

Why is eucryptite (LiAlSiO_4) so rare in granitic pegmatites?

YONGCHAO LIU, JIANKANG LI AND QIANG LIU

Institute of Mineral Resources, Chinese Academy of Geological Sciences

Eucryptite typically occurs as a rare accessory mineral in granitic pegmatites, in the form of (i) eucryptite veinlets, (ii) eucryptite+quartz intergrowth, (iii) eucryptite+albite intergrowth, and (iv) eucryptite nodules and aggregates. Eucryptite is considered as late-stage alteration products of spodumene/petalite. Instead, some eucryptite nodules were partly replaced by spodumene in the Tanco pegmatite, suggesting an early origin [1]. The mechanisms of eucryptite formation in pegmatites remain unclear. Here, using a hydrothermal diamond-anvil cell and Raman spectroscopy, we studied the hydrothermal stability of eucryptite and at which conditions eucryptite can be generated from alteration of spodumene.

Starting materials were natural spodumene (Spd), quartz (Qtz), synthesized eucryptite (Ecp), LiAlSiO_4 -gel, and chemical reagents, which were used in 6 runs: (1) LiAlSiO_4 -gel+ H_2O , (2) Ecp+ H_2O , (3) Ecp+Qtz+ H_2O , (4) Spd+1M-NaCl, (5) Spd+0.5M-NaCl+0.5M-LiCl, (6) Spd+0.1M-NaCl+0.9M-LiCl. In run 1, the solids were completely dissolved into fluids at 800 °C, followed by cooling at 10 °C/min. For other runs, the charges were stepwise heated from 250 to 550 °C with increments of 50 °C, dwelling at each step for 2–97 h. In run 1, Ecp crystalized at 695 °C during cooling. In run 2, there was no obvious reaction of the Ecp except slight dissolution. At the presence of Qtz, the Ecp reacted and Spd formed upon heating to 300 °C (run 3). In run 4, the Spd were corroded and analcime formed at 350 °C, and at 550 °C analcime disappeared and nepheline occurred. Heating of run 5 generated analcime and Li-metasilicate (Li_2SiO_3) at 450 °C. In run 6, Ecp and Li-metasilicate formed at 450 °C.

Our experimental results indicate that the hydrothermal stability of Ecp is controlled by silica activity and Li relative to Na activity, which is consistent with thermodynamic calculations (Fig. 1). Eucryptite formation from sodium metasomatism of Spd requires a fluid with high Li activities. Our findings may help explain the rare occurrence of Ecp in granitic pegmatites, i.e., normally in local silica-undersaturated environments. On the other hand, only the intergrowth of Ecp+Qtz from retrograde breakdown of spodumene/petalite can serve as indicators of low P - T conditions.

Reference

[1] Černý (1972), *Canadian Mineralogist* 11, 708-713.

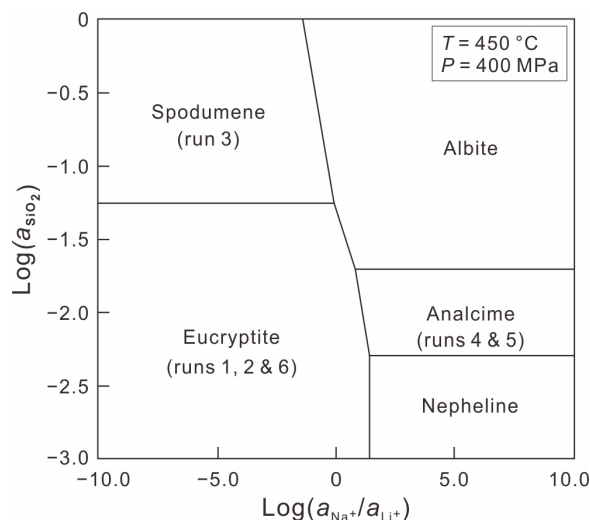


Figure 1. Activity-activity diagram showing the stability of eucryptite as a function of fluid chemistry