IBA quartz chemistry to track phase separation in intrusive rock

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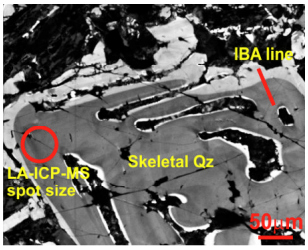
Undercooling and fast crystallisation textures such as myrmekites, granophyric and dendritic and skeletal growths have often been associated with subsolidus crystallisation due to H_2O loss. The exsolution of the fluid phase initiates the nucleation of quartz, K-feldspar and plagioclase by quenching at the binary eutectic.

A combined study of cathodoluminescence imaging and detailed chemistry was applied to tonalitic intrusive rock from the Ngatamariki Geothermal Field, New Zealand. The intrusions underwent phase separation at an estimated depth of 1.6 km and produced a large phyllic alteration halo in the country rocks. The working hypothesis is that the last stage of the magmatic mineralogy has recorded the exsolution stage in their chemistry. Quartz phenocrysts in the tonalite are up to 8 mm in diameter and embayed. Also present are small (<2 mm) skeletal quartz grains cocrystallising with a myrmekitic / granophyric groudmass.

Cathodoluminescence on quartz, La-ICP-MS and Ion Beam Analysis (IBA) were done on rounded and skeletal quartz phenocrysts to track variations in Ti, Al, F, Li and B from core to rim in the different CL zones. The outer rims of the skeletal quartz and groundmass quartz are brighter in CL than the large phenocrysts, suggesting enrichment in Ti and other trace elements (figure). A 15 µm proton beam was raster scanned over the sample to produce elemental maps. Ti and Al were detected via X-rays; F via γ-rays, B and Li via (p,α) nuclear reactions. The IBA techniques give spatial precision to the micron scale and ppm LODs allowing detailed chemistry to track the volatile loss.



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Combined diffusion studies in sanidine, quartz and orthopyroxene: Timescales of magma mixing in the Bishop Tuff

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The ~0.76 Ma Bishop Tuff (eastern California) is an archetypal product of a compositionally stratified magma chamber. A key issue regarding the evolution of the melt-dominant magma body that has arisen from recent studies involves understanding the nature and timing of late-stage mixing with a compositionally contrasting melt. This melt is reflected, for example, in the CL-bright rims on quartz and Sr- and Ba-rich rims on sanidine reported in ignimbrite samples erupted from vents along the northern caldera rim [1, 2, 3].

We use ternary feldspar thermometry combined with 1D diffusion models to calculate timescales for diffusion of key elements in three crystal phases of the Bishop Tuff. We show that Sr in sanidine, Fe-Mg in orthopyroxene and Ti in quartz all indicate mixing timescales of <150 yrs, in contrast to the ~2000 yr timescale from Ba in sanidine. The anomalously long timescales obtained from Ba diffusion in sanidine have implications for the application of this chronometer to low-T (~800 °C) rhyolitic systems. The short timescales modelled indicate that the "contaminant" magma causing the growth of these rims was a relatively transient feature in the ~ 70 kyr history of the melt-dominant magma chamber [4].

[1] Anderson *et al*. (2000) *J. Pet*. **41** 449-473. [2] Peppard *et al*. (2001) *Am. Min*. **86** 1034-1052. [3] Wark *et al*. (2007) *Geology* **35** 235-238. [4] Chamberlain *et al*. (2013) *manuscript in prep*.

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