

Tourmaline geochemical and boron isotopic constraints on the genesis of the Li-rich pegmatites in the eastern Tibetan Plateau

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The magmatic-hydrothermal transition in Li-Cs-Ta-enriched (LCT-type) pegmatites has garnered significant attention, particularly as economic rare metal (such as Li) minerals reach saturation and induce mineralization at this stage. However, it remains challenging to elucidate the intricacies of the melt-fluid evolution process and the distribution behavior of Li. In order to better constrain magmatic-hydrothermal transition processes that govern Li mineralization, we conducted in-situ major and trace element, and B isotope studies of tourmalines from the Dangba Li-rich and Li-poor pegmatites in the central Songpan-Ganze terrane of the eastern Tibetan Plateau. Tourmalines exhibit a range of compositions from magmatic dravite and schorl to hydrothermal elbaite in the Li-rich pegmatite, while the compositions of tourmalines primarily consist of magmatic schorl in the Li-poor pegmatite. The different substitution mechanisms between tourmalines from the Li-rich and Li-poor pegmatites reflect a difference in the conditions under which they were formed. The Li-rich pegmatite may be formed from an oxidizing and high-salinity magmatic-hydrothermal environment, while the Li-poor pegmatite may be formed in a reducing and low-salinity environment with limited water. Tourmalines in the Li-rich pegmatite exhibit significant B isotope fractionation, suggesting that approximately 30 wt% fractionation of B from the evolved melt by fluid exsolution. These observations suggest that the oxy-tourmaline serves as a valuable prospecting indicator for Li precipitation, and high oxidized and salinity melts/fluids played a critical role in Li mineralization. Our study highlights the potential of tourmaline in tracking the magmatic-hydrothermal transition and offering insights into Li mineralization.