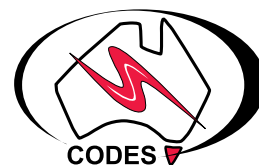


ORE SOLUTIONS

NEWSLETTER OF CODES
THE ARC CENTRE OF EXCELLENCE IN ORE DEPOSITS

SPRING 2010
NO. 27



Breakthrough at Olympic Dam – opens a wealth of possibilities

Research at Olympic Dam has resulted in the development of a new model for the formation of one of the world's largest ore deposits.

For the past twenty years, the prevailing ideas on the origins of the ore body have largely gone unchallenged. The accepted view is that the ore formation was linked to the Mesoproterozoic igneous activity that also produced the Hiltaba granites and Gawler Range Volcanics. However, a team consisting of Jocelyn McPhie and Dima Kamenetsky from CODES, and Kathy Ehrig from BHP Billiton, has produced a radically different hypothesis that proposes an association with a sedimentary basin, and a younger age of mineralisation.

Although sedimentary rocks in the Olympic Dam breccia complex have been recognised by all previous researchers, the small remnants were interpreted as maar crater-fill, and considered to be a relatively insignificant component of the host rocks. However, the new research reveals that these remnants are actually very thick (at least 350 m), well bedded throughout, and dominated by below-wave-base, basin-centre facies. In addition, the provenance of the sedimentary rocks is very diverse, and there are compositionally distinctive



From left: Glen Diemar (MEconGeol student), Dima Kamenetsky (CODES), Ken Cross (Consultant) and Kathy Ehrig (BHP) at the Olympic Dam site.

intervals that imply marked and sustained shifts in source areas. These findings, together with information on the regional context, provide strong evidence that these rocks are remnants of a continental sedimentary basin. The new view of the character and significance of the sedimentary rocks at Olympic Dam prompted re-assessment of the architecture of the host succession. This re-assessment has raised the possibility that mineralisation events were younger

IN THIS ISSUE

LA-ICPMS upgrade	2
Bushveld surprise	4
MMG partnership	6
New leader for Recovery	7
Short course NZ / Tas	10
Outreach	16



CONTINUED PAGE 3 >>

CODES CONTACTS

DIRECTOR

Ross Large
Tel: +61 3 6226 2472
ross.large@utas.edu.au

DEPUTY DIRECTOR

Bruce Gemmell
Tel: +61 3 6226 2893
bruce.gemmell@utas.edu.au

LEADER, PROGRAM 1, LOCATION

Tony Crawford
Tel: +61 3 6226 2490
tony.crawford@utas.edu.au

LEADER, PROGRAM 2, FORMATION

David Cooke
Tel: +61 3 6226 7605
d.cooke@utas.edu.au

(ACTING) LEADER, PROGRAM 3, DISCOVERY

Bruce Gemmell
Tel: +61 3 6226 2893
bruce.gemmell@utas.edu.au

LEADER, PROGRAM 4, RECOVERY

Jeff Foster
Tel: +61 3 6226 2374
jeffrey.foster@utas.edu.au

LEADER, PROGRAM 5, TECHNOLOGY

Leonid Danyushevsky
Tel: +61 3 6226 2469
l.dan@utas.edu.au

CO-ORDINATOR, GRADUATE RESEARCH

Jocelyn McPhie
Tel: +61 3 6226 2892
j.mcphie@utas.edu.au

PA TO THE DIRECTOR

Nilar Hlaing
Tel: +61 3 6226 2472
nilar.hlaing@utas.edu.au

PUBLICATIONS AND MEDIA RESOURCE CENTRE

June Pongratz
Tel: +61 3 6226 2479
june.pongratz@utas.edu.au

COMMUNICATIONS MANAGER including Editor of *Ore Solutions*

Steve Calladine
Tel: +61 3 6226 2743
steve.calladine@utas.edu.au

CODES – ARC CENTRE

OF EXCELLENCE IN ORE DEPOSITS

University of Tasmania
Private Bag 126, Hobart,
Tasmania, 7001 Australia
Tel: +61 3 6226 2472
Fax: +61 3 6226 7662
www.codes.utas.edu.au

LA-ICPMS upgrade

– opens opportunities for collaborative and contract research

The CODES' laser-ablation ICPMS analytical facility has undergone a substantial expansion, incorporating a Resonetics Resolution M50 excimer laser microprobe, and a new generation Agilent 7700 quadrupole mass spectrometer to its extensive range of equipment, and adding an additional lab to its building space. In total, the facility now has three quadrupole ICPMS and three laser microprobes.

Despite space being in short supply, the team in the Technology Program managed to secure an old palaeontology laboratory, which was completely gutted and refurbished to accommodate the expansion. This takes the total number of separate analytical laboratories at CODES to



three, which is in addition to access to the extensive electron microscopy and X-ray microanalysis facilities at the UTAS Central Science Laboratory (CSL).

"The Technology Program is vital to all our research at CODES. It is the thread that runs through our other four programs, contributing greatly to successful outcomes. Therefore, it is vital that we continue to make the necessary investments to ensure that our staff and external users have access to facilities that are not only state-of-the-art, but also have the capacity to handle our increasing analytical requirements," says Director, Professor Ross Large.

The upgrade improves the analytical capability of the Technology Program and provides opportunities for a wider range of collaborative and contract analytical work with other universities, government organisations and industry. In the past, the workload from the internal research programs left limited room for external work, but these expansions enable this aspect of the operations to increase without impinging on core research.

"Our labs now house a broad suite of cutting-edge instrumentation capable of high quality, precise analysis. All laserprobes are equipped with constant geometry ablation cells, characterised by reproducibility of better than 3%. In addition, we have developed a number



Above: Ian Little using the new Resonetics Resolution M50 laser microprobe.
Top: Marcel Guillong working with the new Agilent 7700 quadrupole mass spectrometer.

of unique analytical techniques and calibration standards for analysis of sulphides, and our staff have extensive expertise in analytical protocols and the interpretation of results. This is a compelling combination of attributes that is rarely found elsewhere," says the leader of the Technology Program, Professor Leonid Danyushevsky.

The upgraded facilities cover a wide range of applications encompassing the routine multi-element analysis of sulphide and oxide minerals, including the full range of platinum group elements; U/Pb dating of zircon and monazite; and multi-element analysis of silicate minerals and glasses.

The three labs focus primarily on the following areas, respectively:

- Mapping of trace element zonation in sulphide minerals; including a focus on refractory gold ores – using the Agilent 7700 mass spectrometer and New Wave UP213 laserprobe.
- Quantitative multi-element spot analysis of sulphide and oxide minerals – using Agilent 7500a mass spectrometer and New Wave UP193 laserprobe.
- Uranium and lead dating, plus silicate trace element analysis and imaging – using the Agilent 7500cx mass spectrometer and Resonetics Resolution M50 excimer laserprobe.

For further information on using the facilities, contact Professor Leonid Danyushevsky at +61 3 6226 2469 or l.dan@utas.edu.au

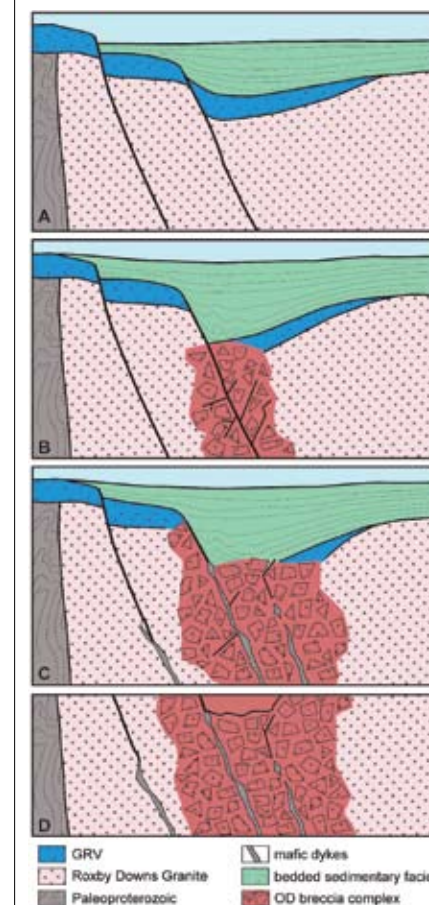
<< CONTINUED FROM PAGE 1

than previously thought. This breakthrough suggests the possibility that sedimentary processes may have been involved in ore formation. If correct, profound impacts can be expected on the exploration strategies of mining companies around the world.

The initial project officially ended in June, but is expected to be extended for at least a further two years. Key objectives will be to place a more precise date on the ore formation, establish sources of the metals, and evaluate links between Olympic Dam and its regional context.

Olympic Dam is a supergiant polymetallic ore deposit, covered by 200-300 metres of younger rocks, on the northeastern edge of the Gawler Craton. The ore minerals (copper sulphides and uranium oxides) occur in hematite-rich breccia within the Roxby Downs Granite. The ore body ranks number one in the world in terms of uranium reserves, and fourth for gold and copper. It also contains significant quantities of silver and rare earth elements.

The team would like to thank former team members Nick Green (ex BHP) and Isabelle Chambefort (ex CODES) for their significant contributions to this success.



Surprising answers to Complex questions

Research conducted by Jeff Foster and Dave Hutchinson has led to the development of a new model to explain the formation of the Merensky Reef in South Africa's Bushveld Igneous Complex — the world's richest resource of platinum group metals.

Although many models have been proposed in the past, they have generally been limited in their scope; bearing in mind that it is increasingly being realised that the ore forming and depositional magmatic process for this world-famous reef must have been extremely intricate.

The CODES' researchers coupled field-based research with the use of the latest in analytical techniques to help maximise the breadth of their findings. This included extensive use of the in-house laser ablation ICPMS system. Their work provided some surprising and intriguing results. For example, a key sample from the lower portion of the Merensky Reef was studied in detail, which included producing high quality 2D surface multi-element maps via the ICPMS. These maps were expected to reveal that platinum and palladium behave similarly and reside in one or the other of

the sulphide phases present in the rock. However, the laser mapping revealed only the presence of palladium, with platinum being absent from all of the sulphides. These findings could not be adequately explained by current theories on the formation of the reef, and this led to the development of a new model.

In essence, the new model proposes that the magmas that were emplaced into the Bushveld Complex to form the Merensky Reef were previously contained within a separate staging chamber located within upper crustal sediments, presumably of the Transvaal Supergroup. During this time, the magmas were contaminated from interaction with the sediments, and fractionated, leading to crystallisation of chromite grains and the formation of immiscible sulphide liquids. Once formed, these liquids were then able to capture



Pioneering research in Cambodia

Field-based research on the Southeast Asia Project has progressed, with extensive work on the Cambodia segment being completed during February and April by Khin Zaw, Grace Cumming and Takayuki Manaka.

These activities have led to an improved regional metallogenic understanding of a new, but poorly understood, Cu-Au-base metal mineral belts in the country, and preliminary geochronological studies are already changing the conceptual and genetic models of the region. The field area is located in dense rainforest in a sparsely populated area of the Mondokiri Province in the eastern part of Cambodia, where sponsor companies Southern Gold, Indochine and OZ Minerals are exploring. The team wish to thank Grant Thomas, Chan Sik Lap (Jacky) and Jaydee Ammuguan of Southern Gold for their help in this isolated region, and to David Meade of Indochine Resources and Mick Sharry of OZ for taking time out of their busy schedules to hold fruitful discussions.

Chromitite layers of the Bushveld

Chromitite layers are a key component in the economics of the Bushveld Complex.

These occur predominantly within the Critical Zone portion of the main Eastern and Western limbs of the complex, with the addition of a further package of chromitiferous layers within proposed Lower Zone equivalent units in the southern termination of the Northern Limb (i.e. Grasvalley Chrome Mine). Stratigraphically, the Lower Group (LG) series of chromitites has the highest chromium content, though factors such as layer thickness and grain size are important considerations for mining viability. The LG6 Steelpoort Seam, together with the MG1 and MG2 seams from the Middle Group series, are the primary contributors to the mined chromium reserves. The chromium content of the Upper Group (UG) chromitite layers is not sufficiently rich in chromium to be a viable resource of the element. However, the UG2 layer, as with the Merensky Reef located a few tens of metres above, is mined extensively for its rich precious metals content, particularly PGEs.

Ni-Cu-PGEs from the magma forming sulphide droplets with high tenors of these elements. Crucially, it would seem that Pt-bearing minerals were formed from these sulphide liquids and, upon their subsequent emplacement into the Bushveld magma chamber, sedimentary-mechanical processes resulted in extreme concentration of heavy particles of chromite and Pt-bearing minerals associated with disrupted sulphides. These components formed a basal crystal charged slurry that had the thermo-mechanical erosive power to cut down into the near-crystalline footwall units (e.g. anorthosites or pre-Merensky norites and pyroxenites).

As these theories also apply to other nickel-copper-PGE bearing systems, the findings are expected to have far reaching impacts. During the coming months the team expect to complete ICPMS mapping of sulphide globules and massive ores from Norilsk-Talnakh region in northern Russia. It also plans to initiate a program of mapping for selected magmatic sulphide-bearing samples from the Jinchuan Group, China and the Pechenga region in Russia.

Top, centre: UG1 chromitite.
Top, right: Platreef contact with granite.
Centre: The PGE-rich UG2 ore body.
Right: Merensky Reef intercumulus sulphide and lower chromitite.



Gold-bearing vein at the Anchor Prospect of the Snoul deposit, owned by Southern Gold Company.



MMG's Rosebery operation on Tasmania's west coast.

MMG new industry partner

Minerals and Metals Group (MMG) has signed an agreement to sponsor CODES as an industry partner.

This takes the total number of partner organisations to ten, comprising Anglo American, AngloGold Ashanti, Barrick, BHP Billiton, MMG, Newcrest, Newmont, Rio Tinto, St Barbara and Teck.

"We are very pleased to welcome MMG as a significant sponsor of our research. I believe that this promises to be a highly fruitful relationship, particularly as the company has operations in Tasmania and Southeast Asia, which are both areas where we have gained considerable experience over many years," says CODES' Director, Ross Large.

MMG is a global base metal miner with a focus on nickel, copper and zinc. It is the world's second largest producer of zinc with offices in six countries worldwide and includes Tasmania's Rosebery mine as part of its portfolio of operations.

"MMG is a newly formed company with an ambitious growth plan to build the next generation's leading global diversified minerals and metals company. This vision includes a strong focus on exploration and innovation in exploration geoscience. We look forward to our association with CODES, the world leaders in Economic Geology research," says MMG's Chief Geologist, Steve Beresford.

Despite what has often been difficult economic conditions for the industry, support from the minerals sector has continued to grow over the years and now represents well over 40% of the Centre's total income. Industry partners receive a number of benefits through their sponsorship, including:

- Association with, and first call on, a world-class research team in ore deposit science.
- Membership of the CODES Science Planning Panel.
- Access to scholarships for staff undertaking Masters degree courses.
- Fee reductions on regular short courses and special in-house courses.
- Branding exposure at major national and international conferences and exhibitions.

Further details on industry sponsorship opportunities can be obtained from Ross Large at + 61 3 6226 2472 or ross.large@utas.edu.au

New leader for Recovery

Jeff Foster has been appointed as the new leader of the Recovery Program.

Jeff has nearly 25 years' experience in the minerals sector, including senior positions at Western Mining Corporation, BHP Billiton and the GeoDiscovery Group. He joined CODES in 2007, where he has successfully led the Discovery Program until this new appointment. Although primarily known for his work on magmatic sulphide systems, both Cu/Ni and PGE types, he has also been pivotal in managing groundbreaking research in the field of geophysics. Because of his experience in this area, it has been decided that he will retain control of the geophysical aspects of his old program.

"I am looking forward to the challenge. The Recovery Program is a particularly exciting area of research because of the potential rewards. The minerals sector is vital to Australia's growth, and advancements in the geomaterial sphere directly benefit the economy through improved productivity and efficiencies. This is intimately associated with enhanced environmental outcomes through effective management of water and energy resources," says Foster.

The Recovery Program has a large element of applied research in its ambit. This inherently involves a high degree of work with industry, which is an ideal fit with Jeff's background.



Jeff Foster has taken over the Recovery Program with immediate effect.

"Jeff's wealth of experience in the minerals industry, thorough knowledge of the GeM project and strong desire to pursue this line of research made him the ideal person to build on the excellent work carried out to date, and ensure there is a seamless transition for our industry sponsors", says CODES' Director, Ross Large.

Jeff takes over from Steve Walters, who has decided to be based at the University of Queensland (UQ) on a full-time basis. Steve, whose family live in Queensland, previously split his time between UTAS and UQ. Although Steve is no longer

employed by CODES, he will retain a very active involvement with the Centre through research collaborations. He has also become leader for our UQ Node, taking over from Ben Adair.

The selection process for someone to take over the reins of the Discovery Program is well advanced and an appointment was imminent as this issue of *Ore Solutions* went to print.



Flurry of theses

We are fairly sure that there is no such thing as a collective noun for a group of theses, but a 'flurry' seems appropriate, at least in the case of the current crop of CODES postgrads. A healthy total of 12 PhD candidates have submitted theses in recent months, and a number more are very close to completion. The full list of submitters is Andrea Agangi, Adam Bath, Susan Belford, Jacqueline Blackwell, Paul Cromie, Mawson Croaker, Tim Ireland, Wallace Mackay, Ralf Schaa, Adel Vatandoost, Wojciech Zukowski and Liezl Cuisson – featured in the photo.

MEETINGS

Southeast Asia project reviewed in Chiang Mai

A meeting to review the progress of the Ore Deposits of Southeast Asia Project has been held in the ancient city of Chiang Mai in northern Thailand.

Attendees included representatives from industry sponsors Kingsgate Consolidated, Pan Australian Resources, OZ Minerals, Barrick, Newmont Mining, Indochine Resources, Monument Mining, Southern Gold and MMG.

Ross Large opened the proceedings, before handing over to project leader Khin Zaw who gave an overview of the initiative and



Professor Sampan Singharajwarapan, Dean of Science at Chiang Mai University, leads a field excursion to the Doi Suthep metamorphic core complex.

the progress to date. Zaw then teamed-up with Sebastien Meffre to present a new understanding of the tectonics and metallogeny of Southeast Asia, based on the acquisition of new geochemical, geochronological and ore deposit data. Other presentations by CODES' researchers and students covered the results of ongoing studies on regional to local geology, magmatism, and the timing of mineralisation. These talks included district-to local-scale characteristics of important porphyry/skarn Cu-Au, epithermal, orogenic, and sediment-hosted Au deposits in mainland Southeast Asia — focussing on the key metallogenic criteria for mineral exploration in the region. The meeting was combined with a field trip to Doi Suthep

metamorphic core complex and the mine at Ban Muang Kut a Triassic-granite related Pb-Zn deposit in Sukothai Fold Belt.

This was the second progress meeting for this project. In addition to the industry representatives, the gathering included 14 CODES researchers, plus delegates from Chiang Mai University and the Department of Mineral Resources Thailand. Notable among the locals who helped facilitate the meeting were UTAS / CODES alumni Weerapan Srichan, Phisit Lintrakum and Sampan Singharajwarapan, who is now Dean of the Faculty of Science at Chiang Mai.

Final meeting for Ni-PGE project

A final meeting was held at the end of April to mark the successful conclusion of the AMIRA 962 Ni-PGE project, which was the first industry-sponsored project at CODES to cover magmatic nickel deposits. The project was led by Leonid Danyushevsky, supported by Sandrin Feig, Andrew McNeill, Tony Crawford, and PhD student Kirill Bychkov, plus external team members Alexey Ariskin from the Vernadsky Institute, Moscow and Eduard Konnikov from the Institute of Experimental Mineralogy, Chernogolovka. Industry sponsors were Anglo American, BHP Billiton, and Votorantim Metais.

WORKSHOPS & SHORT COURSES

Brownfields Exploration

Exploration in data-rich environments close to existing mines has become the preferred method of increasing company resources in recent years. With this in mind, CODES presented the *Brownfields Exploration* Master of Economic Geology short course in June, which is designed to bring students up-to-date with the latest techniques in this important area of exploration.

The course is popular for its high ratio of practical, hands-on elements. For instance, each student had their own PC with advanced 3D viewing software to manipulate the data as they chose. And Dr Mike Roach provided a comprehensive review of the geophysical and GIS techniques that can be applied to mature exploration environments, and reinforced the theory with a series of computer-based practical exercises.

Two well-known industry consultants presented in-depth workshops on



Dr Scott Halley (standing) was one of the high profile presenters at the event. He is seen here leading a targeting workshop, which was a two-day segment of the course.

lithogeochemistry (Dr Scott Halley) and 3D visualisation (Dr Jun Cowan), using real data sets from world-class mineralised districts. Students completed exercises using data sets derived from renowned Canadian and Australian examples of recent Brownfields exploration.

The last two days of the course consisted of the Brownfields Exploration Forum, where some of the most successful explorationists in Australia provided in-depth reviews of their experiences in exploring mature environments in places as diverse as the Chilean Andes to the forests of western

Tasmania. The Forum attracted an array of top class presenters from industry and State Government and was considered by many participants to be the high point of the course. It closed the course in the best possible way: by showing that the theory and practice the students had been learning was actually being applied in the real world of exploration.

The course is part of the National Minerals Geoscience Masters Program. The next course in the series is Ore Deposit Models and Exploration Strategies from 1-12 November, 2010.



Above: Participants studying rock samples during a lab session.

Right: Consultant, Dr Noel White (right) and Professor Steve Scott (left), University of Toronto, providing expert advice.

Photos courtesy of Wei Huixiao, Sun Yat-sen University

Major input to workshop in China

Professor David Cooke, Dr Zhaoshan Chang and Dr Huayong Chen were instructors at the Ore Deposits Models and Exploration workshop held in Wuhan, the capital of China's Hubei province, at the end of May. The six-day event covered a range of topics, including SEDEX and MVT deposits (David Cooke, plus David Leach – USGS), porphyry and epithermal deposits (David Cooke, Zhaoshan Chang), skarn deposits (Zhaoshan Chang), and IOCG deposits (Huayong Chen). Consultant, and CODES' Advisory Board member, Dr. Noel White, delivered presentations on the importance and application of ore deposit models to exploration, iron ores, manganese ores and

laterites. Other instructors were Professor Steve Scott – University of Toronto, Dr Craig Hart – MDRU (UBC), Dr Chusi Li – Indiana University, and Kaihui Yang – Asia Now Resources.

The main purpose of the workshop was to introduce Chinese exploration geologists and students to modern concepts in mineral exploration, based on tested ore deposit models. There is a voracious appetite for this type of knowledge within China's geological community, which was demonstrated by the high number of attendees. Since its inception in 2005,

the workshop has shown a remarkable growth in popularity, with this year's event attracting 262 participants. As the workshop has grown, an increasing number of topics have been added to the programme, resulting in an expansion in the duration of the annual event from three to six days. This evolution is expected to continue when it is Beijing's turn to be hosts late in 2011.

The main sponsors of the event were the Society of Economic Geologists (SEG), Society for Geology Applied to Mineral Deposits (SGA), and China University of Geoscience (CUG).



On course in NZ and Tas

Master of Economic Geology students recently attended a two-part short course in New Zealand and western Tasmania, during which they reviewed current approaches to mapping, facies analysis, and mineralisation in ancient and modern volcanic successions.

The field-based course included nine days exploring modern volcanic successions on the North Island of New Zealand, where the students visited numerous sites including the Rangitoto basaltic volcano, Rotorua caldera and phreatic explosion craters, Waiotapu geothermal reserve, and the active offshore volcano at White Island. Another of the many highlights of the trip was a visit to the Taupo Volcanic Centre, which is at the site of the renowned explosive eruption of 186 AD - New Zealand's largest volcanic event of the past 20,000 years.

The second leg of the course was held over three days in western Tasmania, where the group reviewed mineralisation and alteration processes related to

hydrothermal systems in submarine volcanic environments, and their implications for mineral exploration. The course made use of the Mount Read Volcanics, the host succession to the Hellyer, Mount Lyell and Rosebery massive sulfide deposits. This succession includes excellent examples of facies associations typical of mineralised submarine volcanic settings.

Overall, the course provided the students with an excellent introduction to volcanology and mineralisation in volcanic terrains, including an insight into the processes and products of different eruptions styles, the identification of key volcanic facies associations, interpretation of facies variations, and contrasts in scale

and structure of volcanoes. The course was led by Jocelyn McPhie, assisted by Bruce Gemmell, for the New Zealand leg, while Andrew McNeill took over the reins for activities in western Tasmania.

The next course in this popular series of Master Program courses is Ore Deposit Models and Exploration Strategies, which starts on 1 November. For further details, see the advertisement on the back cover of this issue of *Ore Solutions*, or contact the program co-ordinator, Tony Webster, at awebster@utas.edu.au or +61 3 6226 1942.



Bottom, left: Part of the group enjoying a perfect afternoon for physical volcanology and geothermal systems in the crater of an active volcano on White Island. One of the helicopters needed to ferry the full group to the hard-to-reach location can be seen in the background.

Top, centre: CODES' Masters Students David Freeman (left) and Glen Diemar on top of a debris-avalanche hummock in the White Island amphitheatre.

Opposite: Ephemeral iron and calcium sulphates precipitated from acidic water in a stream on White Island.





Above: MMG geologist, James Cannell, explaining the details of drill core samples during a visit to his company's Sepon Au-Cu mine.

Right: The group takes a break during their visit to the Padaeng zinc mine.



Ten days off the island

– students visit Thailand and Laos

The CODES SEG Student Chapter has completed an extremely rewarding 10-day field excursion to Thailand and Laos that included visits to five mines and a number of interesting geological sites.

The trip commenced with an introductory workshop at the Department of Mineral Resources (DMR) in Bangkok, which provided the participants with a background to Southeast Asian tectonics and ore deposits. The workshop was presented by Khin Zaw from CODES and Somboon Khositant of the DMR. On the second day, the group ventured 280 kilometres north into central Thailand to visit the Chatree Au-Ag mine — the country's largest hard-rock gold resource. The mine is operated by Australian mining company Kingsgate, in conjunction with its Thai subsidiary, Akara Mining. The mineral resource at the site, together with the previously mined ore, totals almost five million ounces of gold, at average grades of 1.2g/t Au (gold) and 12g/t Ag (silver). The deposit is located in the Loei-Phetchabun volcanic belt, which is composed of remnant oceanic and continental arc complexes that were merged between

the Shan-Thai and Indochina Terranes during the Permian – Triassic Period. A thick Carboniferous to Early Permian sedimentary sequence formed of conglomerate, sandstone, shale and limestone dominates the district-scale geology.

The group then moved north-west to the Padaeng zinc mine, which exploits a significant supergene non-sulphide zinc deposit associated with the Padaeng fault. The ore body includes hemimorphite and smithsonite and is hosted by a mixed carbonate-clastic sequence of the Middle Jurassic age. The visit included observations of drill cores and a tour of the open pit mine, which utilises a ladder style structure.

Next stop was the Phu Thap Fah Au mine where reduced gold skarn mineralisation forms economic ore bodies. This deposit is a reduced pyrrhotite–garnet–clinoproxene Au skarn that is hosted in a Permian sequence of siltstone and limestone that is intruded by Triassic granodiorite and related

dioritic dykes. Highlights included a viewing of diamond drill cores that revealed gold mineralisation hosted in carbonaceous black shale, plus a visit to the open pit operations.

On day five, the group crossed the border into Laos, where their first port of call was the Department of Geology and Mines (DGM) in the country's capital, Vientiane. Here they toured the excellent geological museum and attended an introductory workshop on the potential for finding new mineral deposits in the country. The workshop was led by DGM's Deputy Director General, Ms Chansavath Boupah. They then headed off for a guided tour of the Phu Kham Cu-Au mine, which is located 120 kilometres north of the capital in a remote area surrounded by karst mountain formations.

The final three working days of the trip included a visit to one of Southeast Asia's most productive mining operations, MMG's

Sepon Au-Cu mine located in Central Laos. At this site they were welcomed by MMG geologists James Patterson, James Cannell and Paul Wright, who proceeded to explain the intricacies of the operation's sediment-hosted, Carlin-like gold mineralisation, Cu skarn and the associated supergene mineralisation. The location of the mine is known as a particularly dangerous place to visit because the area was heavily bombed during the Vietnam War. And, even though it is 35 years since the end of hostilities, there are still numerous unexploded bombs in the vicinity. These hidden weapons are naturally a concern for any visitor to the area, but for geologists that go fossicking off the beaten track they are especially worrying. (See also, the article on the Troung Son Fold Belt in the last issue of *Ore Solutions*).

On the final day, the only rock the students had to think about was the rock of their boat as they relaxed and enjoyed dinner while cruising down the Chao Phraya River in Bangkok – where it all began.

The field trip was primarily organised by the CODES Student Chapter, particularly Takayuki Manaka, Mathieu Ageneau, Lindsey Clark and Andrea Agangi. Khin Zaw led the excursion and conducted lectures. He was ably assisted by a number of geological staff at the five mine sites, who enthusiastically shared their knowledge on the exploration history and geology of their companies' operations.

As usual, the participants were comprised of a wide variety of people from various sources and cultural backgrounds including industry representatives, and students originating from Australia, UK, USA, Canada, France, Mongolia, Switzerland, Germany, Portugal, Spain, China, Italy, Japan, Peru, Russia and Thailand. In addition to the field guides and participants, the Student Chapter would also like to thank external sponsors Barrick, AngloGold Ashanti, Sundance Minerals, Ivanhoe Mines and the SEG for their generous and invaluable financial support.

VISITORS TO CODES



Professor James DL White from Otago University, presenting a seminar during his two-day visit. Professor White, who was invited by the SEG Student Chapter, gave a total of three seminars related to his new and innovative research projects based on magma-water interaction.



Marcelo Jose Marquez, from the National University of Patagonia in Argentina, delivers a seminar during his recent two-month visit to CODES. During his stay, Marcelo collaborated with Dima Kamenetsky and Jocelyn McPhie on research related to a Jurassic silicic large igneous province in Argentina.

EXHIBITIONS & CONFERENCES



Exhibiting persistence

CODES has continued its high profile presence on the exhibition and conference circuit in recent months, with a strong presence at Roundup in British Columbia, IAGOD in South Australia, and Goldschmidt in Tennessee.

The Centre had exhibition booths at both Roundup and IAGOD, and presented a host of papers over all the events. This included 12 staff members presenting at IAGOD and six at Goldschmidt.

A highlight of the IAGOD conference was a groundbreaking contribution by Jocelyn McPhie and Dima Kamenetsky on the geological architecture of the giant Olympic

Dr Huayong Chen (3rd from right) and Jeff Steadman (2nd from right) with a group of Chinese visitors at the CODES' booth at IAGOD in Adelaide, South Australia.

Dam copper / uranium deposit (see article on cover).

At Goldschmidt, Ross Large gave an invited talk on the source of gold in sedimentary basin ore deposits.

MOVING IN



Visiting PhD student, **Hossein Kouhestani**, from Tarbiat Modares University in Iran, is working with Khin Zaw on the Chah-e-Zard Au-Ag deposit (Iran).



Mohd Basril Iswada Bin Basori (better known as **Basril**) is working on VHMS deposits in central Malaysia, supervised by Khin Zaw and Ross Large.



PhD student, **Selina Wu**, from Canada, is working with Andrew McNeill and Bruce Gemmell on the VHMS deposits of the Hellyer-Que volcanics.



PhD student, **Marc Rinne**, from Canada, is working with Dave Cooke and Anthony Harris on the Wafi-Golpu porphyry-epithermal system in PNG



Ian Little has joined CODES as a Research Technician in the ICPMS lab.



Charles Makoundi is working with Khin Zaw and Ross Large on sediment-hosted ore deposits in central Malaysia. Charles is originally from the Republic of Congo, but moved to CODES from Malaysia.



PhD student **Dan Gregory**, from Canada, is working with Ross Large on sources of gold in orogenic gold deposits.



Planning for science

This year's Science Planning Panel Meeting was held in the Geology Lecture Theatre during June. The full-day program included a blend of presentations by key people from the CODES' Hub and its collaborating Nodes. The audience contained representatives from most of CODES' key stakeholders, who contributed to a number of lively and valuable discussions on future directions for the Centre. These discussions also established an important platform for the CODES' Advisory Board meeting, which was held the following day.

OUR INVOLVEMENT IN THE COMMUNITY OUTREACH

Teaching the teachers

The Teacher Earth Science Education Program (TESEP) is an initiative that operates under the auspices of the Australian Science Teachers Association, providing a series of professional development workshops aimed at primary and lower-secondary school teachers. CODES contributed a number of workshops to the program towards the end of last year and has continued its support in 2010.

Mike Roach at his laptop setting up a practical seismic demonstration for the teachers.

Inset: Al Cuisson (right) explains the finer points of lapidary to a teacher during a TESEP workshop.



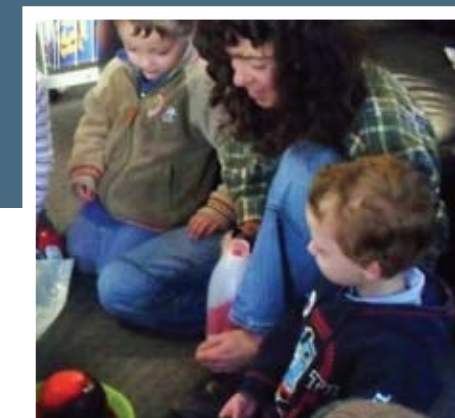
Gemnasium adds polish to visits

Deputy Director, Bruce Gemmell shows the wonders of the CODES Gemnasium to visitors. The Gemnasium is a new feature at CODES consisting of a large bed of brightly polished rocks from around the world. It is already proving very popular feature for visitors of all ages and backgrounds.



Down to Earth

Mike Roach explains the geological structure of the layers of the Earth to year 9 students during a visit by Calvin Christian School.



Message to the mites

Sharon Allen visited the Lady Gowrie Child Centre in June, where she introduced a large group of 3-4 year-olds to the wonders of volcanoes. Sharon brought the visit to life by demonstrating a 'pretend' volcano eruption using vinegar and baking powder.



Science Experience 2010

CODES continued its ongoing participation in the Science Experience initiative by hosting a workshop for year-11 students earlier this year. The program aims to inspire students to continue their science studies, and is supported by the Science Schools Foundation, Rotary, and the Australian Science Teachers Association.

Students experience a geological 'tour' of Tasmania by examining rock samples from around the state.

Career advisors tour Centre

Twenty-one career advisors from secondary schools in Victoria and NSW visited CODES as part the annual UTAS Career Advisor Symposium. During their visit they received a tour of the Centre, including a presentation on the benefits of a career in the earth sciences and a demonstration of the ICPMS facilities.

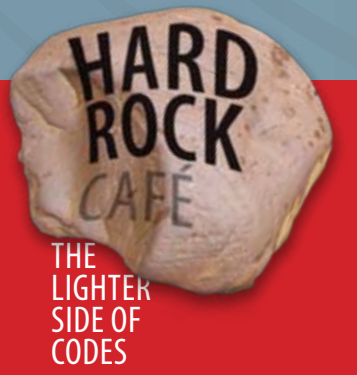
Deputy Director, Bruce Gemmell, rolls out a seismic reading during the career advisors' tour.



Introduction to rocks and fossils

With the aid of lenses from an old pair of Polaroid sunglasses, Rob Scott explains the operation of a petrographic microscope to a group of preparatory and grade one students at Montagu Bay Primary School. The photograph was taken from one of an ongoing series visits Rob has made to the school to introduce the young students to rocks and fossils.





Enter the dragon

The Lindsfarne Rowing Club was the venue earlier this year for a dragon boat racing festival aimed at raising funds for breast cancer. The CODES' entry gave a very good account of themselves, but were unlucky to be drawn to row when a strong breeze was gusting down the Derwent – taking all the puff from their magic dragon. As positions were based on recorded times, this gave teams rowing in milder conditions a bit of an advantage. At least that is their excuse, and they are sticking to it. But no one was too concerned; the main aims of having fun and raising money for charity were both achieved with admirable success.

This event is a little old for this newsletter, but it seemed a shame not to let these photos taken by Wojciech Zukowski see the light of day.



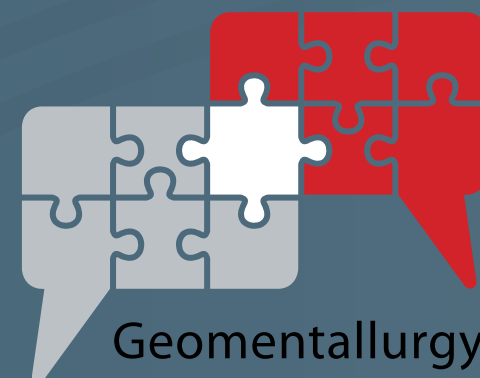
Looking quizzical

As expected, it was a full house at the increasingly popular SEG Students' Chapter Quiz Night held in July.



Skating on thin ice

It was another evening of thrills and spills at the Glenorchy Ice Skating Rink early in July. The evening was organised by the SEG Students' Chapter, but was open to anyone that wanted to join in the fun.



Elementary my dear...

There were not many correct answers to the last puzzle, so this time we have decided to make it a little more sweet and simple.

What five elements make chocolate?

Email entries to: steve.calladine@utas.edu.au by Friday, 12 November, 2010. The winner will receive the choice of either any one of CODES' publications, or a selection of corporate gifts to the value of approximately \$50.

SOLUTION TO PREVIOUS PUZZLE:
The eight Christmas carols or songs were:

1. The Christmas Song.
2. White Christmas.
3. Rudolph the Red-Nosed Reindeer.
4. Blue Christmas.

5. I Saw Mommy Kissing Santa Claus.
6. Jingle Bells.
7. Frosty the Snowman.
8. Jingle Bell Rock.

AND THE WINNER IS ...
The first name out of the stocking was PhD student Jeff Steadman, 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. All short courses count towards continuing professional development.



For further information contact:

Tony Webster – Masters Coordinator, CODES
Tel: +61 (0)3 6226 1942 Fax +61 (0)3 6226 7662
Email: awebster@utas.edu.au

COURSES OFFERED BY CODES

JUNE 2010 (completed)

Brownfields exploration

NOVEMBER 2010

Ore deposit models and exploration strategies

MARCH 2011

Ore deposits of South America (Chile, Peru)

JUNE 2011

Ore deposit geochemistry, hydrology and geochronology

MARCH 2012

Volcanology and mineralisation in volcanic terrains

The MEconGeol programme provides the opportunity to undertaking 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 the Masters Co-ordinator (see details below). 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