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VARIABILITY STUDY WITH FRIT 510 TO SUPPORT A SECOND TANK 40 DECANT

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EXECUTIVE SUMMARY

Sludge Batch 4 (SB4) is currently being processed in the Defense Waste Processing Facility (DWPF) using Frit 510. The slurry pumps in Tank 40 are experiencing in-leakage of bearing water, which is causing the sludge slurry in Tank 40 to become dilute at a rapid rate. Currently, the DWPF is removing this dilution water by performing caustic boiling during the Sludge Receipt and Adjustment Tank (SRAT) cycle. In order to alleviate prolonged SRAT cycle times, which may eventually impact canister production rates, the Liquid Waste Organization (LWO) performed a 100K gallon supernate decant of Tank 40 in April 2008. SRNL performed a supplemental glass variability study to support the April 2008 100K gallon decant incorporating the impact of coupled operations (addition of the Actinide Removal Process (ARP) stream).

Recently LWO requested that SRNL assess the impact of a second decant (up to 100K gallon) to the Frit 510-SB4 system. This second decant occurred in June 2008. LWO provided nominal compositions on May 6, 2008 representing Tank 40 prior to the second decant, following the second decant, and the SB4 Heel prior to blending with Tank 51 to constitute SB5. Paper study assessments were performed for these options based on sludge-only and coupled operations processing (ARP addition), as well as possible Na_2O additions (via NaOH additions) to both flowsheets. A review of the ComPro^{TM} database relative to the compositional region defined by the projections after the second decant coupled with Frit 510 identified only a few glasses with similar glass compositions. These glasses were acceptable from a durability perspective, but did not sufficiently cover the new glass compositional region. Therefore, SRNL recommended that a supplemental variability study be performed to support the June 2008 Tank 40 decant.

Glasses were selected for the variability study based on three sludge compositional projections (sludge-only, coupled and coupled + 2 wt% Na_2O) at waste loadings (WLs) of interest to DWPF (32%, 35% and 38%). These nine glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD) and the Product Consistency Test (PCT).

All of the glasses that were selected for this study satisfy the Product Composition Control System (PCCS) criteria and are deemed processable and acceptable for the DWPF, except for the SB4VS2-03 (sludge-only at 38% WL) target composition. This glass fails the T_L criterion and would not be considered processable based on Slurry Mix Evaporator (SME) acceptability decisions.

The durabilities of all of the study glasses (both quenched and ccc) are well below that of the normalized leachate for boron (NL [B]) of the reference EA glass (16.695 g/L) and are predictable using the current PCCS models. Very little variation exists between the NL [B] of the quenched and ccc versions of the glasses. There is some evidence of a trend toward a less durable glass as WL increases for some of the sludge projections.

Frit 510 is a viable option for the processing of SB4 after a *second* Tank 40 decant with or without the addition of products from the ARP stream as well as the 2 wt% Na_2O addition. The addition of ARP had no negative impacts on the acceptability and predictability of the variability study glasses.

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LIST OF ABBREVIATIONS

AD	Analytical Development
ANOVA	Analysis of Variance
ARM	Approved Reference Material
ARP	Actinide Removal Process
B Del Gp	ΔGp value for boron
bc	Bias-Corrected
ccc	Centerline Canister Cooling
CPC	Chemical Processing Cell
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
ppm	Parts per million
PSAL	Process Science Analytical Laboratory
SB4	Sludge Batch 4
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

Sludge Batch 4 (SB4) is currently being processed in the Defense Waste Processing Facility (DWPF) using Frit 510. The slurry pumps in Tank 40 are experiencing in-leakage of bearing water, which is causing the sludge slurry in Tank 40 to become dilute at a rapid rate. Currently, the DWPF is removing this dilution water by performing caustic boiling during the Sludge Receipt and Adjustment Tank (SRAT) cycle. In order to alleviate prolonged SRAT cycle times, which may eventually impact canister production rates, the Liquid Waste Organization (LWO) performed a 100K gallon supernate decant of Tank 40 in April 2008. SRNL performed a supplemental glass variability study to support the April 2008 100K gallon decant incorporating the impact of coupled operations (addition of the Actinide Removal Process (ARP) stream).[1]

Recently LWO requested that SRNL assess the impact of a second decant (up to 100K gallon) to the Frit 510-SB4 system. This second decant occurred in June 2008. LWO provided nominal compositions on May 6, 2008 representing Tank 40 prior to the second decant, following the second decant, and the SB4 Heel prior to blending with Tank 51 to constitute SB5. Paper study assessments were performed for these options based on sludge-only and coupled operations, as well as possible NaOH additions to both flowsheets.[a,2] A review of the ComPro™ database relative to the compositional region defined by the projections after the second decant coupled with Frit 510 identified only a few historical glasses with similar compositions. These glasses were acceptable from a durability perspective, but did not sufficiently cover the new glass compositional region. Therefore, SRNL recommended that a supplemental variability study be performed to support the June 2008 Tank 40 decant.[2] This work was carried out under the auspices of a Technical Task Request (TTR) issued by LWO and a Task Technical and Quality Assurance Plan (TT&QAP).[3,4]

1.1 Glass Selection Strategy for the Second Variability Study

Three nominal sludge compositions were chosen to be combined with Frit 510 for the experimental variability study:

1. Sludge-only [*Tk 40 Post Late Decant*][b]
2. Coupled[c] [*Tk 40 Post Late Decant w ARP*]
3. Coupled + 2 wt% Na_2O [*Tk 40 Post Late Decant w ARP + 2% Na2O*]

Both options 1 and 2 (sludge-only and coupled) were chosen as bounding conditions for the study. Option 3 (Coupled + 2 wt% Na_2O) was chosen based on the results of the Measurement Acceptability Region (MAR) paper study assessments.[2] LWO was considering the addition of NaOH to Tank 40 or in the Chemical Processing Cell (CPC) in order to increase the size of the projected operating window and/or improve melt rate (assuming that melt rate would be reduced by the decant and/or ARP addition). The MAR assessments indicated that the addition of 1 and 2 wt% Na_2O to a coupled operations flowsheet was feasible; however, the addition of 3 wt% Na_2O caused the system to become limited by nepheline at the upper waste loading. Thus, the 2 wt% addition was chosen for this study, as the upper waste loading was only limited by liquidus temperature (T_L).

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[a] The projected compositions were provided by LWO on May 6, 2008 (D. Larsen via email communication) and are documented in WSRC-STI-2008-00254. Supplemental washing information was provided by J. Gillam (via D. Larsen email and entitled SB4-5_042808_50% retention_40 Decant 2 for 51 Wash D_20cpm.xls).
[b] The terminology in brackets refers to the nomenclature used by LWO.
[c] Compositional information for ARP additions was obtained from X-CLC-S-00113, Rev. 0, Actinide Removal Process Material Balance Calculation with Low Curie Salt Feed, S.G. Subosits, 9/24/2004.

For each of the three sludge options, glasses were selected at waste loadings (WLs) of interest to DWPF (32%, 35% and 38%). These nine glasses were fabricated and characterized using chemical composition analysis, X-ray Diffraction (XRD) and the Product Consistency Test (PCT).[3,4]

2.0 Objectives

The intent of the experimental portion of the variability study was to demonstrate that the glasses of the Frit 510-modified SB4 compositional region (Options 1-3) after a *second* Tank 40 decant were both acceptable relative to the Environmental Assessment (EA) reference glass and predictable by the current process control models for durability.

3.0 Experimental Procedure

3.1 Target Glass Compositions

Target glass compositions of the nine SB4 Tank 40 second decant variability study glasses are presented in Table 1. The nomenclature for the glass identification (ID) can be described as follows: "SB4VS2" refers to Sludge Batch 4 Variability Study 2.

Table 1. Target Compositions of the Second Variability Study Glasses

Glass ID	Sludge - Only			Coupled			Coupled + 2 wt% Na_2O		
	SB4VS2-01	SB4VS2-02	SB4VS2-03	SB4VS2-04	SB4VS2-05	SB4VS2-06	SB4VS2-07	SB4VS2-08	SB4VS2-09
Frit	**510**	**510**	**510**	**510**	**510**	**510**	**510**	**510**	**510**
WL	**32**	**35**	**38**	**32**	**35**	**38**	**32**	**35**	**38**
Al_2O_3	8.63	9.44	10.25	8.31	9.08	9.86	8.11	8.87	9.63
B_2O_3	9.52	9.10	8.68	9.52	9.10	8.68	9.52	9.10	8.68
BaO	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03
CaO	0.95	1.04	1.13	0.92	1.01	1.09	0.90	0.98	1.07
Ce_2O_3	0.02	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.03
Cr_2O_3	0.06	0.06	0.07	0.05	0.06	0.07	0.05	0.06	0.06
CuO	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Fe_2O_3	9.87	10.79	11.72	9.57	10.47	11.37	9.35	10.22	11.10
K_2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
La_2O_3	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Li_2O	5.44	5.20	4.96	5.44	5.20	4.96	5.44	5.20	4.96
MgO	0.93	1.02	1.11	0.89	0.97	1.06	0.87	0.95	1.03
MnO	1.98	2.17	2.35	1.95	2.14	2.32	1.91	2.09	2.27
Na_2O	10.20	10.40	10.61	10.60	10.84	11.08	11.24	11.54	11.84
NiO	0.55	0.60	0.65	0.55	0.60	0.65	0.53	0.58	0.63
PbO	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02
SO_4	0.19	0.20	0.22	0.22	0.24	0.26	0.22	0.24	0.26
SiO_2	48.53	46.51	44.50	48.49	46.47	44.46	48.47	46.45	44.43
TiO_2	0.02	0.02	0.02	0.43	0.47	0.51	0.42	0.46	0.50
U_3O_8	3.01	3.29	3.57	2.91	3.18	3.46	2.84	3.11	3.38
ZnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO_2	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03

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.[4] The raw materials were thoroughly mixed and placed into a 95% platinum / 5% gold, 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.[5] 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 the Process Science Analytical Laboratory (PSAL) for chemical analysis under the auspices of an analytical plan.[6] Two dissolution methods were utilized in measuring these chemical compositions: samples prepared by lithium metaborate (LM) dissolution were used to measure elemental concentrations of aluminum (Al), barium (Ba), calcium (Ca), cerium (Ce), chromium (Cr), copper (Cu), lanthanum (La), magnesium (Mg), manganese (Mn), sodium (Na), nickel (Ni), lead (Pb), sulfur (S), silicon (Si), titanium (Ti), uranium (U), and zirconium (Zr), while samples from glasses prepared by peroxide fusion (PF) dissolution were used to measure elemental concentrations of boron (B), iron (Fe), and lithium (Li). 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.

3.3.2 PCT

A 7-day PCT was performed in triplicate on each quenched and ccc glass to assess chemical durability using Method A of the PCT procedure.[7] 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 PSAL under the auspices of an analytical plan.[8] Samples of a multi-element, standard solution were also included in the analytical plan (as a check on the accuracy of the ICP-AES). Normalized release rates were calculated based on target, measured, and bias-corrected (bc) compositions using the average of the logs of the leachate concentrations.

3.3.3 XRD

Representative samples of quenched and ccc glasses were submitted to Analytical Development (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%.

4.0 Results and Discussion

4.1 Statistical Review of the Chemical Composition Measurements

Table A1 in Appendix A provides the elemental concentration measurements derived from the samples prepared using LM and Table A2 in Appendix A provides the measurements derived from the samples prepared using PF. Measured values of the standards (Batch 1 and a uranium standard, U_{std}) that were included in the PSAL analytical plan along with the study glasses are also provided in these two tables.

The elemental concentrations were converted to oxide concentrations by multiplying the values for each element by the gravimetric factor for the corresponding oxide. During this process, an elemental concentration that was determined to be below the detection limit of the analytical procedures used by the PSAL was reduced to half of that detection limit as the oxide concentration was determined.

4.1.1 Measurements in Analytical Sequence

Figure A1 in Appendix A provides plots of the measurements (in analytical sequence) generated by the PSAL for samples prepared using the LM method. Different symbols and colors are used to represent each of the study and standard glasses. Similar plots are provided in Figure A2 in Appendix A for the samples prepared using the PF method. These plots include all of the measurement data from Tables A1 and A2. While obvious patterns in these plots are difficult to find, a pair of CaO values for one of the study glasses (symbol "X") does stand out from the other pair of CaO values (see Figure A1). A similar trend is also observed for a pair of Li_2O values (see Figure A2). Other significant trends in the analytical process over the course of these measurements are difficult to discern from these plots; more detailed discussions are provided in the following sections.

4.1.2 Composition Measurements by Glass Identifier

Figures A3 and A4 in Appendix A provide plots of the oxide concentration measurements by Glass ID (including Batch 1 and U_{std}) by analytical solution ID for the LM and PF preparation methods, respectively. Different symbols and colors are used to represent the different glasses. These plots show the individual measurements across the duplicates of each preparation method and the two ICP-AES calibrations within each analytical set. A review of the plots presented in these figures reveals the repeatability of the four individual values for each oxide for each glass. The pair of CaO values discussed in the previous section (Section 4.1.1) is associated with glass ID SB4VS-02, which corresponds to Lab ID A09LM. There also appears to be a great deal of scatter in the Fe_2O_3 and Li_2O results for the PF preparations of this same glass. In addition, note that the reference value for the Fe_2O_3 concentration in the U_{std} glass is 13.196 wt%, while the measured values of this oxide are around 10 wt%, and the reference value for Li_2O for U_{std} is 3.057 wt%, while the measured values are around 5 wt% as shown in Figure A4. Due to these inconsistencies, it was requested that PSAL re-measure the solutions for SB4VS2-02 (Lab ID A09) for both prep methods as well as to re-prep and re-measure the standards (Batch 1 and U_{std}) by both prep methods.[d,e] The results from these

[d] Concerns about values measured for glass ID SB4VS-09 (Lab ID A08) were also expressed by D. Best from PSAL via email on 5/29/2008. Thus, this sample was also re-measured (in addition to SB4VS-02) and the newly measured values were also used in the determination of chemical compositions.
[e] The U_{std} is used for bias-correcting only.

additional measurements are provided in Table A3 in Appendix A and are discussed in the following sections to guide the reader through the method in which these data were re-evaluated and used to support the objectives of this task.

4.1.3 Batch 1 and Uranium Standard Results

Figure A5 in Appendix A provides statistical analyses of the Batch 1 and U_{std} results generated by the LM prep method by calibration block for each oxide of interest (reference values for the oxide concentrations of the standard are given in the header for each set of measurements in the figure). The results include analysis of variance (ANOVA) investigations, which determine statistically significant differences between the means of these groups for each of the oxides for each of the standards. The measured values of Al_2O_3, MnO, TiO_2, and ZrO_2 indicate that a significant ICP-AES calibration effect on the block averages at the 5% significance level for the Batch 1 standard. For the U_{std}, CaO, CuO, and Na_2O have values that indicate a significant ICP-AES calibration effect on the block averages at the 5% significance level.

Figure A6 in Appendix A provides a similar set of analyses for the measurements derived from samples prepared via the PF method (reference values for the oxide concentrations of the standard are given in the headers for each set of measurements in the figure). Li_2O has measurements that indicate significant ICP-AES calibration effects on the block averages at the 5% significance level for the Batch 1 standard. For the U_{std}, note that both the Fe_2O_3 and Li_2O measurements of the third block correspond more closely to the reference values than the first two blocks. It is probable the PF results of the U_{std} standard samples reported in Table A2 were mislabeled. These values are most likely from another glass sample other than the U_{std}. Therefore, the PF results from Table A2 for U_{std} will not be utilized in the remainder of the report.

In addition, some of the results from the statistical analyses provide incentive for adjusting the measurements by the effects of the ICP-AES calibration. Therefore, the oxide measurements of the study glasses were bias corrected for the effect of the ICP-AES calibration on each of the analytical blocks and sub-blocks. The average measurement of Batch 1 results for each ICP-AES block/sub-block were used to bias correct the Al_2O_3, B_2O_3, BaO, CaO, Cr_2O_3, CuO, Fe_2O_3, K_2O, Li_2O, MgO, MnO, Na_2O, NiO, SiO_2, and TiO_2 measurements, and the average measurement of the U_{std} values for each set/block were used to bias correct the U_3O_8 measurements. Note that this approach utilizes the LM results for the U_{std} and not the PF results. For oxides other than U_3O_8, the Batch 1 results were used to conduct the bias correction as long as the reference value for the oxide concentration in the Batch 1 glass was greater than or equal to 0.1 wt%.

The bias correction was conducted as follows. For each oxide, let $\bar{a}_{ij}$ be the average measurement for the i[th] oxide at analytical block j for Batch 1 (or U_{std} for uranium), and let t_i be the reference value for the i[th] oxide for Batch 1 (or for U_{std} if uranium). (The averages and reference values are provided in Figures A3 and A4.) Let $\bar{c}_{ijk}$ be the average measurement for the i[th] oxide at analytical block j for the k[th] glass. The bias adjustment was conducted as follows

$$\bar{c}_{ijk} \bullet \left(1 - \frac{\bar{a}_{ij} - t_i}{\bar{a}_{ij}}\right) = \bar{c}_{ijk} \bullet \frac{t_i}{\bar{a}_{ij}}$$

Bias-corrected measurements are indicated by a "bc" suffix, and such adjustments were performed for all of the oxides of this study, except for Ce_2O_3, La_2O_3, PbO, SO_4, and ZrO_2. Both measured and measured "bc" values are included in the discussion that follows. In these discussions bias-corrected values, which are the same as the original values, for Ce_2O_3, La_2O_3, PbO, SO_4, and ZrO_2 are included for completeness (e.g., to allow a sum of oxides to be computed for the bias-corrected results).

4.1.4 Composition Measurements by Glass Identifier with Targeted Compositions

Figures A7 and A8 in Appendix A provide plots of the oxide concentration measurements by Glass ID (including Batch 1 and U_{std}) by Lab ID for the LM and PF preparation methods for each set of analyses. Targeted concentrations of each oxide for each of the study glasses and reference values for the standards are also provided as part of these figures. In addition, the auxiliary measurements of Table A4 are also included in these plots, which show the individual measurements across the duplicates of each preparation method and the replicate ICP-AES calibrations.

A review of the plots reveals the repeatability of the individual oxide values for each glass and serves as a basis for discerning questionable measurement values (and their possible causes). In the plots for CaO, there are obvious inconsistencies in one glass (SB4VS2-02). This is one of the glasses for which re-measurements by PSAL were requested. As seen in the CaO plots, the re-measured values of the solutions are quite similar to the original measurements suggesting that the sample preparation is likely the cause of the differences. The target concentration for CaO for this glass was 1.042 wt%; the second LM preparation yielded values near this target, while the first LM preparation yieled values of approximately 1.5 wt%. A review of these results led the authors to conclude that the values near ~1.5 wt% were not representative of the compositions of the glass. Thus, these values were excluded from further consideration for this report. These questionable data from SB4VS2-02 are listed in Table 2 along with the U_{std} measurements from the original PF preparations that were highlighted in Section 4.1.3. The values in this table were excluded from further analysis and were not used in the determination of the chemical compositions of the study glasses or standards.

4.1.5 Measured versus Targeted Compositions

The remaining measurements for each oxide for each glass (i.e., all of the measurements in Tables A1 through A3 excluding the values appearing in Table 2) were averaged to determine a representative chemical composition for each glass. These determinations were conducted for both the measured and bias-corrected data. A sum of oxides was also computed for each glass based upon both the measured and bias-corrected values. Figure A9 in Appendix A provides plots showing results of each oxide for each glass in order to highlight the comparisons among the measured, bias-corrected, and targeted values. In general, after the elimination of the questionable values, the measured values do agree with the target compositions. The SiO_2 value for SB4VS2-02 is somewhat higher than the targeted concentration for this oxide for this glass.

Table A4 in Appendix A provides a summary of the average compositions as well as the targeted compositions. Also included in the table are relative differences between the measured or bias-corrected values and the targeted values, which are shaded when they are greater than or equal to 5%. Notice that the targeted sums of oxides for the standard glasses do not sum to 100% due to an incomplete coverage of the oxides in the Batch 1 and U_{std} glasses. All of the sums of oxides (both measured and bias-corrected) for the study glasses fall within the interval of 95 to 105 wt%. Overall, these comparisons between the measured and targeted compositions suggest only minor difficulties in hitting the targeted compositions for some of the oxides for some of the glasses, none of which should affect the outcome of the variability study.

Table 2. Questionable Measurements Eliminated From Further Analysis

Study Glass #	Glass ID	Lab ID	Oxide	Measured	Measured bc	Targeted
2	SB4VS2-02	A09 11	CaO (wt%)	1.50	1.61	1.04
2	SB4VS2-02	A09 12	CaO (wt%)	1.50	1.61	1.04
2	SB4VS2-02	A09LM11	CaO (wt%)	1.55	1.61	1.04
2	SB4VS2-02	A09LM12	CaO (wt%)	1.54	1.63	1.04
2	SB4VS2-02	A09PF11	B_2O_3 (wt%)	9.02	9.21	9.10
2	SB4VS2-02	A09PF11	Fe_2O_3 (wt%)	12.57	12.52	10.79
2	SB4VS2-02	A09PF11	Li_2O (wt%)	3.08	3.16	5.20
2	SB4VS2-02	A09PF12	B_2O_3 (wt%)	8.76	8.99	9.10
2	SB4VS2-02	A09PF12	Fe_2O_3 (wt%)	11.87	11.99	10.79
2	SB4VS2-02	A09PF12	Li_2O (wt%)	3.01	3.14	5.20
200	U_{std}	U_{std}PF11	B_2O_3 (wt%)	9.11	9.31	9.21
200	U_{std}	U_{std}PF11	Fe_2O_3 (wt%)	10.47	10.42	13.20
200	U_{std}	U_{std}PF11	Li_2O (wt%)	5.17	5.30	3.06
200	U_{std}	U_{std}PF12	B_2O_3 (wt%)	8.66	8.85	9.21
200	U_{std}	U_{std}PF12	Fe_2O_3 (wt%)	10.11	10.07	13.20
200	U_{std}	U_{std}PF12	Li_2O (wt%)	5.12	5.25	3.06
200	U_{std}	U_{std}PF13	B_2O_3 (wt%)	8.63	8.82	9.21
200	U_{std}	U_{std}PF13	Fe_2O_3 (wt%)	9.98	9.94	13.20
200	U_{std}	U_{std}PF13	Li_2O (wt%)	5.10	5.23	3.06
200	U_{std}	U_{std}PF21	B_2O_3 (wt%)	9.02	9.25	9.21
200	U_{std}	U_{std}PF21	Fe_2O_3 (wt%)	10.27	10.37	13.20
200	U_{std}	U_{std}PF21	Li_2O (wt%)	5.15	5.36	3.06
200	U_{std}	U_{std}PF22	B_2O_3 (wt%)	8.76	8.99	9.21
200	U_{std}	U_{std}PF22	Fe_2O_3 (wt%)	10.09	10.20	13.20
200	U_{std}	U_{std}PF22	Li_2O (wt%)	5.10	5.31	3.06
200	U_{std}	U_{std}PF23	B_2O_3 (wt%)	8.69	8.92	9.21
200	U_{std}	U_{std}PF23	Fe_2O_3 (wt%)	10.05	10.16	13.20
200	U_{std}	U_{std}PF23	Li_2O (wt%)	5.10	5.31	3.06

4.1.6 MAR Assessment

Another assessment that can be made for the SB4 variability study (VS) glasses is how well they satisfy the MAR criteria of DWPF's Product Composition Control System (PCCS). The results of this assessment are shown in Table 3. The columns in the table give the percent waste loading (%WL), the frit, the glass identifier with compositional view, the B del Gp (ΔGp value for boron), the predicted normalized leachate for boron in grams/Liter (NL[B (g/L)]), the liquidus temperature prediction in degrees Celsius (T_L Pred (ºC)), the viscosity prediction at 1150°C in Poise (Visc Pred (P)), the sum of oxides (in wt%), the nepheline discriminator value, and the overall MAR assessment.

All of the glasses that were selected for this study satisfy these criteria and are deemed processable and acceptable for the DWPF, except for the SB4VS2-03 (sludge-only at 38% WL) target composition. This glass fails the T_L criterion and would not be considered processable based on SME acceptability decisions. The relatively high T_L prediction is due to the low Na_2O content of the sludge-only flowsheet and high WL target.

Table 3. Results of the MAR Assessment of SB4 VS Glasses for Measured, Bias Corrected and Targeted Compositional Views

% WL	Sample ID/Frit	Sludge Type	B Del Gp Value	NL [B (g/L)]	TL Pred (ºC)	Visc Pred (P)	Neph Value	MAR Status
32	SB4VS2-01/Frit 510	Tk 40 Post Late Decant (5-6-08)/targeted	-8.33	0.40	942.4	51.5	0.720	
35	SB4VS2-02/Frit 510	Tk 40 Post Late Decant (5-6-08)/targeted	-8.11	0.37	981.6	48.3	0.701	
38	SB4VS2-03/Frit 510	Tk 40 Post Late Decant (5-6-08)/targeted	-7.89	0.34	1018.0	45.1	0.681	TL
32	SB4VS2-04/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/targeted	-8.71	0.47	925.5	47.7	0.720	
35	SB4VS2-05/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/targeted	-8.52	0.44	963.5	44.2	0.700	
38	SB4VS2-06/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/targeted	-8.34	0.41	998.6	40.7	0.680	
32	SB4VS2-07/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/targeted	-9.33	0.61	903.6	42.9	0.715	
35	SB4VS2-08/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/targeted	-9.20	0.58	940.5	39.1	0.695	
38	SB4VS2-09/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/targeted	-9.07	0.55	974.5	35.5	0.674	
32	SB4VS2-01/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured	-8.18	0.38	945.4	52.7	0.720	
35	SB4VS2-02/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured	-8.17	0.38	964.6	54.1	0.697	
38	SB4VS2-03/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured	-7.80	0.33	1004.8	46.1	0.680	
32	SB4VS2-04/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured	-8.63	0.46	920.3	49.4	0.717	
35	SB4VS2-05/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured	-8.47	0.43	961.7	45.0	0.699	
38	SB4VS2-06/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured	-8.14	0.38	987.0	46.7	0.680	
32	SB4VS2-07/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured	-9.12	0.56	904.4	45.1	0.713	
35	SB4VS2-08/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured	-9.10	0.56	928.8	43.5	0.693	
38	SB4VS2-09/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured	-9.07	0.55	956.1	40.6	0.672	
32	SB4VS2-01/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured bc	-8.11	0.37	951.6	53.8	0.722	
35	SB4VS2-02/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured bc	-8.05	0.36	973.4	58.0	0.702	
38	SB4VS2-03/Frit 510	Tk 40 Post Late Decant (5-6-08)/measured bc	-7.70	0.31	1011.6	47.7	0.681	
32	SB4VS2-04/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured bc	-8.54	0.44	927.0	50.5	0.719	
35	SB4VS2-05/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured bc	-8.37	0.41	968.6	46.2	0.700	
38	SB4VS2-06/Frit 510	Tk 40 Post Late Decant w ARP (5-6-08)/measured bc	-8.02	0.36	994.3	48.4	0.682	
32	SB4VS2-07/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured bc	-9.02	0.54	911.3	46.3	0.715	
35	SB4VS2-08/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured bc	-8.98	0.53	936.5	44.9	0.695	
38	SB4VS2-09/Frit 510	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)/measured bc	-8.95	0.52	965.3	43.7	0.677	

4.2 Crystallization

4.2.1 Visual Observations

Prior to discussing the visual observations, a brief explanation of the terms used to describe the as-fabricated (quenched) and ccc glasses is necessary. "Surface" refers to the top of the sample that has not touched the steel plate during quenching or the walls of the crucible during the ccc treatment. The term "bulk" refers to the cross-section of the glass sample. "Homogeneous" indicates that there is no crystallization evident on the surface or in the bulk of the glass. Other terms such as "haze", "clusters", and/or "silver/metallic patches" imply that the surface or bulk of the glass contains crystals or some other characteristic feature. "Black and shiny" implies that crystallization is not apparent to the un-aided eye.

The surface and bulk of each as-fabricated (quenched) glass, except SB4VS2-03 (sludge-only at 38% WL), were "black and shiny," which indicates that the glasses are free of crystallization and homogeneous. As previously noted, SB4VS2-03 was predicted to have a higher T_L due to the lower Na_2O content of the glass. A summary of the visual observations is given in Table 4. The SB4VS2-03 sample did contain a slight amount of crystallization on the surface (i.e. silver swirls); however, the bulk was clean.

Crystallization was much more prevalent in the ccc glasses given that the kinetics for crystallization are more favorable during the slow cooling of the ccc treatment. None of the ccc glasses were determined to be homogeneous based on visual observations as shown in Table 4. The ccc glasses did contain some degree of crystallization on the surface, characterized by "haze" and "patches of silver crystals." Historically, metallic-like features on the surface of DWPF glasses are due to the precipitation of spinels during the slower cooling process. Crystallization was not present in the bulk of any glasses.

4.2.2 XRD

Each of the quenched glasses was amorphous (within the detection limit of the instrument), which, in general, corresponded to the visual observations (Section 4.2.1). Only one of the ccc samples contain crystalline material, while all others were amorphous (within the detection limit of the instrument). A cross between trevorite and magnetite was detected in sample SB4VS2-03ccc (sludge-only at 38% WL). These results were not surprising as crystals were already present on the surface of the quenched sample. A representative pattern[f] of an amorphous sample is shown in Figure 1, while the XRD pattern of SB4VS2-03ccc is shown in Figure 2.

A majority of the samples did contain visual evidence of surface crystals, but crystallization was not observed in any of the XRD patterns (except SB4VS2-03ccc). 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.

[f] The remainder of the XRD patterns (quenched and ccc) can be viewed in the laboratory notebook for the SB4 variability study on pages 151-152 (WSRC-NB-2006-00168).

Table 4. Visual Observations of Quenched and CCC Glasses

Glass ID	Frit	WL	Visual Observations of Quenched Glasses		XRD
			Surface	Bulk	
SB4VS2-01	510	32	Black and shiny	Clean	Amorphous
SB4VS2-02		35	Black and shiny	Clean	Amorphous
SB4VS2-03		38	Small amount of silver swirls	Clean	Amorphous
SB4VS2-04		32	Black and shiny	Clean	Amorphous
SB4VS2-05		35	Black and shiny	Clean	Amorphous
SB4VS2-06		38	Black and shiny	Clean	Amorphous
SB4VS2-07		32	Black and shiny	Clean	Amorphous
SB4VS2-08		35	Black and shiny	Clean	Amorphous
SB4VS2-09		38	Black and shiny	Clean	Amorphous

Glass ID	Frit	WL	Visual Observations of CCC Glasses		XRD
			Surface	Bulk	
SB4VS2-01	510	32	Light haze with some crystals	Clean	Amorphous
SB4VS2-02		35	Light haze with some patches of silver crystals	Clean	Amorphous
SB4VS2-03		38	Light haze with some patches of silver crystals	Clean	Magnetite/Trevorite
SB4VS2-04		32	Light haze with a few scattered silver crystals	Clean	Amorphous
SB4VS2-05		35	Slight haze with a few patches of bright silver crystals	Clean	Amorphous
SB4VS2-06		38	Slight haze with a few patches of bright silver crystals	Clean	Amorphous
SB4VS2-07		32	Very light haze	Clean	Amorphous
SB4VS2-08		35	Light haze with a few patches of silver crystals	Clean	Amorphous
SB4VS2-09		38	Light haze with a few scattered patches of silver crystals	Clean	Amorphous

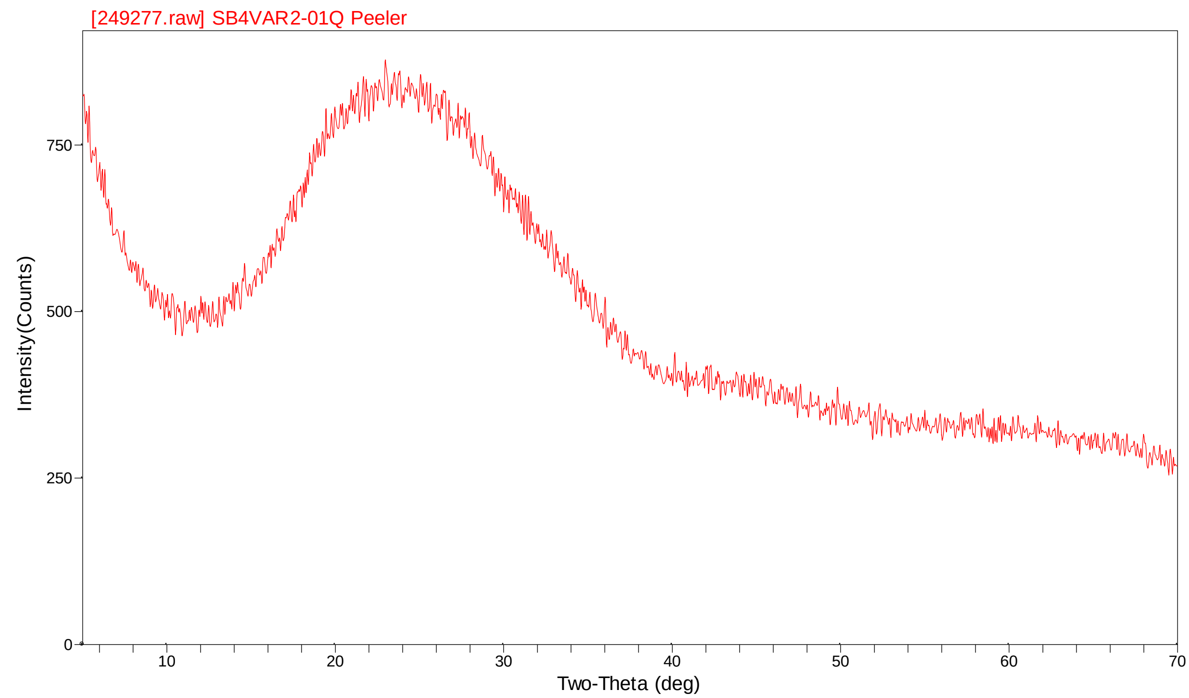

Figure 1. A representative XRD pattern of an amorphous sample. Note: "SB4VAR2" on sample label (upper left hand corner) should be "SB4VS2."

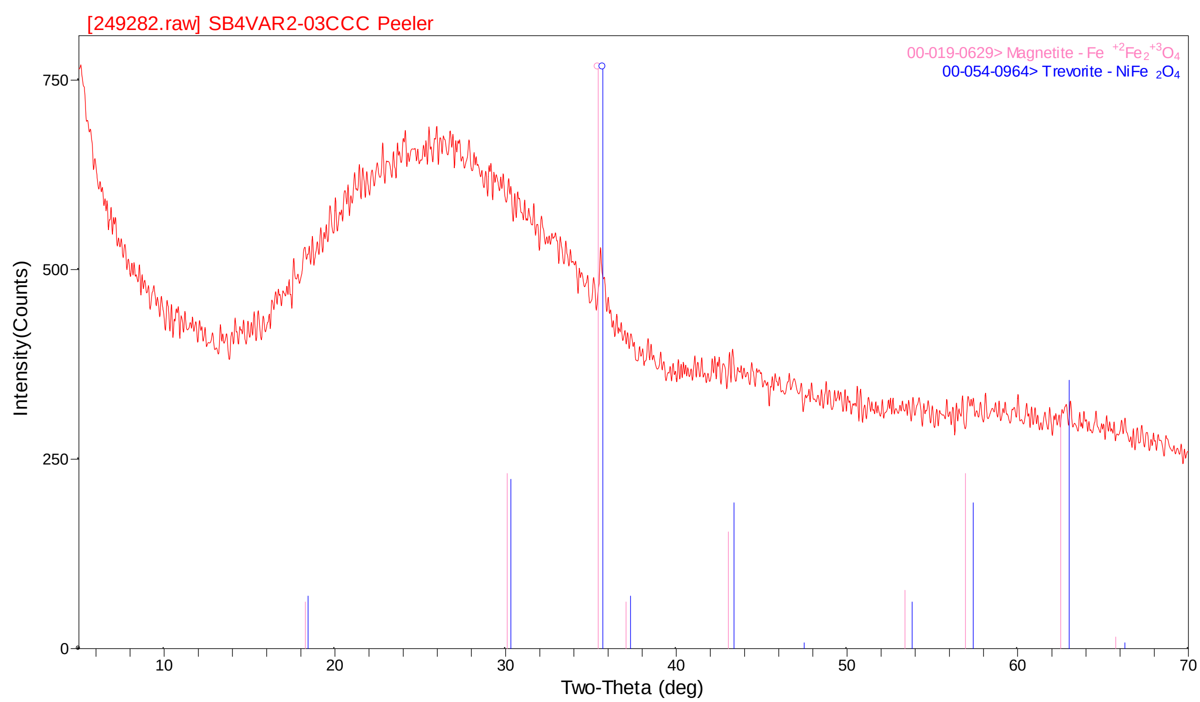

Figure 2. XRD pattern of the ccc version of the SB4VS2-03 glass (sludge-only at 38% WL). Note: "SB4VAR2" on sample label (upper left hand corner) should be "SB4VS2."

4.3 Statistical Review of the PCT Results

Table B1 in Appendix B provides the elemental leachate concentration measurements determined by the PSAL for the solution samples generated by the PCTs. Any measurement in Table B1 below the detection limit of the analytical procedure (indicated by a "<") was replaced by ½ of the detection limit in subsequent analyses. The measured solution-weight loss over the course of the 7-day test does not indicate a solution-weight loss problem for any of the samples.

In addition to adjustments for detection limits, the values were adjusted for the dilution factors: the values for the study glasses, the blanks, and the ARM glass in Table B1 were multiplied by 1.6667 to determine the values in parts per million (ppm) and the values for EA were multiplied by 16.6667. Table B2 in Appendix B provides the resulting measurements.

4.3.1 Measurements in Analytical Sequence

Figure B1 in Appendix B provides plots of the leachate (ppm) concentrations in analytical sequence as generated by the PSAL for all of the data and for the data from only the study glasses, respectively. A different color and symbol are used for each study glass or standard. No issues are seen in these plots.

4.3.2 Results for the Samples of the Multi-Element Solution Standard

Figure B2 in Appendix B provides analyses of the PSAL measurements of the samples of the multi-element solution standard by analytical set and ICP-AES calibration block. An ANOVA was used to determine any statistically significant differences among the block averages for these samples for each element of interest and is included in these figures. There was no indication of a statistically significant difference (at a 5% level) among the averages of these measurements for any of the elements of interest except for Li. However, averaging the ppm values for each set of triplicates helps to minimize the impact of any potential instrumentation effects.

Table 5 summarizes the average measurements and the reference values for the four primary elements of interest (B, Li, Na and Si). The results indicate consistent and accurate measurements from the PSAL processes used to conduct these analyses.

Table 5. Results from Samples of the Multi-Element Solution Standard

Analytical Block	Avg B (ppm)	Avg Li (ppm)	Avg Na (ppm)	Avg Si (ppm)
1	20.1	9.8	81.4	49.8
2	19.4	9.5	77.8	49.3
3	19.0	9.5	80.9	48.1
Grand Average	19.5	9.6	80.1	49.1
Reference Value	20	10	81	50
% difference	-2.61%	-3.79%	-1.17%	-1.89%

4.3.3 Measurements by Glass Identifier

Figure B3 in Appendix B provide plots of the leachate concentrations for each type of submitted sample: the study glasses by heat treatment (quenched and ccc) and the standards (EA, ARM, the multi-element solution standard, and blanks). Figure B4 in Appendix B provide plots of the leachate concentrations for the PCT results of just the study glasses by heat treatment. These plots suggest some scatter in the triplicate values for some analytes for some of the glasses. Also, note the small differences between the quenched and ccc values for each of the study glasses.

4.3.4 Normalized PCT Results

PCT leachate concentrations are typically normalized using the cation composition (expressed as a weight percent) in the glass to obtain a grams-per-liter (g/L) leachate concentration. The normalization of the PCTs is usually conducted using the measured compositions of the glasses. This method is the preferred normalization process for the PCTs. For completeness, the targeted cation and the bias-corrected cation compositions were also used to conduct this normalization.

The common logarithm of the normalized PCT (normalized leachate, NL) for each element of interest was determined and used for comparison. To accomplish this computation, one must

1. Determine the common logarithm of the elemental ppm leachate concentration for each of the triplicates and each of the elements of interest (these values are provided in Table B2 of Appendix B),

2. Average the common logarithms over the triplicates for each element of interest, and then

Normalizing Using Measured Composition (preferred method)

3. Subtract a quantity equal to 1 plus the common logarithm of the average cation measured concentration (expressed as a weight percent of the glass) from the average computed in step 2.

Or Normalizing Using Target Composition

3. Subtract a quantity equal to 1 plus the common logarithm of the target cation concentration (expressed as a weight percent of the glass) from the average computed in step 2.

Or Normalizing Using Measured Bias-Corrected Composition

3. Subtract a quantity equal to 1 plus the common logarithm of the measured bias-corrected cation concentration (expressed as a weight percent of the glass) from the average computed in step 2.

Figure B5 in Appendix B provides scatter plots for these results and offers an opportunity to investigate the consistency in the leaching across the elements for the glasses of this study. All combinations of the normalizations of the PCTs (i.e., those generated using the targeted, measured, and bias-corrected compositional views) and both heat treatments are represented in the series of scatter plots. Consistency in the leaching across the elements is typically demonstrated by a high degree of linear correlation among the values for pairs of these elements, which is true for this study as the smallest correlation in this plot is that for Na and Si, with a value of ~97%.

Table 6 summarizes the normalized PCTs for the glasses of this study, which are listed by glass ID.

4.3.5 Acceptability of the Variability Study Glasses

All of the variability study glasses are acceptable relative to the benchmark EA glass as shown in Table 6. The NL[B] values of the study glasses range from 0.636 g/L to 0.766 g/L regardless of thermal history, compositional view, sludge composition or WL. These NL [B] values are more than an order of magnitude less than the 16.695 g/L reported for EA.

4.3.6 Effects of Heat Treatment on PCTs

Figure B6 in Appendix B provides a series of plots and statistical comparisons that demonstrate the effects of heat treatment on the common logarithm ppm-responses of interest of the triplicate PCTs for each element for each study glass. The quenched version of a given glass yielded measurements indicating a significantly different mean log(ppm) response (at the 5% significance level) as compared to the ccc version of the glass for a given element if the **Prob>|t|** value in the figure is 0.05 or smaller. Only Na value of one glass (SB4VS2-04) showed a statistically significant difference (at the 5% level) in the means of the two heat treatments. In addition, in this instance, the mean log [Na (ppm)] was larger for the quenched heat treatment than the mean log [Na (ppm)] for the ccc version of this glass. These results suggest that there are no indications of these glasses being sensitive to heat treatment.

Figure B7 in Appendix B provides a series of plots that demonstrate the effects of heat treatment on the normalized PCT response based on the three different compositional views: measured, measured bias-corrected, and targeted. The plots are grouped by the sludge type used to determine the target composition for the glass. Waste loadings are also shown as part of the information on these plots. These results indicate that there is very little statistical difference in PCT responses as a function of heat treatment. There is some evidence of a trend toward a less durable glass as WL increases for some of the sludge projections.

4.3.7 Predicted versus Measured PCTs

Figure B8 in Appendix B provides plots of the DWPF models that relate the logarithm of the normalized PCT (for each element of interest) to a linear function of a free energy of hydration term (ΔG_p, kcal/100g glass) derived from all of the glass compositional views and heat treatments.[9] Prediction limits (at a 95% confidence) for an individual PCT result are also plotted along with the linear fit. The EA and ARM results are also indicated on these plots. Figure B9 in Appendix B provides a version of these plots for the quenched glasses only while Figure B10 in Appendix B provides a version for ccc glasses only. Not only are the study glasses acceptable relative to the EA glass, but the plots illustrate the predictablility of the glasses by the current ΔG_p models. Figure 3 provides a close look at the PCT response for boron. All of the study glasses lie within the 95% confidence intervals of the model predictions.

Table 6. Normalized PCTs by Glass ID/Compositional View for SB4/Second Decant Glasses with Frit 510

Glass	WL %	Sludge Case	Heat Treatment	Compositional View	Nepheline Assessment	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	.		ref	reference	0.753	-0.3163	-0.2344	-0.2966	-0.5561	0.483	0.583	0.505	0.278
EA	.		ref	reference	0.704	1.2055	0.9439	1.1009	0.5705	16.052	8.788	12.614	3.719
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	ccc	targeted	0.720	-0.1859	-0.1487	-0.2454	-0.3453	0.652	0.710	0.568	0.452
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	ccc	targeted	0.701	-0.1577	-0.1264	-0.2072	-0.3397	0.696	0.747	0.621	0.457
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	ccc	targeted	0.681	-0.1386	-0.1088	-0.1841	-0.3322	0.727	0.778	0.655	0.465
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	targeted	0.720	-0.1921	-0.1637	-0.2565	-0.3419	0.642	0.686	0.554	0.455
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	targeted	0.700	-0.1845	-0.1534	-0.2249	-0.3431	0.654	0.702	0.596	0.454
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	targeted	0.680	-0.1559	-0.1278	-0.1813	-0.3380	0.698	0.745	0.659	0.459
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	targeted	0.715	-0.1775	-0.1409	-0.2017	-0.3333	0.665	0.723	0.628	0.464
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	targeted	0.695	-0.1777	-0.1442	-0.1796	-0.3373	0.664	0.717	0.661	0.460
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	targeted	0.674	-0.1535	-0.1321	-0.1593	-0.3330	0.702	0.738	0.693	0.465
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	quenched	targeted	0.720	-0.1748	-0.1330	-0.2524	-0.3406	0.669	0.736	0.559	0.456
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	quenched	targeted	0.701	-0.1640	-0.1199	-0.2209	-0.3382	0.685	0.759	0.601	0.459
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	quenched	targeted	0.681	-0.1239	-0.0889	-0.1636	-0.3217	0.752	0.815	0.686	0.477
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	targeted	0.720	-0.1963	-0.1447	-0.2260	-0.3416	0.636	0.717	0.594	0.455
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	targeted	0.700	-0.1898	-0.1471	-0.2179	-0.3573	0.646	0.713	0.606	0.439
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	targeted	0.680	-0.1373	-0.1127	-0.1728	-0.3255	0.729	0.771	0.672	0.473
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	targeted	0.715	-0.1616	-0.1265	-0.1998	-0.3214	0.689	0.747	0.631	0.477
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	targeted	0.695	-0.1650	-0.1332	-0.1780	-0.3380	0.684	0.736	0.664	0.459
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	targeted	0.674	-0.1394	-0.1195	-0.1439	-0.3270	0.725	0.759	0.718	0.471
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	ccc	measured	0.720	-0.1790	-0.1406	-0.2446	-0.3437	0.662	0.723	0.569	0.453

Table 6 cont. Normalized PCTs by Glass ID/Compositional View for SB4/Second Decant Glasses with Frit 510

Glass	WL %	Sludge Case	Heat Treatment	Compositional View	Nepheline Assessment	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)]
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	ccc	measured	0.697	-0.1531	-0.1240	-0.2213	-0.3493	0.703	0.752	0.601	0.447
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	ccc	measured	0.680	-0.1304	-0.0966	-0.1838	-0.3269	0.741	0.801	0.655	0.471
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured	0.717	-0.1796	-0.1525	-0.2588	-0.3377	0.661	0.704	0.551	0.460
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured	0.699	-0.1809	-0.1484	-0.2282	-0.3436	0.659	0.711	0.591	0.453
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured	0.680	-0.1448	-0.1098	-0.1819	-0.3399	0.717	0.777	0.658	0.457
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured	0.713	-0.1676	-0.1275	-0.1994	-0.3294	0.680	0.746	0.632	0.468
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured	0.693	-0.1635	-0.1291	-0.1827	-0.3370	0.686	0.743	0.657	0.460
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured	0.672	-0.1462	-0.1283	-0.1658	-0.3396	0.714	0.744	0.683	0.458
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	quenched	measured	0.720	-0.1679	-0.1248	-0.2515	-0.3390	0.679	0.750	0.560	0.458
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	quenched	measured	0.697	-0.1594	-0.1174	-0.2350	-0.3477	0.693	0.763	0.582	0.449
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	quenched	measured	0.680	-0.1157	-0.0767	-0.1633	-0.3165	0.766	0.838	0.687	0.483
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured	0.717	-0.1838	-0.1335	-0.2283	-0.3375	0.655	0.735	0.591	0.460
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured	0.699	-0.1861	-0.1420	-0.2212	-0.3578	0.651	0.721	0.601	0.439
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured	0.680	-0.1262	-0.0946	-0.1734	-0.3275	0.748	0.804	0.671	0.470
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured	0.713	-0.1517	-0.1131	-0.1975	-0.3174	0.705	0.771	0.635	0.482
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured	0.693	-0.1508	-0.1180	-0.1812	-0.3378	0.707	0.762	0.659	0.459
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured	0.672	-0.1322	-0.1157	-0.1504	-0.3336	0.738	0.766	0.707	0.464
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	ccc	measured bc	0.722	-0.1894	-0.1546	-0.2358	-0.3482	0.647	0.700	0.581	0.449
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	ccc	measured bc	0.702	-0.1534	-0.1339	-0.2157	-0.3584	0.702	0.735	0.609	0.438

Table 6 cont. Normalized PCTs by Glass ID/Compositional View for SB4/Second Decant Glasses with Frit 510

Glass	WL %	Sludge Case	Heat Treatment	Compositional View	Nepheline Assessment	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)]
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	ccc	measured bc	0.681	-0.1407	-0.1107	-0.1749	-0.3314	0.723	0.775	0.668	0.466
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured bc	0.719	-0.1900	-0.1666	-0.2500	-0.3422	0.646	0.681	0.562	0.455
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured bc	0.700	-0.1912	-0.1625	-0.2193	-0.3481	0.644	0.688	0.603	0.449
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	ccc	measured bc	0.682	-0.1551	-0.1238	-0.1731	-0.3444	0.700	0.752	0.671	0.452
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured bc	0.715	-0.1779	-0.1415	-0.1905	-0.3339	0.664	0.722	0.645	0.464
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured bc	0.695	-0.1739	-0.1431	-0.1739	-0.3415	0.670	0.719	0.670	0.456
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	ccc	measured bc	0.677	-0.1492	-0.1392	-0.1602	-0.3487	0.709	0.726	0.691	0.448
SB4VS2-01	32	Tk 40 Post Late Decant (5-6-08)	quenched	measured bc	0.722	-0.1783	-0.1389	-0.2427	-0.3435	0.663	0.726	0.572	0.453
SB4VS2-02	35	Tk 40 Post Late Decant (5-6-08)	quenched	measured bc	0.702	-0.1598	-0.1273	-0.2294	-0.3569	0.692	0.746	0.590	0.440
SB4VS2-03	38	Tk 40 Post Late Decant (5-6-08)	quenched	measured bc	0.681	-0.1261	-0.0908	-0.1545	-0.3210	0.748	0.811	0.701	0.478
SB4VS2-04	32	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured bc	0.719	-0.1942	-0.1476	-0.2194	-0.3420	0.639	0.712	0.603	0.455
SB4VS2-05	35	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured bc	0.700	-0.1965	-0.1561	-0.2123	-0.3623	0.636	0.698	0.613	0.434
SB4VS2-06	38	Tk 40 Post Late Decant w ARP (5-6-08)	quenched	measured bc	0.682	-0.1366	-0.1087	-0.1645	-0.3320	0.730	0.779	0.685	0.466
SB4VS2-07	32	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured bc	0.715	-0.1620	-0.1272	-0.1886	-0.3219	0.689	0.746	0.648	0.477
SB4VS2-08	35	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured bc	0.695	-0.1611	-0.1321	-0.1723	-0.3423	0.690	0.738	0.673	0.455
SB4VS2-09	38	Tk 40 Post Late Decant w ARP + 2% Na2O (5-6-08)	quenched	measured bc	0.677	-0.1351	-0.1267	-0.1448	-0.3427	0.733	0.747	0.716	0.454

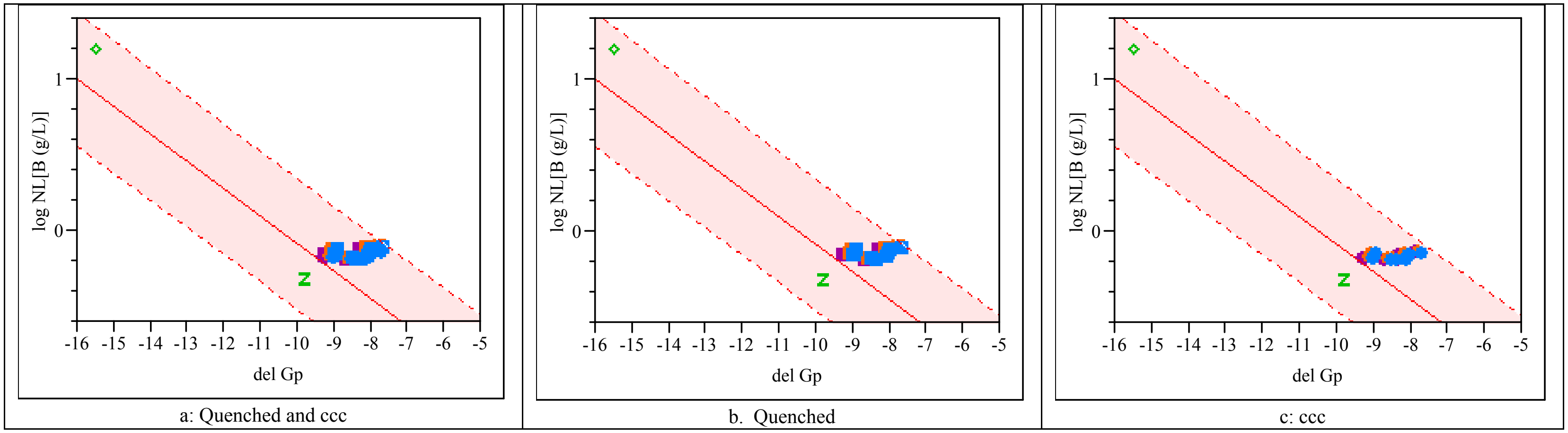

Figure 3. Log NL[B] versus B del Gp model with a 95% confidence interval for individual PCTs.[g]

[g] In plots "a" and "b" it appears that some glasses may be outside the 95% confidence band. A computational algorithm was developed to electronically compare the model predictions with the upper confidence bound. All of the data fall within the 95% confidence bands, thus eliminating the uncertainty. The size of the markers causes the edges to overlap the upper confidence bound.

5.0 Conclusions

Frit 510 is a viable option for the processing of SB4 after a *second* Tank 40 decant with or without the addition of products from the Actinide Removal Process (ARP) as well as 2 wt% Na_2O. The addition of ARP did not have any negative impacts on the acceptability and predictability of the variability study glasses.

All of the glasses that were selected for this study satisfy the PCCS criteria and are deemed processable and acceptable for the DWPF, except for the SB4VS2-03 (sludge-only at 38% WL) target composition. This glass fails the T_L criterion and would not be considered processable based on SME acceptability decisions.

The durabilities of all of the study glasses (both quenched and ccc) are well below that of the NL [B] of the reference EA glass (16.695 g/L) and are predictable using the current PCCS models. Very little variation existed between the NL [B] of the quenched and ccc versions of the glasses. There is some evidence of a trend toward a less durable glass as WL increases for some of the sludge projections.

6.0 References

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Appendix A:

Tables and Figures Supporting the Analysis of the Chemical Composition Measurements of the SB4 Variability Study Glasses in Support of a Second Decant

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Table A1. Measured Elemental Concentrations (wt%) for Samples Prepared Using Lithium Metaborate (part 1)

Glass ID	Blk	Seq.	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
Batch 1	1	1	BCHLM11	2.52	0.124	0.847	<0.010	0.073	0.304	<0.010	0.8	1.29
Ustd	1	2	UstdLM11	2.14	<0.010	0.913	<0.010	0.161	0.005	<0.010	0.674	2.14
SB4VS2-04	1	3	A02LM11	4.45	0.024	0.639	0.012	0.041	0.019	0.013	0.527	1.57
SB4VS2-01	1	4	A07LM21	4.58	0.015	0.663	0.014	0.042	0.021	0.012	0.55	1.57
SB4VS2-09	1	5	A08LM21	5.29	0.024	0.735	0.025	0.039	0.02	0.015	0.61	1.78
SB4VS2-01	1	6	A07LM11	4.54	0.016	0.655	0.014	0.043	0.021	0.013	0.562	1.52
SB4VS2-04	1	7	A02LM21	4.34	0.024	0.628	0.012	0.041	0.019	0.014	0.541	1.47
SB4VS2-07	1	8	A04LM11	4.32	0.013	0.639	0.015	0.038	0.019	0.014	0.499	1.46
SB4VS2-03	1	9	A05LM21	5.33	0.023	0.784	0.024	0.042	0.021	0.014	0.622	1.8
SB4VS2-06	1	10	A03LM11	5.24	0.022	0.749	0.019	0.041	0.021	0.013	0.616	1.81
SB4VS2-08	1	11	A01LM11	4.71	0.025	0.675	0.021	0.038	0.02	0.013	0.569	1.66
Batch 1	1	12	BCHLM12	2.52	0.129	0.83	<0.010	0.077	0.303	<0.010	0.838	1.29
Ustd	1	13	UstdLM12	2.07	<0.010	0.902	<0.010	0.171	0.005	<0.010	0.718	2.06
SB4VS2-05	1	14	A06LM21	4.8	0.024	0.697	0.021	0.042	0.02	0.014	0.598	1.66
SB4VS2-03	1	15	A05LM11	5.38	0.027	0.77	0.022	0.047	0.022	0.015	0.695	1.76
SB4VS2-07	1	16	A04LM21	4.29	0.015	0.616	0.017	0.043	0.022	0.015	0.566	1.48
SB4VS2-05	1	17	A06LM11	4.88	0.024	0.703	0.021	0.041	0.021	0.013	0.591	1.65
SB4VS2-02	1	18	A09LM21	5.1	0.027	0.715	0.013	0.04	0.022	0.015	0.637	1.78
SB4VS2-09	1	19	A08LM11	5.16	0.024	0.745	0.02	0.041	0.019	0.015	0.641	1.84
SB4VS2-06	1	20	A03LM21	5.24	0.024	0.747	0.019	0.043	0.022	0.013	0.642	1.82
SB4VS2-08	1	21	A01LM21	4.75	0.026	0.674	0.022	0.041	0.021	0.014	0.601	1.61
SB4VS2-02	1	22	A09LM11	5.32	0.029	1.11	0.018	0.039	0.022	0.016	0.683	1.71
Batch 1	1	23	BCHLM13	2.51	0.135	0.839	<0.010	0.08	0.311	<0.010	0.874	1.33
Ustd	1	24	UstdLM13	2.09	<0.010	0.925	<0.010	0.174	0.006	<0.010	0.73	2.21
Batch 1	2	1	BCHLM21	2.5	0.124	0.815	<0.010	0.073	0.296	<0.010	0.817	1.25
Ustd	2	2	UstdLM21	2.13	<0.010	0.891	<0.010	0.162	0.007	<0.010	0.685	2.1
SB4VS2-03	2	3	A05LM22	5.35	0.023	0.768	0.026	0.041	0.023	0.013	0.624	1.74
SB4VS2-07	2	4	A04LM22	4.29	0.013	0.617	0.018	0.04	0.023	0.014	0.527	1.41
SB4VS2-05	2	5	A06LM12	4.88	0.021	0.693	0.022	0.038	0.023	0.012	0.553	1.61
SB4VS2-06	2	6	A03LM12	5.26	0.022	0.736	0.021	0.041	0.023	0.013	0.627	1.7
SB4VS2-01	2	7	A07LM12	4.53	0.015	0.64	0.015	0.043	0.023	0.012	0.574	1.39
SB4VS2-04	2	8	A02LM22	4.34	0.024	0.619	0.013	0.041	0.021	0.014	0.541	1.38
SB4VS2-02	2	9	A09LM22	5.03	0.024	0.706	0.015	0.037	0.023	0.014	0.613	1.6
SB4VS2-03	2	10	A05LM12	5.34	0.024	0.766	0.023	0.044	0.024	0.014	0.66	1.68
SB4VS2-09	2	11	A08LM22	5.28	0.024	0.729	0.027	0.039	0.022	0.015	0.624	1.67
Batch 1	2	12	BCHLM22	2.49	0.125	0.825	<0.010	0.074	0.302	<0.010	0.821	1.23
Ustd	2	13	UstdLM22	2.09	<0.010	0.89	<0.010	0.164	0.008	<0.010	0.694	2.07
SB4VS2-01	2	14	A07LM22	4.56	0.015	0.65	0.015	0.042	0.023	0.012	0.563	1.52
SB4VS2-09	2	15	A08LM12	5.17	0.022	0.744	0.022	0.038	0.021	0.014	0.609	1.7
SB4VS2-07	2	16	A04LM12	4.29	0.012	0.634	0.017	0.038	0.022	0.014	0.511	1.41
SB4VS2-04	2	17	A02LM12	4.43	0.023	0.629	0.013	0.041	0.021	0.013	0.536	1.45

Table A1. Measured Elemental Concentrations (wt%) for Samples Prepared Using Lithium Metaborate (part 1)

Glass ID	Blk	Seq.	Lab ID	Al (wt%)	Ba (wt%)	Ca (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
SB4VS2-02	2	18	A09LM12	5.32	0.027	1.1	0.019	0.036	0.024	0.015	0.649	1.6
SB4VS2-06	2	19	A03LM22	5.2	0.022	0.745	0.02	0.041	0.024	0.012	0.626	1.76
SB4VS2-08	2	20	A01LM22	4.74	0.024	0.66	0.023	0.038	0.022	0.013	0.58	1.6
SB4VS2-08	2	21	A01LM12	4.68	0.024	0.663	0.022	0.037	0.022	0.013	0.572	1.56
SB4VS2-05	2	22	A06LM22	4.83	0.023	0.687	0.022	0.04	0.022	0.013	0.59	1.65
Batch 1	2	23	BCHLM23	2.5	0.127	0.829	<0.010	0.075	0.303	<0.010	0.827	1.27
Ustd	2	24	UstdLM23	2.05	<0.010	0.901	<0.010	0.164	0.008	<0.010	0.697	2.02
Batch 1	3	.	Batch glass	2.55	0.121	0.821	<0.010	0.072	0.298	<0.010	0.784	1.32
Ustd	3	.	U glass	2.12	<0.010	0.881	<0.010	0.163	<0.010	<0.010	0.682	2.07
SB4VS2-09	3	.	A08 11	5.33	0.023	0.729	0.02	0.037	0.021	0.014	0.587	1.8
SB4VS2-09	3	.	A08 12	5.36	0.023	0.737	0.02	0.037	0.021	0.014	0.594	1.81
SB4VS2-09	3	.	A08 21	5.28	0.024	0.715	0.025	0.039	0.021	0.015	0.615	1.83
SB4VS2-09	3	.	A08 22	5.32	0.025	0.715	0.025	0.039	0.021	0.015	0.623	1.84
SB4VS2-02	3	.	A09 11	5.37	0.027	1.07	0.017	0.035	0.023	0.015	0.625	1.74
SB4VS2-02	3	.	A09 12	5.29	0.027	1.07	0.017	0.035	0.023	0.014	0.627	1.76
SB4VS2-02	3	.	A09 21	5.2	0.025	0.705	0.013	0.037	0.023	0.014	0.604	1.83
SB4VS2-02	3	.	A09 22	5.19	0.025	0.693	0.013	0.037	0.023	0.014	0.594	1.78
Batch 1	3	.	Batch glass	2.58	0.118	0.799	<0.010	0.07	0.29	<0.010	0.773	1.37
Ustd	3	.	U glass	2.13	<0.010	0.886	<0.010	0.162	<0.010	<0.010	0.684	2.3

Table A1. Measured Elemental Concentrations (wt%) for Samples Prepared Using Lithium Metaborate (part 2)

Glass ID	Blk	Seq.	Lab ID	Na (wt%)	Ni (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Ti (wt%)	U (wt%)	Zr (wt%)
Batch 1	1	1	BCHLM11	7.06	0.54	<0.010	0.012	23.3	0.381	<0.100	0.062
Ustd	1	2	UstdLM11	8.86	0.762	<0.010	0.012	21.2	0.542	1.91	<0.010
SB4VS2-04	1	3	A02LM11	7.97	0.393	0.019	0.069	23	0.251	2.39	0.021
SB4VS2-01	1	4	A07LM21	7.63	0.387	0.021	0.062	22.9	0.017	2.44	0.017
SB4VS2-09	1	5	A08LM21	8.93	0.465	0.023	0.09	21.1	0.275	2.77	0.023
SB4VS2-01	1	6	A07LM11	7.55	0.401	0.022	0.064	22.7	0.017	2.4	0.018
SB4VS2-04	1	7	A02LM21	7.92	0.4	0.019	0.074	22.3	0.258	2.34	0.022
SB4VS2-07	1	8	A04LM11	8.32	0.358	0.018	0.068	22.6	0.241	2.28	0.021
SB4VS2-03	1	9	A05LM21	7.85	0.406	0.02	0.074	20.7	0.018	2.85	0.022
SB4VS2-06	1	10	A03LM11	8.3	0.455	0.029	0.09	21	0.296	2.8	0.021
SB4VS2-08	1	11	A01LM11	8.6	0.418	0.023	0.086	22	0.276	2.53	0.019
Batch 1	1	12	BCHLM12	6.85	0.563	<0.010	0.016	23.3	0.391	<0.100	0.063
Ustd	1	13	UstdLM12	8.87	0.805	<0.010	0.012	21	0.561	1.89	<0.010
SB4VS2-05	1	14	A06LM21	8.09	0.448	0.022	0.081	21.8	0.281	2.53	0.02
SB4VS2-03	1	15	A05LM11	7.97	0.468	0.024	0.078	20.7	0.02	2.85	0.024
SB4VS2-07	1	16	A04LM21	8.35	0.42	0.023	0.08	22.5	0.271	2.26	0.022
SB4VS2-05	1	17	A06LM11	8.2	0.434	0.02	0.081	21.8	0.275	2.57	0.02
SB4VS2-02	1	18	A09LM21	7.95	0.457	0.022	0.075	22.4	0.018	2.73	0.023
SB4VS2-09	1	19	A08LM11	8.92	0.469	0.023	0.091	21.2	0.281	2.76	0.026
SB4VS2-06	1	20	A03LM21	8.26	0.468	0.03	0.091	21	0.303	2.83	0.021
SB4VS2-08	1	21	A01LM21	8.79	0.449	0.024	0.089	21.7	0.287	2.47	0.019
SB4VS2-02	1	22	A09LM11	8.02	0.441	0.021	0.073	21.7	0.018	2.65	0.023
Batch 1	1	23	BCHLM13	6.72	0.584	<0.010	0.016	23.6	0.404	<0.100	0.065
Ustd	1	24	UstdLM13	8.85	0.815	<0.010	0.014	21.5	0.576	1.93	<0.010
Batch 1	2	1	BCHLM21	6.97	0.545	<0.010	0.012	23.1	0.381	<0.100	0.061
Ustd	2	2	UstdLM21	8.76	0.773	<0.010	0.015	21.1	0.548	1.92	<0.010
SB4VS2-03	2	3	A05LM22	7.85	0.41	0.02	0.069	20.5	0.018	2.85	0.021
SB4VS2-07	2	4	A04LM22	8.32	0.396	0.019	0.073	22.2	0.26	2.24	0.021
SB4VS2-05	2	5	A06LM12	8.07	0.409	0.017	0.079	21.6	0.264	2.52	0.019
SB4VS2-06	2	6	A03LM12	8.27	0.464	0.03	0.089	20.8	0.301	2.76	0.021
SB4VS2-01	2	7	A07LM12	7.5	0.408	0.022	0.064	22.1	0.017	2.35	0.018
SB4VS2-04	2	8	A02LM22	7.87	0.409	0.019	0.075	22	0.261	2.29	0.022
SB4VS2-02	2	9	A09LM22	7.76	0.439	0.02	0.071	21.5	0.017	2.6	0.022
SB4VS2-03	2	10	A05LM12	7.79	0.445	0.021	0.075	20.3	0.019	2.79	0.023
SB4VS2-09	2	11	A08LM22	8.83	0.474	0.023	0.094	20.7	0.279	2.71	0.023
Batch 1	2	12	BCHLM22	6.57	0.55	<0.010	0.012	23	0.384	<0.100	0.062
Ustd	2	13	UstdLM22	8.76	0.782	<0.010	0.013	21	0.559	1.9	<0.010
SB4VS2-01	2	14	A07LM22	7.52	0.402	0.021	0.066	22.7	0.017	2.4	0.018
SB4VS2-09	2	15	A08LM12	8.78	0.447	0.021	0.087	20.8	0.271	2.7	0.024
SB4VS2-07	2	16	A04LM12	8.17	0.367	0.017	0.073	22.5	0.246	2.24	0.021
SB4VS2-04	2	17	A02LM12	7.85	0.401	0.018	0.071	22.5	0.258	2.33	0.022

Table A1. Measured Elemental Concentrations (wt%) for Samples Prepared Using Lithium Metaborate (part 2)

Glass ID	Blk	Seq.	Lab ID	Na (wt%)	Ni (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Ti (wt%)	U (wt%)	Zr (wt%)
SB4VS2-02	2	18	A09LM12	7.96	0.419	0.019	0.067	21.4	0.018	2.6	0.022
SB4VS2-06	2	19	A03LM22	8.1	0.454	0.028	0.088	20.7	0.295	2.75	0.02
SB4VS2-08	2	20	A01LM22	8.64	0.427	0.022	0.086	21.6	0.274	2.47	0.018
SB4VS2-08	2	21	A01LM12	8.46	0.421	0.021	0.08	21.5	0.273	2.47	0.018
SB4VS2-05	2	22	A06LM22	8.05	0.442	0.02	0.081	21.8	0.275	2.55	0.02
Batch 1	2	23	BCHLM23	6.73	0.556	<0.010	0.013	23.1	0.389	<0.100	0.063
Ustd	2	24	UstdLM23	8.66	0.785	<0.010	0.012	20.6	0.558	1.85	<0.010
Batch 1	3	.	Batch glass	6.64	0.525	<0.010	0.014	22.4	0.37	<0.100	0.059
Ustd	3	.	U glass	8.81	0.782	<0.010	0.015	20.9	0.549	1.91	<0.010
SB4VS2-09	3	.	A08 11	8.94	0.441	0.021	0.088	21.4	0.262	2.79	0.023
SB4VS2-09	3	.	A08 12	8.98	0.445	0.021	0.085	21.2	0.265	2.81	0.023
SB4VS2-09	3	.	A08 21	9.02	0.469	0.023	0.091	21.5	0.273	2.83	0.022
SB4VS2-09	3	.	A08 22	8.95	0.472	0.024	0.094	20.8	0.274	2.81	0.022
SB4VS2-02	3	.	A09 11	8	0.412	0.018	0.069	22.7	0.017	2.71	0.021
SB4VS2-02	3	.	A09 12	8.04	0.411	0.018	0.068	22.8	0.017	2.72	0.02
SB4VS2-02	3	.	A09 21	7.97	0.436	0.02	0.074	22.5	0.017	2.8	0.02
SB4VS2-02	3	.	A09 22	8.07	0.429	0.019	0.074	22.8	0.017	2.8	0.02
Batch 1	3	.	Batch glass	6.79	0.516	<0.010	0.018	23.1	0.362	<0.100	0.059
Ustd	3	.	U glass	8.93	0.773	<0.010	0.013	21.2	0.547	2	<0.010

Table A2. Measured Elemental Concentrations (wt%)
for Samples Prepared Using Peroxide Fusion

Glass ID	Block	Sequence	Lab ID	B (wt%)	Fe (wt%)	Li (wt%)
Batch 1	1	1	BCHPF11	2.44	9.16	2.00
Ustd	1	2	UstdPF11	2.83	7.32	2.40
SB4VS2-02	1	3	A09PF11	2.80	8.79	1.43
SB4VS2-04	1	4	A02PF21	2.88	6.47	2.48
SB4VS2-05	1	5	A06PF21	2.81	7.21	2.39
SB4VS2-04	1	6	A02PF11	2.91	6.68	2.46
SB4VS2-05	1	7	A06PF11	2.79	7.63	2.38
SB4VS2-01	1	8	A07PF11	2.93	7.40	2.49
SB4VS2-01	1	9	A07PF21	2.90	6.74	2.50
SB4VS2-07	1	10	A04PF11	2.86	6.56	2.43
SB4VS2-06	1	11	A03PF11	2.61	7.65	2.20
Batch 1	1	12	BCHPF12	2.32	8.92	2.02
Ustd	1	13	UstdPF12	2.69	7.07	2.38
SB4VS2-09	1	14	A08PF11	2.57	7.03	2.23
SB4VS2-06	1	15	A03PF21	2.63	7.65	2.26
SB4VS2-08	1	16	A01PF21	2.72	6.67	2.36
SB4VS2-08	1	17	A01PF11	2.72	6.80	2.33
SB4VS2-09	1	18	A08PF21	2.61	7.14	2.29
SB4VS2-02	1	19	A09PF21	2.68	6.90	2.33
SB4VS2-03	1	20	A05PF11	2.67	8.04	2.26
SB4VS2-03	1	21	A05PF21	2.63	8.02	2.24
SB4VS2-07	1	22	A04PF21	2.91	6.33	2.51
Batch 1	1	23	BCHPF13	2.33	8.97	2.00
Ustd	1	24	UstdPF13	2.68	6.98	2.37
Batch 1	2	1	BCHPF21	2.42	8.90	1.97
Ustd	2	2	UstdPF21	2.80	7.18	2.39
SB4VS2-01	2	3	A07PF22	2.91	6.55	2.46
SB4VS2-06	2	4	A03PF22	2.64	7.53	2.22
SB4VS2-07	2	5	A04PF22	2.93	6.40	2.48
SB4VS2-04	2	6	A02PF22	2.88	6.35	2.45
SB4VS2-09	2	7	A08PF12	2.62	7.19	2.24
SB4VS2-02	2	8	A09PF12	2.72	8.30	1.40
SB4VS2-07	2	9	A04PF12	2.86	6.48	2.38
SB4VS2-05	2	10	A06PF12	2.84	7.81	2.41
SB4VS2-09	2	11	A08PF22	2.64	7.24	2.28
Batch 1	2	12	BCHPF22	2.32	8.78	1.98
Ustd	2	13	UstdPF22	2.72	7.06	2.37
SB4VS2-06	2	14	A03PF12	2.63	7.63	2.16
SB4VS2-03	2	15	A05PF22	2.67	8.04	2.22
SB4VS2-08	2	16	A01PF22	2.74	6.69	2.33
SB4VS2-08	2	17	A01PF12	2.76	6.86	2.31
SB4VS2-01	2	18	A07PF12	2.90	7.22	2.47
SB4VS2-03	2	19	A05PF12	2.61	7.73	2.24
SB4VS2-04	2	20	A02PF12	2.82	6.43	2.46
SB4VS2-02	2	21	A09PF22	2.65	6.82	2.31
SB4VS2-05	2	22	A06PF22	2.77	6.98	2.37
Batch 1	2	23	BCHPF23	2.32	8.98	1.98
Ustd	2	24	UstdPF23	2.70	7.03	2.37
Batch 1	3	1	Batch 1	2.47	8.70	2.01
Ustd	3	2	Ustd	2.83	8.65	1.38
SB4VS2-09	3	3	A08 11	2.68	7.35	2.31
SB4VS2-09	3	4	A08 12	2.72	7.41	2.33
SB4VS2-09	3	5	A08 21	2.72	7.47	2.31
SB4VS2-09	3	6	A08 22	2.65	7.55	2.28
SB4VS2-02	3	7	A09 11	2.89	7.36	2.48
SB4VS2-02	3	8	A09 12	2.84	7.40	2.45
SB4VS2-02	3	9	A09 21	2.84	7.67	2.41
SB4VS2-02	3	10	A09 22	2.88	7.45	2.43
Batch 1	3	11	Batch 1	2.41	8.98	2.03
Ustd	3	12	Ustd	2.85	9.30	1.39

Table A3: LM and PF Reruns
(Measurements are in wt% elementals.)

Solution ID	Al	B	Ba	Ca	Ce	Cr	Cu	Fe	La	Li	Mg	Mn	Na	Ni	Pb	S	Si	Ti	U	Zr
Batch glass	2.55	2.47	0.121	0.821	<0.010	0.072	0.298	8.70	<0.010	2.01	0.784	1.32	6.64	0.525	<0.010	0.014	22.4	0.370	<0.100	0.059
U glass	2.12	2.83	<0.010	0.881	<0.010	0.163	<0.010	8.65	<0.010	1.38	0.682	2.07	8.81	0.782	<0.010	0.015	20.9	0.549	1.91	<0.010
A08 11	5.33	2.68	0.023	0.729	0.020	0.037	0.021	7.35	0.014	2.31	0.587	1.80	8.94	0.441	0.021	0.088	21.4	0.262	2.79	0.023
A08 12	5.36	2.72	0.023	0.737	0.020	0.037	0.021	7.41	0.014	2.33	0.594	1.81	8.98	0.445	0.021	0.085	21.2	0.265	2.81	0.023
A08 21	5.28	2.72	0.024	0.715	0.025	0.039	0.021	7.47	0.015	2.31	0.615	1.83	9.02	0.469	0.023	0.091	21.5	0.273	2.83	0.022
A08 22	5.32	2.65	0.025	0.715	0.025	0.039	0.021	7.55	0.015	2.28	0.623	1.84	8.95	0.472	0.024	0.094	20.8	0.274	2.81	0.022
A09 11	5.37	2.89	0.027	1.07	0.017	0.035	0.023	7.36	0.015	2.48	0.625	1.74	8.00	0.412	0.018	0.069	22.7	0.017	2.71	0.021
A09 12	5.29	2.84	0.027	1.07	0.017	0.035	0.023	7.40	0.014	2.45	0.627	1.76	8.04	0.411	0.018	0.068	22.8	0.017	2.72	0.020
A09 21	5.20	2.84	0.025	0.705	0.013	0.037	0.023	7.67	0.014	2.41	0.604	1.83	7.97	0.436	0.020	0.074	22.5	0.017	2.80	0.020
A09 22	5.19	2.88	0.025	0.693	0.013	0.037	0.023	7.45	0.014	2.43	0.594	1.78	8.07	0.429	0.019	0.074	22.8	0.017	2.80	0.020
Batch glass	2.58	2.41	0.118	0.799	<0.010	0.070	0.290	8.98	<0.010	2.03	0.773	1.37	6.79	0.516	<0.010	0.018	23.1	0.362	<0.100	0.059
U glass	2.13	2.85	<0.010	0.886	<0.010	0.162	<0.010	9.30	<0.010	1.39	0.684	2.30	8.93	0.773	<0.010	0.013	21.2	0.547	2.00	<0.010

Table A4. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by SB4-Decant Variability Study 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
SB4VS2-01	Al_2O_3	8.6019	8.8575	8.6332	-0.0313	0.2243	-0.4%	2.6%
SB4VS2-01	B_2O_3	9.3699	9.5962	9.5200	-0.1501	0.0762	-1.6%	0.8%
SB4VS2-01	BaO	0.0170	0.0181	0.0249	-0.0079	-0.0068	-31.6%	-27.4%
SB4VS2-01	CaO	0.9123	0.9574	0.9527	-0.0404	0.0047	-4.2%	0.5%
SB4VS2-01	Ce_2O_3	0.0170	0.0170	0.0224	-0.0054	-0.0054	-24.0%	-24.0%
SB4VS2-01	Cr_2O_3	0.0621	0.0604	0.0558	0.0063	0.0046	11.3%	8.2%
SB4VS2-01	CuO	0.0275	0.0290	0.0199	0.0076	0.0091	38.4%	45.6%
SB4VS2-01	Fe_2O_3	9.9757	10.0071	9.8673	0.1084	0.1398	1.1%	1.4%
SB4VS2-01	La_2O_3	0.0144	0.0144	0.0187	-0.0043	-0.0043	-23.2%	-23.2%
SB4VS2-01	Li_2O	5.3392	5.5150	5.4400	-0.1008	0.0750	-1.9%	1.4%
SB4VS2-01	MgO	0.9324	0.9620	0.9339	-0.0015	0.0281	-0.2%	3.0%
SB4VS2-01	MnO	1.9368	2.0276	1.9803	-0.0435	0.0473	-2.2%	2.4%
SB4VS2-01	Na_2O	10.1774	9.9718	10.1966	-0.0192	-0.2248	-0.2%	-2.2%
SB4VS2-01	NiO	0.5084	0.5394	0.5507	-0.0423	-0.0113	-7.7%	-2.0%
SB4VS2-01	PbO	0.0232	0.0232	0.0206	0.0026	0.0026	12.4%	12.4%
SB4VS2-01	SiO_2	48.3482	48.8504	48.5258	-0.1776	0.3246	-0.4%	0.7%
SB4VS2-01	SO_4	0.1917	0.1917	0.1863	0.0054	0.0054	2.9%	2.9%
SB4VS2-01	TiO_2	0.0284	0.0296	0.0159	0.0125	0.0137	78.3%	86.4%
SB4VS2-01	U_3O_8	2.8271	3.0359	3.0093	-0.1822	0.0266	-6.1%	0.9%
SB4VS2-01	ZrO_2	0.0240	0.0240	0.0258	-0.0018	-0.0018	-7.1%	-7.1%
SB4VS2-01	Sum	99.3346	100.7277	100.0001	-0.6655	0.7276	-0.7%	0.7%
SB4VS2-02	Al_2O_3	9.8774	10.0543	9.4426	0.4348	0.6117	4.6%	6.5%
SB4VS2-02	B_2O_3	9.0050	9.0118	9.1000	-0.0950	-0.0882	-1.0%	-1.0%
SB4VS2-02	BaO	0.0294	0.0323	0.0272	0.0022	0.0051	8.3%	18.7%
SB4VS2-02	CaO	0.9861	1.0481	1.0421	-0.0560	0.0060	-5.4%	0.6%
SB4VS2-02	Ce_2O_3	0.0183	0.0183	0.0245	-0.0062	-0.0062	-25.2%	-25.2%
SB4VS2-02	Cr_2O_3	0.0541	0.0541	0.0610	-0.0069	-0.0069	-11.3%	-11.3%
SB4VS2-02	CuO	0.0286	0.0306	0.0218	0.0068	0.0088	31.4%	40.3%
SB4VS2-02	Fe_2O_3	10.3892	10.5126	10.7924	-0.4032	-0.2798	-3.7%	-2.6%
SB4VS2-02	La_2O_3	0.0172	0.0172	0.0204	-0.0032	-0.0032	-15.9%	-15.9%
SB4VS2-02	Li_2O	5.1705	5.2900	5.2000	-0.0295	0.0900	-0.6%	1.7%
SB4VS2-02	MgO	1.0431	1.1103	1.0215	0.0216	0.0888	2.1%	8.7%
SB4VS2-02	MnO	2.2273	2.2706	2.1660	0.0613	0.1046	2.8%	4.8%
SB4VS2-02	Na_2O	10.7452	10.6081	10.4025	0.3427	0.2056	3.3%	2.0%
SB4VS2-02	NiO	0.5478	0.6007	0.6023	-0.0545	-0.0016	-9.0%	-0.3%
SB4VS2-02	PbO	0.0211	0.0211	0.0225	-0.0014	-0.0014	-6.0%	-6.0%
SB4VS2-02	SiO_2	47.5459	48.5605	46.5126	1.0333	2.0479	2.2%	4.4%
SB4VS2-02	SO_4	0.2138	0.2138	0.2038	0.0101	0.0101	4.9%	4.9%
SB4VS2-02	TiO_2	0.0290	0.0312	0.0174	0.0116	0.0138	66.6%	79.3%
SB4VS2-02	U_3O_8	3.1853	3.3714	3.2914	-0.1061	0.0800	-3.2%	2.4%
SB4VS2-02	ZrO_2	0.0289	0.0289	0.0282	0.0007	0.0007	2.4%	2.4%
SB4VS2-02	Sum	101.1633	102.8858	100.0001	1.1631	2.8857	1.2%	2.9%
SB4VS2-03	Al_2O_3	10.1088	10.4092	10.2520	-0.1432	0.1572	-1.4%	1.5%
SB4VS2-03	B_2O_3	8.5166	8.7223	8.6800	-0.1634	0.0423	-1.9%	0.5%
SB4VS2-03	BaO	0.0271	0.0288	0.0295	-0.0024	-0.0007	-8.2%	-2.5%
SB4VS2-03	CaO	1.0802	1.1336	1.1314	-0.0512	0.0022	-4.5%	0.2%
SB4VS2-03	Ce_2O_3	0.0278	0.0278	0.0266	0.0013	0.0013	4.8%	4.8%
SB4VS2-03	Cr_2O_3	0.0636	0.0618	0.0663	-0.0027	-0.0045	-4.1%	-6.8%
SB4VS2-03	CuO	0.0282	0.0296	0.0236	0.0046	0.0060	19.3%	25.5%
SB4VS2-03	Fe_2O_3	11.3768	11.4130	11.7174	-0.3406	-0.3044	-2.9%	-2.6%
SB4VS2-03	La_2O_3	0.0164	0.0164	0.0222	-0.0058	-0.0058	-26.0%	-26.0%
SB4VS2-03	Li_2O	4.8225	4.9813	4.9600	-0.1375	0.0213	-2.8%	0.4%
SB4VS2-03	MgO	1.0783	1.1123	1.1090	-0.0307	0.0033	-2.8%	0.3%
SB4VS2-03	MnO	2.2531	2.3592	2.3516	-0.0985	0.0076	-4.2%	0.3%
SB4VS2-03	Na_2O	10.6020	10.3878	10.6084	-0.0064	-0.2206	-0.1%	-2.1%
SB4VS2-03	NiO	0.5500	0.5835	0.6539	-0.1039	-0.0704	-15.9%	-10.8%
SB4VS2-03	PbO	0.0229	0.0229	0.0244	-0.0015	-0.0015	-6.2%	-6.2%
SB4VS2-03	SiO_2	43.9626	44.4198	44.4993	-0.5367	-0.0795	-1.2%	-0.2%

Table A4. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by SB4-Decant Variability Study 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
SB4VS2-03	SO_4	0.2217	0.2217	0.2212	0.0005	0.0005	0.2%	0.2%
SB4VS2-03	TiO_2	0.0313	0.0327	0.0189	0.0124	0.0138	65.5%	72.9%
SB4VS2-03	U_3O_8	3.3430	3.5900	3.5735	-0.2305	0.0165	-6.4%	0.5%
SB4VS2-03	ZrO_2	0.0304	0.0304	0.0306	-0.0002	-0.0002	-0.7%	-0.7%
SB4VS2-03	Sum	98.1634	99.5842	99.9998	-1.8364	-0.4156	-1.8%	-0.4%
SB4VS2-04	Al_2O_3	8.2949	8.5413	8.3054	-0.0105	0.2359	-0.1%	2.8%
SB4VS2-04	B_2O_3	9.2492	9.4724	9.5200	-0.2708	-0.0476	-2.8%	-0.5%
SB4VS2-04	BaO	0.0265	0.0282	0.0250	0.0015	0.0032	6.1%	12.7%
SB4VS2-04	CaO	0.8797	0.9233	0.9214	-0.0417	0.0019	-4.5%	0.2%
SB4VS2-04	Ce_2O_3	0.0146	0.0146	0.0239	-0.0092	-0.0092	-38.6%	-38.6%
SB4VS2-04	Cr_2O_3	0.0599	0.0583	0.0547	0.0052	0.0036	9.6%	6.5%
SB4VS2-04	CuO	0.0250	0.0263	0.0196	0.0054	0.0067	27.7%	34.4%
SB4VS2-04	Fe_2O_3	9.2680	9.2971	9.5727	-0.3047	-0.2756	-3.2%	-2.9%
SB4VS2-04	La_2O_3	0.0158	0.0158	0.0188	-0.0030	-0.0030	-15.8%	-15.8%
SB4VS2-04	Li_2O	5.3015	5.4762	5.4400	-0.1385	0.0362	-2.5%	0.7%
SB4VS2-04	MgO	0.8893	0.9175	0.8895	-0.0002	0.0280	0.0%	3.1%
SB4VS2-04	MnO	1.8948	1.9834	1.9547	-0.0599	0.0287	-3.1%	1.5%
SB4VS2-04	Na_2O	10.6526	10.4374	10.5957	0.0569	-0.1583	0.5%	-1.5%
SB4VS2-04	NiO	0.5100	0.5411	0.5450	-0.0350	-0.0039	-6.4%	-0.7%
SB4VS2-04	PbO	0.0202	0.0202	0.0215	-0.0013	-0.0013	-6.1%	-6.1%
SB4VS2-04	SiO_2	48.0273	48.5262	48.4908	-0.4635	0.0354	-1.0%	0.1%
SB4VS2-04	SO_4	0.2165	0.2165	0.2228	-0.0063	-0.0063	-2.8%	-2.8%
SB4VS2-04	TiO_2	0.4287	0.4481	0.4308	-0.0021	0.0173	-0.5%	4.0%
SB4VS2-04	U_3O_8	2.7564	2.9599	2.9118	-0.1554	0.0481	-5.3%	1.7%
SB4VS2-04	ZrO_2	0.0294	0.0294	0.0277	0.0017	0.0017	6.1%	6.1%
SB4VS2-04	Sum	98.5603	99.9332	99.9917	-1.4314	-0.0585	-1.4%	-0.1%
SB4VS2-05	Al_2O_3	9.1594	9.4316	9.0841	0.0753	0.3475	0.8%	3.8%
SB4VS2-05	B_2O_3	9.0238	9.2418	9.1000	-0.0762	0.1418	-0.8%	1.6%
SB4VS2-05	BaO	0.0257	0.0273	0.0273	-0.0016	0.0000	-5.9%	-0.1%
SB4VS2-05	CaO	0.9724	1.0206	1.0078	-0.0354	0.0128	-3.5%	1.3%
SB4VS2-05	Ce_2O_3	0.0252	0.0252	0.0261	-0.0009	-0.0009	-3.5%	-3.5%
SB4VS2-05	Cr_2O_3	0.0588	0.0572	0.0598	-0.0010	-0.0026	-1.6%	-4.4%
SB4VS2-05	CuO	0.0269	0.0283	0.0215	0.0054	0.0068	25.2%	31.7%
SB4VS2-05	Fe_2O_3	10.5905	10.6247	10.4702	0.1203	0.1545	1.1%	1.5%
SB4VS2-05	La_2O_3	0.0152	0.0152	0.0206	-0.0054	-0.0054	-26.0%	-26.0%
SB4VS2-05	Li_2O	5.1400	5.3096	5.2000	-0.0600	0.1096	-1.2%	2.1%
SB4VS2-05	MgO	0.9668	0.9972	0.9729	-0.0061	0.0243	-0.6%	2.5%
SB4VS2-05	MnO	2.1208	2.2212	2.1380	-0.0172	0.0832	-0.8%	3.9%
SB4VS2-05	Na_2O	10.9222	10.7016	10.8390	0.0832	-0.1374	0.8%	-1.3%
SB4VS2-05	NiO	0.5513	0.5848	0.5961	-0.0448	-0.0113	-7.5%	-1.9%
SB4VS2-05	PbO	0.0213	0.0213	0.0235	-0.0022	-0.0022	-9.5%	-9.5%
SB4VS2-05	SiO_2	46.5298	47.0153	46.4743	0.0555	0.5410	0.1%	1.2%
SB4VS2-05	SO_4	0.2412	0.2412	0.2436	-0.0025	-0.0025	-1.0%	-1.0%
SB4VS2-05	TiO_2	0.4566	0.4772	0.4711	-0.0145	0.0061	-3.1%	1.3%
SB4VS2-05	U_3O_8	2.9981	3.2196	3.1848	-0.1867	0.0348	-5.9%	1.1%
SB4VS2-05	ZrO_2	0.0267	0.0267	0.0303	-0.0036	-0.0036	-12.0%	-12.0%
SB4VS2-05	Sum	99.8727	101.2875	99.9910	-0.1184	1.2964	-0.1%	1.3%
SB4VS2-06	Al_2O_3	9.8915	10.1854	9.8627	0.0288	0.3227	0.3%	3.3%
SB4VS2-06	B_2O_3	8.4603	8.6647	8.6800	-0.2197	-0.0153	-2.5%	-0.2%
SB4VS2-06	BaO	0.0251	0.0267	0.0297	-0.0046	-0.0030	-15.4%	-10.2%
SB4VS2-06	CaO	1.0414	1.0929	1.0942	-0.0528	-0.0013	-4.8%	-0.1%
SB4VS2-06	Ce_2O_3	0.0231	0.0231	0.0283	-0.0052	-0.0052	-18.3%	-18.3%
SB4VS2-06	Cr_2O_3	0.0607	0.0589	0.0650	-0.0043	-0.0061	-6.7%	-9.3%
SB4VS2-06	CuO	0.0282	0.0296	0.0233	0.0049	0.0063	20.9%	27.2%
SB4VS2-06	Fe_2O_3	10.8872	10.9221	11.3676	-0.4804	-0.4455	-4.2%	-3.9%
SB4VS2-06	La_2O_3	0.0150	0.0150	0.0223	-0.0073	-0.0073	-32.9%	-32.9%
SB4VS2-06	Li_2O	4.7579	4.9145	4.9600	-0.2021	-0.0455	-4.1%	-0.9%
SB4VS2-06	MgO	1.0410	1.0739	1.0563	-0.0153	0.0176	-1.4%	1.7%

Table A4. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by SB4-Decant Variability Study Glass

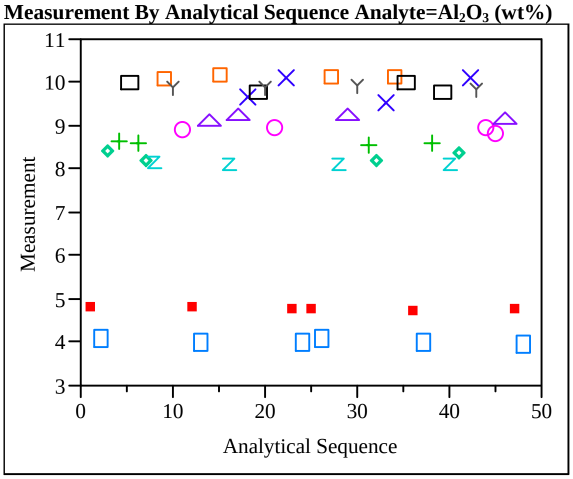
Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
SB4VS2-06	MnO	2.2887	2.3962	2.3212	-0.0325	0.0750	-1.4%	3.2%
SB4VS2-06	Na_2O	11.0974	10.8732	11.0824	0.0150	-0.2092	0.1%	-1.9%
SB4VS2-06	NiO	0.5857	0.6213	0.6472	-0.0615	-0.0259	-9.5%	-4.0%
SB4VS2-06	PbO	0.0315	0.0315	0.0255	0.0060	0.0060	23.6%	23.6%
SB4VS2-06	SiO_2	44.6579	45.1227	44.4579	0.2000	0.6648	0.4%	1.5%
SB4VS2-06	SO_4	0.2681	0.2681	0.2645	0.0036	0.0036	1.4%	1.4%
SB4VS2-06	TiO_2	0.4983	0.5209	0.5115	-0.0132	0.0094	-2.6%	1.8%
SB4VS2-06	U_3O_8	3.2841	3.5266	3.4577	-0.1736	0.0689	-5.0%	2.0%
SB4VS2-06	ZrO_2	0.0280	0.0280	0.0329	-0.0049	-0.0049	-14.8%	-14.8%
SB4VS2-06	Sum	98.9710	100.3955	99.9903	-1.0193	0.4052	-1.0%	0.4%
SB4VS2-07	Al_2O_3	8.1201	8.3613	8.1090	0.0111	0.2523	0.1%	3.1%
SB4VS2-07	B_2O_3	9.3055	9.5303	9.5200	-0.2145	0.0103	-2.3%	0.1%
SB4VS2-07	BaO	0.0148	0.0157	0.0244	-0.0096	-0.0087	-39.4%	-35.6%
SB4VS2-07	CaO	0.8766	0.9200	0.8996	-0.0230	0.0204	-2.6%	2.3%
SB4VS2-07	Ce_2O_3	0.0196	0.0196	0.0233	-0.0037	-0.0037	-15.8%	-15.8%
SB4VS2-07	Cr_2O_3	0.0581	0.0565	0.0534	0.0047	0.0031	8.8%	5.7%
SB4VS2-07	CuO	0.0269	0.0283	0.0192	0.0077	0.0091	40.2%	47.5%
SB4VS2-07	Fe_2O_3	9.2108	9.2407	9.3463	-0.1355	-0.1056	-1.4%	-1.1%
SB4VS2-07	La_2O_3	0.0167	0.0167	0.0184	-0.0017	-0.0017	-9.2%	-9.2%
SB4VS2-07	Li_2O	5.2746	5.4482	5.4400	-0.1654	0.0082	-3.0%	0.2%
SB4VS2-07	MgO	0.8719	0.8994	0.8684	0.0035	0.0310	0.4%	3.6%
SB4VS2-07	MnO	1.8593	1.9468	1.9085	-0.0492	0.0383	-2.6%	2.0%
SB4VS2-07	Na_2O	11.1749	10.9492	11.2357	-0.0608	-0.2865	-0.5%	-2.5%
SB4VS2-07	NiO	0.4902	0.5201	0.5322	-0.0420	-0.0121	-7.9%	-2.3%
SB4VS2-07	PbO	0.0207	0.0207	0.0210	-0.0003	-0.0003	-1.3%	-1.3%
SB4VS2-07	SiO_2	48.0273	48.5277	48.4698	-0.4425	0.0579	-0.9%	0.1%
SB4VS2-07	SO_4	0.2202	0.2202	0.2175	0.0027	0.0027	1.2%	1.2%
SB4VS2-07	TiO_2	0.4245	0.4437	0.4206	0.0039	0.0231	0.9%	5.5%
SB4VS2-07	U_3O_8	2.6591	2.8555	2.8429	-0.1838	0.0126	-6.5%	0.4%
SB4VS2-07	ZrO_2	0.0287	0.0287	0.0270	0.0017	0.0017	6.3%	6.3%
SB4VS2-07	Sum	98.7007	100.0494	99.9972	-1.2965	0.0522	-1.3%	0.1%
SB4VS2-08	Al_2O_3	8.9184	9.1834	8.8692	0.0492	0.3142	0.6%	3.5%
SB4VS2-08	B_2O_3	8.8064	9.0193	9.1000	-0.2936	-0.0807	-3.2%	-0.9%
SB4VS2-08	BaO	0.0276	0.0293	0.0267	0.0009	0.0026	3.5%	9.9%
SB4VS2-08	CaO	0.9347	0.9809	0.9839	-0.0492	-0.0030	-5.0%	-0.3%
SB4VS2-08	Ce_2O_3	0.0258	0.0258	0.0255	0.0003	0.0003	1.2%	1.2%
SB4VS2-08	Cr_2O_3	0.0563	0.0547	0.0584	-0.0021	-0.0037	-3.6%	-6.4%
SB4VS2-08	CuO	0.0266	0.0280	0.0210	0.0056	0.0070	26.7%	33.2%
SB4VS2-08	Fe_2O_3	9.6576	9.6891	10.2225	-0.5649	-0.5334	-5.5%	-5.2%
SB4VS2-08	La_2O_3	0.0155	0.0155	0.0201	-0.0046	-0.0046	-22.7%	-22.7%
SB4VS2-08	Li_2O	5.0216	5.1870	5.2000	-0.1784	-0.0130	-3.4%	-0.2%
SB4VS2-08	MgO	0.9626	0.9931	0.9499	0.0127	0.0432	1.3%	4.5%
SB4VS2-08	MnO	2.0756	2.1734	2.0874	-0.0118	0.0860	-0.6%	4.1%
SB4VS2-08	Na_2O	11.6231	11.3881	11.5390	0.0841	-0.1509	0.7%	-1.3%
SB4VS2-08	NiO	0.5456	0.5788	0.5820	-0.0364	-0.0032	-6.3%	-0.6%
SB4VS2-08	PbO	0.0242	0.0242	0.0229	0.0013	0.0013	5.8%	5.8%
SB4VS2-08	SiO_2	46.4228	46.9057	46.4513	-0.0285	0.4544	-0.1%	1.0%
SB4VS2-08	SO_4	0.2554	0.2554	0.2379	0.0175	0.0175	7.4%	7.4%
SB4VS2-08	TiO_2	0.4629	0.4838	0.4600	0.0029	0.0238	0.6%	5.2%
SB4VS2-08	U_3O_8	2.9303	3.1468	3.1094	-0.1791	0.0374	-5.8%	1.2%
SB4VS2-08	ZrO_2	0.0250	0.0250	0.0296	-0.0046	-0.0046	-15.6%	-15.6%
SB4VS2-08	Sum	98.8182	100.1872	99.9967	-1.1785	0.1905	-1.2%	0.2%
SB4VS2-09	Al_2O_3	9.9648	10.1430	9.6294	0.3354	0.5136	3.5%	5.3%
SB4VS2-09	B_2O_3	8.5368	8.5944	8.6800	-0.1432	-0.0856	-1.7%	-1.0%
SB4VS2-09	BaO	0.0264	0.0289	0.0290	-0.0026	-0.0001	-9.0%	-0.2%
SB4VS2-09	CaO	1.0230	1.0873	1.0683	-0.0453	0.0190	-4.2%	1.8%
SB4VS2-09	Ce_2O_3	0.0269	0.0269	0.0277	-0.0007	-0.0007	-2.6%	-2.6%
SB4VS2-09	Cr_2O_3	0.0565	0.0565	0.0634	-0.0069	-0.0069	-11.0%	-10.9%

Table A4. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by SB4-Decant Variability Study Glass

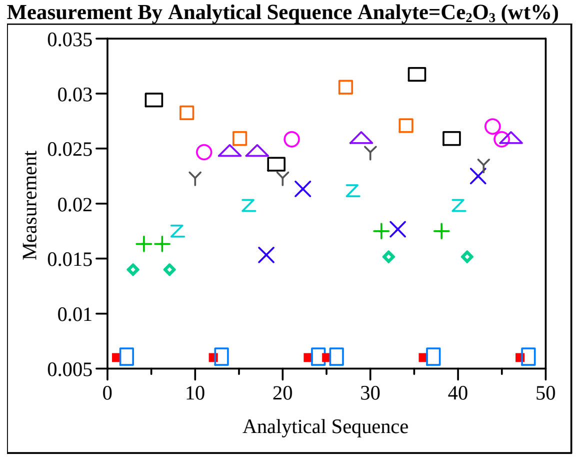
Glass ID	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
SB4VS2-09	CuO	0.0260	0.0277	0.0228	0.0032	0.0049	13.9%	21.7%
SB4VS2-09	Fe_2O_3	10.4332	10.5346	11.0988	-0.6656	-0.5642	-6.0%	-5.1%
SB4VS2-09	La_2O_3	0.0172	0.0172	0.0218	-0.0046	-0.0046	-21.3%	-21.3%
SB4VS2-09	Li_2O	4.9167	5.0427	4.9600	-0.0433	0.0827	-0.9%	1.7%
SB4VS2-09	MgO	1.0163	1.0823	1.0313	-0.0150	0.0510	-1.5%	4.9%
SB4VS2-09	MnO	2.3032	2.3487	2.2663	0.0369	0.0824	1.6%	3.6%
SB4VS2-09	Na_2O	12.0225	11.8691	11.8424	0.1801	0.0267	1.5%	0.2%
SB4VS2-09	NiO	0.5857	0.6425	0.6319	-0.0462	0.0106	-7.3%	1.7%
SB4VS2-09	PbO	0.0241	0.0241	0.0249	-0.0008	-0.0008	-3.2%	-3.2%
SB4VS2-09	SiO_2	45.1125	46.0686	44.4328	0.6797	1.6358	1.5%	3.7%
SB4VS2-09	SO_4	0.2696	0.2696	0.2583	0.0114	0.0114	4.4%	4.4%
SB4VS2-09	TiO_2	0.4545	0.4894	0.4994	-0.0449	-0.0100	-9.0%	-2.0%
SB4VS2-09	U_3O_8	3.2693	3.4608	3.3759	-0.1066	0.0849	-3.2%	2.5%
SB4VS2-09	ZrO_2	0.0314	0.0314	0.0321	-0.0007	-0.0007	-2.2%	-2.2%
SB4VS2-09	Sum	100.1165	101.8458	99.9964	0.1200	1.8494	0.1%	1.8%
Batch 1	Al_2O_3	4.7639	4.8770	4.8770	-0.1131	0.0000	-2.3%	0.0%
Batch 1	B_2O_3	7.6593	7.7770	7.7770	-0.1177	0.0000	-1.5%	0.0%
Batch 1	BaO	0.1400	0.1510	0.1510	-0.0110	0.0000	-7.3%	0.0%
Batch 1	CaO	1.1552	1.2200	1.2200	-0.0648	0.0000	-5.3%	0.0%
Batch 1	Ce_2O_3	0.0059	0.0059	0.0000	0.0059	0.0059		
Batch 1	Cr_2O_3	0.1085	0.1070	0.1070	0.0015	0.0000	1.4%	0.0%
Batch 1	CuO	0.3766	0.3990	0.3990	-0.0224	0.0000	-5.6%	0.0%
Batch 1	Fe_2O_3	12.7583	12.8390	12.8390	-0.0807	0.0000	-0.6%	0.0%
Batch 1	La_2O_3	0.0059	0.0059	0.0000	0.0059	0.0059		
Batch 1	Li_2O	4.3031	4.4290	4.4290	-0.1259	0.0000	-2.8%	0.0%
Batch 1	MgO	1.3544	1.4190	1.4190	-0.0646	0.0000	-4.6%	0.0%
Batch 1	MnO	1.6705	1.7260	1.7260	-0.0555	0.0000	-3.2%	0.0%
Batch 1	Na_2O	9.1546	9.0030	9.0030	0.1516	0.0000	1.7%	0.0%
Batch 1	NiO	0.6965	0.7510	0.7510	-0.0545	0.0000	-7.3%	0.0%
Batch 1	PbO	0.0054	0.0054	0.0000	0.0054	0.0054		
Batch 1	SiO_2	49.4446	50.2200	50.2200	-0.7754	0.0000	-1.5%	0.0%
Batch 1	SO_4	0.0423	0.0423	0.0000	0.0423	0.0423		
Batch 1	TiO_2	0.6384	0.6770	0.6770	-0.0386	0.0000	-5.7%	0.0%
Batch 1	U_3O_8	0.0590	0.0629	0.0000	0.0590	0.0629		
Batch 1	ZrO_2	0.0834	0.0834	0.0980	-0.0146	-0.0146	-14.9%	-14.9%
Batch 1	Sum	94.4258	95.8007	95.6930	-1.2672	0.1077	-1.3%	0.1%
Ustd	Al_2O_3	3.9727	4.0672	4.1000	-0.1273	-0.0328	-3.1%	-0.8%
Ustd	B_2O_3	9.1445	9.0519	9.2090	-0.0645	-0.1571	-0.7%	-1.7%
Ustd	BaO	0.0056	0.0060	0.0000	0.0056	0.0060		
Ustd	CaO	1.2574	1.3279	1.3010	-0.0436	0.0269	-3.4%	2.1%
Ustd	Ce_2O_3	0.0059	0.0059	0.0000	0.0059	0.0059		
Ustd	Cr_2O_3	0.2413	0.2381	0.0000	0.2413	0.2381		
Ustd	CuO	0.0077	0.0081	0.0000	0.0077	0.0081		
Ustd	Fe_2O_3	12.8316	13.0351	13.1960	-0.3644	-0.1609	-2.8%	-1.2%
Ustd	La_2O_3	0.0059	0.0059	0.0000	0.0059	0.0059		
Ustd	Li_2O	2.9818	3.0367	3.0570	-0.0752	-0.0203	-2.5%	-0.7%
Ustd	MgO	1.1533	1.2089	1.2100	-0.0567	-0.0011	-4.7%	-0.1%
Ustd	MnO	2.7390	2.8305	2.8920	-0.1530	-0.0615	-5.3%	-2.1%
Ustd	Na_2O	11.8793	11.6834	11.7950	0.0843	-0.1116	0.7%	-0.9%
Ustd	NiO	0.9984	1.0773	1.1200	-0.1216	-0.0427	-10.9%	-3.8%
Ustd	PbO	0.0054	0.0054	0.0000	0.0054	0.0054		
Ustd	SiO_2	45.0590	45.7691	45.3530	-0.2940	0.4161	-0.6%	0.9%
Ustd	SO_4	0.0397	0.0397	0.0000	0.0397	0.0397		
Ustd	TiO_2	0.9257	0.9822	1.0490	-0.1233	-0.0668	-11.8%	-6.4%
Ustd	U_3O_8	2.2567	2.4060	2.4060	-0.1493	0.0000	-6.2%	0.0%
Ustd	ZrO_2	0.0068	0.0068	0.0000	0.0068	0.0068		
Ustd	Sum	95.5175	96.7919	96.6880	-1.1705	0.1039	-1.2%	0.1%

Figure A1. Oxide Measurements in Analytical Sequence for Samples Prepared Using the LM Method

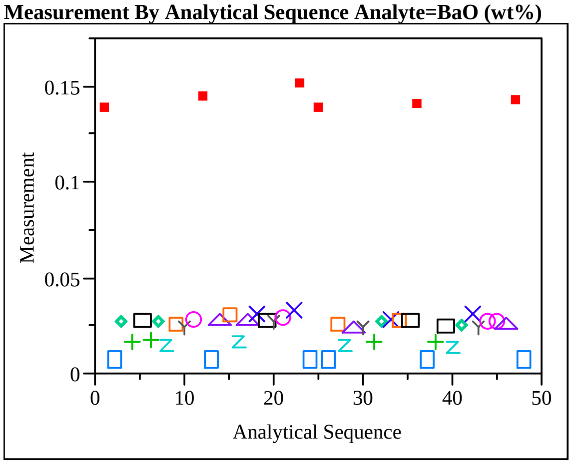
Measurement By Analytical Sequence Analyte=Al_2O_3 (wt%)



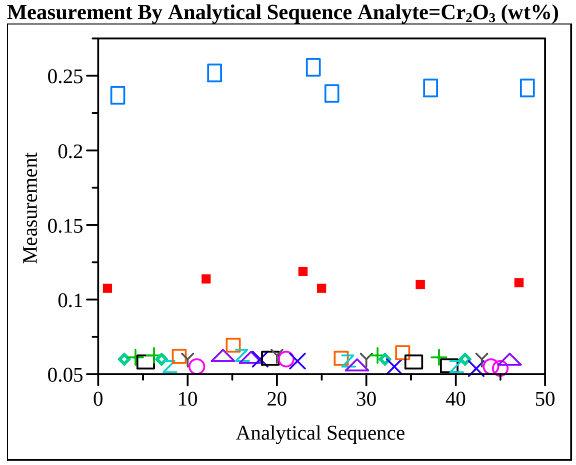
Measurement By Analytical Sequence Analyte=Ce_2O_3 (wt%)



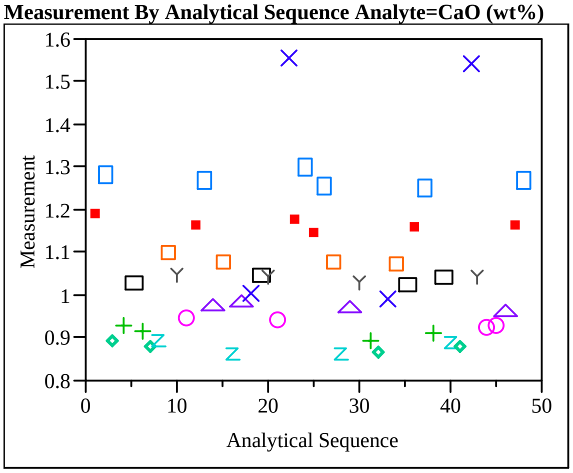
Measurement By Analytical Sequence Analyte=BaO (wt%)



Measurement By Analytical Sequence Analyte=Cr_2O_3 (wt%)



Measurement By Analytical Sequence Analyte=CaO (wt%)



Measurement By Analytical Sequence Analyte=CuO (wt%)

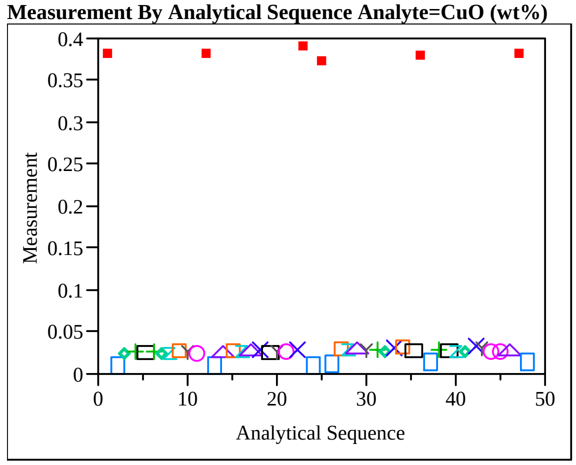


Figure A1. Oxide Measurements in Analytical Sequence for Samples Prepared Using the LM Method

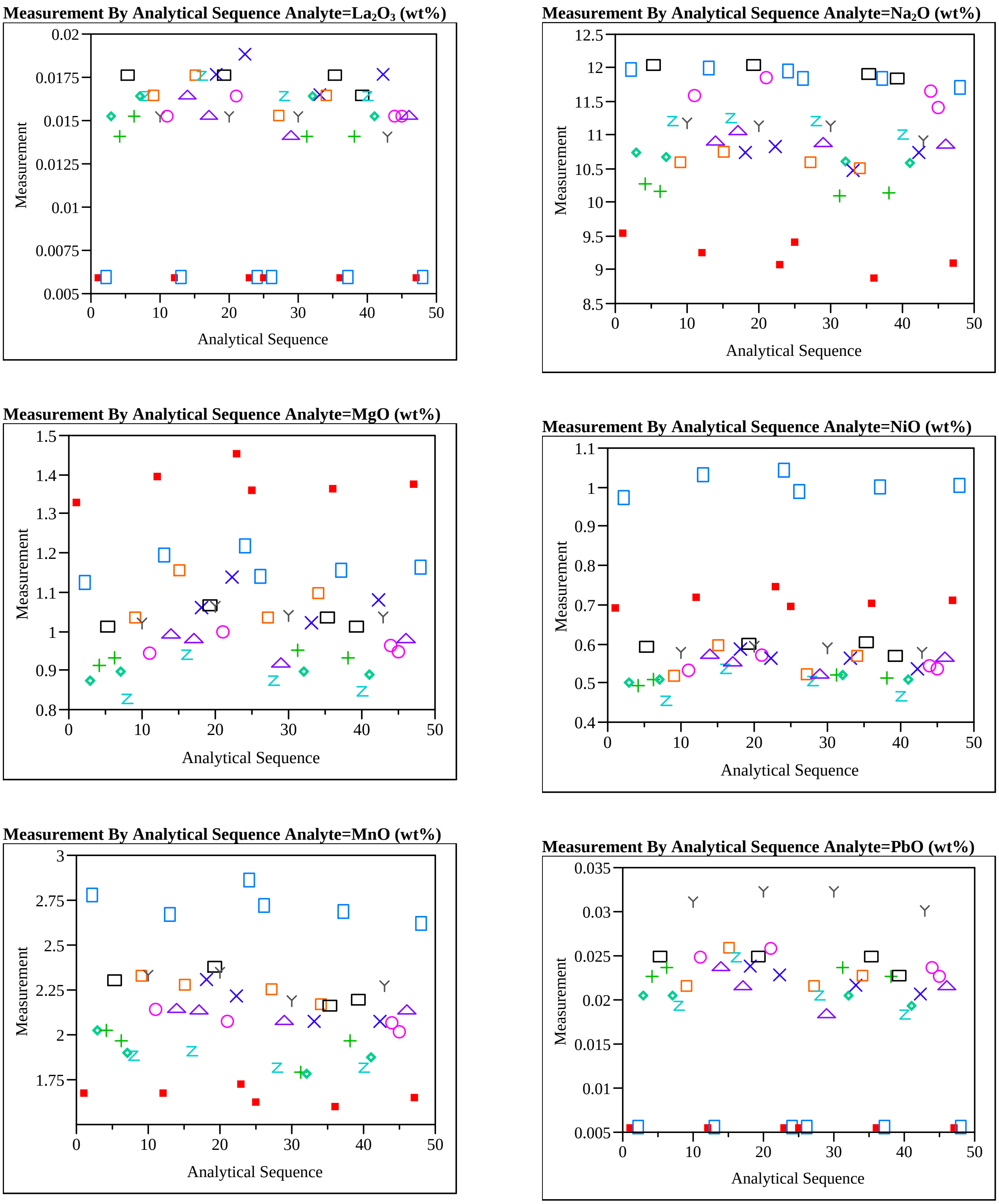
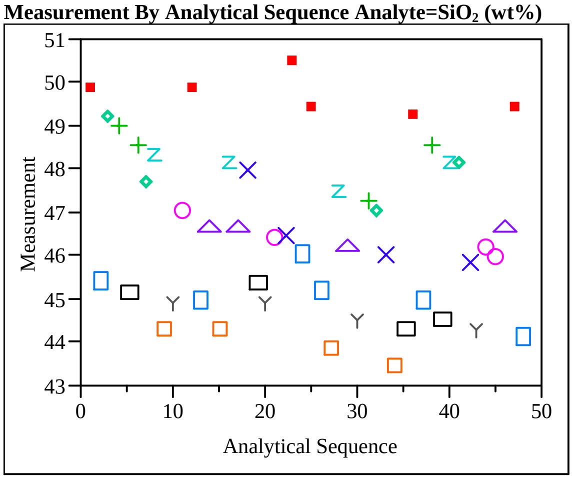
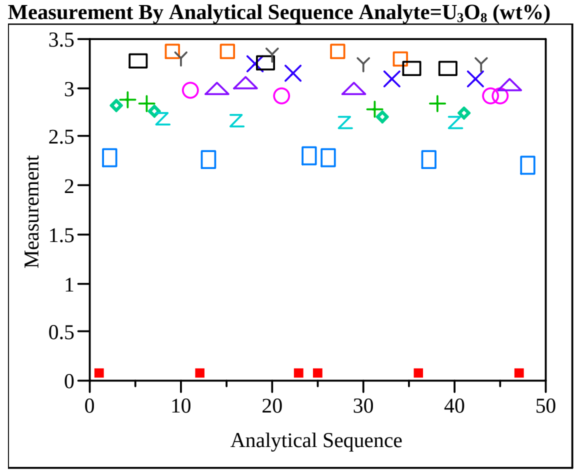


Figure A1. Oxide Measurements in Analytical Sequence for Samples Prepared Using the LM Method

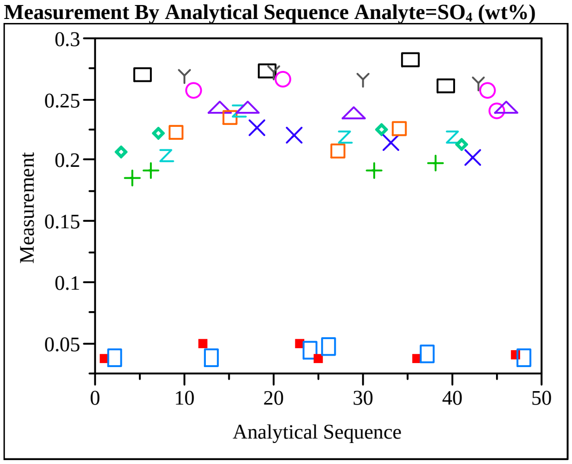
Measurement By Analytical Sequence Analyte=SiO_2 (wt%)



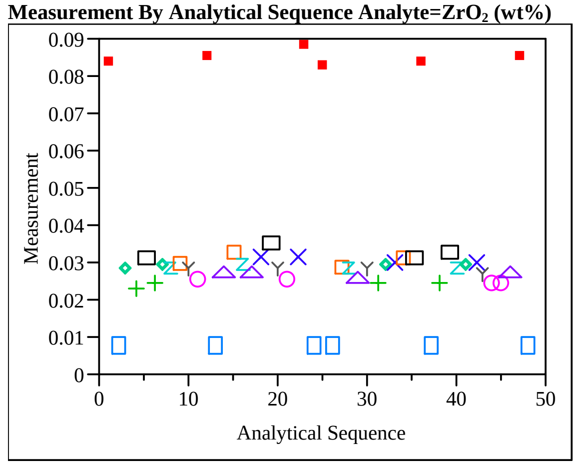
Measurement By Analytical Sequence Analyte=U_3O_8 (wt%)



Measurement By Analytical Sequence Analyte=SO_4 (wt%)



Measurement By Analytical Sequence Analyte=ZrO_2 (wt%)



Measurement By Analytical Sequence Analyte=TiO_2 (wt%)

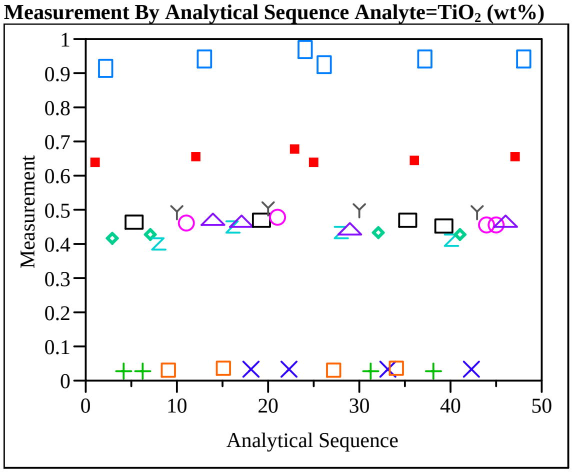
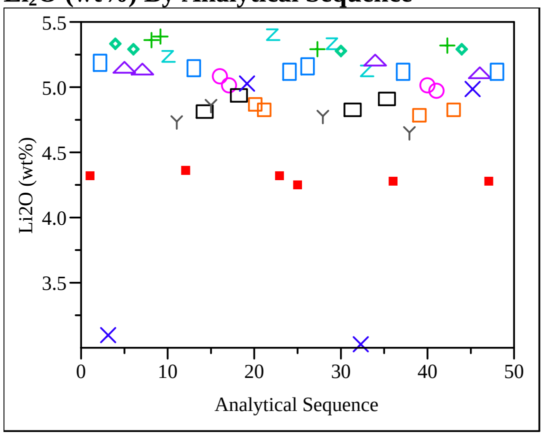
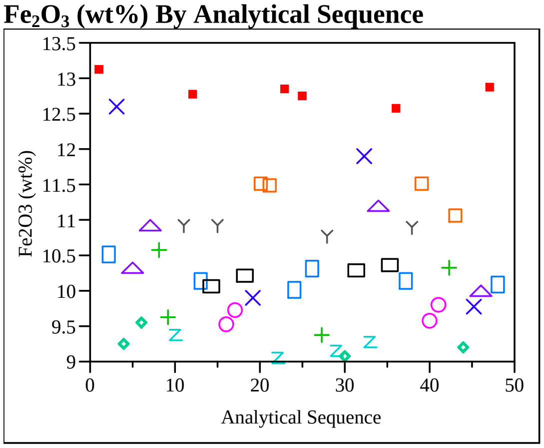


Figure A2. Oxide Measurements in Analytical Sequence for Samples Prepared Using the PF Method

Li_2O (wt%) By Analytical Sequence



Fe_2O_3 (wt%) By Analytical Sequence



B_2O_3 (wt%) By Analytical Sequence

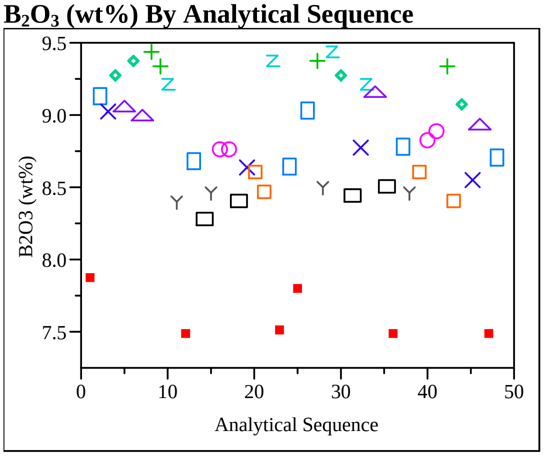
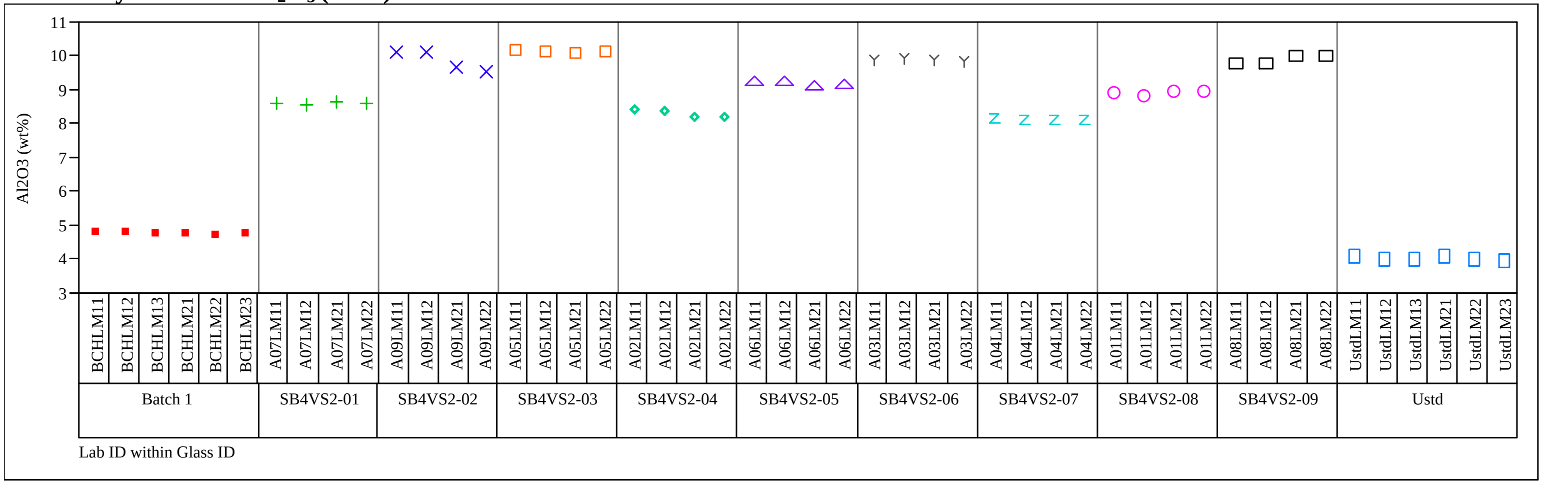


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for Al_2O_3 (wt%)



Variability Chart for BaO (wt%)

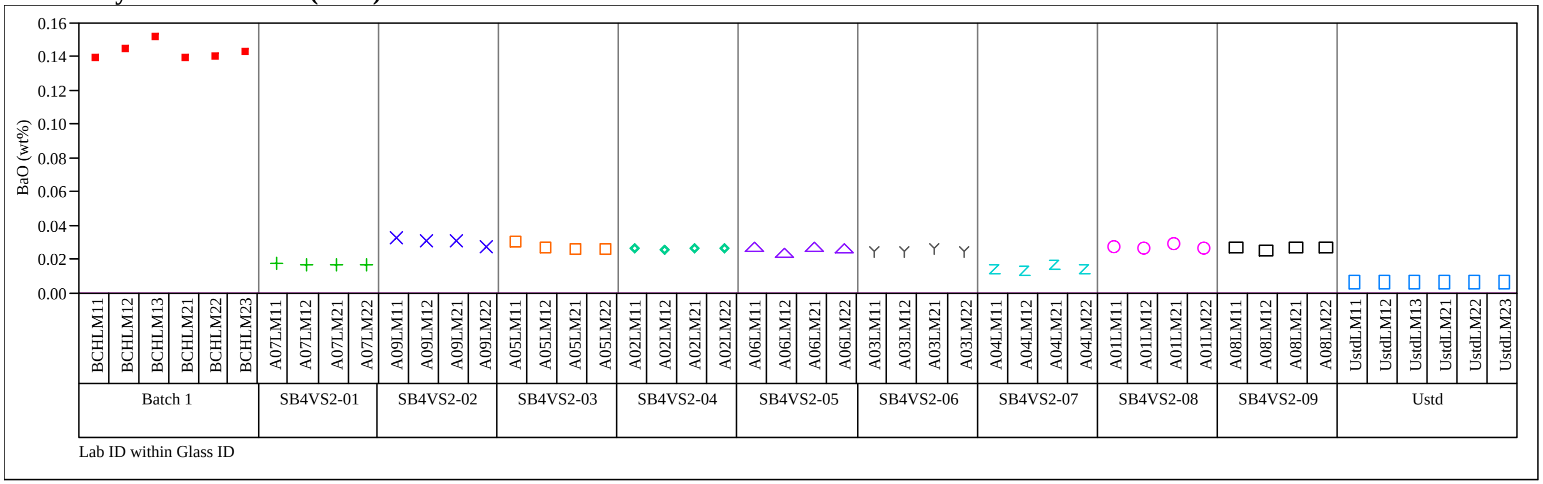
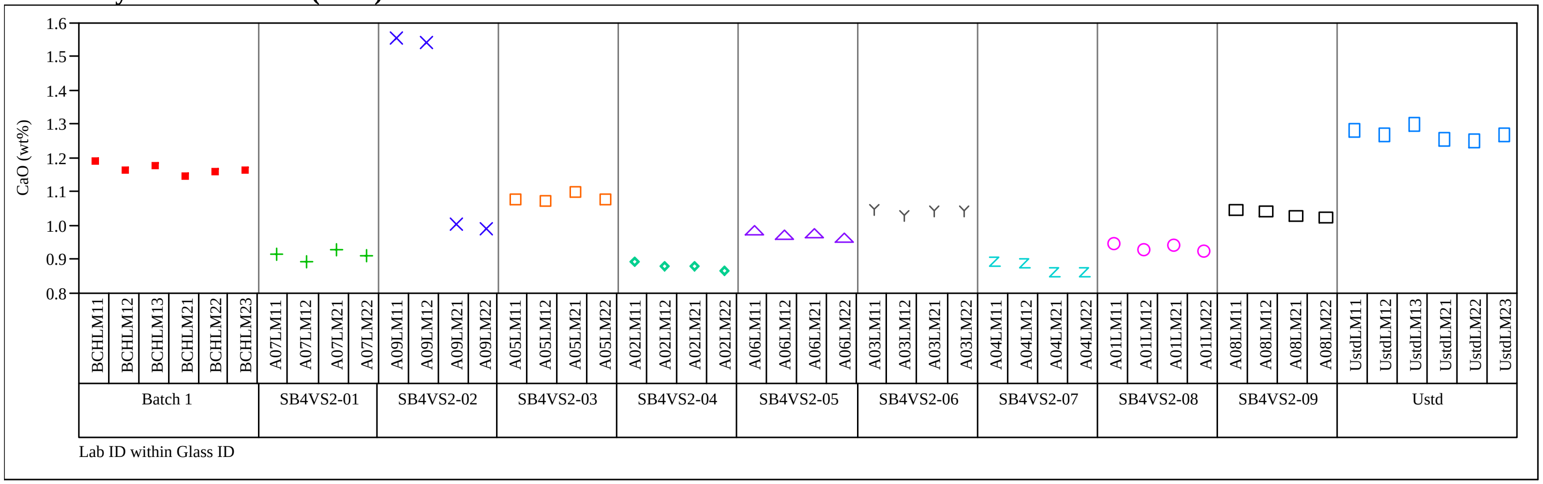


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for CaO (wt%)



Variability Chart for Ce_2O_3 (wt%)

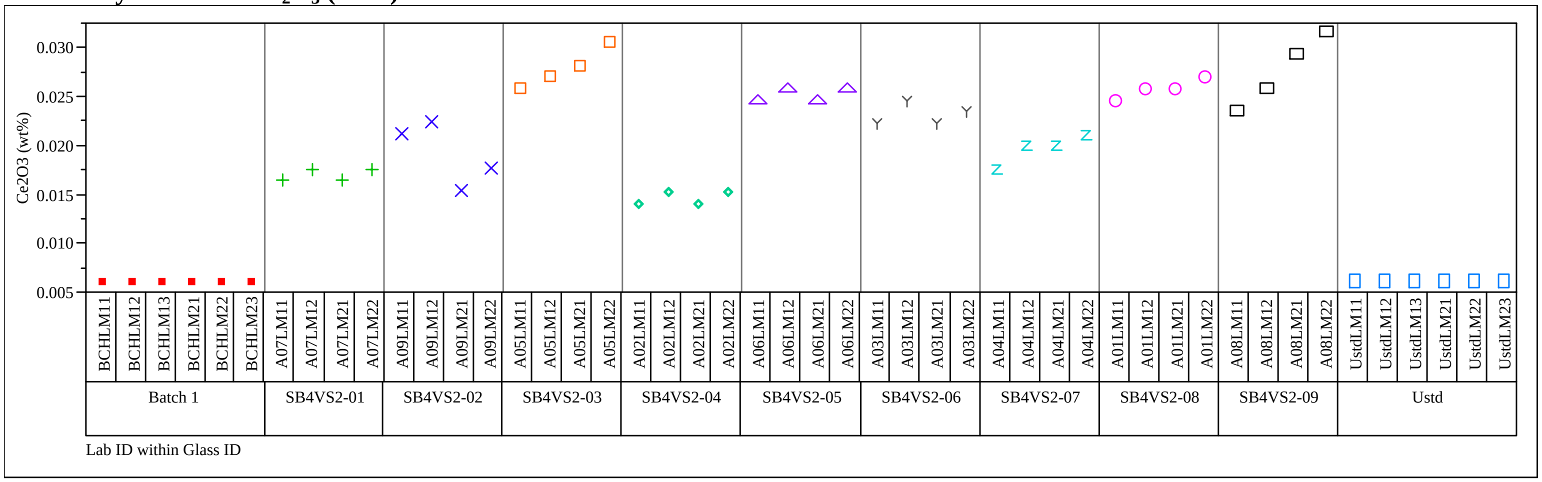
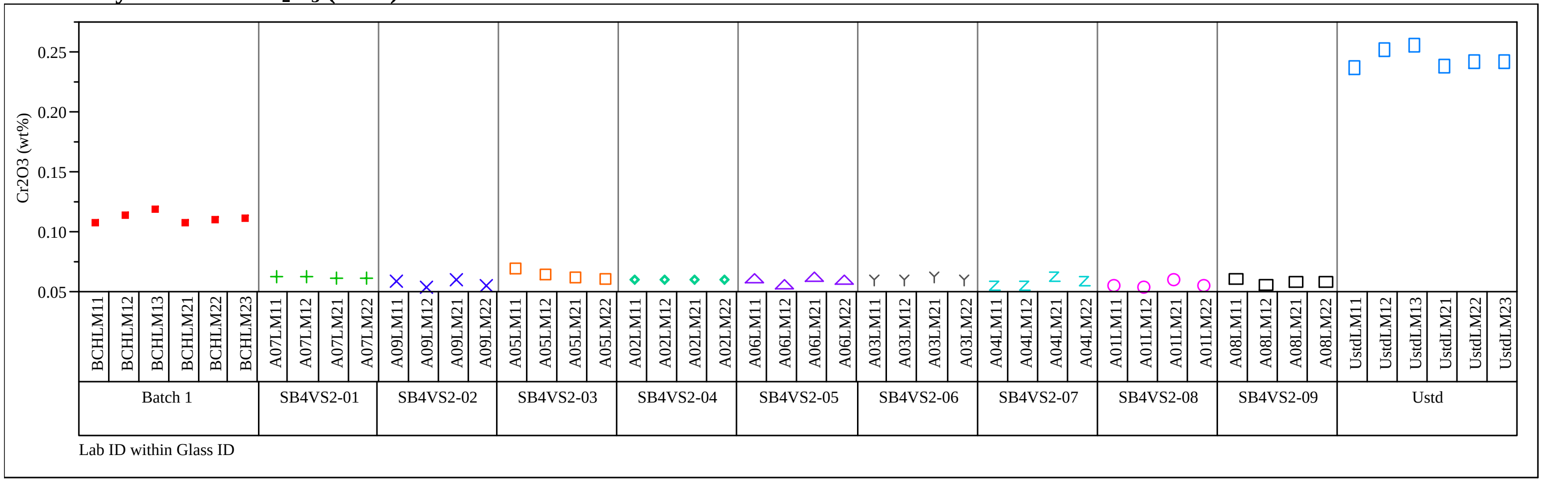


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for Cr_2O_3 (wt%)



Variability Chart for CuO (wt%)

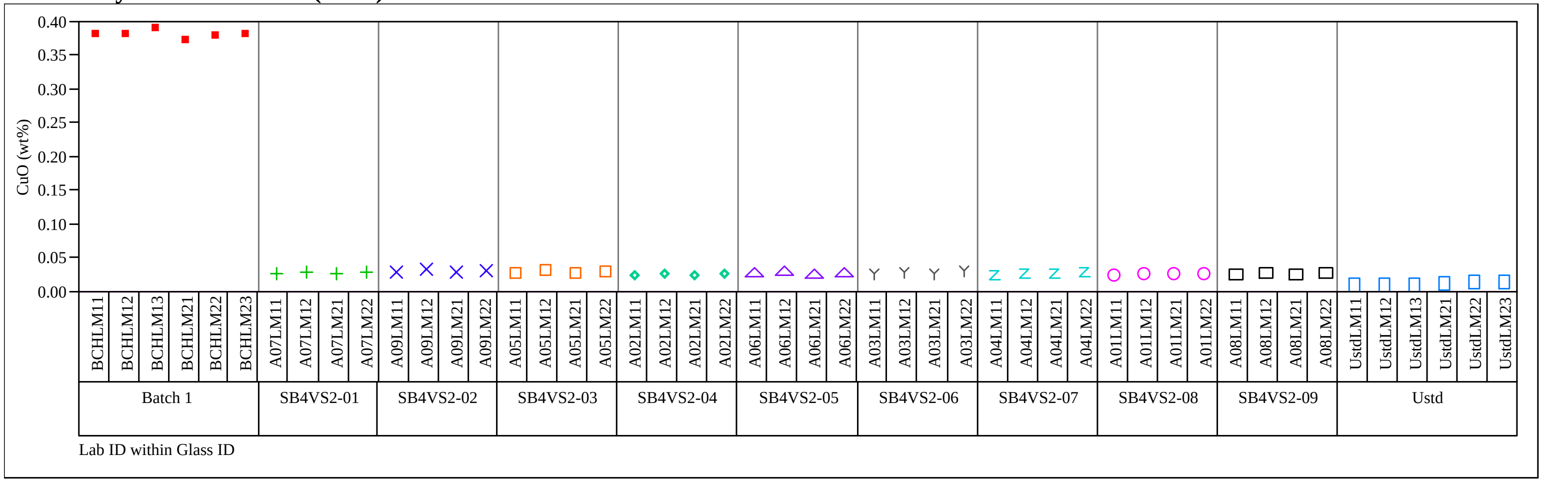
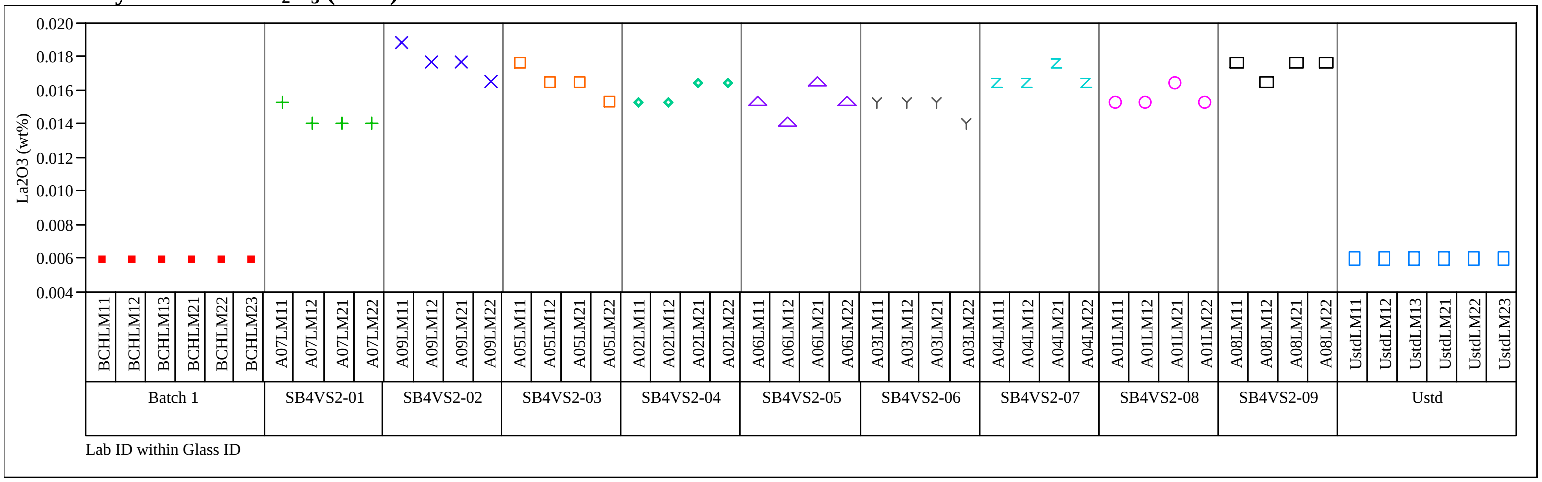


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for La_2O_3 (wt%)



Variability Chart for MgO (wt%)

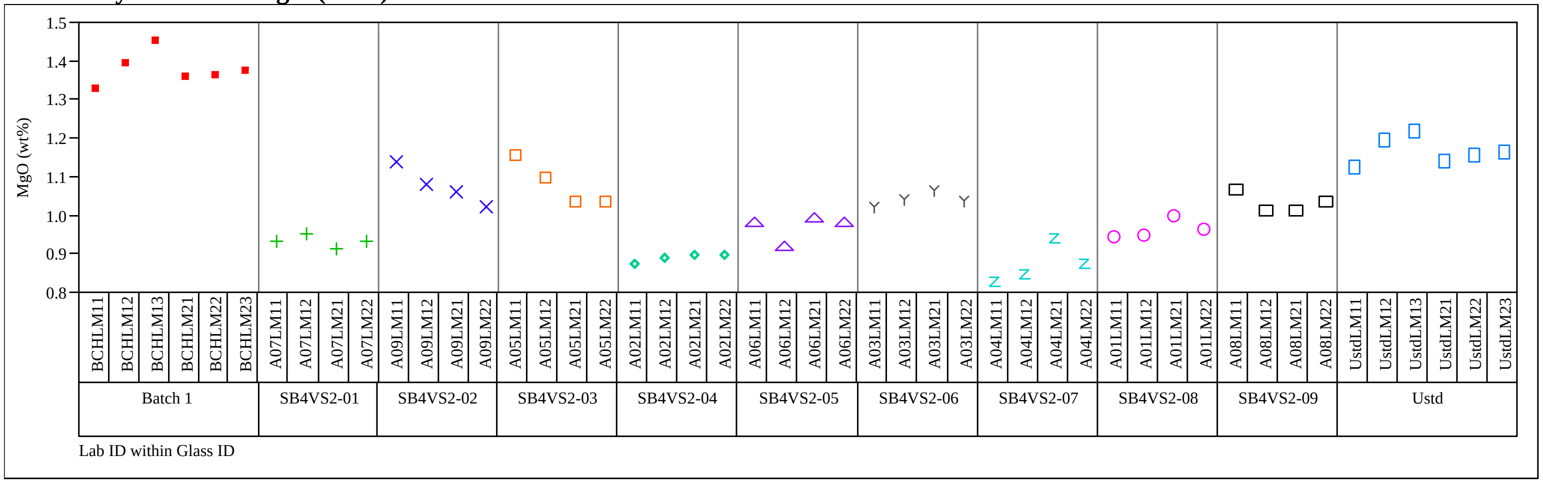
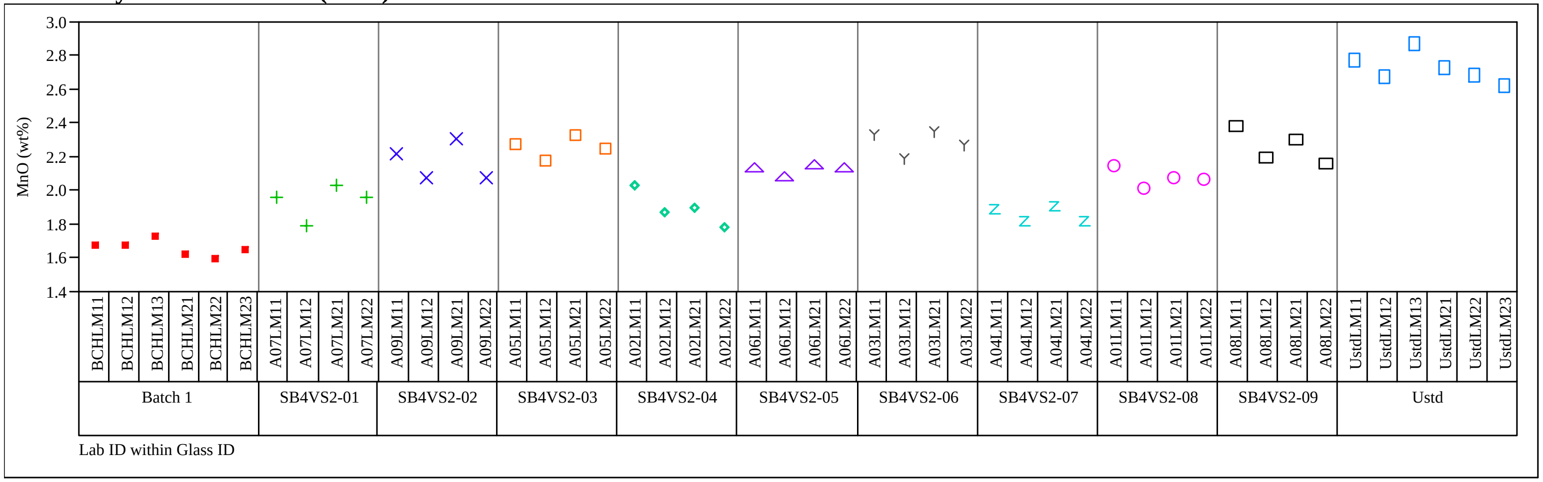


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for MnO (wt%)



Variability Chart for Na_2O (wt%)

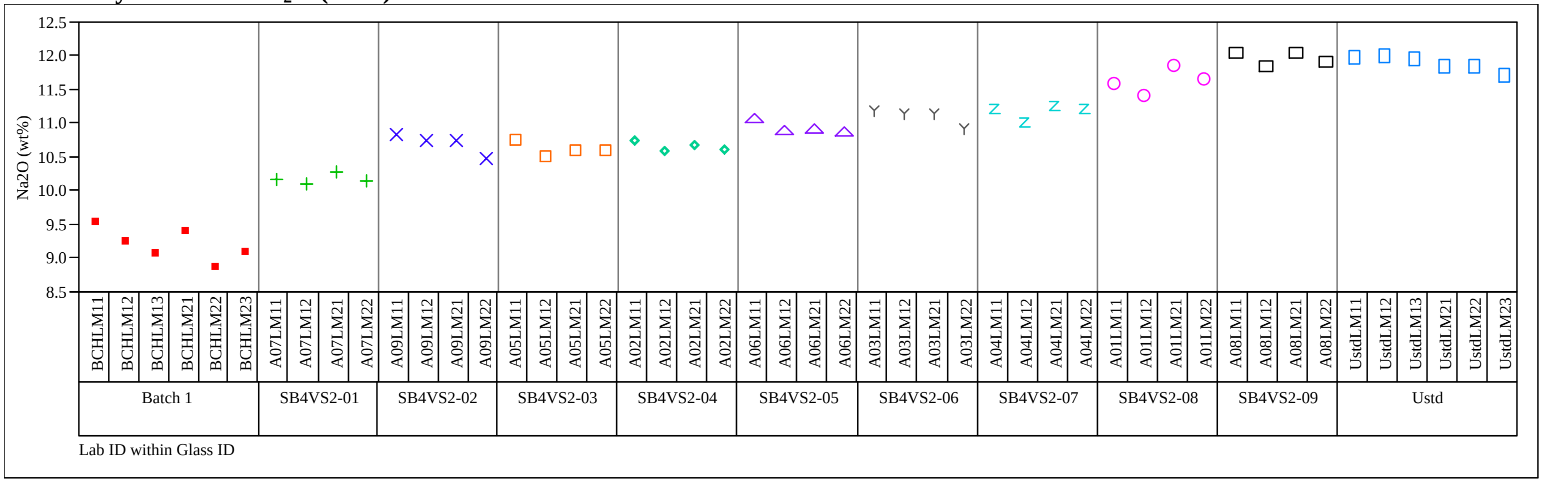
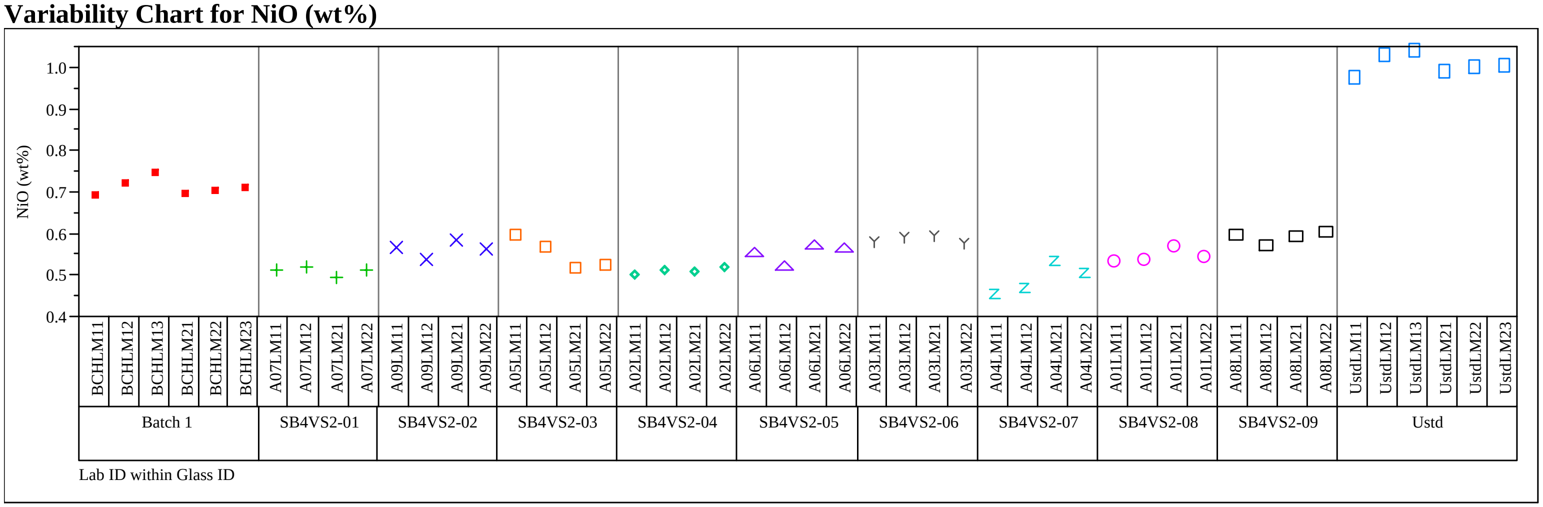


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method



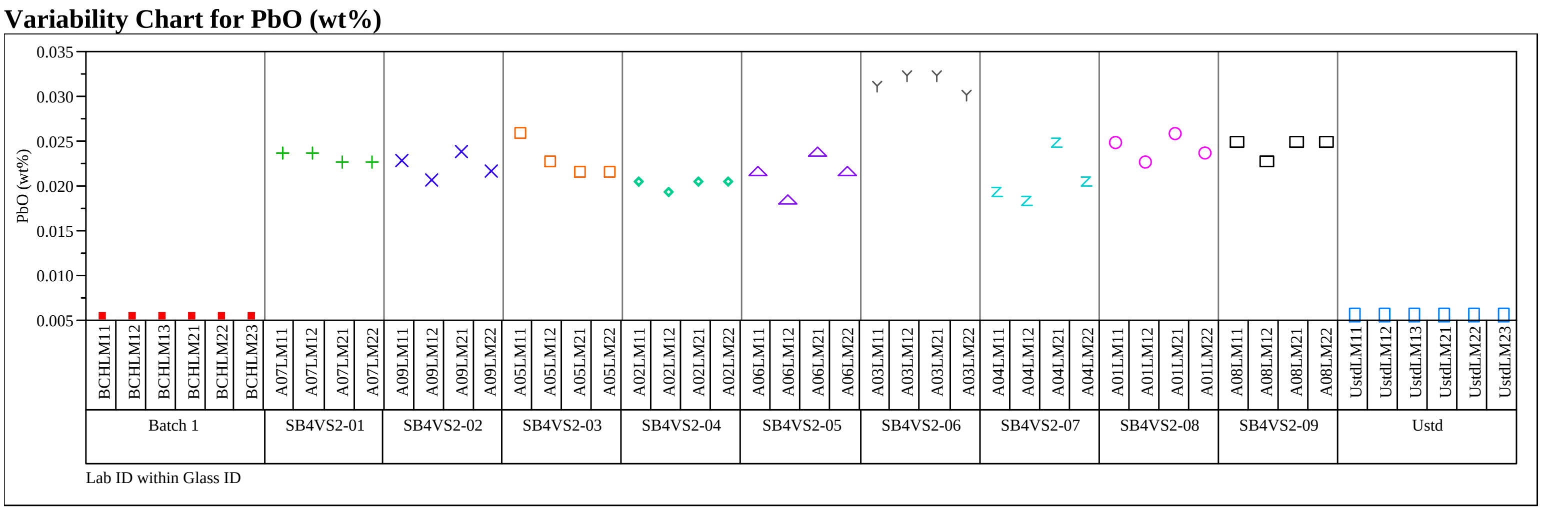
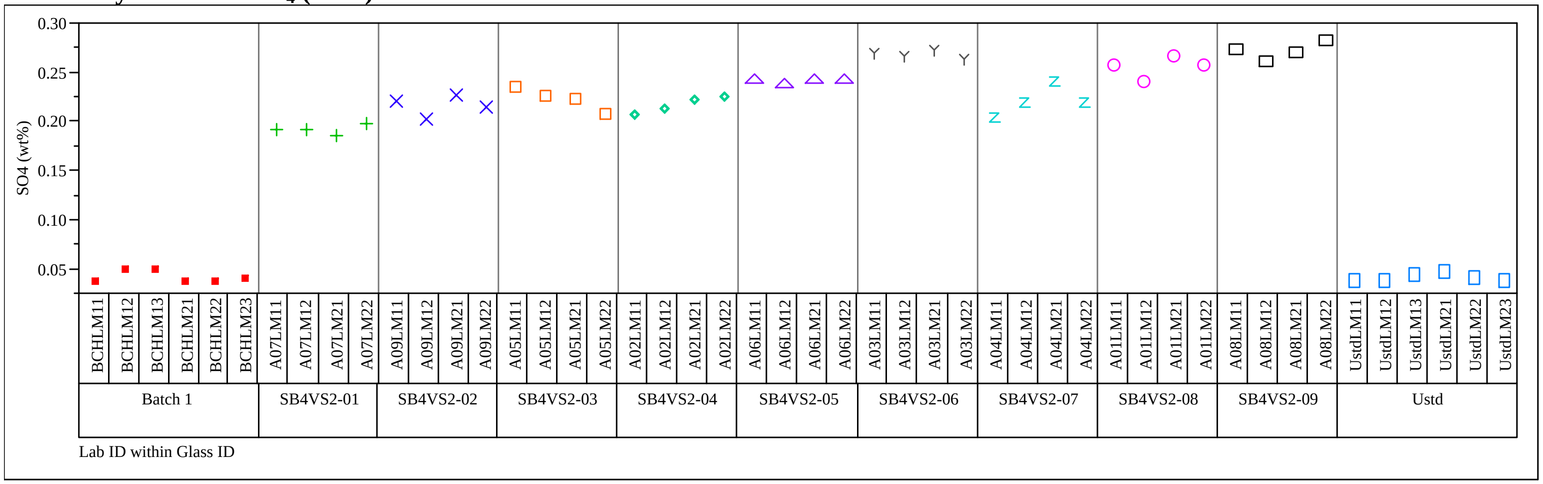


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for SO_4 (wt%)



Variability Chart for SiO_2 (wt%)

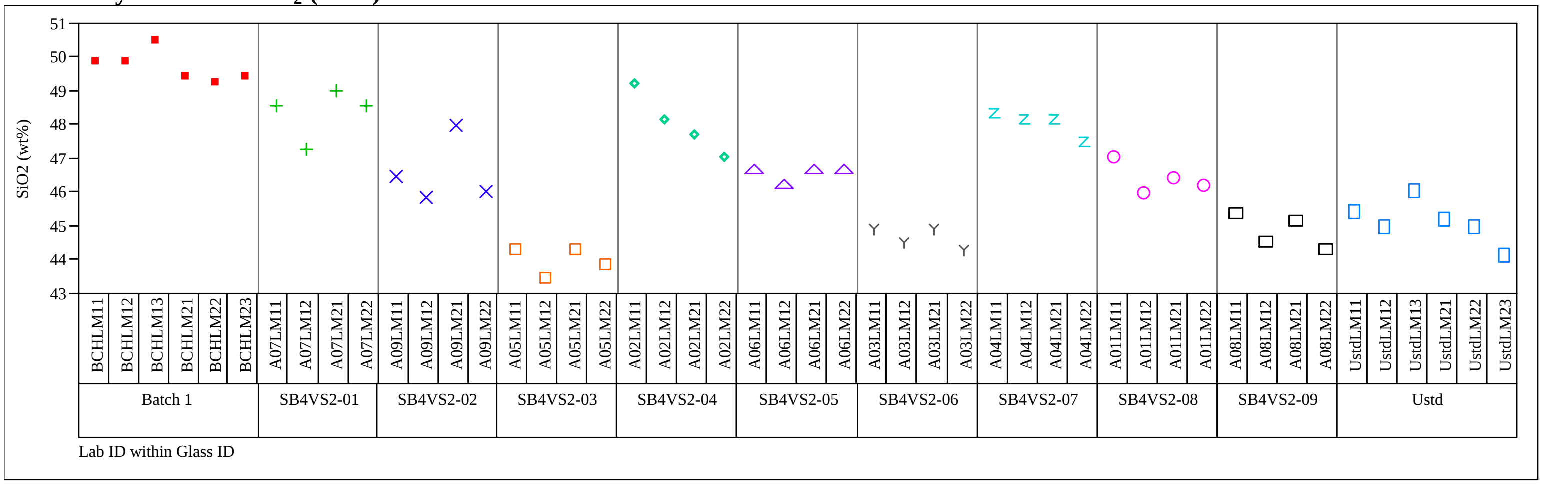
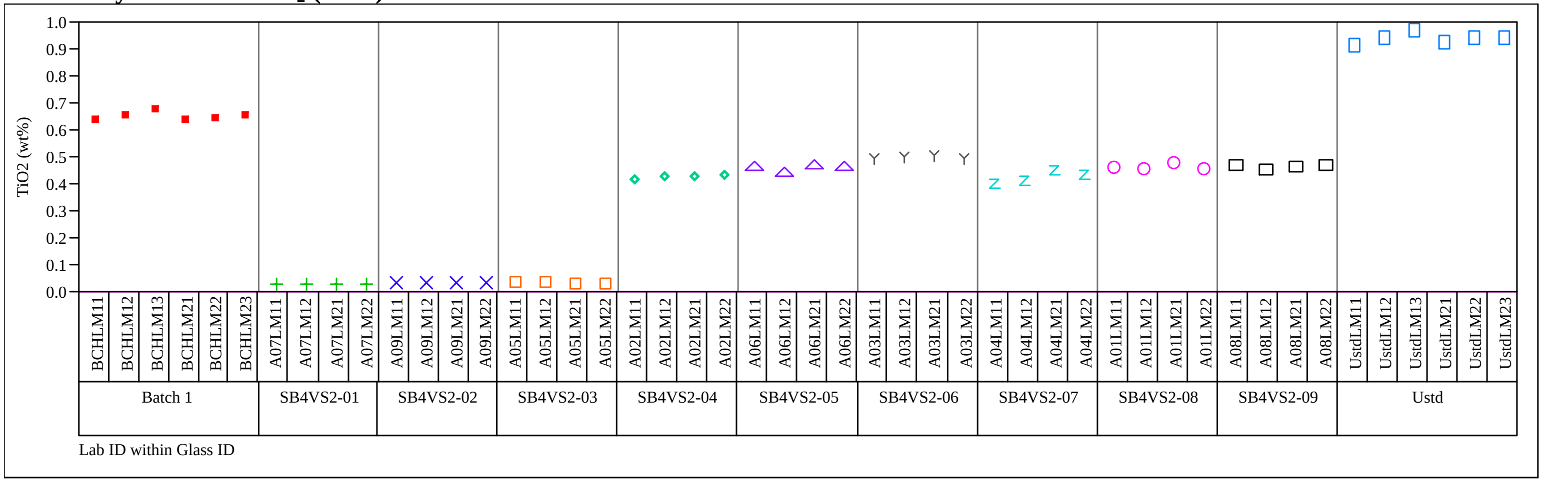


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

Variability Chart for TiO_2 (wt%)



Variability Chart for U_3O_8 (wt%)

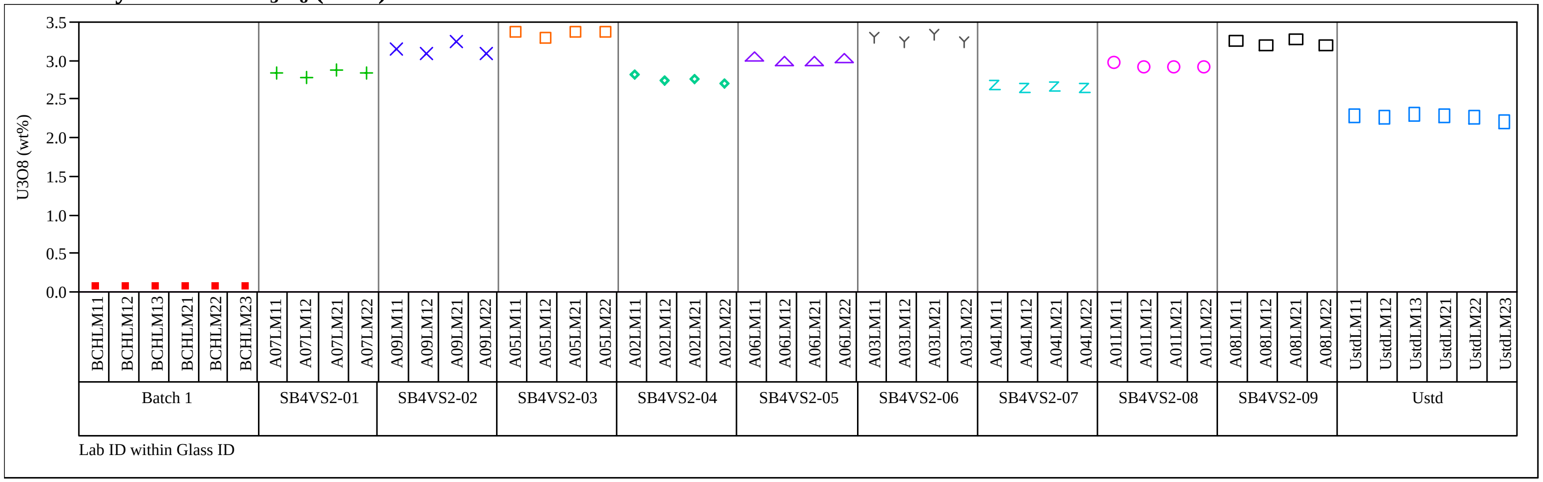


Figure A3. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the LM Method

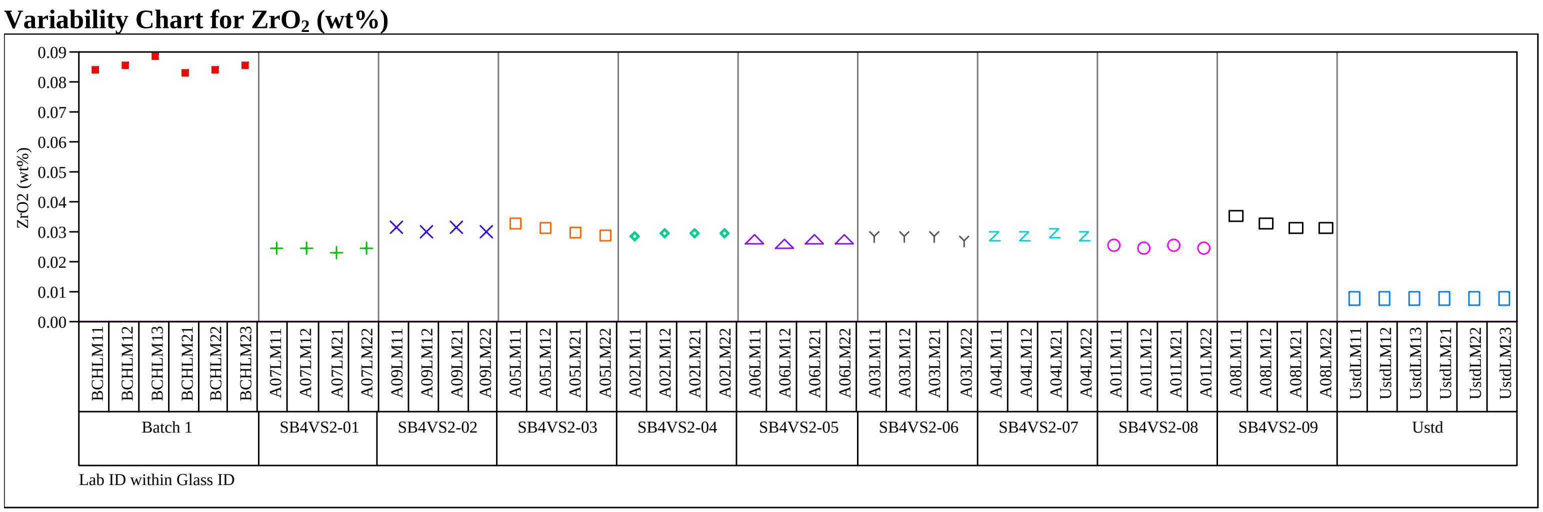
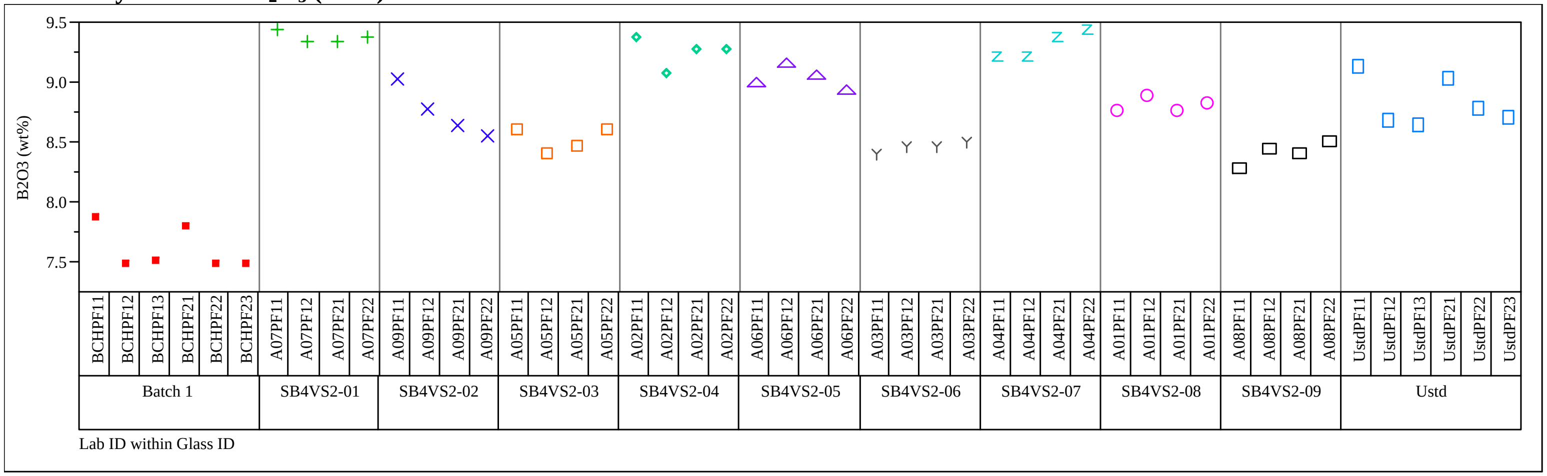


Figure A4. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the PF Method

Variability Chart for B_2O_3 (wt%)



Variability Chart for Fe_2O_3 (wt%)

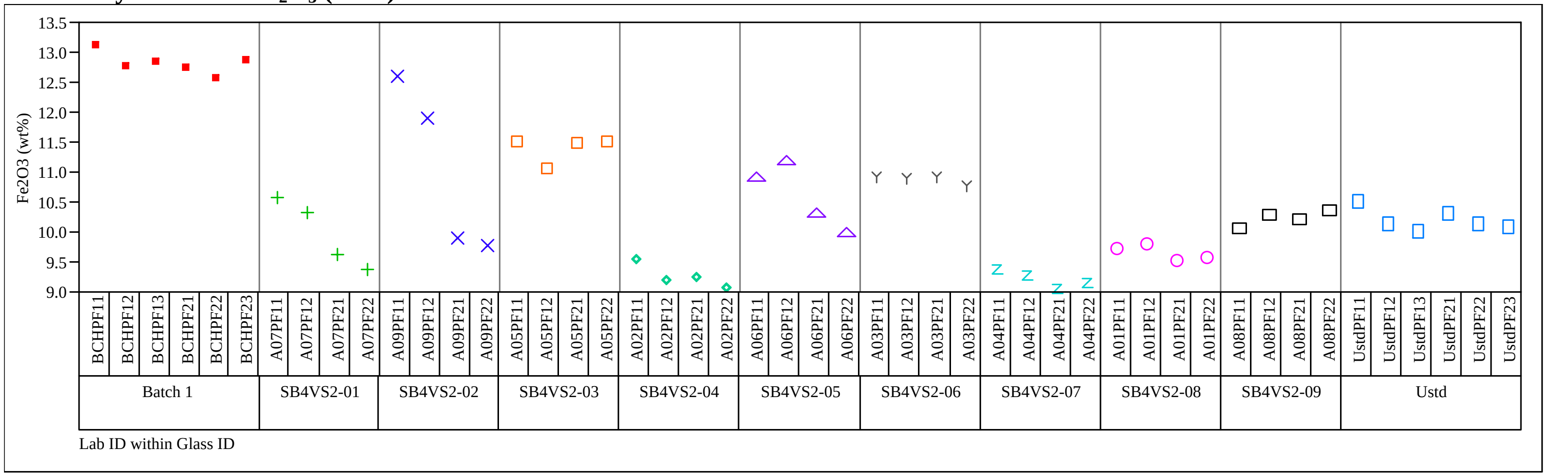


Figure A4. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for Samples Prepared Using the PF Method

Variability Chart for Li_2O (wt%)

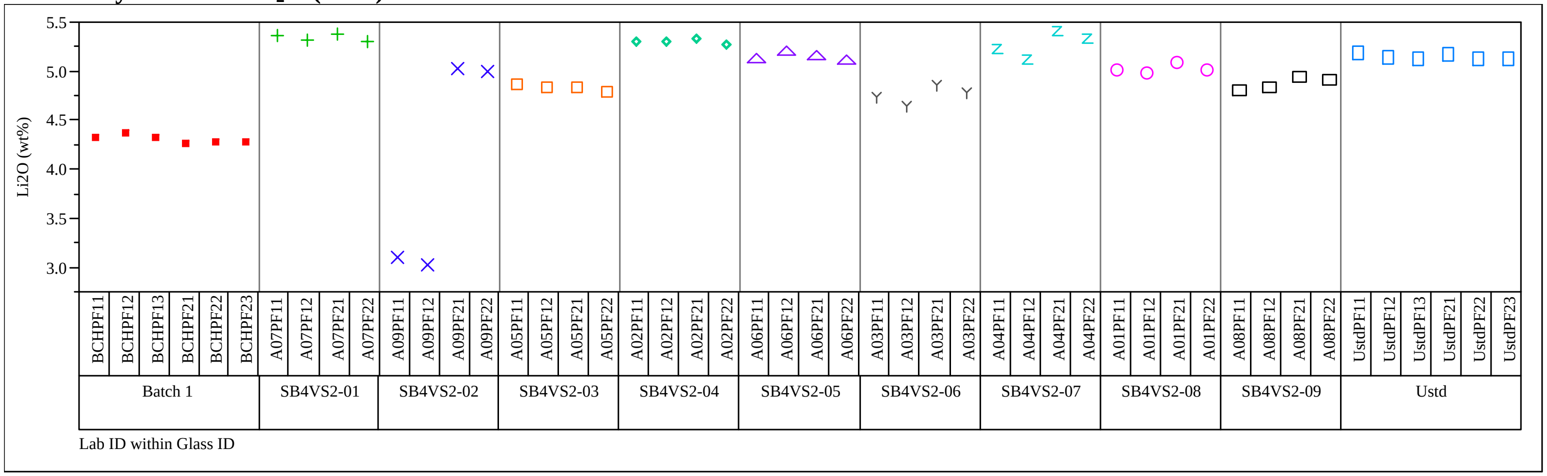
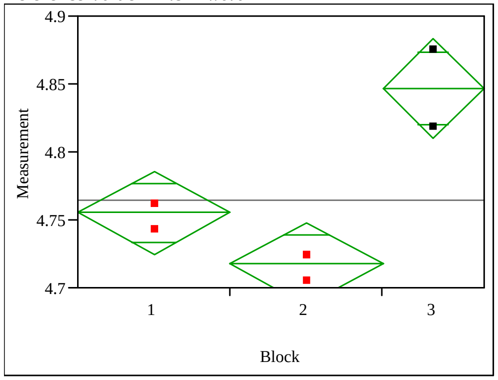


Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Al_2O_3 (wt%)
Reference Value = 4.877 wt%



Oneway Anova
Summary of Fit

Rsquare	0.907223
Adj Rsquare	0.870113
Root Mean Square Error	0.020409
Mean of Response	4.763902
Observations (or Sum Wgts)	8

Analysis of Variance

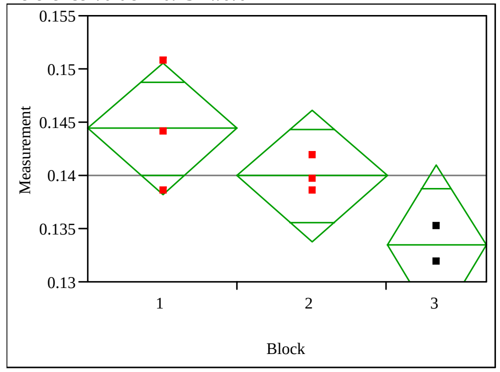
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.02036507	0.010183	24.4464	0.0026
Error	5	0.00208262	0.000417		
C. Total	7	0.02244770			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	4.75524	0.01178	4.7250	4.7855
2	3	4.71745	0.01178	4.6872	4.7477
3	2	4.84657	0.01443	4.8095	4.8837

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=BaO (wt%)
Reference Value = 0.151 wt%



Oneway Anova
Summary of Fit

Rsquare	0.624299
Adj Rsquare	0.474019
Root Mean Square Error	0.004173
Mean of Response	0.139981
Observations (or Sum Wgts)	8

Analysis of Variance

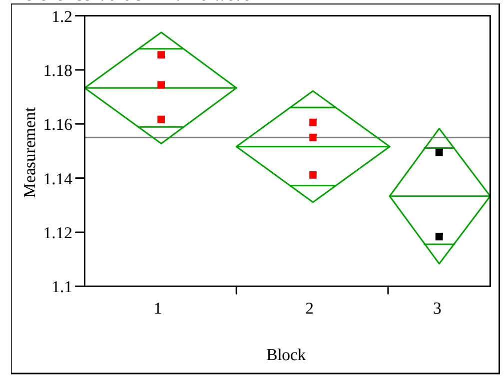
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00014465	0.000072	4.1542	0.0865
Error	5	0.00008705	0.000017		
C. Total	7	0.00023171			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.144401	0.00241	0.13821	0.15059
2	3	0.139935	0.00241	0.13374	0.14613
3	2	0.133422	0.00295	0.12584	0.14101

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=CaO (wt%)
Reference Value = 1.220 wt%



Oneway Anova
Summary of Fit

Rsquare	0.675028
Adj Rsquare	0.54504
Root Mean Square Error	0.013861
Mean of Response	1.155215
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00199537	0.000998	5.1930	0.0602
Error	5	0.00096061	0.000192		
C. Total	7	0.00295597			

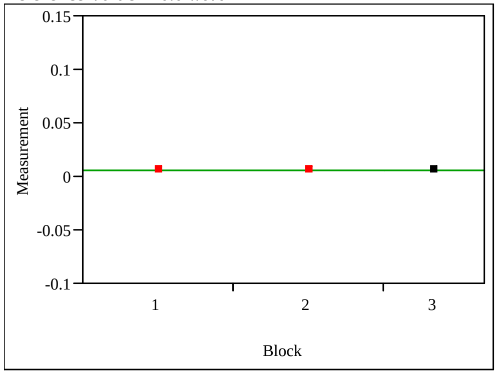
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.17346	0.00800	1.1529	1.1940
2	3	1.15154	0.00800	1.1310	1.1721
3	2	1.13335	0.00980	1.1082	1.1585

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Ce_2O_3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005857
Observations (or Sum Wgts)	8

Analysis of Variance

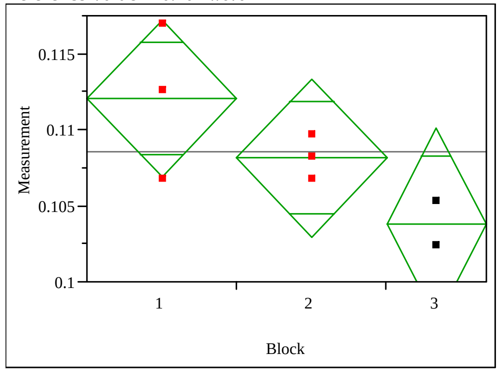
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005857	0	0.00586	0.00586
2	3	0.005857	0	0.00586	0.00586
3	2	0.005857	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Cr_2O_3 (wt%)
Reference Value = 0.107 wt%



Oneway Anova
Summary of Fit

Rsquare	0.575309
Adj Rsquare	0.405432
Root Mean Square Error	0.0035
Mean of Response	0.108524
Observations (or Sum Wgts)	8

Analysis of Variance

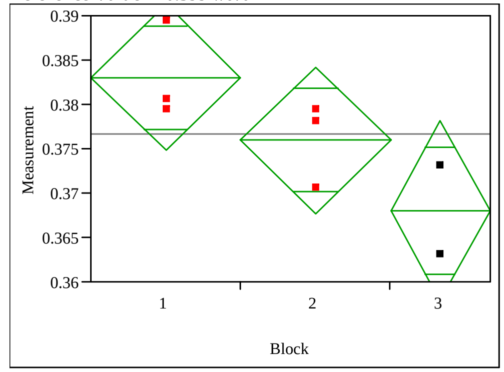
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00008296	0.000041	3.3866	0.1175
Error	5	0.00006124	0.000012		
C. Total	7	0.00014420			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.112056	0.00202	0.10686	0.11725
2	3	0.108158	0.00202	0.10296	0.11335
3	2	0.103774	0.00247	0.09741	0.11013

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=CuO (wt%)
Reference Value = 0.399 wt%



Oneway Anova
Summary of Fit

Rsquare	0.638418
Adj Rsquare	0.493785
Root Mean Square Error	0.005561
Mean of Response	0.376635
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00027299	0.000136	4.4141	0.0786
Error	5	0.00015461	0.000031		
C. Total	7	0.00042760			

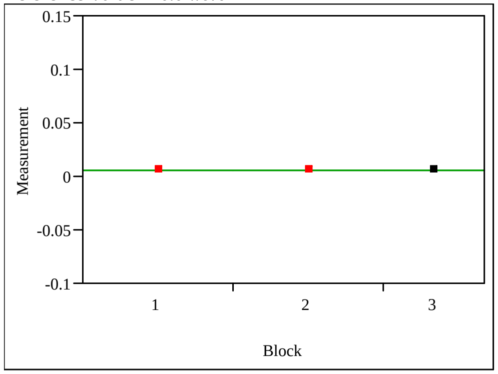
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.383051	0.00321	0.37480	0.39130
2	3	0.375957	0.00321	0.36770	0.38421
3	2	0.368029	0.00393	0.35792	0.37814

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=La_2O_3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005864
Observations (or Sum Wgts)	8

Analysis of Variance

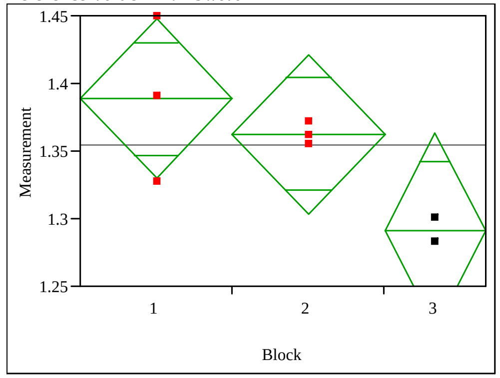
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005864	0	0.00586	0.00586
2	3	0.005864	0	0.00586	0.00586
3	2	0.005864	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=MgO (wt%)
Reference Value = 1.419wt%



Oneway Anova
Summary of Fit

Rsquare	0.599714
Adj Rsquare	0.4396
Root Mean Square Error	0.03959
Mean of Response	1.354417
Observations (or Sum Wgts)	8

Analysis of Variance

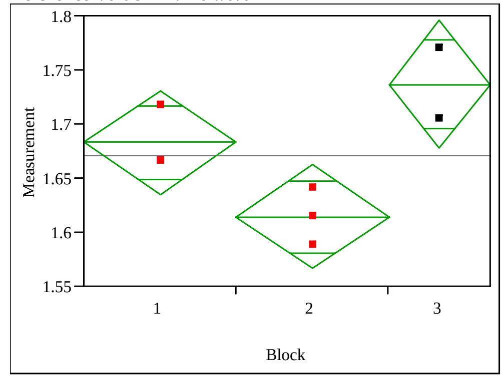
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.01174141	0.005871	3.7455	0.1014
Error	5	0.00783692	0.001567		
C. Total	7	0.01957833			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.38855	0.02286	1.3298	1.4473
2	3	1.36257	0.02286	1.3038	1.4213
3	2	1.29099	0.02799	1.2190	1.3629

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=MnO (wt%)
Reference Value = 1.726 wt%



Oneway Anova
Summary of Fit

Rsquare	0.783377
Adj Rsquare	0.696727
Root Mean Square Error	0.032237
Mean of Response	1.67049
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.01879070	0.009395	9.0408	0.0218
Error	5	0.00519610	0.001039		
C. Total	7	0.02398680			

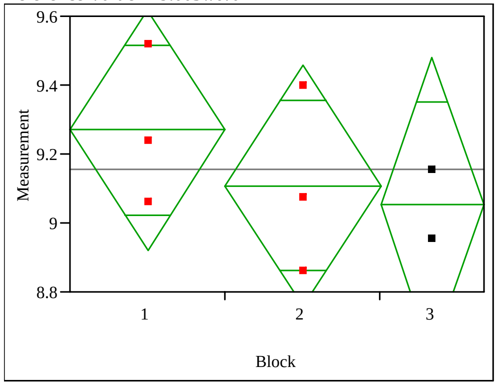
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.68286	0.01861	1.6350	1.7307
2	3	1.61400	0.01861	1.5662	1.6618
3	2	1.73666	0.02279	1.6781	1.7953

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Na_2O (wt%)
Reference Value = 9.003wt%



Oneway Anova
Summary of Fit

Rsquare	0.197061
Adj Rsquare	-0.12411
Root Mean Square Error	0.2344
Mean of Response	9.154605
Observations (or Sum Wgts)	8

Analysis of Variance

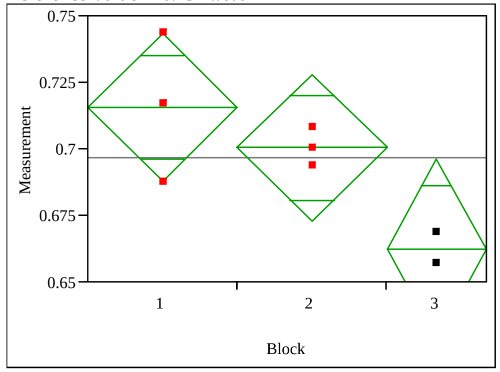
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.06742213	0.033711	0.6136	0.5777
Error	5	0.27471584	0.054943		
C. Total	7	0.34213797			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	9.26975	0.13533	8.9219	9.6176
2	3	9.10799	0.13533	8.7601	9.4559
3	2	9.05182	0.16575	8.6258	9.4779

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=NiO (wt%)
Reference Value = 0.751 wt%



Oneway Anova
Summary of Fit

Rsquare	0.666913
Adj Rsquare	0.533678
Root Mean Square Error	0.018614
Mean of Response	0.696535
Observations (or Sum Wgts)	8

Analysis of Variance

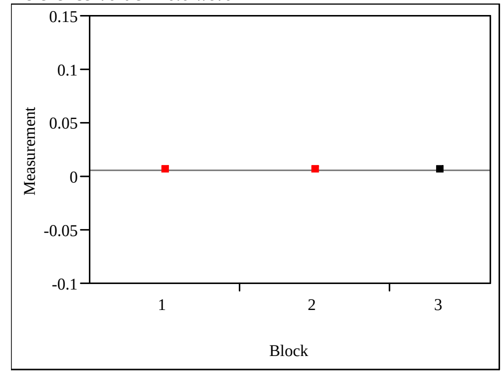
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00346851	0.001734	5.0055	0.0640
Error	5	0.00173233	0.000346		
C. Total	7	0.00520085			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.715569	0.01075	0.68794	0.74319
2	3	0.700299	0.01075	0.67267	0.72792
3	2	0.662336	0.01316	0.62850	0.69617

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=PbO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	.
Mean of Response	0.005386
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	4.5139e-36	2.257e-36	-2.5000	0.0000
Error	5	-4.514e-36	-9.03e-37		
C. Total	7	0			

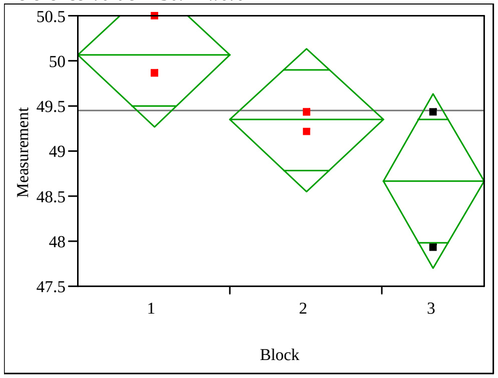
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005386	.	.	.
2	3	0.005386	.	.	.
3	2	0.005386	.	.	.

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=SiO_2 (wt%)
Reference Value = 50.22 wt%



Oneway Anova
Summary of Fit

Rsquare	0.623932
Adj Rsquare	0.473504
Root Mean Square Error	0.534111
Mean of Response	49.44457
Observations (or Sum Wgts)	8

Analysis of Variance

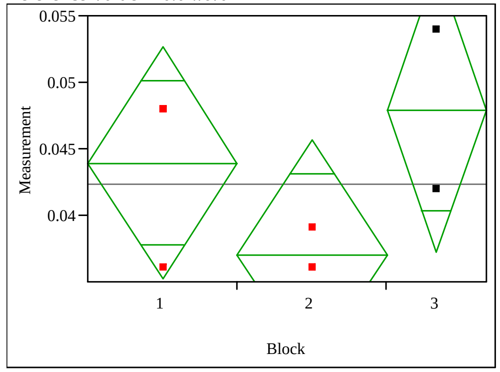
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	2.3664859	1.18324	4.1477	0.0867
Error	5	1.4263751	0.28528		
C. Total	7	3.7928610			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	50.0596	0.30837	49.267	50.852
2	3	49.3465	0.30837	48.554	50.139
3	2	48.6691	0.37767	47.698	49.640

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=SO_4 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.475706
Adj Rsquare	0.265989
Root Mean Square Error	0.005891
Mean of Response	0.042317
Observations (or Sum Wgts)	8

Analysis of Variance

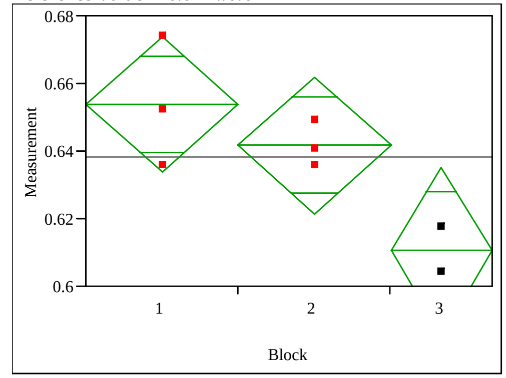
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00015744	0.000079	2.2683	0.1990
Error	5	0.00017352	0.000035		
C. Total	7	0.00033097			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.043940	0.00340	0.03520	0.05268
2	3	0.036949	0.00340	0.02821	0.04569
3	2	0.047934	0.00417	0.03723	0.05864

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=TiO_2 (wt%)
Reference Value = 0.677 wt%



Oneway Anova
Summary of Fit

Rsquare	0.71482
Adj Rsquare	0.600747
Root Mean Square Error	0.013565
Mean of Response	0.638427
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00230600	0.001153	6.2664	0.0434
Error	5	0.00091999	0.000184		
C. Total	7	0.00322599			

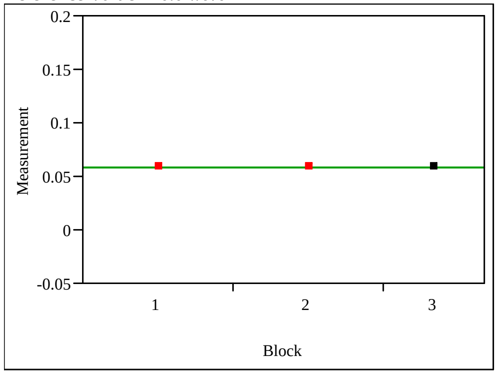
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.653856	0.00783	0.63372	0.67399
2	3	0.641624	0.00783	0.62149	0.66176
3	2	0.610488	0.00959	0.58583	0.63514

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=U_3O_8 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.05896
Observations (or Sum Wgts)	8

Analysis of Variance

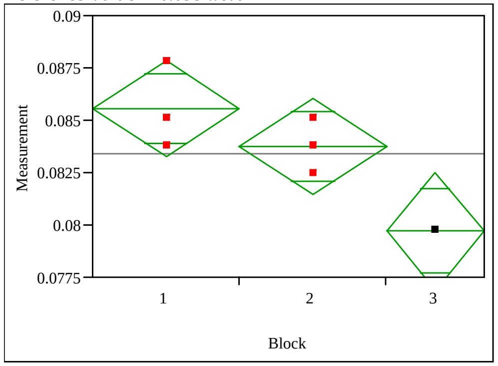
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.058960	0	0.05896	0.05896
2	3	0.058960	0	0.05896	0.05896
3	2	0.058960	0	0.05896	0.05896

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=ZrO_2 (wt%)
Reference Value = 0.098 wt%



Oneway Anova
Summary of Fit

Rsquare	0.774011
Adj Rsquare	0.683616
Root Mean Square Error	0.00156
Mean of Response	0.083412
Observations (or Sum Wgts)	8

Analysis of Variance

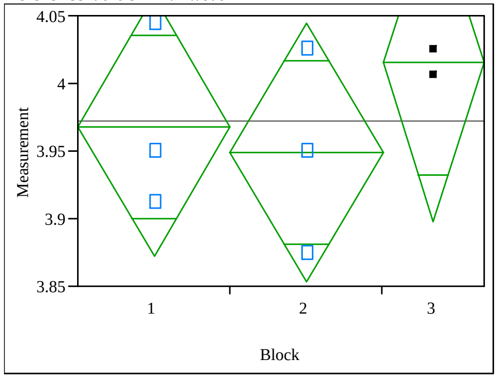
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00004166	0.000021	8.5625	0.0243
Error	5	0.00001216	2.433e-6		
C. Total	7	0.00005383			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.085551	0.00090	0.08324	0.08787
2	3	0.083750	0.00090	0.08143	0.08606
3	2	0.079697	0.00110	0.07686	0.08253

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Al_2O_3 (wt%)
Reference Value = 4.1 wt%



Oneway Anova
Summary of Fit

Rsquare	0.204082
Adj Rsquare	-0.11429
Root Mean Square Error	0.064631
Mean of Response	3.972674
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00535532	0.002678	0.6410	0.5652
Error	5	0.02088573	0.004177		
C. Total	7	0.02624105			

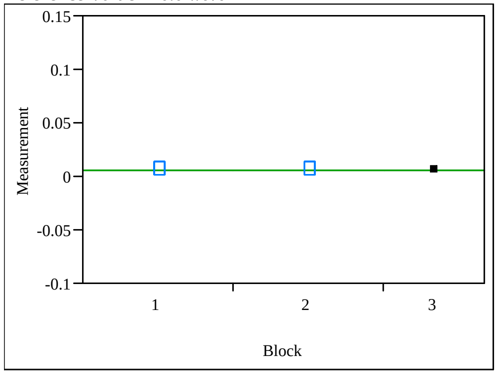
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	3.96795	0.03731	3.8720	4.0639
2	3	3.94906	0.03731	3.8531	4.0450
3	2	4.01519	0.04570	3.8977	4.1327

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=BaO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005583
Observations (or Sum Wgts)	8

Analysis of Variance

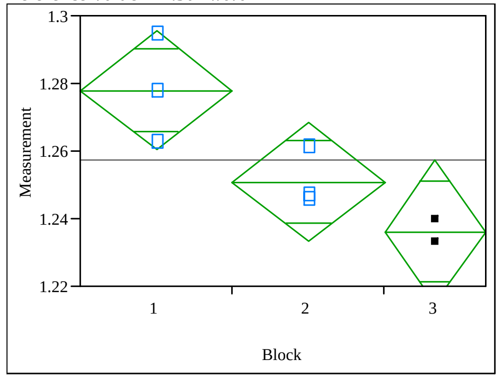
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005583	0	0.00558	0.00558
2	3	0.005583	0	0.00558	0.00558
3	2	0.005583	0	0.00558	0.00558

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=CaO (wt%)
Reference Value = 1.301 wt%



Oneway Anova
Summary of Fit

Rsquare	0.769254
Adj Rsquare	0.676956
Root Mean Square Error	0.011726
Mean of Response	1.257356
Observations (or Sum Wgts)	8

Analysis of Variance

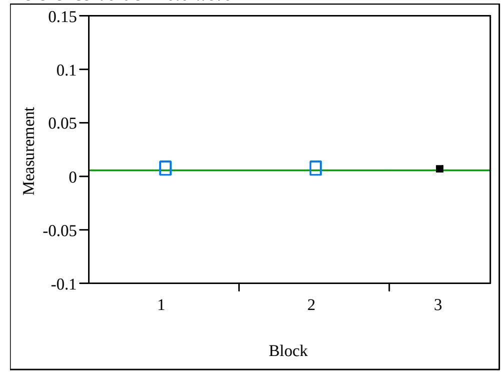
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00229197	0.001146	8.3344	0.0256
Error	5	0.00068750	0.000138		
C. Total	7	0.00297947			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.27794	0.00677	1.2605	1.2953
2	3	1.25088	0.00677	1.2335	1.2683
3	2	1.23619	0.00829	1.2149	1.2575

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Ce_2O_3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005857
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

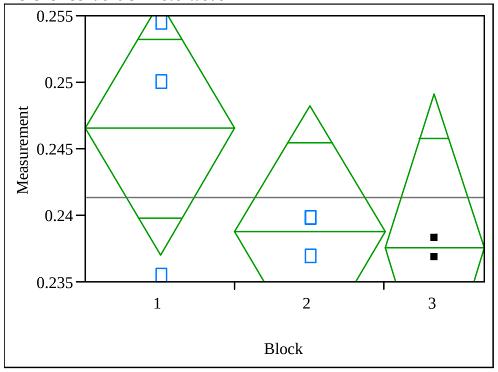
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005857	0	0.00586	0.00586
2	3	0.005857	0	0.00586	0.00586
3	2	0.005857	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Cr_2O_3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.38911
Adj Rsquare	0.144754
Root Mean Square Error	0.006399
Mean of Response	0.241347
Observations (or Sum Wgts)	8

Analysis of Variance

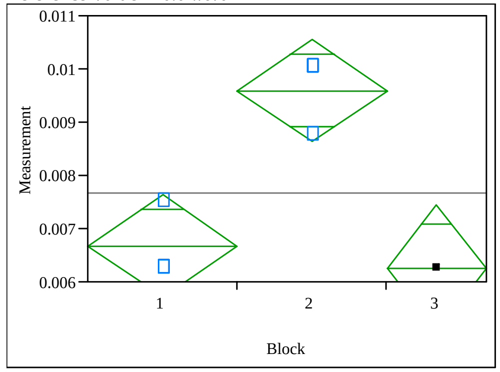
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00013040	0.000065	1.5924	0.2917
Error	5	0.00020473	0.000041		
C. Total	7	0.00033513			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.246523	0.00369	0.23703	0.25602
2	3	0.238728	0.00369	0.22923	0.24822
3	2	0.237510	0.00452	0.22588	0.24914

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=CuO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.89644
Adj Rsquare	0.855016
Root Mean Square Error	0.000646
Mean of Response	0.007667
Observations (or Sum Wgts)	8

Analysis of Variance

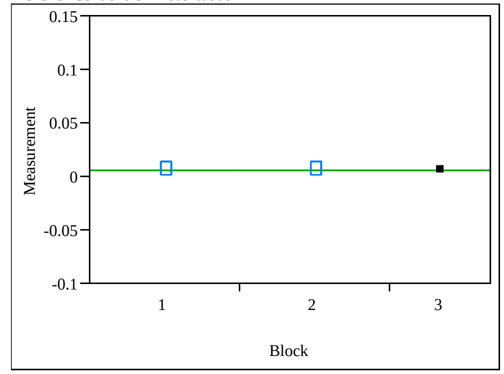
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00001809	9.0429e-6	21.6406	0.0035
Error	5	0.00000209	4.1787e-7		
C. Total	7	0.00002018			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.006676	0.00037	0.00572	0.00764
2	3	0.009597	0.00037	0.00864	0.01056
3	2	0.006259	0.00046	0.00508	0.00743

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=La_2O_3 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005864
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

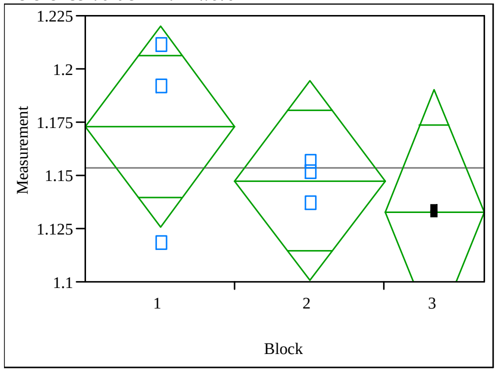
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005864	0	0.00586	0.00586
2	3	0.005864	0	0.00586	0.00586
3	2	0.005864	0	0.00586	0.00586

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=MgO (wt%)
Reference Value = 1.21 wt%



Oneway Anova
Summary of Fit

Rsquare	0.297269
Adj Rsquare	0.016177
Root Mean Square Error	0.031627
Mean of Response	1.153348
Observations (or Sum Wgts)	8

Analysis of Variance

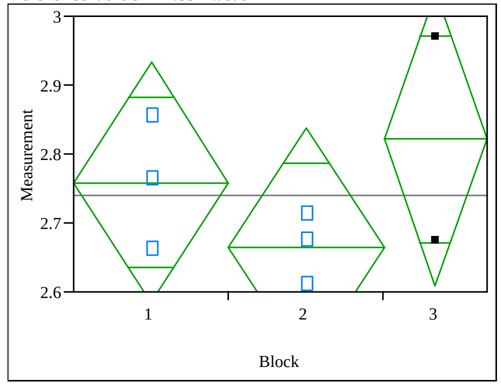
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00211564	0.001058	1.0576	0.4140
Error	5	0.00500126	0.001000		
C. Total	7	0.00711689			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.17297	0.01826	1.1260	1.2199
2	3	1.14754	0.01826	1.1006	1.1945
3	2	1.13262	0.02236	1.0751	1.1901

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=MnO (wt%)
Reference Value = 2.892 wt%



Oneway Anova
Summary of Fit

Rsquare	0.315661
Adj Rsquare	0.041926
Root Mean Square Error	0.116899
Mean of Response	2.738958
Observations (or Sum Wgts)	8

Analysis of Variance

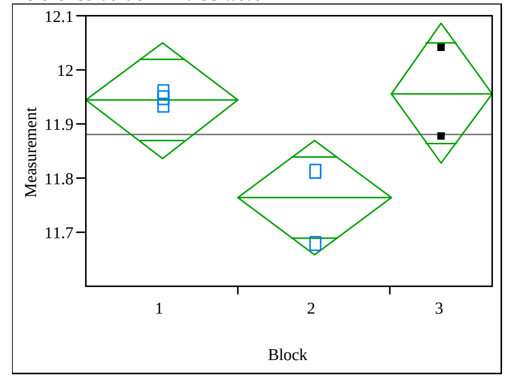
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.03151698	0.015758	1.1532	0.3874
Error	5	0.06832731	0.013665		
C. Total	7	0.09984429			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	2.75886	0.06749	2.5854	2.9324
2	3	2.66418	0.06749	2.4907	2.8377
3	2	2.82127	0.08266	2.6088	3.0338

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Na_2O (wt%)
Reference Value = 11.795 wt%



Oneway Anova
Summary of Fit

Rsquare	0.716112
Adj Rsquare	0.602556
Root Mean Square Error	0.071499
Mean of Response	11.87925
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.06447691	0.032238	6.3063	0.0429
Error	5	0.02556060	0.005112		
C. Total	7	0.09003750			

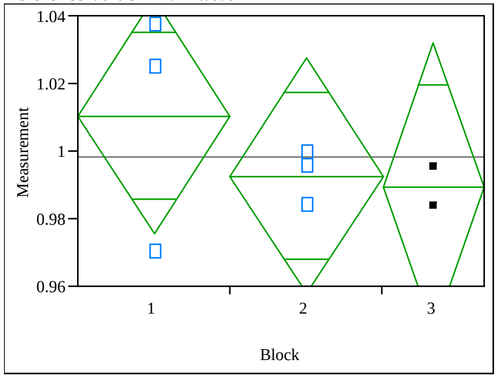
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	11.9433	0.04128	11.837	12.049
2	3	11.7635	0.04128	11.657	11.870
3	2	11.9568	0.05056	11.827	12.087

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=NiO (wt%)
Reference Value = 1.12 wt%



Oneway Anova
Summary of Fit

Rsquare	0.201218
Adj Rsquare	-0.11829
Root Mean Square Error	0.023495
Mean of Response	0.998435
Observations (or Sum Wgts)	8

Analysis of Variance

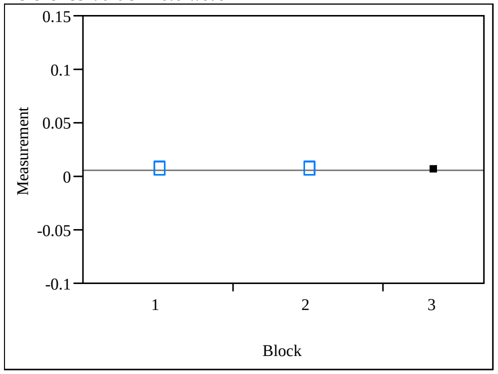
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00069527	0.000348	0.6298	0.5703
Error	5	0.00276002	0.000552		
C. Total	7	0.00345529			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	1.01037	0.01356	0.97550	1.0452
2	3	0.99255	0.01356	0.95768	1.0274
3	2	0.98937	0.01661	0.94666	1.0321

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=PbO (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	.
Mean of Response	0.005386
Observations (or Sum Wgts)	8

Analysis of Variance

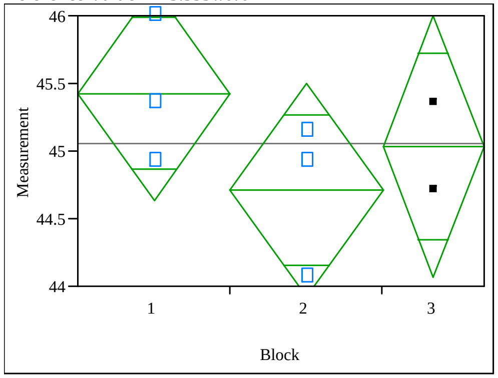
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	4.5139e-36	2.257e-36	-2.5000	0.0000
Error	5	-4.514e-36	-9.03e-37		
C. Total	7	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.005386	.	.	.
2	3	0.005386	.	.	.
3	2	0.005386	.	.	.

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=SiO_2 (wt%)
Reference Value = 45.353wt%



Oneway Anova
Summary of Fit

Rsquare	0.348999
Adj Rsquare	0.088599
Root Mean Square Error	0.534111
Mean of Response	45.05901
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.7646743	0.382337	1.3402	0.3419
Error	5	1.4263751	0.285275		
C. Total	7	2.1910494			

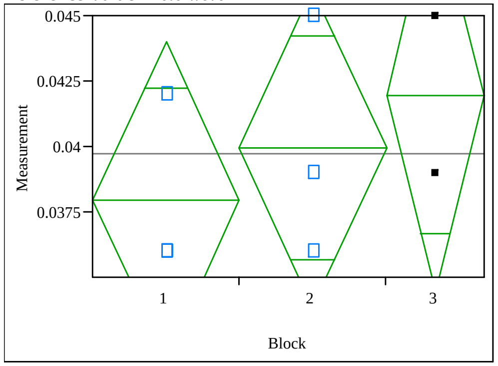
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	45.4245	0.30837	44.632	46.217
2	3	44.7114	0.30837	43.919	45.504
3	2	45.0323	0.37767	44.061	46.003

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=SO_4 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.188406
Adj Rsquare	-0.13623
Root Mean Square Error	0.004093
Mean of Response	0.039696
Observations (or Sum Wgts)	8

Analysis of Variance

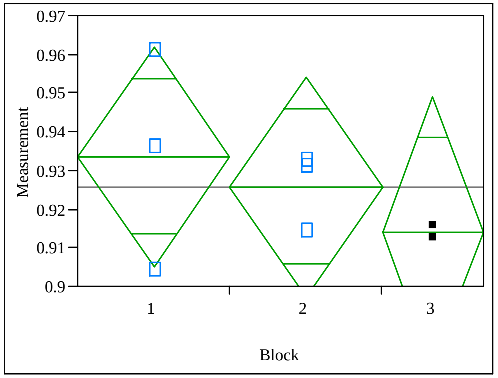
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00001945	9.723e-6	0.5804	0.5934
Error	5	0.00008377	0.000017		
C. Total	7	0.00010322			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.037948	0.00236	0.03187	0.04402
2	3	0.039945	0.00236	0.03387	0.04602
3	2	0.041943	0.00289	0.03450	0.04938

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=TiO_2 (wt%)
Reference Value = 1.049 wt%



Oneway Anova
Summary of Fit

Rsquare	0.199187
Adj Rsquare	-0.12114
Root Mean Square Error	0.019115
Mean of Response	0.92574
Observations (or Sum Wgts)	8

Analysis of Variance

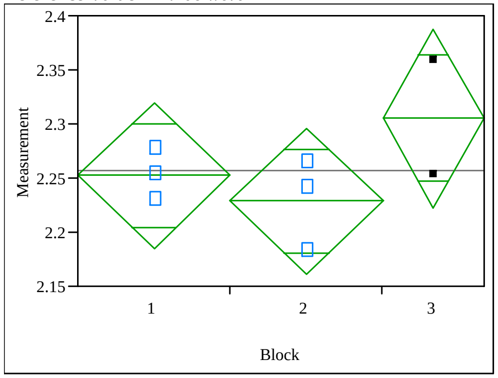
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00045443	0.000227	0.6218	0.5739
Error	5	0.00182699	0.000365		
C. Total	7	0.00228142			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.933524	0.01104	0.90515	0.96189
2	3	0.925740	0.01104	0.89737	0.95411
3	2	0.914064	0.01352	0.87932	0.94881

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=U_3O_8 (wt%)
Reference Value = 2.406 wt%



Oneway Anova
Summary of Fit

Rsquare	0.408143
Adj Rsquare	0.1714
Root Mean Square Error	0.045518
Mean of Response	2.256694
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.00714376	0.003572	1.7240	0.2695
Error	5	0.01035932	0.002072		
C. Total	7	0.01750308			

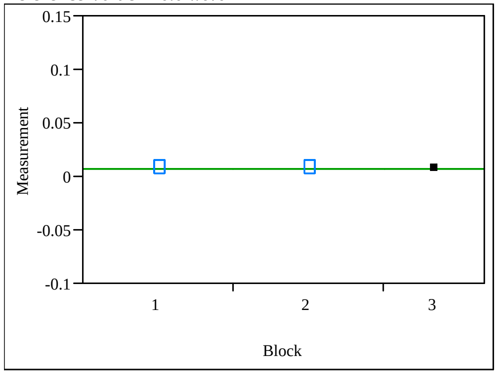
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	2.25227	0.02628	2.1847	2.3198
2	3	2.22869	0.02628	2.1611	2.2962
3	2	2.30534	0.03219	2.2226	2.3881

Std Error uses a pooled estimate of error variance

Figure A5. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the LM Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=ZrO_2 (wt%)
Reference Value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.006754
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0	0	.	.
Error	5	0	0		
C. Total	7	0			

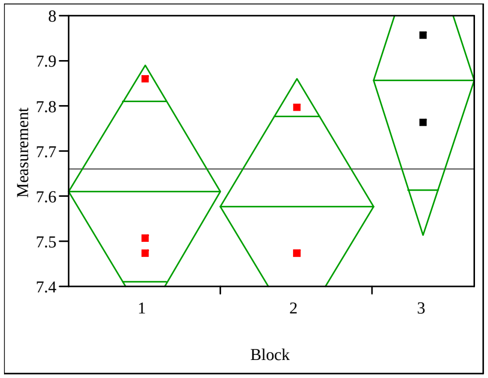
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	0.006754	0	0.00675	0.00675
2	3	0.006754	0	0.00675	0.00675
3	2	0.006754	0	0.00675	0.00675

Std Error uses a pooled estimate of error variance

Figure A6. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the PF Method

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=B_2O_3 (wt%)
Reference Value = 7.777 wt%



Oneway Anova
Summary of Fit

Rsquare	0.36941
Adj Rsquare	0.117174
Root Mean Square Error	0.189583
Mean of Response	7.659337
Observations (or Sum Wgts)	8

Analysis of Variance

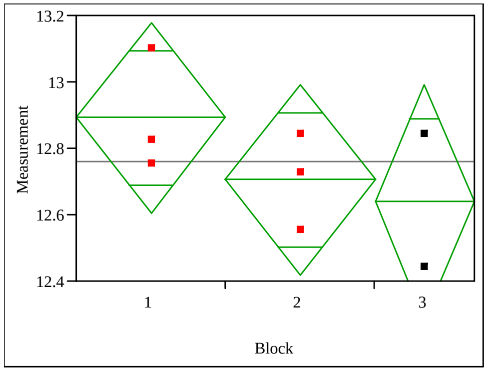
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.10527592	0.052638	1.4645	0.3158
Error	5	0.17970777	0.035942		
C. Total	7	0.28498369			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	7.60970	0.10946	7.3283	7.8911
2	3	7.57750	0.10946	7.2961	7.8589
3	2	7.85656	0.13406	7.5120	8.2012

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Fe_2O_3 (wt%)
Reference Value = 12.839 wt%



Oneway Anova
Summary of Fit

Rsquare	0.324913
Adj Rsquare	0.054878
Root Mean Square Error	0.193441
Mean of Response	12.75829
Observations (or Sum Wgts)	8

Analysis of Variance

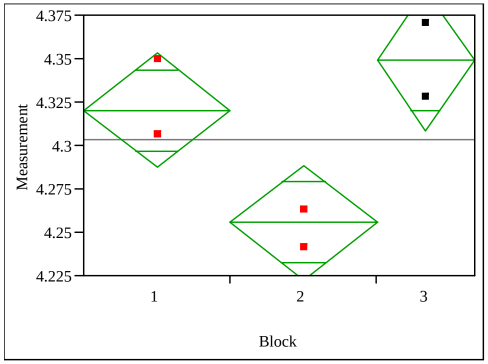
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.09004857	0.045024	1.2032	0.3745
Error	5	0.18709799	0.037420		
C. Total	7	0.27714656			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	12.8911	0.11168	12.604	13.178
2	3	12.7053	0.11168	12.418	12.992
3	2	12.6385	0.13678	12.287	12.990

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Batch 1, Oxide=Li_2O (wt%)
Reference Value = 4.429 wt%



Oneway Anova
Summary of Fit

Rsquare	0.82726
Adj Rsquare	0.758165
Root Mean Square Error	0.022235
Mean of Response	4.303109
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.01183851	0.005919	11.9727	0.0124
Error	5	0.00247199	0.000494		
C. Total	7	0.01431050			

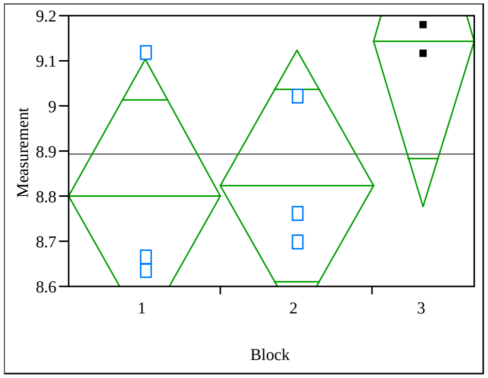
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	4.32015	0.01284	4.2872	4.3532
2	3	4.25557	0.01284	4.2226	4.2886
3	2	4.34886	0.01572	4.3084	4.3893

Std Error uses a pooled estimate of error variance

Figure A6. PSAL Measurements by Analytical Block for Samples of the Standard Glasses Prepared Using the PF Method

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=B_2O_3 (wt%)
Reference Value = 9.209 wt%



Oneway Anova
Summary of Fit

Rsquare	0.447381
Adj Rsquare	0.226333
Root Mean Square Error	0.202964
Mean of Response	8.894974
Observations (or Sum Wgts)	8

Analysis of Variance

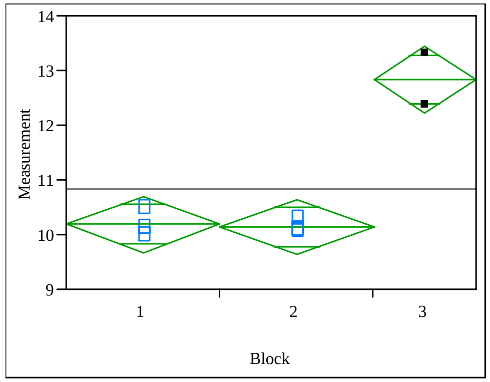
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.16674808	0.083374	2.0239	0.2270
Error	5	0.20597275	0.041195		
C. Total	7	0.37272083			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	8.80106	0.11718	8.4998	9.1023
2	3	8.82253	0.11718	8.5213	9.1238
3	2	9.14452	0.14352	8.7756	9.5134

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Fe_2O_3 (wt%)
Reference Value = 13.196 wt%



Oneway Anova
Summary of Fit

Rsquare	0.948237
Adj Rsquare	0.927532
Root Mean Square Error	0.341885
Mean of Response	10.82819
Observations (or Sum Wgts)	8

Analysis of Variance

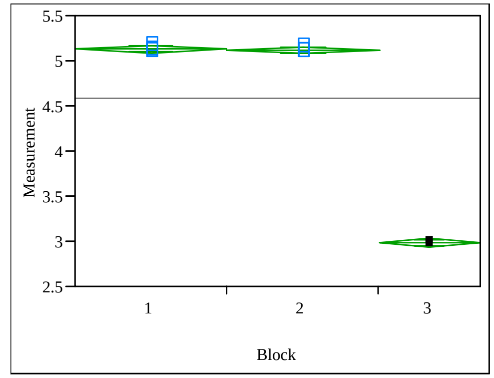
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	10.706020	5.35301	45.7972	0.0006
Error	5	0.584426	0.11689		
C. Total	7	11.290445			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	10.1842	0.19739	9.677	10.692
2	3	10.1366	0.19739	9.629	10.644
3	2	12.8316	0.24175	12.210	13.453

Std Error uses a pooled estimate of error variance

Oneway Analysis of Measurement By Block Glass ID=Ustd, Oxide=Li_2O (wt%)
Reference Value = 3.057 wt%



Oneway Anova
Summary of Fit

Rsquare	0.999473
Adj Rsquare	0.999262
Root Mean Square Error	0.026947
Mean of Response	4.588368
Observations (or Sum Wgts)	8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	6.8834257	3.44171	4739.694	<.0001
Error	5	0.0036307	0.00073		
C. Total	7	6.8870565			

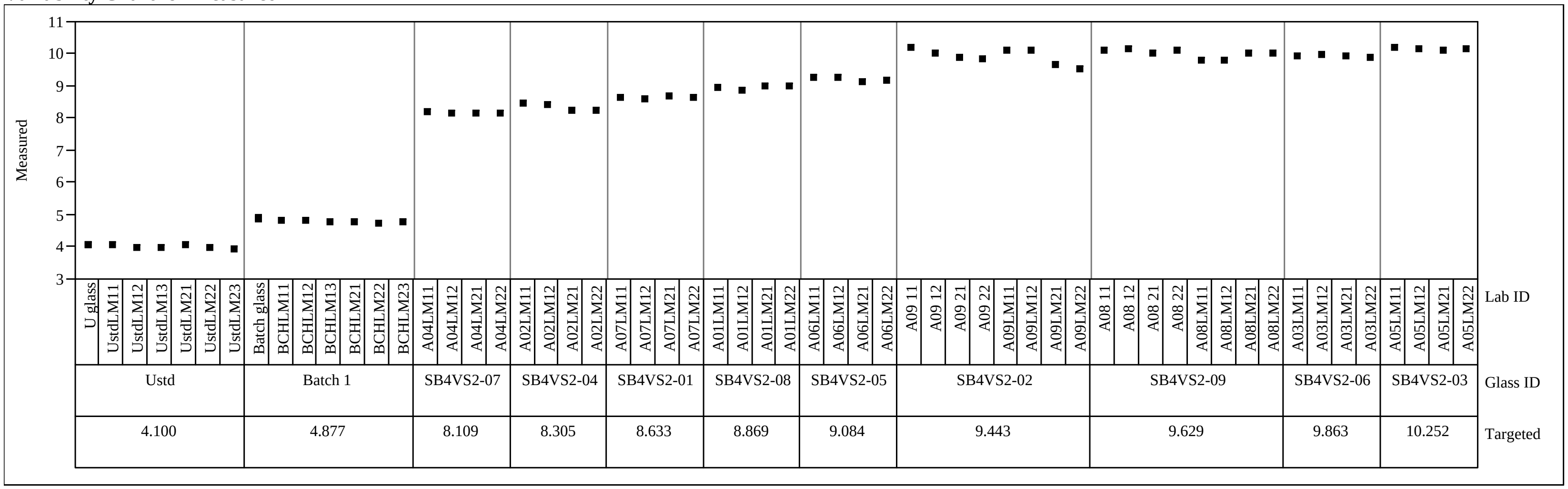
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	5.13108	0.01556	5.0911	5.1711
2	3	5.11673	0.01556	5.0767	5.1567
3	2	2.98177	0.01905	2.9328	3.0307

Std Error uses a pooled estimate of error variance

Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Al_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=Al_2O_3 (wt%)
Variability Chart for Measured bc

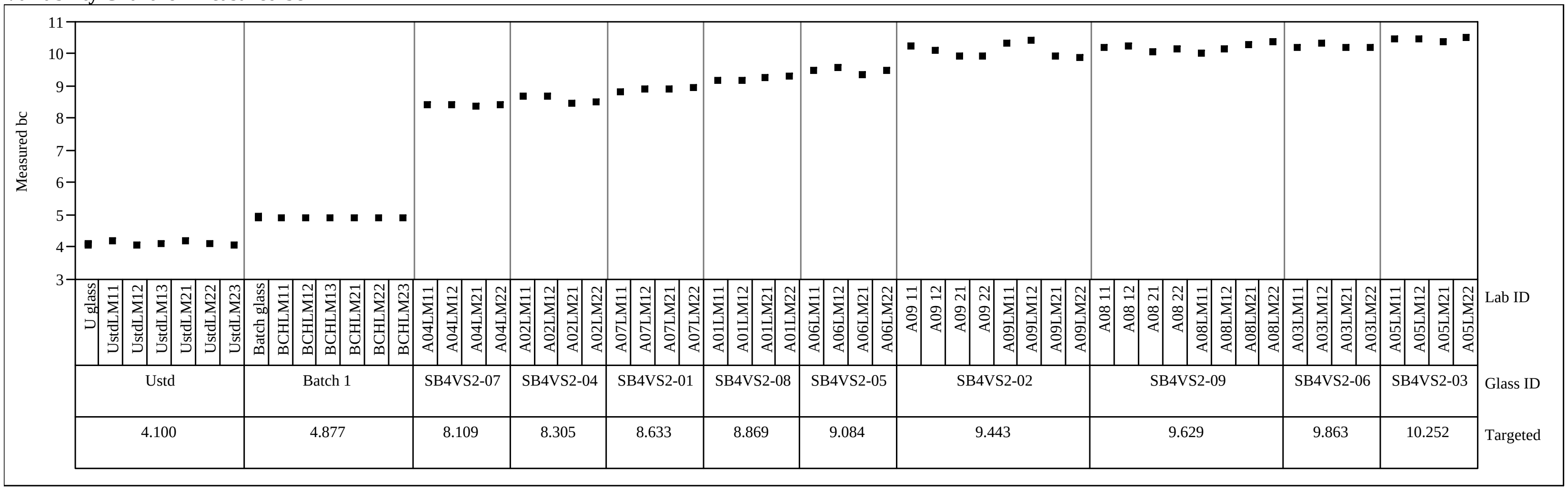
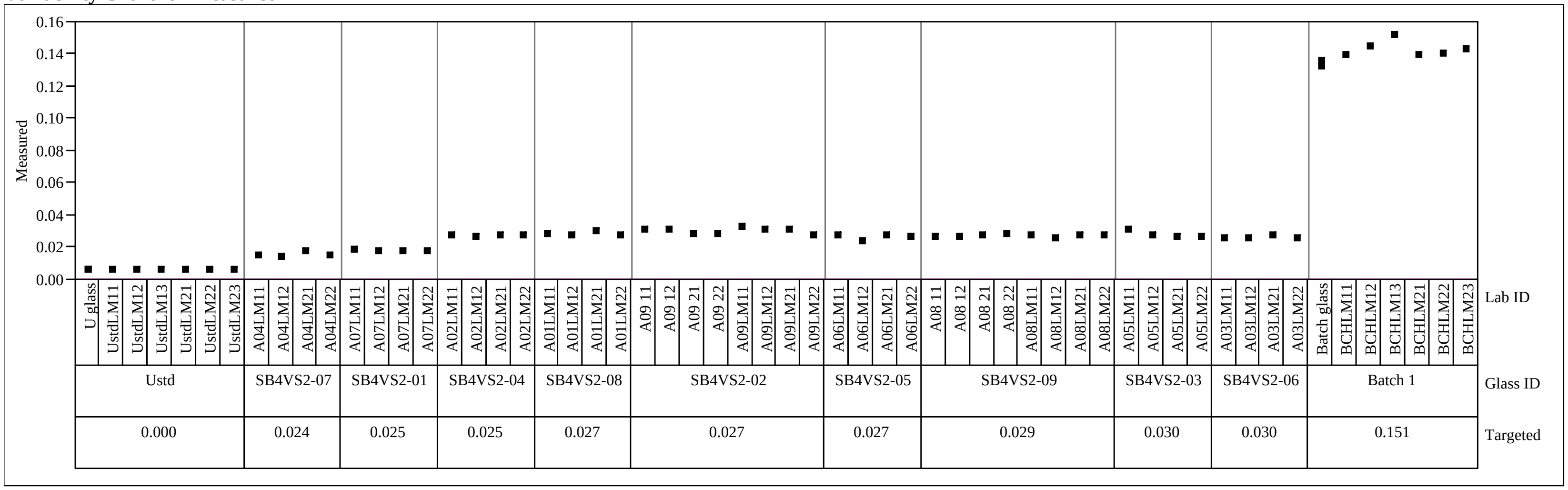


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=BaO (wt%)
Variability Chart for Measured



Variability Gage Oxide=BaO (wt%)
Variability Chart for Measured bc

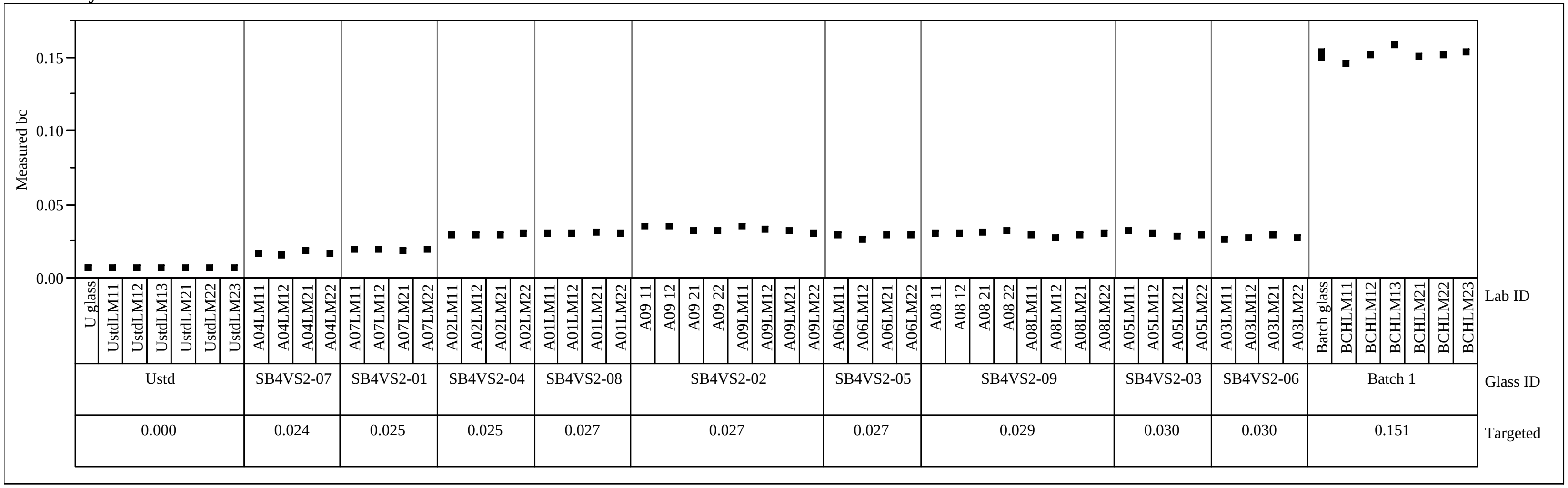
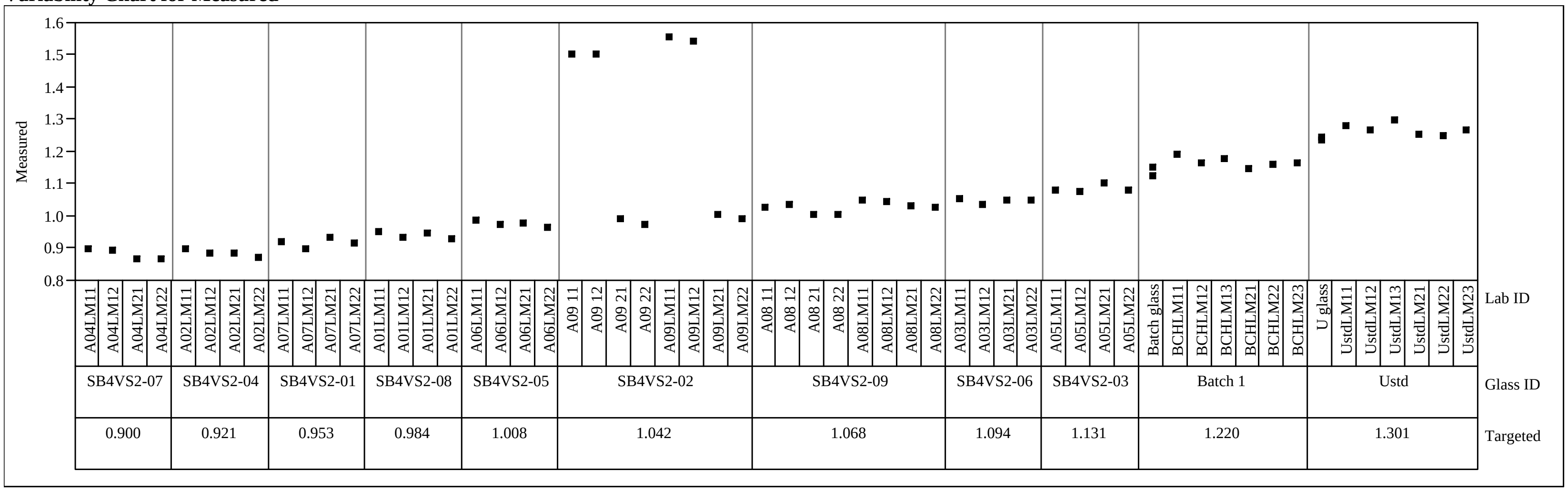


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=CaO (wt%)
Variability Chart for Measured



Variability Gage Oxide=CaO (wt%)
Variability Chart for Measured bc

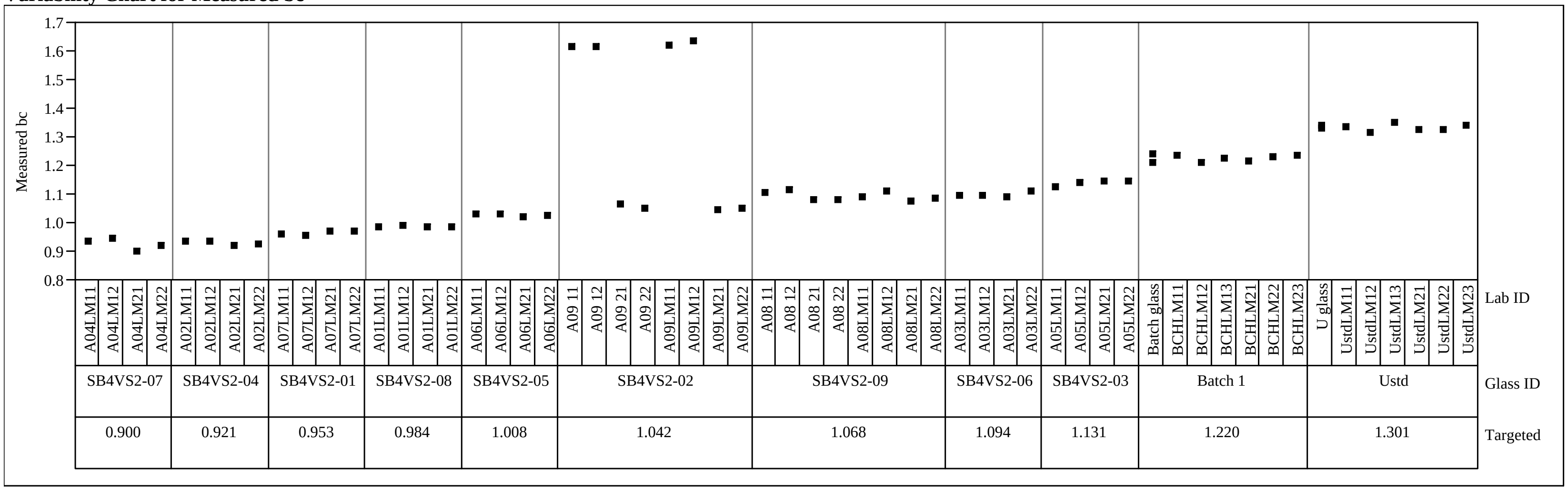
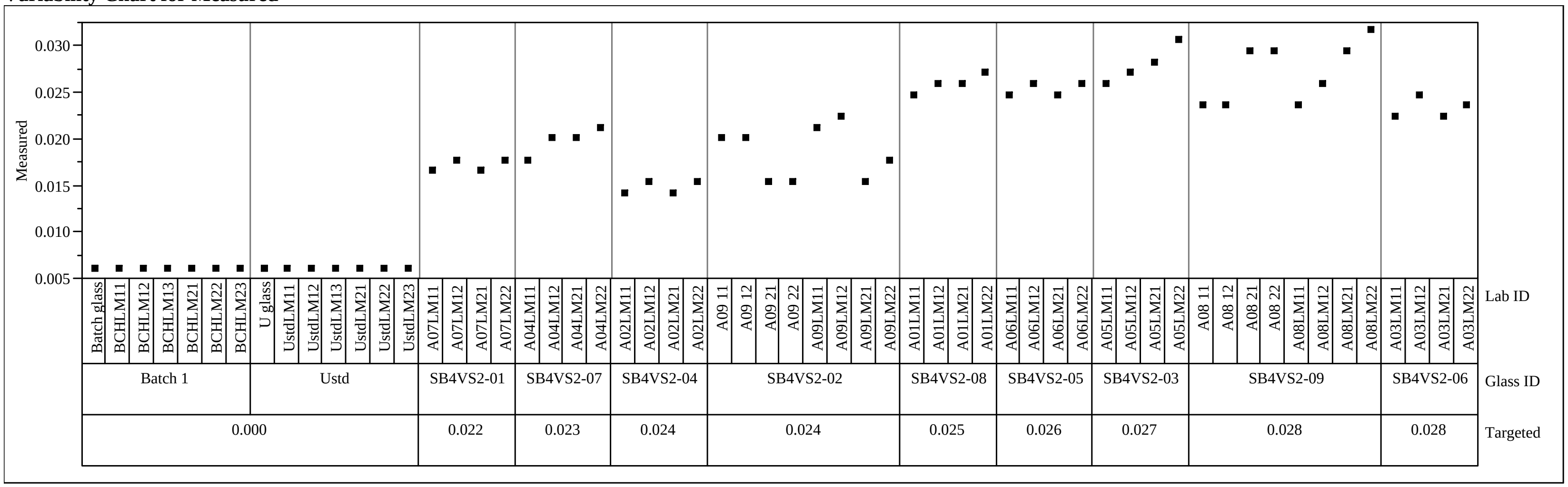


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Ce_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=Ce_2O_3 (wt%)
Variability Chart for Measured bc

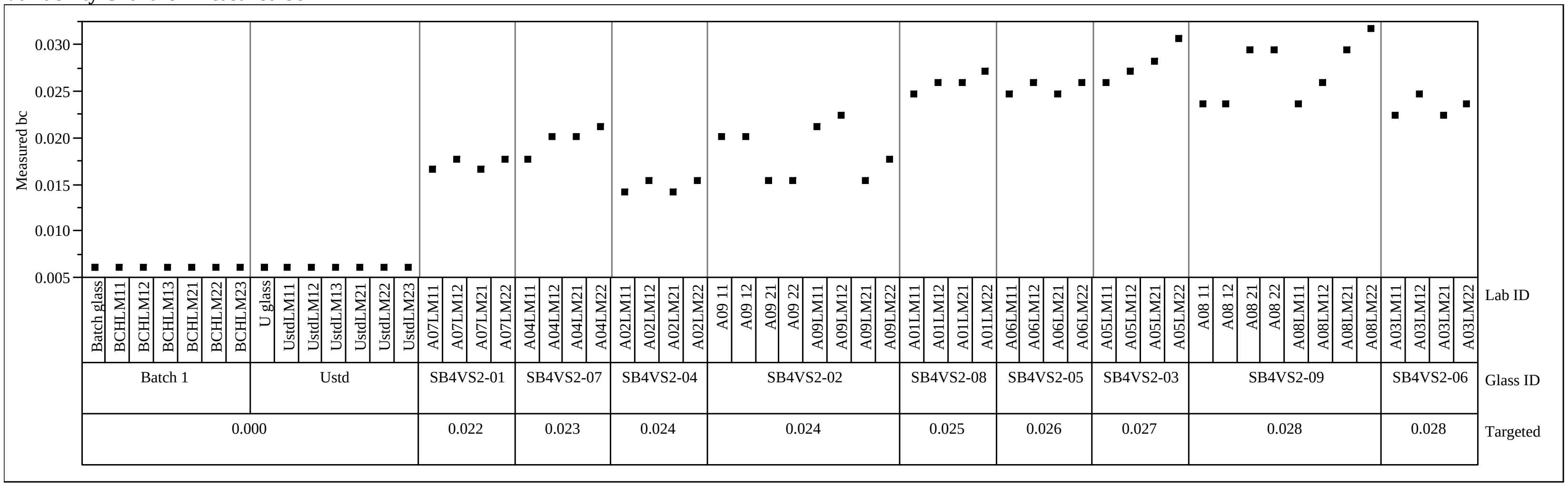
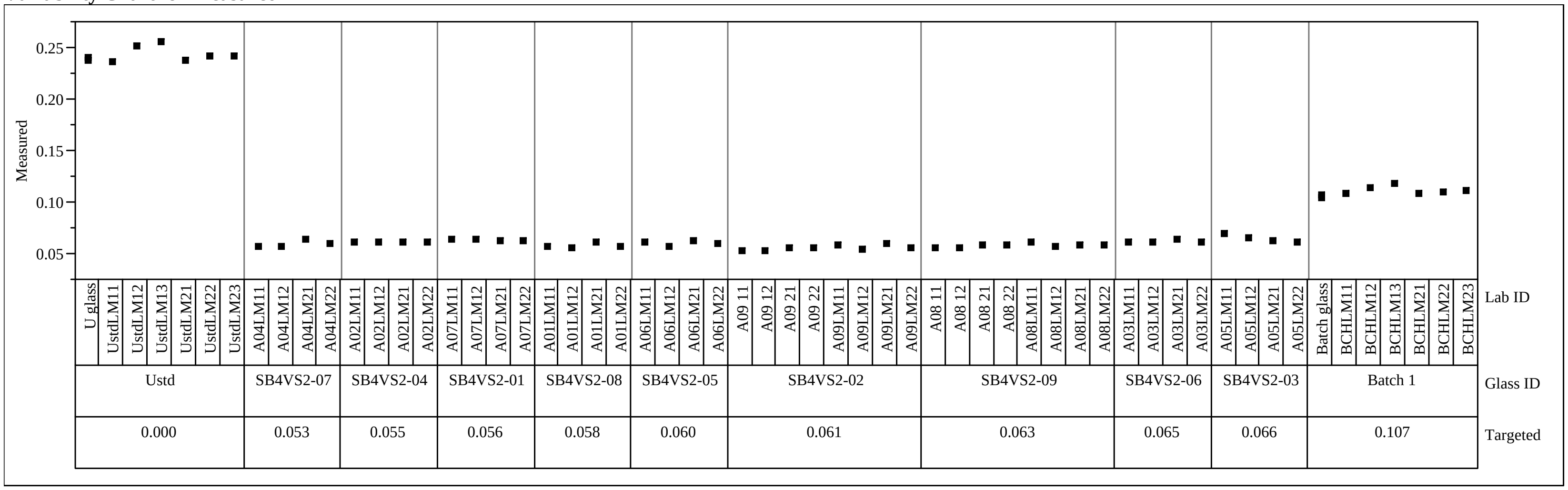


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Cr_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=Cr_2O_3 (wt%)
Variability Chart for Measured bc

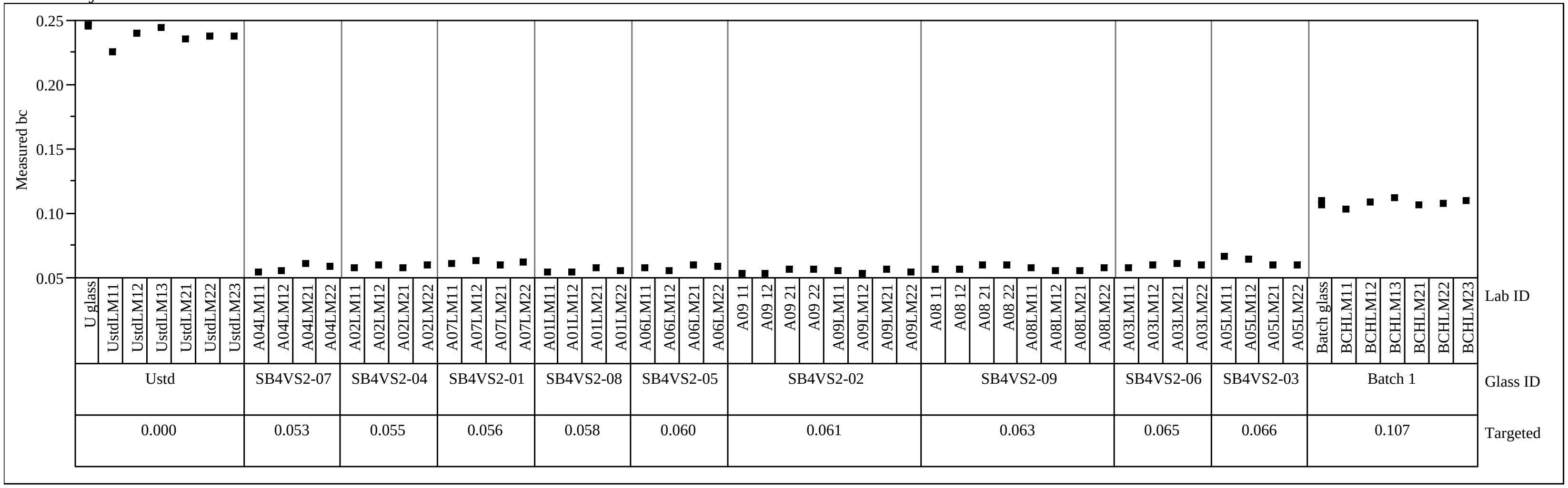
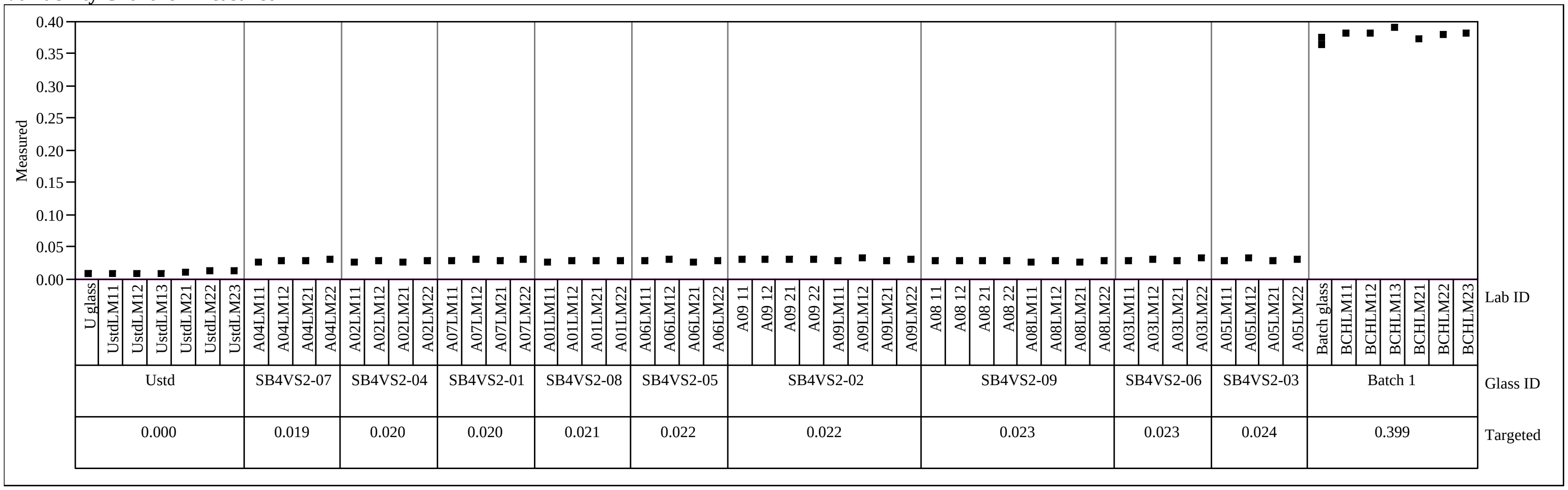


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=CuO (wt%)
Variability Chart for Measured



Variability Gage Oxide=CuO (wt%)
Variability Chart for Measured bc

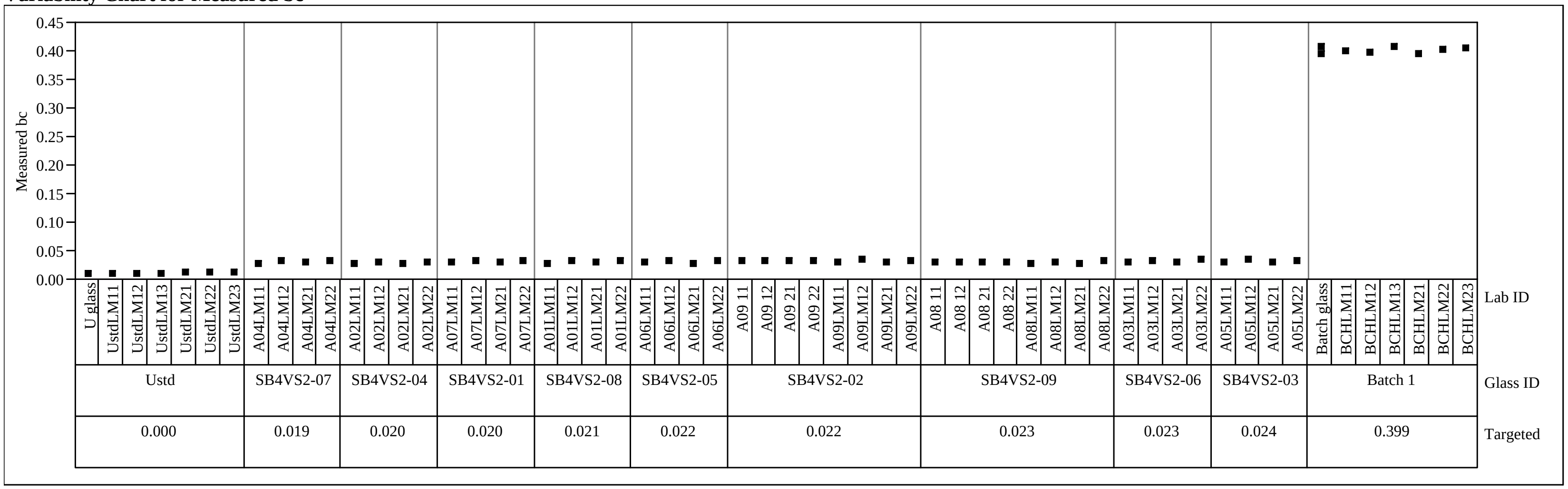
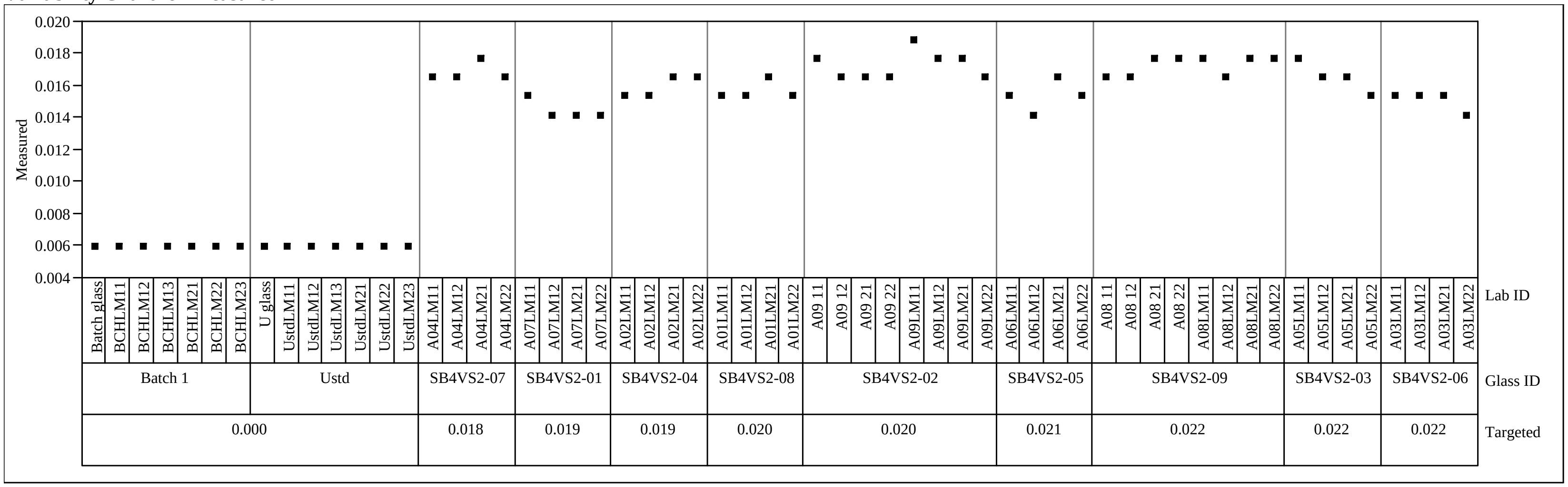


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=La_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=La_2O_3 (wt%)
Variability Chart for Measured bc

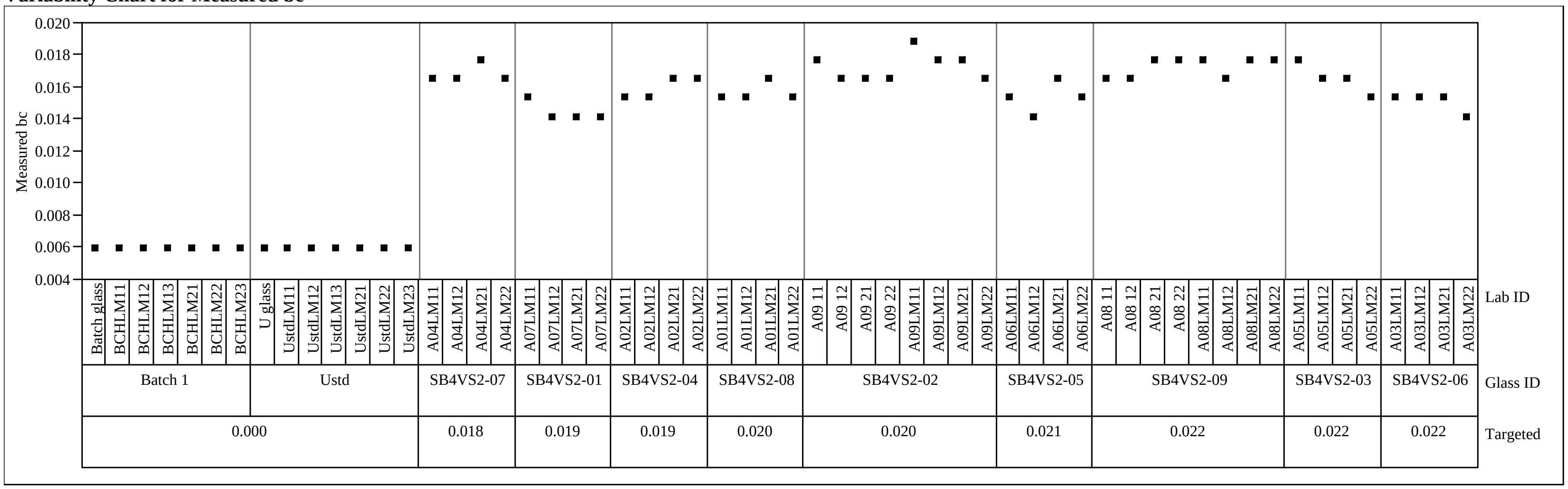
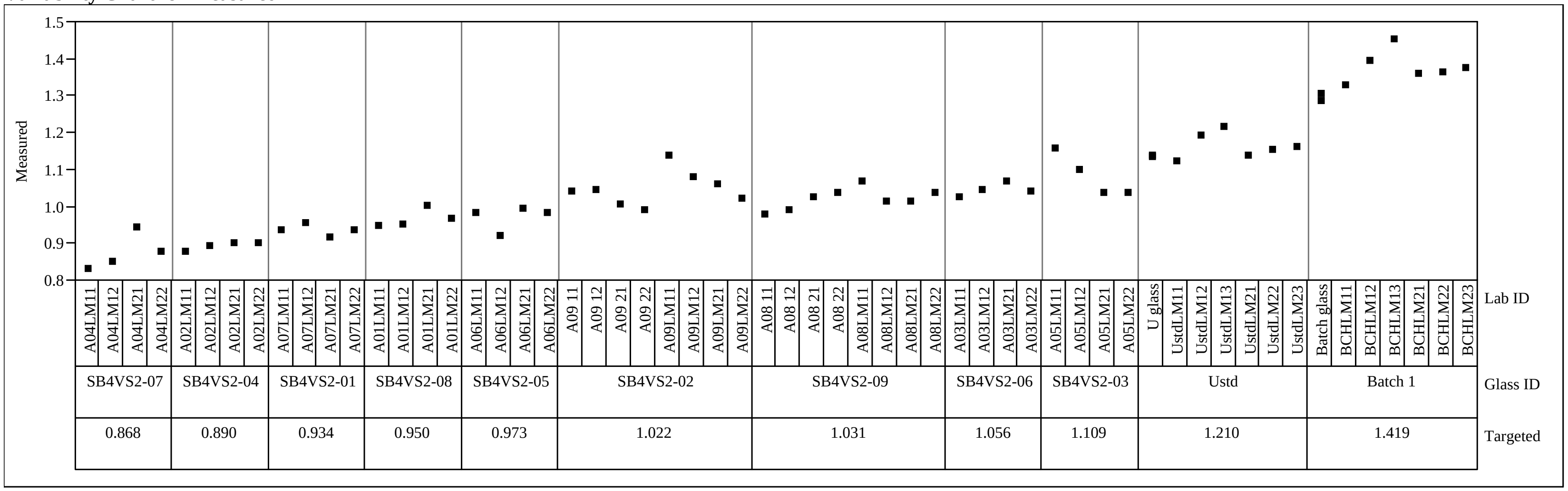


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=MgO (wt%)
Variability Chart for Measured



Variability Gage Oxide=MgO (wt%)
Variability Chart for Measured bc

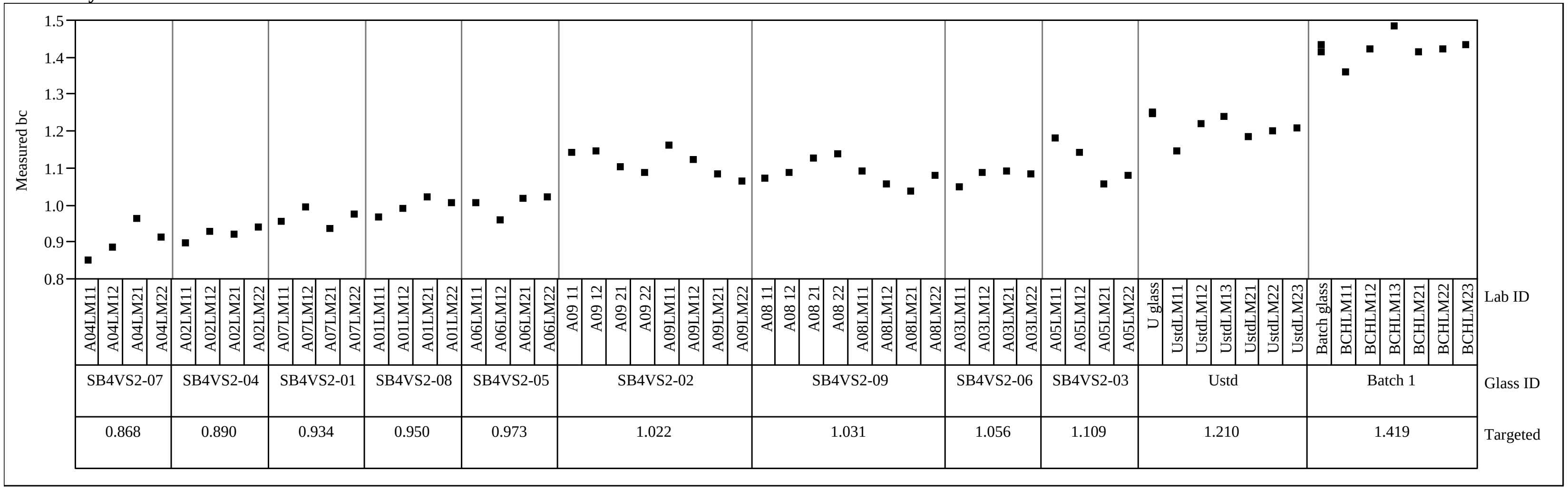
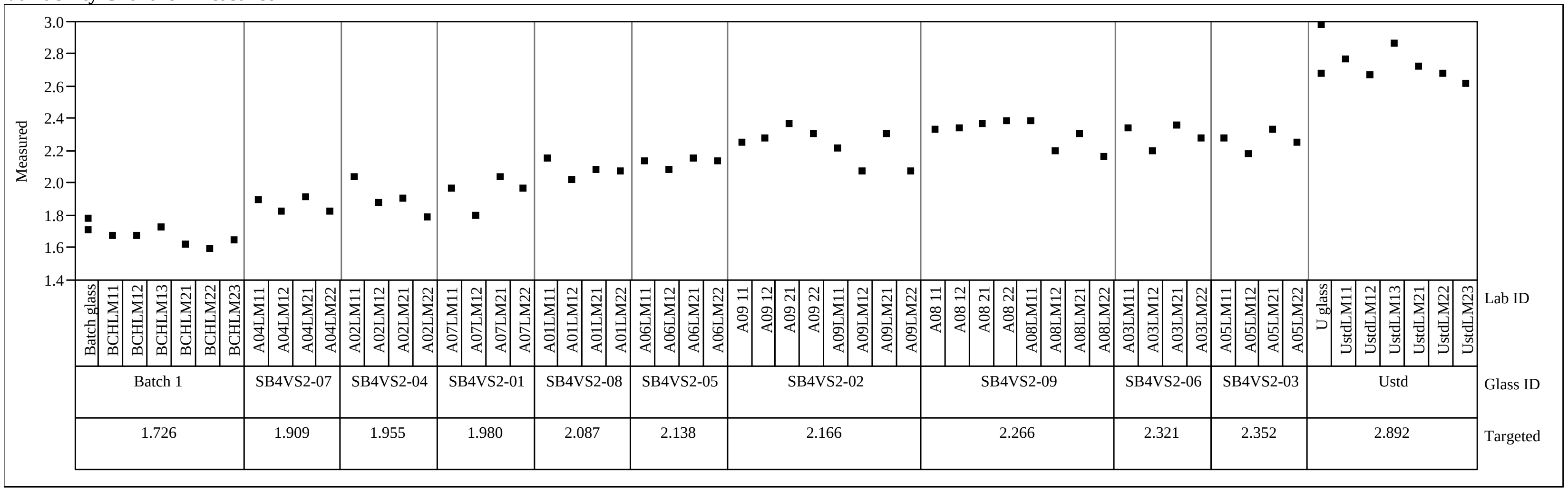


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=MnO (wt%)
Variability Chart for Measured



Variability Gage Oxide=MnO (wt%)
Variability Chart for Measured bc

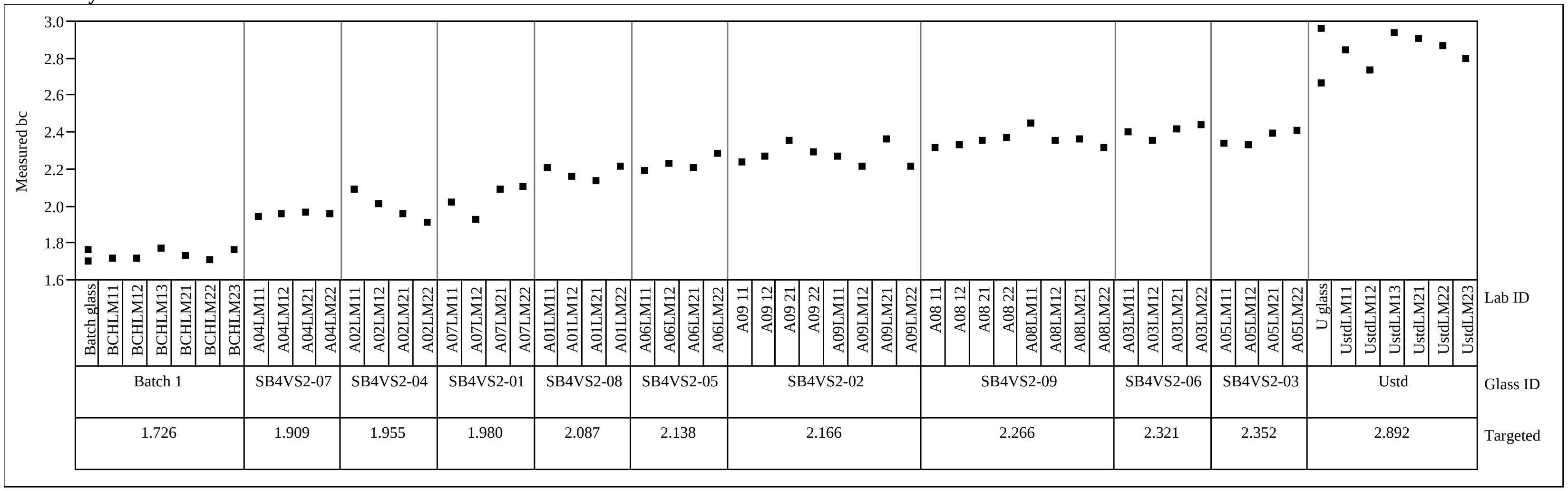
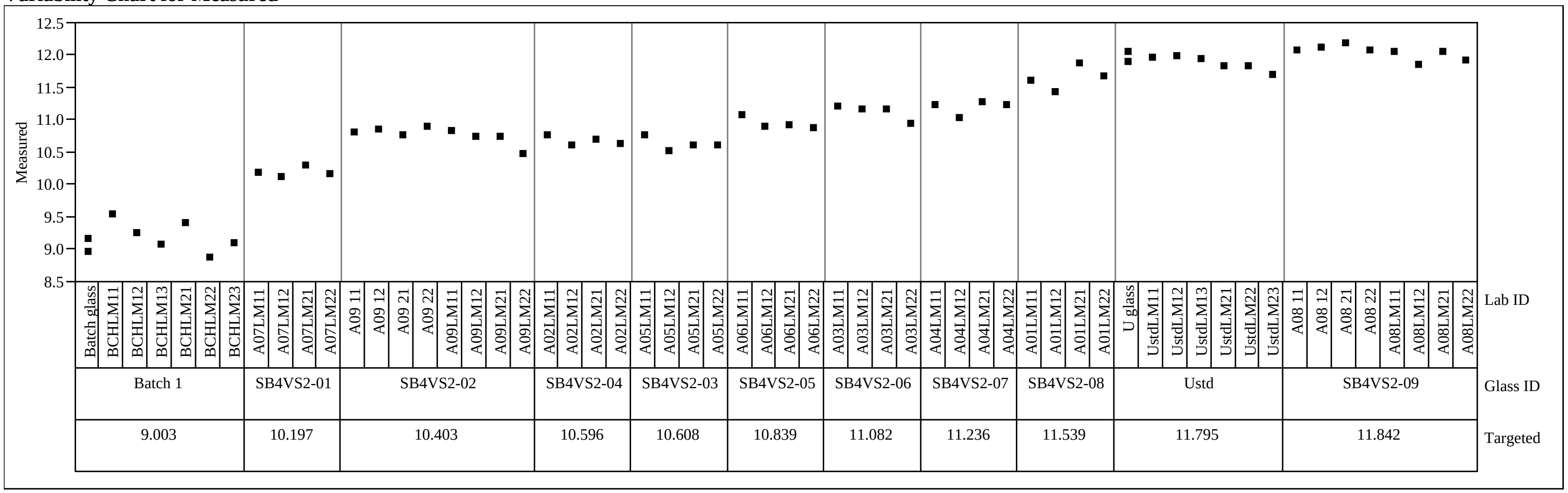


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Na_2O (wt%)
Variability Chart for Measured



Variability Gage Oxide=Na_2O (wt%)
Variability Chart for Measured bc

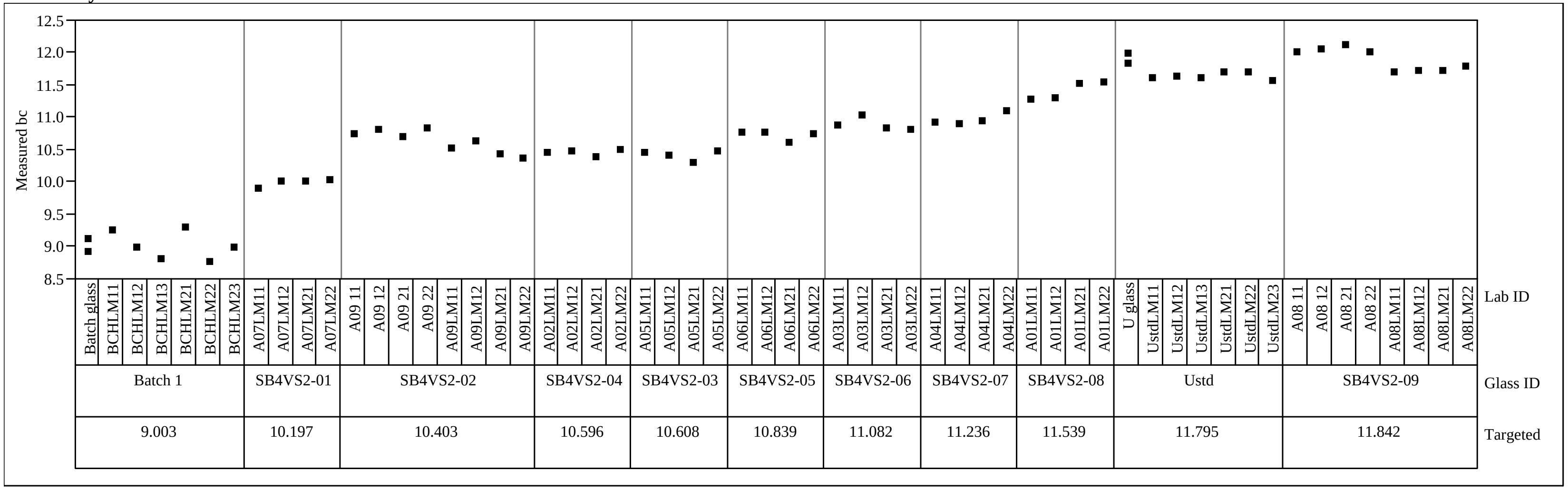
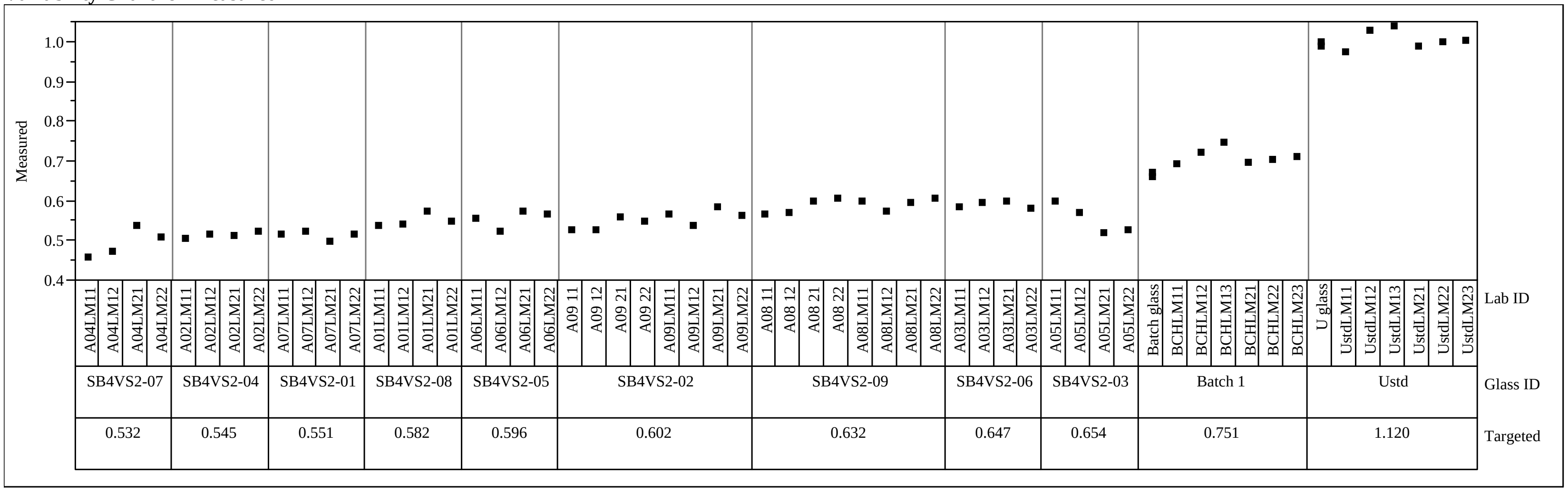


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=NiO (wt%)
Variability Chart for Measured



Variability Gage Oxide=NiO (wt%)
Variability Chart for Measured bc

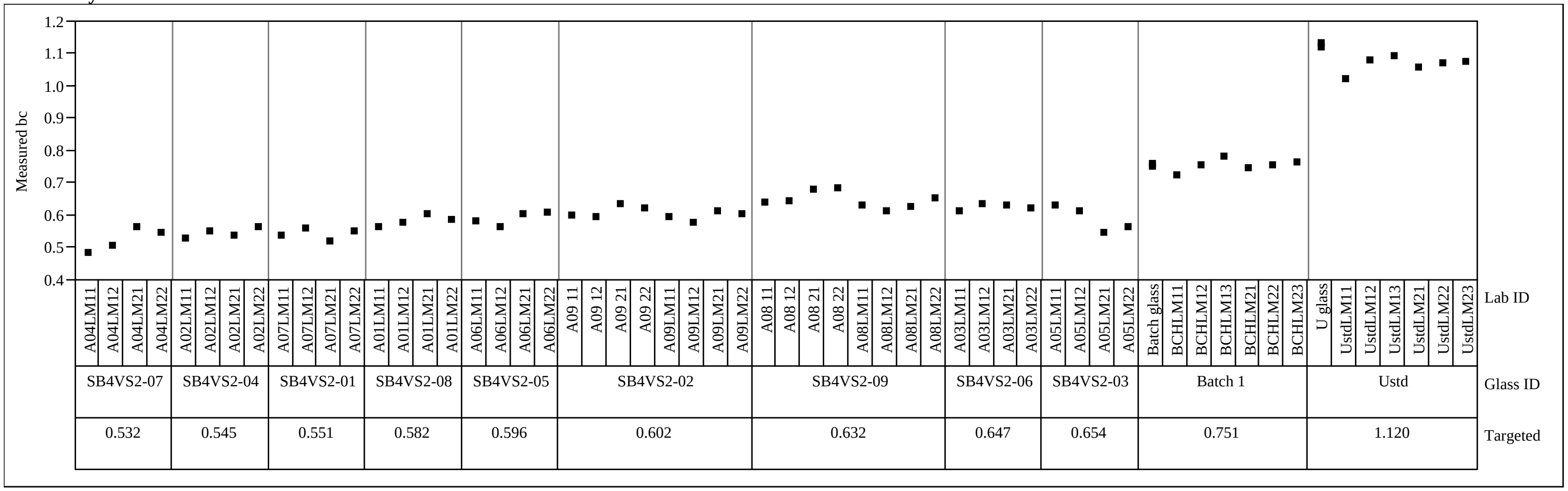
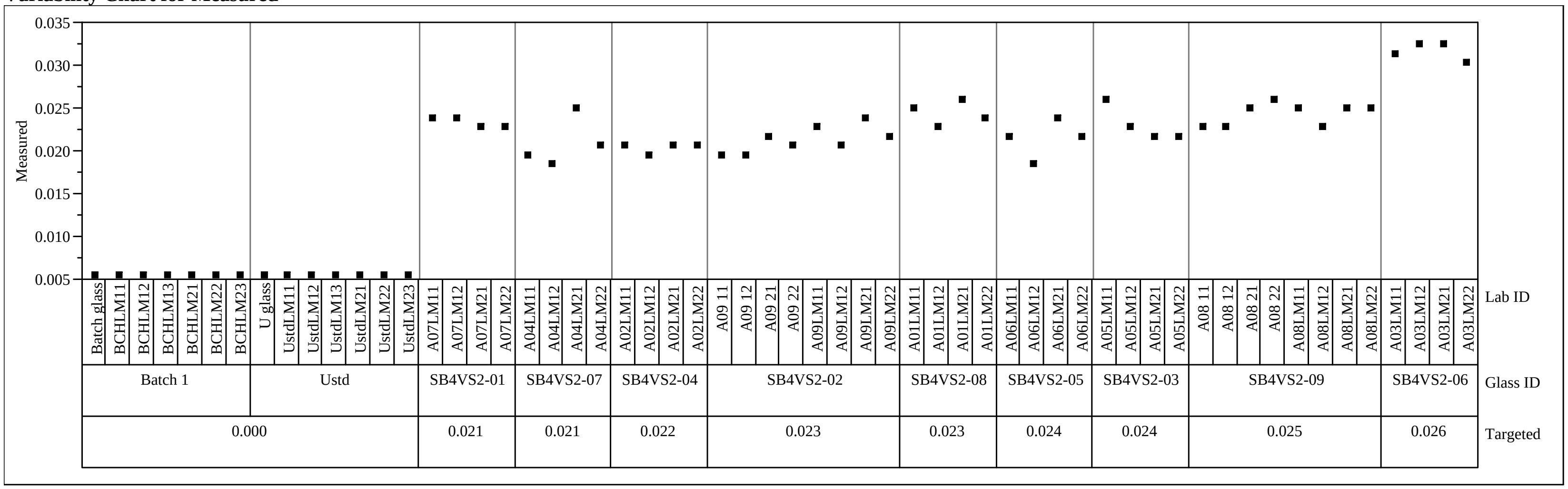


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=PbO (wt%)
Variability Chart for Measured



Variability Gage Oxide=PbO (wt%)
Variability Chart for Measured bc

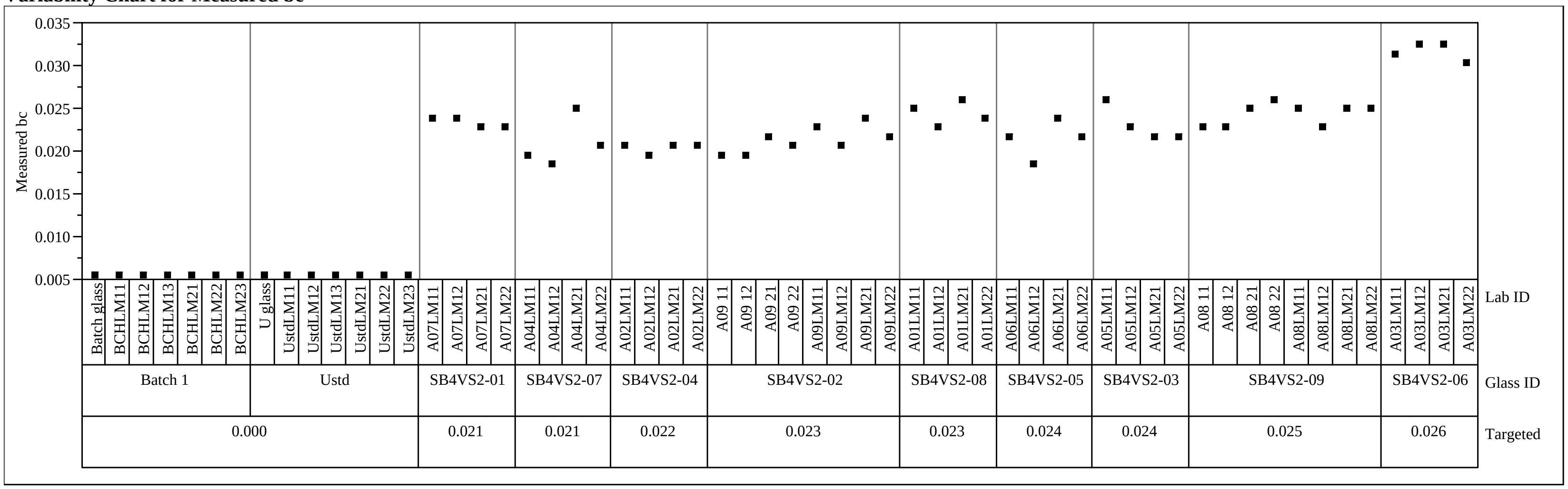
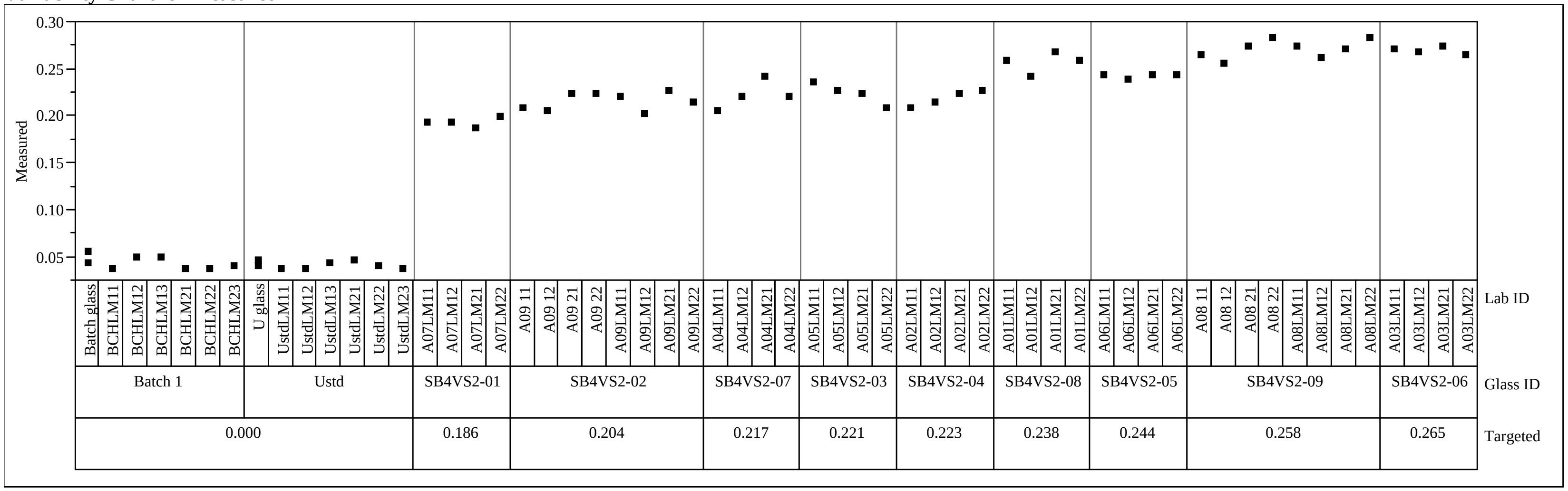


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=SO_4 (wt%)
Variability Chart for Measured



Variability Gage Oxide=SO_4 (wt%)
Variability Chart for Measured bc

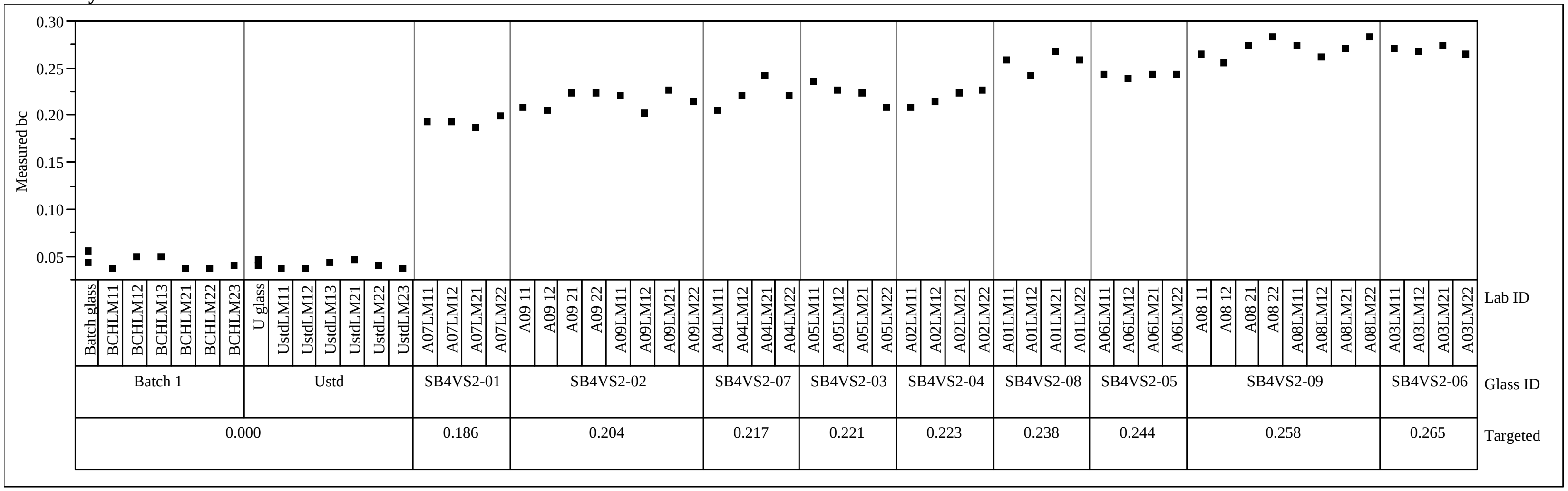
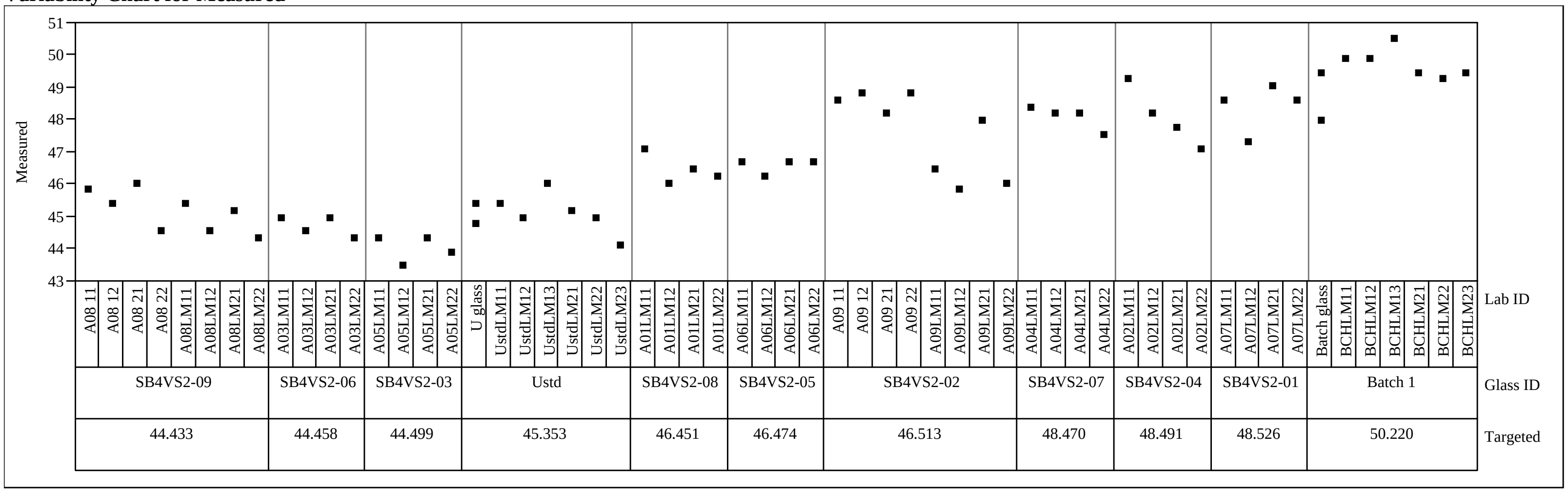


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=SiO_2 (wt%)
Variability Chart for Measured



Variability Gage Oxide=SiO_2 (wt%)
Variability Chart for Measured bc

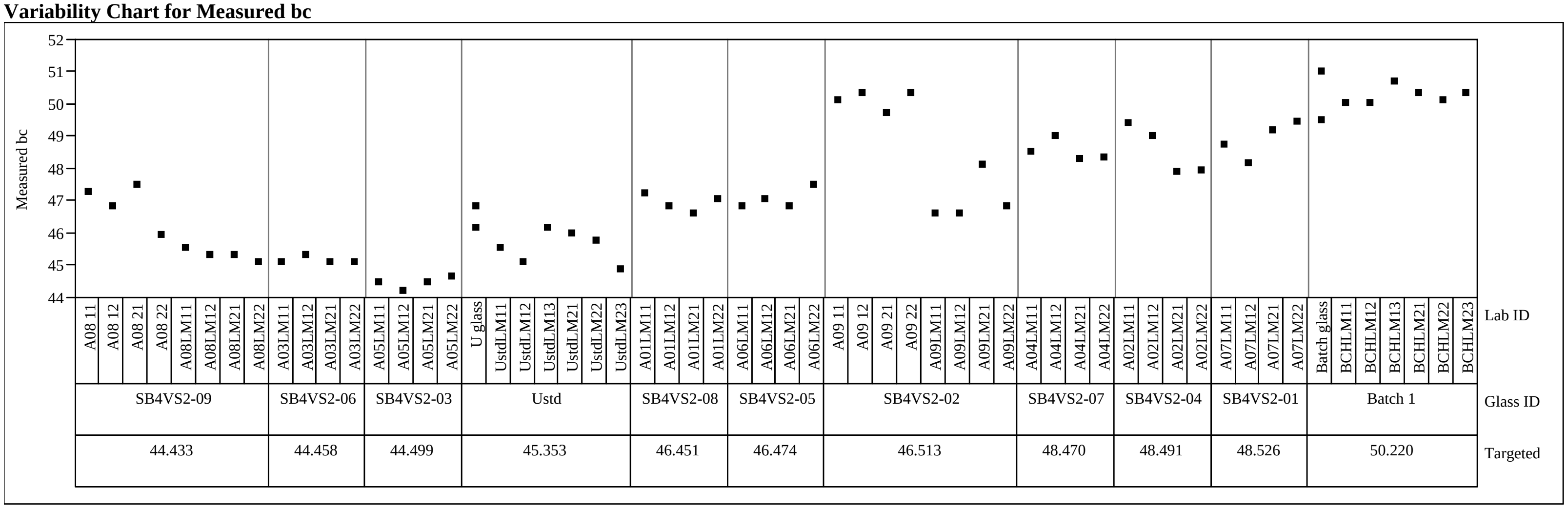
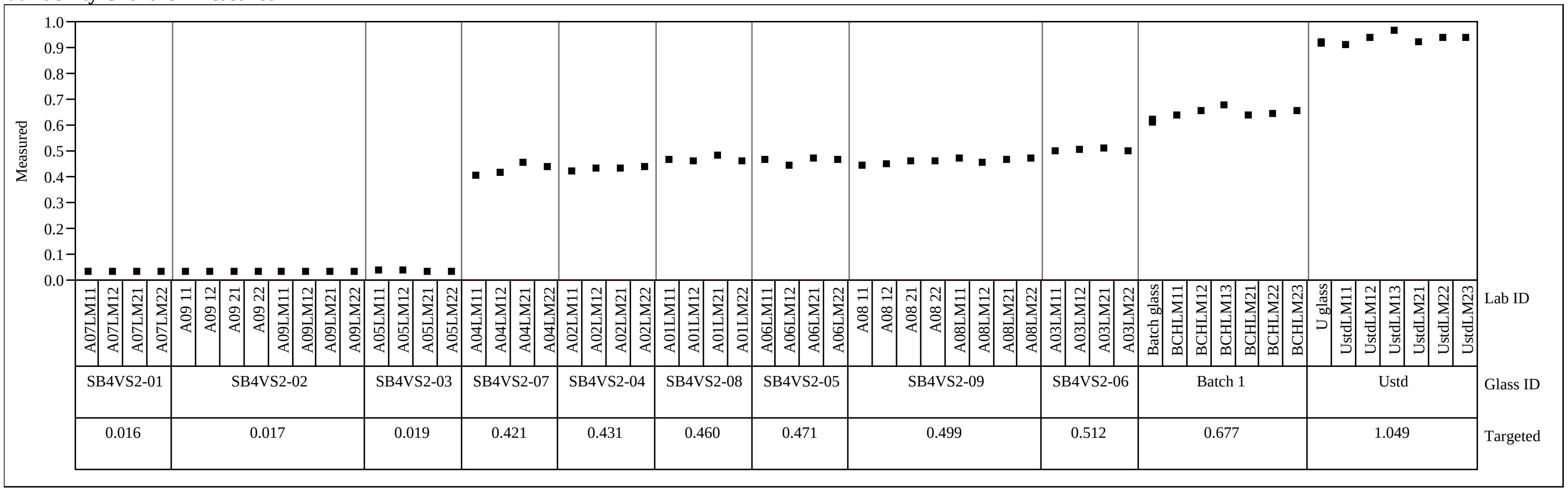


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=TiO_2 (wt%)
Variability Chart for Measured



Variability Gage Oxide=TiO_2 (wt%)
Variability Chart for Measured bc

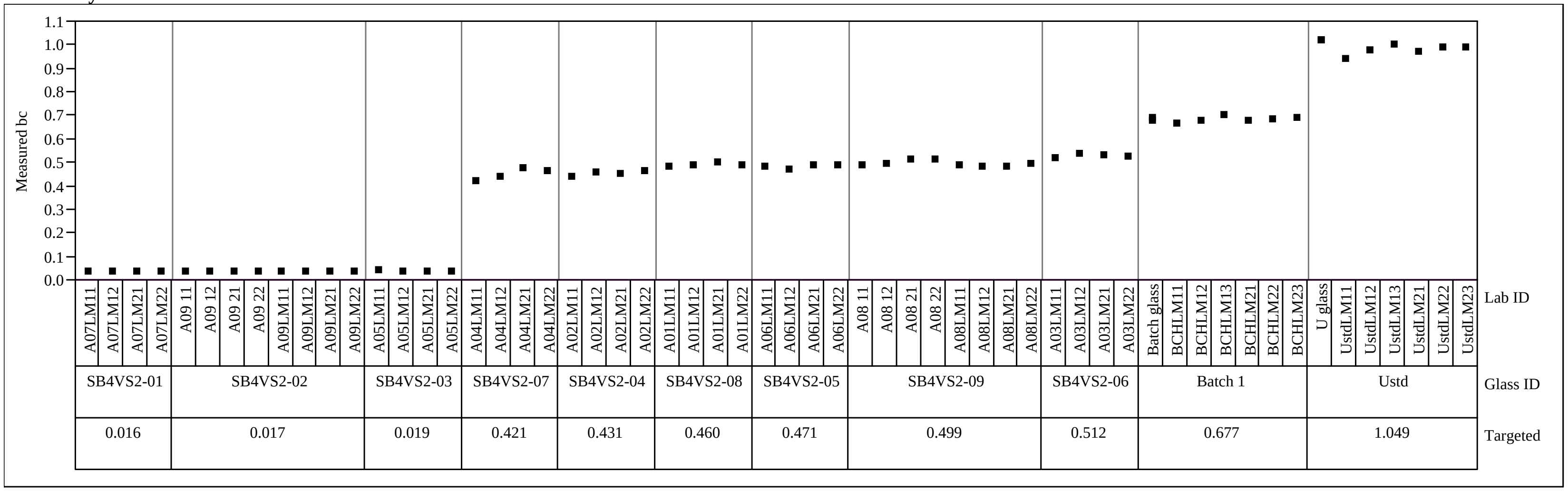
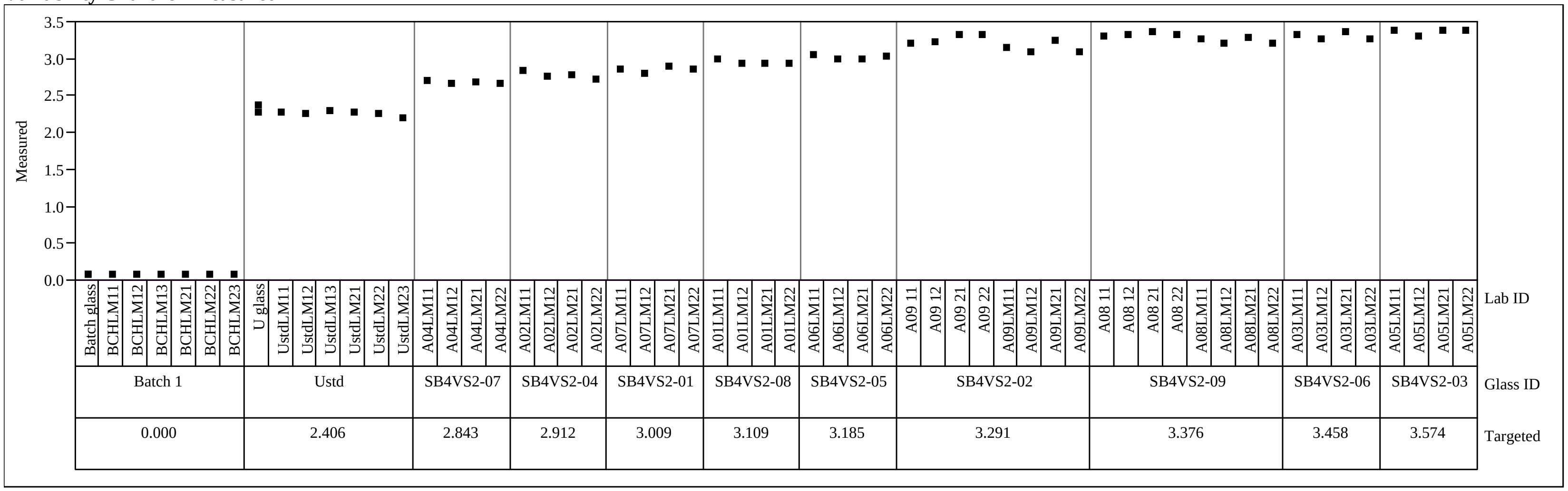


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=U_3O_8 (wt%)
Variability Chart for Measured



Variability Gage Oxide=U_3O_8 (wt%)
Variability Chart for Measured bc

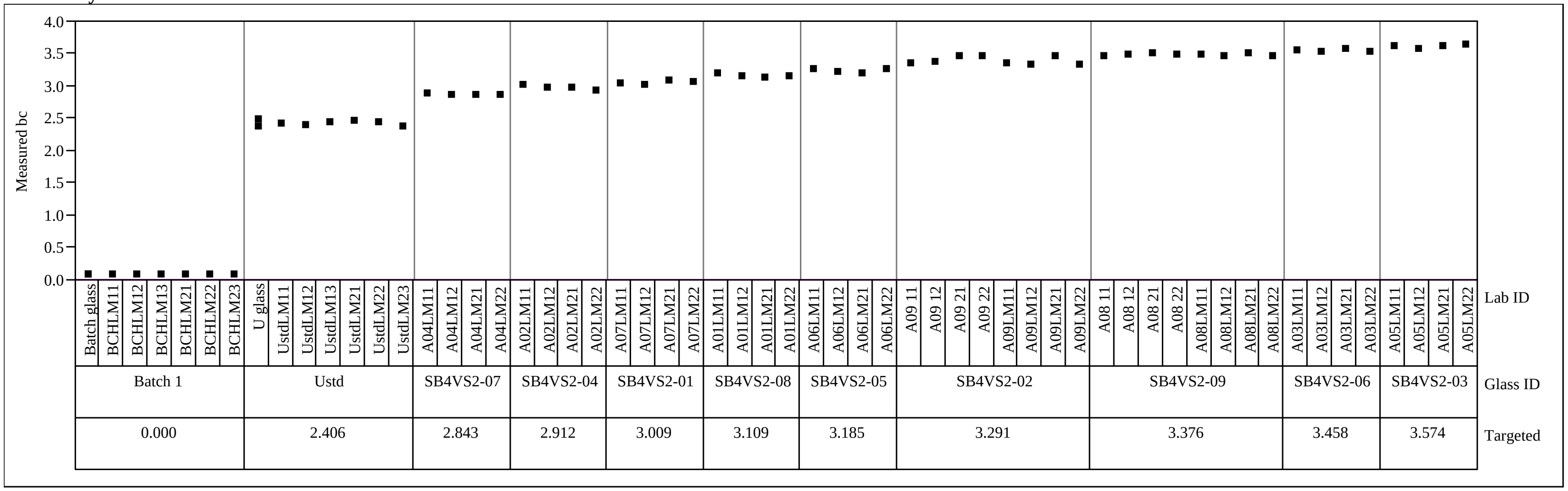
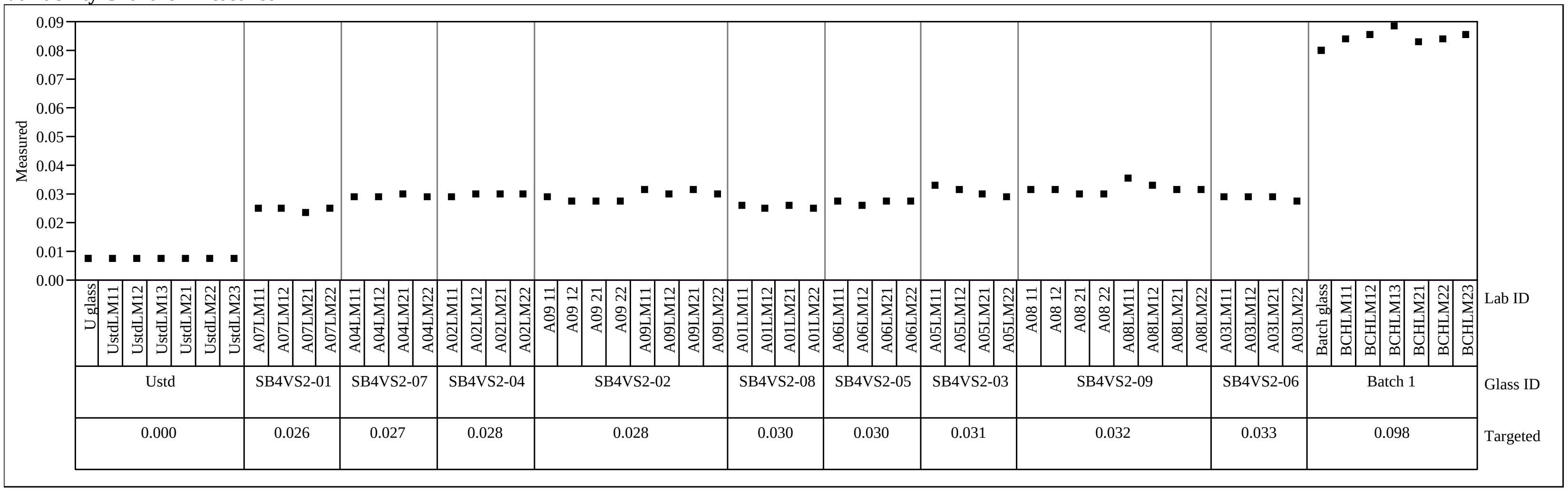


Figure A7. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=ZrO_2 (wt%)
Variability Chart for Measured



Variability Gage Oxide=ZrO_2 (wt%)
Variability Chart for Measured bc

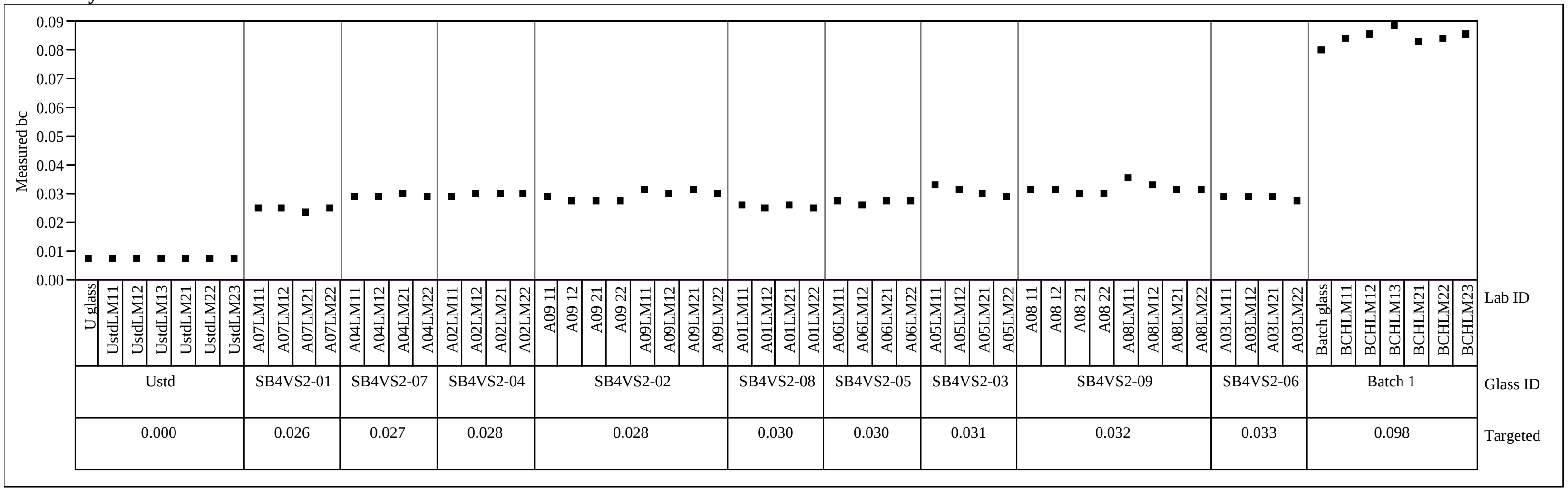
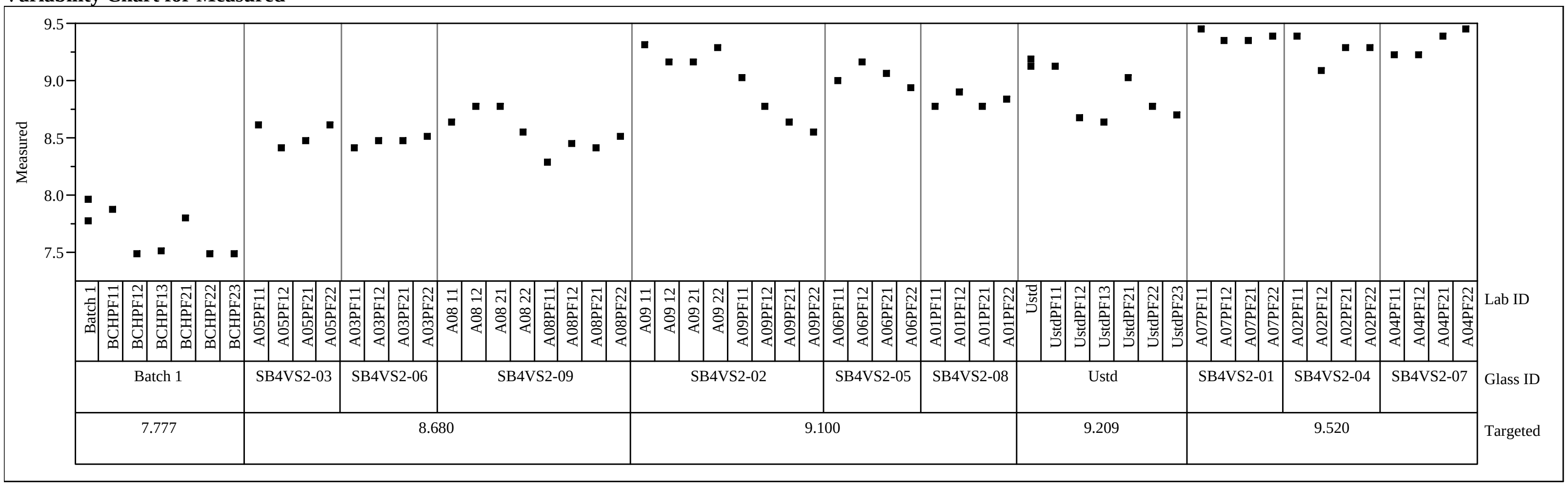


Figure A8. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=B_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=B_2O_3 (wt%)
Variability Chart for Measured bc

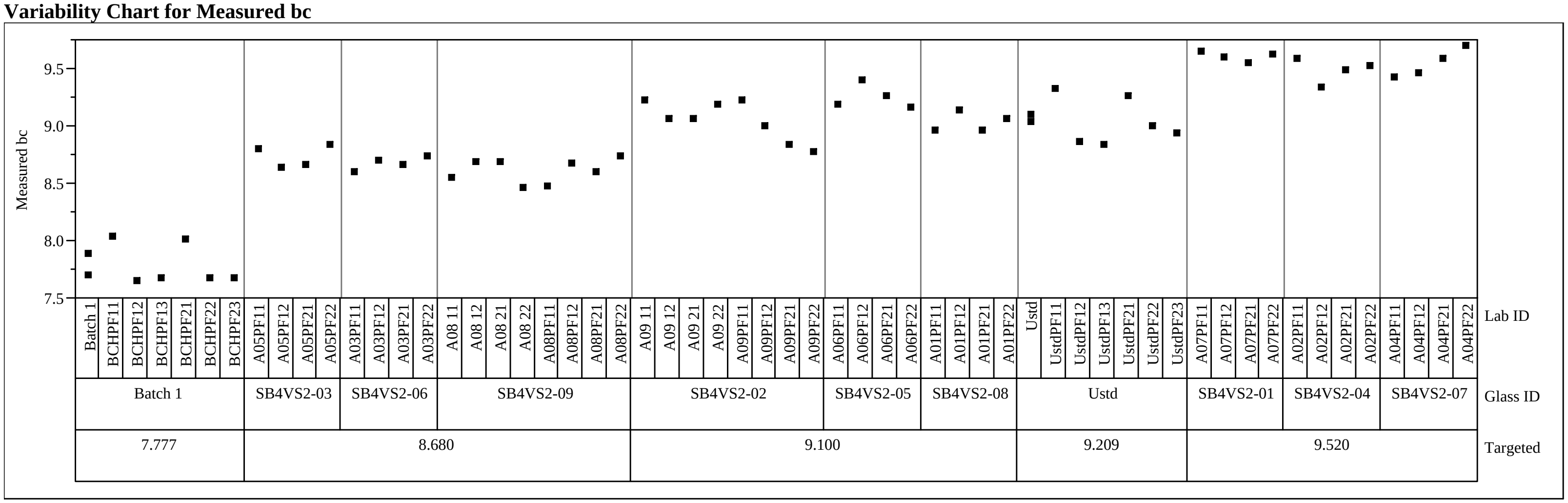
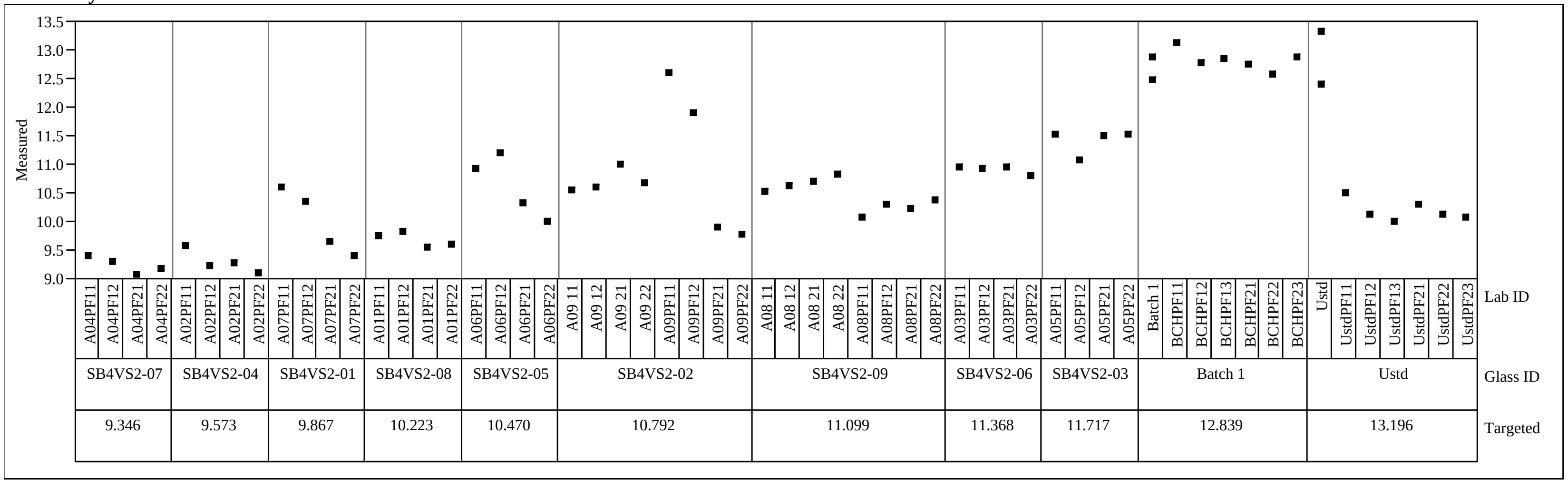


Figure A8. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Fe_2O_3 (wt%)
Variability Chart for Measured



Variability Gage Oxide=Fe_2O_3 (wt%)
Variability Chart for Measured bc

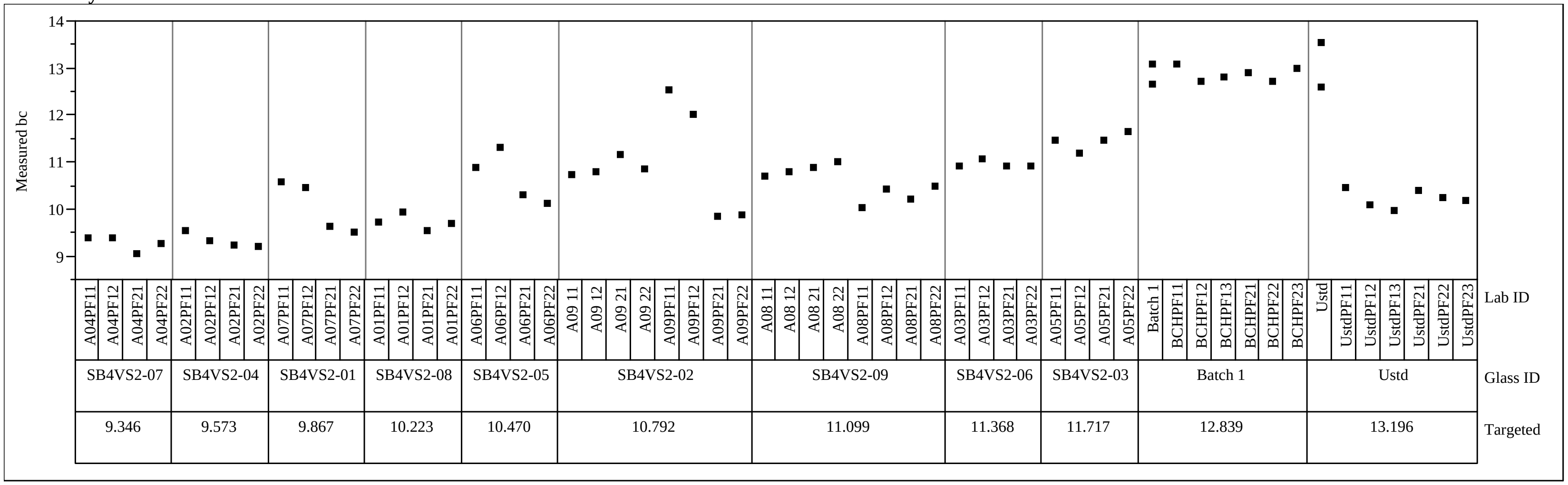
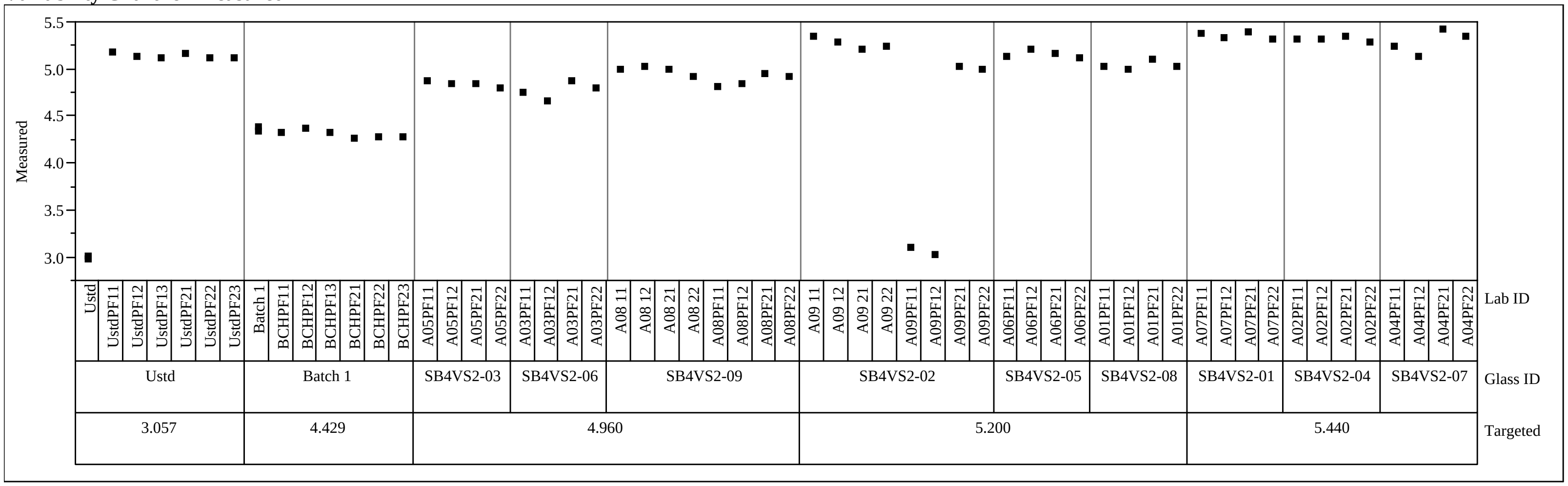


Figure A8. Oxide Measurements by Lab ID within Glass ID Including Auxiliary Measurements for LM Preps

Variability Gage Oxide=Li_2O (wt%)
Variability Chart for Measured



Variability Gage Oxide=Li_2O (wt%)
Variability Chart for Measured bc

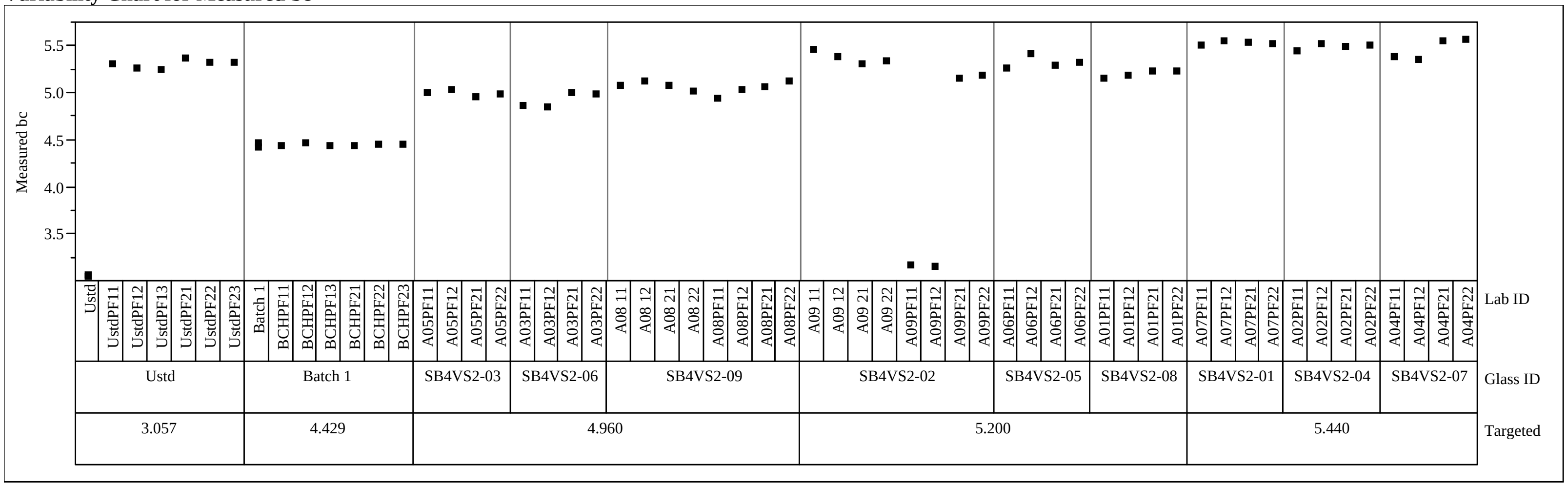
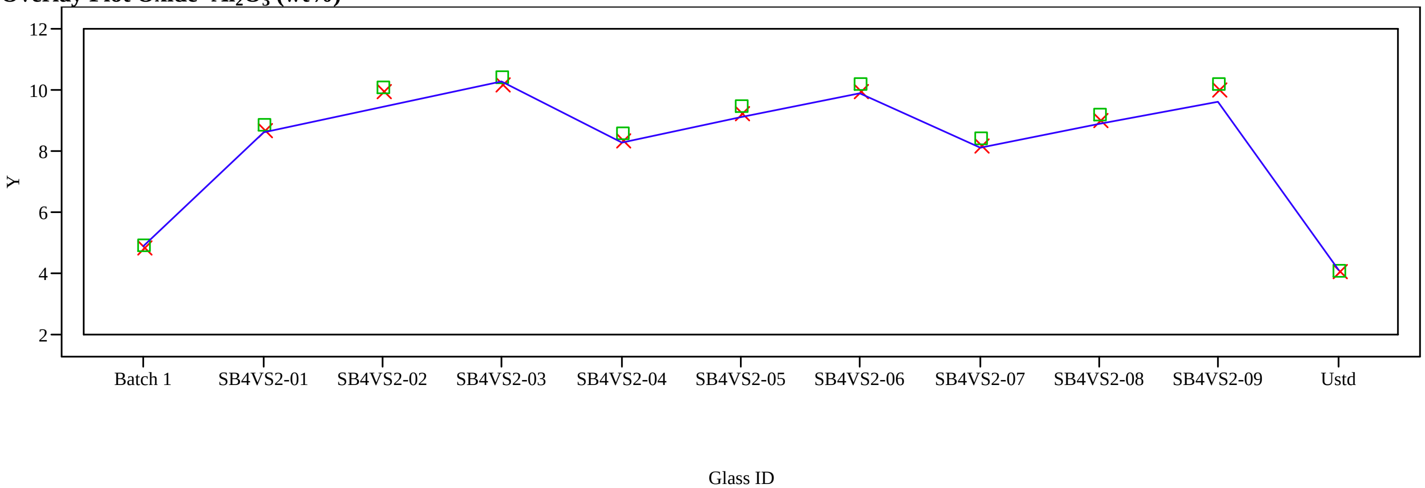


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=Al_2O_3 (wt%)



Overlay Plot Oxide=B_2O_3 (wt%)

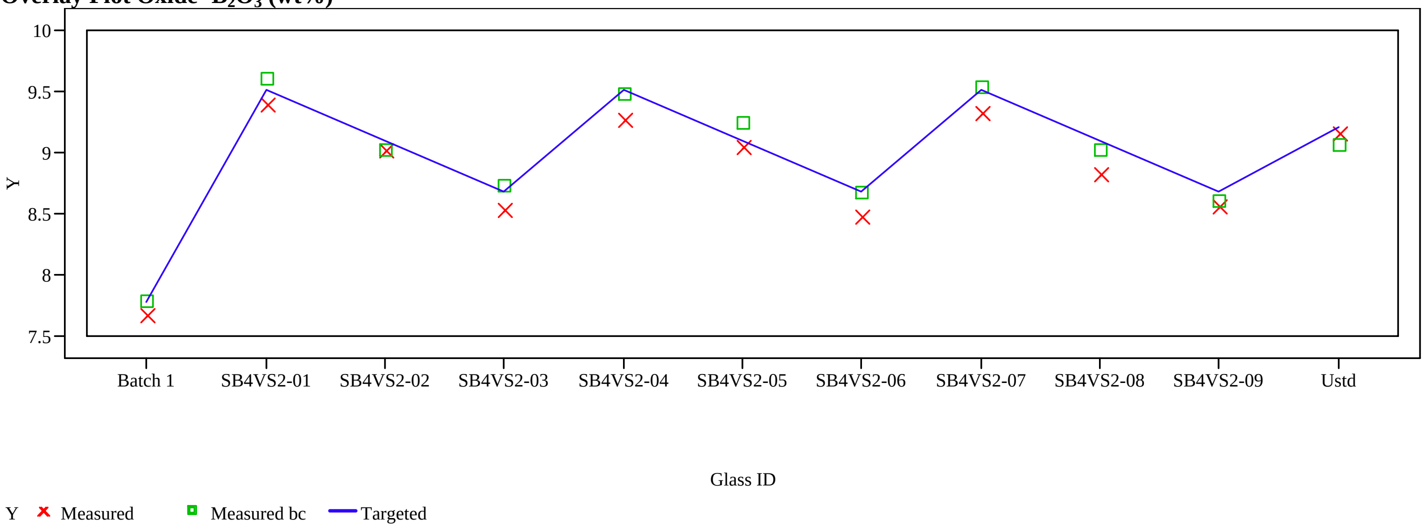
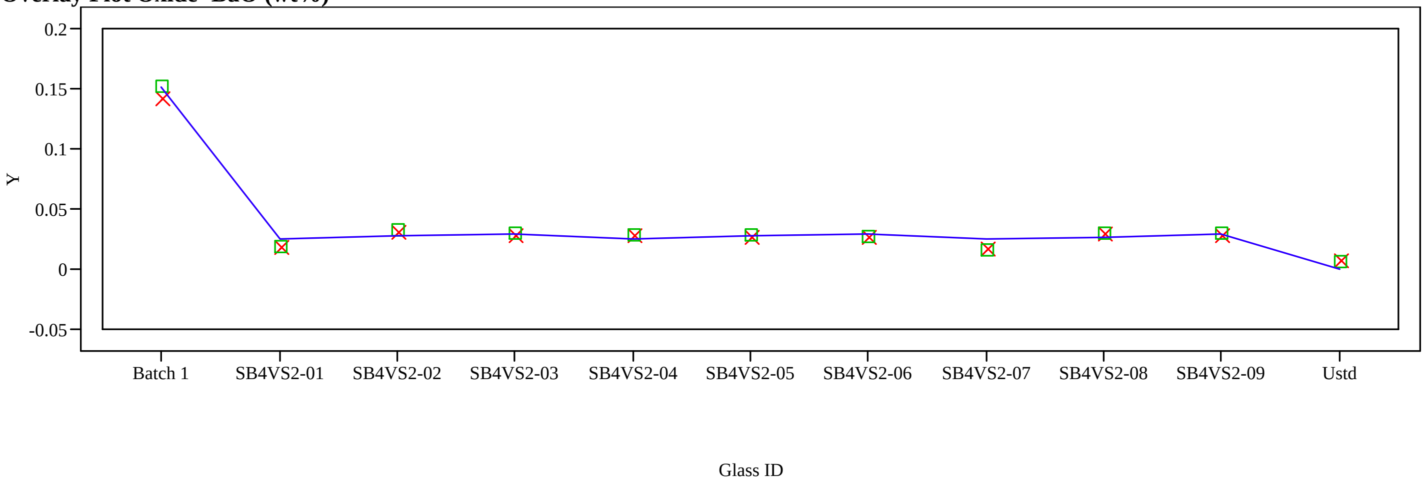


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=BaO (wt%)



Overlay Plot Oxide=CaO (wt%)

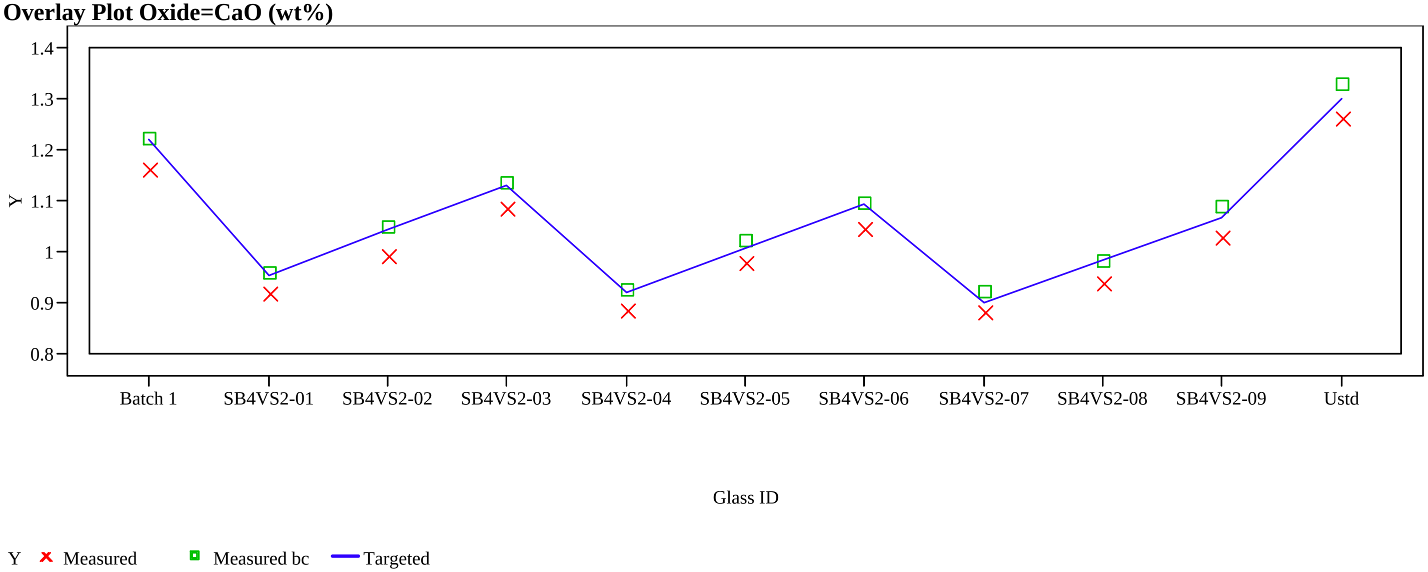
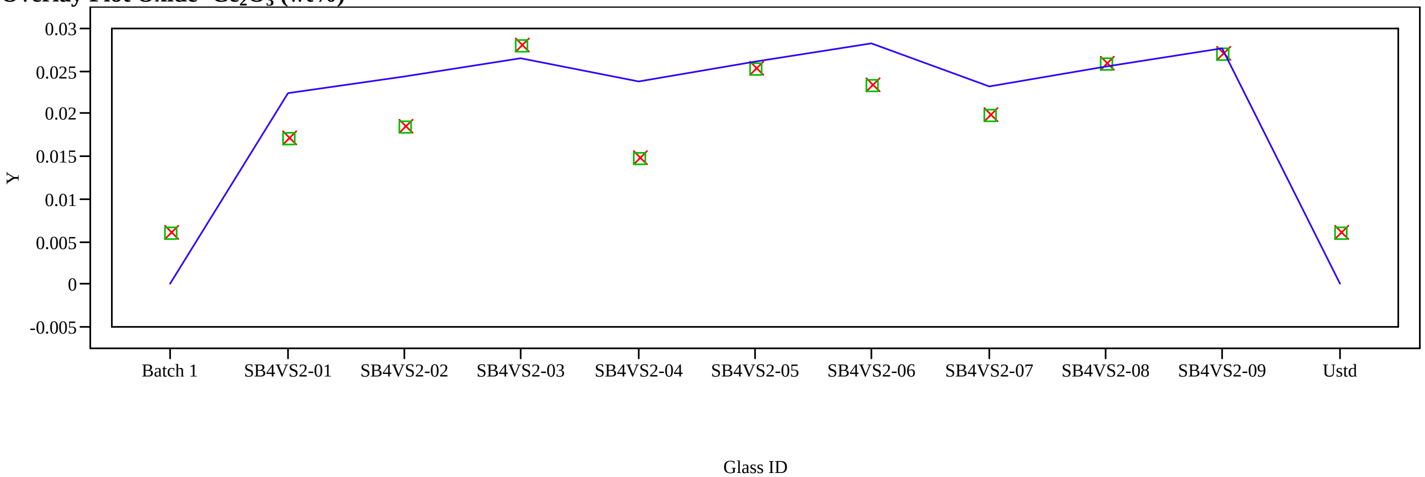


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=Ce_2O_3 (wt%)



Overlay Plot Oxide=Cr_2O_3 (wt%)

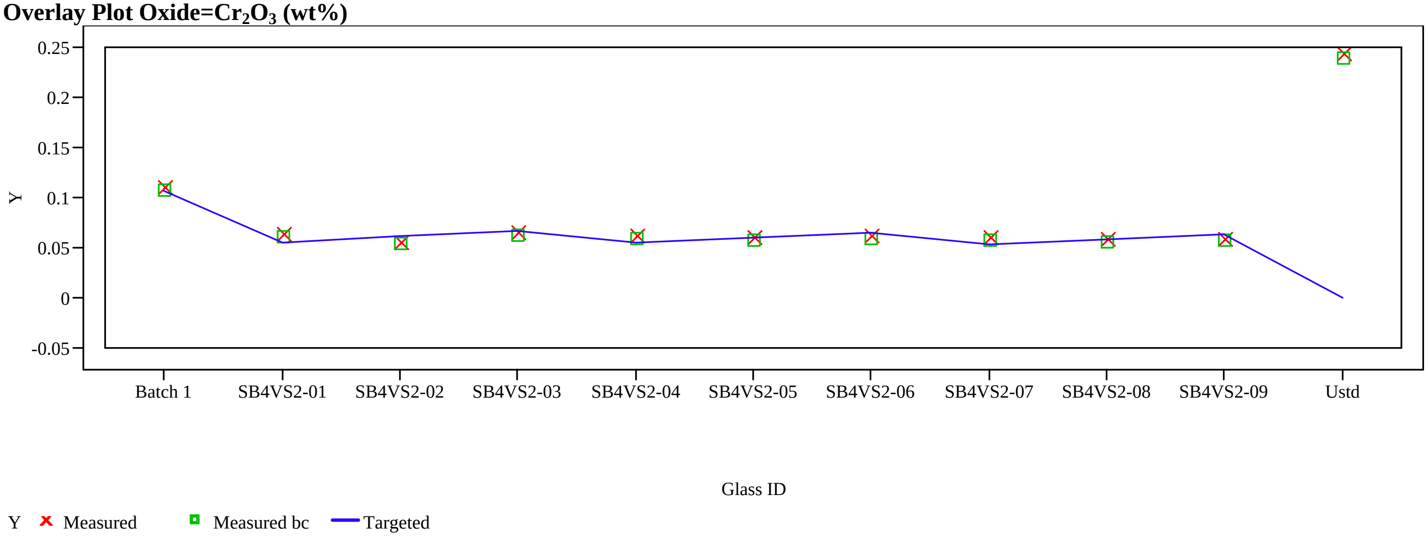
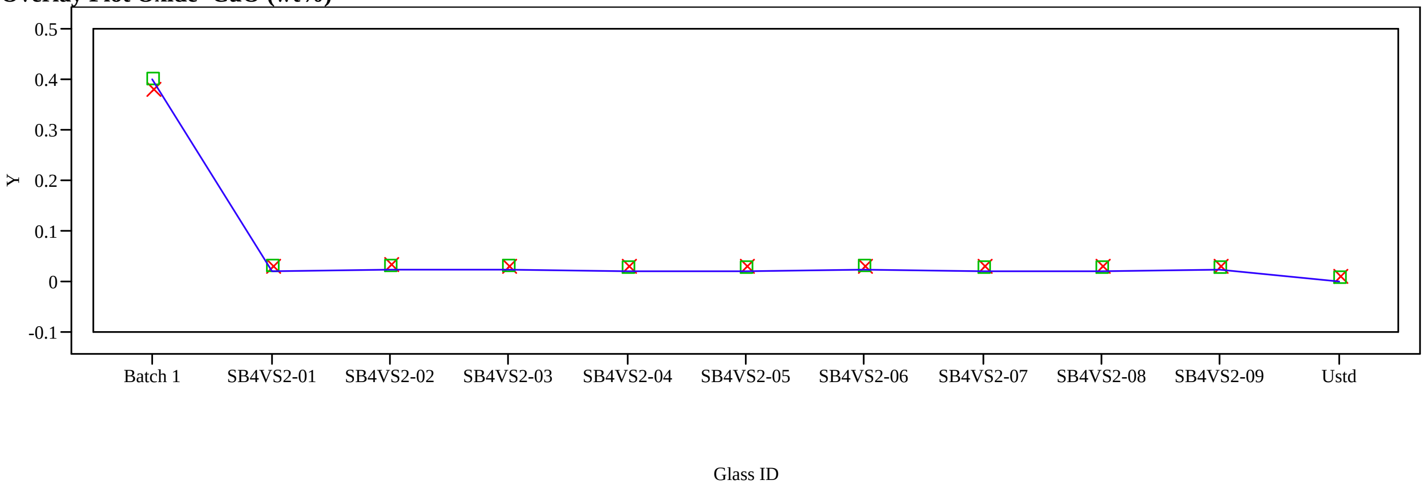


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=CuO (wt%)



Overlay Plot Oxide=Fe_2O_3 (wt%)

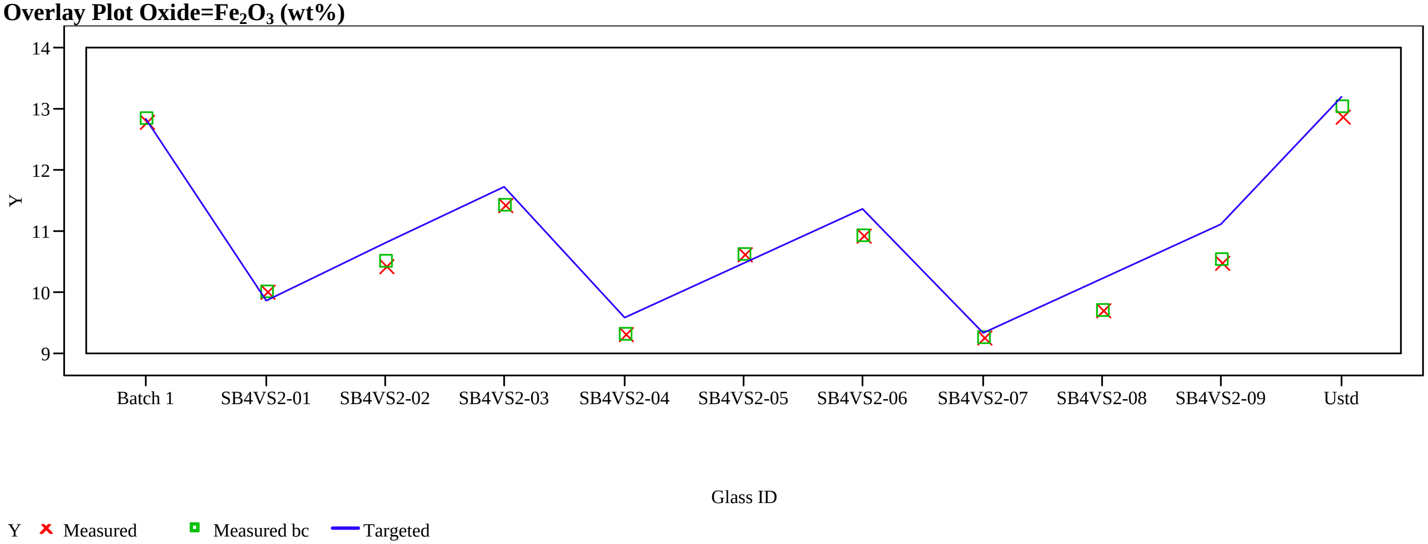
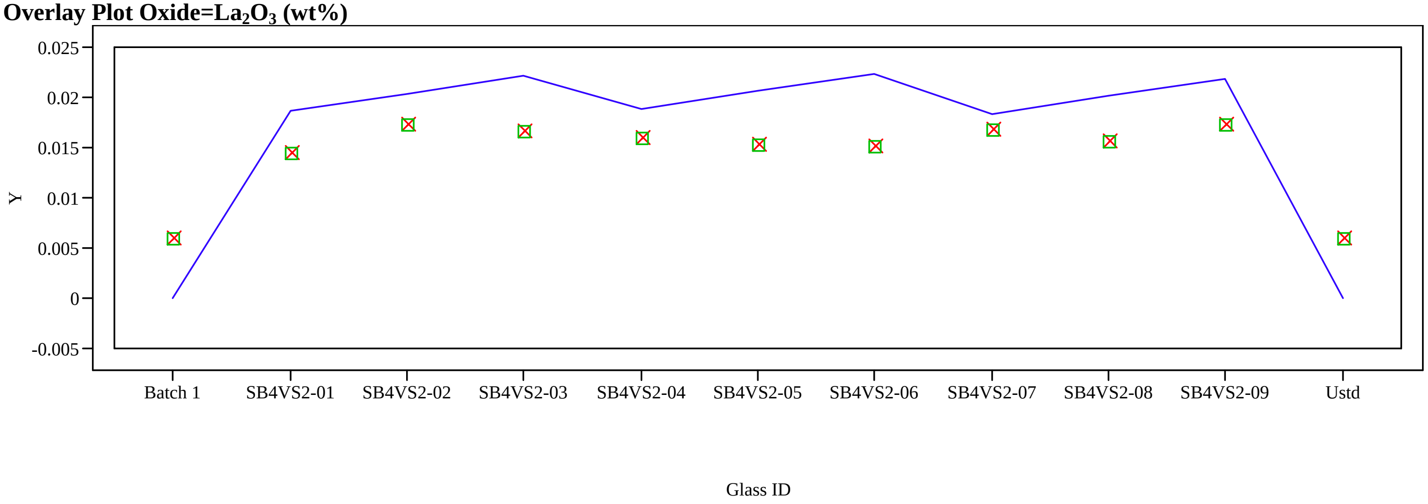


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=La_2O_3 (wt%)



Overlay Plot Oxide=Li_2O (wt%)

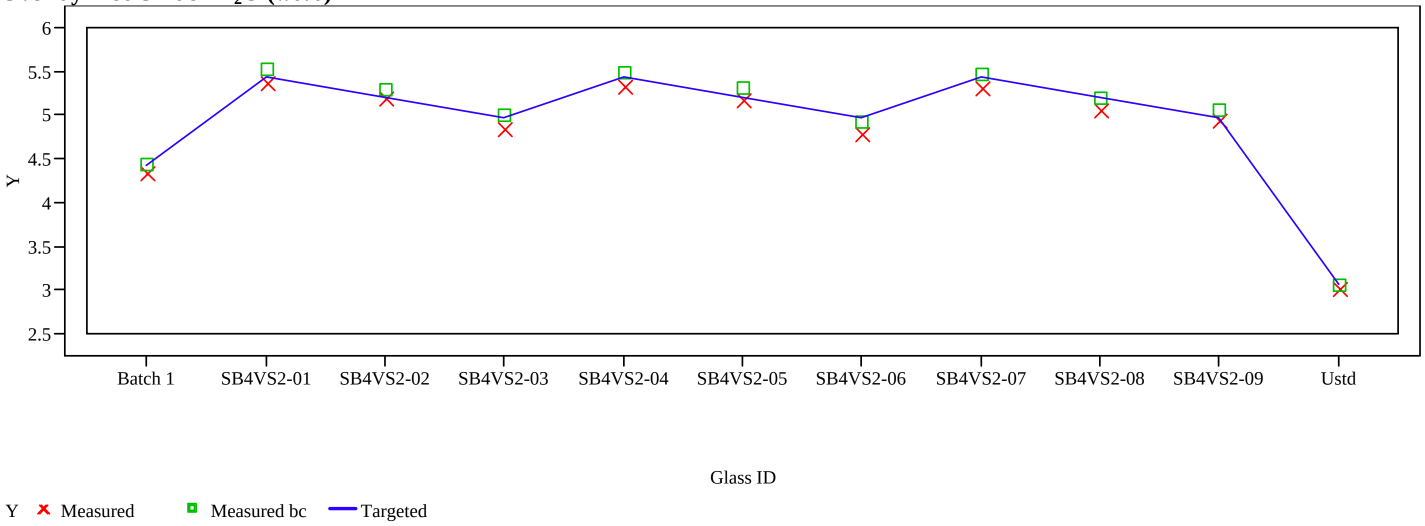
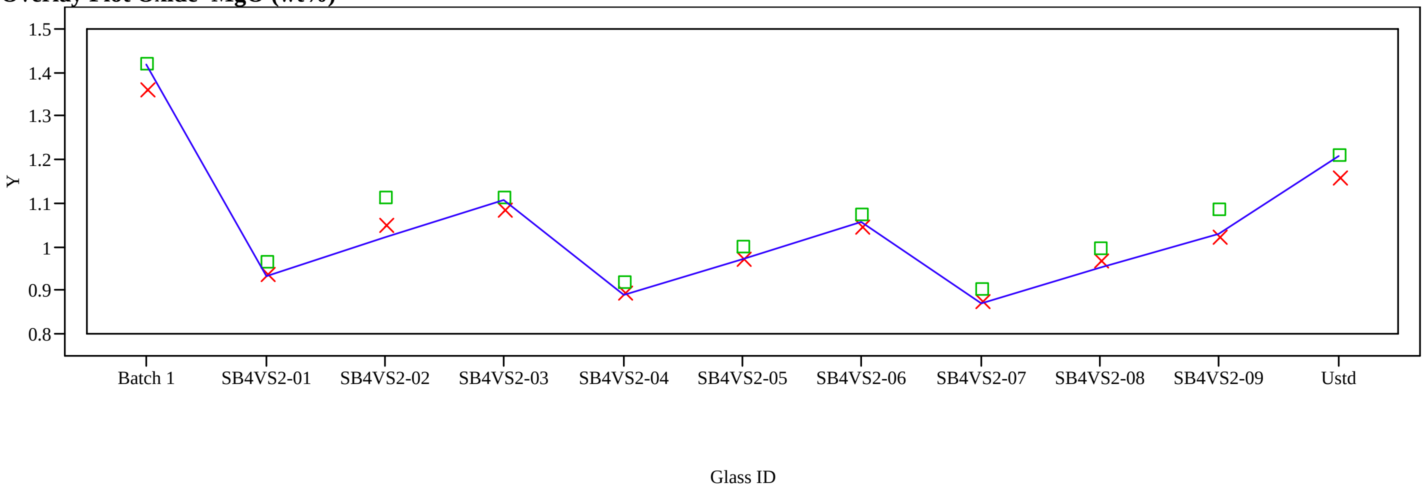


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=MgO (wt%)



Overlay Plot Oxide=MnO (wt%)

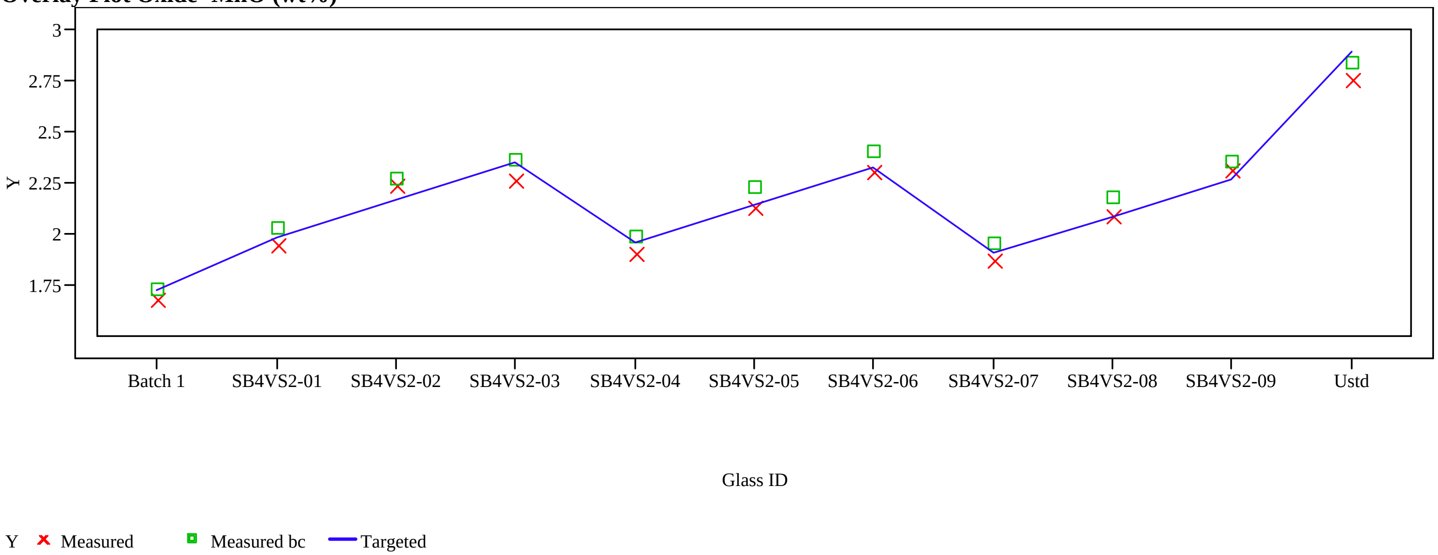
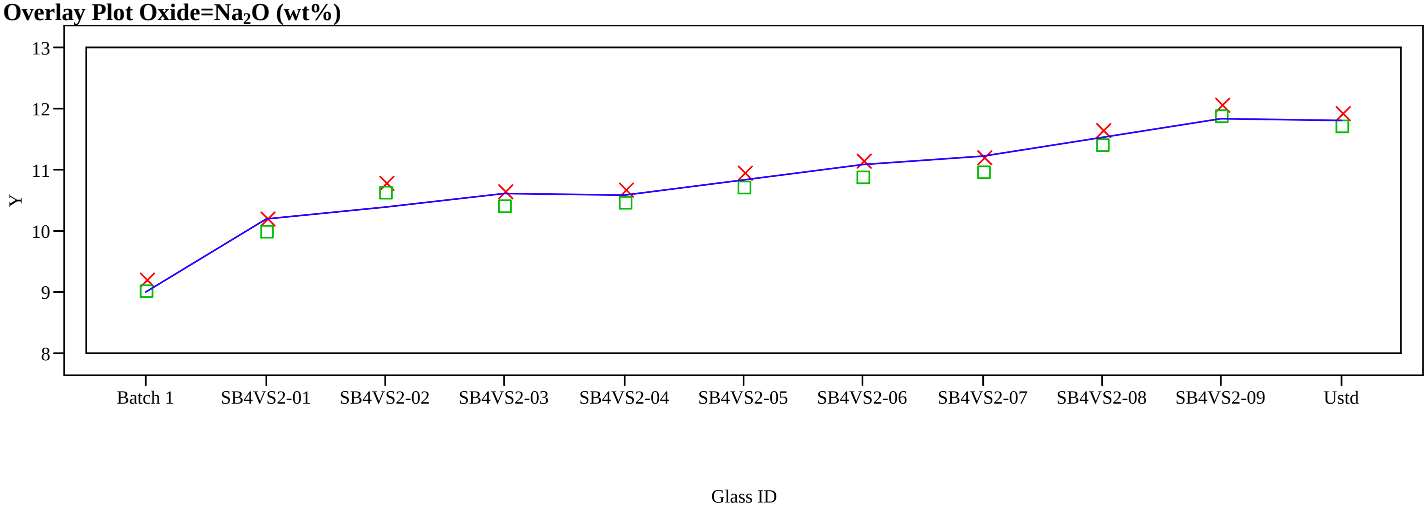


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide



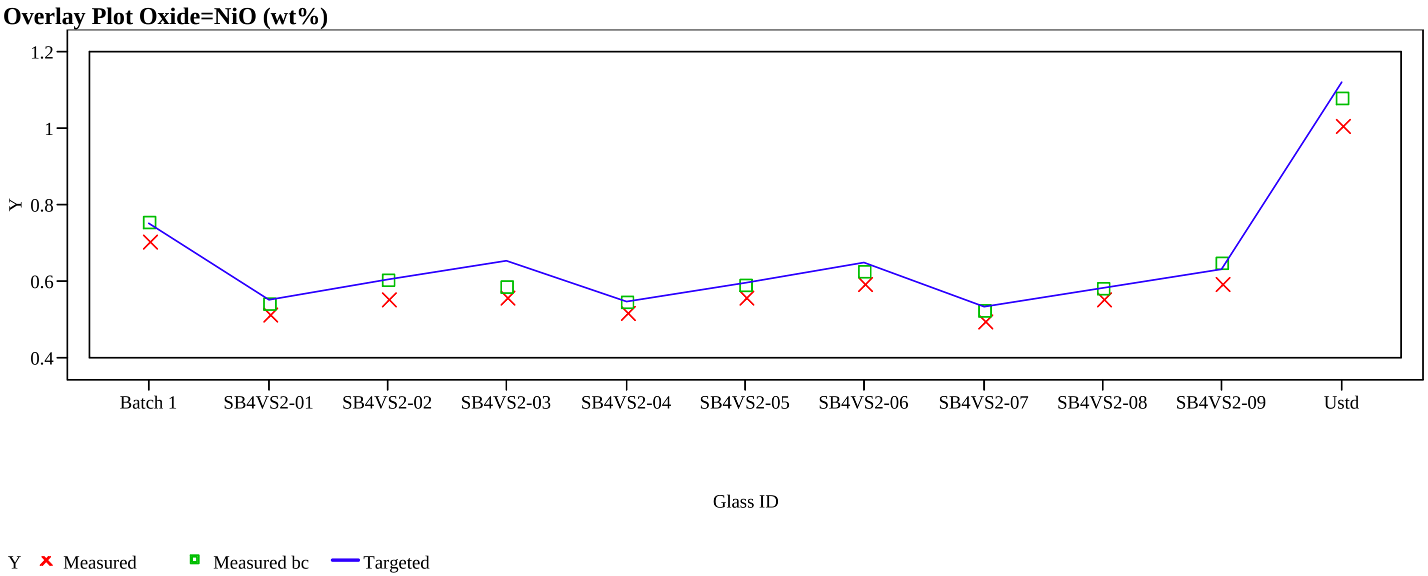
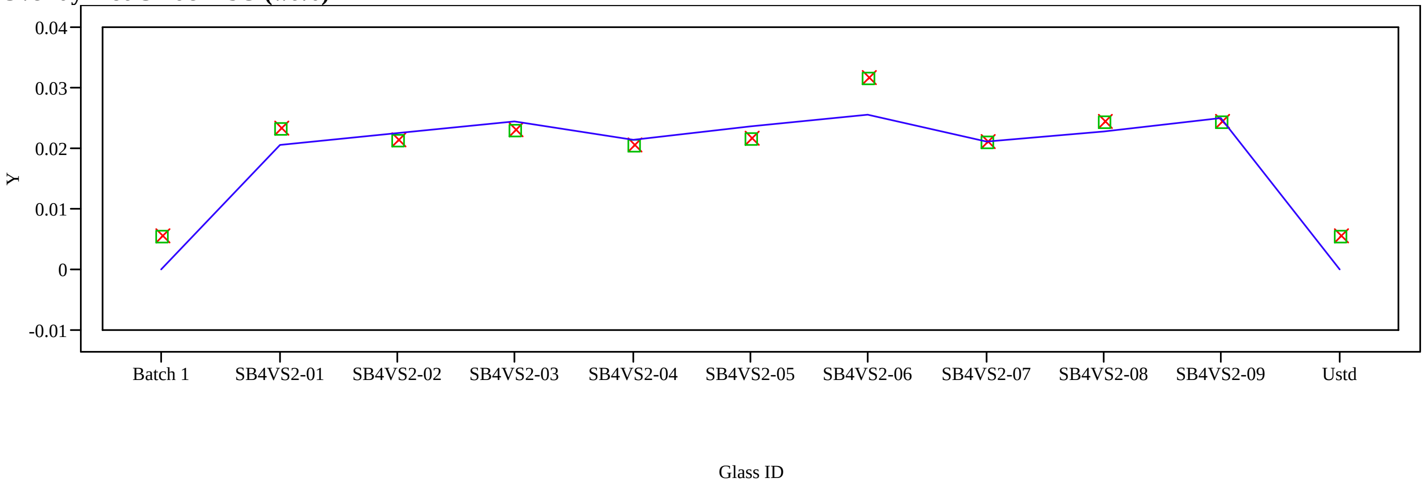


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=PbO (wt%)



Overlay Plot Oxide=SiO_2 (wt%)

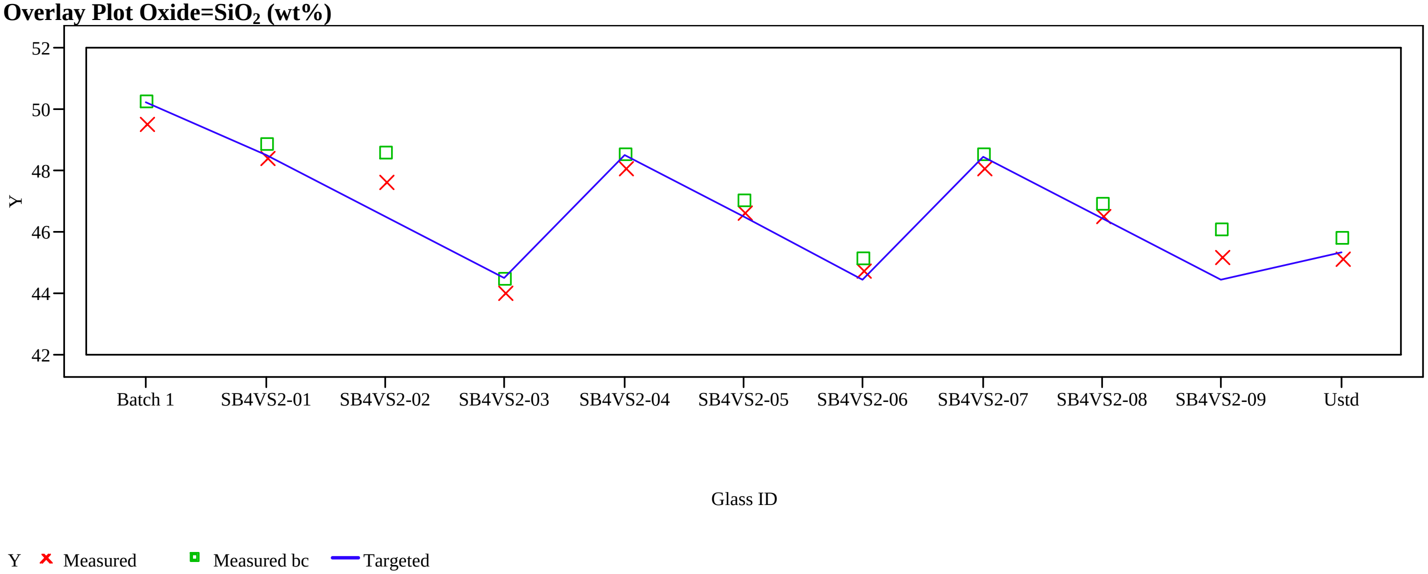
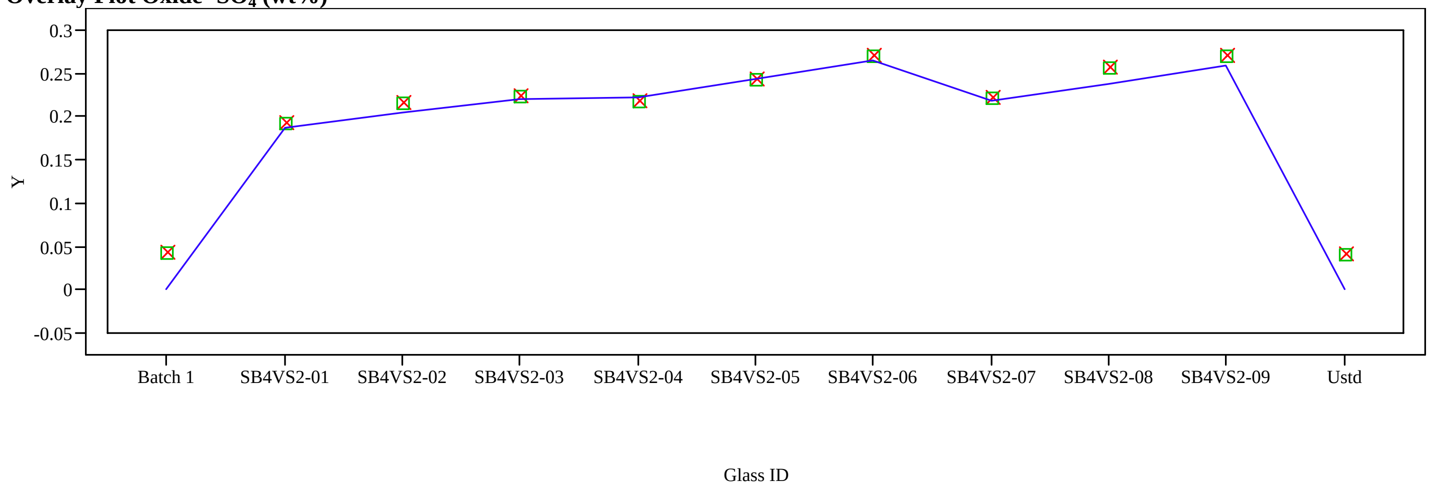


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=SO_4 (wt%)



Overlay Plot Oxide=TiO_2 (wt%)

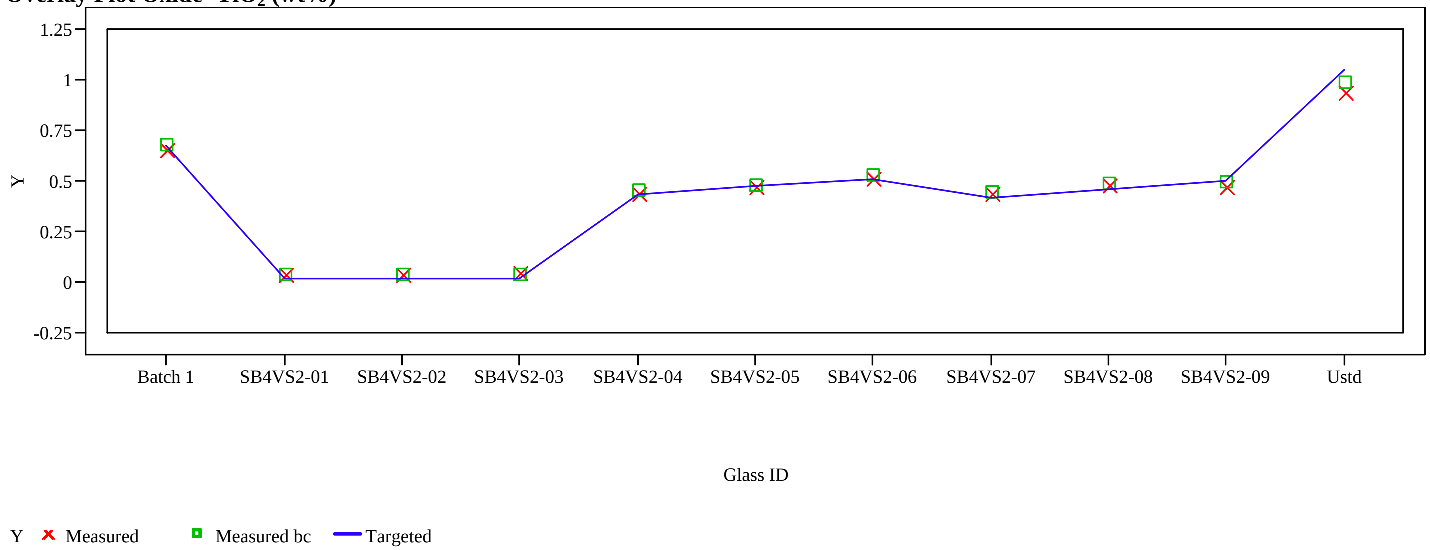
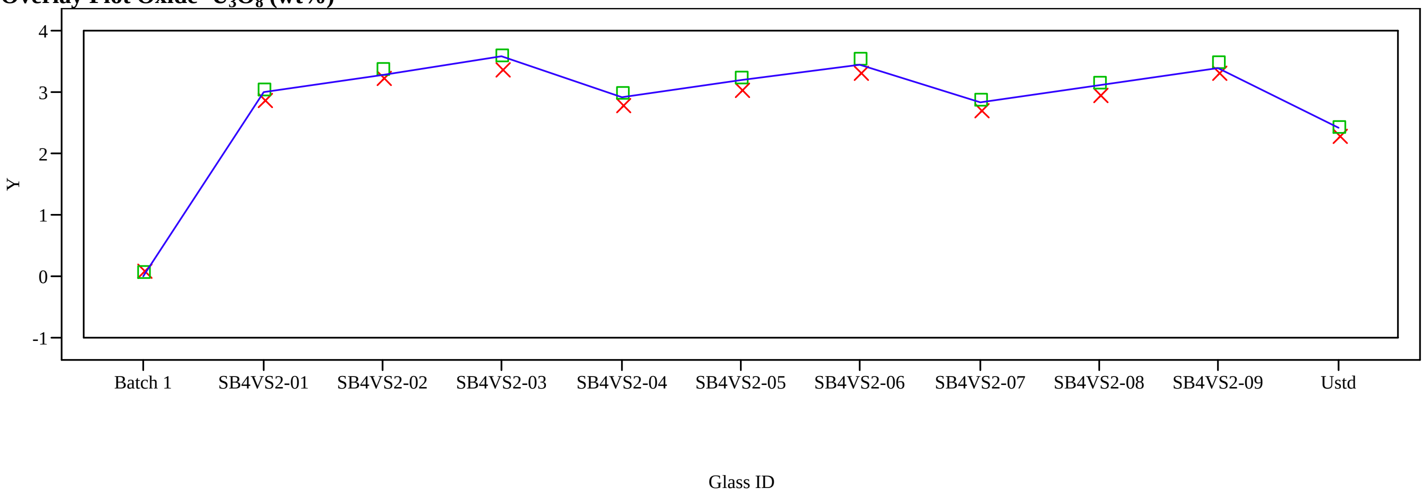


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=U_3O_8 (wt%)



Overlay Plot Oxide=ZrO_2 (wt%)

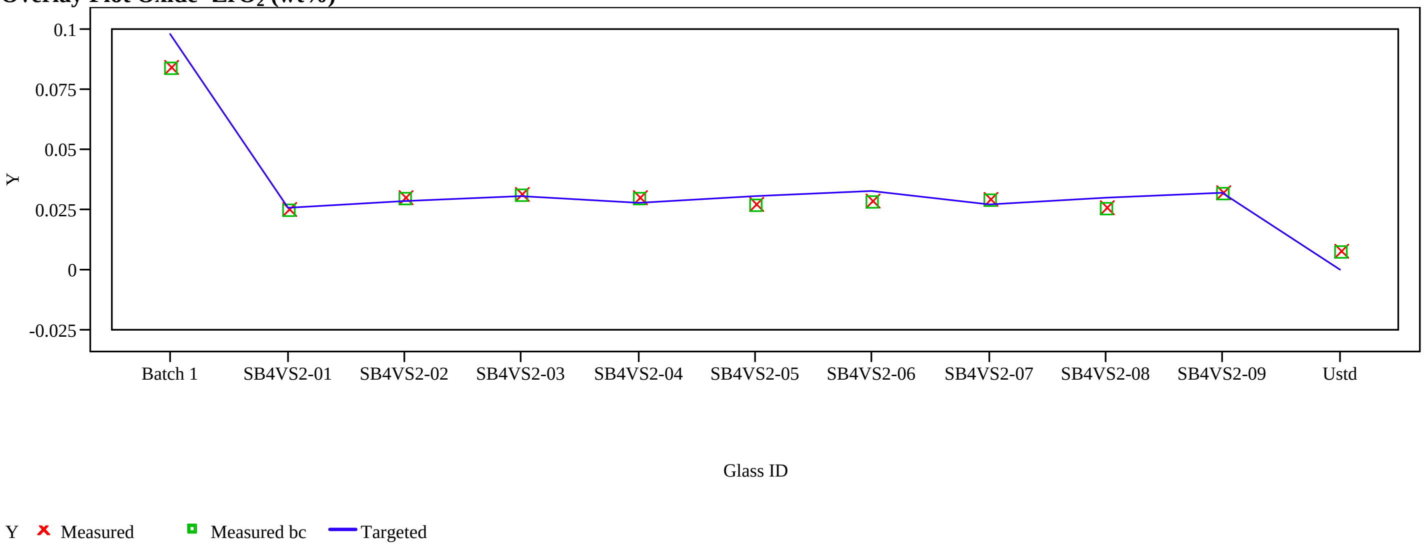
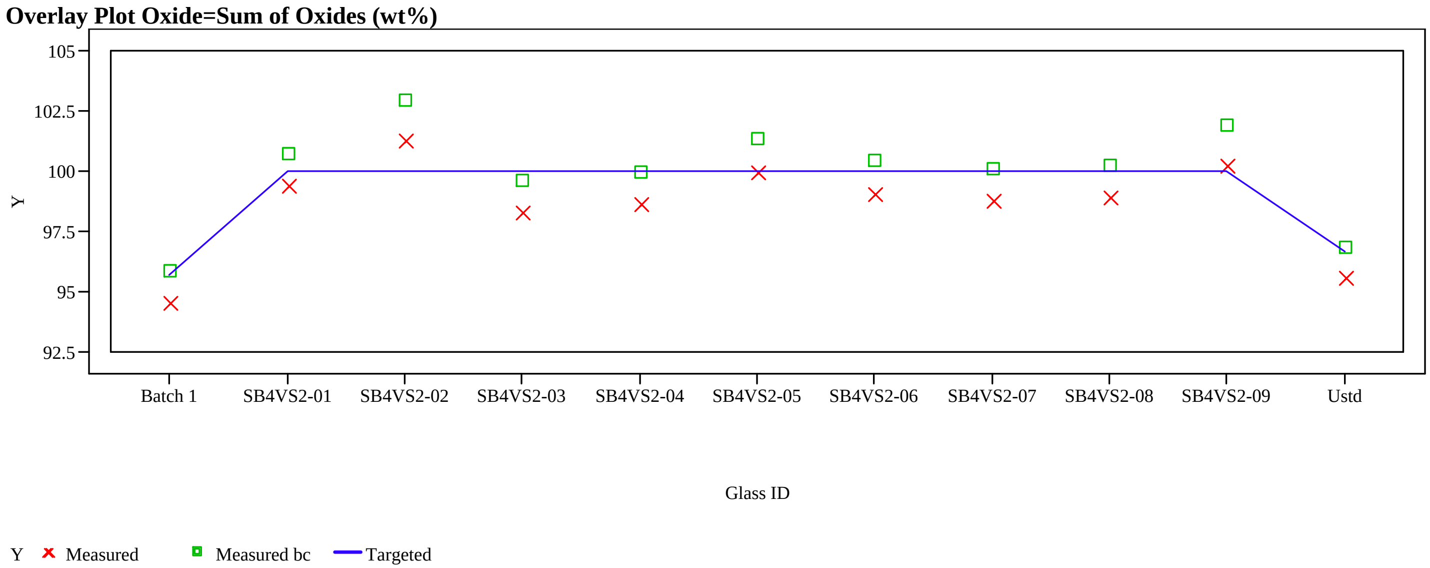


Figure A9. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide



Appendix B:

Tables and Figures Supporting the Analysis of the PCT Results for the SB4 Variability Study Glasses in Support of a Second Decant

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Table B1. PSAL Measurements of the PCT Solutions for the Study Glasses As-Received (ar) and After Appropriate Adjustments (in ppm)

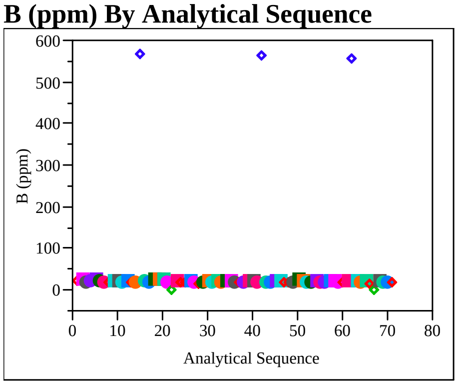
Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
Soln Std	ref	1	1	STD-11	20.7	9.87	80.4	50.5	20.700	9.870	80.400	50.500
SB4VS2-06	quenched	1	2	B47	12.5	11	33.9	59.6	20.834	18.334	56.501	99.335
SB4VS2-04	ccc	1	3	B38	11.7	10.6	27	61.8	19.500	17.667	45.001	103.002
SB4VS2-03	ccc	1	4	B33	12.5	11.3	31.7	60	20.834	18.834	52.834	100.002
SB4VS2-03	quenched	1	5	B52	12.8	11.6	32.4	62.3	21.334	19.334	54.001	103.835
SB4VS2-07	ccc	1	6	B34	12.5	11.4	32.2	65.4	20.834	19.000	53.668	109.002
SB4VS2-09	ccc	1	7	B39	11.9	10.4	37.3	59.3	19.834	17.334	62.168	98.835
ARM-1	ref	1	8	B18	11	8.72	22.9	38	18.334	14.534	38.167	63.335
SB4VS2-05	quenched	1	9	B11	11	10.3	28.2	57.3	18.334	17.167	47.001	95.502
SB4VS2-04	quenched	1	10	B04	12	11.2	27.5	63.6	20.000	18.667	45.834	106.002
SB4VS2-05	ccc	1	11	B42	11.8	10.7	30	60.9	19.667	17.834	50.001	101.502
SB4VS2-08	quenched	1	12	B12	12	10.9	34.6	61.6	20.000	18.167	57.668	102.669
Soln Std	ref	1	13	STD-12	19.7	9.78	80.7	49.2	19.700	9.780	80.700	49.200
SB4VS2-01	ccc	1	14	B43	12	11	26.4	62.3	20.000	18.334	44.001	103.835
EA	ref	1	15	B17	34	10.5	93	50.8	566.668	175.000	1550.003	846.668
SB4VS2-02	ccc	1	16	B09	12.3	11.1	29.1	60.3	20.500	18.500	48.501	100.502
SB4VS2-08	ccc	1	17	B57	11.7	10.7	34.2	61.2	19.500	17.834	57.001	102.002
SB4VS2-07	quenched	1	18	B05	12.6	11.7	33.3	66.2	21.000	19.500	55.501	110.336
SB4VS2-01	quenched	1	19	B29	12.4	11.6	26.7	63.6	20.667	19.334	44.501	106.002
SB4VS2-02	quenched	1	20	B32	12.3	11.4	28.7	61.5	20.500	19.000	47.834	102.502
SB4VS2-06	ccc	1	21	B27	11.7	10.5	33.1	58.6	19.500	17.500	55.168	97.669
blank	ref	1	22	B62	0.143	<1.00	<0.100	<0.100	0.238	0.833	0.083	0.083
SB4VS2-09	quenched	1	23	B56	11.9	10.8	38.6	59.5	19.834	18.000	64.335	99.169
Soln Std	ref	1	24	STD-13	19.9	9.85	83.2	49.6	19.900	9.850	83.200	49.600
Soln Std	ref	2	1	STD-21	19.6	9.37	76.8	48.4	19.600	9.370	76.800	48.400
SB4VS2-08	quenched	2	2	B08	11.4	10.4	32.9	58.4	19.000	17.334	54.834	97.335
SB4VS2-06	ccc	2	3	B54	11.2	10.1	31.4	56.9	18.667	16.834	52.334	94.835
ARM-1	ref	2	4	B19	9.7	7.93	20.4	35.4	16.167	13.217	34.001	59.001
SB4VS2-07	ccc	2	5	B20	11.6	11	31.4	63.7	19.334	18.334	52.334	106.169
SB4VS2-01	quenched	2	6	B13	11.5	10.9	24.7	61.7	19.167	18.167	41.167	102.835
SB4VS2-05	ccc	2	7	B46	10.5	9.76	27.3	57.7	17.500	16.267	45.501	96.169
SB4VS2-02	quenched	2	8	B40	11.4	10.8	26.2	60.5	19.000	18.000	43.668	100.835
SB4VS2-01	ccc	2	9	B50	11.3	10.7	24.9	62	18.834	17.834	41.501	103.335
SB4VS2-07	quenched	2	10	B21	11.8	11	29.8	64.3	19.667	18.334	49.668	107.169
SB4VS2-06	quenched	2	11	B36	11.5	10.5	31.2	59.4	19.167	17.500	52.001	99.002
SB4VS2-04	ccc	2	12	B48	11.1	10.3	25.5	63	18.500	17.167	42.501	105.002
Soln Std	ref	2	13	STD-22	19.6	9.65	77.9	50.9	19.600	9.650	77.900	50.900
SB4VS2-03	ccc	2	14	B01	11.2	10.3	29.1	56.9	18.667	17.167	48.501	94.835
SB4VS2-09	quenched	2	15	B53	11.5	10.3	36.2	59.3	19.167	17.167	60.335	98.835
SB4VS2-04	quenched	2	16	B61	11.2	10.8	28.7	63.4	18.667	18.000	47.834	105.669
SB4VS2-09	ccc	2	17	B35	11.3	10.2	36.3	58	18.834	17.000	60.501	96.669
EA	ref	2	18	B26	33.9	10.4	94	51.3	565.001	173.334	1566.670	855.002
SB4VS2-02	ccc	2	19	B03	11.6	10.7	28.5	59.6	19.334	17.834	47.501	99.335
SB4VS2-08	ccc	2	20	B49	10.9	10.1	33.6	59.3	18.167	16.834	56.001	98.835
SB4VS2-03	quenched	2	21	B30	11.9	11.2	32.7	59	19.834	18.667	54.501	98.335
SB4VS2-05	quenched	2	22	B02	10.3	10	28.8	55.8	17.167	16.667	48.001	93.002
Soln Std	ref	2	23	STD-23	18.9	9.49	78.7	48.5	18.900	9.490	78.700	48.500
Soln Std	ref	3	1	STD-31	19.6	9.46	78.7	48.6	19.600	9.460	78.700	48.600
SB4VS2-04	ccc	3	2	B60	11.4	10.3	25.9	60.9	19.000	17.167	43.168	101.502
SB4VS2-07	quenched	3	3	B59	12.3	11.3	31.7	64.1	20.500	18.834	52.834	106.835
SB4VS2-01	quenched	3	4	B44	11.7	11	24.8	61.1	19.500	18.334	41.334	101.835
SB4VS2-05	ccc	3	5	B15	11	10.1	29	58.9	18.334	16.834	48.334	98.169
SB4VS2-07	ccc	3	6	B41	11.3	10.5	30.7	60.3	18.834	17.500	51.168	100.502
SB4VS2-03	quenched	3	7	B58	11.8	11	32.1	57.3	19.667	18.334	53.501	95.502
SB4VS2-09	ccc	3	8	B55	10.9	10	36	56.4	18.167	16.667	60.001	94.002
SB4VS2-03	ccc	3	9	B28	11.6	10.7	32	57.4	19.334	17.834	53.334	95.669
SB4VS2-08	quenched	3	10	B51	11.4	10.7	34.8	59.5	19.000	17.834	58.001	99.169
SB4VS2-06	quenched	3	11	B31	11.4	10.5	34.4	57.8	19.000	17.500	57.334	96.335

Table B1. PSAL Measurements of the PCT Solutions for the Study Glasses As-Received (ar) and After Appropriate Adjustments (in ppm)

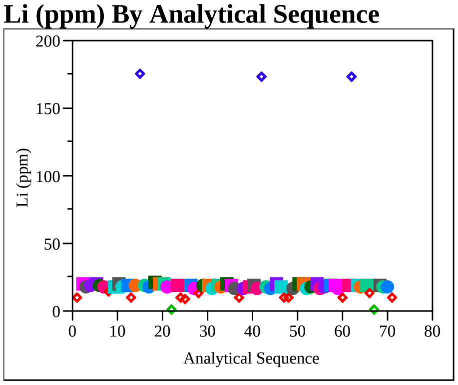
Glass ID	Heat Treatment	Block	Seq	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
SB4VS2-06	ccc	3	12	B10	11	10.3	33	56.3	18.334	17.167	55.001	93.835
Soln Std	ref	3	13	STD-32	18.6	9.5	82	47.7	18.600	9.500	82.000	47.700
SB4VS2-09	quenched	3	14	B23	11.8	10.4	38.8	57.3	19.667	17.334	64.668	95.502
EA	ref	3	15	B07	33.5	10.4	96	50.4	558.334	173.334	1600.003	840.002
SB4VS2-05	quenched	3	16	B22	11.6	10.7	30.7	58.7	19.334	17.834	51.168	97.835
SB4VS2-01	ccc	3	17	B24	11.4	10.6	26.1	60.1	19.000	17.667	43.501	100.169
SB4VS2-02	quenched	3	18	B06	11.2	10.8	28.7	57.7	18.667	18.000	47.834	96.169
ARM-1	ref	3	19	B37	9.84	8.13	22	35.4	16.400	13.550	36.667	59.001
blank	ref	3	20	B16	0.123	<1.00	<0.100	<0.100	0.205	0.833	0.083	0.083
SB4VS2-04	quenched	3	21	B45	10.7	10.6	27.9	58.9	17.834	17.667	46.501	98.169
SB4VS2-02	ccc	3	22	B25	11.5	10.7	28.6	59.1	19.167	17.834	47.668	98.502
SB4VS2-08	ccc	3	23	B14	11.2	10.4	34.1	59.3	18.667	17.334	56.834	98.835
Soln Std	ref	3	24	STD-33	18.7	9.62	82.1	48.1	18.700	9.620	82.100	48.100

Figure B1. Laboratory PCT Measurements in Analytical Sequence for Study Glasses with and without Other Results from the Analytical Plans

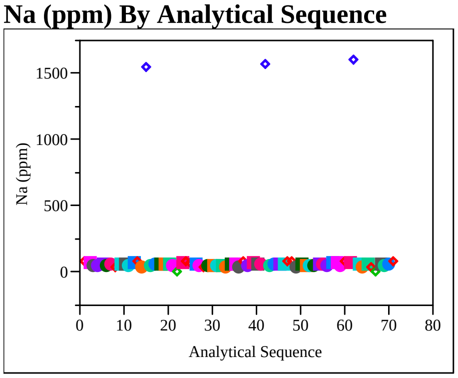
B (ppm) By Analytical Sequence



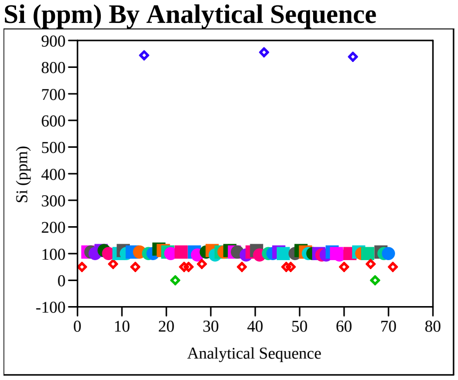
Li (ppm) By Analytical Sequence



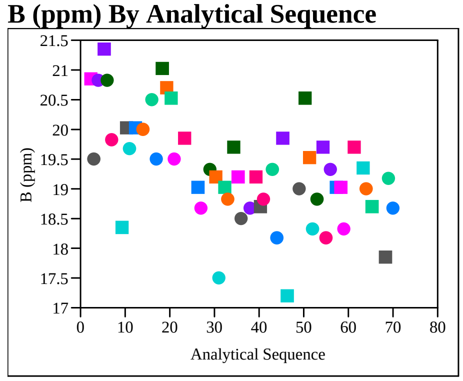
Na (ppm) By Analytical Sequence



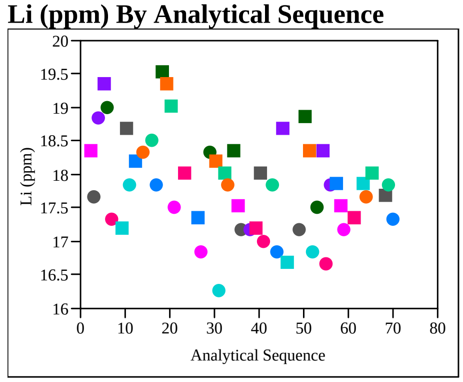
Si (ppm) By Analytical Sequence



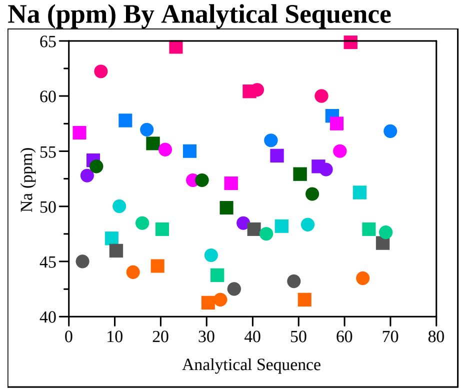
B (ppm) By Analytical Sequence



Li (ppm) By Analytical Sequence



Na (ppm) By Analytical Sequence



Si (ppm) By Analytical Sequence

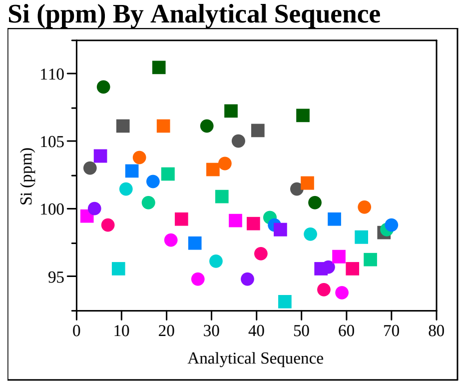
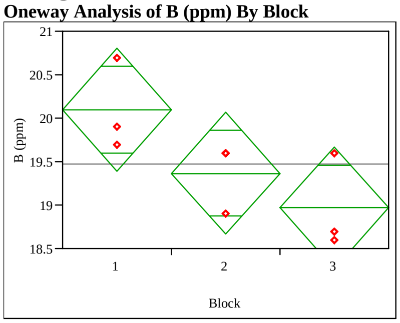


Figure B2. Measurements of the Multi-Element Solution Standard by ICP Block

Oneway Analysis of B (ppm) By Block



Oneway Anova
Summary of Fit

Rsquare	0.570332
Adj Rsquare	0.42711
Root Mean Square Error	0.498888
Mean of Response	19.47778
Observations (or Sum Wgts)	9

Analysis of Variance

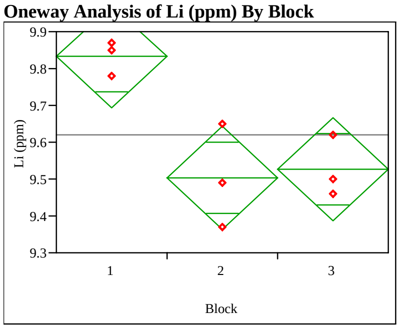
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	1.9822222	0.991111	3.9821	0.0793
Error	6	1.4933333	0.248889		
C. Total	8	3.4755556			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	20.1000	0.28803	19.395	20.805
2	3	19.3667	0.28803	18.662	20.071
3	3	18.9667	0.28803	18.262	19.671

Std Error uses a pooled estimate of error variance

Oneway Analysis of Li (ppm) By Block



Oneway Anova
Summary of Fit

Rsquare	0.778789
Adj Rsquare	0.705052
Root Mean Square Error	0.09815
Mean of Response	9.621111
Observations (or Sum Wgts)	9

Analysis of Variance

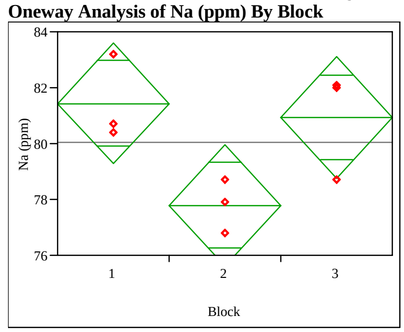
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	0.20348889	0.101744	10.5617	0.0108
Error	6	0.05780000	0.009633		
C. Total	8	0.26128889			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	9.83333	0.05667	9.6947	9.9720
2	3	9.50333	0.05667	9.3647	9.6420
3	3	9.52667	0.05667	9.3880	9.6653

Std Error uses a pooled estimate of error variance

Oneway Analysis of Na (ppm) By Block



Oneway Anova
Summary of Fit

Rsquare	0.623794
Adj Rsquare	0.498392
Root Mean Square Error	1.529343
Mean of Response	80.05556
Observations (or Sum Wgts)	9

Analysis of Variance

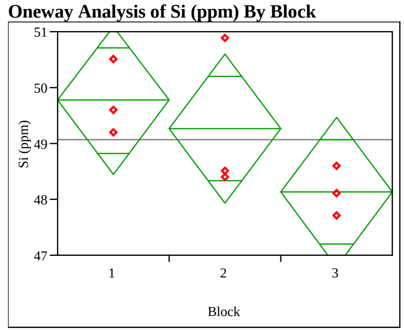
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	23.268889	11.6344	4.9743	0.0532
Error	6	14.033333	2.3389		
C. Total	8	37.302222			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	81.4333	0.88297	79.273	83.594
2	3	77.8000	0.88297	75.639	79.961
3	3	80.9333	0.88297	78.773	83.094

Std Error uses a pooled estimate of error variance

Oneway Analysis of Si (ppm) By Block



Oneway Anova
Summary of Fit

Rsquare	0.442236
Adj Rsquare	0.256314
Root Mean Square Error	0.939858
Mean of Response	49.05556
Observations (or Sum Wgts)	9

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Block	2	4.2022222	2.10111	2.3786	0.1735
Error	6	5.3000000	0.88333		
C. Total	8	9.5022222			

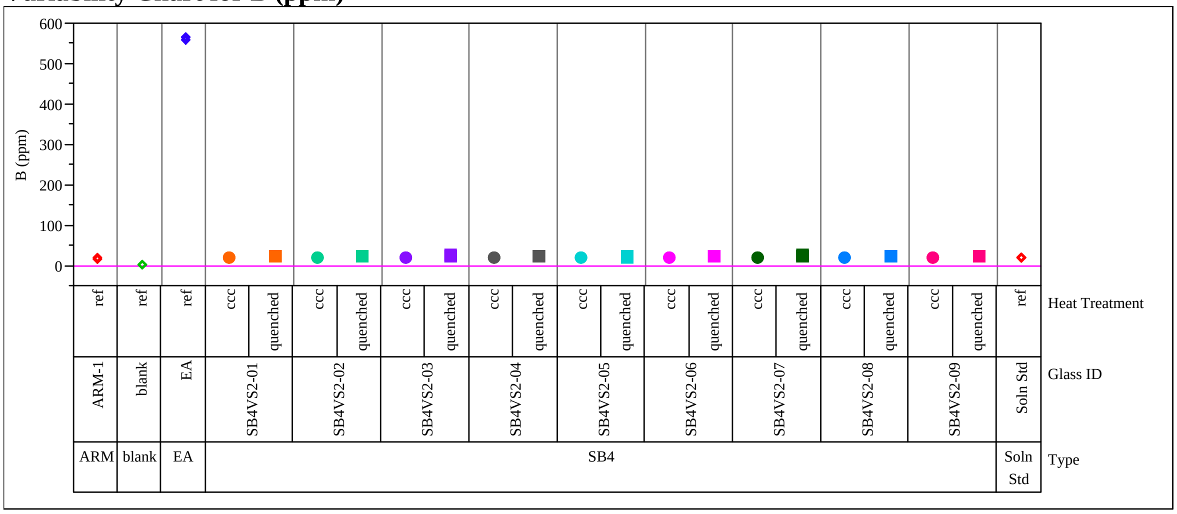
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1	3	49.7667	0.54263	48.439	51.094
2	3	49.2667	0.54263	47.939	50.594
3	3	48.1333	0.54263	46.806	49.461

Std Error uses a pooled estimate of error variance

Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Variability Chart for B (ppm)



Variability Chart for Li (ppm)

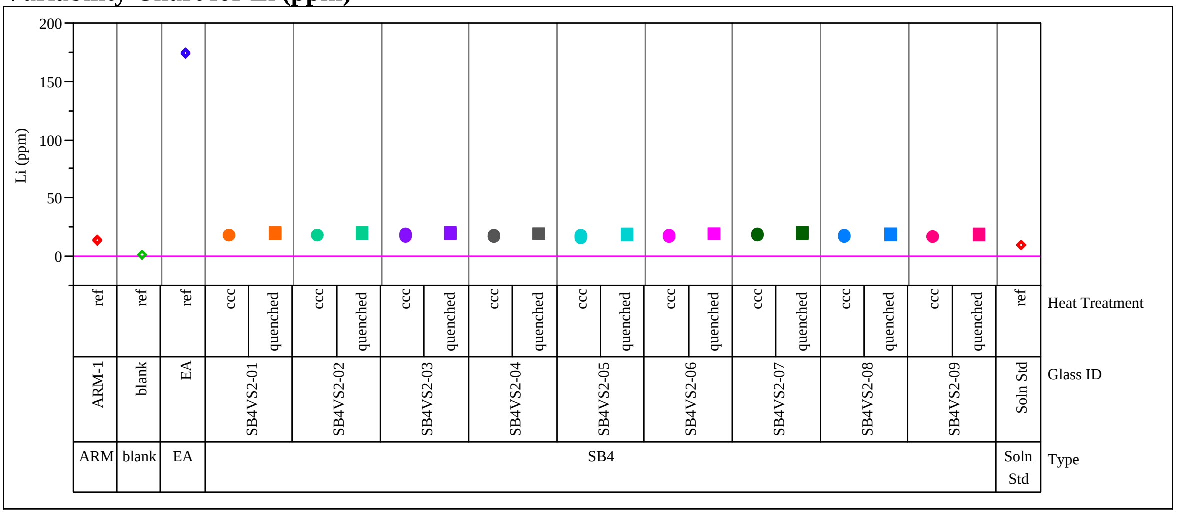
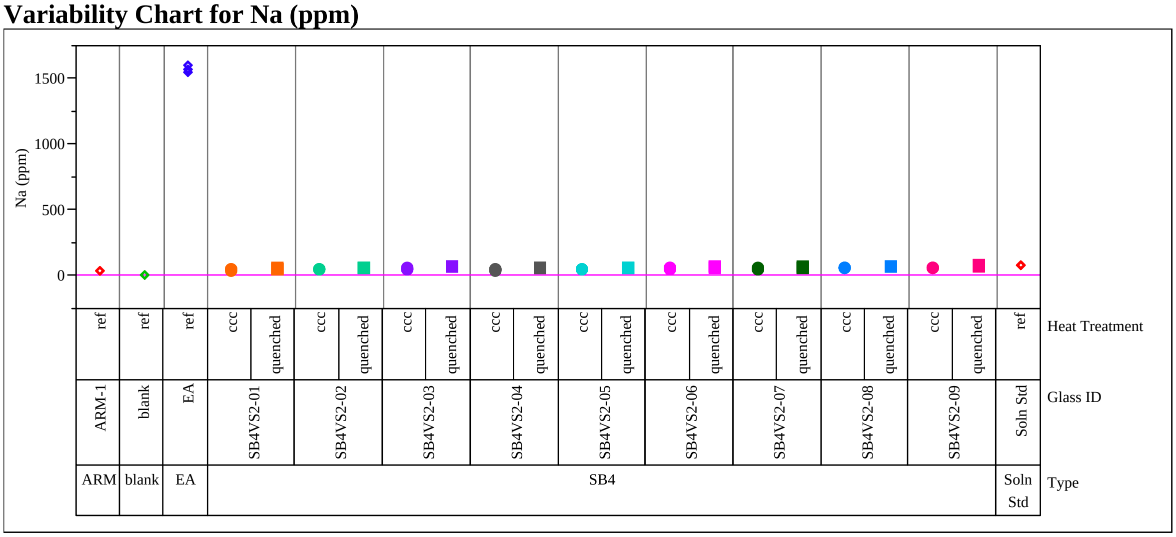


Figure B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards



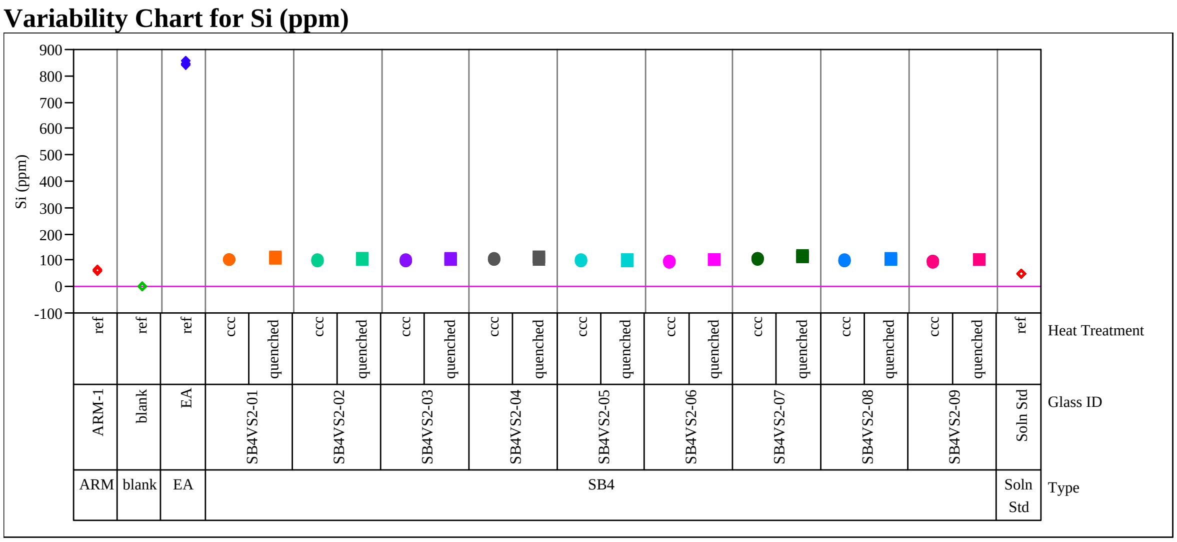
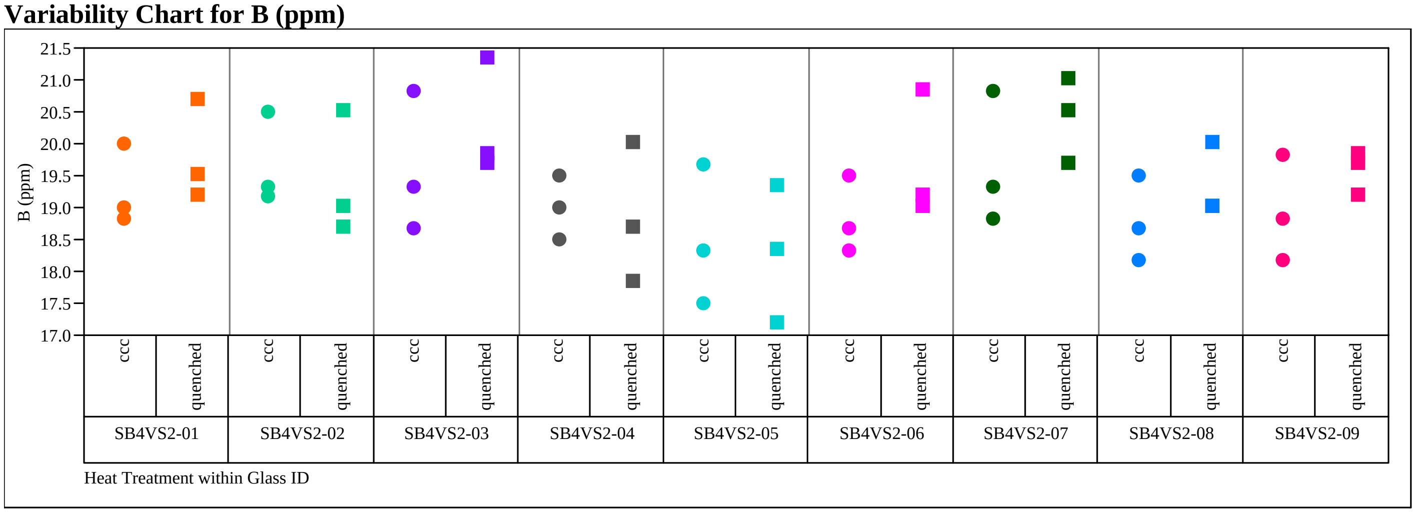


Figure B4. Laboratory PCT Measurements by Glass Identifier for Study Glasses



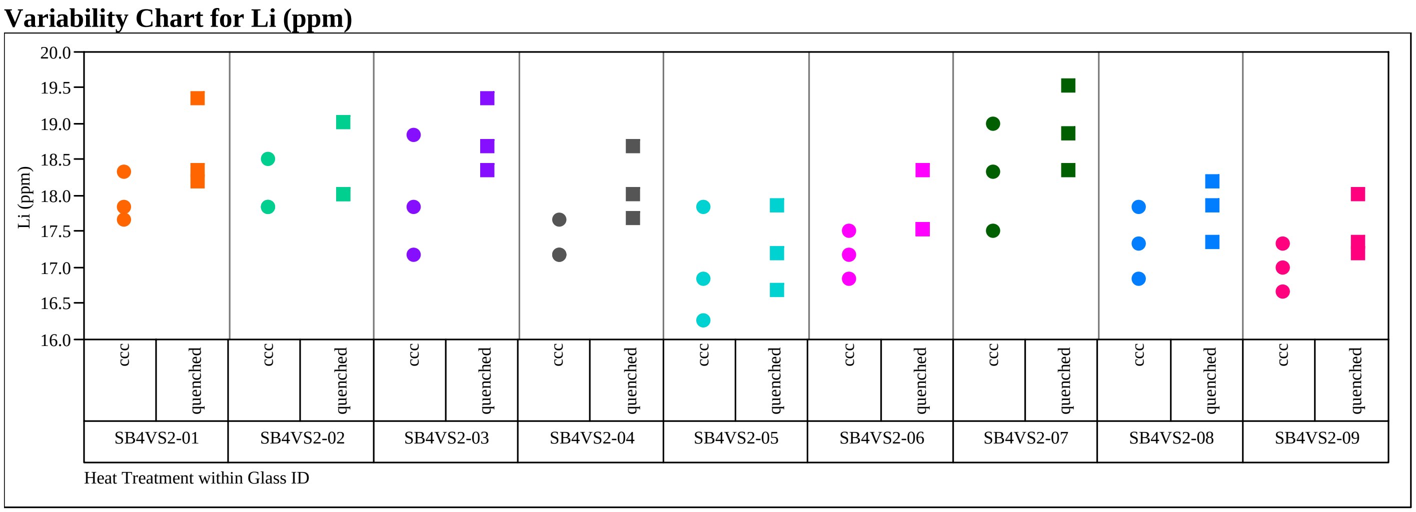
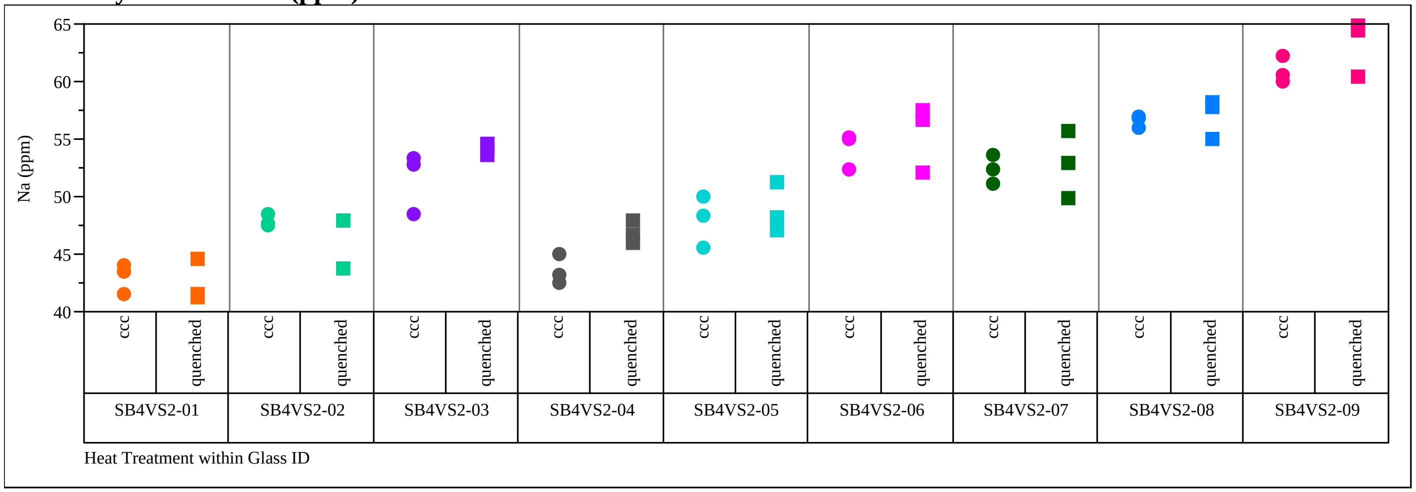


Figure B4. Laboratory PCT Measurements by Glass Identifier for Study Glasses

Variability Chart for Na (ppm)



Variability Chart for Si (ppm)

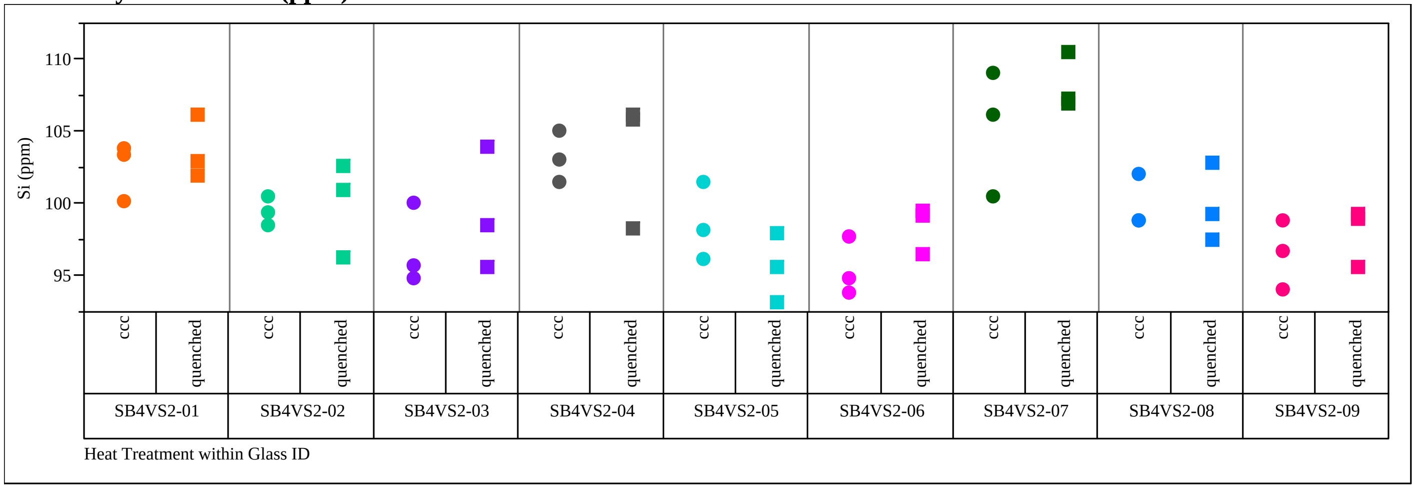
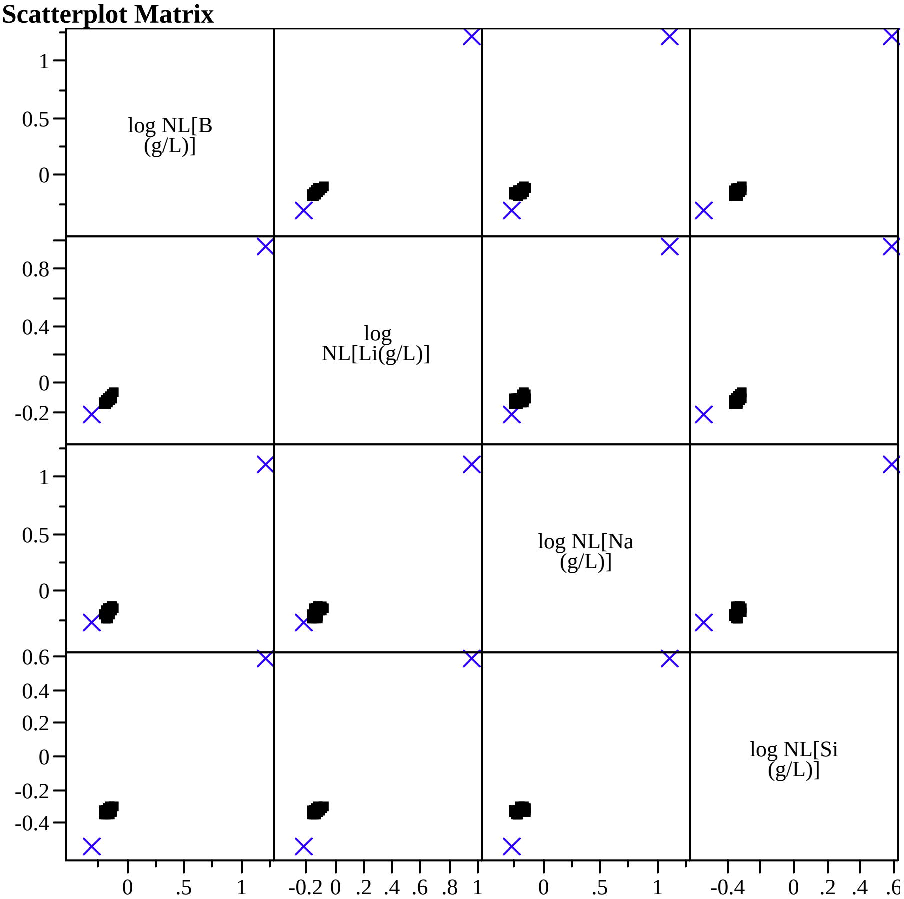


Figure B5. Correlations and Scatter Plots of Normalized PCTs Over All Compositional Views and Heat Treatments

Correlations

	log NL[B (g/L)]	log NL[Li(g/L)]	log NL[Na (g/L)]	log NL[Si (g/L)]
log NL[B (g/L)]	1.0000	0.9984	0.9919	0.9882
log NL[Li(g/L)]	0.9984	1.0000	0.9891	0.9857
log NL[Na (g/L)]	0.9919	0.9891	1.0000	0.9749
log NL[Si (g/L)]	0.9882	0.9857	0.9749	1.0000

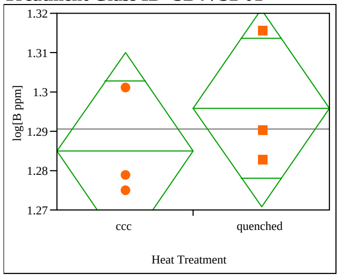
Scatterplot Matrix



EA and ARM are both represented by "X."

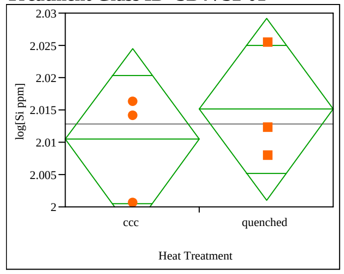
Figure B6. Effects of Heat Treatment on PCT log(ppm)-Response of Study Glasses

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-01



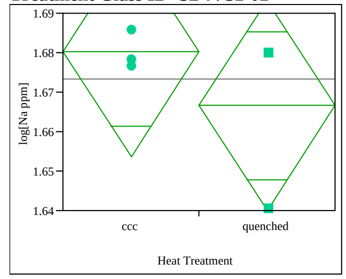
Difference	0.01105	t Ratio	0.862038
Std Err Dif	0.01281	DF	4
Upper CL Dif	0.04663	Prob > |t|	0.4373
Lower CL Dif	-0.02453	Prob > t	0.2186
Confidence	0.95	Prob < t	0.7814

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-01



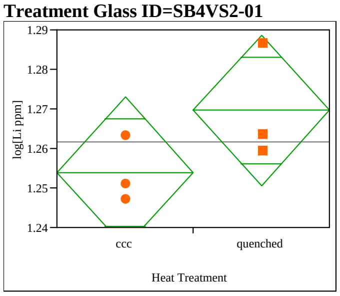
Difference	0.00468	t Ratio	0.652095
Std Err Dif	0.00717	DF	4
Upper CL Dif	0.02459	Prob > |t|	0.5499
Lower CL Dif	-0.01523	Prob > t	0.2750
Confidence	0.95	Prob < t	0.7250

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-02



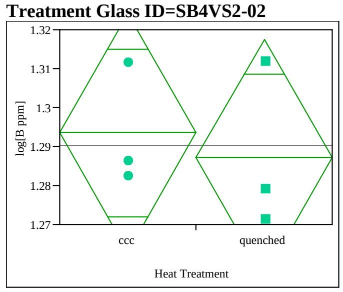
Difference	-0.01368	t Ratio	-1.0143
Std Err Dif	0.01349	DF	4
Upper CL Dif	0.02377	Prob > |t|	0.3678
Lower CL Dif	-0.05112	Prob > t	0.8161
Confidence	0.95	Prob < t	0.1839

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-01



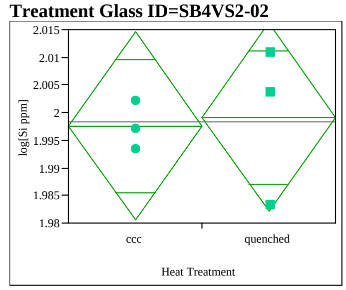
Difference	0.01573	t Ratio	1.61969
Std Err Dif	0.00971	DF	4
Upper CL Dif	0.04270	Prob > |t|	0.1806
Lower CL Dif	-0.01124	Prob > t	0.0903
Confidence	0.95	Prob < t	0.9097

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-02



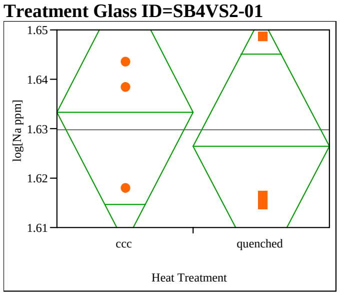
Difference	-0.00634	t Ratio	-0.4096
Std Err Dif	0.01549	DF	4
Upper CL Dif	0.03666	Prob > |t|	0.7031
Lower CL Dif	-0.04935	Prob > t	0.6485
Confidence	0.95	Prob < t	0.3515

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-02



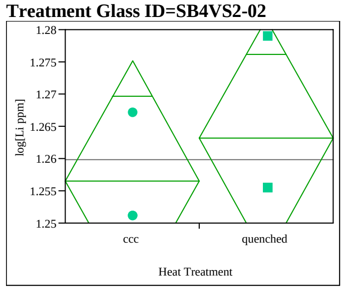
Difference	0.00155	t Ratio	0.178733
Std Err Dif	0.00868	DF	4
Upper CL Dif	0.02566	Prob > |t|	0.8668
Lower CL Dif	-0.02255	Prob > t	0.4334
Confidence	0.95	Prob < t	0.5666

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-01



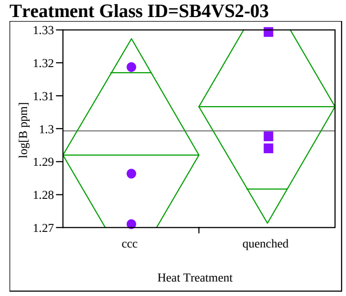
Difference	-0.00693	t Ratio	-0.51462
Std Err Dif	0.01346	DF	4
Upper CL Dif	0.03045	Prob > |t|	0.6339
Lower CL Dif	-0.04431	Prob > t	0.6830
Confidence	0.95	Prob < t	0.3170

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-02



Difference	0.00655	t Ratio	0.692808
Std Err Dif	0.00946	DF	4
Upper CL Dif	0.03282	Prob > |t|	0.5266
Lower CL Dif	-0.01971	Prob > t	0.2633
Confidence	0.95	Prob < t	0.7367

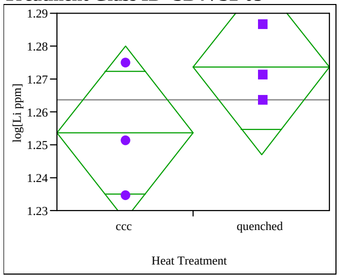
Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-03



Difference	0.01468	t Ratio	0.816358
Std Err Dif	0.01799	DF	4
Upper CL Dif	0.06463	Prob > |t|	0.4601
Lower CL Dif	-0.03526	Prob > t	0.2301
Confidence	0.95	Prob < t	0.7699

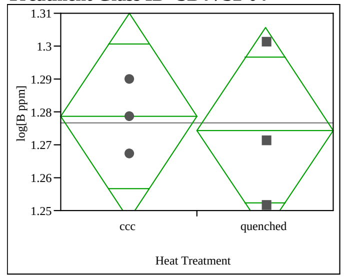
Figure B6. Effects of Heat Treatment on PCT log(ppm)-Response of Study Glasses

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-03



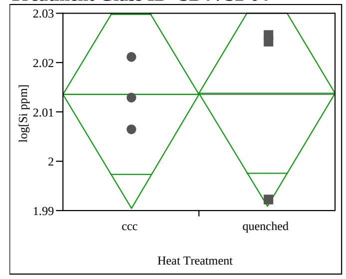
Difference	0.01992	t Ratio	1.475878
Std Err Dif	0.01350	DF	4
Upper CL Dif	0.05740	Prob > |t|	0.2140
Lower CL Dif	-0.01756	Prob > t	0.1070
Confidence	0.95	Prob < t	0.8930

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-04



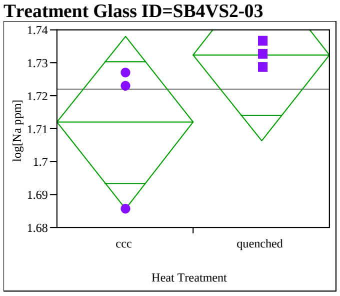
Difference	-0.00421	t Ratio	-0.26466
Std Err Dif	0.01591	DF	4
Upper CL Dif	0.03996	Prob > |t|	0.8043
Lower CL Dif	-0.04838	Prob > t	0.5978
Confidence	0.95	Prob < t	0.4022

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-04



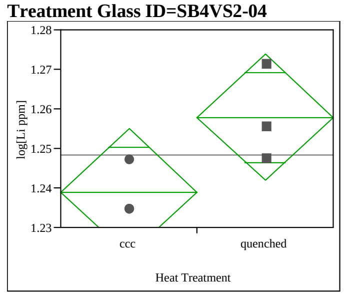
Difference	0.00024	t Ratio	0.020385
Std Err Dif	0.01170	DF	4
Upper CL Dif	0.03272	Prob > |t|	0.9847
Lower CL Dif	-0.03224	Prob > t	0.4924
Confidence	0.95	Prob < t	0.5076

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-03



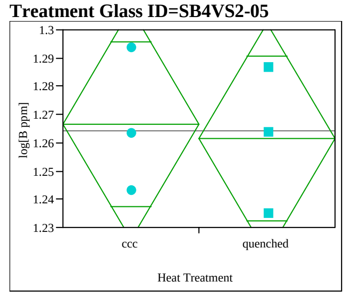
Difference	0.02050	t Ratio	1.538054
Std Err Dif	0.01333	DF	4
Upper CL Dif	0.05750	Prob > |t|	0.1989
Lower CL Dif	-0.01650	Prob > t	0.0994
Confidence	0.95	Prob < t	0.9006

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-04



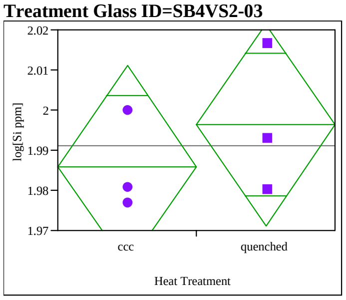
Difference	0.01899	t Ratio	2.32754
Std Err Dif	0.00816	DF	4
Upper CL Dif	0.04164	Prob > |t|	0.0805
Lower CL Dif	-0.00366	Prob > t	0.0402
Confidence	0.95	Prob < t	0.9598

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-05



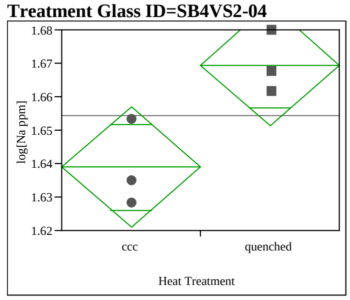
Difference	-0.00526	t Ratio	-0.2507
Std Err Dif	0.02098	DF	4
Upper CL Dif	0.05298	Prob > |t|	0.8144
Lower CL Dif	-0.06350	Prob > t	0.5928
Confidence	0.95	Prob < t	0.4072

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-03



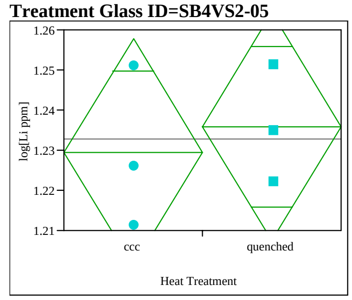
Difference	0.01044	t Ratio	0.814741
Std Err Dif	0.01281	DF	4
Upper CL Dif	0.04602	Prob > |t|	0.4609
Lower CL Dif	-0.02514	Prob > t	0.2305
Confidence	0.95	Prob < t	0.7695

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-04



Difference	0.030538	t Ratio	3.320655
Std Err Dif	0.009196	DF	4
Upper CL Dif	0.056072	Prob > |t|	0.0294
Lower CL Dif	0.005005	Prob > t	0.0147
Confidence	0.95	Prob < t	0.9853

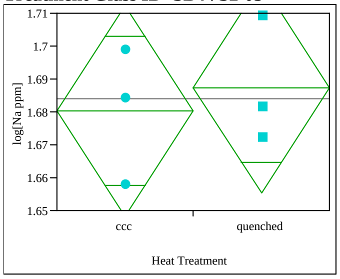
Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-05



Difference	0.00636	t Ratio	0.440546
Std Err Dif	0.01443	DF	4
Upper CL Dif	0.04641	Prob > |t|	0.6823
Lower CL Dif	-0.03370	Prob > t	0.3412
Confidence	0.95	Prob < t	0.6588

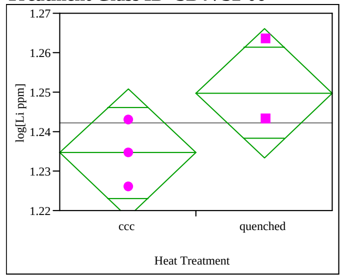
Figure B6. Effects of Heat Treatment on PCT log(ppm)-Response of Study Glasses

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-05



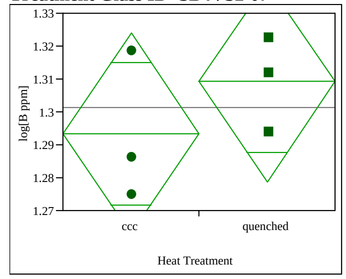
Difference	0.00703	t Ratio	0.4308
Std Err Dif	0.01632	DF	4
Upper CL Dif	0.05236	Prob > |t|	0.6888
Lower CL Dif	-0.03829	Prob > t	0.3444
Confidence	0.95	Prob < t	0.6556

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-06



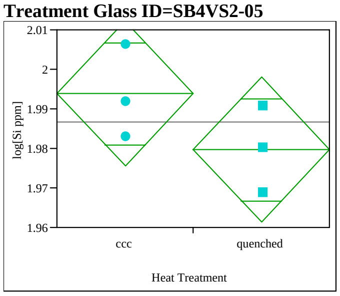
Difference	0.01514	t Ratio	1.821929
Std Err Dif	0.00831	DF	4
Upper CL Dif	0.03821	Prob > |t|	0.1426
Lower CL Dif	-0.00793	Prob > t	0.0713
Confidence	0.95	Prob < t	0.9287

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-07



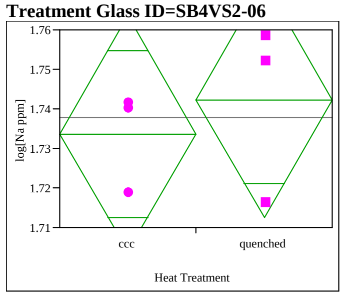
Difference	0.01590	t Ratio	1.023061
Std Err Dif	0.01555	DF	4
Upper CL Dif	0.05906	Prob > |t|	0.3641
Lower CL Dif	-0.02726	Prob > t	0.1821
Confidence	0.95	Prob < t	0.8179

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-05



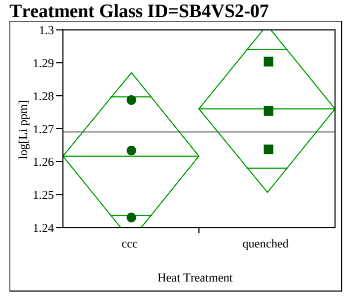
Difference	-0.01416	t Ratio	-1.51791
Std Err Dif	0.00933	DF	4
Upper CL Dif	0.01174	Prob > |t|	0.2036
Lower CL Dif	-0.04006	Prob > t	0.8982
Confidence	0.95	Prob < t	0.1018

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-06



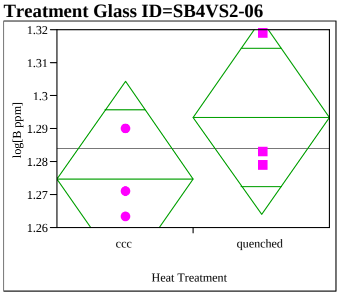
Difference	0.00855	t Ratio	0.564277
Std Err Dif	0.01515	DF	4
Upper CL Dif	0.05060	Prob > |t|	0.6027
Lower CL Dif	-0.03351	Prob > t	0.3014
Confidence	0.95	Prob < t	0.6986

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-07



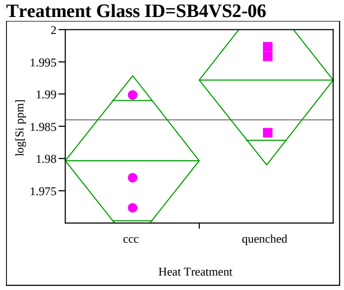
Difference	0.01439	t Ratio	1.113337
Std Err Dif	0.01293	DF	4
Upper CL Dif	0.05028	Prob > |t|	0.3280
Lower CL Dif	-0.02150	Prob > t	0.1640
Confidence	0.95	Prob < t	0.8360

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-06



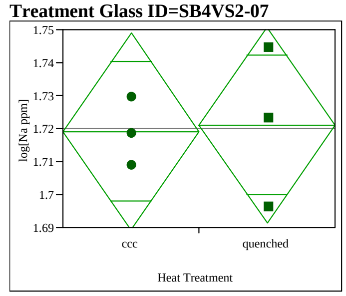
Difference	0.01857	t Ratio	1.235848
Std Err Dif	0.01503	DF	4
Upper CL Dif	0.06030	Prob > |t|	0.2841
Lower CL Dif	-0.02315	Prob > t	0.1421
Confidence	0.95	Prob < t	0.8579

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-06



Difference	0.01248	t Ratio	1.863764
Std Err Dif	0.00670	DF	4
Upper CL Dif	0.03107	Prob > |t|	0.1358
Lower CL Dif	-0.00611	Prob > t	0.0679
Confidence	0.95	Prob < t	0.9321

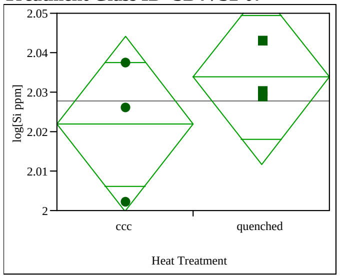
Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-07



Difference	0.00193	t Ratio	0.127262
Std Err Dif	0.01518	DF	4
Upper CL Dif	0.04408	Prob > |t|	0.9049
Lower CL Dif	-0.04022	Prob > t	0.4524
Confidence	0.95	Prob < t	0.5476

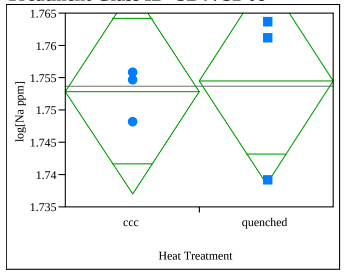
Figure B6. Effects of Heat Treatment on PCT log(ppm)-Response of Study Glasses

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-07



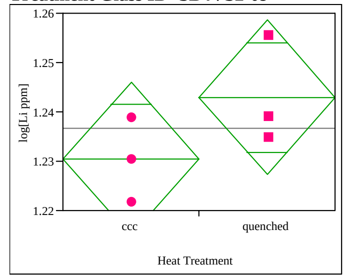
Difference	0.01196	t Ratio	1.058549
Std Err Dif	0.01130	DF	4
Upper CL Dif	0.04334	Prob > |t|	0.3495
Lower CL Dif	-0.01942	Prob > t	0.1747
Confidence	0.95	Prob < t	0.8253

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-08



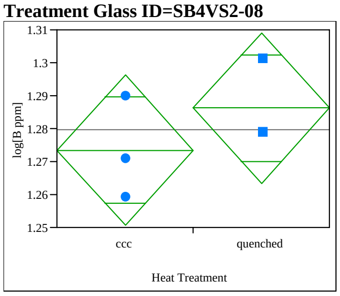
Difference	0.00158	t Ratio	0.194675
Std Err Dif	0.00810	DF	4
Upper CL Dif	0.02407	Prob > |t|	0.8551
Lower CL Dif	-0.02092	Prob > t	0.4276
Confidence	0.95	Prob < t	0.5724

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-09



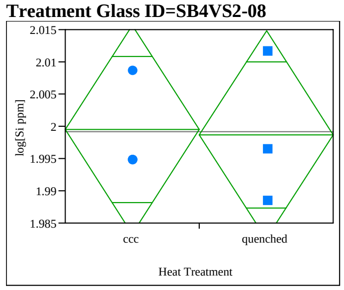
Difference	0.01255	t Ratio	1.573801
Std Err Dif	0.00798	DF	4
Upper CL Dif	0.03470	Prob > |t|	0.1906
Lower CL Dif	-0.00959	Prob > t	0.0953
Confidence	0.95	Prob < t	0.9047

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-08



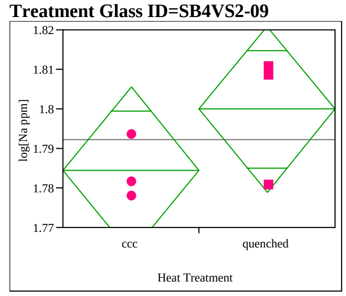
Difference	0.01272	t Ratio	1.093109
Std Err Dif	0.01164	DF	4
Upper CL Dif	0.04503	Prob > |t|	0.3358
Lower CL Dif	-0.01959	Prob > t	0.1679
Confidence	0.95	Prob < t	0.8321

Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-08



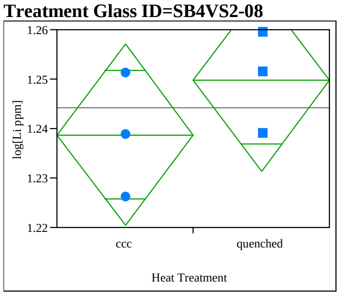
Difference	-0.00078	t Ratio	-0.09577
Std Err Dif	0.00818	DF	4
Upper CL Dif	0.02193	Prob > |t|	0.9283
Lower CL Dif	-0.02350	Prob > t	0.5358
Confidence	0.95	Prob < t	0.4642

Oneway Analysis of log[Na ppm] By Heat Treatment Glass ID=SB4VS2-09



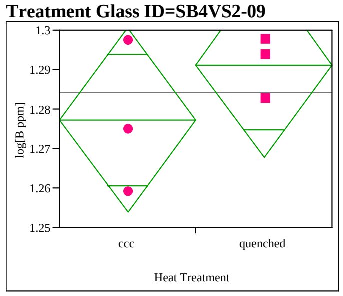
Difference	0.01540	t Ratio	1.433141
Std Err Dif	0.01075	DF	4
Upper CL Dif	0.04524	Prob > |t|	0.2251
Lower CL Dif	-0.01444	Prob > t	0.1126
Confidence	0.95	Prob < t	0.8874

Oneway Analysis of log[Li ppm] By Heat Treatment Glass ID=SB4VS2-08



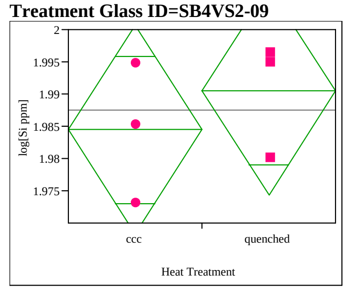
Difference	0.01104	t Ratio	1.179564
Std Err Dif	0.00936	DF	4
Upper CL Dif	0.03701	Prob > |t|	0.3035
Lower CL Dif	-0.01494	Prob > t	0.1518
Confidence	0.95	Prob < t	0.8482

Oneway Analysis of log[B ppm] By Heat Treatment Glass ID=SB4VS2-09



Difference	0.01402	t Ratio	1.17557
Std Err Dif	0.01193	DF	4
Upper CL Dif	0.04715	Prob > |t|	0.3050
Lower CL Dif	-0.01910	Prob > t	0.1525
Confidence	0.95	Prob < t	0.8475

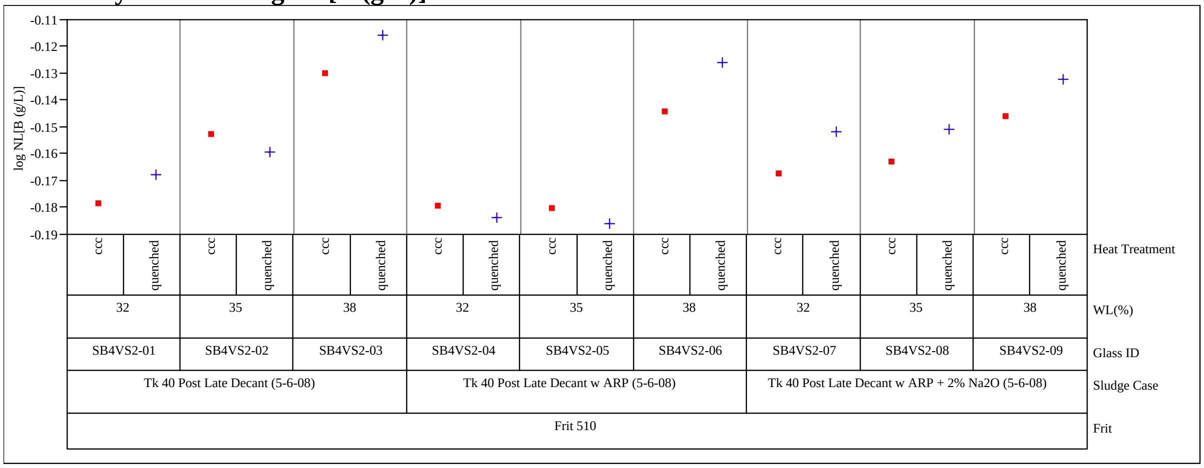
Oneway Analysis of log[Si ppm] By Heat Treatment Glass ID=SB4VS2-09



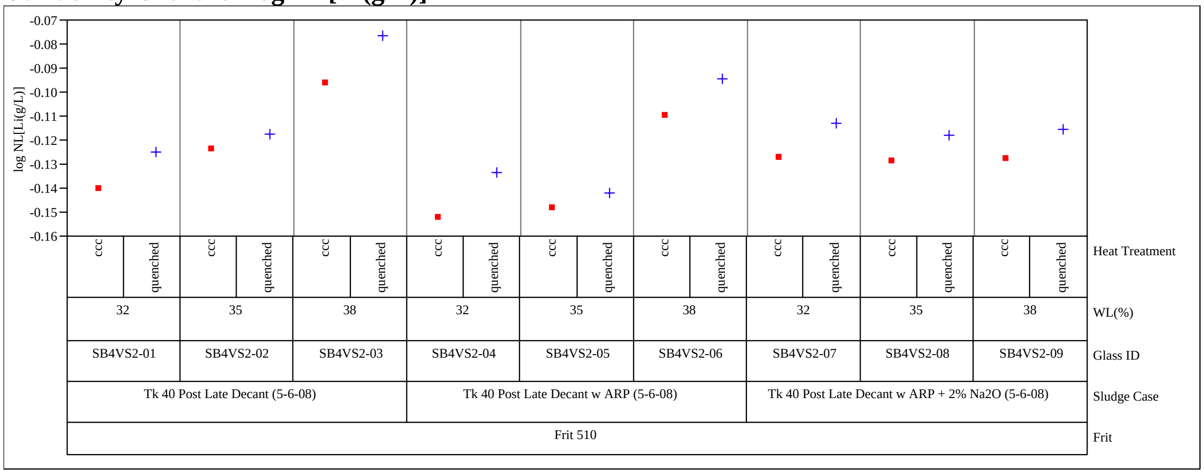
Difference	0.00599	t Ratio	0.731473
Std Err Dif	0.00819	DF	4
Upper CL Dif	0.02872	Prob > |t|	0.5050
Lower CL Dif	-0.01674	Prob > t	0.2525
Confidence	0.95	Prob < t	0.7475

Figure B7. Effects of Heat Treatment for Study Glasses by Compositional View

Comp View=measured
Variability Chart for log NL[B (g/L)]



Comp View=measured
Variability Chart for log NL[Li(g/L)]



Comp View=measured
Variability Chart for log NL[Na (g/L)]

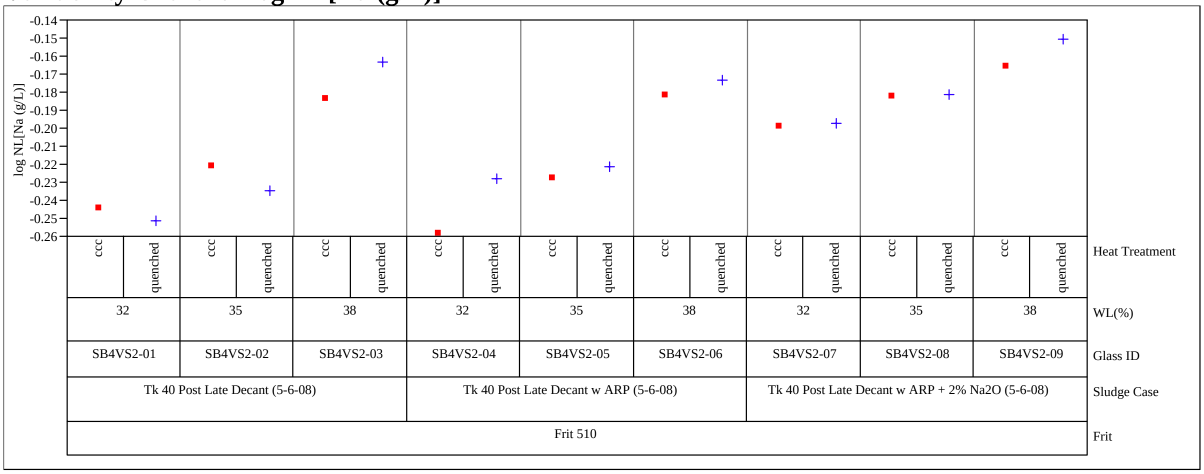
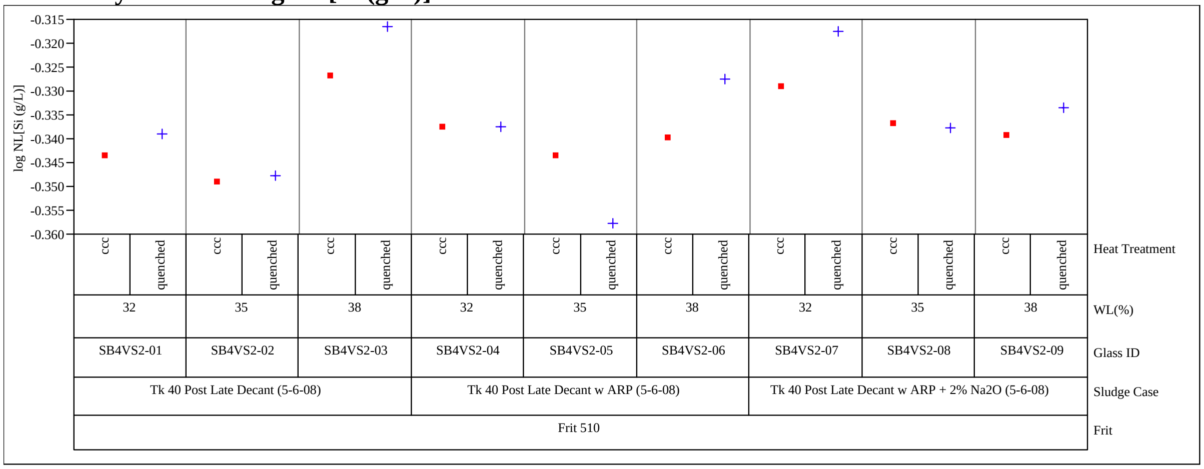
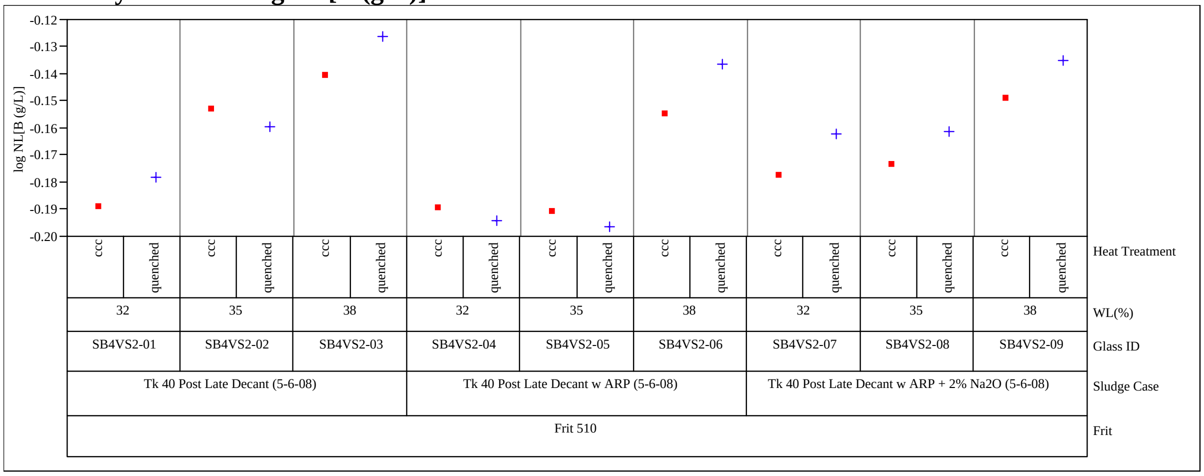


Figure B7. Effects of Heat Treatment for Study Glasses by Compositional View

Comp View=measured
Variability Chart for log NL[Si (g/L)]



Comp View=measured bc
Variability Chart for log NL[B (g/L)]



Comp View=measured bc
Variability Chart for log NL[Li(g/L)]

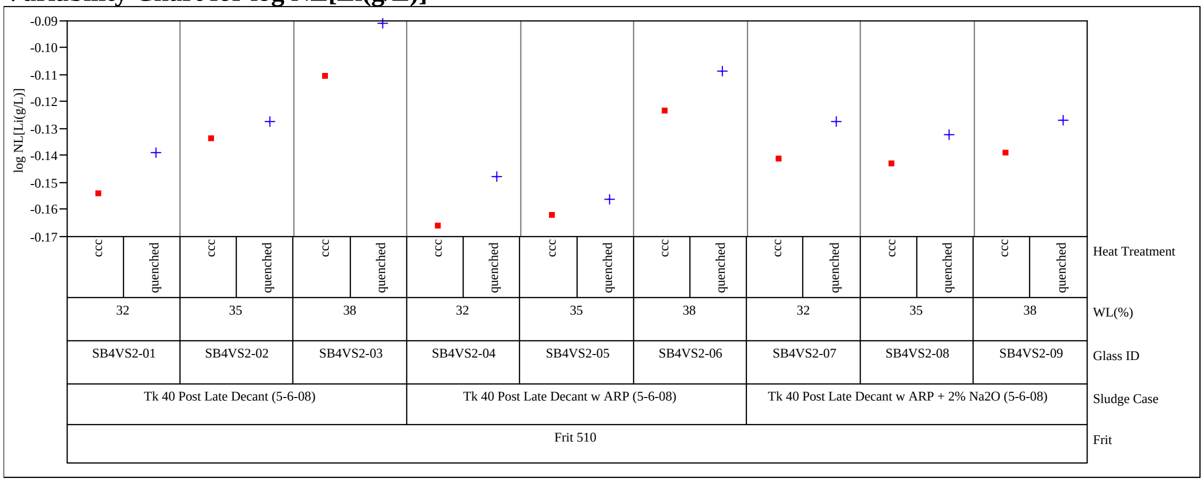
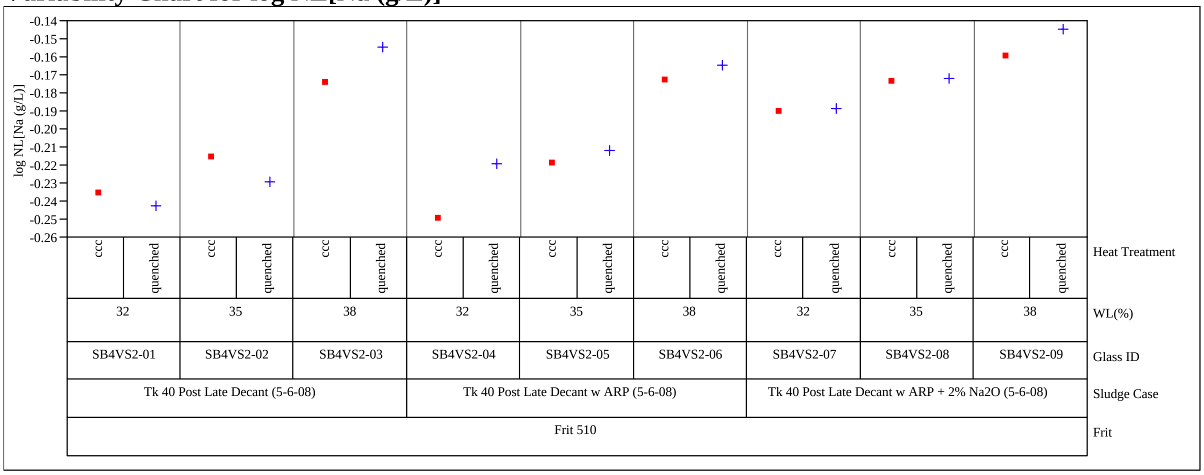
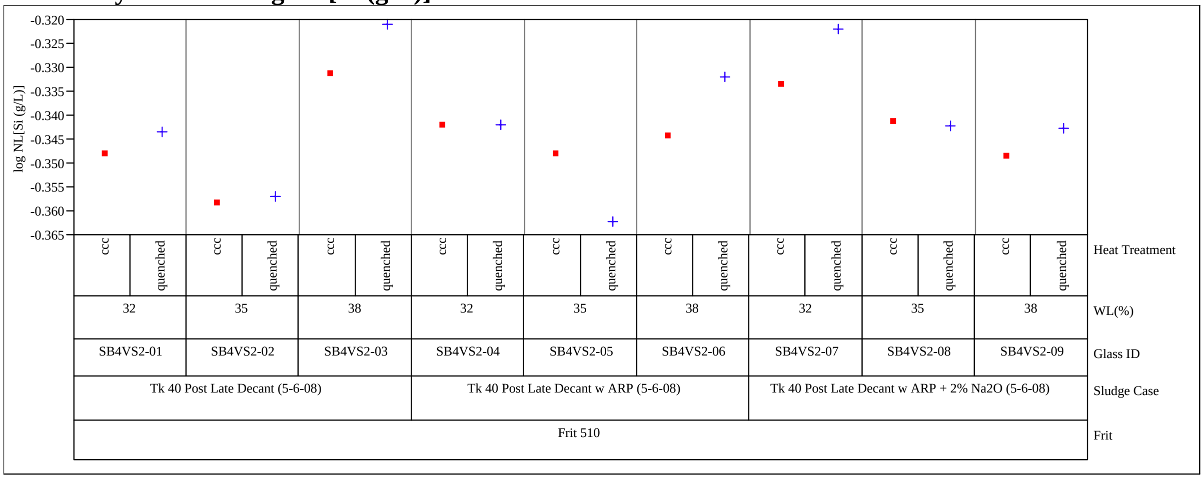


Figure B7. Effects of Heat Treatment for Study Glasses by Compositional View

Comp View=measured bc
Variability Chart for log NL[Na (g/L)]



Comp View=measured bc
Variability Chart for log NL[Si (g/L)]



Comp View=targeted
Variability Chart for log NL[B (g/L)]

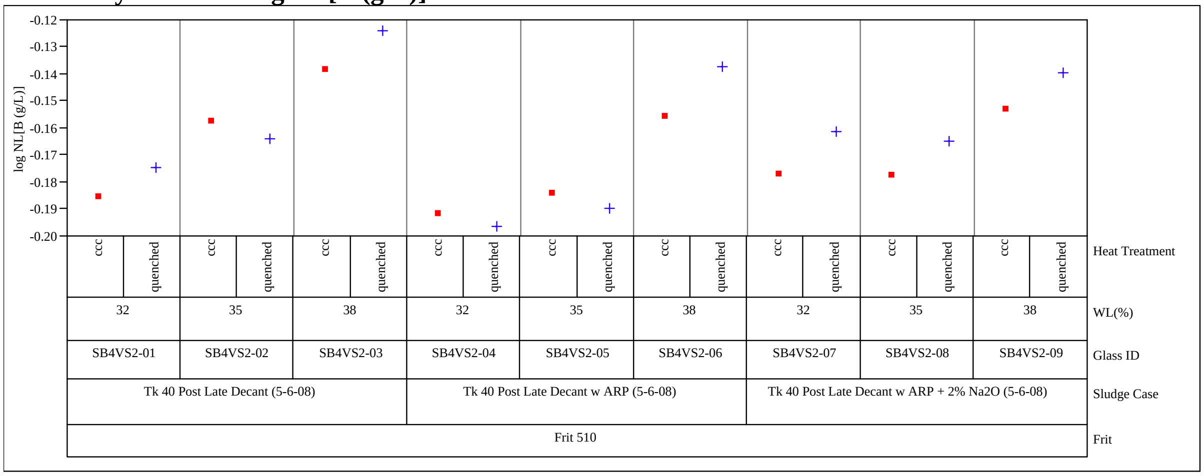
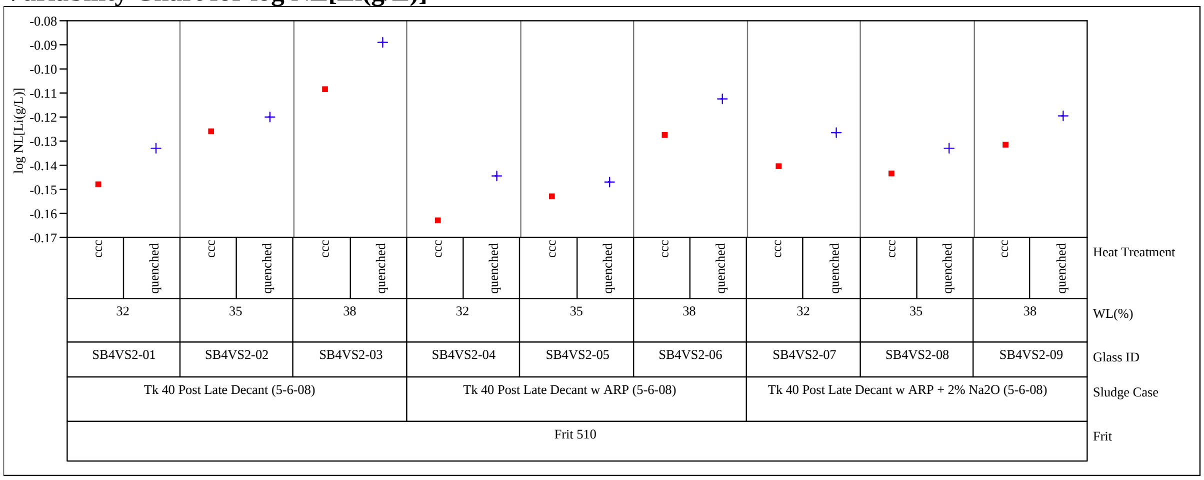
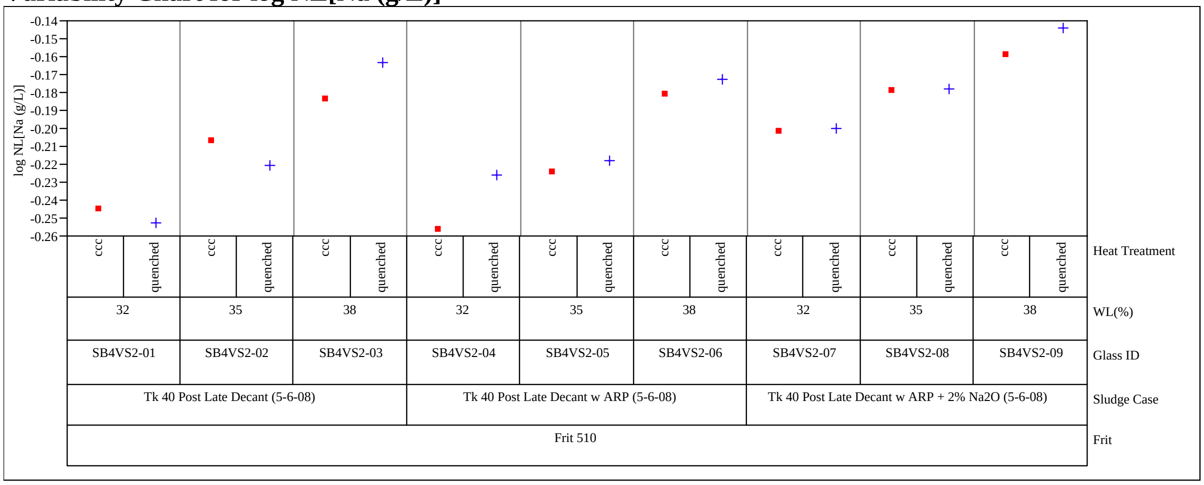


Figure B7. Effects of Heat Treatment for Study Glasses by Compositional View

Comp View=targeted
Variability Chart for log NL[Li(g/L)]



Comp View=targeted
Variability Chart for log NL[Na (g/L)]



Comp View=targeted
Variability Chart for log NL[Si (g/L)]

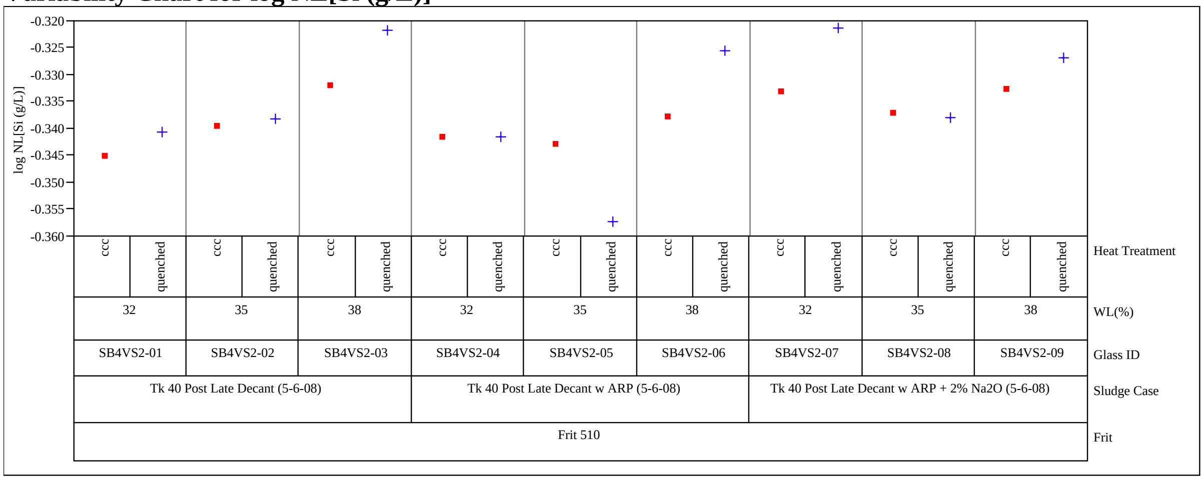
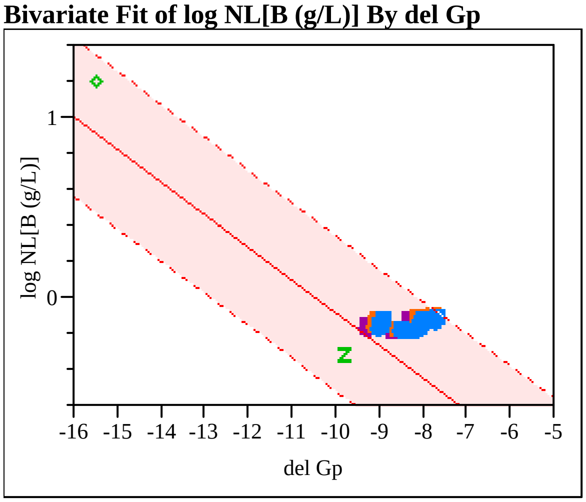


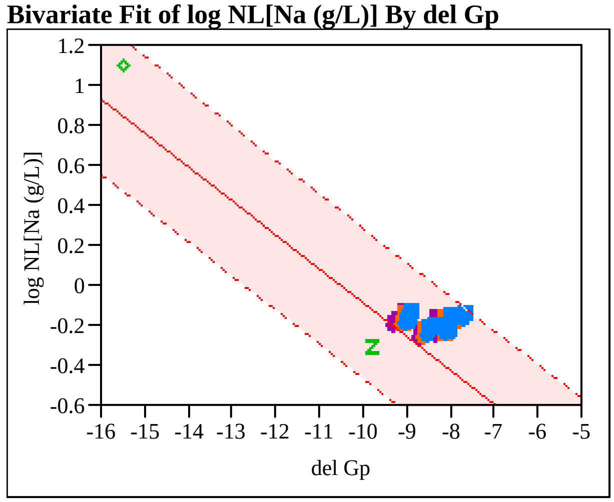
Exhibit B8. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for B, Li, Na, and Si Over All Compositional Views and Heat Treatments

Legend		Glass Standard or Heat Treatment-Compositional View
z	1	ARM
◇	2	EA
●	3	measured bc-ccc
■	4	measured bc-quenched
●	5	measured-ccc
■	6	measured-quenched
●	7	targeted-ccc
■	8	targeted-quenched

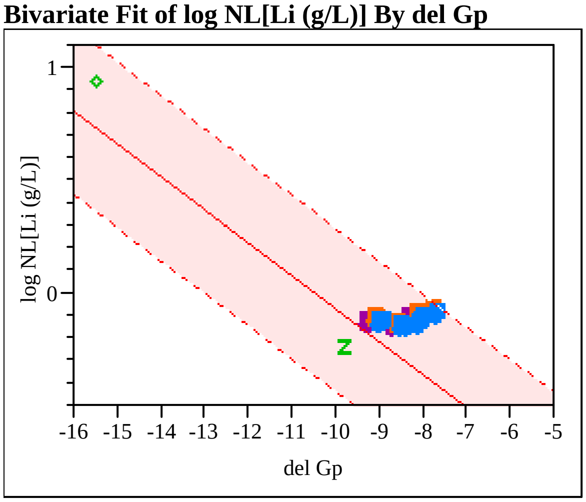
Bivariate Fit of log NL[B (g/L)] By del Gp



Bivariate Fit of log NL[Na (g/L)] By del Gp



Bivariate Fit of log NL[Li (g/L)] By del Gp



Bivariate Fit of log NL[Si (g/L)] By del Gp

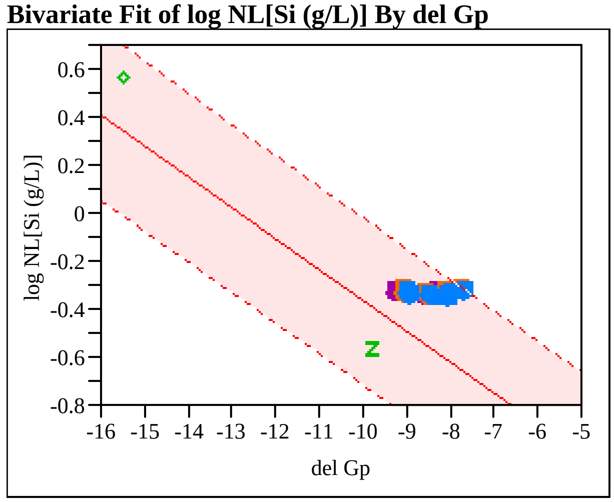
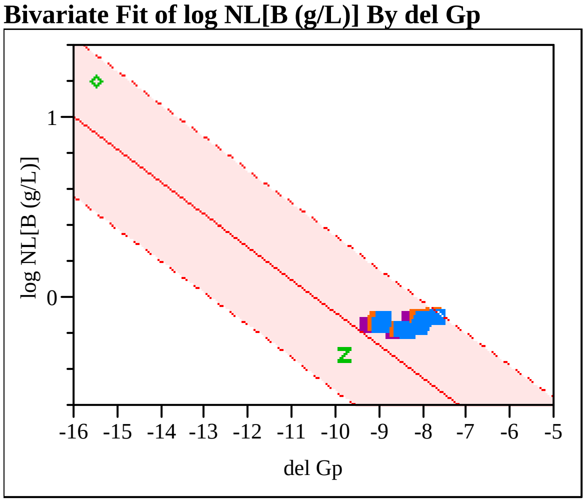


Exhibit B9. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for B, Li, Na, and Si Over All Compositional Views for Quenched Glasses

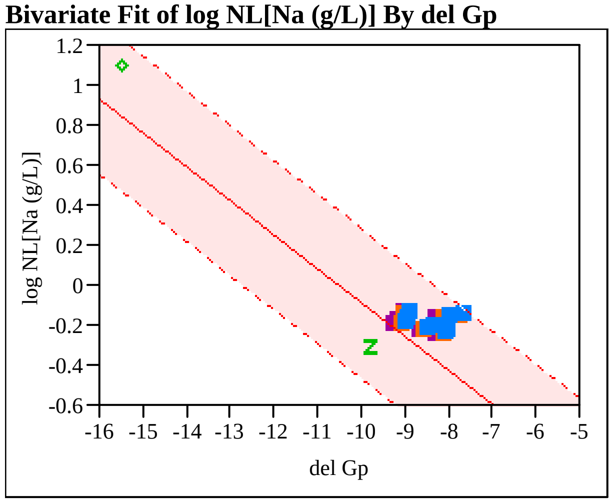
Legend

		Glass Standard or Heat Treatment-Compositional View
z	1	ARM
◇	2	EA
●	3	measured bc-ccc
■	4	measured bc-quenched
●	5	measured-ccc
■	6	measured-quenched
●	7	targeted-ccc
■	8	targeted-quenched

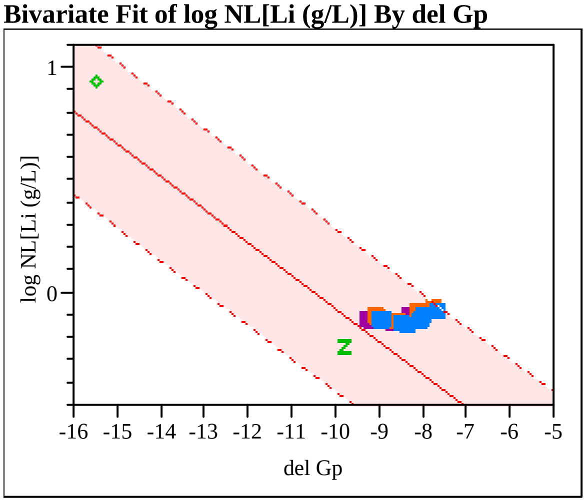
Bivariate Fit of log NL[B (g/L)] By del Gp



Bivariate Fit of log NL[Na (g/L)] By del Gp



Bivariate Fit of log NL[Li (g/L)] By del Gp



Bivariate Fit of log NL[Si (g/L)] By del Gp

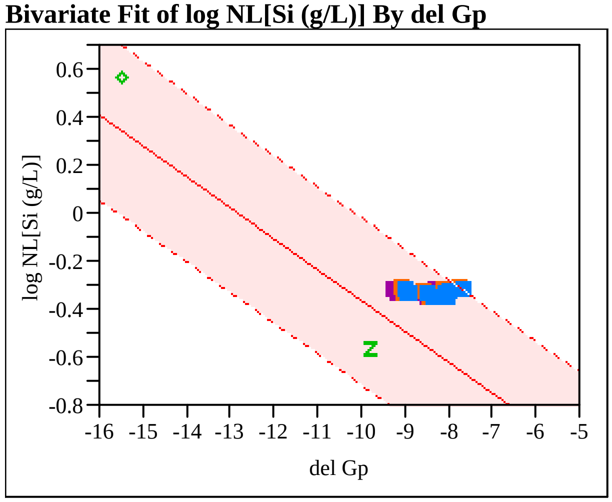
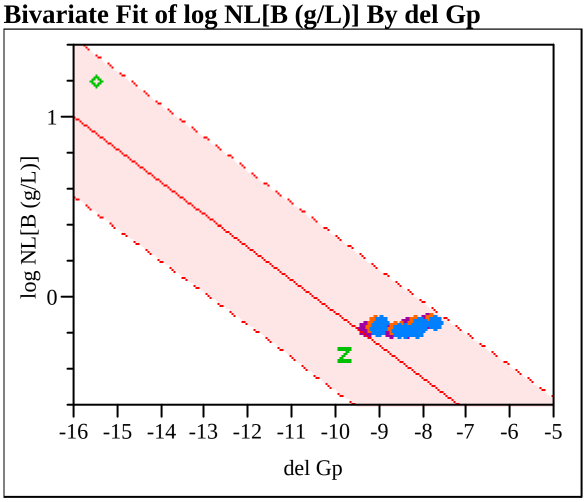


Exhibit B10. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for B, Li, Na, and Si Over All Compositional Views for ccc Glasses

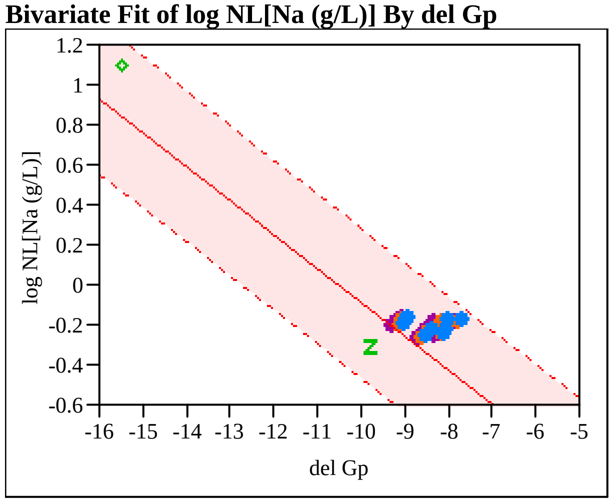
Legend

		Glass Standard or Heat Treatment-Compositional View
z	1	ARM
◇	2	EA
●	3	measured bc-ccc
■	4	measured bc-quenched
●	5	measured-ccc
■	6	measured-quenched
●	7	targeted-ccc
■	8	targeted-quenched

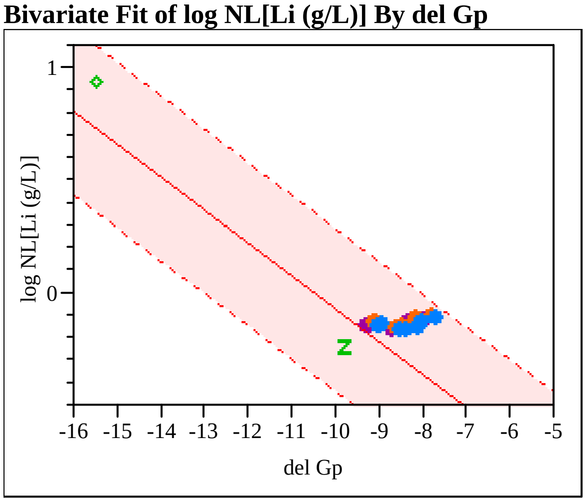
Bivariate Fit of log NL[B (g/L)] By del Gp



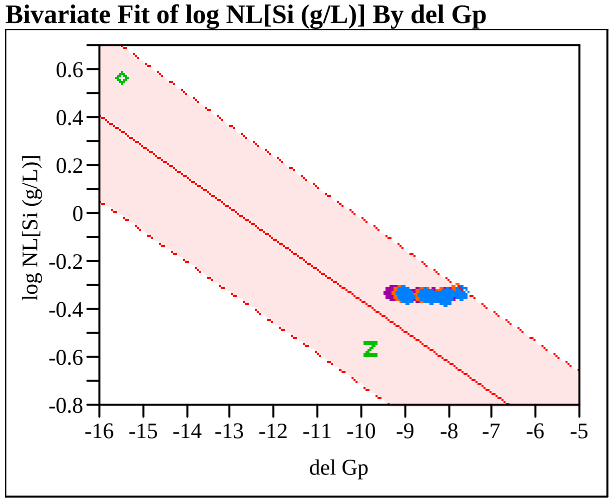
Bivariate Fit of log NL[Na (g/L)] By del Gp



Bivariate Fit of log NL[Li (g/L)] By del Gp



Bivariate Fit of log NL[Si (g/L)] By del Gp



Distribution:

C.J. Bannochie, 773-42A
A.B. Barnes, 999-W
D.R. Best, 786-1A
D.B. Burns, 786-5A
B.A. Davis, 704-27S
T.B. Edwards, 999-W
H.H. Elder, 766-H
T.L. Fellinger, 704-26S
K.M. Fox, 999-W
J.M. Gillam, 766-H
J.C. Griffin, 773-A
B.A. Hamm, 766-H
C.C. Herman, 999-W
J.F. Iaukea, 704-30S
J.E. Marra, 773-A
R.T. McNew, 704-27S
T.A. Nance, 773-42A
J.D. Newell, 999-W
J.E. Occhipinti, 704-S
D.K. Peeler, 999-W
F.C. Raszewski, 999-W
J.W. Ray, 704-S
I.A. Reamer, 999-1W
H.B. Shah, 766-H
M.E. Stone, 999-W
J. Stuberfield, 766-H
M.F. Williams, 999-1W
R.J. Workman, 999-1W
A.L. Youchak, 999-W