THE UNIVERSITY OF WESTERN AUSTRALIA

School of Earth Sciences

Potential research projects offered for Level 4 (Honours) and Level 5 (Masters) students commencing in 2019.

- Geology
- Geochemistry
- Geophysics
- Mineral Geoscience
- Petroleum Geoscience
- Hydrogeology

The projects outlined in this booklet are not necessarily all of those available. Please feel free to talk to staff members about designing projects around your interests.

Geoscience Projects

This document describes projects suitable for students undertaking a 24pt research project as part of an Honours or Masters degree.

Two key points to note:

We encourage you to consider what geoscience research problems interest you and to choose a project topic that will motivate you to do your best work throughout the year. The aim of the 24pt project is to provide an opportunity to learn how research works and to begin developing your research skills. The 24pt project is a pathway to higher degree by research (MSc, MPhil, PhD).

This document does not summarise all available projects and you are welcome to speak with any staff in the School who supervise projects in the areas of interest to you. We recommend that you have a UWA supervisor and a general idea of your project by the end of this year. Do not leave organising a project until the first teaching week of 2019! Remember that many of the staff take leave through January.

Geoscience is a broad discipline that includes Geology, Geophysics, Geochemistry, Geobiology and Computation/Numerical Modelling. The breadth of research activity in the School of Earth Sciences[1] means that students have opportunities to undertake diverse research projects. Research may be focused on resolving questions related to fundamental Earth processes and knowledge or have various levels of application to specific resources including mineral deposits, petroleum and groundwater.

You are welcome to contact staff directly (contact details are provided in the booklet) to discuss projects where they are listed as the main contact. If you are interested in an **MSc (by thesis & coursework) degree**, some of the projects outlined in this booklet can be extended into or set up as larger projects (e.g. 36pt projects). You are welcome to contact supervisors to discuss as required.

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1. New school name from 2017 resulting from demerger of the School of Earth & Environment

Project :	**Oxygen isotope make-up of the Archean mantle**
Majors including :	Geology
Supervisor :	Marco Fiorentini, marco.fiorentini@uwa.edu.au, 6488 3465 and Laure Martin
Description :	Komatiites are remarkable rocks. These crystallised products of the hottest lava flows ever erupted on the surface of the planet provide a snap shot of the Early Earth and a glimpse of the planet's origin. Most of the preserved komatiites are Archaean and Proterozoic in age, although a few rare but notable examples formed in the Phanerozoic, such as the ones outcropping on Gorgona Island off the coast of Columbia. Komatiites are thought to be associated with mantle plumes sourced from deep mantle reservoirs, possibly at the core-mantle boundary. Thus, these lavas provide invaluable insights into the composition of the deep mantle, the nature of core-mantle differentiation processes and the chemical, physical and thermal state of the Early Earth. The modern mantle has an inferred bulk oxygen isotope composition ($\delta^{18}O$) of about 5.5‰. Hadean and Archaean magmatic zircons derived from sources in the upper mantle have $\delta^{18}O$ compositions in a similar range, implying that the oxygen isotopic composition of the upper mantle has remained relatively constant, and comparable to the modern mantle throughout Earth's history. Conversely, the composition of the deep mantle - inferred from $\delta^{18}O$ measurements on olivine crystals from komatiites - appears to have changed through time. Whereas the source of the Gorgona lavas exhibits signatures between 4.4 and 5.5‰, recent works shows that the source of ca. 3.3 Ga komatiites from the Barberton greenstone belt of South Africa is significantly lighter, about 3 to 4‰. This discovery is puzzling because there was previously no indication that the Archaean mantle may have had a different oxygen make-up to its modern counterpart. This project aims to understand whether the light oxygen isotope signature recorded in the South African komatiites is an isolated phenomenon or whether any secular evolution in the oxygen isotope composition of Archaean and Proterozoic komatiites globally can be ascertained. To address this conundrum, the project involves petrographic, minero-chemical and isotopic study of fresh olivine grains from a selected range of 2.7 Ga Australian komatiites and 1.9 Ga Russian ferropicrites.

Project:	**A terrestrial hot spring setting for the origin of life? Darwin's Warm Little Pond revisited**
Majors including:	Geology
Supervisor:	Marco Fiorentini, marco.fiorentini@uwa.edu.au, 6488 3465
Description:	Understanding the origin of life is one of the grand challenges for modern science and gets to the very root of who we are, how we got here, and whether life may exist elsewhere in the solar system. The proposed Honours/Masters project provides the candidate the opportunity to collaborate with a team of researchers and address a focussed component of a larger study funded by the Australian Research Council to unveil the origins of life. More specifically, this study will test the proposal that a terrestrial hot spring field could have been the setting for the origin of life, in preference over the currently favoured site at deep sea vents. The natural laboratory to test this hypothesis is the 3.5 billion year old Dresser Formation in the Pilbara Craton of Western Australia. The Honours/Masters project will investigate the role of base and precious metals in the catalysis of early life mechanisms. More specifically, the work will involve the integration of whole-rock geochemical measurements of selected samples with in-situ minero-chemical information from a range of silicate and sulfide mineral phases. The candidate will have the opportunity to utilise the world-class analytical infrastructure available at the university of Western Australia, including scanning electron microscope, laser ablation ICP-MS and the ion probe. Depending on logistics, the candidate will either work on already available material and/or has the possibility to visit the remote field area where access to the Dresser Formation is possible.

Project:	**The role of volatiles in magma transport dynamics and ore deposit formation**
Majors including:	Geology
Supervisor:	Marco Fiorentini, marco.fiorentini@uwa.edu.au, 6488 3465
Description:	The aim of this project is to determine the fundamental physical processes that form finger-like magma conduits, which trap sulfide minerals enriched in highly valuable nickel (Ni), copper (Cu), cobalt (Co) and platinum group elements (PGE). Together with their traditional use in the manufacture of steel and alloy products, nickel and cobalt have recently acquired a renewed strategic importance for their use in new generation batteries. The ore bodies that contain economic concentrations of metal-rich sulfides occur in extremely rare and poorly constrained narrow, elongate finger-like magma conduits, which are extremely difficult to target in mineral exploration. Understanding their genesis would 1) advance knowledge on magma transport mechanisms within large magma plumbing systems and 2) boost predictive capacity to discover new Ni-Cu-Co-PGE deposits. The candidate will have the chance to work with a multi-national team of researchers to focus on the role of volatiles in sulfide transports along finger-like conduits. Specifically, the Honours/Masters project will focus on the poorly constrained of carbon dioxide, which is known to affect the sulfur capacity of silicate magmas as well as their physical attributes, such as density and viscosity. The work will involve the integration of whole-rock geochemical measurements of selected samples with in-situ minero-chemical information from a range of silicate, carbonate, phosphate and sulfide mineral phases. The candidate will have the opportunity to utilise the world-class analytical infrastructure available at the university of Western Australia, including scanning electron microscope, laser ablation ICP-MS and the ion probe. Depending on logistics, the candidate will either work on already available material and/or has the possibility to visit selected field areas for sampling purposes. It is expected that the project will lay the foundations required to develop much needed new tools for the successful exploration of elusive Ni–Cu–Co–PGE orebodies, addressing the looming shortage of known resources and predicted increases in demand (>$4 trillion) due to global urbanisation.

Project	**Gravity analysis of Kings Park hydrology**
Majors including:	Geology, Geophysics, Hydrogeology
Supervisor:	Alan Aitken, alan.aitken@uwa.edu.au, 6488 7147
Description:	Gravity data can be used to monitor subsurface storage of water, and can help to understand impacts on ecological change. This project seeks to better understand the hydrology of King's Park through gravity data collected over the last 4 years. This project suits those with an interest in environmental applications of geophysics. Some computing experience and reasonable maths ability are required.

Project:	**A methodology of large-scale 3D joint gravity & magnetic inversion**
Majors including:	Any geoscience related degree, physics, computer science
Supervisor:	Alan Aitken, alan.aitken@uwa.edu.au, 6488 7147
Description:	Geophysical inversion is a modelling process that generates a spatial property model (e.g. density) directly from geophysical data. Several projects are available to apply new technologies to gravity and magnetic inversion problems. Work will be completed making full use of Pawsey Centre supercomputer infrastructure and will involve testing new codes against existing approaches, assessing performance and helping to further develop the approach. This project suits those with an interest in geophysics. Software is designed to be used by non-specialists, however, computing experience and reasonable maths ability are required.

Project:	**How the West was One…The Rodona-Totten Shear Zone**
Majors including:	Geology, Geophysics or related
Supervisor:	Alan Aitken, alan.aitken@uwa.edu.au; 6488 7147
Description:	The reconfiguration of Mesoproterozoic Australia occurred between ca. 1600 Ma and ca. 1300 Ma, through a complex series of plate margin processes. The culmination of this was the collision of the South and West Australian continents. Past and recent studies indicate that this collision may have occurred along the Rodona Shear Zone, which lies offshore east of Israelite Bay in WA. This project involves the use of high-resolution aeromagnetic and gravity data from Australia and Antarctica to understand shear-zone structure and kinematics. This new map of the shear zone will be tied in with new geochronological and isotopic data emerging from beneath the Eucla Basin, from the Albany Fraser Orogen, and from Antarctica.

Project:	**Antarctic Geology and East Antarctic Ice Sheet vulnerability**
Majors including:	Geology, Geophysics or related
Supervisor:	Alan Aitken, alan.aitken@uwa.edu.au, 6488 7147
Description:	The vulnerability of the East Antarctic Ice Sheet (EAIS) is the biggest uncertainty in projections of future sea-level rise driven by climate change. Geophysical datasets from the US-UK-AUS ICECAP program have revealed for the first time the geology of Wilkes Land in East Antarctica. Several projects are available that will utilise these new data to reconstruct and understand subglacial geology, including mapping key controls on EAIS flow organisation and evolution. These projects are best suited towards students with an academic focus at MSc level as the results are highly publishable if well executed. Some familiarity with geophysical methods and a willingness to understand cross-disciplinary concepts are essential.

Project:	**Paterson Orogen: Geophysical mapping of geology**
Majors including:	Geology, Geophysics or related
Supervisor:	Alan Aitken, alan.aitken@uwa.edu.au, 6488 7147
Description:	This project will apply geophysical interpretation and analysis to Proterozoic basins within the region of the Paterson Orogen. The project will involve mapping geology from airborne magnetic, remote sensing and gravity data, and linking these observations to seismic profiles (where available) so as to help constrain models of basin evolution and ore deposit formation.

Project:	**Igneous and Metamorphic Petrology**
Majors including:	Geology, Geochemistry
Supervisor:	Tony Kemp, tony.kemp@uwa.edu.au, 6488 7846
Description:	Projects are available in the general fields of igneous and metamorphic petrology. Topics include, but are not limited to - (1) petrology and geochemistry of Proterozoic dolerite dyke swarms, (2) partial melting processes in mafic and metapelitic granulites from field and geochemical studies, (3) tin and rare metal mineralization in pegmatites and (4) characterization of chondritic meteorites. All projects would involve petrography and mineral chemistry, with scope for whole rock geochemistry and, potentially, U-Pb isotope geochronology (zircon, monazite). A small fieldwork component may be included. Projects can be tailored to suit individual interests, and may be undertaken over one or two years.

Project:	**High-Precision Uranium-Lead Geochronology applied to Igneous Processes and Tectonics**
Majors including:	Geology, Geochemistry
Supervisor:	Steve Denyszyn, steven.denyszyn@uwa.edu.au, 6488 7329
Description:	The use of thermal-ionisation mass spectrometry to determine the isotopic composition of uranium and lead in minerals such as zircon and baddeleyite can provide the most accurate and precise ages available for igneous events. This enables the determination of the timing, rate, and correlation of all sorts of geological processes, such as magma chamber development, ore-forming events, tectonic activity from the local to continental scales, or global biotic events such as mass extinctions. A variety of projects are available that will use this methodology, which involves careful laboratory practice, in combination with petrography and geochemistry to answer important questions in these fields using rocks already collected (so work can begin right away). Most currently-available projects involve the study of mafic intrusive rocks (dykes and sills, often from Large Igneous Provinces) and the timing of their emplacement, with implications for ore-deposit genesis, and the reconstruction of past climate and plate motion. If other rock types interest you, there are also projects available to study granites and their mode of emplacement, and metamorphic rocks to determine the timing of formation and metamorphism.

Project:	**Geological mapping of Venus**
Majors including:	Geology
Supervisor:	Myra Keep, myra.keep@uwa.edu.au, 6488 7198
Description:	Our record of the early evolution of Earth is limited by erosion, burial, tectonic dismemberment and periods of impact cratering. The Venusian surface preserves a rare and pristine record of terrestrial planet evolution. We aim to map in detail parts of the Atalanta Planitia Quadrangle (V4) of the northern hemisphere. Our proposed area contains vast areas of Venusian “tesserae” that is thought to represent the oldest surviving Venusian landscapes, and which provides a rich and detailed history of the evolution of the Venusian planetary surface. This project will involve interpreting SAR data and using first-order geological relationships to understand the kinematic evolution of the ancient tessera terrains in this block. Students must have a good understanding of structural geology and tectonics to 3rd year level. The scope of the project is compatible with extension to Masters level.

Project:	**Neotectonics and mass transport deposits in offshore petroleum basins of northern WA**
Majors including:	Geology
Supervisor:	Myra Keep, myra.keep@uwa.edu.au, 6488 7198 Julien Bourget
Description:	The northwest of WA hosts Australia's largest recorded earthquakes (ML 7.3, Meeberrie, 1941). Identification of modern surface offsets (fault scarps) and drainage capture, together with recently acquired earthquake focal mechanism data for 28 recent events, suggests that modern geomorphology may yield evidence as to recent earthquake activity throughout north-western WA, which may have triggered mass transport deposits. This project seeks to map modern structural orientations and fault reactivation in offshore areas in the Carnarvon and Browse basins with a view to understanding the pre-reactivation geometries and timing, and relating them to the modern tectonic setting. Two projects are available, and the scope is compatible for continuation to Masters level.

Project :	**General projects in seismic structural interpretation**
Majors including :	Geology
Supervisor :	Myra Keep, myra.keep@uwa.edu.au, 6488 7198
Description:	Projects are available in seismic structural interpretation across the North West Shelf, on a range of topics including: fault reactivation and inversion, neotectonics, igneous distributions, cross section restoration and others. Please see Myra for details.

Project:	**Depositional history and petroleum reservoir characterisation, North West Shelf basins**
Majors including:	Geology, Petroleum Geoscience
Supervisor:	Annette George, annette.george@uwa.edu.au, 6488 1923
Description:	A wide variety of petroleum reservoirs are encountered in the offshore basins of the North West Shelf of Australia. Petroleum-focused projects can be undertaken in shallow or deep marine depositional systems to reconstruct depositional and tectonic history of specific basins or through specific stratigraphic units (notably reservoirs). These projects typically involve integration of core work (sedimentology, facies analysis ± petrography ± biostratigraphy) with seismic and/or wire line log data in a sequence-stratigraphic framework. There are specific projects focusing on seismic sequence-stratigraphic interpretation of basin-margin history and characterisation of reservoir intervals. These projects are also suitable for 36-42 pt Masters projects.

Project:	**Characterisation of siliciclastic- or carbonate-dominated reservoirs associated with conventional and unconventional resources in onshore WA Basins (e.g. Perth Basin, Canning Basin)**
Majors including:	Geology, Petroleum Geoscience
Supervisor:	Annette George, annette.george@uwa.edu.au, 6488 1923
Description:	Understanding reservoir quality is a fundamental aspect of petroleum system analysis. The onshore basins of WA have been the sites of earliest petroleum exploration in WA, and despite the dominance of the NWS as the major petroleum producer, the onshore basins have had some exciting oil discoveries in the last few years (e.g. Cliff Head, Perth Basin, and Ungani in the Canning Basin). Projects will focus on conventional and unconventional reservoir development using core to petrographic-scale description and interpretation to establish depositional setting/environments and major controls on reservoir quality (i.e. principally distribution of porosity and permeability). Some of these projects include Hylogger® analysis and portable XRF analysis of core to obtain geochemical data for characterising facies and diagenetic effects. Some projects could involve application of higher level microscopic techniques (scanning electron, cathode luminescence).

Project:	**Palynomorph-based biostratigraphy and paleoenvironmental reconstruction of the Triassic Niof and Babulu groups (Timor)**
Majors including:	Geology
Supervisor:	Daniel Peyrot, daniel.peyrot@uwa.edu.au, 6488 2672
Description:	The biostratigraphy of the Lower and Middle Triassic interval of Western Australia is subject to a renewed interest as several hydrocarbon reservoirs covering the interval have been penetrated in different settings of the North West Shelf (NW Australia). The project will focus on the palynological analysis in coetaneous outcropping material from the Niof, Babulu groups (Timor Leste). These successions are already dated by other groups of fossils which will allow a better calibration of the corresponding Australian spores/pollen biostratigraphic zones. The main objectives of the project would be i) to refine the biozonation for the Early-Middle Triassic interval of Western Australia and ii) to characterize the recovery of the vegetation after the Permian/Triassic mass extinction event in the study area.

Project:	**Evolution of the vegetation of Western Australia during the Cretcaeous**
Majors including:	Geology
Supervisor:	Daniel Peyrot, daniel.peyrot@uwa.edu.au, 6488 2672
Description:	The study will focus on twenty Late Jurassic-Late Cretaceous samples from the Canning, Carnarvon and Perth basins. The taxonomy of the material has already been characterized by Balme in a seminal study from 1957. The project will focus on the abundance and composition of the main biological groups in order to characterize the evolution of the vegetation and its transition from Mesophytic conifer-dominated flora to a vegetation with modern characteristics.

Project:	**Taxonomic description of *Leptodinium* FM *sensu* Backhouse and its biostratigraphic significance for the Lower Cretaceous dinoflagellate cyst succession of Western Australia**
Majors including:	Geology
Supervisor:	Daniel Peyrot, daniel.peyrot@uwa.edu.au, 6488 2672
Description:	Dinoflagellate cysts are important biostratigraphic markers to date and correlate Berriasian-Valanginian (Lower Cretaceous) hydrocarbon-bearing strata from the North-West Shelf of Australia. Among other numerous informal taxa defined by consultants, *Leptodinium* FM *sensu* Backhouse has been widely used to refine the regional stratigraphy but has never been formally described. The project will focus on the morphologic characterization and taxonomic formalization of this taxon and its significance to improve the biostratigraphic framework of Western Australia.

Project:	**Evaluating heterogeneity in carbonate reservoirs and their controlling influences: seismic to pore-system studies**
Majors including:	Geology
Supervisor:	Moyra Wilson moyra.wilson@uwa.edu.au 6488 2680
Description:	Carbonate systems host ~50% of the world's hydrocarbon reservoirs and form major subsurface aquifers, yet their poroperm characteristics remain notoriously fickle and difficult to predict. Unlike clastic reservoirs, carbonates ones commonly show a greater range of pore types (e.g. intragranular, biomouldic), significant secondary porosity, bi- to tri-modal pore systems, as well as connected and unconnected pores. Better understanding of the heterogeneity in carbonate reservoirs is reliant on evaluating the considerable depositional and diagenetic variability in carbonate systems. A number of often industry-supported projects are available, including at Masters level. These projects will variably involve training in the study and integration of: core, outcrop, seismic, sequence stratigraphic, facies, microscopy, geochemical and petrophysical datasets. All results are anticipated to be highly publishable when executed to high standard.

Project:	**Coral Reefal Environmental change during periods of global climatic shifts**
Majors including:	Geology, Marine Studies, Environmental Science
Supervisor:	Moyra Wilson moyra.wilson@uwa.edu.au 6488 2680
Description:	Environmental change during global climatic shifts may be manifest in marine carbonate successions through changing: biota, mineralogy, facies, platform structure, early diagenesis and geochemistry. Projects are available to investigate controls on regional versus local change during times of major climatic shifts. These periods include the shift from greenhouse to icehouse conditions during the Cenozoic and the switches from glacials to interglacials that are particularly marked in the Plio-Pleistocene to Recent. These projects will variably involve training in the study and integration of: core, outcrop, seismic, sequence stratigraphic, facies, microscopy and geochemical datasets. All projects may be extendable to Masters level. Where executed to a high standard results are anticipated to be highly publishable.

Project:	**Landscape evolution: impacts on coral reefs and seascapes**
Majors including:	Geology, Marine studies, Environmental Science
Supervisor:	Moyra Wilson moyra.wilson@uwa.edu.au 6488 2680
Description:	Sediment-, nutrient- and freshwater-influx are widely considered deleterious to coral reefs and carbonate development. Yet in the global reefal biodiversity hotspot of Australasia such impacts are common on modern and Cenozoic reefs, but remain poorly understood. Two separate projects are available to evaluate impacts of terrestrial weathering and runoff, together with oceanographic processes on carbonate production and modern coral reefal development. Systems studied will be either a narrow fringing reef system, or reefs on a broader clastic-dominated shelf, both adjacent to weathering tropical landmass. An integrated approach will utilise field data collection, sediment and facies analysis, environmental analysis, experimental weathering studies, with the potential to involve petrology, scanning electron microscopy and geochemistry. This highly publishable research has implications for better understanding the: thresholds for reefal development, future survival of reefs under increased anthropogenic-induced runoff, and dynamic interactions between clastic and carbonate systems. The scope of each project can be extended to Masters.

Project:	**Response of Western Australia's coastline to non-tidal sea level variations**
For majors including:	Geophysics, Marine Science
Supervisors:	Jeff Hansen jeff.hansen@uwa.edu.au, 6488 3724 and Ryan Lowe
Description:	The coastline of Western Australia (WA) is unique in that it features a poleward flowing warm water current, the Leeuwin Current (typically warm water currents occur on the eastern side of continents). The strength of the Leeuwin Current fluctuates seasonally and this fluctuation results in increases and decreases in the sea level along WA that can reach +/- 0.25 m and last for several weeks. These non-tidal sea level variations can be as large as the tide in many parts of Southwest WA. Analysis of seven years of shoreline positions collected at Garden Island, SW of Perth indicate that the shoreline responds more strongly to these non-tidal sea level variations than to seasonal variations in wave height (which typically drive seasonal shoreline changes). The aim of this project is to extend these results to a number of other beaches in WA and compare the shoreline response due to non-tidal sea level fluctuations between reef-fringed and sandy beaches. Shorelines will be extracted from high-resolution aerial photos taken approximately bi-monthly and available from 2009 onwards.

Project:	**Do "representative" coastal sites exists?**
For majors including:	Geophysics, Marine Science
Supervisors:	Jeff Hansen jeff.hansen@uwa.edu.au, 6488 3724, Ryan Lowe
Description:	In order to mitigate the coastal hazards associated with climate change, including rising sea levels and potentially increasing storm intensity, we first need to understand how the present day beach responds to storms and seasonal variations in wave energy. Typically, coastal response is measured using a variety of intensive field or remote sensing techniques. However, it is not feasible to measure large swaths of coast without considerable cost and effort, and it may indeed be unnecessary. The objective of this project is to investigate the idea of a "representative" coastal site. A number of researchers have suggested that in many locations beaches along stretches of coastline extending 10s of km or more respond in a similar manner to storms and seasonal variations in wave energy. Thus, detailed observation may only need to be collected at a single site, with these observations being representative of the coastal response some distance away. The project will test this hypothesis by quantifying beach changes from a number of storm events along the WA coastline at different locations using exiting high-resolution aerial photography.

Project:	**Measuring the variability of the southwestern Australian coastline from aerial imagery**
For majors including:	Geophysics, Marine Science
Supervisors:	Jeff Hansen jeff.hansen@uwa.edu.au, 6488 3724, Michael Cuttler and Ryan Lowe
Description:	The Western Australian coastline is well known to exhibit seasonal variability in morphology. For example, WA beaches are typically wider in summer and narrower in winter. Typical methods for surveying beach morphology require accessing the beach at multiple times throughout the year. However, WA is one of the most remote and rugged coastlines globally. Thus, there are vast stretches of coastline that have limited access and typical survey methods are unable to be used. Recently, advancement in photogrammetry techniques have allowed aerial photography to be exploited for measuring coastal morphology with cm-scale accuracy. These advancements now provide an opportunity for measuring stretches of coastline previously unmeasurable with typical surveying techniques. UWA has partnered with the Peron-Naturaliste Partnership to capture oblique aerial imagery of the southwestern Australian coastline, from Rockingham to Cape Naturaliste. This project will employ photogrammetry techniques and 3 years of bi-annual oblique aerial photographs to measure coastal morphological change along 250 km of coastline. This large-scale analysis will identify erosion/accretion 'hot spots' and provide value insight into the interannual variability of this coastline.

Project:	**Drivers of coastal erosion and accretion along the Coral Bay Coast**
For majors including:	Geophysics, Marine Science
Supervisors:	Jeff Hansen jeff.hansen@uwa.edu.au, 6488 3724 and Mick O'Leary
Description:	The Coral Bay Coast is home to some of Western Australia's most iconic beaches. They are typically comprised of carbonate sediments that were produced within the nearshore reef system and transported cross and/or along shore under the prevailing coastal hydrodynamic regime. However, there is increasing evidence to show that many of the beaches along the Coral Bay coast are currently experiencing a regime of net sediment loss and erosion. The aim of the project is the investigate the historical trends in shoreline position along the Coral Bay Coast using historical aerial photography, and using recently acquired bathymetric Lidar for the region develop a hydrodynamic model to map current movement and sediment transport and identify whether recent coastal infrastructure or increased coral cover along the Coral Bay coast have resulted in the impounding or trapping of sediment, limiting supply to the beach.

Project:	**Hydrogeological controls on water quality in remote communities**
For majors including:	Hydrogeology
Supervisors:	Sarah Bourke sarah.bourke@uwa.edu.au
Description:	Communities in rural and remote Australia commonly rely on groundwater for their potable water supply. The potential for adverse health impacts due to poor water quality in remote areas is a current focus of concern for some communities. However, to date there has not been a systematic assessment of water quality in remote communities. The student will collate and interpret existing data from remote communities across Western Australia. Where data gaps are identified additional data collection may be possible. Based on these data the relationships between any water quality issues and the hydrogeology of the source aquifer(s) will be elucidated.

Project :	**Hyporheic and parafluvial exchange in ephemeral streams**
Majors including :	Hydrogeology
Supervisor :	Sarah Bourke sarah.bourke@uwa.edu.au , Rio Tinto Iron Ore
	Hyporheic and parafluvial flow paths (water flow in the subsurface, beneath and adjacent to streams) are important determinants of nutrient distributions in streams. As yet there are very few studies quantifying these processes in ephemeral streams. This project will involve data collection in the Pilbara, WA to assess the spatial scale and magnitude of these fluxes, with particular focus on how they change during and after flow events in ephemeral streams. Data collection will include environmental tracers (222Rn), nutrient concentrations and water levels within the stream and alluvial aquifer. The interpretation of these data may be done in a numerical modelling framework. This project is part of a borader ARC Linkage project on the ecohydrology of ephemeral streams. The outcomes of this project will help improve our understanding of water fluxes nutrient cycling in semi-arid environments and ephemeral streams.

Project :	**Hydrogeochemistry of the Fortescue Marsh**
Majors including :	Hydrogeology, Geoscience
Supervisor :	Sarah Bourke sarah.bourke@uwa.edu.au , Greg Skrzypek (UWA), Shawan Dogramaci (Rio Tinto)
Description :	The Fortescue Marsh is an ephemeral wetland system in the Pilbara (NW Australia) that can cover an area of 1000 km^2 when inundated. As part of a collaborative research project between UWA and Rio Tinto Iron Ore, hundreds of metres of continuous core were collected along two transects across the Fortescue Marsh The project will focus on measuring hydrogeochemical profiles within a sub-set of these cores that have been sealed in liners and stored in a cool room. The student will log the core and conduct laboratory analysis of multiple parameters, including, but not limited to, moisture content, stable isotopic composition of water and major ion composition. These data will be interpreted to delineate hydrogeochemical processes operating within the Fortescue Basin.

Project :	**Hydrogeologic modelling in a changing climate, and an uncertain world**
Majors including :	Hydrogeology
Supervisor :	Adam Siade (adam.siade@uwa.edu.au), Jon-Philippe Pigois (Department of Water and Environmental Regulation, DWER)
	The primary objective of hydrogeological modelling is to make predictions about how aquifer systems respond to anthropogenic influences. Such predictions are predicated on knowledge of aquifer properties, model construction, and future climate evolution, which are often unknown or highly uncertain. These factors are defined using expert knowledge, climate model results, etc., and can also be indirectly estimated using relatively sparse data observed in the field. However, potentially significant errors may persist, which often results in a significant degree of uncertainty associated with future predictions. For example, the ability for a particular groundwater model to predict the drawdown in a sensitive wetland could be highly uncertain for a number of reasons. Therefore, quantifying this "predictive uncertainty" is paramount for understanding how the natural environmental will respond to future anthropogenic influences such as groundwater pumping. Furthermore, reducing this uncertainty can dramatically improve our ability to develop low-risk groundwater management solutions. This project will focus on advanced methods of numerical groundwater modelling, along with the quantification of uncertainty associated with model predictions throughout the Perth region and beyond. Students will gain experience working with the Perth Regional Aquifer Management (PRAMS) modeling framework, which is the primary management tool for groundwater in the Gnangara area, and extends from Cervantes to south of Mandurah, WA. Students should have some experience with linear algebra and statistics before starting this project.

Project :	**Regional groundwater resource management and allocation planning**
Majors including :	Hydrogeology
Supervisor :	Adam Siade adam.siade@uwa.edu.au , Jon-Philippe Pigois (Department of Water and Environmental Regulation, DWER)
Description :	As climate changes, many populated regions of the world, including Perth, will experience decreases in rainfall, which is essential for recharging groundwater systems. This reduction in available groundwater resources results in a need for more precise, quantitative methods for managing groundwater, especially when population and industry are expected to increase. Groundwater managers and decision-makers must make important decisions in order to create the best balance between (i) providing secure sources of fresh water to all of our taps, and (ii) maintaining the health of groundwater-dependent ecosystems. This study focuses on the methods, and groundwater modeling techniques, used to develop practical management solutions that achieve both of these goals. Topics may include managed aquifer recharge, allocation planning, multi-objective management solutions, and the improved development of important performance criteria including, seawater intrusion controls, water quality evolution, water distribution networks, land-use adaptation, etc. With the appropriate controls, and the aid of sophisticated solution procedures, we can improve the security of Perth's water resources for generations to come. Students will gain experience working with the Perth Regional Aquifer Management (PRAMS) modeling framework, which is the primary management tool for groundwater in the Gnangara area, and extends from Cervantes to south of Mandurah, WA. Students should have some experience with linear algebra before starting this project.

Project:	**Estimating groundwater recharge using environmental tracers**
Majors including:	Hydrogeology
Supervisor:	Jim McCallum (james.mcallum@uwa.edu.au), Henning Prommer and Jon-Philippe Pigois (Department of Water and Environmental Regulation, DWER)
Description:	Groundwater recharge is the primary mechanism through which aquifers are replenished. Hydraulic head measurements can be ambiguous as they are sensitive not only to recharge, but aquifer properties and groundwater pumping. It is therefore important to make independent estimates of recharge to constrain groundwater systems and manage resources effectively. Environmental tracers are chemical compounds that have a modified concentration consistent with their recharge time. Measurements of environmental tracers allow for the time since recharge (or the residence time) of a water parcel to be determined. Combining this information with knowledge of aquifer geometries allows for relationships between recharge and residence times to be established, providing an independent estimate of groundwater recharge. This project will apply interpretive models to an existing dataset of environmental tracer data to determine groundwater recharge rates in the Perth region. The study will focus on a site where there is active use or future planned development of the resource hence project is needed to allow appropriate management.

Project:	**New approaches to 3D geological modelling- Case study of the Ashburton Basin, Western Australia**
Majors including:	Geology Geophysics, Physics, Engineering, Computer Science
Supervisor:	Mark Jessell mark.jessell@uwa.edu.au 6488 5803 and Mark Lindsay
Description:	This project will compare two approaches to building 3D geological models of deformed terrains. The aim of the project is to characterise the outcomes of traditional 3D modelling approaches with a new system that extracts the necessary input data directly from digital maps and databases. The test area will be the Ashburton Basin, an arcuate belt of Paleoproterozoic sedimentary and volcanic rocks which forms the northern margin of the Capricorn Orogen, a major orogenic zone between the Pilbara and Yilgarn Cratons. This project would be suitable for students with an interest in 3D geological modelling and GIS. Programming experience would be a benefit, but is not essential.

Project:	**Topological uncertainty in 3D geology**
Majors including:	Geology Geophysics, Physics, Engineering, Computer Science
Supervisor:	Mark Jessell mark.jessell@uwa.edu.au 6488 5803 and Mark Lindsay
Description:	The geometry of geological models has long been recognised to be an important constraint on the validity of forward process modelling and geophysical inversions, however in many instances the topology of the model is as important if not more so, especially in situations where the continuity of lithologies, or the connectivity of structures controls the outcome, such as in fluid flow or some types of electrical measurements. This project will examine methods to characterise the 3D topology of geological models as a pathway to classifying end-member models that can be used in geophysical inversion schemes. This project is supported by the WA government-funded WA_In3D project, and the scope is compatible for continuation to Masters or PhD level. Computer experience and some maths are required.

Project:	**Geodynamic Atlas of the Guiana Shield**
Majors including:	Geology Geophysics, Physics, Engineering, Computer Science
Supervisor:	Mark Jessell mark.jessell@uwa.edu.au 6488 5803
Description:	The Paleoproterozic Guiana Shield represents a major under-explored region in NE South America. This project will compile existing data from the literature to develop a time sequence of geological events in a time-enabled GIS so that we can define key tectonic controls on mineralisation. The student will have the opportunity to learn new GIS techniques and help build new knowledge for this prospective region.

Project:	**Geophysical Expression of REE-Bearing Carbonatites and Peralkaline Igneous Complexes**
For majors including:	Suitable for Hons (4th year) or M.Sc (5th year) research project. Geoscience degree including EART3353 Geological Mapping and GEOS4411 Mineralising Systems (UWA graduates). Units in mineral systems/economic geology and geophysical data interpretation (graduates from other universities)
Supervisor:	Mike Dentith, michael.dentith@uwa.edu.au and Tony Kemp
Description:	Peralkaline igneous rocks and carbonatites are important sources of REE, strategic elements used in many new technologies. The geophysical expression of the igneous complexes where these rocks mostly occur are very easy to recognise, especially in potential field and radiometric datasets. The 'intra-complex' controls on geophysical complexes are much less well understood. The first phase of this project is a literature review to compile density and magnetism and K-Th-U content data for these unusual rock types. This will form the basis for analysing the geophysical responses of various igneous complexes from Africa, Greenland, Canada and, Brazil. Significant questions to be considered include: (i) which alkaline rock types have distinctive geophysical expressions, (ii) can the diverse magnetic responses be grouped and better understood geologically, (iii) is it possible to map fenitisation and other kinds of alteration using geophysical datasets.

Project:	**Interpreting Airborne Geophysical Data from Sedimentary Basins: Recognising Responses from Evaporites**
For majors including:	Suitable for Hons (4th year) or M.Sc (5th year) research project. Geoscience degree including EART3353 Geological Mapping, EART 3344 Basin Analysis (UWA graduates). . Units in petroleum systems/basin studies and geophysical data interpretation (graduates from other universities)
Supervisor:	Mike Dentith Michael.dentith@uwa.edu.au 6488 2676 and Annette George
Description :	Structural traps associated with movement of evaporites are common in many petroleum provinces and so their recognition is important. Aeromagnetic and aerogravity data from the Canning Basin show responses which, based on their geometry, are possibly related to salt diapirs. Although rarely reported, the 'textbook' magnetic response of salt is a negative anomaly, however these responses are mostly positive anomalies. Core from two drillholes from the study area is available on which to make petrophysical property measurements. Seismic data are also available. The research project comprises an integrated interpretation of the available data leading to an understanding of how salt appears in aeromagnetic data and potentially a publication in a major journal.

Project:	**Radiometric Responses of Mineral Deposits: Are Alteration-Zone Responses Actually Due to Changes in Geochemistry?**
For majors including:	Suitable for Hons (4th year) or M.Sc (5th year) research project. Geoscience degree including EART3353 Geological Mapping and GEOS4411 Mineralising Systems (UWA graduates). Units in mineral systems/economic geology and geophysical data interpretation (graduates from other universities)
Supervisor:	Mike Dentith Michael.dentith@uwa.edu.au 6488 2676
Description:	Several common types of mineral deposits are associated with alteration haloes where the concentration of the three radioelements (K, U, Th) is known to vary. Examples include VMS, epithermal precious metal and porphyry-style deposits. Some important kinds of host rocks for diamonds and REE are also anomalous with respect to radioelement content, notably carbonatites and kimberlites. Radiometric data represent a cheap and readily available way to detect these alteration haloes. However, there is a lack of understanding of how radioelement concentrations vary most alteration systems. Relevant data needs to be compiled and modelling of radiometric responses undertaken to investigate how best to recognise anomalies due to alteration zones in radiometric datasets. A unique radiometric modelling software package has been developed for use in this project. This project is laboratory based and involves data compilation and geophysical data interpretation in a geological context.

Project:	**Hydrothermal alteration mineralogy and zonation in shallow surface Zn-Pb-Ag-V mineralization at the Wolf prospect, Pilbara**
Majors including:	Geology, Mineralogy, Geochemistry
Supervisor:	Steffen Hagemann and Leigh Bettenay contact via phone: 6488-1517 or email: steffen.hagemann@uwa.edu.au
Description:	This project will constraint the mineralogy and zonation in the highly unusual Zn-Pb-Ag-V style mineralization at the Prairie and Wolf prospects. Field work will include the careful documentation of mineralization and alteration in diamond core and mapping of the lithostratigraphy and structures across some selected traverses through the mineralized areas. Laboratory work will emphasise petrography, mineral chemistry (via SEM and EMP), and fluid inclusion as well as *in situ* laser ICP-MS on selected sulphides and silicates including the unusual Zn-chlorite baileychlore. Whole rock major oxide elements, trace elements and REE analyses will be conducted on selected hydrothermally altered samples. The outcomes of this project will be a descriptive hydrothermal alteration model with constraints on the P and T of the mineralising system as well as a set of pathfinder minerals and elements. The project is suitable for a 36 pts MSc thesis and Honours thesis. Prerequisites are good mineralogy and geochemistry background and successful completion of the SEM course early in 2018 (as advertised by CMCA).

Project:	**Garnet and clinopyroxene chemistry of the O'Callaghans polymetallic W-Zn-Pb-Cu skarn, Paterson Orogen, Western Australia: Constraining the physico-chemical conditions of prograde skarn formation**
Majors including:	Geology
Supervisor:	Steffen Hagemann: contact via phone: 6488-1517 or email: steffen.hagemann@uwa.edu.au
Description:	The O'Callaghans polymetallic skarn is located in the Paterson Province in Western Australia and is one of the world's largest W deposit in the world. Garnets and pyroxene are part of the prograde, high temperature hydrothermal silicate alteration which consists of garnet-clinopyroxene-quartz, minor sulphides and scheelite. This investigation will define the garnet and pyroxene species; define intra-garnet and pyroxene zonation and provide P-T estimates based on e.g., the garnet-pyroxene geothermometer. The petrographic and geochemical results of the garnet-pyroxene assemblage will be used to better characterize stage 1 prograde hydrothermal alteration and mineralization at the O'Callaghans skarn deposit and, thereby, further refine the classification of this skarn type. The project is suitable for a 36 pts MSc thesis and Honours thesis. Prerequisites are good mineralogy and geochemistry background and successful completion of the SEM course early in 2018 (as advertised by CMCA).

Project:	**Fluid chemistry of the Karouni gold deposit, Guyana, South America**
Majors including:	Geology, Geochemistry
Supervisor:	Steffen Hageman only via email: steffen.hagemann@uwa.edu.au
Description:	The Karouni orogenic gold deposit is Troy Resources new flagship gold deposit with production starting in 2015. The project involves detailed petrography of quartz veins and breccias, cathodoluminescence of quartz-carbonate crystals and identification of suitable fluid inclusion assemblages. The carefully constrained fluid inclusions will be analysed using the in house fully automated Linkham heating-freezing stage and laser-Raman spectroscopy. The results will be used to constrain the physico-chemical parameters (P-T-X) of the paleohydrothermal system that is responsible for the gold mineralization. A P-T-t curve will also be constructed that will illustrate the evolution of the hydrothermal fluids within the evolution of the structural-metamorphic-magmatic and hydrothermal alteration and mineralization system. The project is suitable for a 36 pts MSc thesis and Honours thesis. Prerequisites are good mineralogy and geochemistry background and successful completion of the SEM course early in 2018 (as advertised by CMCA).

Project:	**Fluid chemistry of the Sertão and Cascavel orogenic gold deposits, Goiás, Brazil**
Majors including:	Geology, Geochemistry
Supervisor:	Steffen Hageman only via email: steffen.hagemann@uwa.edu.au
Description:	The Sertão and Cascavel orogenic gold deposits are located in an Archean/Paleoproterozoic greenstone belt in Goiás, Brazil. The Cascavel deposit will start production end of 2016 and it will be the only gold mine starting production in Brazil in the past three years. The project involves detailed petrography of gold-quartz-carbonate veins, cathodoluminescence of quartz crystals and identification of suitable fluid inclusion assemblages in both deposits. The fluid inclusions will be analysed using the fully automated Linkham heating-freezing stage at CET. The results will be used to constrain the physico-chemical parameters (P-T-X) of the paleohydrothermal system at Sertão and Cascavel. The outcome of this project will be the characterisation of ore fluids in both deposits and interpretation of fluid inclusion assemblages with respect to fluid boiling, mixing and/or cooling as a gold precipitation mechanism. Isochores will be calculated and P-T conditions of gold mineralization estimated in order to construct a P-T-t evolution of these paleohydrothermal systems. This project will be part of a larger investigation on gold and base metal mineralization in the Goiás greenstone belt. The project is suitable for a 36 pts MSc thesis and Honours thesis. Prerequisites are good mineralogy and geochemistry background and successful completion of the SEM course early in 2018 (as advertised by CMCA).

Project:	**Characterisation of proximal to distal alteration footprint of gold deposits in the Yilgarn craton**
Majors including:	Geology, Structural geology, Ore Deposit Geology, Petrography, Geochemistry
Supervisor:	Nicolas Thébaud, nicolas.thebaud@uwa.edu.au 6488 7139
Description:	A range of projects are available focusing on gold deposit of the Yilgarn Craton. These projects aim at characterizing the mineral paragenesis and structural contexts and place gold mineralisation within this context. These studies rely on a multi-disciplinary approach combining structural core logging, mineralogy and lithogeochemistry. Contact the Dr Thebaud for further details on these projects.

Project:	**Early architecture controlling gold mineralisation Yilgarn Craton**
Majors including:	Geology, Ore Deposit Geology, Petrography, Geochemistry
Supervisor:	Nicolas Thébaud, nicolas.thebaud@uwa.edu.au 6488 7139
Description:	Early architecture and fundamental structures have been proposed to apply a first order control on gold mineralisation. Often cryptic, this early architecture, consists of unexposed structures often located along lithostratigraphic interfaces. These structures may have been subsequently reactivated in response to the regional stress field and/or by over-pressured fluids. A range of project are proposed in the Yilgarn Craton taking advantage of the strong synergies existing between the CET and the Geological Survey of Western Australia, to conduct lithostratigraphic analysis at the camp scale in the Eastern Goldfields. These field based mapping projects will aim at re-investigating both field districts using core logging and field mapping techniques to unravel the lithostratigraphic record and its spatial distribution. Such an approach has provided valuable insights into the evolution of magmatic systems, tectonic setting and associated hydrothermal circulation. Accordingly, research methodology will combine sedimentological and volcanological lithofacies analysis with lithogeochemistry and depending on time and resources geochronology including U-Pb SHRIMP, U-Pb LA-ICPMS and/or U-Pb TIMS analyses along selected traverses.

Project:	**U-Pb age distribution of Detrital Zircon populations across the Birimian Terrane / Man Shield boundary, West Africa**
Majors including:	Geology, Geochronology
Supervisor:	Nicolas Thébaud nicolas.thebaud@uwa.edu.au 6488 7139, Luis Parra Avilla and Elena Belousova
Description:	The West African Craton consists of an Archean core, the so-called Man Shield, and a Paleoproterozoic Birimian Terrane that is essentially composed of volcanic belts and intervening sedimentary basins. The overall relation and the boundary between the Man Shield and the Birimian Terrane further to the North remains poorly constrained. In order to understand the regional tectonostratigraphic evolution and associated mineralisation of the Birimian Terrane in Western Africa, it is important to develop a good understanding of the timing of emplacement of the various litho-stratigraphic pakages and intrustions forming the Craton. At present, very little is known about the stratigraphic variation within the Birimian Sedimentary Basins, which forms a large portion of the Birimian Sequence and even less is known about the relation of this basin with the underlying Archean Man Shield. In 2012 a field campaign was conducted in Guinea across the boundary between the Proterozoic and Archean Terranes. During this field campaign, sediments from streams and rivers were collected with the purpose of conducting a TerraneChron® reconnaissance study over the area. TerranChron® is a unique methodology integrating in situ analysis of zircons for U-Pb age, Hf-isotope composition and trace-element composition using LAM-ICPMS, LAM-Multi-Collector (MC) ICPMS and electron microprobe (EMP) providing a powerful tool for the study of crustal evolution and evaluation of the metallogenic potential of terranes. The methodology will be applied to detrital zircons recovered from drainage samples. The use of drainage samples has many advantages: nature has separated and concentrated a statistically more meaningful sample than is achievable by conventional single rock sampling and methods, and this can provide a more comprehensive coverage of rock types particularly in the areas where the rock outcrops are scarce.

Project:	**Finite strain analysis and photogrammetry of a regional scale gold controlling structure in the goldfields of Western Australia: the Boulder Lefroy Shear Zone**
Majors including:	Structural geology
Supervisor:	Nicolas Thebaud nicolas.thebaud@uwa.edu.au and Ivan Zibra (GSWA)
Description:	The Boulder Lefroy Shear Zone in the Eastern Goldfields (Western Australia) is commonly proposed to represent a large-scale plumbing system responsible for the mineralisation of the well-endowed Kalgoorlie area. The detail kinematic and strain recorded in the fault remains however poorly constrained. Using field mapping, drone assisted photogrammetry and finite strain analysis of the Boulder Lefroy field locality near Kambalda combined with geophysical data interpretation, this project aims at characterising further this major structural pathway in-order to better understand its role during the deformation leading to the mineralisation in the region.

Project:	**Lufilian fold belt modelling**
Majors including:	Geology, 3D modelling
Supervisor:	Nicolas Thebaud nicolas.thebaud@uwa.edu.au , Weronika Gorczyk and Aurelien Eglinger
Description:	In the earth sciences, pressure is often assumed to be a well-defined variable dependent on depth and density. Local pressure gradients and magnitudes can however change without any associated change in depth. Detail metamorphic petrology studies of the whiteschist unit of the Lufilian fold belt of Zambia (Africa), have shown that the unit was metamorphosed at a temperature comprised between 600 and 700 °C and pressures below 1.1-1.2 GPa. The amount of structural thickening derived from stratigraphic compilations conducted in the area seems however insufficient to generate metamorphic conditions suitable for formation of the high-pressure whiteschist metamorphic assemblages. Using existing pressure and temperature estimates and petrographic analyses conducted on the whiteschist unit together with the aid of numerical simulations, the aims of this project is to evaluate the role of tectonic overpressure in the formation of whiteschist unit existing in the Lufilian fold belt.