

Boron coordination in omphacite and glaucophane derived from inter-mineral B isotope fractionation in natural rocks

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ABSTRACT

Boron coordination in omphacite and glaucophane was determined by indirect means through the B isotope fractionation among coexisting minerals. Samples from tourmaline-bearing reaction zones in the high-pressure metamorphic mélange on the island of Syros were investigated. These metasomatic zones formed at ~ 0.7 GPa, 415 ± 15 °C. Equilibrium B isotope fractionations among paragenetic dravite, phengite, omphacite, and glaucophane were determined by in situ B isotope analyses using laser ablation multi-collector ICP-MS. The proportions of trigonally and tetrahedrally coordinated B in omphacite and glaucophane were estimated by comparing their boron isotope fractionation relative to dravite (94.6% ^{11}B and 5.4% ^{10}B) and phengite (100% ^{11}B).

The B isotope fractionation of omphacite and phengite against dravite are $-12.0 \pm 1.2\%$ and $-13.4 \pm 2.2\%$, respectively, where $\delta^{11}\text{B}$ values of omphacite are $1.9 \pm 1.6\%$ higher than in coexisting phengite. No significant isotopic difference was observed between glaucophane and phengite. Consequently, we concluded that in clinopyroxene (omphacite), $88 \pm 9\%$ of boron is incorporated in tetrahedral coordination, for example via the $\text{B}(\text{F},\text{OH})\text{Si}_{-1}\text{O}_{-1}$ substitution, with the remaining $12 \pm 9\%$ entering by replacement of SiO_4 tetrahedra with BO_3 triangles. In contrast, B in glaucophane is exclusively incorporated in the tetrahedrally coordinated sites. The boron coordination in high-pressure minerals that host boron in subducting rocks, such as clinopyroxene, amphibole, and mica, is relevant for modeling B isotope fractionation during slab dehydration in subduction zones.

Keywords: Boron coordination, boron isotopes, isotope fractionation, clinopyroxene, amphibole, Lithium, Beryllium, and Boron: Quintessentially Crustal