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Microthermometric behavior of crystal-rich inclusions in spodumene under confining pressure

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A hydrothermal diamond anvil cell (HDAC) was used to observe the microthermometric behavior of solid + liquid + vapor inclusions in spodumene under confining pressure. At 25˚C most spodumene-hosted inclusions contain a carbonate mineral (zabuyelite, rarely calcite or nahcolite), SiO_2 (quartz and or cristobalite), a lithium-bearing phyllosilicate (cookeite), and an aqueous fluid and carbonic phase. Dissolution of inclusion solids at high temperatures and the simultaneous growth of new spodumene on the inclusion walls resulted in a reduction of inclusion volume by up to 30%. After cooling to room temperature, the homogenized inclusions contained only aqueous fluid and a carbonic phase. In contrast, inclusions that failed to homogenize due to leakage or insufficient heating contained glass or partially dissolved minerals when quenched.

The volume of spodumene formed on the walls of the inclusion, as measured from the difference in inclusion size before and after heating, was used to calculate the volume of zabuyelite, cristobalite and cookeite produced by the reaction:

$5LiAlSi_2O_6 + 4H_2O + 2CO_2 = 2Li_2CO_3 + 7SiO_2 + LiAl_4(Si_3Al)O_{10}(OH)_8$

The relative volumes of the calculated reaction products are in close agreement the proportion of daughter minerals in the inclusions prior to heating. The absence of glass in the quenched homogenized inclusions shows that their contents do not represent the products of an entrapped hydrous silicate melt. Furthermore, changes in volume during heating indicate reequilibration with the host mineral making these inclusions unsuitable for temperature and pressure estimation of spodumene crystallization.