

ORE SOLUTIONS

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

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WEATHER GODS ENDORSE NEW ADVANCED FIELD SKILLS MASTER OF ECONOMIC GEOLOGY UNIT



Senior Lecturer Lejun Zhang (wearing hi-vis vest) teaching participants in the new Master of Economic Geology unit, Advanced Field Skills in Economic Geology (KEA718) at Bluestone Bay, Freycinet Peninsula, on the last day of the course in February 2021. They are (L-R): Fu Rong Mah (Honours student), Alex Farrar (PhD student), Takeshy Coaquira (PhD student), Lejun, Till Gallagher, obscured (Honours student) and Carl Jackman (Mineral Resources Tasmania).

CODES has introduced a new Masters short course – with plenty of Tasmanian-based fieldwork involved – aimed at minerals industry professionals, as well as those enrolled in the Master of Economic Geology

The weather gods smiled on the inaugural delivery of CODES' new Master of Economic Geology unit, Advanced Field Skills in Economic Geology (KEA718), even if COVID-19 did not. Unfortunately, a snap, five-day lockdown in Perth in the week before the short course prevented

five Western Australia-based registrants from attending. However, the remaining 14 participants who attended all or part of the short course were treated to two weeks of excellent weather for the inaugural delivery of this new field-based unit, which was taught in various locations on the west, northeast and east coast of Tasmania. Advanced Field Skills in Economic Geology provides instruction and training in a variety of fundamental and advanced mapping and field skills suitable for use in the minerals industry. These include field-based rock and mineral identification,

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FROM THE DIRECTOR

As 2021 gathers steam, Professor David Cooke celebrates the fact that CODES/Earth Sciences students and staff have been able to get out into the field again within Tasmania. And he is greatly heartened by the big increase in first-year student numbers; when they finish their studies this cohort is likely to be in strong demand by the minerals industry as it adjusts to a sustainable future.

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Senior Lecturer Dr Rob Scott (white hat, centre) discusses the geology of the Hall Rivulet Canal mapping area with students participating in the Honours/VIEPS Exploration Field Skills mapping camp, and CODES new Master of Economic Geology short course Advanced Field Skills in Economic Geology. Participants are standing or sitting on steeply dipping slates situated close to the base of the Cambrian White Spur Formation. These stratigraphically overlie the primary target horizon for volcanic-hosted massive sulfide deposits during previous mineral exploration in the area.

fact mapping, from surface mapping and digital mapping techniques, 'Anaconda-style' mapping, structural measurement and graphic logging techniques, and the use of spectral, geochemical and remote sensing data sets in making and interpreting geological maps.

The first week of the short course, led by Dr Robert Scott and CODES PhD student Zeb Zivkovic, was delivered concurrently with CODES' long-running Exploration Field Skills mapping camp for fourth-year and Masters students. The Exploration Field Skills mapping camp provides participants with the opportunity to develop or enhance existing skills in geological mapping, core logging and structural analysis, within a mineral exploration context. For this exercise, participants logged drill core from, mapped and interpreted a ~5 km² area in the highly mineralised Cambrian Mount Read Volcanics. The field area is <15 km along strike to the south of the Rosebery volcanic-hosted massive sulfide (VHMS) deposit and just a few kilometres southwest of the Henty Gold Mine and has long been considered prospective for Cambrian and potentially Devonian base metal deposits.

Before travelling to the west coast, participants spent one day examining three drill cores from the mapping area that are housed at Mineral Resources Tasmania's core storage facility in Hobart, including one that intercepted a narrow interval of low-grade Zn-Pb mineralisation. Participants evaluate textural, paragenetic, mineralogical and geochemical features of the mineralised interval in this drill hole and, together with an assessment of its stratigraphic position, decide whether mineralisation is more likely to be Cambrian or Devonian. HyLogger data for all three drill holes provides further information on the character and extent of hydrothermal alteration in the rock sequence from this area. Data collected during the subsequent four days of field mapping are combined with the results of the core logging to unravel the stratigraphy and structure of the area, as well as the nature and extent of hydrothermal alteration. This information provides the basis for an assessment of the remaining exploration potential of the area, with participants asked to identify any previously untested areas in which significant base metal deposits within 500 m of the surface may exist.



Senior Research Fellow, ARC TMVC Research Hub, Dr Mike Baker leads mapping of the occurrence of alteration minerals in a bench exposure of the Central Volcanic Complex directly above the Western Tharsis deposit at Mt Lyell, for the 'Anaconda-style' mapping component of the Masters short course.

At the end of the first week, Dr Scott and most of the Honours students returned to Hobart. Drs Lejun Zhang and Mike Baker led the next component of the short course, an introduction to the Anaconda-method of mapping and logging drill core. These exercises were also conducted in the Mount Read Volcanics, but this time on Copper Mines of Tasmania's (CMT) Mt Lyell mine leases in Queenstown. CODES is extremely grateful to Geoff Cordery from CMT for facilitating this activity.

The Anaconda mapping exercise involved two days of surface mapping along two traverses situated above the Western Tharsis copper deposit and a half-day logging a section of drill core that intersected the ore zones at depth. During the surface mapping exercise, students collected rock samples for mineralogical analysis using a Terraspec SWIR mineral analyser to identify the main phyllosilicate minerals present. The students used this information to refine (or revise!) their Anaconda maps, and to develop empirical exploration models based on the alteration mineral zonation centred on the Western Tharsis deposit.

Next, participants travelled to George Town in the northeast of Tasmania, where Dr Scott re-joined the party for three days of instruction in structural mapping and analysis techniques. The first day was spent studying simply folded turbidites (Silurian Retreat Formation) at Bellingham, where participants were introduced to form surface and digital mapping using iPads and Fieldmove™ software. The next two days ramped up the structural complexity, mapping in multiply deformed Ordovician Stony Head Sandstone at Beechford, ~20 km west of Bellingham. Here participants used overprinting criteria and collected structural data to resolve the sequence and geometry of at least four fold- and foliation-forming events that affected the turbidites exposed in this area. At Beechford, participants also

received instruction in the mapping and mechanical interpretation of vein arrays and vein fill textures.

"[The course] provides instruction and training in a variety of ... mapping and field skills suitable for use in the minerals industry."

For the final field day of the short course, before returning to Hobart, participants travelled to Bluestone Bay on the Freycinet Peninsula to examine and map features formed across the magmatic – hydrothermal transition, during the latter stages of granite crystallisation. At Bluestone Bay, the students – again led by Lejun Zhang and Mike Baker – completed another Anaconda-style outcrop mapping exercise in which the spatial and paragenetic relationships between multiple intrusive phases, miarolitic cavities, pegmatite dykes, unidirectional solidification textures (USTs) and hydrothermally-altered wall rocks were examined. After this successful first delivery, CODES looks forward to offering Advanced Field Skills in Economic Geology annually in the coming years.

MASTER OF ECONOMIC GEOLOGY OVERVIEW

Dr Robert Scott looks back on a successful 2020 and another exciting year of geology units ahead for those doing the Master of Economic Geology

Despite the significant disruptions caused by COVID-19 in 2020, the MEconGeol managed a successful transition to online delivery for the final three units offered in 2020. A few days before the start of the field-based intensive unit Volcanology and Mineralisation in Volcanic Terrains in March, the fieldwork program had to be hastily reorganised, once travel

to New Zealand became impossible. Amazingly, the first 10 days were successfully relocated to Victoria (Dandenong Ranges Igneous Complex, Newer Volcanics Province) and northwestern Tasmania (Cape Grim, Stanley). The planned three-day visit to the Cambrian Mount Read Volcanics in western Tasmania had to be cancelled as access to many field sites was not possible, and many participants needed to return home before national and international border closures were imposed. Although the unit did not proceed as anyone would have

wished or expected, it is a credit to the trip leaders, Martin Jutzeler and David Cooke, that the educational experience provided was still well received by all participants.

The use of interactive 3D visualisations, a virtual field trip, and lectures and discussion panels featuring leading ore deposit experts from around the world were highlights of the Ore Deposit Models and Exploration Strategies short course in June. This unit was delivered online to the largest ever group of students and external participants (>200 people

from Australia, New Zealand, Africa, South and North America, Europe and Asia) to attend an MEconGeol short course. Next up was the Exploration in Brownfield Terrains short course, delivered online in October. Participants were introduced to strategies for visualising and interpreting large real-world minerals industry datasets. OceanaGold and Kirkland Lake Gold are thanked for the provision of datasets prospectivity assessment exercises that form the core of this unit. Additionally, invited industry experts gave lectures and contributed to discussion panels. Completely new practical content had to be devised for the 2020 delivery of Brownfields, to ensure a successful transition to online teaching. Some of the best student feedback we have ever received for this unit suggests that the changes made were a great success. Between October and December, Matt Cracknell delivered the new Geodata Analytics unit in three online modules. The unit proved so popular that its second delivery commenced in February 2021, less than two months after completion of the 2020 offering.

ALL-NEW MECONGEOL SHORT COURSES

In addition to Advanced Field Skills in Economic Geology (February 2021) and Geodata Analytics (February–April 2021), another new unit, Fundamentals of Economic Geology, will be delivered online this year (30 August–10 September). This unit teaches the fundamental skills needed by all economic geologists, and introduces the equipment and approaches used to recognise and interpret the mineralogy, paragenesis, geochemistry and geophysical characteristics of rocks in ore-forming environments. There is a particular focus on hand specimen and microscopic techniques (and tools) used to resolve sequences of events in rocks from ore-forming environments, and their application to a wide variety of exploration, mineral processing and environmental problems.

Summaries are given here of the research theses by current and completing Master of Economic Geology students.



KIM BOUNDY

Current student,
Master of Economic Geology

Supervisors: Mike Baker, Lejun Zhang

Project title: Geochemistry and geochronology of lithium-enriched pegmatites in the Bynoe pegmatite field, Northern Territory

Kim Boundy commenced her Masters research thesis study of the Bynoe pegmatite field, south of Darwin, Northern Territory, in mid-2020. Her industry sponsor is Core Lithium Ltd, which holds tenements over most of the known pegmatite occurrences. The Bynoe pegmatite field has historically been the focus of tin and tantalum mining, but in recent years its potential for lithium mineralisation has been uncovered. There are hundreds of pegmatites in the field, but not all are lithium enriched. There are six main prospects with resource inventories that vary in chemistry, grade and morphology. Three are the focus of early-stage development work by Core Lithium. Kim's project will seek to categorise the geological, geochemical and geochronological characteristics of pegmatites from the Bynoe pegmatite field. Using this information, she will then seek to constrain the process of lithium mineralisation within the pegmatites and provide a genetic model for pegmatite lithium mineralisation in Proterozoic terrains and make recommendations for future exploration.

Kim is currently working as an independent consultant geologist while undertaking her Masters research activities. As part of her research activities, she will be undertaking fieldwork in conjunction with Core Lithium in mid-2021 in the Northern Territory.



ROSEANNA DALE

Current student,
Master of Economic Geology

Supervisor: Angela Escolme

Project title: Au-Ag deportment variability and the effect on its flotation and recovery at the Monty VMS Cu-Au deposit, Western Australia

Throughout the mining and processing of the Monty Cu-Au deposit, large variability has been seen in the recovery of Au-Ag throughout the orebody. Whilst initial geometallurgical test work focussed on Cu variability, processing to date shows a more detailed investigation on Au-Ag deportment is required.

Roseanna Dale hopes to characterise and model this variability in Au-Ag deportment throughout the Monty deposit. Using the existing grade control assays to define these characteristics into ore types, completing flotation test work and using QEMSCAN to analyse the results. The end goal is to provide a model to the Engineering and Metallurgy teams at Sandfire Resources to enable them to optimise these Au-Ag ore types to use for planning and scheduling of targeted concentrate specifications.

"I have thoroughly enjoyed working my way through the Master of Economic Geology degree. The fieldwork and intense two-week courses surrounded by your peers and some of the industry's best, is an environment that I and everyone can thrive in. It has provided me with specialised knowledge and skills that I can immediately apply to my job when I get back to work".

Please see page 24 for a list of all Masters short courses running in 2021.



CODES Master of Economic Geology student Roseanna Dale carrying out underground mapping at the DeGrussa VMS Cu-Au Mine, Western Australia, which is operated by Sandfire Resources.



LIETH DE SELINCOURT

Current student,
Master of Economic Geology

Supervisors: David Cooke, Mike Baker,
Sebastian Meffre, Matthew Cracknell

Project title: Application of Mineral
Chemistry to Aid Exploration for
Cu-Au-Mo porphyry mineralisation in
the Temora district, New South Wales,
Australia

Lieth de Selincourt’s research project will investigate geochemical variability within chlorite and epidote surrounding the Donnington prospect at Sandfire Resources NL’s Temora Cu-Au porphyry project located in the Macquarie Arc, central New South Wales, to determine if they can be used to vector towards concealed Cu-Au-Mo mineralised intrusions. Zircon U-Pb dating and geochemistry of intrusions will be used to constrain their ages and assess the potential for zircon chemistry to be used as a tool for prospectivity within the district. Pyrite trace element chemistry at Fields prospect will aim to give insights into the genesis of precious and base metal mineralisation.

Lieth’s study includes drill core logging and sampling, mapping of spatial geochemical trends in chlorite, epidote

and pyrite, and geochemical vectoring and fertility appraisals. The aim of the research project is to contribute to ongoing exploration work programs and determine how effective mineral chemistry techniques can be at adding significant value to exploration vectoring and targeting within the Temora project.

“I am excited to be commencing my thesis on the Temora Cu-Au Porphyry Project and have the opportunity to learn from and work closely with the highly experienced and skilled research team. It will be a great way to consolidate the knowledge base I have built since starting this course, gain valuable exposure to the globally significant Macquarie Arc mineral district of eastern Australia and the porphyry indicator mineral and porphyry vectoring and fertility tools developed at CODES over the past decade.”



KYLE HUGHES

Current student,
Master of Economic Geology

Supervisors: Sebastien Meffre, Robert Scott, Jeff Steadman

Project title: Volcanic facies, alteration and mineralisation at the Dobroyde Au prospect, southwestern Macquarie Volcanic Province, NSW

Kyle Hughes' research addresses the poorly understood Dobroyde Au prospect in central NSW. Dobroyde, located in the far west of the Macquarie Volcanic Province (MVP) 40 km south of Lake Cowal, has been extensively drilled to 300 m depth. The host rocks are andesites correlated with the Temora Volcanics. Dobroyde has been interpreted as an advanced argillic Au system and alteration at the prospect grades from an outer propylitic zone to a siliceous core. The andesites are intruded by many small dykes; however, no mineralising intrusions have yet been identified.

In late 2016, New South Resources drilled three new drill holes on the prospect, with one (drill hole NDD005, 744.2 m) testing the geology both down plunge of the known mineralised zone, and several hundred metres below the upper alteration zones. This drill hole intersected several Au mineralised intervals, with a maximum intercept of 1 m at 9.46 g/t Au. Kyle's

project will involve detailed logging and petrographic characterisation of core from drill hole NDD005 to better understand volcanic facies, alteration and mineralisation at Dobroyde. He aims to synthesise historical and recent drilling data for Dobroyde to assess the potential for future mineral deposit discoveries on the prospect.

Kyle's project results from a collaboration between the tenement holder, New South Resources, and a federally funded Linkage project between CODES and the Geological Survey of NSW. His research should further the understanding of Cu-Au mineralisation in the Lachlan Orogen.



LUCY JONES

Current student,
Master of Economic Geology

Supervisor: Angela Escolme

Project title: An investigation into the mineral associations and relationship between chalcopyrite and sphalerite at Cannington Mine, North Queensland

Cannington is a silver, lead and zinc mine located in northwest Queensland, approximately 200 km southeast of Mt Isa. The ore at Cannington is processed through comminution, flotation, leaching and dewatering. Two types of concentrate are produced – lead concentrate and zinc concentrate.



CODES Master of Economic Geology student Lucy Jones on site at the Cannington Mine run by South32 where she works as a mine geologist. The photo was taken at Cannington prior to drilling a large-diameter drill hole for the installation of a new paste line.

In recent years, there have been times when elevated levels of zinc have been reported in lead concentrate. This is due to the visible activation of zinc early in the flotation circuit. When this issue is experienced, plant production loss occurs and significant blending of concentrate may be necessary to meet customer requirements.

It has been determined that copper is the likely catalyst for the early activation of zinc. Copper occurs as chalcopyrite throughout the deposit in different mineralisation types and lithologies. In the lead rougher circuit (after grinding) copper floats easily and quickly. It is believed that if chalcopyrite is still attached to sphalerite after grinding, this will cause zinc to float early. High concentrations of copper in plant feed have not always resulted in early zinc flotation. The aim of this project is to study the mineral associations and relationship between chalcopyrite and sphalerite at Cannington to explain why zinc is activated early in the flotation circuit and predict areas within the deposit that ore containing problematic copper may occur.

"I am really enjoying the Master of Economic Geology... I decided to study at CODES because it is tailored towards industry professionals. The coursework so far has provided me with additional skills and knowledge that I've been able to apply in my role as a mine geologist."



Fieldwork in Ecuador: CODES Master of Economic Geology student Carlos Diaz at work in the Alpala Creek within the Cascabel district, northern Ecuador, in 2018. He is looking at what he describes as an "almost new" outcrop, which was produced after a small landslide, due to heavy rain over previous days.

UPDATES ON OTHER MASTERS PROJECTS:



CARLOS DIAZ

Completed,
Master of Economic Geology

Supervisor: David Cooke

Project title: The Cascabel Cu-Au porphyry cluster in northern Ecuador

The Cascabel Cu-Au-Ag porphyry cluster is located in an area of overlap between the Eocene and Miocene metallogenic belts of the northern Western Cordillera of Ecuador, and formed during east-directed low-angle subduction in the Late Eocene, related to eastward migration of the Macuchi arc. This Masters project allowed the classification of the different rock types identified in the district, the definition of the porphyry-style vein paragenesis and the interpretation of the geochemistry and geochronology of the basement and host rocks, and the different intrusions that form the three main porphyry centres in the district, Alpala, Aguinaga and Tandayama – America.

During the exploration campaign and particularly during diamond drilling, at least 10 major intrusions have been identified in the three principal porphyry centres at Cascabel that include diorites, quartz diorites and hornblende quartz diorites that have been grouped as pre-, syn-, intra- and late-mineralisation, and which host porphyry-style veining and Cu-Au(-Ag) mineralisation. Several minor intrusions have also been identified, which lack significant mineralisation. The proper identification and classification of these intrusions in the different porphyry centres at Cascabel helped with the development of a magmatic-hydrothermal genetic model, which will allow a better understanding of the geological controls in an underexplored region of Ecuador, providing a key reference point for future geological exploration here.

"Having the opportunity to join CODES was one of the best moments of my career. As soon as I knew that I would do

my Masters research at the University of Tasmania, and about the project – where I had been working for a long time – I felt like it was a dream come true. To have been able to share experiences and to have learned from worldwide amazing geoscientists who were always interested to share their knowledge, will definitely leave a positive mark on my professional career. I hope I will be able to put into practice the knowledge that I learned during my time at CODES to benefit the geological knowledge of my country."



COREY JAGO

Completed,
Master of Economic Geology

Supervisors: Sebastien Meffre, David Cooke, Robert Scott

Project title: Spectral analysis of hydrothermal alteration associated with the Northparkes porphyry Cu-Au deposits, New South Wales.

Corey Jago has recently submitted his MEconGeol thesis. His research involved analysing HyLogger hyperspectral data for drill core from the E26 and E48 deposits at Northparkes. He found that both major and subtle alteration zonation at the deposits could be delineated using the SWIR and TIR spectral data.

Corey developed scalar algorithms from key spectral absorption features to interpret compositional, intensity and crystallinity variations of spectrally active minerals with the voluminous dataset. He developed geochemical and spectral discrimination and vectoring tools for near-miss and fertility assessments. In particular, coupling of the newly developed white mica scalars and trace element ratio vectors (from geochemical data) successfully distinguished zones of uneconomic, late-stage phyllic Au-Mo mineralisation from highly prospective porphyry-style Cu-Au.



GEORGE MAROA

Completed,
Master of Economic Geology

Supervisor: Robert Scott

Project title: Characterisation of the geology, mineralisation and genesis of the Bumbo polymetallic sulfide deposit within the Busia-Kakamega Greenstone Belt, Western Kenya.

George Maroa recently completed his MEconGeol thesis. Although primary rock textures and mineralogy at Bumbo were largely obliterated during subsequent deformation and contact metamorphism, George's detailed petrographic studies and analysis of 4-acid digest multi-element geochemical data indicates that the host rocks were predominantly (andesitic) volcanoclastic sandstones with calc-alkaline magmatic arc affinities. George's research findings support previous interpretations of Bumbo as a volcanic-hosted massive sulfide (VHMS) deposit. Lead isotopes for the ores suggest an Archean age and the overall gold content, and Co/Ni and Zn/Cd values for the deposit were found to be within the typical ranges for Archean VHMS deposits. Analysis of the whole rock geochemical data also revealed extensive Na-depletion in the footwall, as is characteristic for VHMS deposits.

"As I await the final grading of my thesis, I must say that my experience at UTAS was wonderful. I am confident that the Master of Economic Geology degree that I will earn from CODES will soon open great opportunities for me. Many thanks to all the staff and students at CODES."

COSMIC: THE AUSTRALIAN EARTH SCIENCES CONVENTION 2021

CODES/Earth Sciences staff and students were the chief organisers of the Geological Society of Australia (GSA) debut virtual Australian Earth Sciences Convention 2021. Here Dr Indrani Mukherjee gives a summary of the proceedings.



Left: Earth Sciences Head of Discipline at UTAS Associate Professor Sebastien Meffre gave an opening address at the virtual 2021 Australian Earth Sciences Convention, which was attended by around 600 delegates from all over the country. CODES-TMVC was among several important sponsors.

Right: Dr Megan Clark (right), Head of the Australian Space Agency, was one of the AESC 2021 Plenary speakers. Here CODES PhD student Hannah Moore, who chaired the Plenary session and hosted the Q&A which followed, gives a closing address after thanking Dr Clark.

The 2021 convention, themed ‘Core to Cosmos’, was held entirely online between 9–12 February. Even though the delegates could not be welcomed in person to the beautiful island state of Tasmania, the ‘Welcome to Country’ by a proud Tasmanian Aboriginal woman, Nala Mansell, superbly graced the official online welcome ceremony.

Around 600 attendees, from a range of sectors including the minerals and petroleum industries, government departments, research and education institutions and consultancy groups registered for the convention.

The GSA was very proud to host its **first ever** session on ‘Indigenous history and its influence on science’ at an Australian geoscience convention. The session featured top experts on indigenous research in Australia, who informed delegates about the breadth and depth of indigenous knowledge and its implications for science.

The technical program committee received around 400 abstracts representing research from various branches of Earth sciences. The convention’s six themes offered the

newest information and research across a range of topics, including new insights into industry (exploration, mining and extraction), geological regions such as the Tasmanides as well as innovations in remote sensing and digital data. Exciting virtual field trips, using Dr Michael Roach’s world-leading virtual geology visualisations, were very well-received. The participants were given access to all presentations from 1 February so they were able to familiarise themselves with the large number of topics. The online live Q&A sessions and discussion forum chats were prolific and also well-received.

The convention showcased high-profile Australian scientists and industry leaders:

- Professor Martin Van Kranendonk (Director of the Australian Centre for Astrobiology Institute at UNSW): Searching for life on Mars in our own backyard: the quest for a second genesis.
- Murray Hitzman (Director, iCrag): The energy transition: Implications for geoscience – a view from the north

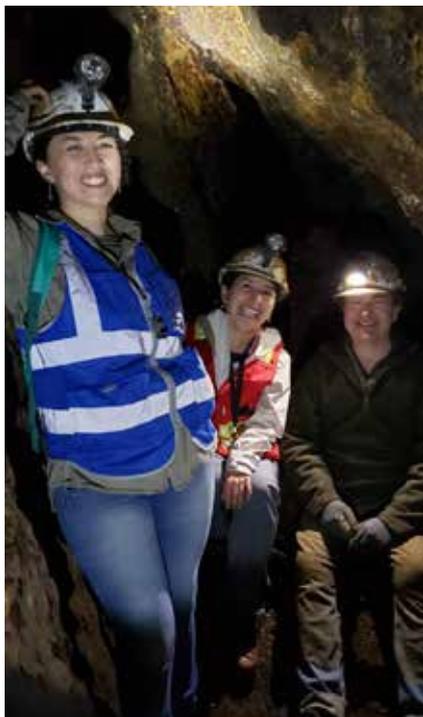
- Dr Jess Melbourne-Thomas (CSIRO Oceans & Atmosphere, and 2020 Tasmanian Australian of the Year): Engagement, diversity and interdisciplinarity to tackle future challenges
- Dr Megan Clark (Head of the Australian Space Agency): Planetary geology, Australia’s involvement in Moon to Mars

Diversity and inclusion events were a highlight for AESC this year. Diversity coordinators Ms Hannah Moore and myself promoted diversity by hosting a two-part session that focussed on inspiring and moving stories from delegates. The session discussed a broad spectrum of topics. Every conference presenter had the option to share a slide with an opinion, statistics or other information about diversity at the conclusion of their presentation as well. The awe-inspiring ‘Picture a scientist’ documentary was available to view on demand.

Both CODES-TMVC and the GSA-TAS division were sponsors for the AESC.

FINALLY, A FACE-TO-FACE GEOLOGY FORUM

After months of lockdown and social distancing due to the COVID-19 pandemic, CODES and Earth Sciences staff and students were pleased to finally be able to meet in person at a geology gathering on Tasmania's west coast during December. CODES Master of Science student Nathaly Guerrero reports.



Left: CODES Master of Science students Nathaly Guerrero (left) and Karla Morales with Adam Wright underground at the Adelaide Mine at Dundas, where crocoite is mined. Adam runs the mine, which sells large specimens of crocoite, Tasmania's official Mineral Emblem.

Right: The post-Geoscience Forum field trip group is at the site of the former Zeehan smelters, on the eastern side of the Henty Road (between Strahan and Zeehan). Dr Tony Webster (trip leader) is pointing out the outcrops of folded Eldon Group sediments exposed in cuttings at the rear of the main smelter floor. The smelters were once the destination for much of the production of the field and their closure in 1913 meant the true death knell of the original Zeehan Ag Pb mines. (Photo: Ron Gregory)

The Tasmania Geoscience Forum, organised by the Tasmanian branch of AusIMM, was held in the Henty Room, Strahan Village, on the west coast of Tasmania, in early December 2020. About 50 people attended. Most of the topics discussed during the forum were about the geology of Tasmania, in which Thomas Schaap, Zebedee Zivkovic (both CODES PhD students) and Olivia Wilson (CODES-TMVC Honours student) stood out with summaries of their research projects.

A total of 15 speakers gave presentations – they ranged from industry and exploration representatives to UTAS and CODES researchers, and there was also a video address by the Tasmanian Minister for Mines, Guy Barnett. Associate Professor Sebastien Meffre gave an introduction

to the main activities with which CODES/Earth Sciences is currently involved. And Dr Julie Hunt gave a presentation on geometallurgical research carried out in conjunction with industry entitled 'Geological contributions to geometallurgy: Rocks first'. The day of presentations was followed by an industry dinner.

As part of the forum, two short field trips were conducted for a limited number of attendees on the day after the presentations:

Field Trip 1: Adelaide Mine Underground Tour, Dundas (led by Adam Wright)

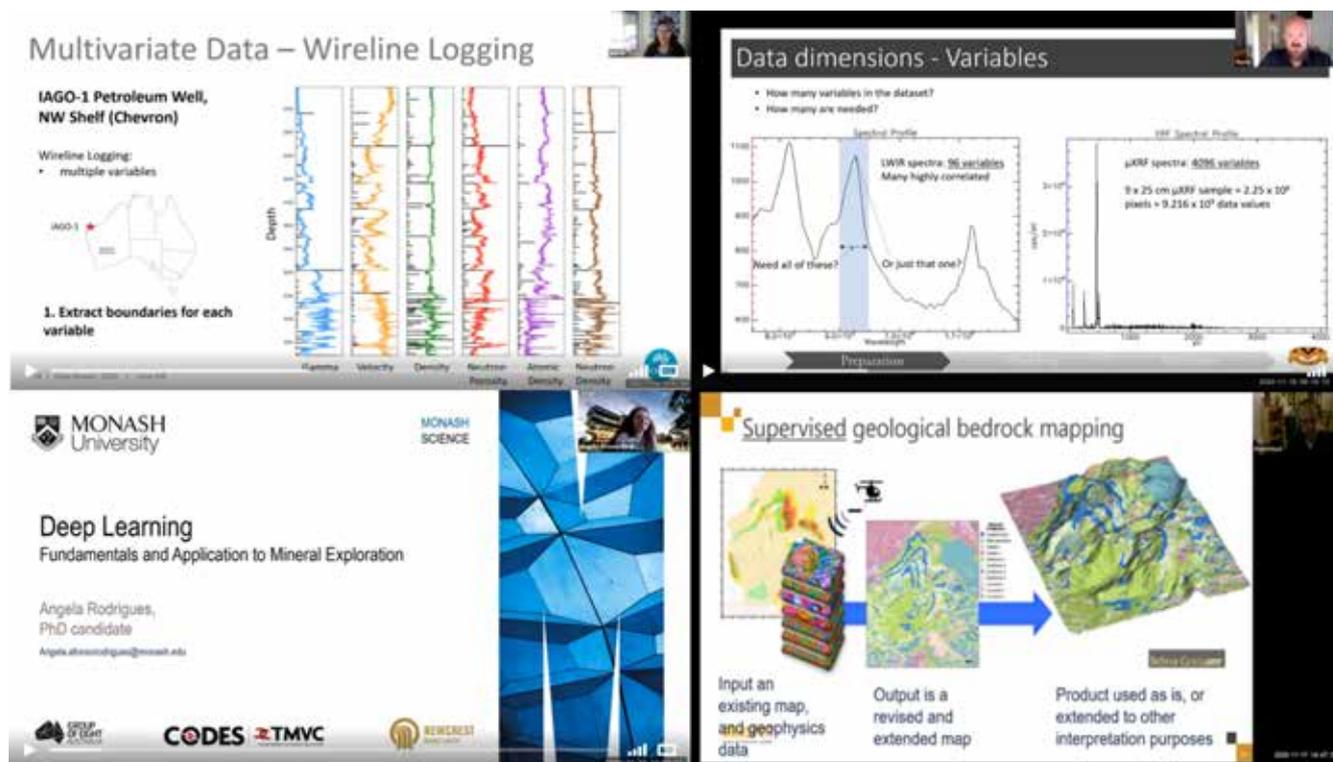
Field Trip 2: Historic Surface Features of the Zeehan Mineral Field (led by Dr Tony Webster from the Geodiscovery Group/ Adjunct Senior Lecturer at CODES)

The forum was very well-attended – in fact, due to COVID-19 social distancing rules it was booked out and many more people would have liked to attend, so future events such as this will take into account the logistics of social distancing to allow a greater number of attendees.

It was both interesting and important to be able to hold a face-to-face gathering after a long time in which all our research and knowledge generated had been shared via online conferences due to the COVID-19 situation and its related safety restrictions worldwide. Being able to have face-to-face discussions helps people to engage with the issues much better and to conduct networking.

GEODATA ANALYTICS – NOW AND INTO THE FUTURE

Dr Matt Cracknell, Research Fellow in Earth Informatics, ARC TMVC Research Hub, leads the new Geodata Analytics Masters short course. He is very pleased about the enthusiastic response to this new course, which is currently being run for a second time and is proving just as popular as the first time round. He sees a bright future for its continued inclusion in the Master of Economic Geology program and says that feedback received when it first ran has been incorporated into the current iteration.



Screenshots: a compilation of screens from the first running of the CODES Masters short course Geodata Analytics. This course first ran in October–December 2020 and is currently being repeated for another cohort of students and industry professionals.

CODES successfully wrapped up the first offering of the Geodata Analytics Masters short course late last year. This short course gives geologists fundamental data analytics knowledge and skills that can be applied to geoscience problems. Students learn to generate reproducible data analysis workflows and communicate results to a broad audience, individually and as a team. It is currently running again.

The Geodata Analytics short course is offered fully online through the UTAS short course platform. This means that we can accommodate both students enrolled in the Master of Economic Geology program and industry-based geologists who want to upskill. In 2020,

around half the students were enrolled in the Masters program and half were industry geologists.

Being fully online means that the Geodata Analytics short course is truly global, with students from Oceania, Europe, Asia and the Americas participating. Furthermore, the short course structure allows students to access learning materials when it suits them.

Based on student feedback, several small but important changes have been made in 2021, mostly around encouraging student engagement, which can be challenging in an online environment. These changes include a dedicated chat room for students

to ask questions and interact with each other and with teaching staff. In addition, start-up workshops are being held across different time zones, with the aim of making the learning experience more appealing.

Both the 2020 and 2021 offerings have reached their 30-student capacity, highlighting the popularity of this course and the need for geologists from all walks of life to gain data analytics skills. While the next offering of this short course is not until later in 2022, we are working towards making the first part of the course, which focusses on self-directed learning, available all year round.

Watch this space!

NEW SPECIAL ISSUES ON MINERAL DEPOSITS OF SE ASIA

Professor Khin Zaw was involved with two research publications on the topic of geology, tectonics and ore deposits of SE Asia, and another on precious gems, during 2020, and here he explains the importance of his research outcomes.



Above: Professor Khin Zaw (in CODES cap) leads a group of geologists on a visit to Mogok in what is termed Myanmar's 'Ruby Land'. Here they look down on the mist-filled gem valley where the city of Mogok lies in northern Myanmar.

Inset: This large ruby, said to be worth around AUD\$2 billion, is from Mogok and is displayed in a museum in Myanmar.

2020 was a tumultuous year for researchers due to the COVID-19 pandemic. Universities and academic institutions across the globe were faced with unprecedented challenges and uncertainty. However, online teaching and seminars, as well as editing and writing papers, were not hindered by the pandemic for the teachers and researchers at CODES.

Professor Khin Zaw was able to work from home where he edited, contributed to, and quietly completed three special issues (SI): The *Journal of Asian Earth Sciences* (JAES) SI on SE Asia contains 17 papers, the *Ore Geology Reviews* SI has a massive 44 papers, and the SI of *Minerals*, entitled 'Mineralogy and Geochemistry of Ruby' has seven papers.

The JAES issue's focus on 'Geology, geodynamics and mineral resources of SE Asia' provides insights from the GEOSEA XV Congress, held in Hanoi in 2018, and is edited by Michel

Faure, Khin Zaw, Van Tri Tran and Van Vuong Nguyen (<https://www.sciencedirect.com/journal/journal-of-asian-earth-sciences/special-issue/10G6V51C68L>). It provides new data in the areas of stratigraphy, paleogeographic reconstructions, magmatic and metamorphic petrology, geochronology, geochemistry, mineral resources and tectonics. It also includes detailed contributions and large syntheses dealing with the Indochina block, and its relationships with neighbouring blocks such as South China, Sibumasu and the Philippines Mobile Belt.

The *Ore Geology Reviews* SI is edited by Xiaoyong Yang, Khin Zaw and Azman Bin Ghani. It provides new results and information for magmatism, tectonic evolution, origin and the timing of ore formation for individual deposits and types on a local and regional scale and broader metallogenesis in the region (<https://www.sciencedirect.com/journal/ore-geology-reviews/>

[special-issue/10RM9J71TTD](https://www.sciencedirect.com/journal/ore-geology-reviews/special-issue/10RM9J71TTD)). Part I presents new information about metallogenesis in the SE Asia-Tethyan tectonic domain including 19 papers covering Peninsular Malaysia-Sumatra, Northern Laos, and Sanjiang Tethyan to the Eastern Kunlun Mountains. Part II includes 25 papers dealing with metallogenesis in the SE Asia-Pacific tectonic domain Sundaland, through the Philippine Mobile Belt-Sulawesi arc to the eastern area of the South China region. This new information on the geodynamic and metallogenic understanding of East and SE Asia will provide an important driver in unlocking the untapped diverse mineral wealth of the region and an enormous impetus for mining and exploration companies to make further major discoveries.

The *Minerals* SI titled 'Mineralogy and Geochemistry of Ruby' provides a window into the world of ruby deposits. This publication is of interest to anyone on the planet who wants to know about rubies! It covers recent advances in techniques and technology relating to studies of genesis and geographic typing for ruby deposits across the world, and why Mogok rubies from Myanmar stand out as the most exquisite and beautiful in the world of gemstones.

For more information: https://www.mdpi.com/journal/minerals/special_issues/Mineralogy_Ruby



WHERE ARE THEY NOW?

In this issue we talk to Dr Patrick Sack, who graduated from CODES with a PhD in 2009. Patrick is now working in Yukon and enjoys combining his geology research work in this remote region of Canada with adventurous family trips in bracing climes!

ANCIENT ROCKS, MODERN FAMILY



DR PATRICK SACK

Regional metallogenist, Yukon Geological Survey

PhD completed at CODES in 2009 entitled 'Characterization of footwall lithologies to the Greens Creek volcanic-hosted massive sulfide (VHMS) deposit, Alaska, USA'.

What is your current job and your work responsibilities?

I am currently employed with the Yukon Geological Survey in Whitehorse, Yukon, where I work as the regional metallogenist. My work is primarily research. Most of the projects I work on are collaborations between academia, other survey geologists and industry. During summer months, I am mostly in the field, in either small two-person fly camps or working out of larger industry exploration camps. A day may consist of core logging or geologic mapping at anything from trench to regional scales. During winter months, I organise samples for analytical work and publish. In a given year, I may write government 'grey literature' papers, publish a map or write journal articles. Prior to COVID I also travelled to labs to conduct analyses such as LA-ICP-MS on pyrite and attended conferences.

What are the things you enjoy most about this role?

I love working on mineral deposits and mineral systems. This job allows me to conduct research on a variety of deposit-types making every project a new and exciting adventure. I also get to work at scales that vary from the submicron to the orogen. At the micro-scale, I have worked on samples from the Carlin-type gold deposits recently discovered in Yukon using techniques such as microprobe and LA-ICP-MS to collect trace element data from the thin gold-bearing rims. The incredibly small thickness (<1 micron) of these rims has led me to collaborate with researchers at Oxford and the Colorado School of Mines where they have access to even finer-scale tools such as nanoSIMS and atom probe. At the orogen scale, I have contributed to a study of Late Triassic to Jurassic plutons across the Intermontane terranes of southern Yukon, a distance of several hundred kilometres. Using petrography, geochronology, geobarometry and isotope geochemistry we have been able to refine our understanding of plutonic suites and better constrain the tectonic history during this period.

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

I grew up in Dawson City, Yukon, and spent a lot of time in the bush as a kid. I was also a nerd in school but struggled to make the leap from small town to big city life. As a result, I was invited by the University of Victoria to not come back after my first year. So, I took a 'gap year' and travelled Australia. When I returned to Canada, I developed my 20 rolls of film (because that was a thing in 1998) and realised that all my pictures were of rocks and rock formations. I knew I loved the bush and, clearly, I loved the rocks so after a semester of college auto mechanics to get my

grades high enough, I convinced the University of Victoria to allow me back. After my first semester of geology classes, I have never really looked back. I completed my undergrad at UVic and then headed south for CODES.

Plenty of things have shaped my career and life path; family is the most important. My family expanded shortly before I went to CODES when I married Nikki Krocker and then again my sons Elliott and Lucas were born during my candidacy. Elliott was born in Vancouver about half way through my candidacy and Lucas in Hobart a few weeks before I submitted my thesis. My daughter Ruby was born back in Whitehorse a few years after I finished and she often laments that she didn't get to join the rest of us on our Tassie adventure!

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

As a government geologist I derive a lot of pride from providing high-quality and (somewhat!) timely data and interpretations to the exploration industry. Since I joined the survey in 2011, explorers have discovered what has become recognised as one of the best examples of Carlin-type gold outside of Nevada. I have been very lucky to work on the related rocks and to contribute micro-analytical data that documents some of the similarities between the Yukon and Nevada deposits. I have also had the pleasure of contributing to a study of plutons in Yukon that is helping us refine the tectonic history of the Late Triassic to Jurassic in the North American Cordillera.

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

While at CODES I did a study of the Greens Greek volcanic-hosted (NOT genic!) massive sulfide deposit in southeast Alaska, USA. My supervisors were Ron Berry and Bruce Gemmell, and Andy West, a mine geologist. As part of my study, I took an idea of Ron's and worked on developing an automated method for finding small zircons in mafic rocks and used the resulting geochronology data to demonstrate the rocks immediately below the deposit were over a hundred million years older than the deposit itself. This initial foray into zircon geochronology has been very helpful in my current role, as one of the primary questions when working at a regional scale is how the rocks relate; geochronology is an important way to document (or not) a temporal relationship.

The thing I enjoyed most about CODES was the community. I still fondly remember the tea room and barbecue discussions about cricket and Aussie rules football. Nothing like being a kid from northern Canada and being asked by Peter McGoldrick and Tony Crawford what you thought about the Hawks' chances this year!

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

One thing that has changed a lot in the past 20 years is connectivity. I visit a lot of larger industry camps and when I started in the field in 2001, the 'fancy' camps might have a dial-up satellite internet connection; most camps did not. The people in camp became your best friends and worst enemies. Evenings were free of 'head office hassle' and games were played. Fast forward to today, when camp internet quality ranks ahead of most other conditions (food, tent mate, scenery...) for determining if it is a 'good' camp. Logistics are easier, life is less disrupted

and so there are good things about increased connectivity. However, kitchen tents are quiet and empty in the evening and a bit of community appears to be lost in camps today. I still don't connect to the internet in my own camps and the one to two months without internet (email) is to me a luxury that few others can afford.

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)?

Geology is about rocks. No matter what fancy analytical tool you use, what scale you work at or what problem you are trying to solve, it starts with rocks. Make sure the foundation of documenting rocks and field relationships is solid and you will always be able to use those samples or observations regardless of what new tool is invented, what finer scale you need to answer your question or what new problem you are trying to solve.



Family fun: "Taken July 2019 at Glacier Lake, southeast Alaska, a short hike off the lower Stikine River. This lake is at the toe of the Great Glacier, evidence of which is floating behind Patrick and his children (L-R): Ruby, Lucas and Elliott. Not seen is the children's mother, Nikki! For 13 days on this river, we had >25 °C weather and spent every spare moment swimming in the glacier-fed waters of the Stikine. Glorious." **CONTINUED OVER PAGE**

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Careers are long, COVID will be short. Focus on life and being happy; when it's all over, there will be plenty of time to focus on careers.

And any little-known facts about yourself?

Life is a team effort and as such achievements are shared between Nikki and me. I consider it a notable achievement for us that we had two children while I was doing a PhD.

Nikki, Elliott, Lucas, Ruby and I are keen adventurers. These days we adventure locally and have had many a grand adventure. One of my favourites was during spring break in 2017 when we rented a camper and drove 2500 km from Whitehorse, Yukon to Tuktoyuktuk, Northwest Territories and back. It was -20° to -30° C the entire time and nearly 400 km of that trip was on an ice road! Literally a road ploughed on the frozen Mackenzie River from Inuvik to the Arctic Ocean and then on the ocean along the coast to Tuk. The pingos are amazing. Another favourite adventure was the 13 days we spent rafting the lower Stikine River in northern British Columbia and southeast Alaska. The camping and glaciers are both outstanding.

My son Lucas' favourite personal trivia question is "Where was I born?" because being born in Tassie is SO cool!



Orange light: This photo was taken in August 2014 at the Nick property in the Ogilvie Mountains of north-central Yukon. This property is the type-locality for a strange type of nickel-molybdenum (NiMo) sulfide mineralisation in the Paleozoic Selwyn basin. Some at CODES may prefer the term highly metalliferous black shales as recently described by Sean Johnson, Ross Large and others. Some of the rocks in the background of this photo have been analysed by LA-ICP-MS at CODES. The brilliant orange is the result of high floodwaters depositing iron oxides as water levels drop after spring melt. Not many explorers would miss this colour anomaly! However, the corresponding mineralised interval is only 10–15 centimetres thick and is quite hard to see in outcrop.

GOOD NEWS ON EARTH SCIENCES STUDENT NUMBERS!

First-year first-semester student numbers have increased significantly over the past year to 120 students enrolling in a renamed unit now called 'Planet Earth'. It is likely that the cause of the increase is due to a number of factors including changes to the BSc with the removal of some compulsory units in other parts of the degree, a completely online version of first-year Earth Science units adding to our normal delivery and possibly the high demand for Earth Science graduates. Academic staff will be working hard to retain these students into the second-year units. First-year Earth Sciences student numbers have actually doubled over the past three years.



Dr Clare Miller (left) and Izzy von Lichtan (second from left) teaching a first-year practical at Blinking Billy Point on the River Derwent near Hobart on 1 March 2021.

INCREASING CORE STRENGTH



Dr Andrew McNeill, Chief Government Geologist (left), with Associate Professor Sebastien Meffre, Head of the Discipline of Earth Sciences, at the MRT Mornington Core Library. The upgrades to this facility will greatly benefit CODES/Earth Sciences students and staff, who will have better access to samples for their research and labs on-site.

CODES and the Discipline of Earth Sciences will benefit from upgrades to the Mineral Resources Tasmania (MRT) Mornington Core Library on Hobart's eastern shore. Dr Andrew McNeill, now Chief Government Geologist and formerly a researcher at CODES, says he hopes that the current upgrades to laboratories and research facilities will form the first part of an expansion program that will see the storage capacity for drill core substantially increased.

The vast library of drill core and samples at Mornington "provide an irreplaceable reference library of Tasmania's geology", said Dr McNeill. This resource is used by the exploration and mining sectors, the construction and infrastructure sectors, as well as for academic research and teaching. So, it is both a vital teaching tool and a trove of information for prospective miners and researchers.

The current upgrades, funded by the State Government, will see \$2.4 million spent on updating the laboratories and research areas so that the growing

number of users and stakeholders have better access to the core samples. Dr McNeill said that the number of users of the core library is steadily growing. "Between 2017 and 2020 the number of visitors to the core library increased by 35 percent, from 455 to 615 per annum". Among these are a substantial number of CODES/Earth Sciences students, as well as participants in several of the Master of Economic Geology courses run by CODES.

Associate Professor Sebastien Meffre from Earth Sciences at UTAS said that the upgrades would be a big step forward and would improve the learning outcomes for students from CODES/Earth Sciences, as well as assisting UTAS and visiting researchers.

LICENCE TO DRILL

Every company in Tasmania with a licence or lease to carry out mining or exploration is required by law to deposit drill core with MRT, and the facility is also used to archive geotechnical core from organisations such as the Hydro, Entura, Tasmania Irrigation and geotechnical consultancies. It also houses samples collected by MRT's own geologists and geoscientists during their research. It currently contains drill core that would measure 770 kilometres if it were laid out end to end.

"The current facility was constructed in 1991 and has been incrementally extended over the past 30 years, with the most recent expansion being a roof-lift in 2014. Engineering constraints, and the requirement to have adequate layout space for drill core logging, sampling and analysis (using the Hylogger) mean that storage capacity in the existing facility cannot be further increased and when additional storage is required then a new building will need to be constructed to house the expanding drill core and sample collections", said Dr McNeill.

To read an ABC Rural item about the recent upgrades to the Mornington Core Library, go to: <https://www.abc.net.au/news/rural/2021-01-19/hobart-rock-library-filled-with-mineral-samples/13060914>

INCA TEAM TRIUMPHS!

CODES Masters student Victor Torres led the Inca Team that took out the first prize in a highly regarded international competition for mineral geoscience university students. He outlines the award and what it means to him.

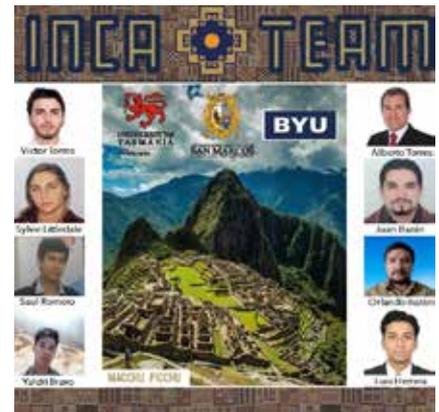
The Frank Arnott – Next Generation Explorers Award (NGEA™) was presented virtually at the PDAC 2021 convention in Toronto, Canada, in early March. It is a highly prestigious award in which multidisciplinary teams come together to interpret complex geoscience datasets from mineralised provinces to identify exploration targets. The Inca Team built their submission on the Yukon Plateau Dataset on a foundation of community engagement and sustainability inspired by Inca cultural traditions, and developed a series of exploration targets based on weights of evidence modelling of a complex array of geological, geochemical and geophysical datasets.

The multidisciplinary team members were myself (Victor Torres, team leader

and Masters student at UTAS), Sylvie Littledale (Masters student at Brigham Young University), Juan Carlos and Orlando Bazan (Masters students from San Marcos University), and Saul Romero, Yaldri Bravo and Fernando Herrera (undergraduate students from San Marcos University). The team mentor was Alberto Torres (Professor at the University of San Marcos).

For me it was an honour to work with such great people and professionals along this journey, from which I learnt a lot. Furthermore, this win was possible because from the beginning we shared the same vision of doing high-quality work that can be applied to the mining industry. We took into consideration the ESG (environmental, social, governance) factors, while striving for scientific excellence for the next discovery, and we took the opportunity to show a bit of our culture, which was applied as the basis of our methodology.

Our team received the award for first place along with prize money of CAN\$5,000. The second place went



Striking gold: The victorious Inca Team, with CODES Masters student and team leader Victor Torres pictured (top left) alongside his teammates; the Inca Team won the prestigious Frank Arnott – Next Generation Explorers Award at the recent 2021 PDAC conference, which was run online in early March.

to the University of Western Australia (UWA), and the third place to the Camborne School of Mines (UK).

Read more about the Frank Arnott Award at: <https://www.pdac.ca/members/students/faa/about-the-award>

DAVID COOKE: SEG DISTINGUISHED LECTURER 2021

The Director of CODES, Professor David Cooke, has been honoured by the Society of Economic Geologists (SEG) by being selected as their Distinguished Lecturer for 2021.

A major objective of the SEG is to disseminate basic and applied scientific information to the economic geology community regarding mineral deposits and mineral resources. To help achieve this objective, each year it selects a Distinguished Lecturer and three Traveling Lecturers. The Distinguished Lecturer is selected based on pre-eminence in economic geology, either on some phase of scientific research or on the application of the science to minerals exploration and/or development.

David's role as Distinguished Lecturer will include presenting keynote talks at meetings where the Society is involved, such as the SEG conference in Whistler, Canada (September 2021). David's talk is entitled "New advances in geochemical exploration – defining the subtle, but giant, geochemical footprints of porphyry Cu and Au deposits using mineral chemistry". In his role as an ambassador for the SEG this year, David is also offering to present this talk to SEG student chapters, which can either reach out to him directly or via the SEG to request a presentation.

David can be contacted at: d.cooke@utas.edu.au



Professor David Cooke (fourth from left) explains the geological features of the Domeyko Fault transect, northern Chile, to a group of students.

THE LIGHTER SIDE OF ROCKS

The COVID-19 pandemic has inspired geoscience communities to develop new online networking and communication opportunities that have significantly enhanced outreach for those communities across the globe. One of those initiatives is GeoHUG (Humans United with Geology), which was created by Jessica Keast from CoreSafe Core Solutions & Prospectors Supplies. Jessica's vision for GeoHUG is for it to be a global platform to connect, laugh, share ideas, information and knowledge with the wider geology community.

GeoHUG meetings are held on Friday afternoons (AEST) and are distinctive in that they kick off with a short session from a local comedian, who is followed by a topical invited presentation, and



Comedy break: participants in the late January GeoHUG Zoom meeting talk geology with a bit of humour on the side in the form of an opening session from stand-up comic Daniel Muggleton (in red jacket).

ends with a networking/conversation session via Zoom. CODES staff and collaborators have been involved in the 2021 GeoHUG series, with Professor David Cooke presenting on 'Geological evolution of Late Ordovician to Early Silurian alkalic porphyry Au-Cu deposits at Cadia, NSW' in late January

and Scott Halley discussing 'Igneous chemistry made easy for Exploration Geologists' in late March.

More information about GeoHUG can be found at <https://geohug.rocks/> including links to past presentations and recordings.

CHERRY ON TOP...AN ACCOLADE FOR FORMER CODES PHD STUDENT

Dr Alexander Cherry, who completed his PhD at CODES and graduated in 2019, has just been awarded the Geological Society of Australia's D.I. Groves Award. This award is presented to the best paper published in the Australian Journal of Earth Sciences by a young author.

His paper was entitled 'Tectonothermal events in the Olympic IOCG Province constrained by apatite and REE-phosphate geochronology', and was presented to him virtually at the recent online Australian Earth Sciences Convention.

Dr Cherry currently works for Alkane Resources as an exploration geologist. His PhD looked at geochronological constraints on genesis, setting and later modification of the Olympic Dam and Acropolis IOCG/IOA deposits, South Australia.

The article can be found in *AJES*, vol. 65/5 at: <https://doi.org/10.1080/08120099.2018.1465473>

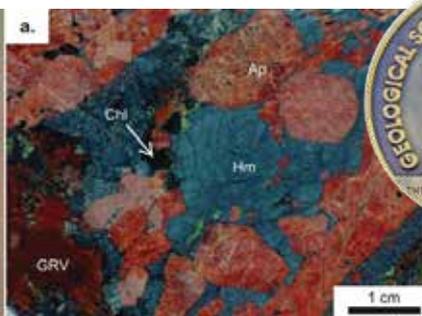
GSA Tasmania Division committee member Associate Professor Rebecca Carey said:

'This is a great time to encourage you all to join the Geological Society of Australia's Tasmanian Division. We have fun field trips, and there are some great speakers lined up for this year'.

See info about the GSA Tas Division: <https://www.gsa.org.au/Public/Divisions/Tasmania/Public/Divisions/Tasmania.aspx?hkey=63e436a3-e31c-45b2-8d7b-f7543465b46b>

Our super-cool website: <https://gsatasmania.wixsite.com/home>

Go here to join: <https://www.gsa.org.au/>



Left: Dr Alexander Cherry, recent recipient of the SEG's D.I. Groves Award.

Centre: Part of a figure from Dr Cherry's article about the Olympic IOCG Province: Apatite from the Acropolis prospect. (a) Coarse-grained, red apatite (Ap) with iron oxide (hematite; Hm) and minor chlorite (Chl) in a vein hosted by Gawler Range Volcanics (GRV) (OD1068, ACD21, 447.5 m) (Cherry et al. 2018, Fig. 3A).

Right: The D.I. Groves Award medal.

KING ISLAND GEOLOGY PARADISE



Dr Michael Roach carries out capture of 360-degree imagery for use in virtual tours using a camera mounted on a 6 m telescopic pole.

In December 2020 Dr Michael Roach and Dr Robert Scott visited King Island off the northwest coast of mainland Tasmania to collect imagery for the production of a series of virtual tours. The geology of King Island is spectacular and diverse. Metamorphic rocks on the southwest and west coasts are some of the oldest rocks exposed

in eastern Australia. These units are intruded by Neoproterozoic granitoids and are unconformably overlain by a sequence of Neoproterozoic rocks including correlates of 'snowball Earth' Marinoan glacial deposits and a thick sequence of rift-related basalts. The Neoproterozoic strata are intruded by early Carboniferous granites that

produced the world-class tungsten skarn deposits at Grassy.

The virtual tour of the geology of King Island was produced for the Australian Earth Sciences Convention in February 2021 and can be viewed at: <https://www.ausgeol.org/assets/media/uploads/tours/Kingisland/index.html>



Left: Contact metamorphosed metasedimentary rocks at Cape Wickham, near the northern tip of King Island.



Right: Dr Michael Roach collecting photography for production of 3D photo-realistic virtual models, City of Melbourne Bay, eastern King Island.

ALL SMILES: DECEMBER 2020 CODES GRADUATIONS

The COVID-19 pandemic meant that many graduations were held virtually in 2020, though some students were able to graduate at face-to-face ceremonies held in Hobart at the Grand Chancellor Hotel in December. These graduations were also live-streamed for those who were unable to attend.



Top left: Professor David Cooke with CODES PhD graduate Dr Erin Lawlis at a face-to-face graduation ceremony held at the Grand Chancellor Hotel during December 2020. Erin's PhD was titled 'Au-bearing pyritic ore of Lihir, Papua New Guinea: Its physiochemical character and nature of the causative fluids'.

Top right: Graduating CODES-TMVC Honours students Wei Xuen Heng and Olivia Wilson at the Grand Chancellor following presentation of their graduation certificates.

Left: Dr Amos Garay proudly displays his PhD graduation certificate in front of the UTAS Sandy Bay Campus buildings. Amos graduated 'virtually' in October 2020, and his research topic was 'Magnetite and epidote chemistry and textures at Las Bambas Cu-Au-Fe skarn, Peru: Assessing district and deposit-scale fertility – implications for ore genesis and exploration'. He is now working for Rio Tinto on their Winu project in WA.

Above: Earth Sciences BSc graduates with their teacher and mentor (L-R): Gypsy Mahar, Zak Weidinger, Dr Karin Orth, Olivia Wilson (Honours) and Jack Elliott-Tideman.

YES, WE DID HAVE AT LEAST ONE SUMMER'S DAY IN TAS...

The weather looked kindly on the CODES/Earth Sciences crew as another year rolled round and it was time to fire up the barbecue and enjoy some relaxation with colleagues. Social distancing and seated eating in practice of course...

A few days before Christmas 2020 CODES Director Professor David Cooke and Head of the Discipline of Earth Sciences Associate Professor Sebastien Meffre got the sausages (and veggie burgers) cooking in order to celebrate the close of the year that we would never forget.

A good turnout made for a pleasant afternoon in the CODES Rock Garden with catering organised by CODES administrative staff, in particular Karen Huizing. Good food and a drink or

too were enjoyed by all. On a more serious note, Dave reminded everyone in his speech that many people at the gathering had friends and family in distant places who were suffering because of COVID-19, and that several CODES/Earth Sciences people were unable to visit their families due to the restrictions brought about by the pandemic. We realised how lucky we have been in Tasmania too – so far.

The 2020 CODES Photo Competition was a little different with social

distancing proving a challenge for the voting process. So, Dave, Sebastien and Deputy Director of CODES Professor Leonid Danyushevsky each chose their preferred winner from a pool of 24 entries (smaller than previous years for obvious reasons). In what is becoming a tradition, each of the three winners received a bottle of Tasmanian vino.

One of the three winning photographs is shown here; the others can be accessed at: <https://www.utas.edu.au/codes/codes-annual-photo-comp>



Left, talking shop: L–R: Professor Leonid Danyushevsky, Dr Karin Orth, Rock Library Curator Izzy von Lichtan, Associate Professor Ron Berry and Postdoctoral Research Fellow Dr Julie Hunt enjoying the shade over lunch...

Right, masterchefs: L–R: Associate Professor Sebastien Meffre and CODES Director Professor David Cooke on the tools at the CODES 2020 Christmas barbecue...



Opposite page top left, keeping the Christmas spirit alive: (L–R) CODES PhD student Hannah Moore, Dr Joshua Phillips, Administrative Assistant Sophie Richardson, CODES Maintenance and Field Equipment Officer Meagan Porter, Senior Administrative Assistant Trish McKay, Lecturer Dr Angela Escolme and Senior Research Fellow Dr Martin Jutzeler.

Opposite page top right, relaxed lunch: Tucking into their meal are (L–R): Laboratory technician Maxwell Morissette, CODES PhD student Peerapong Sritangsirikul, visiting student Fengqin Ran from China and 2020 CODES-TMVC Honours student Wei Xuen Heng.



One of three winning photos in the 2020 CODES Photo Competition was this fieldwork shot taken by Dr Karin Orth: 'Second year KEA208 Earth Materials and Interior students undertaking detailed mapping at Piccaninny Point, eastern Tasmania, February 2020'.

CODES INDUSTRY PARTNERS 2021

We are pleased to announce that First Quantum Minerals has increased its level of support in 2021 and is now a Gold Industry Partner. Please contact us if you would like your company to be an important supporter of CODES' research.

PLATINUM



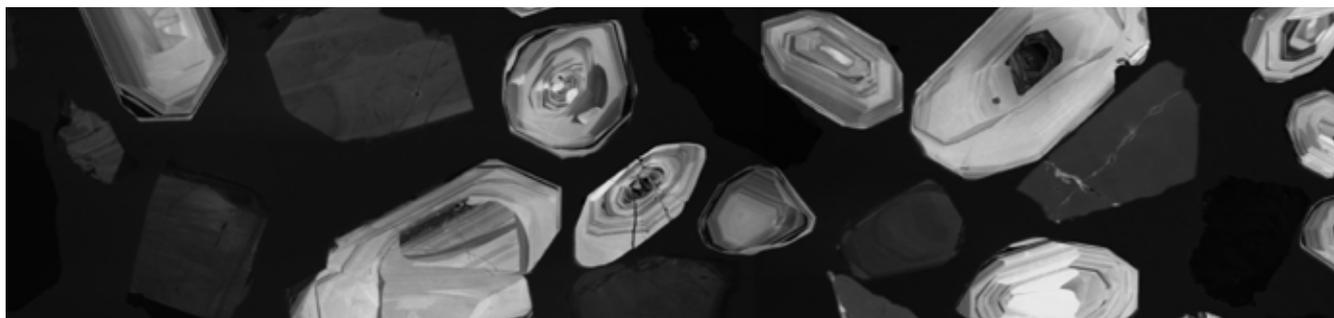
GOLD



SILVER



CODES – CENTRE FOR ORE DEPOSIT AND EARTH SCIENCES MAGMATIC INDICATOR MINERALS SYMPOSIUM 2021



Magmatic indicator minerals—exploration and research applications for magmatic and hydrothermal ore deposits

The Magmatic Indicator Minerals Symposium forms a standalone one-day event as part of the broader Ore Deposit Geochemistry, Hydrology and Geochronology short course.

1 June 2021 — Online 9 AM (UTC+10)

In the past decade, significant research efforts have been devoted to mineral chemistry studies to assist exploration for porphyry and other varieties of magmatic and hydrothermal ore deposits. A range of magmatic indicator minerals have been identified that can be used to identify the presence of, or potential for, magmatic and hydrothermal mineralisation (e.g., zircon, apatite, magnetite, titanite, monazite). These accessory phases can also be used for geochronology and isotopic tracing, and some occur both as magmatic and hydrothermal phases, making them potentially powerful tools to add to the explorer's toolbox. Ideally, these indicator minerals should help explorers to identify the geochemical fingerprint of a mineral deposit and discriminate it from other deposit styles and background rocks.

As part of CODES' biannual Ore Deposit Geochemistry, Hydrology and Geochronology short course, we are presenting a one-day symposium on exploration and research applications of magmatic indicator minerals for magmatic and hydrothermal ore deposits. A series of presenters from world-leading researchers in mineral exploration research groups, government and industry will give presentations and participate in panel discussions that provide symposium participants with a state-of-the-art appraisal of this important and developing new field of geochemical exploration.

SCHEDULE:

Accessory minerals in magmatic rocks (zircon, apatite, monazite, titanite, magnetite): mineralogy, trace element geochemistry and applications to research and exploration—**Michael Baker**

U-Pb dating methods for magmatic minerals—**Sebastien Meffre**

Zircon composition applied to porphyry copper exploration—**Robert Lee**

Developing magnetite chemistry in mineral exploration for Ni-Cu-PGE deposits—**Sarah Dare**

Porphyry indicator minerals (PIMS): apatite case study—**Farhad Bouzari**

Zircon fertility assessments: case study of the Cowal district, NSW—**Christopher Leslie**

PANEL DISCUSSION—Application of zircon, magnetite and apatite geochemistry to mineral exploration (PANEL: **Farhad Bouzari, Sarah Dare, Robert Lee, Christopher Leslie**)

Zircon as a pathfinder for porphyry Cu-Mo-Au deposits—**Yongjun Lu**

From arc magmas to porphyry deposits – Applications of lithogeochemistry and mineral chemistry to exploration—**Christian Ihlenfeld**

Using zircon, titanite and apatite in porphyry exploration—**Matthew Loader**

PANEL DISCUSSION—Porphyry indicator minerals: zircon, titanite and apatite (PANEL: **Christian Ihlenfeld, Yongjun Lu, Matthew Loader**)



Please contact CODES.Info@utas.edu.au for further information and to register.

* NB For full-course participants of the Ore Deposit Geochemistry, Hydrology and Geochronology Masters short course, this symposium is included in your registration

BLAST FROM THE PAST



Team meeting: this photo was taken by Stuart Bull in 2001, during the early days of Amira/ARC Project 544 'Proterozoic sediment-hosted Cu deposits'. He recalls: "We had rented two apartments for the research team in Kitwe in the Zambian Copperbelt which were just outside the centre of town close to the Kitwe Stream. While

this was doubtless a lovely babbling watercourse in the wet season, it rapidly degenerated into a series of fetid, fragrant and debris-choked waterholes perfect for breeding the Anopheles mosquito during the course of the dry season when we were doing our fieldwork. Pictured forcing down the evening medicinal gin and tonic are

(from left to right) Murray Hitzman, Mawson Croaker, Nikki Pollington, David Selley, Peter McGoldrick and David Broughton."

If you have photos from CODES' past you are willing to share please email us (CODES.Info@utas.edu.au)

THE ROCK LIBRARY'S DEBUT ON THE SMALL SCREEN!

In February our Earth Sciences/ CODES Rock Library Curator Izzy von Lichtan was instrumental in facilitating a visit to, and filming session of, the extensive rock collection here at UTAS; the resulting film formed part of the slow-publishing artwork called *Lost Rocks (2017–2021)*.

Izzy explains: "Last year Robyn Banks, daughter of one of the founding UTAS geology professors, Professor Max Banks, contacted me about some fossil questions. I discovered recently that it was part of her research for her book which is part of *Seam IX* of

the *Lost Rocks* art project. Her book recounts her memories of being a child of a geologist, and the hours she spent with him in the field, and also playing in the collection (before OH&S!).

"In February I took her, artist Margaret Woodward and filmographer Justy Phillips around the collection for part of a day, filming Robyn's recollections. A poetic film has resulted, which can be viewed at: <https://vimeo.com/user9353176> (click on the video titled Robyn Banks, Fossil IV, 2021. *Lost Rocks (2017–2021)*)

Information about the launch of the *Lost Rocks* project: <https://www.salarts.org.au/event/lost-rocks-launch/>



A short book, titled *Fossil* by Robyn Banks, forms part of the *Lost Rocks* art project.



A MESSAGE FROM THE CODES DIRECTOR, PROFESSOR DAVID COOKE

I am sure many welcomed the passing of 2020 with a sense of relief and a hope for significant improvement in circumstances for all in the new year. Over the first months of 2021, UTAS staff and students have been fortunate to be able to return to face-to-face student teaching following COVID-safe protocols. Our Honours students are currently conducting fieldwork in Tasmania, and several undergraduate and postgraduate field excursions have been completed over the past two months. Our SEG Student Chapter is preparing for a four-day field excursion to King Island in April, where they will experience the hidden 'geology paradise' that few geoscientists get to visit, including a chance to visit the world-class tungsten skarn deposit at Grassy.

While the COVID pandemic continues to create major disruptions and challenges globally, it has been an intriguing time for the minerals industry both domestically and internationally, with copper and gold prices currently near historic highs, due in part to short-term supply issues and financial volatility. These high metal prices coupled with border closures have stimulated domestic employment opportunities in the resource sector, which may have contributed to increased student interest in resource-related academic disciplines at UTAS in 2021.

Whatever the underlying drivers, it has certainly been very pleasing to see a significant growth in first-year enrolments in Earth Sciences this year. An increased student base in resource-related STEM subjects is essential for providing a more sustainable pipeline of highly qualified professionals for the minerals industry, and also facilitates growth in our capacity for fundamental Earth science research and training. Students choosing to study geology

at this time who are interested in an industry career may be making a strategically wise choice – there are predictions that in the medium term, society's desire to transition to a low-carbon energy future will drive significant growth in demand for copper and 'battery' metals such as cobalt, nickel and lithium. The global structural deficit in copper supplies being forecast by BHP and other major copper producers from the mid-2020s is one indication that our new students may find themselves graduating in a strong employment market with the need to discover more resources, and to mine existing resources more sustainably and effectively. They should enjoy many opportunities to help shape a more sustainable mining industry and to contribute positively to helping resolve some of the significant long-term environmental challenges that our society faces.

Best regards
Dave

UPCOMING SHORT COURSES

ORE DEPOSIT GEOCHEMISTRY, HYDROLOGY AND GEOCHRONOLOGY (KEA704/KEA709)

31 MAY-5 JUNE AND 5-9 JULY 2021

COURSE LEADER: DAVID COOKE

This course covers a variety of geochemical and geochronological techniques used to interpret environments of ore formation and processes of ore genesis, and discusses the implications of these datasets for mineral exploration. Topics include Ar-Ar, U-Pb and Re-Os geochronology, whole rock and trace element chemistry of igneous rocks, sulfide trace element chemistry, stable and radiogenic isotopes, fluid inclusions and hydrothermal geochemistry.

Delivery mode/location: Part 1: Online; Part 2: Online and face-to-face options, Tasmania (Australia).

For more details, download the most recent flyer (PDF 474KB) at: https://www.utas.edu.au/__data/assets/pdf_file/0017/1432403/Geochem-SC-2021-FINAL.pdf

FUNDAMENTALS OF ECONOMIC GEOLOGY (KEA716)

30 AUGUST-10 SEPTEMBER 2021
COURSE LEADER: DAVID COOKE

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

Delivery mode/location: Online

A flyer will be available shortly on the CODES website.

GEOMETALLURGY (KEA711)

18-29 OCTOBER 2021

On-campus delivery and field trip to northwest Tasmania.

ORES IN MAGMATIC ARCS (KEA707)

26 NOVEMBER-8 DECEMBER 2021

Field-based short course, likely delivered in NSW and/or Queensland due to international travel restrictions.

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.