The Discipline of Earth Sciences, Queensland University of Technology has a number of PhD projects on offer to commence in 2018. Applicants will need to be competitive for the QUT Postgraduate Research Award (QUTPRA).

## 1. Wildfires as an agent of geochemical and mineralogical differentiation at the Earth's surface

Fires have affected large parts of the Earth's surface since the Devonian; they potentially exert a significant influence on the mineralogical and geochemical characteristics of an environment that is otherwise considered to be dominated by low temperature processes. A lack of suitable sampling media means that the impact of high intensity fires has proven difficult to test, but recent work identifies magnetic iron pisoliths as a promising archive. Magnetic Fe pisoliths contain a high temperature mineral assemblage including maghemite & chi alumina, requiring >> 500 $^{o}$C to form. Their presence in soils and weathering profiles around the world demonstrates that intense fires have an important role to play in landscape evolution. In addition, our recent work suggests that the geochemical fractionation associated with the formation and subsequent weathering of these wildfire products results in highly unusual sediment trace element patterns across the Australian continent. Here we look for a highly motivated PhD candidate to undertake a detailed mineralogical and geochemical study of samples of Fe pisoliths sampled before and after major bush fire events in Australia, Southern Africa and California. This will provide important constraints on the formation of magnetic Fe pisoliths that can then be applied to ancient examples, providing an entirely new perspective of the role of fire in the Earth system. The candidate will be expected to use a variety of mineralogical and geochemical techniques to investigate the Fe pisoliths including XRD, SEM, Raman spectroscopy, EPMA, EBSD, LA-ICPMS and potentially synchrotron source techniques.

For further information, please contact: Dr David Murphy (david.murphy@qut.edu.au)

## 2. Lithostratigraphy, metamorphism, petrochronology and structural geology of a transect from the margin of a granitic dome into a greenstone keel in the East Pilbara Terrane

Study of Paleoarchean terranes (3.6 Ga-3.2 Ga) provides invaluable information on the early Earth. During this time period substantial volumes of stable continental lithosphere formed, which became the nuclei around which later crust accreted. The distinctive dome and keel crustal architecture has been suggested to form during distinctly different tectonic regimes compared to the modern Earth. Partial convective overturn has been suggested to explain dome and keel crustal architecture, where low density felsic material ascends from depth and high density mafic material descends to depth. The interfaces between granitic domes and mafic dominant greenstone belts therefore represent the ideal locations to investigate the formation and subsequent stabilisation of dome and keel crustal architecture. The project will be to develop a lithostratigraphic, structural and metamorphic model for the interface between

a greenstone keel and its adjacent granitic dome. The qualitative observations from field work will then be quantitatively constrained using petrochronology and thermobarometry.

The candidate will be expected to preform field mapping in structurally complex and remote locations and to use a variety of mineralogical and geochemical techniques including LA-ICPMS dating (zircon, titanite, rutile & mica), XRF, XRD and EPMA. A manual driver's license is required and ideally some 4wd experience.

For further information, please contact: Dr David Murphy (david.murphy@qut.edu.au)

3. **Interrogating the complex chronological signals from different petrochronometers in a variably metamorphosed sedimentary sequence in Arkaroola, South Australia.**

The Neoproterozoic stratigraphy exposed in Arkaroola, northern Flinders Ranges, South Australia include well exposed carbonate and siliclastic units that have experienced a range of metamorphic conditions from sub greenschist facies to amphibolite facies. The stratigraphy was deformed and metamorphosed during the Delamerian Orogeny in the Cambrian. This provides the ideal natural laboratory to test how petrochronometers are affected by metamorphism and deformation. In sub greenschist facies stratigraphy the zircon, rutile, titanite and mica in siliclastic units will record provenance while calcite and dolomite in the carbonate units will potentially record timing of deposition and diagenesis. In the more deformed and metamorphosed stratigraphies new petrochronometers will grow (metamorphic mica and rutile) and preserved sedimentary petrochronometers will be variably reset. Thus this study will provide invaluable information on provenance, deposition and deformation of the Arkaroola Neoproterozoic stratigraphy. Furthermore, this study will provide quantitative data on deformation rates and thermal evolution during the Delamerian Orogeny.

The candidate will be expected to perform field mapping in structurally complex and remote locations and to use a variety of mineralogical and geochemical techniques including LA-ICPMS dating (zircon, titanite, rutile & mica) XRF, XRD and EPMA. A manual driver's licence is required and ideally some 4wd experience.

For further information, please contact: Dr David Murphy (david.murphy@qut.edu.au)

4. **The fluvial sedimentology, stratigraphy and provenance of the mid to late Devonian Merimbula Group, New South Wales**

*Are changes in provenance, accommodation and basin evolution reflected in sedimentary depositional environments of the Devonian Merimbula Group successions in New South Wales, Australia?*

This research focuses on reconstructing the internal physical sedimentology, provenance and stratigraphic architecture of a Devonian aged, dominantly fluvial system, with recorded marine transgressions. Recent dating of primarily intercalated volcanic deposits will provide a stratigraphic framework from which to reconstruct the internal stratigraphy (including sedimentology, palaeocurrent, provenance and geochronological analysis) of the Merimbula Group and produce a palaeo-environmental model.

Outcomes of this study will additionally provide an ancient analogue for recent developments in characterising fluvial depositional system end-members and transition between these end-members. It is only in the last two-decades that there has been advancement in the classification and identification of fluvial depositional environments. Rosgen (1994), Makaske (2001), Lynds (2005), and Colombre (2013), have questioned current fluvial depositional models with their conclusions supporting a review and modernisation of general fluvial classification models. To date, there has been little attempt to apply such continuum models to ancient fluvial successions.

The candidate will be expected to perform field mapping and stratigraphic logging and to use a variety of mineralogical and geochemical techniques including LA-ICPMS dating, XRF, XRD. A manual driver's licence is required and 4WD experience is preferred.

For further information, please contact Dr Jessica Trofimovs (jessica.trofimovs@qut.edu.au)

## 5. Testing the subduction hypothesis for the 2.7 Ga Yilgarn Craton (Kurnalpi Terrane, Western Australia)

*The nature of plate tectonics in the Archean remains a controversial topic, especially with respect to whether or not subduction occurred. The 2.7 Ga Eastern Goldfields Superterrane (EGS) is interpreted by some, based primarily on geochemistry, to preserve a volcanic arc within the Kurnalpi Terrane. However, the Kurnalpi volcano-sedimentary stratigraphy, which arguably provides a clearer picture of the tectonic setting, remains poorly understood, as does its relationship to the rest of the Eastern Goldfields. The research area includes part of two interpreted terranes and a range of ~2.8-2.65 Ga rock types, from komatiites and basalts to andesites and calc-alkaline felsic rocks, as well as a variety of sediments. This principal aim of the project is to develop a stratigraphic and structural history for the study area, using field data as the main basis for timing relationships, and to assess if this is compatible with a subduction origin. Geochemical and geochronological data will provide further constraints on the evolution of the magmatic system(s). This research has important implications for geodynamics as the onset of subduction represents an important event in Earth's history, yet there is little clear physical evidence in the Archean. Additionally, the EGS is one of the richest gold and base-metal terranes in the world and an improved understanding of structural and stratigraphic history has exploration implications.*

*The candidate will be expected to perform field mapping in structurally complex and remote locations and use a variety of mineralogical and geochemical techniques, including LA-ICPMS, XRF and EPMA.*

*For further information, please contact Dr Patrick Hayman (patrick.hayman@qut.edu.au)*