

ORE SOLUTIONS

NEWSLETTER OF **CODES** CENTRE FOR ORE DEPOSIT AND EARTH SCIENCES

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FREE AT LAST: INTERNATIONAL FIELDWORK NOW POSSIBLE FOR CODES PHD STUDENTS

CODES students Hannah Moore and Acacia Clark undertook their PhD fieldwork at Tarawera volcano, New Zealand, in August and September 2022 (six weeks in total). This fieldwork has been a long time coming for Hannah; she started her PhD in October 2019, just before the COVID-19 pandemic began. This was her first opportunity to collect her own data from her principal study site.

Hannah and Acacia's PhD studies are focused on Tarawera volcano in Okataina Caldera in the North Island of New Zealand. The last two most powerful eruptions from a caldera volcano have occurred from Okataina. Hannah's research is focused on the 1886 basaltic Plinian eruption which destroyed a local Maori village at Te Wairoa and is one of New Zealand's greatest natural disasters. The 1886 eruption of Mt Tarawera is the only powerful 'Plinian' basaltic eruption on Earth with quantitative constraints and visual observations of the eruption dynamics and timing, with exceptional exposure and access to near-vent eruption deposits. The eruption deposits are therefore highly valuable to our understanding of basaltic Plinian eruptions around the world, as well as for assessing the hazards posed by future explosive eruptions at Tarawera volcano.



On the brink: CODES PhD students Hannah Moore (left) and Acacia Clark with their supervisor Associate Professor Rebecca Carey (right) pictured while doing research on the Tarawera volcano on New Zealand's North Island during September this year. This was the first time in nearly three years that Hannah had been able to get out into the field to carry out her research.

Acacia's project is focused on the last powerful silicic eruption of Tarawera volcano – the Kaharoa eruption which took place ~1315 CE. She is focused on understanding the transitions between explosive and effusive silicic volcanism at this centre. This eruption was complex, with multiple phases of highly explosive and dome-forming eruptions with a total volume of >10km³. Such an eruption in modern times in New Zealand would be devastating.

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FROM THE DIRECTOR

Professor David Cooke assesses the year to date and looks forward to 2023, when the new Regional Research Collaboration will start its work in earnest.

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CODES CONTACTS

CODES DIRECTOR
David Cooke
Ph: +61 3 6226 7605
d.cooke@utas.edu.au

LEADERS, PROGRAM 1
Ore Deposits and Mineral Exploration
Mike Baker and Lejun Zhang
Ph: +61 3 6226 7210/7211
Michael.Baker@utas.edu.au
Lejun.Zhang@utas.edu.au

LEADERS, PROGRAM 2
Geometallurgy, Geoenvironment and Mining
Julie Hunt and Angela Escolme
Ph: +61 3 6226 5705/2664
Julie.Hunt@utas.edu.au
Angela.Escolme@utas.edu.au

LEADERS, PROGRAM 3
Sedimentation, Tectonics and Earth Evolution
Robert Scott and Jeff Steadman
Ph: +61 3 6226 2786/5554
Robert.Scott@utas.edu.au
Jeffrey.Steadman@utas.edu.au

LEADERS, PROGRAM 4
Magmatic and Volcanic Processes
Rebecca Carey and Martin Jutzeler
Ph: +61 3 6226 2987/2406
Rebecca.Carey@utas.edu.au
Martin.Jutzeler@utas.edu.au

LEADER, PROGRAM 5
Analytical Research
Ivan Belousov
Ph: +61 3 6226 7489
Ivan.Belousov@utas.edu.au

LEADERS, PROGRAM 6
Geophysics and Computational Geosciences
Michael Roach and Matt Cracknell
Ph: +61 3 6226 2474/2481
Michael.Roach@utas.edu.au
M.J.Cracknell@utas.edu.au

NEWSLETTER EDITOR
Caroline Mordaunt
caroline.mordaunt@utas.edu.au

CODES – Centre for Ore Deposit and Earth Sciences
University of Tasmania
Private Bag 79, Hobart
Tasmania 7001 Australia
Ph: +61 3 6226 2472
utas.edu.au/codes
CODES.info@utas.edu.au

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At ease: Hannah Moore takes a break from logging eruption deposits during the research trip to Tarawera; the temperature on top of the volcano was 5°C minimum (the wind chill made it feel much worse!!).

Hannah and Acacia were joined for two weeks by their supervisor, Associate Professor Rebecca Carey, and Dr Michael Roach. For Rebecca, Tarawera volcano is very dear to her heart as she has studied Tarawera for almost two decades! Dr Michael Roach was a valuable asset in the field as he collected UAV drone imagery, from inaccessible locations along the summit of the volcano from which 3D models could be generated. These 3D models have been used by Hannah and Acacia to make accurate measurements and observations from areas where data has not been collected before. Hannah and Acacia's fieldwork also involved detailed mapping/recording of stratigraphic details of the pyroclastic deposits eruption phases and collecting

key samples for density, grain size, componentry, permeability and porosity analysis.

Hannah says: 'This fieldwork had been a dream of mine for many years; I have a huge feeling of accomplishment now that it is done. I savoured and enjoyed every moment of it! The 1886 eruption of Tarawera is such a unique and unusual eruption; there is so much to be learned from it. I hope to advance knowledge on this eruption and on powerful basaltic eruptions in general.'

The team would like to acknowledge the Ngāti Rangitihi Trust for welcoming them to the mountain. They are also grateful to GNS Science for all their logistical help and support in the field. Acacia would like to thank the GSA for funding her part of the trip through the GSA Endowment Fund.

ROSS STRIKES GOLD YET AGAIN!

The founder of CODES, Professor Ross Large, was presented with the Society of Economic Geologists' highest honour in a ceremony at Denver, Colorado, during August.

The award of the 2022 R.A.F. Penrose Gold Medal in recognition of Ross's lifetime of economic geology research, was originally announced late last year when it was also announced that the medal would be presented at the 2022 SEG Conference in the USA.

Ross says: 'It was a great pleasure to be there in Denver in person to receive the Penrose medal. As I said in my short acceptance speech, it is an honour to be the fourth graduate from the University of Tasmania to receive the medal and a testament to the excellent teachers/researchers in our Geology Department.'

The SEG, which presents the medal 'in recognition of a full career in the performance of outstanding work in the Earth sciences', summarises Ross's work on its current page of award winners; and an excerpt follows:

[Ross] received his BSc (Hons) degree from the University of Tasmania in 1969, and his PhD degree from the University of New England in 1974, followed by a postdoctoral position at the University of Toronto. For 13 years Ross worked in mineral exploration for Geopeko Ltd, exploring for gold, tin and base metal mineral deposits. In 1984 he joined the staff of the University of Tasmania and in 1989 established CODES as a National Key Centre for Teaching and Research. Since then, CODES has progressed from a Key Centre, to an ARC Special Research Centre, and more recently to an ARC Centre of Excellence. CODES has become recognised as one of the top ore deposit research centres in the world. Ross has become internationally recognised for his research on the genesis of stratiform gold and base metal sulphide deposits in volcanic arcs and sedimentary basins. ...



Professor Ross Large (right) is presented with the 2022 R.A.F. Penrose Gold Medal by the current SEG President, Chico de Azevedo, at a ceremony in Denver, Colorado, during August. Ross is the 56th recipient of the medal. INSET: The R.A.F. Penrose medal.

Over the last 12 years, Ross has pioneered a new and novel line of research using the trace element chemistry of sedimentary pyrite to determine the chemistry of past oceans and relationship to plate tectonics and evolution of ores in sedimentary basins. Ross received the Waldemar Lindgren Award from the Society of Economic Geologists in 1983, was the SEG Distinguished Lecturer in 1998, was elected President of the SEG for 2004, and received the SEG Silver Medal in 2010. He and his co-authors received the Brian J. Skinner Award for the best paper in Economic Geology for 2011. Among his other recognitions and honors are the President's Award from the Australasian Institute of Mining and Metallurgy, the Haddon Forrester King Medal from the Australian Academy of Science, an Order of Australia, and, with his team, the Eureka Prize for interdisciplinary research based on the geochemistry of marine pyrite.

Ross stepped down as Director of CODES in 2012. Recently he has been working with Adrian Large, a big-data expert, to use data analytics for mineral targeting. Ross and Adrian have joined with an Australian company, Mine Discovery Fund (MDF), to form a new company named Mineraleyes.

The aim of Mineraleyes is to use a novel approach of technology and human intelligence to define a common variety of ore deposit signatures and determine the best quality areas of prospectivity within jurisdictions globally. To date, the Mineraleyes team is concentrating on Australia, Canada and the USA, but is equipped to work in any jurisdiction where big data sets are available, either open to the public or confidential to specific explorers.

See our newsletter, issue No.41 (https://www.utas.edu.au/_data/assets/pdf_file/0006/1556376/OS41-CODES-2021-Summer-newsletter.pdf), for further background to Ross's distinguished career in economic geology.

FARAWAY PLACES: REMOTE FIELDWORK PAYS BIG DIVIDENDS

In September two CODES staff and a CODES PhD student travelled to a remote part of Central Asia to carry out fieldwork related to the new Amira Global P1249 project, and were assisted in the field by geologists from one of the P1249 sponsoring companies. Dr Lejun Zhang gives a brief overview of the trip.

Dr Lejun Zhang, Dr Ivan Belousov and PhD student Rhiannon Jones conducted 19 days of fieldwork in Central Asia from 3–21 September. This fieldwork involved surface mapping and rock chip sampling and is part of the five-year (February 2022–December 2026) Amira Global P1249 project 'Exploring, characterising, and optimising complex orebodies – Integrated deposit knowledge to add value across the Mining Value Chain' led by Professor David Cooke at CODES.

The Amira P1249 project is currently sponsored by 15 mining companies and involves a number of study sites in Australia and overseas. This project will provide its sponsors with new tools for recognising proximity to high-grade ore, and new tools, methods and workflows for translating and upscaling mineralogical, geochemical and

hyperspectral data into quantitative mineralogy for complex orebodies of copper, gold, critical and other metals and provide the information required for mineralogical domaining and resource definition at the mine scale.

This is an active exploration project and has the primary focus of applying and developing effective exploration tools in the porphyry and lithocap environments, which sits within the P1249 Vectoring and Fertility research module led by Dr Lejun Zhang. During the field trip, the CODES research team worked with the local geologist team to design and implement the most appropriate sampling program for the site, conducting detailed sampling and mapping, and also ran on-site workshops to transfer project technologies to our sponsors, one of the key objectives of P1249. The diverse geology provided the research team with a great opportunity to test the exploration tools that the Amira footprint research projects have developed. The first phase of results and exploration recommendations from the P1249 research team will be provided to project sponsors six to twelve months after the samples arrive at CODES.



CODES team leader Dr Lejun Zhang ready to tackle another day during the recent fieldwork trip to Central Asia.

This was the first field campaign that the CODES Amira footprints research team has conducted outside Australia since the outbreak of COVID-19. Working with the local team from the industry sponsor company was a great pleasure, and thanks must go to all concerned.

ACTION-PACKED: THE CODES SEG MACQUARIE ARC FIELD TRIP

CODES PhD students Alex Farrar, Malai Ila'ava and Zeb Zivkovic, who were instrumental in organising the 2022 CODES SEG Student Chapter field trip, outline the Orange, Parkes and West Wyalong legs of this memorable week-long study tour in late September/early October.

MONDAY 26 SEPTEMBER: ORANGE

Three undergrads, nine postgrads and two CODES staff flew from Hobart to Canberra where we met up with three industry participants, and set off for Orange, via a surprise visit to Parliament House! Professor Dave Cooke showed us a road cutting exposure called the 'Capital Hill unconformity', which consists of folded Silurian sedimentary rocks and, obviously, a clearly unconformable contact. Dave explained that these rocks are cover sequence to many of the deposits we would be seeing during the trip. In Orange, we met up with the remaining eight industry participants, and all 25 participants enjoyed a group dinner at Canobolas restaurant.



Tuesday morning: Participants of the CODES SEG field trip concentrating hard as they examine drillcore at Newcrest's Cadia core yard; this was the first site visit for the group, and is a world-class gold deposit.



Wednesday morning: The tour group pictured at an outcrop of the McPhillameys deposit at Blayney; this deposit contains 60.8 million tonnes at 1.04g/t for 2.02 million ounces of gold. A total of 25 staff, students and industry geologists took part in the field trip.

TUESDAY 27 SEPTEMBER

Our first site visit was to the core shed of the world-class Cadia deposits, where the Newcrest team gave a great talk regarding the discovery history of the district, which contains 100 million ounces of gold. We examined key drillholes from Cadia Hill, Ridgeway and Cadia East, where the pencil-like form and spatially restricted nature of porphyry-style alteration were evident, which, combined with extensive post-mineralisation cover, the Newcrest team explained made exploration challenging.

After lunch we visited the Magmatic Resources core shed and looked at a drillhole from the exciting Corvette prospect. Much of the core looks as if it might have passed through a mineralised magmatic-hydrothermal breccia, which contains clasts of porphyry. After Magmatic, we visited the Alkane core shed, and looked at drilling from their Boda exploration prospect. The drillcore consisted of 700 m of intense biotite-pyrite alteration which passed into chalcopryite veins at depth.

WEDNESDAY 28 SEPTEMBER

We drove from Orange to Blayney where we visited the Regis core shed to look at drillcore from McPhillameys deposit, which contains 60Mt @ 1g/t Au. The host lithology for the deposit is mainly Silurian volcanogenic rocks, which have been intensely foliated and contain 5–10% pyrite; the gold mineralisation is associated with pyrite. A highlight of the trip was a visit to the McPhillameys exploration site, where our geological guide James Egan took us through the social side of trying to get a mine permitted.

In the afternoon we drove back into Orange where we visited Sky Metals and their Hume prospect. The prospect is aptly named because the Hume Highway passes to the southern end of the orebody! The mineralisation style is similar to McPhillameys, and consisted of abundant pyrite that looks to have been remobilised into the foliation. Unlike the drillcore we saw from McPhillameys, mineralisation also contains Pb-Zn-Cu-Au mineralisation.

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Friday morning: Alkane's Tomingley Gold Operations site. Participants were given a tour of the processing plant; gold processing commenced here in 2014. INSET: The open pit at Tomingley.

THURSDAY 29 SEPTEMBER: PARKES

The Parkes leg of the trip began at the Northparkes Mine operated by CMOC. We were welcomed by the wonderful Jonathon Hoyer, who went above and beyond to treat us with a smorgasbord of talks, rocks and food! An engaging talk on the geology and history of the mine was followed by a tour of the core yard where we got to see the Northparkes porphyry cluster in its various forms including both mineralised and unmineralised examples. We were then treated to some fossicking on top of a nearby 'waste' dump where everyone was excited to discover their very own piece of Northparkes. After a generous lunch provided by CMOC, we moved on to the next session hosted by Kincorra Copper at Trundle. Here Ben Jones and Sam Spring introduced us to the project. An impressive amount of core was laid out for us and we were expertly guided by Ben and our very own 'Baggy' Enkhbold (former CODES Masters student) who showed us wonderful examples of the skarn mineralisation that forms the bulk of the mineralisation here.

FRIDAY 30 SEPTEMBER

This was another opportunity to see the team at Alkane who very generously offered to show us around their Tomingley Gold Operation in the morning. We were met there by local geologist, Terence Nhan, who was very excited to teach us about the geology and mining operation. This was followed by a visit to the pit lookout and a tour of the core yard where recent drill core that demonstrated the nature of the orogenic gold found in the region had been laid out for us. A highlight was a tour of the processing plant where we learnt about the geometallurgy and processing of the ore.

From Tomingley, the Alkane tour continued when we visited the historic Peak Hill high-sulphidation gold mine. Here Mike Sutherland shared his wealth of knowledge of the area having worked at the mine when it was operating through to supervising its shutdown and rehabilitation. Mike guided us through a wonderful walking tour around the open-cut mine which has now been repurposed as a popular tourist and education attraction.

SATURDAY 1 OCTOBER: WEST WYALONG

After a short stopover at the Parkes Telescope, we drove to West Wyalong on Friday afternoon and dined together at the Royal Hotel. On Saturday morning we visited the Cowal Gold Mine, receiving geology presentations from site geologists, seeing drill core from the Talisker prospect, and being driven to a lookout for a view of the E42 open pit. The morning was rounded off with a barbecue lunch generously provided by Evolution.

Visits to outcrops of the Booberoi Shear Zone and the Wirrinya Lithocap were originally planned for the afternoon but abandoned due to the wet weather. Professor Dave Cooke instead gave presentations based on his address to the Mines and Wines conference (March 2022). This was a great opportunity for participants to engage in a relaxed environment in a conversational presentation style with Professor Cooke and discuss learnings and observations on the trip.

SUNDAY 2 OCTOBER

The morning was spent at Sandfire's core shed in West Wyalong, with core laid out from the Bland Creek, Donnington, Monza and Fields prospects. Donnington, with its sheeted quartz-sulphide-magnetite veins, was particularly instructive and a great call back to the sheeted quartz veins seen at Cadia.

Participants then drove to the Gidginbung Mine, an old high-sulphidation gold mine, currently under Sandfire's tenure. We walked down the old access track which offered great views and lots of opportunities to snag specimens of high-sulphidation mineralisation and alunite!

After a week with lots of drill core, this was a great way to finish a successful field trip of the Macquarie Arc (and also younger Silurian aged mineralisation in the Lachlan Orogen). We bade farewell to the industry participants who went their separate ways from Gidginbung.



Sunday afternoon: On the last day of the tour participants stand on the edge of the old high-sulphidation Gidginbung gold mine.

The UTAS contingent, with two WA-based industry participants, left Gidginbung for a lunch at Temora, before driving to Canberra for Monday morning flights back to their respective homes. The evening in Canberra was spent at the Harmonie German Club watching the NRL Grand Final!

Thank you to all the mining operations that allowed access for our visits and generously gave of their time to show us around.

Photos courtesy of David Cooke, Malai Ila'ava and Zeb Zivkovic.

ANOTHER CODES PHD IS CROWNED

CODES PhD student Tristan Wells (right) pictured after graduating in August 2022 with his supervisor Professor Sebastien Meffre at the Hotel Grand Chancellor in Hobart.



Tristan writes: 'I was lucky enough to have completed my PhD with the guidance of Professors Sebastien Meffre and David Cooke, and Dr Jeff Steadman, all of whom helped to shape the 'early career' geologist that I am today. Sebastien was kind enough to attend the graduation, which I'm informed is his first since his own PhD ceremony ~25 years ago. It was an honour that he was present for the ceremony and celebratory champagne. I thoroughly enjoyed my time at CODES and endeavour to maintain contact with the department in both an academic and industry capacity. Thanks to all those who have helped me with my career to date, especially my former office mates and PhD candidates: Brian McNulty, Thomas Ostersen, Thomas Schaap, Xin-Ni Seow, Max Hohl and Jennifer Thompson.'

Tristan's PhD topic was 'Indicators of, and vectors to, fertile magmas in the Northparkes District and broader Macquarie Arc'; he is currently working as a senior project geologist at Fortescue Metals Group conducting porphyry Cu-Au exploration in the Macquarie Arc.

IT'S ALL IN THE TIMING...



Following a well-timed series of events after Covid lockdowns, Dr Sheree Armistead can't be happier employed as a Postdoctoral Research Fellow – Mineral Deposit Research – at CODES/Earth Sciences working on a collaborative project with Geoscience Australia to understand the tectonic and metallogenic evolution of western Tasmania...and timing is what it's all about with this research too.

I touched down in Hobart in March 2021 after an 18-month stint in Ottawa, Canada. My story would not be unfamiliar to many around the world during COVID – for a whole year I worked from the tiniest table in the tiniest of apartments during rolling lockdowns, and all my grand plans of field trips to remote parts of Canada and lab work were now in disarray. When my partner was offered a job in Hobart, we didn't hesitate in moving back to Australia, to where COVID seemed almost non-existent.

I was lucky to be able to finish off the last six months of my Canadian Postdoctoral Fellowship remotely from Australia. In this project I was based at the Geological Survey of Canada in Ottawa and was funded through the Metal Earth Program at Laurentian University. This research is a collaborative effort between Bruce Eglington (University of Saskatchewan), Sally Pehrsson (Geological Survey of Canada) and David Huston (Geoscience Australia). I used a global compilation of Pb isotopes from ore deposits to understand how Precambrian mineral systems formed, with a particular focus on the Archean Superior Province in Canada. Pb isotopes can track the evolution of different reservoirs within Earth's crust and mantle (and maybe even the core), which help us understand how Earth's first continents and supercontinents formed. This has implications for how ore deposits formed in the early Earth.

Upon arriving in Hobart, I was appointed as an adjunct fellow at IMAS, thanks to my friend and colleague Dr Jacqueline Halpin. I had met Jacqui at the Rodinia Conference in 2017 during my PhD, where we were working on similar tectonic projects in different parts of the world. I did my PhD at the University of Adelaide where I investigated the Neoproterozoic evolution of central Gondwana with my research focusing on Madagascar. I used structural geology, geochronology and isotope geochemistry to build plate tectonic models for this part of the world. I was involved in the development of the global full-plate tectonic model from 1000 Ma to present, led by researchers in the EarthByte group at the University of Sydney. Seeing how regional to tectonic scale geological models impact the whole Earth system really informed my understanding of how different Earth processes at such dramatically different scales are linked.

When moving to Hobart, I wasn't really sure what career prospects I would have beyond finishing my Canadian postdoc. Towards the end of 2021, I spent a couple of months doing some work with Jacqui on the Antarctic rock collection, and worked with Professor David Cooke on bringing together information to develop a sedimentary Cu project. I started working from the CODES/Earth Sciences building, where I've been based ever since. I absolutely love working here; it's great getting to talk to people about geology (a novelty after being locked down in Canada for so long) and everyone is working on such interesting projects. I even got to tag along to the CODES Masters short course trip to western Tasmania in late 2021 where I got to see what VMS deposits actually look like, rather than just thinking about them conceptually in terms of large-scale Pb isotope signatures.

I was incredibly fortunate when Jacqui and I secured an additional six months of funding for the Pb isotope project. I was also given a concurrent six-month appointment as a lecturer in marine geoscience at IMAS, where I taught 150 students from the Ocean University of China.

In the next chapter of my series of fortunate events, in mid-2022, Professor Sebastien Meffre and I received funding from Geoscience Australia for a two-year project investigating the temporal controls on mineral deposits in western Tasmania. I had worked at Geoscience Australia for two years straight after finishing my Honours at Monash University on the structural controls of a stratiform IOCG deposit in the Curnamona Province of South Australia. My interest in ore deposits led me to working with GA's mineral systems and geochronology teams, focusing on the Tasmanides of eastern Australia. Seeing how intricately linked ore deposit formation is to complex tectonic processes within the Tasmanides, inspired me to pursue a PhD delving into how plate tectonics operate at large scales. It was an amazing opportunity to be able to reconnect and collaborate with former colleagues in this new CODES/GA project. Professor Leonid Danyushevsky, Sebastien and I also secured funding from the AuScope Geochemistry Network to help contribute to the development of a geochemistry database.

Recently, and for the first time in four years, I was finally back in the lab with my old friend, the LA-ICP-MS, collecting new data. We are analysing U-Pb in monazite to help constrain the timing of ore formation in western Tasmania. We will also look at other



'One foot in the Cryogenian, one foot in the Tonian.' Sheree is pictured in 2018 looking at Neoproterozoic stratigraphy during an International Commission on Stratigraphy (Cryogenian Subcommission) field workshop in the Flinders Ranges whilst undertaking her PhD at the University of Adelaide.

datable minerals such as apatite, allanite and garnet using novel techniques being developed in the CODES Analytical Laboratories.

I'm especially interested in some of the prospects in northwest Tasmania that are hosted in Proterozoic rocks. The results we have so far indicate a potential for mineral systems much

older than what is currently known. How these different terranes came together tectonically is really fascinating to me, and I'm interested in how tectonic processes may have driven ore formation, and how we can work out exactly when these things happened. There are exciting results coming out of this research, so watch this space!

CODES INDUSTRY PARTNERS 2022

Industry partnerships are open – please join us by contacting Professor David Cooke (d.cooke@utas.edu.au) or Helen Scott (helen.scott@utas.edu.au). By becoming a CODES Industry Partner your company will be contributing to important ongoing minerals research and will have access to significant research benefits.

PLATINUM



GOLD

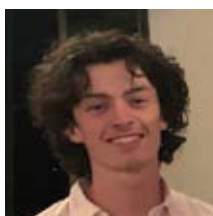


SILVER



HONOURS: SMALL COHORT PACKS A PUNCH

The number of Honours students in 2022 may be our lowest record for at least three decades – due to the current mining boom – but this cohort makes up for that with its huge enthusiasm. Three students started Honours in February and this year there were no mid-year starters. They are currently frantically finalising their high-quality theses; however, they can afford to be somewhat relaxed as two of them already have employment lined up for 2023. Two students have topics in environmental geochemistry based in Tasmania, and one student has an economic geology project in NSW.



FELIX DOBBIN

Project title: *Geology, alteration and mineralisation characterisation of the Kingswood Porphyry Cu-Au Prospect, New South Wales, Australia*

Supervisors: David Cooke, Lejun Zhang

Funding: Magmatic Resources

Felix is studying the geology, alteration and mineralisation of the Kingswood porphyry Cu-Au prospect in central-west New South Wales.

The Kingswood porphyry Cu-Au prospect is part of the Kingswood Corridor and lies within Magmatic Resource's Myall Project, ~85 km north of Parkes and ~50 km north of the Northparkes copper-gold district. The corridor is located within the northern section of the Junee-Narromine Belt of the Macquarie Arc in the East Lachlan Orogen. Weak disseminated Cu-Au and Mo mineralisation was found within a polymictic hydrothermal breccia. Magmatic Resources completed two diamond drill holes in 2021, with further drilling planned for 2022.

To improve our understanding of the characteristics and genesis of the Kingswood porphyry Cu-Au prospect and aid exploration targeting in the district, Felix's study focuses on characterising the lithology types, alteration and mineralisation paragenesis using detailed drill core



Honours student Felix Dobbin (left) with Professor David Cooke examining drill core during 2022 fieldwork; Felix is carrying out research into the Kingswood Porphyry Cu-Au Prospect in New South Wales.

logging (aided by TerraSpec), age dating (zircon U-Pb, Molybdenite Re-Os), whole rock geochemistry and microanalytical techniques (e.g., Secondary Electron Microscope (SEM), Back-scattered Electron (BSE) imaging, Cathodoluminescence (CL) imaging).

The findings of this project will help Magmatic Resources in their exploration targeting and understanding of the prospect. The geochronology work will allow them to place the prospect in the broader geochronological context of the East Lachlan Fold Belt.

"I am enjoying my time at CODES, and it has been very rewarding to see my research come together to start to illuminate the genetic model and paragenesis of Kingswood."



DAN FISHER

Project title: *Lithological, geochemical and mineralogical drivers of water quality at the legacy Scotia Mine, northeast Tasmania*

Supervisors: Clare Miller, Matthew Cracknell

Funding: Mineral Resources Tasmania
Alluvial cassiterite (SnO₂) and sapphire mining at Scotia occurred between 2007 and 2009 leaving a series of contaminated and hydrologically

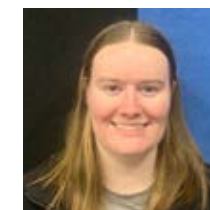


Dan Fisher is studying water quality at the legacy Scotia mine in northern Tasmania for his Honours; here he is pictured in the lab at CODES preparing sediment samples for mineralogical and geochemical analysis.

connected pit lakes. Dan's Honours project aims to target and examine the geochemistry and mineralogy of the remaining sulphide-bearing paleochannel leads to identify sources of acid and metalliferous drainage (AMD) at the legacy Scotia mine.

Through field-based sampling (drilling, core logging, water sampling) and laboratory testing (uXRF, XRD, SEM, AMEX, NAG and solubility testing), Dan's Honours aims to determine the source and fate of AMD at the former mine site and characterise the AMD potential of mineralised SnO₂ leads in NE Tasmania. Additionally, Dan will assess surrounding lithologies for identification of non-acid forming materials suitable for armouring and construction purposes on site. By assessing the mineralogy and reactivity of lithologies at the former Scotia mine, this project aims to assist Mineral Resources Tasmania (MRT) in the rehabilitation of the site. The knowledge generated in this study also will support improved environmental management and the development of effective closure criteria at former, current and future mines in NE Tasmania.

"The best thing is being able to learn and use a wide variety of both field and lab techniques with the hands-on assistance I've received from the staff here at UTAS."



EVA KNIGHT

Project title: *The geochemistry and mineralogy of estuarine sediments: Implications for Rice Grass removal in the Rubicon Estuary*

Supervisors: Clare Miller, Sebastien Meffre, Vishnu Prahalad (Geography)

Funding: Cradle Coast NRM

Eva worked with Cradle Coast NRM, Earth Sciences and Geography to inform the revitalisation of the coastal saltmarsh wetlands of the Rubicon River and Franklin Rivulet in Tasmania. The Rubicon Estuary in northern Tasmania has one of the most extensive infestations of *Spartina anglica* in the southern hemisphere and an eradication program is planned to support the natural regeneration of native habitat. Large-scale removal of *S. anglica* is likely to result in erosion of sediment and the release and

mobility of elements of concern to the downstream environment. To understand the risks associated with sediment remobilisation following *S. anglica* irradiation, Eva's study aimed to characterise the mineralogical hosts of elements of concern in the sediment and evaluate the controls on metal(loid) mobility in the estuary. Additionally, her study assessed uptake of metals by *S. anglica* from the sediment to determine if plant biomass may also provide a source of metal(loid) contamination to the downstream environment.

Knowledge generated in this study will evaluate risks associated with *S. anglica* eradication in the Rubicon Estuary and inform the next steps of the removal program. This project will provide insights to supporting the natural regeneration of native habitats in Tasmania and other parts of the world where invasive species are being controlled in a similar context.

"My Honours project looks at sediment geochemistry and mineralogy in the Rubicon estuary, focusing on trace element remobilisation after removal of invasive rice grasses."



Honours student Eva Knight collecting a sediment core from the Franklin Estuary in northern Tasmania as part of her fieldwork campaign looking at the implications of Rice Grass removal.

WHERE ARE THEY NOW?

After completing fieldwork for her CODES PhD in remote outback NT and loving it, Professor Kim Hein was always going to be drawn to the wide-open spaces and less-populated regions for her work. She now lives and works as a geologist in the West African state of Burkina Faso, where she has found an affinity with the country's mountainous desert areas.

DOING GEOLOGY THAT MOVES THE SOUL



PROFESSOR KIM HEIN

Director of KAAH Geoservices, West Africa, and Professor Emeritus at the University of the Witwatersrand, Johannesburg, and other academic positions

PhD completed at CODES in 1995 entitled 'The structure and geochemistry of gold mineralisation in the Mt Todd goldfield, Pine Creek Inlier, Northern Territory' (supervised by Professor Ross Large and Dr Richard Keele).

What is your current job/employment and your work responsibilities?

I am the director and owner of KAAH Geoservices (a one-woman business right now), which provides consulting services to the exploration and mining community in West Africa. My work is focused on, but not limited to, applied structural geology as related to the discovery and mining of mineral resources.

Additionally, I hold Professor Emeritus status at the University of the Witwatersrand, Johannesburg (WITS), an Adjunct Professorship at UWA, and a Visiting Scientist appointment at ITC-ESA at the University of Twente (Netherlands); in that way I remain busy with research work when time allows.

However, much of my daily work is devoted to resolving big-picture knowledge gaps in the discovery of mineral resources when it comes to large structural-mechanical-geophysical datasets across regions and domains, which I term 'contextual process geology' (i.e., getting a handle on how the local-regional geology expresses itself as a series of measured processes over time). My work is balanced between traditional fieldwork and computer study to include all datasets collected towards visualising the 3D systems at play. Discovery of resources, or the extension of known resources, is the aim of the game.

I am also concerned with human capacity because without human capacity, the rest becomes pointless in my opinion. Apprenticeship has great value in West Africa. Knowledge, learning, training, sharing and upskilling underscore the fact that

most knowledge in West Africa is transferred orally in one form or another (via word-of-mouth, music, symbolic literature, textile, art), although that is changing in some quarters. Spending time in the field and apprenticing geological skills makes sense in Africa because practical skills relate to employment; I spend more time drawing and explaining what I mean than writing for understanding. In my experience, the apprentice forms of learning lead to better visual/conceptual experiences that are retained.

What are the things you enjoy most about this role?

I enjoy every minute of consulting work even when it proves physically, psychologically and emotionally difficult. It is a privilege to assist company growth in Africa, but I love exploration and field science the most. I am lucky to have found like-minds – those who love discovery as much as me.

My field days are deeply enjoyable. Watching the morning sunrise across the Sahel-Saharan, or mapping in fields of giant baobabs are moving to my soul. There is nothing quite like waking up to a morning in West Africa. The colour and texture of the West African landscape is also remarkable. The great dust-sandstorms of the Harmattan that blow in seasonally from the Sahara polish rocks and burn skin, but I wouldn't change it for anything. The heat can be overbearing, especially in the sub-tropical forests of the Ivory Coast, Liberia or Ghana. My favourite remains the mountain deserts of Burkina Faso where I first began my adventures in West Africa.



Professor Kim Hein, who completed her PhD at CODES in 1995, has worked in many areas of West Africa, which she has come to love; she says 'exploration fieldwork in southwest Ghana demands you notice beauty'.

How did you get there/your past roles and how they shaped your path to where you are now?

I was a relative latecomer to geology. Post-high school I worked as a nurse, secretary and process worker (packing ice-cream cones and paper straws). I found geology at a TAFE college in Adelaide in my mid-twenties after saving enough money to return to school; I was inspired by my teacher, Dr Jane James. I recall her teaching skills even today with great affection. My career changed when invited to spend time in the field in the Flinders Ranges. For the first time in my life, I slept in a swag under a giant Red Gum in Brachina Gorge next to a camp fire. Everything about the geology, Brachina Gorge and the lifestyle of field geologists fascinated me and continues to this day.

Ultimately, I was accepted into the University of Adelaide and that led me to CODES and a field-orientated PhD in the Northern Territory; I spent a glorious three years mapping near Katherine Gorge despite the challenges of working alone (at the time) presented. I was in my element.

Thereafter, I joined Western Mining Corporation (WMC) in their Exploration office in Kalgoorlie, and St Ives Gold Mines at Kambalda, where I spent time learning about open-cast and underground mining. But fieldwork called me again. Consequently, after

four years at WMC, I accepted a position as structural geologist with North Ltd/Randgold in their Joint Venture in Burkina Faso in 1995; that position changed my life and steered my geology passion forever towards West African research. After the gold crash of 1998 when many jobs simply disappeared (be warned because it happens), I joined the Universiteit Utrecht (Netherlands) as a researcher and went on to a professorship at WITS; my research as Professor at WITS was focused on the Paleoproterozoic geology of West Africa.

Your career highpoint/greatest achievement to date/source of greatest satisfaction as a geologist?

I wake most days to African skies, big smiles, beautiful rocks, kindness with depth, and a passion to live life fully. A day in the field on mylonites or granitoid complexes, or dealing with difficult geo-puzzles, or maybe an historic underground mine, makes me happy. I am proud of the sum of achievements over the years because each has its own high point, but of course, I am proud of achieving a PhD and going on towards a professorship; both of these demanded a lot of work, or so it seemed at the time.

I am particularly proud to have received the Vice-Chancellor's Transformation Award at WITS (staff category) in 2014, which recognised the transformation of human capacity to the university.

I am also proud to have successfully run my own one-woman consulting company over the past five years. Currently, I am delighted to be helping Asante Gold Corporation, Ghana, in its development of the first Ghanaian gold mining company with majority Ghanaian shareholding. Ghanaians must be proud. Rise Africa!

What did you specialise in at CODES and how did CODES help you to get where you are? What did you enjoy most about CODES?

CODES = my intellectual home. It was the place I learnt to think differently about Earth sciences and my own abilities. I studied at CODES in its early days. We were a small group; that made for unity and comradeship. The industrial focus of CODES had a great impact on my career by steering me towards the minerals industry and applied Earth sciences.

How has the industry changed since you were at CODES? And how do you see it developing in the future?

I have witnessed a substantial shift to technology-driven mining and exploration, but the fundamentals of applied field science have stayed the same. I have also witnessed advances in geophysics, remote sensing and hyperspectral imagery. The growth in planetary research has also been remarkable. We live in an amazing cosmos.

I have also witnessed (and felt) a shift towards diversity and inclusivity in STEM disciplines; my first days in the industry (and academia) were sometimes littered with what today could lead to litigation under discrimination laws, but the situation has certainly changed. The minerals industry and STEM disciplines still have a long way to go in terms of genuine equality, diversity and cultural inclusivity, but I hold hopes high for the future. We can and must do better without arriving in patrimony or contestation.

In the future, I hope the industry performs better in the way it deals with age inclusivity in STEM disciplines. Some companies and universities acknowledge the serious contribution made by former staff and do well at avoiding ageism. I find this to be true

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Mapping in the Mana region of Burkina Faso with an assistant in early 2021. The dust created by the Harmattan wind fills the sky, giving a greenhouse heat effect.

where cultural sensitivities around family and respect are the norm; they recognise the need to retain elder wisdom as familial and natural. However, more often than not in Europe and Africa, former staff are sent to the obscurity of retirement. It is harsh to say the least. We can do better.



Professor Kim Hein working in the core shed at Endeavour Mining's Mana gold mine in early 2021, Burkina Faso.

Words of wisdom for up and coming geologists graduating from CODES?

- Observation and description (not interpretation) are the gods of field geology.
- Understand that the minerals industry is a business that must make profit to survive or nobody has a job; it has a huge capital turnover for relatively small profit margins.
- Understand your role if you decide this sector is for you. I remember it took me a little while to appreciate where I belonged, and the tendency to blame others because of inexperience was unfortunate. Slowly I found out my strengths, but these days I am comfortable to let others lead the way. Although flattery would have taken me to management, logic told me to remain a technocratic, and that serves me well. In any case, my advice is to find what makes you happy in contributing to others and their livelihoods.
- Study field science first. My bias in this regard is very obvious.
- Learn languages and culture. I came from a multi-cultural, multi-lingual family and thus get by with English,

French and Dutch, but my portfolio extends further if need be. In this regard how you behave with other people in West Africa says more about your skills and capacity than your knowledge. Therefore go out of your way to learn greetings, salutations and respect forms in the local language(s). For example, if you understand the need for some people to pray at afternoon prayers in Islamic countries, and can afford respect in terms of time, it will stand you in good stead and offer peace. Local customs and dignitaries should be respected as much as possible. I suppose I can summarise this by asking you to improve your cultural quotient.

- Be bothered to understand science principles and logic! I cannot believe how many times I have to remind people it is geo-logic and not geo-silly, geo-fantasy or geo-nonsense. Stick to the facts in context please.
- Include geomorphology, geobotany and Earth systems science in your thinking as a field scientist.

Little-known facts about you?

My therapy is all things farming, and spinning wool. Growing flowers and food also serves the rural in me.

HIGH FLYERS RECOGNISED FOR THEIR EFFORTS



CODES and Earth Sciences students, staff and stakeholders pictured during the SNS Student Recognition Evening at the Hotel Grand Chancellor on 23 September. They are (L-R): Victor Torres (CODES PhD student and a keynote speaker for the evening); Tony Chisnall (chief geologist from sponsors Avebury Nickel Mine); Professor Sebastien Meffre (Earth Sciences Discipline Head); Joshua Denholm (former CODES student and now an exploration geologist at Avebury); Madison Mulder (high-achieving Earth Sciences student); Eva Baukes (Dr Ramsay J. Ford Memorial Prize for greatest proficiency in Geology in the first year); Karla Morales (former CODES Masters student) and Professor David Cooke (Director of CODES).

On 23 September high-achieving students from the School of Natural Sciences (SNS) were congratulated on their efforts at a ceremony in the Federation Ball Room at the Hotel Grand Chancellor on Hobart's waterfront.

The SNS Student Recognition Evening, which was held later in the year than previously, celebrated the achievements of the 2021 cohort, and was accompanied by a booklet listing all undergraduate, Honours and research higher degree student scholarships, awards and prizes.

Several Earth Sciences undergraduate and Honours students received prizes, while CODES PhD Hannah Moore received the PhD Award for Outstanding Performance during Postgraduate Studies in Earth Sciences for her volcanology research under the supervision of Associate Professor Rebecca Carey. Many CODES and Earth Sciences students also received scholarships and were congratulated for their high marks.

CODES PhD student Victor Torres, who has recently completed a Master of Economic Geology at UTAS and is now researching Cu-Au-Ag mineralised tourmaline breccias, gave one of the keynote speeches for the evening.

The Student Recognition Evening was sponsored by Avebury Nickel Mine, Forico and Hensoldt. Many thanks to these companies for their support of the evening and recognition of the importance of future UTAS graduates to their businesses into the future.

A booklet listing all students who received prizes and scholarships is available at: https://www.utas.edu.au/_data/assets/pdf_file/0009/1626687/SNS-Awards-Night-Booklet-2022.pdf



Gabrielle O'Toole (left), recipient of both the Larry Knight Memorial Scholarship and the Ian McDougall Memorial Scholarship in Geology, with Professor Julianne O'Reilly-Wapstra (Head of Biological Sciences), who presented the scholarship certificates to her.

COLLEGE OF SCIENCES AND ENGINEERING AWARDS

Two members of the CODES team were recognised for their efforts at the annual UTAS CoSE awards in October.

University Associate, **Professor Khin Zaw** from CODES was presented with the Outstanding Adjunct Award in the 2022 CoSE College Awards in early October at a ceremony in early October.

The award is presented for 'Exceptional contributions to the mission of the University through enrichment of academic work or impact on key strategic areas.' Professor Khin Zaw is a highly active member of the CODES Honorary cohort, and is involved with current exploration research projects.

The College Awards are offered across each of the University's Colleges and Divisions in recognition of individuals or teams who have demonstrated exemplary behaviour, passion, and truly outstanding contributions and achievements in their work. Recipients of a College Award will be considered for the University-wide Vice-Chancellor's Award in the same category. The Vice-Chancellor's Awards winners will be announced at a University-wide ceremony in November.

CODES/ Earth Sciences Rock curator and part-time casual teaching assistant **Izzy von Lichtan** was awarded an honourable mention in the Student Focus category of the College Awards.

Congratulations to both recipients from the team at CODES/Earth Sciences!



University Associate, Professor Khin Zaw (right), receives his Outstanding Adjunct Award 2022 from CoSE Executive Dean Terry Bailey at a UTAS function in early October.



Rock curator and part-time teacher Izzy von Lichtan received an honourable mention in the Student Focus category; here she is teaching first-year Earth Sciences students how to do outcrop mapping at Risdon Brook Dam, near Hobart.

CODES CONNECT

CODES and Earth Sciences have many ways of keeping in touch with our researchers, staff, students, graduates, stakeholders, the mining and minerals research community, and industry bodies.

The CODES website (<https://www.utas.edu.au/codes>) is constantly being updated. UTAS is gradually upgrading its webpages and a new-look CODES website will be available soon.

The Discipline of Earth Sciences webpage (<https://www.utas.edu.au/natural-sciences/earth-sciences>) has been updated and now has a link to the Earth Sciences Facebook page as well as short profiles with videos about some of our student researchers.

You can follow one of our Facebook pages:

f CODES: <https://www.facebook.com/CODES.UTAS/>

f Earth Sciences: <https://www.facebook.com/EarthSciUTAS/>

You can also follow our LinkedIn page:

in CODES: [linkedin.com/company/codes-utas](https://www.linkedin.com/company/codes-utas)

BECOME A SUBSCRIBER

If you want to join one of our mailing lists to receive regular updates (newsletters/annual reports/short course information/ PhD opportunities or job vacancies) please email us at: CODES.info@utas.edu.au

FIELDWORK EXPEDITION TO THE WILD WEST

A large contingent of third-year Earth Sciences students along with other interested participants took part in the three-day KEA348 field trip (Environmental Geology) to the west coast of Tasmania during September 2022. The overall aim of this excursion for students was to investigate the impacts of legacy mining on environmental systems. By examining the impacts of mining from source to sink, we aim to find ways to make Tasmania a leader in sustainable resource development, now and into the future. Students visited mine sites and surrounding impacted landscapes in Tasmania to acquire, collate and interpret geochemical, hydrological and geophysical data. Through field-based sampling, the students learn to apply a wide-range of chemical, geological and geophysical techniques to help them characterise and delineate the legacy mining impacts.



The KEA348 group pictured on top of Donaghys Hill in the Franklin-Gordon Wild Rivers National Park on a stormy spring day on their way to Tasmania's west coast.



Setting off from Mt Lyell to collect water samples from the Queen and King rivers ... five vehicles were needed to transport the large group and their equipment; the weather was average for much of the trip, but this didn't dampen the spirits of the participants.



One of the trip leaders, Dr Clare Miller (in blue), investigating the confluence of Haulage Creek and the Queen River, where contamination from Mt Lyell mine is discharged to the downstream environment, and explaining this detail to the students.



Students investigating massive sulphide lenses in a cutting at the side of the road near Zeehan.



Here the trip participants are pictured examining the Princess Creek Dam, the tailings storage facility at Mt Lyell.

THE IMPORTANCE OF BEING SOCIAL



The **2022 CODES Geology Dinner** was held at the Royal Yacht Club of Tasmania on 14 October and once again brought together students and staff for a relaxed and convivial evening that included a two-course dinner, beverages and the traditional staff versus students singing competition, along with amusing and potentially embarrassing anecdotes from the year's geology field trips. There was also an amusing 'Guess the correct baby' photo competition featuring some of the staff in nappies.

The second years won the singing competition with a rendition of The Proclaimers' version of 'Five hundred miles', while the PhD team was penalised for using guitars (were they allowed?). Pictured is the CODES PhD team (L-R, standing): Victor Torres, Rhiannon Jones, Max Hohl, Janne Scheffler (CODES visitor), Zeb Zivkovic, Xin Ni Seow, Alex Farrar, Malai Ila'ava (with guitar), Shannon Frey, David Portocarrero (Masters) and Richard Hill; (L-R, kneeling): Stephen Cooke, Acacia Clark and Hannah Moore. They sang 'You shook me all night long' based on the 1980 song by AC/DC.





In early July CODES staff and students took part in the **Great UTAS Pride Bake Off** to support LGBTQI+ members of the UTAS community. Relaxing in the CODES tea room and ready to taste test the many baked goods for the LGBTQI+ morning tea event are (L-R): Dan Fisher, Clare Miller, Sebastien Meffre, Zeb Zivkovic (obscured), Nicholas Direen, Sheree Armistead and Stephen Cooke.



The **CODES SEG 2022 field trip** was much anticipated following Covid lockdowns and the restriction on travel outside Tasmania. A cohort of 25 staff and students travelled to New South Wales to look at a large number of mine sites and core sheds in the Macquarie Arc region. An important part of these field trips is the networking and socialising that takes place in tandem with the learning. Here participants are pictured enjoying a meal and socialising at a Chinese restaurant in Parkes. Dr Lejun Zhang ordered the meal by phone from Hobart despite not being on the trip – his prior knowledge of the menu combined with his native Mandarin meant that he was able to choose the best dishes for the tired and hungry travellers, and he ordered the perfect amount to go round!

CHANGING FACES

The start of two major new projects – Amira P1249 and the Regional Research Collaboration critical metals project – have enabled the recruitment of a large number of new PhD students and postdoctoral researchers to CODES. Some of them are introduced here and others will be joining us in the next few months. We have also recently had a number of academic visitors.

PhD STUDENT		START DATE	PROGRAM	PROJECT TOPIC
	Victor Torres	15 July 2022	Program 1; supervised by David Cooke	Geology, genesis and geometallurgy of Cu-Au-Ag mineralised tourmaline breccia pipes at Soledad, central Peru
	Joanne Morrison	21 September 2022	Programs 2 and 3; supervised by Jeff Steadman	Geometallurgy of IOCGs
	Billy Beas	7 November 2022	Program 1/Amira P1249; supervised by Lejun Zhang	Exploration significance of halogens in hydrothermal ore deposits
	Axel Cima	28 November 2022	Program 6; supervised by Ivan Belousov	Influence of microinclusions in alteration and vein minerals on vectoring and fertility assessments of porphyry Cu deposits

ARRIVALS



Dr Wei Hong has returned to CODES as a research fellow in minerals characterisation working 50% FTE on the 'Regional Research Collaboration' critical metals project and 50% FTE on the Amira P1249 project 'Exploring, characterising and optimising complex orebodies'.



Dr Owen Missen is a new postdoctoral researcher who will be working on the geoenvironmental aspects of critical metal mineralogy, with a focus on sites in northwestern Tasmania in the 'Regional Research Collaboration' critical metals project.

DEPARTURES



Professor Leonid Danyushevsky has resigned from UTAS and is leaving in December. Leonid has had many roles since 1993, most recently as the Director of the CODES Analytical Laboratories and Deputy Director of CODES. He is thanked for his many significant contributions to research, teaching and service activities in CODES and Earth Sciences.

VISITORS



Dr Jane Barling from Oxford University visited CODES from 15 to 29 October for a meeting of collaborators on 'The re-awakening of a mantle plume – the nature and petrogenesis of Neogene volcanism on the Central Kerguelen Plateau' project led by Associate Professor Rebecca Carey.



Rebekah Bradshaw from the University of Sydney was at CODES between 10 and 14 October working with Dr Martin Crundwell from GNS Science, New Zealand on dredge rock samples from the Coral Sea.



Dr Martin Crundwell from GNS Science in New Zealand visited CODES for two weeks during October to run a two-day Micropaleontology Workshop and to work on dredged rock samples.



Janne Sheffler is with us until end of February 2023. She is an MSc student based at GEOMAR, Kiel, Germany, and working alongside Dr Martin Jutzeler.

COMMUNITY ENGAGEMENT

CODES and Earth Sciences participate in a large number of community engagement activities throughout the year, including school visits and other opportunities to showcase to the public what we do. Here are two recent examples:

STEPs REACHES STRAHAN AND ZEEHAN...

CODES has this year been providing geological expertise to the UTAS West Coast STEPs Program, which provides opportunities for those living on the West Coast to upskill or move into a new area of employment. Professor David Cooke and PhD students have taken part in mining industry sessions for program participants who may be considering a career in this field.

In recent months staff and students from CODES have made the long and winding road trip over to Zeehan (July) and Strahan (September) to explain to program participants the different aspect of the exploration and mining process, in conjunction with mining company staff at the Avebury Nickel Mine and Mt Lyell Copper Mine.

The co-ordinator of the UTAS West Coast STEPs Program, Christine Gray, has been fulsome in her praise of CODES' involvement and its positive impact on participants. She writes:

'We are extremely grateful for the support Dave Cooke and the team at CODES has given the West Coast STEPs program. Visiting sites such as core sheds and the King River Delta provided us with the opportunity to see first-hand the learning and work opportunities involved in the mining industry. It was hard for us all not to be excited and inspired by the genuine enthusiasm shown by Dave and the PhD students as they shared their knowledge and stories. Feedback has been overwhelmingly positive, with participants noting an improved understanding of mining-related study and work options, with several now either employed in local mines, or seeking to enrol in mining-related study.'

Christine says that the successful program has received additional funding and will 'hopefully be able to incorporate another visit to the West Coast in 2023'.



CODES PhD student Zeb Zivkovic teaching during the West Coast STEPs Program: he lies full-length to examine with a hand lens a fragile piece of charcoal which was covered in sulphides (pyrite-chalcopyrite-chalcocite); the charcoal had accumulated these metals in the King River delta from metalliferous fluids flowing into the delta as a result of acid mine drainage further upstream at Queenstown.



Professor David Cooke (right) teaching one of the STEPs participants about the sediments that have accumulated on the King River tailings delta.

FESTIVAL OF BRIGHT IDEAS LIGHTS UP THE DARK

In the gloom of a Hobart winter, the Festival of Bright Ideas shines a light onto STEM subjects and this year provided more than 40 hands-on activities, workshops and performances for an enthusiastic sell-out crowd. It was held on 20 August at the Princes Wharf 1 shed on the Hobart waterfront, and a large number of Tasmanians came along to find out what this annual National Science Week event has to offer.

This year, CODES PhD student Hannah Moore received a STEM Stage Skills Scholarship, kindly supported by Hydro Tasmania, to help her develop her role in a FOBI stage performance. The scholarship involved high-level training in performance theatre and presentation skills with one of Tasmania's leading directors, Maeve Mhairi MacGregor. Maeve helped Hannah and her four fellow scholarship recipients to develop a thematic stage show called 'From Little Things, Big Things Explode', which they performed to five capacity audiences (around 1,000 people in total). The performance showcased their PhD topics, which included themes around microbes, birds, the human body, volcanoes and space. The highlight of Hannah's section of the show (about volcanoes) involved a fun and creative explanation of plate tectonics using her 'warm' props (people) and large cut-out tectonic plates. Hannah said of the experience: 'This was a highly valuable



CODES PhD student Hannah Moore performing her volcano routine in the 'From Little Things, Big Things Explode' stage show at the 2022 Festival of Bright Ideas held on 20 August in Hobart.

experience for me as an emerging science communicator as it helped me gain confidence in speaking to large audiences about science'.

In addition to the stage performances, exhibitors from across the STEM spectrum held displays and demonstrations showcasing their various branches of science. The UTAS Earth Sciences stall was run by PhD students Alex Farrar and Acacia Clark with assistance from Earth Sciences students Madison Mulder and Dan Fisher. They were kept busy throughout the day with a steady stream of interested patrons both young and old.

FOBI Facebook page:
<https://www.facebook.com/fobitas/>



Earth Sciences student Madison Mulder, with the aid of Rosie the dinosaur, answers questions from curious young people at the 2022 Festival of Bright Ideas Earth Sciences stall.

BLAST FROM THE PAST

Back in the day for the CODES SEG Student Chapter... pictured here are Professor Dave Cooke (front row, centre; then Leader of Program 2: Formation), and members of the CODES SEG Student Chapter on the campus of Hefei University of Technology during their 2011 field trip to China. The trip was centred around the Middle-Lower Yangtze Metallogenic Belt (MLYMB), which hosts a plethora of magmatic-hydrothermal Cu-Au-Mo and Fe deposits, including examples of porphyry- and skarn-style systems. Dr Jeff Steadman (second from right in third row disguised with sunnies), a participant on the trip, reminisces: "We had a grand time – 10 days traipsing all over the countryside of Anhui province in springtime, with great geology, food and entertainment (mainly in the form of karaoke sessions) fused together seamlessly by our first-rate guides. It was definitely the highlight of the year for the CODES SEG Student Chapter!"



ALL IN THE DETAIL: MICROPALEONTOLOGY WORKSHOP

Dr Martin Crundwell from GNS Science in New Zealand was a visitor to CODES between 9 and 23 October. A micropaleontologist with 40-plus years of industry and research experience, he was here to run a two-day Micropaleontology Workshop and to work on the biostratigraphy of dredged rock samples collected during voyages of the *RV Investigator*.

Around 16 people enrolled in the workshop, ranging from second-year students to staff, and a variety of topics were covered in the morning sessions including:

- Using foraminifera to date samples
- Using microfossils to determine paleowater depths
- Sea-surface temperatures from planktic foraminifera
- Preparing and analysing dredge rock samples
- Using concentrations of foraminifera to interpolate ages between calibrated control points
- High-resolution Quaternary biostratigraphy
- Using microfossils to date and map coastal sedimentary systems.



Dr Martin Crundwell washes crushed dredge rock samples prior to picking out the microfossils from the matrix for examination under a stereomicroscope.



Dr Karin Orth (foreground) and other workshop participants preparing slides of foraminifera microfossils during the Micropaleontology Workshop run by Dr Martin Crundwell at CODES in October.

Afternoons were devoted to demonstrations on how to prepare and wash microfossil samples and how to use a scanning electron microscope (SEM) to illustrate microfossils; how to pick and mount microfossils; in addition there were activities related to phylogeny and paleoenvironments.

Workshop participant Dr Karin Orth says: 'Martin's workshop introduced the practical side of microfossils to participants. The stunning array of forms of the small calcareous-shelled, single-celled foraminifera can be applied to understand a range of geological and climate-related questions. They are excellent to constrain the age of a sample and so can help with dating and correlation locally and in many cases worldwide. They are also markers of ancient and even recent environments and can help to determine depositional water depth and water temperature and climate zones. As well as a series of lectures the workshop involved a practical component: learning the basics of picking foraminifera and mounting them on to special sections for examination and preservation. This task involved looking down a microscope, locating foraminifera and transferring them individually to a prepared slide. In general, this was a Zen-like experience except when that

very important microfossil pinged off your brush to never be found again.'

Of his visit Martin says: 'I was hosted by Rebecca Carey, and during my visit I was assisted by Rebekah Bradshaw (University of Sydney), Jessica Van Spall, Izzy von Lichten and Karin Orth, to select and prepare subsamples of dredge rock samples from the Coral Sea (IN2019-V04) and the Tasmanian Seamount Chain (IN2018-V08) for age and paleoenvironmental analysis. We crushed and washed the samples over a fine mesh screen to release the microfossils from the matrix. We then put the washed residues under a stereomicroscope and started the laborious task of picking microfossils from the samples and mounting them on microfossil slides. When each sample had been picked thoroughly, we identified the microfossils (mostly foraminifera) and determined the age and environment of deposition. I also had an opportunity to talk with a number of students who are currently using microfossils in their studies or are wanting to undertake microfossil-based research study.

'I would like to thank Rebecca and UTAS for arranging the visit. I was impressed by the diversity and enthusiasm of the participants in the workshop, and I hope I can visit Tasmania again'.

THE NEWSROOM

CODES/Earth Sciences projects, staff and students have been popping up in various media formats over recent months. Catch up with some of the news here...



Stockhead is an online news service that includes dedicated coverage of mining news and trends; this story talked about CODES' 'innovative mineral chemistry vectoring study' at Mt Gilmore.

STOCKHEAD

This is a free, journalistic online news service dedicated to covering the stories of emerging, ASX-listed companies. It has a specific bent towards coverage of mining discoveries and is well worth subscribing to for up-to-the-minute mining-related news and trends.

- July 2022: mention of CODES' role in developing porphyry vectoring and fertility tools: <https://stockhead.com.au/resources/corazon-mining-following-up-on-hints-of-porphry-copper-at-mt-gilmore/>
- August 2022: Professor Noel White talking about the potentially large discovery at Mt Gilmore: <https://stockhead.com.au/resources/something-big-lurks-at-corazons-mt-gilmore-copper-project/>
- October 2022 Recent mention of CODES again: <https://stockhead.com.au/resources/corazon-mining-gets-wheels-in-motion-for-next-phase-of-porphry-copper-exploration-at-mt-gilmore/>

CORAZON MINING

In August Corazon Mining released a video of CODES Honorary staff member Professor Noel White talking about the potential of the company's Mt Gilmore



CODES Honorary staff member Professor Noel White talks to Dr Francisco Testa (left) and Dr Lejun Zhang in the field at Mt Gilmore in New South Wales. Still taken from a Corazon Mining video released in August.

copper project with Dr Lejun Zhang and Dr Francisco Testa, in which Professor White says 'We've seen that we've got a big hydrothermal system. We're not looking at some dinky little thing'.

Watch Professor White enthusing about the work done by CODES researchers and the possible future directions of the Mt Gilmore copper project. Great to see Lejun and Francisco out in the field discussing this potential orebody and taking in the words of this highly experienced economic geologist. See: <https://www.youtube.com/watch?v=7EWj4LLferY>

ANNAH MOYO'S PHD RESEARCH

Annah's PhD researching the use of alkaline wastes and shells for treating AMD generated by mine wastes was completed during the year, and her results have been covered by *The Advocate* and the MRT's newsletter:

- <https://www.theadvocate.com.au/story/7864427/could-seashells-be-the-solution-to-tackling-old-mines-pollution/>
- https://www.stategrowth.tas.gov.au/mrt/news/utas_phd_project_-_controlling_acid_and_metalliferous_drainage_generated_by_legacy_mine_wastes_in_tasmania_using_industrial_wastes

REGIONAL RESEARCH COLLABORATION

The new Regional Research Collaboration project into critical metals in Tasmania encompasses collaboration with several mining companies including G6 Metals. This was covered in brief in the *Australian University Science* magazine (see back page): https://issuu.com/refractionmedia/docs/acds08-issuu?mc_cid=7aa97ec552&mc_eid=59b5b87b44

DR GERRIT OLIVIER'S NEW ROLE

CODES Senior Adjunct Researcher Dr Gerrit Olivier has taken on a new role as Director of Planetary Geophysics at Fleet Space. He was previously Director of the Institute of Mine Seismology based in Kingston, Tasmania.



Front cover of *Australian University Science* magazine that included mention of the CODES collaboration with G6 Metals; this publication is available online from Refraction Media via the Issuu electronic publishing platform.

His new role is covered in a Stockhead story picked up by Apple news, in which his new role is described as looking for critical minerals on the Moon and Mars. Co-founder of Fleet Space Matt Pearson says: 'Dr Gerrit Olivier brings an extraordinary track record in the development of Ambient Noise Tomography techniques to answer the urgent global requirement to find these critical materials while dramatically reducing impact'.

Read more at: <https://apple.news/ACNEuGoYdSee2R4LCL5Fefw>

For those of you able to access the UTAS intranet, there is further coverage at: <https://universitytasmania.sharepoint.com/sites/news-and-events/SitePages/Dr.-Gerrit-Olivier-appointed.aspx>



Dr Gerrit Olivier is a Senior CODES Adjunct Researcher and now works as Director of Planetary Geophysics at Fleet Space.



**A MESSAGE
FROM THE
CODES
DIRECTOR,
PROFESSOR
DAVID COOKE**

The last few months have seen a lot of activity at CODES, with quite a few changes afoot. As this newsletter goes to press, the University of Tasmania is finalising the research agreement for our new Regional Research Collaboration grant to investigate environmentally sustainable production of critical metals from Tasmanian mineral resources. This project is scheduled to start in December 2022, and in the lead up to it getting underway we have now recruited four new

postdoctoral research fellows and eight new PhD students from a very diverse range of countries. They have started to arrive in Tasmania and should all be on deck in the next three months. Our next newsletter will outline the scope and objectives of the new project and highlight the new research team members.

We have also had several new PhD students commence their studies as part of the Amira P1249 project, and in Dr Jeff Steadman's new IOCG project. It's been great to see visitors returning for research collaborations, with Rebecca Carey and Martin Jutzeler hosting several international visitors in recent times. We've recommenced international fieldwork, as highlighted elsewhere in this newsletter, and

have started several new projects, including a new collaboration with Geoscience Australia involving Dr Sheree Armistead and Associate Professor Sebastien Meffre. We're about to recruit a new Economic Geology lecturer and will be holding our first CODES Annual Review since 2019 at the end of November.

There's no doubt that everyone at CODES is looking forward to a restful break over the festive season, with 2023 likely to bring both new opportunities and challenges as new staff and students join us and others move on.

David Cooke

UPCOMING SHORT COURSES

ADVANCED FIELD SKILLS IN ECONOMIC GEOLOGY

5–18 FEBRUARY 2023

A field-based unit run in Tasmania that will teach fundamental and advanced mapping and field skills suitable for use in the minerals industry, including field-based rock and mineral identification, fact and form surface mapping, Anaconda-style mapping, structural measurement and graphic logging techniques for drill core, and the use of spectral, geochemical and remote sensing data sets in making and interpreting geological maps.

Unit leaders: Dr Rob Scott, Dr Lejun Zhang, Dr Francisco Testa

Delivery mode/location:
Face-to-face, Tasmania (Australia)

ORES IN MAGMATIC ARCS

12–24 MARCH 2023 (INDONESIA)*

A field-based unit, which includes visits to world-class deposits in Indonesia, studies of the regional and local geology, and detailed evaluations of ore deposit characteristics, mineralisation styles and genetic models. Exploration techniques are discussed and evaluated.

Unit leaders: Professor David Cooke, Dr Lejun Zhang

Delivery mode/location:
Face-to-face, Indonesia
**COVID-19 travel restrictions permitting*

FUNDAMENTALS OF ECONOMIC GEOLOGY

**WEEK 1: 17–22 APRIL 2023; WEEK 2:
8–12 MAY 2023**

This unit teaches the fundamental skills needed by all economic geologists. Concepts of key geological concepts, mineralogy, paragenesis, geochemistry and geophysical characteristics of ore-

forming environments, and the impact of these data sets on ore genesis and exploration are taught. The unit focusses on identifying and using key tools to recognise the sequence of events that have impacted ore-forming environments, and how these tools can be best used in an exploration context to solve exploration, mineral processing and environmental problems.

Unit leader: Professor David Cooke

Delivery mode/location: Online

For more details of all these courses:

See the course flyers at:

<https://www.utas.edu.au/codes/masters-short-courses>

For further information about short courses in general, please email: CODES.Info@utas.edu.au OR Master of Economic Geology Program Co-ordinator, Dr Robert Scott: Robert.Scott@utas.edu.au
For all other CODES contacts, see page 2.