.845

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	0.000535	0.000535	14.4			
Ca++	0.000279	0.000279	11.2			
Cl-	8.89e-006	8.89e-006	0.315			
CrO4--	2.59e-005	2.59e-005	3.00			
F-	0.000147	0.000147	2.79			
H+	-0.0122	-0.0122	-12.3			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00662	0.00662	404.			
HPO4--	7.35e-006	7.35e-006	0.705			
NH3(aq)	0.000195	0.000195	3.32			
Na+	0.0112	0.0112	257.			
O2(aq)	0.000640	0.000640	20.5			
Pb++	1.80e-008	1.80e-008	0.00373			
SO4--	2.48e-005	2.48e-005	2.38			
UO2++	4.58e-006	4.58e-006	1.24			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	0.0005350	0.0005350	14.42		
Calcium	0.0002790	0.0002790	11.17		
Carbon	0.006622	0.006622	79.48		
Chlorine	8.890e-006	8.890e-006	0.3150		
Chromium	2.590e-005	2.590e-005	1.346		
Fluorine	0.0001470	0.0001470	2.791		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.800e-008	1.800e-008	0.003727		
Nitrogen	0.0001950	0.0001950	2.729		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	7.350e-006	7.350e-006	0.2275		
Sodium	0.01120	0.01120	257.3		
Sulfur	2.480e-005	2.480e-005	0.7947		
Uranium	4.580e-006	4.580e-006	1.089		

Sample 19250 $Ca(OH)_2$ leach, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.500               log fO2 =   -0.704
Eh =   0.5383 volts       pe =   9.1005
Ionic strength      =    0.019551
Activity of water   =    0.999999
Solvent mass        =    0.999904 kg
Solution mass       =    1.000685 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000035 molal
Dissolved solids    =         781 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      591.46 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.009837	226.0	0.8718	-2.0667
CO3--	0.005552	332.9	0.5805	-2.4918
OH-	0.003679	62.52	0.8694	-2.4951
F-	0.001089	20.68	0.8694	-3.0237
AlO2-	0.0008290	48.85	0.8718	-3.1411
NO3-	0.0002890	17.91	0.8669	-3.6011
O2(aq)	0.0002500	7.995	1.0000	-3.6020
HCO3-	0.0002492	15.20	0.8718	-3.6630
CrO4--	0.0001360	15.76	0.5744	-4.1072
CaCO3(aq)	0.0001248	12.48	1.0000	-3.9038
NaCO3-	0.0001036	8.595	0.8718	-4.0441
Cl-	3.446e-005	1.221	0.8669	-4.5247
Ca++	3.049e-005	1.221	0.5979	-4.7392
SO4--	2.484e-005	2.385	0.5744	-4.8456
NaOH(aq)	4.350e-006	0.1738	1.0000	-5.3615
NaHCO3(aq)	2.657e-006	0.2230	1.0000	-5.5756
UO2(OH)3-	1.607e-006	0.5156	0.8718	-5.8535
CaPO4-	1.588e-006	0.2143	0.8718	-5.8587
NaAlO2(aq)	1.119e-006	0.09167	1.0000	-5.9511
CaOH+	9.342e-007	0.05329	0.8718	-6.0892
NaSO4-	9.274e-007	0.1103	0.8718	-6.0923
UO2(CO3)3----	8.217e-007	0.3695	0.1082	-7.0509
NaF(aq)	8.166e-007	0.03426	1.0000	-6.0880
HPO4--	3.041e-007	0.02917	0.5744	-6.7577
CaF+	9.516e-008	0.005617	0.8718	-7.0812
PO4---	9.189e-008	0.008720	0.2866	-7.5795
CaHCO3+	5.060e-008	0.005111	0.8718	-7.3554
NaCl(aq)	4.281e-008	0.002500	1.0000	-7.3684
CaSO4(aq)	3.360e-008	0.004571	1.0000	-7.4737
CaNO3+	2.626e-008	0.002679	0.8718	-7.6403
NaHPO4-	1.429e-008	0.001699	0.8718	-7.9045

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 UO2(OH)4--          1.202e-008      0.004061      0.5744       -8.1608
  (only species > 1e-8 molal listed)

Mineral saturation states
                   log Q/K                         log Q/K
----------------------------------------------------------------
 Fluorapatite      12.5012s/sat   Ice               -0.1387
 Hydroxylapatite    5.1055s/sat   Whitlockite       -0.5081
 CaUO4              4.1871s/sat   Fluorite          -0.7495
 Calcite            1.2492s/sat   Plattnerite       -1.4554
 Aragonite          1.1048s/sat   Corundum          -1.8276
 Diaspore           1.0819s/sat   Dawsonite         -1.8339
 Boehmite           0.6780s/sat   Na2U2O7(am)       -2.4969
 Gibbsite           0.4862s/sat   UO3:2H2O          -2.9650
 Monohydrocalcite   0.4155s/sat   Schoepite         -2.9650
 Na2U2O7(c)         0.0114s/sat
  (only minerals with log Q/K > -3 listed)

Gases                    fugacity      log fug.
-----------------------------------------------
 O2(g)                     0.1978        -0.704
 H2O(g)                   0.02598        -1.585
 CO2(g)                 4.473e-008       -7.349
 HF(g)                  2.311e-016      -15.636
 HCl(g)                 4.675e-023      -22.330
 NO2(g)                 2.704e-023      -22.568
 N2(g)                  1.778e-026      -25.750
 NO(g)                  4.075e-029      -28.390
 Cl2(g)                 1.410e-037      -36.851
 H2(g)                  6.301e-042      -41.201
 CO(g)                  8.803e-053      -52.055
 UO2F2(g)               1.424e-062      -61.847
 SO2(g)                 1.685e-064      -63.773
 Pb(g)                  5.646e-068      -67.248
 UO3(g)                 8.323e-070      -69.080
 Na(g)                  2.950e-071      -70.530
 NH3(g)                 1.608e-072      -71.794
 UO2Cl2(g)              7.175e-079      -78.144
 UOF4(g)                3.081e-081      -80.511
 F2(g)                  2.703e-087      -86.568
 UF5(g)                 5.667e-097      -96.247
 UF4(g)                 1.065e-103     -102.973
 UF6(g)                 2.968e-104     -103.527
 UO2(g)                 1.166e-122     -121.933
 UCl4(g)                1.669e-141     -140.778
 Ca(g)                  9.639e-146     -145.016
 CH4(g)                 5.624e-150     -149.250
 H2S(g)                 1.041e-151     -150.983
 UF3(g)                 9.173e-152     -151.038
 UCl5(g)                1.251e-152     -151.903
 UCl6(g)                1.741e-158     -157.759
 UCl3(g)                1.146e-167     -166.941
 U2F10(g)               3.594e-168     -167.444
 Al(g)                  2.079e-190     -189.682
 C(g)                   4.642e-194     -193.333
 UF2(g)                 1.166e-196     -195.933
 UO(g)                  6.483e-207     -206.188
```

UCl2(g)	4.262e-211	-210.370
UF(g)	3.646e-235	-234.438
S2(g)	6.086e-246	-245.216
C2H4(g)	1.572e-246	-245.804
UCl(g)	3.471e-252	-251.460
U2Cl8(g)	6.866e-272	-271.163
U2Cl10(g)	3.122e-278	-277.506
U(g)	8.456e-292	-291.073

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	0.000830	0.000830	22.4			
Ca++	0.000158	0.000158	6.33			
Cl-	3.45e-005	3.45e-005	1.22			
CrO4--	0.000136	0.000136	15.8			
F-	0.00109	0.00109	20.7			
H+	-0.0131	-0.0131	-13.2			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00603	0.00603	368.			
HPO4--	2.00e-006	2.00e-006	0.192			
NH3(aq)	0.000289	0.000289	4.92			
Na+	0.00995	0.00995	229.			
O2(aq)	0.000828	0.000828	26.5			
Pb++	1.40e-010	1.40e-010	2.90e-005			
SO4--	2.58e-005	2.58e-005	2.48			
UO2++	2.45e-006	2.45e-006	0.661			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	0.0008300	0.0008300	22.38		
Calcium	0.0001580	0.0001580	6.328		
Carbon	0.006034	0.006034	72.42		
Chlorine	3.450e-005	3.450e-005	1.222		
Chromium	0.0001360	0.0001360	7.067		
Fluorine	0.001090	0.001090	20.69		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.400e-010	1.400e-010	2.899e-005		
Nitrogen	0.0002890	0.0002890	4.045		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	2.000e-006	2.000e-006	0.06191		
Sodium	0.009950	0.009950	228.6		
Sulfur	2.580e-005	2.580e-005	0.8267		
Uranium	2.450e-006	2.450e-006	0.5828		

Sample 19250 $Ca(OH)_2$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.560               log fO2 =   -0.704
Eh =   0.5348 volts       pe =   9.0405
Ionic strength      =    0.013484
Activity of water   =    1.000000
Solvent mass        =    0.999913 kg
Solution mass       =    1.000811 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000005 molal
Dissolved solids    =         897 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      811.73 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
CaCO3(aq)	0.004532	453.2	1.0000	-2.3437
OH-	0.004137	70.30	0.8875	-2.4351
CO3--	0.003571	214.1	0.6278	-2.6494
Na+	0.001756	40.33	0.8893	-2.8065
Ca++	0.001484	59.41	0.6416	-3.0214
AlO2-	0.0003189	18.79	0.8893	-3.5472
O2(aq)	0.0002500	7.994	1.0000	-3.6020
HCO3-	0.0001480	9.025	0.8893	-3.8806
NO3-	0.0001364	8.448	0.8857	-3.9180
F-	7.933e-005	1.506	0.8875	-4.1524
CaOH+	5.490e-005	3.131	0.8893	-4.3114
CrO4--	1.520e-005	1.762	0.6230	-5.0236
NaCO3-	1.287e-005	1.067	0.8893	-4.9414
SO4--	7.899e-006	0.7581	0.6230	-5.3080
CaPO4-	5.672e-006	0.7654	0.8893	-5.2972
Cl-	5.468e-006	0.1937	0.8857	-5.3149
CaHCO3+	1.569e-006	0.1585	0.8893	-5.8553
NaOH(aq)	9.094e-007	0.03634	1.0000	-6.0413
CaNO3+	6.479e-007	0.06608	0.8893	-6.2394
CaSO4(aq)	6.050e-007	0.08229	1.0000	-6.2183
Ca2UO2(CO3)3	4.414e-007	0.2338	1.0000	-6.3551
CaF+	3.622e-007	0.02138	0.8893	-6.4921
NaHCO3(aq)	2.931e-007	0.02460	1.0000	-6.5329
UO2(OH)3-	2.447e-007	0.07848	0.8893	-6.6624
NaAlO2(aq)	7.998e-008	0.006550	1.0000	-7.0970
Pb(OH)3-	7.222e-008	0.01863	0.8893	-7.1923
NaSO4-	5.709e-008	0.006790	0.8893	-7.2944
UO2(CO3)3----	2.047e-008	0.009205	0.1501	-8.5125
Pb(OH)2(aq)	1.749e-008	0.004214	1.0000	-7.7573
HPO4--	1.704e-008	0.001634	0.6230	-7.9740
NaF(aq)	1.106e-008	0.0004638	1.0000	-7.9564

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Fluorapatite	16.4926s/sat	Boehmite	0.2119s/sat
Hydroxylapatite	10.2856s/sat	Gibbsite	0.0201s/sat
CaUO4	5.1560s/sat	Ice	-0.1387
Calcite	2.8093s/sat	Fluorite	-1.2891
Aragonite	2.6649s/sat	CaAl2O4:10H2O	-2.3439
Whitlockite	2.3327s/sat	Portlandite	-2.4566
Monohydrocalcite	1.9756s/sat	Corundum	-2.7600
Plattnerite	1.3178s/sat	Cerussite	-2.8986
Diaspore	0.6158s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	2.361e-008	-7.627
HF(g)	1.496e-017	-16.825
NO2(g)	1.135e-023	-22.945
HCl(g)	6.601e-024	-23.180
N2(g)	3.134e-027	-26.504
NO(g)	1.711e-029	-28.767
Cl2(g)	2.811e-039	-38.551
H2(g)	6.301e-042	-41.201
CO(g)	4.645e-053	-52.333
SO2(g)	4.408e-065	-64.356
Pb(g)	3.349e-065	-64.475
UO2F2(g)	8.075e-066	-65.093
UO3(g)	1.126e-070	-69.949
Na(g)	6.167e-072	-71.210
NH3(g)	6.750e-073	-72.171
UO2Cl2(g)	1.935e-081	-80.713
UOF4(g)	7.330e-087	-86.135
F2(g)	1.134e-089	-88.945
UF5(g)	8.730e-104	-103.059
UF4(g)	2.534e-109	-108.596
UF6(g)	2.962e-112	-111.528
UO2(g)	1.577e-123	-122.802
Ca(g)	6.634e-144	-143.178
UCl4(g)	8.973e-146	-145.047
CH4(g)	2.968e-150	-149.528
H2S(g)	2.723e-152	-151.565
UF3(g)	3.370e-156	-155.472
UCl5(g)	9.494e-158	-157.023
UCl6(g)	1.866e-164	-163.729
UCl3(g)	4.365e-171	-170.360
U2F10(g)	8.532e-182	-181.069
Al(g)	7.108e-191	-190.148
C(g)	2.450e-194	-193.611
UF2(g)	6.612e-200	-199.180
UO(g)	8.768e-208	-207.057
UCl2(g)	1.149e-213	-212.940
UF(g)	3.193e-237	-236.496

C2H4(g)	4.378e-247	-246.359
S2(g)	4.165e-247	-246.380
UCl(g)	6.629e-254	-253.179
U2Cl8(g)	1.984e-280	-279.702
U2Cl10(g)	1.799e-288	-287.745
U(g)	1.144e-292	-291.942

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	0.000319	0.000319	8.60			
Ca++	0.00608	0.00608	243.			
Cl-	5.47e-006	5.47e-006	0.194			
CrO4--	1.52e-005	1.52e-005	1.76			
F-	7.97e-005	7.97e-005	1.51			
H+	-0.0137	-0.0137	-13.8			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00827	0.00827	504.			
HPO4--	5.70e-006	5.70e-006	0.547			
NH3(aq)	0.000137	0.000137	2.33			
Na+	0.00177	0.00177	40.7			
O2(aq)	0.000524	0.000524	16.8			
Pb++	9.03e-008	9.03e-008	0.0187			
SO4--	8.56e-006	8.56e-006	0.822			
UO2++	7.09e-007	7.09e-007	0.191			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	0.0003190	0.0003190	8.600		
Calcium	0.006080	0.006080	243.5		
Carbon	0.008267	0.008267	99.21		
Chlorine	5.470e-006	5.470e-006	0.1938		
Chromium	1.520e-005	1.520e-005	0.7897		
Fluorine	7.970e-005	7.970e-005	1.513		
Hydrogen	111.0	111.0	1.118e+005		
Lead	9.030e-008	9.030e-008	0.01870		
Nitrogen	0.0001370	0.0001370	1.917		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	5.700e-006	5.700e-006	0.1764		
Sodium	0.001770	0.001770	40.66		
Sulfur	8.560e-006	8.560e-006	0.2743		
Uranium	7.090e-007	7.090e-007	0.1686		

Sample 19250 $Ca(OH)_2$ leach, Stage 3.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.600               log fO2 =   -0.704
Eh =   0.5324 volts       pe =   9.0005
Ionic strength      =    0.013586
Activity of water   =    1.000000
Solvent mass        =    0.999914 kg
Solution mass       =    1.000886 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000005 molal
Dissolved solids    =         971 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      896.87 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
CaCO3(aq)	0.005528	552.8	1.0000	-2.2574
OH-	0.004538	77.11	0.8872	-2.3951
CO3--	0.003451	206.9	0.6269	-2.6649
Ca++	0.001878	75.19	0.6408	-2.9196
Na+	0.0007829	17.98	0.8889	-3.1574
O2(aq)	0.0002500	7.993	1.0000	-3.6020
HCO3-	0.0001303	7.944	0.8889	-3.9361
CaOH+	7.613e-005	4.341	0.8889	-4.1696
AlO2-	7.560e-005	4.454	0.8889	-4.1726
NO3-	7.347e-005	4.551	0.8853	-4.1868
F-	3.202e-005	0.6077	0.8872	-4.5466
CrO4--	2.780e-005	3.222	0.6220	-4.7621
NaCO3-	5.536e-006	0.4591	0.8889	-5.3079
SO4--	5.028e-006	0.4826	0.6220	-5.5048
Cl-	4.889e-006	0.1732	0.8853	-5.3637
CaPO4-	4.483e-006	0.6049	0.8889	-5.3995
CaHCO3+	1.746e-006	0.1764	0.8889	-5.8090
CaSO4(aq)	4.861e-007	0.06611	1.0000	-6.3133
NaOH(aq)	4.444e-007	0.01776	1.0000	-6.3522
CaNO3+	4.413e-007	0.04500	0.8889	-6.4064
Ca2UO2(CO3)3	3.466e-007	0.1836	1.0000	-6.4602
CaF+	1.848e-007	0.01090	0.8889	-6.7845
UO2(OH)3-	1.764e-007	0.05659	0.8889	-6.8045
NaHCO3(aq)	1.150e-007	0.009649	1.0000	-6.9394
Pb(OH)3-	9.211e-008	0.02376	0.8889	-7.0868
Pb(OH)2(aq)	2.033e-008	0.004899	1.0000	-7.6918
NaSO4-	1.618e-008	0.001924	0.8889	-7.8422
UO2(CO3)3----	1.012e-008	0.004550	0.1491	-8.8212

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Fluorapatite	15.9950s/sat	Diaspore	-0.0496
Hydroxylapatite	10.2222s/sat	Ice	-0.1387
CaUO4	5.1557s/sat	Boehmite	-0.4535
Calcite	2.8956s/sat	Gibbsite	-0.6453
Aragonite	2.7512s/sat	Fluorite	-1.9759
Whitlockite	2.2298s/sat	Portlandite	-2.2748
Monohydrocalcite	2.0619s/sat	Cerussite	-2.9286
Plattnerite	1.3833s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.895e-008	-7.722
HF(g)	5.505e-018	-17.259
NO2(g)	5.577e-024	-23.254
HCl(g)	5.380e-024	-23.269
N2(g)	7.559e-028	-27.122
NO(g)	8.404e-030	-29.076
Cl2(g)	1.867e-039	-38.729
H2(g)	6.301e-042	-41.201
CO(g)	3.728e-053	-52.428
Pb(g)	3.894e-065	-64.410
SO2(g)	2.330e-065	-64.633
UO2F2(g)	7.186e-067	-66.143
UO3(g)	7.401e-071	-70.131
Na(g)	3.014e-072	-71.521
NH3(g)	3.315e-073	-72.480
UO2Cl2(g)	8.450e-082	-81.073
UOF4(g)	8.830e-089	-88.054
F2(g)	1.535e-090	-89.814
UF5(g)	3.869e-106	-105.412
UF4(g)	3.052e-111	-110.515
UF6(g)	4.829e-115	-114.316
UO2(g)	1.037e-123	-122.984
Ca(g)	1.008e-143	-142.996
UCl4(g)	2.603e-146	-145.584
CH4(g)	2.382e-150	-149.623
H2S(g)	1.440e-152	-151.842
UF3(g)	1.103e-157	-156.957
UCl5(g)	2.245e-158	-157.649
UCl6(g)	3.597e-165	-164.444
UCl3(g)	1.554e-171	-170.809
U2F10(g)	1.676e-186	-185.776
Al(g)	1.536e-191	-190.814
C(g)	1.966e-194	-193.706
UF2(g)	5.885e-201	-200.230
UO(g)	5.765e-208	-207.239
UCl2(g)	5.020e-214	-213.299
UF(g)	7.724e-238	-237.112
C2H4(g)	2.820e-247	-246.550
S2(g)	1.164e-247	-246.934
UCl(g)	3.552e-254	-253.450
U2Cl8(g)	1.670e-281	-280.777

U2Cl10(g)	1.006e-289	-288.997
U(g)	7.520e-293	-292.124

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	7.56e-005	7.56e-005	2.04			
Ca++	0.00749	0.00749	300.			
Cl-	4.89e-006	4.89e-006	0.173			
CrO4--	2.78e-005	2.78e-005	3.22			
F-	3.22e-005	3.22e-005	0.611			
H+	-0.0140	-0.0140	-14.1			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00912	0.00912	556.			
HPO4--	4.50e-006	4.50e-006	0.432			
NH3(aq)	7.39e-005	7.39e-005	1.26			
Na+	0.000789	0.000789	18.1			
O2(aq)	0.000398	0.000398	12.7			
Pb++	1.13e-007	1.13e-007	0.0234			
SO4--	5.53e-006	5.53e-006	0.531			
UO2++	5.35e-007	5.35e-007	0.144			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	7.560e-005	7.560e-005	2.038		
Calcium	0.007490	0.007490	299.9		
Carbon	0.009117	0.009117	109.4		
Chlorine	4.890e-006	4.890e-006	0.1732		
Chromium	2.780e-005	2.780e-005	1.444		
Fluorine	3.220e-005	3.220e-005	0.6112		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.130e-007	1.130e-007	0.02339		
Nitrogen	7.390e-005	7.390e-005	1.034		
Oxygen	55.54	55.54	8.878e+005		
Phosphorus	4.500e-006	4.500e-006	0.1393		
Sodium	0.0007890	0.0007890	18.12		
Sulfur	5.530e-006	5.530e-006	0.1772		
Uranium	5.350e-007	5.350e-007	0.1272		

Sample 19250 $Ca(OH)_2$ leach, Stage 4.

```
        Step #     0             Xi = 0.0000
        Temperature =  25.0 C    Pressure =  1.013 bars
        pH = 11.660              log fO2 =   -0.704
        Eh =   0.5289 volts      pe =   8.9405
        Ionic strength      =    0.014267
        Activity of water   =    1.000000
        Solvent mass        =    0.999903 kg
        Solution mass       =    1.000955 kg
        Solution density    =    1.013    g/cm3
        Chlorinity          =    0.000006 molal
        Dissolved solids    =        1051 mg/kg sol'n
        Rock mass           =    0.000000 kg
        Carbonate alkalinity=      985.04 mg/kg as CaCO3

                         moles        moles         grams          cm3
 Reactants             remaining     reacted       reacted       reacted
-----------------------------------------------------------------------------
  O2(g)               -- fixed fugacity buffer --

 No minerals in system.

 Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
----------------------------------------------------------------------------
  CaCO3(aq)              0.006259         625.8      1.0000       -2.2035
  OH-                    0.005224         88.76      0.8849       -2.3351
  CO3--                  0.003609         216.4      0.6208       -2.6497
  Ca++                   0.002071         82.92      0.6351       -2.8810
  O2(aq)                0.0002500         7.992      1.0000       -3.6020
  Na+                   0.0001875         4.306      0.8867       -3.7792
  HCO3-                 0.0001179         7.184      0.8867       -3.9809
  CaOH+                9.578e-005         5.462      0.8867       -4.0710
  AlO2-                3.720e-005         2.192      0.8867       -4.4816
  F-                   3.409e-005        0.6469      0.8849       -4.5205
  CrO4--               1.810e-005         2.097      0.6158       -4.9529
  NO3-                 9.032e-006        0.5594      0.8830       -5.0983
  SO4--                5.917e-006        0.5678      0.6158       -5.4385
  Cl-                  5.899e-006        0.2089      0.8830       -5.2833
  CaPO4-               2.303e-006        0.3107      0.8867       -5.6899
  CaHCO3+              1.726e-006        0.1743      0.8867       -5.8151
  NaCO3-               1.373e-006        0.1139      0.8867       -5.9145
  CaSO4(aq)            6.190e-007       0.08418      1.0000       -6.2083
  CaF+                 2.150e-007       0.01269      0.8867       -6.7198
  Pb(OH)3-             1.354e-007       0.03494      0.8867       -6.9205
  NaOH(aq)             1.219e-007      0.004870      1.0000       -6.9140
  Ca2UO2(CO3)3         1.177e-007       0.06234      1.0000       -6.9292
  UO2(OH)3-            6.850e-008       0.02197      0.8867       -7.2165
  CaNO3+               5.929e-008      0.006046      0.8867       -7.2792
  Pb(OH)2(aq)          2.597e-008      0.006259      1.0000       -7.5855
  NaHCO3(aq)           2.478e-008      0.002079      1.0000       -7.6060
   (only species > 1e-8 molal listed)

 Mineral saturation states
                    log Q/K                           log Q/K
----------------------------------------------------------------
```

Fluorapatite	15.2271s/sat	Ice	-0.1387
Hydroxylapatite	9.4883s/sat	Diaspore	-0.4186
CaUO4	4.8423s/sat	Boehmite	-0.8225
Calcite	2.9495s/sat	Gibbsite	-1.0143
Aragonite	2.8051s/sat	Fluorite	-1.8850
Monohydrocalcite	2.1158s/sat	Portlandite	-2.1162
Whitlockite	1.6877s/sat	Cerussite	-2.9270
Plattnerite	1.4896s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.488e-008	-7.827
HF(g)	5.092e-018	-17.293
HCl(g)	5.639e-024	-23.249
NO2(g)	5.955e-025	-24.225
N2(g)	8.620e-030	-29.064
NO(g)	8.974e-031	-30.047
Cl2(g)	2.051e-039	-38.688
H2(g)	6.301e-042	-41.201
CO(g)	2.929e-053	-52.533
Pb(g)	4.974e-065	-64.303
SO2(g)	2.059e-065	-64.686
UO2F2(g)	2.074e-067	-66.683
UO3(g)	2.496e-071	-70.603
Na(g)	8.266e-073	-72.083
NH3(g)	3.540e-074	-73.451
UO2Cl2(g)	3.131e-082	-81.504
UOF4(g)	2.180e-089	-88.662
F2(g)	1.313e-090	-89.882
UF5(g)	8.835e-107	-106.054
UF4(g)	7.535e-112	-111.123
UF6(g)	1.020e-115	-114.991
UO2(g)	3.496e-124	-123.456
Ca(g)	1.453e-143	-142.838
UCl4(g)	1.060e-146	-145.975
CH4(g)	1.871e-150	-149.728
H2S(g)	1.272e-152	-151.895
UF3(g)	2.945e-158	-157.531
UCl5(g)	9.579e-159	-158.019
UCl6(g)	1.609e-165	-164.794
UCl3(g)	6.034e-172	-171.219
U2F10(g)	8.737e-188	-187.059
Al(g)	6.567e-192	-191.183
C(g)	1.545e-194	-193.811
UF2(g)	1.698e-201	-200.770
UO(g)	1.944e-208	-207.711
UCl2(g)	1.860e-214	-213.731
UF(g)	2.410e-238	-237.618
C2H4(g)	1.741e-247	-246.759
S2(g)	9.091e-248	-247.041
UCl(g)	1.256e-254	-253.901
U2Cl8(g)	2.768e-282	-281.558
U2Cl10(g)	1.831e-290	-289.737
U(g)	2.536e-293	-292.596

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	3.72e-005	3.72e-005	1.00			
Ca++	0.00843	0.00843	338.			
Cl-	5.90e-006	5.90e-006	0.209			
CrO4--	1.81e-005	1.81e-005	2.10			
F-	3.43e-005	3.43e-005	0.651			
H+	-0.0153	-0.0153	-15.5			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00999	0.00999	609.			
HPO4--	2.31e-006	2.31e-006	0.222			
NH3(aq)	9.09e-006	9.09e-006	0.155			
Na+	0.000189	0.000189	4.34			
O2(aq)	0.000268	0.000268	8.57			
Pb++	1.62e-007	1.62e-007	0.0335			
SO4--	6.54e-006	6.54e-006	0.628			
UO2++	1.90e-007	1.90e-007	0.0513			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	3.720e-005	3.720e-005	1.003		
Calcium	0.008430	0.008430	337.5		
Carbon	0.009988	0.009988	119.9		
Chlorine	5.900e-006	5.900e-006	0.2090		
Chromium	1.810e-005	1.810e-005	0.9402		
Fluorine	3.430e-005	3.430e-005	0.6510		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.620e-007	1.620e-007	0.03353		
Nitrogen	9.090e-006	9.090e-006	0.1272		
Oxygen	55.54	55.54	8.877e+005		
Phosphorus	2.310e-006	2.310e-006	0.07148		
Sodium	0.0001890	0.0001890	4.341		
Sulfur	6.540e-006	6.540e-006	0.2095		
Uranium	1.900e-007	1.900e-007	0.04518		

Sample 19250 $Ca(OH)_2$ leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.740               log fO2 =   -0.704
Eh =   0.5241 volts       pe =   8.8605
Ionic strength      =     0.016208
Activity of water   =     1.000000
Solvent mass        =     0.999883 kg
Solution mass       =     1.001095 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000004 molal
Dissolved solids    =         1211 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=      1151.39 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
CaCO3(aq)	0.007277	727.4	1.0000	-2.1381
OH-	0.006324	107.4	0.8788	-2.2551
CO3--	0.004247	254.6	0.6047	-2.5904
Ca++	0.002151	86.12	0.6202	-2.8748
O2(aq)	0.0002500	7.991	1.0000	-3.6020
Na+	0.0001665	3.822	0.8808	-3.8338
CaOH+	0.0001176	6.704	0.8808	-3.9848
HCO3-	0.0001131	6.893	0.8808	-4.0016
AlO2-	1.310e-005	0.7718	0.8808	-4.9378
F-	1.272e-005	0.2414	0.8788	-4.9516
NO3-	1.023e-005	0.6337	0.8766	-5.0472
SO4--	6.913e-006	0.6632	0.5992	-5.3828
CrO4--	6.631e-006	0.7682	0.5992	-5.4008
Cl-	4.489e-006	0.1590	0.8766	-5.4050
CaPO4-	2.274e-006	0.3067	0.8808	-5.6983
CaHCO3+	1.681e-006	0.1697	0.8808	-5.8297
NaCO3-	1.397e-006	0.1158	0.8808	-5.9098
CaSO4(aq)	7.138e-007	0.09706	1.0000	-6.1464
Ca2UO2(CO3)3	2.202e-007	0.1166	1.0000	-6.6571
Pb(OH)3-	1.532e-007	0.03952	0.8808	-6.8697
UO2(OH)3-	1.447e-007	0.04640	0.8808	-6.8946
NaOH(aq)	1.292e-007	0.005163	1.0000	-6.8886
CaF+	8.136e-008	0.004801	0.8808	-7.1447
CaNO3+	6.810e-008	0.006944	0.8808	-7.2219
Pb(OH)2(aq)	2.428e-008	0.005850	1.0000	-7.6147
NaHCO3(aq)	2.083e-008	0.001748	1.0000	-7.6813

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K

Fluorapatite	14.7832s/sat	Plattnerite	1.4604s/sat
Hydroxylapatite	9.5554s/sat	Ice	-0.1387
CaUO4	5.2504s/sat	Diaspore	-0.9548
Calcite	3.0149s/sat	Boehmite	-1.3587
Aragonite	2.8705s/sat	Gibbsite	-1.5505
Monohydrocalcite	2.1812s/sat	Portlandite	-1.9500
Whitlockite	1.6771s/sat	Fluorite	-2.7410

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.180e-008	-7.928
HF(g)	1.570e-018	-17.804
HCl(g)	3.544e-024	-23.451
NO2(g)	5.572e-025	-24.254
N2(g)	7.546e-030	-29.122
NO(g)	8.397e-031	-30.076
Cl2(g)	8.102e-040	-39.091
H2(g)	6.301e-042	-41.201
CO(g)	2.323e-053	-52.634
Pb(g)	4.650e-065	-64.333
SO2(g)	1.620e-065	-64.791
UO2F2(g)	3.439e-068	-67.464
UO3(g)	4.357e-071	-70.361
Na(g)	8.764e-073	-72.057
NH3(g)	3.312e-074	-73.480
UO2Cl2(g)	2.159e-082	-81.666
UOF4(g)	3.434e-091	-90.464
F2(g)	1.247e-091	-90.904
UF5(g)	4.291e-109	-108.367
UF4(g)	1.187e-113	-112.925
UF6(g)	1.527e-118	-117.816
UO2(g)	6.102e-124	-123.215
Ca(g)	2.130e-143	-142.672
UCl4(g)	2.886e-147	-146.540
CH4(g)	1.484e-150	-149.829
H2S(g)	1.000e-152	-152.000
UCl5(g)	1.639e-159	-158.785
UF3(g)	1.505e-159	-158.822
UCl6(g)	1.730e-166	-165.762
UCl3(g)	2.614e-172	-171.583
U2F10(g)	2.061e-192	-191.686
Al(g)	1.911e-192	-191.719
C(g)	1.225e-194	-193.912
UF2(g)	2.816e-202	-201.550
UO(g)	3.394e-208	-207.469
UCl2(g)	1.282e-214	-213.892
UF(g)	1.296e-238	-237.887
C2H4(g)	1.094e-247	-246.961
S2(g)	5.623e-248	-247.250
UCl(g)	1.377e-254	-253.861
U2Cl8(g)	2.052e-283	-282.688
U2Cl10(g)	5.363e-292	-291.271
U(g)	4.427e-293	-292.354

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	1.31e-005	1.31e-005	0.353			
Ca++	0.00955	0.00955	382.			
Cl-	4.49e-006	4.49e-006	0.159			
CrO4--	6.63e-006	6.63e-006	0.768			
F-	1.28e-005	1.28e-005	0.243			
H+	-0.0180	-0.0180	-18.2			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.0116	0.0116	709.			
HPO4--	2.28e-006	2.28e-006	0.219			
NH3(aq)	1.03e-005	1.03e-005	0.175			
Na+	0.000168	0.000168	3.86			
O2(aq)	0.000271	0.000271	8.65			
Pb++	1.78e-007	1.78e-007	0.0368			
SO4--	7.63e-006	7.63e-006	0.732			
UO2++	3.73e-007	3.73e-007	0.101			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	1.310e-005	1.310e-005	0.3531		
Calcium	0.009550	0.009550	382.3		
Carbon	0.01164	0.01164	139.6		
Chlorine	4.490e-006	4.490e-006	0.1590		
Chromium	6.630e-006	6.630e-006	0.3444		
Fluorine	1.280e-005	1.280e-005	0.2429		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.780e-007	1.780e-007	0.03684		
Nitrogen	1.030e-005	1.030e-005	0.1441		
Oxygen	55.54	55.54	8.877e+005		
Phosphorus	2.280e-006	2.280e-006	0.07054		
Sodium	0.0001680	0.0001680	3.858		
Sulfur	7.630e-006	7.630e-006	0.2444		
Uranium	3.730e-007	3.730e-007	0.08869		

Sample 19250 $Ca(OH)_2$ leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.630               log fO2 =   -0.704
Eh =   0.5307 volts       pe =   8.9705
Ionic strength      =    0.013704
Activity of water   =    0.999999
Solvent mass        =    0.999909 kg
Solution mass       =    1.000884 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000023 molal
Dissolved solids    =         975 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      915.89 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
CaCO3(aq)	0.005574	557.3	1.0000	-2.2539
OH-	0.004865	82.66	0.8868	-2.3651
CO3--	0.003596	215.6	0.6258	-2.6478
Ca++	0.001823	72.99	0.6398	-2.9332
Na+	0.0002946	6.767	0.8886	-3.5820
O2(aq)	0.0002500	7.993	1.0000	-3.6020
HCO3-	0.0001266	7.715	0.8886	-3.9490
CaOH+	7.909e-005	4.511	0.8886	-4.1532
AlO2-	6.420e-005	3.783	0.8886	-4.2438
CrO4--	4.920e-005	5.702	0.6209	-4.5150
NO3-	2.585e-005	1.601	0.8849	-4.6406
Cl-	2.340e-005	0.8286	0.8849	-4.6840
F-	2.228e-005	0.4228	0.8868	-4.7043
SO4--	7.254e-006	0.6961	0.6209	-5.3464
NaCO3-	2.167e-006	0.1797	0.8886	-5.7154
CaPO4-	2.122e-006	0.2863	0.8886	-5.7245
CaHCO3+	1.644e-006	0.1660	0.8886	-5.8355
CaSO4(aq)	6.784e-007	0.09227	1.0000	-6.1685
NaOH(aq)	1.791e-007	0.007157	1.0000	-6.7468
Ca2UO2(CO3)3	1.680e-007	0.08901	1.0000	-6.7746
CaNO3+	1.505e-007	0.01535	0.8886	-6.8738
CaF+	1.246e-007	0.007353	0.8886	-6.9558
Pb(OH)3-	1.106e-007	0.02854	0.8886	-7.0074
UO2(OH)3-	9.960e-008	0.03194	0.8886	-7.0531
NaHCO3(aq)	4.198e-008	0.003523	1.0000	-7.3769
Pb(OH)2(aq)	2.278e-008	0.005490	1.0000	-7.6424

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K

Fluorapatite	14.8352s/sat	Ice	-0.1387
Hydroxylapatite	9.2501s/sat	Diaspore	-0.1508
CaUO4	4.9236s/sat	Boehmite	-0.5547
Calcite	2.8991s/sat	Gibbsite	-0.7465
Aragonite	2.7547s/sat	Portlandite	-2.2284
Monohydrocalcite	2.0654s/sat	Fluorite	-2.3049
Whitlockite	1.5663s/sat	Cerussite	-2.9221
Plattnerite	1.4327s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.716e-008	-7.765
HF(g)	3.573e-018	-17.447
HCl(g)	2.402e-023	-22.619
NO2(g)	1.831e-024	-23.737
N2(g)	8.145e-029	-28.089
NO(g)	2.759e-030	-29.559
Cl2(g)	3.721e-038	-37.429
H2(g)	6.301e-042	-41.201
CO(g)	3.378e-053	-52.471
Pb(g)	4.363e-065	-64.360
SO2(g)	2.923e-065	-64.534
UO2F2(g)	1.594e-067	-66.797
UO3(g)	3.897e-071	-70.409
Na(g)	1.215e-072	-71.916
NH3(g)	1.088e-073	-72.963
UO2Cl2(g)	8.867e-081	-80.052
UOF4(g)	8.252e-090	-89.083
F2(g)	6.466e-091	-90.189
UF5(g)	2.347e-107	-106.629
UF4(g)	2.853e-112	-111.545
UF6(g)	1.901e-116	-115.721
UO2(g)	5.458e-124	-123.263
Ca(g)	1.122e-143	-142.950
UCl4(g)	5.444e-144	-143.264
CH4(g)	2.158e-150	-149.666
H2S(g)	1.806e-152	-151.743
UCl5(g)	2.096e-155	-154.679
UF3(g)	1.589e-158	-157.799
UCl6(g)	1.499e-161	-160.824
UCl3(g)	7.278e-170	-169.138
U2F10(g)	6.167e-189	-188.210
Al(g)	1.217e-191	-190.915
C(g)	1.781e-194	-193.749
UF2(g)	1.305e-201	-200.884
UO(g)	3.036e-208	-207.518
UCl2(g)	5.267e-213	-212.278
UF(g)	2.640e-238	-237.578
C2H4(g)	2.314e-247	-246.636
S2(g)	1.831e-247	-246.737
UCl(g)	8.350e-254	-253.078
U2Cl8(g)	7.305e-277	-276.136
U2Cl10(g)	8.767e-284	-283.057
U(g)	3.960e-293	-292.402

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	6.42e-005	6.42e-005	1.73			
Ca++	0.00748	0.00748	300.			
Cl-	2.34e-005	2.34e-005	0.829			
CrO4--	4.92e-005	4.92e-005	5.70			
F-	2.24e-005	2.24e-005	0.425			
H+	-0.0144	-0.0144	-14.5			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00930	0.00930	567.			
HPO4--	2.13e-006	2.13e-006	0.204			
NH3(aq)	2.60e-005	2.60e-005	0.442			
Na+	0.000297	0.000297	6.82			
O2(aq)	0.000302	0.000302	9.66			
Pb++	1.34e-007	1.34e-007	0.0277			
SO4--	7.94e-006	7.94e-006	0.762			
UO2++	2.74e-007	2.74e-007	0.0739			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Aluminum	6.420e-005	6.420e-005	1.731		
Calcium	0.007480	0.007480	299.5		
Carbon	0.009299	0.009299	111.6		
Chlorine	2.340e-005	2.340e-005	0.8289		
Chromium	4.920e-005	4.920e-005	2.556		
Fluorine	2.240e-005	2.240e-005	0.4252		
Hydrogen	111.0	111.0	1.118e+005		
Lead	1.340e-007	1.340e-007	0.02774		
Nitrogen	2.600e-005	2.600e-005	0.3639		
Oxygen	55.54	55.54	8.878e+005		
Phosphorus	2.130e-006	2.130e-006	0.06592		
Sodium	0.0002970	0.0002970	6.822		
Sulfur	7.940e-006	7.940e-006	0.2544		
Uranium	2.740e-007	2.740e-007	0.06516		

Sample 19250 $CaCO_3$ leach, 1 day (Stage 1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.980               log fO2 =   -0.851
Eh =   0.6852 volts       pe =  11.5837
Ionic strength      =     0.010709
Activity of water   =     1.000000
Solvent mass        =     0.999990 kg
Solution mass       =     1.000692 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000006 molal
Dissolved solids    =          701 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       266.19 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.009294	213.5	0.8992	-2.0779
HCO3-	0.004000	243.9	0.8992	-2.4441
F-	0.001459	27.69	0.8977	-2.8829
HPO4--	0.0003241	31.09	0.6518	-3.6752
CO3--	0.0002456	14.73	0.6559	-3.7929
UO2(CO3)3----	0.0002286	102.8	0.1799	-4.3858
O2(aq)	0.0001782	5.698	1.0000	-3.7491
NO3-	0.0001580	9.788	0.8962	-3.8490
Fe(OH)3(aq)	0.0001158	12.37	1.0000	-3.9362
AlO2-	4.671e-005	2.753	0.8992	-4.3767
NaHCO3(aq)	4.286e-005	3.598	1.0000	-4.3679
Ca++	4.088e-005	1.637	0.6678	-4.5639
Fe(OH)4-	3.090e-005	3.825	0.8992	-4.5562
MnO4-	2.787e-005	3.312	0.8977	-4.6018
CrO4--	2.564e-005	2.972	0.6518	-4.7770
NaHPO4-	1.633e-005	1.942	0.8992	-4.8331
SO4--	1.553e-005	1.491	0.6518	-4.9946
OH-	1.076e-005	0.1828	0.8977	-5.0151
Ni++	1.032e-005	0.6054	0.6678	-5.1616
CaCO3(aq)	9.340e-006	0.9342	1.0000	-5.0296
UO2(CO3)2--	8.866e-006	3.456	0.6518	-5.2382
CaPO4-	8.420e-006	1.136	0.8992	-5.1209
CO2(aq)	8.329e-006	0.3663	1.0000	-5.0794
Cl-	6.042e-006	0.2141	0.8962	-5.2664
NaCO3-	4.895e-006	0.4060	0.8992	-5.3564
Ca2UO2(CO3)3	4.861e-006	2.576	1.0000	-5.3133
H2PO4-	3.948e-006	0.3826	0.8992	-5.4498
CaHPO4(aq)	3.169e-006	0.4309	1.0000	-5.4991
PbCO3(aq)	1.858e-006	0.4961	1.0000	-5.7310
MnCO3(aq)	1.472e-006	0.1691	1.0000	-5.8320
CaHCO3+	1.216e-006	0.1228	0.8992	-5.9612

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  NaF(aq)             1.100e-006       0.04618      1.0000       -5.9584
  NaSO4-              6.217e-007       0.07396      0.8992       -6.2526
  MnPO4-              4.572e-007       0.06849      0.8992       -6.3861
  Mn++                4.133e-007       0.02269      0.6678       -6.5591
  Pb(CO3)2--          3.034e-007       0.09922      0.6518       -6.7038
  Fe(OH)2+            2.883e-007       0.02589      0.8992       -6.5862
  PO4---              2.522e-007       0.02394      0.3812       -7.0170
  MnO4--              2.416e-007       0.02871      0.6518       -6.8028
  MnHPO4(aq)          2.217e-007       0.03343      1.0000       -6.6543
  CaF+                1.910e-007       0.01128      0.8992       -6.7650
  UO2(OH)3-           1.589e-007       0.05097      0.8992       -6.8451
  (UO2)2CO3(OH)3-     1.488e-007       0.09681      0.8992       -6.8735
  HAlO2(aq)           1.241e-007      0.007438      1.0000       -6.9063
  UO2(OH)2(aq)        1.208e-007       0.03671      1.0000       -6.9179
  UO2PO4-             7.370e-008       0.02688      0.8992       -7.1787
  PbOH+               6.501e-008       0.01457      0.8992       -7.2332
  Ni(OH)2(aq)         6.430e-008      0.005957      1.0000       -7.1918
  NaAlO2(aq)          6.340e-008      0.005193      1.0000       -7.1979
  HCrO4-              6.075e-008      0.007103      0.8992       -7.2626
  CaSO4(aq)           3.569e-008      0.004856      1.0000       -7.4474
  Pb(OH)2(aq)         2.248e-008      0.005418      1.0000       -7.6483
  CaNO3+              2.154e-008      0.002198      0.8992       -7.7128
  NaOH(aq)            1.280e-008     0.0005117      1.0000       -7.8927
  MnF+                1.082e-008     0.0007994      0.8992       -8.0119
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                         log Q/K
----------------------------------------------------------------
  Birnessite       68.2626s/sat   Cerussite          1.2269s/sat
  Todorokite       59.3566s/sat   Whitlockite        1.1429s/sat
  Trevorite        19.1384s/sat   CaUO4              0.8509s/sat
  Hematite         16.0189s/sat   Corundum           0.7411s/sat
  Pyromorphite     15.9531s/sat   Ca-Autunite        0.6812s/sat
  Fluorapatite     15.2062s/sat   Dawsonite          0.6582s/sat
  Hausmannite      14.0062s/sat   Bunsenite          0.3265s/sat
  Bixbyite         13.7306s/sat   Rhodochrosite      0.1696s/sat
  Pyrolusite       10.9630s/sat   Calcite            0.1234s/sat
  MnO2(gamma)       9.4452s/sat   Ni(OH)2            0.0499s/sat
  Pyromorphite-OH   8.5694s/sat   Mn(OH)3            0.0414s/sat
  Ferrite-Ca        8.0020s/sat   Aragonite         -0.0210
  Goethite          7.5293s/sat   Ice               -0.1387
  Pb4O(PO4)2        7.0701s/sat   Fluorite          -0.2926
  Parsonsite        6.8013s/sat   Crocoite          -0.5773
  Manganite         6.5472s/sat   Monohydrocalcite  -0.7103
  Magnetite         6.1663s/sat   Corkite           -1.1615
  Hydroxylapatite   5.1497s/sat   UO3:2H2O          -1.4366
  Pb3(PO4)2         5.0298s/sat   Schoepite         -1.4366
  Hydrocerussite    3.6299s/sat   UO2(OH)2(beta)    -1.5490
  PbHPO4            3.5342s/sat   UO3:.9H2O(alpha)  -1.6200
  Plumbogummite     2.8976s/sat   Schoepite-dehy(.  -1.6200
  MnHPO4            2.7127s/sat   Schoepite-dehy(.  -1.7003
  Fe(OH)3(ppd)      2.4082s/sat   Schoepite-dehy(1  -1.7064
  Diaspore          2.3663s/sat   Na2U2O7(c)        -1.9941
  Boehmite          1.9624s/sat   NiCO3             -2.1375
  Gibbsite          1.7706s/sat   PbCO3.PbO         -2.2113
  Ni3(PO4)2         1.7663s/sat   Strengite         -2.2285
```

Plattnerite 1.3533s/sat Schoepite-dehy(. -2.8096
(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1410	-0.851
H2O(g)	0.02598	-1.585
CO2(g)	0.0002452	-3.610
HF(g)	1.058e-013	-12.975
NO2(g)	5.508e-021	-20.259
HCl(g)	2.806e-021	-20.552
N2(g)	1.452e-021	-20.838
NO(g)	9.832e-027	-26.007
Cl2(g)	4.288e-034	-33.368
H2(g)	7.464e-042	-41.127
CO(g)	5.716e-049	-48.243
UO2F2(g)	1.008e-055	-54.997
SO2(g)	1.553e-059	-58.809
Pb(g)	5.099e-065	-64.292
UO3(g)	2.810e-068	-67.551
UOF4(g)	4.575e-069	-68.340
NH3(g)	5.923e-070	-69.227
Na(g)	9.448e-074	-73.025
UO2Cl2(g)	8.729e-074	-73.059
F2(g)	4.786e-082	-81.320
UF5(g)	4.194e-082	-81.377
UF6(g)	9.243e-087	-86.034
UF4(g)	1.873e-091	-90.727
UO2(g)	4.662e-121	-120.331
UCl4(g)	8.668e-133	-132.062
U2F10(g)	1.969e-138	-137.706
UF3(g)	3.835e-142	-141.416
UCl5(g)	3.582e-142	-141.446
CH4(g)	6.070e-146	-145.217
UCl6(g)	2.751e-146	-145.561
H2S(g)	1.594e-146	-145.797
Ca(g)	1.559e-150	-149.807
UCl3(g)	1.079e-160	-159.967
Al(g)	5.160e-189	-188.287
UF2(g)	1.158e-189	-188.936
C(g)	3.571e-190	-189.447
UO(g)	3.071e-205	-204.513
UCl2(g)	7.276e-206	-205.138
UF(g)	8.609e-231	-230.065
S2(g)	1.018e-235	-234.992
C2H4(g)	1.305e-238	-237.884
UCl(g)	1.074e-248	-247.969
U2Cl8(g)	1.852e-254	-253.732
U2Cl10(g)	2.561e-257	-256.592
U(g)	4.746e-290	-289.324

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	4.69e-005	4.69e-005	1.26			
Ca++	7.30e-005	7.30e-005	2.92			
Cl-	6.05e-006	6.05e-006	0.214			

CrO4--	2.57e-005	2.57e-005	2.98
F-	0.00146	0.00146	27.7
Fe++	0.000147	0.000147	8.20
H+	-0.00175	-0.00175	-1.76
H2O	55.5	55.5	9.99e+005
HCO3-	0.00503	0.00503	307.
HPO4--	0.000357	0.000357	34.2
Mn++	3.07e-005	3.07e-005	1.69
NH3(aq)	0.000158	0.000158	2.69
Na+	0.00936	0.00936	215.
Ni++	1.04e-005	1.04e-005	0.610
O2(aq)	0.000566	0.000566	18.1
Pb++	2.26e-006	2.26e-006	0.468
SO4--	1.62e-005	1.62e-005	1.56
UO2++	0.000243	0.000243	65.6

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	4.690e-005	4.690e-005	1.265		
Calcium	7.300e-005	7.300e-005	2.924		
Carbon	0.005034	0.005034	60.43		
Chlorine	6.050e-006	6.050e-006	0.2143		
Chromium	2.570e-005	2.570e-005	1.335		
Fluorine	0.001460	0.001460	27.72		
Hydrogen	111.0	111.0	1.118e+005		
Iron	0.0001470	0.0001470	8.204		
Lead	2.260e-006	2.260e-006	0.4679		
Manganese	3.070e-005	3.070e-005	1.685		
Nickel	1.040e-005	1.040e-005	0.6100		
Nitrogen	0.0001580	0.0001580	2.212		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	0.0003570	0.0003570	11.05		
Sodium	0.009360	0.009360	215.0		
Sulfur	1.620e-005	1.620e-005	0.5191		
Uranium	0.0002430	0.0002430	57.80		

Sample 19250 $CaCO_3$ leach, 1 month.

```
         Step #     0              Xi = 0.0000
         Temperature =  25.0 C     Pressure =  1.013 bars
         pH =  8.800               log fO2 =   -0.724
         Eh =   0.6978 volts       pe =  11.7954
         Ionic strength      =     0.011342
         Activity of water   =     0.999999
         Solvent mass        =     0.999997 kg
         Solution mass       =     1.000733 kg
         Solution density    =     1.013    g/cm3
         Chlorinity          =     0.000022 molal
         Dissolved solids    =          736 mg/kg sol'n
         Rock mass           =     0.000000 kg
         Carbonate alkalinity=       278.20 mg/kg as CaCO3

                          moles        moles          grams          cm3
 Reactants              remaining     reacted        reacted        reacted
----------------------------------------------------------------------------
  O2(g)                -- fixed fugacity buffer --

 No minerals in system.

 Aqueous species        molality    mg/kg sol'n    act. coef.     log act.
---------------------------------------------------------------------------
  Na+                    0.009921         227.9       0.8968        -2.0508
  HCO3-                  0.004468         272.4       0.8968        -2.3972
  F-                     0.001908         36.23       0.8953        -2.7674
  HPO4--                0.0004182         40.11       0.6447        -3.5692
  O2(aq)                0.0002387         7.632       1.0000        -3.6222
  NO3-                  0.0002360         14.62       0.8937        -3.6760
  UO2(CO3)3----         0.0002033         91.41       0.1722        -4.4558
  CO3--                 0.0001827         10.95       0.6490        -3.9260
  NaHCO3(aq)            5.083e-005        4.267       1.0000        -4.2939
  AlO2-                 4.594e-005        2.708       0.8968        -4.3851
  Ca++                  2.674e-005        1.071       0.6614        -4.7523
  CrO4--                2.561e-005        2.968       0.6447        -4.7822
  NaHPO4-               2.225e-005        2.645       0.8968        -4.7000
  Cl-                   2.157e-005       0.7642       0.8937        -4.7149
  Fe(OH)3(aq)           1.982e-005        2.117       1.0000        -4.7029
  SO4--                 1.925e-005        1.848       0.6447        -4.9063
  CO2(aq)               1.404e-005       0.6176       1.0000        -4.8525
  UO2(CO3)2--           1.036e-005        4.039       0.6447        -5.1751
  Ni++                  1.036e-005       0.6073       0.6614        -5.1644
  H2PO4-                7.647e-006       0.7411       0.8968        -5.1638
  OH-                   7.128e-006       0.1211       0.8953        -5.1951
  CaPO4-                4.613e-006       0.6225       0.8968        -5.3833
  CaCO3(aq)             4.454e-006       0.4454       1.0000        -5.3513
  MnO4-                 4.361e-006       0.5182       0.8953        -5.4085
  NaCO3-                3.845e-006       0.3189       0.8968        -5.4624
  Fe(OH)4-              3.503e-006       0.4336       0.8968        -5.5029
  CaHPO4(aq)            2.621e-006       0.3563       1.0000        -5.5815
  Ca2UO2(CO3)3          1.737e-006       0.9201       1.0000        -5.7603
  NaF(aq)               1.528e-006      0.06412       1.0000        -5.8158
  CaHCO3+               8.799e-007      0.08889       0.8968        -6.1029
  NaSO4-                8.133e-007      0.09676       0.8968        -6.1370
```

PbCO3(aq)	5.286e-007	0.1412	1.0000	-6.2768
MnCO3(aq)	4.069e-007	0.04674	1.0000	-6.3905
PO4---	2.180e-007	0.02069	0.3720	-7.0910
HAlO2(aq)	1.842e-007	0.01104	1.0000	-6.7347
CaF+	1.619e-007	0.009558	0.8968	-6.8380
Mn++	1.567e-007	0.008603	0.6614	-6.9845
MnPO4-	1.451e-007	0.02174	0.8968	-6.8855
(UO2)2CO3(OH)3-	1.443e-007	0.09390	0.8968	-6.8880
UO2PO4-	1.330e-007	0.04852	0.8968	-6.9233
UO2(OH)2(aq)	1.126e-007	0.03421	1.0000	-6.9485
MnHPO4(aq)	1.062e-007	0.01602	1.0000	-6.9737
UO2(OH)3-	9.808e-008	0.03147	0.8968	-7.0557
HCrO4-	9.109e-008	0.01065	0.8968	-7.0878
Fe(OH)2+	7.490e-008	0.006725	0.8968	-7.1729
NaAlO2(aq)	6.620e-008	0.005422	1.0000	-7.1792
Pb(CO3)2--	6.423e-008	0.02100	0.6447	-7.3829
NaCl(aq)	2.866e-008	0.001674	1.0000	-7.5427
CaSO4(aq)	2.835e-008	0.003856	1.0000	-7.5475
Ni(OH)2(aq)	2.789e-008	0.002583	1.0000	-7.5546
MnO4--	2.341e-008	0.002782	0.6447	-7.8213
CaNO3+	2.085e-008	0.002126	0.8968	-7.7283
PO3F--	1.792e-008	0.001754	0.6447	-7.9373
PbOH+	1.665e-008	0.003730	0.8968	-7.8259
NiSO4(aq)	1.135e-008	0.001755	1.0000	-7.9450

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	62.3600s/sat	Corundum	1.0843s/sat
Todorokite	54.1760s/sat	Ca-Autunite	1.0034s/sat
Trevorite	17.2423s/sat	Dawsonite	0.9038s/sat
Hematite	14.4857s/sat	Cerussite	0.6811s/sat
Pyromorphite	14.2189s/sat	Plattnerite	0.6440s/sat
Fluorapatite	14.1573s/sat	Whitlockite	0.4295s/sat
Bixbyite	12.2232s/sat	CaUO4	0.2717s/sat
Hausmannite	11.7134s/sat	Bunsenite	-0.0363
Pyrolusite	10.2410s/sat	Ice	-0.1387
MnO2(gamma)	8.7232s/sat	Calcite	-0.1983
Goethite	6.7626s/sat	Fluorite	-0.2502
Parsonsite	6.1572s/sat	Ni(OH)2	-0.3129
Pyromorphite-OH	6.1037s/sat	Aragonite	-0.3427
Ferrite-Ca	5.9203s/sat	Rhodochrosite	-0.3889
Manganite	5.7935s/sat	Mn(OH)3	-0.7123
Pb4O(PO4)2	4.9111s/sat	Crocoite	-0.9953
Magnetite	3.8347s/sat	Monohydrocalcite	-1.0320
Hydroxylapatite	3.8053s/sat	UO3:2H2O	-1.4672
Pb3(PO4)2	3.6436s/sat	Schoepite	-1.4672
Plumbogummite	3.5717s/sat	UO2(OH)2(beta)	-1.5796
PbHPO4	3.2275s/sat	UO3:.9H2O(alpha)	-1.6506
Diaspore	2.5379s/sat	Schoepite-dehy(.	-1.6506
MnHPO4	2.3933s/sat	Schoepite-dehy(.	-1.7309
Boehmite	2.1340s/sat	Schoepite-dehy(1	-1.7370
Gibbsite	1.9422s/sat	NiCO3	-2.2734
Hydrocerussite	1.7654s/sat	Na2U2O7(c)	-2.3611
Fe(OH)3(ppd)	1.6415s/sat	Strengite	-2.5292
Ni3(PO4)2	1.6098s/sat	Schoepite-dehy(.	-2.8402

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1889	-0.724
H2O(g)	0.02598	-1.585
CO2(g)	0.0004134	-3.384
HF(g)	2.089e-013	-12.680
HCl(g)	1.512e-020	-19.820
NO2(g)	1.154e-020	-19.938
N2(g)	3.553e-021	-20.449
NO(g)	1.780e-026	-25.750
Cl2(g)	1.441e-032	-31.841
H2(g)	6.449e-042	-41.191
CO(g)	8.326e-049	-48.080
UO2F2(g)	3.662e-055	-54.436
SO2(g)	3.767e-059	-58.424
Pb(g)	7.435e-066	-65.129
UOF4(g)	6.481e-068	-67.188
UO3(g)	2.619e-068	-67.582
NH3(g)	7.442e-070	-69.128
UO2Cl2(g)	2.362e-072	-71.627
Na(g)	6.177e-074	-73.209
UF5(g)	1.090e-080	-79.962
F2(g)	2.160e-081	-80.666
UF6(g)	5.105e-085	-84.292
UF4(g)	2.293e-090	-89.640
UO2(g)	3.754e-121	-120.426
UCl4(g)	5.882e-130	-129.231
U2F10(g)	1.331e-135	-134.876
UCl5(g)	1.409e-138	-137.851
UF3(g)	2.209e-141	-140.656
UCl6(g)	6.271e-142	-141.203
CH4(g)	5.703e-146	-145.244
H2S(g)	2.495e-146	-145.603
Ca(g)	3.810e-151	-150.419
UCl3(g)	1.264e-158	-157.898
Al(g)	6.152e-189	-188.211
UF2(g)	3.141e-189	-188.503
C(g)	4.494e-190	-189.347
UCl2(g)	1.469e-204	-203.833
UO(g)	2.137e-205	-204.670
UF(g)	1.099e-230	-229.959
S2(g)	3.338e-235	-234.476
C2H4(g)	1.543e-238	-237.812
UCl(g)	3.743e-248	-247.427
U2Cl8(g)	8.525e-249	-248.069
U2Cl10(g)	3.962e-250	-249.402
U(g)	2.853e-290	-289.545

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	4.62e-005	4.62e-005	1.25			
Ca++	4.30e-005	4.30e-005	1.72			
Cl-	2.16e-005	2.16e-005	0.765			
CrO4--	2.57e-005	2.57e-005	2.98			

F-	0.00191	0.00191	36.3
Fe++	2.34e-005	2.34e-005	1.31
H+	-0.00130	-0.00130	-1.31
H2O	55.5	55.5	9.99e+005
HCO3-	0.00536	0.00536	327.
HPO4--	0.000456	0.000456	43.7
Mn++	5.21e-006	5.21e-006	0.286
NH3(aq)	0.000236	0.000236	4.02
Na+	0.0100	0.0100	230.
Ni++	1.04e-005	1.04e-005	0.610
O2(aq)	0.000722	0.000722	23.1
Pb++	6.19e-007	6.19e-007	0.128
SO4--	2.01e-005	2.01e-005	1.93
UO2++	0.000216	0.000216	58.3

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	4.620e-005	4.620e-005	1.246		
Calcium	4.300e-005	4.300e-005	1.722		
Carbon	0.005361	0.005361	64.35		
Chlorine	2.160e-005	2.160e-005	0.7652		
Chromium	2.570e-005	2.570e-005	1.335		
Fluorine	0.001910	0.001910	36.26		
Hydrogen	111.0	111.0	1.118e+005		
Iron	2.340e-005	2.340e-005	1.306		
Lead	6.190e-007	6.190e-007	0.1282		
Manganese	5.210e-006	5.210e-006	0.2860		
Nickel	1.040e-005	1.040e-005	0.6099		
Nitrogen	0.0002360	0.0002360	3.303		
Oxygen	55.53	55.53	8.878e+005		
Phosphorus	0.0004560	0.0004560	14.11		
Sodium	0.01000	0.01000	229.7		
Sulfur	2.010e-005	2.010e-005	0.6441		
Uranium	0.0002160	0.0002160	51.38		

Sample 19250 $CaCO_3$ leach, Stage 2.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.060               log fO2 =   -0.710
Eh =   0.7417 volts       pe =  12.5388
Ionic strength      =     0.002517
Activity of water   =     1.000000
Solvent mass        =     0.999999 kg
Solution mass       =     1.000217 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000002 molal
Dissolved solids    =          218 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       104.02 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001971	120.2	0.9463	-2.7293
Na+	0.001664	38.25	0.9463	-2.8028
O2(aq)	0.0002463	7.879	1.0000	-3.6086
F-	0.0002249	4.272	0.9459	-3.6722
HPO4--	0.0001416	13.59	0.8013	-3.9451
Ca++	4.416e-005	1.769	0.8067	-4.4483
CO2(aq)	3.593e-005	1.581	1.0000	-4.4446
AlO2-	3.193e-005	1.883	0.9463	-4.5197
H2PO4-	1.676e-005	1.625	0.9463	-4.7997
UO2(CO3)2--	1.503e-005	5.861	0.8013	-4.9193
UO2(CO3)3----	1.297e-005	5.836	0.4121	-5.2721
Fe(OH)3(aq)	1.276e-005	1.363	1.0000	-4.8941
NO3-	1.260e-005	0.7809	0.9455	-4.9241
CO3--	1.251e-005	0.7507	0.8027	-4.9981
(UO2)2CO3(OH)3-	4.404e-006	2.867	0.9463	-5.3801
NaHCO3(aq)	4.188e-006	0.3518	1.0000	-5.3780
CrO4--	3.284e-006	0.3809	0.8013	-5.5797
SO4--	2.883e-006	0.2769	0.8013	-5.6364
UO2PO4-	2.425e-006	0.8849	0.9463	-5.6393
CaHPO4(aq)	2.221e-006	0.3022	1.0000	-5.6534
Ni++	1.849e-006	0.1085	0.8067	-5.8263
Cl-	1.810e-006	0.06414	0.9455	-5.7668
NaHPO4-	1.571e-006	0.1868	0.9463	-5.8279
Mn++	1.562e-006	0.08582	0.8067	-5.8995
OH-	1.228e-006	0.02087	0.9459	-5.9351
Ca2UO2(CO3)3	1.075e-006	0.5701	1.0000	-5.9684
UO2(OH)2(aq)	9.363e-007	0.2846	1.0000	-6.0286
CaHCO3+	7.818e-007	0.07902	0.9463	-6.1309
CaCO3(aq)	7.599e-007	0.07604	1.0000	-6.1193
HAlO2(aq)	7.425e-007	0.04453	1.0000	-6.1293
CaPO4-	6.742e-007	0.09103	0.9463	-6.1952

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 MnHPO4(aq)          5.438e-007       0.08205      1.0000       -6.2646
 MnCO3(aq)           4.192e-007       0.04818      1.0000       -6.3776
 Fe(OH)4-            3.889e-007       0.04816      0.9463       -6.4341
 MnO4-               3.145e-007       0.03740      0.9459       -6.5265
 PbCO3(aq)           2.655e-007       0.07092      1.0000       -6.5760
 Fe(OH)2+            2.511e-007       0.02256      0.9463       -6.6241
 UO2(OH)3-           1.407e-007       0.04515      0.9463       -6.8758
 MnPO4-              1.281e-007       0.01920      0.9463       -6.9164
 HCrO4-              7.562e-008      0.008846      0.9463       -7.1453
 UO2CO3(aq)          6.813e-008       0.02248      1.0000       -7.1667
 NaCO3-              5.464e-008      0.004534      0.9463       -7.2865
 UO2HPO4(aq)         4.579e-008       0.01675      1.0000       -7.3393
 CaF+                3.848e-008      0.002273      0.9463       -7.4388
 NaF(aq)             3.368e-008      0.001414      1.0000       -7.4726
 NaSO4-              2.540e-008      0.003023      0.9463       -7.6191
 MnHCO3+             1.891e-008      0.002193      0.9463       -7.7472
 PbOH+               1.702e-008      0.003815      0.9463       -7.7930
 CaSO4(aq)           1.063e-008      0.001447      1.0000       -7.9735
 PO4---              1.022e-008     0.0009708      0.6074       -8.2069
  (only species > 1e-8 molal listed)

Mineral saturation states
                   log Q/K                          log Q/K
----------------------------------------------------------------
 Birnessite       59.2409s/sat   CaUO4              0.0158s/sat
 Todorokite       51.4451s/sat   Plattnerite       -0.0563
 Trevorite        14.7178s/sat   Ice               -0.1387
 Hematite         14.1031s/sat   (UO2)3(PO4)2:4H2  -0.2372
 Pyromorphite     13.6839s/sat   Rhodochrosite     -0.3760
 Bixbyite         11.4401s/sat   Schoepite         -0.5473
 Fluorapatite     11.4252s/sat   UO3:2H2O          -0.5473
 Hausmannite      10.5353s/sat   UO2(OH)2(beta)    -0.6597
 Pyrolusite        9.8528s/sat   UO3:.9H2O(alpha)  -0.7307
 MnO2(gamma)       8.3350s/sat   Schoepite-dehy(.  -0.7307
 Parsonsite        7.8712s/sat   Schoepite-dehy(.  -0.8110
 Plumbogummite     6.8890s/sat   Schoepite-dehy(1  -0.8171
 Goethite          6.5714s/sat   Whitlockite       -0.8901
 Pyromorphite-OH   5.8806s/sat   Calcite           -0.9663
 Manganite         5.4019s/sat   Crocoite          -1.0199
 Ferrite-Ca        4.3617s/sat   Mn(OH)3           -1.1039
 Pb4O(PO4)2        4.2910s/sat   Aragonite         -1.1107
 Ca-Autunite       3.8756s/sat   Strengite         -1.6163
 Pb3(PO4)2         3.7306s/sat   Fluorite          -1.7556
 PbHPO4            3.6245s/sat   Monohydrocalcite  -1.8000
 Magnetite         3.2574s/sat   Schoepite-dehy(.  -1.9203
 Diaspore          3.1433s/sat   Bunsenite         -2.1782
 MnHPO4            3.1024s/sat   UO2CO3            -2.3766
 Boehmite          2.7394s/sat   Rutherfordine     -2.3969
 Gibbsite          2.5476s/sat   Schoepite-dehy(.  -2.4383
 Corundum          2.2951s/sat   Ni(OH)2           -2.4548
 Fe(OH)3(ppd)      1.4503s/sat   Berlinite         -2.5528
 Hydroxylapatite   1.2380s/sat   Ni3(PO4)2         -2.6077
 Hydrocerussite    0.4601s/sat   Corkite           -2.7467
 Dawsonite         0.4251s/sat   UO2HPO4:4H2O      -2.7560
 Cerussite         0.3819s/sat
  (only minerals with log Q/K > -3 listed)
```

Gases	fugacity	log fug.
O2(g)	0.1949	-0.710
H2O(g)	0.02598	-1.585
CO2(g)	0.001058	-2.976
HF(g)	1.430e-013	-12.845
HCl(g)	7.374e-021	-20.132
NO2(g)	3.555e-021	-20.449
N2(g)	3.166e-022	-21.500
NO(g)	5.397e-027	-26.268
Cl2(g)	3.481e-033	-32.458
H2(g)	6.349e-042	-41.197
CO(g)	2.097e-048	-47.678
UO2F2(g)	1.426e-054	-53.846
SO2(g)	2.085e-058	-57.681
Pb(g)	1.437e-066	-65.843
UO3(g)	2.178e-067	-66.662
UOF4(g)	1.182e-067	-66.928
NH3(g)	2.170e-070	-69.664
UO2Cl2(g)	4.672e-072	-71.331
Na(g)	1.974e-075	-74.705
UF5(g)	1.350e-080	-79.870
F2(g)	1.027e-081	-80.988
UF6(g)	4.358e-085	-84.361
UF4(g)	4.116e-090	-89.386
UO2(g)	3.073e-120	-119.512
UCl4(g)	2.725e-130	-129.565
U2F10(g)	2.039e-135	-134.691
UCl5(g)	3.208e-139	-138.494
UF3(g)	5.751e-141	-140.240
UCl6(g)	7.019e-143	-142.154
CH4(g)	1.371e-145	-144.863
H2S(g)	1.318e-145	-144.880
Ca(g)	2.502e-152	-151.602
UCl3(g)	1.191e-158	-157.924
Al(g)	2.422e-188	-187.616
UF2(g)	1.186e-188	-187.926
C(g)	1.114e-189	-188.953
UCl2(g)	2.818e-204	-203.550
UO(g)	1.722e-204	-203.764
UF(g)	6.016e-230	-229.221
S2(g)	9.608e-234	-233.017
C2H4(g)	9.196e-238	-237.036
UCl(g)	1.460e-247	-246.836
U2Cl8(g)	1.829e-249	-248.738
U2Cl10(g)	2.054e-251	-250.687
U(g)	2.264e-289	-288.645

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	3.27e-005	3.27e-005	0.882			
Ca++	5.08e-005	5.08e-005	2.04			
Cl-	1.81e-006	1.81e-006	0.0642			
CrO4--	3.36e-006	3.36e-006	0.390			
F-	0.000225	0.000225	4.27			
Fe++	1.34e-005	1.34e-005	0.748			

H+	-0.000228	-0.000228	-0.230
H2O	55.5	55.5	1.00e+006
HCO3-	0.00210	0.00210	128.
HPO4--	0.000166	0.000166	15.9
Mn++	3.00e-006	3.00e-006	0.165
NH3(aq)	1.26e-005	1.26e-005	0.215
Na+	0.00167	0.00167	38.4
Ni++	1.85e-006	1.85e-006	0.109
O2(aq)	0.000275	0.000275	8.80
Pb++	2.98e-007	2.98e-007	0.0617
SO4--	2.92e-006	2.92e-006	0.280
UO2++	4.15e-005	4.15e-005	11.2

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	3.270e-005	3.270e-005	0.8821		
Calcium	5.080e-005	5.080e-005	2.036		
Carbon	0.002103	0.002103	25.25		
Chlorine	1.810e-006	1.810e-006	0.06416		
Chromium	3.360e-006	3.360e-006	0.1747		
Fluorine	0.0002250	0.0002250	4.274		
Hydrogen	111.0	111.0	1.119e+005		
Iron	1.340e-005	1.340e-005	0.7482		
Lead	2.980e-007	2.980e-007	0.06173		
Manganese	3.000e-006	3.000e-006	0.1648		
Nickel	1.850e-006	1.850e-006	0.1086		
Nitrogen	1.260e-005	1.260e-005	0.1764		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0001660	0.0001660	5.141		
Sodium	0.001670	0.001670	38.38		
Sulfur	2.920e-006	2.920e-006	0.09361		
Uranium	4.150e-005	4.150e-005	9.876		

Sample 19250 $CaCO_3$ leach, Stage 3.

```
Step #      0              Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH =  8.340                log fO2 =   -0.724
Eh =   0.7250 volts        pe =  12.2555
Ionic strength      =      0.002548
Activity of water   =      1.000000
Solvent mass        =      0.999996 kg
Solution mass       =      1.000219 kg
Solution density    =      1.013    g/cm3
Chlorinity          =      0.000002 molal
Dissolved solids    =           222 mg/kg sol'n
Rock mass           =      0.000000 kg
Carbonate alkalinity=        100.02 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001794	109.5	0.9460	-2.7702
Na+	0.001535	35.28	0.9460	-2.8380
O2(aq)	0.0002389	7.642	1.0000	-3.6218
F-	0.0001969	3.740	0.9456	-3.7300
HPO4--	0.0001182	11.34	0.8003	-4.0242
AlO2-	7.240e-005	4.269	0.9460	-4.1644
Ca++	4.873e-005	1.953	0.8057	-4.4060
NO3-	4.759e-005	2.950	0.9452	-4.3470
UO2(CO3)3----	3.020e-005	13.59	0.4100	-4.9073
CO3--	2.173e-005	1.303	0.8017	-4.7590
UO2(CO3)2--	2.010e-005	7.838	0.8003	-4.7936
CO2(aq)	1.716e-005	0.7550	1.0000	-4.7655
(UO2)2CO3(OH)3-	1.043e-005	6.786	0.9460	-5.0060
CrO4--	1.008e-005	1.169	0.8003	-5.0933
Fe(OH)3(aq)	7.469e-006	0.7980	1.0000	-5.1267
H2PO4-	7.334e-006	0.7111	0.9460	-5.1588
MnO4-	7.302e-006	0.8683	0.9456	-5.1609
Ni++	6.986e-006	0.4099	0.8057	-5.2496
Mn++	5.452e-006	0.2994	0.8057	-5.3573
NaHCO3(aq)	3.515e-006	0.2952	1.0000	-5.4541
Ca2UO2(CO3)3	3.027e-006	1.604	1.0000	-5.5190
MnCO3(aq)	2.534e-006	0.2912	1.0000	-5.5963
OH-	2.340e-006	0.03979	0.9456	-5.6551
CaHPO4(aq)	2.041e-006	0.2776	1.0000	-5.6901
UO2PO4-	1.711e-006	0.6244	0.9460	-5.7908
Cl-	1.600e-006	0.05670	0.9452	-5.8205
MnHPO4(aq)	1.580e-006	0.2383	1.0000	-5.8014
UO2(OH)2(aq)	1.510e-006	0.4590	1.0000	-5.8211
CaCO3(aq)	1.453e-006	0.1453	1.0000	-5.8379
SO4--	1.450e-006	0.1393	0.8003	-5.9353
PbCO3(aq)	1.219e-006	0.3256	1.0000	-5.9140

NaHPO4-	1.208e-006	0.1437	0.9460	-5.9421
CaPO4-	1.181e-006	0.1594	0.9460	-5.9519
HAlO2(aq)	8.831e-007	0.05296	1.0000	-6.0540
CaHCO3+	7.846e-007	0.07930	0.9460	-6.1295
MnPO4-	7.094e-007	0.1063	0.9460	-6.1732
Fe(OH)4-	4.339e-007	0.05374	0.9460	-6.3867
UO2(OH)3-	4.324e-007	0.1388	0.9460	-6.3883
HCrO4-	1.217e-007	0.01423	0.9460	-6.9389
NaCO3-	8.741e-008	0.007253	0.9460	-7.0826
PbOH+	8.590e-008	0.01925	0.9460	-7.0901
Fe(OH)2+	7.716e-008	0.006932	0.9460	-7.1367
MnHCO3+	6.001e-008	0.006957	0.9460	-7.2459
UO2CO3(aq)	5.247e-008	0.01731	1.0000	-7.2801
CaF+	3.714e-008	0.002193	0.9460	-7.4543
NaF(aq)	2.719e-008	0.001141	1.0000	-7.5656
MnOH+	2.611e-008	0.001878	0.9460	-7.6073
MnF+	2.327e-008	0.001720	0.9460	-7.6573
Pb++	2.296e-008	0.004756	0.8017	-7.7350
NaAlO2(aq)	1.796e-008	0.001472	1.0000	-7.7457
Pb(CO3)2--	1.753e-008	0.005734	0.8003	-7.8530
UO2HPO4(aq)	1.695e-008	0.006203	1.0000	-7.7708
PO4---	1.629e-008	0.001546	0.6057	-8.0060
NaSO4-	1.177e-008	0.001401	0.9460	-7.9532
MnO4--	1.156e-008	0.001375	0.8003	-8.0337

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	68.0189s/sat	CaUO4	0.8256s/sat
Todorokite	59.1274s/sat	Dawsonite	0.4243s/sat
Pyromorphite	16.3473s/sat	Rhodochrosite	0.4053s/sat
Trevorite	15.3893s/sat	Mn(OH)3	-0.0050
Hausmannite	13.8353s/sat	Crocoite	-0.1107
Hematite	13.6379s/sat	Ice	-0.1387
Bixbyite	13.6378s/sat	UO3:2H2O	-0.3398
Fluorapatite	12.1816s/sat	Schoepite	-0.3398
Pyrolusite	10.9484s/sat	Whitlockite	-0.3614
MnO2(gamma)	9.4306s/sat	UO2(OH)2(beta)	-0.4522
Pyromorphite-OH	8.8776s/sat	Ni3(PO4)2	-0.4757
Parsonsite	8.7662s/sat	UO3:.9H2O(alpha)	-0.5232
Pb4O(PO4)2	6.9442s/sat	Schoepite-dehy(.	-0.5232
Plumbogummite	6.8197s/sat	Schoepite-dehy(.	-0.6035
Manganite	6.5008s/sat	Schoepite-dehy(1	-0.6096
Goethite	6.3388s/sat	Calcite	-0.6849
Pb3(PO4)2	5.4010s/sat	Aragonite	-0.8293
Ferrite-Ca	4.4988s/sat	(UO2)3(PO4)2:4H2	-0.8928
PbHPO4	3.9683s/sat	Bunsenite	-1.0415
Ca-Autunite	3.6148s/sat	Ni(OH)2	-1.3181
MnHPO4	3.5656s/sat	Monohydrocalcite	-1.5186
Diaspore	3.2186s/sat	Schoepite-dehy(.	-1.7128
Boehmite	2.8147s/sat	Fluorite	-1.8290
Hydrocerussite	2.7668s/sat	Becquerelite	-2.1647
Gibbsite	2.6229s/sat	Schoepite-dehy(.	-2.2308
Magnetite	2.5629s/sat	Strengite	-2.4880
Corundum	2.4457s/sat	UO2CO3	-2.4900
Hydroxylapatite	2.3322s/sat	Rutherfordine	-2.5103

Fe(OH)3(ppd)	1.2177s/sat	Na2U2O7(c)	-2.6005
Cerussite	1.0439s/sat	PbCO3.PbO	-2.8914
Plattnerite	0.9200s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1890	-0.724
H2O(g)	0.02598	-1.585
CO2(g)	0.0005051	-3.297
HF(g)	6.567e-014	-13.183
NO2(g)	7.099e-021	-20.149
HCl(g)	3.420e-021	-20.466
N2(g)	1.342e-021	-20.872
NO(g)	1.094e-026	-25.961
Cl2(g)	7.375e-034	-33.132
H2(g)	6.446e-042	-41.191
CO(g)	1.017e-048	-47.993
UO2F2(g)	4.853e-055	-54.314
SO2(g)	2.930e-059	-58.533
Pb(g)	1.402e-065	-64.853
UO3(g)	3.512e-067	-66.454
UOF4(g)	8.484e-069	-68.071
NH3(g)	4.571e-070	-69.340
UO2Cl2(g)	1.620e-072	-71.790
Na(g)	3.495e-075	-74.457
UF5(g)	4.486e-082	-81.348
F2(g)	2.135e-082	-81.671
UF6(g)	6.603e-087	-86.180
UF4(g)	3.001e-091	-90.523
UO2(g)	5.032e-120	-119.298
UCl4(g)	2.064e-131	-130.685
U2F10(g)	2.253e-138	-137.647
UCl5(g)	1.118e-140	-139.951
UF3(g)	9.196e-142	-141.036
UCl6(g)	1.126e-144	-143.948
CH4(g)	6.957e-146	-145.158
H2S(g)	1.938e-146	-145.713
Ca(g)	1.017e-151	-150.993
UCl3(g)	1.960e-159	-158.708
Al(g)	2.948e-188	-187.531
UF2(g)	4.159e-189	-188.381
C(g)	5.487e-190	-189.261
UO(g)	2.863e-204	-203.543
UCl2(g)	1.007e-204	-203.997
UF(g)	4.629e-230	-229.335
S2(g)	2.016e-235	-234.696
C2H4(g)	2.299e-238	-237.639
UCl(g)	1.134e-247	-246.945
U2Cl8(g)	1.050e-251	-250.979
U2Cl10(g)	2.497e-254	-253.603
U(g)	3.821e-289	-288.418

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Al+++	7.33e-005	7.33e-005	1.98			

Ca++	6.03e-005	6.03e-005	2.42
Cl-	1.60e-006	1.60e-006	0.0567
CrO4--	1.02e-005	1.02e-005	1.18
F-	0.000197	0.000197	3.74
Fe++	7.98e-006	7.98e-006	0.446
H+	-0.000573	-0.000573	-0.577
H2O	55.5	55.5	1.00e+006
HCO3-	0.00199	0.00199	122.
HPO4--	0.000134	0.000134	12.9
Mn++	1.77e-005	1.77e-005	0.972
NH3(aq)	4.76e-005	4.76e-005	0.810
Na+	0.00154	0.00154	35.4
Ni++	6.99e-006	6.99e-006	0.410
O2(aq)	0.000345	0.000345	11.0
Pb++	1.36e-006	1.36e-006	0.282
SO4--	1.47e-006	1.47e-006	0.141
UO2++	7.79e-005	7.79e-005	21.0

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	7.330e-005	7.330e-005	1.977		
Calcium	6.030e-005	6.030e-005	2.416		
Carbon	0.001993	0.001993	23.94		
Chlorine	1.600e-006	1.600e-006	0.05671		
Chromium	1.020e-005	1.020e-005	0.5302		
Fluorine	0.0001970	0.0001970	3.742		
Hydrogen	111.0	111.0	1.119e+005		
Iron	7.980e-006	7.980e-006	0.4456		
Lead	1.360e-006	1.360e-006	0.2817		
Manganese	1.770e-005	1.770e-005	0.9722		
Nickel	6.990e-006	6.990e-006	0.4102		
Nitrogen	4.760e-005	4.760e-005	0.6666		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	0.0001340	0.0001340	4.150		
Sodium	0.001540	0.001540	35.40		
Sulfur	1.470e-006	1.470e-006	0.04713		
Uranium	7.790e-005	7.790e-005	18.54		

Sample 19250 $CaCO_3$ leach, Stage 4.

```
Step #      0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  7.920                log fO2 =   -0.713
Eh =   0.7500 volts       pe =  12.6781
Ionic strength       =    0.001553
Activity of water    =    1.000000
Solvent mass         =    0.999997 kg
Solution mass        =    1.000166 kg
Solution density     =    1.013    g/cm3
Chlorinity           =    0.000001 molal
Dissolved solids     =         169 mg/kg sol'n
Rock mass            =    0.000000 kg
Carbonate alkalinity=       81.11 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001512	92.25	0.9570	-2.8395
Na+	0.0008131	18.69	0.9570	-3.1089
O2(aq)	0.0002446	7.825	1.0000	-3.6116
Ca++	4.260e-005	1.707	0.8419	-4.4453
HPO4--	4.126e-005	3.960	0.8384	-4.4610
CO2(aq)	3.847e-005	1.693	1.0000	-4.4148
AlO2-	3.844e-005	2.267	0.9570	-4.4344
F-	3.609e-005	0.6855	0.9567	-4.4619
UO2(CO3)2--	2.137e-005	8.333	0.8384	-4.7468
(UO2)2CO3(OH)3-	2.063e-005	13.43	0.9570	-4.7046
Fe(OH)3(aq)	1.945e-005	2.079	1.0000	-4.7110
NO3-	1.720e-005	1.066	0.9565	-4.7839
UO2(CO3)3----	9.049e-006	4.072	0.4938	-5.3498
Ni++	6.988e-006	0.4101	0.8419	-5.2304
H2PO4-	6.974e-006	0.6763	0.9570	-5.1756
CO3--	6.726e-006	0.4036	0.8393	-5.2483
Mn++	3.367e-006	0.1850	0.8419	-5.5474
CrO4--	3.088e-006	0.3582	0.8384	-5.5868
UO2PO4-	2.493e-006	0.9100	0.9570	-5.6223
UO2(OH)2(aq)	2.314e-006	0.7034	1.0000	-5.6357
SO4--	1.704e-006	0.1636	0.8384	-5.8452
NaHCO3(aq)	1.606e-006	0.1349	1.0000	-5.7944
Cl-	1.290e-006	0.04572	0.9565	-5.9088
HAlO2(aq)	1.248e-006	0.07482	1.0000	-5.9040
Ca2UO2(CO3)3	9.113e-007	0.4831	1.0000	-6.0403
OH-	8.793e-007	0.01495	0.9567	-6.0751
CaHPO4(aq)	6.818e-007	0.09274	1.0000	-6.1664
CaHCO3+	6.038e-007	0.06104	0.9570	-6.2382
MnCO3(aq)	5.299e-007	0.06091	1.0000	-6.2758
Fe(OH)2+	5.225e-007	0.04694	0.9570	-6.3010
CaCO3(aq)	4.300e-007	0.04303	1.0000	-6.3666

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  Fe(OH)4-            4.247e-007       0.05260      0.9570       -6.3910
  MnHPO4(aq)          3.729e-007       0.05626      1.0000       -6.4285
  PbCO3(aq)           3.676e-007       0.09820      1.0000       -6.4347
  MnO4-               2.636e-007       0.03135      0.9567       -6.5982
  UO2(OH)3-           2.490e-007       0.07993      0.9570       -6.6229
  NaHPO4-             2.340e-007       0.02783      0.9570       -6.6499
  UO2CO3(aq)          1.803e-007       0.05950      1.0000       -6.7440
  CaPO4-              1.482e-007       0.02001      0.9570       -6.8482
  HCrO4-              1.015e-007       0.01188      0.9570       -7.0124
  UO2HPO4(aq)         6.572e-008       0.02405      1.0000       -7.1823
  MnPO4-              6.293e-008      0.009432      0.9570       -7.2203
  MnHCO3+             3.264e-008      0.003784      0.9570       -7.5054
  PbOH+               3.004e-008      0.006733      0.9570       -7.5414
  Pb++                2.041e-008      0.004227      0.8393       -7.7663
  NaCO3-              1.501e-008      0.001245      0.9570       -7.8429
  H+                  1.253e-008    1.263e-005      0.9594       -7.9200
  Al(OH)2+            1.080e-008     0.0006588      0.9570       -7.9856
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                          log Q/K
----------------------------------------------------------------
  Birnessite        59.8082s/sat   CaUO4             0.1316s/sat
  Todorokite        51.9419s/sat   Plattnerite       0.0538s/sat
  Trevorite         15.4000s/sat   Ice              -0.1387
  Hematite          14.4694s/sat   UO3:2H2O         -0.1544
  Pyromorphite      13.5319s/sat   Schoepite        -0.1544
  Bixbyite          11.5826s/sat   UO2(OH)2(beta)   -0.2668
  Hausmannite       10.7499s/sat   Rhodochrosite    -0.2742
  Pyrolusite         9.9234s/sat   UO3:.9H2O(alpha) -0.3378
  Fluorapatite       8.6824s/sat   Schoepite-dehy(. -0.3378
  MnO2(gamma)        8.4056s/sat   Schoepite-dehy(. -0.4181
  Parsonsite         8.0153s/sat   Schoepite-dehy(1 -0.4242
  Plumbogummite      7.2048s/sat   Crocoite         -0.6355
  Goethite           6.7545s/sat   Hydroxylapatite  -0.8552
  Pyromorphite-OH    5.7306s/sat   Mn(OH)3          -1.0326
  Manganite          5.4732s/sat   Calcite          -1.2136
  Ferrite-Ca         4.4509s/sat   Aragonite        -1.3580
  Pb4O(PO4)2         4.2653s/sat   Schoepite-dehy(. -1.5274
  Ca-Autunite        3.9125s/sat   Strengite        -1.6691
  Magnetite          3.8075s/sat   Bunsenite        -1.8623
  Pb3(PO4)2          3.5934s/sat   Becquerelite     -1.9318
  PbHPO4             3.5001s/sat   UO2CO3           -1.9539
  Diaspore           3.3686s/sat   Rutherfordine    -1.9742
  Boehmite           2.9647s/sat   Schoepite-dehy(. -2.0454
  MnHPO4             2.9385s/sat   Monohydrocalcite -2.0473
  Gibbsite           2.7729s/sat   Ni3(PO4)2        -2.1317
  Corundum           2.7458s/sat   Ni(OH)2          -2.1389
  Fe(OH)3(ppd)       1.6334s/sat   Whitlockite      -2.1932
  Hydrocerussite     0.8542s/sat   Corkite          -2.2505
  Cerussite          0.5232s/sat   Berlinite        -2.5634
  (UO2)3(PO4)2:4H2   0.4696s/sat   UO2HPO4:4H2O     -2.5990
  Dawsonite          0.2341s/sat   UO2HPO4          -2.9439
   (only minerals with log Q/K > -3 listed)

 Gases                 fugacity      log fug.
-----------------------------------------------
```

O2(g)	0.1935	-0.713
H2O(g)	0.02598	-1.585
CO2(g)	0.001133	-2.946
HF(g)	3.203e-014	-13.494
HCl(g)	7.340e-021	-20.134
NO2(g)	6.787e-021	-20.168
N2(g)	1.170e-021	-20.932
NO(g)	1.034e-026	-25.985
Cl2(g)	3.437e-033	-32.464
H2(g)	6.371e-042	-41.196
CO(g)	2.254e-048	-47.647
UO2F2(g)	1.769e-055	-54.752
SO2(g)	2.465e-058	-57.608
Pb(g)	1.864e-066	-65.730
UO3(g)	5.382e-067	-66.269
UOF4(g)	7.356e-070	-69.133
NH3(g)	4.193e-070	-69.377
UO2Cl2(g)	1.144e-071	-70.942
Na(g)	7.079e-076	-75.150
F2(g)	5.138e-083	-82.289
UF5(g)	1.886e-083	-82.725
UF6(g)	1.362e-088	-87.866
UF4(g)	2.571e-092	-91.590
UO2(g)	7.621e-120	-119.118
UCl4(g)	6.631e-130	-129.178
UCl5(g)	7.759e-139	-138.110
U2F10(g)	3.981e-141	-140.400
UCl6(g)	1.687e-142	-141.773
UF3(g)	1.606e-142	-141.794
H2S(g)	1.574e-145	-144.803
CH4(g)	1.488e-145	-144.827
Ca(g)	1.326e-152	-151.877
UCl3(g)	2.917e-158	-157.535
Al(g)	4.091e-188	-187.388
UF2(g)	1.481e-189	-188.830
C(g)	1.202e-189	-188.920
UCl2(g)	6.945e-204	-203.158
UO(g)	4.286e-204	-203.368
UF(g)	3.359e-230	-229.474
S2(g)	1.361e-233	-232.866
C2H4(g)	1.077e-237	-236.968
UCl(g)	3.622e-247	-246.441
U2Cl8(g)	1.084e-248	-247.965
U2Cl10(g)	1.201e-250	-249.920
U(g)	5.652e-289	-288.248

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	3.97e-005	3.97e-005	1.07			
Ca++	4.63e-005	4.63e-005	1.86			
Cl-	1.29e-006	1.29e-006	0.0457			
CrO4--	3.19e-006	3.19e-006	0.370			
F-	3.61e-005	3.61e-005	0.686			
Fe++	2.04e-005	2.04e-005	1.14			
H+	-0.000343	-0.000343	-0.346			
H2O	55.5	55.5	1.00e+006			

HCO3-	0.00165	0.00165	101.
HPO4--	5.23e-005	5.23e-005	5.02
Mn++	4.64e-006	4.64e-006	0.255
NH3(aq)	1.72e-005	1.72e-005	0.293
Na+	0.000815	0.000815	18.7
Ni++	6.99e-006	6.99e-006	0.410
O2(aq)	0.000284	0.000284	9.10
Pb++	4.22e-007	4.22e-007	0.0874
SO4--	1.72e-006	1.72e-006	0.165
UO2++	7.79e-005	7.79e-005	21.0

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	3.970e-005	3.970e-005	1.071		
Calcium	4.630e-005	4.630e-005	1.855		
Carbon	0.001654	0.001654	19.87		
Chlorine	1.290e-006	1.290e-006	0.04573		
Chromium	3.190e-006	3.190e-006	0.1658		
Fluorine	3.610e-005	3.610e-005	0.6857		
Hydrogen	111.0	111.0	1.119e+005		
Iron	2.040e-005	2.040e-005	1.139		
Lead	4.220e-007	4.220e-007	0.08742		
Manganese	4.640e-006	4.640e-006	0.2549		
Nickel	6.990e-006	6.990e-006	0.4102		
Nitrogen	1.720e-005	1.720e-005	0.2409		
Oxygen	55.51	55.51	8.881e+005		
Phosphorus	5.230e-005	5.230e-005	1.620		
Sodium	0.0008150	0.0008150	18.73		
Sulfur	1.720e-006	1.720e-006	0.05514		
Uranium	7.790e-005	7.790e-005	18.54		

Sample 19250 $CaCO_3$ leach, Stage 5.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH =  7.550              log fO2 =   -0.705
Eh =   0.7720 volts      pe =  13.0502
Ionic strength      =    0.001294
Activity of water   =    1.000000
Solvent mass        =    1.000001 kg
Solution mass       =    1.000136 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000001 molal
Dissolved solids    =         135 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=       73.31 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.001415	86.31	0.9605	-2.8668
Na+	0.0004142	9.521	0.9605	-3.4003
O2(aq)	0.0002495	7.982	1.0000	-3.6030
Ca++	0.0001434	5.745	0.8538	-3.9122
CO2(aq)	8.470e-005	3.727	1.0000	-4.0721
NO3-	1.599e-005	0.9913	0.9600	-4.8139
UO2(CO3)2--	1.159e-005	4.519	0.8507	-5.0063
AlO2-	9.555e-006	0.5635	0.9605	-5.0373
(UO2)2CO3(OH)3-	7.516e-006	4.893	0.9605	-5.1415
F-	7.444e-006	0.1414	0.9603	-5.1458
HPO4--	6.298e-006	0.6044	0.8507	-5.2710
Mn++	4.220e-006	0.2318	0.8538	-5.4433
CO3--	2.656e-006	0.1593	0.8515	-5.6456
H2PO4-	2.523e-006	0.2447	0.9605	-5.6156
Ca2UO2(CO3)3	2.340e-006	1.240	1.0000	-5.6308
CaHCO3+	1.928e-006	0.1949	0.9605	-5.7323
SO4--	1.909e-006	0.1833	0.8507	-5.7895
UO2(CO3)3----	1.881e-006	0.8465	0.5236	-6.0066
Fe(OH)3(aq)	1.866e-006	0.1994	1.0000	-5.7292
UO2(OH)2(aq)	1.444e-006	0.4389	1.0000	-5.8405
Cl-	1.140e-006	0.04041	0.9600	-5.9609
NaHCO3(aq)	7.708e-007	0.06475	1.0000	-6.1130
HAlO2(aq)	7.296e-007	0.04376	1.0000	-6.1369
CaCO3(aq)	5.878e-007	0.05883	1.0000	-6.2307
UO2PO4-	5.629e-007	0.2054	0.9605	-6.2671
OH-	3.737e-007	0.006355	0.9603	-6.4451
CrO4--	3.720e-007	0.04314	0.8507	-6.4997
CaHPO4(aq)	3.604e-007	0.04903	1.0000	-6.4432
MnCO3(aq)	2.698e-007	0.03101	1.0000	-6.5690
UO2CO3(aq)	2.477e-007	0.08173	1.0000	-6.6061
Ni++	1.950e-007	0.01144	0.8538	-6.7787

```
  Fe(OH)2+            1.170e-007       0.01052      0.9605       -6.9492
  MnHPO4(aq)          7.340e-008       0.01108      1.0000       -7.1343
  UO2(OH)3-           6.604e-008       0.02120      0.9605       -7.1977
  MnHCO3+             3.881e-008      0.004500      0.9605       -7.4286
  UO2HPO4(aq)         3.490e-008       0.01277      1.0000       -7.4571
  CaPO4-              3.330e-008      0.004497      0.9605       -7.4950
  H+                  2.928e-008    2.951e-005      0.9626       -7.5500
  HCrO4-              2.899e-008      0.003391      0.9605       -7.5553
  MnO4-               2.656e-008      0.003159      0.9603       -7.5933
  CaSO4(aq)           2.567e-008      0.003494      1.0000       -7.5906
  PbCO3(aq)           2.339e-008      0.006248      1.0000       -7.6310
  NaHPO4-             1.846e-008      0.002196      0.9605       -7.7513
  Fe(OH)4-            1.731e-008      0.002144      0.9605       -7.7792
  Al(OH)2+            1.476e-008     0.0009000      0.9605       -7.8485
   (only species > 1e-8 molal listed)

 Mineral saturation states
                    log Q/K                           log Q/K
----------------------------------------------------------------
  Birnessite        54.7471s/sat   UO3:2H2O          -0.3592
  Todorokite        47.5123s/sat   Schoepite         -0.3592
  Hematite          12.4331s/sat   UO2(OH)2(beta)    -0.4716
  Trevorite         11.0753s/sat   UO3:.9H2O(alpha)  -0.5426
  Bixbyite          10.3152s/sat   Schoepite-dehy(.  -0.5426
  Pyrolusite         9.2918s/sat   Rhodochrosite     -0.5674
  Hausmannite        8.8466s/sat   Schoepite-dehy(.  -0.6229
  MnO2(gamma)        7.7740s/sat   Schoepite-dehy(1  -0.6290
  Fluorapatite       7.1241s/sat   Cerussite         -0.6731
  Pyromorphite       5.9446s/sat   Calcite           -1.0777
  Goethite           5.7363s/sat   Pb3(PO4)2         -1.1638
  Manganite          4.8394s/sat   Aragonite         -1.2221
  Plumbogummite      4.8269s/sat   Plattnerite       -1.4810
  Parsonsite         4.5924s/sat   Mn(OH)3           -1.6664
  Ca-Autunite        3.1560s/sat   Schoepite-dehy(.  -1.7322
  Diaspore           3.1357s/sat   UO2CO3            -1.8160
  Boehmite           2.7318s/sat   Rutherfordine     -1.8363
  Gibbsite           2.5400s/sat   Monohydrocalcite  -1.9114
  Corundum           2.2799s/sat   Pb4O(PO4)2        -2.0309
  MnHPO4             2.2327s/sat   Hydroxylapatite   -2.0995
  Ferrite-Ca         2.2077s/sat   Pyromorphite-OH   -2.1747
  PbHPO4             1.8911s/sat   Schoepite-dehy(.  -2.2502
  Magnetite          0.7509s/sat   Crocoite          -2.3474
  Fe(OH)3(ppd)       0.6152s/sat   Strengite         -2.7573
  Ice               -0.1387        Berlinite         -2.8663
  CaUO4             -0.2801        UO2HPO4:4H2O      -2.8738
  (UO2)3(PO4)2:4H2  -0.2848        Whitlockite       -2.9538
  Dawsonite         -0.3175
   (only minerals with log Q/K > -3 listed)

 Gases                 fugacity      log fug.
----------------------------------------------
  O2(g)                  0.1974       -0.705
  H2O(g)                0.02598       -1.585
  CO2(g)               0.002493       -2.603
  HF(g)              1.555e-014      -13.808
  HCl(g)             1.526e-020      -19.816
  NO2(g)             1.478e-020      -19.830
```

N2(g)	5.331e-021	-20.273
NO(g)	2.229e-026	-25.652
Cl2(g)	1.501e-032	-31.824
H2(g)	6.308e-042	-41.200
CO(g)	4.912e-048	-47.309
UO2F2(g)	2.600e-056	-55.585
SO2(g)	1.525e-057	-56.817
UO3(g)	3.358e-067	-66.474
Pb(g)	5.335e-068	-67.273
NH3(g)	8.818e-070	-69.055
UO2Cl2(g)	3.086e-071	-70.511
UOF4(g)	2.547e-071	-70.594
Na(g)	1.536e-076	-75.814
F2(g)	1.222e-083	-82.913
UF5(g)	3.154e-085	-84.501
UF6(g)	1.111e-090	-89.954
UF4(g)	8.816e-094	-93.055
UO2(g)	4.708e-120	-119.327
UCl4(g)	7.661e-129	-128.116
UCl5(g)	1.873e-137	-136.727
UCl6(g)	8.509e-141	-140.070
UF3(g)	1.129e-143	-142.947
U2F10(g)	1.113e-144	-143.953
H2S(g)	9.450e-145	-144.025
CH4(g)	3.149e-145	-144.502
Ca(g)	8.156e-153	-152.089
UCl3(g)	1.612e-157	-156.793
Al(g)	2.357e-188	-187.628
C(g)	2.593e-189	-188.586
UF2(g)	2.134e-190	-189.671
UCl2(g)	1.837e-203	-202.736
UO(g)	2.622e-204	-203.581
UF(g)	9.924e-231	-230.003
S2(g)	5.005e-232	-231.301
C2H4(g)	4.916e-237	-236.308
U2Cl8(g)	1.446e-246	-245.840
UCl(g)	4.585e-247	-246.339
U2Cl10(g)	7.002e-248	-247.155
U(g)	3.423e-289	-288.466

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Al+++	1.03e-005	1.03e-005	0.278			
Ca++	0.000151	0.000151	6.05			
Cl-	1.14e-006	1.14e-006	0.0404			
CrO4--	4.01e-007	4.01e-007	0.0465			
F-	7.45e-006	7.45e-006	0.142			
Fe++	2.00e-006	2.00e-006	0.112			
H+	-4.69e-005	-4.69e-005	-0.0473			
H2O	55.5	55.5	1.00e+006			
HCO3-	0.00155	0.00155	94.5			
HPO4--	9.91e-006	9.91e-006	0.951			
Mn++	4.64e-006	4.64e-006	0.255			
NH3(aq)	1.60e-005	1.60e-005	0.272			
Na+	0.000415	0.000415	9.54			
Ni++	1.95e-007	1.95e-007	0.0114			

O2(aq)	0.000282	0.000282	9.02
Pb++	2.87e-008	2.87e-008	0.00595
SO4--	1.94e-006	1.94e-006	0.186
UO2++	3.32e-005	3.32e-005	8.96

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	1.030e-005	1.030e-005	0.2779		
Calcium	0.0001510	0.0001510	6.051		
Carbon	0.001549	0.001549	18.61		
Chlorine	1.140e-006	1.140e-006	0.04041		
Chromium	4.010e-007	4.010e-007	0.02085		
Fluorine	7.450e-006	7.450e-006	0.1415		
Hydrogen	111.0	111.0	1.119e+005		
Iron	2.000e-006	2.000e-006	0.1117		
Lead	2.870e-008	2.870e-008	0.005946		
Manganese	4.640e-006	4.640e-006	0.2549		
Nickel	1.950e-007	1.950e-007	0.01144		
Nitrogen	1.600e-005	1.600e-005	0.2241		
Oxygen	55.51	55.51	8.881e+005		
Phosphorus	9.910e-006	9.910e-006	0.3069		
Sodium	0.0004150	0.0004150	9.539		
Sulfur	1.940e-006	1.940e-006	0.06220		
Uranium	3.320e-005	3.320e-005	7.901		

Sample 19250 $CaCO_3$ leach, Stage 6.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH =  8.300               log fO2 =   -0.778
Eh =   0.7265 volts       pe =  12.2818
Ionic strength      =     0.002488
Activity of water   =     0.999998
Solvent mass        =     0.999991 kg
Solution mass       =     1.000237 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000059 molal
Dissolved solids    =          246 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       116.03 mg/kg as CaCO3
```

Reactants	moles remaining	moles reacted	grams reacted	cm3 reacted
O2(g)	-- fixed fugacity buffer --			

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
HCO3-	0.002073	126.5	0.9466	-2.7072
Na+	0.001137	26.12	0.9466	-2.9682
O2(aq)	0.0002106	6.737	1.0000	-3.6766
NO3-	0.0001280	7.932	0.9458	-3.9171
Fe(OH)3(aq)	0.0001062	11.34	1.0000	-3.9740
F-	0.0001039	1.974	0.9462	-4.0072
AlO2-	9.274e-005	5.468	0.9466	-4.0566
Ca++	6.638e-005	2.660	0.8076	-4.2708
Cl-	5.919e-005	2.098	0.9458	-4.2520
HPO4--	4.270e-005	4.097	0.8023	-4.4652
UO2(CO3)3----	3.650e-005	16.42	0.4141	-4.8205
UO2(CO3)2--	2.322e-005	9.054	0.8023	-4.7298
CO3--	2.285e-005	1.371	0.8037	-4.7360
CO2(aq)	2.175e-005	0.9570	1.0000	-4.6625
CrO4--	1.342e-005	1.556	0.8023	-4.9678
Mn++	1.028e-005	0.5644	0.8076	-5.0810
Ni++	9.292e-006	0.5452	0.8076	-5.1247
(UO2)2CO3(OH)3-	9.043e-006	5.886	0.9466	-5.0675
MnO4-	8.933e-006	1.062	0.9462	-5.0730
Ca2UO2(CO3)3	6.888e-006	3.651	1.0000	-5.1619
Fe(OH)4-	5.622e-006	0.6962	0.9466	-5.2740
MnCO3(aq)	5.047e-006	0.5800	1.0000	-5.2970
NaHCO3(aq)	3.010e-006	0.2528	1.0000	-5.5214
H2PO4-	2.911e-006	0.2822	0.9466	-5.5598
SO4--	2.801e-006	0.2690	0.8023	-5.6483
OH-	2.133e-006	0.03626	0.9462	-5.6951
CaCO3(aq)	2.091e-006	0.2092	1.0000	-5.6797
PbCO3(aq)	1.700e-006	0.4543	1.0000	-5.7694
UO2(OH)2(aq)	1.308e-006	0.3977	1.0000	-5.8833
HAlO2(aq)	1.241e-006	0.07444	1.0000	-5.9062
CaHCO3+	1.237e-006	0.1251	0.9466	-5.9313

Fe(OH)2+	1.202e-006	0.1080	0.9466	-5.9440
MnHPO4(aq)	1.081e-006	0.1631	1.0000	-5.9662
CaHPO4(aq)	1.009e-006	0.1373	1.0000	-5.9960
UO2PO4-	5.884e-007	0.2147	0.9466	-6.2541
CaPO4-	5.321e-007	0.07185	0.9466	-6.2978
MnPO4-	4.424e-007	0.06630	0.9466	-6.3780
UO2(OH)3-	3.415e-007	0.1096	0.9466	-6.4905
NaHPO4-	3.238e-007	0.03852	0.9466	-6.5135
HCrO4-	1.780e-007	0.02082	0.9466	-6.7734
MnHCO3+	1.310e-007	0.01519	0.9466	-6.9066
PbOH+	1.036e-007	0.02322	0.9466	-7.0085
NaCO3-	6.823e-008	0.005662	0.9466	-7.1899
UO2CO3(aq)	5.764e-008	0.01902	1.0000	-7.2393
MnOH+	4.496e-008	0.003234	0.9466	-7.3710
CaNO3+	3.435e-008	0.003506	0.9466	-7.4879
Pb++	3.030e-008	0.006277	0.8037	-7.6134
CaF+	2.676e-008	0.001581	0.9466	-7.5963
Pb(CO3)2--	2.572e-008	0.008412	0.8023	-7.6855
MnF+	2.321e-008	0.001715	0.9466	-7.6582
NaAlO2(aq)	1.706e-008	0.001398	1.0000	-7.7681
NaSO4-	1.688e-008	0.002009	0.9466	-7.7966
CaSO4(aq)	1.556e-008	0.002118	1.0000	-7.8080
MnO4--	1.329e-008	0.001580	0.8023	-7.9722
NaF(aq)	1.064e-008	0.0004466	1.0000	-7.9731
NaCl(aq)	1.006e-008	0.0005880	1.0000	-7.9972

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Birnessite	69.4249s/sat	CaUO4	0.8185s/sat
Todorokite	60.3646s/sat	Rhodochrosite	0.7046s/sat
Trevorite	17.7398s/sat	Dawsonite	0.5049s/sat
Pyromorphite	17.0806s/sat	Mn(OH)3	0.1776s/sat
Hematite	15.9435s/sat	Crocoite	0.1365s/sat
Hausmannite	14.3968s/sat	Ice	-0.1387
Bixbyite	14.0030s/sat	Schoepite	-0.4020
Fluorapatite	11.1371s/sat	UO3:2H2O	-0.4020
Pyrolusite	11.1173s/sat	Corkite	-0.4538
MnO2(gamma)	9.5995s/sat	UO2(OH)2(beta)	-0.5144
Parsonsite	8.0651s/sat	Calcite	-0.5267
Pyromorphite-OH	8.0024s/sat	UO3:.9H2O(alpha)	-0.5854
Goethite	7.4915s/sat	Schoepite-dehy(.	-0.5854
Ferrite-Ca	6.8596s/sat	Schoepite-dehy(.	-0.6657
Manganite	6.6834s/sat	Aragonite	-0.6711
Plumbogummite	6.5825s/sat	Schoepite-dehy(1	-0.6718
Pb4O(PO4)2	6.3885s/sat	Whitlockite	-0.9179
Magnetite	6.0349s/sat	Bunsenite	-0.9966
Pb3(PO4)2	4.8036s/sat	Ni3(PO4)2	-1.0631
PbHPO4	3.6488s/sat	Ni(OH)2	-1.2732
MnHPO4	3.4008s/sat	Monohydrocalcite	-1.3604
Diaspore	3.3664s/sat	Strengite	-1.6963
Hydrocerussite	3.0976s/sat	Schoepite-dehy(.	-1.7750
Boehmite	2.9625s/sat	(UO2)3(PO4)2:4H2	-1.8017
Ca-Autunite	2.8233s/sat	Fluorite	-2.2483
Gibbsite	2.7707s/sat	Schoepite-dehy(.	-2.2930
Corundum	2.7413s/sat	UO2CO3	-2.4492

Fe(OH)3(ppd)	2.3704s/sat	Rutherfordine	-2.4695
Hydroxylapatite	1.5250s/sat	Becquerelite	-2.4830
Cerussite	1.1885s/sat	PbCO3.PbO	-2.7052
Plattnerite	0.9342s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1666	-0.778
H2O(g)	0.02598	-1.585
CO2(g)	0.0006403	-3.194
HF(g)	3.803e-014	-13.420
HCl(g)	1.388e-019	-18.857
NO2(g)	2.161e-020	-19.665
N2(g)	1.601e-020	-19.796
NO(g)	3.549e-026	-25.450
Cl2(g)	1.141e-030	-29.943
H2(g)	6.866e-042	-41.163
CO(g)	1.373e-048	-47.862
UO2F2(g)	1.410e-055	-54.851
SO2(g)	7.264e-059	-58.139
Pb(g)	1.644e-065	-64.784
UO3(g)	3.043e-067	-66.517
UO2Cl2(g)	2.314e-069	-68.636
NH3(g)	1.735e-069	-68.761
UOF4(g)	8.270e-070	-69.082
Na(g)	2.437e-075	-74.613
F2(g)	6.722e-083	-82.172
UF5(g)	2.614e-083	-82.583
UF6(g)	2.159e-088	-87.666
UF4(g)	3.115e-092	-91.506
UO2(g)	4.644e-120	-119.333
UCl4(g)	5.174e-125	-124.286
UCl5(g)	1.103e-132	-131.957
UCl6(g)	4.369e-135	-134.360
U2F10(g)	7.646e-141	-140.117
UF3(g)	1.701e-142	-141.769
CH4(g)	1.135e-145	-144.945
H2S(g)	5.806e-146	-145.236
Ca(g)	1.229e-151	-150.910
UCl3(g)	1.249e-154	-153.903
Al(g)	4.554e-188	-187.342
UF2(g)	1.371e-189	-188.863
C(g)	7.890e-190	-189.103
UCl2(g)	1.632e-201	-200.787
UO(g)	2.814e-204	-203.551
UF(g)	2.719e-230	-229.566
S2(g)	1.595e-234	-233.797
C2H4(g)	5.391e-238	-237.268
U2Cl10(g)	2.428e-238	-237.615
U2Cl8(g)	6.597e-239	-238.181
UCl(g)	4.672e-246	-245.331
U(g)	4.000e-289	-288.398

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg

Al+++	9.40e-005	9.40e-005	2.54
Ca++	8.51e-005	8.51e-005	3.41
Cl-	5.92e-005	5.92e-005	2.10
CrO4--	1.36e-005	1.36e-005	1.58
F-	0.000104	0.000104	1.98
Fe++	0.000113	0.000113	6.31
H+	-0.000987	-0.000987	-0.995
H2O	55.5	55.5	1.00e+006
HCO3-	0.00232	0.00232	141.
HPO4--	4.96e-005	4.96e-005	4.76
Mn++	2.60e-005	2.60e-005	1.43
NH3(aq)	0.000128	0.000128	2.18
Na+	0.00114	0.00114	26.2
Ni++	9.30e-006	9.30e-006	0.546
O2(aq)	0.000506	0.000506	16.2
Pb++	1.87e-006	1.87e-006	0.387
SO4--	2.84e-006	2.84e-006	0.273
UO2++	8.70e-005	8.70e-005	23.5

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Aluminum	9.400e-005	9.400e-005	2.536		
Calcium	8.510e-005	8.510e-005	3.410		
Carbon	0.002317	0.002317	27.82		
Chlorine	5.920e-005	5.920e-005	2.098		
Chromium	1.360e-005	1.360e-005	0.7070		
Fluorine	0.0001040	0.0001040	1.975		
Hydrogen	111.0	111.0	1.119e+005		
Iron	0.0001130	0.0001130	6.309		
Lead	1.870e-006	1.870e-006	0.3874		
Manganese	2.600e-005	2.600e-005	1.428		
Nickel	9.300e-006	9.300e-006	0.5457		
Nitrogen	0.0001280	0.0001280	1.792		
Oxygen	55.52	55.52	8.880e+005		
Phosphorus	4.960e-005	4.960e-005	1.536		
Sodium	0.001140	0.001140	26.20		
Sulfur	2.840e-006	2.840e-006	0.09105		
Uranium	8.700e-005	8.700e-005	20.70		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (1).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.770              log fO2 =   -0.704
Eh =   0.5224 volts      pe =   8.8308
Ionic strength      =    1.028486
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.086294 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       79439 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      350.10 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.038	2.197e+004	0.6606	-0.1638
NO3-	1.000	5.708e+004	0.6066	-0.2171
OH-	0.009370	146.7	0.6351	-2.2254
CO3--	0.002053	113.4	0.1631	-3.4751
NaCO3-	0.001137	86.84	0.6606	-3.1245
NaOH(aq)	0.0006473	23.83	1.0000	-3.1889
O2(aq)	0.0002500	7.364	1.0000	-3.6020
Cl-	2.637e-005	0.8607	0.6066	-4.7959
HCO3-	1.837e-005	1.032	0.6606	-4.9160
NaHCO3(aq)	1.187e-005	0.9177	1.0000	-4.9257
UO2(OH)3-	3.990e-006	1.179	0.6606	-5.5791
NaCl(aq)	1.834e-006	0.09864	1.0000	-5.7367
UO2(OH)4--	1.699e-007	0.05286	0.1423	-7.6167
UO2(CO3)3----	9.507e-008	0.03939	0.0003	-10.5354

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.3662s/sat	Schoepite	-2.9603
Na2U2O7(am)	1.8579s/sat	UO3:2H2O	-2.9603
Ice	-0.1387		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.342e-009	-8.872
NO2(g)	3.519e-020	-19.454
N2(g)	3.010e-020	-19.521
HCl(g)	1.345e-023	-22.871
NO(g)	5.303e-026	-25.275
Cl2(g)	1.168e-038	-37.933
H2(g)	6.301e-042	-41.201
CO(g)	2.642e-054	-53.578

Na(g)	4.390e-069	-68.358
NH3(g)	2.092e-069	-68.679
UO3(g)	8.415e-070	-69.075
UO2Cl2(g)	6.009e-080	-79.221
UO2(g)	1.179e-122	-121.929
UCl4(g)	1.158e-143	-142.936
CH4(g)	1.688e-151	-150.773
UCl5(g)	2.497e-155	-154.603
UCl6(g)	1.000e-161	-161.000
UCl3(g)	2.763e-169	-168.559
C(g)	1.393e-195	-194.856
UO(g)	6.555e-207	-206.183
UCl2(g)	3.570e-212	-211.447
C2H4(g)	1.416e-249	-248.849
UCl(g)	1.010e-252	-251.996
U2Cl8(g)	3.303e-276	-275.481
U2Cl10(g)	1.244e-283	-282.905
U(g)	8.551e-292	-291.068

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-940.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00322	0.00322	181.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.04	1.04	2.20e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	4.26e-006	4.26e-006	1.06			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.003220	0.003220	35.60		
Chlorine	2.821e-005	2.821e-005	0.9206		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.53	58.53	8.620e+005		
Sodium	1.040	1.040	2.201e+004		
Uranium	4.259e-006	4.259e-006	0.9332		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (2).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.769              log fO2 =   -0.704
Eh =   0.5225 volts      pe =   8.8319
Ionic strength      =    1.042024
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.086916 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       79966 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      229.54 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.069	2.260e+004	0.6605	-0.1513
NO3-	1.000	5.705e+004	0.6062	-0.2174
OH-	0.009350	146.3	0.6349	-2.2265
CO3--	0.001333	73.61	0.1625	-3.6642
NaCO3-	0.0007569	57.80	0.6605	-3.3011
NaOH(aq)	0.0006644	24.45	1.0000	-3.1775
O2(aq)	0.0002500	7.360	1.0000	-3.6020
Cl-	2.632e-005	0.8586	0.6062	-4.7970
HCO3-	1.192e-005	0.6690	0.6605	-5.1040
NaHCO3(aq)	7.922e-006	0.6123	1.0000	-5.1012
NaCl(aq)	1.882e-006	0.1012	1.0000	-5.7254
UO2(OH)3-	1.788e-006	0.5281	0.6605	-5.9278
UO2(OH)4--	7.623e-008	0.02371	0.1417	-7.9665
UO2(CO3)3----	1.188e-008	0.004919	0.0003	-11.4480

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.6937s/sat	Ice	-0.1387
Na2U2O7(am)	1.1854s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	8.731e-010	-9.059
NO2(g)	3.526e-020	-19.453
N2(g)	3.022e-020	-19.520
HCl(g)	1.346e-023	-22.871
NO(g)	5.313e-026	-25.275
Cl2(g)	1.168e-038	-37.933
H2(g)	6.301e-042	-41.201
CO(g)	1.718e-054	-53.765
Na(g)	4.506e-069	-68.346

NH3(g)	2.096e-069	-68.679
UO3(g)	3.779e-070	-69.423
UO2Cl2(g)	2.699e-080	-79.569
UO2(g)	5.294e-123	-122.276
UCl4(g)	5.201e-144	-143.284
CH4(g)	1.098e-151	-150.959
UCl5(g)	1.122e-155	-154.950
UCl6(g)	4.494e-162	-161.347
UCl3(g)	1.241e-169	-168.906
C(g)	9.062e-196	-195.043
UO(g)	2.944e-207	-206.531
UCl2(g)	1.603e-212	-211.795
C2H4(g)	5.991e-250	-249.223
UCl(g)	4.537e-253	-252.343
U2Cl8(g)	6.667e-277	-276.176
U2Cl10(g)	2.511e-284	-283.600
U(g)	3.841e-292	-291.416

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00211	0.00211	118.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.07	1.07	2.26e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.88e-006	1.88e-006	0.466			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.002110	0.002110	23.32		
Chlorine	2.821e-005	2.821e-005	0.9200		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.53	58.53	8.615e+005		
Sodium	1.070	1.070	2.263e+004		
Uranium	1.878e-006	1.878e-006	0.4112		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 week.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.770              log fO2 =   -0.704
Eh =   0.5224 volts      pe =   8.8306
Ionic strength      =    1.015959
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.085714 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       78947 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      133.66 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.019	2.158e+004	0.6607	-0.1718
NO3-	1.000	5.711e+004	0.6070	-0.2168
OH-	0.009371	146.8	0.6353	-2.2252
CO3--	0.0007885	43.58	0.1637	-3.8891
NaOH(aq)	0.0006357	23.42	1.0000	-3.1967
NaCO3-	0.0004299	32.87	0.6607	-3.5466
O2(aq)	0.0002500	7.368	1.0000	-3.6020
Cl-	2.640e-005	0.8622	0.6070	-4.7952
HCO3-	7.075e-006	0.3976	0.6607	-5.3302
NaHCO3(aq)	4.488e-006	0.3472	1.0000	-5.3480
NaCl(aq)	1.803e-006	0.09705	1.0000	-5.7440
UO2(OH)3-	1.492e-006	0.4413	0.6607	-6.0061
UO2(OH)4--	6.330e-008	0.01971	0.1429	-8.0435

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.4960s/sat	Ice	-0.1387
Na2U2O7(am)	0.9877s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	5.170e-010	-9.287
NO2(g)	3.520e-020	-19.454
N2(g)	3.011e-020	-19.521
HCl(g)	1.347e-023	-22.871
NO(g)	5.304e-026	-25.275
Cl2(g)	1.171e-038	-37.932
H2(g)	6.301e-042	-41.201
CO(g)	1.017e-054	-53.993
Na(g)	4.311e-069	-68.365
NH3(g)	2.092e-069	-68.679

UO3(g)	3.146e-070	-69.502
UO2Cl2(g)	2.253e-080	-79.647
UO2(g)	4.407e-123	-122.356
UCl4(g)	4.352e-144	-143.361
CH4(g)	6.500e-152	-151.187
UCl5(g)	9.398e-156	-155.027
UCl6(g)	3.770e-162	-161.424
UCl3(g)	1.037e-169	-168.984
C(g)	5.365e-196	-195.270
UO(g)	2.451e-207	-206.611
UCl2(g)	1.338e-212	-211.873
C2H4(g)	2.100e-250	-249.678
UCl(g)	3.782e-253	-252.422
U2Cl8(g)	4.668e-277	-276.331
U2Cl10(g)	1.763e-284	-283.754
U(g)	3.197e-292	-291.495

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.05e+005			
HCO3-	0.00123	0.00123	69.1			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.02	1.02	2.16e+004			
O2(aq)	2.00	2.00	5.90e+004			
UO2++	1.56e-006	1.56e-006	0.388			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001230	0.001230	13.61		
Chlorine	2.821e-005	2.821e-005	0.9211		
Hydrogen	111.0	111.0	1.031e+005		
Nitrogen	1.000	1.000	1.290e+004		
Oxygen	58.52	58.52	8.624e+005		
Sodium	1.020	1.020	2.160e+004		
Uranium	1.559e-006	1.559e-006	0.3418		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.767              log fO2 =   -0.704
Eh =   0.5225 volts      pe =   8.8335
Ionic strength      =    1.056566
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.087587 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       80533 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      193.76 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.099	2.322e+004	0.6604	-0.1393
NO3-	1.000	5.701e+004	0.6058	-0.2177
OH-	0.009320	145.7	0.6346	-2.2281
CO3--	0.001115	61.52	0.1619	-3.7435
NaOH(aq)	0.0006806	25.03	1.0000	-3.1671
NaCO3-	0.0006482	49.47	0.6604	-3.3685
O2(aq)	0.0002500	7.356	1.0000	-3.6020
Cl-	2.628e-005	0.8566	0.6058	-4.7981
HCO3-	9.964e-006	0.5590	0.6604	-5.1817
NaHCO3(aq)	6.808e-006	0.5259	1.0000	-5.1670
UO2(OH)3-	5.197e-006	1.534	0.6604	-5.4645
NaCl(aq)	1.930e-006	0.1037	1.0000	-5.7145
UO2(OH)4--	2.218e-007	0.06894	0.1410	-7.5048
UO2(CO3)3----	2.064e-008	0.008541	0.0003	-11.2181

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.6443s/sat	Schoepite	-2.8430
Na2U2O7(am)	2.1360s/sat	UO3:2H2O	-2.8430
Ice	-0.1387	UO2(OH)2(beta)	-2.9554

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	7.326e-010	-9.135
NO2(g)	3.536e-020	-19.451
N2(g)	3.039e-020	-19.517
HCl(g)	1.347e-023	-22.871
NO(g)	5.329e-026	-25.273
Cl2(g)	1.170e-038	-37.932
H2(g)	6.301e-042	-41.201
CO(g)	1.442e-054	-53.841

Na(g)	4.615e-069	-68.336
NH3(g)	2.102e-069	-68.677
UO3(g)	1.102e-069	-68.958
UO2Cl2(g)	7.890e-080	-79.103
UO2(g)	1.544e-122	-121.811
UCl4(g)	1.524e-143	-142.817
CH4(g)	9.212e-152	-151.036
UCl5(g)	3.290e-155	-154.483
UCl6(g)	1.319e-161	-160.880
UCl3(g)	3.632e-169	-168.440
C(g)	7.603e-196	-195.119
UO(g)	8.588e-207	-206.066
UCl2(g)	4.687e-212	-211.329
C2H4(g)	4.217e-250	-249.375
UCl(g)	1.325e-252	-251.878
U2Cl8(g)	5.721e-276	-275.243
U2Cl10(g)	2.160e-283	-282.666
U(g)	1.120e-291	-290.951

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.919			
H+	-1.01	-1.01	-938.			
H2O	54.5	54.5	9.03e+005			
HCO3-	0.00178	0.00178	99.9			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.10	1.10	2.33e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	5.44e-006	5.44e-006	1.35			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001780	0.001780	19.66		
Chlorine	2.821e-005	2.821e-005	0.9195		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.288e+004		
Oxygen	58.52	58.52	8.609e+005		
Sodium	1.100	1.100	2.325e+004		
Uranium	5.444e-006	5.444e-006	1.191		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (1), duplicate.

```
          Step #     0              Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 11.770               log fO2 =   -0.704
          Eh =   0.5224 volts       pe =   8.8302
          Ionic strength      =    1.023300
          Activity of water   =    0.999999
          Solvent mass        =    1.000000 kg
          Solution mass       =    1.086054 kg
          Solution density    =    1.013    g/cm3
          Chlorinity          =    0.000028 molal
          Dissolved solids    =       79235 mg/kg sol'n
          Rock mass           =    0.000000 kg
          Carbonate alkalinity=      332.63 mg/kg as CaCO3

 No minerals in system.

 Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
---------------------------------------------------------------------------
  Na+                     1.028    2.177e+004      0.6606       -0.1679
  NO3-                    1.000    5.709e+004      0.6068       -0.2170
  OH-                  0.009380         146.9      0.6352       -2.2249
  CO3--                0.001957         108.1      0.1634       -3.4953
  NaCO3-               0.001074         82.11      0.6606       -3.1488
  NaOH(aq)            0.0006419         23.64      1.0000       -3.1925
  O2(aq)              0.0002500         7.366      1.0000       -3.6020
  Cl-                2.639e-005        0.8614      0.6068       -4.7956
  HCO3-              1.751e-005        0.9838      0.6606       -4.9367
  NaHCO3(aq)         1.121e-005        0.8668      1.0000       -4.9506
  UO2(OH)3-          2.092e-006        0.6184      0.6606       -5.8595
  NaCl(aq)           1.818e-006       0.09781      1.0000       -5.7405
  UO2(OH)4--         8.901e-008       0.02771      0.1426       -7.8966
  UO2(CO3)3----      4.283e-008       0.01775      0.0003      -10.8781
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                           log Q/K
----------------------------------------------------------------
  Na2U2O7(c)        3.7971s/sat   Ice               -0.1387
  Na2U2O7(am)       1.2888s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                 fugacity      log fug.
-----------------------------------------------
  O2(g)                  0.1978       -0.704
  H2O(g)                0.02598       -1.585
  CO2(g)             1.278e-009       -8.893
  NO2(g)             3.516e-020      -19.454
  N2(g)              3.005e-020      -19.522
  HCl(g)             1.345e-023      -22.871
  NO(g)              5.298e-026      -25.276
  Cl2(g)             1.167e-038      -37.933
  H2(g)              6.301e-042      -41.201
  CO(g)              2.516e-054      -53.599
  Na(g)              4.353e-069      -68.361
```

NH3(g)	2.090e-069	-68.680
UO3(g)	4.407e-070	-69.356
UO2Cl2(g)	3.144e-080	-79.502
UO2(g)	6.172e-123	-122.210
UCl4(g)	6.055e-144	-143.218
CH4(g)	1.607e-151	-150.794
UCl5(g)	1.305e-155	-154.884
UCl6(g)	5.227e-162	-161.282
UCl3(g)	1.445e-169	-168.840
C(g)	1.327e-195	-194.877
UO(g)	3.433e-207	-206.464
UCl2(g)	1.868e-212	-211.729
C2H4(g)	1.284e-249	-248.891
UCl(g)	5.288e-253	-252.277
U2Cl8(g)	9.034e-277	-276.044
U2Cl10(g)	3.400e-284	-283.469
U(g)	4.478e-292	-291.349

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-940.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00306	0.00306	172.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.03	1.03	2.18e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	2.23e-006	2.23e-006	0.553			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.003060	0.003060	33.84		
Chlorine	2.821e-005	2.821e-005	0.9208		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.290e+004		
Oxygen	58.53	58.53	8.622e+005		
Sodium	1.030	1.030	2.180e+004		
Uranium	2.226e-006	2.226e-006	0.4878		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (2), duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.769               log fO2 =   -0.704
Eh =   0.5224 volts       pe =   8.8316
Ionic strength      =    1.036974
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.086683 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       79769 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      224.06 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.059	2.240e+004	0.6605	-0.1554
NO3-	1.000	5.706e+004	0.6063	-0.2173
OH-	0.009355	146.4	0.6349	-2.2262
CO3--	0.001305	72.09	0.1627	-3.6727
NaCO3-	0.0007352	56.15	0.6605	-3.3137
NaOH(aq)	0.0006588	24.25	1.0000	-3.1813
O2(aq)	0.0002500	7.362	1.0000	-3.6020
Cl-	2.634e-005	0.8593	0.6063	-4.7967
HCO3-	1.168e-005	0.6556	0.6605	-5.1128
NaHCO3(aq)	7.690e-006	0.5944	1.0000	-5.1141
NaCl(aq)	1.866e-006	0.1004	1.0000	-5.7290
UO2(OH)3-	1.700e-006	0.5024	0.6605	-5.9495
UO2(OH)4--	7.245e-008	0.02254	0.1419	-7.9879
UO2(CO3)3----	1.054e-008	0.004366	0.0003	-11.4964

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.6421s/sat	Ice	-0.1387
Na2U2O7(am)	1.1338s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	8.548e-010	-9.068
NO2(g)	3.524e-020	-19.453
N2(g)	3.019e-020	-19.520
HCl(g)	1.346e-023	-22.871
NO(g)	5.311e-026	-25.275
Cl2(g)	1.168e-038	-37.933
H2(g)	6.301e-042	-41.201
CO(g)	1.682e-054	-53.774
Na(g)	4.467e-069	-68.350

NH3(g)	2.095e-069	-68.679
UO3(g)	3.592e-070	-69.445
UO2Cl2(g)	2.566e-080	-79.591
UO2(g)	5.031e-123	-122.298
UCl4(g)	4.946e-144	-143.306
CH4(g)	1.075e-151	-150.969
UCl5(g)	1.067e-155	-154.972
UCl6(g)	4.275e-162	-161.369
UCl3(g)	1.180e-169	-168.928
C(g)	8.872e-196	-195.052
UO(g)	2.798e-207	-206.553
UCl2(g)	1.524e-212	-211.817
C2H4(g)	5.742e-250	-249.241
UCl(g)	4.313e-253	-252.365
U2Cl8(g)	6.029e-277	-276.220
U2Cl10(g)	2.271e-284	-283.644
U(g)	3.650e-292	-291.438

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00206	0.00206	116.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.06	1.06	2.24e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.79e-006	1.79e-006	0.444			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.002060	0.002060	22.77		
Chlorine	2.821e-005	2.821e-005	0.9202		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.53	58.53	8.617e+005		
Sodium	1.060	1.060	2.243e+004		
Uranium	1.785e-006	1.785e-006	0.3910		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 week, duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.770               log fO2 =   -0.704
Eh =   0.5224 volts       pe =   8.8307
Ionic strength      =     1.015617
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.085698 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        78933 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       104.75 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.019	2.158e+004	0.6607	-0.1718
NO3-	1.000	5.711e+004	0.6070	-0.2168
OH-	0.009369	146.8	0.6353	-2.2253
NaOH(aq)	0.0006356	23.42	1.0000	-3.1968
CO3--	0.0006179	34.16	0.1637	-3.9950
NaCO3-	0.0003370	25.76	0.6607	-3.6524
O2(aq)	0.0002500	7.369	1.0000	-3.6020
Cl-	2.640e-005	0.8622	0.6070	-4.7952
HCO3-	5.547e-006	0.3117	0.6607	-5.4360
NaHCO3(aq)	3.518e-006	0.2722	1.0000	-5.4537
NaCl(aq)	1.803e-006	0.09706	1.0000	-5.7440
UO2(OH)3-	1.451e-006	0.4290	0.6607	-6.0184
UO2(OH)4--	6.152e-008	0.01916	0.1429	-8.0559

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.4716s/sat	Ice	-0.1387
Na2U2O7(am)	0.9633s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	4.054e-010	-9.392
NO2(g)	3.520e-020	-19.453
N2(g)	3.013e-020	-19.521
HCl(g)	1.348e-023	-22.870
NO(g)	5.305e-026	-25.275
Cl2(g)	1.171e-038	-37.931
H2(g)	6.301e-042	-41.201
CO(g)	7.977e-055	-54.098
Na(g)	4.310e-069	-68.365
NH3(g)	2.093e-069	-68.679

UO3(g)	3.060e-070	-69.514
UO2Cl2(g)	2.192e-080	-79.659
UO2(g)	4.285e-123	-122.368
UCl4(g)	4.236e-144	-143.373
CH4(g)	5.097e-152	-151.293
UCl5(g)	9.149e-156	-155.039
UCl6(g)	3.671e-162	-161.435
UCl3(g)	1.009e-169	-168.996
C(g)	4.207e-196	-195.376
UO(g)	2.383e-207	-206.623
UCl2(g)	1.302e-212	-211.885
C2H4(g)	1.291e-250	-249.889
UCl(g)	3.678e-253	-252.434
U2Cl8(g)	4.422e-277	-276.354
U2Cl10(g)	1.671e-284	-283.777
U(g)	3.109e-292	-291.507

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.05e+005			
HCO3-	0.000964	0.000964	54.2			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.02	1.02	2.16e+004			
O2(aq)	2.00	2.00	5.90e+004			
UO2++	1.51e-006	1.51e-006	0.377			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.0009640	0.0009640	10.66		
Chlorine	2.821e-005	2.821e-005	0.9211		
Hydrogen	111.0	111.0	1.031e+005		
Nitrogen	1.000	1.000	1.290e+004		
Oxygen	58.52	58.52	8.624e+005		
Sodium	1.020	1.020	2.160e+004		
Uranium	1.515e-006	1.515e-006	0.3321		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 month, duplicate.

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.769              log fO2 =   -0.704
Eh =   0.5225 volts      pe =   8.8320
Ionic strength      =    1.036553
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.086664 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       79752 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      188.16 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.059	2.240e+004	0.6605	-0.1553
NO3-	1.000	5.706e+004	0.6063	-0.2173
OH-	0.009347	146.3	0.6350	-2.2266
CO3--	0.001096	60.54	0.1628	-3.7485
NaOH(aq)	0.0006582	24.23	1.0000	-3.1816
NaCO3-	0.0006175	47.16	0.6605	-3.3895
O2(aq)	0.0002500	7.362	1.0000	-3.6020
Cl-	2.634e-005	0.8594	0.6063	-4.7967
HCO3-	9.814e-006	0.5511	0.6605	-5.1883
NaHCO3(aq)	6.464e-006	0.4997	1.0000	-5.1895
UO2(OH)3-	3.508e-006	1.037	0.6605	-5.6350
NaCl(aq)	1.866e-006	0.1004	1.0000	-5.7290
UO2(OH)4--	1.493e-007	0.04645	0.1419	-7.6738
UO2(CO3)3----	1.291e-008	0.005346	0.0003	-11.4082

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.2712s/sat	Ice	-0.1387
Na2U2O7(am)	1.7629s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	7.192e-010	-9.143
NO2(g)	3.527e-020	-19.453
N2(g)	3.024e-020	-19.519
HCl(g)	1.347e-023	-22.871
NO(g)	5.315e-026	-25.274
Cl2(g)	1.170e-038	-37.932
H2(g)	6.301e-042	-41.201
CO(g)	1.415e-054	-53.849
Na(g)	4.464e-069	-68.350

NH3(g)	2.097e-069	-68.678
UO3(g)	7.418e-070	-69.130
UO2Cl2(g)	5.308e-080	-79.275
UO2(g)	1.039e-122	-121.983
UCl4(g)	1.025e-143	-142.989
CH4(g)	9.043e-152	-151.044
UCl5(g)	2.213e-155	-154.655
UCl6(g)	8.875e-162	-161.052
UCl3(g)	2.443e-169	-168.612
C(g)	7.464e-196	-195.127
UO(g)	5.779e-207	-206.238
UCl2(g)	3.153e-212	-211.501
C2H4(g)	4.064e-250	-249.391
UCl(g)	8.914e-253	-252.050
U2Cl8(g)	2.589e-276	-275.587
U2Cl10(g)	9.772e-284	-283.010
U(g)	7.538e-292	-291.123

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-938.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00173	0.00173	97.1			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.06	1.06	2.24e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	3.67e-006	3.67e-006	0.913			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001730	0.001730	19.12		
Chlorine	2.821e-005	2.821e-005	0.9202		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.52	58.52	8.617e+005		
Sodium	1.060	1.060	2.243e+004		
Uranium	3.674e-006	3.674e-006	0.8047		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661 yellow, 24 hour (1).

```
Step #      0              Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH = 11.770                log fO2 =   -0.704
Eh =   0.5223 volts        pe =   8.8301
Ionic strength       =     1.018174
Activity of water    =     0.999999
Solvent mass         =     1.000000 kg
Solution mass        =     1.085818 kg
Solution density     =     1.013    g/cm3
Chlorinity           =     0.000028 molal
Dissolved solids     =        79035 mg/kg sol'n
Rock mass            =     0.000000 kg
Carbonate alkalinity=        320.60 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.018	2.156e+004	0.6607	-0.1721
NO3-	1.000	5.710e+004	0.6069	-0.2169
OH-	0.009382	146.9	0.6353	-2.2247
CO3--	0.001892	104.6	0.1636	-3.5093
NaCO3-	0.001030	78.75	0.6607	-3.1670
NaOH(aq)	0.0006360	23.43	1.0000	-3.1966
O2(aq)	0.0002500	7.368	1.0000	-3.6020
Cl-	2.640e-005	0.8621	0.6069	-4.7952
HCO3-	1.695e-005	0.9524	0.6607	-4.9509
NaHCO3(aq)	1.074e-005	0.8311	1.0000	-4.9689
UO2(OH)3-	3.167e-006	0.9364	0.6607	-5.6794
NaCl(aq)	1.802e-006	0.09698	1.0000	-5.7443
UO2(OH)4--	1.346e-007	0.04189	0.1428	-7.7163
UO2(CO3)3----	5.831e-008	0.02417	0.0003	-10.7404

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.1489s/sat	Ice	-0.1387
Na2U2O7(am)	1.6406s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.237e-009	-8.908
NO2(g)	3.515e-020	-19.454
N2(g)	3.004e-020	-19.522
HCl(g)	1.346e-023	-22.871
NO(g)	5.298e-026	-25.276
Cl2(g)	1.168e-038	-37.933
H2(g)	6.301e-042	-41.201
CO(g)	2.434e-054	-53.614
Na(g)	4.313e-069	-68.365

NH3(g)	2.090e-069	-68.680
UO3(g)	6.669e-070	-69.176
UO2Cl2(g)	4.764e-080	-79.322
UO2(g)	9.341e-123	-122.030
UCl4(g)	9.183e-144	-143.037
CH4(g)	1.555e-151	-150.808
UCl5(g)	1.981e-155	-154.703
UCl6(g)	7.938e-162	-161.100
UCl3(g)	2.191e-169	-168.659
C(g)	1.284e-195	-194.892
UO(g)	5.195e-207	-206.284
UCl2(g)	2.830e-212	-211.548
C2H4(g)	1.202e-249	-248.920
UCl(g)	8.007e-253	-252.097
U2Cl8(g)	2.078e-276	-275.682
U2Cl10(g)	7.831e-284	-283.106
U(g)	6.777e-292	-291.169

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-940.			
H2O	54.5	54.5	9.05e+005			
HCO3-	0.00295	0.00295	166.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.02	1.02	2.16e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	3.36e-006	3.36e-006	0.836			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.002950	0.002950	32.63		
Chlorine	2.821e-005	2.821e-005	0.9210		
Hydrogen	111.0	111.0	1.031e+005		
Nitrogen	1.000	1.000	1.290e+004		
Oxygen	58.53	58.53	8.624e+005		
Sodium	1.020	1.020	2.160e+004		
Uranium	3.363e-006	3.363e-006	0.7371		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661 yellow, 24 hour (2).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.768              log fO2 =   -0.704
Eh =   0.5225 volts      pe =   8.8324
Ionic strength      =    1.046454
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.087120 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       80138 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      181.71 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.079	2.281e+004	0.6605	-0.1472
NO3-	1.000	5.704e+004	0.6061	-0.2175
OH-	0.009340	146.1	0.6348	-2.2270
CO3--	0.001052	58.07	0.1623	-3.7676
NaOH(aq)	0.0006699	24.65	1.0000	-3.1740
NaCO3-	0.0006022	45.98	0.6605	-3.4004
O2(aq)	0.0002500	7.359	1.0000	-3.6020
Cl-	2.631e-005	0.8580	0.6061	-4.7974
HCO3-	9.404e-006	0.5278	0.6605	-5.2068
NaHCO3(aq)	6.310e-006	0.4876	1.0000	-5.2000
NaCl(aq)	1.898e-006	0.1021	1.0000	-5.7216
UO2(OH)3-	1.790e-006	0.5286	0.6605	-5.9273
UO2(OH)4--	7.635e-008	0.02374	0.1415	-7.9665

(only species > 1e-8 molal listed)

Mineral saturation states	log Q/K		log Q/K
Na2U2O7(c)	3.7029s/sat	Ice	-0.1387
Na2U2O7(am)	1.1946s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	6.897e-010	-9.161
NO2(g)	3.529e-020	-19.452
N2(g)	3.027e-020	-19.519
HCl(g)	1.346e-023	-22.871
NO(g)	5.318e-026	-25.274
Cl2(g)	1.169e-038	-37.932
H2(g)	6.301e-042	-41.201
CO(g)	1.357e-054	-53.867
Na(g)	4.543e-069	-68.343
NH3(g)	2.098e-069	-68.678

UO3(g)	3.788e-070	-69.422
UO2Cl2(g)	2.707e-080	-79.568
UO2(g)	5.306e-123	-122.275
UCl4(g)	5.220e-144	-143.282
CH4(g)	8.673e-152	-151.062
UCl5(g)	1.126e-155	-154.948
UCl6(g)	4.513e-162	-161.345
UCl3(g)	1.245e-169	-168.905
C(g)	7.159e-196	-195.145
UO(g)	2.951e-207	-206.530
UCl2(g)	1.608e-212	-211.794
C2H4(g)	3.739e-250	-249.427
UCl(g)	4.549e-253	-252.342
U2Cl8(g)	6.715e-277	-276.173
U2Cl10(g)	2.531e-284	-283.597
U(g)	3.849e-292	-291.415

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-938.			
H2O	54.5	54.5	9.03e+005			
HCO3-	0.00167	0.00167	93.7			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.08	1.08	2.28e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.87e-006	1.87e-006	0.465			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.001670	0.001670	18.45		
Chlorine	2.821e-005	2.821e-005	0.9199		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.288e+004		
Oxygen	58.52	58.52	8.613e+005		
Sodium	1.080	1.080	2.284e+004		
Uranium	1.874e-006	1.874e-006	0.4103		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661 yellow, 1 week.

```
          Step #     0               Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 11.770               log fO2 =   -0.704
          Eh =   0.5224 volts       pe =   8.8304
          Ionic strength      =    1.010572
          Activity of water   =    0.999999
          Solvent mass        =    1.000000 kg
          Solution mass       =    1.085465 kg
          Solution density    =    1.013    g/cm3
          Chlorinity          =    0.000028 molal
          Dissolved solids    =       78736 mg/kg sol'n
          Rock mass           =    0.000000 kg
          Carbonate alkalinity=      100.17 mg/kg as CaCO3

  No minerals in system.

  Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
 ---------------------------------------------------------------------------
   Na+                     1.009    2.137e+004      0.6608       -0.1760
   NO3-                    1.000    5.712e+004      0.6072       -0.2167
   OH-                  0.009374         146.9      0.6354       -2.2250
   NaOH(aq)            0.0006299         23.21      1.0000       -3.2007
   CO3--               0.0005928         32.77      0.1640       -4.0124
   NaCO3-              0.0003206         24.51      0.6608       -3.6740
   O2(aq)              0.0002500         7.370      1.0000       -3.6020
   Cl-                2.642e-005        0.8629      0.6072       -4.7948
   HCO3-              5.324e-006        0.2993      0.6608       -5.4537
   NaHCO3(aq)         3.345e-006        0.2588      1.0000       -5.4757
   NaCl(aq)           1.787e-006       0.09623      1.0000       -5.7478
   UO2(OH)3-          1.472e-006        0.4355      0.6608       -6.0119
   UO2(OH)4--         6.237e-008       0.01943      0.1432       -8.0491
    (only species > 1e-8 molal listed)

  Mineral saturation states
                     log Q/K                            log Q/K
 ----------------------------------------------------------------
   Na2U2O7(c)         3.4759s/sat   Ice                 -0.1387
   Na2U2O7(am)        0.9676s/sat
    (only minerals with log Q/K > -3 listed)

  Gases                fugacity      log fug.
 -----------------------------------------------
   O2(g)                  0.1978       -0.704
   H2O(g)                0.02598       -1.585
   CO2(g)             3.888e-010       -9.410
   NO2(g)             3.519e-020      -19.454
   N2(g)              3.010e-020      -19.521
   HCl(g)             1.348e-023      -22.870
   NO(g)              5.303e-026      -25.275
   Cl2(g)             1.172e-038      -37.931
   H2(g)              6.301e-042      -41.201
   CO(g)              7.652e-055      -54.116
   Na(g)              4.271e-069      -68.369
   NH3(g)             2.092e-069      -68.679
```

UO3(g)	3.103e-070	-69.508
UO2Cl2(g)	2.223e-080	-79.653
UO2(g)	4.346e-123	-122.362
UCl4(g)	4.299e-144	-143.367
CH4(g)	4.889e-152	-151.311
UCl5(g)	9.286e-156	-155.032
UCl6(g)	3.727e-162	-161.429
UCl3(g)	1.024e-169	-168.990
C(g)	4.036e-196	-195.394
UO(g)	2.417e-207	-206.617
UCl2(g)	1.321e-212	-211.879
C2H4(g)	1.188e-250	-249.925
UCl(g)	3.731e-253	-252.428
U2Cl8(g)	4.553e-277	-276.342
U2Cl10(g)	1.721e-284	-283.764
U(g)	3.153e-292	-291.501

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.921			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.05e+005			
HCO3-	0.000922	0.000922	51.8			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.01	1.01	2.14e+004			
O2(aq)	2.00	2.00	5.90e+004			
UO2++	1.54e-006	1.54e-006	0.382			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.0009220	0.0009220	10.20		
Chlorine	2.821e-005	2.821e-005	0.9213		
Hydrogen	111.0	111.0	1.031e+005		
Nitrogen	1.000	1.000	1.290e+004		
Oxygen	58.52	58.52	8.626e+005		
Sodium	1.010	1.010	2.139e+004		
Uranium	1.537e-006	1.537e-006	0.3370		

Experiment #1 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661 yellow, 1 month.

```
          Step #     0             Xi = 0.0000
          Temperature =  25.0 C    Pressure =  1.013 bars
          pH = 11.762              log fO2 =   -0.704
          Eh =   0.5228 volts      pe =   8.8384
          Ionic strength      =    1.141981
          Activity of water   =    0.999999
          Solvent mass        =    1.000000 kg
          Solution mass       =    1.091526 kg
          Solution density    =    1.013    g/cm3
          Chlorinity          =    0.000028 molal
          Dissolved solids    =       83851 mg/kg sol'n
          Rock mass           =    0.000000 kg
          Carbonate alkalinity=      250.18 mg/kg as CaCO3

  No minerals in system.

  Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
 ---------------------------------------------------------------------------
   Na+                     1.268    2.671e+004      0.6601       -0.0771
   NO3-                    1.000    5.681e+004      0.6036       -0.2192
   OH-                  0.009230         143.8      0.6335       -2.2331
   CO3--                0.001369         75.26      0.1585       -3.6637
   NaCO3-              0.0008993         68.38      0.6601       -3.2265
   NaOH(aq)            0.0007764         28.45      1.0000       -3.1099
   O2(aq)              0.0002500         7.329      1.0000       -3.6020
   Cl-                2.601e-005        0.8448      0.6036       -4.8041
   HCO3-              1.212e-005        0.6774      0.6601       -5.0970
   NaHCO3(aq)         9.550e-006        0.7350      1.0000       -5.0200
   UO2(OH)3-          4.681e-006         1.377      0.6601       -5.5101
   NaCl(aq)           2.197e-006        0.1176      1.0000       -5.6582
   UO2(OH)4--         2.026e-007       0.06274      0.1374       -7.5553
   UO2(CO3)3----      3.792e-008       0.01564      0.0003      -11.0094
    (only species > 1e-8 molal listed)

  Mineral saturation states
                     log Q/K                          log Q/K
 ----------------------------------------------------------------
   Na2U2O7(c)        4.6775s/sat   Schoepite         -2.8836
   Na2U2O7(am)       2.1692s/sat   UO3:2H2O          -2.8836
   Ice              -0.1387        UO2(OH)2(beta)    -2.9960
    (only minerals with log Q/K > -3 listed)

  Gases                 fugacity      log fug.
 -----------------------------------------------
   O2(g)                  0.1978      -0.704
   H2O(g)                0.02598      -1.585
   CO2(g)             9.007e-010      -9.045
   NO2(g)             3.564e-020     -19.448
   N2(g)              3.088e-020     -19.510
   HCl(g)             1.344e-023     -22.872
   NO(g)              5.371e-026     -25.270
   Cl2(g)             1.165e-038     -37.934
   H2(g)              6.301e-042     -41.201
   CO(g)              1.773e-054     -53.751
```

Na(g)	5.265e-069	-68.279
NH3(g)	2.119e-069	-68.674
UO3(g)	1.004e-069	-68.998
UO2Cl2(g)	7.151e-080	-79.146
UO2(g)	1.406e-122	-121.852
UCl4(g)	1.375e-143	-142.862
CH4(g)	1.133e-151	-150.946
UCl5(g)	2.961e-155	-154.529
UCl6(g)	1.185e-161	-160.926
UCl3(g)	3.285e-169	-168.484
C(g)	9.348e-196	-195.029
UO(g)	7.820e-207	-206.107
UCl2(g)	4.249e-212	-211.372
C2H4(g)	6.375e-250	-249.195
UCl(g)	1.204e-252	-251.920
U2Cl8(g)	4.658e-276	-275.332
U2Cl10(g)	1.750e-283	-282.757
U(g)	1.020e-291	-290.991

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.916			
H+	-1.01	-1.01	-935.			
H2O	54.5	54.5	9.00e+005			
HCO3-	0.00229	0.00229	128.			
NH3(aq)	1.00	1.00	1.56e+004			
Na+	1.27	1.27	2.67e+004			
O2(aq)	2.00	2.00	5.86e+004			
UO2++	4.93e-006	4.93e-006	1.22			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.002290	0.002290	25.20		
Chlorine	2.821e-005	2.821e-005	0.9161		
Hydrogen	111.0	111.0	1.025e+005		
Nitrogen	1.000	1.000	1.283e+004		
Oxygen	58.53	58.53	8.579e+005		
Sodium	1.270	1.270	2.675e+004		
Uranium	4.925e-006	4.925e-006	1.074		

Experiment #2 (1.0 M NaOH) sample 19661, 24 hour (1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.771               log fO2 =   -0.704
Eh =   0.4040 volts       pe =   6.8296
Ionic strength       =    0.963136
Activity of water    =    0.999999
Solvent mass         =    1.000000 kg
Solution mass        =    1.041200 kg
Solution density     =    1.013    g/cm3
Chlorinity           =    0.000028 molal
Dissolved solids     =       39570 mg/kg sol'n
Rock mass            =    0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.9881	2.182e+004	0.6613	-0.1848
OH-	0.9376	1.532e+004	0.6365	-0.2242
NaOH(aq)	0.06185	2376.	1.0000	-1.2087
O2(aq)	0.0002500	7.683	1.0000	-3.6020
UO2(OH)4--	0.0001171	38.03	0.1456	-4.7682
UO2(OH)3-	2.804e-005	8.646	0.6613	-4.7318
Cl-	2.645e-005	0.9006	0.6088	-4.7931
NaCl(aq)	1.758e-006	0.09869	1.0000	-5.7549

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	6.0187s/sat	Ice	-0.1387
Na2U2O7(am)	3.5104s/sat	Na2UO4(alpha)	-2.1318

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.350e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.176e-042	-41.930
Na(g)	4.194e-067	-66.377
UO3(g)	5.903e-071	-70.229
UO2Cl2(g)	4.246e-085	-84.372
UO2(g)	8.268e-124	-123.083
UCl4(g)	8.242e-153	-152.084
UCl5(g)	1.784e-166	-165.749
UCl6(g)	7.173e-175	-174.144
UCl3(g)	1.960e-176	-175.708
UO(g)	4.598e-208	-207.337
UCl2(g)	2.522e-217	-216.598
UCl(g)	7.112e-256	-255.148
U(g)	5.998e-293	-292.222
U2Cl8(g)	1.674e-294	-293.776

U2Cl10(g) 6.351e-306 -300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-968.			
H2O	56.5	56.5	9.78e+005			
Na+	1.05	1.05	2.32e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	0.000145	0.000145	37.6			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9604		
Hydrogen	112.0	112.0	1.084e+005		
Oxygen	56.51	56.51	8.683e+005		
Sodium	1.050	1.050	2.318e+004		
Uranium	0.0001452	0.0001452	33.19		

Experiment #2 (1.0 M NaOH) sample 19661, 24 hour (2).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.769               log fO2 =   -0.704
Eh =   0.4041 volts       pe =   6.8310
Ionic strength      =    0.985438
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.042332 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       40612 mg/kg sol'n
Rock mass           =    0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.035	2.284e+004	0.6610	-0.1647
OH-	0.9351	1.526e+004	0.6360	-0.2257
NaOH(aq)	0.06456	2477.	1.0000	-1.1900
O2(aq)	0.0002500	7.675	1.0000	-3.6020
UO2(OH)4--	6.280e-005	20.37	0.1444	-5.0424
Cl-	2.637e-005	0.8970	0.6080	-4.7949
UO2(OH)3-	1.497e-005	4.611	0.6610	-5.0045
NaCl(aq)	1.834e-006	0.1028	1.0000	-5.7366

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.5135s/sat	Ice	-0.1387
Na2U2O7(am)	3.0052s/sat	Na2UO4(alpha)	-2.3657

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.174e-042	-41.930
Na(g)	4.378e-067	-66.359
UO3(g)	3.161e-071	-70.500
UO2Cl2(g)	2.271e-085	-84.644
UO2(g)	4.428e-124	-123.354
UCl4(g)	4.401e-153	-152.356
UCl5(g)	9.518e-167	-166.021
UCl6(g)	3.824e-175	-174.417
UCl3(g)	1.047e-176	-175.980
UO(g)	2.463e-208	-207.609
UCl2(g)	1.349e-217	-216.870
UCl(g)	3.806e-256	-255.420
U(g)	3.212e-293	-292.493
U2Cl8(g)	4.772e-295	-294.321

U2Cl10(g) 1.808e-306 -300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.77e+005			
Na+	1.10	1.10	2.43e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	7.78e-005	7.78e-005	20.1			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9594		
Hydrogen	112.0	112.0	1.083e+005		
Oxygen	56.51	56.51	8.674e+005		
Sodium	1.100	1.100	2.426e+004		
Uranium	7.777e-005	7.777e-005	17.76		

Experiment #2 (1.0 M NaOH) sample 19661, 1 week.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 13.769              log fO2 =   -0.704
Eh =   0.4041 volts      pe =   6.8316
Ionic strength      =    0.994362
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.042783 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       41027 mg/kg sol'n
Rock mass           =    0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.054	2.324e+004	0.6609	-0.1569
OH-	0.9342	1.524e+004	0.6358	-0.2263
NaOH(aq)	0.06564	2518.	1.0000	-1.1828
O2(aq)	0.0002500	7.672	1.0000	-3.6020
UO2(OH)4--	3.649e-005	11.83	0.1440	-5.2795
Cl-	2.634e-005	0.8956	0.6077	-4.7957
UO2(OH)3-	8.686e-006	2.674	0.6609	-5.2410
NaCl(aq)	1.864e-006	0.1045	1.0000	-5.7295

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.0561s/sat	Ice	-0.1387
Na2U2O7(am)	2.5478s/sat	Na2UO4(alpha)	-2.5872

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.174e-042	-41.930
Na(g)	4.451e-067	-66.352
UO3(g)	1.836e-071	-70.736
UO2Cl2(g)	1.318e-085	-84.880
UO2(g)	2.572e-124	-123.590
UCl4(g)	2.553e-153	-152.593
UCl5(g)	5.520e-167	-166.258
UCl6(g)	2.217e-175	-174.654
UCl3(g)	6.077e-177	-176.216
UO(g)	1.430e-208	-207.845
UCl2(g)	7.830e-218	-217.106
UCl(g)	2.210e-256	-255.656
U(g)	1.866e-293	-292.729
U2Cl8(g)	1.606e-295	-294.794

U2Cl10(g)   6.081e-307   -300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.76e+005			
Na+	1.12	1.12	2.47e+004			
O2(aq)	0.000250	0.000250	7.67			
UO2++	4.52e-005	4.52e-005	11.7			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9590		
Hydrogen	112.0	112.0	1.083e+005		
Oxygen	56.51	56.51	8.670e+005		
Sodium	1.120	1.120	2.469e+004		
Uranium	4.518e-005	4.518e-005	10.31		

Experiment #2 (1.0 M NaOH) sample 19661, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.771               log fO2 =   -0.704
Eh =   0.4040 volts       pe =   6.8297
Ionic strength      =     0.967592
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.041398 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        39752 mg/kg sol'n
Rock mass           =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.9976	2.202e+004	0.6612	-0.1807
OH-	0.9375	1.531e+004	0.6364	-0.2243
NaOH(aq)	0.06242	2397.	1.0000	-1.2047
O2(aq)	0.0002500	7.682	1.0000	-3.6020
Cl-	2.643e-005	0.8999	0.6086	-4.7935
UO2(OH)4--	2.053e-005	6.665	0.1453	-5.5251
UO2(OH)3-	4.909e-006	1.513	0.6612	-5.4886
NaCl(aq)	1.773e-006	0.09952	1.0000	-5.7512

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.5132s/sat	Ice	-0.1387
Na2U2O7(am)	2.0049s/sat	Na2UO4(alpha)	-2.8805

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.350e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.175e-042	-41.930
Na(g)	4.233e-067	-66.373
UO3(g)	1.034e-071	-70.986
UO2Cl2(g)	7.427e-086	-85.129
UO2(g)	1.448e-124	-123.839
UCl4(g)	1.440e-153	-152.842
UCl5(g)	3.115e-167	-166.507
UCl6(g)	1.252e-175	-174.902
UCl3(g)	3.426e-177	-176.465
UO(g)	8.052e-209	-208.094
UCl2(g)	4.412e-218	-217.355
UCl(g)	1.245e-256	-255.905
U(g)	1.050e-293	-292.979
U2Cl8(g)	5.110e-296	-295.292

U2Cl10(g)	1.937e-307	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-968.			
H2O	56.5	56.5	9.78e+005			
Na+	1.06	1.06	2.34e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	2.54e-005	2.54e-005	6.60			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9602		
Hydrogen	112.0	112.0	1.084e+005		
Oxygen	56.51	56.51	8.682e+005		
Sodium	1.060	1.060	2.340e+004		
Uranium	2.544e-005	2.544e-005	5.815		

Experiment #2 (1.0 M NaOH) sample 19661, 24 hour (1), duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.771               log fO2 =   -0.704
Eh =   0.4040 volts       pe =   6.8295
Ionic strength      =     0.963136
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.041199 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        39569 mg/kg sol'n
Rock mass           =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.9881	2.182e+004	0.6613	-0.1848
OH-	0.9376	1.532e+004	0.6365	-0.2242
NaOH(aq)	0.06185	2376.	1.0000	-1.2087
O2(aq)	0.0002500	7.683	1.0000	-3.6020
UO2(OH)4--	0.0001141	37.06	0.1456	-4.7794
UO2(OH)3-	2.732e-005	8.425	0.6613	-4.7431
Cl-	2.645e-005	0.9006	0.6088	-4.7931
NaCl(aq)	1.758e-006	0.09869	1.0000	-5.7549

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.9962s/sat	Ice	-0.1387
Na2U2O7(am)	3.4879s/sat	Na2UO4(alpha)	-2.1430

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.350e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.176e-042	-41.930
Na(g)	4.194e-067	-66.377
UO3(g)	5.752e-071	-70.240
UO2Cl2(g)	4.137e-085	-84.383
UO2(g)	8.057e-124	-123.094
UCl4(g)	8.031e-153	-152.095
UCl5(g)	1.738e-166	-165.760
UCl6(g)	6.989e-175	-174.156
UCl3(g)	1.909e-176	-175.719
UO(g)	4.481e-208	-207.349
UCl2(g)	2.458e-217	-216.609
UCl(g)	6.930e-256	-255.159
U(g)	5.845e-293	-292.233
U2Cl8(g)	1.589e-294	-293.799

U2Cl10(g)	6.030e-306	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-968.			
H2O	56.5	56.5	9.78e+005			
Na+	1.05	1.05	2.32e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	0.000141	0.000141	36.7			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9604		
Hydrogen	112.0	112.0	1.084e+005		
Oxygen	56.51	56.51	8.683e+005		
Sodium	1.050	1.050	2.318e+004		
Uranium	0.0001415	0.0001415	32.34		

Experiment #2 (1.0 M NaOH) sample 19661, 24 hour (2), duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.770               log fO2 =   -0.704
Eh =   0.4041 volts       pe =   6.8307
Ionic strength      =     0.980976
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.042103 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        40402 mg/kg sol'n
Rock mass           =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.026	2.263e+004	0.6611	-0.1686
OH-	0.9357	1.527e+004	0.6361	-0.2254
NaOH(aq)	0.06402	2457.	1.0000	-1.1937
O2(aq)	0.0002500	7.677	1.0000	-3.6020
UO2(OH)4--	6.608e-005	21.44	0.1447	-5.0196
Cl-	2.639e-005	0.8977	0.6082	-4.7946
UO2(OH)3-	1.577e-005	4.857	0.6611	-4.9820
NaCl(aq)	1.819e-006	0.1020	1.0000	-5.7402

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.5506s/sat	Ice	-0.1387
Na2U2O7(am)	3.0423s/sat	Na2UO4(alpha)	-2.3508

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.350e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.175e-042	-41.930
Na(g)	4.341e-067	-66.362
UO3(g)	3.327e-071	-70.478
UO2Cl2(g)	2.390e-085	-84.622
UO2(g)	4.660e-124	-123.332
UCl4(g)	4.633e-153	-152.334
UCl5(g)	1.002e-166	-165.999
UCl6(g)	4.027e-175	-174.395
UCl3(g)	1.102e-176	-175.958
UO(g)	2.592e-208	-207.586
UCl2(g)	1.420e-217	-216.848
UCl(g)	4.006e-256	-255.397
U(g)	3.381e-293	-292.471
U2Cl8(g)	5.290e-295	-294.277

U2Cl10(g)	2.005e-306	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.77e+005			
Na+	1.09	1.09	2.40e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	8.18e-005	8.18e-005	21.2			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9596		
Hydrogen	112.0	112.0	1.083e+005		
Oxygen	56.51	56.51	8.676e+005		
Sodium	1.090	1.090	2.405e+004		
Uranium	8.184e-005	8.184e-005	18.69		

Experiment #2 (1.0 M NaOH) sample 19661, 1 week, duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 13.769              log fO2 =   -0.704
Eh =   0.4041 volts      pe =   6.8310
Ionic strength      =    0.985437
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.042323 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       40604 mg/kg sol'n
Rock mass           =    0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.035	2.284e+004	0.6610	-0.1647
OH-	0.9353	1.526e+004	0.6360	-0.2256
NaOH(aq)	0.06457	2478.	1.0000	-1.1900
O2(aq)	0.0002500	7.675	1.0000	-3.6020
UO2(OH)4--	3.648e-005	11.83	0.1444	-5.2783
Cl-	2.637e-005	0.8970	0.6080	-4.7949
UO2(OH)3-	8.697e-006	2.679	0.6610	-5.2404
NaCl(aq)	1.834e-006	0.1028	1.0000	-5.7366

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.0417s/sat	Ice	-0.1387
Na2U2O7(am)	2.5334s/sat	Na2UO4(alpha)	-2.6016

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.174e-042	-41.930
Na(g)	4.378e-067	-66.359
UO3(g)	1.836e-071	-70.736
UO2Cl2(g)	1.318e-085	-84.880
UO2(g)	2.572e-124	-123.590
UCl4(g)	2.555e-153	-152.593
UCl5(g)	5.525e-167	-166.258
UCl6(g)	2.220e-175	-174.654
UCl3(g)	6.080e-177	-176.216
UO(g)	1.430e-208	-207.845
UCl2(g)	7.833e-218	-217.106
UCl(g)	2.210e-256	-255.656
U(g)	1.866e-293	-292.729
U2Cl8(g)	1.608e-295	-294.794

U2Cl10(g)	6.092e-307	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.77e+005			
Na+	1.10	1.10	2.43e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	4.52e-005	4.52e-005	11.7			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9594		
Hydrogen	112.0	112.0	1.083e+005		
Oxygen	56.51	56.51	8.674e+005		
Sodium	1.100	1.100	2.426e+004		
Uranium	4.518e-005	4.518e-005	10.32		

Experiment #2 (1.0 M NaOH) sample 19661, 1 month, duplicate.

```
          Step #     0              Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 13.770               log fO2 =   -0.704
          Eh =   0.4041 volts       pe =   6.8303
          Ionic strength      =    0.976513
          Activity of water   =    0.999999
          Solvent mass        =    1.000000 kg
          Solution mass       =    1.041859 kg
          Solution density    =    1.013    g/cm3
          Chlorinity          =    0.000028 molal
          Dissolved solids    =       40178 mg/kg sol'n
          Rock mass           =    0.000000 kg

  No minerals in system.

  Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
 ---------------------------------------------------------------------------
   Na+                     1.017    2.243e+004      0.6611       -0.1726
   OH-                    0.9364    1.529e+004      0.6362       -0.2250
   NaOH(aq)              0.06349         2438.      1.0000       -1.1973
   O2(aq)              0.0002500         7.679      1.0000       -3.6020
   Cl-                 2.640e-005       0.8984      0.6083       -4.7942
   UO2(OH)4--          2.559e-005        8.304      0.1449       -5.4309
   UO2(OH)3-           6.109e-006        1.883      0.6611       -5.3937
   NaCl(aq)            1.804e-006       0.1012      1.0000       -5.7438
    (only species > 1e-8 molal listed)

  Mineral saturation states
                    log Q/K                          log Q/K
 ----------------------------------------------------------------
   Na2U2O7(c)         4.7192s/sat   Ice                -0.1387
   Na2U2O7(am)        2.2109s/sat   Na2UO4(alpha)      -2.7701
    (only minerals with log Q/K > -3 listed)

  Gases                  fugacity      log fug.
 -----------------------------------------------
   O2(g)                  0.1978      -0.704
   H2O(g)                0.02598      -1.585
   HCl(g)              1.349e-025    -24.870
   H2(g)               6.301e-042    -41.201
   Cl2(g)              1.175e-042    -41.930
   Na(g)               4.306e-067    -66.366
   UO3(g)              1.288e-071    -70.890
   UO2Cl2(g)           9.252e-086    -85.034
   UO2(g)              1.804e-124   -123.744
   UCl4(g)             1.793e-153   -152.746
   UCl5(g)             3.879e-167   -166.411
   UCl6(g)             1.558e-175   -174.807
   UCl3(g)             4.267e-177   -176.370
   UO(g)               1.003e-208   -207.999
   UCl2(g)             5.496e-218   -217.260
   UCl(g)              1.551e-256   -255.809
   U(g)                1.309e-293   -292.883
   U2Cl8(g)            7.925e-296   -295.101
```

U2Cl10(g)	3.002e-307	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.77e+005			
Na+	1.08	1.08	2.38e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	3.17e-005	3.17e-005	8.22			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9598		
Hydrogen	112.0	112.0	1.084e+005		
Oxygen	56.51	56.51	8.678e+005		
Sodium	1.080	1.080	2.383e+004		
Uranium	3.170e-005	3.170e-005	7.242		

Experiment #2 (1.0 M NaOH) sample 19661 yellow, 24 hour (1).

```
Step #     0               Xi = 0.0000
Temperature =  25.0 C      Pressure =  1.013 bars
pH = 13.771                log fO2 =   -0.704
Eh =   0.4040 volts        pe =   6.8297
Ionic strength       =     0.963139
Activity of water    =     0.999999
Solvent mass         =     1.000000 kg
Solution mass        =     1.041226 kg
Solution density     =     1.013    g/cm3
Chlorinity           =     0.000028 molal
Dissolved solids     =        39593 mg/kg sol'n
Rock mass            =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.9882	2.182e+004	0.6613	-0.1848
OH-	0.9373	1.531e+004	0.6365	-0.2243
NaOH(aq)	0.06183	2375.	1.0000	-1.2088
O2(aq)	0.0002500	7.683	1.0000	-3.6020
UO2(OH)4--	0.0001924	62.47	0.1456	-4.5526
UO2(OH)3-	4.608e-005	14.21	0.6613	-4.5161
Cl-	2.645e-005	0.9005	0.6088	-4.7931
NaCl(aq)	1.758e-006	0.09869	1.0000	-5.7549

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	6.4501s/sat	Ice	-0.1387
Na2U2O7(am)	3.9418s/sat	Na2UO4(alpha)	-1.9162

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.351e-025	-24.869
H2(g)	6.301e-042	-41.201
Cl2(g)	1.177e-042	-41.929
Na(g)	4.193e-067	-66.378
UO3(g)	9.704e-071	-70.013
UO2Cl2(g)	6.985e-085	-84.156
UO2(g)	1.359e-123	-122.867
UCl4(g)	1.357e-152	-151.867
UCl5(g)	2.938e-166	-165.532
UCl6(g)	1.182e-174	-173.927
UCl3(g)	3.225e-176	-175.491
UO(g)	7.559e-208	-207.122
UCl2(g)	4.150e-217	-216.382
UCl(g)	1.170e-255	-254.932
U(g)	9.861e-293	-292.006
U2Cl8(g)	4.537e-294	-293.343

U2Cl10(g) 1.722e-305 -300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.960			
H+	-1.00	-1.00	-968.			
H2O	56.5	56.5	9.78e+005			
Na+	1.05	1.05	2.32e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	0.000238	0.000238	61.9			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9604		
Hydrogen	112.0	112.0	1.084e+005		
Oxygen	56.51	56.51	8.683e+005		
Sodium	1.050	1.050	2.318e+004		
Uranium	0.0002385	0.0002385	54.52		

Experiment #2 (1.0 M NaOH) sample 19661 yellow, 24 hour (2).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.768               log fO2 =   -0.704
Eh =   0.4042 volts       pe =   6.8324
Ionic strength      =     1.003294
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.043271 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        41476 mg/kg sol'n
Rock mass           =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.073	2.365e+004	0.6608	-0.1492
OH-	0.9327	1.521e+004	0.6356	-0.2271
NaOH(aq)	0.06669	2557.	1.0000	-1.1759
O2(aq)	0.0002500	7.668	1.0000	-3.6020
UO2(OH)4--	0.0001215	39.36	0.1435	-4.7586
UO2(OH)3-	2.888e-005	8.888	0.6608	-4.7193
Cl-	2.631e-005	0.8942	0.6074	-4.7964
NaCl(aq)	1.894e-006	0.1061	1.0000	-5.7226

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	6.1149s/sat	Ice	-0.1387
Na2U2O7(am)	3.6066s/sat	Na2UO4(alpha)	-2.0509

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.174e-042	-41.930
Na(g)	4.522e-067	-66.345
UO3(g)	6.116e-071	-70.214
UO2Cl2(g)	4.392e-085	-84.357
UO2(g)	8.566e-124	-123.067
UCl4(g)	8.510e-153	-152.070
UCl5(g)	1.840e-166	-165.735
UCl6(g)	7.394e-175	-174.131
UCl3(g)	2.025e-176	-175.694
UO(g)	4.764e-208	-207.322
UCl2(g)	2.609e-217	-216.584
UCl(g)	7.362e-256	-255.133
U(g)	6.215e-293	-292.207
U2Cl8(g)	1.785e-294	-293.748

U2Cl10(g)	6.760e-306	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-966.			
H2O	56.5	56.5	9.76e+005			
Na+	1.14	1.14	2.51e+004			
O2(aq)	0.000250	0.000250	7.67			
UO2++	0.000150	0.000150	38.9			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9585		
Hydrogen	112.0	112.0	1.082e+005		
Oxygen	56.51	56.51	8.666e+005		
Sodium	1.140	1.140	2.512e+004		
Uranium	0.0001504	0.0001504	34.30		

Experiment #2 (1.0 M NaOH) sample 19661 yellow, 1 week.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 13.769               log fO2 =   -0.704
Eh =   0.4041 volts       pe =   6.8310
Ionic strength      =     0.985437
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.042327 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        40608 mg/kg sol'n
Rock mass           =     0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.035	2.284e+004	0.6610	-0.1647
OH-	0.9352	1.526e+004	0.6360	-0.2256
NaOH(aq)	0.06456	2478.	1.0000	-1.1900
O2(aq)	0.0002500	7.675	1.0000	-3.6020
UO2(OH)4--	4.755e-005	15.42	0.1444	-5.1632
Cl-	2.637e-005	0.8970	0.6080	-4.7949
UO2(OH)3-	1.133e-005	3.491	0.6610	-5.1254
NaCl(aq)	1.834e-006	0.1028	1.0000	-5.7366

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	5.2718s/sat	Ice	-0.1387
Na2U2O7(am)	2.7635s/sat	Na2UO4(alpha)	-2.4865

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.174e-042	-41.930
Na(g)	4.378e-067	-66.359
UO3(g)	2.393e-071	-70.621
UO2Cl2(g)	1.719e-085	-84.765
UO2(g)	3.352e-124	-123.475
UCl4(g)	3.331e-153	-152.477
UCl5(g)	7.203e-167	-166.142
UCl6(g)	2.894e-175	-174.538
UCl3(g)	7.925e-177	-176.101
UO(g)	1.864e-208	-207.729
UCl2(g)	1.021e-217	-216.991
UCl(g)	2.881e-256	-255.540
U(g)	2.432e-293	-292.614
U2Cl8(g)	2.734e-295	-294.563

U2Cl10(g) 1.035e-306 -300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-967.			
H2O	56.5	56.5	9.77e+005			
Na+	1.10	1.10	2.43e+004			
O2(aq)	0.000250	0.000250	7.68			
UO2++	5.89e-005	5.89e-005	15.3			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9594		
Hydrogen	112.0	112.0	1.083e+005		
Oxygen	56.51	56.51	8.674e+005		
Sodium	1.100	1.100	2.426e+004		
Uranium	5.888e-005	5.888e-005	13.45		

Experiment #2 (1.0 M NaOH) sample 19661 yellow, 1 month.

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 13.768              log fO2 =   -0.704
Eh =   0.4042 volts      pe =   6.8322
Ionic strength      =    1.003288
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.043238 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       41446 mg/kg sol'n
Rock mass           =    0.000000 kg
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.073	2.365e+004	0.6608	-0.1492
OH-	0.9332	1.521e+004	0.6356	-0.2269
NaOH(aq)	0.06672	2558.	1.0000	-1.1758
O2(aq)	0.0002500	7.668	1.0000	-3.6020
Cl-	2.631e-005	0.8942	0.6074	-4.7964
UO2(OH)4--	2.295e-005	7.437	0.1435	-5.4823
UO2(OH)3-	5.454e-006	1.678	0.6608	-5.4432
NaCl(aq)	1.894e-006	0.1061	1.0000	-5.7226

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.6671s/sat	Ice	-0.1387
Na2U2O7(am)	2.1588s/sat	Na2UO4(alpha)	-2.7746

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
HCl(g)	1.349e-025	-24.870
H2(g)	6.301e-042	-41.201
Cl2(g)	1.173e-042	-41.931
Na(g)	4.524e-067	-66.344
UO3(g)	1.154e-071	-70.938
UO2Cl2(g)	8.282e-086	-85.082
UO2(g)	1.617e-124	-123.791
UCl4(g)	1.603e-153	-152.795
UCl5(g)	3.466e-167	-166.460
UCl6(g)	1.392e-175	-174.856
UCl3(g)	3.817e-177	-176.418
UO(g)	8.993e-209	-208.046
UCl2(g)	4.920e-218	-217.308
UCl(g)	1.389e-256	-255.857
U(g)	1.173e-293	-292.931
U2Cl8(g)	6.335e-296	-295.198

U2Cl10(g)	2.397e-307	-300.000

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.959			
H+	-1.00	-1.00	-966.			
H2O	56.5	56.5	9.76e+005			
Na+	1.14	1.14	2.51e+004			
O2(aq)	0.000250	0.000250	7.67			
UO2++	2.84e-005	2.84e-005	7.35			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Chlorine	2.821e-005	2.821e-005	0.9586		
Hydrogen	112.0	112.0	1.082e+005		
Oxygen	56.51	56.51	8.666e+005		
Sodium	1.140	1.140	2.512e+004		
Uranium	2.840e-005	2.840e-005	6.481		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (1).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.774              log fO2 =   -0.704
Eh =   0.5222 volts      pe =   8.8269
Ionic strength      =    1.033659
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.086538 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       79645 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=     1207.13 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.025	2.170e+004	0.6606	-0.1692
NO3-	1.000	5.707e+004	0.6064	-0.2172
OH-	0.009455	148.0	0.6350	-2.2216
CO3--	0.007111	392.7	0.1629	-2.9362
NaCO3-	0.003883	296.6	0.6606	-2.5909
NaOH(aq)	0.0006450	23.74	1.0000	-3.1904
O2(aq)	0.0002500	7.363	1.0000	-3.6020
HCO3-	6.298e-005	3.537	0.6606	-4.3809
NaHCO3(aq)	4.018e-005	3.107	1.0000	-4.3960
Cl-	2.639e-005	0.8612	0.6064	-4.7957
NaCl(aq)	1.812e-006	0.09746	1.0000	-5.7419
UO2(OH)3-	1.031e-006	0.3046	0.6606	-6.1669
UO2(CO3)3----	9.978e-007	0.4133	0.0003	-9.5180
UO2(OH)4--	4.434e-008	0.01380	0.1421	-8.2007

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.1797s/sat	Natron	-2.5559
Na2U2O7(am)	0.6714s/sat	Na2CO3:7H2O	-2.8916
Ice	-0.1387		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	4.562e-009	-8.341
NO2(g)	3.487e-020	-19.458
N2(g)	2.956e-020	-19.529
HCl(g)	1.334e-023	-22.875
NO(g)	5.255e-026	-25.279
Cl2(g)	1.148e-038	-37.940
H2(g)	6.301e-042	-41.201
CO(g)	8.978e-054	-53.047

Na(g)	4.374e-069	-68.359
NH3(g)	2.073e-069	-68.683
UO3(g)	2.154e-070	-69.667
UO2Cl2(g)	1.513e-080	-79.820
UO2(g)	3.018e-123	-122.520
UCl4(g)	2.868e-144	-143.542
CH4(g)	5.737e-151	-150.241
UCl5(g)	6.133e-156	-155.212
UCl6(g)	2.437e-162	-161.613
UCl3(g)	6.900e-170	-169.161
C(g)	4.735e-195	-194.325
UO(g)	1.678e-207	-206.775
UCl2(g)	8.989e-213	-212.046
C2H4(g)	1.636e-248	-247.786
UCl(g)	2.565e-253	-252.591
U2Cl8(g)	2.026e-277	-276.693
U2Cl10(g)	7.506e-285	-284.125
U(g)	2.189e-292	-291.660

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.02	-1.02	-947.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.0111	0.0111	623.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.03	1.03	2.18e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	2.07e-006	2.07e-006	0.515			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.01110	0.01110	122.7		
Chlorine	2.821e-005	2.821e-005	0.9204		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.55	58.55	8.622e+005		
Sodium	1.030	1.030	2.179e+004		
Uranium	2.074e-006	2.074e-006	0.4543		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (2).

```
Step #     0             Xi = 0.0000
Temperature =  25.0 C    Pressure =  1.013 bars
pH = 11.770              log fO2 =   -0.704
Eh =   0.5224 volts      pe =   8.8308
Ionic strength      =    1.051244
Activity of water   =    0.999999
Solvent mass        =    1.000000 kg
Solution mass       =    1.087347 kg
Solution density    =    1.013    g/cm3
Chlorinity          =    0.000028 molal
Dissolved solids    =       80330 mg/kg sol'n
Rock mass           =    0.000000 kg
Carbonate alkalinity=      593.13 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.077	2.278e+004	0.6604	-0.1478
NO3-	1.000	5.702e+004	0.6059	-0.2176
OH-	0.009375	146.6	0.6347	-2.2255
CO3--	0.003436	189.7	0.1621	-3.2541
NaCO3-	0.001962	149.8	0.6604	-2.8875
NaOH(aq)	0.0006715	24.70	1.0000	-3.1730
O2(aq)	0.0002500	7.357	1.0000	-3.6020
HCO3-	3.057e-005	1.715	0.6604	-4.6949
Cl-	2.631e-005	0.8579	0.6059	-4.7975
NaHCO3(aq)	2.048e-005	1.582	1.0000	-4.6886
NaCl(aq)	1.896e-006	0.1019	1.0000	-5.7223
UO2(OH)3-	1.385e-006	0.4090	0.6604	-6.0386
UO2(CO3)3----	1.576e-007	0.06522	0.0003	-10.3317
UO2(OH)4--	5.939e-008	0.01846	0.1413	-8.0763

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.4790s/sat	Ice	-0.1387
Na2U2O7(am)	0.9707s/sat	Natron	-2.8311

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	2.234e-009	-8.651
NO2(g)	3.515e-020	-19.454
N2(g)	3.004e-020	-19.522
HCl(g)	1.341e-023	-22.873
NO(g)	5.298e-026	-25.276
Cl2(g)	1.160e-038	-37.936
H2(g)	6.301e-042	-41.201
CO(g)	4.396e-054	-53.357
Na(g)	4.554e-069	-68.342

NH3(g)	2.090e-069	-68.680
UO3(g)	2.921e-070	-69.534
UO2Cl2(g)	2.072e-080	-79.684
UO2(g)	4.091e-123	-122.388
UCl4(g)	3.965e-144	-143.402
CH4(g)	2.809e-151	-150.551
UCl5(g)	8.522e-156	-155.069
UCl6(g)	3.403e-162	-161.468
UCl3(g)	9.494e-170	-169.023
C(g)	2.318e-195	-194.635
UO(g)	2.276e-207	-206.643
UCl2(g)	1.231e-212	-211.910
C2H4(g)	3.921e-249	-248.407
UCl(g)	3.495e-253	-252.457
U2Cl8(g)	3.875e-277	-276.412
U2Cl10(g)	1.449e-284	-283.839
U(g)	2.968e-292	-291.528

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.02	-1.02	-941.			
H2O	54.5	54.5	9.03e+005			
HCO3-	0.00545	0.00545	306.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.08	1.08	2.28e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.60e-006	1.60e-006	0.398			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.005450	0.005450	60.20		
Chlorine	2.821e-005	2.821e-005	0.9197		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.288e+004		
Oxygen	58.54	58.54	8.613e+005		
Sodium	1.080	1.080	2.283e+004		
Uranium	1.604e-006	1.604e-006	0.3510		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 week.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.769               log fO2 =   -0.704
Eh =   0.5224 volts       pe =   8.8314
Ionic strength      =     1.037268
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.086697 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        79780 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       249.08 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.059	2.239e+004	0.6605	-0.1554
NO3-	1.000	5.706e+004	0.6063	-0.2173
OH-	0.009359	146.5	0.6349	-2.2260
CO3--	0.001451	80.14	0.1627	-3.6268
NaCO3-	0.0008172	62.41	0.6605	-3.2678
NaOH(aq)	0.0006589	24.25	1.0000	-3.1812
O2(aq)	0.0002500	7.362	1.0000	-3.6020
Cl-	2.634e-005	0.8593	0.6063	-4.7967
HCO3-	1.297e-005	0.7285	0.6605	-5.0670
NaHCO3(aq)	8.544e-006	0.6605	1.0000	-5.0683
NaCl(aq)	1.866e-006	0.1004	1.0000	-5.7291
UO2(OH)3-	1.207e-006	0.3567	0.6605	-6.0983
UO2(OH)4--	5.146e-008	0.01601	0.1419	-8.1365
UO2(CO3)3----	1.028e-008	0.004256	0.0003	-11.5077

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.3446s/sat	Ice	-0.1387
Na2U2O7(am)	0.8363s/sat		

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	9.496e-010	-9.022
NO2(g)	3.523e-020	-19.453
N2(g)	3.017e-020	-19.520
HCl(g)	1.345e-023	-22.871
NO(g)	5.309e-026	-25.275
Cl2(g)	1.167e-038	-37.933
H2(g)	6.301e-042	-41.201
CO(g)	1.869e-054	-53.728
Na(g)	4.468e-069	-68.350

NH3(g)	2.094e-069	-68.679
UO3(g)	2.550e-070	-69.594
UO2Cl2(g)	1.820e-080	-79.740
UO2(g)	3.571e-123	-122.447
UCl4(g)	3.505e-144	-143.455
CH4(g)	1.194e-151	-150.923
UCl5(g)	7.558e-156	-155.122
UCl6(g)	3.027e-162	-161.519
UCl3(g)	8.367e-170	-169.077
C(g)	9.855e-196	-195.006
UO(g)	1.986e-207	-206.702
UCl2(g)	1.081e-212	-211.966
C2H4(g)	7.086e-250	-249.150
UCl(g)	3.060e-253	-252.514
U2Cl8(g)	3.028e-277	-276.519
U2Cl10(g)	1.140e-284	-283.943
U(g)	2.591e-292	-291.587

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00229	0.00229	129.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.06	1.06	2.24e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.27e-006	1.27e-006	0.316			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.002290	0.002290	25.31		
Chlorine	2.821e-005	2.821e-005	0.9202		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.53	58.53	8.617e+005		
Sodium	1.060	1.060	2.243e+004		
Uranium	1.270e-006	1.270e-006	0.2782		

Experiment #3 (0.01 M NaOH, 0.001 M Na_2CO_3) sample 19661, 1 month.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.797               log fO2 =   -0.704
Eh =   0.5208 volts       pe =   8.8037
Ionic strength      =     0.018046
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.001041 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =         1040 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       119.23 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.02333	535.8	0.8757	-1.6898
OH-	0.007252	123.2	0.8735	-2.1983
CO3--	0.001112	66.67	0.5909	-3.1823
UO2(OH)3-	0.0008982	288.1	0.8757	-3.1043
O2(aq)	0.0002500	7.992	1.0000	-3.6020
NaCO3-	5.012e-005	4.155	0.8757	-4.3577
Cl-	2.812e-005	0.9960	0.8711	-4.6109
HCO3-	2.555e-005	1.557	0.8757	-4.6503
NaOH(aq)	2.052e-005	0.8200	1.0000	-4.6877
UO2(OH)4--	1.312e-005	4.432	0.5851	-5.1147
UO2(OH)2(aq)	1.014e-006	0.3080	1.0000	-5.9939
NaHCO3(aq)	6.517e-007	0.05469	1.0000	-6.1860
(UO2)3(OH)7-	5.833e-007	0.5414	0.8757	-6.2918
UO2(CO3)3----	4.675e-007	0.2102	0.1166	-7.2636
NaCl(aq)	8.363e-008	0.004883	1.0000	-7.0776
(UO2)2CO3(OH)3-	6.697e-008	0.04356	0.8757	-7.2317

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	6.2639s/sat	Schoepite-dehy(.	-0.6960
Na2U2O7(am)	3.7556s/sat	UO3:.9H2O(alpha)	-0.6960
Ice	-0.1387	Schoepite-dehy(.	-0.7763
Schoepite	-0.5126	Schoepite-dehy(1	-0.7824
UO3:2H2O	-0.5126	Schoepite-dehy(.	-1.8856
UO2(OH)2(beta)	-0.6250	Schoepite-dehy(.	-2.4036

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	2.325e-009	-8.634
HCl(g)	1.936e-023	-22.713
Cl2(g)	2.417e-038	-37.617

H2(g)	6.301e-042	-41.201
CO(g)	4.576e-054	-53.340
UO3(g)	2.359e-067	-66.627
Na(g)	1.392e-070	-69.856
UO2Cl2(g)	3.487e-077	-76.458
UO2(g)	3.304e-120	-119.481
UCl4(g)	1.391e-140	-139.857
CH4(g)	2.924e-151	-150.534
UCl5(g)	4.314e-152	-151.365
UCl6(g)	2.487e-158	-157.604
UCl3(g)	2.307e-166	-165.637
C(g)	2.413e-195	-194.617
UO(g)	1.838e-204	-203.736
UCl2(g)	2.071e-209	-208.684
C2H4(g)	4.249e-249	-248.372
UCl(g)	4.074e-250	-249.390
U2Cl8(g)	4.765e-270	-269.322
U2Cl10(g)	3.715e-277	-276.430
U(g)	2.397e-289	-288.620

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.999			
H+	-0.0112	-0.0112	-11.3			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00119	0.00119	72.5			
Na+	0.0234	0.0234	537.			
O2(aq)	0.000250	0.000250	7.99			
UO2++	0.000915	0.000915	247.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001190	0.001190	14.28		
Chlorine	2.821e-005	2.821e-005	0.9990		
Hydrogen	111.0	111.0	1.118e+005		
Oxygen	55.52	55.52	8.874e+005		
Sodium	0.02340	0.02340	537.4		
Uranium	0.0009147	0.0009147	217.5		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (1), duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.771               log fO2 =   -0.704
Eh =   0.5223 volts       pe =   8.8294
Ionic strength      =     1.031926
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.086455 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        79575 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       641.58 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.037	2.195e+004	0.6606	-0.1642
NO3-	1.000	5.707e+004	0.6065	-0.2172
OH-	0.009401	147.2	0.6350	-2.2240
CO3--	0.003764	207.9	0.1630	-3.2122
NaCO3-	0.002080	158.9	0.6606	-2.8620
NaOH(aq)	0.0006488	23.88	1.0000	-3.1879
O2(aq)	0.0002500	7.363	1.0000	-3.6020
HCO3-	3.354e-005	1.884	0.6606	-4.6545
Cl-	2.638e-005	0.8607	0.6065	-4.7960
NaHCO3(aq)	2.165e-005	1.674	1.0000	-4.6646
NaCl(aq)	1.832e-006	0.09852	1.0000	-5.7372
UO2(OH)3-	1.706e-006	0.5042	0.6606	-5.9481
UO2(CO3)3----	2.488e-007	0.1031	0.0003	-10.1200
UO2(OH)4--	7.294e-008	0.02269	0.1422	-7.9843

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	3.6274s/sat	Ice	-0.1387
Na2U2O7(am)	1.1191s/sat	Natron	-2.8220

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	2.444e-009	-8.612
NO2(g)	3.507e-020	-19.455
N2(g)	2.990e-020	-19.524
HCl(g)	1.341e-023	-22.873
NO(g)	5.285e-026	-25.277
Cl2(g)	1.160e-038	-37.936
H2(g)	6.301e-042	-41.201
CO(g)	4.809e-054	-53.318
Na(g)	4.399e-069	-68.357

NH3(g)	2.085e-069	-68.681
UO3(g)	3.586e-070	-69.445
UO2Cl2(g)	2.544e-080	-79.594
UO2(g)	5.023e-123	-122.299
UCl4(g)	4.870e-144	-143.312
CH4(g)	3.073e-151	-150.512
UCl5(g)	1.047e-155	-154.980
UCl6(g)	4.180e-162	-161.379
UCl3(g)	1.166e-169	-168.933
C(g)	2.536e-195	-194.596
UO(g)	2.794e-207	-206.554
UCl2(g)	1.511e-212	-211.821
C2H4(g)	4.692e-249	-248.329
UCl(g)	4.291e-253	-252.367
U2Cl8(g)	5.845e-277	-276.233
U2Cl10(g)	2.187e-284	-283.660
U(g)	3.644e-292	-291.438

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.02	-1.02	-942.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00590	0.00590	331.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.04	1.04	2.20e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	2.03e-006	2.03e-006	0.504			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.005900	0.005900	65.23		
Chlorine	2.821e-005	2.821e-005	0.9204		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.54	58.54	8.620e+005		
Sodium	1.040	1.040	2.201e+004		
Uranium	2.029e-006	2.029e-006	0.4446		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 24 hour (2), duplicate.

```
         Step #     0             Xi = 0.0000
         Temperature =  25.0 C    Pressure =  1.013 bars
         pH = 11.769              log fO2 =   -0.704
         Eh =   0.5224 volts      pe =   8.8311
         Ionic strength      =    1.044235
         Activity of water   =    0.999999
         Solvent mass        =    1.000000 kg
         Solution mass       =    1.087021 kg
         Solution density    =    1.013    g/cm3
         Chlorinity          =    0.000028 molal
         Dissolved solids    =       80054 mg/kg sol'n
         Rock mass           =    0.000000 kg
         Carbonate alkalinity=      418.88 mg/kg as CaCO3

 No minerals in system.

 Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
---------------------------------------------------------------------------
  Na+                      1.068    2.259e+004      0.6605       -0.1516
  NO3-                     1.000    5.704e+004      0.6061       -0.2174
  OH-                   0.009366         146.5      0.6348       -2.2258
  CO3--                 0.002434         134.4      0.1624       -3.4031
  NaCO3-                0.001380         105.4      0.6605       -3.0403
  NaOH(aq)             0.0006652         24.48      1.0000       -3.1771
  O2(aq)               0.0002500         7.360      1.0000       -3.6020
  Cl-                  2.633e-005       0.8586      0.6061       -4.7971
  HCO3-                2.170e-005        1.218      0.6605       -4.8436
  NaHCO3(aq)           1.442e-005        1.114      1.0000       -4.8411
  NaCl(aq)             1.881e-006       0.1011      1.0000       -5.7257
  UO2(OH)3-            1.411e-006       0.4167      0.6605       -6.0306
  UO2(OH)4--           6.031e-008      0.01876      0.1416       -8.0686
  UO2(CO3)3----        5.683e-008      0.02353      0.0003      -10.7698
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                            log Q/K
----------------------------------------------------------------
  Na2U2O7(c)        3.4875s/sat   Ice                -0.1387
  Na2U2O7(am)       0.9792s/sat   Natron             -2.9877
   (only minerals with log Q/K > -3 listed)

 Gases                fugacity      log fug.
-----------------------------------------------
  O2(g)                   0.1978      -0.704
  H2O(g)                 0.02598      -1.585
  CO2(g)              1.587e-009      -8.799
  NO2(g)              3.519e-020     -19.454
  N2(g)               3.011e-020     -19.521
  HCl(g)              1.343e-023     -22.872
  NO(g)               5.304e-026     -25.275
  Cl2(g)              1.164e-038     -37.934
  H2(g)               6.301e-042     -41.201
  CO(g)               3.124e-054     -53.505
  Na(g)               4.511e-069     -68.346
```

NH3(g)	2.092e-069	-68.679
UO3(g)	2.978e-070	-69.526
UO2Cl2(g)	2.119e-080	-79.674
UO2(g)	4.171e-123	-122.380
UCl4(g)	4.069e-144	-143.391
CH4(g)	1.996e-151	-150.700
UCl5(g)	8.759e-156	-155.058
UCl6(g)	3.503e-162	-161.456
UCl3(g)	9.726e-170	-169.012
C(g)	1.647e-195	-194.783
UO(g)	2.320e-207	-206.635
UCl2(g)	1.259e-212	-211.900
C2H4(g)	1.980e-249	-248.703
UCl(g)	3.568e-253	-252.448
U2Cl8(g)	4.079e-277	-276.389
U2Cl10(g)	1.531e-284	-283.815
U(g)	3.026e-292	-291.519

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-940.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00385	0.00385	216.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.07	1.07	2.26e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.53e-006	1.53e-006	0.380			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.003850	0.003850	42.54		
Chlorine	2.821e-005	2.821e-005	0.9199		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.53	58.53	8.615e+005		
Sodium	1.070	1.070	2.263e+004		
Uranium	1.529e-006	1.529e-006	0.3349		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19661, 1 week, duplicate.

```
          Step #     0              Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 11.769               log fO2 =   -0.704
          Eh =   0.5224 volts       pe =   8.8317
          Ionic strength      =     1.036465
          Activity of water   =     0.999999
          Solvent mass        =     1.000000 kg
          Solution mass       =     1.086659 kg
          Solution density    =     1.013    g/cm3
          Chlorinity          =     0.000028 molal
          Dissolved solids    =        79748 mg/kg sol'n
          Rock mass           =     0.000000 kg
          Carbonate alkalinity=       180.55 mg/kg as CaCO3

 No minerals in system.

 Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
---------------------------------------------------------------------------
  Na+                     1.059    2.240e+004      0.6605       -0.1553
  NO3-                    1.000    5.706e+004      0.6063       -0.2173
  OH-                  0.009353         146.4      0.6350       -2.2263
  CO3--                0.001052         58.09      0.1628       -3.7665
  NaOH(aq)            0.0006587         24.24      1.0000       -3.1813
  NaCO3-              0.0005925         45.26      0.6605       -3.4074
  O2(aq)              0.0002500         7.362      1.0000       -3.6020
  Cl-                2.634e-005        0.8594      0.6063       -4.7967
  HCO3-              9.411e-006        0.5285      0.6605       -5.2065
  NaHCO3(aq)         6.199e-006        0.4792      1.0000       -5.2077
  NaCl(aq)           1.867e-006        0.1004      1.0000       -5.7290
  UO2(OH)3-          1.366e-006        0.4035      0.6605       -6.0448
  UO2(OH)4--         5.816e-008       0.01809      0.1419       -8.0833
   (only species > 1e-8 molal listed)

 Mineral saturation states
                   log Q/K                          log Q/K
----------------------------------------------------------------
  Na2U2O7(c)        3.4518s/sat   Ice               -0.1387
  Na2U2O7(am)       0.9435s/sat
   (only minerals with log Q/K > -3 listed)

 Gases                fugacity      log fug.
-----------------------------------------------
  O2(g)                  0.1978      -0.704
  H2O(g)                0.02598      -1.585
  CO2(g)             6.892e-010      -9.162
  NO2(g)             3.525e-020     -19.453
  N2(g)              3.021e-020     -19.520
  HCl(g)             1.346e-023     -22.871
  NO(g)              5.312e-026     -25.275
  Cl2(g)             1.169e-038     -37.932
  H2(g)              6.301e-042     -41.201
  CO(g)              1.356e-054     -53.868
  Na(g)              4.467e-069     -68.350
  NH3(g)             2.096e-069     -68.679
```

UO3(g)	2.886e-070	-69.540
UO2Cl2(g)	2.062e-080	-79.686
UO2(g)	4.042e-123	-122.393
UCl4(g)	3.978e-144	-143.400
CH4(g)	8.667e-152	-151.062
UCl5(g)	8.582e-156	-155.066
UCl6(g)	3.440e-162	-161.463
UCl3(g)	9.488e-170	-169.023
C(g)	7.153e-196	-195.145
UO(g)	2.248e-207	-206.648
UCl2(g)	1.225e-212	-211.912
C2H4(g)	3.733e-250	-249.428
UCl(g)	3.466e-253	-252.460
U2Cl8(g)	3.899e-277	-276.409
U2Cl10(g)	1.470e-284	-283.833
U(g)	2.932e-292	-291.533

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-938.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00166	0.00166	93.2			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.06	1.06	2.24e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.43e-006	1.43e-006	0.355			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001660	0.001660	18.35		
Chlorine	2.821e-005	2.821e-005	0.9203		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.52	58.52	8.617e+005		
Sodium	1.060	1.060	2.243e+004		
Uranium	1.429e-006	1.429e-006	0.3131		

Experiment #3 (0.01 M NaOH, 0.001 M Na_2CO_3) sample 19661, 1 month, duplicate.

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.785               log fO2 =   -0.704
Eh =   0.5215 volts       pe =   8.8152
Ionic strength      =     0.019664
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.001131 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =         1130 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       126.25 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	0.02642	606.7	0.8715	-1.6378
OH-	0.007097	120.6	0.8691	-2.2099
CO3--	0.001171	70.21	0.5798	-3.1681
UO2(OH)3-	0.0009488	304.3	0.8715	-3.0826
O2(aq)	0.0002500	7.991	1.0000	-3.6020
NaCO3-	5.864e-005	4.862	0.8715	-4.2915
Cl-	2.811e-005	0.9956	0.8666	-4.6133
HCO3-	2.724e-005	1.660	0.8715	-4.6245
NaOH(aq)	2.252e-005	0.8997	1.0000	-4.6474
UO2(OH)4--	1.370e-005	4.626	0.5736	-5.1046
UO2(OH)2(aq)	1.095e-006	0.3326	1.0000	-5.9606
NaHCO3(aq)	7.794e-007	0.06540	1.0000	-6.1082
(UO2)3(OH)7-	7.182e-007	0.6665	0.8715	-6.2035
UO2(CO3)3----	6.361e-007	0.2859	0.1077	-7.1644
NaCl(aq)	9.373e-008	0.005472	1.0000	-7.0281
(UO2)2CO3(OH)3-	8.325e-008	0.05414	0.8715	-7.1394

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	6.4111s/sat	Schoepite-dehy(.	-0.6627
Na2U2O7(am)	3.9028s/sat	UO3:.9H2O(alpha)	-0.6627
Ice	-0.1387	Schoepite-dehy(.	-0.7430
Schoepite	-0.4793	Schoepite-dehy(1	-0.7491
UO3:2H2O	-0.4793	Schoepite-dehy(.	-1.8523
UO2(OH)2(beta)	-0.5917	Schoepite-dehy(.	-2.3703

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	2.534e-009	-8.596
HCl(g)	1.977e-023	-22.704
Cl2(g)	2.521e-038	-37.598

H2(g)	6.301e-042	-41.201
CO(g)	4.988e-054	-53.302
UO3(g)	2.547e-067	-66.594
Na(g)	1.527e-070	-69.816
UO2Cl2(g)	3.926e-077	-76.406
UO2(g)	3.567e-120	-119.448
UCl4(g)	1.633e-140	-139.787
CH4(g)	3.187e-151	-150.497
UCl5(g)	5.176e-152	-151.286
UCl6(g)	3.047e-158	-157.516
UCl3(g)	2.653e-166	-165.576
C(g)	2.630e-195	-194.580
UO(g)	1.984e-204	-203.702
UCl2(g)	2.333e-209	-208.632
C2H4(g)	5.048e-249	-248.297
UCl(g)	4.492e-250	-249.348
U2Cl8(g)	6.575e-270	-269.182
U2Cl10(g)	5.347e-277	-276.272
U(g)	2.588e-289	-288.587

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.999			
H+	-0.0113	-0.0113	-11.3			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00126	0.00126	76.8			
Na+	0.0265	0.0265	609.			
O2(aq)	0.000250	0.000250	7.99			
UO2++	0.000967	0.000967	261.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001260	0.001260	15.12		
Chlorine	2.821e-005	2.821e-005	0.9989		
Hydrogen	111.0	111.0	1.118e+005		
Oxygen	55.52	55.52	8.874e+005		
Sodium	0.02650	0.02650	608.5		
Uranium	0.0009666	0.0009666	229.8		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19887 yellow, 24 hour (1).

```
          Step #     0             Xi = 0.0000
          Temperature =  25.0 C    Pressure =  1.013 bars
          pH = 11.771              log fO2 =   -0.704
          Eh =   0.5223 volts      pe =   8.8299
          Ionic strength      =    1.038281
          Activity of water   =    0.999999
          Solvent mass        =    1.000000 kg
          Solution mass       =    1.086751 kg
          Solution density    =    1.013    g/cm3
          Chlorinity          =    0.000028 molal
          Dissolved solids    =       79826 mg/kg sol'n
          Rock mass           =    0.000000 kg
          Carbonate alkalinity=      759.23 mg/kg as CaCO3

 No minerals in system.

 Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
---------------------------------------------------------------------------
  Na+                     1.047    2.215e+004      0.6605       -0.1602
  NO3-                    1.000    5.706e+004      0.6063       -0.2173
  OH-                  0.009392         147.0      0.6349       -2.2245
  CO3--                0.004439         245.1      0.1627       -3.1413
  NaCO3-               0.002471         188.7      0.6605       -2.7872
  NaOH(aq)            0.0006540         24.07      1.0000       -3.1844
  O2(aq)              0.0002500         7.361      1.0000       -3.6020
  HCO3-              3.953e-005         2.220      0.6605       -4.5831
  Cl-                2.636e-005        0.8599      0.6063       -4.7964
  NaHCO3(aq)         2.575e-005         1.990      1.0000       -4.5893
  UO2(OH)3-          5.937e-006         1.754      0.6605       -5.4065
  NaCl(aq)           1.847e-006       0.09931      1.0000       -5.7336
  UO2(CO3)3----      1.432e-006        0.5930      0.0003       -9.3644
  UO2(OH)4--         2.541e-007       0.07903      0.1419       -7.4432
   (only species > 1e-8 molal listed)

 Mineral saturation states
                    log Q/K                          log Q/K
----------------------------------------------------------------
  Na2U2O7(c)         4.7184s/sat   Schoepite          -2.7886
  Na2U2O7(am)        2.2101s/sat   UO2(OH)2(beta)     -2.9010
  Ice               -0.1387        UO3:.9H2O(alpha)   -2.9720
  Natron            -2.7432        Schoepite-dehy(.   -2.9720
  UO3:2H2O          -2.7886
   (only minerals with log Q/K > -3 listed)

 Gases                  fugacity      log fug.
-----------------------------------------------
  O2(g)                  0.1978        -0.704
  H2O(g)                0.02598        -1.585
  CO2(g)             2.883e-009        -8.540
  NO2(g)             3.510e-020       -19.455
  N2(g)              2.995e-020       -19.524
  HCl(g)             1.341e-023       -22.872
  NO(g)              5.290e-026       -25.277
  Cl2(g)             1.160e-038       -37.935
```

H2(g)	6.301e-042	-41.201
CO(g)	5.674e-054	-53.246
Na(g)	4.435e-069	-68.353
NH3(g)	2.087e-069	-68.681
UO3(g)	1.249e-069	-68.903
UO2Cl2(g)	8.866e-080	-79.052
UO2(g)	1.750e-122	-121.757
UCl4(g)	1.698e-143	-142.770
CH4(g)	3.625e-151	-150.441
UCl5(g)	3.650e-155	-154.438
UCl6(g)	1.458e-161	-160.836
UCl3(g)	4.064e-169	-168.391
C(g)	2.992e-195	-194.524
UO(g)	9.733e-207	-206.012
UCl2(g)	5.267e-212	-211.278
C2H4(g)	6.532e-249	-248.185
UCl(g)	1.495e-252	-251.825
U2Cl8(g)	7.104e-276	-275.148
U2Cl10(g)	2.659e-283	-282.575
U(g)	1.270e-291	-290.896

		In fluid		Sorbed		Kd
Original basis	total moles	moles	mg/kg	moles	mg/kg	L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.02	-1.02	-943.			
H2O	54.5	54.5	9.04e+005			
HCO3-	0.00698	0.00698	392.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.05	1.05	2.22e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	7.63e-006	7.63e-006	1.90			

Elemental composition		In fluid		Sorbed	
	total moles	moles	mg/kg	moles	mg/kg
Carbon	0.006980	0.006980	77.14		
Chlorine	2.821e-005	2.821e-005	0.9202		
Hydrogen	111.0	111.0	1.030e+005		
Nitrogen	1.000	1.000	1.289e+004		
Oxygen	58.54	58.54	8.618e+005		
Sodium	1.050	1.050	2.221e+004		
Uranium	7.629e-006	7.629e-006	1.671		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19887 yellow, 24 hour (2).

```
Step #     0              Xi = 0.0000
Temperature =  25.0 C     Pressure =  1.013 bars
pH = 11.768               log fO2 =   -0.704
Eh =   0.5225 volts       pe =   8.8329
Ionic strength      =     1.053181
Activity of water   =     0.999999
Solvent mass        =     1.000000 kg
Solution mass       =     1.087434 kg
Solution density    =     1.013    g/cm3
Chlorinity          =     0.000028 molal
Dissolved solids    =        80404 mg/kg sol'n
Rock mass           =     0.000000 kg
Carbonate alkalinity=       331.96 mg/kg as CaCO3
```

No minerals in system.

Aqueous species	molality	mg/kg sol'n	act. coef.	log act.
Na+	1.088	2.301e+004	0.6604	-0.1435
NO3-	1.000	5.702e+004	0.6059	-0.2176
OH-	0.009331	145.9	0.6347	-2.2275
CO3--	0.001916	105.7	0.1620	-3.5079
NaCO3-	0.001105	84.31	0.6604	-3.1370
NaOH(aq)	0.0006750	24.83	1.0000	-3.1707
O2(aq)	0.0002500	7.357	1.0000	-3.6020
Cl-	2.629e-005	0.8572	0.6059	-4.7978
HCO3-	1.712e-005	0.9606	0.6604	-4.9467
NaHCO3(aq)	1.159e-005	0.8951	1.0000	-4.9361
UO2(OH)3-	7.172e-006	2.118	0.6604	-5.3245
NaCl(aq)	1.913e-006	0.1028	1.0000	-5.7182
UO2(OH)4--	3.062e-007	0.09519	0.1412	-7.3642
UO2(CO3)3----	1.437e-007	0.05948	0.0003	-10.3730

(only species > 1e-8 molal listed)

Mineral saturation states

	log Q/K		log Q/K
Na2U2O7(c)	4.9160s/sat	UO2(OH)2(beta)	-2.8160
Na2U2O7(am)	2.4077s/sat	Schoepite-dehy(.	-2.8870
Ice	-0.1387	UO3:.9H2O(alpha)	-2.8870
Schoepite	-2.7036	Schoepite-dehy(.	-2.9673
UO3:2H2O	-2.7036	Schoepite-dehy(1	-2.9734

(only minerals with log Q/K > -3 listed)

Gases	fugacity	log fug.
O2(g)	0.1978	-0.704
H2O(g)	0.02598	-1.585
CO2(g)	1.257e-009	-8.901
NO2(g)	3.532e-020	-19.452
N2(g)	3.033e-020	-19.518
HCl(g)	1.346e-023	-22.871
NO(g)	5.323e-026	-25.274
Cl2(g)	1.169e-038	-37.932

H2(g)	6.301e-042	-41.201
CO(g)	2.474e-054	-53.607
Na(g)	4.577e-069	-68.339
NH3(g)	2.100e-069	-68.678
UO3(g)	1.520e-069	-68.818
UO2Cl2(g)	1.086e-079	-78.964
UO2(g)	2.128e-122	-121.672
UCl4(g)	2.096e-143	-142.679
CH4(g)	1.581e-151	-150.801
UCl5(g)	4.523e-155	-154.345
UCl6(g)	1.813e-161	-160.742
UCl3(g)	4.999e-169	-168.301
C(g)	1.305e-195	-194.885
UO(g)	1.184e-206	-205.927
UCl2(g)	6.454e-212	-211.190
C2H4(g)	1.242e-249	-248.906
UCl(g)	1.825e-252	-251.739
U2Cl8(g)	1.083e-275	-274.965
U2Cl10(g)	4.083e-283	-282.389
U(g)	1.544e-291	-290.811

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-939.			
H2O	54.5	54.5	9.03e+005			
HCO3-	0.00305	0.00305	171.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.09	1.09	2.30e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	7.63e-006	7.63e-006	1.89			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.003050	0.003050	33.69		
Chlorine	2.821e-005	2.821e-005	0.9196		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.288e+004		
Oxygen	58.53	58.53	8.611e+005		
Sodium	1.090	1.090	2.304e+004		
Uranium	7.629e-006	7.629e-006	1.670		

Experiment #3 (1.0 M $NaNO_3$, 0.01 M NaOH) sample 19887 yellow, 1 week.

```
          Step #     0              Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 11.768               log fO2 =   -0.704
          Eh =   0.5225 volts       pe =   8.8325
          Ionic strength      =     1.051859
          Activity of water   =     0.999999
          Solvent mass        =     1.000000 kg
          Solution mass       =     1.087369 kg
          Solution density    =     1.013    g/cm3
          Chlorinity          =     0.000028 molal
          Dissolved solids    =        80349 mg/kg sol'n
          Rock mass           =     0.000000 kg
          Carbonate alkalinity=       217.67 mg/kg as CaCO3

  No minerals in system.

  Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
 ------------------------------------------------------------------------
   Na+                     1.089    2.302e+004      0.6604       -0.1433
   NO3-                    1.000    5.702e+004      0.6059       -0.2176
   OH-                  0.009339         146.1      0.6347       -2.2272
   CO3--                0.001256         69.34      0.1621       -3.6911
   NaCO3-              0.0007247         55.32      0.6604       -3.3200
   NaOH(aq)            0.0006758         24.86      1.0000       -3.1702
   O2(aq)              0.0002500         7.357      1.0000       -3.6020
   Cl-                2.629e-005        0.8572      0.6059       -4.7978
   HCO3-              1.122e-005        0.6295      0.6604       -5.1302
   NaHCO3(aq)         7.595e-006        0.5868      1.0000       -5.1194
   NaCl(aq)           1.914e-006        0.1029      1.0000       -5.7181
   UO2(OH)3-          1.366e-006        0.4033      0.6604       -6.0447
   UO2(OH)4--         5.834e-008       0.01814      0.1412       -8.0841
    (only species > 1e-8 molal listed)

  Mineral saturation states
                     log Q/K                          log Q/K
 ----------------------------------------------------------------
   Na2U2O7(c)         3.4758s/sat   Ice               -0.1387
   Na2U2O7(am)        0.9675s/sat
    (only minerals with log Q/K > -3 listed)

  Gases                 fugacity      log fug.
 -----------------------------------------------
   O2(g)                  0.1978       -0.704
   H2O(g)                0.02598       -1.585
   CO2(g)             8.230e-010       -9.085
   NO2(g)             3.529e-020      -19.452
   N2(g)              3.028e-020      -19.519
   HCl(g)             1.345e-023      -22.871
   NO(g)              5.318e-026      -25.274
   Cl2(g)             1.167e-038      -37.933
   H2(g)              6.301e-042      -41.201
   CO(g)              1.620e-054      -53.791
   Na(g)              4.583e-069      -68.339
   NH3(g)             2.098e-069      -68.678
```

UO3(g)	2.891e-070	-69.539
UO2Cl2(g)	2.064e-080	-79.685
UO2(g)	4.050e-123	-122.393
UCl4(g)	3.975e-144	-143.401
CH4(g)	1.035e-151	-150.985
UCl5(g)	8.571e-156	-155.067
UCl6(g)	3.433e-162	-161.464
UCl3(g)	9.489e-170	-169.023
C(g)	8.542e-196	-195.068
UO(g)	2.252e-207	-206.647
UCl2(g)	1.226e-212	-211.911
C2H4(g)	5.323e-250	-249.274
UCl(g)	3.470e-253	-252.460
U2Cl8(g)	3.895e-277	-276.410
U2Cl10(g)	1.466e-284	-283.834
U(g)	2.938e-292	-291.532

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.920			
H+	-1.01	-1.01	-938.			
H2O	54.5	54.5	9.03e+005			
HCO3-	0.00200	0.00200	112.			
NH3(aq)	1.00	1.00	1.57e+004			
Na+	1.09	1.09	2.30e+004			
O2(aq)	2.00	2.00	5.89e+004			
UO2++	1.43e-006	1.43e-006	0.356			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.002000	0.002000	22.09		
Chlorine	2.821e-005	2.821e-005	0.9197		
Hydrogen	111.0	111.0	1.029e+005		
Nitrogen	1.000	1.000	1.288e+004		
Oxygen	58.53	58.53	8.611e+005		
Sodium	1.090	1.090	2.305e+004		
Uranium	1.433e-006	1.433e-006	0.3137		

Experiment #3 (0.01 M NaOH, 0.001 M Na_2CO_3) sample 19887 yellow, 1 month.

```
          Step #     0              Xi = 0.0000
          Temperature =  25.0 C     Pressure =  1.013 bars
          pH = 11.854               log fO2 =   -0.704
          Eh =   0.5174 volts       pe =   8.7460
          Ionic strength      =     0.019214
          Activity of water   =     0.999999
          Solvent mass        =     1.000000 kg
          Solution mass       =     1.000984 kg
          Solution density    =     1.013    g/cm3
          Chlorinity          =     0.000028 molal
          Dissolved solids    =          983 mg/kg sol'n
          Rock mass           =     0.000000 kg
          Carbonate alkalinity=       115.22 mg/kg as CaCO3

  No minerals in system.

  Aqueous species       molality    mg/kg sol'n    act. coef.     log act.
 ---------------------------------------------------------------------------
   Na+                   0.02512         577.0      0.8726       -1.6591
   OH-                  0.008311         141.2      0.8703       -2.1407
   CO3--                0.001076         64.50      0.5828       -3.2027
   UO2(OH)3-           0.0005489         176.0      0.8726       -3.3197
   O2(aq)              0.0002500         7.992      1.0000       -3.6020
   NaCO3-              5.149e-005        4.270      0.8726       -4.3474
   Cl-                 2.812e-005       0.9959      0.8678       -4.6126
   NaOH(aq)            2.515e-005        1.005      1.0000       -4.5995
   HCO3-               2.142e-005        1.306      0.8726       -4.7283
   UO2(OH)4--          9.257e-006        3.126      0.5767       -5.2726
   NaHCO3(aq)          5.843e-007      0.04904      1.0000       -6.2333
   UO2(OH)2(aq)        5.409e-007       0.1643      1.0000       -6.2669
   UO2(CO3)3----       1.760e-007      0.07912      0.1100       -7.7131
   (UO2)3(OH)7-        1.014e-007      0.09409      0.8726       -7.0533
   NaCl(aq)            8.939e-008     0.005219      1.0000       -7.0487
   (UO2)2CO3(OH)3-     1.597e-008      0.01039      0.8726       -7.8558
    (only species > 1e-8 molal listed)

  Mineral saturation states
                    log Q/K                          log Q/K
 ----------------------------------------------------------------
   Na2U2O7(c)         5.8943s/sat   Schoepite-dehy(.  -0.9690
   Na2U2O7(am)        3.3860s/sat   UO3:.9H2O(alpha)  -0.9690
   Ice               -0.1387        Schoepite-dehy(.  -1.0493
   Schoepite         -0.7856        Schoepite-dehy(1  -1.0554
   UO3:2H2O          -0.7856        Schoepite-dehy(.  -2.1586
   UO2(OH)2(beta)    -0.8980        Schoepite-dehy(.  -2.6766
    (only minerals with log Q/K > -3 listed)

  Gases                 fugacity      log fug.
 -----------------------------------------------
   O2(g)                  0.1978      -0.704
   H2O(g)                0.02598      -1.585
   CO2(g)              1.702e-009     -8.769
   HCl(g)              1.688e-023    -22.773
   Cl2(g)              1.839e-038    -37.735
```

H2(g)	6.301e-042	-41.201
CO(g)	3.349e-054	-53.475
UO3(g)	1.258e-067	-66.900
Na(g)	1.705e-070	-69.768
UO2Cl2(g)	1.415e-077	-76.849
UO2(g)	1.762e-120	-119.754
UCl4(g)	4.293e-141	-140.367
CH4(g)	2.140e-151	-150.670
UCl5(g)	1.162e-152	-151.935
UCl6(g)	5.841e-159	-158.234
UCl3(g)	8.163e-167	-166.088
C(g)	1.766e-195	-194.753
UO(g)	9.800e-205	-204.009
UCl2(g)	8.404e-210	-209.076
C2H4(g)	2.275e-249	-248.643
UCl(g)	1.895e-250	-249.722
U2Cl8(g)	4.541e-271	-270.343
U2Cl10(g)	2.693e-278	-277.570
U(g)	1.278e-289	-288.893

Original basis	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg	Kd L/kg
Cl-	2.82e-005	2.82e-005	0.999			
H+	-0.0112	-0.0112	-11.2			
H2O	55.5	55.5	9.99e+005			
HCO3-	0.00115	0.00115	70.1			
Na+	0.0252	0.0252	579.			
O2(aq)	0.000250	0.000250	7.99			
UO2++	0.000559	0.000559	151.			

Elemental composition	total moles	In fluid moles	In fluid mg/kg	Sorbed moles	Sorbed mg/kg
Carbon	0.001150	0.001150	13.80		
Chlorine	2.821e-005	2.821e-005	0.9990		
Hydrogen	111.0	111.0	1.118e+005		
Oxygen	55.52	55.52	8.875e+005		
Sodium	0.02520	0.02520	578.8		
Uranium	0.0005592	0.0005592	133.0		

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