THE UNIVERSITY OF WESTERN AUSTRALIA

# Honours & Masters Research Projects 2025

**School of Earth & Oceans**

# Potential research projects offered for Level 4 (Honours) and Level 5 (Masters) students commencing in 2025

- Geology
- Geochemistry
- Geophysics
- Environmental and Marine Geoscience
- Hydrogeology
- Mineral Geoscience
- Energy Geoscience
- Numerical Modelling and Geodata Analytics
- Oceanography
- Offshore Geotechnical Engineering

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

# Projects in Earth & Ocean

**This document describes projects suitable for students undertaking a 24pt research project as part of an Earth Science Honours or coursework Master's degree. Some projects are also suitable for the larger 36 pt thesis in the Master of Science by Thesis & Coursework**

We encourage you to consider the earth science research problems that excite you and to choose a project topic that will motivate you to do your best work throughout the year. Your project may align with your career aspirations and/or be a topic that you are keen to explore. The aim of the 24pt project is to provide you with an opportunity to learn how research works, to develop your research skills and demonstrate capacity to undertake research.

The 24pt project is one of the ***best ways*** to demonstrate skills in problem-solving, communication (reading, writing and speaking), and completing a major task on time – all key elements for employment in a wide range of careers including the resources industries and related government agencies. It is also a pathway to higher degrees by research (MSc, MPhil, PhD) with students often discovering a passion for research through undertaking their Honours or Masters project!

This document does not summarise all available projects and you are welcome to speak with any staff in the School of Earth and Oceans 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 for both semester 1 and semester 2 commencements in 2025. Do not leave organising a project until the first teaching week of 2025 or late July! Remember that many academic staff take leave through January.

**Earth Science is a broad science** that includes Geology, Geophysics, Geochemistry, Geobiology, Environmental Geoscience, Oceanography, Marine Geoscience, Antarctic Geoscience, Computation/Numerical Modelling and Geodata Analytics. The breadth of research activity in the School of Earth and Oceans means that students have opportunities to choose from a wide range of projects. Research may be focused on resolving questions related to fundamental Earth processes and Earth evolution, and thus advancing key knowledge, or have various levels of application to discovery, extraction or storage of specific resources including mineral deposits, groundwater and energy, and to management of coastal zones, water-dependent ecosystems, agricultural regions and mine sites.

**You are welcome to contact staff directly** (email addresses are provided in the booklet) to discuss projects. 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 prospective supervisors to discuss as required.

# Research Areas at SEO

## Crustal structure of the Capricorn Orogen and controls on carbonatite-hosted REE mineralisation

**Supervisors:** Alan Aitken, alan.aitken@uwa.edu.au; Marco Fiorentini, marco.fiorentini@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Master of Geoscience, Master of Ore Deposit Geology

**Description:** This ARC-supported project will apply gravity and magnetic inversions to understand the structure of the deep crust and upper mantle of the Capricorn orogen, representing the assembly of the West Australian Craton and over a billion years of intraplate reworking. The project will seek to understand if (and how) the evolving crustal structure focused carbonatite-hosted REE deposits within the orogen. The project involves training in geophysical inversion approaches.

## Graph-analysis of subglacial mud for understanding glacial dynamics and ice histories

**Supervisors:**
Alan Aitken, alan.aitken@uwa.edu.au
Guillaume Pirot, guillaume.pirot@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Marine Science Honours

**Description:** Novel graph-based modelling approaches provide the capacity to quantify the sediment productivity of glacier systems associated with dynamic subglacial hydrology. This project will investigate the past and projected future sediment productivity and detrital provenance of glaciers under changing climate. Results will inform multidisciplinary studies as part of the Australian Centre of Excellence in Antarctic Science. The project involves training in the use of Matlab and Python.

## Mapping workflows for geology under cover: A data analytics approach

**Supervisors:**
Alan Aitken, alan.aitken@uwa.edu.au
Mareen Lösing, mareen.loesing@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Marine Science Honours

**Description:** Knowledge of the geology beneath the Antarctic Ice Sheet is essential to understand ice-sheet bed conditions. Antarctic Geology is very poorly known with <2% outcrop and very few subglacial samples, while Australia is better constrained. This project will seek to use machine-learning approaches to map the hidden geology of both continents together and so provide critical constraints on subglacial boundary conditions that control ice flow. As part of the Australian Centre of Excellence in Antarctic Science, the project involves training in applying machine learning techniques in Python.

## Simulating the birth, life and death of Earth's crust with Monte-Carlo approaches

**Supervisors:**
Alan Aitken alan.aitken@uwa.edu.au
Tony Kemp tony.kemp@uwa.edu.au
Chris Fisher chris.fisher@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** Globally, the Earth's crust has developed over time from a thin crust in the Mesoarchean to a maximum in the Paleoproterozoic and a systematic decline since the Mesoproterozoic. This project will reconcile, using Monte-Carlo simulations, the spatio-temporal evolution of the Earth's crust constrained by present-day crustal thickness and isotopic data recording the past evolution of the crust. The simulations will reveal how the Earth's crust has formed under the influence of secular and tectonic processes. The project will involve training in the use of Matlab and Python.

## Interconnection of geochemistry and microbiome of corals shallow water as indicators of health and resilience of coral communities.

**Supervisors:**
Aleksey Sadekov, Aleksey.Sadekov@uwa.edu.au
Marco Coolen (Curtin University)

**Majors or Masters:** Earth Science Honours, Marine Geoscience

**Description:** Coral health is an essential factor in maintaining productive and sustainable reef ecosystems. The primary production within coral reefs supports approximately 25% of all known marine species and impacts over a billion people worldwide (Moberg and Folke, 1999). However, recent climate changes and their subsequent effects on coral health, such as coral bleaching, raise significant questions about the resilience of reef communities in the future (Hough-Guldberg et al., 2007).

In this project, our aim is to explore the relationship between the geochemistry of Porites corals and their microbiome. These corals were collected from Ningaloo Reef, WA, and then cultured in a UWA laboratory under stable seawater conditions. By analysing differences in geochemistry and microbiome, we can gain unique insights into the calcification ability of reef-forming coral species. This understanding will contribute to a better grasp of the resilience of coral communities in the face of challenges like acidification and heat stress.

The primary focus of this project lies in coral geochemistry, which will be closely linked with existing data on the coral microbiome collected during the culturing experiments.

## Geochemistry of coral skeleton as indicators of coral health and short-lived stress events such as marine heat waves, oxygen depletion, coral bleaching.

**Supervisors:**
Aleksey Sadekov, Aleksey.Sadekov@uwa.edu.au
Claire Ross (Department of Biodiversity, Conservation and Attractions)

**Majors or Masters:** Earth Science Honours, Marine Geoscience

**Description:** Coral health is an essential factor in maintaining productive and sustainable reef ecosystems. The primary production within coral reefs supports approximately 25% of all known marine species and impacts over a billion people worldwide (Moberg and Folke, 1999). However, recent climate changes and their subsequent effects on coral health, such as coral bleaching, raise significant questions about the resilience of reef communities in the future (Hough-Guldberg et al., 2007).

In this project, we aim to better understand the geochemistry of coral skeletons and their connection with coral calcification processes. Corals will be collected from Ningaloo Reef, WA. By analysing differences in geochemistry, we aim to establish a connection between geochemical signatures (proxies) and short-lived stress events such as coral bleaching, seawater oxygen depletion, and heat waves. This understanding will contribute to a better grasp of the resilience of coral communities in the face of the challenges posed by future climate change.

The primary focus of this project lies in coral geochemistry, which will be closely linked with existing data on the coral microbiome collected during the culturing experiments.

## Deep sea carbonate sediments as a major sink/source of Rare Earth Elements (REEs) in the ocean.

**Supervisors:**
Aleksey Sadekov, Aleksey.Sadekov@uwa.edu.au
April Abbott (Coastal Carolina University)

**Majors or Masters:** Earth Science Honours, Marine Geoscience

**Description:** Rare earth element (REE) signatures of planktonic foraminiferal shells in deep-sea sediments have been extensively used to reconstruct the evolution of deep-water masses and their interactions with the ocean carbon cycle and global climate (Osborne et al., 2017; Skinner et al., 2019). Concentrations of REEs in living planktonic foraminifera are around 2–3 orders of magnitude smaller than in shells extracted from deep-sea sediments, implying a diagenetic origin of REE signatures in the latter. A commonly accepted hypothesis is that foraminiferal shells in sediments are coated with a thin layer of Fe-Mn oxides and/or organic matter, leading to significant enrichment in REEs (Roberts et al., 2012; Haley et al., 2004).

This project will investigate the origin of this 'diagenetic coating' using high-resolution Laser Ablation ICP mass spectrometry and electron microscopy of individual planktonic foraminiferal shells. The project will utilise materials collected during the 2020 research cruise of RV Falkor. This material was sampled using remotely operated underwater vehicles, providing samples from a uniquely preserved sediment-water interface, which is critical for investigating REE cycling in the ocean. The aim of the project is to link the geochemistry of pore water in these sediments with the REE geochemistry of foraminiferal shell coatings.

## Teeth geochemistry as a tracer of environmental pollution in the Perth metropolitan area and the rural communities from Goldfields of WA.

**Supervisors:**
Aleksey Sadekov, Aleksey.Sadekov@uwa.edu.au
Christine Jeffries-Stokes christine.jeffries-stokes@rcswa.edu.au

**Majors or Masters:** Earth Science Honours

**Description:** The geochemistry of human teeth has been shown to provide critical information about habitat changes, migration patterns of early human populations, and environmental pollution in modern communities. For example, human teeth absorb heavy metals in the dentin, making teeth geochemistry a potential tool for quantifying residents' exposure to heavy metal pollution. This project will explore the similarities and differences in the geochemistry of teeth samples collected from residents of the Perth metropolitan area and communities across the Goldfields region of WA. The aim of the project is to characterise the trace and heavy metal composition of teeth samples using Laser Ablation ICP mass spectrometry and link it to environmental conditions in each study region.

## Microbialites

**Supervisors:**
Annette George, annette.george@uwa.edu.au
France Champenois, france.champenois@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Microbialites are common carbonate rocks, recording the activity of microbial communities that may form mats, stromatolites and thrombolites. Through geological time, calcimicrobes have been important contributors to stromatolites and thrombolites and more broadly to reef development and other types of carbonate buildups. They have been associated with major biotic crises through Earth history although their roles leading up to, during and immediately after these crises is debated. These projects focus on characterising microbialites and fascinating calcimicrobes in ancient terranes and paleoenvironmental and paleoecological interpretation at different scales. Characterisation requires petrographic and micro-imaging and micro-analytical geochemical techniques, with varying macro-scale contexts depending on project. These topics are also suitable for 36 pt Master of Science projects.

## Sedimentary basins as deep time archives and subsurface characterisation, WA Basins

**Supervisors:**
Annette George, annette.george@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Western Australia has a broad suite of sedimentary basins that record significant events through geological time. These projects may focus on reconstructing depositional and tectonic history of a specific basin or focus on specific stratigraphic intervals (e.g. for energy reservoirs, carbon sequestration, biotic crises/mass extinctions, groundwater, mineral resources). Projects may include drillcore to petrographic-scale description and interpretation to establish depositional and relative sea-level history (using sequence stratigraphy and related datasets e.g. biostratigraphy and chemostratigraphy) and/or major controls on the distribution of porosity and permeability. Projects may include Hylogger® spectral analysis and portable XRF analysis of core to obtain geochemical data for characterising facies, chemostratigraphic correlation and establishing diagenetic history. Some projects could involve application of higher level microscopic techniques (e.g. SEM). These topics are also suitable for 36 pt Master of Science projects.

## Cyclic penetrometer testing: what can it tell us about geotechnical response?

**Supervisors:**
Britta Bienen, britta.bienen@uwa.edu.au;
Vikram Singh, Vikram.singh@uwa.edu.au

**Majors or Masters:** Civil Engineering

**Description:** In situ penetrometer testing, e.g. cone penetrometer testing (CPT) is standard in geotechnical site investigation. Penetrating the probe cyclically instead of only monotonically has the potential to tell us much more about the soil characteristics, and this information may be used directly in foundation design, e.g. piles. Using numerical modelling techniques, students will uncover the soil response to the cyclic penetrometer action. This can form the basis for recommendations to industry.

## Axial response of vibro-driven piles

**Supervisors:**
Britta Bienen, britta.bienen@uwa.edu.au
Fraser Bransby, fraser.bransby@uwa.edu.au

**Majors or Masters:** Civil Engineering

**Description:** Vibro-driving is a dynamic pile installation method which uses vertical cyclic motion to penetrate the pile to target depth. As this installation method is less noisy than impact driving and can also be fast while remaining controlled, it is increasingly considered for piles supporting offshore wind turbines. Uncertainties remain though regarding the post-installation pile response – if the pile is easy to penetrate, will the foundation have sufficient stiffness and strength? This will be investigated in this project using numerical modelling.

## Developing novel geochemical methods for laser ablation mapping of key minerals for mineral exploration and targeting

**Supervisors:**
Christopher Fisher, Chris.Fisher@uwa.edu.au
Aleksey Sadekov, Aleksey.Sadekov@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** The method of laser ablation-based mass spectrometry is an extremely powerful, and highly utilized, analytical tool that is applied across a broad range of topics in modern Earth Science studies.

This project aims to develop a robust methodology for producing high-resolution "laser ablation maps" of different minerals for their trace element distribution (e.g., olivine, garnet, zircon, and apatite). For example, the trace element distribution in the mineral garnet is often used to help understand metamorphic reactions and help interpret Lu-Hf garnet ages. The trace element distribution in zircon can provide crucial constraints on the magmatic evolution that leads to economic porphyry Cu deposits. Development work will be conducted at the CMCA laser ablation laboratory located on the UWA campus. This is an ideal project for students with an interest in igneous petrology, geochemistry, and potentially geochronology as well as modern analytical techniques.

## Cost and value analysis of data collection scenarios to reduce geological uncertainty

**Supervisors:**
Guillaume Pirot, guillaume.pirot@uwa.edu.au

**Majors or Masters:** Hydrogeology, Earth Science Honours

**Description:** The objective of this project is to assess the economic efficiency of different data acquisition strategies in a geological characterization context. Based on real cases reported by industry partners, an ensemble of synthetic scenarios will be tested. It will involve 3D geological modelling and integration of surface and borehole geological data observations as well as geophysical measurements. This project is supported by the MinEx CRC industry and public consortium (https://minexcrc.com.au/program-two-data-from-drilling/project-6-automated-3d-modelling/ ). The scope is compatible for continuation to Masters or PhD level. This project would be suitable for students with an interest in 3D geological modelling and statistics. Programming experience would be a benefit, but is not essential.

## Assessment of geological uncertainty

**Supervisors:**
Guillaume Pirot guillaume.pirot@uwa.edu.au
Jérémie Giraud, jeremie.giraud@uwa.edu.au

**Majors or Masters:** Hydrogeology, Earth Science Honours

**Description:** To improve the sustainability of our management and use of subsurface resources (water, energy and minerals), decision makers rely on ensemble of predictions, derived from ensemble of subsurface models. To estimate prediction confidence, it is necessary to characterize properly the uncertainty and diversity of (hydro-) geological or geophysical models. Though several measures can be computed to characterize this geodiversity, the choice of the measures is often subjective. This project will review and benchmark the different indicators in order to formulate some recommendations with respect to the properties of interest. The techniques to be investigated will be defined with the student and can comprise data science concepts, image processing, graph theory, etc.

This project is supported by the MinEx CRC industry and public consortium (https://minexcrc.com.au/program-two-data-from-drilling/project-6-automated-3d-modelling/ ). This project is suitable for students with an interest in 3D geological modelling and statistics. Programming experience would be beneficial but is not essential.

## Tracking mantle metasomatism and its role in the mobilisation of critical metals.

**Supervisors:**
Isra Ezad, isra.ezad@uwa.edu.au
Marco Fiorentini, marco.fiorentini@uwa.edu.au

**Majors or Masters:** Earth Science, Geoscience, Ore Deposit Geology

**Description:** Mantle xenoliths are the most pristine samples of the interior of our planet and represent fragments of rock that ultimately melt to produce many important ore deposits. Mantle xenoliths also record evidence of metasomatism, melts or fluids that modify the mantle and transport critical metals and sulfides redistributing them to ore forming regions of the planet.

The aim of this research project is to demystify what these metasomtic melts and fluids are by determining their chemical composition, their ability to transport critical metals and recognising how they infiltrate the mantle.

This project will have access to a unique collection of mantle xenoliths from Eastern Australia that record metasomatism, this project will use microanalytical techniques to investigate how these reactive melts formed, how they are transporting critical metals and link their formation to sulfide-ore genesis. High-resolution imaging and 3D imaging of the mantle xenoliths will take place at the Centre for Microscopy Characterisation and Analysis. This project is part of larger BHP sponsored project investigating how mantle metasomatism affects critical metal deposit formation.

## Releasing gold from the mantle: an experimental study

**Supervisors:**
Isra Ezad, isra.ezad@uwa.edu.au
Quentin Masurel, quentin.masurel@uwa.edu.au

**Majors or Masters:** Earth Science, Geoscience, Ore Deposit Geology

**Description:** Understanding how Au-bearing melts migrate from the mantle to the surface is fundamental to our knowledge of Au-bearing systems. The requirements for a metasomatized mantle or multiple fluxing events of melts and fluids to the lower crust might be important. These processes in the mobilisation of Au remain largely unknown.

This project will conduct high-pressure experiments to understand how Au is extracted from the mantle and lower crust, by dissolving Au in a range of fluids and melts to determine Au's mobility. This project will test whether a pre-enriched mantle is required and how volatiles like carbon dioxide and water effect Au transport.

## Garnet as a P-T-t-d tracer of metamorphism and mineralisation at the Baomahun gold project, Archean Sula-Kangari greenstone belt, Sierra Leone

**Supervisors:**
Julien Perret, julien.perret@uwa.edu.au
Naomi Tucker, naomi.tucker@uwa.edu.au

**Majors or Masters:** Earth Science, Geoscience, Ore Deposit Geology

**Description:** The Baomahun lode gold deposit is located within the pelitic to psammitic metasedimentary unit of the Archean Sula-Kangari greenstone belt in Sierra Leone. The early paragenetic work completed suggests evidence for two garnet generations at Baomahun: (i) syntectonic, zoned porphyroblasts related to metamorphism during regional deformation in magnetite-grunerite-garnet-rich schist beds, and (ii) hydrothermal, syn-mineralisation, inclusion-free grains associated with biotite, arsenopyrite and pyrrhotite proximal to mineralisation.

Building on these deposit-scale paragenetic considerations, and the properties of garnet as a petrochronometer and fluid-rock interaction tracer, this research project aims to unravel the pressure-temperature conditions and absolute timing reached during regional deformation and metamorphism, as well as the subsequent gold-mineralising hydrothermal event recorded at Baomahun. If relevant, other accessory minerals could be considered for dating purposes. It represents a fantastic chance to bring pioneering insights on the tectono-metamorphic evolution and gold mineral system of the Archean nucleus of the West African craton, which has been barely documented until now.

This project also offers an excellent opportunity for prospective students to gain solid laboratory work experience, by applying a multi-method approach. It will indeed requires combining several microscopy imagery techniques (microXRF mapping, TIMA, micro-XRF mapping), in situ elemental geochemical investigation (EMPA), pressure-temperature modelling and thermobarometry, and relevant isotopic geochemical methods for geochronology (in situ LA-ICP-MS and/or ID-TIMS).

## Resilience of ironstone mound-springs in a changing climate

**Supervisors:**
Malvina Chmielarski malvina.chmielarski@uwa.edu.au
Caroline Mather, caroline.mather@uwa.edu.au
Sarah Bourke, sarah.bourke@uwa.edu.au
Moyra Wilson, moyra.wilson@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Hydrogeology

**Description:** Western Australia's climate is shifting with more change predicted over coming decades. These changes in climate will continue to impact the distribution of freshwater resources across, and beneath, Western Australian landscapes. Where climates are drying, groundwater springs controlled by fixed geological structures are likely to continue to provide persistent surface water and may prove essential for facilitating species redistribution and survival. Ironstone mound-springs in the northern Perth Basin provide one example of groundwater springs that are associated with regional-scale geological structure: outcrop of the Otorowiri siltstone. The project candidate will analyse rock and sediment samples from the springs to establish the conditions and processes of mineral precipitation.

The research aims to: 1) establish the source of water forming the ironstone, and 2) investigate whether microbial activity influences mineral precipitation. Methods may include petrographic (optical, SEM, TEM) mineral and element analysis to establish the precipitation processes and detect potential evidence of microbes. This analysis will be combined with existing groundwater chemistry data to understand the association between the bedrock geological structures, springs and the ironstone formation. The outcomes of this project will improve the knowledge of the characteristics, formation processes and conditions for ironstone precipitation, and can help inform water resource management and groundwater dependent ecosystem conservation during this critical period of drying climate in Western Australia.

We are seeking a talented and determined student interested in a geology project with a focus in understanding environmental settings. The successful student will have the opportunity to develop a range of lab skills to assess sample mineralogy and geochemistry; and will learn to conceptualise environments with a holistic perspective encompassing geology, hydrogeology, and biogeochemistry.

## The chemical make-up of life

**Supervisors:**
Matthew Dodd, matthew.dodd@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Life is only known to exist on Earth and has done so for at least 3.8 billion years. Over this time life has evolved from simple single cell organisms to the multitude of complex organisms alive today. During this process the evolution of life has been directed by changing environmental conditions. How environmental change has controlled the chemical make-up of life during its evolution remains an enigma. The project will involve the geochemical analysis of organic compounds in marine sediments through the Precambrian era in order to determine the chemical make-up of organisms through time. The results of this work will help guide the search for life elsewhere in the universe and provide clues to the origins of life on Earth. Sample analysis will involve the preparation of geological samples for analysis, the measurement of trace and major elements in organic compounds making use of spectrophotometry and mass spectrometry instruments. This project(s) is also suitable for 36 pt Master of Science projects. Please email for further information.

## The depositional history of Middle Gidley Island sediment basin, Murujuga

**Supervisors:**
Mick O'Leary, mick.oleary@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** Murujuga, in NW Western Australia, comprises an archipelago of distinctive igneous terrain that is renowned for abundant and diverse Aboriginal rock art. This region has undergone extreme climatic and geographic change, notably since the Last Glacial Maximum (LGM; between 30-18 kya) where sea levels rose ~130 m and transformed Murujuga from an inland range to a coastal archipelago. This project aims to investigate the depositional history of 10 m thick sedimentary deposits on Middle Gidley Island, Murujuga, improve our understanding of environmental and climatic change over the period of deposition. As part of this project, the mineralogy, geochemistry and texture of the sediments will be analysed to reconstruct the depositional history. Core scanning techniques, such as hyperspectral scanning and scanning-XRF techniques may be employed to detail changes in the composition of sediments with depth, and therefore over time. Outcomes of this research will improve our knowledge of environmental and climatic change in NW WA and inform on how climatic shifts may have influenced human occupation and rock art production in this unique art province.

This exciting multidisciplinary project will be supported by supervisors across three Schools at UWA and is supported by ARC Linkage Project "Dating Murujuga's Dreaming" in the Centre for Rock Art Research and Management at UWA and in collaboration with Murujuga Aboriginal Corporation.

## Drivers of coastal erosion and accretion along the Coral Bay Coast

**Supervisors:**
Mick O'Leary, mick.oleary@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**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.

## Legacy and preservation of tropical cyclone deposits along the Pilbara Coast

**Supervisors:**
Mick O'Leary, mick.oleary@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** Climate models are yet to accurately predict how tropical cyclone intensity and frequency might change under future climate scenarios. An alternative approach is to reconstruct time series of cyclone activity/intensity from the geological record. However, the nature of cyclone generated storm deposits and their preservation potential has not been explored. The aim of this project is to investigate the sedimentary deposits of recent and historical cyclone events along the Pilbara coast and establish what kind of sediment logical deposit constitutes a cyclonic event and whether these types of deposits are able to preserved within in the coastal sedimentary environments.

## Submerged paleocoastal environments on the NW Shelf

**Supervisors:**
Mick O'Leary, mick.oleary@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** During the last glacial cycle (80,000 to 10,000 yrs BP) sea level was between 20 and 120 metres lower than present. This period of time captured major climatological events, as well the arrival of first Australians and extinction of Australia's mega fauna. In order to reconstruct how these coastal paleoenvironments may have supported human populations, and responded to changing regional climate this project will analyse a collection sediment cores collected on the North West Shelf. The student will employ sedimentological and geochronologial methods to reconstruct paleoevironmental evolution of the NW Shelf during this late Pleistocene period.

## Research projects involving working with geophysical datasets

**Supervisors:**
Mike Dentith, michael.dentith@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Mineral Geoscience, Energy Geoscience, Ore Deposit Geology

**Description:** Projects are available in diverse range of applications of geophysical data to solving geoscience problems, especially involving the integrated interpretation of geophysical, geological and petrophysical datasets. Broad subject areas include mineral exploration, petroleum exploration, near surface-environmental-engineering geophysics and earthquake studies.

Projects involving more quantitative studies are also available for students with appropriate computing and numerical skills, but all geophysical projects will include some form of numerical analysis.

In 2025 there are opportunities in:

- Magnetic-gravity-seismic studies of basin-hosted natural hydrogen and base metal-mineral systems. Evaporites and associated halotectonics are increasingly recognised as important controls on the creation of clean energy and critical metal resources. The expression of these controls in non-seismic (magnetic, gravity, EM) geophysical datasets is poorly understood. the Officer and Canning Basins are excellent test cases to develop this understanding.
- Passive seismic and ground penetrating radar based studies of young sedimentary environments in the near-surface. The Tamala Limestone in the Perth metro area is seen as an analogue for seabed geotechnical conditions that need to be understood to safely locate offshore windfarms. Understanding the geophysical characteristics of the onshore rocks places constraints on the nature of offshore analogues
- Magnetic-seismic studies of impact craters (astroblemes) in sedimentary basins. Basin-hosted astroblemes commonly have a distinctive magnetic signature comprising a series of concentric annular anomalies. The origin of these anomalies is not understood. Several examples occur in Western Australia and geophysical data will analysed to try and understand the phenomenon.
- Petrophysics – the study of the physical properties of rocks. Petrophysics is key to understanding the

geological information in geophysical datasets. Large databases integrating petrophysics-geochemistry-mineralogy information are emerging and the opportunity exists to uses statistical methods to define key relationships in rocks from economically important terrains (New England Orogen, SW Yilgarn, Eastern Goldfields). The ultimate aim is to create a petrophysical classification of rocks to complement geological classifications.

It may be possible to arrange projects on other subjects aligned with student interests.

## Evaluating heterogeneity in carbonate reservoirs and their controlling influences: seismic to pore-system studies

**Supervisors:**
Moyra Wilson, moyra.wilson@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Carbonate systems host ~50% of the world's hydrocarbon reservoirs and form major subsurface aquifers, yet their poro-perm characteristics remain notoriously fickle and difficult to predict. Unlike siliciclastics, carbonate systems 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.

## Coral Reefal Environmental change during periods of global climatic shifts

**Supervisors:**
Moyra Wilson, moyra.wilson@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**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.

## Reefal and carbonate edifices: integrated seismic and sample studies to evaluate environmental change and economic aspects

**Supervisors:**
Moyra Wilson, moyra.wilson@uwa.edu.au
Victorien Paumard, victorien.paumard@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** Reefal and carbonate systems are sensitive indicators of environmental change, building edifices or platforms that are some of the world's largest bioconstructions. In the subsurface the origins, evolution, controlling influences on, and economic potential of such edifices are best investigated through combined seismic, log and sample datasets. A range of studies on subsurface carbonate systems from Australasia will involve training in seismic analysis, facies approaches, petrology and where possible petrophysics to investigate the evolution of a range of carbonate systems and their controlling influences.

## Western Australia's coastal deposits as proxies for global climate change

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** Marine and coastal deposits of SW Australia lie at the transition of warm to temperate waters, with the reefal and carbonate deposits acting as sensitive indicators of local to regional environmental and climatic change. A series of projects are available to investigate the impacts of oceanographic, climatic habitat, and eustatic sea level changes on the modern and Plio-Pleistocene coastal and marine deposits of SW Australia. These projects will variably involve training in the study and integration of: modern sediment studies, field outcrop, microscopy and geochemical datasets with fieldwork a possibility. This topic is also suitable for a 36 pt Master of Science project.

## Coastal Particle Dynamics: the link between Coastal Setting, Oceanography Erosion and Accumulation

**Supervisors:**
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Jeff Hansen, jeff.hansen@uwa.edu.au
Michael Cuttler, michael.cuttler@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Oceanography

**Description:** What are the environmental controls on coastal erosion, accumulation and particle dynamics on carbonate islands at the limits of tropical coral reef development in WA's super stormy location? The setting and nature of beaches, intervening headlands and adjacent marine areas together with winds, waves, currents and storms are critical influences on coastal erosion and accumulation thereby strongly impacting coastal and offshore infrastructure. The aim of this project is: through a detailed study of coastal sediment, wrack and coastal debris (commonly plastics), landscape, seascape characterisation linked to evidence of coastal evolution, oceanographic and weather records to better evaluate influences on particle dynamics and the nature of coastal erosion versus accumulations on carbonate islands versus mainland coastal beaches. Detailed satellite imagery, GPS surveys, drone and/or aerial photography will be integrated through photogrammetry surveys to evaluate the volumetrics and better understand the magnitude of coastal environmental change through erosions and accretion. Specific islands being studied are Rottnest, Montebello, Barrow Island or potentially Christmas Island. Additionally, there is the potential for students to assess and the efficacy of different infrastructure types in the varying coastal settings.

*This project has research permits and support secured from the Rottnest Island Authority, support from Rottnest Express and potential Riverlab support.*. RiverLab is a high profile component of the Woodside FutureLab at UWA. While undertaking their final year project, RiverLab students will have access to a cohort experience which includes Science Communication Training, Industry networking opportunities, and interactions with researchers from a wide range of backgrounds. At the completion of the project, students will present a 3 minute thesis talk to the Woodside FutureLab team.

## Thresholds for coral reef survival

**Supervisors:**
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Jody Webster (University of Sydney)

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Carbonate systems build amongst the largest edifices on the planet, are able to keep-up with most tectonic or glacio-eustatic induced sea-level rises and consequently the foundering of many platforms is often enigmatic. The cause of demise of platforms and the deposition of potential overlying seal units are critical for understanding thresholds for carbonate platform survival as well as petroleum systems evaluations in better understanding relationships between reservoirs and caprocks.

The paradox of foundering of carbonate platforms has been variously linked to 'drowning' via (1) fast glacio-eustatic sea-level rise, (2) tectonic induced sea-level rise (3) nutrient and/or clastic poisoning and (4) subaerial exposure, shut-down of the carbonate factory and a subsequent inability to 'catch-up' on subsequent reflooding. Despite better understanding of the foundering of carbonate platforms being critical for their survival, evaluations of the sedimentary, geochemical and petrophysical signatures of each of the potential causes for demise remain understudied. This study will evaluate the sedimentary, geochemical and diagenetic signatures across key outcrop analogue sections and subsurface reservoirs to understand the impacts of different causes of foundering on reservoir and caprock development. Dataset for study include carbonate reefal rocks from SE Asia, Australia and Hawaii.

## Neotectonics and mass transport deposits in offshore petroleum basins of northern WA

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** The northwest of WA hosts Australia's largest recorded earthquakes (ML 7.3, Meeberrie, 1941). Identification of modern surface offsets (fault scarps), both onshore and offshore, together with recently calculated earthquake focal mechanism data suggests that modern geomorphology may yield evidence as to recent earthquake activity throughout northwestern WA, which may have triggered mass transport deposits. This project seeks to map modern mass transport deposits and fault reactivation in offshore areas in the Carnarvon Basin, using 3D seismic data, to understand the pre-reactivation geometries and timing, and relating them to the modern tectonic setting.

## General projects in seismic structural interpretation

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**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 potentially also in microstructure and geomechanics for qualified students.

## Identifying mass transport deposits in the Japan Trench – records of past mega-earthquakes

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Trench-slope basins along the Japan Trench potentially record sedimentary evidence of historical mega-earthquakes. New sub-bottom profile and seismic data, along with a number of piston cores, allow us to interpret likely mass-transport deposits triggered by tsunamis generated from historical large magnitude earthquakes that are recorded in the trench-slope basins. This project is part of IODP project 386, investigating event stratigraphy and paleo earthquakes in the Japan Trench.

## Structural Geology and/or petrology projects, Albany-Fraser orogenic belt

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au
Tony Kemp tony.kemp@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** At both Hopetoun or Bremer Bay there are several potential projects to resolve aspects of the structural geology and/or petrology. These projects are most suitable for the students who have completed the EART3343 field trip to the same area and are familiar with the geology.

## Seismic structural interpretation of the Lord Howe Rise and correlation to velocity models

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au
Ron Hackney (ANU)

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** A new velocity model for the Lord Howe Rise, generated from a dense network of ocean-bottom seismometers, shows unexplained velocity inversions in the model, which need to be correlated to geology. Using a high resolution 2D seismic survey, we need to investigate the geology and structural controls, and try to correlate the geological and structural interpretations with the velocity model.

## Geological mapping of Venus

**Supervisors:**
Myra Keep, myra.keep@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience

**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.

## Refining the record of deep subduction in Norway

**Supervisors:**
Naomi Tucker, naomi.tucker@uwa.edu.au
Chris Clark (Curtin University)

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** The Western Gneiss Complex in Norway is reported to contain coesite-bearing eclogites implying that the rocks have been subducted to depths >100km. However, recent studies of the host felsic gneisses suggest that the rocks do not record pressures of more than 12 kbar. These contradictory observations have significant implications for how we understand what goes on inside a subduction channel during continental subduction. There are three potential ideas to explore:

1. Hypothesis 1 – felsic gneisses were subducted to and exhumed from UHP depths but converted back leaving a cryptic record of their high-pressure history

2. Hypothesis 2 – the felsic gneisses were never subducted but juxtaposed later during the exhumation of the eclogites

3. Hypothesis 3 – There are two types of felsic gneisses, those that were subducted and are associated with eclogitic gneisses and those that were never subducted and only record metamorphism at mid to lower crustal depths during the Caledonian (i.e. it's a bit of 1 and a bit of 2 but it's complicated)

To test these hypotheses requires a detailed understanding of the field relationships of the eclogites and felsic gneisses (structural geology), characterisation of the *P–T* conditions recorded by the gneisses, eclogites and other styles of boudins found within the gneisses (metamorphic petrology) and the chronology of deposition, burial and exhumation preserved within the rocks (geochronology). Some familiarity with metamorphic petrography is essential (i.e. EART3343 or equivalent). This project is supported by an Australian Research Council Discovery Project Grant.

## A geological cold case: investigating blueschist conglomerates from a Cambrian-Ordovician subduction channel

**Supervisors:**
Naomi Tucker, naomi.tucker@uwa.edu.au
Martin Hand (University of Adelaide)

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** Unique exposures of high-pressure low-temperature metamorphic rocks are preserved at Port Macquarie in New South Wales. Here, a tectonic mélange hosts an assortment of different high-P blueschists and eclogites that record a complex evolution of Cambrian-Ordovician subduction along the eastern margin of Gondwana.

Rare blocks of deformed, blueschist conglomerate occur within the mélange. Although they were metamorphosed to blueschist facies, these meta-conglomerates retain relic primary igneous textures, such as relic phenocrysts that are now replaced by coarse lawsonite and glaucophane. The rocks contain a variety of clasts, including chrome-spinels that are embedded in a fine-grained matrix of glaucophane, chlorite and titanite.

These rocks are thought to represent detritus from the subduction channel, which accumulated in an accretionary wedge between the two converging tectonic plates. At some point after sedimentation, the conglomerates were subjected to blueschist facies metamorphism at depth, before being rapidly exhumed back to the surface.

K-Ar age dating from blueschists in the mélange, and Sm-Nd ages from the meta-conglomerates, suggest that the rocks in the subduction channel were exhumed at ca. 490-470 Ma. However, recently obtained U-Pb ages from detrital zircon in the meta-conglomerates suggest that blueschist metamorphism instead occurred *after* ca. 340 Ma. These contradictory observations mean that the metamorphic evolution of the blueschist conglomerates in the subduction channel requires further investigation.

This project will involve a combination of titanite U-Pb geochronology, Rb-Sr geochronology, major and trace element mineral chemistry, and P-T modelling. Some familiarity with metamorphic petrography is essential (i.e. EART3343 or equivalent). This project is supported by an Australian Research Council Discovery Project.

## Petrochronology in the Savannah Ni-Cu-Co Camp.

**Supervisors:**
Naomi Tucker, naomi.tucker@uwa.edu.au
Laure Martin (CMCA)

**Majors or Masters:** Earth Science Honours

**Description:** The aim of this study is to better understand the processes leading to Ni-Cu-Co mineralisation in the Savannah deposit, located in the East Kimberley region of WA. The deposit consists of interlayered mafic-ultramafic sequences, from peridotite-norite-gabbronorite to troctolite, that intruded the Tickalara Metamorphics during the Paleoproterozoic Halls Creek orogeny. Massive sulfides bearing rocks in the Savannah deposit are associated with abundant crystallization of garnet within the orebody (Le Vaillant et al. (2020). Garnets are also abundantly observed within the country rocks, mainly composed of metapelites metamorphosed in the granulite facies.

The proposed methodology is twofold. (1) Identify the petrological relationships between the massive sulphides and their host granulite to understand their potential interactions and the implication for the formation of the mineralisation. (2) Characterise the timing of these interactions using Lu-Hf in garnet and U-Pb in zircon/monazite in-situ in rock sections, to integrate geochronology and microstructures.

## Characterisation of proximal to distal alteration footprint of gold deposits

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**Description:** A range of projects are available focusing on gold (Au) mineralization. These projects aim to either characterize the mineral paragenesis and structural contexts of Au mineralization within a specific deposit, or investigate the mineralogical and petrological characteristics associated with the processes of Au transport and deposition.

These studies adopt a multidisciplinary approach, potentially combining the following methods:

1. Field mapping to delineate geological structures and mineralized zones.
2. Structural core logging to understand the deformation history and the spatial relationship of Au with surrounding rocks.
3. Ore mineralogy to analyse the composition, texture, and paragenesis of Au-bearing minerals.
4. Lithogeochemistry to assess the chemical characteristics of the host rocks and alteration zones.

This integrated approach aims to generate a comprehensive understanding of the geological processes governing gold mineralization, which is vital for exploration and resource development.

## Yilgarn mapping projects in collaboration with the Geological Survey of Western Australia

**Supervisors:**
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R. Quentin de Gromard, Tim Ivanic (GSWA)

**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**Description:** In collaboration with the Geological Survey of Western Australia (GSWA), multiple areas within the nearby Yilgarn Craton have been identified as requiring detailed geological investigation. A variety of projects are available for field-based studies, conducted through a collaboration between the School of Earth and Oceans and GSWA's mapping division.

These mapping projects may cover a range of topics, including but not limited to:

- defining stratigraphic assemblages and correlating stratigraphic packages across greenstone belts.
- petrology and geochemistry of volcanic rocks, to understand their formation and alteration histories.
- petrology and geochemistry of granitic and gabbroic magmatic suites, focusing on their emplacement processes and regional significance.
- structural observations and constraints on the deformation history of targeted areas, aiming to understand the tectonic evolution.

The research methodology will integrate:

1. field-based geological mapping to document lithological and structural relationships.
2. petrological investigation and characterization using optical and electron microscopy to analyze mineral textures and compositions.
3. microprobe mineral analyses on selected samples to provide detailed chemical compositions.
4. geochronology (if required) to establish the timing of key geological events.

This collaborative effort aims to enhance the geological understanding of the Yilgarn Craton, with implications for mineral exploration and regional tectonic history. These topics are suitable for 36 pt Master of Science research projects.

## Geochronological investigation of the Sula Mountains greenstone belt in Sierra Leone

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** The Sula Mountains greenstone belt is one of the oldest greenstone sequences at the surface of the Earth, located in the heart of the Leo-Man Domain in West Africa. This belt is believed to have developed during the Paleoarchean era. However, the geochronological record for this region remains sparse, limiting our understanding of its early geological history.

To address this gap in knowledge, this project aims to conduct U-Pb geochronology and Lu-Hf isotopic analysis on both igneous and detrital samples collected during the 2024 field campaign. By doing so, the project seeks to shed light on the early formation of this Archean nucleus.

Project Objectives:

1- Revise the stratigraphic sequence of the Sula Mountains greenstone belt using existing literature and recent field observations.
2- Perform petrographic and geochemical analyses on key sample suites collected from the field and those already available for study.
3- Investigate the geochronological and isotopic records (using U-Pb, Lu-Hf, and O isotopes) to determine both the age and the source regions of the sampled materials, thereby providing new insights into the region's geological evolution.

## 4D evolution of the Wunaamin Miliwundi Orogen

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**Description:** The geodynamic evolution of Australia between 1900-1780 Ma remains debated. The debate is currently polarized between two camps: one team that proposes that collision of the NAC occurred at c. 1835 Ma and collision between the WAC and Kimberley Craton at c. 1820 Ma; another team that hypothesize the collision of all elements only occurred at c. 1300 Ma.

This study will focus on deciphering the c. 1900-1780 Ma geological evolution for a key piece of the abovementioned geodynamic puzzle: the Wunaamin Miliwundi Orogen in the Lamboo Province of the North Australian Craton. The key objective of this research project is to clarify the depositional, metamorphic, and magmatic evolution the Wunaamin Miluwundi Orogen in order to inform on possible geodynamic scenarios.

In order to achieve this goal, the geoscientist will undertake a thorough space-time-integrated analysis and interpretation of available multi-disciplinary datasets (e.g. SEEBASE GIS data package, aeromagnetics, gravity, 1:1M seamless chronostratigraphic solid geology, 1:250 000 solid geology maps, published scientific articles, public geological survey data and records including U-Pb-Hf zircon and whole rock geochemistry). Ideally, the tectono-stratigraphic evolution of the Wunaamin Miliwundi Orogen would be animated/visualized in GIS in space and time (i.e. time slices) and/or in GPlates.

## Deep crustal architecture of the Yilgarn Craton

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**Description:** The Archean Yilgarn Craton hosts world-class endowment in orogenic gold and is regarded by many explorers as a mature region. Thus, the identification and mapping of the fundamental lithospheric architecture of the craton is critical for explorers to improve their predictive capacity. Recent research has identified strike-extensive ENE- to NE-trending, steep, discontinuities in the Yilgarn Craton's lower-mid crust, some of which are consistently imaged in geological, geophysical, and isotopic datasets. One emerging working hypothesis is that some of these lineaments, or more precisely their intersections, exert a strong control on the location of major gold deposits.

This study will rely on a three-fold workflow:

- Building on Yilgarn 2020 collaborative research knowledge, identify depth-extensive lineaments through the integrated interpretation of multi-disciplinary data (e.g. U-Pb-Hf zircon, whole rock geochemistry, aeromagnetics, gravity, topography, depth to Moho, passive seismic, geology, earthquake epicentres). Where possible compare and integrate semi-automated and manual mapping approaches.
- Assess the geological robustness of the identified lineaments through comparison between independent datasets (e.g. multi-data stacking method).
- Define the influence of fault hierarchy and network topology (i.e. length scales and order, orientations, and intersection relationships).

Undertake geostatistical testing of the spatial relationships between these lineaments and the distribution, endowment, and nature of gold systems.

## Stream-aquifer interaction – moving beyond the hillslope

**Supervisors:**
Sarah Bourke sarah.bourke@uwa.edu.au

**Majors or Masters:** Hydrogeology, Earth Science Honours

**Description:** It is now widely acknowledged that best-practice water resource management requires a robust understanding of water fluxes between surface water and groundwater. Streamflow is often generated by groundwater outflowing to the surface, while water infiltration from streams forms an important source of aquifer recharge. The majority of studies examining streamflow generation processes have been conducted in the context of hill-slope hydrology, where topography plays is the dominant control on water movement. However, in highly weathered landscapes like WA, subsurface geology can be more important than topography in determining how much water ends in in streams and aquifers. Research project opportunities can include the analysis of existing data sets as well as field data collection to improve our understanding of geological controls on surface water – groundwater interaction and streamflow generation. Field sites may include Preston, Pemberton or sites in northern WA. Research projects will be aligned with current water resource management challenges and the outcomes will be used to inform robust water management decisions.

## Hydrogeological controls on water quality in remote communities

**Supervisors:**
Sarah Bourke sarah.bourke@uwa.edu.au

**Majors or Masters:** Hydrogeology, Earth Science Honours

**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.

## Geological structures as controls on groundwater flow in southwest WA

**Supervisors:**
Sarah Bourke sarah.bourke@uwa.edu.au

**Majors or Masters:** Hydrogeology, Geoscience

**Description:** Geological structures are a key control on groundwater flow paths and residence times. Robust management of groundwater resources therefore requires an understanding of the presence of faults and folds and their influence on groundwater flow.

Research project opportunities are available to work on existing data sets held by DWER to refine our understanding of geological structures in south-west WA. Research will involve the re-interpretation of drill logs, water levels, environmental tracer data and geophysical data sets to refine our understanding of subsurface geological structures and their influence on groundwater flow. Project outcomes will be directly related to current groundwater management issues and will inform robust water resource management decisions.

## Modern fluvial-deltaic reservoir analogues for subsurface Reservoir modelling

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** Subsurface reservoir facies modelling (for oil, gas, geo-sequestration, waste disposal and water resources) requires a range of uncertainty to be considered regarding the size, shape and 3D geometry of geobodies in the subsurface. Predicting likely spatial relationships of facies both in 2D and in the connected 3D space is critically important because it can impact the outcome of flow simulations it models (high-permeability networks, barriers and seals).

This project focussed on coastal-deltaic geobodies and specifically on aspects of several modern Deltas on the WA coast from the Gascoyne region to the Pilbara. The project will be GIS based followed up by a field sortie to confirm facies predictions and to obtain vital statistics on texture and sedimentary structures. Sediment sampling, augering, drone mapping, coring, and a range of geophysical tools will be used to make facies maps that will be used to characterize the Deltas in the mode of the WAVE3 classification scheme and ultimately to guide reservoir modelling as training images. Field work will be conducted between May and August. The project will be supported by funds from the new Reservoir Analogues Consortium funded by industry.

## Quantitative Seismic stratigraphy

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Energy Geoscience

**Description:** With ~15% of siliciclastic hydrocarbon reservoirs located within deep-water basins, a key challenge for the industry is to predict when and where coarse-grained sediments are delivered from the edge of continental margins (i.e. shelf-edge) to the continental slope and basins, and how these sediments accumulate in deep water (i.e. type and architecture of deep-water systems).

This project aims at applying the innovative approach of quantitative 3D seismic interpretation (QSS) to investigate the linkages (quantified relationships) between shelf margin architecture, hydrodynamic processes along deltaic shorelines and reservoir properties (type, volume, architecture) in deep water in a variety of basin settings. The project is underpinned by state-of-the-art, full volume, semi-automated 3D seismic interpretation methods that enable very high-resolution seismic stratigraphic analysis of large datasets in a short time frame. The project will involve detailed analysis of one or more subsurface case studies (margins in a variety of climatic and tectonic settings), including the use of appropriate analogues from literature and outcrops.

This study will evaluate how quantitative measurement of shelf edge parameters on seismic data can be a useful exploration tool to predict shallow marine depositional style and deep-water play development.

## Quaternary to Recent coastal processes and evolution from high resolution seafloor mapping of the Western Australian continental shelf

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Marine Geoscience

**Description:** Regional scale seafloor mapping of the West Australian continental shelf based on high resolution 3D seismic datasets and satellite imagery offers a valuable dataset for understanding larger scale coastal processes and shoreline evolution based on sedimentation patterns observed from bathymetric datasets. The project will help create improved datasets from various data sources and using GIS mapping (enhanced by sediment sampling, drone mapping and shallow borehole data), will focus on the evolution of selected clastic and/or carbonate geobodies and their spatial and temporal relationships.

The results will be used to improve our understanding of the evolution of the continental shelf during significant changes in relative sea-level and variable climate history, with spin-off value for sedimentology of shallow marine and shoreline deposits, including geotechnical aspects and geo-archaeology. The opportunity to conduct field work may arise in conjunction with related projects by the School. The project will be supported by funds from industry and related research grants and related research grants focused on climate change and its impact on coastal evolution.

## Curation and Analysis of the Meteorite and Tektite Collection

**Supervisors:**
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Tony Kemp, tony.kemp@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience

**Description:** Meteorites are rare, incredibly valuable rock samples delivered to Earth from the cosmos and provide unique information on the earliest evolution of the solar system and the formation of the terrestrial planets. This project aims to curate and analyse the meteorite and tektite collection housed at EdCC Earth Science Museum. It involves conducting a comprehensive literature review of the existing knowledge on the museum's meteorites and tektites, identifying gaps in current understanding, and selecting specific specimens for detailed research based on criteria such as significance, representativeness, and research potential.

The research will apply various innovative analytical and visualisation techniques to enrich the geological data, including petrography (optical and electron microscopy) and mineral chemistry, and contextualise the specimens scientifically and historically. Such studies would also confirm whether the meteorite samples are classified correctly and matched with known meteorite falls or represent new discoveries to science. If the latter, the specimens will be registered in the Meteoritical Society database (https://www.lpi.usra.edu/meteor/). Collaboration with the International Space Centre will be sought to incorporate interdisciplinary perspectives.

Additionally, the project will ensure proper cataloguing of the specimens into the museum management system and prepare the collection for the curation of a novel exhibition display, presenting selected specimens in the context of modern research practices and the broader implications for understanding our planet and its place in the universe, telling a captivating story of the evolution of our solar system and planet formation.

## Terrific tourmaline: a tracer of critical mineral potential?

**Supervisors:**
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**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**Description:** The 'Critical Minerals' underpin high technology applications on Earth and in space and are essential for the transition to low carbon energy sources. Pegmatites are a major source of some of the most critical commodities, such as lithium, tantalum, beryllium and the rare earth elements. These generally small igneous bodies are, however, difficult to explore for, particularly under cover, and there is no robust model to explain why some pegmatites are enormously endowed in critical minerals, yet others are barren. There is therefore much interest in developing proxies based on the chemistry of certain resistate minerals (i.e., minerals that can survive as stream sediments and in weathering profiles) as to whether a particular area may be fertile for rare metal pegmatites or not. This project will test this approach using the mineral tourmaline.

This is a complex boro-silicate common in pegmatites, sometimes as gemstones; how the chemistry of tourmaline varies within pegmatite bodies and relates to their critical mineral potential is unknown. The project will involve studying tourmaline crystals from a variety of pegmatites and their host rocks in Western Australia, including the green and pink varieties that are prized as gems. Analysis would involve conventional petrographic examination, as well as electron microscopy and laser ablation ICPMS techniques to explore whether tourmaline chemistry can be linked to high grades of pegmatite-hosted critical metals like lithium, tantalum or the rare earth elements. A secondary aim is to use the microstructure and trace element chemistry of tourmaline to unravel the crystallisation history of pegmatites, and the degree to which they are fractionated.

## Igneous and metamorphic petrology of crustal rocks

**Supervisors:**
Tony Kemp, tony.kemp@uwa.edu.au

**Majors or Masters:** Earth Science Honours, Geoscience, Ore Deposit Geology

**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 and gabbro intrusions in the Yilgarn Craton and Albany-Fraser Orogen, (2) use of hornblende-plagioclase geobarometry in granites to reconstruct Archean geodynamics, (3) formation and magmatic evolution of anorthosite complexes, (4) critical mineral resources – lithium and rare metal mineralization in pegmatites, and (5) partial melting processes in granulites. All projects would involve petrography and mineral chemistry, with scope for whole rock geochemistry and, potentially, U-Pb isotope geochronology. A fieldwork component could potentially be included. Projects can be tailored to suit individual interest


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