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New porphyry project expands the toolbox

A new project has been launched that builds on AMIRA P765A, often referred to as the explorer's toolbox for porphyry and epithermal districts, while branching out into essential new areas of study.

AMIRA P1060, Enhanced Geochemical Targeting in Magmatic-Hydrothermal Systems, builds on the P765A research by augmenting this toolbox through a variety of enhancements and new developments. The overall aim is the recognition, definition and discrimination of ore bodies using mineral-specific pathfinder elements. This encompasses a focus on exploration in lithocaps, including methods that target high grade ore zones, determine the level of erosion and likely degree of telescoping, and discriminate barren or weakly mineralised areas. The team will also further develop

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Project leaders Dave Cooke (left) and Bruce Gemmell (right) with team member Huayong Chen at the Cerro Casale porphyry Au-Cu deposit, which is likely to be a key case study site in the new project.

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CRC bid provides opportunities for SMEs

Above: Deputy Director, Bruce Gemmell, addresses the Science Planning Panel regarding the CRC bid.

Left: Attendees at this year's meeting of CODES' Science Planning Panel, where the CRC bid was an important item on the agenda.

CODES is looking to expand its engagement with small to medium enterprises (SMEs), including junior producers and explorers, as part of its bid to become a Co-operative Research Centre (CRC).

CODES became an Australian Research Council (ARC) Centre of Excellence (CoE) in 2005, and later it successfully applied for an extension of this funding model. This took its tenure as a CoE to eight years, which is the maximum period allowed under ARC rules. The natural progression beyond that point is to become a CRC, which facilitates commercialisation of research outcomes and encourages a higher level of involvement with SMEs.

Planning for the CRC commenced in May 2010 and the application was submitted on the 1st of July this year. So far, CODES has signed collaborative agreements with 11 major mining companies, 7 SMEs* and 3 State Geological Surveys. The main external research institute involved in the bid is the highly regarded Sustainable Minerals Institute at the University of Queensland. Together with CODES/UTAS, they are known as an Essential Partner.

"CODES has evolved significantly, and as part of that process our collaborations with mining companies have increased substantially. We have successfully built a team of truly world-class researchers with a wealth of knowledge and experience, and a number of organisations have benefited over the years by being able to tap into this resource, while being able to tailor research projects to meet their individual requirements. The CRC model will enable us to expand our collaborators to a wider group of research institutions and companies, including a broader range of junior explorers and producers who will be able to leverage off our resources in an extremely cost effective manner," says Director, Professor Ross Large.

The range of collaborative research initiatives proposed for the CRC will enable mining companies to benefit from improved geochemical and geophysical detection techniques that focus on gathering key information early, so that deposits are discovered quicker and at less cost – ideally by reducing the amount of drilling required. It also helps them to characterise ore bodies at an early stage, allowing them to establish what problems may lie ahead, and whether the deposit is worth mining. These outputs are particularly relevant to junior exploration companies that may not have the resources or expertise to conduct major characterisation studies.

These are just examples of the many benefits miners can receive from a range of projects that cover a wide spectrum of the geosciences from genesis, detection and early characterisation, through to processing and post-mine environmental remediation. These are underpinned by a comprehensive suite of technology-based micro-analysis and software initiatives that form an integral part of all the programs. Also inherent to all the programs is the Centre's renowned education activities, which benefit mining companies in a variety of ways including specially tailored short courses, workshops, on-site training programs, postgraduate project work, and having first call on a steady stream of the world's finest geoscience graduates.

"With our increasing focus on end-user driven outcomes, applying to become a CRC is seen as a natural step in our evolution, and we are excited by the opportunities that lie ahead," says Large.

CODES' application was one of 26 submitted on 1 July, with those successful in progressing to the interview stage expected to be announced by the end of August.

For more information on collaboration opportunities, for companies large and small, you can contact Ross Large on +61 3 6226 2472 or email ross.large@utas.edu.au

* Note: In terms of the CRC, an SME is classed as a company with less than 200 employees and a market capitalisation of less than $500 million.

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tools for targeting and vectoring in green rocks (propylitic alteration), particularly magnetite, calcite and pyrite. In both cases, blind site testing will be retained as an effective method of validating the techniques.

The P1060 project is AMIRA's biggest pure geoscience project, with 21 sponsors providing funding of over $3.5 million. The research is being led by Professors David Cooke and Bruce Gemmell from CODES' UTAS Hub, with key support from Lakehead University in Canada and Imperial College London.

The sponsors are Anglo American, AngloGold Ashanti, Barrick, BHP Billiton, Buenaventura, Codelco, Eldorado, First Quantum, Freeport, Gold Fields, G-Resources, Inmet, Intrepid, Lundin, MMG, Newcrest, Newmont, Rio Tinto, Teck, Vale and Xstrata Copper. This group includes the retention of most of the participants from P765A.

The initial project meeting was held at CODES in June, despite a major geological challenge that was, for once, beyond the team's control – the ash cloud caused by the Chilean volcano. Nevertheless, travel obstacles were overcome with the aid of video conferencing technology; plus help from AMIRA International who provided the subscription connection, and the CODES IT team (ITSoil) who supplied technical support.

The old AMIRA P765A project - Geochemical and Geological Halos in Green Rocks and Lithocaps (the explorer's toolbox for porphyry and epithermal districts) - was concluded at a very successful meeting held in Hobart late last year. This final meeting was repeated in Santiago, Chile, in March, specifically for the South American contingent of project partners.

During the life of this successful project, the team developed effective tools and techniques to help predict the likely direction and distance to porphyry-style mineralised centres, and discriminate between porphyry, epithermal and metamorphic environments. In addition, significant progress was made towards developing and testing fertility indicators. In total, 17 companies supported the project.

P1060 research activities building on this strong platform commenced in July.

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New Star in GeM^{III}

Respected environmental geochemist, Bernd Lottermoser, has joined the School of Earth Sciences under the UTAS New Stars Program. Bernd's initial work with CODES is on the GeM^{III} project, where he will play a key role in developing Theme 1 – predictive environmental indices, and linking its activities with the other themes within the project.

A research team has been built around Bernd within this theme, which aims to develop more cost-efficient small-scale testing and modelling to provide predictive indices for environmental attributes, mainly in the area of propensity for dust generation and speciation; characterisation of texture-related acid-base reactions; and provision of new and more effective micro-analytical technologies to map deportment of deleterious and harmful trace elements, with an emphasis on secondary mobility and bioavailability.

The team will also build on its early success at gold mines in Queensland, where they are using kinetic leaching testing methods to predict the onset of acid generation. They plan to continue to focus on combining mineralogical and textural data with geochemical assays to establish more realistic characterisation of rocks in regard to acid generation. By combining element and mineral mapping results, they believe they will be able to predict the release of deleterious elements based on the solubility of the host minerals.

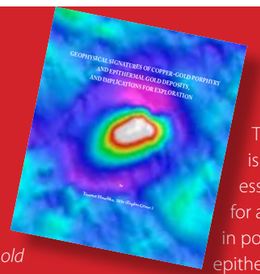
Bernd comes with an impressive CV that spans a career encompassing work in the mining industry and lecturing at prestigious universities in Germany, the UK and Australia. His exceptional research record has been recognised by the awarding of a Humboldt Research Fellowship in Germany, a European Union Erasmus Mundus Fellowship, and the Australian Government's Endeavour Executive Award and Michael Daly Award for Excellence in Science Communication. He has also authored and co-authored over 150 publications in various areas of the earth sciences, with a particular focus on the environmental geochemistry of mine sites. His seminal textbook entitled *Mine Wastes – Characterisation, Treatment, and Environmental Impacts* is used widely around the world, and has even been used in legal cases presented in the Supreme Court of the United States. This acclaimed publication is now in its third edition, with plans for it to be translated into other languages.

Bernd Lottermoser is an important addition to the GeM^{III} team.

His international reputation has led to invites to be a member of various international scientific bodies, including the committee for the forthcoming International Conference on Uranium Mining and Hydrogeology in Germany. In addition, he is on the editorial boards of a number highly rated journals, including *Geochemistry: Exploration, Environment, Analysis; Environmental Earth Sciences*; and the *Australian Journal of Earth Sciences*.

Signature publication launched

There is a new addition to CODES' popular range of geological publications. *Geophysical signatures of copper–gold porphyry and epithermal gold deposits, and implications for exploration*, written by experienced geophysicist Terence (Terry) Hoschke, outlines and discusses the geophysical data from a number of porphyry and epithermal deposits from the Pacific Rim, including Batu Hijau, Elang, Grasberg, Alumbrera, Martabe, Yanacocha, Pajingo and Waihi.



The publication is considered essential reading for anyone involved in porphyry or epithermal exploration.

The book is based on a study submitted as part of his Master of Science (Exploration Geoscience) degree at UTAS, which he attained this year. Terry completed the degree while working in his current position of Principal Geophysicist for Newmont in Perth.

For details on the full range of CODES' publications, please visit our website at: www.codes.utas.edu.au

Research broadens in SE Asia

A new extension project is set to commence in Southeast Asia that builds on previous work in the region, while expanding the research in terms of its geographical footprint and geological scope.

GIS studies of the region were conducted from 1992 to 1999, which led to an ARC Linkage Project that investigated the geochronology, metallogenesis and deposit styles of the Loei Fold Belt in Thailand and Laos, which was completed in 2007. The Loei Project was superseded in 2008 by the original Ore Deposits of Southeast Asia Project, funded by CODES and industry sponsors, broadening the research to include the Truong Son Fold Belt, in Vietnam and Laos, related to the formation of the Paleo-Tethys Ocean realm. However, this extension to that latter project widens the scope of the research even further to encompass the tectonic and metallogenic frameworks of a much larger part of the Southeast Asian region and, in addition to the Paleo-Tethys, will include the Meso-Tethys and Ceno-Tethys realms.

"Rifting of crustal fragments from Gondwana, and the formation and closure of both the Meso-Tethys and Ceno-Tethys, are particularly important factors in the metallogeny of Pb-Zn, porphyry Cu-Au, and related epithermal and sediment-hosted Au deposits in the region. We will be focusing on these aspects, while extending the methods and techniques developed in the previous projects to cover the remaining parts of Southeast Asia, such as the Sinbumasu terrane, the Kratie-Dalat and Kawlin-Wuntho-Monywa-Martabe fold belts, and the Bentong-Raub and Song Ma (Ailaoshan) suture zones," says project leader, Assoc. Prof. Khin Zaw.

The following deposits have been provisionally selected for detailed studies, but Khin Zaw says that other deposits can still be added to the list to suit the requirements of existing and prospective industry partners.

- Sediment-hosted Au (Selinsing, Tersang, Penjom and Lubok Mandi) in Malaysia.
- Intrusive related gold (IRG), sediment-hosted Cu-Mo-Au, and Pb-Zn-Ag deposits in the Kratie-Dalat Fold Belt in Cambodia, Vietnam and Laos.
- Alkaline epithermal Au system at Lamarai, central Thailand.
- Polymetallic Au-Pb-Zn system in the Bau Mining District, East Malaysia.
- High-sulfidation Cu-Au systems (Martabe, Monywa, Miwah) in Sumatra and Myanmar.
- Stratabound Pb-Zn-Ag deposits in Sinbumasu and the south China Terrane.
- Luang Namtha porphyry Cu-Mo-Ag deposits in northern Laos.
- Pb-Zn-Ag deposits in Thailand and Malaysia.
- IOCG Cu-Au-REE and porphyry Cu-Au-Mo system, in northern Vietnam.

One of the principle aims of the project is to provide sponsors operating in Southeast Asia with an increased understanding of the formation and evolution of the ore deposits in the area and, most importantly, where they are located. This will result in an improved geological and geochronological framework that will greatly assist the companies with area selection and exploration targeting.

By building on micro-analytical, geochemical, isotopic and geochronological techniques developed in the earlier research, the team will be able to deliver a number of important outcomes, which include:

- Region-specific exploration models for the main ore deposit types.
- Geochemical, geochronological and isotopic criteria to distinguish favourable volcanic/magmatic belts and specific ore target types.

Map showing mineralised fold belts and suture zones. Areas selected for detailed studies are denoted by red elliptical lines. Areas of previous research are illustrated by the circles.

- A GIS-supported, Google-based atlas of important Southeast Asian ore deposits, including volcanic/magmatic belts, with all geological, geochemical, geochronological and isotopic data as sets of data sheets for the suites of rock samples studied.

The original Ore Deposits of Southeast Asia project was wound-up at a final meeting at CODES late last year. This successful phase of the research greatly enhanced the knowledge of the geology of large parts of the region and produced a new tectonic model for the targeted areas; based to a large extent on a new geochemical, geochronological and ore deposits database developed within the project.

The extension to this project retains most of the researchers from the previous phase, including Khin Zaw as leader, and team members Ross Large, Sebastien Meffre, Jacqui Halpin and Tony Crawford from CODES, Clive Burrett from the UTAS School of Earth Sciences, and various collaborators from Southeast Asia. So far, previous industry partners Indochine, Issara, MMG and Monument have been signed-up for the extension and new partners East Asia Minerals, Olympus Pacific Minerals and Tiger Realm Resources have joined the group. A number of preliminary meetings have been held with various stakeholders, but the first official project meeting is scheduled for October this year.

For enquires about industry partnership opportunities in the Southeast Asia region, contact Khin Zaw on +61 3 6226 2787 or email khin.zaw@utas.edu.au

Algerian first

A lead-zinc project has commenced in Algeria, which marks the first time that CODES has been involved in research in this major North African country. Brendan McGee's PhD project aims to develop ore deposit vectors for resource expansion at the Tala Hamza deposit, adjacent to the country's Mediterranean coast.

The deposit lies within the 125 square kilometre Oued Amizour tenement, which contains a number of lead-zinc prospects. The overall project is being undertaken by Terramin Australia via Algerian company WMZ, of which Terramin has 65% shareholding. Although the 68 million tonne Tala Hamza deposit is the most significant ore body in the tenement, Brendan plans to expand his research to look for similar mineralisation styles within the broader lease area.

"It is a very exciting project because so little is known about the deposit. While it is widely understood that it contains an unusual style of volcanic-hosted mineralisation, its genetic origin is poorly understood. The research to date has been sparse, and very little is known about the nature of the source, the character of the mineralising fluids and their mode of transport, or the manner of deposition of the minerals," says Brendan.

He plans to remedy this lack of knowledge by developing a genetic model for the deposit. This will greatly help to resolve the uncertainties surrounding the nature and timing of the alteration and mineralisation relative to deposition of the host rocks.

Field work was undertaken late last year, and consisted mainly of the logging and sampling of diamond drill core from both within the deposit and regional exploration holes. Samples are already back at CODES and have undergone short wavelength infrared (SWIR) analyses to determine the alteration mineralogy; dating of the host, altered and mineralised rocks; and whole-rock geochemistry.

Terramin has completed its feasibility study for mining at Tala Hamza, and this is currently under review. If the proposal is successful, the operation has the potential to be one of the top ten zinc mines in the world, based on annual production. Let's hope that this high value increases even further as Brendan helps to reveal its secrets.

Top, left: Brendan McGee in the Oued Amizour (Volcanic-Plutonic Massif) field area, looking out towards the Mediterranean from a drill pad.

Top, right: Brendan core logging and sampling in the WMZ core yard.

Upskilling courses look at soft options

Students and researchers took the opportunity to learn about the latest developments in interpretive software at two training courses held at CODES / UTAS in May and June.

The first course, held over two days in May, was led by Dr Dave Lawie from ioGlobal, who demonstrated his company's latest version of its ioGAS geochemical data analysis software. Attendees saw how this innovative package can aid their research through a suite of interactive tools designed to optimise workflows, maximise the value gained from data, and deliver a range of high quality interpretive outputs.

The second course was presented by Dr Jun Cowan from Prestologic, who demonstrated the updated version of the versatile Leapfrog 3D modelling software. This novel software rapidly generates intricate 3D models from maps and drill hole information, which enable users to utilise significantly more of their geological data. Attendees learned how even the most complex geologies can be understood, as Jun demonstrated how the software is capable of building interlocking geological models incorporating a variety of folds and faults. The first day and a half of the three-day course was devoted to learning the theoretical side of the software, with the remaining time spent applying the software in a practical sense by using it to build a model of the geology of the Hellyer VHMS deposit.

Research Fellow, Helen Thomas, using the ioGAS software.

"It is important to ensure that our students and researchers are educated in the very latest technological developments, and we have access to the best available tools to aid our research. Courses by such highly regarded experts as Drs Lawie and Cowan are a key part of achieving these aims. A total of 32 people attended the courses and I believe we all found them to be extremely beneficial. I was particularly impressed with how both packages enable the maximum value to be gained from accumulated data," says Andrew McNeill, who organised the courses.

Both software packages are being used in CODES' education programs, including the MEconGeol Brownfields Course, plus a number of its research projects around the world. For example, Drs Helen Thomas and Sebastien Meffre are using ioGAS to help efficiently analyse quantified LA-ICP-MS mapping data as part of the Application of New Technologies to Gold Deposits project (AMIRA P1041). Use of ioGAS in this context enables fast and effective classification of laser data, which allows value-added results to be provided to sponsor companies.

Students meet industry

Students at various academic levels took the opportunity to meet with key people from CODES' industry sponsors at a networking event held at the UTAS Uni Club in April. Each of the sponsor companies involved made good use of their allocated timeslot at the podium to give a brief synopsis of their company and talk about potential employment opportunities. Industry participants included Anglo American, AngloGold Ashanti, Barrick, BHP Billiton, Newcrest, Newmont and Rio Tinto. On behalf of the budding geologists, Jeff Steadman gave an overview of SEG Student Chapter activities, with similar talks by Will Hagel and Eddie Morris for the student members of the Geological Society, and Meg Ellis on behalf of the AusIMM Student Chapter.

With the short speeches over, the group were free to mingle, socialise and talk about opportunities of mutual benefit. Everyone agreed that the event was a great success and one that should appear at regular intervals on the calendar. The forum was organised, in conjunction with the SEG Students Chapter, to coincide with the day of CODES' Science Planning Panel meeting.

Left: Students and industry representatives networking.

Above: Meg Ellis talks on behalf of the AusIMM Student Chapter.

Mike Solomon Lecture

The inaugural lecture in honour of Mike Solomon was held at the UTAS Earth Sciences Lecture Theatre during April. When Mike sadly passed away in 2009, CODES' management got together with the SEG Student Chapter to discuss the best way to pay tribute to someone who had played such a pivotal role within the Centre and in the development of Economic Geology, both in Australia and internationally.

It was decided that rather than have a plaque that gathers dust on a wall, a more fitting tribute would be an ongoing lecture that would keep Mike's memory alive in a way that would best reflect his approach to the sciences – via a dynamic forum that would further the understanding of geology and encourage lively debate on cutting-edge issues.

Top: Paul Kitto, one of Mike's former students, delivering the inaugural Mike Solomon Lecture.

Above: SEG Student Chapter Co-president, Jeff Steadman, thanks presenter Paul Kitto. Others in photo, from the left, are Ross Large, Dan Gregory and Tony Crawford. To the right of Paul is Dave Cooke and Bruce Gemmell.

One of Mike's greatest legacies is the profound influence he had on his students. His lively and insightful lectures were known for bringing subjects alive and inspiring young, aspirant geologists to strive for greater heights in their chosen career paths. He also played a vital mentoring role to many of those students as they followed their vocation. Therefore, what better way to pay tribute to Mike than through a lecture delivered by one his former students who has gone on to be a leader in their chosen field? There were many potential candidates for that role, but the person given the honour of delivering the first lecture was Dr Paul Kitto, who studied under Mike as an undergraduate. Paul is now the MD and CEO of Ampella Mining, and he gave a fascinating talk on his company's highly successful exploration activities at various projects in Burkina Faso, West Africa, and how they are approaching the transition to becoming a significant gold producer in the next few years. His talk highlighted the tremendous potential for discovery in this mineral-rich area of the continent, which is one of the few areas in the world that has shown significant potential in new gold resources in recent years.

The Mike Solomon Honorary Lecture was organised by the SEG Student Chapter and is planned to be an annual event. Also, see article on page 19 for further news on Paul Kitto.

A program of Discovery for Andrew

Andrew McNeill has been appointed as leader of the Discovery Program, taking over from Jeff Foster who now leads the Recovery Program – as reported in the last issue of *Ore Solutions*. There was strong competition for this senior position, but Andrew's blend of academic and industry experience, coupled with his excellent track record as a long-standing member of the Discovery team, were key factors in the appointment.

He takes over the reins of the program at an interesting time. AMIRA project P765A, Geochemical and Geological Halos in Green Rocks and Lithocaps, has just come to an end, and a new project building on this research is beginning to gain momentum (see article on P1060 on the front cover). There are also interesting developments in a number of geophysical research initiatives, including a project that investigates the application of near-mine ambient seismic methods to brownfields mineral exploration, and in-mine seismic rock mass characterisation. Another new project (AMIRA P1031) is researching the location and formation of copper, uranium and precious metals in oxidising sedimentary basins. And the existing project researching the structure and formation of Grange Resources' Savage River magnetite deposit is being expanded to include a geological interpretation of the Centre Pit and South Pit deposits.

"There is a lot planned for the coming months. I am looking forward to the challenges that lie ahead, both in the projects where I am directly involved and the ones in which I play more of a supervisory role. It is certainly a time of transition for the program, with some of the key projects coming to an end, and other projects just beginning, or being substantially expanded.

"My main objective is to build on the extensive wealth of knowledge gained by the previous research, while ensuring that we continue to branch out into new and challenging areas," says Andrew.

Andrew has had a long relationship with CODES and the School of Earth Sciences. After attaining BSc Honours at UTAS in 1986, he spent the next five years working on Tasmania's west coast, in the Mount Read Volcanics. This time comprised of two years conducting regional mapping, and three years exploring for VHMS deposits with Aberfoyle. He then returned to UTAS, completing his PhD studies with a thesis on melt inclusions in mid ocean ridge basalts (MORB). The next ten years were spent working for Aberfoyle and Zinifex (and its predecessors) exploring for VHMS deposits in regional, near-mine and in-mine settings; although he did have a brief hiatus to explore for structurally hosted copper deposits. Andrew returned to CODES in 2006 to work on his two specialities: melt inclusions (as part of the AMIRA P962 nickel project) and the Mount Read Volcanics.

We look forward to reporting on further developments in the Discovery Program in future issues.

"My main objective is to build on the extensive wealth of knowledge gained by the previous research, while ensuring that we continue to branch out into new and challenging areas..."

New leader of the Discovery Program, Andrew McNeill, during a recent visit to the Australian Synchrotron.

Left: The group hunts for magnetite and hematite specimens in the Savage River open pit.

Above: The group prepares to go underground at Beaconsfield. From left: Jeff Steadman, Hamish Johns, Selina Wu, Lejun Zhang, Ana Liza Cuison, Takayuki Manaka, Dan Gregory and Nick Nolan.

Students go west

The CODES SEG Student Chapter has completed an informative, four-day field excursion to western Tasmania that included visits to five mining operations.

Also included in the packed itinerary was a stop at the world-famous Beaconsfield Mine in the north of the state, which was squeezed into a hectic final day.

The first four mines visited fall within the Cambrian Mt Read Volcanics, which are well known to many geologists as being an arcuate belt of acid to intermediate volcanics occupying the eastern margin of the Dundas Trough. The volcanic belt is bounded to the east by Precambrian basement rocks of the Tyennan Region and younger Cambro-Ordovician siliciclastics, and appears to interfinger with fossiliferous volcano-sedimentary rocks of the Dundas Group and Western Sedimentary Sequence to the west.

The excursion started with a tour of the Queenstown-based Mt Lyell copper mine, which holds the record for being the longest continuously operating mine in Australia. The mine opened in 1893 and was producing without a break for over one hundred years until it closed for just twelve months at the end of 1994. The operation is currently owned by Copper Mines of Tasmania, which is part of the fast growing Vedanta group of companies.

Part of the tour included an overview of the mine's long and colourful history, including a summary of the various models that have been proposed for the copper-gold-silver deposit, which culminated in a convincing argument in favour of a porphyry model. Other highlights of the visit included a presentation on the exceptional remediation work being performed by the company, plus a tour of the old surface workings, where the students viewed alteration halos that can still clearly be seen along the edges of the pit.

The next morning, the students ventured 23 km north of Queenstown to Unity Mining's Henty Gold Mine, where they were given an explanation of the deposit and shown a display of diamond drill core that intersected a selection of the mineralised lenses currently being mined. There was no doubt that the group was fascinated by the alteration associated with the mineralisation, but it was the visible gold in the core that really captured its imagination.

In the afternoon, the group visited the world-class VHMS deposit at Rosebery, which is being exploited by the Minerals and Metals Group (MMG) – who recently became one of CODES' industry partners. The deposit is a complex of metal sulfides containing lead, zinc, copper, silver, gold and iron that extends for approximately 2 kilometres north-south, and to a depth of 1.5 kilometres. A highlight of this part of the itinerary was a tour of the core facility, where the students had the opportunity to view thick intersections of high grade massive red sphalerite-galena ore. The day was rounded-off with a brief stop at the now closed Mt. Bischoff tin mine, where they picked through the specimen pile at the gate, finding several nice specimens of pyrrhotite and bladed calcite.

The penultimate day started with a trip to Bass Metals' Hellyer mine, where they examined drill core from the newly developed Fossey deposit and high grade samples from the Hellyer and Que River deposits. This was the last of the four ore deposit stops within the Mount Read Volcanics belt, which showed the complex variation in VHMS ore types from south (Mt. Lyell) to north (Hellyer).

In the afternoon, they bid farewell to the volcanic belt and travelled west to visit Grange Resources' magnetite deposit at Savage River. The mine comprises three principal open pits – North, Central and South – that average 100-150m in depth, covering a 4km strike length and separated by unmined zones of thin or low grade material. The Central Pit is separated from North Pit by the Savage River, which runs through a pillar area left to retain the river channel. This was the first time that many of the group had visited an iron ore mine and the scale of the operation left a lasting mark. After the tour of the site, the remainder of the day was spent collecting magnetite and coarse grained specular hematite specimens, followed by a late night drive to the north ready for the final leg of the excursion.

The group had an early start on the final day to go underground at the Beaconsfield Mine along with the first morning shift. Everyone enjoyed a highly informative stay underground where they examined the mineralised reef at three different levels on the eastern side of the mine. Once at the surface, perhaps just slightly relieved knowing the well-publicised events of 2006, the group examined drill core from the western (higher grade) side of the mine.

All that was left was the drive back to Hobart after a very full and rewarding few days.

Laser Raman system adds to capability

Vadim Kamenetsky was part of a team of five UTAS Chief Investigators that has successfully secured a $240,000 ARC Linkage Grant to purchase a laser Raman system for the university's Central Science Laboratory.

While the instrument will be available for use by a number of areas within UTAS, it is an important addition to the suite of state-of-the art equipment available at CODES' UTAS Hub. This new generation instrument provides numerous benefits including fast imaging capabilities that enable researchers to analyse materials rapidly, in a non-destructive manner, with minimal sample preparation.

The instrument will be advantageous across the range of CODES' programs. For example, it will play an important role in gold mineralogy, and the relationship between gold and organic matter, which is a topic of major interest to the sediment-hosted gold team. It will also be critical in gaining a better understanding of the partial melting and metasomatic reactions that occur on the grain boundaries in mantle and crustal rocks. A greater knowledge of the processes that occur at mineral boundaries is essential for building accurate models of fluid percolation through rocks at different pressures and temperatures which, in turn, are required for constraining models of deep-earth resources.

It also has the potential to be used in the GeM^{III} project, where it could help significantly in the design of efficient, integrated protocols for the mineralogical characterisation of mine feed for the minerals industry. At present, this area is dominated by scanning electron microscope methods, which are expensive and difficult to maintain on remote mine sites. By being able to measure a larger number of samples, mining companies will be in a position to make better informed decisions on investments such as the size and type of mill to install, which will greatly reduce their risk factors.

The fast-mapping laser Raman system was installed in late July.

Vadim (Dima) Kamenetsky (right) and Thomas Rodemann, Deputy Director of the UTAS Central Science Laboratory, 'test drive' the new laser Raman system.

Roundup 2011

CODES was, once again, an exhibitor at the Mineral Exploration Roundup, held in Vancouver earlier this year. Now in its 28th year, Roundup has grown to become one of the world's foremost technical exploration conferences – this year attracting over 7,000 participants.

The CODES booth has been a regular feature at the event for a number of years, but this year it underwent a significant redesign.

Jeff Foster supervising the 'new look' CODES booth at Roundup 2011.

Right: The group after the workshop at Hefei University of Technology.

Top, left: The group visiting the Dafanshan alunite mine.

Bottom, left: Students learn about the geology of the Shapinggou molybdenum deposit.

Centre: Part of the group at the Xinqiao polymetallic (Cu-Au-Pb-Zn-S) open pit mine.

Bottom: Dan Gregory and Selina Wu study Huangshan granite at Yellow Mountain.

Yangtze trip for students

There is no doubt that the 12-day field excursion in May to China's Middle and Lower Yangtze Mineral Belt was the main event on this year's SEG Student Chapter events calendar.

The trip commenced with an activity-packed two days at Hefei University of Technology in Anhui Province, where Dave Cooke, Zhaoshan Chang, and Huayong Chen delivered a porphyry, epithermal, skarn and IOCG workshop. This also included an overview of the geological background of the Middle and Lower Yangtze Mineral Belt, presented by Hefei University's Taofa Zhou, plus presentations and lively discussions on all the students' research papers.

The field activities got off to a fascinating start with a visit to the developing Fushan National Geopark. Undergraduate students from Hefei University joined the group and walked through successions of volcaniclastic breccias and erosional caves that were covered with ancient Chinese scripts carved into the walls.

The group then ventured west to Jinzhai to visit the Shapinggou Mo deposit, where stockwork mineralisation is hosted in a granodiorite porphyry, displaying text book examples of unidirectional solidification textures (USTs) coated with molybdenite.

Next stops on the busy itinerary were the Nihe Fe skarn deposit and Longqiao Fe skarn mine in the Luzong Volcanic Basin, plus the Shaxi porphyry Cu-Au deposit. The Nihe deposit is an endoskarn with a large magnetite body, hosted within a Cretaceous diorite porphyry along the boundary between a porphyritic intrusion and an overlying trachyandestite. The Longqiao orebody comprises massive to lamellar magnetite, predominantly hosted by a succession of bedded siltstone. A Cretaceous syenite intruded the sedimentary package and closely predates the large phlogopite plates that are associated with mineralisation.

Later on, the group visited the Dafanshan mine, where alunite has been mined intermittently since the Tang Dynasty (~700AD). This was followed by an interesting stop at the Makou iron workings.

Most of the next day was spent at the Xinqiao Cu-Au-Pb-Zn-S mine. This deposit occurs on the northern limb of a regional anticline where the Upper Devonian sandstone and Upper Carboniferous dolomite decoupled during folding. Mineralisation is characterised by massive pyrite and lesser chalcopyrite, with local Pb-Zn lenses up to 10 metres thick.

On the penultimate day, the group studied drill core from the Yaojialing Cu-Au-Pb-Zn deposit, where Permian limestone packages are intruded by a Cretaceous granodiorite porphyry, and mineralisation is concentrated along the interfingering contacts. A four-hour drive brought them to the world-famous Huangshan Geopark, undoubtedly a highlight of the excursion. In addition to its breathtaking scenery, this UNESCO World Heritage Site has an interesting geological history. It features numerous imposing peaks, whose formation dates back to the Mesozoic era, when the ancient Yangtze Sea disappeared as a result of crustal movements and subsequent uplift. Of particular note in the area are the glacial features and landforms, the numerous folds and faults resulting from tectonic activity, and high altitude karst topography, including calcareous tufa shoals, waterfalls and stepped lakes.

The field excursion was brought to a close with a visit to the Taocun apatite-magnetite mine in the Ningwu Volcanic Basin. Mineralisation at this site is hosted in a Cretaceous granodiortie porphyry, characterised by irregular zones of semi-massive to vein-like magnetite and apatite.

With many kilometres and geological adventures behind them, all that remained was a well-earned sightseeing trip to Nanjing and some shopping near its famous Confucius Temple. As the great philosopher once said:

"I hear and I forget.
I see and I remember.
I do and I understand."

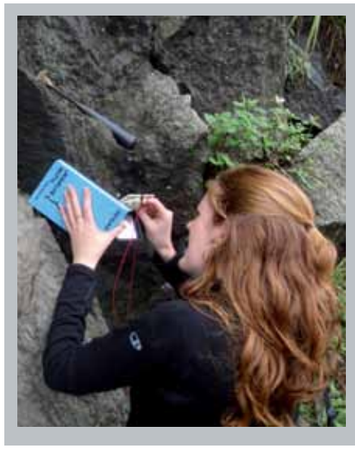
While some students may argue that they won't forget what they heard, none would disagree that they will always remember what they saw – and it has certainly improved what they understand.

The trip was organised by the SEG Student Chapter Committee who would like to thank David Cooke, Huayong Chen, and Zhaoshan Chang from CODES for leading the excursion, plus Taofa Zhou, Lejun Zhang and Fan Yu from Hefei University for their considerable help along the way. They also thank the industry-based geologists from AngloGold Ashanti, Gold Fields, Rio Tinto, and OZ Minerals for their participation, plus AngloGold Ashanti, CODES, and Data Metallogenica for their additional financial support.

Ross Large receives Distinguished Alumni Award

CODES' Director, Ross Large, has received a Distinguished Alumni Award at the UTAS Foundation Awards Dinner held at Wrest Point. Over 500 guests attended the gala event, which recognised alumni that have gone on to achieve exceptional success in their chosen fields since graduating from the university.

Distinguished Professor, Ross Large, with the Premier of Tasmania the Honourable Lara Giddings MP, who received the Foundation Graduate Award. Photo by Lisa Gipton and courtesy of UTAS *Alumni News*.



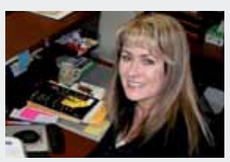
Excellence rewarded

Research Fellow, Dr Jacqui Halpin, has received a UTAS Award for Research Excellence. The award is just reward for the significant contribution she has made to CODES' research activities in recent years. Jacqui joined the Centre in 2007, after completing a PhD on Antarctic geochronology and metamorphic petrology. Her early work at CODES focused on the nature and age of the basement rocks of the Naturaliste Plateau offshore south-western Australia, which was followed by major contributions to the Congolese-Zambian Copper Belt and Ore Deposits of Southeast Asia projects, particularly in the field of geochronology. Jacqui has also built an excellent publication record in high-ranking journals over this period and fostered productive collaborations with a number of national and international researchers.

Jacqui was the only person at her research level to be selected for the award, which celebrates excellence in research and teaching across the breadth of UTAS.

Moving in

PhD student Evan Orovan, from Canada, is working on the Exploring the Porphyry Environment project with Dave Cooke.



Deborah Macklin has been appointed as PA to the Director, Ross Large.

PhD student Daniele Redi is working with Leonid Danyushevsky on the characterisation of volcanic products.

Dr Janina Micko, from Canada, has joined the Formation Program working on the Exploring the Porphyry Environment project with Dave Cooke.

Andy Wakefield has been appointed as Geophysics Technician.

Graduates find serendipity in Mongolia

What are the chances that three people, from different locations, will meet up in a remote corner of the world and discover that they all graduated from CODES?

We will come to the odds of that occurring in a moment, but that is exactly what happened to Luisa D'Andrea, Graham Crook and Roger Norris on a recent trip to Ulan Bator. Each had been sent to Mongolia's capital by their respective employers within the Rio Tinto group to attend a workshop on drilling safety. One evening, after a long day of 'workshopping', the delegates got chatting over dinner and were surprised to find their common link went well beyond working for the same company.

What are the odds of that happening? Actually, they are probably not as long as you would expect; bearing in mind CODES' ever-growing international 'family' of geologists and the far-flung places that they find themselves in - but it is a tale worth telling, nonetheless.

Above: from left Roger Norris, who is running Exploration for Rio Tinto out of Melbourne; Luisa D'Andrea, who is working for Rio Tinto's Project Generation Group; and Graham Crook, who is Resource Geology Manager at the Oyu Tolgoi mine in Mongolia.

Where are you now?

The story of Luisa, Graham and Roger meeting up in Mongolia prompted us to think that it would be good to have a regular article featuring people that have spent time at CODES at some point in their lives – graduates, researchers, staff, collaborators etc. Therefore, we welcome anyone that falls into that category to send us a suitable photo, plus a few details on where they are now, and any other significant milestones since leaving the Centre. Anecdotes like the Mongolia incident are welcome, but are not essential.

Send to steve.calladine@utas.edu.au

Below: CODES people, past and present, get together at last year's SEG Meeting in Keystone, USA.

XRF analyser

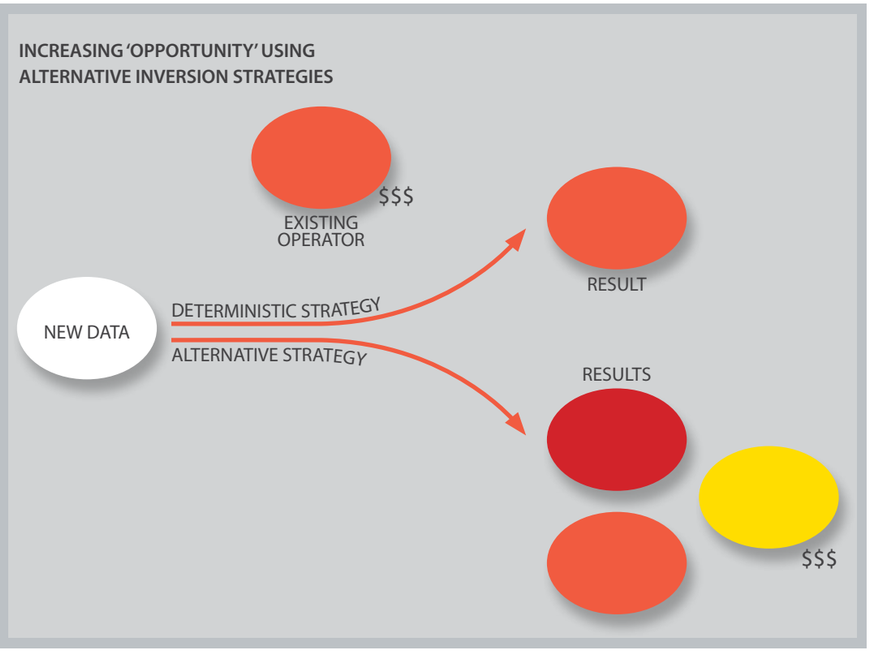
a handy tool

The small, lightweight, handheld analyser is perfectly suited for use at mine sites and in the field.

A group, including a number of industry visitors, at a demonstration of the new Delta portable handheld XRF analyser, which has been acquired by CODES. The analyser enables initial qualitative geochemical screening of rock samples, semi-quantitative spot analyses, and quick, inexpensive quantitative analyses of a wide range of major and trace elements. It is ideal for initial geochemical evaluation of sample suites, and qualitative analysis of small-scale geological features, relationships and associations.

Geophysicists maximise opportunity

A team led by Anya Reading has proposed alternate strategies for analysing data that will result in a significant increase in the amount of useful geological information available from a variety of geophysical research techniques.



The approaches, which have been published in a feature article in the April 2011 issue of the CSIRO's *Preview* journal, could have far-reaching effects across the field of geophysics through the next decade. The other team members are Jeff Foster and PhD candidate Matt Cracknell from the CODES Hub, plus Malcolm Sambridge, via an important collaboration with the ANU Node.

Currently, most geophysical techniques enable inferences to be made from airborne, ground-based or borehole data through a deterministic process whereby a single model 'answer' is generated. Well-founded algorithms include uncertainty estimates for different parameters in the model and/or some form of model validation. Whereas, utilising a broader range of mathematically-based methods will provide a much richer range of information from the same set of geophysical data.

"There is no doubt that the deterministic approach has been successful to date and we are certainly advocating that it should continue. However, we believe that alternate inversion methods can be used to complement this process and enhance the amount of meaningful geological information we glean from the data. It will ensure that both constrained and poorly constrained parts of the model are clearly presented, quantitative information is provided that gives us a fuller understanding of the model and, most importantly, likely ore deposit drill targets are not overlooked," says Reading.

The goal of exploration geophysics is to infer the nature of buried structure and, in particular, generate drill targets that lead to a mineral deposit discovery or reserve delineation. Some of the alternate methods being proposed to increase the probability of achieving this goal are multiple model ensembles, machine learning and model parameter sampling.

MULTIPLE MODEL ENSEMBLES

One of the techniques used in the multiple model ensembles approach searches the range of parameters more widely, producing an ensemble of reasonably well fitting models, rather than focusing on just one best-fit model. This style of inversion has become known as the 'Monte Carlo' approach because it works primarily on the principle that if you calculate enough models you will eventually find a 'winner'. That description can be misleading because it implies a scattergun approach, while in reality it is opening up the research to a much wider range of potential findings; as opposed to the deterministic method, which focuses narrowly on a direct linear relationship. Therefore, 'Monte Carlo' is particularly suited to inverse problems where deterministic methods can sometimes provide skewed results. In the past, this alternative method was computationally very expensive. However, it has now become viable due to refinements to the method and advances in computer processing and data storage capabilities.

MACHINE LEARNING

Machine learning takes an empirical approach. Its algorithms use sets of related observations that do not necessarily have an obvious physical relationship between each other. They may be described as 'disparate' datasets, related only in that they are observed at the same point on the surface of the Earth. Predictive relationships are then extracted by means of the patterns occurring between the disparate observables. Although these methods are commonly used within the IT community, they are seldom used in geophysics and the team believe that there is a lot of scope to expand their use in this area.

MODEL PARAMETER SAMPLING

This approach provides a solution that consists of a probability distribution for each of the model parameters, rather than just for a single model. The result is a full set of probabilistic information, which is then used to construct the best-fit model. The distributions are found by sampling the multi-dimensional posterior model space, taking into account the probability of the occurrence and value of each parameter.

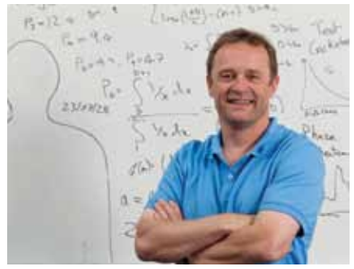
Model parameter sampling falls under the category of Bayesian techniques, which have met with failure in the past when applied to exploration applications. However, the team believes that the subsequent criticism of this technique is unfounded and, with improved understanding of the underlying fundamentals and insightful use, it facilitates extremely well-founded, high opportunity algorithms that are suitable for use in a desk-top environment.

The team's vision for exploration is to provide a suite of tools that will enable geophysicists to use their data to infer geological information more effectively; thereby providing results with a combination of geological assurance and enhanced target generation opportunity.

In addition to the paper in *Preview*, results from this project have been presented at the 2010 ASEG International Geophysical Conference and at the 2011 International Union of Geodesy and Geophysics Conference.

For further information, contact Dr Anya Reading on +61 3 6226 2477 or email anya.reading@utas.edu.au

Inversion Strategy	Constrained	Unconstrained
Deterministic e.g. majority of current exploration geophysics software	Widely used High assurance Low opportunity	Less used Lower assurance Increased opportunity
Multiple model ensembles e.g. Monte Carlo (direct search) Genetic Algorithm (adaptive) Neighbourhood Algorithm (adaptive) Stochastic Algorithms	Less used (computation) Managed assurance Increased opportunity	Less used (computation) Managed assurance Maximum opportunity
Machine learning e.g. Naive Bayes, Random Forest	Now tractable Managed assurance Increased opportunity	Now tractable Managed assurance Maximum opportunity
Model parameter sampling e.g. Markov Chain Monte Carlo (MCMC)	Now tractable Managed assurance Increased opportunity	Now tractable Managed assurance Maximum opportunity



Top: Team leader, Dr Anya Reading.
Above: Key collaborator Malcolm Sambridge from ANU.

HITTING THE SPOT

~ a question of balancing assurance and opportunity

Mineral deposit target generation is the primary goal of geophysical modelling and inversion. Assurance and opportunity are two important concepts that play a key role in achieving this goal and delivering successful outcomes for mining companies.

- **Assurance** – In simple terms, this covers the extent to which a model is likely to lead to the discovery of an economically viable ore body. High assurance corresponds to low risk. However, confining drilling to high assurance targets can result in viable targets being overlooked. We also have to consider that there may be no high assurance targets.
- **Opportunity** is the concept that targets are generated with sufficient open criteria that few targets are overlooked. It ensures that not only the best opportunities are investigated, but also all other potential areas of viable mineralisation. This unconstrained approach is of particular benefit in new exploration areas, where the natural variability of the mineral systems might result in a target still being prospective even if one indicator parameter changes.

The team proposes that opportunity can be maximised by adopting a broader range of mathematical approaches, while assurance can be managed very effectively.

PARTS OF THIS STORY ARE BASED ON EXTRACTS FROM AN ARTICLE THAT FIRST APPEARED IN *PREVIEW.*

Diagram top: illustrates that while deterministic strategies provide high assurance results, they only provide a single 'answer'. Whereas, alternate strategies increase opportunity by suggesting a number of models that are appropriate to the data.

Diagram left: provides a summary of selected data inference strategies as applied to geophysical modelling and inversion. Strategies are grouped according to inference style. Current usage patterns and assurance/ opportunity characteristics are noted.

Hands-on in the Andes

Two years flashed by in the blink of an eye and it was time for another group of Masters students to head off to the Andes for the Ore Deposits of South America Short Course.

This biennial course is one of the most popular on the Master of Economic Geology program because of the highly practical nature of its content, the range of deposit styles covered, and the exciting locations in the itinerary. The course takes place in the southern part of the Andes in Peru and Chile and incorporates the major ore deposit styles of the continent, including porphyry Cu-Mo, high sulfidation epithermal Au, and iron-oxide Cu-Au. Highlights of this year's packed travel program included climbing the peaks of the world-famous Toromocho porphyry Cu-Mo and skarn deposit in Peru, and stops at El Teniente - the world's largest underground copper mine, and Chuquicamata - the world's largest open pit copper operation.

During their two weeks in South America, the students participated in studies of the regional and local geology, with detailed evaluations of the ore deposit characteristics, mineralisation styles and genetic models. Exploration techniques for porphyry and epithermal deposits were also discussed first-hand in the field.

Interspersed in the program was a series of talks by leading experts for each deposit style.

The course leaders were Dave Cooke and Bruce Gemmell, who led ten Masters students, eight industry participants and four CODES' PhDs / postdocs on another successful trip.

See the back cover of this issue for further details on the increasingly popular Master of Economic Geology program.

From top to bottom: View east from the Cerro De Papas to the central Andes in Chile.

Steeply dipping breccia bed on the Cordillera Domeyko, Chile.

Crystalline pyrite in late stage pyrite-sphalerite-quartz vein, from the Rio Blanco deposit, Chile.

Inspecting core samples at Tomorocho, Peru.

Dave Cooke gives an overview of Domeyko fault zone, northern Chile.

Manto Verde (IOCG) Cu-Au mine, Chile.

Research grant for Rebecca

Congratulations to Dr Rebecca Carey who has secured an ARC Discovery Grant to research submarine volcanoes: degassing of silicic magma with implications for ascent and eruption processes. The grant is for $280 000, spread over three years. Rebecca is currently working with the University of Hawaii and the University of California Berkeley, but is expected to relocate to CODES / UTAS in September. Rebecca will soon feel at home when she arrives, having graduated with BSc Honours in geology from UTAS in 2002.
She went on to attain a PhD in geology and geophysics from the University of Hawaii in 2008.

We look forward to saying aloha, and welcome back, Rebecca.

Success for former student

Ampella Mining, headed by former CODES' PhD student and Research Fellow Paul Kitto, was recently named Gold Explorer of the Year by *Gold Mining Journal*.

"It is an honour to receive such an award that has been judged by our peers in the industry. Our exploration success is due to a dedicated and hardworking team of employees who are continuing to work towards upgrading our current resource and targeting new prospects at Batie West," said Dr Kitto.

Batie West in Burkina Faso was one of the main projects that he covered during his address at the Mike Solomon lecture in April (see article on page 8). The nine Batie West tenements cover an area of 1,800 square kilometres and occupy a 110 kilometre long gold-bearing shear zone that occurs along the south-west margin of the Boromo Greenstone Belt in southern Burkina Faso, adjacent to the country boundaries of Cote d'Ivoire and Ghana. The French exploited this region in the 1940s, but no modern exploration has been undertaken since. However, Paul realised the potential in the area after noticing that the prospective lithologies in Burkina Faso are the same as in Ghana (part of the Proterozoic Birimian Greenstone Belt), which have produced a world-class gold resource in the Ashanti deposit, among others. Furthermore, about 70% of the total surface exposure of these rocks is in Burkina Faso, yet no major gold discoveries have been made in this country to date.

Since taking the helm at Ampella in June 2008, Paul has undertaken a thorough review of the company's current exploration programs and consequently made strategic recommendations to take the company forward. In addition to his current position as MD and CEO of Ampella, he has had a highly successful international career in exploration, including positions with Gold Fields, Renison, and Aurion Gold. More recently, he was Exploration Director for Sun Mining, which has operations in Russia and other former Soviet Union countries. He says that he received the news of the Explorer of the Year award while standing in a core shed in Burkina Faso, logging in 45°C heat. That's a long way from the bitter cold of Russia. It is also a long way from his days experiencing the chilly Tassie winters at Renison Bell – but then Paul Kitto has indeed come a long way since those days.

PhD graduations

A selection of PhD graduates and supervisors* taken at the last graduation ceremony. From left: Ana Liza Cuison, David Cooke*, Jocelyn McPhie*, Heidi Pass, Jacqueline Blackwell, Susan Belford, Adam Bath, Garry Davidson*. A total of seven PhD students graduated on the day. Graduates not in the photo are Paul Cromie and Ralf Schaa.

A further six students were due to graduate at the August graduation ceremony, which was just too late for this issue of *Ore Solutions*.

Schools visit CODES

Left: Pupils from Mount Stuart Primary School learn about seismology from Mike Roach.

Bottom, left: Mike Roach explains the science behind the Ring of Fire to students from Claremont Primary.

Below: Research Fellow, Helen Thomas (far right), guides students from Fahan School for girls through an interactive educational exercise that utilises a variety of rock samples from around the world.

Workshop for Year-11 students

The Centre continued its ongoing participation in the Science Experience initiative by hosting a workshop for Year-11 students. The program's objective is to inspire students to continue their science studies.

CODES visits schools

Anya Reading tells Year-6 girls at Mount Carmel College what it is like to work as a geophysicist. The girls had lots of questions for Anya about her career and recent seismic events around the world.

Seniors schooled in geology

Andrew McNeill addresses a meeting of the School for Seniors at the Rosny LINC facility on Hobart's eastern shore. The group meets regularly to hear guest speakers talk on a wide range of subjects, with the aim of broadening their horizons in a relaxed, sociable setting. Andrew fitted the bill perfectly, delivering a presentation that covered an insight into the world of geology, interspersed with amusing anecdotes from his much-travelled career.

TESEP continues

CODES continued its support for the Teacher Earth Science Education Program (TESEP), which is primarily a series of professional development workshops aimed at upper primary / lower secondary school teachers.

Left: Simon Stephens takes the teachers on a tour of the lapidary facility.

Below: The teachers perform a range of practical experiments and exercises during one of the workshops.

Breathtaking honour for Garry

Congratulations to Garry Davidson, who was selected to represent Tasmania at the recent National Underwater Hockey Championships in Canberra. Garry has represented the state at either Men's or Masters levels an exhausting 14 times over the years, gaining two national Men's titles and five Masters titles in the process. He is also a regular player for local team 'The Berserkers'.

Guests get a taste of Portugal

Guests sample the range of fine cheese and wines on offer at the latest social event organised by the CODES SEG Student Chapter. The wine and cheese tasting evening was held on July 26 and included an array of fine produce from Tasmania, mainland Australia, and much further afield. Particularly popular was the selection of cheeses from Portugal.

Good sports

PhD student, Pedro Fonseca, stretches to make a shot during one of the regular badminton sessions held at the UTAS Unigym. The sessions are organised by PhD students Lindsey Clark and Mathieu Ageneau and are open to everyone at CODES.

The yin and yang of Yangtze

The serious, geological part of the Yangtze trip is covered in the centre spread. Here is a small selection of photos from the social side of the trip.

Right: Rocky mountain high. The group celebrates reaching the top of Bright Summit Peak during a trip to the Huangshan Geopark.

Middle, right: He ain't heavy… Chris Large (left) and Dan Gregory give Jeff Steadman a lift on a traditional Chinese sedan chair in Huangshan Geopark.

Below: Roisin Kyne looks in need of a lift.
Bottom: A relaxing dinner in Hefei.

Geomentallurgy

Cryptic conundrum

It is found in gold, but never in copper.
It is integral to mining, yet it is never seen in any part of mines.
It is also an important part of geology, but is never included in earth sciences.

What is it?

You don't necessarily have to be a geologist to work out this issue's puzzle. In fact, it might help if you are not. Email entries to: steve.calladine@utas.edu.au by Friday, 28 October, 2011. The winner will have the choice of receiving either one of CODES' publications or a selection of corporate gifts to the value of approximately $50. The competition is open to readers in Australia and overseas.

SOLUTION TO PREVIOUS PUZZLE:
The five elements that make up chocolate were carbon, holmium, cobalt, lanthanum, tellurium (C Ho Co La Te).

AND THE WINNER IS ...
The first name out of the hat was PhD student Selina Wu who chose one of CODES publications.

Mastering Economic Geology

…AND YOUR FUTURE

Would you like to broaden your knowledge of mineral deposit geology while adding the world's most comprehensive postgraduate mineral exploration and mining geology degree to your CV? If so, then the Master of Economic Geology (MEconGeol) program at the University of Tasmania could be just what you are looking for.

The MEconGeol is designed for working geoscientists and provides a thorough update on the latest developments in economic geology and mineral exploration, delivered by a team of highly qualified national and international presenters from both industry and academia. Through a series of manageable short courses, the program emphasises practical content, including research opportunities, and field excursions to diverse locations — from the arid plateau of the Atacama Desert in Chile, to Amazon rainforest, the snow-capped heights of the Andes and the spectacular active volcanic formations of New Zealand.

FLEXIBLE COMPLETION OPTIONS

– ideal for industry participants

The program is offered jointly between the University of Tasmania (CODES), the University of Western Australia (CET), James Cook University (EGRU) and Curtin University (WASM). Each of the participating universities offers up to five, two-week courses in rotation over a two-year period. There are two options for completing the degree:

• Option 1 – complete six units of coursework and a minor research thesis. Four of the units must be completed at CODES, and the remainder at other participating universities. Duration: Up to 30 months part-time (but this is flexible).

• Option 2 – complete eight units of coursework, at least four of which must be undertaken at CODES. Duration: Up to 30 months part-time (but this is flexible).

We realise that as a working geoscientist you are busy, so we endeavour to have all of the assessment tasks completed immediately before or during short courses (while you are on campus or on the field trips). For some short courses there may be some pre-course work, usually in the form of pre-course reading, or a short assignment (such as preparing a PowerPoint presentation).

There is no obligation to enrol. If you want to see what the courses are like before committing to a return to part-time study, then you can participate as an industry geoscientist. All our courses are open to not-for-degree participants and count as continuing professional development. You can just attend for particular modules that might interest you, or you can attend for the whole short course. If you attend as a not-for-degree participant but complete all the assessment tasks, we will keep your final results on file and if you decide to take on the Masters at a future date, we will credit that unit to your degree. It is a way of trying before you buy.

CODES

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Email: deborah.macklin@utas.edu.au

UTAS

COURSES OFFERED BY CODES

MARCH 2012
Geometallurgy

APRIL 2012
Volcanology and mineralisation in volcanic terrains

JUNE 2012
Brownfields exploration

OCTOBER / NOVEMBER 2012
Ore deposit models and exploration strategies

MARCH 2013
Ore deposits of South America (Chile, Peru)

JUNE 2013
Ore deposit geochemistry, hydrology and geochronology

* DATES SUBJECT TO CHANGE. CHECK WEBSITE FOR LATEST INFORMATION.

The MEconGeol programme provides the opportunity to undertake a research project worth 25% of the total degree. It's not compulsory, but those that have taken the option have invariably found that completing a research project of their own design, related to their own work, is what really made it a 'Masters'. It has proven to many that they are truly geoscientists and was the most rewarding part of their studies.

COST

The Masters short courses are a remarkably cost effective way to increase your knowledge of ore deposits, the rocks that host them and the processes that form them. The UTAS course administration fee for enrolled domestic Masters students (including New Zealanders) is around $AUD 850 per unit. International students can expect to pay around $AUD 2,392 per unit (a total of $AUD 19,136). International students should contact CODES' Deborah Macklin (see details below, left). Additional costs apply to field-based courses.

ENTRY REQUIREMENTS

A BSc (Hons), or a BSc with at least two years' industry experience.

www.codes.utas.edu.au/masters