

Direct observation of melting and crystallization in the system $\text{LiAlSi}_4\text{O}_{10}\text{-H}_2\text{O}$ using the hydrothermal diamond anvil cell: implications for late-stage crystal growth in lithium-rich pegmatites

M.G. Reid and A.J. Anderson

Department of Earth Sciences, St. Francis Xavier University, Antigonish, Nova Scotia B2G 2W5, Canada

[<mikegreid7@gmail.com>](mailto:mikegreid7@gmail.com)

A series of hydrothermal diamond anvil cell (HDAC) experiments ($n = 41$) were conducted in order to investigate melting and crystallization in the system $\text{LiAlSi}_4\text{O}_{10}\text{-H}_2\text{O}$. Hydrated lithium aluminosilicate melt was undercooled to various pressures and temperatures below the petalite hydrothermal melting curve. In situ observation of this undercooled melt afforded measurement of crystal growth rates in real time. Crystallization was observed to occur in the silicate melt, the aqueous fluid, or concurrently in both mediums. Crystal growth in the aqueous fluid was complemented by the consumption of silicate melt. Some of the crystals that initially grew in the silicate melt continued to grow beyond the melt–fluid interface by the transfer of melt material in the aqueous fluid. Raman spectroscopic and SEM-EDS analysis of the experimental products indicate that quartz and α -spodumene formed under high pressure conditions, and β -spodumene and virgilite \pm lithian mica crystallized at lower pressures. The growth rates of lithium aluminosilicate minerals ranged between 7.52×10^{-8} and 8.52×10^{-6} cm/s and were essentially the same in the melt and aqueous fluid. The results of the HDAC experiments provide insights into crystal growth processes in watersaturated lithium-rich pegmatites. In agreement with previous models of crystal growth in miarolitic pegmatites, these experiments show that aqueous fluid acts as an effective transport medium for the diffusion of residual silicate melt material to the growing crystal faces.