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Geochemistry of tourmaline from granitic pegmatites in East Qinling and its implications for mineralization

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The East Qinling region is one of the most important pegmatite provinces hosting rare-element deposits in China[1]. Tourmaline is a ubiquitous mineral in various types of pegmatites in East Qinling and commonly exhibits black to dark blue color in many pegmatites. In this study, we investigated the compositional variation of black tourmaline from barren to Li pegmatites to demonstrate that tourmaline geochemistry can potentially serve as a mineralization indicator. The investigated black tourmalines belong to schorl series and evolve close to schorl-elbaite series in composition in Li pegmatites. In the Li pegmatite, the black to dark blue tourmalines with the Li_2O content reaching ~ 1.0 % and $\delta^{11}B$ values ranging from -18.96 ‰ to -16.89 ‰ show high Li, Mn, and Zn concentrations but extremely low Mg, Ti, Sc, and V.

Boron isotopes reveal two types of tourmalines in the some pegmatites. Type I tourmalines enriched in heavy B isotope likely crystallized from the pegmatite-forming melts whereas Type II tourmalines showing more negative $\delta^{11}B$ values likely precipitated from the exsolved fluids. Such fluids also resulted in formation of hydrothermal tourmalines in the country rocks. No significant B isotopic fractionation was observed during the interaction between the exsolved fluids and the country rocks. Nevertheless, the interaction between pegmatites and their country rocks caused addition of Mg, Ti, and V into the pegmatite and meanwhile migration of Li, B, and Al towards the country rocks. From barren to Li pegmatites, with increasing differentiation degree of pegmatites, the Li, Mn, Zn, and F contents of schorl tourmaline increase and exhibit negative correlation with tourmaline $\delta^{11}B$. This suggests that Li, Mn, Zn, and F contents and B isotopic compositions of schorl tourmaline can indicate various pegmatite-hosted rare-element mineralization in East Qinling.