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Evaluation of matrix effects for lithium and boron isotopes by multicollector SIMS

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We present an improved method for multicollector measurements of Li and B isotopes by secondary ion mass spectrometry (SIMS) using the IMS 1280-HR, developed specifically for small particles or heterogeneous samples, such as inclusions or thin coatings, that can be rapidly consumed during sputtering. The standard approach for Li isotope measurements by SIMS has been peak-hopping by mono-collection, which misses or averages heterogeneity, yielding inaccurate results. Instrument tuning included a ~120 mV bias on the BY-e deflector associated with the normal-incident electron gun to compensate for Earth's magnet field and minimize fractionation of secondary ions. δ^7Li results on glassy reference materials yield ± 0.9–1.3‰ uncertainties (1σ SD) for replicate measurements. Li isotopes measured by SIMS are sensitive to compositional matrix effects that biases Li isotopes, and which scale near-linearly with Δ SiO_2 * -0.67‰ (Denny et al. 2024; Δ = difference in wt% SiO_2 between 2 samples). We extend this multicollection method to B isotopes to test whether δ^{11}B is similarly sensitive to compositional matrix effects. However, there is a limited range of glassy silicate reference materials with reliable bulk δ^{11}B values available in the literature. To address this, we measured 9 well-characterized reference materials by solution using the NEOMA MC-ICP-MS (Scott et al., 2025), expanding the compositional range from 38.7 to 75.6 wt% SiO_2. δ^{11}B SIMS multicollection results from 21 glassy reference material show there is a compositional matrix effect that scales with Δ SiO_2 * 0.27‰. The relationship between measured isotopic ratio and SiO_2 content is more scattered and less correlated with SiO_2 for B compared to Li. Reproducibility of multicollected δ^{11}B is 0.5–1.9‰ (1σ SD). The increased scatter in the trend of δ^{11}B vs SiO_2 (or other elements) is partly attributable to a wider range (i.e., irreproducibility) in published solution ICP-MS or TIMS measurements, which is currently a limiting factor for more accurate B isotopic measurements.