

ORE SOLUTIONS

NEWSLETTER OF CODES CENTRE FOR ORE DEPOSIT AND EARTH SCIENCES

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UTAS TO COLLABORATE WITH INDUSTRY ON CRITICAL METALS IN TASMANIA



The announcement of \$3.5 million in Australian Government funding for CODES and the UTAS School of Education took place on 1 May at the Kara mine (owned by Tasmania Mines), south of Burnie. The funding for the 'Environmentally sustainable production of critical metals' project will enable UTAS to grow the state's important critical metals sector as well as educate and engage regional communities in the resource extraction process. Present were (L-R): Marcus Mollison (Tasmania Mines Pty Ltd), Senator Bridget McKenzie (then Federal Minister for Regional Education), Gavin Pearce (Member for Braddon), Professor Sharon Fraser (CALE), Professor David Cooke (CODES) and Greg Coster (Tasmania Mines Pty Ltd).

UTAS has been granted \$3.5 million from the Australian Government's Regional Research Collaboration Program to fund a novel three-year collaborative partnership between researchers from CODES, education researchers in the College of Arts, Law and Education (CALE) and the Tasmanian minerals industry.

The partnership will enable UTAS to work with industry and government to investigate environmentally sustainable critical metals and improve educational outcomes and regional job opportunities for communities in Tasmania's west coast region. Nine Tasmanian industry partners will participate in the project, along with the Tasmanian Minerals, Manufacturing and Energy Council (MTEC) and Mineral Resources Tasmania (MRT). The research project will be known as 'Environmentally sustainable production of critical metals'.

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FROM THE DIRECTOR

Professor David Cooke looks forward to a busy year with the commencement of the new critical metals project and the opportunities it will open up for CODES.

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P20

IN THIS ISSUE

The Class of 2022: PhD numbers set to climb during the year	3
Staff focus: Dr Jeff Steadman	8
Where are they now?: Dr David Huston	12
CODES shines at Mines and Wines	15
Blast from the past	19

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Critical metals (including tungsten, cobalt, nickel, rare earth elements, tin and magnesium) are vital but scarce resources that society requires for modern technology, infrastructure and the transition to a renewable energy future.

“Australia is seeking to grow its capacity in critical metal resource extraction and production to help meet these needs domestically,” said Professor David Cooke, Director of CODES. “And this project aims to provide new methods and approaches to critical metal processing from existing mines, and from legacy mine wastes leading to improved environmental outcomes.”

The main aims of the collaboration are to:

- Facilitate environmentally sustainable critical metals production in Tasmania.
- Grow UTAS' research capacity and capability through skills development.
- Improve student retention rates and grow the pool of job-ready graduates for the regions.
- Create sustainable long-term research partnerships.

The collaboration will also include partner academic institutions – the University of Queensland and the Université de Liège (Belgium). The nine industry partners are: Group 6 Metals (Dolphin mine on King Island), ABx Group (Deep Leads exploration project), Bluestone Mines Tasmania Joint Venture (Renison mine), Tasmania Mines (Kara mine), Mallee Resources (Avebury mine), GWR – Tasmanian Magnesium (Prospect Ridge), Copper Mines of Tasmania (Mt Lyell mine), Grange Resources (Savage River mine) and MMG (Rosebery mine).

The critical metals project will be led by four Chief Investigators – three from CODES (Professor David Cooke, Professor Leonid Danyushevsky and Dr Julie Hunt) and one from the UTAS School of Education (Professor Sharon Fraser). Together they will lead a team of early- to mid-career academic and technical staff, and project-funded postdoctoral researchers in the three elements of the project:

- *Element 1:* Unlocking critical metal resources – developing characterisation and department



Mineral processing at the Kara Fe-W skarn, western Tasmania. Magnetite – scheelite ore is crushed prior to processing, with a sequential flotation process used to generate a scheelite concentrate in the pilot tungsten processing plant.

toolboxes and workflows for effective resource evaluation and improvements to waste management.

- *Element 2:* Pathways to production – address barriers to cost-effective critical metal production including issues with crushing and grinding, separation of critical metals from gangue, and efficient energy use.
- *Element 3:* Education and engagement – devise innovative solutions to community-based barriers that affect engagement in STEM and limit the growth of the STEM-capable workforce needed for critical metals production in regional areas.

Students and postdoctoral researchers will spend several months on-site with the industry partners to collect samples, test new processes and workflows and help to address the objectives of the project. They will conduct laboratory research at CODES and, where appropriate, at the partner academic institutions.

Funding for this project will enable CODES to take on three new postdocs and eight PhDs, who will work alongside the nine industry partner companies. A ninth PhD student will work in CALE, researching ways in which place-based curricula can inspire young people's interest in learning STEM in school and beyond in the western Tasmanian mining communities. Some of the PhD positions have already been advertised on the UTAS website – if you are interested in carrying out research in this area, you are strongly encouraged to apply:

<https://www.utas.edu.au/codes/available-rhd-projects>

THE CLASS OF 2022: PHD NUMBERS SET TO CLIMB DURING THE YEAR



Isaac Brown, who recently arrived at CODES, is undertaking a PhD at the Haveron deposit in Western Australia. Here he is core logging at Newcrest's Haveron core facility in the corner of the Great Sandy Desert in the Paterson province (60 km east of the Telfer Au mine); the Martu are the traditional landowners of the whole area.

Higher Degree Research Co-ordinators Associate Professor Rebecca Carey and Dr Matthew Cracknell summarise the state of play with our PhD cohort, and look forward to a rosy future with an increase in PhD numbers in coming months.

The first half of 2022 has featured a refreshing return to almost pre-COVID conditions with face-to-face meeting opportunities and conferences, and fieldwork – YAY! for the return of fieldwork. Below are some highlights of late 2021/early 2022, in addition to successes in research, PhD thesis submissions and awards.

Firstly, we would like to warmly welcome back to Hobart and CODES our PhD student Sibebe do Nascimento who was in Brazil until recently. Sibebe will spend the next eight months with us completing the remainder of her analytical work and the submission of her thesis for examination.

It's been a really productive time for

our PhD students over the past year, which is a testament to the resilience of our students, but also supervisors and professional staff who have shown wonderful support. At the end of 2021, four students submitted their PhD theses for examination: Joseph Knight, Robert Davidson, Tom Schaap and Jennifer Thompson. A further two students have submitted in 2022: Peter Berger and Tristan Wells. Congratulations to all these students and best wishes for their PhD completion and future careers.

We also want to acknowledge recent student awards – Hannah Moore won the School of Natural Sciences PhD Award for Outstanding Performance during Postgraduate Studies 2021, which is awarded to one student in each scientific discipline within our College per year. Hannah's award reflects both her research outcomes and impact in addition to contributions to the University in areas of teaching, science communication and service to inclusion, diversity and equity.

Further, Hannah was accepted for a highly prestigious place in the 2022 STEM Stage Skills Scholarship program. Hannah will receive high-level training in stage and presentation skills around science communication, and will then give a presentation at the Festival of Bright Ideas later in 2022.

In other news, as the CODES Graduate Research Co-ordinators we have started a program of engagement with past and present HDR students to try to find out what makes CODES such a great place for graduate research and what we can do better. More opportunity for networking with like-minded others in industry and government sectors has featured in these discussions and we will be focusing on creating more opportunities throughout 2022.

In addition, the new Regional Research Collaboration funding success for CODES (see page 1) and other ongoing projects, such as Amira P1249, mean that CODES will be recruiting a large number of PhD students in the coming months. Stay tuned.

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NEW AND RECENT CODES PhD RECRUITS



CHRIS ALLEN

Supervisors: Clare Miller, Matt Cracknell, Heather Jamieson (Queen's University)

Project title: *Optimising remediation of legacy mines – Geoenvironmental and geometallurgical characterisation of weathered polymetallic mine waste rocks*

Funding: Bluestone Mines Tasmania Joint Venture/Mineral Resources Tasmania

Chris is a past graduate of CODES, having completed Honours in 2010. He has worked in the mineral exploration space since then, with the intention of returning to study or transitioning to a more remedial role always lingering in the background.

Chris is researching the effects of weathering on polymetallic mine waste rocks in western Tasmania. The project has the dual objectives of improving upon the long-term management of mine waste rocks and identifying potential valorisation opportunities through geochemical and geometallurgical characterisation of primary and secondary lithologies and leachates. Acid drainage from waste rock is a well-researched area, but the potential for additional deleterious metal(oids) or favourable deportment of critical metals within secondary minerals is currently understudied.

The study intends to focus on multiple sites across western Tasmania. The first of which is the well-named Happy Valley waste rock dump at the former Mount Bischoff tin mine, currently held by BMJV (joint sponsors of the project with MRT). The project is primarily based around instrumental (e.g., SEM, SWIR, synchrotron) and geochemical methods (static and kinetic columns), but will also integrate field mapping and geophysical techniques to identify



Chris Allen recently joined CODES and his PhD involves optimising remediation of legacy mines in Tasmania. Here he is pictured searching for signs of AMD at the Happy Valley waste rock dump at the former Mount Bischoff tin mine in western Tasmania.

zones of particular concern. The potential effects of climate change on these materials will also be investigated during kinetic tests by the simulation of 'drought' periods on select samples. This project aims to inform mine closure guidelines for Tasmania and attempt to identify potential opportunities for reprocessing and/or advise on appropriate containment of materials.

"I am excited to have the opportunity to be involved with CODES again, and to work with some of the great researchers here."



ISAAC BROWN

Supervisors: Lejun Zhang, David Cooke, Thomas Rodemann (CSL)

Project title: *Geology, geochemistry and genesis of the Havieron gold-copper deposit, Paterson Province, Western Australia*

Funding: Newcrest Mining

This study focuses on the recently discovered Havieron deposit. Havieron is located within the Paterson Province, Western Australia, a region of known significant mineral resources including the giant Telfer Au-Cu deposit, >20Moz contained gold. Multiple recent discoveries in the province make it a prospective area for explorers and academic study.

The Havieron deposit is an ovoid zone of hydrothermal brecciation that is vertically extensive for >1km. Gold mineralisation is focused in the SE of the brecciation, often associated with massive sulphides and intense magmatic-hydrothermal activity. Due to the early stage of mine development and some of the unique characteristics of the Havieron deposit, further understanding of this deposit is important for the operation of the mine as well as further exploration opportunities.

Isaac will work to document and describe the geological features present at Havieron in order to develop controls on the mineralisation and its relationship to the rest of the province. Analytical work will be carried out alongside fieldwork observations to constrain the paragenesis of the deposit including the absolute timing of magmatism, hydrothermal activity and sulphide deposition. The final component of this project will be the creation of a genetic model highlighting the features that can be utilised for exploration targeting.

Isaac is currently completing detailed logging and sampling of drill core with the aim to generate a series of cross-sections through the deposit. All data and drill core at Havieron are provided by Newcrest Mining, the industry partner for this project and operator at the Havieron deposit.

"I am currently conducting fieldwork as part of my project and greatly enjoying spending time in the Great Sandy Desert logging core."



STEPHEN COOKE

Supervisors: Matthew Cracknell, Leonid Danyushevsky

Project title: Pathways to mineral discoveries through computer-based modelling of geochemical data

Funding: Amira Global

Stephen's project is focused on gaining an updated understanding into the advantages and limitations of pre-existing geochemical data analysis methods. Initially, his project will investigate expanding the utility and functionality of LocatOre, a piece of software he started developing in 2017 as part of Amira projects P1153 and then P1202. The goal of LocatOre is to help geologists to predict the heat and fluid source of ore deposits through the use of mineral chemistry data and associated proximator equations, i.e., the relationship between distance to source and mineral chemistry composition. This software has been well received by Amira sponsors – however, there are still uncertainties involved with some of the estimations that the software makes. He hopes that his research into this project will eliminate those uncertainties and ensure that LocatOre is reliable and functional.



Stephen Cooke is undertaking a CODES PhD looking at pathways to mineral discoveries through computer-based modelling of geochemical data, and will be mainly working on the new Amira P1249 project.

Despite working as member of CODES staff in 2021, Stephen has very little academic geological background. His Honours degree focused on computer science and software development, which are skills he hopes he will be able to bring to the field of geology to help bridge the gap between data-driven and knowledge-driven approaches to geochemical analysis.

"I am enjoying my time working at CODES, and I greatly appreciate how welcoming my fellow students and staff have been."



SHANNON FREY

Supervisors: Martin Jutzeler, Rebecca Carey

Project title: Behaviour of submarine caldera-forming silicic eruptions in the Kermadec Arc, New Zealand

Shannon is studying the large-scale sediment waves found near the Macauley caldera in the Kermadec Arc. These bedforms are the product of high-volume density flows and can have an eruptive origin. Conventional views of eruption-fed sediment flows are based on the classic turbidite model, which characteristically are long-flowing and have basin-filling behaviour. However, steep volcanic slopes present in submarine settings and a reduced density contrast between the sediment flow and surrounding water allow for upper-flow regime conditions to occur, resulting in the deposition of large-scale sediment waves such as dunes, anti-dunes and cyclic steps on the volcanic flank. The Macauley sediment waves will be studied from core and detailed seismic data, with possible supplemental experimental data. Understanding these bedforms can provide a framework for recognising similar features in other subaqueous volcanic regions and provide insight into the depositional processes operating and the transfer of material from the caldera to deeper marine settings of insular or submarine volcanos.



Shannon Frey, who is doing a PhD at CODES looking at the behaviour of submarine caldera-forming silicic eruptions, pictured with an epoxy peel from a core collected off the southeast coast of Tasmania.

"I am happy to be in Tasmania and a part of the UTAS community and have thoroughly enjoyed my research so far."



MARKUS STAUBMANN

Supervisors: Clare Miller, Matthew Cracknell, David Cooke

Project title: Integrated ore deposit knowledge: Optimising mineralogical characterisation through the mining value chain

Funding: Evolution Mining

Markus commenced his candidature in March this year and is researching mineralogical characterisation within the GRE46 gold corridor at the Cowal Gold Mine in Central NSW.

GRE46 is one of several structurally controlled, epithermal to mesothermal gold deposits that form Evolution Mining's Cowal Gold Operation. The main active open pit (E42 deposit) is situated along the shore of the large natural inland ephemeral Lake Cowal, with GRE46 mineralisation extending out beneath the lake surface. Mining at GRE46 is exclusively via underground methods, with underground ore scheduled to be

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CODES PhD student Markus Staubmann pictured at the Cowal mine in Central New South Wales; he is researching mineralogical characterisation through the mining value chain.

blended with the open-pit material. Gold mineralisation is predominantly associated with hydrothermal quartz-carbonate-pyrite ± sphalerite-chalcopyrite-galena veins, hosted within a sequence of andesitic and dacitic volcanoclastic rocks and lavas.

The host sequence is commonly chlorite-K-feldspar-hematite-calcite-pyrite (propylitic) altered, often with a later sericite ± ankerite (phyllic) assemblage that is interpreted to be associated with the base-metal-gold event.

Markus will investigate the mineralogical variability throughout the GRE46 gold corridor from a geometallurgy perspective, and how this variability may be used to optimise operational performance and waste characterisation. The PhD study sits within Module 2 (Characterisation and domaining) of the Amira P1249 collaborative research project, entitled 'Exploring, characterising, and optimising complex orebodies – Upscaling orebody knowledge to add value across the mining value chain'.

"It is very early days for my research topic, and I have just returned from an initial visit out to site. But I'm enjoying being back at CODES [Markus completed his undergraduate/Honours in 2010 and Masters at CODES in 2020]. It has been nice to see many familiar faces. Thanks to Clare Miller, Dave Cooke, and Matt Cracknell, as well as Helen Scott and Karen Huizing for their assistance during the application process and initial setup."

MAKE YOUR MARK: PHD OPPORTUNITIES AT CODES

CODES currently has a large number of PhD research projects open to eligible students as several new research projects have been given the go-ahead. It's a great time to check out the research areas we have and find out what CODES and Tasmania can offer you.

There are three PhD research areas linked to our new \$3.5 million 'Environmentally sustainable production of critical metals' project, which is funded by the Australian Government's Regional Research Collaboration program. These are:

- Critical metals from legacy mine wastes, supervised by Dr Clare Miller.
- Pathways to production – critical metals, supervised by Dr Julie Hunt.
- Characterisation of skarn-type deposits, supervised by Professor David Cooke.

A total of eight PhD research projects will be offered in conjunction with this big project, so keep an eye on the CODES website as more become available.

There are also several PhD opportunities linked to the recently established Amira P1249 project: 'Exploring, characterising, and optimising complex orebodies – Integrated deposit knowledge to add value across the mining value chain':

- Halogens in hydrothermal ore deposits, supervised by Professor David Cooke.
- Microinclusions in porphyry Cu deposits, supervised by Dr Ivan Belousov.
- Hyperspectral mineralogy & geochemistry, supervised by Dr Lejun Zhang.

Further PhD research projects include the following, and further opportunities will be made available in coming months:

- Orebody knowledge of the Western Tharsis, supervised by Dr Lejun Zhang.
- Submarine caldera volcanism, Kermadec Arc, supervised by Dr Martin Jutzeler.
- 3D geological and geophysical modelling, supervised by Dr Matthew Cracknell.

Each of these PhDs offers funding and, in some cases, removal expenses; tuition fee offsets for up to four years are also available for some of the openings. The closing date for all of these PhD opportunities is 18 July 2022.

To find out more and to apply, go to: <https://www.utas.edu.au/research/degrees/available-projects>

SOLVING THE MYSTERIES OF MINERALISATION TIMING IN WESTERN TASMANIA



Associate Professor Sebastien Meffre and Dr Sheree Armistead, who will be leading the new research project, pictured in the autumnal Rock Garden at CODES.

Postdoctoral researcher Dr Sheree Armistead outlines an upcoming new joint research project that will sit within Program 1 at CODES and Geoscience Australia's Exploring for the Future Program.

A new CODES project funded by Geoscience Australia and due to start in June will shed light on the timing of mineralisation in some of western Tasmania's ore deposits. The project team includes UTAS researchers Associate Professor Sebastien Meffre and postdoctoral researcher Dr Sheree Armistead, as well as Geoscience Australia's Drs David Huston, Andrew Cross and Geoff Fraser. Researchers aim to constrain the ages of mineralisation from the Interview River, Savage River, Henty, Darwin South and Mount Lyell deposits.

Western Tasmanian mineral deposit ages have typically been inferred from host rock ages, with very few direct ages available. Recent work by Geoscience Australia has identified the presence of phosphate minerals such as monazite and xenotime in many of these deposits, which can be used to directly date mineralisation.

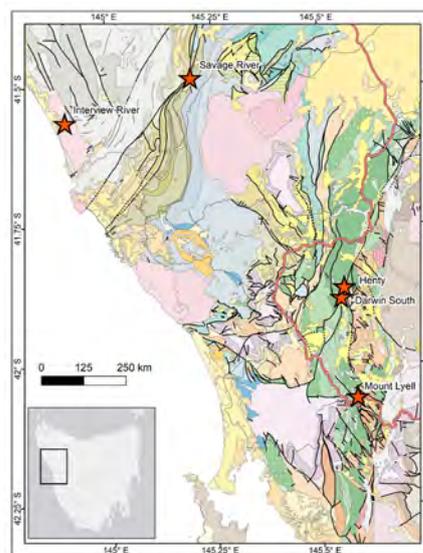
The team will use Geoscience Australia's SHRIMP facilities in Canberra to obtain accurate and precise dates on very tiny monazite and xenotime crystals. Apatite U-Pb data will also be collected using the LA-ICP-MS facilities here at the CODES Analytical Laboratories to provide rapid and accurate information on mineral chemistry and age.

The results of this research will constrain the timing of these five key mineral deposits in western Tasmania, helping with mineral exploration research and providing insights into the broader metallogenic and tectonic evolution of this region.

The two-year project will form part of the Temporal Controls on Mineralisation Module within Geoscience Australia's Exploring for the Future Program, which aims to stimulate mineral exploration investment, including critical minerals, and to open new mineral provinces.

This project closely aligns with the newly announced \$3.5 million 'Environmentally sustainable production of critical metals' project

that will see an increase in critical minerals research capacity at CODES with a strong focus on western Tasmanian mineral deposits (see page 1 for more on this).



Map showing the five intended research areas for the joint CODES/Geoscience Australia project on the timing of mineralisation in some of western Tasmania's ore deposits.

FROM OBSCURITY TO THE HOTTEST TICKET IN TOWN



Dr Jeff Steadman, who completed his PhD at CODES in 2015, will head up the planned new project 'Iron oxide copper-gold deposits: Geochemistry and geometallurgy' starting in mid-2022.

Now midway through his eighth year as a postdoctoral research fellow, Jeff Steadman is no stranger to the corridors of CODES. In this issue he shares some of his story and talks about his new research project, titled 'Iron oxide copper-gold deposits: Geochemistry and geometallurgy', which is planned to begin in mid-2022.

I came to Hobart from Kansas City in August 2009 to undertake a PhD with Ross Large. However, there were complications from the outset: I couldn't begin my candidature right away because I hadn't yet finished my Master's. At the time, Ross wasn't 100% sure whether I would finish it, but to his relief (and mine), I did – nine months later!

When my PhD finally kicked off in May 2010, I went into research overdrive and spent my entire research budget

in six months! Ross was gracious yet again and made provision for required analytical work and fieldwork from his own research funds so that my candidature could continue (NB: Seven years later, I finished my first postdoctoral research project 30% under-budget!).

Even with such mighty expenditures and voluminous data generation, I lacked a 'breakthrough' element in my research. This was a long-term threat to the success of my candidature. I realised that if I failed to produce strong outcomes, then my thesis might not pass review.

My breakthrough finally came in May 2013, when I was invited to sample pyrite-rich black shales at the Kalgoorlie Super Pit in Western Australia by one of the senior geologists there at the time. These historically overlooked rock units

formed the hinge point of my thesis and catapulted me from relative obscurity to being one of the hottest and most controversial tickets in Western Australia. The high point of this season for me was at the Gold '14 conference in Kalgoorlie, where I stood in front of a sold-out (if somewhat unreceptive) crowd at the WA School of Mines and demonstrated to some of the biggest names in gold deposit research that syngenetic gold is present at what many consider to be the most un-syngenetic gold deposit in the world!

(I should also add that during this same period, I received a second breakthrough in the form of my wife, who, like me, had come to CODES to pursue a PhD. Virtually none of what follows would have been accomplished without her by my side!)

Six months after Gold '14, my PhD thesis was accepted, and I began my career as a postdoctoral research fellow on a three-year industry-funded project, called 'The power of pyrite'. As the name implies, my research concentrated exclusively on pyrite chemistry and its applicability in exploration and paragenetic studies. Due to the diversity of my sponsor group, this work was conducted across a wide range of deposit types. However, after some time I began to branch out into other minerals – specifically magnetite, hematite and apatite – via a one-on-one project with the Geological Survey of South Australia that I took over from Associate Professor Dan Gregory when he left CODES in 2015. Unlike my pyrite work, all my studies on these latter minerals focused on one deposit style: the enigmatic and controversial (but highly interesting) iron oxide copper-gold (IOCG) family.

It wasn't until 2018 that my involvement with IOCG systems



A sample of copper-gold ore from the Ernest Henry IOCG deposit. The reddish colour is caused by microcrystals of hematite that are distributed throughout the matrix of the rock. Magnetite is present on the right side of the rock, and pyrite-chalcopyrite mineralisation traverses up the middle of the sample.

became paramount. That year, I joined another three-year project, funded solely by the Queensland Department of Resources, named 'Mineral geochemistry vectoring: Uncovering Northwest Queensland's hidden potential'. On this project, I was part of a team that included Professor David Cooke and Associate Professor Shaun Barker, as well as Dr Jonathan Cloutier. We were successful in delineating the trace element 'signature' of the Ernest Henry IOCG deposit across a range of minerals – notably, chlorite and epidote, in addition to pyrite, magnetite and apatite – and utilised this information to expand the hydrothermal 'footprint' of this system.

A special issue of *Economic Geology*, covering numerous aspects of our work, is planned for publication in 2023.

In January, I, together with Associate Professor Sebastien Meffre, wrote a project proposal, entitled 'Iron oxide copper-gold deposits: Geochemistry and geometallurgy', aiming to expand the work I and my colleagues did in the Cloncurry district over the past three years. The project is currently at the contracting stage and has garnered interest from 13 entities, including a mix of industry and government bodies, and is expected to begin in mid-2022. Our focus will be on unravelling the geochemical and

geometallurgical complexities of four common minerals in IOCG systems – pyrite, magnetite, hematite and apatite – which will aid companies that are either exploring for IOCGs or are actively mining an IOCG deposit.

We will recruit several PhD students to work with us on this project in coming months.

These are exciting times to be conducting ore deposit research, and CODES is the best place to be if you want to generate truly transformative outcomes for the field of economic geology and the mining sector. I look forward to what the rest of 2022 holds!

IT'S NOT ALL ABOUT ORE DEPOSITS: GEOLOGY AND CITIES

Honorary CODES academic staff member Dr Tony Webster has just had a book published that provides a different take on geology – how it shaped our capital cities...

The geology and natural landscapes surrounding you are probably not the first things that come to mind when walking down any street in the central business district of a modern Australian capital city. These landscapes are the most densely urbanised and modified in Australia and have been the centre of activity in each city since they were founded by the British in the late eighteenth to early nineteenth centuries. However, after leaving Earth Sciences/CODES, Honorary Senior Lecturer Tony Webster became curious to know if it was possible to reconstruct the original CBD landscapes as they were at the time of European settlement and to then determine if the original landforms and local geology had played any part in the ways that each city had developed from its earliest days.

Tony found out that it is most certainly possible to recreate the pre-European landscapes of each city, and to a remarkable degree of detail, using historic maps and charts, artworks, written descriptions, and modern topographic and geological information. The results have just been published by US academic publisher Rowman and Littlefield as Tony's second book, *The Foundation of Australia's Capital Cities: Geology, Landscape and Urban Character*.

The Foundation of Australia's Capital Cities is the story of how the places chosen for Australia's seven colonial capitals came to shape their unique urban character and built environments. Tony traces the effects of each city's geologically diverse coastal or riverine landforms and the local natural materials that were available for construction, highlighting how the geology and original landforms resulted in development patterns that have persisted today.

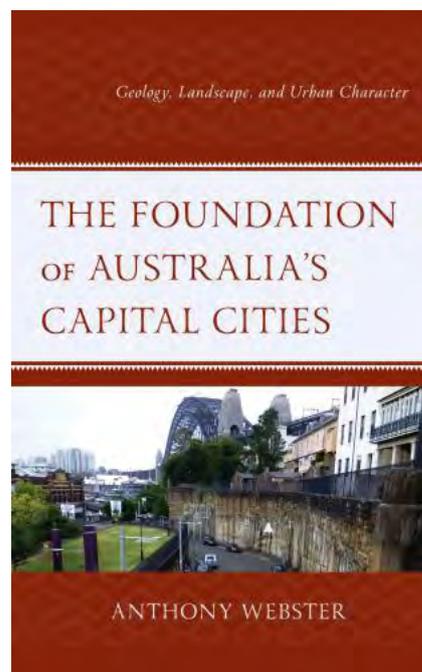
Tony also found that despite the intense urban development of our CBDs, the original landscapes are still with us, and when the conditions are right, they can rapidly be reclaimed by nature. Understanding the pre-urban landscapes is relevant to planning all modern cities, for the development of tools such as flood prediction maps. Local stone is also fundamental to the unique character of our built environments. It is what makes each of our Australian cities unique.

Tony recently gave a joint presentation to the Royal Society of Tasmania and the Geological Society of Australia (Tasmanian Division) about this topic, focusing on Hobart. A recording can be accessed here: <https://www.gsatasmania.org/post/joint-royal-society-of-tasmania-gsa-speaker-event-15th-of-may>

(Tony's first book, *The Geology of the Broken Hill Pb-Zn-Ag Deposit, New South Wales, Australia*, was published by CODES in 2006: <https://www.utas.edu.au/codes/publications/publications-for-sale>)



Dr Tony Webster with his latest book, *The Foundation of Australia's Capital Cities: Geology, Landscape, and Urban Character*, which looks at how geology has shaped Australia's major urban centres.



To order the book, go to:

<https://rowman.com/ISBN/9781498597951/>

The-Foundation-of-Australia%E2%80%99s-Capital-Cities-Geology-Landscape-and-Urban-Character

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INDRANI MUKHERJEE TAKES ON A NEW CHALLENGE



Dr Indrani Mukherjee pictured at the CODES/ES Geology Dinner in October 2021 moderating one of the amusing challenges set for students and staff during the evening.

Dr Indrani Mukherjee, who gained her PhD at CODES in 2018, and went on to become a postdoctoral researcher here, has moved to the University of Toronto in Canada to take up a postdoctoral position researching critical metals in black shales and developing biogenicity tools.

While working at CODES, Indrani worked on the 'Power of pyrite' project with Professor Ross Large, which focused on both fundamental and applied aspects of pyrite geochemistry. It investigated the value of pyrite geochemistry in establishing deep time trends of nutrient availability in ancient oceans and its profound impact on the evolution of early life. And it explored the use of the pyrite technique in devising and informing exploration strategies for sediment-hosted ore deposits. The project delivered its final results to collaborating industry partners and two state geological surveys in September 2021.

Indrani was also a driving force at CODES encouraging her colleagues to take part in equity and diversity events and social gatherings, emphasising all along the importance of inclusion.

She relished her time at CODES as she recounts here:

"I have had the most amazing journey at CODES. I consider myself very lucky to have been part of what I think is a very diverse and loving group of people. I have been at CODES for over eight years and during that time have had an incredible journey, both academically and non-academically. I thank every single one of you.

"Chronologically, I do owe a lot to my Indian mentor Professor Mihir Deb who sent me to CODES in the first place. Thank you to Prof. [Ross Large] for being the world's best supervisor and for all the support he has given and continues to give. A special thank you to Jacqui Halpin and Rebecca Carey for their exceptional mentorship – especially during tough times. I am very grateful to all my friends and colleagues – thank you for your beautiful friendship, support and putting up with me. A special shout out to the "Maxibar" – life would simply be a boring billion years (pun unintended) without you all. If life was a theme park, I'd say CODES has been one of my favourite rides so far!"

CODES JOINS NATIONAL GEOCHEMISTRY DATABASE NETWORK

CODES has joined the AuScope Geochemistry Network (AGN) as a partner to contribute to the AusGeochem database. Professor Leonid Danyushevsky, Associate Professor Sebastien Meffre and Dr Sheree Armistead are facilitating the upload of over 150 CODES geochemistry data sets to the AusGeochem database by the end of 2022. The team will also be involved in the continued development of the data repository and generating new data templates.

The AGN was established in 2019 as an Australian consortium of Earth Sciences research institutes to develop national geochemistry infrastructure. It was born out of a need for better organisation and coordination of geochemistry laboratories and data standards across the country. The AusGeochem database is a FAIR (findable, accessible, interoperable and reusable) data repository of geochemical data, with the goal of providing large-scale data sets to aid in innovative projects by Australian researchers.

Key benefits for partners in the AGN are: increased visibility of data and research outputs, increased promotion of laboratories' capabilities and expertise, and reduced energy spent on data management and cataloguing.

Check out the AGN website www.auscope.org.au/agn for more information.



WHERE ARE THEY NOW?

In this issue one of the first geology PhD students at what was to become CODES talks about his journey from high school in Colorado, with a holiday job preparing samples for analysis, to working as the Principal Research Scientist at Geoscience Australia...and what comes next.

THE IMPORTANCE OF TEAMWORK



DR DAVID HUSTON

Principal Research Scientist and Economic Geologist at Geoscience Australia

PhD completed at CODES in 1988 entitled 'Aspects of the geology of massive sulfide deposits from the Balcooma district, northern Queensland and Rosebery, Tasmania: Implications for ore genesis'.

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

I am currently a Principal Research Scientist and Economic Geologist at Geoscience Australia (GA), Australia's national geoscience public sector organisation. Although my job is largely scientific, it also involves project development, liaison with other agencies and the public, mentoring, and providing advice to government.

Scientifically, my main interests include national and global-scale metallogeny (including links between mineralisation and the tectonic and environmental evolution of Earth through time), the geochronology of mineralisation, mineral system analysis at all scales, radiogenic isotope mapping, and the geology and economics of critical minerals. Ultimately, the goal of this work is to provide data, context and new concepts for the exploration industry in Australia.

What are the things you enjoy most about this role?

The thing I enjoy the most about my current role is the ability to interact with other scientists at GA, within Australia and around the world. In recent years, I have become very familiar with early mornings and late nights spent in online meetings with European or North American collaborators. The most interesting part of these interactions has been engaging with geoscientists outside of my speciality – tectonicists, geophysicists, igneous petrologists and stratigraphers, just to name a few. These scientists provide different perspectives and useful new data sets to understand and predict mineralising systems at the global, province and district scales. Consequently, I have gained new knowledge that enhances my understanding of how mineral

systems operate. As part of my role in critical minerals I collaborate with researchers outside of geology entirely – metallurgists, economists and environmental engineers.

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

My first job in high school was at the US Geological Survey in Denver preparing samples for analysis – crushing, sieving and the like. During summers, I collected stream sediment samples in remote Alaska from helicopters – very exciting for an 18–19-year-old. I kept this part-time job all through my BSc at the Colorado School of Mines and my MSc at the University of Arizona. I came to Tasmania because one of my MSc supervisors, Chris Eastoe, was from Tasmania, and Ross Large had just started as the new economic geology lecturer at the University of Tasmania. I was one of Ross's first PhD students.

For my PhD and subsequent postdoc at the University of Tasmania I documented the geology and geochemistry of volcanic-hosted massive sulfide (VHMS) deposits in Queensland and Tasmania and iron oxide copper-gold (IOCG) deposits at Tennant Creek in the Northern Territory. As part of the postdoc I did microanalyses of pyrite trace elements using the proton microprobe (PIXEprobe) from VHMS deposits. Microanalysis of pyrite using laser ablation analysis is now one of CODES' specialities.

In 1992 I took up a job at the Geological Survey of Canada (GSC) in Ottawa documenting the oxygen and hydrogen isotope systematics of the Kidd Creek deposit in Ontario. This was mainly a lab-based position with only a few field trips to the mine site. I became very familiar with the ins and outs of oxygen isotope



The geologist at work: David pictured inspecting samples of mafic volcanics, north Queensland, September 2008.

analysis during this time, analysing well over a thousand samples (and didn't blow myself up). After the Kidd Creek study I spent a summer doing regional alteration mapping in the Snow Lake district, Manitoba. This was fun not only because of the geology (amphibolite-grade metamorphism really helps in identifying (metamorphosed) alteration assemblages), but also because we got around on a combination of Zodiacs and Beaver float planes, possibly unique to Canada as field vehicles.

In late 1995 I returned to Australia to take up an economic geologist position with the Australian Geological Survey Organisation (GA's predecessor). My first GA job was as the economic geologist on the Pilbara Project. This role involved studying all styles of mineralisation, not just VHMS deposits. Since the Pilbara Project I have worked in mineral provinces all around Australia, in all states and of all ages. This exposure has led to knowledge of a range of deposit types, and my current interests in metallogenesis, mineral deposit geochronology, the use of radiogenic isotopes in metallogenesis, and the relationship of metallogenesis to the tectonic and environmental evolution of Earth.

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

I have gained greatest satisfaction in my career by working in teams –

sometimes as a bit player, but other times in a major role. During my time at GA, these teams have contributed to many aspects of economic geology, including:

- Development of the mineral system paradigm and its application to mineral potential analysis. Identification of the potential of Australian salt lakes for potash. Development of a GIS tool, called Economic Fairways, that assesses the economic viability of potential resource development considering mining and processing costs, the availability of infrastructure and cover thickness.
- Development of the concept of lead isotope mapping and its application to metallogeny and tectonics. Understanding the relationship of mineralisation to tectonic and environmental processes, including secular changes, and how this relates to large-scale controls on metallogenesis as mapped by geological, geochemical and geophysical data sets (e.g., radiogenic isotope, potential field, magnetotelluric, and passive and active seismic data).
- Documenting and understanding the abundance and origin of critical minerals in a range of mineral systems.

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

CODES gave me the building blocks on which to base my evolving interests. It provided me with knowledge of ore forming processes and geochemistry that I have used throughout my career. It also encouraged me to broaden my horizons by developing new skills and techniques – microanalysis using the PIXEprobe for geochemistry and laser ablation.

When I was at the University of Tasmania, what was to become CODES was much smaller – there were only four PhD students – Khin Zaw, Garry Davidson, Richard Wedekind and me – and even when I began my postdoc, there were only 10 people in Ross's entire research group. This meant that we were fairly close as a group and even fraternised with the petrologists from David Green's research group. I think this small group atmosphere

and the mixing with others of different disciplines is what I enjoyed about CODES (before it was CODES). The other thing I valued was the informality in the Geology Department – students, even undergraduates, knew their lecturers and even department heads by their given names, something that I have since discovered applies almost everywhere in Australian academia.

Reflections on your work and the geology sphere/minerals industry as you approach a change of direction.

Like many others of my generation (tail-end baby boomer), I am approaching retirement. Although I intend to keep my hand in research, thereby keeping my mind active, I intend to move sideways into a related, but different, field – the economics of mineral discovery and how the consumption of mineral resources evolves as an economy evolves.

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

It's very rare that I get a soapbox whereby I can spout about experiences that I have gained over nearly four decades as an (mostly geological survey-based) economic geologist, so here goes:

1. Data is king. Ideas and interpretations change over time, but high-quality, reproducible data does not change. At some point in your career, you will look back at ideas you had 10, 20 or more years ago and ask yourself "What was I thinking?", but the geochemical or isotopic analyses you used to develop the idea should stand in good stead.
2. Check your data. We, as economic geologists, often analyse geochemically strange rocks, which means we need to be cautious of the results, particularly if they are unusual. Over my career I have had several instances where unusual matrix effects produced geochemical and isotopic data that appeared to be good, but in fact were erroneous. These instances included Pb overlap on Nb XRF peaks from strongly mineralised samples, polyatomic Nd-P-O interference on Pb isotope peaks

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The creation of CODES: David Huston completed his PhD at what was to become CODES in 1988. This photo appears to have been taken in the late 1980s, just before CODES was officially established in 1989. It shows (L–R): David Huston (PhD student), Richard Wedekind (PhD student), Khin Zaw (PhD student), Mark Rattenbury (postdoc), Ross Large (then lecturer in economic geology), Bruce Gemmell (postdoc), Greg Jenkins (postdoc) and Garry Davidson (PhD student).

during ICP-MS analysis of Nd-P-rich samples and nuclear reactions induced by proton bombardment of chalcopyrite. With the help of co-workers, these problems were resolved, but they left me with the lesson that data must be checked, particularly if it is of unusual composition or produces unusual results.

3. Don't be dogmatic.
(Note to self: Need to work on this.)
4. Become broad, not narrow.
In academia there is a strong

temptation to focus research into a narrow field, that is, to know more and more about less and less. In the right field, this approach can jumpstart a career. During my early career, I went down that path, focusing on the geochemistry and stable isotopes of VHMS deposits. When I joined GA, I was forced to look beyond VHMS deposits because we had to assess the metallogenic evolution of a mineral province. I also was exposed to different types of data sets – reflection seismic and

magnetotelluric data that have enhanced my understanding of mineral systems and led to innovative research relating deposits, such as shale-hosted massive sulfide and orogenic gold deposits, to crustal boundaries and conductivity anomalies deep in the crust.

Little-known facts about you?

Like many geoscientists I enjoy outdoor activities – fishing, bushwalking and camping. I also collect stamps and ice skate regularly.

CODES INDUSTRY PARTNERS 2022

Industry partnerships remains open for 2022 – please join us by contacting Professor David Cooke (d.cooke@utas.edu.au) or Helen Scott (helen.scott@utas.edu.au). By becoming a CODES Industry Partner your company will be contributing to important ongoing minerals research and will have access to significant research benefits.

PLATINUM



GOLD



SILVER



CODES SHINES AT MINES AND WINES



Director of CODES, Professor David Cooke, giving the opening address at the Eighth Mines and Wines conference in Orange, NSW. This was the first time that he had given an in-person national conference address since before the COVID-19 pandemic began in early 2020.

Several CODES HDR students and staff, along with director Professor David Cooke, travelled to Orange in NSW for the Eighth Mines and Wines Conference (11–13 May), which had been postponed from last year due to the pandemic.

Up to 400 participants attended this three-day event that showcased recent exploration successes in the Tasmanides, updated participants on significant new government data compilations and highlighted outcomes of major academic research initiatives. Participants appreciated the opportunity to interact with others in person, rather than online, and to have the opportunity to network and socialise once again. For several of our CODES staff, students and adjuncts, it was the first opportunity this decade to participate in a face-to-face conference. It was particularly pleasing to see so many CODES alumni at the event, including presentations by several of our former staff and students, as highlighted in the accompanying photo collage. Congratulations to the organisers for their determination to put on an

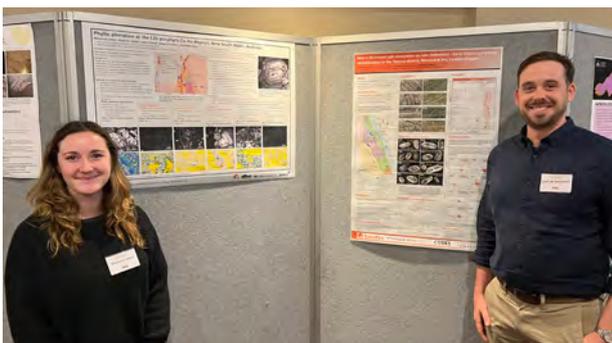
exceptional face-to-face conference under trying circumstances, for publishing an excellent compilation of conference papers in *AIG Bulletin 70*, and for assembling a great array of talks and posters. We are already looking forward to the next conference in two years' time.

CODES PhD student Malai Ila'ava commented on the proceedings:

"It was mentioned a few times by several speakers that this Mines and Wines 2022 was the best attended so far and, with three days of talks, the most ambitious roster of speakers ever! The large turnout certainly added to the excitement of attending an in-person conference amongst old friends and industry peers for the first time in a long time."

Rhiannon Jones, also a CODES PhD, added:

"The Mines and Wines conference was a great opportunity to learn about the different projects and research within the Tasmanides. It was fantastic to be able to meet so many people and get a feel for different opportunities in research, exploration, and mining across eastern Australia."



CODES PhD student Rhiannon Jones and Masters student Lieth de Selincourt looking pleased with their respective posters at the 2022 Mines and Wines.



CODES PhD student Malai Ila'ava, talking about volcanic facies at the Lake Cowal Gold Mine.



Former CODES staff member Dr Anthony Harris from Newcrest presenting on porphyries in the Lachlan Orogen.



Dr Nathan Chapman, former CODES PhD student and now working for Sandfire Resources, talks on the topic of the 'Anatomy of the Fields intermediate-low sulphidation epithermal system'.



Dr Alex Cherry, Project Exploration Geologist with Alkane Resources Ltd and former CODES PhD student, talking about the Roswell and San Antonio gold deposits.



Jonathan Hoye, a former CODES Masters student, who now works for CMOC-Northparkes Mines, talks about the porphyries of the Lachlan Orogen.



Independent geophysical consultant Terry Hoschke, who did a Masters at CODES, on the geophysical characteristics of porphyries in the Lachlan Orogen.



Dr Stuart Smith, a former CODES PhD student from the 1990s supervised by Bruce Gemmill and Dave Cooke, presenting on 'Inflection Resources – pushing the Macquarie Arc north'.

STEPS TO GEOLOGY AND MINING CAREERS...

The University of Tasmania has implemented a new community outreach program in western Tasmania. The 'STEPS' program (Skills. Training. Education. Pathways.) is being coordinated by Christine Gray (West Coast Community Learning Pathways Project Officer) and aims to build confidence in participants who can discover how their life experiences, interests and existing skills can be developed to take advantage of learning and work opportunities on the West Coast.

In mid-May, CODES PhD student Zeb Zivkovic and Director of CODES, Professor David Cooke, together with staff from the Henty gold mine, ran a mining-focused session for local residents in Queenstown to broaden their awareness of minerals industry-related jobs/careers and learning opportunities that are available on Tasmania's West Coast. The half-day session included presentations and hands-on activities, a site visit to Henty's exploration core shed and an overview of water sampling and monitoring of the King-Queen river system.



Participants in the West Coast STEPs program at the Henty Mine core shed (owned by Catalyst Metals) in Queenstown. Catalyst's Geologist Robert Reid (left foreground) talks to a participant while Director of CODES Professor David Cooke (in hi-vis vest) explains the function of the drill core.

Zeb commented:

"The day went really well. I was really happy with the level of engagement from the participants and their eagerness to learn more about mining in their community. The environmental demonstration seemed to really resonate with people. I think it is really important for people living in Queenstown to see that there are people working on the environmental problems there and that there are opportunities for locals to participate and contribute towards ongoing research and eventual rehabilitation."

"There is often this mis-conception that mines only employ engineers and skilled tradespeople but the reality is that they require a whole host of skilled and unskilled jobs to keep the operation running. Sessions like the one we had today are really important in communicating how mines operate and the variety of roles that are required. This, I hope, might encourage more people to consider mining as a career."

This was the first of four mining-related sessions running in 2022, with the second event to be held in Zeehan in late June.

HYLOGGER WORKSHOP WITH CSIRO A BIG SUCCESS



In late April Dr Lejun Zhang, in collaboration with Carsten Laukamp and Jessica Stromberg from the CSIRO, helped to run a two-day workshop at CODES entitled 'Introduction to HyLogger Data and Advanced Hyperspectral Data Processing'. David Green from MRT also assisted. The workshop was a big success with 15 participants in person and about another 40 people taking part online. Here participants are pictured outside CODES during a break between sessions (Lejun is on the far left).

The workshop was initiated by AuScope and their NVCL (National Virtual Core Library) project; the project is the largest drill core mineralogical database in the world and is freely available to users. The aim of the workshops is to provide students, researchers and industry geologists with the background knowledge and tools to 'make the most out of the NVCL data sets'.

BIG TURNOUT FOR THE GARRY DAVIDSON MEMORIAL TOUCH FOOTY MATCH



Staff (wearing hi-vis vests) and student players pictured on the Sandy Bay oval after the fourth annual Garry Davidson Memorial Touch Footy match on 26 May 2022.

A beautiful sunny autumnal day on the Sandy Bay oval was the setting once again for the now annual touch footy match to honour the memory of our much-missed colleague, Dr Garry Davidson, who passed away in 2017.

Students and staff both fielded large teams and there were plenty of subs to fill in for those who fell by the wayside during the game. This is the third memorial match held in Garry's memory: 2018, 2019 and 2021 (no match in 2020 due to COVID) all saw the staff team triumphant. And this year the staff yet again won the match, with a score of 4-1 in the staff's favour.

Many thanks to Rebecca Carey and Karin Orth for organising the event, and to CODES PhD student Javier Merrill for taking on the role of chief BBQ steward for the ever-popular snags afterwards.

After the match Karin Orth presented the team trophy (the highly-prized fluffy white unicorn with pink decoration) to the captain of the winning team – Rebecca Carey. Students need to get in training for next year's match very soon.



Rebecca Carey (left) after receiving the match trophy for the staff team from Karin Orth.



The post-match BBQ was very popular – especially amongst the hungry students.



Play in progress with a misty River Derwent in the background.

TIME FOR TEA...

A number of morning and afternoon teas have been held in recent weeks to mark various important occasions in the CODES/Earth Sciences community here at UTAS.



Critical for CODES: In early May CODES Director Professor David Cooke (middle, standing) announced at a special afternoon tea that CODES had been successful in securing a \$3.5 million grant from the Australian Government to carry out research into critical metals in Tasmania. This will be a joint project with the UTAS School of Education (see page 1 for more on this).



Star Wars comes to CODES: On the fourth of May each year Star Wars fans celebrate the franchise with a day named after a play on the words 'May the force be with you'. This year stalwart Star Wars fan Dr Matthew Cracknell led the charge bringing in Star Wars-themed sweet treats for everyone. Here (L-R) Administrative Officer Karen Huizing, Dr Matt Cracknell, CODES PhD student Peter Berger (who has just submitted his thesis) and Rock Curator Izzy von Lichten (aka Scout Trooper – an outfit made by Izzy herself) tuck into the eats.



Farewell and bon voyage: CODES Postdoctoral researcher Dr Indrani Mukherjee (centre) was farewelled at an afternoon tea in May; she has moved to Canada and will be working as a postdoctoral researcher at the University of Toronto. Here she is flanked by CODES PhD students Hannah Moore and Max Hohl.



That's cool: CODES PhD student Richard Hill (left) admires the Storm Trooper helmet worn by CODES PhD student Zeb Zivkovic (and which came from Izzy's collection) during the 'May the Fourth' morning tea.

BLAST FROM THE PAST

“Several days of scientific talks and remembering past happy events amongst students and staff were topped off with a cruise led by Dr Max Banks describing the geology of the Derwent,” reminisces former CODES director Professor Large.



A big bash: Pictured here in 1997 are attendees at one of the events to mark the 50th anniversary of the UTAS Geology Department – taken on what are now the steps to the Discipline of Earth Sciences. The Department was formed in 1947 when Professor Warren Carey (centre front row in three-piece suit) was appointed professor of geology. He is flanked here by Professor David H. Green and Professor Ross Large. Dr Max Banks is fifth from the left in the front row.

CHANGING FACES

ARRIVALS



There are no new PhD arrivals to report, although we welcome the return of **Sibe do Nascimento** from South America – she will recommence her PhD, which sits within Program 2, after two years in her home country complicated by the COVID-19 pandemic.



Fanghua Dai arrived at CODES earlier this year and is working as a Laboratory Technician in the mineral separation laboratory within the CODES Analytical Laboratories. She has a Masters degree in geology from China University of Geosciences (Wuhan) in China, and now lives permanently in Australia.

DEPARTURES



Dr Indrani Mukherjee left CODES in late April and will take up a position at the University of Toronto, Canada, where she will be working as a postdoctoral researcher. (See also page 11.)



A MESSAGE FROM THE CODES DIRECTOR, PROFESSOR DAVID COOKE

Since our last newsletter, CODES has been successful in bidding for a Regional Research Collaboration (RRC) grant, the details of which are outlined elsewhere in this issue. This was an unexpected funding opportunity with a very tight time frame of less than four weeks from being invited by UTAS to apply for the funding to final grant submission.

Without the enthusiasm and willingness of our academic, industry and government partners to participate in the bid, we would never have been able to put together a successful application in such a short time frame. I would therefore like to thank our colleagues at the School of Education at UTAS –

particularly Professor Sharon Fraser – for joining the collaboration. I also thank Professor Rick Valenta at the Sustainable Minerals Institute, University of Queensland, and Professor Eric Pirard at GeMMe, the Georesources, Minerals Engineering & Extractive Metallurgy research group at Université de Liège – without their efforts in securing the support of their host institutions for the bid, we could not have submitted the application.

I also thank the staff at ABx Group, Bluestone Mines Tasmania Joint Venture, Copper Mines of Tasmania, Grange Resources, Group 6 Metals, Mallee Resources, Mineral Resources Tasmania, MMG, Tasmania Mines, Tasmanian Magnesium, and TMEC for their strong support of the bid, and we look forward to collaborating with them on this major research initiative over the next three years.

I also thank Chief Investigators Leonid Danyushevsky and Julie Hunt, CODES

Project Administration Manager Helen Scott and UTAS Research Development Manager (Academic Division) Sarah Bascomb for their amazing efforts in putting together the successful bid. The RRC funding will allow CODES to employ three new postdoctoral researchers and eight new PhD students, and secures the positions of two of our existing postdoctoral researchers for another three years, and as such provides a great opportunity for renewal, growth and stability at CODES.

We look forward to the transformations and collaboration opportunities that this funding will enable, and the opportunities that it will provide both for research on Tasmania's amazing diversity of mineral resources and for education and community outreach with Tasmania's mining communities.

David Cooke

UPCOMING SHORT COURSES

GEODATA ANALYTICS

8 AUGUST–18 SEPTEMBER, 19–24 SEPTEMBER AND 26 SEPTEMBER – 16 OCTOBER 2022

This short course will provide industry-based geoscientists with an understanding of the fundamental concepts of database handling and manipulation, statistical analyses, pattern recognition and machine learning for the processing, analysis and modelling of large volumes of multivariate geoscience data. It will focus on rigorous approaches of the above methods for extracting and visualising meaningful information from geochemical, geophysical and geological information with applications for mineral exploration; ore extraction and processing; and waste management.

This short course is divided into three modules delivered online and in succession.

Course leader: Dr Matthew Cracknell

Delivery mode/location: Online

EXPLORATION IN BROWNFIELD TERRAINS

24–29 OCTOBER AND 28 NOVEMBER–2 DECEMBER 2022

The compilation of large data sets that are common in areas of significant previous exploration can present a challenge for any geologist. This course is a lab-based unit that looks at exploration in and around mine sites where there is often abundant data. This course will cover GIS applications, and the interpretation of geochemical and geophysical data at various scales. This information will be enhanced by practical exercises involving the integration of multiple datasets from world-class mineralised districts.

Course leaders: Dr Jonathan Cloutier, Dr Robert Scott, Dr Michael Roach

Delivery mode/location: Online

VOLCANOLOGY AND MINERALISATION IN VOLCANIC TERRAINS

11–24 NOVEMBER 2022

This course 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.

Course Leaders: Associate Professor Rebecca Carey, Dr Martin Jutzeler, Professor David Cooke

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

For more details: See the course flyers at: <https://www.utas.edu.au/codes/masters-short-courses>

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