

Matrix effects in B isotope analysis of silicate minerals by SIMS

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Boron isotope ratio measurements by SIMS show negligible matrix-dependent instrumental mass fractionation (IMF) when analysing natural silicate glasses [1]. However, here we demonstrate that the same does not apply to (hydrated) silicate minerals. A set of amphibole, white mica and serpentine grains analysed previously by TIMS (CNR-Pisa) were measured in-situ in two different SIMS laboratories (EIMF, Cameca 1270, and WHOI, Cameca 1280) at sufficient mass resolution to resolve ⁹BeH, ⁹BeH₂ and ¹⁰BH interferences. Significant systematic differences between TIMS and SIMS were measured in B isotope ratios among the different mineral groups (Table 1), using silicate glass standards for calibration (GOR128-G, StHs6/80-G, BCR-2G, GSD-1G). Within each mineral group, IMF was constant, analogous to what is observed for tourmaline [2]. Uncertainties in IMF values were mostly due to B isotope heterogeneities in the minerals, plus minor variation in IMF between analytical sessions. IMF measured at WHOI was different than at EIMF, indicating that instrumental setup has a small but detectable effect on IMF. Matrix-matched standards are needed to obtain accurate results when measuring B isotopes in hydrated minerals by SIMS.

Table 1. IMF ($(^{11}\text{B}/^{10}\text{B})_{\text{SIMS}}/(^{11}\text{B}/^{10}\text{B})_{\text{TIMS}} - 1) \times 1000$

<i>Mineral</i>	<i>n</i>	<i>IMF EIMF</i>	<i>IMF WHOI</i>	<i>B μg/g</i>
White mica	3	-2.3±1.0‰	-5.5±0.5‰	25-270
Serpentine	4	-6.8±1.1‰	-3.7±1.7‰	2-98
Ca-amphibole	2	-2.6±0.4‰	-0.8±0.8‰	2-8

n = number of mineral grains from different localities

References: 1 Marschall and Monteleone (2015) Geost. Geoanal. Res. 39, 31-46; [2] Ludwig et al. (2011) Min. Mag. 75, 2485-94.