Geophysical Research Abstracts
Vol. 13, EGU2011-7533, 2011
EGU General Assembly 2011

BAM-S005 Type A and B: New silicate reference glasses for microanalysis

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BAM-S005 Type A and B from the Federal Institute for Materials Research and Testing (BAM), Berlin, Germany, are certified soda-lime reference glasses for use with X-ray fluorescence spectrometry (XRF). 22 trace elements in both types have been certified by 3 up to 9 different analytical methods in 23 different laboratories. In order to test whether these glasses are also suitable for microanalysis, we have determined the homogeneity of major and trace elements by using electron probe microanalysis (EPMA), laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) and secondary ion mass spectrometry (SIMS).

The homogeneity test of major elements (SiO2, Na2O, CaO, MgO, Al2O3) was carried out by EPMA. For these elements, the variation (relative standard deviation, RSD) of the concentration data ranges between 0.4% and 1.8 %. The RSD values are similar to the analytical repeatability of EPMA indicating that the BAM-S005 glasses are homogeneous with respect to major elements. The concentration data (%m/m) for both types are identical within uncertainty limits (SiO2 = 70.5 $\pm$0.3 (A), 70.5 $\pm$ 0.3 (B); Na2O = 13.5 $\pm$ 0.1 (A), 13.7 $\pm$ 0.1 (B); CaO = 10.71 $\pm$ 0.06 (A), 10.76 $\pm$ 0.06 (B); MgO = 2.11 $\pm$ 0.04 (A); 2.14 $\pm$ 0.03 (B); Al2O3 = 1.16 $\pm$ 0.01 (A), 1.18 $\pm$ 0.01 (B)) and agree well with the informative values of BAM.

LA-ICP-MS and SIMS have been used to investigate the trace element homogeneity. Altogether we analyzed 44 trace elements in our study, including the certified elements and others, such as U, Th, Nd and Ho. Many LA-ICP-MS measurements were performed at different locations using two different Nd:YAG laser ablation systems (193 nm and 213 nm wavelengths) and different spot sizes (25, 55 and 75 μm corresponding to test portion masses of about 0.03, 0.4 and 1 μg). As expected, the RSD values obtained from the 55 μm and 75 μm spot analyses are better (ca. 5 – 7 %) than those obtained from the 25 μm spot analyses (ca. 15 %) because of the higher test portion masses. The RSD values of most trace element analyses are well within the repeatability of LA-ICP-MS. This means that more than 35 trace elements are homogeneously distributed even at low test portion masses of about 0.4 μg. Exceptions are Se, Cl and the low abundant (< 0.2 μg g-1) Cs, Sm, Eu, Gd, Ta with significantly higher RSD values. Se and Cl may be inhomogeneously distributed in the BAM glasses. Such elements are also inhomogeneously distributed in other reference glasses, such as from NIST.

In summary, our results demonstrate that the BAM-S005 glasses are homogeneous with respect to major and more than 35 trace elements at the small-scale. They are therefore suitable for many microanalytical purposes. In particular, the BAM-S005 glasses can be used as calibration materials for the determination of the 22 trace element (e.g., S, Cd, As, Sn, Pb) abundances certified by BAM.