

# ORE SOLUTIONS

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

> SUMMER 2023 **No.47**

## WINNING TEAM: CODES PHD STUDENT SHARES IN A 2023 EUREKA PRIZE!

**CODES PhD student, Hannah Moore, is a member of the *That's What I Call Science* podcast team, which won this year's Eureka Prize for STEM Inclusion.**

*That's What I Call Science* (TWICS), the Tasmanian science radio show and podcast, has been recognised at the 2023 Australian Museum Eureka Prizes, Australia's most high-profile science awards. This year, the awards recognised 19 individuals and teams across the categories of Research and Innovation, Leadership, Science Engagement and School Science. TWICS took out a gong for the Department of Industry, Science and Resources Eureka Prize for STEM Inclusion!

The TWICS podcast reaches over 10,000 people a week with programming designed to increase representation of diverse voices in STEMM (as used by TWICS, this stands for 'science, technology, engineering, maths and medicine'). Since 2019, they've given the science community a platform to upskill and create engaging and accessible content for a breadth of listeners.

Hannah is an editor and co-host for the team and is excited to produce a geology mini-series in the future, so stay tuned! All episodes are released on Edge Radio in Hobart and syndicated across Australia via the Community Broadcasting



CODES PhD student Hannah Moore (third from right) is part of the Tasmanian TWICS podcast team that recently won a Eureka prize. She secured an invitation to represent the TWICS team at the Prime Minister's Prizes for Science awards dinner in October, and is pictured here with other 2023 Eureka prize winners.

Association of Australia's Community Radio Network and are available across all major podcast platforms.

Hannah's PhD is entitled 'Shallow conduit, vent, and sedimentation processes involved in the 1886 basaltic Plinian eruption at Tarawera Volcano, Aotearoa, New Zealand'. In 2022 and 2023, Hannah spent a total of ten weeks at Mt Tarawera collecting data and samples in order to complete her thesis.

As well as her passion for volcanology, Hannah is deeply committed to science communication and outreach. She has organised numerous outreach events for CODES/ES, including the Earth Sciences stall at the Festival of Bright Ideas. Hannah

aims to forge a career that integrates her love for geology and science communication, with a particular focus on inspiring young people to pursue Earth Sciences.

**For more information about TWICS, visit <https://thatsscience.org/>**

### IN THIS ISSUE

The class of 2023: Honours	3
The class of 2023: PhDs	5
Where are they now?:	
Dr Shawn Hood	11
Staff focus:	
Dr Paula Montoya	15
Fab fieldwork photos	18

### FROM THE DIRECTOR

**Professor David Cooke** pays tribute to PhD student Joanne Morrison, who passed away in August. He also recognises the achievements of other PhD students and staff over the past few months.

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**P28**

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**Western Tasmania memories:** Jo Morrison (top left) with Rebekah McLelland (top right), Rebecca Carey (bottom left) and Christine Lawley (bottom right). This photo was taken in 2014 in western Tasmania during a Masters field trip led by Rebecca Carey.

# VALE JO MORRISON

**We are deeply saddened at the passing of Joanne (Jo) Morrison in August. Joanne was an exemplary, high-performing student in the University's Master of Economic Geology program (2012–16), and in 2022 we were very pleased that Joanne chose to return to UTAS as a PhD student working on the geometallurgy of the Ernest Henry copper-gold deposit in Queensland. Joanne built new friendships with our more recently appointed staff and students during her visits to UTAS over the past year, and we will all miss seeing her cheerful face in the corridors at CODES.**

**Two of Jo's supervisors recall their time working with her on projects at CODES:**

## **ASSOCIATE PROFESSOR RON BERRY (MASTER OF ECONOMIC GEOLOGY SUPERVISOR):**

*In early 2012, Julie Hunt and Ron Berry went to Cadia Valley to report on aspects of the Amira P841a GEM project that they were working on for Newcrest. Joanne was the mine geologist who gave them an excellent tour of the site including looking at the new drill core photography system that Newcrest had built. Joanne was interested in enrolling for an MEconGeol at CODES and we talked about possible projects at the mine. The discussion expanded out to include one of the metallurgists and as a result we pencilled in a geometallurgical topic. Then all went quiet for a couple of years as Jo juggled her busy life at the mine and her family.*

*It was late 2015 when Jo started the project using multi-element lithogeochemistry to predict metallurgical responses of interest to the Cadia East metallurgists. The mine reanalysed 4,000 pulps with a multi-element routine and Jo had the job to search through this data for features relevant to the Panel cave planning that was happening at that time. Jo survived the remote supervision and the constant stress of full-time work, family demands and the thesis writing to finish the valuable thesis by December 2016. I think she was looking forward to those Christmas holidays. Supervising her project was a pleasure.*

## **DR JEFF STEADMAN (PHD CO-SUPERVISOR):**

*I first met Joanne in early 2022 when she reached out to me regarding an advertised PhD project. I was impressed not only by her very strong resume, but also how well the project suited her specifically – as I told her, it was as if she was created for that project and vice versa. Ned Howard, our primary contact for this project at Evolution Mining and a UTAS Geology alumnus, even stated "I have never seen a resume for a PhD student like [hers] before!"*

*In the ensuing 15 months, I had the pleasure of working with her, both during her visits to Hobart from Orange as well as on Teams. Jo was sharp and had a keen eye for textural detail in ore types. She maintained a cheerful countenance and a fighting spirit, right up to the last. She never quit.*

*Joanne is missed dearly by all of us in the IOCG<sup>3</sup> project, and we will ensure that her academic legacy is preserved in all aspects of geometallurgical research this project undertakes.*

# HONOURS: THE CLASS OF 2023

Honours student numbers have bumped up this year. Four students started in February, and we welcomed two additional mid-year starters – Emily Conn and Sarah Purdom – who will be finishing in mid-2024. The research topics of this cohort are highly varied, with themes including ore deposits, submarine volcanology and regional tectonics. The projects were located in Tasmania, Victoria, NSW and the SW Pacific, and funded by industry, MRT and ARC grants. Read about their research below:



## EMILY CONN

**Supervisors:** Martin Jutzeler, Rebecca Carey

**Project title:** *Sediment core stratigraphy at Havre, Kermadec Arc/Rangitāhua*

**Funding:** Discovery Grant

Underwater volcanism comprises 85% of global volcanic activity, but we know little of how it works. We're discovering how eruption dynamics are affected by the ocean's water column by analysing volcanic material from the seafloor. Textural and chemical analysis allows us to reconstruct volcanic behaviour and environmental impacts, including hazards to nearby communities.

Emily, who began her Honours in July 2023, is studying volcanic ash sampled around Havre submarine caldera,



**Looking for gold:** Harrison Keeble at work in the Cowal gold mine core shed owned by Evolution Mining while undertaking his Honours research into the E41 deposit.

offshore NZ in the Kermadec Arc/Rangitāhua. Highlights so far have been sailing on the RV *Investigator's* 2022 VULKA voyage and travelling to Germany to undertake analyses. Emily's research focusses on constraining componentry, ash morphology, geochemistry, and volatiles of the ash, to reconstruct eruption processes and expand regional stratigraphy.

*"I'm incredibly grateful for the expertise, patience and helpfulness of everyone I've worked with at UTAS, both in the field and lab, and who have ensured this research is a success and contributes to an emerging and important field of study."*



## HARRISON KEEBLE

**Supervisors:** Lejun Zhang, David Cooke, Thomas Rodemann (CSL), Ned Howard (Evolution Mining)

**Project title:** *Characterisation of the regolith profile of the E41 deposit, Cowal, NSW: Implications for ore processing and mineral exploration*

**Funding:** Evolution Mining

Regolith covers over 80% of Australia and often holds key information about the ore deposits beneath it. The Endeavour 41 deposit at the Cowal gold mine in central NSW, was investigated to explore the supergene enrichment of gold in the regolith profile that covers the deposit. The mineralogy and geochemistry of the regolith was studied to develop a paragenetic sequence of the Fe-oxides that host gold and a possible mechanism for the gold enrichment. This knowledge will guide the approach Evolution will take in how it will process and mine the regolith material to extract the gold.

*"During my time working on this project, I have come to realise the importance that regolith plays in the mining*



**Voyage of discovery:** CODES Honours student Emily Conn on board the RV *Investigator* conducts core description on samples that have just been retrieved from the seafloor.

*industry and geology. There is an area of untapped knowledge in regolith that I hope to be able to continue working with in the future."*



## MADISON MULDER

**Supervisors:** Rebecca Carey, Sebastien Meffre, Karin Orth

**Project title:** *The Louisiade Ophiolite obduction and its implications on the Tectonic evolution of the Southwest Pacific*

**Funding:** Discovery Grant

The Louisiade Plateau is an underwater feature located in the Coral Sea, just south of the Solomon Islands. Through dredging of this plateau, the RV *Investigator* voyage IN2019\_V04 discovered the Louisiade Ophiolite. My project used samples from this voyage to conduct petrographical, geochemical and geochronological research to characterise the ophiolite and understand when and how it obducted onto the Louisiade Plateau. By utilising advanced analytical techniques, I was able to gain a comprehensive understanding of its geological history and create a refined tectonic model of the Coral Sea.

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**Access all areas:** CODES Honours student Issi Port needed a kayak to access some of the rocks he was studying for his research into the Eastern Tyennan Region, Lake Pedder.

*"Starting my undergraduate degree at CODES in 2020 was challenging, but I am extremely grateful to all the staff who worked hard to provide me with valuable hands-on assistance. It has been very rewarding being able to use a wide variety of analytical techniques and see my project come together."*



#### ISSI PORT

**Supervisors:** Robert Scott, Sebastien Meffre

**Project title:** *The structure, stratigraphy and metamorphism of the Eastern Tyennan Region, Lake Pedder, Tasmania*

**Funding:** MRT, CODES

Issi's Honours project examined the stratigraphy, structure, deformation and metamorphic history of Proterozoic rocks around Lake Pedder, Tasmania. His project involved multiple field campaigns in quintessential western Tasmanian weather. Geological mapping was predominantly undertaken from the seat of his kayak, as he mapped the exposures on the shoreline of the lake. Issi applied both classical and contemporary methods to unravelling the geological history of this area. His work included the application of laser ablation detrital zircon and garnet geochronology, as well as Time-of-Flight elemental mapping.

*"I have enjoyed the wholesome and warm-hearted CODES community during my undergrad and Honours. I feel*

*immensely proud to have studied under such an elite league of lecturers and academics. I leave CODES equipped with honed tools that any metasedimentary block would fear, as well as a newly found penchant for Guinness beer."*



#### SARAH PURDOM

**Supervisors:** Sebastien Meffre, Jeffrey Steadman

**Project title:** *Alteration and genesis of a possible intrusion-related gold deposit near Stawell, Victoria, Australia*

**Funding:** Battery Minerals

I was part of the July 2023 intake of Honours students and I am studying a potential intrusion-related gold deposit (IRGD) approximately 5 km SW of Stawell, Victoria, within the White Rabbit Diorite. This deposit is part of the White Rabbit Diorite just to the west of the Moyston Fault and located within the Delamarian Orogen. My study aims to investigate the genesis and alteration of this deposit and the relationship gold mineralisation has with alteration and veins. Battery Minerals drilled 8 diamond drill holes throughout the field area and found quartz sheeted veins, weakly disseminated pyrite and pyrrhotite through diorite. The findings of this project will aid Battery Minerals' knowledge and exploration targeting.



**Helping hand:** Honours student Millie Young had some help from CODES colleagues with collecting samples for her project at Peak Hill in February 2023. Left to right are: PhD student Markus Staubmann, Millie, Dr Lejun Zhang, Honours student Harrison Keeble and postdoctoral researcher Yamila Cajal.

*"The best thing about studying at CODES is being able to learn a variety of techniques both in the field and lab and seeing how these come together to create science."*



#### MILLIE YOUNG

**Supervisors:** Lejun Zhang, David Cooke, Yamila Cajal, Alex Cherry (Alkane Resources)

**Project title:** *Geology and alteration mineral chemistry of the Peak Hill Au-Cu deposit, NSW – Genetic and exploration implications*

**Funding:** Alkane Resources

Peak Hill is a high sulphidation epithermal Au-Cu deposit located in the Macquarie Arc, central western New South Wales. The Macquarie Arc hosts many world-class deposits including major alkalic porphyry Au-Cu and calc-alkaline porphyry Au-Cu deposits. Recently Alkane Resources have posed the question of whether there is an underlying porphyry deposit at Peak Hill. This project aims to identify and interpret magmatic-hydrothermal fluid flow centres at Peak Hill and provide insights into the location of a potential porphyry source using detailed graphic core logging, open pit mapping, aided by short-wave infrared (SWIR), petrographic analysis, SEM (scanning electron microscopy) and AMICS (Automated Mineral Identification and Characterization System). The outcome of this project will help provide a better understanding of the Peak Hill deposit and contribute to the implications of new exploration targets, as well as provide a better understanding of the regional geology and exploration potential.

*"I started my university degree with the intention of becoming a marine biologist but then I discovered rocks!! I've really enjoyed studying at CODES; my Honours year has definitely been the most challenging but it's very rewarding seeing how much I've learnt."*

# PHD PROJECTS IN DETAIL: THE CLASS OF 2023

This year has so far seen fourteen new PhD students from across the world join CODES to undertake projects across a range of themes within the Regional Research Collaboration critical metals project, as well as other major research projects. Below, some of our newest students outline their projects and how they are benefitting from their time at CODES. Some students, who have only recently started their projects or who are overseas at present, have opted to outline their work in a future issue of the newsletter.



## ALFREDTINA APPIAH

**Supervisors:** Julie Hunt, Mohammad Fathi, Owen Missen, Wei Hong

**Project title:** *Pathways to production: Magnesite deposits at Prospect Ridge, northwest Tasmania*

**Funding:** Australian Government Department of Education, GWR Group Ltd

Efficient recovery of minerals from an orebody can pose intractable challenges particularly when dealing with minerals with similar properties, such as carbonates. It is, however, vital to understand compositional variabilities for the minerals of interest and their effect on recovery processes. My research falls under 'Element 2: Pathways to Production' within the Regional Research Collaboration project and focusses on magnesium as the critical metal.

The main aim of my research is to characterise magnesite deposits (Arthur and Lyons river) in terms of geology, alteration and mineralisation

in north western Tasmania and to apply this knowledge to investigate the recovery of magnesite. Recovery via hydrometallurgical processes, such as flotation, is being investigated to help optimise mineral processing parameters to maximum recovery. This research will also investigate opportunities to use carbonate waste materials to improve environmental management of acid drainage in other mines or legacy sites.

*"It has been fun working with geologists! I have built an in-depth knowledge about my research, and I like how the objectives of this research are in alignment with my career goals."*



## FUSEINI ATANGA

**Supervisors:** Michael Baker, Sheree Armistead, Lejun Zhang

**Project title:** *Akyem gold deposit characterisation*

**Funding:** Amira P1249, Newmont

Fuseini's project commenced in October 2023 and will aim to improve our understanding of the paragenesis



CODES PhD student Alfredtina ('Alfie') Appiah in the lab at CODES undertaking evaluation of the influence of pH in magnesite flotation.



Fuseini Atanga pictured at the Newmont Africa Akyem gold mine in Ghana while doing fieldwork just prior to travelling to Tasmania to start his PhD in October.

of mineralisation and alteration at the Akyem orogenic gold deposit in southern Ghana. The project will develop methods for deposit characterisation using hyperspectral imagery and geochemical data, and characterise the mineralogical, textural, and geochemical features of the deposit to optimise mine planning and develop effective tools to aid gold exploration in the Ashanti Belt of southern Ghana. The outcomes of this project will form an integral part of the Amira P1249 research program, which is part of the Centre for Ore Deposit and Earth Sciences (CODES), a global leader in ore deposit research at the University of Tasmania.

*"Embarking on this PhD program is a culmination of my academic goals. It aligns perfectly with the research I pursued during my Masters, providing a natural progression for my academic journey. I get to delve into a research area that I love in a more comprehensive and detailed manner. What truly excites me is the abundance of expertise available at CODES. The prospect of learning from seasoned professionals is invaluable. It presents a unique opportunity to not only refine my existing skills but also to broaden my horizons significantly within this field."*

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## JOSE BARILLAS DIAZ

**Supervisors:** David Cooke, Lejun Zhang, Wei Hong, Yamila Cajal

**Project title:** *Atypical nickel mineralization in metasomatic rocks — The Avebury Ni deposit, western Tasmania*

**Funding:** Australian Government Department of Education, Mallee Resources Ltd

My PhD project focusses on studying the mineralogy, paragenesis and mineral chemistry of the critical minerals of the Avebury Ni deposit in western Tasmania. This project is part of the Regional Research Collaboration Project 'Element 1: Unlocking Critical Metal Resources'. Since my project started in February 2023, I have conducted three field trips to Avebury, where I collected samples and verified paragenetic relationships by logging drill core and underground mapping. At the Avebury Ni deposit, mineralogy is particularly complex due to the metasomatised ultramafic rocks as the result of the intrusion of the Late Devonian Heemskirk granite. Avebury deposit in Tasmania is considered the best example of hydrothermal Ni. These types of deposits are considered relatively rare. Understanding the



Professor David Cooke with PhD student Angela Costa on King Island while doing fieldwork research into scheelite.

mineral assemblage zonation related to the nickel and cobalt mineralisation, alteration, and the processes responsible for its formation is predicted to be particularly useful for helping with prospecting for this unusual type of hydrothermal Ni deposit.

*"The study of the Avebury deposit has been challenging and exciting due to the complexity of this mineralogy. During this year, I have been fortunate to enjoy and learn from my supervisors, classmates, and the feedback from the entire geology department at the Avebury mine. It is an exciting deposit to investigate. I hope to obtain valuable results from laboratory analyses to help me understand the origin of this unique type of Ni mineralisation."*



## AXEL CIMA

**Supervisors:** Ivan Belousov, David Cooke, Matthew Cracknell

**Project title:** *Influence of microinclusions in alteration and vein minerals on vectoring and fertility assessment of porphyry Cu ± Au ± Mo deposit*

**Funding:** Amira P1249

In my research project, I am dedicated to investigating the influence of mineral micro-inclusions in porphyry-related alteration minerals, including chlorite, epidote and white mica, on vectoring and fertility assessment tools. During the initial year, I meticulously examined legacy laser data from Batu Hijau, Indonesia, identifying and categorising micro-inclusions such as titanite, apatite, rutile and zircon within chlorite and epidote. Currently, I am using EPMA and LA-ICP-MS techniques to delve into the chemical composition of these inclusions, aiming to discern variations across the deposit and potential implications for mineral chemistry studies in green rock environments. My ultimate goal is to extract insights for the future application of micro-inclusion population analyses to enhance vectoring strategies.



Jose Barillas Diaz giving a presentation at the CODES Mining Roadshow held at Zeehan in June – this event was part of outreach for the Regional Research Collaboration project.

*"Coming from Patagonia made it easy for me to love Tassie and its charms. I frequently travel to the West Coast with my wife, immersing ourselves in the beauty of its landscapes and scenic routes. Despite the sudden transition, we are currently in the process of settling down, and we find joy in being here, sharing many moments with our CODES family."*



### ANGELA COSTA

**Supervisors:** Julie Hunt, Lejun Zhang, David Cooke, Yamila Cajal

**Project title:** *Characterisation of tungsten mineralisation at Grassy, King Island, Tasmania – implications for ore genesis, exploration, and pathways to production*

**Funding:** Australian Government Department of Education, Group 6 Metals Ltd

Angela's PhD project is part of the Regional Research Collaboration project aimed at the enhancement and sustainability of critical metals production in Tasmania. The project will characterise the geology, alteration and mineralisation of the tungsten skarn system from the Dolphin Mine and West prospects located in Grassy, King Island, through mine mapping, drill core logging, paragenetic and laboratory investigations.

Angela hopes to contribute positively to the return of tungsten production on King Island by supporting Group 6 Metals with improvement of orebody knowledge and by developing new exploration tools that can be applied to the area. Angela plans to conduct part of her research focussed on the fertility of the granitic intrusions at Grassy that were the main source for the fluids and metals that generated the W-(Mo) deposits in the region. With this scope, she expects to contribute to the global knowledge of skarn deposits and W-(Mo)-related granite intrusions.



Musa Emmanuel Dogara undertaking gravity beneficiation using a shaking table at the Kara mine in western Tasmania as part of his PhD research.

*"The experience of returning to academia and starting my PhD at CODES has been amazing. I have been feeling great to be honest, loving all the amazing fieldwork in Tasmania and a recent opportunity to visit the copper deposits from South Australia, including the world-class Olympic Dam IOCG deposit."*



### MUSA EMMANUEL DOGARA

**Supervisors:** Julie Hunt, Mohammad Fathi, Owen Missen

**Project title:** *Pathways to production for the iron-tungsten skarn-type deposits: Kara mine, northwestern Tasmania*

**Funding:** Australian Government Department of Education, Tasmania Mines Pty Ltd

The aim of my research is to develop a sustainable geometallurgical model for processing of scheelite (tungsten ore) at the Kara mine. Specifically, my research involves detailed mineral characterisation using scanning

electron microscope (SEM)-based techniques, to characterise the ore and gangue minerals focussing on critical metal (tungsten) deportment, liberation and association. The research also involves:

- Evaluation of processing methods currently used on site for tungsten-bearing ore, using bench-scale tests to assess optimisation of critical metal recovery for different domains/ore types (this includes gravity, magnetic and flotation mineral processing techniques).
- Assessing the feasibility of coarse flotation of scheelite, using novel flotation reagents that are environmentally friendly, and to optimise critical metal (tungsten) recovery. This will result in lower energy and reagent consumption which in turn will lower production costs.

*"So far, it has been a fascinating seven months filled with learning new things and comprehending how geological variability affects mineral processing/metallurgy. Crucially, the cutting-edge facilities and my skilled supervisory team in CODES have made my studies very exciting."*

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CODES PhD student Javier Gil Rodriguez presenting his poster about Renison Bell research at the Australian Earth Sciences Convention in Perth, June 2023.



## JAVIER GIL RODRIGUEZ

**Supervisors:** David Cooke, Owen Missen, Wei Hong

**Project title:** *Characterisation of skarn-type deposits: Renison Bell tin deposit*

**Funding:** Australian Government Department of Education, Bluestone Mines Tasmania JV, Mineral Resources Tasmania, CODES

Javier's research is part of the Regional Research Collaboration project (RRC) and is located in western Tasmania. The aim of this project is to characterise the skarn-related carbonate replacement tin deposit at Renison Bell and improve orebody knowledge in order to evaluate the potential for discovery and recovery of critical metals. Renison Bell is Australia's largest tin producer with potential for Cu as by-product. However, the potential for recovery of other critical metals such as In, Co or Ni from ores, gangue and/or waste, or discovery of other granite-related critical metal resources such as W, Nb or Ta in the district is yet to be explored.

At Renison Bell, tin mineralisation and associated metals occur mostly along main structures (e.g., Federal Bassett Fault) and on Late Neo-Proterozoic to Early Cambrian dolostones that have been replaced by sulphides and cassiterite.

*"This first year at CODES has been very challenging, but the great project that I am working on and the warm support from faculty and other students have made my stay in Tasmania very joyful."*



## ISAAC EVINEMI

**Supervisors:** Matthew Cracknell, Michael Baker, Lejun Zhang

**Project title:** *Mineralogical domaining and predictive modelling of porphyry copper deposits using deep learning approaches*

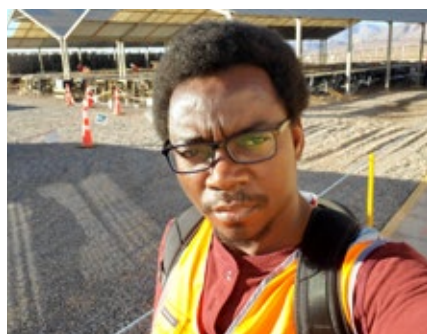
**Funding:** CODELCO

My research is part of the Amira P1249 (Module 2) project. The study area is the Potrerillos mining district (PMD),

located in the upper Eocene-Oligocene metallogenic belt of northern Chile, in the Central Andes. The Potrerillos district is host to several porphyry Cu deposits, including Porfido Norte, Porfido Gonzalez, Porfido Hueso, and Mina Viejas.

This research will focus on the Porfido Norte site and aim to integrate data (geophysics, geochemistry, Corescan, etc.) from this area into a deep learning architecture to build a mineralogical domaining and predictive model. This model will inform CODELCO on the geometallurgical sampling of the orebody to help inform advanced exploration decisions and actions. Secondly, this research also seeks to develop a model or algorithm that can be utilised on other similar porphyry Cu deposits to explore their mineral assemblages and correlations, and make well-informed decisions regarding advanced exploration tactics.

*"I'm just a few months into the program and everyone at CODES has been so supportive. I'm really happy to be here and to be part of this project. I look forward to a fruitful time ahead as we collectively find ways of providing solutions to these challenges. Hopefully, we can make history together."*



Isaac Evinemi at the CODELCO core shed, in the mining centre of El Salvador in the Atacama Region of northern Chile, South America, where he was carrying out fieldwork in October.





## DECLAN HIGGINS

**Supervisors:** Rebecca Carey, Jeffrey Oalman, Ery Hughes (GNS)

**Project title:** *Volcanic and sub-surface volcanic architectures: How and where are eruptions initiated in large caldera volcanoes?*

**Funding:** CODES

My research is focussed on the 1886 Basaltic Plinian eruption of Mount Tarawera on the North Island of New Zealand. Basaltic Plinian eruptions are rare in the geological record but are potentially the most dangerous endmember of basaltic volcanism as they have far-reaching impacts and can be difficult to predict due to their rapid onset.

My PhD aims to explain the drivers of eruption onset, eruption intensity and transition in eruption style during the 1886 eruption of Mount Tarawera. I plan to use a range of microanalytical and statistical techniques to quantify melt inclusion volatile contents and vesicle and microlite populations to thermodynamically model the pressure and temperature conditions of the volcanic conduits and model degassing pathways to determine the distribution of volatiles between gas and melt phases from shallow storage to surface.



Declan Higgins' PhD is about the 1886 Basaltic Plinian eruption of Mount Tarawera on the North Island of New Zealand. Declan is pictured earlier in 2023 during fieldwork in New Zealand.

*"Contributing to an exciting area of study with world-class researchers in an amazing field site is a great privilege. I am grateful for the opportunity to be able to study here at UTAS."*



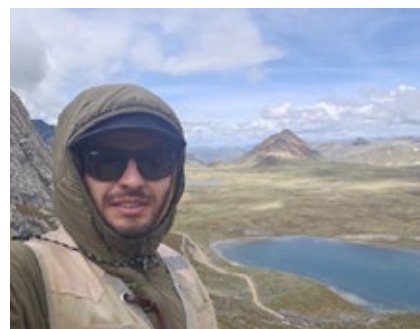
## ARKA SAHU

**Supervisors:** Lejun Zhang, Thomas Rodemann (CSL), Matthew Cracknell

**Project title:** *Multiscale hyperspectral mineral chemistry data mining*

**Funding:** Amira P1249

Arka's research is part of the Amira P1249 project, incorporating elements from both Modules 1 and 2. The research focusses on exploring the nuanced relationship between the spectral signatures of minerals in the infrared spectrum and their corresponding chemical compositions, to develop innovative tools for ore deposit centre prediction. To achieve this goal, Arka leverages the rich legacy mineral and whole-rock chemistry datasets available at CODES and employs advanced Fourier-Transform instruments at the Central Science Laboratory at UTAS for acquiring spectral signatures from historical samples. Arka's research shows early promise in enhancing the efficiency



Victor Torres in Peru, with a view towards the Yumpag world-class silver discovery in the Uchucchacua district from Buenaventura behind him. Victor is researching mineralised tourmaline breccia pipes at Soledad, central Peru, for his PhD.

and precision of ore deposit centre prediction through hyperspectral and mineral chemistry data mining.

*"I embarked on my PhD journey at CODES in January 2023, and the experience has been truly enriching. CODES offers a unique blend of academia and industry exposure. The diverse and inclusive PhD cohort, along with the very supportive staff and faculty, has made my onboarding quite smooth. Looking forward to the rest of my time here!"*



## VICTOR TORRES

**Supervisors:** David Cooke, Lejun Zhang, Julie Hunt

**Project title:** *Geology, genesis and geometalurgy of Cu-Au-Ag mineralised tourmaline breccia pipes at Soledad, central Peru*

**Funding:** Chakana Copper

Victor's PhD will characterise the geology, alteration and mineralisation of the tourmaline breccia hosted mineralisation at Soledad. He will constrain the ages of volcanism, intrusive activity and brecciation using U-Pb zircon dating and characterise the mineralogy of breccias and altered rocks using a range of petrographic and analytical techniques. The potential to use tourmaline mineral

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chemistry as a tool to vector high-grade mineralisation in breccia pipes and to assess the fertility of undrilled breccia pipes will be assessed using LA-ICP-MS analyses of trace element chemistry of mineral grains.

Research will also focus on detailed mineralogical characterisation of sulphides and sulphosalts for geometallurgical purposes to optimise mineral processing options. A new genetic and exploration model for breccia hosted mineralisation at Soledad will be proposed.

*"It has been a great journey to be associated with CODES for over five years and this research is a product of that continuous learning and great mentoring. I am very happy to be part of this world-class research centre."*



#### EMRECAN YURDAKUL

**Supervisors:** Lejun Zhang, Michael Baker, Robert Scott

**Project title:** *Orebody knowledge of the Western Tharsis Cu-Au Deposit, Tasmania: Implications for ore processing and mineral exploration*

**Funding:** Mineral Resources Tasmania, Copper Mines of Tasmania

The scope of my research project is understanding the orebody of the Western Tharsis Cu-Au Deposit (12.4 Mt @ 1.3% Cu, 0.3 g/t Au) in the Mt Lyell district of western Tasmania. The district hosts worldwide known volcanic-hosted massive sulphide (VHMS) deposits which have been mined for over 100 years. By contrast, the Western Tharsis deposit is unmined and shows implications of a porphyry – high sulfidation epithermal system with abundant advanced argillic alteration minerals (e.g., topaz, zunyite, pyrophyllite, aluminium-phosphate-sulfate (APS) minerals) in alteration mineralogy. Another key aspect of the



PhD student Emrecan Yurdakul (left) with supervisor Dr Lejun Zhang at Mt Lyell, western Tasmania, while undertaking fieldwork for his research into the orebody of the Western Tharsis.

project is revealing the critical mineral potential of the district. Unlocking the orebody knowledge of the Western Tharsis deposit will contribute to the rebooting of mining in the district with the potential for new exploration targets and mineral commodities.

*"I always feel privileged to have had the opportunity to be a part of CODES, which is one of the unique institutes in the world that has been successful in bridging science and industry."*



#### ZEBEDEE ZIVKOVIC

**Supervisors:** Mike Baker, Matthew Cracknell, Shaun Barker (MDRU)

**Project title:** *Whole-rock lithogeochemical methods in magmatic-hydrothermal environments: applications to mineral exploration*

**Funding:** Dreadnought Resources, Mineral Resources Tasmania

Zeb's PhD research explores the ways that whole-rock geochemistry is used by industry to determine lithogeochemical outputs such as rock

composition, alteration and fertility. This is presented as three papers, the first of which has been published in 2023 in *Geochemistry: Exploration, Environment, Analysis*. This paper assesses and quantifies the impact of using fusion and acid digestion whole-rock methods on lithogeochemical interpretation. Results from this study found that using acid digestion techniques negatively affected many of the key elements used for lithogeochemical interpretation; however, ratios of Ti-Nb-Ta and Eu-Sm-Gd preserved lithogeochemical information based on assessment of geochemical data from the Mount Read Volcanics in western Tasmania.

Paper two presents a formal method for using and interpreting whole-rock lithogeochemistry using mixed digestion methods and demonstrates this using a case study from the Rosebery VHMS deposit in western Tasmania. Paper three presents a second case study from the west Kimberley region of WA. Here, the lithogeochemical method is used to classify a new intrusion with supporting petrographic and geochronological data.

*"My time here at CODES has had its ups and downs (as I'm sure most PhDs can appreciate); however, I have always been able to rely on the staff and my fellow students for support for which I am very grateful."*



## WHERE ARE THEY NOW?

A year ago Dr Shawn Hood, who graduated with his PhD from CODES in 2019, took on the role of General Manager of ALS Data Analytics & Consulting based in Vancouver. He is excited to be at the forefront of advancements in melding novel solutions with traditional geological approaches in the search for resources.

# AI AND MACHINE LEARNING: THE POTENTIAL IS HUGE!



### DR SHAWN HOOD

**General Manager of ALS Data Analytics & Consulting based in Vancouver, Canada**

PhD completed at CODES in 2019 entitled 'Machine-assisted modelling of lithology and metasomatism' (supervised by Dr Matthew Cracknell and Associate Professor Anya Reading)

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

I am currently the General Manager of ALS Data Analytics & Consulting, also known as ALS GoldSpot Discoveries. I oversee technology strategies, applying Artificial Intelligence (AI) to mineral exploration and mining projects, supervising ongoing research & development programs, and harmonising novel solutions with traditional geological approaches learned from both industry and academia.

A typical day for me varies, which is an aspect of the job I enjoy. Consulting fieldwork ebbs and flows during the year, depending on weather and accessibility of remote sites – and so the activity of the field data collection teams tends to be seasonal. The geodata interpretation teams and expert geoscience groups are more consistently busy, and I quietly peek into client projects very regularly. Almost everyone works remotely/virtually, and this makes it much easier to track and understand what projects are active, since all our work is organised through project management systems. Activity from the Research & Development and software development groups is consistent but does have a punctuated fervour. These teams are always hard at work to create new tools and solutions based on their interactions with the geoscientists and their observations of workflow bottlenecks. As projects gain traction with the geologists it requires a lot of time and effort to keep the end goals and purpose in focus. Generally, I try to maintain an understanding of what everyone is working on, to give feedback on how it relates to other teams' work, and to communicate the advantages of the work to clients who don't have exposure to data-driven methods. With every project we are becoming better at all this, and it's very fulfilling to be part of a team that is improving together.

### What are the things you enjoy most about this role/when did you start it?

I started my role as the General Manager in December 2022, when our team of about 70 talented data scientists and geoscientists was acquired by ALS Global. What I enjoy most about this position are the

opportunities to merge the power of advanced technology, especially AI and machine learning, with traditional geological methods. It's a fascinating fusion of the past, present and future of geological exploration, and it's exciting to be at the forefront of these advancements.

When I first started at GoldSpot in 2019 the team was quite small. There had been a lot of resistance to data-driven techniques in the mineral exploration and mining industry, mainly due to a lack of understanding. However, we spent a lot of time working to communicate the efficiency of different data analytical techniques when they are underpinned by sound geological reasoning. From there we were able to expand our AI development and consulting capabilities to provide solutions all across the world and in many different ore deposit environments.

One of the issues we had at GoldSpot was the assumption that we only worked on gold projects. In reality, the workflows we created are very



Shawn pictured in 2007 during one of his early roles: logging core in the Howard's Pass Pb-Zn deposit in the Yukon, Canada.

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Shawn's first geo job was as a core technician in Mongolia: here he is pictured in 2005 checking out transport options near the Oyu Tolgoi large copper deposit in southern Mongolia where he worked.

modular and adaptable: I would say everything we do relates strongly back to geological first-principles whenever possible. For example, most of us are strong supporters and active members of the Society of Economic Geologists. This reflects a shared passion for ore deposit sciences and a desire to understand the controls on mineralising systems, along with the 'signals' that represent them in the rock record.

Being able to build trust in technology with a group of people who share the same passion and vision has been very rewarding, and I think that journey is still just beginning for our industry.

#### **How did you get there/your past roles and how they shaped your path?**

I began my geo career as a core technician in Mongolia, and the experience of being near a large copper deposit like Oyu Tolgoi exposed me to a lot of discussion around regional exploration, big ore systems, and deposit discovery. Throughout my undergraduate and Masters studies I was lucky to have a great series of jobs that related to mineral exploration and they shaped my love of the discipline. However, it was while working in underground mining that I was bitten by the data analytics bug – resource estimation, geostatistics and the data density of the mine environment led me to understand the immense potential of harnessing data in our industry.

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

I enjoy projects where some type of rigorous geological understanding helps to untangle an annoying or thorny problem, and the satisfaction that comes from seeing that work result in tangible, impactful outcomes. One situation like that came before machine learning was on the radar for most of us in mining. I was at a gold mine and working with a great group of people who enjoyed mining and thinking about problems from creative angles. We were able to change a site's core logging approach, collect consistent geological data over about six or eight months, and then create entirely new resource domains using an automated probabilistic approach based on geology. The project led to a greatly improved representation of the mine's gold resource and new workflows used at other deposits in the region.

#### **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?**

At CODES, I specialised in applying machine learning towards problems involving the spatial representation and understanding of lithology and metasomatism at ore deposits.

*CODES equipped me with the tools to interpret vast datasets from exploration and mining data, opportunities to grow as a geologist by participating in incredible field trips and courses, and*

*the time and academic mentorship to explore how machine learning could be integrated with conventional geoscience workflows.*

What I cherished most about my time at CODES was the innovative conversations and patient support of my supervisors Matt Cracknell and Anya Reading. As mentors they helped me become a better scientific thinker and project manager, and I still quote them both regularly.

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

Since my time at CODES, the industry has become increasingly aware of AI and machine learning. I am witnessing a generational shift as new graduates enter the workforce and have high expectations about data and data analytics. They simply expect tools and technology to be in place; however, the mining industry is still a laggard in terms of overall technology adoption. Companies are now looking for people who are capable data scientists, but this is only part of what they need. Without solid geological foundations, the tools provided by data science are ineffective. In the future, I envision an integration of technology and geology, with due respect between the two.

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

Make the most of your time at CODES! Take the field trips, help out at BBQs, volunteer for the community events, hang out in the tearoom, go to networking events, and attend the short courses. Your experience and the CODES community will be richer for it.



Mapping ore drives with a colleague at the Athena-Hamlet underground Au mine in Western Australia (2014). It was while working underground that Shawn was bitten by the data analytics bug.



# CODES ON THE WORLD STAGE

**CODES staff and postgraduate students have continued to make their mark at international gatherings across the globe – and closer to home at a major conference in Perth. Here are just a few images from the past few months showing some of the events that have been showcasing CODES research to the world geoscience community.**

## SEG 2023 CONFERENCE

**26–29 August, London**

In late August, four CODES researchers attended the 2023 Society of Economic Geologists (SEG) Conference at the Hilton London Metropole in the UK. The conference theme was 'Resourcing the green transition' and attracted a large contingent of academia and industry representatives from around the world. Technical sessions were geared towards the current push for the sustainable development of green and critical metals, including sessions on the responsible discovery and recovery of gold and copper resources, battery metals, and advancements in economic geology and transformational sciences.

Research presented by CODES staff included talks by Professor David Cooke, Dr Mike Baker and Dr Jeff Steadman, and two posters by Dr Wei Hong. The CODES booth was also present on the exhibition floor for the duration of the conference, and saw an almost constant stream of interest from student attendees and industry professionals showing strong interest in the postgraduate research programs at CODES, including the Masters short course series and available PhD projects.

## 17TH BIENNIAL SGA MEETING: SOCIETY FOR GEOLOGY APPLIED TO MINERAL DEPOSITS

**28 August–1 September, Zurich**

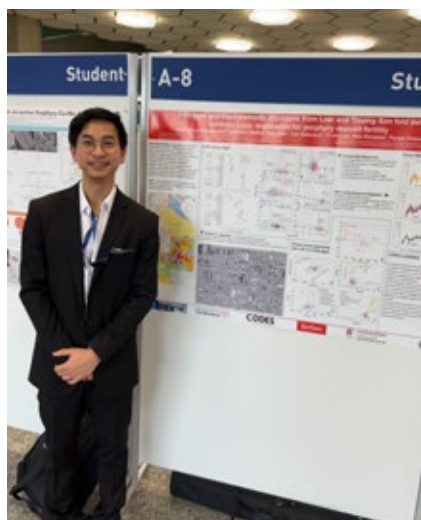
The theme of this meeting, held on the campus of ETH Zurich, was 'Mineral resources in a changing world'. CODES staff members and students who attended included Dr Julie Hunt, postdoctoral researcher Yamila Cajal, and PhD students Max



Dr Mike Baker speaking at the SEG 2023 Conference in London during August on 'Random forest classification of epidote mineral chemistry from the Aitik deposit, northern Sweden'.



The CODES booth was well-attended at the SEG 2023 Conference, held at the Hilton London Metropole hotel, and there were many enquiries about CODES' short courses for industry geologists. Here Dr Wei Hong and Dr Mike Baker answer queries from prospective students.



CODES PhD student Peerapong Sritangsirikul stands next to his poster at the SGA 2023 conference in Zurich; he is researching the Loei and Truong Son fold belts in northern Laos.



CODES out in force at the recent SGA 2023 conference in Zurich (L-R): Postdoctoral Research Fellow in Geometallurgy/Economic Geology Dr Julie Hunt; PhD students Max Hohl, Peerapong Sritangsirikul, Alex Farrar; and Research Fellow in Critical Metals Characterisation Yamila Cajal.

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Hohl, Alex Farrar and Peerapong Sritangsirikul. Yamila, Max and Alex all gave oral presentations, while Julie and Peerapong each presented a poster.

Julie Hunt took part in one of the pre-meeting field trips entitled 'Li extraction in the Upper Rhine Graben', which included a visit to a research geothermal power plant in Bruchsal and a direct lithium extraction (DLE) pilot plant designed to extract lithium from geothermal brines.

## LATIN ROCKS 2023 CONFERENCE

11–12 October, Santiago

Dr Matt Cracknell and PhD student Isaac Evinemi attended the Chile Explore – Latin Rocks conference in Santiago on 11–12 October. Approximately 200 conference delegates were treated to a range of quality presentations on Cu exploration. These talks covered topics such as regional- and district-scale indicators for porphyry exploration, new and novel data analysis methods for characterising deposits (including a talk by Matt on methods for locating buried porphyry targets), and updates on recent changes to exploration-relevant legislation in South America.

Matt writes: "The final session for both days featured a panel discussion on issues affecting the geoscience industry (specifically mining and mineral exploration). One of these sessions focussed on how the industry might reverse the declining rates in economic geology graduates. The ensuing discussion centred on what young people should want in a geoscience career, complete with highlights on the challenges faced around attracting and consolidating a diverse workforce. Despite the good intentions of this talk and the 'wicked' problems raised I could not help thinking that the dominantly male and middle-aged panel members were somehow demonstrating the fundamental reasons behind the problems they were lamenting."



Dr Matthew Cracknell expands on the topic of locating buried porphyry targets at the Chile Explore – Latin Rocks 2023 Conference in Santiago, which was held in mid-October.



Professor David Cooke was the keynote speaker at the NewGenGold Conference in Perth; he spoke about porphyry provinces of the circum-Pacific to a packed audience on 15 November.

## NEWGENGOLD CONFERENCE 2023

14–15 November, Perth

Professor David Cooke was the keynote speaker at the NewGenGold Conference, which is held every two years in Western Australia and is regarded as one of the world's foremost gold exploration

conferences. David's keynote address was entitled 'Gold-rich porphyry provinces of the circum-Pacific – characteristics, origins and exploration criteria'.

His talk was very well received and was characterised as 'fabulous', 'spot-on: a great academic + practical "overview", delivered with clarity', and 'worth the price of admission alone'.



# GOLD DISCOVERIES ALL IN A DAY'S WORK FOR PAULA



**Dr Paula Montoya has recently joined CODES as a Postdoctoral Research Fellow in Economic Geology. She is passionate about combining academic theory and applied science within her chosen discipline. Here she explains her background: studying, working and teaching in Colombia and Mexico...and what she hopes to achieve at CODES.**

Before I became a geologist, I was always interested in understanding how the Earth was formed, so I decided to study geology in one of South America's oldest mining faculties – at Universidad Nacional de Colombia located in Medellín, Colombia, in 1999. During this time, I became a 'research polymetallic lover'; when I say this, I mean that the university environment inspired me to understand in detail how mineralisation was formed. So, I decided to focus my career on two specialisations: economic geology and mineral exploration. I was also enrolled in an industry internship doing fieldwork in the remote Colombian jungle. I spent a year working with a foreign company exploring Ag-Au orogenic vein systems at the Segovia-Remedios Gold Belt; and I did my undergraduate thesis on hydrothermal fluid sources based on field mapping and detailed mineral petrography.

When I graduated, my dream was to apply the scientific knowledge I had gained to explore mineral deposits, so I began to work with mining companies in Colombia. Fortunately, at that time, we faced the 'second boom of mineral exploration'. Hundreds of mining companies around the world were based in Medellín recruiting young geologists to send into the field to do mapping and sampling. This gave me the opportunity to become an exploration geologist working with Canadian and Colombian junior mining companies. The main exploration tools I had available in the field then were a hammer, compass and hand lenses, therefore I developed a keen sense for detailed observation, useful for geology mapping, mineralogy, paragenesis and alteration assemblage descriptions. I truly believe that field observations and detailed petrography are the basis for understanding

hydrothermal fluids. My early life as a mineral explorer encompassed several long 40-day field campaigns in remote places across the country and I spent time with geochemical data analysis on my days off when the lab results arrived. The lack of 'high-tech' tools made me quite observant and a resilient person in the field.

In 2006, I became an exploration geologist coordinator, overseeing advanced exploration campaigns, mostly mapping, drilling, logging, sampling and estimating exploration resources for the company – a joint venture between Mineros S.A., the biggest Colombian gold mining company, and AngloGold Ashanti, a South African mining company. The focus of Mineros was to find gold vein systems in order to maintain their exploration program, whereas for AngloGold Ashanti it was to find world-class deposits.



While an undergraduate at the Universidad Nacional de Colombia Paula also did an internship in the remote Colombian jungle – she found the large python she's holding in this photograph actually in her bed one evening. It was necessary to check bedding every night before retiring to ensure no wildlife was hiding there.

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Underground at San Dimas Mine district, Mexico: after finishing her PhD Paula went into the field in 2019 to explain her research findings to the mining geologist team at First Majestic Silver Corp.

After a year of exploration, AngloGold Ashanti invited me to work with them directly. That was a milestone in my career because with AngloGold Ashanti we discovered two world-class gold and copper porphyry deposits in the Northern Andes: La Colosa and Quebradona. Also, I had the opportunity to collaborate with an amazing discovery team, including remarkable senior exploration geologists, Drs Richard Sillitoe, Rudi Jahoda, Ruben Padilla, Timoleón Garzón, and a great team of other geologists. We drilled the La Colosa prospect, increasing the ore resources to more than 30 Moz of Au. In 2010, the La Colosa project began the pre-feasibility phase, and more detailed analyses were needed to understand, predict and design high-quality metallurgical processes. In this regard, AngloGold Ashanti was included as a sponsor of the Amira P843 and P843 GEM<sup>III</sup> projects in collaboration with CODES, JKMRC, BRC, CMLR (Sustainable Minerals

Institute, University of Queensland) and the Parker Centre (CSIRO). At that time, I was a senior geologist for AngloGold Ashanti, and coordinated the sponsors' meetings from the industry side. This position led me to gain a Masters scholarship at CODES, 100% funded by AngloGold Ashanti.

The first time I came to Australia was to start my Masters research on mapping and modelling the La Colosa comminution model which was developed based on proxy data of more than 15,000 drillhole samples using different kinds of statistical, geostatistical, 3D modelling techniques and comminution test work, mentored by Drs Ron Berry and Julie Hunt. Additionally, I was involved with the La Colosa Geometallurgy-Recovery model developed by Masters student Stacey Leichliter at CODES.

Our research findings were highly relevant to decisions about mills and plant design at the La Colosa pre-feasibility stage, and to the Colombian

Environmental Impact Assessment (EIA) for obtaining the environmental licence and, last but not least, in improving scientific knowledge about gold porphyry deposits. The outcomes were shared at the first AusIMM International Geometallurgy Conference, GeoMet 2011; the 2nd Amira International Meeting 2011 in Australia; and at the 1st GECAMIN Geometallurgy International Conference 2012 in Chile. When I finished my Masters, I became a senior geologist specialist with the Geoscience group within AngloGold Ashanti, collaborating with the team to study porphyry or epithermal deposits around the globe.

In 2016, I moved to Mexico to do my doctorate at Centro de Geociencias at Universidad Nacional Autónoma de México (CGEO, UNAM) with a scholarship from the National Council of Science and Technology in Mexico (CONACYT). In collaboration with Drs Luca Ferrari and Gilles Levresse we re-evaluated the world-class Ag-Au epithermal deposit San Dimas District located in the middle of the largest continental igneous province in the world called Sierra Madre Occidental. The results of my PhD were based on a mix of exciting fieldwork in Mexican deserts, underground mapping and 'reading' hundreds of core at the core shed, plus many hours of test work on mineral chemistry for mineral classification and thermobarometry (SEM, EPMA), mineral separation for U-Pb (LA-ICP-MS) and <sup>40</sup>Ar/<sup>39</sup>Ar dating and fluid inclusion studies in microthermometry, decreptometry,  $\delta^{18}\text{O}$  and  $\delta^2\text{H}$  isotopes and noble gas isotopes to understand fluid compositions and genesis. I developed a new method to separate fluid inclusion water from ore overprinted events. We made important contributions to the brownfields exploration programs and mine planning for the industry.

My PhD studies received an honourable mention in 2020; and I won an award from the Organization of American States, OAS-CONACYT-AMEXID, for the best PhD student at Centro de



Geociencias, UNAM (2016), a UNAM recognition award for PhD graduation on time (2020); and also the BAL-UNAM Award for the best Earth Science PhD thesis combining academic theory and applied science in economic geology (2020). This last award was highly relevant in Mexico because geology theses are evaluated not only for their academic merit but also for their relevance to industry (Grupo México and Grupo Fresnillo). The outcomes were shared in international and national conferences and were published in peer-reviewed journals.

After my PhD, I became a full-time assistant professor at Universidad del Norte in northern Colombia, moving to live near the paradisiacal Caribbean Sea, and was invited to be a guest researcher at UNAM in Mexico. Since 2019, I have been highly involved with teaching, promoting a supportive learning environment that connects industry and academia. I taught igneous and metamorphic petrology and petrography, and learned from these young people how this new generation learns and enjoys geology. I was the principal supervisor for many students' theses. And I continued to act as a consultant, leading scientific applied projects on ore deposits for Mexican and Colombian mining



Paula (in dark blue with red logo) with the team of explorers who discovered La Colosa, Colombia, in 2007. They are (L-R, standing): German Orozco, Jennifer Betancourt, Andres Naranjo, Milton Obando, Andres Cepeda, Andres Rodriguez, Paula, Richard Sillitoe, William Pulido, Edwin Palacio and Timoleon Garzon. Squatting at the front are Harold Bedoya (left) and Ruben Padilla.

companies, and securing substantial funding from the mining sector. A milestone of two of my recently concluded projects – Las Plomosas Pb-Zn epithermal deposit and San Marcial Ag-Au epithermal – was the discovery of a new Cu-Mo porphyry and epithermal Rosario district. The outcomes were shared at ROUNDUP 2023 in Vancouver, Canada, and the Discoveries Mining Conference 2023 in Mazatlán, Mexico, where I presented an invited plenary talk.

I have now returned to Australia to take up a position as a Postdoctoral Research Fellow at CODES. This is an exciting opportunity to improve my knowledge of mineral deposits and collaborate with the world-class team at CODES. I want to apply my knowledge of exploration, and combine my experience with industry, research and teaching to contribute to this global CODES team. Also, I am very excited to explore the beauty of Hobart, a Georgian-style city surrounded by nature and beautiful walking tracks.

## DIPLOMATIC MANOEUVRES

**His Excellency, Mr Johan Pontus Melander, the Swedish Ambassador to Australia, visited the University of Tasmania on 21 September 2023 to discuss opportunities to cooperate in mining, critical minerals and rare earths with the Vice-Chancellor, Professor Rufus Black, and the Director of CODES, Professor David Cooke.**

UTAS has existing cooperations with Sweden through research and HDR studies, in particular between CODES and their ongoing partnership with Sweden's Boliden Mining, who are sponsoring the Amira P1249 research project, 2022–2026. A new PhD study



Right to left: His Excellency, Mr Johan Pontus Melander, meeting with Professor David Cooke; former CODES PhD student and current Physics Research Fellow in Computational Physics (Geophysics) and Swedish citizen Dr Tobias Stål; and CODES Analytical Laboratories Manager and Swedish descendant Dr Paul Olin during their tour of CODES' analytical facilities.

of the Nautanen IOCG deposit in Norbotten, Sweden, will commence in 2024 supported by Boliden. During

the visit, His Excellency toured CODES' analytical facilities and met with staff from CODES and Physics.

## FIELDWORK

# FIELDWORK ACROSS FOUR CONTINENTS

**CODES staff and students have been running up a few frequent flyer points in recent months with fieldwork trips to North America, Africa, Europe and mainland Australia – as well as South America. Here is just a taste of what's been happening:**

## CANADA: VANCOUVER ISLAND

**June 2023**

In June 2023, Dr Lejun Zhang (CODES), and collaborators from Lakehead University, including Peter Hollings, Chase Turner and Luis Zappa, conducted fieldwork at the Northwest Expo project on Vancouver Island, British Columbia, Canada. This fieldwork is part of Chase Turner's MSc studies focussing on vectoring to the centre of the mineralisation within the Northwest Expo lithocap, as part of the Amira P1249 research project.

The Northwest Expo project is an active exploration project owned by NorthIsle Copper and Gold Inc in Canada. It is composed of large areas of intense silicic, advanced argillic, phyllic and propylitic alteration. High-level porphyry-type mineralisation has been intersected from previous drilling. To enhance the ongoing exploration efforts, Chase Turner and the broader research team of P1249 will employ a combination of mapping, whole-rock geochemistry, mineral chemistry and SWIR (Short-Wave Infrared Spectroscopy) techniques to investigate the Northwest Expo lithocap with the goal of better constraining the timing of the mineralisation, the relationship to the surrounding alteration, identifying upflow zones within the lithocap, and providing insights for vectoring to the centre of the mineralisation.

## GHANA: AKYEM

**August 2023**

For the first time in its 20-year history, the Amira Footprints Program has ventured into Africa! In August 2023, Dr Mike Baker and new CODES PhD student Fuseini Atanga commenced fieldwork at Newmont Africa's Akyem orogenic gold deposit in southern Ghana.

Akyem is a world-class gold mine located in the northeastern part of the Ashanti belt of southern Ghana. The mine is owned and operated by Newmont, with development as an open pit operation commencing in 2005 and commercial production beginning in 2013. During his first field campaign, Fuseini graphically logged over a dozen drillholes and collected close to 200 samples over the course of four weeks for the purposes of developing an initial understanding of the paragenetic complexity of alteration and mineralisation at Akyem. This fieldwork is part of Fuseini's PhD project on *Deposit characterisation and exploration vectors for the Akyem Orogenic Gold Deposit, Ghana* that commenced in October 2023 as part of the Amira P1249 project at CODES (see page 5).



Canada: Dr Lejun Zhang (right) and Chase Turner (MSc student at Lakehead University) examining drill core from the Northwest Expo prospect at Vancouver Island in Canada, for the Amira P1249 project.



Canada: P1249 fieldwork underway. Here Chase Turner, Luis Zappa and Dr Lejun Zhang are sampling the Northwest Expo lithocap at Vancouver Island.



Ghana: CODES PhD student Fuseini Atanga pictured at the Newmont Africa Akyem gold mine in southern Ghana while doing fieldwork there with Dr Mike Baker as part of the Amira P1249 project.





Spain: Dr Wei Hong and Yamila Cajal walk along an old aqueduct while collecting samples in the Aguas Teñidas-Magdalena mines of Huelva Province.

## SPAIN: HUELVA PROVINCE

### August–September 2023

Professor David Cooke, Dr Michael Baker, Dr Wei Hong and Yamila Cajal conducted an initial field visit to the Sandfire Resources-MATSA Aguas Teñidas-Magdalena mines in the Iberian Pyrite Belt (IPB) of Huelva Province, Spain, from 29 August to 6 September. The Magdalena volcanic-hosted massive sulfide (VHMS) deposit is a newly discovered world-class copper-zinc-lead-silver mine located in the northern IPB of southwest Spain. The research within this sub-project is aimed at characterising and understanding the paragenesis of the Magdalena deposit, allowing for comparison to other known VHMS deposits in the northern IPB and contributing to further exploration for this style of VHMS mineralisation. The researchers worked closely with MATSA staff at Magdalena mine and collected 91 rock chip samples from around the Magdalena deposit. This study is part of the Amira P1249 project and is currently recruiting a PhD student who is expected to start in the first half of 2024.



Spain: Dr Mike Baker (far right) talking sampling strategy to colleagues from MATSA-Sandfire Resources (middle three) and CODES staff (Yamila Cajal, nearest camera) and pointing to rock outcrops in the Aguas Teñidas-Magdalena region, Huelva Province, Spain.

## SOUTH AUSTRALIA: PROMINENT HILL

### September 2023

Dr Jeff Steadman spent a week in South Australia, combining the SEG Student Chapter field trip to the Gawler Craton and fieldwork at Prominent Hill into one itinerary. Prominent Hill is one of four primary study sites in Jeff's 'IOCG<sup>3</sup>' research project, and this visit served as the initial sampling and deposit orientation excursion.

Prominent Hill is a complex system composed of multiple rock types that formed at different times, not to mention multiple generations of hydrothermal alteration and ore minerals. Furthermore, the structural architecture is such that all these components are now juxtaposed and confined to a relatively small area, which is good for mining but obfuscates the origins of the deposit. The challenge and the opportunity for IOCG<sup>3</sup> is to shed new light on the geochemical profiles of the key hydrothermal alteration minerals, such as hematite, apatite and pyrite. This work will ultimately benefit our sponsors by providing a better understanding of the geochemical behaviour of these minerals in a hematite-dominated IOCG system like Prominent Hill.



South Australia: Aerial shot of the Prominent Hill mine complex (view to the north), including the open pit, waste dumps and tailings dam (large circle in the foreground). This iron oxide copper-gold (IOCG) deposit is owned and operated by BHP, who are sponsoring Dr Jeff Steadman's IOCG<sup>3</sup> project.



# AWE-INSPIRING SEG TRIP TO SOUTH AUSTRALIA



The 2023 CODES SEG Student Chapter field trip participants are pictured here at Olympic Dam. The group included people from CODES, the University of Adelaide, DEM-GSSA, First Quantum Minerals (FQM) and Chris Booth – Olympic Dam Superintendent (Geology).

**In September the CODES SEG Student Chapter ventured to South Australia for its annual field trip, and visited several mines as well as the Fleet Space Technologies facility in Adelaide. Here, the Student Chapter President, PhD student AXEL CIMA, reports on the week's adventures.**

Our recent field trip to South Australia, organised by the SEG Student Chapter in collaboration with the University of Adelaide's student chapter, was an incredibly enriching experience that left an indelible mark on our understanding of geology and exploration. With a primary focus on Gawler's craton geology and iron oxide-copper-gold (IOCG) systems, the trip was an immersive journey into the world of mineral exploration and geological phenomena.

One of the highlights of the trip was the opportunity to visit several mines, including the iconic Olympic Dam, Prominent Hill and Kanmantoo. These visits allowed us to witness firsthand the geological complexities

and mineral deposits associated with IOCG systems. Exploring these mines was not only educational but also awe-inspiring, giving us a deep appreciation for the intricate interplay of geological forces that shape our planet's resources.

In addition to the field trips, we had the privilege of participating in two networking events. The first, sponsored by the Australian Institute of Geoscientists (AIG), connected us with professionals and experts in the field. The second, organised by the



Students at the lookout in BHP's Prominent Hill mine site, observing the main contact and fault zones associated with the copper ore hosted in hematite breccias.



Society of Economic Geologists (SEG), offered a platform for knowledge exchange and the forging of valuable connections with fellow students from the University of Adelaide.

One standout aspect of our trip was the visit to the Fleet Space Technologies site, where we were introduced to cutting-edge technologies poised to revolutionise exploration practices in Australia. This not only expanded our horizons but also served as an icebreaker, fostering camaraderie and connections among participants.

It is essential to extend our gratitude to the SEG and, in particular, First Quantum Minerals, the major sponsor for CODES students, for their unwavering support. Without their generosity, this incredible learning opportunity would not have been possible.



The Kanmantoo mine (Hillgrove Resources) visit: (L-R): Ashleigh Ball (FQM and CODES Masters student); Angela Costa (CODES PhD student); Will Leonard (FQM); Alex Farrar (FQM and CODES PhD student); Zeb Zivkovic (CODES PhD student); Saud Algahtani, Britney Russel and Chloe Smythe (all University of Adelaide undergrads).



The visit to the Fleet Space Technologies facility in Adelaide was another highlight of the trip; the group toured the site and were introduced to the cutting-edge technologies being used in efforts to accelerate critical mineral exploration.

## CODES INDUSTRY PARTNERS 2023

Industry partnerships are now open for 2024 – please join us by contacting Professor David Cooke ([d.cooke@utas.edu.au](mailto:d.cooke@utas.edu.au)) or Helen Scott ([helen.scott@utas.edu.au](mailto: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



RioTinto



### SILVER



# HIGHLY SUCCESSFUL CAREERS EXPO IN ZEEHAN

**UTAS Regional Learning Officer (West Coast) BELINDA MARTIN reports on the huge efforts put into making the Zeehan Careers and Study Expo Pilot such a success, securing its future for 2024 and including the CODES Regional Research Collaboration critical metals project as part of the event.**

Professors Sebastien Meffre (Earth Sciences) and Sharon Fraser (Education) attended the pilot of the Careers and Study Expo event in Zeehan during September with several other colleagues from the University of Tasmania. The CODES Regional Research Collaboration project, which is focussed on research into the discovery and processing of critical metals, and how the local community can benefit from this, was showcased.

What a buzz! The air was full of anticipation, energy and excitement and it was great to see the interest being expressed by students and adults in regard to Earth science and

why geology can be such a cool and interesting career!

UTAS, in collaboration with Study Hub West Coast, worked to bring together a selection of local industry, employers, tertiary and vocational education institutions, service providers and local government to make this expo a brilliant success. Students, parents, teachers, community members, education providers and local industry provided advice and information on career and education possibilities.

One of the highlights of the day was the electric vibe in the room with so many fantastic exhibitors who we cannot thank enough for making this such a wonderful day. There were more than 50 students from the two West Coast high schools, making this a vibrant and energetic event. In addition, there was good participation from the community in the afternoon, with information on learning and education as well as the challenge of upskilling or career changes.



Professor Sharon Fraser and Professor Sebastien Meffre hold the fort at the successful Zeehan Careers and Study Expo, which was held on 6 September at the Study Hub West Coast in Zeehan. (Photo courtesy of West North West Working.)

Thanks to the CODES/ES team and everyone who participated in making this event wonderful. Next year we hope to make it even bigger and better.

## MINERALS RESOURCES: MORE OUTREACH ON THE WEST COAST

**The weekend of 11–12 November saw CODES postdoctoral researcher Owen Missen head out to Zeehan once more for the West Coast Heritage & Minerals Fair.**

Owen teamed up with UTAS Regional Learning Officer for the West Coast, Belinda Martin, to run the CODES stall over the two days of the fair, and caught up with many West Coasters keen to know more about the geology of Tasmania.

Apart from the amazing specimens of rock (including large pieces of King Island scheelite ore, a sample



**Rock on:** CODES postdoctoral researcher Owen Missen and UTAS Regional Learning Officer (West Coast) Belinda Martin running the CODES stall at the West Coast Heritage & Minerals Fair in Zeehan. The chocolate rock sweets proved extremely popular!

Cygnets porphyry, high-grade galena specimens and a range of polished pieces from Hellyer mine) visitors to the stall were treated to CODES rock

sweets and other giveaways including the ever-popular 'magnifying rulers', CODES scale-bars and polished rocks for children from the 'Gemnasium'.



# COMPETITION HEATS UP AT THE ANNUAL GEOLOGY DINNER

Once again, the UTAS geology community got together for their Annual Geology Dinner, which this year was held at the University Club on the Sandy Bay campus on 29 September. The three-hour open bar was understandably a very good icebreaker, and the rivalry between the various cohorts in the famed singing competition was as intense as ever. We are informed that the various zany award categories as devised by the Geology Society were particularly good this year. Matt Cracknell received the 'All-rounder good guy award'. No surprises there. And Xin Ni received an award for the 'fastest corridor power walk' as she is often seen walking swiftly around the building. CODES PhD student Acacia Clark recalls the event as being 'a great night with good food and wonderful company!'



The third-year Earth Sciences students won the coveted singing competition crown with their rendition of 'The Gambler' by Kenny Rogers (released in 1978 on Rogers' album of the same name). Pictured here are (back, L-R): Bryce de Haan, Evan Williams, Caitlyn Smart, Will Grant, Saffron McKinnon; (front, L-R): Jasper Fowler, Yvette Chan, Zoe Gorrie and Laura Cockerill. Laura won the 'New York Fashion Week to Nyrstar' award for the best dressed person at an industrial site.



CODES PhD students get into the swing of things as they sing their geology take on 'Have you ever seen the rain?' (originally released as a single by Creedence Clearwater Revival in 1971) with guitar accompaniment from Malai Ila'ava and Vinicius da Cruz.

CODES and Earth Sciences staff – at least a few of them! – belt out their version of 'Road to nowhere' from the 1985 Talking Heads album called *Little Creatures*.





# MASTERS OF ALL THEY SURVEY

The 'Ores in Magmatic Arcs' Masters short course took place once again this year running from 25 October to 11 November, against the spectacular backdrop of the Andes. The course offered 24 students and industry geologists the opportunity to visit world-class ore deposits in Chile and Peru. It was led by Professor David Cooke with assistance from postdoctoral researcher Yamila Cajal and CODES PhD students Victor Torres and Jaime Osorio. CODES graduate Dr José Piquer (Universidad Austral de Chile) was a guest lecturer during two days of the Chilean part of the course.



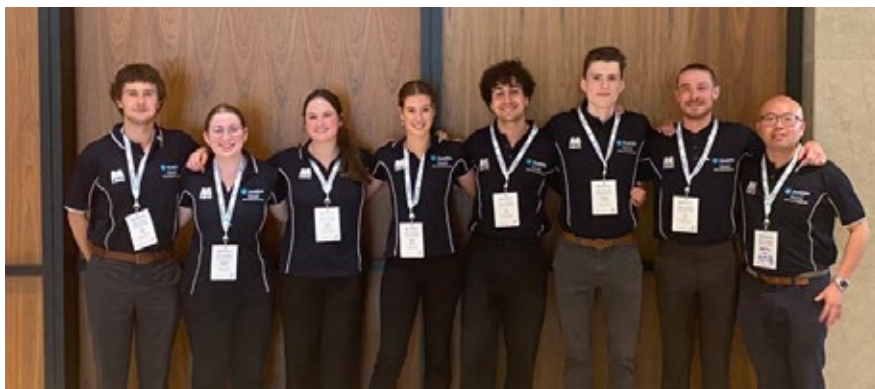
Participants on the 'Ores in Magmatic Arcs' Masters short course to Chile and Peru pictured in late October 2023 on the Rio Maipo transect through the Central Chilean Andes, learning about the geological setting and structural controls on the world's largest porphyry Cu-Mo deposits at Rio Blanco–Los Bronces and El Teniente.



Dr Yamila Cajal (right) and PhD candidates Jaime Osorio (centre) and Victor Torres at the Uccuchucacua Ag-Mn carbonate-replacement deposit in the Central Peruvian Andes. Yamila, Jaime and Victor co-led the 'Ores in Magmatic Arcs – South America' Masters field excursion with Professor David Cooke in late October–early November 2023, where 24 participants visited 17 mines and exploration projects and conducted several regional transects over 18 days in order to learn about the porphyry, epithermal, skarn, carbonate-replacement, IOCG and VHMS deposits of the Chilean and Peruvian Andes.



# ASPIRING LEADERS SCORE HIGHLY AT INDUSTRY SUMMIT



The eight UTAS geology and engineering students pictured at the AusIMM New Leaders Summit in September: (L-R): Beau Imber (geology/engineering), Gabrielle O'Toole, Sophia Minter, Stella Brown (engineering), Issi Port, Harrison Keeble, Tom Sarre, Anthony Tai.

## AUSIMM NEW LEADERS SUMMIT, ADELAIDE, 2023

In late September, a group of eight students from UTAS attended the AusIMM New Leaders Summit hosted in Adelaide. They represented the AusIMM Tasmania student chapter as ambassadors for geology and engineering students in Tasmania.

The summit exposed the UTAS students to current studies and discussions in industry, with technical talks and discussion panels presenting topics focussing on environmental, social and

corporate governance, decarbonisation, and innovations in science and technology pertaining to mining and the minerals industry. The summit included numerous networking events and social activities, where UTAS students gained insight from industry members and forged connections with other student chapter members from across Australia. The AusIMM Adelaide chapter hosted daytrips to operations and plants in the Adelaide periphery, including a visit to the South Australian Geological Survey core shed. The week ended with a (rather competitive) game



CODES Honours student Harrison Keeble at the AusIMM summit presenting on his thesis topic: applications of Fourier transform infrared spectroscopy (FTIR).

of beach volleyball at Glenelg beach between the student chapters.

Two CODES/ES students were selected to give presentations at this year's summit, with Harrison Keeble (Honours 2023) presenting on the applications of Fourier transform infrared spectroscopy (FTIR) from his Honours project, and Sophia Minter (2nd year 2023) presenting on decarbonisation in the mining industry. Harrison received an award for the best submitted abstract along with two other recipients, and these were presented at the summit.

## TECHNOLOGY TRANSFER IN ACTION

CODES staff Matt Cracknell, Yamila Cajal and David Cooke, PhD students Jamie Osorio and Isaac Evinemi and collaborator Dr José Piquer from Universidad Austral de Chile completed a series of workshops and technology transfer meetings in Santiago, Chile, in mid-October. The team met with staff from Rio Tinto, AngloAmerican, CODELCO, Goldfields, South32, Fortescue and First Quantum, where they discussed recent research findings from Amira P1249 and conducted training workshops to facilitate uptake of software and workflows developed by the research team. Matt Cracknell and Isaac Evinemi also attended the Chile Explore conference during their visit to Chile, where Matt gave



CODES postdoctoral researcher Yamila Cajal runs a training workshop for staff from CODELCO during one of the many training sessions conducted by CODES in South America during October.

a presentation on data analytics and mineral chemistry applied to porphyry exploration. The team also completed fieldwork in northern Chile at CODELCO's Porfido Norte project and Atex's Valeriano porphyry Cu-Au system.

## AIG HONOURS BURSARIES AWARDED

CODES Honours students Issi Port and Harrison Keeble were both recently awarded an AIG Honours bursary for 2023. These bursaries are awarded to geoscience Honours students who have demonstrated the ability to effectively communicate their Honours project and the implications that their project will have on the wider geoscience community. Congratulations to both!

## CODES ACHIEVES EU ERASMUS+ GRANT SUCCESS!

**In February 2023 Dr Michael Roach travelled to RWTH Aachen to collaborate with Professor Bernd Lottermoser's research group on a European Commission Erasmus+ Grant proposal to develop virtual educational resources related to critical minerals exploration and production cycles.**

This proposal has recently been awarded €400,000 over two years, and the project commencement is expected to be April 2024.

RWTH Aachen are the lead institution for the grant with collaborators at CODES, the University of Huelva (Spain) and the Technical University of Crete (Greece).

Details of the proposed work program for this project will be provided in later CODES newsletters.



Dr Michael Roach (left) from CODES with Professor Bernd Lottermoser (RWTH Aachen) photographed in 2022 in front of historic underground lignite mine workings in Germany. Together with the University of Huelva in Spain and the Technical University of Crete in Greece, their proposal to develop virtual educational resources related to critical minerals exploration has just been awarded a €400,000 EU Erasmus+ Grant.

## RRC PROJECT UPDATE: LAB WORK IN EUROPE

**During the Australian winter, Dr Julie Hunt, Leader of 'Element 2: Pathways to Production' within the Regional Research Collaboration (RRC) critical metals project, has been working at the GeMMe, University of Liege (Belgium), on electric pulse fragmentation, and at the Institute of Mineral Resources Engineering, RWTH Aachen University (Germany).**

### GeMMe UNIVERSITY OF LIEGE, BELGIUM, SEPTEMBER 2023

Lab work with collaborators in Belgium.

Testing of run of mine (ROM) tungsten-bearing ore, with the help of staff at the GeMMe laboratory, was carried out using electric pulse fragmentation (Selfrag) to determine if liberated scheelite ( $\text{CaWO}_4$ ) can be produced using this size reduction methodology. Typical, mechanical, crushing of ore can produce unwanted size reduction of scheelite, due to the brittle nature of this mineral, resulting in very fine particles of scheelite which can be lost to tails in a processing circuit. The samples are now back at CODES, and testing to determine the degree of scheelite liberation will commence shortly.



### RWTH AACHEN UNIVERSITY, GERMANY, SEPTEMBER 2023

Lab work with Institute of Mineral Resources Engineering, RWTH Aachen University, with Professor Bernd Lottermoser.

Skarn-related Fe-W ore was analysed, at the Institute of Mineral Resources Engineering, RWTH Aachen University, using Computed Tomography (CT) with the help of PhD candidate Leonard Krebbers. Scanning was carried out to determine the original (un-broken) size range and distribution of fine-grained scheelite ( $\text{CaWO}_4$ ) in the ore in a 3D regime. This will help determine if fine-sized scheelite, commonly lost to tails during production, is a result of original mineral size or production of fines during crushing and grinding. Testing and analysis is ongoing at Aachen.





# CHANGING FACES

Another three PhD students have joined us in the past couple of months, and will be working on research linked to the Amira P1249 project and the big Regional Research Collaboration (RRC) critical metals project. And we welcome Dr Paula Montoya from Colombia as a new CODES staff member.

PHD STUDENT	START DATE	PROGRAM	PROJECT TITLE
 <b>Giovana Oliveira Pimentel</b>	2 October 2023	Supervisors: Mike Baker, Matthew Cracknell; working in Program 1 within the Amira P1249 project	Rock characterisation of Platreef-style PGE mineralisation
 <b>Fuseini Atanga</b>	9 October 2023	Supervisor: Mike Baker; working within Program 1 on the Amira P1249 project	Akyem gold deposit characterisation
 <b>Pratichee Mondal</b>	7 November 2023	Supervisors: Julie Hunt, Owen Missen, Mohammad Fathi; working on the RRC project linked with Program 2	Recovery of critical metals from legacy mine waste facilities: Savage River, northwest Tasmania

## ARRIVAL



**Dr Paula Montoya** joined CODES in early October to take up the role of Postdoctoral Research Fellow in Economic Geology. Paula was previously an assistant professor at Universidad del Norte in Colombia. Read more about her background and career on page 15 of this newsletter.

## VISITOR



**Dr Eric Dominic Forson** from the University of Ghana in Accra finished his three-month stint working with Dr Matthew Cracknell in early October and departed for West Africa. He was collaborating on machine learning topics, and hopes to continue collaborating with academics at CODES and Earth Sciences into the future.

## PROMOTIONS



**Dr Owen Missen** will be moving from his current postdoctoral research position to work as a Lecturer in Environmental Geology for the coming year. Congratulations Owen!



**Dr Paul Olin** is now the Leader of the CODES Analytical Laboratories (previously he was Deputy Leader). Congratulations Paul!

## PHDS MOVING ON UP



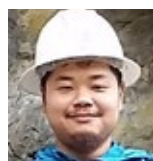
**Alex Farrar** has submitted his thesis for examination. It is titled: 'Tectonic and structural controls on the spatio-temporal distribution of giant porphyry copper deposits in the central Andes'. Alex works as Principal Geologist – Predictive Exploration for First Quantum Minerals.



**Max Hohl** has recently submitted his thesis for examination. It is titled 'Defining the mineral chemistry footprints of the Starra iron oxide-copper gold deposits in northwest Queensland'. He is currently working as a Laboratory Analyst with the CODES Analytical Laboratories.



**Rhiannon Jones** submitted her PhD thesis for examination in August. The title is 'The significance of phyllic alteration at the E26 porphyry Cu-Au deposit, NSW, Australia'.



**Yi Sun** submitted his PhD thesis in July. It is titled: 'Geology of the quartz-pyrite-gold (QPG) mineralization and the new model of the Mankayan district, Northern Luzon, Philippines'. He is now working for Gold Fields in Western Australia.



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

We were shocked and saddened to learn of the sudden and unexpected passing of PhD candidate Joanne Morrison in August. Jo was well-loved by all who had the pleasure to work with her – she had built many lasting friendships as a Masters student and PhD candidate at CODES. Her contributions to our University were outstanding, from both personal and academic perspectives. She was a kind, generous, inquisitive, and brilliant student who will be profoundly missed. Our thoughts are with Jo's family and friends.

The past few months were a particularly busy time for PhD completions, with theses submitted by Alex Farrar, Max Hohl, Rhiannon Jones, Elena Lounejeva, Xin Ni Seow and Yi Sun. These are huge personal milestones for the candidates and their supervisory teams, and I congratulate you all for your achievements – it is great to see all of these years of hard work finally pay off!

Congratulations also to PhD student Alex Farrar and coauthors for their recent publication on 'A model for the Lithospheric architecture of the Central Andes and the localisation of giant porphyry copper deposit clusters' – this article topped the 'most read' list in *Economic Geology* for several weeks in September 2023, and is still in the top five in mid-November

– a testament to the relevance and impact of Alex' research.

Several team members participated in the SEG and SGA conferences and the Amira Exploration Managers forum in Europe in late August – these were highly productive meetings with regards to technology transfer and engagement with the broader academic and industry communities – well done to all who presented at the conferences. The CODES booth at the SEG conference attracted huge interest from potential students and research collaborators – thanks to the team members for staffing the booth and inspiring interest from the broader community.

**David Cooke**

**UPCOMING SHORT COURSES**

**ADVANCED FIELD SKILLS  
IN ECONOMIC GEOLOGY  
(KEA718)**

**4–17 FEBRUARY 2024**

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 Robert Scott, Dr Lejun Zhang, Dr Francisco Testa, Dr Mike Baker

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

**VOLCANOLOGY AND  
MINERALISATION IN  
VOLCANIC TERRAINS (KEA708)**

**1–14 MARCH 2024**

This unit provides an introduction to the processes and products of different eruption styles, contrasts in scale and structure of volcanoes, identification of key volcanic facies associations and interpretation of facies variations. Mineralisation and alteration processes related to hydrothermal systems in subaerial and submarine volcanic environments and implications for mineral exploration are included. This is a field-based unit with trips to the North Island of New Zealand to examine modern volcanic systems and a trip to the West Coast of Tasmania to examine the well-mineralised and altered Cambrian Mt Read Volcanics.

**Unit leaders:** Associate Professor Rebecca Carey, Professor David Cooke, Dr Robert Scott

**Delivery mode/location:**  
Face-to-face, New Zealand (North Island) and Australia (Tasmania)

**FUNDAMENTALS OF ECONOMIC  
GEOLOGY (KEA716)**

**APRIL–MAY 2024**

This unit teaches the fundamental skills needed by all economic geologists. 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](mailto:CODES.Info@utas.edu.au)  
OR Master of Economic Geology Program Co-ordinator, Dr Robert Scott: [Robert.Scott@utas.edu.au](mailto:Robert.Scott@utas.edu.au)