The effect of boron on nucleation and growth in pegmatite-forming melts

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Granitic pegmatites are renowned for their large, meter-sized, crystals that grow in the space of months to years, but the mechanisms for their genesis remain obscure. Boron, as one of the fluxing components, is believed to play an important role in the formation of granitic pegmatites [1, 2] by lowering the viscosity, the solidus and the liquidus temperatures of the melt, and increasing the water solubility of the melt.

Experiments were conducted to study the influence of boron on nucleation in granitic composition melts. The starting material was prepared by crushing and grinding rhyolitic obsidian (LCO) from Lake County, Oregon, USA with addition of 0.25 wt. % B_2O_3 (LCOB). In each run one capsule was filled with LCOB + 4 wt. % H_2O, one with LCO + 4 wt. % H_2O, and one with only LCOB to separate the effects of water from boron. Experiments were conducted at 500 ° C, 500 MPa for 1, 2, and 4 weeks. Conditions were chosen to replicate the low temperatures and short crystallization times of granitic pegmatites. Duplicate experiments at the same conditions were performed to reproduce the original results. The experimental run products were imaged using an SEM and Raman spectrometry mapping to determine the textural features and mineral compositions.

In 1-week duration LCOB + water experiments only metal oxide crystals (predominantly magnetite) are present, which are also present in zero time runs. In 2-weeks duration experiments there are signs of heterogeneous nucleation on the capsule walls. The crystallization takes the form of spherulites composed mostly of K-feldspar with lesser amounts of intergrown quartz. In 4-weeks duration experiments similar spherulitic crystallization can be observed.

In the 2-week duration B-free experiments the spherulitic crystallization was not detected, but K-feldspar-quartz spherulites were noted in 4-week, B-free experiments.

The water-free experimental run products show no crystallization other than minor metal oxide crystals.

Those preliminary results demonstrate that boron in combination of water facilitates nucleation in melts of granitic composition.

[1] London, D. (2008). Pegmatites: Mineralogical Association of Canada. [2] Simmons, W. B., Webber, K. L. (2008). *European Journal of Mineralogy*, 20, 4, 421-438.