Granite production in the Delamerian Orogen

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The Delamerian- Ross Orogen is important for several reasons: i) it records the critical transition of SE Gondwana from a passive to subduction margin. ii) it provides a model for the evolution of a tectonic style subsequently perpetuated in the Palaeozoic Lachlan fold belt to the east. iii) it provides a glimpse of the association of thermo-magmatic processes with an extension-dominated style of orogenesis that is very different from classical Alpine-Himalayan and Andean models iv) the geochemistry of its magmas confronts some firmly held views on the use of geochemical discrimination diagrams in their tectonic assignation.

Our results indicate that in spite of general continuity between the Ross and Delamerian belts, the Ross Orogen had a history of active convergent or transpressional tectonism that starting started much earlier at ~540Ma. Felsic magmatism, deformation and metamorphism continued for 25Ma in the Ross before it started in the Adelaide Fold Belt, where the oldest Cambrian granite is 514Ma (Foden et al. 2002). The delayed on-set of subduction in the Delamerian Orogen during which time opening of the Kanmantoo trough continued implies continued westward motion of the Australian portion of eastern Gondwana. This may have been accommodated by either subduction or deformation in either the Mozambique Suture or more probably in the northern end of the South Prince Charles Mountains – Prydz Bay suture until the Mid Cambrian.

In the South Australian sector of the Cambro-Ordovician Ross-Delamerian Orogen (RDO), granites range in age from Middle Cambrian to Early Ordovician. Their occurrence is largely confined to deep, Early Cambrian, sediment-filled basins where they are associated with mafic rocks. The syn-tectonic suites have compositions forming a continuum between I- and S-type granites. After the cessation of convergent deformation at ~490 Ma an abrupt

transition to a bimodal magmatic association of mafic intrusions and felsic granites and volcanic rocks of S- and A-type affinities occurred. As exposed on the south coast of Kangaroo Island, S-type granite originated as *in situ* partial melts of the Early Cambrian sediments locally intruded by either mafic magmas or I-S granite magmas. These migmatite complexes were mingled with intrusions from the magmas that provided the underlying heat sources. Also on Kangaroo Island, composite S-type rhyodacite - dolerite dykes indicate that crustal melting involved mantle-derived melts. Field observations, major and trace element and Nd-Sr isotopic data indicate that granite magmas in this fold belt result from mixing of crustal and mantle source components, and from fractional crystallisation (AFC-type processes). Whilst the Nd-Sr composition of granite suites from the Delamerian Orogen form a continuous geochemical trend between the crust and the mantle melts, the A- and I-types cluster towards the mantle endmember and the S-types towards the crustal endmember. This dichotomy reflects three granite magma production situations: 1. Lower crustal mafic magma chambers which are contaminated by, and mingled with, melts of the local meta-sediments producing I-type magmas, 2. Crustal melts formed in the heated zones above upwelling mantle or close to mafic or I-type granite intrusions producing S-type magmas, and 3. Upper crustal mafic intrusions where closed-system fractionation dominates to produce A-type granite. The extent of fractionation and crustal assimilation varied progressively through the ~ 30Ma deformation history (514 Ma - 485 Ma) of this orogen. Importantly in this sector of the RDO, the crustal endmember is only represented by the Cambrian basin sedimentary fill (Kanmantoo Group) and expressly excludes the older Precambrian crust.

Foden, J., Elburg, M.A., Turner, S.P., Sandiford, M., O'Callaghan, J. & Mitchell, S. (2002). Granite production in the Delamerian Orogen, South Australia. *J. Geol. Soc. Lond.,* **159**, 601-621.

