American Mineralogist, Volume 108, pages 447–454, 2023

Secondary ion mass spectrometer analyses for trace elements in glass standards using variably charged silicon ions for normalization

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Abstract

Trace element analyses of silicate materials by secondary ion mass spectrometry (SIMS) typically normalize the secondary ion count rate for the isotopes of interest to the count rate for one of the silicon isotopes. While the great majority of SIMS analyses use the signal from Si^{+}, some laboratories have used a multiply charged ion (Si^{2+} or Si^{3+}). We collected data and constructed calibration curves for lithium, beryllium, and boron using these different normalizing species on synthetic basaltic glass and soda-lime silicate glass standards. The calibrations showed little effect of changing matrix when Si^{+} was used, but larger effects (up to a factor of ~2) when using Si^{2+} or Si^{3+} are a warning that care must be taken to avoid inaccurate analyses. The smallest matrix effects were observed at maximum transmission compared to detecting ions with a few tens of eV of initial kinetic energy ("conventional energy filtering"). Normalizing the light element ion intensities to Al^{3+} showed a smaller matrix effect than multiply-charged Si ions. When normalized to $^{16}O^{+}$ (which includes oxygen from the sample and from the primary beam), the two matrices showed distinct calibration curves, suggesting that changing sputter yields (atoms ejected per primary atom impact) may play a role in the probability of producing multiply charged silicon ions.

Keywords: SIMS, lithium, beryllium, boron; Lithium, Beryllium and Boron: Quintessentially Crustal