

Boron isotopes in the continental crust: granites, pegmatites, felsic volcanic rocks and related ore deposits

R.B. TRUMBULL*¹ AND J.F. SLACK²

GFZ German Research Centre for Geosciences, 14473
Potsdam, Germany (*correspondence: bobby@gfz-
potsdam.de)

²U.S. Geological Survey (Emeritus), Farmington, ME, USA
04938 (jslack7@gmail.com)

A compilation of over 250 B-isotope analyses of felsic igneous rocks from 90 localities worldwide shows a first-order distinction in $\delta^{11}\text{B}$ values between I-type magmas (subduction-related, meta-igneous sources) and S-type magmas (derived from metasedimentary rocks). Boron in I-type igneous rocks is isotopically heavy (mean = -2 ‰, s.d. = 5) relative to the current value for unaltered MORB at -7.1 ± 0.9 ‰ [1], which presumably reflects the involvement of seafloor-altered material in the magma source. S-type igneous rocks have lighter B-isotope compositions (mean = -11 ‰, s.d. = 4). This mean is close to the commonly cited value of -10 ‰ for average continental crust, but since much of Earth's crust derives from I-type magmas, its average B-isotope value is probably higher than previously thought. We suggest that the value of -10 ‰ is appropriate only for the upper crust, and caution that the B-isotope composition of the bulk continental crust and mantle may be very similar.

The dichotomy of B-isotope compositions in I- and S-type magmas appears to also hold true for their related magmatic-hydrothermal ore deposits. We demonstrate this contrast with data from porphyry and IOCG systems (I-type) and from Sn-W deposits and granitic pegmatites (S-type). In the ore systems, however, the source distinction is commonly blurred by significant and locally complex secondary effects of isotopic fractionation related to the exsolution of fluids from magma, mixing with one or more external fluids, and cooling and fluid-rock interactions. On the other hand, those effects provide clues for understanding the source(s) of mineralizing fluids and processes of ore formation. Tourmaline has been the focus of most studies applying *in situ* B-isotope analyses to ore-related systems [2], but our examples show the potential of expanding the application to muscovite.

[1] Marschall *et al.* (2017) *GCA* **207**, 102-138. [2] Slack & Trumbull (2011) *Elements* **7**, 321-326.