

Vestiges of the Earliest Crust; Crustal Evolution in the Yilgarn Craton, Australia

Supervisors

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Project description

The generation and evolution of the continental crust is a long-standing geological problem that impacts on topics as disparate as the origins of life and the development of plate tectonics. While competing models argue over the details of how and when the continental crust grew, a large body of zircon U-Pb and Hf isotope data indicate that a significant amount of the crust was produced before 3 Ga and that the origins of the continental crust lie in Hadean times (4.0-4.55 Ga) (e.g., Arndt, 2013). Studying this critical portion of Earth history is hampered by the lack of Hadean rocks exposed at the Earth's surface. However, Archaean meta-sediments from the Jack Hills and Mount Narryer areas of the Yilgarn Craton of Western Australia, provide a keyhole into the Hadean because they contain detrital zircons which yield ages of 4.4-4.0 Ga (Valley et al., 2014).

Recent fieldwork in the Yilgarn has revealed that the Jack Hills and Mount Narryer meta-sediments also contain a wide variety of other detrital minerals in addition to zircon, including garnet, chromite and magnetite. These provide promising new targets for the application of a smorgasbord of isotopic techniques to discern better the nature of the now missing, earliest crust. Furthermore, the metasedimentary sequence at Mt Narryer contains macroscopic fragments of prior crust, notably in the form of garnet-rich pebbles. These are also amenable to isotopic interrogation and possibly represent fragments of Hadean crust. A key part of the studentship will be to map and thus identify the most suitable samples from the Mt Narryer sequence for isotopic studies. Detrital chromite and magnetite will be utilised to provide Re-Os age constraints and platinum group element systematics of the crust during a time when the late heavy bombardment was synchronous with crustal growth, whereas garnets will provide complimentary Lu-Hf data to the zircon dating studies. Therefore the studentship provides a unique chance to develop cutting edge isotope techniques on the oldest geological samples on the Earth and gain insights into the origins of the continental crust

The studentship will be based at Bristol, where training in clean laboratory techniques and Re-Os isotope measurements will be undertaken. Fieldwork will be undertaken in Western Australia with collaborators from the University of Western Australia. Skills in laser ablation MC-ICP-MS and other state-of-the-art mass spectrometry will be additionally gained in the laboratories of our CASE partner, the British Geological Survey.

References

Arndt, N. T., 2013. Formation and evolution of the continental crust. *Geochemical Perspectives*, **2**, 405-533.

Valley, J.W., et al, 2014. Hadean age for a post-magma-ocean zircon confirmed by atom-probe tomography. *Nature Geoscience*, **7**, 219-223.



Garnet-rich pebbles in Archaen meta-sedimentary rocks from Mt Narryer.



Fieldwork in the Yilgarn craton, Western Australia.