

VARIATION AND FRACTIONATION OF LITHIUM ISOTOPES WITHIN SINGLE  
TOURMALINE CRYSTALS IN THE PEGMATITES OF THE BLACK HILLS, SD

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ABSTRACT

Extremely large elongated crystals, attributed to low nucleation rates and rapid growth during fast cooling, are just one example the unusual disequilibrium features found in granitic pegmatites. Lithium isotope ratios are no exception. Previous studies have shown pegmatites to have significantly elevated  $\delta^7\text{Li}$  compared to normal crustal values and large variations across individual pegmatite intrusions. Variable and extreme isotope fractionation has been linked to kinetics of crystallization, differential diffusion of  $^6\text{Li}$  and  $^7\text{Li}$ , fractional crystallization, and interaction with fluids. Although a number of isotopic studies of pegmatites exist at the outcrop scale, studies on single crystals are rare. For this study, tourmaline crystals were collected from several texturally different Proterozoic leucogranite pegmatite localities in the Black Hills, SD. Slices of tourmalines, cut perpendicular to the crystal's long axis, were dissolved by an alkali fusion technique. Li concentration and isotope values were determined for each slice. Results reveal extreme fractionation and variability of Li isotopes within single tourmaline crystals. The  $\delta^7\text{Li}$  values measured are among the highest ever measured in rocks, though the average for each crystal falls within previously measured  $\delta^7\text{Li}$ . The highest  $\delta^7\text{Li}$  measured in a slice is 35.7‰; the average for the crystal is 17.4‰. There is a weak correlation between  $\delta^7\text{Li}$  and Li concentration along the lengths of tourmalines; however, one tourmaline showed no correlation. A large portion of fractionation is likely due to kinetic effects resulting from the 16% mass difference between  $^7\text{Li}$  and  $^6\text{Li}$ . High Li concentrations may be due to fractional crystallization.