Peralkalinity in peraluminous granitic pegmatites. II. Evidence from experiments on carbonate formation in spodumene-bearing assemblages

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ABSTRACT

Carbonate has often been identified in aqueous carbonic inclusions in spodumene-bearing and other pegmatites, but its origin remains unclear. Here, the conditions at which carbonate and hydrogen carbonate can be generated from spodumene, CO₂ and H₂O, were studied using a hydrothermal diamondanvil cell (HDAC) and Raman spectroscopy. In all experiments, spodumene persisted in aqueous carbonic solution up to the maximum temperature (600 to 800 °C). Heating of hydrogen carbonate/ oxalate solutions produced CO₂- and HCO₃-rich peralkaline fluids, which resulted in strong corrosion of spodumene (and polylithionite-trilithionite) and, in one run, formation of zabuyelite $[Li_2(CO_3)]$ crystals at low temperatures. The experiments indicate that the reaction of spodumene with CO_2 and H₂O requires a peralkaline fluid to proceed rapidly. In addition, they show that spodumene crystallizes upon the heating of quartz, muscovite, and aqueous lithium carbonate solution. We conclude that if the aqueous fluid was rich in alkali hydrogen carbonate, zabuyelite in fluid inclusions in pegmatites can form both via a subsolidus reaction of CO₂-bearing fluid inclusion with the spodumene host or by trapping a peralkaline fluid early in the evolution of simple or complex pegmatites. The results of our experimental study strengthen the conclusion that, although counterintuitive, hydrogen carbonate-rich peralkaline fluids may be involved in the evolution of peraluminous granitic pegmatites, in which peralkaline minerals are normally absent or very rare.

Keywords: Zabuyelite, carbonate, hydrogen carbonate, CO₂, pegmatite, spodumene, hydrothermal diamond-anvil cell