

ORE SOLUTIONS

NEWSLETTER OF CODES CENTRE FOR ORE DEPOSIT AND EARTH SCIENCES

> SUMMER 2021 No.41

ROSS STRIKES GOLD AGAIN

ROSS LARGE'S DISTINGUISHED CAREER RECOGNISED BY THE SEG



Professor Ross Large pictured in his office at CODES alongside the microscope he uses for his studies on pyrite paragenesis. Ross has been named as the recipient of the Society of Economic Geologists 2022 R.A.F. Penrose Gold Medal and is planning to travel to Denver in the USA next August to receive the medal in person.

After receiving the gratifying news that he has been awarded the Society of Economic Geologists 2022 R.A.F. Penrose Gold Medal in recognition of his lifetime of economic geology research, Professor Ross Large is taking time to absorb the information and reflect on its importance.

He also has to break the news to his wife Marley that the beautiful frame she has had made to house his other geology accolades will have to be

redesigned to hold the R.A.F Penrose Gold Medal as well.

Named after the American geologist Richard A.F. Penrose, the founding president of the Society of Economic Geologists, the medal was established in 1923 and is presented not less than once every three years. Ross will be the 56th recipient of the medal.

He says the medal is the most prestigious in the world for economic geology 'so it is a very significant

IN THIS ISSUE

Honours class of 2021	5
Focus on Maya Kamenetsky	8
Where are they now?: José Piquer	12
Upcoming conferences	16
Geology Dinner	17

CONTINUED OVER PAGE

FROM THE DIRECTOR

Professor David Cooke reflects on the year's achievements and on what is to come in 2022.

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honour, and it does cover the whole career. It is a privilege to be able to carry on the tradition of UTAS [three previous UTAS geologists have received the medal].’ And Ross said that the SEG had been particularly impressed by the diversity of his research. The medal recognises his ‘multifaceted contributions to the science and profession of economic geology’ throughout his career. Ross has been involved with researching the genesis of ore deposits, especially those in volcanic and sedimentary settings, worldwide including in Canada, Russia and Africa as well as here in Australia.

He plans to travel to Denver in Colorado, USA, for the 2022 SEG Conference with his wife in August next year to receive the medal in person – once he can work his way through all the COVID-19-induced travel requirements.

Ross says his research ethos has been based on the foundation UTAS geology professor, the great S. Warren Carey, who taught his students to ‘disbelieve if you can’. Carey always said that about two-thirds of published research theory is subsequently proven to be misleading or downright wrong, and thus there is plenty of opportunity for students to challenge current theories and ‘disbelieve if you can’.

Ross was the founder of CODES in 1989, jointly funded by the Australian Research Council, the University of Tasmania, the mining industry and the State Government. Since then, CODES has progressed to become recognised as one of the top ore deposit research centres in the world. After stepping down from the Director’s role in 2012, he has remained here at CODES

researching pyrite chemistry from ore deposits and black shales in order to understand the deep time evolution of the oceans, atmosphere and ore deposits using the composition of sedimentary pyrite measured in the labs at CODES. He said that having the CODES LA-ICP-MS labs has enabled this research: ‘They are the best in the world for what they do and I couldn’t have done the research without them’.

The geology department at UTAS and CODES now has four R.A.F. Penrose Gold Medal winners to its credit: in 2007 Dr Michael Solomon, who was working here as a teacher and researcher, was awarded the medal for his work on the genesis of sea floor massive sulfide deposits.

Two years later in 2009 Professor David I. Groves, who graduated from UTAS with a geology degree and then a PhD in 1968, was awarded the medal for his research into Archean nickel and orogenic gold deposits.

And in 2013 Professor Noel C. White, who did his PhD at UTAS, and is currently an adjunct professor at UTAS and James Cook University as well as a professor at Hefei University of Technology in China, received the medal for his economic geology research – particularly on epithermal gold deposits.

For the University of Tasmania to produce four SEG Gold Medal winners is an amazing achievement, possibly the only university in the world to reach this landmark position. This result is due undoubtedly to the ‘Carey Factor’ and the high international quality of both teaching and research at the UTAS Geology/Earth Sciences Department over the past 60 years.



In the field: Professor Ross Large (left) inspecting drill core at Yerrida Basin in Western Australia with Dr Stuart Bull in 2021.

FACE-TO-FACE TEACHING RESUMES

ORES IN MAGMATIC ARCS JUST MAGNIFICENT

ORES IN MAGMATIC ARCS (22 NOVEMBER–3 DECEMBER)

As part of our Master of Economic Geology program at UTAS, a group of 21 staff and students from CODES conducted a week-long field trip to western Tasmania from 22–27 November. The students were provided with a unique opportunity to learn about Tasmania's amazing ore deposits through a series of mine site visits, and also through visits to exploration core sheds and regional geological transects. The mining community of western Tasmania were very accommodating and generous with their time, providing presentations on the geology and mining operations and providing access to the rocks, outcrops and drill core, so that the students gained first-hand experience of the Mt Lyell, Rosebery, Henty, Renison, Kara and Mt Bischoff mine sites, together with several exploration projects. The group was blessed with beautiful weather, making this field learning experience all the more memorable.



All in: All participants (except the photographer, Mike Roach) in the CODES Masters short course 'Ores in Magmatic Arcs'; this photo was taken at the Mount Lyell mine. From L–R: Richard Hill, Carl Jackman, Lucy Jones, Emma Beattie, Zeb Zivkovic, Pascal Kabilo, Eric Roberts, Alex Farrar, Ian Borg, Lejun Zhang, Clare Miller, David Cooke (rear), Hannah Moore, Xin Ni Seow, Max Hohl (rear), Acacia Clark, Rhiannon Jones, Chris Allen, Sheree Armistead and Tom Schaap.



Single file: 'Ores in Magmatic Arcs' short course participants traversing a valley north of Lake Plimsoll to examine outcropping of the Owen Conglomerate. (Photo: Clare Miller)



Improvisation: At the Mount Bischoff mine Scott Halley draws a carbonate phase diagram in the dirt for course participants while Mark Aheimer from Bluestone Mines Tasmania looks on. (Photo: Mike Roach)



Close encounter: CODES Masters of Economic Geology and PhD students examine volcanic structures and textures with Dr Sheree Armistead (CODES post-doc, front left) and Geoff Cordery (back right) at Mount Lyell. (Photo: Clare Miller)



In view: CODES Masters students and staff on the 'Ores in Magmatic Arcs' Masters short course pictured inside the Mount Lyell mine, looking west down the hill at the historical mine infrastructure, November 2021. (Photo: Zeb Zivkovic)

BUILDING ON SANDSTONE

Introducing Professor Eric Roberts from James Cook University, who is on a two-month visit to Earth Sciences/CODES researching sandstones and shales

I am visiting the University of Tasmania as part of my sabbatical during November and December of this year, and I'm here working on the stratigraphy and provenance of the continental Triassic sandstones and shales that are exposed across Tasmania. I am working on a project with Dr Andrew Rozefelds (former TMAG curator), Dr Espen Knutsen

and current TMAG curator Dr David Hocking, along with Associate Professor Sebastien Meffre and with help from Izzy von Lichten in the rock collections at UTAS, to see if we can systematically recalibrate the age and stratigraphy of the Triassic continental vertebrate fauna from Tasmania, as well as to understand the sedimentary provenance of these sandstones. Hopefully, this work will permit a much better understanding of the relationship between the Triassic faunas of Tasmania and Queensland, as well as the source of syndepositional volcanic zircons in both states.



Professor Eric Roberts, who hails from the western states of the USA, is Head of Earth and Environmental Sciences at James Cook University in Queensland, and specialises in sedimentology; he is at UTAS for a two-month visiting professorship.

QUALITY NOT QUANTITY THE HALLMARK FOR THE HONOURS CLASS OF 2021

Dr Angela Escolme coordinated the Honours program for a second year in 2021 and, as she prepared to take on her new role as a mum, she handed the baton to Dr Indrani Mukherjee close to the finish line in October. This year presented its own challenges and uncertainties – however, the students’ quality research speaks volumes of their determination. Despite COVID-19’s continuing disruptions, our Honours students did a brilliant job in 2021!



The 2021 CODES Honours student cohort was a little smaller than in recent years, due in part to the fact that many of the top geology graduates have been taking up highly paid jobs in industry at a time when the COVID-19 pandemic has left people feeling uncertain as to future job prospects. This photograph was taken at Hadley’s Hotel at the annual CODES/Earth Sciences Geology Dinner in October: (L–R): Honours students Stephanie Morrish, Dina Chu, Kate Cheesman and Zak Weidinger (see page 17 for more Geology Dinner photos).

As they do every year, this year’s Earth Science students embarked on the journey to pursue Honours here at UTAS. The Honours degree in Earth Sciences is designed to train our students for both industry and academia. The program consists of thesis-based research balanced with a literature review and four weeks of short units that take place in Tasmania or at universities in Victoria. The Honours program has two intakes a year (February and July) and consists of around 38 weeks of study, with graduations in December and August. Our Honours program allows full- or part-time enrolment.

The 2021 academic year saw successful completion of four Honours projects; all four students are expected to graduate in December 2021. We also have one 2020 part-time mid-year starter (Till Gallagher) who will graduate in April 2022: Till is currently taking a break from his Honours studies while employed by Flynn Gold Ltd in the search for gold in northeast Tasmania.

The student numbers for 2022 look to be promising, demonstrating continued interest from graduate students in obtaining additional qualifications before joining the workforce. We hope to attract students from UTAS and externally in 2022, given the diversity of research topics and projects on offer at the moment!

RESEARCH TOPICS

Honours students **Kate Cheesman, Dina Chu, Stephanie Morrish and Zak Weidinger** covered a broad spectrum of research topics in their theses. These include geophysics, economic geology, biology, environmental geology, geochemistry, palaeontology and volcanology. Details of their research topics can be found in the following profiles along with some words from the students themselves. Also included is our Dean’s Summer Research Scholarship recipient, Madison Mulder, who is between her second and third years of her geology degree.

The year 2021 provided opportunities to travel for fieldwork but was marred by lockdown uncertainties. The students, however, persevered. Dedicated supervisors, supportive staff and hard-working students made for an excellent Honours program.

SPONSORS

A massive thank you to all our industry partners for giving our students a fantastic opportunity in their careers. Industry sponsors include Bluestone Mines Tasmania and Kirkland Lake Gold Ltd. We are also grateful to the ASEG for sponsoring Zak’s project. The Geological Society of Australia’s Endowment Fund Honours Award was awarded to Till Gallagher (see page 11). We also thank the UTAS Foundation, Mineral Resources Tasmania, the AMIRA P1202 sponsor group and CODES Analytical Laboratories. In addition, a proportion of the project work was supported by internal, university-based funding.

KATE CHEESMAN



Current student, completing end 2021

Supervisors: Clare Miller, Matthew Cracknell, Leon Barmuta (Ecology)

Project title: Invertebrate biomonitoring: A geoscience tool for AMD remediation, North-West Tasmania

Financial support: Mineral Resources Tasmania and Bluestone Mines Tasmania

Using a multi-disciplinary approach, Kate’s Honours research aims to inform the development of a fast and cost-effective tool for monitoring the impact and drivers of acid and metalliferous (AMD) in the Mount Bischoff catchment. Legacy tin mining at Mount Bischoff, northwest Tasmania, has resulted in the generation of AMD which discharges into the upper Arthur River. Remediation activities have been proposed for the site and long-term monitoring of water quality is planned to assess the effectiveness of these remediation strategies. Surface water geochemistry, sediment geochemistry and physiochemical parameters can provide a direct indication of AMD; however, these data provides limited insight into the ecological impact and controls of AMD in the system. The addition of mineralogy and an appropriate ecosystem receptor can provide valuable information to a long-term AMD monitoring study and provide insights not readily captured by bulk geochemical analysis. Kate’s study used benthic macroinvertebrates in combination with sediment mineralogy and water geochemistry to understand the overall impacts of AMD on the ecological health of the study site and identify drivers of change in freshwater environments over time.

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"The Honours year was challenging, fun, and an unforgettable experience that has taught me many valuable practical and general life skills. I am very appreciative for the opportunity to bring two disciplines together in order to tackle an environmental issue. I have been fortunate to be surrounded by the lovely people of CODES, Earth Sciences and Life Sciences, who have all been incredibly supportive and inspiring."

DINA CHU



Current student, completing end 2021

Supervisor: Michael Roach

Project title: Geophysical characterisation of the Pine Creek region, NT, with petrophysical properties

Financial support: Kirkland Lake Gold

Dina Chu investigated the geophysical characteristics of gold mineralisation at Pine Creek in the Northern Territory for her Honours project. She collected petrophysical data on a suite of over 200 drill core samples from Pine Creek including both un-mineralised and mineralised rocks. Properties measured were density, magnetic susceptibility, magnetic remanence, inductive conductivity, galvanic resistivity, induced polarisation, P-wave velocity and S-wave velocity. Dina used this information to undertake both qualitative and quantitative interpretation of regional geophysical data and to assess the potential for direct geophysical detection of gold-bearing ore at Pine Creek. Dina's project was supported by Kirkland Lake Gold.

"The Honours year has been challenging, yet beneficial in gaining and applying new skills. Studying Earth Science at UTAS and CODES has been very rewarding and I am forever grateful for the knowledge shared and assistance given throughout my studies. It's something I'll fondly look back on for years to come."

STEPHANIE MORRISH



Current student, completing end 2021

Supervisors: Rebecca Carey, Martin Jutzeler

Project title: The geological evolution of the Frederick and Sula Seamounts, Coral Sea

Financial support: ARC Discovery Project grant

Stephanie Morrish is conducting an Honours research project on understanding the geological evolution of a chain of submarine volcanoes offshore Eastern Australia. These volcanoes are part of the Tasmantid Volcanic Chain which extends down from the Papua New Guinea area to east of Tasmania. A 2019 voyage on the RV Investigator sampled many of the volcanic edifices along the northern part of this chain. The chain is mostly linear apart from an offshore region to the east of Brisbane where it splits into two separate short chains before going back to a linear chain towards the south. Stephanie has focused her research on this area where the chain bifurcates and is studying two extinct volcanoes called Frederick and Sula Seamounts.

Stephanie is working with geochemists from Edinburgh University to understand the magmatic sources and eruption histories of these seamounts to their individual magmatic and volcanic history, but then to compare this data to other seamounts to provide insight into the possible mechanisms for the bifurcated chain geometry.

"My time at CODES has confirmed my love of research and understanding the unknown. The opportunities to conduct science at sea have been a highlight and dream come true. The connections you make with the lecturers and staff is something I have valued. I have learnt a lot in my Honours year not just geologically but about myself."

ZAK WEIDINGER



Current student, completing end 2021

Supervisors: Michael Roach, Matthew Cracknell, Clare Miller

Project title: Geophysical investigation of the Royal George Tailings Repository, Northeast Tasmania

Project support: Mineral Resources Tasmania

Zak Weidinger's Honours research project investigated the hydrogeological setting of the abandoned Royal George Tin Mine tailings repository in northeast Tasmania using time-lapse geophysical methods. Zak mapped the entire area using frequency-domain electromagnetics and gamma ray spectroscopy to identify the distribution of tailings material. He then acquired repeat electrical resistivity imaging, seismic refraction and ground penetrating radar datasets along a series of lines across the tailings repository to assess subsurface variations due to changing hydrological conditions.

Zak's research suggests that variations in groundwater level rather than surface water flow is the main factor that affects generation and discharge of acid and metalliferous waters from this site. Zak's project was supported by Mineral Resources Tasmania through the Mining Sector Innovation Initiative Program.

"My time at CODES has been incredibly rewarding. I have learned so much about both Earth Sciences and myself. My Honours project has allowed me to apply my knowledge and skills to a real-world environmental issue which has been very fulfilling. I will miss learning from, and picking the brains of, the experts at CODES."



DEAN'S SUMMER RESEARCH SCHOLARSHIP

MADISON MULDER

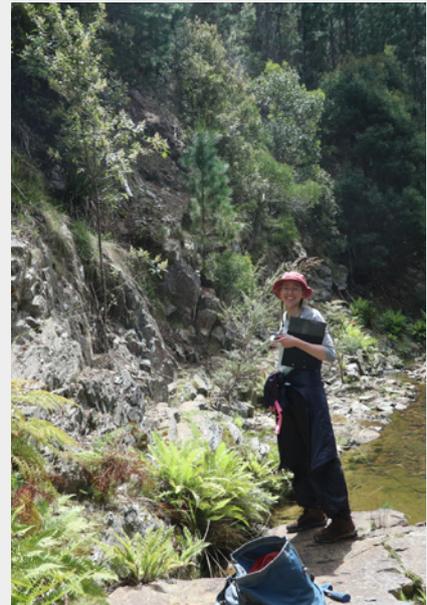
Project title: Comparison of provenance of northern- and southern-sourced Scamander Formation in Eastern Tasmania.

Supervisors: Karin Orth, Sebastien Meffre, Ron Berry.

Madison Mulder, who has just completed the second year of her geology degree, will be working on the Scamander Formation in NE Tasmania over the summer. She is collecting sandstone

samples in regions of known paleocurrent directions and analysing detrital zircons from these rocks. The project builds on the dataset collected in a summer research project by student Eva Knight in the same area last year (2020–2021). The aim is to test if there were different source terrains for the turbidite succession during the Devonian south of Scamander compared to the north of the area. She will also interrogate the MRT rock geochemistry database, if time permits, to augment her study.

"I am most looking forward to being able to practise and learn new skills over the course of my summer research project. Due to COVID a lot of my learning of geology was online last year and by doing the summer research project it has given me the chance to practise some of the skills I missed out on like hand specimen descriptions. My main goal of this project is to figure out whether I like research and want to get into it as a career pathway, and so far I am enjoying myself immensely. It has been very exciting so far and I can't wait for the rest of the summer."



Dean's Summer Research Scholarship student Madison Mulder pictured in November taking measurements of the dip/dip direction of an outcrop along Arm Creek in Upper Scamander for her summer research project.



CODES Honours student Kate Cheesman sampling for macroinvertebrates and collecting sediment and water samples in the Arthur River, Waratah (northwest Tasmania), in March 2021.



Pictured aboard the RV *Investigator* during the June–July 2021 voyage named 'Investigating the IOT: Biodiversity assessment of Australia's Indian Ocean Territories (IOT)' is CODES Honours student Stephanie Morrish. She is holding two samples of volcanics from a seamount. Stephanie was the sole geologist on the ship and her job was to categorise any rocks that came on board. The voyage was run by Museums Victoria, and Stephanie's place on the ship was facilitated by Associate Professor Jo Whittaker and Associate Professor Rebecca Carey.



Dr Matt Cracknell (left) hands a cheque for \$5,000 to CODES Honours student Zak Weidinger; Zak won the inaugural Richard Lane Scholarship from the Australian Society of Exploration Geophysicists (see our last newsletter for further details).



Dina Chu's Honours research at CODES examines the geophysical characterisation of the Pine Creek area. Here she is pictured selecting Pine Creek drill core samples at Kirkland Lake Gold's Union Reef core shed, in the NT during May 2021.



CODES Honours student Zak Weidinger examining acid mine drainage in a seep at the Royal George tailings repository in northeast Tasmania during his August fieldwork in 2021.

Three of the 2020 Honours students - Eliza Fisher, Olivia Wilson and Wei Xuen Heng - were featured in the November 2021 issue of Undergraduate Research News Australia: https://www.acur.org.au/wp-content/uploads/2021/11/ACUR-Newsletter_No20-2021-final1.pdf

SMALL IS BEAUTIFUL (AND VERY IMPORTANT)



Dr Maya Kamenetsky pictured in the Melt/fluid Inclusion Laboratory using a microscope with a Linkam heating stage and observing changes in inclusions during heating.

Dr Maya Kamenetsky talks about her work as a Research Fellow at CODES and the importance of using micro-analytical techniques in the quest for ever more detailed knowledge about existing ore deposits.

I am a Research Fellow at CODES and during the past ten years I have been working in a research team on a collaborative industry-funded project with BHP called 'Connections between Olympic Dam and its regional geological setting'. The members of this team are Jocelyn McPhie, Dima Kamenetsky and Karin Orth from CODES, Kathy Ehrig from BHP, Roland Maas from the University of Melbourne, and several CODES PhD students. The main goal of the project is to investigate magmatic and tectonic events associated with the formation of the Olympic Dam supergiant deposit through extensive dating and petrological characterisation of

samples followed by constraints on the sources of metals (Fe, Cu, Au, U) and fluids (S, Cl, F), which have contributed to the Olympic Dam deposit and nearby prospects.

Olympic Dam is one of the world's most significant deposits of copper, gold, silver and uranium and is situated in the northeastern Gawler Craton, South Australia. Since its discovery in 1975, neither the size nor the diversity of metals and minerals have been adequately explained. Although much research has been devoted to Olympic Dam, fundamental questions regarding metal and fluid sources, and age(s) of these sources and related mineralisation remain unanswered.

My role in this project includes carrying out geochronological analytical work and making comprehensive databases for prospective geochemical modelling.

These databases include optical and BSE images, geochemical analyses of valuable mineral species (pyrite, chalcopyrite, bornite, chalcocite and uraninite), and value-destructive mineral species, such as sericite, chlorite and feldspar. These essential data can lead to improving critical metal (Cu, Au, U, REE) recovery and concentrate quality at the Olympic Dam deposit.

This year my research is mostly focused on the study of phase evolution and compositional changes of fluids recorded in melt/fluid inclusions from quartz and other minerals (carbonate, fluorite and barite) from distal to proximal granite hosting the Olympic Dam deposit.

Melt/fluid inclusions are tiny samples of fluid trapped in minerals, either during their initial growth (primary inclusions) or later when fractures in the host mineral heal in the

presence of a fluid phase (secondary inclusions). Therefore, inclusions can provide information on the physical and chemical nature of fluids during mineral growth, as well as the later hydrothermal history of the system.

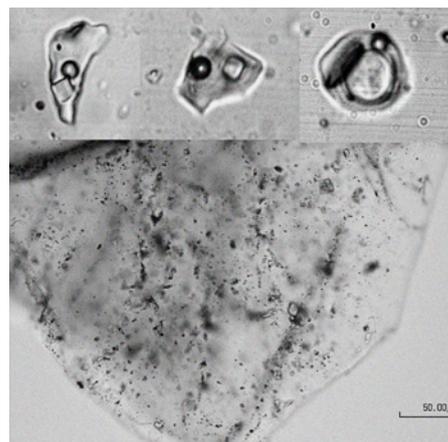
Formation of hydrothermal ore deposits requires a fluid with the capability to transport and deposit metals. Among the most important factors driving the formation of hydrothermal mineral deposits are the temperatures, pressures and compositions of the ore-forming fluids; and melt/fluid inclusions in ore and gangue minerals provide the best tool available to obtain this information.

Fluid and melt inclusion study requires a special approach and several methodologies and techniques. It starts with special samples preparation, followed by petrographical characterisation of the samples and minerals of interest (quartz, fluorite and carbonate) using optical microscopy, scanning electron microscopy and cathodoluminescence.

The temperature of the mineralising fluid represents one of the most important factors in the formation of ore deposits. Fluid inclusions provide the most direct and, in most cases, the most accurate technique for estimating temperatures of ore formation. After initial petrographical characterisation, heating experiments will be performed. For these I will be using a Linkam heating stage that allows me to observe and record the changing of the phases in the melt/fluid inclusion as it is reheated to its original melt temperature.

The compositions of coexisting phases and salinity in fluid inclusions will be determined using Raman spectroscopy (volatiles, such as H₂O and CO₂) and LA-ICP-MS (major and trace elements in melt/fluid inclusions as well as evaluating the relative metal budget of magmatic and hydrothermal fluids).

I hope that the results of this project can significantly advance the current understanding of Olympic Dam by recognising the different stages of fluid evolution towards mineralising compositions and provide just a small glimpse into the bigger picture of the Olympic Dam.



Different types of melt/fluid inclusions (upper row) and inclusion distribution (bottom image) in granitic quartz from the Olympic Dam deposit.

OPEN DAY 2021

This year the UTAS Open Day was a face-to-face event, although masks were mandatory. The Sandy Bay campus played host to prospective students and visitors on 21 November.

CODES PhD students Hannah Moore (left) and Acacia Clark ran the Earth Sciences booth and were kept busy with enquiries. Well done ladies!



RESEARCH EXCELLENCE

INDRANI GOES DOWN TO THE WIRE

Reaching the finals of a national early career researcher (ECR) competition is no easy feat, but CODES Postdoctoral Research Fellow in Geochemistry Indrani Mukherjee lived to tell the tale. Here she recounts the experience of reaching the final four entrants from across the nation in the CRC-ECR annual competition. She is the first ECR at UTAS to reach the finals of this competition since Dr Tomas Remenyi did so in 2017:

"It was an exciting and rare opportunity to showcase my research at a national platform. The CRC-ECR competition involved submitting a one-minute video of my research. I was one of the

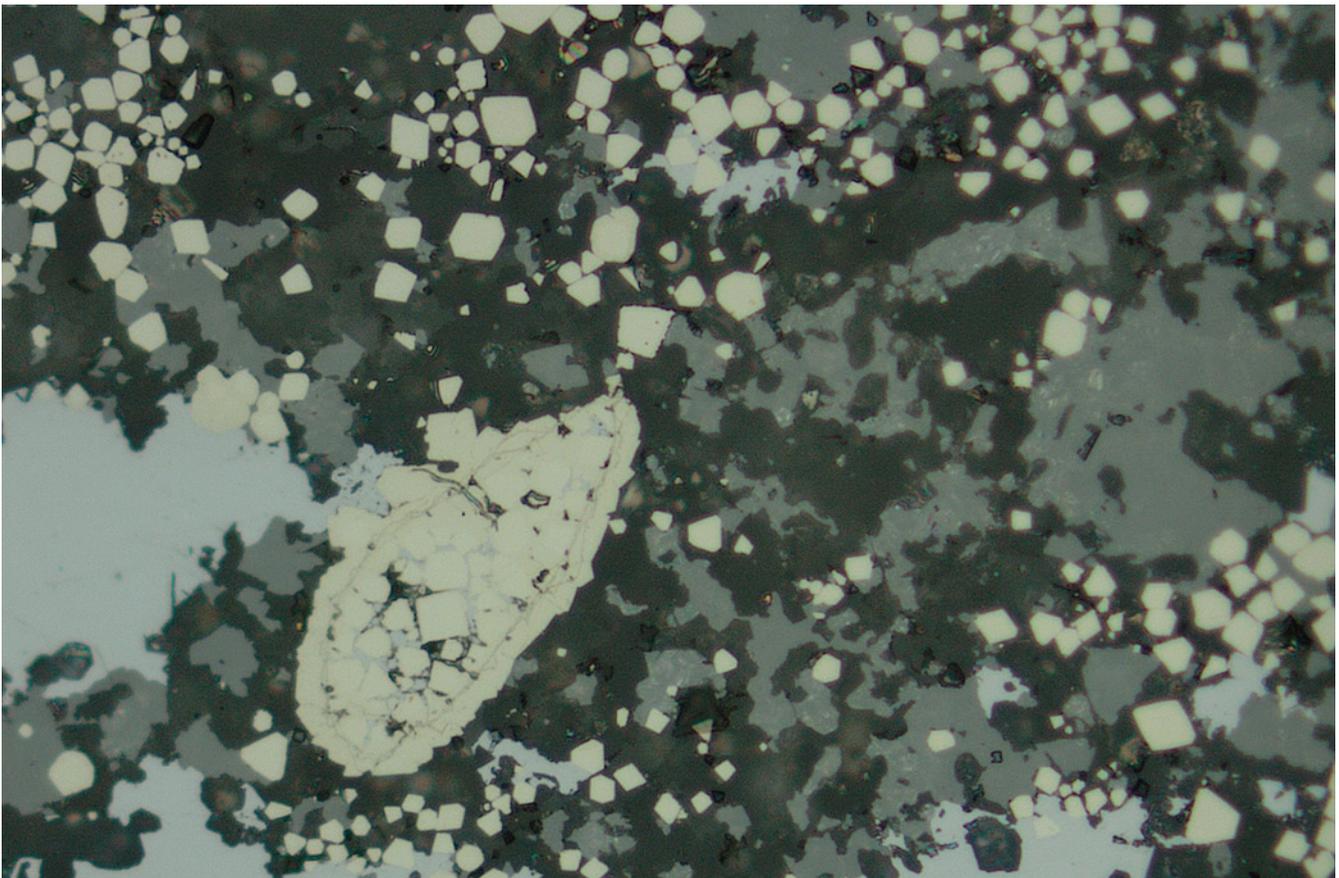
four entries that was selected for the national competition that featured in the 'Collaborate-Innovate' conference. The competition presented an opportunity for a five-minute presentation of my entry. Although an online presentation did not match up to an in-person delivery, I did appreciate the opportunity to share my work to the wider scientific community.

"The presentation was well-received and scored me a collaboration with Professor Paulo de Souza (Head of School, Griffith University), who specialises in the area of micro-sensing, and explores applications of his instruments across different fields of science and in industry, including mining, space and ICT. He contributed to the design, production,

deployment and operation of a sensor used by NASA onboard two rovers on Mars. My collaboration with Paulo involves application of microanalytical techniques to distinguish between biological vs non-biological textures. This includes the application of the Mossbauer spectroscopy."

For coverage of this competition see: <https://www.innovationaus.com/?s=The+smart+money+bets+on+the+cr-trained+phd+innovators>

<https://www.nationaltribune.com.au/dylan-ashton-wins-ecr-prize-for-work-on-using-kangaroo-tendon-for-grafts-on-humans/>



Indrani's research: Reflected light image of fine crystals of pyrite and sphalerite with a pyrite aggregate (positioned in the centre of the image), potentially of biological origin. The pyrite aggregate may possibly represent a biological organism that was replaced by the iron sulphide soon after its deposition and before its decay. Microanalytical compositional imaging combined with statistics can differentiate between the fine pyrite crystals dispersed in the matrix vs the lens shaped pyrite aggregate that is possibly of biological origin. This sample represents pyrites in dolomitic black shales that are 1.6 billion years old. Her research uses compositional information from a variety of pyrite textures (biological and non-biological) to shed light on ancient life 1.6 billion years ago.

VICE-CHANCELLOR'S AWARDS 2021

VC'S INNOVATION AWARD FOR 2021



Senior Lecturer Dr Michael Roach has been awarded the Vice-Chancellor's Innovation Award 2021 for his work on the Virtual Geology library (AusGeol.org) and for work on developing virtual teaching resources for UTAS. Here he is pictured using a drone to gather geological data on the east coast of Tasmania. (Michael was unable to attend the VC's award presentations as he was in the field.) Congratulations to Mike from all at CODES and Earth Sciences!

VC'S EARLY CAREER RESEARCHER AWARD FOR 2021



Postdoctoral Research Fellow in Geochemistry Dr Indrani Mukherjee has been awarded the VC's Early Career Researcher Award for 2021. Indrani's research focuses on developing a nuanced understanding of Earth's ancient marine environments. She uses novel and cutting-edge geochemical techniques to question key concepts, and explores links between early Earth evolution, the origin of complex life and formation of precious mineral deposits. She is pictured at the VC's

Awards presentation event on 1 December with Professor Kate Darian-Smith, Executive Dean and Pro Vice-Chancellor, College of Arts, Law and Education. Congratulations to Indrani from all at CODES and Earth Sciences!

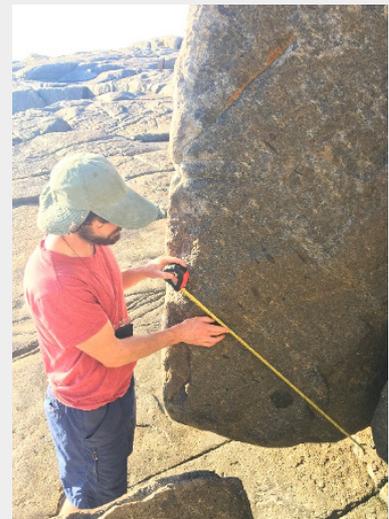
At the Vice-Chancellor's Awards Associate Professor Sebastien Meffre was recognised for his 25 years of service to UTAS. Congratulations Sebastien!

GSA ENDOWMENT FUND HONOURS AWARD 2021



CODES Honours student Till Gallagher was selected to receive the 2021 Geological Society of Australia's Endowment Fund Honours Award for Tasmania. His \$1,000 prize money will be used towards supporting further fieldwork. Currently Till is taking a break from study to work for Flynn Gold Ltd., exploring for gold in northeastern Tasmania. He will return to CODES early next year to continue his Honours.

"I was thrilled to receive the endowment fund not only because it was the first time I had applied for a grant but also because I was now able to attain some extra geochronological ages for my project. I had already processed and acquired 9 U-Pb radiometric dates for rocks in my study areas but really wanted to better understand the ages of some new rocks that I had come across later during fieldwork. Receiving this fund has allowed me to do just this and while the results are somewhat perplexing this has increased my understanding of the temporal relationships of units in my project. By the end of my project, I am hoping to comment with more certainty on the origin and significance of this enigmatic texture."



CODES Honours student Till Gallagher measuring an enigmatic texture that he and his supervisory team distinguish as 'White igneous lenticular Domains', or WiLDs. This texture, thought by some to be relict pumice, is found throughout much of the St Marys Porphyrite on the east coast of Tasmania.

WHERE ARE THEY NOW?

In this issue we meet 2015 CODES PhD graduate José Piquer, who is now a professor of geology at the Universidad Austral de Chile in South America...and lives in a city that is remarkably similar to Hobart

THE CALL OF THE MOUNTAINS...



DR JOSÉ PIQUER

Professor at the Institute of Earth Sciences, Universidad Austral de Chile

PhD completed at CODES in 2015 entitled 'Structural geology of the Andes of Central Chile: Controls on magmatism and the emplacement of giant ore deposits'.

What is your current employment and your work responsibilities?

Since I obtained my PhD at CODES and came back to Chile, I have been a full-time professor at the Institute of Earth Sciences of Universidad Austral de Chile. My duties include teaching undergraduate units in our Geology program, conducting research in various projects (including an active collaboration with CODES through AMIRA projects led by Dave Cooke, in which I participate as a collaborator), doing outreach activities for the community (mostly for children at schools), and engaging with industry through collaborative research

projects and sporadic consulting jobs. This year, in March, I was elected as the head of the Institute of Earth Sciences, which means I have to coordinate and promote the growth of our Institute, in accordance with our strategic plan.

What are the things you enjoy most about this role?

Without a doubt, the thing I most enjoy about my job is doing fieldwork in the beautiful Andes mountains, either with groups of undergraduate students or as part of research projects. Sadly, this was almost impossible during 2020 and early 2021 due to the pandemic and the associated restrictions, but fortunately now the situation in Chile is much better and we are allowed to travel again; I am regularly going on fieldtrips and enjoying the mountains of central and southern Chile. I am also enjoying the strategic aspects of my new role leading the Institute of Earth Sciences, as we have to plan for the future growth of the Institute, including definitions about the research fields in which we will focus and the profiles of the new academic positions we will open to enlarge our team.

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

This is my first academic job, to which I applied while I was still in Hobart, completing the last stages of my PhD in late 2014. Before studying at CODES, I worked for almost eight years as an exploration geologist. Most of that time I was working at the explorations department of CODELCO, the Chilean, state-owned mining company. It was an enjoyable time, which gave me the opportunity to work together with some of the greatest exploration geologists in Chile and learn from their knowledge and experience. That job also allowed me to travel throughout central and northern Chile, exploring

for different types of deposits in various geologic settings, while enjoying the landscapes of the Andes mountains and the Atacama Desert.

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

I can think of three very special moments. One of them is, of course, obtaining my PhD degree at CODES. Before that, during the time I worked as an exploration geologist, my highpoint was when a drilling campaign I recommended led to the discovery of a new ore body in the Rio Blanco-Los Bronces porphyry Cu-Mo cluster of central Chile. And during the time working at the university, I think my highpoint was earlier this year, when the journal *Geology*, one of the most prestigious scientific journals in our field, published our work in which we proposed a new model for the structural controls on the emplacement of giant porphyry deposits.

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?

My research at CODES was about the relationship between faults and the emplacement of magmatic-hydrothermal systems, at different scales. CODES was absolutely fundamental to get me where I am now. First of all, having a PhD is now a requisite for any serious academic job; it would have been impossible to even apply to my current job without the degree I obtained at CODES. Also, in my current research projects I am still constantly applying the various tools and knowledge I learned at CODES, mainly from my PhD supervisors (Dave Cooke, Rob Scott and Ron Berry). Regarding what I enjoyed about CODES: well, many things, but if I have to choose one, I will say that I really enjoyed being able to work in a truly

international research group. It is not an exaggeration to say that every continent was well represented at CODES. This was a real privilege.

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

Although now I work in the academy, I am still strongly connected with industry, and it has certainly changed in many ways since the days when I was working as an exploration geologist, before going to CODES. Probably the most important change is the increasing awareness in the community and governments about the possible environmental and social impacts of the mining industry. Humanity desperately needs the products that come from mining, so exploration and mine geologists will still have to do their job, but we will also need to be innovative and make sure that mining is done in a responsible way. In particular, in the case of Chile, where most large mine operations are in the Atacama Desert, water usage is critical. Considering the strong scarcity of fresh water, new operations will have to rely on seawater, and be efficient so as to recycle as much water as possible.

Words of wisdom for up-and-coming geologists graduating from CODES (especially given the COVID-19 pandemic and how this might change things in the future)?

As a result of the COVID-19 pandemic, there are now lots of wonderful, free talks and workshops available on many websites. It is possible to find almost every topic in economic geology covered. Take advantage of this wonderful learning opportunity! And also, share your knowledge: probably you will find many opportunities to give open online talks about your research. This is also a chance to reach a truly international audience, with viewers from all over the world.

Another recommendation, particularly now that the restrictions are lifting as the vaccination rates improve, is to take every possible opportunity to go out into the field. It is possible to learn a lot online, but seeing the rocks in the field is

impossible to replace. Get involved in field trips as much as you can.

Also, sometimes geologists are so focused and passionate about their job, that they lose their connection with broader society. Try not to fall into that trap. Earth scientists have a lot to contribute to society, and this can be done, for example, by collaborating and participating in geological societies, participating in different instances in which local or national governments or parliaments seek advice from experts in Earth sciences, or increasing the awareness about the relevance of Earth sciences for our daily lives in the broader community (particularly in children!).

Any little-known facts about yourself that you think we should know?

Before studying geology, I enjoyed mountain climbing. When I was at high school, with two friends we started climbing mountains in the Andes close to the city of Santiago, where I lived at that time. In 1995 we completed some basic mountaineering courses, and during the following years we went to the

mountains as much as we could. The reason I decided to study geology, was that I knew it was a career which would give me the opportunity to spend a lot of time in the mountains (and get paid for it!).

Another fact that might be unknown by many people who knew me during my time at CODES, is that when we moved to Hobart, we did it with a newborn baby. With my wife I already had a boy, who was three years old at that time, and she was pregnant when we were informed that I was awarded the scholarship I needed to be able to move to Hobart to begin my PhD. We planned everything so that the new baby (which was finally a girl) would be born right before moving to Hobart. When we took the flight to Hobart, she was one month old. The process of getting a passport and an Australian visa for a newborn baby was quite funny. Now she is 10 years old, and we live together with my wife and son in Valdivia, southern Chile, where the main campus of Universidad Austral is located. And here a last fun fact: Valdivia is a city which has many similarities with Hobart. It is about



Professor José Piquer (far left wearing grey hat) with a group of his students on a field trip to the central Chilean Andes. Here they are pictured at Baños Morales, in the Maipo river valley. In the background are strongly folded Mesozoic rocks, and the active San Jose volcano, which marks the border with Argentina. They were looking at the regional context in which the giant porphyry Cu deposits of central Chile were formed.

CONTINUED FROM PREVIOUS PAGE

the same size, relatively slow-paced and relaxed, located in an estuary, at almost the same latitude, surrounded by temperate rainforests, even the highest building is the casino!!

José's paper referred to above was written with colleagues Pablo Sanchez-Alfaro and Pamela Pérez-Flores and is called 'A new model for the optimal structural context for giant porphyry copper deposit formation':

<https://doi.org/10.1130/G48287.1>



The Chilean city of Valdivia, where José currently lives and where the Universidad Austral de Chile has its main campus, has many similarities with Hobart.

CODES CONNECT

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

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

The Discipline of Earth Sciences webpage ([https://www.utas.edu.au/natural-sciences/earth-](https://www.utas.edu.au/natural-sciences/earth-sciences)

[sciences](#)) has been updated and now has a link to the Earth Sciences Facebook page as well as short profiles with videos about some of our student researchers.

You can follow one of our Facebook pages:

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

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

You can also follow our LinkedIn page:

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

BECOME A SUBSCRIBER

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

CODES.info@utas.edu.au

CODES INDUSTRY PARTNERS 2021

Several new Industry Partners have joined with CODES in the past few months; our current Industry Partners are listed here. Please contact us if you would like your company to be an important supporter of CODES' research.

PLATINUM



GOLD



SILVER



COPPER



FRANKLIN BEAUTY UNCOVERED

UTAS security guard Galvin Miller got a huge surprise when he dug up an intriguing-looking rock during a spot of gardening at his property in Franklin. Here Dr Robert Scott explains its origins and its geological importance – after the rock was sawn in half by the CODES Lapidary Manager Al Cuison.

Galvin's spectacular specimen is a water-worn cobble of calcium carbonate-cemented breccia. The texture of the carbonate resembles travertine, suggesting this rock was probably formed by ancient hot spring activity, either in the Franklin area, or nearby. Although the cobble has been rounded by fluvial transport, the rock itself is relatively soft, and probably unlikely to survive transport over distances of tens of kilometres or more. The rock consists of numerous, mm- to cm-sized, greenish grey to rust-coloured rock fragments that are concentrically rimmed by multiple, thin layers of pale to darker rust-coloured calcium carbonate, set in a pale orange, calcite-cemented granular matrix of quartz and

calcium carbonate. The sparse darker and pale greenish grey rock fragments are either limestone or carbonate-altered mudstone, and most probably derived from the Permian Lower Parmeener Supergroup, which, along with Jurassic dolerite, comprise the bedrock in the Franklin area.

The appearance of the calcium carbonate in this sample is typical of travertine, a type of terrestrial limestone formed by the rapid precipitation of calcium carbonate from CO₂-rich ground waters, most commonly around the vents of mineral hot springs. Travertine often forms in concentric layers and is typically white, tan, cream or (as in this case) rust-coloured. The finer-grained matrix of the breccia closely resembles material that forms clasts at the core of many of the rimmed fragments. In addition, the breccia also includes aggregates of concentrically rimmed clasts that are themselves rimmed by similar, but later stage, concentric overgrowths of calcium carbonate. Collectively, these features indicate the breccia formed through multiple episodes

of fragmentation and cementation as would be expected if it formed in an episodically high-energy hydrodynamic environment, like the vent zone of an active hot spring.

Travertine has been found in several other locations in the greater Hobart area, most notably in now buried nineteenth-century quarries located in Geilston Bay and Burnett Street, in inner Hobart. At these other Hobart localities, travertine deposits were associated with Tertiary basalts dated around 22 million years old. Interestingly, these other deposits have yielded some of the oldest known marsupial fossils from southern Australia (Tedford et al., *Nature*, 1975). Although not widespread, Tertiary basalt does occur upstream of Franklin, in the Huonville area. Thus, it is likely that this beautiful rock is of similar age and origin to the other Hobart travertine deposits. Accordingly, Galvin's sharp-eyed discovery, is interpreted as the product of hot spring activity linked to basaltic volcanism and rifting that occurred in the proto-Huon Valley at least 22 million years ago.



UTAS security guard Galvin Miller (centre) holding the rock he found in his garden at Franklin in the Huon area of Tasmania, flanked by Professor David Cooke (left) and Dr Robert Scott.



A closer view of the cobble of calcium carbonate-cemented breccia, which Dr Scott dates to probably at least 22 million years old.

UPCOMING CONFERENCES

(SOME) FIELD TRIPS ARE BACK!

In early 2022 CODES/Earth Sciences staff will be contributing to two geology conferences, and both geologists and students will be raring to go after so many months in and out of lockdowns and so much uncertainty around travel, although the SGA conference in New Zealand has recently fallen victim to COVID-19 restrictions. Here are the details –



SPECIALIST GROUP IN TECTONICS AND STRUCTURAL GEOLOGY (SGTSG) 2022 CONFERENCE

**KING ISLAND
8–10 FEBRUARY 2022**

This conference will be themed 'Structure in the Strait' and will encompass three days of field trips, robust discussions and relaxing networking opportunities over a beer or two. There will be an opening

'icebreaker' event at King Island Boat Club on the evening preceding the conference (7 February).

Several half-day field trips throughout the week will highlight King Island's spectacular geology. Conference sessions including posters and talks will showcase Australia's best research in structural geology and tectonics.

In the words of Ros Cayley from the Geological Survey of Victoria: "This is going to be one of the most keenly anticipated SGTSG conferences in a long, long while, and not just because King Island geology holds some of the keys to the mysterious geological

link that exists between Tasmania and the mainland. The coastal exposures of geology are awesome, and it's going to be fantastic catching up with friends old and new... 'In Real Life!'"

Many presenters have already been confirmed for this event – the full program will be available before 10 January on the website. If your organisation would like to sponsor student costs, the icebreaker, drinks or dinner, please email Sebastien Meffre (sebastien.meffre@utas.edu.au) or the organising committee (sgtsg2022tas@gmail.com).

See the website for further details and to register:

<https://www.sgtsg.org/>

Registrations have been extended until 5 December; abstracts close on 7 December.



16TH SGA BIENNIAL MEETING 2022

**VIRTUAL EVENT (HOSTED FROM
NEW ZEALAND)
28–31 MARCH 2022**

The theme of this important virtual conference is 'The critical role of minerals in a carbon-neutral future'. The vital role that so-called green minerals will play in a world that is

transitioning to zero emissions will be explored during the conference, as well as the ongoing need to sustainably mine rare earth elements and continue R&D into mineral resources and their geology.

Several members of CODES staff – including David Cooke, Lejun Zhang, Jonathan Cloutier and Matthew Cracknell – will be running short courses and workshops at the conference; in addition, David Cooke

will give a plenary address on the topic of 'Geological evolution of the Lihir gold deposit, Papua New Guinea'. And David Cooke together with Lejun Zhang, will be chairing the conference session on 'Porphyry and high sulphidation epithermal systems'. This session will aim to provide a holistic overview of the vital resources of Cu, Mo, Au and Ag. Some of the short courses and workshops will be run pre- and post-conference, so make room in your diary for them if you'd like to attend.

See the conference website for further details and to register:

www.sga2022.org

This conference was originally planned to take place in New Zealand but ongoing COVID-19 outbreaks have meant that it has been converted to online. Earlybird registration closes on 1 February.

POST-PANDEMIC: THE GEOLOGY DINNER RETURNS

There was no Geology Dinner in 2020 due to COVID-19 restrictions, and so this year CODES/Earth Sciences students and staff were extra keen to celebrate the year's achievements together and generally let their hair down in what has been another frustrating year for fieldwork and face-to-face international collaborations.



Student revelry: CODES Honours, Masters and PhD students (with one important interloper – Chris Large) pictured during the CODES/Earth Sciences Geology Dinner celebrations at Hadley's Hotel in central Hobart during October. They are (L–R): back row: Karla Morales, Zeb Zivkovic, Hannah Moore, Chris Large, Tom Schaap, Peter Berger, Rhiannon Jones, Alex Farrar; front row: Richard Hill, Acacia Clark and Xin Ni Seow.



Staff choir: The tradition of the singing competition lives on. Here the staff team belt out their version of the 1968 Dusty Springfield hit 'Son of a Preacher Man', in which the staff gently suggested that students should get a degree if they wanted a fulfilling career. From L–R: Karin Orth, Lejun Zhang, Francisco Testa, Angela Escolme, Indrani Mukherjee, Sebastien Meffre, Mike Roach, Rob Scott, Clare Miller, Matt Cracknell, Martin Jutzeler (partly obscured), David Cooke and Rebecca Carey. MC for the evening, third-year Earth Sciences student Dan Fisher (right), looks on.



Judgemental: CODES students and staff cast a critical eye over the entrants in the singing competition. The venue this year was Hadley's Hotel, which provided a grand backdrop for the occasion.

VIRTUAL GEOLOGY TAKES FLIGHT

Senior Lecturer Dr Michael Roach and Associate Professor Sebastien Meffre undertook a 40-minute helicopter flight in early November to image the spectacular sea cliffs on the Tasman Peninsula as part of the Virtual Tasmania project.

On this trip Mike and Sebastien used two Nikon Z7 (48 MPixel) cameras mounted on DJI Ronin stabilisers to gather data to compile 3D virtual representations of the sea cliffs including Cape Raoul, which has some of the highest sea cliffs and dolerite columns in the southern hemisphere – some of them plunging over 200 metres into the ocean. The data-gathering for the Cape Raoul 3D model shown below took only two minutes and eight seconds – the 3D image of the cape was created from photography collected on a single pass along the coastline at an altitude of around 300 metres.

Mike explained: 'The survey of the Tasman Peninsula coastline was a trial to assess the viability of the

helicopter-borne photogrammetry data-gathering process. Many of the most significant and iconic aspects of Tasmania's geology, such as mountains and coastal exposures, are very difficult to access and the scale of these features makes drone-based data collection impractical. Helicopter operations provide the only effective approach to image these areas. The work on the Tasman Peninsula has demonstrated the feasibility and cost-effectiveness of helicopter photogrammetry. Our intention now is to apply these methods to generate geolocated, photorealistic, 3D models of some of the highly significant, but almost completely inaccessible, geological features in southwest and western Tasmania.'

Mike is the driving force behind the Virtual Library of Australia's Geology (<https://www.ausgeol.org/>), which has been developed by him at UTAS, and which aims to document Australia's diverse geological heritage and to develop educational resources to accompany these visualisations. His 3D visualisations of geological features have been used extensively in the teaching of undergraduate and Master of Economic Geology units at CODES/ Earth Sciences.

To see the complete 3D image of Cape Raoul compiled by Mike, go to: <https://sketchfab.com/models/112ba2ecc264db291271cb-fc5551456/embed>



A screenshot taken from the 3D representation of Cape Raoul on the Tasman Peninsula built up using photogrammetry from two Nikon cameras shot from a single helicopter pass over the cape lasting just over two minutes.



Detail of the Osborne Helitours helicopter used for the Cape Raoul data-gathering trip showing the two Nikon cameras used mounted on stabilisers. Filming took place with the doors of the helicopter open.



The spectacular Cape Raoul as viewed from the helicopter during the data-gathering trip in early November.

CHANGING FACES

While COVID-19 has continued to cause disruption to our lives, the staff and students at CODES/ES continue to come and go...we have one new PhD student joining our ranks, while there have been changes of personnel in the CODES Analytical Laboratories and elsewhere.

STEPHEN COOKE



PHD Student

Start Date: 13 November 2021

Program: Programs 1/5, supervised by Matthew Cracknell, Leonid Danyushevsky, Jeremy Sumner

Project Title: Computer-based modelling of geochemical data

DEPARTURES



Terrie Sawyer has left her role as a Laboratory Analyst at the CODES Analytical Laboratories.



Eleanor Marshall will be leaving the CODES front-of-house role in December and returning to her role at the UTAS English Language Centre. Karen Huizing will resume her role at CODES in the new year.

ARRIVALS



Elena Lounejeva is returning to CODES in a casual capacity to work as a Laboratory Analyst; she will also complete her PhD at CODES.



Dr Sheree Armistead recently joined CODES as a postdoctoral research fellow, after finishing up a two-year postdoc with the Geological Survey of Canada and Laurentian University in Ottawa, Canada. Sheree's research explores the links between plate tectonics and mineral systems.

BLAST FROM THE PAST



Rockstars: In the 1990s, the grunge-thrash-punk-jazz fusion supergroup 'Lard' burst onto the Tasmanian music scene. Originating in the garages of several of the CODES postdocs and PhD students, and with ambition far outstripping ability, Lard was founded with the

recognition that replacing the word 'love' with 'lard' made many songs far more entertaining. With their signature tune 'Whole lotta lard', the band tortured the eardrums of attendees at several CODES functions before following the well-worn path of many supergroups, with some foundation members splintering into

Band members from L-R: Stuart Bull (lead guitar), David Cooke (bass guitar) and Dave Selley (vocals) with Matt White on drums (obscured).

a breakaway group in Western Australia while other members remained at CODES reminiscing on days of former glory. There have been several attempts to initiate a band reunion but sadly none have come to fruition as yet.



A MESSAGE FROM THE CODES DIRECTOR, PROFESSOR DAVID COOKE

2021 saw the successful completion of several of CODES major industry-funded research projects, including the TMVC, AMIRA P1202 and P1206, CRC ORE, and the pyrite project and NW Queensland project. It was a stellar performance by our staff and students as they pulled together their final research results and delivered them

to our sponsors via online workshops and written reports, and maintained an excellent level of industry impact and engagement despite another year of pandemic-induced uncertainty and disruption globally.

We also delivered the largest number of Master of Economic Geology units in a single year, including three new units (Fundamentals of Economic Geology, Advanced Field Skills in Economic Geology, and Special Topics).

In 2022 we look forward to the start-up of our new AMIRA porphyry footprints project (AMIRA P1249) in January 2022,

with several more new projects in the development pipeline. We also have some exciting new developments coming in the Masters teaching program that we will outline in the next newsletter. But right now, we are all looking forward to a well-earned break over the summer here in Tasmania.

I wish you all the best for the festive season and a prosperous and happy new year.

David Cooke

UPCOMING SHORT COURSES



ADVANCED FIELD SKILLS IN ECONOMIC GEOLOGY (KEA718)

13–26 FEBRUARY 2022

A field-based short course 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.

Course leaders: Professor David Cooke, Dr Rob Scott, Dr Lejun Zhang

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

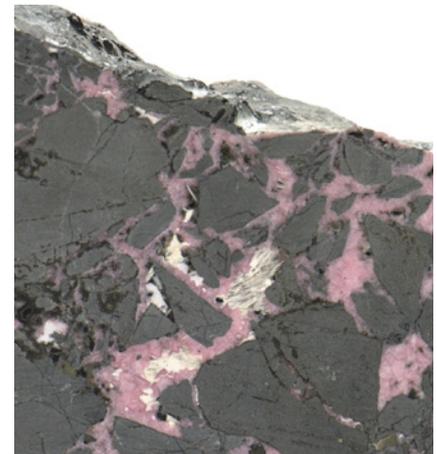
For more details: See the course flyer at: <https://www.utas.edu.au/codes/masters-short-courses>



FUNDAMENTALS OF ECONOMIC GEOLOGY (KEA716)

4–9 APRIL 2022 AND 2–6 MAY 2022

This short course teaches the fundamental skills needed by all economic geologists. Concepts of key geological concepts, mineralogy, paragenesis, geochemistry and geophysical characteristics of ore-forming environments, and the impact of these data sets of ore genesis and exploration are taught. The short course focuses 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.

Course leader: Professor David Cooke
Delivery mode/location: Online

For more details: See the course flyer 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.