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REDUCTION OF CONSTRAINTS FOR COUPLED OPERATIONS

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LIST OF ABBREVIATIONS

ΔG_p	Free Energy of Hydration
AD	Analytical Development
ANOVA	Analysis of Variance
ARM	Approved Reference Material
B Del G_p	ΔG_p Value for Boron
bc	Bias Correction
ccc	Centerline Canister Cooled
DWPF	Defense Waste Processing Facility
EA	Environmental Assessment
homg	Homogeneity
HLW	High Level Waste
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ID	Identification
lfrit	low frit
LM	Lithium Metaborate Fusion
lsum	Low Sum of Oxides
MAR	Measurement Acceptability Region
newhv	new high viscosity
newlv	new low viscosity
NL [B (g/L)]	Normalized Boron Release (g/L)
PAR	Property Acceptability Region
PCCS	Process Composition Control System
PCT	Product Consistency Test
PF	Sodium Peroxide Fusion
Pred	Prediction
PSAL	Process Science Analytical Laboratory
ROC	Reduction of Constraints
SB	Sludge Batch
SWPF	Salt Waste Processing Facility
T_L	Liquidus Temperature
TT&QAP	Task Technical and Quality Assurance Plan
TTR	Task Technical Request
U_{std}	Uranium Standard
WL	Waste Loading
XRD	X-ray Diffraction

1.0 EXECUTIVE SUMMARY

The homogeneity constraint was implemented in the Defense Waste Processing Facility (DWPF) Product Composition Control System (PCCS) to help ensure that the current durability models would be applicable to the glass compositions being processed during DWPF operations. While the homogeneity constraint is typically an issue at lower waste loadings (WLs), it may impact the operating windows for DWPF operations, where the glass forming systems may be limited to lower waste loadings based on fissile or heat load limits. In the sludge batch 1b (SB1b) variability study, application of the homogeneity constraint at the measurement acceptability region (MAR) limit eliminated much of the potential operating window for DWPF. As a result, Edwards and Brown developed criteria that allowed DWPF to relax the homogeneity constraint from the MAR to the property acceptance region (PAR) criterion, which opened up the operating window for DWPF operations. These criteria are defined as:

(1) use the alumina constraint as currently implemented in PCCS ($Al_2O_3 \geq 3$ wt%) and add a sum of alkali constraint with an upper limit of 19.3 wt% ($\sum M_2O < 19.3$ wt%), or

(2) adjust the lower limit on the Al_2O_3 constraint to 4 wt% ($Al_2O_3 \geq 4$ wt%).

Herman et al. previously demonstrated that these criteria could be used to replace the homogeneity constraint for future sludge-only batches. The compositional region encompassing coupled operations flowsheets could not be bounded as these flowsheets were unknown at the time. With the initiation of coupled operations at DWPF in 2008, the need to revisit the homogeneity constraint was realized. This constraint was specifically addressed through the variability study for SB5 where it was shown that the homogeneity constraint could be ignored if the alumina and alkali constraints were imposed. Additional benefit could be gained if the homogeneity constraint could be replaced by the Al_2O_3 and sum of alkali constraint for future coupled operations processing based on projections from Revision 14 of the High Level Waste (HLW) System Plan.

As with the first phase of testing for sludge-only operations, replacement of the homogeneity constraint with the alumina and sum of alkali constraints will ensure acceptable product durability over the compositional region evaluated. Although these study glasses only provide limited data in a large compositional region, the approach and results are consistent with previous studies that challenged the homogeneity constraint for sludge-only operations. That is, minimal benefit is gained by imposing the homogeneity constraint if the other PCCS constraints are satisfied. The normalized boron releases of all of the glasses are well below the Environmental Assessment (EA) glass results, regardless of thermal history. Although one of the glasses had a normalized boron release of approximately 10 g/L and was not predictable, the glass is still considered acceptable. This particular glass has a low Al_2O_3 concentration, which may have attributed to the anomalous behavior. Given that poor durability has been previously observed in other glasses with low Al_2O_3 and Fe_2O_3 concentrations, including the sludge-only reduction of constraints study, further investigations appear to be warranted.

Based on the results of this study, it is recommended that the homogeneity constraint (in its entirety with the associated low frit/high frit constraints) be eliminated for coupled operations as

defined by Revision 14 of the HLW System Plan with up to 2 wt% TiO_2. The use of the alumina and sum of alkali constraints should be continued along with the variability study to determine the predictability of the current durability models and/or that the glasses are acceptable with respect to durability. The use of a variability study for each batch is consistent with the glass product control program and it will help to assess new streams or compositional changes.

It is also recommended that the influence of alumina and alkali on durability be studied in greater detail. Limited data suggests that there may be a need to adjust the lower Al_2O_3 limit and/or the upper alkali limit in order to prevent the fabrication of unacceptable glasses. An in-depth evaluation of all previous data as well as any new data would help to better define an alumina and alkali combination that would avoid potential phase separation and ensure glass durability.

2.0 INTRODUCTION

The homogeneity constraint was implemented in the Defense Waste Processing Facility (DWPF) Product Composition Control System (PCCS) to help ensure that the current durability models would be applicable to the glass compositions being processed during DWPF operations. The Product Consistency Test (PCT) response of phase separated glasses has been shown to be unpredictable[1,2]. Thus, a discriminator to avoid unpredictable behavior was developed so that the durability model could be limited to homogeneous glasses or glasses containing isotropic crystals, such as spinel. The homogeneity constraint was derived from a discriminant analysis[A] of 110 glasses (88 homogeneous and 22 phase separated) and is a linear discriminant function of terms representing sludge and frit, in which higher concentrations of sludge components appear to lessen the chances of phase separation. While the homogeneity constraint is typically an issue at lower waste loadings (WLs), it may impact the operating windows[B] for DWPF operations, where the glass forming systems may be limited to lower waste loadings based on fissile or heat load limits. In the sludge batch 1b (SB1b) variability study, application of the homogeneity constraint at the measurement acceptability region (MAR) limit eliminated much of the potential operating window for DWPF.[3] As a result, Edwards and Brown developed criteria that allowed DWPF to relax the homogeneity constraint from the MAR to the property acceptance region (PAR) criterion, which opened up the operating window for DWPF operations.[3] These criteria are defined as:

(1) use the alumina constraint as currently implemented in PCCS ($Al_2O_3 \geq 3$ wt%) and add a sum of alkali constraint with an upper limit of 19.3 wt% ($\sum M_2O < 19.3$ wt%), or

(2) adjust the lower limit on the Al_2O_3 constraint to 4 wt% ($Al_2O_3 \geq 4$ wt%).

Historical glasses of interest to DWPF having these criteria were found to be acceptable using a normalized boron release (NL [B]) of 10 g/L as a benchmark.[3] This value was chosen so that the boron releases of the study glasses were well below that of the Environmental Assessment (EA) glass when accounting for measurement uncertainty. It should be emphasized that this limit was selected only as a guide to develop the Al_2O_3 and/or sum of alkali criteria.

Herman et al. later demonstrated that the Al_2O_3 and/or sum of alkali criteria could be used to replace the homogeneity constraint over a bounding glass composition region for sludge-only processing.[4] The compositional region encompassing coupled operations flowsheets could not be bounded at that time as these flowsheets were unknown. In the sludge-only study, replacing the homogeneity constraint was considered defensible if all of the glasses were predictable by PCCS and/or acceptable compared to the 10 g/L normalized boron release benchmark. Two of the glasses that failed the homogeneity constraint did not meet these criteria, but they did meet the alternative Al_2O_3 and/or sum of alkali criteria; however, replacing the homogeneity constraint with the Al_2O_3 and/or sum of alkali constraint was recommended along with the continued performance of variaibilty studies for each sludge batch.

[A] Linear discriminant analysis is a classification method used in statistics to determine a linear combination of features, which best separate two or more groups of objects or events. In this case, a discriminator based on frit and sludge terms was developed to separate homogenous glasses from phase-separated glasses.

[B] The WL interval over which a particular glass system is considered to be acceptable based on model predictions.

With the initiation of coupled operations at DWPF in 2008, the need to revisit the homogeneity constraint was realized. This constraint was specifically addressed through the variability study for SB5.[5] Additional benefit would be gained for future coupled operations processing if the homogeneity constraint could be replaced by the Al_2O_3 and/or sum of alkali constraint using a similar methodology as was done for sludge-only processing.

This study has been performed in order to address technical issues discussed in the Technical Task Request (TTR) and was performed in accordance with the Task Technical and Quality Assurance Plan (TT&QAP).[6,7]

2.1 GLASS SELECTION STRATEGY

As stated in the TT&QAP, the latest version of the High Level Waste (HLW) System Plan (Revision 14) was used as the compositional basis for future coupled operations flowsheets.[C,8] The minimum and maximum ranges for each sludge oxide are included in Table 1 (with and without Al-dissolution). The minimum and maximum sludge oxide ranges were combined with the primary frit components (B_2O_3, Li_2O, Na_2O and SiO_2) over waste loading ranges of interest to develop a glass compositional region that potentially bounds future DWPF processing for coupled operations. This range represents WLs from 30 to 50% with the exception of Al_2O_3 concentration, which was lowered to ensure constraint coverage. Table 2 summarizes the bounding glass compositional region used in this study as a result of these assumptions. JMP™ was used to D-optimally[D] select 29 glasses based on the oxide ranges[E] in Table 2 that challenged (or were close to challenging) the homogeneity constraint or its associated constraints.

A summary of the MAR assessment results is provided in Table 3. In addition to homogeneity (homg), some of the glasses also challenge the TiO_2[F], liquidus temperature (T_L), low frit/high frit[G] (lfrit/hfrit) and viscosity (newhv) constraints.[9,H] It should be noted that all[I] of the glasses satisfy the Al_2O_3 and/or sum or alkali criteria while falling outside of the MAR for the homogeneity constraint, which is consistent with the objectives of this study. The nomenclature for the glass identification (ID) can be described as follows: "ROC" refers to Reduction of Constraints. Glasses ROC-01 through ROC-29 represent extreme vertices and ROC-30 represents the centroid of the glass region of interest for coupled operations.

[C] While it is realized that some processing scenarios exist for elevated levels of TiO_2 (i.e., > 2 wt%) or the addition of other process streams, the DWPF flowsheets for these scenarios were not available and SRNL could only use what was defined in the system plan.

[D] D-optimality is an experimental design method that minimizes the variance of the estimates of the coefficients of the proposed model. In this study, the proposed model was taken to be a linear function of the oxides listed in Table 2.

[E] "Others" in Table 2 includes: BaO, CdO, Ce_2O_3, La_2O_3, PbO, SO_4, ZnO and ZrO_2.

[F] While the PCCS limit for TiO_2 in glass is 2 wt%, select compositions in this study fail the TiO_2 MAR once measurement uncertainties are applied to the 2 wt% value.

[G] Both the low frit and high frit constraints are associated with homogeneity.

[H] Although not waste form affecting, a risk-based management decision regarding T_L and viscosity predictions may be necessary with respect to melter feed acceptance; however, failure of these constraints will not impact the outcome of this study.

[I] ROC-08 failed the alkali constraint (R_2O) for the given amount of Al_2O_3 due to the measurement uncertainty accounted for in PCCS.

Table 1. Projection Ranges Based on the HLW System Plan Revision 14 (a) with Al-Dissolution and (b) without Al-Dissolution

Oxide	Min (wt%)	Max (wt%)
Al_2O_3	11.95	30.60
BaO	0.07	0.28
CaO	1.91	3.66
Ce_2O_3	0.20	0.96
Cr_2O_3	0.19	0.41
CuO	0.05	0.14
Fe_2O_3	24.32	41.22
K_2O	0.07	0.29
La_2O_3	0.03	0.31
MgO	0.35	2.65
MnO	2.09	10.66
Na_2O	19.91	27.21
NiO	0.34	4.51
PbO	0.09	0.39
SO_4	0.09	1.88
SiO_2	1.79	7.26
ThO_2	0.01	3.12
TiO_2	0.00	3.89
U_3O_8	0.63	17.66
ZnO	0.05	0.24
ZrO_2	0.10	0.67

(a)

Oxide	Min (wt%)	Max (wt%)
Al_2O_3	19.14	34.31
BaO	0.12	0.27
CaO	1.74	2.89
Ce_2O_3	0.08	0.81
Cr_2O_3	0.20	0.36
CuO	0.04	0.14
Fe_2O_3	18.71	34.25
K_2O	0.13	0.41
La_2O_3	0.09	0.26
MgO	0.27	2.26
MnO	1.21	8.79
Na_2O	19.12	27.85
NiO	0.17	3.94
PbO	0.04	0.33
SO_4	0.16	1.07
SiO_2	2.54	8.27
ThO_2	0.00	1.84
TiO_2	0.46	3.35
U_3O_8	0.54	18.80
ZnO	0.05	0.23
ZrO_2	0.23	0.56

(b)

Table 2. Oxide Intervals (wt%) Used to Develop Glass Compositions

Oxide	Min (wt%)	Max (wt%)
Al_2O_3	3.25	18
B_2O_3	4.5	14
CaO	0	4
Cr_2O_3	0	0.2
Fe_2O_3	5	21
Li_2O	4	7
MgO	0	1.5
MnO	0.3	5.5
Na_2O	10	18
NiO	0	2.5
SiO_2	30	55
TiO_2	0.5	2
U_3O_8	0	9.5
Others	0	2

Table 3. MAR Assessment Results

Glass ID	MAR Results
ROC-01	TiO_2
ROC-02	T_L TiO_2 Homg
ROC-03	TiO_2 lFrit
ROC-04	TiO_2
ROC-05	Homg lFrit
ROC-06	Homg
ROC-07	Homg hFrit
ROC-08	TiO_2 Homg R_2O lFrit
ROC-09	
ROC-10	lFrit
ROC-11	Homg lFrit
ROC-12	Homg
ROC-13	Homg
ROC-14	T_L TiO_2
ROC-15	T_L Homg

Glass ID	MAR Results
ROC-16	TiO_2 Homg
ROC-17	TiO_2 Homg
ROC-18	TiO_2 Homg lFrit
ROC-19	TiO_2 Homg
ROC-20	TiO_2
ROC-21	T_L TiO_2 Homg
ROC-22	T_L Homg lFrit
ROC-23	T_L newhv TiO_2
ROC-24	TiO_2
ROC-25	Homg
ROC-26	Homg
ROC-27	T_L TiO_2 lFrit
ROC-28	TiO_2 Homg
ROC-29	T_L
ROC-30	Homg

3.0 OBJECTIVE

The objective of this task is to develop a technical basis for replacing the homogeneity constraint (in its entirety with the associated low/high frit constraints) with the Al_2O_3 and/or sum or alkali criteria for future coupled operations flowsheets (as projected by Revision 14 of the HLW System Plan using the 2 wt% TiO_2 glass limit).

4.0 EXPERIMENTAL PROCEDURES

4.1 TARGET GLASS COMPOSITIONS

Target compositions of the thirty test glasses (expressed as wt% oxides) are presented in Table 4.

4.2 GLASS FABRICATION

Each glass was prepared from the proper proportions of reagent-grade metal oxides, carbonates, H_3BO_3, and salts in 150 g batches.[10] The raw materials were thoroughly mixed and placed into a platinum alloy, 250 mL crucible. Batched materials were placed into a high-temperature furnace at the target melt temperature of 1150°C. The crucible was removed from the furnace after an isothermal hold at 1150°C for 1 hour. The molten glass was quenched by pouring the liquid onto a clean, stainless steel plate. The glass pour patty was used as a sampling stock for the various property measurements (i.e., chemical composition and durability testing). 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.[11] This cooling schedule is referred to as the centerline canister cooling (ccc) curve.

4.3 PROPERTY MEASUREMENTS

4.3.1 Compositional Analysis

To confirm that the as-fabricated glasses met the target compositions, a representative sample from each glass was submitted to Analytical Development (AD) for chemical analysis under the auspices of two analytical plans.[12,13] Two dissolution methods were performed by the Process Science Analytical Laboratory (PSAL) to allow measurement of these chemical compositions: lithium metaborate fusion (LM) and sodium peroxide fusion (PF). For each 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. Analytical plans were 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.

4.3.2 Product Consistency Test (PCT)

The PCT was performed in triplicate on each quenched and ccc glass to assess chemical durability using Method A of the procedure.[14] Also included in the experimental test matrix were the EA glass[15], the Approved Reference Material (ARM) glass[15], and blanks from the sample cleaning batch. Samples were ground, washed, and prepared according to the standard procedure. The resulting solutions were sampled (filtered and acidified) and analyzed by AD under the auspices of three analytical plans.[16-18] Samples of a multi-element, standard solution were also included in each analytical plan to verify the accuracy of the ICP-AES instrument. Normalized release rates were calculated based on the elemental concentrations of different compositional views using the average of the leachate concentrations.

Table 4. Target Compositions

Glass ID	Al_2O_3	B_2O_3	BaO	CaO	CdO	Ce_2O_3	Cr_2O_3	CuO	Fe_2O_3	La_2O_3	Li_2O	MgO	MnO	Na_2O	NiO	PbO	SO_4	SiO_2	TiO_2	U_3O_8	ZnO	ZrO_2
ROC-01	10.86	6.34	0.03	0.60	0.10	0.12	0.20	0.04	8.62	0.03	5.88	1.50	5.50	10.46	0.00	0.07	0.16	37.90	2.00	9.50	0.04	0.07
ROC-02	5.91	10.19	0.00	4.00	0.00	0.00	0.18	0.00	6.70	0.00	4.00	1.35	0.30	13.89	2.50	0.00	0.00	44.71	1.96	4.31	0.00	0.00
ROC-03	3.76	9.98	0.08	0.00	0.30	0.36	0.00	0.13	14.14	0.10	4.00	0.00	0.48	10.00	0.00	0.22	0.48	44.25	2.00	9.38	0.13	0.21
ROC-04	7.96	5.42	0.08	4.00	0.30	0.36	0.00	0.13	6.76	0.10	6.01	0.00	0.30	11.81	2.50	0.22	0.48	41.74	2.00	9.50	0.13	0.21
ROC-05	4.55	6.86	0.00	0.10	0.00	0.00	0.00	0.00	14.52	0.00	4.00	1.50	5.50	10.53	0.07	0.00	0.00	42.36	0.50	9.50	0.00	0.00
ROC-06	5.10	14.00	0.00	4.00	0.00	0.00	0.20	0.00	5.00	0.00	4.00	0.00	5.50	10.62	0.00	0.00	0.00	41.58	0.50	9.50	0.00	0.00
ROC-07	3.46	13.69	0.00	0.00	0.00	0.00	0.20	0.00	10.23	0.00	5.40	0.00	0.30	10.10	0.00	0.00	0.00	53.88	0.50	2.24	0.00	0.00
ROC-08	3.51	4.50	0.00	0.00	0.00	0.00	0.20	0.00	6.22	0.00	4.75	1.50	5.50	13.92	2.50	0.00	0.00	47.74	2.00	7.67	0.00	0.00
ROC-09	3.91	10.07	0.08	4.00	0.30	0.36	0.00	0.13	8.29	0.10	4.00	1.50	3.79	13.30	2.50	0.22	0.48	45.94	0.50	0.20	0.13	0.21
ROC-10	3.33	5.36	0.08	0.00	0.30	0.36	0.20	0.13	15.02	0.10	4.52	1.50	1.29	11.16	0.00	0.22	0.48	45.63	0.50	9.50	0.13	0.21
ROC-11	3.25	4.50	0.08	1.32	0.30	0.36	0.20	0.13	5.60	0.10	4.56	0.21	5.50	10.00	2.50	0.22	0.48	50.37	0.50	9.50	0.13	0.21
ROC-12	5.48	7.60	0.00	3.96	0.00	0.00	0.00	0.00	5.91	0.00	6.45	1.50	0.30	13.43	2.50	0.00	0.00	49.74	0.50	2.63	0.00	0.00
ROC-13	10.63	4.50	0.00	1.42	0.00	0.00	0.00	0.00	6.62	0.00	5.57	1.50	5.50	10.00	0.00	0.00	0.00	45.44	0.50	8.31	0.00	0.00
ROC-14	11.40	13.01	0.08	0.00	0.30	0.36	0.00	0.13	6.54	0.10	5.26	1.50	4.20	10.34	2.50	0.22	0.48	38.66	1.97	2.62	0.13	0.21
ROC-15	7.02	4.50	0.08	0.00	0.30	0.36	0.20	0.13	10.27	0.10	4.00	0.00	1.05	15.14	2.50	0.22	0.48	43.83	0.50	9.00	0.13	0.21
ROC-16	3.25	9.43	0.08	0.00	0.30	0.36	0.00	0.13	5.00	0.10	6.68	0.00	5.44	10.00	0.00	0.22	0.48	47.79	2.00	8.41	0.13	0.21
ROC-17	6.34	4.86	0.00	0.16	0.00	0.00	0.20	0.00	10.03	0.00	4.66	0.00	5.50	16.00	2.50	0.00	0.00	47.56	2.00	0.18	0.00	0.00
ROC-18	3.80	5.05	0.00	2.01	0.00	0.00	0.00	0.00	11.32	0.00	4.00	0.00	4.87	10.00	2.20	0.00	0.00	49.52	2.00	5.23	0.00	0.00
ROC-19	3.94	13.27	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	4.00	1.50	0.30	10.13	2.50	0.00	0.00	50.39	2.00	6.97	0.00	0.00
ROC-20	3.58	10.30	0.08	4.00	0.30	0.36	0.20	0.13	8.38	0.10	4.08	0.38	5.50	12.92	0.00	0.22	0.48	46.47	2.00	0.19	0.13	0.21
ROC-21	10.37	11.66	0.00	0.09	0.00	0.00	0.20	0.00	7.82	0.00	4.23	1.11	5.28	10.00	1.52	0.00	0.00	36.22	2.00	9.50	0.00	0.00
ROC-22	3.25	6.43	0.00	0.00	0.00	0.00	0.00	0.00	14.69	0.00	4.52	0.00	5.50	10.00	2.50	0.00	0.00	46.84	1.82	4.43	0.00	0.00
ROC-23	9.99	5.69	0.08	0.00	0.30	0.36	0.20	0.13	7.17	0.10	4.91	1.42	1.89	10.89	1.93	0.22	0.48	49.35	2.00	2.55	0.13	0.21
ROC-24	10.21	11.09	0.08	0.00	0.30	0.36	0.20	0.13	6.89	0.10	4.04	1.50	5.44	10.28	0.15	0.22	0.48	44.95	2.00	1.25	0.13	0.21
ROC-25	4.88	4.50	0.08	0.00	0.30	0.36	0.20	0.13	11.84	0.10	4.00	1.50	5.50	15.45	0.05	0.22	0.48	47.08	0.50	2.51	0.13	0.21
ROC-26	9.07	6.49	0.00	0.00	0.00	0.00	0.00	0.00	5.00	0.00	4.00	0.00	3.29	17.17	0.00	0.00	0.00	48.68	0.50	5.80	0.00	0.00
ROC-27	3.94	4.50	0.08	0.00	0.30	0.36	0.00	0.13	15.17	0.10	4.00	1.50	5.50	11.80	1.95	0.22	0.48	43.65	2.00	3.99	0.13	0.21
ROC-28	4.49	4.50	0.08	0.00	0.30	0.36	0.00	0.13	6.34	0.10	4.13	1.50	0.47	17.67	0.00	0.22	0.48	55.00	2.00	1.89	0.13	0.21
ROC-29	10.76	12.48	0.08	0.06	0.30	0.36	0.00	0.13	7.76	0.10	4.60	0.00	4.91	10.67	2.50	0.22	0.48	38.10	0.50	5.66	0.13	0.21
ROC-30	6.14	7.96	0.04	1.03	0.16	0.19	0.10	0.07	8.72	0.05	4.63	0.83	3.60	11.99	1.31	0.11	0.25	45.70	1.37	5.58	0.07	0.11

5.0 RESULTS AND DISCUSSION

5.1 CHEMICAL COMPOSITION MEASUREMENTS

Table A1 (in two parts) in Appendix A provides the elemental concentration measurements from the study glasses that were prepared using LM, and Table A2 in Appendix A provides the measurements from the samples of these glasses prepared using PF. Measurements for the Batch 1 and uranium standard (U_{std}) glass are also provided in these two tables. Note that these two tables contain measurements for glasses from another glass study that were included in the analytical plans (with IDs FY09EM21-28, FY09EM21-29, and FY09EM21-30). These three glasses will not be used to support the objectives of this study.

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 was reduced to half[J] of that detection limit as the oxide concentration was determined.[19]

5.1.1 Measurements in Analytical Sequence

Exhibit A1 in Appendix A provides plots in analytical sequence of the sample measurements generated by AD for each oxide by preparation method (i.e., LM and PF) and analytical set. The plots are in analytical sequence over the two sets of measurements. These plots include all of the measurement data from Tables A1 and A2.[K] A close review of these plots suggests that there are consistency issues in the measurements for some oxides for some of the glasses. These issues are explored in more detail in the following sections.

5.1.2 Composition Measurements by Glass Identifier

Exhibit A2 in Appendix A provides plots of the oxide concentration measurements by Glass ID/Lab ID for each analytical set (including Batch 1 and U_{std}). These plots demonstrate the individual measurements across the duplicates of each preparation method and the two ICP-AES calibrations for each glass within each analytical set. While there appears to be good repeatability among the measurements for each of the oxides for most of the glasses, there are some issues that should be noted. The measured values for the oxides derived using the PF method for Set #1 suggest a dissolution problem for ROC-01, ROC-07, and ROC-13, specifically the values of Al_2O_3, B_2O_3, Fe_2O_3, Li_2O and SiO_2. In addition, the measured values for the oxides derived using the LM method suggest dissolution problems for ROC-06, ROC-08, ROC-17, and ROC-28 (for example, see the SiO_2 plot for Set #2). A more thorough discussion of these analytical issues is provided in the following section along with a path forward for resolving the problem to obtain representative chemical compositions of the study glasses.

[J] Historically, the United States Environmental Protection Agency (USEPA) has advocated that non-detected measurements be replaced by one-half of the detection limit. The data should then be analyzed as if all of the measurements were observed with equal precision.

[K] In the Set #2 results, glasses from another study are included in these plots for completeness (i.e., glasses FY09EM21-28, FY09EM21-29 and FY09EM21-30).

5.1.3 Batch 1 and Uranium Standard Results

Exhibit A3 in Appendix A provides statistical analyses of the Batch 1 and U_{std} results by analytical set/calibration block for each oxide of interest for the LM preparation method. The results also include analysis of variance (ANOVA) investigations, which determine statistically significant differences among the means of these groups for each of the oxides for each of the standards. The following components indicate a significant ICP-AES calibration effect on the block averages at the 5% significance level:

- Batch 1: BaO, CaO, CuO, MgO, MnO, Na_2O, NiO, TiO_2, and ZrO_2
- U_{std}: CaO, Cr_2O_3, CuO, MgO, MnO, Na_2O, NiO, TiO_2, and U_3O_8

Exhibit A4 in Appendix A provides statistical analyses of the Batch 1 and U_{std} results by analytical set/calibration block and ANOVA investigations for each oxide of interest for the PF preparation method. The following components indicate a significant ICP-AES calibration effect on the block averages at the 5% significance level:

- Batch 1: Al_2O_3, Fe_2O_3, and Li_2O
- U_{std}: B_2O_3 and Li_2O

Reference values for the oxide concentrations of the standards are given in the header for each set of measurements in Exhibits A3 and A4.

Results from these statistical analyses provide incentive for adjusting the measurements by the effects of the ICP-AES calibration. Thus, bias correction of these data was pursued in order to determine if the adjusted values impacted the conclusions of this study.[L] Batch 1 results were used to bias correct all of the oxides (except uranium) as long as the reference value for the oxide concentration in the Batch 1 glass was greater than or equal to 0.1 wt%. U_{std} results were used to bias correct the uranium values. By applying this approach, the Batch 1 results 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 U_{std} values were used to bias correct the U_3O_8. Bias correction was *not* conducted on CdO, Ce_2O_3, La_2O_3, PbO, SO_4, ThO_2, ZnO, or ZrO_2.

The bias-correction was calculated 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 Exhibits A3. 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 is given by:

[L] It should be emphasized that bias correction is considered in order to demonstrate that the results and conclusions from this study are not affected by the compositional view (target, measured, or measured-bc). Demonstrating that the compositional view does not alter or change the conclusions shows a degree of robustness for the objective of the study.

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

Bias-corrected measurements are indicated by a "bc" suffix in the remainder of the document. Both measured and measured "bc" values are included in the following discussion. For completeness, the original values of CdO, Ce_2O_3, La_2O_3, PbO, SO_4, ThO_2, ZnO, and ZrO_2 were included in the bias-corrected results in order to calculate a "bc" sum of oxides.

5.1.4 Composition Measurements by Glass Identifier with Targeted Compositions

Exhibit A5 in Appendix provides plots of the oxide concentration measurements by Glass ID/ Lab ID (including Batch 1 and U_{std}). The data are sorted by increasing target oxide content. A review of the plots reveals the repeatability of the individual oxide values for each glass. The measurements for the oxides derived using the PF method for Set #1 suggest a dissolution problem for ROC-01, ROC-07, and ROC-13. Table 5 provides a listing of the measurements corresponding to these glasses. Notice that both the measured and measured bc values are well below the target values for the first dissolution. These entries have been shaded in Table 5. Due to these anomalies, the first dissolution for each of these glasses was not used to determine the measured or the measured bias-corrected compositions for these glasses. The measurements for the oxides derived using the LM method suggest a dissolution problem for the second dissolution of ROC-06 and the first dissolution of ROC-08 in Set #1 and for the first dissolution of ROC-17 and the second dissolution of ROC-28 in Set #2. Table 6 through Table 9 provides a listing of the measurements corresponding to these glasses. Once again, note the discrepancies between the measured (and measured bc) values and the targeted values for dissolutions being questioned. These entries have been shaded in Table 6 through Table 9. Due to these anomalies, the shaded entries were not used to determine the measured or the measured bias-corrected compositions for the ROC-06, ROC-08, ROC-17, and ROC-28 glasses.

Table 5. ROC-01, ROC-07, and ROC-13 Peroxide Fusion Measurements

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-01	a05PF11	Al_2O_3	8.45	8.55	10.86
	a05PF12		8.47	8.53	10.86
	a05PF21		10.98	11.11	10.86
	a05PF22		11.00	11.09	10.86
	a05PF11	B_2O_3	4.83	5.13	6.34
	a05PF12		4.80	5.10	6.34
	a05PF21		6.12	6.50	6.34
	a05PF22		6.09	6.47	6.34
	a05PF11	Fe_2O_3	6.55	6.62	8.62
	a05PF12		6.65	6.65	8.62
	a05PF21		8.56	8.66	8.62
	a05PF22		8.66	8.66	8.62
	a05PF11	Li_2O	4.50	4.70	5.88
	a05PF12		4.39	4.67	5.88
	a05PF21		5.68	5.94	5.88
	a05PF22		5.55	5.90	5.88
	a05PF11	SiO_2	29.09	29.70	37.90
	a05PF12		29.52	29.96	37.90
	a05PF21		37.87	38.65	37.90
	a05PF22		38.08	38.64	37.90

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-07	a07PF11	Al_2O_3	1.64	1.66	3.46
	a07PF12		1.64	1.66	3.46
	a07PF21		3.70	3.74	3.46
	a07PF22		3.68	3.72	3.46
	a07PF11	B_2O_3	5.83	6.22	13.69
	a07PF12		5.73	6.22	13.69
	a07PF21		13.07	13.95	13.69
	a07PF22		12.98	14.08	13.69
	a07PF11	Fe_2O_3	4.30	4.34	10.23
	a07PF12		4.30	4.37	10.23
	a07PF21		9.75	9.83	10.23
	a07PF22		9.71	9.87	10.23
	a07PF11	Li_2O	2.30	2.41	5.40
	a07PF12		2.26	2.38	5.40
	a07PF21		5.12	5.36	5.40
	a07PF22		5.15	5.41	5.40
	a07PF11	SiO_2	23.10	23.62	53.88
	a07PF12		23.10	23.58	53.88
	a07PF21		52.20	53.35	53.88
	a07PF22		52.20	53.28	53.88

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-13	a14PF11	Al_2O_3	8.90	8.98	10.63
	a14PF12		8.86	8.95	10.63
	a14PF21		10.83	10.93	10.63
	a14PF22		10.81	10.91	10.63
	a14PF11	B_2O_3	3.57	3.81	4.50
	a14PF12		3.41	3.70	4.50
	a14PF21		4.31	4.60	4.50
	a14PF22		4.25	4.61	4.50
	a14PF11	Fe_2O_3	5.48	5.52	6.62
	a14PF12		5.45	5.54	6.62
	a14PF21		6.62	6.67	6.62
	a14PF22		6.56	6.67	6.62
	a14PF11	Li_2O	4.50	4.71	5.57
	a14PF12		4.48	4.71	5.57
	a14PF21		5.53	5.79	5.57
	a14PF22		5.43	5.70	5.57
	a14PF11	SiO_2	37.22	38.05	45.44
	a14PF12		37.44	38.21	45.44
	a14PF21		45.35	46.36	45.44
	a14PF22		45.14	46.07	45.44

Table 6. ROC-06 Lithium Metaborate Measurements

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-06	a03LM11	BaO	0.00	0.00	0.00
	a03LM12		0.00	0.00	0.00
	a03LM21		0.00	0.00	0.00
	a03LM22		0.00	0.00	0.00
	a03LM11	CaO	3.88	3.78	4.00
	a03LM12		3.86	3.78	4.00
	a03LM21		3.09	3.01	4.00
	a03LM22		3.09	3.03	4.00
	a03LM11	CdO	0.00	0.00	0.00
	a03LM12		0.00	0.00	0.00
	a03LM21		0.00	0.00	0.00
	a03LM22		0.00	0.00	0.00
	a03LM11	Ce_2O_3	0.02	0.02	0.00
	a03LM12		0.03	0.03	0.00
	a03LM21		0.01	0.01	0.00
	a03LM22		0.03	0.03	0.00
	a03LM11	Cr_2O_3	0.19	0.19	0.20
	a03LM12		0.19	0.18	0.20
	a03LM21		0.15	0.15	0.20
	a03LM22		0.15	0.15	0.20
	a03LM11	CuO	0.02	0.02	0.00
	a03LM12		0.02	0.02	0.00
	a03LM21		0.02	0.02	0.00
	a03LM22		0.02	0.02	0.00
	a03LM11	K_2O	0.03	0.03	0.00
	a03LM12		0.09	0.09	0.00
	a03LM21		0.06	0.06	0.00
	a03LM22		0.03	0.03	0.00
	a03LM11	La_2O_3	0.01	0.01	0.00
	a03LM12		0.01	0.01	0.00
	a03LM21		0.01	0.01	0.00
	a03LM22		0.01	0.01	0.00
	a03LM11	MgO	0.00	0.00	0.00
	a03LM12		0.01	0.01	0.00
	a03LM21		0.00	0.00	0.00
	a03LM22		0.01	0.01	0.00

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-06	a03LM11	MnO	5.49	5.49	5.50
	a03LM12		5.38	5.41	5.50
	a03LM21		4.33	4.33	5.50
	a03LM22		4.34	4.36	5.50
	a03LM11	Na_2O	10.73	10.47	10.62
	a03LM12		10.64	10.36	10.62
	a03LM21		8.53	8.33	10.62
	a03LM22		8.61	8.39	10.62
	a03LM11	NiO	0.03	0.03	0.00
	a03LM12		0.03	0.02	0.00
	a03LM21		0.02	0.02	0.00
	a03LM22		0.03	0.02	0.00
	a03LM11	PbO	0.01	0.01	0.00
	a03LM12		0.01	0.01	0.00
	a03LM21		0.01	0.01	0.00
	a03LM22		0.01	0.01	0.00
	a03LM11	SO_4	0.22	0.22	0.00
	a03LM12		0.22	0.22	0.00
	a03LM21		0.22	0.22	0.00
	a03LM22		0.22	0.22	0.00
	a03LM11	TiO_2	0.43	0.44	0.50
	a03LM12		0.43	0.44	0.50
	a03LM21		0.35	0.35	0.50
	a03LM22		0.35	0.35	0.50
	a03LM11	U_3O_8	9.21	9.11	9.50
	a03LM12		9.20	8.94	9.50
	a03LM21		7.18	7.10	9.50
	a03LM22		7.19	6.99	9.50
	a03LM11	ZnO	0.01	0.01	0.00
	a03LM12		0.01	0.01	0.00
	a03LM21		0.01	0.01	0.00
	a03LM22		0.01	0.01	0.00
	a03LM11	ZrO_2	0.00	0.00	0.00
	a03LM12		0.00	0.00	0.00
	a03LM21		0.00	0.00	0.00
	a03LM22		0.01	0.01	0.00

Table 7. ROC-08 Lithium Metaborate Measurements

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-08	a10LM11	BaO	0.00	0.00	0.00
	a10LM12		0.00	0.00	0.00
	a10LM21		0.00	0.00	0.00
	a10LM22		0.00	0.00	0.00
	a10LM11	CaO	0.03	0.03	0.00
	a10LM12		0.03	0.03	0.00
	a10LM21		0.03	0.03	0.00
	a10LM22		0.03	0.03	0.00
	a10LM11	CdO	0.00	0.00	0.00
	a10LM12		0.00	0.00	0.00
	a10LM21		0.00	0.00	0.00
	a10LM22		0.00	0.00	0.00
	a10LM11	Ce_2O_3	0.01	0.01	0.00
	a10LM12		0.01	0.01	0.00
	a10LM21		0.01	0.01	0.00
	a10LM22		0.01	0.01	0.00
	a10LM11	Cr_2O_3	0.15	0.15	0.20
	a10LM12		0.15	0.15	0.20
	a10LM21		0.16	0.16	0.20
	a10LM22		0.16	0.16	0.20
	a10LM11	CuO	0.02	0.02	0.00
	a10LM12		0.02	0.02	0.00
	a10LM21		0.02	0.02	0.00
	a10LM22		0.02	0.02	0.00
	a10LM11	K_2O	0.03	0.03	0.00
	a10LM12		0.03	0.03	0.00
	a10LM21		0.10	0.10	0.00
	a10LM22		0.03	0.03	0.00
	a10LM11	La_2O_3	0.01	0.01	0.00
	a10LM12		0.01	0.01	0.00
	a10LM21		0.01	0.01	0.00
	a10LM22		0.01	0.01	0.00
	a10LM11	MgO	1.33	1.32	1.50
	a10LM12		1.32	1.30	1.50
	a10LM21		1.41	1.40	1.50
	a10LM22		1.42	1.41	1.50

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-08	a10LM11	MnO	4.98	4.98	5.50
	a10LM12		4.95	4.97	5.50
	a10LM21		5.32	5.32	5.50
	a10LM22		5.40	5.42	5.50
	a10LM11	Na_2O	12.20	11.91	13.92
	a10LM12		12.20	11.89	13.92
	a10LM21		13.16	12.84	13.92
	a10LM22		13.20	12.86	13.92
	a10LM11	NiO	2.15	2.10	2.50
	a10LM12		2.19	2.11	2.50
	a10LM21		2.33	2.27	2.50
	a10LM22		2.34	2.25	2.50
	a10LM11	PbO	0.01	0.01	0.00
	a10LM12		0.01	0.01	0.00
	a10LM21		0.01	0.01	0.00
	a10LM22		0.01	0.01	0.00
	a10LM11	SO_4	0.22	0.22	0.00
	a10LM12		0.22	0.22	0.00
	a10LM21		0.22	0.22	0.00
	a10LM22		0.22	0.22	0.00
	a10LM11	TiO_2	1.78	1.80	2.00
	a10LM12		1.75	1.79	2.00
	a10LM21		1.93	1.95	2.00
	a10LM22		1.90	1.94	2.00
	a10LM11	U_3O_8	6.38	6.31	7.67
	a10LM12		6.37	6.19	7.67
	a10LM21		6.89	6.81	7.67
	a10LM22		6.96	6.76	7.67
	a10LM11	ZnO	0.01	0.01	0.00
	a10LM12		0.01	0.01	0.00
	a10LM21		0.01	0.01	0.00
	a10LM22		0.01	0.01	0.00
	a10LM11	ZrO_2	0.00	0.00	0.00
	a10LM12		0.00	0.00	0.00
	a10LM21		0.00	0.00	0.00
	a10LM22		0.00	0.00	0.00

Table 8. ROC-17 Lithium Metaborate Measurements

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-17	b09LM11	BaO	0.00	0.00	0.00
	b09LM12		0.00	0.00	0.00
	b09LM21		0.00	0.00	0.00
	b09LM22		0.00	0.00	0.00
	b09LM11	CaO	0.16	0.16	0.16
	b09LM12		0.16	0.16	0.16
	b09LM21		0.17	0.17	0.16
	b09LM22		0.17	0.17	0.16
	b09LM11	CdO	0.00	0.00	0.00
	b09LM12		0.00	0.00	0.00
	b09LM21		0.00	0.00	0.00
	b09LM22		0.00	0.00	0.00
	b09LM11	Ce_2O_3	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.01	0.01	0.00
	b09LM22		0.01	0.01	0.00
	b09LM11	Cr_2O_3	0.15	0.15	0.20
	b09LM12		0.15	0.15	0.20
	b09LM21		0.17	0.17	0.20
	b09LM22		0.17	0.17	0.20
	b09LM11	CuO	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.02	0.02	0.00
	b09LM22		0.01	0.01	0.00
	b09LM11	K_2O	0.03	0.03	0.00
	b09LM12		0.03	0.03	0.00
	b09LM21		0.03	0.03	0.00
	b09LM22		0.03	0.03	0.00
	b09LM11	La_2O_3	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.01	0.01	0.00
	b09LM22		0.01	0.01	0.00
	b09LM11	MgO	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.02	0.02	0.00
	b09LM22		0.02	0.02	0.00

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-17	b09LM11	MnO	4.87	5.07	5.50
	b09LM12		4.92	5.06	5.50
	b09LM21		5.28	5.50	5.50
	b09LM22		5.36	5.51	5.50
	b09LM11	Na_2O	15.37	14.96	16.00
	b09LM12		14.83	15.15	16.00
	b09LM21		16.85	16.40	16.00
	b09LM22		15.64	15.98	16.00
	b09LM11	NiO	2.07	2.04	2.50
	b09LM12		2.09	2.04	2.50
	b09LM21		2.29	2.25	2.50
	b09LM22		2.28	2.23	2.50
	b09LM11	PbO	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.01	0.01	0.00
	b09LM22		0.01	0.01	0.00
	b09LM11	SiO_2	42.57	43.08	47.56
	b09LM12		42.36	43.11	47.56
	b09LM21		46.85	47.41	47.56
	b09LM22		46.42	47.24	47.56
	b09LM11	SO_4	0.22	0.22	0.00
	b09LM12		0.22	0.22	0.00
	b09LM21		0.22	0.22	0.00
	b09LM22		0.22	0.22	0.00
	b09LM11	TiO_2	1.88	2.00	2.00
	b09LM12		1.90	2.01	2.00
	b09LM21		2.04	2.16	2.00
	b09LM22		2.05	2.16	2.00
	b09LM11	U_3O_8	0.26	0.26	0.18
	b09LM12		0.29	0.28	0.18
	b09LM21		0.30	0.30	0.18
	b09LM22		0.31	0.31	0.18
	b09LM11	ZnO	0.01	0.01	0.00
	b09LM12		0.01	0.01	0.00
	b09LM21		0.01	0.01	0.00
	b09LM22		0.01	0.01	0.00
	b09LM11	ZrO_2	0.00	0.00	0.00
	b09LM12		0.00	0.00	0.00
	b09LM21		0.00	0.00	0.00
	b09LM22		0.00	0.00	0.00

Table 9. ROC-28 Lithium Metaborate Measurements

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-28	b08LM11	BaO	0.08	0.08	0.08
	b08LM12		0.08	0.08	0.08
	b08LM21		0.07	0.07	0.08
	b08LM22		0.07	0.07	0.08
	b08LM11	CaO	0.01	0.01	0.00
	b08LM12		0.01	0.01	0.00
	b08LM21		0.03	0.03	0.00
	b08LM22		0.02	0.02	0.00
	b08LM11	CdO	0.27	0.27	0.30
	b08LM12		0.26	0.26	0.30
	b08LM21		0.25	0.25	0.30
	b08LM22		0.25	0.25	0.30
	b08LM11	Ce_2O_3	0.32	0.32	0.36
	b08LM12		0.32	0.32	0.36
	b08LM21		0.29	0.29	0.36
	b08LM22		0.30	0.30	0.36
	b08LM11	Cr_2O_3	0.02	0.02	0.00
	b08LM12		0.02	0.02	0.00
	b08LM21		0.02	0.02	0.00
	b08LM22		0.02	0.02	0.00
	b08LM11	CuO	0.14	0.14	0.13
	b08LM12		0.13	0.14	0.13
	b08LM21		0.13	0.13	0.13
	b08LM22		0.12	0.12	0.13
	b08LM11	K_2O	0.03	0.03	0.00
	b08LM12		0.03	0.03	0.00
	b08LM21		0.03	0.03	0.00
	b08LM22		0.03	0.03	0.00
	b08LM11	La_2O_3	0.07	0.07	0.10
	b08LM12		0.07	0.07	0.10
	b08LM21		0.07	0.07	0.10
	b08LM22		0.07	0.07	0.10
	b08LM11	MgO	1.48	1.49	1.50
	b08LM12		1.49	1.48	1.50
	b08LM21		1.39	1.40	1.50
	b08LM22		1.40	1.39	1.50

Glass ID	Lab ID	Analyte	Measured	Measured bc	Target
			(wt%)		
ROC-28	b08LM11	MnO	0.48	0.49	0.47
	b08LM12		0.48	0.49	0.47
	b08LM21		0.45	0.47	0.47
	b08LM22		0.45	0.46	0.47
	b08LM11	Na_2O	17.25	17.27	17.67
	b08LM12		16.98	16.99	17.67
	b08LM21		16.31	16.32	17.67
	b08LM22		16.04	16.05	17.67
	b08LM11	NiO	0.03	0.03	0.00
	b08LM12		0.02	0.02	0.00
	b08LM21		0.03	0.03	0.00
	b08LM22		0.03	0.03	0.00
	b08LM11	PbO	0.19	0.19	0.22
	b08LM12		0.18	0.18	0.22
	b08LM21		0.18	0.18	0.22
	b08LM22		0.16	0.16	0.22
	b08LM11	SiO_2	52.84	54.25	55.00
	b08LM12		53.05	54.23	55.00
	b08LM21		50.27	51.61	55.00
	b08LM22		49.85	50.95	55.00
	b08LM11	SO_4	0.22	0.22	0.48
	b08LM12		0.54	0.54	0.48
	b08LM21		0.22	0.22	0.48
	b08LM22		0.22	0.22	0.48
	b08LM11	TiO_2	1.90	1.96	2.00
	b08LM12		1.92	1.97	2.00
	b08LM21		1.80	1.85	2.00
	b08LM22		1.80	1.85	2.00
	b08LM11	U_3O_8	1.83	1.85	1.89
	b08LM12		1.82	1.82	1.89
	b08LM21		1.67	1.70	1.89
	b08LM22		1.73	1.73	1.89
	b08LM11	ZnO	0.11	0.11	0.13
	b08LM12		0.11	0.11	0.13
	b08LM21		0.11	0.11	0.13
	b08LM22		0.10	0.10	0.13
	b08LM11	ZrO_2	0.18	0.18	0.21
	b08LM12		0.18	0.18	0.21
	b08LM21		0.17	0.17	0.21
	b08LM22		0.17	0.17	0.21

5.1.5 Measured versus Target Compositions

Table A4 in Appendix A provides a summary of the average compositions as well as the target compositions and some associated differences and relative differences. Exhibit A6 in Appendix A provides plots showing results for each glass for each oxide to help highlight the comparisons among the measured, bias-corrected, and targeted values. In general, the measured/measured bias-corrected values are consistent with the target oxide content in each of the study glasses. It should be noted that there is some scatter in the SO_4 values around their intended targets. In addition, there also appears to be a detection limit issue for SO_4 around 0.2 wt%. The measured NiO, Na_2O and ZrO_2 values for some of the study glasses are below the target values and the Cr_2O_3 values[M] for the U_{std} are both high. None of these issues impact the outcome of this study.

The sums of oxides (measured and bias-corrected) for the study glasses fall within the interval of 95 to 105 wt% *except* for the measured values of ROC-20[N]; however, bias corrected measurements for this glass do have a sum of oxides above the lower limit of 95%.

5.2 MAR ASSESSMENT

MAR assessment results are provided in Table 10.[O] The columns in the table list the glass identifier with compositional view, nepheline value, TiO_2 concentration (wt%), homogeneity constraint (wt%) and the overall MAR assessment and the predicted values for: ΔG_p value for boron (B Del G_p value), normalized leachate for boron in grams/Liter (NL[B (g/L)]), liquidus temperature in degrees Celsius (T_L (ºC)) and viscosity at 1150°C in Poise (Visc (P)).

Note that the PAR value of the homogeneity constraint is 210.92 (wt%). The MAR assessment conducted by current version of PCCS requires that the homogeneity constraint be satisfied at the PAR (i.e., the glass composition must yield a value for the homogeneity constraint that is greater than 210.92 wt%). The MAR assessment for homogeneity may be satisfied by either (1) the homogeneity constraint being satisfied at the MAR, or (2) the homogeneity constraint being satisfied at the PAR *and* the alumina and/or sum of alkali constraint being satisfied at the MAR. The results from Herman et al. justified the use of the MAR assessment of the alumina and alkali constraints to provide an administrative override to satisfy the homogeneity requirement in its entirety (i.e., the homogeneity constraint being met at the PAR could be ignored) for sludge-only processing.[4] For this study, the largest value of the homogeneity constraint over the target compositions is 213.11 (wt%). Note that while all of the target compositions of the study glasses fail or just satisfy the PAR, none of the target compositions satisfy the homogeneity constraint itself at the MAR value.

[M] The reference value of Cr_2O_3 was 0 wt%; however, the measured value has been consistently around 0.25 wt%, indicating that there is some Cr_2O_3 present in the standard.

[N] Note that the target sums of oxides for the standard glasses do not equal 100% due to an incomplete coverage of the oxides in the Batch 1 and U_{std} glasses.

[O] If the MAR status is blank, then the glass could be processed at DWPF.

Table 10. PCCS Assessment Results

Glass ID	Compositional View	B Del G_p	NL [B (g/L)]	T_L(°C)	Viscosity (P)	TiO_2 (wt%)	Homogeneity (wt%)	Nepheline Value	MAR Status
ROC-01	target	-9.43	0.64	964	27	2.00	211.35	0.64	TiO_2
	measured	-8.89	0.51	967	33	1.91	211.07	0.64	
	measured bc	-8.87	0.51	967	32	1.93	213.67	0.65	TiO_2
ROC-02	target	-11.84	1.75	1023	29	1.96	210.52	0.69	T_L TiO_2 Homg
	measured	-11.15	1.32	1026	32	1.88	203.03	0.69	T_L Homg
	measured bc	-11.12	1.30	1020	32	1.90	205.79	0.70	T_L Homg
ROC-03	target	-7.68	0.31	890	27	2.00	213.11	0.76	TiO_2 lFrit
	measured	-7.47	0.28	898	31	1.79	212.92	0.76	lFrit
	measured bc	-7.43	0.28	901	31	1.82	215.75	0.77	lFrit
ROC-04	target	-10.36	0.94	963	27	2.00	212.53	0.68	TiO_2
	measured	-9.80	0.75	955	32	1.80	211.89	0.68	
	measured bc	-9.84	0.76	948	31	1.83	213.88	0.69	
ROC-05	target	-9.74	0.73	924	27	0.50	210.52	0.74	Homg lFrit
	measured	-9.30	0.61	943	30	0.51	208.64	0.74	Homg
	measured bc	-9.31	0.61	945	30	0.52	212.16	0.74	
ROC-06	target	-12.30	2.12	724	29	0.50	192.21	0.73	Homg
	measured	-12.18	2.02	725	30	0.43	191.35	0.72	Homg
	measured bc	-12.16	2.00	728	30	0.44	194.44	0.73	Homg
ROC-07	target	-9.25	0.60	830	37	0.50	210.52	0.80	Homg hFrit
	measured	-8.74	0.48	832	41	0.47	204.52	0.80	Homg
	measured bc	-8.78	0.49	834	40	0.48	208.79	0.80	Homg hFrit
ROC-08	target	-13.25	3.16	896	37	2.00	168.64	0.73	TiO_2 Homg R_2O lFrit
	measured	-12.46	2.27	895	41	1.92	164.65	0.73	Homg lFrit
	measured bc	-12.34	2.16	891	42	1.94	166.66	0.74	TiO_2 Homg lFrit
ROC-09	target	-13.28	3.20	939	27	0.50	211.65	0.73	
	measured	-11.69	1.65	974	35	0.55	204.97	0.74	Homg lFrit
	measured bc	-11.60	1.58	970	35	0.56	207.10	0.74	Homg lFrit
ROC-10	target	-9.20	0.58	975	27	0.50	213.11	0.76	lFrit
	measured	-8.28	0.40	975	36	0.47	209.80	0.77	Homg lFrit
	measured bc	-8.22	0.39	977	37	0.48	212.25	0.77	lFrit
ROC-11	target	-10.23	0.89	916	88	0.50	171.33	0.79	Homg lFrit
	measured	-9.94	0.80	914	92	0.55	170.30	0.78	Homg lFrit
	measured bc	-9.87	0.77	907	93	0.56	172.33	0.79	Homg lFrit
ROC-12	target	-13.20	3.09	891	27	0.50	210.52	0.73	Homg
	measured	-12.48	2.29	912	29	0.50	207.20	0.72	Homg
	measured bc	-12.53	2.34	903	28	0.51	210.03	0.73	Homg
ROC-13	target	-8.75	0.48	843	86	0.50	210.52	0.69	Homg
	measured	-7.60	0.30	868	106	0.47	208.55	0.70	newhv Homg
	measured bc	-7.64	0.30	867	104	0.47	211.68	0.70	newhv
ROC-14	target	-9.01	0.54	1087	27	1.97	211.78	0.64	T_L TiO_2
	measured	-8.45	0.43	1076	33	2.01	210.06	0.64	T_L TiO_2 Homg
	measured bc	-8.56	0.45	1068	31	2.04	214.13	0.65	TL TiO2
ROC-15	target	-10.89	1.18	1041	30	0.50	208.42	0.66	T_L Homg
	measured	-9.53	0.67	1043	42	0.48	207.50	0.68	T_L Homg
	measured bc	-9.47	0.65	1036	43	0.49	209.93	0.68	T_L Homg

Table 10 cont. PCCS Assessment Results

Glass ID	Compositional View	B Del G_p	NL [B (g/L)]	T_L(°C)	Viscosity (P)	TiO_2 (wt%)	Homogeneity (wt%)	Nepheline Value	MAR Status
ROC-16	target	-12.21	2.05	592	27	2.00	167.69	0.78	TiO_2 Homg
	measured	-11.74	1.68	635	25	2.38	165.10	0.77	TiO_2 Homg lFrit
	measured bc	-11.90	1.80	631	26	2.45	167.89	0.78	TiO_2 Homg lFrit
ROC-17	target	-13.23	3.13	957	27	2.00	210.52	0.68	TiO_2 Homg
	measured	-13.29	3.21	936	26	2.04	208.40	0.67	TiO_2 Homg
	measured bc	-13.39	3.35	935	25	2.16	213.11	0.67	TiO_2
ROC-18	target	-8.67	0.47	986	72	2.00	206.70	0.78	TiO_2 Homg lFrit
	measured	-8.98	0.53	978	60	1.90	204.60	0.77	Homg lFrit
	measured bc	-9.07	0.55	970	62	1.95	207.01	0.77	TiO_2 Homg lFrit
ROC-19	target	-8.70	0.47	980	63	2.00	175.24	0.78	TiO_2 Homg
	measured	-8.80	0.49	979	61	1.83	171.27	0.77	Homg
	measured bc	-8.89	0.51	972	60	1.94	173.65	0.77	TiO_2 Homg
ROC-20	target	-13.23	3.13	762	28	2.00	211.03	0.74	TiO_2
	measured	-12.34	2.16	787	26	2.01	201.21	0.73	lsum TiO_2 Homg lFrit
	measured bc	-12.52	2.33	790	24	2.12	205.67	0.73	newlv TiO_2 Homg lFrit
ROC-21	target	-8.59	0.45	1098	30	2.00	202.87	0.64	T_L TiO_2 Homg
	measured	-8.65	0.46	1077	31	1.97	202.34	0.63	T_L TiO_2 Homg
	measured bc	-8.78	0.49	1075	30	2.03	208.52	0.64	T_L TiO_2 Homg
ROC-22	target	-9.11	0.56	1026	34	1.82	210.06	0.78	T_L Homg lFrit
	measured	-9.26	0.60	1013	33	1.86	209.94	0.77	T_L Homg lFrit
	measured bc	-9.42	0.64	1011	32	1.91	215.75	0.77	T_L lFrit
ROC-23	target	-7.01	0.23	1085	101	2.00	213.10	0.70	T_L newhv TiO_2
	measured	-6.73	0.21	1044	96	1.90	208.72	0.68	T_L lsum Homg
	measured bc	-6.80	0.21	1038	98	1.95	211.19	0.69	T_L TiO_2
ROC-24	target	-8.05	0.36	967	78	2.00	211.98	0.69	TiO_2
	measured	-8.05	0.36	954	80	1.71	212.02	0.68	
	measured bc	-8.17	0.38	955	76	1.81	217.62	0.68	
ROC-25	target	-13.19	3.08	846	28	0.50	210.91	0.70	Homg
	measured	-12.44	2.26	876	24	0.49	208.87	0.69	newlv Homg
	measured bc	-12.54	2.35	871	26	0.50	210.93	0.69	
ROC-26	target	-13.00	2.85	669	48	0.50	201.89	0.65	Homg
	measured	-12.87	2.69	690	47	0.49	203.80	0.64	Homg
	measured bc	-12.93	2.77	689	47	0.51	205.59	0.64	Homg
ROC-27	target	-10.09	0.84	1034	27	2.00	213.11	0.74	T_L TiO_2 lFrit
	measured	-9.78	0.74	1027	28	1.88	211.13	0.73	T_L lFrit
	measured bc	-9.86	0.77	1019	29	1.93	213.02	0.73	T_L TiO_2 lFrit
ROC-28	target	-13.28	3.20	665	48	2.00	194.13	0.71	TiO_2 Homg
	measured	-12.82	2.64	681	48	1.91	189.62	0.71	Homg
	measured bc	-12.85	2.67	678	51	1.97	192.17	0.71	TiO_2 Homg
ROC-29	target	-9.24	0.59	1052	28	0.50	213.11	0.64	T_L
	measured	-9.02	0.54	1046	30	0.48	213.58	0.63	T_L
	measured bc	-9.17	0.58	1043	28	0.51	219.47	0.63	T_L
ROC-30	target	-10.55	1.02	938	38	1.37	203.76	0.72	Homg
	measured	-10.60	1.05	940	37	1.36	207.36	0.71	Homg
	measured bc	-10.75	1.11	940	35	1.44	212.33	0.71	

5.3 PCT

Table B1 in Appendix B provides the elemental leachate concentration measurements for the solution samples generated by the PCTs. Any measurement below the detection limit of the analytical procedure (indicated by a "<") was replaced by one half of the detection limit in subsequent analyses. In addition to adjustments for detection limits, the values were adjusted for the dilution factors: study glasses, blanks and the ARM glass 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 values. There were no solution weight loss issues over the course of the seven day test.

5.3.1 Measurements in Analytical Sequence

Exhibit B1 in Appendix B provides plots of the leachate concentrations in analytical sequence for all of the data from all three sets of PCTs. No issues were observed in these plots.

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

Exhibit B2 in Appendix B provides analyses of measurements of the multi-element solution standard by analytical set/ICP-AES calibration block, and ANOVA investigations for each element of interest. A statistically significant difference (at a 5% level) among the averages of these measurements was indicated for B, Li, and Si. No attempt was made to bias correct for these effects since averaging the ppm values for each set of triplicates minimizes the impact of any potential ICP-AES effects.

Table 11 summarizes the average measurements and the reference values for the four elements of interest. The results indicate consistent and accurate measurements throughout the measurement process.

Table 11. Results from Samples of the Multi-Element Solution Standard

Analytical Set/Block	Avg B (ppm)	Avg Li (ppm)	Avg Na (ppm)	Avg Si (ppm)
1/1	19.93	10.07	82.37	50.43
1/2	19.77	9.97	81.73	50.03
1/3	20.07	9.99	81.53	50.50
2/1	20.10	9.90	81.43	50.03
2/2	20.07	9.97	82.00	50.10
2/3	20.20	10.07	82.03	49.93
3/1	20.10	10.00	81.63	50.07
3/2	20.47	10.07	80.53	50.77
3/3	20.20	10.03	81.00	50.63
Grand Average	20.10	10.01	81.59	50.28
Reference Value	20	10	81	50
% difference	0.5%	0.1%	0.7%	0.6%

5.3.3 Measurements by Glass Identifier

Exhibit B3 in Appendix B provides plots of the leachate concentrations for both the quenched and ccc version of each glass, as well as the reference samples (EA, ARM[16], multi-element solution standard and blanks).[2] Two units of measure are used in these plots: ppm and the common logarithms of the ppm values. The common logarithm plots allow for the assessment of the repeatability of the measurements and any differences between the quenched and ccc version of a given glass.

For some of the glasses, scatter in the triplicate values of some analytes is observed; however, these results do not affect the outcome of this study.

5.3.4 Normalized PCT Results

PCT leachate concentrations were normalized using the target, measured and bias-corrected cation compositions (wt%) in the glass to obtain a grams-per-liter (g/L) leachate concentration.

As is the usual convention, 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 leachate concentration (ppm) for each of the triplicates and each of the elements of interest (these values are provided in Table B1 of Appendix B).

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

Normalizing Using Measured Composition

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.

[16] The concentrations of each element of interest for ARM are within the control limits in THERMO™.

Exhibit B4 in Appendix B provides scatter plots that contain normalized released rates for both the quenched and ccc version of the glass based on the target, measured and bias-corrected compositions. These plots offer an opportunity to investigate the consistency in the leaching across the elements for the glasses of this study. 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. The smallest correlation in this plot is for Li and Si, with a value of ~91.5%, which demonstrates the consistency of the results among the four analytes.

Table 12 summarizes the normalized PCT results for the glasses of this study, which are listed by heat treatment and compositional view for each glass. In general, glasses with higher Al_2O_3 concentrations are more durable, which is to be expected. The PCT results for all of the glasses are acceptable based upon comparisons to the EA results. The NL [B] value for ROC-09 based on the measured compositional view of ROC-09 is 10.14 g/L, which is slightly above the 10 g/L benchmark[17] used by Edwards and Brown, but it is still well below that of the EA glass when measurement uncertainty is applied and is thus considered to be acceptable.[3]

[17] It should be emphasized that this limit was selected only as a guide to develop the Al_2O_3 and/or sum or alkali criteria.

Table 12. Normalized PCT Results

Set	Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li (g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B (g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
1	**ARM**	reference	reference	-0.31	-0.23	-0.29	-0.55	0.49	0.59	0.51	0.28
2	**ARM**	reference	reference	-0.26	-0.21	-0.28	-0.54	0.54	0.61	0.53	0.29
3	**ARM**	reference	reference	-0.28	-0.22	-0.29	-0.54	0.52	0.60	0.52	0.29
1	**EA**	reference	reference	1.23	0.98	1.12	0.61	17.00	9.52	13.24	4.02
2	**EA**	reference	reference	1.24	0.98	1.13	0.60	17.43	9.64	13.56	3.99
3	**EA**	reference	reference	1.24	0.99	1.13	0.61	17.55	9.77	13.41	4.04
1	**ROC-01**	ccc	target	0.05	0.12	-0.03	-0.15	1.11	1.30	0.94	0.71
1		ccc	measured	0.06	0.14	-0.02	-0.15	1.15	1.36	0.96	0.71
1		ccc	measured bc	0.04	0.11	-0.01	-0.16	1.09	1.30	0.99	0.70
1		quenched	target	0.02	0.02	-0.04	-0.23	1.05	1.04	0.91	0.59
1		quenched	measured	0.04	0.04	-0.03	-0.23	1.10	1.09	0.93	0.58
1		quenched	measured bc	0.01	0.01	-0.02	-0.24	1.03	1.03	0.96	0.57
1	**ROC-02**	ccc	target	-0.11	-0.10	-0.07	-0.39	0.77	0.79	0.85	0.41
1		ccc	measured	-0.08	-0.08	-0.05	-0.37	0.83	0.84	0.89	0.43
1		ccc	measured bc	-0.11	-0.10	-0.05	-0.38	0.78	0.80	0.90	0.42
1		quenched	target	-0.04	-0.03	0.02	-0.32	0.92	0.93	1.04	0.48
1		quenched	measured	0.00	-0.01	0.04	-0.30	0.99	0.98	1.09	0.50
1		quenched	measured bc	-0.04	-0.03	0.04	-0.31	0.92	0.94	1.11	0.49
1	**ROC-03**	ccc	target	-0.09	-0.04	-0.24	-0.34	0.81	0.91	0.57	0.46
1		ccc	measured	-0.08	-0.03	-0.24	-0.34	0.83	0.94	0.58	0.45
1		ccc	measured bc	-0.11	-0.05	-0.23	-0.35	0.78	0.89	0.59	0.45
1		quenched	target	-0.10	-0.03	-0.26	-0.35	0.80	0.93	0.55	0.45
1		quenched	measured	-0.09	-0.02	-0.26	-0.35	0.81	0.96	0.55	0.44
1		quenched	measured bc	-0.12	-0.04	-0.25	-0.36	0.76	0.91	0.57	0.44
1	**ROC-04**	ccc	target	-0.24	0.05	-0.08	-0.33	0.57	1.12	0.83	0.47
1		ccc	measured	-0.22	0.06	-0.07	-0.33	0.60	1.15	0.85	0.47
1		ccc	measured bc	-0.25	0.04	-0.06	-0.33	0.56	1.09	0.87	0.46
1		quenched	target	-0.14	-0.08	-0.05	-0.36	0.73	0.84	0.89	0.44
1		quenched	measured	-0.12	-0.06	-0.04	-0.36	0.76	0.86	0.92	0.44
1		quenched	measured bc	-0.14	-0.09	-0.03	-0.37	0.72	0.82	0.93	0.43
1	**ROC-05**	ccc	target	0.09	0.18	0.00	-0.16	1.24	1.51	1.00	0.70
1		ccc	measured	0.12	0.20	0.01	-0.15	1.32	1.58	1.03	0.71
1		ccc	measured bc	0.09	0.18	0.02	-0.16	1.22	1.50	1.05	0.69
1		quenched	target	0.10	0.07	-0.01	-0.23	1.24	1.18	0.98	0.59
1		quenched	measured	0.12	0.09	0.00	-0.22	1.32	1.23	1.01	0.60
1		quenched	measured bc	0.09	0.07	0.01	-0.23	1.23	1.18	1.02	0.59
1	**ROC-06**	ccc	target	0.31	0.30	0.21	-0.29	2.02	1.97	1.62	0.51
1		ccc	measured	0.32	0.30	0.21	-0.29	2.09	1.99	1.61	0.52
1		ccc	measured bc	0.29	0.28	0.22	-0.30	1.94	1.90	1.65	0.50
1		quenched	target	0.35	0.33	0.24	-0.31	2.23	2.13	1.73	0.50
1		quenched	measured	0.36	0.33	0.24	-0.30	2.30	2.16	1.72	0.50
1		quenched	measured bc	0.33	0.31	0.25	-0.31	2.14	2.06	1.77	0.49
1	**ROC-07**	ccc	target	0.24	0.22	0.07	-0.16	1.73	1.67	1.17	0.70
1		ccc	measured	0.26	0.25	0.09	-0.14	1.82	1.76	1.22	0.72
1		ccc	measured bc	0.23	0.22	0.10	-0.15	1.69	1.67	1.25	0.70
1		quenched	target	0.32	0.29	0.12	-0.15	2.07	1.96	1.33	0.70
1		quenched	measured	0.34	0.31	0.14	-0.14	2.17	2.06	1.38	0.73
1		quenched	measured bc	0.31	0.29	0.15	-0.15	2.02	1.96	1.42	0.71
1	**ROC-08**	ccc	target	0.49	0.45	0.41	0.22	3.11	2.82	2.58	1.67
1		ccc	measured	0.51	0.47	0.44	0.24	3.24	2.94	2.73	1.73
1		ccc	measured bc	0.48	0.45	0.45	0.23	3.04	2.79	2.80	1.70
1		quenched	target	0.52	0.44	0.44	0.21	3.33	2.73	2.74	1.63
1		quenched	measured	0.54	0.46	0.46	0.23	3.47	2.85	2.89	1.68
1		quenched	measured bc	0.51	0.43	0.47	0.22	3.27	2.71	2.97	1.66
1	**ROC-09**	ccc	target	0.55	0.46	0.48	0.05	3.57	2.89	2.98	1.12
1		ccc	measured	0.57	0.49	0.52	0.06	3.74	3.07	3.31	1.15
1		ccc	measured bc	0.55	0.47	0.53	0.05	3.52	2.92	3.39	1.13
1		quenched	target	0.99	0.86	0.89	0.35	9.68	7.25	7.83	2.21
1		quenched	measured	1.01	0.89	0.94	0.35	10.14	7.72	8.68	2.26
1		quenched	measured bc	0.98	0.87	0.95	0.35	9.55	7.33	8.90	2.22

Table 12 cont. Normalized PCT Results

Set	Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li (g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B (g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
1	ROC-10	ccc	target	0.07	0.06	-0.02	-0.18	1.18	1.15	0.97	0.67
1		ccc	measured	0.08	0.08	0.02	-0.18	1.20	1.19	1.04	0.66
1		ccc	measured bc	0.05	0.05	0.03	-0.19	1.13	1.13	1.06	0.65
1		quenched	target	0.11	0.09	0.03	-0.14	1.29	1.24	1.06	0.72
1		quenched	measured	0.12	0.11	0.06	-0.15	1.32	1.27	1.14	0.72
1		quenched	measured bc	0.09	0.08	0.07	-0.15	1.24	1.21	1.17	0.70
2	ROC-11	ccc	target	-0.01	0.02	-0.06	-0.21	0.98	1.05	0.86	0.62
2		ccc	measured	0.01	0.05	-0.06	-0.20	1.02	1.11	0.86	0.63
2		ccc	measured bc	-0.02	0.02	-0.05	-0.21	0.96	1.05	0.88	0.62
2		quenched	target	0.05	0.03	-0.01	-0.19	1.11	1.07	0.97	0.64
2		quenched	measured	0.06	0.05	-0.01	-0.18	1.15	1.13	0.97	0.66
2		quenched	measured bc	0.04	0.03	0.00	-0.19	1.08	1.08	0.99	0.64
2	ROC-12	ccc	target	-0.07	0.04	0.03	-0.28	0.85	1.10	1.08	0.53
2		ccc	measured	-0.05	0.05	0.05	-0.27	0.90	1.12	1.13	0.54
2		ccc	measured bc	-0.08	0.03	0.06	-0.28	0.83	1.07	1.14	0.53
2		quenched	target	-0.05	0.05	0.08	-0.25	0.90	1.12	1.20	0.56
2		quenched	measured	-0.03	0.06	0.10	-0.24	0.94	1.15	1.26	0.58
2		quenched	measured bc	-0.06	0.04	0.11	-0.25	0.88	1.10	1.27	0.56
2	ROC-13	ccc	target	-0.10	-0.05	-0.16	-0.30	0.79	0.89	0.69	0.50
2		ccc	measured	-0.08	-0.04	-0.12	-0.30	0.83	0.91	0.77	0.50
2		ccc	measured bc	-0.11	-0.06	-0.11	-0.31	0.77	0.87	0.78	0.49
2		quenched	target	-0.11	-0.07	-0.15	-0.30	0.78	0.85	0.71	0.50
2		quenched	measured	-0.09	-0.06	-0.10	-0.30	0.82	0.87	0.79	0.50
2		quenched	measured bc	-0.12	-0.08	-0.10	-0.31	0.76	0.83	0.80	0.49
2	ROC-14	ccc	target	0.18	0.14	-0.02	-0.37	1.52	1.38	0.96	0.43
2		ccc	measured	0.20	0.16	0.00	-0.37	1.59	1.44	0.99	0.43
2		ccc	measured bc	0.17	0.14	0.00	-0.38	1.48	1.37	1.01	0.42
2		quenched	target	0.01	-0.02	-0.13	-0.39	1.01	0.95	0.73	0.40
2		quenched	measured	0.02	-0.01	-0.12	-0.39	1.06	0.99	0.76	0.40
2		quenched	measured bc	-0.01	-0.03	-0.11	-0.40	0.98	0.94	0.77	0.40
2	ROC-15	ccc	target	-0.10	-0.03	0.04	-0.19	0.80	0.94	1.08	0.65
2		ccc	measured	-0.08	-0.01	0.07	-0.19	0.83	0.99	1.18	0.65
2		ccc	measured bc	-0.11	-0.03	0.08	-0.20	0.78	0.94	1.20	0.64
2		quenched	target	-0.08	-0.11	0.00	-0.24	0.83	0.77	1.01	0.58
2		quenched	measured	-0.06	-0.09	0.04	-0.24	0.86	0.81	1.10	0.57
2		quenched	measured bc	-0.09	-0.12	0.05	-0.25	0.81	0.77	1.11	0.56
2	ROC-16	ccc	target	0.68	0.63	0.49	0.27	4.80	4.23	3.11	1.87
2		ccc	measured	0.71	0.64	0.50	0.29	5.11	4.39	3.15	1.96
2		ccc	measured bc	0.68	0.63	0.50	0.28	4.82	4.29	3.14	1.92
2		quenched	target	0.70	0.63	0.51	0.28	4.96	4.29	3.23	1.89
2		quenched	measured	0.72	0.65	0.52	0.30	5.29	4.45	3.27	1.98
2		quenched	measured bc	0.70	0.64	0.52	0.29	4.98	4.35	3.27	1.93
2	ROC-17	ccc	target	0.01	0.11	0.13	-0.12	1.01	1.28	1.36	0.76
2		ccc	measured	0.01	0.13	0.13	-0.11	1.02	1.33	1.34	0.78
2		ccc	measured bc	-0.02	0.10	0.13	-0.11	0.96	1.26	1.34	0.77
2		quenched	target	0.07	0.05	0.14	-0.13	1.18	1.13	1.37	0.75
2		quenched	measured	0.08	0.07	0.13	-0.12	1.19	1.17	1.35	0.76
2		quenched	measured bc	0.05	0.04	0.13	-0.12	1.12	1.10	1.35	0.75
2	ROC-18	ccc	target	-0.11	-0.02	-0.12	-0.29	0.79	0.96	0.75	0.52
2		ccc	measured	-0.09	-0.02	-0.13	-0.26	0.81	0.95	0.74	0.54
2		ccc	measured bc	-0.12	-0.03	-0.13	-0.27	0.77	0.93	0.74	0.53
2		quenched	target	0.00	0.02	-0.04	-0.24	0.99	1.05	0.91	0.57
2		quenched	measured	0.01	0.02	-0.05	-0.22	1.03	1.04	0.89	0.60
2		quenched	measured bc	-0.01	0.01	-0.05	-0.23	0.97	1.02	0.89	0.58
2	ROC-19	ccc	target	0.31	0.28	0.15	-0.14	2.02	1.90	1.41	0.73
2		ccc	measured	0.33	0.30	0.14	-0.12	2.15	1.98	1.38	0.76
2		ccc	measured bc	0.31	0.29	0.14	-0.13	2.03	1.93	1.38	0.75
2		quenched	target	0.31	0.29	0.15	-0.14	2.06	1.94	1.41	0.72
2		quenched	measured	0.34	0.31	0.14	-0.13	2.19	2.02	1.38	0.75
2		quenched	measured bc	0.32	0.30	0.14	-0.13	2.06	1.98	1.39	0.74

Table 12 cont. Normalized PCT Results

Set	Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li (g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B (g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
2	ROC-20	ccc	target	0.80	0.71	0.70	0.23	6.34	5.18	5.02	1.70
2		ccc	measured	0.83	0.74	0.73	0.26	6.74	5.53	5.32	1.83
2		ccc	measured bc	0.80	0.72	0.73	0.26	6.35	5.21	5.33	1.81
2		quenched	target	0.92	0.80	0.81	0.27	8.23	6.28	6.39	1.87
2		quenched	measured	0.94	0.83	0.83	0.31	8.75	6.70	6.77	2.02
2		quenched	measured bc	0.92	0.80	0.83	0.30	8.24	6.31	6.79	1.99
2	ROC-21	ccc	target	-0.03	-0.02	-0.13	-0.30	0.94	0.96	0.74	0.51
2		ccc	measured	-0.01	0.00	-0.15	-0.29	0.99	1.01	0.71	0.51
3		ccc	measured bc	-0.03	-0.02	-0.15	-0.30	0.93	0.95	0.71	0.50
2		quenched	target	0.00	0.00	-0.11	-0.32	1.00	0.99	0.77	0.48
2		quenched	measured	0.02	0.02	-0.13	-0.31	1.04	1.04	0.74	0.49
3		quenched	measured bc	-0.01	-0.01	-0.13	-0.32	0.98	0.98	0.74	0.48
3	ROC-22	ccc	target	0.06	0.10	-0.02	-0.16	1.14	1.25	0.95	0.69
3		ccc	measured	0.05	0.10	-0.03	-0.15	1.13	1.27	0.93	0.70
3		ccc	measured bc	0.03	0.08	-0.03	-0.16	1.06	1.20	0.93	0.69
3		quenched	target	0.20	0.18	0.10	-0.11	1.57	1.52	1.25	0.78
3		quenched	measured	0.19	0.19	0.09	-0.10	1.55	1.54	1.23	0.79
3		quenched	measured bc	0.16	0.16	0.09	-0.11	1.46	1.46	1.23	0.77
3	ROC-23	ccc	target	-0.26	-0.16	-0.28	-0.36	0.55	0.69	0.53	0.44
3		ccc	measured	-0.24	-0.15	-0.27	-0.33	0.58	0.71	0.54	0.47
3		ccc	measured bc	-0.26	-0.16	-0.27	-0.34	0.55	0.69	0.54	0.46
3		quenched	target	-0.17	-0.12	-0.24	-0.34	0.68	0.76	0.58	0.45
3		quenched	measured	-0.15	-0.11	-0.23	-0.31	0.71	0.78	0.59	0.49
3		quenched	measured bc	-0.18	-0.12	-0.23	-0.32	0.67	0.76	0.59	0.47
3	ROC-24	ccc	target	-0.23	-0.18	-0.29	-0.42	0.59	0.67	0.52	0.38
3		ccc	measured	-0.22	-0.16	-0.30	-0.41	0.60	0.69	0.50	0.39
3		ccc	measured bc	-0.25	-0.19	-0.30	-0.42	0.57	0.65	0.51	0.38
3		quenched	target	-0.22	-0.15	-0.30	-0.42	0.61	0.71	0.51	0.38
3		quenched	measured	-0.21	-0.14	-0.31	-0.42	0.62	0.73	0.50	0.38
3		quenched	measured bc	-0.24	-0.16	-0.30	-0.43	0.58	0.69	0.50	0.38
3	ROC-25	ccc	target	0.09	0.07	0.09	-0.13	1.23	1.17	1.23	0.74
3		ccc	measured	0.10	0.07	0.11	-0.10	1.25	1.17	1.29	0.79
3		ccc	measured bc	0.07	0.06	0.11	-0.11	1.17	1.14	1.29	0.78
3		quenched	target	0.14	0.08	0.16	-0.11	1.37	1.20	1.44	0.77
3		quenched	measured	0.14	0.08	0.18	-0.08	1.38	1.19	1.51	0.83
3		quenched	measured bc	0.12	0.07	0.18	-0.09	1.30	1.17	1.51	0.81
3	ROC-26	ccc	target	-0.14	-0.09	-0.02	-0.26	0.72	0.81	0.96	0.55
3		ccc	measured	-0.13	-0.09	-0.02	-0.25	0.75	0.81	0.96	0.56
3		ccc	measured bc	-0.15	-0.10	-0.02	-0.26	0.71	0.79	0.96	0.55
3		quenched	target	-0.08	-0.08	0.05	-0.24	0.83	0.84	1.12	0.57
3		quenched	measured	-0.07	-0.08	0.05	-0.23	0.86	0.83	1.12	0.58
3		quenched	measured bc	-0.09	-0.09	0.05	-0.24	0.81	0.81	1.13	0.57
3	ROC-27	ccc	target	0.09	0.12	0.06	-0.11	1.22	1.33	1.14	0.77
3		ccc	measured	0.10	0.13	0.06	-0.10	1.26	1.34	1.16	0.79
3		ccc	measured bc	0.07	0.12	0.06	-0.11	1.19	1.31	1.16	0.77
3		quenched	target	0.18	0.14	0.12	-0.10	1.51	1.37	1.33	0.80
3		quenched	measured	0.19	0.14	0.13	-0.09	1.56	1.38	1.35	0.81
3		quenched	measured bc	0.17	0.13	0.13	-0.10	1.48	1.34	1.35	0.79
3	ROC-28	ccc	target	0.29	0.22	0.28	0.06	1.93	1.67	1.91	1.15
3		ccc	measured	0.31	0.23	0.30	0.08	2.02	1.69	1.98	1.20
3		ccc	measured bc	0.28	0.22	0.30	0.07	1.91	1.65	1.98	1.17
3		quenched	target	0.41	0.32	0.39	0.13	2.56	2.06	2.44	1.33
3		quenched	measured	0.43	0.32	0.40	0.14	2.68	2.09	2.51	1.38
3		quenched	measured bc	0.40	0.31	0.40	0.13	2.53	2.04	2.51	1.35
3	ROC-29	ccc	target	0.21	0.18	0.00	-0.33	1.63	1.49	0.99	0.47
3		ccc	measured	0.22	0.19	-0.01	-0.32	1.66	1.54	0.98	0.48
3		ccc	measured bc	0.19	0.16	-0.01	-0.33	1.56	1.45	0.99	0.47
3		quenched	target	0.07	0.06	-0.06	-0.34	1.19	1.14	0.86	0.46
3		quenched	measured	0.08	0.07	-0.07	-0.33	1.21	1.18	0.85	0.47
3		quenched	measured bc	0.06	0.05	-0.07	-0.34	1.14	1.11	0.86	0.46
3	ROC-30	ccc	target	-0.03	-0.01	-0.06	-0.25	0.93	0.97	0.88	0.56
3		ccc	measured	-0.03	0.00	-0.06	-0.25	0.93	0.99	0.86	0.56
3		ccc	measured bc	-0.06	-0.03	-0.06	-0.25	0.88	0.93	0.87	0.56
3		quenched	target	-0.04	-0.03	-0.05	-0.26	0.91	0.93	0.90	0.55
3		quenched	measured	-0.04	-0.03	-0.06	-0.26	0.91	0.94	0.88	0.55
3		quenched	measured bc	-0.07	-0.05	-0.06	-0.26	0.86	0.89	0.88	0.55

5.3.5 Effects of Heat Treatment

Exhibit B5 in Appendix B provides plots of the normalized PCT responses between the two heat treatments. These plots provide a basis for judging the practical impact of differences in the PCT response due to the heat treatment of the glass. In general, the PCT responses of the ccc versions are relatively consistent with those of the quenched versions (within experimental error), *except* for ROC-09, in which the normalized release rates of the quenched glass are considerably higher than those of the ccc glass.[18] Due to these anomalous results, the durability of ROC-09 was re-measured (both heat treatments) and the new data is designated as ROC-09R (Table 13). All of the re-measured values are comparable to those determined in the initial measurement. For the quenched ROC-09R glass, all three compositional views have a NL [B] ≥ 10 g/L. Despite these results, the boron releases of each compositional view are still well below the EA benchmark, acceptable and consistent with the results of the initial measurement. In order to confirm that the quenched and ccc glasses were not inadvertently switched, both were submitted for X-ray Diffraction (XRD) analysis. Each of the glasses was determined to be amorphous (within the 0.5 vol% detection limit of the instrument) as shown in Figure 1. Since crystalline peaks were not detected in either the quenched or ccc glass, no insight was gained on crystallization impacts that could have lead to the significant difference in PCT response.

Table 13. Re-measured PCT Responses of ROC-09

Set	Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li (g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B (g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
3	ROC-09M	ccc	target	0.57	0.48	0.50	0.06	3.68	3.05	3.13	1.15
3		ccc	measured	0.59	0.51	0.54	0.07	3.86	3.25	3.47	1.17
3		ccc	measured bc	0.56	0.49	0.55	0.06	3.63	3.08	3.56	1.15
3		quenched	target	1.01	0.88	0.90	0.36	10.17	7.66	8.01	2.27
3		quenched	measured	1.03	0.91	0.95	0.37	10.66	8.15	8.88	2.32
3		quenched	measured bc	1.00	0.89	0.96	0.36	10.03	7.74	9.10	2.28

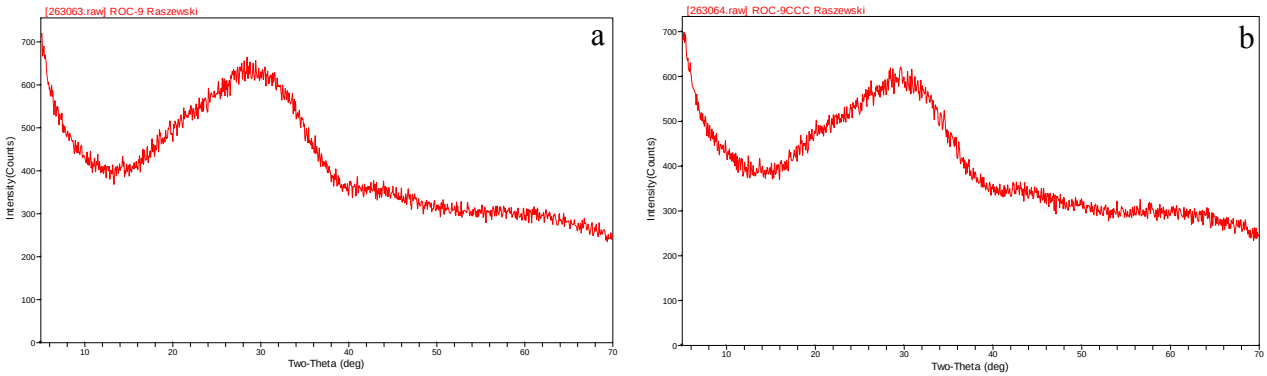


Figure 1. XRD patterns of the ROC-09 quenched (a) and ccc (b) glasses.

[18] It should be noted that boron releases of the quenched ROC-04, -18, -20, -22 and -28 are slightly higher than those of the ccc versions. Recognizing that there is measurement uncertainty, there is not enough variation between the quenched and ccc glasses to be of concern.

Due to these results, ROC-09 was completely re-batched, re-melted and re-measured via XRD and PCT. The XRD results are similar to those shown in Figure 1 and the PCT results are consistent with those previously determined for ROC-09 (Table 14).[19] Based on consistent results of the ROC-09 glasses (original and re-fabricated), this particular glass composition is prone to low durability (although still acceptable based on the use of the 10 g/L guideline) even though no crystallization was detected.

Table 14. PCT Responses of Re-melted ROC-09

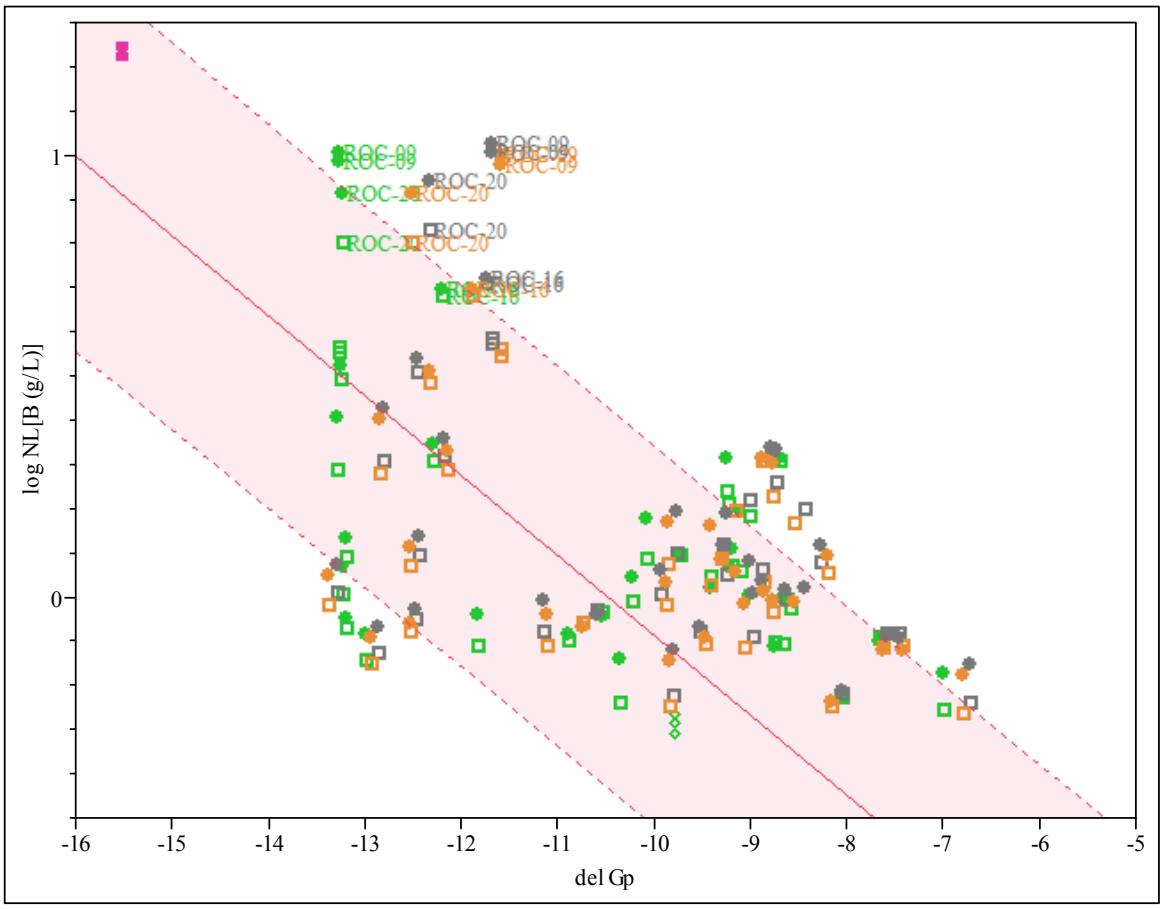
Set	Glass ID	Heat Treatment	Comp View	log NL [B (g/L)]	log NL [Li (g/L)]	log NL [Na (g/L)]	log NL [Si (g/L)]	NL B (g/L)	NL Li (g/L)	NL Na (g/L)	NL Si (g/L)
4	ROC-09RM	ccc	target	0.56	0.47	0.48	0.02	3.65	2.94	3.01	1.04
4	ROC-09RM	quenched	target	0.98	0.86	0.91	0.33	9.62	7.24	8.05	2.14

5.3.6 Predicted versus Measured PCT Results

Exhibits B7 through B10 in Appendix B provide plots of the DWPF models for B, Li, Na, and Si that relate the logarithm of the normalized PCT result (for each element of interest) to a linear function of a free energy of hydration term (ΔG_p, kcal/100g glass) derived for each of the glass compositional views and heat treatments.[2] Prediction limits at a 95% confidence level for an individual PCT result are plotted along with the linear fit. The EA and ARM results are also indicated on these plots.

Note that there are some points that fall above the confidence limits for NL [B (g/L)] as shown in Figure 2, specifically ROC-09, ROC-16 and ROC-20. Each of these glasses is unpredictable with respect to the ΔG_p model except for their target views; however, these glasses are acceptable, which demonstrates that the alumina/sum of alkali constraint prevents the production of unacceptable glasses based on coupled operations flowsheets. It is worth noting that these glasses have relatively low Al_2O_3 and Fe_2O_3 concentrations, and their poor durability behavior is consistent with similar glasses from the reduction of constraints study for sludge-only operations. Glasses at higher ΔG_p values (less negative) are also unpredictable; however, none of these glasses have a normalized boron releases greater than 2.5 g/L. There are also unpredictable glasses that fall below the confidence band around a ΔG_p value of -13. In this region, the durability model is somewhat conservative in that it over-predicted the release rates for boron. These glasses are of no concern as the release rates of boron are very low.

[19] PCT responses were only normalized with respect to the target compositions as the glasses were not submitted for compositional analysis.



Legend

Symbol	Standard/ Comp View-Heat Treatment
z	EA
◊	ARM
□	Measured-ccc
□	Measured bc -ccc
□	Targeted-ccc
●	Measured-quenched
●	Measured bc - quenched
●	Targeted- quenched

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

6.0 SUMMARY

6.1 CHEMICAL COMPOSITION ASSESSMENT

Due to a significant ICP-AES calibration effect (at the 5% significance value), bias-correction of the glass composition data was pursued. Batch 1 results 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 U_{std} values were used to bias correct the U_3O_8 measurements. Bias correction was *not* conducted on the CdO, Ce_2O_3, La_2O_3, PbO, SO_4, ThO_2, ZnO, or ZrO_2 measurements. While a bias-corrected view was included as part of these evaluations, the conclusions of the study were not sensitive to compositional views used to represent the study glasses.

A PF dissolution issue was observed for glasses ROC-01, ROC-07 and ROC-13, and a LM dissolution issue was seen in the results for glasses ROC-06, ROC-08, ROC-17, and ROC-28. The measurements from the questionable dissolutions for these glasses were not used to determine the measured or measured bias-corrected values for the chemical compositions for these glasses.

In general, the measured/measured bias-corrected values, once screened for the issues identified in the previous paragraph, were consistent with the target oxide content in each of the study glasses. It should be noted that there was some scatter in the SO_4 values around their intended targets. In addition, the measured NiO values for some of the study glasses were below the target values.

The sums of oxides (measured and bias-corrected) for the study glasses fall within the interval of 95 to 105 wt% *except* for the measured value of ROC-20; however, bias corrected measurements for this glass did have a sum of oxides above the low limit of 95%. Although compositional issues were identified, none of the issues had an impact on the results or conclusions drawn from this study.

6.2 PCT ASSESSMENT

In general, PCT results for the ccc versions of the study glasses are relatively consistent with those of the quenched versions (within experimental error), *except* for ROC-09 in which the release rates of the quenched glass are considerably higher than those of the ccc glass. Due to these anomalous results, ROC-09 was re-measured. All of the re-measured values were comparable to those determined in the primary measurement. In order to confirm that the quenched and ccc glasses were not switched, both were submitted for XRD analysis. Each of the glasses was determined to be amorphous (within the 0.5 vol% detection limit of the instrument). As a final step, ROC-09 was completely re-batched, re-melted and re-measured via XRD and PCT. Both the XRD and PCT results are consistent with those of the original glass. Thus, there is some other factor influencing the durability of this glass and it is recommended that the influence of alumina and alkali on durability be studied in greater detail. Similar results have been observed in glasses fabricated for the sludge-only reduction of constraints task and in support of a current EM-31 task.[20] The anomalous behaviors of all

of these glasses warrant further study using advanced characterization methods in order to determine the mechanism(s) for the poor durability.

The PCT results for all of the glasses are acceptable based upon comparisons to the EA results and use of the normalized boron 10 g/L benchmark established by Brown and Edwards in support of implementation of the homogeneity constraint.[3] While the boron releases for some compositional views of ROC-09 (initial and re-measured) are slightly above the 10 g/L, the values are still well below the EA results. Even though ROC-09 had a boron release of approximately 10 g/L and the measured composition failed the homogeneity constraint, SRNL recommends the elimination of the homogeneity constraint, which is consistent with the recommendation that was made for sludge-only processing. The use of the alumina and sum of alkali constraints should be continued along with the variability study to determine the applicability of the current durability models and/or that the glasses are acceptable with respect to durability. As with the first phase of testing for sludge-only operations, replacement of the homogeneity constraint with the alumina and sum of alkali constraints will ensure acceptable product durability over the compositional region evaluated. Although these study glasses only provide limited data in a large compositional region, the approach and results are consistent with previous studies that challenged the homogeneity constraint for sludge-only operations. That is, no added benefit is gained by implementation of the homogeneity constraint if the other PCCS constraints are protected and variability studies are continued.

Of the thirty glasses tested in this study, three glasses (ROC-09, ROC-16 and ROC-20) were determined to be unpredictable with respect to the ΔG_p model for durability; however, these glasses are acceptable, which demonstrates that the alumina/sum of alkali constraint prevents the production of unacceptable glasses based on coupled operations flowsheets. Glasses at higher ΔG_p values (less negative) are also unpredictable; however, none of these glasses have a normalized boron releases greater than 2.5 g/L. There are also unpredictable glasses that fall below the confidence band around a ΔG_p value of -13. In this region, the durability model is somewhat conservative in that it over-predicted the release rates for boron. These glasses are of no concern as the release rates of boron are very low.

7.0 RECOMMENDATIONS

Based on the results of this study and conclusions from other SRNL glass studies, it is recommended that the homogeneity constraint (in its entirety with the associated low frit/high frit constraints) be eliminated for coupled operations (up to 2 wt% TiO_2). The variability study should be used to verify that the current durability models are applicable and/or that the glasses are acceptable with respect to durability.

Based on the anomalous results of ROC-09, it is also recommended that the influence of alumina and alkali on durability be studied in greater detail. Limited data suggests that there may be a need to adjust the lower Al_2O_3 limit and/or the upper alkali limit in order to prevent the fabrication of unacceptable glasses. An in-depth evaluation of all previous data as well as any new data would help to better define an alumina and alkali combination that would avoid potential phase separation and ensure glass durability.

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Appendix A:

Tables and Exhibits Supporting the Analysis of the Chemical Composition Measurements of the Study Glasses

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Ba (wt%)	Ca (wt%)	Cd (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	K (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
1	Batch 1	1	1	1	BCHLM111	0.133	0.903	< 0.007	< 0.010	0.072	0.301	2.68	< 0.009	0.86	1.32
1	Ustd	1	1	2	UstdLM111	< 0.002	0.95	< 0.007	< 0.010	0.157	0.011	2.41	< 0.009	0.73	2.03
1	ROC-01	1	1	3	a05LM11	0.0234	0.436	0.075	0.106	0.118	0.044	0.065	0.01	0.86	4.06
1	ROC-08	1	1	4	a10LM21	< 0.002	0.0227	< 0.007	< 0.010	0.11	0.015	0.085	< 0.009	0.85	4.12
1	ROC-07	1	1	5	a07LM21	< 0.002	0.0199	< 0.007	< 0.010	0.114	0.008	0.088	< 0.009	0.01	0.232
1	ROC-09	1	1	6	a12LM11	0.066	2.53	0.226	0.238	< 0.010	0.089	0.092	0.068	0.82	2.63
1	ROC-06	1	1	7	a03LM21	< 0.002	2.21	< 0.007	0.012	0.102	0.013	0.05	< 0.009	0	3.35
1	ROC-11	1	1	8	a08LM11	0.0724	0.913	0.238	0.32	0.112	0.104	0.052	0.062	0.14	4.21
1	ROC-01	1	1	9	a05LM21	0.0234	0.433	0.072	0.104	0.121	0.046	0.06	0.01	0.86	4.07
1	ROC-03	1	1	10	a01LM11	0.0722	0.123	0.236	0.314	< 0.010	0.104	0.05	0.063	0.01	0.383
1	Batch 1	1	1	11	BCHLM121	0.134	0.893	< 0.007	< 0.010	0.074	0.299	2.75	< 0.009	0.86	1.34
1	Ustd	1	1	12	UstdLM121	< 0.002	0.942	< 0.007	< 0.010	0.159	0.011	2.47	< 0.009	0.722	2.05
1	ROC-07	1	1	13	a07LM11	< 0.002	0.021	< 0.007	< 0.010	0.115	0.007	< 0.050	< 0.009	0.01	0.232
1	ROC-09	1	1	14	a12LM21	0.0673	2.57	0.23	0.248	< 0.010	0.09	0.053	0.069	0.83	2.69
1	ROC-08	1	1	15	a10LM11	< 0.002	0.0192	< 0.007	< 0.010	0.102	0.014	< 0.050	< 0.009	0.8	3.86
1	ROC-10	1	1	16	a13LM11	0.0683	0.0179	0.224	0.297	0.104	0.095	< 0.050	0.058	0.84	0.936
1	ROC-10	1	1	17	a13LM21	0.0682	0.0175	0.224	0.298	0.104	0.095	< 0.050	0.058	0.84	0.935
1	ROC-03	1	1	18	a01LM21	0.0704	0.0292	0.232	0.306	< 0.010	0.104	< 0.050	0.075	0.01	0.359
1	ROC-06	1	1	19	a03LM11	< 0.002	2.77	< 0.007	0.019	0.128	0.015	< 0.050	< 0.009	0	4.25
1	ROC-11	1	1	20	a08LM21	0.0711	0.89	0.233	0.308	0.113	0.103	< 0.050	0.06	0.14	4.18
1	Batch 1	1	1	21	BCHLM131	0.134	0.887	< 0.007	< 0.010	0.074	0.298	2.78	< 0.009	0.86	1.35
1	Ustd	1	1	22	UstdLM131	< 0.002	0.934	< 0.007	< 0.010	0.162	0.011	2.49	< 0.009	0.72	2.08
1	Batch 1	1	2	1	BCHLM112	0.133	0.905	< 0.007	< 0.010	0.073	0.298	2.71	< 0.009	0.858	1.31
1	Ustd	1	2	2	UstdLM112	< 0.002	0.94	< 0.007	< 0.010	0.16	0.011	2.38	< 0.009	0.722	2.04
1	ROC-06	1	2	3	a03LM12	< 0.002	2.76	< 0.007	0.029	0.127	0.016	0.078	< 0.009	0.005	4.17
1	ROC-01	1	2	4	a05LM22	0.0234	0.433	0.074	0.115	0.118	0.047	0.068	0.01	0.853	4.04
1	ROC-10	1	2	5	a13LM22	0.0682	0.0186	0.226	0.308	0.104	0.095	0.056	0.06	0.833	0.927
1	ROC-07	1	2	6	a07LM22	< 0.002	0.0209	< 0.007	< 0.010	0.115	0.009	0.06	< 0.009	0.006	0.232
1	ROC-11	1	2	7	a08LM22	0.0715	0.896	0.235	0.322	0.112	0.103	< 0.050	0.06	0.144	4.13
1	ROC-07	1	2	8	a07LM12	< 0.002	0.022	< 0.007	< 0.010	0.117	0.008	< 0.050	< 0.009	0.007	0.231
1	ROC-03	1	2	9	a01LM22	0.0709	0.0306	0.233	0.317	< 0.010	0.103	< 0.050	0.08	0.007	0.357
1	ROC-09	1	2	10	a12LM12	0.0667	2.53	0.228	0.269	< 0.010	0.089	< 0.050	0.07	0.82	2.63
1	Batch 1	1	2	11	BCHLM122	0.134	0.885	< 0.007	< 0.010	0.074	0.297	2.79	< 0.009	0.866	1.34
1	Ustd	1	2	12	UstdLM122	< 0.002	0.93	< 0.007	< 0.010	0.162	0.012	2.53	< 0.009	0.727	2.07
1	ROC-10	1	2	13	a13LM12	0.0676	0.019	0.226	0.306	0.102	0.095	< 0.050	0.06	0.827	0.93
1	ROC-09	1	2	14	a12LM22	0.0671	2.56	0.23	0.272	< 0.010	0.089	< 0.050	0.07	0.823	2.67
1	ROC-08	1	2	15	a10LM12	< 0.002	0.0203	< 0.007	< 0.010	0.1	0.015	< 0.050	< 0.009	0.793	3.83
1	ROC-03	1	2	16	a01LM12	0.0725	0.125	0.237	0.326	< 0.010	0.105	< 0.050	0.06	0.009	0.384
1	ROC-11	1	2	17	a08LM12	0.0729	0.913	0.239	0.33	0.112	0.105	< 0.050	0.06	0.141	4.2
1	ROC-06	1	2	18	a03LM22	< 0.002	2.21	< 0.007	0.022	0.102	0.014	< 0.050	< 0.009	0.005	3.36
1	ROC-01	1	2	19	a05LM12	0.0236	0.434	0.076	0.117	0.119	0.045	< 0.050	0.01	0.872	4.16
1	ROC-08	1	2	20	a10LM22	< 0.002	0.0246	< 0.007	< 0.010	0.11	0.017	< 0.050	< 0.009	0.857	4.18
1	Batch 1	1	2	21	BCHLM132	0.133	0.879	< 0.007	< 0.010	0.0737	0.296	2.83	< 0.009	0.866	1.34
1	Ustd	1	2	22	UstdLM132	< 0.002	0.929	< 0.007	< 0.010	0.161	0.0115	2.5	< 0.009	0.724	2.07
1	Batch 1	2	1	1	BCHLM211	0.133	0.903	< 0.007	< 0.010	0.072	0.297	2.66	< 0.009	0.859	1.31
1	Ustd	2	1	2	UstdLM211	< 0.002	0.951	< 0.007	< 0.010	0.16	0.011	2.37	< 0.009	0.713	2.04
1	ROC-13	2	1	3	a14LM21	< 0.002	0.91	< 0.007	0.022	< 0.010	0.012	< 0.050	< 0.009	0.817	3.91
1	ROC-12	2	1	4	a06LM21	< 0.002	2.69	< 0.007	< 0.010	< 0.010	0.01	< 0.050	< 0.009	0.876	0.235
1	ROC-05	2	1	5	a11LM21	< 0.002	0.102	< 0.007	0.028	< 0.010	0.018	< 0.050	< 0.009	0.897	4.24
1	ROC-02	2	1	6	a09LM11	< 0.002	2.73	< 0.007	< 0.010	0.107	0.013	< 0.050	< 0.009	0.792	0.234
1	ROC-13	2	1	7	a14LM11	< 0.002	0.902	< 0.007	0.021	< 0.010	0.013	< 0.050	< 0.009	0.825	3.96
1	ROC-05	2	1	8	a11LM11	< 0.002	0.1	< 0.007	0.027	< 0.010	0.019	< 0.050	< 0.009	0.874	4.11
1	ROC-14	2	1	9	a04LM21	0.0713	0.0433	0.236	0.284	< 0.010	0.1	< 0.050	0.06	0.867	3.15
1	Batch 1	2	1	10	BCHLM221	0.134	0.881	< 0.007	< 0.010	0.074	0.294	2.75	< 0.009	0.852	1.33
1	Ustd	2	1	11	UstdLM221	< 0.002	0.932	< 0.007	< 0.010	0.163	0.012	2.44	< 0.009	0.718	2.05
1	ROC-04	2	1	12	a02LM21	0.0679	2.71	0.226	0.32	< 0.010	0.101	< 0.050	0.05	0.006	0.271
1	ROC-14	2	1	13	a04LM11	0.0703	0.0357	0.234	0.285	< 0.010	0.102	< 0.050	0.06	0.851	3.07
1	ROC-12	2	1	14	a06LM11	< 0.002	2.66	< 0.007	< 0.010	< 0.010	0.01	< 0.050	< 0.009	0.865	0.233
1	ROC-15	2	1	15	a15LM21	0.0683	0.0208	0.225	0.309	0.113	0.098	< 0.050	0.05	0.008	0.768
1	ROC-04	2	1	16	a02LM11	0.0694	2.7	0.228	0.326	< 0.010	0.102	< 0.050	0.06	0.006	0.224
1	ROC-15	2	1	17	a15LM11	0.0686	0.0224	0.226	0.308	0.11	0.097	< 0.050	0.05	0.008	0.767
1	ROC-02	2	1	18	a09LM21	< 0.002	2.67	< 0.007	< 0.010	0.106	0.012	< 0.050	< 0.009	0.781	0.23
1	Batch 1	2	1	19	BCHLM231	0.134	0.882	< 0.007	< 0.010	0.074	0.295	2.74	< 0.009	0.855	1.33
1	Ustd	2	1	20	UstdLM231	< 0.002	0.926	< 0.007	< 0.010	0.162	0.011	2.46	< 0.009	0.718	2.04
1	Batch 1	2	2	1	BCHLM212	0.138	0.92	< 0.007	< 0.010	0.075	0.301	2.69	< 0.009	0.852	1.33
1	Ustd	2	2	2	UstdLM212	< 0.002	0.968	< 0.007	< 0.010	0.165	0.013	2.39	< 0.009	0.715	2.07
1	ROC-04	2	2	3	a02LM12	0.0708	2.69	0.225	0.335	< 0.010	0.105	0.058	0.06	0.006	0.223
1	ROC-14	2	2	4	a04LM12	0.0724	0.0366	0.231	0.288	< 0.010	0.105	0.062	0.06	0.877	3.1
1	ROC-02	2	2	5	a09LM12	< 0.002	2.73	< 0.007	< 0.010	0.109	0.014	0.067	< 0.009	0.816	0.237
1	ROC-13	2	2	6	a14LM12	< 0.002	0.935	< 0.007	0.025	< 0.010	0.014	0.068	< 0.009	0.85	3.98

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Ba (wt%)	Ca (wt%)	Cd (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	K (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
1	ROC-05	2	2	7	a11LM22	< 0.002	0.104	< 0.007	0.033	< 0.010	0.019	0.052	< 0.009	0.922	4.29
1	ROC-14	2	2	8	a04LM22	0.0734	0.0449	0.235	0.291	< 0.010	0.103	< 0.050	0.06	0.893	3.17
1	ROC-12	2	2	9	a06LM22	< 0.002	2.7	< 0.007	< 0.010	< 0.010	0.011	0.055	< 0.009	0.933	0.246
1	Batch 1	2	2	10	BCHLM222	0.138	0.907	< 0.007	< 0.010	0.076	0.299	2.68	< 0.009	0.853	1.34
1	Ustd	2	2	11	UstdLM222	< 0.002	0.954	< 0.007	< 0.010	0.165	0.013	2.47	< 0.009	0.721	2.07
1	ROC-13	2	2	12	a14LM22	< 0.002	0.935	< 0.007	0.025	< 0.010	0.013	< 0.050	< 0.009	0.848	3.97
1	ROC-04	2	2	13	a02LM22	0.0685	2.71	0.224	0.321	< 0.010	0.102	< 0.050	0.05	0.006	0.268
1	ROC-02	2	2	14	a09LM22	< 0.002	2.66	< 0.007	< 0.010	0.109	0.013	< 0.050	< 0.009	0.807	0.234
1	ROC-15	2	2	15	a15LM22	0.0703	0.0214	0.223	0.315	0.117	0.102	< 0.050	0.05	0.008	0.78
1	ROC-12	2	2	16	a06LM12	< 0.002	2.68	< 0.007	< 0.010	< 0.010	0.011	< 0.050	< 0.009	0.903	0.238
1	ROC-15	2	2	17	a15LM12	0.0706	0.0229	0.226	0.318	0.114	0.1	< 0.050	0.06	0.009	0.782
1	ROC-05	2	2	18	a11LM12	< 0.002	0.104	< 0.007	0.031	< 0.010	0.02	< 0.050	< 0.009	0.912	4.2
1	Batch 1	2	2	19	BCHLM232	0.138	0.903	< 0.007	< 0.010	0.076	0.3	2.71	< 0.009	0.858	1.35
1	Ustd	2	2	20	UstdLM232	< 0.002	0.95	< 0.007	< 0.010	0.166	0.013	2.4	< 0.009	0.722	2.09
2	Batch 1	1	1	1	BCHLM111	0.133	0.887	< 0.007	< 0.020	0.072	0.307	2.61	< 0.009	0.851	1.29
2	Ustd 1	1	1	2	UstdLM111	< 0.002	0.922	< 0.007	< 0.020	0.164	0.008	2.31	< 0.009	0.718	2.08
2	ROC-16	1	1	3	b05LM11	0.07	0.014	0.277	0.28	0.02	0.112	< 0.050	0.0518	0.009	3.98
2	ROC-23	1	1	4	b10LM21	0.077	< 0.010	0.227	0.26	0.093	0.11	< 0.050	0.0545	0.813	1.35
2	ROC-22	1	1	5	b07LM21	< 0.002	0.012	< 0.007	< 0.020	0.023	0.009	< 0.050	< 0.009	0.005	4.2
2	ROC-25	1	1	6	b12LM11	0.071	0.019	0.233	0.266	0.123	0.107	< 0.050	0.0634	0.857	3.95
2	ROC-21	1	1	7	b03LM21	< 0.002	0.068	< 0.007	0.026	0.108	0.016	< 0.050	< 0.009	0.652	4.03
2	ROC-28	1	1	8	b08LM11	0.069	< 0.010	0.233	0.269	0.011	0.11	< 0.050	0.0599	0.89	0.37
2	ROC-16	1	1	9	b05LM21	0.07	0.014	0.279	0.281	0.018	0.108	< 0.050	0.0514	0.011	4
2	ROC-18	1	1	10	b01LM11	< 0.002	1.44	< 0.007	< 0.020	0.024	0.012	< 0.050	< 0.009	0.011	3.64
2	FY09EM21-30	1	1	11	b18LM11	0.038	1.17	0.12	0.147	0.058	0.068	< 0.050	0.0233	0.381	1.78
2	Batch 1	1	1	12	BCHLM121	0.133	0.865	< 0.007	< 0.020	0.073	0.311	2.73	< 0.009	0.85	1.29
2	Ustd 1	1	1	13	UstdLM121	< 0.002	0.919	< 0.007	< 0.020	0.16	0.009	2.4	< 0.009	0.712	2.09
2	ROC-22	1	1	14	b07LM11	< 0.002	0.013	< 0.007	< 0.020	0.024	0.01	< 0.050	< 0.009	0.006	4.29
2	ROC-25	1	1	15	b12LM21	0.071	0.019	0.234	0.262	0.122	0.109	< 0.050	0.0627	0.858	3.94
2	ROC-23	1	1	16	b10LM11	0.08	0.011	0.235	0.262	0.094	0.111	< 0.050	0.0556	0.829	1.39
2	ROC-27	1	1	17	b13LM11	0.072	0.01	0.24	0.273	0.025	0.112	< 0.050	0.0625	0.881	3.96
2	ROC-27	1	1	18	b13LM21	0.073	0.01	0.242	0.276	0.026	0.116	< 0.050	0.0641	0.889	4.05
2	ROC-18	1	1	19	b01LM21	< 0.002	1.51	< 0.007	< 0.020	0.022	0.012	< 0.050	< 0.009	0.008	3.74
2	ROC-21	1	1	20	b03LM11	< 0.002	0.067	< 0.007	0.025	0.109	0.016	< 0.050	< 0.009	0.638	3.98
2	ROC-28	1	1	21	b08LM21	0.064	0.018	0.221	0.251	0.012	0.104	< 0.050	0.0561	0.837	0.35
2	FY09EM21-30	1	1	22	b18LM21	0.039	1.2	0.127	0.149	0.061	0.067	< 0.050	0.0306	0.393	1.84
2	Batch 1	1	1	23	BCHLM131	0.134	0.863	< 0.007	< 0.020	0.075	0.315	2.88	< 0.009	0.85	1.31
2	Ustd 1	1	1	24	UstdLM131	< 0.002	0.918	< 0.007	< 0.020	0.163	0.01	2.42	< 0.009	0.713	2.1
2	Batch 1	1	2	1	BCHLM112	0.133	0.874	< 0.007	< 0.020	0.072	0.305	2.69	< 0.009	0.86	1.31
2	Ustd 1	1	2	2	UstdLM112	< 0.002	0.891	< 0.007	< 0.020	0.162	0.008	2.36	< 0.009	0.724	2.12
2	ROC-21	1	2	3	b03LM12	< 0.002	0.065	< 0.007	0.03	0.105	0.015	< 0.050	< 0.009	0.648	4.02
2	ROC-16	1	2	4	b05LM22	0.069	0.012	0.275	0.286	0.018	0.105	0.061	0.0517	0.011	4.06
2	ROC-27	1	2	5	b13LM22	0.073	< 0.010	0.239	0.285	0.025	0.109	0.062	0.0642	0.902	4.09
2	ROC-22	1	2	6	b07LM22	< 0.002	< 0.010	< 0.007	< 0.020	0.022	0.009	0.067	< 0.009	0.005	4.27
2	ROC-28	1	2	7	b08LM22	0.065	0.015	0.217	0.258	0.011	0.094	< 0.050	0.057	0.846	0.35
2	ROC-22	1	2	8	b07LM12	< 0.002	0.011	< 0.007	< 0.020	0.023	0.01	< 0.050	< 0.009	0.006	4.33
2	ROC-18	1	2	9	b01LM22	< 0.002	1.51	< 0.007	< 0.020	0.021	0.011	< 0.050	< 0.009	0.007	3.8
2	ROC-25	1	2	10	b12LM12	0.071	0.017	0.234	0.274	0.121	0.103	< 0.050	0.0641	0.863	4.02
2	FY09EM21-30	1	2	11	b18LM22	0.038	1.18	0.124	0.157	0.059	0.063	< 0.050	0.0313	0.395	1.86
2	Batch 1	1	2	12	BCHLM122	0.133	0.832	< 0.007	< 0.020	0.072	0.306	2.83	< 0.009	0.862	1.32
2	Ustd 1	1	2	13	UstdLM122	< 0.002	0.884	< 0.007	< 0.020	0.164	0.008	2.58	< 0.009	0.723	2.13
2	ROC-27	1	2	14	b13LM12	0.071	< 0.010	0.236	0.282	0.024	0.103	< 0.050	0.0636	0.889	4.02
2	ROC-25	1	2	15	b12LM22	0.07	0.017	0.231	0.269	0.12	0.104	< 0.050	0.0634	0.871	4.02
2	ROC-23	1	2	16	b10LM12	0.078	< 0.010	0.231	0.273	0.093	0.108	< 0.050	0.0568	0.841	1.41
2	ROC-18	1	2	17	b01LM12	< 0.002	1.43	< 0.007	< 0.020	0.023	0.011	< 0.050	< 0.009	0.011	3.72
2	ROC-28	1	2	18	b08LM12	0.069	< 0.010	0.231	0.274	0.011	0.105	< 0.050	0.0603	0.901	0.37
2	ROC-21	1	2	19	b03LM22	< 0.002	0.065	< 0.007	0.029	0.107	0.016	< 0.050	< 0.009	0.658	4.1
2	ROC-16	1	2	20	b05LM12	0.069	0.011	0.275	0.287	0.02	0.104	< 0.050	0.0523	0.009	4.06
2	ROC-23	1	2	21	b10LM22	0.077	< 0.010	0.227	0.265	0.0931	0.103	< 0.050	0.0554	0.823	1.37
2	FY09EM21-30	1	2	22	b18LM12	0.038	1.15	0.119	0.148	0.0573	0.059	< 0.050	0.0235	0.385	1.8
2	Batch 1	1	2	23	BCHLM132	0.133	0.828	< 0.007	< 0.020	0.0727	0.303	2.68	< 0.009	0.863	1.31
2	Ustd 1	1	2	24	UstdLM132	< 0.002	0.886	< 0.007	< 0.020	0.161	0.009	2.42	< 0.009	0.724	2.12
2	Batch 1	2	1	1	BCHLM211	0.132	0.88	< 0.007	< 0.020	0.071	0.313	2.76	< 0.009	0.853	1.29
2	Ustd 1	2	1	2	UstdLM211	< 0.002	0.94	< 0.007	< 0.020	0.167	0.011	2.5	< 0.009	0.721	2.09
2	ROC-30	2	1	3	b14LM21	0.038	0.755	0.126	0.176	0.064	0.063	0.064	0.03	0.503	2.7
2	ROC-29	2	1	4	b06LM21	0.069	0.056	0.219	0.313	0.02	0.109	0.059	0.061	0.006	3.63
2	ROC-20	2	1	5	b11LM21	0.07	2.7	0.228	0.283	0.13	0.095	< 0.050	0.063	0.219	3.88
2	ROC-17	2	1	6	b09LM11	< 0.002	0.111	< 0.007	< 0.020	0.103	0.008	< 0.050	< 0.009	0.006	3.77
2	ROC-30	2	1	7	b14LM11	0.039	0.762	0.129	0.175	0.065	0.064	< 0.050	0.03	0.512	2.74
2	ROC-20	2	1	8	b11LM11	0.07	2.66	0.227	0.273	0.128	0.097	< 0.050	0.061	0.215	3.84

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Ba (wt%)	Ca (wt%)	Cd (wt%)	Ce (wt%)	Cr (wt%)	Cu (wt%)	K (wt%)	La (wt%)	Mg (wt%)	Mn (wt%)
2	FY09EM21-28	2	1	9	b04LM21	0.039	1.29	0.121	0.157	0.068	0.065	< 0.050	0.035	0.412	1.91
2	ROC-26	2	1	10	b17LM21	< 0.002	0.01	< 0.007	< 0.020	0.015	0.022	< 0.050	< 0.009	0.005	2.52
2	ROC-24	2	1	11	b16LM11	0.073	< 0.010	0.237	0.303	0.107	0.111	< 0.050	0.066	0.886	4.07
2	Batch 1	2	1	12	BCHLM221	0.131	0.862	< 0.007	< 0.020	0.073	0.314	2.72	< 0.009	0.849	1.28
2	Ustd 1	2	1	13	UstdLM221	< 0.002	0.916	< 0.007	< 0.020	0.168	0.014	2.41	< 0.009	0.716	2.07
2	ROC-19	2	1	14	b02LM21	< 0.002	0.014	< 0.007	< 0.020	0.016	0.017	< 0.050	< 0.009	0.886	0.239
2	FY09EM21-28	2	1	15	b04LM11	0.035	1.16	0.11	0.147	0.064	0.055	< 0.050	0.033	0.374	1.72
2	ROC-29	2	1	16	b06LM11	0.069	0.053	0.221	0.314	0.02	0.108	< 0.050	0.061	0.006	3.61
2	FY09EM21-29	2	1	17	b15LM21	0.039	1.24	0.129	0.159	0.062	0.062	< 0.050	0.037	0.397	1.83
2	ROC-19	2	1	18	b02LM11	< 0.002	0.013	< 0.007	< 0.020	0.018	0.018	< 0.050	< 0.009	0.915	0.234
2	FY09EM21-29	2	1	19	b15LM11	0.04	1.25	0.131	0.162	0.064	0.069	< 0.050	0.038	0.4	1.84
2	ROC-17	2	1	20	b09LM21	< 0.002	0.12	< 0.007	< 0.020	0.116	0.012	< 0.050	< 0.009	0.012	4.09
2	ROC-24	2	1	21	b16LM21	0.073	< 0.010	0.239	0.293	0.109	0.114	< 0.050	0.067	0.884	4.06
2	ROC-26	2	1	22	b17LM11	< 0.002	0.012	< 0.007	< 0.020	0.016	0.021	< 0.050	< 0.009	0.005	2.47
2	Batch 1	2	1	23	BCHLM231	0.132	0.855	< 0.007	< 0.020	0.074	0.323	2.6	< 0.009	0.857	1.28
2	Ustd 1	2	1	24	UstdLM231	< 0.002	0.911	< 0.007	< 0.020	0.168	0.016	2.27	< 0.009	0.721	2.08
2	Batch 1	2	2	1	BCHLM212	0.132	0.875	< 0.007	< 0.020	0.072	0.307	2.79	< 0.009	0.852	1.3
2	Ustd 1	2	2	2	UstdLM212	< 0.002	0.936	< 0.007	< 0.020	0.166	0.012	2.47	< 0.009	0.717	2.11
2	ROC-19	2	2	3	b02LM12	< 0.002	0.014	< 0.007	< 0.020	0.018	0.016	0.081	< 0.009	0.898	0.234
2	FY09EM21-28	2	2	4	b04LM12	0.035	1.16	0.106	0.141	0.065	0.062	0.057	0.033	0.369	1.73
2	ROC-17	2	2	5	b09LM12	< 0.002	0.112	< 0.007	< 0.020	0.106	0.008	< 0.050	< 0.009	0.007	3.81
2	ROC-30	2	2	6	b14LM12	0.038	0.76	0.126	0.17	0.067	0.062	< 0.050	0.031	0.509	2.76
2	ROC-20	2	2	7	b11LM22	0.07	2.71	0.225	0.279	0.135	0.097	< 0.050	0.063	0.218	3.92
2	FY09EM21-28	2	2	8	b04LM22	0.038	1.29	0.118	0.155	0.071	0.07	< 0.050	0.036	0.411	1.93
2	ROC-29	2	2	9	b06LM22	0.069	0.056	0.216	0.304	0.021	0.111	< 0.050	0.061	0.007	3.68
2	ROC-24	2	2	10	b16LM22	0.073	0.01	0.229	0.296	0.11	0.111	< 0.050	0.066	0.87	4.08
2	ROC-26	2	2	11	b17LM12	< 0.002	0.013	< 0.007	< 0.020	0.016	0.022	< 0.050	< 0.009	0.005	2.47
2	Batch 1	2	2	12	BCHLM222	0.131	0.861	< 0.007	< 0.020	0.076	0.31	2.6	< 0.009	0.842	1.29
2	Ustd 1	2	2	13	UstdLM222	< 0.002	0.907	< 0.007	< 0.020	0.162	0.017	2.52	< 0.009	0.701	2.06
2	ROC-30	2	2	14	b14LM22	0.038	0.749	0.126	0.17	0.068	0.063	< 0.050	0.031	0.504	2.77
2	ROC-19	2	2	15	b02LM22	< 0.002	0.015	< 0.007	< 0.020	0.017	0.019	< 0.050	< 0.009	0.888	0.244
2	ROC-17	2	2	16	b09LM22	< 0.002	0.121	< 0.007	< 0.020	0.118	0.01	< 0.050	< 0.009	0.012	4.15
2	FY09EM21-29	2	2	17	b15LM22	0.04	1.25	0.127	0.154	0.065	0.069	< 0.050	0.038	0.394	1.86
2	ROC-29	2	2	18	b06LM12	0.069	0.054	0.219	0.305	0.021	0.11	< 0.050	0.061	0.007	3.68
2	FY09EM21-29	2	2	19	b15LM12	0.04	1.26	0.128	0.155	0.067	0.067	< 0.050	0.038	0.397	1.87
2	ROC-20	2	2	20	b11LM12	0.071	2.66	0.227	0.264	0.133	0.1	< 0.050	0.062	0.216	3.92
2	ROC-26	2	2	21	b17LM22	< 0.002	0.011	< 0.007	< 0.020	0.016	0.025	< 0.050	< 0.009	0.005	2.57
2	ROC-24	2	2	22	b16LM12	0.074	< 0.010	0.237	0.296	0.111	0.114	< 0.050	0.067	0.887	4.17
2	Batch 1	2	2	23	BCHLM232	0.134	0.856	< 0.007	< 0.020	0.077	0.319	2.6	< 0.009	0.851	1.31
2	Ustd 1	2	2	24	UstdLM232	< 0.002	0.912	< 0.007	< 0.020	0.166	0.015	2.39	< 0.009	0.716	2.11

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Na (wt%)	Ni (wt%)	P (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Ti (wt%)	U (wt%)	Zn (wt%)	Zr (wt%)
1	Batch 1	1	1	1	BCHLM111	6.78	0.607	< 0.015	0.0101	< 0.150		0.4	< 0.267	< 0.020	0.065
1	Ustd	1	1	2	UstdLM111	8.83	0.77	< 0.015	< 0.010	< 0.150		0.56	2.07	< 0.020	< 0.005
1	ROC-01	1	1	3	a05LM11	7.63	0.0208	0.0173	< 0.010	< 0.150		1.16	7.52	0.038	< 0.005
1	ROC-08	1	1	4	a10LM21	9.76	1.83	0.0177	< 0.010	< 0.150		1.16	5.84	< 0.020	< 0.005
1	ROC-07	1	1	5	a07LM21	7.24	0.0285	< 0.015	< 0.010	< 0.150		0.28	1.8	< 0.020	< 0.005
1	ROC-09	1	1	6	a12LM11	8.84	1.81	< 0.015	0.177	0.232		0.33	0.47	0.11	0.133
1	ROC-06	1	1	7	a03LM21	6.33	0.0196	< 0.015	< 0.010	< 0.150		0.21	6.09	< 0.020	< 0.005
1	ROC-11	1	1	8	a08LM11	7.47	1.9	0.0227	0.226	0.208		0.3	7.84	0.121	0.139
1	ROC-01	1	1	9	a05LM21	7.48	0.0234	0.0215	< 0.010	< 0.150		1.14	7.44	0.039	< 0.005
1	ROC-03	1	1	10	a01LM11	7.39	0.0221	< 0.015	0.2	0.201		1.11	7.53	0.113	0.146
1	Batch 1	1	1	11	BCHLM121	6.86	0.606	< 0.015	0.0105	< 0.150		0.4	< 0.267	< 0.020	0.065
1	Ustd	1	1	12	UstdLM121	8.85	0.757	< 0.015	< 0.010	< 0.150		0.6	2.13	< 0.020	< 0.005
1	ROC-07	1	1	13	a07LM11	7.13	0.0356	< 0.015	0.0102	< 0.150		0.3	1.76	< 0.020	< 0.005
1	ROC-09	1	1	14	a12LM21	8.95	1.83	< 0.015	0.185	0.232		0.34	0.484	0.113	0.135
1	ROC-08	1	1	15	a10LM11	9.05	1.69	0.015	< 0.010	< 0.150		1.07	5.41	< 0.020	< 0.005
1	ROC-10	1	1	16	a13LM11	7.71	0.0244	< 0.015	0.192	0.223		0.28	7.2	0.102	0.132
1	ROC-10	1	1	17	a13LM21	7.68	0.0224	< 0.015	0.191	0.21		0.3	7.23	0.102	0.132
1	ROC-03	1	1	18	a01LM21	7.29	0.0209	< 0.015	0.198	0.204		1.06	7.4	0.109	0.138
1	ROC-06	1	1	19	a03LM11	7.96	0.0267	0.0219	0.01	< 0.150		0.26	7.81	< 0.020	< 0.005
1	ROC-11	1	1	20	a08LM21	7.43	1.85	0.0227	0.227	0.223		0.34	7.61	0.12	0.137
1	Batch 1	1	1	21	BCHLM131	6.89	0.602	< 0.015	< 0.010	< 0.150		0.41	< 0.267	< 0.020	0.066
1	Ustd	1	1	22	UstdLM131	8.88	0.754	< 0.015	< 0.010	< 0.150		0.57	1.99	< 0.020	< 0.005
1	Batch 1	1	2	1	BCHLM112	6.75	0.61	< 0.015	< 0.010	< 0.150		0.399	< 0.267	< 0.020	0.066
1	Ustd	1	2	2	UstdLM112	8.77	0.77	< 0.015	< 0.010	< 0.150		0.558	2.1	< 0.020	< 0.005
1	ROC-06	1	2	3	a03LM12	7.89	0.02	0.033	< 0.010	< 0.150		0.259	7.8	< 0.020	< 0.005
1	ROC-01	1	2	4	a05LM22	7.47	0.02	0.031	< 0.010	0.17		1.12	7.4	0.041	< 0.005
1	ROC-10	1	2	5	a13LM22	7.71	0.02	0.015	0.19	0.244		0.277	7.2	0.104	0.13
1	ROC-07	1	2	6	a07LM22	7.21	0.03	< 0.015	< 0.010	< 0.150		0.273	1.8	< 0.020	< 0.005
1	ROC-11	1	2	7	a08LM22	7.37	1.89	0.036	0.23	0.271		0.337	7.6	0.123	0.135
1	ROC-07	1	2	8	a07LM12	7.22	0.03	< 0.015	< 0.010	< 0.150		0.271	1.8	< 0.020	< 0.005
1	ROC-03	1	2	9	a01LM22	7.32	0.02	0.02	0.2	0.244		1.04	7.5	0.112	0.135
1	ROC-09	1	2	10	a12LM12	8.85	1.84	< 0.015	0.19	0.293		0.327	0.495	0.114	0.132
1	Batch 1	1	2	11	BCHLM122	6.87	0.62	< 0.015	0.01	< 0.150		0.399	< 0.267	< 0.020	0.065
1	Ustd	1	2	12	UstdLM122	8.91	0.78	< 0.015	< 0.010	< 0.150		0.557	2.1	< 0.020	< 0.005
1	ROC-10	1	2	13	a13LM12	7.69	0.02	< 0.015	0.19	0.206		0.276	7.3	0.102	0.129
1	ROC-09	1	2	14	a12LM22	8.97	1.85	< 0.015	0.19	0.259		0.331	0.501	0.114	0.134
1	ROC-08	1	2	15	a10LM12	9.05	1.72	0.022	< 0.010	< 0.150		1.05	5.4	< 0.020	< 0.005
1	ROC-03	1	2	16	a01LM12	7.47	0.02	0.017	0.21	0.241		1.09	7.6	0.115	0.143
1	ROC-11	1	2	17	a08LM12	7.5	1.93	0.03	0.23	0.262		0.34	7.8	0.125	0.137
1	ROC-06	1	2	18	a03LM22	6.39	0.02	0.025	< 0.010	< 0.150		0.207	6.1	< 0.020	0.006
1	ROC-01	1	2	19	a05LM12	7.69	0.02	0.027	< 0.010	< 0.150		1.15	7.6	0.04	< 0.005
1	ROC-08	1	2	20	a10LM22	9.79	1.84	0.023	< 0.010	< 0.150		1.14	5.9	< 0.020	< 0.005
1	Batch 1	1	2	21	BCHLM132	6.94	0.61	< 0.015	< 0.010	< 0.150		0.395	< 0.267	< 0.020	0.065
1	Ustd	1	2	22	UstdLM132	8.94	0.778	< 0.015	< 0.010	< 0.150		0.557	2.1	< 0.020	< 0.005
1	Batch 1	2	1	1	BCHLM211	6.82	0.63	< 0.015	< 0.010	< 0.150		0.397	< 0.267	< 0.020	0.065
1	Ustd	2	1	2	UstdLM211	8.77	0.78	< 0.015	< 0.010	< 0.150		0.562	2.1	< 0.020	< 0.005
1	ROC-13	2	1	3	a14LM21	6.7	0.03	0.02	< 0.010	< 0.150		0.276	6.1	< 0.020	< 0.005
1	ROC-12	2	1	4	a06LM21	9.55	1.95	< 0.015	< 0.010	< 0.150		0.296	2.2	< 0.020	0.008
1	ROC-05	2	1	5	a11LM21	7.74	0.1	< 0.015	0.01	< 0.150		0.308	7.7	< 0.020	< 0.005
1	ROC-02	2	1	6	a09LM11	10	1.95	< 0.015	< 0.010	< 0.150		1.12	3.5	< 0.020	0.008
1	ROC-13	2	1	7	a14LM11	6.78	0.03	0.021	< 0.010	< 0.150		0.277	6.2	< 0.020	< 0.005
1	ROC-05	2	1	8	a11LM11	7.54	0.09	< 0.015	< 0.010	< 0.150		0.295	7.6	< 0.020	< 0.005
1	ROC-14	2	1	9	a04LM21	7.5	1.81	< 0.015	0.21	0.234		1.2	2.1	0.119	0.017
1	Batch 1	2	1	10	BCHLM221	6.8	0.61	< 0.015	0.01	< 0.150		0.395	< 0.267	< 0.020	0.065
1	Ustd	2	1	11	UstdLM221	8.88	0.79	< 0.015	< 0.010	< 0.150		0.555	2.1	< 0.020	< 0.005
1	ROC-04	2	1	12	a02LM21	8.57	1.83	0.031	0.17	0.236		1.09	7.7	0.117	0.14
1	ROC-14	2	1	13	a04LM11	7.39	1.73	< 0.015	0.2	0.222		1.18	2.1	0.116	0.018
1	ROC-12	2	1	14	a06LM11	9.49	1.95	< 0.015	< 0.010	< 0.150		0.292	2.2	< 0.020	0.008
1	ROC-15	2	1	15	a15LM21	10.3	1.8	0.021	0.2	0.277		0.285	6.8	0.116	0.129
1	ROC-04	2	1	16	a02LM11	8.56	1.73	0.035	0.18	0.235		1.06	7.7	0.119	0.14
1	ROC-15	2	1	17	a15LM11	10.4	1.79	0.021	0.2	0.255		0.285	6.8	0.116	0.129
1	ROC-02	2	1	18	a09LM21	9.83	1.91	< 0.015	< 0.010	< 0.150		1.11	3.5	< 0.020	0.007
1	Batch 1	2	1	19	BCHLM231	6.82	0.62	< 0.015	0.01	< 0.150		0.395	< 0.267	< 0.020	0.065
1	Ustd	2	1	20	UstdLM231	8.82	0.78	< 0.015	< 0.010	< 0.150		0.552	2.1	< 0.020	< 0.005
1	Batch 1	2	2	1	BCHLM212	6.7	0.6	< 0.015	0.01	< 0.150		0.408	< 0.267	< 0.020	0.066
1	Ustd	2	2	2	UstdLM212	8.69	0.76	< 0.015	< 0.010	< 0.150		0.573	2.1	< 0.020	< 0.005
1	ROC-04	2	2	3	a02LM12	8.42	1.69	0.038	0.19	0.275		1.08	7.6	0.125	0.142
1	ROC-14	2	2	4	a04LM12	7.32	1.68	< 0.015	0.22	0.239		1.21	2.1	0.122	0.018
1	ROC-02	2	2	5	a09LM12	9.92	1.9	< 0.015	< 0.010	< 0.150		1.14	3.5	< 0.020	0.009
1	ROC-13	2	2	6	a14LM12	6.74	0.02	0.032	< 0.010	< 0.150		0.283	6.1	< 0.020	< 0.005

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Na (wt%)	Ni (wt%)	P (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Ti (wt%)	U (wt%)	Zn (wt%)	Zr (wt%)
1	ROC-05	2	2	7	a11LM22	7.69	0.09	0.025	0.01	< 0.150		0.314	7.7	< 0.020	< 0.005
1	ROC-14	2	2	8	a04LM22	7.43	1.76	< 0.015	0.22	0.21		1.23	2.1	0.125	0.017
1	ROC-12	2	2	9	a06LM22	9.53	1.92	< 0.015	< 0.010	< 0.150		0.31	2.2	< 0.020	0.009
1	Batch 1	2	2	10	BCHLM222	6.75	0.6	< 0.015	< 0.010	< 0.150		0.404	< 0.267	< 0.020	0.066
1	Ustd	2	2	11	UstdLM222	8.79	0.76	< 0.015	< 0.010	< 0.150		0.567	2.1	< 0.020	< 0.005
1	ROC-13	2	2	12	a14LM22	6.63	0.03	0.028	< 0.010	< 0.150		0.282	6	< 0.020	< 0.005
1	ROC-04	2	2	13	a02LM22	8.45	1.77	0.036	0.18	0.273		1.09	7.8	0.122	0.138
1	ROC-02	2	2	14	a09LM22	9.68	1.85	0.016	< 0.010	< 0.150		1.13	3.4	< 0.020	0.008
1	ROC-15	2	2	15	a15LM22	10.2	1.75	0.025	0.21	0.247		0.291	6.8	0.123	0.131
1	ROC-12	2	2	16	a06LM12	9.44	1.9	< 0.015	< 0.010	< 0.150		0.299	2.1	< 0.020	0.009
1	ROC-15	2	2	17	a15LM12	10.3	1.75	0.03	0.22	0.253		0.292	6.9	0.122	0.131
1	ROC-05	2	2	18	a11LM12	7.47	0.08	0.022	0.01	< 0.150		0.306	7.5	< 0.020	< 0.005
1	Batch 1	2	2	19	BCHLM232	6.76	0.6	< 0.015	0.01	< 0.150		0.405	< 0.267	< 0.020	0.066
1	Ustd	2	2	20	UstdLM232	8.77	0.76	< 0.015	< 0.010	< 0.150		0.569	2.1	< 0.020	< 0.005
2	Batch 1	1	1	1	BCHLM111	6.59	0.593	< 0.0150	< 0.010	<0.150	22.7	0.387	< 0.200	< 0.020	0.065
2	Ustd 1	1	1	2	UstdLM111	8.64	0.841	< 0.0150	< 0.010	<0.150	20.6	0.564	2	< 0.020	< 0.005
2	ROC-16	1	1	3	b05LM11	7.34	0.02	0.026	0.189	<0.150	21.2	1.42	6.64	0.092	0.125
2	ROC-23	1	1	4	b10LM21	7.86	1.21	< 0.0150	0.174	<0.150	21.2	1.12	1.94	0.096	0.124
2	ROC-22	1	1	5	b07LM21	7.54	1.67	< 0.0150	< 0.010	<0.150	21.3	1.1	3.53	< 0.020	< 0.005
2	ROC-25	1	1	6	b12LM11	11	0.066	< 0.0150	0.169	0.188	20.5	0.29	2.02	0.092	0.128
2	ROC-21	1	1	7	b03LM21	7.68	1.16	0.028	< 0.010	<0.150	16.9	1.19	7.68	< 0.020	< 0.005
2	ROC-28	1	1	8	b08LM11	12.8	0.02	< 0.0150	0.173	<0.150	24.7	1.14	1.55	0.091	0.134
2	ROC-16	1	1	9	b05LM21	7.38	0.021	0.028	0.192	<0.150	21.3	1.43	6.64	0.093	0.13
2	ROC-18	1	1	10	b01LM11	7.52	1.48	< 0.0150	< 0.010	<0.150	21.4	1.11	4.11	< 0.020	0.007
2	FY09EM21-30	1	1	11	b18LM11	8.55	0.806	< 0.0150	0.078	<0.150	17.9	2.14	4.67	0.05	0.071
2	Batch 1	1	1	12	BCHLM121	6.69	0.601	< 0.0150	< 0.010	<0.150	22.8	0.397	< 0.200	< 0.020	0.064
2	Ustd 1	1	1	13	UstdLM121	8.67	0.853	< 0.0150	< 0.010	<0.150	20.7	0.576	2.01	< 0.020	< 0.005
2	ROC-22	1	1	14	b07LM11	7.72	1.71	< 0.0150	< 0.010	<0.150	21.8	1.12	3.61	< 0.020	< 0.005
2	ROC-25	1	1	15	b12LM21	11	0.065	< 0.0150	0.173	0.161	20.6	0.289	1.99	0.091	0.127
2	ROC-23	1	1	16	b10LM11	8.1	1.25	< 0.0150	0.181	<0.150	21.8	1.15	2.05	0.1	0.128
2	ROC-27	1	1	17	b13LM11	8.7	1.15	< 0.0150	0.182	<0.150	19.9	1.12	3.2	0.098	0.131
2	ROC-27	1	1	18	b13LM21	8.73	1.18	< 0.0150	0.185	<0.150	20.1	1.13	3.22	0.1	0.132
2	ROC-18	1	1	19	b01LM21	7.75	1.56	< 0.0150	< 0.010	<0.150	22.6	1.16	4.29	< 0.020	0.008
2	ROC-21	1	1	20	b03LM11	7.74	1.15	0.028	< 0.010	<0.150	16.8	1.17	7.54	< 0.020	< 0.005
2	ROC-28	1	1	21	b08LM21	12.1	0.027	< 0.0150	0.169	<0.150	23.5	1.08	1.42	0.09	0.124
2	FY09EM21-30	1	1	22	b18LM21	8.82	0.846	< 0.0150	0.083	<0.150	18.6	2.19	4.8	0.052	0.072
2	Batch 1	1	1	23	BCHLM131	6.74	0.612	< 0.0150	< 0.010	<0.150	23.1	0.399	< 0.200	< 0.020	0.065
2	Ustd 1	1	1	24	UstdLM131	8.73	0.864	< 0.0150	< 0.010	<0.150	20.9	0.572	2.03	< 0.020	< 0.005
2	Batch 1	1	2	1	BCHLM112	6.62	0.586	< 0.0150	< 0.010	<0.150	23	0.395	< 0.200	< 0.020	0.065
2	Ustd 1	1	2	2	UstdLM112	8.56	0.846	< 0.0150	< 0.010	<0.150	20.7	0.572	2.05	< 0.020	< 0.005
2	ROC-21	1	2	3	b03LM12	7.56	1.14	0.032	< 0.010	<0.150	16.7	1.17	7.62	< 0.020	< 0.005
2	ROC-16	1	2	4	b05LM22	7.3	0.019	0.034	0.177	<0.150	21.4	1.43	6.7	0.085	0.128
2	ROC-27	1	2	5	b13LM22	8.63	1.17	< 0.0150	0.166	<0.150	20	1.13	3.28	0.09	0.131
2	ROC-22	1	2	6	b07LM22	7.49	1.68	< 0.0150	< 0.010	<0.150	21.4	1.11	3.61	< 0.020	< 0.005
2	ROC-28	1	2	7	b08LM22	11.9	0.023	< 0.0150	0.152	<0.150	23.3	1.08	1.47	0.081	0.124
2	ROC-22	1	2	8	b07LM12	7.6	1.69	< 0.0150	< 0.010	<0.150	21.8	1.12	3.65	< 0.020	< 0.005
2	ROC-18	1	2	9	b01LM22	7.67	1.54	< 0.0150	< 0.010	<0.150	22.6	1.16	4.38	< 0.020	0.008
2	ROC-25	1	2	10	b12LM12	10.8	0.06	< 0.0150	0.166	0.156	20.7	0.293	1.95	0.087	0.126
2	FY09EM21-30	1	2	11	b18LM22	8.7	0.83	< 0.0150	0.077	<0.150	18.5	2.2	4.91	0.048	0.072
2	Batch 1	1	2	12	BCHLM122	6.64	0.589	< 0.0150	< 0.010	<0.150	23	0.395	< 0.200	< 0.020	0.064
2	Ustd 1	1	2	13	UstdLM122	8.6	0.847	< 0.0150	< 0.010	<0.150	20.8	0.572	2.03	< 0.020	< 0.005
2	ROC-27	1	2	14	b13LM12	8.42	1.13	< 0.0150	0.169	0.169	19.9	1.12	3.26	0.092	0.131
2	ROC-25	1	2	15	b12LM22	10.8	0.061	< 0.0150	0.164	<0.150	20.6	0.291	2.03	0.087	0.127
2	ROC-23	1	2	16	b10LM12	7.92	1.25	< 0.0150	0.175	<0.150	21.8	1.15	2.02	0.095	0.126
2	ROC-18	1	2	17	b01LM12	7.48	1.47	< 0.0150	< 0.010	<0.150	21.6	1.12	4.18	< 0.020	0.008
2	ROC-28	1	2	18	b08LM12	12.6	0.019	< 0.0150	0.169	0.18	24.8	1.15	1.54	0.088	0.132
2	ROC-21	1	2	19	b03LM22	7.7	1.15	0.029	< 0.010	<0.150	16.9	1.19	7.77	< 0.020	< 0.005
2	ROC-16	1	2	20	b05LM12	7.29	0.02	0.032	0.188	<0.150	21.3	1.43	6.69	0.09	0.125
2	ROC-23	1	2	21	b10LM22	7.93	1.21	< 0.0150	0.173	<0.150	21.4	1.13	1.98	0.0945	0.124
2	FY09EM21-30	1	2	22	b18LM12	8.58	0.803	< 0.0150	0.075	<0.150	17.9	2.13	4.7	0.0473	0.071
2	Batch 1	1	2	23	BCHLM132	6.77	0.593	< 0.0150	< 0.010	<0.150	22.9	0.393	< 0.200	< 0.020	0.065
2	Ustd 1	1	2	24	UstdLM132	8.71	0.84	< 0.0150	< 0.010	<0.150	20.7	0.573	2.04	< 0.020	< 0.005
2	Batch 1	2	1	1	BCHLM211	6.7	0.595	< 0.0150	< 0.010	<0.150	23.1	0.39	< 0.200	< 0.020	0.063
2	Ustd 1	2	1	2	UstdLM211	8.87	0.848	< 0.0150	< 0.010	<0.150	21	0.566	1.99	< 0.020	< 0.005
2	ROC-30	2	1	3	b14LM21	9.12	0.956	< 0.0150	0.103	<0.150	21.1	0.805	4.64	0.063	0.07
2	ROC-29	2	1	4	b06LM21	8.14	1.76	< 0.0150	0.192	0.191	17.6	0.288	4.53	0.114	0.129
2	ROC-20	2	1	5	b11LM21	9.24	0.02	< 0.0150	0.185	<0.150	20.2	1.21	0.563	0.101	0.136
2	ROC-17	2	1	6	b09LM11	11.4	1.63	< 0.0150	< 0.010	<0.150	19.9	1.13	0.221	< 0.020	< 0.005
2	ROC-30	2	1	7	b14LM11	9.43	0.963	< 0.0150	0.104	<0.150	21.6	0.815	4.63	0.064	0.072
2	ROC-20	2	1	8	b11LM11	9.2	0.017	< 0.0150	0.185	<0.150	19.9	1.19	0.532	0.101	0.13

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

Set	Glass ID	Block	Sub-Block	Sequence	Lab ID	Na (wt%)	Ni (wt%)	P (wt%)	Pb (wt%)	S (wt%)	Si (wt%)	Ti (wt%)	U (wt%)	Zn (wt%)	Zr (wt%)
2	FY09EM21-28	2	1	9	b04LM21	9.64	0.911	< 0.0150	0.098	<0.150	20	2.14	1.87	0.065	0.077
2	ROC-26	2	1	10	b17LM21	13.1	0.018	< 0.0150	< 0.010	<0.150	22.5	0.294	4.62	< 0.020	< 0.005
2	ROC-24	2	1	11	b16LM11	7.99	0.151	< 0.0150	0.199	<0.150	20.8	1.03	1.1	0.107	0.128
2	Batch 1	2	1	12	BCHLM221	6.84	0.605	< 0.0150	< 0.010	<0.150	23.1	0.381	< 0.200	< 0.020	0.063
2	Ustd 1	2	1	13	UstdLM221	8.97	0.861	< 0.0150	< 0.010	<0.150	21	0.553	2.03	< 0.020	< 0.005
2	ROC-19	2	1	14	b02LM21	7.74	1.85	< 0.0150	< 0.010	<0.150	22.5	1.08	5.38	< 0.020	< 0.005
2	FY09EM21-28	2	1	15	b04LM11	8.81	0.837	< 0.0150	0.093	<0.150	18.1	1.93	1.58	0.06	0.07
2	ROC-29	2	1	16	b06LM11	8.24	1.76	< 0.0150	0.203	0.234	17.7	0.282	4.43	0.119	0.129
2	FY09EM21-29	2	1	17	b15LM21	9.41	0.85	< 0.0150	0.117	<0.150	19	2.12	3.37	0.059	0.062
2	ROC-19	2	1	18	b02LM11	8.1	1.93	< 0.0150	< 0.010	<0.150	23.2	1.11	5.57	< 0.020	< 0.005
2	FY09EM21-29	2	1	19	b15LM11	9.56	0.845	< 0.0150	0.119	<0.150	19.5	2.13	3.39	0.06	0.077
2	ROC-17	2	1	20	b09LM21	12.5	1.8	< 0.0150	< 0.010	<0.150	21.9	1.22	0.251	< 0.020	< 0.005
2	ROC-24	2	1	21	b16LM21	8.05	0.148	< 0.0150	0.206	<0.150	20.9	1.01	1.18	0.111	0.129
2	ROC-26	2	1	22	b17LM11	13.2	0.02	< 0.0150	< 0.010	<0.150	22.3	0.281	4.52	< 0.020	< 0.005
2	Batch 1	2	1	23	BCHLM231	7.04	0.601	< 0.0150	< 0.010	<0.150	23.4	0.378	< 0.200	< 0.020	0.063
2	Ustd 1	2	1	24	UstdLM231	9.2	0.872	< 0.0150	< 0.010	<0.150	21.2	0.548	2.07	< 0.020	< 0.005
2	Batch 1	2	2	1	BCHLM212	6.55	0.595	< 0.0150	< 0.010	<0.150	22.9	0.385	< 0.200	< 0.020	0.062
2	Ustd 1	2	2	2	UstdLM212	8.64	0.848	< 0.0150	< 0.010	<0.150	20.9	0.565	2.15	< 0.020	< 0.005
2	ROC-19	2	2	3	b02LM12	7.5	1.87	< 0.0150	< 0.010	<0.150	22.6	1.11	5.64	< 0.020	< 0.005
2	FY09EM21-28	2	2	4	b04LM12	8.32	0.811	< 0.0150	0.09	<0.150	17.7	1.94	1.68	0.061	0.067
2	ROC-17	2	2	5	b09LM12	11	1.64	< 0.0150	< 0.010	<0.150	19.8	1.14	0.246	< 0.020	< 0.005
2	ROC-30	2	2	6	b14LM12	9.02	0.956	< 0.0150	0.108	<0.150	21.3	0.822	4.8	0.067	0.072
2	ROC-20	2	2	7	b11LM22	8.92	0.022	< 0.0150	0.199	<0.150	20.2	1.21	0.584	0.108	0.135
2	FY09EM21-28	2	2	8	b04LM22	9.17	0.909	< 0.0150	0.101	<0.150	19.7	2.15	1.87	0.068	0.078
2	ROC-29	2	2	9	b06LM22	7.81	1.77	< 0.0150	0.208	0.188	17.6	0.292	4.46	0.122	0.131
2	ROC-24	2	2	10	b16LM22	7.54	0.141	< 0.0150	0.207	<0.150	20.4	1.02	1.18	0.112	0.13
2	ROC-26	2	2	11	b17LM12	12.2	0.021	< 0.0150	< 0.010	<0.150	21.7	0.288	4.53	< 0.020	< 0.005
2	Batch 1	2	2	12	BCHLM222	6.51	0.6	< 0.0150	< 0.010	<0.150	22.9	0.383	< 0.200	< 0.020	0.063
2	Ustd 1	2	2	13	UstdLM222	8.38	0.839	< 0.0150	< 0.010	<0.150	20.4	0.551	2.07	< 0.020	< 0.005
2	ROC-30	2	2	14	b14LM22	8.8	0.975	< 0.0150	0.112	<0.150	21.3	0.812	4.64	0.068	0.07
2	ROC-19	2	2	15	b02LM22	7.42	1.87	< 0.0150	< 0.010	<0.150	22.6	1.09	5.44	< 0.020	< 0.005
2	ROC-17	2	2	16	b09LM22	11.6	1.79	< 0.0150	< 0.010	<0.150	21.7	1.23	0.267	< 0.020	< 0.005
2	FY09EM21-29	2	2	17	b15LM22	8.83	0.855	< 0.0150	0.123	<0.150	19	2.15	3.42	0.062	0.065
2	ROC-29	2	2	18	b06LM12	7.79	1.78	< 0.0150	0.213	0.211	17.7	0.288	4.55	0.125	0.132
2	FY09EM21-29	2	2	19	b15LM12	8.85	0.839	< 0.0150	0.123	<0.150	19.4	2.16	3.44	0.062	0.074
2	ROC-20	2	2	20	b11LM12	8.82	0.02	< 0.0146	0.202	<0.150	20.1	1.2	0.57	0.108	0.129
2	ROC-26	2	2	21	b17LM22	12.5	0.02	< 0.0146	< 0.010	<0.150	22.7	0.3	4.77	< 0.020	< 0.005
2	ROC-24	2	2	22	b16LM12	7.61	0.144	< 0.0149	0.215	<0.150	21	1.04	1.21	0.114	0.131
2	Batch 1	2	2	23	BCHLM232	6.55	0.614	< 0.0150	< 0.010	<0.150	23.4	0.386	< 0.200	< 0.020	0.063
2	Ustd 1	2	2	24	UstdLM232	8.56	0.871	< 0.0150	< 0.010	<0.150	21.1	0.556	2.08	< 0.020	< 0.005

Table A2. Measured Elemental Concentrations (wt%) for the Study Glasses Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sub-Block	Sequence	Al (wt%)	B (wt%)	Fe (wt%)	Li (wt%)	Si (wt%)
1	Batch 1	1	1	1	2.54	2.27	8.83	1.98	22.9
1	Ustd	1	1	2	2.13	2.75	9.31	1.36	21.1
1	ROC-10	1	1	3	1.94	1.62	9.91	2.05	21.3
1	ROC-10	1	1	4	1.98	1.64	9.94	2.08	21.5
1	ROC-01	1	1	5	4.47	1.5	4.58	2.09	13.6
1	ROC-08	1	1	6	1.98	1.35	4.03	2.12	21.3
1	ROC-03	1	1	7	2.16	3.04	9.47	1.81	20.5
1	ROC-09	1	1	8	2.16	2.99	5.76	1.77	21
1	ROC-04	1	1	9	4.32	1.6	4.7	2.74	19.5
1	ROC-03	1	1	10	2.19	3.05	9.56	1.83	20.7
1	Batch 1	1	1	11	2.55	2.28	8.91	1.97	23.1
1	Ustd	1	1	12	2.15	2.75	9.33	1.37	21.1
1	ROC-04	1	1	13	4.35	1.62	4.77	2.74	19.6
1	ROC-15	1	1	14	3.84	1.33	7.13	1.78	20.6
1	ROC-09	1	1	15	2.16	2.97	5.76	1.76	20.9
1	ROC-15	1	1	16	3.85	1.34	7.13	1.8	20.6
1	ROC-11	1	1	17	1.9	1.34	3.87	2.02	23
1	ROC-01	1	1	18	5.81	1.9	5.99	2.64	17.7
1	ROC-11	1	1	19	1.88	1.33	3.84	2.02	23.1
1	ROC-08	1	1	20	2.02	1.34	4.19	2.15	21.8
1	Batch 1	1	1	21	2.56	2.27	8.9	1.96	23.0
1	Ustd	1	1	22	2.16	2.73	9.31	1.35	21.1
1	Batch 1	1	2	1	2.57	2.27	8.94	1.94	23.1
1	Ustd	1	2	2	2.15	2.76	9.42	1.34	21.2
1	ROC-01	1	2	3	4.48	1.49	4.65	2.04	13.8
1	ROC-09	1	2	4	2.16	2.99	5.84	1.73	21.1
1	ROC-03	1	2	5	2.21	3.06	9.71	1.8	21
1	ROC-01	1	2	6	5.82	1.89	6.06	2.58	17.8
1	ROC-15	1	2	7	3.85	1.34	7.19	1.75	20.6
1	ROC-09	1	2	8	2.17	2.99	5.82	1.72	21
1	ROC-08	1	2	9	1.99	1.33	4.11	2.07	21.5
1	ROC-10	1	2	10	1.95	1.61	10	2	21.4
1	Batch 1	1	2	11	2.56	2.28	9.02	1.94	23.2
1	Ustd	1	2	12	2.14	2.75	9.4	1.33	21.2
1	ROC-11	1	2	13	1.91	1.37	3.91	1.98	23.1
1	ROC-11	1	2	14	1.88	1.35	3.88	1.98	23.1
1	ROC-04	1	2	15	4.35	1.61	4.76	2.68	19.6
1	ROC-04	1	2	16	4.36	1.61	4.78	2.7	19.6
1	ROC-15	1	2	17	3.85	1.34	7.21	1.75	20.6
1	ROC-08	1	2	18	2.03	1.35	4.24	2.11	21.8
1	ROC-03	1	2	19	2.18	3.02	9.62	1.76	20.7
1	ROC-10	1	2	20	1.97	1.63	10.1	2.02	21.6
1	Batch 1	1	2	21	2.55	2.27	8.98	1.93	23.1
1	Ustd	1	2	22	2.14	2.75	9.41	1.33	21.1
1	Batch 1	2	1	1	2.57	2.27	8.94	1.99	23
1	Ustd	2	1	2	2.16	2.73	9.3	1.36	21.1
1	ROC-13	2	1	3	4.71	1.11	3.83	2.09	17.4
1	ROC-05	2	1	4	2.5	2.01	9.99	1.77	19.4
1	ROC-06	2	1	5	2.85	4.2	3.28	1.85	19.1
1	ROC-07	2	1	6	0.869	1.81	3.01	1.07	10.8
1	ROC-06	2	1	7	2.88	4.23	3.49	1.87	19.4
1	ROC-14	2	1	8	6.05	3.90	4.59	2.37	18
1	ROC-05	2	1	9	2.51	2.05	10.1	1.79	19.5
1	Batch 1	2	1	10	2.55	2.26	8.87	1.96	22.9
1	Ustd	2	1	11	2.17	2.76	9.43	1.36	21.3
1	ROC-02	2	1	12	3.09	2.92	4.56	1.76	20
1	ROC-12	2	1	13	3.02	2.28	4.23	2.96	22.8
1	ROC-14	2	1	14	6.03	3.89	4.58	2.35	18.1
1	ROC-12	2	1	15	2.97	2.25	4.17	2.95	22.5
1	ROC-13	2	1	16	5.73	1.34	4.63	2.57	21.2
1	ROC-07	2	1	17	1.96	4.06	6.82	2.38	24.4
1	ROC-02	2	1	18	3.14	2.96	4.6	1.78	20.2
1	Batch 1	2	1	19	2.55	2.26	8.91	1.95	23.0
1	Ustd	2	1	20	2.15	2.73	9.29	1.35	21.0
1	Batch 1	2	2	1	2.55	2.24	8.85	1.96	23
1	Ustd	2	2	2	2.15	2.69	9.28	1.35	21.2
1	ROC-12	2	2	3	3.02	2.24	4.19	2.91	22.9
1	ROC-05	2	2	4	2.53	2.00	10.1	1.78	19.6
1	ROC-13	2	2	5	4.69	1.06	3.81	2.08	17.5
1	ROC-14	2	2	6	6.07	3.84	4.55	2.34	18

Table A2. Measured Elemental Concentrations (wt%) for the Study Glasses Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sub-Block	Sequence	Al (wt%)	B (wt%)	Fe (wt%)	Li (wt%)	Si (wt%)
1	ROC-07	2	2	7	0.87	1.78	3.01	1.05	10.8
1	ROC-14	2	2	8	6.04	3.85	4.56	2.34	18
1	ROC-07	2	2	9	1.95	4.03	6.79	2.39	24.4
1	Batch 1	2	2	10	2.56	2.21	8.81	1.96	23
1	Ustd	2	2	11	2.17	2.71	9.31	1.36	21.3
1	ROC-12	2	2	12	2.99	2.24	4.15	2.9	22.5
1	ROC-02	2	2	13	3.16	2.95	4.58	1.74	20.3
1	ROC-02	2	2	14	3.09	2.91	4.51	1.72	19.9
1	ROC-06	2	2	15	2.85	4.18	3.27	1.81	19.1
1	ROC-13	2	2	16	5.72	1.32	4.59	2.52	21.1
1	ROC-06	2	2	17	2.88	4.23	3.49	1.82	19.5
1	ROC-05	2	2	18	2.49	1.98	9.95	1.76	19.4
1	Batch 1	2	2	19	2.56	2.23	8.84	1.95	23
1	Ustd	2	2	20	2.15	2.69	9.28	1.34	21.1
2	Batch 1	1	1	1	2.550	2.230	8.910	1.960	
2	Ustd 1	1	1	2	2.140	2.710	9.380	1.360	
2	ROC-27	1	1	3	2.320	1.330	10.200	1.820	
2	ROC-27	1	1	4	2.280	1.310	10.100	1.830	
2	ROC-16	1	1	5	1.830	2.720	3.700	2.990	
2	ROC-23	1	1	6	5.610	1.640	4.840	2.190	
2	ROC-18	1	1	7	2.140	1.470	7.760	1.860	
2	ROC-25	1	1	8	2.900	1.380	8.640	1.910	
2	ROC-19	1	1	9	2.150	3.760	3.380	1.760	
2	ROC-18	1	1	10	2.160	1.490	7.880	1.870	
2	ROC-26	1	1	11	5.060	1.870	3.580	1.850	
2	Batch 1	1	1	12	2.580	2.210	8.960	2.030	
2	Ustd 1	1	1	13	2.170	2.640	9.330	1.390	
2	ROC-19	1	1	14	2.210	3.870	3.410	1.810	
2	FY09EM21-29	1	1	15	3.820	1.980	8.550	2.260	
2	ROC-25	1	1	16	2.810	1.360	8.150	1.820	
2	FY09EM21-29	1	1	17	3.860	2.020	8.720	2.290	
2	ROC-28	1	1	18	2.540	1.310	4.350	1.880	
2	ROC-16	1	1	19	1.850	2.730	3.630	3.020	
2	ROC-28	1	1	20	2.540	1.320	4.390	1.900	
2	ROC-23	1	1	21	5.640	1.680	4.850	2.230	
2	ROC-26	1	1	22	5.080	1.930	3.560	1.870	
2	Batch 1	1	1	23	2.580	2.260	8.950	2.030	
2	Ustd 1	1	1	24	2.190	2.720	9.420	1.400	
2	Batch 1	1	2	1	2.570	2.260	8.900	1.970	
2	Ustd 1	1	2	2	2.170	2.740	9.400	1.370	
2	ROC-16	1	2	3	1.810	2.790	3.710	2.980	
2	ROC-25	1	2	4	2.880	1.430	8.710	1.900	
2	ROC-18	1	2	5	2.150	1.530	7.930	1.870	
2	ROC-16	1	2	6	1.830	2.760	3.700	2.980	
2	FY09EM21-29	1	2	7	3.810	2.050	8.960	2.280	
2	ROC-25	1	2	8	2.780	1.360	8.360	1.830	
2	ROC-23	1	2	9	5.620	1.700	4.930	2.220	
2	ROC-27	1	2	10	2.380	1.350	10.600	1.880	
2	ROC-26	1	2	11	5.060	1.960	3.650	1.870	
2	Batch 1	1	2	12	2.570	2.300	9.230	2.030	
2	Ustd 1	1	2	13	2.160	2.790	9.670	1.400	
2	ROC-28	1	2	14	2.530	1.350	4.130	1.900	
2	ROC-28	1	2	15	2.570	1.360	4.160	1.910	
2	ROC-19	1	2	16	2.170	3.880	3.200	1.760	
2	ROC-19	1	2	17	2.220	4.010	3.320	1.810	
2	FY09EM21-29	1	2	18	3.840	2.070	8.650	2.250	
2	ROC-23	1	2	19	5.650	1.740	4.660	2.240	
2	ROC-18	1	2	20	2.170	1.580	7.860	1.890	
2	ROC-27	1	2	21	2.330	1.420	10.400	1.870	
2	ROC-26	1	2	22	5.110	2.010	3.500	1.880	
2	Batch 1	1	2	23	2.600	2.410	9.200	2.040	
2	Ustd 1	1	2	24	2.180	2.900	9.680	1.430	
2	Batch 1	2	1	1	2.450	2.270	8.670	1.930	
2	Ustd 1	2	1	2	2.060	2.730	9.180	1.350	
2	ROC-30	2	1	3	3.310	2.390	6.100	2.050	
2	ROC-20	2	1	4	1.850	2.910	5.680	1.710	
2	ROC-21	2	1	5	5.400	3.410	5.380	1.810	
2	ROC-22	2	1	6	1.790	1.990	10.000	2.030	
2	ROC-21	2	1	7	5.430	3.420	5.400	1.820	
2	FY09EM21-28	2	1	8	3.750	2.070	8.680	2.210	

Table A2. Measured Elemental Concentrations (wt%) for the Study Glasses Prepared Using Peroxide Fusion

Set	Glass ID	Block	Sub-Block	Sequence	Al (wt%)	B (wt%)	Fe (wt%)	Li (wt%)	Si (wt%)
2	ROC-20	2	1	9	1.900	3.010	5.890	1.770	
2	FY09EM21-30	2	1	10	3.600	1.980	8.590	2.090	
2	ROC-24	2	1	11	5.470	3.280	4.580	1.760	
2	Batch 1	2	1	12	2.510	2.310	8.930	1.960	
2	Ustd 1	2	1	13	2.100	2.770	9.340	1.340	
2	ROC-17	2	1	14	3.430	1.490	6.780	2.030	
2	ROC-29	2	1	15	5.920	3.810	5.320	2.060	
2	FY09EM21-28	2	1	16	3.820	2.110	8.830	2.190	
2	ROC-29	2	1	17	5.910	3.790	5.320	2.030	
2	ROC-30	2	1	18	3.580	2.560	6.550	2.170	
2	ROC-22	2	1	19	1.910	2.050	10.400	2.090	
2	ROC-17	2	1	20	3.400	1.480	6.790	2.020	
2	FY09EM21-30	2	1	21	3.680	2.030	8.770	2.110	
2	ROC-24	2	1	22	5.640	3.400	4.710	1.810	
2	Batch 1	2	1	23	2.420	2.210	8.530	1.820	
2	Ustd 1	2	1	24	2.170	2.820	9.550	1.390	
2	Batch 1	2	2	1	2.530	2.260	8.630	1.960	
2	Ustd 1	2	2	2	2.140	2.780	9.240	1.370	
2	ROC-29	2	2	3	5.930	3.800	5.220	2.060	
2	ROC-20	2	2	4	1.960	3.100	5.890	1.810	
2	ROC-30	2	2	5	3.410	2.470	6.180	2.100	
2	FY09EM21-28	2	2	6	3.780	2.090	8.640	2.210	
2	ROC-22	2	2	7	1.870	2.020	10.100	2.070	
2	FY09EM21-28	2	2	8	3.830	2.110	8.730	2.240	
2	ROC-22	2	2	9	1.840	2.020	10.100	2.080	
2	FY09EM21-30	2	2	10	3.710	2.040	8.700	2.170	
2	ROC-24	2	2	11	5.630	3.410	4.610	1.790	
2	Batch 1	2	2	12	2.590	2.360	9.040	2.020	
2	Ustd 1	2	2	13	2.150	2.810	9.450	1.410	
2	ROC-29	2	2	14	5.980	3.770	5.310	2.130	
2	ROC-17	2	2	15	3.420	1.490	6.730	2.130	
2	ROC-17	2	2	16	3.500	1.510	6.890	2.160	
2	ROC-21	2	2	17	5.590	3.520	5.540	1.950	
2	ROC-30	2	2	18	3.380	2.440	6.260	2.130	
2	ROC-21	2	2	19	5.610	3.520	5.530	1.930	
2	ROC-20	2	2	20	1.970	3.010	5.860	1.820	
2	FY09EM21-30	2	2	21	3.690	2.030	8.840	2.240	
2	ROC-24	2	2	22	5.740	3.450	4.760	1.910	
2	Batch 1	2	2	23	2.460	2.230	8.670	1.950	
2	Ustd 1	2	2	24	2.190	2.860	9.630	1.460	

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	Batch 1	Al2O3 (wt%)	4.8292	4.8770	4.8770	-0.0478	0.0000	-1.0%	0.0%
1	Batch 1	B2O3 (wt%)	7.2743	7.7770	7.7770	-0.5027	0.0000	-6.5%	0.0%
1	Batch 1	BaO (wt%)	0.1504	0.1510	0.1510	-0.0006	0.0000	-0.4%	0.0%
1	Batch 1	CaO (wt%)	1.2532	1.2200	1.2200	0.0332	0.0000	2.7%	0.0%
1	Batch 1	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	Batch 1	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	Batch 1	Cr2O3 (wt%)	0.1081	0.1070	0.1070	0.0011	0.0000	1.0%	0.0%
1	Batch 1	CuO (wt%)	0.3729	0.3990	0.3990	-0.0261	0.0000	-6.5%	0.0%
1	Batch 1	Fe2O3 (wt%)	12.7243	12.8390	12.8390	-0.1147	0.0000	-0.9%	0.0%
1	Batch 1	K2O (wt%)	3.2896	3.3270	3.3270	-0.0374	0.0000	-1.1%	0.0%
1	Batch 1	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	Batch 1	Li2O (wt%)	4.2143	4.4290	4.4290	-0.2147	0.0000	-4.8%	0.0%
1	Batch 1	MgO (wt%)	1.4232	1.4190	1.4190	0.0042	0.0000	0.3%	0.0%
1	Batch 1	MnO (wt%)	1.7205	1.7260	1.7260	-0.0055	0.0000	-0.3%	0.0%
1	Batch 1	Na2O (wt%)	9.1821	9.0030	9.0030	0.1791	0.0000	2.0%	0.0%
1	Batch 1	NiO (wt%)	0.7757	0.7510	0.7510	0.0247	0.0000	3.3%	0.0%
1	Batch 1	PbO (wt%)	0.0086	0.0086	0.0000	0.0086	0.0086		
1	Batch 1	SiO2 (wt%)	49.2574	50.2200	50.2200	-0.9626	0.0000	-1.9%	0.0%
1	Batch 1	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	Batch 1	TiO2 (wt%)	0.6682	0.6770	0.6770	-0.0088	0.0000	-1.3%	0.0%
1	Batch 1	U3O8 (wt%)	0.1574	0.1536	0.0000	0.1574	0.1536		
1	Batch 1	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	Batch 1	ZrO2 (wt%)	0.0884	0.0884	0.0980	-0.0096	-0.0096	-9.8%	-9.8%
1	Batch 1	Sum	97.7501	99.4249	99.0200	-1.2699	0.4049	-1.3%	0.4%
2	Batch 1	Al2O3 (wt%)	4.7883	4.8770	4.8770	-0.0887	0.0000	-1.8%	0.0%
2	Batch 1	B2O3 (wt%)	7.3280	7.7770	7.7770	-0.4490	0.0000	-5.8%	0.0%
2	Batch 1	BaO (wt%)	0.1480	0.1510	0.1510	-0.0030	0.0000	-2.0%	0.0%
2	Batch 1	CaO (wt%)	1.2054	1.2200	1.2200	-0.0146	0.0000	-1.2%	0.0%
2	Batch 1	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	Batch 1	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	Batch 1	Cr2O3 (wt%)	0.1071	0.1070	0.1070	0.0001	0.0000	0.1%	0.0%
2	Batch 1	CuO (wt%)	0.3894	0.3990	0.3990	-0.0096	0.0000	-2.4%	0.0%
2	Batch 1	Fe2O3 (wt%)	12.7029	12.8390	12.8390	-0.1361	0.0000	-1.1%	0.0%
2	Batch 1	K2O (wt%)	3.2615	3.3270	3.3270	-0.0655	0.0000	-2.0%	0.0%
2	Batch 1	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	Batch 1	Li2O (wt%)	4.2520	4.4290	4.4290	-0.1770	0.0000	-4.0%	0.0%
2	Batch 1	MgO (wt%)	1.4151	1.4190	1.4190	-0.0039	0.0000	-0.3%	0.0%
2	Batch 1	MnO (wt%)	1.6764	1.7260	1.7260	-0.0496	0.0000	-2.9%	0.0%
2	Batch 1	Na2O (wt%)	9.0136	9.0030	9.0030	0.0106	0.0000	0.1%	0.0%
2	Batch 1	NiO (wt%)	0.7618	0.7510	0.7510	0.0108	0.0000	1.4%	0.0%
2	Batch 1	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	Batch 1	SiO2 (wt%)	49.2574	50.2200	50.2200	-0.9626	0.0000	-1.9%	0.0%
2	Batch 1	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	Batch 1	TiO2 (wt%)	0.6490	0.6770	0.6770	-0.0280	0.0000	-4.1%	0.0%
2	Batch 1	U3O8 (wt%)	0.1179	0.1176	0.0000	0.1179	0.1176		
2	Batch 1	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	Batch 1	ZrO2 (wt%)	0.0861	0.0861	0.0980	-0.0119	-0.0119	-12.1%	-12.1%
2	Batch 1	Sum	97.4234	99.3893	99.0200	-1.5966	0.3693	-1.6%	0.4%
1	ROC-01	Al2O3 (wt%)	10.9874	11.0997	10.8584	0.1291	0.2414	1.2%	2.2%
1	ROC-01	B2O3 (wt%)	6.1017	6.4827	6.3394	-0.2377	0.1433	-3.7%	2.3%
1	ROC-01	BaO (wt%)	0.0262	0.0265	0.0259	0.0003	0.0007	1.2%	2.6%
1	ROC-01	CaO (wt%)	0.6073	0.5936	0.5962	0.0110	-0.0026	1.9%	-0.4%
1	ROC-01	CdO (wt%)	0.0848	0.0848	0.0957	-0.0109	-0.0109	-11.4%	-11.4%
1	ROC-01	Ce2O3 (wt%)	0.1294	0.1294	0.1164	0.0131	0.0131	11.2%	11.2%
1	ROC-01	Cr2O3 (wt%)	0.1739	0.1734	0.2000	-0.0261	-0.0266	-13.0%	-13.3%
1	ROC-01	CuO (wt%)	0.0570	0.0609	0.0414	0.0156	0.0195	37.7%	47.2%
1	ROC-01	Fe2O3 (wt%)	8.6139	8.6624	8.6212	-0.0073	0.0411	-0.1%	0.5%
1	ROC-01	K2O (wt%)	0.0657	0.0658	0.0000	0.0657	0.0658		
1	ROC-01	La2O3 (wt%)	0.0117	0.0117	0.0316	-0.0198	-0.0198	-62.8%	-62.8%
1	ROC-01	Li2O (wt%)	5.6191	5.9178	5.8767	-0.2576	0.0411	-4.4%	0.7%
1	ROC-01	MgO (wt%)	1.4282	1.4183	1.5000	-0.0718	-0.0817	-4.8%	-5.4%
1	ROC-01	MnO (wt%)	5.2713	5.2849	5.5000	-0.2287	-0.2151	-4.2%	-3.9%
1	ROC-01	Na2O (wt%)	10.2010	9.9484	10.4607	-0.2598	-0.5123	-2.5%	-4.9%
1	ROC-01	NiO (wt%)	0.0268	0.0260	0.0000	0.0268	0.0260		
1	ROC-01	PbO (wt%)	0.0054	0.0054	0.0698	-0.0644	-0.0644	-92.3%	-92.3%
1	ROC-01	SiO2 (wt%)	37.9726	38.6447	37.9018	0.0707	0.7429	0.2%	2.0%
1	ROC-01	SO4 (wt%)	0.2958	0.2958	0.1552	0.1407	0.1407	90.7%	90.7%
1	ROC-01	TiO2 (wt%)	1.9057	1.9313	2.0000	-0.0943	-0.0687	-4.7%	-3.4%
1	ROC-01	U3O8 (wt%)	8.8322	8.6575	9.5000	-0.6678	-0.8425	-7.0%	-8.9%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	ROC-01	ZnO (wt%)	0.0492	0.0492	0.0434	0.0057	0.0057	13.2%	13.2%
1	ROC-01	ZrO2 (wt%)	0.0034	0.0034	0.0662	-0.0628	-0.0628	-94.9%	-94.9%
1	ROC-01	Sum	98.4697	99.5737	100.0000	-1.5303	-0.4263	-1.5%	-0.4%
1	ROC-02	Al2O3 (wt%)	5.8952	5.9516	5.9109	-0.0156	0.0407	-0.3%	0.7%
1	ROC-02	B2O3 (wt%)	9.4504	10.1678	10.1906	-0.7402	-0.0228	-7.3%	-0.2%
1	ROC-02	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-02	CaO (wt%)	3.7743	3.6599	4.0000	-0.2257	-0.3401	-5.6%	-8.5%
1	ROC-02	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-02	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	ROC-02	Cr2O3 (wt%)	0.1575	0.1548	0.1800	-0.0225	-0.0252	-12.5%	-14.0%
1	ROC-02	CuO (wt%)	0.0163	0.0174	0.0000	0.0163	0.0174		
1	ROC-02	Fe2O3 (wt%)	6.5230	6.6041	6.6982	-0.1752	-0.0942	-2.6%	-1.4%
1	ROC-02	K2O (wt%)	0.0428	0.0437	0.0000	0.0428	0.0437		
1	ROC-02	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-02	Li2O (wt%)	3.7676	3.9510	4.0000	-0.2324	-0.0490	-5.8%	-1.2%
1	ROC-02	MgO (wt%)	1.3250	1.3263	1.3500	-0.0250	-0.0237	-1.9%	-1.8%
1	ROC-02	MnO (wt%)	0.3018	0.3030	0.3000	0.0018	0.0030	0.6%	1.0%
1	ROC-02	Na2O (wt%)	13.2879	13.0992	13.8866	-0.5987	-0.7874	-4.3%	-5.7%
1	ROC-02	NiO (wt%)	2.4209	2.3423	2.5000	-0.0791	-0.1577	-3.2%	-6.3%
1	ROC-02	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	ROC-02	SiO2 (wt%)	42.9999	43.9198	44.7108	-1.7109	-0.7911	-3.8%	-1.8%
1	ROC-02	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-02	TiO2 (wt%)	1.8765	1.9010	1.9601	-0.0836	-0.0591	-4.3%	-3.0%
1	ROC-02	U3O8 (wt%)	4.0977	3.9814	4.3129	-0.2151	-0.3315	-5.0%	-7.7%
1	ROC-02	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-02	ZrO2 (wt%)	0.0108	0.0108	0.0000	0.0108	0.0108		
1	ROC-02	Sum	96.2065	97.6927	100.0000	-3.7935	-2.3073	-3.8%	-2.3%
1	ROC-03	Al2O3 (wt%)	4.1286	4.1707	3.7616	0.3670	0.4091	9.8%	10.9%
1	ROC-03	B2O3 (wt%)	9.7965	10.4083	9.9798	-0.1833	0.4285	-1.8%	4.3%
1	ROC-03	BaO (wt%)	0.0798	0.0809	0.0801	-0.0003	0.0007	-0.4%	0.9%
1	ROC-03	CaO (wt%)	0.1077	0.1052	0.0009	0.1067	0.1043	11240.2%	10985.4%
1	ROC-03	CdO (wt%)	0.2679	0.2679	0.2965	-0.0286	-0.0286	-9.6%	-9.6%
1	ROC-03	Ce2O3 (wt%)	0.3698	0.3698	0.3606	0.0093	0.0093	2.6%	2.6%
1	ROC-03	Cr2O3 (wt%)	0.0073	0.0073	0.0000	0.0073	0.0073		
1	ROC-03	CuO (wt%)	0.1302	0.1392	0.1282	0.0020	0.0110	1.5%	8.6%
1	ROC-03	Fe2O3 (wt%)	13.7108	13.7877	14.1391	-0.4283	-0.3514	-3.0%	-2.5%
1	ROC-03	K2O (wt%)	0.0376	0.0378	0.0000	0.0376	0.0378		
1	ROC-03	La2O3 (wt%)	0.0815	0.0815	0.0978	-0.0162	-0.0162	-16.6%	-16.6%
1	ROC-03	Li2O (wt%)	3.8752	4.0812	4.0000	-0.1248	0.0812	-3.1%	2.0%
1	ROC-03	MgO (wt%)	0.0149	0.0148	0.0000	0.0149	0.0148		
1	ROC-03	MnO (wt%)	0.4787	0.4799	0.4843	-0.0055	-0.0043	-1.1%	-0.9%
1	ROC-03	Na2O (wt%)	9.9314	9.6855	10.0010	-0.0696	-0.3155	-0.7%	-3.2%
1	ROC-03	NiO (wt%)	0.0264	0.0256	0.0000	0.0264	0.0256		
1	ROC-03	PbO (wt%)	0.2176	0.2176	0.2163	0.0012	0.0012	0.6%	0.6%
1	ROC-03	SiO2 (wt%)	44.3370	45.1214	44.2513	0.0857	0.8701	0.2%	2.0%
1	ROC-03	SO4 (wt%)	0.6666	0.6666	0.4808	0.1858	0.1858	38.7%	38.7%
1	ROC-03	TiO2 (wt%)	1.7931	1.8171	2.0000	-0.2069	-0.1829	-10.3%	-9.1%
1	ROC-03	U3O8 (wt%)	8.8528	8.6774	9.3820	-0.5291	-0.7045	-5.6%	-7.5%
1	ROC-03	ZnO (wt%)	0.1397	0.1397	0.1346	0.0051	0.0051	3.8%	3.8%
1	ROC-03	ZrO2 (wt%)	0.1898	0.1898	0.2051	-0.0153	-0.0153	-7.5%	-7.5%
1	ROC-03	Sum	99.2411	100.5731	100.0000	-0.7589	0.5731	-0.8%	0.6%
1	ROC-04	Al2O3 (wt%)	8.2099	8.2938	7.9615	0.2484	0.3323	3.1%	4.2%
1	ROC-04	B2O3 (wt%)	5.1840	5.5078	5.4163	-0.2323	0.0914	-4.3%	1.7%
1	ROC-04	BaO (wt%)	0.0772	0.0769	0.0801	-0.0029	-0.0032	-3.6%	-4.1%
1	ROC-04	CaO (wt%)	3.7813	3.6667	4.0000	-0.2187	-0.3333	-5.5%	-8.3%
1	ROC-04	CdO (wt%)	0.2579	0.2579	0.2965	-0.0386	-0.0386	-13.0%	-13.0%
1	ROC-04	Ce2O3 (wt%)	0.3813	0.3813	0.3606	0.0207	0.0207	5.7%	5.7%
1	ROC-04	Cr2O3 (wt%)	0.0073	0.0072	0.0000	0.0073	0.0072		
1	ROC-04	CuO (wt%)	0.1283	0.1374	0.1282	0.0001	0.0092	0.1%	7.2%
1	ROC-04	Fe2O3 (wt%)	6.7946	6.8329	6.7642	0.0305	0.0688	0.5%	1.0%
1	ROC-04	K2O (wt%)	0.0401	0.0409	0.0000	0.0401	0.0409		
1	ROC-04	La2O3 (wt%)	0.0645	0.0645	0.0978	-0.0333	-0.0333	-34.0%	-34.0%
1	ROC-04	Li2O (wt%)	5.8451	6.1560	6.0107	-0.1655	0.1453	-2.8%	2.4%
1	ROC-04	MgO (wt%)	0.0099	0.0100	0.0000	0.0099	0.0100		
1	ROC-04	MnO (wt%)	0.3183	0.3195	0.3000	0.0183	0.0195	6.1%	6.5%
1	ROC-04	Na2O (wt%)	11.4580	11.2951	11.8055	-0.3475	-0.5103	-2.9%	-4.3%
1	ROC-04	NiO (wt%)	2.2332	2.1607	2.5000	-0.2668	-0.3393	-10.7%	-13.6%
1	ROC-04	PbO (wt%)	0.1939	0.1939	0.2163	-0.0225	-0.0225	-10.4%	-10.4%
1	ROC-04	SiO2 (wt%)	41.8768	42.6183	41.7419	0.1349	0.8764	0.3%	2.1%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	ROC-04	SO4 (wt%)	0.7632	0.7632	0.4808	0.2824	0.2824	58.7%	58.7%
1	ROC-04	TiO2 (wt%)	1.8014	1.8250	2.0000	-0.1986	-0.1750	-9.9%	-8.7%
1	ROC-04	U3O8 (wt%)	9.0798	8.8220	9.5000	-0.4202	-0.6780	-4.4%	-7.1%
1	ROC-04	ZnO (wt%)	0.1503	0.1503	0.1346	0.0157	0.0157	11.7%	11.7%
1	ROC-04	ZrO2 (wt%)	0.1891	0.1891	0.2051	-0.0160	-0.0160	-7.8%	-7.8%
1	ROC-04	Sum	98.8456	99.7703	100.0000	-1.1544	-0.2297	-1.2%	-0.2%
1	ROC-05	Al2O3 (wt%)	4.7379	4.7832	4.5531	0.1848	0.2301	4.1%	5.1%
1	ROC-05	B2O3 (wt%)	6.4720	6.9628	6.8633	-0.3913	0.0995	-5.7%	1.4%
1	ROC-05	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-05	CaO (wt%)	0.1434	0.1390	0.1048	0.0386	0.0342	36.8%	32.6%
1	ROC-05	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-05	Ce2O3 (wt%)	0.0348	0.0348	0.0000	0.0348	0.0348		
1	ROC-05	Cr2O3 (wt%)	0.0073	0.0072	0.0000	0.0073	0.0072		
1	ROC-05	CuO (wt%)	0.0238	0.0255	0.0000	0.0238	0.0255		
1	ROC-05	Fe2O3 (wt%)	14.3470	14.5255	14.5163	-0.1692	0.0092	-1.2%	0.1%
1	ROC-05	K2O (wt%)	0.0382	0.0391	0.0000	0.0382	0.0391		
1	ROC-05	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-05	Li2O (wt%)	3.8214	4.0075	4.0000	-0.1786	0.0075	-4.5%	0.2%
1	ROC-05	MgO (wt%)	1.4945	1.4961	1.5000	-0.0055	-0.0039	-0.4%	-0.3%
1	ROC-05	MnO (wt%)	5.4360	5.4566	5.5000	-0.0640	-0.0434	-1.2%	-0.8%
1	ROC-05	Na2O (wt%)	10.2583	10.1127	10.5327	-0.2744	-0.4200	-2.6%	-4.0%
1	ROC-05	NiO (wt%)	0.1145	0.1107	0.0723	0.0422	0.0384	58.4%	53.2%
1	ROC-05	PbO (wt%)	0.0094	0.0094	0.0000	0.0094	0.0094		
1	ROC-05	SiO2 (wt%)	41.6629	42.5541	42.3575	-0.6946	0.1966	-1.6%	0.5%
1	ROC-05	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-05	TiO2 (wt%)	0.5100	0.5166	0.5000	0.0100	0.0166	2.0%	3.3%
1	ROC-05	U3O8 (wt%)	8.9914	8.7361	9.5000	-0.5086	-0.7639	-5.4%	-8.0%
1	ROC-05	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-05	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	ROC-05	Sum	98.3539	99.7678	100.0000	-1.6461	-0.2322	-1.6%	-0.2%
1	ROC-06	Al2O3 (wt%)	5.4134	5.4652	5.1016	0.3119	0.3636	6.1%	7.1%
1	ROC-06	B2O3 (wt%)	13.5558	14.5849	14.0000	-0.4442	0.5849	-3.2%	4.2%
1	ROC-06	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-06	CaO (wt%)	3.8688	3.7817	4.0000	-0.1312	-0.2183	-3.3%	-5.5%
1	ROC-06	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-06	Ce2O3 (wt%)	0.0281	0.0281	0.0000	0.0281	0.0281		
1	ROC-06	Cr2O3 (wt%)	0.1864	0.1857	0.2000	-0.0136	-0.0143	-6.8%	-7.1%
1	ROC-06	CuO (wt%)	0.0194	0.0207	0.0000	0.0194	0.0207		
1	ROC-06	Fe2O3 (wt%)	4.8360	4.8961	5.0000	-0.1640	-0.1039	-3.3%	-2.1%
1	ROC-06	K2O (wt%)	0.0620	0.0619	0.0000	0.0620	0.0619		
1	ROC-06	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-06	Li2O (wt%)	3.9560	4.1486	4.0000	-0.0440	0.1486	-1.1%	3.7%
1	ROC-06	MgO (wt%)	0.0041	0.0041	0.0000	0.0041	0.0041		
1	ROC-06	MnO (wt%)	5.4360	5.4497	5.5000	-0.0640	-0.0503	-1.2%	-0.9%
1	ROC-06	Na2O (wt%)	10.6829	10.4185	10.6188	0.0641	-0.2003	0.6%	-1.9%
1	ROC-06	NiO (wt%)	0.0297	0.0288	0.0000	0.0297	0.0288		
1	ROC-06	PbO (wt%)	0.0081	0.0081	0.0000	0.0081	0.0081		
1	ROC-06	SiO2 (wt%)	41.2350	42.1170	41.5797	-0.3447	0.5374	-0.8%	1.3%
1	ROC-06	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-06	TiO2 (wt%)	0.4328	0.4387	0.5000	-0.0672	-0.0613	-13.4%	-12.3%
1	ROC-06	U3O8 (wt%)	9.2037	9.0218	9.5000	-0.2963	-0.4782	-3.1%	-5.0%
1	ROC-06	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-06	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	ROC-06	Sum	99.2090	100.9106	100.0000	-0.7910	0.9106	-0.8%	0.9%
1	ROC-07	Al2O3 (wt%)	3.6940	3.7293	3.4635	0.2305	0.2658	6.7%	7.7%
1	ROC-07	B2O3 (wt%)	13.0245	14.0130	13.6919	-0.6674	0.3211	-4.9%	2.3%
1	ROC-07	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-07	CaO (wt%)	0.0293	0.0287	0.0000	0.0293	0.0287		
1	ROC-07	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-07	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	ROC-07	Cr2O3 (wt%)	0.1684	0.1679	0.2000	-0.0316	-0.0321	-15.8%	-16.1%
1	ROC-07	CuO (wt%)	0.0100	0.0107	0.0000	0.0100	0.0107		
1	ROC-07	Fe2O3 (wt%)	9.7291	9.8501	10.2256	-0.4965	-0.3756	-4.9%	-3.7%
1	ROC-07	K2O (wt%)	0.0596	0.0598	0.0000	0.0596	0.0598		
1	ROC-07	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-07	Li2O (wt%)	5.1347	5.3849	5.4049	-0.2703	-0.0201	-5.0%	-0.4%
1	ROC-07	MgO (wt%)	0.0137	0.0136	0.0000	0.0137	0.0136		
1	ROC-07	MnO (wt%)	0.2992	0.3000	0.3000	-0.0008	0.0000	-0.3%	0.0%
1	ROC-07	Na2O (wt%)	9.7056	9.4653	10.0968	-0.3912	-0.6315	-3.9%	-6.3%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	ROC-07	NiO (wt%)	0.0395	0.0383	0.0000	0.0395	0.0383		
1	ROC-07	PbO (wt%)	0.0068	0.0068	0.0000	0.0068	0.0068		
1	ROC-07	SiO2 (wt%)	52.1989	53.3155	53.8793	-1.6803	-0.5637	-3.1%	-1.0%
1	ROC-07	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-07	TiO2 (wt%)	0.4687	0.4749	0.5000	-0.0313	-0.0251	-6.3%	-5.0%
1	ROC-07	U3O8 (wt%)	2.1108	2.0689	2.2381	-0.1273	-0.1691	-5.7%	-7.6%
1	ROC-07	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-07	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	ROC-07	Sum	96.9496	99.1843	100.0000	-3.0504	-0.8157	-3.1%	-0.8%
1	ROC-08	Al2O3 (wt%)	3.7884	3.8272	3.5110	0.2774	0.3161	7.9%	9.0%
1	ROC-08	B2O3 (wt%)	4.3227	4.5926	4.5000	-0.1773	0.0926	-3.9%	2.1%
1	ROC-08	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-08	CaO (wt%)	0.0331	0.0324	0.0000	0.0331	0.0324		
1	ROC-08	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-08	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	ROC-08	Cr2O3 (wt%)	0.1608	0.1602	0.2000	-0.0392	-0.0398	-19.6%	-19.9%
1	ROC-08	CuO (wt%)	0.0200	0.0214	0.0000	0.0200	0.0214		
1	ROC-08	Fe2O3 (wt%)	5.9225	5.9558	6.2185	-0.2960	-0.2627	-4.8%	-4.2%
1	ROC-08	K2O (wt%)	0.0663	0.0666	0.0000	0.0663	0.0666		
1	ROC-08	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-08	Li2O (wt%)	4.5480	4.7898	4.7458	-0.1978	0.0440	-4.2%	0.9%
1	ROC-08	MgO (wt%)	1.4154	1.4055	1.5000	-0.0846	-0.0945	-5.6%	-6.3%
1	ROC-08	MnO (wt%)	5.3585	5.3723	5.5000	-0.1415	-0.1277	-2.6%	-2.3%
1	ROC-08	Na2O (wt%)	13.1767	12.8505	13.9166	-0.7399	-1.0662	-5.3%	-7.7%
1	ROC-08	NiO (wt%)	2.3350	2.2623	2.5000	-0.1650	-0.2377	-6.6%	-9.5%
1	ROC-08	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	ROC-08	SiO2 (wt%)	46.2089	47.0269	47.7401	-1.5312	-0.7132	-3.2%	-1.5%
1	ROC-08	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-08	TiO2 (wt%)	1.9182	1.9439	2.0000	-0.0818	-0.0561	-4.1%	-2.8%
1	ROC-08	U3O8 (wt%)	6.9219	6.7848	7.6679	-0.7460	-0.8831	-9.7%	-11.5%
1	ROC-08	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-08	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	ROC-08	Sum	96.4586	97.3544	100.0000	-3.5414	-2.6456	-3.5%	-2.6%
1	ROC-09	Al2O3 (wt%)	4.0860	4.1278	3.9112	0.1749	0.2166	4.5%	5.5%
1	ROC-09	B2O3 (wt%)	9.6114	10.2116	10.0718	-0.4604	0.1398	-4.6%	1.4%
1	ROC-09	BaO (wt%)	0.0746	0.0755	0.0801	-0.0056	-0.0046	-7.0%	-5.7%
1	ROC-09	CaO (wt%)	3.5645	3.4843	4.0000	-0.4355	-0.5157	-10.9%	-12.9%
1	ROC-09	CdO (wt%)	0.2610	0.2610	0.2965	-0.0355	-0.0355	-12.0%	-12.0%
1	ROC-09	Ce2O3 (wt%)	0.3007	0.3007	0.3606	-0.0598	-0.0598	-16.6%	-16.6%
1	ROC-09	Cr2O3 (wt%)	0.0073	0.0073	0.0000	0.0073	0.0073		
1	ROC-09	CuO (wt%)	0.1117	0.1194	0.1282	-0.0165	-0.0088	-12.9%	-6.8%
1	ROC-09	Fe2O3 (wt%)	8.2851	8.3317	8.2899	-0.0048	0.0418	-0.1%	0.5%
1	ROC-09	K2O (wt%)	0.0587	0.0590	0.0000	0.0587	0.0590		
1	ROC-09	La2O3 (wt%)	0.0812	0.0812	0.0978	-0.0165	-0.0165	-16.9%	-16.9%
1	ROC-09	Li2O (wt%)	3.7568	3.9565	4.0010	-0.2442	-0.0445	-6.1%	-1.1%
1	ROC-09	MgO (wt%)	1.3652	1.3557	1.5000	-0.1348	-0.1443	-9.0%	-9.6%
1	ROC-09	MnO (wt%)	3.4281	3.4369	3.7862	-0.3580	-0.3493	-9.5%	-9.2%
1	ROC-09	Na2O (wt%)	12.0006	11.7035	13.2996	-1.2990	-1.5961	-9.8%	-12.0%
1	ROC-09	NiO (wt%)	2.3319	2.2592	2.5000	-0.1681	-0.2408	-6.7%	-9.6%
1	ROC-09	PbO (wt%)	0.1998	0.1998	0.2163	-0.0165	-0.0165	-7.6%	-7.6%
1	ROC-09	SiO2 (wt%)	44.9253	45.7206	45.9404	-1.0151	-0.2198	-2.2%	-0.5%
1	ROC-09	SO4 (wt%)	0.7610	0.7610	0.4808	0.2802	0.2802	58.3%	58.3%
1	ROC-09	TiO2 (wt%)	0.5538	0.5612	0.5000	0.0538	0.0612	10.8%	12.2%
1	ROC-09	U3O8 (wt%)	0.5749	0.5634	0.2000	0.3749	0.3634	187.4%	181.7%
1	ROC-09	ZnO (wt%)	0.1404	0.1404	0.1346	0.0057	0.0057	4.3%	4.3%
1	ROC-09	ZrO2 (wt%)	0.1803	0.1803	0.2051	-0.0248	-0.0248	-12.1%	-12.1%
1	ROC-09	Sum	96.6603	97.8980	100.0000	-3.3397	-2.1020	-3.3%	-2.1%
1	ROC-10	Al2O3 (wt%)	3.7034	3.7413	3.3256	0.3779	0.4157	11.4%	12.5%
1	ROC-10	B2O3 (wt%)	5.2323	5.5591	5.3579	-0.1255	0.2012	-2.3%	3.8%
1	ROC-10	BaO (wt%)	0.0760	0.0770	0.0801	-0.0041	-0.0031	-5.1%	-3.9%
1	ROC-10	CaO (wt%)	0.0255	0.0250	0.0010	0.0245	0.0240	2453.5%	2396.3%
1	ROC-10	CdO (wt%)	0.2570	0.2570	0.2965	-0.0395	-0.0395	-13.3%	-13.3%
1	ROC-10	Ce2O3 (wt%)	0.3540	0.3540	0.3606	-0.0066	-0.0066	-1.8%	-1.8%
1	ROC-10	Cr2O3 (wt%)	0.1513	0.1508	0.2000	-0.0487	-0.0492	-24.4%	-24.6%
1	ROC-10	CuO (wt%)	0.1189	0.1271	0.1282	-0.0093	-0.0011	-7.2%	-0.8%
1	ROC-10	Fe2O3 (wt%)	14.2791	14.3594	15.0212	-0.7421	-0.6619	-4.9%	-4.4%
1	ROC-10	K2O (wt%)	0.0395	0.0395	0.0000	0.0395	0.0395		
1	ROC-10	La2O3 (wt%)	0.0692	0.0692	0.0978	-0.0286	-0.0286	-29.2%	-29.2%
1	ROC-10	Li2O (wt%)	4.3865	4.6196	4.5212	-0.1346	0.0985	-3.0%	2.2%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	ROC-10	MgO (wt%)	1.3847	1.3751	1.5000	-0.1153	-0.1249	-7.7%	-8.3%
1	ROC-10	MnO (wt%)	1.2034	1.2065	1.2887	-0.0853	-0.0822	-6.6%	-6.4%
1	ROC-10	Na2O (wt%)	10.3762	10.1193	11.1585	-0.7823	-1.0392	-7.0%	-9.3%
1	ROC-10	NiO (wt%)	0.0276	0.0268	0.0000	0.0276	0.0268		
1	ROC-10	PbO (wt%)	0.2055	0.2055	0.2163	-0.0109	-0.0109	-5.0%	-5.0%
1	ROC-10	SiO2 (wt%)	45.8880	46.7003	45.6260	0.2620	1.0743	0.6%	2.4%
1	ROC-10	SO4 (wt%)	0.6613	0.6613	0.4808	0.1806	0.1806	37.6%	37.6%
1	ROC-10	TiO2 (wt%)	0.4725	0.4787	0.5000	-0.0275	-0.0213	-5.5%	-4.3%
1	ROC-10	U3O8 (wt%)	8.5286	8.3598	9.5000	-0.9714	-1.1402	-10.2%	-12.0%
1	ROC-10	ZnO (wt%)	0.1276	0.1276	0.1346	-0.0070	-0.0070	-5.2%	-5.2%
1	ROC-10	ZrO2 (wt%)	0.1766	0.1766	0.2051	-0.0285	-0.0285	-13.9%	-13.9%
1	ROC-10	Sum	97.7448	98.8165	100.0000	-2.2552	-1.1835	-2.3%	-1.2%
1	ROC-11	Al2O3 (wt%)	3.5759	3.6124	3.2500	0.3259	0.3624	10.0%	11.2%
1	ROC-11	B2O3 (wt%)	4.3388	4.6098	4.5000	-0.1612	0.1098	-3.6%	2.4%
1	ROC-11	BaO (wt%)	0.0804	0.0814	0.0801	0.0002	0.0013	0.3%	1.6%
1	ROC-11	CaO (wt%)	1.2635	1.2351	1.3177	-0.0542	-0.0826	-4.1%	-6.3%
1	ROC-11	CdO (wt%)	0.2699	0.2699	0.2965	-0.0266	-0.0266	-9.0%	-9.0%
1	ROC-11	Ce2O3 (wt%)	0.3748	0.3748	0.3606	0.0142	0.0142	3.9%	3.9%
1	ROC-11	Cr2O3 (wt%)	0.1641	0.1635	0.2000	-0.0359	-0.0365	-18.0%	-18.2%
1	ROC-11	CuO (wt%)	0.1299	0.1388	0.1282	0.0017	0.0106	1.3%	8.3%
1	ROC-11	Fe2O3 (wt%)	5.5401	5.5712	5.5974	-0.0573	-0.0262	-1.0%	-0.5%
1	ROC-11	K2O (wt%)	0.0382	0.0384	0.0000	0.0382	0.0384		
1	ROC-11	La2O3 (wt%)	0.0710	0.0710	0.0978	-0.0268	-0.0268	-27.4%	-27.4%
1	ROC-11	Li2O (wt%)	4.3058	4.5348	4.5575	-0.2517	-0.0228	-5.5%	-0.5%
1	ROC-11	MgO (wt%)	0.2342	0.2326	0.2094	0.0248	0.0232	11.9%	11.1%
1	ROC-11	MnO (wt%)	5.3972	5.4110	5.5000	-0.1028	-0.0890	-1.9%	-1.6%
1	ROC-11	Na2O (wt%)	10.0325	9.7841	10.0000	0.0325	-0.2159	0.3%	-2.2%
1	ROC-11	NiO (wt%)	2.4082	2.3331	2.5000	-0.0918	-0.1669	-3.7%	-6.7%
1	ROC-11	PbO (wt%)	0.2459	0.2459	0.2163	0.0295	0.0295	13.6%	13.6%
1	ROC-11	SiO2 (wt%)	49.3643	50.2384	50.3680	-1.0037	-0.1296	-2.0%	-0.3%
1	ROC-11	SO4 (wt%)	0.7220	0.7220	0.4808	0.2412	0.2412	50.2%	50.2%
1	ROC-11	TiO2 (wt%)	0.5492	0.5567	0.5000	0.0492	0.0567	9.8%	11.3%
1	ROC-11	U3O8 (wt%)	9.0946	8.9150	9.5000	-0.4054	-0.5850	-4.3%	-6.2%
1	ROC-11	ZnO (wt%)	0.1522	0.1522	0.1346	0.0176	0.0176	13.0%	13.0%
1	ROC-11	ZrO2 (wt%)	0.1851	0.1851	0.2051	-0.0201	-0.0201	-9.8%	-9.8%
1	ROC-11	Sum	98.5376	99.4770	100.0000	-1.4624	-0.5230	-1.5%	-0.5%
1	ROC-12	Al2O3 (wt%)	5.6685	5.7227	5.4812	0.1873	0.2415	3.4%	4.4%
1	ROC-12	B2O3 (wt%)	7.2528	7.8031	7.5976	-0.3448	0.2055	-4.5%	2.7%
1	ROC-12	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-12	CaO (wt%)	3.7534	3.6394	3.9570	-0.2036	-0.3176	-5.1%	-8.0%
1	ROC-12	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-12	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	ROC-12	Cr2O3 (wt%)	0.0073	0.0072	0.0000	0.0073	0.0072		
1	ROC-12	CuO (wt%)	0.0131	0.0141	0.0000	0.0131	0.0141		
1	ROC-12	Fe2O3 (wt%)	5.9833	6.0576	5.9144	0.0689	0.1432	1.2%	2.4%
1	ROC-12	K2O (wt%)	0.0391	0.0400	0.0000	0.0391	0.0400		
1	ROC-12	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-12	Li2O (wt%)	6.3080	6.6152	6.4512	-0.1432	0.1639	-2.2%	2.5%
1	ROC-12	MgO (wt%)	1.4829	1.4845	1.5000	-0.0171	-0.0155	-1.1%	-1.0%
1	ROC-12	MnO (wt%)	0.3073	0.3085	0.3000	0.0073	0.0085	2.4%	2.8%
1	ROC-12	Na2O (wt%)	12.8094	12.6277	13.4279	-0.6186	-0.8002	-4.6%	-6.0%
1	ROC-12	NiO (wt%)	2.4559	2.3763	2.5000	-0.0441	-0.1237	-1.8%	-4.9%
1	ROC-12	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	ROC-12	SiO2 (wt%)	48.5086	49.5463	49.7360	-1.2274	-0.1898	-2.5%	-0.4%
1	ROC-12	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-12	TiO2 (wt%)	0.4991	0.5056	0.5000	-0.0009	0.0056	-0.2%	1.1%
1	ROC-12	U3O8 (wt%)	2.5648	2.4919	2.6345	-0.0698	-0.1426	-2.6%	-5.4%
1	ROC-12	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-12	ZrO2 (wt%)	0.0115	0.0115	0.0000	0.0115	0.0115		
1	ROC-12	Sum	97.9239	99.5103	100.0000	-2.0761	-0.4897	-2.1%	-0.5%
1	ROC-13	Al2O3 (wt%)	10.8174	10.9208	10.6333	0.1841	0.2875	1.7%	2.7%
1	ROC-13	B2O3 (wt%)	4.2825	4.6073	4.5000	-0.2175	0.1073	-4.8%	2.4%
1	ROC-13	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	ROC-13	CaO (wt%)	1.2880	1.2487	1.4250	-0.1370	-0.1763	-9.6%	-12.4%
1	ROC-13	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	ROC-13	Ce2O3 (wt%)	0.0272	0.0272	0.0000	0.0272	0.0272		
1	ROC-13	Cr2O3 (wt%)	0.0073	0.0072	0.0000	0.0073	0.0072		
1	ROC-13	CuO (wt%)	0.0163	0.0174	0.0000	0.0163	0.0174		
1	ROC-13	Fe2O3 (wt%)	6.5909	6.6728	6.6168	-0.0258	0.0561	-0.4%	0.8%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
1	ROC-13	K2O (wt%)	0.0431	0.0440	0.0000	0.0431	0.0440		
1	ROC-13	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	ROC-13	Li2O (wt%)	5.4791	5.7459	5.5719	-0.0927	0.1741	-1.7%	3.1%
1	ROC-13	MgO (wt%)	1.3847	1.3861	1.5000	-0.1153	-0.1139	-7.7%	-7.6%
1	ROC-13	MnO (wt%)	5.1067	5.1262	5.5000	-0.3933	-0.3738	-7.2%	-6.8%
1	ROC-13	Na2O (wt%)	9.0485	8.9200	10.0000	-0.9515	-1.0800	-9.5%	-10.8%
1	ROC-13	NiO (wt%)	0.0350	0.0338	0.0000	0.0350	0.0338		
1	ROC-13	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	ROC-13	SiO2 (wt%)	45.2462	46.2142	45.4395	-0.1933	0.7746	-0.4%	1.7%
1	ROC-13	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	ROC-13	TiO2 (wt%)	0.4662	0.4723	0.5000	-0.0338	-0.0277	-6.8%	-5.5%
1	ROC-13	U3O8 (wt%)	7.1931	6.9889	8.3136	-1.1205	-1.3248	-13.5%	-15.9%
1	ROC-13	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	ROC-13	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	ROC-13	Sum	97.2884	98.6891	100.0000	-2.7116	-1.3109	-2.7%	-1.3%
1	ROC-14	Al2O3 (wt%)	11.4268	11.5360	11.3993	0.0274	0.1366	0.2%	1.2%
1	ROC-14	B2O3 (wt%)	12.4610	13.4064	13.0085	-0.5475	0.3979	-4.2%	3.1%
1	ROC-14	BaO (wt%)	0.0802	0.0799	0.0801	0.0001	-0.0003	0.1%	-0.3%
1	ROC-14	CaO (wt%)	0.0561	0.0544	0.0000	0.0561	0.0544		
1	ROC-14	CdO (wt%)	0.2673	0.2673	0.2965	-0.0292	-0.0292	-9.8%	-9.8%
1	ROC-14	Ce2O3 (wt%)	0.3362	0.3362	0.3606	-0.0244	-0.0244	-6.8%	-6.8%
1	ROC-14	Cr2O3 (wt%)	0.0073	0.0072	0.0000	0.0073	0.0072		
1	ROC-14	CuO (wt%)	0.1283	0.1374	0.1282	0.0001	0.0092	0.1%	7.2%
1	ROC-14	Fe2O3 (wt%)	6.5337	6.6149	6.5397	-0.0060	0.0752	-0.1%	1.2%
1	ROC-14	K2O (wt%)	0.0413	0.0422	0.0000	0.0413	0.0422		
1	ROC-14	La2O3 (wt%)	0.0704	0.0704	0.0978	-0.0274	-0.0274	-28.0%	-28.0%
1	ROC-14	Li2O (wt%)	5.0593	5.3057	5.2589	-0.1996	0.0469	-3.8%	0.9%
1	ROC-14	MgO (wt%)	1.4460	1.4475	1.5000	-0.0540	-0.0525	-3.6%	-3.5%
1	ROC-14	MnO (wt%)	4.0318	4.0472	4.1973	-0.1656	-0.1501	-3.9%	-3.6%
1	ROC-14	Na2O (wt%)	9.9887	9.8469	10.3446	-0.3559	-0.4977	-3.4%	-4.8%
1	ROC-14	NiO (wt%)	2.2205	2.1484	2.5000	-0.2795	-0.3516	-11.2%	-14.1%
1	ROC-14	PbO (wt%)	0.2289	0.2289	0.2163	0.0126	0.0126	5.8%	5.8%
1	ROC-14	SiO2 (wt%)	38.5609	39.3858	38.6590	-0.0981	0.7268	-0.3%	1.9%
1	ROC-14	SO4 (wt%)	0.6778	0.6778	0.4808	0.1971	0.1971	41.0%	41.0%
1	ROC-14	TiO2 (wt%)	2.0099	2.0361	1.9686	0.0414	0.0675	2.1%	3.4%
1	ROC-14	U3O8 (wt%)	2.4763	2.4060	2.6241	-0.1478	-0.2181	-5.6%	-8.3%
1	ROC-14	ZnO (wt%)	0.1500	0.1500	0.1346	0.0154	0.0154	11.4%	11.4%
1	ROC-14	ZrO2 (wt%)	0.0236	0.0236	0.2051	-0.1815	-0.1815	-88.5%	-88.5%
1	ROC-14	Sum	98.2824	100.2562	100.0000	-1.7176	0.2562	-1.7%	0.3%
1	ROC-15	Al2O3 (wt%)	7.2699	7.3442	7.0171	0.2528	0.3271	3.6%	4.7%
1	ROC-15	B2O3 (wt%)	4.3066	4.5755	4.5000	-0.1934	0.0755	-4.3%	1.7%
1	ROC-15	BaO (wt%)	0.0775	0.0772	0.0801	-0.0026	-0.0029	-3.2%	-3.6%
1	ROC-15	CaO (wt%)	0.0306	0.0297	0.0011	0.0295	0.0286	2638.2%	2554.7%
1	ROC-15	CdO (wt%)	0.2570	0.2570	0.2965	-0.0395	-0.0395	-13.3%	-13.3%
1	ROC-15	Ce2O3 (wt%)	0.3660	0.3660	0.3606	0.0055	0.0055	1.5%	1.5%
1	ROC-15	Cr2O3 (wt%)	0.1659	0.1630	0.2000	-0.0341	-0.0370	-17.1%	-18.5%
1	ROC-15	CuO (wt%)	0.1242	0.1330	0.1282	-0.0040	0.0048	-3.1%	3.8%
1	ROC-15	Fe2O3 (wt%)	10.2438	10.3014	10.2719	-0.0281	0.0295	-0.3%	0.3%
1	ROC-15	K2O (wt%)	0.0301	0.0307	0.0000	0.0301	0.0307		
1	ROC-15	La2O3 (wt%)	0.0616	0.0616	0.0978	-0.0362	-0.0362	-37.0%	-37.0%
1	ROC-15	Li2O (wt%)	3.8106	4.0132	4.0000	-0.1894	0.0132	-4.7%	0.3%
1	ROC-15	MgO (wt%)	0.0137	0.0137	0.0000	0.0137	0.0137		
1	ROC-15	MnO (wt%)	0.9997	1.0035	1.0459	-0.0462	-0.0424	-4.4%	-4.1%
1	ROC-15	Na2O (wt%)	13.8844	13.6873	15.1379	-1.2535	-1.4506	-8.3%	-9.6%
1	ROC-15	NiO (wt%)	2.2555	2.1823	2.5000	-0.2445	-0.3177	-9.8%	-12.7%
1	ROC-15	PbO (wt%)	0.2235	0.2235	0.2163	0.0072	0.0072	3.3%	3.3%
1	ROC-15	SiO2 (wt%)	44.0696	44.8500	43.8261	0.2435	1.0239	0.6%	2.3%
1	ROC-15	SO4 (wt%)	0.7729	0.7729	0.4808	0.2922	0.2922	60.8%	60.8%
1	ROC-15	TiO2 (wt%)	0.4808	0.4871	0.5000	-0.0192	-0.0129	-3.8%	-2.6%
1	ROC-15	U3O8 (wt%)	8.0480	7.8195	9.0000	-0.9520	-1.1805	-10.6%	-13.1%
1	ROC-15	ZnO (wt%)	0.1484	0.1484	0.1346	0.0138	0.0138	10.3%	10.3%
1	ROC-15	ZrO2 (wt%)	0.1756	0.1756	0.2051	-0.0295	-0.0295	-14.4%	-14.4%
1	ROC-15	Sum	97.8161	98.7165	100.0000	-2.1839	-1.2835	-2.2%	-1.3%
2	ROC-16	Al2O3 (wt%)	3.4578	3.4660	3.2500	0.2078	0.2160	6.4%	6.6%
2	ROC-16	B2O3 (wt%)	8.8547	9.3890	9.4333	-0.5786	-0.0444	-6.1%	-0.5%
2	ROC-16	BaO (wt%)	0.0776	0.0788	0.0801	-0.0025	-0.0013	-3.2%	-1.6%
2	ROC-16	CaO (wt%)	0.0178	0.0181	0.0000	0.0178	0.0181		
2	ROC-16	CdO (wt%)	0.3158	0.3158	0.2965	0.0194	0.0194	6.5%	6.5%
2	ROC-16	Ce2O3 (wt%)	0.3321	0.3321	0.3606	-0.0285	-0.0285	-7.9%	-7.9%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
2	ROC-16	Cr2O3 (wt%)	0.0278	0.0279	0.0000	0.0278	0.0279		
2	ROC-16	CuO (wt%)	0.1343	0.1390	0.1282	0.0060	0.0108	4.7%	8.4%
2	ROC-16	Fe2O3 (wt%)	5.2684	5.2425	5.0000	0.2684	0.2425	5.4%	4.8%
2	ROC-16	K2O (wt%)	0.0410	0.0413	0.0000	0.0410	0.0413		
2	ROC-16	La2O3 (wt%)	0.0608	0.0608	0.0978	-0.0370	-0.0370	-37.9%	-37.9%
2	ROC-16	Li2O (wt%)	6.4426	6.5940	6.6785	-0.2359	-0.0845	-3.5%	-1.3%
2	ROC-16	MgO (wt%)	0.0166	0.0166	0.0000	0.0166	0.0166		
2	ROC-16	MnO (wt%)	5.1971	5.3234	5.4398	-0.2427	-0.1164	-4.5%	-2.1%
2	ROC-16	Na2O (wt%)	9.8775	9.8831	10.0000	-0.1225	-0.1169	-1.2%	-1.2%
2	ROC-16	NiO (wt%)	0.0255	0.0252	0.0000	0.0255	0.0252		
2	ROC-16	PbO (wt%)	0.2009	0.2009	0.2163	-0.0154	-0.0154	-7.1%	-7.1%
2	ROC-16	SiO2 (wt%)	45.5671	46.6772	47.7923	-2.2252	-1.1151	-4.7%	-2.3%
2	ROC-16	SO4 (wt%)	0.2247	0.2247	0.4808	-0.2561	-0.2561	-53.3%	-53.3%
2	ROC-16	TiO2 (wt%)	2.3811	2.4508	2.0000	0.3811	0.4508	19.1%	22.5%
2	ROC-16	U3O8 (wt%)	7.8623	7.9156	8.4061	-0.5437	-0.4905	-6.5%	-5.8%
2	ROC-16	ZnO (wt%)	0.1120	0.1120	0.1346	-0.0226	-0.0226	-16.8%	-16.8%
2	ROC-16	ZrO2 (wt%)	0.1716	0.1716	0.2051	-0.0336	-0.0336	-16.4%	-16.4%
2	ROC-16	Sum	96.6668	98.7063	100.0000	-3.3332	-1.2937	-3.3%	-1.3%
2	ROC-17	Al2O3 (wt%)	6.4952	6.7244	6.3367	0.1585	0.3877	2.5%	6.1%
2	ROC-17	B2O3 (wt%)	4.8057	5.1058	4.8628	-0.0571	0.2430	-1.2%	5.0%
2	ROC-17	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	ROC-17	CaO (wt%)	0.1686	0.1700	0.1558	0.0128	0.0142	8.2%	9.1%
2	ROC-17	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-17	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	ROC-17	Cr2O3 (wt%)	0.1710	0.1696	0.2000	-0.0290	-0.0304	-14.5%	-15.2%
2	ROC-17	CuO (wt%)	0.0138	0.0140	0.0000	0.0138	0.0140		
2	ROC-17	Fe2O3 (wt%)	9.7184	9.9799	10.0294	-0.3110	-0.0495	-3.1%	-0.5%
2	ROC-17	K2O (wt%)	0.0301	0.0311	0.0000	0.0301	0.0311		
2	ROC-17	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-17	Li2O (wt%)	4.4888	4.7591	4.6645	-0.1757	0.0947	-3.8%	2.0%
2	ROC-17	MgO (wt%)	0.0199	0.0200	0.0000	0.0199	0.0200		
2	ROC-17	MnO (wt%)	5.3197	5.5054	5.5000	-0.1803	0.0054	-3.3%	0.1%
2	ROC-17	Na2O (wt%)	16.2434	16.1908	16.0018	0.2416	0.1891	1.5%	1.2%
2	ROC-17	NiO (wt%)	2.2841	2.2405	2.5000	-0.2159	-0.2595	-8.6%	-10.4%
2	ROC-17	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-17	SiO2 (wt%)	46.6367	47.3252	47.5645	-0.9277	-0.2392	-2.0%	-0.5%
2	ROC-17	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-17	TiO2 (wt%)	2.0433	2.1606	2.0000	0.0433	0.1606	2.2%	8.0%
2	ROC-17	U3O8 (wt%)	0.3054	0.3017	0.1845	0.1209	0.1172	65.5%	63.5%
2	ROC-17	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-17	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	ROC-17	Sum	99.0122	100.9661	100.0000	-0.9878	0.9661	-1.0%	1.0%
2	ROC-18	Al2O3 (wt%)	4.0719	4.0815	3.7950	0.2769	0.2865	7.3%	7.6%
2	ROC-18	B2O3 (wt%)	4.8862	5.1794	5.0465	-0.1603	0.1329	-3.2%	2.6%
2	ROC-18	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	ROC-18	CaO (wt%)	2.0603	2.0938	2.0149	0.0455	0.0790	2.3%	3.9%
2	ROC-18	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-18	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	ROC-18	Cr2O3 (wt%)	0.0329	0.0331	0.0000	0.0329	0.0331		
2	ROC-18	CuO (wt%)	0.0144	0.0149	0.0000	0.0144	0.0149		
2	ROC-18	Fe2O3 (wt%)	11.2339	11.1786	11.3221	-0.0882	-0.1435	-0.8%	-1.3%
2	ROC-18	K2O (wt%)	0.0301	0.0304	0.0000	0.0301	0.0304		
2	ROC-18	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-18	Li2O (wt%)	4.0313	4.1260	4.0000	0.0313	0.1260	0.8%	3.2%
2	ROC-18	MgO (wt%)	0.0153	0.0153	0.0000	0.0153	0.0153		
2	ROC-18	MnO (wt%)	4.8097	4.9266	4.8704	-0.0606	0.0563	-1.2%	1.2%
2	ROC-18	Na2O (wt%)	10.2515	10.2574	10.0000	0.2515	0.2574	2.5%	2.6%
2	ROC-18	NiO (wt%)	1.9247	1.9070	2.2033	-0.2786	-0.2963	-12.6%	-13.4%
2	ROC-18	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-18	SiO2 (wt%)	47.1716	48.3208	49.5168	-2.3452	-1.1960	-4.7%	-2.4%
2	ROC-18	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-18	TiO2 (wt%)	1.8974	1.9529	2.0000	-0.1027	-0.0471	-5.1%	-2.4%
2	ROC-18	U3O8 (wt%)	4.9998	5.0335	5.2311	-0.2313	-0.1976	-4.4%	-3.8%
2	ROC-18	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-18	ZrO2 (wt%)	0.0105	0.0105	0.0000	0.0105	0.0105		
2	ROC-18	Sum	97.7060	99.4264	100.0000	-2.2940	-0.5736	-2.3%	-0.6%
2	ROC-19	Al2O3 (wt%)	4.1333	4.1431	3.9421	0.1911	0.2009	4.8%	5.1%
2	ROC-19	B2O3 (wt%)	12.4932	13.2450	13.2672	-0.7740	-0.0222	-5.8%	-0.2%
2	ROC-19	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
2	ROC-19	CaO (wt%)	0.0196	0.0198	0.0000	0.0196	0.0198		
2	ROC-19	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-19	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	ROC-19	Cr2O3 (wt%)	0.0252	0.0250	0.0000	0.0252	0.0250		
2	ROC-19	CuO (wt%)	0.0219	0.0222	0.0000	0.0219	0.0222		
2	ROC-19	Fe2O3 (wt%)	4.7573	4.7350	5.0000	-0.2427	-0.2650	-4.9%	-5.3%
2	ROC-19	K2O (wt%)	0.0470	0.0485	0.0000	0.0470	0.0485		
2	ROC-19	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-19	Li2O (wt%)	3.8429	3.9332	4.0000	-0.1571	-0.0668	-3.9%	-1.7%
2	ROC-19	MgO (wt%)	1.4871	1.4959	1.5000	-0.0129	-0.0041	-0.9%	-0.3%
2	ROC-19	MnO (wt%)	0.3070	0.3177	0.3000	0.0070	0.0177	2.3%	5.9%
2	ROC-19	Na2O (wt%)	10.3661	10.3344	10.1324	0.2337	0.2020	2.3%	2.0%
2	ROC-19	NiO (wt%)	2.3923	2.3467	2.5000	-0.1077	-0.1533	-4.3%	-6.1%
2	ROC-19	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-19	SiO2 (wt%)	48.6156	49.3332	50.3904	-1.7748	-1.0572	-3.5%	-2.1%
2	ROC-19	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-19	TiO2 (wt%)	1.8306	1.9358	2.0000	-0.1694	-0.0642	-8.5%	-3.2%
2	ROC-19	U3O8 (wt%)	6.4944	6.4182	6.9679	-0.4734	-0.5497	-6.8%	-7.9%
2	ROC-19	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-19	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	ROC-19	Sum	97.1016	98.6216	100.0000	-2.8984	-1.3784	-2.9%	-1.4%
2	ROC-20	Al2O3 (wt%)	3.6278	3.7550	3.5811	0.0467	0.1739	1.3%	4.9%
2	ROC-20	B2O3 (wt%)	9.6838	10.2880	10.3037	-0.6199	-0.0157	-6.0%	-0.2%
2	ROC-20	BaO (wt%)	0.0784	0.0804	0.0801	-0.0017	0.0002	-2.1%	0.3%
2	ROC-20	CaO (wt%)	3.7534	3.7841	4.0000	-0.2466	-0.2159	-6.2%	-5.4%
2	ROC-20	CdO (wt%)	0.2590	0.2590	0.2965	-0.0375	-0.0375	-12.6%	-12.6%
2	ROC-20	Ce2O3 (wt%)	0.3218	0.3218	0.3606	-0.0388	-0.0388	-10.7%	-10.7%
2	ROC-20	Cr2O3 (wt%)	0.1922	0.1906	0.2000	-0.0078	-0.0094	-3.9%	-4.7%
2	ROC-20	CuO (wt%)	0.1217	0.1235	0.1282	-0.0065	-0.0047	-5.0%	-3.7%
2	ROC-20	Fe2O3 (wt%)	8.3352	8.5592	8.3788	-0.0436	0.1804	-0.5%	2.2%
2	ROC-20	K2O (wt%)	0.0301	0.0311	0.0000	0.0301	0.0311		
2	ROC-20	La2O3 (wt%)	0.0730	0.0730	0.0978	-0.0247	-0.0247	-25.3%	-25.3%
2	ROC-20	Li2O (wt%)	3.8268	4.0578	4.0820	-0.2553	-0.0242	-6.3%	-0.6%
2	ROC-20	MgO (wt%)	0.3599	0.3620	0.3769	-0.0170	-0.0149	-4.5%	-4.0%
2	ROC-20	MnO (wt%)	5.0228	5.1980	5.5000	-0.4772	-0.3020	-8.7%	-5.5%
2	ROC-20	Na2O (wt%)	12.1927	12.1585	12.9201	-0.7275	-0.7616	-5.6%	-5.9%
2	ROC-20	NiO (wt%)	0.0251	0.0246	0.0000	0.0251	0.0246		
2	ROC-20	PbO (wt%)	0.2076	0.2076	0.2163	-0.0087	-0.0087	-4.0%	-4.0%
2	ROC-20	SiO2 (wt%)	42.9999	43.6356	46.4681	-3.4682	-2.8325	-7.5%	-6.1%
2	ROC-20	SO4 (wt%)	0.2247	0.2247	0.4808	-0.2561	-0.2561	-53.3%	-53.3%
2	ROC-20	TiO2 (wt%)	2.0058	2.1210	2.0000	0.0058	0.1210	0.3%	6.0%
2	ROC-20	U3O8 (wt%)	0.6630	0.6550	0.1892	0.4738	0.4658	250.4%	246.2%
2	ROC-20	ZnO (wt%)	0.1301	0.1301	0.1346	-0.0045	-0.0045	-3.4%	-3.4%
2	ROC-20	ZrO2 (wt%)	0.1790	0.1790	0.2051	-0.0261	-0.0261	-12.7%	-12.7%
2	ROC-20	Sum	94.3138	96.4196	100.0000	-5.6862	-3.5804	-5.7%	-3.6%
2	ROC-21	Al2O3 (wt%)	10.4064	10.7723	10.3731	0.0333	0.3991	0.3%	3.8%
2	ROC-21	B2O3 (wt%)	11.1650	11.8616	11.6624	-0.4974	0.1992	-4.3%	1.7%
2	ROC-21	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	ROC-21	CaO (wt%)	0.0927	0.0942	0.0905	0.0022	0.0036	2.4%	4.0%
2	ROC-21	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-21	Ce2O3 (wt%)	0.0322	0.0322	0.0000	0.0322	0.0322		
2	ROC-21	Cr2O3 (wt%)	0.1568	0.1577	0.2000	-0.0432	-0.0423	-21.6%	-21.2%
2	ROC-21	CuO (wt%)	0.0197	0.0204	0.0000	0.0197	0.0204		
2	ROC-21	Fe2O3 (wt%)	7.8097	8.0195	7.8215	-0.0117	0.1980	-0.1%	2.5%
2	ROC-21	K2O (wt%)	0.0301	0.0304	0.0000	0.0301	0.0304		
2	ROC-21	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-21	Li2O (wt%)	4.0421	4.2851	4.2309	-0.1889	0.0542	-4.5%	1.3%
2	ROC-21	MgO (wt%)	1.0762	1.0759	1.1057	-0.0295	-0.0299	-2.7%	-2.7%
2	ROC-21	MnO (wt%)	5.2068	5.3334	5.2781	-0.0713	0.0553	-1.4%	1.0%
2	ROC-21	Na2O (wt%)	10.3392	10.3450	10.0010	0.3382	0.3440	3.4%	3.4%
2	ROC-21	NiO (wt%)	1.4634	1.4500	1.5154	-0.0520	-0.0654	-3.4%	-4.3%
2	ROC-21	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-21	SiO2 (wt%)	35.9937	36.8709	36.2213	-0.2276	0.6496	-0.6%	1.8%
2	ROC-21	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-21	TiO2 (wt%)	1.9682	2.0258	2.0000	-0.0318	0.0258	-1.6%	1.3%
2	ROC-21	U3O8 (wt%)	9.0238	9.0849	9.5000	-0.4762	-0.4151	-5.0%	-4.4%
2	ROC-21	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-21	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	ROC-21	Sum	99.0823	101.7156	100.0000	-0.9177	1.7156	-0.9%	1.7%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
2	ROC-22	Al2O3 (wt%)	3.5003	3.6241	3.2510	0.2493	0.3731	7.7%	11.5%
2	ROC-22	B2O3 (wt%)	6.5042	6.9105	6.4325	0.0717	0.4780	1.1%	7.4%
2	ROC-22	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	ROC-22	CaO (wt%)	0.0143	0.0145	0.0010	0.0133	0.0135	1334.2%	1352.5%
2	ROC-22	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-22	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	ROC-22	Cr2O3 (wt%)	0.0336	0.0338	0.0000	0.0336	0.0338		
2	ROC-22	CuO (wt%)	0.0119	0.0123	0.0000	0.0119	0.0123		
2	ROC-22	Fe2O3 (wt%)	14.5115	14.9023	14.6920	-0.1805	0.2103	-1.2%	1.4%
2	ROC-22	K2O (wt%)	0.0428	0.0432	0.0000	0.0428	0.0432		
2	ROC-22	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-22	Li2O (wt%)	4.4511	4.7214	4.5235	-0.0724	0.1979	-1.6%	4.4%
2	ROC-22	MgO (wt%)	0.0091	0.0091	0.0000	0.0091	0.0091		
2	ROC-22	MnO (wt%)	5.5167	5.6508	5.5000	0.0167	0.1508	0.3%	2.7%
2	ROC-22	Na2O (wt%)	10.2280	10.2338	10.0000	0.2280	0.2338	2.3%	2.3%
2	ROC-22	NiO (wt%)	2.1473	2.1278	2.5000	-0.3527	-0.3722	-14.1%	-14.9%
2	ROC-22	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-22	SiO2 (wt%)	46.1554	47.2800	46.8442	-0.6888	0.4358	-1.5%	0.9%
2	ROC-22	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-22	TiO2 (wt%)	1.8557	1.9100	1.8222	0.0334	0.0877	1.8%	4.8%
2	ROC-22	U3O8 (wt%)	4.2451	4.2738	4.4336	-0.1885	-0.1598	-4.3%	-3.6%
2	ROC-22	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-22	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	ROC-22	Sum	99.4949	102.0153	100.0000	-0.5051	2.0153	-0.5%	2.0%
2	ROC-23	Al2O3 (wt%)	10.6379	10.6631	9.9919	0.6459	0.6712	6.5%	6.7%
2	ROC-23	B2O3 (wt%)	5.4416	5.7690	5.6859	-0.2443	0.0830	-4.3%	1.5%
2	ROC-23	BaO (wt%)	0.0871	0.0884	0.0801	0.0070	0.0083	8.7%	10.4%
2	ROC-23	CaO (wt%)	0.0091	0.0092	0.0000	0.0091	0.0092		
2	ROC-23	CdO (wt%)	0.2627	0.2627	0.2965	-0.0337	-0.0337	-11.4%	-11.4%
2	ROC-23	Ce2O3 (wt%)	0.3104	0.3104	0.3606	-0.0502	-0.0502	-13.9%	-13.9%
2	ROC-23	Cr2O3 (wt%)	0.1363	0.1371	0.1991	-0.0628	-0.0620	-31.5%	-31.1%
2	ROC-23	CuO (wt%)	0.1352	0.1400	0.1282	0.0070	0.0118	5.5%	9.2%
2	ROC-23	Fe2O3 (wt%)	6.8912	6.8579	7.1702	-0.2791	-0.3123	-3.9%	-4.4%
2	ROC-23	K2O (wt%)	0.0301	0.0304	0.0000	0.0301	0.0304		
2	ROC-23	La2O3 (wt%)	0.0652	0.0652	0.0978	-0.0326	-0.0326	-33.3%	-33.3%
2	ROC-23	Li2O (wt%)	4.7794	4.8917	4.9053	-0.1259	-0.0136	-2.6%	-0.3%
2	ROC-23	MgO (wt%)	1.3706	1.3701	1.4206	-0.0500	-0.0505	-3.5%	-3.6%
2	ROC-23	MnO (wt%)	1.7819	1.8252	1.8947	-0.1128	-0.0695	-6.0%	-3.7%
2	ROC-23	Na2O (wt%)	10.7200	10.7261	10.8896	-0.1697	-0.1636	-1.6%	-1.5%
2	ROC-23	NiO (wt%)	1.5652	1.5509	1.9340	-0.3688	-0.3830	-19.1%	-19.8%
2	ROC-23	PbO (wt%)	0.1893	0.1893	0.2163	-0.0270	-0.0270	-12.5%	-12.5%
2	ROC-23	SiO2 (wt%)	46.1019	47.2250	49.3543	-3.2524	-2.1293	-6.6%	-4.3%
2	ROC-23	SO4 (wt%)	0.2247	0.2247	0.4808	-0.2561	-0.2561	-53.3%	-53.3%
2	ROC-23	TiO2 (wt%)	1.8974	1.9529	2.0000	-0.1027	-0.0471	-5.1%	-2.4%
2	ROC-23	U3O8 (wt%)	2.3555	2.3715	2.5543	-0.1989	-0.1829	-7.8%	-7.2%
2	ROC-23	ZnO (wt%)	0.1200	0.1200	0.1346	-0.0146	-0.0146	-10.9%	-10.9%
2	ROC-23	ZrO2 (wt%)	0.1695	0.1695	0.2051	-0.0356	-0.0356	-17.4%	-17.4%
2	ROC-23	Sum	95.2820	96.9503	100.0000	-4.7180	-3.0497	-4.7%	-3.0%
2	ROC-24	Al2O3 (wt%)	10.6190	10.9931	10.2084	0.4106	0.7846	4.0%	7.7%
2	ROC-24	B2O3 (wt%)	10.8994	11.5795	11.0905	-0.1911	0.4891	-1.7%	4.4%
2	ROC-24	BaO (wt%)	0.0818	0.0838	0.0801	0.0017	0.0037	2.1%	4.6%
2	ROC-24	CaO (wt%)	0.0087	0.0088	0.0005	0.0083	0.0084	1804.5%	1820.5%
2	ROC-24	CdO (wt%)	0.2690	0.2690	0.2965	-0.0275	-0.0275	-9.3%	-9.3%
2	ROC-24	Ce2O3 (wt%)	0.3479	0.3479	0.3606	-0.0127	-0.0127	-3.5%	-3.5%
2	ROC-24	Cr2O3 (wt%)	0.1597	0.1583	0.2000	-0.0403	-0.0417	-20.2%	-20.8%
2	ROC-24	CuO (wt%)	0.1408	0.1428	0.1282	0.0126	0.0146	9.8%	11.4%
2	ROC-24	Fe2O3 (wt%)	6.6696	6.8489	6.8900	-0.2204	-0.0410	-3.2%	-0.6%
2	ROC-24	K2O (wt%)	0.0301	0.0311	0.0000	0.0301	0.0311		
2	ROC-24	La2O3 (wt%)	0.0780	0.0780	0.0978	-0.0198	-0.0198	-20.2%	-20.2%
2	ROC-24	Li2O (wt%)	3.9129	4.1494	4.0384	-0.1255	0.1111	-3.1%	2.8%
2	ROC-24	MgO (wt%)	1.4622	1.4708	1.5000	-0.0378	-0.0292	-2.5%	-1.9%
2	ROC-24	MnO (wt%)	5.2875	5.4719	5.4448	-0.1573	0.0271	-2.9%	0.5%
2	ROC-24	Na2O (wt%)	10.5110	10.4792	10.2812	0.2299	0.1981	2.2%	1.9%
2	ROC-24	NiO (wt%)	0.1858	0.1822	0.1463	0.0395	0.0360	27.0%	24.6%
2	ROC-24	PbO (wt%)	0.2227	0.2227	0.2163	0.0064	0.0064	2.9%	2.9%
2	ROC-24	SiO2 (wt%)	44.4440	45.1002	44.9492	-0.5052	0.1510	-1.1%	0.3%
2	ROC-24	SO4 (wt%)	0.2247	0.2247	0.4808	-0.2561	-0.2561	-53.3%	-53.3%
2	ROC-24	TiO2 (wt%)	1.7097	1.8079	2.0000	-0.2903	-0.1921	-14.5%	-9.6%
2	ROC-24	U3O8 (wt%)	1.3767	1.3601	1.2509	0.1258	0.1092	10.1%	8.7%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
2	ROC-24	ZnO (wt%)	0.1382	0.1382	0.1346	0.0036	0.0036	2.6%	2.6%
2	ROC-24	ZrO2 (wt%)	0.1749	0.1749	0.2051	-0.0302	-0.0302	-14.7%	-14.7%
2	ROC-24	Sum	98.9542	101.3236	100.0000	-1.0458	1.3236	-1.0%	1.3%
2	ROC-25	Al2O3 (wt%)	5.3709	5.3837	4.8802	0.4907	0.5035	10.1%	10.3%
2	ROC-25	B2O3 (wt%)	4.4515	4.7201	4.5000	-0.0485	0.2201	-1.1%	4.9%
2	ROC-25	BaO (wt%)	0.0790	0.0802	0.0801	-0.0011	0.0001	-1.4%	0.1%
2	ROC-25	CaO (wt%)	0.0252	0.0256	0.0000	0.0252	0.0256		
2	ROC-25	CdO (wt%)	0.2662	0.2662	0.2965	-0.0303	-0.0303	-10.2%	-10.2%
2	ROC-25	Ce2O3 (wt%)	0.3136	0.3136	0.3606	-0.0470	-0.0470	-13.0%	-13.0%
2	ROC-25	Cr2O3 (wt%)	0.1776	0.1786	0.2000	-0.0224	-0.0214	-11.2%	-10.7%
2	ROC-25	CuO (wt%)	0.1324	0.1371	0.1282	0.0042	0.0088	3.3%	6.9%
2	ROC-25	Fe2O3 (wt%)	12.1024	12.0425	11.8414	0.2610	0.2011	2.2%	1.7%
2	ROC-25	K2O (wt%)	0.0301	0.0304	0.0000	0.0301	0.0304		
2	ROC-25	La2O3 (wt%)	0.0744	0.0744	0.0978	-0.0234	-0.0234	-23.9%	-23.9%
2	ROC-25	Li2O (wt%)	4.0152	4.1095	4.0000	0.0152	0.1095	0.4%	2.7%
2	ROC-25	MgO (wt%)	1.4299	1.4294	1.5000	-0.0701	-0.0706	-4.7%	-4.7%
2	ROC-25	MnO (wt%)	5.1422	5.2672	5.5000	-0.3578	-0.2328	-6.5%	-4.2%
2	ROC-25	Na2O (wt%)	14.6932	14.7016	15.4453	-0.7521	-0.7438	-4.9%	-4.8%
2	ROC-25	NiO (wt%)	0.0802	0.0794	0.0493	0.0308	0.0301	62.5%	61.0%
2	ROC-25	PbO (wt%)	0.1810	0.1810	0.2163	-0.0354	-0.0354	-16.4%	-16.4%
2	ROC-25	SiO2 (wt%)	44.0696	45.1432	47.0780	-3.0084	-1.9348	-6.4%	-4.1%
2	ROC-25	SO4 (wt%)	0.4344	0.4344	0.4808	-0.0464	-0.0464	-9.6%	-9.6%
2	ROC-25	TiO2 (wt%)	0.4850	0.4992	0.5000	-0.0150	-0.0008	-3.0%	-0.2%
2	ROC-25	U3O8 (wt%)	2.3555	2.3715	2.5058	-0.1504	-0.1343	-6.0%	-5.4%
2	ROC-25	ZnO (wt%)	0.1111	0.1111	0.1346	-0.0235	-0.0235	-17.5%	-17.5%
2	ROC-25	ZrO2 (wt%)	0.1716	0.1716	0.2051	-0.0336	-0.0336	-16.4%	-16.4%
2	ROC-25	Sum	96.1918	97.7512	100.0000	-3.8082	-2.2488	-3.8%	-2.2%
2	ROC-26	Al2O3 (wt%)	9.5939	9.6167	9.0736	0.5203	0.5431	5.7%	6.0%
2	ROC-26	B2O3 (wt%)	6.2547	6.6304	6.4909	-0.2362	0.1395	-3.6%	2.1%
2	ROC-26	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	ROC-26	CaO (wt%)	0.0161	0.0162	0.0000	0.0161	0.0162		
2	ROC-26	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	ROC-26	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	ROC-26	Cr2O3 (wt%)	0.0230	0.0228	0.0000	0.0230	0.0228		
2	ROC-26	CuO (wt%)	0.0282	0.0286	0.0000	0.0282	0.0286		
2	ROC-26	Fe2O3 (wt%)	5.1076	5.0827	5.0000	0.1076	0.0827	2.2%	1.7%
2	ROC-26	K2O (wt%)	0.0301	0.0311	0.0000	0.0301	0.0311		
2	ROC-26	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	ROC-26	Li2O (wt%)	4.0205	4.1150	4.0000	0.0205	0.1150	0.5%	2.9%
2	ROC-26	MgO (wt%)	0.0083	0.0083	0.0000	0.0083	0.0083		
2	ROC-26	MnO (wt%)	3.2377	3.3507	3.2934	-0.0557	0.0573	-1.7%	1.7%
2	ROC-26	Na2O (wt%)	17.1870	17.1338	17.1686	0.0184	-0.0348	0.1%	-0.2%
2	ROC-26	NiO (wt%)	0.0251	0.0246	0.0000	0.0251	0.0246		
2	ROC-26	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	ROC-26	SiO2 (wt%)	47.7064	48.4107	48.6758	-0.9694	-0.2651	-2.0%	-0.5%
2	ROC-26	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	ROC-26	TiO2 (wt%)	0.4850	0.5128	0.5000	-0.0150	0.0128	-3.0%	2.6%
2	ROC-26	U3O8 (wt%)	5.4361	5.3720	5.7977	-0.3616	-0.4257	-6.2%	-7.3%
2	ROC-26	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	ROC-26	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	ROC-26	Sum	99.4277	100.6245	100.0000	-0.5723	0.6245	-0.6%	0.6%
2	ROC-27	Al2O3 (wt%)	4.3978	4.4082	3.9423	0.4555	0.4659	11.6%	11.8%
2	ROC-27	B2O3 (wt%)	4.3549	4.6163	4.5006	-0.1456	0.1158	-3.2%	2.6%
2	ROC-27	BaO (wt%)	0.0807	0.0819	0.0801	0.0005	0.0018	0.7%	2.2%
2	ROC-27	CaO (wt%)	0.0105	0.0106	0.0010	0.0095	0.0097	1003.4%	1015.5%
2	ROC-27	CdO (wt%)	0.2733	0.2733	0.2965	-0.0232	-0.0232	-7.8%	-7.8%
2	ROC-27	Ce2O3 (wt%)	0.3268	0.3268	0.3606	-0.0338	-0.0338	-9.4%	-9.4%
2	ROC-27	Cr2O3 (wt%)	0.0365	0.0367	0.0010	0.0355	0.0357	3546.7%	3567.6%
2	ROC-27	CuO (wt%)	0.1377	0.1425	0.1282	0.0095	0.0143	7.4%	11.2%
2	ROC-27	Fe2O3 (wt%)	14.7617	14.6873	15.1747	-0.4130	-0.4873	-2.7%	-3.2%
2	ROC-27	K2O (wt%)	0.0413	0.0417	0.0000	0.0413	0.0417		
2	ROC-27	La2O3 (wt%)	0.0746	0.0746	0.0978	-0.0232	-0.0232	-23.7%	-23.7%
2	ROC-27	Li2O (wt%)	3.9829	4.0764	4.0010	-0.0181	0.0754	-0.5%	1.9%
2	ROC-27	MgO (wt%)	1.4763	1.4758	1.5000	-0.0237	-0.0242	-1.6%	-1.6%
2	ROC-27	MnO (wt%)	5.2035	5.3301	5.4981	-0.2946	-0.1680	-5.4%	-3.1%
2	ROC-27	Na2O (wt%)	11.6198	11.6264	11.7989	-0.1791	-0.1725	-1.5%	-1.5%
2	ROC-27	NiO (wt%)	1.4729	1.4594	1.9462	-0.4732	-0.4868	-24.3%	-25.0%
2	ROC-27	PbO (wt%)	0.1890	0.1890	0.2163	-0.0273	-0.0273	-12.6%	-12.6%
2	ROC-27	SiO2 (wt%)	42.7325	43.7739	43.6480	-0.9155	0.1259	-2.1%	0.3%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

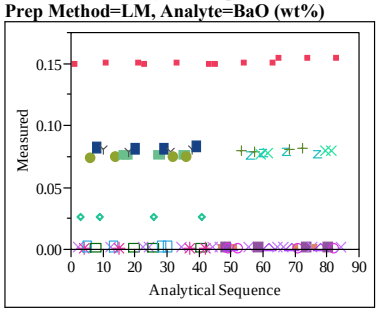
Set	Glass #	Oxide	Measured (wt%)	Measured Bias-Corrected (wt%)	Targeted (wt%)	Diff of Measured	Diff of Meas BC	% Diff of Measured	% Diff of Meas BC
2	ROC-27	SO4 (wt%)	0.2951	0.2951	0.4808	-0.1857	-0.1857	-38.6%	-38.6%
2	ROC-27	TiO2 (wt%)	1.8765	1.9314	2.0000	-0.1235	-0.0686	-6.2%	-3.4%
2	ROC-27	U3O8 (wt%)	3.8206	3.8464	3.9884	-0.1678	-0.1420	-4.2%	-3.6%
2	ROC-27	ZnO (wt%)	0.1183	0.1183	0.1346	-0.0164	-0.0164	-12.2%	-12.2%
2	ROC-27	ZrO2 (wt%)	0.1773	0.1773	0.2051	-0.0278	-0.0278	-13.6%	-13.6%
2	ROC-27	Sum	97.4604	98.9994	100.0000	-2.5396	-1.0006	-2.5%	-1.0%
2	ROC-28	Al2O3 (wt%)	4.8088	4.8202	4.4852	0.3236	0.3350	7.2%	7.5%
2	ROC-28	B2O3 (wt%)	4.2986	4.5574	4.5000	-0.2014	0.0574	-4.5%	1.3%
2	ROC-28	BaO (wt%)	0.0770	0.0782	0.0801	-0.0031	-0.0019	-3.9%	-2.4%
2	ROC-28	CaO (wt%)	0.0070	0.0071	0.0000	0.0070	0.0071		
2	ROC-28	CdO (wt%)	0.2650	0.2650	0.2965	-0.0315	-0.0315	-10.6%	-10.6%
2	ROC-28	Ce2O3 (wt%)	0.3180	0.3180	0.3606	-0.0426	-0.0426	-11.8%	-11.8%
2	ROC-28	Cr2O3 (wt%)	0.0161	0.0162	0.0000	0.0161	0.0162		
2	ROC-28	CuO (wt%)	0.1346	0.1393	0.1282	0.0064	0.0111	5.0%	8.7%
2	ROC-28	Fe2O3 (wt%)	6.0869	6.0588	6.3446	-0.2577	-0.2859	-4.1%	-4.5%
2	ROC-28	K2O (wt%)	0.0301	0.0304	0.0000	0.0301	0.0304		
2	ROC-28	La2O3 (wt%)	0.0705	0.0705	0.0978	-0.0273	-0.0273	-27.9%	-27.9%
2	ROC-28	Li2O (wt%)	4.0851	4.1811	4.1343	-0.0492	0.0468	-1.2%	1.1%
2	ROC-28	MgO (wt%)	1.4850	1.4845	1.5000	-0.0150	-0.0155	-1.0%	-1.0%
2	ROC-28	MnO (wt%)	0.4777	0.4894	0.4745	0.0033	0.0149	0.7%	3.1%
2	ROC-28	Na2O (wt%)	17.1196	17.1293	17.6732	-0.5536	-0.5439	-3.1%	-3.1%
2	ROC-28	NiO (wt%)	0.0248	0.0246	0.0000	0.0248	0.0246		
2	ROC-28	PbO (wt%)	0.1842	0.1842	0.2163	-0.0321	-0.0321	-14.9%	-14.9%
2	ROC-28	SiO2 (wt%)	52.9477	54.2376	55.0000	-2.0523	-0.7624	-3.7%	-1.4%
2	ROC-28	SO4 (wt%)	0.3820	0.3820	0.4808	-0.0988	-0.0988	-20.5%	-20.5%
2	ROC-28	TiO2 (wt%)	1.9099	1.9658	2.0000	-0.0901	-0.0342	-4.5%	-1.7%
2	ROC-28	U3O8 (wt%)	1.8219	1.8343	1.8882	-0.0663	-0.0539	-3.5%	-2.9%
2	ROC-28	ZnO (wt%)	0.1114	0.1114	0.1346	-0.0232	-0.0232	-17.2%	-17.2%
2	ROC-28	ZrO2 (wt%)	0.1797	0.1797	0.2051	-0.0255	-0.0255	-12.4%	-12.4%
2	ROC-28	Sum	96.8415	98.5649	100.0000	-3.1585	-1.4351	-3.2%	-1.4%
2	ROC-29	Al2O3 (wt%)	11.2142	11.6105	10.7599	0.4543	0.8506	4.2%	7.9%
2	ROC-29	B2O3 (wt%)	12.2115	12.9744	12.4790	-0.2675	0.4954	-2.1%	4.0%
2	ROC-29	BaO (wt%)	0.0770	0.0789	0.0801	-0.0031	-0.0012	-3.9%	-1.5%
2	ROC-29	CaO (wt%)	0.0766	0.0772	0.0584	0.0182	0.0188	31.1%	32.2%
2	ROC-29	CdO (wt%)	0.2499	0.2499	0.2965	-0.0466	-0.0466	-15.7%	-15.7%
2	ROC-29	Ce2O3 (wt%)	0.3619	0.3619	0.3606	0.0014	0.0014	0.4%	0.4%
2	ROC-29	Cr2O3 (wt%)	0.0300	0.0297	0.0000	0.0300	0.0297		
2	ROC-29	CuO (wt%)	0.1371	0.1390	0.1282	0.0089	0.0108	6.9%	8.4%
2	ROC-29	Fe2O3 (wt%)	7.5667	7.7705	7.7595	-0.1928	0.0110	-2.5%	0.1%
2	ROC-29	K2O (wt%)	0.0404	0.0416	0.0000	0.0404	0.0416		
2	ROC-29	La2O3 (wt%)	0.0715	0.0715	0.0978	-0.0262	-0.0262	-26.8%	-26.8%
2	ROC-29	Li2O (wt%)	4.4565	4.7264	4.5994	-0.1429	0.1270	-3.1%	2.8%
2	ROC-29	MgO (wt%)	0.0108	0.0108	0.0000	0.0108	0.0108		
2	ROC-29	MnO (wt%)	4.7129	4.8773	4.9056	-0.1927	-0.0283	-3.9%	-0.6%
2	ROC-29	Na2O (wt%)	10.7773	10.7457	10.6726	0.1047	0.0731	1.0%	0.7%
2	ROC-29	NiO (wt%)	2.2491	2.2062	2.5000	-0.2509	-0.2938	-10.0%	-11.8%
2	ROC-29	PbO (wt%)	0.2197	0.2197	0.2163	0.0034	0.0034	1.6%	1.6%
2	ROC-29	SiO2 (wt%)	37.7586	38.3166	38.1045	-0.3459	0.2120	-0.9%	0.6%
2	ROC-29	SO4 (wt%)	0.6172	0.6172	0.4808	0.1364	0.1364	28.4%	28.4%
2	ROC-29	TiO2 (wt%)	0.4796	0.5071	0.5000	-0.0205	0.0071	-4.1%	1.4%
2	ROC-29	U3O8 (wt%)	5.2976	5.2356	5.6611	-0.3636	-0.4255	-6.4%	-7.5%
2	ROC-29	ZnO (wt%)	0.1494	0.1494	0.1346	0.0148	0.0148	11.0%	11.0%
2	ROC-29	ZrO2 (wt%)	0.1759	0.1759	0.2051	-0.0292	-0.0292	-14.2%	-14.2%
2	ROC-29	Sum	98.9413	101.1931	100.0000	-1.0587	1.1931	-1.1%	1.2%
2	ROC-30	Al2O3 (wt%)	6.4621	6.6914	6.1383	0.3238	0.5532	5.3%	9.0%
2	ROC-30	B2O3 (wt%)	7.9371	8.4330	7.9577	-0.0206	0.4753	-0.3%	6.0%
2	ROC-30	BaO (wt%)	0.0427	0.0438	0.0423	0.0004	0.0014	0.9%	3.4%
2	ROC-30	CaO (wt%)	1.0585	1.0672	1.0250	0.0335	0.0421	3.3%	4.1%
2	ROC-30	CdO (wt%)	0.1448	0.1448	0.1566	-0.0119	-0.0119	-7.6%	-7.6%
2	ROC-30	Ce2O3 (wt%)	0.2023	0.2023	0.1905	0.0118	0.0118	6.2%	6.2%
2	ROC-30	Cr2O3 (wt%)	0.0965	0.0956	0.0959	0.0006	-0.0002	0.6%	-0.2%
2	ROC-30	CuO (wt%)	0.0789	0.0800	0.0677	0.0111	0.0122	16.4%	18.1%
2	ROC-30	Fe2O3 (wt%)	8.9678	9.2094	8.7193	0.2485	0.4902	2.9%	5.6%
2	ROC-30	K2O (wt%)	0.0419	0.0431	0.0000	0.0419	0.0431		
2	ROC-30	La2O3 (wt%)	0.0358	0.0358	0.0517	-0.0159	-0.0159	-30.7%	-30.7%
2	ROC-30	Li2O (wt%)	4.5480	4.8244	4.6296	-0.0816	0.1949	-1.8%	4.2%
2	ROC-30	MgO (wt%)	0.8408	0.8457	0.8263	0.0145	0.0194	1.8%	2.4%
2	ROC-30	MnO (wt%)	3.5411	3.6646	3.6001	-0.0589	0.0646	-1.6%	1.8%
2	ROC-30	Na2O (wt%)	12.2567	12.2221	11.9887	0.2680	0.2334	2.2%	1.9%

Table A3. Average Measured and Bias-Corrected Chemical Compositions Versus Targeted Compositions by Oxide by Glass ID

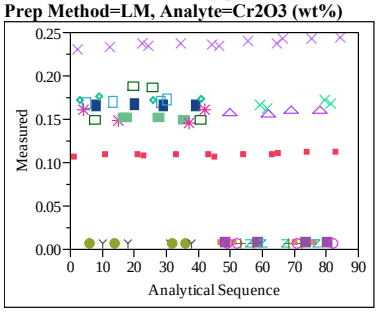
				Measured					
			Measured	Bias-Corrected	Targeted	Diff of	Diff of	% Diff of	% Diff of
Set	Glass #	Oxide	(wt%)	(wt%)	(wt%)	Measured	Meas BC	Measured	Meas BC
2	ROC-30	NiO (wt%)	1.2248	1.2014	1.3057	-0.0810	-0.1044	-6.2%	-8.0%
2	ROC-30	PbO (wt%)	0.1150	0.1150	0.1143	0.0007	0.0007	0.6%	0.6%
2	ROC-30	SiO2 (wt%)	45.6206	46.2945	45.7022	-0.0817	0.5923	-0.2%	1.3%
2	ROC-30	SO4 (wt%)	0.2247	0.2247	0.2540	-0.0293	-0.0293	-11.5%	-11.5%
2	ROC-30	TiO2 (wt%)	1.3569	1.4348	1.3707	-0.0138	0.0641	-1.0%	4.7%
2	ROC-30	U3O8 (wt%)	5.5157	5.4506	5.5839	-0.0682	-0.1332	-1.2%	-2.4%
2	ROC-30	ZnO (wt%)	0.0815	0.0815	0.0711	0.0104	0.0104	14.6%	14.6%
2	ROC-30	ZrO2 (wt%)	0.0959	0.0959	0.1084	-0.0125	-0.0125	-11.5%	-11.5%
2	ROC-30	Sum	100.4899	102.5018	100.0000	0.4899	2.5018	0.5%	2.5%
1	Ustd	Al2O3 (wt%)	4.0656	4.1058	4.1000	-0.0344	0.0058	-0.8%	0.1%
1	Ustd	B2O3 (wt%)	8.8011	9.4093	9.2090	-0.4079	0.2003	-4.4%	2.2%
1	Ustd	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
1	Ustd	CaO (wt%)	1.3183	1.2833	1.3010	0.0173	-0.0177	1.3%	-1.4%
1	Ustd	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
1	Ustd	Ce2O3 (wt%)	0.0059	0.0059	0.0000	0.0059	0.0059		
1	Ustd	Cr2O3 (wt%)	0.2365	0.2341	0.0000	0.2365	0.2341		
1	Ustd	CuO (wt%)	0.0147	0.0157	0.0000	0.0147	0.0157		
1	Ustd	Fe2O3 (wt%)	13.3522	13.4726	13.1960	0.1562	0.2766	1.2%	2.1%
1	Ustd	K2O (wt%)	2.9422	2.9758	2.9990	-0.0568	-0.0232	-1.9%	-0.8%
1	Ustd	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
1	Ustd	Li2O (wt%)	2.9064	3.0545	3.0570	-0.1506	-0.0025	-4.9%	-0.1%
1	Ustd	MgO (wt%)	1.1956	1.1921	1.2100	-0.0144	-0.0179	-1.2%	-1.5%
1	Ustd	MnO (wt%)	2.6577	2.6662	2.8920	-0.2343	-0.2258	-8.1%	-7.8%
1	Ustd	Na2O (wt%)	11.8961	11.6641	11.7950	0.1011	-0.1309	0.9%	-1.1%
1	Ustd	NiO (wt%)	0.9797	0.9485	1.1200	-0.1403	-0.1715	-12.5%	-15.3%
1	Ustd	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
1	Ustd	SiO2 (wt%)	45.2462	46.1307	45.3530	-0.1068	0.7777	-0.2%	1.7%
1	Ustd	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
1	Ustd	TiO2 (wt%)	0.9424	0.9548	1.0490	-0.1066	-0.0942	-10.2%	-9.0%
1	Ustd	U3O8 (wt%)	2.4655	2.4060	2.4060	0.0595	0.0000	2.5%	0.0%
1	Ustd	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
1	Ustd	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
1	Ustd	Sum	99.2824	100.7758	99.6870	-0.4046	1.0888	-0.4%	1.1%
2	Ustd	Al2O3 (wt%)	4.0656	4.1415	4.1000	-0.0344	0.0415	-0.8%	1.0%
2	Ustd	B2O3 (wt%)	8.9272	9.4740	9.2090	-0.2818	0.2650	-3.1%	2.9%
2	Ustd	BaO (wt%)	0.0011	0.0011	0.0000	0.0011	0.0011		
2	Ustd	CaO (wt%)	1.2758	1.2912	1.3010	-0.0252	-0.0098	-1.9%	-0.8%
2	Ustd	CdO (wt%)	0.0040	0.0040	0.0000	0.0040	0.0040		
2	Ustd	Ce2O3 (wt%)	0.0117	0.0117	0.0000	0.0117	0.0117		
2	Ustd	Cr2O3 (wt%)	0.2401	0.2398	0.0000	0.2401	0.2398		
2	Ustd	CuO (wt%)	0.0143	0.0146	0.0000	0.0143	0.0146		
2	Ustd	Fe2O3 (wt%)	13.4952	13.6421	13.1960	0.2992	0.4461	2.3%	3.4%
2	Ustd	K2O (wt%)	2.9161	2.9754	2.9990	-0.0829	-0.0236	-2.8%	-0.8%
2	Ustd	La2O3 (wt%)	0.0053	0.0053	0.0000	0.0053	0.0053		
2	Ustd	Li2O (wt%)	2.9907	3.1161	3.0570	-0.0663	0.0591	-2.2%	1.9%
2	Ustd	MgO (wt%)	1.1893	1.1926	1.2100	-0.0207	-0.0174	-1.7%	-1.4%
2	Ustd	MnO (wt%)	2.7072	2.7873	2.8920	-0.1848	-0.1047	-6.4%	-3.6%
2	Ustd	Na2O (wt%)	11.7422	11.7277	11.7950	-0.0528	-0.0673	-0.4%	-0.6%
2	Ustd	NiO (wt%)	1.0848	1.0695	1.1200	-0.0352	-0.0505	-3.1%	-4.5%
2	Ustd	PbO (wt%)	0.0054	0.0054	0.0000	0.0054	0.0054		
2	Ustd	SiO2 (wt%)	44.5688	45.4396	45.3530	-0.7843	0.0866	-1.7%	0.2%
2	Ustd	SO4 (wt%)	0.2247	0.2247	0.0000	0.2247	0.2247		
2	Ustd	TiO2 (wt%)	0.9408	0.9814	1.0490	-0.1082	-0.0676	-10.3%	-6.4%
2	Ustd	U3O8 (wt%)	2.4124	2.4060	2.4060	0.0064	0.0000	0.3%	0.0%
2	Ustd	ZnO (wt%)	0.0124	0.0124	0.0000	0.0124	0.0124		
2	Ustd	ZrO2 (wt%)	0.0034	0.0034	0.0000	0.0034	0.0034		
2	Ustd	Sum	98.8385	100.7668	99.6870	-0.8485	1.0798	-0.9%	1.1%

Exhibit A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

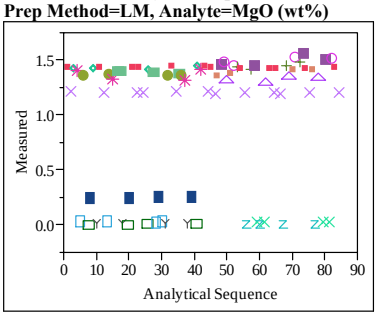
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=BaO (wt%)



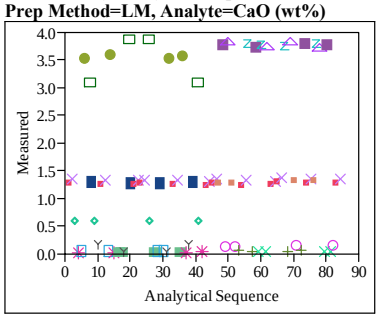
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=Cr2O3 (wt%)



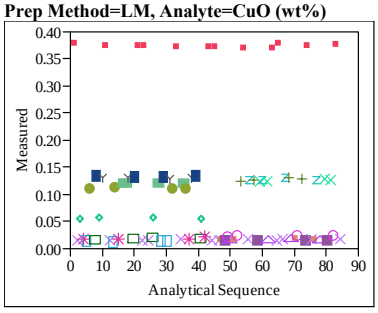
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=MgO (wt%)



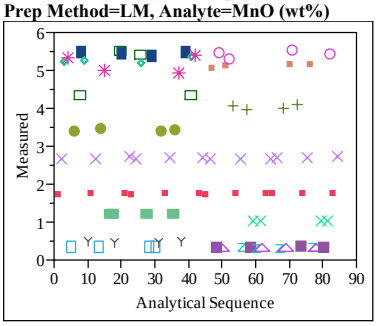
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=CaO (wt%)



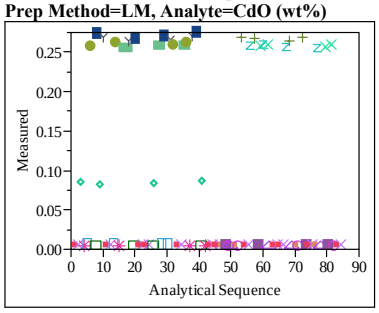
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=CuO (wt%)



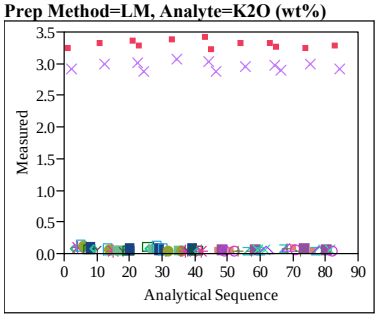
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=MnO (wt%)



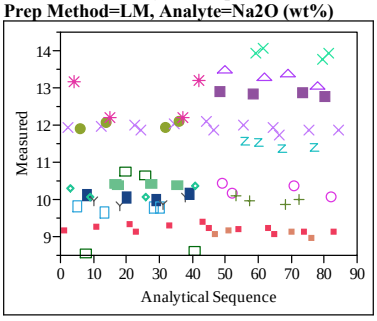
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=CdO (wt%)



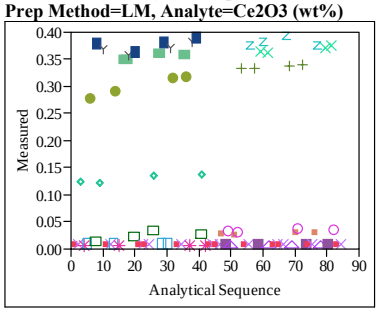
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=K2O (wt%)



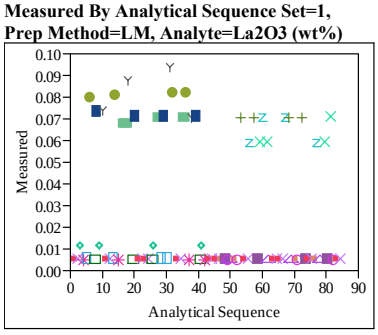
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=Na2O (wt%)



Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=Ce2O3 (wt%)



Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=La2O3 (wt%)



Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=NiO (wt%)

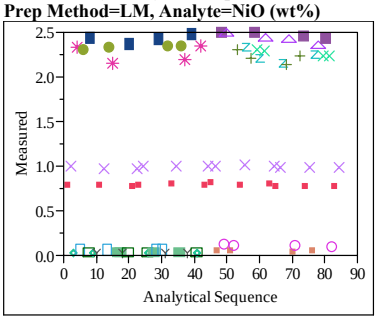
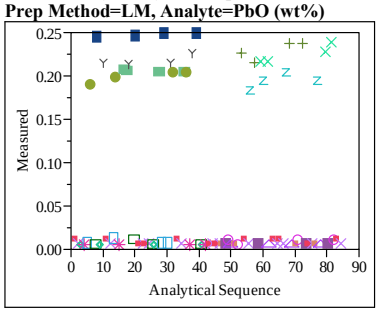
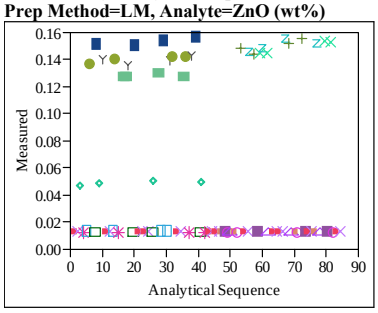


Exhibit A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

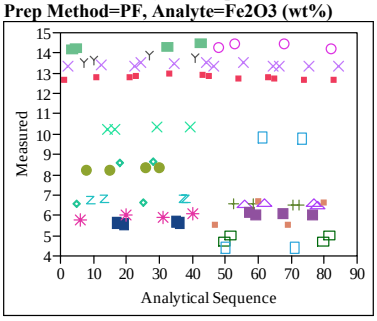
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=PbO (wt%)



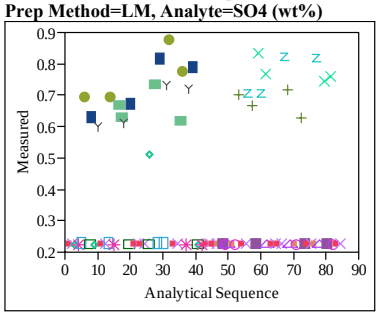
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=ZnO (wt%)



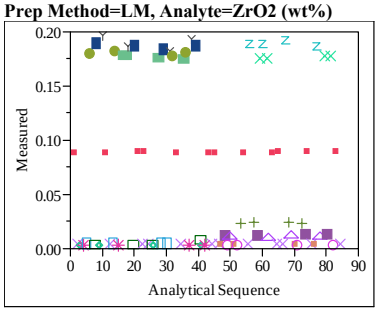
Measured By Analytical Sequence Set=1, Prep Method=PF, Analyte=Fe2O3 (wt%)



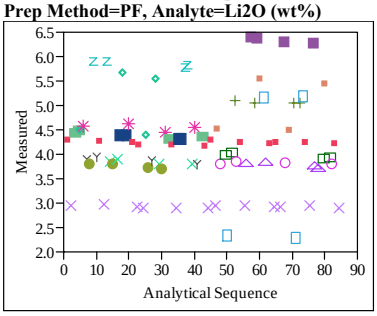
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=SO4 (wt%)



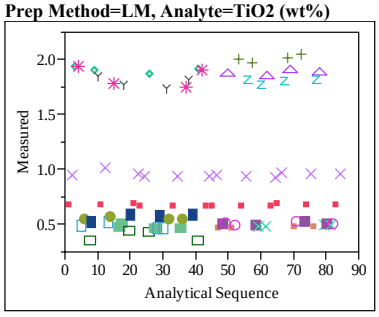
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=ZrO2 (wt%)



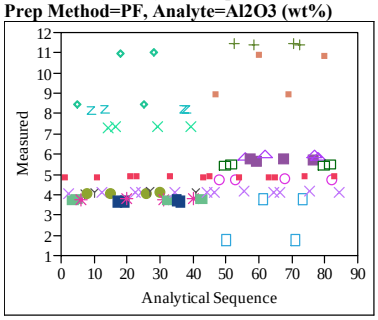
Measured By Analytical Sequence Set=1, Prep Method=PF, Analyte=Li2O (wt%)



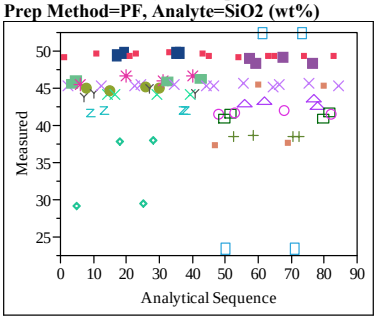
Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=TiO2 (wt%)



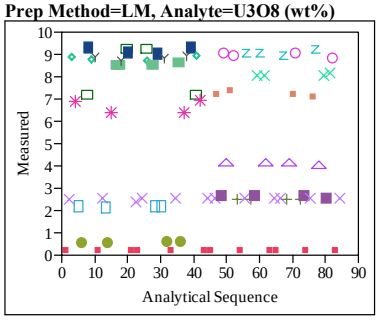
Measured By Analytical Sequence Set=1, Prep Method=PF, Analyte=Al2O3 (wt%)



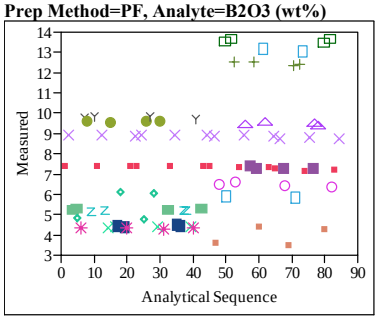
Measured By Analytical Sequence Set=1, Prep Method=PF, Analyte=SiO2 (wt%)



Measured By Analytical Sequence Set=1, Prep Method=LM, Analyte=U3O8 (wt%)



Measured By Analytical Sequence Set=1, Prep Method=PF, Analyte=B2O3 (wt%)



Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=BaO (wt%)

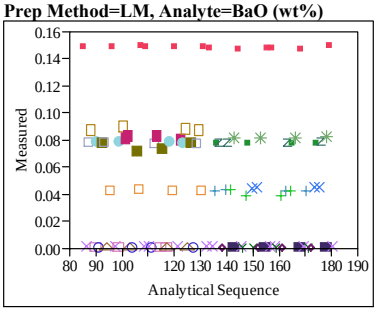
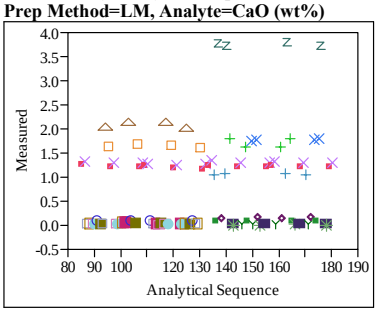
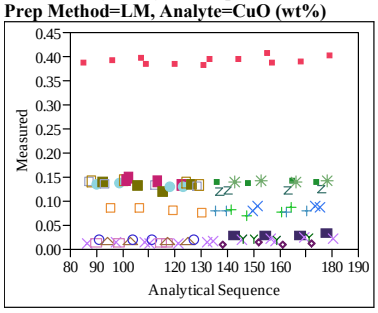


Exhibit A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

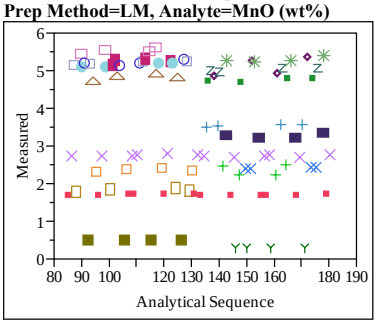
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=CaO (wt%)



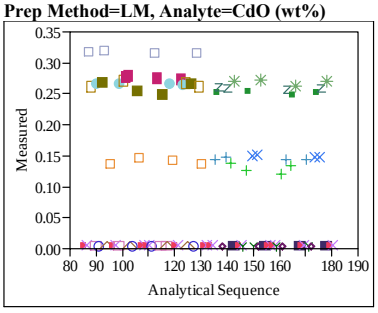
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=CuO (wt%)



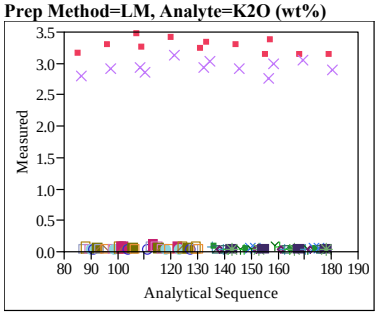
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=MnO (wt%)



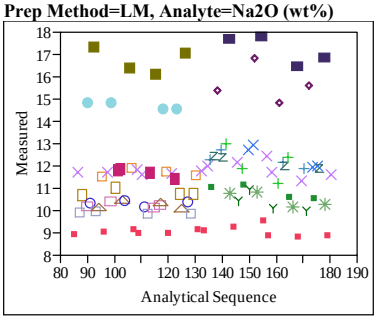
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=CdO (wt%)



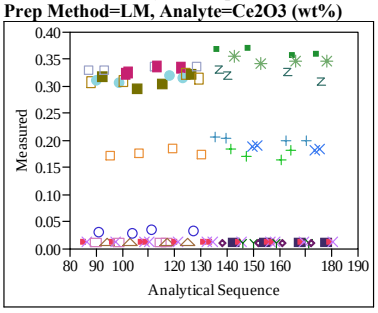
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=K2O (wt%)



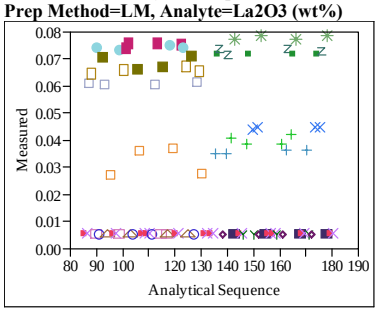
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=Na2O (wt%)



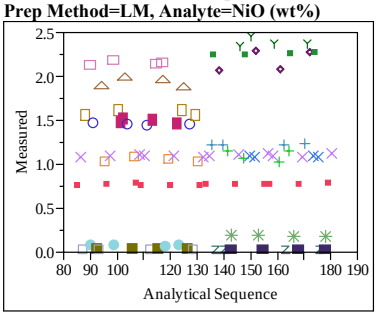
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=Ce2O3 (wt%)



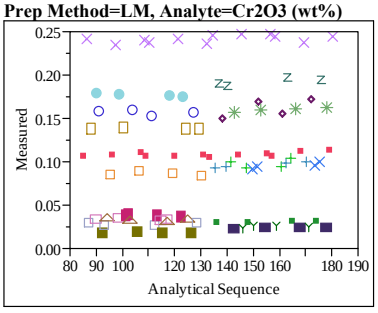
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=La2O3 (wt%)



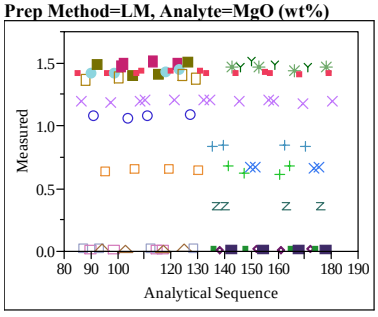
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=NiO (wt%)



Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=Cr2O3 (wt%)



Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=MgO (wt%)



Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=PbO (wt%)

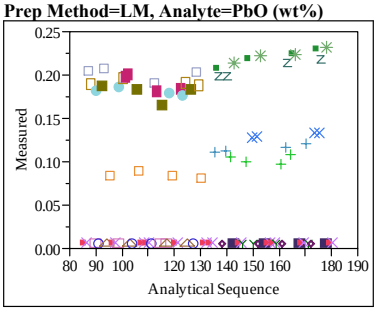
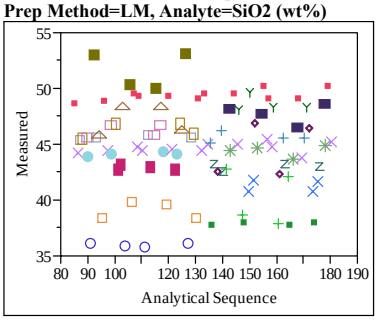
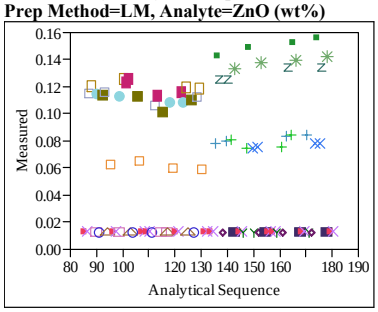


Exhibit A1. Measurements in Analytical Sequence for Samples by Oxide by Prep Method and by Analytical Set

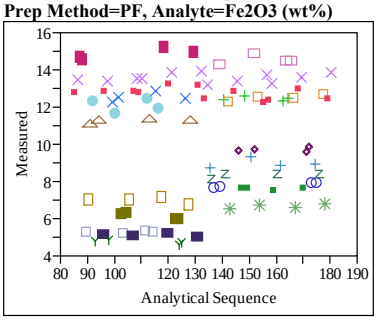
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=SiO2 (wt%)



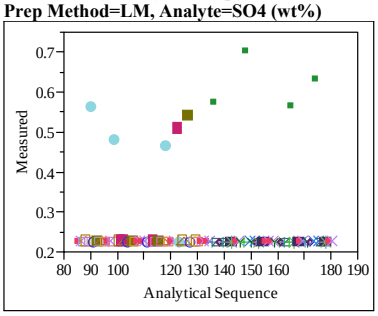
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=ZnO (wt%)



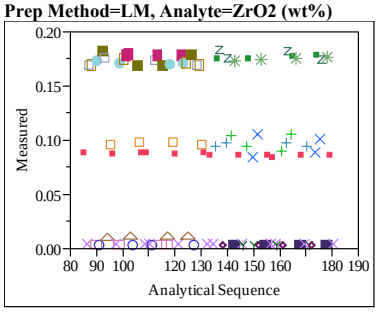
Measured By Analytical Sequence Set=2, Prep Method=PF, Analyte=Fe2O3 (wt%)



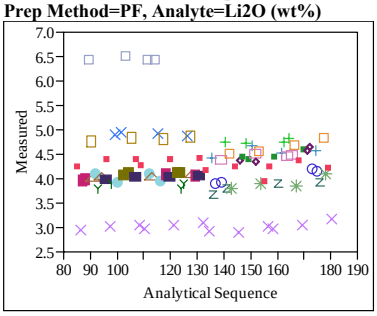
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=SO4 (wt%)



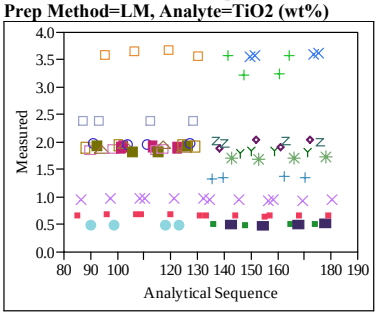
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=ZrO2 (wt%)



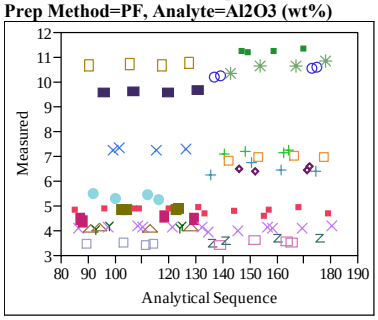
Measured By Analytical Sequence Set=2, Prep Method=PF, Analyte=Li2O (wt%)



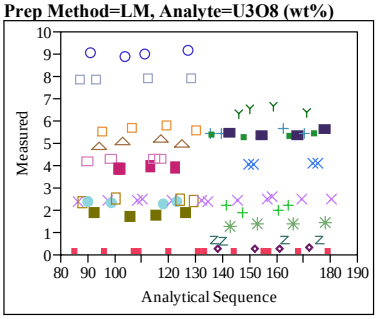
Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=TiO2 (wt%)



Measured By Analytical Sequence Set=2, Prep Method=PF, Analyte=Al2O3 (wt%)



Measured By Analytical Sequence Set=2, Prep Method=LM, Analyte=U3O8 (wt%)



Measured By Analytical Sequence Set=2, Prep Method=PF, Analyte=B2O3 (wt%)

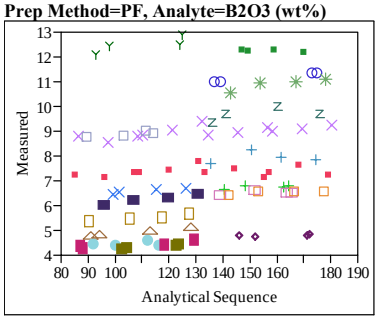
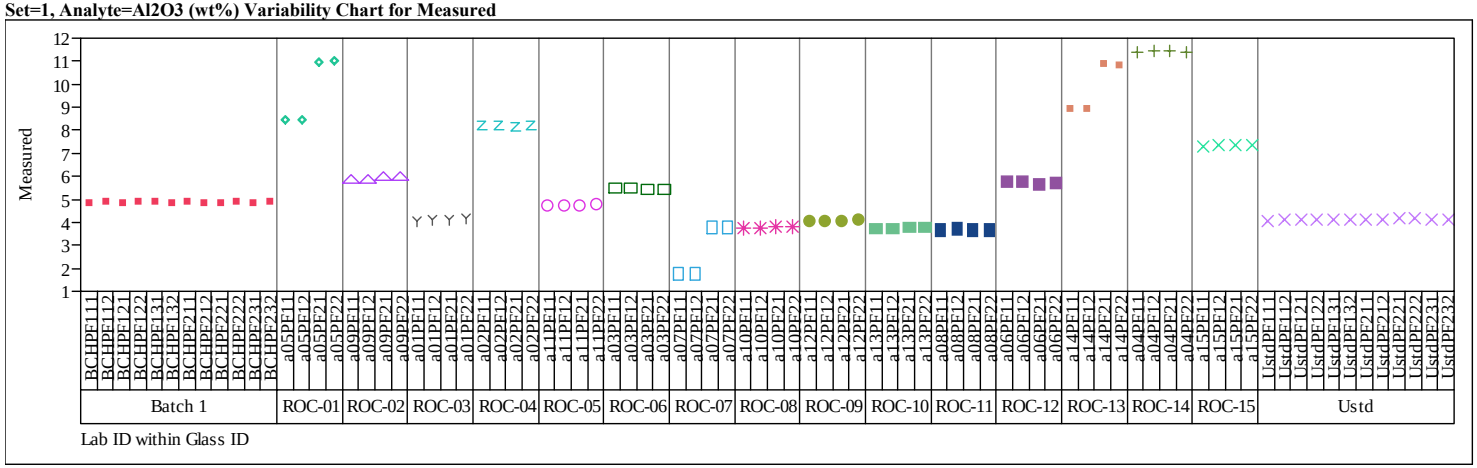


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=Al2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=B2O3 (wt%) Variability Chart for Measured

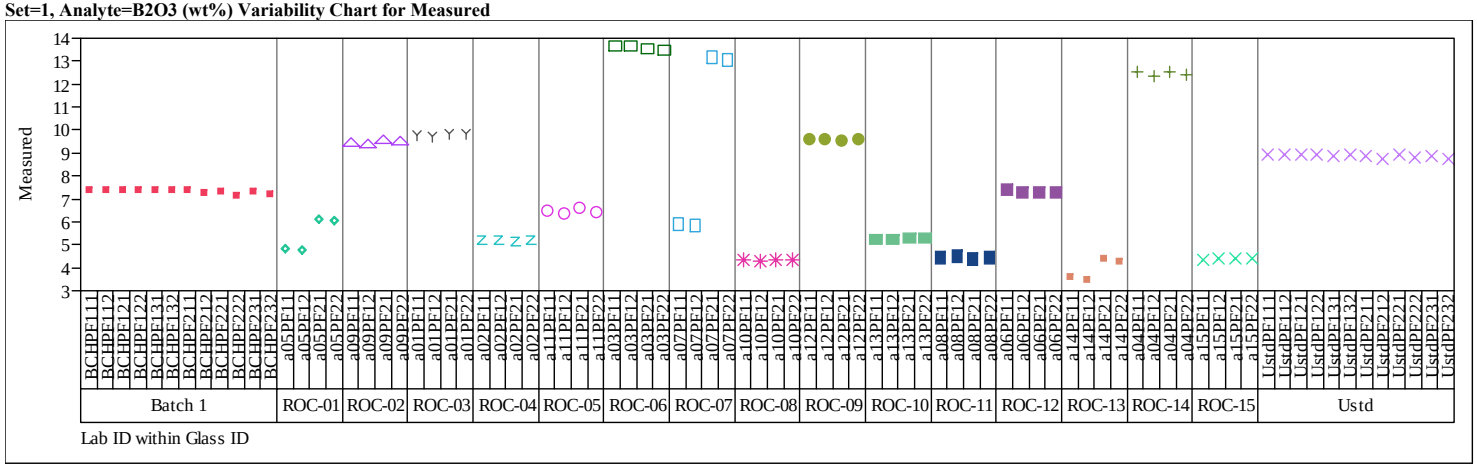
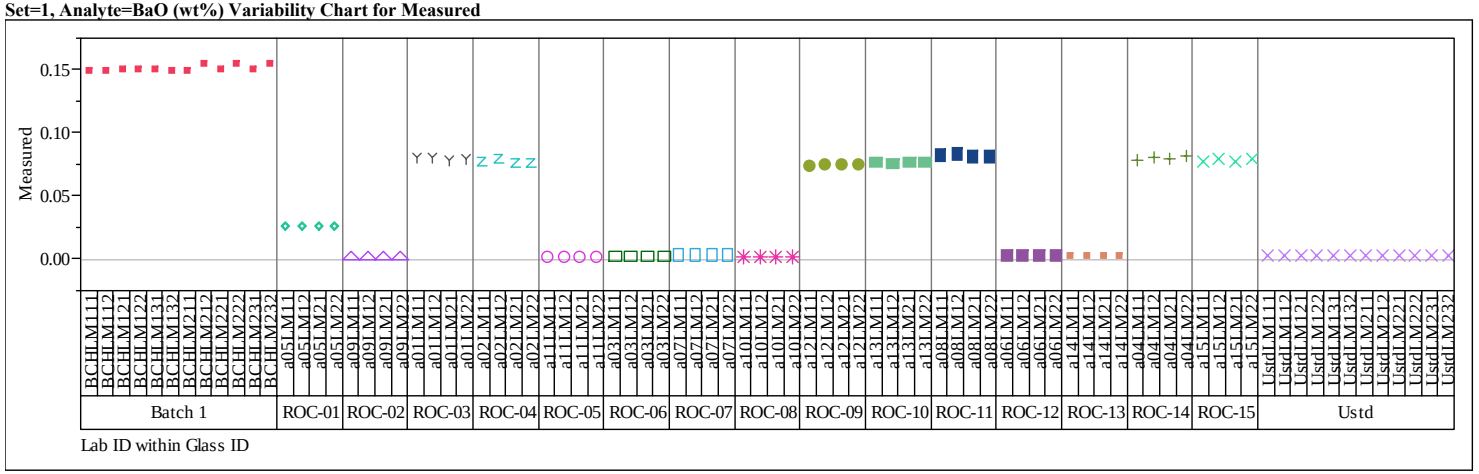


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=BaO (wt%) Variability Chart for Measured



Set=1, Analyte=CaO (wt%) Variability Chart for Measured

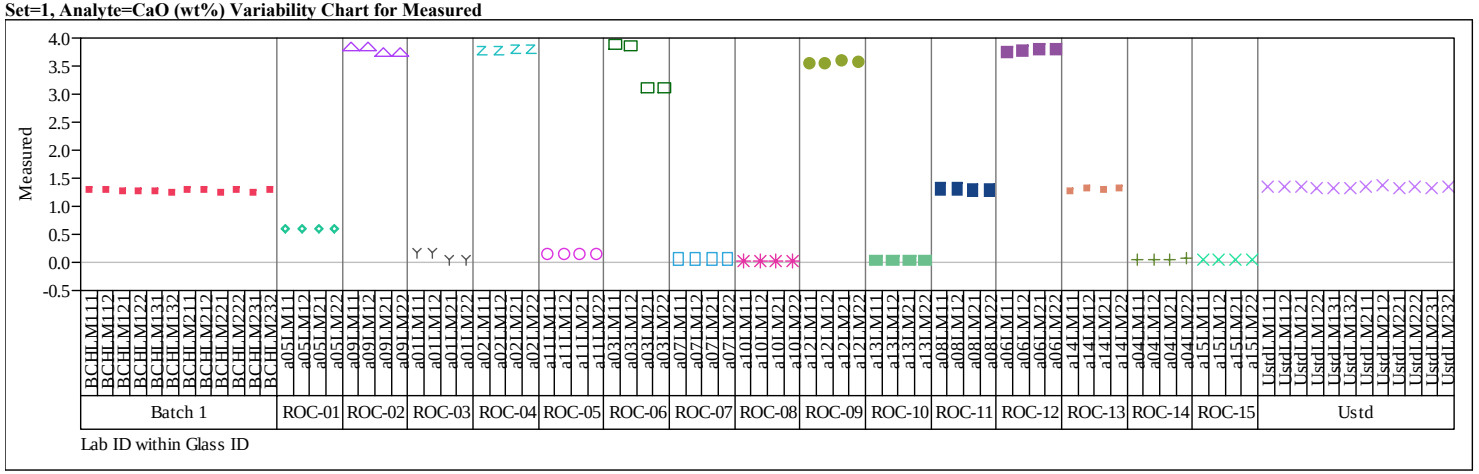
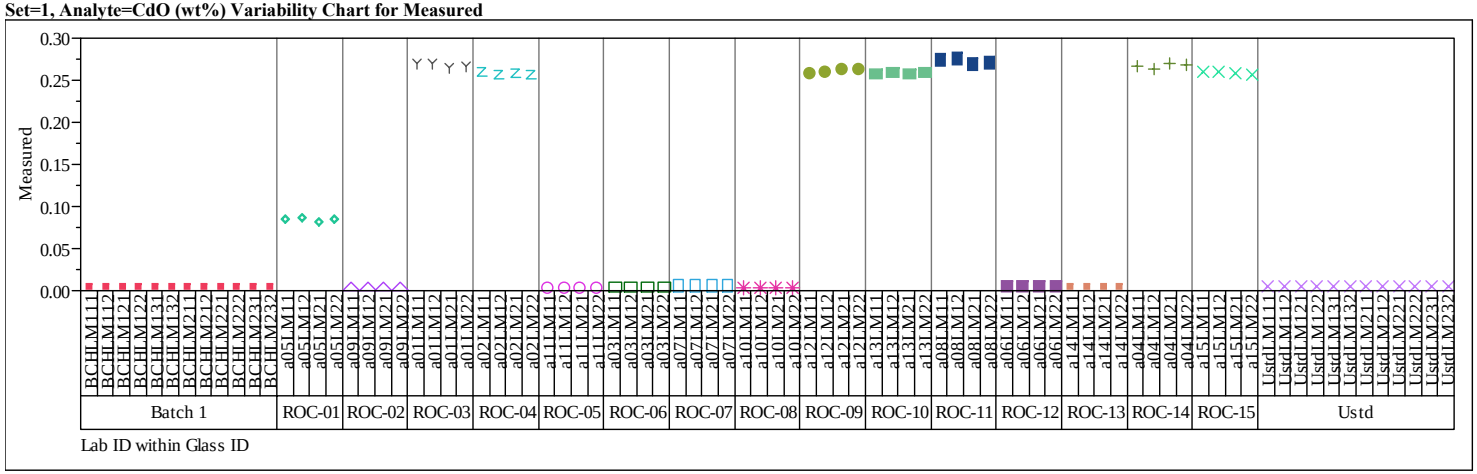


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=CdO (wt%) Variability Chart for Measured



Set=1, Analyte=Ce2O3 (wt%) Variability Chart for Measured

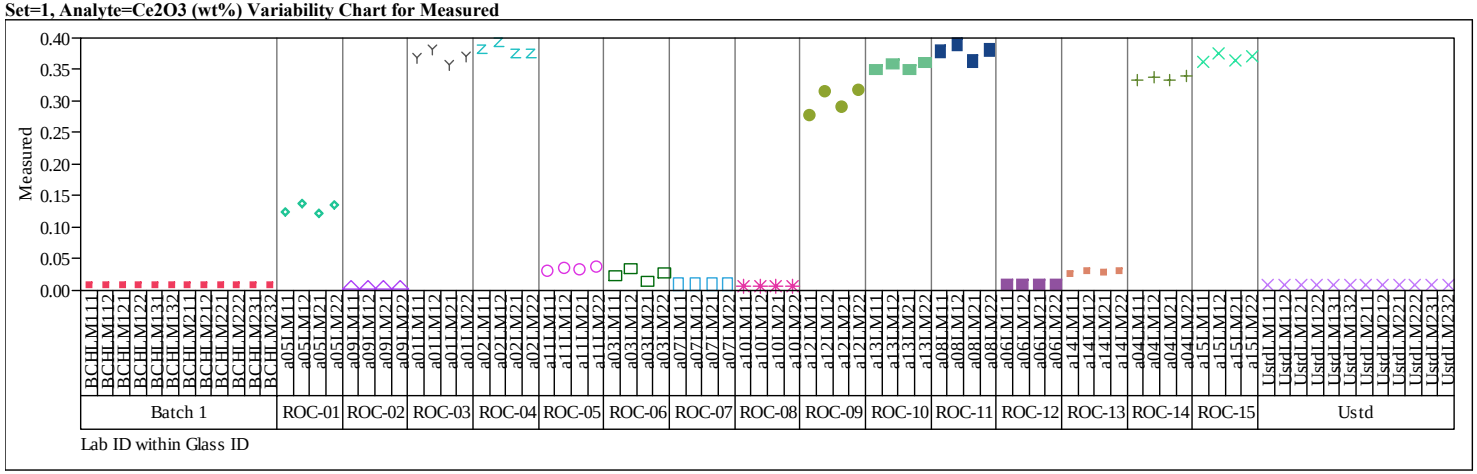
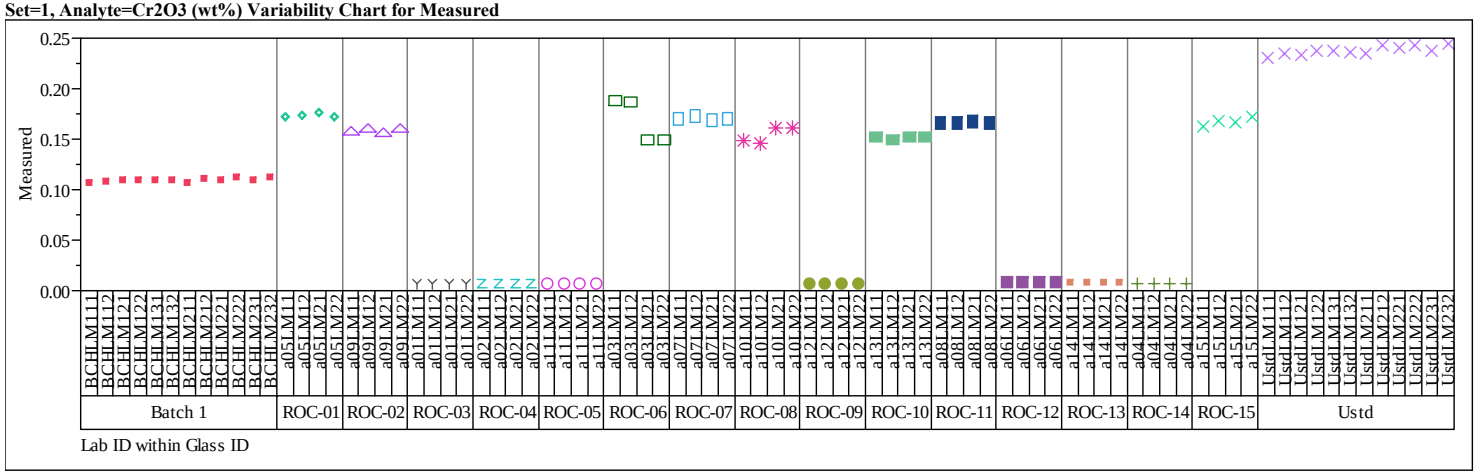


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=Cr2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=CuO (wt%) Variability Chart for Measured

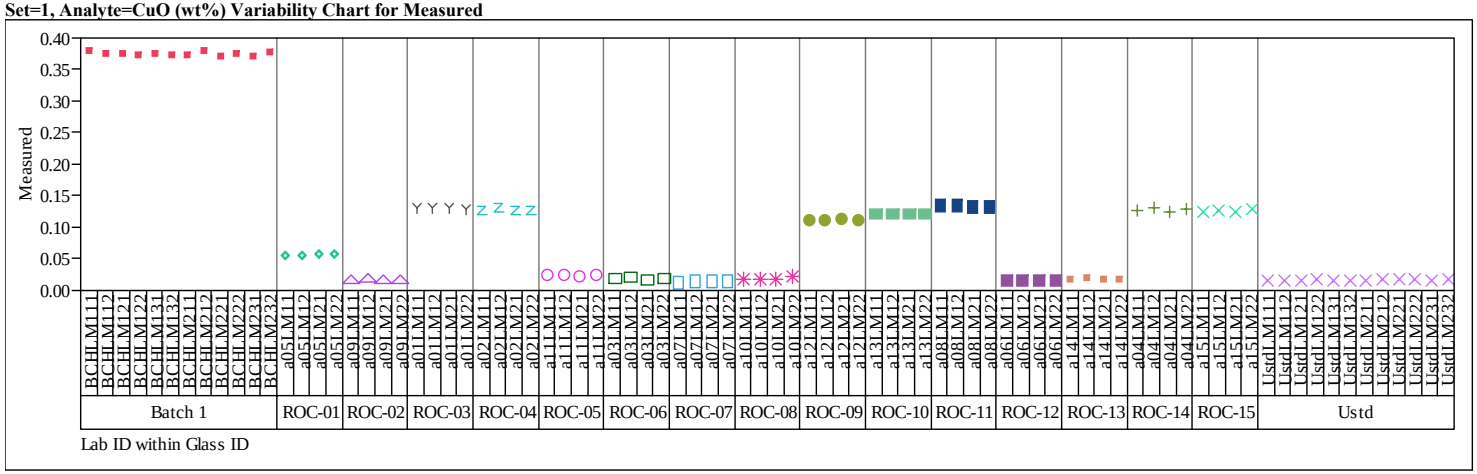
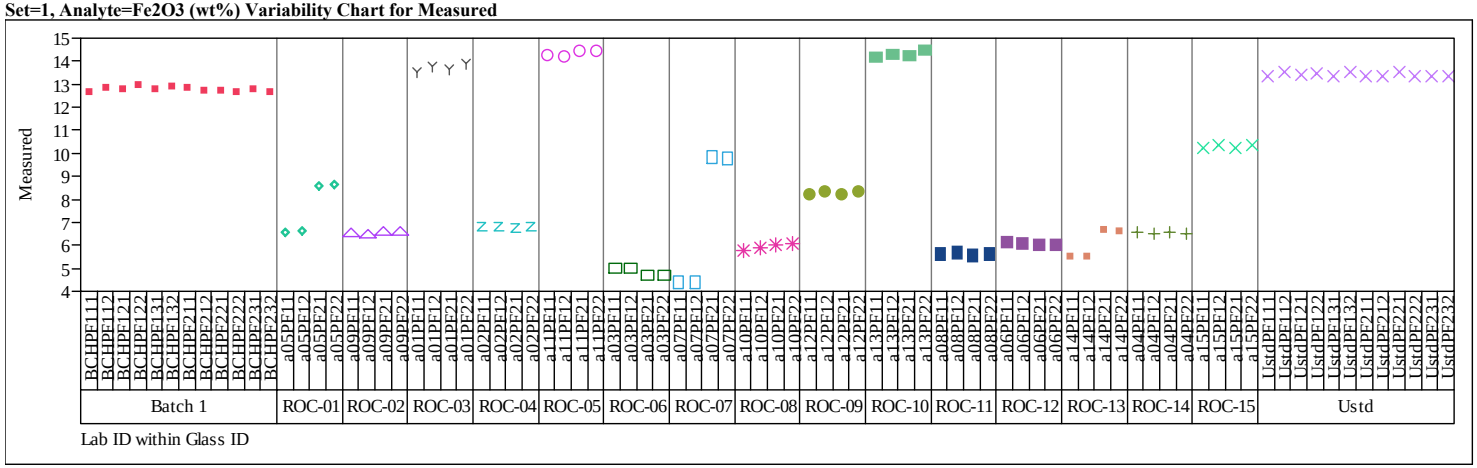


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=Fe2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=K2O (wt%) Variability Chart for Measured

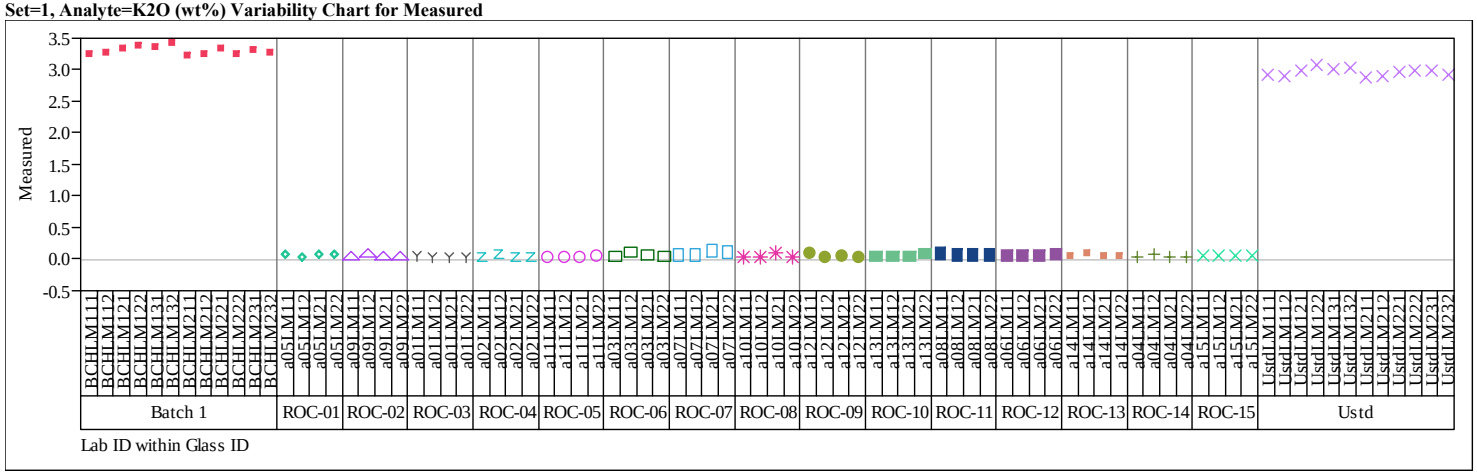
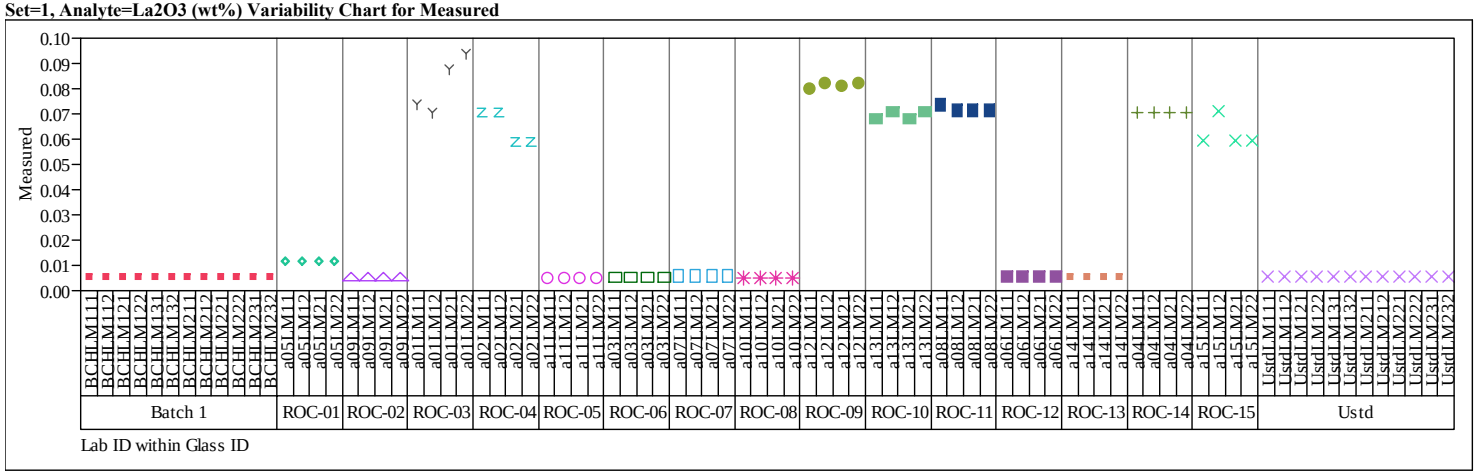


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=La2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=Li2O (wt%) Variability Chart for Measured

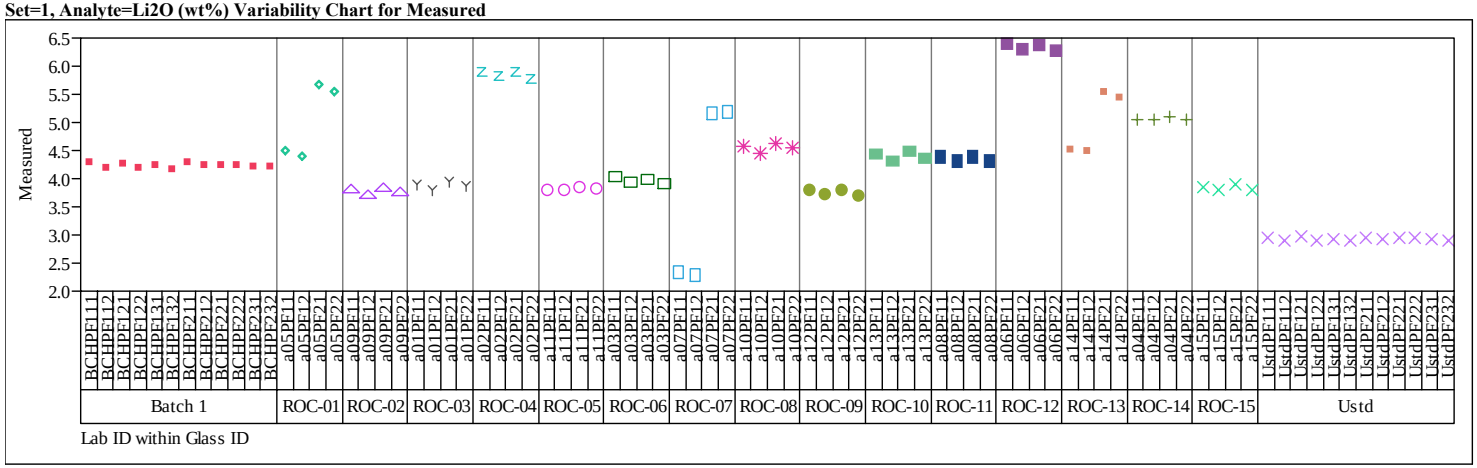
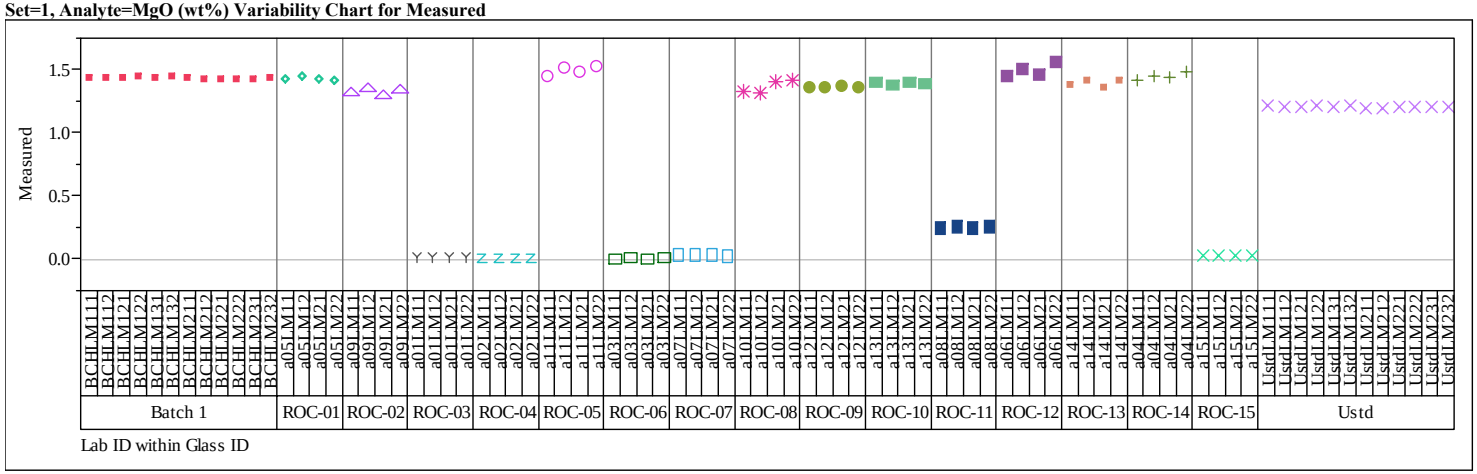


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=MgO (wt%) Variability Chart for Measured



Set=1, Analyte=MnO (wt%) Variability Chart for Measured

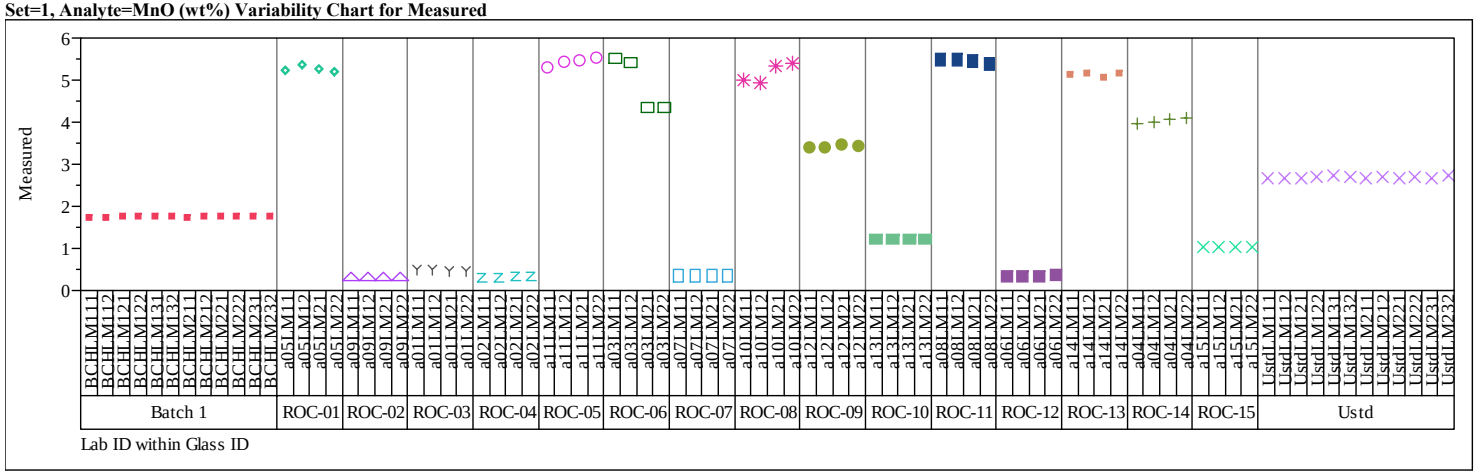
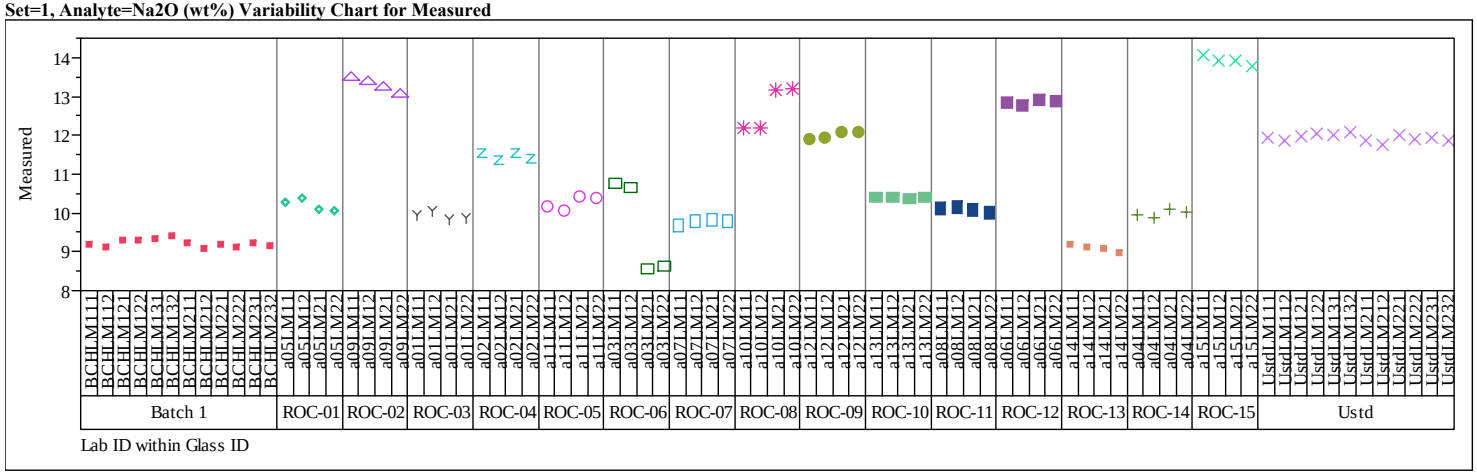


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=Na2O (wt%) Variability Chart for Measured



Set=1, Analyte=NiO (wt%) Variability Chart for Measured

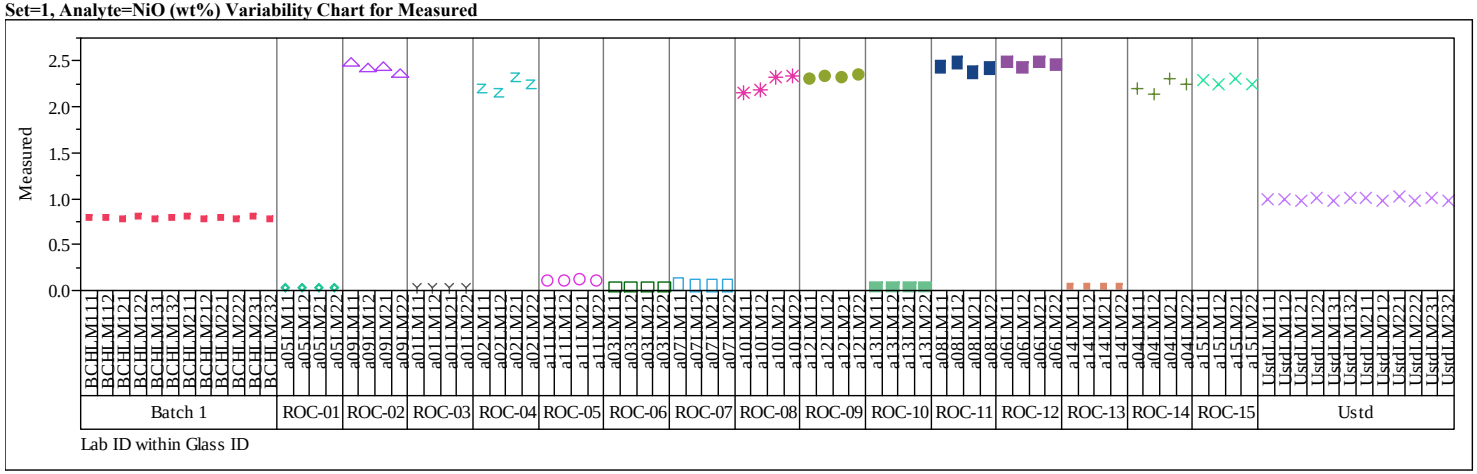
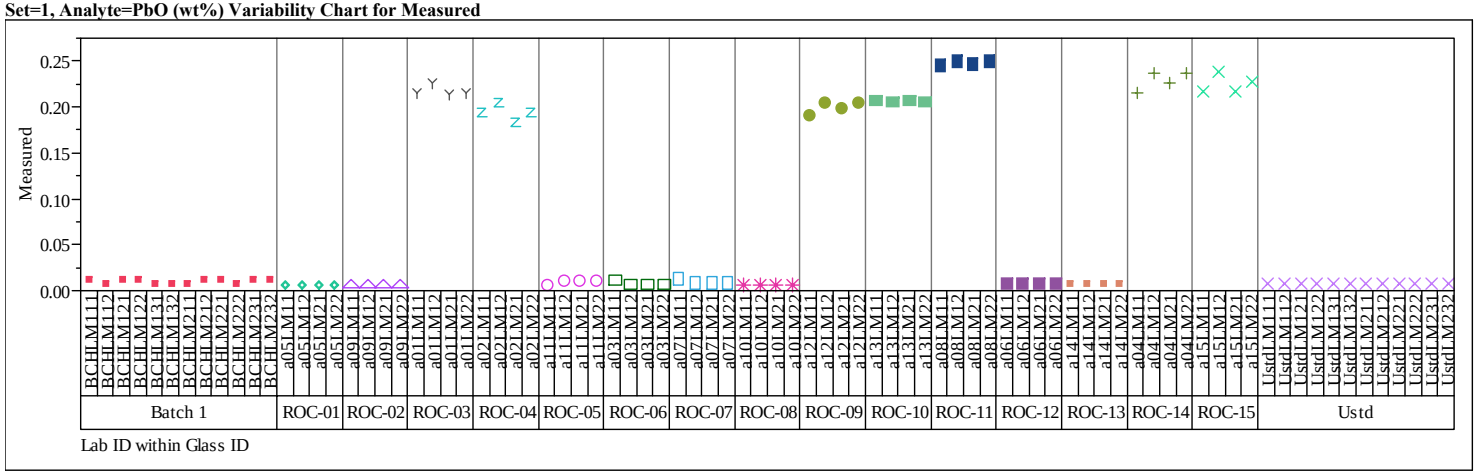


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=PbO (wt%) Variability Chart for Measured



Set=1, Analyte=SiO2 (wt%) Variability Chart for Measured

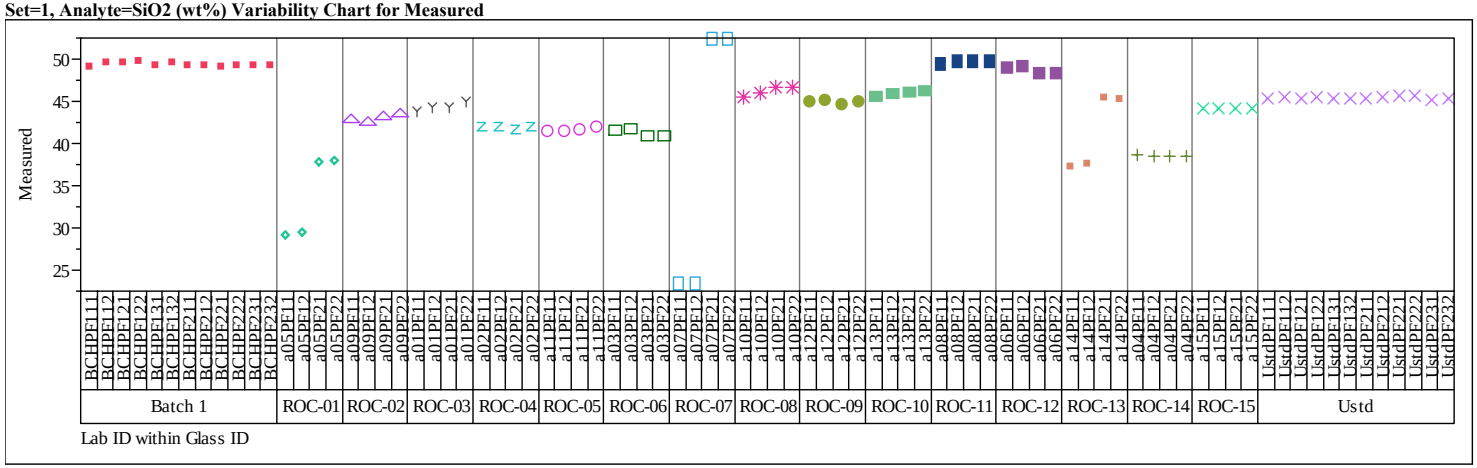
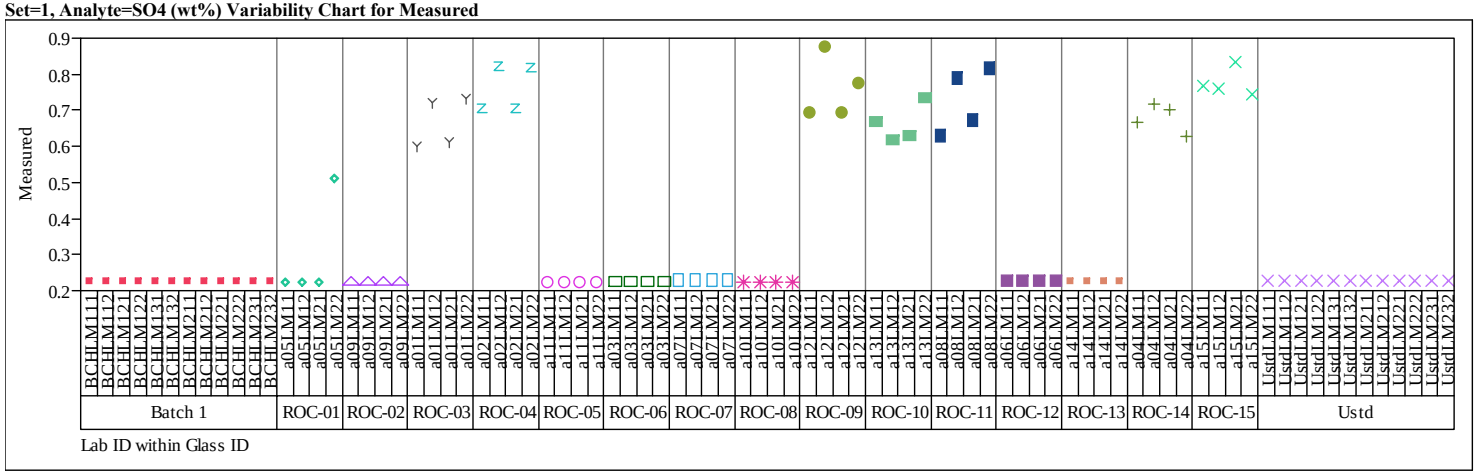


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=SO4 (wt%) Variability Chart for Measured



Set=1, Analyte=TiO2 (wt%) Variability Chart for Measured

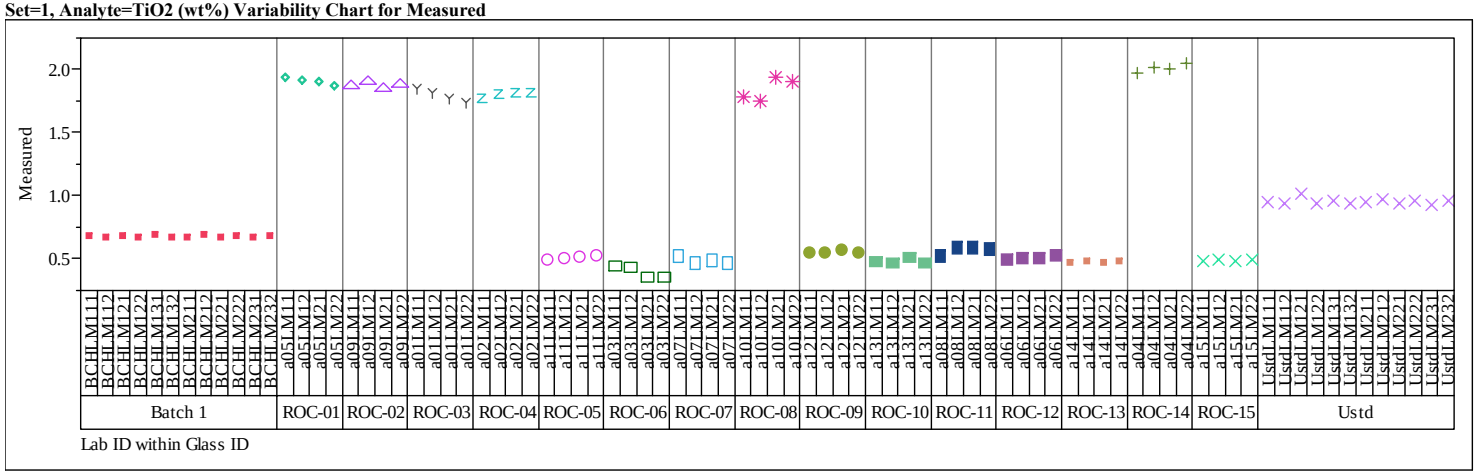
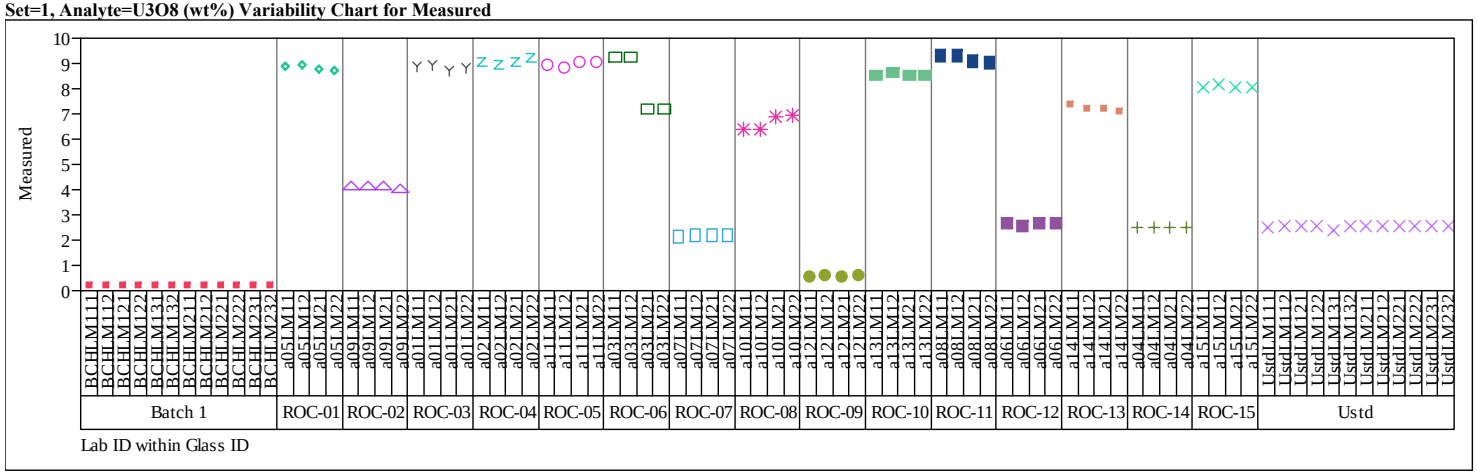


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=U3O8 (wt%) Variability Chart for Measured



Set=1, Analyte=ZnO (wt%) Variability Chart for Measured

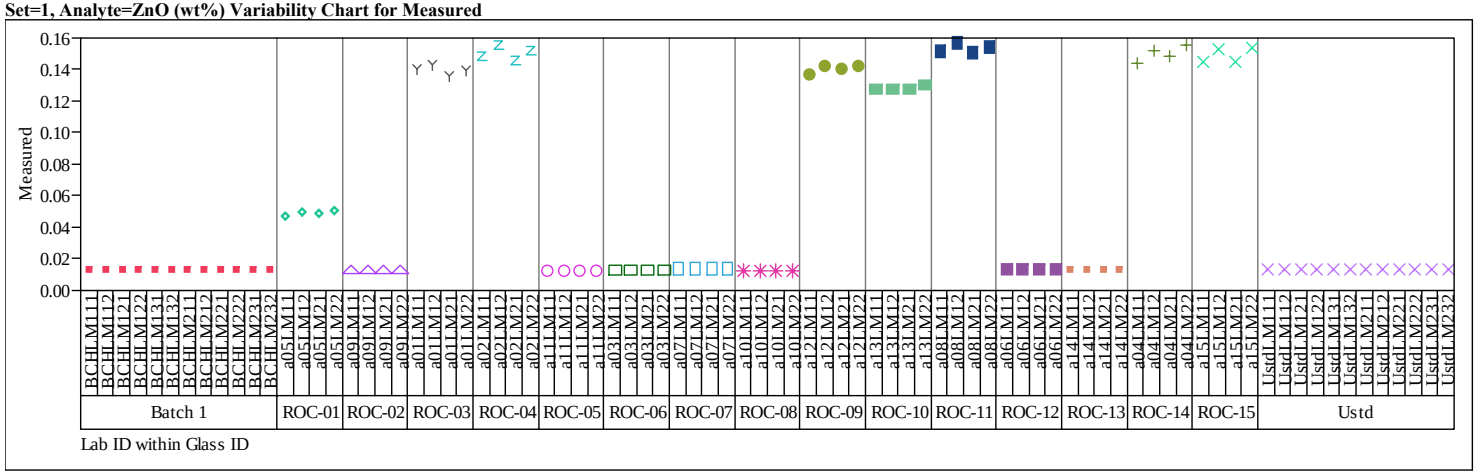
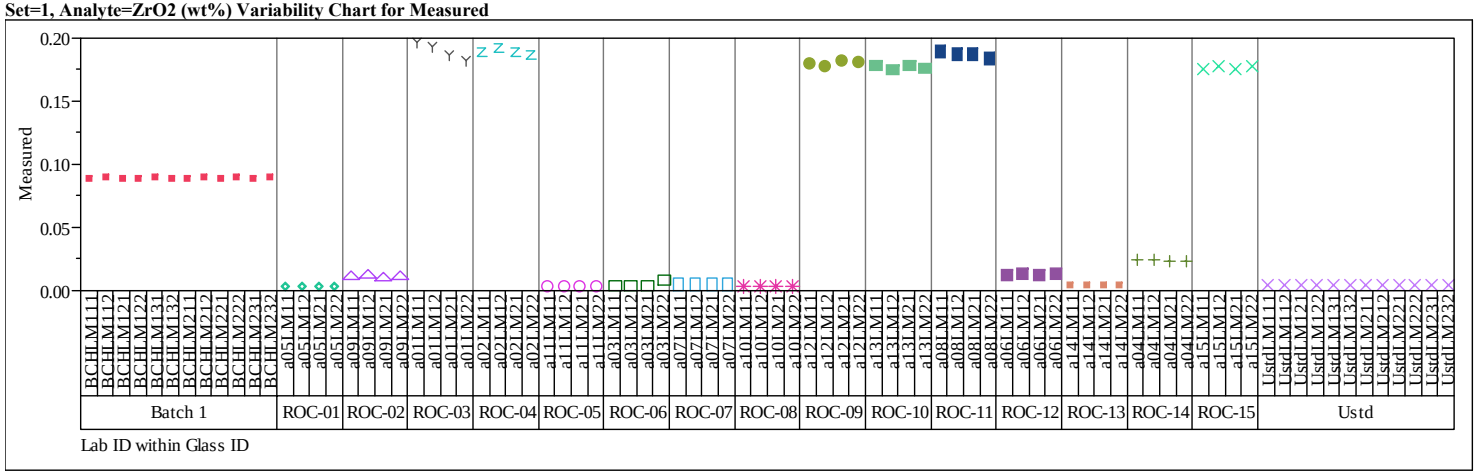


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=1, Analyte=ZrO2 (wt%) Variability Chart for Measured



Set=2, Analyte=Al2O3 (wt%) Variability Chart for Measured

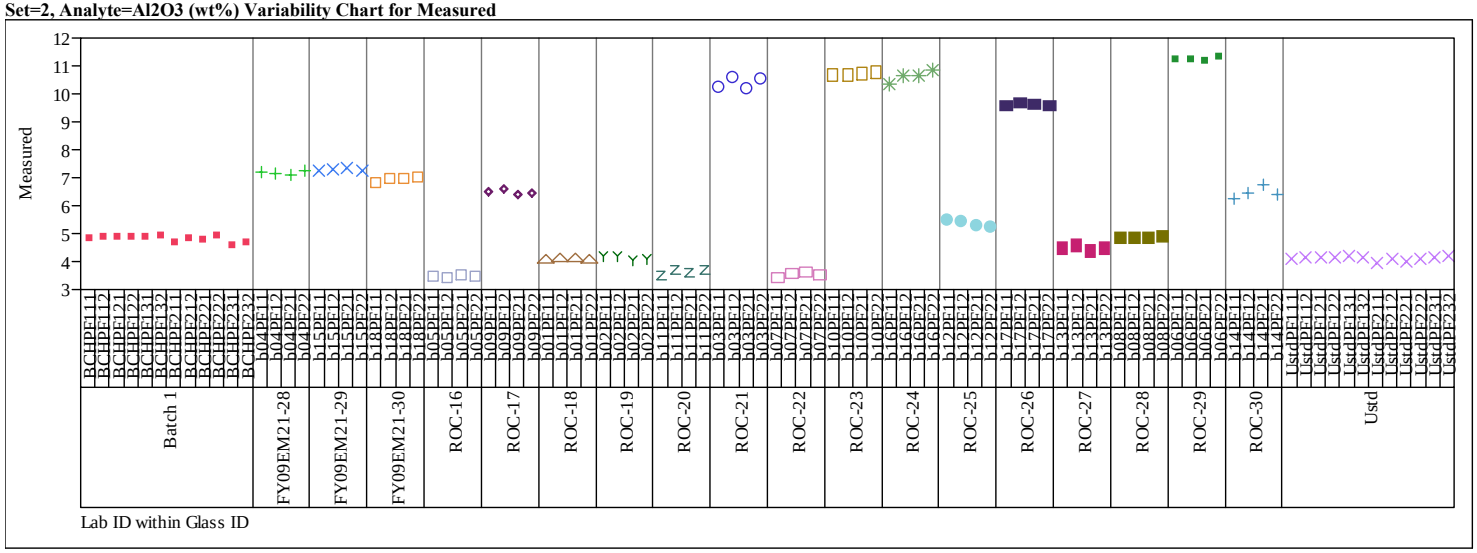
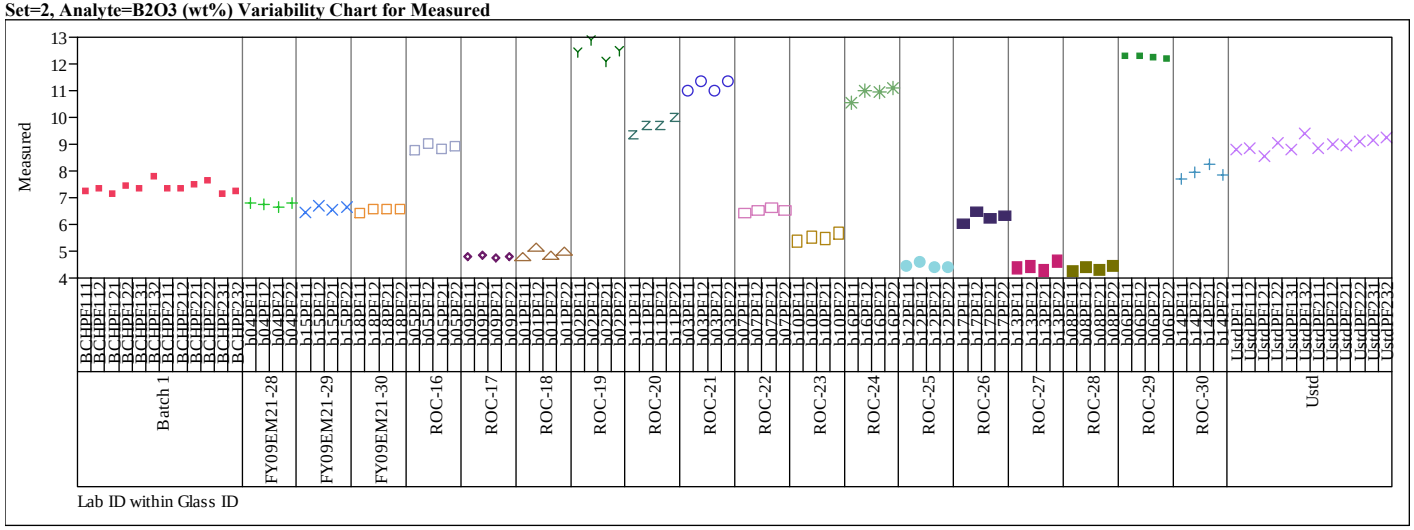


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=B2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=BaO (wt%) Variability Chart for Measured

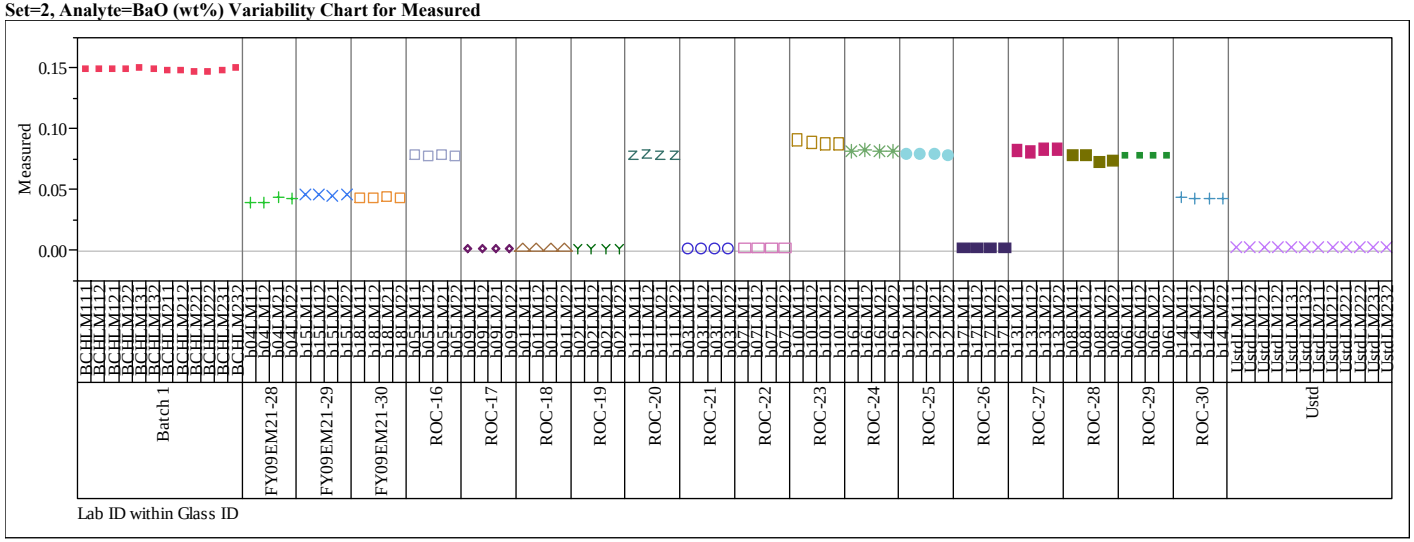
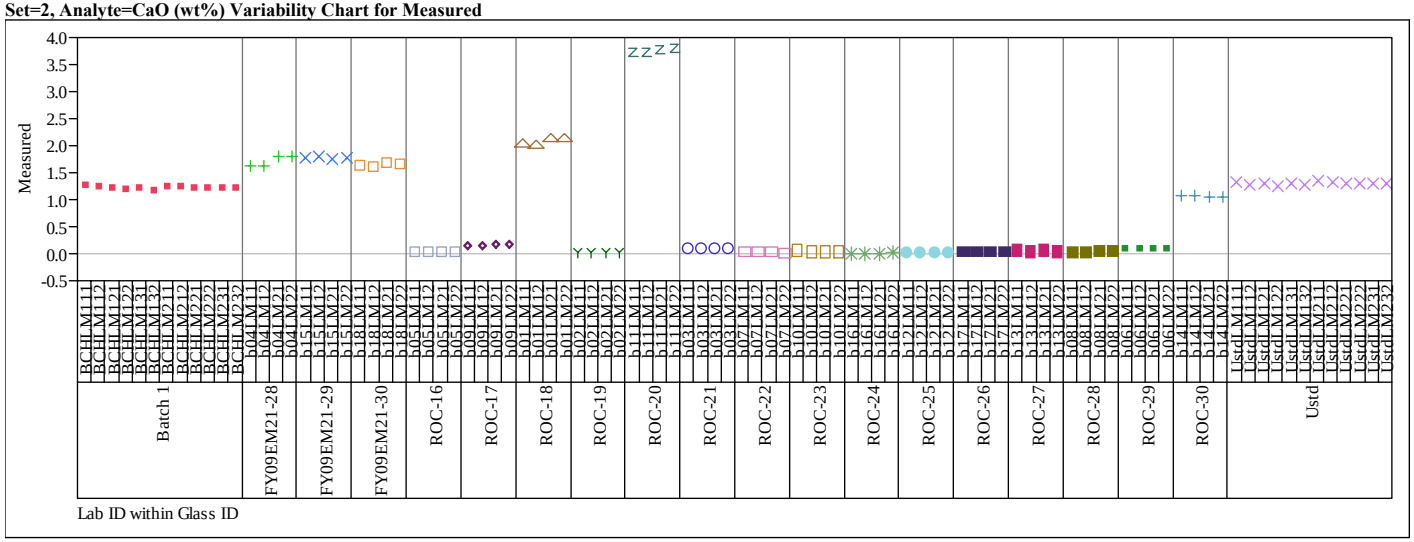


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=CaO (wt%) Variability Chart for Measured



Set=2, Analyte=CdO (wt%) Variability Chart for Measured

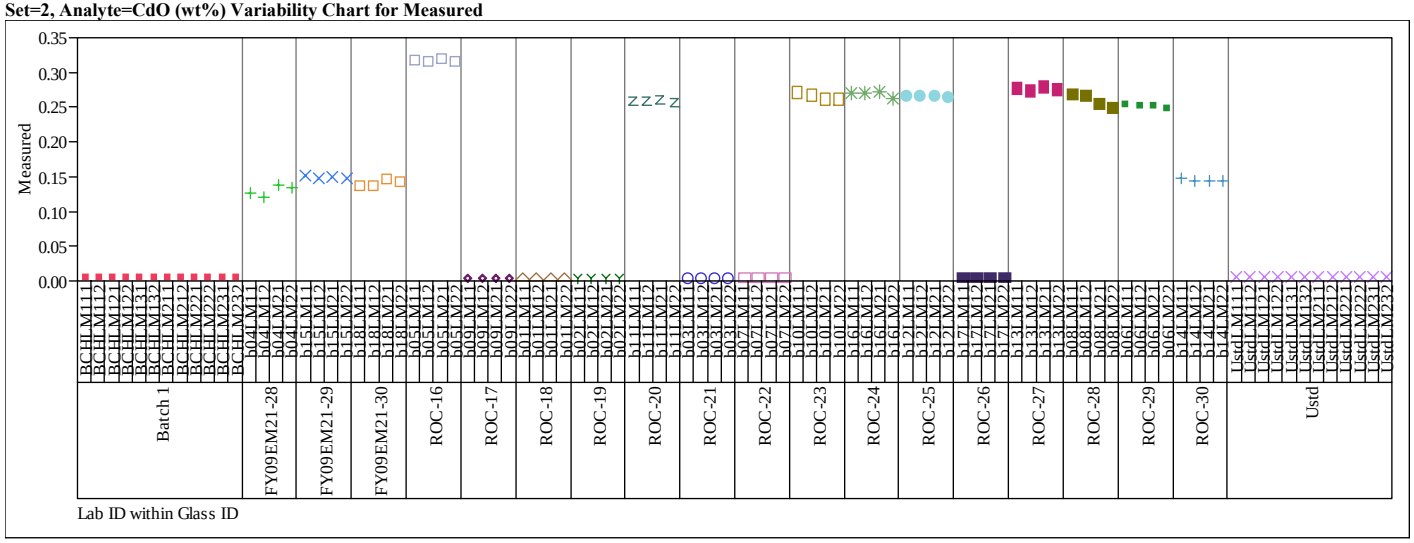
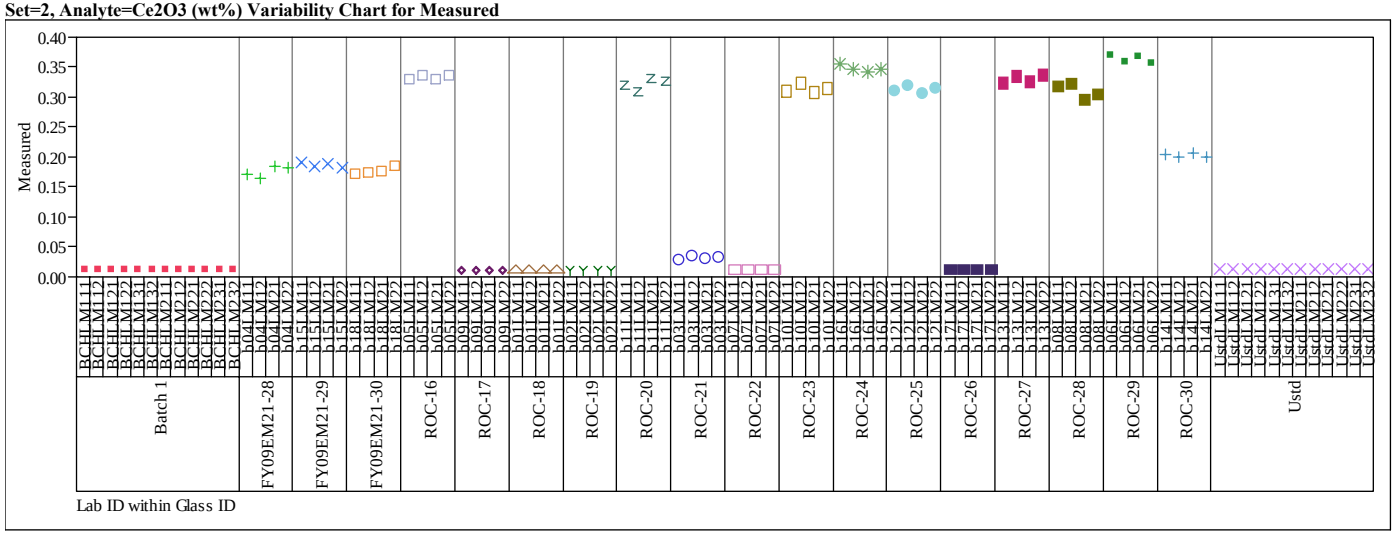


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=Ce2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=Cr2O3 (wt%) Variability Chart for Measured

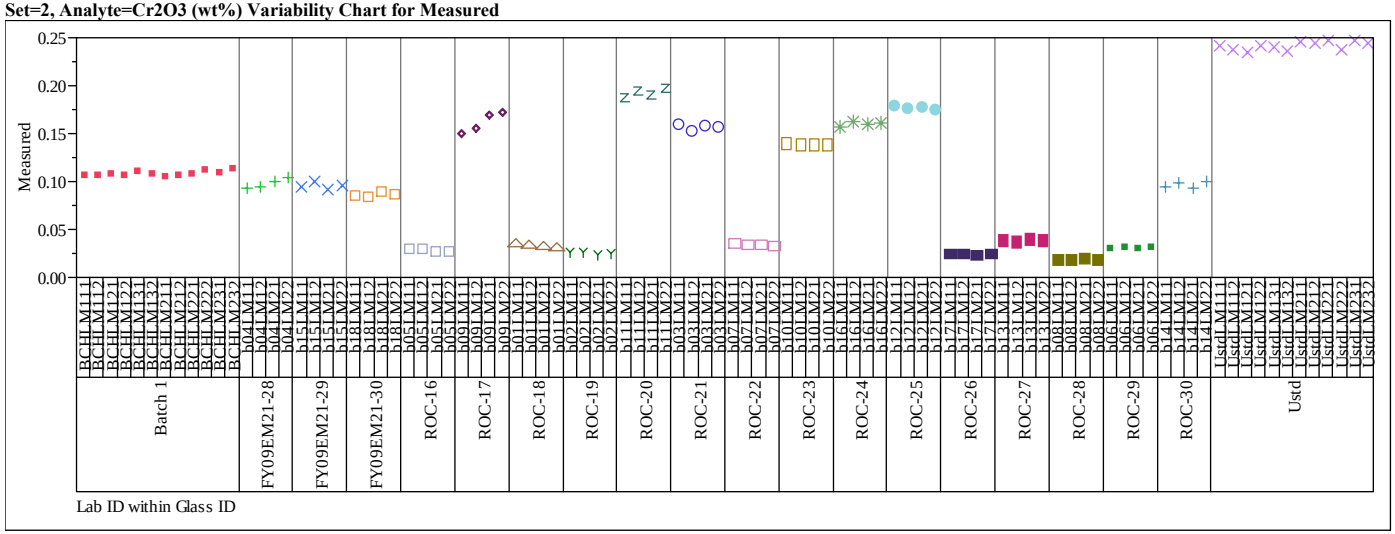
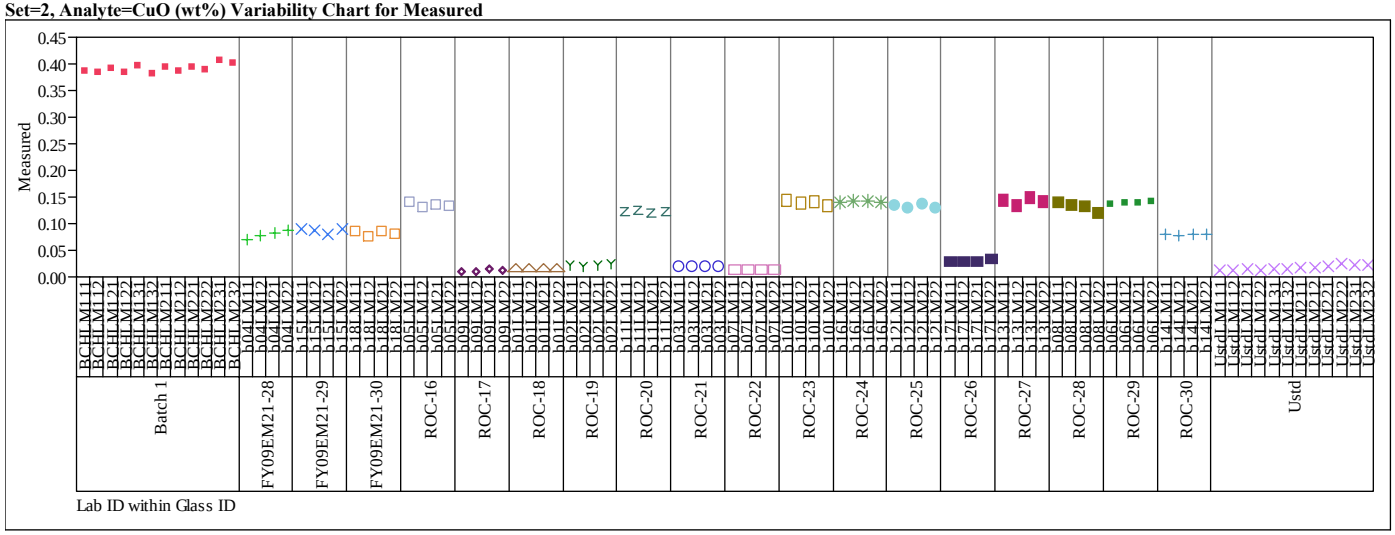


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=CuO (wt%) Variability Chart for Measured



Set=2, Analyte=Fe2O3 (wt%) Variability Chart for Measured

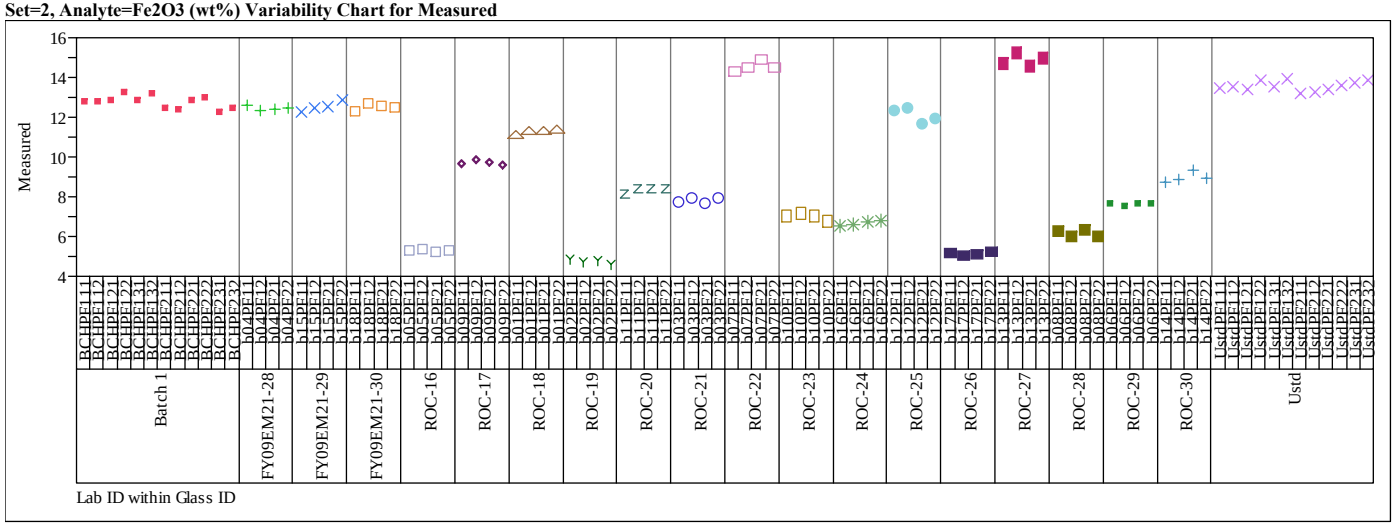
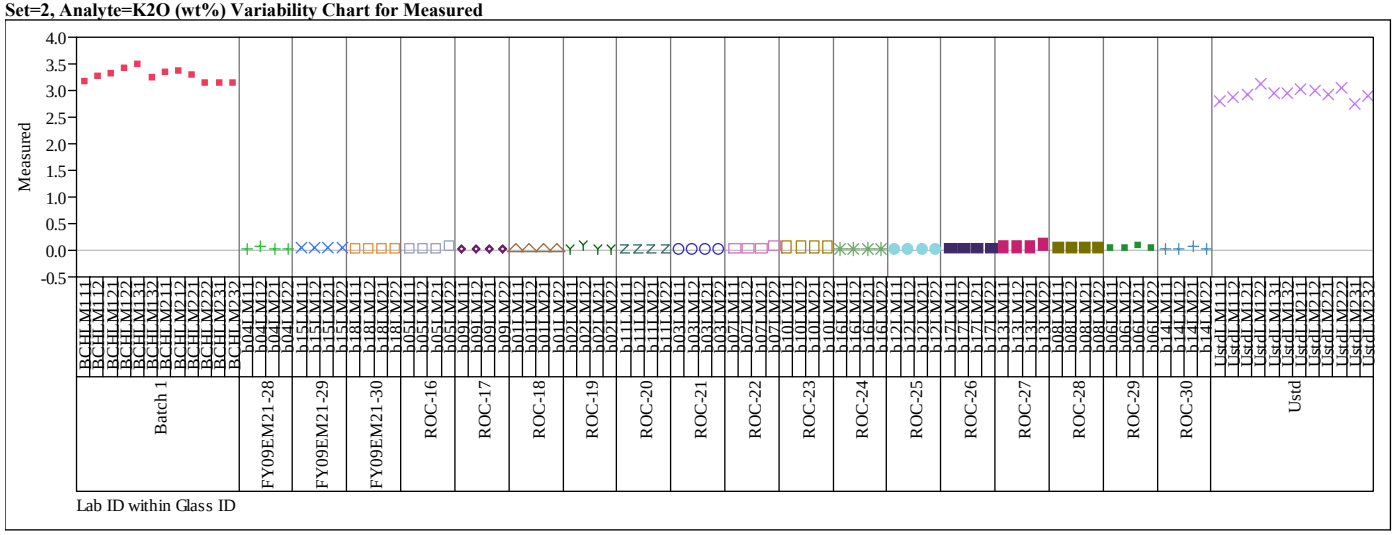


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=K2O (wt%) Variability Chart for Measured



Set=2, Analyte=La2O3 (wt%) Variability Chart for Measured

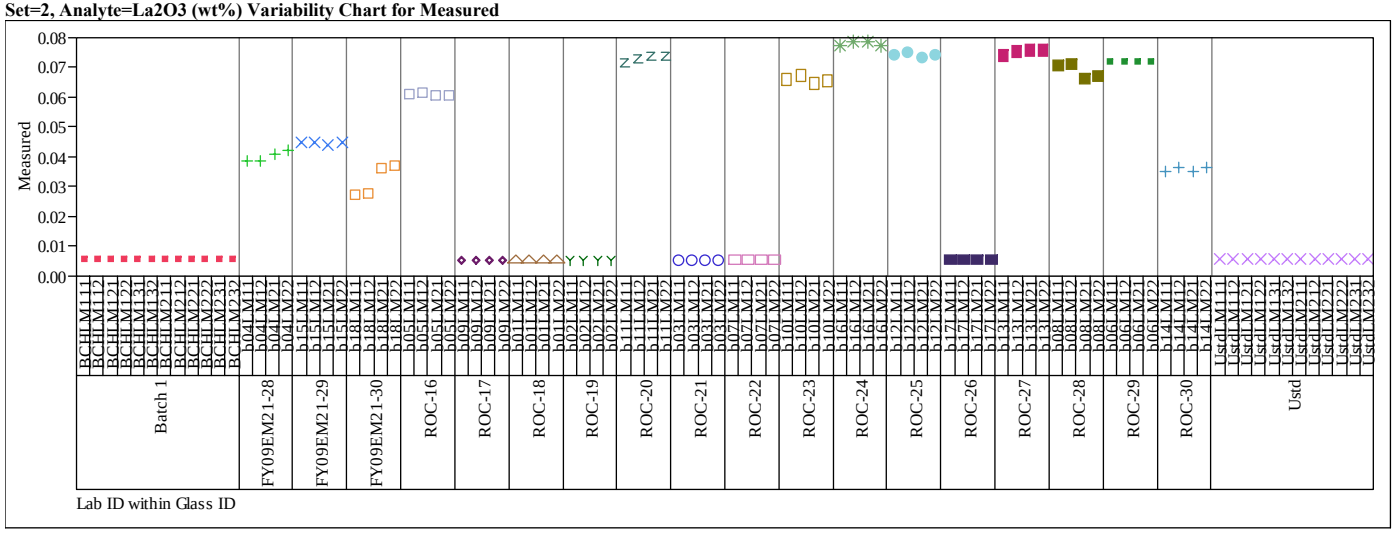
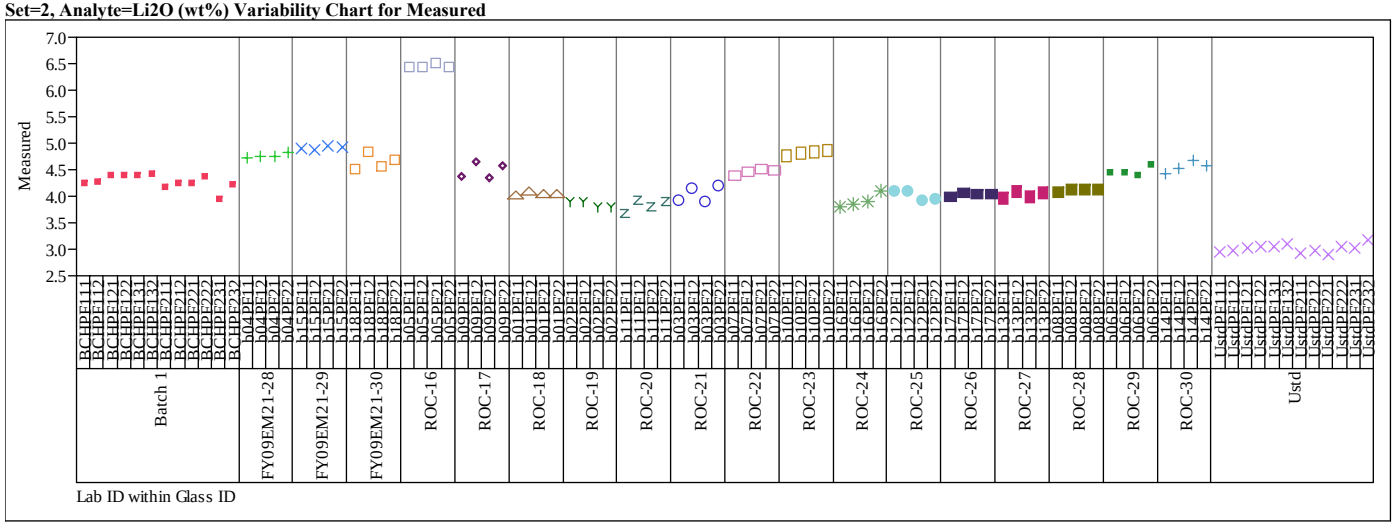


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=Li2O (wt%) Variability Chart for Measured



Set=2, Analyte=MgO (wt%) Variability Chart for Measured

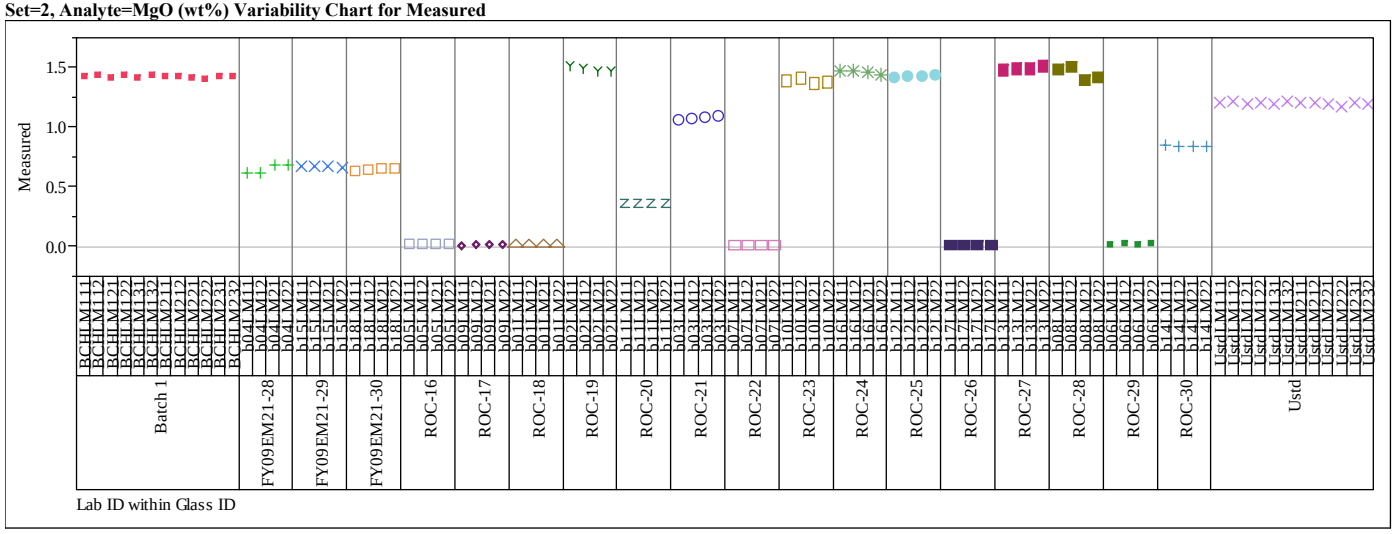
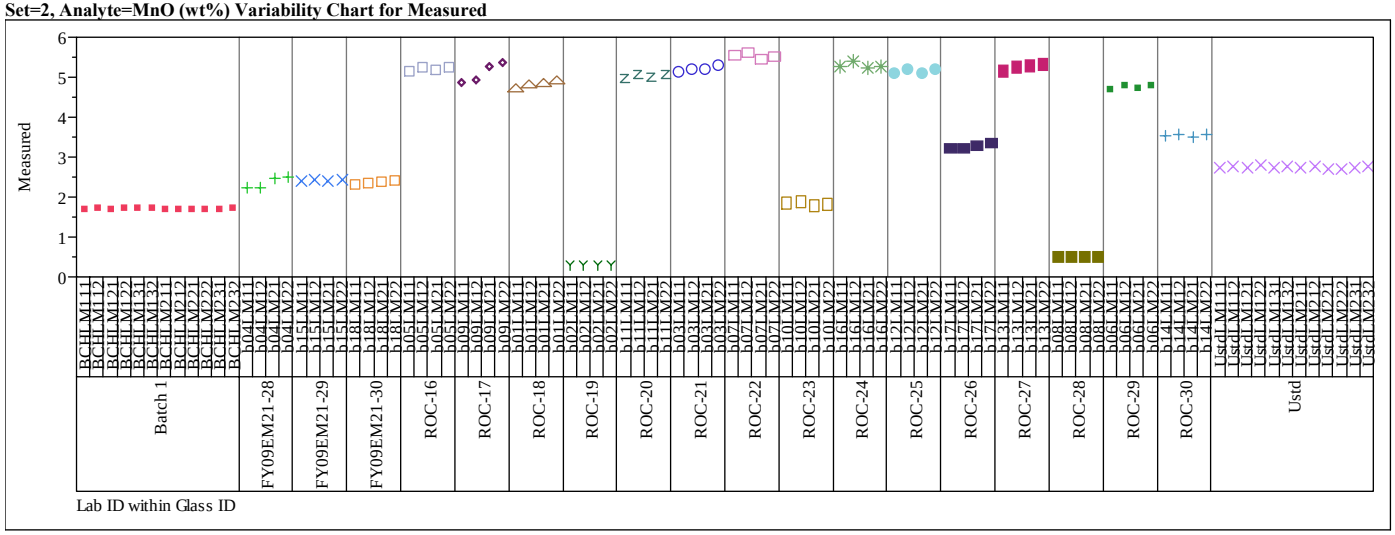


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=MnO (wt%) Variability Chart for Measured



Set=2, Analyte=Na2O (wt%) Variability Chart for Measured

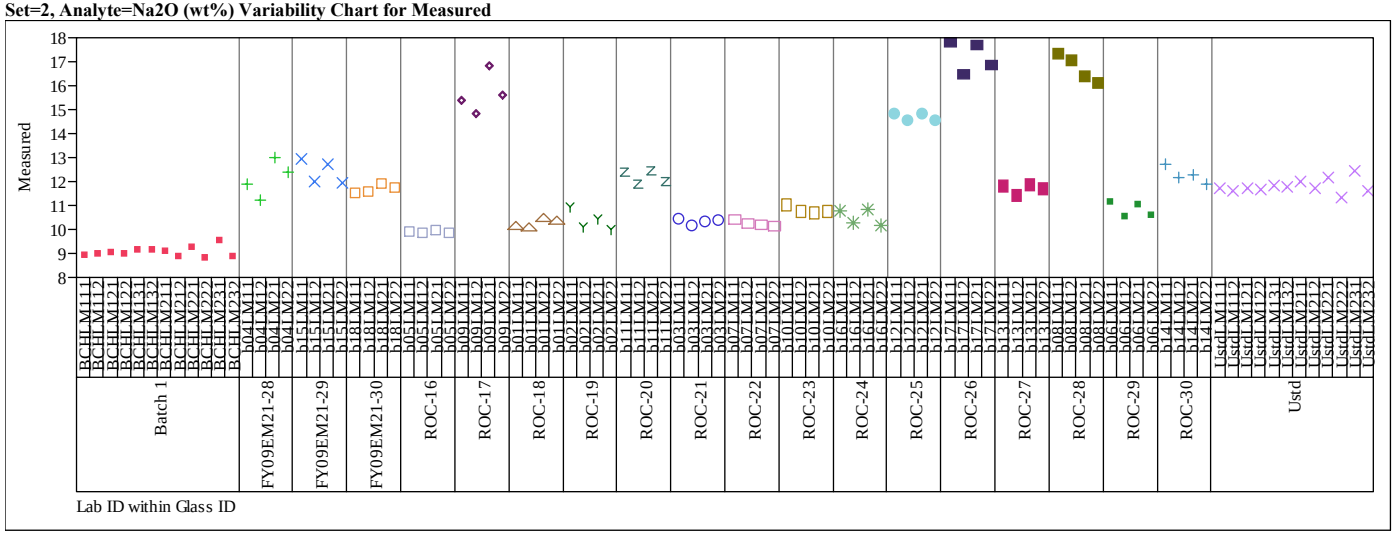
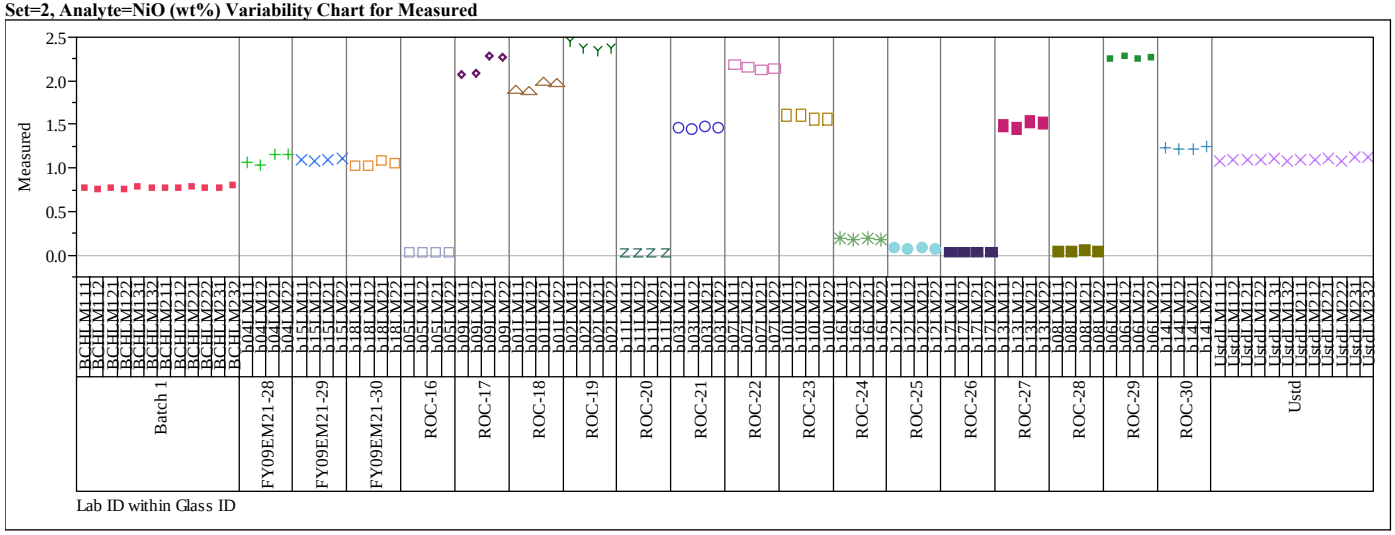


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=NiO (wt%) Variability Chart for Measured



Set=2, Analyte=PbO (wt%) Variability Chart for Measured

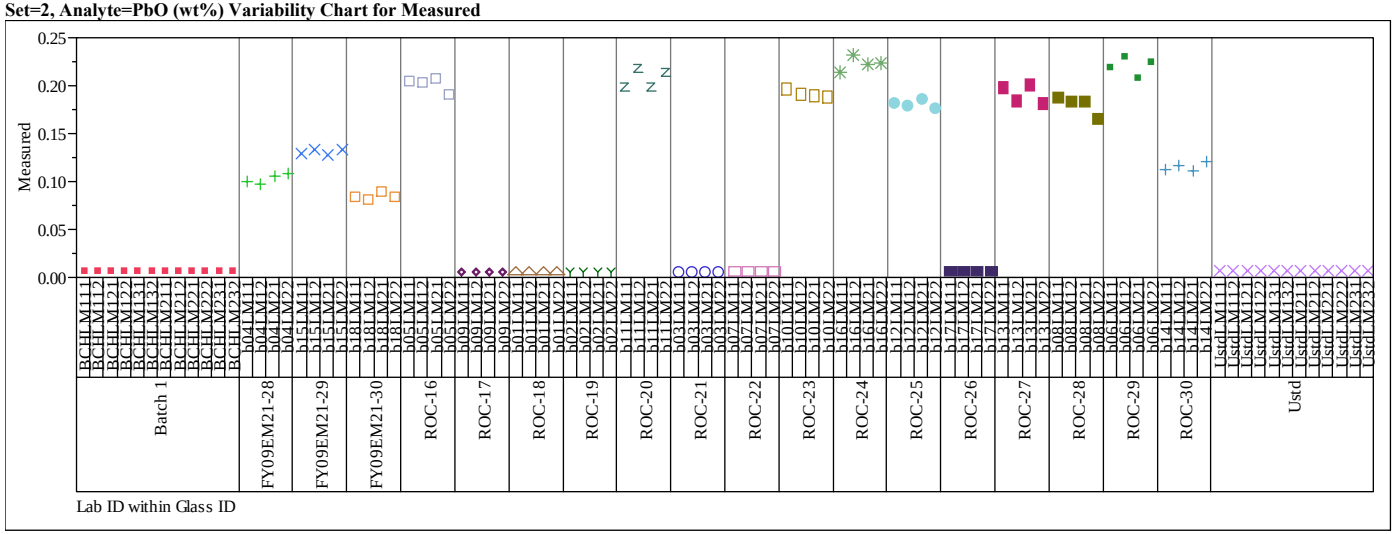
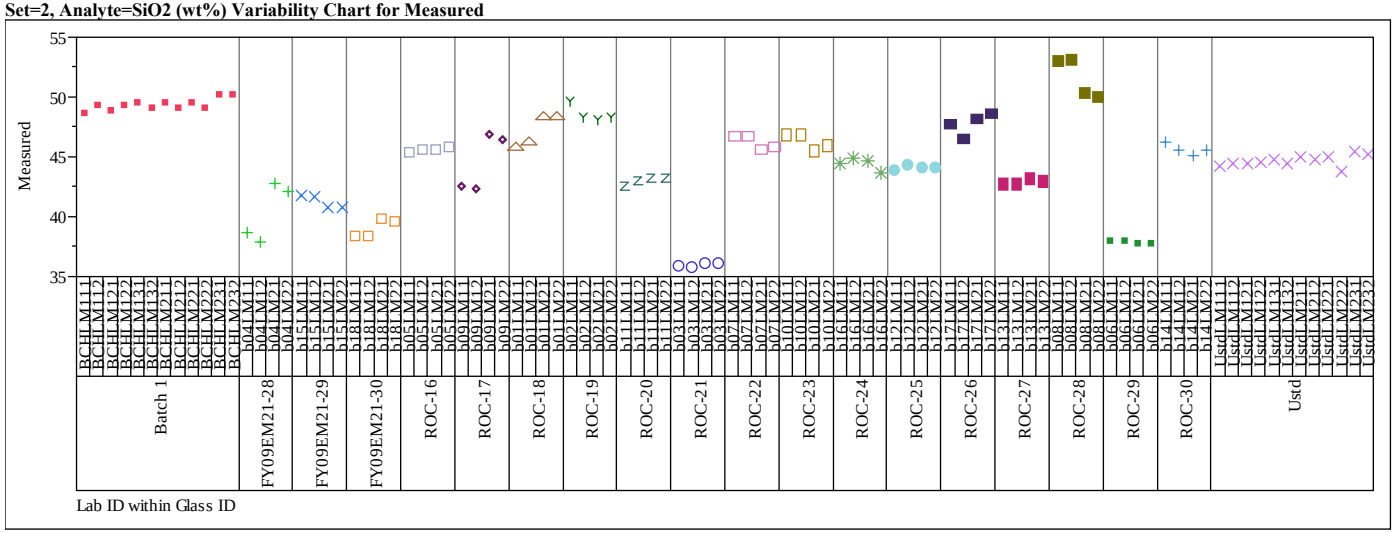


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=SiO2 (wt%) Variability Chart for Measured



Set=2, Analyte=SO4 (wt%) Variability Chart for Measured

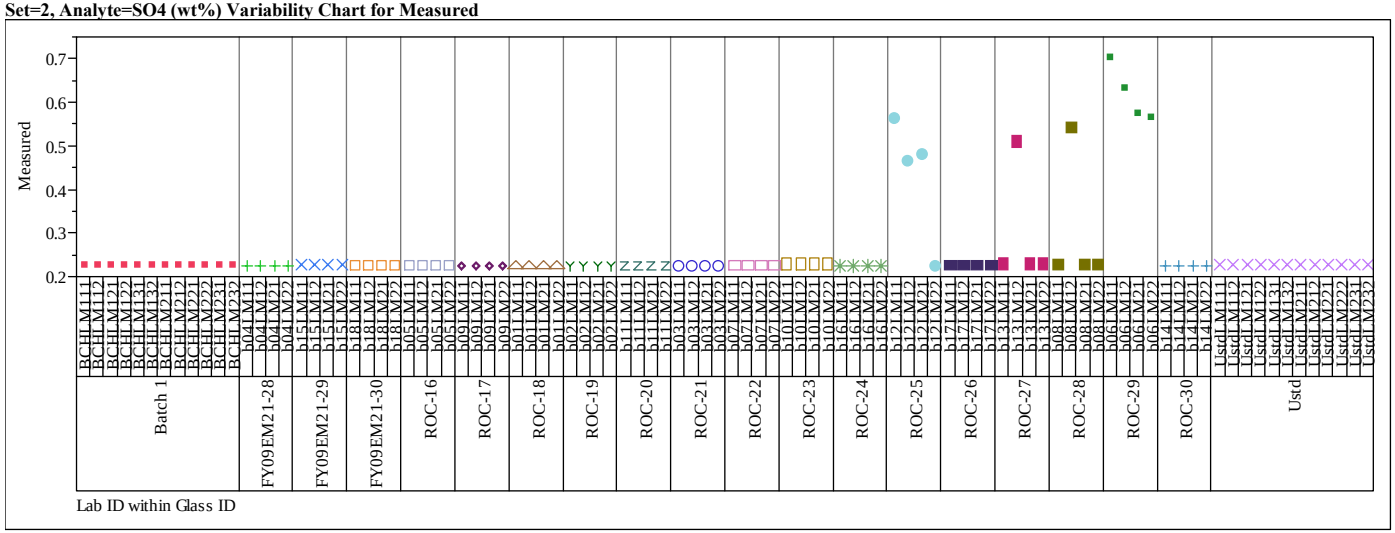
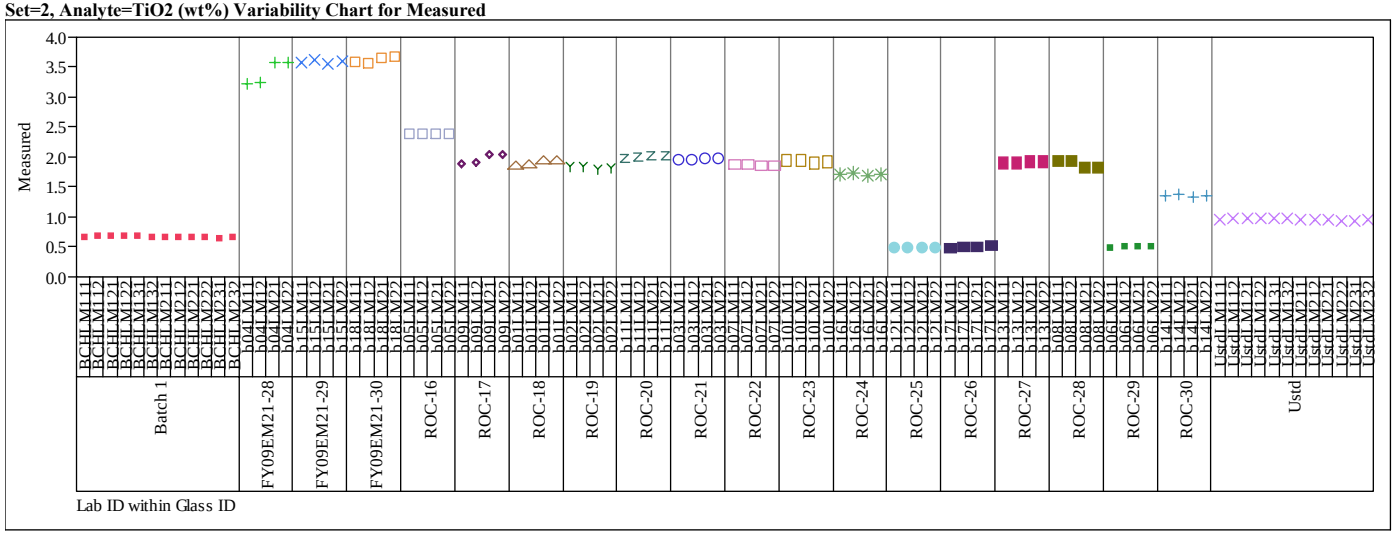


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=TiO2 (wt%) Variability Chart for Measured



Set=2, Analyte=U3O8 (wt%) Variability Chart for Measured

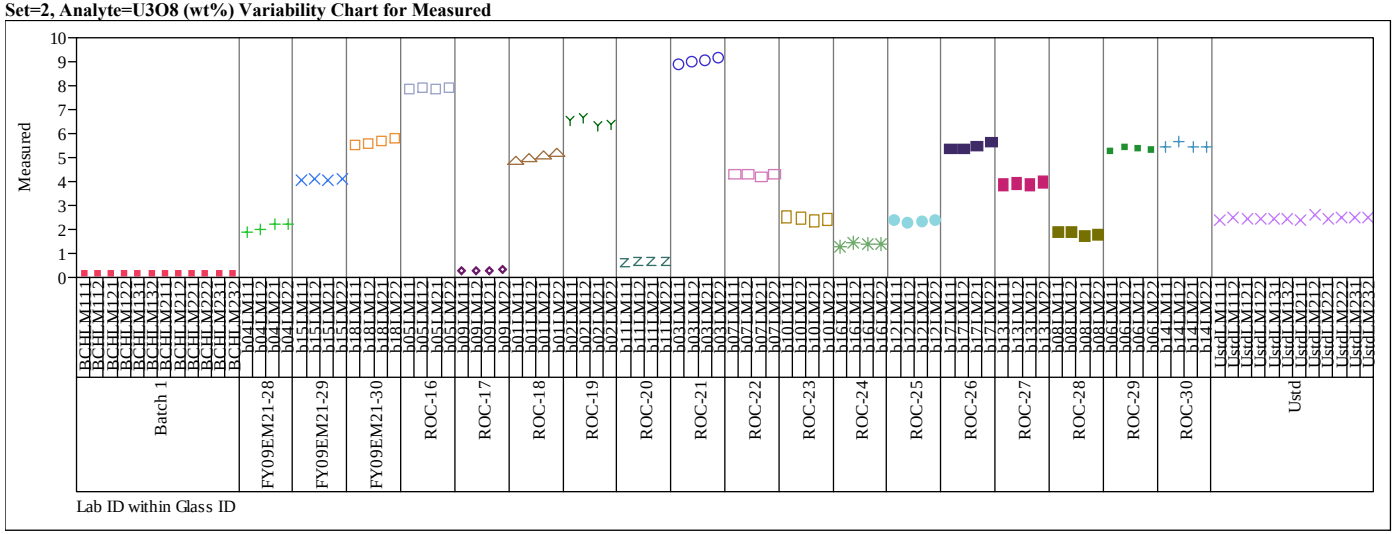
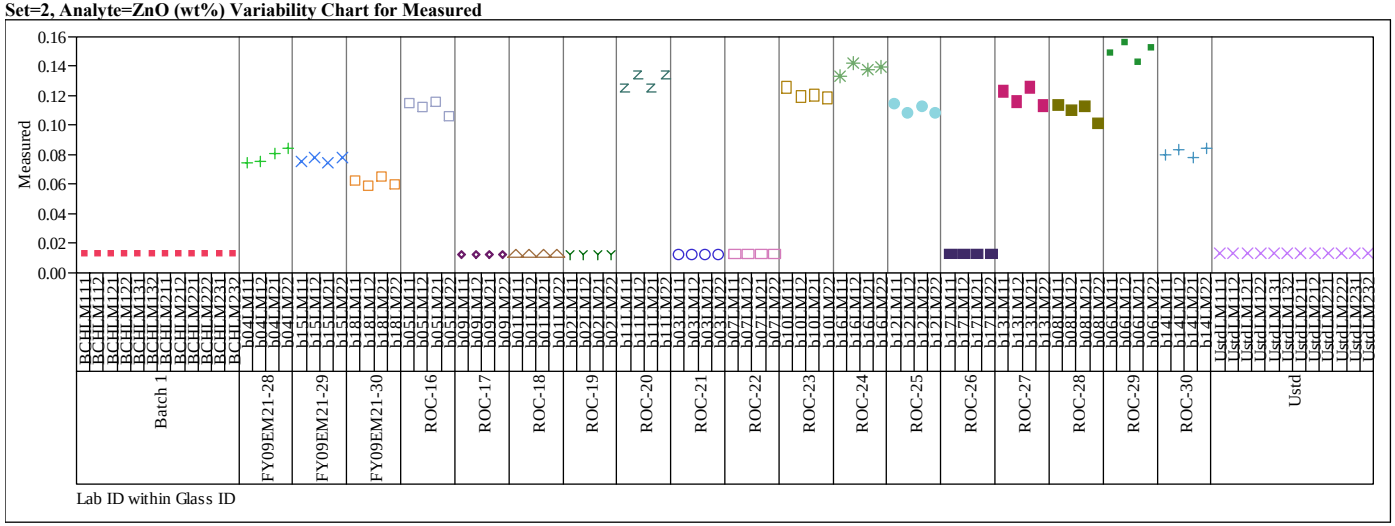


Exhibit A2. Measurements by Lab ID within Glass ID for Samples by Oxide and by Set

Set=2, Analyte=ZnO (wt%) Variability Chart for Measured



Set=2, Analyte=ZrO2 (wt%) Variability Chart for Measured

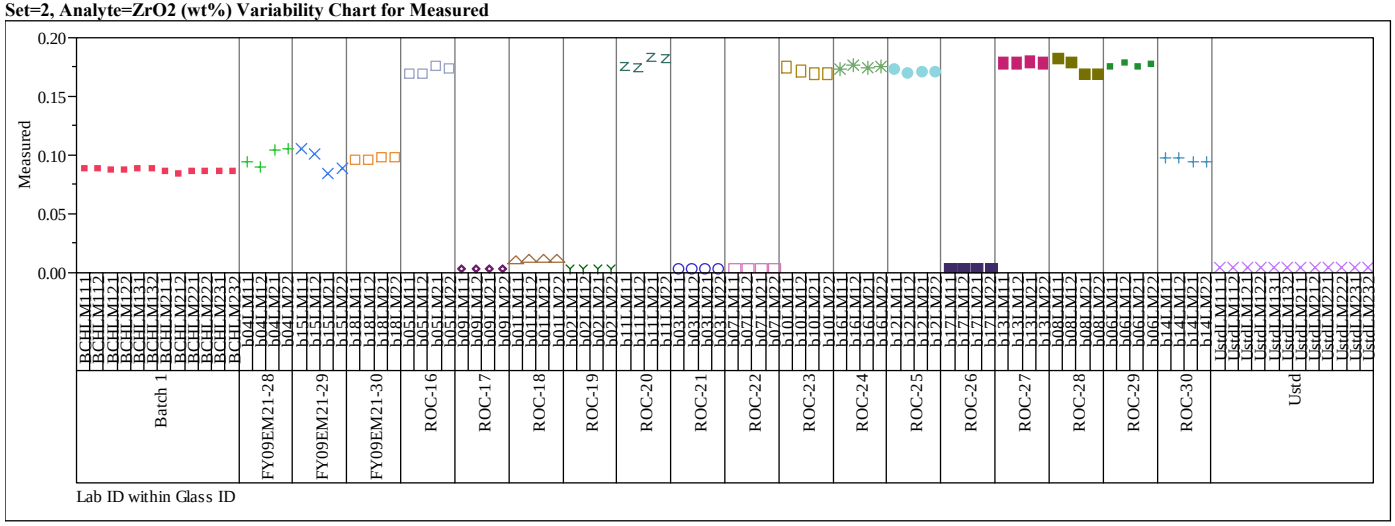
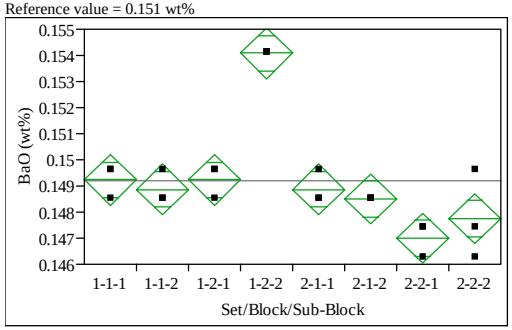


Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of BaO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.151 wt%



Oneway Anova
Summary of Fit

Rsquare	0.904335
Adj Rsquare	0.862481
Root Mean Square Error	0.000789
Mean of Response	0.149192
Observations (or Sum Wgts)	24

Analysis of Variance

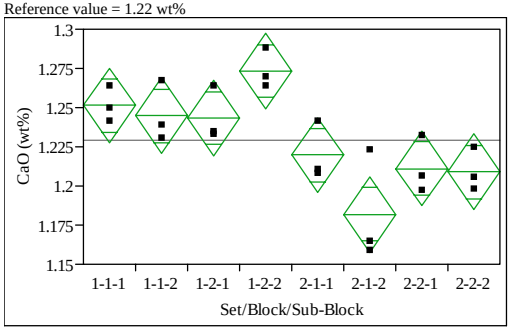
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00009427	0.000013	21.6071	<.0001
Error	16	0.00000997	6.233e-7		
C. Total	23	0.00010424			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.149239	0.00046	0.14827	0.15021
1-1-2	3	0.148867	0.00046	0.14790	0.14983
1-2-1	3	0.149239	0.00046	0.14827	0.15021
1-2-2	3	0.154077	0.00046	0.15311	0.15504
2-1-1	3	0.148867	0.00046	0.14790	0.14983
2-1-2	3	0.148495	0.00046	0.14753	0.14946
2-2-1	3	0.147006	0.00046	0.14604	0.14797
2-2-2	3	0.147750	0.00046	0.14678	0.14872

Std Error uses a pooled estimate of error variance

Oneway Analysis of CaO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 1.22 wt%



Oneway Anova
Summary of Fit

Rsquare	0.743227
Adj Rsquare	0.630888
Root Mean Square Error	0.019626
Mean of Response	1.229314
Observations (or Sum Wgts)	24

Analysis of Variance

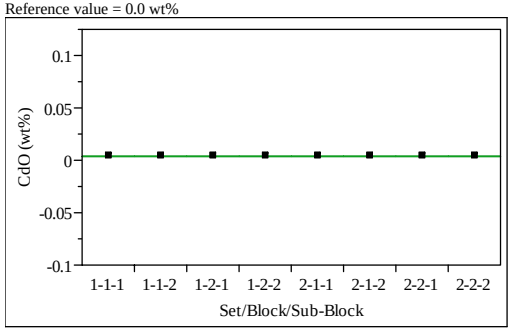
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.01783879	0.002548	6.6160	0.0009
Error	16	0.00616303	0.000385		
C. Total	23	0.02400182			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	1.25135	0.01133	1.2273	1.2754
1-1-2	3	1.24482	0.01133	1.2208	1.2688
1-2-1	3	1.24342	0.01133	1.2194	1.2674
1-2-2	3	1.27327	0.01133	1.2493	1.2973
2-1-1	3	1.21964	0.01133	1.1956	1.2437
2-1-2	3	1.18186	0.01133	1.1578	1.2059
2-2-1	3	1.21124	0.01133	1.1872	1.2353
2-2-2	3	1.20891	0.01133	1.1849	1.2329

Std Error uses a pooled estimate of error variance

Oneway Analysis of CdO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.003998
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

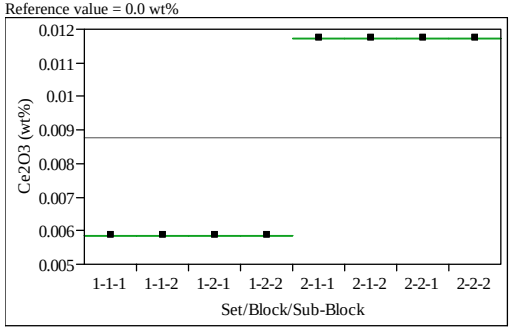
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.003998	0	0.00400	0.00400
1-1-2	3	0.003998	0	0.00400	0.00400
1-2-1	3	0.003998	0	0.00400	0.00400
1-2-2	3	0.003998	0	0.00400	0.00400
2-1-1	3	0.003998	0	0.00400	0.00400
2-1-2	3	0.003998	0	0.00400	0.00400
2-2-1	3	0.003998	0	0.00400	0.00400
2-2-2	3	0.003998	0	0.00400	0.00400

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Ce2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	1
Adj Rsquare	1
Root Mean Square Error	0
Mean of Response	0.008785
Observations (or Sum Wgts)	24

Analysis of Variance

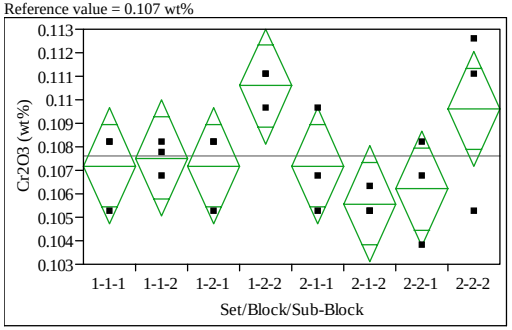
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00020579	0.000029	.	.
Error	16	0.00000000	0.000000		
C. Total	23	0.00020579			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.005857	0	0.00586	0.00586
1-1-2	3	0.005857	0	0.00586	0.00586
1-2-1	3	0.005857	0	0.00586	0.00586
1-2-2	3	0.005857	0	0.00586	0.00586
2-1-1	3	0.011713	0	0.01171	0.01171
2-1-2	3	0.011713	0	0.01171	0.01171
2-2-1	3	0.011713	0	0.01171	0.01171
2-2-2	3	0.011713	0	0.01171	0.01171

Std Error uses a pooled estimate of error variance

Oneway Analysis of Cr2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.107 wt%



Oneway Anova
Summary of Fit

Rsquare	0.476819
Adj Rsquare	0.247927
Root Mean Square Error	0.002008
Mean of Response	0.107635
Observations (or Sum Wgts)	24

Analysis of Variance

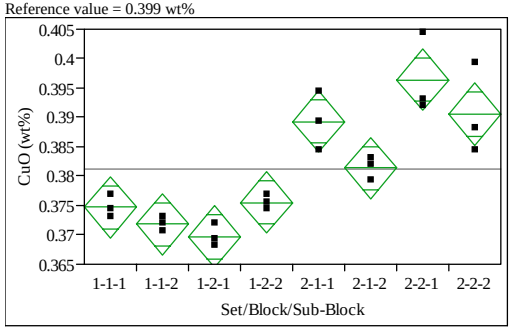
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00005877	8.3961e-6	2.0832	0.1062
Error	16	0.00006449	4.0304e-6		
C. Total	23	0.00012326			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.107184	0.00116	0.10473	0.10964
1-1-2	3	0.107525	0.00116	0.10507	0.10998
1-2-1	3	0.107184	0.00116	0.10473	0.10964
1-2-2	3	0.110594	0.00116	0.10814	0.11305
2-1-1	3	0.107184	0.00116	0.10473	0.10964
2-1-2	3	0.105576	0.00116	0.10312	0.10803
2-2-1	3	0.106210	0.00116	0.10375	0.10867
2-2-2	3	0.109620	0.00116	0.10716	0.11208

Std Error uses a pooled estimate of error variance

Oneway Analysis of CuO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.399 wt%



Oneway Anova
Summary of Fit

Rsquare	0.873378
Adj Rsquare	0.817981
Root Mean Square Error	0.004299
Mean of Response	0.381173
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00203919	0.000291	15.7658	<.0001
Error	16	0.00029564	0.000018		
C. Total	23	0.00233483			

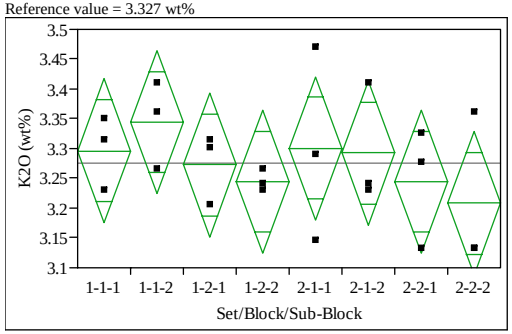
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.374705	0.00248	0.36944	0.37997
1-1-2	3	0.371785	0.00248	0.36652	0.37705
1-2-1	3	0.369698	0.00248	0.36444	0.37496
1-2-2	3	0.375540	0.00248	0.37028	0.38080
2-1-1	3	0.389310	0.00248	0.38405	0.39457
2-1-2	3	0.381382	0.00248	0.37612	0.38664
2-2-1	3	0.396403	0.00248	0.39114	0.40166
2-2-2	3	0.390562	0.00248	0.38530	0.39582

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of K2O (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 3.327 wt%



Oneway Anova
Summary of Fit

Rsquare	0.196686
Adj Rsquare	-0.15476
Root Mean Square Error	0.098355
Mean of Response	3.275508
Observations (or Sum Wgts)	24

Analysis of Variance

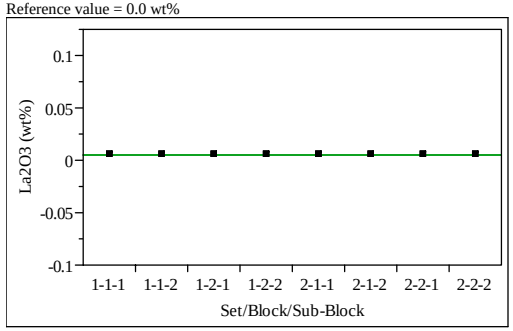
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.03789688	0.005414	0.5596	0.7775
Error	16	0.15477986	0.009674		
C. Total	23	0.19267674			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	3.29659	0.05679	3.1762	3.4170
1-1-2	3	3.34477	0.05679	3.2244	3.4652
1-2-1	3	3.27250	0.05679	3.1521	3.3929
1-2-2	3	3.24439	0.05679	3.1240	3.3648
2-1-1	3	3.30060	0.05679	3.1802	3.4210
2-1-2	3	3.29257	0.05679	3.1722	3.4130
2-2-1	3	3.24439	0.05679	3.1240	3.3648
2-2-2	3	3.20825	0.05679	3.0879	3.3286

Std Error uses a pooled estimate of error variance

Oneway Analysis of La2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005278
Observations (or Sum Wgts)	24

Analysis of Variance

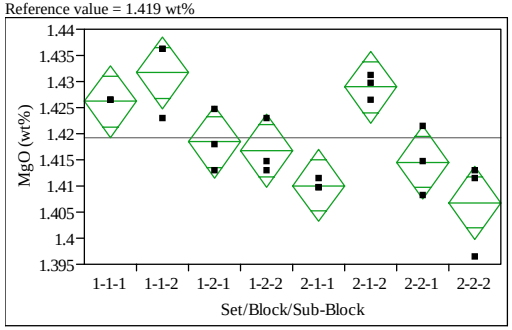
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.005278	0	0.00528	0.00528
1-1-2	3	0.005278	0	0.00528	0.00528
1-2-1	3	0.005278	0	0.00528	0.00528
1-2-2	3	0.005278	0	0.00528	0.00528
2-1-1	3	0.005278	0	0.00528	0.00528
2-1-2	3	0.005278	0	0.00528	0.00528
2-2-1	3	0.005278	0	0.00528	0.00528
2-2-2	3	0.005278	0	0.00528	0.00528

Std Error uses a pooled estimate of error variance

Oneway Analysis of MgO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 1.419 wt%



Oneway Anova
Summary of Fit

Rsquare	0.767488
Adj Rsquare	0.665764
Root Mean Square Error	0.005654
Mean of Response	1.419159
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00168836	0.000241	7.5448	0.0004
Error	16	0.00051149	0.000032		
C. Total	23	0.00219985			

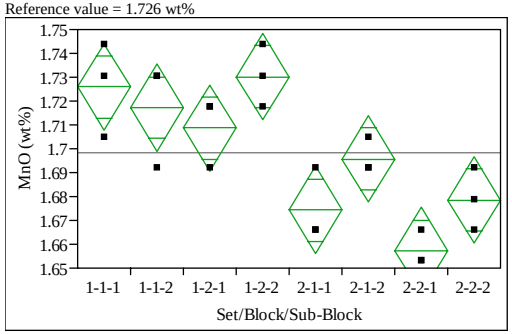
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	1.42614	0.00326	1.4192	1.4331
1-1-2	3	1.43167	0.00326	1.4247	1.4386
1-2-1	3	1.41840	0.00326	1.4115	1.4253
1-2-2	3	1.41674	0.00326	1.4098	1.4237
2-1-1	3	1.41011	0.00326	1.4032	1.4170
2-1-2	3	1.42890	0.00326	1.4220	1.4358
2-2-1	3	1.41453	0.00326	1.4076	1.4215
2-2-2	3	1.40679	0.00326	1.3999	1.4137

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of MnO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 1.726 wt%



Oneway Anova
Summary of Fit

Rsquare	0.805987
Adj Rsquare	0.721106
Root Mean Square Error	0.014909
Mean of Response	1.698466
Observations (or Sum Wgts)	24

Analysis of Variance

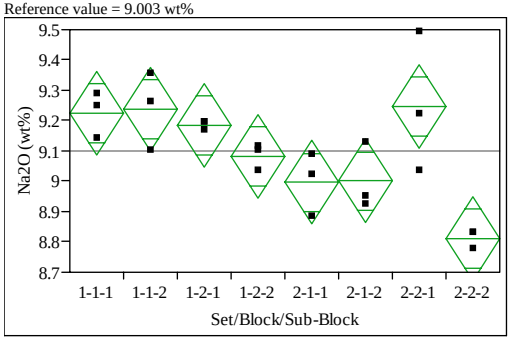
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.01477554	0.002111	9.4955	0.0001
Error	16	0.00355669	0.000222		
C. Total	23	0.01833223			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	1.72590	0.00861	1.7077	1.7442
1-1-2	3	1.71730	0.00861	1.6990	1.7355
1-2-1	3	1.70869	0.00861	1.6904	1.7269
1-2-2	3	1.73021	0.00861	1.7120	1.7485
2-1-1	3	1.67426	0.00861	1.6560	1.6925
2-1-2	3	1.69578	0.00861	1.6775	1.7140
2-2-1	3	1.65704	0.00861	1.6388	1.6753
2-2-2	3	1.67856	0.00861	1.6603	1.6968

Std Error uses a pooled estimate of error variance

Oneway Analysis of Na2O (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 9.003 wt%



Oneway Anova
Summary of Fit

Rsquare	0.712927
Adj Rsquare	0.587332
Root Mean Square Error	0.112614
Mean of Response	9.097877
Observations (or Sum Wgts)	24

Analysis of Variance

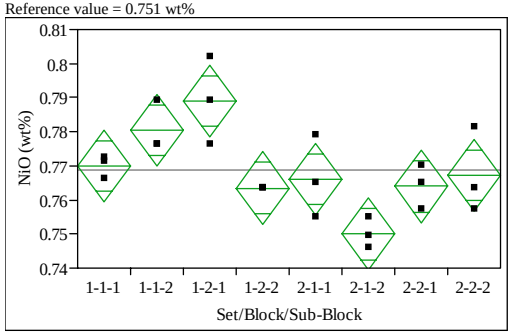
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.50391322	0.071988	5.6764	0.0020
Error	16	0.20290995	0.012682		
C. Total	23	0.70682317			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	9.22481	0.06502	9.0870	9.3626
1-1-2	3	9.23829	0.06502	9.1005	9.3761
1-2-1	3	9.18437	0.06502	9.0465	9.3222
1-2-2	3	9.08103	0.06502	8.9432	9.2189
2-1-1	3	8.99565	0.06502	8.8578	9.1335
2-1-2	3	9.00015	0.06502	8.8623	9.1380
2-2-1	3	9.24728	0.06502	9.1094	9.3851
2-2-2	3	8.81143	0.06502	8.6736	8.9493

Std Error uses a pooled estimate of error variance

Oneway Analysis of NiO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.751 wt%



Oneway Anova
Summary of Fit

Rsquare	0.708671
Adj Rsquare	0.581215
Root Mean Square Error	0.008607
Mean of Response	0.768749
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00288329	0.000412	5.5601	0.0022
Error	16	0.00118530	0.000074		
C. Total	23	0.00406858			

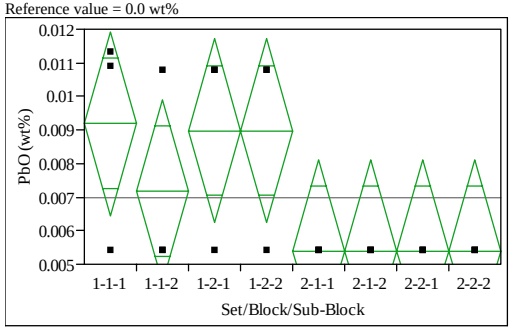
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.769863	0.00497	0.75933	0.78040
1-1-2	3	0.780467	0.00497	0.76993	0.79100
1-2-1	3	0.788950	0.00497	0.77842	0.79948
1-2-2	3	0.763500	0.00497	0.75297	0.77403
2-1-1	3	0.766045	0.00497	0.75551	0.77658
2-1-2	3	0.749927	0.00497	0.73939	0.76046
2-2-1	3	0.763924	0.00497	0.75339	0.77446
2-2-2	3	0.767318	0.00497	0.75678	0.77785

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of PbO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.464345
Adj Rsquare	0.229996
Root Mean Square Error	0.002234
Mean of Response	0.006984
Observations (or Sum Wgts)	24

Analysis of Variance

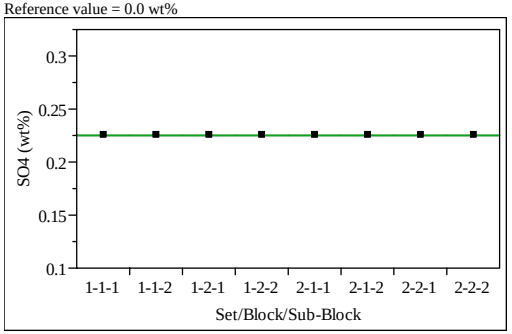
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00006921	9.8874e-6	1.9814	0.1219
Error	16	0.00007984	4.99e-6		
C. Total	23	0.00014905			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.009192	0.00129	0.00646	0.01193
1-1-2	3	0.007181	0.00129	0.00445	0.00992
1-2-1	3	0.008977	0.00129	0.00624	0.01171
1-2-2	3	0.008977	0.00129	0.00624	0.01171
2-1-1	3	0.005386	0.00129	0.00265	0.00812
2-1-2	3	0.005386	0.00129	0.00265	0.00812
2-2-1	3	0.005386	0.00129	0.00265	0.00812
2-2-2	3	0.005386	0.00129	0.00265	0.00812

Std Error uses a pooled estimate of error variance

Oneway Analysis of SO4 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.224693
Observations (or Sum Wgts)	24

Analysis of Variance

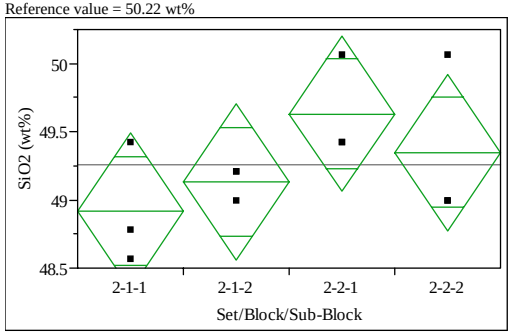
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.224693	0	0.22469	0.22469
1-1-2	3	0.224693	0	0.22469	0.22469
1-2-1	3	0.224693	0	0.22469	0.22469
1-2-2	3	0.224693	0	0.22469	0.22469
2-1-1	3	0.224693	0	0.22469	0.22469
2-1-2	3	0.224693	0	0.22469	0.22469
2-2-1	3	0.224693	0	0.22469	0.22469
2-2-2	3	0.224693	0	0.22469	0.22469

Std Error uses a pooled estimate of error variance

Oneway Analysis of SiO2 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 50.22 wt%



Missing Rows
12
Oneway Anova
Summary of Fit

Rsquare	0.363184
Adj Rsquare	0.124378
Root Mean Square Error	0.42786
Mean of Response	49.25738
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	3	0.8352303	0.278410	1.5208	0.2820
Error	8	1.4645134	0.183064		
C. Total	11	2.2997438			

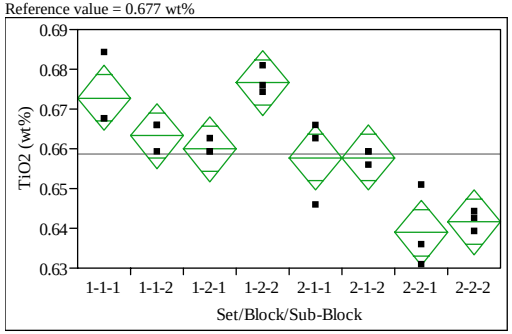
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	0	.	.	.	.
1-1-2	0	.	.	.	.
1-2-1	0	.	.	.	.
1-2-2	0	.	.	.	.
2-1-1	3	48.9187	0.24703	48.349	49.488
2-1-2	3	49.1326	0.24703	48.563	49.702
2-2-1	3	49.6318	0.24703	49.062	50.201
2-2-2	3	49.3465	0.24703	48.777	49.916

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of TiO2 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.677 wt%



Oneway Anova
Summary of Fit

Rsquare	0.837895
Adj Rsquare	0.766974
Root Mean Square Error	0.006681
Mean of Response	0.658582
Observations (or Sum Wgts)	24

Analysis of Variance

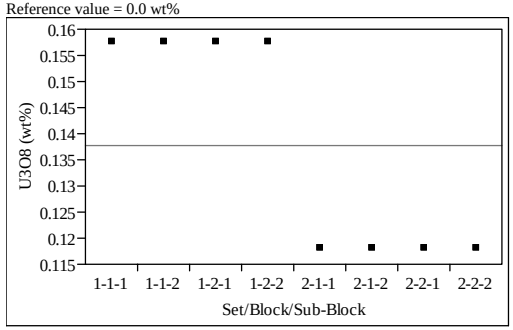
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00369108	0.000527	11.8145	<.0001
Error	16	0.00071410	0.000045		
C. Total	23	0.00440519			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.672760	0.00386	0.66458	0.68094
1-1-2	3	0.663308	0.00386	0.65513	0.67148
1-2-1	3	0.659972	0.00386	0.65180	0.66815
1-2-2	3	0.676652	0.00386	0.66848	0.68483
2-1-1	3	0.657748	0.00386	0.64957	0.66592
2-1-2	3	0.657748	0.00386	0.64957	0.66592
2-2-1	3	0.638844	0.00386	0.63067	0.64702
2-2-2	3	0.641624	0.00386	0.63345	0.64980

Std Error uses a pooled estimate of error variance

Oneway Analysis of U3O8 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	1
Adj Rsquare	1
Root Mean Square Error	.
Mean of Response	0.137672
Observations (or Sum Wgts)	24

Analysis of Variance

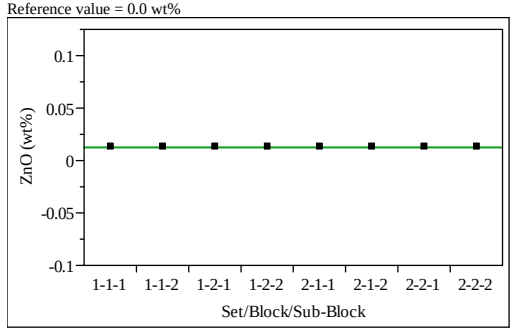
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.0093630	0.00134	-1.2e+16	0.0000
Error	16	-1.735e-18	-1.1e-19		
C. Total	23	0.0093630			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.157423	.	.	.
1-1-2	3	0.157423	.	.	.
1-2-1	3	0.157423	.	.	.
1-2-2	3	0.157423	.	.	.
2-1-1	3	0.117920	.	.	.
2-1-2	3	0.117920	.	.	.
2-2-1	3	0.117920	.	.	.
2-2-2	3	0.117920	.	.	.

Std Error uses a pooled estimate of error variance

Oneway Analysis of ZnO (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.012448
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

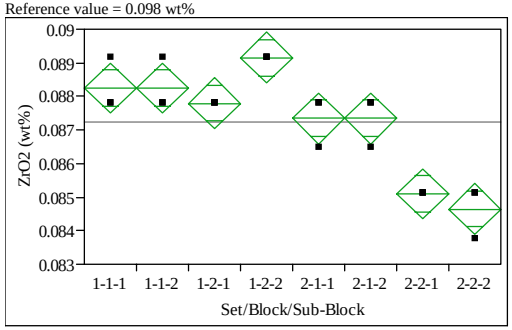
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.012448	0	0.01245	0.01245
1-1-2	3	0.012448	0	0.01245	0.01245
1-2-1	3	0.012448	0	0.01245	0.01245
1-2-2	3	0.012448	0	0.01245	0.01245
2-1-1	3	0.012448	0	0.01245	0.01245
2-1-2	3	0.012448	0	0.01245	0.01245
2-2-1	3	0.012448	0	0.01245	0.01245
2-2-2	3	0.012448	0	0.01245	0.01245

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of ZrO2 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 0.098 wt%



Oneway Anova
Summary of Fit

Rsquare	0.895288
Adj Rsquare	0.849476
Root Mean Square Error	0.000617
Mean of Response	0.087239
Observations (or Sum Wgts)	24

Analysis of Variance

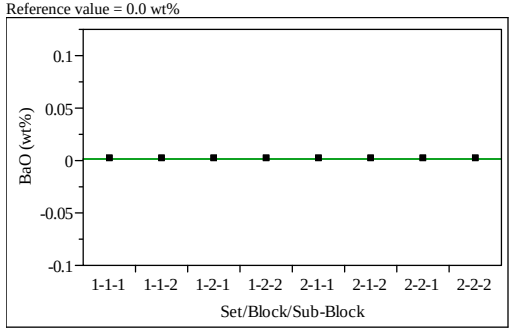
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00005200	7.429e-6	19.5429	<.0001
Error	16	0.00000608	3.8014e-7		
C. Total	23	0.00005809			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.088252	0.00036	0.08750	0.08901
1-1-2	3	0.088252	0.00036	0.08750	0.08901
1-2-1	3	0.087802	0.00036	0.08705	0.08856
1-2-2	3	0.089153	0.00036	0.08840	0.08991
2-1-1	3	0.087352	0.00036	0.08660	0.08811
2-1-2	3	0.087352	0.00036	0.08660	0.08811
2-2-1	3	0.085100	0.00036	0.08435	0.08586
2-2-2	3	0.084650	0.00036	0.08390	0.08540

Std Error uses a pooled estimate of error variance

Oneway Analysis of BaO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	1
Adj Rsquare	1
Root Mean Square Error	0
Mean of Response	0.001116
Observations (or Sum Wgts)	24

Analysis of Variance

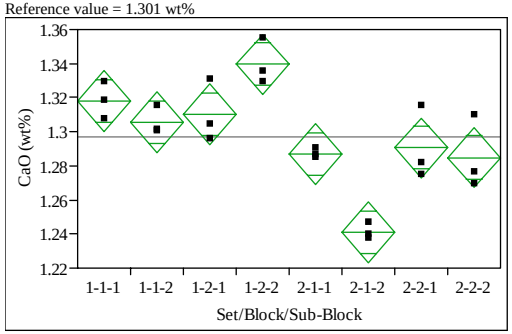
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	4.5139e-36	6.448e-37	.	.
Error	16	0	0		
C. Total	23	4.5139e-36			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.001117	0	0.00112	0.00112
1-1-2	3	0.001117	0	0.00112	0.00112
1-2-1	3	0.001117	0	0.00112	0.00112
1-2-2	3	0.001117	0	0.00112	0.00112
2-1-1	3	0.001117	0	0.00112	0.00112
2-1-2	3	0.001117	0	0.00112	0.00112
2-2-1	3	0.001117	0	0.00112	0.00112
2-2-2	3	0.001117	0	0.00112	0.00112

Std Error uses a pooled estimate of error variance

Oneway Analysis of CaO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 1.301 wt%



Oneway Anova
Summary of Fit

Rsquare	0.840604
Adj Rsquare	0.770868
Root Mean Square Error	0.014496
Mean of Response	1.297058
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.01773079	0.002533	12.0541	<.0001
Error	16	0.00336213	0.000210		
C. Total	23	0.02109291			

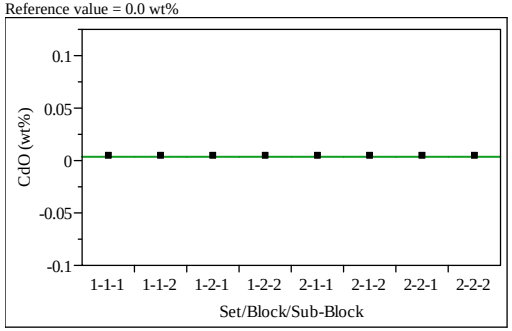
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	1.31805	0.00837	1.3003	1.3358
1-1-2	3	1.30545	0.00837	1.2877	1.3232
1-2-1	3	1.31012	0.00837	1.2924	1.3279
1-2-2	3	1.33950	0.00837	1.3218	1.3572
2-1-1	3	1.28680	0.00837	1.2691	1.3045
2-1-2	3	1.24109	0.00837	1.2233	1.2588
2-2-1	3	1.29053	0.00837	1.2728	1.3083
2-2-2	3	1.28493	0.00837	1.2672	1.3027

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of CdO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.003998
Observations (or Sum Wgts)	24

Analysis of Variance

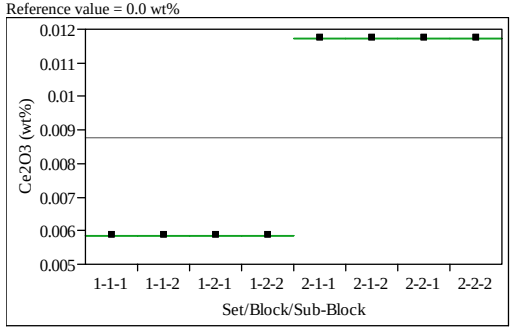
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.003998	0	0.00400	0.00400
1-1-2	3	0.003998	0	0.00400	0.00400
1-2-1	3	0.003998	0	0.00400	0.00400
1-2-2	3	0.003998	0	0.00400	0.00400
2-1-1	3	0.003998	0	0.00400	0.00400
2-1-2	3	0.003998	0	0.00400	0.00400
2-2-1	3	0.003998	0	0.00400	0.00400
2-2-2	3	0.003998	0	0.00400	0.00400

Std Error uses a pooled estimate of error variance

Oneway Analysis of Ce2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	1
Adj Rsquare	1
Root Mean Square Error	0
Mean of Response	0.008785
Observations (or Sum Wgts)	24

Analysis of Variance

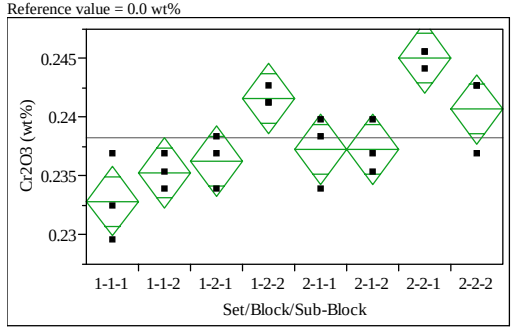
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00020579	0.000029	.	.
Error	16	0.00000000	0.000000		
C. Total	23	0.00020579			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.005857	0	0.00586	0.00586
1-1-2	3	0.005857	0	0.00586	0.00586
1-2-1	3	0.005857	0	0.00586	0.00586
1-2-2	3	0.005857	0	0.00586	0.00586
2-1-1	3	0.011713	0	0.01171	0.01171
2-1-2	3	0.011713	0	0.01171	0.01171
2-2-1	3	0.011713	0	0.01171	0.01171
2-2-2	3	0.011713	0	0.01171	0.01171

Std Error uses a pooled estimate of error variance

Oneway Analysis of Cr2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.770891
Adj Rsquare	0.670656
Root Mean Square Error	0.002442
Mean of Response	0.238302
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00032106	0.000046	7.6908	0.0004
Error	16	0.00009542	5.964e-6		
C. Total	23	0.00041648			

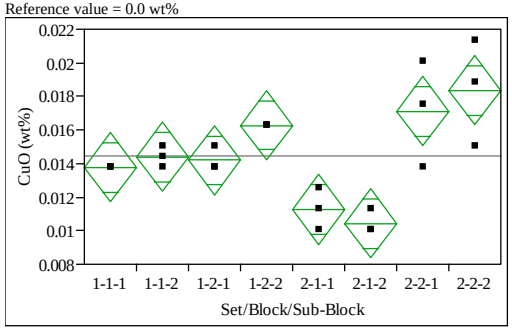
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.232882	0.00141	0.22989	0.23587
1-1-2	3	0.235318	0.00141	0.23233	0.23831
1-2-1	3	0.236292	0.00141	0.23330	0.23928
1-2-2	3	0.241651	0.00141	0.23866	0.24464
2-1-1	3	0.237266	0.00141	0.23428	0.24026
2-1-2	3	0.237266	0.00141	0.23428	0.24026
2-2-1	3	0.245062	0.00141	0.24207	0.24805
2-2-2	3	0.240677	0.00141	0.23769	0.24367

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of CuO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	0.775046
Adj Rsquare	0.676629
Root Mean Square Error	0.00169
Mean of Response	0.014474
Observations (or Sum Wgts)	24

Analysis of Variance

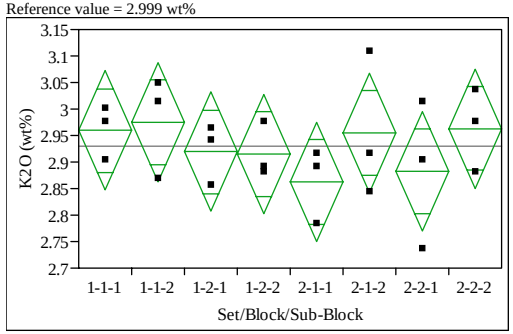
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00015747	0.000022	7.8751	0.0003
Error	16	0.00004570	2.857e-6		
C. Total	23	0.00020317			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.013770	0.00098	0.01170	0.01584
1-1-2	3	0.014396	0.00098	0.01233	0.01646
1-2-1	3	0.014187	0.00098	0.01212	0.01626
1-2-2	3	0.016273	0.00098	0.01420	0.01834
2-1-1	3	0.011266	0.00098	0.00920	0.01333
2-1-2	3	0.010432	0.00098	0.00836	0.01250
2-2-1	3	0.017108	0.00098	0.01504	0.01918
2-2-2	3	0.018360	0.00098	0.01629	0.02043

Std Error uses a pooled estimate of error variance

Oneway Analysis of K2O (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 2.999 wt%



Oneway Anova
Summary of Fit

Rsquare	0.20731
Adj Rsquare	-0.13949
Root Mean Square Error	0.091608
Mean of Response	2.929186
Observations (or Sum Wgts)	24

Analysis of Variance

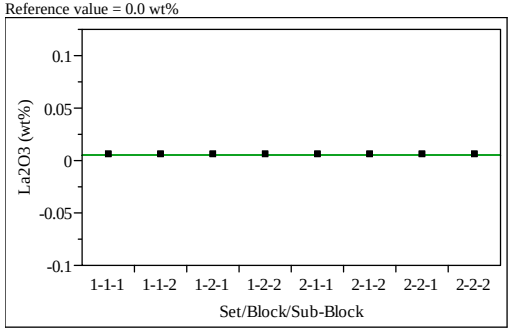
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.03511568	0.005017	0.5978	0.7490
Error	16	0.13427153	0.008392		
C. Total	23	0.16938721			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	2.95930	0.05289	2.8472	3.0714
1-1-2	3	2.97536	0.05289	2.8632	3.0875
1-2-1	3	2.91915	0.05289	2.8070	3.0313
1-2-2	3	2.91513	0.05289	2.8030	3.0273
2-1-1	3	2.86293	0.05289	2.7508	2.9751
2-1-2	3	2.95529	0.05289	2.8432	3.0674
2-2-1	3	2.88301	0.05289	2.7709	2.9951
2-2-2	3	2.96332	0.05289	2.8512	3.0754

Std Error uses a pooled estimate of error variance

Oneway Analysis of La2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.005278
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

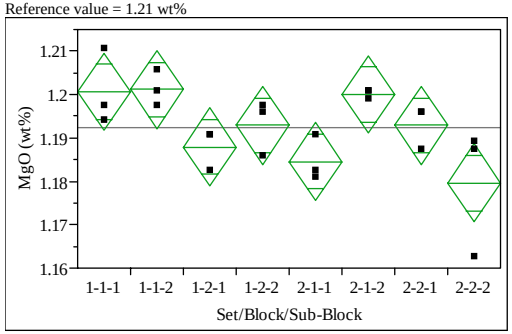
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.005278	0	0.00528	0.00528
1-1-2	3	0.005278	0	0.00528	0.00528
1-2-1	3	0.005278	0	0.00528	0.00528
1-2-2	3	0.005278	0	0.00528	0.00528
2-1-1	3	0.005278	0	0.00528	0.00528
2-1-2	3	0.005278	0	0.00528	0.00528
2-2-1	3	0.005278	0	0.00528	0.00528
2-2-2	3	0.005278	0	0.00528	0.00528

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of MgO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 1.21 wt%



Oneway Anova
Summary of Fit

Rsquare	0.61006
Adj Rsquare	0.439462
Root Mean Square Error	0.007331
Mean of Response	1.192456
Observations (or Sum Wgts)	24

Analysis of Variance

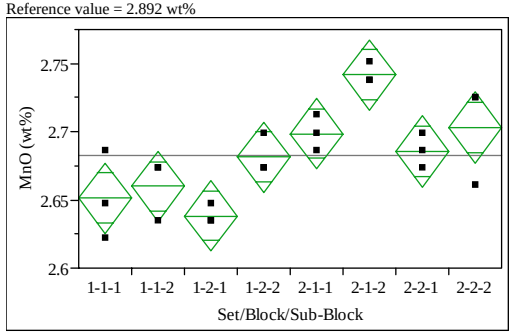
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00134519	0.000192	3.5760	0.0165
Error	16	0.00085982	0.000054		
C. Total	23	0.00220501			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	1.20061	0.00423	1.1916	1.2096
1-1-2	3	1.20116	0.00423	1.1922	1.2101
1-2-1	3	1.18790	0.00423	1.1789	1.1969
1-2-2	3	1.19287	0.00423	1.1839	1.2018
2-1-1	3	1.18458	0.00423	1.1756	1.1936
2-1-2	3	1.20006	0.00423	1.1911	1.2090
2-2-1	3	1.19287	0.00423	1.1839	1.2018
2-2-2	3	1.17960	0.00423	1.1706	1.1886

Std Error uses a pooled estimate of error variance

Oneway Analysis of MnO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 2.892 wt%



Oneway Anova
Summary of Fit

Rsquare	0.759926
Adj Rsquare	0.654894
Root Mean Square Error	0.021249
Mean of Response	2.682468
Observations (or Sum Wgts)	24

Analysis of Variance

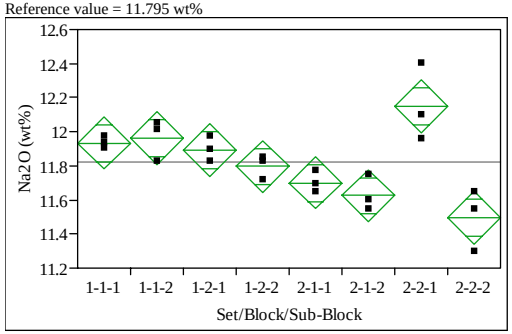
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.02286839	0.003267	7.2352	0.0005
Error	16	0.00722452	0.000452		
C. Total	23	0.03009291			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	2.65126	0.01227	2.6253	2.6773
1-1-2	3	2.65987	0.01227	2.6339	2.6859
1-2-1	3	2.63835	0.01227	2.6123	2.6644
1-2-2	3	2.68139	0.01227	2.6554	2.7074
2-1-1	3	2.69861	0.01227	2.6726	2.7246
2-1-2	3	2.74165	0.01227	2.7156	2.7677
2-2-1	3	2.68570	0.01227	2.6597	2.7117
2-2-2	3	2.70291	0.01227	2.6769	2.7289

Std Error uses a pooled estimate of error variance

Oneway Analysis of Na2O (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 11.795 wt%



Oneway Anova
Summary of Fit

Rsquare	0.785425
Adj Rsquare	0.691548
Root Mean Square Error	0.125371
Mean of Response	11.81915
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.9205373	0.131505	8.3666	0.0002
Error	16	0.2514872	0.015718		
C. Total	23	1.1720245			

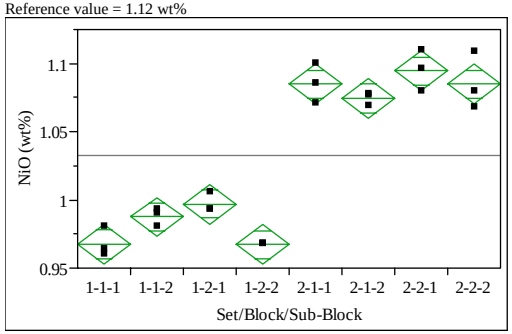
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	11.9343	0.07238	11.781	12.088
1-1-2	3	11.9613	0.07238	11.808	12.115
1-2-1	3	11.8939	0.07238	11.740	12.047
1-2-2	3	11.7950	0.07238	11.642	11.948
2-1-1	3	11.7006	0.07238	11.547	11.854
2-1-2	3	11.6243	0.07238	11.471	11.778
2-2-1	3	12.1500	0.07238	11.997	12.303
2-2-2	3	11.4939	0.07238	11.341	11.647

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of NiO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 1.12 wt%



Oneway Anova
Summary of Fit

Rsquare	0.96826
Adj Rsquare	0.954374
Root Mean Square Error	0.011878
Mean of Response	1.032263
Observations (or Sum Wgts)	24

Analysis of Variance

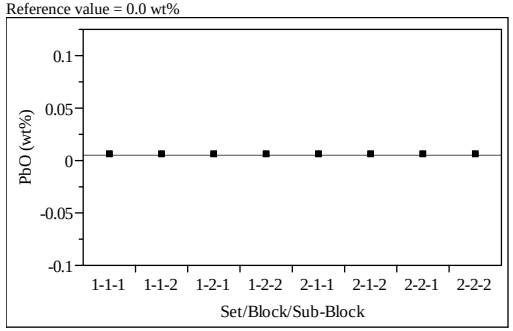
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.06886042	0.009837	69.7290	<.0001
Error	16	0.00225724	0.000141		
C. Total	23	0.07111767			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.96752	0.00686	0.9530	0.9821
1-1-2	3	0.98746	0.00686	0.9729	1.0020
1-2-1	3	0.99679	0.00686	0.9823	1.0113
1-2-2	3	0.96710	0.00686	0.9526	0.9816
2-1-1	3	1.08502	0.00686	1.0705	1.0996
2-1-2	3	1.07441	0.00686	1.0599	1.0890
2-2-1	3	1.09477	0.00686	1.0802	1.1093
2-2-2	3	1.08502	0.00686	1.0705	1.0996

Std Error uses a pooled estimate of error variance

Oneway Analysis of PbO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	4
Adj Rsquare	5.3125
Root Mean Square Error	.
Mean of Response	0.005386
Observations (or Sum Wgts)	24

Analysis of Variance

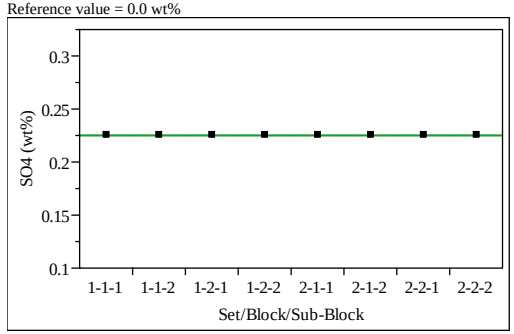
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	7.2222e-35	1.032e-35	-3.0476	0.0000
Error	16	-5.417e-35	-3.39e-36		
C. Total	23	1.8056e-35			

Means for Oneway Anova

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

Std Error uses a pooled estimate of error variance

Oneway Analysis of SO4 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.224693
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

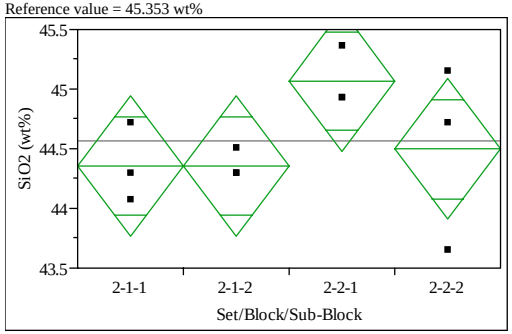
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.224693	0	0.22469	0.22469
1-1-2	3	0.224693	0	0.22469	0.22469
1-2-1	3	0.224693	0	0.22469	0.22469
1-2-2	3	0.224693	0	0.22469	0.22469
2-1-1	3	0.224693	0	0.22469	0.22469
2-1-2	3	0.224693	0	0.22469	0.22469
2-2-1	3	0.224693	0	0.22469	0.22469
2-2-2	3	0.224693	0	0.22469	0.22469

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of SiO2 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 45.353 wt%



Missing Rows
12

Oneway Anova
Summary of Fit

Rsquare	0.4
Adj Rsquare	0.175
Root Mean Square Error	0.441028
Mean of Response	44.56875
Observations (or Sum Wgts)	12

Analysis of Variance

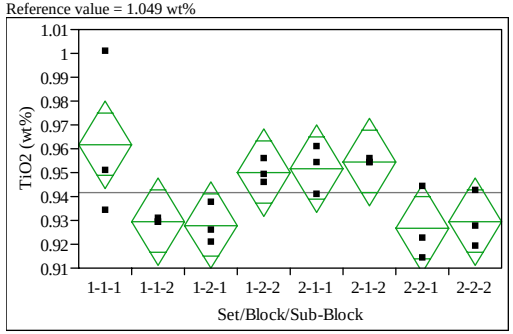
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	3	1.0373637	0.345788	1.7778	0.2290
Error	8	1.5560455	0.194506		
C. Total	11	2.5934092			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	0	.	.	.	.
1-1-2	0	.	.	.	.
1-2-1	0	.	.	.	.
1-2-2	0	.	.	.	.
2-1-1	3	44.3548	0.25463	43.768	44.942
2-1-2	3	44.3548	0.25463	43.768	44.942
2-2-1	3	45.0679	0.25463	44.481	45.655
2-2-2	3	44.4974	0.25463	43.910	45.085

Std Error uses a pooled estimate of error variance

Oneway Analysis of TiO2 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 1.049 wt%



Oneway Anova
Summary of Fit

Rsquare	0.548621
Adj Rsquare	0.351142
Root Mean Square Error	0.014962
Mean of Response	0.941586
Observations (or Sum Wgts)	24

Analysis of Variance

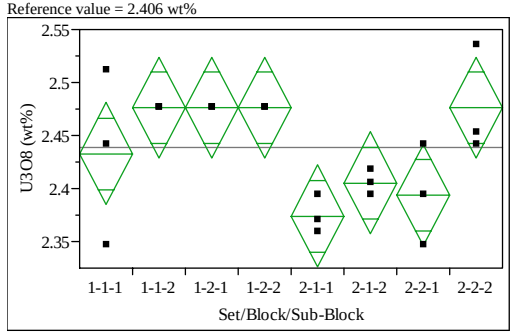
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.00435325	0.000622	2.7781	0.0429
Error	16	0.00358165	0.000224		
C. Total	23	0.00793490			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.961880	0.00864	0.94357	0.98019
1-1-2	3	0.929632	0.00864	0.91132	0.94794
1-2-1	3	0.927964	0.00864	0.90965	0.94628
1-2-2	3	0.950204	0.00864	0.93189	0.96852
2-1-1	3	0.951872	0.00864	0.93356	0.97018
2-1-2	3	0.954652	0.00864	0.93634	0.97296
2-2-1	3	0.926852	0.00864	0.90854	0.94516
2-2-2	3	0.929632	0.00864	0.91132	0.94794

Std Error uses a pooled estimate of error variance

Oneway Analysis of U3O8 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 2.406 wt%



Oneway Anova
Summary of Fit

Rsquare	0.614934
Adj Rsquare	0.446468
Root Mean Square Error	0.039035
Mean of Response	2.438979
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.03893435	0.005562	3.6502	0.0152
Error	16	0.02438032	0.001524		
C. Total	23	0.06331468			

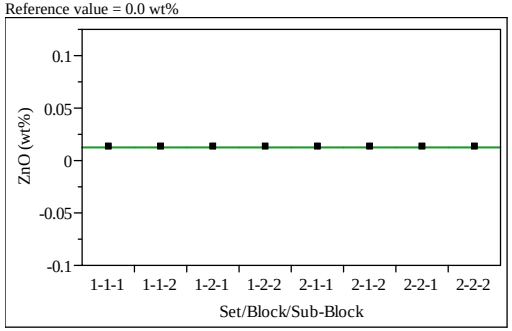
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	2.43308	0.02254	2.3853	2.4809
1-1-2	3	2.47632	0.02254	2.4285	2.5241
1-2-1	3	2.47632	0.02254	2.4285	2.5241
1-2-2	3	2.47632	0.02254	2.4285	2.5241
2-1-1	3	2.37412	0.02254	2.3263	2.4219
2-1-2	3	2.40557	0.02254	2.3578	2.4533
2-2-1	3	2.39378	0.02254	2.3460	2.4416
2-2-2	3	2.47632	0.02254	2.4285	2.5241

Std Error uses a pooled estimate of error variance

Exhibit A3. LM Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of ZnO (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.012448
Observations (or Sum Wgts)	24

Analysis of Variance

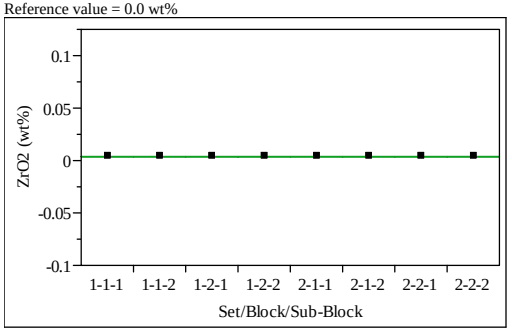
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.012448	0	0.01245	0.01245
1-1-2	3	0.012448	0	0.01245	0.01245
1-2-1	3	0.012448	0	0.01245	0.01245
1-2-2	3	0.012448	0	0.01245	0.01245
2-1-1	3	0.012448	0	0.01245	0.01245
2-1-2	3	0.012448	0	0.01245	0.01245
2-2-1	3	0.012448	0	0.01245	0.01245
2-2-2	3	0.012448	0	0.01245	0.01245

Std Error uses a pooled estimate of error variance

Oneway Analysis of ZrO2 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 0.0 wt%



Oneway Anova
Summary of Fit

Rsquare	.
Adj Rsquare	.
Root Mean Square Error	0
Mean of Response	0.003377
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0	0	.	.
Error	16	0	0		
C. Total	23	0			

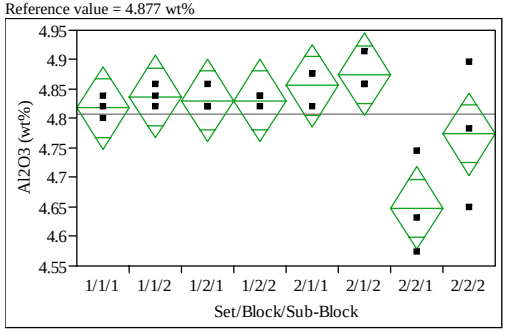
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1-1-1	3	0.003377	0	0.00338	0.00338
1-1-2	3	0.003377	0	0.00338	0.00338
1-2-1	3	0.003377	0	0.00338	0.00338
1-2-2	3	0.003377	0	0.00338	0.00338
2-1-1	3	0.003377	0	0.00338	0.00338
2-1-2	3	0.003377	0	0.00338	0.00338
2-2-1	3	0.003377	0	0.00338	0.00338
2-2-2	3	0.003377	0	0.00338	0.00338

Std Error uses a pooled estimate of error variance

Exhibit A4. PF Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Al2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 4.877 wt%



Oneway Anova
Summary of Fit

Rsquare	0.671171
Adj Rsquare	0.527309
Root Mean Square Error	0.057077
Mean of Response	4.808778
Observations (or Sum Wgts)	24

Analysis of Variance

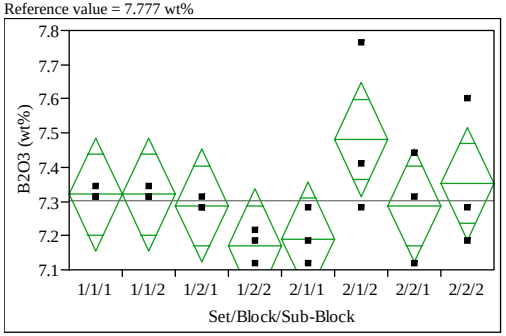
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.10639227	0.015199	4.6654	0.0051
Error	16	0.05212507	0.003258		
C. Total	23	0.15851734			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	4.81822	0.03295	4.7484	4.8881
1/1/2	3	4.83712	0.03295	4.7673	4.9070
1/2/1	3	4.83082	0.03295	4.7610	4.9007
1/2/2	3	4.83082	0.03295	4.7610	4.9007
2/1/1	3	4.85602	0.03295	4.7862	4.9259
2/1/2	3	4.87491	0.03295	4.8051	4.9448
2/2/1	3	4.64817	0.03295	4.5783	4.7180
2/2/2	3	4.77414	0.03295	4.7043	4.8440

Std Error uses a pooled estimate of error variance

Oneway Analysis of B2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 7.777 wt%



Oneway Anova
Summary of Fit

Rsquare	0.400353
Adj Rsquare	0.138007
Root Mean Square Error	0.135497
Mean of Response	7.301123
Observations (or Sum Wgts)	24

Analysis of Variance

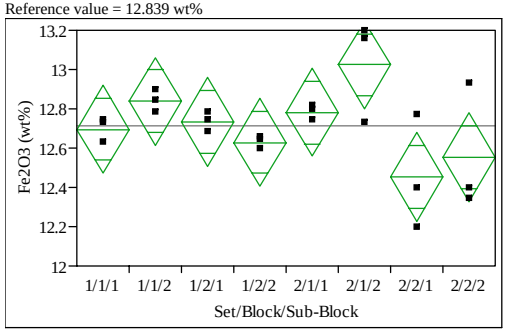
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.19612338	0.028018	1.5261	0.2282
Error	16	0.29375309	0.018360		
C. Total	23	0.48987647			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	7.31991	0.07823	7.1541	7.4857
1/1/2	3	7.31991	0.07823	7.1541	7.4857
1/2/1	3	7.28771	0.07823	7.1219	7.4535
1/2/2	3	7.16964	0.07823	7.0038	7.3355
2/1/1	3	7.19111	0.07823	7.0253	7.3569
2/1/2	3	7.48090	0.07823	7.3151	7.6467
2/2/1	3	7.28771	0.07823	7.1219	7.4535
2/2/2	3	7.35211	0.07823	7.1863	7.5179

Std Error uses a pooled estimate of error variance

Oneway Analysis of Fe2O3 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 12.839 wt%



Oneway Anova
Summary of Fit

Rsquare	0.54981
Adj Rsquare	0.352852
Root Mean Square Error	0.183277
Mean of Response	12.71361
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.6563760	0.093768	2.7915	0.0422
Error	16	0.5374468	0.033590		
C. Total	23	1.1938228			

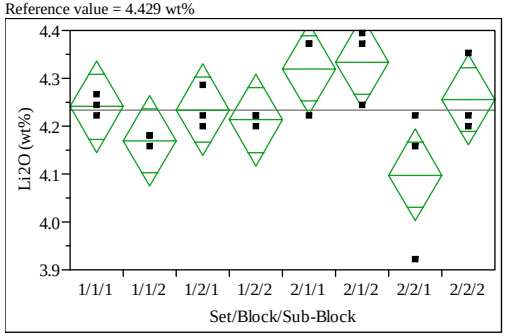
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	12.6957	0.10581	12.471	12.920
1/1/2	3	12.8387	0.10581	12.614	13.063
1/2/1	3	12.7339	0.10581	12.510	12.958
1/2/2	3	12.6290	0.10581	12.405	12.853
2/1/1	3	12.7815	0.10581	12.557	13.006
2/1/2	3	13.0246	0.10581	12.800	13.249
2/2/1	3	12.4527	0.10581	12.228	12.677
2/2/2	3	12.5528	0.10581	12.328	12.777

Std Error uses a pooled estimate of error variance

Exhibit A4. PF Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of Li2O (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 4.429 wt%



Oneway Anova
Summary of Fit

Rsquare	0.558929
Adj Rsquare	0.36596
Root Mean Square Error	0.07812
Mean of Response	4.23314
Observations (or Sum Wgts)	24

Analysis of Variance

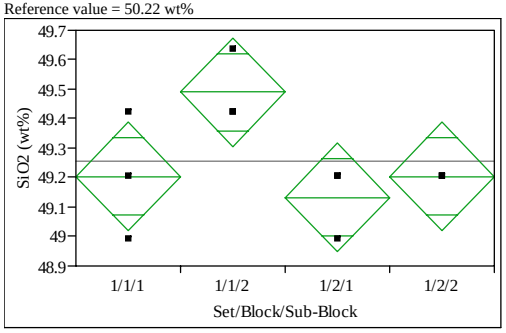
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.12373461	0.017676	2.8965	0.0370
Error	16	0.09764355	0.006103		
C. Total	23	0.22137816			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	4.24121	0.04510	4.1456	4.3368
1/1/2	3	4.16945	0.04510	4.0738	4.2651
1/2/1	3	4.23404	0.04510	4.1384	4.3296
1/2/2	3	4.21251	0.04510	4.1169	4.3081
2/1/1	3	4.32015	0.04510	4.2245	4.4158
2/1/2	3	4.33451	0.04510	4.2389	4.4301
2/2/1	3	4.09769	0.04510	4.0021	4.1933
2/2/2	3	4.25557	0.04510	4.1600	4.3512

Std Error uses a pooled estimate of error variance

Oneway Analysis of SiO2 (wt%) By Set/Block/Sub-Block Type=Batch 1
Reference value = 50.22 wt%



Missing Rows
12

Oneway Anova
Summary of Fit

Rsquare	0.59596
Adj Rsquare	0.444444
Root Mean Square Error	0.138091
Mean of Response	49.25738
Observations (or Sum Wgts)	12

Analysis of Variance

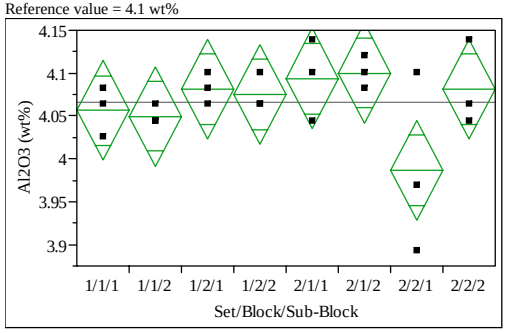
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	3	0.22501639	0.075005	3.9333	0.0539
Error	8	0.15255348	0.019069		
C. Total	11	0.37756987			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	49.2039	0.07973	49.020	49.388
1/1/2	3	49.4891	0.07973	49.305	49.673
1/2/1	3	49.1326	0.07973	48.949	49.316
1/2/2	3	49.2039	0.07973	49.020	49.388
2/1/1	0	.	.	.	.
2/1/2	0	.	.	.	.
2/2/1	0	.	.	.	.
2/2/2	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Oneway Analysis of Al2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 4.1 wt%



Oneway Anova
Summary of Fit

Rsquare	0.432331
Adj Rsquare	0.183976
Root Mean Square Error	0.047395
Mean of Response	4.065574
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.02737161	0.003910	1.7408	0.1695
Error	16	0.03594012	0.002246		
C. Total	23	0.06331173			

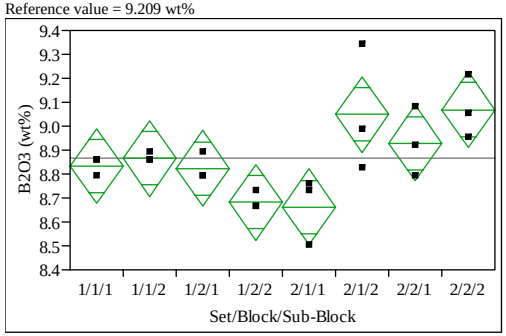
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	4.05613	0.02736	3.9981	4.1141
1/1/2	3	4.04983	0.02736	3.9918	4.1078
1/2/1	3	4.08132	0.02736	4.0233	4.1393
1/2/2	3	4.07502	0.02736	4.0170	4.1330
2/1/1	3	4.09392	0.02736	4.0359	4.1519
2/1/2	3	4.10022	0.02736	4.0422	4.1582
2/2/1	3	3.98685	0.02736	3.9288	4.0449
2/2/2	3	4.08132	0.02736	4.0233	4.1393

Std Error uses a pooled estimate of error variance

Exhibit A4. PF Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of B2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 9.209 wt%



Oneway Anova
Summary of Fit

Rsquare	0.638047
Adj Rsquare	0.479693
Root Mean Square Error	0.129131
Mean of Response	8.864116
Observations (or Sum Wgts)	24

Analysis of Variance

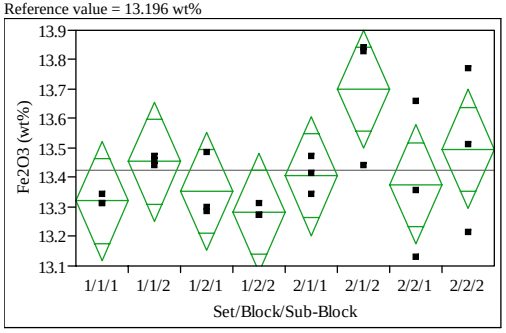
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.47030733	0.067187	4.0292	0.0100
Error	16	0.26679692	0.016675		
C. Total	23	0.73710425			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	8.83326	0.07455	8.6752	8.9913
1/1/2	3	8.86546	0.07455	8.7074	9.0235
1/2/1	3	8.82253	0.07455	8.6645	8.9806
1/2/2	3	8.68300	0.07455	8.5250	8.8410
2/1/1	3	8.66153	0.07455	8.5035	8.8196
2/1/2	3	9.04792	0.07455	8.8899	9.2060
2/2/1	3	8.92986	0.07455	8.7718	9.0879
2/2/2	3	9.06939	0.07455	8.9113	9.2274

Std Error uses a pooled estimate of error variance

Oneway Analysis of Fe2O3 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 13.196 wt%



Oneway Anova
Summary of Fit

Rsquare	0.455839
Adj Rsquare	0.217769
Root Mean Square Error	0.164907
Mean of Response	13.42369
Observations (or Sum Wgts)	24

Analysis of Variance

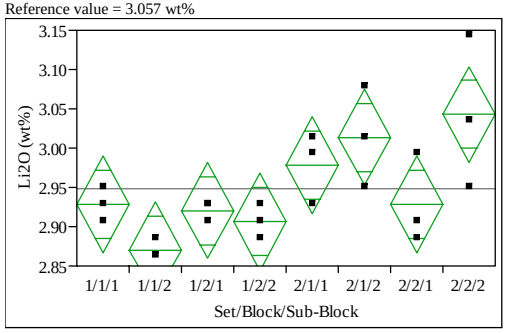
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.36448677	0.052070	1.9147	0.1335
Error	16	0.43510843	0.027194		
C. Total	23	0.79959520			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	13.3200	0.09521	13.118	13.522
1/1/2	3	13.4535	0.09521	13.252	13.655
1/2/1	3	13.3534	0.09521	13.152	13.555
1/2/2	3	13.2819	0.09521	13.080	13.484
2/1/1	3	13.4058	0.09521	13.204	13.608
2/1/2	3	13.7013	0.09521	13.499	13.903
2/2/1	3	13.3772	0.09521	13.175	13.579
2/2/2	3	13.4964	0.09521	13.295	13.698

Std Error uses a pooled estimate of error variance

Oneway Analysis of Li2O (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 3.057 wt%



Oneway Anova
Summary of Fit

Rsquare	0.637315
Adj Rsquare	0.47864
Root Mean Square Error	0.050106
Mean of Response	2.948576
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	7	0.07058686	0.010084	4.0165	0.0101
Error	16	0.04016981	0.002511		
C. Total	23	0.11075667			

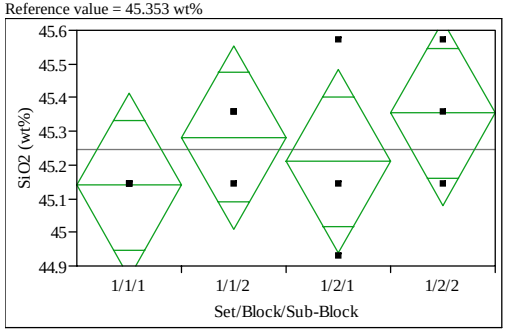
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	2.92794	0.02893	2.8666	2.9893
1/1/2	3	2.87053	0.02893	2.8092	2.9319
1/2/1	3	2.92077	0.02893	2.8594	2.9821
1/2/2	3	2.90642	0.02893	2.8451	2.9677
2/1/1	3	2.97818	0.02893	2.9169	3.0395
2/1/2	3	3.01406	0.02893	2.9527	3.0754
2/2/1	3	2.92794	0.02893	2.8666	2.9893
2/2/2	3	3.04277	0.02893	2.9814	3.1041

Std Error uses a pooled estimate of error variance

Exhibit A4. PF Measurements by Analytical Set, Block, and Sub-Block for Samples of the Batch 1 and Ustd Standards by Oxide

Oneway Analysis of SiO2 (wt%) By Set/Block/Sub-Block Type=Ustd
Reference value = 45.353 wt%



Missing Rows
12

Oneway Anova
Summary of Fit

Rsquare	0.185185
Adj Rsquare	-0.12037
Root Mean Square Error	0.204822
Mean of Response	45.2462
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block/Sub-Block	3	0.07627674	0.025426	0.6061	0.6294
Error	8	0.33561766	0.041952		
C. Total	11	0.41189440			

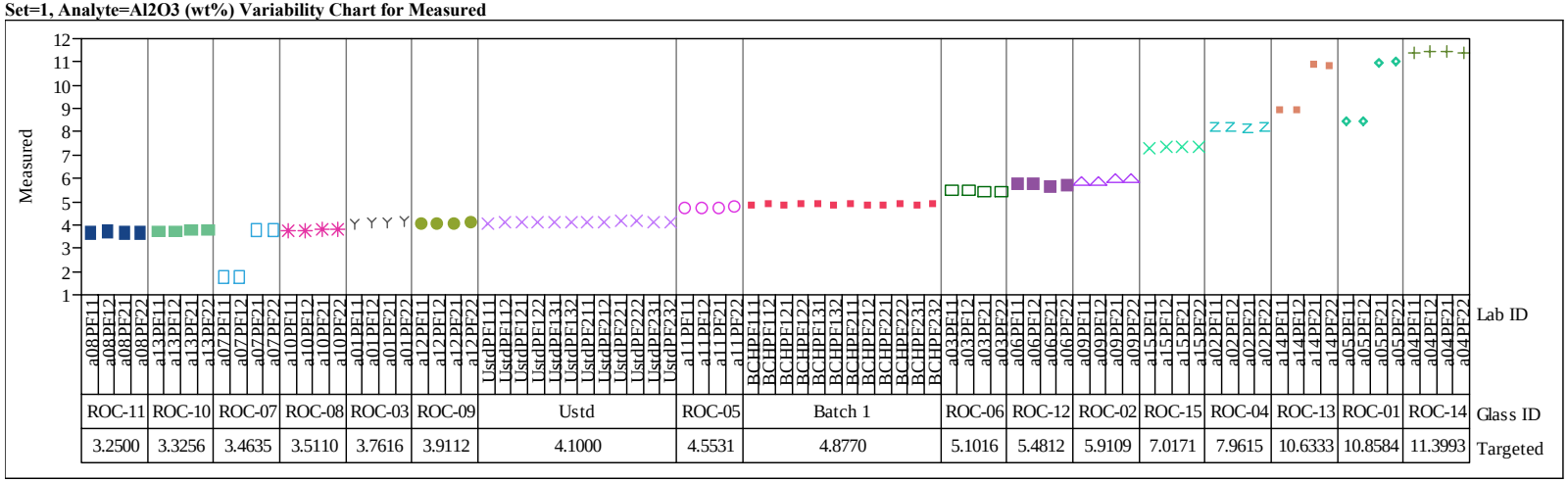
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1/1	3	45.1392	0.11825	44.867	45.412
1/1/2	3	45.2819	0.11825	45.009	45.555
1/2/1	3	45.2105	0.11825	44.938	45.483
1/2/2	3	45.3532	0.11825	45.080	45.626
2/1/1	0	.	.	.	.
2/1/2	0	.	.	.	.
2/2/1	0	.	.	.	.
2/2/2	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Al2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=Al2O3 (wt%) Variability Chart for Measured bc

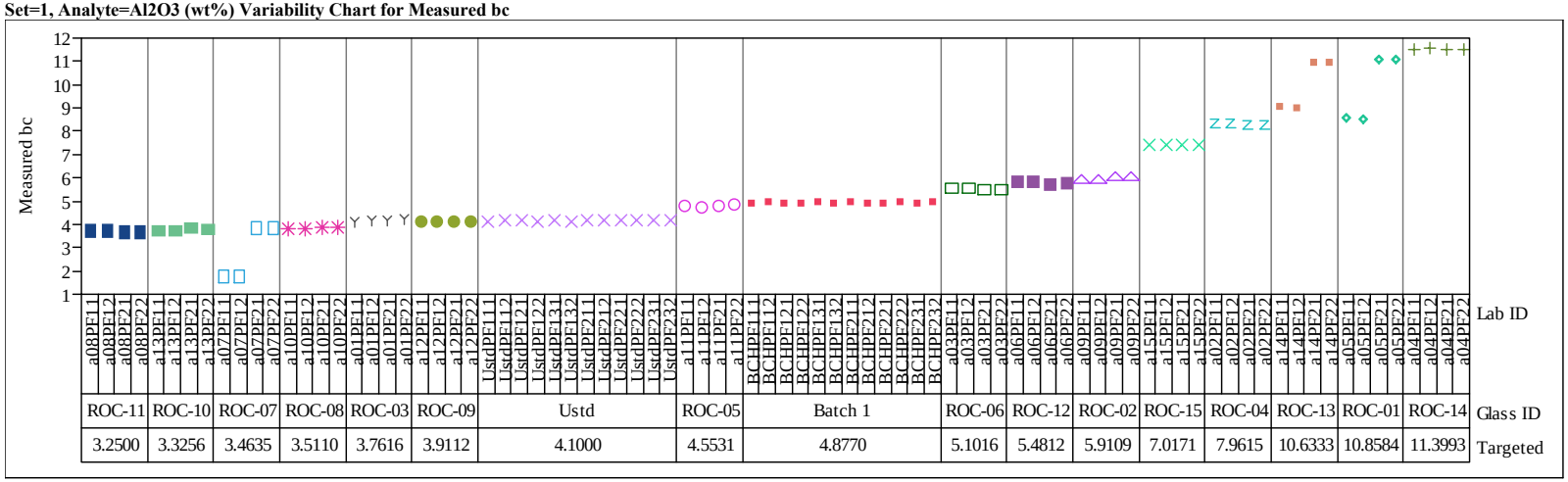
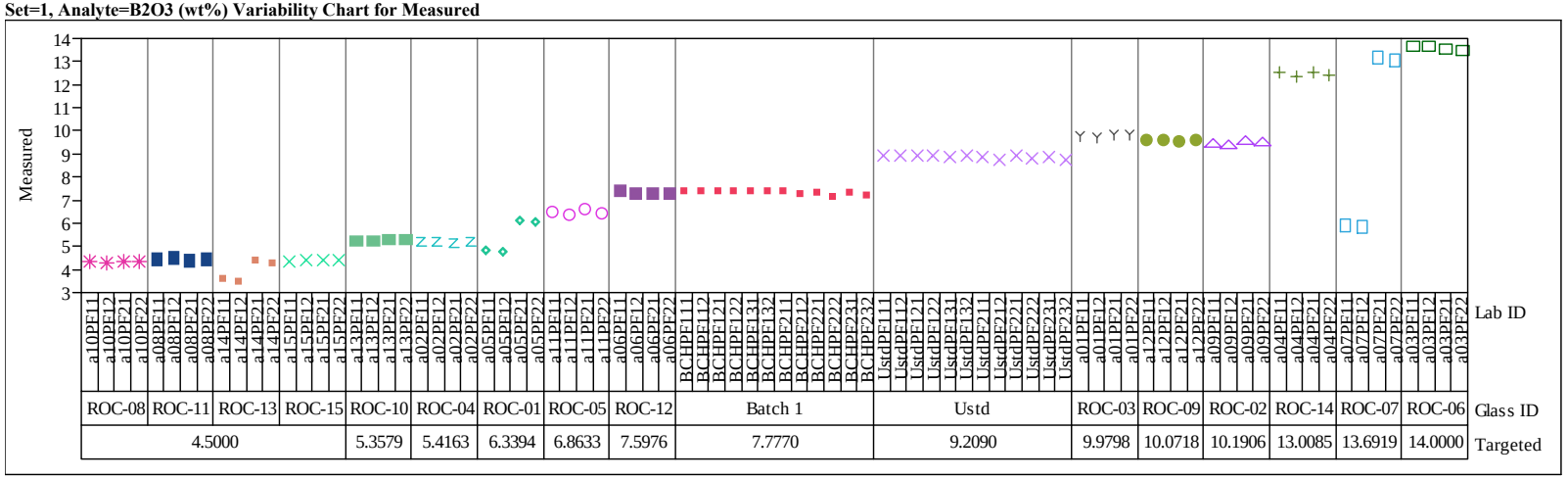


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=B2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=B2O3 (wt%) Variability Chart for Measured bc

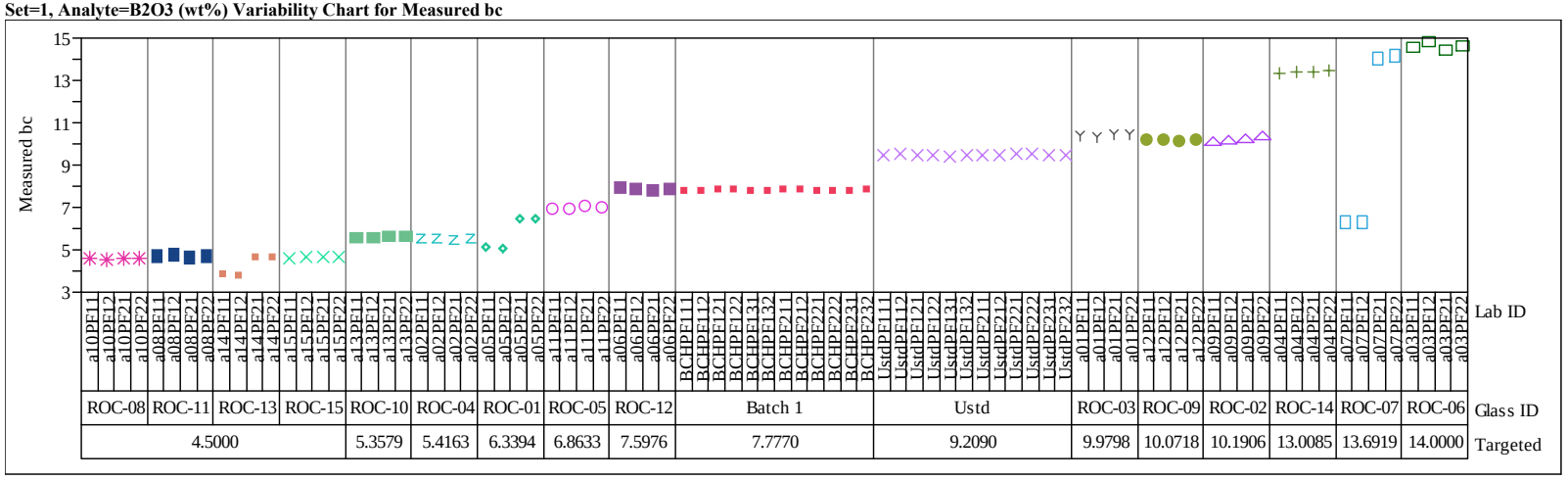
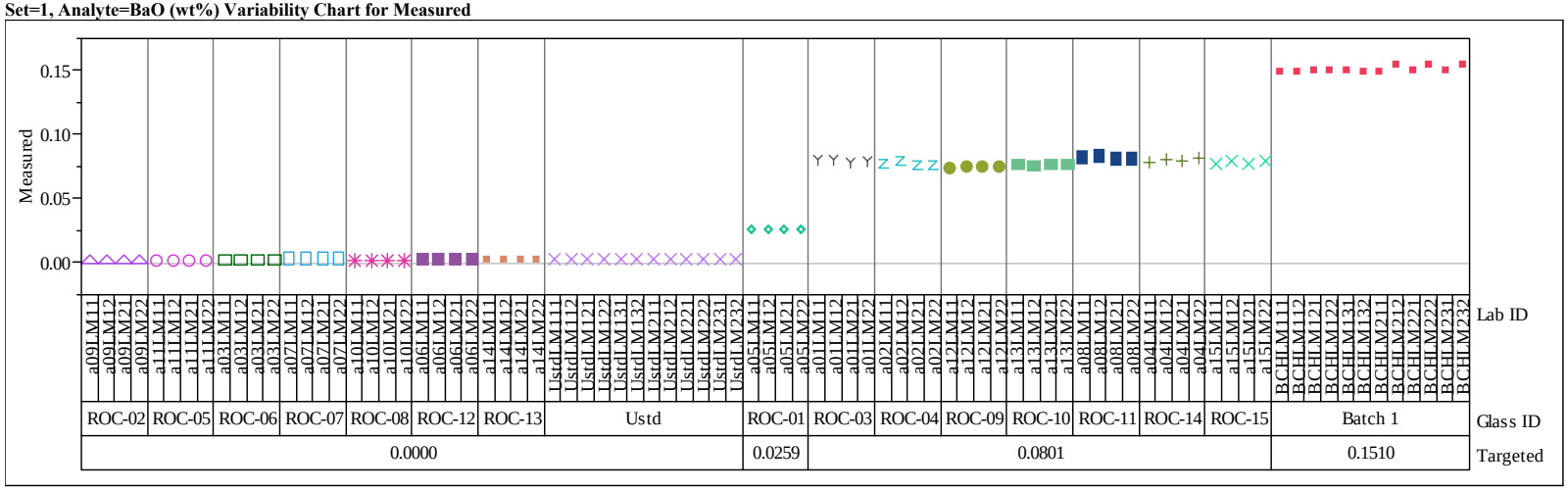


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=BaO (wt%) Variability Chart for Measured



Set=1, Analyte=BaO (wt%) Variability Chart for Measured bc

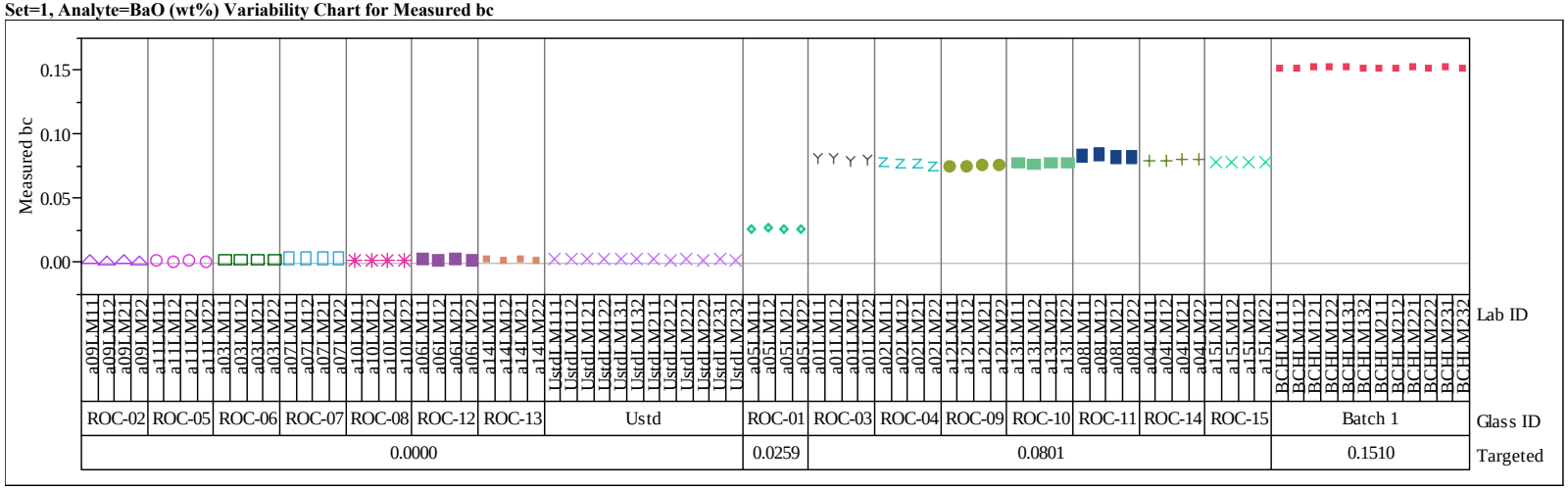
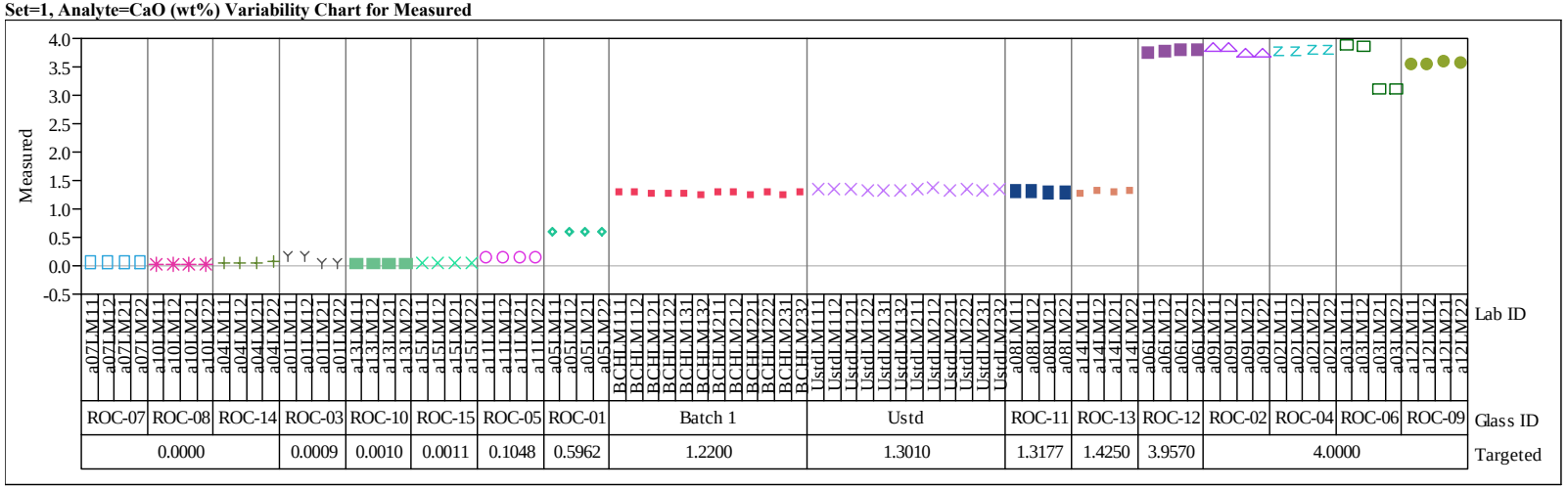


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=CaO (wt%) Variability Chart for Measured



Set=1, Analyte=CaO (wt%) Variability Chart for Measured bc

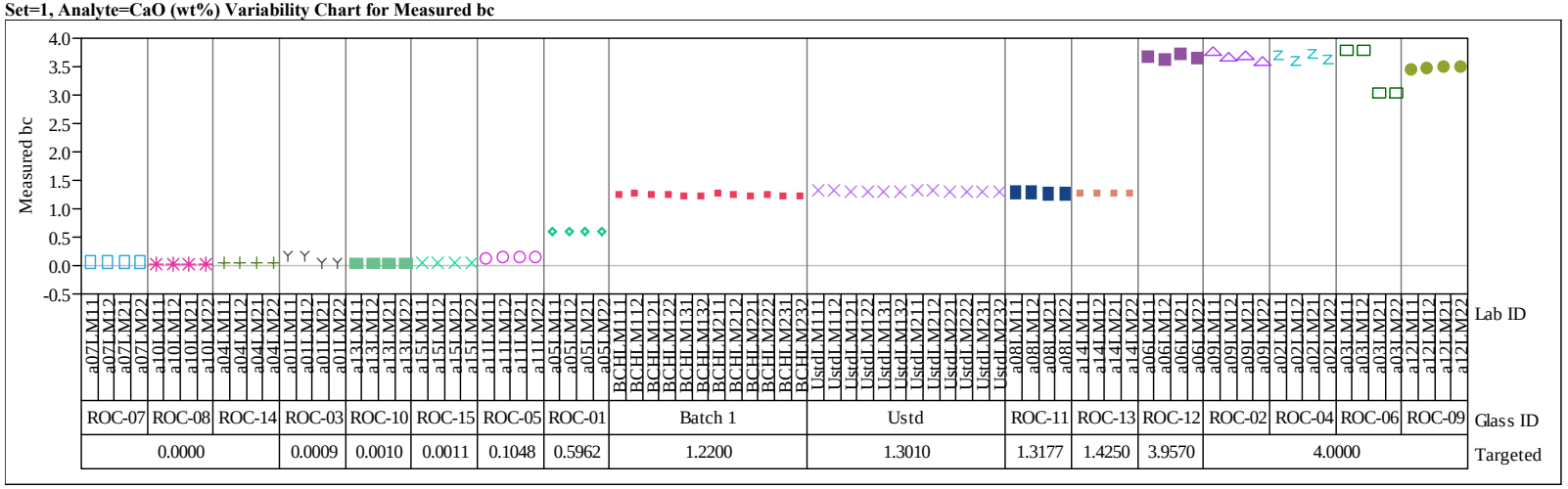
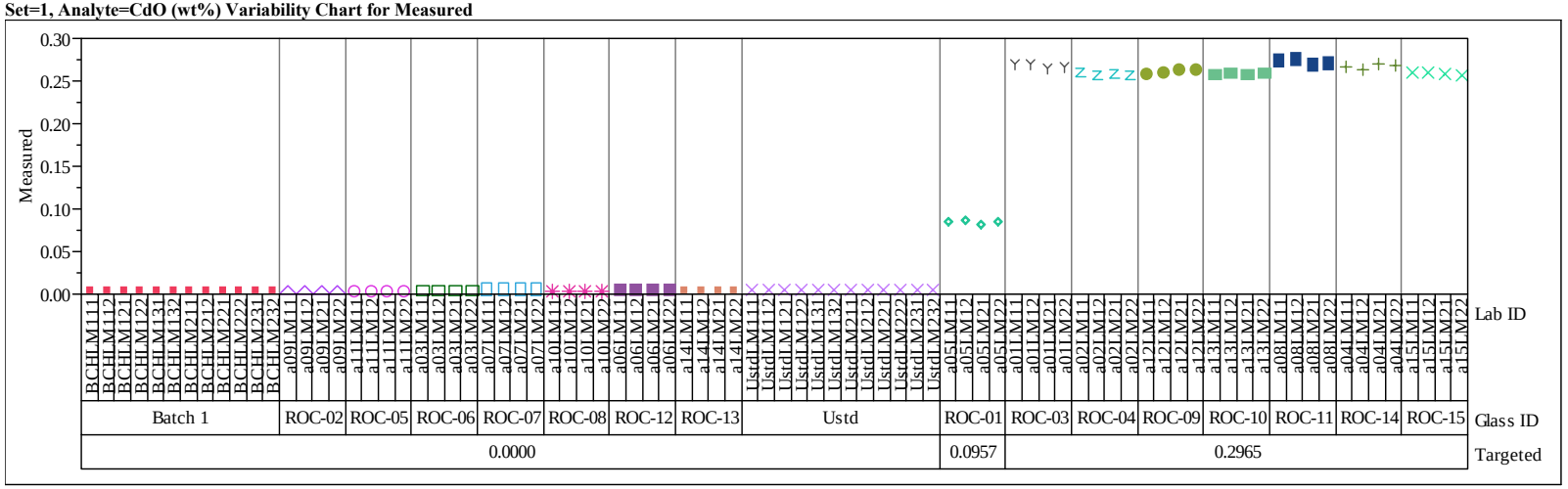


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=CdO (wt%) Variability Chart for Measured



Set=1, Analyte=CdO (wt%) Variability Chart for Measured bc

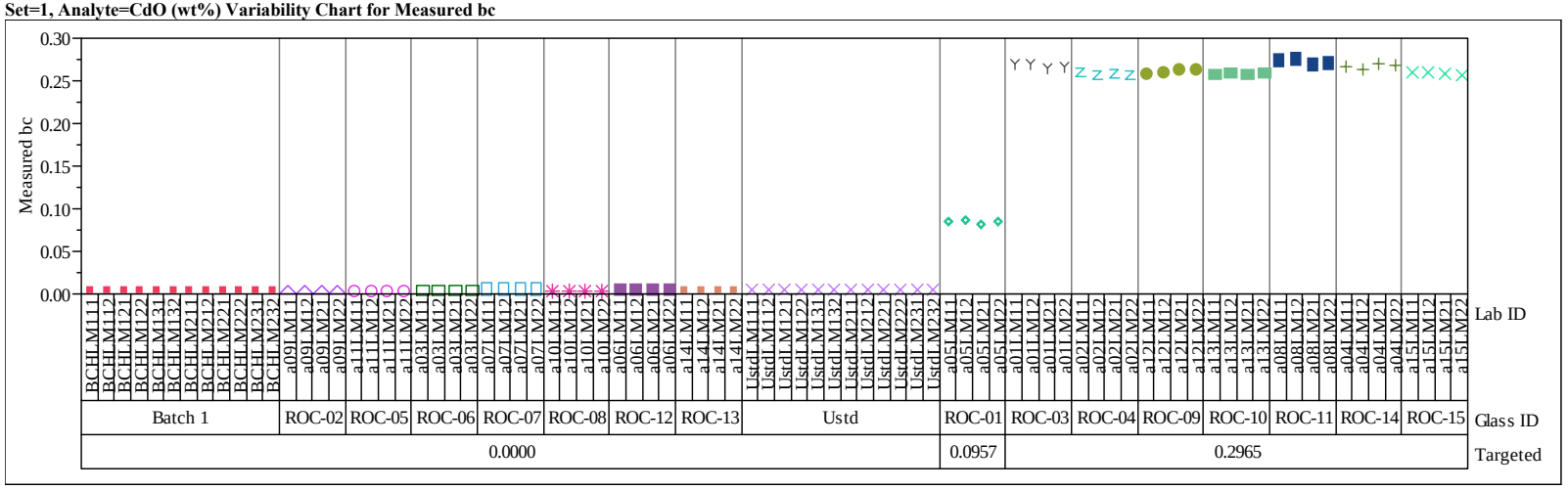
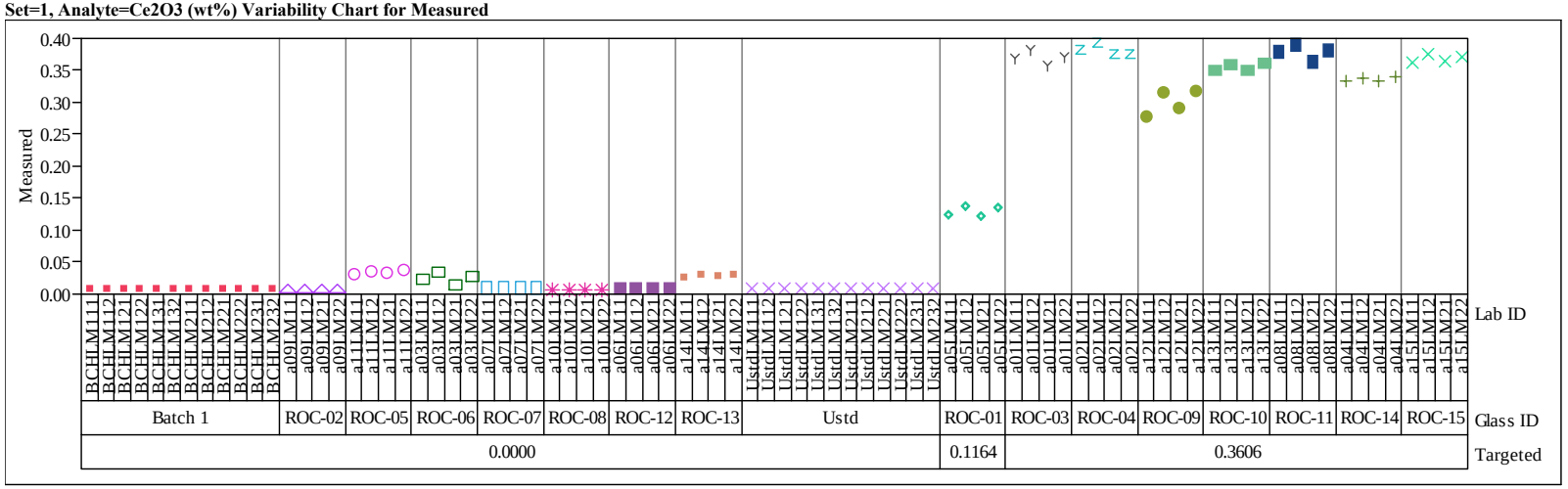


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Ce2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=Ce2O3 (wt%) Variability Chart for Measured bc

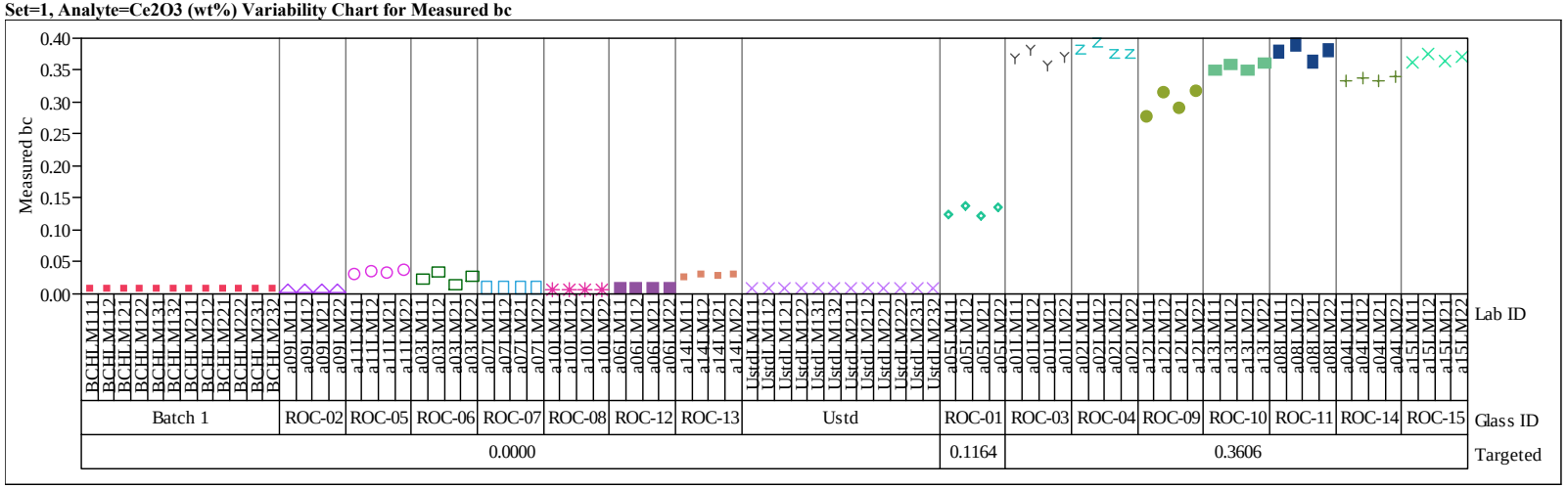
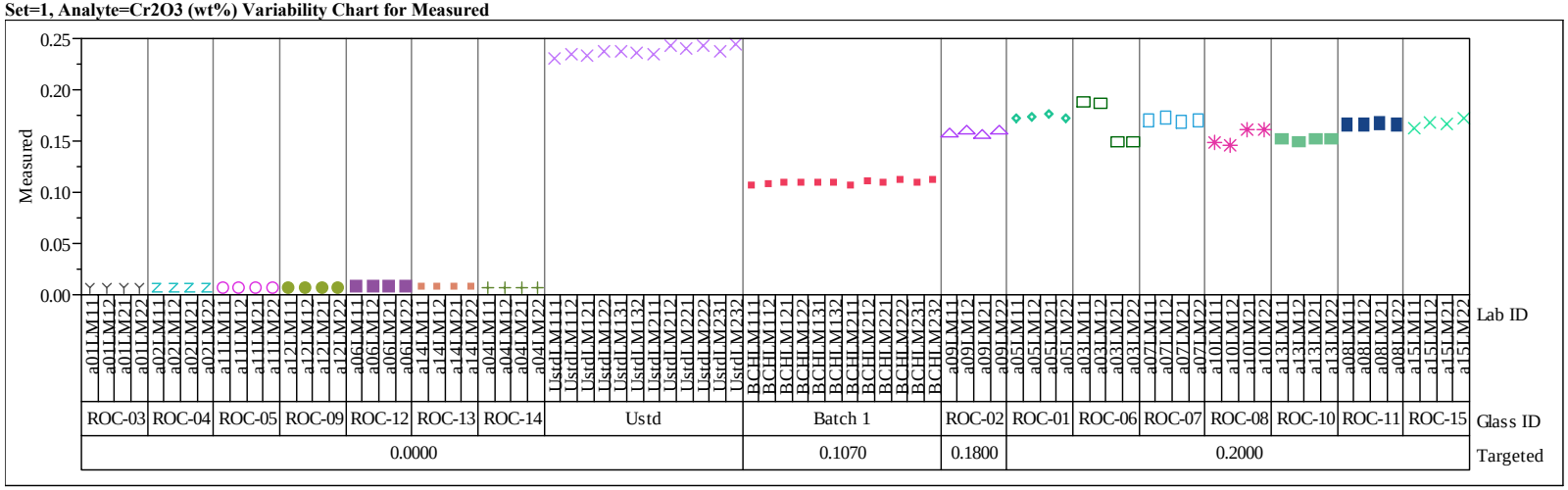


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Cr2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=Cr2O3 (wt%) Variability Chart for Measured bc

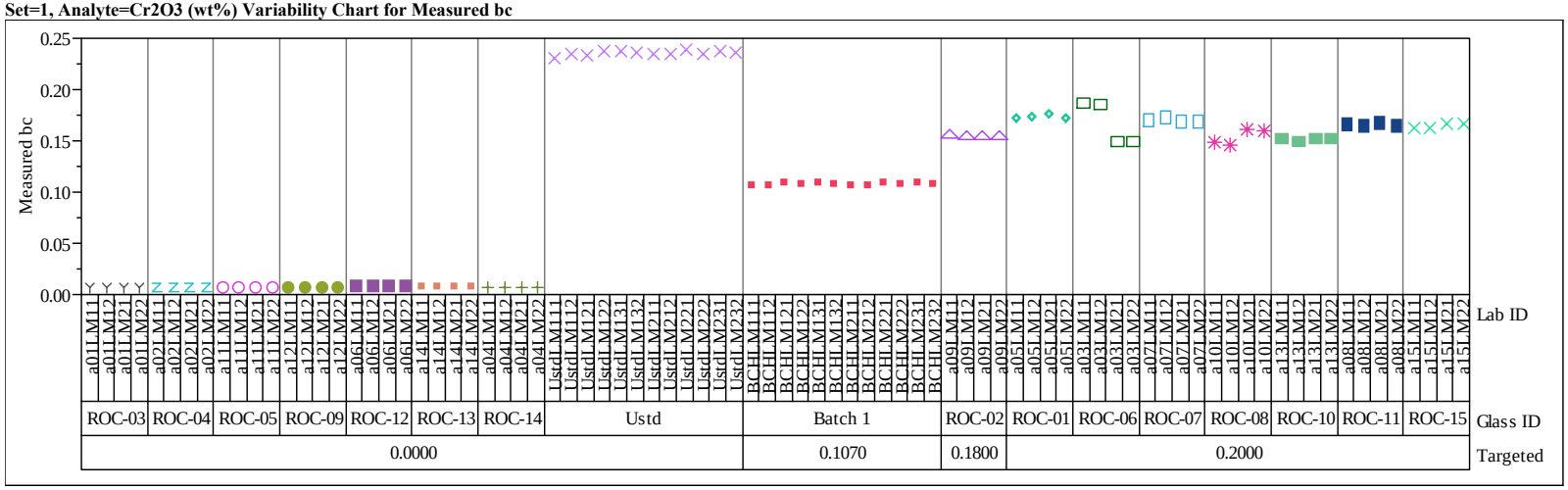
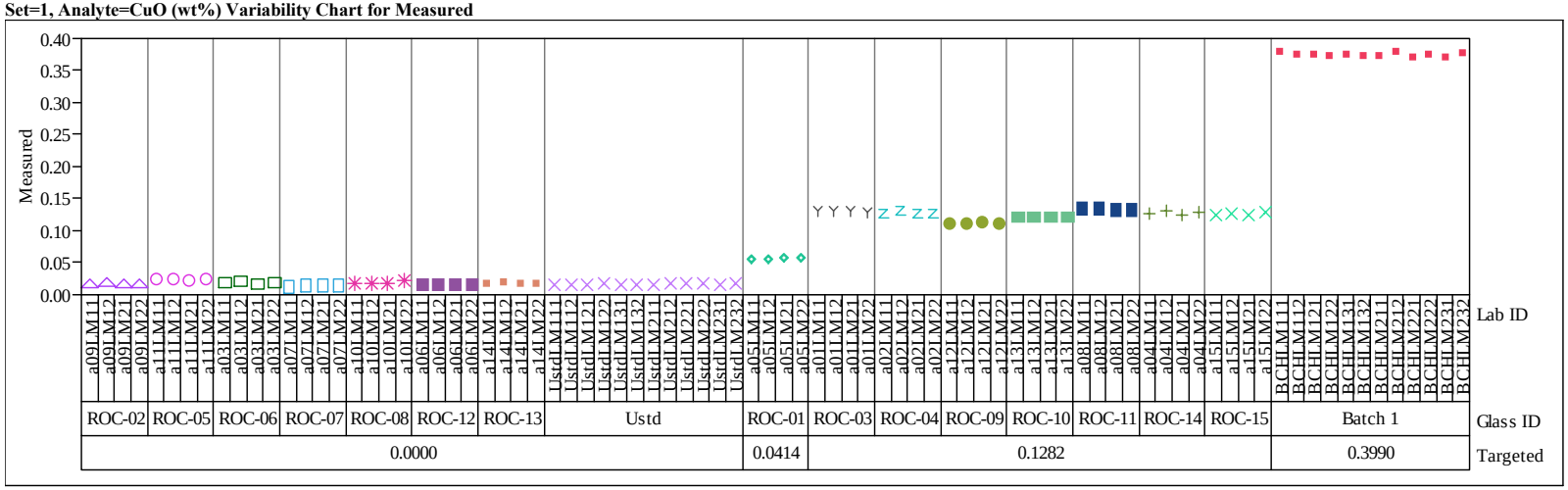


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=CuO (wt%) Variability Chart for Measured



Set=1, Analyte=CuO (wt%) Variability Chart for Measured bc

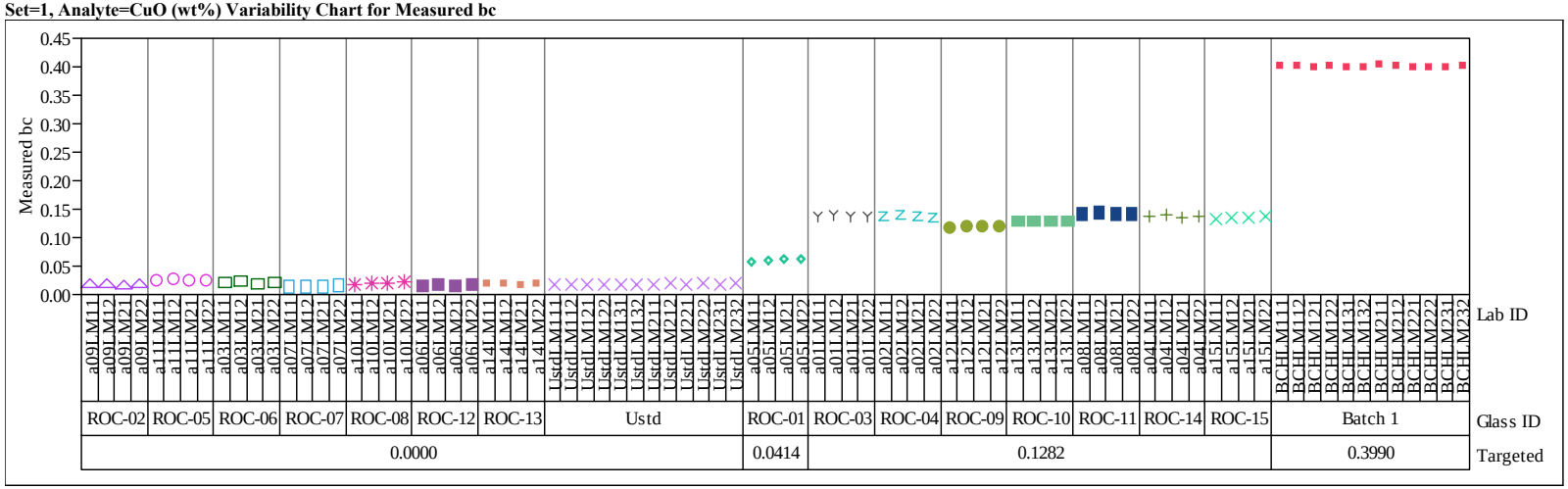
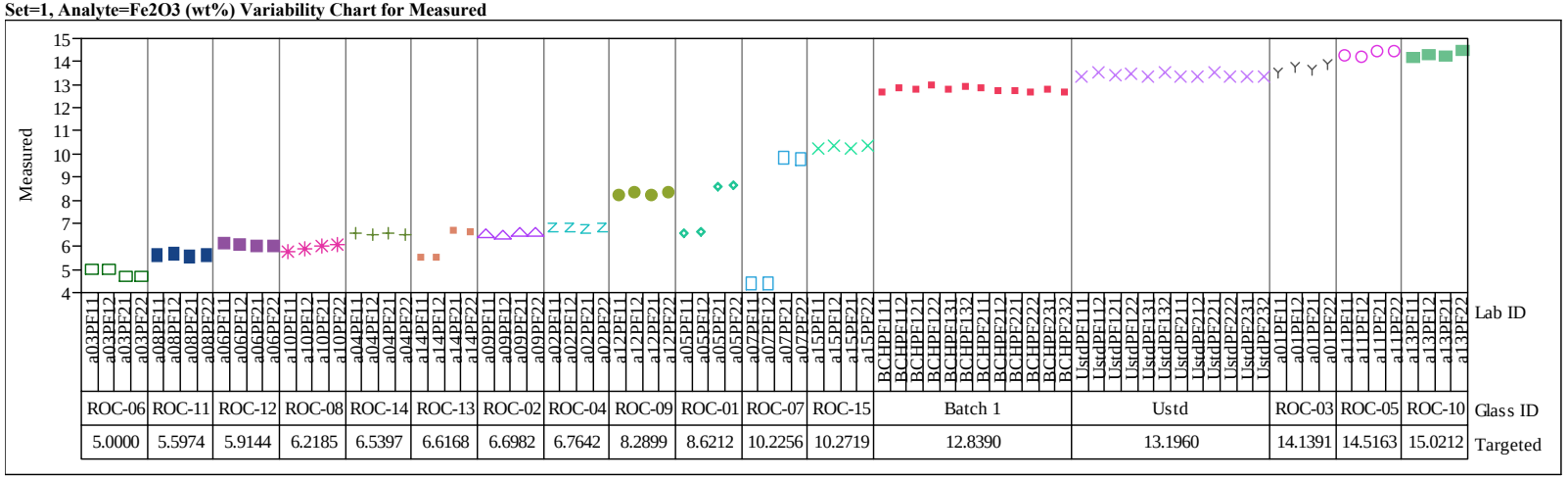


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Fe2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=Fe2O3 (wt%) Variability Chart for Measured bc

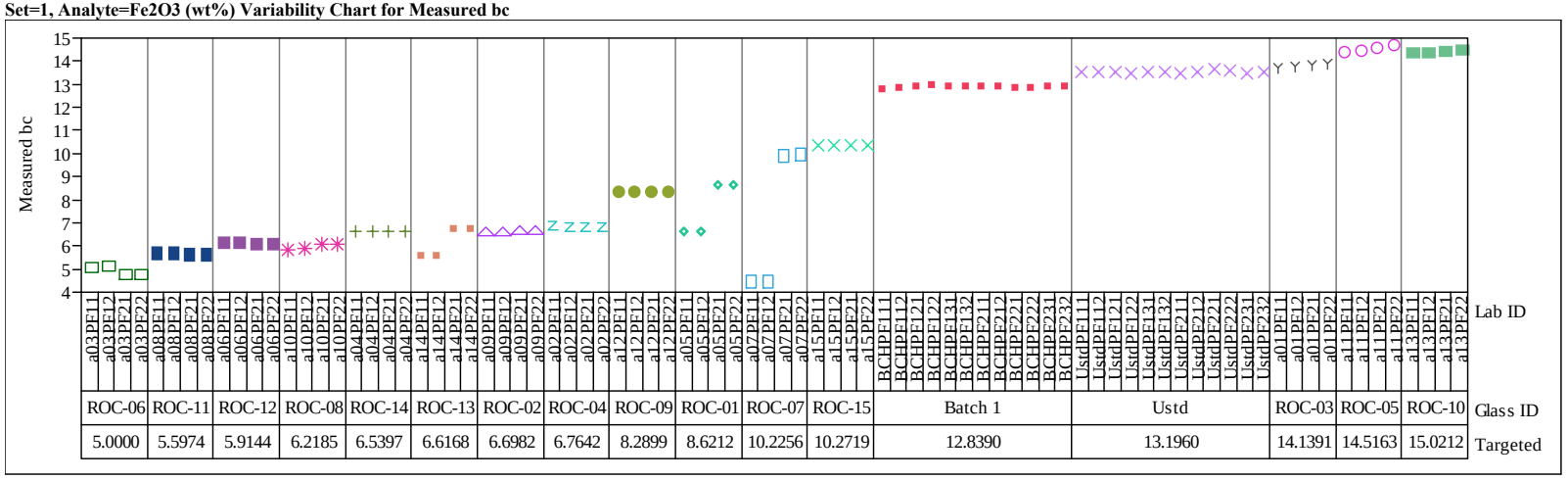
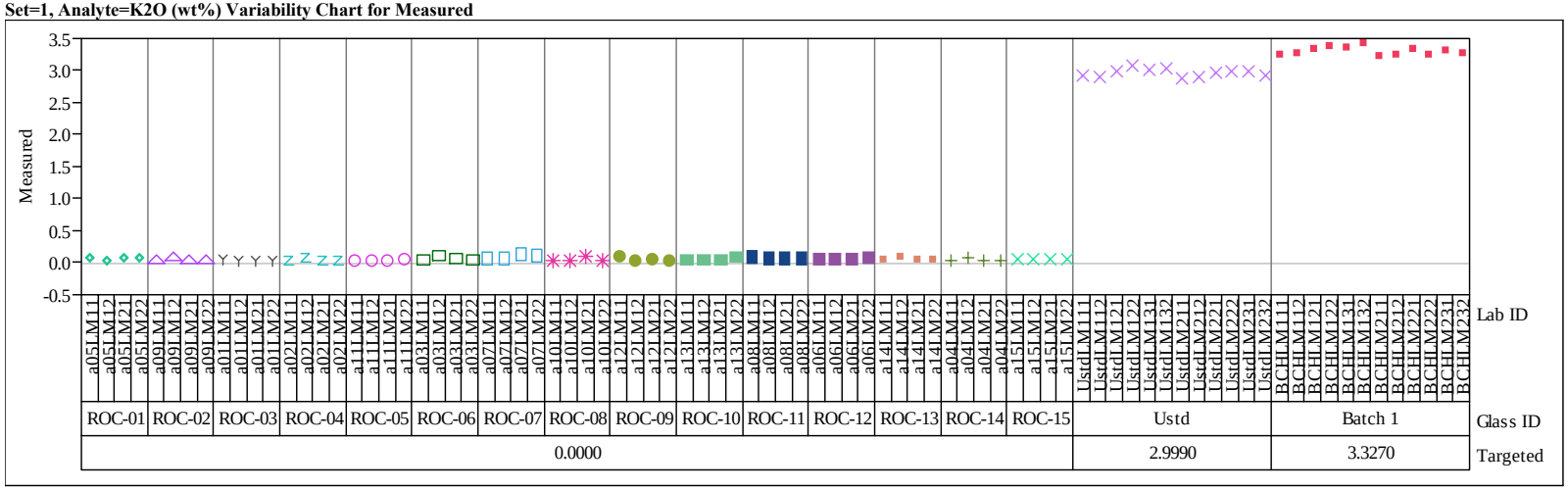


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=K2O (wt%) Variability Chart for Measured



Set=1, Analyte=K2O (wt%) Variability Chart for Measured bc

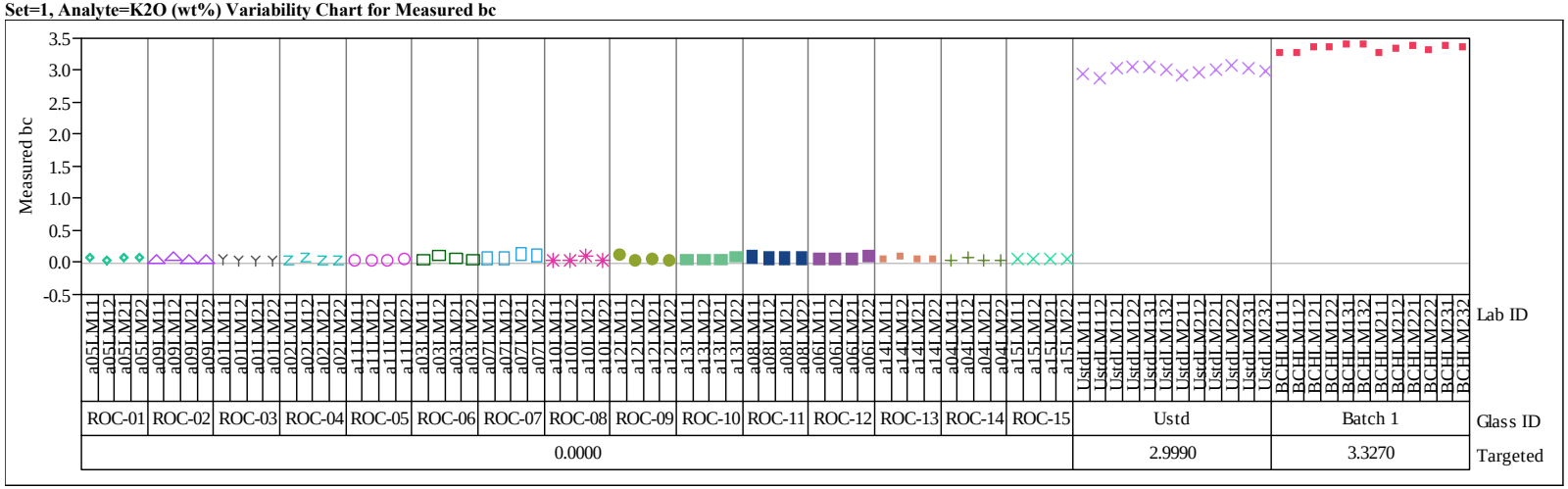
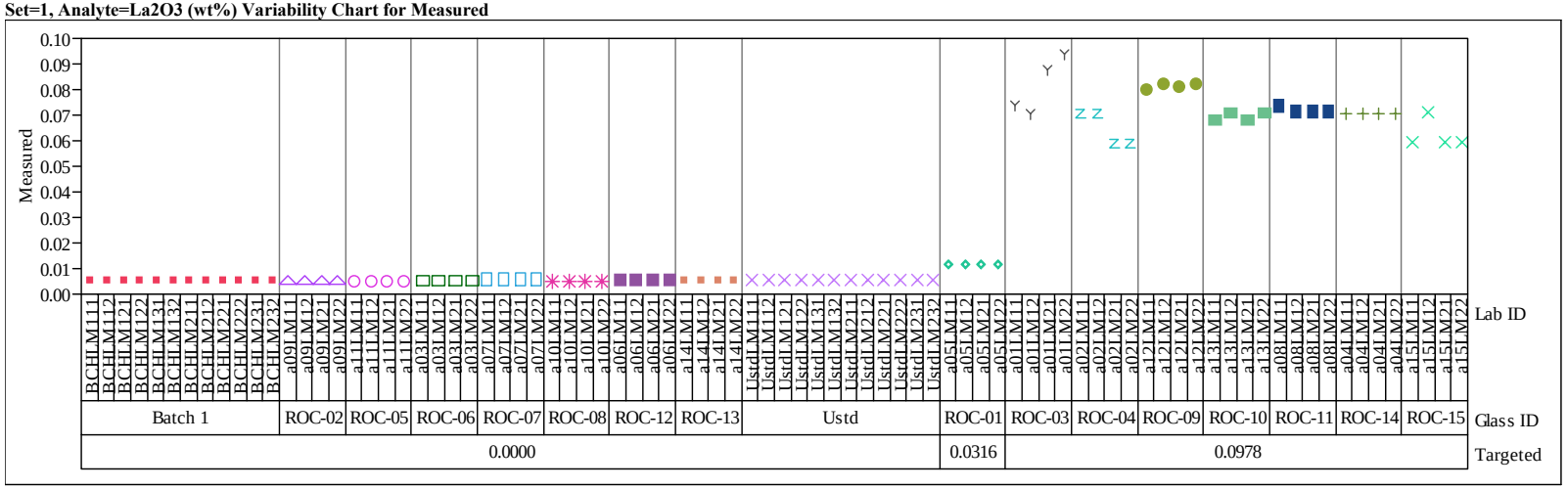


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=La2O3 (wt%) Variability Chart for Measured



Set=1, Analyte=La2O3 (wt%) Variability Chart for Measured bc

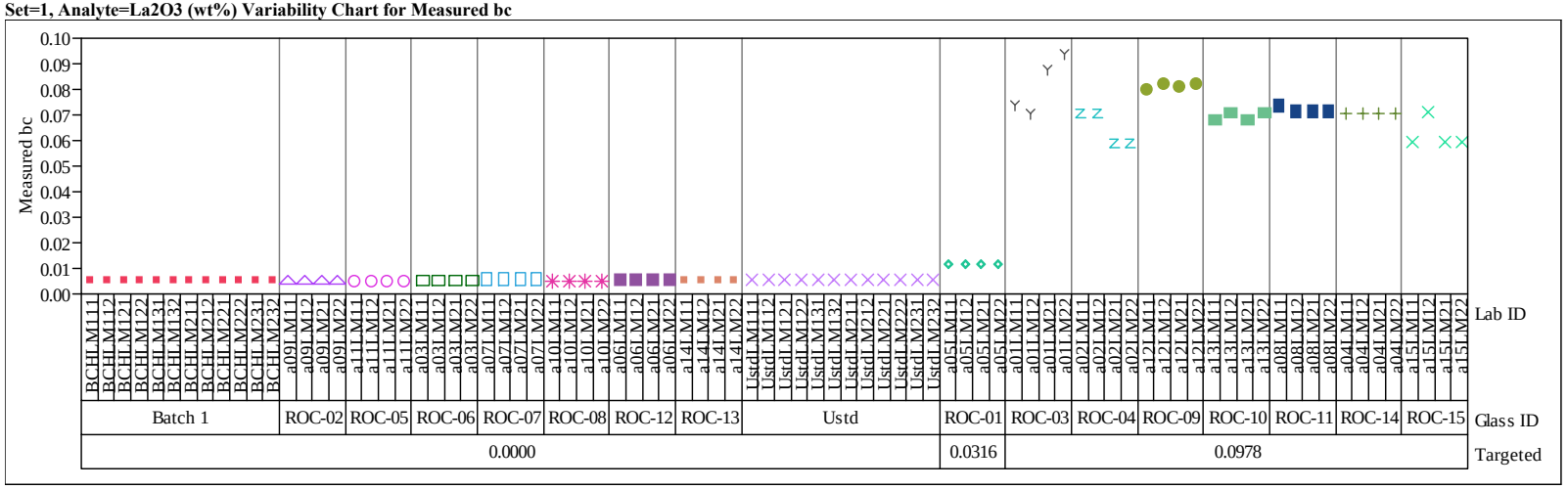
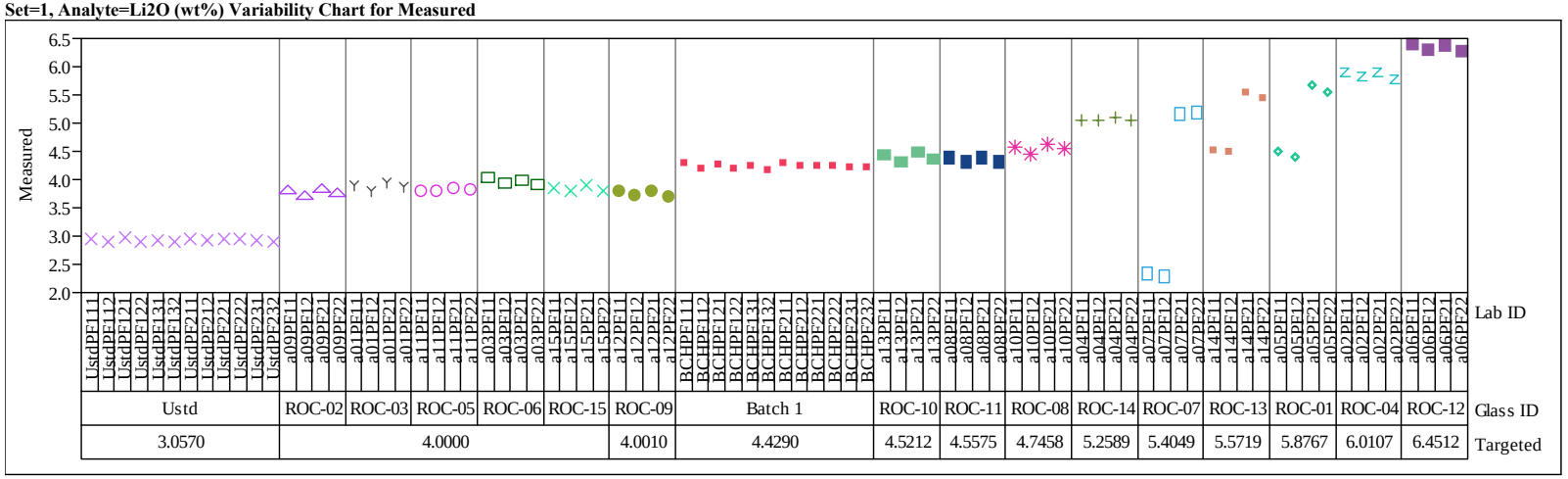


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Li2O (wt%) Variability Chart for Measured



Set=1, Analyte=Li2O (wt%) Variability Chart for Measured bc

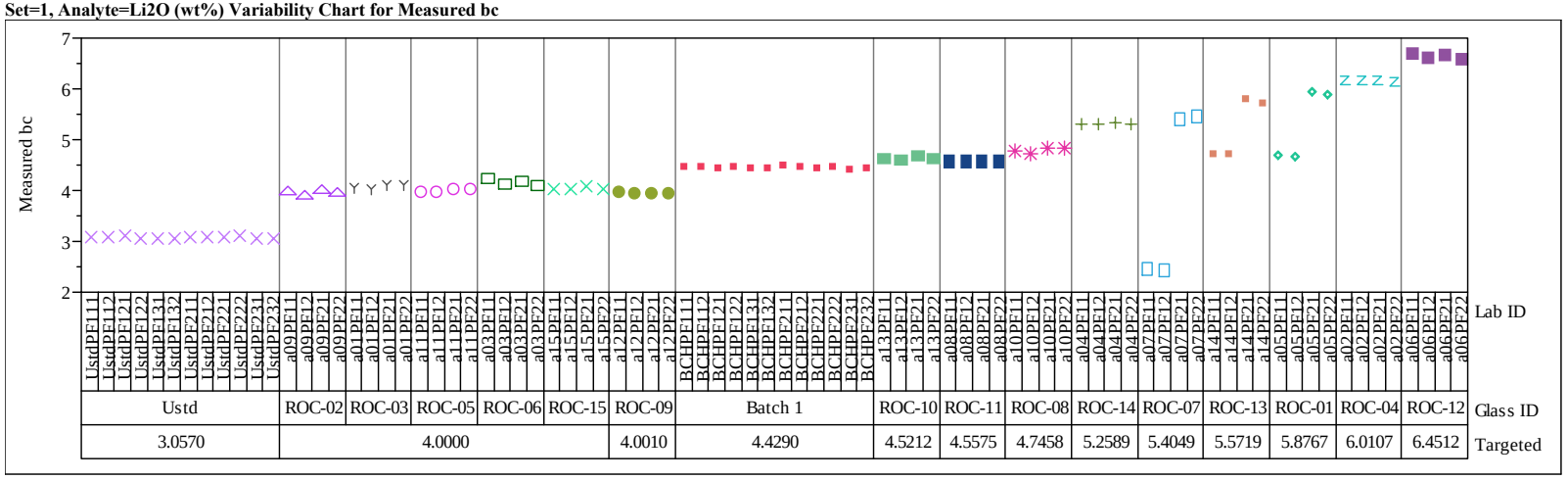
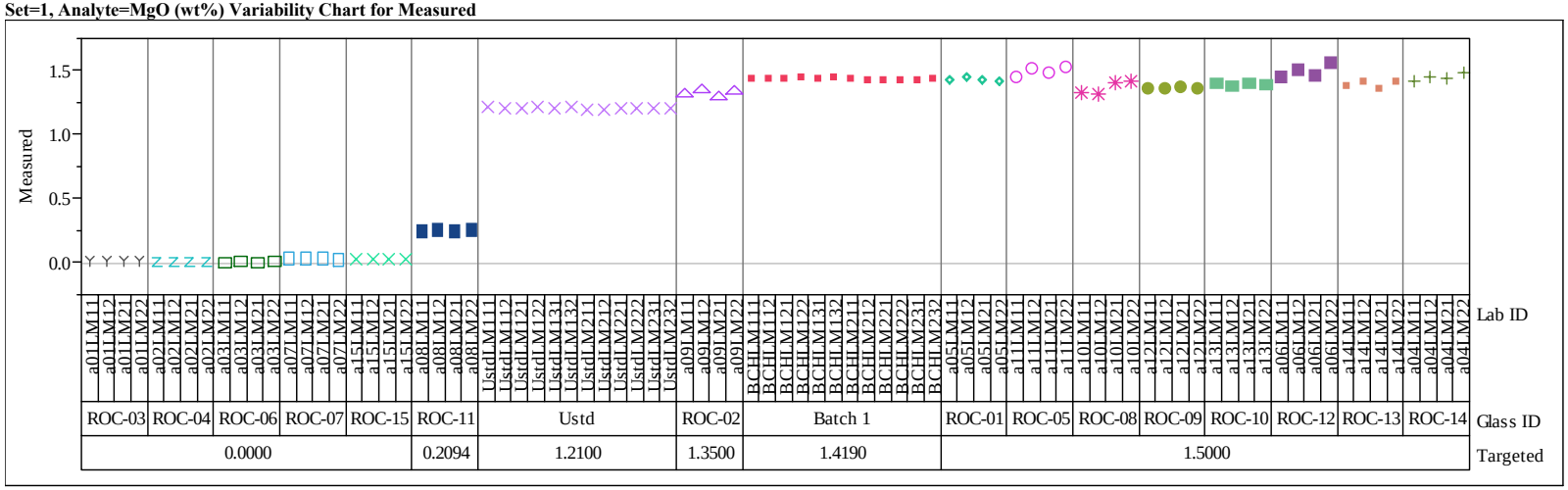


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=MgO (wt%) Variability Chart for Measured



Set=1, Analyte=MgO (wt%) Variability Chart for Measured bc

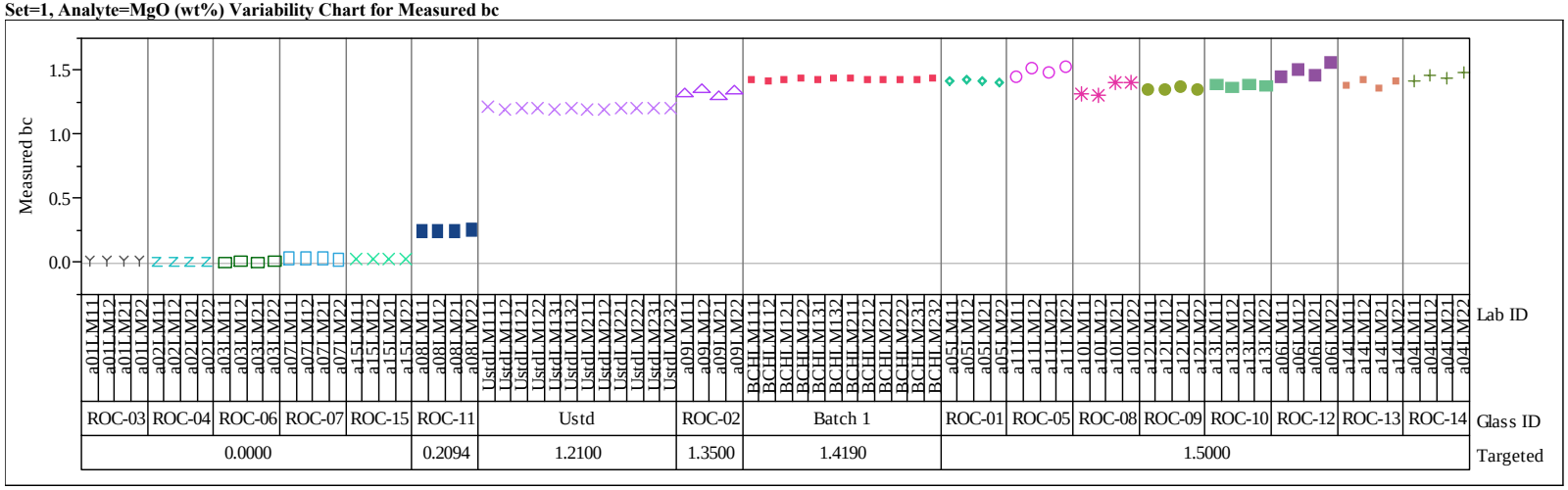
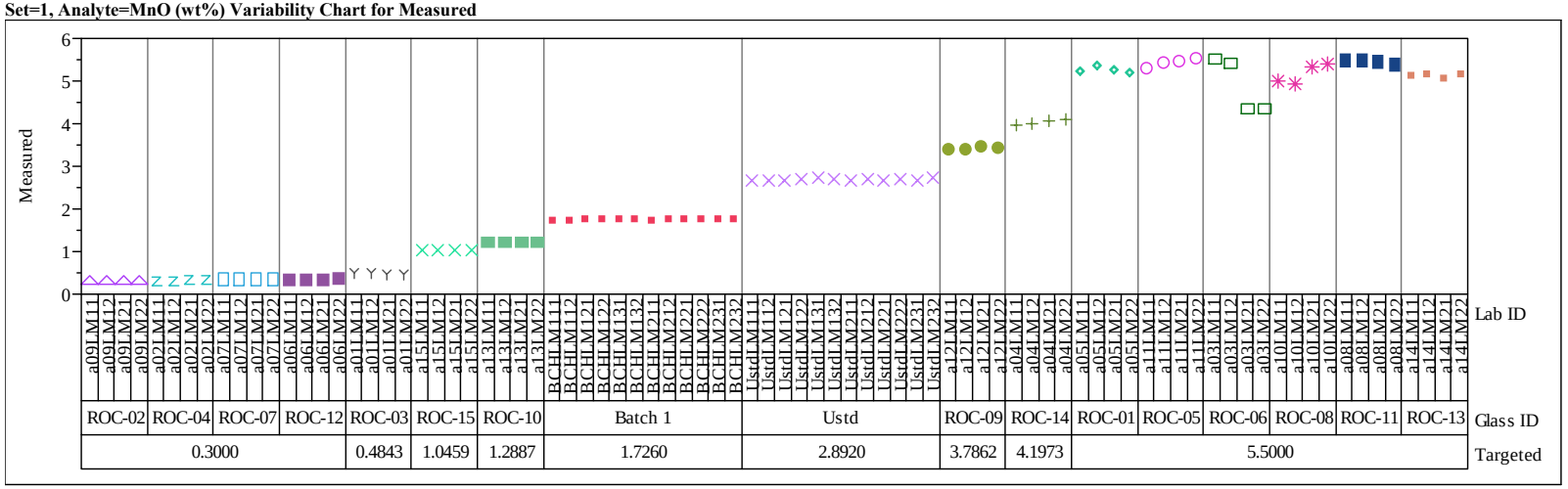


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=MnO (wt%) Variability Chart for Measured



Set=1, Analyte=MnO (wt%) Variability Chart for Measured bc

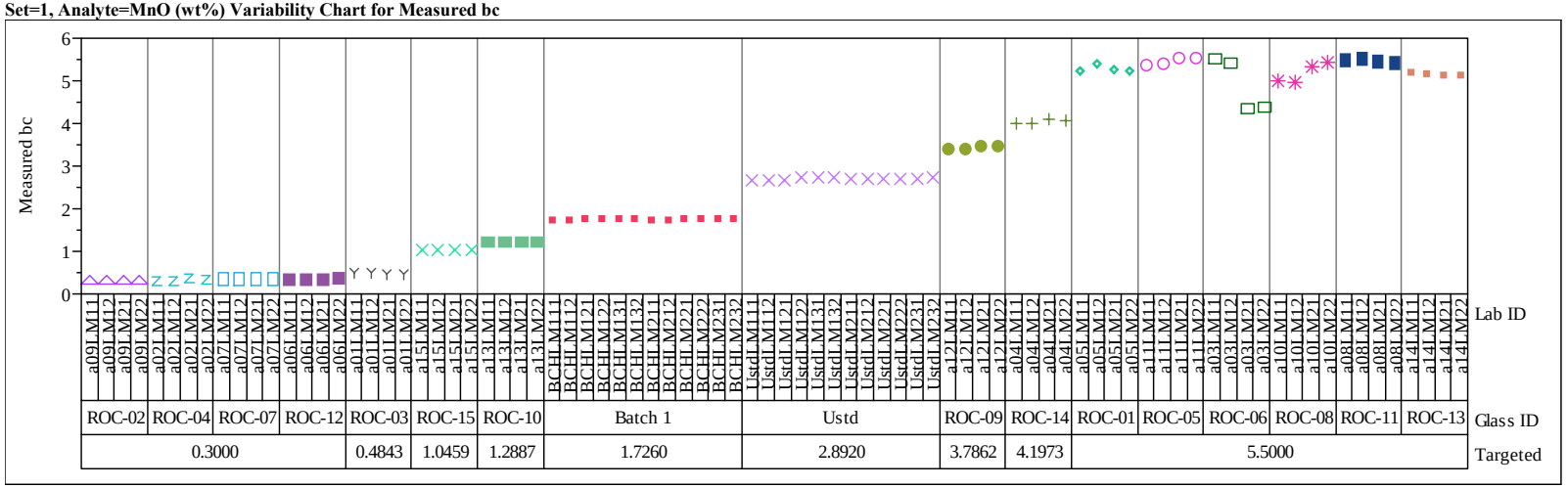
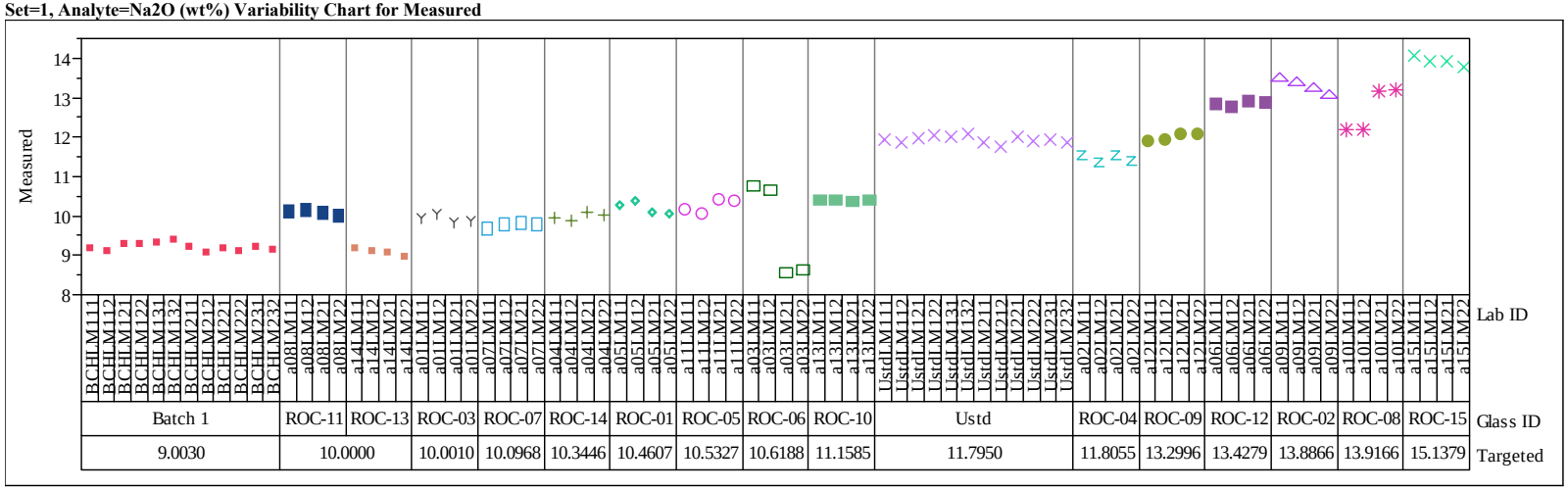


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=Na2O (wt%) Variability Chart for Measured



Set=1, Analyte=Na2O (wt%) Variability Chart for Measured bc

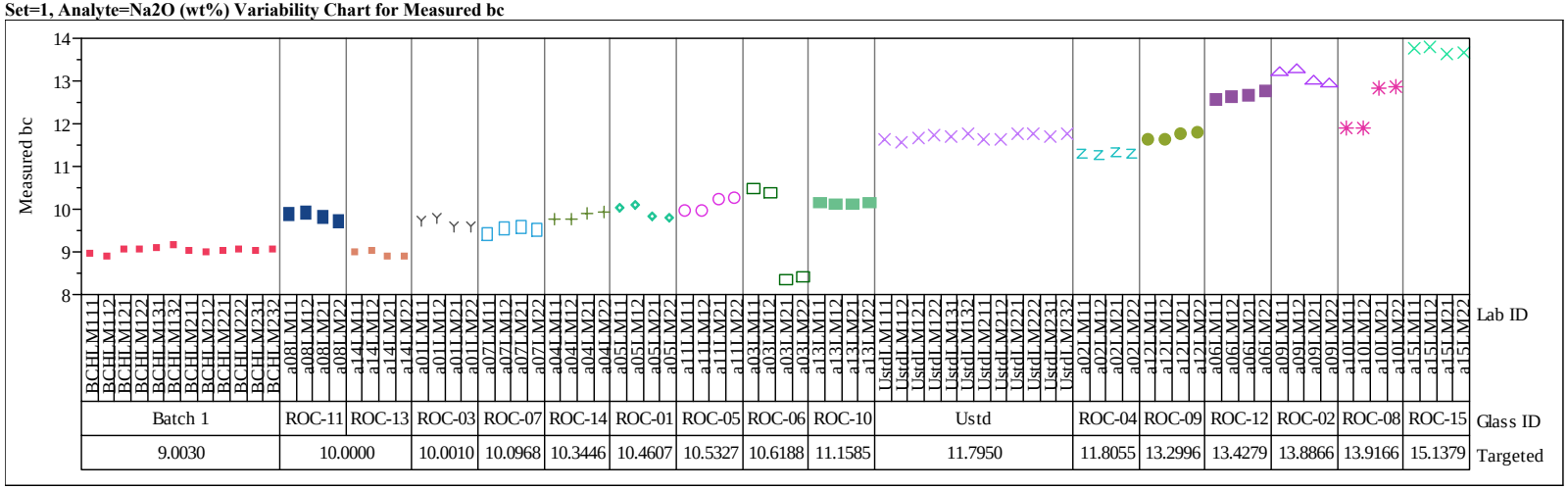
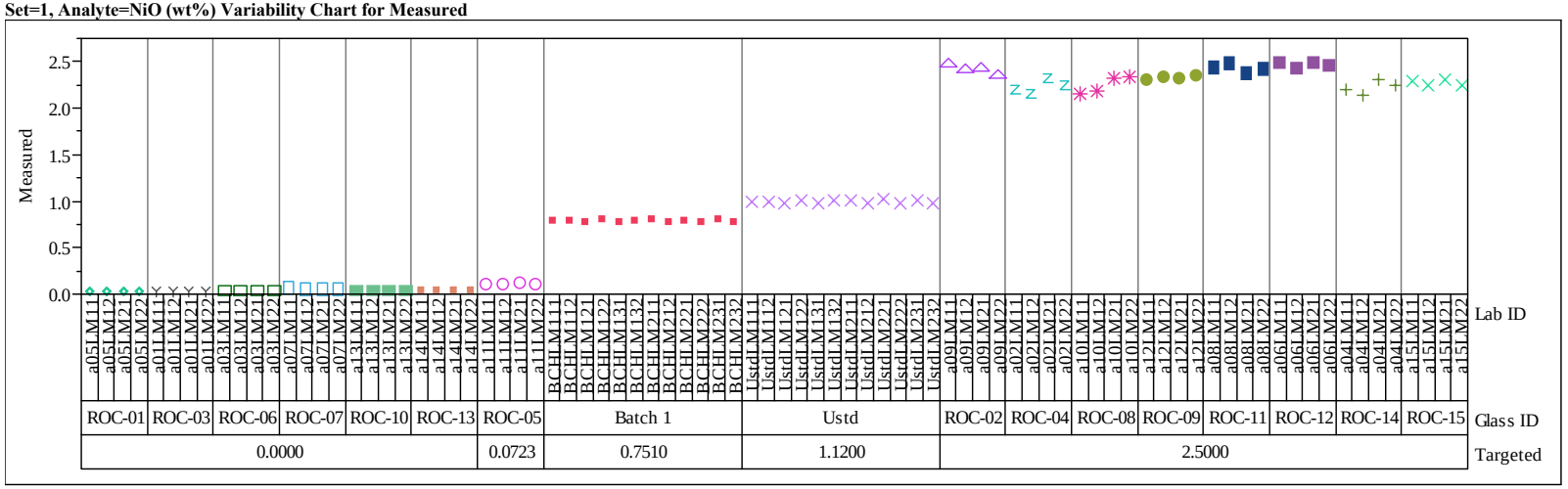


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=NiO (wt%) Variability Chart for Measured



Set=1, Analyte=NiO (wt%) Variability Chart for Measured bc

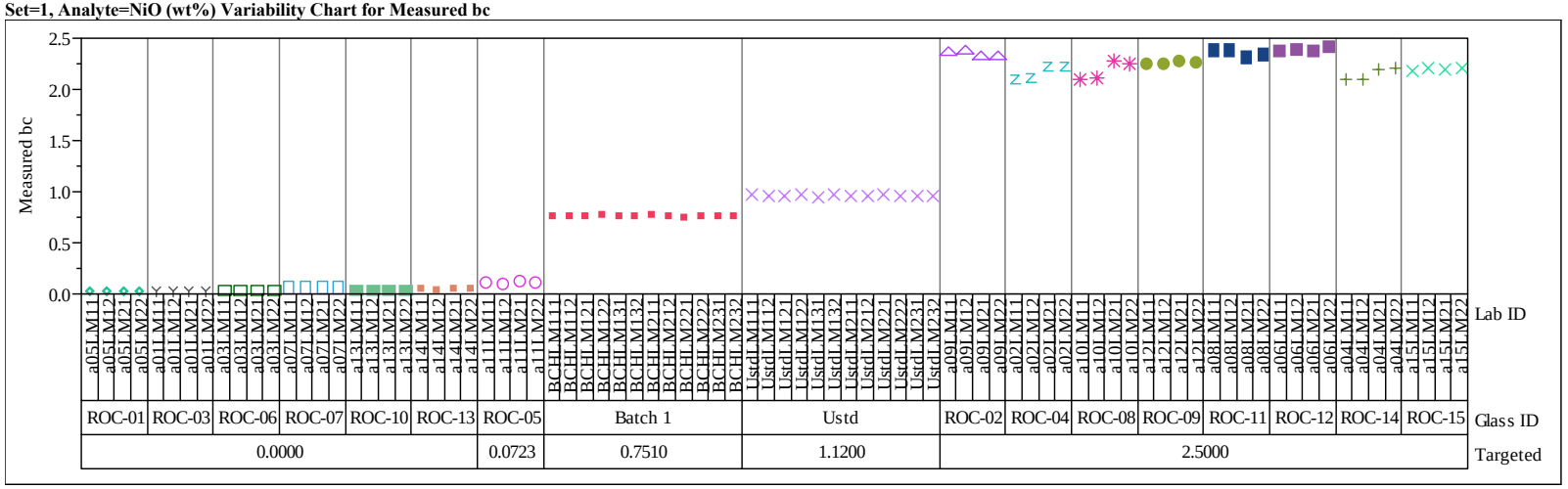
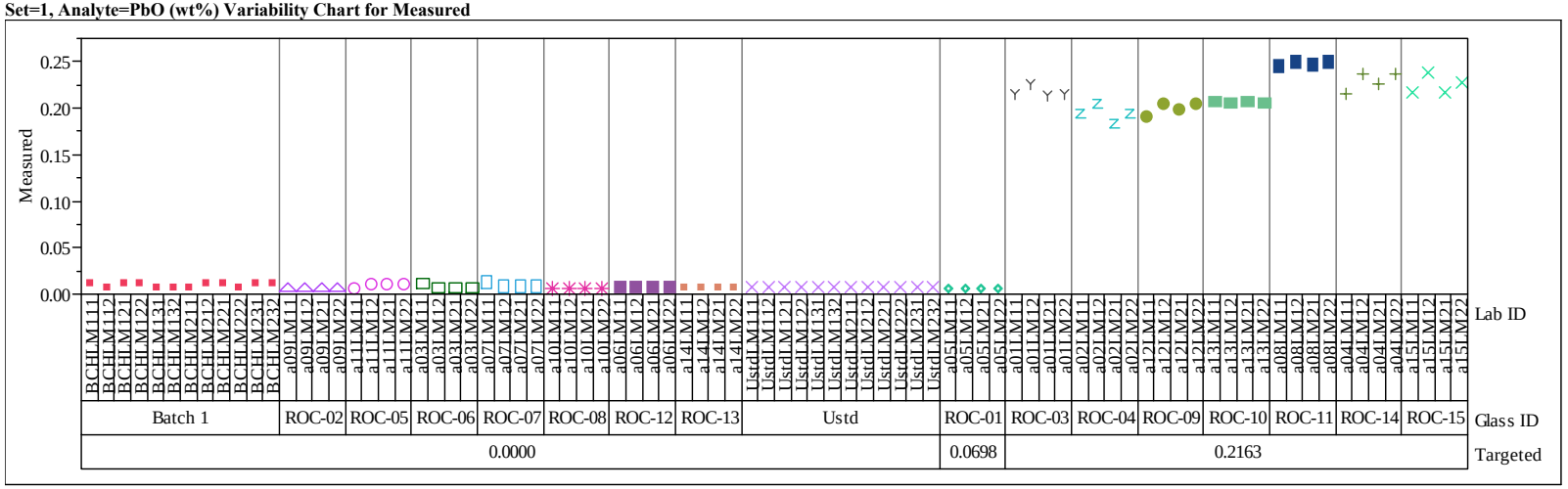


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=PbO (wt%) Variability Chart for Measured



Set=1, Analyte=PbO (wt%) Variability Chart for Measured bc

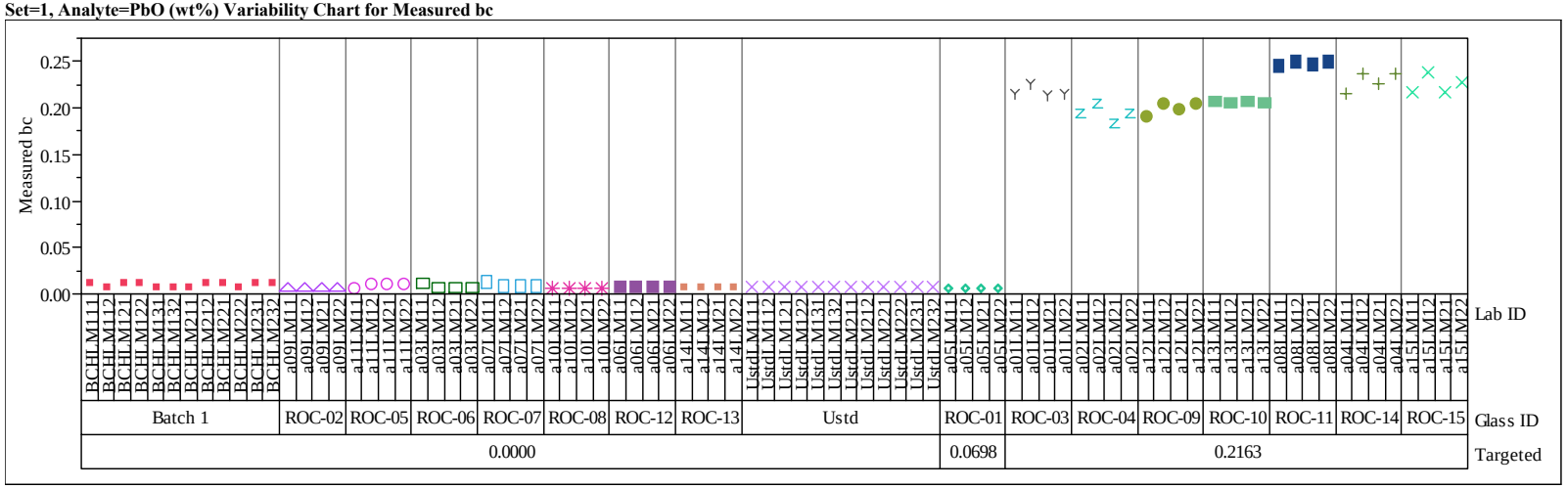
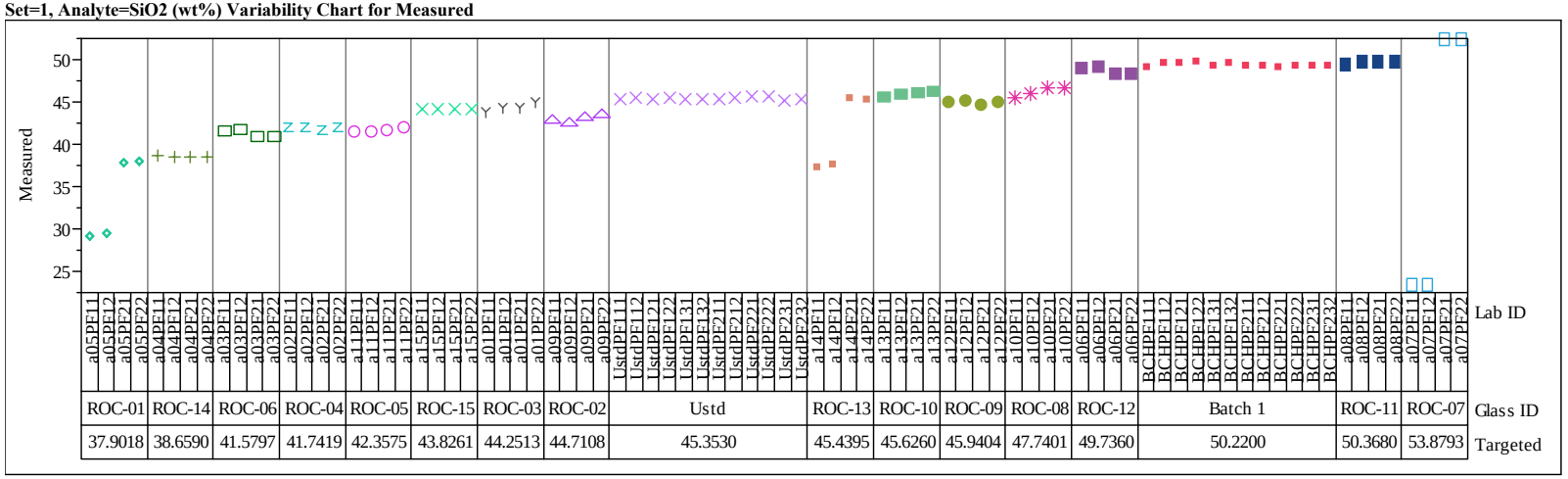


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=SiO2 (wt%) Variability Chart for Measured



Set=1, Analyte=SiO2 (wt%) Variability Chart for Measured bc

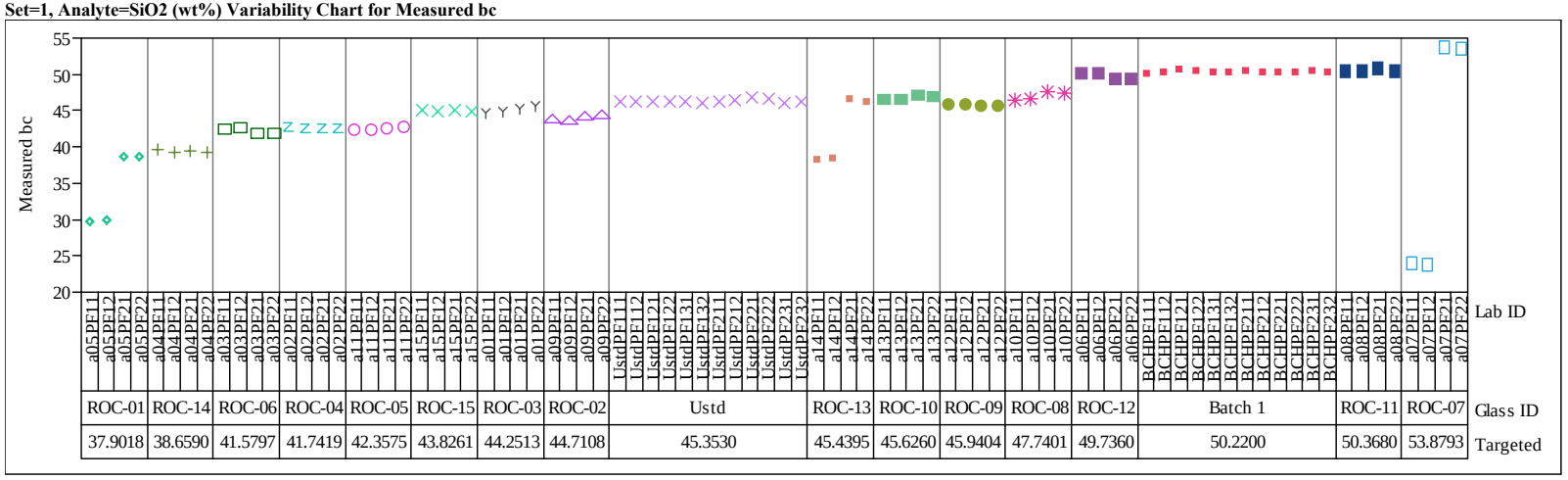
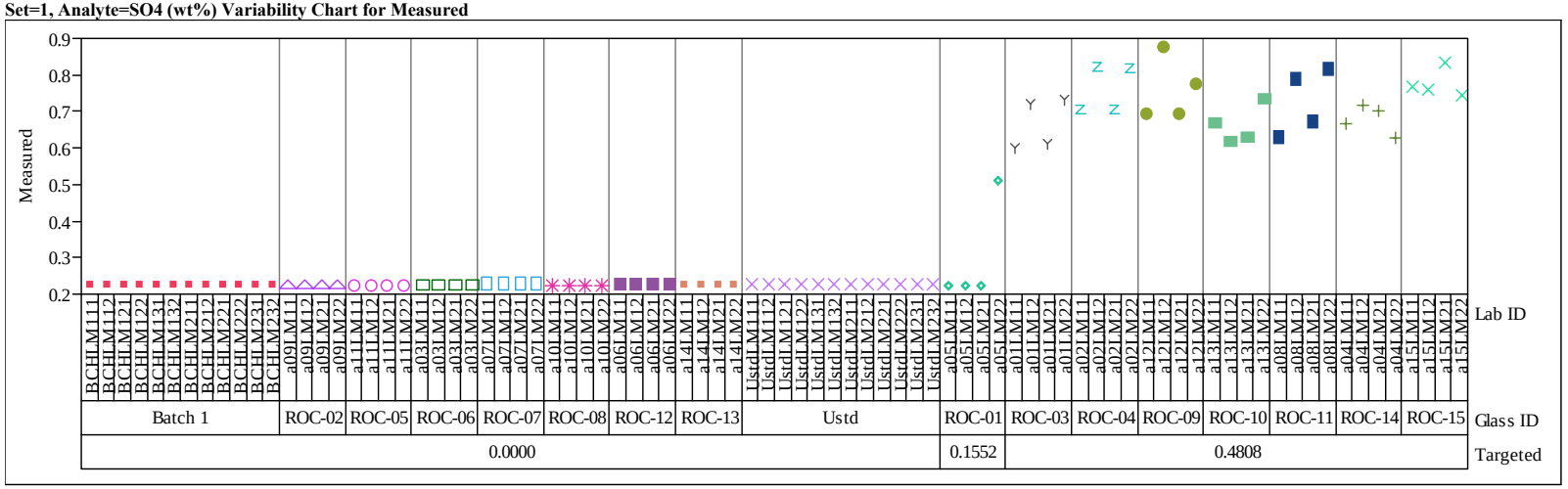


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=SO4 (wt%) Variability Chart for Measured



Set=1, Analyte=SO4 (wt%) Variability Chart for Measured bc

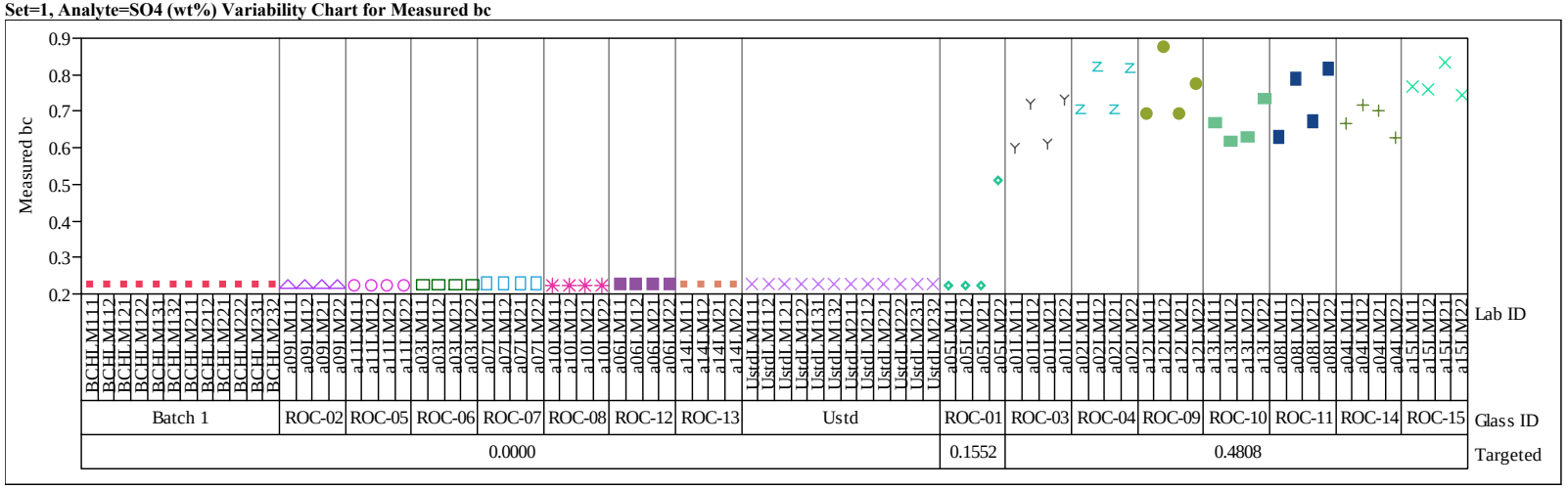
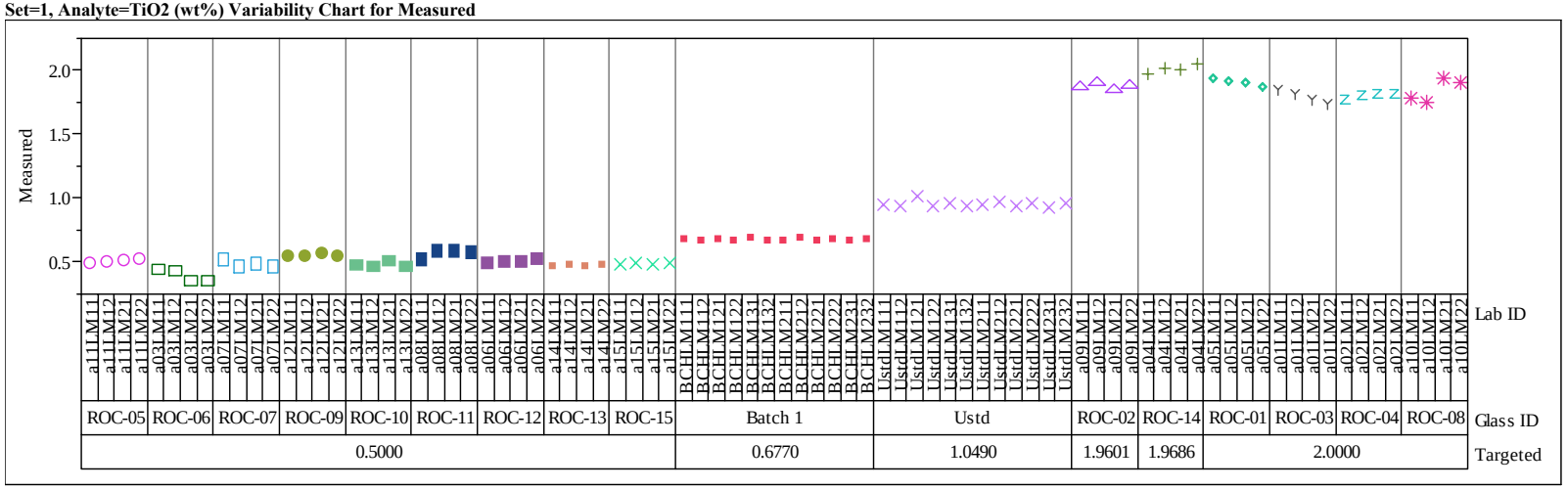


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=TiO2 (wt%) Variability Chart for Measured



Set=1, Analyte=TiO2 (wt%) Variability Chart for Measured bc

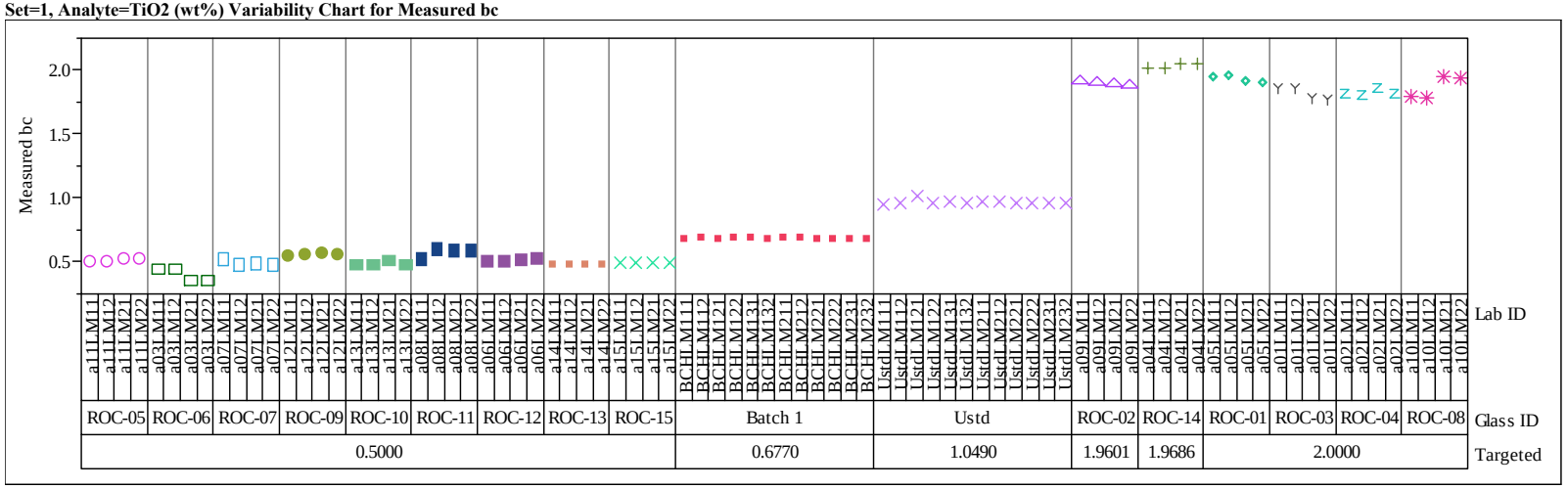
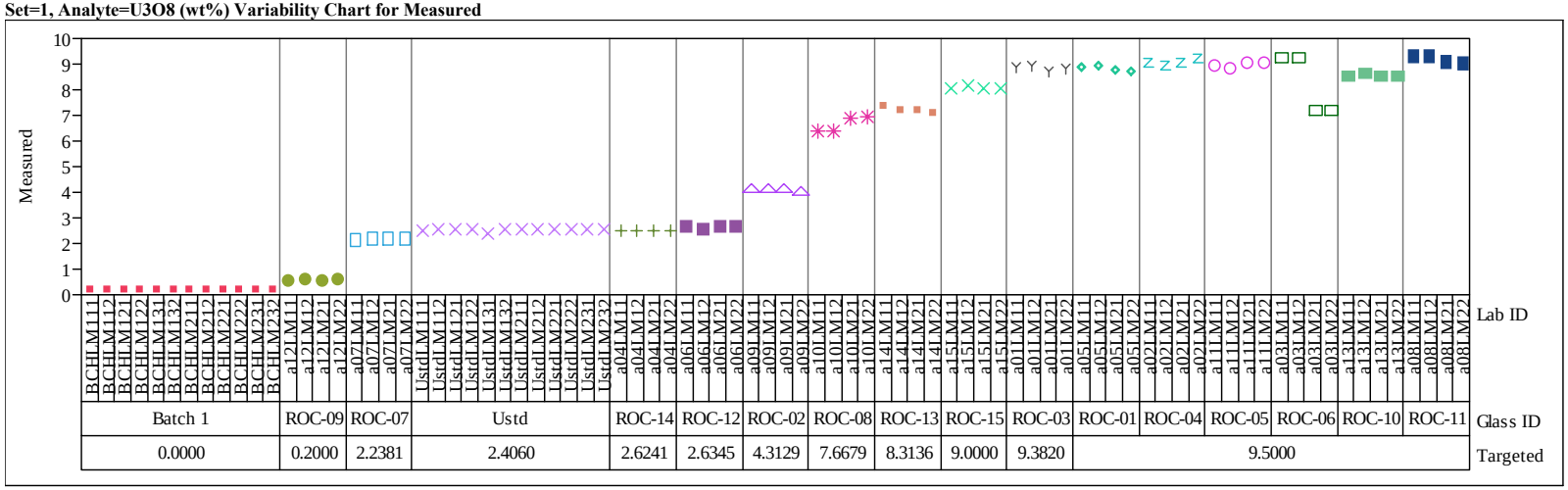


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=U3O8 (wt%) Variability Chart for Measured



Set=1, Analyte=U3O8 (wt%) Variability Chart for Measured bc

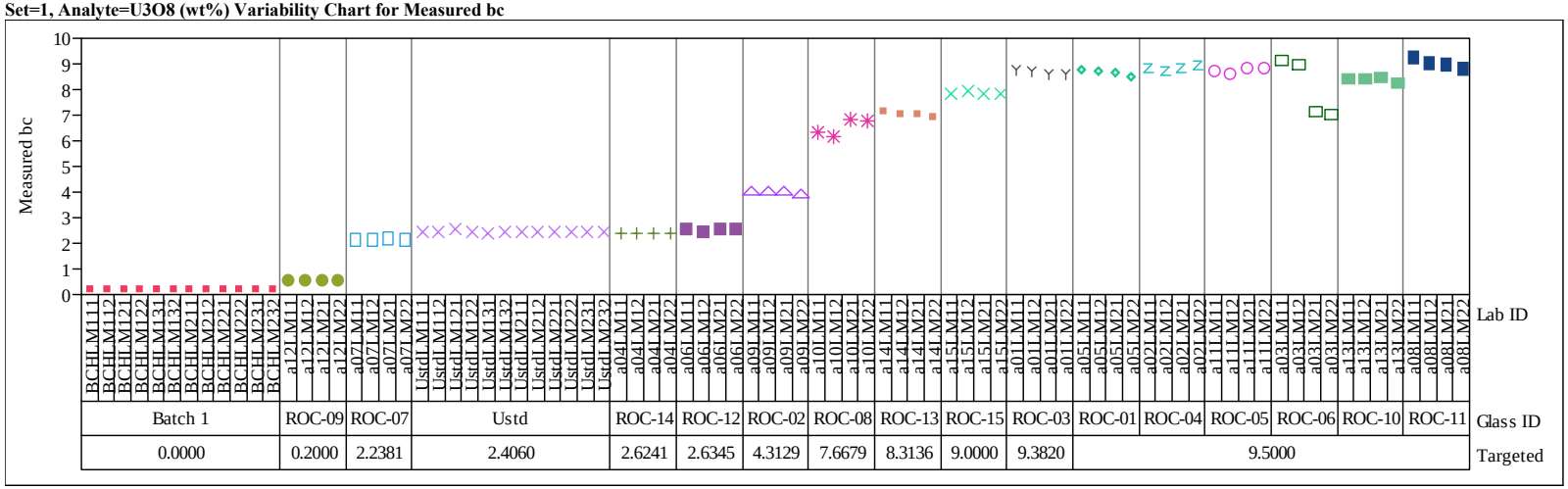
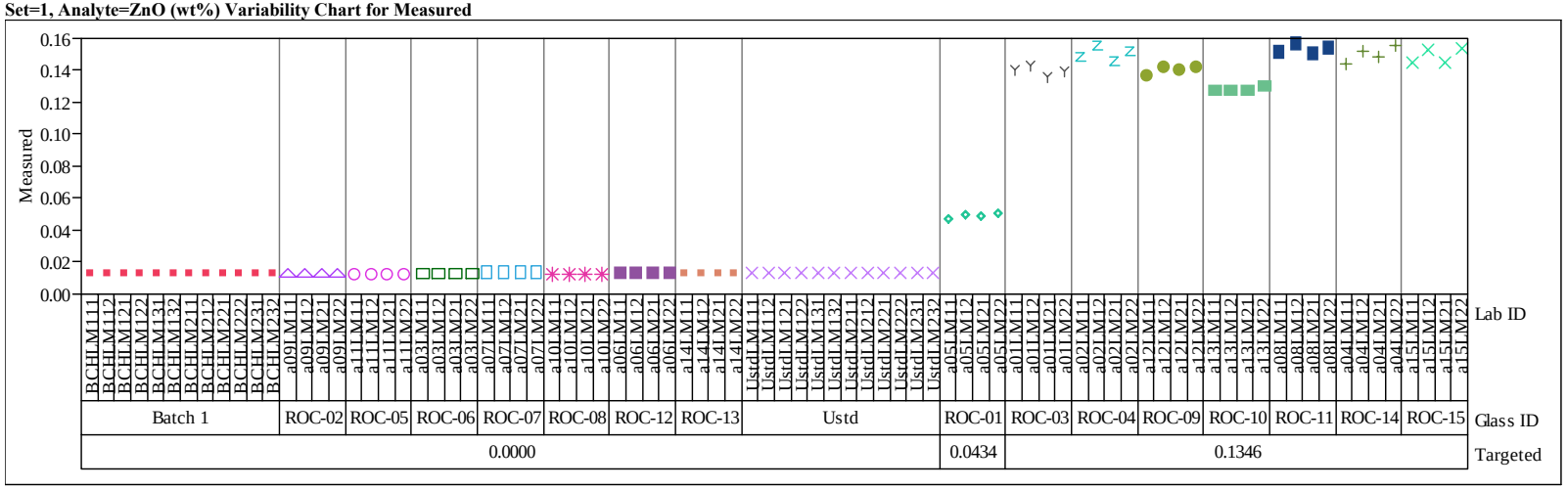


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=ZnO (wt%) Variability Chart for Measured



Set=1, Analyte=ZnO (wt%) Variability Chart for Measured bc

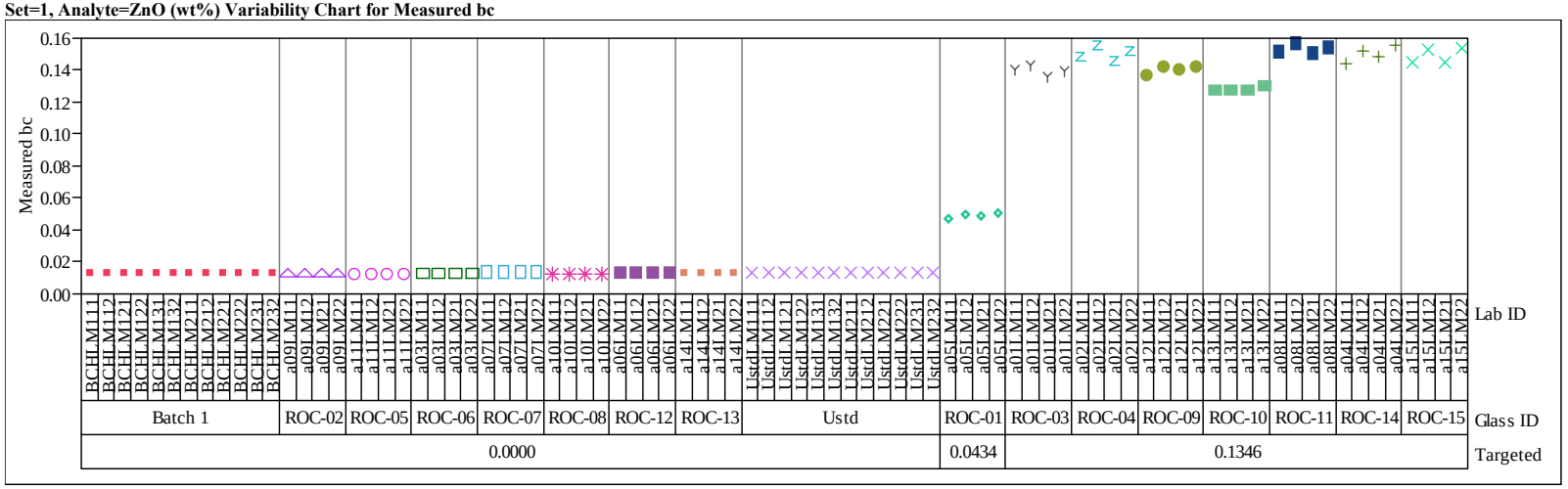
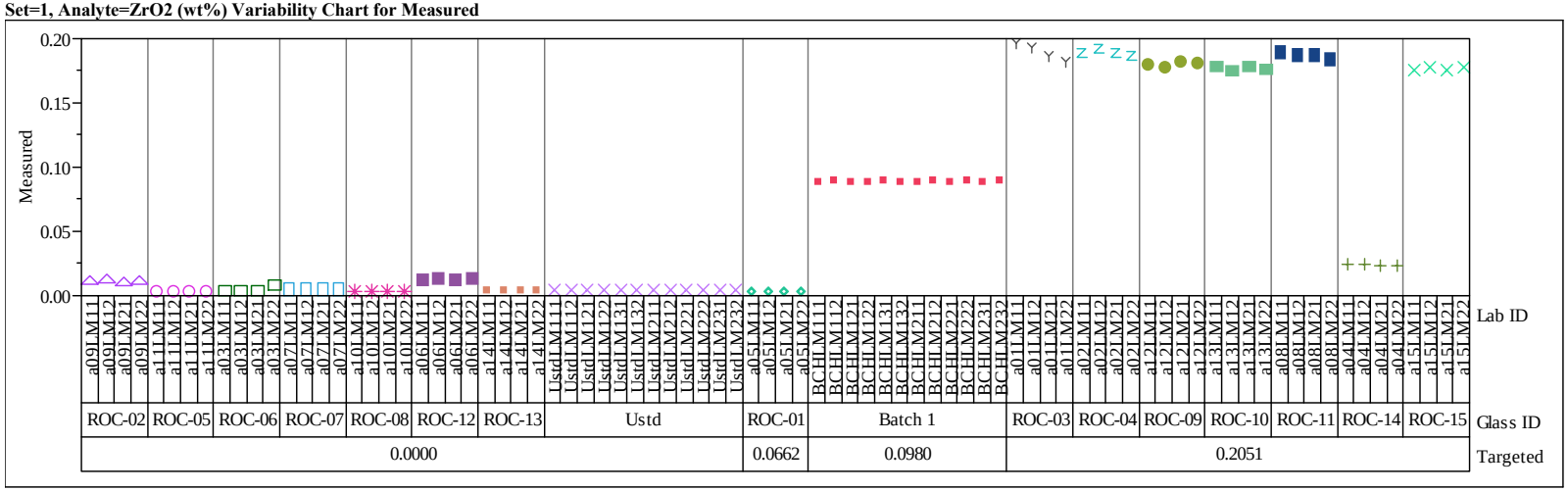


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=1, Analyte=ZrO2 (wt%) Variability Chart for Measured



Set=1, Analyte=ZrO2 (wt%) Variability Chart for Measured bc

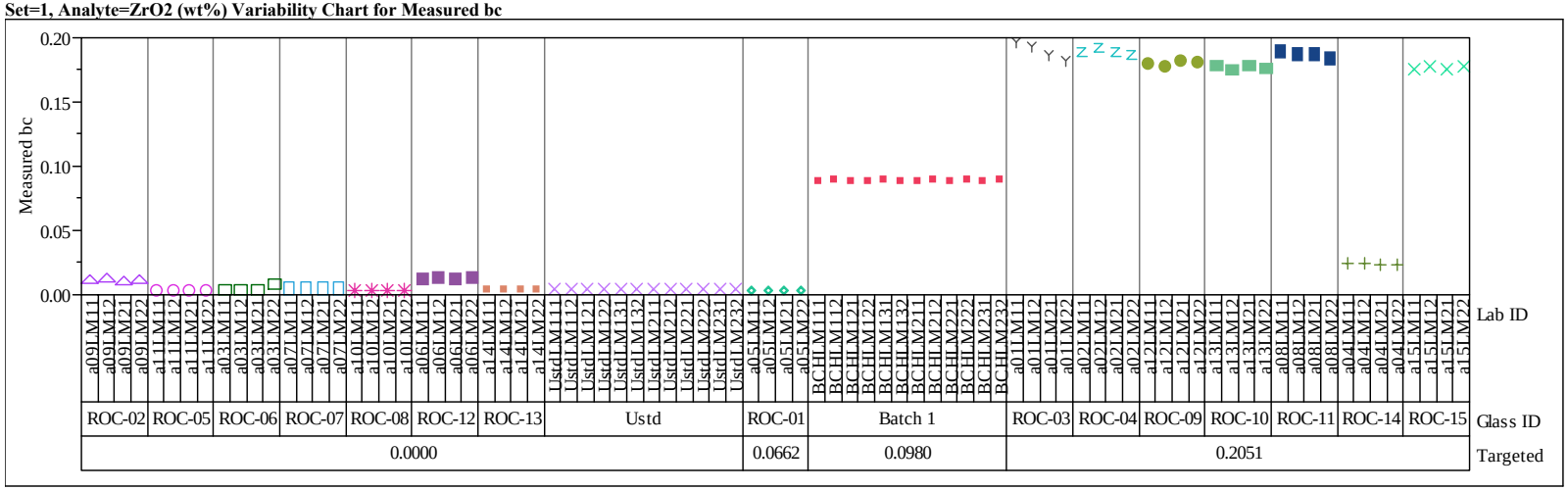
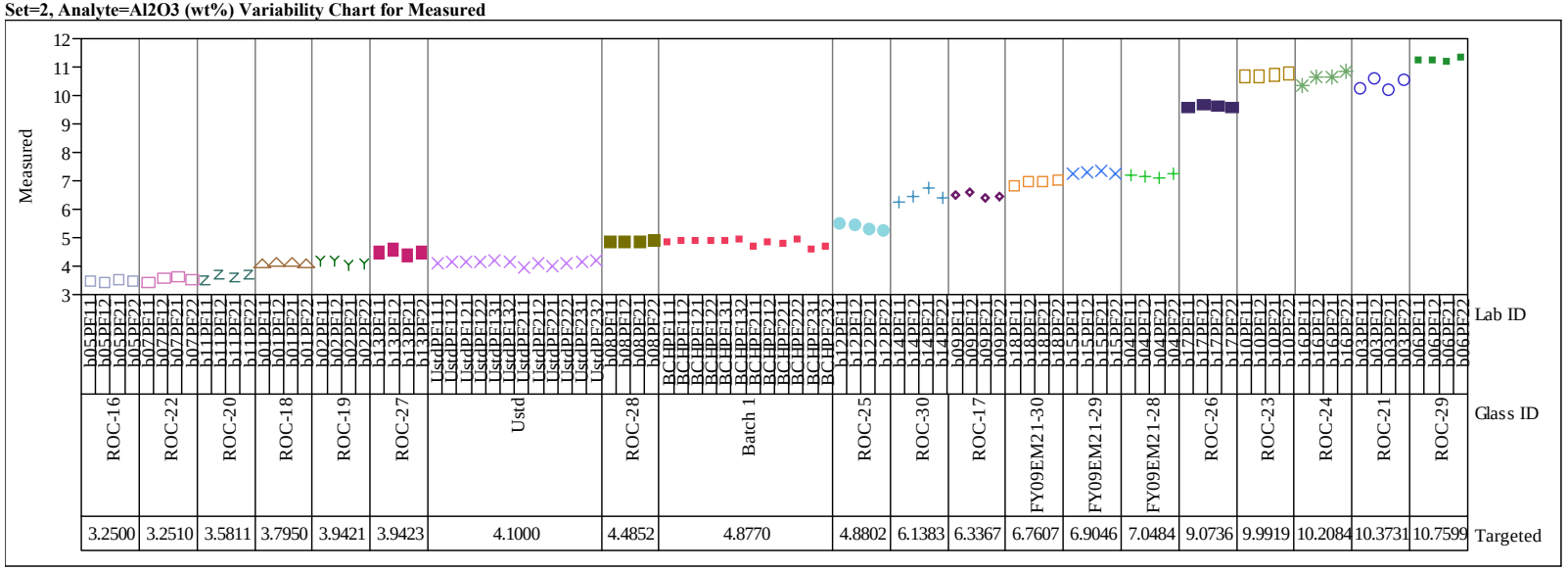


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Al2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=Al2O3 (wt%) Variability Chart for Measured bc

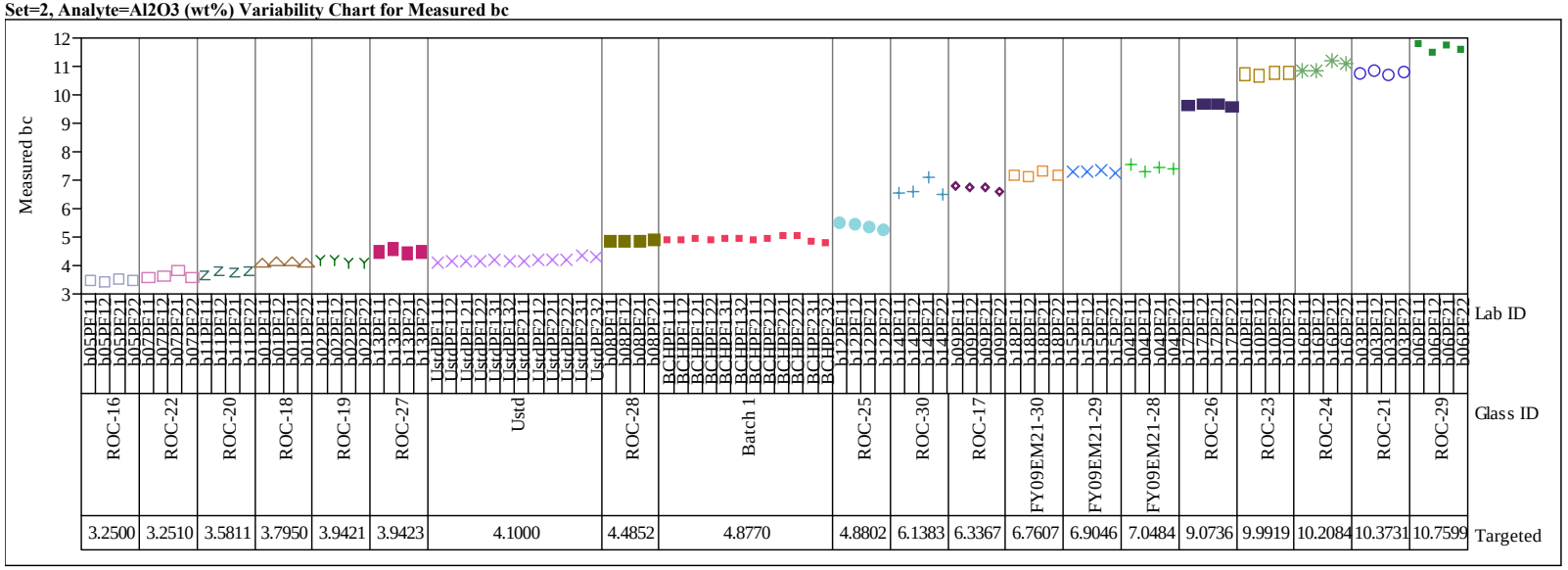
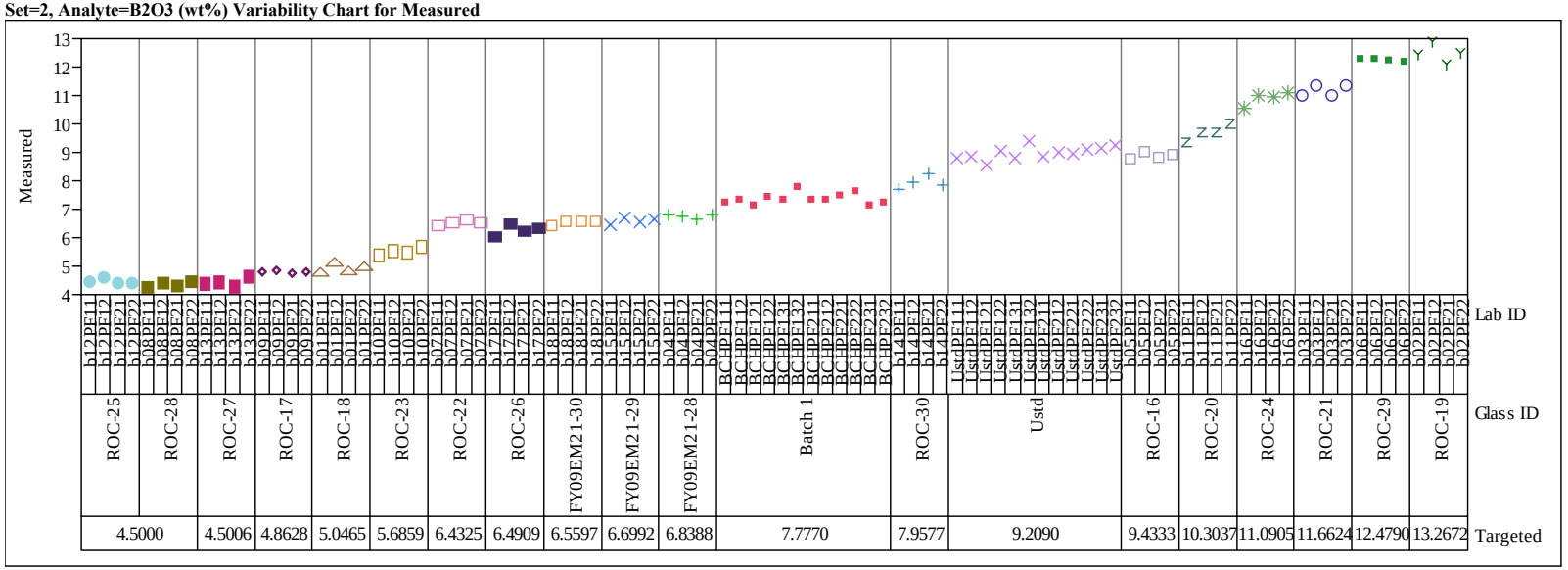


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=B2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=B2O3 (wt%) Variability Chart for Measured bc

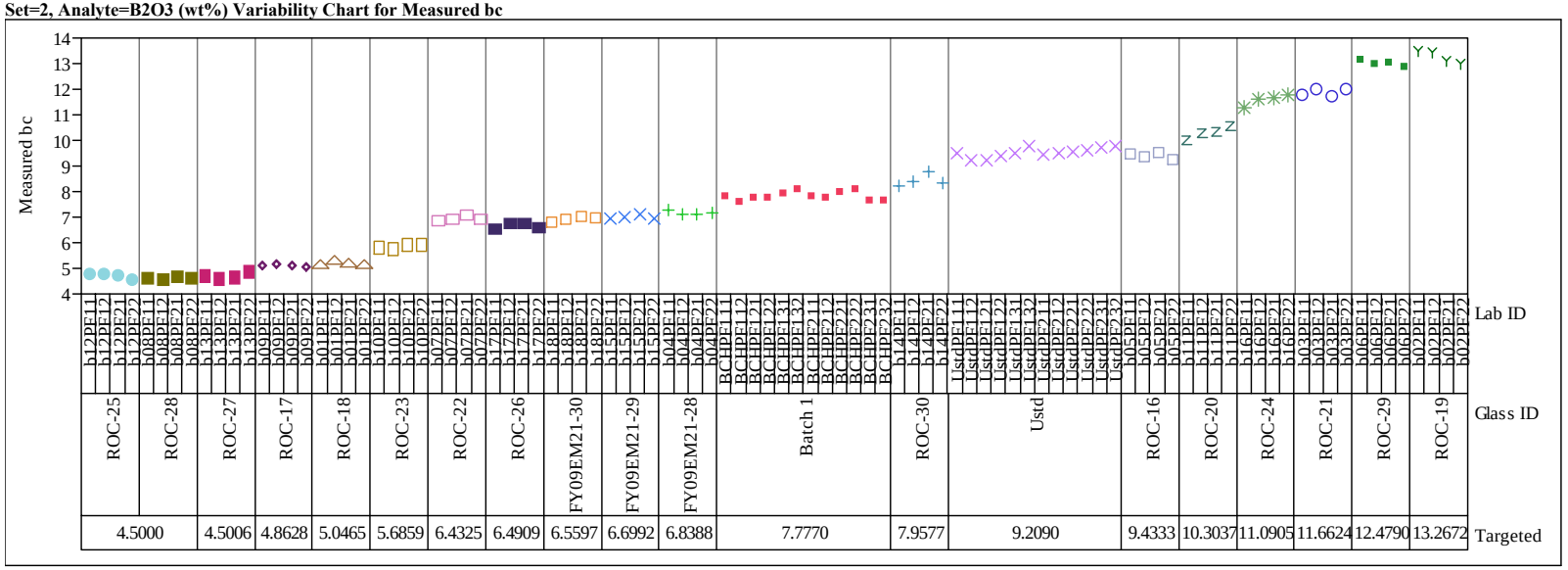
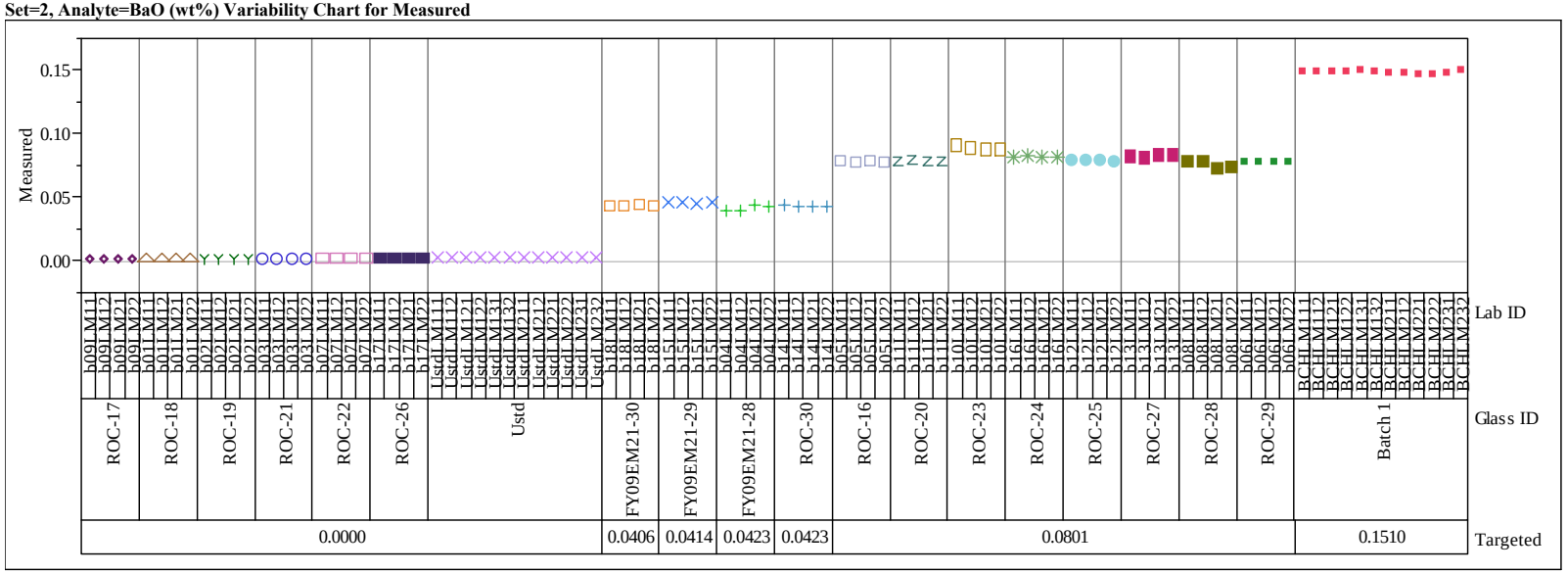


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=BaO (wt%) Variability Chart for Measured



Set=2, Analyte=BaO (wt%) Variability Chart for Measured bc

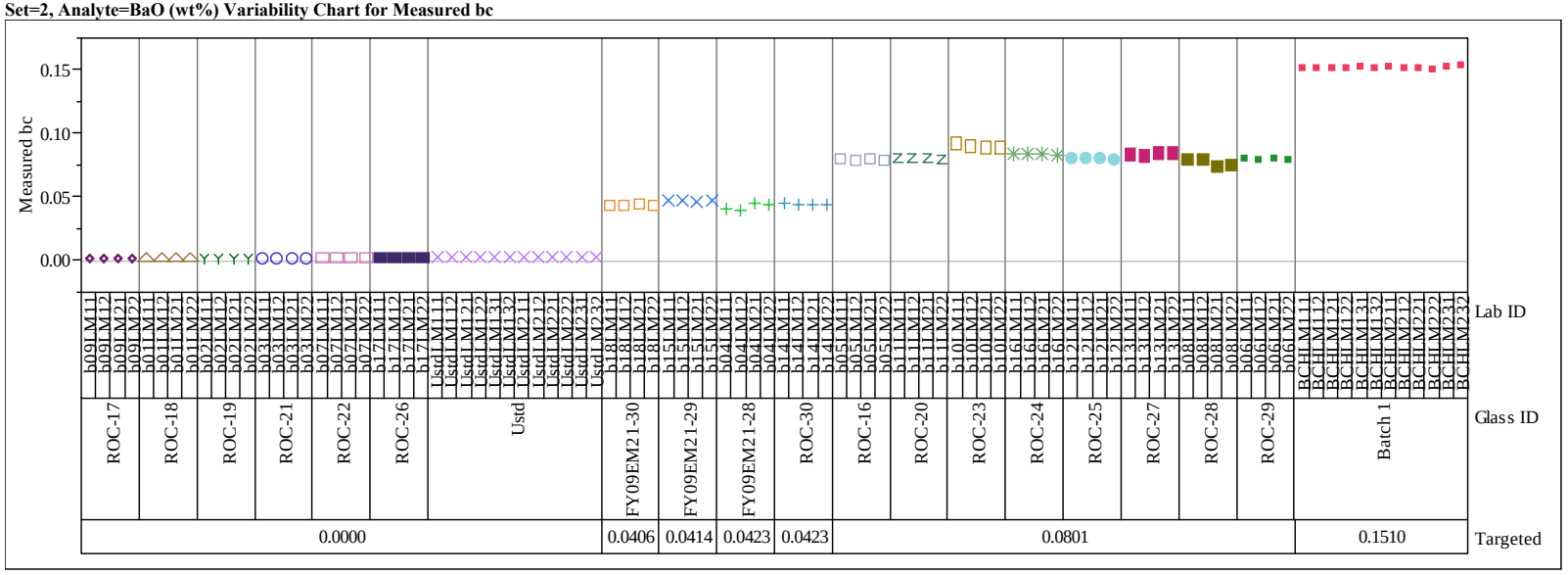
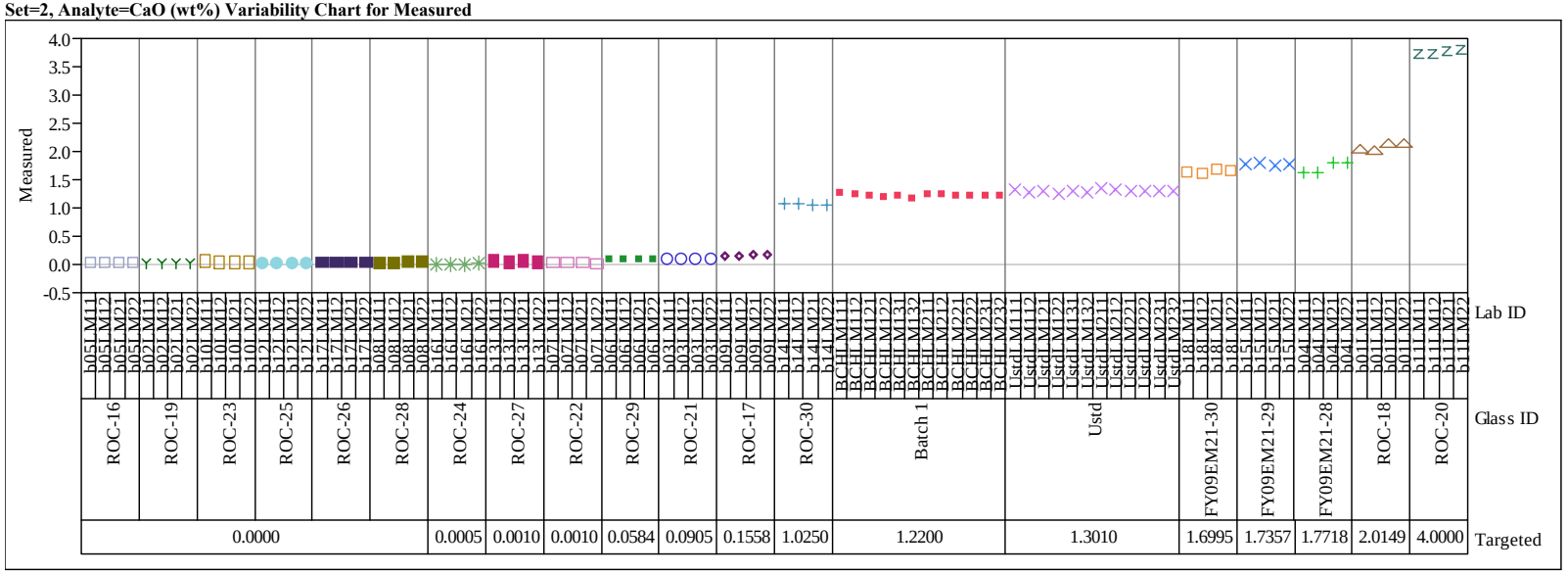


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=CaO (wt%) Variability Chart for Measured



Set=2, Analyte=CaO (wt%) Variability Chart for Measured bc

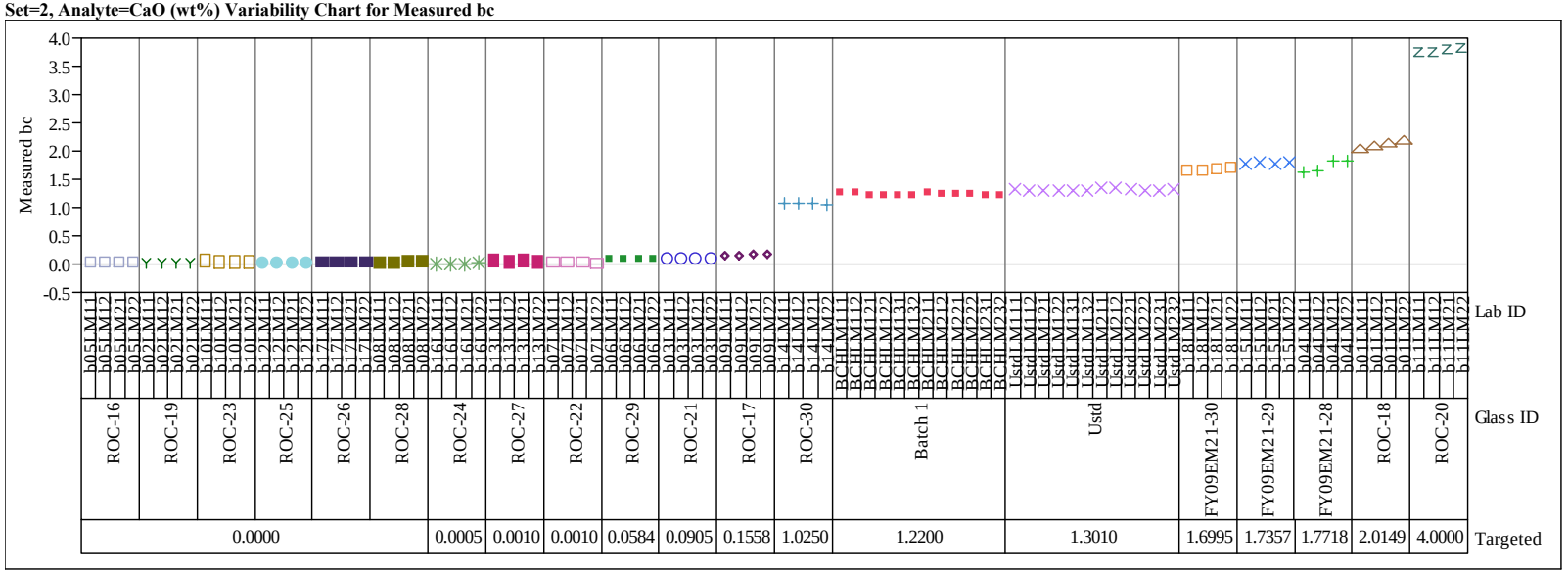
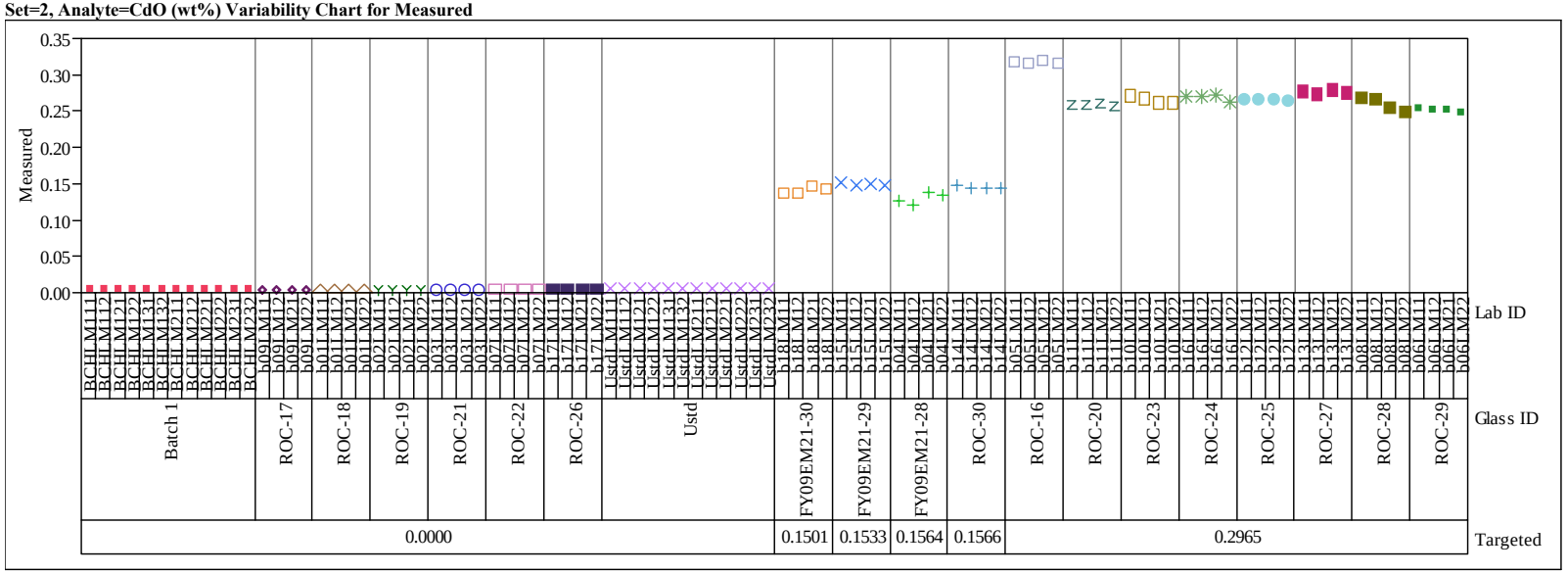


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=CdO (wt%) Variability Chart for Measured



Set=2, Analyte=CdO (wt%) Variability Chart for Measured bc

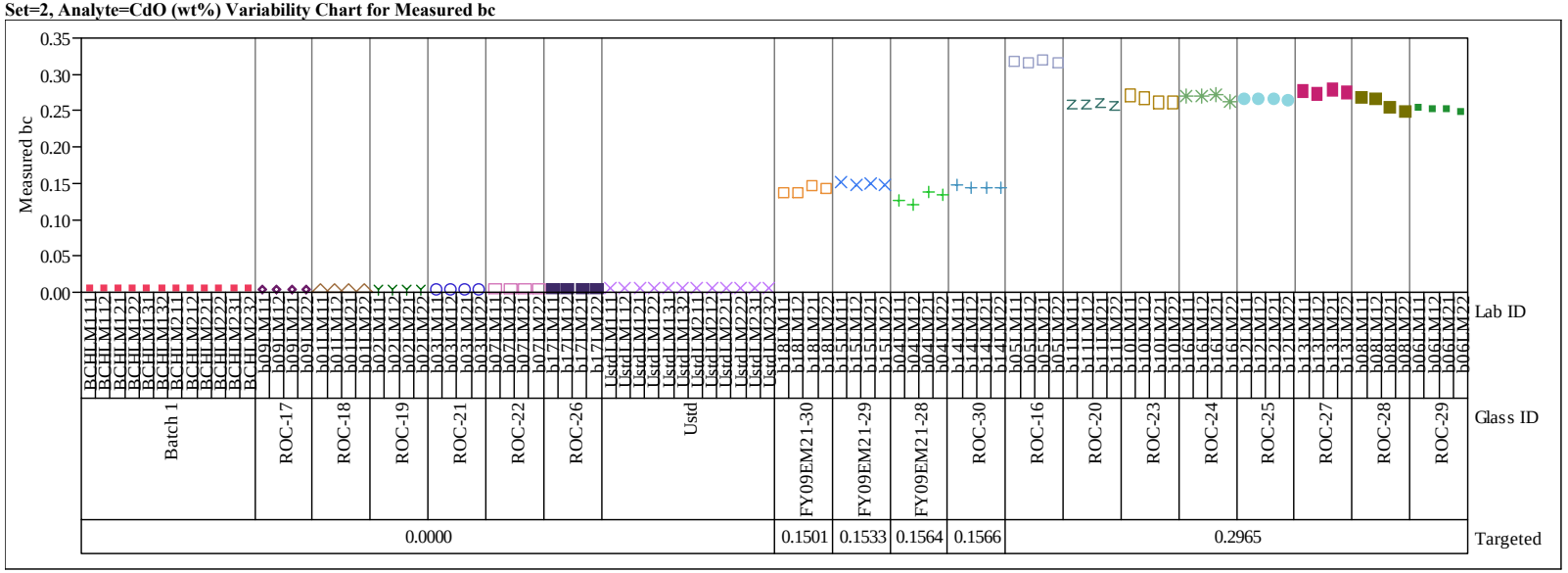
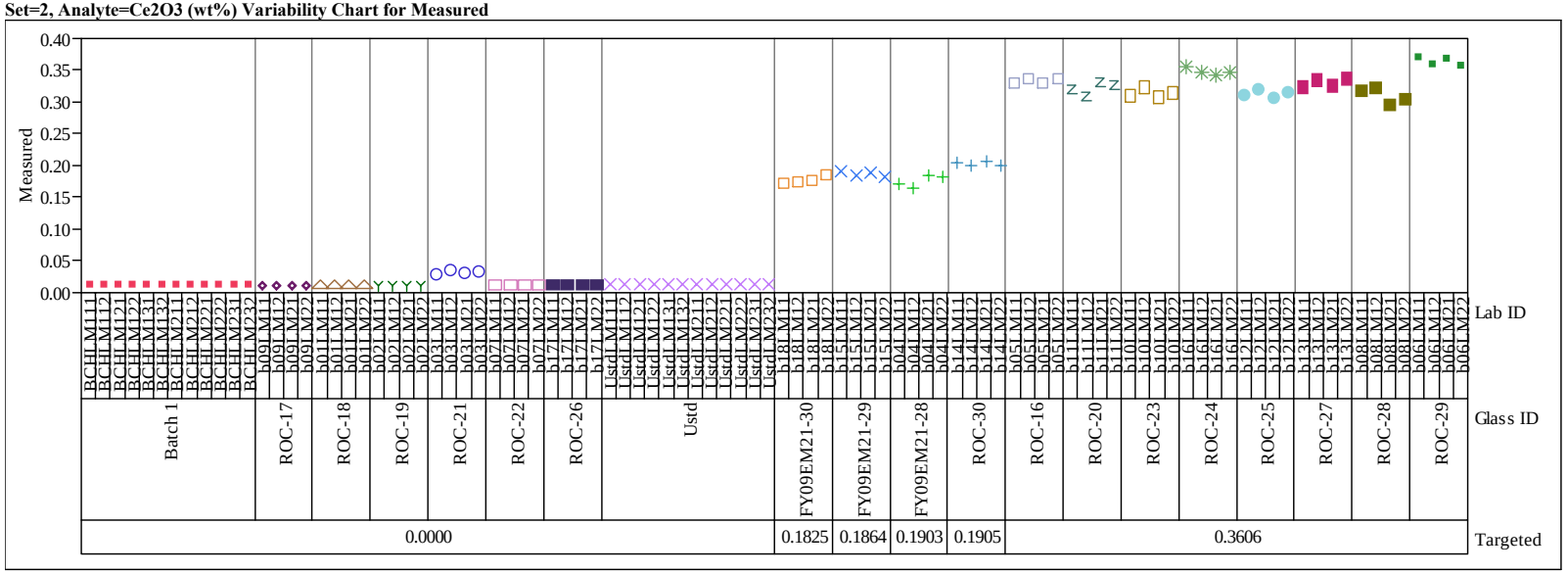


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Ce2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=Ce2O3 (wt%) Variability Chart for Measured bc

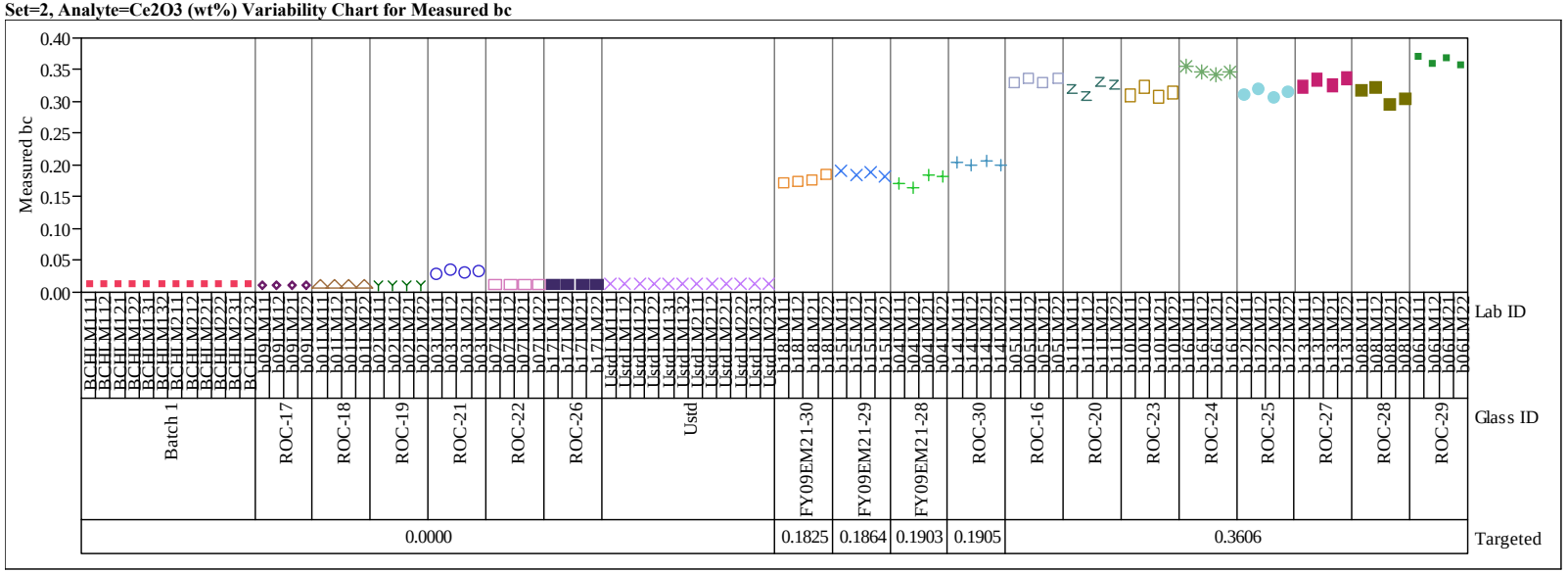
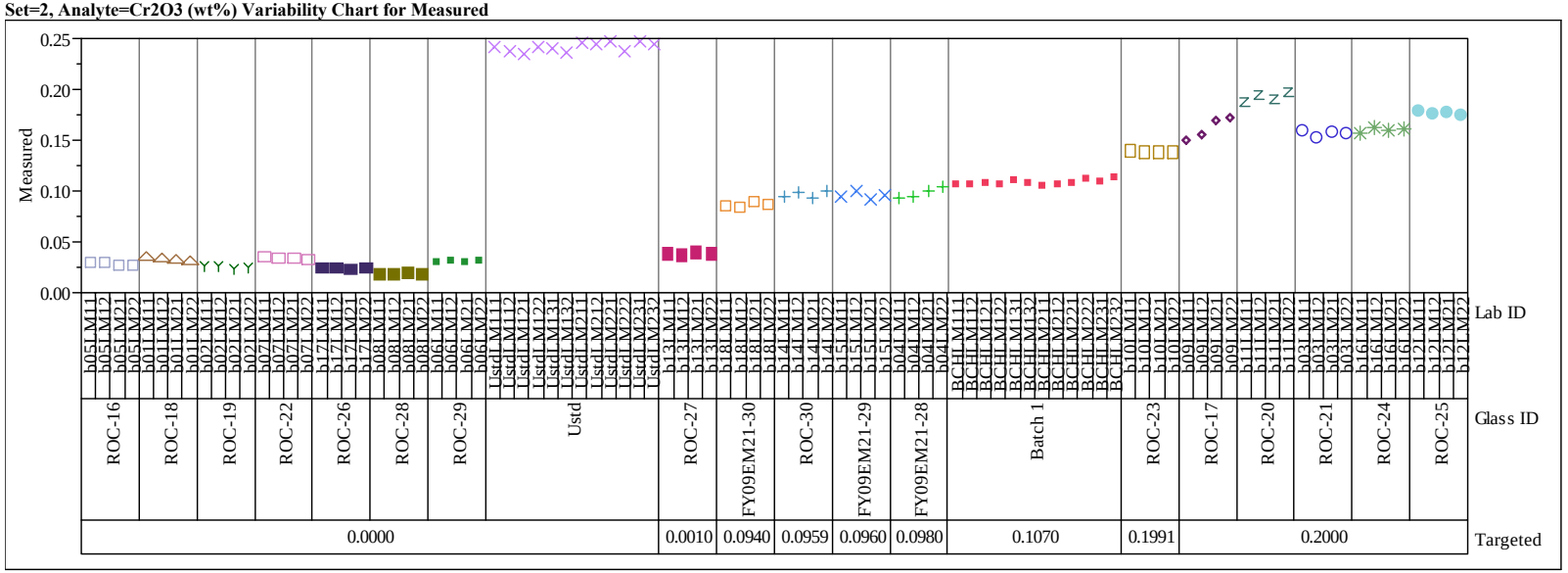


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Cr2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=Cr2O3 (wt%) Variability Chart for Measured bc

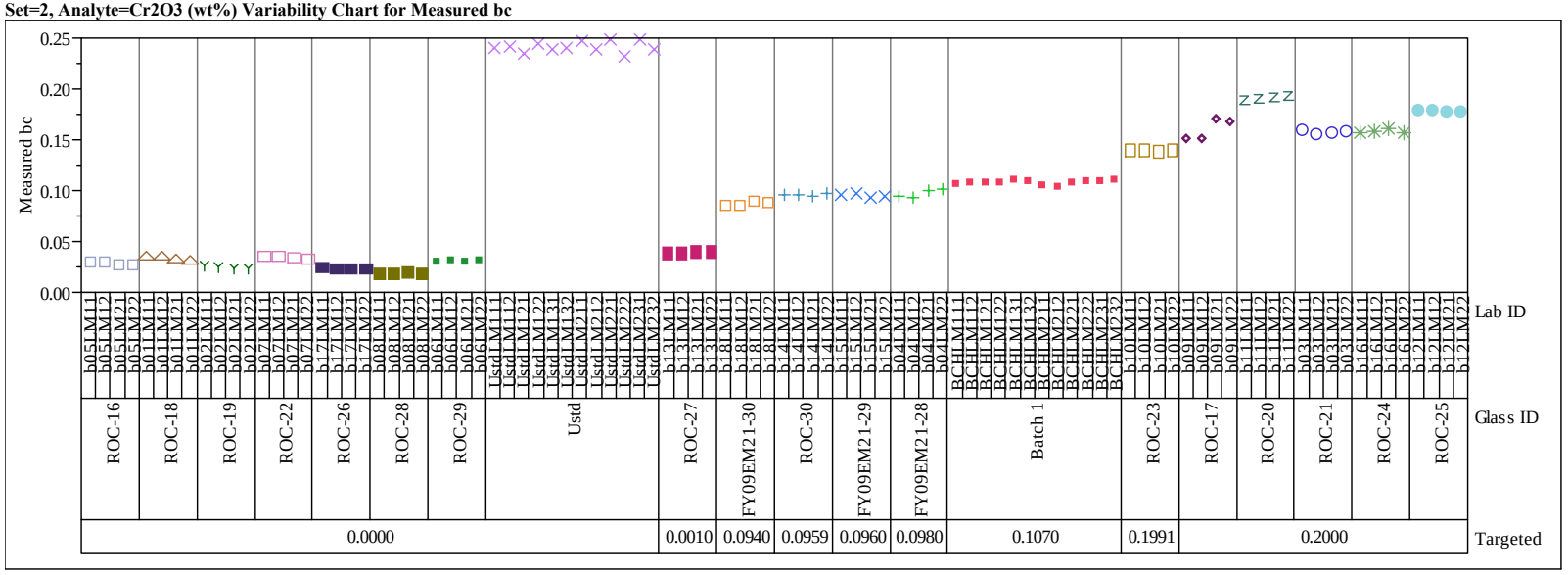
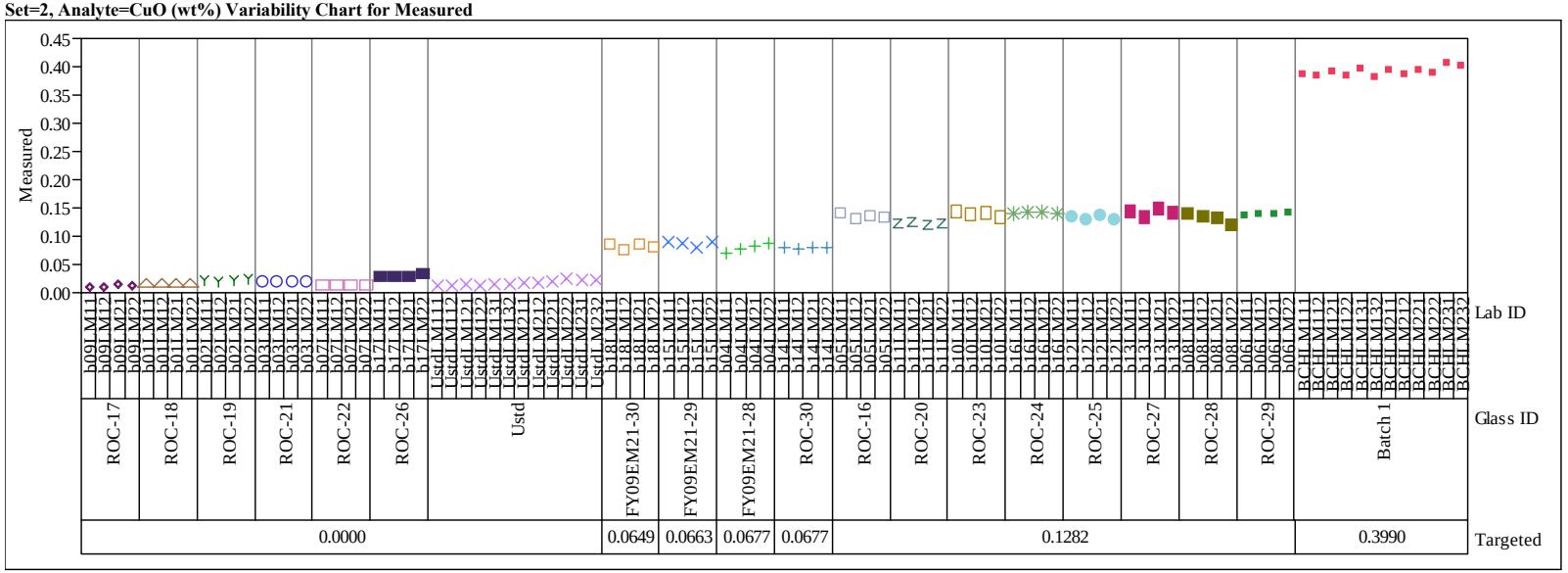


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=CuO (wt%) Variability Chart for Measured



Set=2, Analyte=CuO (wt%) Variability Chart for Measured bc

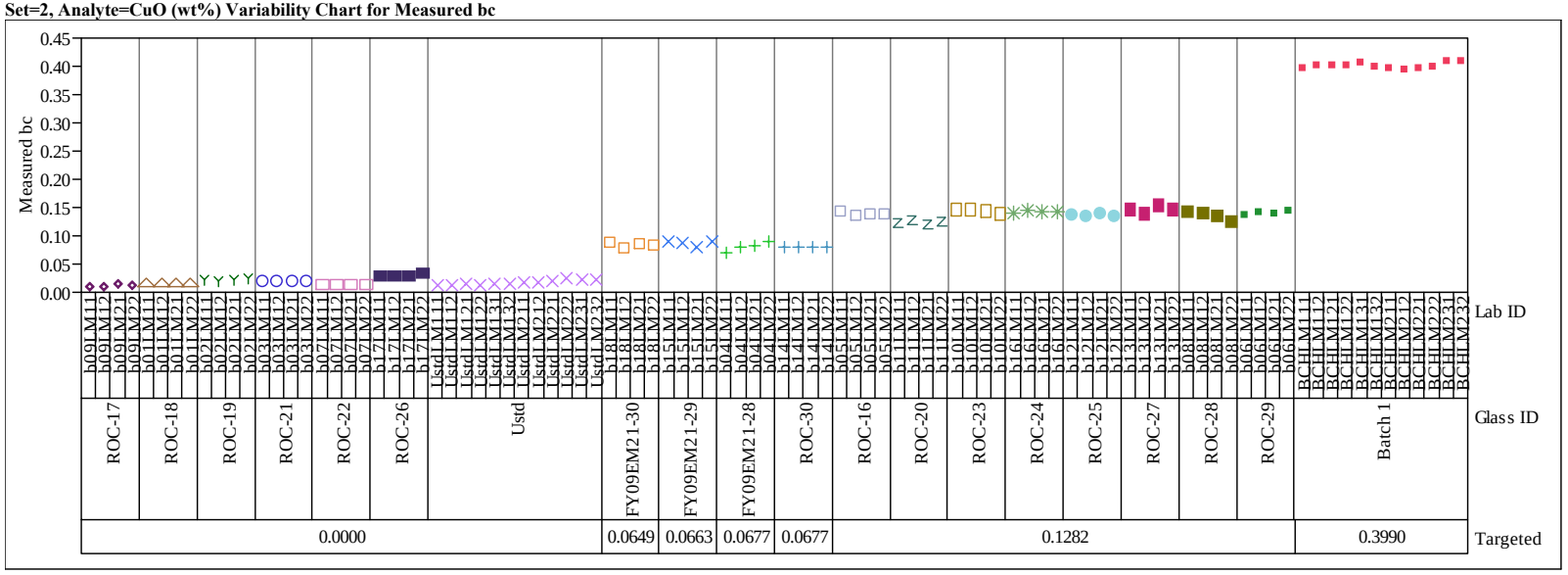
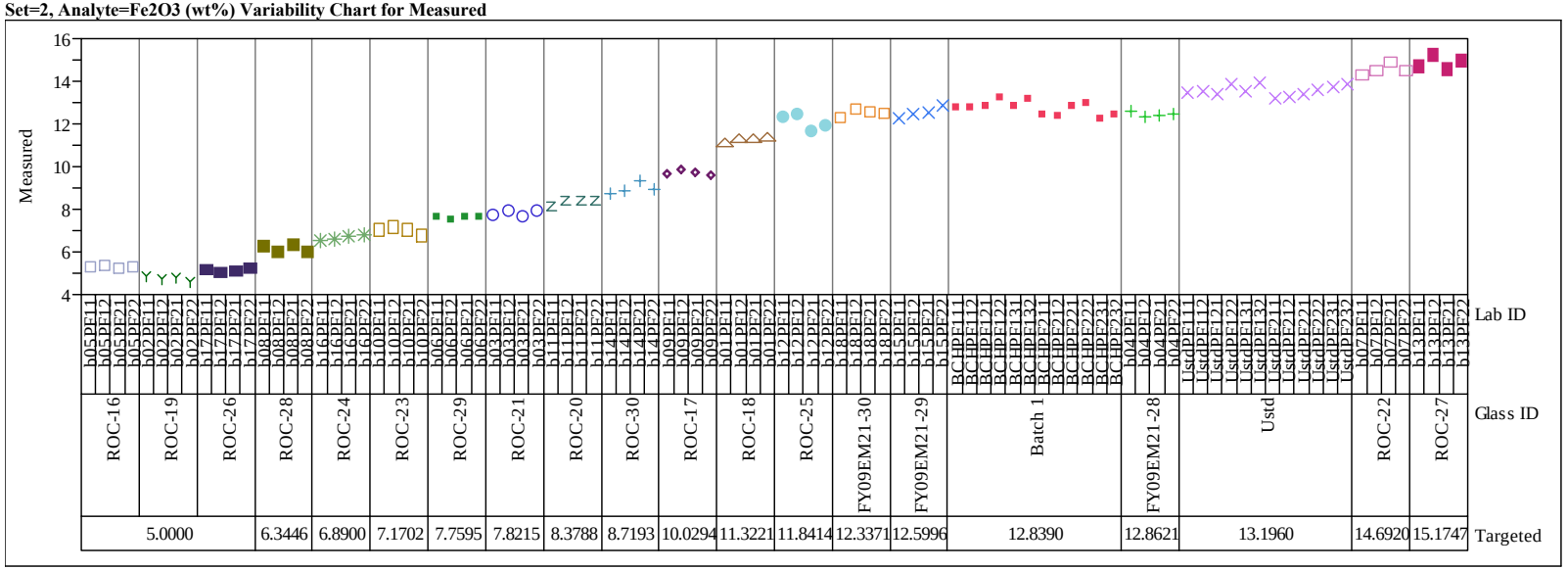


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Fe2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=Fe2O3 (wt%) Variability Chart for Measured bc

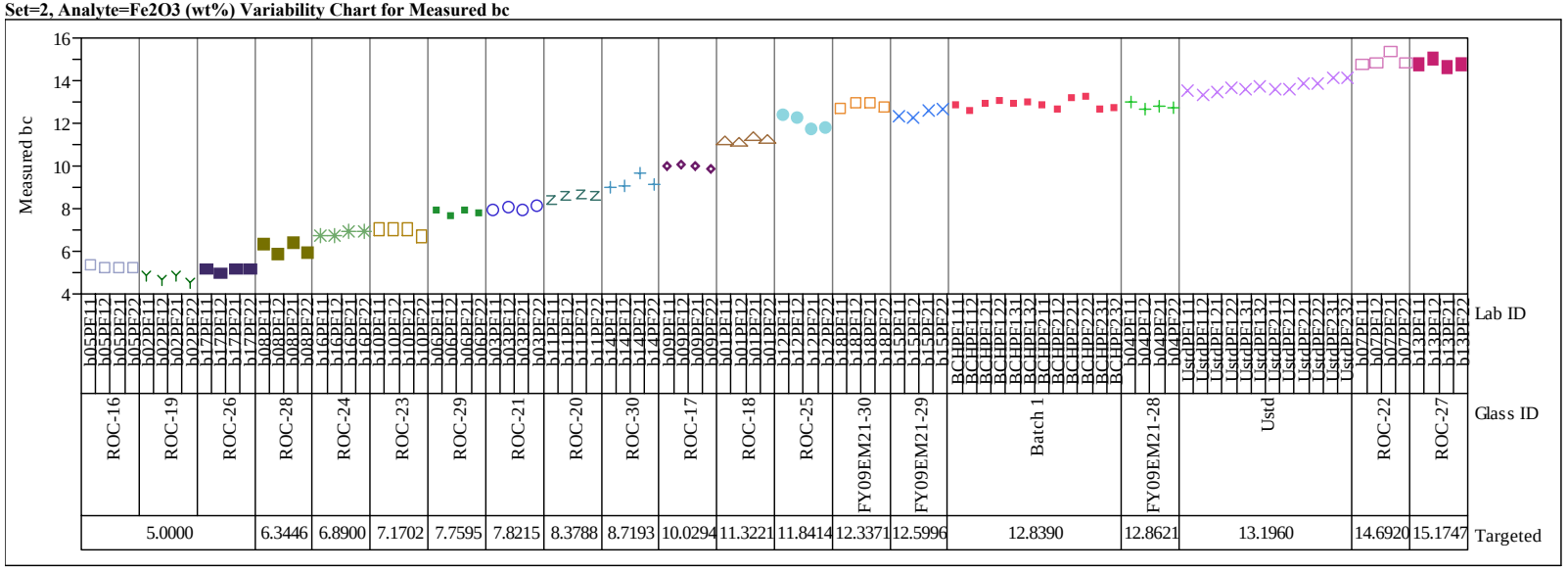
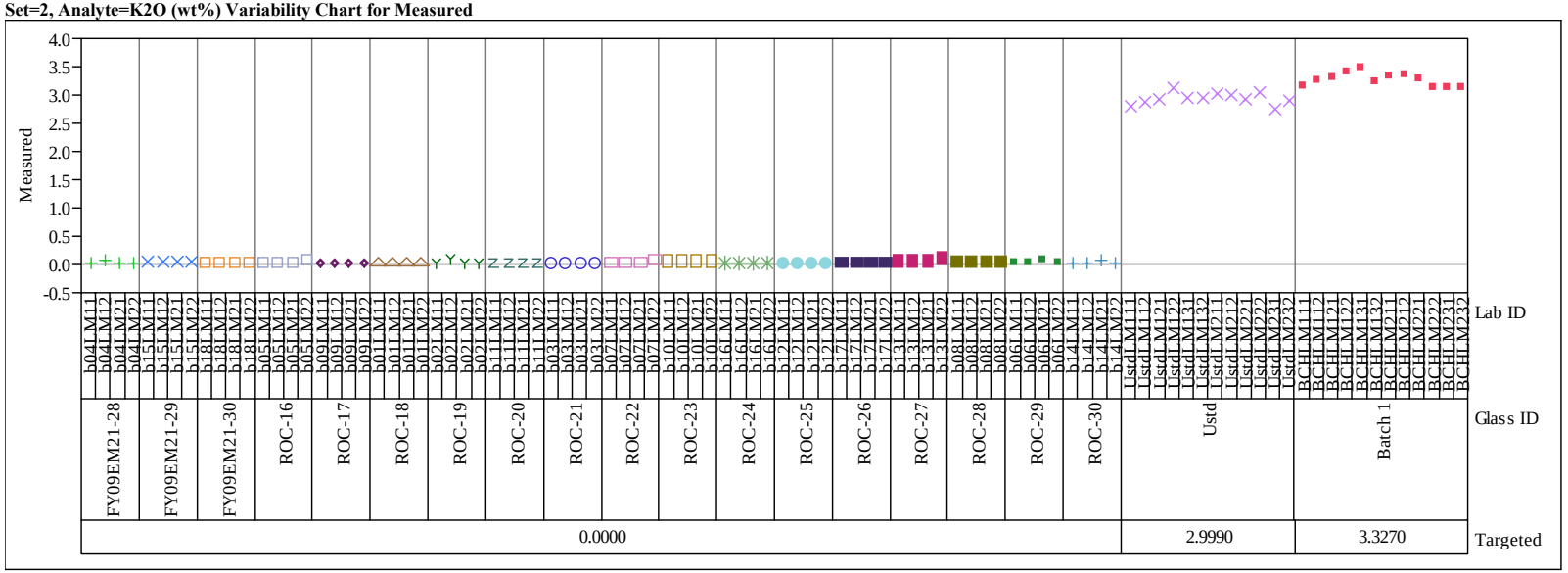


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=K2O (wt%) Variability Chart for Measured



Set=2, Analyte=K2O (wt%) Variability Chart for Measured bc

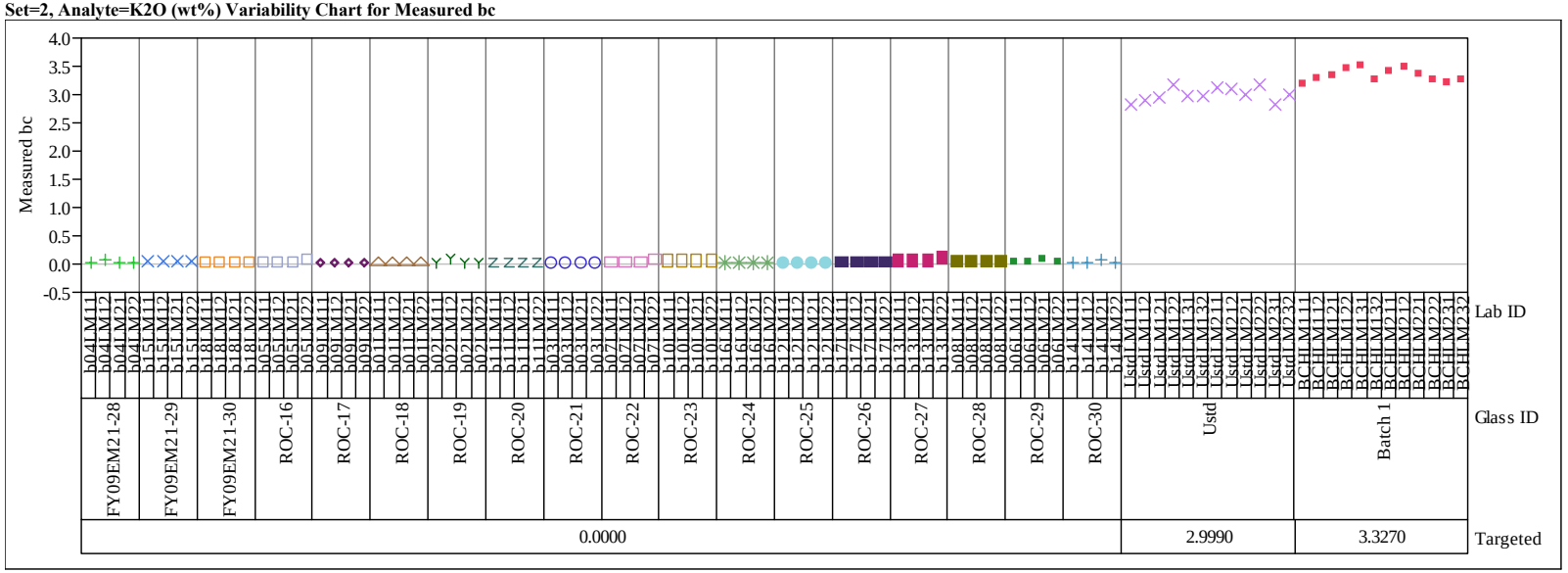
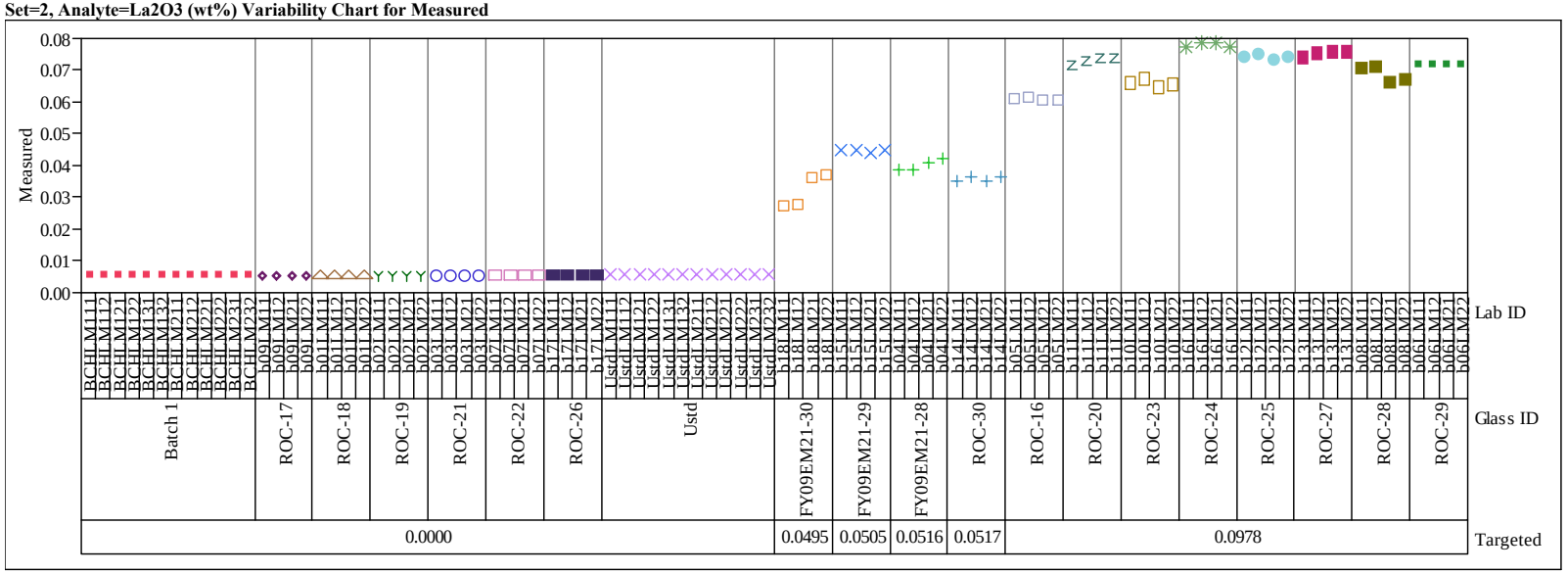


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=La2O3 (wt%) Variability Chart for Measured



Set=2, Analyte=La2O3 (wt%) Variability Chart for Measured bc

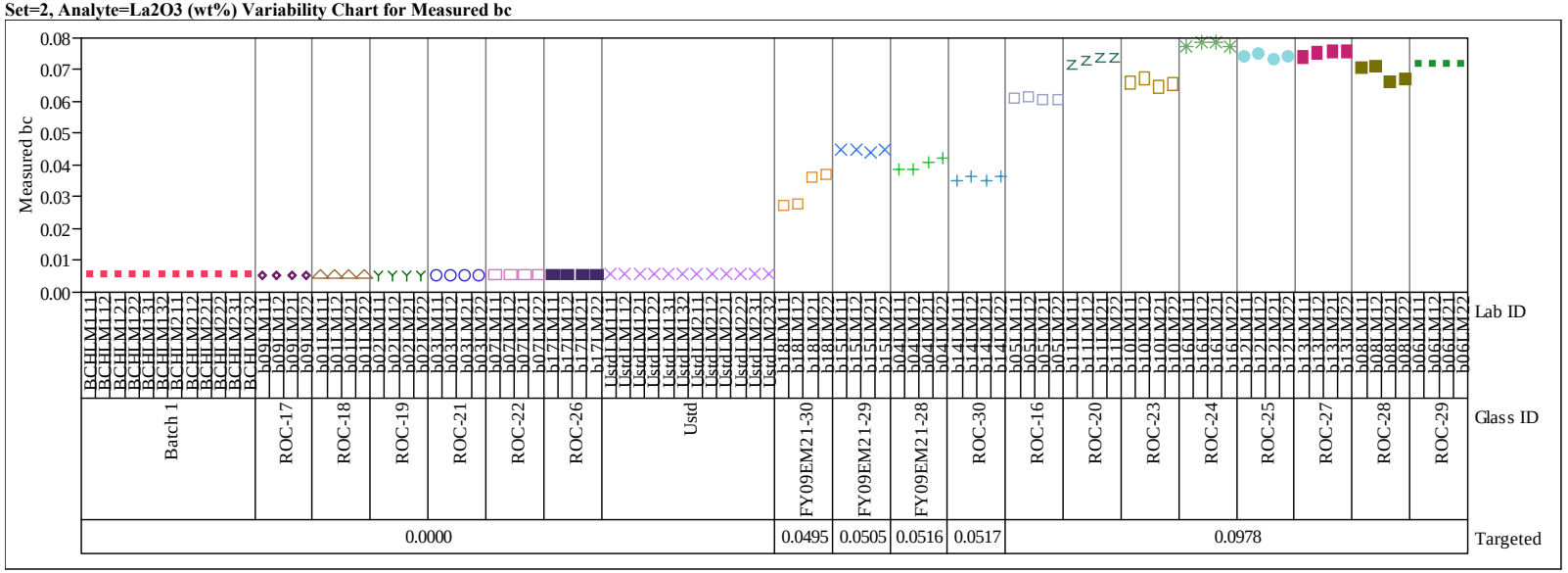
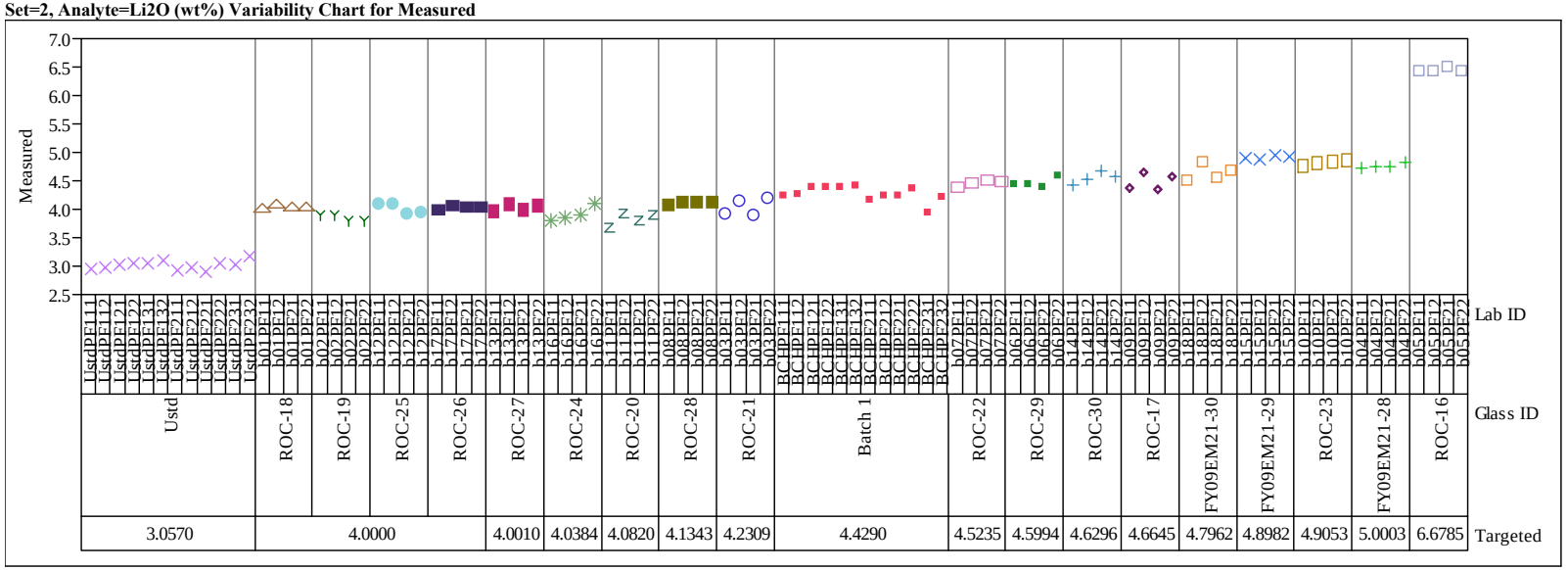


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Li2O (wt%) Variability Chart for Measured



Set=2, Analyte=Li2O (wt%) Variability Chart for Measured bc

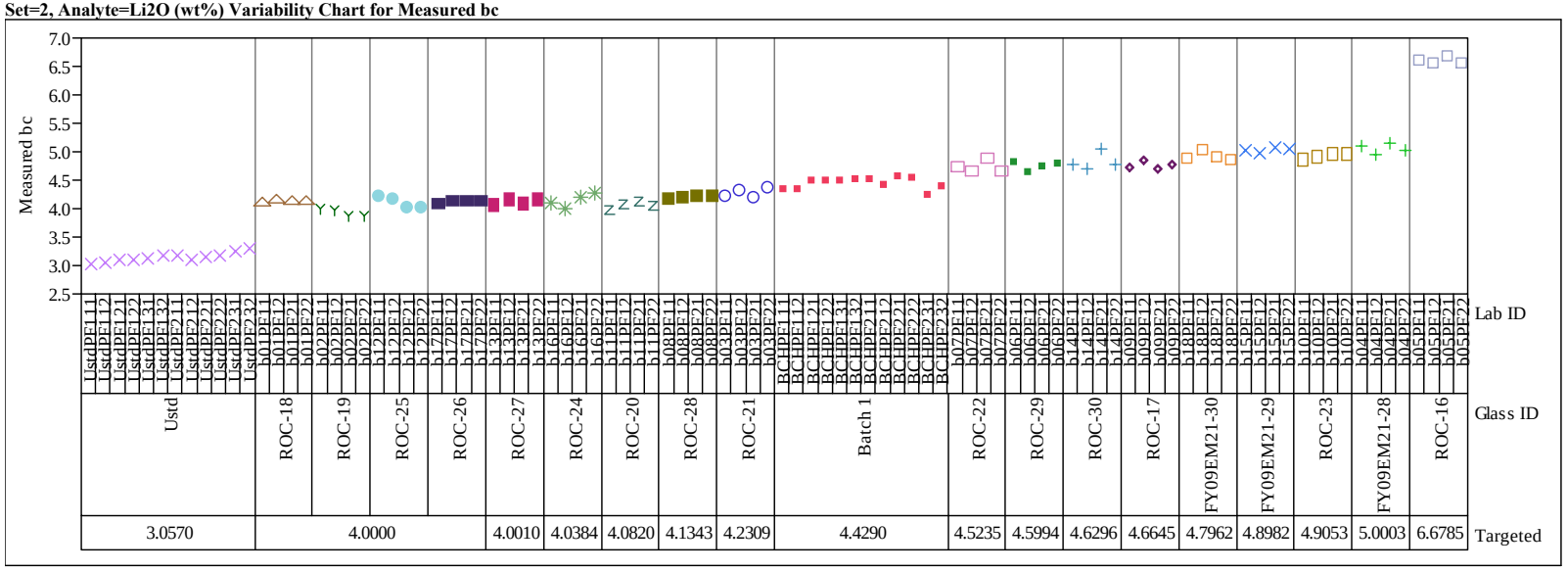
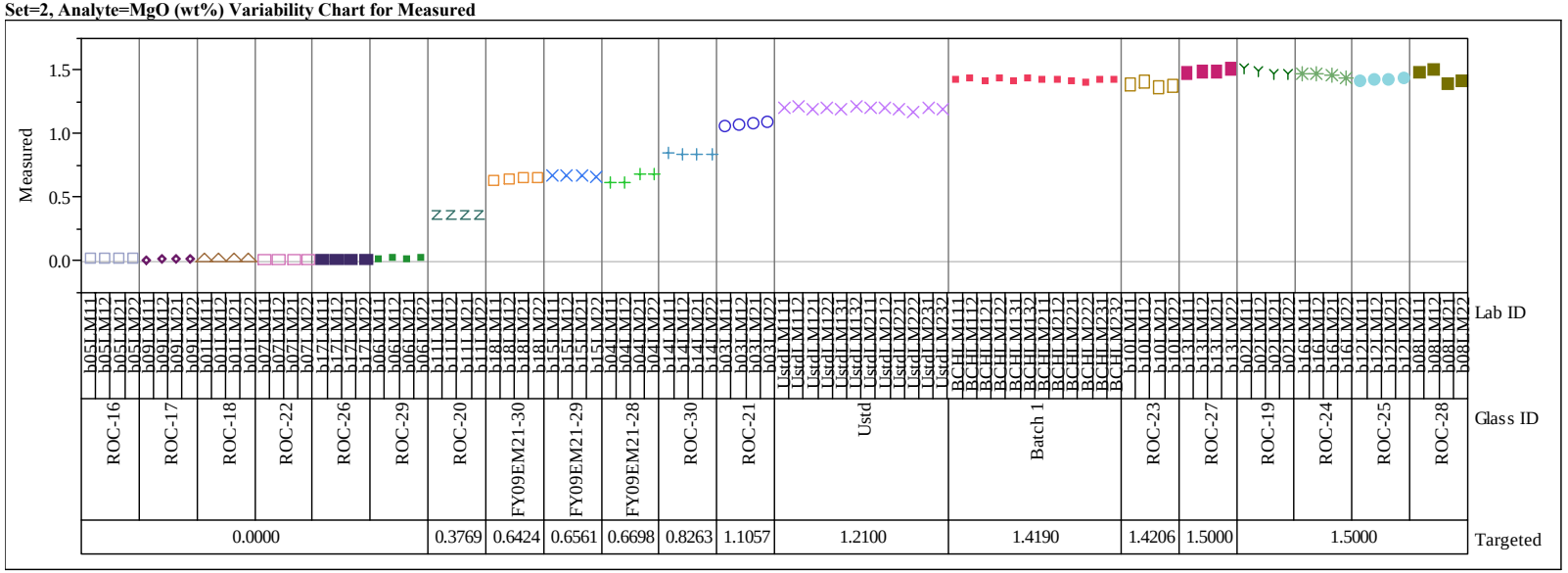


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=MgO (wt%) Variability Chart for Measured



Set=2, Analyte=MgO (wt%) Variability Chart for Measured bc

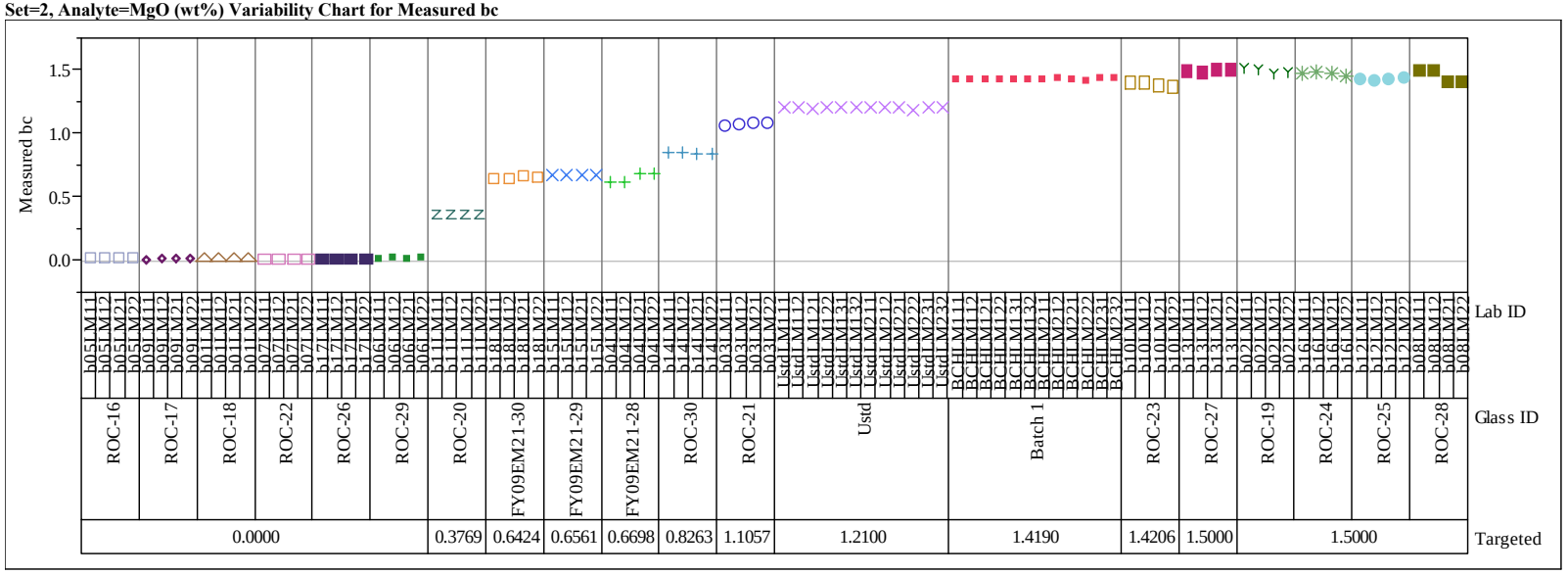
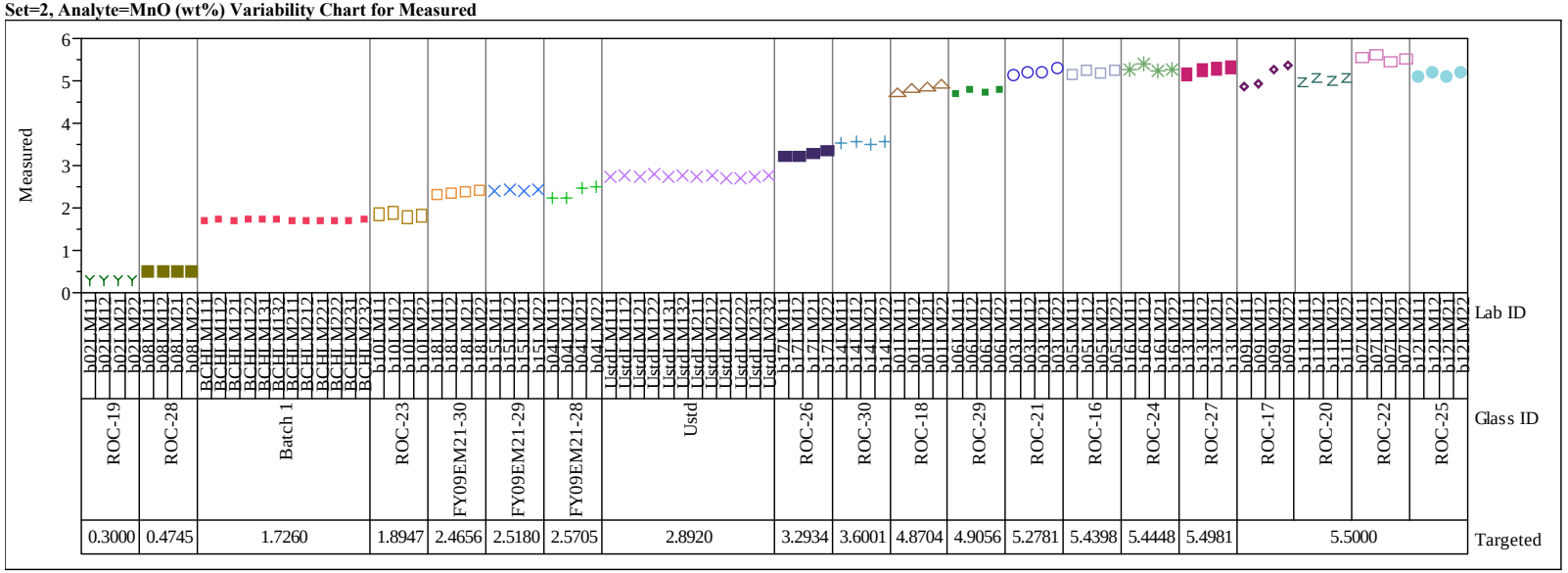


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=MnO (wt%) Variability Chart for Measured



Set=2, Analyte=MnO (wt%) Variability Chart for Measured bc

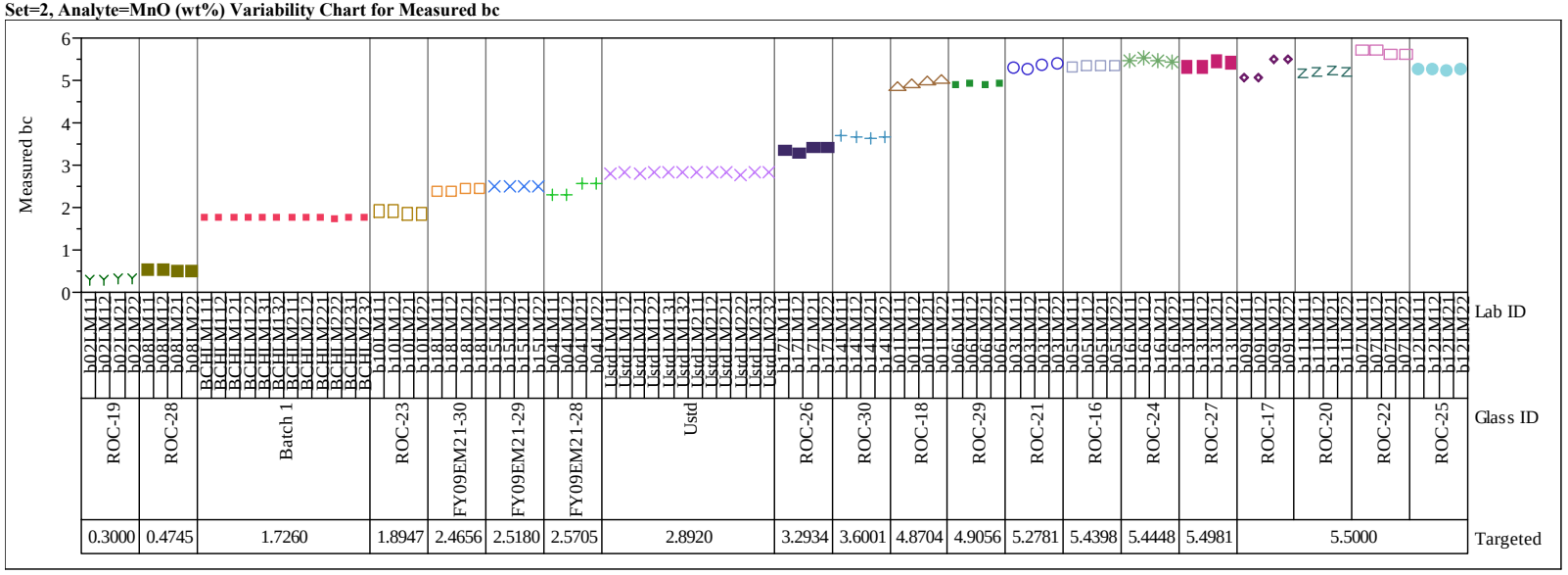
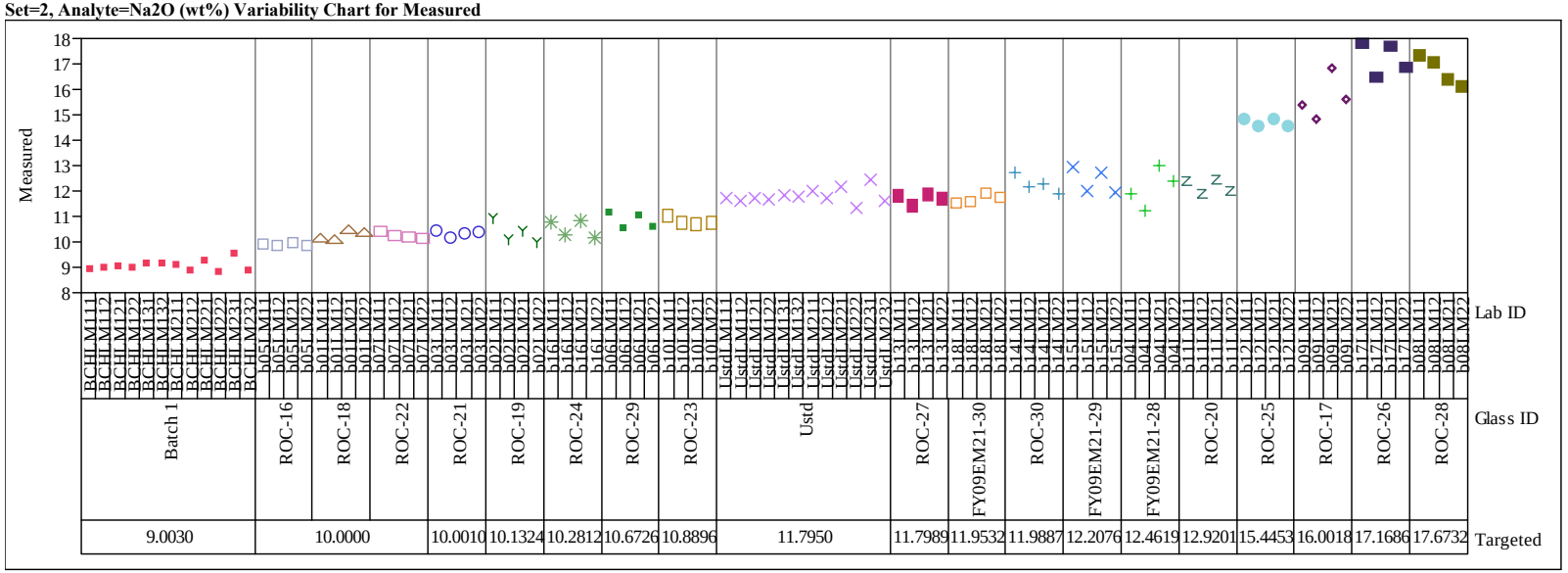


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=Na2O (wt%) Variability Chart for Measured



Set=2, Analyte=Na2O (wt%) Variability Chart for Measured bc

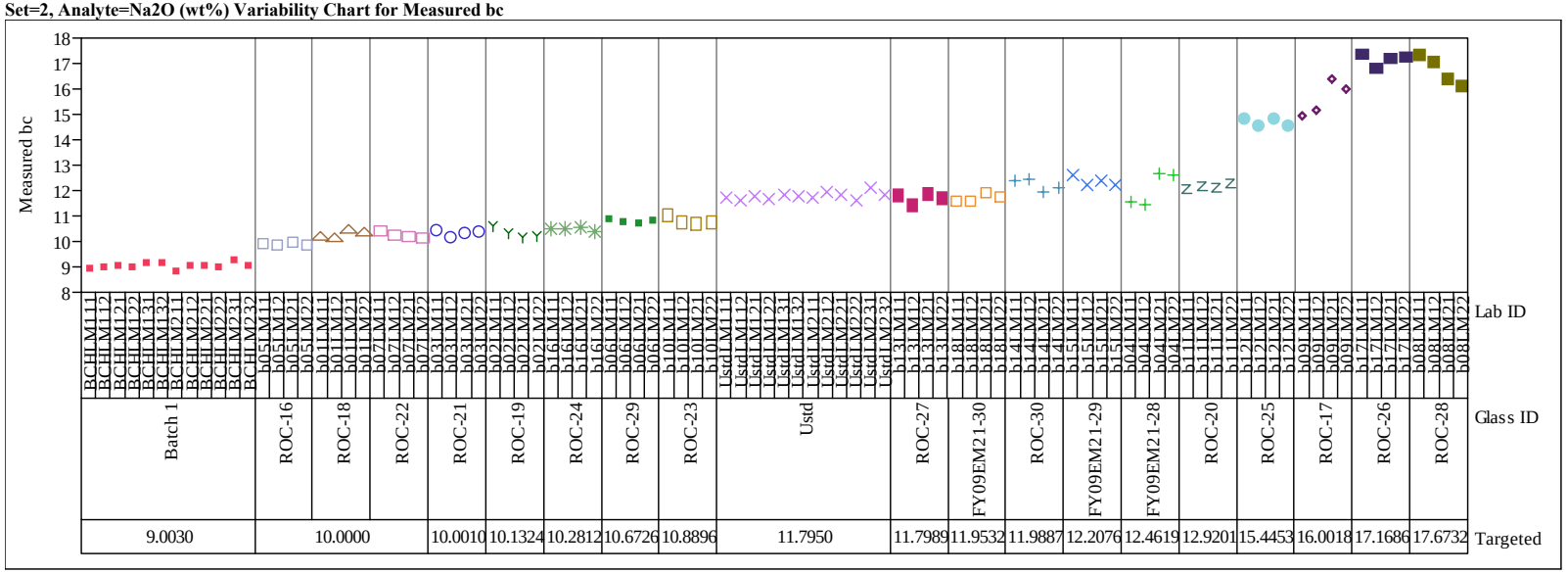
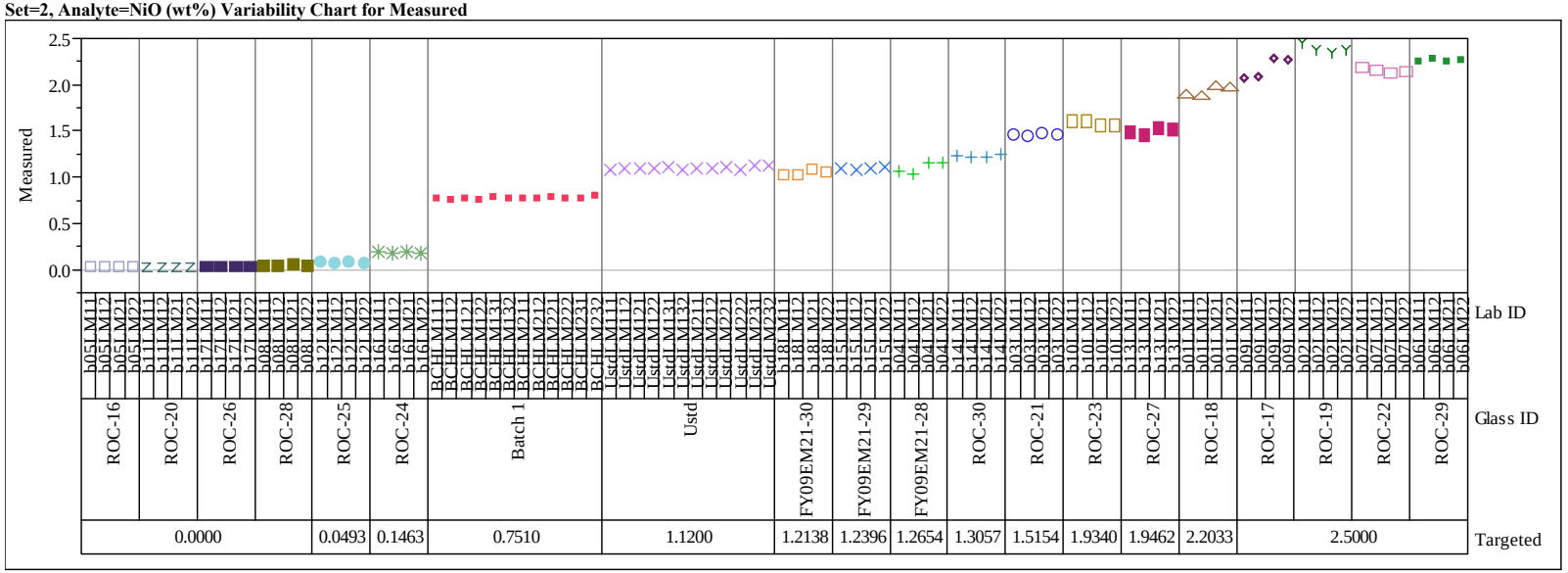


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=NiO (wt%) Variability Chart for Measured



Set=2, Analyte=NiO (wt%) Variability Chart for Measured bc

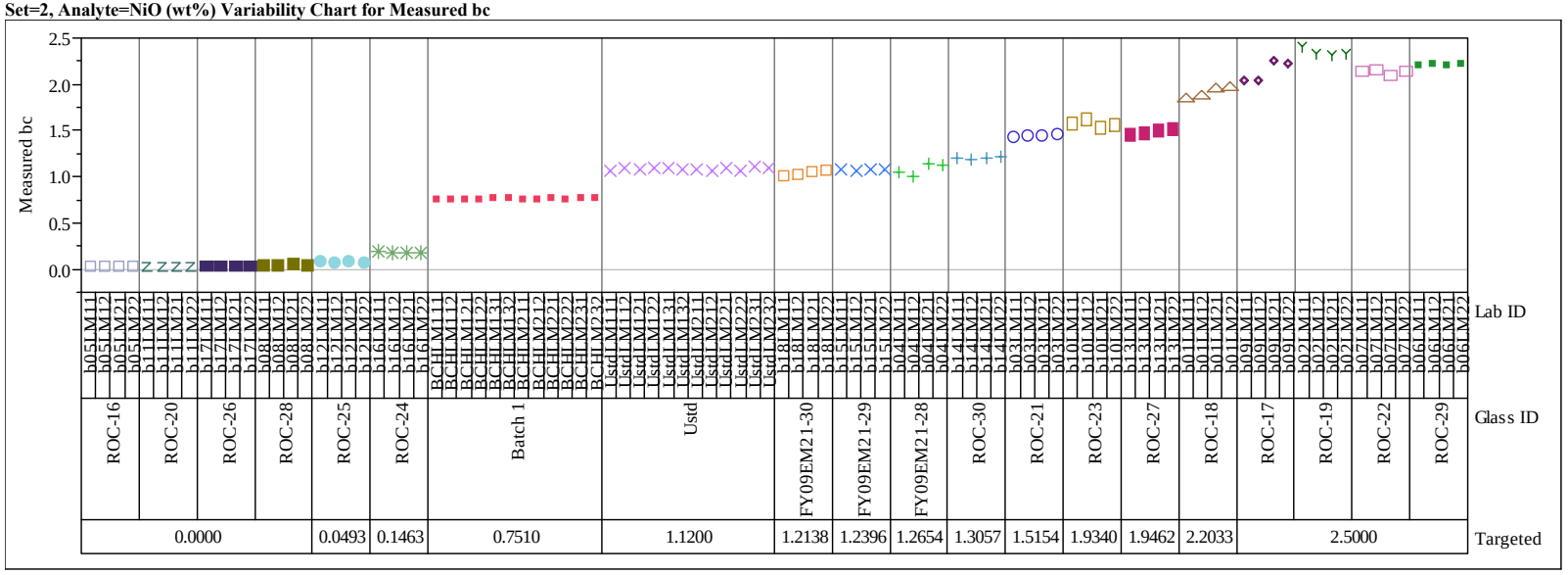
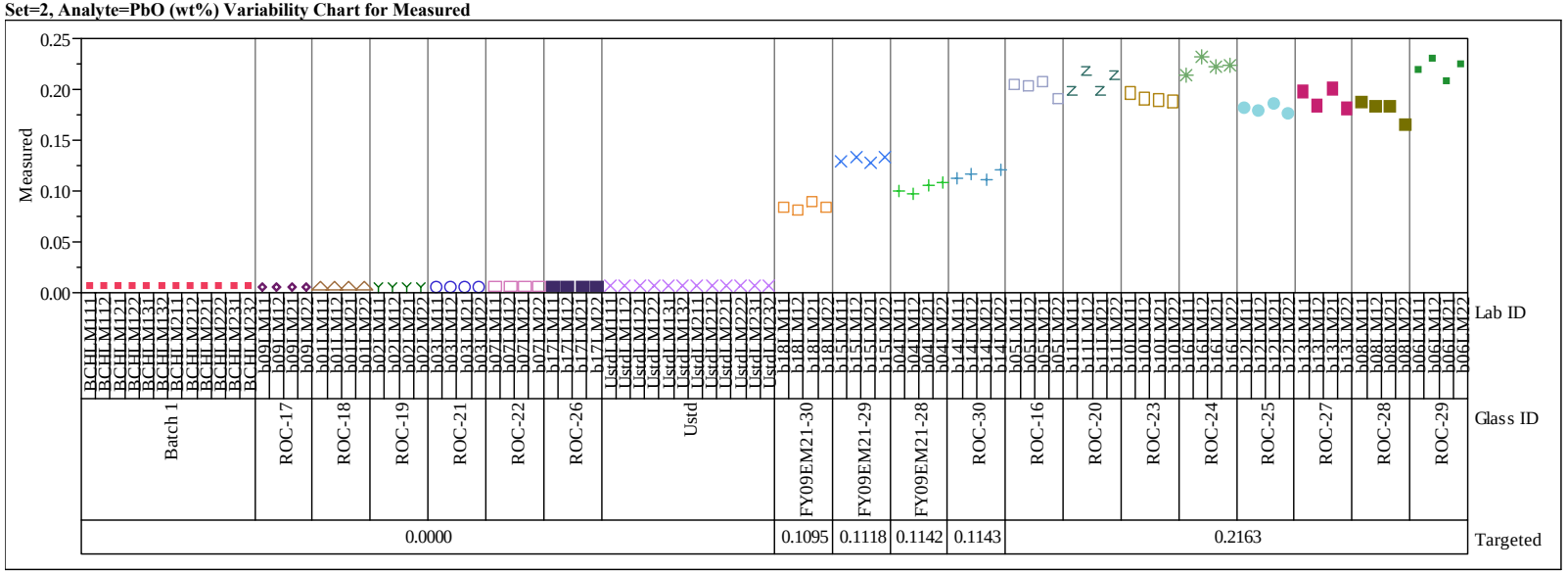


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=PbO (wt%) Variability Chart for Measured



Set=2, Analyte=PbO (wt%) Variability Chart for Measured bc

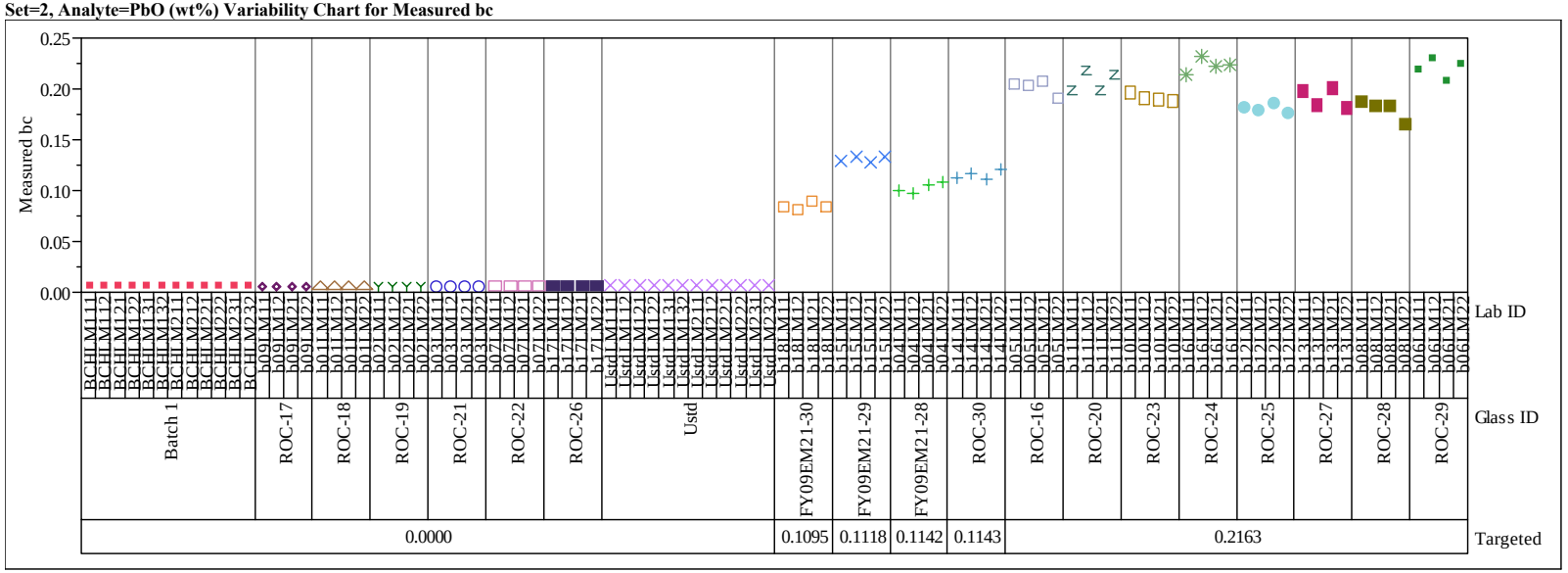
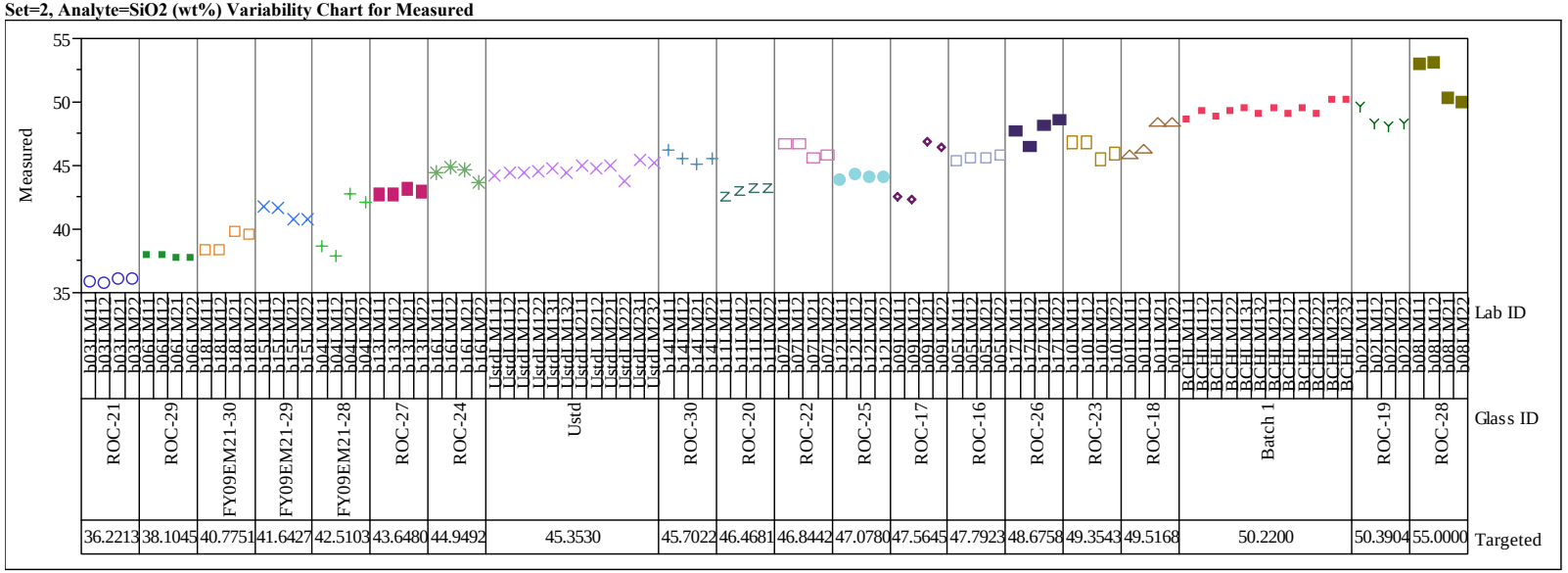


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=SiO2 (wt%) Variability Chart for Measured



Set=2, Analyte=SiO2 (wt%) Variability Chart for Measured bc

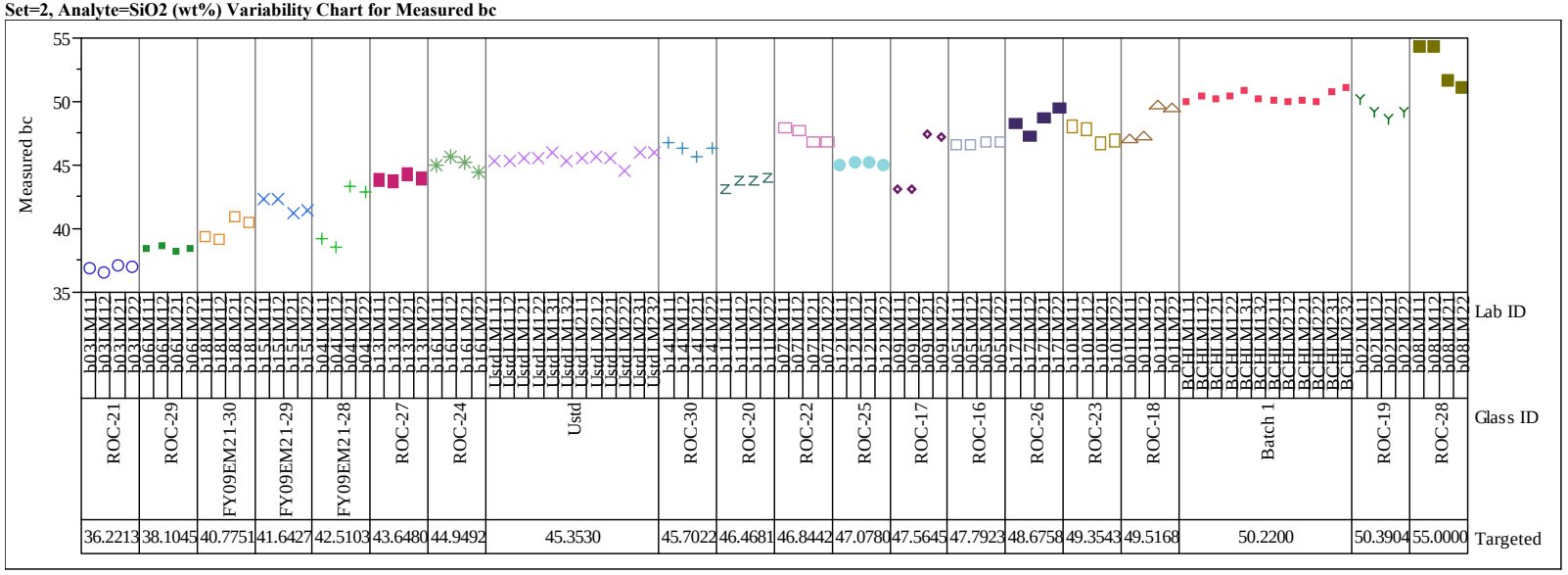
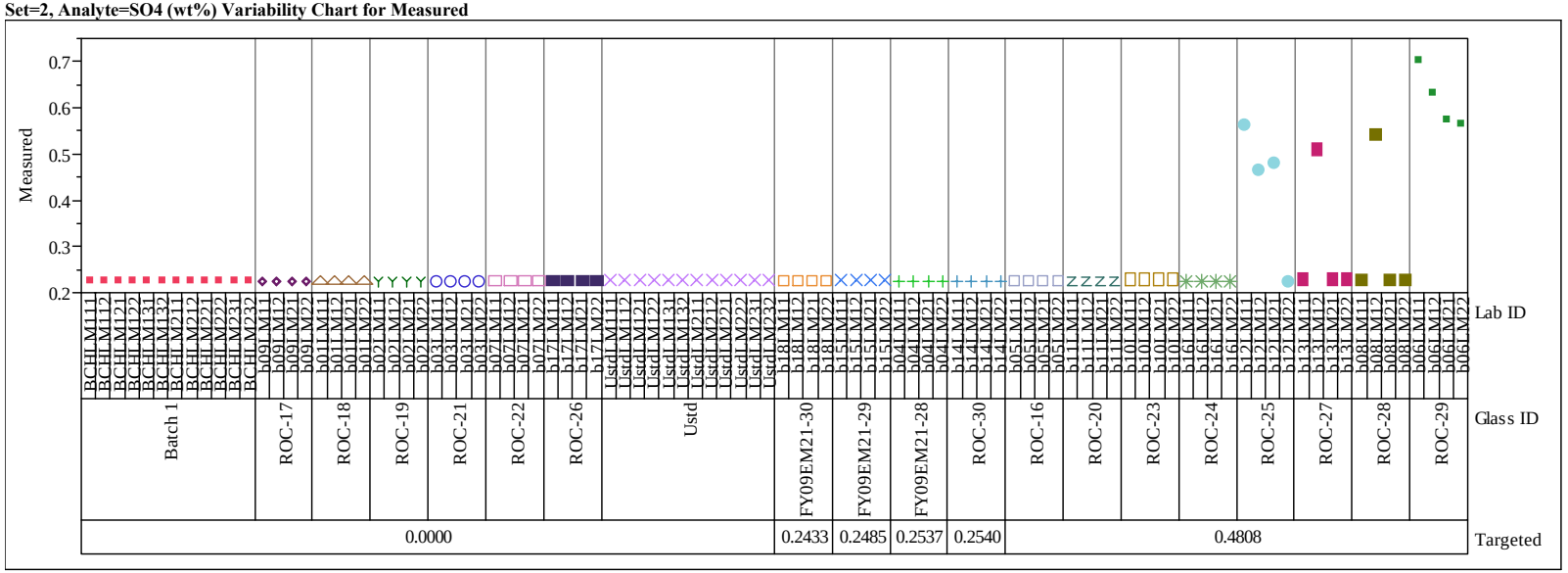


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=SO4 (wt%) Variability Chart for Measured



Set=2, Analyte=SO4 (wt%) Variability Chart for Measured bc

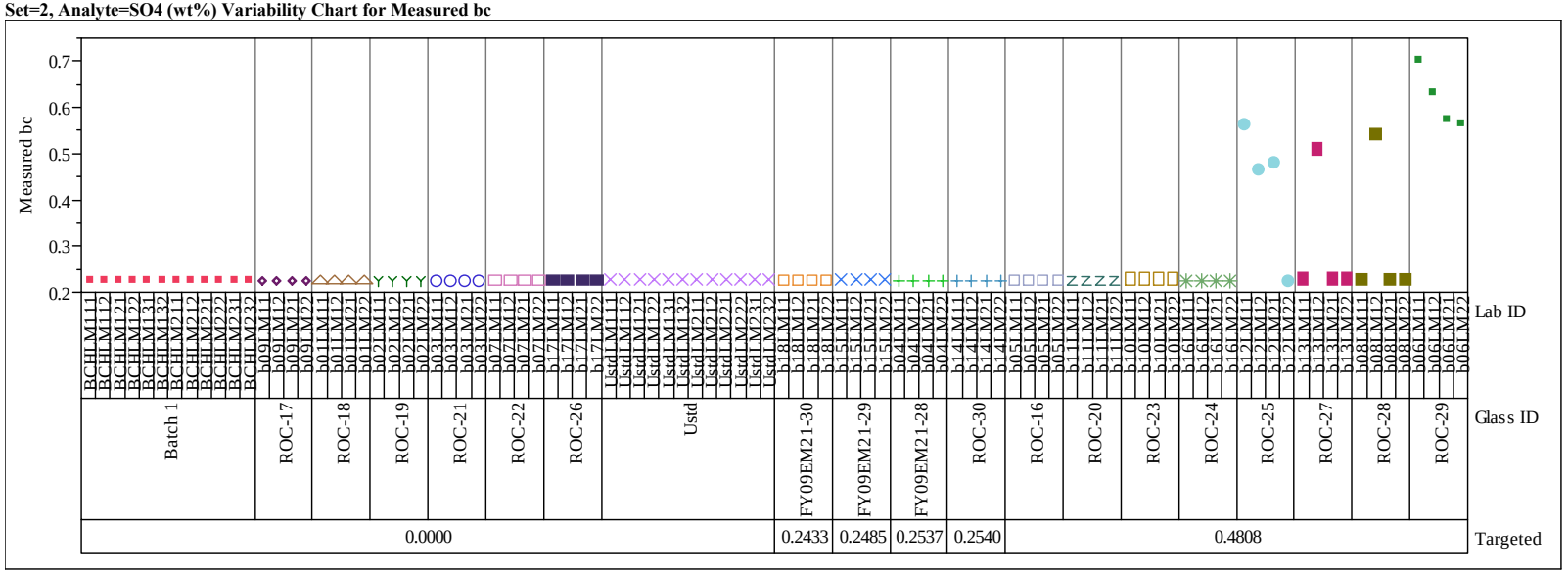
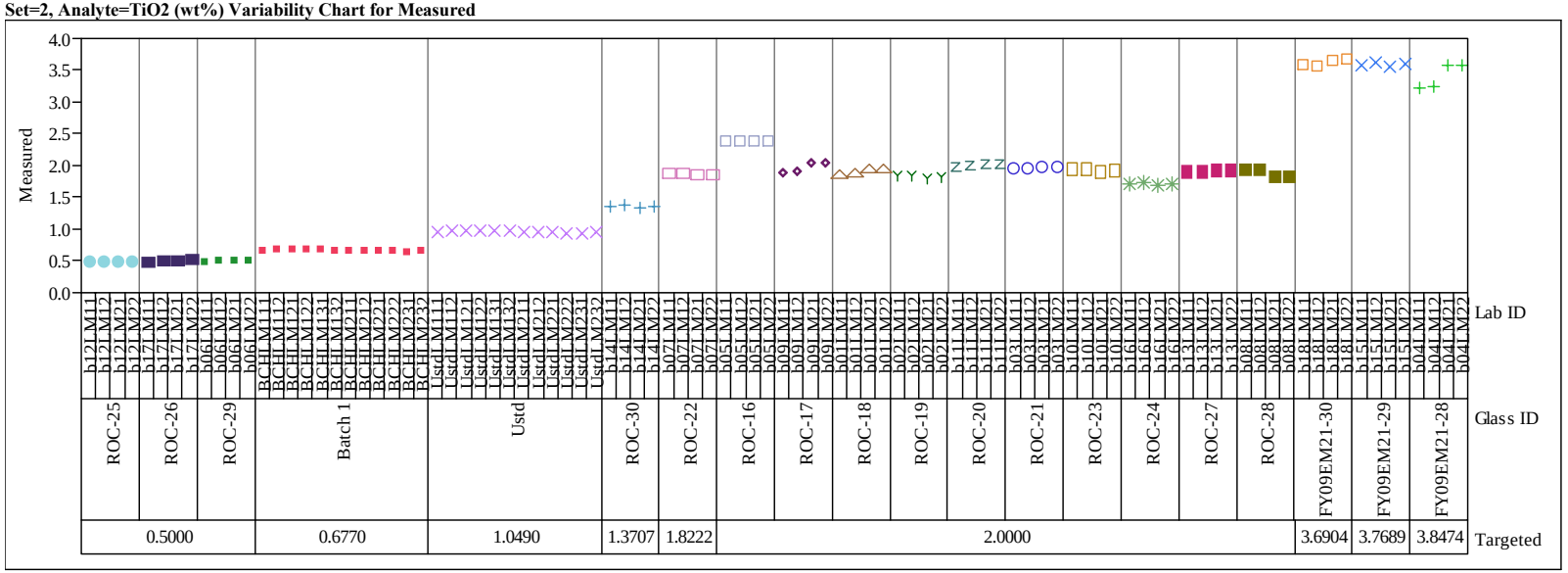


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=TiO2 (wt%) Variability Chart for Measured



Set=2, Analyte=TiO2 (wt%) Variability Chart for Measured bc

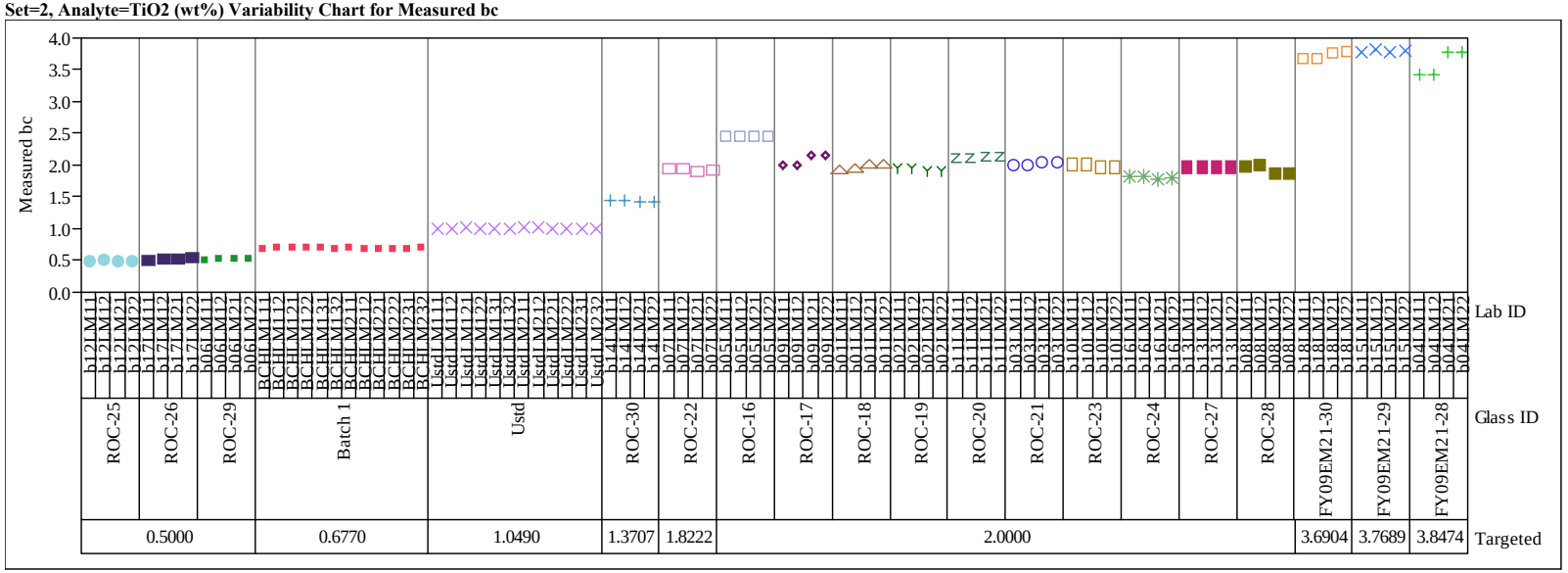
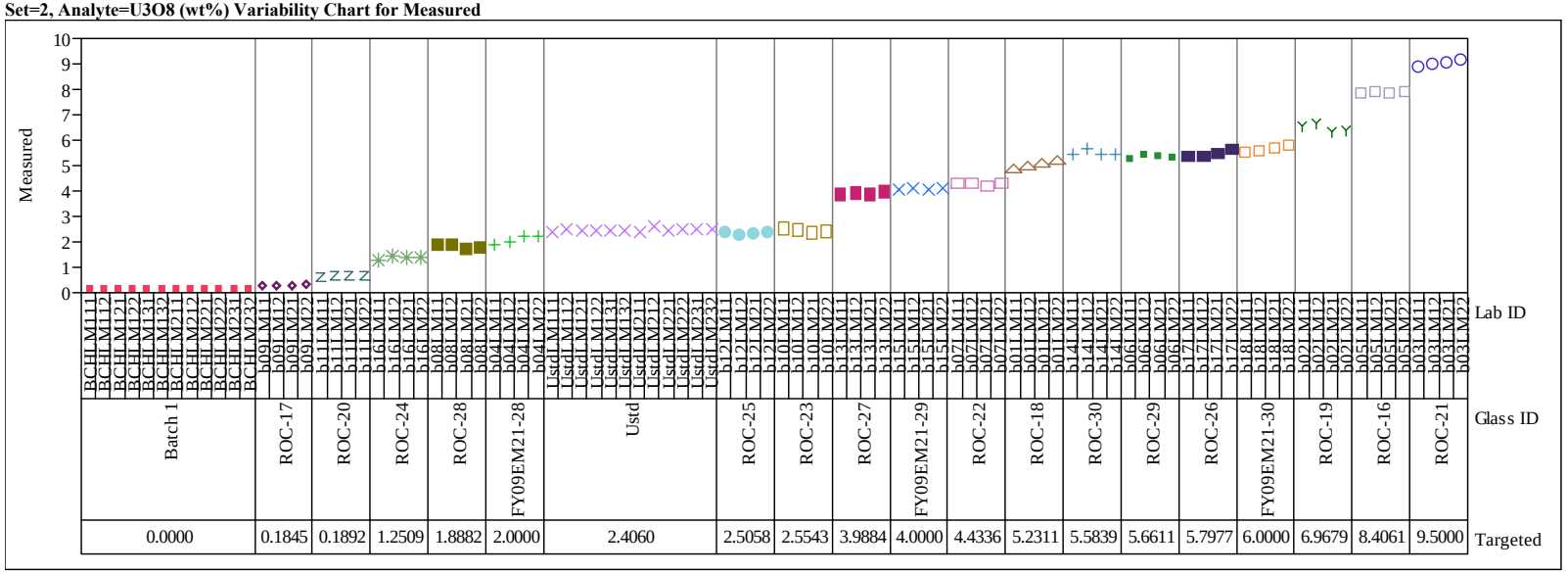


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=U3O8 (wt%) Variability Chart for Measured



Set=2, Analyte=U3O8 (wt%) Variability Chart for Measured bc

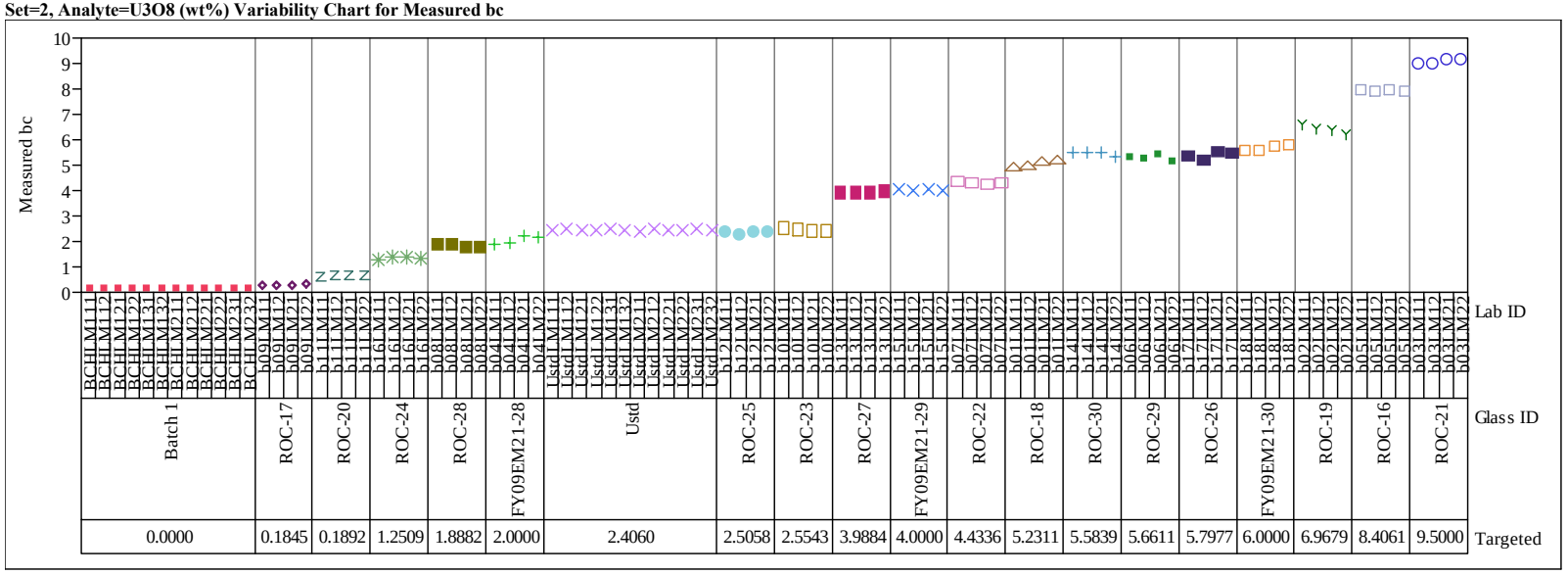
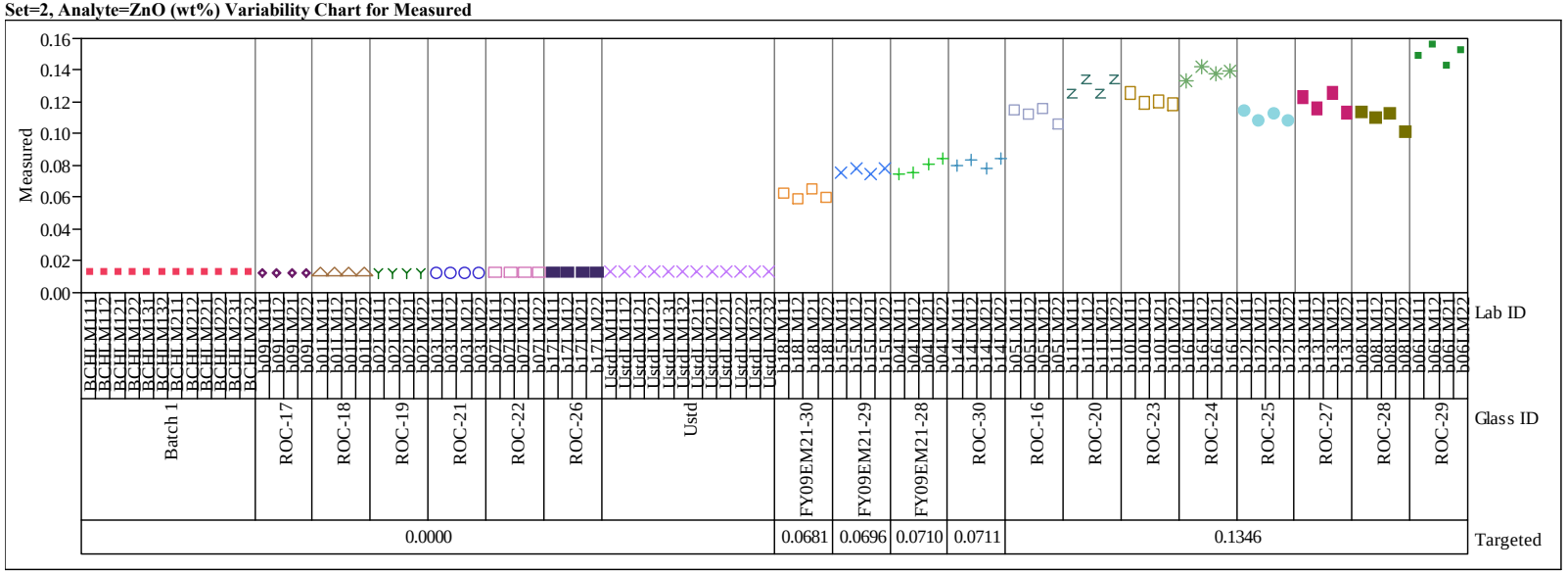


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=ZnO (wt%) Variability Chart for Measured



Set=2, Analyte=ZnO (wt%) Variability Chart for Measured bc

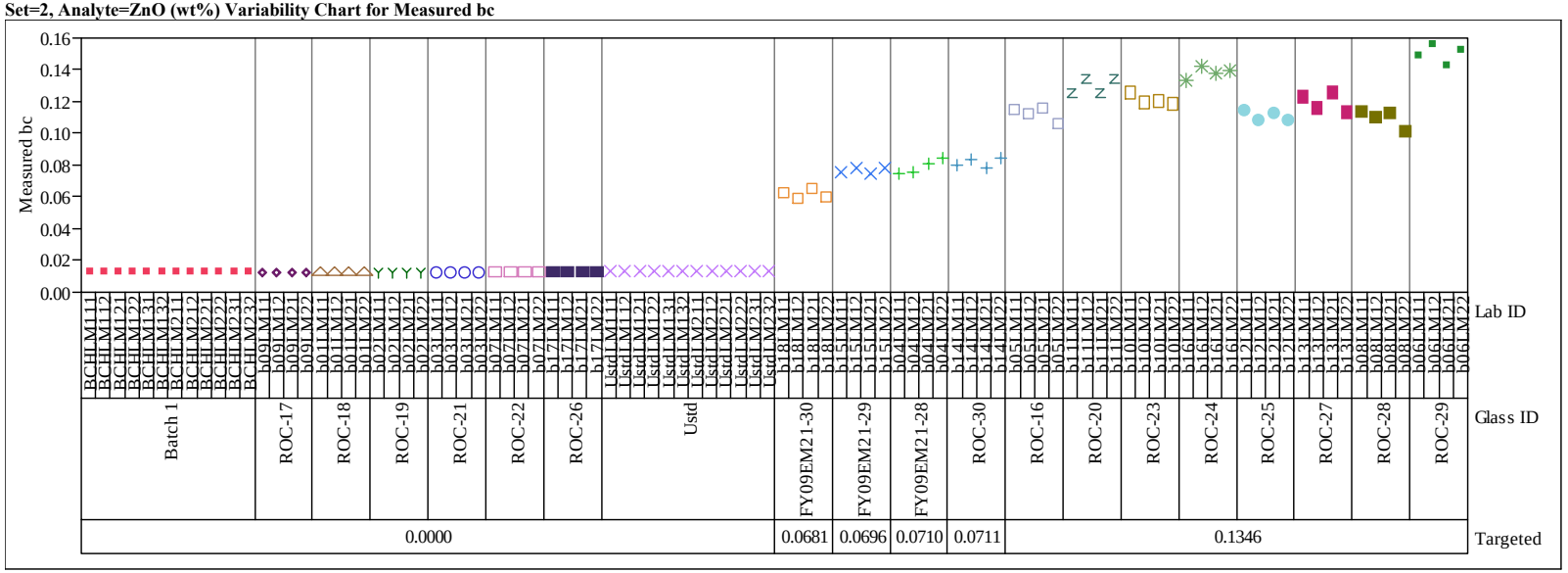
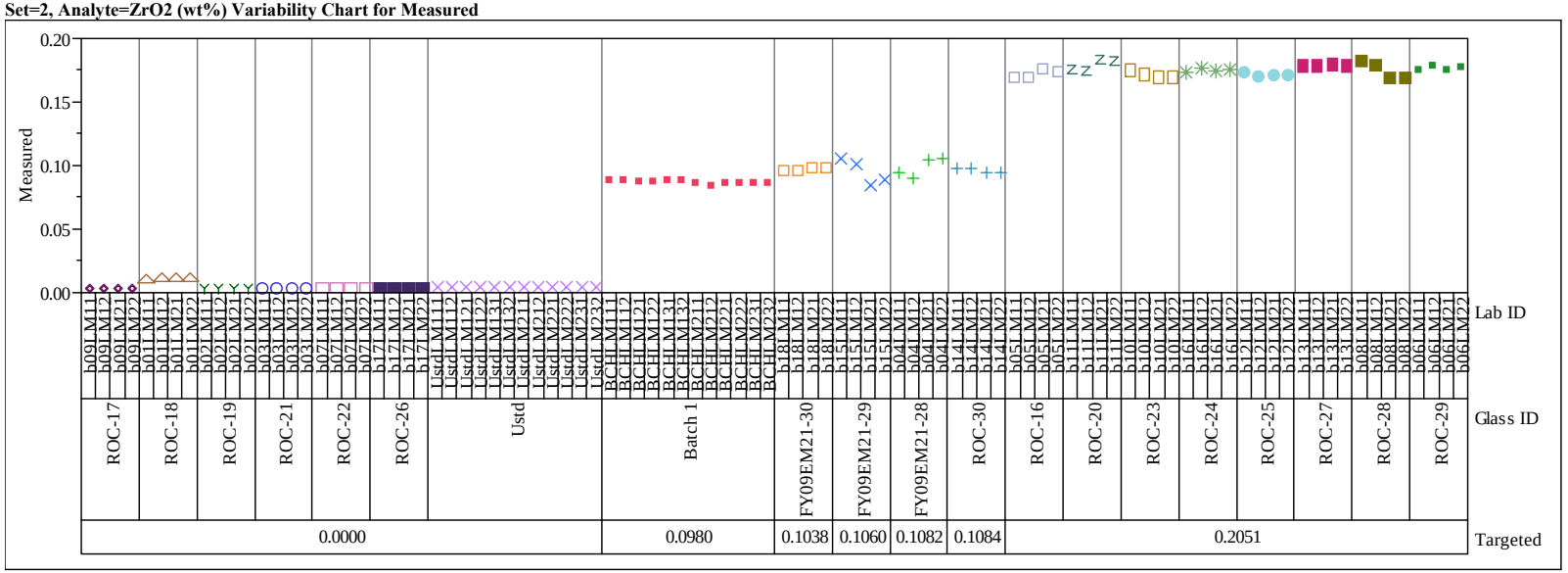


Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Set=2, Analyte=ZrO2 (wt%) Variability Chart for Measured



Set=2, Analyte=ZrO2 (wt%) Variability Chart for Measured bc

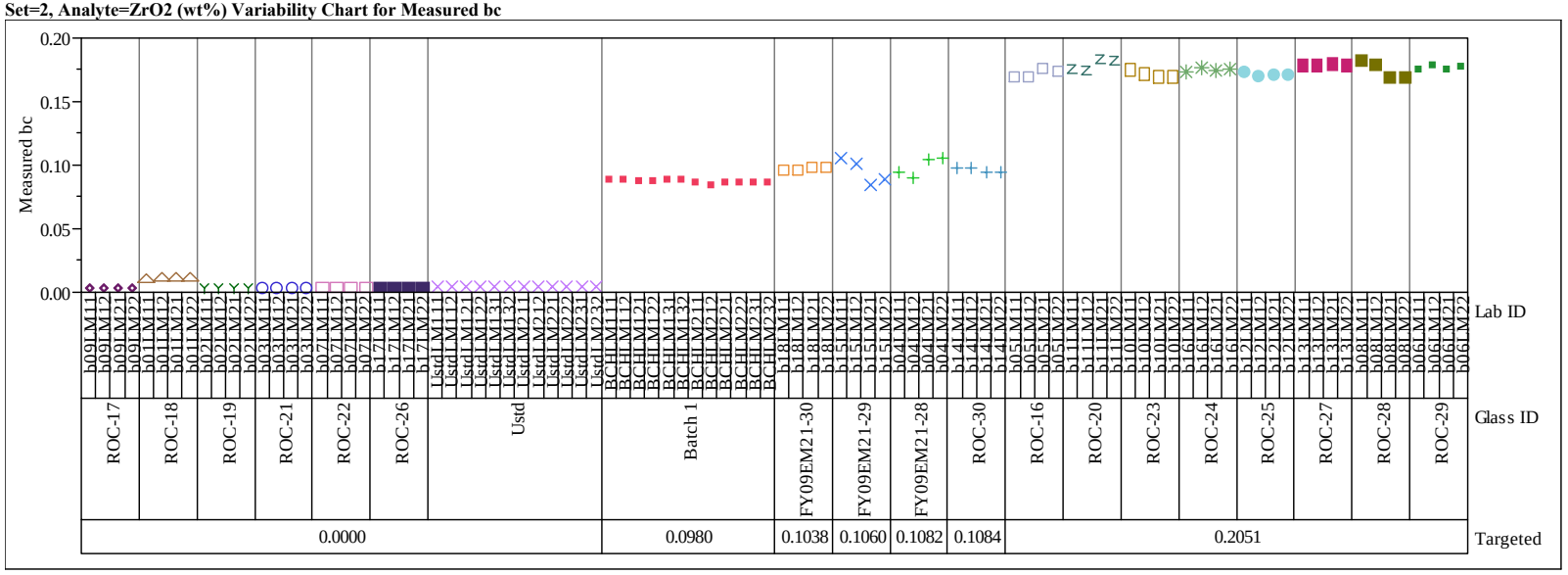
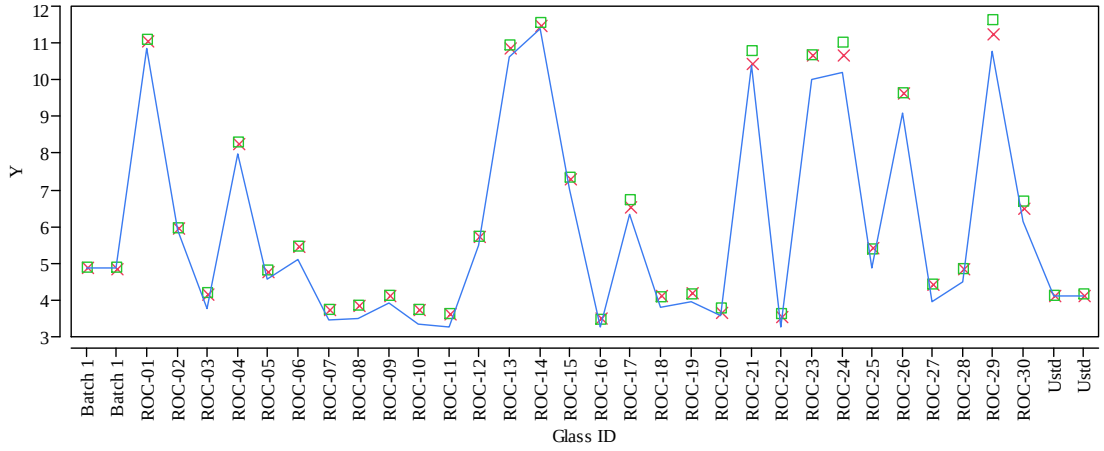


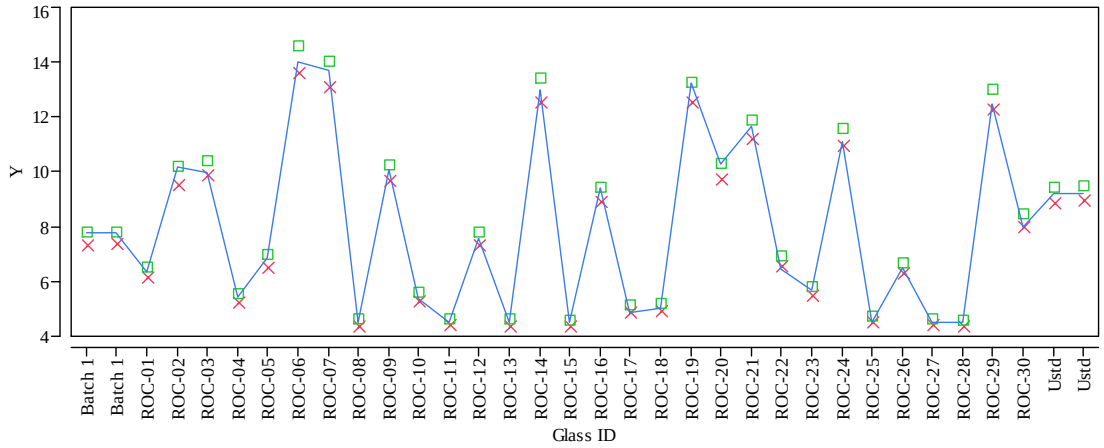
Exhibit A5. Oxide Measurements by Lab ID within Glass ID Sorted by Targeted Concentrations

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

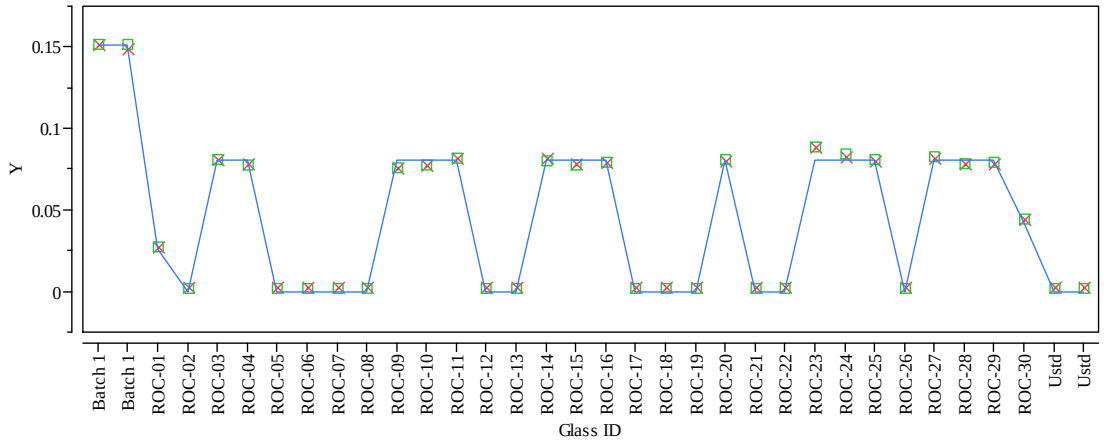
Overlay Plot Oxide=Al2O3 (wt%)



Overlay Plot Oxide=B2O3 (wt%)



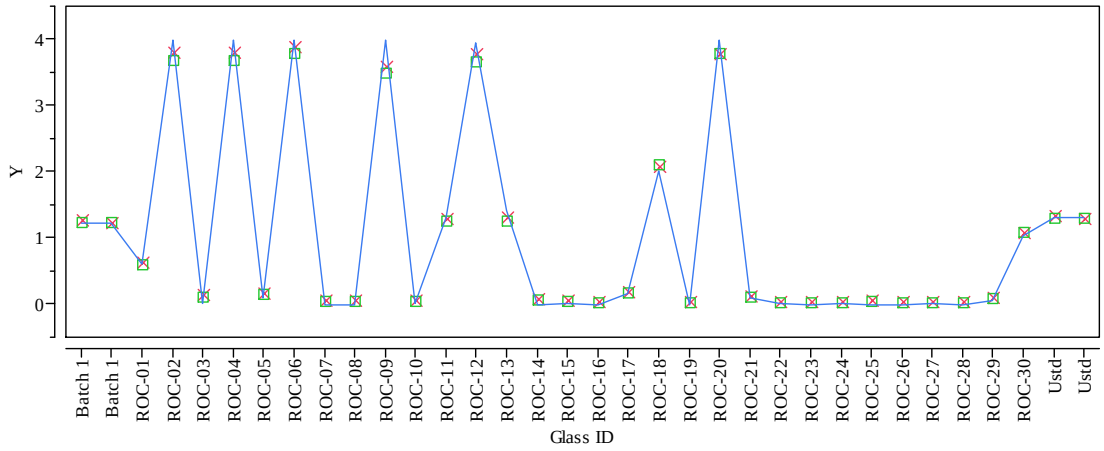
Overlay Plot Oxide=BaO (wt%)



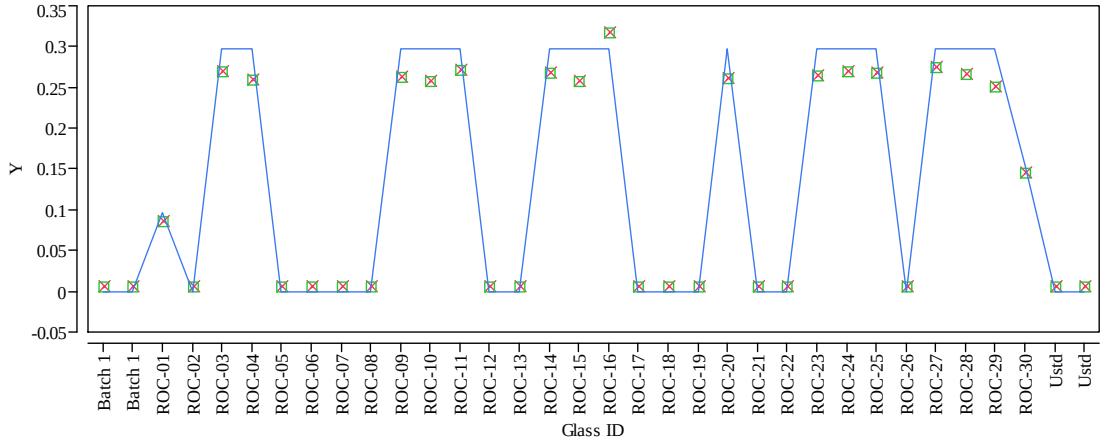
Y × Measured ▫ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

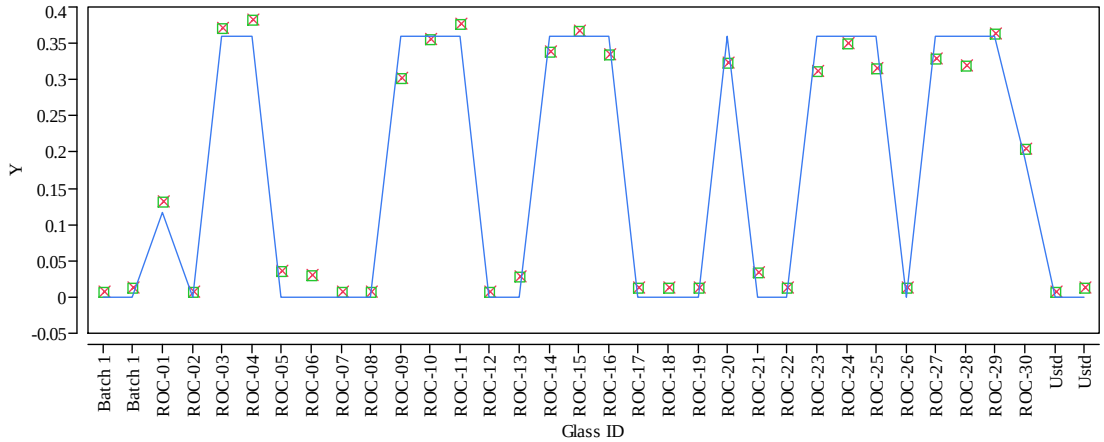
Overlay Plot Oxide=CaO (wt%)



Overlay Plot Oxide=CdO (wt%)



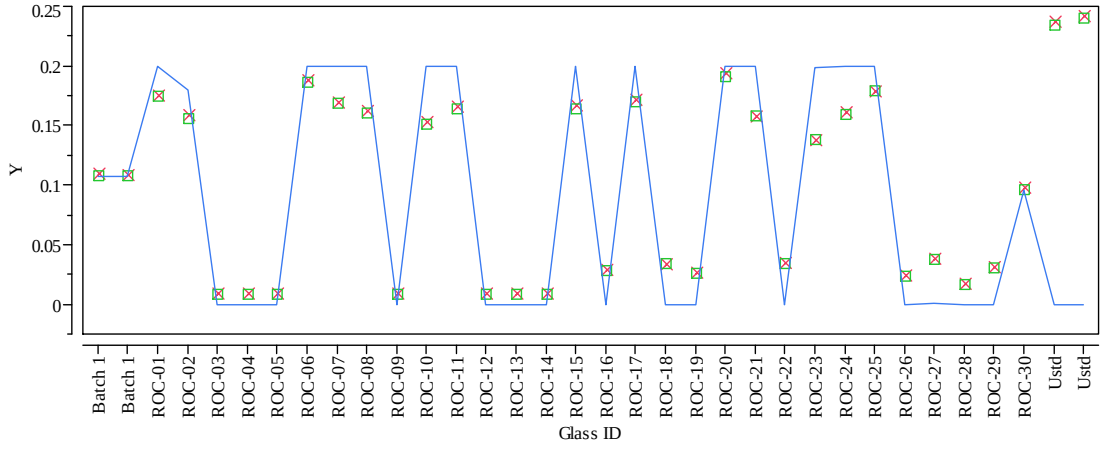
Overlay Plot Oxide=Ce2O3 (wt%)



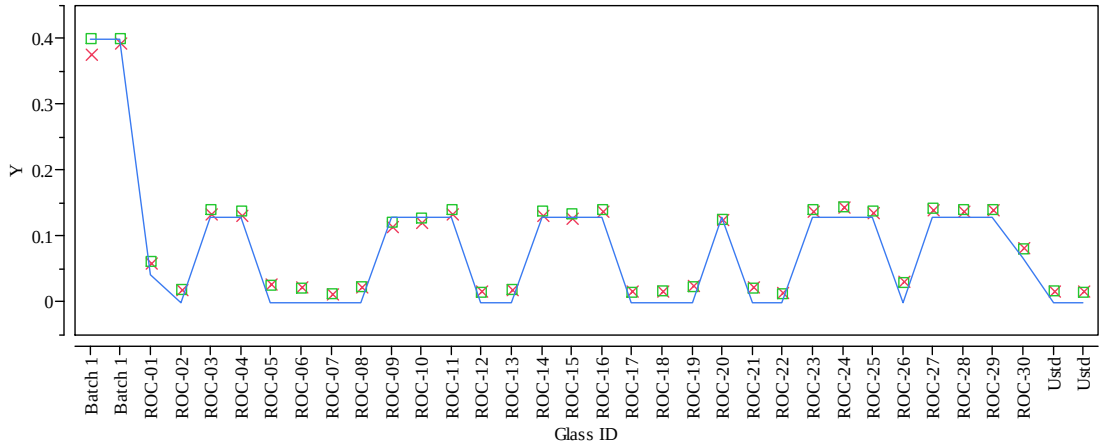
Y × Measured ▫ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

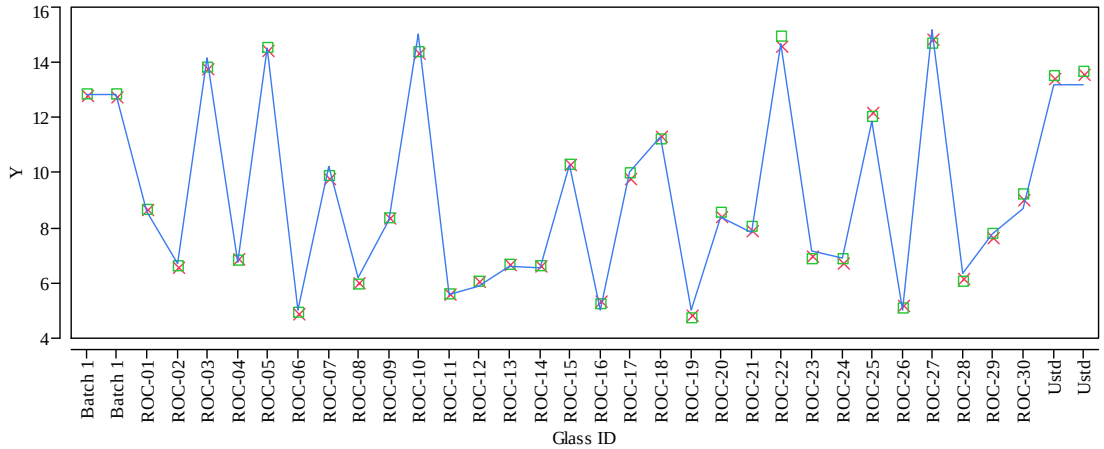
Overlay Plot Oxide=Cr2O3 (wt%)



Overlay Plot Oxide=CuO (wt%)



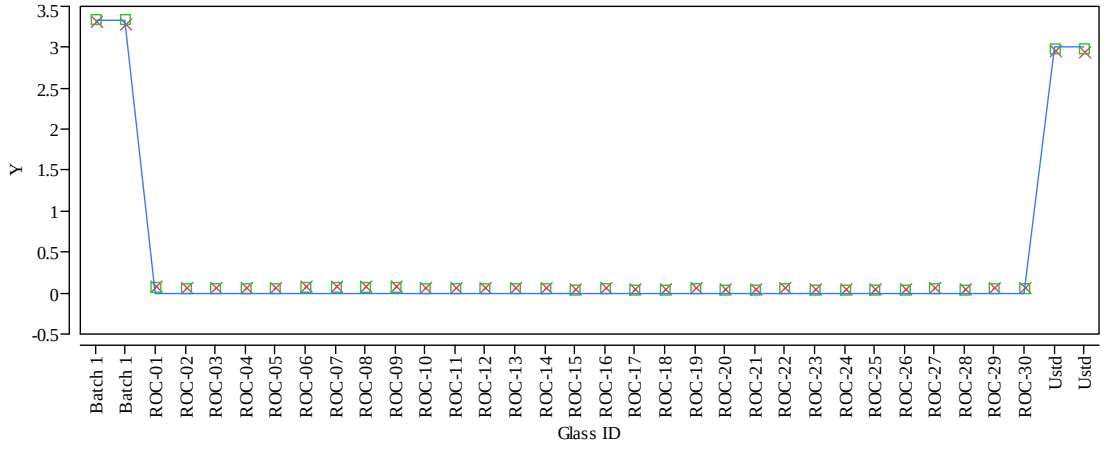
Overlay Plot Oxide=Fe2O3 (wt%)



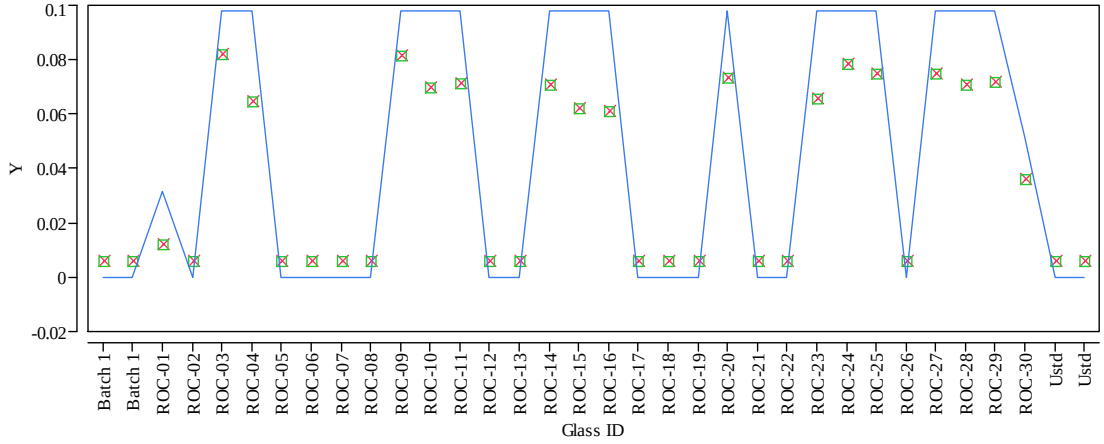
Y × Measured □ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

Overlay Plot Oxide=K2O (wt%)



Overlay Plot Oxide=La2O3 (wt%)



Overlay Plot Oxide=Li2O (wt%)

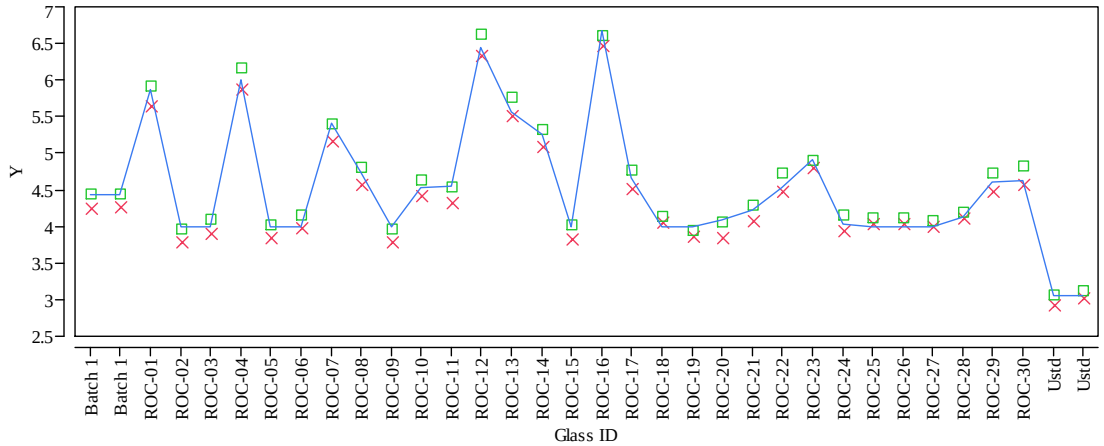
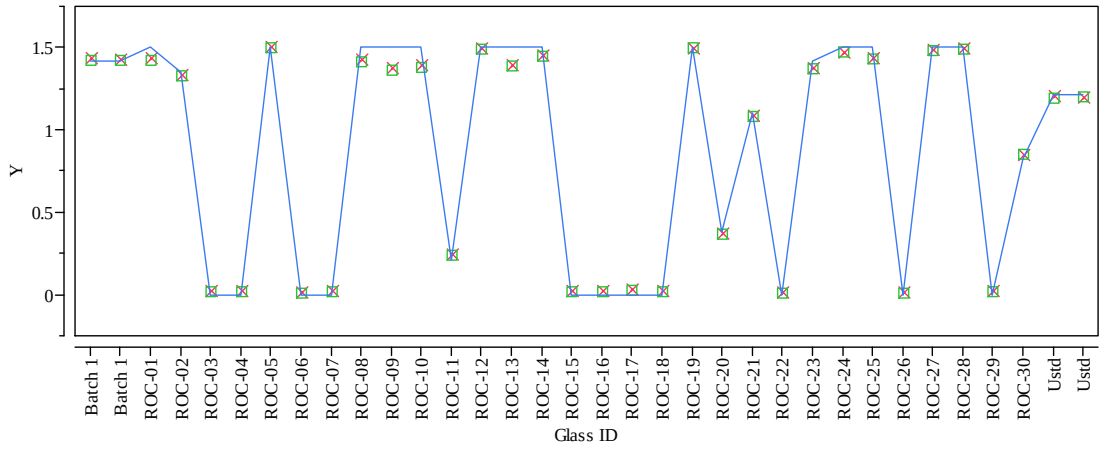
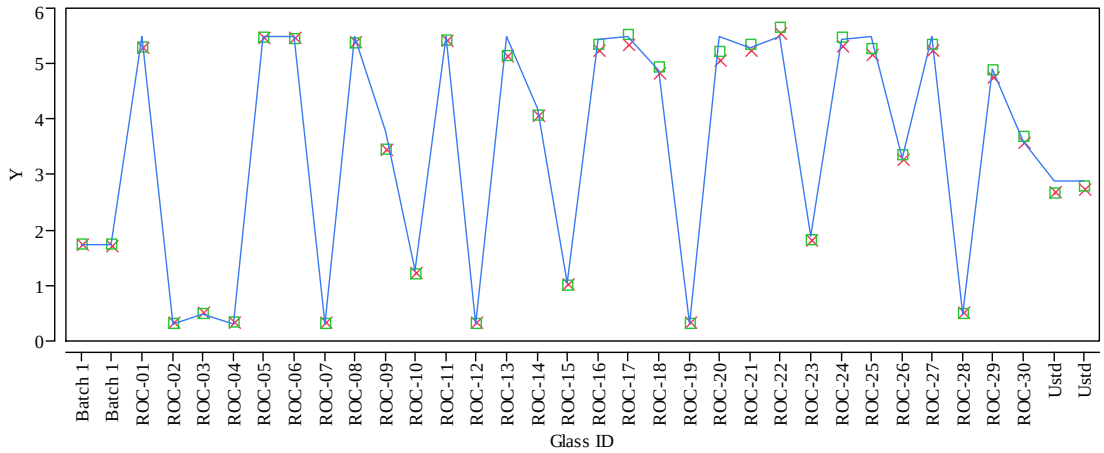


Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

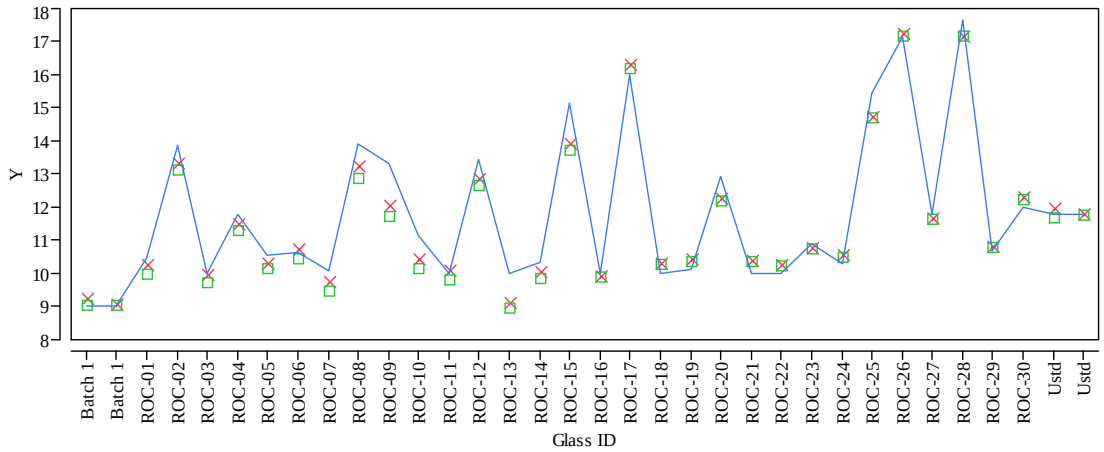
Overlay Plot Oxide=MgO (wt%)



Overlay Plot Oxide=MnO (wt%)



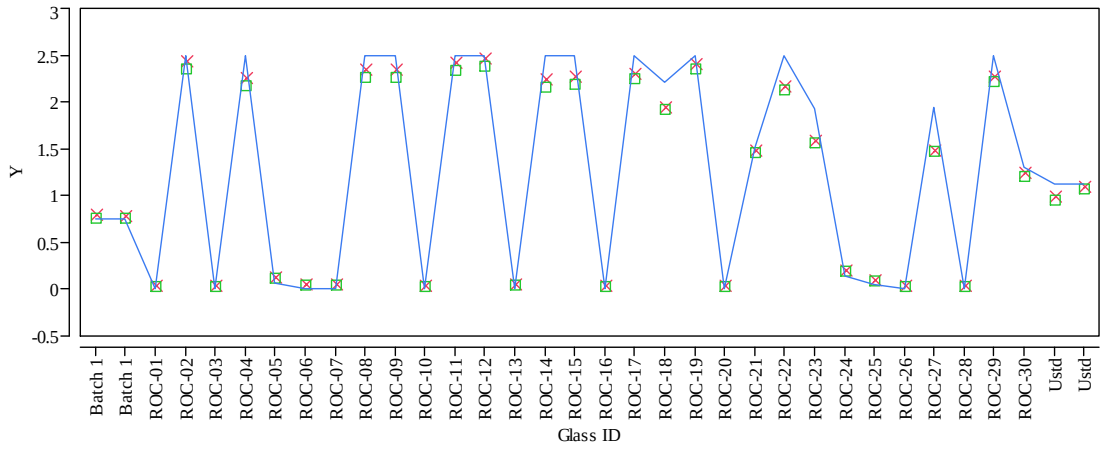
Overlay Plot Oxide=Na2O (wt%)



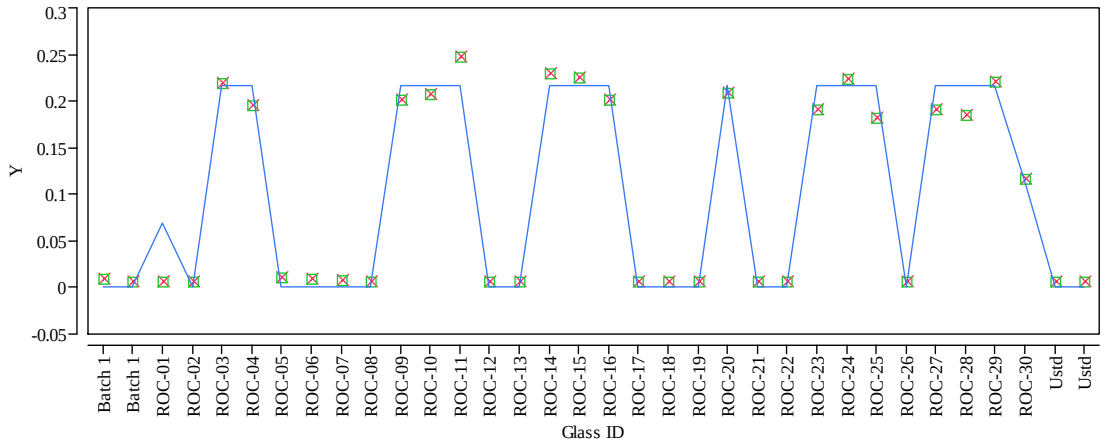
Y × Measured ▫ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

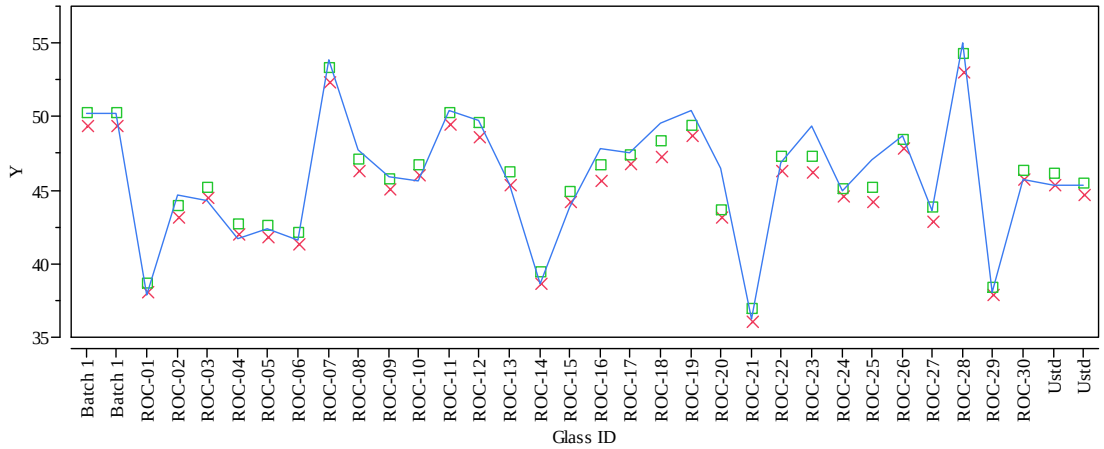
Overlay Plot Oxide=NiO (wt%)



Overlay Plot Oxide=PbO (wt%)



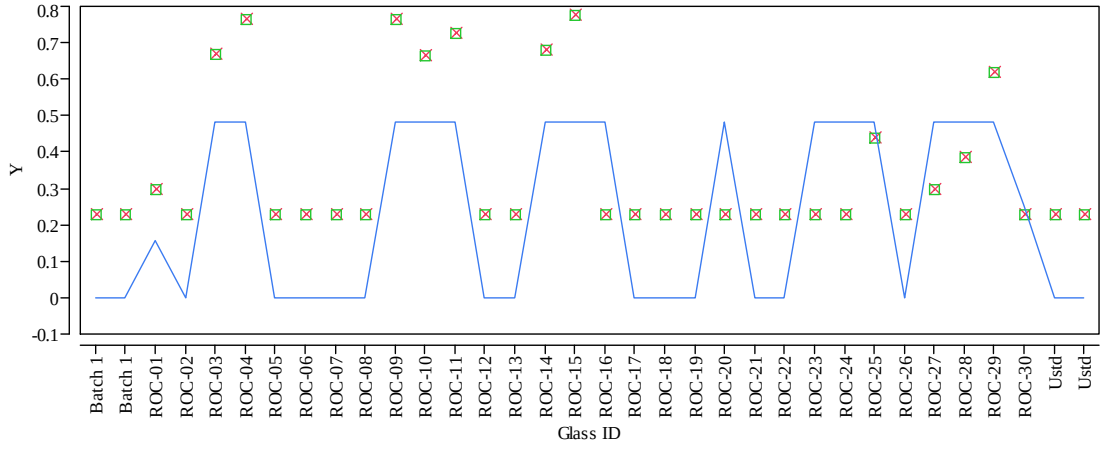
Overlay Plot Oxide=SiO2 (wt%)



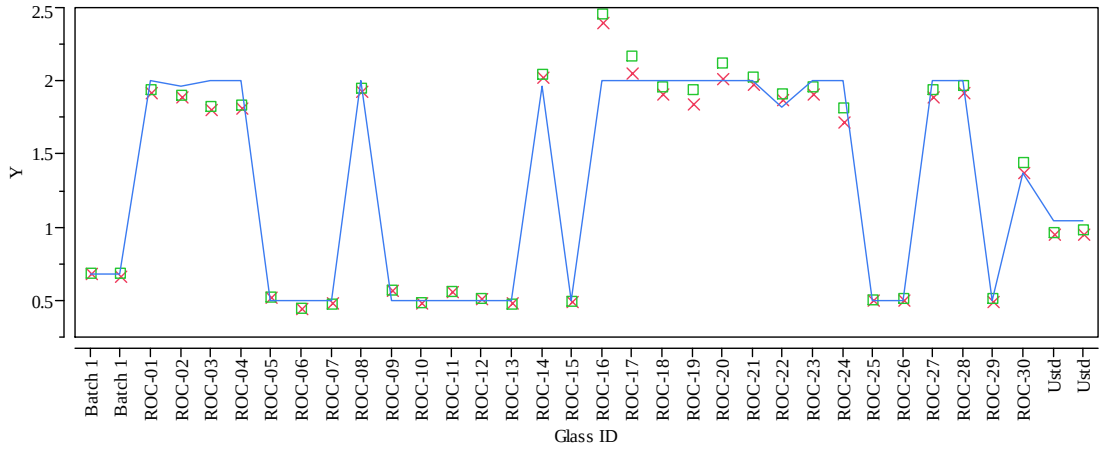
Y × Measured ▫ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

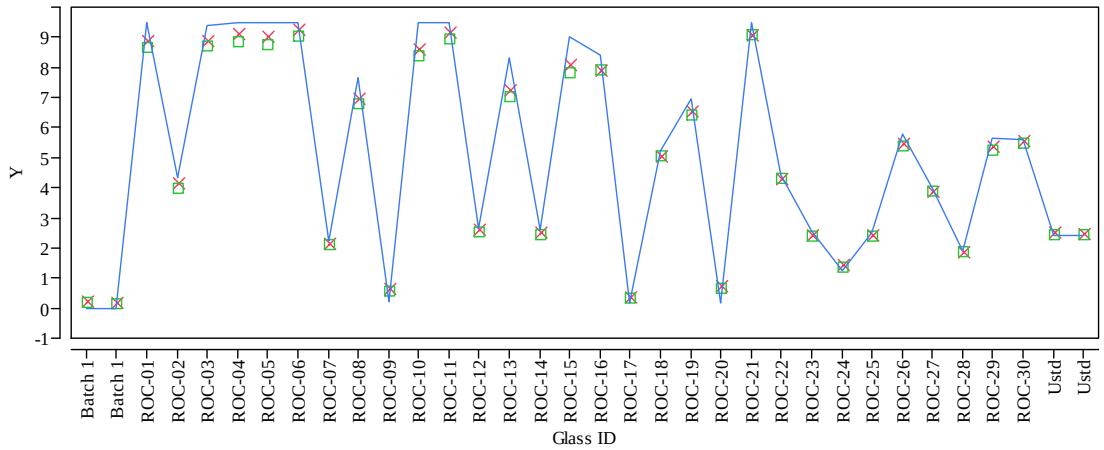
Overlay Plot Oxide=SO4 (wt%)



Overlay Plot Oxide=TiO2 (wt%)



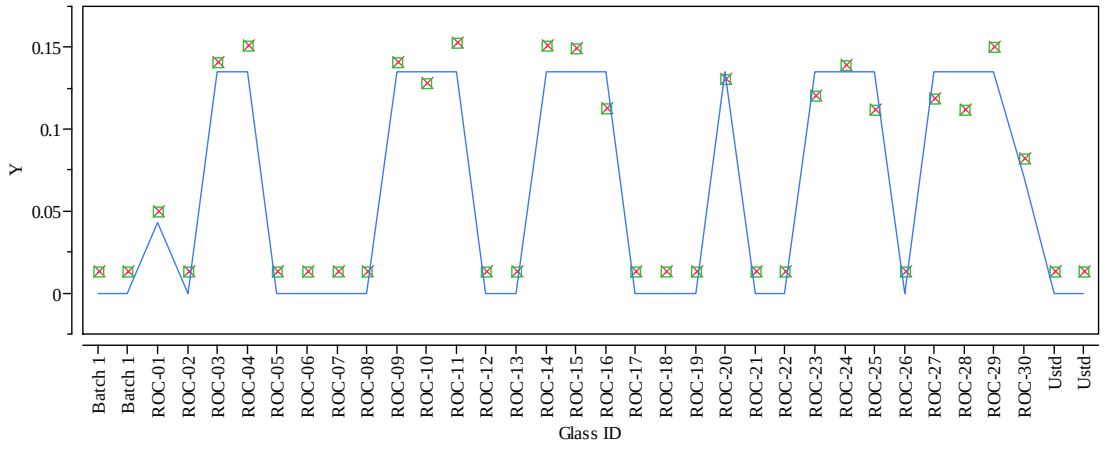
Overlay Plot Oxide=U3O8 (wt%)



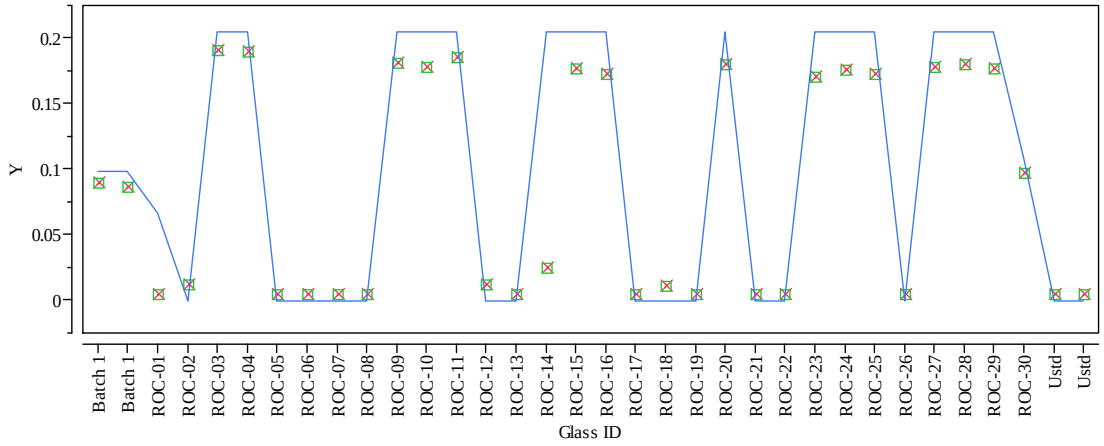
Y × Measured □ Measured bc — Targeted

Exhibit A6. Average Measured and Bias-Corrected (bc) Versus Targeted Compositions by Glass ID by Oxide

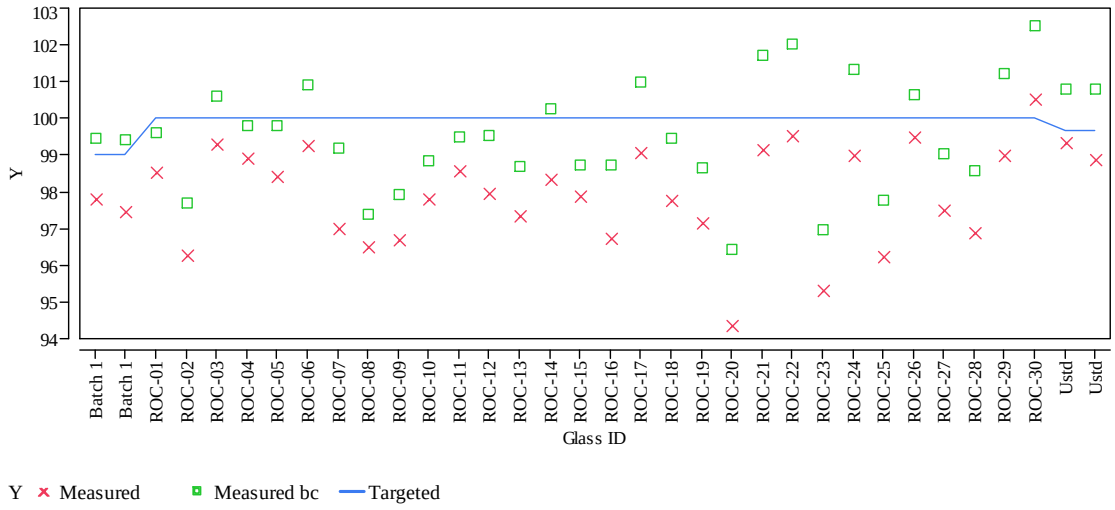
Overlay Plot Oxide=ZnO (wt%)



Overlay Plot Oxide=ZrO2 (wt%)



Overlay Plot Oxide=Sum of Oxides



Appendix B:

Tables and Exhibits Supporting the Analysis of the PCT Results for the Study Glasses

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Table B1. Analytical Development's Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

Set	Glass ID	Heat Treatment	Block	Seq	Analytical Sequence	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
1	Soln Std	ref	1	1	1	std-11	19.8	10.1	82.4	50.4	19.800	10.100	82.400	50.400
1	ROC-10	quenched	1	2	2	c17	12.8	15.7	52.6	91.1	21.334	26.167	87.668	151.836
1	ROC-04	quenched	1	3	3	c51	7.29	14.0	46.7	50.9	12.150	23.334	77.835	84.835
1	ROC-10	ccc	1	4	4	c20	12.7	15.9	52.4	93.8	21.167	26.501	87.335	156.336
1	ROC-02	ccc	1	5	5	c23	14.4	8.62	51.4	50.4	24.000	14.367	85.668	84.002
1	ROC-06	ccc	1	6	6	c36	52.4	21.8	75.8	59.1	87.335	36.334	126.336	98.502
1	ROC-05	ccc	1	7	7	c27	16.4	17.6	48.9	86.1	27.334	29.334	81.502	143.503
1	ROC-06	quenched	1	8	8	c56	58.3	23.9	82.2	57.8	97.169	39.834	137.003	96.335
1	ROC-03	ccc	1	9	9	c32	15.1	10.2	25.6	56.3	25.167	17.000	42.668	93.835
1	ROC-01	quenched	1	10	10	c09	12.4	17.0	42.3	62.3	20.667	28.334	70.501	103.835
1	blank	ref	1	11	11	c06	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
1	ROC-09	ccc	1	12	12	c65	72.1	35.4	194	178	120.169	59.001	323.340	296.673
1	Soln Std	ref	1	13	13	std-12	19.9	10.1	81.8	50.2	19.900	10.100	81.800	50.200
1	ROC-03	quenched	1	14	14	c41	14.50	10.2	24.1	54.2	24.167	17.000	40.167	90.335
1	EA	ref	1	15	15	c46	33.9	11.0	94.7	53.5	565.001	183.334	1578.336	891.668
1	ROC-07	ccc	1	16	16	c08	44.6	25.4	53.2	106	74.335	42.334	88.668	176.670
1	ROC-05	quenched	1	17	17	c50	16.2	13.5	47.2	73.1	27.001	22.500	78.668	121.836
1	ROC-08	quenched	1	18	18	c44	27.4	35.5	167	214	45.668	59.168	278.339	356.674
1	ROC-01	ccc	1	19	19	c52	13.1	21.5	44.1	75.7	21.834	35.834	73.501	126.169
1	ROC-08	ccc	1	20	20	c12	26.2	37.6	161	222	43.668	62.668	268.339	370.007
1	ROC-02	quenched	1	21	21	c57	17.6	10.4	65.1	60.6	29.334	17.334	108.502	101.002
1	ROC-07	quenched	1	22	22	c64	50.3	28.1	56.8	101	83.835	46.834	94.669	168.337
1	ARM-1	ref	1	23	23	c26	10.5	8.32	22.0	36.7	17.500	13.867	36.667	61.168
1	ROC-09	quenched	1	24	24	c48	185	82.1	469	289	308.340	136.836	781.682	481.676
1	ROC-04	ccc	1	25	25	c68	5.85	18.6	43.2	55.0	9.750	31.001	72.001	91.669
1	Soln Std	ref	1	26	26	std-13	20.1	10.0	82.9	50.7	20.100	10.000	82.900	50.700
1	Soln Std	ref	2	1	27	std-21	19.6	9.96	81.1	49.8	19.600	9.960	81.100	49.800
1	ARM-1	ref	2	2	28	c60	9.98	8.11	21.3	35.8	16.634	13.517	35.501	59.668
1	ROC-02	ccc	2	3	29	c21	14.4	8.74	51.8	50.8	24.000	14.567	86.335	84.668
1	ROC-06	quenched	2	4	30	c11	58.5	24.1	83.3	58.3	97.502	40.167	138.836	97.169
1	ROC-10	quenched	2	5	31	c15	12.7	15.6	52.8	91.9	21.167	26.001	88.002	153.170
1	ROC-05	quenched	2	6	32	c01	15.9	13.3	46.5	70.1	26.501	22.167	77.502	116.836
1	ROC-02	quenched	2	7	33	c05	17.3	10.4	64.6	59.6	28.834	17.334	107.669	99.335
1	ROC-01	ccc	2	8	34	c35	12.9	20.9	43.0	74.2	21.500	34.834	71.668	123.669
1	ROC-08	quenched	2	9	35	c29	28.5	36.9	173	223	47.501	61.501	288.339	371.674
1	ROC-06	ccc	2	10	36	c19	55.2	23.1	80.6	62.7	92.002	38.501	134.336	104.502
1	ROC-05	ccc	2	11	37	c13	15.7	16.8	47.1	82.2	26.167	28.001	78.502	137.003
1	ROC-10	ccc	2	12	38	c58	12.9	16.2	52.9	93.1	21.500	27.001	88.168	155.170
1	Soln Std	ref	2	13	39	std-22	19.8	10.0	81.9	50.1	19.800	10.000	81.900	50.100
1	ROC-09	quenched	2	14	40	c10	178	79.8	459	282	296.673	133.003	765.015	470.009
1	ROC-03	ccc	2	15	41	c63	15.2	10.2	25.8	56.9	25.334	17.000	43.001	94.835
1	ROC-07	ccc	2	16	42	c03	43.0	24.5	51.7	103	71.668	40.834	86.168	171.670
1	ROC-08	ccc	2	17	43	c43	25.2	37.0	159	229	42.001	61.668	265.005	381.674
1	ROC-04	ccc	2	18	44	c67	5.79	18.9	44.1	56.0	9.650	31.501	73.501	93.335
1	ROC-09	ccc	2	19	45	c31	66.1	31.4	174	132	110.169	52.334	290.006	220.004
1	ROC-04	quenched	2	20	46	c25	7.25	13.7	46.0	50.6	12.084	22.834	76.668	84.335
1	ROC-07	quenched	2	21	47	c53	53.5	29.9	61.2	109	89.168	49.834	102.002	181.670
1	ROC-03	quenched	2	22	48	c54	14.4	10.0	23.9	53.8	24.000	16.667	39.834	89.668
1	ROC-01	quenched	2	23	49	c04	12.9	17.4	44.1	64.3	21.500	29.001	73.501	107.169
1	EA	ref	2	24	50	c45	35.8	11.5	99.6	56.0	596.668	191.667	1660.003	933.335
1	Soln Std	ref	2	25	51	std-23	19.9	9.96	82.2	50.2	19.900	9.960	82.200	50.200
1	Soln Std	ref	3	1	52	std-31	19.8	10.0	81.6	50.2	19.800	10.000	81.600	50.200
1	ROC-04	ccc	3	2	53	c38	5.75	18.7	43.2	55.2	9.584	31.167	72.001	92.002
1	ROC-04	quenched	3	3	54	c34	7.56	14.5	48.1	53.0	12.600	24.167	80.168	88.335
1	ROC-06	ccc	3	4	55	c14	50.7	21.1	73.1	57.1	84.502	35.167	121.836	95.169
1	ROC-07	ccc	3	5	56	c49	44.8	25.5	53.3	107	74.668	42.501	88.835	178.337
1	ROC-08	quenched	3	6	57	c62	28.0	36.1	169	218	46.668	60.168	281.672	363.341
1	ROC-01	ccc	3	7	58	c40	13.4	21.7	44.3	77.4	22.334	36.167	73.835	129.003
1	ROC-03	ccc	3	8	59	c18	15.0	10.1	25.3	56.3	25.001	16.834	42.168	93.835
1	ROC-07	quenched	3	9	60	c42	54.6	30.4	61.6	109	91.002	50.668	102.669	181.670
1	ROC-01	quenched	3	10	61	c24	12.1	16.7	40.8	60.2	20.167	27.834	68.001	100.335
1	blank	ref	3	11	62	c47	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
1	ROC-06	quenched	3	12	63	c33	57.5	23.4	80.3	57.2	95.835	39.001	133.836	95.335
1	Soln Std	ref	3	13	64	std-32	19.9	9.98	81.2	50.3	19.900	9.980	81.200	50.300
1	ROC-09	quenched	3	14	65	c22	182	80.5	463	284	303.339	134.169	771.682	473.343
1	ROC-03	quenched	3	15	66	c66	15.5	10.8	25.5	57.9	25.834	18.000	42.501	96.502
1	ROC-02	quenched	3	16	67	c07	17.4	10.2	63.7	59.6	29.001	17.000	106.169	99.335
1	ROC-09	ccc	3	17	68	c02	63.0	30.0	163	129	105.002	50.001	271.672	215.004
1	ARM-1	ref	3	18	69	c37	10.8	8.47	22.6	38.0	18.000	14.117	37.667	63.335
1	ROC-02	ccc	3	19	70	c55	15.3	9.07	54.1	53.4	25.501	15.117	90.168	89.002

Table B1. Analytical Development's Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

Set	Glass ID	Heat Treatment	Block	Seq	Analytical Sequence	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
1	ROC-05	ccc	3	20	71	c59	15.5	16.0	45.3	80.3	25.834	26.667	75.502	133.836
1	ROC-08	ccc	3	21	72	c28	26.8	37.2	160	221	44.668	62.001	266.672	368.341
1	ROC-10	ccc	3	22	73	c39	9.86	11.9	39.8	71.6	16.434	19.834	66.335	119.336
1	EA	ref	3	23	74	c16	37.8	11.4	103	55.5	630.001	190.000	1716.670	925.002
1	ROC-05	quenched	3	24	75	c61	15.60	12.6	44.3	68.9	26.001	21.000	73.835	114.836
1	ROC-10	quenched	3	25	76	c30	13.0	15.4	52.5	93.5	21.667	25.667	87.502	155.836
1	Soln Std	ref	3	26	77	std-33	20.5	10.0	81.8	51.0	20.500	10.000	81.800	51.000
2	Soln Std	ref	1	1	78	std-11	20.1	9.93	81.5	49.9	20.100	9.930	81.500	49.900
2	ROC-20	quenched	1	2	79	d17	159	71.7	368	245	265.005	119.502	613.346	408.342
2	ROC-14	quenched	1	3	80	d51	25.7	14.3	35.0	45.1	42.834	23.834	58.335	75.168
2	ROC-20	ccc	1	4	81	d20	122	58.3	288	221	203.337	97.169	480.010	368.341
2	ROC-12	ccc	1	5	82	d23	12.0	19.3	63.5	72.5	20.000	32.167	105.835	120.836
2	ROC-16	ccc	1	6	83	d36	84.6	77.9	138	250	141.003	129.836	230.005	416.675
2	ROC-15	ccc	1	7	84	d27	6.79	10.5	73.4	80.9	11.317	17.500	122.336	134.836
2	ROC-16	quenched	1	8	85	d56	85.0	77.2	140	247	141.670	128.669	233.338	411.675
2	ROC-13	ccc	1	9	86	d32	6.59	13.6	30.5	63.9	10.984	22.667	50.834	106.502
2	ROC-11	quenched	1	10	87	d09	9.38	13.5	43.6	91.6	15.634	22.500	72.668	152.670
2	blank	ref	1	11	88	d06	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
2	ROC-19	ccc	1	12	89	d65	50.0	20.9	63.2	103	83.335	34.834	105.335	171.670
2	Soln Std	ref	1	13	90	std-12	20.1	9.92	81.2	50.1	20.100	9.920	81.200	50.100
2	ROC-13	quenched	1	14	91	d41	6.32	12.7	30.4	61.5	10.534	21.167	50.668	102.502
2	EA	ref	1	15	92	d46	37.6	11.9	104	58.3	626.668	198.334	1733.337	971.669
2	ROC-17	ccc	1	16	93	d08	9.19	16.5	96.3	102	15.317	27.501	160.503	170.003
2	ROC-15	quenched	1	17	94	d50	6.92	8.60	68.2	71.7	11.534	14.334	113.669	119.502
2	ROC-18	quenched	1	18	95	d44	9.42	11.7	40.9	80.3	15.700	19.500	68.168	133.836
2	ROC-11	ccc	1	19	96	d52	8.26	13.2	38.2	86.8	13.767	22.000	63.668	144.670
2	ROC-18	ccc	1	20	97	d12	7.52	10.7	34.1	73.4	12.534	17.834	56.834	122.336
2	ROC-12	quenched	1	21	98	d57	12.6	19.8	69.9	78.0	21.000	33.001	116.502	130.003
2	ROC-17	quenched	1	22	99	d64	10.6	14.3	96.3	97.6	17.667	23.834	160.503	162.670
2	ARM-1	ref	1	23	100	d26	12.7	9.16	24.1	39.2	21.167	15.267	40.167	65.335
2	ROC-19	quenched	1	24	101	d48	50.4	21.0	62.6	101	84.002	35.001	104.335	168.337
2	ROC-14	ccc	1	25	102	d68	35.8	19.3	42.6	45.9	59.668	32.167	71.001	76.502
2	Soln Std	ref	1	26	103	std-13	20.1	9.84	81.6	50.1	20.100	9.840	81.600	50.100
2	Soln Std	ref	2	1	104	std-21	20.1	9.99	82.3	50.2	20.100	9.990	82.300	50.200
2	ARM-1	ref	2	2	105	d60	10.8	8.27	21.5	36.1	18.000	13.784	35.834	60.168
2	ROC-12	ccc	2	3	106	d21	12.1	19.7	64.6	73.6	20.167	32.834	107.669	122.669
2	ROC-16	quenched	2	4	107	d11	90.2	81.8	150	262	150.336	136.336	250.005	436.675
2	ROC-20	quenched	2	5	108	d15	154	69.0	359	238	256.672	115.002	598.345	396.675
2	ROC-15	quenched	2	6	109	d01	6.52	8.12	64.1	66.7	10.867	13.534	106.835	111.169
2	ROC-12	quenched	2	7	110	d05	13.0	20.4	73.7	79.5	21.667	34.001	122.836	132.503
2	ROC-11	ccc	2	8	111	d35	8.15	13.2	38.8	87.0	13.584	22.000	64.668	145.003
2	ROC-18	quenched	2	9	112	d29	9.32	11.7	40.7	79.5	15.534	19.500	67.835	132.503
2	ROC-16	ccc	2	10	113	d19	84.1	78.3	139	251	140.169	130.503	231.671	418.342
2	ROC-15	ccc	2	11	114	d13	6.59	10.4	72.8	79.6	10.984	17.334	121.336	132.669
2	ROC-20	ccc	2	12	115	d58	123	59.3	293	224	205.004	98.835	488.343	373.341
2	Soln Std	ref	2	13	116	std-22	20.1	10.0	81.8	50.1	20.100	10.000	81.800	50.100
2	ROC-19	quenched	2	14	117	d10	51.4	22.0	64.8	103	85.668	36.667	108.002	171.670
2	ROC-13	ccc	2	15	118	d63	6.52	13.7	30.5	63.2	10.867	22.834	50.834	105.335
2	ROC-17	ccc	2	16	119	d03	9.24	16.8	97.9	102	15.400	28.001	163.170	170.003
2	ROC-18	ccc	2	17	120	d43	7.19	10.4	32.8	71.1	11.984	17.334	54.668	118.502
2	ROC-14	ccc	2	18	121	d67	37.6	20.9	45.9	47.9	62.668	34.834	76.502	79.835
2	ROC-19	ccc	2	19	122	d31	50.4	21.5	64.3	105	84.002	35.834	107.169	175.004
2	ROC-14	quenched	2	20	123	d25	23.4	13.3	32.5	42.3	39.001	22.167	54.168	70.501
2	ROC-17	quenched	2	21	124	d53	10.6	14.6	97.3	99.6	17.667	24.334	162.170	166.003
2	ROC-13	quenched	2	22	125	d54	6.60	13.4	32.6	64.1	11.000	22.334	54.334	106.835
2	ROC-11	quenched	2	23	126	d04	8.96	13.2	42.1	87.6	14.934	22.000	70.168	146.003
2	EA	ref	2	24	127	d45	38.7	11.9	107	56.6	645.001	198.334	1783.337	943.335
2	Soln Std	ref	2	25	128	std-23	20.0	9.93	81.9	50.0	20.000	9.930	81.900	50.000
2	Soln Std	ref	3	1	129	std-31	20.3	10.0	81.6	50.0	20.300	10.000	81.600	50.000
2	ROC-14	ccc	3	2	130	d38	37.2	20.6	44.2	45.5	62.001	34.334	73.668	75.835
2	ROC-14	quenched	3	3	131	d34	24.5	14.1	33.9	43.9	40.834	23.500	56.501	73.168
2	ROC-16	ccc	3	4	132	d14	84.2	80.2	138	252	140.336	133.669	230.005	420.008
2	ROC-17	ccc	3	5	133	d49	9.08	16.7	96.1	102	15.134	27.834	160.170	170.003
2	ROC-18	quenched	3	6	134	d62	9.30	11.7	40.5	77.8	15.500	19.500	67.501	129.669
2	ROC-11	ccc	3	7	135	d40	8.28	13.5	38.5	87.0	13.800	22.500	64.168	145.003
2	ROC-13	ccc	3	8	136	d18	6.76	14.4	31.7	65.0	11.267	24.000	52.834	108.336
2	ROC-17	quenched	3	9	137	d42	10.8	15.0	99.1	103	18.000	25.001	165.170	171.670
2	ROC-11	quenched	3	10	138	d24	9.63	14.1	44.2	93.2	16.050	23.500	73.668	155.336
2	blank	ref	3	11	139	d47	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
2	ROC-16	quenched	3	12	140	d33	86.5	80.7	142	251	144.170	134.503	236.671	418.342

Table B1. Analytical Development's Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

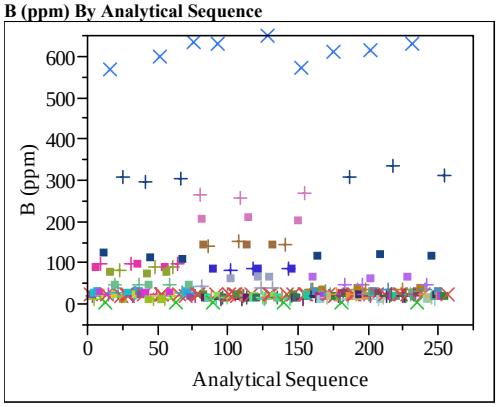
Set	Glass ID	Heat Treatment	Block	Seq	Analytical Sequence	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
2	Soln Std	ref	3	13	141	std-32	20.1	10.1	82.0	49.7	20.100	10.100	82.000	49.700
2	ROC-19	quenched	3	14	142	d22	51.0	22.0	63.9	102	85.002	36.667	106.502	170.003
2	ROC-13	quenched	3	15	143	d66	6.65	13.6	32.2	64.3	11.084	22.667	53.668	107.169
2	ROC-12	quenched	3	16	144	d07	12.7	20.4	71.4	78.0	21.167	34.001	119.002	130.003
2	ROC-19	ccc	3	17	145	d02	49.7	21.2	63.2	103	82.835	35.334	105.335	171.670
2	ARM-1	ref	3	18	146	d37	11.0	8.60	22.3	37.0	18.334	14.334	37.167	61.668
2	ROC-12	ccc	3	19	147	d55	12.2	20.2	64.7	74.6	20.334	33.667	107.835	124.336
2	ROC-15	ccc	3	20	148	d59	6.67	10.6	72.8	79.2	11.117	17.667	121.336	132.003
2	ROC-18	ccc	3	21	149	d28	7.45	10.9	33.9	71.8	12.417	18.167	56.501	119.669
2	ROC-20	ccc	3	22	150	d39	120	59.2	285	218	200.004	98.669	475.010	363.341
2	EA	ref	3	23	151	d16	34.0	10.6	93.7	49.2	566.668	176.667	1561.670	820.002
2	ROC-15	quenched	3	24	152	d61	7.34	9.07	71.5	74.1	12.234	15.117	119.169	123.502
2	ROC-20	quenched	3	25	153	d30	161	73.6	376	247	268.339	122.669	626.679	411.675
2	Soln Std	ref	3	26	154	std-33	20.2	10.1	82.5	50.1	20.200	10.100	82.500	50.100
3	Soln Std	ref	1	1	155	std-11	20.1	10.0	81.0	50.2	20.100	10.000	81.000	50.200
3	ROC-22	ccc	1	2	156	e23	13.1	15.2	41.1	86.7	21.834	25.334	68.501	144.503
3	FY09EM21-29	ccc	1	3	157	e78	9.91	12.4	49.1	66.5	16.517	20.667	81.835	110.836
3	ROC-28	quenched	1	4	158	e44	21.8	24.2	197	229	36.334	40.334	328.340	381.674
3	ROC-21	quenched	1	5	159	e09	21.0	11.4	33.6	48.5	35.001	19.000	56.001	80.835
3	ROC-29	ccc	1	6	160	e65	38.7	19.7	47.8	50.6	64.501	32.834	79.668	84.335
3	ROC-24	ccc	1	7	161	e68	12.0	7.38	22.3	47.3	20.000	12.300	37.167	78.835
3	ROC-24	quenched	1	8	162	e51	12.4	7.95	22.6	46.8	20.667	13.250	37.667	78.002
3	ROC-28	ccc	1	9	163	e12	16.7	20.0	157	175	27.834	33.334	261.672	291.673
3	ROC-09	ccc	1	10	164	e92	68.9	34.2	188	148	114.836	57.001	313.340	246.672
3	ROC-25	ccc	1	11	165	e27	10.4	13.1	86.1	95.1	17.334	21.834	143.503	158.503
3	ROC-23	ccc	1	12	166	e32	5.95	9.56	26.6	60.8	9.917	15.934	44.334	101.335
3	ROC-21	ccc	1	13	167	e52	19.8	11.0	31.9	49.6	33.001	18.334	53.168	82.668
3	FY09EM21-30	ccc	1	14	168	e70	9.98	12.7	47.1	67.1	16.634	21.167	78.502	111.836
3	ROC-22	quenched	1	15	169	e57	17.9	18.5	54.6	101	29.834	30.834	91.002	168.337
3	ROC-26	quenched	1	16	170	e56	10.0	9.34	86.8	77.7	16.667	15.567	144.670	129.503
3	Soln Std	ref	1	17	171	std-12	20.0	9.99	81.9	50.0	20.000	9.990	81.900	50.000
3	FY09EM21-29	quenched	1	18	172	e73	14.6	16.1	61.4	76.6	24.334	26.834	102.335	127.669
3	ROC-26	ccc	1	19	173	e36	8.59	8.84	71.9	72.6	14.317	14.734	119.836	121.002
3	EA	ref	1	20	174	e46	36.5	11.6	101	55.6	608.335	193.334	1683.337	926.669
3	ARM-1	ref	1	21	175	e26	10.5	8.31	21.1	36.9	17.500	13.850	35.167	61.501
3	ROC-27	ccc	1	22	176	e08	10.2	14.8	61.3	93.4	17.000	24.667	102.169	155.670
3	FY09EM21-28	quenched	1	23	177	e74	13.4	14.6	57.4	68.9	22.334	24.334	95.669	114.836
3	ROC-25	quenched	1	24	178	e50	11.4	13.4	99.4	105	19.000	22.334	165.670	175.004
3	ROC-30	quenched	1	25	179	e17	12.8	11.3	45.9	67.5	21.334	18.834	76.502	112.502
3	blank	ref	1	26	180	e06	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
3	FY09EM21-30	quenched	1	27	181	e69	13.3	14.6	54.6	68.8	22.167	24.334	91.002	114.669
3	ROC-29	quenched	1	28	182	e48	27.6	14.7	40.8	49.4	46.001	24.500	68.001	82.335
3	ROC-30	ccc	1	29	183	e20	13.5	12.3	46.2	70.4	22.500	20.500	77.002	117.336
3	ROC-27	quenched	1	30	184	e64	12.5	15.2	69.6	94.8	20.834	25.334	116.002	158.003
3	ROC-23	quenched	1	31	185	e41	7.26	10.5	29.1	62.8	12.100	17.500	48.501	104.669
3	ROC-09	quenched	1	32	186	e87	184	83.1	465	284	306.673	138.503	775.016	473.343
3	FY09EM21-28	ccc	1	33	187	e72	10.5	13.2	51.4	68.7	17.500	22.000	85.668	114.502
3	Soln Std	ref	1	34	188	std-13	20.2	10.0	82.0	50.0	20.200	10.000	82.000	50.000
3	Soln Std	ref	2	1	189	std-21	20.6	10.1	81.0	51.0	20.600	10.100	81.000	51.000
3	FY09EM21-28	quenched	2	2	190	e79	13.9	14.9	58.8	71.6	23.167	24.834	98.002	119.336
3	ROC-22	quenched	2	3	191	e05	20.5	20.4	58.4	105	34.167	34.001	97.335	175.004
3	ROC-26	ccc	2	4	192	e19	9.21	9.48	77.5	79.6	15.350	15.800	129.169	132.669
3	ROC-21	ccc	2	5	193	e35	20.5	11.2	32.8	51.4	34.167	18.667	54.668	85.668
3	ROC-24	ccc	2	6	194	e67	12.5	7.56	24.7	49.3	20.834	12.600	41.167	82.168
3	ROC-29	quenched	2	7	195	e10	27.5	14.4	41.3	49.0	45.834	24.000	68.835	81.668
3	FY09EM21-30	quenched	2	8	196	e71	13.5	14.7	55.7	69.2	22.500	24.500	92.835	115.336
3	ROC-21	quenched	2	9	197	e04	22.0	11.9	35.2	49.9	36.667	19.834	58.668	83.168
3	FY09EM21-28	ccc	2	10	198	e76	9.84	12.5	48.5	66.7	16.400	20.834	80.835	111.169
3	FY09EM21-29	quenched	2	11	199	e77	14.3	15.6	59.5	74.5	23.834	26.001	99.169	124.169
3	EA	ref	2	12	200	e45	36.7	11.6	98.8	55.2	611.668	193.334	1646.670	920.002
3	ROC-25	quenched	2	13	201	e01	11.4	13.3	98.1	100	19.000	22.167	163.503	166.670

Table B1. Analytical Development's Measurements of the PCT Solutions As-Received (ar) and After Appropriate Adjustments (in ppm)

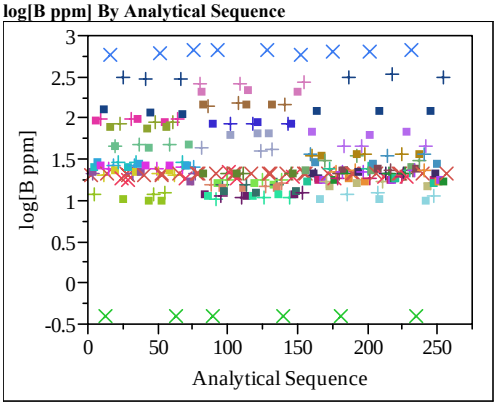
Set	Glass ID	Heat Treatment	Block	Seq	Analytical Sequence	Lab ID	B ar	Li ar	Na ar	Si ar	B (ppm)	Li (ppm)	Na (ppm)	Si (ppm)
3	ROC-29	ccc	2	14	202	e31	36.4	18.5	46.6	50.6	60.668	30.834	77.668	84.335
3	ROC-22	ccc	2	15	203	e21	13.6	15.7	41.4	89.9	22.667	26.167	69.001	149.836
3	ROC-28	ccc	2	16	204	e43	16.0	18.7	147	160	26.667	31.167	245.005	266.672
3	Soln Std	ref	2	17	205	std-22	20.3	10.0	79.9	50.3	20.300	10.000	79.900	50.300
3	ROC-23	quenched	2	18	206	e54	7.42	10.5	28.0	63.9	12.367	17.500	46.668	106.502
3	ROC-30	ccc	2	19	207	e58	14.0	12.7	46.7	73.4	23.334	21.167	77.835	122.336
3	ROC-09	ccc	2	20	208	e89	69.5	34.1	183	147	115.836	56.834	305.006	245.005
3	ROC-23	ccc	2	21	209	e63	5.93	9.39	24.7	60.0	9.884	15.650	41.167	100.002
3	ROC-26	quenched	2	22	210	e11	10.3	9.43	85.6	79.1	17.167	15.717	142.670	131.836
3	ARM-1	ref	2	23	211	e60	11.4	8.8	22.8	38.8	19.000	14.667	38.001	64.668
3	ROC-24	quenched	2	24	212	e25	12.7	7.99	23.6	48.2	21.167	13.317	39.334	80.335
3	ROC-28	quenched	2	25	213	e29	20.8	22.8	183	180	34.667	38.001	305.006	300.006
3	ROC-27	quenched	2	26	214	e53	12.8	15.2	69.5	95.6	21.334	25.334	115.836	159.337
3	ROC-30	quenched	2	27	215	e15	13.8	12.1	48.5	71.6	23.000	20.167	80.835	119.336
3	ROC-25	ccc	2	28	216	e13	10.4	12.9	83.6	96.6	17.334	21.500	139.336	161.003
3	ROC-09	quenched	2	29	217	e91	201	89	497	307	335.007	148.336	828.350	511.677
3	FY09EM21-30	ccc	2	30	218	e75	10.3	12.9	46.8	69.2	17.167	21.500	78.002	115.336
3	ROC-27	ccc	2	31	219	e03	10.5	15.1	60.4	95.6	17.500	25.167	100.669	159.337
3	FY09EM21-29	ccc	2	32	220	e81	10.8	13.1	50.5	70.9	18.000	21.834	84.168	118.169
3	Soln Std	ref	2	33	221	std-23	20.5	10.1	80.7	51.0	20.500	10.100	80.700	51.000
3	Soln Std	ref	3	1	222	std-31	20.4	10.1	81.6	51.0	20.400	10.100	81.600	51.000
3	ROC-21	quenched	3	2	223	e24	22.2	11.9	34.0	49.0	37.001	19.834	56.668	81.668
3	ROC-25	quenched	3	3	224	e61	11.6	13.4	99.1	102	19.334	22.334	165.170	170.003
3	ROC-24	quenched	3	4	225	e34	12.5	7.94	23.3	47.5	20.834	13.234	38.834	79.168
3	ROC-27	quenched	3	5	226	e42	12.8	15.4	70.5	102	21.334	25.667	117.502	170.003
3	ARM-1	ref	3	6	227	e37	11.1	8.57	22.7	37.6	18.500	14.284	37.834	62.668
3	ROC-29	ccc	3	7	228	e02	38.4	19.3	47.1	50.1	64.001	32.167	78.502	83.502
3	FY09EM21-29	quenched	3	8	229	e83	13.8	15.1	58.2	73.0	23.000	25.167	97.002	121.669
3	EA	ref	3	9	230	e16	37.7	11.6	101	55.0	628.335	193.334	1683.337	916.669
3	ROC-30	quenched	3	10	231	e30	14.0	12.5	49.0	73.7	23.334	20.834	81.668	122.836
3	ROC-22	ccc	3	11	232	e55	14.3	16.4	44.0	96.3	23.834	27.334	73.335	160.503
3	FY09EM21-30	quenched	3	12	233	e86	14.0	15.3	57.7	72.7	23.334	25.501	96.169	121.169
3	blank	ref	3	13	234	e47	< 0.460	< 0.102	< 0.332	< 0.301	0.383	0.085	0.277	0.251
3	ROC-30	ccc	3	14	235	e39	13.8	12.7	48.3	73.1	23.000	21.167	80.502	121.836
3	ROC-22	quenched	3	15	236	e07	18.0	18.6	54.6	101	30.001	31.001	91.002	168.337
3	ROC-21	ccc	3	16	237	e40	21.3	11.8	33.7	53.3	35.501	19.667	56.168	88.835
3	Soln Std	ref	3	17	238	std-32	20.1	10.0	81.9	50.4	20.100	10.000	81.900	50.400
3	ROC-28	quenched	3	18	239	e62	21.8	24.4	195	211	36.334	40.667	325.007	351.674
3	FY09EM21-28	quenched	3	19	240	e85	13.8	15.2	57.9	72.4	23.000	25.334	96.502	120.669
3	ROC-29	quenched	3	20	241	e22	27.7	14.7	40.8	49.9	46.168	24.500	68.001	83.168
3	ROC-23	ccc	3	21	242	e18	5.73	9.41	25.4	60.1	9.550	15.684	42.334	100.169
3	ROC-26	ccc	3	22	243	e14	8.41	8.84	70.6	72.7	14.017	14.734	117.669	121.169
3	ROC-26	quenched	3	23	244	e33	9.79	9.17	85.3	77.4	16.317	15.284	142.170	129.003
3	ROC-09	ccc	3	24	245	e88	69.0	33.7	185	148	115.002	56.168	308.340	246.672
3	ROC-23	quenched	3	25	246	e66	6.89	10.1	26.8	61.7	11.484	16.834	44.668	102.835
3	ROC-25	ccc	3	26	247	e59	10.2	13.2	83.1	103	17.000	22.000	138.503	171.670
3	FY09EM21-29	ccc	3	27	248	e84	9.50	11.9	46.9	65.4	15.834	19.834	78.168	109.002
3	ROC-24	ccc	3	28	249	e38	12.3	7.59	23.9	48.9	20.500	12.650	39.834	81.502
3	ROC-28	ccc	3	29	250	e28	15.9	19.0	148	201	26.501	31.667	246.672	335.007
3	FY09EM21-28	ccc	3	30	251	e80	9.68	12.4	47.0	66.5	16.134	20.667	78.335	110.836
3	FY09EM21-30	ccc	3	31	252	e82	9.98	13.0	47.3	68.6	16.634	21.667	78.835	114.336
3	ROC-09	quenched	3	32	253	e90	188	84.1	461	287	313.340	140.169	768.349	478.343
3	ROC-27	ccc	3	33	254	e49	9.92	14.6	58.3	94.1	16.534	24.334	97.169	156.836
3	Soln Std	ref	3	34	255	std-33	20.1	10.0	79.5	50.5	20.100	10.000	79.500	50.500

Exhibit B1. PCT Measurements in Analytical Sequence over All of the Analytical Plans

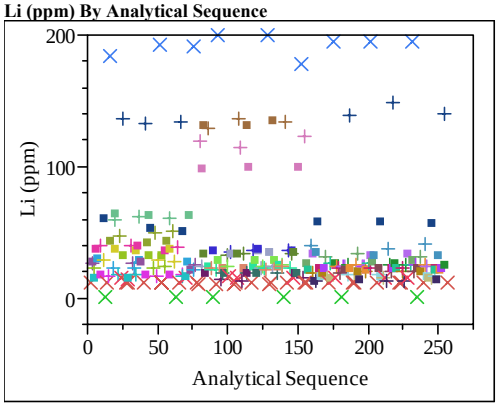
B (ppm) By Analytical Sequence



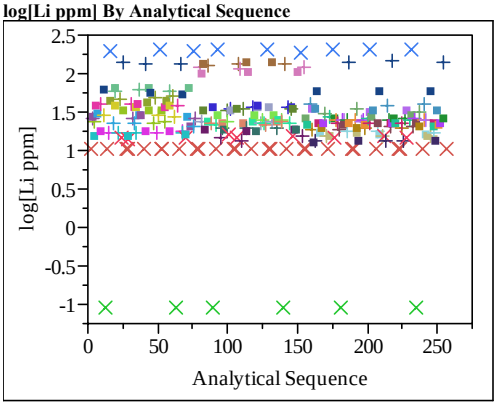
log[B ppm] By Analytical Sequence



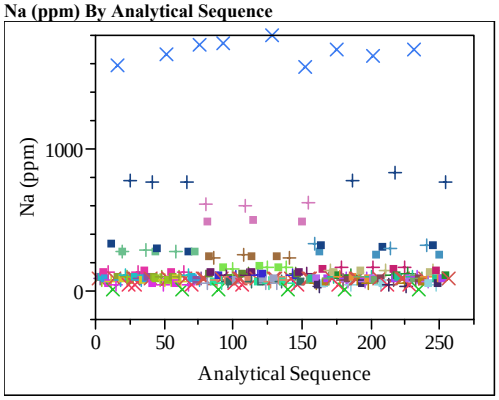
Li (ppm) By Analytical Sequence



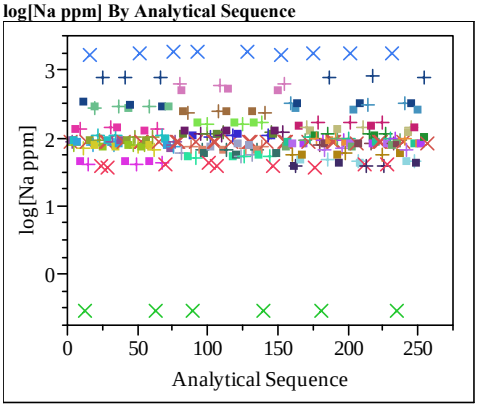
log[Li ppm] By Analytical Sequence



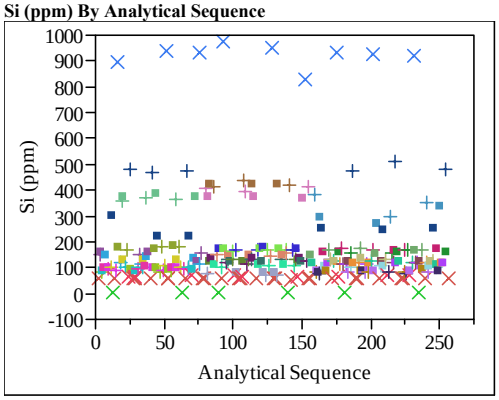
Na (ppm) By Analytical Sequence



log[Na ppm] By Analytical Sequence



Si (ppm) By Analytical Sequence



log[Si ppm] By Analytical Sequence

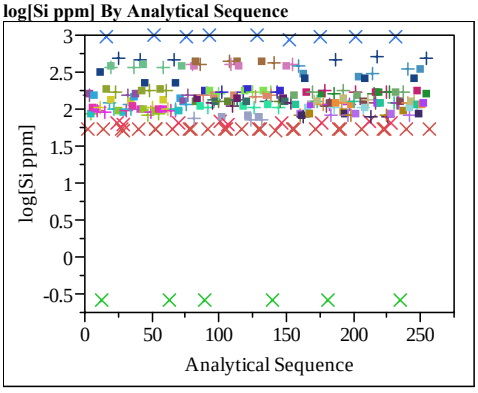
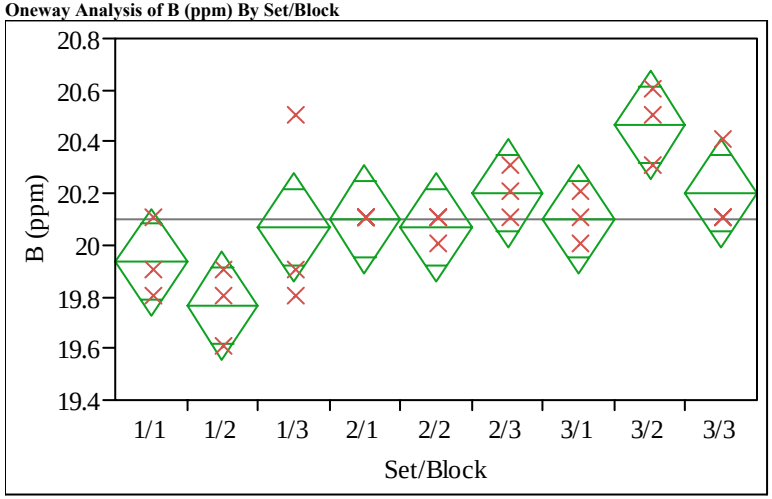


Exhibit B2. Measurements of the Multi-Element Solution Standard by ICP Block

Oneway Analysis of B (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.624413
Adj Rsquare	0.457486
Root Mean Square Error	0.172133
Mean of Response	20.1
Observations (or Sum Wgts)	27

Analysis of Variance

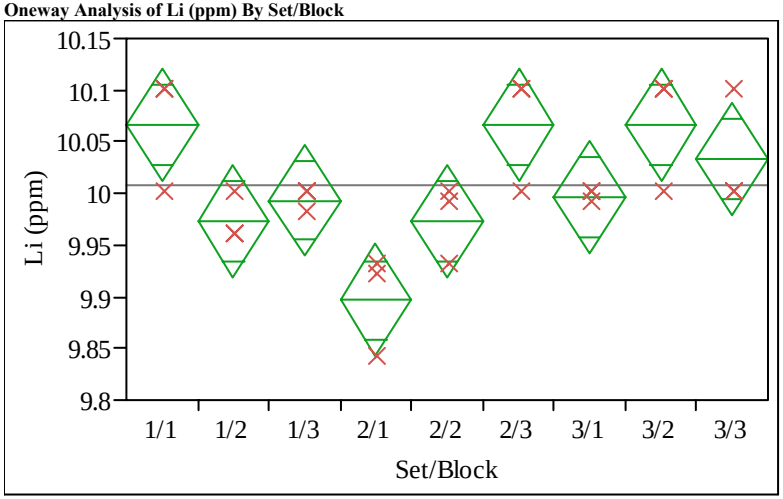
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	0.8866667	0.110833	3.7406	0.0096
Error	18	0.5333333	0.029630		
C. Total	26	1.4200000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	19.9333	0.09938	19.725	20.142
1/2	3	19.7667	0.09938	19.558	19.975
1/3	3	20.0667	0.09938	19.858	20.275
2/1	3	20.1000	0.09938	19.891	20.309
2/2	3	20.0667	0.09938	19.858	20.275
2/3	3	20.2000	0.09938	19.991	20.409
3/1	3	20.1000	0.09938	19.891	20.309
3/2	3	20.4667	0.09938	20.258	20.675
3/3	3	20.2000	0.09938	19.991	20.409

Std Error uses a pooled estimate of error variance

Oneway Analysis of Li (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.686291
Adj Rsquare	0.546865
Root Mean Square Error	0.044597
Mean of Response	10.00741
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	0.07831852	0.009790	4.9223	0.0024
Error	18	0.03580000	0.001989		
C. Total	26	0.11411852			

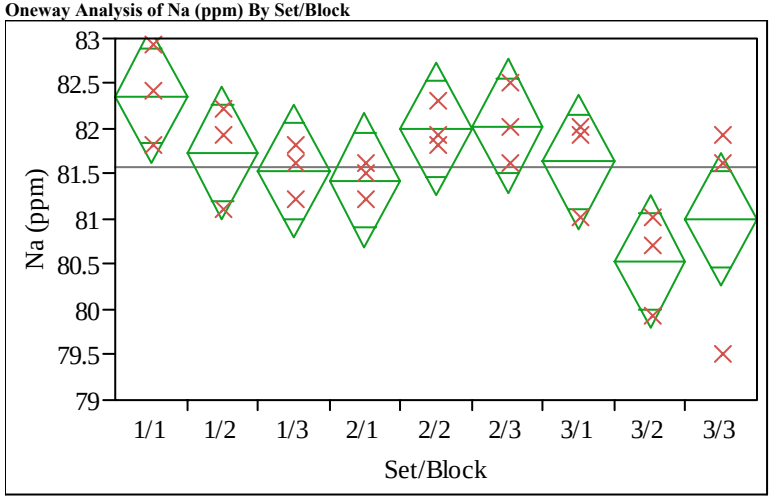
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	10.0667	0.02575	10.013	10.121
1/2	3	9.9733	0.02575	9.919	10.027
1/3	3	9.9933	0.02575	9.939	10.047
2/1	3	9.8967	0.02575	9.843	9.951
2/2	3	9.9733	0.02575	9.919	10.027
2/3	3	10.0667	0.02575	10.013	10.121
3/1	3	9.9967	0.02575	9.943	10.051
3/2	3	10.0667	0.02575	10.013	10.121
3/3	3	10.0333	0.02575	9.979	10.087

Std Error uses a pooled estimate of error variance

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

Oneway Analysis of Na (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.524684
Adj Rsquare	0.313433
Root Mean Square Error	0.612221
Mean of Response	81.58519
Observations (or Sum Wgts)	27

Analysis of Variance

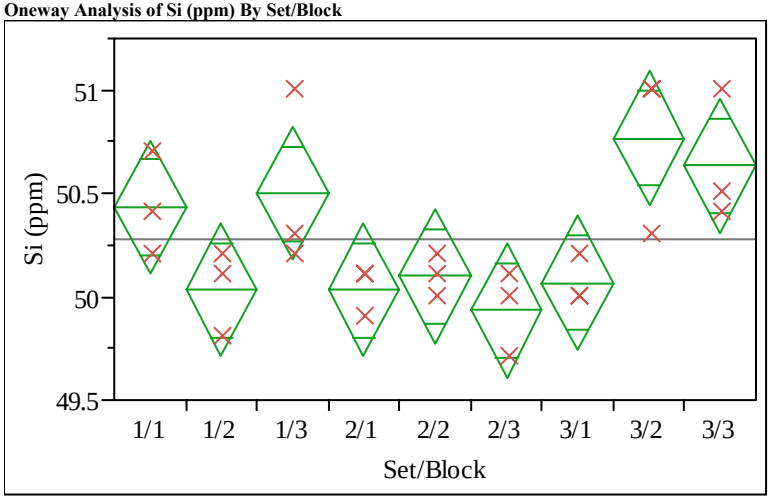
Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	7.447407	0.930926	2.4837	0.0519
Error	18	6.746667	0.374815		
C. Total	26	14.194074			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	82.3667	0.35347	81.624	83.109
1/2	3	81.7333	0.35347	80.991	82.476
1/3	3	81.5333	0.35347	80.791	82.276
2/1	3	81.4333	0.35347	80.691	82.176
2/2	3	82.0000	0.35347	81.257	82.743
2/3	3	82.0333	0.35347	81.291	82.776
3/1	3	81.6333	0.35347	80.891	82.376
3/2	3	80.5333	0.35347	79.791	81.276
3/3	3	81.0000	0.35347	80.257	81.743

Std Error uses a pooled estimate of error variance

Oneway Analysis of Si (ppm) By Set/Block



Oneway Anova
Summary of Fit

Rsquare	0.637218
Adj Rsquare	0.475982
Root Mean Square Error	0.26736
Mean of Response	50.27778
Observations (or Sum Wgts)	27

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Set/Block	8	2.2600000	0.282500	3.9521	0.0074
Error	18	1.2866667	0.071481		
C. Total	26	3.5466667			

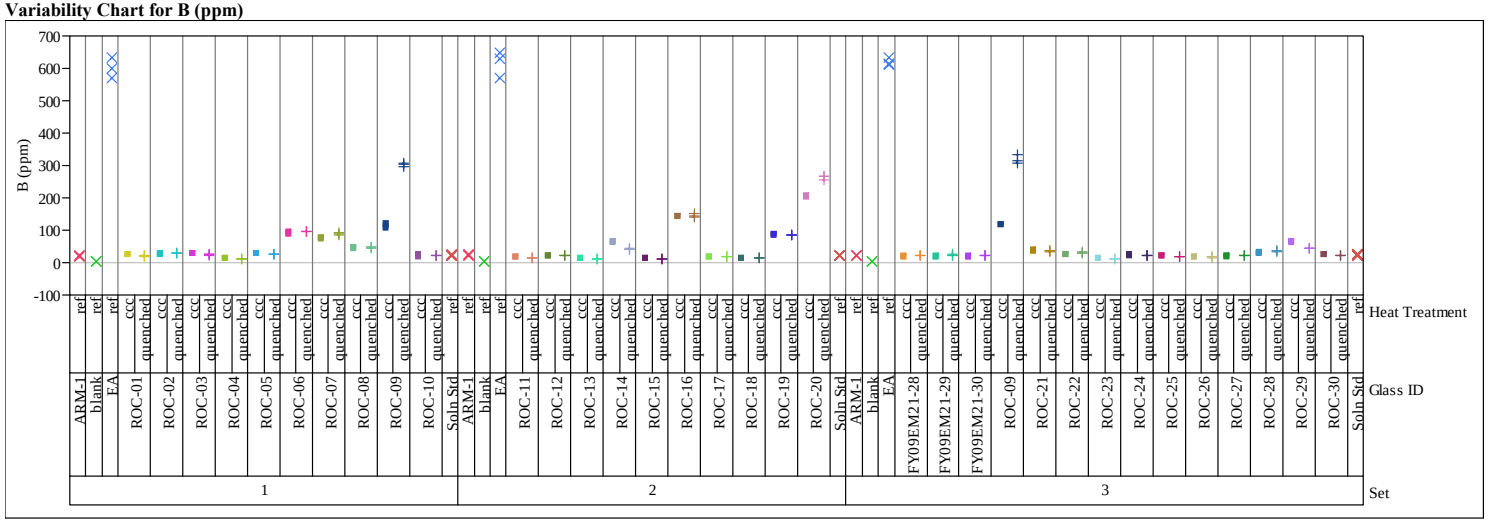
Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
1/1	3	50.4333	0.15436	50.109	50.758
1/2	3	50.0333	0.15436	49.709	50.358
1/3	3	50.5000	0.15436	50.176	50.824
2/1	3	50.0333	0.15436	49.709	50.358
2/2	3	50.1000	0.15436	49.776	50.424
2/3	3	49.9333	0.15436	49.609	50.258
3/1	3	50.0667	0.15436	49.742	50.391
3/2	3	50.7667	0.15436	50.442	51.091
3/3	3	50.6333	0.15436	50.309	50.958

Std Error uses a pooled estimate of error variance

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

Variability Chart for B (ppm)



Variability Chart for Li (ppm)

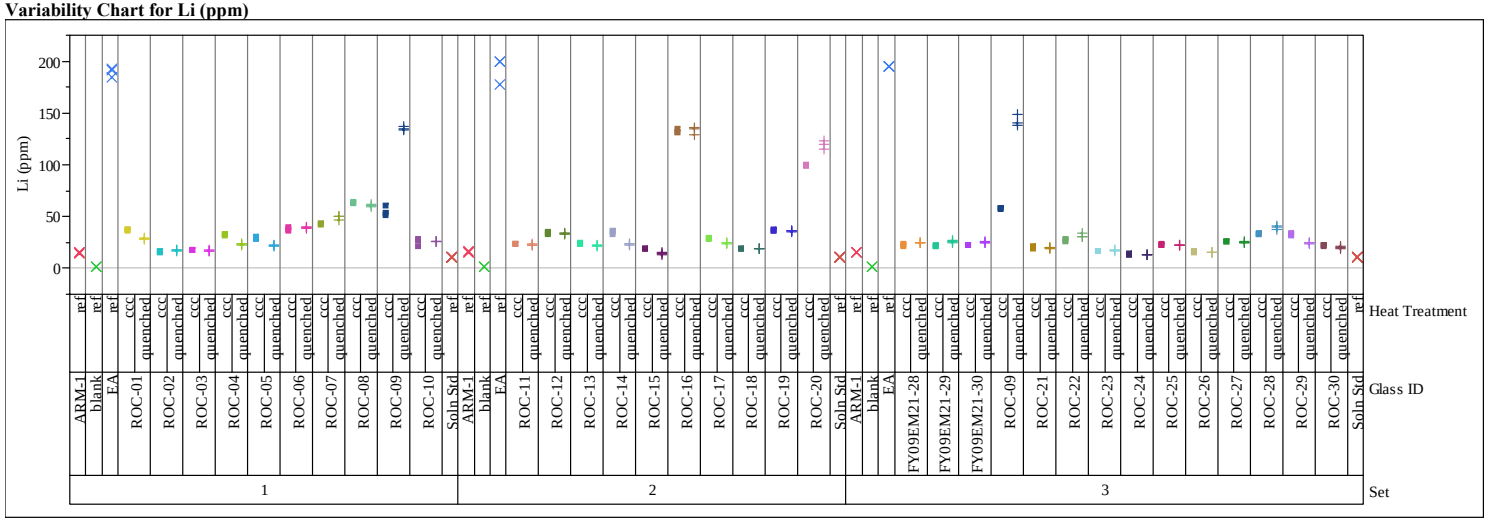
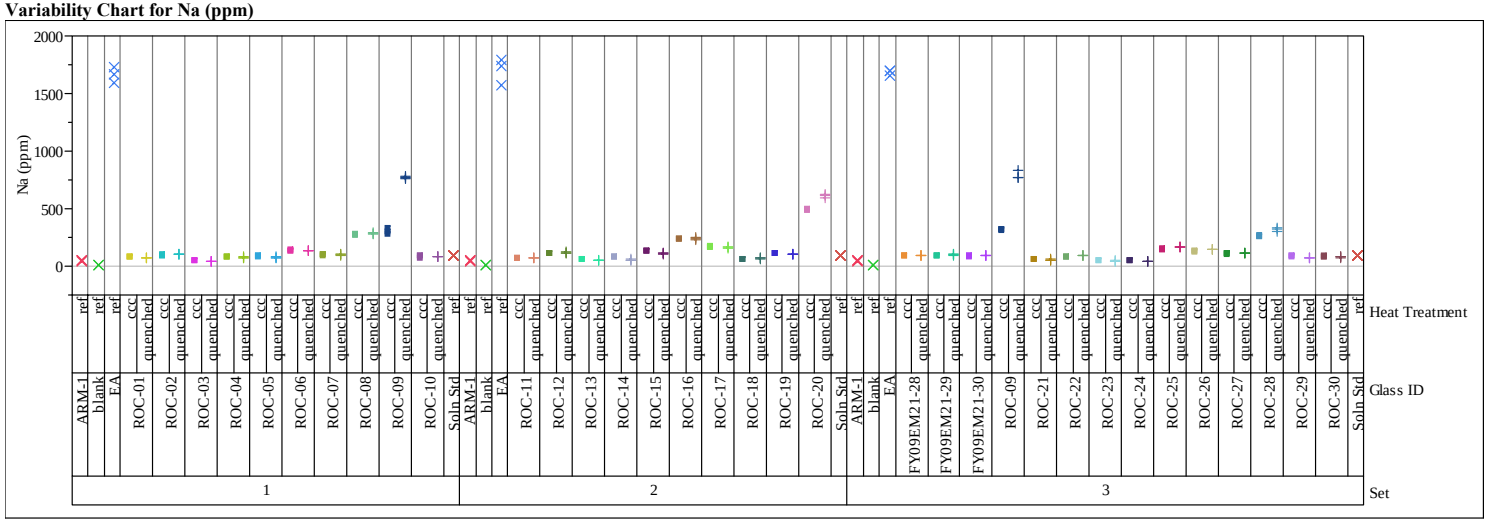


Exhibit B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Variability Chart for Na (ppm)



Variability Chart for Si (ppm)

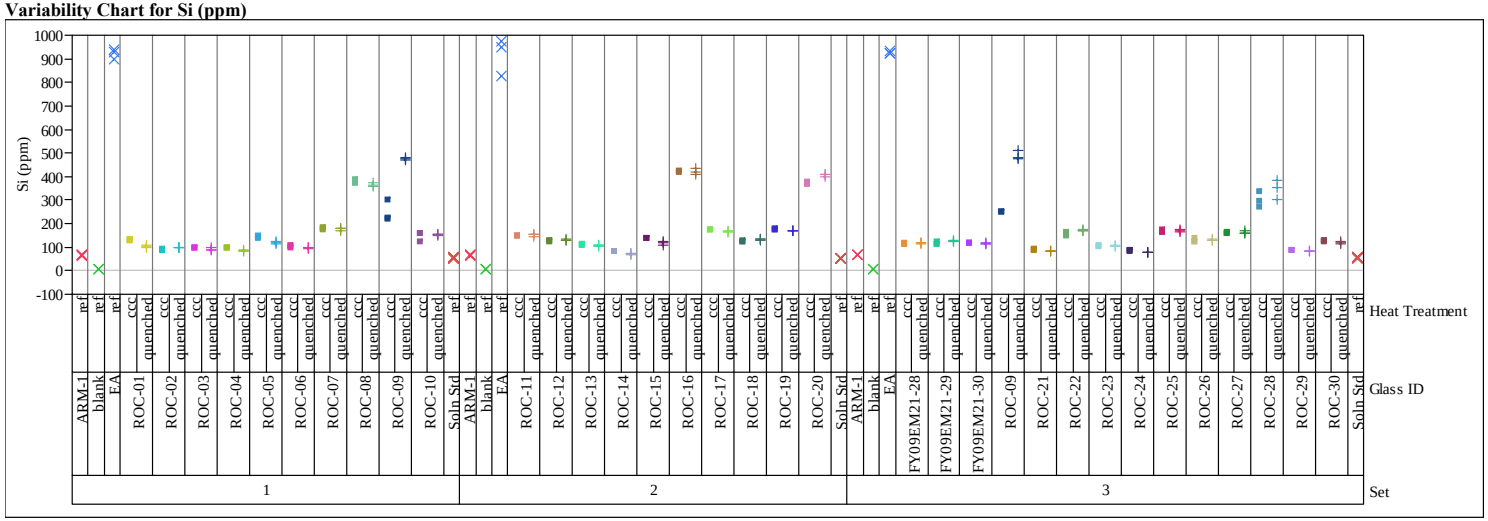
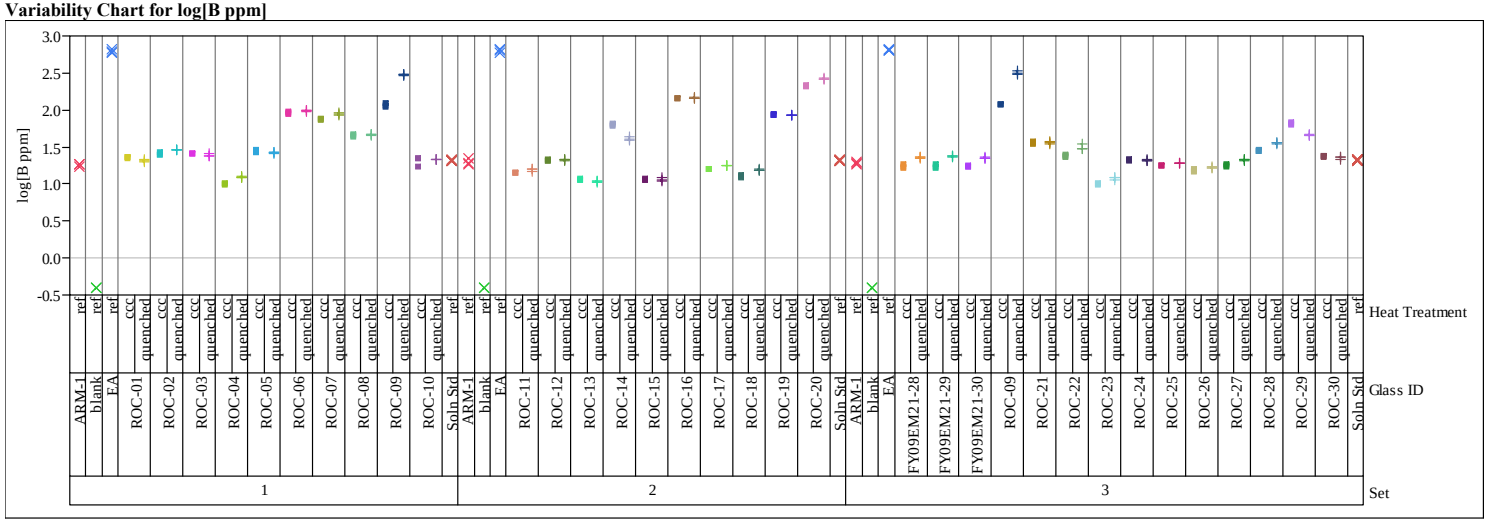


Exhibit B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Variability Chart for log[B ppm]



Variability Chart for log[Li ppm]

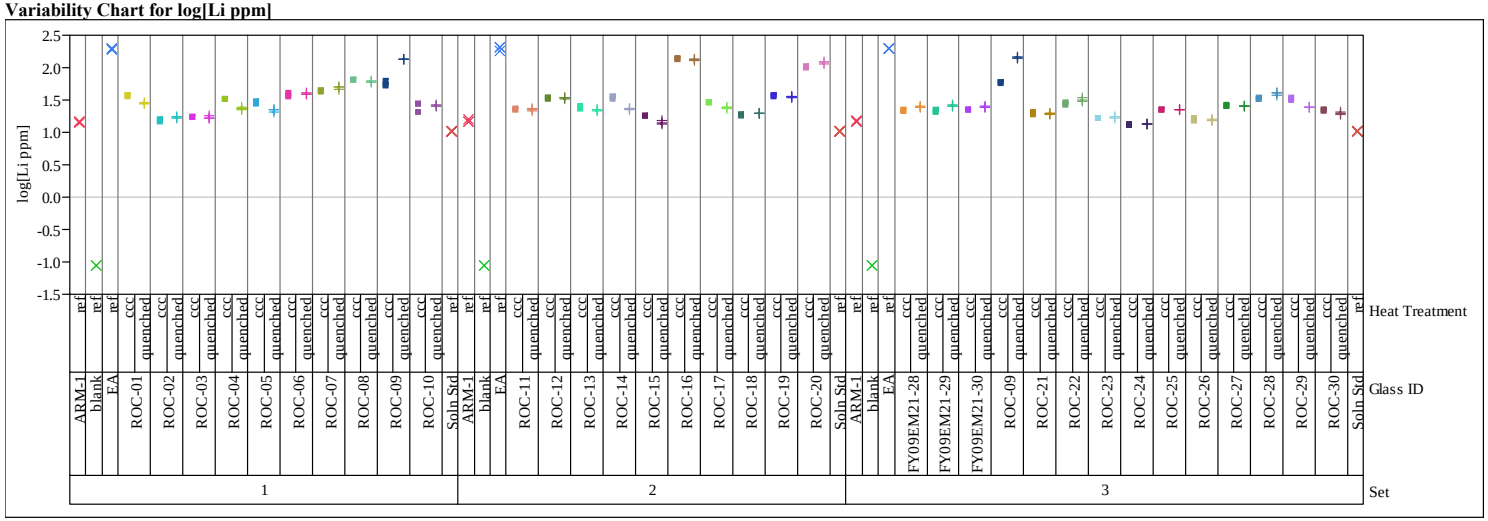
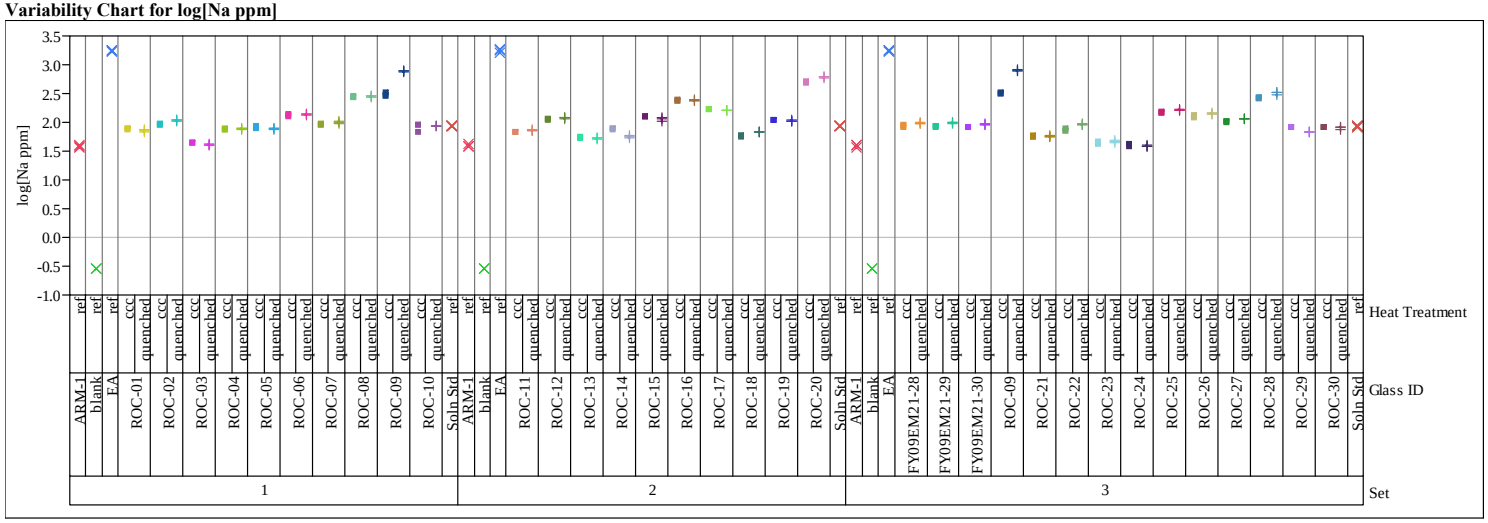


Exhibit B3. Laboratory PCT Measurements by Glass Identifier for Study Glasses and Standards

Variability Chart for log[Na ppm]



Variability Chart for log[Si ppm]

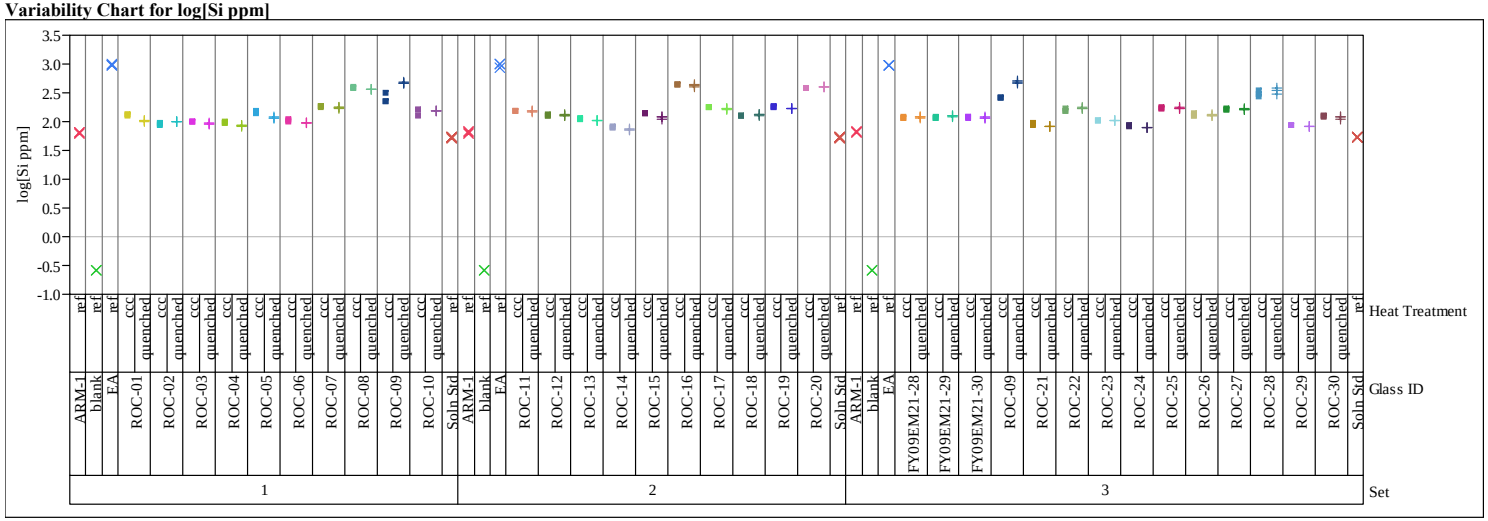


Exhibit B4. Correlations and Scatter Plots of Normalized PCTs Over All Compositional Views and Heat Treatments

Multivariate 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	0.9882	0.9608	0.9170
log NL[Li(g/L)]	0.9882	1.0000	0.9576	0.9152
log NL[Na (g/L)]	0.9608	0.9576	1.0000	0.9371
log NL[Si (g/L)]	0.9170	0.9152	0.9371	1.0000

Scatterplot Matrix

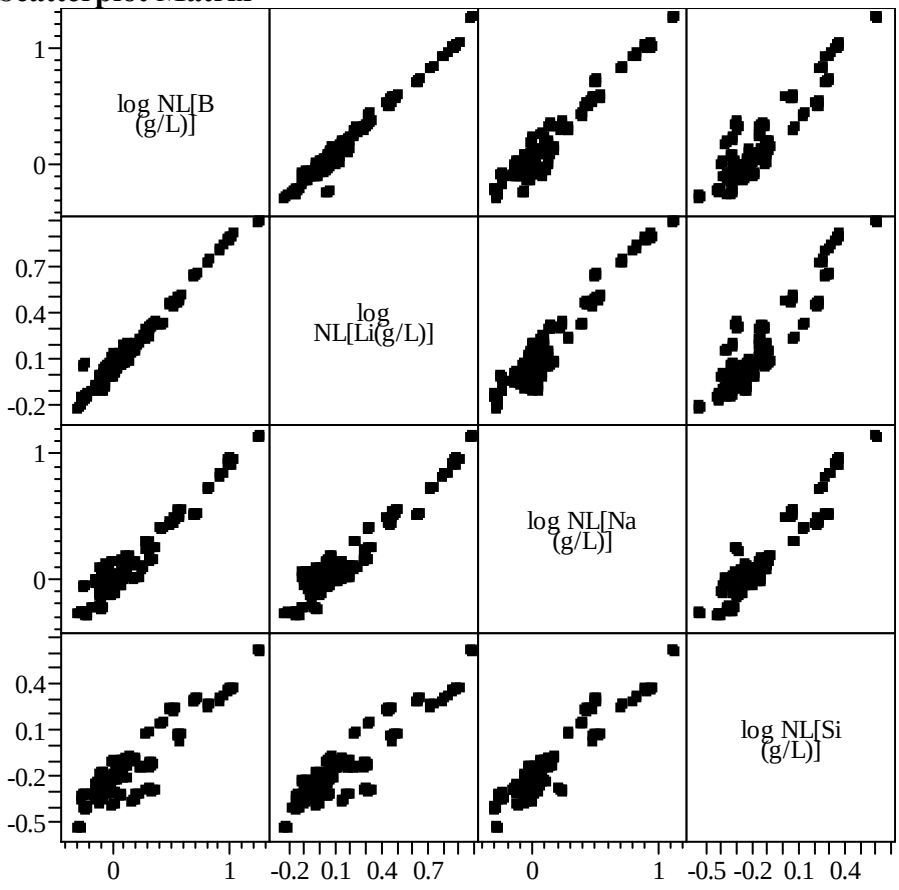
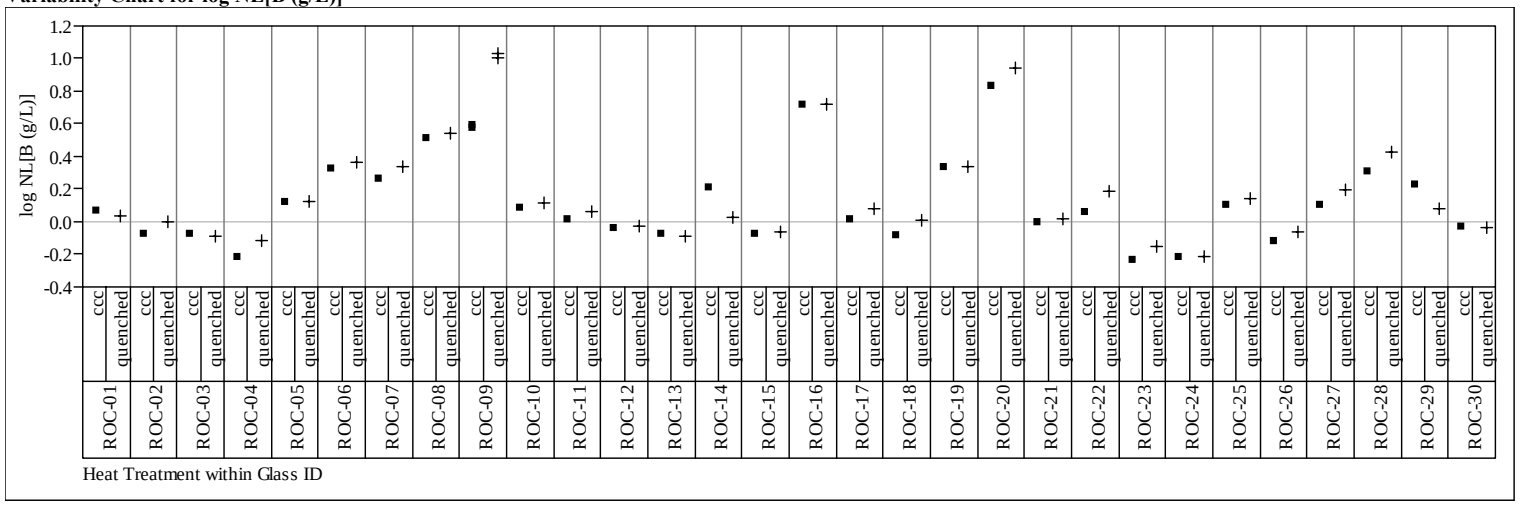


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

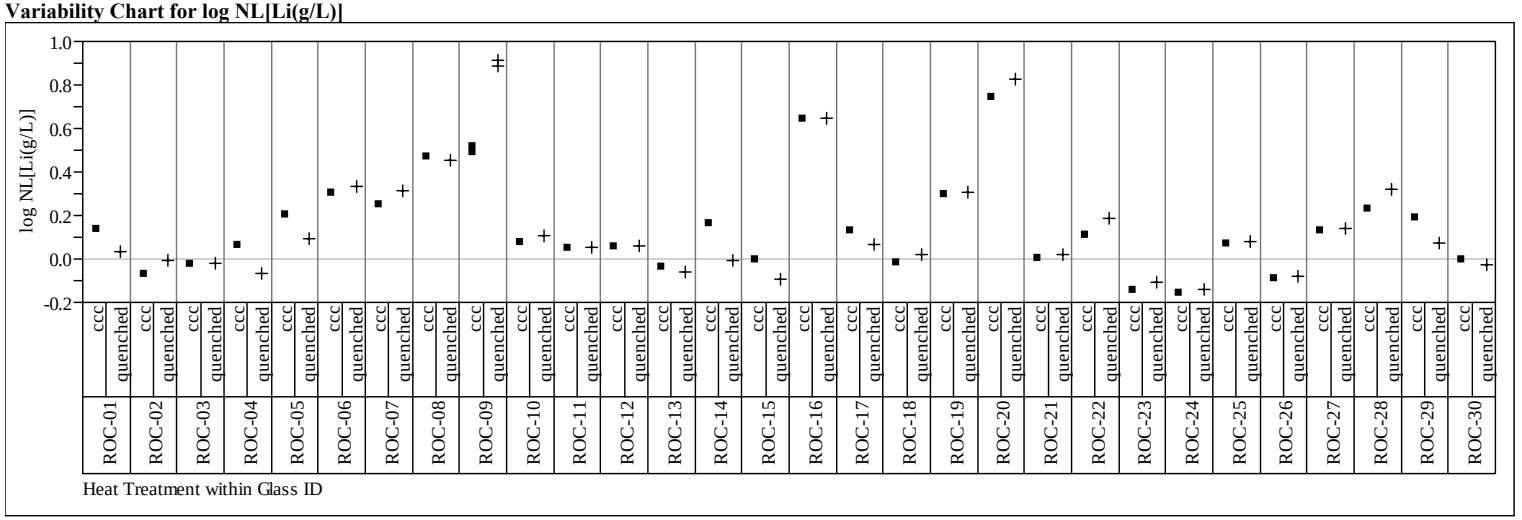
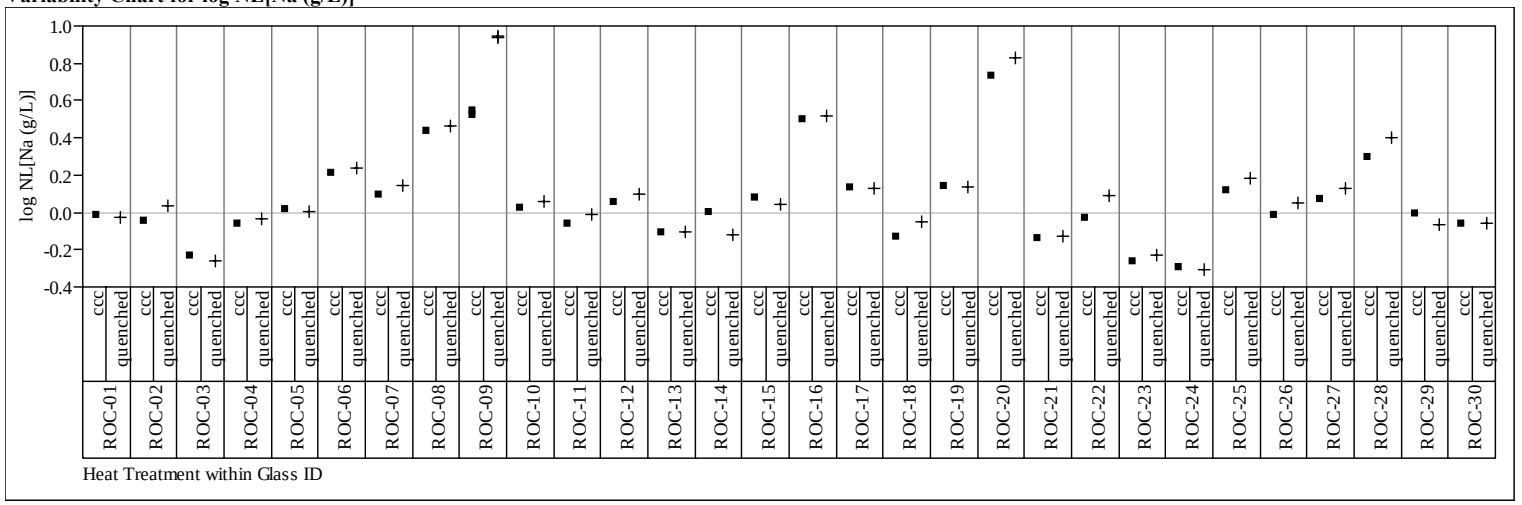


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

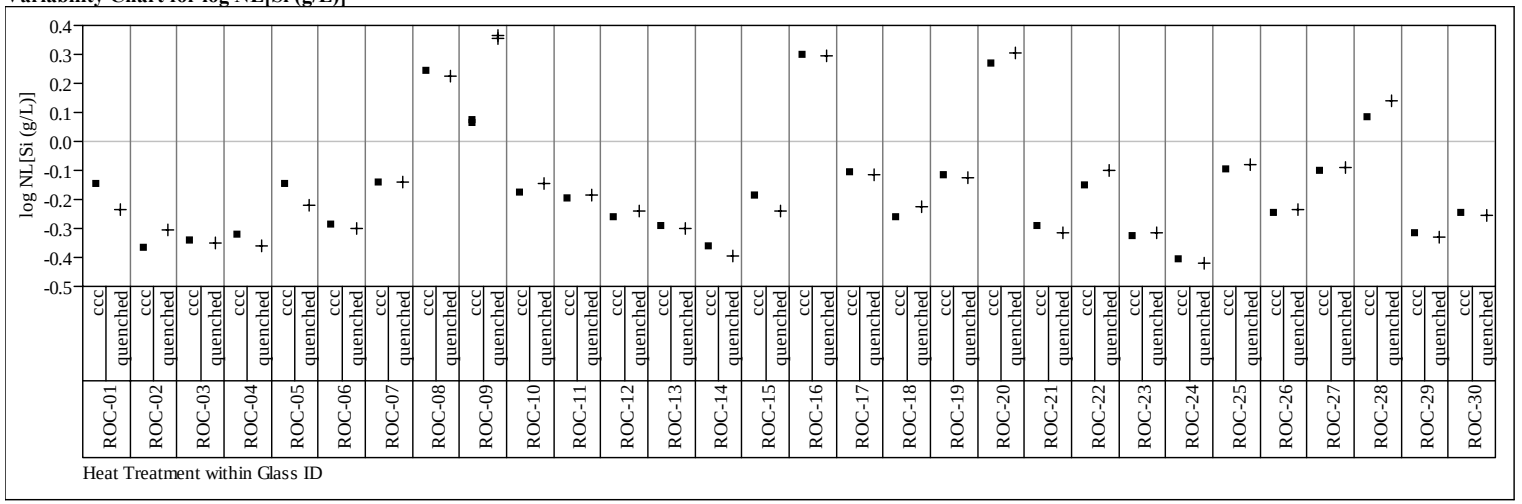
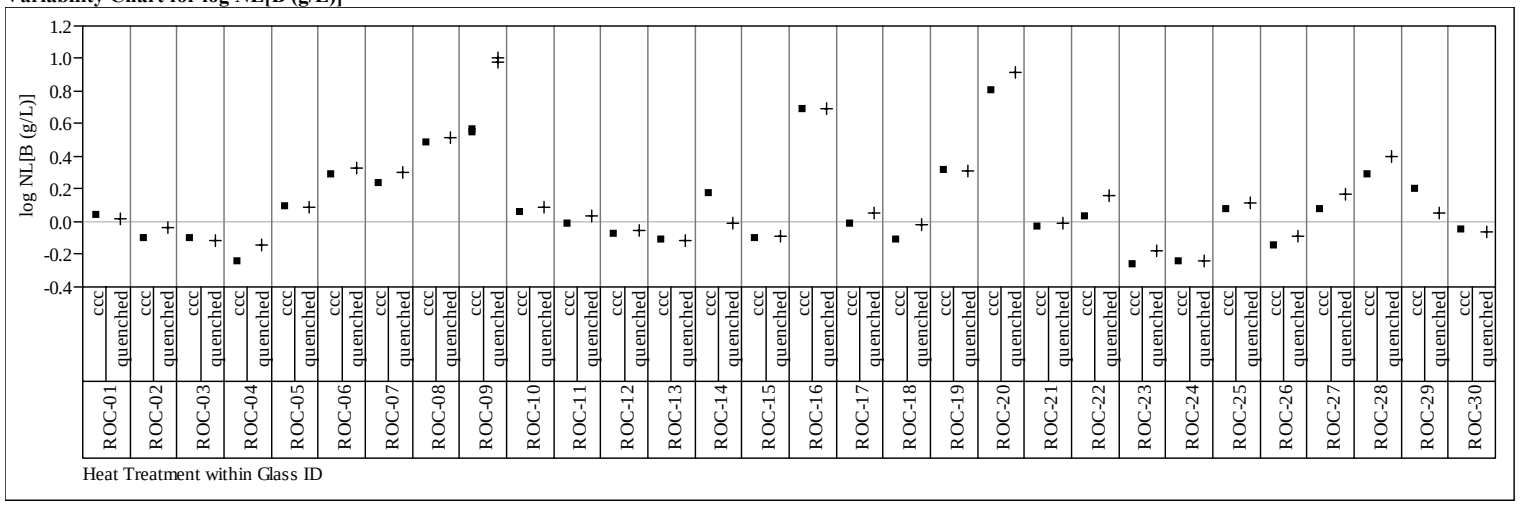


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

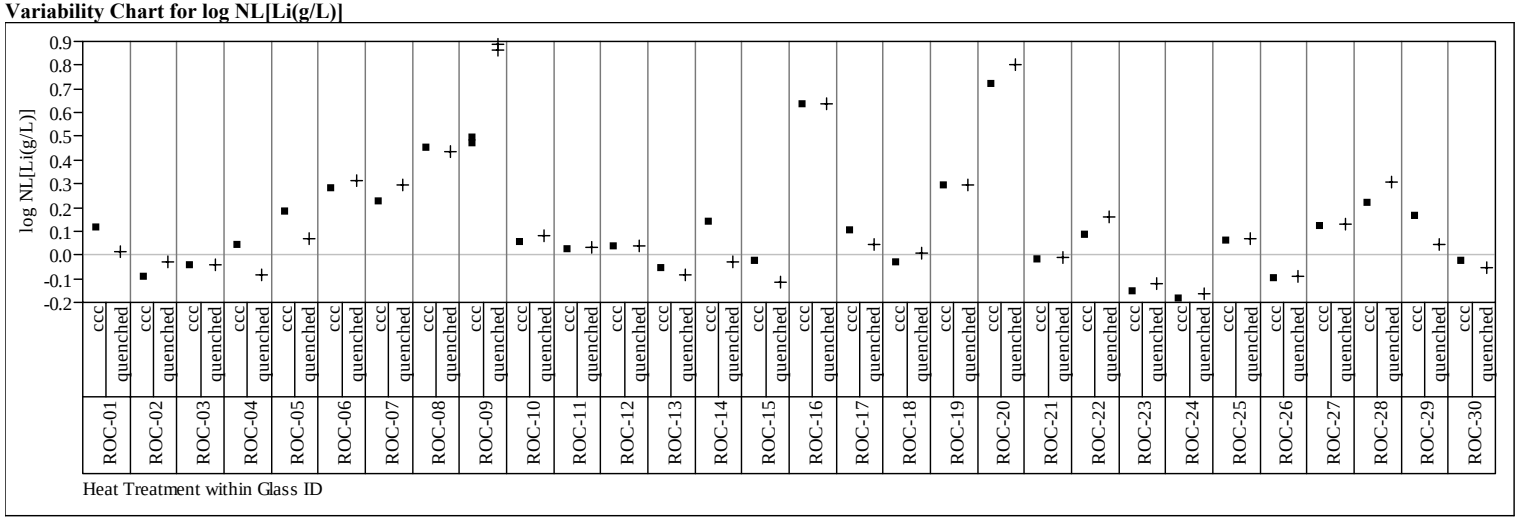
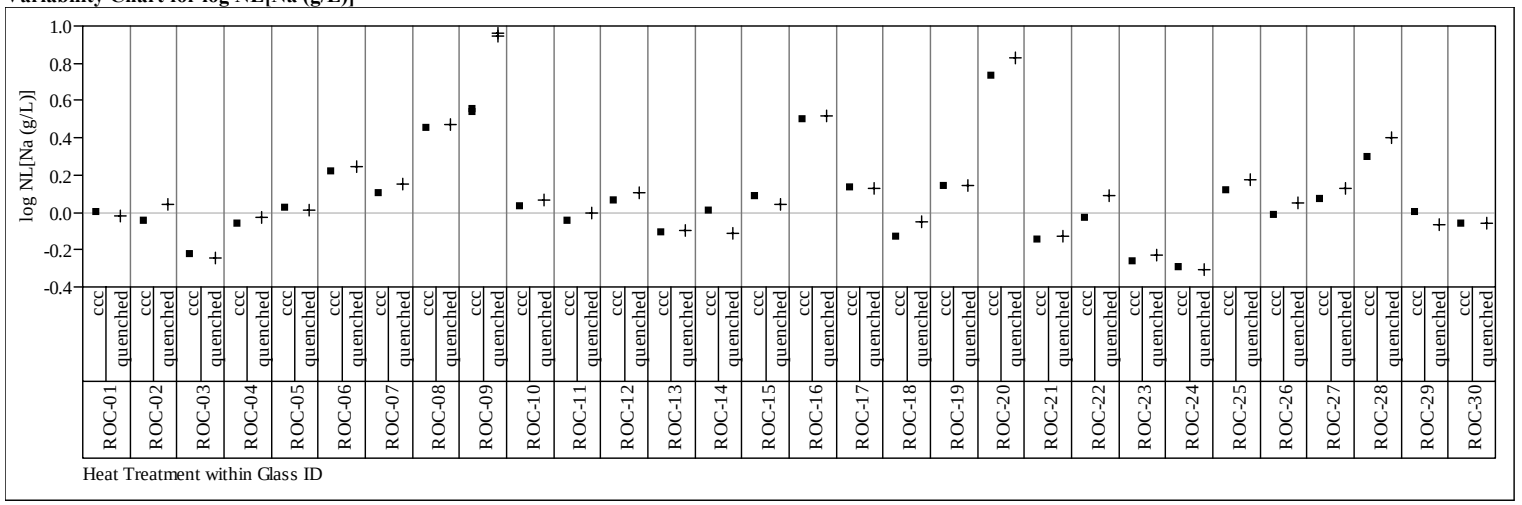


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

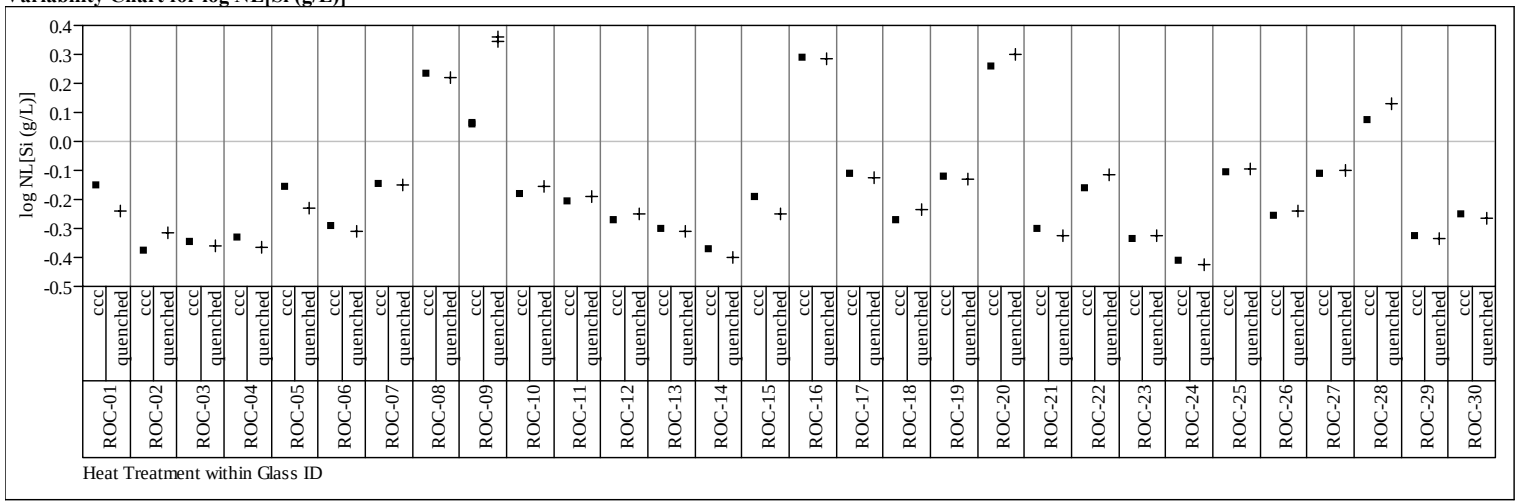
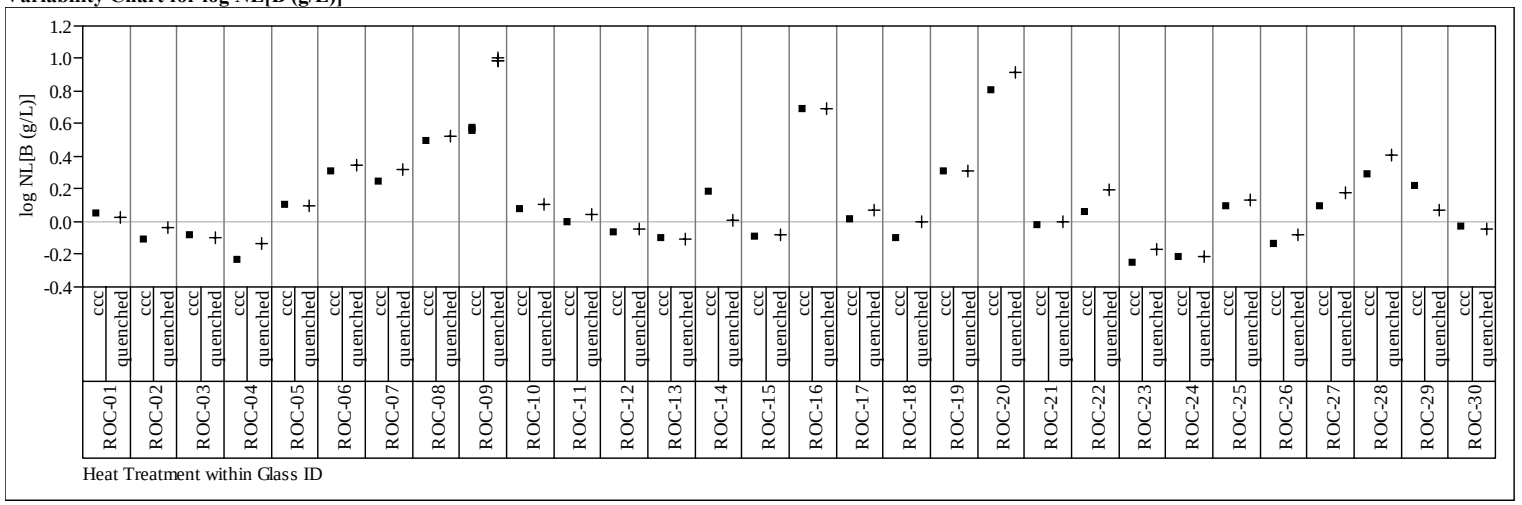


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

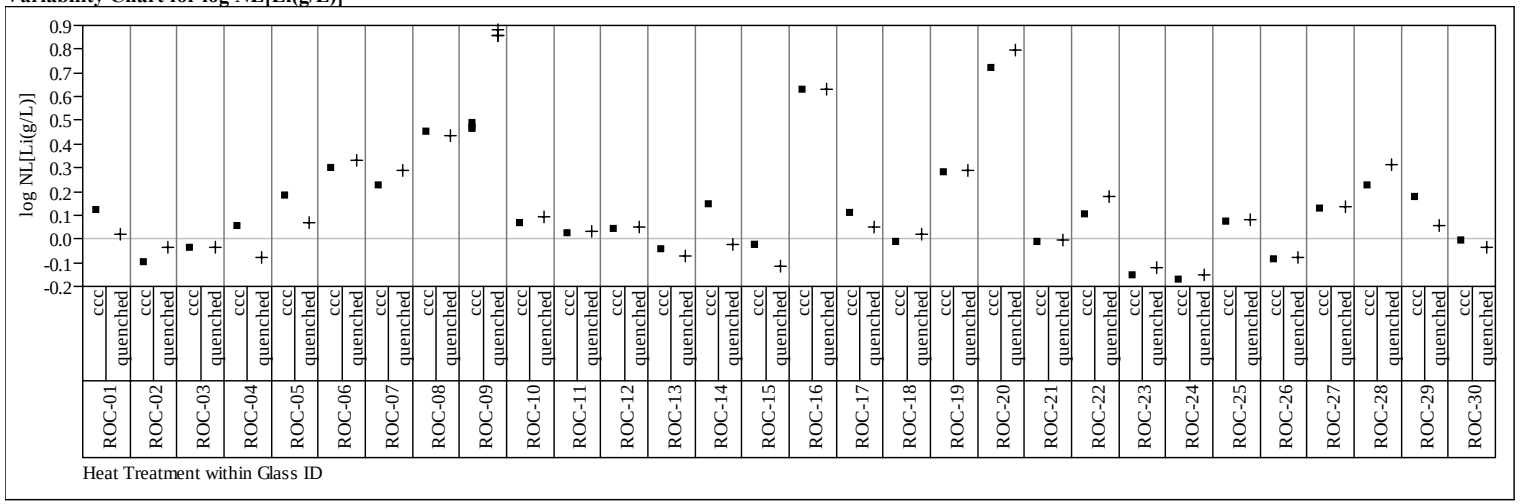
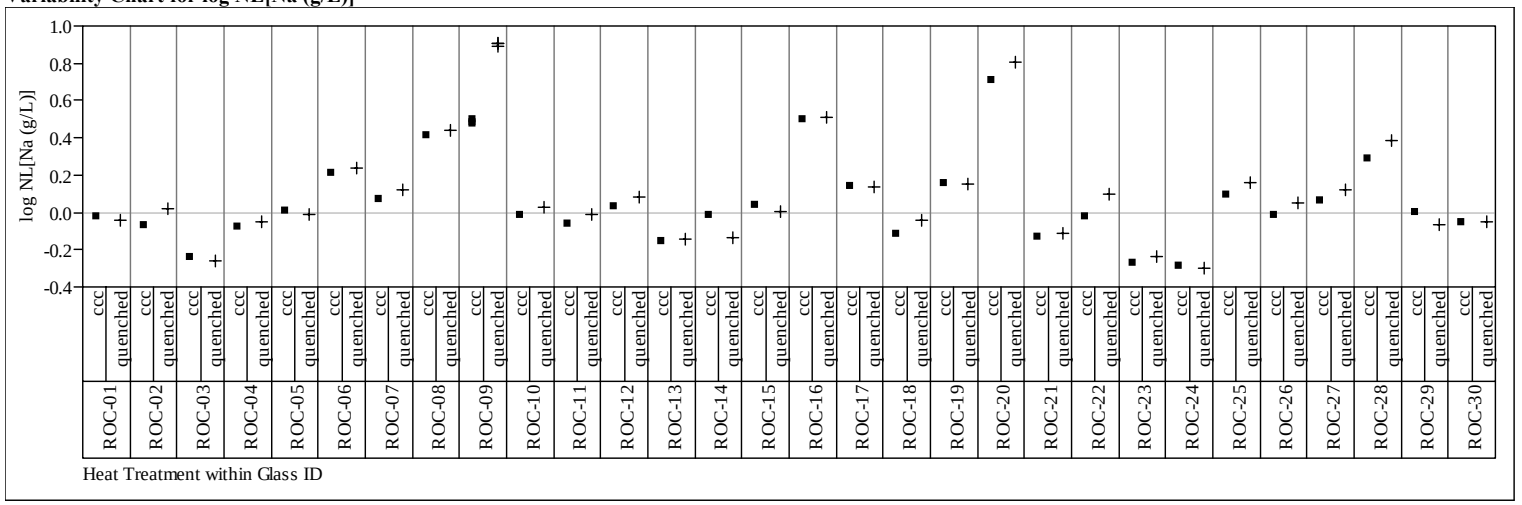


Exhibit B5. Effects of Heat Treatment for Study Glasses by Compositional View

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



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

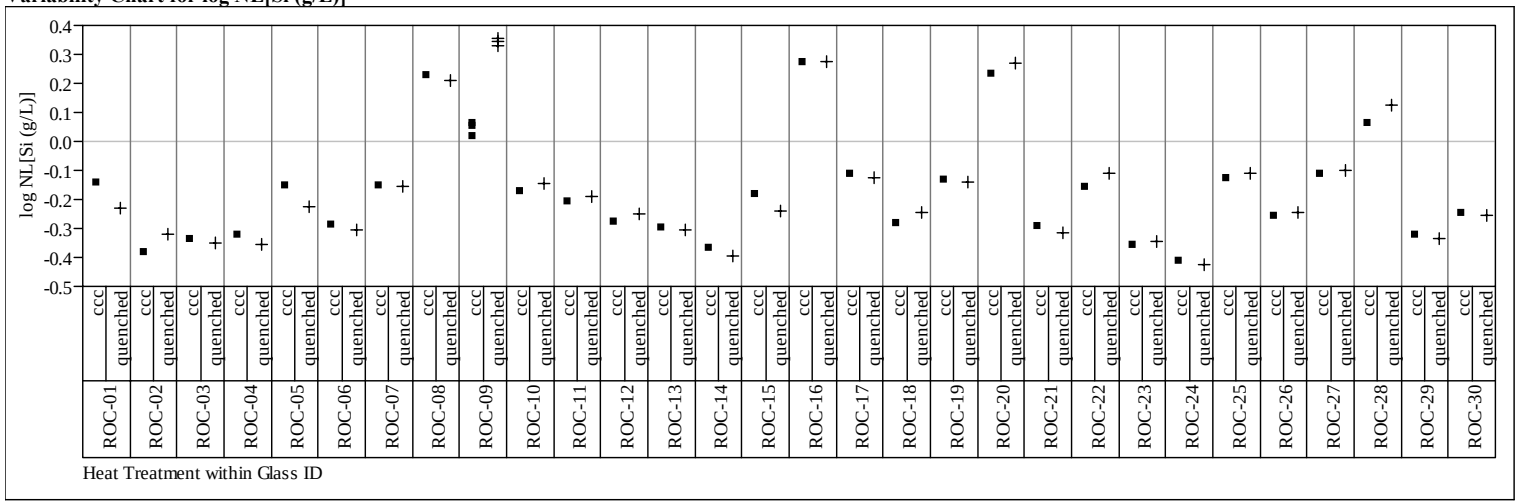


Exhibit B6. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for B over All Compositional Views and Heat Treatments

Legend

Symbol	Standard/ Comp View-Heat Treatment
z	EA
◊	ARM
□	Measured-ccc
□	Measured bc -ccc
□	Targeted-ccc
●	Measured-quenched
●	Measured bc - quenched
●	Targeted- quenched

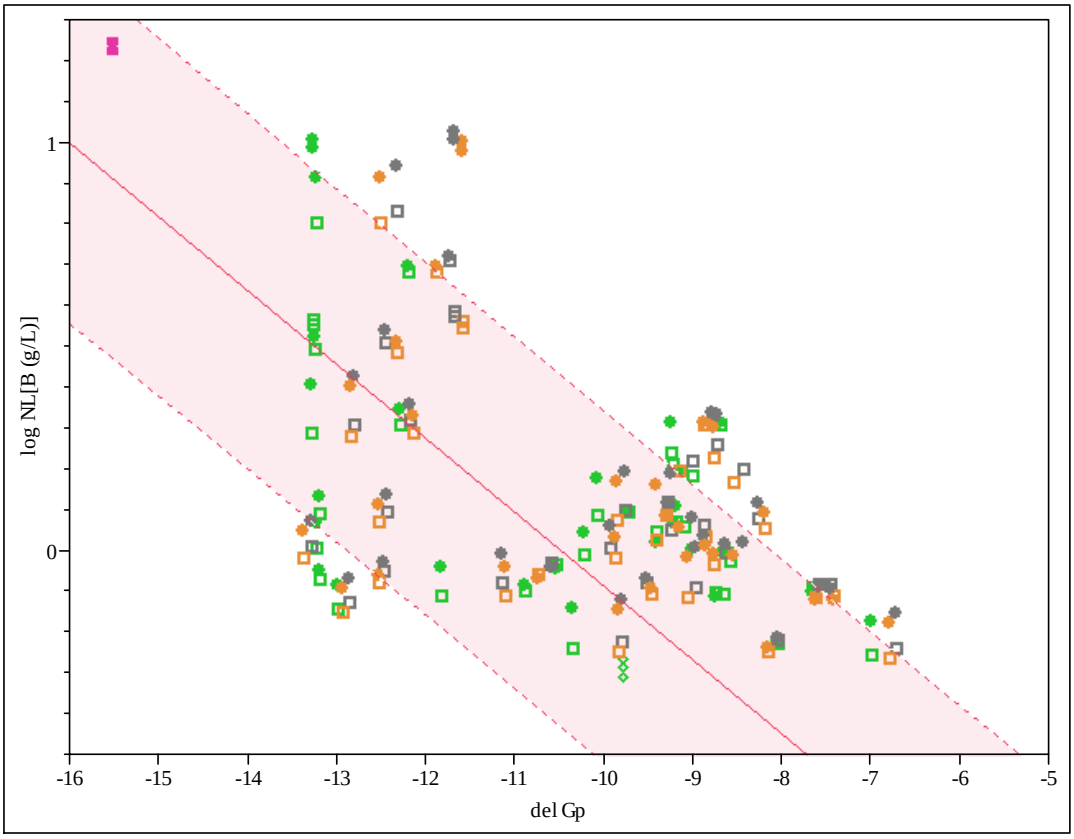


Exhibit B7. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for Li over All Compositional Views and Heat Treatments

Legend

Symbol	Standard/ Comp View-Heat Treatment
z	EA
◊	ARM
□	Measured-ccc
□	Measured bc -ccc
□	Targeted-ccc
●	Measured-quenched
●	Measured bc - quenched
●	Targeted- quenched

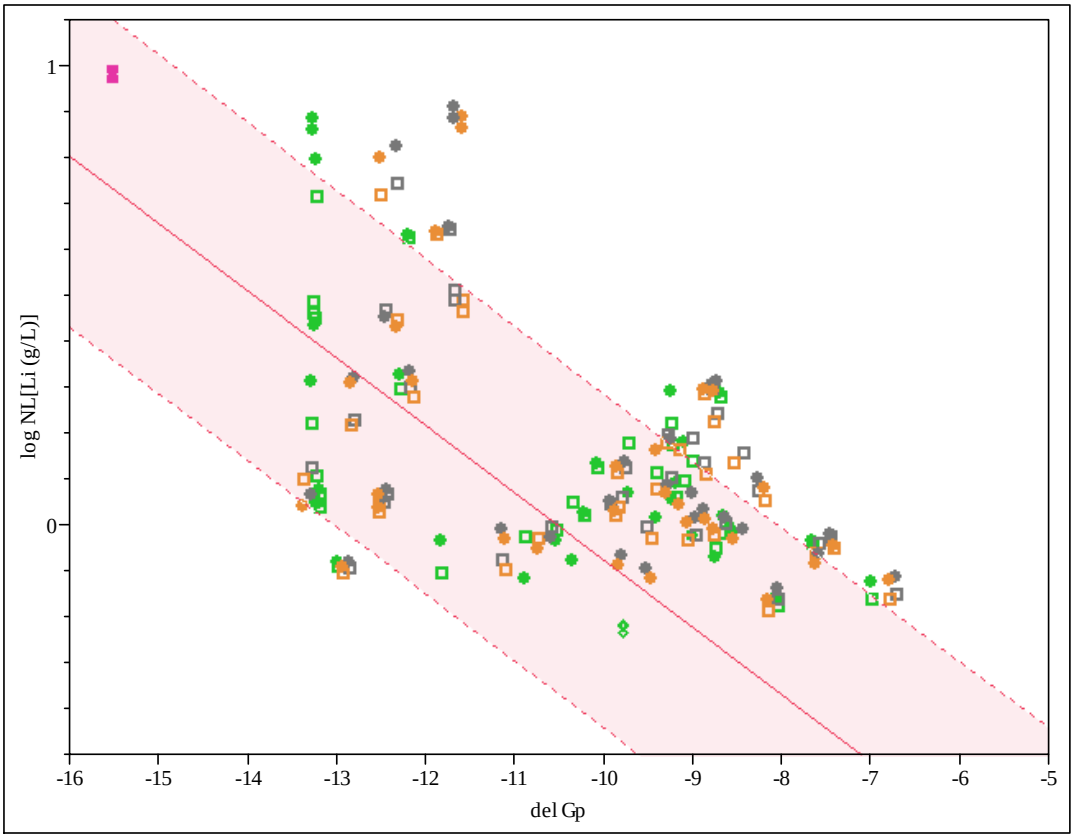


Exhibit B8. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for Na over All Compositional Views and Heat Treatments

Legend

Symbol	Standard/ Comp View-Heat Treatment
z	EA
◊	ARM
□	Measured-ccc
□	Measured bc -ccc
□	Targeted-ccc
●	Measured-quenched
●	Measured bc - quenched
●	Targeted- quenched

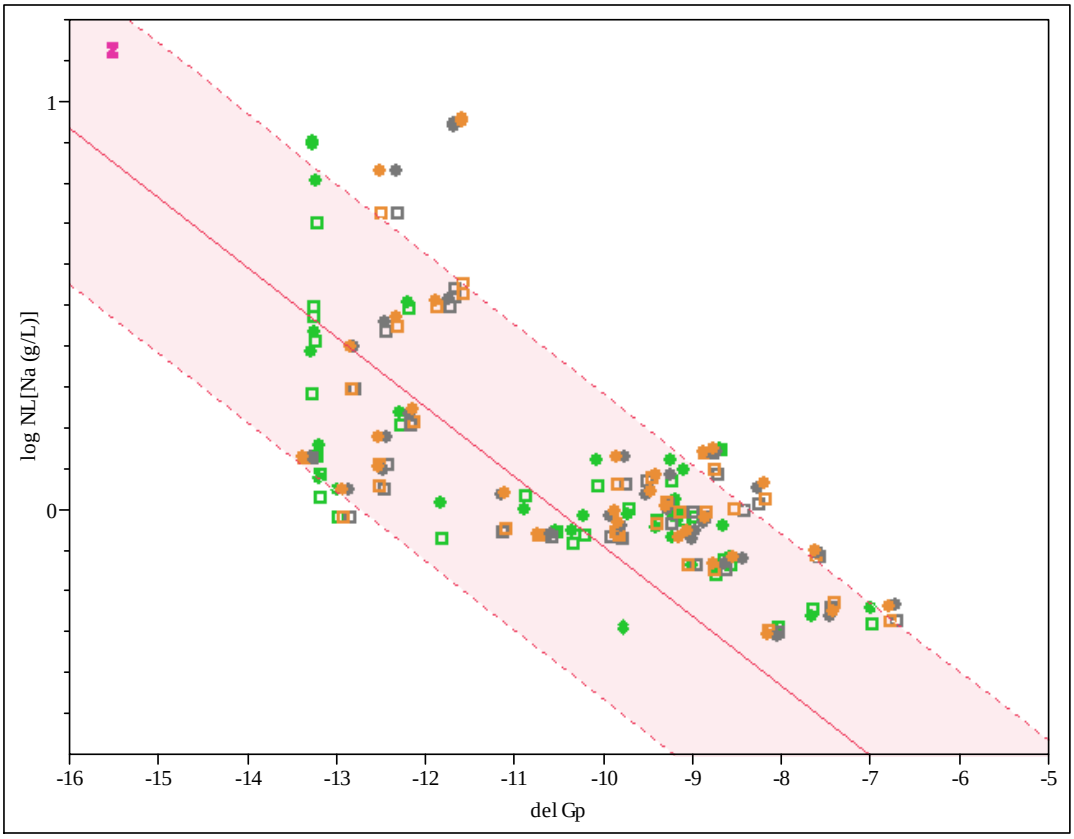
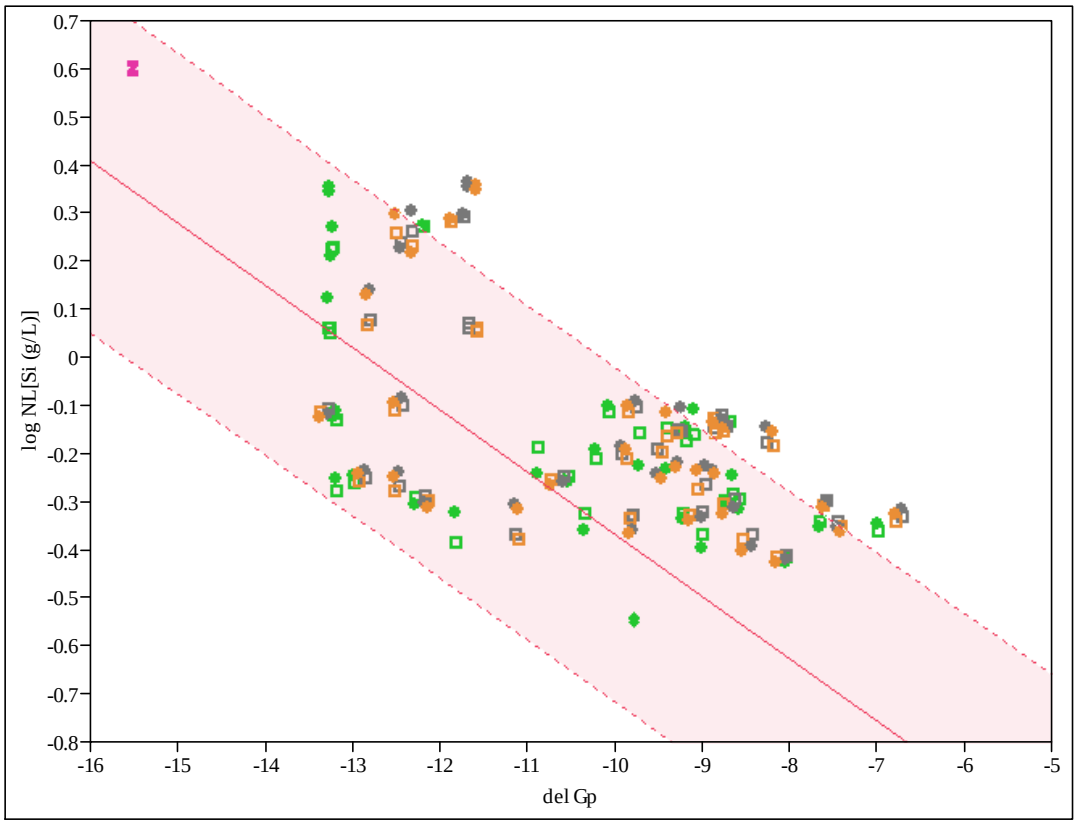


Exhibit B9. del Gp (ΔG_p) Predictions versus Common Logarithm Normalized Leachate (log NL[.]) for Si over All Compositional Views and Heat Treatments

Legend

Symbol	Standard/ Comp View-Heat Treatment
z	EA
◊	ARM
□	Measured-ccc
□	Measured bc -ccc
□	Targeted-ccc
●	Measured-quenched
●	Measured bc - quenched
●	Targeted- quenched



Distribution:

C.J. Bannochie, 773-42A
A.B. Barnes, 999-W
A.L. Billings, 999-W
J.M. Bricker, 704-27S
M.A. Broome, 704-29S
D.A. Crowley, 773-43A
T.B. Edwards, 999-W
T.L. Fellinger, 704-26S
S.D. Fink, 773-A
K.M. Fox, 999-W
B.J. Giddings, 786-5A
J.M. Gillam, 766-H
B.A. Hamm, 766-H
C.C. Herman, 999-W
R.N. Hinds, 704-S
E.W. Holtzscheiter, 704-15S
J.F. Iaukea, 704-30S
C.M. Jantzen, 773-A
D.D. Larsen, 766-H
S.L. Marra, 773-A
R.T. McNew, 704-27S
J.E. Occhipinti, 704-S
D.K. Peeler, 999-W
F.M. Pennebaker, 773-42A
H.M. Pittman, 704-27S
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J.H. Scogin, 773-A
H.B. Shah, 766-H
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M.E. Stone, 999-W
J.P. Vaughan, 773-41A