THEME 5:
THE DEEPER EARTH

Session 5.5:
Granites and Crustal Anatexis

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The session focuses on the processes of melting, emplacement and crystallization of granitoid rocks, broadly defined. Contributions are invited on the mineralogy, petrology, geochemistry, applied geochronology, structure, geophysics and tectonics of granitoid migmatites, plutons and batholiths. Outstanding questions of interest include the following: Can the classification of granitoids into A-, I-, S-type, etc. be justified, specifically with regard to tectonic setting and overall sources? What combination of techniques can most effectively be used to constrain source types and heat budgets for granitoid magmatism? Have any advances been made on determining the role of fluids, magma mixing and blending, assimilation and hybridization, and/or tectonic setting of granitoids and granitoid migmatites?

5.5.12

Can we rely on tectonic discrimination of granitoids using geochemistry? An example from the Seychelles

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Constraining tectonic setting in old rocks is one goal of geoscience. Comparison of various features with well known modern examples is the most fruitful approach, although the sole use of geochemistry as a tectonic discriminator does not always work well. A good example is the unmetamorphosed Neoproterozoic granitoids of the Seychelles, which have been interpreted by almost all workers as having formed in an extensional, hotspot- or rift-related tectonic setting. The main evidence includes their perceived alkaline character, their depletions in $\delta^{18}O$ and trace element signatures that plot in the "within-plate" field. Our group has acquired an extensive database of WR geochemistry, Sr-Nd-O isotopes, U-Pb zircon ages and paleomagnetic determinations, which are better interpreted in terms of a continental or Andean-type arc setting [1-4]. Arguments are as follows: Lithologies include subsolvus and hypersolvus granodiorites and monzogabbros, with coeval dolerite dykes, resulting in a variety of intermediate rocks occurring as enclaves and irregular masses [1]; this assemblage is common in Andean plutons. Ages span ~100 m.y. (703-809 Ma, mainly 752 ± 4 Ma), difficult to reconcile with plume- or rift-related models [2]. Two groups of granitoids can be distinguished, whose petrology, geochemistry and isotopic compositions ($\varepsilon_{Nd\ 750}$ = +2.85 to -3.83; I_{Sr} = 0.7031– 0.7263) imply derivation from variable proportions of a mixed source composed of a juvenile, mantle-derived component, and an ancient component similar to Archean tonalitic gneisses in NW India [1]. We argue that the low $\delta^{18}O$ (4.1 ± 2.6 $^{o}/_{oo}$) of Seychelles granitoids relative to most igneous rocks (5.5-11 $^{o}/_{oo}$) is a source feature, rather than implying surface water interaction with extensional magma chambers [3]. Paleomagnetic data constrain the position of the Seychelles to the margins of a then extant (super)continent at ~750 Ma, consistent with a continental arc setting [4]. Reliance on geochemical discrimination alone, therefore, could result in a misleading inference regarding the tectonic setting of Seychelles, and other granitoids.

References

[1] Ashwal L.D., Demaiffe D. and Torsvik, T.H. (2002) *J Petrol* **43,** 45-83.

[2] Tucker R.D., Ashwal, L.D. and Torsvik, T.H. (2001) *EPSL* **187,** 27-38.

[3] Harris C. and Ashwal L.D. (2002) *CMP* **143,** 366-376.

[4] Torsvik T.H., Ashwal L.D., Tucker R.D. and Eide E.A. (2001) *Precamb Res* **110,** 47-59.