



High-temperature metamorphism of the northeastern Gawler Craton, Australia

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High-temperature/low-pressure metamorphism, significantly elevated geothermal gradients and complex ~1600-1580 Ma tectonothermal evolutions are not uncommon within mineralised eastern Australian Proterozoic orogenic belts, and are preserved within the Broken Hill Block (central western New South Wales), the Mount Isa and Coen Inliers (far north Queensland) and the Reynolds Range (central Australia). More recently, this geological signature has been recognised within the Mount Woods Inlier in the northeastern Gawler Craton, South Australia.

The Palaeo- to Mesoproterozoic Mount Woods Domain (MWD) is highly prospective for FeO-Cu-Au deposits (including association with the recently discovered Prominent Hill FeO-Cu-Au orebody), and has been explored for Broken Hill-type Pb-Zn-Ag mineralisation. Although of economic significance, the MWD is geologically poorly understood as it is mostly overlain by extensive Neoproterozoic and Cambrian cover sequences. Limited work conducted in the area shows a complex history involving early sedimentation to ~1740 Ma (e.g. Fanning et al., 1988, Precambrian Research, v. 40/41, p. 363), metamorphism and deformation during the Kimban Orogeny (~1730-1710 Ma), possibly followed by younger sedimentation to ~1640 Ma (Holm, OZCHRON). Metamorphic zircon overgrowths yield an age of ~1590 Ma (e.g. Holm, OZCHRON; Chalmers 2007, PIRSA Report Book 2007/20), which is approximately

contemporaneous with mineralisation at Prominent Hill and extrusion of the nearby Gawler Range Volcanics (~ 1592 Ma; e.g. Fanning et al., 1988).

A garnet-cordierite-spinel bearing pelite sampled in the northern MWD was used to reconstruct the prograde pressure-temperature path. Porphyroblasts interpreted to have been andalusite indicate that early phases of prograde metamorphism occurred at conditions of ~ 1.8 - 4.2 kbar and ~ 510 - 630°C . As a result of subsequent heating, andalusite porphyroblasts are completely replaced by cordierite-spinel symplectites, and are isolated from the remainder of the bulk rock by cordierite moats. Garnet was also a product of prograde heating. Peak metamorphism attained conditions of ~ 4.7 kbar and 765°C . Metamorphism is associated with elevated geothermal gradients, estimated to be $\sim 65^\circ\text{C km}^{-1}$ during the early stages of metamorphism and $\sim 45^\circ\text{C km}^{-1}$ during peak metamorphism.

The commonality of these geological histories across eastern Proterozoic Australia, as well as the occurrence and widespread nature of high-temperature/low-pressure metamorphism brings into question the nature of the ~ 1600 - 1580 Ma orogenic event in eastern Australia.