B isotopic composition (LA MC-ICP-MS) of tourmaline from the Quadrilátero Ferrífero (SE Brazil): Constraints on magmatic-hydrothermal fluid evolution

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In the Archean Quadrilátero Ferrífero district (SE Brazil), tourmaline occurs within a leucogranitic intrusion, pegmatitic bodies, numerous plagioclase- and quartz-veins, as well as disseminated in the surrounding greenstone belt rocks. Their chemical and B isotope composition was determined by electron microprobe and LA MC-ICP-MS to investigate the hydrothermal evolution of the region.

The tourmalines vary from schorl in the leucogranite to dravite compositions in the metasediments. A net increase in Cr contents from magmatic to hydrothermal tourmalines illustrates that tourmaline major-element composition is mostly controlled by that of the host rock.

Tourmaline $\delta^{11}B$ values range from -27.1 to -10.7 ‰, with a major cluster around -12 to -18 ‰. There is a general trend of decreasing B isotope compositions from magmatic tourmaline hosted in the leucogranite and plagioclase veins (~ -13.5 ‰) towards those present in the schists and quartz veins (~ -18 ‰), which is consistent with a model of tourmaline growth from late-stage exsolved magmatic fluids.

Evidence for a separate fluid component is given by the presence in some metasediments and crosscutting quartz veins of tourmalines with $\delta^{11}B$ as low as -27 ‰, way beyond the reach of fractionation due to fluid exsolution. Quartz vein-hosted tourmalines are chemically and isotopically zoned. We distinguished two coexisting types of grains, with opposite core-to-rim variations: one has an isotopically heavy (-18 ‰) Al-rich blue core, and the other a relatively light (-21 ‰) Mg-Ca-Ti-rich dark brown core. Their respective rims show chemical and isotopic compositions intermediate between the two. We suggest that the dark brown cores formed from an isotopically light fluid released from the schists during contact metamorphism, while the blue cores crystallized within the magmatic fluids. Their rims record the subsequent partial mixing of both fluids during hydrothermal alteration of the country rocks.