Boron geochemistry in the amphibolite to granulite transition, southern India

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Geochemical studies of high-grade metamorphic rocks can document either fluid infiltration or melt extraction processes in forming granulite facies assemblages. Typically these show that granulites are depleted in U, Rb and Cs (e.g., Janardhan *et al.* 1982; Condie and Allen 1984). Boron is concentrated in both fluids and melts, so we predict that B content of granulites will be due to either fluid and/or melt extraction. In southern India, previous workers have identified the presence of CO_2-rich fluid inclusions as well as depletion of U, Rb, and Cs, which both imply that passage of a CO_2-rich fluid during the formation of the granulites (e.g., Hansen *et al.* 1984). Thus, we can attribute any changes in B content to influx of CO_2 during formation of the south Indian granulites.

Thirty-six samples were analyzed for major, trace element, REE, and B content. As we observe in other granulite terrains and in felsic crustal xenoliths (e.g., granulites in Lewisian and SW Norway, xenoliths from Snake River Plain and Kilbourne Hole), B contents are low (2-5 ppm) in most lithologies. B does not correlate with either SiO_2 or K_2O content. Average B values for various lithologies are: khondalites, 3.5 ppm; charnockites, 4.0 ppm and garnet + biotite + cordierite gneisses, 3.0 ppm regardless of metamorphic grade. One exception is a calc-silicate granulite sample which has 14.5 ppm B. This higher B content may be due to limited fluid interaction within lower permeability layers. Alpha track images of selected samples show that in the khondalites, high track densities correlated with B correspond to biotite: as modal abundance of biotite increases so does the whole-rock B content. However, in charnockites which are both massive and incipient, B is mainly along grain boundaries. Thus, the whole-rock B content reported is a maximum value for this lithology. Potential B hosts in the calc-silicate rocks include both diopside and wollastonite. In samples of amphibolite-charnockite pairs from Kabbaldurga, Ponmudi, Attingal, Kadamkod and Kottovattum quarries, there is no systematic difference in B

content. For instance, average B contents in Kabbaldurga quarry are: gneisses have 3.4 ppm compared to incipient charnockites with 4.0 ppm and intrusive pegmatites with 3.9 ppm. We hypothesize that B has been depleted by metamorphic processes prior to charnockitization.

In conclusion, B contents is low in most amphibolite and granulite lithologies in southern India. B is not a useful tracer of fluid processes in high grade metamorphic terrains. One exception is calc-silicates which may not have interacted with either CO_2 or melts passing through.

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