

Evaluating Matrix Effects for Boron Isotope Measurements in Silicate Materials Using LG-SIMS

NATALIE E SIEVERS, MINDY ZIMMER AND ZEBADIAH TEICHERT

Pacific Northwest National Laboratory

Presenting Author: natalie.sievers@pnl.gov

Boron isotope compositions in minerals and glasses are a common proxy used in subduction zone geochemistry due to their high mobility and incompatibility with the fluids entering the deep earth and can be used to understand crustal recycling. Similarly, B isotope systematics are of interest to nuclear forensics because ^{10}B has a high cross section for thermal neutron capture, thus boron isotope ratios can be sensitive indicators of neutron fluence. In-situ, high precision isotopic measurements are well-suited for addressing these topics, especially for materials with small-scale heterogeneities. We utilize multicollector secondary ion mass spectrometry (SIMS) methods using a Cameca ims 1280-HR to focus on two major analytical challenges: the large mass dispersion of light isotopes on the multicollection detection system, and the matrix effect of boron isotopes in silica glasses.

For lighter isotope systems including boron, the mass dispersion between isotopes is large, resulting in degraded peak shapes when the detectors are far from the axial mass. By adjusting the dsp2y stigmator after the magnetic sector, and subsequently moving the detectors closer to the axial mass, the dispersion of masses is lessened, which improves peak shape and uniformity.

We present boron isotopic compositions from a wide range of synthetic and natural silica glass reference materials to establish the degree that matrix effects, resulting from material composition variability, influence the measured $^{10}\text{B}/^{11}\text{B}$ ratios. While these standards vary in composition in several major elements, we show that SiO_2 content is a significant factor in the mass bias in these measurements, and that for most glasses, a linear relationship between $^{10}\text{B}/^{11}\text{B}$ ratio and SiO_2 content exists.