Product Consistency Testing of West Valley Compositional Variation Glasses

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Summary

Nuclear waste glass produced by the West Valley Demonstration Project (WVDP) must meet the requirements of the Waste Acceptance Preliminary Specification (WAPS) as developed by the U.S. Department of Energy (DOE). To assist WVDP in complying with WAPS, the Materials Characterization Center (MCC) at Pacific Northwest Laboratory (PNL) used the Product Consistency Test (PCT) to evaluate 44 West Valley glasses that had previously been tested in FY 1987 and FY 1988. This report summarizes the results of the PCTs.

The glasses tested, which were fabricated as sets of Compositional Variation Glasses for studies performed by the West Valley Support Task (WVST) at PNL during FY 1987 and FY 1988, were doped with Th and U and were variations of West Valley reference glasses. In addition, Approved Reference Material-1 (ARM-1) was used as a test standard (ARM-1 is supplied by the MCC).

The PCT was originated at Westinghouse Savannah River Company (WSRC) by C. M. Jantzen and N. R. Bibler (Jantzen and Bibler 1989).^(a) The test is a seven-day modified MCC-3 test that uses crushed glass in the size range -100 +200 mesh with deionized water in a Teflon container. There is no agitation during the PCT, and no attempt to exclude CO₂ from the test environment.

Based on B and Li release, the glasses performed about the same as in previous modified MCC-3 testing performed in FY 1987 and FY 1988 (Reimus et al. 1988). The modified MCC-3 tests performed by Reimus et al. were similar to the PCT except for a small amount of agitation of the containers and the exclusion of CO₂ from the tests.

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^(a) Jantzen, C. M., and N. E. Bibler. 1989. "Nuclear Waste Glass Product Consistency Test (PCT) Method." Version 3.0. Westinghouse Savannah River Co., Aiken, South Carolina.

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1.0 Introduction

West Valley Nuclear Services (WVNS) must show that the nuclear waste glass produced by the West Valley Demonstration Project will be acceptable for disposal. In particular, WVNS must demonstrate compliance with the requirements of the Waste Acceptance Preliminary Specifications (WAPS)^(a) that are being developed by the U.S. Department of Energy (DOE). The Materials Characterization Center (MCC) at Pacific Northwest Laboratory (PNL)^(b) will assist WVNS with technical expertise, facilities, and equipment to fully characterize the glasses produced in their vitrification system and to evaluate the chemical durability and performance of these glasses with respect to WAPS requirements.

The objective of this portion of MCC support to WVNS was to evaluate, using the Product Consistency Test (PCT), the 44 glasses fabricated and evaluated by the West Valley Support Task at PNL during FY 1987 and FY 1988. During those years, the glasses were tested using a modified MCC-3 test that required a small amount of agitation and exclusion of CO₂. However, the WAPS now contains specific references to the PCT and the resulting B, Li, and Na releases from proposed nuclear waste glasses. Therefore, the 44 glasses were retested using the PCT method.

Included in the matrix were two nearly duplicate glasses and the MCC reference glass, Approved Reference Material-1 (ARM-1), which was used since the WSRC Environmental Assessment (EA) reference glass was not yet available. (The acceptance standard specified in WAPS 1.3 is EA glass).

The PCT was originated at the Westinghouse Savannah River Company (WSRC) by C. M. Jantzen and N. E. Bibler (Jantzen and Bibler 1989)^(c) and was designed to require less time than the previously used MCC-1 test. Despite the shorter time requirement, the PCT successfully tests the product quality of the glass, while maintaining ease of sample preparation and procedures for radioactive glass and remote operation. The test is a seven-day modified MCC-3 test that uses crushed glass in the size range -100 +200 mesh. There is no agitation during the test and no attempt to exclude CO₂ from the tests.

The data presented in this report were produced as part of West Valley's program to demonstrate the chemical durability of their waste glass and, therefore, its suitability for long-term disposal. These data are expected to be part of a data set that West Valley will use to support their Waste Form Qualification activities.

(a) U.S. Department of Energy. 1990. "Waste Acceptance Preliminary Specifications for Vitrified High-Level Waste Forms." (Draft copy), Office of Civilian Radioactive Waste Management, U.S. Department of Energy, Washington, D.C.

(b) Pacific Northwest Laboratory is operated for the U.S. Department of Energy by Battelle Memorial Institute under Contract DE-ACO6-76RLO 1830.

(c) Jantzen, C. M., and N. E. Bibler. 1989. "Nuclear Waste Glass Product Consistency Test (PCT) Method." Version 3.0. Westinghouse Savannah River Co., Aiken, South Carolina.

This testing was performed at Quality Assurance (QA) Impact Level II in accordance with the PNL QA program, PNL-MA-70, and the MCC QA plan currently in effect. The procedure for this testing was specified in a test instruction and the technical procedure MCC-TP-19, Rev. 0, "Leaching Tests Using the PCT Test Method." Quality assurance verification activities included an audit by PNL during December 1990.

Following the conclusions, this report discusses test methods and materials and calculations and results. Appendix A includes information and analytical results from these tests.

2.0 Conclusions

The 44 West Valley doped glasses from separate sets of Compositional Variation Glasses (CVG) of 1987 and 1988 were tested using the PCT. Conclusions were drawn by observing and comparing the normalized releases (g/m^2) of B and Li from the glasses. Boron and Li were targeted in this test because they are soluble even when large amounts of glass have been leached and because they are specified in the current WAPS (as is Na). The conclusions can be summarized as follows:

- The releases of B and Li from the 44 glasses were similar to those observed during modified MCC-3 testing that was performed by PNL during FY 1987 and FY 1988. In the majority of cases, the difference in normalized releases was $\leq 10\%$
- The WVDG-20 glass was the most chemically durable of the glasses while WVDG-35 exhibited the least chemical durability. These results were consistent with previous work conducted by Reimus et al. (1988). The WVDG-20 glass contained more Al_2O_3 , more B_2O_3 , less Fe_2O_3 , less alkali oxides, and slightly more SiO_2 than the WVDG-35.
- The reference glass, ARM-1, showed similar leaching during the three PCT series that were performed. This verifies the reproducibility of this test over the space of six weeks.
- Releases of B and Li from the reference glass, ARM-1, were much less than the releases from ARM-1 during PCT testing of the West Valley Sludge Glass-1 (WVSG-1).^(a) This is probably due to the fact that the crushed glass in the WVSG-1 series was not washed, as stipulated by a former version of the PCT, and therefore contained a large amount of fines.
- Releases of U averaged about 22% higher than in the previously conducted tests (Reimus et al. 1988).

(a) Olson, K. M., M. L. Elliott, J. W. Shade, and H. D. Smith. 1990. "Fabrication, Characterization, and Evaluation of West Valley Sludge Glass-1 (WVSG-1), a Fully Radioactive Glass Made with High-Level Waste from the West Valley Demonstration Project." Letter report prepared by Pacific Northwest Laboratory, Richland, Washington.

3.0 Experimental Method and Materials

The test matrix for these experiments is shown in Table 3.1. A series of 50 PCT tests, including the 44 West Valley glasses plus duplicates, ARM-1 tests, and blanks, was conducted three separate times at two-week intervals, as shown in Table 3.1. The test series were separately randomized, and these random orders were adhered to throughout testing and analysis. Each series began over a two-day period, and at the conclusion of each series, leachate analyses were performed during a single day.

3.1 Test Materials

A total of 44 test glasses plus 2 duplicates and 1 reference glass was tested. The analyzed compositions of these glasses appear in Table 3.2. All of these glasses were doped with Th and U, hence the name West Valley doped glass (WVDG), which is used to label the samples. The glasses were fabricated and originally tested in the four following groups:

- First Set of Compositional Variation Glasses, FY 1987

WVDG-1, WVDG-2, and WVDG-4 to WVDG-8 were based on the West Valley Ceramic Melter-47 (WVCM-47) glass composition. The composition of WVDG-1 was the same as WVCM-47 glass, and several components were changed individually, to create each of

Table 3.1. Matrix for PCT of West Valley Compositional Variation Glasses

	<u>Tests Began</u>	<u>Tests Ended</u>	<u>ICP Analysis</u>
Randomize 50 Tests:			
25 Tests, single day	Week 1	Week 2	12-11-90
25 Tests, single day	(Week of 10-29-90)	(Week of 11-4-90)	
Rerandomize 50 Tests:			
25 Tests, single day	Week 3	Week 4	12-12-90
25 Tests, single day	(Week of 11-12-90)	(Week of 11-19-90)	
Rerandomize 50 Tests:			
25 Tests, single day	Week 5	Week 6	12-20-90
25 Tests, single day	(Week of 11-26-90)	(Week of 12-3-90)	

Table 3.2. Composition of Test Materials, Wt%

Oxide Component	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6	WVDG-7	WVDG-8	WVDG-11R	WVDG-12R	WVDG-13R
Al ₂ O ₃	8.74	8.61	7.16	8.38	6.90	8.55	8.84	9.01	10.46	10.52	10.58
B ₂ O ₃	12.15	12.17	9.33	11.77	12.41	12.15	12.15	7.51	10.97	10.82	10.78
BaO	0.05	0.05	0.07	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
CaO	0.68	0.83	0.63	0.68	0.68	0.69	0.65	0.67	0.62	0.63	0.61
CeO ₂	0.07	0.07	0.10	0.07	0.09	0.05	0.07	0.10	0.07	0.07	0.07
Cr ₂ O ₃	0.19	0.20	0.29	0.20	0.21	0.19	0.20	0.19	0.17	0.17	0.17
Cs ₂ O	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.14	0.09	0.10	0.12
CuO											
Fe ₂ O ₃	11.74	11.72	10.81	11.06	11.91	11.55	11.55	12.29	11.90	11.82	11.90
K ₂ O	1.16	0.91	1.92	1.71	1.50	0.70	1.27	1.71	2.67	2.85	2.87
La ₂ O ₃	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03
Li ₂ O	1.74	1.76	2.34	1.71	1.76	1.71	1.71	1.84	2.63	2.57	2.59
MgO	1.32	1.30	1.70	1.29	1.35	1.29	1.28	1.39	1.25	1.25	1.26
MnO ₂	1.30	1.32	1.76	1.30	1.36	1.30	1.29	1.37	1.32	1.31	1.31
MoO ₃	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Na ₂ O	9.13	9.04	9.82	11.47	9.10	9.13	8.68	9.38	9.52	9.58	9.38
Nd ₂ O ₃	0.12	0.11	0.16	0.14	0.12	0.11	0.09	0.13	0.07	0.08	0.09
NiO	0.31	0.27	0.36	0.27	0.30	0.28	0.28	0.30	0.31	0.29	0.31
P ₂ O ₃	2.58	2.60	2.41	2.54	2.63	3.56	2.51	2.68	2.48	2.52	2.50
PdO ₂	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Pr ₆ O ₁₁	0.03	0.03	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
RhO ₂	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
RuO ₂	0.00	0.08	0.07	0.00	0.00	0.00	0.00	0.00	0.08	0.08	0.08
SiO ₂	43.25	43.60	45.46	41.94	44.43	43.42	43.03	45.83	40.61	40.16	40.18
Sm ₂ O ₃	0.03	0.03	0.00	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
SO ₃	0.30	0.30	0.27	0.29	0.31	0.30	0.29	0.32	0.31	0.30	0.31
SrO	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
ThO ₂	2.86	2.80	2.73	2.94	3.11	2.75	3.83	2.75	2.20	2.53	2.48
TiO ₂	0.96	0.96	1.22	0.90	0.97	0.93	0.96	1.01	0.95	0.94	0.96
UO ₂	0.54	0.53	0.54	0.54	0.57 ^(a)	0.53	0.46	0.58	0.63	0.65	0.69
Y ₂ O ₃	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02
ZnO								0.05	0.02	0.06	
ZrO ₂	0.59	0.56	0.64	0.54	0.60	0.56	0.62	0.57	0.46	0.54	0.52
TOTAL ^(b)	99.99	100.02	99.99	100.00	100.00	100.01	100.01	99.97	99.99	99.99	99.98

(a) The UO₂ value was set to the target value because the analytical value was not available.

(b) Totals do not equal 100 because of rounding errors.

Table 3.2. (contd)

Oxide Component	WDGR-14R	WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20	WVDG-21	WVDG-22	WVDG-23
Al ₂ O ₃	10.58	9.60	9.43	9.43	9.47	12.23	12.24	12.51	12.50	9.42
B ₂ O ₃	10.98	12.58	12.61	9.78	10.62	10.08	10.62	10.05	11.57	12.48
BaO	0.05	0.33	0.32	0.32	0.11	0.32	0.31	0.11	0.11	0.11
CaO	0.61	1.36	1.37	1.43	0.54	1.31	1.34	0.50	0.50	0.50
CeO ₂	0.07	1.24	0.38	1.36	0.39	0.38	1.35	0.39	1.32	0.42
Cr ₂ O ₃	0.17	0.24	0.07	0.26	0.08	0.07	0.26	0.08	0.26	0.08
Cs ₂ O	0.13	0.12	0.04	0.13	0.04	0.04	0.13	0.04	0.13	0.04
CuO	0.07	0.02	0.08	0.02	0.02	0.07	0.02	0.07	0.02	0.02
Fe ₂ O ₃	11.99	8.80	14.42	8.87	14.44	14.20	8.75	14.67	14.03	14.24
K ₂ O	2.19	1.64	1.31	2.07	1.75	1.97	2.23	1.23	1.84	1.86
La ₂ O ₃	0.03	0.07	0.02	0.08	0.02	0.02	0.07	0.02	0.07	0.02
Li ₂ O	2.61	2.73	1.91	2.34	2.44	2.07	2.04	2.31	1.82	1.80
MgO	1.25	1.27	1.22	1.29	0.44	1.28	1.42	0.53	0.48	0.54
MnO ₂	1.31	2.51	2.23	2.49	0.54	0.50	0.52	2.50	2.46	0.51
MoO ₃	0.01	0.07	0.02	0.08	0.02	0.02	0.07	0.02	0.07	0.02
Na ₂ O	9.51	10.17	8.64	10.57	11.14	9.88	8.63	10.46	8.31	8.23
Nd ₂ O ₃	0.08	0.24	0.07	0.26	0.08	0.07	0.26	0.08	0.26	0.08
NiO	0.29	0.53	0.16	0.58	0.17	0.16	0.58	0.17	0.57	0.18
P ₂ O ₅	2.50	1.33	3.23	1.24	1.55	1.35	3.34	3.38	1.43	3.30
PdO ₂	0.01									
Pr ₆ O ₁₁	0.03	0.07	0.02	0.08	0.02	0.02	0.07	0.02	0.07	0.02
RhO ₂	0.01									
RuO ₂	0.08									
SiO ₂	40.20	39.79	39.95	39.57	43.20	36.01	39.95	37.54	37.38	39.31
Sm ₂ O ₃	0.03	0.03	0.01	0.04	0.01	0.01	0.04	0.01	0.04	0.01
SO ₃	0.30	0.40	0.12	0.43	0.13	0.12	0.43	0.12	0.42	0.14
SrO	0.03	0.03	0.01	0.04	0.01	0.01	0.04	0.01	0.04	0.01
ThO ₂	2.59	1.66	1.60	4.69	1.96	5.24	1.87	1.59	1.75	4.95
TiO ₂	0.96	1.44	0.44	1.58	0.46	0.44	1.57	0.46	1.54	0.50
UO ₂	0.64	0.92	0.13	0.08	0.09	0.93	0.95	0.92	0.11	0.93
Y ₂ O ₃	0.02	0.03	0.01	0.04	0.01	0.01	0.04	0.01	0.04	0.01
ZnO		0.02	0.02	0.06			0.02	0.06	0.02	0.02
ZrO ₂	0.73	0.69	0.21	0.75	0.22	0.21	0.75	0.22	0.73	0.24
TOTAL ^(a)	99.99	100.01	99.99	100.02	99.99	98.99	100.00	99.99	99.98	99.99

(a) Totals do not equal 100 because of rounding errors.

Table 3.2. (contd)

Oxide Component	WVDG-24	WVDG-25	WVDG-26	WVDG-27	WVDG-28	WVDG-29	WVDG-30	WVDG-31B	WVDG-31C	WVDG-33
Al ₂ O ₃	12.32	9.30	12.27	12.17	9.68	9.28	10.07	10.99	11.14	8.22
B ₂ O ₃	13.22	10.90	13.38	12.58	10.66	11.45	11.88	10.71	10.32	9.03
BaO	0.11	0.10	0.30	0.11	0.11	0.32	0.20	0.05	0.05	0.06
CaO	0.48	0.50	1.34	0.49	0.48	1.33	0.84	0.63	0.61	0.40
CeO ₂	0.40	0.44	0.45	1.44	1.38	0.44	0.80	0.03	0.06	0.67
Cr ₂ O ₃	0.08	0.08	0.09	0.28	0.27	0.08	0.16	0.18	0.17	0.13
Cs ₂ O	0.04	0.04	0.04	0.14	0.13	0.04	0.08	0.06	0.06	0.07
CuO	0.02	0.02	0.03	0.08	0.08	0.02	0.04	0.01	0.00	0.04
Fe ₂ O ₃	8.67	8.67	8.67	8.68	12.11	8.74	11.48	11.93	11.65	11.45
K ₂ O	2.52	2.02	2.64	2.45	1.35	1.84	1.81	2.74	3.04	3.44
La ₂ O ₃	0.02	0.02	0.03	0.08	0.08	0.02	0.04	0.03	0.04	0.04
Li ₂ O	2.05	2.03	2.00	2.28	2.05	2.57	2.10	2.56	2.50	2.91
MgO	0.56	0.53	1.35	0.62	0.62	1.36	1.01	1.25	1.29	0.98
MnO ₂	2.44	2.40	0.55	0.51	0.52	0.50	1.20	1.31	1.28	1.28
MoO ₃	0.02	0.02	0.03	0.08	0.08	0.02	0.04	0.00	0.00	0.04
Na ₂ O	9.56	9.09	9.09	10.14	8.86	10.74	9.63	9.47	9.24	10.51
Nd ₂ O ₃	0.08	0.08	0.09	0.28	0.27	0.08	0.16	0.12	0.14	0.13
NiO	0.17	0.19	0.19	0.62	0.59	0.19	0.35	0.34	0.32	0.29
P ₂ O ₃	1.41	3.13	1.62	3.48	1.53	3.27	2.42	2.54	2.56	2.47
PdO ₂								0.01	0.01	
Pr ₆ O ₁₁	0.02	0.02	0.03	0.08	0.08	0.02	0.04	0.03	0.03	0.04
RhO ₂								0.01	0.01	
RuO ₂								0.08	0.08	
SiO ₂	42.10	45.00	40.95	36.72	43.38	44.68	40.06	42.39	39.77	42.50 ^(a)
Sm ₂ O ₃	0.01	0.01	0.01	0.04	0.04	0.01	0.02	0.03	0.03	0.02
SO ₃	0.13	0.14	0.14	0.46	0.44	0.14	0.26	0.30	0.31	0.21
SrO	0.01	0.01	0.01	0.04	0.04	0.01	0.02	0.03	0.03	0.02
ThO ₂	1.88	4.36	3.80	3.46	1.72	1.93	3.26	2.33	3.28	3.17
TiO ₂	0.47	0.51	0.53	1.68	1.61	0.51	0.94	0.92	0.92	0.78
UO ₂	0.93	0.10	0.10	0.11	0.96	0.10	0.59	0.45	0.51	0.50
Y ₂ O ₃	0.01	0.01	0.01	0.04	0.04	0.01	0.02	0.02	0.02	0.02
ZnO	0.02		0.02	0.06	0.06	0.02	0.03			0.03
ZrO ₂	0.22	0.24	0.25	0.80	0.77	0.24	0.45	0.47	0.51	0.37
TOTAL ^(b)	99.99	99.98	100.01	100.00	99.99	99.96	100.00	100.02	99.98	100.02

(a) The SiO₂ of WVDG-33 through WVDG-48 were set to the target values due to a relatively large bias in the ICP analysis of SiO₂. This was done per Reimus et al. (1988).

(b) Totals do not equal 100 because of rounding errors.

Table 3.2. (contd)

Oxide Component	WVDG-34	WVDG-35	WVDG-36	WVDG-37	WVDG-38	WVDG-39	WVDG-40	WVDG-41	WVDG-42	WVDG-43
Al ₂ O ₃	5.17	10.02	5.69	9.98	10.24	10.05	6.09	5.92	5.55	10.04
B ₂ O ₃	10.81	7.15	10.80	7.78	7.58	11.22	7.53	7.26	6.75	12.43
BaO	0.03	0.10	0.02	0.02	0.02	0.09	0.10	0.03	0.10	0.03
CaO	0.18	0.70	0.16	0.14	0.16	0.66	0.72	0.20	0.68	0.20
CeO ₂	1.91	0.32	1.88	1.86	1.93	0.51	0.42	0.48	1.85	0.41
Cr ₂ O ₃	0.37	0.06	0.37	0.36	0.37	0.10	0.08	0.09	0.36	0.08
Cs ₂ O	0.19	0.03	0.18	0.18	0.19	0.05	0.04	0.05	0.18	0.04
CuO	0.11	0.02	0.10	0.10	0.11	0.03	0.02	0.03	0.10	0.02
Fe ₂ O ₃	9.77	14.98	14.66	9.77	9.67	9.28	15.35	9.48	9.53	9.53
K ₂ O	3.62	3.71	2.54	3.90	3.26	3.62	3.17	3.75	3.47	2.68
La ₂ O ₃	0.11	0.02	0.10	0.10	0.11	0.03	0.02	0.03	0.10	0.02
Li ₂ O	3.07	3.14	2.15	3.30	2.76	3.06	2.69	3.17	2.94	2.27
MgO	0.45	1.74	0.40	0.36	0.39	1.64	1.78	0.51	1.67	0.49
MnO ₂	1.98	1.95	0.12	0.13	0.11	0.11	0.12	0.12	1.95	1.94
MoO ₃	0.11	0.02	0.10	0.10	0.11	0.03	0.02	0.03	0.10	0.02
Na ₂ O	11.07	11.34	7.75	11.91	9.95	11.04	9.68	11.44	10.60	8.17
Nd ₂ O ₃	0.37	0.06	0.37	0.36	0.37	0.10	0.08	0.09	0.36	0.08
NiO	0.82	0.14	0.81	0.80	0.83	0.22	0.18	0.21	0.80	0.18
P ₂ O ₃	1.87	0.60	0.59	0.50	0.60	3.81	0.60	3.80	3.68	2.39
PdO ₂										
Pr ₆ O ₁₁	0.11	0.02	0.10	0.10	0.11	0.03	0.02	0.03	0.10	0.02
RhO ₂										
RuO ₂										
SiO ₂	40.00 ^(a)	38.00 ^(a)	41.10 ^(a)	42.00 ^(a)	40.90 ^(a)	38.00 ^(a)	44.36 ^(a)	45.00 ^(a)	40.00 ^(a)	42.00 ^(a)
Sm ₂ O ₃	0.05	0.01	0.05	0.05	0.05	0.01	0.01	0.01	0.05	0.01
SO ₃	0.61	0.10	0.60	0.60	0.61	0.16	0.13	0.15	0.59	0.13
SrO	0.05	0.01	0.05	0.05	0.05	0.01	0.01	0.01	0.05	0.01
ThO ₂	1.92	2.78	5.81	2.09	4.13	5.11	4.19	5.27	5.00	4.14
TiO ₂	2.23	0.38	2.19	2.16	2.25	0.60	0.49	0.56	2.16	0.48
UO ₂	1.83	2.40	0.13	0.14	0.09	0.10	1.82	1.99	0.12	1.92
Y ₂ O ₃	0.05	0.01	0.05	0.05	0.05	0.01	0.01	0.01	0.05	0.01
ZnO	0.08	0.01	0.08	0.08	0.08	0.02	0.02	0.02	0.08	0.02
ZrO ₂	1.06	0.18	1.04	1.03	1.07	0.28	0.23	0.27	1.03	0.23
TOTAL ^(b)	100.00	100.00	99.99	100.00	100.01	99.98	99.98	100.01	100.00	99.99

(a) The SiO₂ of WVDG-33 through WVDG-48 were set to the target values due to a relatively large bias in the ICP analysis of SiO₂. This was done per Reimus et al. (1988).

(b) Totals do not equal 100 because of rounding errors.

Table 3.2. (contd)

Oxide Component	WVDG-44	WVDG-45	WVDG-46	WVDG-47	WVDG-48	ARM-1, MCC Reference Glass
Al ₂ O ₃	8.32	10.21	7.00	5.69	9.43	5.59
B ₂ O ₃	11.50	7.31	12.23	11.21	10.56	11.30
BaO	0.03	0.02	0.10	0.02	0.10	0.66
CaO	0.19	0.16	0.68	0.16	0.68	2.23
CeO ₂	0.40	0.41	0.37	0.36	2.05	1.51
Cr ₂ O ₃	0.08	0.08	0.07	0.07	0.40	
Cs ₂ O	0.04	0.04	0.04	0.04	0.20	1.16
CuO	0.02	0.02	0.02	0.02	0.11	
Fe ₂ O ₃	15.81	15.51	10.39	14.94	9.24	
K ₂ O	3.53	3.84	3.37	2.67	2.68	
La ₂ O ₃	0.02	0.02	0.02	0.02	0.11	
Li ₂ O	2.99	3.25	2.86	2.26	2.27	5.08
MgO	0.48	0.40	1.67	0.40	1.67	
MnO ₂	0.13	2.01	1.96	1.94	0.12	
MoO ₃	0.02	0.02	0.02	0.02	0.11	1.67
Na ₂ O	10.79	11.73	10.30	8.18	8.18	9.67
Nd ₂ O ₃	0.08	0.08	0.07	0.07	0.40	5.96
NiO	0.17	0.18	0.16	0.15	0.88	
P ₂ O ₅	0.62	3.90	0.59	3.93	4.28	0.65
PdO ₂						
Pr ₆ O ₁₁	0.02	0.02	0.02	0.02	0.11	
RhO ₂						
RuO ₂						
SiO ₂	38.00 ^(a)	38.00 ^(a)	45.00 ^(a)	45.00	38.00 ^(b)	46.50
Sm ₂ O ₃	0.01	0.01	0.01	0.01	0.06	
SO ₃	0.13	0.13	0.12	0.11	0.66	
SrO	0.01	0.01	0.01	0.01	0.06	0.45
ThO ₂	3.71	1.79	2.16	1.95	2.06	
TiO ₂	0.47	0.48	0.43	0.42	2.39	3.21
UO ₂	2.15	0.10	0.11	0.12	1.90	
Y ₂ O ₃	0.01	0.01	0.01	0.01	0.06	
ZnO	0.02	0.02	0.02	0.02	0.09	
ZrO ₂	0.02	0.23	0.21	0.20	1.14	
TOTAL ^(c)	99.97	99.99	100.02	100.02	100.00	98.90 ^(c)

(a) The SiO₂ of WVDG-33 through WVDG-48 were set to the target values due to a relatively large bias in the ICP analysis of SiO₂. This was done per Reimus et al. (1988).

(b) Totals do not equal 100 because of rounding errors.

(c) Total does not equal 100 because it is not normalized to 100%.

the glasses WVDG-4 to WVDG-8. The composition of WVDG-2 was the same as WVCM-47 with the addition of noble metal oxides. WVDG-3 was an alternate glass based on another West Valley reference glass, ATM-10.

- Redox Variation Glasses, FY 1987

WVDG-11R to WVDG-14R shared the same composition, which was close to that of WVCM-50, but the redox state of the glass varied. The $\text{Fe}^{2+}/\text{Fe}^{3+}$ ratio varied from 0.068 to 0.424.

- Second Set of Compositional Variation Glasses, FY 1987

WVDG-15 to WVDG-30 were selected to explore a polyhedral region centered around the WVCM-50 glass composition. WVDG-30 was nominally the WVCM-50 composition, while the other compositions were 15 vertices of the polyhedral region. The oxide limits of this polyhedral region are shown in Table 3.3. (Two duplicates of WVDG-30, WVDG-31B and WVDG-31C were also included.)

- Compositional Variation Glasses, FY 1988

WVDG-33 to WVDG-48 were selected to explore a polyhedral region centered around the WV-8801 composition. Glass WVDG-33 was the WV-8801 composition, while the remaining glasses were 15 vertices of the polyhedral region. The oxide limits of this polyhedral region are shown in Table 3.4.

In addition to the test materials, ARM-1 was used as a test standard. The ARM-1 glass is a standard reference glass supplied by the MCC and is described by Mellinger and Daniel (1984).

The glass powders were prepared by breaking small amounts of glass into pieces using a Plattner tool-steel mortar. Next, the glass pieces were crushed with a mechanical mortar and pestle. The crushed glass was then shaken through 100- and 200-mesh brass sieves. Powder that did not pass through the 100-mesh sieve was ground further in the pulverizer. This process was repeated until all powder passed the 100-mesh sieve.

The sieved powders were washed seven times as specified in V.3.0 of the PCT. In the first two washes, fresh deionized water was squirted into the glass powders; settling was allowed for 15 s, then the water was decanted. In the next two washes, the powders were placed in an ultrasonic cleaner with fresh deionized water. Decanting was performed after 2 min of ultrasonic cleaning. The three final washes were performed using fresh alcohol with the glass powders in an ultrasonic cleaner. Again, decanting was performed after 2 min of ultrasonic cleaning. The powders were dried overnight at 90°C.

Table 3.3. Definition of Compositional Variation Region
Based on WVCM-50

Single Component Constraints, wt%		
9.0 ≤	Al ₂ O ₃	≤ 12.0
10.0 ≤	B ₂ O ₃	≤ 14.0
1.0 ≤	BaO + CaO + MgO ^(a)	≤ 3.0
9.0 ≤	Fe ₂ O ₃	≤ 15.0
11.6 ≤	K ₂ O + Li ₂ O + Na ₂ O ^(a)	≤ 15.6
0.5 ≤	MnO ₂	≤ 2.5
1.5 ≤	P ₂ O ₅	≤ 3.5
36.0 ≤	SiO ₂	≤ 44.0
2.0 ≤	ThO ₂	≤ 5.25
0.1 ≤	UO ₂	≤ 1.0
1.0 ≤	Others	≤ 8.0
Multiple Component Constraints, wt%		
48.0 ≤	SiO ₂ + Al ₂ O ₃	≤ 54
23.6 ≤	Alkalis + B ₂ O ₃	≤ 27.6
3.3 ≤	(SiO ₂ + Al ₂ O ₃)/Alkalis	≤ 4.1
3.7 ≤	(SiO ₂ + Al ₂ O ₃)/B ₂ O ₃	≤ 4.7

(a) The BaO:CaO:MgO and K₂O:Li₂O:
Na₂O wt% ratios were held constant
at their levels in the WVCM-50 glass.

Table 3.4. Definition of Compositional Variation Region Based on WV-8801, Wt%

Components	WV-8801	Single Component Constraints	
		Lower Bound	Upper Bound
Al ₂ O ₃	7.75	4.5 ^(a)	10.0
B ₂ O ₃	9.26	6.0 ^(b)	13.0
BaO + CaO + MgO ^(c)	1.77	0.5	2.5
Fe ₂ O ₃	12.04	10.0	16.0
K ₂ O + Li ₂ O + Na ₂ O ^(c)	16.32	12.0	21.0 ^(d)
MnO ₂	1.30	0.1	2.0
P ₂ O ₅	2.48	0.5	4.0
SiO ₂	42.50	38.0	45.0
ThO ₂	3.55	2.0	5.0
UO ₂		0.54	0.12.0
Others ^(e)	2.49 ^(f)	1.0	8.0

Multiple Component Constraints			
		Lower Bound	Upper Bound
SiO ₂ + Al ₂ O ₃	50.25	45.0	52.0
Alkalis + B ₂ O ₃	25.58	23.0	29.0
(SiO ₂ + Al ₂ O ₃)/Alkalis	3.08	2.6	4.3
(SiO ₂ + Al ₂ O ₃)/B ₂ O ₃	5.43	4.0	6.5
SiO ₂ /Al ₂ O ₃	5.48	3.8	8.0

- (a) Due to the multiple component constraints, the attainable lower limit for Al₂O₃ is 5 wt%.
- (b) Due to the multiple component constraints, the attainable lower limit for B₂O₃ is 6.92 wt%.
- (c) The BaO:CaO:MgO and K₂O:Li₂O:Na₂O wt% ratios were held constant at their levels in the WV-8801 glass.
- (d) Due to the multiple component constraints, the attainable upper limit for alkalis is 20 wt%.
- (e) Includes the following oxide mix: CeO₂ (6.35), Cr₂O₃ (5.56), Cs₂O (3.57), CuO (2.38), La₂O₃ (1.59), MoO₃ (1.98), Nd₂O₃ (5.56), NiO (9.92), PdO₂ (1.19), Pr₆O₁₁ (1.59), RhO₂ (0.79), RuO₂ (3.17), Sm₂O₃ (0.79), SnO₂ (1.19), SO₃ (8.73), SrO (0.79), TeO₂ (0.40), TiO₂ (35.32), Y₂O₃ (0.79), ZnO₂ (0.79), ZrO₂ (7.54). Numbers in parentheses give relative wt% of the oxides in this mix.
- (f) This level for "Others" was obtained by subtracting from 100 the total wt% levels of the preceding ten components.

3.2 Test Procedure

The PCT was originated at the Westinghouse Savannah River Company by C. M. Jantzen and N. R. Bibler (Jantzen and Bibler 1989). The test is a modified MCC-3 test that runs for seven days and uses crushed glass in the size range -100 +200 mesh. The difference between the MCC-3 and PCT is that there is no agitation during the PCT test, nor is CO₂ excluded from the test environment.

Approximately 3 g of 100- to 200-mesh crushed glass and 30 mL of deionized water leachant were sealed inside a Teflon test vessel, in which the test temperature was 90°C ± 2°C. Atmospheric CO₂ was not excluded from the test and the container was not agitated during the test. The Teflon containers were placed in an oven at 90°C. The container lids were tightened within 24 h after being placed in the oven. Six containers cost > 10% of their leachant during the seven days of testing, most likely because crushed glass was present in the seal of the Teflon containers. Data from these six tests were not used.

3.3 Leachate Analysis

At the end of the seven-day cycle, the Teflon containers were removed from the oven, weighed, and allowed to cool. The Teflon leaching vessels were opened, and approximately 1 mL of leachate was removed from each for pH measurement using a Ross combination electrode. These 1-mL portions of leachate were discarded after the pH measurements were taken.

The remaining leachate from each vessel was filtered using a 0.45-μm filter and split into three aliquots. Approximately 10 mL was acidified to 1% with Ultrex HNO₃ and analyzed by inductively coupled plasma (ICP) spectrometry and laser fluorescence for U. Approximately 10 mL was sent without acidification for ion chromatograph (IC) analysis. The remaining leachate was acidified and stored for possible future analysis.

4.0 Calculations and Results

This section presents the calculations and results from the PCT of the 44 West Valley Compositional Variation Glasses plus two duplicate glasses and the ARM-1 reference glass and blanks. Additional information and ICP analytical data from the PCT of these glasses are listed in the Appendix, Tables A.1 to A.3; data from U analyses are included in these Appendix tables. IC data are listed in Table A.4. Estimates of data variability using statistical error propagation techniques were not calculated due to time and budget constraints.

4.1 Calculations

Only normalized results, in units of g/m^2 , are presented in this section. For a particular set of test conditions (i.e., a specified combination of time and glass composition), the normalized element mass loss of the i -th element computed for the j -th specimen (NL_{ij}) is given by:

$$NL_{ij} = \frac{C_{ij} - B_i}{f_i(S_j/V_j)}$$

where C_{ij} = concentration of element i observed in leachate from specimen j

B_i = concentration of element i observed in leachate from blank

f_i = average mass fraction of element i in the specimen, where $f_i =$
(mass fraction oxide in glass) $\frac{\text{(atomic weight metal in oxide)}}{\text{atomic weight of oxide}}$

S_j = surface area of specimen j

V_j = initial volume of leachant in test vessel containing specimen j .

The ratio of S/V (specimen surface area to leachant volume) was approximately 2000 m^{-1} for these PCTs. S/V was calculated for each sample from the mass of sample, using an assumed glass sample surface area of $0.02 \text{ m}^2/\text{g}$ and the actual volume of leachant. This assumed specific surface area of 100- to 200-mesh glass, $0.02 \text{ m}^2/\text{g}$, is based on an average-sized spherical particle of 0.055 mm and glass density of 2.7 g/cm^3 .

Normalized releases are averages for the three tests of each glass, except in cases where one of the tests lost greater than 10% of its original leachant. In the six such cases, normalized values are averages for only two of the three tests. Generally, normalized values are given for all metals whose oxides constituted more than 1% of the glass composition.

4.2 Results

The results are briefly discussed below, in the order in which the four sets of glasses were made in FY 1987 and FY 1988.

4.2.1 First Set of Compositional Variation Glasses: 8 Glasses, FY 1987

These glasses were based on the WVCN-47 composition, nominally the composition of WVDG-1. The glass WVDG-2 contained noble metal oxides and WVDG-3 was similar to ATM-10, a West Valley reference glass not included in the Compositional Variability Study. Single elements were changed in all of the other glasses in this set, with the remaining oxide percentages proportionally adjusted to offset the changes. Based on WVCN-47, WVDG-4 contained higher Na_2O ; WVDG-5 contained lower Al_2O_3 ; WVDG-6 contained higher P_2O_5 ; WVDG-7 contained higher ThO_2 ; and WVDG-8 contained lower B_2O_3 .

The averaged normalized release values from this set of glasses are listed in Table 4.1. The averaged release values for B, Li, and Si (Table 4.1) are plotted in Figure 4.1. Figure 4.1 shows normalized releases of B and Li as required by the WAPS (DOE 1990). The element Si is included

Table 4.1. Normalized Elemental Releases (g/m^2) from First Set of FY 1987 Compositional Variation Glasses

	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6	WVDG-7	WVDG-8
Al	0.114	0.113	0.095	0.110	0.093	0.114	0.106	0.106
B	0.180	0.207	0.238	0.261	0.214	0.199	0.180	0.173
Fe	0.008	0.004	0.005	0.004	0.003	0.004	0.005	0.003
K	0.101	0.140	0.095	0.075	0.102	0.179	0.163	0.087
Li	0.250	0.311	0.291	0.303	0.285	0.303	0.267	0.273
Mg	0.007	0.006	0.013	0.007	0.005	0.004	0.007	0.006
Mn	0.007	0.004	0.005	0.004	0.002	0.002	0.003	0.003
Mo	0.171	0.193	(a)	0.229	0.249	0.188	0.201	0.176
Na	0.159	0.181	0.233	0.266	0.198	0.169	0.169	0.174
P	0.085	0.108	0.200	0.188	0.129	0.101	0.091	0.119
Si	0.127	0.133	0.139	0.134	0.128	0.131	0.125	0.121
Th	0.007	0.004					0.003	
Ti	0.006	0.003	0.002	0.002	0.002	0.003	0.003	0.002
U	0.062	0.043	0.039	0.041	0.034	0.056	0.048	0.049
pH	9.40	9.340	9.77	9.78	9.46	9.50	9.37	9.73

(a) Absence of data indicates less than analytical detection limit.

Figure 4.1. Normalized Elemental Mass Loss of B, Li, and Si for First Set of FY 1987 Compositional Variation Glasses (8 Glasses, WVDG-1 to WVDG-8). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

because it was plotted by Reimus et al. (1988). The error bars are ± 1 standard deviation based on variability of leachate values only, i.e., uncertainty in surface area/initial volume (S/V), composition, and blank and volume corrections were not included. Uncertainty in S/V, glass composition, and blank and volume correctors would each be expected to add to the standard deviation. The uncertainty contribution from variations in S/V could be calculated from sample weight and leachant volume numbers recorded by laboratory personnel. Uncertainty from glass composition analysis was estimated for Reimus et al. (1988). The uncertainty from blank and volume corrections would need to be estimated.

As was found by Reimus et al. (1988), the least chemically durable glass in Figure 4.1 based on normalized release, appears to be WVDG-4, the "high Na_2O " glass. Glasses WVDG-7 (high ThO_2) and WVDG-8 (low B_2O_3) appear to be as chemically durable as the reference glass, WVDG-1. These comparisons are based on B release.

4.2.2 Redox Variation Glasses: 4 Glasses, FY 1987

The averaged normalized release values are listed in Table 4.2. The normalized releases for B, Li, and Si are plotted in Figure 4.2. There appears to be a trend toward higher releases with higher redox ($\text{Fe}^{2+}/\text{Fe}^{3+}$) ratio; no similar trend was shown during previous testing by Reimus et al. (1988).

Table 4.2. Normalized Elemental Releases (g/m^2) from Redox Set of FY 1987 Compositional Variation Glasses

	<u>WVDG-11R</u>	<u>WVDG-12R</u>	<u>WVDG-13R</u>	<u>WVDG-14R</u>
$\text{Fe}^{2+}/\text{Fe}^{3+}$	0.068	0.126	0.236	0.424
Al	0.116	0.115	0.119	0.126
B	0.205	0.217	0.237	0.288
Fe	0.005	0.004	0.004	0.008
K	0.134	0.131	0.127	0.195
Li	0.246	0.263	0.279	0.333
Mg	0.008	0.009	0.009	0.017
Mn	0.005	0.004	0.004	0.008
Mo	0.197	0.217	0.225	0.235
Na	0.204	0.214	0.243	0.302
P	0.168	0.164	0.178	0.201
Si	0.122	0.123	0.128	0.136
Th	(a)			
Ti	0.003	0.003	0.002	0.003
U	0.052	0.037	0.038	0.084
pH	9.81	9.81	9.74	9.95

(a) Absence of data indicates less than analytical detection limit.

Figure 4.2. Normalized Elemental Mass Loss of B, Li, and Si for Redox Set of FY 1987 Compositional Variation Glasses (4 Glasses, WVDG-11R to WVDG-14R). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

4.2.3 Second Set of Compositional Variation Glasses: 16 Glasses, FY 1987

The averaged normalized elemental releases are listed in Table 4.3. The normalized releases for B, Li, and Si are displayed in Figure 4.3 for glasses WVDG-15 to WVDG-22 and Figure 4.4 for WVDG-23 to WVDG-30. Based on normalized release, the least chemically durable glasses were WVDG-17, WVDG-27, and WVDG-15 and the most chemically durable was WVDG-20. These same results were observed in the testing by Reimus et al. (1988).

Consistently, the least chemically durable glasses (WVDG-17, WVDG-27, and WVDG-15) had the highest amount of alkali oxides (Na_2O , K_2O , and Li_2O) at 14.54 wt% to 14.98 wt%, and the most chemically durable glass (WVDG-20) had the least amount of alkali oxides at 12.90 wt%. The reference glass, WVCN-50 (WVDG-30), had an intermediate amount of alkali oxides, 13.54 wt%.

Table 4.3. Normalized Elemental Releases (g/m²) from Second Set of FY 1987 Compositional Variation Glasses

WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20	WVDG-21	WVDG-22	WVDG-23	WVDG-24	WVDG-25	WVDG-26	WVDG-27	WVDG-28	WVDG-29	WVDG-30
Al	0.109	0.108	0.111	0.132	0.127	0.113	0.159	0.147	0.138	0.122	0.126	0.103	0.131	0.100	0.126
B	0.296	0.189	0.292	0.225	0.160	0.225	0.253	0.210	0.253	0.213	0.188	0.309	0.201	0.217	0.209
Fe	0.004	0.002	0.004	0.008	0.002	0.014	0.004	0.023	0.006	0.008	0.004	0.018	0.011	0.006	0.006
K	0.148	0.149	0.128	0.128	0.084	0.220	0.077	0.307	0.079	0.109	0.068	0.099	0.110	0.142	0.117
Li	0.300	0.235	0.292	0.269	0.242	0.252	0.300	0.012	0.286	0.253	0.257	0.327	0.289	0.018	0.007
Mg	0.010	0.005	0.010	(a)	0.005	0.012		0.012			0.006	0.012		0.018	0.007
Mn	0.004	0.002	0.004	0.006	0.002	0.012	0.005	0.016	0.003	0.005	0.003	0.010	0.009	0.007	0.004
Mo	0.254	0.148	0.258	0.191	0.136	0.180	0.183	0.151	0.142	0.154	0.124	0.171	0.162	0.192	0.199
Na	0.264	0.165	0.273	0.219	0.139	0.222	0.179	0.187	0.173	0.164	0.156	0.243	0.169	0.214	0.196
P	0.241	0.092	0.265	0.176	0.062	0.141	0.104	0.126	0.150	0.093	0.100	0.115	0.113	0.202	0.124
Si	0.132	0.090	0.128	0.137	0.113	0.152	0.145	0.146	0.124	0.131	0.105	0.154	0.139	0.120	0.126
Th				0.005		0.020	0.011	0.025		0.005	0.002	0.015	0.011		0.005
Ti	0.001	0.001	0.001	0.005	0.002	0.013	0.004	0.021	0.003	0.005	0.002	0.012	0.009	0.002	0.003
U	0.049	0.035	0.290	0.063	0.009	0.082	0.054	0.082	0.054	0.043	0.041	0.073	0.056	0.060	0.039
pH	9.89	9.42	10.12	9.94	9.77	9.46	9.71	9.39	9.45	9.58	9.48	9.55	9.51	9.79	9.63

(a) Absence of data indicates less than instrument detection limits.

Figure 4.3. Normalized Elemental Mass Loss of B, Li, and Si for Second Set of FY 1987 Compositional Variation Glasses (8 Glasses, WVDG-15 to WVDG-22). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

Figure 4.4. Normalized Elemental Mass Loss of B, Li, and Si for Second Set of FY 1987 Compositional Variation Glasses (8 Glasses, WVDG-23 to WVDG-30). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

4.2.4 Compositional Variation Glasses: 16 Glasses, FY 1988

The normalized elemental releases are listed in Table 4.4. Normalized releases for B, Li, and Si are displayed in Figure 4.5 for WVDG-33 to WVDG-40 and Figure 4.6 for WVDG-41 to WVDG-48. Based on normalized B-release values, the least chemically durable glasses in this group were WVDG-35 and WVDG-42, and the most chemically durable glass was WVDG-48. Again the least chemically durable glasses (WVDG-35 and WVDG-42) had the highest amount of alkali oxides at 18.19% and 17.01%, respectively, and the most chemically durable glass (WVDG-48) had the least amount of alkali oxides at 13.13%. The reference glass, WV-8801, (WVDG-33) contained an intermediate amount of alkali oxides at 16.86%.

4.2.5 Comparisons of All Glasses

The leaching results that were obtained during this PCT and previous MCC-3 testing (Reimus et al. 1988) of the 44 glasses are presented in Figures 4.7 through 4.10. Boron, Li, and Si releases are shown in Figure 4.7, 4.8, and 4.9, respectively. These results are in agreement with each other when these PCT and previous MCC-3 tests are compared. However, U-release results (Figure 4.10) from the two tests do not agree. Results from these PCT tests are about 22% higher than those from Reimus et al. (1988).

4.3 Duplicate Tests

Included in the PCT were three glasses with the same target composition: WVDG-31B and -31C were duplicates of WVDG-30. All three glasses were identical in composition to the Catholic University of America (CUA) reference glass WVCN-50. Their analyzed compositions can be compared in Table 3.2. The normalized releases of B, Li, and Si are listed in Table 4.5. The three glasses show nearly identical durability, in the plotted B, Li, and Si results in Figure 4.11.

4.4 Arm-1 Reference Glass Tests

Six samples of reference glass ARM-1 were included in the test matrix. The averaged normalized releases are listed in Table 4.6 as are the averaged normalized releases from a different PCT of ARM-1 that was tested along with WVSG-1 (Olson et al. 1990).^(a) Comparison shows that the 1992 testing yielded concentrations of the major elements in the leachate that were much lower (as little as half as much) than those from the 1990 PCT of WVSG-1. This would be expected, since the crushed glass was not washed for the earlier tests, and a large amount of -200 mesh glass was expected to be present in those specimens.

(a) Olson, K. M., M. L. Elliott, J. W. Shade, and H. D. Smith. 1990. "Fabrication, Characterization, and Evaluation of West Valley Sludge Glass-1 (WVSG-1), a Fully Radioactive Glass Made with High-Level Waste from the West Valley Demonstration Project." Letter report prepared by Pacific Northwest Laboratory, Richland, Washington.

Table 4.4. Normalized Elemental Releases (g/m²) from FY 1988 Composition Variation Glasses

	WVDG-33	WVDG-34	WVDG-35	WVDG-36	WVDG-37	WVDG-38	WVDG-39	WVDG-40	WVDG-41	WVDG-42	WVDG-43	WVDG-44	WVDG-45	WVDG-46	WVDG-47	WVDG-48
Al	0.116	0.122	0.182	0.111	0.152	0.134	0.122	0.095	0.127	0.086	0.137	0.146	0.160	0.110	0.122	0.126
B	0.247	0.417	0.400	0.244	0.231	0.197	0.271	0.305	0.314	0.380	0.208	0.357	0.260	0.372	0.224	0.179
Fe	0.009	0.004	0.013	0.003	0.011	0.007	0.008	0.004	0.011	0.009	0.038	0.007	0.009	0.010	0.029	0.003
K	0.138	0.175	0.225	0.157	0.140	0.131	0.169	0.188	0.173	0.223	0.096	0.161	0.167	0.165	0.124	0.118
Li	0.263	0.388	0.394	0.251	0.267	0.240	0.249	0.305	0.299	0.355	0.257	0.358	0.265	0.317	0.233	0.206
Mg	0.017	(a)	0.018				0.018	0.012		0.018	0.013			0.023	0.019	0.004
Mn	0.008	0.004	0.009	0.004	0.008	0.004	0.009	0.004	0.008	0.008	0.021	0.006	0.008	0.010	0.022	0.004
Mo	0.270	0.395	0.349	0.280	0.318	0.256	0.187	0.314	0.198	0.555	0.131	0.230	0.381	0.232	0.180	0.174
Na	0.245	0.363	0.399	0.164	0.267	0.197	0.247	0.289	0.369	0.364	0.138	0.331	0.300	0.299	0.156	0.129
P	0.206	0.253	0.287	0.125	0.193	0.146	0.206	0.224	0.305	0.351	0.096	0.173	0.269	0.196	0.143	0.066
Si	0.138	0.168	0.185	0.134	0.148	0.133	0.128	0.154	0.161	0.173	0.138	0.152	0.155	0.145	0.140	0.123
Th	0.003			0.003	0.007	0.005	0.004		0.004		0.024	0.004	0.007	0.005	0.026	
Ti	0.005	0.003	0.003	0.003	0.009	0.006	0.002	0.001	0.003	0.003	0.023	0.004	0.008	0.004	0.022	0.003
U	0.068	0.037	0.079	0.042	0.033	0.076	0.054	0.074	0.085	0.021	0.066	0.066	0.056	0.075	0.110	0.006
pH	10.17	10.14	10.83	9.68	10.38	10.23	9.90	10.32	10.52	10.44	9.35	10.29	10.57	10.01	9.30	9.32

(a) Absence of data indicates less than analytical detection limit.

Figure 4.5. Normalized Elemental Mass Loss of B, Li, and Si for Set of FY 1988 Compositional Variation Glasses (8 Glasses, WVDG-33 to WVDG-40). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

Figure 4.6. Normalized Elemental Mass Loss of B, Li, and Si for Set of FY 1988 Compositional Variation Glasses (8 Glasses, WVDG-41 to WVDG-48). (Error bars are ± 1 standard deviation taking into account variation in leachate concentrations only.)

39203046.8

Figure 4.7a. Normalized Elemental Mass Loss of B from all 44 Test Glasses, Results from PCT Tests

39203046.9

Figure 4.7b. Normalized Elemental Mass Loss of B from all 44 Test Glasses, Results from Modified MCC-3 Testing Performed by Reimus et al. (1988)

Figure 4.8a. Normalized Elemental Mass Loss of Li from all 44 Test Glasses, Results from PCT Tests

Figure 4.8b. Normalized Elemental Mass Loss of Li from all 44 Test Glasses, Results from Modified MCC-3 Testing Performed by Reimus et al. (1988)

Figure 4.9a. Normalized Elemental Mass Loss of Si from all 44 Test Glasses, Results from PCT Tests

Figure 4.9b. Normalized Elemental Mass Loss of Si from all 44 Test Glasses, Results from Modified MCC-3 Testing Performed by Reimus et al. (1988)

Figure 4.10a. Normalized Elemental Mass Loss of U from all 44 Test Glasses, Results from PCT Tests. The U Release from WVDG-17 was omitted because of the size of the average U release (0.29 g/m²) and error bars (0.47 g/m²).

Figure 4.10b. Normalized Elemental Mass Loss of U from all 44 Test Glasses, Results from Modified MCC-3 Testing Performed by Reimus et al. (1988).

Table 4.5. Normalized Elemental (g/m²) Releases from Three Glasses Having Target Composition of WVCM-50

	WVDG-31B	WVDG-31C	WVDG-30	Mean	Standard Deviation	Relative Standard Deviation, % ^(b)
Al	0.080	0.111	0.126	0.106	0.023	22.2
B	0.151	0.221	0.209	0.194	0.037	19.3
Fe	0.004	0.005	0.006	0.005	0.001	20.0
K	0.082	0.114	0.117	0.104	0.019	18.6
Li	0.180	0.263	0.267	0.237	0.049	20.8
Mg	0.010	0.006	0.007	0.008	0.002	27.2
Mn	0.005	0.005	0.004	0.005	0.001	12.4
Mo	(a)	0.199		0.199		
Na	0.145	0.211	0.196	0.184	0.035	18.8
P	0.123	0.160	0.124	0.136	0.021	15.5
Si	0.091	0.129	0.126	0.115	0.021	18.3
Th	0.003		0.005	0.004	0.001	35.4
Ti	0.003	0.003	0.003	0.003	0.000	0.0
U	0.040	0.058	0.039	0.046	0.011	23.4
pH	9.783	9.873	9.630	9.76	0.123	1.26

(a) Absence of data indicates less than analytical detection limits.

(b) Percent relative standard deviation computed before rounding the means and standard deviation to three decimal places.

Figure 4.11. Normalized Release of B, Li, and Si from Nearly Duplicate Glasses, WVDG-30, WVDG-31B, and WVDG-31C. (Error bars are $\pm$ standard deviation taking into account variation in leachate concentrations only.)

**Table 4.6. Normalized Elemental Releases from ARM-1 Reference Tests
Accompanying West Valley PCT Tests**

	ARM-1 with Compositional Variability Glasses (Average of 6)	ARM-1 with WVSG-1 Testing (1990) (Average of 8) ^(a)
Al	0.074	0.048
B	0.249	0.425
Ca	0.005	0.004
Li	0.297	0.481
Mo	0.255	0.411
Na	0.260	0.397
P	0.155	0.228
Si	0.140	0.175
Sr	0.003	0.002
Ti	0.001	0.001
Zn	0.002	0.002
Zr	0.001	0.001
pH	10.36	10.35

(a) ARM-1 was not washed.

4.5 Leachate pH

The measured leachate pH values are listed in the tables in Appendix A and in Tables 4.1 to 4.6. The average pH values are plotted in Figure 4.12.

35203046.16

Figure 4.12. Leachate pH from 44 Test Glasses

5.0 References

Mellinger, G. B., and J. L. Daniel. 1984. *Approved Reference and Testing Materials for Use in Nuclear Waste Management Research and Development Programs*. PNL-4955-2, Pacific Northwest Laboratory, Richland, Washington.

Reimus, M.A.H., G. F. Piepel, G. B. Mellinger, and L. R. Bunnell. 1988. *West Valley Glass Product Qualification Durability Studies, FY 1987-1988: Effects of Composition, Redox State, Thermal History, and Groundwater*. PNL-6723, Pacific Northwest Laboratory, Richland, Washington.

Appendix A

Product Consistency Test Information and Results

Appendix A

Product Consistency Test Information and Results

The PCT described in this report was performed under MCC-TP-19 (Materials Characterization Center, Technical Procedure 19) and Test Instruction 1. The laboratory record book (LRB) used for this work was BNW 51741. The making of the West Valley doped glasses (WVDG glasses) was described in LRB BNW 51398.

A run order number is listed for each sample in Appendix A; these numbers were assigned by MCC personnel. The first number indicates the order in which the test was assembled; the order was chosen randomly by computer. The second number indicates the test series (1, 2, or 3). Since artificial numbers were created for ARM-1 (WVDG-49 and WVDG-50) and blanks (WVDG-51 and WVDG-52), the numbers were also used for the blind numbers when the leachate samples were sent for analysis.

An analytical number is also listed for each sample. These numbers were assigned by the analytical laboratory and should be included in any inquiries made to that laboratory. The order of analysis was the same random order used in assembling the tests.

Table A.1. Test Information and Leachate ICP and XRF Results for First Series of PCT Tests of West Valley Compositional Variability Glasses

	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6
Days of Test	7	7	7	7	7	7
Date Test Began	29-OCT-90	30-OCT-90	29-OCT-90	29-OCT-90	30-OCT-90	30-OCT-90
Date Test Ended	05-NOV-90	06-NOV-90	05-NOV-90	05-NOV-90	06-NOV-90	06-NOV-90
Specimen Wgt., g	2.0841	3.0945	3.1205	3.1660	3.0538	3.0465
Leachant Volume, mL	20.84	30.94	31.21	31.65	30.55	30.46
SA/V	2000.1	2000.3	1999.7	2000.6	1999.2	2000.3
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.31	9.32	9.68	9.61	9.38	9.55
Total Init. Wgt., g	98.46	114.05	112.17	111.21	111.71	113.20
Total Final Weight, g	98.15	112.24	111.12	109.66	111.25	110.41
Run Order and Blind No.	19-1	36-1	3-1	10-1	28-1	49-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7901	90-7918	90-7885	90-7892	90-7910	90-7931
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	10.1	10.5	7.19	9.87	7.20	10.5
B (0.01)	13.6	15.5	13.1	19.7	17.5	15.5
Ba (0.005)	0.006	0.002	0.003	0.001	0.002	0.001
Ca (0.02)	0.109	0.041	0.075	0.032	0.041	0.036
Cd (0.005)	-0.001 ^(b)	-0.001	-0.000	-0.001	0.001	-0.000
Ce (0.05)	0.011	0.012	-0.003	0.006	0.028	0.031
Cr (0.02)	0.012	0.003	0.013	0.004	0.003	-0.001
Cu (0.005)	0.000	0.004	-0.001	-0.002	0.001	-0.001
Fe (0.01)	1.71	0.700	0.829	0.635	0.488	0.634
K (0.3)	1.65	1.80	2.71	1.57	2.96	2.26
La (0.01)	0.008	0.001	0.002	0.001	0.005	0.004
Li (0.005)	4.03	5.01	6.23	5.02	4.87	5.01
Mg (0.06)	0.126	0.076	0.295	0.121	0.072	0.045
Mn (0.005)	0.139	0.065	0.121	0.071	0.047	0.037
Mo (0.02)	0.023	0.023	0.046	0.033	0.030	0.022
Na (0.02)	21.2	24.3	33.4	46.6	27.9	23.4
Nd (0.03)	0.027	0.003	0.007	0.003	0.022	0.015
Ni (0.03)	0.027	0.016	0.024	0.019	0.017	0.010
P (0.1)	1.92	2.46	4.17	4.23	3.15	3.26
Ru (0.05)	0.005	-0.002	0.000	-0.005	0.011	0.005
Sb (0.05)	0.018	-0.000	0.028	0.019	0.019	0.002
Si (0.02)	49.8	54.7	57.5	52.1	55.1	54.3
Sr (0.003)	0.003	0.001	0.001	0.001	0.001	0.001
Th (0.15)	0.455	0.160	0.081	0.078	0.105	0.097
Ti (0.005)	0.093	0.037	0.034	0.023	0.023	0.029
U (0.015)	0.528	0.401	0.421	0.403	0.333	0.856
V (0.01)	0.005	0.001	0.002	0.002	0.005	0.002
Y (0.01)	0.003	0.001	0.001	0.001	0.001	0.001
Zn (0.02)	-0.010	-0.014	-0.012	-0.016	-0.014	-0.016
Zr (0.01)	0.006	0.008	0.000	0.000	0.001	0.001

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-7	WVDG-8	WVDG-11R	WVDG-12R	WVDG-13R	WVDG-14R
Days of Test	7	7	7	7	7	7
Date Test Began	30-OCT-90	30-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90	29-OCT-90
Date Test Ended	06-NOV-90	06-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90	05-NOV-90
Specimen Wgt., g	3.0538	3.0712	3.0158	3.0326	3.0430	3.1316
Leachant Volume, mL	30.54	30.71	30.16	30.32	30.44	31.30
SA/V	2000.0	2000.1	1999.9	2000.4	1999.3	2001.0
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.29	9.60	9.69	9.73	9.65	9.84
Total Init. Wgt., g	113.60	111.70	111.53	113.22	113.12	113.45
Total Final Weight, g	110.87	111.25	110.66	112.39	110.14	111.07
Run Order and Blind No.	34-1	45-1	15-1	31-1	21-1	7-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7916	90-7927	90-7897	90-7913	90-7903	90-7889
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	10.4	9.68	12.9	13.9	13.3	13.4
B (0.01)	14.3	7.76	14.0	15.7	16.2	18.7
Ba (0.005)	0.004	0.001	0.003	0.003	0.002	0.003
Ca (0.02)	0.062	0.039	0.098	0.053	0.038	0.049
Cd (0.005)	0.003	-0.002 ^(b)	-0.001	0.003	0.000	0.000
Ce (0.05)	0.073	0.018	0.020	0.033	0.005	0.010
Cr (0.02)	0.011	-0.001	-0.002	0.002	-0.000	-0.000
Cu (0.005)	0.007	-0.002	0.000	0.001	-0.001	0.002
Fe (0.01)	0.816	0.317	0.501	1.02	0.683	0.920
K (0.3)	4.88	2.41	5.94	7.15	5.56	6.14
La (0.01)	0.016	0.001	0.005	0.008	0.000	0.005
Li (0.005)	4.52	4.53	5.87	6.67	6.93	7.61
Mg (0.06)	0.119	0.081	0.125	0.196	0.096	0.187
Mn (0.005)	0.064	0.035	0.057	0.110	0.075	0.087
Mo (0.02)	0.030	0.026	0.027	0.034	0.029	0.029
Na (0.02)	23.0	23.6	28.1	32.3	34.6	39.9
Nd (0.03)	0.067	0.006	0.029	0.035	-0.003	0.010
Ni (0.03)	0.029	0.003	0.003	0.026	0.013	0.011
P (0.1)	2.13	2.72	3.62	3.84	3.89	4.12
Ru (0.05)	0.030	0.000	0.007	0.018	-0.002	-0.002
Sb (0.05)	0.036	-0.000	0.015	0.029	0.011	0.019
Si (0.02)	51.6	49.9	45.3	48.9	47.7	47.2
Sr (0.003)	0.002	0.000	0.002	0.002	0.001	0.001
Th (0.15)	0.252	0.057	0.054	0.118	0.071	0.086
Ti (0.005)	0.047	0.015	0.024	0.043	0.027	0.027
U (0.015)	0.500	0.577	0.800	0.588	0.559	1.77
V (0.01)	0.011	0.002	0.003	0.007	0.002	0.003
Y (0.01)	0.005	0.001	0.001	0.002	0.000	0.001
Zn (0.02)	-0.017	-0.015	-0.014	-0.012	-0.015	-0.015
Zr (0.01)	0.015	0.004	0.007	0.003	0.000	-0.001

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20
Days of Test	7	7	7	7	7	7
Date Test Began	30-OCT-90	30-OCT-90	29-OCT-90	29-OCT-90	29-OCT-90	29-OCT-90
Date Test Ended	06-NOV-90	06-NOV-90	05-NOV-90	05-NOV-90	05-NOV-90	05-NOV-90
Specimen Wgt., g	3.0423	3.1104	3.0257	3.0538	2.9820	3.0481
Leachant Volume, mL	30.42	31.10	30.25	30.54	29.79	30.48
SA/V	2000.2	2000.3	2000.5	1999.9	2002.0	2000.1
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.76	9.29	10.00	9.78	9.73	9.33
Total Init. Wgt., g	112.95	113.73	112.85	111.33	112.16	112.93
Total Final Weight, g	111.86	111.76	111.60	110.07	109.89	111.94
Run Order and Blind No.	42-1	38-1	4-1	24-1	2-1	25-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7924	90-7920	90-7886	90-7906	90-7884	90-7907
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	11.2	11.3	11.0	13.2	17.4	14.3
B (0.01)	23.1	15.3	17.8	14.9	14.2	10.2
Ba (0.005)	0.003	0.006	0.004	0.007	0.004	0.005
Ca (0.02)	0.034	0.057	0.358	0.046	0.059	0.059
Cd (0.005)	0.000	-0.003 ^(b)	-0.001	0.000	0.000	0.001
Ce (0.05)	0.028	0.023	0.020	0.033	0.008	0.028
Cr (0.02)	0.029	-0.001	0.033	0.004	-0.001	-0.000
Cu (0.005)	0.004	0.000	0.005	0.001	-0.001	0.002
Fe (0.01)	0.331	0.433	0.392	1.79	0.326	0.201
K (0.3)	4.25	3.22	3.99	4.06	3.64	3.23
La (0.01)	0.002	0.001	0.002	0.002	0.001	0.003
Li (0.005)	7.61	4.38	6.34	6.04	5.80	4.35
Mg (0.06)	0.137	0.072	0.134	0.012	0.086	0.054
Mn (0.005)	0.100	0.071	0.109	0.050	0.012	0.009
Mo (0.02)	0.240	0.042	0.275	0.055	0.060	0.125
Na (0.02)	39.7	22.2	42.6	36.0	32.1	17.2
Nd (0.03)	0.012	0.007	0.016	0.004	0.004	0.009
Ni (0.03)	0.016	0.006	0.030	0.021	-0.001	0.009
P (0.1)	2.81	2.69	2.86	2.38	2.09	1.75
Ru (0.05)	0.003	0.005	0.001	-0.002	-0.001	0.007
Sb (0.05)	0.020	-0.001	0.014	-0.007	-0.005	0.003
Si (0.02)	49.2	46.6	46.1	54.3	43.0	40.5
Sr (0.003)	0.000	0.000	0.001	0.001	0.000	0.001
Th (0.15)	0.014	0.033	0.046	0.204	0.028	0.040
Ti (0.005)	0.014	0.007	0.018	0.035	0.005	0.023
U (0.015)	1.24	0.102	0.032	0.126	1.06	0.152
V (0.01)	0.002	0.001	0.003	0.003	0.003	0.002
Y (0.01)	0.001	0.001	0.001	0.001	0.001	0.001
Zn (0.02)	-0.012	-0.014	0.441	-0.010	-0.017	-0.011
Zr (0.01)	0.001	0.002	-0.001	0.002	0.002	0.010

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-21	WVDG-22	WVDG-23	WVDG-24	WVDG-25	WVDG-26
Days of Test	7	7	7	7	7	7
Date Test Began	30-OCT-90	30-OCT-90	30-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90
Date Test Ended	06-NOV-90	06-NOV-90	06-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90
Specimen Wgt., g	3.1931	3.1301	3.1439	3.0863	3.0439	3.0672
Leachant Volume, mL	30.93	31.31	31.43	30.85	30.43	30.66
SA/V	2064.7	1999.4	2000.6	2000.8	2000.6	2000.8
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.53	9.26	9.21	9.43	9.44	9.42
Total Init. Wgt., g	113.79	113.90	113.880	110.380	113.340	110.850
Total Final Weight, g	111.55	112.14	111.880	107.760	112.550	109.270
Run Order and Blind No.	26-1	32-1	47-1	6-1	37-1	18-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7908	90-7914	90-7929	90-7888	90-7919	90-7900
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	22.4	20.5	14.6	17.1	12.4	13.8
B (0.01)	15.1	16.0	21.0	19.5	12.8	15.8
Ba (0.005)	0.027	0.007	0.020	0.005	0.004	0.005
Ca (0.02)	0.145	0.066	0.087	0.067	0.029	0.053
Cd (0.005)	0.003	0.003	-0.002 ^(b)	0.000	0.001	0.001
Ce (0.05)	0.155	0.203	0.123	0.039	0.042	0.008
Cr (0.02)	0.022	-0.001	0.027	0.002	0.007	0.003
Cu (0.005)	0.012	0.016	0.012	0.004	0.004	0.001
Fe (0.01)	4.76	0.780	4.97	0.745	0.685	0.266
K (0.3)	4.89	4.42	1.71	3.88	3.44	3.26
La (0.01)	0.011	0.017	0.005	0.007	0.007	0.005
Li (0.005)	5.80	5.34	5.50	6.11	4.84	4.92
Mg (0.06)	0.091	0.039	0.071	0.043	0.021	0.080
Mn (0.005)	0.631	0.171	0.113	0.166	0.103	0.016
Mo (0.02)	0.054	0.184	0.042	0.049	0.039	0.051
Na (0.02)	36.7	23.4	24.3	26.2	22.3	21.7
Nd (0.03)	0.046	0.066	0.018	0.028	0.021	0.024
Ni (0.03)	0.031	0.014	0.018	0.020	0.012	0.009
P (0.1)	4.45	1.41	2.79	1.98	2.60	1.46
Ru (0.05)	0.004	0.016	-0.007	0.004	0.007	0.006
Sb (0.05)	0.017	0.009	0.000	-0.003	0.005	0.022
Si (0.02)	56.1	52.4	56.6	51.0	55.2	40.8
Sr (0.003)	0.003	0.003	0.002	0.002	0.001	0.002
Th (0.15)	0.823	0.344	2.362	0.106	0.245	0.060
Ti (0.005)	0.117	0.088	0.133	0.021	0.021	0.012
U (0.015)	1.67	0.165	1.86	1.00	0.105	0.086
V (0.01)	0.010	0.009	0.014	0.004	0.004	0.004
Y (0.01)	0.005	0.008	0.003	0.002	0.002	0.001
Zn (0.02)	-0.009	-0.008	-0.008	-0.016	-0.012	-0.013
Zr (0.01)	0.001	0.010	0.000	0.010	0.008	0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-27	WVDG-28	WVDG-29	WVDG-30	WVDG-31B	WVDG-31C	WVDG-33	WVDG-34
Days of Test	7	7	7	7	7	7	7	7
Date Test Began	30-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90	29-OCT-9	30-OCT-9	29-OCT-90	30-OCT-90
Date Test Ended	06-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90	05-NOV-9	06-NOV-9	05-NOV-90	06-NOV-90
Specimen Wgt., g	3.0599	3.0425	3.3036	3.1366	3.057	3.3580	3.0584	3.0256
Leachant Volume, mL	30.60	30.42	33.03	31.38	30.52	33.58	30.59	30.25
SA/V	1999.9	2000.3	2000.4	1999.1	1999.8	2000.0	1999.6	2000.4
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.44	9.45	9.68	9.52	9.59	9.75	10.06	9.85
Total Init. Wgt., g	111.020	110.960	115.900	112.610	110.87	116.21	112.83	113.53
Total Final Weight, g	109.830	109.590	114.690	110.880	109.28	115.18	112.37	105.84
Run Order and Blind No.	29-1	23-1	39-1	16-1	20-1	40-1	22-1	46-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7911	90-7905	90-7921	90-7898	90-7902	90-7922	90-7904	90-7928

Elements	Leachate Analyzed Concentration, mg/L							
Al (0.05) ^(a)	21.3	13.1	9.75	13.4	12.9	13.4	9.86	6.83 ^(b)
B (0.01)	23.8	12.9	15.2	15.4	13.9	14.4	13.4	31.7
Ba (0.005)	0.006	0.008	0.007	0.003	0.003	0.004	0.002	0.002
Ca (0.02)	0.053	0.053	0.067	0.063	0.046	0.046	0.039	0.044
Cd (0.005)	0.001	0.000	0.001	0.001	-0.002 ^(c)	-0.002	-0.002	-0.001
Ce (0.05)	0.182	0.166	0.044	0.013	0.007	0.026	0.003	0.031
Cr (0.02)	0.028	0.013	0.001	0.007	0.010	0.006	0.005	0.066
Cu (0.005)	0.016	0.013	0.003	0.002	0.000	0.001	0.002	0.014
Fe (0.01)	1.32	1.44	0.636	0.338	0.868	1.36	0.974	0.669
K (0.3)	4.54	3.07	4.84	3.65	5.28	6.04	7.93	10.9
La (0.01)	0.014	0.010	0.007	0.004	0.005	0.007	-0.001	0.004
Li (0.005)	6.75	5.25	5.96	5.15	5.89	6.27	6.75	12.8
Mg (0.06)	0.024	0.033	0.273	0.034	0.198	0.107	0.155	0.024
Mn (0.005)	0.038	0.047	0.039	0.024	0.102	0.139	0.103	0.124
Mo (0.02)	0.184	0.172	0.052	0.106	0.035	0.030	0.143	0.642
Na (0.02)	36.1	21.4	33.7	27.7	28.0	29.4	36.6	67.9
Nd (0.03)	0.048	0.031	0.023	0.020	0.015	0.031	-0.010	0.015
Ni (0.03)	0.021	0.023	0.013	0.011	0.015	0.049	0.022	0.059
P (0.1)	3.49	1.50	5.71	2.62	3.73	3.65	4.29	4.58
Ru (0.05)	0.010	0.002	0.006	0.005	0.003	0.004	-0.002	-0.002
Sb (0.05)	0.005	0.007	0.011	0.018	0.009	0.005	0.012	0.008
Si (0.02)	52.4	54.2	49.8	45.9	46.3	48.9	52.5	67.6
Sr (0.003)	0.002	0.002	0.000	0.001	0.002	0.002	0.001	0.003
Th (0.15)	0.580	0.280	0.070	0.055	0.095	0.171	0.125	0.092
Ti (0.005)	0.070	0.141	0.012	0.013	0.042	0.062	0.032	0.105
U (0.015) ^(d)	0.075	0.813	0.177	0.559	0.744	0.387	0.607	0.987
V (0.01)	0.009	0.004	0.004	0.004	0.004	0.005	0.002	0.003
Y (0.01)	0.006	0.005	0.002	0.001	0.002	0.002	0.000	0.001
Zn (0.02)	-0.005	-0.007	-0.012	-0.015	-0.014	-0.014	-0.009	-0.003
Zr (0.01)	0.001	0.004	0.004	0.007	-0.001	0.013	0.000	0.001

(a) Numbers in parentheses are instrument detection limits.

(b) Data excluded from calculations because leachant loss >10%.

(c) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-35	WVDG-36	WVDG-37	WVDG-38	WVDG-39	WVDG-40
Days of Test	7	7	7	7	7	7
Date Test Began	30-OCT-90	30-OCT-90	29-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90
Date Test Ended	06-NOV-90	06-NOV-90	05-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90
Specimen Wgt., g	3.0225	3.0198	3.0298	3.1003	3.1675	3.0370
Leachant Volume, mL	30.22	30.21	30.31	31.01	31.67	30.37
SA/V	2000.3	1999.2	1999.2	1999.5	2000.3	2000.0
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	10.82	9.47	10.49	10.08	9.77	10.09
Total Init. Wgt., g	111.66	112.86	112.81	111.34	113.64	112.80
Total Final Weight, g	110.53	111.54	109.99	110.88	111.70	110.08
Run Order and Blind No.	43-1	33-1	5-1	13-1	50-1	14-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7925	90-7915	90-7887	90-7895	90-7932	90-7896
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	19.6	6.62	16.9	14.6	12.6	5.92
B (0.01)	18.1	16.4	12.0	9.35	18.4	14.1
Ba (0.005)	0.005	0.003	0.003	0.001	0.002	0.002
Ca (0.02)	0.034	0.042	0.034	0.068	0.030	0.091
Cd (0.005)	-0.002 ^(b)	0.003	-0.001	-0.002	-0.003	0.002
Ce (0.05)	-0.001	0.075	0.026	0.014	0.034	0.003
Cr (0.02)	0.002	0.006	0.031	0.019	-0.002	0.001
Cu (0.005)	0.001	0.017	0.022	0.006	0.002	0.001
Fe (0.01)	2.74	0.658	1.26	0.549	0.615	0.759
K (0.3)	13.7	7.17	9.77	6.24	8.99	8.80
La (0.01)	-0.001	0.020	0.009	0.007	0.004	0.003
Li (0.005)	11.7	5.00	8.93	6.13	6.96	7.60
Mg (0.06)	0.389	0.039	0.045	0.008	0.230	0.242
Mn (0.005)	0.250	0.006	0.011	0.075	0.005	0.005
Mo (0.02)	0.089	0.377	0.446	0.378	0.069	0.086
Na (0.02)	67.8	22.5	51.2	28.9	39.7	41.2
Nd (0.03)	-0.007	0.072	0.027	0.013	0.007	0.004
Ni (0.03)	0.008	0.010	0.095	0.009	0.010	0.001
P (0.1)	1.55	0.644	0.899	0.756	6.56	1.14
Ru (0.05)	-0.010	0.029	0.002	0.000	-0.001	0.001
Sb (0.05)	-0.025	0.038	0.006	-0.002	-0.001	0.019
Si (0.02)	66.5	50.3	60.2	49.6	44.2	61.4
Sr (0.003)	0.001	0.002	0.003	0.003	0.000	0.001
Th (0.15)	0.069	0.299	0.240	0.152	0.079	0.056
Ti (0.005)	0.014	0.090	0.209	0.089	0.010	0.006
U (0.015)	3.61	0.157	0.138	0.298	0.126	2.28
V (0.01)	0.002	0.012	0.004	0.003	0.003	0.004
Y (0.01)	-0.000	0.005	0.004	0.003	0.001	0.001
Zn (0.02)	-0.025	-0.010	0.005	-0.008	-0.013	-0.021
Zr (0.01)	-0.000	0.040	0.026	0.019	-0.000	-0.000

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-41	WVDG-42	WVDG-43	WVDG-44	WVDG-45	WVDG-46
Days of Test	7	7	7	7	7	7
Date Test Began	29-OCT-90	30-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90	30-OCT-90
Date Test Ended	05-NOV-90	06-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90	06-NOV-90
Specimen Wgt., g	3.2295	3.0256	3.0513	3.4579	2.8213	3.1170
Leachant Volume, mL	32.30	30.25	30.51	34.59	28.20	31.11
SA/V	1999.7	2000.4	2000.2	1999.4	2000.9	2003.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	10.42	10.21	9.26	10.15	10.44	9.90
Total Init. Wgt., g	114.67	112.56	106.57	116.77	108.28	113.88
Total Final Weight, g	113.41	111.02	104.59	115.09	107.91	113.11
Run Order and Blind No.	8-1	30-1	9-1	58-1	1-1	41-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7890	90-7912	90-7891	90-7930	90-7883	90-7923
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	7.99	5.49	15.4	13.2	17.1	8.21
B (0.01)	14.2	16.8	17.4	25.3	11.7	28.3
Ba (0.005)	0.004	0.004	0.007	0.001	0.003	0.003
Ca (0.02)	0.043	0.045	0.085	0.021	0.066	0.034
Cd (0.005)	0.000	0.002	-0.000 ^(b)	-0.001	0.002	-0.000
Ce (0.05)	0.026	0.031	0.037	0.009	0.012	-0.003
Cr (0.02)	0.002	0.020	0.026	-0.001	0.014	0.003
Cu (0.005)	0.007	0.031	0.021	0.002	0.003	0.000
Fe (0.01)	1.42	1.62	6.18	1.31	2.12	1.41
K (0.3)	11.9	13.8	4.42	9.31	10.3	8.53
La (0.01)	0.008	0.007	0.011	0.001	0.002	-0.003
Li (0.005)	8.62	10.3	5.91	9.91	7.82	8.50
Mg (0.06)	0.053	0.491	0.088	0.021	0.028	0.459
Mn (0.005)	0.013	0.279	0.602	0.006	0.227	0.255
Mo (0.02)	0.078	0.770	0.043	0.060	0.104	0.063
Na (0.02)	61.9	60.6	17.7	52.7	51.4	46.0
Nd (0.03)	0.029	0.029	0.032	-0.005	0.004	-0.006
Ni (0.03)	0.016	0.129	0.045	0.008	0.015	0.008
P (0.1)	9.95	11.9	2.18	0.933	8.97	1.02
Ru (0.05)	0.003	0.013	-0.004	-0.006	-0.004	-0.005
Sb (0.05)	0.002	0.027	0.006	-0.023	0.005	0.002
Si (0.02)	66.2	67.3	56.3	55.6	53.1	62.1
Sr (0.003)	0.002	0.002	0.002	0.000	0.001	-0.000
Th (0.15)	0.341	0.092	2.09	0.216	0.220	0.168
Ti (0.005)	0.024	0.087	0.167	0.018	0.048	0.018
U (0.015)	2.73	0.067	3.72	2.37	0.169	0.209
V (0.01)	0.006	0.008	0.015	0.002	0.003	0.001
Y (0.01)	0.002	0.002	0.005	0.001	0.001	-0.000
Zn (0.02)	-0.024	0.014	-0.014	-0.021	-0.009	-0.010
Zr (0.01)	0.003	0.005	0.008	0.002	-0.001	-0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.1. (contd)

	WVDG-47	WVDG-48	WVDG-49 (ARM-1)	WVDG-50 (ARM-1)	WVDG-51 (Blank)	WVDG-52 (Blank)
Days of Test	7	7	7	7	7	7
Date Test Began	30-OCT-90	30-OCT-90	29-OCT-90	29-OCT-90	30-OCT-90	29-OCT-90
Date Test Ended	06-NOV-90	06-NOV-90	05-NOV-90	05-NOV-90	06-NOV-90	05-NOV-90
Specimen Wgt., g	3.0617	3.1124	3.9049	3.1206	no specimen	no specimen
Leachant Volume, mL	30.62	31.14	39.05	31.21	32.87	29.47
SA/V	1999.8	1999.0	1999.9	1999.7		
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.16	6.16	6.16	6.16	6.16	6.16
Final pH	9.23	9.21	10.13	10.22	9.55	9.41
Total Init. Wgt., g	111.52	113.70	118.66	113.54	111.19	108.86
Total Final Weight, g	110.17	111.06	115.30	112.28	111.02	108.51
Run Order and Blind No.	35-1	27-1	12-1	17-1	44-1	11-1
Date of Analysis	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90	11-DEC-90
Analytical Number	90-7917	90-7909	90-7894	90-7899	90-7926	90-7893
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	7.50	13.4	4.83	4.60	-0.014 ^(b)	0.005
B (0.01)	15.6	12.5	19.4	16.9	0.057	0.012
Ba (0.005)	0.007	0.006	0.011	0.005	-0.000	0.001
Ca (0.02)	0.064	0.075	0.186	0.219	0.021	0.060
Cd (0.005)	0.003	0.002	-0.001	-0.000	-0.002	-0.001
Ce (0.05)	0.088	0.047	0.038	0.013	0.005	-0.001
Cr (0.02)	0.020	0.000	0.003	-0.002	-0.000	0.000
Cu (0.005)	0.020	0.017	0.002	0.004	-0.004	-0.001
Fe (0.01)	6.71	0.350	-0.009	-0.030	-0.042	-0.004
K (0.3)	6.80	5.90	0.000	0.488	-0.623	0.036
La (0.01)	0.021	0.011	0.005	0.007	-0.002	0.002
Li (0.005)	4.82	4.53	16.1	13.5	0.006	0.010
Mg (0.06)	0.113	0.071	0.034	0.044	-0.009	0.018
Mn (0.005)	0.592	0.005	0.000	0.000	-0.001	-0.001
Mo (0.02)	0.053	0.272	6.221	5.563	0.002	0.002
Na (0.02)	20.0	16.4	41.6	36.2	0.068	0.051
Nd (0.03)	0.078	0.035	0.144	0.042	-0.009	0.002
Ni (0.03)	0.031	0.014	-0.003	-0.001	0.000	-0.006
P (0.1)	4.83	2.60	0.947	0.887	0.023	0.020
Ru (0.05)	0.022	0.014	0.007	0.013	-0.010	-0.002
Sb (0.05)	0.029	0.021	0.018	0.027	-0.019	0.011
Si (0.02)	58.2	45.4	65.2	59.8	-0.007	0.074
Sr (0.003)	0.003	0.002	0.016	0.022	-0.000	0.001
Th (0.15)	0.990	0.106	0.014	0.011	-0.001	0.026
Ti (0.005)	0.123	0.075	0.061	0.012	-0.001	0.001
U (0.015)	0.372	0.244	NA	NA		
V (0.01)	0.015	0.006	0.009	0.010	-0.003	-0.000
Y (0.01)	0.007	0.004	0.001	0.002	-0.001	-0.000
Zn (0.02)	-0.008	-0.006	0.072	0.032	-0.013	-0.013
Zr (0.01)	0.008	0.010	0.037	0.011	-0.003	-0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. Test Information and Leachate ICP and XRF Results for Second Series of PCT Tests of West Valley Compositional Variability Glasses

	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6
Days of Test	7	7	7	7	7	7
Date Test Began	12-NOV-90	12-NOV-90	12-NOV-90	13-NOV-90	12-NOV-90	12-NOV-90
Date Test Ended	19-NOV-90	19-NOV-90	19-NOV-90	20-NOV-90	19-NOV-90	19-NOV-90
Specimen Wgt., g	3.1085	3.0771	3.1807	3.0870	3.1250	3.0609
Leachant Volume, mL	31.08	30.76	31.82	30.88	31.25	30.61
SA/V	2000.3	2000.7	1999.2	1999.4	2000.0	1999.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.42	9.50	9.74	9.80	9.47	9.43
Total Init. Wgt., g	113.84	112.45	114.24	112.24	110.73	111.25
Total Final Weight, g	112.50	112.26	113.98	109.64	110.22	109.90
Run Order and Blind No.	11-2	10-2	5-2	27-2	2-2	18-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-7991	90-7990	90-7985	90-8007	90-7982	90-7998
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	11.3	10.0	7.50	9.68	6.38	10.2
B (0.01)	13.7	15.2	14.6	18.9	15.7	14.8
Ba (0.005)	0.004	0.001	0.002	0.002	0.001	0.002
Ca (0.02)	0.073	0.099	0.034	0.031	0.058	0.040
Cd (0.005)	-0.001 ^(b)	0.001	0.000	0.001	0.001	0.001
Ce (0.05)	0.031	0.024	0.022	0.030	0.010	0.026
Cr (0.02)	0.012	0.004	0.017	0.007	0.006	0.001
Cu (0.005)	0.002	0.000	-0.000	0.001	-0.001	0.002
Fe (0.01)	1.40	0.578	0.791	0.600	0.415	0.478
K (0.3)	2.29	1.65	3.47	1.92	1.97	2.24
La (0.01)	0.008	0.004	0.003	0.005	0.002	0.006
Li (0.005)	4.10	4.90	6.56	4.79	4.48	4.77
Mg (0.06)	0.149	0.099	0.285	0.121	0.053	0.060
Mn (0.005)	0.119	0.054	0.109	0.070	0.039	0.034
Mo (0.02)	0.010	0.017	0.039	0.032	0.025	0.015
Na (0.02)	21.8	23.4	35.2	45.3	25.4	22.6
Nd (0.03)	0.026	0.012	0.008	0.022	0.003	0.015
Ni (0.03)	0.025	0.016	0.012	0.016	0.012	0.002
P (0.1)	1.94	2.41	4.42	4.15	2.81	3.11
Ru (0.05)	0.003	0.003	0.000	0.008	-0.005	0.003
Sb (0.05)	-0.020	-0.003	0.010	0.013	0.000	-0.007
Si (0.02)	52.5	52.3	61.5	52.8	50.7	52.4
Sr (0.003)	0.002	0.001	0.001	0.001	0.001	0.001
Th (0.15)	0.381	0.052	0.086	0.069	0.086	0.084
Ti (0.005)	0.076	0.031	0.033	0.025	0.023	0.026
U (0.015)	0.813	0.383	0.438	0.462	0.382	0.334
V (0.01)	0.006	0.004	0.003	0.004	0.002	0.004
Y (0.01)	0.003	0.001	0.001	0.002	0.001	0.002
Zn (0.02)	-0.012	-0.013	-0.015	-0.014	-0.016	-0.014
Zr (0.01)	0.008	0.016	0.002	0.003	0.008	0.009

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-7	WVDG-8	WVDG-11R	WVDG-12R	WVDG-13R	WVDG-14R
Days of Test	7	7	7	7	7	7
Date Test Began	13-NOV-90	13-NOV-90	13-NOV-90	13-NOV-90	13-NOV-90	13-NOV-90
Date Test Ended	20-NOV-90	20-NOV-90	20-NOV-90	20-NOV-90	20-NOV-90	20-NOV-90
Specimen Wgt., g	3.1478	3.1215	3.1154	3.2001	3.0556	3.0879
Leachant Volume, mL	31.49	31.21	31.15	32.00	30.56	30.88
SA/V	1999.2	2000.3	2000.3	2000.1	1999.7	1999.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.41	9.76	9.75	9.85	9.57	9.96
Total Init. Wgt., g	114.25	113.84	113.90	113.85	113.79	113.33
Total Final Weight, g	113.19	112.74	111.74	112.90	112.99	110.89
Run Order and Blind No.	28-2	49-2	45-2	47-2	32-2	33-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-8008	90-8029	90-8025	90-8027	90-8012	90-8013
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	10.2	9.61	12.7	12.3	13.4	14.1
B (0.01)	14.0	7.76	14.0	14.0	15.5	19.5
Ba (0.005)	0.003	0.002	0.003	0.002	0.002	0.004
Ca (0.02)	0.034	0.039	0.028	0.074	0.016	0.027
Cd (0.005)	0.001	0.001	0.000	-0.002 ^(b)	-0.000	0.000
Ce (0.05)	0.027	0.004	0.007	-0.006	0.032	0.054
Cr (0.02)	0.006	0.003	0.001	-0.002	0.002	0.005
Cu (0.005)	0.000	-0.001	-0.001	-0.001	0.002	0.004
Fe (0.01)	0.812	0.457	1.17	0.435	0.711	1.622
K (0.3)	1.56	1.24	5.10	4.22	5.93	7.06
La (0.01)	0.006	0.002	0.005	0.000	0.008	0.013
Li (0.005)	4.34	4.46	6.16	6.03	6.48	8.10
Mg (0.06)	0.070	0.088	0.122	0.094	0.175	0.334
Mn (0.005)	0.064	0.053	0.113	0.049	0.078	0.177
Mo (0.02)	0.020	0.021	0.022	0.020	0.028	0.032
Na (0.02)	22.2	23.2	29.6	29.7	33.1	42.9
Nd (0.03)	0.022	0.003	0.006	-0.010	0.025	0.050
Ni (0.03)	0.015	0.004	0.007	0.002	0.008	0.024
P (0.1)	2.03	2.700	3.60	3.50	3.90	4.42
Ru (0.05)	0.005	-0.004	-0.003	-0.010	0.007	0.016
Sb (0.05)	0.006	-0.004	-0.005	-0.004	0.014	0.017
Si (0.02)	52.1	49.8	46.8	45.1	49.0	51.5
Sr (0.003)	0.002	0.001	0.002	0.001	0.001	0.002
Th (0.15)	0.249	0.072	0.130	0.053	0.081	0.136
Ti (0.005)	0.043	0.021	0.062	0.019	0.029	0.053
U (0.015)	0.359	0.475	0.609	0.281	0.368	0.568
V (0.01)	0.005	0.001	0.002	-0.001	0.006	0.008
Y (0.01)	0.002	0.000	0.001	-0.001	0.002	0.003
Zn (0.02)	-0.015	-0.014	-0.012	-0.010	-0.015	-0.017
Zr (0.01)	0.012	0.005	-0.000	0.004	0.006	0.005

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20
Days of Test	7	7	7	7	7	7
Date Test Began	13-NOV-90	13-NOV-90	12-NOV-90	12-NOV-90	12-NOV-90	12-NOV-90
Date Test Ended	20-NOV-90	20-NOV-90	19-NOV-90	19-NOV-90	19-NOV-90	19-NOV-90
Specimen Wgt., g	3.1308	3.2050	3.0640	3.0939	3.1833	3.0756
Leachant Volume, mL	31.30	32.05	30.64	30.94	31.84	30.76
SA/V	2000.5	2000.0	2000.000	1999.935	1999.560	1999.740
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.99	9.44	10.08	9.98	9.70	9.48
Total Init. Wgt., g	113.41	113.83	113.08	113.55	114.75	113.60
Total Final Weight, g	111.93	113.30	112.90	111.98	113.10	112.87
Run Order and Blind No.	41-2	44-2	3-2	15-2	4-2	25-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-8021	90-8024	90-7983	90-7995	90-7984	90-8005
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	11.0	10.1	11.1	13.0	16.0	14.2
B (0.01)	23.2	13.9	18.1	14.7	12.8	10.1
Ba (0.005)	0.003	0.006	0.002	0.007	0.005	0.012
Ca (0.02)	0.018	0.044	0.037	0.059	0.059	0.068
Cd (0.005)	-0.000 ^(b)	-0.002	-0.000	-0.001	0.000	0.000
Ce (0.05)	0.004	0.014	0.037	0.033	0.026	0.070
Cr (0.02)	0.029	0.002	0.036	0.000	-0.000	0.009
Cu (0.005)	0.003	-0.000	0.008	0.001	0.001	0.004
Fe (0.01)	0.398	0.342	0.301	1.58	0.396	0.359
K (0.3)	2.60	1.88	5.13	3.45	4.22	3.34
La (0.01)	-0.001	0.001	0.004	0.001	0.003	0.009
Li (0.005)	7.66	3.79	6.50	6.11	5.18	4.37
Mg (0.06)	0.147	0.044	0.114	0.014	0.113	0.089
Mn (0.005)	0.119	0.054	0.085	0.043	0.015	0.017
Mo (0.02)	0.235	0.033	0.271	0.040	0.053	0.118
Na (0.02)	40.2	19.9	44.0	36.1	29.2	17.3
Nd (0.03)	-0.013	-0.002	0.016	0.008	0.011	0.025
Ni (0.03)	0.016	-0.006	0.021	0.015	-0.003	-0.003
P (0.1)	2.81	2.45	2.93	2.36	2.03	1.75
Ru (0.05)	-0.008	-0.002	0.003	-0.009	0.001	0.010
Sb (0.05)	-0.009	-0.004	-0.002	-0.025	-0.007	0.015
Si (0.02)	48.9	42.1	48.3	55.1	41.1	41.3
Sr (0.003)	0.001	0.001	0.001	0.001	0.001	0.002
Th (0.15)	0.024	0.034	0.027	0.194	0.038	0.080
Ti (0.005)	0.016	0.006	0.013	0.031	0.007	0.050
U (0.015)	0.528	0.076	1.19	0.105	1.577	0.068
V (0.01)	0.000	0.002	0.004	0.003	0.004	0.004
Y (0.01)	0.000	0.000	0.001	0.001	0.001	0.003
Zn (0.02)	-0.007	-0.012	-0.008	-0.008	-0.015	-0.012
Zr (0.01)	-0.003	0.003	0.005	0.006	0.004	0.008

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-21	WVDG-22	WVDG-23	WVDG-24	WVDG-25	WVDG-26
Days of Test	7	7	7	7	7	7
Date Test Began	12-NOV-90	12-NOV-90	12-NOV-90	13-NOV-90	12-NOV-90	13-NOV-90
Date Test Ended	19-NOV-90	19-NOV-90	19-NOV-90	20-NOV-90	19-NOV-90	20-NOV-90
Specimen Wgt., g	3.3066	3.1245	3.2029	3.0444	3.0614	3.2246
Leachant Volume, mL	33.06	31.24	32.02	30.45	30.63	32.25
SA/V	2000.363	2000.320	2000.6	1999.6	1999.0	2000.0
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.80	9.38	9.40	9.44	9.66	9.53
Total Init. Wgt., g	112.26	113.10	115.30	113.33	113.08	113.00
Total Final Weight, g	111.79	112.23	114.39	111.93	112.31	111.96
Run Order and Blind No.	9-2	13-2	20-2	38-2	7-2	37-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-7989	90-7993	90-8000	90-8018	90-7987	90-8017
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	21.0	18.6	13.4	15.4	12.1	13.5
B (0.01)	14.0	14.5	18.9	16.3	12.4	15.5
Ba (0.005)	0.009	0.004	0.020	0.005	0.005	0.011
Ca (0.02)	0.075	0.043	0.114	0.039	0.044	0.063
Cd (0.005)	0.000	0.001	-0.000 ^(b)	0.000	0.000	-0.001
Ce (0.05)	0.059	0.123	0.140	0.026	0.048	0.011
Cr (0.02)	0.007	-0.004	0.021	0.000	0.008	0.000
Cu (0.005)	0.004	0.008	0.015	0.001	0.005	0.001
Fe (0.01)	1.90	0.559	4.62	0.712	1.03	0.782
K (0.3)	3.92	2.38	2.45	2.37	3.31	1.79
La (0.01)	0.003	0.008	0.013	0.002	0.006	0.001
Li (0.005)	5.41	4.91	4.90	4.96	4.68	4.78
Mg (0.06)	0.059	0.022	0.082	0.024	0.033	0.114
Mn (0.005)	0.256	0.127	0.106	0.043	0.153	0.039
Mo (0.02)	0.039	0.150	0.033	0.034	0.037	0.037
Na (0.02)	34.4	21.3	22.1	23.4	21.8	21.2
Nd (0.03)	0.008	0.026	0.049	0.005	0.020	-0.007
Ni (0.03)	0.002	-0.001	0.011	0.006	0.011	0.012
P (0.1)	4.13	1.29	5.59	1.79	2.51	1.45
Ru (0.05)	-0.003	-0.001	0.006	-0.008	0.009	-0.004
Sb (0.05)	-0.019	-0.026	0.002	-0.019	0.004	-0.013
Si (0.02)	53.8	49.2	52.0	48.1	53.5	41.3
Sr (0.003)	0.001	0.002	0.003	0.001	0.001	0.001
Th (0.15)	0.457	0.255	2.21	0.108	0.371	0.153
Ti (0.005)	0.050	0.063	0.125	0.024	0.034	0.016
U (0.015)	1.29	0.093	1.04	0.798	0.073	0.078
V (0.01)	0.004	0.004	0.018	0.001	0.006	0.001
Y (0.01)	0.002	0.004	0.005	0.000	0.002	0.000
Zn (0.02)	-0.015	-0.010	-0.011	-0.014	-0.010	-0.011
Zr (0.01)	0.001	0.012	0.015	0.008	0.008	0.005

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-27	WVDG-28	WVDG-29	WVDG-30	WVDG-31B	WVDG-31C	WVDG-33	WVDG-34
Days of Test	7	7	7	7	7	7	7	7
Date Test Began	13-NOV-90	13-NOV-90	13-NOV-90	12-NOV-90	12-NOV-9	13-NOV-9	12-NOV-90	12-NOV-90
Date Test Ended	20-NOV-90	20-NOV-90	20-NOV-90	19-NOV-90	19-NOV-9	20-NOV-9	19-NOV-90	19-NOV-90
Specimen Wgt., g	3.0853	3.0948	3.2008	3.0419	3.0158	3.0464	2.9952	3.0518
Leachant Volume, mL	30.85	30.95	32.02	30.42	30.17	30.46	29.94	30.52
SA/V	2000.2	2000.0	1999.3	1999.9	1999.2	2000.3	2000.8	1999.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.59	9.51	9.78	9.66	9.83	9.86	10.23	10.15
Total Init. Wgt., g	113.55	113.47	115.18	112.78	112.54	111.95	112.93	112.88
Total Final Weight, g	108.74	111.21	113.28	111.39	112.13	110.57	112.03	110.08
Run Order and Blind No.	31-2	39-2	50-2	24-2	17-2	40-2	12-2	1-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-8011	90-8019	90-8030	90-8004	90-7997	90-8020	90-7992	90-7981
Elements	Leachate Analyzed Concentration, mg/L							
Al (0.05) ^(a)	22.9 ^(b)	13.6	9.39	12.6	13.4	13.0	10.3	6.47
B (0.01)	27.0	13.4	15.2	14.8	14.2	14.3	14.4	27.4
Ba (0.005)	0.019	0.013	0.007	0.004	0.002	0.001	0.004	0.000
Ca (0.02)	0.071	0.035	0.037	0.041	0.044	0.010	0.046	0.022
Cd (0.005)	0.000	-0.001 ^(c)	0.001	0.000	-0.001	-0.001	0.001	0.002
Ce (0.05)	0.672	0.274	0.005	0.047	0.021	-0.009	0.015	0.008
Cr (0.02)	0.103	0.021	-0.000	0.007	0.007	0.001	0.002	0.070
Cu (0.005)	0.051	0.021	0.001	0.003	0.002	-0.003	0.007	0.006
Fe (0.01)	3.99	2.55	0.674	0.522	0.821	0.468	1.73	0.439
K (0.3)	3.47	1.19	2.72	3.62	5.86	4.36	8.15	10.2
La (0.01)	0.043	0.013	-0.001	0.006	0.005	-0.003	0.002	-0.000
Li (0.005)	7.82	5.60	6.00	5.05	6.02	6.15	7.32	10.8
Mg (0.06)	0.083	0.031	0.275	0.047	0.228	0.087	0.243	0.012
Mn (0.005)	0.136	0.084	0.046	0.038	0.098	0.056	0.166	0.089
Mo (0.02)	0.197	0.170	0.050	0.096	0.028	0.018	0.135	0.552
Na (0.02)	40.8	22.7	33.9	27.1	28.9	29.3	39.4	58.3
Nd (0.03)	0.159	0.042	-0.011	0.021	-0.014	-0.013	0.006	0.003
Ni (0.03)	0.051	0.030	0.008	0.014	0.008	0.002	0.034	0.042
P (0.1)	3.90	1.55	5.60	2.58	3.90	3.56	4.59	3.98
Ru (0.05)	0.012	0.008	-0.004	0.005	0.004	-0.008	-0.002	-0.003
Sb (0.05)	0.011	-0.009	0.006	0.002	0.013	0.016	-0.037	0.005
Si (0.02)	58.8	57.9	48.6	45.3	49.3	47.8	56.5	60.7
Sr (0.003)	0.007	0.004	0.001	0.001	0.002	0.001	0.001	0.001
Th (0.15)	1.60	0.427	0.078	0.083	0.096	0.073	0.177	0.046
Ti (0.005)	0.523	0.243	0.012	0.021	0.038	0.018	0.055	0.055
U (0.015)	0.315	0.811	0.075	0.256	0.469	0.833	0.743	2.12
V (0.01)	0.015	0.001	0.002	0.006	0.004	0.000	0.003	0.003
Y (0.01)	0.021	0.008	-0.000	0.002	0.002	-0.000	0.001	0.001
Zn (0.02)	0.008	0.001	-0.008	-0.013	-0.013	-0.014	-0.008	-0.009
Zr (0.01)	0.007	0.004	-0.001	0.009	0.002	0.002	0.000	0.001

(a) Numbers in parentheses are instrument detection limits.

(b) Data excluded from calculations because of leachant loss >10%.

(c) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-35	WVDG-36	WVDG-37	WVDG-38	WVDG-39	WVDG-40
Days of Test	7	7	7	7	7	7
Date Test Began	12-NOV-90	13-NOV-90	12-NOV-90	13-NOV-90	13-NOV-90	13-NOV-90
Date Test Ended	19-NOV-90	20-NOV-90	19-NOV-90	20-NOV-90	20-NOV-90	20-NOV-90
Specimen Wgt., g	3.2360	3.0063	3.0830	3.0301	3.2320	3.0882
Leachant Volume, mL	32.37	30.16	30.84	30.29	32.32	30.88
SA/V	1999.4	1993.6	1999.4	2000.7	2000.0	2000.1
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	10.61	9.94	9.81	10.24	9.99	10.38
Total Init. Wgt., g	115.90	113.09	113.70	112.97	114.67	113.73
Total Final Weight, g	114.83	111.81	112.49	112.20	113.51	112.14
Run Order and Blind No.	22-2	43-2	6-2	29-2	26-2	34-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-8002	90-8023	90-7986	90-8009	90-8006	90-8014
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	18.9	6.54	15.7	14.6	12.3	6.09
B (0.01)	17.6	16.3	10.8	9.34	17.7	14.5
Ba (0.005)	0.005	0.001	0.004	0.002	0.002	0.004
Ca (0.02)	0.042	0.006	0.058	0.025	0.231	0.037
Cd (0.005)	0.001	-0.000 ^(b)	0.002	0.001	0.001	0.001
Ce (0.05)	0.008	0.039	0.070	0.068	0.037	0.047
Cr (0.02)	0.002	0.002	0.049	0.033	0.003	0.004
Cu (0.005)	0.001	0.010	0.041	0.016	0.004	0.006
Fe (0.01)	2.61	0.640	1.82	0.793	0.499	1.10
K (0.3)	12.9	5.05	9.16	7.36	9.37	10.3
La (0.01)	0.001	0.010	0.016	0.015	0.007	0.011
Li (0.005)	11.4	5.04	7.97	6.17	6.58	7.66
Mg (0.06)	0.394	0.017	0.057	0.035	0.231	0.319
Mn (0.005)	0.241	0.003	0.017	0.119	0.005	0.006
Mo (0.02)	0.086	0.359	0.408	0.377	0.073	0.084
Na (0.02)	66.1	11.7	46.1	29.4	37.9	42.0
Nd (0.03)	0.002	0.026	0.051	0.059	0.026	0.041
Ni (0.03)	-0.004	-0.006	0.138	0.022	0.004	0.006
P (0.1)	1.49	0.667	0.859	0.804	6.63	1.22
Ru (0.05)	-0.000	0.004	0.002	0.013	0.010	0.016
Sb (0.05)	-0.009	-0.008	0.010	0.009	0.011	0.024
Si (0.02)	64.5	51.5	58.0	51.6	43.3	64.9
Sr (0.003)	0.001	0.002	0.006	0.003	0.002	0.001
Th (0.15)	0.063	0.299	0.310	0.222	0.090	0.049
Ti (0.005)	0.013	0.087	0.303	0.143	0.010	0.008
U (0.015)	2.16	0.089	0.080	0.035	0.062	2.74
V (0.01)	0.005	0.006	0.005	0.008	0.005	0.009
Y (0.01)	0.000	0.004	0.007	0.006	0.002	0.003
Zn (0.02)	-0.024	-0.008	0.013	-0.005	0.013	-0.023
Zr (0.01)	0.001	0.032	0.037	0.038	0.003	0.005

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-41	WVDG-42	WVDG-43	WVDG-44	WVDG-45	WVDG-46
Days of Test	7	7	7	7	7	7
Date Test Began	12-NOV-90	12-NOV-90	13-NOV-90	13-NOV-90	12-NOV-90	13-NOV-90
Date Test Ended	19-NOV-90	19-NOV-90	20-NOV-90	20-NOV-90	19-NOV-90	20-NOV-90
Specimen Wgt., g	3.0677	3.0772	3.0388	3.0369	3.2642	3.1433
Leachant Volume, mL	30.69	30.77	30.40	30.36	32.64	31.43
SA/V	1999.2	2000.1	1999.2	2000.6	2000.1	2000.2
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	10.54	10.50	9.44	10.22	10.60	10.02
Total Init. Wgt., g	114.00	114.06	112.72	113.15	115.76	114.40
Total Final Weight, g	112.66	113.74	111.67	110.57	114.90	112.69
Run Order and Blind No.	19-2	8-2	36-2	46-2	21-2	30-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	90-7999	90-7988	90-8016	90-8026	90-8001	90-9010
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	7.92	4.71	14.4	12.2	17.6	8.31
B (0.01)	14.1	15.1	15.5	25.9	12.1	30.5
Ba (0.005)	0.002	0.003	0.008	0.001	0.002	0.005
Ca (0.02)	0.036	0.085	0.050	0.006	0.035	0.063
Cd (0.005)	0.001	0.000	-0.002 ^(b)	0.000	-0.001	0.000
Ce (0.05)	0.017	0.016	0.045	0.012	0.030	0.033
Cr (0.02)	0.001	0.015	0.021	0.004	0.013	0.006
Cu (0.005)	0.006	0.022	0.020	0.002	0.009	0.013
Fe (0.01)	1.50	1.19	5.18	0.917	2.28	1.69
K (0.3)	10.4	11.8	3.91	8.11	10.7	9.13
La (0.01)	0.003	0.002	0.011	0.002	0.005	0.005
Li (0.005)	8.81	9.08	5.23	10.2	8.29	9.00
Mg (0.06)	0.056	0.363	0.068	0.023	0.031	0.527
Mn (0.005)	0.013	0.196	0.555	0.006	0.241	0.292
Mo (0.02)	0.072	0.682	0.029	0.062	0.096	0.067
Na (0.02)	62.5	53.7	16.5	54.1	54.1	48.9
Nd (0.03)	0.008	0.013	0.032	-0.003	0.019	0.018
Ni (0.03)	0.018	0.071	0.029	0.004	0.009	0.011
P (0.1)	10.1	10.6	1.97	0.947	9.47	1.11
Ru (0.05)	0.005	0.004	-0.005	-0.003	0.001	0.011
Sb (0.05)	-0.009	-0.011	-0.008	-0.003	-0.012	0.016
Si (0.02)	68.3	61.4	54.5	52.2	57.1	62.7
Sr (0.003)	0.001	0.002	0.003	0.001	0.001	0.001
Th (0.15)	0.392	0.082	1.82	0.168	0.229	0.213
Ti (0.005)	0.025	0.071	0.137	0.014	0.054	0.025
U (0.015)	3.41	0.057	0.721	3.03	0.072	0.138
V (0.01)	0.005	0.005	0.013	0.003	0.006	0.007
Y (0.01)	0.002	0.002	0.004	0.000	0.001	0.001
Zn (0.02)	-0.022	0.005	-0.012	-0.019	-0.010	-0.002
Zr (0.01)	0.001	0.003	0.012	0.002	0.001	0.003

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.2. (contd)

	WVDG-47	WVDG-48	WVDG-49 (ARM-1)	WVDG-50 (ARM-1)	WVDG-51 Blank	WVDG-52 Blank
Days of Test	7	7	7	7	7	7
Date Test Began	12-NOV-90	13-NOV-90	12-NOV-90	13-NOV-90	12-NOV-90	13-NOV-90
Date Test Ended	19-NOV-90	20-NOV-90	19-NOV-90	20-NOV-90	19-NOV-90	20-NOV-90
Specimen Wgt., g	3.0404	3.0757	3.1006	3.1178	no specimen	no specimen
Leachant Volume, mL	30.39	30.77	31.02	31.17	31.76	27.93
SA/V	2000.9	1999.2	1999.1	2000.5		
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.14	6.14	6.14	6.14	6.14	6.14
Final pH	9.32	9.35	10.42	10.45	8.40	8.14
Total Init. Wgt., g	112.32	113.73	113.38	113.76	111.52	107.44
Total Final Weight, g	111.01	112.02	112.57	112.27	111.31	107.27
Run Order and Blind No.	16-2	48-2	23-2	35-2	14-2	42-2
Date of Analysis	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90	12-DEC-90
Analytical Number	0-7996	90-8028	90-8003	90-8015	90-7994	90-8022
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	7.35	12.1	4.11	4.44	-0.003 ^(b)	-0.003
B (0.01)	15.3	11.4	16.8	17.3	0.053	0.063
Ba (0.005)	0.005	0.005	0.004	0.009	0.000	0.001
Ca (0.02)	0.051	0.044	0.217	0.231	0.028	0.004
Cd (0.005)	0.001	0.000	-0.001	0.001	-0.003	-0.002
Ce (0.05)	0.045	0.028	0.015	0.075	0.014	-0.014
Cr (0.02)	0.015	0.002	-0.002	-0.002	-0.005	-0.002
Cu (0.005)	0.016	0.013	0.009	0.007	-0.001	-0.000
Fe (0.01)	5.86	0.344	-0.035	-0.033	-0.040	-0.022
K (0.3)	5.14	3.79	-0.262	1.86	-0.159	-1.34
La (0.01)	0.010	0.006	0.002	0.012	0.000	-0.002
Li (0.005)	4.80	4.23	13.3	14.1	0.005	0.006
Mg (0.06)	0.062	0.058	0.025	0.066	-0.002	-0.009
Mn (0.005)	0.524	0.005	0.001	0.001	-0.001	0.002
Mo (0.02)	0.034	0.247	5.420	5.615	-0.014	-0.005
Na (0.02)	19.9	15.3	35.9	37.6	0.026	0.029
Nd (0.03)	0.034	0.012	0.030	0.128	-0.000	-0.015
Ni (0.03)	0.016	0.001	-0.004	-0.003	-0.008	-0.008
P (0.1)	4.79	2.45	0.927	0.917	0.015	0.006
Ru (0.05)	0.001	-0.001	0.003	0.019	-0.005	-0.008
Sb (0.05)	-0.017	0.005	0.007	0.027	-0.025	-0.021
Si (0.02)	59.1	42.4	59.6	62.4	0.003	0.045
Sr (0.003)	0.003	0.002	0.020	0.024	0.000	0.000
Th (0.15)	0.879	0.115	0.005	-0.002	-0.001	-0.010
Ti (0.005)	0.108	0.073	0.011	0.042	0.000	0.000
U (0.015)	0.237	0.233				
V (0.01)	0.010	0.001	0.008	0.014	-0.000	-0.003
Y (0.01)	0.004	0.003	-0.000	0.003	0.000	-0.002
Zn (0.02)	-0.007	-0.007	0.028	0.063	-0.014	-0.010
Zr (0.01)	0.004	0.006	0.011	0.031	-0.001	-0.004

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. Test Information and Leachate ICP and XRF Results for Third Series of PCT Tests of West Valley Compositional Variability Glasses

	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6
Days of Test	7	7	7	7	7	7
Date Test Began	27-NOV-90	27-NOV-90	27-NOV-90	26-NOV-90	27-NOV-90	27-NOV-90
Date Test Ended	04-DEC-90	04-DEC-90	04-DEC-90	03-DEC-90	04-DEC-90	04-DEC-90
Specimen Wgt., g	3.0029	3.7657	4.0075	4.0919	3.8760	3.7881
Leachant Volume, mL	30.01	37.66	40.07	40.90	38.78	37.87
SA/V	2001.3	1999.8	2000.2	2000.9	1999.0	2000.6
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.47	9.37	9.90	9.92	9.52	9.53
Total Init. Wgt., g	112.22	119.42	122.98	124.38	122.41	120.91
Total Final Weight, g	110.26	116.73	122.55	123.88	122.47	118.90
Run Order and Blind No.	43-3	32-3	42-3	5-3	39-3	50-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8074	90-8063	90-8073	90-8036	90-8070	90-8080
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	10.2	10.5	7.03	9.84	6.65	10.4
B (0.01)	13.6	16.3	13.8	18.8	16.2	14.9
Ba (0.005)	0.002	0.002	0.001	0.001	0.001	0.001
Ca (0.02)	0.019	0.011	0.003	-0.049 ^(b)	0.007	0.002
Cd (0.005)	0.001	0.001	-0.001	-0.001	-0.001	-0.002
Ce (0.05)	0.002	0.016	-0.001	0.007	-0.005	-0.009
Cr (0.02)	0.007	0.005	0.010	0.004	0.002	0.003
Cu (0.005)	0.000	0.001	0.001	-0.002	0.006	0.001
Fe (0.01)	0.861	0.820	0.723	0.594	0.486	0.646
K (0.3)	1.56	1.90	2.55	1.55	1.61	0.720
La (0.01)	-0.001	0.004	-0.011	0.001	-0.001	-0.004
Li (0.005)	4.02	5.35	6.19	4.64	4.58	4.69
Mg (0.06)	0.082	0.086	0.234	0.100	0.046	0.020
Mn (0.005)	0.071	0.067	0.091	0.058	0.037	0.043
Mo (0.02)	0.021	0.022	0.040	0.028	0.020	0.022
Na (0.02)	21.7	25.4	33.3	44.0	26.5	22.7
Nd (0.03)	0.020	0.010	0.014	0.008	0.012	0.014
Ni (0.03)	0.006	0.017	0.001	0.000	-0.004	-0.014
P (0.1)	1.94	2.50	4.07	4.12	2.92	3.05
Ru (0.05)	-0.000	0.004	0.002	-0.000	-0.002	0.000
Sb (0.05)	-0.007	-0.007	0.000	0.001	-0.008	-0.002
Si (0.02)	51.9	55.1	58.1	52.5	52.6	53.2
Sr (0.003)	0.001	0.001	0.001	0.000	0.001	0.001
Th (0.15)	0.261	0.198	0.075	0.062	0.092	0.104
Ti (0.005)	0.043	0.042	0.026	0.018	0.021	0.029
U (0.015)	0.447	0.447	0.282	0.315	0.316	0.389
V (0.01)	0.003	0.003	0.001	0.001	0.000	-0.001
Y (0.01)	0.001	0.001	0.000	0.000	0.000	0.000
Zn (0.02)	-0.057	-0.064	-0.038	-0.069	-0.037	-0.057
Zr (0.01)	0.013	0.002	-0.007	-0.005	0.001	0.001

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-7	WVDG-8	WVDG-11R	WVDG-12R	WVDG-13R	WVDG-14R
Days of Test	7	7	7	7	7	7
Date Test Began	26-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90	26-NOV-90	27-NOV-90
Date Test Ended	03-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90	03-DEC-90	04-DEC-90
Specimen Wgt., g	3.8715	3.9792	3.8572	3.9742	3.7614	3.8252
Leachant Volume, mL	38.71	39.78	38.58	39.75	37.60	38.27
SA/V	2000.3	2000.6	1999.6	1999.6	2000.7	1999.1
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.42	9.84	10.00	9.86	10.00	10.04
Total Init. Wgt., g	121.74	123.10	123.51	123.75	119.92	123.33
Total Final Weight, g	121.36	121.94	122.85	122.16	117.92	117.99
Run Order and Blind No.	23-3	37-3	15-3	6-3	13-3	30-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8054	90-8068	90-8046	90-8037	90-8044	90-8061
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	9.26	10.9	13.0	12.3	13.2	15.0 ^(b)
B (0.01)	12.5	8.74	14.2	14.2	16.0	20.8
Ba (0.005)	0.002	0.001	0.003	0.002	0.001	0.002
Ca (0.02)	0.011	0.003	-0.018 ^(c)	-0.033	-0.049	0.002
Cd (0.005)	0.001	-0.002	0.000	-0.001	0.002	0.001
Ce (0.05)	0.006	0.003	0.019	0.005	0.016	0.008
Cr (0.02)	0.003	0.001	0.001	-0.003	-0.004	0.003
Cu (0.005)	0.003	0.010	-0.001	0.012	0.000	0.008
Fe (0.01)	0.535	0.61	0.668	0.540	0.689	1.41
K (0.3)	1.87	1.61	5.40	5.21	5.36	6.51
La (0.01)	0.004	-0.001	0.004	0.001	0.002	0.005
Li (0.005)	3.89	5.00	6.0	6.12	6.74	8.55
Mg (0.06)	0.053	0.127	0.137	0.094	0.138	0.256
Mn (0.005)	0.035	0.067	0.067	0.058	0.067	0.133
Mo (0.02)	0.020	0.024	0.031	0.022	0.024	0.034
Na (0.02)	20.3	25.9	28.7	29.6	33.8	45.1
Nd (0.03)	0.006	0.010	0.000	0.004	0.006	0.020
Ni (0.03)	0.006	-0.002	0.029	0.000	0.012	0.013
P (0.1)	1.84	2.98	3.69	3.49	3.88	4.60
Ru (0.05)	0.004	-0.004	0.006	-0.001	0.002	0.004
Sb (0.05)	-0.005	-0.006	0.010	0.000	-0.005	-0.001
Si (0.02)	47.1	55.8	47.0	44.9	48.2	54.2
Sr (0.003)	0.001	0.001	0.002	0.001	0.001	0.001
Th (0.15)	0.178	0.094	0.080	0.066	0.081	0.110
Ti (0.005)	0.026	0.027	0.033	0.030	0.025	0.040
U (0.015)	0.300	0.447	0.333	0.389	0.471	0.526
V (0.01)	0.001	0.001	0.003	0.002	0.003	0.004
Y (0.01)	0.001	0.000	0.001	0.000	0.001	0.001
Zn (0.02)	-0.051	-0.062	-0.083	-0.081	-0.092	-0.087
Zr (0.01)	0.007	0.001	-0.003	0.001	0.000	-0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Data excluded from calculations because leachant loss > 10%.

(c) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20
Days of Test	7	7	7	7	7	7
Date Test Began	27-NOV-90	26-NOV-90	26-NOV-90	27-NOV-90	26-NOV-90	27-NOV-90
Date Test Ended	04-DEC-90	03-DEC-90	03-DEC-90	04-DEC-90	03-DEC-90	04-DEC-90
Specimen Wgt., g	3.773	3.7982	4.1398	3.6720	3.9782	3.6559
Leachant Volume, mL	27.74	37.98	41.39	36.71	39.78	36.56
SA/V	2720.5	2000.1	2000.4	2000.5	2000.1	1999.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.91	9.52	10.28	10.07	9.87	9.56
Total Init. Wgt., g	117.67	117.06	125.59	118.20	123.18	119.44
Total Final Weight, g	115.85	115.29	124.94	117.57	120.70	113.99
Run Order and Blind No.	41-3	14-3	11-3	38-3	7-3	48-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8072	90-8045	90-8042	90-8069	90-8038	90-8078
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	11.2	10.8	11.1	13.4	16.1	15.6 ^(b)
B (0.01)	23.1	15.4	17.5	15.1	13.2	11.4
Ba (0.005)	0.004	0.005	0.006	0.004	0.004	0.005
Ca (0.02)	0.010	-0.030 ^(c)	-0.037	-0.001	-0.041	0.007
Cd (0.005)	0.001	-0.001	0.000	-0.002	-0.001	-0.000
Ce (0.05)	0.002	0.022	0.026	-0.003	0.016	0.009
Cr (0.02)	0.030	-0.001	0.033	0.002	-0.001	0.001
Cu (0.005)	0.006	-0.000	0.008	0.008	0.009	0.009
Fe (0.01)	0.511	0.491	0.826	1.24	0.390	0.265
K (0.3)	3.01	2.62	3.93	3.33	3.57	2.44
La (0.01)	-0.002	0.004	0.002	-0.004	0.001	-0.004
Li (0.005)	7.6	4.39	6.2	6.18	5.32	5.07
Mg (0.06)	0.167	0.081	0.222	0.005	0.076	0.034
Mn (0.005)	0.135	0.070	0.199	0.033	0.012	0.010
Mo (0.02)	0.237	0.045	0.271	0.049	0.052	0.129
Na (0.02)	39.7	21.7	42.2	36.7	29.9	19.1
Nd (0.03)	0.035	0.004	0.076	0.017	0.005	0.005
Ni (0.03)	-0.009	0.009	0.010	-0.010	0.006	-0.004
P (0.1)	2.80	2.63	2.81	2.43	2.07	1.92
Ru (0.05)	-0.001	0.004	-0.003	0.005	0.001	-0.002
Sb (0.05)	-0.015	0.007	-0.002	-0.012	0.002	-0.011
Si (0.02)	48.9	11.8	47.5	56.1	41.3	45.1
Sr (0.003)	0.001	0.001	0.001	0.001	0.001	0.001
Th (0.15)	0.018	0.050	0.055	0.162	0.043	0.046
Ti (0.005)	0.018	0.008	0.027	0.021	0.005	0.025
U (0.015)	0.622	0.062	0.032	0.095	0.910	0.234
V (0.01)	0.001	0.004	0.004	0.000	0.003	0.000
Y (0.01)	-0.000	0.001	0.001	-0.001	0.000	-0.000
Zn (0.02)	-0.059	-0.073	-0.064	-0.073	-0.107	-0.086
Zr (0.01)	-0.005	-0.003	-0.002	0.001	-0.003	0.011

(a) Numbers in parentheses are instrument detection limits.

(b) Data excluded from calculations because leachant loss > 10%.

(c) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-21	WVDG-22	WVDG-23	WVDG-24	WVDG-25	WVDG-26
Days of Test	7	7	7	7	7	7
Date Test Began	27-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90	27-NOV-90	26-NOV-90
Date Test Ended	04-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90	04-DEC-90	03-DEC-90
Specimen Wgt., g	4.0318	3.7684	3.7467	3.7620	3.9103	3.6855
Leachant Volume, mL	40.32	37.68	37.47	37.61	39.11	36.86
SA/V	1999.9	2000.2	1999.8	2000.5	1999.6	1999.8
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.80	9.52	9.30	9.49	9.64	9.49
Total Init. Wgt., g	123.63	119.05	120.92	120.43	122.83	119.56
Total Final Weight, g	122.79	118.63	117.90	117.18	122.39	116.54
Run Order and Blind No.	40-3	26-3	25-3	24-3	28-3	17-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8071	90-8057	90-8056	90-8055	90-8059	90-8048
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	20.5	19.3	13.4	15.4	12.8	12.8
B (0.01)	13.7	14.8	19.2	16.8	13.1	14.8
Ba (0.005)	0.009	0.007	0.017	0.004	0.006	0.003
Ca (0.02)	0.018	0.014	0.046	-0.003 ^(b)	0.001	0.034
Cd (0.005)	-0.001	0.001	0.001	-0.001	0.001	0.001
Ce (0.05)	0.058	0.155	0.103	0.009	0.029	0.000
Cr (0.02)	0.006	0.003	0.020	0.006	0.003	-0.002
Cu (0.005)	0.009	0.020	0.016	0.005	0.010	0.012
Fe (0.01)	1.91	0.894	4.33	0.639	1.21	0.332
K (0.3)	3.84	2.67	2.17	2.28	3.17	2.49
La (0.01)	0.002	0.009	0.010	0.003	0.003	0.000
Li (0.005)	5.22	4.99	5.00	5.27	4.83	4.62
Mg (0.06)	0.035	0.019	0.063	0.018	0.013	0.029
Mn (0.005)	0.248	0.181	0.096	0.115	0.175	0.016
Mo (0.02)	0.044	0.170	0.038	0.047	0.040	0.039
Na (0.02)	33.6	21.8	22.4	24.1	22.6	20.3
Nd (0.03)	0.004	0.007	0.016	0.014	0.016	0.007
Ni (0.03)	0.012	0.028	0.026	0.001	0.005	-0.008
P (0.1)	4.07	1.23	2.56	1.78	2.50	1.31
Ru (0.05)	-0.000	0.001	0.000	-0.001	0.005	-0.003
Sb (0.05)	-0.029	-0.002	-0.003	0.002	0.002	-0.009
Si (0.02)	52.4	50.8	52.2	47.8	56.3	38.8
Sr (0.003)	0.001	0.003	0.002	0.001	0.001	0.001
Th (0.15)	0.417	0.372	2.052	0.102	0.424	0.048
Ti (0.005)	0.048	0.092	0.116	0.013	0.034	0.007
U (0.015)	1.112	0.073	1.140	0.866	0.062	0.065
V (0.01)	0.003	0.004	0.014	0.002	0.004	0.001
Y (0.01)	0.002	0.005	0.004	0.000	0.001	0.000
Zn (0.02)	-0.010	-0.102	-0.074	-0.090	-0.070	-0.069
Zr (0.01)	-0.002	0.003	0.005	0.003	-0.001	-0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-27	WVDG-28	WVDG-29	WVDG-30	WVDG-31B	WVDG-31C
Days of Test	7	7	7	7	7	7
Date Test Began	26-NOV-90	26-NOV-90	26-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90
Date Test Ended	03-DEC-90	03-DEC-90	03-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90
Specimen Wgt., g	3.7983	3.8052	4.2921	4.0645	3.7532	3.7561
Leachant Volume, mL	37.97	38.06	42.93	40.64	37.53	37.54
SA/V	2000.7	1999.6	1999.6	2000.2	1999.6	2001.1
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.62	9.57	9.92	9.71	9.93	10.01
Total Init. Wgt., g	121.13	120.25	126.45	122.40	120.19	119.41
Total Final Weight, g	120.07	114.00	125.55	121.16	118.00	118.61
Run Order and Blind No.	3-3	19-3	4-3	33-3	10-3	2-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8034	90-8050	90-8035	90-8064	90-8041	90-8033
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	19.0	13.6 ^(b)	10.2	14.2	13.4	12.9
B (0.01)	22.0	13.7	16.1	16.2	14.5	14.0
Ba (0.005)	0.003	0.006	0.009	0.015	0.002	0.000
Ca (0.02)	-0.041 ^(c)	0.006	-0.014	0.032	-0.042	-0.043
Cd (0.005)	0.001	0.000	-0.002	0.000	0.001	-0.002
Ce (0.05)	0.099	0.118	0.006	0.072	-0.002	-0.004
Cr (0.02)	0.020	0.012	0.001	0.010	0.008	-0.000
Cu (0.005)	0.007	0.017	-0.002	0.010	0.000	-0.003
Fe (0.01)	1.04	1.32	1.006	1.84	1.14	0.527
K (0.3)	2.07	1.80	3.42	2.900	4.59	4.86
La (0.01)	0.005	0.003	-0.003	0.006	-0.001	-0.001
Li (0.005)	6.22	5.70	6.09	5.8	6.23	5.93
Mg (0.06)	-0.004	0.008	0.332	0.073	0.224	0.083
Mn (0.005)	0.024	0.043	0.057	0.130	0.125	0.051
Mo (0.02)	0.168	0.177	0.053	0.108	0.037	0.023
Na (0.02)	32.8	22.7	34.6	29.4	29.4	28.2
Nd (0.03)	0.005	0.015	0.009	0.054	0.014	0.005
Ni (0.03)	0.010	0.009	-0.011	0.015	-0.008	-0.004
P (0.1)	3.11	1.50	5.96	2.70	3.91	3.51
Ru (0.05)	-0.008	-0.010	-0.010	0.001	-0.008	-0.007
Sb (0.05)	-0.010	0.012	0.000	-0.005	0.013	0.016
Si (0.02)	47.9	57.6	51.6	49.9	49.3	46.8
Sr (0.003)	0.001	0.002	0.000	0.002	0.001	0.000
Th (0.15)	0.480	0.254	0.113	0.306	0.110	0.075
Ti (0.005)	0.132	0.122	0.016	0.075	0.050	0.019
U (0.015)	0.037	1.22	0.063	0.4	0.415	0.333
V (0.01)	0.004	-0.000	0.001	0.004	0.007	0.001
Y (0.01)	0.003	0.003	-0.000	0.002	0.001	0.000
Zn (0.02)	-0.114	-0.071	-0.067	-0.076	-0.085	-0.082
Zr (0.01)	0.004	0.000	-0.006	-0.001	-0.004	0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Data excluded from calculations because leachant loss > 10%.

(c) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-33	WVDG-34	WVDG-35	WVDG-36	WVDG-37	WVDG-38
Days of Test	7	7	7	7	7	7
Date Test Began	26-NOV-90	27-NOV-90	27-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90
Date Test Ended	03-DEC-90	04-DEC-90	04-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90
Specimen Wgt., g	3.8227	3.7762	3.7581	3.7515	4.0532	3.768
Leachant Volume, mL	38.23	37.78	37.56	37.51	40.53	37.37
SA/V	1999.8	1999.0	2001.1	2000.3	2000.1	1999.9
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	10.22	10.42	11.06	9.63	10.83	10.37
Total Init. Wgt., g	121.26	120.94	120.76	121.44	122.84	120.26
Total Final Weight, g	118.36	121.07	119.65	120.12	122.23	119.56
Run Order and Blind No.	16-3	47-3	34-3	27-3	1-3	12-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8047	90-8077	90-8065	90-8058	90-8032	90-8043
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	10.1	6.67	19.6	6.79	15.6	14.5
B (0.01)	14.0	24.9	17.8	16.4	10.7	9.25
Ba (0.005)	0.005	0.000	0.004	0.001	0.001	0.002
Ca (0.02)	0.030	-0.006 ^(b)	-0.003	-0.004	-0.023	-0.049
Cd (0.005)	-0.001	-0.001	-0.000	0.001	0.002	-0.001
Ce (0.05)	-0.010	-0.015	-0.001	0.019	0.026	0.066
Cr (0.02)	0.009	0.068	0.005	0.005	0.030	0.039
Cu (0.005)	0.020	0.016	0.004	0.017	0.026	0.023
Fe (0.01)	1.38	0.418	2.48	0.592	1.27	1.36
K (0.3)	7.39	9.54	14.0	5.40	8.05	6.32
La (0.01)	-0.002	-0.004	0.001	0.005	0.006	0.015
Li (0.005)	7.293	9.70	11.5	5.00	7.68	6.18
Mg (0.06)	0.210	0.012	0.356	0.005	0.015	0.016
Mn (0.005)	0.135	0.068	0.207	0.004	0.010	0.086
Mo (0.02)	0.146	0.537	0.096	0.382	0.412	0.373
Na (0.02)	38.8	52.9	67.4	22.6	44.4	29.1
Nd (0.03)	0.026	0.039	0.003	0.003	0.086	0.039
Ni (0.03)	-0.011	-0.010	-0.006	0.015	0.015	0.049
P (0.1)	4.44	3.85	1.49	0.639	0.777	0.739
Ru (0.05)	-0.008	-0.004	-0.001	0.002	-0.005	-0.000
Sb (0.05)	-0.020	0.001	-0.007	0.011	0.006	-0.014
Si (0.02)	55.1	60.0	65.9	52.7	56.1	50.9
Sr (0.003)	0.002	0.001	0.001	0.002	0.003	0.005
Th (0.15)	0.163	0.044	0.059	0.271	0.235	0.411
Ti (0.005)	0.044	0.040	0.012	0.076	0.196	0.234
U (0.015)	0.474	0.447	4.25	0.046	0.049	0.040
V (0.01)	0.000	0.001	0.003	0.004	0.002	0.005
Y (0.01)	0.000	-0.000	0.000	0.002	0.003	0.007
Zn (0.02)	-0.047	-0.030	-0.128	-0.035	-0.080	-0.081
Zr (0.01)	-0.005	-0.003	-0.003	0.024	0.033	0.056

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-39	WVDG-40	WVDG-41	WVDG-42	WVDG-43	WVDG-44
Days of Test	7	7	7	7	7	7
Date Test Began	27-NOV-90	27-NOV-90	27-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90
Date Test Ended	04-DEC-90	04-DEC-90	04-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90
Specimen Wgt., g	3.7956	3.7563	3.7794	3.8127	3.8366	3.7781
Leachant Volume, mL	37.97	37.54	37.78	38.13	38.36	37.77
SA/V	1999.3	2001.2	2000.7	1999.8	2000.3	2000.6
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	9.95	10.50	10.61	10.62	9.35	10.50
Total Init. Wgt., g	120.80	119.29	120.85	120.74	120.05	117.60
Total Final Weight, g	117.51	119.23	119.37	120.35	118.65	117.27
Run Order and Blind No.	29-3	36-3	49-3	35-3	8-3	9-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8060	90-8067	90-8079	90-8066	90-8039	90-8040
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	14.0	6.36	7.95	5.000	13.8	13.1
B (0.01)	20.6	14.3	14.3	16.1	15.4	25.5
Ba (0.005)	0.005	0.002	0.002	0.002	0.005	0.001
Ca (0.02)	0.021	0.001	-0.002 ^(b)	0.008	-0.039	-0.059
Cd (0.005)	0.000	0.000	-0.003	0.000	0.001	-0.000
Ce (0.05)	0.003	-0.007	-0.015	-0.002	0.032	0.005
Cr (0.02)	0.008	0.001	-0.002	0.014	0.010	0.003
Cu (0.005)	0.015	0.015	0.009	0.013	0.018	0.009
Fe (0.01)	1.81	1.01	1.59	0.814	3.89	2.18
K (0.3)	-0.609	8.99	9.556	12.0	3.18	8.84
La (0.01)	0.002	-0.003	-0.004	0.001	0.004	0.002
Li (0.005)	7.7	7.61	9.01	9.74	5.13	9.77
Mg (0.06)	0.557	0.226	0.013	0.226	0.049	0.019
Mn (0.005)	0.019	0.005	0.013	0.123	0.415	0.012
Mo (0.02)	0.083	0.082	0.079	0.759	0.035	0.064
Na (0.02)	43.9	41.7	63.4	57.6	16.1	52.2
Nd (0.03)	0.033	0.007	0.014	0.037	0.024	0.010
Ni (0.03)	-0.001	-0.008	-0.014	-0.007	0.014	0.001
P (0.1)	7.38	1.18	10.3	11.3	1.83	0.923
Ru (0.05)	-0.001	-0.002	-0.012	0.001	-0.004	-0.006
Sb (0.05)	-0.008	-0.013	-0.017	0.009	0.012	0.001
Si (0.02)	48.8	65.9	68.7	65.5	51.9	54.6
Sr (0.003)	0.001	0.001	0.001	0.001	0.002	0.001
Th (0.15)	0.315	0.043	0.336	0.038	1.29	0.319
Ti (0.005)	0.031	0.005	0.022	0.031	0.099	0.029
U (0.015)	0.100	2.12	2.83	0.022	2.27	2.14
V (0.01)	0.003	0.002	0.001	0.003	0.008	0.002
Y (0.01)	0.001	-0.001	-0.001	0.000	0.003	0.000
Zn (0.02)	-0.072	-0.038	0.050	-0.012	-0.092	-0.093
Zr (0.01)	-0.004	-0.003	-0.005	-0.003	0.007	0.002

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-45	WVDG-46	WVDG-47	WVDG-48	WVDG-49 (ARM-1)	WVDG-50 (ARM-1)
Days of Test	7	7	7	7	7	7
Date Test Began	27-NOV-90	26-NOV-90	27-NOV-90	26-NOV-90	26-NOV-90	27-NOV-90
Date Test Ended	04-DEC-90	03-DEC-90	04-DEC-90	03-DEC-90	03-DEC-90	04-DEC-90
Specimen Wgt., g	3.7480	3.9912	3.7644	3.9323	3.7844	3.7237
Leachant Volume, mL	37.50	39.91	37.63	39.33	37.42	37.24
SA/V	1998.9	2000.1	2000.7	1999.6	2022.7	1999.8
Specimen Mesh Size	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200	-100 +200
Initial pH	6.44	6.44	6.44	6.44	6.44	6.44
Final pH	10.68	10.10	9.36	9.40	10.58	10.30
Total Init. Wgt., g	120.55	123.24	119.46	123.63	121.01	120.48
Total Final Weight, g	120.06	122.65	114.12	121.55	120.87	117.46
Run Order and Blind No.	46-3	20-3	44-3	18-3	21-3	45-3
Date of Analysis	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90	20-DEC-90
Analytical Number	90-8076b	90-8051	90-8075	90-8049	90-8052	90-8076a
Elements	Leachate Analyzed Concentration, mg/L					
Al (0.05) ^(a)	17.1	7.88	7.283	12.3	4.36	4.26
B (0.01)	11.6	26.2	16.1	11.6	17.6	17.2
Ba (0.005)	0.003	0.002	0.005	0.002	0.005	0.005
Ca (0.02)	-0.007 ^(b)	0.007	0.015	0.012	0.169	0.211
Cd (0.005)	-0.002	0.000	-0.001	-0.001	0.001	0.001
Ce (0.05)	0.006	-0.008	0.018	0.007	0.008	-0.001
Cr (0.02)	0.007	0.007	0.014	0.006	-0.004	-0.004
Cu (0.005)	0.018	0.008	0.011	0.019	0.007	0.002
Fe (0.01)	1.72	1.27	5.52	0.377	0.012	0.019
K (0.3)	10.6	8.12	3.56	4.00	0.083	-0.711
La (0.01)	0.002	-0.003	0.001	0.003	0.001	-0.003
Li (0.005)	7.95	7.85	5.07	4.30	13.7	13.9
Mg (0.06)	0.026	0.403	0.045	0.085	0.015	0.004
Mn (0.005)	0.173	0.220	0.508	0.006	0.002	0.003
Mo (0.02)	0.096	0.057	0.049	0.249	5.85	5.50
Na (0.02)	51.4	42.6	20.7	15.5	36.8	36.8
Nd (0.03)	0.012	0.002	0.026	0.005	0.000	0.001
Ni (0.03)	0.001	-0.012	0.008	0.006	0.034	0.030
P (0.1)	9.07	0.904	5.08	2.39	0.896	0.802
Ru (0.05)	-0.000	-0.006	-0.004	-0.001	0.003	0.001
Sb (0.05)	-0.015	0.004	-0.004	-0.008	0.004	-0.005
Si (0.02)	54.9	58.6	59.8	43.0	61.5	60.1
Sr (0.003)	0.002	0.000	0.001	0.002	0.019	0.021
Th (0.15)	0.196	0.143	0.833	0.096	0.008	0.015
Ti (0.005)	0.039	0.015	0.098	0.070	0.015	0.017
U (0.015)	0.078	0.091	0.107	0.162	0.000	0.000
V (0.01)	0.003	0.001	0.005	0.001	0.008	0.006
Y (0.01)	0.000	-0.000	0.002	0.001	0.000	-0.000
Zn (0.02)	-0.094	-0.040	-0.031	-0.065	0.034	0.018
Zr (0.01)	-0.004	-0.005	-0.005	0.001	0.010	0.009

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.3. (contd)

	WVDG-51 (ARM-1)	WVDG-52 (ARM-1)
Days of Test	7	7
Date Test Began	27-NOV-90	26-NOV-90
Date Test Ended	04-DEC-90	03-DEC-90
Specimen Wgt., g	no specimen	no specimen
Leachant Volume, mL	37.07	37.18
SA/V		
Specimen Mesh Size	-100 +200	-100 +200
Initial pH	6.44	6.44
Final pH	7.95	7.18
Total Init. Wgt., g	115.54	116.87
Total Final Weight, g	115.12	116.75
Run Order and Blind No.	31-3	22-3
Date of Analysis	20-DEC-90	20-DEC-90
Analytical Number	90-8062	90-8053
Elements	Leachate Analyzed Concentration, mg/L	
Al (0.05) ^(a)	0.011	0.002
B (0.01)	0.000	0.034
Ba (0.005)	-0.000 ^(b)	-0.000
Ca (0.02)	0.005	0.010
Cd (0.005)	-0.002	-0.001
Ce (0.05)	-0.003	0.002
Cr (0.02)	0.001	0.001
Cu (0.005)	0.001	-0.000
Fe (0.01)	-0.004	-0.003
K (0.3)	-0.241	-0.056
La (0.01)	0.001	-0.001
Li (0.005)	-0.000	0.003
Mg (0.06)	-0.008	0.001
Mn (0.005)	0.001	0.001
Mo (0.02)	0.004	0.005
Na (0.02)	0.058	0.039
Nd (0.03)	-0.002	-0.004
Ni (0.03)	0.001	0.001
P (0.1)	-0.012	-0.029
Ru (0.05)	0.006	0.001
Sb (0.05)	-0.004	0.000
Si (0.02)	-0.028	-0.023
Sr (0.003)	0.000	0.000
Th (0.15)	-0.009	-0.011
Ti (0.005)	0.000	0.000
U (0.015)	0.000	0.000
V (0.01)	-0.001	-0.001
Y (0.01)	0.000	-0.000
Zn (0.02)	0.001	0.002
Zr (0.01)	-0.005	-0.005

(a) Numbers in parentheses are instrument detection limits.

(b) Negative numbers are the result of random variation at low concentrations.

Table A.4. Leachate IC Results for Ion Chromatograph Results for all PCT Tests of West Valley Compositional Variability Series

	WVDG-1	WVDG-2	WVDG-3	WVDG-4	WVDG-5	WVDG-6	WVDG-7	WVDG-8	WVDG-11R
F, Series 1	<0.2	<0.2*	<0.2*(a)	<0.2*	<0.2	<0.2*	<0.2	<0.2	<0.2*
F, Series 2	<0.2*	<0.2	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
F, Series 3	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	0.2*
Cl, Series 1	0.2	0.2	<0.2	0.2	0.2	0.2	0.2	0.2	0.2
Cl, Series 2	<0.2	<0.2	0.2	0.3	<0.2	<0.2	0.2	<0.2	<0.2
Cl, Series 3	<0.2	<0.2	0.2	0.3*	0.2*	<0.2	<0.2*	<0.2	0.2*
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO ₃ , Series 1	<0.4	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₃ , Series 2	0.4	<0.4	0.4	0.5	<0.4	1.9	<0.4	<0.4	<0.4
NO ₃ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
PO ₄ , Series 1	5.5	6.8	13.1	12.8	8.8	9.6	5.9	8.0	11.0
PO ₄ , Series 2	5.4	7.4	13.1	13.5	8.8	9.4	6.4	8.8	10.0
PO ₄ , Series 3	5.4	7.3	11.8	13.0	8.3	9.1	5.5	8.6	10.9
SO ₄ , Series 1	1.2	1.2	2.0	1.6	1.3	1.3	1.2	1.2	1.4
SO ₄ , Series 2	1.1	1.2	2.1	1.5	1.2	1.4	1.2	1.2	1.4
SO ₄ , Series 3	1.2	1.3	1.9	1.5	1.3	1.4	1.2	1.2	1.5
	WVDG-12R	WVDG-13R	WVDG-14R	WVDG-15	WVDG-16	WVDG-17	WVDG-18	WVDG-19	WVDG-20
F, Series 1	<0.2	<0.2	<0.2*	<0.2*	<0.2*	<0.2*	<0.2	<0.2*	<0.2
F, Series 2	<0.2*	<0.2*	<0.2*	<0.2*	<0.2	<0.2*	<0.2*	<0.2*	<0.2*
F, Series 3	<0.2*	0.2*	<0.2*	<0.2*	0.2*	<0.2*	<0.2*	<0.2	<0.2*
Cl, Series 1	<0.2	0.2	0.2	0.3	0.2	0.2	<0.2	0.2	0.2
Cl, Series 2	<0.2	<0.2	0.3	0.2	<0.2	<0.2	<0.2	0.2	<0.2
Cl, Series 3	<0.2*	<0.2	0.9*	0.3*	<0.2*	0.3*	<0.2	<0.2	<0.2
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.75*	<0.2	<0.2	<0.2
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO ₃ , Series 1	0.4	0.4	<0.4	<0.4	<0.4	1.8*	<0.4	0.5	<0.4
NO ₃ , Series 2	<0.4	<0.4	<0.4	0.7	<0.4	0.5	<0.4	<0.4	<0.4
NO ₃ , Series 3	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
PO ₄ , Series 1	11.7	11.0	13.0	8.4	7.1	8.7	6.9	5.7	4.0
PO ₄ , Series 2	10.3	11.1	12.9	8.7	6.8	8.3	7.6	4.9	4.2
PO ₄ , Series 3	9.9	11.4	13.3	7.9	7.3	8.6	7.0	4.9	4.6
SO ₄ , Series 1	2.3	1.4	1.5	2.1	0.5	2.4	0.7	1.1	1.1
SO ₄ , Series 2	2.6	1.4	1.5	2.1	0.5	2.3	0.7	1.0	1.2
SO ₄ , Series 3	3.3	1.5	1.6	2.0	0.6	2.5	0.7	1.2	1.4

(a) Asterisk indicates matrix interference.

Table A.4. (contd)

	WVDG-21	WVDG-22	WVDG-23	WVDG-24	WVDG-25	WVDG-26	WVDG-27	WVDG-28	WVDG-29
F, Series 1	<0.2	<0.2	<0.2*	<0.2*(a)	<0.2*	<0.2	<0.2	<0.2	<0.2*
F, Series 2	0.20	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
F, Series 3	<0.2*	<0.2*	<0.2*	<0.2*	<0.2	0.2*	<0.2*	0.2*	<0.2*
Cl, Series 1	0.20	0.2	0.2	0.2	0.2	<0.2	0.3	0.2	0.2
Cl, Series 2	<0.2	<0.2	0.3	<0.2	0.2	0.3	0.4	<0.2	<0.2
Cl, Series 3	0.2*	<0.2*	<0.2*	<0.2*	<0.2	<0.2*	0.3*	0.2*	0.3*
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.75*	<0.2	<0.2
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO ₃ , Series 1	<0.4	<0.4	<0.4	<0.4	0.6	<0.4	<0.4*	<0.4	<0.4
NO ₃ , Series 2	<0.4	1.0	0.5	0.5	0.6	<0.4	<0.4	<0.4	<0.4
NO ₃ , Series 3	<0.4	<0.4	<0.4	0.4	<0.4	<0.4	<0.4	<0.4	<0.4
PO ₄ , Series 1	11.60	3.0	7.3	6.0	7.0	6.7	8.8	3.9	17.5
PO ₄ , Series 2	11.10	3.0	7.0	4.7	7.0	3.7	10.0	4.3	16.9
PO ₄ , Series 3	10.10	3.0	6.6	4.5	7.4	3.6	8.6	4.6	18.7
SO ₄ , Series 1	0.07	1.6	0.6	0.6	0.5	0.5	1.5	1.5	0.7
SO ₄ , Series 2	0.70	1.6	0.6	0.6	0.5	0.6	1.7	1.6	0.7
SO ₄ , Series 3	0.70	1.7	0.7	0.6	0.5	0.6	1.6	1.6	0.7
	WVDG-30	WVDG-31B	WVDG-31C	WVDG-33	WVDG-34	WVDG-35	WVDG-36	WVDG-37	WVDG-38
F, Series 1	<0.2*	<0.2	<0.2*	<0.2	<0.2	<0.2*	<0.2	<0.2*	<0.2*
F, Series 2	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
F, Series 3	<0.2*	<0.2*	<0.2*	0.2*	<0.2*	<0.2*	<0.2*	<0.2*	0.3*
Cl, Series 1	0.2	0.2	0.2	0.2	0.4	0.2	0.3	0.2	0.2
Cl, Series 2	<0.2	<0.2	<0.2	<0.2	0.4	0.3	0.3	<0.2	<0.2
Cl, Series 3	0.2*	0.2	<0.2*	0.2*	0.4*	0.2*	<0.2*	0.2*	<0.2
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NO ₃ , Series 1	<0.4	<0.4	0.5	<0.4	0.4	<0.4	<0.4	0.4	<0.4
NO ₃ , Series 2	<0.4	0.9	<0.4	0.5	<0.4	0.4	<0.4	<0.4*	<0.4
NO ₃ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5	<0.4
PO ₄ , Series 1	7.7	10.2	10.4	12.7	13.5	4.3	1.8	2.7	6.2
PO ₄ , Series 2	6.4	26.6	10.6	14.2	11.8	4.4	2.0	2.7	2.3
PO ₄ , Series 3	6.8	11.1	9.9	13.3	11.4	4.3	2.0	2.6	1.8
SO ₄ , Series 1	1.1	1.3	1.7	0.9	3.3	0.9	1.7	2.3	1.7
SO ₄ , Series 2	1.6	<0.4	1.4	1.0	3.0	1.0	1.8	2.3	1.8
SO ₄ , Series 3	1.1	1.4	1.3	1.0	3.0	1.0	1.8	2.3	1.8

(a) Asterisk indicates matrix interference.

Table A.4. (contd)

	WVDG-39	WVDG-40	WVDG-41	WVDG-42	WVDG-43	WVDG-44	WVDG-45	WVDG-46	WVDG-47
F, Series 1	0.5	<0.2*(a)	<0.2*	<0.2	<0.2*	<0.2*	<0.2*	<0.2*	<0.2
F, Series 2	<0.2*	<0.2*	<0.4*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*	<0.2*
F, Series 3	<0.2	0.2	<0.2*	<0.2*	<0.2*	0.2*	not	0.2*	<0.2*
Cl, Series 1	0.2	0.3	0.9	0.3	0.2	<0.2*	0.2	0.4	0.2
Cl, Series 2	0.4	0.3	<0.2	0.3	<0.2	0.4	0.2	0.4	<0.2
Cl, Series 3	0.3	0.2	<0.2	0.3*	<0.2*	0.3*	analyzed	0.4*	<0.2*
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4		<0.4	<0.4
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.75*
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		<0.2	<0.2
NO ₃ , Series 1	<0.4	<0.4	1.3	<0.4	<0.4	<0.4	0.4	<0.4	0.4
NO ₃ , Series 2	0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.5
NO ₃ , Series 3	0.6	<0.4	<0.40.5	<0.4	<0.4		<0.4	<0.4	
PO ₄ , Series 1	19.9	3.4	31.6	33.4	5.9	2.8	28.3	2.8	14.6
PO ₄ , Series 2	20.0	3.7	29.5	31.6	5.1	2.8	26.6	3.1	14.2
PO ₄ , Series 3	21.8	4.1	29.5	32.1	4.4	2.7		2.9	14.4
SO ₄ , Series 1	0.6	0.8	0.7	3.6	0.4	0.9	0.8	0.6	0.5
SO ₄ , Series 2	0.6	0.8	0.7	3.6	1.2	0.7	0.9	0.8	0.5
SO ₄ , Series 3	0.5	0.9	0.6	3.7	0.4	0.7		0.6	<0.6
	WVDG-48	WVDG-49 (ARM-1)	WVDG-50 (ARM-1)	WVDG-51 (Blank)	WVDG-52 (Blank)				
F, Series 1	<0.2	<0.2*	<0.2	0.2	<0.2				
F, Series 2	<0.2*	<0.2*	<0.2	0.2	<0.2*				
F, Series 3	0.2*	0.2*	<0.2*	<0.2	0.2				
Cl, Series 1	0.2	0.3	0.3	<0.2	<0.2				
Cl, Series 2	<0.2	0.3	0.3	<0.2	<0.2				
Cl, Series 3	<0.2*	0.3*	<0.2*	<0.2	<0.2				
NO ₂ , Series 1	<0.4	<0.4	<0.4	<0.4	<0.4				
NO ₂ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4				
NO ₂ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4				
Br, Series 1	<0.2	<0.2	<0.2	<0.2	<0.5*				
Br, Series 2	<0.2	<0.2	<0.2	<0.2	<0.2				
Br, Series 3	<0.2	<0.2	<0.2	<0.2	<0.2				
NO ₃ , Series 1	<0.4	0.5	<0.4	<0.4	<0.4*				
NO ₃ , Series 2	<0.4	<0.4	<0.4	<0.4	<0.4				
NO ₃ , Series 3	<0.4	<0.4	<0.4	<0.4	<0.4				
PO ₄ , Series 1	6.7	2.7	2.3	<0.4	<0.4				
PO ₄ , Series 2	6.5	2.5	2.5	<0.4	<0.4				
PO ₄ , Series 3	6.1	2.3	2.3	<0.4	<0.4				
SO ₄ , Series 1	1.2	<0.4	<0.4	<0.4	<0.4				
SO ₄ , Series 2	1.2	<0.4	<0.4	<0.4	<0.4				
SO ₄ , Series 3	1.2	<0.4	<0.4	<0.4	<0.4				

(a) Asterisk indicates matrix interference.

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