

Boron isotope composition of borosilicates in kornerupine-corundum-plagioclase domains from Akarui Point, Lützow-Holm Complex, East Antarctica

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Rare kornerupine-corundum-plagioclase domains are found at the boundary between an ultramafic lens and the host hornblende-gneiss or within a hornblende-gneiss next to a pyroxenite lens in Akarui Point, Lützow-Holm Complex (LHC), East Antarctica [1]. The peak metamorphic conditions of ~800-900 °C and ~8-11 kbar have been estimated in Akarui Point [1-3], under which kornerupine is stable [4]. The domain has high B concentration as suggested by the presence of large kornerupine crystals (up to 4 cm in diameter, ~1.9 wt% B₂O₃) as a major constituting mineral [1]. Because B is highly incompatible and its concentration in mafic and ultramafic rocks is generally low, and because abundant ruby corundum suggests incorporation of ultramafic rocks as a source of Cr, the domain is likely a product of interaction between a B-bearing fluid, ultramafic lenses and the host Hb-gneiss. In order to constrain the source of B-bearing fluid, we determined B isotope composition of kornerupine and tourmaline in the kornerupine-corundum-plagioclase domain by *in situ* SIMS analysis.

Two kornerupine-corundum-plagioclase domains were analyzed in this study. The kornerupine and coexisting corundum (ruby) have inclusions of 'prograde tourmaline' that is either a precursor of kornerupine or a contemporaneous product with kornerupine under nearly constant *P-T* conditions during the infiltration of fluid. It is not found as inclusions in biotite and plagioclase. Kornerupine is partly retrogressed to secondary minerals of tourmaline, biotite, corundum (sapphire), andalusite and magnesite at the rim or along cracks. These may represent retrograde reaction products of kornerupine with a CO₂-H₂O fluid [1].

The $\delta^{11}\text{B}$ values [= $\{(^{11}\text{B}/^{10}\text{B})_{\text{sample}}/(^{11}\text{B}/^{10}\text{B})_{\text{NIST951}} - 1\} * 1000$] of the kornerupine are -11.6 to -7.8 ($\pm 0.3-0.5$) ‰ [average = -9.9 ± 0.9 ‰] for sample AKR2002 and -9.8 to -5.3 ($\pm 0.3-0.5$) ‰ [average = -8.0 ± 1.2 ‰] for sample TK2002122104. The former sample does not accompany any type of tourmaline. The latter sample has prograde and secondary tourmaline; B isotope analyses gave $\delta^{11}\text{B} = -2.0$ to $+0.6$ ($\pm 0.2-0.3$) ‰ [average = -1.3 ± 0.9 ‰] for the prograde tourmaline and $\delta^{11}\text{B} = -4.6$ to -3.7 ($\pm 0.2-0.3$) ‰ [average = -4.1 ± 0.4 ‰] for the secondary tourmaline. The $\delta^{11}\text{B}$ values of kornerupine are lower than tourmaline in the studied samples, which is consistent with results from granulite facies paragneisses from Larsemann Hills [5]. In [5], measured distribution of B isotopes $\Delta^{11}\text{B}_{\text{Tur-Prs}} = \delta^{11}\text{B}_{\text{Tur}} - \delta^{11}\text{B}_{\text{Prs}} = +5.0$ (± 1.4) ‰ is proposed to represent isotopic equilibrium between tourmaline and prismatic (kornerupine). *Ab initio* calculation following the method developed by [6] and [7] at 1000 K gives a B isotope fractionation factor of $+6.4$ ‰ [5]. Based on these criteria, kornerupine and prograde tourmaline in sample TK2002122104 ($\Delta^{11}\text{B}_{\text{Tur-Krn}} = -6.7 \pm 1.5$ ‰) are interpreted as isotopically in equilibrium. This supports the interpretation that the kornerupine and prograde tourmaline in sample TK2002122104 are contemporaneous products during B-bearing fluid infiltration. Since kornerupine stability requires high-*T* than 700 °C [4], B isotopic fractionation between fluid and the prograde tourmaline was almost negligible [8]. Therefore, B isotope composition of the prograde tourmaline represents that of the B-bearing fluid.

The value of $\delta^{11}\text{B} = -1.3 \pm 0.9$ ‰ is significantly lower than the sea water value. Alternatively, this value is similar to MORB, mantle rocks and blackwall tourmaline formed at contacts between ultramafic (serpentinite-peridotite) and crustal (mafic or felsic) rocks [e.g. 9, 10]. Indeed, mode of occurrence of the kornerupine-corundum-plagioclase domains is similar to blackwalls found in high-*P* metamorphic terranes. The domain would represent a high-*T* type of blackwall or metamorphosed blackwall. Therefore, fluids related to the oceanic plate subduction is a potential source of B-bearing fluid to form the kornerupine-corundum-plagioclase domain.

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