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Crustal growth and episodic reworking over one billion years in the Capricorn Orogen, Western Australia: evidence from Lu-Hf and O isotope data

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Fundamental to understanding the generation and evolution of a crustal block is knowledge of the relationship between additions of new material from the mantle, and the extent of crustal recycling [1]. Hafnium isotope ratios can be used to characterise relative contributions from mantle, crustal and recycled reservoirs within magmas. Oxygen isotopes can be used to constrain the extent of crustal interaction during magma emplacement. When used in conjunction, they can help unravel multiple crystallisation histories of a crustal block, and follow the source composition through magma evolution.

The Capricorn Orogen records the Paleoproterozoic collision of the Yilgarn and Pilbara Cratons to form the West Australian Craton, and over one billion years of subsequent intracontinental crustal reworking. U-Pb zircon geochronology records three discrete tectono-magmatic events which resulted in voluminous granitic magmatism: the 2005-1975 Ma Glenburgh Orogeny, the 1820-1770 Ma Capricorn Orogeny, and the 1680-1620 Ma Durlacher Orogeny [2].

We present U-Pb, Lu-Hf and δ18O isotopic data from zircon from 50 samples of granites and granitoids from the Capricorn Orogen to provide constraints on the crustal evolution of the Paleoproterozoic crust. Our results confirm crustal growth by juvenile mantle input was limited to the Glenburgh Orogeny associated with the amalgamation of the West Australian Craton, while all subsequent Paleoproterozoic magmatism was primarily derived from significant reworking of the pre-existing crustal components. Time-sliced maps showing the variation in Hf and O isotopes can be used to image crustal evolution in space and time, and are particularly useful in constraining the spatial and temporal extent of juvenile magmatic additions to the crust. These maps suggest that crustal growth was concentrated along, or in the terranes adjacent to, the Yilgarn Craton margin. Our results are in agreement with previous isotopic studies [3], and provide additional constraints for the evolution of the Paleoproterozoic crust within the Capricorn Orogen.

[1] Cawood et al. 2013. Geological Society of America Bulletin, 125(1-2), 14-32
[2] Sheppard et al. 2010. Geological Survey of Western Australia, Perth, Western Australia, 336
[3] Johnson et al. 2017. Lithos, 268, 76-86