Department of Earth Sciences

Geology, Geophysics and Environmental Geoscience Honours

Circos Provider 00123M

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!!! Disclaimer !!!

We are doing our best to bring together interesting and challenging projects that cover a wide range of interests and locations. These projects frequently require skills or qualities inherent to the project like willingness to work in remote areas or ability to drive a four wheel drive vehicle. Projects in this booklet are to be considered preliminary as contracts with companies may not have been signed yet, access to locations including project locations, conditions, offers of support and all other concessions are preliminary only and at the discretion of the principal supervisor in consultation with the Head of Department, Earth Sciences. It is the students' responsibility to obtain the qualifications necessary to enrol in the Honours program. Under certain circumstances a student may need to complete additional coursework (e.g. Summer School) to fulfil the enrolment prerequisites. It is to the discretion of the principal supervisor to consider such students once they meet the enrolment requirements. Project allocation is non-transferable and there is no entitlement of the student to the selected project.

Introduction

The Bachelor of Science (Honours) in the School of Physical Sciences at the University of Adelaide is the gateway to increased job opportunities and a great range of rewarding careers in research. Our teaching and research staff are international leaders in their fields of science. Join us for your Honours project and you will be a member of a research team working at the leading edge of geological and geophysical sciences. We offer three Honours programs: Honours Geology, Honours Geophysics and Honours Environmental Geoscience.

This booklet includes the 2022 Honours research projects but we also encourage you to talk with staff as the projects listed in the booklet may not reflect all the projects available. We recommend that you consider the preferred field in geology or geophysics in which you would like to do a project and then get in contact with the academics who supervise projects in the field. You may also want to talk with current Honours students to find out what Honours is like from a student perspective.

The Australian School of Petroleum & Energy Resources offers an Honours degree year in Petroleum Geology and Geophysics – follow ASPER Petroleum Geology & Geophysics for further information. If you are interested in undertaking this program, complete the Faculty of Science Expression of Interest (EOI) form (specific instructions can be found by following the link or on the EOI form itself) and contact the coordinator, Dr. Mark Bunch (mark.bunch@adelaide.edu.au), to make him aware of your application.

What is Honours like? As an Honours student you become a member of the Department and a valued colleague. You will spend most of your time as part of a research group sharing goals, triumphs, disappointments and all of the other things that are part of the adventure of scientific research. For the first time, you will become responsible for the outcome of your own scientific work. Honours students also partake in all aspects of the social life of the School. You will form friendships and professional associations that will last a lifetime.

The Honours degree will give you a thorough training in scientific methods and detailed insight into geological, geophysical and environmental geoscience processes in the area of research that you pursue. The scientific approach to problem solving, maturity and self-discipline gained during the Honours year will equip you for a wide variety of careers. Many of our students elect to continue in the research domain by enrolling in the School's PhD programs. However, the analytical and communication skills that our students acquire have led other Honours graduates into a range of careers in many different fields and industries.

Derrick Hasterok
Honours Coordinator

Contact details

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Choosing a research project

If you are thinking about doing Honours, it is a good idea to talk to the current and past Honours students; they will give you frank and helpful advice.

It is sensible to identify **four projects** of interest in this booklet and then arrange to meet with the supervisor(s) to discuss in more detail. It is also recommended that you select projects from different supervisors when submitting your "Expression of Interest Form." Remember that the supervisors mentioned in this booklet will not expect you to have a great deal of knowledge about their particular field(s) of research, so do not feel intimidated. It is also worth remembering that different supervisors have different ways of assigning projects. Some may use first-in, first-served approach, while others may consider all inquiries before offering a project to a particular student. If you are genuinely interested in a project, make sure that you leave a contact number/email in case another student also expresses an interest.

We **strongly encourage you to talk to potential supervisors** about the projects before making your selection. This will help you identify which projects are of interest to you and indicate your enthusiasm to potential supervisors. It may also be the case that there are other potential projects that are not listed in this booklet. In addition, if you have a good idea that you would like to explore, by all means bring it to our attention.

Note that Honours acceptance will ***require a minimum credit average*** of four third-year courses relevant to your chosen project and ***completion of a BSc major***. The four courses must be agreed upon by the Honours coordinator and your proposed supervisor. Specific requirements will be listed as prerequisites for individual projects. Some general guidance is given in the table below.

Honours Program	**Typical BSc major**	**Typical courses drawn from**	**In some cases**
Geology	Geology, Paleontology, Geophysics or Minerals Geoscience	**Geology***, Geophysics*, Paleontology*	Chemistry (BSc)
Geophysics	Geology, Geophysics or Physics or Minerals Geoscience	Geophysics IIIA, IIIB and Exploration Methods III, or Physics*, Tectonics III, Igneous and Metamorphic Geology III	BSc Space Science and Astrophysics
Environmental Geoscience	Geology, Geophysics, Paleontology, Ecology, Evolutionary Biology or Minerals Geoscience	Geology*, Paleontology*, Geophysics*, Soil and Water, Ecology*, Evolutionary Biology*	Chemistry (BSc)

*Courses selected from major, bold indicates generally preferred.

What is Honours all about?

The Honours year in the Department of Earth Sciences consists of a major research project, course work and field camps. The course work and field camps provide extra skills and resources, and a level of professional achievement that will form a significant part of your resume. Research projects are undertaken with the supervision of a staff member in the University, and sometimes also involves personnel from industry or other government organisations such as Department of State Development (DSD) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO). During your research project, you will have the opportunity to:

- Develop your own fieldwork program
- Travel to interesting and unique places
- Conduct laboratory analyses using state-of-the-art instrumentation
- Instigate computer analyses and modelling with industry-standard software
- Meet and network with industry and government scientists
- Attend and present results at conferences, workshops and meetings
- Write a scientific publication that can be developed into a refereed publication

The mix depends on the project and your own personal interests.

The major goal of the Honours programs is to equip you with a wide range of skills that will allow you to tackle graduate employment programs or further postgraduate research with confidence!

Why do Honours?

For many students, the decision to do Honours is a natural choice at the end of their Bachelor of Science degree. For those students who have decided that they are intrigued and fascinated by the process of research, Honours is the beginning of the business of becoming a scientist. For students who seek a career in industry, an Honours degree is usually the basic requirement for employment. Whether you have decided to do Honours as a prelude to seeking employment, or continuing in research, the decision to do Honours is not a trivial one, since it is a challenging year that will be associated with highs and lows. However, we expect it will also be the most interesting and rewarding of your University career.

When to apply and the process?

It is never too early to think about honours. Between now and the end of the semester you should start talking and thinking about your Honours year. To be accepted into Honours, *you will need to complete a BSc degree before Honours begins*. If you find yourself a few credits short at the end of December, it may be possible to pick up a few units in the Summer Semester (January-February) to complete your degree, but your results must be finalised so that you can be completed from your degree and enrolled into your Honours program by the end of February. If you have not completed your degree by December you must contact Jenny Reiners by email (jenny.reiners@adelaide.edu.au) to discuss your options.

It is now possible to start Honours mid-year. So if a summer completion is not an option, or desired, you may apply for a mid-year start. The process is the same, but the dates for application and start are different and there is some rearrangement of tasks to accommodate the schedule (see sections below for details and dates).

The application process is administered by the Faculty of Sciences and all applicants must fill out the online form titled "Expression of Interest Form" at sciences.adelaide.edu.au/study/honours/apply-for-honours
This form provides the Faculty of Sciences with all your information and allows them to keep you informed of the process. This form can be filled in at any time – the sooner the better. See closing dates on the following page.

You will be informed of the outcome of your Expression of Interest via an email in December (after examination results are confirmed). To accept your offer you need to complete an internal transfer or lodge an application through SATAC.

OS-HELP Funding

Financial assistance for students is available through OS-HELP. This is a loan scheme administered by the Department of Education that allows students to borrow up to $6,913 (current for 2020) for a six month period overseas for a maximum of two study periods. Your OS-HELP is added to your accumulated HECS-HELP debt. Go to the Global Learning website for information on eligibility. Further information about travelling to New Zealand and how to apply for OS-HELP funding will be sent to all applicants. Unfortunately, OS-HELP scheme is not available in the case of a domestic field trip (Tasmania), though there may be some additional sources of funding.
adelaide.edu.au/study-overseas/funding

Elizabeth Maud McBriar Memorial Scholarship

The Elizabeth Maud McBriar OAM Memorial Scholarship has been established by Mr Tom Davis (Ms McBriar's nephew) to support female students, who are undertaking an Honours degree in the area of Geology, Geophysics and Environmental Geoscience at the University of Adelaide. The scholarship, $5000, is awarded to a female student undertaking an Honours Degree of Bachelor of Science in the Department of Earth Sciences, (encompassing Geology, Geophysics or Environmental Geoscience) at the University of Adelaide. Applications are accepted between **17 January 2022** and **25 February 2022**.

Applicants must be Australian citizens, New Zealand Citizens, permanent residents of Australia or holders of a permanent humanitarian visa undertaking study as a Commonwealth supported student and must remain enrolled on a full time basis in the approved program for which the scholarship was approved.
Selection of the successful candidate will be made according to academic merit. Academic merit for continuing students will be determined according to students' cumulative Grade Point Average (GPA) or equivalent scores.

Important dates for Application/Acceptance

Closing Date:

While there is no closing date for your **Expression of Interest** (EOI), we suggest submitting your project and supervisor preferences before the 1st of November 2021. Students will be notified of the outcome of their applications beginning on the 2nd December 2021.

Apply for honours here: https://sciences.adelaide.edu.au/study/honours/apply-for-honours

Should you have any questions about the application process they can email the Sciences Services Hub (faculty.sciences@adelaide.edu.au) or contact them on 8313 5673.

Event	**Semester 1, 2022**	**Semester 2, 2022 (mid-year)**
Suggested Application Submission Date	By 1st November 2021	By 1st June 2022
Date of Notification Offers	From 2nd Dec 2021	From 13th July
Prospective Honours Student to Submit Acceptance	Early Dec	Mid July
Honours Enrolments Commence	Early January 2022	Mid July
Honours Studies Commence	31st January 2022	25th July 2022

Late applications:

Late applications are considered in exceptional circumstances as we need to finalise bookings for the New Zealand/Tasmania field trip in mid-December. There is an exception for mid-year entry.

Enrolment and induction

From **Monday, 31st January 2022** (1st semester start) and **Monday, 25th July 2022** (2nd semester start), you will formally start in one of the Honours programs and be introduced to the staff and facilities of the School and University. ***<u>You MUST be at the University for this date.</u>*** Please make good (and efficient!) use of such facilities; we are all here to help as much as we can. Your supervisor will help you with any special needs you may have.

Honours students will be provided with access to a desktop computer. We will locate these computers in a number of Honours rooms. For more general use, computers in the Mawson Suite can still be used when classes are not scheduled. As an enrolled student, you will have access to e-mail and MyUni facilities, as in previous years.

A number of Health and Safety and Welfare (HSW) courses will be prescribed for you. Occupational Health and Safety comprises many things, including safe four-wheel driving, first-aid training, and laboratory and field safety courses. Make as much use of these courses as possible, they comprise a valuable part of your research training and will be an asset on your resume!

We also recommend that you undertake a number of academic courses that are run by the Graduate Centre or through the School. These include:

1. Research proposal as seminar and/or documents
2. Reviewing literature
3. Writing a journal article for publication
4. Endnote referencing

These courses are offered regularly by Researcher Education and Development (RED) (adelaide.edu.au/red)

Assessment breakdown

All of our honours programs are composed of two undergraduate courses, one coursework based and the other research project based. To complete the honours degree you must perform satisfactorily in both courses.

	Start date			
Program	**Semester 1**		**Semester 2**	
Honours Geology	Advanced Geology (Hons) Part I	4.5 Units	Advanced Geology (Hons) Part II	4.5 Units
	Honours Geology Project Part I	7.5 Units	Honours Geology Project Part II	7.5 Units
Honours Geophysics	Advanced Geophysics (Hons) Part I	6 Units	Advanced Geophysics (Hons) Part I	6 Units
	Honours Geophysics Part II	6 Units	Honours Geophysics Part II	6 Units
Honours Environmental Geoscience	Advanced Environmental Geoscience (Hons) Part I	4.5 Units	Advanced Environmental Geoscience (Hons) Part I	4.5 Units
	Honours Environmental Geoscience Project Part II	7.5 Units	Honours Environmental Geoscience Project Part II	7.5 Units

Advanced Geology (Hons) Part I and Part II (9 Units)

1. New Zealand/Tasmania trip "Continents on the move"
2. A course on Geoscience Data Analysis
3. Thesis Support Tasks
4. Research Seminars

Advanced Geophysics (Hons) Part I and Part II (12 Units)

1. New Zealand/Tasmania trip "Continents on the move"
2. A course on Geoscience Data Analysis
3. A course on programming in Python
4. Thesis Support Tasks
5. Research Seminars

Advanced Environmental Geoscience (Hons) Part I and Part II (9 Units)

1. New Zealand/Tasmania trip "Climate and biological history"
2. A course on Geoscience Data Analysis
3. Thesis Support Tasks
4. Research Seminars

New Zealand/Tasmania

Subject to confirmation, the Honours Geology and Geophysics and Environmental Geoscience students will have the opportunity to attend an excursion to New Zealand/Tasmania as part of their course work. The dates for this trip are yet to be determined but will take place in late February-early March.

Thesis support tasks

Throughout the year you have a number of Thesis support tasks to complete. The tasks have been devised as exercises based on your project, which will enable you to proceed through your project on time and with full support and feedback from your supervisors. Each task is outlined below.

Semester 1 start (2022 dates)

Thesis Support Session	Lecture session*	Hand Up Task*	Feedback Due*
Hypothesis & Project Aims	1st March 2022	15th March 2022	25th March 2021
Time Management	15th March 2022	5th April 2022	15th April 2022
Background & Literature Review	22nd March 2022	12th April 2022	22nd April 2022
Bibliography	29th March 2022	—	—
Introduction	5th April 2022	26th April 2022	6th May 2022
Methods	19th April 2022	10th May 2022	20th May 2022
Posters	24th May 2022	—	—
Presenting Your Results	12th July 2022	2nd August 2022	12th August 2022
Results vs. Discussion	9th August 2022	—	—
Abstract	16th August 2022	—	—
Draft Thesis	—	12th September 2022	30th September 2022
Presentation Skills	1st November 2022	—	—

*Dates subject to change. You will be informed in good time prior to these changes.

Semester 2 start (2022 to 2023 dates)

Thesis Support Session	**Lecture session***	**Hand Up Task***	**Feedback Due***
Hypothesis & Project Aims	2nd August 2022	16th August 2022	26th September 2022
Time Management	16th August 2022	30th August 2022	9th September 2022
Background & Literature Review	30th August 2022	20th September 2022	30th September 2022
Bibliography	13th September 2022	—	—
Introduction	20th September 2022	11th October 2022	21st October 2022
Methods	11th October 2022	1st November 2022	11th November 2022
Posters	15th November 2022	—	—
Presenting Your Results	29th November 2022	10th January 2023	20th January 2023
Results vs. Discussion	10th January 2023	—	—
Abstract	28th February 2023	—	—
Draft Thesis	—	27th March 2023	7th April 2023
Presentation Skills	16th May 2023	—	—

*Dates subject to change. You will be informed in good time prior to these changes.

Research seminars

As an Honours student you are expected to get involved with the research community at the University. You will be expected to attend the weekly research seminars, often presented by our academic research staff, postgraduate students, as well as national and international visiting geologists and geophysicists. Your attendance at these seminars will be recorded and written summaries of what you heard will be collected.

Honours Geology, Honours Geophysics and Honours Environmental Geoscience projects

Research output from the project will be in the format of a scientific paper in the style of the Australian Journal of Earth Sciences (AJES). The aim is to encourage a conciseness of thought and expression that can be communicated to the wider scientific community. Most journal papers are of the order of 5000 to 8000 words (approximately 12-15 printed pages), typically with 5 to 15 figures. We anticipate that some research undertaken during the year may be published with very little modification, as has been the case in previous years. However, not all projects lead to publications and a successful Honours year is not dependent on achieving a publishable result. Projects vary in scope, funding and time. Some students combine summer vacation work with their Honours year. Assessment of your project is geared towards how you do your project, rather than the glittering outcomes; we are looking to see how you work in research!

Your final thesis (in digital manuscript format) will be submitted at the due date through MyUni. The advantages of this are that we significantly reduce the amount of paper involved in the process and that you will not need to worry about the printing. This online administration will also improve on your computer skills. To support you with this there are a number of seminars and workshops available at the University, for example on the use of EndNote, graphics software packages, desk top publishing and improving your skills at writing a thesis. There may be an opportunity to attend a conference during the year and maybe present your results to the wider community. Please talk to your supervisors about potential meetings.

At the end of your Honours year you will be required to present your final project, including your initial aims, methods, results and final conclusions. This oral presentation will be held a few weeks after the submission of your final draft. The audience will include the entire Honours group and staff and postgraduates of the Department of Earth Sciences, as well as any industry professionals involved with the Honours class throughout the year. The presentation will be 15 minutes in length followed by 5 minutes of questions from your examination panel.

Prizes

The School offers the prestigious Tate Medal as a prize for top Honours student in Geology or Environmental Geoscience and the Zonge Prize in Geophysics as a prize for the top Honours student in Geophysics.

Assessment

To graduate with an Honours degree, the student must submit all of the required work in both courses of the program that they are enrolled into (e.g. Advanced Geology (Hons) and Honours Geology Project). The individual items of assessment within both courses will be marked following the M10 mark scheme:

Grade Value Description

HD ≥85% High Distinction

D 75-84% Distinction

C 65-74% Credit

P 50-64% Pass

Fail ≤49% Fail

Grade	Value	Description
HD	≥85%	High Distinction
D	75-84%	Distinction
C	65-74%	Credit
P	50-64%	Pass
Fail	≤49%	Fail

The final class of the degree will be determined by the assessments of both courses within the honours program following the GS5 mark scheme:

Grade	Value	Description
1	≥80%	First Class
2A	70-79%	Second Class Div A
2B	60-69%	Second Class Div B
3	50-59%	Third Class
NAH	≤49%	Not Awarded

The numerical value for the Honours grade will not appear on an Academic Certificate, i.e., only the honours class will appear.

All assessment items will be assessed by the staff teaching those components of the course. However, the final thesis will be marked by three examiners.

Finalising the Honours year

The final step of your Honours year is to sign out. This will involve a number of steps, each of which will have to be confirmed by the respective person in charge. You will receive a list of sign out tasks after the Research Seminar and this list will have to be handed in to the main office. **Only once this sign out is complete will your Honours course be considered finished and results can then be finalised.**

Career paths

There is a general perception that your choice of Honours project will fix you to a certain career path. This is not the case: keep in mind that employers are looking for confident and capable people who have successfully tackled and completed a challenging project and professional coursework. You are most likely to be successful during Honours if you choose a research project that interests and motivates you.

If you are interested in continuing into research, or if during your Honours year you begin to enjoy the research experience, you may feel that your choice of project commits, or has committed you to a specialised area. However, the problem solving skills that you will learn, and the confidence gained from completing your Honours project means that you are well equipped to change direction to take advantage of new opportunities. The University's scholarships page has more details on postgraduate research. The Honours year in Earth Sciences is the professional year that gains you access to employment. Graduates have a wide range of career prospects, as shown below.

Honours Planner, Semester 1, 2022 start

Honours Geology, Geophysics, Environmental Geoscience

Time	**Activity**	**Notes**
31st January 2022	Introduction	You must be at the University to complete this
Late February 2022	Field Trip	More details towards end of 2021/beginning of 2022
Mid-February to September	Honours Course	Geoscience Data Analysis
March to May (TBD)	Geophysics Course	Numerical Methods (Honours Geophysics only)
February to September	Thesis Support Tasks	Oral presentation (marked) and report hand in
February to October	Research work	Including weekly seminar series
17th October 2022	Final thesis submission	
4th November	Research Seminars	
Early December	Results posted	

Honours Planner, Semester 2, 2022 start

Honours Geology, Geophysics, Environmental Geoscience

Time	**Activity**	**Notes**
25th July 2022	Introduction	You must be at the University to complete this
August (TBD)	Honours Course	Geoscience Data Analysis
September/October (TBD)	Geophysics Course	Numerical Methods (Honours Geophysics only)
August to March	Thesis Support Tasks	Oral presentation (marked) and report hand in
February 2023 Dates TBC	Field Trip	More details towards end of 2022/beginning of 2023
February to April	Research work	Including weekly seminar series
8th May 2023	Final thesis submission	
26th May 2023	Research Seminars	
Early July 2023	Results posted	

Honours Projects
Semester 1, 2022

MinEx CRC Projects

A number of our projects this year are supported by the Mineral Exploration Cooperative Research Centre (MinEx CRC: https://minexcrc.com.au) and can be identified by the logo above. The MinEx CRC is a 10-year $220M program that is the world's largest research effort in mineral exploration and has an agenda of developing technologies for faster, cheaper and more environmentally friendly methods of discovering and drilling-out mineral deposits. MinEx CRC is a collaboration between industry, academia and government across Australia and internationally.

MinEx CRC supported Honours projects are part of the National Drilling Initiative (NDI) research program. This program is supported by all State and Territory Geological Surveys and Geoscience Australia. These projects come with a $1000 bursary that can be used to support the student (e.g. a stipend) or project costs (e.g. analysis, conference/workshop attendance, field work).

Students will be expected to:

1. attend a short zoom workshop approximately three months into their project and give a short presentation on their research aims and how the $1000 allocated to their project will be spent;
2. acknowledge support of MinEx CRC in any material produced (presentations, reports, theses);
3. submit a copy of their final thesis for archiving in the MinEx CRC data repository;
4. submit a digital version of data (e.g. spreadsheets) for archiving in the MinEx CRC data repository. All metadata must be included, such as sample number, sample location/coordinates, units for data, type of analysis, location of data analysis and standards used.

Students will be encouraged to attend the MinEx CRC Annual Conference, particularly if they are based in the same city as the conference location of any given year. No financial support will be provided for conference attendance (e.g. travel, accommodation), however the $1000 payment may be used in this way if decided by the student and Primary Supervisor.

Students undertaking MinEx CRC Honours projects will have the opportunity to engage with the broader MinEx CRC community including fellow Honours and Postgraduate students as well as MinEx CRC Researchers and Industry Participants and Affiliates.

Geology Honours Projects

Morgan Blades

- The Proterozoic Planetary Pivot: Oxygen,Snowballs and Metals

Alan Collins

- Expanding the exploration search space for HYC or Century style base-metal mineral systems in the Birrindudu Basin
- The NT's Georgina Basin - Understanding its Geology and Base-Metal Potential

Superbasin links on Supercontinents – do the Centralian and Adelaide Superbasins link through the north Stuart Shelf?

Determining the origins of natural CO2 accumulations in the Otway Basin

Juraj Farkas

Chromium isotopes in the Earth's upper mantle and oceanic crust: Insights from Oman ophiolite

In-situ Rb-Sr dating of glauconite: New constraints on depositional ages of sediments

Isotope Chemostratigraphy of the Greater McArthur Basin, Northern Territory

Stijn Glorie

Crustal evolution through the lens of apatite crystals

Garnets, diamonds and glaciers in South Australia

- Uncovering the exhumation history of the East Tennant region

Martin Hand

Paragenesis of a new Cu-Au system at Kanmantoo and its implication for Delamerian mineral systems

A forensic search for America down under using a new age-dating tool

Vulcan iron-oxide copper gold: mineral paragenesis and alteration and mineralisation

Derrick Hasterok

The Fire Down Below: Heat Generation in the Lower Crust

The Impact of Fluid Flow on Crustal Radioactivity – pushing heat around during tectonic reworking

Ros King

Structural Geology by drone photography

Did pipe-like structures at Hallett Cove trigger Snowball Earth termination?

Richard Lilly

Timing and Distribution of Critical Metals Bi-Co, and Ag in the Carrapateena Deposit

What the F? Origin and Distribution of Fluorine at the Carrapateena Deposit

Lucy McGee

What goes down, must come up? Tracking sediment input to subduction zone magmas using radiogenic and stable Sr isotopes

Partial melting of the crust by basaltic magma: Crustal contamination 'caught in the act'

Metal transport in active arc volcanic systems

Mineral chemistry of phyllosilicates as an exploration tool – a case study from Vulcan IOCG prospect

Tony Milnes

Characterising the Delamerian beneath the Murray Basin

Carl Spandler

What is Nundorite? Weird alkaline rocks of the Mount Arrowsmith Volcanics, Western NSW, and their critical mineral potential

Jessica Walsh

The origin and evolution of light rare earth element (LREE) deposits at Browns Range, northern WA

Diana Zivak

The use of rutile geochemistry in characterising the provenance of heavy mineral sands

The Proterozoic Planetary Pivot: Oxygen, Snowballs and Metals

PREREQUISITES

You will have completed the Geology Major (or equivalent), be interested in the geology of the State and be keen on contributing to a dynamic research group

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Morgan Blades 08 8313 3174 morgan.blades@adelaide.edu.au
Alan Collins
Juraj Farkas
Carmen Krapf & Adrian Fabris, Geological Survey of SA
Phil Gilmore, Geological Survey of NSW

This project is a part of the MinEx CRC (minexcrc.com.au), the world's largest mineral exploration collaboration bringing together industry, government and research organisations. You will be working in collaboration with the Geological Surveys of SA and NSW. You will also be part of the Tectonics and Earth Systems (TES) Research Group.

sciences.adelaide.edu.au/physical-sciences/research/earth-sciences-research/tectonics-and-earth-systems

RESEARCH PROJECT

Even if we find life on Mars, it will be like life on Earth a billion years ago or more. Our oxygenated atmosphere, our nutrient rich seas--what makes Earth different from any other planet we know—developed while the rocks of the Flinders Ranges were deposited. This transition to oxygenated basin waters also sees some of the major sedimentary hosted redox-sensitive metals (e.g. copper and cobalt – metals vital for new technologies). The student doing this project will investigate geochemical proxies for redox, biological activity and salinity in rocks deposited immediately after this transition. Rocks from the Tapley Hill Formation from the Stuart Shelf, the central Flinders and possibly from the Barrier Ranges (with fieldwork and sample collection from core stores).

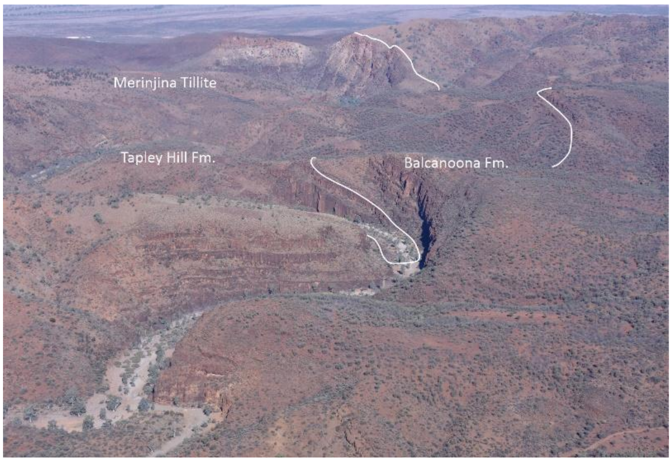


Figure: Kingsmill Creek from the air at Arkaroola. The Tapley Hill Formation marks the transgression after the Sturtian glaciation. Within it there are geochemical clues about the planet's redox state, and how this affects mineralisation during this Proterozoic pivot to habitability.

Expanding the exploration search space for HYC or Century style base-metal mineral systems in the Birrindudu Basin

PREREQUISITES

You will have completed the Geology Major (or equivalent) AND be super enthusiastic about understanding the past world!

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Alan Collins 08 8313 3174
alan.collins@adelaide.edu.au

Morgan Blades
Juraj Farkas
Amber Jarrett, Northern Territory Geological Survey

This project is a part of the **MinEx CRC** (https://minexcrc.com.au/), which is the world's largest mineral exploration collaboration bringing together Industry, Government and Research Organisations. You will also be part of the Tectonics and Earth Systems (TES) and Metal Isotopes (MIG) Research Groups

RESEARCH PROJECT

The Birrindudu basin is the underexplored western extension of the greater McArthur Basin (far west NT) that includes vast base-metal mineral deposits in the ca. 1.64 Ga McArthur Group. The Birrindudu Basin's Limbunya Group is age and lithologically equivalent to the McArthur Group. This project will investigate the chemical and isotopic composition of this group to unravel the palaeodepositional setting, water chemistry and mineral system potential of this part of the Birrindudu Basin for sedimentary-hosted metals.

Figure: Amazing 1.64 Ga stromatolites in the Limbunya Group. What was the world like back then? What was the chemistry of the basin waters?

The NT's Georgina Basin - Understanding its Geology and Base-Metal Potential

PREREQUISITES

You will have completed the Geology Major (or equivalent) AND be super enthusiastic about understanding the past world!

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Alan Collins 08 8313 3174
alan.collins@adelaide.edu.au

Morgan Blades
Juraj Farkas
Amber Jarrett, Northern Territory Geological Survey

This project is a part of the **MinEx CRC** (https://minexcrc.com.au/), which is the world's largest mineral exploration collaboration bringing together Industry, Government and Research Organisations. You will also be part of the Tectonics and Earth Systems (TES) and Metal Isotopes (MIG) Research Groups. https://sciences.adelaide.edu.au/physical-sciences/research/earth-sciences-research/tectonics-and-earth-systems

RESEARCH PROJECT

The Georgina Basin is a vast, but incredibly underexplored, part of the Neoproterozoic to Palaeozoic Centralian Superbasin that spans east NT and west Queensland. It lay along the flooded eastern shelf of continental Australia passing east into the ancestral Pacific Ocean passive margin. As such it was likely a high-nutrient marine system with diverse water chemistry and water oxidation levels. This project will investigate aspects of the geochemistry of the Palaeozoic of the basin, examine the past water chemistries, investigate the stable isotope stratigraphy in order to feed into a mineral system model.

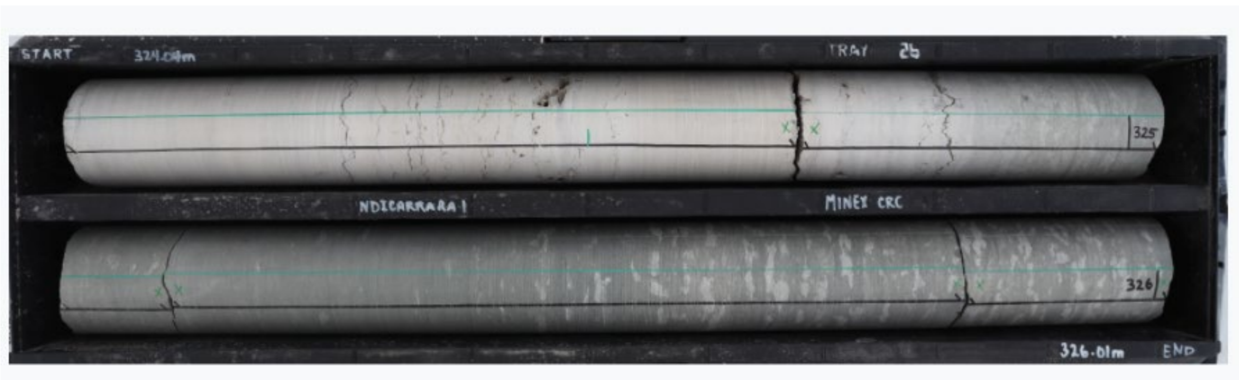


Figure: Some brand new, lovely, core from the Georgina Basin… waiting for an enthusiastic honours student to find out what secrets lie within!!!

Superbasin links on Supercontinents – do the Centralian and Adelaide Superbasins link through the north Stuart Shelf?

PREREQUISITES

You will have completed the Geology Major (or equivalent), be interested in the geology of the State and be keen on contributing to a dynamic research group.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

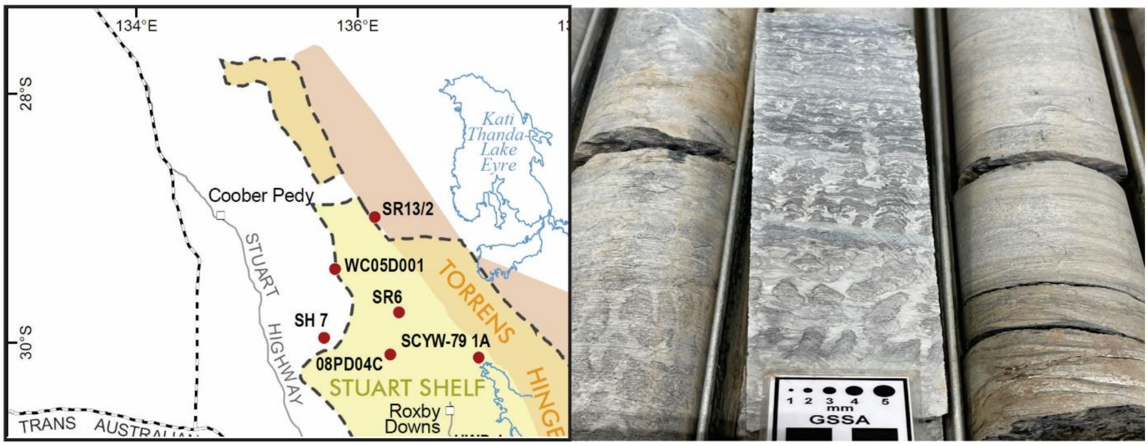
Alan Collins 08 8313 3174
alan.collins@adelaide.edu.au

Morgan Blades
Juraj Farkas
Carmen Krapf, Geological Survey of SA

You will also be part of the Tectonics and Earth Systems (TES) and Metal Isotope Research Group (MIG). https://sciences.adelaide.edu.au/physical-sciences/research/earth-sciences-research/tectonics-and-earth-systems

RESEARCH PROJECT

It’s not clear whether the northern Stuart Shelf and the SE Officer Basin linked in the Neoproterozoic—it is a part of the State we don’t know too much about. Yet, this is a time just before the planet plunged into the Cryogenian glaciations and when the planet was pivoting to become a life-sustaining world more recognisable to us. In this project you will look at a series of rocks from drill cores in the northern Stuart Shelf, to apply brand-new techniques to date sedimentary and volcanic systems and couple these with geochemistry to really unravel what this part of the world was like in the Tonian. This is part of a major Stuart Shelf study and links with the Flinders World Heritage Nomination.



(left) Boreholes in the northern Stuart Shelf. (right) amazing stromatolites in the Tonian(?) of WC05D001

Determining the origins of natural CO_2 accumulations in the Otway Basin

PREREQUISITES

It would be useful for the student to have completed Geochemistry II, Tectonics III and Mineral and Energy Resources III.

SUPERVISORS

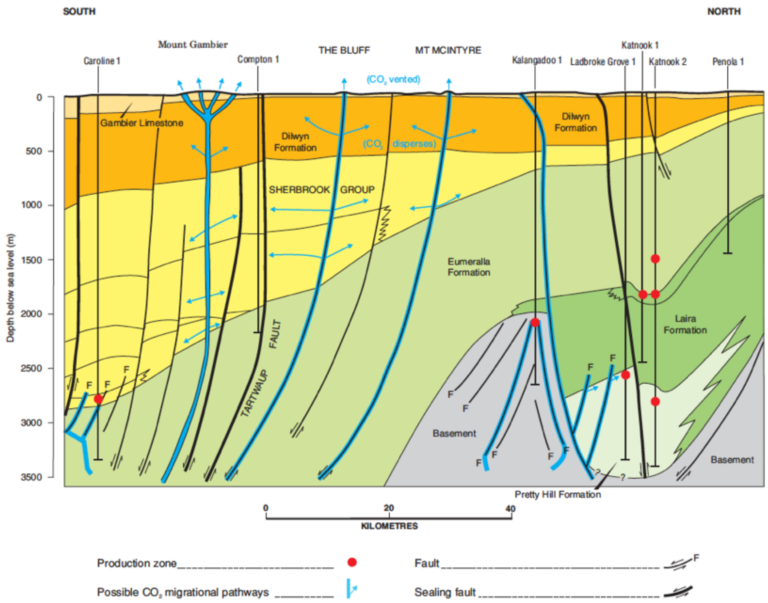
Alan Collins 08 8313 3174
alan.collins@adelaide.edu.au

Tony Hall
Simon Holford
Ulrike Schacht

You will be part of the Tectonics and Earth Systems (TES) Research Groups.
https://sciences.adelaide.edu.au/physical-sciences/research/earth-sciences-research/tectonics-and-earth-systems

RESEARCH PROJECT

Large (>15%) natural accumulations of CO_2 are rare phenomena, but the SA Otway Basin contains a number of natural CO_2 deposits, inadvertently discovered during petroleum drilling. The Caroline field, which contained ~99% CO_2, was produced CO_2 commercially for ~50 years. It is close to the Quaternary volcanoes that include the ~4500 yr old Mount Gambier, and isotopic analyses of carbon, helium and noble gases from the Caroline field indicate a mantle origin for the CO_2, which likely migrated into the Cretaceous-age sedimentary reservoirs via basement-linked faults.



In early 2020 a new CO_2 rich (~93%) discovery was made in Nangwarry-1. The objective of this project will be to conduct the first isotopic analyses on gas samples from this well, to determine where the CO_2 came from. Through petrographic analyses the project will also investigate the degree to which natural CO_2 accumulations in the Otway Basin can be regarded as analogues for Carbon Capture and Storage (CCS) projects.

Figure: Schematic cross-section through the Otway Basin depicting the structural context of natural CO_2 accumulations. Frears, B. 1997. MESA Journal, 5, 22-23.

Chromium isotopes in the Earth's upper mantle and oceanic crust: Insights from Oman ophiolite

PREREQUISITES

The proposed research would suit someone with ambitions for postgraduate studies and interests in geochemistry and metal exploration, and/or a career in the exploration industry.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Juraj Farkas 08 8313 6794 juraj.farkas@adelaide.edu.au
Carl Spandler
Alan Collins
Robert Klaebe

RESEARCH PROJECT

The Earth's upper mantle and oceanic crust (also known as ophiolite sequences) host one of the largest reserves of chromium on our planet. These sequences of ultramafic and mafic rocks are rarely exposed on the earth surface, but the Semail Ophiolite in Oman represent such unique and accessible "window" into the composition and chemistry of our planet's interior at the mantle-crust boundary (see Figure). Chromium (Cr) accumulations in ophiolites are typically in the form of magmatic chromite ($FeCr_2O_4$) ore bodies (podiform chromite deposits) formed presumably via partial melting of the upper mantle material near the Moho transition zone, and subsequent accumulation of chromite at the bottom of magma chambers. The exact mechanisms for these local enrichments of Cr at the mantle-crust boundary are however poorly understood. This project will use a new geochemical tracer, stable Cr isotopes ($^{53}Cr/^{52}Cr$ ratios), as a proxy to better understand (i) the sources, (ii) redox conditions, and (iii) geochemical pathways leading to the accumulation and redistribution of Cr in the ophiolite complexes, including podiform chromite deposits. Overall, this project aims to generate the first continuous Cr isotope profile across the Earth's upper mantle and oceanic crust (based on the analysis of available samples from Semail Ophiolite). Results will thus contribute to better understanding of magmatic processes and redox conditions in the mantle-crust system

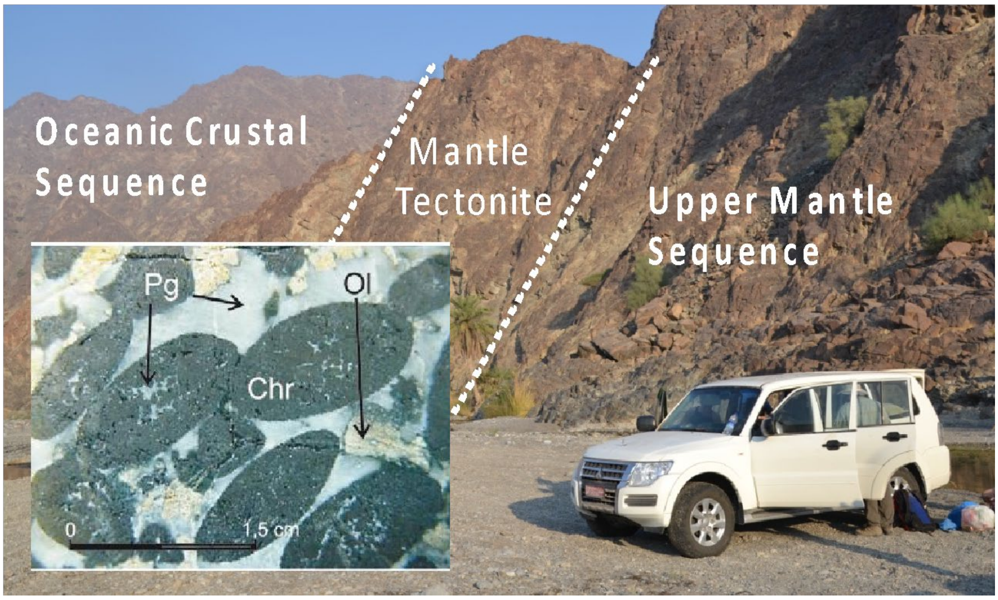


FIGURE: Exposures of ultramafic and mafic rocks (harzburgites, gabbro, and chromites) from the crust-mantle boundary in the Semail Ophiolite, Oman. Inset: Podiform chromites (Chr) with olivines (Ol) in ophiolites (Images from J. Farkas and S. Henares)

In-situ Rb-Sr dating of glauconite: New constraints on depositional ages of sediments

PREREQUISITES

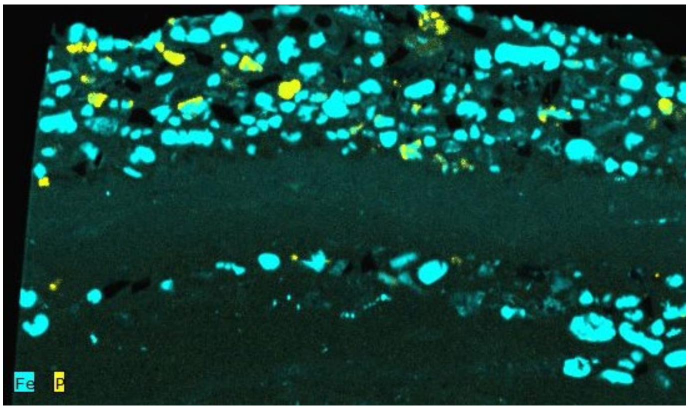
The proposed research would suit someone with ambitions for postgraduate studies and interests in Earth system evolution studies, and/or career in basin exploration.

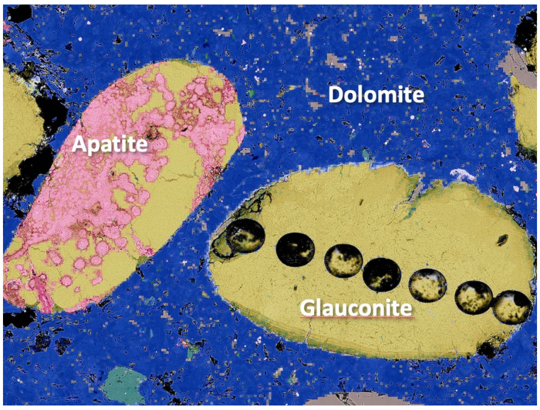
SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Juraj Farkas 08 8313 6794 juraj.farkas@adelaide.edu.au
Alan Collins
Stijn Glorie
Morgan Blades
Cecilia Loyola
Charles Verdel (NTGS)

RESEARCH PROJECT

A general lack of macrofossils in Precambrian sedimentary record of onshore depositional systems in central Australia, such as the Amadeus Basin and/or Georgina Basin, prevents robust and reliable intra-basin correlation based on biostratigraphy, which thus calls for the development of novel and alternative dating techniques and chemostratigraphy tools. This project funded via ARC Discovery Grant will apply new laser-based geochronometers, specifically in-situ Rb-Sr dating of glauconite (K- and Fe-rich marine green clays) which will be coupled with in-situ U-Pb and Pb-Pb dating of associated phosphates (biogenic / early diagenetic apatite). Existing data show that such glauconite/apatite mineral association is quite common (see image below), especially in Precambrian and Ediacaran/Cambrian marine carbonates and sandstones; and could be thus used for such coupled dating, with pilot data showing consistent Rb-Sr and Pb-Pb ages. Samples for this project will be collected from new MinEx NDI cores, but also from existing legacy cores archived at Geological Surveys, and possibly new field sampling campaigns. Existing and future HyLogger spectral data from NDI and legacy cores will be used to identify glauconite and phosphate-rich horizons to streamline the sampling process and select most suitable material for in-situ dating and further geochemical and mineralogical analysis.





FIGURES: Left: mXRF elemental map of Fe-rich glauconite grains (blue) and P-rich apatite (yellow) hosted in a carbonate rock. Right: A close up view (BSE, Nanomin map) showing the association of glauconite (with laser-spots after in-situ RbSr dating) and apatite hosted in Precambrian dolomite.

Isotope Chemostratigraphy of the Greater McArthur Basin, Northern Territory

PREREQUISITES

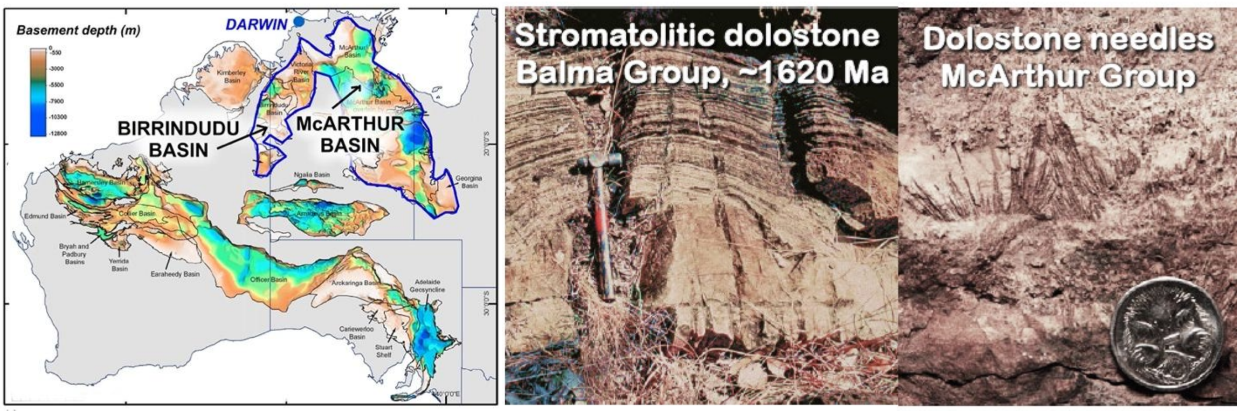
The proposed research would suit someone with ambitions for postgraduate studies and interests in Earth system evolution studies, and/or career in basin exploration.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Juraj Farkas 08 8313 6794 juraj.farkas@adelaide.edu.au
Alan Collins
Morgan Blades
Amber Jarrett (NTGS)

RESEARCH PROJECT

Future advances in the exploration of Proterozoic depositional systems require the development of new and alternative correlative tools that are independent of the biostratigraphy, as the latter is limited by poor preservation of reliable microfossils (i.e., Acritarchs) and the lack of coeval macrofossils. Isotope chemostratigraphy, based on traditional and novel proxies, provides alternative means for an intra-basin correlation. The greater McArthur Basin, with proven world's oldest hydrocarbon reserves, comprises Paleo- to Mesoproterozoic successions of the McArthur and Birrindudu Basins, likely linked in the subsurface (see Figure). The mid-Proterozoic carbonate record in these basins is dominated by dolostones, originally formed in various shallow-marine, lagoonal and sabkha/playa environments (see Fig.). The aim of this project is to test whether the C and Sr isotope changes can be traced across the greater McArthur Basin, and to reconstruct the palaeo-seawater and redox chemistry in this unique depositional system. This research will be funded via a new ARC Linkage project, involving academia, industry and government partners, thus providing unique opportunity for (i) networking, (ii) research training, and (iii) hands-on experience with modern instrumentations and isotope analytical techniques, as well as a fieldwork in NT.



FIGURES: Left = The greater McArthur Basin (blue outline), with McArthur and Birrindudu Basins. Centre and Right = Mid-Proterozoic dolomites of the McArthur and Balma Groups.

Crustal evolution through the lens of apatite crystals

PREREQUISITES

This project would suit someone with ambitions for postgraduate studies or a career in the mineral exploration industry. Enthusiasm for Tectonics and geochronology is desirable.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Stijn Glorie 08 8313 2206 stijn.glorie@adelaide.edu.au
Alex Simpson
Chris Kirkland
Derrick Hasterok

RESEARCH PROJECT

This project forms part of a prestigious recently funded Australian Research Council Discovery Project that aims at establishing apatite as a new tool to study the evolution of the continental crust. The crust shaped the composition of the atmosphere and the oceans with consequences for the evolution of life through the availability of oxygen and nutrients. However, when and how the continental crust was generated remains a core question. Current models for continental crust development rely on the mineral zircon. However, zircons only record the history of evolved (more felsic) rocks. To address this bias, the project will focus on apatite, which forms in less evolved (more mafic) rocks. More specifically, (detrital) apatites from case studies in Australia and Antarctica will be analysed for U-Pb, Sm-Nd and Lu-Hf, in an attempt to construct a database of Pb-Nd-Hf (model) ages that can be integrated with the zircon record to provide a more holistic description for how our planet developed.

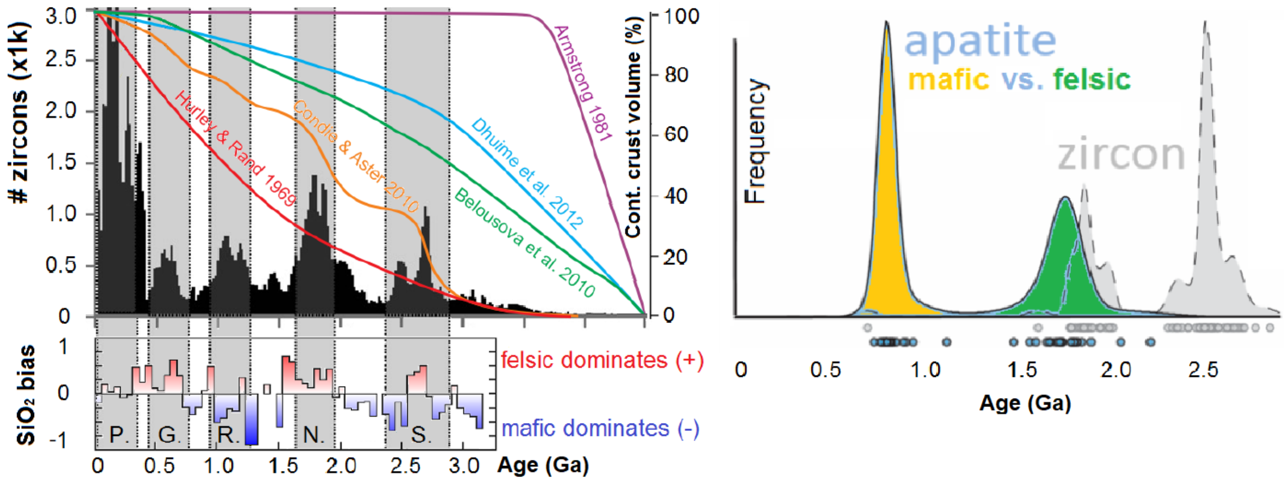


Figure: (upper left) Histogram for the global detrital zircon age record, with peaks corresponding to times of supercontinents. The overlain curves represent a variety of published crustal growth models based on zircon datasets. (lower left) Relative abundance of felsic versus mafic rocks through time, illustrating that zircons form a biased archive: troughs in the zircon record correspond with higher abundances of mafic rocks. (right) Combined detrital zircon-apatite age histogram from a case study in Siberia, illustrating that apatites sample significantly more of the mafic (~0.85 Ga) source rocks that are largely undetected by zircons.

Garnets, diamonds and glaciers in South Australia

PREREQUISITES

This project would suit someone with ambitions for postgraduate studies or a career in the mineral exploration industry. Enthusiasm for Tectonics, Geochronology and Sedimentary Geology is desirable.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Stijn Glorie 08 8313 2206
stijn.glorie@adelaide.edu.au

Martin Hand
Alex Simpson

RESEARCH PROJECT

Those of you that went on the Tectonics fieldtrip will remember the red placer deposits on the beach at Petrel Cove. These deposits have an extraordinarily high concentration of garnets and at least one diamond has been found in these garnet-bearing sands. But where do they come from? This project will aim to address this question by assessing the garnet compositions as well as determining the age of the garnets. Our pilot data indicates that the garnets have a `strange` age of ~593 Ma and one `mystery grain` even has a much older ~1100 Ma garnet zone. These are not common ages for South Australia. Our working hypothesis is that the deposits came from Permian glacial deposits that might have an origin in Antarctica. This honours project will directly assess this hypothesis. In addition, diamonds and garnets have been described in similar placer deposits in the Echunga goldfields (Adelaide Hills) and in the Springfield Basin (southern Flinders Ranges) and a secondary aim is to compare samples from these with the Petrel Cove deposits. The project will involve a small component of fieldwork as well as intensive use of state-of-the-art micro-analytical infrastructure at Adelaide Microscopy.

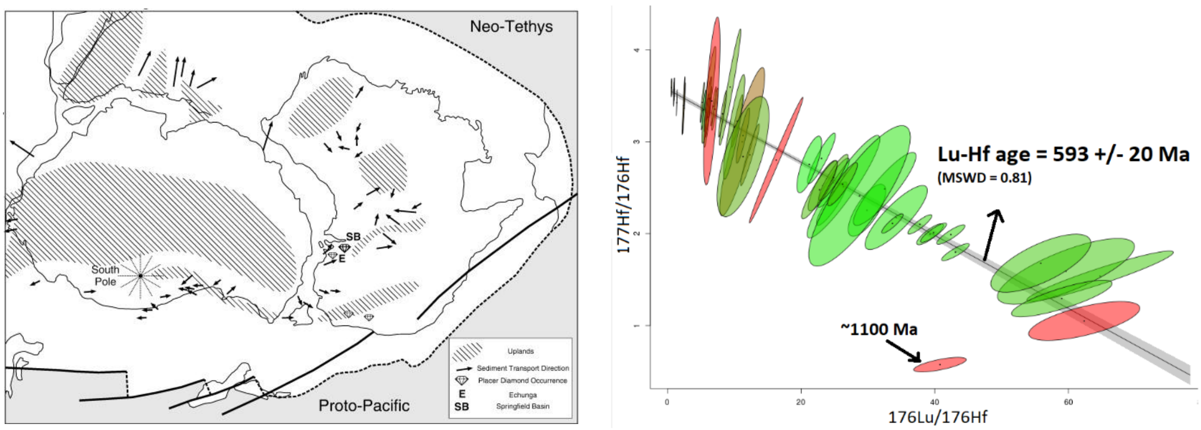


Figure: (left) Reconstruction of eastern Gondwana during Permo-Carboniferous glaciation, showing uplands as source regions of glacial sediments, sedimentary transport directions and placer deposits with diamonds (from Tappert et al. 2009). (right) Our pilot garnet age data from Petrel Cove, showing that most grains preserve a ~593 Ma age, while one `mystery` grain (red ellipses) produced a garnet zone of ~1100 Ma.

Uncovering the exhumation history of the East Tennant region

PREREQUISITES

This project would suit someone with ambitions for postgraduate studies or a career in mineral exploration. Enthusiasm for Tectonics is desirable.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Stijn Glorie 08 8313 2206 stijn.glorie@adelaide.edu.au
Angus Nixon
Geoff Fraser & Anthony Schofield, Geoscience Australia (Canberra)

RESEARCH PROJECT

The TISA (Tennant to Mt Isa) region is a largely unexplored area stretching between eastern Northern Territory and western Queensland that is of considerable national interest for mineral exploration. However, most of this area is difficult to access due to the thick blanket of sedimentary cover sequences. Significant investment in this region, driven by Geoscience Australia and the MinEx CRC, has delivered a plethora of samples and data that assist mineral exploration under cover. This includes a recent (2020) drilling campaign in the East Tennant area, from which 10 drill cores were obtained (drilled to basement) in an area of critical importance to unlock the underexplored TISA mineral potential.

This project will contribute to the mineral potential analysis by revealing, for the first time, the exhumation history of East Tennant region. In more detail, thermal history models will be reconstructed using a combination of U-Pb and fission track thermochronology, applied to the apatite fraction that was retrieved from the drill core samples. This approach will allow to map the exhumation level of the covered basement and the associated preservation potential of ore deposits which has profound implications for mineral exploration. (see e.g. Glorie et al. 2019: www.sciencedirect.com/science/article/pii/S0169136819306468 for a similar study).

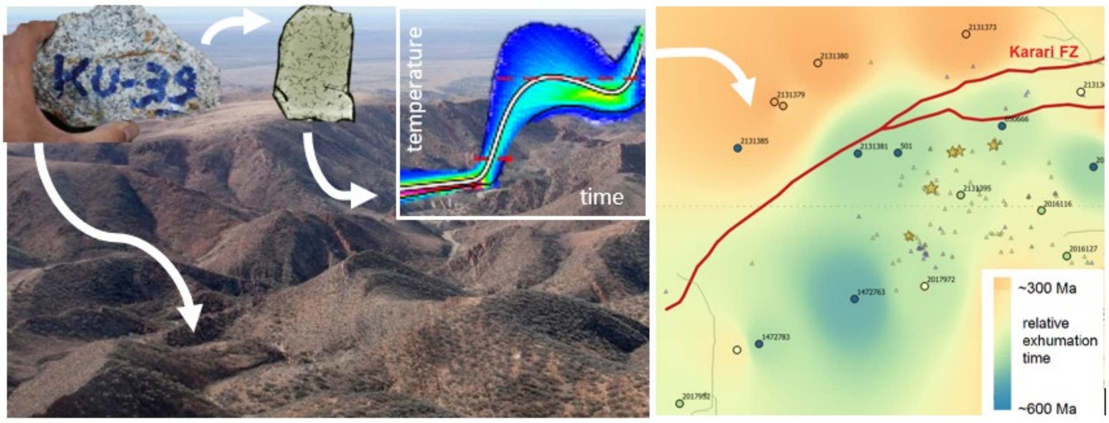


Figure: Project workflow, illustrating that thermal history information will be extracted from apatites, which can be used to map the relative exhumation level of the crust (example from Glorie et al. 2019).

Paragenesis of a new Cu-Au system at Kanmantoo and its implication for Delamerian mineral systems

PREREQUISITES

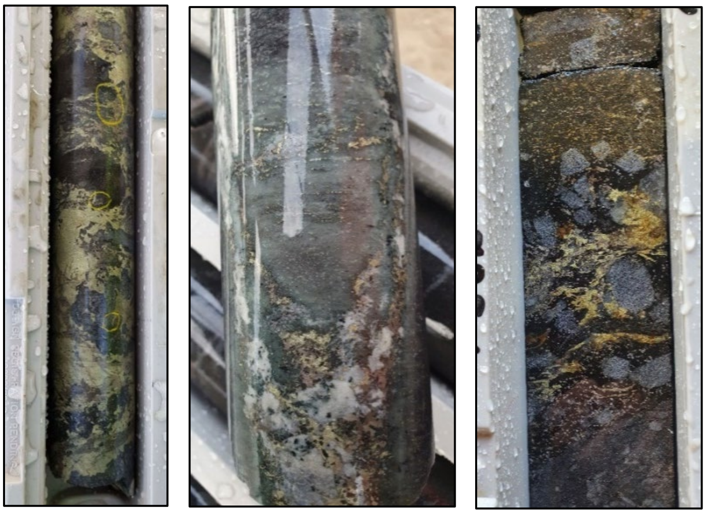
Igneous & Metamorphic Geology III; Mineral & Energy Resources III; Geochemistry II desirable

SUPERVISORS/PROJECT PARTNERS

Martin Hand martin.hand@adelaide.edu.au
Lucy McGee
Peter Rolley & Caitlin Rowett, Hillgrove Resources

RESEARCH PROJECT

The Kanmantoo Cu-Au deposit within the Tapanappa formation of the Cambrian Kanmantoo Group has a complicated paragenesis, and likely has several generations of metal precipitation. Recent drilling has encountered a Zn-Pb-Ag (low grade) sulphide system, an Fe-Cu-Au system and a Na-CO_3-Cu-Au system within andalusite-cordierite meta-sediments. How are these systems related, if at all? This project offers an excellent opportunity to look at stunning examples of mineralisation and its relationships to the evolving host rock system. The aim of the project is to unravel the sulphide paragenesis with respect to deformation and metamorphism of the host rock system as well as the syn and post deformation sulphide textures. The student will complete detailed petrographic analysis, in addition to textural analysis by scanning electron microscope and mineral chemistry by electron microprobe. Geochronological analysis will be undertaken if dateable minerals occur in texturally constraining locations to ascertain critical age constraints. Trace element compositions of sulphides and gangue minerals will be determined via laser ablation ICPMS to explore differences in fluid chemistry between the different styles of mineralisation. This project will be undertaken in collaboration with Hillgrove Resources with funds in place for analytical work.



Left: Fe-Cu-Au brecciation (343m downhole),

Centre: Post-deformation albite – carbonate vein with sulphides (505m downhole),

Right: Fe-Cu veining amongst andalusite crystals (583m downhole)

A forensic search for America down under using a new age dating tool

PREREQUISITES

Igneous and Metamorphic III and Tectonics III

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Martin Hand martin.hand@adelaide.edu.au
Stijn Glorie
Alex Simpson
Dillon Brown

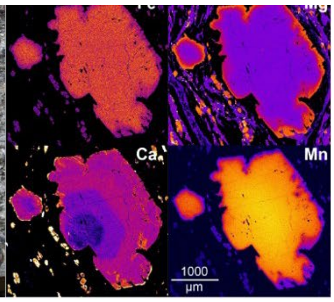
RESEARCH PROJECT

When supercontinents break, they fall apart over timescales of 100-200 million years. Those falling apart processes are recorded in the tectonic histories of the busted continental fragment edges. Think of a plate you drop in your kitchen. Obviously it breaks a bit faster than in 100-200 million years, but the record of what happened is recorded by the mechanical and thermal character of the edges of the plate fragments. However in the Earth, those fragment edges may subsequently collide with other things, and their earlier tectonic character becomes obscured, to the extent that it's not obvious what happened in the first place. However, just like any crime scene that has been obscured, if you have the right forensic tools, you can see through those younger events to determine what really happened.

To quote from Mission Impossible, "*your mission, should you choose to accept it*", is to find fragments of North America buried in southern Australia and determine their tectonic DNA. That sounds a like a big task, but unlike Mission Impossible, we have a revolutionary new weapon developed by the project supervisors that will make this a breeze. Recent work by researchers has shown there are fragments of North America buried beneath southern Australia and New Zealand derived from destruction of the 1200-900 million year old supercontinent Rodinia. However, those studies are largely based on age data alone which is often not that useful for understanding how the crust records the destruction of continents. The revolutionary method we have developed is called *Garnet Speed Dating*. It determines the age of garnet in hours as opposed to existing methods that take weeks or months. Garnet is the most important mineral for determining tectonic environment and evolution in the lithosphere. *Garnet Speed Dating* can easily see through younger tectonic events that obscure what originally happened.

In this project we will work with researchers from the Uni of Tasmania. It's rare an Honours project is in the vanguard of a revolution in tectonic analysis. This project is that. If you would like to know more about this revolutionary age-dating technique and what you'll be doing, contact the project supervisors.





Vulcan iron-oxide copper gold: mineral paragenesis and alteration and mineralisation

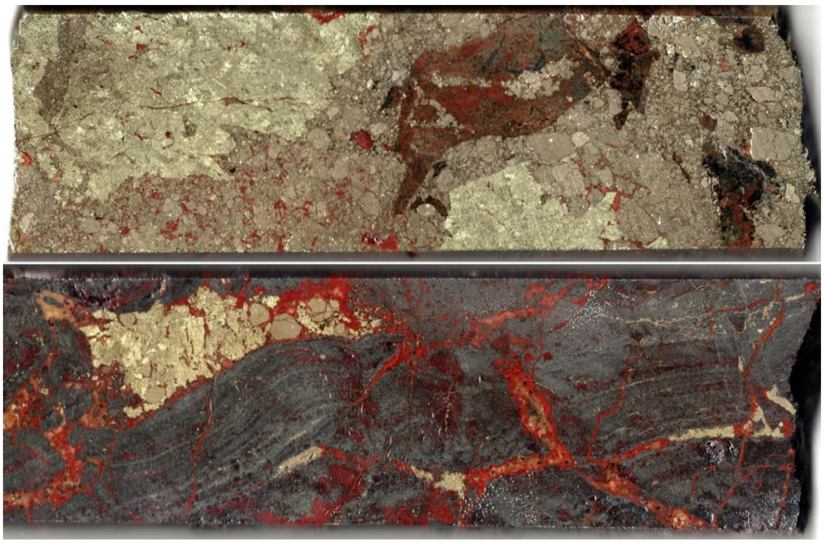
PREREQUISITES
Mineral and Energy Resources III, Igneous and Metamorphic Geology III

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS
Martin Hand martin.hand@adelaide.edu.au
Stijn Glorie
Alex Simpson
Greg Swain (Fortescue Metals Group)

RESEARCH PROJECT
This project forms part of a large industry and government funded initiative to integrate mineralogical, geochemical and isotopic data with geophysics to create a new way to look at iron-oxide copper gold (IOCG) systems in the Gawler Craton and more generally. The Vulcan IOCG system is located near the supergiant Olympic Dam deposit and is the focus of intensive exploration by Fortescue Metals Group with Joint Venture partners.

The aim of this project is to develop a model for the paragenetic evolution of the mineralisation based on mineral textural analysis, trace element compositional variations in sulphides, Fe-oxides and their associated gangue minerals, as well as obtaining isotopic data to try and identify causative reservoirs involved in the mineralisation.

The project will be closely integrated with a synchronous project employing novel and newly developed isotopic dating techniques to place absolute age constraints on the timing of mineralisation and alteration, and the project will involve the application of some of those methods. The project will be further integrated with a parallel study examining the potential for compositional variation in phyllosilicates to aid in IOCG exploration.



The Fire Down Below: Heat Generation in the Lower Crust

PREREQUISITES

This is primarily a geologic-based project with some minor geophysics. Tectonics III

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Derrick Hasterok 08 8313 4540
derrick.hasterok@adelaide.edu.au

Martin Hand

RESEARCH PROJECT

The chemistry of deep samples presents a paradox. Some limited studies of exposures of upturned sections of the crust indicate the concentrations of heat producing elements are systematically higher than observed among xenoliths with otherwise similar major element chemistry. The aim of this project will be to expand the database of samples that can be used to determine the validity of these prior models of deep crustal exposures and xenoliths. If a systematic bias exists, then the goal will be to identify the source of this difference and establish which dataset should be trusted. In either case, there are important implications for lithospheric temperatures and resistance to deformation as well as for the geochemical model of the Earth with consequences for mantle convection and the long-term cooling of the planet.

As part of this study, you will gain experience with methods for analysing large datasets (big data) through basic computer coding using Matlab and statistical techniques (including spatial statistics).

FIGURE: A lower crustal and mantle xenolith contained in a lava flow in British Columbia (photo: Ben Edwards).

The Impact of Fluid Flow on Crustal Radioactivity – pushing heat around during tectonic reworking

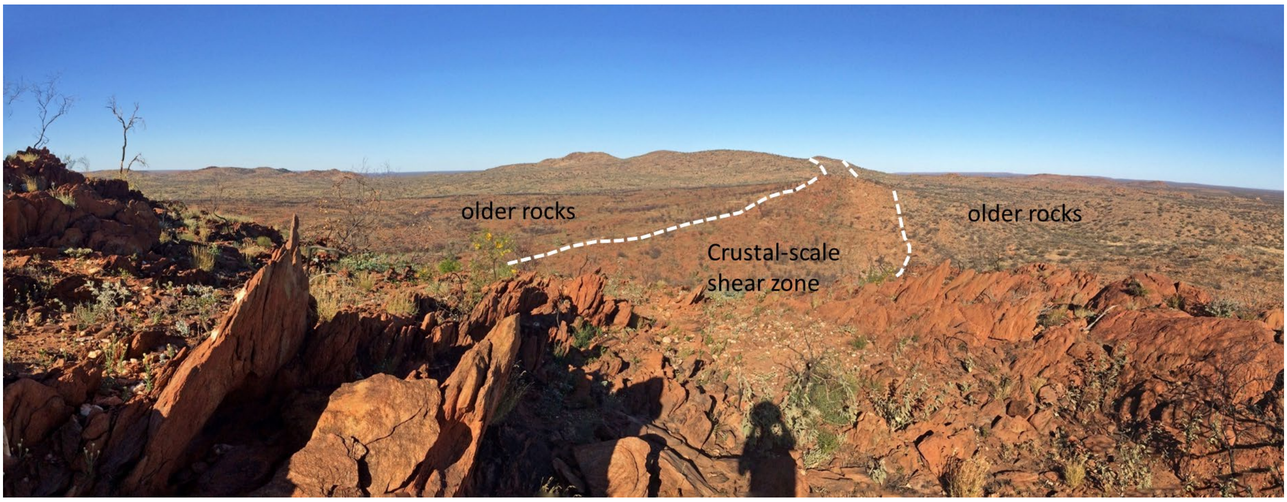
PREREQUISITES
Ig-Met III, Geochem II, Tectonics III

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS
Derrick Hasterok 08 8313 4540
derrick.hasterok@adelaide.edu.au

Martin Hand

RESEARCH PROJECT
Crustal radioactivity affects crustal temperatures and thus has a potential influence on a wide range of crustal and lithospheric processes including melting, magmatism, and strength. High crustal radioactivity may also be indicators of possible mineralization. Models of crustal radioactivity imply that it decreases with depth, more so than one would expect from a changing bulk composition, but why? Possible explanations include fractionation and crystallization processes, assimilation of enriched crustal material during ascent, and fluid redistribution.

The aim of the project is to explore the potential for fluid redistribution. Fluids, depending upon their composition, have the potential to mobilize heat producing elements (K, Th, and U) and redistribute them to different locations or stratigraphic depths. In this project, you will study the magnitude of the redistribution on several crustal-scale shear zones in Australia by collecting in-situ radioactivity and major element chemistry profiles across these shear zones. The project results will improve regional and global modelling of heat production distribution and temperature models of the crust and lithosphere that has undergone tectonic reworking.



Structural Geology by drone photography

PREREQUISITES

The students should have completed Structural Geology II, and most likely Sedimentary Geology II, Tectonics III or Exploration Methods III. It would be also an advantage if the students is somewhat tech-savvy…

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Ros King 08 8313 5844 rosalind.king@adelaide.edu.au
Simon Holford
Mark Bunch

RESEARCH PROJECT

Fracture networks in sedimentary rocks can exert an influence on the storage and movement through the subsurface of a variety of Earth resources, including water, hydrogen, ore deposits and hydrocarbons. Fracture networks are vital to enhanced geothermal systems, like we have in Australia, and also the storage of CO_2 from the atmosphere. Quantifying these fracture networks in the subsurface requires core data, seismic data and well data. These data are often sparse and assumptions of the subsurface must be made. To better constrain these assumptions outcrop analogues are important. However, all too often these outcrops are not extensive enough or access to good three-dimensional data of fracture systems is restricted due to land use and/or safety of the geologist; and in many cases collection of field data is time consuming. In this project, we use sites where fractured sediments crop out to test a new method for mapping fractures. We will use drone data to interpret fracture networks in previously inaccessible areas to build better analogue models to better understand how fluids move through the subsurface.

Figure: Filled veins demonstrating offset of sediment layers at Arkaroola, Flinders Ranges

Did pipe-like structures at Hallett Cove trigger Snowball Earth termination?

PREREQUISITES

It would be useful for the student to have completed Geochemistry II, Tectonics III and Mineral and Energy Resources III.

SUPERVISORS

Ros King rosalind.king@adelaide.edu.au
Simon Holford
Alan Collins
Mark Bunch

RESEARCH PROJECT

Pipe-like features are common features in sedimentary basins, occurring over multiple spatial scales (from cm to hundreds of metres) and are often associated with focused vertical fluid migration related to pore-fluid expulsion, hydrocarbon migration and the formation and/or disassociation of methane hydrate deposits. At Hallett Cove, to the southwest of Adelaide, a series of carbonate-cemented pipe-like features have been described within siltstones of the Reynella Member of the glacial Elatina Formation. A number of hypotheses have been proposed for the origin of these pipes, including the notion (supported by carbon isotopes) that they were formed during the focused vertical seepage of methane hydrates, the destabilisation of which may have potentially contributed to the termination of the Marinoan 'Snowball Earth' at the start of the Ediacaran period. An alternative hypothesis is that these features are periglacial palaeosol deposits.

Our recent re-evaluation of these pipes has indicated that they may form part of a broader sub-vertical 'mesh' of interconnected calcite-filled faults and fractures. Similar meshes are observed in an array of tectonic settings and often form important conduits for large-volume flow of pressurised subsurface fluids. The aim of this project is to conduct detailed field-based mapping of the pipes to establish their structural context and evaluate the competing hypotheses for their genesis, and to assess the potential role of the structural mesh as a permeable pathway for Snowball-Earth triggering methane hydrate flux.

Figure: Calcite-cemented fracture mesh at Hallett Cove.

Timing and Distribution of Critical Metals Bi-Co, and Ag in the Carrapateena Deposit

PREREQUISITES

Mineral and Energy Resources III, interest in ore systems, geochemistry and the minerals industry. Cover letter and C.V. requested to be sent to project supervisor to indicate willingness to engage in collaborative research with minerals industry partners.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Richard Lilly richard.lilly@adelaide.edu.au
Martin Hand
Carl Spandler
OZ Minerals Senior Geologist

OZ MINERALS

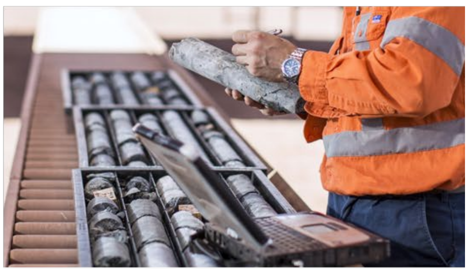
RESEARCH PROJECT

OZ Minerals Carrapateena copper-gold deposit is located on the eastern margin of the Gawler Craton in South Australia and is one of the most significant new copper-gold projects in Australia. Since discovery in 2005 very limited research has been completed on the system and there is a wealth of opportunity to advance our understanding of this style of giant South Australian IOCG deposit.

Critical metals Bi-Co, and Ag are present at elevated levels in the Carrapateena deposit and are often associated with copper sulphide minerals. However, the relative timing, distribution and importance of these elements in the mineralising system are yet to be fully understood. The successful student will work closely with OZ Minerals geoscientists to collect appropriate mineral samples, including those suitable for geochronology, which will then be analysed by a variety of techniques. Not only will the project assess the distribution of these critical metals, but geochronology will be used to establish when the metals were introduced to the system.

The project will use methods including petrography, SEM analysis of mineral textures, LA-ICPMS analysis (trace element and geochronology) of minerals and 3D modelling of metal distribution.

The project will increase our understanding of how these giant IOCG systems form and assist future ore domaining of the different zones of the Carrapateena ore body. The project will also have direct implications for assessment of satellite prospects and exploration targeting.

What the F? Origin and Distribution of Fluorine at the Carrapateena Deposit

PREREQUISITES

Mineral and Energy Resources III, interest in ore systems, geochemistry and the minerals industry. Cover letter and C.V. requested to be sent to project supervisor to indicate willingness to engage in collaborative research with minerals industry partners.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Richard Lilly richard.lilly@adelaide.edu.au
Martin Hand
OZ Minerals Senior Geologist

RESEARCH PROJECT

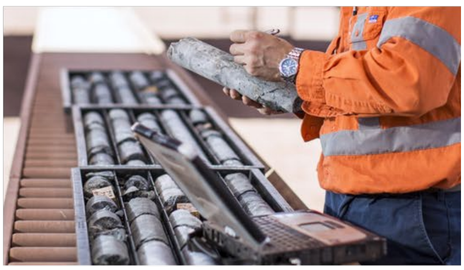
OZ Minerals Carrapateena copper-gold deposit is located on the eastern margin of the Gawler Craton in South Australia and is one of the most significant new copper-gold projects in Australia. Since discovery in 2005 very limited research has been completed on the system and there is a wealth of opportunity to advance our understanding of this style of giant South Australian IOCG deposit.

Fluorine, often in the form of the minerals fluorite (CaF_2) or fluoroapatite ($Ca_5(PO_4)_3F$) is a common accessory element in IOCG systems. Fluorine is also a powerful ligand, and has the ability to strip metals from host rocks and transport them in hydrothermal fluids. The giant IOCG systems of the Eastern Gawler Craton (including Carrapateena and its satellite systems) all contain varying amounts of fluorine, but it's role in the origin and transport of the contained metals is poorly understood.

The successful student will work closely with OZ Minerals geoscientists to collect appropriate samples of fluorite and fluoroapatite from Carrapateena and satellite systems including Freemantle Doctor, which will then be analysed by a variety of techniques. The project will then compare results between the different zones of the Carrapateena mineral system to establish when the fluorine entered the system and whether it carried a significant amount of metal.

The project will use methods including petrography, SEM analysis of mineral textures, LA-ICPMS analysis (trace element and geochronology) of minerals and 3D modelling of element distribution. The project will increase our understanding of how these giant IOCG systems form and will have direct implications for assessment of satellite prospects and exploration targeting.





What goes down, must come up? Tracking sediment input to subduction zone magmas using radiogenic and stable Sr isotopes

PREREQUISITES

Geochemistry II; Igneous & Metamorphic Geology III; Interest in volcanology

SUPERVISORS

Lucy McGee 08 8313 3260 lucy.mcgee@adelaide.edu.au
Juraj Farkas

RESEARCH PROJECT

Subduction zones are places on Earth of intense destruction and creation: sediments and associated rocks are dragged into the zone of melting in the mantle wedge, and magmas are created which are erupted at the surface. Compositional parameters such as radiogenic isotope tracers – for example strontium isotopes $^{87}Sr/^{86}Sr$ – show us that what goes in to creating individual batches of magma is not always a uniform recipe, even within an individual subduction zone. The Pucón area of Southern Chile is an area of prolific subduction volcanism containing large stratovolcanoes and small scoria cones, each with its own unique 'flavour'.

The student who works on this project will analyse both radiogenic ($^{87}Sr/^{86}Sr$) and stable ($\delta^{88}Sr$) Sr isotopes in volcanic samples from this geologically active area to investigate in detail the inputs of materials to the magmas which built the volcanoes, and the likely sources of these (i.e., Sr derived from mantle, recycled crust, carbonate sediments). Through this, he/she will gain insights into the 'recycling system' of sediments/carbonates on Earth, with implications for melt formation and also the deep carbon cycle on our planet.


Left: Volcán Villarrica, a stratovolcano in the Southern Volcanic Zone of Chile. Right: Caburgua scoria cone, just 10km north of Villarrica. Each has a very different geochemical composition

Partial melting of the crust by basaltic magma: Crustal contamination 'caught in the act'

PREREQUISITES

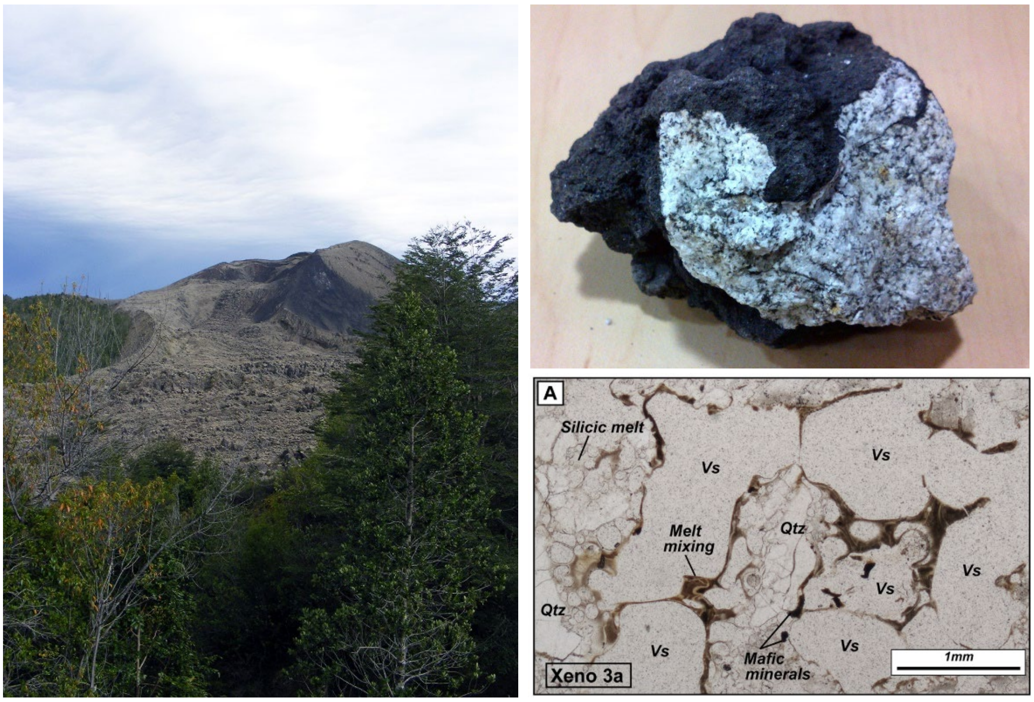
Igneous & Metamorphic Geology III essential; Geochemistry II desirable

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Lucy McGee 08 8313 3260 lucy.mcgee@adelaide.edu.au
Carl Spandler

RESEARCH PROJECT

Volcán Mirador in the Lakes Region of Southern Chile erupted in 1979 AD within the monogenetic volcanic field Carrán-Los Venados. 9 x 10^6 m^3 of basaltic lava flows and pyroclastic material was erupted in approximately one month; within this material are stunning samples of granitoids which have been partially melted. These xenoliths are samples of the basement rock/crust which were picked up by the ascending basaltic magmas and started the process of crustal contamination. As granitoids are composed of several minerals with different melting temperatures and the xenoliths are only partially 'digested', crustal contamination is a disequilibrium process. A suite of xenoliths therefore provides us with an excellent opportunity to look at the process of partial melting of the crust by hot basaltic magma 'caught in the act'. This project will examine hand samples and thin sections of the melted granitoids and obtain chemical data on the residual mineral phases and melt produced by the melting process. This will provide vital information on how the crust melts and chemical effects on ascending magma.



Left: Volcán Mirador in Southern Chile. Top right: a melted granitoid xenolith from Mirador (c. 6cm long). Bottom right: thin section photograph of a partially melted granite xenolith from China (McGee et al. 2015)

Metal transport in active arc volcanic systems

PREREQUISITES
Geochemistry II; Igneous & Metamorphic Geology III; Interest in volcanic processes; Experience with Excel or similar

SUPERVISORS
Lucy McGee 08 8313 3260 lucy.mcgee@adelaide.edu.au
Justin Payne, UniSA
Mark Reagan, University of Iowa

MinEx CRC

RESEARCH PROJECT
Ore deposits such as porphyrys owe their metal endowment to a combination of important characteristics but are ultimately driven by the presence of an underlying magmatic system, and importantly, the transport of metals with magmatic volatiles. Examining active volcanic systems where the magma dynamics can be more clearly observed can help us to understand the processes of metal transfer through the crust. This project will combine two novel isotope systems to explore time-scales and mechanisms of metal transport at the active subduction zone volcanoes Augustine (Alaska) and Arenal (Costa Rica). At the shortest end of the U-series decay chain ^{226}Ra (Radium) decays to ^{210}Pb (lead), which is present in the volatile component of magmas; Excesses or deficits of ^{210}Pb can therefore shed light on volatile loss or gain in the magmatic-volcanic system. Excitingly, as U-series isotopes are time sensitive, timescales of processes affecting metal transport in magmas may be possible to deduce. The student will add Cu isotopes (which are fractionated by fluids) and models to an existing dataset of U-series isotopes to look at the way in which Cu is mobilised with respect to magmatic volatiles.


Left: Arenal, Costa Rica, last erupted from 1968 to 2010 (image from CostaRica.org). Right: Augustine volcano, Alaska last erupted in 2006 (image from USGS)

Mineral chemistry of phyllosilicates as an exploration tool – a case study from Vulcan IOCG prospect

PREREQUISITES

Igneous & Metamorphic Geology III; Geochemistry II and/or Mineral & Energy Resources III

SUPERVISORS AND PROJECT PARTNERS

Lucy McGee 08 8313 3260 lucy.mcgee@adelaide.edu.au
Karin Barovich
Marija Dmitrijeva & Greg Swain, Fortescue Metals Group Ltd

RESEARCH PROJECT

Mica and chlorite (phyllosilicates) are the dominant alteration minerals that occur in hydrothermal ore-forming environments, including iron oxide copper-gold (IOCG) deposits. Phyllosilicate composition varies with parameters of the ore-forming environment such as temperature and fluid composition. Such information is crucial when targeting metal-endowed systems; their chemistry, therefore, may be an important exploration tool. In this project major, minor, and trace element chemistry as well as halogens (chlorine, fluorine) in white mica and chlorite from Vulcan IOCG prospect will be obtained by detailed micro-analysis. Comparisons with hyperspectral core scanning will bridge micron-scale observations with whole-rock spectral data. The Vulcan prospect is under an active exploration program thus allowing a student to actively contribute to scientific knowledge and exploration targeting in the Vulcan system. This project would suit a student with a keen interest in geochemistry who is interested in going into the minerals industry. *~*Possible vacation work available*~*

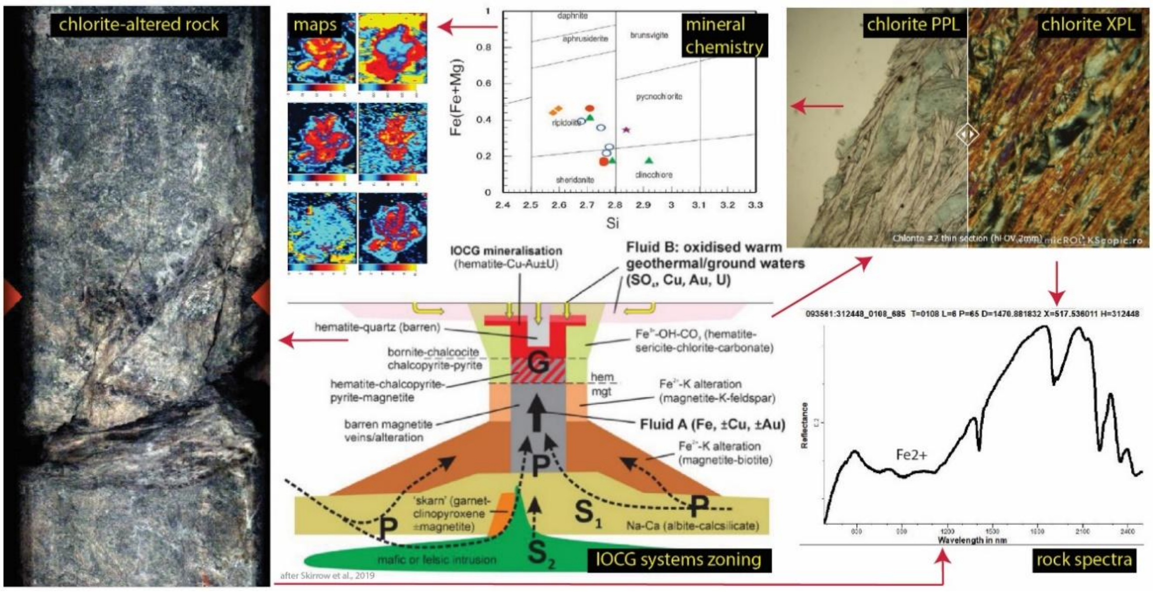


Figure: A graphic abstract of project proposal featuring chlorite alteration in Vulcan IOCG system (left).

Characterising the Delamerian beneath the Murray Basin

PREREQUISITES

Ig & Met III, interest in landscape evolution

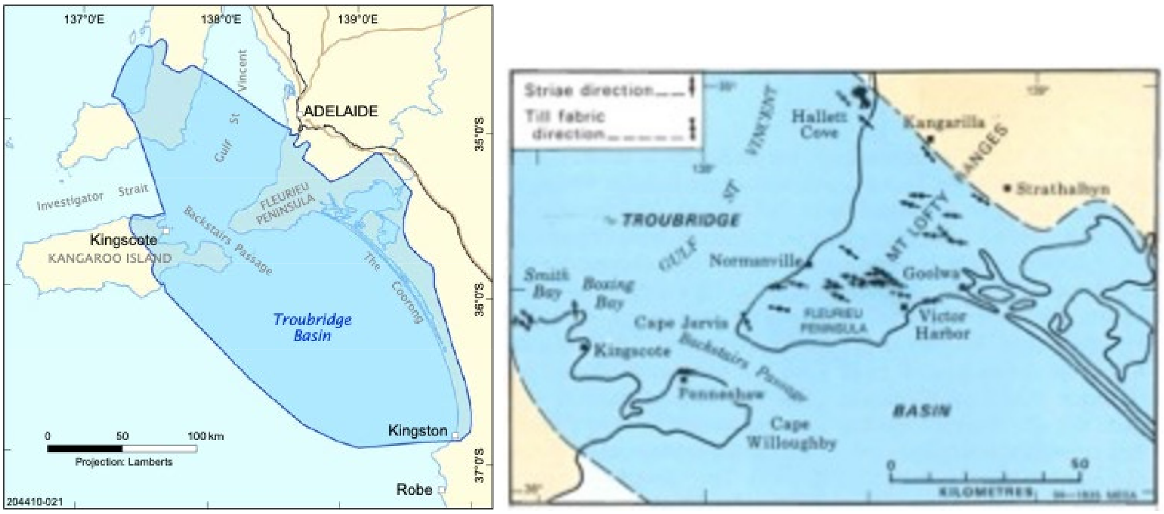
SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Tony Milnes anthony.milnes@adelaide.edu.au
Alan Collins

RESEARCH PROJECT

Rocks forming part of the Delamerian Orogen were exposed at the landsurface beneath what is now the Murray Basin during the Carboniferous-Permian glaciation and were eroded by ice moving west-northwestwards. The resulting rock clasts (erratics) transported by the ice were deposited in a variety of glacial sediments (diamictites, tills, fluvioglacial sands) overlying grooved and striated rock pavements on rocks now exposed in the Mt Lofty Ranges and on Yorke Peninsula and Kangaroo Island. Examining the variety (petrology) and provenance (zircon ages) of these erratics, which can be sampled as fresh specimens in quarry and natural exposures of the glacial sediments, could provide an indication of the variety of rocks exposed beneath a large part of the Murray Basin during the glaciation.

The project would involve sampling and description (hand specimen, thin and polished section microscope studies) of the variety of rock types that occur as erratics in selected quarry and field sites on Fleurieu and Yorke Peninsulas. LA-ICPMS analysis of zircons in polished thin sections of selected rock types ought to provide age and provenance data. Links with data from related projects on the Delamarian in southeastern Australia could be made to generate a description of this currently hidden part of the Delamerian Orogen and of the Carboniferous-Permian landscape that it formed.



Figures: (a) Rough extent of Carboniferous-Permian glacigene sediments in the Troubridge Basin. (b) Direction of ice movement over outcrops of Delamerian rocks in part of the Troubidge Basin.

What is Nundorite? Weird alkaline rocks of the Mount Arrowsmith Volcanics, Western NSW, and their critical mineral potential

PREREQUISITES

Ign & Met Geol II essential; Ign & Met Geol III and Geochemistry II desirable

SUPERVISORS

Carl Spandler 08 8313 3870 carl.spandler@adelaide.edu.au
Jessica Walsh
Diana Zivak

This project will be undertaken as part of the Australian Critical Minerals Research Centre (ACMRC).

RESEARCH PROJECT

The Mount Arrowsmith Volcanics are a deformed and metamorphosed sequence of alkaline volcanic (basalts, trachytes, alkali rhyolites) and intrusive (syenites, ultramafics?) rocks that form the Neoproterozoic basement to the rift-related Koonebury Belt of Western NSW. The Mount Arrowsmith Volcanics are the type locality (and only known locality!) of an enigmatic rock-type known as 'nundorite'; an aegirine-nephelite-natrolite rock of unknown origin. Nundorite is unusually enriched in critical elements Zr, Nb and REE. There have also been reports of carbonatites (if true, the only ones in eastern Australia) and alkaline ultramafic rocks in the region, but there has been very little geological work on any of these rocks to date.

This project will study the petrology, mineralogy and geochemistry of the Mt Arrowsmith volcanics (including fieldwork), in order to:

1. Figure out how the hell Nundorite forms; 2. Determine the origin and evolution of the Mount Arrowsmith Volcanics; 3. Determine the tectonic setting in which these rocks were formed, and; 4. Evaluate the critical mineral (Zr, Hf, Nb, REE, etc) ore potential of this rock package.

Figure 1. Slab and polished stone of Nundorite. Note the bright green aegirine (sodian pyroxene). Western NSW field area (courtesy of George Miller).

The origin and evolution of light rare earth element (LREE) deposits at Browns Range, northern WA

PREREQUISITES

Ign & Met Geol II essential; Ign & Met Geol III and Geochemistry II desirable; enthusiasm for critical minerals and renewable energy transition.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Jessica Walsh 08 8313 5934 jessica.walsh@adelaide.edu.au
Carl Spandler
Diana Zivak
Kurt Warburton (Northern Minerals)

This project is part of the Australian Critical Minerals Research Centre (ACMRC) and the project partner is Northern Minerals Limited.

RESEARCH PROJECT

The transition to renewable energy is underpinned by technologies that are more critical mineral intensive than fossil fuel incumbents. These future technologies, such as high-tech electronics, telecommunications, and transport, depend on minerals, such as lithium, graphite, cobalt, titanium, and rare earth elements (REE). Australia is host to a diverse range of REE deposits, and is therefore well-placed to be a future major supplier.

A recently new and unusual ore style ('unconformity-related REE mineralisation'), has been defined for the Browns Range region; an area dominated by heavy rare earth element (HREE; Tb to Lu + Y) mineralisation in the form of xenotime [(YHREE)PO_4). However, some deposits (Area 5 and Area 5 North) consist of light rare earth element (LREE; La to Gd) mineralisation in the form of florencite [$LREEAl_3(PO_4)2(OH)_6$], with minor xenotime. The reason for this transition from HREE to LREE, between deposits and prospects at Browns Range is unknown.

This project will include the petrology, mineralogy, and geochemistry of LREE mineralisation occurring at the Area 5 and Area 5 North deposits, and Proterozoic basin host rock (Gardiner Sandstone), in order to: (i) detail the mineral paragenesis and alterations associated with the ore and host rocks; (ii) investigate ore mineral chemistry; and (iii) define the geological processes responsible for the different in mineralisation between deposits and prospects.

Figure: Field photo of preliminary exploration work being undertaken by Northern Minerals, at Browns Range, northern WA.

The use of rutile geochemistry in characterising the provenance of heavy mineral sands

PREREQUISITES

None, however completion of Geochemistry II and a general interest in geochemistry and mineralogy would be beneficial.

SUPERVISORS

Diana Zivak 08 8313 0935 diana.zivak@adelaide.edu.au
Carl Spandler
Jessica Walsh

RESEARCH PROJECT

Rutile (TiO_2) is a refractory mineral that occurs in a wide range of metamorphic, igneous and sedimentary rocks. Due to its refractory nature, rutile is easily concentrated during coastal marine sedimentary processes and is the main source of Ti in heavy mineral sand deposits. The availability of rutile in heavy mineral sands is heavily dependent upon the type of weathered and eroded terrains that source the heavy minerals. For example, metamorphic terrains are more likely to source greater amounts of rutile than felsic igneous terrains. Traditionally, provenance studies using rutile relied on the Nb and Cr concentrations (representing metapelitic and metamafic sources respectively), however, studies have shown these to yield false results, with a range of Nb and Cr obtained from a single rutile grain, demonstrating chemical heterogeneity on a micron scale (see Figure). A recent study on the use of rutile for metal exploration demonstrated the benefits of using multiple elements (in addition to Nb and Cr) to determine rutile provenance.

This project will use rutile geochemistry in heavy mineral sands to determine their provenance. Rutile geochemistry will be obtained using the state-of-the-art laser ablation ICP-MS instruments at Adelaide Microscopy on samples from southern Australian mineral sand deposits. Principal Component Analysis on multiple elements (Nb, Cr, V, Fe, Zr, Sn, Sb, Hf, Ta, W, Mo and U) will be carried out to differentiate between the different types of rutile and their source provenance. Regional scale literature review of the basement rocks surrounding southern Australia will be required to link rutile geochemistry to its likely source rock lithology. The information obtained in this study will aid in conceptualisation of exploration programs that target specific areas likely to yield large amount of rutile and will provide insights into movement of heavy mineral phases during erosion, transportation and deposition.

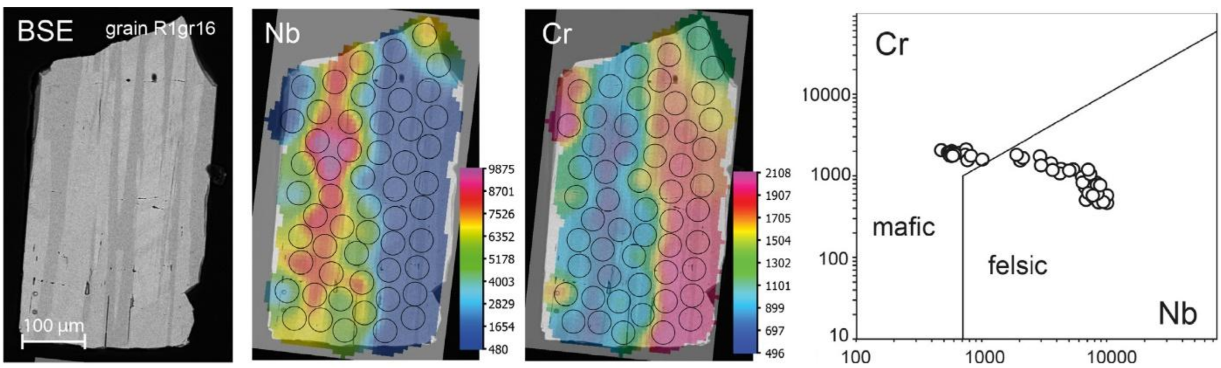


Figure: A single metamorphic rutile grain showing heterogeneity in Nb and Cr on a micron scale and its distribution of the Nb vs. Cr plot used to discriminate between different types of source rocks. BSE = backscattered electron image acquired by scanning electron microscope.

Geophysics Projects

Derrick Hasterok

Geothermal Regimes in Iron-Oxide Copper Gold Deposits: Pathfinding for New Discoveries and De-Risking Mine Infrastructure Planning

Compositional controls on physical properties: new constraints from laboratory measurements

Graham Heinson

The Curnamona Cube

Nanosatellites and drone geophysics: new technologies for Earth, Moon and Mars

Geothermal Regimes in Iron-Oxide Copper Gold Deposits: Pathfinding for New Discoveries and De-Risking Mine Infrastructure Planning

PREREQUISITES

Mineral and Energy Resources III and Geophysics III, and interest in ore systems, geochemistry and the minerals industry. Cover letter and C.V. requested to be sent to project supervisor to indicate willingness to engage in collaborative research with minerals industry partners.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Derrick Hasterok derrick.hasterok@adelaide.edu.au
Martin Hand
Richard Lilly
OZ Minerals Senior Geologist

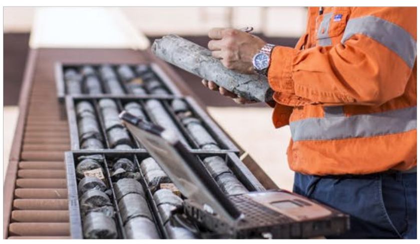
RESEARCH PROJECT

The Eastern Gawler Craton in South Australia has significantly elevated crustal heat flow, resulting in high geothermal gradients. It has been long theorised there may be a link between this elevated thermal regime and the formation of a globally significant IOCG minerals province. OZ Minerals Carrapateena copper-gold deposit is one of the most significant new copper-gold projects in Australia.

This project will use temperature data from diamond drill holes at Carrapateena and in nearby host granites in conjunction with thermal conductivity measurements on drill core, and the extensive OZ Minerals geochemical database, to characterise the geothermal regime within the deposit and its surrounds. The results of the project will have two important and far-reaching applications. (1) Characterising the thermal regime will allow temperatures to be predicted within the deposit. This information is critical to mine infrastructure planning on ventilation systems as underground development expands. (2) Characterising the thermal regime at Carrapeteena will test the hypothesis that big IOCG deposits in the Gawler Craton have geothermal anomalies associated with them. If this is true, thermal logging of future exploration drill holes would be a powerful tool for finding large IOCG deposits.

The successful student will work closely with OZ Minerals geoscientists to collect thermal data from Carrapateena. The proposed project may also include a component of data science including machine learning, potentially using programming in Matlab or Python, applied to the extensive OZ Minerals database.

The project will increase our understanding of how these giant IOCG systems form, provide important inputs into mine infrastructure planning, and may have far-reaching implications for exploration targeting.



Compositional controls on physical properties: new constraints from laboratory measurements

PREREQUISITES

Geophysics III or Physics background

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

Derrick Hasterok 08 8313 4540
derrick.hasterok@adelaide.edu.au

Rian Dutch, Geological Survey of South Australia

MinEx CRC

RESEARCH PROJECT

One of the limitations to developing geophysical models of the crust is minimal control on physical property determinations on rocks directly relevant to the subsurface. As part of this project you will be measuring the physical properties on samples with known compositions from the South Australian drill core library. The goal of this project is to develop a set of robust, compositionally based models to predict a number of physical properties including, density, thermal conductivity, and heat production. With such models, it will be possible to estimate the distribution of physical properties in the subsurface, providing a priori constraints for gravity and heat flow investigations. You will gain experience with petrophysical measurement techniques. You will need to develop a sampling strategy that adequately samples a wide array of rock compositions among both igneous and sedimentary rocks. To analyze the data you will be required to learn some basic computer programming for both data analysis and data management.

This project is a collaboration between UA and the GSSA and will contribute to the MinEx CRC national drilling initiative regions by providing measured rock properties and model data to assist with geological modelling.

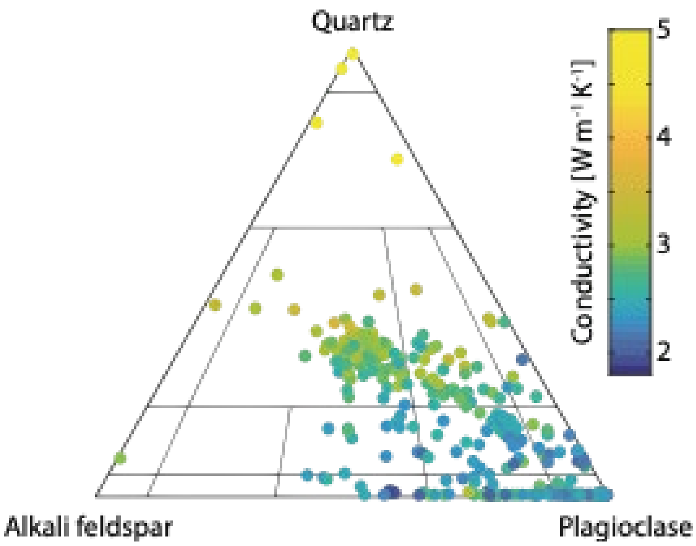


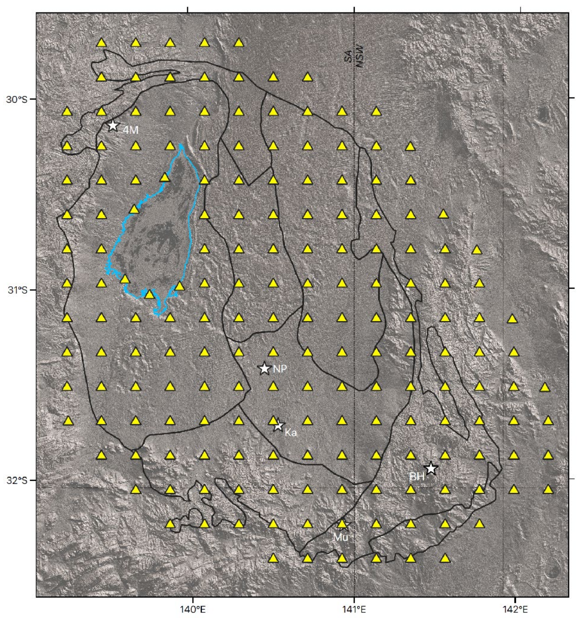
Figure: The thermal conductivity variations of igneous rocks systematically varies with composition. Do metamorphic rocks behave similarly?

The Curnamona Cube

PREREQUISITES
Geophysics Major

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS
Graham Heinson 08 8313 5377 graham.heinson@adelaide.edu.au
Stephan Thiel
Kate Robertson

RESEARCH PROJECT
The University of Adelaide, in collaboration with ANU and the Uni Melbourne, have recently been funded $1 Million by AuScope to undertake a major geophysics program across the Curnamona Province. The project will also include the State Geological Surveys of South Australia and New South Wales, the federal agency Geoscience Australia, and industrial partners from the space technology and mineral exploration sectors. The Curnamona Province is a greenfields environment for mineral exploration due to extensive and deep sedimentary cover. We will collect two world-class data sets for research, government and industrial communities:



1. **Curnamona Cube**. ~100 MT and 100 seismic sites in a 20 km grid across the Curnamona Province over two years (yellow triangles). Survey dimensions 300 km by 300 km will generate data and models infrastructure from the surface to a depth of 300 km;

2. **Curnamona Telescope Super Site**. As a pilot Super Site, we will establish a small grid of long-deployment MT, passive seismics and heat-flow needle probes close to the Kalkaroo deposit.

Figure: Extent of the Curnamona Province. Mines and major deposits are shown as white stars (BH - Broken Hill; Ka – Kalkaroo, NP – North Portia, Mu – Mutooroo, 4M – Four Mile).

Two Honours projects are available, to work on separate data sets:

1. **The Curnamona Cube Seismic Model**. The student will be involved with the collection, processing, modelling and interpretation of 100+ passive seismometers, and developing 3D seismic models.

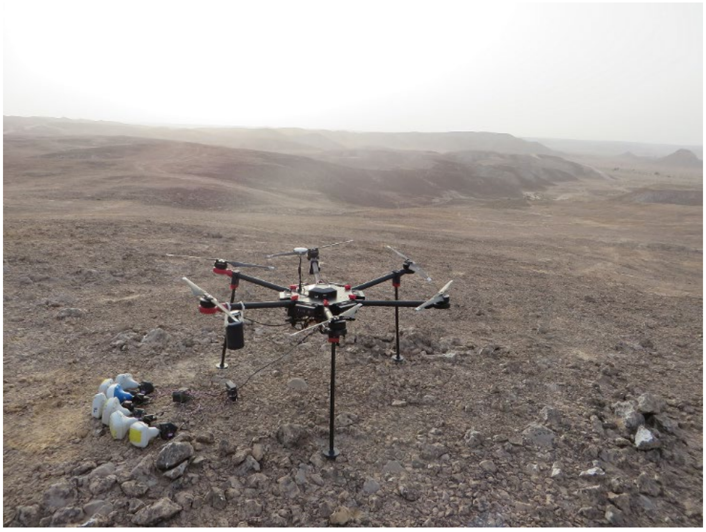
2. **Curnamona Telescope Super Site**. Establishing a long-deployment site of a small grid of MT, seismometers and heat probes will require significant technological challenges, and we seek a student with a strong interest in instrumentation and data analytics. The long-baseline collocated instruments will provide a unique research opportunity to view deep into the Earth.

Nanosatellites and drone geophysics: new technologies for Earth, Moon and Mars

PREREQUISITES
Geophysics Major

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS
Graham Heinson 08 8313 5377 graham.heinson@adelaide.edu.au
Matthew Pearson

RESEARCH PROJECT
Geomagnetic depth sounding (GDS) is a geophysical technique that maps the anomalous vertical magnetic variational fields. Unlike the magnetotelluric (MT) method that requires long pairs of grounded electric dipoles, the GDS method simply requires a three-component magnetic sensor and data acquisition system that does not need to be attached to the ground.



We propose to develop a research program to use drones for remote deployment of GDS sensors. The vision is to have a swarm of drones from a field base to a number of locations, recording for a few days to weeks before being recalled and fly back with the sensors. Real-time remote data transfer could be undertaken using Fleet Space Technologies LoRaWAN™ Gateway and satellite modem. Real-time data analytics would provide information as to how long GDS sensors should be deployed for, and to evolve survey logistics with time.

The project would involve (a) building a lightweight three-component fluxgate magnetometer with mass of less than 1 kg and size smaller than a shoebox; (b) collecting field data to test out the logistics of deployment; (c) developing the technology for remote data analysis; and (d) investigating the potential to deploy autonomously.

Fleet Space Technologies nanosatellite Centauri.

Environmental Geoscience Projects

Lee Arnold

Reconstructing megafauna histories and palaeoenvironmental change at Naracoorte cave palaeontological sites

'Forensic' geomorphology evidence for palaeo-environmental change on Kangaroo Island

Juraj Farkas

Setting up 'Australian Critical Zone Network' (OZCZO): A pilot study in South Australia

Alexander Francke

Reconstructing the past monsoon climates of Japan using isotopes and lake sediments

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Resolving the spatial dynamics of the Coorong's palaeo-hydrology

Droughts and fire: unravelling past climate extremes on Kangaroo Island, South Australia

Plasma ashing for Earth Sciences: optimising and validating a novel technique for organic removal

Reconstructing megafauna histories and palaeoenvironmental change at Naracoorte cave palaeontological sites

PREREQUISITES

Good numerical skills and a capacity to conduct hands-on laboratory research. There is no pre-requisite course, although Field Palaeontology III, Geochronology, Fossil and Palaeoenvironments III, or Earth Systems History III would be beneficial.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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Martina Demuro

Liz Reed

RESEARCH PROJECT

The fossil deposits at the UNESCO World Heritage Naracoorte Caves National Park preserve major ecological turnovers spanning the last 500 ka, and provide a unique opportunity for understanding the causes of late Pleistocene megafaunal extinction in Australia. Establishing reliable age estimates on these fossil sites and associated palaeoenvironmental sedimentary records is critical for understanding long-term biodiversity shifts over glacial-interglacial timescales. This project will use single-grain optically stimulated luminescence (OSL) quartz dating, together with geochemical analysis and/or palaeoecological proxies, to determine late Pleistocene fossil and climate histories from Naracoorte caves.

Sample collection will be conducted by the student and research team during autumn 2022. The dating samples will be prepared and measured by the student at the University of Adelaide's Prescott Environmental Luminescence Laboratory. The chronologies established in this study will be compared with dating results obtained on related sites, and used to examine whether past faunal successions were driven by major climate change or human interactions.

Figure: (left) View of one of the Naracoorte cave megafauna sedimentary sequences (Alexandra Cave); (right) OSL dating preparation and measurement facility at the University of Adelaide.

‘Forensic’ geomorphology evidence for palaeo-environmental change on Kangaroo Island

PREREQUISITES

Good numerical skills and a capacity to conduct hands-on laboratory research. There is no pre-requisite course, although Field Palaeontology III, Geochronology, Fossil and Palaeoenvironments III, or Earth Systems History III would be beneficial.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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RESEARCH PROJECT

Kangaroo Island (KI) represents a fascinating, yet largely unexplored, region for examining the timing, causes and consequences of Quaternary environmental change. Evidence from existing KI lake, cave and marine core records suggests that the island experienced major landscape change during the late Pleistocene and Holocene, with potential implications for human abandonment during the late Holocene, regional disappearance of megafauna, and changes to long-term fire regimes. In addition to traditional palaeoclimate archives, KI preserves a wide range of relict landforms and geomorphic features (alluvial fans, dune systems, former lake shorelines) that provide forensic evidence for very different past landscapes. Establishing reliable chronologies on these diagnostic environmental records is essential for understanding past, and future, climate change impacts on the island.

This project will use a combination of single-grain OSL dating, surveying and satellite mapping of relict landforms, and geochemical/sedimentological analyses, to help establish an improved geomorphic history of KI. The dating study will focus on identified diagnostic landforms, including the White’s Lagoon lunette, coastal dune systems and alluvial fan exposures. Sample collection and landscape surveying will be conducted by the student and research team in autumn 2022. The results will be used to examine how KI responded to synoptic-scale climate and ocean drivers, and to test competing hypotheses about KI’s climate during critical periods of human arrival, abandonment and megafaunal extinction.

Figure: Left – View of one of the possible KI study sites. Right – OSL dating sample collection.

Setting up 'Australian Critical Zone Network' (OZCZO): A pilot study in South Australia

PREREQUISITES

The proposed research would suit someone with ambitions for postgraduate studies and/or career in government agencies or environmental monitoring / consultancy companies.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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David Chittleborough & Wayne Meyer (UoA)
Matthias Leopold (Uni. Western Australia)

RESEARCH PROJECT

The Earth's 'critical zone' is the integrated geo-bio-hydrological system with water, carbon and metal cycling and related complex biogeochemical processes in the Earth's outer skin (i.e. the regolith). The Australian Critical Zone Observatories network (OZCZO) is a new continental-scale infrastructure that is the first of its kind to be established in the Southern Hemisphere (https://www.tern.org.au/news-ozczo-announcement/). This project aims to generate and collect pilot geochemical and hydrological data from one of its key sites – Calperum CZ station - located near Renmark in South Australia. Pilot datasets of selected processes will be collected using the new infrastructure (see Figure below), complemented by existing legacy core material from the local regolith. Samples will be analysed for elemental concentrations and radiogenic and stable Sr isotope compositions ($^{87}Sr/^{86}Sr$ and $\delta^{88/86}Sr$), using ICP MS/MS and TIMS techniques established at the University of Adelaide. Acquired data measured in rock, soil and groundwater samples will fill essential knowledge gaps related to interactions of under- and above-ground environmental processes and cycling of chemical elements, water and solutes in the 'critical zone'. The combination of this new data and that from recent soil, water, vegetation and atmospheric measurements will enable new insight into the responses of the earth's "living skin" to disturbance and ongoing environmental change.

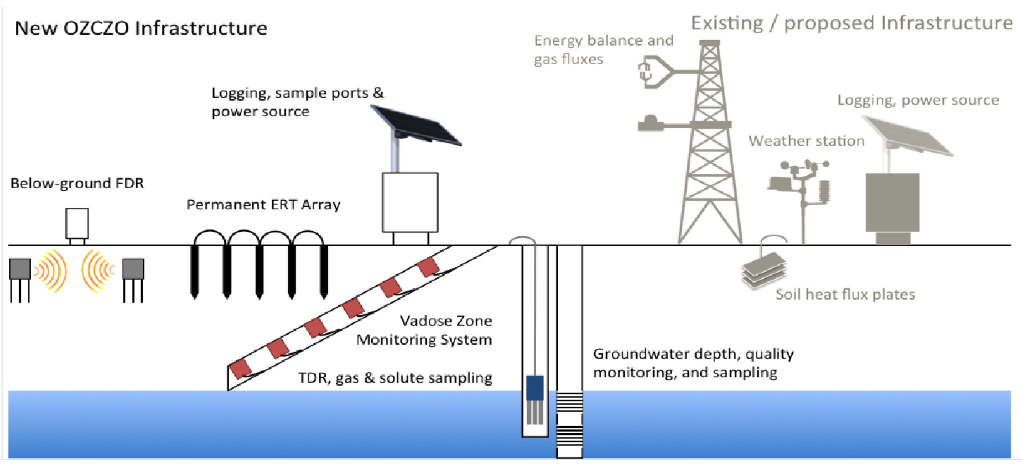

FIGURE: A new OZCZO infrastructure with Vadose Monitoring System (VMS) to be installed and used at Calperum Site (SA) for the purposes of environmental monitoring of biogeochemical processes in Critical Zone.

Reconstructing the past monsoon climates of Japan using isotopes and lake sediments

PREREQUISITES

No specific prerequisites, though Earth Systems History 3 would be useful. An interest in laboratory work, geochemistry, and statistics would be useful, but all students will be trained in any necessary techniques.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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Jonathan Tyler

RESEARCH PROJECT

The sediments of Lake Suigetsu, Japan, represent one of the world's most important archives of Quaternary climate variability. Uniquely, these sediments comprise annual laminations (varves) which span at least the last 70,000 years. These varves, in combination with dated volcanic tephra layers, provide one of the best dated records in the world, even contributing to the radiocarbon calibration curve (Nakagawa et al., 2012).

An Australian Research Council funded project aims to use the Lake Suigetsu sediments to reconstruct variability in the East Asian Monsoon during periods of major and abrupt global climatic change during the last glacial-interglacial cycle. In collaboration with researchers in Japan and at the British Geological Survey, we will use oxygen isotope analysis from two components of the sediments: biogenic silica (diatom fossils) and authigenic siderite minerals (iron carbonate). Oxygen isotopes record past climates via: (a) the isotope composition of precipitation; (b) the effect of lake mixing and evaporation on lake water oxygen isotopes; and (c) the effect of temperature on mineral-water oxygen isotope fractionation. As part of the project, we aim to quantify the above minerals before isotope analysis using infrared spectroscopy.

This Honours project aims to contribute to this project by developing an infra-red based model for quantifying mineral composition, and then by analysing and interpreting oxygen isotope data from either/both sedimentary biogenic silica and siderite. In the process, the student will gain training and experience with various lab techniques. Interpretations can be supported by other, existing datasets from the Suigetsu core, such as diatom, pollen, or XRF-core scanning data. Interpretations are ideally supported by statistical analyses.

Figure: The Lake Suigetsu sediments even have their own dedicated Suigetsu Varves Museum. This photo shows resin-embedded sections of the sediment core, back lit so that members of the public can view the varves. Research samples are also stored at this museum, which we will visit once COVID-19 restrictions are lifted (source: https://fupo.jp/article/若狭町の.

Reference: Nakagawa, T. et al. (2012). *Quaternary Science Reviews, 36*, 164-176.

Resolving the spatial dynamics of the Coorong's palaeo-hydrology

PREREQUISITES

No prerequisites, though some combination of *Geochemistry 2*, *Earth Systems History 3* or *Geochronology, Fossils and Palaeoenvironments 3* would be useful.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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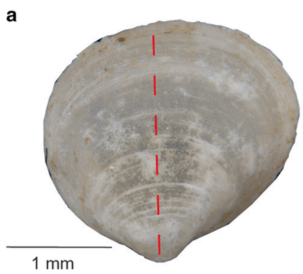
John Tibby

RESEARCH PROJECT

The Coorong Lagoon is one of South Australia's most iconic and contested environmental systems. A site of special scientific interest, and listed under the Ramsar Convention for protection of wetlands, the lagoon has tremendous environmental, societal, cultural and economic significance. The Coorong's South Lagoon is a restricted hypersaline basin with salinities 3-4 times seawater. It is also highly eutrophic, which is harmful to plant and animal life. The South Australian State Government are exploring several ideas to lower the salinity and nutrients in the Coorong, one of which is to open up the system to the ocean and flush it with sea water. However, recent research by our group suggests that in parts of the Coorong, this high salinity has been the natural state over the last 2000 years (Chamberlayne 2021). Thus, flushing the lagoon with seawater could effectively destroy a natural ecosystem and replace it with something completely new. However, to date, most of our work to date has focused on just one or two locations within the Coorong, and given the lagoon is over 100 km long, it is unclear just how representative these data are when it comes to the entire system.

Oxygen isotope geochemistry of fossil carbonate biominerals (i.e. molluscs, ostracods or foraminifera) provide a valuable tool for reconstructing the past hydrology of lakes and lagoons. Building on our previous research, this project will seek to extract fossil shells from multiple sediment cores, already collected along a north-south transect along the Coorong. Using these multiple cores, the aim is to construct time slice 'isoscapes' (isotopic maps) of the ancient Coorong to assess the degree to which a common pattern of change can be detected across the lagoon. In addition, the spatial gradient between locations – e.g. between the North vs. South Lagoons should provide a means of determining the origin of past freshwater inputs as well as the degree of local evaporation. These data will help develop a more detailed understanding of the natural hydrology of the Coorong, and thus contribute to the restoration and management of the system. In addition, the project will provide new insights into the nature and causes of past climate variability in south-eastern Australia.

Figures: (left) Aerial photo of the Coorong (sa.gov.au); (right) Arthritica helmsi, a common bivalve from the Coorong used for isotope analysis (Chamberlayne 2021)



Reference: Chamberlayne (2021) PhD Thesis, University of Adelaide.

Droughts and fire: unravelling past climate extremes on Kangaroo Island, South Australia

PREREQUISITES

No prerequisites, though some combination of *Geochemistry 2*, *Earth Systems History 3* or *Geochronology, Fossils and Palaeoenvironments 3* would be useful.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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John Tibby
Alexander Francke

RESEARCH PROJECT

Over recent decades, South Australia has experienced a combination of devastating droughts and bushfires – most recently the widespread fires of January 2020 – which are the consequence of rising temperature, declining rainfall and post-colonial landscape alteration. Unravelling the causes, and thus future, of such extreme events requires a long term perspective, including data on the interplay between climate variability and bushfires in environments where humans were absent. In this respect, Kangaroo Island provides a fascinating case study. For several thousand years prior to European colonisation, Kangaroo Island was entirely uninhabited by people. It has been proposed that the departure of Traditional Owners from the island was in part responsible for an increase in bushfire intensity, yet that subsequent fire activity varied as a result of climatic changes.

Our research using lake sediments on Kangaroo Island aims to address these hypotheses. Palaeo-fire (charcoal, biomarker) and vegetation (pollen, DNA) records are currently being developed, yet there is a need to develop complimentary climate reconstructions to compare against these data. The proposed Honours project would therefore use oxygen isotope analysis from carbonate ostracod microfossils to reconstruct climate and hydrological change over the last ~3000 years to provide a climatic perspective for past fire activity. As well as the value to bushfire research, the data will be used to evaluate the frequency and drivers of past climate extremes – particularly the occurrence of long term droughts. The research is funded by an Australian Research Council (ARC) Discovery Project, and would suit someone with an interest in either postgraduate research or applied environmental geoscience.



Figures: (left) Kangaroo Island bushfires, January 2020 (kangarooislandoats.com.au); (middle) a sediment corer on the beach of Lashmar Lagoon, Kangaroo Island; (above) a live ostracod, with carbonate shell (tinyurl.com/5am4rsmy)

Plasma ashing for Earth Sciences: optimising and validating a novel technique for organic removal

PREREQUISITES

No prerequisites, though some combination of *Geochemistry 2*, *Earth Systems History 3* or *Geochronology, Fossils and Palaeoenvironments 3* would be useful. An enthusiasm for experimental science and the use of new technology is a must.

SUPERVISORS / RESEARCH GROUP / PROJECT PARTNERS

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Bryan Coad

RESEARCH PROJECT

Many fields of Earth Science research require the removal/destruction of organic matter – to purify microfossils, isolate volcanic glass shards, to analyse clay mineralogy and most frequently to analyse the elemental and isotope geochemical composition of silicate or carbonate minerals in sediments. Usually, researchers will attack organic matter using chemicals like bleach, hydrogen peroxide, nitric acid or sulfuric acid, however in many cases these chemicals can also attack or alter the materials we want to analyse, undermining the research. This demand is particularly acute when it comes to analysing oxygen isotopes from fine grained carbonates in organic rich sediments. These minerals often dissolve in both acidic and basic conditions, and heating the minerals in a fluid for prolonged periods can alter their isotopic composition.

Plasma ashing provides a tantalising solution to these problems. Plasmas work by using high frequency radio waves under vacuum to excite gas molecules into highly reactive states. For example, plasmas produced from oxygen in air generate reactive oxygen species which can break down organic matter quickly, at low temperature and without any water (or acid) involved. Recent research has shown this method to be highly effective at removing organic matter whilst maintaining the silicate structure of diatom biominerals (Saad et al. 2020).

This project aims to optimise and apply the plasma ashing technique for pre-treatment of lake sediments prior to oxygen isotope analysis. In particular, the work will focus on Holocene lake sediments from Victoria, with the ultimate goal of developing a novel record of past climate variability. The project will seek to identify the optimum power, time and gas type to achieve this aim, as well as explore the means of up-scaling the procedure.

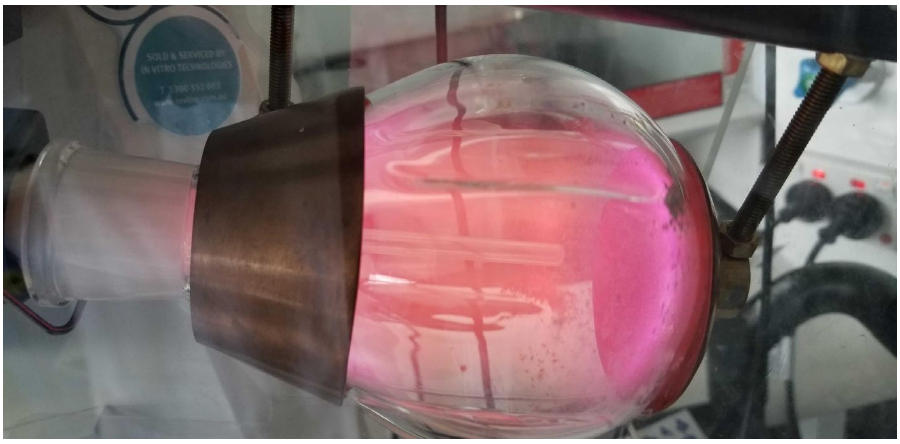

Figure: Plasma in action! One of the nice things about plasma ashing is that you get to watch a beautiful spectacle as the organic matter is oxidised.

Reference: Saad, Emily M., et al. "Effect of cleaning methods on the dissolution of diatom frustules." *Marine Chemistry* 224 (2020): 103826.