U-PB ZIRCON, ZIRCON HF AND WHOLE-ROCK SM-ND ISOTOPIC CONSTRAINTS ON THE EVOLUTION OF PALAEOPROTEROZOIC ROCKS IN THE NORTHERN GAWLER CRATON

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The northern Gawler Craton occupies a pivotal place in the architecture of Proterozoic Australia, forming the volume that links the Meso-NeoArchaean core of the Gawler Craton to the comparatively juvenile Mesoproterozoic Musgrave Province. Due to an almost complete lack of outcrop and thick Neoproterozoic to recent cover, little is known about the Palaeoproterozoic basement rocks from the northern Gawler Craton. Compounding this problem is a very limited suite of basement intersecting drill holes. Existing data (Payne et al., 2006, Precam. Res.; Payne et al., 2008; AJES), indicate that: (a) sedimentary sequences were deposited in the interval c. 1750-1720 Ma, and were derived from comparatively enriched crust with age components including 1780 and 1820 Ma, (b) regional medium to high-grade metamorphism in the northern Gawler Craton occurred in the interval 1725-1690 Ma.

To complement recent work, the current study presents U-Pb zircon ages, zircon Lu-Hf and whole rock Sm-Nd isotopic data from additional orthogneiss and metasedimentary rocks intersected in drill core. U-Pb zircon ages obtained from granitic orthogneisses provide interpreted igneous crystallisation ages at ca 1780 Ma, and metamorphism at ca 1720 Ma. Metamorphic monazite ages of 1720 Ma are consistent with zircon-based interpreted timing of metamorphism at c. 1720 Ma. P-T calculations indicate that the c. 1720 Ma metamorphic rocks have been exhumed from the mid-lower crust, with metamorphic conditions ranging up to 9 kbar and 750°C.

Isotopic Hf zircon data from most samples of felsic orthogneiss show that zircons are somewhat evolved with $\varepsilon_{Hf\,(\sim1700\,Ma)}$ values of around 0 to -5 and model ages of ca 2.5 to 2.7 Ga. Isotopic whole rock Sm-Nd values from most samples have relatively evolved $\varepsilon_{Nd\,(1700)}$ values of -6 to -2.5, which is similar to previously analysed metasedimentary samples from the Northern Gawler Craton. The isotopic data suggest that the protoliths to Northern Gawler felsic rocks were sourced from a significant portion of evolved continental crust. In contrast, a more mafic unit, from drill hole Middle Bore 1, has a very juvenile signature with $\varepsilon_{Hf\,(\sim1700\,Ma)}$ values of ca +6 to +9, and $\varepsilon_{Nd\,(1700)}$ values of ca -3.5.

Monazite U-Pb age data also provide evidence for a younger group of granites in the northern Gawler Craton that intruded at ca 1450 Ma. These are either weakly deformed or undeformed, and are similar in age to granulite facies metamorphism that is recorded by the formation of migmatitic garnet-cordierite-bearing assemblages in metasedimentary rocks. These ca 1450 Ma ages are similar to the timing of widespread cooling and shear zone development in the central and southern Gawler Craton (Hand et al., Econ Geology xxxx). Tectonism of this age is rare in Australia, however its areal extent in the Gawler Craton points to the existence of a largely unrecognised tectonothermal event in the southern Australian Proterozoic.

While it is dangerous to compare different regions on the basis of event time lines, there are a number of intriguing similarities between the late Palaeoproterozoic and early Mesoproterozoic evolution of SW Laurentia and the Gawler Craton. Both experienced widespread deformation at c. 1730-1690 Ma, with synchronous or immediately preceeding sedimentation derived from erosion of crust dominated by a narrow range (1800-1730 Ma) of zircon ages. Both area's received comparatively juvenile sediments at around 1650 Ma, and experienced tectonism and metamorphism at c. 1650 Ma. In the Gawler Craton, reactivation associated with magmatism and medium to high-grade metamorphism occurred in the interval c 1450-1430 Ma. This is similar in age to the onset of widespread magmatism, locally associated with deformation and metamorphism in SW Laurentia.