Crystallization of low-K calc-alkaline igneous rocks at lower crustal pressures

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We will present phase relations and compositions from high-pressure equilibrium crystallization experiments on low-K calc-alkaline rocks saturated in H_2O. The wider rationale of this study is to advocate the role of crystal fractionation in the lower crust of subduction-related magmatic arcs, as an alternative to the more conventional partial melting of amphibolites [1]. Furthermore, we aim to clarify the role of epidote (+Na-mica) during igneous crystallization near the solidus, and its potential effect on derivative granitic rock compositions by comparing our results with studies on natural sodium-rich granitoids [2].

As starting materials, we use a powdered natural paragonite+epidote+garnet-bearing mafic rock derived from the lower crust of the Kohistan paleo-island arc, and a trace-element-doped gel of similar composition. Experimental pressure and temperature were varied in the near-solidus domain (1.0-1.6 GPa; 650-800 °C), representing conditions relevant for deep arc crust formation. All experimental runs were buffered at NNO.

First results show that amphibole occurs in all runs, garnet is present at pressures above 1.0 GPa, and plagioclase is present in all runs except where epidote is present. As minor phases, rutile or ilmenite, and quartz are observed. In accordance with the addition of ~15 wt% water, coexisting liquids were saturated in H_2O, as indicated by the occurrence of 'bubbles'. Close to the solidus at 1.2 GPa, plagioclase disappears and an amphibole+garnet+rutile+ epidote+quartz assemblage coexists with vapour and hydrous melt. On a water-free basis (EMP analyses recalculated to 100 wt%), the glasses have high silica contents (~70-76 wt%) and low amounts of total alkali (~1.1-1.5 wt%), placing them into the dacite and rhyolite fields on the TAS diagram.

More experimental and analytical work is underway, and we will present a comprehensive set of data on phase relations, major-element compositions and element partitioning at the Conference.

[1] Brown & Rushmer (2006.) *Cambridge University Press.*
[2] Petford & Atherton (1996) *J. Pet.* **37**, 1491–1521.

How deep is deep? Plant biogeochemistry for detecting deep mineralisation

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Transported and potentially deep regolith extends across much of Australia, presenting a challenge for mineral explorers using traditional surface geochemical exploration techniques. Plant biogeochemistry is emerging as a valuable supplementary tool in exploration programs within these environments.

The application of plant biogeochemistry involves the chemical analysis of plant material (subaerial), where the elements are sourced from the regolith via the roots. Accumulation of elements in plant material is dependant on the element and its bioavailability. Element concentrations in plants are typically orders of magnitude lower than in geochemical material and exhibit different element associations.

Plant material has been analysed from the Tunkillia Au-prospect in the Gawler Craton, South Australia. Extensive exploration drilling has defined a biomodal distribution of Au – low concentrations at near-surface, a depletion zone, and primary mineralisation at depths exceeding 40 m. Gold concentrations in a variety of plant species have been up to 20 times background levels of plants in the region.

At Tunkillia, a large plant biogeochemistry and down-hole geochemistry dataset is integrated with isotope and soil biota analysis. This assists modelling of the vertical transportation of elements and limitations of plant root systems that access deep into the regolith profile.