**Supplementary Material 3. EDS performance**

To determine how accurate the quantification tool is on the Quantax software for the EDS was, eight lead glass standards were analyzed following the same protocol as used for the analysis of the glazed ceramics from Central Asia. The standards were borrowed from the Metropolitan Museum of Art’s Scientific Research Department, where they are generally used for calibration/quantification by WDS for lead glasses. The standards include the following: Corning Glass C, Corning TNJ, Society for Glass Technology (SGT) glasses 3, 8, and 9, SSV glasses 64 and 135, and the community bureau of reference (BCR) lead glass 126A. All are high lead glasses, which range from 20.6 to 43.64 wt% PbO.

**Table 1.** Compositions of Standard Reference materials, reported in oxide wt%.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | BCR No 126 A | SGT 8 | SGT 3 | SGT 9 | Corning TNJ | Corning C | SSV 64 | SSV 135 |
| SiO2 | 57.8000 | 56.34 | 55.33 | 56.7 | 41.27 | 34.87 | 56.4 | 63.6 |
| PbO | 23.9829 | 30.59 | 31.7 | 28.4 | 43.64 | 36.70 | 25.8 | 20.6 |
| K2O | 9.9919 | 11.85 | 11.12 | 8.4 | 3.31 | 2.84 | 12.2 | 4.53 |
| Al2O3 | 0.1262 | 0.05 | 0.13 | 1.4 | 1.21 | 0.87 | 0.07 | 1.34 |
| Fe2O3 | 0.0055 | 0.01 | 0.016 | 0.045 |  | 0.34 | 0.013 | 0.025 |
| Sb2O3 | 0.2914 |  |  |  |  |  | 0.08 |  |
| BaO | 1.0535 |  |  |  |  | 11.40 |  |  |
| CaO | 1.0325 | <0.02 | 0.1 | 0.1 | 5.92 | 5.07 | 0.06 | 0.12 |
| MgO | 0.5116 | <0.02 | 0.04 |  | 3.27 | 2.76 | 0.02 | 0.03 |
| ZnO | 1.0056 |  |  |  |  | 0.05 |  |  |
| Na2O | 3.5740 | 0.23 | 0.22 | 4 | 1.34 | 1.07 | 4.3 | 7.65 |
| Li2O | 0.4939 |  |  |  |  |  |  |  |
| TiO2 |  | 0.02 | 0.02 | 0.03 |  | 0.79 |  |  |
| As2O3 |  | 0.32 | 0.67 | 0.4 |  |  | 0.45 | 0.52 |
| B2O3 |  | 0.36 |  |  |  | 0.20 | 0.5 |  |
| SrO |  |  |  | 0.1 |  |  |  |  |
| CoO |  |  |  |  |  | 0.18 |  | 0.33 |
| NiO |  |  |  |  |  | 0.02 |  | 1.1 |
| CuO |  |  |  |  |  | 1.13 |  |  |
| SnO2 |  |  |  |  |  | 0.19 |  |  |

**Methods**

The standard black was carbon coated and examined in low vacuum with an acceleration voltage of 15 kV and in “analytical” observation condition mode. Five EDS measurements were recorded for each sample. Data for each measurement was collected for >300 seconds, and the spot size ranged from 50-100 μm in diameter.

**Table 2.** Mean (m), standard deviation (σ), and relative standard deviation (RSD) for the eight standard lead glasses. The mean and standard deviation are reported in wt%. Green text indicates a relative standard deviation between 0-10%, yellow is 10-20%, and red is greater. than 20%.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Elem. | BCR 126A (n=5) | | | Corning C (n=10) | | | Corning TNJ (n=5) | | | SGT 3 (n=5) | | | SGT 8 (n=5) | | | SGT 9 (n=5) | | | SSV 64 (n=5) | | | SSV 135 (n=5) | | |
|  | m | σ | RSD | m | σ | RSD | m | σ | RSD | m | σ | RSD | m | σ | RSD | m | σ | RSD | m | σ | RSD | m | σ | RSD |
| O | 25.12 | 0.24 | 1% | 18.37 | 0.48 | 3% | 17.47 | 0.09 | 1% | 23.13 | 0.29 | 1% | 24.27 | 0.32 | 1% | 24.41 | 0.25 | 1% | 25.89 | 0.18 | 1% | 28.79 | 0.13 | 0% |
| Na | 2.95 | 0.10 | 3% | 0.79 | 0.25 | 31% | 0.97 | 0.12 | 13% | 0.11 | 0.10 | 92% | 0.08 | 0.11 | 137% | 2.89 | 0.12 | 4% | 2.61 | 0.08 | 3% | 5.84 | 0.10 | 2% |
| Mg | 0.23 | 0.06 | 27% | 1.52 | 0.29 | 19% | 2.10 | 0.15 | 7% | 0.14 | 0.04 | 32% | 0.04 | 0.05 | 110% | 0.09 | 0.09 | 100% | 0.05 | 0.04 | 88% | 0.09 | 0.06 | 64% |
| Al | 0.11 | 0.07 | 63% | 0.29 | 0.25 | 85% | 0.83 | 0.18 | 22% | 0.09 | 0.06 | 64% | 0.08 | 0.06 | 72% | 0.84 | 0.09 | 11% | 0.07 | 0.07 | 93% | 0.86 | 0.07 | 8% |
| Si | 31.46 | 0.17 | 1% | 18.88 | 0.35 | 2% | 22.61 | 0.17 | 1% | 30.43 | 0.25 | 1% | 31.10 | 0.29 | 1% | 31.14 | 0.24 | 1% | 30.20 | 0.26 | 1% | 34.23 | 0.15 | 0% |
| Cl | 0.01 | 0.01 | 224% | 0.04 | 0.05 | 131% | <0.01 |  |  | 0.02 | 0.02 | 144% | 0.02 | 0.04 | 158% | <0.01 |  |  | <0.01 |  |  | 0.08 | 0.05 | 64% |
| K | 8.73 | 0.51 | 6% | 2.21 | 0.16 | 7% | 2.38 | 0.41 | 17% | 9.73 | 0.48 | 5% | 10.53 | 0.89 | 8% | 7.51 | 0.57 | 8% | 9.81 | 0.74 | 7% | 4.17 | 0.18 | 4% |
| Ca | 0.70 | 0.09 | 13% | 4.19 | 0.38 | 9% | 4.80 | 0.78 | 16% | <0.01 |  |  | <0.01 |  |  | <0.01 |  |  | <0.01 |  |  | <0.01 |  |  |
| Ti | 0.15 | 0.09 | 57% | 1.53 | 0.53 | 35% | <0.01 |  |  | 0.04 | 0.06 | 145% | 0.02 | 0.02 | 99% | 0.03 | 0.05 | 203% | 0.02 | 0.03 | 122% | 0.02 | 0.04 | 224% |
| Fe | 0.09 | 0.08 | 90% | 0.30 | 0.20 | 65% | 0.09 | 0.09 | 103% | 0.06 | 0.06 | 101% | 0.04 | 0.08 | 224% | 0.08 | 0.11 | 139% | 0.07 | 0.07 | 99% | 0.09 | 0.09 | 97% |
| Co | 0.08 | 0.13 | 177% | 0.16 | 0.21 | 134% | 0.03 | 0.06 | 204% | 0.02 | 0.03 | 140% | 0.02 | 0.02 | 137% | 0.03 | 0.07 | 224% | 0.01 | 0.01 | 149% | 0.45 | 0.15 | 33% |
| Ni | 0.05 | 0.06 | 122% | <0.01 |  |  | 0.06 | 0.05 | 92% | <0.01 |  |  | <0.01 |  |  | 0.05 | 0.06 | 111% | 0.02 | 0.03 | 145% | 0.90 | 0.15 | 17% |
| Cu | 0.10 | 0.10 | 101% | 1.21 | 0.22 | 19% | 0.02 | 0.05 | 224% | 0.06 | 0.08 | 136% | <0.01 |  |  | 0.04 | 0.08 | 224% | <0.01 |  |  | 0.03 | 0.05 | 144% |
| Zn | 0.85 | 0.18 | 21% | 0.02 | 0.04 | 273% | <0.01 |  |  | 0.07 | 0.13 | 176% | 0.01 | 0.01 | 149% | 0.06 | 0.09 | 139% | 0.02 | 0.05 | 224% | 0.07 | 0.10 | 149% |
| Sn | 1.31 | 0.15 | 12% | <0.01 |  |  | <0.01 |  |  | 0.10 | 0.09 | 92% | 0.38 | 0.09 | 25% | 0.53 | 0.18 | 35% | 1.83 | 0.21 | 12% | 0.80 | 0.10 | 13% |
| Ba | 0.48 | 0.15 | 30% | 9.52 | 1.51 | 16% | <0.01 |  |  | 0.07 | 0.07 | 104% | 0.04 | 0.09 | 224% | <0.01 |  |  | 0.02 | 0.05 | 224% | <0.01 |  |  |
| Pb | 24.25 | 0.32 | 1% | 38.04 | 1.23 | 3% | 42.61 | 0.50 | 1% | 33.79 | 0.67 | 2% | 30.99 | 0.64 | 2% | 29.32 | 0.37 | 1% | 25.21 | 0.37 | 1% | 20.56 | 0.25 | 1% |
| Bi | 3.34 | 0.17 | 5% | 2.92 | 1.53 | 52% | 6.01 | 0.31 | 5% | 2.12 | 0.19 | 9% | 2.37 | 0.14 | 6% | 2.96 | 0.18 | 6% | 4.15 | 0.24 | 6% | 3.02 | 0.13 | 4% |

Table 2 reports the average composition of the eight standard lead glasses as reported by the Quantax software, as well as the standard deviation of the measurements, and the relative standard deviations. The results indicate that the software consistently reports data for elements with a concentration over 1 wt%. The only exception for this is Ca and K reported in Corning TNJ. Calibrations curves for major (Figure 1) and minor (Figure 2) confirm this observation.

**Figure 1.** Bivariate calibration plots for Pb, Si, Al, Ca, K, and Na (in wt%) across the eight certified reference materials analyzed. Error bars indicate ±1σ on the measured values.

**Figure 2.** Bivariate calibration plots for Fe and Mg (in ppm) across the eight certified reference materials analyzed. Error bars indicate ±1σ on the measured values.