

ORE SOLUTIONS

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

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EXPANDING OREBODY KNOWLEDGE: AMIRA P1249 NOW UP AND RUNNING



CODES/TMVC PhD students Xin Ni Seow (left) and Rhiannon Jones using a portable TerraSpec Mineral Spectrometer to analyse minerals in one of the rock stores at CODES. Both Xin Ni and Rhiannon have been working on Amira P1202 and the results of their research will feed into Amira P1249, which has just started.

This year sees the start of an important new CODES research collaboration with Amira Global sponsored by more than a dozen prominent mining companies. Here Dr Mike Baker summarises the venture, which will be ongoing for the next five years.

In February 2022, Amira Global's P1249 project, 'Exploring, characterising, and optimising complex orebodies – Upscaling orebody knowledge to add value across the mining value chain',

commenced with a start-up meeting held by CODES at the University of Tasmania. The meeting was attended both in-person and online by representatives of the research team, Amira and sponsor companies.

This new five-year project will provide its sponsors with new tools for recognising proximity to high-grade ore, and new tools, methods and workflows for translating and upscaling mineralogical, geochemical and hyperspectral data into quantitative mineralogy for complex

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FROM THE DIRECTOR

Professor David Cooke looks forward to an exciting year of research and discovery in 2022.

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Researchers and industry stakeholders participating in the Amira P1249 project gathered at CODES in mid-February for a project start-up meeting. They are pictured here in the CODES Rock Garden with CODES Director Professor David Cooke at far right and Program Manager Technology & Innovation at Amira Global Dr Olga Verezub third from right.

orebodies of copper, gold, critical and other metals. The project team, led by Professor David Cooke, will aim to optimise orebody knowledge and provide the information required for mineralogical domaining and resource definition at the mine scale. P1249 will focus on transition zones – the alteration domains that extend from the orebody into the surrounding unmineralised rocks. Although the primary focus of the project will be on porphyry, epithermal, carbonate replacement and skarn deposits, the project is also applicable to Mt Isa-style Cu, IOCG, orogenic Au and other deposit styles.

By delivering new and more effective methods and workflows for mineralogical characterisation in the transition zone, P1249 will deliver better exploration models, facilitate informed decision making at all stages of the mining value chain, and identify value opportunities in waste streams that may help reduce waste volumes, thereby providing new orebody knowledge essential for optimising ore extraction and recovery from complex orebodies. The research team will provide new and refined geochemical and geological tools for fertility assessments to establish whether there is a significant mineral

resource nearby (i.e., how large is the resource?) and to ensure that deposits are discovered more quickly and at less cost by reducing the amount of drilling required for discovery (vectoring – how far, how deep and in what direction?). These tools will be designed to ensure cost-effective exploration through implementation early in an exploration program, allowing opportunities to be recognised from near-miss drilling, and to allow the presence, location, and potential size of porphyry, epithermal, skarn, carbonate-replacement and other resources to be determined rapidly.

Total project cost over the five years will be AU\$6.2M including research organisation and in-kind contributions of AU\$2.3M. As of February 2022, fifteen companies have officially signed on to sponsor P1249, including Anglo American, AngloGold Ashanti, BHP, Boliden, CMOC/Northparkes, Codelco, Evolution Mining, First Quantum Minerals, Fortescue Metals Group, Glencore/Mt Isa Mines, Newcrest, Newmont, Rio Tinto, Sandfire Resources, and South32.

If your company would like to be part of this exciting new venture, please contact Olga Verezub at Amira Global: olga.verezub@amira.global

MASTERS 2022: THE STATE OF PLAY



Participants in the Advanced Field Skills in Economic Geology Masters short course looking at pegmatites and unidirectional solidification textures at Bluestone Bay on the Freycinet Peninsula. They are (clockwise from bottom left): Luke Pickering (MEconGeol student), Jessica Askew (also MEconGeol), Felix Dobbin (UTAS Honours student), Dr Lejun Zhang (course presenter from CODES), Jackline Lumamba (industry participant) and Dr Mike Baker (course presenter from CODES).

MASTER OF ECONOMIC GEOLOGY STILL GOING PLACES...

Here the CODES Master of Economic Geology Program Co-ordinator Dr Robert Scott brings you up to date with the latest field trip reports, and flags some future changes to the degree structure.

After two years of COVID-induced lockdowns and border closures, which forced delivery of the Master of Economic Geology online, some things are finally getting back to normal. In late 2021 and early 2022, two field-based short courses were successfully delivered. In December 2021, Ores in Magmatic Arcs was uprooted from its normal homes (in either South America or Indonesia) and delivered over two weeks in Tasmania. In February 2022, Advanced Field Skills

in Economic Geology was run for a second time. While Western Australia's decision not to re-open their border in early February meant that WA-based students and industry participants unfortunately could not attend, for the remaining participants the trip ran smoothly and was enjoyed by all. A new requirement that participants complete pre- and mid-trip rapid antigen tests, as well as the wearing of face masks whilst travelling or indoors, were the only significant changes to the normal delivery of field-based courses.

The first week of Advanced Field Skills is delivered concurrently with the CODES/Victorian Institute of Earth and Planetary Sciences (VIEPS) Honours/Masters Exploration Field Skills short course. This part of the short course, based out of Queenstown, provides participants with the opportunity to develop or enhance existing skills in geological mapping, core logging and structural analysis, within a mineral exploration context. Participants logged core from, mapped and

ultimately assessed the exploration potential of a ~5 km² area located <15 km south-southwest (along strike) from the Rosebery volcanic-hosted massive sulfide (VHMS) deposit. Thanks are due to Hydro Tasmania for facilitating access to the mapping area, and Mineral Resources Tasmania for laying out over 1,300 m of drill core from the area for participants to log and interpret.

Participants for the first week of the short course were trip leaders Robert Scott and PhD student Zeb Zivkovic, three UTAS Honours students, five VIEPS students, three Master of Economic Geology students, a CODES PhD student and a participant from industry. At the end of the week, Rob, Zeb and most of the Honours and VIEPS students returned to Hobart, and Mike Baker and Lejun Zhang, accompanied by an additional PhD student, took over to lead a two-and-a-half-day Anaconda mapping and core logging exercise on the Mt Lyell mine lease in Queenstown. CODES is extremely grateful to Geoff Cordery

from CMT for facilitating this activity. After completing the Mt Lyell exercise, participants travelled to George Town on the northeast coast of Tasmania, where Robert Scott re-joined the group for three days of structural mapping exercises in multiply deformed, Lower Palaeozoic turbidites exposed in wave-cut rock platforms at Bellingham and Beechford. On the final day, participants travelled to the Freycinet Peninsula on the east coast, to examine features formed in granitic rocks at the magmatic–hydrothermal transition exposed at Bluestone Bay. Here the students – again led by Lejun Zhang and Mike Baker – completed another Anaconda method mapping exercise, in which the spatial and paragenetic relationships between various intrusive phases, miarolitic cavities, unidirectional solidification textures (USTs) and hydrothermally-altered wall rocks were documented.

FUTURE PROGRAM

Advanced Field Skills in Economic Geology is the first of six MEconGeol units to be offered in 2022. Volcanology and Mineralisation in Volcanic Terrains, in November, will also be delivered face-to-face in the field (locations to be confirmed). The other four units (KEA716, KEA712, KEA713 and KEA710) will all be delivered online.

As part of the University of Tasmania's ongoing Postgraduate Coursework Transformation, some changes to the structure of the Master of Economic Geology are planned. Most likely from 2023, the units Fundamentals of Economic Geology (KEA716) and Ore Deposit Models and Exploration Strategies (KEA712) will become compulsory. Students will also be required to complete at least one of the three field-based units already mentioned in this article. Otherwise the flexibility of unit choices available to students since the advent of the national Mineral Geoscience Masters program in the early 2000s remains.

See the back cover of this newsletter for information on our next two upcoming Masters short courses for students and industry participants.

MASTERS BY RESEARCH

Here we feature two of our 2021 Masters by Research students – Emma has completed and Ben is in the process of completion.



EMMA BEATTIE

Master of Economic Geology

Supervisors: Robert Scott, Alex Brown (Mount Isa Mines)

Project title: The olivine rocks of Brownsnake West, Tommy Creek Domain (Mount Isa Inlier, Northwest Queensland)

Emma has worked in mining exploration since 2006, but has been a geologist for only six years (she was a field technician previously). She began her Masters in 2021.

"While researching my thesis I received really helpful feedback from Rob Scott, not only on the technical issues, but also on how to write academically. The project sought to understand the origin of some rocks comprising 80% olivine, that were clearly not orthomagmatic. We concluded it was potentially a metamorphic assemblage resulting from an unusual chemical (sideritic) prolyth. Hopefully this added a small piece to the large puzzle of the Tommy Creek Block, being unravelled by my boss, mentor, and the smartest person I know, Alex Brown (Mount Isa Mines)."

Emma also took the KEA717 Special Topics option, which she enjoyed:

"KEA717 Special Topics on the Callisto Manganese Trend, Eastern Succession (Mount Isa Inlier, Northwest Queensland) was also great, because it enabled me to take a project from work, and get assistance from a wide range of experts at CODES. I learned a lot, and produced good results at work, justifying the time. So, a good result on both fronts!"



CODES Masters student Emma Beattie making friends with an interloper during fieldwork south of Mount Isa in northwest Queensland. She is planning to attend future Masters short course field trips as an industry participant having recently completed the Master of Economic Geology degree by research.

"The project looked at what was potentially a metamorphosed exhalite horizon in stratigraphy equivalent to the Dugald River orebody. It involved whole-rock geochemistry as well as mineral chemistry from the electron microprobe. The project found a hydrothermal overprint with an oxidation gradient to the north, providing a vector to potential base metal mineralisation associated with the event."

"I loved the Masters program, because it was directly relevant to my job in exploration, and all the skills we learned were practical – we could apply them directly to our jobs, straightaway. Everyone involved in teaching was not only a great teacher, but an expert in what they do, whether in the industry or research. The course is also extremely well organised by Rob [Scott] and Helen [Scott] – they made it flexible and easy to navigate, which is not something to be taken for granted with academic admin. Because I did this course, I was able to improve my skills in so many areas while I was working full-time in the industry. I applied for my dream job with the state Geological Survey at the end of last year, and because of this degree I got it!"



BEN JOHNSON

Master of Economic Geology

Supervisors: Indrani Mukherjee, Ross Large, Jeff Steadman

Project title: Pyrite textures and trace element chemistry of the Century Deposit – implication for exploration

Ben is working on the pyrite textures and trace element chemistry of proximal, intermediate and distal drillholes from the Century Deposit. Located in northwest Queensland and part of the world-class Carpentarian Zinc Belt, the Century deposit was discovered in 1990 and was mined from 1999 until 2015. The current owners, New Century, are reprocessing tailings and exploring the surrounding district for new deposits.

Ben's research is focused on using Laser Ablation Inductively Coupled Plasma Mass Spectroscopy (LA-ICP-MS) to investigate hydrothermal geochemistry at a microscopic level, comparing mineral chemistry within the Century deposit to surrounding sedimentary rocks of the same age. Previous CODES research in the McArthur River district in the Northern Territory has identified enrichments in trace elements such as thallium and zinc in pyrites surrounding known deposits. The ultimate aim of Ben's work is to develop geochemical vectors to aid exploration for clastic-dominated sediment-hosted zinc-lead-silver deposits in shale basins, and the research is part of the broader PY005 project at CODES within Program 1, run by Dr Indrani Mukherjee and Professor Ross Large in association with industry sponsors.

"As well as providing a great base and update in a range of cutting-edge geology topics, the CODES Masters program allows you to interact with many other early- and mid-career geologists doing a range of jobs around the world. It provides an excellent overview of available career pathways and opportunities while you get to look at interesting rocks."



CODES Masters student Ben Johnson mapping Proterozoic rocks north of Mt Isa in northwest Queensland...hopefully standing 100 m above an undiscovered copper deposit. Chris is currently completing a Masters by Research degree.

MASTERS BY COURSEWORK

Four Master of Economic Geology coursework students, most of whom have completed the degree while working either part-time or full-time in industry, here give their assessment of what they enjoyed about studying at CODES, and what the degree means for their future work in the minerals industry.



CHRIS BOOTH

Graduated August 2021

Superintendent Geology, Geoscience & Resource Engineering, Olympic Dam Copper, BHP

After completing my undergraduate degree in Earth Sciences in 2007, I knew someday I would want to return

to UTAS to complete postgraduate qualifications. Being able to do short intensive studies allowed me to balance my work responsibilities and build on my geoscience knowledge with a very relevant curriculum that is aimed at industry geologists.

I particularly enjoyed the fieldwork and opportunities to visit economic deposits from around the world with lecturers and other students who are passionate about what they do and support each other during the courses. I have created lifelong friendships and industry networking which has definitely enabled me to advance my career.

Completing my final subjects during COVID had its challenges; however, the team at UTAS adapted extremely well and provided modified alternatives and new subjects which can be studied from home.

I would particularly like to thank Rob [Scott] as I probably would have never finished without his support, and the whole team for creating a high-value experience. I wish I could do more subjects!



Chris Booth pictured at the Olympic Dam core facility; this is one of the busiest core facilities in Australia with over 250 km of drill core expected to pass through it within the next 12 months. Chris recently graduated from the Master of Economic Geology coursework degree – and wants to do more CODES short courses.



Alister Orton, who has recently completed the coursework Master of Economic Geology degree at CODES and works as a geologist at Evolution Mining, is seen here looking at bushveld complex rocks during an African field trip in 2018.



ALISTER ORTON

Graduating shortly

Geologist at Evolution Mining

The Master of Economic Geology is a very engaging and educating program to be enrolled in that provides an excellent balance between theoretical and practical knowledge. The program allows for interactions with other industry patrons as well as academics, which is a great advantage as this allows for intricate learning amongst experienced industry personnel. All this while at a pace that is flexible and suits individual needs.

UTAS is a very professional establishment whilst at the same time accommodating and welcoming in their dealings. I have thoroughly enjoyed the course to date and recommend it to anyone in the industry who is looking to upskill and gain exposure to new technologies, new approaches and expansive geology. I will be trying to apply all learnings from the course going forward and hope to engage with the university in the future to utilise many of the services for industry they have on offer.

I'd like to thank Rob Scott for making the course so seamless. He is very organised and pulls it all together. His hard work is easily noticed and much appreciated.



MARKUS STAUBMANN

Graduated August 2021

Business Development and Exploration Manager at S2 Resources

I was initially drawn to the national Minerals Geoscience Masters (MGM) program due to its flexibility which allows you to study economic geology via multiple institutions without significant interference to full-time employment. Having previously



Recent Master of Economic Geology graduate Markus Staubmann is working as the Business Development and Exploration Manager at S2 Resources, and is pictured here at the Nova-Bollinger nickel-copper mine (Fraser Range, WA). He is standing in front of a twin boom jumbo, which is being used to blast holes to start developing the decline access to the orebody.

completed my undergraduate studies at the University of Tasmania in 2010, and having seen the variety of MEconGeo courses on offer through CODES, it was an easy choice to enrol with UTAS as my primary study centre.

For me personally, the intensive short course structure has been exactly the right mix between providing practical in-field training and exposure to a variety of geological terrains, underpinned by comprehensive classroom-based teaching by world-renowned leaders in their respective fields (including industry-based guests). The immersive nature of these courses is a great way to maximise their effectiveness, and I have come away from each course with a greater level of knowledge and skills that have been directly applicable in my role as Business Development and Exploration Manager at S2 Resources.

The knowledge, skills and broader geological, geometallurgical, and environmental context that is collectively gained throughout the CODES MEconGeol short courses has been instrumental in my career development to date, and will no doubt be a benefit in the years to come.



VICTOR TORRES

Graduated December 2021

Project Geologist, Chakana Copper Corp

Doing a Masters at CODES was definitely a life-changing experience, on both the personal and professional level. Lessons learned have had a direct impact on real-world problems in economic geology, as well as on this South American geologist: the Masters has broadened my knowledge and experience – from the Andes to the rest of the world.

The staff and people at CODES are amazing and tend to all have the same passion for geology, which makes the classes and field trips so enjoyable and worthwhile. The laboratories are excellent for doing research, and the online courses were very well structured to give you the maximum knowledge and applicable tools. Therefore, I definitely can say it is a



Master of Economic Geology coursework graduate Victor Torres pictured at the Cordillera Negra, Peru, exploring for mineralised tourmaline breccias for Chakana Copper Corp, where he works as a project geologist.

great program for economic geologists wanting to upgrade their knowledge and skills to meet both the present and future challenges in the mineral industry – plus Hobart is an amazing place to be.

Special thanks to my supervisor Professor David Cooke, who has been so patient, and key in my professional development!

Victor originally started a Masters by Research, but has now completed the coursework Masters; his research thesis will form the basis of his PhD here at CODES.

CHAIN REACTION: WORKING TO MAXIMISE VALUE IN MINING

Dr Julie Hunt talks about her work and the importance of using geometallurgy to optimise efficiency and profitability throughout the mining value chain

I'm a Research Fellow at CODES and since 2006 have been working in geometallurgy with various research teams on collaborative industry-funded projects. This began with the Geometallurgical Mapping and Mine Modelling (GeM; AMIRA P843 and P843A) projects which took place from 2005 to 2013.

Geometallurgy is a cross-discipline approach that investigates relationships between geological variability and mineral exploitation. It documents the impacts of this variability throughout the mining value chain from mining, through comminution (i.e., crushing and grinding), processing and recovery, waste and tailings, product saleability, and ultimately mine closure. It is used to identify geological attributes, in addition to grade, that affect the value of a resource (e.g., hardness, deleterious elements or minerals, acid rock drainage potential etc.). It results in quantitative spatially constrained data that can be used in 3D models and mine planning activities to help optimise efficiency and profitability.

During the GeM projects, workflows, protocols and small-scale tests were developed to provide proxies for processing parameters; for example, calculating mineralogy from geochemistry and using geochemistry and/or mineralogy \pm rebound hardness to estimating Bond work index (i.e., a measure of grindability). The aim was low-cost abundant data that could be used to develop statistically-relevant models. Ideally, proxies can be developed for assay intervals and propagated throughout a drillhole database to provide continuous downhole information. Geometallurgy continues to be one of the main



Dr Julie Hunt at CODES with a selection of rock and drill core samples from projects she is working on as part of her work on increasing value within the mining chain. Her work involves identifying geological controls on upgrade potential in porphyry copper, intrusive-related gold and epithermal zinc-lead-silver deposits.

research streams at CODES and since the completion of the GeM projects has continued within *Program 2: Geometallurgy, geoenvironment and mining* in one-on-one projects with industry and as modules within larger Amira projects.

Most recently I've been working on a collaborative project with the Cooperative Research Centre for Optimising Resource Extraction (CRC ORE), which is based in Brisbane. This project focuses on the geological

controls of grade deportment by size which is a form of natural deportment where economic phases partition into specific size fractions during early comminution stages. Utilisation of natural deportment on a mine scale has the potential to reduce energy and water usage through rejection of uneconomic coarse size fractions early in the comminution circuit. For example, some of the CRC ORE case studies show that ~ 80% of the value is contained in only ~ 30% of the rock mass. Our work at CODES focuses on

identifying geological controls on upgrade potential in porphyry copper, intrusive-related gold and epithermal zinc-lead-silver deposits.

My roles at CODES include program and project management, analysis of existing mine site data, collection and analysis of new data, sample characterisation, element/mineral deportment, development of models to estimate processing parameters, trialling of new testing and equipment, and development of workflows as well as industry-focused geometallurgy training.

Training includes the geometallurgy short course offered within the Master of Economic Geology program here at CODES. The course was most recently presented in October/November 2021. It included sessions on: geometallurgy principles; sampling; small- and



A graphic depicting the processes in the mining value chain that can contribute to efficiency and profitability in the mining sector. This graphic was originally designed for the GeM projects, which took place between 2005 and 2013, but it has equal relevance today.

bench-scale testing equipment; comminution; gold processing; recovery; chemical extraction; grade engineering; circuit design; environmental geology; geomicrobiology; calculated mineralogy; image analysis; sustainability and social licence to

operate; statistics and data analytics; plus a practical project. The course involved over 20 presenters including invited experts from SimSAGe, Curtin University, Mineralis, Mineral Mapping, Anglo American, CSIRO, and Voconiq plus case study presentations from BHP, Newcrest and MMG.

IN OTHER NEWS....

- Please note that the Specialist Group in Tectonics and Structural Geology (SGTSG) 2022 Conference flagged in our last newsletter has been postponed and will now take place on 22–24 November 2022. See <https://www.sgtsg.org/> for further details.
- Two former Master of Economic Geology graduates from CODES have been instrumental in the discovery of the Hemi gold deposit in Western Australia. Allan Kneeshaw and Phil Tornatora (along with colleague

Andy Beckwith) from the De Grey Mining Team won the 2021 AMEC Prospector Award (Association of Mining and Exploration Companies) for their efforts. See: https://www.linkedin.com/posts/association-of-mining-and-exploration-companies-amec_-and-the-one-weve-been-waiting-for-the-activity-6872158274578370560-fRfP/ Thanks to Bruce Gemmell for bringing this to our attention.

- As part of his SEG Distinguished Lecturer 2021 series of talks Professor David Cooke gave a Zoom presentation in November entitled 'New advances in geochemical exploration—Detecting the subtle, but giant, geochemical footprints of porphyry Cu and Au deposits using mineral chemistry' to students and academics at Hefei University of Technology in China. There were 300 participants, and many more would like to have joined the lecture.

CODES CONNECT

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

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

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

You can follow one of our Facebook pages:

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

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

You can also follow our LinkedIn page:

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

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CODES.info@utas.edu.au

UNRAVELLING THE SECRETS OF ANCIENT OXYGEN LEVELS ON EARTH

Emeritus Professor Ross Large, founder and former director of CODES, is leading an international study into how oxygen levels rose thus allowing new minerals and early life to evolve.

Oxygen is critical for life, but what promoted the first rise in atmospheric oxygen on Earth and precisely when it happened have been challenging scientists for the past 70 years.

Most scientific research suggests oxygen rose rapidly about 2.4 billion years ago and then fell just as abruptly over the next 200 million years – this event is called the Great Oxygenation Event (GOE).

A new international study led by a team of geologists from the University of Tasmania in collaboration with scientists from the Carnegie Institution in Washington and the University of Toronto offers an alternative theory.

Atmospheric oxygen rose over a period of a billion years, with a peak close to present-day levels of 21% oxygen around 1.9 billion years ago. Oxygen then declined for a further period known as the 'Boring billion'.

Their research has demonstrated that the evolution of minerals in the Earth's crust correlates with the rise of oxygen due to the presence of new oxidised metal species that only became available because of the rise in oxygen.

CODES Emeritus Professor Ross Large said their results are based on a wealth of data from a range of minerals and isotopes.

The teams at UTAS, the University of Toronto and the Carnegie Institution have built massive databases on the chemistry of a wide range of minerals, involving tens of thousands of analyses collected over the past 15 years.

Professor Large says the first rise in oxygen was accompanied by a decline in carbon dioxide and methane, producing ocean and atmosphere conditions more amenable to life.



"We propose that two phases of mountain building helped drive the rise in oxygen, production of new minerals and evolution of early life. The first occurred around 2.8 billion years ago with the formation of the supercontinent Kenorland, and the second around 2.1 billion years ago, which formed the supercontinent Nuna."

The third oxygen cycle started about a billion years ago, and from then on, the cycles increased in frequency from about 200 million years apart down to 60 million years apart. Previous research by the team has shown that each oxygen cycle ended with a mass extinction but was rapidly followed by an explosion in evolution.

Contrary to some suggestions, Professor Large does not consider

we are heading into another mass extinction. He said that past mass extinctions involved carbon dioxide rising to greater than 4,000 parts per million (ppm), compared to about 300 ppm today, and oxygen dropping well below 10% and possibly as low as 5%, compared with 21% today. He suggests that, based on Earth cycles, the next mass extinction is about 30 million years away.

A version of this article first appeared on the UTAS intranet in March 2022.

See the forthcoming article about this research in *Geosystems and Geoenvironment*: <https://www.sciencedirect.com/science/article/pii/S2772883822000152>

PLANET EARTH TAKES OFF!

Associate Professor Sebastien Meffre explains the big rise in first-year student numbers for a popular Earth Sciences unit, and hopes that the trend will continue.

Our Semester 1 first-year undergraduate unit Planet Earth (KEA101) has seen a sharp rise in student numbers in the past few years, with enrolments at the beginning of semester increasing from 56 students in 2019 to 153 this year (see graphic).

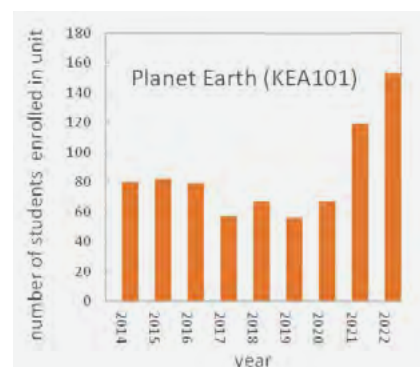
This is probably due to a number of factors:

- First-year BSc Earth Sciences units are offered both face-to-face and online, making these accessible to students in northern Tasmania and interstate.

- Changes to course structures have made Earth Sciences units more widely available.
- Students seem to be starting to recognise that Earth scientists play an important role in society. We (and other stakeholders) have been promoting this message in schools and at community events and the message may be starting to resonate.

The CODES/Earth Sciences team will be working hard to give our first years a great semester so that they enrol in KEA102, Earth Evolution, next semester.

See page 16 for photos from the first-year excursion to Lower Sandy Bay.



Student numbers for the first-year unit called Planet Earth have shot up in recent years. This may be due in part to the fact that a wider appreciation of the role of Earth scientists in society is starting to filter through to school students following sustained outreach and community events promoting the topic.

BLAST FROM THE PAST



25 YEARS AGO...

In 1997 CODES was granted Special Research Centre status by the ARC, and the celebrations were well-deserved – and well-attended. In the 25 years since then CODES has grown to be a world-renowned centre for ore deposit research. Pictured here are (L-R) Professor Tony Crawford, Mohammad Adabi, an Iranian PhD student, and Professor Ross Large, then Director of CODES, standing at the entrance to the CODES Conference Room during a function to mark the opening of the CODES SRC.

WHERE ARE THEY NOW?

In this issue we talk to Dr Jacqueline Blackwell, who now heads up her own geological exploration consultancy while also working full-time as a geologist in the province of Ontario, Canada

THE BEST OF BOTH WORLDS



DR JACQUELINE BLACKWELL

Chief Geologist at Gold Candle Ltd

PhD completed at CODES in October 2010, entitled 'Characteristics and origins of breccias in a volcanic-hosted alkalic epithermal gold deposit, Ladolam, Lihir Island, Papua New Guinea'.

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

I am the Chief Geologist for Gold Candle Ltd, and the Principal Consulting Geologist and President/Owner of Long Point Geologic Ltd.

Gold Candle Ltd is a privately owned company that owns the Kerr-Addison gold exploration project in Virginiatown, Ontario, and is currently operating a multi-drill exploration program. The Kerr-Addison deposit is an Archean greenstone belt gold deposit that hosted one of Canada's largest underground mines, producing over 11 million ounces of gold from 1938 to 1997.

As the Chief Geologist I am involved with a variety of projects and geologic studies that collectively aim to de-risk

the project and advance the resource from an inferred to an indicated category. These include drill hole targeting, guidance and mentoring of core logging geologists and management of core logging data. I am responsible for geologic model development, metallurgical studies, and guiding analytical and geologic studies that aim to understand the distribution of gold in the deposit.

Although acting as a Chief Geologist for Gold Candle is currently a full-time position, it is important to me to maintain my independent consulting company, Long Point Geologic. This has given me the opportunity to travel to various deposits and continue to focus on understanding and learning the facies control in altered volcanic rocks and hydrothermal-volcanic breccia complexes on targeted projects.

What are the things you enjoy most about this role?

I am passionate about understanding altered volcanic rocks and being able to translate geologic observations into tangible products. Running my own consultancy has allowed me the freedom to explore this area of geology and to continue to learn new ways to approach problems.

I am passionate about teaching and training younger geologists to trust their observations. Both my current full-time position and various field-based consulting jobs have allowed me to act as a mentor to students, recent graduates and company geologists.

I recently tried teaching labs at Thompson Rivers University with Professor Nancy Van Wagoner. Being part of the academic community is very fulfilling.

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

My current career is the result of a series of seized opportunities and

great mentors along the way. I got my start as an exploration geologist at the Mt Polley mine in Likely, BC. We were using three surface-based diamond drill rigs to define a resource in a copper porphyry deposit. I started as a geotechnician, moving core boxes, measuring RQD and recovery, and categorising fractures. This taught me the basics of diamond drilling, and I quickly transitioned into a geologic core logging role. Core logging has always been a passion of mine. Too often core logging is viewed as just an entry-level position and performed robotically. It is important to realise that each metre was drilled at large expense just so that we can understand the geology, and the person logging the core is truly getting the best opportunity to observe and understand the rocks. This was the job that first sparked my interest in breccia-hosted mineral deposits.

After working at Mt Polley for two years, I moved across the world to complete a PhD at the University of Tasmania under supervision from David Cooke and Jocelyn McPhie. Everything about this experience was life-changing for me. I was able to travel to Papua New Guinea to study volcanic-hydrothermal rocks that were so young they were still hot. My supervisors taught me so much and I will always be grateful for the time I got to spend soaking up their experience. My PhD at UTAS was more than just the project and the supervision, I was brought into a community of professors, fellow students, and past PhD fellows who continue to influence my career and have turned out to be my best friends.

After completing my PhD I was given an opportunity to move back home to Vancouver and work for Gold Fields Canada Exploration. Gold Fields had a couple of big projects; one at Woodjam near Horsefly, BC, and one in the Abitibi greenstone belt near Larder Lake, Ontario. Gold Fields Canada closed its

doors in 2014 but by that time I had gained a lot of geologic mapping, core logging and 3D modelling experience. Instead of looking for a new company to work for, I decided to strike it out on my own and try consulting.

It was at this point that I was introduced to the owner of a private company, Gold Candle Ltd, who hired me to map and conduct surface exploration of their Kerr-Addison mine project. At the time, the mine had been shut down for ~ 20 years, nothing remained on surface and the underground workings had been flooded and closed off. This small summer exploration program has turned into a seven-year-long project that has drilled over 40,000 m of core and has defined a 43-101 compliant pit-constrained inferred resource.

When I am not working at Kerr-Addison on a drilling project, I try to continue to consult for a couple of clients per year on altered volcanic stratigraphy and volcanic-hydrothermal breccia complexes. I have been lucky to have worked for Newcrest in Fiji and Cote d'Ivoire, for Oceanagold in the Philippines, for Kinross in Chile, for Almadex in Chile, for Barrick on their Japan Gold JV, and for Pretivm in northern British Columbia.

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

There are several:

- Getting dropped off by a helicopter in the coast mountains near Atlin, BC, above the tree-line, with radiolarian expert Fabrice Cordey.
- Logging core at Mt Polley through a fluidal clast-bearing breccia.
- Using volcanic stratigraphy to put together a geologic model of the Deerhorn deposit at the Woodjam project.
- Mapping and core logging breccias at the La Coipa deposit for Kinross in Chile.
- Finally getting to Pretivm's Brucejack deposit in northern BC and driving on a glacier bus to get to the camp.
- Development of a core logging system and mapping out the stratigraphy of the Kerr-Addison deposit. Translating that geology into a 3D model that guided the development of the inferred resource.



Out in all weathers: Dr Jacqueline Blackwell pictured in February this year standing in front of a drill rig on the Kerr-Addison deposit in northern Ontario, while working as Chief Geologist for Gold Candle Ltd.

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?

I specialised in mapping and core logging the lithofacies of altered volcanic host rocks and hydrothermal breccias. I didn't know it at the time, but my research topic provided me with an expertise in a very applicable and practical niche. I love these rocks and luckily still get to study them in a consultancy role.

I was fortunate to have supervisors

David Cooke and Jocelyn McPhie, who I still admire for being the most passionate geologists and patient teachers. After you have written a thesis that gets past Dave and Joce, assessment reports and 43-101 technical reports are a piece of cake.

The field courses offered by CODES were unbelievable; volcanoes in New Zealand and ore deposits of South America are two of the most incredible trips I've ever been on. Hobart, Tasmania, is a stunning place to live, and during my time at CODES



Spectacular: Jacqueline's first job. Here she is in 2003 prior to doing her PhD, mapping in the mountains near Altin, BC.

I made some of the best friends of my life. I met so many amazing geologists through the short courses, field trips, tea-room discussions, and barrels. The connections made at CODES continue to be important as I navigate my career.

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

First, the workplace is continuing to become more inclusive of women. It is not yet an equal industry, but every woman who works in geology and mining has the potential to bring us closer to that goal.

Every exploration camp has WiFi! We used to get dropped in the mountains with a radio and a satellite phone for emergencies. Technology has increased in amazing ways. Where we used to use a field compass and inclinometer to line up a drill rig, we now use automated north seeking gyroscopic compasses. Downhole surveying technology has also improved, meaning we can track drillhole deviation in 3D in real time as surveys are performed and uploaded to cloud servers. This all amounts to a higher degree of accuracy in 3D modelling.

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

- Get outside and explore your own backyard.
- When you travel for work, don't forget to explore the culture around you.
- Try to communicate in another language; if you mess up it makes for a funnier story later.
- Don't eat watermelons in Africa if you are only there for a short two-week trip.
- Wear bug dope and long sleeves.
- When jobs are easy to get and pay well, save your pennies so you can be a ski or surfing bum during the next downturn. They will happen. This could also provide the means to return to school to upgrade your education.

Are there any little-known facts about yourself that you think we should know?

I learned to knit while waiting at the drill rig in the middle of the night between drill hole shut down, surveying, and pulling rods to move to the next site.

I love to garden and am currently obsessed with growing dahlias. And I love organising hikes and trips with my family. We recently took a family trip to the Burgess Shale fossil site in Yoho National Park, BC.

CODES INDUSTRY PARTNERS 2022

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

PLATINUM



GOLD



RioTinto

Teck

SILVER



CHRISTMAS CHEER

After a trying second year of COVID, the CODES and Earth Sciences staff and students gathered to celebrate prior to the Christmas break. Despite the challenges, another year was successfully completed, and people were there to reminisce, to mull over the future and to enjoy a social time with friends and colleagues.

The lunchtime BBQ in the CODES Rock Garden also saw the presentation of prizes for the now well-established CODES Christmas Photo Competition. There were plenty of entries in 2021 as Tasmanian-based field trips and expeditions were once again on the menu, and as people doubled down to consolidate their research in the absence of fieldwork travel.



Relax and enjoy: CODES/TMVC PhD student Javier Merrill (left) with Lecturer in Geodata Analytics Dr Matthew Cracknell and Emeritus Distinguished Professor Ross Large enjoying the social occasion.



Cooking with gas: Director of CODES Professor David Cooke (left) with Professor Leonid Danyushevsky turn up the heat on the snags in order to satisfy the hungry hordes!



Photogenic: The proud winners of the CODES Christmas Photo Competition with their winning shots. They are (L–R): Associate Professor Sebastien Meffre; Dr Martin Jutzeler (who is holding both his entry (left) and Dr Rob Scott's entry); CODES PhD student Zeb Zivkovic; and CODES/TMVC PhD student Rhiannon Jones. Congratulations to them all. The winning photographs will be incorporated into the CODES 2021 Annual Report.

HAVING A FIELD DAY – OR FOUR!

CODES and Earth Sciences students have been busy during the first few weeks of Semester 1, and all three year groups, plus the Honours cohort and Master of Economic Geology students, have been off on field trips to look at some of the amazing geology we have here in Tasmania...

FIRST-YEAR FIELD TRIP...

On 24 February possibly our largest ever contingent of first-year KEA101 Earth Sciences students – 120 in all – were accompanied on two separate field trips to nearby Lower Sandy Bay with leaders Associate Professors Sebastien Meffre and Rebecca Carey and Dr Clare Miller with Izzy von Lichten. This trip was a general introduction to the local geology that aims to provide a context for what they will learn later in the course.



The morning group of KEA101 first-years on the beach at Lower Sandy Bay. (Photo: Sebastien Meffre)



Participants in the morning session of the first-year field trip to Lower Sandy Bay enjoy a short break on the shoreline. (Photo: Izzy von Lichten)

SECOND-YEAR FIELD TRIP...

The second-year cohort of 22 students undertook a field trip to Tasmania's East Coast between 14 and 18 February, and were based at Coles Bay and St Helens. Trip leaders were Associate Professor Rebecca Carey, Dr Michael Roach and CODES PhD student Colin Jones.



CODES PhD student Colin Jones (front right) talks about magmatic enclaves and a pegmatite dike to a group of second-years at Bluestone Bay, Freycinet Peninsula. (Photo: Rebecca Carey)



Second-year students pictured at Cape Tourville Lighthouse at the end of a long day exploring the granites and magmatic-hydrothermal transition textures at Bluestone Bay on the Freycinet Peninsula. (Photo: Rebecca Carey)

THIRD-YEAR FIELD TRIP...

Eleven third-years travelled to Tasmania's West Coast with Associate Professor Sebastien Meffre assisted by Research Fellow Sheree Armistead, on 14–19 February and were based at Rosebery.



Light relief: Cleveland, the spitting alpaca at the Tullah Cottage Café, meets third-year student Issi Port (look carefully and you can see tiny pieces of airborne carrot that Cleveland has sent in Issi's direction). (Photo: Sebastien Meffre)



Third-year students complete the Lake Plimsol field test as part of the assessment for the field trip. (Photo: Sebastien Meffre)

HONOURS FIELD TRIP...

The 2022 Honours Exploration Field Skills and Mapping Camp field trip took place between 13 and 20 February on the West Coast of Tasmania and was led by Dr Rob Scott with CODES PhD student Zeb Zivkovic assisting.

The group included three CODES Honours students plus five students from Victorian universities (VIEPS students) along with several CODES Masters students and short course industry participants.



The Honours Mapping Camp calls for immersion in all types of Tasmanian terrain, including creeks...here students are pictured collecting structural data in Hall Rivulet Canal. (Photo: Rob Scott)



Donaghys Hill Lookout, en route to Queenstown on Tasmania's West Coast, proved a spectacular vantage point for participants in the Exploration Field Skills and Mapping Camp, and beautiful weather added to the experience. The summit of Frenchmans Cap can be seen in the far distance. (Photo: Rob Scott)

GOOD FORTUNE ALL ROUND



HONOURS IN THE BAG:

December is graduation time at UTAH and in 2021 it was the turn of four CODES Honours students. Pictured here on the sunny Hobart waterfront after their face-to-face graduation at the Hotel Grand Chancellor are (L-R): supervisor Associate Professor Rebecca Carey, Stephanie Morrish, Dina Chu, Zak Weidinger, Kate Cheesman and supervisor Dr Martin Jutzeler.



DUMPLINGS AND FORTUNE COOKIES:

CODES students and staff celebrated Chinese New Year with a special gathering on 4 February in the CODES Rock Garden. The event was coordinated by Dr Indrani Mukherjee, and PhD students prepared special fortune cookies while those who attended were encouraged to wear red. (Photo: Helen Scott)

CHANGING FACES

Three new CODES PhD students have joined us in the first three months of 2022. In addition, CODES PhD students Shannon Frey and Malai Ila'va, who have been included in previous newsletters and have already started their research but have been unable to travel to Tasmania until now, are finally in the state and have joined us in person. In addition, the CODES Analytical Laboratories has a new staff member and we have new people to assist with fieldwork and vehicle issues.

PHD STUDENT	START DATE	PROGRAM	PROJECT TOPIC
 Chris Allen	7 February 2022	Program 2, supervised by Clare Miller	Optimising remediation of legacy mines – Mineralogical controls on long-term waste rock weathering and mine drainage
 Isaac Brown	24 February 2022 but working in the field in WA initially for several months	Program 1, supervised by Lejun Zhang, David Cooke, Thomas Rodemann (CSL)	Geology, geochemistry, and genesis of the Havieron gold-copper deposit, Patterson Province, Western Australia
 Markus Staubmann	1 March 2022, supported by Evolution Mining	Module 2 of Amira P1249, supervised by Clare Miller, Matthew Cracknell and David Cooke	Integrated ore deposit knowledge: Optimising mineralogical characterisation through the mining value chain

ARRIVALS



Dr Jeffrey Oalman joined CODES in January as a Laboratory Analyst working within the CODES Analytical Laboratories, and is enjoying the work and lifestyle Tasmania has to offer. He previously worked at the Earth Observatory of Nanyang Technological University in Singapore.



Michelle Lang started work as a Field and Fleet Officer for the School of Natural Sciences in early January. She will be working across the School assisting CODES with fieldwork and vehicle fleet matters, and sharing this role with Vince Scoleri.



Dr Vince Scoleri is now working as the Senior Field and Fleet Officer for the School of Natural Sciences, and is your go-to person for all Earth Sciences and CODES fieldwork and vehicle issues.

DEPARTURES



Regi Broeren left her role as the part-time Technical Officer for CODES/Earth Sciences in January, and will continue with her PhD in Biological Sciences.



Vanessa Seabourne left her role in Earth Sciences administration and is now working outside UTAS.



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

2022 has started with a bang at CODES. It's been great to see our international students arrive on campus now that international borders have been reopened, and we are particularly pleased to see record enrolments in Earth Sciences' first-year geology unit.

We are very pleased to have kicked off the year with the start of our major new five-year industry-funded AMIRA P1249 project, and it was a pleasure to host industry sponsors in person for the kick-off meeting in February. Members of the research team are heading up to NSW for P1249 fieldwork in late March.

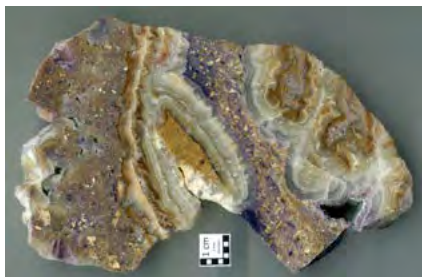
At the time of writing, several CODES volcanology staff and students are about to depart on a major and timely oceanographic cruise to the Tonga–Kermadec Arc – we'll be highlighting the outcomes of that voyage in our next newsletter.

Our program of Master of Economic Geology short courses kicked off with the Advanced Field Skills in Economic Geology unit in February. Fundamentals of Economic Geology is going to be delivered online in early April (registrations now open) and our flagship Ore Deposit Models and Exploration Strategies unit will be offered in late May.

It looks like another busy and productive year is in store for our team at CODES.

David Cooke

UPCOMING 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. Topics include ore deposit types, mineralogy, paragenesis, geochemistry, and geophysical characteristics of ore-forming environments. The relevance of these themes to studies of ore genesis and mineral exploration is explained. The short course focuses on identifying and using key tools to recognise the sequence of events that have impacted on 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>



ORE DEPOSIT MODELS AND EXPLORATION STRATEGIES (KEA701/KEA712)

**30 MAY–4 JUNE 2022 AND
4–8 JULY 2022**

Ore Deposit Models and Exploration Strategies is an up-to-date synopsis of ore-deposit types and their characteristics. Important features which relate to their genesis and exploration will be discussed and exploration models will be presented for each style. Major deposit styles covered include porphyry Cu-Mo-Au, skarn, epithermal Au-Ag, volcanic-hosted massive sulfide, sediment-hosted Zn, Pb and Cu, Broken Hill-type Pb-Zn, IOCG and orogenic Au.



The short course is presented by CODES staff and a team of Australian and international experts on each deposit style.

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.