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SLUDGE BATCH 5 VARIABILITY STUDY WITH FRIT 418

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September 2008

Environmental & Chemical Process Technology
Savannah River National Laboratory
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Prepared for the U.S. Department of Energy Under
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EXECUTIVE SUMMARY

The Defense Waste Processing Facility (DWPF) is preparing to initiate processing Sludge Batch 5 (SB5) in early FY 2009. In support of the upcoming processing, the Savannah River National Laboratory (SRNL) provided a recommendation to utilize Frit 418 as a transitional frit to initiate processing of SB5. This recommendation was based on the results of assessments on the compositional projections for SB5 available at that time from both the Liquid Waste Organization (LWO) and SRNL (using a model-based approach). To support qualification of the Frit 418-SB5 system, SRNL executed a variability study to assess the acceptability of the Frit 418-SB5 glasses with respect to durability and the applicability of the current durability models.

Twenty one glasses were selected for the variability study based on the available SB5 projections primarily spanning a waste loading (WL) range of 25-37%. In order to account for the addition of caustic to Tank 40, which occurred in July 2008, 3 wt% Na_2O was added to the original Tank 40 heel projections. The addition of the Actinide Removal Process (ARP) stream to the blend composition was also included. Two of the glasses were fabricated at 25% and 28% WL in order to challenge the homogeneity constraint of the Product Composition Control System (PCCS) for SB5 coupled operations. These twenty one glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD) and the Product Consistency Test (PCT).

The results of this study indicate that Frit 418 is a viable option for sludge-only and coupled operations. The addition of ARP did not have any negative impacts on the acceptability and predictability of the variability study glasses.

Based on the measured PCT response, all of the glasses were acceptable as compared to the Environmental Assessment (EA) reference glass regardless of the thermal history and were also predictable using the current PCCS model for durability.

The homogeneity constraint can be ignored for SB5 for coupled operations (based on the Appendix J compositional information), as both of the glasses targeting lower WLs (SB5VS-18 and SB5VS-19) had durabilities that were acceptable with respect to the reference EA glass.

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LIST OF ABBREVIATIONS

AD	Analytical Development
ARM	Approved Reference Material
ARP	Actinide Removal Process
bc	Bias Correction
B Del G_p	ΔG_p value for boron
ccc	Centerline Canister Cooling
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ID	Identification
LM	Lithium Metaborate
LWO	Liquid Waste Organization
MAR	Measure Acceptability Region
NL[B]	Normalized Leachate for Boron
NL[Li]	Normalized Leachate for Lithium
NL[Na]	Normalized Leachate for Sodium
NL[Si]	Normalized Leachate for Silicon
PCCS	Product Composition Control System
PCT	Product Consistency Test
PF	Sodium Peroxide Fusion
PSAL	Process Science Analytical Laboratory
SB5	Sludge Batch 5
SME	Slurry Mix Evaporator
SRAT	Sludge Receipt and Adjustment Tank
SRNL	Savannah River National Laboratory
T_L Pred	Liquidus Temperature Prediction
U_{std}	Uranium Standard
Visc Pred	Viscosity Prediction
WL	Waste Loading
XRD	X-ray Diffraction

1.0 Introduction

The Defense Waste Processing Facility (DWPF) is preparing to initiate processing Sludge Batch 5 (SB5) in early FY 2009. In support of the upcoming processing, the Savannah River National Laboratory (SRNL) provided a recommendation to utilize Frit 418[a] as a transitional frit to initiate processing of SB5.[1] This recommendation was based on the results of assessments on the compositional projections for SB5 available at that time from both the Liquid Waste Organization (LWO)[b] and SRNL (using a model-based approach).[c,d] It should be noted that further experimental testing is required to optimize a frit composition for melt rate as Frit 418 was primarily selected due to its robustness to compositional uncertainty of the blending and/or washing strategy for SB5.[e]

To support qualification of the Frit 418-SB5 system, SRNL executed a variability study to assess the acceptability of the Frit 418-SB5 glasses with respect to durability and the applicability of the current durability models. The experimental portion of the variability study was initiated by a DWPF Technical Task Request (TTR)[2] and was performed under a SRNL Task Technical and Quality Assurance Plan (TT&QAP).[3]

1.1 Glass Selection Strategy

For a complete discussion of the sludge projections see WSRC-STI-2008-00338.[1] Only a brief summary of those specific projections used to the support the variability study will be provided in this section.

The projections for the composition of SB5 documented in WSRC-STI-2008-00338 cover the various SB5 projections from LWO and SRNL modeling efforts.[1] These compositions were utilized in two ways for input to this variability study. The first approach utilized the sludge region bounded by the variation stage assessment discussed in WSRC-STI-2008-00338. This approach was used to select sludge compositions from the bounding region of SB5 compositional possibilities to demonstrate the robustness of the SB5-Frit 418 glass system to sludge variation. Specifically, the bounding intervals for sludge components developed in that report (presented in the report as Table 4-1) are repeated as Table 1 below. The "Others" component is used to represent a group of minor oxides that are handled collectively in the projected composition of SB5 (see WSRC-STI-2008-00338 for details). The intervals of Table 1 provided the basis for selecting 12 bounding compositions for SB5. The 12 sludge compositions were selected by employing the Coordinate Exchange algorithm that is available in the Custom Design platform of JMP™ Version 6.0.3.[4] Twelve is the minimum number of design points that could be selected from the region defined by Table 1 since the table defines 12 components (including "Others") that are required to fully identify a sludge composition. The SB5 centroid composition (average of the bounding sludge compositions) was also utilized in the variability study. The 12 bounding compositions and the SB5 centroid were combined with Frit 418 at a 34% WL (Table 2).[f]

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[a] $8B_2O_3$-$8Li_2O$-$8Na_2O$-$76SiO_2$ (wt%)

[b] The most recent SB5 composition projections (those used in this study) were received from LWO via email from D. D. Larsen on June 5, 2008. Washing data used to calculate a SO_4^{2-} concentration were included in a spreadsheet attached to the email, titled 'SB4-5_060408_For Variability Study Comparison.xls.xlsm'. See WSRC-NB-2007-00003 for further detail.

[c] The composition projections developed by SRNL and used in this study were received via email from A. S. Choi on June 12, 2008. See WSRC-NB-2007-00003 for further detail.

[d] For further information on the SRNL model-based approach, see Choi, A. S., "Aluminum Dissolution Flowsheet Modeling in Support of SB5 Frit Development," Savannah River National Laboratory, Aiken, SC, Report No. WSRC-STI-2008-00001, Rev. 0, 2008.

[e] Based on recent melt rate information, Frit 550 ($12B_2O_3$-$8Li_2O$-$7Na_2O$-$73SiO_2$ [wt%]) has been identified as a primary candidate for potentially increasing the melt rate of SB5 (relative to the Frit 418 based system). Slurry fed melt rate testing is planned in the October-November 2008 timeframe with both Frit 418 and Frit 550. If DWPF elects to utilize Frit 550 based on the melt rate data, a supplemental variability study would be required.

[f] 34% WL is the nominal target for SB5 processing.

Table 1. SB5 Bounding Concentration Intervals

Oxide	Minimum (wt%)	Maximum (wt%)
Al_2O_3	18.977	24.211
CaO	1.840	3.119
Fe_2O_3	25.292	32.814
MgO	1.024	2.250
MnO	5.299	6.877
Na_2O	19.332	29.245
NiO	2.377	3.820
SO_4	0.310	0.857
SiO_2	1.649	3.056
TiO_2	0.000	1.815
U_3O_8	7.302	9.505
Others	0.284	1.284

Two of the nominal compositions from WSRC-STI-2008-00338 (BS-07 [3 wt% Na_2O addition to the Tank 40 heel] and BS-15 [3 wt% Na_2O addition to the Tank 40 heel and the addition of the Actinide Removal Process (ARP) stream])[g] were combined with Frit 418 at various WLs to complete the selection of glasses for this variability study (Table 3).[h] These two SB5 projections were based only on SRNL projections, as they more closely represented the composition of the SB5 qualification sample.[5] Each of these nominal sludge compositions was combined with Frit 418 at WLs of 31%, 34%, and 37% to demonstrate the operating windows for these glass systems. In addition, the BS-15 projection was combined with Frit 418 at WLs of 25% and 28% to intentionally challenge the homogeneity constraint for this SB5 projection as a coupled-operations flowsheet.[6]

A total of twenty one glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD) and the Product Consistency Test (PCT).

[g] BS-07 and BS-15 are based on the SB5 blend projection, which is composed of a mass ratio of 25:75 (Tank 40 heel to the Tank 51 SB5 batch). Compositional information for ARP additions was obtained from Appendix J of S.G. Subosits, "Actinide Removal Process Material Balance Calculation with Low Curie Salt Feed," *X-CLC-S-00113, Rev. 0*, September 24, 2004.

[h] See the Measurement Acceptability Region (MAR) results for the nominal stage assessment provided in WSRC-STI-2008-00338 for details of the projected operating windows for the BS-07 and BS-15 options with Frit 418.

Table 2. Twelve Bounding SB5 Sludge Compositions and the Centroid

Type	Al_2O_3	CaO	Fe_2O_3	MgO	MnO	Na_2O	NiO	SO_4	SiO_2	TiO_2	U_3O_8	Others
Bounding	18.977	1.84	32.4	1.024	6.572	23.63	2.377	0.857	2.924	1.813	7.302	0.284
Bounding	24.085	1.84	25.292	2.223	5.299	25.682	3.674	0.857	1.649	1.813	7.302	0.284
Bounding	18.977	3.016	32.4	2.223	5.299	19.922	3.674	0.38	2.924	1.813	9.088	0.284
Bounding	18.977	3.016	25.292	1.024	6.572	29.016	3.674	0.38	1.649	1.813	7.302	1.284
Bounding	24.085	3.016	32.33	2.223	6.572	19.781	2.377	0.38	1.649	0	7.302	0.284
Bounding	24.085	3.016	25.292	1.024	6.572	23.184	3.674	0.857	2.924	0	9.088	0.284
Bounding	18.977	3.016	26.496	2.223	5.299	29.245	2.377	0.857	2.924	0	7.302	1.284
Bounding	24.085	1.84	32.4	1.024	5.299	19.788	3.674	0.38	2.924	0	7.302	1.284
Bounding	24.085	1.84	25.292	2.223	6.572	22.122	2.377	0.38	2.924	1.813	9.088	1.284
Bounding	24.085	3.016	29.726	1.024	5.299	19.781	2.377	0.857	1.649	1.813	9.088	1.284
Bounding	18.977	1.84	32.4	2.223	6.572	21.435	3.674	0.857	1.649	0	9.088	1.284
Bounding	18.977	1.84	29.836	1.024	5.299	29.245	2.377	0.38	1.649	0	9.088	0.284
SB5 Centroid	21.266	2.425	28.713	1.621	5.93	24.248	3.019	0.619	2.281	0.901	8.191	0.785

Table 3. Nominal Compositions of BS-07 and BS-15

Sludge ID	SB5 blend + 3 wt% Na_2O (BS-07)	SB5 blend + 3 wt% Na_2O + ARP (BS-15)
Al_2O_3	21.915	21.127
BaO	0.142	0.139
CaO	2.465	2.391
CdO	0.098	0.093
Ce_2O_3	0.016	0.024
Cr_2O_3	0.102	0.102
CuO	0.025	0.026
Fe_2O_3	29.632	28.752
K_2O	0.13	0.129
La_2O_3	0.012	0.015
Li_2O	0.013	0.013
MgO	1.62	1.544
MnO	6.018	5.943
Na_2O	22.753	23.596
NiO	3.159	3.068
P_2O_5	0.332	0.318
PbO	0.013	0.018
SO_4	0.621	0.732
SiO_2	2.227	2.149
TiO_2	0.01	1.307
U_3O_8	8.329	8.072
ZnO	0.01	0.014
ZrO_2	0.148	0.15

2.0 Objectives

The objective of the experimental portion of the variability study was to demonstrate that the glasses of the Frit 418-SB5 compositional region had chemical durabilities that were both acceptable relative to the Environmental Assessment (EA) reference glass and predictable by the current process control models for durability.

3.0 Experimental Procedures

3.1 Target Glass Compositions

Target glass compositions of the twenty one SB5 variability study glasses are presented in Table 4. The nomenclature for the glass identification (ID) can be described as follows: "SB5VS" refers to Sludge Batch 5 Variability Study.

3.2 Glass Fabrication

Each variability study glass was prepared from the proper proportions of reagent-grade metal oxides, carbonates, H_3BO_3, and salts in 150 g batches.[7] The raw materials were thoroughly mixed and placed into a platinum alloy, 250 ml crucible. Batched materials were placed into a high-temperature furnace at the target melt temperature of 1150°C. The crucible was removed from the furnace after an isothermal hold at 1150°C for 1 hour. The molten glass was quenched by pouring the liquid onto a clean, stainless steel plate. The glass pour patty was used as a sampling stock for the various property measurements (i.e., chemical composition, durability testing and XRD).

Approximately 25 g of each glass was heat-treated to simulate cooling along the centerline of a DWPF-type canister to gauge the effects of thermal history on the product performance.[8] This cooling schedule is referred to as the centerline canister cooling (ccc) curve.

3.3 Property Measurements

3.3.1 Compositional Analysis

To confirm that the as-fabricated glasses met the target compositions, a representative sample from each glass was submitted to Analytical Development (AD) for chemical analysis under the auspices of an analytical plan (SRNL-SCS-2008-00071).[9] Two dissolution methods were utilized in measuring these chemical compositions: lithium metaborate fusion (LM) and sodium peroxide fusion (PF). For each study glass, measurements were obtained from samples prepared in duplicate by each of these dissolution methods. All of the prepared samples were analyzed (twice for each element of interest) by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES) with the instrumentation being re-calibrated between the duplicate analyses. The analytical plan was developed in such a way as to provide the opportunity to evaluate potential sources of bias and error. Glass standards were also intermittently measured to assess the performance of the ICP-AES instrument over the course of these analyses.

Table 4. Target Glass Compositions (wt%)

Glass ID	Bounding Compositions												Centroid
	SB5VS-01	SB5VS-02	SB5VS-03	SB5VS-04	SB5VS-05	SB5VS-06	SB5VS-07	SB5VS-08	SB5VS-09	SB5VS-10	SB5VS-11	SB5VS-12	SB5VS-13
	34% WL												
Al_2O_3	6.452	8.189	6.452	6.452	8.189	8.189	6.452	8.189	8.189	8.189	6.452	6.452	7.230
B_2O_3	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280	5.280
BaO	0.010	0.010	0.010	0.045	0.010	0.010	0.045	0.045	0.045	0.045	0.045	0.010	0.027
CaO	0.626	0.626	1.026	1.026	1.026	1.026	1.026	0.626	0.626	1.026	0.626	0.626	0.825
CdO	0.006	0.006	0.006	0.029	0.006	0.006	0.029	0.029	0.029	0.029	0.029	0.006	0.018
Ce_2O_3	0.003	0.003	0.003	0.012	0.003	0.003	0.012	0.012	0.012	0.012	0.012	0.003	0.008
Cr_2O_3	0.009	0.009	0.009	0.042	0.009	0.009	0.042	0.042	0.042	0.042	0.042	0.009	0.026
CuO	0.003	0.003	0.003	0.012	0.003	0.003	0.012	0.012	0.012	0.012	0.012	0.003	0.008
Fe_2O_3	11.016	8.599	11.016	8.599	10.992	8.599	9.009	11.016	8.599	10.107	11.016	10.144	9.762
K_2O	0.010	0.010	0.010	0.045	0.010	0.010	0.045	0.045	0.045	0.045	0.045	0.010	0.028
La_2O_3	0.002	0.002	0.002	0.009	0.002	0.002	0.009	0.009	0.009	0.009	0.009	0.002	0.005
Li_2O	5.281	5.281	5.281	5.284	5.281	5.281	5.284	5.284	5.284	5.284	5.284	5.281	5.282
MgO	0.348	0.756	0.756	0.348	0.756	0.348	0.756	0.348	0.756	0.348	0.756	0.348	0.551
MnO	2.234	1.802	1.802	2.234	2.234	2.234	1.802	1.802	2.234	1.802	2.234	1.802	2.016
Na_2O	13.314	14.012	12.053	15.145	12.006	13.163	15.223	12.008	12.801	12.006	12.568	15.223	13.524
NiO	0.808	1.249	1.249	1.249	0.808	1.249	0.808	1.249	0.808	0.808	1.249	0.808	1.027
P_2O_5	0.029	0.029	0.029	0.131	0.029	0.029	0.131	0.131	0.131	0.131	0.131	0.029	0.080
PbO	0.002	0.002	0.002	0.010	0.002	0.002	0.010	0.010	0.010	0.010	0.010	0.002	0.006
SO_4	0.291	0.291	0.129	0.129	0.129	0.291	0.291	0.129	0.129	0.291	0.291	0.129	0.211
SiO_2	51.154	50.721	51.154	50.721	50.721	51.154	51.154	51.154	51.154	50.721	50.721	50.721	50.936
TiO_2	0.616	0.616	0.616	0.616	0.000	0.000	0.000	0.000	0.616	0.616	0.000	0.000	0.306
U_3O_8	2.483	2.483	3.090	2.483	2.483	3.090	2.483	2.483	3.090	3.090	3.090	3.090	2.785
ZnO	0.001	0.001	0.001	0.004	0.001	0.001	0.004	0.004	0.004	0.004	0.004	0.001	0.002
ZrO_2	0.011	0.011	0.011	0.048	0.011	0.011	0.048	0.048	0.048	0.048	0.048	0.011	0.029

Table 2 cont. Target Glass Compositions (wt%)[i]

Glass ID	BS-07 (3 wt% Na_2O)	BS-15 (3 wt% Na_2O + ARP)	BS-07 (3 wt% Na_2O)	BS-07 (3 wt% Na_2O)	BS-15 (3 wt% Na_2O + ARP)	BS-15 (3 wt% Na_2O + ARP)	BS-15 (3 wt% Na_2O + ARP)	BS-15 (3 wt% Na_2O + ARP)
	SB5VS-14	SB5VS-15	SB5VS-16	SB5VS-17	SB5VS-18	SB5VS-19	SB5VS-20	SB5VS-21
	34% WL	34% WL	31% WL	37% WL	25% WL	28% WL	31% WL	37% WL
Al_2O_3	7.451	7.183	6.794	8.109	5.282	5.916	6.549	7.817
B_2O_3	5.280	5.280	5.520	5.040	6.000	5.760	5.520	5.040
BaO	0.048	0.047	0.044	0.053	0.035	0.039	0.043	0.051
CaO	0.838	0.813	0.764	0.912	0.598	0.669	0.741	0.885
CdO	0.033	0.032	0.030	0.036	0.023	0.026	0.029	0.034
Ce_2O_3	0.005	0.008	0.005	0.006	0.006	0.007	0.007	0.009
Cr_2O_3	0.035	0.035	0.032	0.038	0.026	0.029	0.032	0.038
CuO	0.009	0.009	0.008	0.009	0.007	0.007	0.008	0.010
Fe_2O_3	10.075	9.776	9.186	10.964	7.188	8.051	8.913	10.638
K_2O	0.044	0.044	0.040	0.048	0.032	0.036	0.040	0.048
La_2O_3	0.004	0.005	0.004	0.004	0.004	0.004	0.005	0.006
Li_2O	5.280	5.280	5.520	5.040	6.000	5.760	5.520	5.040
MgO	0.551	0.525	0.502	0.599	0.386	0.432	0.479	0.571
MnO	2.046	2.021	1.866	2.227	1.486	1.664	1.842	2.199
Na_2O	13.016	13.303	12.573	13.459	11.899	12.367	12.835	13.771
NiO	1.074	1.043	0.979	1.169	0.767	0.859	0.951	1.135
P_2O_5	0.151	0.145	0.138	0.164	0.106	0.119	0.132	0.157
PbO	0.004	0.006	0.004	0.005	0.005	0.005	0.006	0.007
SO_4	0.211	0.249	0.192	0.230	0.183	0.205	0.227	0.271
SiO_2	50.917	50.891	53.130	48.704	57.537	55.322	53.106	48.675
TiO_2	0.003	0.444	0.003	0.004	0.327	0.366	0.405	0.484
U_3O_8	2.832	2.744	2.582	3.082	2.018	2.260	2.502	2.987
ZnO	0.003	0.005	0.003	0.004	0.004	0.004	0.004	0.005
ZrO_2	0.050	0.051	0.046	0.055	0.038	0.042	0.047	0.056

[i] The BS-15 compositions are shaded.

3.3.2 XRD

Representative samples of quenched and ccc glasses were submitted to AD for XRD analysis. Samples were analyzed under conditions providing a detection limit of approximately 0.5 vol%, i.e. no crystals can be detected if the amount in the sample is less than ~0.5 vol%.

3.3.3 PCT

The PCT was performed in triplicate on each quenched and ccc glass to assess chemical durability using Method A of the procedure.[10] Also included in the experimental test matrix was the EA glass, the Approved Reference Material (ARM) glass, and blanks from the sample cleaning batch. Samples were ground, washed, and prepared according to the standard procedure. The resulting solutions were sampled (filtered and acidified) and analyzed by AD under the auspices of two analytical plans.[11,12] Samples of a multi-element, standard solution were also included in the analytical plan (as a check on the accuracy of the ICP-AES instrument). Normalized release rates were calculated based on the compositions of different compositional views using the average of the leachate concentrations.

4.0 Results and Discussion

4.1 Chemical Composition Measurements

In this section, a high-level review of the statistical analysis of the chemical composition data is provided. For a detailed discussion of the statistical analyses of the chemical composition data, the reader is referred to SRNL-L3100-2008-00012.[13] The average composition for each compositional view (target, measured and measured bias corrected [bc]) are shown in Table 5 at the end of this report. Also included in the table are the relative differences between the measured or bias-corrected values and the target values. These differences are shaded when they are greater than or equal to 5%. The results of the Batch 1 and uranium standard glass are included for reference.

The Fe_2O_3 values for the variability study glasses were consistently lower than the target values, while the values of the standard glasses were close to the reference concentrations. The range of the difference between the target and measured values was 1.6 to 11.8%. These results suggest a possible batching and/or fabrication issue for the Fe_2O_3 content of the glasses. There was also scatter in the measured SiO_2 values (difference of 0-6.4%) in both the study glasses and standards, which may be due to analytical issues (i.e., dissolution technique and/or ICP-AES performance). The sum of oxides for each glass, except SB5VS-04, was within the interval of 95 to 105 wt%. It should be noted that the oxide sum for SB5VS-04 was just below 95%. A review of the data reveals that the measured SiO_2 value for this glass is well below the target concentration, resulting in a much lower sum of oxides than expected. Although there were minor composition irregularities, the compositional analyses did not indicate any significant issues with the study glasses that would affect the conclusions drawn from this study.

4.2 XRD

Each of the quenched glasses was amorphous (within the detection limit of the instrument [0.5 vol%]). A majority of the ccc samples contained visual evidence of surface crystals, but crystallization was not observed in any of the XRD patterns. Since the surface is only a small fraction of the sample and sampling for XRD is random, it is probable that the crystalline content was much below the detection

limit of the instrument. A representative XRD pattern[j] of an amorphous quenched and ccc sample is shown in Figure 1.

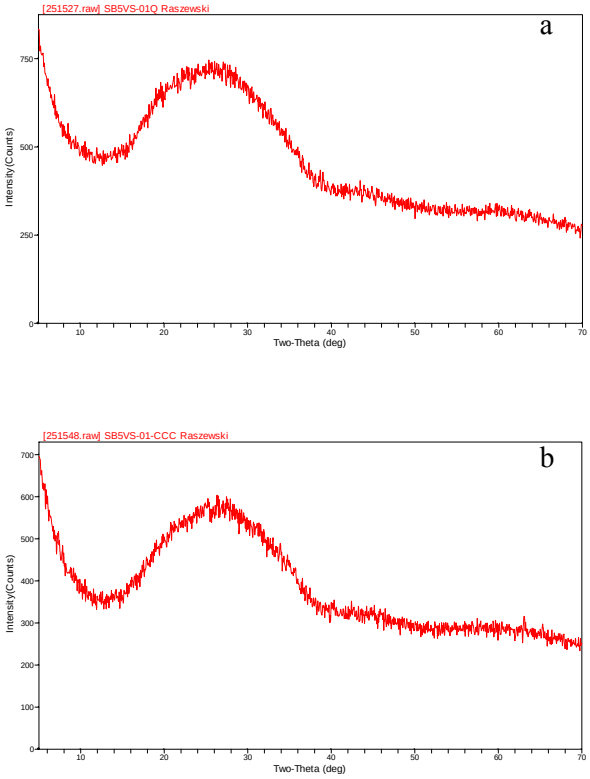

Figure 1. A representative XRD pattern for an amorphous quenched (a) and ccc (b) sample.

4.3 PCT

As with the chemical composition information, this section will only provide a high-level review of the durability data. For a complete discussion of the statistical analyses of the PCT data see SRNL-L3100-2008-00012.[13] Normalized PCT data are shown in Table 6 at the end of this report. AE and ARM results are included for reference.

The normalized boron release (NL [B (g/L)] was in the range of 0.63-0.97 g/L for the quenched glasses and 0.62-0.98 g/L for the ccc glasses (regardless of compositional view). There was no indication of a dramatic heat treatment impact for any of the SB5 VS glasses. The PCTs for all of the glasses, even those glasses that were chosen to challenge the homogeneity constraint (SB5VS-18 and SB5VS-19), were acceptable based upon comparisons to the EA glass (16.695 g/L) for all compositional views. The glasses are also predictable with respect to the durability models as shown in Figure 2. The points plotted in the figure cover all compositional views as well as both heat treatments, which are within the 95% confidence interval. EA and ARM results are also indicated on the plot for reference. The small cluster of points closer to the edge of the confidence band was generated by bounding sludge compositions that led to

[j] The remainder of the XRD patterns (quenched and ccc) can be viewed in the laboratory notebook for the SB5 variability study on pages 30-33 (WSRC-NB-2007-00002).

glasses with more negative B del G_p values than the other glasses.[k]

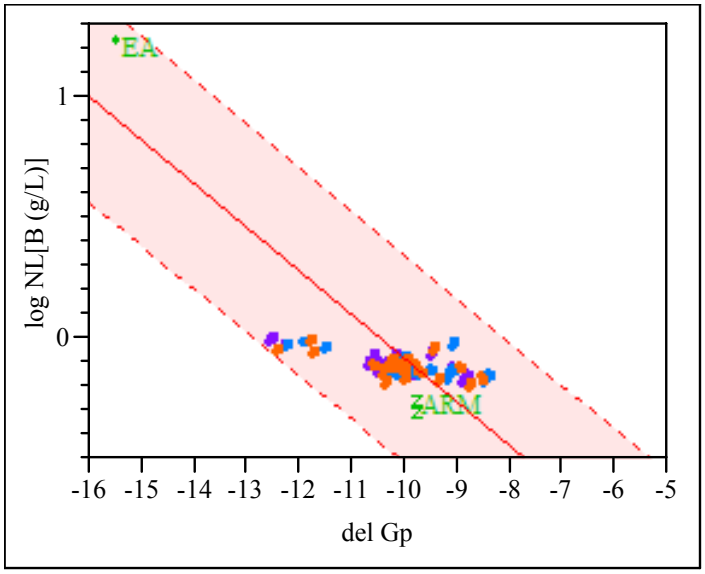

Figure 2. log NL[B (g/L)] versus del G_p (ΔG_p) model with a 95% confidence interval for individual PCTs.

5.0 Conclusions

Frit 418 is a viable option for the processing of SB5 for both sludge-only and coupled operations. The addition of ARP did not have any negative impacts on the acceptability and predictability of the variability study glasses.

Based on the measured PCT response, all of the glasses are acceptable as compared to the Environmental Assessment (EA) reference glass regardless of the thermal history and predictable using the current PCCS model for durability.

The homogeneity constraint can be ignored for SB5 for coupled operations (based on the Appendix J compositional information), as both of the glasses (SB5VS-18 and SB5VS-19) had durabilities that were acceptable with respect to the reference EA glass.

6.0 Acknowledgements

The authors would like to thank AD, David Best, Holly Hall, Irene Reamer and Pat Simmons for support on this task.

[k] Specifically these glasses are SB5VS-04, SB5VS-07 and SB5VS-12, which were predicted to have B del G_P values of -12.506, -12.551 and -12.280, respectively. See Display 2 of SRNL-L3100-2008-00012 for more details.

Table 5. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
1	SB5VS-01	Al2O3 (wt%)	6.4337	6.5207	6.4522	-0.0185	0.0684	-0.3%	1.1%
1	SB5VS-01	B2O3 (wt%)	5.4175	5.6550	5.2800	0.1375	0.3750	2.6%	7.1%
1	SB5VS-01	BaO (wt%)	0.0106	0.0103	0.0099	0.0007	0.0004	7.0%	3.6%
1	SB5VS-01	CaO (wt%)	0.6076	0.6111	0.6256	-0.0180	-0.0146	-2.9%	-2.3%
1	SB5VS-01	CdO (wt%)	0.0057	0.0057	0.0064	-0.0007	-0.0007	-10.8%	-10.8%
1	SB5VS-01	Ce2O3 (wt%)	0.0205	0.0205	0.0027	0.0178	0.0178	648.4%	648.4%
1	SB5VS-01	Cr2O3 (wt%)	0.0091	0.0090	0.0094	-0.0003	-0.0004	-2.9%	-4.6%
1	SB5VS-01	CuO (wt%)	0.0113	0.0112	0.0027	0.0085	0.0085	312.1%	310.7%
1	SB5VS-01	Fe2O3 (wt%)	10.6012	10.6336	11.0159	-0.4147	-0.3823	-3.8%	-3.5%
1	SB5VS-01	K2O (wt%)	0.0205	0.0202	0.0100	0.0105	0.0102	105.1%	102.1%
1	SB5VS-01	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
1	SB5VS-01	Li2O (wt%)	4.7310	5.3037	5.2810	-0.5500	0.0227	-10.4%	0.4%
1	SB5VS-01	MgO (wt%)	0.3540	0.3412	0.3483	0.0057	-0.0071	1.6%	-2.0%
1	SB5VS-01	MnO (wt%)	2.2144	2.2119	2.2344	-0.0200	-0.0225	-0.9%	-1.0%
1	SB5VS-01	Na2O (wt%)	13.3856	13.2278	13.3141	0.0716	-0.0863	0.5%	-0.6%
1	SB5VS-01	NiO (wt%)	0.7670	0.7536	0.8081	-0.0411	-0.0545	-5.1%	-6.7%
1	SB5VS-01	P2O5 (wt%)	0.0206	0.0206	0.0290	-0.0083	-0.0083	-28.8%	-28.8%
1	SB5VS-01	PbO (wt%)	0.0073	0.0073	0.0022	0.0050	0.0050	226.5%	226.5%
1	SB5VS-01	SiO2 (wt%)	50.8084	50.5041	51.1540	-0.3456	-0.6499	-0.7%	-1.3%
1	SB5VS-01	SO4 (wt%)	0.3161	0.3161	0.2913	0.0247	0.0247	8.5%	8.5%
1	SB5VS-01	TiO2 (wt%)	0.5996	0.5884	0.6164	-0.0168	-0.0280	-2.7%	-4.5%
1	SB5VS-01	U3O8 (wt%)	2.3613	2.4210	2.4828	-0.1215	-0.0618	-4.9%	-2.5%
1	SB5VS-01	ZnO (wt%)	0.0084	0.0084	0.0008	0.0076	0.0076	902.7%	902.7%
1	SB5VS-01	ZrO2 (wt%)	0.0172	0.0172	0.0107	0.0066	0.0066	61.5%	61.5%
1	SB5VS-01	Sum	98.7289	99.2186	99.9901	-1.2612	-0.7715	-1.3%	-0.8%
2	SB5VS-02	Al2O3 (wt%)	7.8036	7.8834	8.1889	-0.3852	-0.3055	-4.7%	-3.7%
2	SB5VS-02	B2O3 (wt%)	5.4658	5.3960	5.2800	0.1858	0.1160	3.5%	2.2%
2	SB5VS-02	BaO (wt%)	0.0106	0.0101	0.0099	0.0007	0.0002	7.0%	2.0%
2	SB5VS-02	CaO (wt%)	0.5975	0.5960	0.6256	-0.0282	-0.0296	-4.5%	-4.7%
2	SB5VS-02	CdO (wt%)	0.0051	0.0051	0.0064	-0.0013	-0.0013	-19.7%	-19.7%
2	SB5VS-02	Ce2O3 (wt%)	0.0234	0.0234	0.0027	0.0207	0.0207	755.3%	755.3%
2	SB5VS-02	Cr2O3 (wt%)	0.0102	0.0097	0.0094	0.0008	0.0003	8.8%	2.8%
2	SB5VS-02	CuO (wt%)	0.0119	0.0115	0.0027	0.0092	0.0088	335.0%	321.6%
2	SB5VS-02	Fe2O3 (wt%)	8.0135	7.9532	8.5992	-0.5857	-0.6461	-6.8%	-7.5%
2	SB5VS-02	K2O (wt%)	0.0145	0.0144	0.0100	0.0045	0.0044	44.8%	44.1%
2	SB5VS-02	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
2	SB5VS-02	Li2O (wt%)	5.0001	5.4506	5.2810	-0.2809	0.1696	-5.3%	3.2%
2	SB5VS-02	MgO (wt%)	0.7392	0.7215	0.7559	-0.0167	-0.0344	-2.2%	-4.6%
2	SB5VS-02	MnO (wt%)	1.7560	1.7133	1.8016	-0.0456	-0.0883	-2.5%	-4.9%
2	SB5VS-02	Na2O (wt%)	13.3418	13.0051	14.0118	-0.6699	-1.0067	-4.8%	-7.2%
2	SB5VS-02	NiO (wt%)	1.1618	1.1116	1.2490	-0.0872	-0.1374	-7.0%	-11.0%
2	SB5VS-02	P2O5 (wt%)	0.0203	0.0203	0.0290	-0.0086	-0.0086	-29.9%	-29.9%
2	SB5VS-02	PbO (wt%)	0.0073	0.0073	0.0022	0.0050	0.0050	226.5%	226.5%
2	SB5VS-02	SiO2 (wt%)	47.9738	50.1351	50.7210	-2.7472	-0.5859	-5.4%	-1.2%
2	SB5VS-02	SO4 (wt%)	0.2876	0.2876	0.2913	-0.0037	-0.0037	-1.3%	-1.3%
2	SB5VS-02	TiO2 (wt%)	0.5971	0.5850	0.6164	-0.0193	-0.0314	-3.1%	-5.1%
2	SB5VS-02	U3O8 (wt%)	2.2670	2.3283	2.4828	-0.2158	-0.1545	-8.7%	-6.2%
2	SB5VS-02	ZnO (wt%)	0.0115	0.0115	0.0008	0.0107	0.0107	1274.0%	1274.0%
2	SB5VS-02	ZrO2 (wt%)	0.0149	0.0149	0.0107	0.0042	0.0042	39.3%	39.3%
2	SB5VS-02	Sum	95.1347	97.2949	99.9904	-4.8557	-2.6955	-4.9%	-2.7%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
3	SB5VS-03	Al2O3 (wt%)	6.3582	6.4442	6.4522	-0.0941	-0.0081	-1.5%	-0.1%
3	SB5VS-03	B2O3 (wt%)	4.8138	5.0260	5.2800	-0.4662	-0.2540	-8.8%	-4.8%
3	SB5VS-03	BaO (wt%)	0.0100	0.0097	0.0099	0.0001	-0.0002	1.3%	-1.9%
3	SB5VS-03	CaO (wt%)	1.0004	1.0061	1.0255	-0.0251	-0.0194	-2.4%	-1.9%
3	SB5VS-03	CdO (wt%)	0.0046	0.0046	0.0064	-0.0018	-0.0018	-28.7%	-28.7%
3	SB5VS-03	Ce2O3 (wt%)	0.0243	0.0243	0.0027	0.0216	0.0216	787.3%	787.3%
3	SB5VS-03	Cr2O3 (wt%)	0.0117	0.0115	0.0094	0.0023	0.0021	24.3%	22.2%
3	SB5VS-03	CuO (wt%)	0.0128	0.0128	0.0027	0.0101	0.0101	369.3%	367.7%
3	SB5VS-03	Fe2O3 (wt%)	10.5655	10.5971	11.0159	-0.4504	-0.4188	-4.1%	-3.8%
3	SB5VS-03	K2O (wt%)	0.0169	0.0166	0.0100	0.0069	0.0066	68.9%	66.4%
3	SB5VS-03	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
3	SB5VS-03	Li2O (wt%)	4.6610	5.2260	5.2810	-0.6200	-0.0550	-11.7%	-1.0%
3	SB5VS-03	MgO (wt%)	0.7802	0.7519	0.7559	0.0243	-0.0040	3.2%	-0.5%
3	SB5VS-03	MnO (wt%)	1.7657	1.7636	1.8016	-0.0359	-0.0380	-2.0%	-2.1%
3	SB5VS-03	Na2O (wt%)	11.9332	11.7927	12.0533	-0.1202	-0.2606	-1.0%	-2.2%
3	SB5VS-03	NiO (wt%)	1.1834	1.1628	1.2490	-0.0656	-0.0862	-5.3%	-6.9%
3	SB5VS-03	P2O5 (wt%)	0.0206	0.0206	0.0290	-0.0083	-0.0083	-28.8%	-28.8%
3	SB5VS-03	PbO (wt%)	0.0083	0.0083	0.0022	0.0061	0.0061	274.9%	274.9%
3	SB5VS-03	SiO2 (wt%)	48.1877	47.9051	51.1540	-2.9663	-3.2489	-5.8%	-6.4%
3	SB5VS-03	SO4 (wt%)	0.1753	0.1753	0.1293	0.0460	0.0460	35.6%	35.6%
3	SB5VS-03	TiO2 (wt%)	0.6205	0.6088	0.6164	0.0041	-0.0076	0.7%	-1.2%
3	SB5VS-03	U3O8 (wt%)	2.9008	2.9743	3.0900	-0.1892	-0.1157	-6.1%	-3.7%
3	SB5VS-03	ZnO (wt%)	0.0096	0.0096	0.0008	0.0088	0.0088	1051.2%	1051.2%
3	SB5VS-03	ZrO2 (wt%)	0.0155	0.0155	0.0107	0.0049	0.0049	45.7%	45.7%
3	SB5VS-03	Sum	95.0803	95.5677	99.9901	-4.9098	-4.4224	-4.9%	-4.4%
4	SB5VS-04	Al2O3 (wt%)	6.2165	6.2800	6.4522	-0.2358	-0.1723	-3.7%	-2.7%
4	SB5VS-04	B2O3 (wt%)	5.4577	5.3885	5.2800	0.1777	0.1085	3.4%	2.1%
4	SB5VS-04	BaO (wt%)	0.0449	0.0429	0.0448	0.0002	-0.0019	0.4%	-4.3%
4	SB5VS-04	CaO (wt%)	0.9899	0.9876	1.0255	-0.0356	-0.0380	-3.5%	-3.7%
4	SB5VS-04	CdO (wt%)	0.0257	0.0257	0.0289	-0.0032	-0.0032	-11.1%	-11.1%
4	SB5VS-04	Ce2O3 (wt%)	0.0293	0.0293	0.0124	0.0169	0.0169	136.7%	136.7%
4	SB5VS-04	Cr2O3 (wt%)	0.0420	0.0397	0.0425	-0.0005	-0.0028	-1.1%	-6.6%
4	SB5VS-04	CuO (wt%)	0.0194	0.0188	0.0123	0.0071	0.0065	57.2%	52.3%
4	SB5VS-04	Fe2O3 (wt%)	8.1171	8.0560	8.5992	-0.4821	-0.5432	-5.6%	-6.3%
4	SB5VS-04	K2O (wt%)	0.0458	0.0456	0.0451	0.0007	0.0005	1.5%	1.0%
4	SB5VS-04	La2O3 (wt%)	0.0029	0.0029	0.0089	-0.0060	-0.0060	-67.2%	-67.2%
4	SB5VS-04	Li2O (wt%)	4.8440	5.2825	5.2840	-0.4400	-0.0015	-8.3%	0.0%
4	SB5VS-04	MgO (wt%)	0.3441	0.3359	0.3483	-0.0042	-0.0125	-1.2%	-3.6%
4	SB5VS-04	MnO (wt%)	2.1692	2.1168	2.2344	-0.0652	-0.1176	-2.9%	-5.3%
4	SB5VS-04	Na2O (wt%)	14.4910	14.1253	15.1453	-0.6543	-1.0201	-4.3%	-6.7%
4	SB5VS-04	NiO (wt%)	1.2047	1.1527	1.2490	-0.0443	-0.0963	-3.5%	-7.7%
4	SB5VS-04	P2O5 (wt%)	0.0481	0.0481	0.1308	-0.0826	-0.0826	-63.2%	-63.2%
4	SB5VS-04	PbO (wt%)	0.0127	0.0127	0.0101	0.0026	0.0026	25.9%	25.9%
4	SB5VS-04	SiO2 (wt%)	47.3855	49.5195	50.7210	-3.3355	-1.2015	-6.6%	-2.4%
4	SB5VS-04	SO4 (wt%)	0.1850	0.1850	0.1293	0.0557	0.0557	43.1%	43.1%
4	SB5VS-04	TiO2 (wt%)	0.6101	0.5976	0.6164	-0.0063	-0.0188	-1.0%	-3.0%
4	SB5VS-04	U3O8 (wt%)	2.3142	2.3767	2.4828	-0.1686	-0.1062	-6.8%	-4.3%
4	SB5VS-04	ZnO (wt%)	0.0106	0.0106	0.0038	0.0068	0.0068	179.5%	179.5%
4	SB5VS-04	ZrO2 (wt%)	0.0486	0.0486	0.0482	0.0005	0.0005	1.0%	1.0%
4	SB5VS-04	Sum	94.6591	96.7289	99.9552	-5.2961	-3.2264	-5.3%	-3.2%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
5	SB5VS-05	Al2O3 (wt%)	7.9359	8.0170	8.1889	-0.2530	-0.1718	-3.1%	-2.1%
5	SB5VS-05	B2O3 (wt%)	5.3611	5.2923	5.2800	0.0811	0.0123	1.5%	0.2%
5	SB5VS-05	BaO (wt%)	0.0100	0.0096	0.0099	0.0001	-0.0003	1.3%	-3.4%
5	SB5VS-05	CaO (wt%)	1.0036	1.0012	1.0255	-0.0220	-0.0243	-2.1%	-2.4%
5	SB5VS-05	CdO (wt%)	0.0051	0.0051	0.0064	-0.0013	-0.0013	-19.7%	-19.7%
5	SB5VS-05	Ce2O3 (wt%)	0.0193	0.0193	0.0027	0.0166	0.0166	605.6%	605.6%
5	SB5VS-05	Cr2O3 (wt%)	0.0124	0.0117	0.0094	0.0030	0.0023	32.1%	24.8%
5	SB5VS-05	CuO (wt%)	0.0119	0.0115	0.0027	0.0092	0.0088	335.0%	321.6%
5	SB5VS-05	Fe2O3 (wt%)	10.3832	10.3050	10.9921	-0.6089	-0.6870	-5.5%	-6.3%
5	SB5VS-05	K2O (wt%)	0.0166	0.0165	0.0100	0.0066	0.0065	65.9%	65.1%
5	SB5VS-05	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
5	SB5VS-05	Li2O (wt%)	4.9732	5.4218	5.2810	-0.3078	0.1408	-5.8%	2.7%
5	SB5VS-05	MgO (wt%)	0.7529	0.7348	0.7559	-0.0030	-0.0211	-0.4%	-2.8%
5	SB5VS-05	MnO (wt%)	2.1595	2.1077	2.2344	-0.0749	-0.1267	-3.4%	-5.7%
5	SB5VS-05	Na2O (wt%)	11.9096	11.6090	12.0056	-0.0960	-0.3966	-0.8%	-3.3%
5	SB5VS-05	NiO (wt%)	0.7597	0.7268	0.8081	-0.0484	-0.0813	-6.0%	-10.1%
5	SB5VS-05	P2O5 (wt%)	0.0206	0.0206	0.0290	-0.0083	-0.0083	-28.8%	-28.8%
5	SB5VS-05	PbO (wt%)	0.0105	0.0105	0.0022	0.0083	0.0083	371.6%	371.6%
5	SB5VS-05	SiO2 (wt%)	48.4017	50.5777	50.7210	-2.3193	-0.1433	-4.6%	-0.3%
5	SB5VS-05	SO4 (wt%)	0.2464	0.2464	0.1293	0.1172	0.1172	90.6%	90.6%
5	SB5VS-05	TiO2 (wt%)	0.0083	0.0082	0.0000	0.0083	0.0082		
5	SB5VS-05	U3O8 (wt%)	2.3407	2.4039	2.4828	-0.1421	-0.0789	-5.7%	-3.2%
5	SB5VS-05	ZnO (wt%)	0.0084	0.0084	0.0008	0.0076	0.0076	902.7%	902.7%
5	SB5VS-05	ZrO2 (wt%)	0.0149	0.0149	0.0107	0.0042	0.0042	39.3%	39.3%
5	SB5VS-05	Sum	96.3657	98.5803	99.9904	-3.6247	-1.4100	-3.6%	-1.4%
6	SB5VS-06	Al2O3 (wt%)	8.1296	8.2395	8.1889	-0.0593	0.0506	-0.7%	0.6%
6	SB5VS-06	B2O3 (wt%)	5.7395	5.9914	5.2800	0.4595	0.7114	8.7%	13.5%
6	SB5VS-06	BaO (wt%)	0.0103	0.0100	0.0099	0.0004	0.0001	4.2%	0.8%
6	SB5VS-06	CaO (wt%)	1.0092	1.0149	1.0255	-0.0164	-0.0106	-1.6%	-1.0%
6	SB5VS-06	CdO (wt%)	0.0051	0.0051	0.0064	-0.0013	-0.0013	-19.7%	-19.7%
6	SB5VS-06	Ce2O3 (wt%)	0.0243	0.0243	0.0027	0.0216	0.0216	787.3%	787.3%
6	SB5VS-06	Cr2O3 (wt%)	0.0113	0.0111	0.0094	0.0019	0.0017	20.4%	18.4%
6	SB5VS-06	CuO (wt%)	0.0138	0.0137	0.0027	0.0110	0.0110	403.7%	401.9%
6	SB5VS-06	Fe2O3 (wt%)	8.2637	8.2887	8.5992	-0.3355	-0.3105	-3.9%	-3.6%
6	SB5VS-06	K2O (wt%)	0.0142	0.0139	0.0100	0.0042	0.0040	41.8%	39.7%
6	SB5VS-06	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
6	SB5VS-06	Li2O (wt%)	4.8171	5.3993	5.2810	-0.4639	0.1183	-8.8%	2.2%
6	SB5VS-06	MgO (wt%)	0.3536	0.3408	0.3483	0.0053	-0.0075	1.5%	-2.2%
6	SB5VS-06	MnO (wt%)	2.2273	2.2247	2.2344	-0.0071	-0.0096	-0.3%	-0.4%
6	SB5VS-06	Na2O (wt%)	13.2542	13.0981	13.1625	0.0917	-0.0645	0.7%	-0.5%
6	SB5VS-06	NiO (wt%)	1.2044	1.1834	1.2490	-0.0446	-0.0656	-3.6%	-5.3%
6	SB5VS-06	P2O5 (wt%)	0.0206	0.0206	0.0290	-0.0083	-0.0083	-28.8%	-28.8%
6	SB5VS-06	PbO (wt%)	0.0102	0.0102	0.0022	0.0080	0.0080	359.5%	359.5%
6	SB5VS-06	SiO2 (wt%)	51.6641	51.3519	51.1540	0.5101	0.1979	1.0%	0.4%
6	SB5VS-06	SO4 (wt%)	0.3940	0.3940	0.2913	0.1026	0.1026	35.2%	35.2%
6	SB5VS-06	TiO2 (wt%)	0.0150	0.0147	0.0000	0.0150	0.0147		
6	SB5VS-06	U3O8 (wt%)	2.9716	3.0468	3.0900	-0.1185	-0.0432	-3.8%	-1.4%
6	SB5VS-06	ZnO (wt%)	0.0084	0.0084	0.0008	0.0076	0.0076	902.7%	902.7%
6	SB5VS-06	ZrO2 (wt%)	0.0155	0.0155	0.0107	0.0049	0.0049	45.7%	45.7%
6	SB5VS-06	Sum	100.1772	100.7215	99.9901	0.1871	0.7314	0.2%	0.7%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
7	SB5VS-07	Al2O3 (wt%)	6.1928	6.2482	6.4522	-0.2594	-0.2040	-4.0%	-3.2%
7	SB5VS-07	B2O3 (wt%)	5.6187	5.8662	5.2800	0.3387	0.5862	6.4%	11.1%
7	SB5VS-07	BaO (wt%)	0.0435	0.0414	0.0448	-0.0012	-0.0034	-2.8%	-7.5%
7	SB5VS-07	CaO (wt%)	0.9420	0.9537	1.0255	-0.0835	-0.0718	-8.1%	-7.0%
7	SB5VS-07	CdO (wt%)	0.0266	0.0266	0.0289	-0.0024	-0.0024	-8.2%	-8.2%
7	SB5VS-07	Ce2O3 (wt%)	0.0287	0.0287	0.0124	0.0163	0.0163	131.9%	131.9%
7	SB5VS-07	Cr2O3 (wt%)	0.0387	0.0373	0.0425	-0.0037	-0.0052	-8.8%	-12.2%
7	SB5VS-07	CuO (wt%)	0.0200	0.0199	0.0123	0.0077	0.0075	62.2%	60.9%
7	SB5VS-07	Fe2O3 (wt%)	8.3423	8.2204	9.0085	-0.6662	-0.7881	-7.4%	-8.7%
7	SB5VS-07	K2O (wt%)	0.0428	0.0433	0.0451	-0.0023	-0.0018	-5.2%	-4.0%
7	SB5VS-07	La2O3 (wt%)	0.0049	0.0049	0.0089	-0.0040	-0.0040	-45.2%	-45.2%
7	SB5VS-07	Li2O (wt%)	4.6933	5.2629	5.2840	-0.5907	-0.0211	-11.2%	-0.4%
7	SB5VS-07	MgO (wt%)	0.6849	0.6938	0.7559	-0.0710	-0.0621	-9.4%	-8.2%
7	SB5VS-07	MnO (wt%)	1.7173	1.6614	1.8016	-0.0843	-0.1402	-4.7%	-7.8%
7	SB5VS-07	Na2O (wt%)	14.3899	14.0820	15.2232	-0.8333	-1.1412	-5.5%	-7.5%
7	SB5VS-07	NiO (wt%)	0.7470	0.7281	0.8081	-0.0611	-0.0801	-7.6%	-9.9%
7	SB5VS-07	P2O5 (wt%)	0.0510	0.0510	0.1308	-0.0798	-0.0798	-61.0%	-61.0%
7	SB5VS-07	PbO (wt%)	0.0162	0.0162	0.0101	0.0061	0.0061	60.7%	60.7%
7	SB5VS-07	SiO2 (wt%)	50.7549	50.4687	51.1540	-0.3991	-0.6853	-0.8%	-1.3%
7	SB5VS-07	SO4 (wt%)	0.3850	0.3850	0.2913	0.0936	0.0936	32.1%	32.1%
7	SB5VS-07	TiO2 (wt%)	0.0096	0.0090	0.0000	0.0096	0.0090		
7	SB5VS-07	U3O8 (wt%)	2.2582	2.3794	2.4828	-0.2247	-0.1035	-9.0%	-4.2%
7	SB5VS-07	ZnO (wt%)	0.0115	0.0115	0.0038	0.0077	0.0077	204.1%	204.1%
7	SB5VS-07	ZrO2 (wt%)	0.0493	0.0493	0.0482	0.0011	0.0011	2.4%	2.4%
7	SB5VS-07	Sum	97.0690	97.2887	99.9549	-2.8859	-2.6662	-2.9%	-2.7%
8	SB5VS-08	Al2O3 (wt%)	7.9548	8.0253	8.1889	-0.2341	-0.1636	-2.9%	-2.0%
8	SB5VS-08	B2O3 (wt%)	5.2243	5.4266	5.2800	-0.0557	0.1466	-1.1%	2.8%
8	SB5VS-08	BaO (wt%)	0.0466	0.0443	0.0448	0.0018	-0.0004	4.1%	-1.0%
8	SB5VS-08	CaO (wt%)	0.5849	0.5921	0.6256	-0.0408	-0.0336	-6.5%	-5.4%
8	SB5VS-08	CdO (wt%)	0.0291	0.0291	0.0289	0.0002	0.0002	0.7%	0.7%
8	SB5VS-08	Ce2O3 (wt%)	0.0278	0.0278	0.0124	0.0154	0.0154	124.8%	124.8%
8	SB5VS-08	Cr2O3 (wt%)	0.0398	0.0384	0.0425	-0.0026	-0.0041	-6.2%	-9.7%
8	SB5VS-08	CuO (wt%)	0.0219	0.0217	0.0123	0.0096	0.0094	77.5%	76.0%
8	SB5VS-08	Fe2O3 (wt%)	10.5977	10.4428	11.0159	-0.4183	-0.5731	-3.8%	-5.2%
8	SB5VS-08	K2O (wt%)	0.0446	0.0451	0.0451	-0.0005	0.0000	-1.2%	0.1%
8	SB5VS-08	La2O3 (wt%)	0.0050	0.0050	0.0089	-0.0040	-0.0040	-44.5%	-44.5%
8	SB5VS-08	Li2O (wt%)	4.8279	5.3022	5.2840	-0.4561	0.0182	-8.6%	0.3%
8	SB5VS-08	MgO (wt%)	0.3026	0.3066	0.3483	-0.0457	-0.0417	-13.1%	-12.0%
8	SB5VS-08	MnO (wt%)	1.8141	1.7552	1.8016	0.0125	-0.0464	0.7%	-2.6%
8	SB5VS-08	Na2O (wt%)	11.8354	11.5824	12.0079	-0.1724	-0.4254	-1.4%	-3.5%
8	SB5VS-08	NiO (wt%)	1.1974	1.1671	1.2490	-0.0516	-0.0819	-4.1%	-6.6%
8	SB5VS-08	P2O5 (wt%)	0.0390	0.0390	0.1308	-0.0918	-0.0918	-70.2%	-70.2%
8	SB5VS-08	PbO (wt%)	0.0180	0.0180	0.0101	0.0080	0.0080	79.4%	79.4%
8	SB5VS-08	SiO2 (wt%)	50.5410	51.4335	51.1540	-0.6130	0.2795	-1.2%	0.5%
8	SB5VS-08	SO4 (wt%)	0.2150	0.2150	0.1293	0.0857	0.0857	66.3%	66.3%
8	SB5VS-08	TiO2 (wt%)	0.0092	0.0086	0.0000	0.0092	0.0086		
8	SB5VS-08	U3O8 (wt%)	2.2906	2.4133	2.4828	-0.1922	-0.0695	-7.7%	-2.8%
8	SB5VS-08	ZnO (wt%)	0.0096	0.0096	0.0038	0.0059	0.0059	154.8%	154.8%
8	SB5VS-08	ZrO2 (wt%)	0.0520	0.0520	0.0482	0.0038	0.0038	8.0%	8.0%
8	SB5VS-08	Sum	97.7283	99.0007	99.9549	-2.2267	-0.9543	-2.2%	-1.0%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
9	SB5VS-09	Al2O3 (wt%)	7.5816	7.6841	8.1889	-0.6072	-0.5047	-7.4%	-6.2%
9	SB5VS-09	B2O3 (wt%)	5.4738	5.6883	5.2800	0.1938	0.4083	3.7%	7.7%
9	SB5VS-09	BaO (wt%)	0.0441	0.0427	0.0448	-0.0007	-0.0021	-1.5%	-4.6%
9	SB5VS-09	CaO (wt%)	0.5674	0.5706	0.6256	-0.0582	-0.0550	-9.3%	-8.8%
9	SB5VS-09	CdO (wt%)	0.0223	0.0223	0.0289	-0.0067	-0.0067	-23.0%	-23.0%
9	SB5VS-09	Ce2O3 (wt%)	0.0246	0.0246	0.0124	0.0122	0.0122	98.8%	98.8%
9	SB5VS-09	Cr2O3 (wt%)	0.0336	0.0330	0.0425	-0.0089	-0.0094	-20.9%	-22.2%
9	SB5VS-09	CuO (wt%)	0.0182	0.0181	0.0123	0.0058	0.0057	47.0%	46.5%
9	SB5VS-09	Fe2O3 (wt%)	7.5595	7.5825	8.5992	-1.0397	-1.0167	-12.1%	-11.8%
9	SB5VS-09	K2O (wt%)	0.0473	0.0466	0.0451	0.0022	0.0015	4.8%	3.3%
9	SB5VS-09	La2O3 (wt%)	0.0027	0.0027	0.0089	-0.0062	-0.0062	-69.8%	-69.8%
9	SB5VS-09	Li2O (wt%)	4.8171	5.2911	5.2840	-0.4669	0.0071	-8.8%	0.1%
9	SB5VS-09	MgO (wt%)	0.7139	0.6880	0.7559	-0.0420	-0.0679	-5.6%	-9.0%
9	SB5VS-09	MnO (wt%)	2.0595	2.0571	2.2344	-0.1749	-0.1773	-7.8%	-7.9%
9	SB5VS-09	Na2O (wt%)	12.1590	12.0157	12.8015	-0.6425	-0.7858	-5.0%	-6.1%
9	SB5VS-09	NiO (wt%)	0.7056	0.6933	0.8081	-0.1025	-0.1148	-12.7%	-14.2%
9	SB5VS-09	P2O5 (wt%)	0.0504	0.0504	0.1308	-0.0803	-0.0803	-61.4%	-61.4%
9	SB5VS-09	PbO (wt%)	0.0108	0.0108	0.0101	0.0007	0.0007	7.1%	7.1%
9	SB5VS-09	SiO2 (wt%)	50.5944	51.4957	51.1540	-0.5596	0.3417	-1.1%	0.7%
9	SB5VS-09	SO4 (wt%)	0.1535	0.1535	0.1293	0.0243	0.0243	18.8%	18.8%
9	SB5VS-09	TiO2 (wt%)	0.5771	0.5663	0.6164	-0.0393	-0.0501	-6.4%	-8.1%
9	SB5VS-09	U3O8 (wt%)	2.7092	2.7777	3.0900	-0.3808	-0.3123	-12.3%	-10.1%
9	SB5VS-09	ZnO (wt%)	0.0112	0.0112	0.0038	0.0074	0.0074	195.9%	195.9%
9	SB5VS-09	ZrO2 (wt%)	0.0473	0.0473	0.0482	-0.0009	-0.0009	-1.8%	-1.8%
9	SB5VS-09	Sum	95.9841	97.5735	99.9549	-3.9708	-2.3814	-4.0%	-2.4%
10	SB5VS-10	Al2O3 (wt%)	7.9548	8.0258	8.1889	-0.2341	-0.1630	-2.9%	-2.0%
10	SB5VS-10	B2O3 (wt%)	5.2323	5.4644	5.2800	-0.0477	0.1844	-0.9%	3.5%
10	SB5VS-10	BaO (wt%)	0.0444	0.0422	0.0448	-0.0004	-0.0026	-0.9%	-5.7%
10	SB5VS-10	CaO (wt%)	0.9647	0.9767	1.0255	-0.0608	-0.0489	-5.9%	-4.8%
10	SB5VS-10	CdO (wt%)	0.0268	0.0268	0.0289	-0.0021	-0.0021	-7.2%	-7.2%
10	SB5VS-10	Ce2O3 (wt%)	0.0346	0.0346	0.0124	0.0222	0.0222	179.3%	179.3%
10	SB5VS-10	Cr2O3 (wt%)	0.0391	0.0377	0.0425	-0.0034	-0.0048	-7.9%	-11.3%
10	SB5VS-10	CuO (wt%)	0.0238	0.0236	0.0123	0.0114	0.0112	92.7%	91.1%
10	SB5VS-10	Fe2O3 (wt%)	9.3860	9.2489	10.1067	-0.7207	-0.8578	-7.1%	-8.5%
10	SB5VS-10	K2O (wt%)	0.0443	0.0448	0.0451	-0.0008	-0.0003	-1.8%	-0.6%
10	SB5VS-10	La2O3 (wt%)	0.0044	0.0044	0.0089	-0.0045	-0.0045	-50.8%	-50.8%
10	SB5VS-10	Li2O (wt%)	4.7256	5.2980	5.2840	-0.5584	0.0140	-10.6%	0.3%
10	SB5VS-10	MgO (wt%)	0.2985	0.3024	0.3483	-0.0498	-0.0459	-14.3%	-13.2%
10	SB5VS-10	MnO (wt%)	1.7851	1.7270	1.8016	-0.0165	-0.0746	-0.9%	-4.1%
10	SB5VS-10	Na2O (wt%)	11.8793	11.6248	12.0056	-0.1264	-0.3808	-1.1%	-3.2%
10	SB5VS-10	NiO (wt%)	0.7765	0.7569	0.8081	-0.0316	-0.0512	-3.9%	-6.3%
10	SB5VS-10	P2O5 (wt%)	0.0332	0.0332	0.1308	-0.0975	-0.0975	-74.6%	-74.6%
10	SB5VS-10	PbO (wt%)	0.0129	0.0129	0.0101	0.0029	0.0029	28.5%	28.5%
10	SB5VS-10	SiO2 (wt%)	50.1131	49.8235	50.7210	-0.6079	-0.8975	-1.2%	-1.8%
10	SB5VS-10	SO4 (wt%)	0.3078	0.3078	0.2913	0.0165	0.0165	5.7%	5.7%
10	SB5VS-10	TiO2 (wt%)	0.6259	0.5849	0.6164	0.0095	-0.0315	1.5%	-5.1%
10	SB5VS-10	U3O8 (wt%)	2.8890	3.0443	3.0900	-0.2010	-0.0458	-6.5%	-1.5%
10	SB5VS-10	ZnO (wt%)	0.0106	0.0106	0.0038	0.0068	0.0068	179.5%	179.5%
10	SB5VS-10	ZrO2 (wt%)	0.0432	0.0432	0.0482	-0.0049	-0.0049	-10.2%	-10.2%
10	SB5VS-10	Sum	97.2560	97.4995	99.9552	-2.6992	-2.4558	-2.7%	-2.5%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

Glass #	Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
11	SB5VS-11	Al2O3 (wt%)	6.4574	6.5447	6.4522	0.0051	0.0924	0.1%	1.4%
11	SB5VS-11	B2O3 (wt%)	5.2967	5.5029	5.2800	0.0167	0.2229	0.3%	4.2%
11	SB5VS-11	BaO (wt%)	0.0486	0.0470	0.0448	0.0038	0.0022	8.5%	5.0%
11	SB5VS-11	CaO (wt%)	0.6094	0.6128	0.6256	-0.0163	-0.0128	-2.6%	-2.0%
11	SB5VS-11	CdO (wt%)	0.0283	0.0283	0.0289	-0.0007	-0.0007	-2.3%	-2.3%
11	SB5VS-11	Ce2O3 (wt%)	0.0363	0.0363	0.0124	0.0239	0.0239	193.5%	193.5%
11	SB5VS-11	Cr2O3 (wt%)	0.0347	0.0341	0.0425	-0.0078	-0.0084	-18.3%	-19.7%
11	SB5VS-11	CuO (wt%)	0.0213	0.0212	0.0123	0.0089	0.0089	72.4%	71.8%
11	SB5VS-11	Fe2O3 (wt%)	10.3081	10.3389	11.0159	-0.7078	-0.6770	-6.4%	-6.1%
11	SB5VS-11	K2O (wt%)	0.0452	0.0445	0.0451	0.0001	-0.0006	0.2%	-1.3%
11	SB5VS-11	La2O3 (wt%)	0.0072	0.0072	0.0089	-0.0017	-0.0017	-18.9%	-18.9%
11	SB5VS-11	Li2O (wt%)	5.1078	5.6091	5.2840	-0.1762	0.3251	-3.3%	6.2%
11	SB5VS-11	MgO (wt%)	0.8030	0.7742	0.7559	0.0471	0.0182	6.2%	2.4%
11	SB5VS-11	MnO (wt%)	2.2015	2.1989	2.2344	-0.0329	-0.0355	-1.5%	-1.6%
11	SB5VS-11	Na2O (wt%)	12.6038	12.4555	12.5681	0.0357	-0.1125	0.3%	-0.9%
11	SB5VS-11	NiO (wt%)	1.2353	1.2137	1.2490	-0.0137	-0.0353	-1.1%	-2.8%
11	SB5VS-11	P2O5 (wt%)	0.0309	0.0309	0.1308	-0.0998	-0.0998	-76.3%	-76.3%
11	SB5VS-11	PbO (wt%)	0.0234	0.0234	0.0101	0.0134	0.0134	133.0%	133.0%
11	SB5VS-11	SiO2 (wt%)	52.3059	53.2205	50.7210	1.5849	2.4995	3.1%	4.9%
11	SB5VS-11	SO4 (wt%)	0.3880	0.3880	0.2913	0.0966	0.0966	33.2%	33.2%
11	SB5VS-11	TiO2 (wt%)	0.0083	0.0082	0.0000	0.0083	0.0082		
11	SB5VS-11	U3O8 (wt%)	2.9274	3.0016	3.0900	-0.1627	-0.0885	-5.3%	-2.9%
11	SB5VS-11	ZnO (wt%)	0.0146	0.0146	0.0038	0.0108	0.0108	286.3%	286.3%
11	SB5VS-11	ZrO2 (wt%)	0.0459	0.0459	0.0482	-0.0022	-0.0022	-4.6%	-4.6%
11	SB5VS-11	Sum	100.5890	102.2024	99.9552	0.6338	2.2472	0.6%	2.2%
12	SB5VS-12	Al2O3 (wt%)	6.4526	6.5399	6.4522	0.0004	0.0877	0.0%	1.4%
12	SB5VS-12	B2O3 (wt%)	5.3209	5.5275	5.2800	0.0409	0.2475	0.8%	4.7%
12	SB5VS-12	BaO (wt%)	0.0114	0.0111	0.0099	0.0015	0.0012	15.4%	11.7%
12	SB5VS-12	CaO (wt%)	0.6122	0.6156	0.6256	-0.0135	-0.0100	-2.2%	-1.6%
12	SB5VS-12	CdO (wt%)	0.0046	0.0046	0.0064	-0.0018	-0.0018	-28.7%	-28.7%
12	SB5VS-12	Ce2O3 (wt%)	0.0237	0.0237	0.0027	0.0210	0.0210	766.0%	766.0%
12	SB5VS-12	Cr2O3 (wt%)	0.0088	0.0086	0.0094	-0.0006	-0.0008	-6.8%	-8.4%
12	SB5VS-12	CuO (wt%)	0.0153	0.0153	0.0027	0.0126	0.0125	460.9%	459.0%
12	SB5VS-12	Fe2O3 (wt%)	9.9543	9.9844	10.1442	-0.1899	-0.1598	-1.9%	-1.6%
12	SB5VS-12	K2O (wt%)	0.0166	0.0163	0.0100	0.0066	0.0063	65.9%	63.4%
12	SB5VS-12	La2O3 (wt%)	0.0001	0.0001	0.0020	-0.0019	-0.0019	-94.1%	-94.1%
12	SB5VS-12	Li2O (wt%)	4.9947	5.4850	5.2810	-0.2863	0.2040	-5.4%	3.9%
12	SB5VS-12	MgO (wt%)	0.3582	0.3453	0.3483	0.0099	-0.0030	2.8%	-0.9%
12	SB5VS-12	MnO (wt%)	1.8109	1.8088	1.8016	0.0093	0.0072	0.5%	0.4%
12	SB5VS-12	Na2O (wt%)	15.3672	15.1864	15.2232	0.1440	-0.0368	0.9%	-0.2%
12	SB5VS-12	NiO (wt%)	0.7816	0.7680	0.8081	-0.0265	-0.0401	-3.3%	-5.0%
12	SB5VS-12	P2O5 (wt%)	0.0206	0.0206	0.0290	-0.0083	-0.0083	-28.8%	-28.8%
12	SB5VS-12	PbO (wt%)	0.0113	0.0113	0.0022	0.0091	0.0091	407.9%	407.9%
12	SB5VS-12	SiO2 (wt%)	49.7922	50.6690	50.7210	-0.9288	-0.0520	-1.8%	-0.1%
12	SB5VS-12	SO4 (wt%)	0.2127	0.2127	0.1293	0.0835	0.0835	64.6%	64.6%
12	SB5VS-12	TiO2 (wt%)	0.0100	0.0098	0.0000	0.0100	0.0098		
12	SB5VS-12	U3O8 (wt%)	2.9303	3.0046	3.0900	-0.1597	-0.0854	-5.2%	-2.8%
12	SB5VS-12	ZnO (wt%)	0.0093	0.0093	0.0008	0.0085	0.0085	1014.1%	1014.1%
12	SB5VS-12	ZrO2 (wt%)	0.0169	0.0169	0.0107	0.0062	0.0062	58.3%	58.3%
12	SB5VS-12	Sum	98.7365	100.2949	99.9904	-1.2539	0.3045	-1.3%	0.3%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
13	SB5VS-13	Al2O3 (wt%)	7.0620	7.1246	7.2304	-0.1684	-0.1058	-2.3%	-1.5%
13	SB5VS-13	B2O3 (wt%)	5.2726	5.4770	5.2800	-0.0074	0.1970	-0.1%	3.7%
13	SB5VS-13	BaO (wt%)	0.0285	0.0271	0.0274	0.0011	-0.0003	4.0%	-1.0%
13	SB5VS-13	CaO (wt%)	0.7783	0.7878	0.8246	-0.0463	-0.0368	-5.6%	-4.5%
13	SB5VS-13	CdO (wt%)	0.0183	0.0183	0.0177	0.0006	0.0006	3.4%	3.4%
13	SB5VS-13	Ce2O3 (wt%)	0.0258	0.0258	0.0076	0.0182	0.0182	240.8%	240.8%
13	SB5VS-13	Cr2O3 (wt%)	0.0248	0.0239	0.0260	-0.0011	-0.0020	-4.3%	-7.8%
13	SB5VS-13	CuO (wt%)	0.0163	0.0161	0.0075	0.0087	0.0086	115.7%	113.9%
13	SB5VS-13	Fe2O3 (wt%)	9.3717	9.2348	9.7623	-0.3906	-0.5274	-4.0%	-5.4%
13	SB5VS-13	K2O (wt%)	0.0289	0.0293	0.0276	0.0013	0.0017	4.9%	6.2%
13	SB5VS-13	La2O3 (wt%)	0.0003	0.0003	0.0055	-0.0052	-0.0052	-94.6%	-94.6%
13	SB5VS-13	Li2O (wt%)	4.9409	5.4248	5.2820	-0.3411	0.1428	-6.5%	2.7%
13	SB5VS-13	MgO (wt%)	0.5062	0.5128	0.5511	-0.0449	-0.0383	-8.1%	-6.9%
13	SB5VS-13	MnO (wt%)	2.0110	1.9457	2.0163	-0.0052	-0.0706	-0.3%	-3.5%
13	SB5VS-13	Na2O (wt%)	13.2980	13.0138	13.5243	-0.2263	-0.5106	-1.7%	-3.8%
13	SB5VS-13	NiO (wt%)	0.9770	0.9522	1.0266	-0.0496	-0.0743	-4.8%	-7.2%
13	SB5VS-13	P2O5 (wt%)	0.0206	0.0206	0.0799	-0.0593	-0.0593	-74.2%	-74.2%
13	SB5VS-13	PbO (wt%)	0.0113	0.0113	0.0061	0.0052	0.0052	84.0%	84.0%
13	SB5VS-13	SiO2 (wt%)	51.7711	52.6716	50.9360	0.8351	1.7356	1.6%	3.4%
13	SB5VS-13	SO4 (wt%)	0.2869	0.2869	0.2105	0.0764	0.0764	36.3%	36.3%
13	SB5VS-13	TiO2 (wt%)	0.3240	0.3028	0.3065	0.0175	-0.0037	5.7%	-1.2%
13	SB5VS-13	U3O8 (wt%)	2.5824	2.7208	2.7850	-0.2026	-0.0642	-7.3%	-2.3%
13	SB5VS-13	ZnO (wt%)	0.0106	0.0106	0.0023	0.0083	0.0083	357.3%	357.3%
13	SB5VS-13	ZrO2 (wt%)	0.0334	0.0334	0.0294	0.0040	0.0040	13.6%	13.6%
13	SB5VS-13	Sum	99.4009	100.6722	99.9724	-0.5715	0.6999	-0.6%	0.7%
14	SB5VS-14	Al2O3 (wt%)	7.3691	7.4444	7.4511	-0.0821	-0.0067	-1.1%	-0.1%
14	SB5VS-14	B2O3 (wt%)	5.5060	5.4359	5.2800	0.2260	0.1559	4.3%	3.0%
14	SB5VS-14	BaO (wt%)	0.0475	0.0452	0.0483	-0.0008	-0.0030	-1.7%	-6.3%
14	SB5VS-14	CaO (wt%)	0.8213	0.8194	0.8381	-0.0168	-0.0187	-2.0%	-2.2%
14	SB5VS-14	CdO (wt%)	0.0308	0.0308	0.0333	-0.0025	-0.0025	-7.4%	-7.4%
14	SB5VS-14	Ce2O3 (wt%)	0.0287	0.0287	0.0054	0.0233	0.0233	427.5%	427.5%
14	SB5VS-14	Cr2O3 (wt%)	0.0343	0.0324	0.0347	-0.0003	-0.0022	-1.0%	-6.5%
14	SB5VS-14	CuO (wt%)	0.0178	0.0173	0.0085	0.0093	0.0088	109.9%	103.4%
14	SB5VS-14	Fe2O3 (wt%)	9.4003	9.3295	10.0749	-0.6746	-0.7454	-6.7%	-7.4%
14	SB5VS-14	K2O (wt%)	0.0434	0.0432	0.0442	-0.0008	-0.0010	-1.9%	-2.3%
14	SB5VS-14	La2O3 (wt%)	0.0001	0.0001	0.0041	-0.0040	-0.0040	-97.1%	-97.1%
14	SB5VS-14	Li2O (wt%)	4.8978	5.3398	5.2800	-0.3822	0.0598	-7.2%	1.1%
14	SB5VS-14	MgO (wt%)	0.5588	0.5455	0.5508	0.0080	-0.0053	1.5%	-1.0%
14	SB5VS-14	MnO (wt%)	2.0466	1.9969	2.0461	0.0004	-0.0492	0.0%	-2.4%
14	SB5VS-14	Na2O (wt%)	12.9206	12.5945	13.0160	-0.0954	-0.4215	-0.7%	-3.2%
14	SB5VS-14	NiO (wt%)	1.0498	1.0044	1.0741	-0.0242	-0.0696	-2.3%	-6.5%
14	SB5VS-14	P2O5 (wt%)	0.0544	0.0544	0.1511	-0.0967	-0.0967	-64.0%	-64.0%
14	SB5VS-14	PbO (wt%)	0.0105	0.0105	0.0044	0.0061	0.0061	137.6%	137.6%
14	SB5VS-14	SiO2 (wt%)	48.1877	50.3571	50.9170	-2.7293	-0.5599	-5.4%	-1.1%
14	SB5VS-14	SO4 (wt%)	0.3056	0.3056	0.2111	0.0945	0.0945	44.8%	44.8%
14	SB5VS-14	TiO2 (wt%)	0.0117	0.0114	0.0034	0.0083	0.0080	243.4%	236.4%
14	SB5VS-14	U3O8 (wt%)	2.6974	2.7703	2.8319	-0.1344	-0.0615	-4.7%	-2.2%
14	SB5VS-14	ZnO (wt%)	0.0100	0.0100	0.0034	0.0066	0.0066	192.9%	192.9%
14	SB5VS-14	ZrO2 (wt%)	0.0554	0.0554	0.0503	0.0051	0.0051	10.1%	10.1%
14	SB5VS-14	Sum	96.1057	98.2828	99.9622	-3.8565	-1.6793	-3.9%	-1.7%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
15	SB5VS-15	Al2O3 (wt%)	7.1423	7.2055	7.1832	-0.0409	0.0223	-0.6%	0.3%
15	SB5VS-15	B2O3 (wt%)	4.8057	5.0155	5.2800	-0.4743	-0.2645	-9.0%	-5.0%
15	SB5VS-15	BaO (wt%)	0.0491	0.0467	0.0473	0.0019	-0.0005	3.9%	-1.1%
15	SB5VS-15	CaO (wt%)	0.7843	0.7939	0.8129	-0.0287	-0.0190	-3.5%	-2.3%
15	SB5VS-15	CdO (wt%)	0.0306	0.0306	0.0316	-0.0011	-0.0011	-3.4%	-3.4%
15	SB5VS-15	Ce2O3 (wt%)	0.0305	0.0305	0.0082	0.0223	0.0223	273.2%	273.2%
15	SB5VS-15	Cr2O3 (wt%)	0.0343	0.0331	0.0347	-0.0003	-0.0016	-1.0%	-4.6%
15	SB5VS-15	CuO (wt%)	0.0197	0.0196	0.0088	0.0109	0.0107	123.0%	121.2%
15	SB5VS-15	Fe2O3 (wt%)	9.3538	9.2172	9.7757	-0.4219	-0.5585	-4.3%	-5.7%
15	SB5VS-15	K2O (wt%)	0.0440	0.0445	0.0439	0.0001	0.0007	0.2%	1.5%
15	SB5VS-15	La2O3 (wt%)	0.0013	0.0013	0.0051	-0.0038	-0.0038	-74.1%	-74.1%
15	SB5VS-15	Li2O (wt%)	4.8333	5.4180	5.2800	-0.4467	0.1380	-8.5%	2.6%
15	SB5VS-15	MgO (wt%)	0.4896	0.4960	0.5250	-0.0353	-0.0290	-6.7%	-5.5%
15	SB5VS-15	MnO (wt%)	2.0433	1.9769	2.0206	0.0227	-0.0437	1.1%	-2.2%
15	SB5VS-15	Na2O (wt%)	13.2205	12.9381	13.3026	-0.0821	-0.3646	-0.6%	-2.7%
15	SB5VS-15	NiO (wt%)	1.0260	1.0000	1.0431	-0.0172	-0.0431	-1.6%	-4.1%
15	SB5VS-15	P2O5 (wt%)	0.0407	0.0407	0.1446	-0.1039	-0.1039	-71.9%	-71.9%
15	SB5VS-15	PbO (wt%)	0.0097	0.0097	0.0061	0.0036	0.0036	58.4%	58.4%
15	SB5VS-15	SiO2 (wt%)	51.1828	50.8784	50.8910	0.2918	-0.0126	0.6%	0.0%
15	SB5VS-15	SO4 (wt%)	0.3063	0.3063	0.2490	0.0573	0.0573	23.0%	23.0%
15	SB5VS-15	TiO2 (wt%)	0.4604	0.4302	0.4444	0.0160	-0.0142	3.6%	-3.2%
15	SB5VS-15	U3O8 (wt%)	2.5795	2.7176	2.7445	-0.1650	-0.0269	-6.0%	-1.0%
15	SB5VS-15	ZnO (wt%)	0.0112	0.0112	0.0048	0.0064	0.0064	135.4%	135.4%
15	SB5VS-15	ZrO2 (wt%)	0.0540	0.0540	0.0510	0.0030	0.0030	5.9%	5.9%
15	SB5VS-15	Sum	98.5528	98.7153	99.9380	-1.3852	-1.2227	-1.4%	-1.2%
16	SB5VS-16	Al2O3 (wt%)	6.7455	6.8055	6.7937	-0.0481	0.0118	-0.7%	0.2%
16	SB5VS-16	B2O3 (wt%)	5.6268	5.8746	5.5200	0.1068	0.3546	1.9%	6.4%
16	SB5VS-16	BaO (wt%)	0.0447	0.0425	0.0440	0.0006	-0.0015	1.5%	-3.5%
16	SB5VS-16	CaO (wt%)	0.7244	0.7333	0.7642	-0.0397	-0.0308	-5.2%	-4.0%
16	SB5VS-16	CdO (wt%)	0.0271	0.0271	0.0304	-0.0033	-0.0033	-10.7%	-10.7%
16	SB5VS-16	Ce2O3 (wt%)	0.0258	0.0258	0.0050	0.0208	0.0208	419.5%	419.5%
16	SB5VS-16	Cr2O3 (wt%)	0.0311	0.0299	0.0316	-0.0006	-0.0017	-1.8%	-5.4%
16	SB5VS-16	CuO (wt%)	0.0156	0.0155	0.0078	0.0079	0.0078	101.9%	100.3%
16	SB5VS-16	Fe2O3 (wt%)	8.8570	8.7275	9.1859	-0.3289	-0.4584	-3.6%	-5.0%
16	SB5VS-16	K2O (wt%)	0.0373	0.0378	0.0403	-0.0030	-0.0025	-7.3%	-6.2%
16	SB5VS-16	La2O3 (wt%)	0.0005	0.0005	0.0037	-0.0033	-0.0033	-87.4%	-87.4%
16	SB5VS-16	Li2O (wt%)	4.9678	5.5670	5.5200	-0.5522	0.0470	-10.0%	0.9%
16	SB5VS-16	MgO (wt%)	0.4386	0.4444	0.5022	-0.0636	-0.0578	-12.7%	-11.5%
16	SB5VS-16	MnO (wt%)	1.8916	1.8301	1.8656	0.0260	-0.0355	1.4%	-1.9%
16	SB5VS-16	Na2O (wt%)	12.5229	12.2551	12.5734	-0.0505	-0.3183	-0.4%	-2.5%
16	SB5VS-16	NiO (wt%)	0.9486	0.9246	0.9793	-0.0306	-0.0546	-3.1%	-5.6%
16	SB5VS-16	P2O5 (wt%)	0.0481	0.0481	0.1378	-0.0897	-0.0897	-65.1%	-65.1%
16	SB5VS-16	PbO (wt%)	0.0121	0.0121	0.0040	0.0081	0.0081	200.7%	200.7%
16	SB5VS-16	SiO2 (wt%)	52.7337	52.4125	53.1300	-0.3963	-0.7175	-0.7%	-1.4%
16	SB5VS-16	SO4 (wt%)	0.2786	0.2786	0.1925	0.0861	0.0861	44.8%	44.8%
16	SB5VS-16	TiO2 (wt%)	0.0129	0.0121	0.0031	0.0098	0.0090	317.0%	289.6%
16	SB5VS-16	U3O8 (wt%)	2.4144	2.5438	2.5820	-0.1676	-0.0382	-6.5%	-1.5%
16	SB5VS-16	ZnO (wt%)	0.0096	0.0096	0.0031	0.0065	0.0065	211.2%	211.2%
16	SB5VS-16	ZrO2 (wt%)	0.0439	0.0439	0.0459	-0.0020	-0.0020	-4.3%	-4.3%
16	SB5VS-16	Sum	98.4589	98.7020	99.9653	-1.5064	-1.2633	-1.5%	-1.3%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
17	SB5VS-17	Al2O3 (wt%)	7.6619	7.7402	8.1086	-0.4466	-0.3684	-5.5%	-4.5%
17	SB5VS-17	B2O3 (wt%)	5.3048	5.2375	5.0400	0.2648	0.1975	5.3%	3.9%
17	SB5VS-17	BaO (wt%)	0.0475	0.0452	0.0525	-0.0051	-0.0073	-9.7%	-13.9%
17	SB5VS-17	CaO (wt%)	0.8623	0.8602	0.9121	-0.0498	-0.0518	-5.5%	-5.7%
17	SB5VS-17	CdO (wt%)	0.0306	0.0306	0.0363	-0.0057	-0.0057	-15.7%	-15.7%
17	SB5VS-17	Ce2O3 (wt%)	0.0284	0.0284	0.0059	0.0225	0.0225	379.8%	379.8%
17	SB5VS-17	Cr2O3 (wt%)	0.0362	0.0342	0.0377	-0.0016	-0.0036	-4.1%	-9.5%
17	SB5VS-17	CuO (wt%)	0.0163	0.0158	0.0093	0.0070	0.0065	75.9%	70.5%
17	SB5VS-17	Fe2O3 (wt%)	9.7970	9.7233	10.9638	-1.1668	-1.2405	-10.6%	-11.3%
17	SB5VS-17	K2O (wt%)	0.0479	0.0477	0.0481	-0.0002	-0.0004	-0.5%	-0.9%
17	SB5VS-17	La2O3 (wt%)	0.0003	0.0003	0.0044	-0.0042	-0.0042	-94.1%	-94.1%
17	SB5VS-17	Li2O (wt%)	4.7633	5.1931	5.0400	-0.2767	0.1531	-5.5%	3.0%
17	SB5VS-17	MgO (wt%)	0.5746	0.5608	0.5994	-0.0248	-0.0386	-4.1%	-6.4%
17	SB5VS-17	MnO (wt%)	2.1111	2.0601	2.2267	-0.1155	-0.1665	-5.2%	-7.5%
17	SB5VS-17	Na2O (wt%)	12.8835	12.5584	13.4586	-0.5751	-0.9002	-4.3%	-6.7%
17	SB5VS-17	NiO (wt%)	1.0724	1.0261	1.1688	-0.0964	-0.1428	-8.3%	-12.2%
17	SB5VS-17	P2O5 (wt%)	0.0573	0.0573	0.1645	-0.1072	-0.1072	-65.2%	-65.2%
17	SB5VS-17	PbO (wt%)	0.0127	0.0127	0.0048	0.0078	0.0078	163.1%	163.1%
17	SB5VS-17	SiO2 (wt%)	47.7599	49.9100	48.7040	-0.9441	1.2060	-1.9%	2.5%
17	SB5VS-17	SO4 (wt%)	0.3258	0.3258	0.2297	0.0961	0.0961	41.8%	41.8%
17	SB5VS-17	TiO2 (wt%)	0.0104	0.0102	0.0037	0.0067	0.0065	181.8%	176.1%
17	SB5VS-17	U3O8 (wt%)	2.7800	2.8551	3.0817	-0.3018	-0.2266	-9.8%	-7.4%
17	SB5VS-17	ZnO (wt%)	0.0118	0.0118	0.0037	0.0081	0.0081	219.6%	219.6%
17	SB5VS-17	ZrO2 (wt%)	0.0530	0.0530	0.0548	-0.0017	-0.0017	-3.2%	-3.2%
17	SB5VS-17	Sum	96.2488	98.3977	99.9591	-3.7103	-1.5614	-3.7%	-1.6%
18	SB5VS-18	Al2O3 (wt%)	5.0922	5.1376	5.2818	-0.1895	-0.1442	-3.6%	-2.7%
18	SB5VS-18	B2O3 (wt%)	5.9971	6.2302	6.0000	-0.0029	0.2302	0.0%	3.8%
18	SB5VS-18	BaO (wt%)	0.0324	0.0308	0.0348	-0.0024	-0.0039	-6.8%	-11.4%
18	SB5VS-18	CaO (wt%)	0.5443	0.5509	0.5978	-0.0535	-0.0468	-8.9%	-7.8%
18	SB5VS-18	CdO (wt%)	0.0220	0.0220	0.0233	-0.0013	-0.0013	-5.4%	-5.4%
18	SB5VS-18	Ce2O3 (wt%)	0.0217	0.0217	0.0060	0.0157	0.0157	261.2%	261.2%
18	SB5VS-18	Cr2O3 (wt%)	0.0263	0.0253	0.0255	0.0008	-0.0002	3.2%	-0.6%
18	SB5VS-18	CuO (wt%)	0.0131	0.0130	0.0065	0.0066	0.0065	102.2%	100.6%
18	SB5VS-18	Fe2O3 (wt%)	6.6981	6.6002	7.1880	-0.4899	-0.5878	-6.8%	-8.2%
18	SB5VS-18	K2O (wt%)	0.0313	0.0317	0.0323	-0.0009	-0.0005	-2.9%	-1.7%
18	SB5VS-18	La2O3 (wt%)	0.0013	0.0013	0.0038	-0.0025	-0.0025	-65.6%	-65.6%
18	SB5VS-18	Li2O (wt%)	5.6621	6.2183	6.0000	-0.3379	0.2183	-5.6%	3.6%
18	SB5VS-18	MgO (wt%)	0.3304	0.3347	0.3860	-0.0556	-0.0513	-14.4%	-13.3%
18	SB5VS-18	MnO (wt%)	1.4946	1.4460	1.4858	0.0088	-0.0398	0.6%	-2.7%
18	SB5VS-18	Na2O (wt%)	11.2727	11.0315	11.8990	-0.6263	-0.8675	-5.3%	-7.3%
18	SB5VS-18	NiO (wt%)	0.7304	0.7119	0.7670	-0.0366	-0.0551	-4.8%	-7.2%
18	SB5VS-18	P2O5 (wt%)	0.0206	0.0206	0.1063	-0.0857	-0.0857	-80.6%	-80.6%
18	SB5VS-18	PbO (wt%)	0.0110	0.0110	0.0045	0.0065	0.0065	145.4%	145.4%
18	SB5VS-18	SiO2 (wt%)	57.2263	58.2410	57.5370	-0.3107	0.7040	-0.5%	1.2%
18	SB5VS-18	SO4 (wt%)	0.2172	0.2172	0.1831	0.0341	0.0341	18.6%	18.6%
18	SB5VS-18	TiO2 (wt%)	0.3386	0.3164	0.3268	0.0119	-0.0103	3.6%	-3.2%
18	SB5VS-18	U3O8 (wt%)	1.8219	1.9196	2.0180	-0.1961	-0.0984	-9.7%	-4.9%
18	SB5VS-18	ZnO (wt%)	0.0115	0.0115	0.0035	0.0080	0.0080	229.0%	229.0%
18	SB5VS-18	ZrO2 (wt%)	0.0311	0.0311	0.0375	-0.0064	-0.0064	-17.2%	-17.2%
18	SB5VS-18	Sum	97.6482	99.1757	99.9539	-2.3057	-0.7782	-2.3%	-0.8%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
19	SB5VS-19	Al2O3 (wt%)	5.9378	6.0180	5.9156	0.0222	0.1025	0.4%	1.7%
19	SB5VS-19	B2O3 (wt%)	5.5946	5.8128	5.7600	-0.1654	0.0528	-2.9%	0.9%
19	SB5VS-19	BaO (wt%)	0.0396	0.0384	0.0389	0.0007	-0.0005	1.8%	-1.4%
19	SB5VS-19	CaO (wt%)	0.6545	0.6582	0.6695	-0.0150	-0.0113	-2.2%	-1.7%
19	SB5VS-19	CdO (wt%)	0.0228	0.0228	0.0260	-0.0032	-0.0032	-12.3%	-12.3%
19	SB5VS-19	Ce2O3 (wt%)	0.0237	0.0237	0.0067	0.0170	0.0170	253.0%	253.0%
19	SB5VS-19	Cr2O3 (wt%)	0.0281	0.0276	0.0286	-0.0004	-0.0009	-1.5%	-3.2%
19	SB5VS-19	CuO (wt%)	0.0141	0.0140	0.0073	0.0068	0.0068	93.4%	92.8%
19	SB5VS-19	Fe2O3 (wt%)	7.5846	7.6077	8.0506	-0.4660	-0.4429	-5.8%	-5.5%
19	SB5VS-19	K2O (wt%)	0.0373	0.0368	0.0361	0.0012	0.0007	3.4%	1.9%
19	SB5VS-19	La2O3 (wt%)	0.0010	0.0010	0.0042	-0.0032	-0.0032	-76.3%	-76.3%
19	SB5VS-19	Li2O (wt%)	5.5545	6.0996	5.7600	-0.2055	0.3396	-3.6%	5.9%
19	SB5VS-19	MgO (wt%)	0.4428	0.4267	0.4323	0.0104	-0.0056	2.4%	-1.3%
19	SB5VS-19	MnO (wt%)	1.6592	1.6573	1.6640	-0.0048	-0.0068	-0.3%	-0.4%
19	SB5VS-19	Na2O (wt%)	12.3814	12.2355	12.3669	0.0145	-0.1314	0.1%	-1.1%
19	SB5VS-19	NiO (wt%)	0.8325	0.8180	0.8590	-0.0265	-0.0410	-3.1%	-4.8%
19	SB5VS-19	P2O5 (wt%)	0.0550	0.0550	0.1191	-0.0641	-0.0641	-53.8%	-53.8%
19	SB5VS-19	PbO (wt%)	0.0108	0.0108	0.0050	0.0057	0.0057	113.7%	113.7%
19	SB5VS-19	SiO2 (wt%)	54.7661	55.7297	55.3220	-0.5559	0.4077	-1.0%	0.7%
19	SB5VS-19	SO4 (wt%)	0.2314	0.2314	0.2051	0.0264	0.0264	12.9%	12.9%
19	SB5VS-19	TiO2 (wt%)	0.3690	0.3621	0.3660	0.0031	-0.0039	0.8%	-1.1%
19	SB5VS-19	U3O8 (wt%)	2.1461	2.2004	2.2602	-0.1140	-0.0597	-5.0%	-2.6%
19	SB5VS-19	ZnO (wt%)	0.0103	0.0103	0.0039	0.0063	0.0063	162.0%	162.0%
19	SB5VS-19	ZrO2 (wt%)	0.0446	0.0446	0.0420	0.0026	0.0026	6.1%	6.1%
19	SB5VS-19	Sum	98.4418	100.1425	99.9489	-1.5072	0.1935	-1.5%	0.2%
20	SB5VS-20	Al2O3 (wt%)	6.4196	6.4852	6.5494	-0.1298	-0.0642	-2.0%	-1.0%
20	SB5VS-20	B2O3 (wt%)	5.5946	5.5232	5.5200	0.0746	0.0032	1.4%	0.1%
20	SB5VS-20	BaO (wt%)	0.0486	0.0463	0.0431	0.0055	0.0032	12.7%	7.5%
20	SB5VS-20	CaO (wt%)	0.7108	0.7091	0.7412	-0.0304	-0.0321	-4.1%	-4.3%
20	SB5VS-20	CdO (wt%)	0.0263	0.0263	0.0288	-0.0026	-0.0026	-8.9%	-8.9%
20	SB5VS-20	Ce2O3 (wt%)	0.0258	0.0258	0.0074	0.0183	0.0183	246.4%	246.4%
20	SB5VS-20	Cr2O3 (wt%)	0.0307	0.0290	0.0316	-0.0009	-0.0026	-2.9%	-8.3%
20	SB5VS-20	CuO (wt%)	0.0169	0.0164	0.0081	0.0088	0.0083	109.7%	103.2%
20	SB5VS-20	Fe2O3 (wt%)	8.3888	8.3256	8.9131	-0.5244	-0.5875	-5.9%	-6.6%
20	SB5VS-20	K2O (wt%)	0.0401	0.0399	0.0400	0.0001	-0.0001	0.2%	-0.3%
20	SB5VS-20	La2O3 (wt%)	0.0001	0.0001	0.0047	-0.0045	-0.0045	-97.5%	-97.5%
20	SB5VS-20	Li2O (wt%)	5.1777	5.6459	5.5200	-0.3423	0.1259	-6.2%	2.3%
20	SB5VS-20	MgO (wt%)	0.4730	0.4617	0.4786	-0.0056	-0.0169	-1.2%	-3.5%
20	SB5VS-20	MnO (wt%)	1.8174	1.7735	1.8423	-0.0250	-0.0688	-1.4%	-3.7%
20	SB5VS-20	Na2O (wt%)	12.4892	12.1740	12.8348	-0.3455	-0.6607	-2.7%	-5.1%
20	SB5VS-20	NiO (wt%)	0.9089	0.8696	0.9511	-0.0422	-0.0815	-4.4%	-8.6%
20	SB5VS-20	P2O5 (wt%)	0.0395	0.0395	0.1318	-0.0923	-0.0923	-70.0%	-70.0%
20	SB5VS-20	PbO (wt%)	0.0113	0.0113	0.0056	0.0057	0.0057	102.7%	102.7%
20	SB5VS-20	SiO2 (wt%)	49.9527	52.2083	53.1060	-3.1533	-0.8977	-5.9%	-1.7%
20	SB5VS-20	SO4 (wt%)	0.2517	0.2517	0.2270	0.0246	0.0246	10.8%	10.8%
20	SB5VS-20	TiO2 (wt%)	0.4007	0.3926	0.4052	-0.0044	-0.0126	-1.1%	-3.1%
20	SB5VS-20	U3O8 (wt%)	2.3496	2.4131	2.5023	-0.1528	-0.0893	-6.1%	-3.6%
20	SB5VS-20	ZnO (wt%)	0.0112	0.0112	0.0043	0.0069	0.0069	158.1%	158.1%
20	SB5VS-20	ZrO2 (wt%)	0.0493	0.0493	0.0465	0.0028	0.0028	6.0%	6.0%
20	SB5VS-20	Sum	95.2343	97.5285	99.9430	-4.7087	-2.4145	-4.7%	-2.4%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
21	SB5VS-21	Al2O3 (wt%)	7.3596	7.4348	7.8170	-0.4574	-0.3822	-5.9%	-4.9%
21	SB5VS-21	B2O3 (wt%)	5.3370	5.2689	5.0400	0.2970	0.2289	5.9%	4.5%
21	SB5VS-21	BaO (wt%)	0.0522	0.0498	0.0514	0.0008	-0.0017	1.5%	-3.2%
21	SB5VS-21	CaO (wt%)	0.8255	0.8236	0.8847	-0.0591	-0.0611	-6.7%	-6.9%
21	SB5VS-21	CdO (wt%)	0.0320	0.0320	0.0344	-0.0024	-0.0024	-7.0%	-7.0%
21	SB5VS-21	Ce2O3 (wt%)	0.0284	0.0284	0.0089	0.0195	0.0195	219.9%	219.9%
21	SB5VS-21	Cr2O3 (wt%)	0.0340	0.0321	0.0377	-0.0038	-0.0056	-10.0%	-15.0%
21	SB5VS-21	CuO (wt%)	0.0166	0.0161	0.0096	0.0070	0.0065	72.4%	67.1%
21	SB5VS-21	Fe2O3 (wt%)	9.7506	9.6772	10.6382	-0.8877	-0.9611	-8.3%	-9.0%
21	SB5VS-21	K2O (wt%)	0.0461	0.0459	0.0477	-0.0017	-0.0019	-3.5%	-3.9%
21	SB5VS-21	La2O3 (wt%)	0.0001	0.0001	0.0056	-0.0054	-0.0054	-97.9%	-97.9%
21	SB5VS-21	Li2O (wt%)	4.6556	5.0761	5.0400	-0.3844	0.0361	-7.6%	0.7%
21	SB5VS-21	MgO (wt%)	0.5414	0.5285	0.5713	-0.0298	-0.0428	-5.2%	-7.5%
21	SB5VS-21	MnO (wt%)	2.0627	2.0133	2.1989	-0.1362	-0.1856	-6.2%	-8.4%
21	SB5VS-21	Na2O (wt%)	13.2205	12.8869	13.7705	-0.5500	-0.8837	-4.0%	-6.4%
21	SB5VS-21	NiO (wt%)	1.0326	0.9880	1.1352	-0.1025	-0.1472	-9.0%	-13.0%
21	SB5VS-21	P2O5 (wt%)	0.0613	0.0613	0.1573	-0.0960	-0.0960	-61.0%	-61.0%
21	SB5VS-21	PbO (wt%)	0.0108	0.0108	0.0067	0.0041	0.0041	61.7%	61.7%
21	SB5VS-21	SiO2 (wt%)	47.5459	49.6819	48.6750	-1.1291	1.0069	-2.3%	2.1%
21	SB5VS-21	SO4 (wt%)	0.3176	0.3176	0.2710	0.0466	0.0466	17.2%	17.2%
21	SB5VS-21	TiO2 (wt%)	0.4720	0.4624	0.4836	-0.0115	-0.0212	-2.4%	-4.4%
21	SB5VS-21	U3O8 (wt%)	2.7004	2.7734	2.9866	-0.2863	-0.2132	-9.6%	-7.1%
21	SB5VS-21	ZnO (wt%)	0.0124	0.0124	0.0052	0.0073	0.0073	140.3%	140.3%
21	SB5VS-21	ZrO2 (wt%)	0.0527	0.0527	0.0555	-0.0028	-0.0028	-5.1%	-5.1%
21	SB5VS-21	Sum	96.1680	98.2741	99.9320	-3.7640	-1.6580	-3.8%	-1.7%
100	Batch 1	Al2O3 (wt%)	4.8245	4.8770	4.8770	-0.0525	0.0000	-1.1%	0.0%
100	Batch 1	B2O3 (wt%)	7.6043	7.7770	7.7770	-0.1727	0.0000	-2.2%	0.0%
100	Batch 1	BaO (wt%)	0.1577	0.1510	0.1510	0.0067	0.0000	4.4%	0.0%
100	Batch 1	CaO (wt%)	1.2137	1.2200	1.2200	-0.0063	0.0000	-0.5%	0.0%
100	Batch 1	CdO (wt%)	0.0010	0.0010	0.0000	0.0010	0.0010		
100	Batch 1	Ce2O3 (wt%)	0.0023	0.0023	0.0000	0.0023	0.0023		
100	Batch 1	Cr2O3 (wt%)	0.1111	0.1070	0.1070	0.0041	0.0000	3.8%	0.0%
100	Batch 1	CuO (wt%)	0.4047	0.3990	0.3990	0.0057	0.0000	1.4%	0.0%
100	Batch 1	Fe2O3 (wt%)	12.9221	12.8390	12.8390	0.0831	0.0000	0.6%	0.0%
100	Batch 1	K2O (wt%)	3.3354	3.3270	3.3270	0.0084	0.0000	0.3%	0.0%
100	Batch 1	La2O3 (wt%)	0.0005	0.0005	0.0000	0.0005	0.0005		
100	Batch 1	Li2O (wt%)	4.0152	4.4290	4.4290	-0.4138	0.0000	-9.3%	0.0%
100	Batch 1	MgO (wt%)	1.4422	1.4190	1.4190	0.0232	0.0000	1.6%	0.0%
100	Batch 1	MnO (wt%)	1.7603	1.7260	1.7260	0.0343	0.0000	2.0%	0.0%
100	Batch 1	Na2O (wt%)	9.1821	9.0030	9.0030	0.1791	0.0000	2.0%	0.0%
100	Batch 1	NiO (wt%)	0.7733	0.7510	0.7510	0.0223	0.0000	3.0%	0.0%
100	Batch 1	P2O5 (wt%)	0.0206	0.0206	0.0000	0.0206	0.0206		
100	Batch 1	PbO (wt%)	0.0066	0.0066	0.0000	0.0066	0.0066		
100	Batch 1	SiO2 (wt%)	49.3109	50.2200	50.2200	-0.9091	0.0000	-1.8%	0.0%
100	Batch 1	SO4 (wt%)	0.1330	0.1330	0.0000	0.1330	0.1330		
100	Batch 1	TiO2 (wt%)	0.7019	0.6770	0.6770	0.0249	0.0000	3.7%	0.0%
100	Batch 1	U3O8 (wt%)	0.0884	0.0916	0.0000	0.0884	0.0916		
100	Batch 1	ZnO (wt%)	0.0108	0.0108	0.0000	0.0108	0.0108		
100	Batch 1	ZrO2 (wt%)	0.0984	0.0984	0.0980	0.0004	0.0004	0.4%	0.4%
100	Batch 1	Sum	98.1211	99.2869	99.0200	-0.8989	0.2669	-0.9%	0.3%

Table 5 cont. Summary of the Target, Average Measured/Bias-Corrected Chemical Compositions

				Measured					
	Glass		Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Glass #	ID	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
200	Ustd	Al2O3 (wt%)	3.8661	3.9082	4.1000	-0.2339	-0.1918	-5.7%	-4.7%
200	Ustd	B2O3 (wt%)	9.4200	9.6356	9.2090	0.2110	0.4266	2.3%	4.6%
200	Ustd	BaO (wt%)	0.0014	0.0014	0.0000	0.0014	0.0014		
200	Ustd	CaO (wt%)	1.2681	1.2746	1.3010	-0.0329	-0.0264	-2.5%	-2.0%
200	Ustd	CdO (wt%)	0.0003	0.0003	0.0000	0.0003	0.0003		
200	Ustd	Ce2O3 (wt%)	0.0171	0.0171	0.0000	0.0171	0.0171		
200	Ustd	Cr2O3 (wt%)	0.2550	0.2457	0.0000	0.2550	0.2457		
200	Ustd	CuO (wt%)	0.0114	0.0112	0.0000	0.0114	0.0112		
200	Ustd	Fe2O3 (wt%)	13.1096	13.0261	13.1960	-0.0864	-0.1699	-0.7%	-1.3%
200	Ustd	K2O (wt%)	2.9098	2.9022	2.9990	-0.0892	-0.0968	-3.0%	-3.2%
200	Ustd	La2O3 (wt%)	0.0001	0.0001	0.0000	0.0001	0.0001		
200	Ustd	Li2O (wt%)	2.8502	3.1437	3.0570	-0.2068	0.0867	-6.8%	2.8%
200	Ustd	MgO (wt%)	1.1955	1.1761	1.2100	-0.0145	-0.0339	-1.2%	-2.8%
200	Ustd	MnO (wt%)	2.7596	2.7064	2.8920	-0.1324	-0.1856	-4.6%	-6.4%
200	Ustd	Na2O (wt%)	11.7119	11.4841	11.7950	-0.0831	-0.3109	-0.7%	-2.6%
200	Ustd	NiO (wt%)	1.0602	1.0298	1.1200	-0.0598	-0.0902	-5.3%	-8.1%
200	Ustd	P2O5 (wt%)	0.0206	0.0206	0.0000	0.0206	0.0206		
200	Ustd	PbO (wt%)	0.0032	0.0032	0.0000	0.0032	0.0032		
200	Ustd	SiO2 (wt%)	47.0052	47.8674	45.3530	1.6522	2.5144	3.6%	5.5%
200	Ustd	SO4 (wt%)	0.1070	0.1070	0.0000	0.1070	0.1070		
200	Ustd	TiO2 (wt%)	0.9917	0.9567	1.0490	-0.0573	-0.0923	-5.5%	-8.8%
200	Ustd	U3O8 (wt%)	2.3243	2.4060	2.4060	-0.0817	0.0000	-3.4%	0.0%
200	Ustd	ZnO (wt%)	0.0097	0.0097	0.0000	0.0097	0.0097		
200	Ustd	ZrO2 (wt%)	0.0032	0.0032	0.0000	0.0032	0.0032		
200	Ustd	Sum	100.9013	101.9366	99.6870	1.2143	2.2496	1.2%	2.3%

Table 6. Normalized PCT Data

Glass ID	WL(%)	Frit	Sludge Case	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
ARM	0	ref	ref	ref	reference	-0.2748	-0.1767	-0.2695	-0.5202	0.531	0.666	0.538	0.302
EA	0	ref	ref	ref	reference	1.2382	1.0154	1.1201	0.6070	17.307	10.360	13.185	4.046
ARM	0	ref	ref	ref	reference	-0.3218	-0.2304	-0.2885	-0.5493	0.477	0.588	0.515	0.282
EA	0	ref	ref	ref	reference	1.2328	0.9993	1.1233	0.6075	17.094	9.984	13.283	4.051
SB5VS-01	34	418	D-Optimal EV	ccc	targeted	-0.0803	0.0473	-0.0309	-0.1773	0.831	1.115	0.931	0.665
SB5VS-01	34	418	D-Optimal EV	quenched	targeted	-0.1051	0.0125	-0.0121	-0.1808	0.785	1.029	0.973	0.660
SB5VS-01	34	418	D-Optimal EV	ccc	Measured	-0.0914	0.0951	-0.0332	-0.1744	0.810	1.245	0.926	0.669
SB5VS-01	34	418	D-Optimal EV	quenched	Measured	-0.1163	0.0602	-0.0144	-0.1778	0.765	1.149	0.967	0.664
SB5VS-01	34	418	D-Optimal EV	ccc	Measured bc	-0.1101	0.0455	-0.0281	-0.1718	0.776	1.110	0.937	0.673
SB5VS-01	34	418	D-Optimal EV	quenched	Measured bc	-0.1349	0.0106	-0.0093	-0.1752	0.733	1.025	0.979	0.668
SB5VS-02	34	418	D-Optimal EV	ccc	targeted	-0.1200	0.0052	-0.0416	-0.1938	0.759	1.012	0.909	0.640
SB5VS-02	34	418	D-Optimal EV	quenched	targeted	-0.1124	-0.0095	-0.0080	-0.1916	0.772	0.978	0.982	0.643
SB5VS-02	34	418	D-Optimal EV	ccc	Measured	-0.1351	0.0290	-0.0204	-0.1696	0.733	1.069	0.954	0.677
SB5VS-02	34	418	D-Optimal EV	quenched	Measured	-0.1274	0.0142	0.0133	-0.1674	0.746	1.033	1.031	0.680
SB5VS-02	34	418	D-Optimal EV	ccc	Measured bc	-0.1295	-0.0085	-0.0093	-0.1888	0.742	0.981	0.979	0.647
SB5VS-02	34	418	D-Optimal EV	quenched	Measured bc	-0.1219	-0.0232	0.0244	-0.1866	0.755	0.948	1.058	0.651
SB5VS-03	34	418	D-Optimal EV	ccc	targeted	-0.0767	0.0119	-0.0711	-0.2273	0.838	1.028	0.849	0.593
SB5VS-03	34	418	D-Optimal EV	quenched	targeted	-0.0737	0.0034	-0.0508	-0.2173	0.844	1.008	0.890	0.606
SB5VS-03	34	418	D-Optimal EV	ccc	Measured	-0.0366	0.0661	-0.0668	-0.2013	0.919	1.164	0.858	0.629
SB5VS-03	34	418	D-Optimal EV	quenched	Measured	-0.0336	0.0576	-0.0465	-0.1914	0.926	1.142	0.899	0.644
SB5VS-03	34	418	D-Optimal EV	ccc	Measured bc	-0.0553	0.0164	-0.0616	-0.1988	0.880	1.039	0.868	0.633
SB5VS-03	34	418	D-Optimal EV	quenched	Measured bc	-0.0523	0.0079	-0.0413	-0.1888	0.886	1.018	0.909	0.647
SB5VS-04	34	418	D-Optimal EV	ccc	targeted	-0.0083	0.1334	0.1034	-0.1185	0.981	1.360	1.269	0.761
SB5VS-04	34	418	D-Optimal EV	quenched	targeted	-0.0110	0.1068	0.1329	-0.1092	0.975	1.279	1.358	0.778
SB5VS-04	34	418	D-Optimal EV	ccc	Measured	-0.0227	0.1712	0.1226	-0.0890	0.949	1.483	1.326	0.815
SB5VS-04	34	418	D-Optimal EV	quenched	Measured	-0.0254	0.1445	0.1521	-0.0796	0.943	1.395	1.419	0.832
SB5VS-04	34	418	D-Optimal EV	ccc	Measured bc	-0.0171	0.1336	0.1337	-0.1081	0.961	1.360	1.361	0.780
SB5VS-04	34	418	D-Optimal EV	quenched	Measured bc	-0.0198	0.1069	0.1632	-0.0988	0.955	1.279	1.456	0.797
SB5VS-05	34	418	D-Optimal EV	ccc	targeted	-0.1185	-0.0187	-0.1119	-0.2570	0.761	0.958	0.773	0.553
SB5VS-05	34	418	D-Optimal EV	quenched	targeted	-0.1439	-0.0556	-0.1182	-0.2892	0.718	0.880	0.762	0.514
SB5VS-05	34	418	D-Optimal EV	ccc	Measured	-0.1251	0.0074	-0.1084	-0.2367	0.750	1.017	0.779	0.580
SB5VS-05	34	418	D-Optimal EV	quenched	Measured	-0.1505	-0.0295	-0.1147	-0.2689	0.707	0.934	0.768	0.538
SB5VS-05	34	418	D-Optimal EV	ccc	Measured bc	-0.1195	-0.0301	-0.0973	-0.2558	0.759	0.933	0.799	0.555
SB5VS-05	34	418	D-Optimal EV	quenched	Measured bc	-0.1449	-0.0670	-0.1036	-0.2880	0.716	0.857	0.788	0.515
SB5VS-06	34	418	D-Optimal EV	ccc	targeted	-0.1443	-0.0066	-0.0664	-0.2377	0.717	0.985	0.858	0.579
SB5VS-06	34	418	D-Optimal EV	quenched	targeted	-0.1338	-0.0067	-0.0393	-0.2335	0.735	0.985	0.914	0.584
SB5VS-06	34	418	D-Optimal EV	ccc	Measured	-0.1806	0.0333	-0.0694	-0.2420	0.660	1.080	0.852	0.573
SB5VS-06	34	418	D-Optimal EV	quenched	Measured	-0.1700	0.0333	-0.0423	-0.2378	0.676	1.080	0.907	0.578
SB5VS-06	34	418	D-Optimal EV	ccc	Measured bc	-0.1992	-0.0162	-0.0643	-0.2393	0.632	0.963	0.862	0.576
SB5VS-06	34	418	D-Optimal EV	quenched	Measured bc	-0.1887	-0.0163	-0.0371	-0.2352	0.648	0.963	0.918	0.582
SB5VS-07	34	418	D-Optimal EV	ccc	targeted	-0.0220	0.0973	0.0885	-0.1386	0.951	1.251	1.226	0.727
SB5VS-07	34	418	D-Optimal EV	quenched	targeted	-0.0235	0.0919	0.1155	-0.1236	0.947	1.236	1.305	0.752
SB5VS-07	34	418	D-Optimal EV	ccc	Measured	-0.0490	0.1488	0.1129	-0.1352	0.893	1.408	1.297	0.733
SB5VS-07	34	418	D-Optimal EV	quenched	Measured	-0.0505	0.1434	0.1400	-0.1202	0.890	1.391	1.380	0.758
SB5VS-07	34	418	D-Optimal EV	ccc	Measured bc	-0.0678	0.0990	0.1223	-0.1327	0.856	1.256	1.325	0.737
SB5VS-07	34	418	D-Optimal EV	quenched	Measured bc	-0.0692	0.0936	0.1494	-0.1177	0.853	1.241	1.411	0.763

Table 6 cont. Normalized PCT Data

Glass ID	WL(%)	Frit	Sludge Case	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB5VS-08	34	418	D-Optimal EV	ccc	targeted	-0.1502	-0.0335	-0.1270	-0.2414	0.708	0.926	0.747	0.574
SB5VS-08	34	418	D-Optimal EV	quenched	targeted	-0.1741	-0.0597	-0.1310	-0.2537	0.670	0.871	0.740	0.558
SB5VS-08	34	418	D-Optimal EV	ccc	Measured	-0.1456	0.0057	-0.1207	-0.2362	0.715	1.013	0.757	0.580
SB5VS-08	34	418	D-Optimal EV	quenched	Measured	-0.1695	-0.0205	-0.1247	-0.2485	0.677	0.954	0.750	0.564
SB5VS-08	34	418	D-Optimal EV	ccc	Measured bc	-0.1621	-0.0350	-0.1113	-0.2438	0.688	0.923	0.774	0.570
SB5VS-08	34	418	D-Optimal EV	quenched	Measured bc	-0.1860	-0.0612	-0.1153	-0.2561	0.652	0.868	0.767	0.554
SB5VS-09	34	418	D-Optimal EV	ccc	targeted	-0.1598	-0.0443	-0.1126	-0.2582	0.692	0.903	0.772	0.552
SB5VS-09	34	418	D-Optimal EV	quenched	targeted	-0.1466	-0.0403	-0.0774	-0.2476	0.713	0.911	0.837	0.565
SB5VS-09	34	418	D-Optimal EV	ccc	Measured	-0.1755	-0.0041	-0.0902	-0.2534	0.668	0.991	0.812	0.558
SB5VS-09	34	418	D-Optimal EV	quenched	Measured	-0.1623	-0.0002	-0.0551	-0.2429	0.688	1.000	0.881	0.572
SB5VS-09	34	418	D-Optimal EV	ccc	Measured bc	-0.1922	-0.0449	-0.0851	-0.2611	0.642	0.902	0.822	0.548
SB5VS-09	34	418	D-Optimal EV	quenched	Measured bc	-0.1790	-0.0409	-0.0499	-0.2505	0.662	0.910	0.891	0.562
SB5VS-10	34	418	D-Optimal EV	ccc	targeted	-0.1907	-0.0611	-0.1460	-0.2564	0.645	0.869	0.715	0.554
SB5VS-10	34	418	D-Optimal EV	quenched	targeted	-0.1885	-0.0521	-0.1212	-0.2692	0.648	0.887	0.756	0.538
SB5VS-10	34	418	D-Optimal EV	ccc	Measured	-0.1868	-0.0126	-0.1414	-0.2511	0.650	0.971	0.722	0.561
SB5VS-10	34	418	D-Optimal EV	quenched	Measured	-0.1846	-0.0036	-0.1166	-0.2640	0.654	0.992	0.764	0.545
SB5VS-10	34	418	D-Optimal EV	ccc	Measured bc	-0.2056	-0.0623	-0.1320	-0.2486	0.623	0.866	0.738	0.564
SB5VS-10	34	418	D-Optimal EV	quenched	Measured bc	-0.2034	-0.0533	-0.1072	-0.2615	0.626	0.885	0.781	0.548
SB5VS-11	34	418	D-Optimal EV	ccc	targeted	-0.0753	0.0241	-0.0439	-0.1911	0.841	1.057	0.904	0.644
SB5VS-11	34	418	D-Optimal EV	quenched	targeted	-0.0845	0.0117	-0.0211	-0.1971	0.823	1.027	0.952	0.635
SB5VS-11	34	418	D-Optimal EV	ccc	Measured	-0.0766	0.0388	-0.0452	-0.2045	0.838	1.094	0.901	0.624
SB5VS-11	34	418	D-Optimal EV	quenched	Measured	-0.0858	0.0264	-0.0224	-0.2105	0.821	1.063	0.950	0.616
SB5VS-11	34	418	D-Optimal EV	ccc	Measured bc	-0.0932	-0.0018	-0.0400	-0.2120	0.807	0.996	0.912	0.614
SB5VS-11	34	418	D-Optimal EV	quenched	Measured bc	-0.1024	-0.0142	-0.0172	-0.2180	0.790	0.968	0.961	0.605
SB5VS-12	34	418	D-Optimal EV	ccc	targeted	-0.0352	0.1071	0.0615	-0.1065	0.922	1.280	1.152	0.782
SB5VS-12	34	418	D-Optimal EV	quenched	targeted	-0.0360	0.0676	0.0914	-0.0760	0.920	1.169	1.234	0.839
SB5VS-12	34	418	D-Optimal EV	ccc	Measured	-0.0386	0.1313	0.0574	-0.0985	0.915	1.353	1.141	0.797
SB5VS-12	34	418	D-Optimal EV	quenched	Measured	-0.0394	0.0918	0.0873	-0.0680	0.913	1.235	1.223	0.855
SB5VS-12	34	418	D-Optimal EV	ccc	Measured bc	-0.0551	0.0906	0.0625	-0.1061	0.881	1.232	1.155	0.783
SB5VS-12	34	418	D-Optimal EV	quenched	Measured bc	-0.0559	0.0512	0.0924	-0.0756	0.879	1.125	1.237	0.840
SB5VS-13	34	418	SB5 Centroid	ccc	targeted	-0.1153	-0.0027	-0.0537	-0.2230	0.767	0.994	0.884	0.598
SB5VS-13	34	418	SB5 Centroid	quenched	targeted	-0.1118	-0.0127	-0.0341	-0.2097	0.773	0.971	0.925	0.617
SB5VS-13	34	418	SB5 Centroid	ccc	Measured	-0.1147	0.0263	-0.0464	-0.2301	0.768	1.062	0.899	0.589
SB5VS-13	34	418	SB5 Centroid	quenched	Measured	-0.1112	0.0163	-0.0268	-0.2168	0.774	1.038	0.940	0.607
SB5VS-13	34	418	SB5 Centroid	ccc	Measured bc	-0.1312	-0.0143	-0.0370	-0.2376	0.739	0.968	0.918	0.579
SB5VS-13	34	418	SB5 Centroid	quenched	Measured bc	-0.1277	-0.0243	-0.0174	-0.2243	0.745	0.946	0.961	0.597
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	targeted	-0.1419	-0.0475	-0.0547	-0.2378	0.721	0.896	0.882	0.578
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	targeted	-0.1349	-0.0672	-0.0572	-0.2490	0.733	0.857	0.877	0.564
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured	-0.1601	-0.0149	-0.0515	-0.2138	0.692	0.966	0.888	0.611
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured	-0.1531	-0.0345	-0.0540	-0.2250	0.703	0.924	0.883	0.596
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured bc	-0.1545	-0.0524	-0.0404	-0.2330	0.701	0.886	0.911	0.585
SB5VS-14	34	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured bc	-0.1475	-0.0721	-0.0429	-0.2442	0.712	0.847	0.906	0.570
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	targeted	-0.1490	-0.0561	-0.0593	-0.2457	0.710	0.879	0.872	0.568
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	targeted	-0.1515	-0.0629	-0.0378	-0.2443	0.706	0.865	0.917	0.570
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured	-0.1081	-0.0177	-0.0566	-0.2481	0.780	0.960	0.878	0.565
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured	-0.1106	-0.0245	-0.0351	-0.2468	0.775	0.945	0.922	0.567
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured bc	-0.1267	-0.0673	-0.0472	-0.2456	0.747	0.856	0.897	0.568
SB5VS-15	34	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured bc	-0.1292	-0.0741	-0.0258	-0.2442	0.743	0.843	0.942	0.570

Table 6 cont. Normalized PCT Data

Glass ID	WL(%)	Frit	Sludge Case	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li(g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B(g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	targeted	-0.1498	-0.0258	-0.0530	-0.2328	0.708	0.942	0.885	0.585
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	targeted	-0.1549	-0.0488	-0.0547	-0.2388	0.700	0.894	0.882	0.577
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured	-0.1582	0.0200	-0.0512	-0.2296	0.695	1.047	0.889	0.589
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured	-0.1632	-0.0030	-0.0529	-0.2355	0.687	0.993	0.885	0.581
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured bc	-0.1769	-0.0295	-0.0418	-0.2269	0.665	0.934	0.908	0.593
SB5VS-16	31	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured bc	-0.1819	-0.0524	-0.0435	-0.2328	0.658	0.886	0.905	0.585
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	targeted	-0.0964	-0.0304	-0.0458	-0.2281	0.801	0.932	0.900	0.591
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	targeted	-0.1345	-0.0687	-0.0480	-0.2683	0.734	0.854	0.895	0.539
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured	-0.1187	-0.0059	-0.0268	-0.2196	0.761	0.987	0.940	0.603
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured	-0.1567	-0.0442	-0.0290	-0.2598	0.697	0.903	0.935	0.550
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	ccc	Measured bc	-0.1131	-0.0434	-0.0157	-0.2387	0.771	0.905	0.964	0.577
SB5VS-17	37	418	BS-07 (C40/C51 25/75 w 3% SO)	quenched	Measured bc	-0.1512	-0.0817	-0.0179	-0.2789	0.706	0.829	0.960	0.526
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	targeted	-0.1323	-0.0325	-0.0816	-0.1924	0.737	0.928	0.829	0.642
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	targeted	-0.1454	-0.0220	-0.0604	-0.2236	0.715	0.951	0.870	0.598
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured	-0.1321	-0.0073	-0.0581	-0.1900	0.738	0.983	0.875	0.646
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured	-0.1452	0.0032	-0.0369	-0.2213	0.716	1.007	0.919	0.601
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured bc	-0.1486	-0.0480	-0.0487	-0.1977	0.710	0.895	0.894	0.634
SB5VS-18	25	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured bc	-0.1618	-0.0375	-0.0275	-0.2289	0.689	0.917	0.939	0.590
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	targeted	-0.1517	-0.0212	-0.0614	-0.2012	0.705	0.952	0.868	0.629
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	targeted	-0.1335	-0.0045	-0.0189	-0.2009	0.735	0.990	0.957	0.630
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured	-0.1390	-0.0054	-0.0619	-0.1968	0.726	0.988	0.867	0.636
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured	-0.1208	0.0113	-0.0194	-0.1965	0.757	1.026	0.956	0.636
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured bc	-0.1557	-0.0461	-0.0568	-0.2044	0.699	0.899	0.877	0.625
SB5VS-19	28	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured bc	-0.1374	-0.0294	-0.0143	-0.2040	0.729	0.935	0.968	0.625
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	targeted	-0.1185	-0.0289	-0.0606	-0.2102	0.761	0.936	0.870	0.616
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	targeted	-0.1313	-0.0340	-0.0384	-0.2101	0.739	0.925	0.915	0.616
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured	-0.1244	-0.0011	-0.0487	-0.1836	0.751	0.997	0.894	0.655
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured	-0.1371	-0.0062	-0.0265	-0.1835	0.729	0.986	0.941	0.655
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured bc	-0.1188	-0.0387	-0.0376	-0.2027	0.761	0.915	0.917	0.627
SB5VS-20	31	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured bc	-0.1315	-0.0438	-0.0154	-0.2027	0.739	0.904	0.965	0.627
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	targeted	-0.0863	-0.0235	-0.0176	-0.2101	0.820	0.947	0.960	0.617
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	targeted	-0.0827	-0.0443	-0.0058	-0.2089	0.827	0.903	0.987	0.618
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured	-0.1112	0.0109	0.0001	-0.1999	0.774	1.026	1.000	0.631
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured	-0.1076	-0.0099	0.0119	-0.1987	0.781	0.977	1.028	0.633
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	ccc	Measured bc	-0.1056	-0.0266	0.0112	-0.2189	0.784	0.941	1.026	0.604
SB5VS-21	37	418	BS-15 (C40/C51 25/75 w 3% ARP)	quenched	Measured bc	-0.1020	-0.0474	0.0230	-0.2178	0.791	0.897	1.054	0.606

7.0 References

1. K.M. Fox, T.B. Edwards, and D.K. Peeler, "Recommended Frit Composition for Initial Sludge Batch 5 Processing at the Defense Waste Processing Facility," Savannah River National Laboratory, Aiken, SC, WSRC-STI-2008-00338, Rev. 0, 2008.

2. B.H. Culbertson, "Sludge Batch 5 Glass Variability Studies," Defense Waste Processing Facility, Aiken, SC, Technical Task Request HLW-DWPF-TTR-2007-0009, Rev. 0, 2006.

3. D.K. Peeler, "Sludge Batch 5 Glass Variability Studies," Savannah River National Laboratory, Aiken, SC, WSRC-STI-2006-00320, Rev. 0, 2007.

4. JMP™ Version 6.0.3, SAS Institute Inc., Cary, NC, 2005.

5. B.R. Pickenheim, J.M. Pareizs, C.J. Bannochie, H.M. Ajo, and S.H. Reboul, "Data from the SRNL Shielded Cells Demonstration of the DWPF Srat Using SB5 Tank 51 Qualification Sample (SC-6)," Savannah River National Laboratory, Aiken, SC, SRNL-PSE-2008-00157, 2008.

6. C.C. Herman, T.B. Edwards, D.R. Best, D.M. Marsh, and R.J. Workman, "Reduction of Constraints: Phase 2 Experimental Assessment for Sludge-Only Processing," Savannah River National Laboratory, Aiken, SC, WSRC-TR-2002-00482 Rev. 0, 2002.

7. F.C. Raszewski and M.E. Stone, "Experimental Testing to Support Additional SB4 Tank 40 Decants (TT&QAP)," Savannah River National Laboratory, Aiken, SC, WSRC-STI-2008-00254, Rev. 0, 2008.

8. S.L. Marra and C.M. Jantzen, "Characterization of Projected DWPF Glass Heat Treated to Simulate Canister Centerline Cooling," Westinghouse Savannah River Company, Aiken, SC, WSRC-TR-92-142, Rev. 1, 1993.

9. T.B. Edwards, "An Analytical Plan for Measuring the Chemical Compositions of SB5 Variability Study Glasses," Savannah River National Laboratory, Aiken, SC, SRNL-SCS-2008-00071, 2008.

10. "Standard Test Methods for Determining Chemical Durability of Nuclear, Hazardous, and Mixed Waste Glasses and Multiphase Glass Ceramics: The Product Consistency Test (PCT)," ASTM International, West Conshohocken, PA, ASTM C 1285-02, 2002.

11. T.B. Edwards, "An Analytical Plan for Measuring the First Set of PCT Solutions for the SB5 VS Glasses," Savannah River National Laboratory, Aiken, SC, SRNL-SCS-2008-00072, 2008.

12. T.B. Edwards, "An Analytical Plan for Measuring the Second Set of PCT Solutions for the SB5 VS Glasses," Savannah River National Laboratory, Aiken, SC, SRNL-SCS-2008-00073, 2008.

13. F.C. Raszewski, T.B. Edwards, and D.K. Peeler, "A Review of the Chemical Compositional and PCT Measurements for the SB5 Variability Study Glasses," Savannah River National Laboratory, Aiken, SC, SRNL-L3100-2008-00012, 2008.

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