

Geochemistry and boron isotope compositions of tourmalines from the granite-greisen-quartz vein system in Dayishan pluton, Southern China: Implications for potential mineralization

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ABSTRACT

Tourmaline occurs widely within Dayishan ore field, Nanling Range, and is associated with magmatic-hydrothermal rare metal mineralization. Four types of tourmaline are recognized: (1) tourmaline in coarse-grained monzogranite (Tur-G1); (2) tourmaline in medium-fine-grained monzogranite (Tur-G2); (3) tourmaline aggregates associated with muscovite in greisen (Tur-Gr), showing a yellow core (Tur-Gry) and blue rim (Tur-Grb); and (4) quartz-vein-hosted tourmaline (Tur-V). In this study, we performed systematic investigations of in situ boron isotopic and elemental compositions of tourmalines in different granite, greisen, and quartz veins by EPMA and LA-MC-ICP-MS. Results show that almost all tourmalines exhibit schorl compositional affinity with extremely low Ca contents, high Fe/(Fe+Mg), and the calculated X-site occupancies in tourmalines show their affinities to the alkali group. Substitution processes of major element variations are dominantly caused by MgFe₋₁, FeAl₋₁, (Ca,Mg)(□₋₁,Al₂), and R(Na,Mg)₋₁ exchange vectors. Based on geochemistry and petrology, Tur-G1, Tur-G2, and Tur-Gry precipitated from a boron-rich melt, while Tur-Grb and Tur-V crystallized from hydrothermal fluid. Many trace element concentrations overlap and most are <10 ppm. The significantly higher contents of Sn and Zn and positive Eu anomaly reflect the influence of an external fluid. Magmatic tourmalines fall into a narrow range of δ¹¹B values between -15.58 and -14.09‰, indicating a single boron source of the granitic magma. Hydrothermal tourmalines display slightly lighter B isotopic compositions (-16.31 to -14.91‰), which are consistent with precipitation from externally derived fluids with lighter boron. Based on the isotopic and chemical compositional evidence, Sn and Zn may come from the host rock rather than granite.

Keywords: Tourmaline, boron isotope, Sn deposit, Nanling range, potential mineralization