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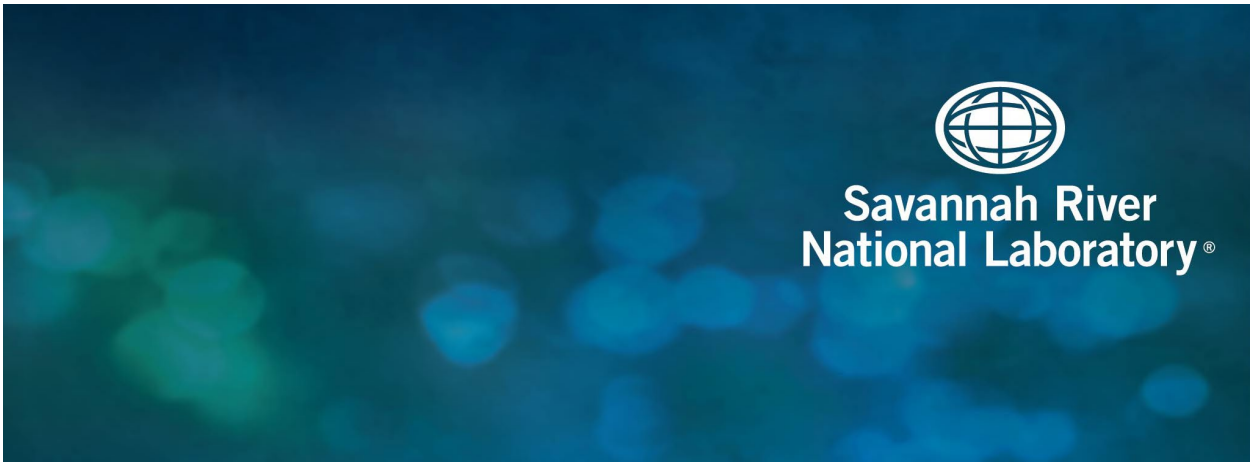

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Characterization of the Sulfur-Saturated Melt Versions of the HLW HAIG Glasses

M. C. Hsieh

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EXECUTIVE SUMMARY

This report provides the results from the chemical analyses of a series of sulfur-saturated melt versions of the High-Level Waste High-Aluminum Glass study glasses, a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory. These data will be used in the development, validation, and implementation of enhanced property/composition models for waste glass vitrification at Hanford.

Chemical analyses were performed on a representative sample of each of the sulfur-saturated melt versions of the glasses to allow for comparisons with targeted compositions as well as the measured compositions of the quenched glasses. The relative differences between the targeted and measured concentrations of B_2O_3, Cr_2O_3, K_2O, Li_2O, Na_2O, and P_2O_5 for several of the glasses were greater than ±10%. The relative differences between the targeted and measured concentrations of Al_2O_3 and ZrO_2 for one of the glasses were greater than ±10%. As expected, the measured concentrations of SO_3 in most of the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

The wash solutions contained mainly sodium, sulfur, and sulfate ions.

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LIST OF ABBREVIATIONS

ARG-1	Analytical Reference Glass-1
BDL	below detection limit
DOE	U. S. Department of Energy
HLW HAlG	High-Level Waste High-Aluminum Glass
hp std	High Purity Standards ICP multi-element custom solution SM-744-063
IC	ion chromatography
ICP-OES	inductively coupled plasma – optical emission spectroscopy
ID	identifier
KH	potassium hydroxide fusion
LM	lithium metaborate fusion
LRM	low-activity test reference material
ORP	Office of River Protection
PF	sodium peroxide fusion
PNNL	Pacific Northwest National Laboratory
Q	quenched
seq	sequence
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
SSM	sulfur-saturated melt
std	High Purity Standards ICP multi-element custom solution SM-744-013
TTQAP	Task Technical and Quality Assurance Plan
wt.%	weight percent
WTP	Waste Treatment and Immobilization Plant

1.0 Introduction

The U.S. Department of Energy (DOE) is responsible for building the Hanford Tank Waste Treatment and Immobilization Plant (WTP) at the Hanford site in Washington to remediate 56 million gallons of radioactive waste historically stored in 177 underground tanks. The Office of River Protection (ORP) has requested that the Savannah River National Laboratory (SRNL) contribute in areas of recognized capabilities and expertise for glass waste form development to support successful startup of the WTP.

Successful efforts have allowed for demonstration of greatly enhanced treatment efficiencies of those projected from the minimum requirements set forth in the WTP Contract[a]. Additional flexibility and expansion of the qualified glass forming region are the current focus.[1] SRNL support of this work is defined in the Task Technical and Quality Assurance Plan (TTQAP).[2]

This report provides results from the chemical analyses of the sulfur-saturated melt (SSM) versions of the High-Level Waste High-Aluminum Glass (HLW HAlG) study glasses, a series of simulated nuclear waste glasses designed and fabricated at Pacific Northwest National Laboratory (PNNL). The glasses were selected as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.[3] The resulting data will be used in the development, validation, and implementation of enhanced property/composition models for nuclear waste glasses.[1]

2.0 Experimental Procedure

2.1 Quality Assurance

Requirements for performing reviews of technical reports and the extent of review are established in Savannah River Site (SRS) Manual E7, Procedure 2.60.[4] SRNL documents the extent and type of review using the SRNL Technical Report Design Checklist contained in WSRC-IM-2002-00011.[5] Laboratory data for this study were recorded in the SRNL Electronic Laboratory Notebook system, experiment L6390-00441-06. The glasses provided by PNNL were designed and fabricated following a Task Plan.[1]

2.2 Glasses Selected for Study

The baseline (quenched) glass compositions in this study were designed and fabricated by PNNL. Characterization of the baseline glasses were reported earlier.[6] Samples of each of the SSM versions of the study glasses, along with samples of the wash solutions resulting from the preparation of each of the SSM glasses, were received at SRNL for chemical composition analysis. The PNNL identifiers (IDs) for the glass samples and associated SRNL sample identifiers are listed in Table 2-1. The identifiers for the wash solutions are likewise listed in Table 2-2.

[a] Contract DE-AC27-01RV14136, as amended, U.S. Department of Energy, Richland, WA (2000).

Table 2-1. Identifiers for the HLW HAlG SSM Study Glasses

PNNL Glass ID	Lab ID
HAlG-01-Q-SSM-S	S-14308
HAlG-02-Q-SSM-S	S-14309
HAlG-03-Q-SSM-S	S-14310
HAlG-04-Q-SSM-S	S-14311
HAlG-05-Q-SSM-S	S-14312
HAlG-06-Q-SSM-S	S-14313
HAlG-07-1-Q-SSM-S	S-14314
HAlG-08-Q-SSM-S	S-14315
HAlG-09-Q-SSM-S	S-14316
HAlG-11-Q-SSM-S	S-14317
HAlG-12-Q-SSM-S	S-14318
HAlG-13-Q-SSM-S	S-14319
HAlG-14-Q-SSM-S	S-14320
HAlG-15-Q-SSM-S	S-14321
HAlG-16-Q-SSM-S	S-14322
HAlG-17-Q-SSM-S	S-14323
HAlG-18-Q-SSM-S	S-14324
HAlG-19-Q-SSM-S	S-14325
HAlG-20-Q-SSM-S	S-14326
HAlG-21-Q-SSM-S	S-14327
HAlG-22-Q-SSM-S	S-14328
HAlG-23-Q-SSM-S	S-14329
HAlG-24-Q-SSM-S	S-14330
HAlG-25-Q-SSM-S	S-14331
EWG-HAlG-SSM-S	S-14332

Table 2-2. Identifiers for the HLW HAlG SSM Wash Solutions

PNNL Wash Solution ID	Lab ID
HAlG-01-Q-SSM-W	S-14283
HAlG-02-Q-SSM-W	S-14284
HAlG-03-Q-SSM-W	S-14285
HAlG-04-Q-SSM-W	S-14286
HAlG-05-Q-SSM-W	S-14287
HAlG-06-Q-SSM-W	S-14288
HAlG-07-1-Q-SSM-W	S-14289
HAlG-08-Q-SSM-W	S-14290
HAlG-09-Q-SSM-W	S-14291
HAlG-11-Q-SSM-W	S-14292
HAlG-12-Q-SSM-W	S-14293
HAlG-13-Q-SSM-W	S-14294
HAlG-14-Q-SSM-W	S-14295
HAlG-15-Q-SSM-W	S-14296
HAlG-16-Q-SSM-W	S-14297
HAlG-17-Q-SSM-W	S-14298
HAlG-18-Q-SSM-W	S-14299
HAlG-19-Q-SSM-W	S-14300
HAlG-20-Q-SSM-W	S-14301
HAlG-21-Q-SSM-W	S-14302
HAlG-22-Q-SSM-W	S-14303
HAlG-23-Q-SSM-W	S-14304
HAlG-24-Q-SSM-W	S-14305
HAlG-25-Q-SSM-W	S-14306
EWG-HAlG-SSM-W	S-14307

2.3 Glass Composition Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the glasses listed in Table 2-1 to allow for comparisons with the targeted compositions. Three dissolution techniques were used for preparing each of the glass samples, in duplicate, for analysis (potassium hydroxide fusion (KH), lithium metaborate fusion (LM), and sodium peroxide fusion (PF)).[8-10] Note that for some analytes, the analytical plan specified more than one preparation method for analysis. The results were reviewed and, in general, the method that provided better recovery of the analyte was selected for reporting.

Each of the duplicate samples was analyzed twice for each element of interest by inductively coupled plasma – optical emission spectroscopy (ICP-OES)[11] or ion chromatography (IC),[12] for a total of four measurements per element per glass. Glass standards were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. Specifically, several samples of Analytical Reference Glass-1 (ARG-1) and low-activity test reference material (LRM) were included as part of the analytical plan.[7] The ARG-1 composition reported as the "Corning, Inc., Glass Composition"[13] and the LRM composition reported as the "Consensus Average"[14] are used as the reference compositions of this glass. The preparation and measurement methods used for each of the reported glass components are listed in Table 2-3.

Table 2-3. Preparation and Measurement Methods Used in Reporting the Analyte Concentrations of the Study Glasses

Analyte	Measurement Method	Preparation Method
Al	ICP-OES	PF
B	ICP-OES	PF
Bi	ICP-OES	LM
Ca	ICP-OES	LM
Cd	ICP-OES	LM
Cr	ICP-OES	LM
F	IC	KH
Fe	ICP-OES	LM
K	ICP-OES	PF
Li	ICP-OES	PF
Mg	ICP-OES	LM
Mn	ICP-OES	LM
Na	ICP-OES	LM
Ni	ICP-OES	LM
P	ICP-OES	PF
S	ICP-OES	LM
Si	ICP-OES	PF
Sr	ICP-OES	LM
Ti	ICP-OES	LM
Zn	ICP-OES	LM
Zr	ICP-OES	PF

2.4 Wash Solution Analysis

Chemical analyses were performed under the auspices of an analytical plan[7] on a representative sample of each of the wash solutions resulting from the preparation of the SSM versions of the glasses, as listed in Table 2-2. The samples were diluted at SRNL based on the expected concentrations of the species in solution in preparation for the analysis.

Each of the samples was analyzed in triplicate for each element of interest by ICP-OES[11] and IC[12]. Solution standards and blanks were also intermittently measured to assess the performance of the ICP-OES and IC instruments over the course of these analyses. The measurement methods used for each of the reported wash solution components are listed in Table 2-4.

Table 2-4. Measurement Methods Used in Reporting the Analyte Concentrations of the Wash Solutions

Analyte	Measurement Method
Al	ICP-OES
B	ICP-OES
Bi	ICP-OES
Ca	ICP-OES
Cd	ICP-OES
Cr	ICP-OES
F^-	IC
Fe	ICP-OES
K	ICP-OES
Li	ICP-OES
Mg	ICP-OES
Mn	ICP-OES
Na	ICP-OES
Ni	ICP-OES
P	ICP-OES
PO_4^{3-}	IC
S	ICP-OES
SO_4^{2-}	IC
Si	ICP-OES
Sr	ICP-OES
Ti	ICP-OES
Zn	ICP-OES
Zr	ICP-OES

3.0 Results and Discussion

JMP® Version 16.0.0 (SAS Institute, Inc.)[15] was used to support these analyses.

3.1 Review and Evaluation of the SSM Glass Composition Measurements

Table A-1, Table A-2, and Table A-3 in Appendix A provide the elemental concentration measurements in weight percent (wt.%) from glasses prepared using KH, LM, and PF methods, respectively. Elemental measurements for samples of the LRM glass are also included in these tables of Appendix A.

3.1.1 Treatment of Detection Limits

The elemental concentrations in Table A-1, Table A-2, and Table A-3 in Appendix A were converted to oxide concentrations by multiplying the values of each element by the gravimetric factor for the corresponding oxide. A concentration measurement that was reported to be below the detection limit (BDL) was set to the detection limit for the purposes of data review and calculating a sum of oxides for each glass. Concentration measurements that were BDL are denoted with a less than symbol (<).

3.1.2 Composition Measurements by Glass Identifier

Exhibit A-1 in Appendix A provides plots of the oxide concentration measurements by the PNNL Glass ID (including the LRM glasses) by Lab ID grouped by targeted concentration. Different symbols and colors are used to represent the different glasses. These plots show the individual measurements across the

duplicates of each preparation method and the two instrument calibrations for each glass. Plotting the data in this format provides an opportunity to review the values for each individual glass as a function of the duplicate preparations and duplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the four individual values for each oxide for each glass. There were no indications of errors in preparation or measurement that had to be addressed in treatment of the data.

3.1.3 Results for the LRM Standard Glass

Exhibit A-2 in Appendix A provides a comparison of the LRM results to their acceptability limits utilized by SRNL.[11] The review is in the form of plots of the measurements arranged by preparation method and element, framed by upper and lower acceptability limits for the concentration of each element of interest. The results show that all measurements of the LRM elements of interest were within the acceptability limits during the execution of these analyses.

3.1.4 Measured versus Targeted Compositions

All measurements for each oxide for each glass (Table A-1, Table A-2, and Table A-3 in Appendix A) were used in calculating oxide values, which were then averaged to determine a representative chemical composition for each glass. A sum of oxides was also computed for each glass based upon the averaged oxide values. Exhibit A-3 in Appendix A provides plots showing the result for each glass for each oxide to allow PNNL to draw comparisons between the measured and targeted values. All ARG-1 standard glass measurements were within 10% of reference values[13].

Table A-4 in Appendix A provides a summary of the average compositions, targeted compositions and some associated differences and relative differences. The measured sums of oxides for all but one of the glasses fall within the interval of 97.2 wt.% to 102 wt.%, indicating acceptable recovery of the glass components.[16] One glass, HAlG-18-Q-SSM-S, had a measured sum of oxides equal to 90.4 wt.%. Also, a standard glass, EWG-HAlG-SSM-S, had a measured sum of oxides equal to 89.0 wt.%. Because not all components were listed in the targeted composition, the targeted sum of oxides was 87.9 wt.%. Entries in Table A-4 show the relative differences between the measured and targeted values for the analytes with measured and targeted values above 1 wt.%. The relative differences were shaded if they are 10% or more and are summarized below.

- Al_2O_3 relative difference was 16% for EWG-HAlG-SSM-S.
- B_2O_3 relative differences were 10% or greater for HAlG-11-Q-SSM-S, HAlG-18-Q-SSM-S, and HAlG-21-SSM-S.
- Cr_2O_3 relative differences were 10% or greater for HAlG-02-Q-SSM-S, HAlG-04-Q-SSM-S, HAlG-06-Q-SSM-S, HAlG-09-Q-SSM-S, HAlG-11-Q-SSM-S, HAlG-12-Q-SSM-S, HAlG-14-Q-SSM-S, HAlG-15-Q-SSM-S, HAlG-16-Q-SSM-S, HAlG-20-Q-SSM-S, and HAlG-22-Q-SSM-S.
- K_2O relative differences were greater than 10% for HAlG-07-1-Q-SSM-S, HAlG-13-Q-SSM-S, HAlG-18-Q-SSM-S, HAlG-21-Q-SSM-S, and HAlG-22-Q-SSM-S.
- Li_2O relative differences were greater than 10% for HAlG-02-Q-SSM-S, HAlG-09-Q-SSM-S, HAlG-18-Q-SSM-S, HAlG-20-Q-SSM-S, HAlG-21-Q-SSM-S, and HAlG-24-Q-SSM-S.
- Na_2O relative differences were greater than 10% for HAlG-08-Q-SSM-S, HAlG-18-Q-SSM-S, HAlG-20-Q-SSM-S, HAlG-23-Q-SSM-S, and HAlG-24-Q-SSM-S.
- P_2O_5 relative differences were 10% or greater for HAlG-01-Q-SSM-S, HAlG-03-Q-SSM-S, HAlG-06-Q-SSM-S, HAlG-07-1-Q-SSM-S, HAlG-08-Q-SSM-S, HAlG-09-Q-SSM-S, HAlG-11-Q-SSM-S, HAlG-16-Q-SSM-S, HAlG-18-Q-SSM-S, HAlG-19-Q-SSM-S, HAlG-20-Q-SSM-S, HAlG-23-Q-SSM-S, HAlG-24-Q-SSM-S, and HAlG-25-Q-SSM-S.
- The ZrO_2 relative difference was 11% for EWG-HAlG-SSM-S.
- As expected, the measured SO_3 concentrations in the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

3.2 Comparison of Measured Compositions of Baseline and SSM Glasses

Exhibit A-4 in Appendix A provides a comparison of the measured oxide concentrations among the baseline (quenched) and SSM versions of the study glasses. A review of Exhibit A-4 led to the following observations:

- The measured Cr_2O_3 concentrations were lower in the SSM versions of the study glasses.
- The measured SO_3 concentrations were higher for SSM versions of the study glasses, as expected, due to the use of the sulfur saturation method in fabricating these glasses.

The discussion of the analyses of the wash solutions, provided in Section 3.3, may provide further insight into the measured compositions of the SSM glasses.

3.3 Review and Evaluation of the Wash Solution Measurements

Table B-1 in Appendix B provides the elemental concentration measurements in mg/L for the wash solutions as measured by ICP-OES. Table B-2 in Appendix B provides the anion concentration measurements in mg/L for the wash solutions as measured by IC. Elemental measurements of the blanks and standard solutions are included in the tables of Appendix B.

3.3.1 Treatment of Detection Limits

The elemental and anion concentrations in Table B-1 and Table B-2 of Appendix B include measurements that were reported to be below the detection limit. These values were set to the detection limit for the purposes of data review and of calculating an average composition for each wash solution.

3.3.2 Composition Measurements by Wash Solution Identifier

Exhibit B-1 in Appendix B provides plots of the elemental and anion concentration measurements grouped by the wash solution identifier (including the blanks and standard solutions). Different symbols and colors are used to represent the different solutions. Plotting the data in this format provides an opportunity to review the values for each individual solution as a function of the triplicate measurements. A review of the plots presented in these exhibits reveals the repeatability of the three individual values for each analyte for each solution. These observations were not considered to indicate an error in preparation or measurement that had to be addressed in treatment of the data. Therefore, the entire set of measurement data was used in determining representative, measured compositions for the wash solutions.

3.3.3 Results for the Standard Solutions

Table B-3 in Appendix B provides comparisons of the standard solution results to their reference values. The results in this table indicate no issues with the performance of the analyses.

3.3.4 Measured Compositions of the Wash Solutions

From the discussion of Section 3.3.2, all the measurements for each analyte for each wash solution (Table B-1 and Table B-2 of Appendix B) were averaged to determine a representative chemical composition for each solution. Table B-4 in Appendix B provides a summary of the average measured compositions of the wash solutions. The following observations are offered from the review of Table B-4:

- The wash solutions contained mainly Na (382-1610 mg/L), S (356-710 mg/L), and SO_4^{2-} (1040-2130 mg/L), which could be attributed to the excess sodium sulfate added as part of the SSM preparation process.
- The measured concentrations of Al, B, Ca, Cr, F^-, K, Li, P, Si, and PO_4^{3-} in the wash solutions were generally 100 mg/L or lower for the majority of the glasses.
- The measured concentration of B in HAlG-11-Q-SSM-S and HAlG-18-Q-SSM-S were 161mg/L and 217 mg/L, respectively.
- The measured concentrations of Cr in sevenglasses were higher than 100 mg/L:

    - HAlG-11-Q-SSM-S, HAlG-12-Q-SSM-S, HAlG-14-Q-SSM-S, HAlG-15-Q-SSM-S, HAlG-16-Q-SSM-S, HAlG-18-Q-SSM-S, and HAlG-19-Q-SSM-S.
- The measured concentrations of K in four glasses were higher than 100 mg/L:
    - HAlG-01-Q-SSM-W, HAlG-04-Q-SSM-W, HAlG-07-1-Q-SSM-W, and HAlG-13-Q-SSM-W.
- The measured concentrations of Bi, Cd, Fe, Mg, Mn, Ni, Sr, Ti, Zn and Zr in the wash solutions were near or below the detection limits.

4.0 Summary

Chemical analyses were performed on a series of SSM versions of simulated nuclear waste glasses and resulting wash solutions with ICP-OES and IC. The glasses were designed and fabricated by PNNL as part of a broader study of the influence of glass composition on chemical durability, sulfur retention, and other properties.

The relative differences between the targeted and measured concentrations of B_2O_3, Cr_2O_3, K_2O, Li_2O, Na_2O, and P_2O_5 for several of the glasses were greater than ±10%. The relative differences between the targeted and measured concentrations of Al_2O_3 and ZrO_2 for one of the glasses were greater than ±10%. As expected, the measured concentrations of SO_3 in most of the glasses were higher than targeted due to the use of the sulfur saturation method in fabricating these glasses.

The wash solutions contained mainly sodium, sulfur, and sulfate ions.

5.0 References

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Appendix A. Tables and Exhibits Supporting the HLW HAlG Glass Composition Measurements

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	F^-
LRM	1	1	1	LRMKH111	0.898
ARG-1	1	1	2	ARGKH111	<0.0500
HAlG-12-Q-SSM-S	1	1	3	S-14318KH11	0.320
HAlG-23-Q-SSM-S	1	1	4	S-14329KH21	0.276
HAlG-17-Q-SSM-S	1	1	5	S-14323KH11	0.216
HAlG-24-Q-SSM-S	1	1	6	S-14330KH11	0.178
HAlG-13-Q-SSM-S	1	1	7	S-14319KH11	0.457
HAlG-25-Q-SSM-S	1	1	8	S-14331KH21	0.0620
HAlG-22-Q-SSM-S	1	1	9	S-14328KH11	0.512
HAlG-17-Q-SSM-S	1	1	10	S-14323KH21	0.214
LRM	1	1	11	LRMKH112	0.897
ARG-1	1	1	12	ARGKH112	<0.0500
HAlG-22-Q-SSM-S	1	1	13	S-14328KH21	0.509
HAlG-03-Q-SSM-S	1	1	14	S-14310KH21	0.128
HAlG-25-Q-SSM-S	1	1	15	S-14331KH11	0.0621
HAlG-12-Q-SSM-S	1	1	16	S-14318KH21	0.321
HAlG-24-Q-SSM-S	1	1	17	S-14330KH21	0.181
HAlG-03-Q-SSM-S	1	1	18	S-14310KH11	0.128
HAlG-23-Q-SSM-S	1	1	19	S-14329KH11	0.277
HAlG-13-Q-SSM-S	1	1	20	S-14319KH21	0.455
LRM	1	1	21	LRMKH113	0.905
ARG-1	1	1	22	ARGKH113	<0.0500
LRM	1	2	1	LRMKH121	0.906
ARG-1	1	2	2	ARGKH121	<0.0500
HAlG-17-Q-SSM-S	1	2	3	S-14323KH22	0.216
HAlG-22-Q-SSM-S	1	2	4	S-14328KH22	0.511
HAlG-23-Q-SSM-S	1	2	5	S-14329KH22	0.278
HAlG-25-Q-SSM-S	1	2	6	S-14331KH22	0.0628
HAlG-25-Q-SSM-S	1	2	7	S-14331KH12	0.0627
HAlG-24-Q-SSM-S	1	2	8	S-14330KH22	0.181
HAlG-24-Q-SSM-S	1	2	9	S-14330KH12	0.180
HAlG-12-Q-SSM-S	1	2	10	S-14318KH12	0.229
LRM	1	2	11	LRMKH122	0.906
ARG-1	1	2	12	ARGKH122	<0.0500
HAlG-17-Q-SSM-S	1	2	13	S-14323KH12	0.218
HAlG-03-Q-SSM-S	1	2	14	S-14310KH12	0.129
HAlG-03-Q-SSM-S	1	2	15	S-14310KH22	0.128
HAlG-13-Q-SSM-S	1	2	16	S-14319KH12	0.468
HAlG-23-Q-SSM-S	1	2	17	S-14329KH12	0.277
HAlG-12-Q-SSM-S	1	2	18	S-14318KH22	0.324
HAlG-13-Q-SSM-S	1	2	19	S-14319KH22	0.457
HAlG-22-Q-SSM-S	1	2	20	S-14328KH12	0.515
LRM	1	2	21	LRMKH123	0.903
ARG-1	1	2	22	ARGKH123	<0.0500
LRM	2	1	1	LRMKH211	0.899
ARG-1	2	1	2	ARGKH211	<0.0500
HAlG-15-Q-SSM-S	2	1	3	S-14321KH21	0.215

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	F^-
HAlG-09-Q-SSM-S	2	1	4	S-14316KH21	0.0975
HAlG-14-Q-SSM-S	2	1	5	S-14320KH11	0.0621
HAlG-06-Q-SSM-S	2	1	6	S-14313KH11	0.115
HAlG-11-Q-SSM-S	2	1	7	S-14317KH21	0.195
HAlG-19-Q-SSM-S	2	1	8	S-14325KH11	0.101
HAlG-15-Q-SSM-S	2	1	9	S-14321KH11	0.216
HAlG-16-Q-SSM-S	2	1	10	S-14322KH11	0.154
HAlG-11-Q-SSM-S	2	1	11	S-14317KH11	0.194
LRM	2	1	12	LRMKH212	0.895
ARG-1	2	1	13	ARGKH212	<0.0500
HAlG-06-Q-SSM-S	2	1	14	S-14313KH21	0.113
HAlG-21-Q-SSM-S	2	1	15	S-14327KH21	0.329
HAlG-19-Q-SSM-S	2	1	16	S-14325KH21	0.100
HAlG-18-Q-SSM-S	2	1	17	S-14324KH21	0.224
HAlG-16-Q-SSM-S	2	1	18	S-14322KH21	0.154
HAlG-14-Q-SSM-S	2	1	19	S-14320KH21	0.0613
HAlG-09-Q-SSM-S	2	1	20	S-14316KH11	0.0958
HAlG-18-Q-SSM-S	2	1	21	S-14324KH11	0.221
HAlG-21-Q-SSM-S	2	1	22	S-14327KH11	0.328
LRM	2	1	23	LRMKH213	0.899
ARG-1	2	1	24	ARGKH213	<0.0500
LRM	2	2	1	LRMKH221	0.911
ARG-1	2	2	2	ARGKH221	<0.0500
HAlG-19-Q-SSM-S	2	2	3	S-14325KH22	0.102
HAlG-11-Q-SSM-S	2	2	4	S-14317KH22	0.198
HAlG-06-Q-SSM-S	2	2	5	S-14313KH22	0.115
HAlG-09-Q-SSM-S	2	2	6	S-14316KH22	0.0994
HAlG-14-Q-SSM-S	2	2	7	S-14320KH12	0.0632
HAlG-21-Q-SSM-S	2	2	8	S-14327KH12	0.286
HAlG-18-Q-SSM-S	2	2	9	S-14324KH12	0.224
HAlG-15-Q-SSM-S	2	2	10	S-14321KH22	0.218
HAlG-15-Q-SSM-S	2	2	11	S-14321KH12	0.220
LRM	2	2	12	LRMKH222	0.907
ARG-1	2	2	13	ARGKH222	<0.0500
HAlG-16-Q-SSM-S	2	2	14	S-14322KH12	0.157
HAlG-14-Q-SSM-S	2	2	15	S-14320KH22	0.0626
HAlG-06-Q-SSM-S	2	2	16	S-14313KH12	0.117
HAlG-09-Q-SSM-S	2	2	17	S-14316KH12	0.0980
HAlG-19-Q-SSM-S	2	2	18	S-14325KH12	0.104
HAlG-16-Q-SSM-S	2	2	19	S-14322KH22	0.157
HAlG-18-Q-SSM-S	2	2	20	S-14324KH22	0.227
HAlG-11-Q-SSM-S	2	2	21	S-14317KH12	0.198
HAlG-21-Q-SSM-S	2	2	22	S-14327KH22	0.335
LRM	2	2	23	LRMKH223	0.909
ARG-1	2	2	24	ARGKH223	<0.0500
LRM	3	1	1	LRMKH311	0.898
ARG-1	3	1	2	ARGKH311	<0.0500

Table A-1. KH Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	F^-
HAlG-08-Q-SSM-S	3	1	3	S-14315KH21	0.0654
HAlG-08-Q-SSM-S	3	1	4	S-14315KH11	0.0631
HAlG-05-Q-SSM-S	3	1	5	S-14312KH11	0.268
HAlG-01-Q-SSM-S	3	1	6	S-14308KH11	0.549
HAlG-04-Q-SSM-S	3	1	7	S-14311KH11	0.468
HAlG-02-Q-SSM-S	3	1	8	S-14309KH21	0.0931
HAlG-20-Q-SSM-S	3	1	9	S-14326KH11	0.144
HAlG-02-Q-SSM-S	3	1	10	S-14309KH11	0.0879
LRM	3	1	11	LRMKH312	0.901
ARG-1	3	1	12	ARGKH312	<0.0500
HAlG-07-1-Q-SSM-S	3	1	13	S-14314KH21	0.439
HAlG-05-Q-SSM-S	3	1	14	S-14312KH21	0.274
HAlG-20-Q-SSM-S	3	1	15	S-14326KH21	0.145
EWG-HAlG-SSM-S	3	1	16	S-14332KH11	<0.0500
HAlG-01-Q-SSM-S	3	1	17	S-14308KH21	0.552
HAlG-07-1-Q-SSM-S	3	1	18	S-14314KH11	0.438
HAlG-04-Q-SSM-S	3	1	19	S-14311KH21	0.469
EWG-HAlG-SSM-S	3	1	20	S-14332KH21	<0.0500
LRM	3	1	21	LRMKH313	0.908
ARG-1	3	1	22	ARGKH313	<0.0500
LRM	3	2	1	LRMKH321	0.900
ARG-1	3	2	2	ARGKH321	<0.0500
HAlG-08-Q-SSM-S	3	2	3	S-14315KH12	0.0639
HAlG-08-Q-SSM-S	3	2	4	S-14315KH22	0.0659
HAlG-02-Q-SSM-S	3	2	5	S-14309KH22	0.0945
HAlG-07-1-Q-SSM-S	3	2	6	S-14314KH22	0.442
EWG-HAlG-SSM-S	3	2	7	S-14332KH12	<0.0500
HAlG-05-Q-SSM-S	3	2	8	S-14312KH22	0.278
HAlG-01-Q-SSM-S	3	2	9	S-14308KH22	0.557
HAlG-04-Q-SSM-S	3	2	10	S-14311KH22	0.474
LRM	3	2	11	LRMKH322	0.905
ARG-1	3	2	12	ARGKH322	<0.0500
HAlG-04-Q-SSM-S	3	2	13	S-14311KH12	0.477
EWG-HAlG-SSM-S	3	2	14	S-14332KH22	<0.0500
HAlG-07-1-Q-SSM-S	3	2	15	S-14314KH12	0.443
HAlG-01-Q-SSM-S	3	2	16	S-14308KH12	0.558
HAlG-20-Q-SSM-S	3	2	17	S-14326KH12	0.147
HAlG-05-Q-SSM-S	3	2	18	S-14312KH12	0.274
HAlG-20-Q-SSM-S	3	2	19	S-14326KH22	0.148
HAlG-02-Q-SSM-S	3	2	20	S-14309KH12	0.0898
LRM	3	2	21	LRMKH322	0.910
ARG-1	3	2	22	ARGKH322	<0.0500

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Bi	Ca	Cd	Cr	Fe	Mg	Mn	Na	Ni	S	Sr	Ti	Zn
LRM	1	1	1	LRMLM111	<0.100	0.352	0.138	0.125	1.01	0.0645	0.0638	15.1	0.135	0.0987	<0.0500	0.0587	<0.0500
ARG-1	1	1	2	ARGLM111	<0.100	1.04	<0.0250	0.0643	9.69	0.510	1.47	8.38	0.792	0.0658	<0.0500	0.673	<0.0500
HAlG-14-Q-SSM-S	1	1	3	S-14320LM21	<0.100	0.133	<0.0250	0.633	6.84	0.0595	0.0220	13.6	0.106	0.388	<0.0500	<0.0500	<0.0500
HAlG-07-1-Q-SSM-S	1	1	4	S-14314LM11	0.515	0.842	0.0938	0.0299	6.29	0.362	0.0676	14.7	0.691	0.256	0.0871	0.158	0.165
EWG-HAlG-SSM-S	1	1	5	S-14332LM11	<0.100	1.61	<0.0250	<0.0250	<0.100	<0.0500	<0.0100	7.24	<0.100	<0.0500	0.394	2.00	1.21
HAlG-21-Q-SSM-S	1	1	6	S-14327LM11	0.394	0.647	0.0736	0.183	5.59	0.278	0.0540	11.8	0.555	0.384	0.0665	0.119	0.128
HAlG-12-Q-SSM-S	1	1	7	S-14318LM21	0.397	0.648	0.0717	0.715	0.154	0.280	0.0563	14.3	0.551	0.295	0.0656	0.137	0.124
HAlG-21-Q-SSM-S	1	1	8	S-14327LM21	0.399	0.649	0.0743	0.184	5.63	0.281	0.0541	12.0	0.562	0.362	0.0667	0.117	0.129
HAlG-24-Q-SSM-S	1	1	9	S-14330LM11	0.868	2.43	0.0800	0.451	3.79	0.310	0.752	9.75	0.301	0.425	0.0829	<0.0500	<0.0500
HAlG-17-Q-SSM-S	1	1	10	S-14323LM21	0.259	0.433	0.0485	0.0602	0.533	0.190	0.0314	13.8	0.368	0.360	<0.0500	0.0996	0.0832
LRM	1	1	11	LRMLM112	<0.100	0.356	0.140	0.127	1.04	0.0652	0.0644	15.9	0.137	0.117	<0.0500	0.0596	<0.0500
ARG-1	1	1	12	ARGLM112	<0.100	1.06	<0.0250	0.0650	10.0	0.515	1.50	8.65	0.802	<0.0500	<0.0500	0.683	<0.0500
HAlG-12-Q-SSM-S	1	1	13	S-14318LM11	0.398	0.653	0.0723	0.720	0.150	0.282	0.0482	14.8	0.558	0.308	0.0665	0.139	0.126
HAlG-17-Q-SSM-S	1	1	14	S-14323LM11	0.261	0.436	0.0487	0.0615	0.535	0.192	0.0308	13.9	0.370	0.357	<0.0500	0.102	0.0835
HAlG-08-Q-SSM-S	1	1	15	S-14315LM11	<0.100	0.145	<0.0250	0.371	7.47	0.0638	0.0240	14.3	0.118	0.348	<0.0500	0.0518	<0.0500
EWG-HAlG-SSM-S	1	1	16	S-14332LM21	<0.100	1.64	<0.0250	<0.0250	<0.100	<0.0500	<0.0100	7.49	<0.100	0.0586	0.400	2.04	1.22
HAlG-24-Q-SSM-S	1	1	17	S-14330LM21	0.857	2.46	0.0793	0.445	3.86	0.307	0.749	10.1	0.300	0.432	0.0820	<0.0500	<0.0500
HAlG-07-1-Q-SSM-S	1	1	18	S-14314LM21	0.517	0.851	0.0945	0.0302	6.51	0.364	0.0691	15.5	0.704	0.233	0.0883	0.159	0.165
HAlG-14-Q-SSM-S	1	1	19	S-14320LM11	<0.100	0.134	<0.0250	0.630	7.05	0.0600	0.0218	14.4	0.106	0.391	<0.0500	<0.0500	<0.0500
HAlG-08-Q-SSM-S	1	1	20	S-14315LM21	<0.100	0.142	<0.0250	0.363	7.45	0.0625	0.0232	14.3	0.115	0.333	<0.0500	0.0503	<0.0500
LRM	1	1	21	LRMLM113	<0.100	0.356	0.140	0.127	1.06	0.0654	0.0644	16.0	0.137	0.102	<0.0500	0.0596	<0.0500
ARG-1	1	1	22	ARGLM113	<0.100	1.05	<0.0250	0.0637	10.2	0.506	1.48	8.93	0.783	0.0519	<0.0500	0.670	<0.0500
LRM	1	2	1	LRMLM121	<0.100	0.347	0.137	0.125	1.03	0.0637	0.0633	15.8	0.134	0.0906	<0.0500	0.0583	<0.0500
ARG-1	1	2	2	ARGLM121	<0.100	1.01	<0.0250	0.0633	10.0	0.498	1.38	9.03	0.774	<0.0500	<0.0500	0.665	<0.0500
EWG-HAlG-SSM-S	1	2	3	S-14332LM12	<0.100	1.66	<0.0250	<0.0250	<0.100	<0.0500	<0.0100	7.55	<0.100	<0.0500	0.378	2.09	1.22
HAlG-24-Q-SSM-S	1	2	4	S-14330LM12	0.851	2.45	0.0779	0.443	3.81	0.302	0.738	9.92	0.294	0.430	0.0794	<0.0500	<0.0500
HAlG-08-Q-SSM-S	1	2	5	S-14315LM12	<0.100	0.141	<0.0250	0.366	7.37	0.0623	0.0236	14.4	0.115	0.326	<0.0500	0.0508	<0.0500
HAlG-12-Q-SSM-S	1	2	6	S-14318LM22	0.388	0.633	0.0702	0.705	0.153	0.274	0.0555	14.9	0.542	0.288	0.0631	0.135	0.119
HAlG-14-Q-SSM-S	1	2	7	S-14320LM22	<0.100	0.131	<0.0250	0.624	7.00	0.0581	0.0219	14.4	0.103	0.389	<0.0500	<0.0500	<0.0500
HAlG-21-Q-SSM-S	1	2	8	S-14327LM12	0.385	0.635	0.0720	0.181	5.73	0.274	0.0531	12.5	0.546	0.377	0.0643	0.118	0.123
EWG-HAlG-SSM-S	1	2	9	S-14332LM22	<0.100	1.66	<0.0250	<0.0250	<0.100	<0.0500	<0.0100	7.54	<0.100	<0.0500	0.385	2.08	1.23
HAlG-07-1-Q-SSM-S	1	2	10	S-14314LM12	0.526	0.840	0.0937	0.0300	6.47	0.361	0.0681	15.7	0.694	0.237	0.0860	0.159	0.161
LRM	1	2	11	LRMLM122	<0.100	0.349	0.137	0.125	1.04	0.0639	0.0634	16.1	0.135	0.117	<0.0500	0.0587	<0.0500
ARG-1	1	2	12	ARGLM122	<0.100	1.03	<0.0250	0.0640	10.0	0.502	1.40	8.84	0.782	<0.0500	<0.0500	0.673	<0.0500
HAlG-17-Q-SSM-S	1	2	13	S-14323LM12	0.267	0.430	0.0483	0.0615	0.532	0.190	0.0307	13.8	0.367	0.352	<0.0500	0.102	0.0821
HAlG-21-Q-SSM-S	1	2	14	S-14327LM22	0.410	0.649	0.0740	0.185	5.74	0.280	0.0545	12.4	0.563	0.374	0.0661	0.118	0.126
HAlG-17-Q-SSM-S	1	2	15	S-14323LM22	0.264	0.429	0.0482	0.0605	0.534	0.190	0.0314	14.0	0.367	0.350	<0.0500	0.0999	0.0820
HAlG-14-Q-SSM-S	1	2	16	S-14320LM12	<0.100	0.133	<0.0250	0.635	7.07	0.0598	0.0217	14.5	0.106	0.399	<0.0500	<0.0500	<0.0500
HAlG-07-1-Q-SSM-S	1	2	17	S-14314LM22	0.521	0.840	0.0932	0.0305	6.51	0.360	0.0688	15.6	0.697	0.254	0.0864	0.158	0.161
HAlG-12-Q-SSM-S	1	2	18	S-14318LM12	0.401	0.645	0.0717	0.719	0.150	0.280	0.048	15.1	0.553	0.327	0.0651	0.138	0.122
HAlG-08-Q-SSM-S	1	2	19	S-14315LM22	<0.100	0.141	<0.0250	0.367	7.45	0.0625	0.0232	14.4	0.115	0.346	<0.0500	0.0505	<0.0500
HAlG-24-Q-SSM-S	1	2	20	S-14330LM22	0.877	2.51	0.0793	0.450	3.90	0.308	0.752	10.2	0.300	0.452	0.0813	<0.0500	<0.0500
LRM	1	2	21	LRMLM123	<0.100	0.352	0.139	0.126	1.06	0.0644	0.0641	16.3	0.136	0.0946	<0.0500	0.0591	<0.0500
ARG-1	1	2	22	ARGLM123	<0.100	1.03	<0.0250	0.0643	10.2	0.505	1.47	9.55	0.787	0.0661	<0.0500	0.679	<0.0500
LRM	2	1	1	LRMLM211	<0.100	0.345	0.136	0.124	1.00	0.0631	0.0627	15.2	0.133	0.0899	<0.0500	0.0576	<0.0500
ARG-1	2	1	2	ARGLM211	<0.100	1.04	<0.0250	0.0646	9.83	0.502	1.49	8.64	0.790	<0.0500	<0.0500	0.671	<0.0500
HAlG-05-Q-SSM-S	2	1	3	S-14312LM11	0.350	0.590	0.0685	0.392	7.56	0.254	0.0532	12.8	0.495	0.316	0.0604	0.123	0.115

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Bi	Ca	Cd	Cr	Fe	Mg	Mn	Na	Ni	S	Sr	Ti	Zn
HAlG-06-Q-SSM-S	2	1	4	S-14313LM21	0.153	0.263	0.0281	0.691	1.03	0.114	0.0189	15.4	0.218	0.316	<0.0500	0.0741	0.0509
HAlG-02-Q-SSM-S	2	1	5	S-14309LM21	0.121	0.211	<0.0250	0.784	3.19	0.0912	0.0202	14.9	0.175	0.382	<0.0500	0.0555	<0.0500
HAlG-06-Q-SSM-S	2	1	6	S-14313LM11	0.160	0.266	0.0286	0.703	1.02	0.116	0.0190	15.3	0.221	0.322	<0.0500	0.0754	0.0512
HAlG-01-Q-SSM-S	2	1	7	S-14308LM21	0.645	1.05	0.118	<0.0250	0.968	0.439	0.0713	15.1	0.898	0.313	0.109	0.181	0.205
HAlG-20-Q-SSM-S	2	1	8	S-14326LM11	0.188	0.307	0.0348	0.774	0.515	0.135	0.0216	11.7	0.265	0.456	<0.0500	0.0579	0.0599
HAlG-02-Q-SSM-S	2	1	9	S-14309LM11	0.120	0.215	<0.0250	0.791	3.24	0.0923	0.0201	15.0	0.177	0.397	<0.0500	0.0570	<0.0500
HAlG-22-Q-SSM-S	2	1	10	S-14328LM11	0.603	0.962	0.111	0.918	0.832	0.415	0.0657	11.0	0.837	0.417	0.0964	0.177	0.186
HAlG-01-Q-SSM-S	2	1	11	S-14308LM11	0.650	1.04	0.120	<0.0250	0.979	0.443	0.0723	15.0	0.910	0.341	0.110	0.182	0.209
LRM	2	1	12	LRMLM212	<0.100	0.365	0.145	0.130	1.02	0.0664	0.0659	15.6	0.141	0.105	<0.0500	0.0608	<0.0500
ARG-1	2	1	13	ARGLM212	<0.100	1.07	<0.0250	0.0662	9.85	0.518	1.52	8.80	0.813	0.0620	<0.0500	0.688	<0.0500
HAlG-25-Q-SSM-S	2	1	14	S-14331LM11	<0.100	0.148	<0.0250	0.378	7.22	0.0643	0.0245	13.7	0.119	0.358	<0.0500	0.0521	<0.0500
HAlG-11-Q-SSM-S	2	1	15	S-14317LM21	0.283	0.479	0.0491	0.265	1.25	0.206	0.0337	13.8	0.403	0.255	<0.0500	0.107	0.0912
HAlG-25-Q-SSM-S	2	1	16	S-14331LM21	<0.100	0.146	<0.0250	0.375	7.19	0.0640	0.0246	13.7	0.119	0.357	<0.0500	0.0516	<0.0500
HAlG-05-Q-SSM-S	2	1	17	S-14312LM21	0.358	0.602	0.0701	0.400	7.48	0.259	0.0539	12.6	0.509	0.334	0.0616	0.125	0.117
HAlG-11-Q-SSM-S	2	1	18	S-14317LM11	0.274	0.474	0.0487	0.262	1.26	0.204	0.0335	13.9	0.398	0.224	<0.0500	0.106	0.0904
HAlG-22-Q-SSM-S	2	1	19	S-14328LM21	0.580	0.943	0.109	0.897	0.812	0.407	0.0644	10.8	0.820	0.380	0.0936	0.174	0.182
HAlG-16-Q-SSM-S	2	1	20	S-14322LM21	0.185	0.329	0.0340	0.746	2.94	0.144	0.0271	14.3	0.272	0.292	<0.0500	0.0837	0.0624
HAlG-16-Q-SSM-S	2	1	21	S-14322LM11	0.182	0.330	0.0337	0.740	2.95	0.143	0.0269	14.2	0.270	0.283	<0.0500	0.0826	0.0629
HAlG-20-Q-SSM-S	2	1	22	S-14326LM21	0.175	0.302	0.0342	0.761	0.504	0.133	0.0206	11.8	0.260	0.465	<0.0500	0.0572	0.0585
LRM	2	1	23	LRMLM213	<0.100	0.358	0.141	0.127	1.02	0.0648	0.0642	15.7	0.137	0.113	<0.0500	0.0589	<0.0500
ARG-1	2	1	24	ARGLM213	<0.100	1.05	<0.0250	0.0658	9.87	0.513	1.47	8.72	0.805	0.0704	<0.0500	0.681	<0.0500
LRM	2	2	1	LRMLM221	<0.100	0.349	0.139	0.127	0.991	0.0632	0.0625	15.1	0.135	0.0638	<0.0500	0.0584	<0.0500
ARG-1	2	2	2	ARGLM221	<0.100	1.02	<0.0250	0.0638	9.62	0.492	1.43	8.91	0.775	<0.0500	<0.0500	0.663	<0.0500
HAlG-20-Q-SSM-S	2	2	3	S-14326LM22	0.175	0.291	0.0332	0.754	0.504	0.128	0.0198	11.4	0.252	0.465	<0.0500	0.0553	0.0556
HAlG-05-Q-SSM-S	2	2	4	S-14312LM12	0.339	0.574	0.0670	0.388	7.46	0.246	0.0516	12.5	0.483	0.319	0.0570	0.120	0.111
HAlG-25-Q-SSM-S	2	2	5	S-14331LM22	<0.100	0.139	<0.0250	0.365	7.24	0.0607	0.0230	13.9	0.114	0.329	<0.0500	<0.0500	<0.0500
HAlG-20-Q-SSM-S	2	2	6	S-14326LM12	0.169	0.292	0.0331	0.749	0.504	0.128	0.0200	11.6	0.253	0.470	<0.0500	0.0531	0.0554
HAlG-05-Q-SSM-S	2	2	7	S-14312LM22	0.337	0.575	0.0673	0.389	7.49	0.247	0.0508	12.9	0.485	0.312	0.0571	0.120	0.110
HAlG-06-Q-SSM-S	2	2	8	S-14313LM12	0.147	0.256	0.0274	0.688	1.01	0.111	0.0178	15.3	0.213	0.327	<0.0500	0.0720	<0.0500
HAlG-22-Q-SSM-S	2	2	9	S-14328LM12	0.543	0.893	0.104	0.868	0.791	0.385	0.0600	10.5	0.777	0.395	0.0866	0.163	0.169
HAlG-02-Q-SSM-S	2	2	10	S-14309LM22	0.103	0.198	<0.0250	0.746	3.17	0.0850	0.0184	14.8	0.163	0.371	<0.0500	<0.0500	<0.0500
HAlG-11-Q-SSM-S	2	2	11	S-14317LM22	0.256	0.452	0.0462	0.254	1.25	0.193	0.0310	14.1	0.378	0.223	<0.0500	0.100	0.0845
LRM	2	2	12	LRMLM222	<0.100	0.318	0.126	0.118	1.01	0.0590	0.0577	15.5	0.123	0.0629	<0.0500	0.0549	<0.0500
ARG-1	2	2	13	ARGLM222	<0.100	0.973	<0.0250	0.0635	9.70	0.490	1.41	8.62	0.757	0.0500	<0.0500	0.673	<0.0500
HAlG-16-Q-SSM-S	2	2	14	S-14322LM22	0.205	0.313	0.0322	0.735	2.94	0.139	0.0261	14.3	0.260	0.281	<0.0500	0.0829	0.0600
HAlG-01-Q-SSM-S	2	2	15	S-14308LM12	0.647	1.02	0.111	<0.0250	0.939	0.418	0.0675	14.9	0.850	0.329	0.104	0.174	0.192
HAlG-25-Q-SSM-S	2	2	16	S-14331LM12	<0.100	0.139	<0.0250	0.367	7.21	0.0613	0.0230	13.8	0.113	0.323	<0.0500	0.0511	<0.0500
HAlG-11-Q-SSM-S	2	2	17	S-14317LM12	0.298	0.453	0.0467	0.260	1.26	0.198	0.0320	14.0	0.384	0.202	<0.0500	0.105	0.0868
HAlG-06-Q-SSM-S	2	2	18	S-14313LM22	0.171	0.254	0.0272	0.689	1.01	0.111	0.0180	15.1	0.212	0.314	<0.0500	0.0742	<0.0500
HAlG-22-Q-SSM-S	2	2	19	S-14328LM22	0.608	0.903	0.105	0.890	0.802	0.393	0.0618	10.4	0.788	0.395	0.0917	0.174	0.175
HAlG-01-Q-SSM-S	2	2	20	S-14308LM22	0.653	1.03	0.113	<0.0250	0.943	0.421	0.0677	14.9	0.854	0.346	0.105	0.174	0.195
HAlG-02-Q-SSM-S	2	2	21	S-14309LM12	0.137	0.204	<0.0250	0.778	3.18	0.0892	0.0189	14.8	0.169	0.396	<0.0500	0.0536	<0.0500
HAlG-16-Q-SSM-S	2	2	22	S-14322LM12	0.207	0.317	0.0323	0.736	2.94	0.139	0.0258	14.1	0.261	0.285	<0.0500	0.0831	0.0605
LRM	2	2	23	LRMLM223	<0.100	0.348	0.137	0.128	1.01	0.0636	0.0628	15.6	0.134	0.0817	<0.0500	0.0600	<0.0500
ARG-1	2	2	24	ARGLM223	<0.100	1.02	<0.0250	0.0644	9.74	0.496	1.44	8.63	0.771	<0.0500	<0.0500	0.685	<0.0500
LRM	3	1	1	LRMLM311	<0.100	0.349	0.140	0.127	0.998	0.0644	0.0619	15.1	0.139	0.0939	<0.0500	0.0618	<0.0500
ARG-1	3	1	2	ARGLM311	<0.100	0.994	<0.0250	0.0623	9.67	0.484	1.42	8.55	0.764	0.0518	<0.0500	0.650	<0.0500

Table A-2. LM Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Bi	Ca	Cd	Cr	Fe	Mg	Mn	Na	Ni	S	Sr	Ti	Zn
HAlG-09-Q-SSM-S	3	1	3	S-14316LM11	0.119	0.216	<0.0250	0.475	3.25	0.0932	0.0202	11.0	0.176	0.505	<0.0500	0.0629	<0.0500
HAlG-13-Q-SSM-S	3	1	4	S-14319LM21	0.465	0.779	0.0833	0.0553	5.82	0.328	0.0617	12.7	0.658	0.389	0.0809	0.156	0.152
HAlG-19-Q-SSM-S	3	1	5	S-14325LM11	0.113	0.193	<0.0250	0.197	4.17	0.0849	0.0205	14.6	0.157	0.339	<0.0500	0.0638	<0.0500
HAlG-23-Q-SSM-S	3	1	6	S-14329LM21	0.336	0.533	0.0601	0.478	0.144	0.230	0.0356	9.64	0.461	0.493	0.0547	0.0983	0.104
HAlG-03-Q-SSM-S	3	1	7	S-14310LM11	0.183	0.292	0.0329	0.0916	3.79	0.129	0.0269	13.2	0.252	0.324	<0.0500	0.0629	0.0579
HAlG-04-Q-SSM-S	3	1	8	S-14311LM11	0.540	0.859	0.0984	0.532	4.73	0.368	0.0658	14.3	0.750	0.277	0.0886	0.168	0.168
HAlG-18-Q-SSM-S	3	1	9	S-14324LM11	0.300	0.488	0.0528	0.177	0.337	0.208	0.0324	12.4	0.414	0.359	0.0501	0.0955	0.0946
HAlG-04-Q-SSM-S	3	1	10	S-14311LM21	0.540	0.859	0.0989	0.532	4.71	0.368	0.0661	14.4	0.753	0.258	0.0882	0.168	0.168
LRM	3	1	11	LRMLM312	<0.100	0.356	0.143	0.128	1.01	0.0654	0.0626	15.5	0.141	0.0694	<0.0500	0.0629	<0.0500
ARG-1	3	1	12	ARGLM312	<0.100	1.03	<0.0250	0.0633	9.66	0.491	1.45	8.70	0.777	<0.0500	<0.0500	0.664	<0.0500
HAlG-13-Q-SSM-S	3	1	13	S-14319LM11	0.480	0.800	0.0862	0.0565	5.83	0.338	0.0636	12.7	0.678	0.398	0.0829	0.161	0.156
HAlG-19-Q-SSM-S	3	1	14	S-14325LM21	0.111	0.197	<0.0250	0.200	4.17	0.0858	0.0207	14.7	0.160	0.355	<0.0500	0.0643	<0.0500
HAlG-23-Q-SSM-S	3	1	15	S-14329LM11	0.339	0.550	0.0619	0.489	0.150	0.236	0.0366	9.71	0.475	0.504	0.0562	0.0990	0.106
HAlG-15-Q-SSM-S	3	1	16	S-14321LM21	0.257	0.419	0.0453	0.953	0.880	0.181	0.0288	11.6	0.355	0.373	<0.0500	0.0964	0.0828
HAlG-18-Q-SSM-S	3	1	17	S-14324LM21	0.300	0.488	0.0528	0.176	0.336	0.209	0.0325	12.6	0.414	0.359	0.0502	0.0950	0.0947
HAlG-03-Q-SSM-S	3	1	18	S-14310LM21	0.182	0.292	0.0331	0.0922	3.800	0.129	0.0270	13.2	0.252	0.330	<0.0500	0.0631	0.0581
HAlG-15-Q-SSM-S	3	1	19	S-14321LM11	0.256	0.417	0.0452	0.951	0.886	0.181	0.0287	11.5	0.355	0.372	<0.0500	0.0963	0.0806
HAlG-09-Q-SSM-S	3	1	20	S-14316LM21	0.126	0.220	<0.0250	0.483	3.21	0.0946	0.0203	11.0	0.180	0.468	<0.0500	0.0642	<0.0500
LRM	3	1	21	LRMLM313	<0.100	0.356	0.143	0.129	1.01	0.0655	0.0626	15.6	0.141	0.0982	<0.0500	0.0632	<0.0500
ARG-1	3	1	22	ARGLM313	<0.100	1.02	<0.0250	0.0634	9.65	0.490	1.45	8.57	0.778	0.0665	<0.0500	0.664	<0.0500
LRM	3	2	1	LRMLM321	<0.100	0.358	0.144	0.130	1.01	0.0652	0.0631	14.7	0.140	0.0918	<0.0500	0.0631	<0.0500
ARG-1	3	2	2	ARGLM321	<0.100	1.02	<0.0250	0.0634	9.79	0.486	1.45	8.37	0.770	<0.0500	<0.0500	0.660	<0.0500
HAlG-23-Q-SSM-S	3	2	3	S-14329LM12	0.341	0.552	0.0621	0.494	0.151	0.235	0.0367	9.37	0.472	0.521	0.0562	0.0986	0.105
HAlG-15-Q-SSM-S	3	2	4	S-14321LM22	0.248	0.422	0.0454	0.960	0.881	0.180	0.0288	11.2	0.354	0.378	<0.0500	0.0960	0.0812
HAlG-23-Q-SSM-S	3	2	5	S-14329LM22	0.327	0.544	0.0608	0.486	0.147	0.231	0.0360	9.24	0.463	0.540	0.0553	0.0982	0.104
HAlG-13-Q-SSM-S	3	2	6	S-14319LM22	0.465	0.798	0.0852	0.0566	5.97	0.333	0.0627	12.4	0.665	0.368	0.0821	0.159	0.152
HAlG-04-Q-SSM-S	3	2	7	S-14311LM22	0.532	0.865	0.0992	0.537	4.89	0.366	0.0660	14.1	0.748	0.263	0.0882	0.168	0.165
HAlG-15-Q-SSM-S	3	2	8	S-14321LM12	0.245	0.417	0.0450	0.949	0.879	0.178	0.0283	11.3	0.349	0.371	<0.0500	0.0950	0.0788
HAlG-09-Q-SSM-S	3	2	9	S-14316LM22	0.118	0.221	<0.0250	0.486	3.27	0.0939	0.0202	10.6	0.178	0.505	<0.0500	0.0637	<0.0500
HAlG-18-Q-SSM-S	3	2	10	S-14324LM22	0.293	0.493	0.0531	0.178	0.339	0.207	0.0326	12.1	0.412	0.371	0.0505	0.0944	0.0938
LRM	3	2	11	LRMLM322	<0.100	0.358	0.143	0.129	1.02	0.0649	0.0627	15.1	0.140	0.0982	<0.0500	0.0629	<0.0500
ARG-1	3	2	12	ARGLM322	<0.100	1.02	<0.0250	0.0635	9.85	0.488	1.44	8.45	0.772	0.0508	<0.0500	0.663	<0.0500
HAlG-03-Q-SSM-S	3	2	13	S-14310LM22	0.172	0.295	0.0331	0.0933	3.87	0.129	0.0271	12.8	0.250	0.320	<0.0500	0.0621	0.0574
HAlG-13-Q-SSM-S	3	2	14	S-14319LM12	0.471	0.808	0.0870	0.0570	6.01	0.337	0.0638	12.4	0.676	0.388	0.0833	0.161	0.155
HAlG-19-Q-SSM-S	3	2	15	S-14325LM12	0.103	0.197	<0.0250	0.200	4.27	0.0850	0.0205	14.3	0.158	0.355	<0.0500	0.0635	<0.0500
HAlG-09-Q-SSM-S	3	2	16	S-14316LM12	0.115	0.220	<0.0250	0.483	3.37	0.0940	0.0209	10.8	0.177	0.496	<0.0500	0.0639	<0.0500
HAlG-19-Q-SSM-S	3	2	17	S-14325LM22	0.106	0.199	<0.0250	0.201	4.28	0.0854	0.0206	14.3	0.159	0.351	<0.0500	0.0639	<0.0500
HAlG-18-Q-SSM-S	3	2	18	S-14324LM12	0.298	0.496	0.0533	0.180	0.341	0.208	0.0327	12.1	0.414	0.373	0.0507	0.0955	0.0947
HAlG-04-Q-SSM-S	3	2	19	S-14311LM12	0.538	0.872	0.0994	0.540	4.86	0.369	0.0665	14.0	0.750	0.264	0.0895	0.170	0.168
HAlG-03-Q-SSM-S	3	2	20	S-14310LM12	0.181	0.298	0.0333	0.0933	3.88	0.130	0.0272	12.7	0.253	0.329	<0.0500	0.0624	0.0579
LRM	3	2	21	LRMLM323	<0.100	0.358	0.144	0.130	1.02	0.0652	0.0629	15.1	0.140	0.0928	<0.0500	0.0632	<0.0500
ARG-1	3	2	22	ARGLM323	<0.100	1.02	<0.0250	0.0637	9.83	0.491	1.45	8.41	0.774	0.0531	<0.0500	0.667	<0.0500

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	B	K	Li	P	Si	Zr
LRM	1	1	1	LRMPF111	5.35	2.43	1.43	<0.100	0.193	26.5	0.725
ARG-1	1	1	2	ARGLM111	2.59	2.64	2.54	1.50	<0.100	23.1	<0.100
HAlG-14-Q-SSM-S	1	1	3	S-14320PF11	12.2	5.18	0.416	2.40	0.275	11.1	0.437
HAlG-12-Q-SSM-S	1	1	4	S-14318PF21	11.4	5.02	1.15	0.313	0.443	14.3	4.39
HAlG-23-Q-SSM-S	1	1	5	S-14329PF21	10.9	5.33	1.09	2.54	1.31	16.3	1.54
HAlG-11-Q-SSM-S	1	1	6	S-14317PF11	13.7	2.46	0.795	2.10	1.47	13.3	4.16
HAlG-01-Q-SSM-S	1	1	7	S-14308PF21	11.0	2.96	1.77	0.204	1.58	15.8	3.25
HAlG-15-Q-SSM-S	1	1	8	S-14321PF11	12.1	2.68	0.833	2.70	0.101	19.9	0.816
HAlG-17-Q-SSM-S	1	1	9	S-14323PF11	11.1	4.03	0.860	1.15	0.392	17.9	3.12
HAlG-12-Q-SSM-S	1	1	10	S-14318PF11	11.4	5.02	1.19	0.313	0.428	14.4	4.45
LRM	1	1	11	LRMPF112	5.42	2.45	1.47	<0.100	0.184	26.8	0.817
ARG-1	1	1	12	ARGLM112	2.55	2.61	2.48	1.50	<0.100	23.0	<0.100
HAlG-17-Q-SSM-S	1	1	13	S-14323PF21	11.0	4.00	0.906	1.14	0.396	17.9	3.10
HAlG-01-Q-SSM-S	1	1	14	S-14308PF11	10.9	2.91	1.88	0.227	1.56	15.8	3.27
HAlG-14-Q-SSM-S	1	1	15	S-14320PF21	12.0	5.08	0.351	2.37	0.322	10.9	0.450
HAlG-02-Q-SSM-S	1	1	16	S-14309PF21	12.9	6.19	0.477	0.459	1.51	11.3	1.54
HAlG-02-Q-SSM-S	1	1	17	S-14309PF11	12.5	5.97	0.478	0.447	1.49	11.0	1.47
HAlG-15-Q-SSM-S	1	1	18	S-14321PF21	12.2	2.69	0.796	2.69	0.123	20.2	0.818
HAlG-11-Q-SSM-S	1	1	19	S-14317PF21	13.6	2.44	0.697	2.08	1.45	13.3	4.18
HAlG-23-Q-SSM-S	1	1	20	S-14329PF11	11.2	5.44	1.11	2.57	1.36	16.7	1.56
LRM	1	1	21	LRMPF113	5.46	2.45	1.45	<0.100	0.253	26.8	0.787
ARG-1	1	1	22	ARGLM113	2.58	2.62	2.56	1.50	0.106	23.2	<0.100
LRM	1	2	1	LRMPF121	5.32	2.38	1.25	<0.100	0.200	26.0	0.714
ARG-1	1	2	2	ARGLM121	2.52	2.55	2.39	1.43	0.119	22.4	<0.100
HAlG-17-Q-SSM-S	1	2	3	S-14323PF12	10.9	3.88	0.709	1.09	0.425	17.5	2.99
HAlG-12-Q-SSM-S	1	2	4	S-14318PF22	11.2	4.84	0.968	0.267	0.435	13.8	4.25
HAlG-14-Q-SSM-S	1	2	5	S-14320PF12	11.9	4.96	0.150	2.27	0.275	10.7	0.445
HAlG-15-Q-SSM-S	1	2	6	S-14321PF12	11.7	2.57	0.701	2.54	0.104	19.2	0.776
HAlG-11-Q-SSM-S	1	2	7	S-14317PF22	13.4	2.39	0.644	1.99	1.46	13.0	4.01
HAlG-14-Q-SSM-S	1	2	8	S-14320PF22	12.1	5.02	0.245	2.30	0.304	10.8	0.437
HAlG-15-Q-SSM-S	1	2	9	S-14321PF22	11.8	2.59	0.632	2.53	0.114	19.3	0.779
HAlG-11-Q-SSM-S	1	2	10	S-14317PF12	13.3	2.37	0.654	1.97	1.43	12.8	3.95
LRM	1	2	11	LRMPF122	5.32	2.36	1.21	<0.100	0.244	25.8	0.759
ARG-1	1	2	12	ARGLM122	2.52	2.53	2.33	1.43	0.104	22.4	<0.100
HAlG-23-Q-SSM-S	1	2	13	S-14329PF12	10.7	5.18	0.955	2.44	1.32	16.3	1.45
HAlG-02-Q-SSM-S	1	2	14	S-14309PF22	12.3	5.82	0.341	0.405	1.48	10.6	1.41
HAlG-02-Q-SSM-S	1	2	15	S-14309PF12	12.3	5.82	0.345	0.403	1.49	10.6	1.39
HAlG-23-Q-SSM-S	1	2	16	S-14329PF22	10.6	5.14	0.959	2.42	1.37	15.7	1.45
HAlG-17-Q-SSM-S	1	2	17	S-14323PF22	10.8	3.89	0.759	1.09	0.457	17.3	3.00
HAlG-01-Q-SSM-S	1	2	18	S-14308PF12	10.8	2.89	1.61	0.184	1.58	15.4	3.16
HAlG-01-Q-SSM-S	1	2	19	S-14308PF22	10.6	2.82	1.59	0.194	1.58	15.1	3.05
HAlG-12-Q-SSM-S	1	2	20	S-14318PF12	11.3	4.88	1.05	0.265	0.474	14.0	4.32
LRM	1	2	21	LRMPF123	5.27	2.36	1.30	<0.100	0.223	25.8	0.779
ARG-1	1	2	22	ARGLM123	2.49	2.53	2.25	1.42	0.119	22.3	<0.100
LRM	2	1	1	LRMPF211	5.23	2.33	1.28	<0.100	0.197	25.6	0.723
ARG-1	2	1	2	ARGLM211	2.52	2.53	2.34	1.47	0.112	22.4	<0.100
HAlG-08-Q-SSM-S	2	1	3	S-14315PF21	12.4	4.33	0.303	0.879	1.66	11.5	<0.100

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	B	K	Li	P	Si	Zr
HAlG-22-Q-SSM-S	2	1	4	S-14328PF11	10.5	2.73	1.41	1.85	1.04	17.5	1.52
HAlG-19-Q-SSM-S	2	1	5	S-14325PF21	14.2	2.36	0.323	2.44	0.611	12.4	1.99
HAlG-21-Q-SSM-S	2	1	6	S-14327PF11	11.7	3.22	0.995	1.96	1.71	12.1	0.865
HAlG-05-Q-SSM-S	2	1	7	S-14312PF11	10.3	6.23	1.02	0.183	0.358	10.3	2.21
HAlG-08-Q-SSM-S	2	1	8	S-14315PF11	12.7	4.43	0.325	0.882	1.73	11.9	<0.100
HAlG-22-Q-SSM-S	2	1	9	S-14328PF21	10.8	2.79	1.54	1.86	1.05	18.0	1.58
HAlG-05-Q-SSM-S	2	1	10	S-14312PF21	10.4	6.32	1.03	0.188	0.345	10.5	2.25
HAlG-13-Q-SSM-S	2	1	11	S-14319PF21	10.7	2.44	1.14	2.11	0.252	13.5	4.03
LRM	2	1	12	LRMPF212	5.27	2.33	1.27	<0.100	0.204	25.8	0.810
ARG-1	2	1	13	ARGLM212	2.53	2.51	2.36	1.46	<0.100	22.6	0.104
HAlG-13-Q-SSM-S	2	1	14	S-14319PF11	10.9	2.49	1.15	2.14	0.262	13.8	4.06
HAlG-07-1-Q-SSM-S	2	1	15	S-14314PF11	12.5	3.41	1.30	<0.100	0.800	12.1	1.44
HAlG-18-Q-SSM-S	2	1	16	S-14324PF11	14.2	2.74	0.697	2.40	1.53	10.7	2.38
HAlG-20-Q-SSM-S	2	1	17	S-14326PF11	10.8	5.95	0.522	1.50	1.75	13.9	2.23
HAlG-19-Q-SSM-S	2	1	18	S-14325PF11	14.4	2.36	0.315	2.44	0.615	12.5	2.00
HAlG-07-1-Q-SSM-S	2	1	19	S-14314PF21	12.9	3.48	1.34	<0.100	0.841	12.4	1.46
HAlG-20-Q-SSM-S	2	1	20	S-14326PF21	10.7	5.91	0.511	1.47	1.73	13.8	2.21
HAlG-21-Q-SSM-S	2	1	21	S-14327PF21	11.7	3.21	0.989	1.98	1.68	12.2	0.845
HAlG-18-Q-SSM-S	2	1	22	S-14324PF21	14.0	2.69	0.681	2.39	1.51	10.8	2.34
LRM	2	1	23	LRMPF213	5.34	2.33	1.29	<0.100	0.242	26.0	0.782
ARG-1	2	1	24	ARGLM213	2.51	2.51	2.30	1.46	0.106	22.5	0.101
LRM	2	2	1	LRMPF221	5.10	2.28	1.21	<0.100	0.181	25.2	0.682
ARG-1	2	2	2	ARGLM221	2.42	2.46	2.23	1.40	<0.100	21.9	<0.100
HAlG-05-Q-SSM-S	2	2	3	S-14312PF12	9.95	6.01	1.01	0.142	0.314	10.0	2.07
HAlG-20-Q-SSM-S	2	2	4	S-14326PF22	10.5	5.76	0.539	1.42	1.70	13.4	2.09
HAlG-07-1-Q-SSM-S	2	2	5	S-14314PF22	12.0	3.31	1.24	<0.100	0.805	11.7	1.31
HAlG-13-Q-SSM-S	2	2	6	S-14319PF12	10.3	2.36	1.07	2.04	0.261	13.0	3.77
HAlG-05-Q-SSM-S	2	2	7	S-14312PF22	10.1	6.13	0.933	0.137	0.300	10.2	2.14
HAlG-22-Q-SSM-S	2	2	8	S-14328PF12	10.5	2.72	1.41	1.78	1.01	17.4	1.50
HAlG-21-Q-SSM-S	2	2	9	S-14327PF22	11.4	3.19	0.992	1.91	1.73	11.8	0.798
HAlG-13-Q-SSM-S	2	2	10	S-14319PF22	10.4	2.38	1.06	2.06	0.281	13.2	3.81
HAlG-08-Q-SSM-S	2	2	11	S-14315PF22	12.2	4.24	0.268	0.84	1.69	11.3	<0.100
LRM	2	2	12	LRMPF222	5.13	2.30	1.27	<0.100	0.248	25.3	0.720
ARG-1	2	2	13	ARGLM222	2.45	2.48	2.27	1.42	<0.100	22.0	<0.100
HAlG-19-Q-SSM-S	2	2	14	S-14325PF22	13.8	2.30	0.290	2.32	0.577	12.0	1.87
HAlG-08-Q-SSM-S	2	2	15	S-14315PF12	12.1	4.24	0.251	0.831	1.70	11.3	<0.100
HAlG-07-1-Q-SSM-S	2	2	16	S-14314PF12	12.2	3.34	1.22	<0.100	0.840	11.7	1.31
HAlG-21-Q-SSM-S	2	2	17	S-14327PF12	11.5	3.19	0.971	1.91	1.73	11.8	0.799
HAlG-20-Q-SSM-S	2	2	18	S-14326PF12	10.4	5.68	0.471	1.40	1.73	13.3	2.04
HAlG-19-Q-SSM-S	2	2	19	S-14325PF12	13.9	2.29	0.260	2.39	0.614	12.0	1.86
HAlG-18-Q-SSM-S	2	2	20	S-14324PF12	13.6	2.65	0.606	2.27	1.48	10.2	2.18
HAlG-22-Q-SSM-S	2	2	21	S-14328PF22	10.6	2.74	1.49	1.80	1.05	17.5	1.50
HAlG-18-Q-SSM-S	2	2	22	S-14324PF22	13.5	2.63	0.590	2.27	1.51	10.5	2.17
LRM	2	2	23	LRMPF223	5.15	2.29	1.19	<0.100	0.246	25.3	0.722
ARG-1	2	2	24	ARGLM223	2.45	2.48	2.26	1.42	<0.100	22.1	<0.100
LRM	3	1	1	LRMPF311	4.98	2.29	1.37	0.102	0.206	25.1	0.702
ARG-1	3	1	2	ARGLM311	2.4	2.47	2.34	1.42	0.111	21.9	<0.100

Table A-3. PF Measurements (wt.%) of the SSM Study Glasses (continued)

PNNL ID	Block	Sub – Block	Seq	Lab ID	Al	B	K	Li	P	Si	Zr
HAlG-24-Q-SSM-S	3	1	3	S-14330PF11	10.7	4.46	0.643	1.21	0.392	14.5	0.678
EWG-HAlG-SSM-S	3	1	4	S-14332PF11	3.34	3.40	0.117	2.13	0.238	20.9	1.46
HAlG-03-Q-SSM-S	3	1	5	S-14310PF21	9.93	4.49	0.561	0.36	1.30	15.2	1.41
HAlG-04-Q-SSM-S	3	1	6	S-14311PF11	10.5	3.00	1.36	0.179	0.185	15.8	0.45
HAlG-16-Q-SSM-S	3	1	7	S-14322PF11	11.1	3.06	0.647	1.21	0.820	14.7	3.62
HAlG-09-Q-SSM-S	3	1	8	S-14316PF21	10.4	6.24	0.350	2.29	0.528	10.7	3.93
HAlG-24-Q-SSM-S	3	1	9	S-14330PF21	10.7	4.43	0.603	1.20	0.378	14.5	0.703
HAlG-06-Q-SSM-S	3	1	10	S-14313PF11	13.9	5.64	0.555	0.144	0.889	11.8	0.183
LRM	3	1	11	LRMPF312	5.09	2.29	1.30	<0.100	0.267	25.2	0.744
ARG-1	3	1	12	ARGLM312	2.49	2.51	2.32	1.43	0.126	22.3	0.102
HAlG-03-Q-SSM-S	3	1	13	S-14310PF11	10.1	4.63	0.552	0.362	1.28	15.5	1.45
HAlG-25-Q-SSM-S	3	1	14	S-14331PF21	12.4	4.46	0.400	0.905	1.73	11.9	<0.100
HAlG-16-Q-SSM-S	3	1	15	S-14322PF21	11.1	3.08	0.567	1.22	0.884	14.7	3.62
HAlG-04-Q-SSM-S	3	1	16	S-14311PF21	10.5	2.96	1.42	0.137	0.181	15.8	0.453
EWG-HAlG-SSM-S	3	1	17	S-14332PF21	3.51	3.54	0.164	2.22	0.222	21.9	1.53
HAlG-09-Q-SSM-S	3	1	18	S-14316PF11	10.6	6.31	0.354	2.33	0.554	10.9	3.98
HAlG-06-Q-SSM-S	3	1	19	S-14313PF21	14.2	5.79	0.547	0.164	0.887	12.1	0.188
HAlG-25-Q-SSM-S	3	1	20	S-14331PF11	12.3	4.40	0.360	0.889	1.73	11.8	<0.100
LRM	3	1	21	LRMPF313	5.05	2.30	1.36	0.153	0.271	25.3	0.728
ARG-1	3	1	22	ARGLM313	2.46	2.5	2.41	1.42	0.122	22.2	0.101
LRM	3	2	1	LRMPF321	5.22	2.34	1.40	<0.100	0.182	25.7	0.706
ARG-1	3	2	2	ARGLM321	2.46	2.50	2.37	1.36	<0.100	22.2	<0.100
EWG-HAlG-SSM-S	3	2	3	S-14332PF12	3.47	3.46	<0.100	2.13	0.188	21.3	1.47
HAlG-06-Q-SSM-S	3	2	4	S-14313PF12	14.0	5.62	0.537	<0.100	0.859	11.7	0.147
HAlG-25-Q-SSM-S	3	2	5	S-14331PF12	12.2	4.26	0.364	0.763	1.68	11.4	<0.100
HAlG-03-Q-SSM-S	3	2	6	S-14310PF12	10.1	4.53	0.595	0.255	1.28	15.1	1.38
HAlG-24-Q-SSM-S	3	2	7	S-14330PF22	11.2	4.51	0.633	1.14	0.394	14.7	0.686
HAlG-06-Q-SSM-S	3	2	8	S-14313PF22	14	5.60	0.456	<0.100	0.856	11.7	0.156
HAlG-16-Q-SSM-S	3	2	9	S-14322PF22	11.3	3.05	0.609	0.997	0.837	14.7	3.63
HAlG-03-Q-SSM-S	3	2	10	S-14310PF22	10.2	4.55	0.494	0.238	1.24	15.2	1.41
LRM	3	2	11	LRMPF322	5.17	2.30	1.32	<0.100	0.229	25.4	0.732
ARG-1	3	2	12	ARGLM322	2.47	2.49	2.37	1.35	<0.100	22.1	<0.100
HAlG-09-Q-SSM-S	3	2	13	S-14316PF22	10.5	6.15	0.467	2.27	0.482	10.6	3.90
HAlG-24-Q-SSM-S	3	2	14	S-14330PF12	11.1	4.53	0.648	1.15	0.356	14.7	0.688
HAlG-09-Q-SSM-S	3	2	15	S-14316PF12	10.6	6.19	0.446	2.24	0.509	10.7	3.91
HAlG-25-Q-SSM-S	3	2	16	S-14331PF22	12.2	4.26	0.325	0.763	1.62	11.4	<0.100
EWG-HAlG-SSM-S	3	2	17	S-14332PF22	3.44	3.45	0.151	2.09	0.229	21.1	1.46
HAlG-04-Q-SSM-S	3	2	18	S-14311PF12	10.6	2.96	1.32	<0.100	0.13	15.6	0.420
HAlG-16-Q-SSM-S	3	2	19	S-14322PF12	11.4	3.03	0.601	0.998	0.788	14.6	3.61
HAlG-04-Q-SSM-S	3	2	20	S-14311PF22	10.8	2.99	1.41	<0.100	0.129	15.8	0.433
LRM	3	2	21	LRMPF323	5.25	2.32	1.29	<0.100	0.186	25.6	0.729
ARG-1	3	2	22	ARGLM323	2.53	2.51	2.46	1.36	<0.100	22.4	<0.100

Table A-4. Comparison of Measured and Targeted Compositions

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
ARG-1	Al_2O_3	4.72	4.73	-0.013	0%
ARG-1	B_2O_3	8.13	8.67	-0.543	-6%
ARG-1	Bi_2O_3	<0.111	0	0.111	
ARG-1	CaO	1.44	1.43	0.008	1%
ARG-1	CdO	<0.0286	0	0.029	
ARG-1	Cr_2O_3	0.0936	0.093	0.001	
ARG-1	F	<0.05	0	0.050	
ARG-1	Fe_2O_3	14.1	14	0.071	1%
ARG-1	K_2O	2.85	2.71	0.140	5%
ARG-1	Li_2O	3.08	3.21	-0.130	-4%
ARG-1	MgO	0.827	0.86	-0.033	
ARG-1	MnO	1.87	1.88	-0.006	0%
ARG-1	Na_2O	11.7	11.5	0.239	2%
ARG-1	NiO	0.994	1.05	-0.056	-5%
ARG-1	P_2O_5	<0.245	0.22	0.025	
ARG-1	SiO_2	47.9	47.9	-0.003	0%
ARG-1	SO_3	<0.137	0	0.137	
ARG-1	SrO	<0.0591	0.0037	0.055	
ARG-1	TiO_2	1.12	1.15	-0.031	-3%
ARG-1	ZnO	<0.0622	0.02	0.042	
ARG-1	ZrO_2	<0.136	0.13	0.006	
ARG-1	**Sum of Oxides**	**99.7**	**99.6**	**0.097**	**0%**
EWG-HAlG-SSM-S	Al_2O_3	6.50	5.59	0.91	16%
EWG-HAlG-SSM-S	B_2O_3	11.1	11.3	-0.151	-1%
EWG-HAlG-SSM-S	Bi_2O_3	<0.111	0	0.111	
EWG-HAlG-SSM-S	CaO	2.30	2.23	0.068	3%
EWG-HAlG-SSM-S	CdO	<0.0286	0	0.029	
EWG-HAlG-SSM-S	Cr_2O_3	<0.0365	0	0.037	
EWG-HAlG-SSM-S	F	<0.05	0	0.050	
EWG-HAlG-SSM-S	Fe_2O_3	<0.143	0	0.143	
EWG-HAlG-SSM-S	K_2O	<0.16	0	0.160	
EWG-HAlG-SSM-S	Li_2O	4.61	5.08	-0.467	-9%
EWG-HAlG-SSM-S	MgO	<0.0829	0	0.083	
EWG-HAlG-SSM-S	MnO	<0.0129	0	0.013	
EWG-HAlG-SSM-S	Na_2O	10.0	9.67	0.379	4%
EWG-HAlG-SSM-S	NiO	<0.127	0	0.127	
EWG-HAlG-SSM-S	P_2O_5	0.502	0.65	-0.148	
EWG-HAlG-SSM-S	SiO_2	45.6	46.5	-0.933	-2%
EWG-HAlG-SSM-S	SO_3	<0.13	0	0.130	
EWG-HAlG-SSM-S	SrO	0.460	0.45	0.010	
EWG-HAlG-SSM-S	TiO_2	3.42	3.21	0.214	7%
EWG-HAlG-SSM-S	ZnO	1.52	1.46	0.059	4%
EWG-HAlG-SSM-S	ZrO_2	2.00	1.8	0.199	11%
EWG-HAlG-SSM-S	**Sum of Oxides**	**89.0**	**87.9**	**1.023**	**1%**
HAlG-01-Q-SSM-S	Al_2O_3	20.5	20.2	0.254	1%
HAlG-01-Q-SSM-S	B_2O_3	9.32	9.5	-0.178	-2%
HAlG-01-Q-SSM-S	Bi_2O_3	0.723	0.714	0.009	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-01-Q-SSM-S	CaO	1.45	1.43	0.018	1%
HAlG-01-Q-SSM-S	CdO	0.132	0.143	-0.011	
HAlG-01-Q-SSM-S	Cr_2O_3	<0.0365	0.019	0.018	
HAlG-01-Q-SSM-S	F	0.554	0.82	-0.266	
HAlG-01-Q-SSM-S	Fe_2O_3	1.37	1.36	0.009	1%
HAlG-01-Q-SSM-S	K_2O	2.06	2.1	-0.037	-2%
HAlG-01-Q-SSM-S	Li_2O	0.435	0.495	-0.060	
HAlG-01-Q-SSM-S	MgO	0.713	0.714	-0.001	
HAlG-01-Q-SSM-S	MnO	0.0900	0.087	0.003	
HAlG-01-Q-SSM-S	Na_2O	20.2	20	0.186	1%
HAlG-01-Q-SSM-S	NiO	1.12	1.14	-0.023	-2%
HAlG-01-Q-SSM-S	P_2O_5	3.61	4.21	-0.601	-14%
HAlG-01-Q-SSM-S	SiO_2	33.2	31.5	1.713	5%
HAlG-01-Q-SSM-S	SO_3	0.830	0.486	0.344	
HAlG-01-Q-SSM-S	SrO	0.127	0.147	-0.020	
HAlG-01-Q-SSM-S	TiO_2	0.296	0.286	0.010	
HAlG-01-Q-SSM-S	ZnO	0.249	0.241	0.008	
HAlG-01-Q-SSM-S	ZrO_2	4.30	4.41	-0.111	-3%
HAlG-01-Q-SSM-S	**Sum of Oxides**	**101**	**100**	**1.264**	**1%**
HAlG-02-Q-SSM-S	Al_2O_3	23.6	23.9	-0.281	-1%
HAlG-02-Q-SSM-S	B_2O_3	19.2	19.7	-0.542	-3%
HAlG-02-Q-SSM-S	Bi_2O_3	0.134	0.143	-0.009	
HAlG-02-Q-SSM-S	CaO	0.290	0.286	0.004	
HAlG-02-Q-SSM-S	CdO	<0.0286	0.029	0	
HAlG-02-Q-SSM-S	Cr_2O_3	1.13	1.6	-0.468	-29%
HAlG-02-Q-SSM-S	F	0.0913	0.164	-0.073	
HAlG-02-Q-SSM-S	Fe_2O_3	4.57	4.78	-0.212	-4%
HAlG-02-Q-SSM-S	K_2O	0.494	0.42	0.074	
HAlG-02-Q-SSM-S	Li_2O	0.923	1.07	-0.147	-14%
HAlG-02-Q-SSM-S	MgO	0.148	0.143	0.005	
HAlG-02-Q-SSM-S	MnO	0.0250	0.017	0.008	
HAlG-02-Q-SSM-S	Na_2O	20.1	19.2	0.852	4%
HAlG-02-Q-SSM-S	NiO	0.218	0.229	-0.011	
HAlG-02-Q-SSM-S	P_2O_5	3.42	3.71	-0.290	-8%
HAlG-02-Q-SSM-S	SiO_2	23.3	22.3	0.965	4%
HAlG-02-Q-SSM-S	SO_3	0.965	0.097	0.868	
HAlG-02-Q-SSM-S	SrO	<0.0591	0.029	0.030	
HAlG-02-Q-SSM-S	TiO_2	<0.0901	0.057	0.033	
HAlG-02-Q-SSM-S	ZnO	<0.0622	0.048	0.014	
HAlG-02-Q-SSM-S	ZrO_2	1.96	2.07	-0.108	-5%
HAlG-02-Q-SSM-S	**Sum of Oxides**	**101**	**100**	**0.712**	**1%**
HAlG-03-Q-SSM-S	Al_2O_3	19.1	20.1	-1.049	-5%
HAlG-03-Q-SSM-S	B_2O_3	14.7	15.7	-1.049	-7%
HAlG-03-Q-SSM-S	Bi_2O_3	0.200	0.213	-0.013	
HAlG-03-Q-SSM-S	CaO	0.412	0.426	-0.014	
HAlG-03-Q-SSM-S	CdO	0.0378	0.043	-0.005	
HAlG-03-Q-SSM-S	Cr_2O_3	0.135	0.172	-0.037	
HAlG-03-Q-SSM-S	F	0.128	0.244	-0.116	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-03-Q-SSM-S	Fe_2O_3	5.48	5.69	-0.207	-4%
HAlG-03-Q-SSM-S	K_2O	0.663	0.625	0.038	
HAlG-03-Q-SSM-S	Li_2O	0.654	0.93	-0.276	
HAlG-03-Q-SSM-S	MgO	0.214	0.213	0.001	
HAlG-03-Q-SSM-S	MnO	0.0349	0.026	0.009	
HAlG-03-Q-SSM-S	Na_2O	17.5	16.7	0.790	5%
HAlG-03-Q-SSM-S	NiO	0.320	0.341	-0.021	
HAlG-03-Q-SSM-S	P_2O_5	2.92	3.37	-0.448	-13%
HAlG-03-Q-SSM-S	SiO_2	32.6	32.8	-0.176	-1%
HAlG-03-Q-SSM-S	SO_3	0.813	0.145	0.668	
HAlG-03-Q-SSM-S	SrO	<0.0591	0.044	0.015	
HAlG-03-Q-SSM-S	TiO_2	0.104	0.085	0.019	
HAlG-03-Q-SSM-S	ZnO	0.072	0.072	0	
HAlG-03-Q-SSM-S	ZrO_2	1.91	2.02	-0.112	-6%
HAlG-03-Q-SSM-S	**Sum of Oxides**	**98.0**	**100**	**-1.982**	**-2%**
HAlG-04-Q-SSM-S	Al_2O_3	20.0	20.7	-0.671	-3%
HAlG-04-Q-SSM-S	B_2O_3	9.59	10.2	-0.613	-6%
HAlG-04-Q-SSM-S	Bi_2O_3	0.599	0.621	-0.022	
HAlG-04-Q-SSM-S	CaO	1.21	1.24	-0.031	-3%
HAlG-04-Q-SSM-S	CdO	0.113	0.124	-0.011	
HAlG-04-Q-SSM-S	Cr_2O_3	0.782	1.13	-0.348	-31%
HAlG-04-Q-SSM-S	F	0.472	0.713	-0.241	
HAlG-04-Q-SSM-S	Fe_2O_3	6.86	6.89	-0.031	0%
HAlG-04-Q-SSM-S	K_2O	1.66	1.82	-0.161	-9%
HAlG-04-Q-SSM-S	Li_2O	<0.278	0.382	-0.104	
HAlG-04-Q-SSM-S	MgO	0.610	0.621	-0.011	
HAlG-04-Q-SSM-S	MnO	0.0853	0.076	0.009	
HAlG-04-Q-SSM-S	Na_2O	19.1	19.5	-0.358	-2%
HAlG-04-Q-SSM-S	NiO	0.955	0.993	-0.038	
HAlG-04-Q-SSM-S	P_2O_5	0.358	0.371	-0.013	
HAlG-04-Q-SSM-S	SiO_2	33.7	33	0.694	2%
HAlG-04-Q-SSM-S	SO_3	0.663	0.422	0.241	
HAlG-04-Q-SSM-S	SrO	0.105	0.128	-0.023	
HAlG-04-Q-SSM-S	TiO_2	0.281	0.248	0.033	
HAlG-04-Q-SSM-S	ZnO	0.208	0.21	-0.002	
HAlG-04-Q-SSM-S	ZrO_2	0.593	0.604	-0.011	
HAlG-04-Q-SSM-S	**Sum of Oxides**	**98.3**	**100**	**-1.712**	**-2%**
HAlG-05-Q-SSM-S	Al_2O_3	19.2	20	-0.751	-4%
HAlG-05-Q-SSM-S	B_2O_3	19.9	21.2	-1.325	-6%
HAlG-05-Q-SSM-S	Bi_2O_3	0.386	0.428	-0.042	
HAlG-05-Q-SSM-S	CaO	0.819	0.856	-0.037	
HAlG-05-Q-SSM-S	CdO	0.0779	0.086	-0.008	
HAlG-05-Q-SSM-S	Cr_2O_3	0.573	0.662	-0.089	
HAlG-05-Q-SSM-S	F	0.274	0.491	-0.218	
HAlG-05-Q-SSM-S	Fe_2O_3	10.7	11.1	-0.381	-3%
HAlG-05-Q-SSM-S	K_2O	1.20	1.26	-0.058	-5%
HAlG-05-Q-SSM-S	Li_2O	0.350	0.452	-0.102	
HAlG-05-Q-SSM-S	MgO	0.417	0.428	-0.011	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-05-Q-SSM-S	MnO	0.0676	0.052	0.016	
HAlG-05-Q-SSM-S	Na_2O	17.1	15.7	1.420	9%
HAlG-05-Q-SSM-S	NiO	0.627	0.685	-0.058	
HAlG-05-Q-SSM-S	P_2O_5	0.754	0.78	-0.026	
HAlG-05-Q-SSM-S	SiO_2	21.9	22	-0.072	0%
HAlG-05-Q-SSM-S	SO_3	0.800	0.291	0.509	
HAlG-05-Q-SSM-S	SrO	0.0698	0.088	-0.018	
HAlG-05-Q-SSM-S	TiO_2	0.203	0.171	0.032	
HAlG-05-Q-SSM-S	ZnO	0.141	0.145	-0.004	
HAlG-05-Q-SSM-S	ZrO_2	2.93	3.06	-0.132	-4%
HAlG-05-Q-SSM-S	**Sum of Oxides**	**98.6**	**99.9**	**-1.354**	**-1%**
HAlG-06-Q-SSM-S	Al_2O_3	26.5	27.9	-1.400	-5%
HAlG-06-Q-SSM-S	B_2O_3	18.2	19.6	-1.367	-7%
HAlG-06-Q-SSM-S	Bi_2O_3	0.176	0.182	-0.006	
HAlG-06-Q-SSM-S	CaO	0.363	0.365	-0.002	
HAlG-06-Q-SSM-S	CdO	0.0318	0.036	-0.004	
HAlG-06-Q-SSM-S	Cr_2O_3	1.01	1.19	-0.177	-15%
HAlG-06-Q-SSM-S	F	0.115	0.209	-0.094	
HAlG-06-Q-SSM-S	Fe_2O_3	1.45	1.47	-0.015	-1%
HAlG-06-Q-SSM-S	K_2O	0.631	0.536	0.095	
HAlG-06-Q-SSM-S	Li_2O	<0.273	0.322	-0.049	
HAlG-06-Q-SSM-S	MgO	0.187	0.182	0.005	
HAlG-06-Q-SSM-S	MnO	0.0238	0.022	0.002	
HAlG-06-Q-SSM-S	Na_2O	20.6	19.7	0.891	5%
HAlG-06-Q-SSM-S	NiO	0.275	0.292	-0.017	
HAlG-06-Q-SSM-S	P_2O_5	2.00	2.32	-0.320	-14%
HAlG-06-Q-SSM-S	SiO_2	25.3	25.2	0.097	0%
HAlG-06-Q-SSM-S	SO_3	0.798	0.124	0.674	
HAlG-06-Q-SSM-S	SrO	<0.0591	0.038	0.021	
HAlG-06-Q-SSM-S	TiO_2	0.123	0.073	0.050	
HAlG-06-Q-SSM-S	ZnO	<0.0629	0.062	0.001	
HAlG-06-Q-SSM-S	ZrO_2	0.228	0.247	-0.019	
HAlG-06-Q-SSM-S	**Sum of Oxides**	**98.4**	**100**	**-1.634**	**-2%**
HAlG-07-1-Q-SSM-S	Al_2O_3	23.4	23.7	-0.270	-1%
HAlG-07-1-Q-SSM-S	B_2O_3	10.9	11.3	-0.401	-4%
HAlG-07-1-Q-SSM-S	Bi_2O_3	0.579	0.597	-0.018	
HAlG-07-1-Q-SSM-S	CaO	1.18	1.19	-0.010	-1%
HAlG-07-1-Q-SSM-S	CdO	0.107	0.119	-0.012	
HAlG-07-1-Q-SSM-S	Cr_2O_3	0.0441	0.074	-0.030	
HAlG-07-1-Q-SSM-S	F	0.441	0.685	-0.245	
HAlG-07-1-Q-SSM-S	Fe_2O_3	9.21	9.08	0.134	1%
HAlG-07-1-Q-SSM-S	K_2O	1.54	1.75	-0.214	-12%
HAlG-07-1-Q-SSM-S	Li_2O	<0.215	0.175	0.040	
HAlG-07-1-Q-SSM-S	MgO	0.600	0.597	0.003	
HAlG-07-1-Q-SSM-S	MnO	0.0883	0.073	0.015	
HAlG-07-1-Q-SSM-S	Na_2O	20.7	19.8	0.925	5%
HAlG-07-1-Q-SSM-S	NiO	0.886	0.954	-0.068	
HAlG-07-1-Q-SSM-S	P_2O_5	1.88	2.1	-0.218	-10%

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-07-1-Q-SSM-S	SiO_2	25.6	24.8	0.818	3%
HAlG-07-1-Q-SSM-S	SO_3	0.612	0.406	0.206	
HAlG-07-1-Q-SSM-S	SrO	0.103	0.123	-0.020	
HAlG-07-1-Q-SSM-S	TiO_2	0.264	0.239	0.025	
HAlG-07-1-Q-SSM-S	ZnO	0.203	0.202	0.001	
HAlG-07-1-Q-SSM-S	ZrO_2	1.86	1.9	-0.036	-2%
HAlG-07-1-Q-SSM-S	**Sum of Oxides**	**100**	**99.9**	**0.628**	**1%**
HAlG-08-Q-SSM-S	Al_2O_3	23.3	24.3	-0.965	-4%
HAlG-08-Q-SSM-S	B_2O_3	13.9	14.8	-0.922	-6%
HAlG-08-Q-SSM-S	Bi_2O_3	<0.111	0.096	0.015	
HAlG-08-Q-SSM-S	CaO	0.199	0.192	0.007	
HAlG-08-Q-SSM-S	CdO	<0.0286	0.019	0.010	
HAlG-08-Q-SSM-S	Cr_2O_3	0.536	0.649	-0.113	
HAlG-08-Q-SSM-S	F	0.0646	0.11	-0.045	
HAlG-08-Q-SSM-S	Fe_2O_3	10.6	10.7	-0.070	-1%
HAlG-08-Q-SSM-S	K_2O	0.345	0.283	0.062	
HAlG-08-Q-SSM-S	Li_2O	1.85	1.8	0.047	3%
HAlG-08-Q-SSM-S	MgO	0.104	0.096	0.008	
HAlG-08-Q-SSM-S	MnO	0.0303	0.012	0.018	
HAlG-08-Q-SSM-S	Na_2O	19.3	17.5	1.844	11%
HAlG-08-Q-SSM-S	NiO	0.147	0.154	-0.007	
HAlG-08-Q-SSM-S	P_2O_5	3.88	4.36	-0.476	-11%
HAlG-08-Q-SSM-S	SiO_2	24.6	24.8	-0.198	-1%
HAlG-08-Q-SSM-S	SO_3	0.845	0.065	0.780	
HAlG-08-Q-SSM-S	SrO	<0.0591	0.02	0.039	
HAlG-08-Q-SSM-S	TiO_2	0.0848	0.038	0.047	
HAlG-08-Q-SSM-S	ZnO	<0.0622	0.033	0.029	
HAlG-08-Q-SSM-S	ZrO_2	<0.135	0.041	0.094	
HAlG-08-Q-SSM-S	**Sum of Oxides**	**100**	**100**	**0.204**	**0%**
HAlG-09-Q-SSM-S	Al_2O_3	19.9	21.1	-1.213	-6%
HAlG-09-Q-SSM-S	B_2O_3	20.0	21.8	-1.764	-8%
HAlG-09-Q-SSM-S	Bi_2O_3	0.133	0.156	-0.023	
HAlG-09-Q-SSM-S	CaO	0.307	0.312	-0.005	
HAlG-09-Q-SSM-S	CdO	<0.0286	0.031	-0.002	
HAlG-09-Q-SSM-S	Cr_2O_3	0.704	1.06	-0.356	-34%
HAlG-09-Q-SSM-S	F	0.0977	0.179	-0.081	
HAlG-09-Q-SSM-S	Fe_2O_3	4.68	4.81	-0.128	-3%
HAlG-09-Q-SSM-S	K_2O	0.487	0.459	0.028	
HAlG-09-Q-SSM-S	Li_2O	4.91	5.62	-0.706	-13%
HAlG-09-Q-SSM-S	MgO	0.156	0.156	0	
HAlG-09-Q-SSM-S	MnO	0.0263	0.019	0.007	
HAlG-09-Q-SSM-S	Na_2O	14.6	13.6	1.026	8%
HAlG-09-Q-SSM-S	NiO	0.226	0.25	-0.024	
HAlG-09-Q-SSM-S	P_2O_5	1.19	1.36	-0.172	-13%
HAlG-09-Q-SSM-S	SiO_2	22.9	23.2	-0.256	-1%
HAlG-09-Q-SSM-S	SO_3	1.23	0.106	1.126	1062%
HAlG-09-Q-SSM-S	SrO	<0.0591	0.032	0.027	
HAlG-09-Q-SSM-S	TiO_2	0.106	0.062	0.044	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-09-Q-SSM-S	ZnO	<0.0622	0.053	0.009	
HAlG-09-Q-SSM-S	ZrO_2	5.31	5.6	-0.291	-5%
HAlG-09-Q-SSM-S	**Sum of Oxides**	**97.2**	**100**	**-2.755**	**-3%**
HAlG-11-Q-SSM-S	Al_2O_3	25.5	24.5	1.008	4%
HAlG-11-Q-SSM-S	B_2O_3	7.78	8.84	-1.064	-12%
HAlG-11-Q-SSM-S	Bi_2O_3	0.310	0.316	-0.006	
HAlG-11-Q-SSM-S	CaO	0.650	0.631	0.019	
HAlG-11-Q-SSM-S	CdO	0.0545	0.063	-0.009	
HAlG-11-Q-SSM-S	Cr_2O_3	0.380	1.81	-1.430	-79%
HAlG-11-Q-SSM-S	F	0.196	0.362	-0.166	
HAlG-11-Q-SSM-S	Fe_2O_3	1.79	1.73	0.064	4%
HAlG-11-Q-SSM-S	K_2O	0.840	0.927	-0.087	
HAlG-11-Q-SSM-S	Li_2O	4.38	4.59	-0.209	-5%
HAlG-11-Q-SSM-S	MgO	0.332	0.316	0.016	
HAlG-11-Q-SSM-S	MnO	0.0420	0.039	0.003	
HAlG-11-Q-SSM-S	Na_2O	18.8	19.9	-1.095	-6%
HAlG-11-Q-SSM-S	NiO	0.497	0.505	-0.008	
HAlG-11-Q-SSM-S	P_2O_5	3.33	3.7	-0.372	-10%
HAlG-11-Q-SSM-S	SiO_2	28.0	25.8	2.225	9%
HAlG-11-Q-SSM-S	SO_3	0.564	0.215	0.349	
HAlG-11-Q-SSM-S	SrO	<0.0591	0.065	-0.006	
HAlG-11-Q-SSM-S	TiO_2	0.174	0.126	0.048	
HAlG-11-Q-SSM-S	ZnO	0.110	0.107	0.003	
HAlG-11-Q-SSM-S	ZrO_2	5.50	5.43	0.075	1%
HAlG-11-Q-SSM-S	**Sum of Oxides**	**99.3**	**100**	**-0.640**	**-1%**
HAlG-12-Q-SSM-S	Al_2O_3	21.4	21.1	0.299	1%
HAlG-12-Q-SSM-S	B_2O_3	15.9	16.1	-0.194	-1%
HAlG-12-Q-SSM-S	Bi_2O_3	0.441	0.455	-0.014	
HAlG-12-Q-SSM-S	CaO	0.902	0.91	-0.008	
HAlG-12-Q-SSM-S	CdO	0.0816	0.091	-0.009	
HAlG-12-Q-SSM-S	Cr_2O_3	1.04	1.65	-0.605	-37%
HAlG-12-Q-SSM-S	F	0.299	0.522	-0.224	
HAlG-12-Q-SSM-S	Fe_2O_3	0.217	0.17	0.047	
HAlG-12-Q-SSM-S	K_2O	1.31	1.34	-0.028	-2%
HAlG-12-Q-SSM-S	Li_2O	0.623	0.713	-0.090	
HAlG-12-Q-SSM-S	MgO	0.463	0.455	0.008	
HAlG-12-Q-SSM-S	MnO	0.0671	0.056	0.011	
HAlG-12-Q-SSM-S	Na_2O	19.9	19.4	0.517	3%
HAlG-12-Q-SSM-S	NiO	0.701	0.728	-0.027	
HAlG-12-Q-SSM-S	P_2O_5	1.02	1.06	-0.040	-4%
HAlG-12-Q-SSM-S	SiO_2	30.2	28.6	1.618	6%
HAlG-12-Q-SSM-S	SO_3	0.760	0.309	0.451	
HAlG-12-Q-SSM-S	SrO	0.0770	0.094	-0.017	
HAlG-12-Q-SSM-S	TiO_2	0.229	0.182	0.047	
HAlG-12-Q-SSM-S	ZnO	0.153	0.154	-0.001	
HAlG-12-Q-SSM-S	ZrO_2	5.88	5.96	-0.081	-1%
HAlG-12-Q-SSM-S	**Sum of Oxides**	**102**	**100**	**1.660**	**2%**
HAlG-13-Q-SSM-S	Al_2O_3	20.0	20.4	-0.419	-2%

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-13-Q-SSM-S	B_2O_3	7.78	8.24	-0.456	-6%
HAlG-13-Q-SSM-S	Bi_2O_3	0.524	0.574	-0.050	
HAlG-13-Q-SSM-S	CaO	1.11	1.15	-0.036	-3%
HAlG-13-Q-SSM-S	CdO	0.0976	0.115	-0.017	
HAlG-13-Q-SSM-S	Cr_2O_3	0.0824	0.254	-0.172	
HAlG-13-Q-SSM-S	F	0.459	0.659	-0.200	
HAlG-13-Q-SSM-S	Fe_2O_3	8.45	8.61	-0.164	-2%
HAlG-13-Q-SSM-S	K_2O	1.33	1.69	-0.359	-21%
HAlG-13-Q-SSM-S	Li_2O	4.49	4.81	-0.316	-7%
HAlG-13-Q-SSM-S	MgO	0.554	0.574	-0.020	
HAlG-13-Q-SSM-S	MnO	0.0813	0.07	0.011	
HAlG-13-Q-SSM-S	Na_2O	16.9	16.8	0.117	1%
HAlG-13-Q-SSM-S	NiO	0.852	0.919	-0.067	
HAlG-13-Q-SSM-S	P_2O_5	0.605	0.644	-0.039	
HAlG-13-Q-SSM-S	SiO_2	28.6	28.1	0.513	2%
HAlG-13-Q-SSM-S	SO_3	0.963	0.39	0.573	
HAlG-13-Q-SSM-S	SrO	0.0973	0.118	-0.021	
HAlG-13-Q-SSM-S	TiO_2	0.266	0.23	0.036	
HAlG-13-Q-SSM-S	ZnO	0.191	0.194	-0.003	
HAlG-13-Q-SSM-S	ZrO_2	5.29	5.37	-0.078	-1%
HAlG-13-Q-SSM-S	**Sum of Oxides**	**98.7**	**99.9**	**-1.165**	**-1%**
HAlG-14-Q-SSM-S	Al_2O_3	22.8	22.9	-0.132	-1%
HAlG-14-Q-SSM-S	B_2O_3	16.3	16.8	-0.507	-3%
HAlG-14-Q-SSM-S	Bi_2O_3	<0.111	0.087	0.024	
HAlG-14-Q-SSM-S	CaO	0.186	0.173	0.013	
HAlG-14-Q-SSM-S	CdO	<0.0286	0.017	0.012	
HAlG-14-Q-SSM-S	Cr_2O_3	0.922	1.76	-0.838	-48%
HAlG-14-Q-SSM-S	F	0.0623	0.1	-0.038	
HAlG-14-Q-SSM-S	Fe_2O_3	9.99	9.98	0.014	0%
HAlG-14-Q-SSM-S	K_2O	0.350	0.255	0.095	
HAlG-14-Q-SSM-S	Li_2O	5.03	5.34	-0.313	-6%
HAlG-14-Q-SSM-S	MgO	0.0984	0.087	0.011	
HAlG-14-Q-SSM-S	MnO	0.0282	0.011	0.017	
HAlG-14-Q-SSM-S	Na_2O	19.2	18.6	0.575	3%
HAlG-14-Q-SSM-S	NiO	0.134	0.139	-0.005	
HAlG-14-Q-SSM-S	P_2O_5	0.674	0.795	-0.121	
HAlG-14-Q-SSM-S	SiO_2	23.3	22.2	1.065	5%
HAlG-14-Q-SSM-S	SO_3	0.978	0.059	0.919	
HAlG-14-Q-SSM-S	SrO	<0.0591	0.018	0.041	
HAlG-14-Q-SSM-S	TiO_2	<0.0834	0.035	0.048	
HAlG-14-Q-SSM-S	ZnO	<0.0622	0.029	0.033	
HAlG-14-Q-SSM-S	ZrO_2	0.597	0.614	-0.017	
HAlG-14-Q-SSM-S	**Sum of Oxides**	**101**	**100**	**0.897**	**1%**
HAlG-15-Q-SSM-S	Al_2O_3	22.6	22.4	0.180	1%
HAlG-15-Q-SSM-S	B_2O_3	8.48	8.65	-0.174	-2%
HAlG-15-Q-SSM-S	Bi_2O_3	0.280	0.297	-0.017	
HAlG-15-Q-SSM-S	CaO	0.586	0.595	-0.009	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-15-Q-SSM-S	CdO	0.0517	0.059	-0.007	
HAlG-15-Q-SSM-S	Cr_2O_3	1.39	1.95	-0.557	-29%
HAlG-15-Q-SSM-S	F	0.217	0.341	-0.124	
HAlG-15-Q-SSM-S	Fe_2O_3	1.26	1.29	-0.030	-2%
HAlG-15-Q-SSM-S	K_2O	0.892	0.874	0.018	
HAlG-15-Q-SSM-S	Li_2O	5.63	5.93	-0.300	-5%
HAlG-15-Q-SSM-S	MgO	0.298	0.297	0.001	
HAlG-15-Q-SSM-S	MnO	0.0370	0.036	0.001	
HAlG-15-Q-SSM-S	Na_2O	15.4	14.9	0.467	3%
HAlG-15-Q-SSM-S	NiO	0.450	0.476	-0.026	
HAlG-15-Q-SSM-S	P_2O_5	0.253	0.176	0.077	
HAlG-15-Q-SSM-S	SiO_2	42.0	40.1	1.937	5%
HAlG-15-Q-SSM-S	SO_3	0.933	0.202	0.731	
HAlG-15-Q-SSM-S	SrO	<0.0591	0.061	-0.002	
HAlG-15-Q-SSM-S	TiO_2	0.160	0.119	0.041	
HAlG-15-Q-SSM-S	ZnO	0.101	0.101	0	
HAlG-15-Q-SSM-S	ZrO_2	1.08	1.1	-0.023	-2%
HAlG-15-Q-SSM-S	**Sum of Oxides**	**102**	**100**	**2.184**	**2%**
HAlG-16-Q-SSM-S	Al_2O_3	21.2	21.6	-0.390	-2%
HAlG-16-Q-SSM-S	B_2O_3	9.84	10.4	-0.563	-5%
HAlG-16-Q-SSM-S	Bi_2O_3	0.217	0.223	-0.006	
HAlG-16-Q-SSM-S	CaO	0.451	0.445	0.006	
HAlG-16-Q-SSM-S	CdO	0.0378	0.045	-0.007	
HAlG-16-Q-SSM-S	Cr_2O_3	1.08	2	-0.920	-46%
HAlG-16-Q-SSM-S	F	0.156	0.256	-0.101	
HAlG-16-Q-SSM-S	Fe_2O_3	4.21	4.21	-0.003	0%
HAlG-16-Q-SSM-S	K_2O	0.730	0.654	0.076	
HAlG-16-Q-SSM-S	Li_2O	2.38	2.54	-0.158	-6%
HAlG-16-Q-SSM-S	MgO	0.234	0.223	0.011	
HAlG-16-Q-SSM-S	MnO	0.0342	0.027	0.007	
HAlG-16-Q-SSM-S	Na_2O	19.2	19	0.175	1%
HAlG-16-Q-SSM-S	NiO	0.338	0.356	-0.018	
HAlG-16-Q-SSM-S	P_2O_5	1.91	2.21	-0.303	-14%
HAlG-16-Q-SSM-S	SiO_2	31.4	30.5	0.894	3%
HAlG-16-Q-SSM-S	SO_3	0.712	0.151	0.561	
HAlG-16-Q-SSM-S	SrO	<0.0591	0.046	0.013	
HAlG-16-Q-SSM-S	TiO_2	0.139	0.089	0.050	
HAlG-16-Q-SSM-S	ZnO	0.0765	0.075	0.001	
HAlG-16-Q-SSM-S	ZrO_2	4.89	4.93	-0.040	-1%
HAlG-16-Q-SSM-S	**Sum of Oxides**	**99.3**	**100**	**-0.714**	**-1%**
HAlG-17-Q-SSM-S	Al_2O_3	20.7	20.6	0.090	0%
HAlG-17-Q-SSM-S	B_2O_3	12.7	13.1	-0.381	-3%
HAlG-17-Q-SSM-S	Bi_2O_3	0.293	0.305	-0.012	
HAlG-17-Q-SSM-S	CaO	0.604	0.61	-0.006	
HAlG-17-Q-SSM-S	CdO	0.0553	0.061	-0.006	
HAlG-17-Q-SSM-S	Cr_2O_3	0.089	0.132	-0.043	
HAlG-17-Q-SSM-S	F	0.216	0.35	-0.134	
HAlG-17-Q-SSM-S	Fe_2O_3	0.763	0.763	0	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-17-Q-SSM-S	K_2O	0.974	0.896	0.078	
HAlG-17-Q-SSM-S	Li_2O	2.41	2.63	-0.224	-9%
HAlG-17-Q-SSM-S	MgO	0.316	0.305	0.011	
HAlG-17-Q-SSM-S	MnO	0.0401	0.037	0.003	
HAlG-17-Q-SSM-S	Na_2O	18.7	17.5	1.204	7%
HAlG-17-Q-SSM-S	NiO	0.468	0.488	-0.020	
HAlG-17-Q-SSM-S	P_2O_5	0.957	1.05	-0.093	-9%
HAlG-17-Q-SSM-S	SiO_2	37.8	36.5	1.259	3%
HAlG-17-Q-SSM-S	SO_3	0.886	0.207	0.679	
HAlG-17-Q-SSM-S	SrO	<0.0591	0.063	-0.004	
HAlG-17-Q-SSM-S	TiO_2	0.168	0.122	0.046	
HAlG-17-Q-SSM-S	ZnO	0.103	0.103	0	
HAlG-17-Q-SSM-S	ZrO_2	4.12	4.13	-0.007	0%
HAlG-17-Q-SSM-S	**Sum of Oxides**	**102**	**100**	**2.439**	**2%**
HAlG-18-Q-SSM-S	Al_2O_3	26.1	28.6	-2.478	-9%
HAlG-18-Q-SSM-S	B_2O_3	8.62	11.2	-2.579	-23%
HAlG-18-Q-SSM-S	Bi_2O_3	0.332	0.366	-0.034	
HAlG-18-Q-SSM-S	CaO	0.687	0.732	-0.045	
HAlG-18-Q-SSM-S	CdO	0.0605	0.073	-0.012	
HAlG-18-Q-SSM-S	Cr_2O_3	0.260	0.745	-0.485	
HAlG-18-Q-SSM-S	F	0.224	0.42	-0.196	
HAlG-18-Q-SSM-S	Fe_2O_3	0.484	0.518	-0.034	
HAlG-18-Q-SSM-S	K_2O	0.775	1.08	-0.305	-28%
HAlG-18-Q-SSM-S	Li_2O	5.02	5.87	-0.848	-14%
HAlG-18-Q-SSM-S	MgO	0.345	0.366	-0.021	
HAlG-18-Q-SSM-S	MnO	0.042	0.045	-0.003	
HAlG-18-Q-SSM-S	Na_2O	16.6	18.7	-2.120	-11%
HAlG-18-Q-SSM-S	NiO	0.526	0.586	-0.060	
HAlG-18-Q-SSM-S	P_2O_5	3.45	3.97	-0.516	-13%
HAlG-18-Q-SSM-S	SiO_2	22.6	22.9	-0.330	-1%
HAlG-18-Q-SSM-S	SO_3	0.913	0.249	0.664	
HAlG-18-Q-SSM-S	SrO	0.0596	0.075	-0.015	
HAlG-18-Q-SSM-S	TiO_2	0.159	0.146	0.013	
HAlG-18-Q-SSM-S	ZnO	0.118	0.124	-0.006	
HAlG-18-Q-SSM-S	ZrO_2	3.06	3.31	-0.247	-7%
HAlG-18-Q-SSM-S	**Sum of Oxides**	**90.4**	**100**	**-9.659**	**-10%**
HAlG-19-Q-SSM-S	Al_2O_3	26.6	27.6	-1.005	-4%
HAlG-19-Q-SSM-S	B_2O_3	7.49	8.02	-0.526	-7%
HAlG-19-Q-SSM-S	Bi_2O_3	0.121	0.136	-0.015	
HAlG-19-Q-SSM-S	CaO	0.275	0.271	0.004	
HAlG-19-Q-SSM-S	CdO	<0.0286	0.027	0.002	
HAlG-19-Q-SSM-S	Cr_2O_3	0.292	0.846	-0.554	
HAlG-19-Q-SSM-S	F	0.102	0.156	-0.054	
HAlG-19-Q-SSM-S	Fe_2O_3	6.04	6.14	-0.103	-2%
HAlG-19-Q-SSM-S	K_2O	0.358	0.398	-0.040	
HAlG-19-Q-SSM-S	Li_2O	5.16	5.5	-0.338	-6%
HAlG-19-Q-SSM-S	MgO	0.141	0.136	0.005	
HAlG-19-Q-SSM-S	MnO	0.0266	0.017	0.010	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-19-Q-SSM-S	Na_2O	19.5	19.8	-0.288	-1%
HAlG-19-Q-SSM-S	NiO	0.202	0.217	-0.015	
HAlG-19-Q-SSM-S	P_2O_5	1.38	1.69	-0.305	-18%
HAlG-19-Q-SSM-S	SiO_2	26.2	26.1	0.053	0%
HAlG-19-Q-SSM-S	SO_3	0.874	0.092	0.782	
HAlG-19-Q-SSM-S	SrO	<0.0591	0.028	0.031	
HAlG-19-Q-SSM-S	TiO_2	0.107	0.054	0.053	
HAlG-19-Q-SSM-S	ZnO	<0.0622	0.046	0.016	
HAlG-19-Q-SSM-S	ZrO_2	2.61	2.69	-0.083	-3%
HAlG-19-Q-SSM-S	**Sum of Oxides**	**97.6**	**100**	**-2.373**	**-2%**
HAlG-20-Q-SSM-S	Al_2O_3	20.0	20.9	-0.871	-4%
HAlG-20-Q-SSM-S	B_2O_3	18.8	20	-1.244	-6%
HAlG-20-Q-SSM-S	Bi_2O_3	0.197	0.217	-0.020	
HAlG-20-Q-SSM-S	CaO	0.417	0.434	-0.017	
HAlG-20-Q-SSM-S	CdO	0.0386	0.043	-0.004	
HAlG-20-Q-SSM-S	Cr_2O_3	1.11	1.27	-0.160	-13%
HAlG-20-Q-SSM-S	F	0.146	0.249	-0.103	
HAlG-20-Q-SSM-S	Fe_2O_3	0.725	0.735	-0.010	
HAlG-20-Q-SSM-S	K_2O	0.615	0.638	-0.023	
HAlG-20-Q-SSM-S	Li_2O	3.12	3.53	-0.414	-12%
HAlG-20-Q-SSM-S	MgO	0.217	0.217	0	
HAlG-20-Q-SSM-S	MnO	0.0265	0.026	0	
HAlG-20-Q-SSM-S	Na_2O	15.7	14.1	1.571	11%
HAlG-20-Q-SSM-S	NiO	0.328	0.347	-0.019	
HAlG-20-Q-SSM-S	P_2O_5	3.96	4.48	-0.522	-12%
HAlG-20-Q-SSM-S	SiO_2	29.1	29.3	-0.206	-1%
HAlG-20-Q-SSM-S	SO_3	1.16	0.148	1.011	683%
HAlG-20-Q-SSM-S	SrO	<0.0591	0.045	0.014	
HAlG-20-Q-SSM-S	TiO_2	0.0932	0.087	0.006	
HAlG-20-Q-SSM-S	ZnO	0.0714	0.073	-0.002	
HAlG-20-Q-SSM-S	ZrO_2	2.89	3.13	-0.236	-8%
HAlG-20-Q-SSM-S	**Sum of Oxides**	**98.7**	**100**	**-1.248**	**-1%**
HAlG-21-Q-SSM-S	Al_2O_3	21.9	22.7	-0.829	-4%
HAlG-21-Q-SSM-S	B_2O_3	10.3	11.8	-1.488	-13%
HAlG-21-Q-SSM-S	Bi_2O_3	0.443	0.466	-0.023	
HAlG-21-Q-SSM-S	CaO	0.902	0.932	-0.030	
HAlG-21-Q-SSM-S	CdO	0.0839	0.093	-0.009	
HAlG-21-Q-SSM-S	Cr_2O_3	0.268	0.445	-0.177	
HAlG-21-Q-SSM-S	F	0.320	0.535	-0.216	
HAlG-21-Q-SSM-S	Fe_2O_3	8.11	8.15	-0.040	0%
HAlG-21-Q-SSM-S	K_2O	1.19	1.37	-0.181	-13%
HAlG-21-Q-SSM-S	Li_2O	4.18	4.64	-0.463	-10%
HAlG-21-Q-SSM-S	MgO	0.461	0.466	-0.005	
HAlG-21-Q-SSM-S	MnO	0.0696	0.057	0.013	
HAlG-21-Q-SSM-S	Na_2O	16.4	15.9	0.512	3%
HAlG-21-Q-SSM-S	NiO	0.708	0.746	-0.038	
HAlG-21-Q-SSM-S	P_2O_5	3.92	4.3	-0.376	-9%
HAlG-21-Q-SSM-S	SiO_2	25.6	25.5	0.118	0%

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-21-Q-SSM-S	SO_3	0.934	0.317	0.617	
HAlG-21-Q-SSM-S	SrO	0.0779	0.096	-0.018	
HAlG-21-Q-SSM-S	TiO_2	0.197	0.186	0.011	
HAlG-21-Q-SSM-S	ZnO	0.157	0.158	-0.001	
HAlG-21-Q-SSM-S	ZrO_2	1.12	1.18	-0.063	-5%
HAlG-21-Q-SSM-S	**Sum of Oxides**	**97.4**	**100**	**-2.686**	**-3%**
HAlG-22-Q-SSM-S	Al_2O_3	20.0	20.7	-0.671	-3%
HAlG-22-Q-SSM-S	B_2O_3	8.84	9.29	-0.451	-5%
HAlG-22-Q-SSM-S	Bi_2O_3	0.650	0.675	-0.025	
HAlG-22-Q-SSM-S	CaO	1.29	1.35	-0.055	-4%
HAlG-22-Q-SSM-S	CdO	0.123	0.135	-0.012	
HAlG-22-Q-SSM-S	Cr_2O_3	1.31	1.72	-0.414	-24%
HAlG-22-Q-SSM-S	F	0.512	0.775	-0.263	
HAlG-22-Q-SSM-S	Fe_2O_3	1.16	1.18	-0.023	-2%
HAlG-22-Q-SSM-S	K_2O	1.76	1.98	-0.218	-11%
HAlG-22-Q-SSM-S	Li_2O	3.92	4.32	-0.396	-9%
HAlG-22-Q-SSM-S	MgO	0.663	0.675	-0.012	
HAlG-22-Q-SSM-S	MnO	0.0813	0.082	-0.001	
HAlG-22-Q-SSM-S	Na_2O	14.4	13.2	1.190	9%
HAlG-22-Q-SSM-S	NiO	1.02	1.08	-0.055	-5%
HAlG-22-Q-SSM-S	P_2O_5	2.38	2.58	-0.203	-8%
HAlG-22-Q-SSM-S	SiO_2	37.7	37.1	0.552	1%
HAlG-22-Q-SSM-S	SO_3	0.991	0.459	0.532	
HAlG-22-Q-SSM-S	SrO	0.109	0.139	-0.030	
HAlG-22-Q-SSM-S	TiO_2	0.287	0.27	0.017	
HAlG-22-Q-SSM-S	ZnO	0.222	0.228	-0.006	
HAlG-22-Q-SSM-S	ZrO_2	2.06	2.13	-0.070	-3%
HAlG-22-Q-SSM-S	**Sum of Oxides**	**99.5**	**100**	**-0.617**	**-1%**
HAlG-23-Q-SSM-S	Al_2O_3	20.5	20.9	-0.399	-2%
HAlG-23-Q-SSM-S	B_2O_3	17.0	17.5	-0.523	-3%
HAlG-23-Q-SSM-S	Bi_2O_3	0.374	0.401	-0.027	
HAlG-23-Q-SSM-S	CaO	0.762	0.803	-0.041	
HAlG-23-Q-SSM-S	CdO	0.0699	0.08	-0.010	
HAlG-23-Q-SSM-S	Cr_2O_3	0.711	0.881	-0.170	
HAlG-23-Q-SSM-S	F	0.277	0.461	-0.184	
HAlG-23-Q-SSM-S	Fe_2O_3	0.212	0.192	0.020	
HAlG-23-Q-SSM-S	K_2O	1.24	1.18	0.059	5%
HAlG-23-Q-SSM-S	Li_2O	5.37	5.73	-0.364	-6%
HAlG-23-Q-SSM-S	MgO	0.386	0.401	-0.015	
HAlG-23-Q-SSM-S	MnO	0.0468	0.049	-0.002	
HAlG-23-Q-SSM-S	Na_2O	12.8	11.1	1.693	15%
HAlG-23-Q-SSM-S	NiO	0.595	0.642	-0.047	
HAlG-23-Q-SSM-S	P_2O_5	3.07	3.42	-0.350	-10%
HAlG-23-Q-SSM-S	SiO_2	34.8	33.5	1.264	4%
HAlG-23-Q-SSM-S	SO_3	1.28	0.273	1.012	371%
HAlG-23-Q-SSM-S	SrO	0.0658	0.083	-0.017	
HAlG-23-Q-SSM-S	TiO_2	0.164	0.161	0.003	
HAlG-23-Q-SSM-S	ZnO	0.130	0.136	-0.006	

Table A-4. Comparison of Measured and Targeted Compositions (continued)

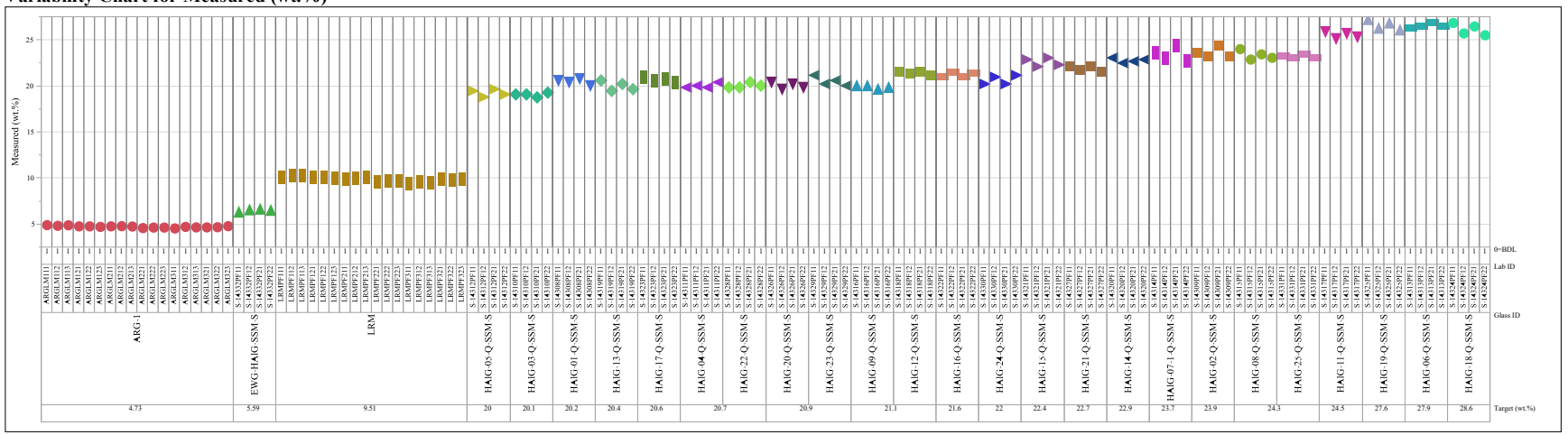
PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
HAlG-23-Q-SSM-S	ZrO_2	2.03	2.1	-0.074	-4%
HAlG-23-Q-SSM-S	**Sum of Oxides**	**102**	**100**	**1.823**	**2%**
HAlG-24-Q-SSM-S	Al_2O_3	20.6	22	-1.357	-6%
HAlG-24-Q-SSM-S	B_2O_3	14.4	15.5	-1.067	-7%
HAlG-24-Q-SSM-S	Bi_2O_3	0.962	1	-0.038	-4%
HAlG-24-Q-SSM-S	CaO	3.45	3.5	-0.054	-2%
HAlG-24-Q-SSM-S	CdO	0.0904	0.1	-0.010	
HAlG-24-Q-SSM-S	Cr_2O_3	0.654	0.75	-0.096	
HAlG-24-Q-SSM-S	F	0.180	0.3	-0.120	
HAlG-24-Q-SSM-S	Fe_2O_3	5.49	5.5	-0.010	0%
HAlG-24-Q-SSM-S	K_2O	0.761	0.7	0.061	
HAlG-24-Q-SSM-S	Li_2O	2.53	3	-0.470	-16%
HAlG-24-Q-SSM-S	MgO	0.509	0.5	0.009	
HAlG-24-Q-SSM-S	MnO	0.965	1	-0.035	-3%
HAlG-24-Q-SSM-S	Na_2O	13.5	11.5	1.970	17%
HAlG-24-Q-SSM-S	NiO	0.380	0.4	-0.020	
HAlG-24-Q-SSM-S	P_2O_5	0.871	1	-0.129	-13%
HAlG-24-Q-SSM-S	SiO_2	31.2	31.5	-0.266	-1%
HAlG-24-Q-SSM-S	SO_3	1.09	0.3	0.786	262%
HAlG-24-Q-SSM-S	SrO	0.0963	0.12	-0.024	
HAlG-24-Q-SSM-S	TiO_2	<0.0834	0	0.083	
HAlG-24-Q-SSM-S	ZnO	<0.0622	0	0.062	
HAlG-24-Q-SSM-S	ZrO_2	0.930	1	-0.070	-7%
HAlG-24-Q-SSM-S	**Sum of Oxides**	**98.9**	**99.7**	**-0.795**	**-1%**
HAlG-25-Q-SSM-S	Al_2O_3	23.2	24.3	-1.106	-5%
HAlG-25-Q-SSM-S	B_2O_3	14.0	14.8	-0.810	-5%
HAlG-25-Q-SSM-S	Bi_2O_3	<0.111	0.096	0.015	
HAlG-25-Q-SSM-S	CaO	0.200	0.192	0.008	
HAlG-25-Q-SSM-S	CdO	<0.0286	0.019	0.010	
HAlG-25-Q-SSM-S	Cr_2O_3	0.543	0.649	-0.106	
HAlG-25-Q-SSM-S	F	0.0624	0.11	-0.048	
HAlG-25-Q-SSM-S	Fe_2O_3	10.3	10.7	-0.385	-4%
HAlG-25-Q-SSM-S	K_2O	0.436	0.283	0.153	
HAlG-25-Q-SSM-S	Li_2O	1.79	1.8	-0.013	-1%
HAlG-25-Q-SSM-S	MgO	0.104	0.096	0.008	
HAlG-25-Q-SSM-S	MnO	0.0307	0.012	0.019	
HAlG-25-Q-SSM-S	Na_2O	18.6	17.5	1.069	6%
HAlG-25-Q-SSM-S	NiO	0.148	0.154	-0.006	
HAlG-25-Q-SSM-S	P_2O_5	3.87	4.36	-0.488	-11%
HAlG-25-Q-SSM-S	SiO_2	24.9	24.8	0.069	0%
HAlG-25-Q-SSM-S	SO_3	0.853	0.065	0.788	
HAlG-25-Q-SSM-S	SrO	<0.0591	0.02	0.039	
HAlG-25-Q-SSM-S	TiO_2	<0.0854	0.038	0.047	
HAlG-25-Q-SSM-S	ZnO	<0.0622	0.033	0.029	
HAlG-25-Q-SSM-S	ZrO_2	<0.135	0.041	0.094	
HAlG-25-Q-SSM-S	**Sum of Oxides**	**99.5**	**100**	**-0.612**	**-1%**
LRM	Al_2O_3	9.88	9.51	0.370	4%
LRM	B_2O_3	7.54	7.85	-0.314	-4%

Table A-4. Comparison of Measured and Targeted Compositions (continued)

PNNL ID	Oxide	Mean Measurement (wt.%)	Targeted (wt.%)	Difference of Measured versus Targeted	% Difference Measured versus Targeted
LRM	Bi_2O_3	<0.111	0	0.111	
LRM	CaO	0.492	0.54	-0.048	
LRM	CdO	0.159	0.16	-0.001	
LRM	Cr_2O_3	0.185	0.19	-0.005	
LRM	F	0.903	0.86	0.043	
LRM	Fe_2O_3	1.46	1.38	0.078	6%
LRM	K_2O	1.58	1.48	0.103	7%
LRM	Li_2O	<0.222	0.11	0.112	
LRM	MgO	0.107	0.1	0.007	
LRM	MnO	0.0814	0.08	0.001	
LRM	Na_2O	20.9	20	0.864	4%
LRM	NiO	0.174	0.19	-0.016	
LRM	P_2O_5	0.504	0.54	-0.036	
LRM	SiO_2	55.1	54.2	0.851	2%
LRM	SO_3	0.233	0.3	-0.067	
LRM	SrO	<0.0591	0	0.059	
LRM	TiO_2	0.100	0.1	0	
LRM	ZnO	<0.0622	0	0.062	
LRM	ZrO_2	1.00	0.93	0.073	8%
LRM	**Sum of Oxides**	**101**	**98.6**	**2.249**	**2%**

Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations

Oxide=Al_2O_3, Prep Method=PF
Variability Chart for Measured (wt.%)



Oxide=B_2O_3, Prep Method=PF
Variability Chart for Measured (wt.%)

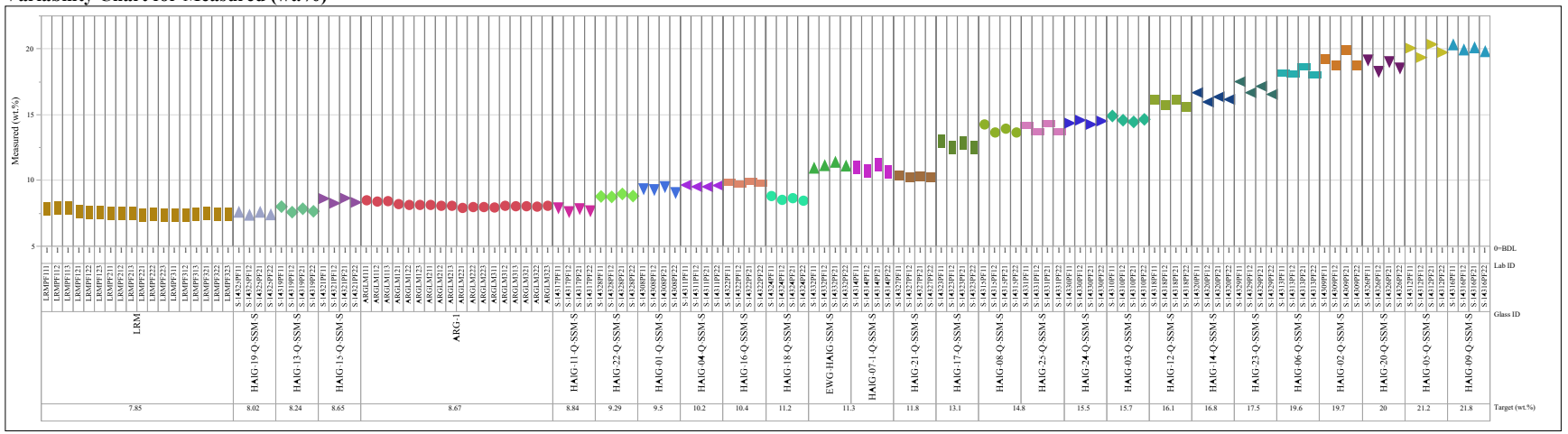
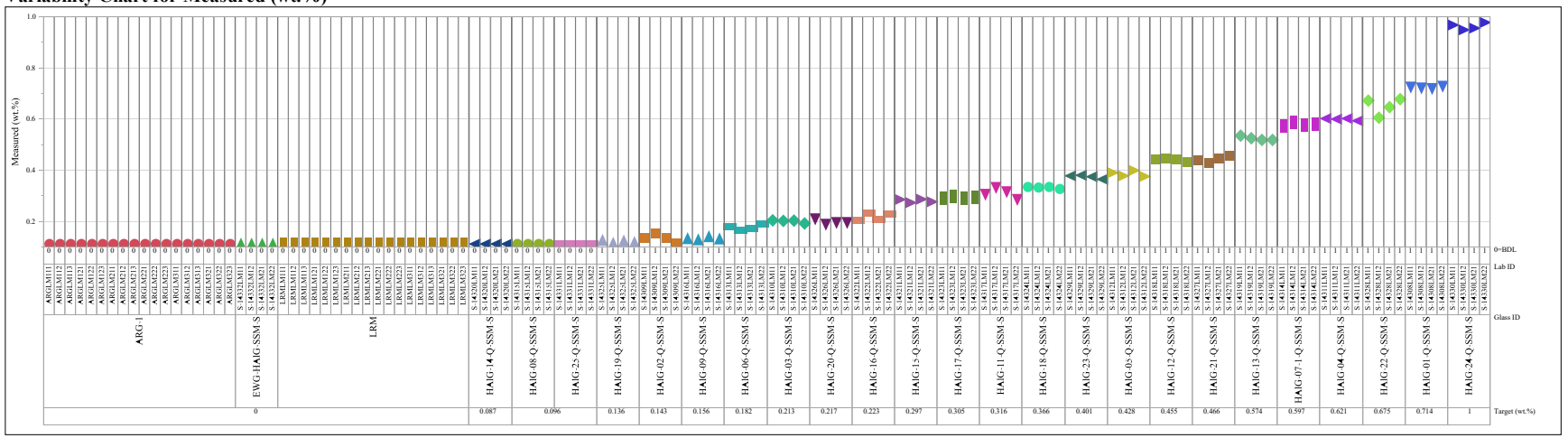


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=Bi_2O_3, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=CaO, Prep Method=LM
Variability Chart for Measured (wt.%)

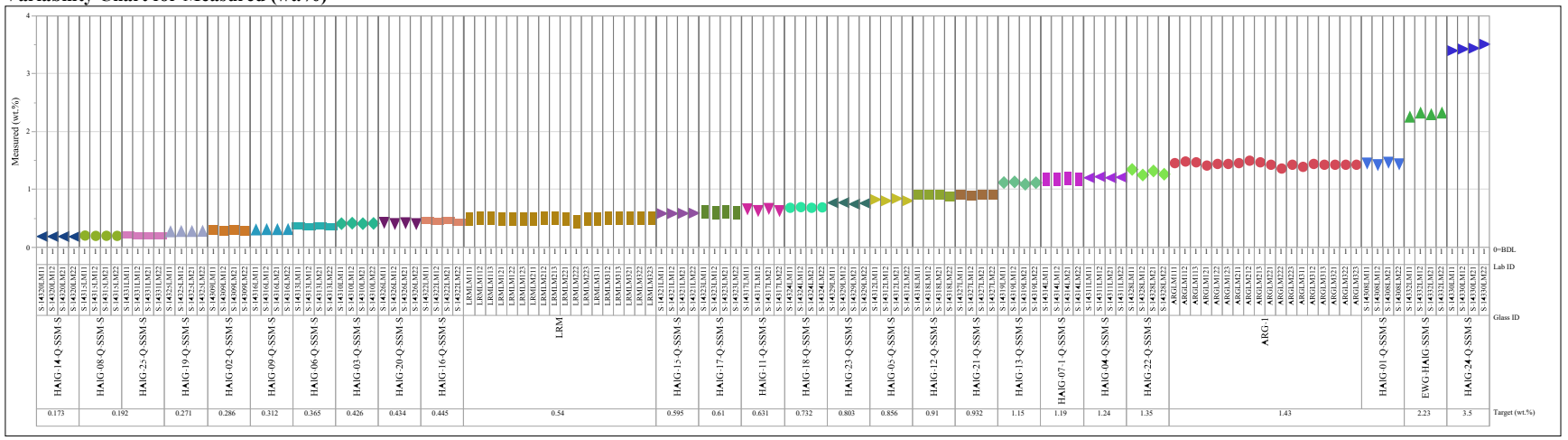
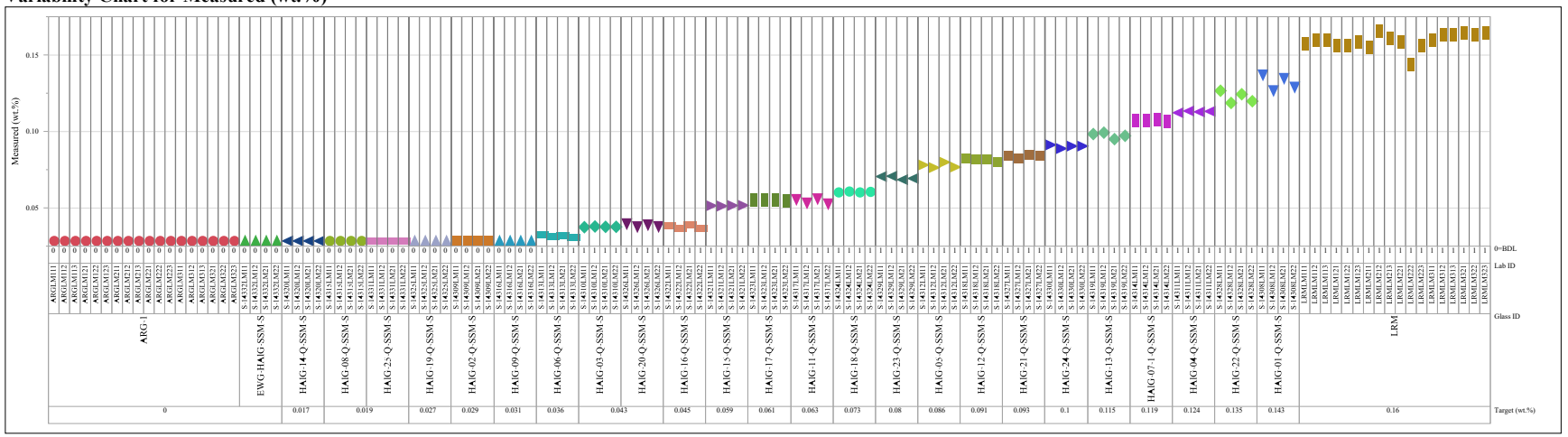


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=CdO, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=Cr_2O_3, Prep Method=LM
Variability Chart for Measured (wt.%)

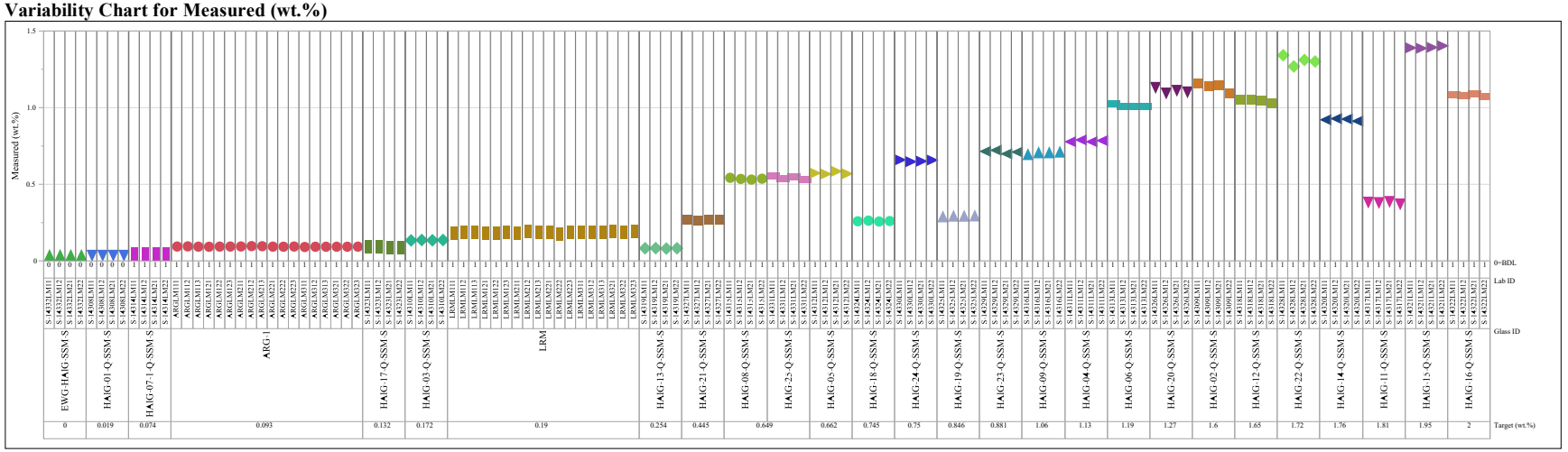
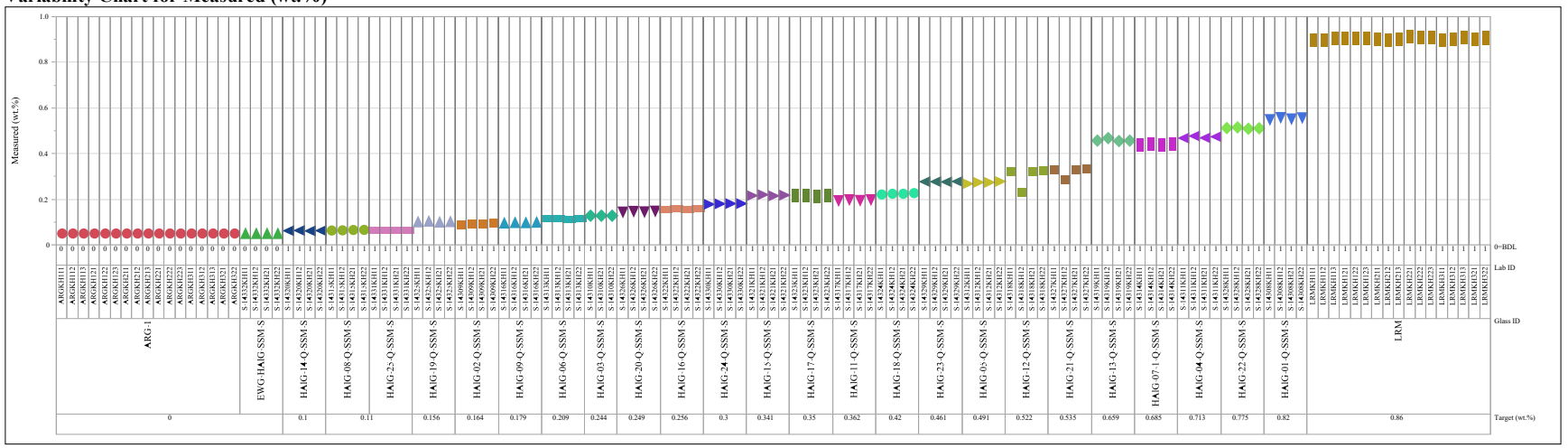


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=F^-, Prep Method=KH
Variability Chart for Measured (wt.%)



Oxide=Fe_2O_3, Prep Method=LM
Variability Chart for Measured (wt.%)

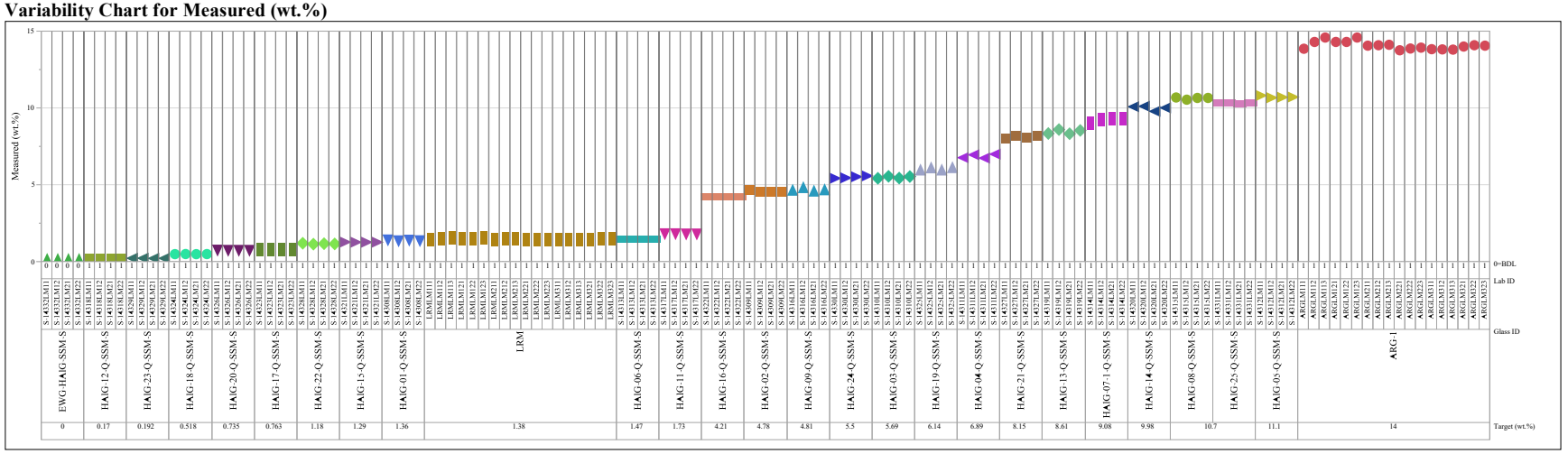
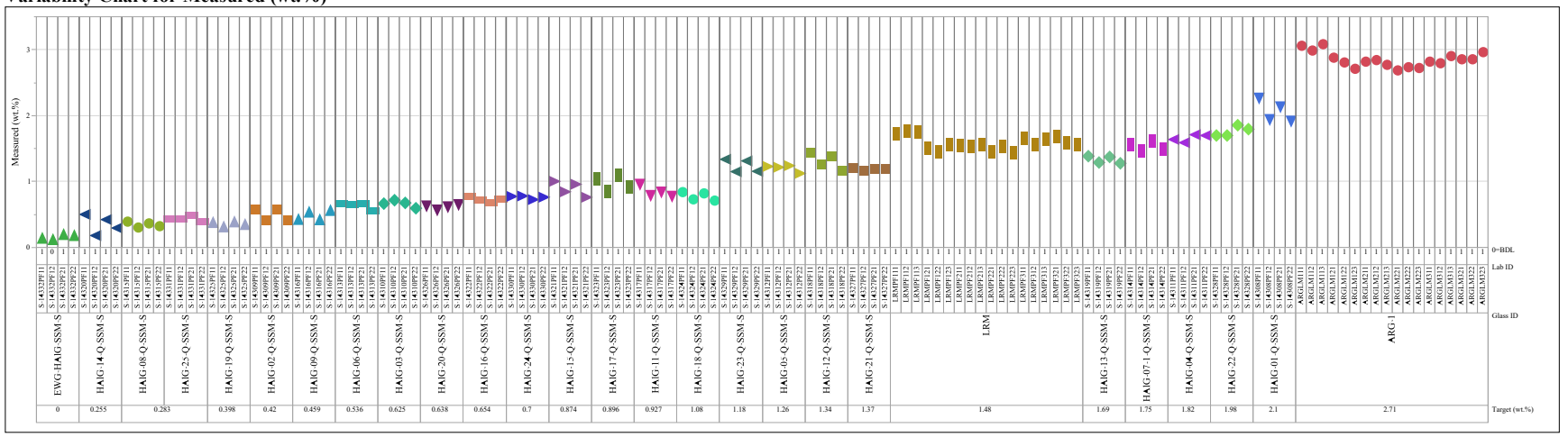


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=K_2O, Prep Method=PF
Variability Chart for Measured (wt.%)



Oxide=Li_2O, Prep Method=PF
Variability Chart for Measured (wt.%)

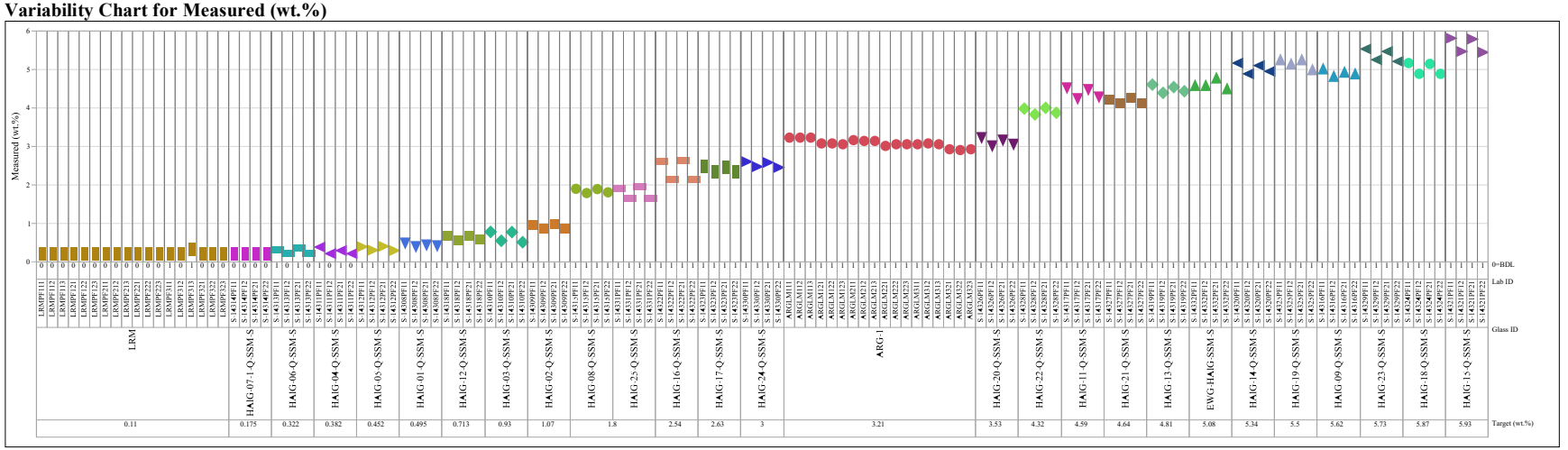
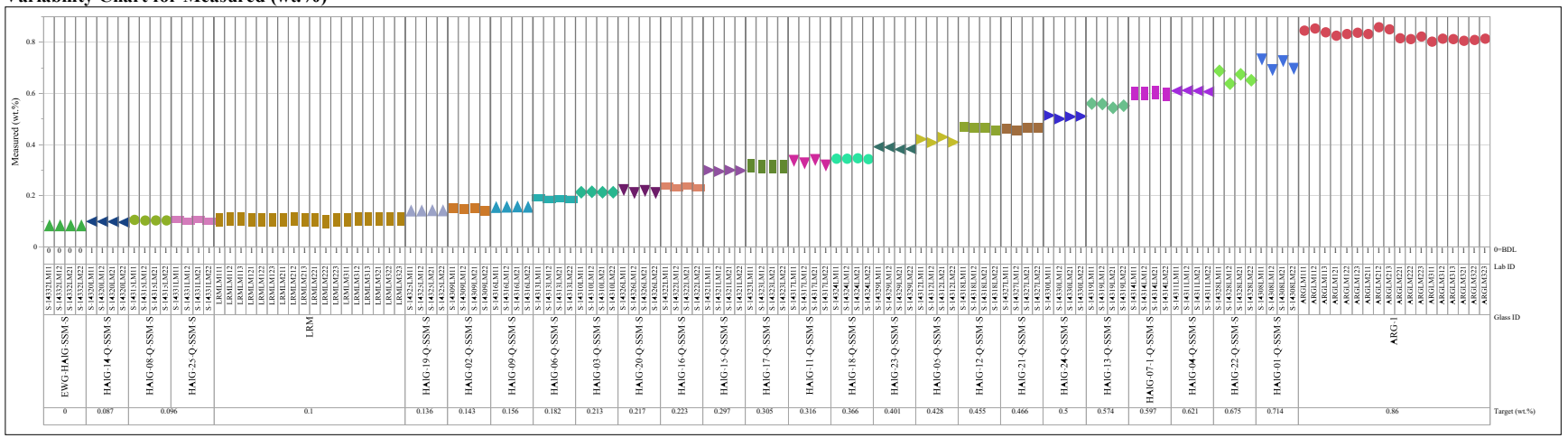


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=MgO, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=MnO, Prep Method=LM
Variability Chart for Measured (wt.%)

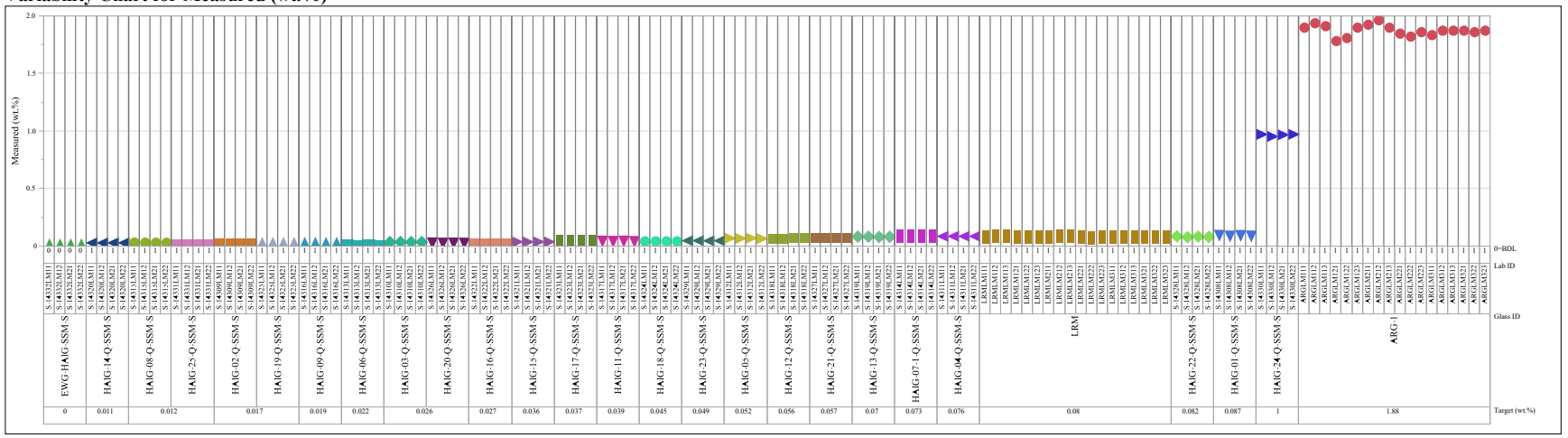
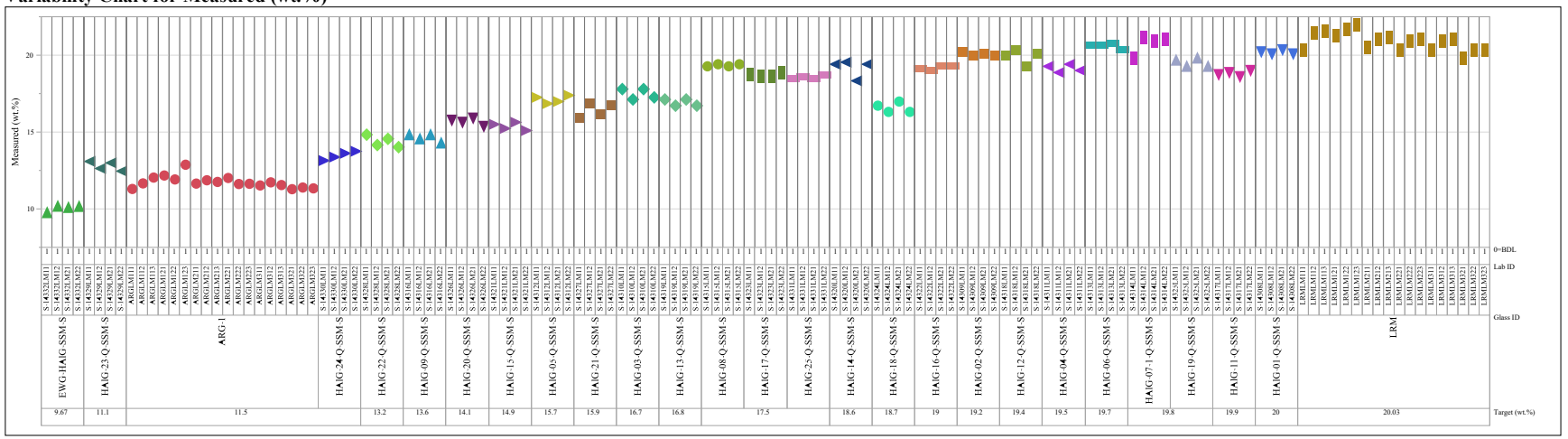


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=Na_2O, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=NiO, Prep Method=LM
Variability Chart for Measured (wt.%)

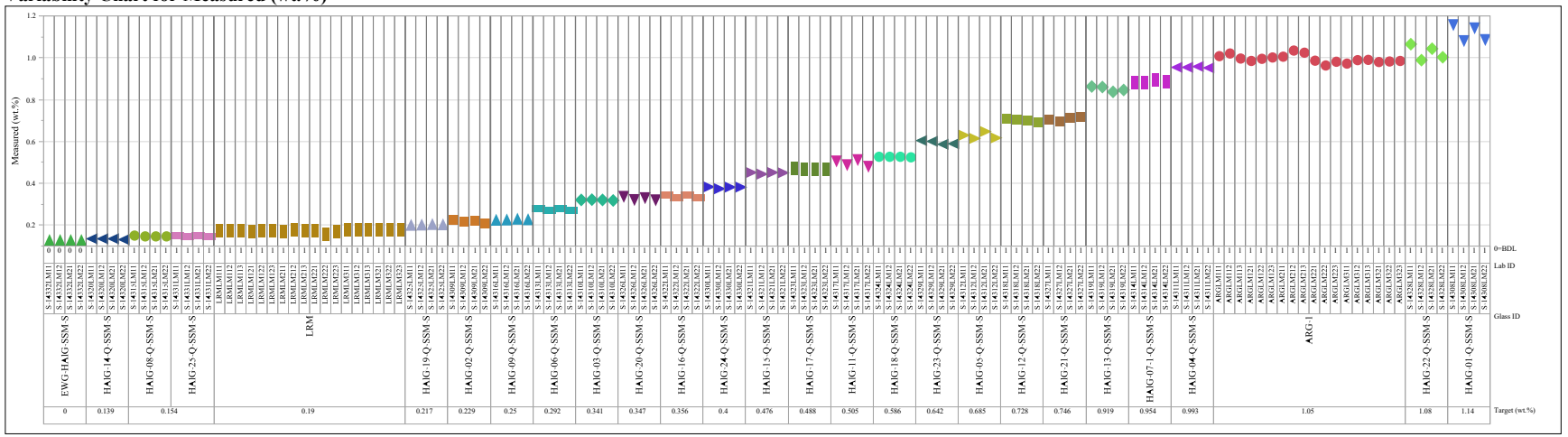
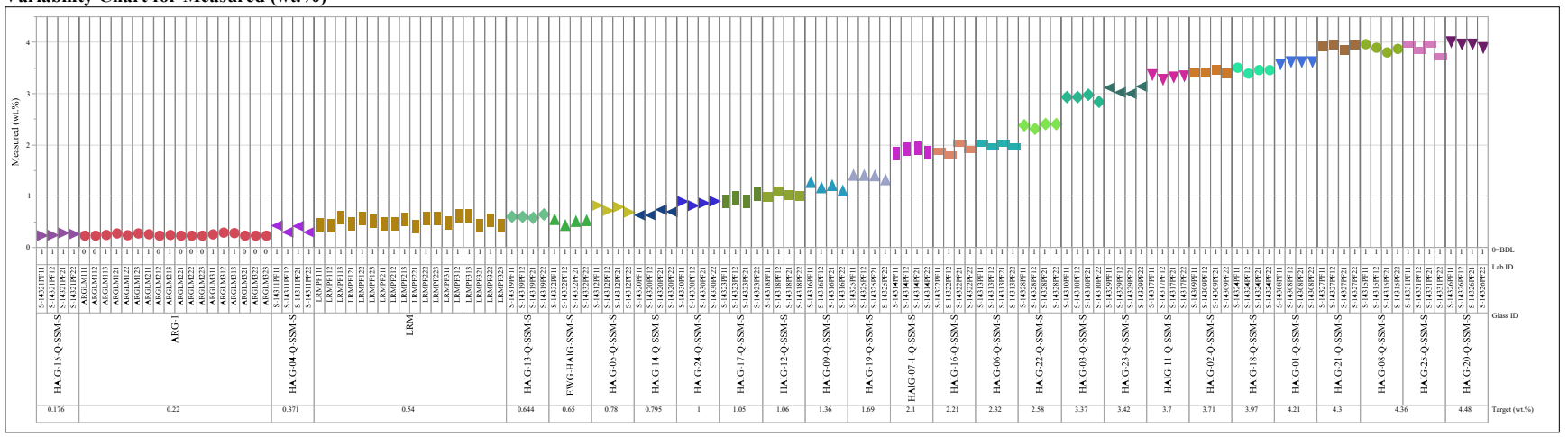


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=P_2O_5, Prep Method=PF
Variability Chart for Measured (wt.%)



Oxide=SiO_2, Prep Method=PF
Variability Chart for Measured (wt.%)

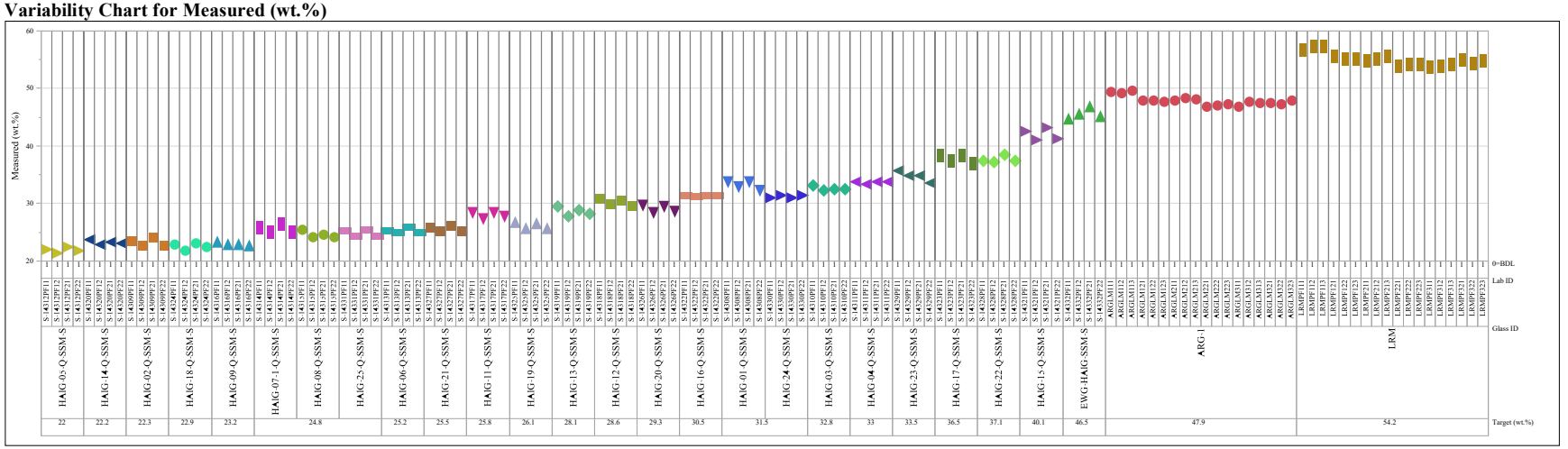
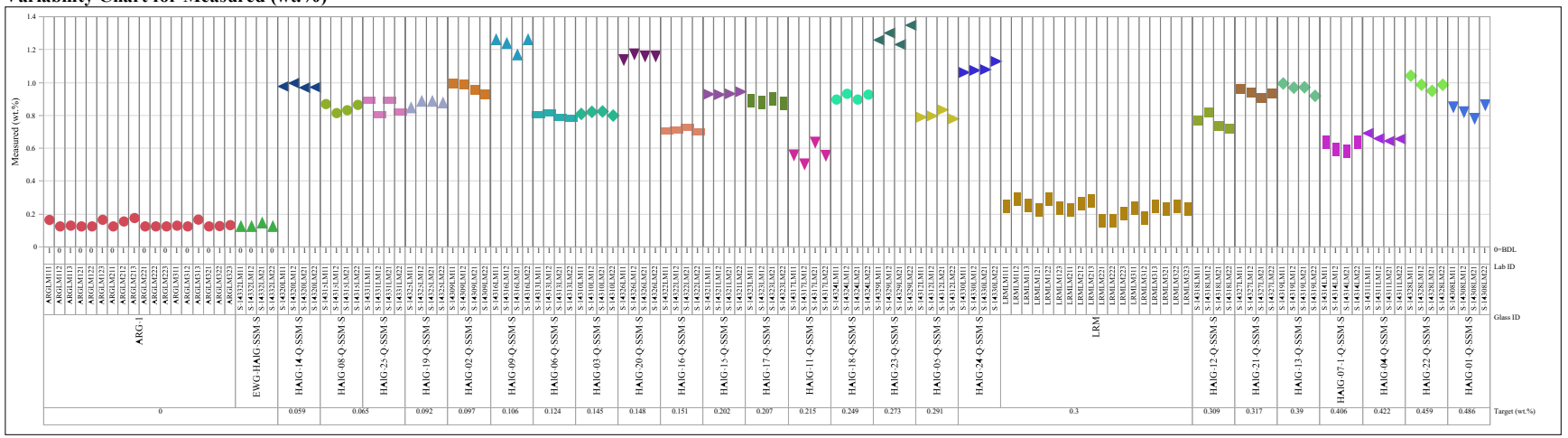


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=SO_3, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=SrO, Prep Method=LM
Variability Chart for Measured (wt.%)

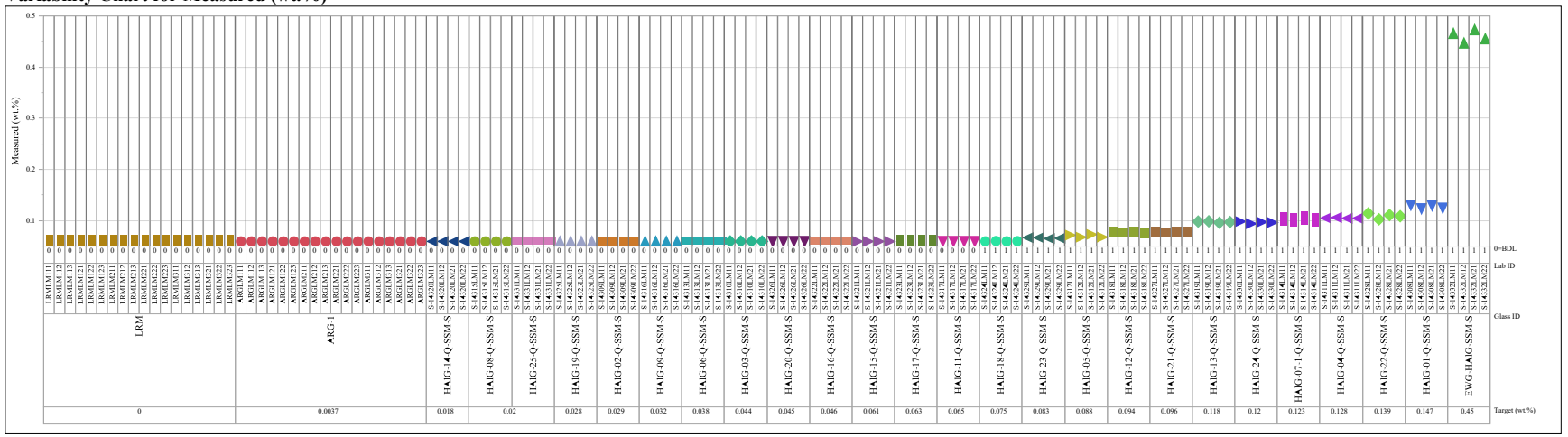
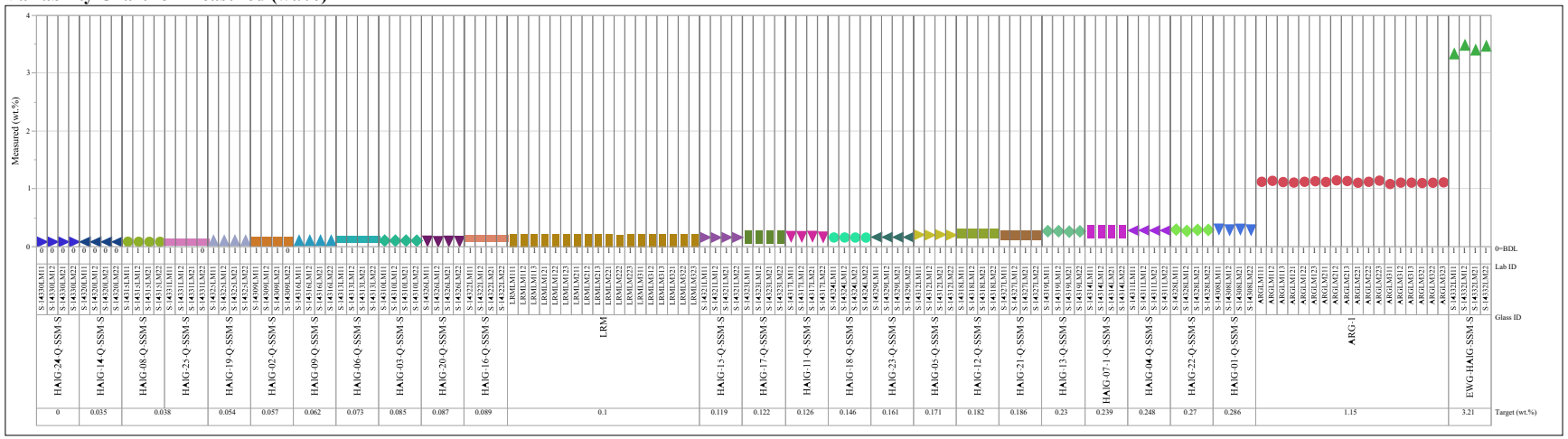


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=TiO_2, Prep Method=LM
Variability Chart for Measured (wt.%)



Oxide=ZnO, Prep Method=LM
Variability Chart for Measured (wt.%)

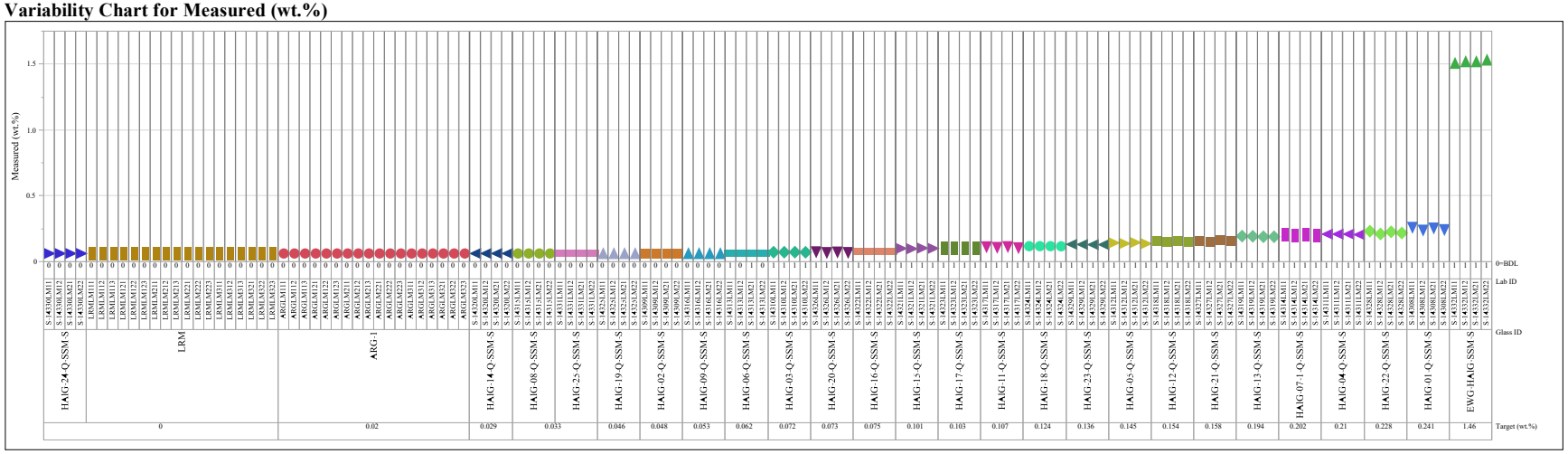


Exhibit A-1. Plots of Oxide Measurements by Glass Identifier by Targeted Concentrations (continued)

Oxide=ZrO_2, Prep Method=PF
Variability Chart for Measured (wt.%)

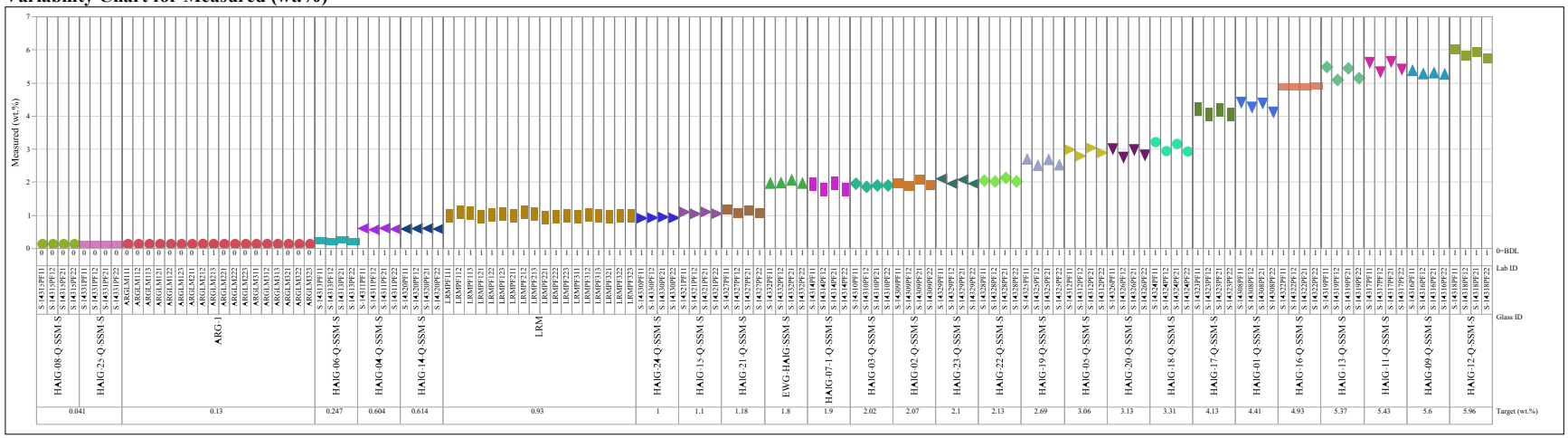
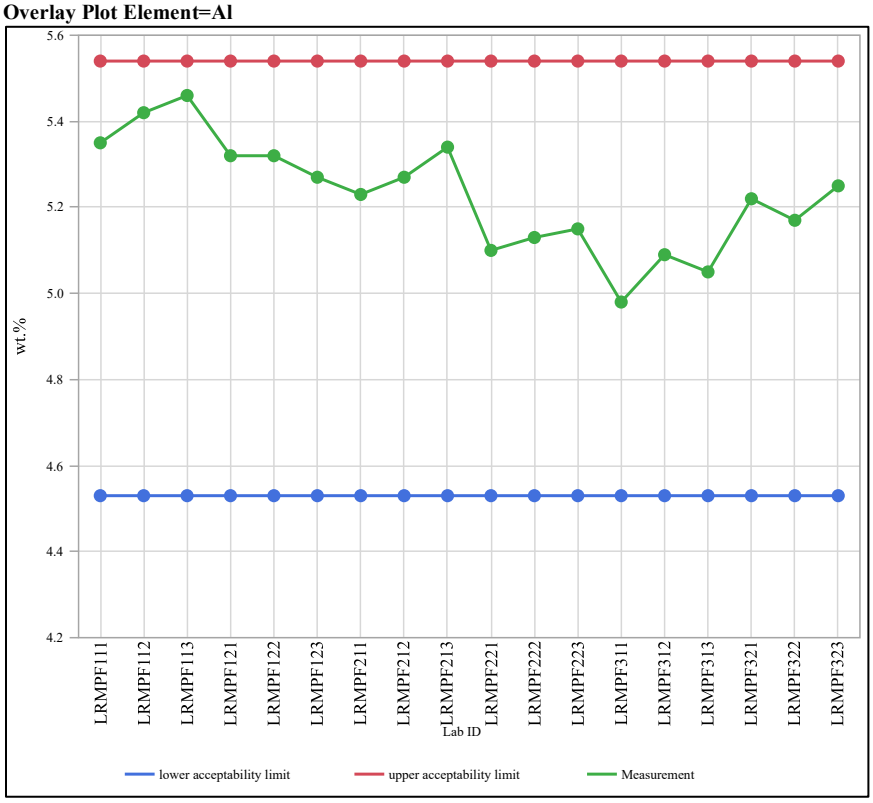


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass

Overlay Plot Element=Al



Overlay Plot Element=B

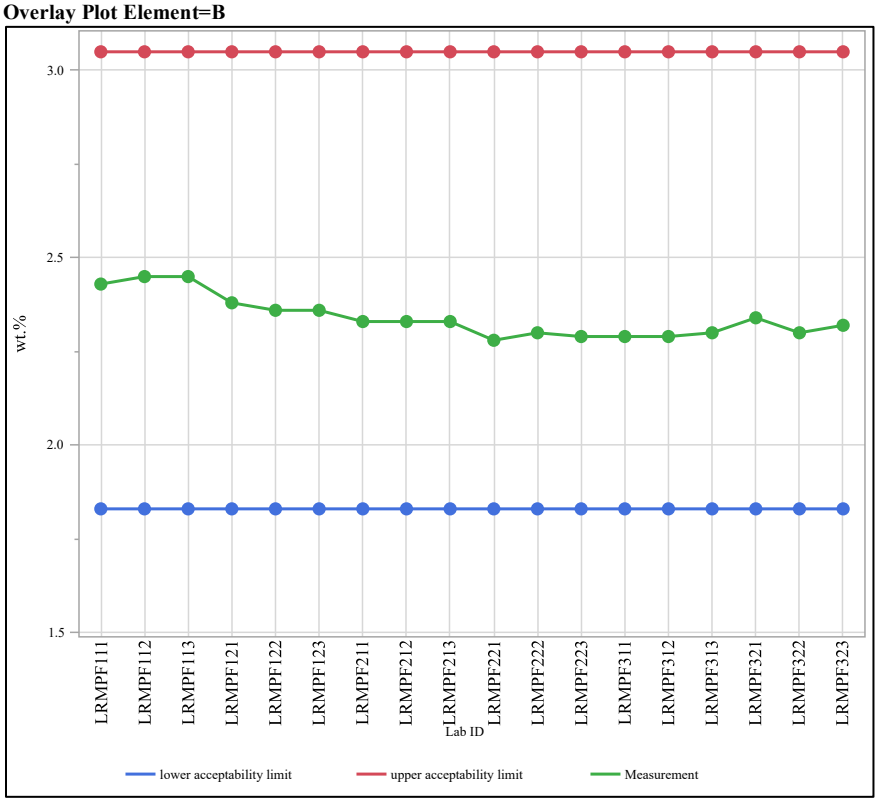
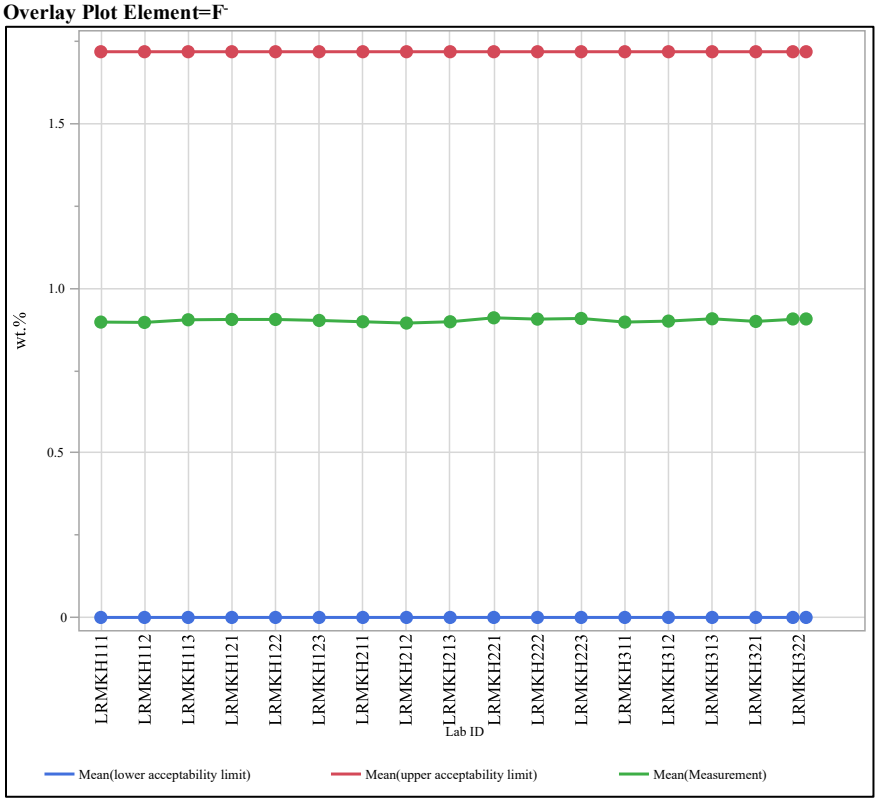


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=F-



Overlay Plot Element=Fe

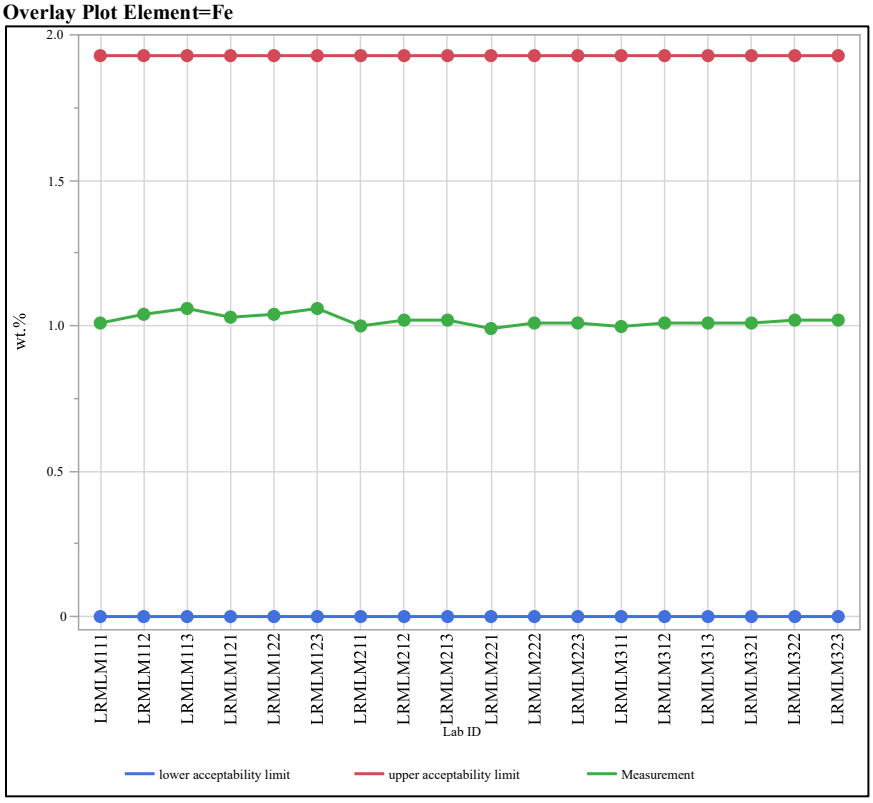
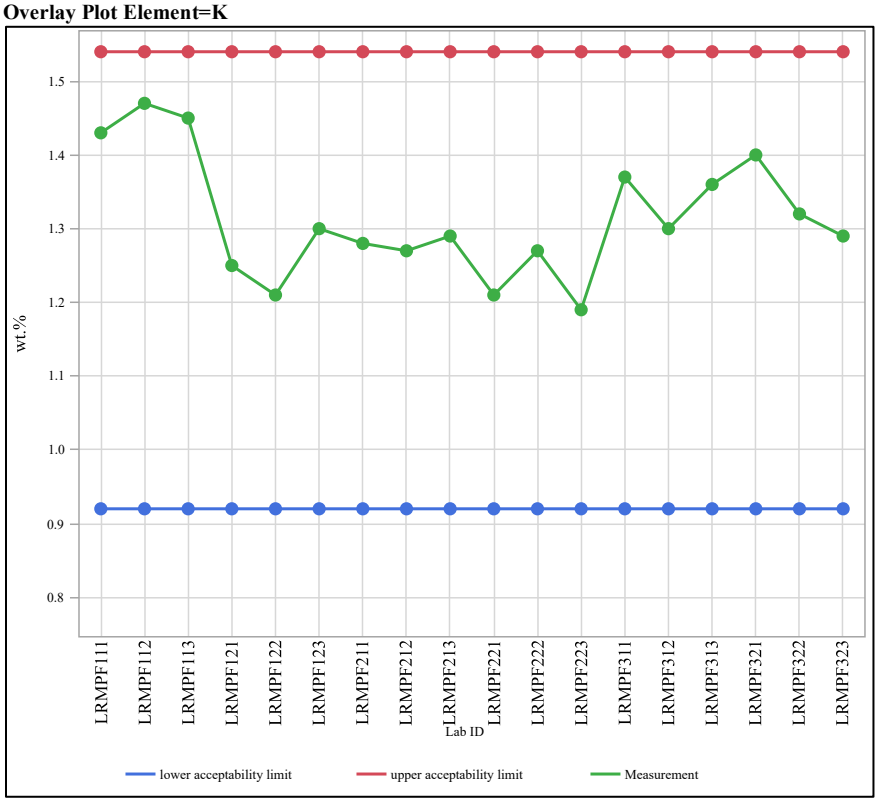


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=K



Overlay Plot Element=Na

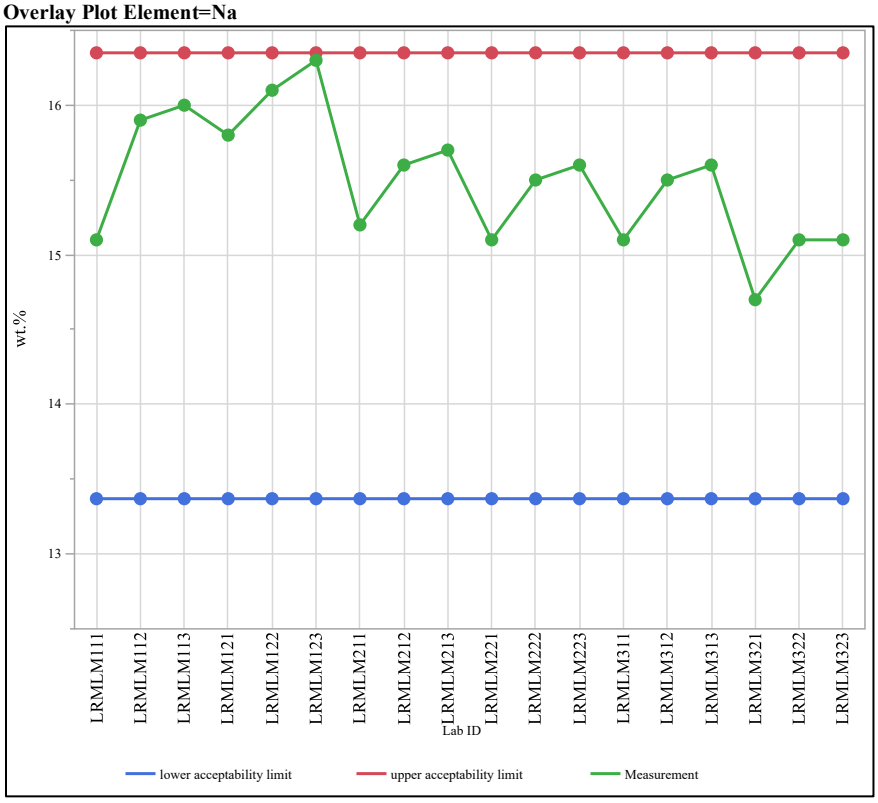
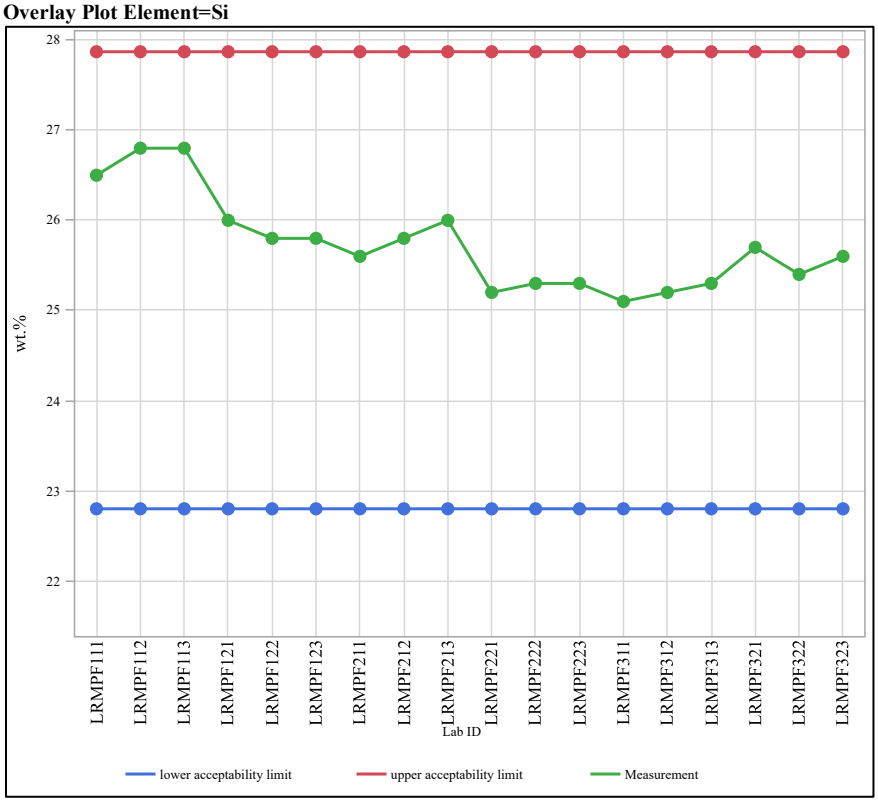


Exhibit A-2. Acceptability Evaluation for Measurements of the LRM Glass (continued)

Overlay Plot Element=Si



Overlay Plot Element=Zr

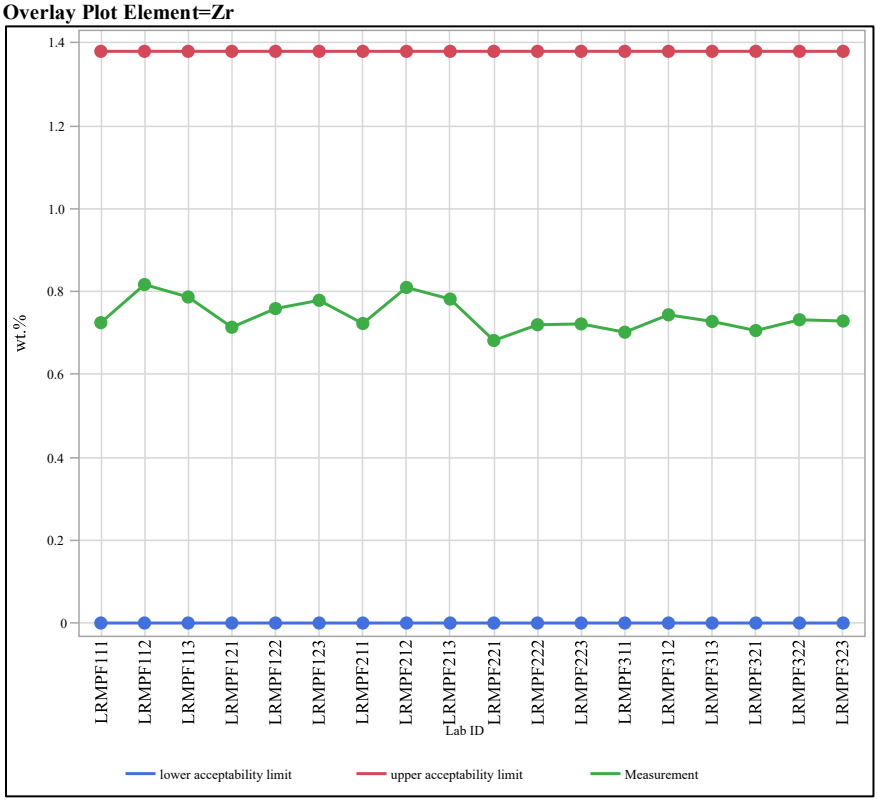
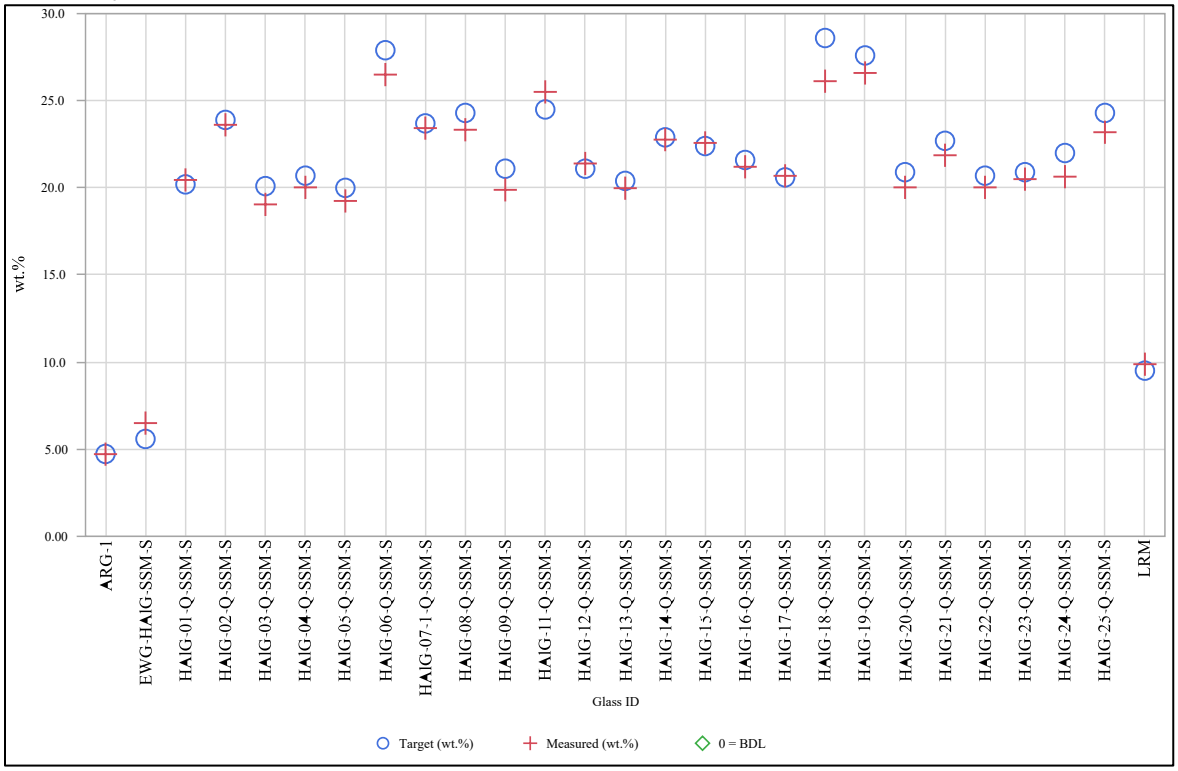


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide

Oxide=Al_2O_3



Oxide=B_2O_3

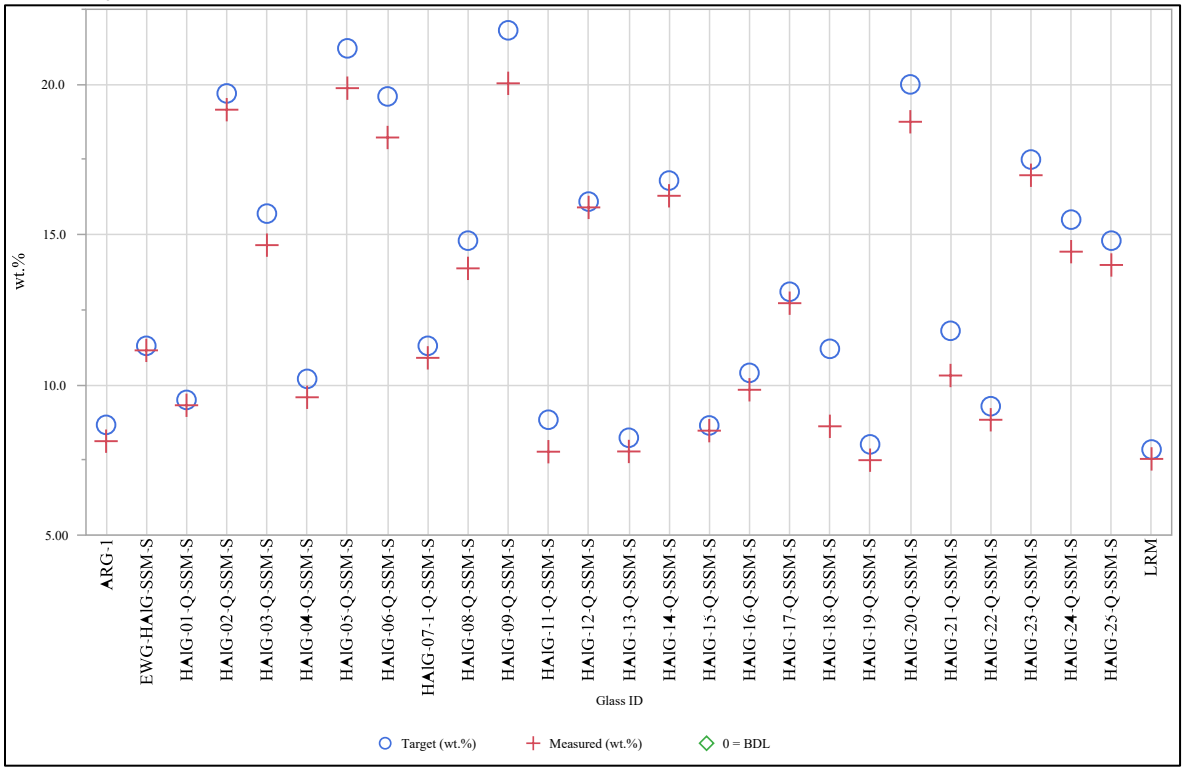
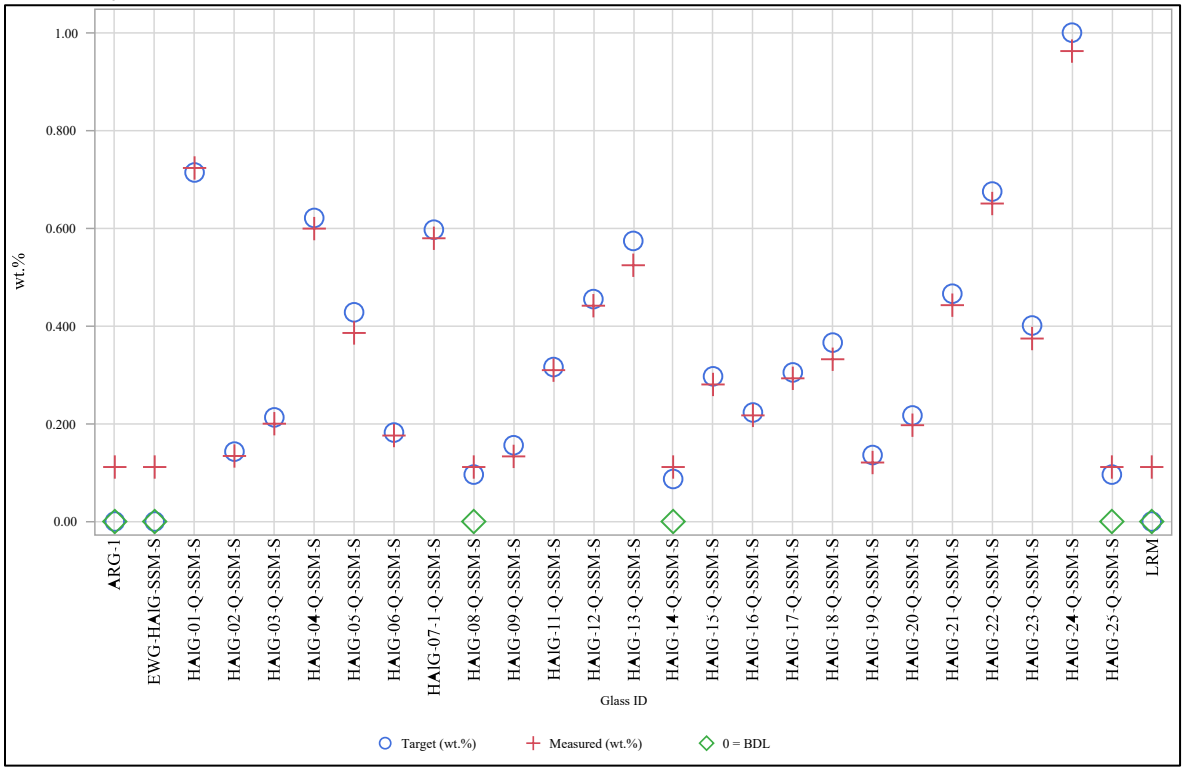


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=Bi_2O_3



Oxide=CaO

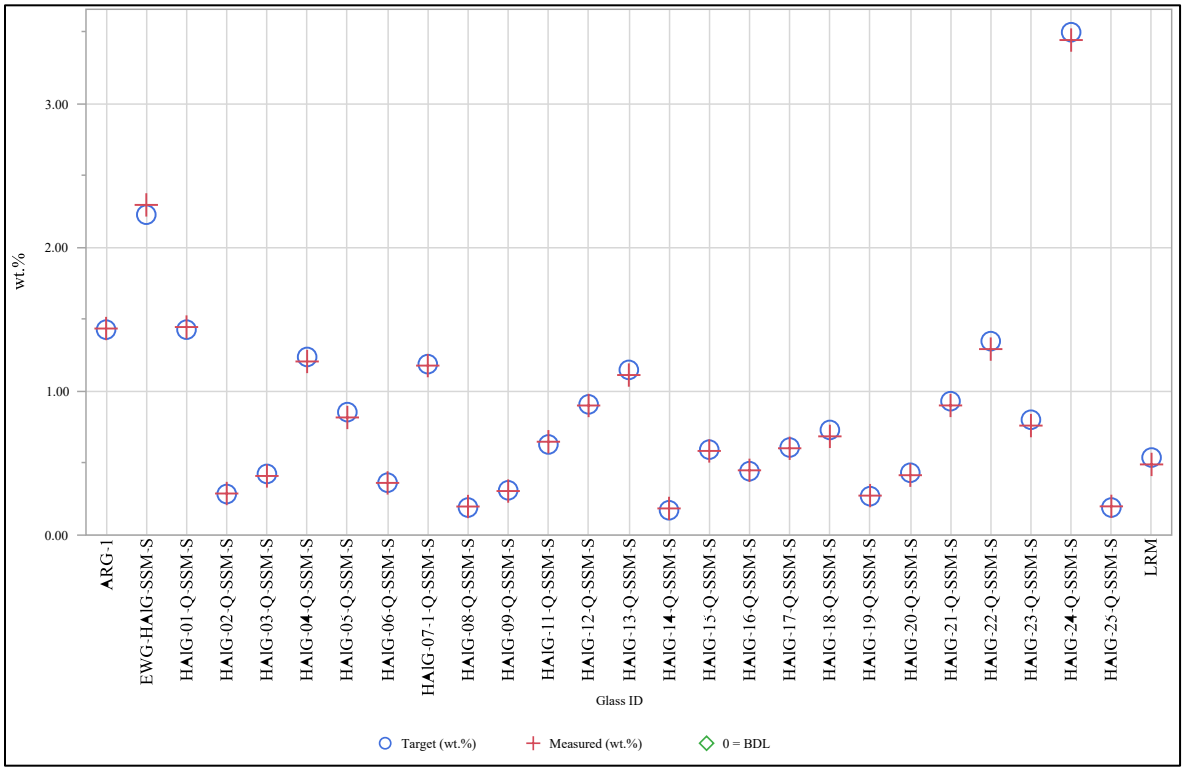
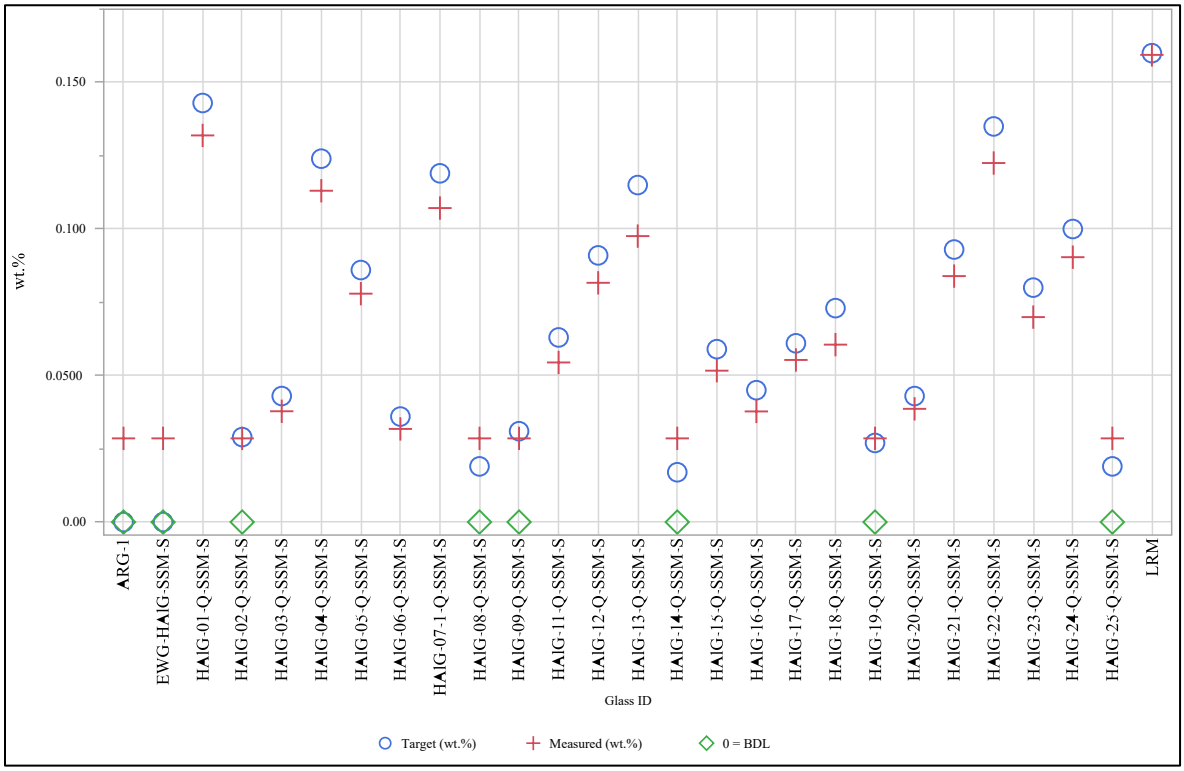


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=CdO



Oxide=Cr_2O_3

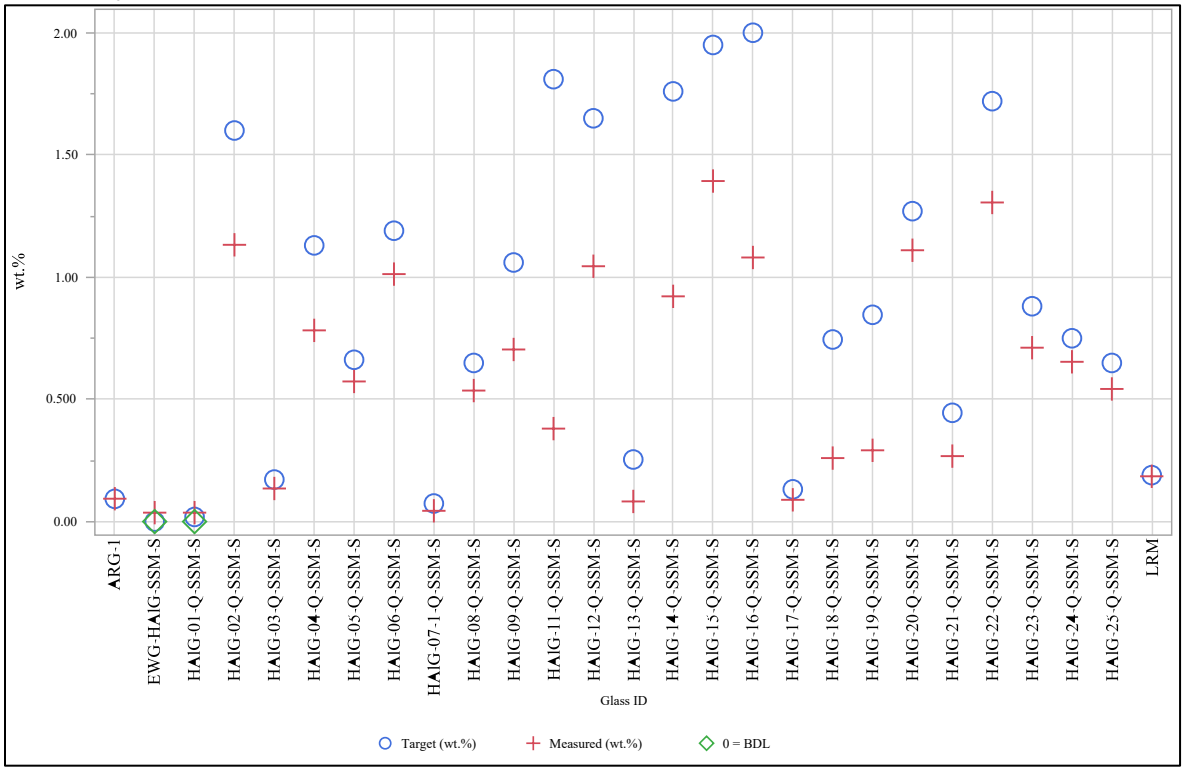
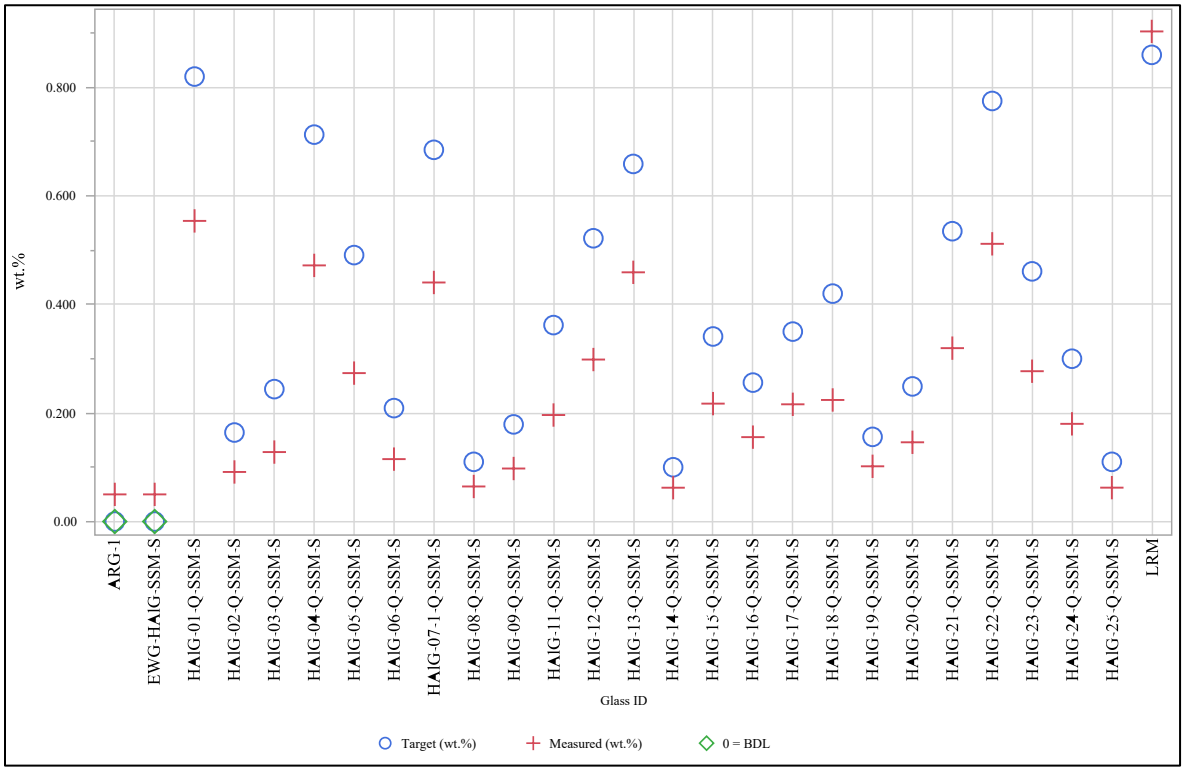


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=F⁻



Oxide=Fe_2O_3

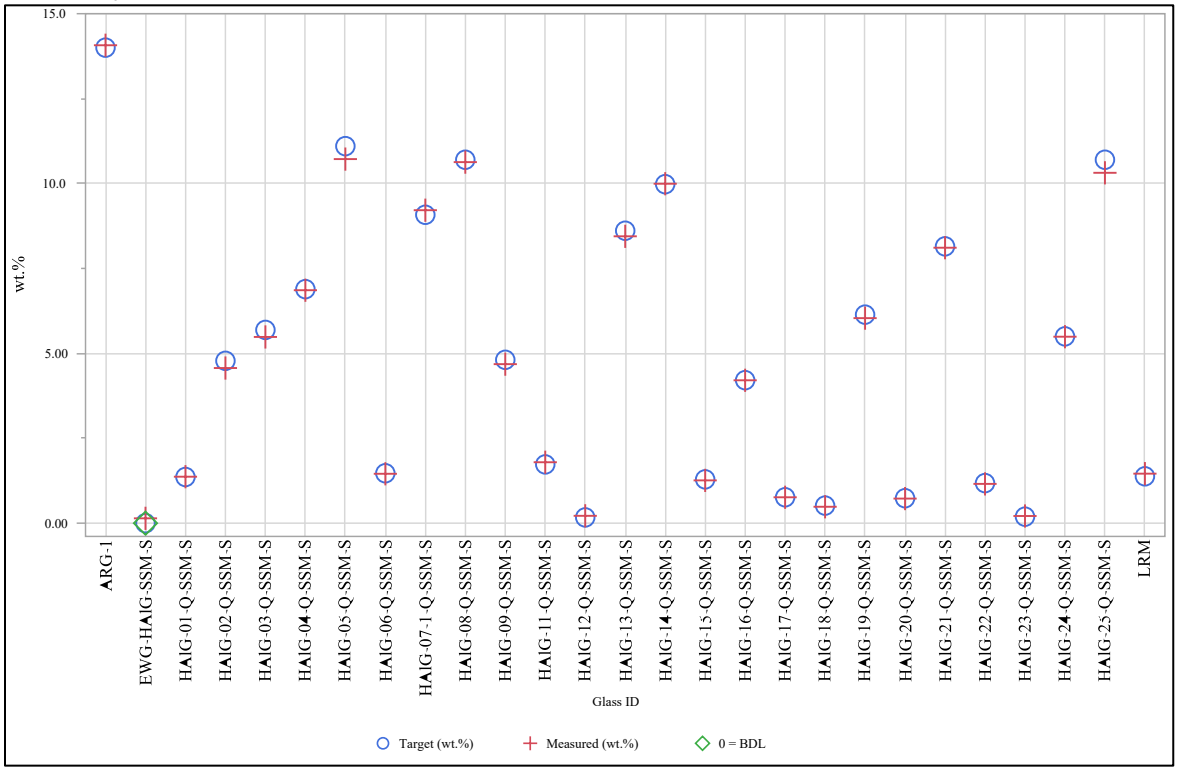
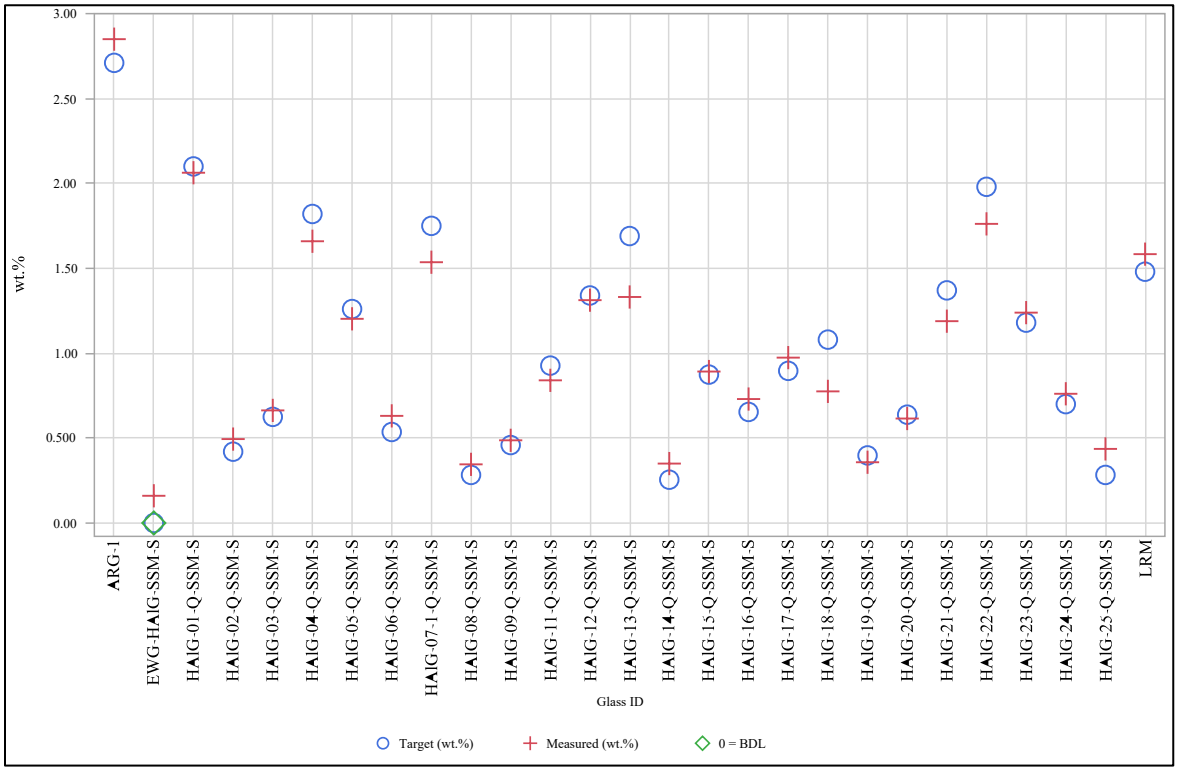


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=K_2O



Oxide=Li_2O

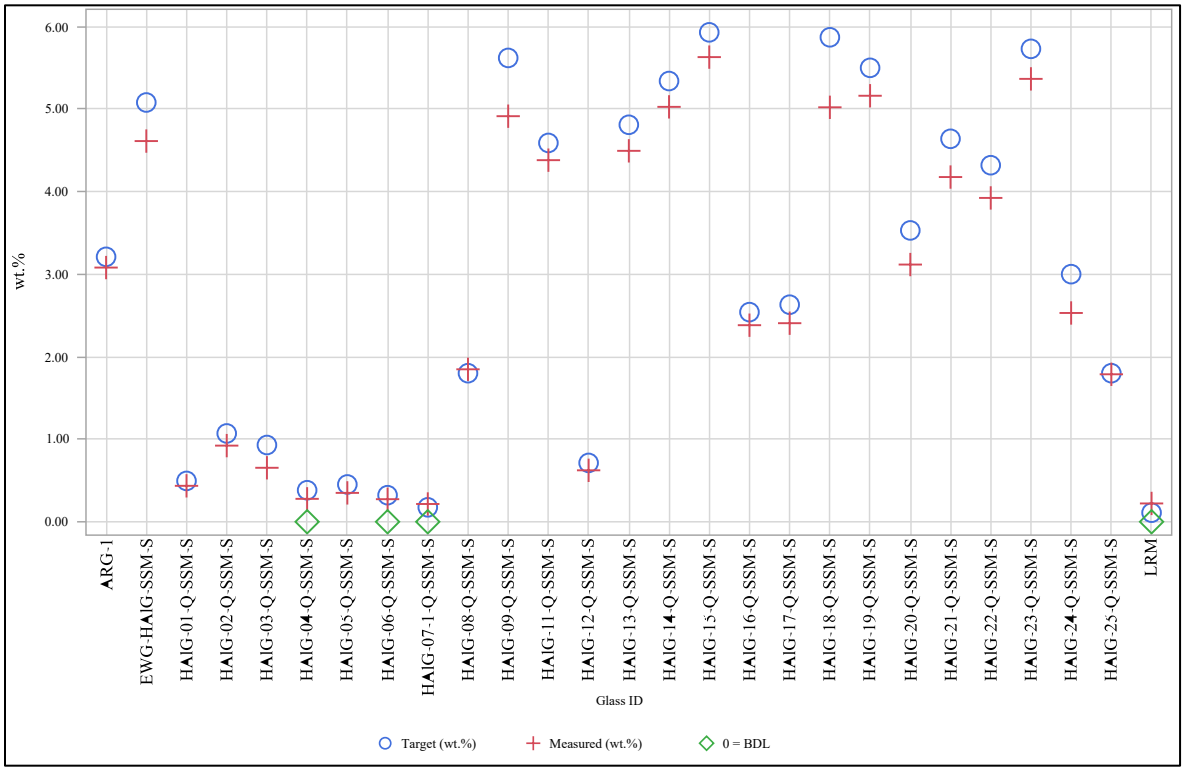
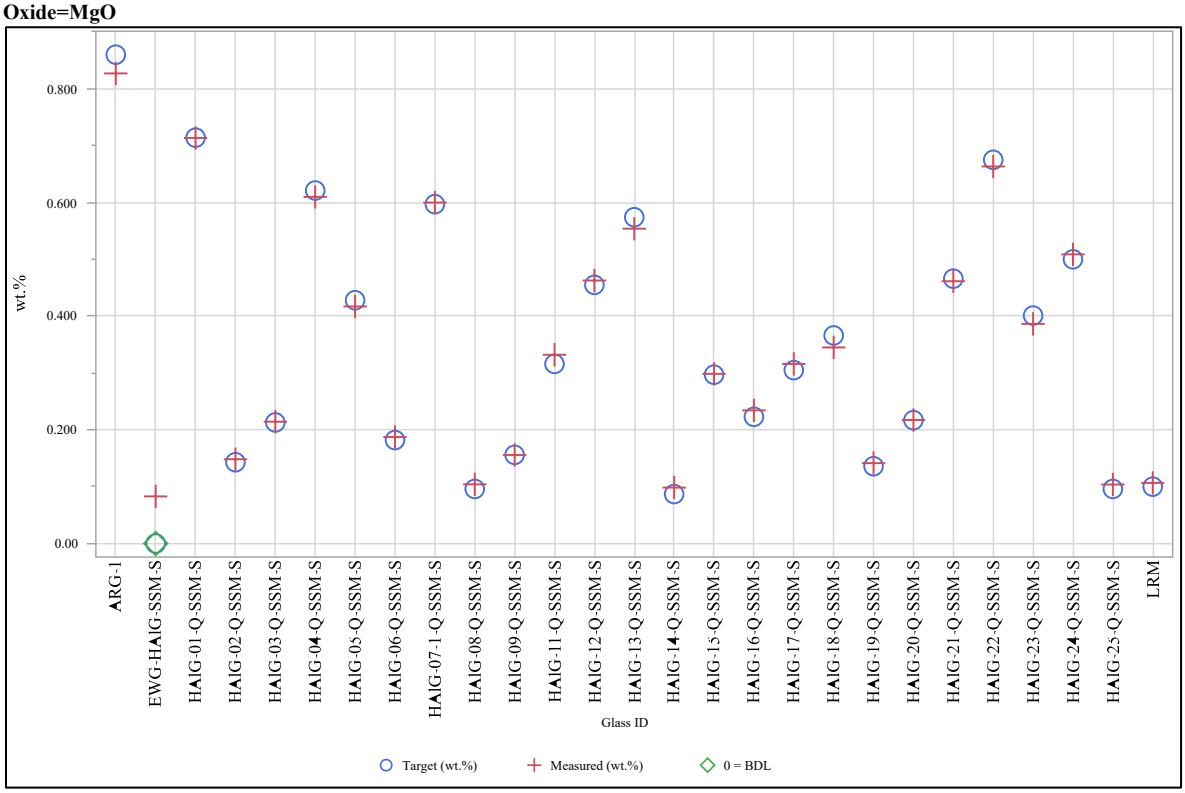


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=MgO



Oxide=MnO

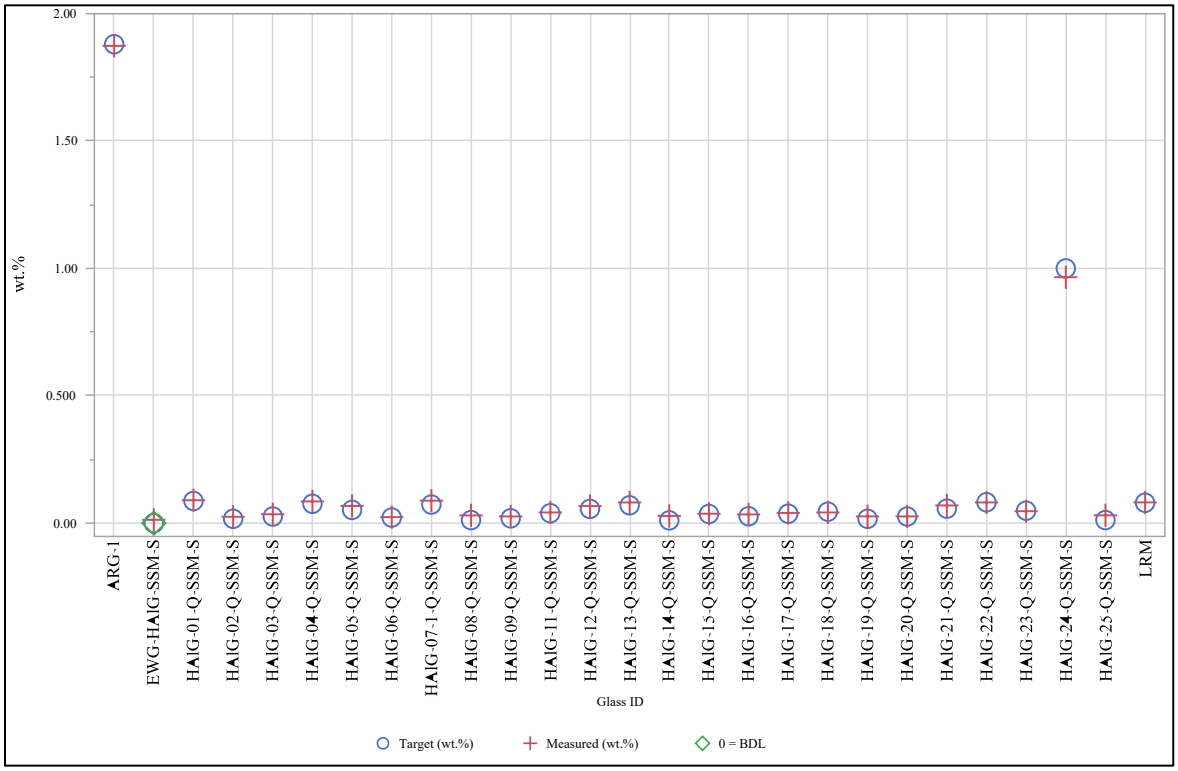
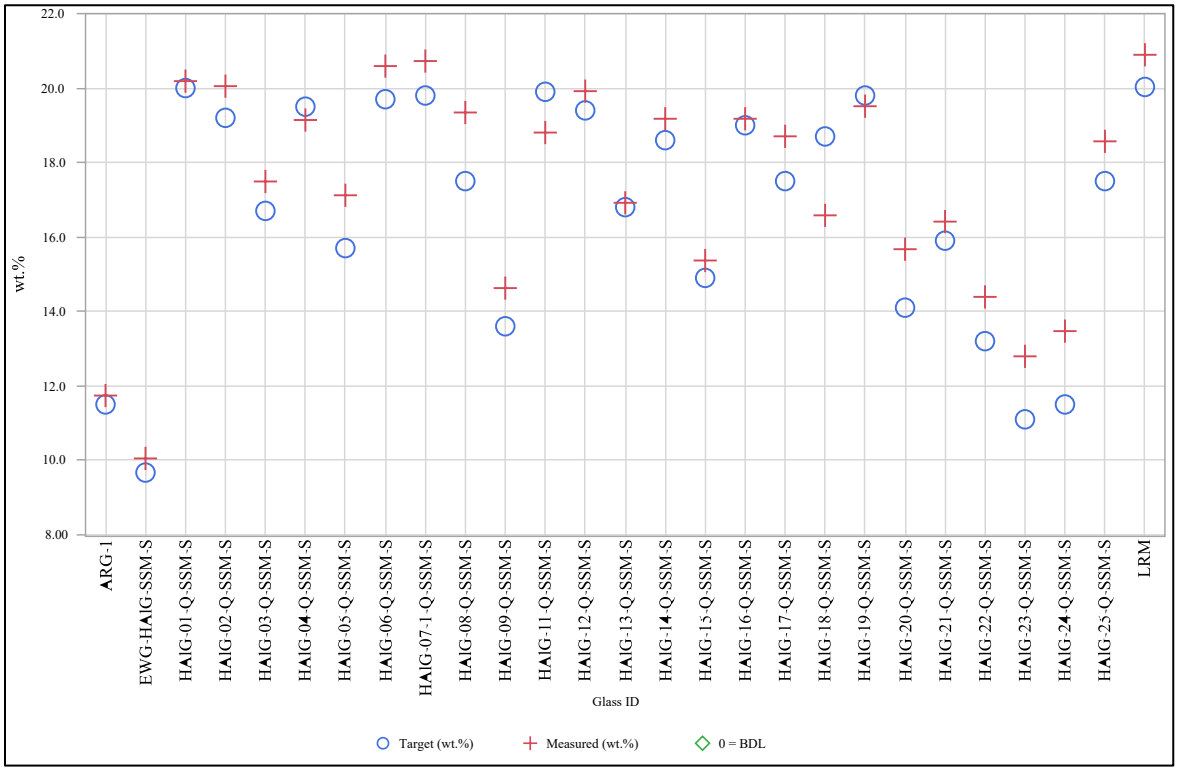


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=Na_2O



Oxide=NiO

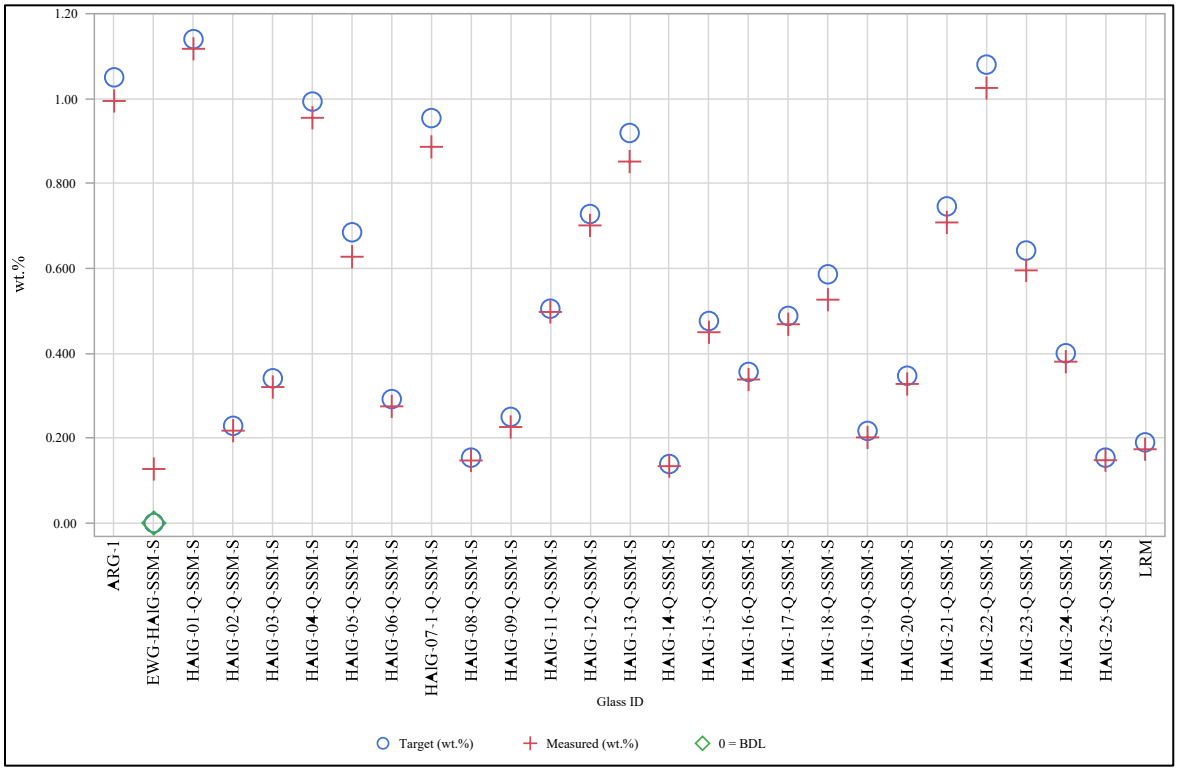
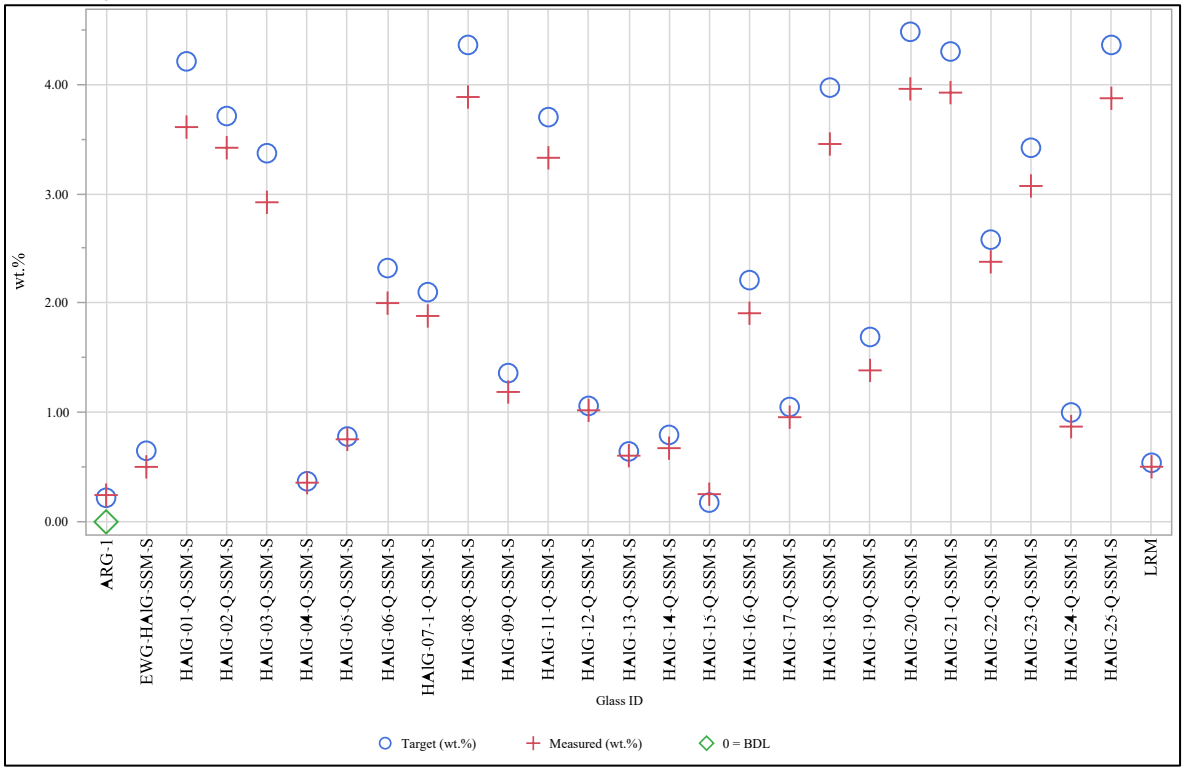


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=P_2O_5



Oxide=SiO_2

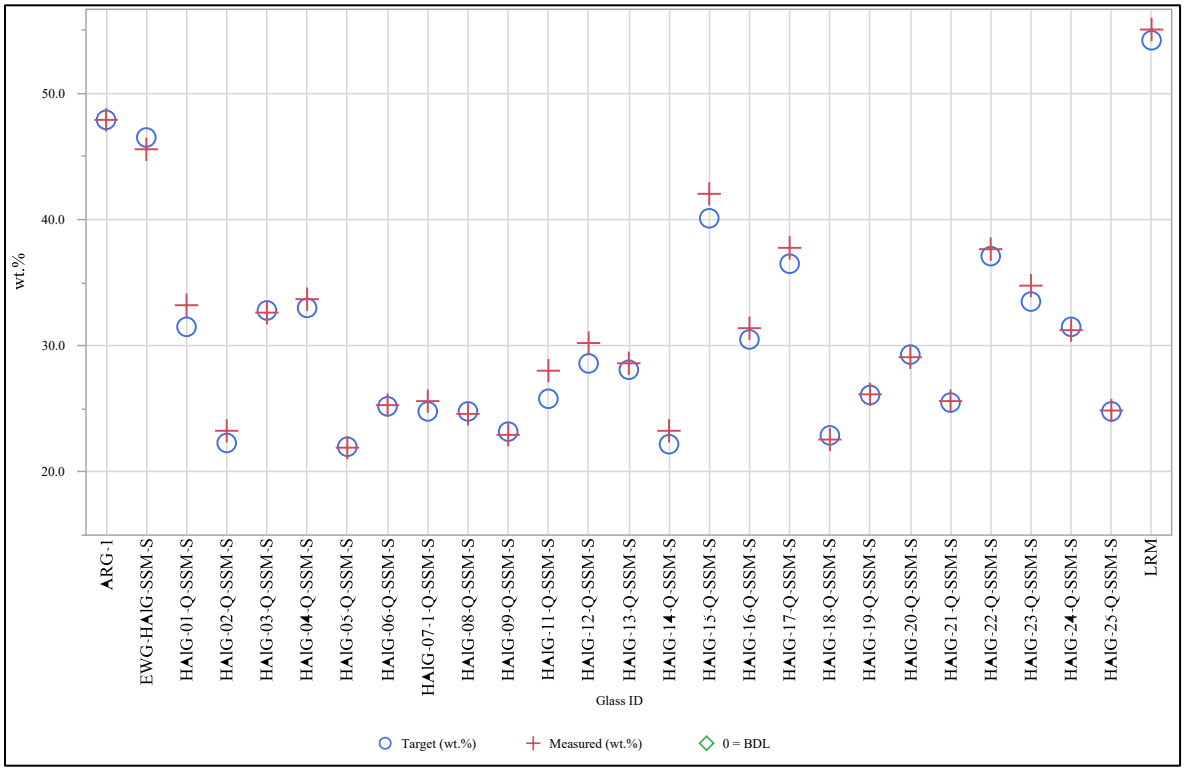
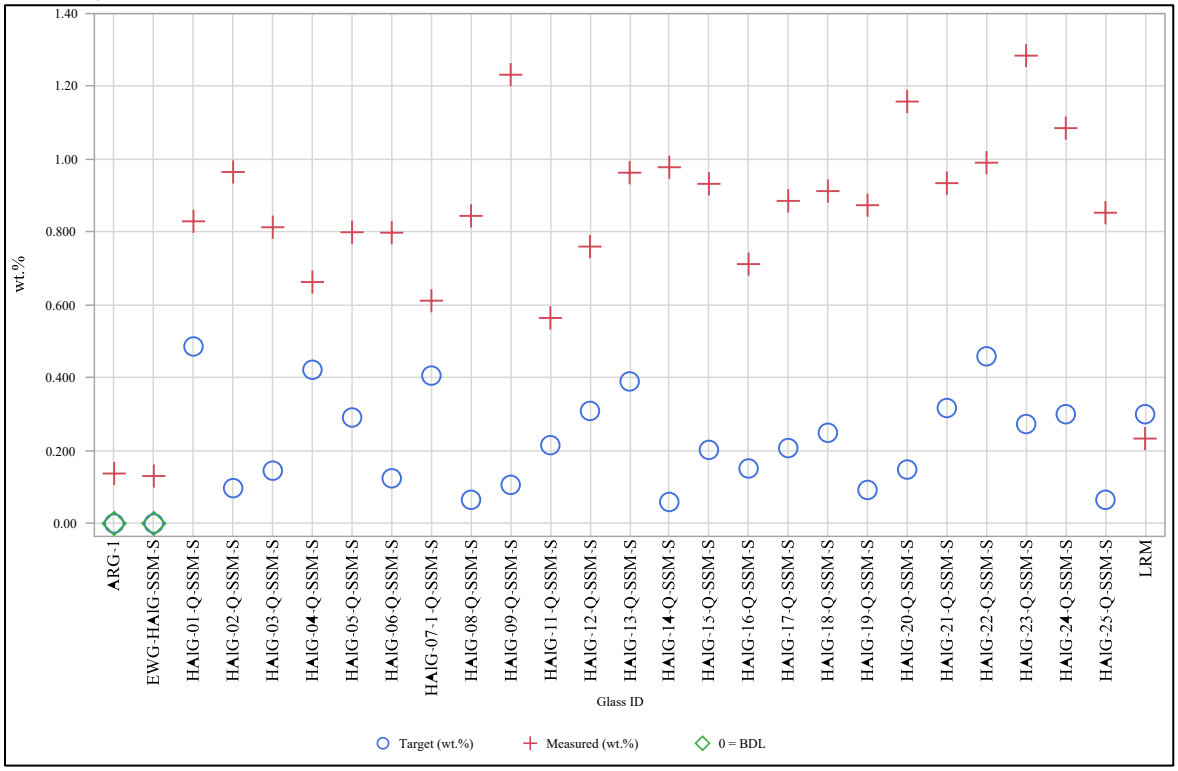


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=SO_3



Oxide=SrO

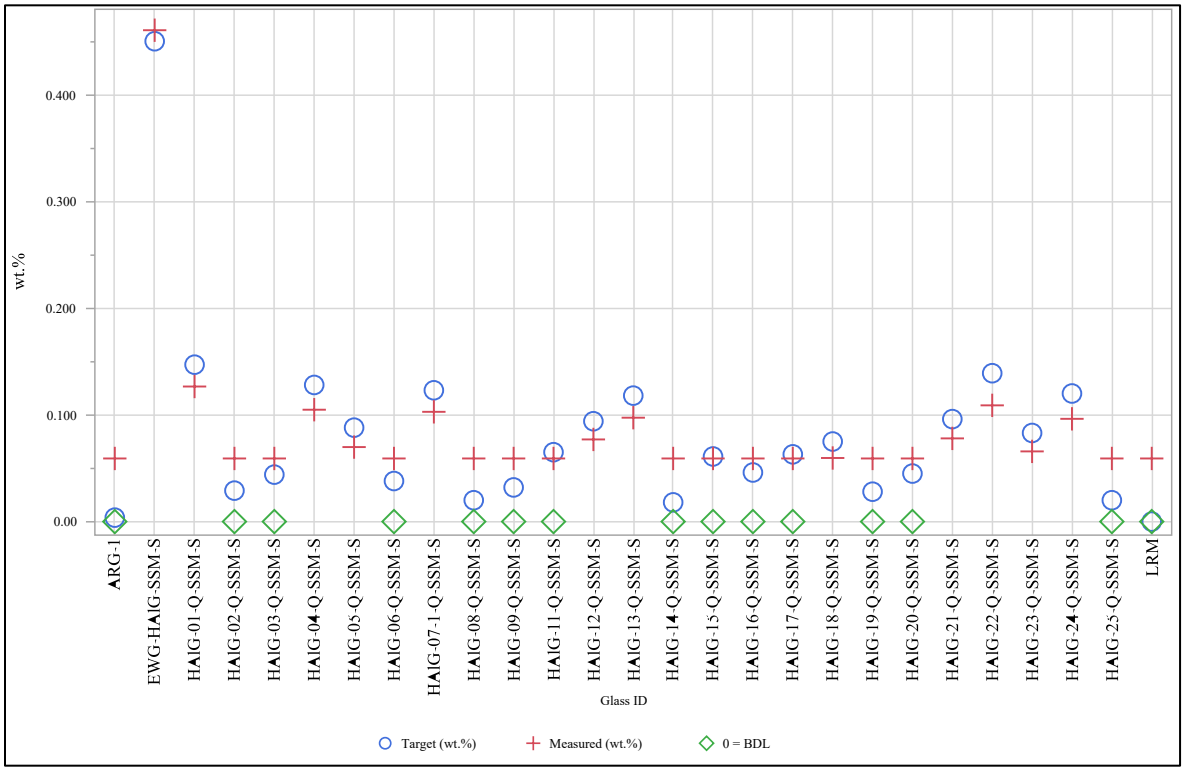
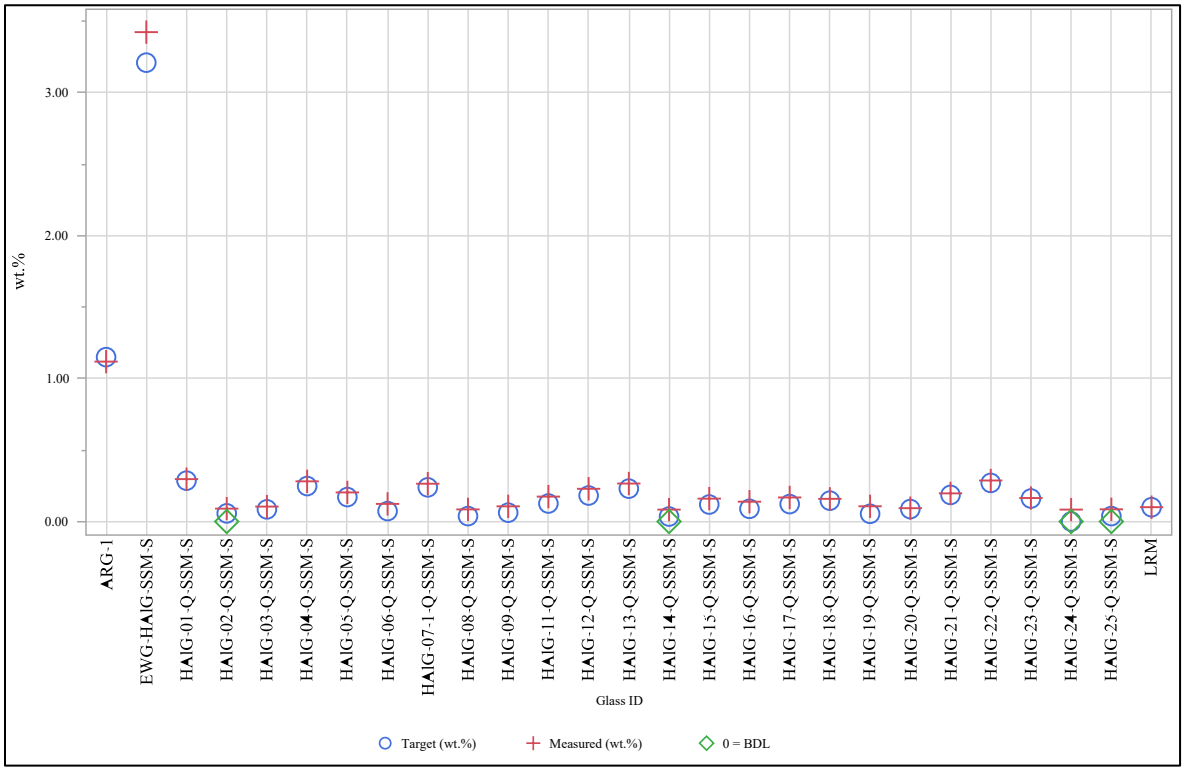


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=TiO_2



Oxide=ZnO

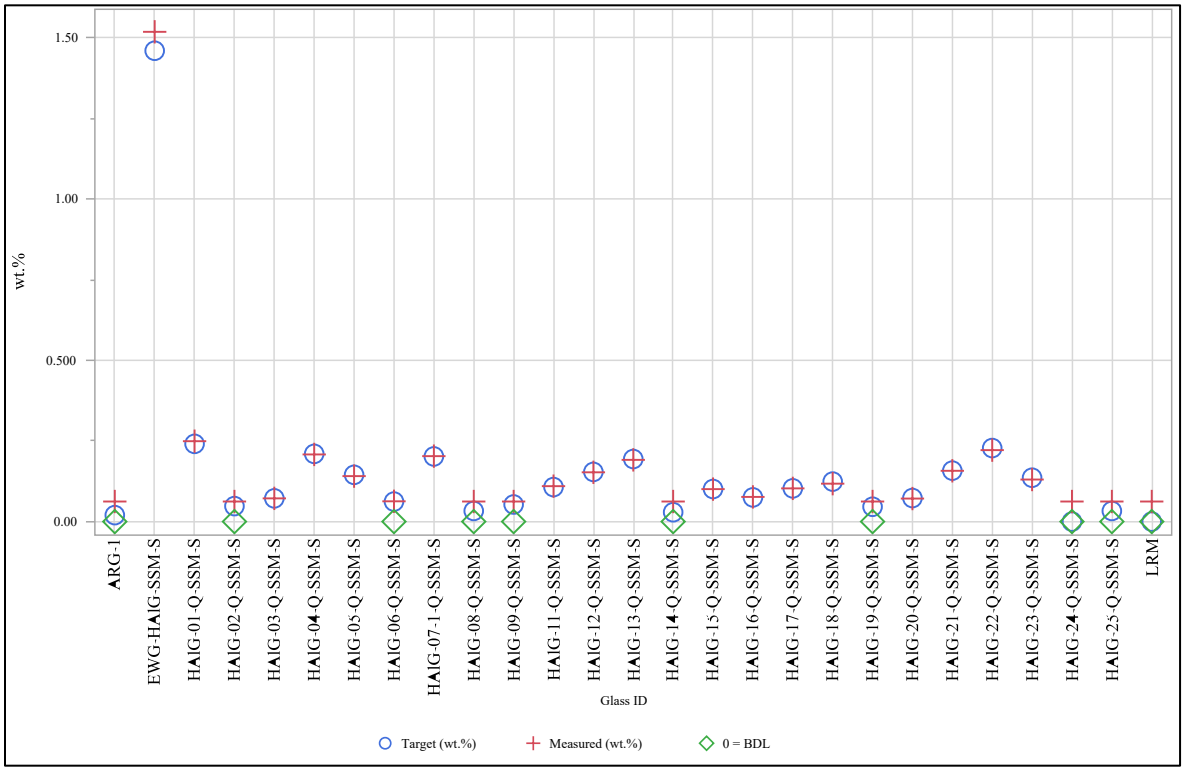
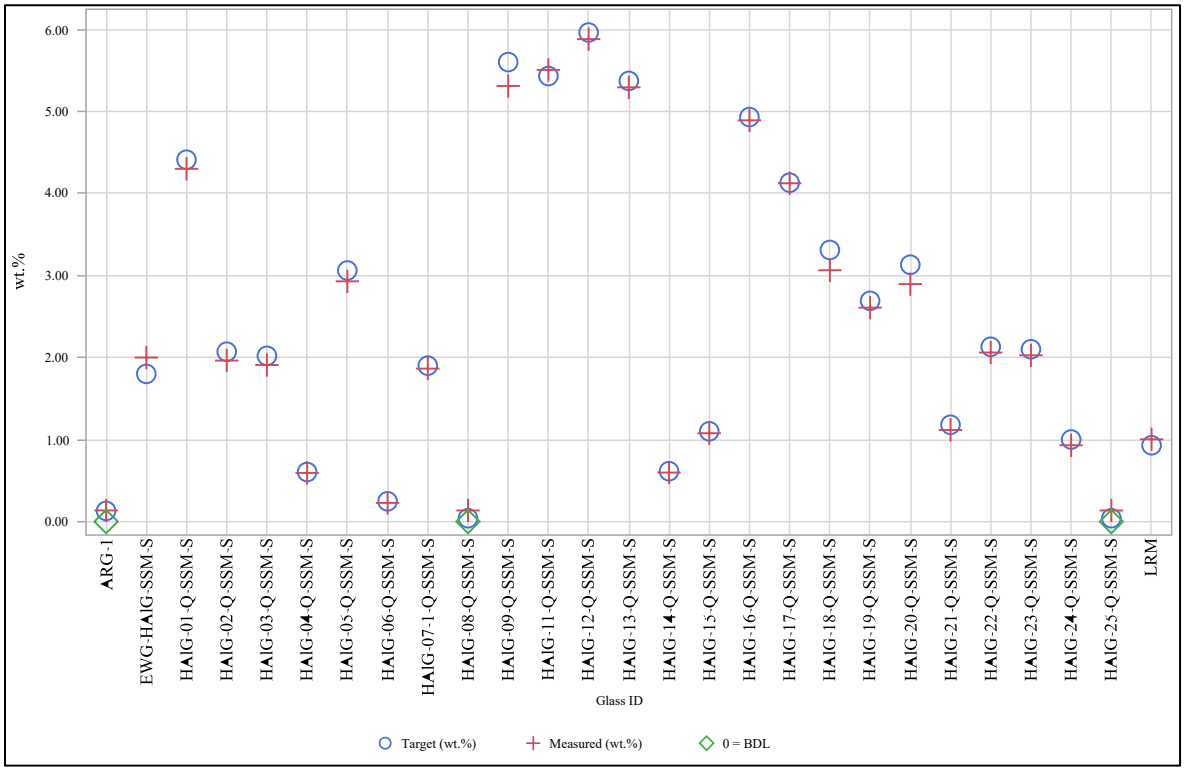


Exhibit A-3. Measured versus Targeted Concentrations by Glass ID by Oxide (continued)

Oxide=ZrO_2



Oxide=Sum of Oxides

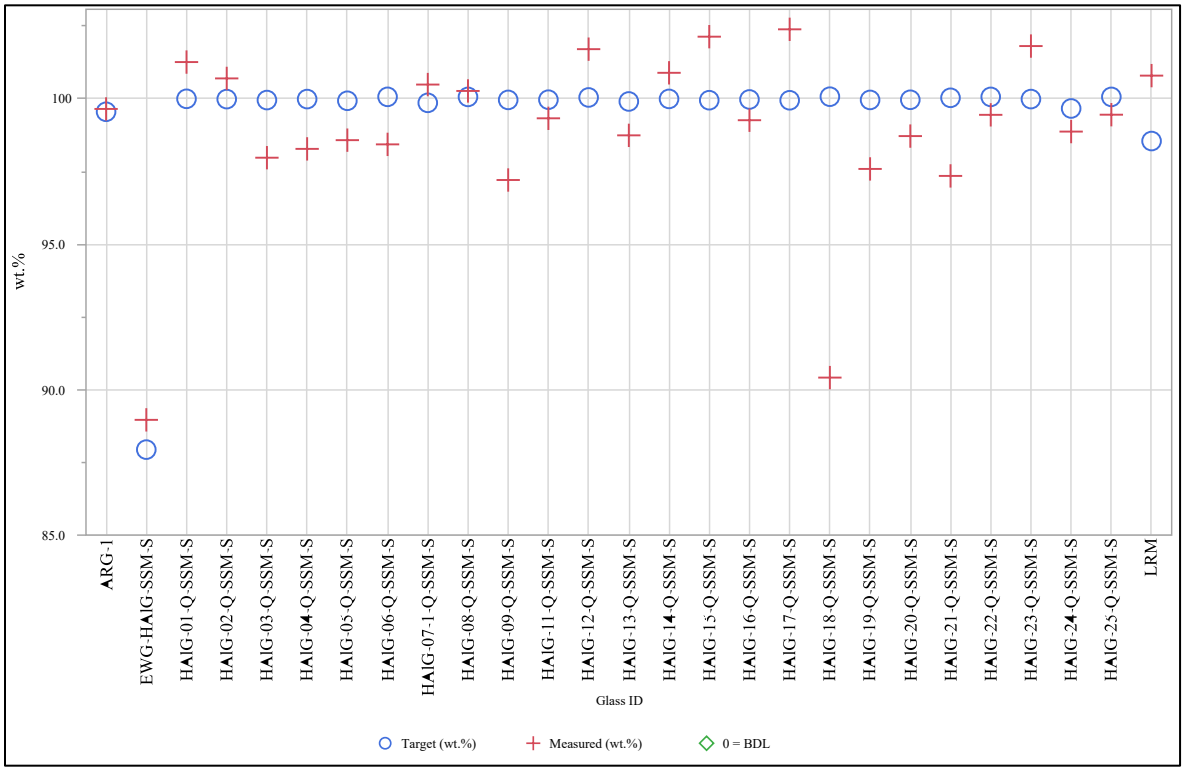
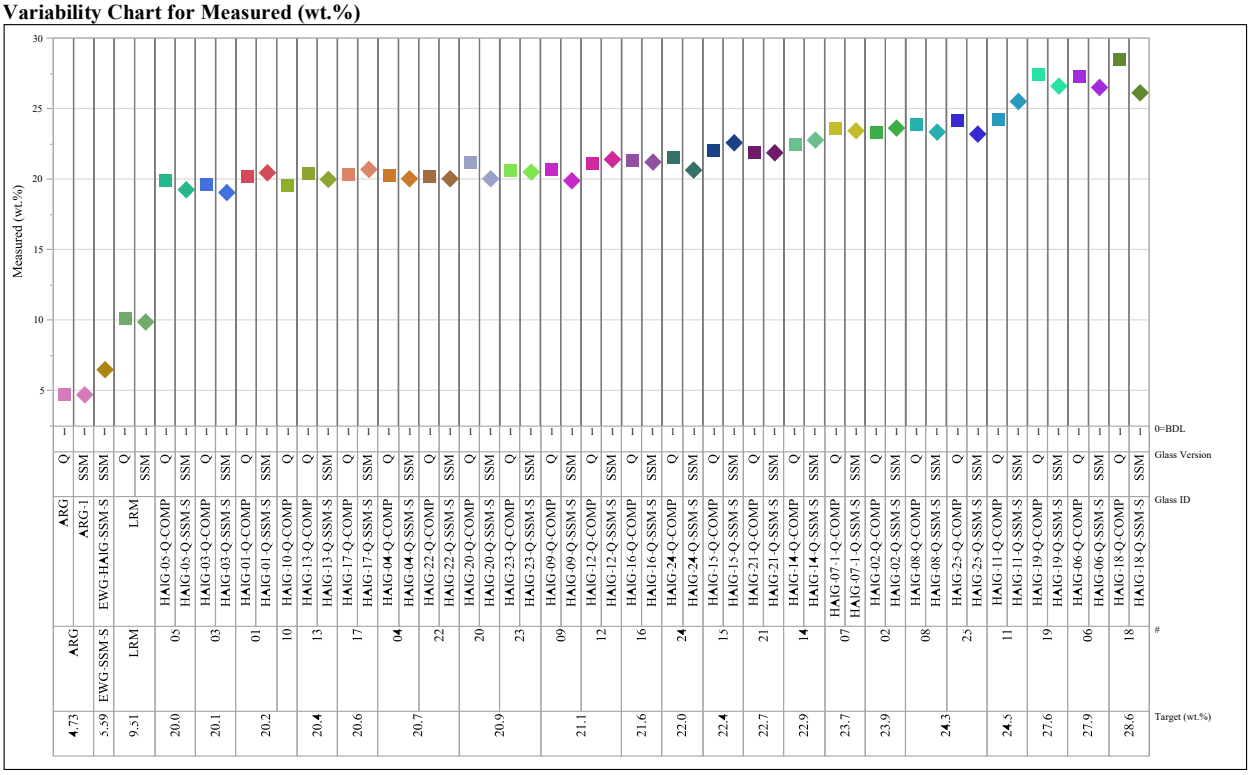


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses

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



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

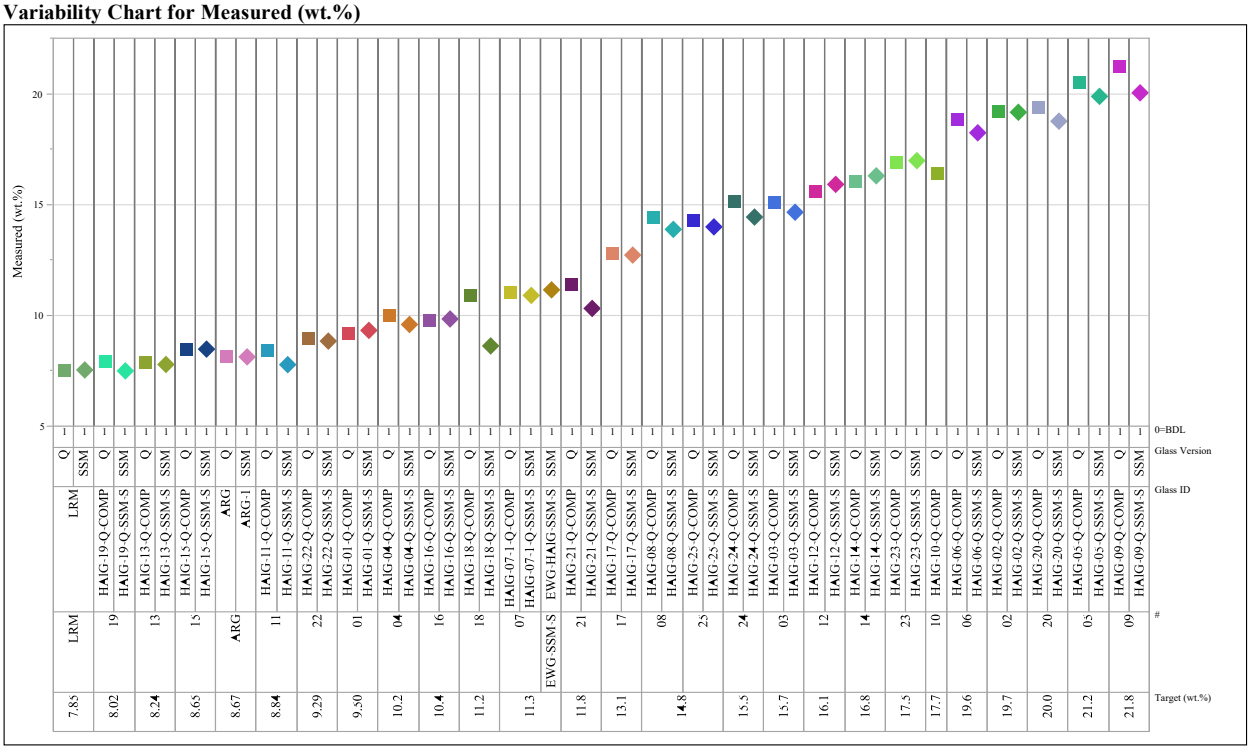
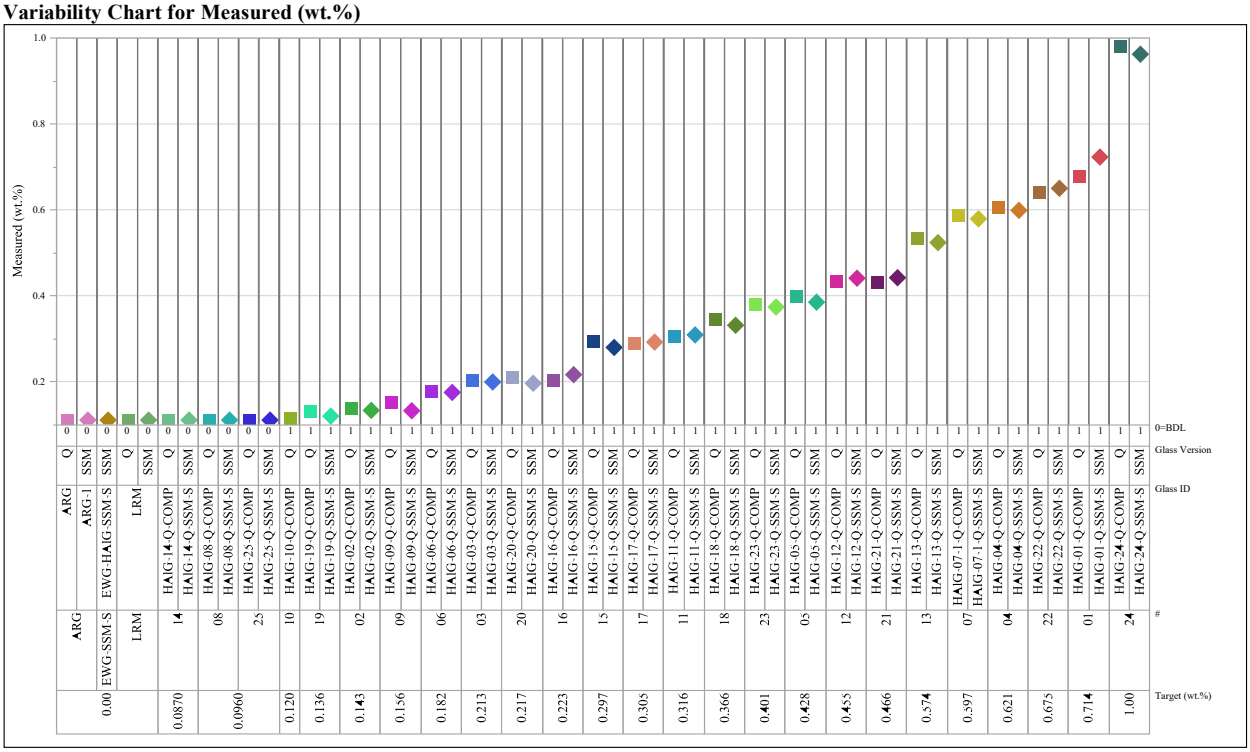


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=Bi_2O_3
Variability Chart for Measured (wt.%)



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

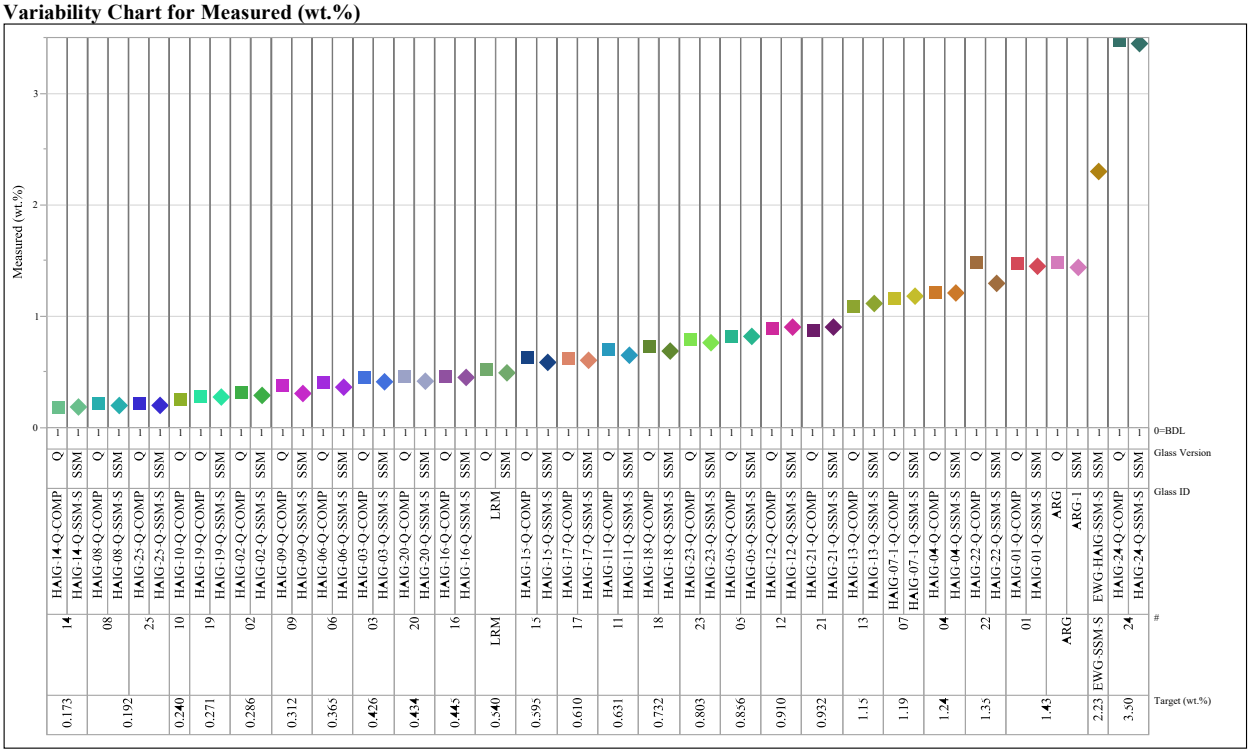
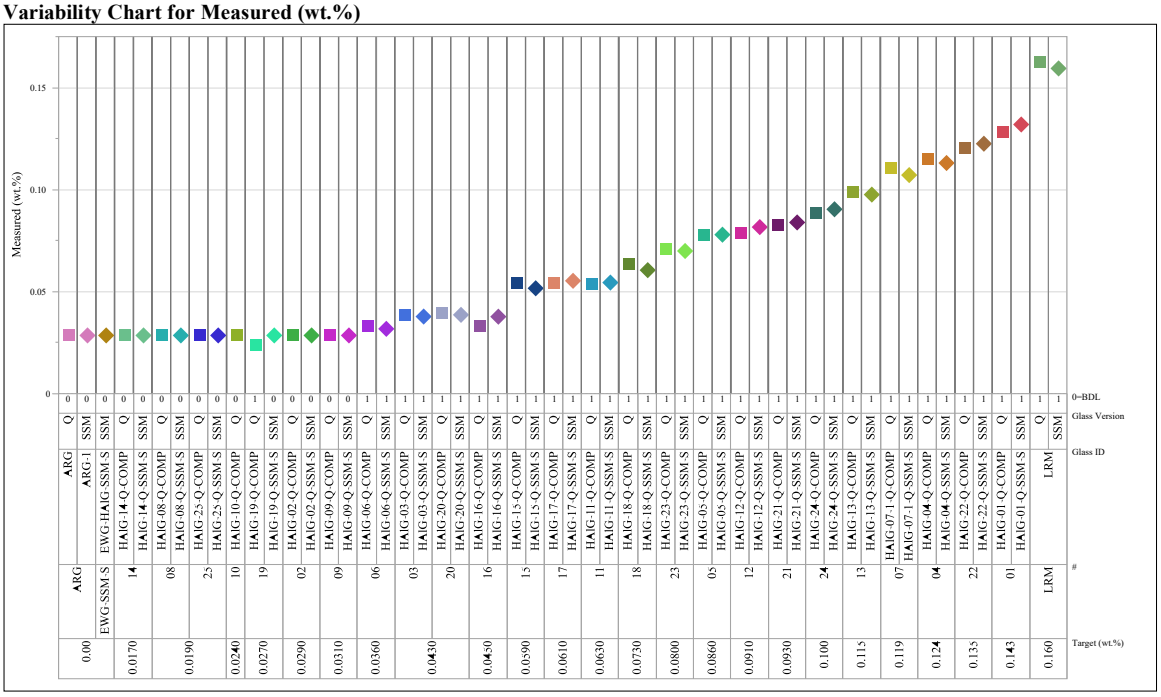


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=CdO
Variability Chart for Measured (wt.%)



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

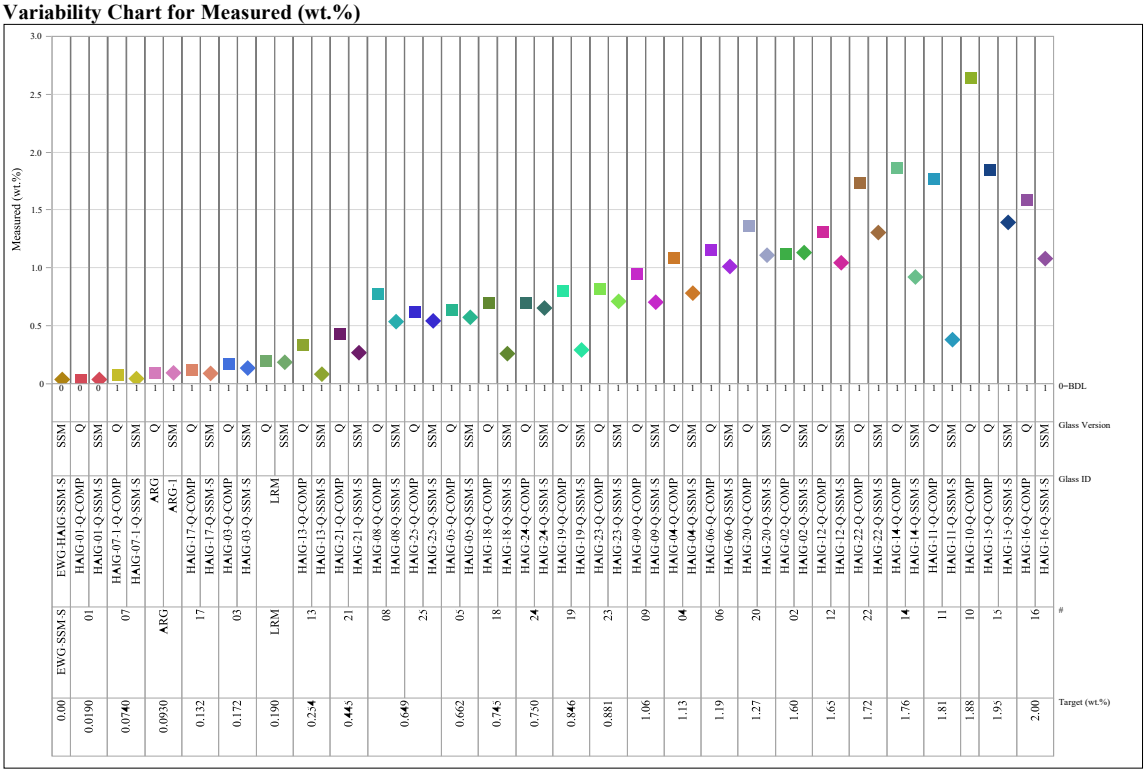
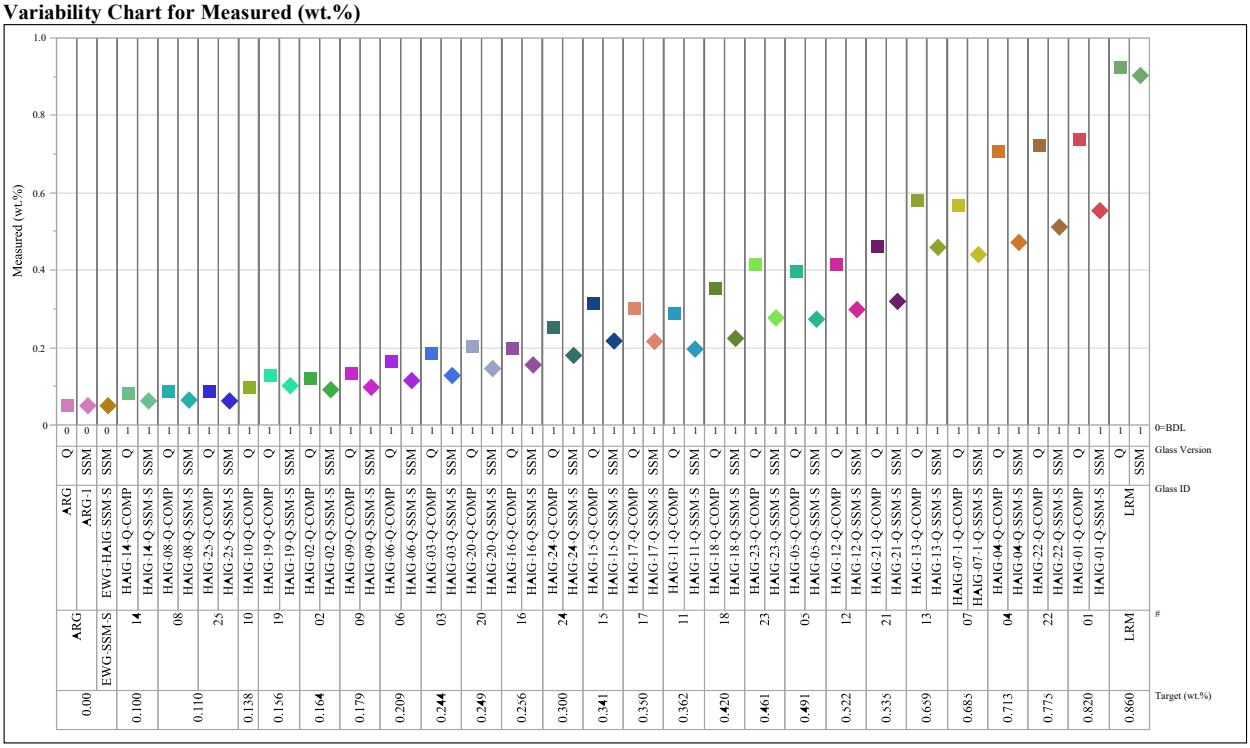


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=F^-
Variability Chart for Measured (wt.%)



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

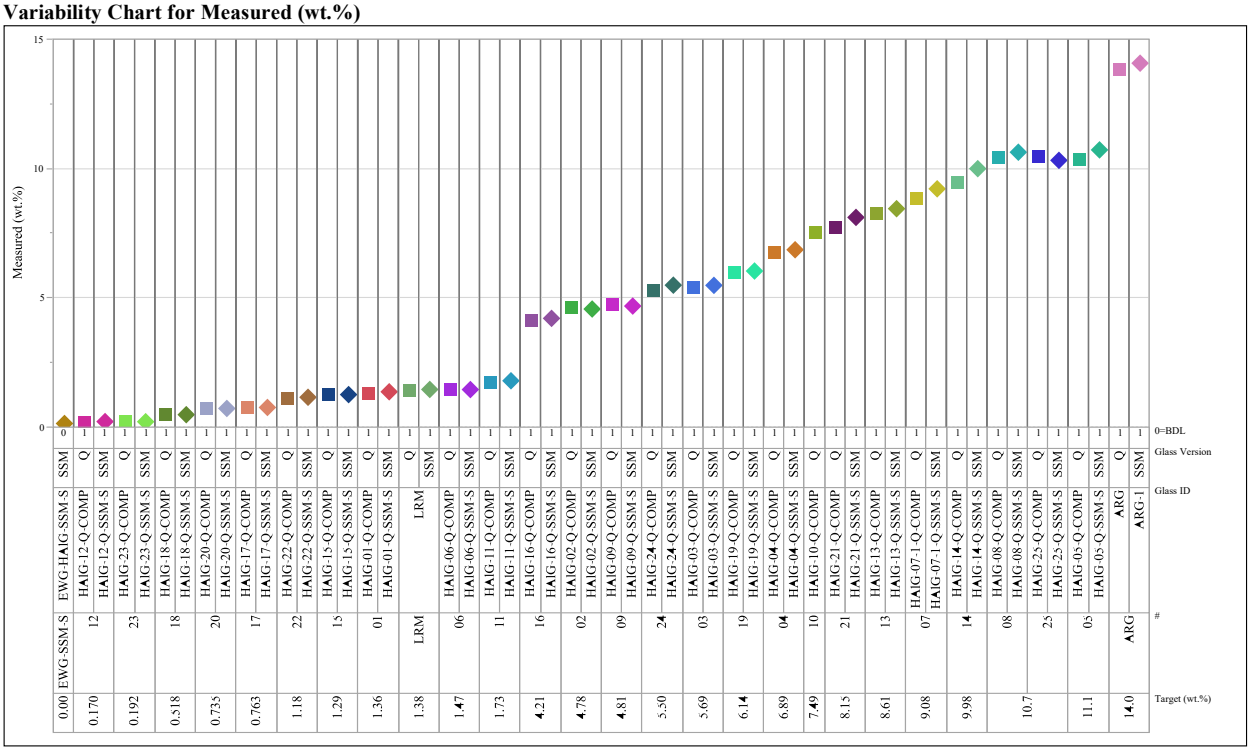
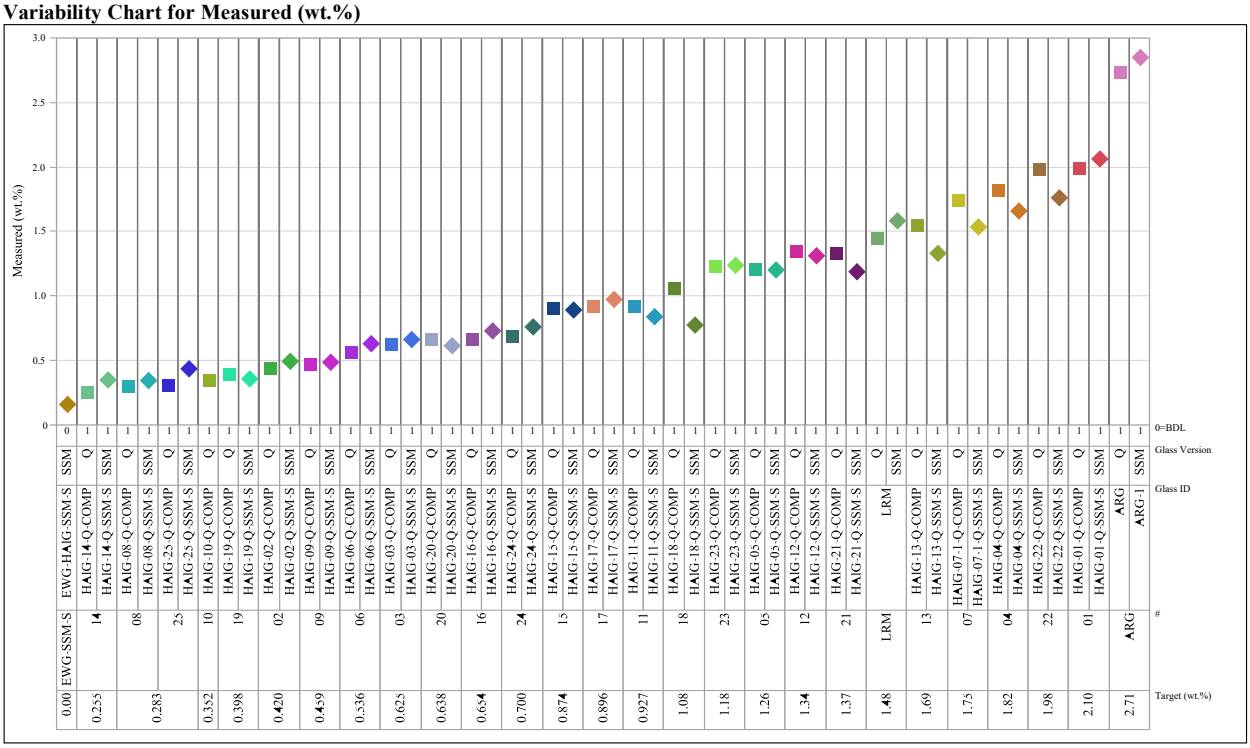


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=K_2O
Variability Chart for Measured (wt.%)



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

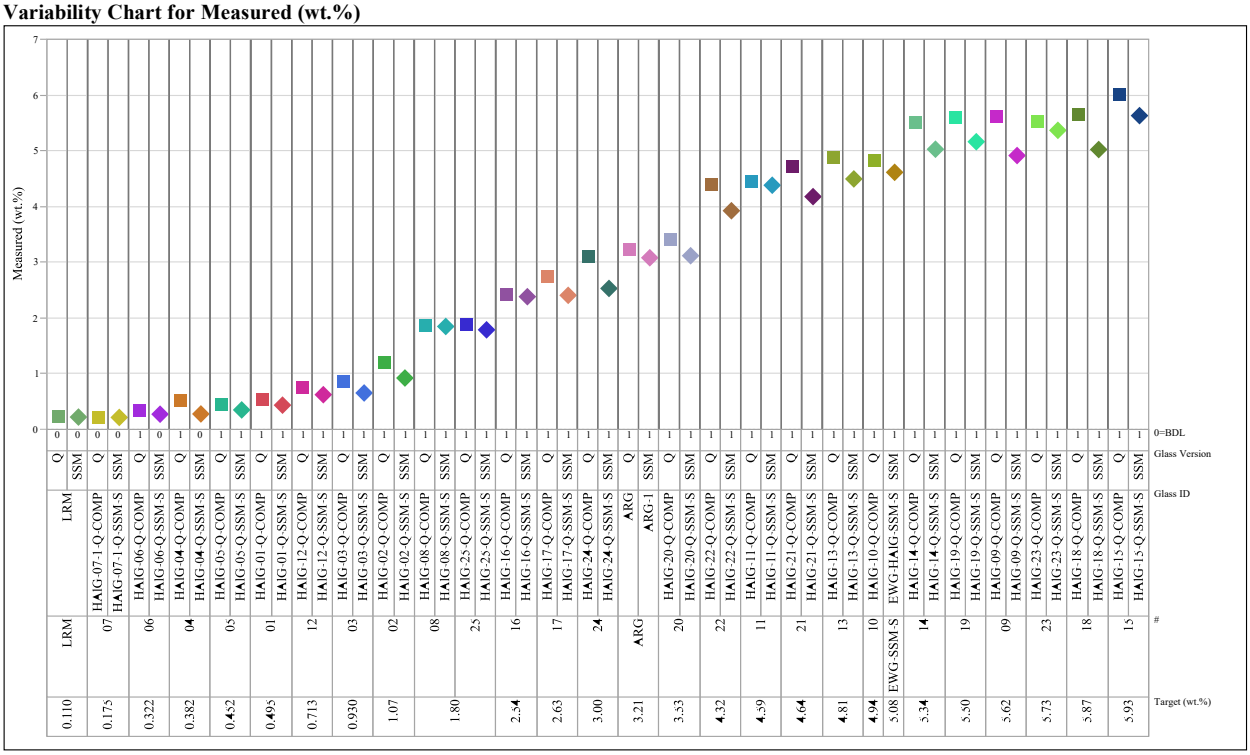
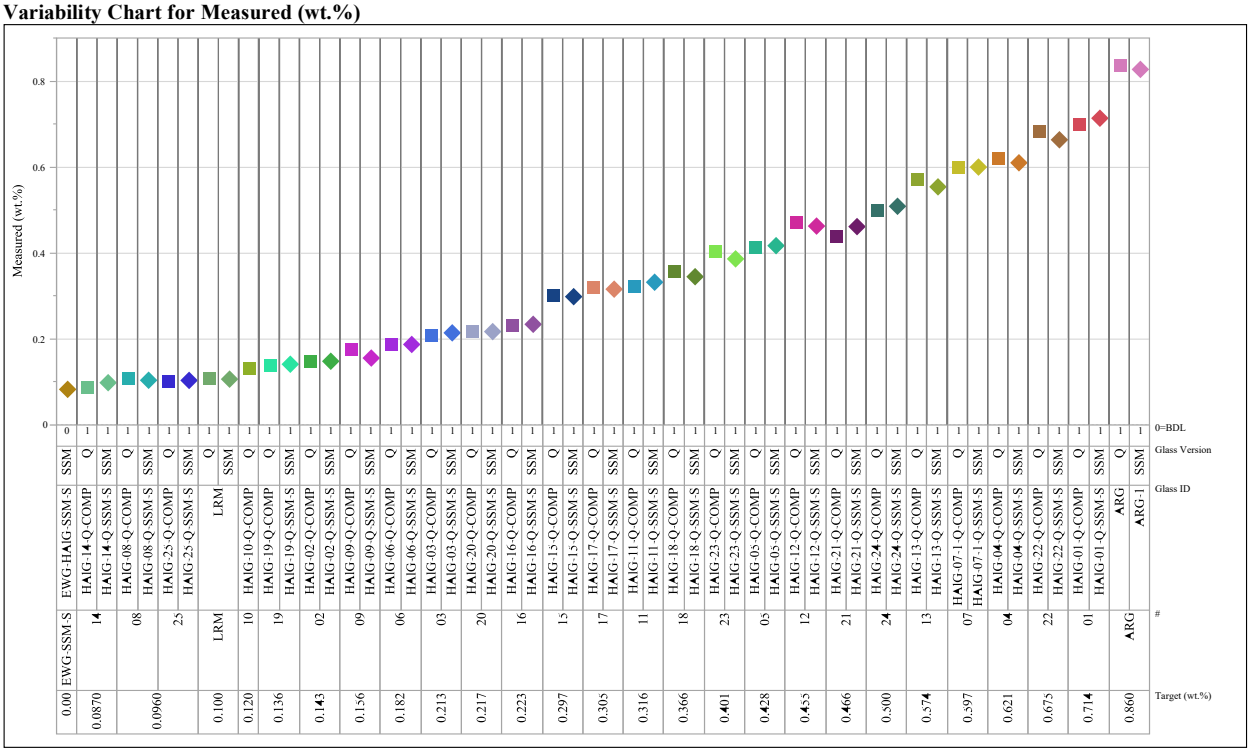


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

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



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

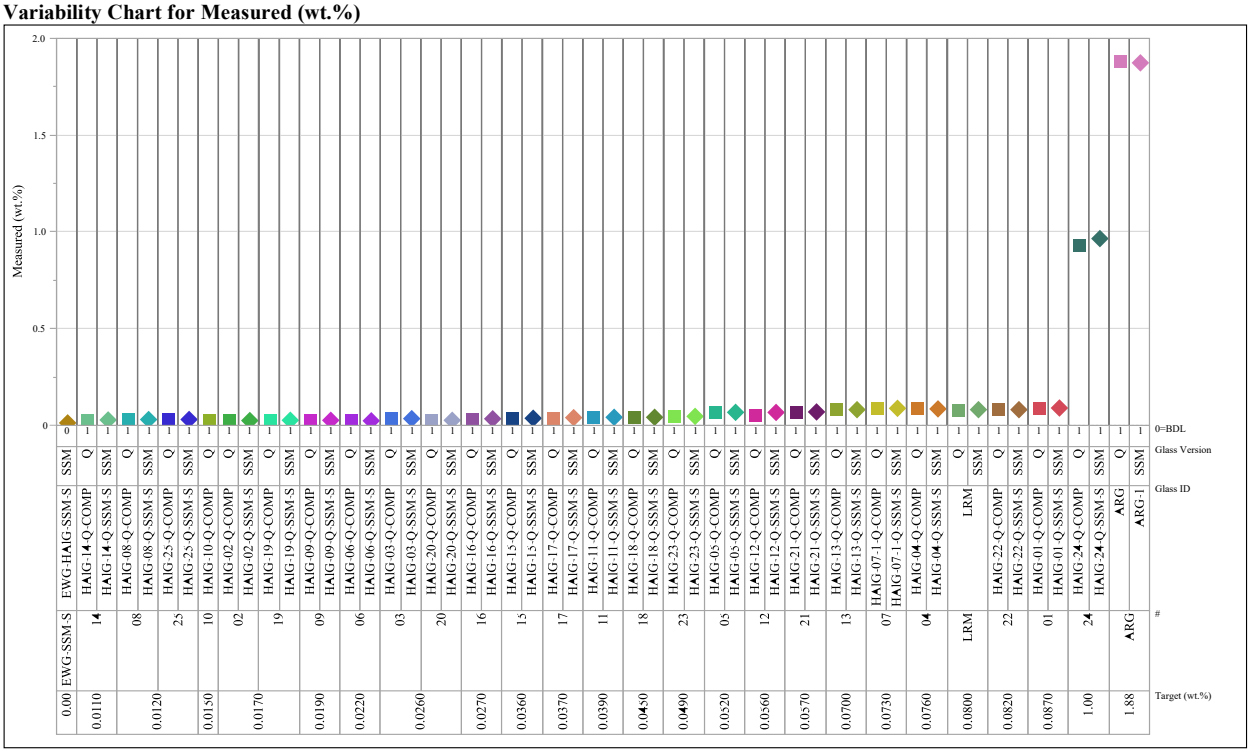
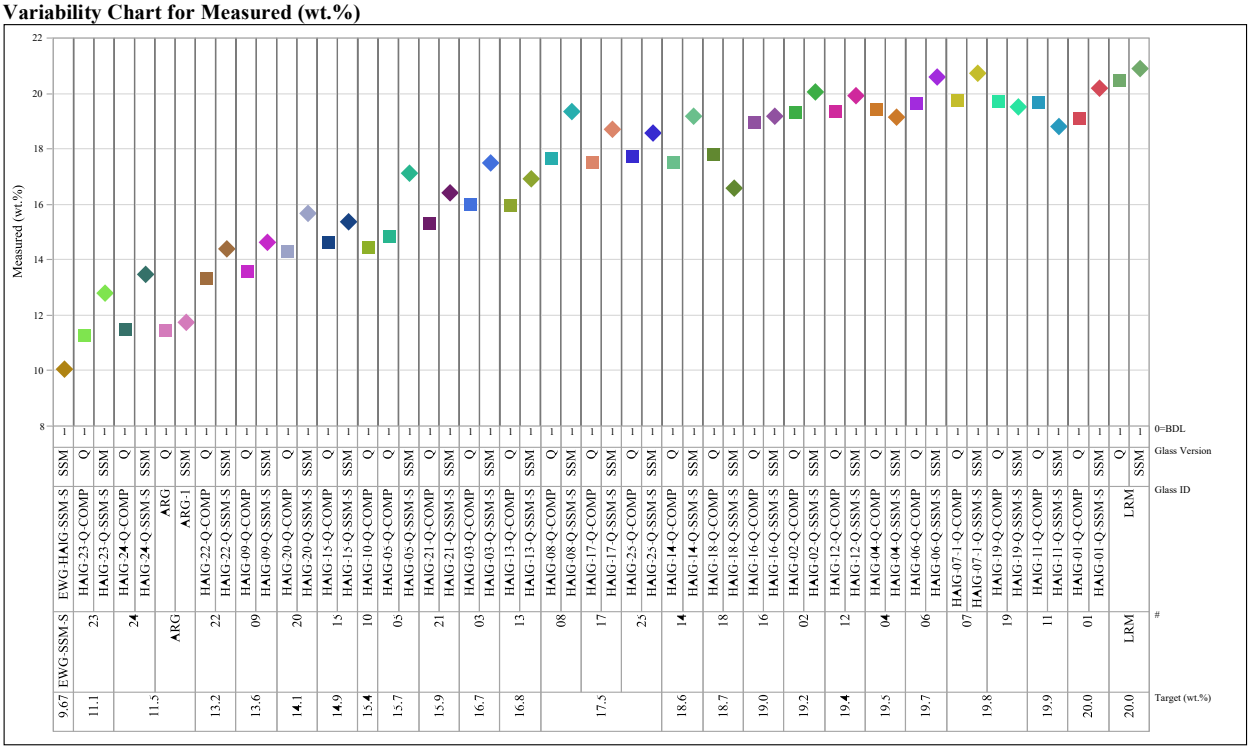


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

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



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

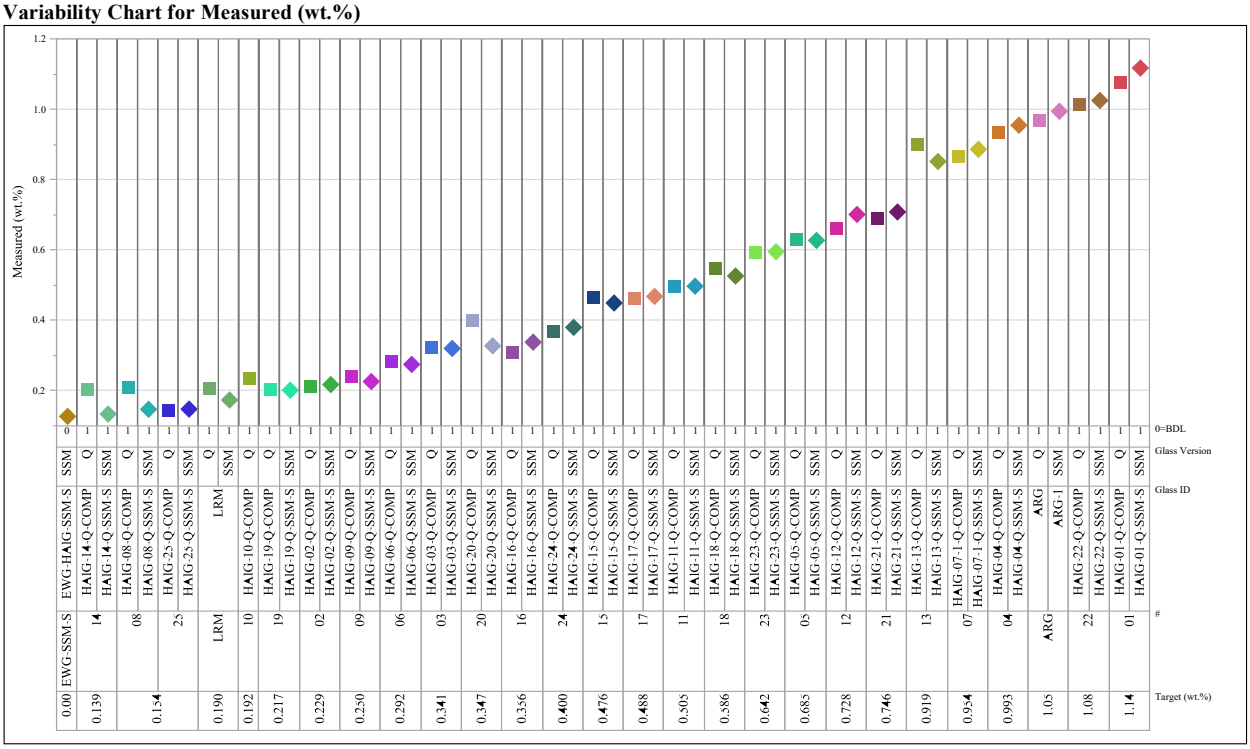
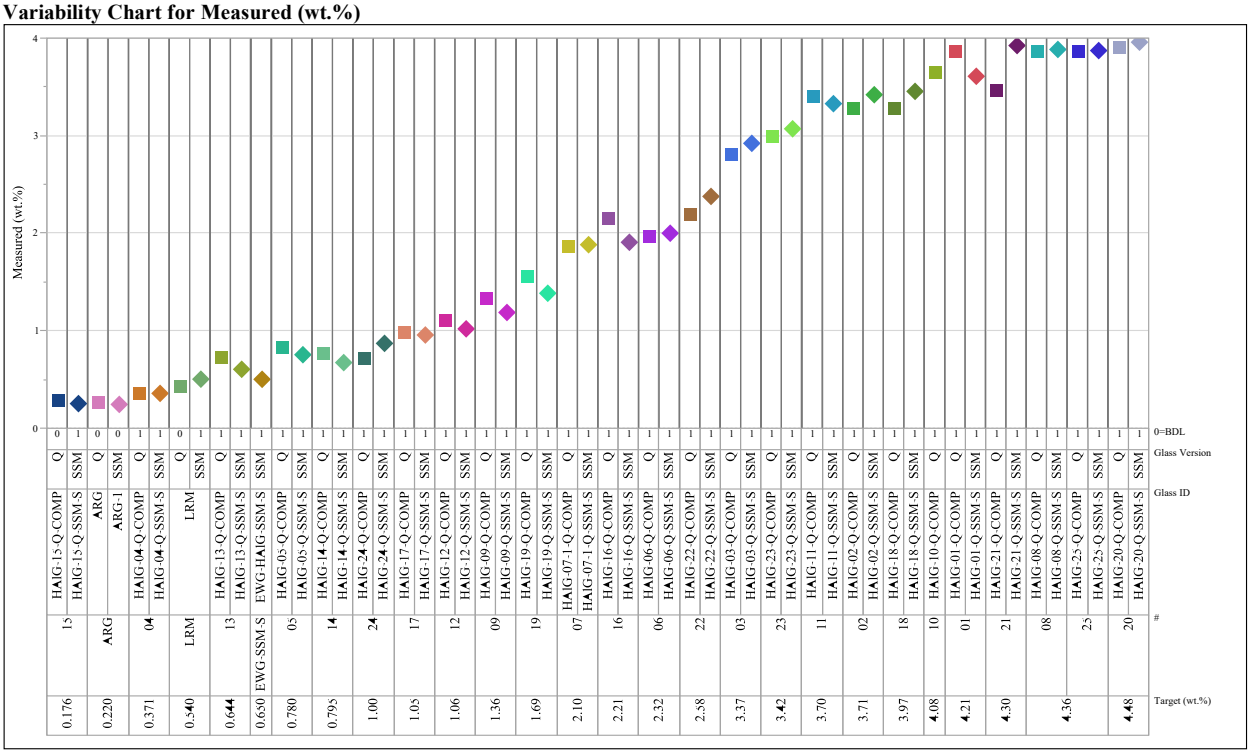


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=P_2O_5
Variability Chart for Measured (wt.%)



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

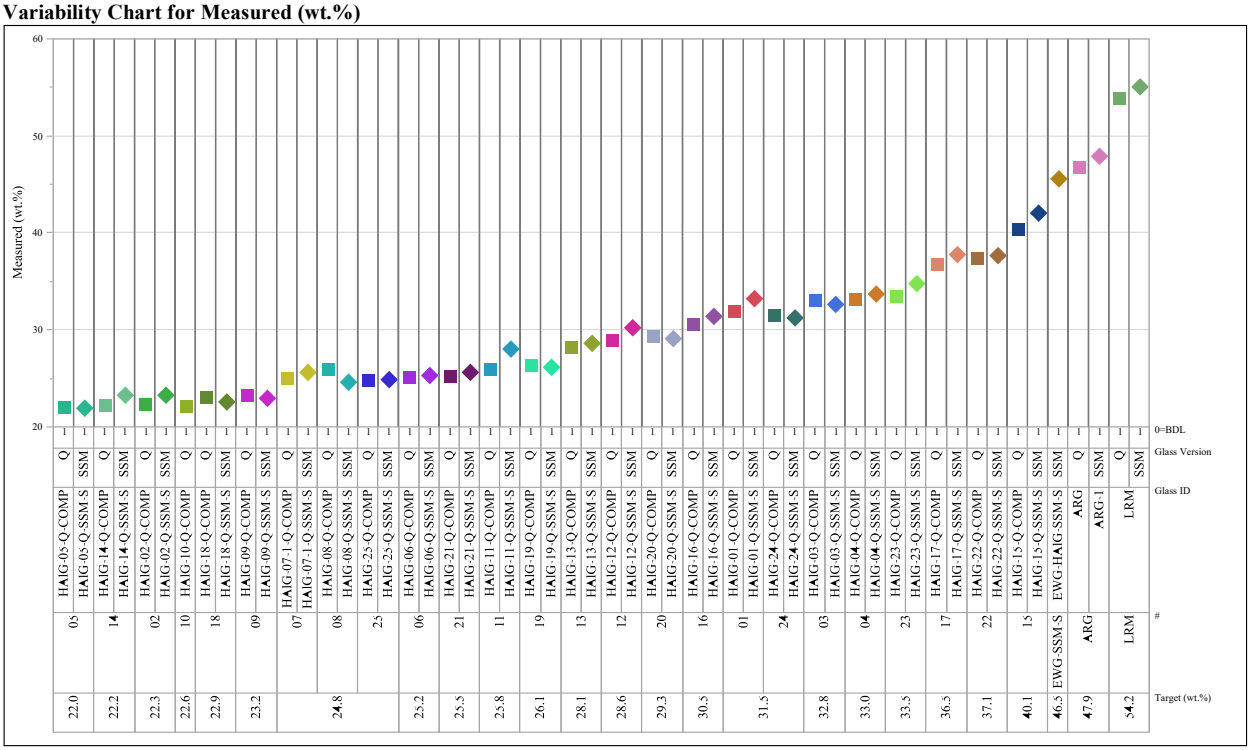
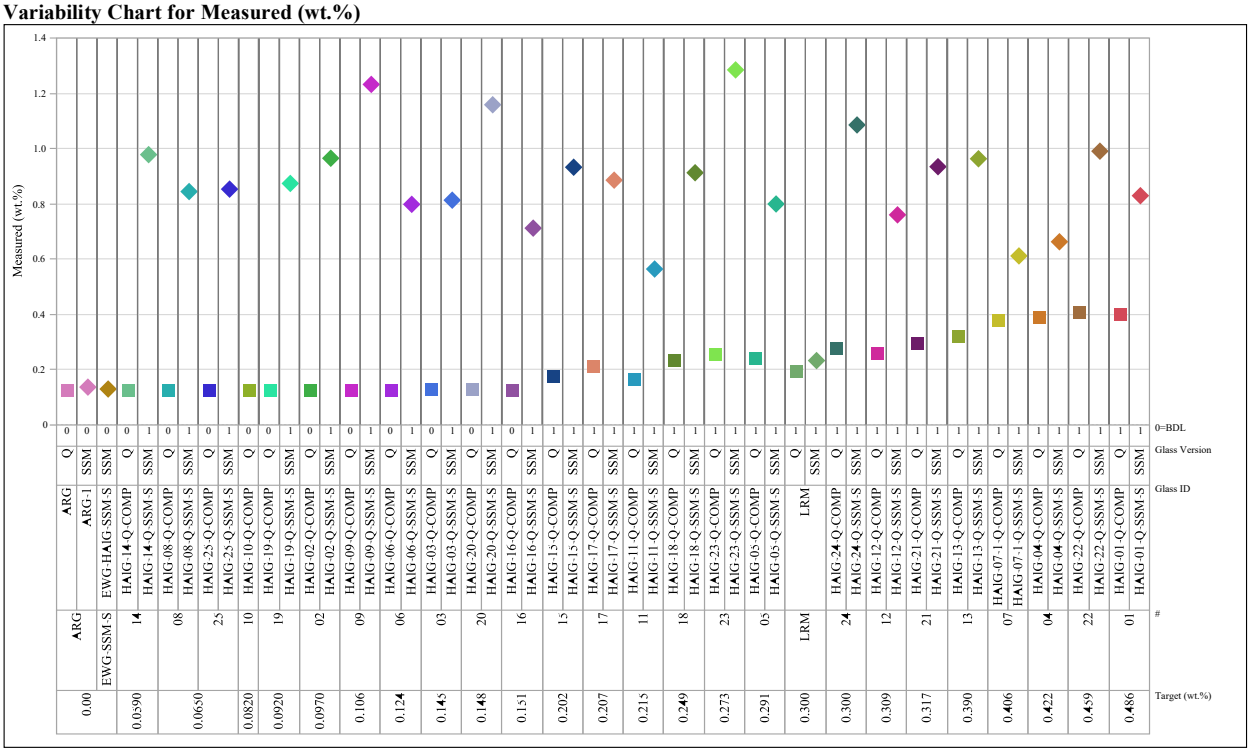


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

Oxide=SO_3
Variability Chart for Measured (wt.%)



Oxide=SrO
Variability Chart for Measured (wt.%)

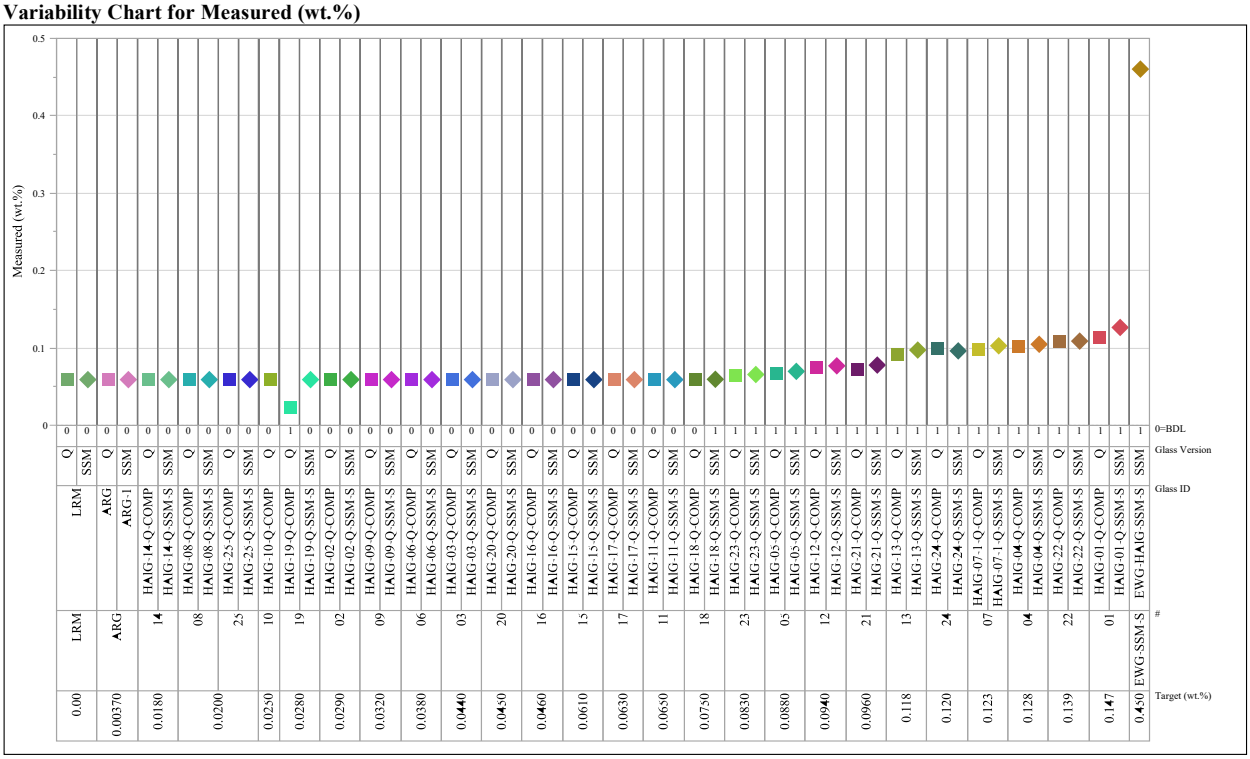
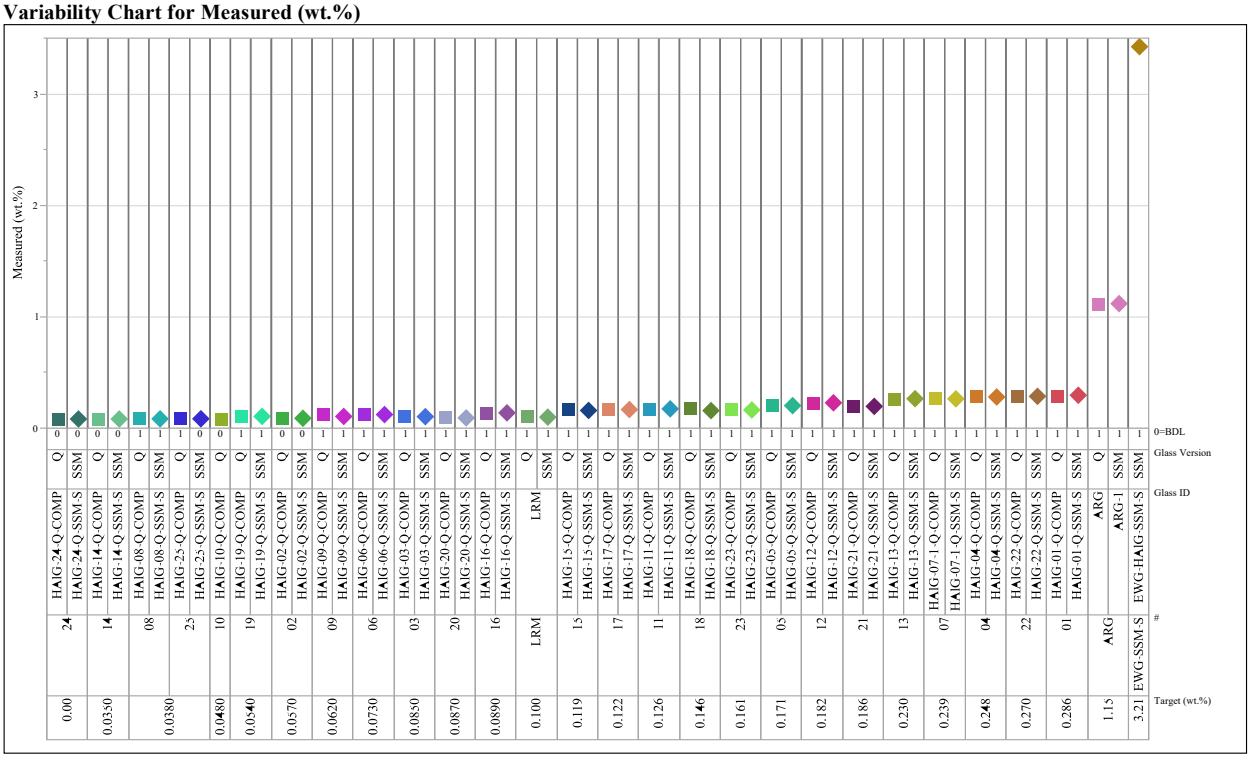


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

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



Oxide=ZnO
Variability Chart for Measured (wt.%)

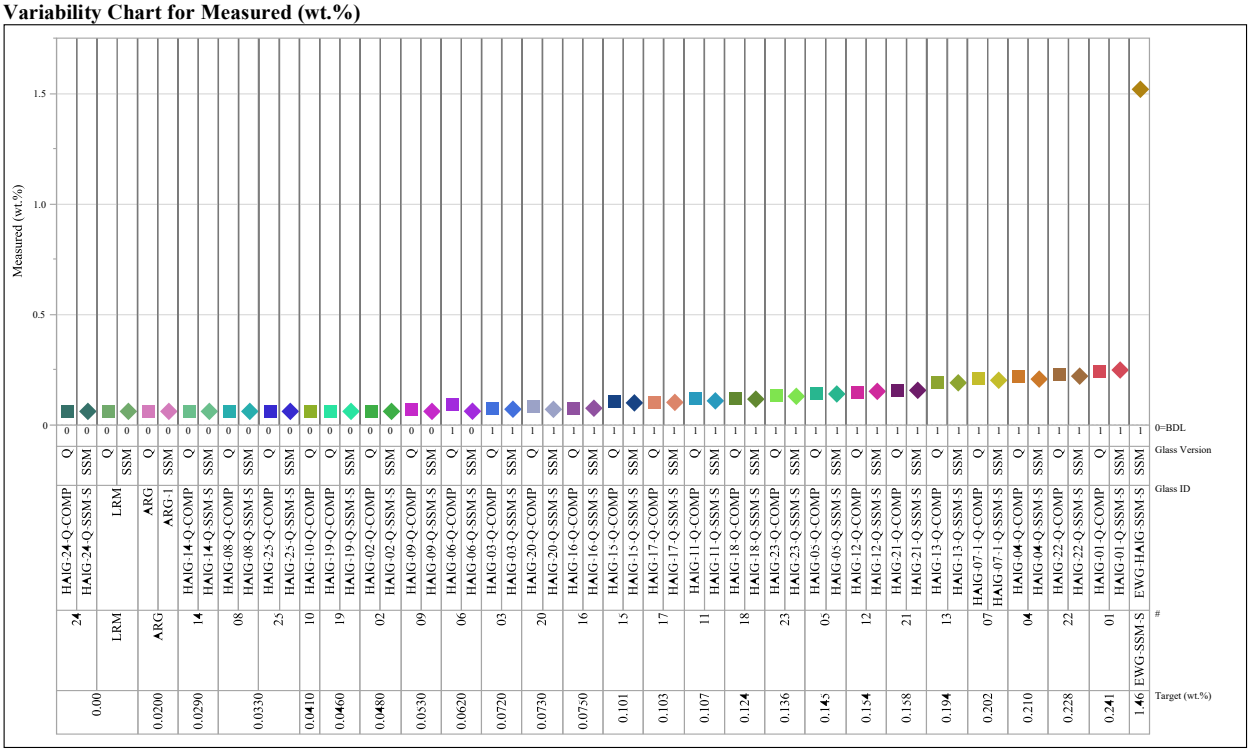
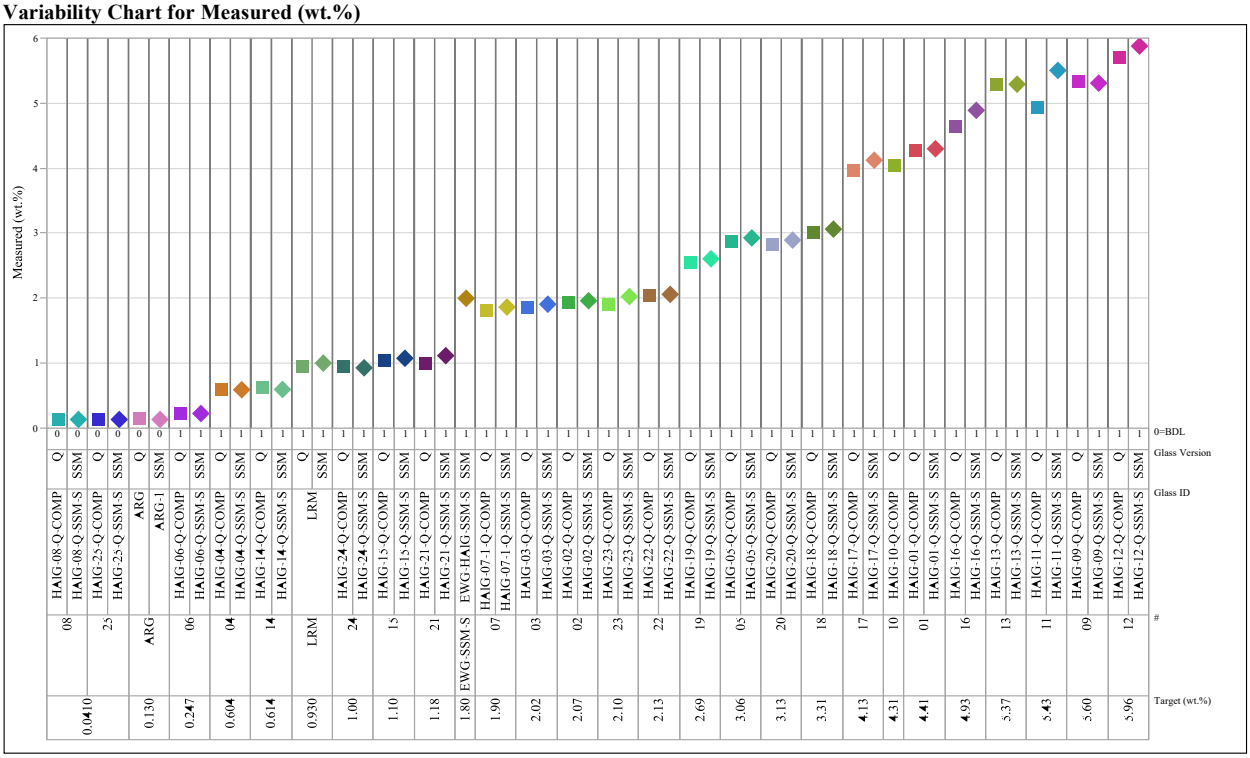
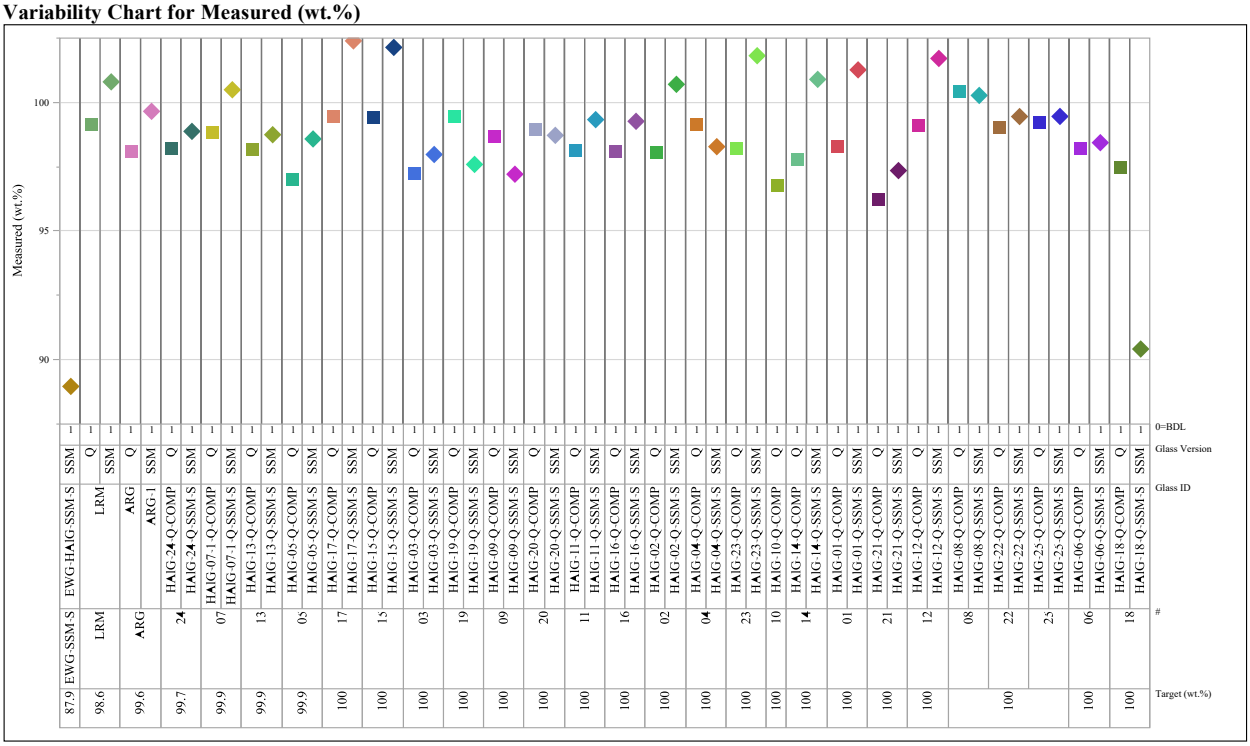


Exhibit A-4. Comparisons of the Measured Compositions of the Quenched and SSM Versions of the Study Glasses (continued)

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



Oxide=Sum of Oxides
Variability Chart for Measured (wt.%)



Appendix B. Tables and Exhibits Supporting the HLW HAlG Wash Solution Composition Measurements

Table B-1. Measurements (mg/L) of the SSM Wash Solutions Measured by ICP-OES

PNNL ID	Block	Seq.	Lab ID	Al	B	Bi	Ca	Cd	Cr	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Si	Sr	Ti	Zn	Zr
std	1	1	std-11	3.82	19.2	<1.00	<1.00	<1.00	<1.00	3.98	9.25	9.54	<1.00	<1.00	80.3	<1.00	<1.00	<1.00	47.0	<1.00	<1.00	<1.00	<1.00
hpstd	1	2	hpstd-11	51.0	<1.00	<1.00	<1.00	<1.00	<1.00	51.1	<1.00	<1.00	<1.00	20.6	147	10.3	<1.00	9.12	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-20-Q-SSM-W	1	3	S-14301-1	4.38	13.9	<1.00	3.62	<1.00	26.8	<1.00	16.2	38.8	<1.00	<1.00	551	<1.00	20.4	442	2.22	<1.00	<1.00	<1.00	<1.00
HAlG-23-Q-SSM-W	1	4	S-14304-1	2.83	11.6	<1.00	3.85	<1.00	30.7	<1.00	29.8	56.5	<1.00	<1.00	374	<1.00	15.3	356	2.42	<1.00	<1.00	<1.00	<1.00
HAlG-13-Q-SSM-W	1	5	S-14294-1	3.91	7.81	<1.00	1.74	<1.00	53.6	<1.00	110	36.8	<1.00	<1.00	858	<1.00	12.7	596	2.50	<1.00	<1.00	<1.00	<1.00
HAlG-17-Q-SSM-W	1	6	S-14298-1	2.63	18.0	<1.00	2.64	<1.00	12.9	<1.00	37.0	28.5	<1.00	<1.00	742	<1.00	13.1	513	2.42	<1.00	<1.00	<1.00	<1.00
HAlG-19-Q-SSM-W	1	7	S-14300-1	11.8	10.3	<1.00	<1.00	<1.00	164	<1.00	28.4	35.7	<1.00	<1.00	1050	<1.00	31.0	610	4.62	<1.00	<1.00	<1.00	<1.00
HAlG-21-Q-SSM-W	1	8	S-14302-1	13.8	72.6	<1.00	6.34	<1.00	51.4	<1.00	73.4	40.4	1.61	<1.00	989	<1.00	4.75	616	2.11	<1.00	<1.00	<1.00	<1.00
HAlG-18-Q-SSM-W	1	9	S-14299-1	13.0	202	<1.00	<1.00	<1.00	122	<1.00	95.8	71.0	<1.00	<1.00	1320	<1.00	5.92	548	1.60	<1.00	<1.00	<1.00	<1.00
HAlG-24-Q-SSM-W	1	10	S-14305-1	1.12	6.89	<1.00	30.7	<1.00	18.9	<1.00	25.5	39.0	<1.00	<1.00	491	<1.00	1.39	442	1.18	1.96	<1.00	<1.00	<1.00
HAlG-15-Q-SSM-W	1	11	S-14296-1	2.36	13.3	<1.00	2.27	<1.00	141	<1.00	51.7	68.8	<1.00	<1.00	778	<1.00	4.80	597	3.25	<1.00	<1.00	<1.00	<1.00
HAlG-02-Q-SSM-W	1	12	S-14284-1	9.01	25.3	<1.00	<1.00	<1.00	54.4	<1.00	14.9	10.9	<1.00	<1.00	768	<1.00	14.2	488	1.84	<1.00	<1.00	<1.00	<1.00
HAlG-07-1-Q-SSM-W	1	13	S-14289-1	5.18	14.0	<1.00	2.79	<1.00	11.4	<1.00	102	2.20	<1.00	<1.00	1000	<1.00	15.7	716	1.93	<1.00	<1.00	<1.00	<1.00
HAlG-16-Q-SSM-W	1	14	S-14297-1	4.27	10.2	<1.00	2.15	<1.00	163	<1.00	31.7	16.8	<1.00	<1.00	957	<1.00	21.3	570	3.02	<1.00	<1.00	<1.00	<1.00
std	1	15	std-12	3.83	18.8	<1.00	<1.00	<1.00	<1.00	4.01	9.20	9.31	<1.00	<1.00	80.4	<1.00	<1.00	<1.00	47.2	<1.00	<1.00	<1.00	<1.00
hpstd	1	16	hpstd-12	49.1	<1.00	<1.00	<1.00	<1.00	<1.00	49.3	<1.00	<1.00	<1.00	19.8	140	9.94	<1.00	9.72	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-12-Q-SSM-W	1	17	S-14293-1	2.95	17.2	<1.00	4.16	<1.00	112	<1.00	61.9	7.70	<1.00	<1.00	999	<1.00	10.4	580	1.33	<1.00	<1.00	<1.00	<1.00
HAlG-04-Q-SSM-W	1	18	S-14286-1	1.94	17.7	<1.00	7.73	<1.00	95.4	<1.00	112	6.01	<1.00	<1.00	1080	<1.00	5.29	679	1.60	1.47	<1.00	<1.00	<1.00
HAlG-09-Q-SSM-W	1	19	S-14291-1	9.65	25.7	<1.00	<1.00	<1.00	61.6	<1.00	16.9	60.3	<1.00	<1.00	552	<1.00	11.8	394	2.77	<1.00	<1.00	<1.00	<1.00
HAlG-14-Q-SSM-W	1	20	S-14295-1	14.6	38.7	<1.00	<1.00	<1.00	202	<1.00	17.4	59.3	<1.00	<1.00	813	<1.00	15.5	499	3.24	<1.00	<1.00	<1.00	<1.00
HAlG-25-Q-SSM-W	1	21	S-14306-1	6.17	10.6	<1.00	<1.00	<1.00	27.2	<1.00	9.09	16.4	<1.00	<1.00	592	<1.00	12.5	395	2.45	<1.00	<1.00	<1.00	<1.00
HAlG-06-Q-SSM-W	1	22	S-14288-1	10.7	25.0	<1.00	1.20	<1.00	38.0	<1.00	17.1	4.12	<1.00	<1.00	704	<1.00	9.33	454	2.31	<1.00	<1.00	<1.00	<1.00
HAlG-08-Q-SSM-W	1	23	S-14290-1	2.28	12.0	<1.00	<1.00	<1.00	26.7	<1.00	9.08	15.1	<1.00	<1.00	624	<1.00	11.7	444	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-03-Q-SSM-W	1	24	S-14285-1	2.59	8.35	<1.00	2.76	<1.00	10.3	<1.00	14.1	7.49	<1.00	<1.00	610	<1.00	10.8	433	1.72	<1.00	<1.00	<1.00	<1.00
HAlG-11-Q-SSM-W	1	25	S-14292-1	32.4	166	<1.00	<1.00	<1.00	431	<1.00	87.6	69.6	<1.00	<1.00	1630	<1.00	28.0	727	4.47	<1.00	<1.00	<1.00	<1.00
HAlG-01-Q-SSM-W	1	26	S-14283-1	2.83	14.0	<1.00	1.09	<1.00	3.99	<1.00	108	4.30	<1.00	<1.00	1200	<1.00	66.7	726	2.76	<1.00	<1.00	<1.00	<1.00
HAlG-22-Q-SSM-W	1	27	S-14303-1	1.38	6.98	<1.00	13.8	<1.00	92.3	<1.00	89.6	50.0	1.08	<1.00	732	<1.00	5.73	551	1.77	2.58	<1.00	<1.00	<1.00
EWG-HAlG-SSM-W	1	28	S-14307-1	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	595	<1.00	<1.00	407	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-05-Q-SSM-W	1	29	S-14287-1	1.48	19.7	<1.00	5.63	<1.00	13.0	<1.00	40.1	5.24	<1.00	<1.00	558	<1.00	<1.00	379	<1.00	<1.00	<1.00	<1.00	<1.00
std	1	30	std-13	3.92	18.5	<1.00	<1.00	<1.00	<1.00	4.00	9.50	9.51	<1.00	<1.00	77.8	<1.00	<1.00	<1.00	48.5	<1.00	<1.00	<1.00	<1.00
hpstd	1	31	hpstd-13	47.0	<1.00	<1.00	<1.00	<1.00	<1.00	47.3	<1.00	<1.00	<1.00	18.9	140	9.57	<1.00	9.90	<1.00	<1.00	<1.00	<1.00	<1.00
std	2	1	std-21	3.90	19.2	<1.00	<1.00	<1.00	<1.00	4.01	10.0	10.1	<1.00	<1.00	81.1	<1.00	<1.00	<1.00	48.2	<1.00	<1.00	<1.00	<1.00
hpstd	2	2	hpstd-21	48.6	<1.00	<1.00	<1.00	<1.00	<1.00	49.1	<1.00	<1.00	<1.00	19.7	149	9.90	<1.00	10.6	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-21-Q-SSM-W	2	3	S-14302-2	14.5	79.3	<1.00	7.28	<1.00	52.7	<1.00	75.2	42.2	1.72	<1.00	945	<1.00	5.09	667	2.25	<1.00	<1.00	<1.00	<1.00
HAlG-07-1-Q-SSM-W	2	4	S-14289-2	5.45	16.0	<1.00	3.10	<1.00	11.5	<1.00	101	2.20	<1.00	<1.00	1090	<1.00	16.7	759	2.07	<1.00	<1.00	<1.00	<1.00
HAlG-23-Q-SSM-W	2	5	S-14304-2	2.92	13.0	<1.00	4.27	<1.00	31.2	<1.00	29.8	57.5	<1.00	<1.00	380	<1.00	16.3	375	2.50	<1.00	<1.00	<1.00	<1.00
HAlG-09-Q-SSM-W	2	6	S-14291-2	9.97	28.9	<1.00	<1.00	<1.00	63.8	<1.00	17.5	64.6	<1.00	<1.00	566	<1.00	12.7	464	2.90	<1.00	<1.00	<1.00	<1.00
HAlG-05-Q-SSM-W	2	7	S-14287-2	1.48	21.1	<1.00	5.89	<1.00	13.1	<1.00	39.3	5.23	<1.00	<1.00	558	<1.00	<1.00	404	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-03-Q-SSM-W	2	8	S-14285-2	2.76	10.1	<1.00	3.13	<1.00	10.9	<1.00	14.6	7.85	<1.00	<1.00	647	<1.00	11.9	449	1.82	<1.00	<1.00	<1.00	<1.00
HAlG-12-Q-SSM-W	2	9	S-14293-2	3.04	19.9	<1.00	4.67	<1.00	137	<1.00	60.6	7.65	<1.00	<1.00	1110	<1.00	11.2	702	1.37	<1.00	<1.00	<1.00	<1.00
HAlG-20-Q-SSM-W	2	10	S-14301-2	4.30	13.6	<1.00	3.83	<1.00	26.3	<1.00	16.3	39.7	<1.00	<1.00	561	<1.00	21.0	462	2.52	<1.00	<1.00	<1.00	<1.00
HAlG-22-Q-SSM-W	2	11	S-14303-2	1.41	8.90	<1.00	15.0	<1.00	95.3	<1.00	88.1	48.0	1.13	<1.00	843	<1.00	5.92	676	1.70	2.87	<1.00	<1.00	<1.00
HAlG-08-Q-SSM-W	2	12	S-14290-2	2.41	14.1	<1.00	<1.00	<1.00	27.8	<1.00	9.77	16.1	<1.00	<1.00	661	<1.00	12.7	465	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-13-Q-SSM-W	2	13	S-14294-2	4.00	8.80	<1.00	1.90	<1.00	54.1	<1.00	109	37.4	<1.00	<1.00	935	<1.00	13.2	708	2.54	<1.00	<1.00	<1.00	<1.00
HAlG-16-Q-SSM-W	2	14	S-14297-2	4.59	12.3	<1.00	2.57	<1.00	203	<1.00	32.6	18.3	<1.00	<1.00	1180	<1.00	23.7	730	3.31	<1.00	<1.00	<1.00	<1.00
std	2	15	std-22	3.88	18.6	<1.00	<1.00	<1.00	<1.00	4.00	9.62	9.92	<1.00	<1.00	82.8	<1.00	<1.00	<1.00	48.4	<1.00	<1.00	<1.00	<1.00
hpstd	2	16	hpstd-22	48.1	<1.00	<1.00	<1.00	<1.00	<1.00	48.4	<1.00	<1.00	<1.00	19.6	148	9.77	<1.00	10.7	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-14-Q-SSM-W	2	17	S-14295-2	14.9	39.2	<1.00	<1.00	<1.00	258	<1.00	17.5	61.0	<1.00	<1.00	1010	<1.00	16.3	637	3.32	<1.00	<1.00	<1.00	<1.00

Table B-1. Measurements (mg/L) of the SSM Wash Solutions Measured by ICP-OES (continued)

PNNL ID	Block	Seq.	Lab ID	Al	B	Bi	Ca	Cd	Cr	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Si	Sr	Ti	Zn	Zr
HAlG-15-Q-SSM-W	2	18	S-14296-2	2.39	14.9	<1.00	2.46	<1.00	146	<1.00	51.1	69.3	<1.00	<1.00	817	<1.00	5.16	636	3.39	<1.00	<1.00	<1.00	<1.00
HAlG-06-Q-SSM-W	2	19	S-14288-2	11.5	27.9	<1.00	1.34	<1.00	40.7	<1.00	17.8	4.30	<1.00	<1.00	758	<1.00	10.4	479	2.48	<1.00	<1.00	<1.00	<1.00
HAlG-04-Q-SSM-W	2	20	S-14286-2	2.01	20.2	<1.00	8.84	<1.00	97.1	<1.00	110	5.93	<1.00	<1.00	1150	<1.00	5.64	778	3.43	1.59	<1.00	<1.00	<1.00
HAlG-19-Q-SSM-W	2	21	S-14300-2	12.3	11.8	<1.00	<1.00	<1.00	170	<1.00	28.7	36.5	<1.00	<1.00	1070	<1.00	32.1	659	4.80	<1.00	<1.00	<1.00	<1.00
HAlG-11-Q-SSM-W	2	22	S-14292-2	32.4	166	<1.00	<1.00	<1.00	424	<1.00	84.9	69.1	<1.00	<1.00	1610	<1.00	29.1	713	4.27	<1.00	<1.00	<1.00	<1.00
HAlG-02-Q-SSM-W	2	23	S-14284-2	9.20	26.2	<1.00	<1.00	<1.00	55.4	<1.00	15.3	11.2	<1.00	<1.00	840	<1.00	15.0	539	1.86	<1.00	<1.00	<1.00	<1.00
HAlG-17-Q-SSM-W	2	24	S-14298-2	2.68	19.6	<1.00	2.90	<1.00	13.0	<1.00	37.1	28.8	<1.00	<1.00	795	<1.00	13.5	579	2.49	<1.00	<1.00	<1.00	<1.00
EWG-HAlG-SSM-W	2	25	S-14307-2	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	596	<1.00	<1.00	430	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-24-Q-SSM-W	2	26	S-14305-2	1.14	7.70	<1.00	34.4	<1.00	19.2	<1.00	25.4	39.5	<1.00	<1.00	474	<1.00	1.51	462	1.18	2.10	<1.00	<1.00	<1.00
HAlG-01-Q-SSM-W	2	27	S-14283-2	2.80	15.3	<1.00	1.06	<1.00	4.17	<1.00	104	4.23	<1.00	<1.00	1140	<1.00	66.6	714	2.70	<1.00	<1.00	<1.00	<1.00
HAlG-25-Q-SSM-W	2	28	S-14306-2	6.67	12.8	<1.00	<1.00	<1.00	28.5	1.03	9.84	16.6	<1.00	<1.00	696	<1.00	13.5	483	2.65	<1.00	<1.00	<1.00	<1.00
HAlG-18-Q-SSM-W	2	29	S-14299-2	12.9	231	<1.00	<1.00	<1.00	135	<1.00	93.9	72.0	<1.00	<1.00	1340	<1.00	6.20	613	1.59	<1.00	<1.00	<1.00	<1.00
std	2	30	std-23	3.88	19.1	<1.00	<1.00	<1.00	<1.00	4.02	9.43	9.81	<1.00	<1.00	80.2	<1.00	<1.00	<1.00	48.5	<1.00	<1.00	<1.00	<1.00
hpstd	2	31	hpstd-23	49.5	<1.00	<1.00	<1.00	<1.00	<1.00	49.7	<1.00	<1.00	<1.00	20.1	145	9.97	<1.00	10.5	<1.00	<1.00	<1.00	<1.00	<1.00
std	3	1	std-31	4.02	19.9	<1.00	<1.00	<1.00	<1.00	4.05	9.81	10.3	<1.00	<1.00	79.5	<1.00	<1.00	<1.00	49.0	<1.00	<1.00	<1.00	<1.00
hpstd	3	2	hpstd-31	50.4	<1.00	<1.00	<1.00	<1.00	<1.00	49.8	<1.00	<1.00	<1.00	20.2	150	10.1	<1.00	10.2	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-15-Q-SSM-W	3	3	S-14296-3	3.44	15.5	<1.00	2.57	<1.00	133	<1.00	51.4	71.7	<1.00	<1.00	834	<1.00	5.22	557	4.98	<1.00	<1.00	<1.00	<1.00
HAlG-07-1-Q-SSM-W	3	4	S-14289-3	5.02	15.2	<1.00	2.98	<1.00	10.7	<1.00	102	2.33	<1.00	<1.00	1050	<1.00	15.7	654	1.84	<1.00	<1.00	<1.00	<1.00
HAlG-18-Q-SSM-W	3	5	S-14299-3	11.7	218	<1.00	<1.00	<1.00	130	<1.00	97.8	75.1	<1.00	<1.00	1390	<1.00	6.39	573	1.63	<1.00	<1.00	<1.00	<1.00
EWG-HAlG-SSM-W	3	6	S-14307-3	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	611	<1.00	<1.00	386	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-03-Q-SSM-W	3	7	S-14285-3	2.96	10.6	<1.00	3.22	<1.00	10.4	<1.00	14.5	7.97	<1.00	<1.00	625	<1.00	11.6	399	2.22	<1.00	<1.00	<1.00	<1.00
HAlG-13-Q-SSM-W	3	8	S-14294-3	4.09	9.09	<1.00	1.98	<1.00	52.4	<1.00	107	38.4	<1.00	<1.00	939	<1.00	13.2	620	2.70	<1.00	<1.00	<1.00	<1.00
HAlG-24-Q-SSM-W	3	9	S-14305-3	<1.00	8.09	<1.00	33.4	<1.00	17.9	<1.00	24.9	41.6	<1.00	<1.00	478	<1.00	1.36	427	1.13	1.97	<1.00	<1.00	<1.00
HAlG-25-Q-SSM-W	3	10	S-14306-3	2.15	12.7	<1.00	<1.00	<1.00	27.3	<1.00	9.35	17.3	<1.00	<1.00	692	<1.00	13.0	429	1.09	<1.00	<1.00	<1.00	<1.00
HAlG-19-Q-SSM-W	3	11	S-14300-3	13.0	11.9	<1.00	<1.00	<1.00	160	2.05	28.5	36.8	<1.00	<1.00	1030	<1.00	32.5	584	5.99	<1.00	<1.00	<1.00	<1.00
HAlG-09-Q-SSM-W	3	12	S-14291-3	9.49	27.1	<1.00	<1.00	<1.00	58.7	<1.00	16.4	59.8	<1.00	<1.00	542	<1.00	12.1	376	2.63	<1.00	<1.00	<1.00	<1.00
HAlG-11-Q-SSM-W	3	13	S-14292-3	32.3	152	<1.00	<1.00	<1.00	394	<1.00	84.1	68.5	<1.00	<1.00	1580	<1.00	29.6	634	4.25	<1.00	<1.00	<1.00	<1.00
HAlG-16-Q-SSM-W	3	14	S-14297-3	4.35	11.9	<1.00	2.42	<1.00	168	<1.00	31.1	17.8	<1.00	<1.00	1050	<1.00	22.6	577	3.05	<1.00	<1.00	<1.00	<1.00
std	3	15	std-32	3.93	19.0	<1.00	<1.00	<1.00	<1.00	3.91	9.41	9.84	<1.00	<1.00	80.8	<1.00	<1.00	<1.00	46.9	<1.00	<1.00	<1.00	<1.00
hpstd	3	16	hpstd-32	48.8	<1.00	<1.00	<1.00	<1.00	<1.00	47.6	<1.00	<1.00	<1.00	19.3	145	9.69	<1.00	9.40	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-20-Q-SSM-W	3	17	S-14301-3	5.41	14.1	<1.00	4.27	<1.00	25.4	<1.00	15.7	40.7	<1.00	<1.00	551	<1.00	22.1	429	3.38	<1.00	<1.00	<1.00	<1.00
HAlG-23-Q-SSM-W	3	18	S-14304-3	3.31	12.6	<1.00	4.15	<1.00	28.8	<1.00	28.0	54.4	<1.00	<1.00	392	<1.00	15.5	336	3.07	<1.00	<1.00	<1.00	<1.00
HAlG-06-Q-SSM-W	3	19	S-14288-3	10.7	25.5	<1.00	1.33	<1.00	37.9	<1.00	16.8	4.16	<1.00	<1.00	721	<1.00	9.91	437	2.15	<1.00	<1.00	<1.00	<1.00
HAlG-05-Q-SSM-W	3	20	S-14287-3	1.66	20.4	<1.00	5.75	<1.00	12.4	<1.00	38.1	5.13	<1.00	<1.00	522	<1.00	<1.00	332	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-08-Q-SSM-W	3	21	S-14290-3	2.52	13.8	<1.00	<1.00	<1.00	25.9	<1.00	8.85	15.3	<1.00	<1.00	624	<1.00	12.2	402	<1.00	<1.00	<1.00	<1.00	<1.00
HAlG-01-Q-SSM-W	3	22	S-14283-3	2.65	14.6	<1.00	1.05	<1.00	3.75	<1.00	99.1	4.06	<1.00	<1.00	1040	<1.00	64.5	583	2.48	<1.00	<1.00	<1.00	<1.00
HAlG-21-Q-SSM-W	3	23	S-14302-3	14.2	76.1	<1.00	7.14	<1.00	50.9	<1.00	74.5	43.9	1.66	<1.00	907	<1.00	5.05	584	2.19	<1.00	<1.00	<1.00	<1.00
HAlG-12-Q-SSM-W	3	24	S-14293-3	3.07	19.1	<1.00	4.67	<1.00	121	<1.00	59.7	7.68	<1.00	<1.00	1020	<1.00	11.0	597	1.39	<1.00	<1.00	<1.00	<1.00
HAlG-04-Q-SSM-W	3	25	S-14286-3	1.99	19.5	<1.00	8.62	<1.00	92.2	<1.00	110	5.55	<1.00	<1.00	1020	<1.00	5.65	596	1.61	1.50	<1.00	<1.00	<1.00
HAlG-22-Q-SSM-W	3	26	S-14303-3	1.34	8.71	<1.00	14.2	<1.00	88.6	<1.00	85.9	50.1	1.05	<1.00	686	<1.00	5.69	472	1.59	2.59	<1.00	<1.00	<1.00
HAlG-14-Q-SSM-W	3	27	S-14295-3	15.1	38.4	<1.00	<1.00	<1.00	212	<1.00	17.8	62.4	<1.00	<1.00	929	<1.00	16.3	497	3.33	<1.00	<1.00	<1.00	<1.00
HAlG-17-Q-SSM-W	3	28	S-14298-3	4.01	19.0	<1.00	2.94	<1.00	11.9	<1.00	36.0	28.7	<1.00	<1.00	715	<1.00	13.0	470	4.55	<1.00	<1.00	<1.00	<1.00
HAlG-02-Q-SSM-W	3	29	S-14284-3	9.58	24.7	<1.00	1.11	<1.00	51.9	<1.00	15.1	11.3	<1.00	<1.00	854	<1.00	15.0	478	2.24	<1.00	<1.00	<1.00	<1.00
std	3	30	std-33	3.95	19.0	<1.00	<1.00	<1.00	<1.00	3.91	9.54	9.88	<1.00	<1.00	80.2	<1.00	<1.00	<1.00	46.8	<1.00	<1.00	<1.00	<1.00
hpstd	3	31	hpstd-33	48.4	<1.00	<1.00	<1.00	<1.00	<1.00	47.1	<1.00	<1.00	<1.00	19.0	146	9.59	<1.00	9.27	<1.00	<1.00	<1.00	<1.00	<1.00

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC

PNNL ID	Block	Seq.	Lab ID	F^-	PO_4^{3-}	SO_4^{2-}
IC Blank	1	1	IC BLANK 1-1	<5.00	<10.0	<10.0
5 ppm std	1	2	5 ppm std	4.97	4.98	5.06
HAlG-04-Q-SSM-W	1	3	S-14286-1	25.7	17.1	2120
HAlG-08-Q-SSM-W	1	4	S-14290-1	<5.00	32.5	1290
HAlG-16-Q-SSM-W	1	5	S-14297-1	7.75	64.9	1880
HAlG-15-Q-SSM-W	1	6	S-14296-1	13.7	12.4	1770
HAlG-07-1-Q-SSM-W	1	7	S-14289-1	17.3	41.5	2090
HAlG-06-Q-SSM-W	1	8	S-14288-1	<5.00	25.3	1410
HAlG-24-Q-SSM-W	1	9	S-14305-1	<5.00	<10.0	1310
HAlG-13-Q-SSM-W	1	10	S-14294-1	28.2	32.4	1910
IC Blank	1	11	IC BLANK 1-2	<5.00	<10.0	<10.0
5 ppm std	1	12	5 ppm std	4.98	4.91	5.00
HAlG-12-Q-SSM-W	1	13	S-14293-1	11.3	28.2	1870
HAlG-19-Q-SSM-W	1	14	S-14300-1	7.33	94.6	1850
HAlG-14-Q-SSM-W	1	15	S-14295-1	<5.00	41.0	1670
HAlG-01-Q-SSM-W	1	16	S-14283-1	26.8	<10.0	2070
HAlG-11-Q-SSM-W	1	17	S-14292-1	33.8	85.5	2040
HAlG-18-Q-SSM-W	1	18	S-14299-1	35.4	14.6	1810
HAlG-05-Q-SSM-W	1	19	S-14287-1	<5.00	<10.0	1160
HAlG-03-Q-SSM-W	1	20	S-14285-1	<5.00	28.5	1250
IC Blank	1	21	IC BLANK 1-3	<5.00	<10.0	<10.0
5 ppm std	1	22	5 ppm std	4.96	5.18	4.99
HAlG-02-Q-SSM-W	1	23	S-14284-1	<5.00	42.1	1510
HAlG-20-Q-SSM-W	1	24	S-14301-1	<5.00	59.4	1280
HAlG-17-Q-SSM-W	1	25	S-14298-1	9.06	36.3	1670
HAlG-09-Q-SSM-W	1	26	S-14291-1	<5.00	32.3	1260
HAlG-21-Q-SSM-W	1	27	S-14302-1	23.9	13.0	1850
HAlG-22-Q-SSM-W	1	28	S-14303-1	31.0	15.8	1790
EWG-HAlG-SSM-W	1	29	S-14307-1	<5.00	<10.0	1260
HAlG-25-Q-SSM-W	1	30	S-14306-1	<5.00	32.8	1340
HAlG-23-Q-SSM-W	1	31	S-14304-1	8.51	44.3	1030
IC Blank	1	32	IC BLANK 1-4	<5.00	<10.0	<10.0
5 ppm std	1	33	5 ppm std	4.95	5.10	4.99
IC Blank	2	1	IC BLANK 2-1	<5.00	<10.0	<10.0
5 ppm std	2	2	5 ppm std	4.97	4.85	5.07
HAlG-11-Q-SSM-W	2	3	S-14292-2	33.9	91.5	2040
HAlG-24-Q-SSM-W	2	4	S-14305-2	<5.00	<10.0	1320
HAlG-15-Q-SSM-W	2	5	S-14296-2	13.8	12.0	1770
HAlG-20-Q-SSM-W	2	6	S-14301-2	<5.00	60.3	1280
HAlG-21-Q-SSM-W	2	7	S-14302-2	23.9	12.3	1850
HAlG-22-Q-SSM-W	2	8	S-14303-2	31.1	14.5	1790
HAlG-14-Q-SSM-W	2	9	S-14295-2	<5.00	41.6	1670
HAlG-07-1-Q-SSM-W	2	10	S-14289-2	17.3	42.0	2100
IC Blank	2	11	IC BLANK 2-2	<5.00	<10.0	<10.0
5 ppm std	2	12	5 ppm std	4.97	4.87	5.02
HAlG-08-Q-SSM-W	2	13	S-14290-2	<5.00	32.0	1290
HAlG-13-Q-SSM-W	2	14	S-14294-2	28.5	31.1	1910
EWG-HAlG-SSM-W	2	15	S-14307-2	<5.00	<10.0	1270

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC (continued)

PNNL ID	Block	Seq.	Lab ID	F^-	PO_4^{3-}	SO_4^{2-}
HAlG-17-Q-SSM-W	2	16	S-14298-2	9.05	34.9	1670
HAlG-12-Q-SSM-W	2	17	S-14293-2	11.3	29.6	1890
HAlG-18-Q-SSM-W	2	18	S-14299-2	35.5	15.2	1810
HAlG-05-Q-SSM-W	2	19	S-14287-2	<5.00	<10.0	1170
HAlG-23-Q-SSM-W	2	20	S-14304-2	8.54	43.7	1030
IC Blank	2	21	IC BLANK 2-3	<5.00	<10.0	<10.0
5 ppm std	2	22	5 ppm std	4.95	5.11	5.00
HAlG-19-Q-SSM-W	2	23	S-14300-2	7.45	108	1860
HAlG-06-Q-SSM-W	2	24	S-14288-2	<5.00	25.2	1410
HAlG-16-Q-SSM-W	2	25	S-14297-2	7.82	64.1	1880
HAlG-25-Q-SSM-W	2	26	S-14306-2	<5.00	33.5	1340
HAlG-03-Q-SSM-W	2	27	S-14285-2	<5.00	29.8	1250
HAlG-04-Q-SSM-W	2	28	S-14286-2	25.8	13.8	2130
HAlG-02-Q-SSM-W	2	29	S-14284-2	<5.00	40.4	1530
HAlG-09-Q-SSM-W	2	30	S-14291-2	<5.00	32.1	1270
HAlG-01-Q-SSM-W	2	31	S-14283-2	26.9	<10.0	2080
IC Blank	2	32	IC BLANK 2-4	<5.00	<10.0	<10.0
5 ppm std	2	33	5 ppm std	4.98	5.09	5.06
IC Blank	3	1	IC BLANK 3-1	<5.00	<10.0	<10.0
5 ppm std	3	2	5 ppm std	5.01	4.93	5.14
HAlG-19-Q-SSM-W	3	3	S-14300-3	7.42	107	1870
HAlG-05-Q-SSM-W	3	4	S-14287-3	<5.00	<10.0	1180
HAlG-01-Q-SSM-W	3	5	S-14283-3	27.0	<10.0	2090
HAlG-03-Q-SSM-W	3	6	S-14285-3	<5.00	31.5	1260
HAlG-04-Q-SSM-W	3	7	S-14286-3	25.9	15.0	2140
HAlG-14-Q-SSM-W	3	8	S-14295-3	<5.00	43.8	1690
HAlG-20-Q-SSM-W	3	9	S-14301-3	<5.00	60.8	1290
HAlG-21-Q-SSM-W	3	10	S-14302-3	24.0	13.3	1860
IC Blank	3	11	IC BLANK 3-2	<5.00	<10.0	<10.0
5 ppm std	3	12	5 ppm std	5.03	4.96	5.09
HAlG-08-Q-SSM-W	3	13	S-14290-3	<5.00	32.6	1300
HAlG-15-Q-SSM-W	3	14	S-14296-3	14.0	11.7	1790
HAlG-12-Q-SSM-W	3	15	S-14293-3	11.4	27.5	1910
HAlG-11-Q-SSM-W	3	16	S-14292-3	34.3	91.7	2060
HAlG-16-Q-SSM-W	3	17	S-14297-3	7.87	65.5	1900
EWG-HAlG-SSM-W	3	18	S-14307-3	<5.00	<10.0	1280
HAlG-18-Q-SSM-W	3	19	S-14299-3	35.9	14.3	1830
HAlG-07-1-Q-SSM-W	3	20	S-14289-3	17.5	44.5	2110
IC Blank	3	21	IC BLANK 3-3	<5.00	<10.0	<10.0
5 ppm std	3	22	5 ppm std	5.01	5.05	5.05
HAlG-24-Q-SSM-W	3	23	S-14305-3	<5.00	<10.0	1330
HAlG-06-Q-SSM-W	3	24	S-14288-3	<5.00	26.6	1420
HAlG-22-Q-SSM-W	3	25	S-14303-3	31.4	15.5	1810
HAlG-09-Q-SSM-W	3	26	S-14291-3	<5.00	32.9	1270
HAlG-17-Q-SSM-W	3	27	S-14298-3	9.11	35.6	1680
HAlG-13-Q-SSM-W	3	28	S-14294-3	28.6	34.0	1930
HAlG-23-Q-SSM-W	3	29	S-14304-3	8.68	43.2	1050
HAlG-25-Q-SSM-W	3	30	S-14306-3	<5.00	34.2	1350

Table B-2. Measurements (mg/L) of the SSM Wash Solutions Measured by IC (continued)

PNNL ID	Block	Seq.	Lab ID	F^-	PO_4^{3-}	SO_4^{2-}
HAlG-02-Q-SSM-W	3	31	S-14284-3	<5.00	39.7	1530
IC Blank	3	32	IC BLANK 3-4	<5.00	<10.0	<10.0
5 ppm std	3	33	5 ppm std	5.07	5.11	5.11

Table B-3. Results for Standards Utilized During the Measurement of the Wash Solutions

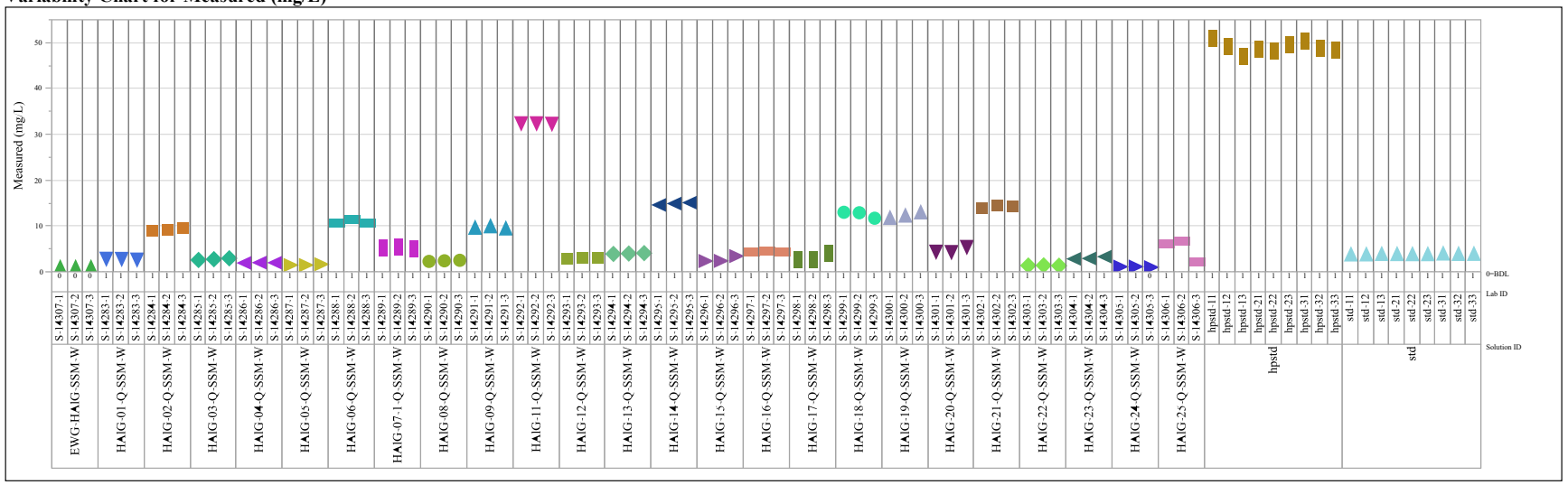
Solution ID	Instrument	Analyte	Reference Value (mg/L)	Mean Measurement (mg/L)
5 ppm std	IC	F-	5	4.99
5 ppm std	IC	PO_4	5	5.01
5 ppm std	IC	SO_4	5	5.05
hpstd	ICP	Al	50	49.0
hpstd	ICP	B	0	<1.00
hpstd	ICP	Bi	0	<1.00
hpstd	ICP	Ca	0	<1.00
hpstd	ICP	Cd	0	<1.00
hpstd	ICP	Cr	0	<1.00
hpstd	ICP	Fe	50	48.8
hpstd	ICP	K	0	<1.00
hpstd	ICP	Li	0	<1.00
hpstd	ICP	Mg	0	<1.00
hpstd	ICP	Mn	20	19.7
hpstd	ICP	Na	150	146
hpstd	ICP	Ni	10	9.87
hpstd	ICP	P	0	<1.00
hpstd	ICP	S	10	9.93
hpstd	ICP	Si	0	<1.00
hpstd	ICP	Sr	0	<1.00
hpstd	ICP	Ti	0	<1.00
hpstd	ICP	Zn	0	<1.00
hpstd	ICP	Zr	0	<1.00
soln std	ICP	Al	4	3.90
soln std	ICP	B	20	19.0
soln std	ICP	Bi	0	<1.00
soln std	ICP	Ca	0	<1.00
soln std	ICP	Cd	0	<1.00
soln std	ICP	Cr	0	<1.00
soln std	ICP	Fe	4	3.99
soln std	ICP	K	10	9.53
soln std	ICP	Li	10	9.80
soln std	ICP	Mg	0	<1.00
soln std	ICP	Mn	0	<1.00
soln std	ICP	Na	81	80.3
soln std	ICP	Ni	0	<1.00
soln std	ICP	P	0	<1.00
soln std	ICP	S	0	<1.00
soln std	ICP	Si	50	47.8
soln std	ICP	Sr	0	<1.00
soln std	ICP	Ti	0	<1.00
soln std	ICP	Zn	0	<1.00
soln std	ICP	Zr	0	<1.00

Table B-4. Average Measurements (mg/L) of the SSM Wash Solutions

		IC			ICP-OES																				
Lab ID	**PNNL ID**	**F^-**	**PO_4^{3-}**	**SO_4^{2-}**	**Al**	**B**	**Bi**	**Ca**	**Cd**	**Cr**	**Fe**	**K**	**Li**	**Mg**	**Mn**	**Na**	**Ni**	**P**	**PO_4**	**S**	**Si**	**SO_4**	**Sr**	**Ti**	**Zn**	**Zr**
S-14283	HAlG-01-Q-SSM-W	26.9	<10.0	2080	2.76	14.6	<1.00	1.07	<1.00	3.97	<1.00	104	4.20	<1.00	<1.00	1130	<1.00	65.9	202	674	2.65	2020	<1.00	<1.00	<1.00	<1.00
S-14284	HAlG-02-Q-SSM-W	<5.00	40.7	1520	9.26	25.4	<1.00	<1.04	<1.00	53.9	<1.00	15.1	11.1	<1.00	<1.00	821	<1.00	14.7	45.2	502	1.98	1500	<1.00	<1.00	<1.00	<1.00
S-14285	HAlG-03-Q-SSM-W	<5.00	29.9	1250	2.77	9.68	<1.00	3.04	<1.00	10.5	<1.00	14.4	7.77	<1.00	<1.00	627	<1.00	11.4	35.1	427	1.92	1280	<1.00	<1.00	<1.00	<1.00
S-14286	HAlG-04-Q-SSM-W	25.8	15.3	2130	1.98	19.1	<1.00	8.40	<1.00	94.9	<1.00	111	5.83	<1.00	<1.00	1080	<1.00	5.53	16.9	684	2.21	2050	1.52	<1.00	<1.00	<1.00
S-14287	HAlG-05-Q-SSM-W	<5.00	<10.0	1170	1.54	20.4	<1.00	5.76	<1.00	12.8	<1.00	39.2	5.20	<1.00	<1.00	546	<1.00	<1.00	<3.07	372	<1.00	1110	<1.00	<1.00	<1.00	<1.00
S-14288	HAlG-06-Q-SSM-W	<5.00	25.7	1410	11.0	26.1	<1.00	1.29	<1.00	38.9	<1.00	17.2	4.19	<1.00	<1.00	728	<1.00	9.88	30.3	457	2.31	1370	<1.00	<1.00	<1.00	<1.00
S-14289	HAlG-07-1-Q-SSM-W	17.4	42.7	2100	5.22	15.1	<1.00	2.96	<1.00	11.2	<1.00	102	2.24	<1.00	<1.00	1050	<1.00	16.0	49.2	710	1.95	2130	<1.00	<1.00	<1.00	<1.00
S-14290	HAlG-08-Q-SSM-W	<5.00	32.4	1290	2.40	13.3	<1.00	<1.00	<1.00	26.8	<1.00	9.23	15.5	<1.00	<1.00	636	<1.00	12.2	37.4	437	<1.00	1310	<1.00	<1.00	<1.00	<1.00
S-14291	HAlG-09-Q-SSM-W	<5.00	32.4	1270	9.70	27.2	<1.00	<1.00	<1.00	61.4	<1.00	16.9	61.6	<1.00	<1.00	553	<1.00	12.2	37.4	411	2.77	1230	<1.00	<1.00	<1.00	<1.00
S-14292	HAlG-11-Q-SSM-W	34.0	89.6	2050	32.4	161	<1.00	<1.00	<1.00	416	<1.00	85.5	69.1	<1.00	<1.00	1610	<1.00	28.9	88.6	691	4.33	2070	<1.00	<1.00	<1.00	<1.00
S-14293	HAlG-12-Q-SSM-W	11.3	28.4	1890	3.02	18.7	<1.00	4.50	<1.00	123	<1.00	60.7	7.68	<1.00	<1.00	1040	<1.00	10.9	33.3	626	1.36	1880	<1.00	<1.00	<1.00	<1.00
S-14294	HAlG-13-Q-SSM-W	28.4	32.5	1920	4.00	8.57	<1.00	1.87	<1.00	53.4	<1.00	109	37.5	<1.00	<1.00	911	<1.00	13.0	40.0	641	2.58	1920	<1.00	<1.00	<1.00	<1.00
S-14295	HAlG-14-Q-SSM-W	<5.00	42.1	1680	14.9	38.8	<1.00	<1.00	<1.00	224	<1.00	17.6	60.9	<1.00	<1.00	917	<1.00	16.0	49.2	544	3.30	1630	<1.00	<1.00	<1.00	<1.00
S-14296	HAlG-15-Q-SSM-W	13.8	12.0	1780	2.73	14.6	<1.00	2.43	<1.00	140	<1.00	51.4	69.9	<1.00	<1.00	810	<1.00	5.06	15.5	597	3.87	1790	<1.00	<1.00	<1.00	<1.00
S-14297	HAlG-16-Q-SSM-W	7.81	64.8	1890	4.40	11.5	<1.00	2.38	<1.00	178	<1.00	31.8	17.6	<1.00	<1.00	1060	<1.00	22.5	69.1	626	3.13	1870	<1.00	<1.00	<1.00	<1.00
S-14298	HAlG-17-Q-SSM-W	9.07	35.6	1670	3.11	18.9	<1.00	2.83	<1.00	12.6	<1.00	36.7	28.7	<1.00	<1.00	751	<1.00	13.2	40.5	521	3.15	1560	<1.00	<1.00	<1.00	<1.00
S-14299	HAlG-18-Q-SSM-W	35.6	14.7	1820	12.5	217	<1.00	<1.00	<1.00	129	<1.00	95.8	72.7	<1.00	<1.00	1350	<1.00	6.17	18.9	578	1.61	1730	<1.00	<1.00	<1.00	<1.00
S-14300	HAlG-19-Q-SSM-W	7.40	103	1860	12.4	11.3	<1.00	<1.00	<1.00	165	<1.35	28.5	36.3	<1.00	<1.00	1050	<1.00	31.9	97.7	618	5.14	1850	<1.00	<1.00	<1.00	<1.00
S-14301	HAlG-20-Q-SSM-W	<5.00	60.2	1280	4.70	13.9	<1.00	3.91	<1.00	26.2	<1.00	16.1	39.7	<1.00	<1.00	554	<1.00	21.2	64.9	444	2.71	1330	<1.00	<1.00	<1.00	<1.00
S-14302	HAlG-21-Q-SSM-W	23.9	12.9	1850	14.2	76.0	<1.00	6.92	<1.00	51.7	<1.00	74.4	42.2	1.66	<1.00	947	<1.00	4.96	15.2	622	2.18	1860	<1.00	<1.00	<1.00	<1.00
S-14303	HAlG-22-Q-SSM-W	31.2	15.3	1800	1.38	8.20	<1.00	14.3	<1.00	92.1	<1.00	87.9	49.4	1.09	<1.00	754	<1.00	5.78	17.7	566	1.69	1700	2.68	<1.00	<1.00	<1.00
S-14304	HAlG-23-Q-SSM-W	8.58	43.7	1040	3.02	12.4	<1.00	4.09	<1.00	30.2	<1.00	29.2	56.1	<1.00	<1.00	382	<1.00	15.7	48.1	356	2.66	1070	<1.00	<1.00	<1.00	<1.00
S-14305	HAlG-24-Q-SSM-W	<5.00	<10.0	1320	<1.09	7.56	<1.00	32.8	<1.00	18.7	<1.00	25.3	40.0	<1.00	<1.00	481	<1.00	1.42	4.35	444	1.16	1330	2.01	<1.00	<1.00	<1.00
S-14306	HAlG-25-Q-SSM-W	<5.00	33.5	1340	5.00	12.0	<1.00	<1.00	<1.00	27.7	<1.01	9.43	16.8	<1.00	<1.00	660	<1.00	13.0	39.9	436	2.06	1310	<1.00	<1.00	<1.00	<1.00
S-14307	EWG-HAlG-SSM-W	<5.00	<10.0	1270	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00	601	<1.00	<1.00	<3.07	408	<1.00	1220	<1.00	<1.00	<1.00	<1.00

Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte

Analyte=Al, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=B, Analysis=ICP
Variability Chart for Measured (mg/L)

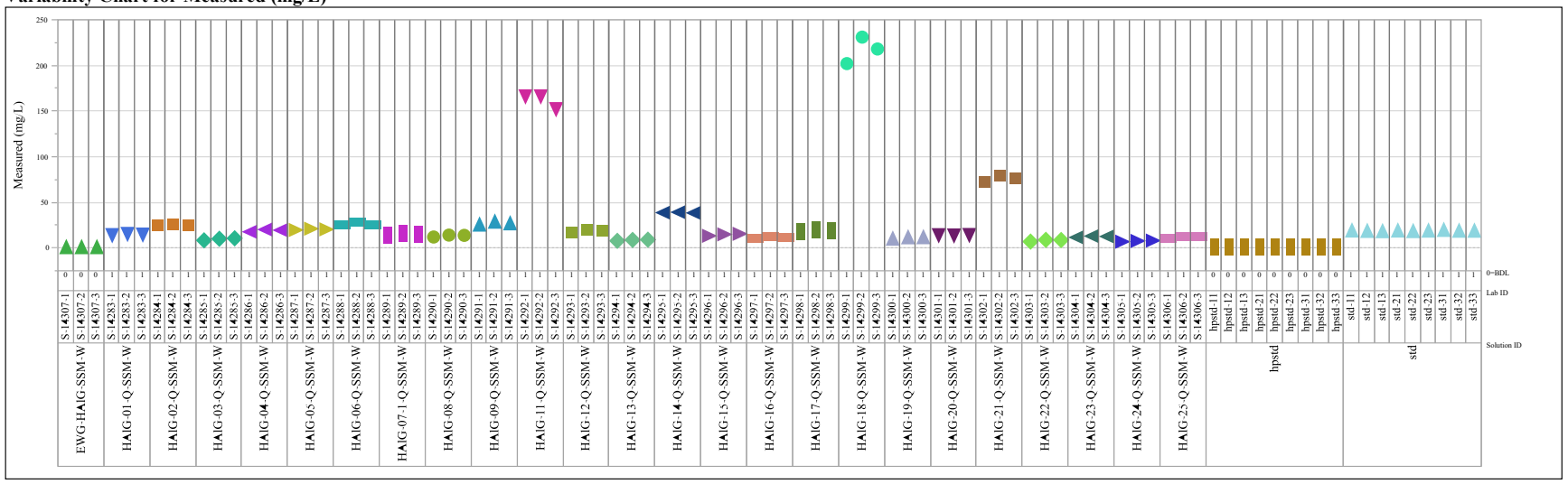
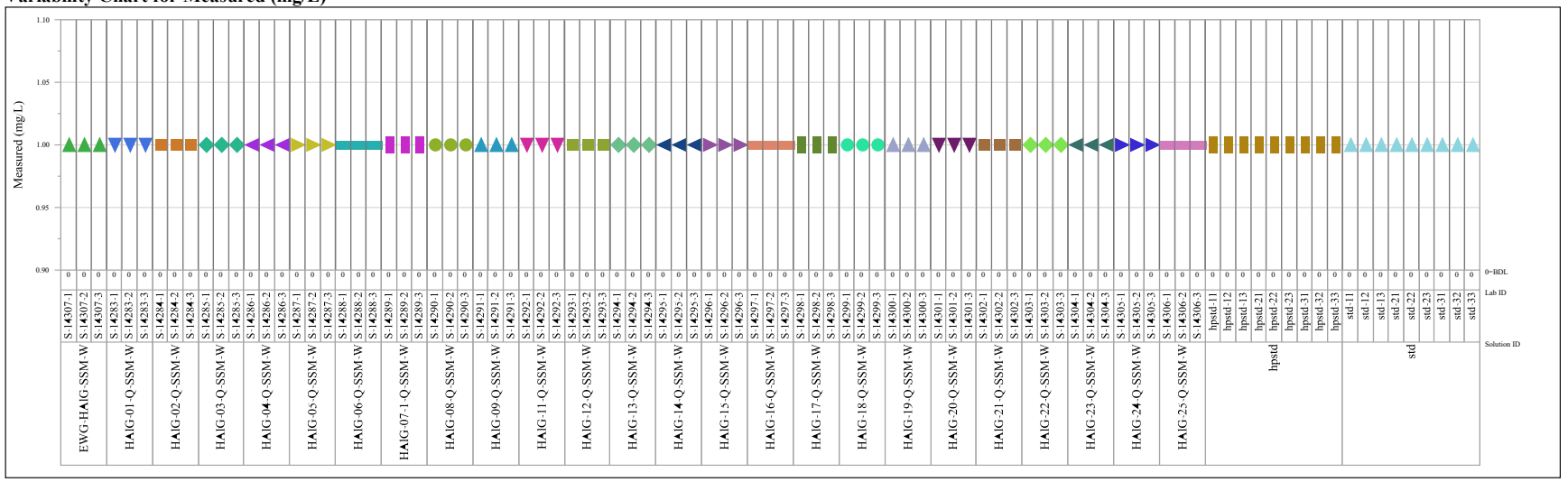


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Bi, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Ca, Analysis=ICP
Variability Chart for Measured (mg/L)

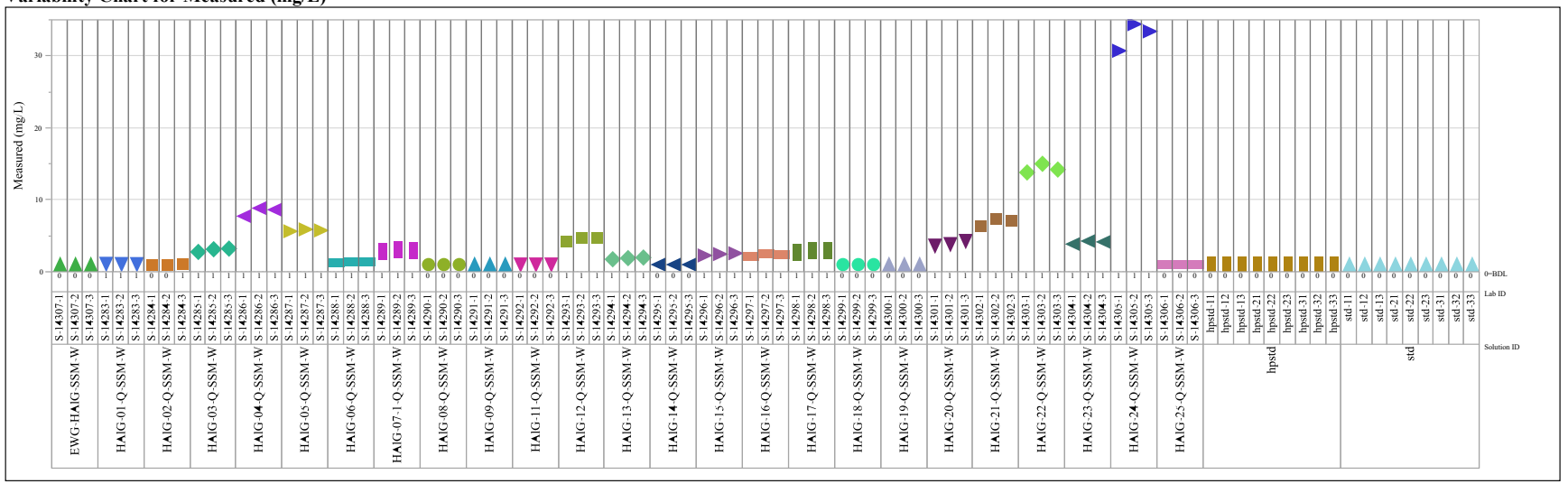
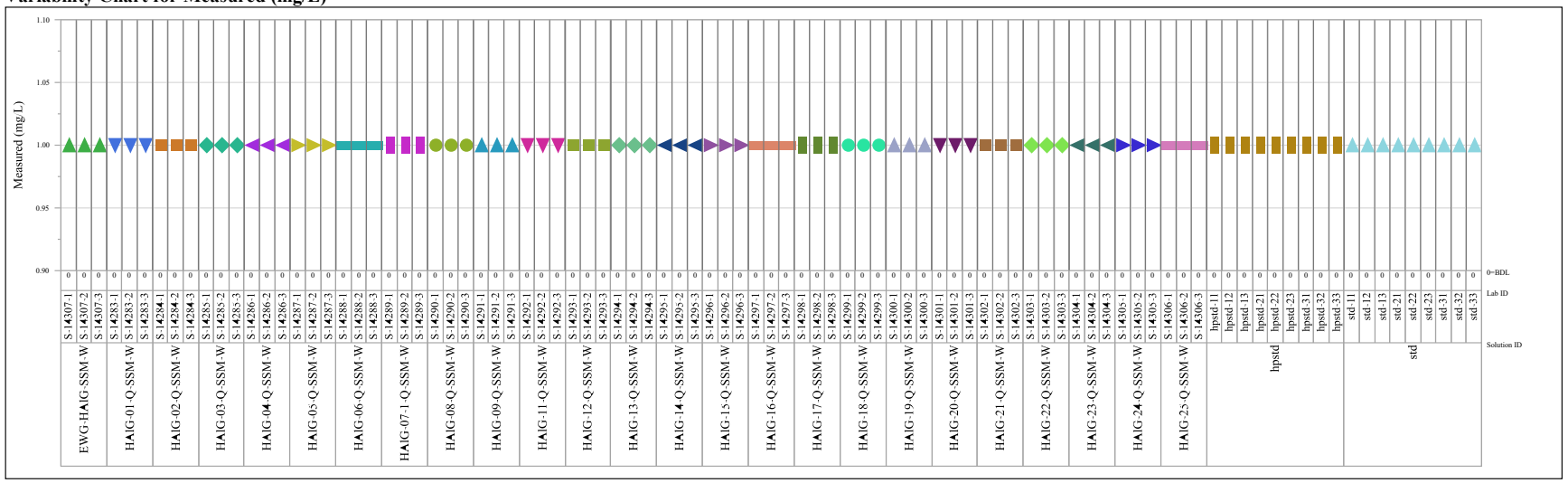


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Cd, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Cr, Analysis=ICP
Variability Chart for Measured (mg/L)

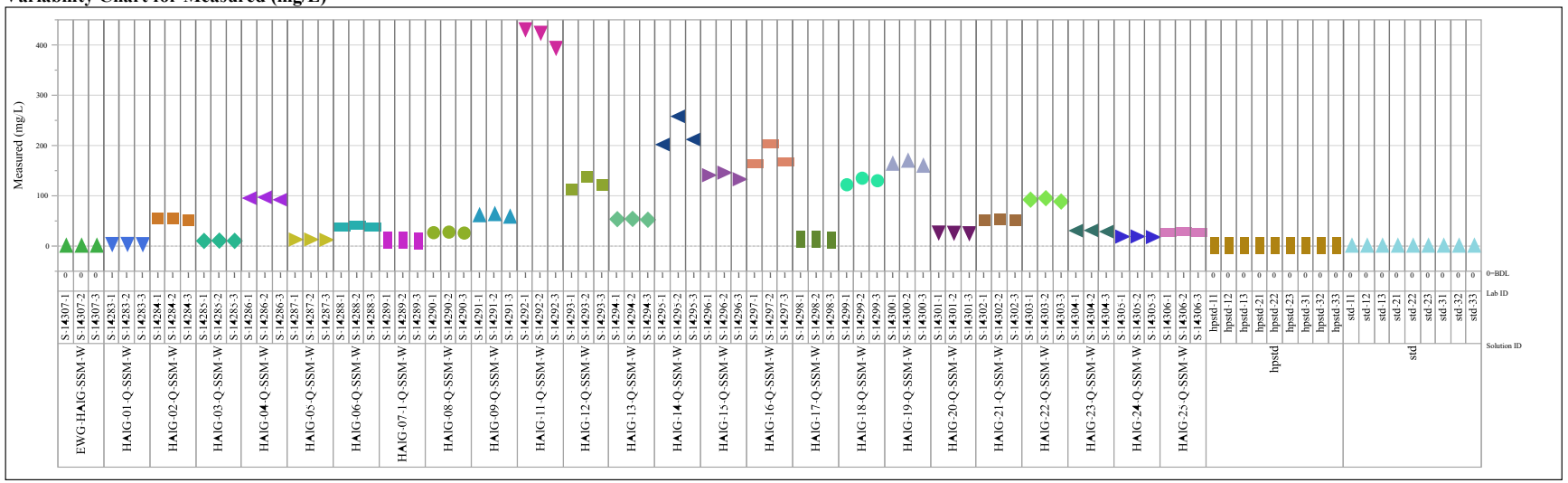
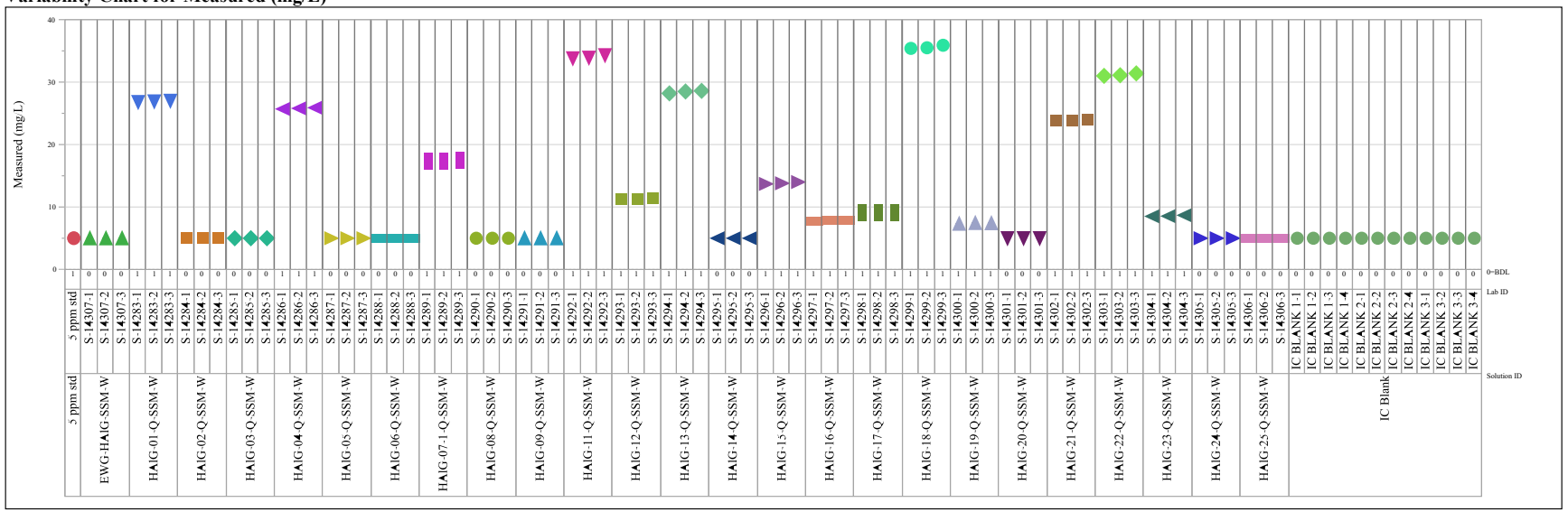


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=F, Analysis=IC
Variability Chart for Measured (mg/L)



Analyte=Fe, Analysis=ICP
Variability Chart for Measured (mg/L)

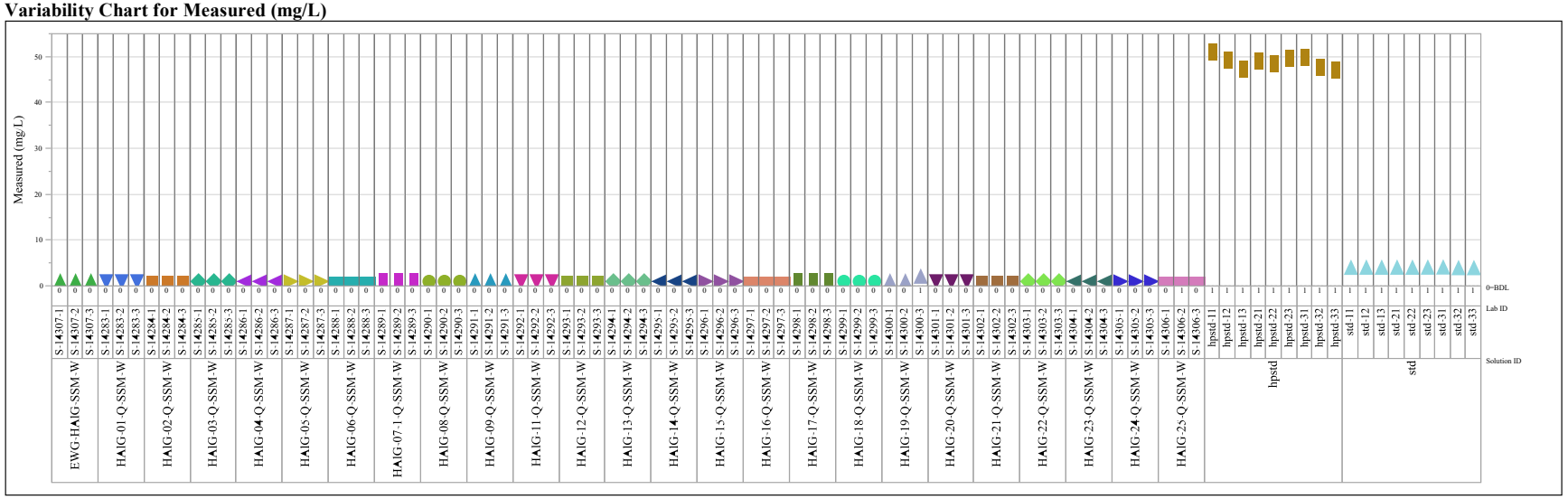
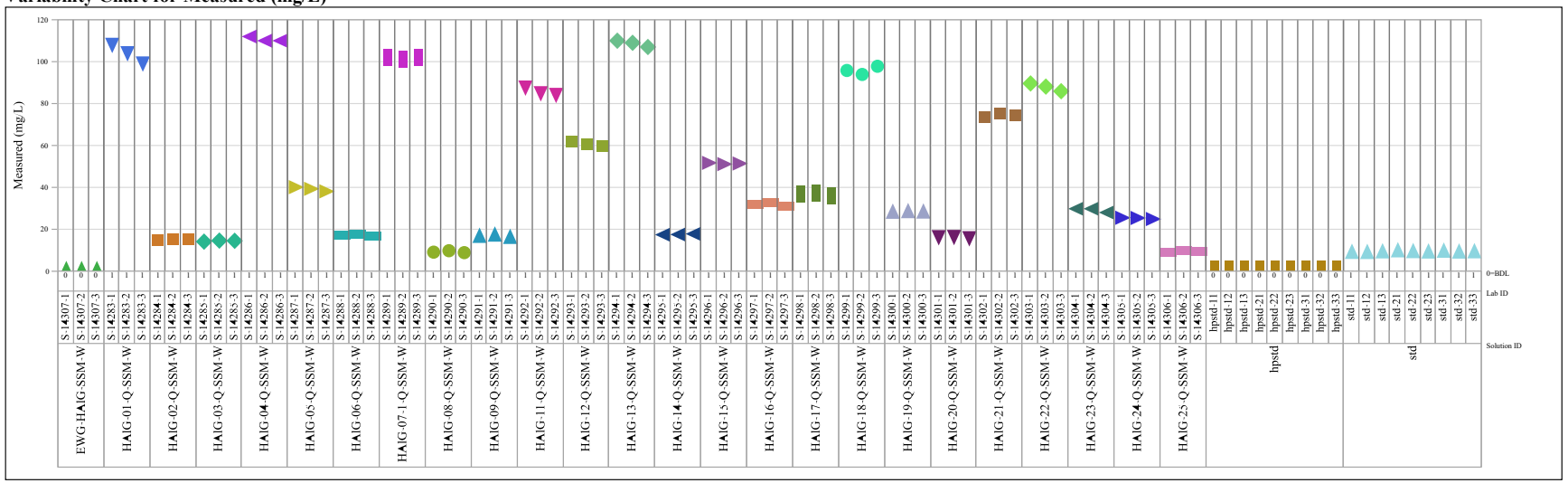


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=K, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Li, Analysis=ICP
Variability Chart for Measured (mg/L)

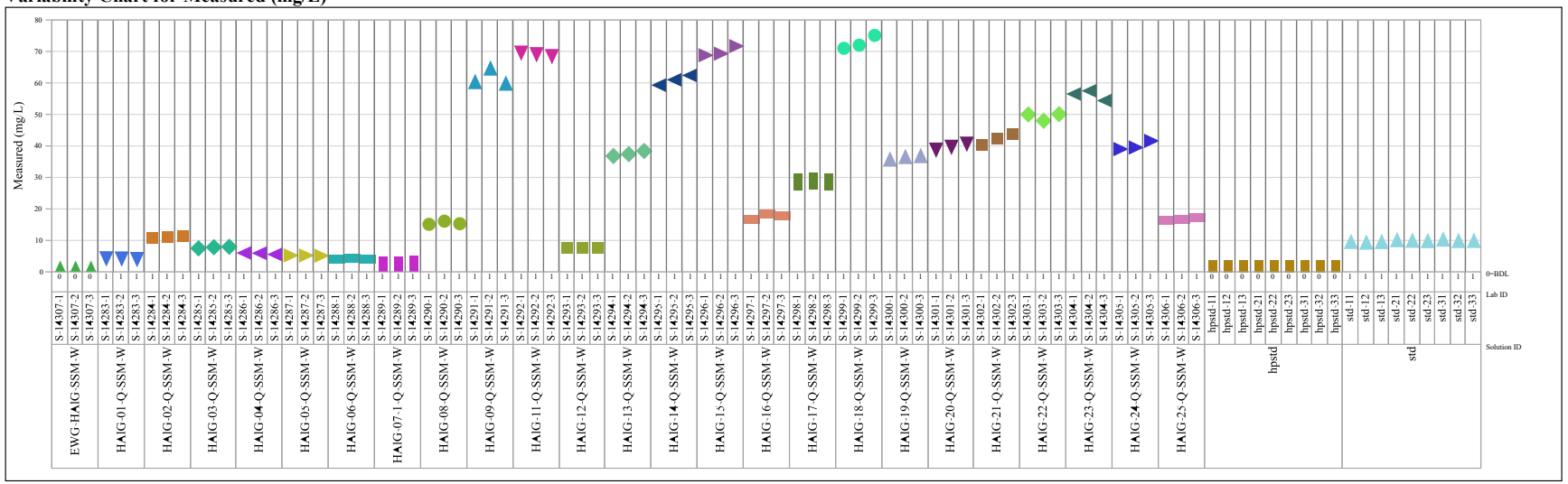
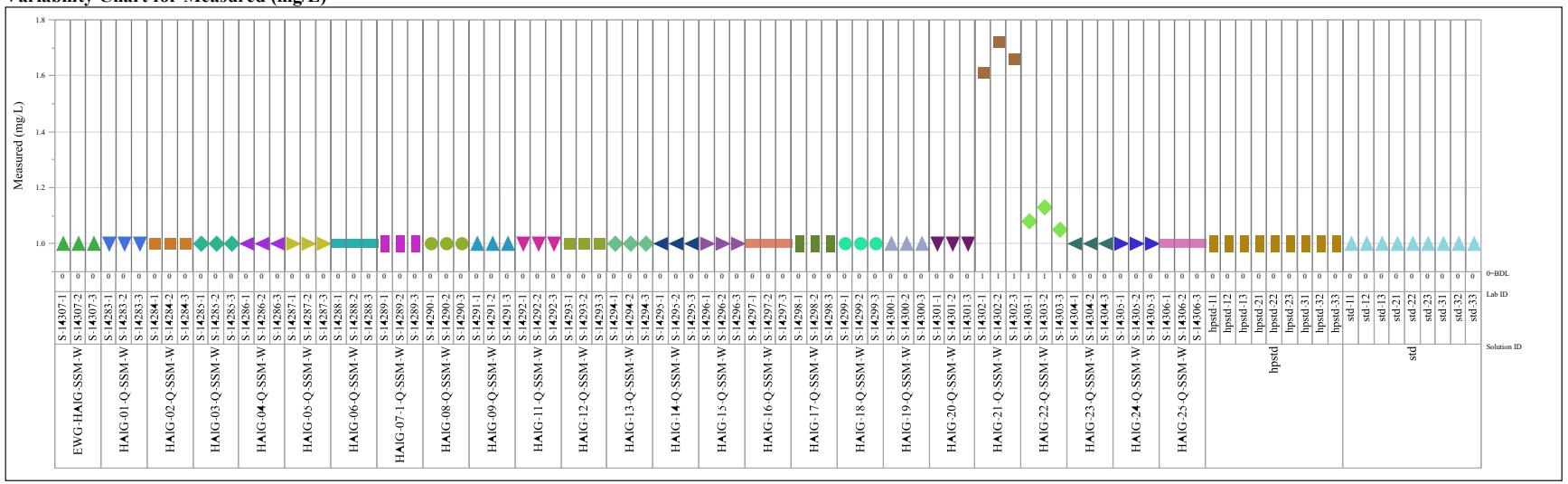


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Mg, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Mn, Analysis=ICP
Variability Chart for Measured (mg/L)

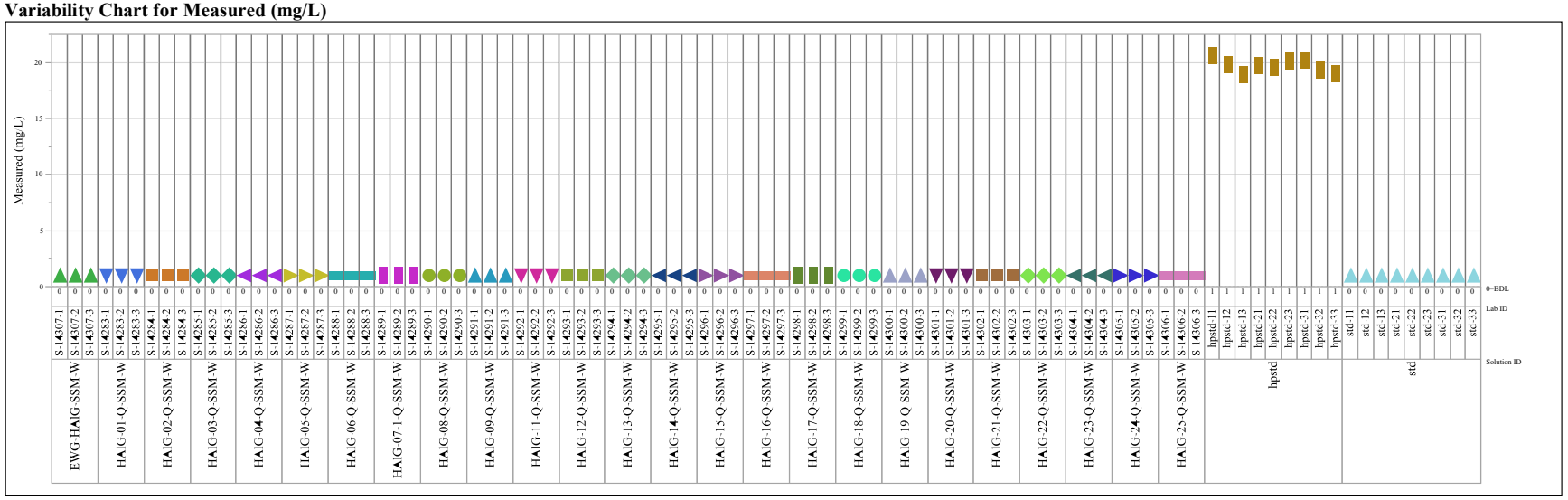
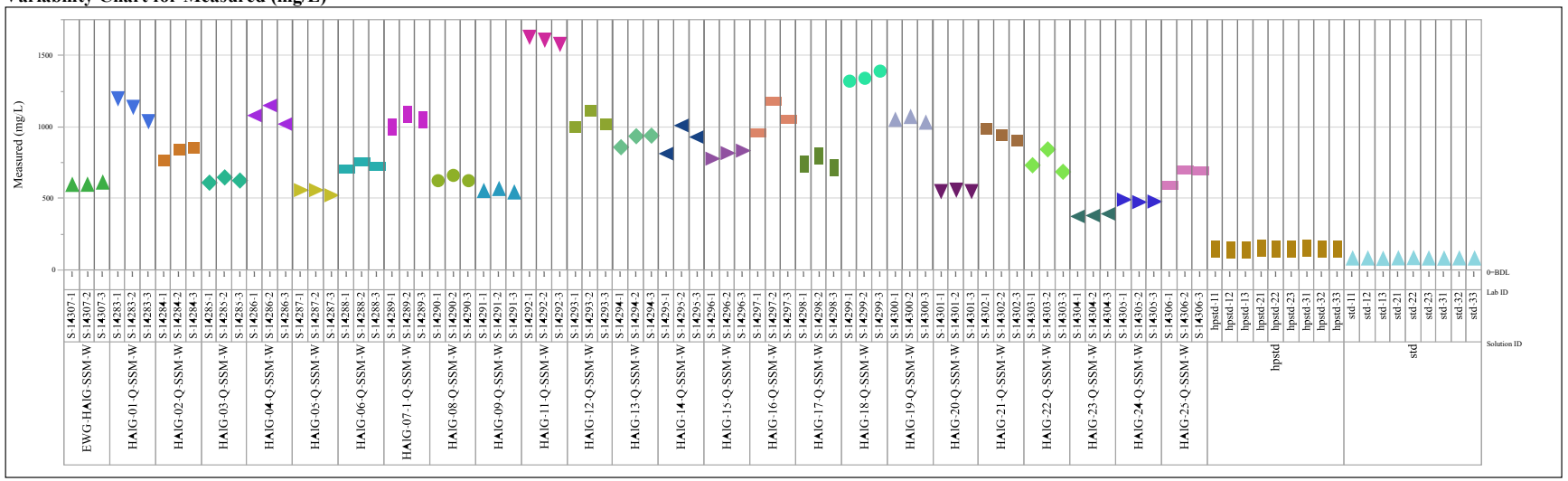


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Na, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Ni, Analysis=ICP
Variability Chart for Measured (mg/L)

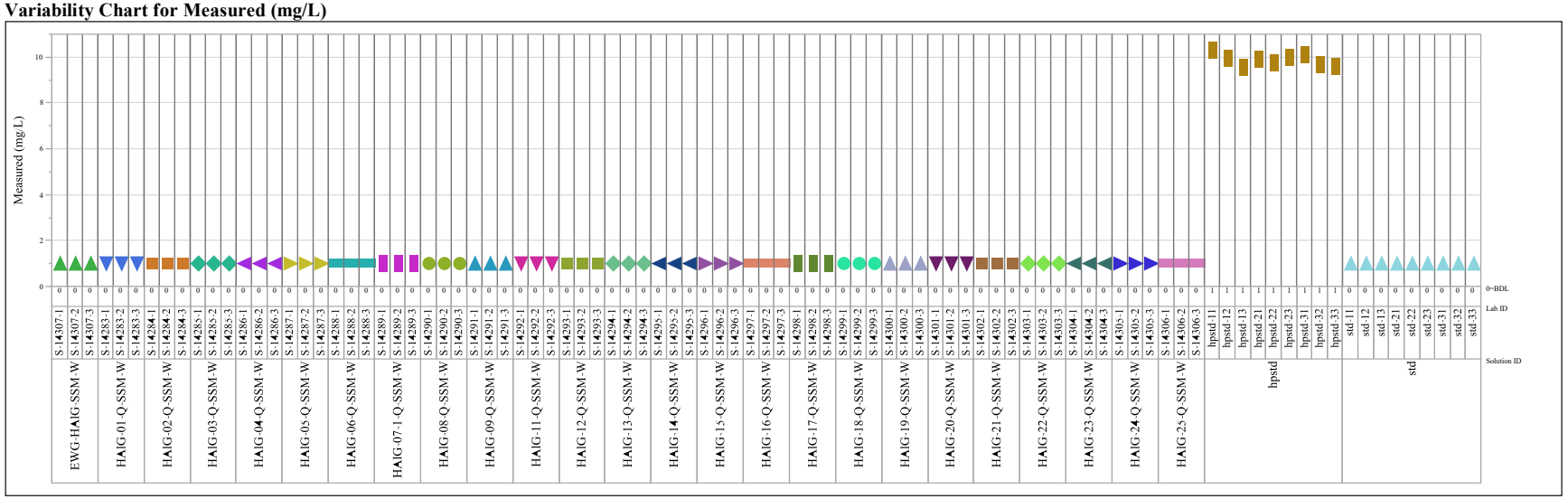
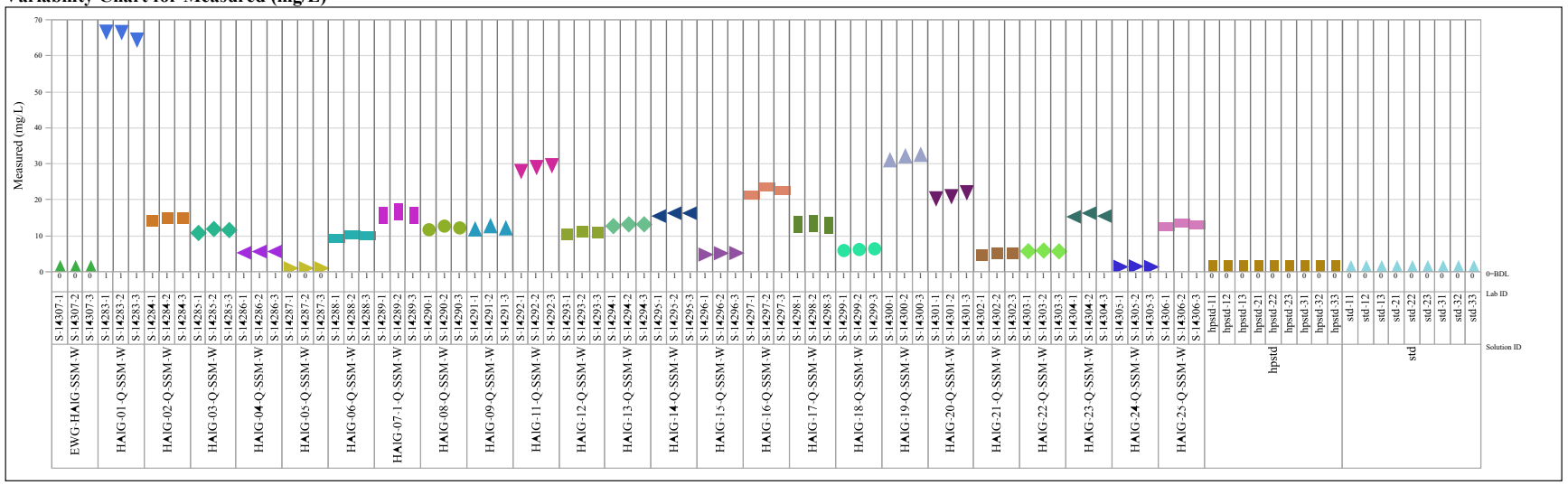


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=P, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=PO4, Analysis=IC
Variability Chart for Measured (mg/L)

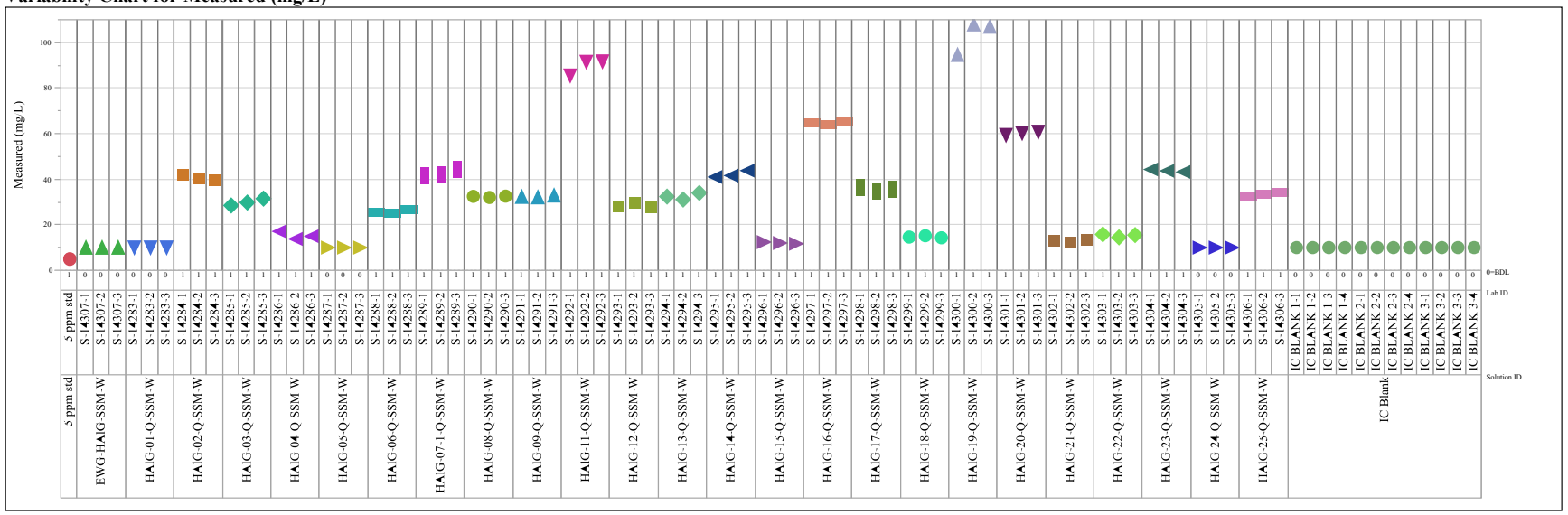
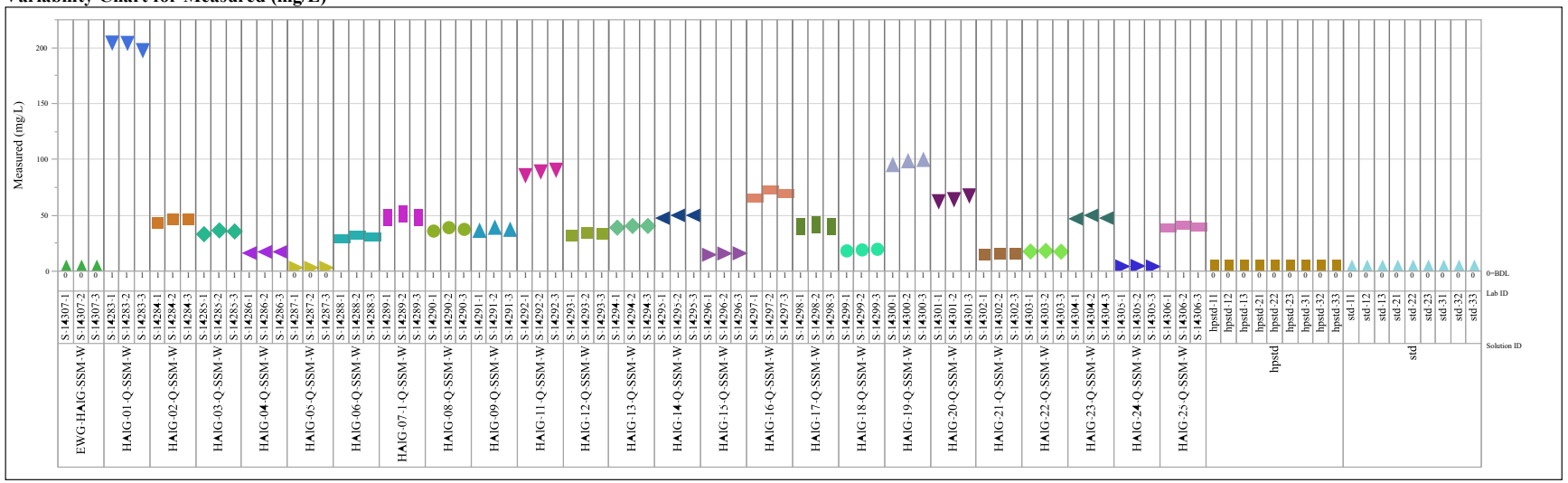


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=PO4, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=S, Analysis=ICP
Variability Chart for Measured (mg/L)

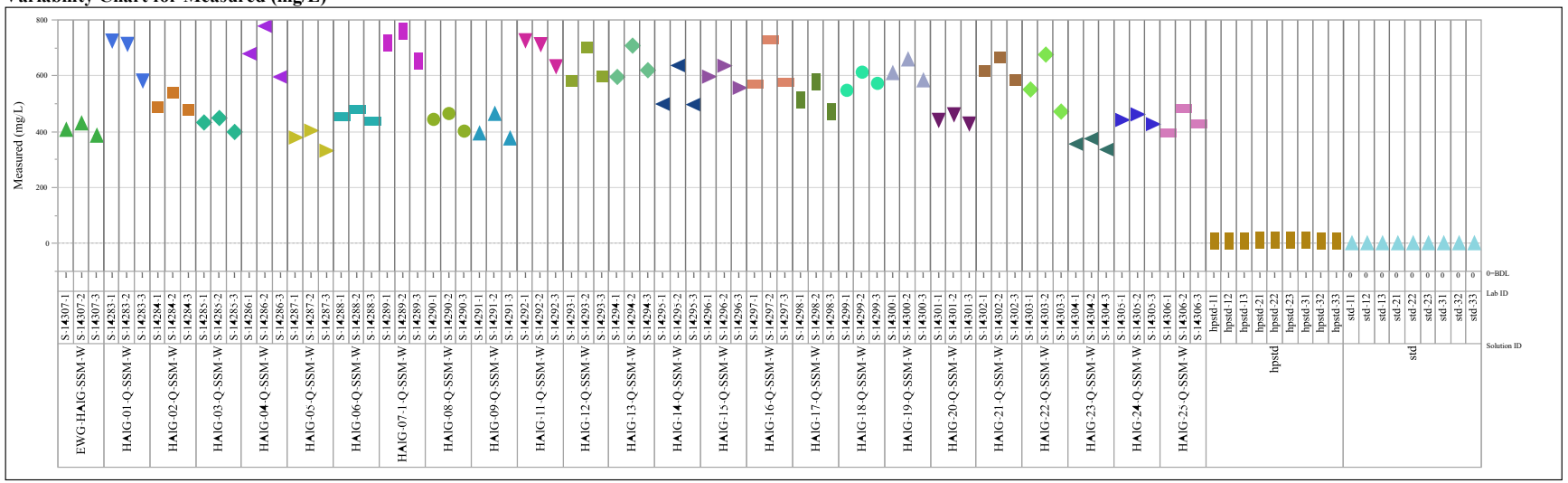
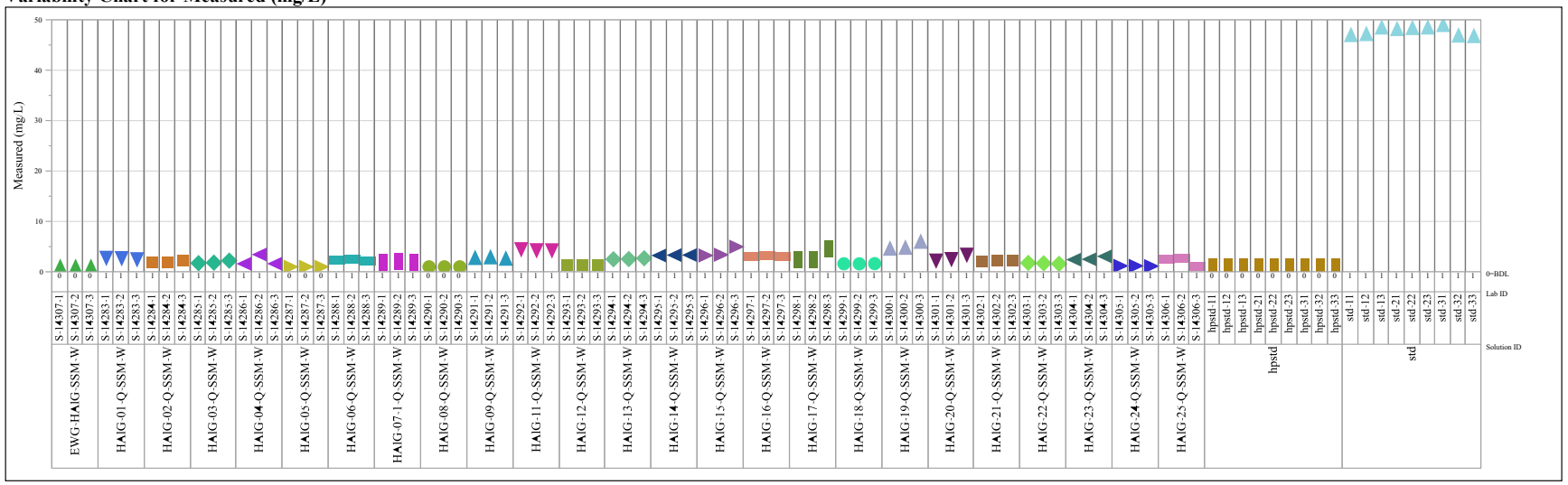


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Si, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=SO4, Analysis=IC
Variability Chart for Measured (mg/L)

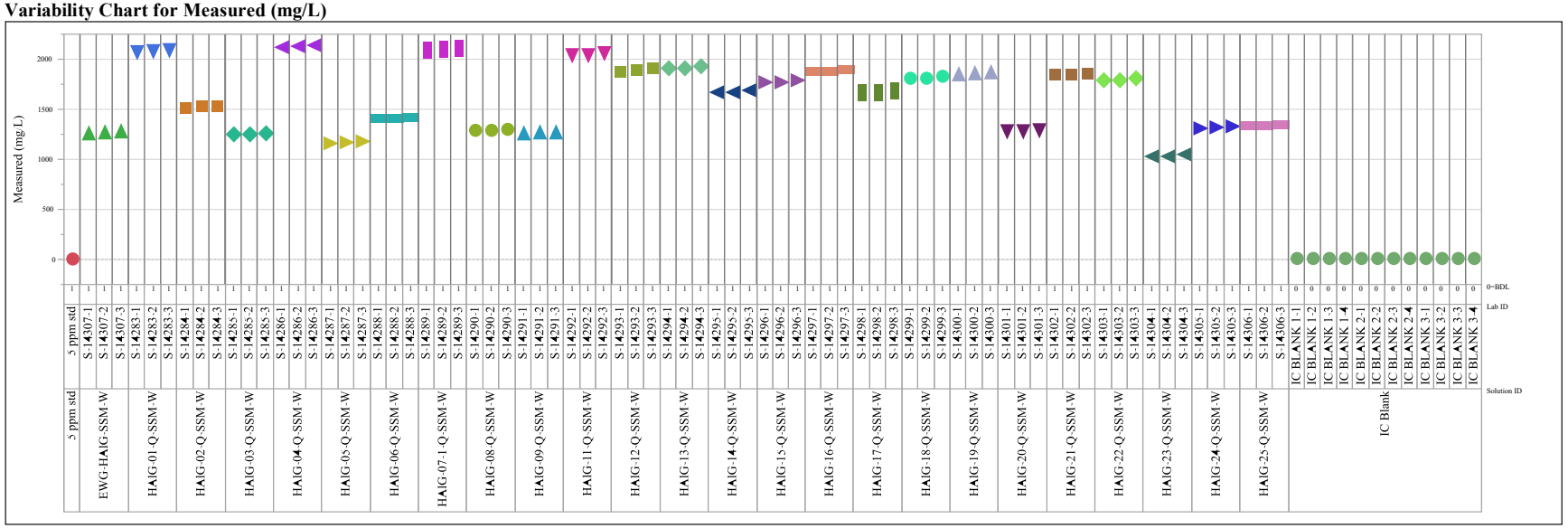
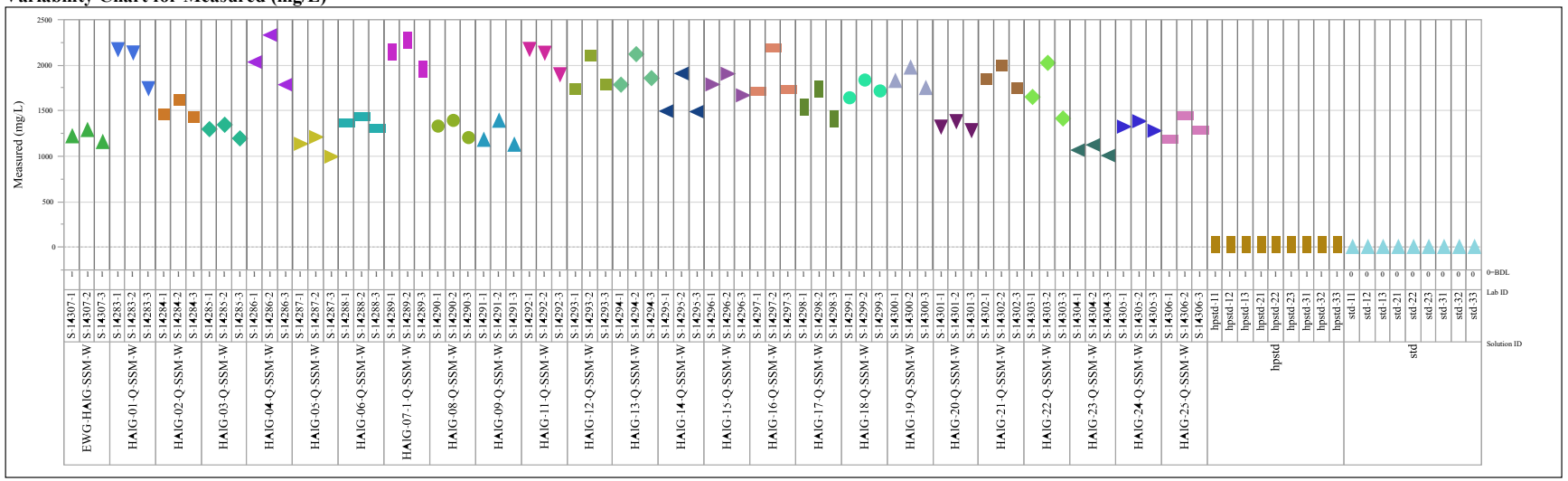


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=SO4, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Sr, Analysis=ICP
Variability Chart for Measured (mg/L)

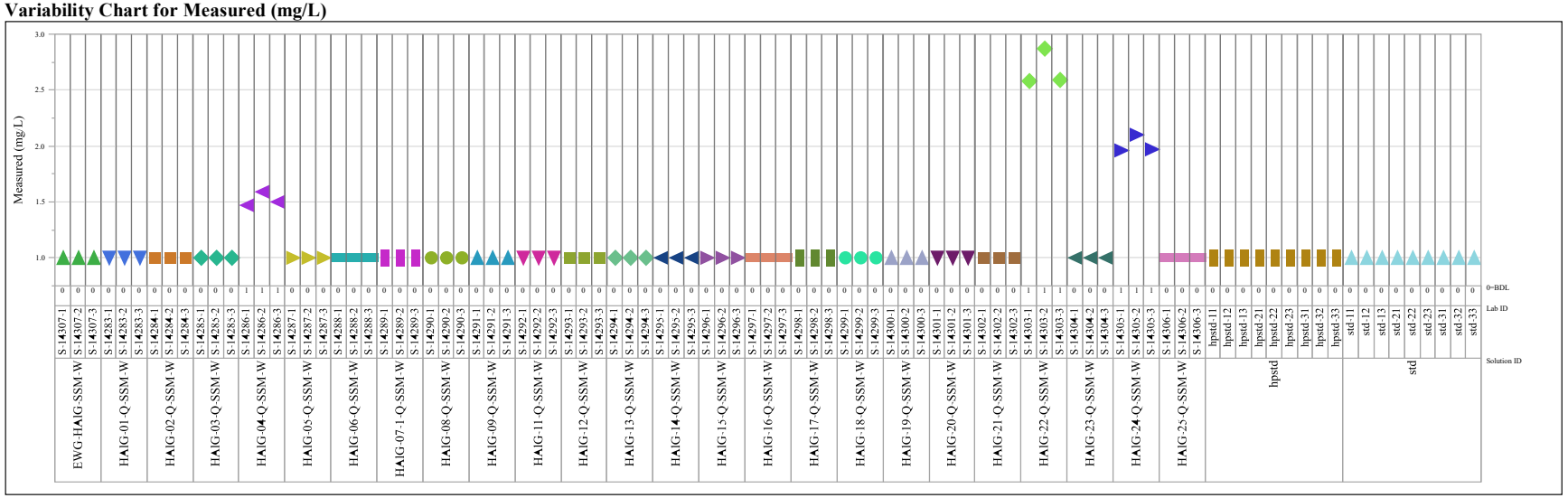
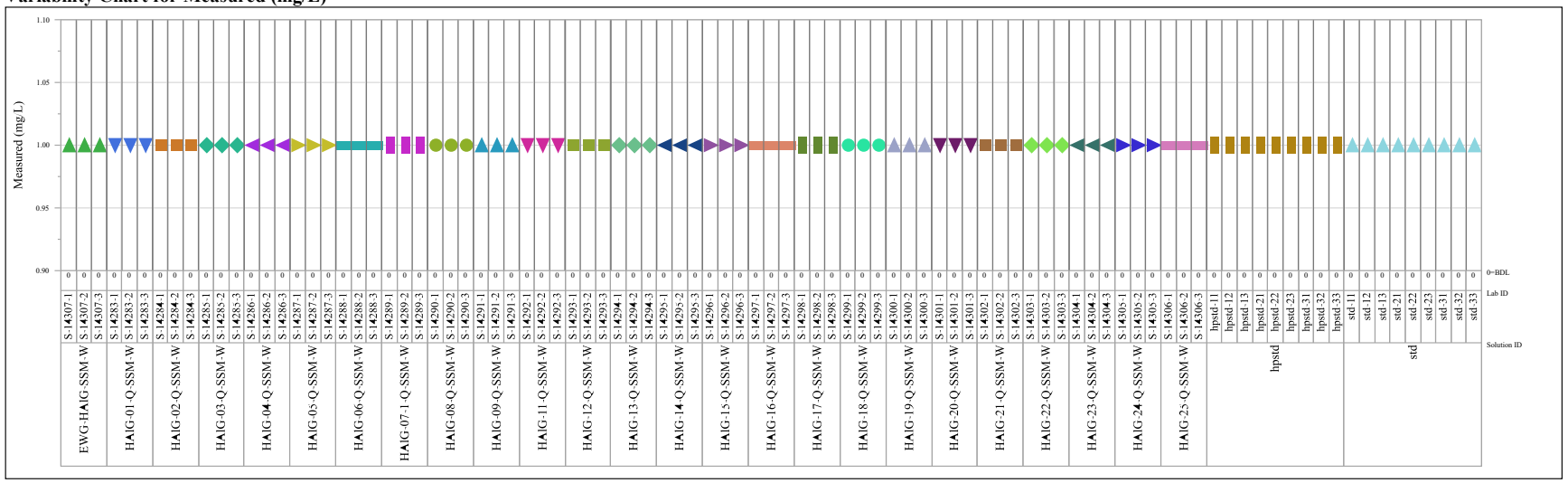


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Ti, Analysis=ICP
Variability Chart for Measured (mg/L)



Analyte=Zn, Analysis=ICP
Variability Chart for Measured (mg/L)

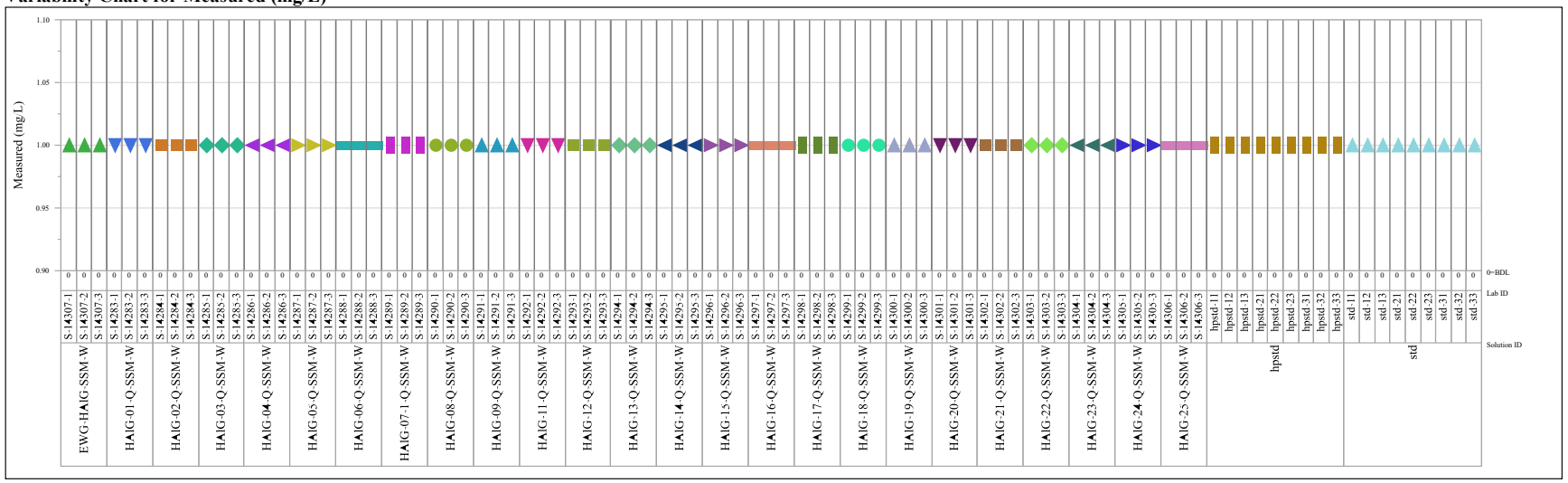
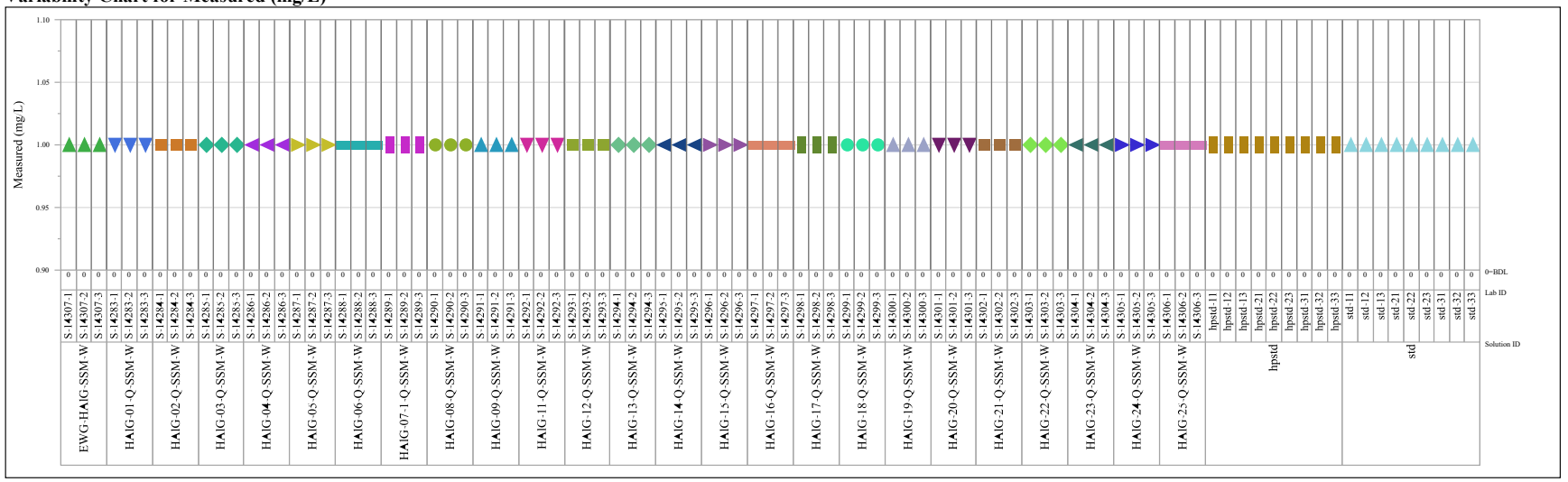


Exhibit B-1. Measurements of SSM Wash Solutions by Solution ID by Analyte (continued)

Analyte=Zr, Analysis=ICP
Variability Chart for Measured (mg/L)



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