Metamorphic and geochronological constraints on the evolution of the Kalinjala Shear Zone, Eyre Peninsula

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ABSTRACT

In situ monazite U-Pb dating from metasedimentary rocks in the core of the crustal scale Kalinjala Shear Zone in the eastern Gawler Craton indicate that peak condition of > 9 kbar at temperatures of around 810 ºC occurred at *c.* 1700 Ma during the craton wide Kimban Orogeny. Detrital zircon ages in metasedimentary rocks that contain the peak metamorphic assemblages indicate that maximum depositional ages for rocks in the core of the shear zone were around 1780 Ma, indicating that sedimentation occurred in the interval *c.* 1780-1700 Ma. Metapelite contains an early assemblage preserved in garnet cores characterised by a kyanite-rutile association. The enclosing matrix contains a cordierite-bearing assemblage that formed during the development of the principle gneissic fabric within the shear zone and documents ~4 kbar of decompression of the shear zone core during deformation. Garnet-biotite diffusional modelling suggests that the shear zone core cooled > 50 ºCMyr^{-1} implying rapid exhumation of the core. Fe-mg garnet diffusional modelling suggests that on the flanks of the shear zone that exhumation and cooling rates were slower, and the maximum metamorphic pressures were less than in the core, suggesting that the central region of the Kalinjala Shear Zone was rapidly exhumed compared to the flanks of the shear zone. Where the shear zone reworks rocks belonging to the early Paleoproterozoic Carnot Gneiss, early formed high pressure, high temperature assemblages are overprinted by lower pressure granulite assemblages leading to the formation of secondary cordierite-spinel at the expense of garnet-sillimanite. In Mg-Al rich rocks these early assemblages include rare garnet-sillimanite-orthopyroxene assemblages which formed at the expense of early sapphirine-rutile bearing associations. The garnet-sillimanite-orthopyroxene assemblage has been overprinted by cordierite-spinel-sapphirine-biotite at *c.* 1745 Ma. This age is slightly older than

typically assigned to the Kimban Orogeny, and suggests that the event may be longer lived than previously thought. The timing of the earlier high pressure assemblage is equivocal, and could conceivably be related to the previously recognised *c.* 2450 Ma high-grade metamorphism in the Carnot Gneiss, and therefore not part of the Kimban-aged metamorphic architecture. The metamorphic constraints and age data from the core of the Kalinjala Shear Zone, combined with existing data, support a transpressional setting associated with the Kimban Orogeny. No evidence was found to support previously proposed models that include an extensional setting, or a *c.* 1850 Ma evolution of the shear system.

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