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Analysis of the Sludge Batch 8 (Macrobatch 10) DWPF Pour Stream Glass Sample

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EXECUTIVE SUMMARY

A pour stream (PS) sample taken during processing of Sludge Batch 8 (SB8, Macrobatch 10) was analyzed by Savannah River National Laboratory (SRNL) to verify compliance with the Defense Waste Processing Facility (DWPF) Glass Product Control Program.

The following conclusions were drawn from these analyses:

- The sum of oxides for the SB8 PS glass (97.41 wt%) is within the Product Composition Control System (PCCS) limits (100 ± 5 wt%).
- The average Waste Dilution Factor (WDF) calculated from the Tank 40 dried sludge analysis results for SB8 is 1.9 ± 0.1. In general, the radionuclide concentration of the SB8 PS glass sample calculated using this WDF is in good agreement with the measured radionuclide content.
- The Product Consistency Test (PCT) results indicate that the SB8 PS glass meets the Waste Acceptance Product Specifications (WAPS) for durability, with normalized release rates for boron, lithium and sodium all at least two standard deviations lower than those of the Environmental Assessment (EA) glass.
- The average measured density of the SB8 PS glass is 2.72 g/cm^3, consistent with previous PS samples.
- The average measured $Fe^{2+}/\Sigma Fe$ ratio of the SB8 PS glass is 0.15, within the target range of 0.09-0.33, and closely resembling the predicted REDOX value of 0.15.

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LIST OF ABBREVIATIONS

AR	Aqua Regia
ARG-1	Approved Reference Glass 1
ARM-1	Approved Reference Material 1
ASTM	American Society for Testing and Materials
C_i	Concentration of "*i*" in leachate
CG	Concentration in Glass
CS	Concentration in Sludge
D&S-FE	DWPF and Saltstone Facility Engineering
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
f_i	Mass fraction of "*i*" in glass.
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectroscopy
MB10	Macrobatch 10
MFT	Melter Feed Tank
m/z	Mass to Charge Ratio
NIST	National Institute of Standards and Technology
NC_i	Normalized Release of "i"
PCCS	Product Composition Control System
PCT	Product Consistency Test
PF	Peroxide Fusion
PRFT	Precipitate Reactor Feed Tank
PS	Pour Stream
REDOX	Reduction/Oxidation
SB8	Sludge Batch 8
SEFT	Strip Effluent Feed Tank
SPT	Sludge Pump Tank
SRNL	Savannah River National Laboratory
TTR	Technical Task Request
TTQAP	Task Technical Quality Assurance Plan
UV-VIS	Ultra Violet - Visible
WAPS	Waste Acceptance Product Specifications
WDF	Waste Dilution Factor

1.0 Introduction

To meet the objectives of the Defense Waste Processing Facility (DWPF) Glass Product Control Program[1], DWPF and Saltstone Facility Engineering (D&S-FE) requested that Savannah River National Laboratory (SRNL) analyze a radioactive glass pour stream (PS) sample collected during the processing of Sludge Batch 8 (SB8), also known as Macrobatch 10 (MB10)[2]. The analyses requested by D&S-FE (listed as tasks one through five in the Technical Task Request (TTR)[2]) included determination of the chemical and radionuclide composition, performance of the Product Consistency Test (PCT)[3], and measurement of glass density and REDOX state. The tasks associated with accomplishing these analyses were controlled under a Task Technical and Quality Assurance Plan (TTQAP)[4] and Analytical Study Plan[5]. This report provides results from the requested analyses and satisfies deliverable number five of the TTR[2].

Two PS glass samples were delivered to the SRNL Shielded Cells from DWPF in September 2014. Information pertinent to these glass samples is shown in Table 1-1.

Table 1-1. DWPF PS Glass Sample Information

Glass Canister	Sample Date	Melter Feed Tank Batch	Primary Container	Notes
S04274	08/11/2014	708	PC0128	Analysis
S04250	06/02/2014	702/703	PC0127	Archive

Additional information related to processing of the analyzed PS glass sample is given in Table 1-2.

Table 1-2. Processing Information During MFT Batch 708

Previous MFT Batch Heel (gal)	SPT Added (gal)	PRFT Added (gal)	SEFT Added (gal)	Predicted REDOX	Bubbler Utilization
1,281	5,824 sludge + 1,200 flush	0 (last added Batch 696)	5,197	0.15[a]	Bubblers Running

2.0 Experimental Procedure

2.1 Chemical Composition

A sample of the SB8 PS glass was ground using a Retsch Wig-L-Bug with agate ball. The ground glass was then sieved using a 200-mesh W. S. Tyler sieve. Quadruplicate samples of the -200 mesh glass powder were subsequently prepared for analysis via Aqua Regia (AR) and Peroxide Fusion (PF) digestions[6, 7]. Triplicate samples of a standard glass (ARG-1)[8] were also prepared for analysis using the same digestion methods. All prepared samples were analyzed by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES). A multi-element standard and blank were also measured during sample analysis to assess instrument performance.

2.2 Radionuclide Composition

Glasses prepared for ICP-AES were also analyzed with ICP-MS, alpha spectroscopy, and beta and gamma counting to determine radionuclide composition. The reportable radionuclides, determined

[a] Resulted in 0.126 in SME

by Bannochie and Diprete[9], not measured were calculated from the total dried solids[10] using a Waste Dilution Factor (WDF).

2.3 Product Consistency Test

The PCT Method A was performed on quadruplicate samples of the SB8 PS glass according to procedure[11]. Quadruplicate samples of reference glasses ARM-1[12] and EA[13], as well as triplicate blanks were included in PCT testing. PCT leachates were diluted, acidified, and analyzed by ICP-AES. Triplicate samples of a multi-element standard, as well as an analytical standard solution, were also measured during sample analysis to assess instrument performance.

2.4 Density

The density of the SB8 PS glass was measured using a Le Chatelier specific gravity flask (utilizing ASTM Type I[14] water as the immersion fluid). NIST traceable glasses[15, 16] were also measured to verify the Le Chatelier specific gravity flask for density measurement.

2.5 REDOX

A sample of the SB8 PS glass was ground using a Retsch Wig-L-Bug with agate ball. The ground glass was then sieved using a 200-mesh W. S. Tyler sieve. Duplicate samples of the -200 mesh glass powder were subsequently prepared for REDOX measurement and analyzed with a UV-VIS spectrometer according to procedure[17]. A sample of EA glass was also prepared and analyzed to act as a measurement check.

2.6 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in Manual E7 Procedure 2.60[18]. SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011, Rev. 2[19]. All data collected as part of this study is maintained in the SRNL Electronic Laboratory Notebook system, experiment L6207-00223-16.

3.0 Results and Discussion

3.1 Visual Examination

Upon receipt, the SB8 PS glass was partially broken out of the Pt/Au boat for visual examination. As shown in Figure 3-1, the glass appeared homogeneous, black, and shiny.

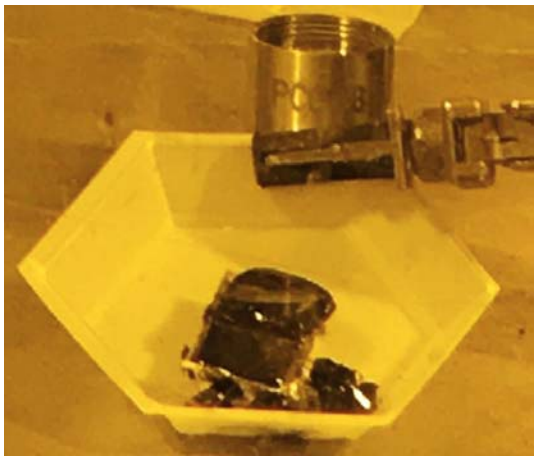

Figure 3-1. Image of As-Received SB8 PS Glass

3.2 Chemical Composition

The dissolution method, average measured composition (in wt%) of the SB8 PS and ARG-1 glasses and reported composition for the ARG-1 glass are given in Table 3-1. Analytes determined to be less than the detection limits are designated with a "<" sign and are excluded from the total oxide summation. As shown in Table 3-1, there is good agreement between reported and measured values for the reference ARG-1 glass. Additionally, the sum of oxides for the SB8 PS glass is >97 wt%, showing acceptable recovery of the glass components. As-measured data, including measurement relative standard deviation, is provided in Appendix A.

Table 3-1. Chemical Composition (wt%) of SB8 PS and ARG-1 Glasses

Oxide	Dissolution Method	SB8-PS [Measured]	ARG-1 [Measured]	ARG-1 [Reference[8]]
Al_2O_3	AR	7.10	4.76	4.73
B_2O_3	AR	4.71	8.49	8.67
BaO	AR	0.05	0.09	0.088
BeO	PF	<0.001	0.01	-
CaO	AR	0.76	1.53	1.43
CeO_2	AR	0.14	<0.006	-
Cr_2O_3	AR	0.09	0.10	0.093
CuO	AR	<0.003	<0.003	0.004
Fe_2O_3	AR	12.30	14.58	14.0
Gd_2O_3	AR	0.03	<0.00	-
K_2O	AR	<0.05	2.53	2.71
La_2O_3	AR	0.03	<0.01	-
Li_2O	PF	3.88	3.34	3.21
MgO	AR	0.20	0.87	0.86
MnO	AR	3.34	1.83	1.88[b]
Na_2O	AR	14.12	10.88	11.5
NiO	PF	0.97	1.01	1.05
P_2O_5	AR	<0.41	<0.48	0.22
SiO_2	PF	46.42	46.56	47.9
SrO	PF	0.02	0.01	0.0037
ThO_2	AR	0.50	<0.02	-
TiO_2	PF	0.02	1.20	1.15
U_3O_8	AR	2.02	<0.33	-
V_2O_5	PF	<0.001	0.02	-
ZnO	AR	0.64	0.02	0.02
ZrO_2	AR	0.07	0.06	0.13
Total	-	97.41	97.89	99.65[b]

[b] ARG-1 has a reported concentration of 2.31 wt% MnO_2 and a total oxide concentration of 100.08 wt%{Smith, 1993 #171}. These values were modified to display the glass composition using MnO.

3.3 Waste Dilution Factor (WDF)

The WDF was determined by dividing the concentration of a specific component (*i*) that was present in the dried Tank 40 sludge[10] (CS) by the concentration of the same component in the glass (CG), as shown in Equation 1.

$$WDF_i = \frac{CS_i}{CG_i} \quad (1)$$

The calculated results for aluminum, calcium, iron, and manganese are given in Table 3-2 and were used to calculate an average WDF value.

Table 3-2. WDF of Select Analytes

Element	Concentration in Dried Sludge (wt %)[10]	Measured Concentration in Glass (wt %)	WDF
Al	6.98	3.76	1.9
Ca	0.968	0.543	1.8
Fe	16.9	8.60	2.0
Mn	5.29	2.58	2.0
Average	-	-	1.9
St. Dev.	-	-	0.1

3.4 Radionuclide Composition

The average radionuclide composition of the isotopes deemed reportable in the WAPS for SB8[9] is shown in Table 3-3. The concentrations of radionuclides not measured directly were calculated by dividing their concentration in the dried Tank 40 sludge, listed in the 2014 report by Bannochie and DiPrete[9], by the average WDF value shown in Table 3-2. It should be noted that this calculation is based solely on the sludge stream and does not include contributions from the Cs-laden strip effluent stream processed at DWPF. In general, good agreement between calculated and measured values is observed, and variation between calculated and measured values closely resembles that from previous PS glass studies[20, 21]. Lower than calculated technetium values may be attributed to volatility during melting. Measurement data, including measurement relative standard deviation, is provided in Appendix A.

Table 3-3. Measured Reportable Radionuclide Composition

Radionuclide	Specific Activity (Ci/g)[9]	Concentration in Dried Sludge (µCi/g)[9]	Calculated Concentration in Glass (Ci/kg)	Measured Concentration in Glass (Ci/kg)	Counting Method
Ni-59	8.08E-02	7.53E-01	3.94E-04	-	-
Ni-63	6.17E+01	9.21E+01	4.82E-02	-	-
Se-79	6.97E-02	1.04E-02	5.44E-06	-	-
Sr-90	1.36E+02	9.39E+03	4.91E+00	5.43E+00	Sr-90
Zr-93	2.51E-03	7.02E-01	3.67E-04	3.00E-04	Zr-93
Nb-93m	2.83E+02	6.23E-01	3.26E-04	-	-
Tc-99	1.70E-02	3.43E-01	1.79E-04	3.11E-05	Tc-99
Cd-113m	2.17E+02	2.12E+00	1.11E-03	-	-
Sn-126	2.84E-02	2.82E-01	1.47E-04	9.26E-05	ICP-MS
Cs-135	1.15E-03	4.55E-03	2.38E-06	<5.08E-06	Cs-135
Cs-137	8.70E+01	8.14E+02	4.26E-01	9.25E-01	Direct Gamma Counting
Sm-151	2.63E+01	1.61E+02	8.42E-02	-	-
Th-229	2.13E-01	2.46E-04	1.29E-07	-	-
Th-232[c]	1.10E-07	8.95E-04	4.68E-07	4.27E-07	ICP-MS
U-233	9.68E-03	6.00E-02	3.14E-05	3.28E-05	ICP-MS
U-234	6.25E-03	4.50E-02	2.35E-05	2.24E-05	ICP-MS
U-235	2.16E-06	5.41E-04	2.83E-07	2.42E-07	ICP-MS
U-236	6.47E-05	1.01E-03	5.28E-07	4.90E-07	ICP-MS
Np-237	7.05E-04	2.50E-02	1.31E-05	1.02E-05	ICP-MS
Pu-238	1.71E+01	1.96E+02	1.02E-01	6.85E-02	Pu-238/Pu-241
U-238	3.36E-07	1.25E-02	6.54E-06	5.62E-06	ICP-MS
Pu-239	6.22E-02	7.78E+00	4.07E-03	3.64E-03	ICP-MS
Pu-240	2.28E-01	2.83E+00	1.48E-03	1.25E-03	ICP-MS
Am-241	3.43E+00	2.74E+01	1.43E-02	1.20E-02	Cs-Removed Gamma Counting
Pu-241	1.03E+02	3.92E+01	2.05E-02	1.28E-02	Pu-238/Pu-241
Am-242m	9.72E+00	1.41E-01	7.37E-05	-	-
Pu-242	3.82E-03	7.31E-03	3.82E-06	1.75E-06	ICP-MS
Am-243	1.99E-01	1.88E+00	9.83E-04	-	-
Cm-244	8.09E+01	6.31E+01	3.30E-02	-	-
Cm-245	1.72E-01	1.08E-02	5.65E-06	-	-
Cm-246	3.07E-01	3.10E-02	1.62E-05	-	-
Cf-249	4.38E+00	1.68E-02	8.78E-06	-	-
Cf-251	1.86E+00	4.78E-02	2.50E-05	-	-

[c] Th-232 is included because it was measured at greater than 0.2 wt% by ICP-MS

3.5 Product Consistency Test

The average measured normalized release (NC_i) values for boron, lithium sodium, and silicon, determined for the SB8 PS (calculated using the average composition given in Table 3-1), ARM-1, and EA glasses are given in Table 3-4. Standard deviations, calculated according to Equation 2 where NC_i is the normalized release based on individual leachate analyses, $\overline{NC_i}$ is the average normalized release (calculated according to Equation 3), and n is the number of leachates analyzed, are also given in Table 3-4. In Equation 3, C_i is the concentration of "i" measured in the leachate (corrected for dilution), and f_i is the average mass fraction of "i" in the glass.

$$standard\ deviation = \sqrt{\frac{\sum[NC_i - \overline{NC_i}]^2}{n}} \quad (2)$$

$$\overline{NC_i} = 10^{\left(\frac{\sum \log\left(\frac{C_i}{f_i}\right)}{n}\right)} \quad (3)$$

No issues with water loss were observed throughout testing. The differences between reported and measured average values, as well as relative standard deviations, for the multielement solutions analyzed alongside the PCT leachates, shown in Appendix A, were both less than 10%, indicating there were no significant errors in analytical measurement. ICP-AES analysis of the 0.4 M HNO_3 solution used to acidify the PCT leachates revealed the presence of select impurities, specifically 28.7 mg/L of Na and 9.16 mg/L of Si. Based on this information, the measured leachate values were corrected by subtracting out the known concentrations added for these elements during acidification/dilution. The as-measured leachate concentrations of the ARM-1, EA, and SB8 PS glasses as well as blanks are given in Appendix A. While the measured values for the standard glasses are slightly higher than the reported values, the normalized release values of boron, lithium, and silicon for the ARM-1 glass fell within the control charts[12], and the SB8 PS glass has a measured normalized release well below the acceptable limits set by the EA glass[d]. No attempt to bias correct the results (based on analytes measured in the blanks[e]) was made, since this would only decrease conservatism.

Table 3-4. Normalized PCT Results (g/L)

Glass ID		ARM-1[f]	SB8 PS	EA Glass	EA Glass [Reported[13]]
NC_B	**Average**	0.51	0.84	20.36	16.7
	St. Dev.	0.018	0.048	2.314	1.2
NC_{Li}	**Average**	0.57	0.79	11.19	9.6
	St. Dev.	0.013	0.008	1.289	0.7
NC_{Na}	**Average**	0.62	1.26	15.12	13.3
	St. Dev.	0.073	0.019	1.631	0.9
NC_{Si}	**Average**	0.29	0.67	4.38	3.9
	St. Dev.	0.002	0.013	0.452	0.4

[d] Per the WAPS[22], normalized release of B, Li, and Na must be at least two standard deviations lower than the EA benchmark glass.
[e] Acidified blank leachates had average measured concentrations of 13.53 mg/L of Na and 4.97 mg/L of Si. After correcting for impurities from acidification/dilution these values equate to 3.42 mg/L of Na and 2.19 mg/L of Si.
[f] Presented values are based on analyses of triplicate samples. The fourth sample was excluded since it displayed comparatively elevated silicon release.

3.6 Density

The average measured densities for the NIST traceable glasses and the SB8 PS glass are given in Table 3-5. The NIST glasses show good agreement between the two methods used for density measurement (~1% difference), and closely match the reported value (~0.1% difference). The SB8 PS glass density value is in good agreement with PS glass samples analyzed previously[20, 21] (2.70 g/cm^3 reported), and coincides with a waste loading between 36-38 wt%[23]. Raw measurements are provided in Appendix A.

Table 3-5. Measured Density

Glass ID	Density (g/cm^3)	RSD (%)
SB8 PS	2.715	4.4
NIST SRM 93a	2.201	2.7
NIST SRM 93a[g]	2.224	0.02
NIST SRM 1826[g]	2.551	0.001
NIST SRM 1826 [Reference[15]]	2.549	0.002

3.7 REDOX

The average measured Fe^{2+}/Fe^{3+} and $Fe^{2+}/\Sigma Fe$ ratios for the SB8 PS and reference EA glasses are given in Table 3-6. The values for the EA glass closely match the reported values[13, 17]. The average $Fe^{2+}/\Sigma Fe$ value for the SB8 PS glass falls within the reported target range of 0.09-0.33[25], and closely matches the 0.15 predicted value shown in Table 1-2. Raw measurements are provided in Appendix A.

Table 3-6. Measured REDOX Data

Glass ID	Fe^{2+}/Fe^{3+}	$Fe^{2+}/\Sigma Fe$
SB8 PS	0.18	0.15
EA Glass	0.22	0.18
EA Glass - Reported[13, 17]	0.22-0.23	0.18

[g] Measured following ITS-0057[24] to verify NIST SRM 93a as a standard for use with the Le Chatelier specific gravity flask

4.0 Conclusions

- The sum of oxides for the SB8 PS glass (97.41 wt%) is within the Product Composition Control System (PCCS) limits (100 ± 5 wt%)[26].
- The average WDF calculated from the Tank 40 dried sludge analysis results for SB8 is 1.9 ± 0.1. In general, the radionuclide concentration of the SB8 PS glass sample calculated using this WDF is in good agreement with the measured radionuclide content.
- The PCT results indicate that the SB8 PS glass meets the WAPS for durability[22], with normalized release rates for boron, lithium and sodium all at least two standard deviations lower than that of the EA glass.
- The average measured density of the SB8 PS glass is 2.72 g/cm^3, consistent with previous PS samples.
- The average measured $Fe^{2+}/\Sigma Fe$ ratio of the SB8 PS glass is 0.15, within the target range of 0.09-0.33.

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Appendix A. Supplemental Data

Table A-1. Measured Elemental Concentration of Samples Prepared by Aqua Regia

Glass ID	Blank	Multielement Standard	ARG-1		
Replicate	1	1	1	2	3
Lab ID	LW11613	LW11610	LW11607	LW11608	LW11609
Units	µg/g	mg/L	µg/g	µg/g	µg/g
Ag	< 12.8 (N/A %RSD)	< 0.016 (N/A %RSD)	< 14.3 (N/A %RSD)	< 12.8 (N/A %RSD)	< 15.8 (N/A %RSD)
Al	< 150 (N/A %RSD)	4.27 (10 %RSD)	26200 (10 %RSD)	24700 (10 %RSD)	24600 (10 %RSD)
B	< 200 (N/A %RSD)	19.9 (10 %RSD)	26800 (10 %RSD)	26300 (10 %RSD)	26000 (10 %RSD)
Ba	< 2.53 (N/A %RSD)	< 0.00316 (N/A %RSD)	824 (10.1 %RSD)	806 (10 %RSD)	810 (10 %RSD)
Be	< 0.598 (N/A %RSD)	< 0.000747 (N/A %RSD)	26.4 (10 %RSD)	25.7 (10 %RSD)	25.2 (10 %RSD)
Ca	< 6.93 (N/A %RSD)	< 0.00866 (N/A %RSD)	11100 (10 %RSD)	10800 (10 %RSD)	10900 (10 %RSD)
Cd	< 3.43 (N/A %RSD)	< 0.00429 (N/A %RSD)	< 4.7 (N/A %RSD)	< 4.22 (N/A %RSD)	< 5.19 (N/A %RSD)
Ce	< 45.5 (N/A %RSD)	< 0.0568 (N/A %RSD)	< 50.9 (N/A %RSD)	< 45.7 (N/A %RSD)	< 56.3 (N/A %RSD)
Co	< 8.97 (N/A %RSD)	< 0.0112 (N/A %RSD)	< 100 (N/A %RSD)	< 90.2 (N/A %RSD)	< 111 (N/A %RSD)
Cr	< 7.43 (N/A %RSD)	< 0.00929 (N/A %RSD)	658 (10.1 %RSD)	645 (10 %RSD)	657 (10 %RSD)
Cu	< 19.4 (N/A %RSD)	< 0.0242 (N/A %RSD)	< 21.7 (N/A %RSD)	< 19.5 (N/A %RSD)	< 24 (N/A %RSD)
Fe	< 45 (N/A %RSD)	4.2 (10 %RSD)	102000 (10 %RSD)	101000 (10 %RSD)	103000 (10 %RSD)
Gd	< 8.79 (N/A %RSD)	< 0.011 (N/A %RSD)	< 109 (N/A %RSD)	< 8.83 (N/A %RSD)	< 20 (N/A %RSD)
K	< 391 (N/A %RSD)	9.03 (10 %RSD)	20900 (10.2 %RSD)	21000 (10 %RSD)	21100 (10.1 %RSD)
La	< 8.85 (N/A %RSD)	< 0.0111 (N/A %RSD)	< 9.92 (N/A %RSD)	< 8.9 (N/A %RSD)	< 11 (N/A %RSD)
Li	< 45 (N/A %RSD)	9.94 (10 %RSD)	15000 (10 %RSD)	14600 (10 %RSD)	14600 (10 %RSD)
Mg	< 0.559 (N/A %RSD)	< 0.000699 (N/A %RSD)	5320 (10 %RSD)	5230 (10 %RSD)	5250 (10 %RSD)
Mn	< 25 (N/A %RSD)	< 0.00125 (N/A %RSD)	14400 (10 %RSD)	14100 (10 %RSD)	14100 (10 %RSD)
Mo	< 31.9 (N/A %RSD)	< 0.0399 (N/A %RSD)	< 350 (N/A %RSD)	< 380 (N/A %RSD)	< 395 (N/A %RSD)

Table A-2. Measured Elemental Concentration of Samples Prepared by Aqua Regia (Continued)

Glass ID	Blank	Multielement Standard	ARG-1		
Replicate	1	1	1	2	3
Lab ID	LW11613	LW11610	LW11607	LW11608	LW11609
Units	µg/g	mg/L	µg/g	µg/g	µg/g
Na	< 69.4 (N/A %RSD)	82.5 (10 %RSD)	81500 (10 %RSD)	80600 (10 %RSD)	80100 (10 %RSD)
Ni	< 150 (N/A %RSD)	< 0.0495 (N/A %RSD)	7860 (10 %RSD)	7660 (10 %RSD)	7700 (10 %RSD)
P	< 173 (N/A %RSD)	< 0.216 (N/A %RSD)	< 1940 (N/A %RSD)	< 2140 (N/A %RSD)	< 2140 (N/A %RSD)
Pb	< 58.7 (N/A %RSD)	< 0.0734 (N/A %RSD)	< 65.7 (N/A %RSD)	< 59 (N/A %RSD)	< 72.6 (N/A %RSD)
S	< 3580 (N/A %RSD)	< 4.48 (N/A %RSD)	< 4010 (N/A %RSD)	< 3600 (N/A %RSD)	< 4430 (N/A %RSD)
Sb	< 99.4 (N/A %RSD)	< 0.124 (N/A %RSD)	< 111 (N/A %RSD)	< 99.9 (N/A %RSD)	< 123 (N/A %RSD)
Si	< 200 (N/A %RSD)	49.5 (10 %RSD)	8990 (10 %RSD)	12700 (10 %RSD)	11900 (10.1 %RSD)
Sn	< 242 (N/A %RSD)	< 1.2 (N/A %RSD)	< 271 (N/A %RSD)	< 243 (N/A %RSD)	< 299 (N/A %RSD)
Sr	< 69.8 (N/A %RSD)	< 0.0872 (N/A %RSD)	< 78.2 (N/A %RSD)	< 70.1 (N/A %RSD)	< 86.4 (N/A %RSD)
Th	< 32.2 (N/A %RSD)	< 0.0402 (N/A %RSD)	< 423 (N/A %RSD)	< 32.3 (N/A %RSD)	< 39.8 (N/A %RSD)
Ti	< 1.55 (N/A %RSD)	< 0.00194 (N/A %RSD)	5520 (10 %RSD)	5180 (10 %RSD)	5370 (10 %RSD)
U	< 199 (N/A %RSD)	< 0.248 (N/A %RSD)	< 2900 (N/A %RSD)	< 2800 (N/A %RSD)	< 2800 (N/A %RSD)
V	< 3.42 (N/A %RSD)	< 0.00428 (N/A %RSD)	116 (10.3 %RSD)	113 (10.2 %RSD)	113 (11.4 %RSD)
Zn	< 3.45 (N/A %RSD)	< 0.00431 (N/A %RSD)	195 (10 %RSD)	168 (10 %RSD)	162 (10 %RSD)
Zr	< 2.54 (N/A %RSD)	< 0.00318 (N/A %RSD)	581 (10 %RSD)	576 (10 %RSD)	214 (10 %RSD)

Table A-3. Measured Elemental Concentration of Samples Prepared by Aqua Regia (Continued)

Glass ID	SB8 PS			
Replicate	1	2	3	4
Lab ID	LW11600	LW11601	LW11602	LW11603
Units	µg/g	µg/g	µg/g	µg/g
Ag	< 14.7 (N/A %RSD)	< 14.5 (N/A %RSD)	< 15.2 (N/A %RSD)	< 13.9 (N/A %RSD)
Al	38200 (10 %RSD)	36300 (10 %RSD)	37900 (10 %RSD)	37800 (10 %RSD)
B	14900 (10 %RSD)	14500 (10 %RSD)	14600 (10 %RSD)	14500 (10 %RSD)
Ba	441 (10 %RSD)	431 (10 %RSD)	436 (10 %RSD)	494 (10 %RSD)
Be	< 15 (N/A %RSD)	< 6.8 (N/A %RSD)	< 15 (N/A %RSD)	< 6.5 (N/A %RSD)
Ca	5350 (10 %RSD)	5240 (10 %RSD)	5280 (10 %RSD)	5890 (10 %RSD)
Cd	< 150 (N/A %RSD)	< 150 (N/A %RSD)	< 150 (N/A %RSD)	< 150 (N/A %RSD)
Ce	1140 (10.5 %RSD)	1120 (10.1 %RSD)	1110 (10.1 %RSD)	1140 (10.1 %RSD)
Co	< 102 (N/A %RSD)	< 102 (N/A %RSD)	< 107 (N/A %RSD)	< 97.6 (N/A %RSD)
Cr	595 (10.1 %RSD)	583 (10.1 %RSD)	594 (10 %RSD)	656 (10.1 %RSD)
Cu	< 22.3 (N/A %RSD)	< 22 (N/A %RSD)	< 23 (N/A %RSD)	< 21.1 (N/A %RSD)
Fe	86700 (10 %RSD)	84800 (10 %RSD)	86200 (10 %RSD)	86500 (10 %RSD)
Gd	226 (10.3 %RSD)	217 (10 %RSD)	216 (10.6 %RSD)	212 (10 %RSD)
K	< 451 (N/A %RSD)	< 445 (N/A %RSD)	< 465 (N/A %RSD)	< 425 (N/A %RSD)
La	297 (10.1 %RSD)	288 (10 %RSD)	291 (10.1 %RSD)	294 (10 %RSD)
Li	16800 (10 %RSD)	16400 (10 %RSD)	16500 (10 %RSD)	16400 (10 %RSD)
Mg	1120 (10 %RSD)	1190 (10 %RSD)	1210 (10 %RSD)	1280 (10 %RSD)
Mn	26200 (10 %RSD)	25700 (10 %RSD)	25900 (10 %RSD)	25600 (10 %RSD)
Mo	< 368 (N/A %RSD)	< 363 (N/A %RSD)	< 380 (N/A %RSD)	< 347 (N/A %RSD)

Table A-4. Measured Elemental Concentration of Samples Prepared by Aqua Regia (Continued)

Glass ID	SB8 PS			
Replicate	1	2	3	4
Lab ID	LW11600	LW11601	LW11602	LW11603
Units	µg/g	µg/g	µg/g	µg/g
Na	106000 (10 %RSD)	103000 (10 %RSD)	105000 (10 %RSD)	105000 (10 %RSD)
Ni	7950 (10 %RSD)	7840 (10 %RSD)	7890 (10.1 %RSD)	7910 (10 %RSD)
P	< 1500 (N/A %RSD)	< 1800 (N/A %RSD)	< 2060 (N/A %RSD)	< 1880 (N/A %RSD)
Pb	< 677 (N/A %RSD)	< 668 (N/A %RSD)	< 699 (N/A %RSD)	< 638 (N/A %RSD)
S	< 8700 (N/A %RSD)	< 4070 (N/A %RSD)	< 8700 (N/A %RSD)	< 3890 (N/A %RSD)
Sb	< 115 (N/A %RSD)	< 113 (N/A %RSD)	< 118 (N/A %RSD)	< 108 (N/A %RSD)
Si	16200 (10 %RSD)	18500 (10 %RSD)	15100 (10 %RSD)	18400 (10 %RSD)
Sn	< 279 (N/A %RSD)	< 275 (N/A %RSD)	< 288 (N/A %RSD)	< 263 (N/A %RSD)
Sr	< 900 (N/A %RSD)	< 794 (N/A %RSD)	< 830 (N/A %RSD)	< 759 (N/A %RSD)
Th	4460 (10 %RSD)	4370 (10 %RSD)	4400 (10 %RSD)	4370 (10 %RSD)
Ti	94.5 (10.2 %RSD)	93.3 (10.2 %RSD)	91.4 (10.2 %RSD)	99.2 (10.1 %RSD)
U	17300 (10 %RSD)	17100 (10 %RSD)	17200 (10 %RSD)	16800 (10 %RSD)
V	< 3.94 (N/A %RSD)	< 3.89 (N/A %RSD)	< 4.07 (N/A %RSD)	< 3.72 (N/A %RSD)
Zn	145 (10 %RSD)	139 (10 %RSD)	140 (10 %RSD)	20100 (10 %RSD)
Zr	514 (10 %RSD)	574 (10 %RSD)	481 (10 %RSD)	651 (10 %RSD)

Table A-5. Measured Elemental Concentration of Samples Prepared by Peroxide Fusion

Glass ID	Blank	Multielement Standard	ARG-1		
Replicate	1	1	1	2	3
Lab ID	LW11612	LW11611	LW11604	LW11605	LW11606
Units	µg/g	mg/L	µg/g	µg/g	µg/g
Ag	< 600 (N/A %RSD)	< 0.013 (N/A %RSD)	< 439 (N/A %RSD)	< 728 (N/A %RSD)	< 510 (N/A %RSD)
Al	< 950 (N/A %RSD)	3.76 (10.2 %RSD)	25000 (10 %RSD)	25800 (10 %RSD)	27200 (10 %RSD)
B	< 200 (N/A %RSD)	23.1 (11.9 %RSD)	24700 (10 %RSD)	25300 (10 %RSD)	26700 (10 %RSD)
Ba	< 5.06 (N/A %RSD)	< 0.01 (N/A %RSD)	736 (10.1 %RSD)	749 (10 %RSD)	809 (10.1 %RSD)
Be	< 4.02 (N/A %RSD)	< 0.000587 (N/A %RSD)	26.6 (10 %RSD)	29.6 (10 %RSD)	29.2 (11 %RSD)
Ca	1840 (10 %RSD)	0.0835 (10.6 %RSD)	10700 (10 %RSD)	12300 (10 %RSD)	12000 (10 %RSD)
Cd	< 8.39 (N/A %RSD)	< 0.016 (N/A %RSD)	< 8.46 (N/A %RSD)	< 9.4 (N/A %RSD)	< 8.75 (N/A %RSD)
Ce	< 123 (N/A %RSD)	< 0.0771 (N/A %RSD)	< 102 (N/A %RSD)	< 114 (N/A %RSD)	< 106 (N/A %RSD)
Co	< 14.1 (N/A %RSD)	< 0.00882 (N/A %RSD)	< 37.9 (N/A %RSD)	< 15.8 (N/A %RSD)	< 29.2 (N/A %RSD)
Cr	< 23 (N/A %RSD)	< 0.00929 (N/A %RSD)	645 (10.3 %RSD)	648 (10.4 %RSD)	685 (10.2 %RSD)
Cu	< 38.7 (N/A %RSD)	< 0.0242 (N/A %RSD)	< 39 (N/A %RSD)	< 43.4 (N/A %RSD)	< 40.4 (N/A %RSD)
Fe	300 (10.2 %RSD)	4.16 (10 %RSD)	92200 (10 %RSD)	95000 (10 %RSD)	100000 (10 %RSD)
Gd	< 17.6 (N/A %RSD)	< 0.011 (N/A %RSD)	< 17.7 (N/A %RSD)	< 19.7 (N/A %RSD)	< 18.3 (N/A %RSD)
K	< 782 (N/A %RSD)	8.64 (10.8 %RSD)	21900 (10.1 %RSD)	22600 (10 %RSD)	23800 (10 %RSD)
La	35.2 (10.6 %RSD)	< 0.0045 (N/A %RSD)	< 7.26 (N/A %RSD)	< 8.07 (N/A %RSD)	< 7.51 (N/A %RSD)
Li	< 30 (N/A %RSD)	9.35 (10.2 %RSD)	14900 (10 %RSD)	15300 (10 %RSD)	16300 (10 %RSD)
Mg	77.6 (10.2 %RSD)	0.007 (20.1 %RSD)	4640 (10 %RSD)	4970 (10 %RSD)	5210 (10 %RSD)
Mn	< 2.05 (N/A %RSD)	< 0.00125 (N/A %RSD)	13200 (10 %RSD)	13700 (10 %RSD)	14400 (10 %RSD)
Mo	< 63.8 (N/A %RSD)	< 0.0399 (N/A %RSD)	< 77.2 (N/A %RSD)	< 85.9 (N/A %RSD)	< 79.9 (N/A %RSD)

Table A-6. Measured Elemental Concentration of Samples Prepared by Peroxide Fusion (Continued)

Glass ID	Blank		Multielement Standard		ARG-1					
Replicate	1		1		1		2		3	
Lab ID	LW11612		LW11611		LW11604		LW11605		LW11606	
Units	µg/g		mg/L		µg/g		µg/g		µg/g	
Na	-	-	80.7	(10.1 %RSD)	-	-	-	-	-	-
Ni	< 79.2	(N/A %RSD)	< 0.0495	(N/A %RSD)	7660	(10.1 %RSD)	7840	(10 %RSD)	8320	(10.1 %RSD)
P	< 200	(N/A %RSD)	< 0.0776	(N/A %RSD)	< 963	(N/A %RSD)	< 1190	(N/A %RSD)	< 1173	(N/A %RSD)
Pb	< 117	(N/A %RSD)	< 0.0734	(N/A %RSD)	< 118	(N/A %RSD)	< 131	(N/A %RSD)	< 122	(N/A %RSD)
S	< 13200	(N/A %RSD)	< 7	(N/A %RSD)	< 7220	(N/A %RSD)	< 8020	(N/A %RSD)	< 7470	(N/A %RSD)
Sb	< 152	(N/A %RSD)	< 0.222	(N/A %RSD)	< 153	(N/A %RSD)	< 170	(N/A %RSD)	< 158	(N/A %RSD)
Si	< 96	(N/A %RSD)	49.8	(10 %RSD)	208000	(10 %RSD)	216000	(10.1 %RSD)	229000	(10 %RSD)
Sn	< 146	(N/A %RSD)	< 0.0267	(N/A %RSD)	< 230	(N/A %RSD)	< 275	(N/A %RSD)	< 307	(N/A %RSD)
Sr	13.6	(10 %RSD)	< 0.025	(N/A %RSD)	41.1	(10 %RSD)	44.8	(10 %RSD)	45.9	(10 %RSD)
Th	< 143	(N/A %RSD)	< 0.0896	(N/A %RSD)	300	(11.6 %RSD)	340	(12.9 %RSD)	390	(10.8 %RSD)
Ti	< 19.2	(N/A %RSD)	< 0.008	(N/A %RSD)	6880	(10 %RSD)	7080	(10 %RSD)	7530	(10 %RSD)
U	< 335	(N/A %RSD)	< 0.209	(N/A %RSD)	1390	(20 %RSD)	1870	(20 %RSD)	1580	(30 %RSD)
V	< 6.85	(N/A %RSD)	< 0.01	(N/A %RSD)	124	(14.3 %RSD)	136	(10.1 %RSD)	140	(11 %RSD)
Zn	< 50	(N/A %RSD)	< 0.05	(N/A %RSD)	244	(10 %RSD)	293	(10.1 %RSD)	248	(10.3 %RSD)
Zr	-	-	< 0.00318	(N/A %RSD)	-	-	-	-	-	-

Table A-7. Measured Elemental Concentration of Samples Prepared by Peroxide Fusion (Continued)

Glass ID	SB8 PS			
Replicate	1	2	3	4
Lab ID	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g
Ag	< 680 (N/A %RSD)	< 500 (N/A %RSD)	< 580 (N/A %RSD)	< 711 (N/A %RSD)
Al	37100 (10 %RSD)	37100 (10 %RSD)	37100 (10 %RSD)	36800 (10 %RSD)
B	14300 (10 %RSD)	14100 (10 %RSD)	14000 (10 %RSD)	13900 (10 %RSD)
Ba	397 (10.3 %RSD)	399 (10.1 %RSD)	400 (10.1 %RSD)	399 (10.1 %RSD)
Be	< 4.02 (N/A %RSD)	< 2.95 (N/A %RSD)	< 3.01 (N/A %RSD)	4.48 (10 %RSD)
Ca	7180 (10 %RSD)	6340 (10 %RSD)	5760 (10 %RSD)	6000 (10 %RSD)
Cd	< 20.6 (N/A %RSD)	< 24.3 (N/A %RSD)	< 17.6 (N/A %RSD)	< 10.8 (N/A %RSD)
Ce	1030 (11.1 %RSD)	770 (10.3 %RSD)	822 (12.3 %RSD)	< 845 (11 %RSD)
Co	< 30 (N/A %RSD)	< 75 (N/A %RSD)	< 55 (N/A %RSD)	< 55 (N/A %RSD)
Cr	591 (10.1 %RSD)	575 (10.6 %RSD)	594 (10.2 %RSD)	626 (10.4 %RSD)
Cu	< 45.4 (N/A %RSD)	< 43.6 (N/A %RSD)	< 44.8 (N/A %RSD)	< 43.4 (N/A %RSD)
Fe	81200 (10 %RSD)	81600 (10 %RSD)	81800 (10 %RSD)	80300 (10 %RSD)
Gd	210 (10.8 %RSD)	208 (10.3 %RSD)	206 (10.8 %RSD)	199 (10.4 %RSD)
K	< 917 (N/A %RSD)	< 880 (N/A %RSD)	< 905 (N/A %RSD)	< 1000 (N/A %RSD)
La	175 (10.3 %RSD)	199 (10.2 %RSD)	197 (11.2 %RSD)	140 (10.8 %RSD)
Li	18000 (10 %RSD)	18100 (10 %RSD)	18000 (10 %RSD)	17400 (10 %RSD)
Mg	1180 (10 %RSD)	1120 (10 %RSD)	1140 (10 %RSD)	1160 (10 %RSD)
Mn	22700 (10 %RSD)	22800 (10 %RSD)	22800 (10 %RSD)	24900 (10 %RSD)
Mo	< 74.8 (N/A %RSD)	< 167 (N/A %RSD)	< 73.9 (N/A %RSD)	< 85.9 (N/A %RSD)

Table A-8. Measured Elemental Concentration of Samples Prepared by Peroxide Fusion (Continued)

Glass ID	SB8 PS							
Replicate	1		2		3		4	
Lab ID	LW11596		LW11597		LW11598		LW11599	
Units	µg/g		µg/g		µg/g		µg/g	
Na	-	-	-	-	-	-	-	-
Ni	7530	(10.3 %RSD)	7700	(10 %RSD)	7580	(10 %RSD)	7990	(10.1 %RSD)
P	< 900	(N/A %RSD)	< 800	(N/A %RSD)	< 950	(N/A %RSD)	< 388	(N/A %RSD)
Pb	< 138	(N/A %RSD)	< 132	(N/A %RSD)	< 300	(N/A %RSD)	< 332	(N/A %RSD)
S	< 6490	(N/A %RSD)	< 6150	(N/A %RSD)	< 15300	(N/A %RSD)	< 8020	(N/A %RSD)
Sb	< 178	(N/A %RSD)	< 171	(N/A %RSD)	< 175	(N/A %RSD)	< 170	(N/A %RSD)
Si	210000	(10.5 %RSD)	217000	(10.1 %RSD)	224000	(10 %RSD)	203000	(10.3 %RSD)
Sn	< 233	(N/A %RSD)	< 367	(N/A %RSD)	< 246	(N/A %RSD)	< 230	(N/A %RSD)
Sr	188	(10 %RSD)	177	(10 %RSD)	178	(10 %RSD)	159	(10.8 %RSD)
Th	4020	(10.6 %RSD)	3980	(10.1 %RSD)	3980	(11.1 %RSD)	3880	(10 %RSD)
Ti	138	(10 %RSD)	132	(10 %RSD)	166	(10 %RSD)	78.1	(11 %RSD)
U	17700	(12 %RSD)	16400	(10.4 %RSD)	16600	(12 %RSD)	17300	(10.1 %RSD)
V	< 8.03	(N/A %RSD)	< 7.7	(N/A %RSD)	< 7.92	(N/A %RSD)	< 7.67	(N/A %RSD)
Zn	203	(11.4 %RSD)	213	(10.6 %RSD)	192	(15.3 %RSD)	197	(14.9 %RSD)
Zr	-	-	-	-	-	-	-	-

Table A-9. Measured Concentrations of m/z via ICP-MS

Glass ID	Blank	SB8 PS			
Replicate	1	1	2	3	4
Lab ID	LW11612	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g	µg/g
M/Z 59	< 4.00E-01 N/A %RSD	4.90E+01 8.92E-01 %RSD	4.87E+01 1.92E00 %RSD	4.95E+01 5.83E-01 %RSD	5.05E+01 7.84E-01 %RSD
M/Z 82	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
M/Z 84	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
M/Z 85	< 8.00E-01 N/A %RSD	4.24E+00 1.27E00 %RSD	4.17E+00 5.10E00 %RSD	4.51E+00 3.42E-01 %RSD	4.68E+00 2.58E00 %RSD
M/Z 86	< 4.00E+00 N/A %RSD	5.11E+00 5.37E00 %RSD	4.68E+00 1.29E01 %RSD	4.92E+00 5.80E00 %RSD	4.77E+00 6.36E00 %RSD
M/Z 87	< 4.00E+00 N/A %RSD	1.15E+01 1.12E-01 %RSD	1.13E+01 5.68E00 %RSD	1.19E+01 5.19E00 %RSD	1.15E+01 4.61E00 %RSD
M/Z 88	1.23E+01 2.57E00 %RSD	1.24E+02 4.59E-01 %RSD	1.15E+02 1.93E00 %RSD	1.19E+02 2.30E00 %RSD	1.20E+02 5.91E-01 %RSD
M/Z 89	< 8.00E-01 N/A %RSD	1.18E+02 3.39E-01 %RSD	1.10E+02 1.79E-01 %RSD	9.69E+01 3.20E00 %RSD	1.06E+02 5.42E-02 %RSD
M/Z 93	< 3.00E+01 N/A %RSD	1.86E+02 1.27E00 %RSD	1.67E+02 1.16E00 %RSD	1.61E+02 1.68E00 %RSD	1.71E+02 8.72E-01 %RSD
M/Z 95	< 4.00E+01 N/A %RSD	< 4.69E+01 N/A %RSD	< 4.50E+01 N/A %RSD	< 4.63E+01 N/A %RSD	< 4.48E+01 N/A %RSD
M/Z 97	< 8.00E-01 N/A %RSD	1.10E+01 3.06E-01 %RSD	1.07E+01 3.72E-02 %RSD	1.06E+01 2.95E00 %RSD	1.11E+01 7.17E-01 %RSD
M/Z 98	< 8.00E-01 N/A %RSD	1.57E+01 4.68E00 %RSD	1.56E+01 2.04E00 %RSD	1.58E+01 8.93E-02 %RSD	1.59E+01 1.12E00 %RSD
M/Z 99	< 4.00E-01 N/A %RSD	1.47E+00 2.63E00 %RSD	1.54E+00 4.02E00 %RSD	1.48E+00 4.93E-01 %RSD	1.46E+00 3.88E00 %RSD
M/Z 100	< 8.00E-01 N/A %RSD	1.19E+01 2.21E00 %RSD	1.15E+01 9.24E-01 %RSD	1.16E+01 1.35E00 %RSD	1.18E+01 1.00E00 %RSD
M/Z 101	< 4.00E-01 N/A %RSD	5.66E+01 2.94E-01 %RSD	5.96E+01 8.10E-01 %RSD	5.83E+01 2.64E00 %RSD	6.17E+01 4.77E-01 %RSD
M/Z 102	< 8.00E-01 N/A %RSD	4.90E+01 2.22E-01 %RSD	5.23E+01 8.07E-01 %RSD	5.07E+01 2.51E00 %RSD	5.40E+01 4.91E-02 %RSD
M/Z 103	< 4.00E-01 N/A %RSD	5.89E+01 6.91E-01 %RSD	5.74E+01 3.71E-01 %RSD	5.92E+01 1.31E00 %RSD	5.94E+01 1.31E00 %RSD
M/Z 104	< 4.00E-01 N/A %RSD	3.05E+01 4.31E00 %RSD	3.19E+01 1.51E00 %RSD	3.14E+01 2.60E00 %RSD	3.26E+01 7.41E-01 %RSD
M/Z 105	< 4.00E-01 N/A %RSD	5.17E+00 1.39E00 %RSD	3.04E+00 2.77E00 %RSD	5.24E+00 5.58E-01 %RSD	4.72E+00 1.79E00 %RSD
M/Z 106	< 1.00E+02 N/A %RSD	< 1.17E+02 N/A %RSD	< 1.13E+02 N/A %RSD	< 1.16E+02 N/A %RSD	1.17E+02 1.44E-01 %RSD
M/Z 107	< 1.00E+02 N/A %RSD	< 1.17E+02 N/A %RSD	< 1.13E+02 N/A %RSD	< 1.16E+02 N/A %RSD	< 1.12E+02 N/A %RSD
M/Z 108	< 6.00E+01 N/A %RSD	< 7.04E+01 N/A %RSD	< 6.76E+01 N/A %RSD	< 6.94E+01 N/A %RSD	< 6.73E+01 N/A %RSD
M/Z 109	< 4.00E+01 N/A %RSD	< 4.69E+01 N/A %RSD	< 4.50E+01 N/A %RSD	< 4.63E+01 N/A %RSD	< 4.48E+01 N/A %RSD
M/Z 110	< 6.00E+01 N/A %RSD	< 7.04E+01 N/A %RSD	< 6.76E+01 N/A %RSD	< 6.94E+01 N/A %RSD	< 6.73E+01 N/A %RSD

Table A-10. Measured Concentrations of m/z via ICP-MS (Continued)

Glass ID	Blank	SB8 PS			
Replicate	1	1	2	3	4
Lab ID	LW11612	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g	µg/g
M/Z 111	< 4.00E+01 N/A %RSD	< 4.69E+01 N/A %RSD	< 4.50E+01 N/A %RSD	< 4.63E+01 N/A %RSD	< 4.48E+01 N/A %RSD
112	< 2.00E+01 N/A %RSD	2.92E+01 1.68E00 %RSD	2.62E+01 7.78E-01 %RSD	2.83E+01 3.66E00 %RSD	3.20E+01 1.94E00 %RSD
113	< 6.00E+00 N/A %RSD	1.22E+01 3.56E00 %RSD	1.10E+01 6.01E00 %RSD	1.22E+01 3.87E00 %RSD	1.35E+01 1.40E00 %RSD
114	< 2.00E+00 N/A %RSD	1.98E+01 1.39E00 %RSD	1.96E+01 3.50E00 %RSD	2.04E+01 1.89E-01 %RSD	2.02E+01 3.03E00 %RSD
116	< 4.00E+01 N/A %RSD	1.64E+02 1.13E00 %RSD	1.55E+02 9.66E-01 %RSD	1.60E+02 8.73E-01 %RSD	1.65E+02 1.61E00 %RSD
117	< 4.00E+01 N/A %RSD	< 4.69E+01 N/A %RSD	< 4.50E+01 N/A %RSD	< 4.63E+01 N/A %RSD	< 4.48E+01 N/A %RSD
118	< 4.00E+01 N/A %RSD	< 4.69E+01 N/A %RSD	< 4.50E+01 N/A %RSD	< 4.63E+01 N/A %RSD	< 4.48E+01 N/A %RSD
119	< 2.00E+01 N/A %RSD	3.64E+02 7.59E-01 %RSD	3.42E+02 5.99E-02 %RSD	3.41E+02 1.46E00 %RSD	3.50E+02 4.76E-01 %RSD
120	< 1.00E+02 N/A %RSD	< 1.17E+02 N/A %RSD	< 1.13E+02 N/A %RSD	< 1.16E+02 N/A %RSD	< 1.12E+02 N/A %RSD
121	< 4.00E-01 N/A %RSD	1.63E+00 1.12E01 %RSD	1.92E+00 1.61E00 %RSD	1.79E+00 7.06E00 %RSD	1.68E+00 7.85E00 %RSD
122	< 1.20E+01 N/A %RSD	< 1.41E+01 N/A %RSD	< 1.35E+01 N/A %RSD	< 1.39E+01 N/A %RSD	< 1.35E+01 N/A %RSD
123	< 1.00E+00 N/A %RSD	1.96E+00 4.47E00 %RSD	1.85E+00 4.79E00 %RSD	1.90E+00 7.34E00 %RSD	1.84E+00 1.05E01 %RSD
124	< 1.60E+01 N/A %RSD	< 1.88E+01 N/A %RSD	< 1.80E+01 N/A %RSD	< 1.85E+01 N/A %RSD	< 1.79E+01 N/A %RSD
125	< 4.00E-01 N/A %RSD	1.70E+00 2.06E01 %RSD	1.36E+00 1.03E01 %RSD	1.42E+00 1.45E01 %RSD	1.39E+00 1.87E01 %RSD
126	< 4.00E-01 N/A %RSD	3.10E+00 2.71E00 %RSD	3.42E+00 9.41E00 %RSD	3.19E+00 5.96E00 %RSD	3.34E+00 9.26E00 %RSD
128	< 4.00E-01 N/A %RSD	1.02E+01 3.05E-01 %RSD	9.74E+00 6.88E-02 %RSD	9.99E+00 4.01E-01 %RSD	1.09E+01 3.07E-01 %RSD
130	< 4.00E-01 N/A %RSD	5.07E+01 2.99E-01 %RSD	4.81E+01 1.62E00 %RSD	4.93E+01 9.10E-01 %RSD	4.86E+01 3.64E00 %RSD
133	< 2.00E+00 N/A %RSD	1.61E+01 1.84E-01 %RSD	2.10E+01 1.01E01 %RSD	2.87E+01 8.23E00 %RSD	3.32E+01 2.98E00 %RSD
134	< 4.00E-01 N/A %RSD	7.28E+00 6.00E-01 %RSD	7.29E+00 4.98E00 %RSD	7.51E+00 1.72E00 %RSD	7.33E+00 2.14E00 %RSD
135	< 4.00E-01 N/A %RSD	6.86E+00 2.96E00 %RSD	6.83E+00 2.27E-01 %RSD	7.05E+00 4.76E-01 %RSD	6.58E+00 4.35E-01 %RSD
136	< 4.00E-01 N/A %RSD	6.47E+00 1.09E00 %RSD	6.27E+00 1.53E00 %RSD	6.49E+00 3.39E00 %RSD	6.19E+00 4.60E00 %RSD
137	< 8.00E-01 N/A %RSD	1.37E+02 2.43E-01 %RSD	1.34E+02 1.83E-01 %RSD	1.33E+02 1.60E00 %RSD	1.33E+02 3.68E-01 %RSD
138	< 4.00E+00 N/A %RSD	2.88E+02 4.61E-01 %RSD	2.81E+02 2.99E-01 %RSD	2.84E+02 1.16E00 %RSD	2.79E+02 1.20E-01 %RSD
139	< 4.00E-01 N/A %RSD	2.47E+02 2.75E-01 %RSD	2.34E+02 6.65E-01 %RSD	2.41E+02 1.35E00 %RSD	2.44E+02 5.74E-01 %RSD
140	< 4.00E-01 N/A %RSD	7.86E+02 1.99E-01 %RSD	6.83E+02 6.75E-01 %RSD	6.34E+02 1.35E00 %RSD	6.63E+02 1.06E00 %RSD

Table A-11. Measured Concentrations of m/z via ICP-MS (Continued)

Glass ID	Blank	SB8 PS			
Replicate	1	1	2	3	4
Lab ID	LW11612	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g	µg/g
M/Z 141	< 4.00E-01 N/A %RSD	2.28E+02 5.20E-01 %RSD	1.95E+02 2.85E-01 %RSD	1.79E+02 6.45E-01 %RSD	1.88E+02 7.32E-01 %RSD
142	< 4.00E-01 N/A %RSD	3.08E+02 3.77E-01 %RSD	2.65E+02 2.49E-01 %RSD	2.47E+02 2.48E00 %RSD	2.58E+02 1.90E-01 %RSD
143	< 4.00E-01 N/A %RSD	2.12E+02 6.17E-02 %RSD	1.84E+02 5.83E-01 %RSD	1.71E+02 1.17E00 %RSD	1.78E+02 1.51E-01 %RSD
144	< 4.00E-01 N/A %RSD	2.23E+02 1.34E00 %RSD	1.91E+02 1.01E00 %RSD	1.78E+02 1.57E00 %RSD	1.85E+02 1.77E-01 %RSD
145	< 4.00E-01 N/A %RSD	1.47E+02 6.84E-01 %RSD	1.28E+02 2.14E-02 %RSD	1.18E+02 2.76E00 %RSD	1.23E+02 1.03E-01 %RSD
146	< 4.00E-01 N/A %RSD	1.19E+02 1.13E00 %RSD	1.04E+02 5.21E-01 %RSD	9.69E+01 6.73E-01 %RSD	9.98E+01 7.57E-02 %RSD
147	< 4.00E-01 N/A %RSD	8.38E+01 1.37E-02 %RSD	7.30E+01 1.83E-01 %RSD	6.35E+01 1.01E00 %RSD	6.72E+01 8.74E-01 %RSD
148	< 4.00E-01 N/A %RSD	7.38E+01 3.64E-01 %RSD	6.40E+01 3.71E-01 %RSD	6.02E+01 3.00E00 %RSD	6.17E+01 6.82E-01 %RSD
149	< 4.00E-01 N/A %RSD	4.95E+00 4.23E-01 %RSD	4.21E+00 5.61E-02 %RSD	3.63E+00 7.12E-02 %RSD	3.89E+00 4.72E00 %RSD
150	< 4.00E-01 N/A %RSD	7.03E+01 1.93E-01 %RSD	6.17E+01 1.49E00 %RSD	5.55E+01 1.86E00 %RSD	5.76E+01 1.30E00 %RSD
151	< 4.00E-01 N/A %RSD	6.73E+00 1.43E00 %RSD	5.68E+00 8.59E-01 %RSD	4.95E+00 1.01E00 %RSD	5.21E+00 8.01E-01 %RSD
152	< 4.00E-01 N/A %RSD	2.43E+01 6.97E-01 %RSD	2.12E+01 3.17E-01 %RSD	1.83E+01 1.54E00 %RSD	1.97E+01 7.31E-01 %RSD
153	< 4.00E-01 N/A %RSD	1.00E+01 1.19E00 %RSD	8.75E+00 1.23E00 %RSD	7.49E+00 1.19E00 %RSD	8.13E+00 3.80E00 %RSD
154	< 4.00E-01 N/A %RSD	1.53E+01 1.69E00 %RSD	1.38E+01 4.06E-01 %RSD	1.19E+01 1.78E00 %RSD	1.28E+01 5.46E-01 %RSD
155	< 4.00E-01 N/A %RSD	5.86E+01 3.03E-01 %RSD	5.27E+01 8.60E-01 %RSD	4.52E+01 9.94E-01 %RSD	4.86E+01 1.24E00 %RSD
156	< 4.00E-01 N/A %RSD	8.60E+01 9.61E-01 %RSD	7.62E+01 2.48E-01 %RSD	6.64E+01 2.00E00 %RSD	7.11E+01 4.45E-01 %RSD
157	< 4.00E-01 N/A %RSD	6.23E+01 5.61E-02 %RSD	5.54E+01 8.01E-02 %RSD	4.79E+01 1.22E00 %RSD	5.11E+01 2.71E-01 %RSD
158	< 4.00E-01 N/A %RSD	9.83E+01 3.68E-01 %RSD	8.82E+01 1.35E-01 %RSD	7.55E+01 1.28E00 %RSD	8.19E+01 1.62E00 %RSD
159	< 4.00E-01 N/A %RSD	2.98E+00 7.99E-01 %RSD	2.45E+00 1.46E00 %RSD	2.24E+00 9.38E-01 %RSD	2.37E+00 2.60E00 %RSD
160	< 4.00E-01 N/A %RSD	8.81E+01 2.65E-01 %RSD	7.88E+01 5.12E-01 %RSD	6.77E+01 1.01E00 %RSD	7.22E+01 4.51E-01 %RSD
161	< 4.00E-01 N/A %RSD	1.82E+00 4.42E-01 %RSD	1.65E+00 2.99E00 %RSD	1.53E+00 2.21E00 %RSD	1.60E+00 3.45E00 %RSD
162	< 4.00E-01 N/A %RSD	1.41E+00 9.68E-02 %RSD	1.29E+00 1.93E-01 %RSD	1.22E+00 3.77E00 %RSD	1.25E+00 3.68E00 %RSD
163	< 4.00E-01 N/A %RSD	6.99E-01 3.89E00 %RSD	6.58E-01 3.61E00 %RSD	5.93E-01 8.93E-01 %RSD	6.15E-01 9.53E00 %RSD
164	< 4.00E-01 N/A %RSD	8.19E-01 6.15E00 %RSD	7.03E-01 6.74E00 %RSD	6.54E-01 2.32E-01 %RSD	7.05E-01 2.21E00 %RSD
165	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD

Table A-12. Measured Concentrations of m/z (µg/g) via ICP-MS (Continued)

Glass ID	Blank	SB8 PS			
Replicate	1	1	2	3	4
Lab ID	LW11612	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g	µg/g
M/Z 166	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
167	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
168	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
169	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
170	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
171	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
172	< 4.00E-01 N/A %RSD	6.46E-01 2.32E00 %RSD	5.86E-01 4.08E-01 %RSD	< 4.63E-01 N/A %RSD	5.60E-01 9.61E00 %RSD
173	< 4.00E-01 N/A %RSD	6.23E-01 5.05E00 %RSD	5.99E-01 1.85E00 %RSD	5.46E-01 4.92E00 %RSD	5.49E-01 7.09E-01 %RSD
174	< 2.00E+00 N/A %RSD	< 2.35E+00 N/A %RSD	< 2.25E+00 N/A %RSD	< 2.31E+00 N/A %RSD	2.27E+00 1.30E00 %RSD
175	< 4.00E-01 N/A %RSD	5.92E-01 1.92E00 %RSD	5.20E-01 9.26E00 %RSD	5.23E-01 1.82E00 %RSD	5.17E-01 7.51E00 %RSD
176	5.36E+01 1.78E-01 %RSD	5.17E+01 7.11E-01 %RSD	3.84E+01 2.60E-01 %RSD	4.48E+01 1.16E-01 %RSD	5.74E+01 7.05E-02 %RSD
177	1.97E+02 2.03E-01 %RSD	1.91E+02 1.58E00 %RSD	1.42E+02 8.79E-01 %RSD	1.64E+02 7.46E-01 %RSD	2.12E+02 3.74E-01 %RSD
178	2.86E+02 1.06E00 %RSD	2.80E+02 1.11E00 %RSD	2.09E+02 9.69E-01 %RSD	2.41E+02 8.93E-01 %RSD	3.15E+02 4.12E-02 %RSD
179	1.45E+02 1.13E00 %RSD	1.39E+02 1.39E00 %RSD	1.02E+02 1.28E00 %RSD	1.20E+02 9.13E-04 %RSD	1.55E+02 3.32E-01 %RSD
180	3.64E+02 1.49E00 %RSD	3.64E+02 6.59E-01 %RSD	2.69E+02 1.24E00 %RSD	3.14E+02 4.42E-02 %RSD	4.00E+02 1.24E-02 %RSD
181	< 4.00E+00 N/A %RSD	< 4.69E+00 N/A %RSD	< 4.50E+00 N/A %RSD	4.66E+00 1.19E00 %RSD	< 4.48E+00 N/A %RSD
182	< 4.00E+00 N/A %RSD	< 4.69E+00 N/A %RSD	< 4.50E+00 N/A %RSD	< 4.63E+00 N/A %RSD	< 4.48E+00 N/A %RSD
183	< 2.00E+00 N/A %RSD	< 2.35E+00 N/A %RSD	< 2.25E+00 N/A %RSD	< 2.31E+00 N/A %RSD	< 2.24E+00 N/A %RSD
184	< 4.00E+00 N/A %RSD	< 4.69E+00 N/A %RSD	< 4.50E+00 N/A %RSD	< 4.63E+00 N/A %RSD	< 4.48E+00 N/A %RSD
185	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
186	< 4.00E+00 N/A %RSD	< 4.69E+00 N/A %RSD	< 4.50E+00 N/A %RSD	< 4.63E+00 N/A %RSD	< 4.48E+00 N/A %RSD
187	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
191	< 8.00E-01 N/A %RSD	< 9.39E-01 N/A %RSD	< 9.01E-01 N/A %RSD	< 9.26E-01 N/A %RSD	< 8.97E-01 N/A %RSD

Table A-13. Measured Concentrations of m/z (µg/g) via ICP-MS (Continued)

Glass ID	Blank	SB8 PS			
Replicate	1	1	2	3	4
Lab ID	LW11612	LW11596	LW11597	LW11598	LW11599
Units	µg/g	µg/g	µg/g	µg/g	µg/g
M/Z 193	< 4.00E+00 N/A %RSD	< 4.69E+00 N/A %RSD	< 4.50E+00 N/A %RSD	< 4.63E+00 N/A %RSD	< 4.48E+00 N/A %RSD
194	< 8.00E+00 N/A %RSD	< 9.39E+00 N/A %RSD	< 9.01E+00 N/A %RSD	< 9.26E+00 N/A %RSD	< 8.97E+00 N/A %RSD
195	< 8.00E+00 N/A %RSD	< 9.39E+00 N/A %RSD	< 9.01E+00 N/A %RSD	< 9.26E+00 N/A %RSD	< 8.97E+00 N/A %RSD
196	< 8.00E+00 N/A %RSD	< 9.39E+00 N/A %RSD	< 9.01E+00 N/A %RSD	< 9.26E+00 N/A %RSD	< 8.97E+00 N/A %RSD
198	< 8.00E-01 N/A %RSD	< 9.39E-01 N/A %RSD	< 9.01E-01 N/A %RSD	< 9.26E-01 N/A %RSD	< 8.97E-01 N/A %RSD
203	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
204	< 4.00E-01 N/A %RSD	2.11E+00 2.81E00 %RSD	2.04E+00 2.87E00 %RSD	2.04E+00 6.46E00 %RSD	2.02E+00 8.94E-01 %RSD
205	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
206	< 4.00E-01 N/A %RSD	3.73E+01 1.43E00 %RSD	3.79E+01 6.43E-01 %RSD	3.80E+01 3.02E-01 %RSD	3.73E+01 4.12E-03 %RSD
207	< 4.00E-01 N/A %RSD	3.25E+01 3.58E-01 %RSD	3.27E+01 7.18E-01 %RSD	3.29E+01 1.15E-02 %RSD	3.26E+01 5.19E-01 %RSD
208	< 4.00E-01 N/A %RSD	7.76E+01 1.20E00 %RSD	7.79E+01 6.87E-01 %RSD	7.91E+01 1.36E00 %RSD	7.87E+01 7.23E-01 %RSD
230	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
232	< 1.20E+01 N/A %RSD	4.01E+03 6.72E-01 %RSD	3.82E+03 6.85E-01 %RSD	3.82E+03 6.40E-01 %RSD	3.88E+03 1.95E-01 %RSD
233	< 4.00E-01 N/A %RSD	3.62E+00 1.20E00 %RSD	3.36E+00 2.22E00 %RSD	3.27E+00 7.18E-01 %RSD	3.30E+00 7.68E-01 %RSD
234	< 4.00E-01 N/A %RSD	3.79E+00 1.91E-02 %RSD	3.51E+00 3.50E-01 %RSD	3.52E+00 8.53E-01 %RSD	3.49E+00 5.16E00 %RSD
235	< 4.00E-01 N/A %RSD	1.19E+02 1.02E00 %RSD	1.10E+02 1.90E-01 %RSD	1.09E+02 2.12E-01 %RSD	1.10E+02 2.68E-01 %RSD
236	< 4.00E-01 N/A %RSD	7.93E+00 5.24E00 %RSD	7.61E+00 3.71E00 %RSD	7.39E+00 1.05E01 %RSD	7.38E+00 2.45E00 %RSD
237	< 4.00E-01 N/A %RSD	1.57E+01 1.04E00 %RSD	1.41E+01 1.21E00 %RSD	1.41E+01 2.82E00 %RSD	1.38E+01 5.50E-01 %RSD
238	< 8.00E-01 N/A %RSD	1.77E+04 4.08E-01 %RSD	1.66E+04 4.06E-01 %RSD	1.63E+04 6.58E-01 %RSD	1.64E+04 2.35E-01 %RSD
239	< 4.00E-01 N/A %RSD	6.40E+01 1.59E-01 %RSD	5.90E+01 1.98E-01 %RSD	5.50E+01 9.78E-01 %RSD	5.59E+01 1.03E00 %RSD
240	< 4.00E-01 N/A %RSD	6.04E+00 2.16E00 %RSD	5.44E+00 9.36E-01 %RSD	5.16E+00 3.69E00 %RSD	5.27E+00 6.88E-01 %RSD
241	< 4.00E-01 N/A %RSD	4.15E+00 7.06E-02 %RSD	3.66E+00 2.59E00 %RSD	3.44E+00 1.71E-01 %RSD	3.52E+00 2.27E00 %RSD
242	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD
243	< 4.00E-01 N/A %RSD	5.73E-01 2.13E-01 %RSD	4.98E-01 4.52E00 %RSD	4.92E-01 1.92E00 %RSD	4.99E-01 4.07E00 %RSD
244	< 4.00E-01 N/A %RSD	< 4.69E-01 N/A %RSD	< 4.50E-01 N/A %RSD	< 4.63E-01 N/A %RSD	< 4.48E-01 N/A %RSD

Table A-14. Measured Radionuclide Concentration via Counting

Glass ID	Blank			SB8 PS										
Replicate	1			1		2		3			4			
Lab ID[h]	11612/11613			11596		11597/11601		11598/11602			11599/11603			
Units	DPM/g			DPM/g		DPM/g		DPM/g			DPM/g			
Co-60	<	4.88E+03	MDA	7.21E+05	5.00%	7.01E+05	5.00%	7.33E+05	5.00%		6.96E+05	5.00%		
Sr-90	<	6.20E+07	MDA	1.26E+10	13.00%	1.15E+10	12.40%	1.32E+10	14.30%		1.09E+10	11.40%		
Zr-93		8.94E+03	20%	-	-	6.32E+05	20%	6.61E+05	20%		7.08E+05	20%		
Tc-99	<	3.09E+03	MDA	7.41E+04	6.30%	6.57E+04	6.29%	6.69E+04	6.37%		6.91E+04	6.46%		
Cs-134	<	3.01E+06	MDA	< 3.02E+06	MDA	< 2.37E+06	MDA	< 2.50E+06	MDA	<	3.17E+06	MDA		
Cs-135				< 1.20E+04	Upper Limit	< 1.12E+04	Upper Limit	< 1.04E+04	DL	<	1.15E+04	Upper Limit		
Cs-137	<	3.52E+06	MDA	2.11E+09	5.00%	2.09E+09	5.00%	2.03E+09	5.00%		1.98E+09	5.00%		
Eu-152	<	9.60E+03	MDA	2.35E+05	5.00%	2.13E+05	10.90%	1.91E+05	12.00%	<	1.16E+05	MDA		
Eu-154	<	6.84E+03	MDA	7.73E+06	5.00%	6.62E+06	5.00%	5.69E+06	5.00%		6.12E+06	5.00%		
Eu-155	<	1.22E+04	MDA	8.32E+05	5.00%	1.35E+06	12.30%	6.44E+05	23.40%		4.62E+05	27.80%		
Pu-238	<	6.59E+06	MDA	1.52E+08	9.71%	1.54E+08	9.63%	1.62E+08	10.40%		1.37E+08	8.28%		
Pu-239/240	<	5.46E+06	MDA	8.45E+06	32.80%	7.53E+06	34.60%	5.62E+06	44.40%		7.93E+06	19.00%		
Pu-241	<	1.72E+05	MDA	2.94E+07	17.00%	2.89E+07	17.00%	2.98E+07	17.50%		2.56E+07	16.30%		
Am-241	<	3.84E+04	MDA	2.90E+07	5.00%	2.66E+07	5.00%	2.55E+07	5.00%		2.58E+07	5.00%		

[h] Zr-93 samples prepared with Aqua Regia Digestion, all other samples prepared with Peroxide Fusion

Table A-15. Measured pH of PCT Leachates

Glass ID	Replicate	Lab ID	pH
Blank	1	LW11444	8.77
	2	LW11445	7.86
	3	LW11446	7.41
ARM-1	1	LW11432	10.69
	2	LW11433	10.49
	3	LW11434	10.47
	4	LW11435	10.45
EA Glass	1	LW11440	11.83
	2	LW11441	11.95
	3	LW11442	11.86
	4	LW11443	11.9
SB8 PS	1	LW11436	10.96
	2	LW11437	11.25
	3	LW11438	11.19
	4	LW11439	11.21

Table A-16. Multi-Element Solution Data Measured Along PCT Leachates

Replicate	1		2		3		Average	RSD	Reported Value	Difference
Lab ID	11447		11448		11449		-	-	-	-
Units	mg/L		mg/L		mg/L		mg/L	%	µg/mL	%
Al	3.95	(10 %RSD)	3.98	(10 %RSD)	3.95	(10 %RSD)	3.96	0.44%	4	-1.00%
B	20.00	(10.8 %RSD)	20.00	(10.8 %RSD)	20.20	(10.8 %RSD)	20.07	0.58%	20	0.33%
Fe	4.17	(10 %RSD)	4.15	(10 %RSD)	4.17	(10 %RSD)	4.16	0.28%	4	4.08%
K	9.22	(10.3 %RSD)	9.20	(10.3 %RSD)	9.36	(10.3 %RSD)	9.26	0.94%	10	-7.40%
Li	9.74	(10.2 %RSD)	9.73	(10.2 %RSD)	9.81	(10.2 %RSD)	9.76	0.45%	10	-2.40%
Na	81.10	(10 %RSD)	80.40	(10.2 %RSD)	79.50	(10.2 %RSD)	80.33	1.00%	81	-0.82%
Si	49.40	(10.4 %RSD)	49.70	(10.3 %RSD)	49.60	(10 %RSD)	49.57	0.31%	50	-0.87%

Table A-17. Measured Elemental Concentration of Diluted and Acidified PCT Leachates

Glass ID	ARM-1[i]			
Replicate	1	2	3	4
Lab ID	LW11432	LW11433	LW11434	LW11435
Units	mg/L	mg/L	mg/L	mg/L
Ag	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)
Al	2.96 (10 %RSD)	3.07 (10 %RSD)	3.04 (10 %RSD)	3.37 (10 %RSD)
B	10.6 (10.2 %RSD)	10.4 (10.2 %RSD)	11.3 (10.3 %RSD)	12.7 (10.3 %RSD)
Ba	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)
Be	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)
Ca	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)
Cd	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)
Ce	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)
Co	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)
Cr	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)
Cu	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)
Fe	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)
Gd	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)
K	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)
La	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)
Li	7.95 (10.1 %RSD)	7.97 (10.1 %RSD)	8.36 (10.1 %RSD)	9.4 (10.2 %RSD)
Mg	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)
Mn	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)
Mo	3.26 (10 %RSD)	3.26 (10 %RSD)	3.47 (10 %RSD)	3.88 (10 %RSD)

[i] 6 mL of leachate was diluted/acidified with 4 mL of 0.4 M HNO_3

Table A-18. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	ARM-1[j]			
Replicate	1	2	3	4
Lab ID	LW11432	LW11433	LW11434	LW11435
Units	mg/L	mg/L	mg/L	mg/L
Na	37.9 (12.5 %RSD)	34.8 (12.2 %RSD)	42.4 (13.1 %RSD)	40.1 (12.8 %RSD)
Ni	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)
P	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)
Pb	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)
S	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)
Sb	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)
Si	41.4 (10.5 %RSD)	42.1 (11 %RSD)	41.8 (10 %RSD)	58.9 (10 %RSD)
Sn	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)
Sr	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)
Th	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)
Ti	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)
U	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)
V	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)
Zn	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)
Zr	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)

[j] 6 mL of leachate was diluted/acidified with 4 mL of 0.4 M HNO_3

Table A-19. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	EA Glass[k]			
Replicate	1	2	3	4
Lab ID	LW11440	LW11441	LW11442	LW11443
Units	mg/L	mg/L	mg/L	mg/L
Ag	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)
Al	< 0.452 (N/A %RSD)	< 0.452 (N/A %RSD)	< 0.452 (N/A %RSD)	< 0.452 (N/A %RSD)
B	39.4 (12.7 %RSD)	36.5 (12.4 %RSD)	47.9 (13.8 %RSD)	46.7 (13.7 %RSD)
Ba	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)
Be	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)
Ca	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)
Cd	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)
Ce	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)
Co	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)
Cr	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)
Cu	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)
Fe	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)
Gd	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)
K	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)
La	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)
Li	12.2 (10.3 %RSD)	11.3 (10.3 %RSD)	14.8 (10.4 %RSD)	14.6 (10.4 %RSD)
Mg	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)
Mn	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)
Mo	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)

[k] 0.6 mL of leachate was diluted with 5.4 mL of ASTM Type I H_2O and acidified with 4 mL of 0.4 M HNO_3

Table A-20. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	EA Glass[1]			
Replicate	1	2	3	4
Lab ID	LW11440	LW11441	LW11442	LW11443
Units	mg/L	mg/L	mg/L	mg/L
Na	123 (10 %RSD)	111 (10.1 %RSD)	124 (10 %RSD)	145 (10 %RSD)
Ni	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)
P	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)
Pb	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)
S	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)
Sb	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)
Si	63.1 (10.1 %RSD)	56.9 (10.2 %RSD)	61.7 (10.2 %RSD)	73.8 (10 %RSD)
Sn	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)
Sr	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)
Th	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)
Ti	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)
U	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)
V	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)
Zn	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)
Zr	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)

[1] 0.6 mL of leachate was diluted with 5.4 mL of ASTM Type I H_2O and acidified with 4 mL of 0.4 M HNO_3

Table A-21. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	SB8 PS[m]			
Replicate	1	2	3	4
Lab ID	LW11436	LW11437	LW11438	LW11439
Units	mg/L	mg/L	mg/L	mg/L
Ag	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)
Al	0.931 (10 %RSD)	0.959 (10 %RSD)	1.02 (10 %RSD)	0.994 (10 %RSD)
B	0.73 (10 %RSD)	0.718 (10 %RSD)	0.8 (10 %RSD)	0.684 (10 %RSD)
Ba	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)
Be	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)
Ca	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)
Cd	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)
Ce	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)
Co	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)
Cr	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)
Cu	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)
Fe	0.396 (10 %RSD)	0.407 (10 %RSD)	0.399 (10 %RSD)	0.364 (10 %RSD)
Gd	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)
K	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)
La	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)
Li	0.839 (10 %RSD)	0.859 (10 %RSD)	0.861 (10 %RSD)	0.86 (10 %RSD)
Mg	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)
Mn	0.0965 (10 %RSD)	0.101 (10 %RSD)	0.087 (10 %RSD)	0.079 (10 %RSD)
Mo	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)

[m] 0.6 mL of leachate was diluted with 5.4 mL of ASTM Type I H_2O and acidified with 4 mL of 0.4 M HNO_3

Table A-22. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	SB8 PS[n]			
Replicate	1	2	3	4
Lab ID	LW11436	LW11437	LW11438	LW11439
Units	mg/L	mg/L	mg/L	mg/L
Na	19.6 (10.7 %RSD)	19.3 (10.7 %RSD)	19.3 (10.7 %RSD)	19.4 (10.7 %RSD)
Ni	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)
P	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)
Pb	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)
S	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)
Sb	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)
Si	12.1 (10.3 %RSD)	12.5 (10.3 %RSD)	12.5 (10.3 %RSD)	12.5 (10.3 %RSD)
Sn	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)
Sr	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)
Th	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)
Ti	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)
U	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)
V	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)
Zn	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)
Zr	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)

[n] 0.6 mL of leachate was diluted with 5.4 mL of ASTM Type I H_2O and acidified with 4 mL of 0.4 M HNO_3

Table A-23. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	Blank[o]		
Replicate	1	2	3
Lab ID	LW11444	LW11445	LW11446
Units	mg/L	mg/L	mg/L
Ag	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)
Al	< 0.452 (N/A %RSD)	< 0.452 (N/A %RSD)	< 0.452 (N/A %RSD)
B	< 0.16 (N/A %RSD)	< 0.16 (N/A %RSD)	< 0.16 (N/A %RSD)
Ba	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)
Be	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)
Ca	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)
Cd	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)
Ce	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)
Co	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)
Cr	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)
Cu	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)
Fe	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)	< 0.103 (N/A %RSD)
Gd	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)
K	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)	< 4.89 (N/A %RSD)
La	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)
Li	< 0.155 (N/A %RSD)	< 0.155 (N/A %RSD)	< 0.155 (N/A %RSD)
Mg	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)
Mn	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)
Mo	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)

[o] 6 mL of leachate was diluted/acidified with 4 mL of 0.4 M HNO_3

Table A-24. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	Blank[p]		
Replicate	1	2	3
Lab ID	LW11444	LW11445	LW11446
Units	mg/L	mg/L	mg/L
Na	14.7 (10.4 %RSD)	13.1 (10.3 %RSD)	12.8 (10.3 %RSD)
Ni	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)
P	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)
Pb	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)
S	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)
Sb	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)
Si	5.34 (10.1 %RSD)	4.85 (10 %RSD)	4.73 (10 %RSD)
Sn	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)
Sr	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)
Th	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)
Ti	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)
U	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)
V	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)
Zn	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)
Zr	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)

[p] 6 mL of leachate was diluted/acidified with 4 mL of 0.4 M HNO_3

Table A-25. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	Multi-Element Solution[q]		
Replicate	1	2	3
Lab ID	LW11447	LW11448	LW11449
Units	mg/L	mg/L	mg/L
Ag	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)	< 0.13 (N/A %RSD)
Al	3.95 (10 %RSD)	3.98 (10 %RSD)	3.95 (10 %RSD)
B	20 (10.8 %RSD)	20 (10.8 %RSD)	20.2 (10.8 %RSD)
Ba	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)	< 0.0316 (N/A %RSD)
Be	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)	< 0.00497 (N/A %RSD)
Ca	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)	< 0.0866 (N/A %RSD)
Cd	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)	< 0.0429 (N/A %RSD)
Ce	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)	< 1.22 (N/A %RSD)
Co	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)	< 0.0882 (N/A %RSD)
Cr	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)	< 0.106 (N/A %RSD)
Cu	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)	< 0.0494 (N/A %RSD)
Fe	4.17 (10 %RSD)	4.15 (10 %RSD)	4.17 (10 %RSD)
Gd	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)	< 0.11 (N/A %RSD)
K	9.22 (20 %RSD)	9.2 (20 %RSD)	9.36 (20 %RSD)
La	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)	< 0.0713 (N/A %RSD)
Li	9.74 (10.2 %RSD)	9.73 (10.2 %RSD)	9.81 (10.2 %RSD)
Mg	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)	< 0.00699 (N/A %RSD)
Mn	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)	< 0.0626 (N/A %RSD)
Mo	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)	< 0.183 (N/A %RSD)

[q] No dilution of acidification was done to the standard

Table A-26. Measured Elemental Concentration of Diluted and Acidified PCT Leachates (Continued)

Glass ID	Multi-Element Solution[r]		
Replicate	1	2	3
Lab ID	LW11447	LW11448	LW11449
Units	mg/L	mg/L	mg/L
Na	81.1 (10 %RSD)	80.4 (10.2 %RSD)	79.5 (10.2 %RSD)
Ni	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)	< 0.495 (N/A %RSD)
P	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)	< 2.16 (N/A %RSD)
Pb	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)	< 5.58 (N/A %RSD)
S	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)	< 44.8 (N/A %RSD)
Sb	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)	< 1.24 (N/A %RSD)
Si	49.4 (10.4 %RSD)	49.7 (10.3 %RSD)	49.6 (10 %RSD)
Sn	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)	< 3.02 (N/A %RSD)
Sr	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)	< 0.872 (N/A %RSD)
Th	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)	< 0.472 (N/A %RSD)
Ti	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)	< 0.0819 (N/A %RSD)
U	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)	< 3.39 (N/A %RSD)
V	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)	< 0.0428 (N/A %RSD)
Zn	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)	< 0.0774 (N/A %RSD)
Zr	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)	< 0.0418 (N/A %RSD)

[r] No dilution of acidification was done to the standard

Table A-27. Glass Density Determined by Buoyancy

Sample ID	Replicate	Air Mass (g)	Immersed Mass (g)	Water Temp (°C)	Density of Water (g/mL)	Density of Sample (g/cm^3)
NIST 1826	1	21.7606	8.5115	22	0.9978	2.5510
	2	21.7608	8.5089	23	0.9975	2.5510
NIST 93a	1	11.0459	4.9546	22	0.9978	2.2245
	2	11.045	4.9554	22	0.9978	2.2240
	3	11.0451	4.9563	22	0.9978	2.2236

Table A-28. Le Chatelier Flask Density Data

Sample ID	Replicate	Initial Water Level (mL)	Glass Mass (g)	Final Water Level (mL)	Glass Volume (mL)	Glass Density (g/mL)
SB8 PS	1	18.1	4.854	20.0	1.9	2.55
	2	20.0	2.280	20.8	0.8	2.85
	3	18.1	7.134	20.8	2.7	2.64
	4	20.8	4.043	22.2	1.4	2.89
	5	18.1	11.177	22.2	4.1	2.73
	6	22.2	1.051	22.6	0.4	2.63
	7	18.1	12.228	22.6	4.5	2.72
NIST 93a	1	19.0	6.715	22.000	3.0	2.238
	2	20.0	6.702	23.000	3.0	2.234
	3	18.0	4.264	20.000	2.0	2.132

Table A-29. REDOX Data

Glass ID	Replicate	Fe^{2+}	ΣFe	Fe^{3+}	$Fe^{2+}/\Sigma Fe$	Fe^{2+}/Fe^{3+}
EA Glass	1	0.1725	0.946	0.7735	0.182	0.223
SB8 PS	1	0.3680	1.8350	1.467	0.201	0.251
	2	0.1440	1.4370	1.293	0.100	0.111

Distribution:

Name:	Name:
Timothy Brown	Jeffrey Crenshaw
Alex Cozzi	James Folk
David Crowley	Jeremiah Ledbetter
Drew Fellinger	Tony Polk
Samuel Fink	Patricia Sµggs
Nancy Halverson	
Erich Hansen	Michael Broome
Connie Herman	Kevin Brotherton
John Mayer	Eric Freed
Daniel McCabe	John Iaukea
Gregg Morgan	Vijay Jain
Frank Pennebaker	Victoria Kmiec
Amy Ramsey	Jocelyn Lampert
William Ramsey	Azadeh Samadi-Dezfouli
Geoffrey Smoland	Cameron Sherer
Michael Stone	Jeff Ray
Joseph Manna	Reece Wall
Boyd Wiedenman	
Bill Wilmarth	Richard Edwards
Records Administration (EDWS)	Terri Fellinger
	Jeffrey Gillam
Alexander Choi	Barbara Hamm
Charles Crawford	Bill Holtzscheiter
Kevin Fox	Chris Martino
Fabienne Johnson	Hasmukh Shah
John Pareizs	Aaron Staub
Cory Trivelpiece	Christie Sudduth
Matthew Williams	
	Stephanie Harrington
	Ryan McNew
	Jocelin Stevens