Public Abstract

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Title:Variation and fractionation of lithium isotopes within single tourmaline crystals in the pegmatites of the Black Hills, SD

Pegmatites are granite intrusions best known for their spectacularly large crystals. Recent models suggest that the crystals attain their size during rapid cooling of pegmatite dikes, perhaps even at subsolidus conditions. Lithium is an important component in many pegmatites. Its concentration variations and fractionation of its isotopes, 7Li and 6Li, can be used as a measure of the kinetics of crystallization. Tourmaline, a mineral commonly found in pegmatites, incorporates Li. Thus concentrations of Li and Li isotope ratios in tourmaline can be used as a proxy to study kinetics of pegmatite crystallization.

This study examines the concentration of Li and its isotopes in tourmaline from the pegmatites of the Black Hills, SD. In the dikes, tourmaline occurs as elongated crystals that nucleated near boundaries with cold host rock and point toward centers of dikes.

Results reveal extreme fractionation of Li isotopes along tourmaline’s long c-axes. Some measured Li isotope ratios are among the highest ever measured in rocks. A large portion of fractionation is likely due to kinetic effects resulting from the 16% mass difference between 7Li and 6Li. Because 7Li diffuses slower in silicate melts, during rapid crystallization of tourmaline 7Li is likely to be preferentially accumulated at the crystal-melt interface, thus producing unusually high 7Li/6Li ratios. Thus, measured unusually high 7Li/6Li ratios are consistent with rapid crystallization of pegmatite dikes, although non-systematic ratio profiles along c-axes suggest that other factors, such as interrupted crystallization or crystallization of other minerals, may contribute to the observed variation Li isotope fractionation.