ore solutions

*Newsletter of the Centre for Ore Deposit Research, an ARC Special Research Centre at the University of Tasmania*

# CODES RELODED

## … planning for the NEW CODES

CODES core research funding from the Commonwealth Government, through the Australian Research Council, ceases in 2005, and we have been actively talking with our stakeholders and other collaborators about future directions for the Centre. At our Science Planning Meeting in March, involving researchers, collaborators and industry supporters, there was strong agreement on three aspects: (1) we should continue to develop our role as one of the world-leading research centres in ore deposits, (2) we should maintain our very successful structure of a focussed one-node centre at the University of Tasmania and avoid the problems of multi-node centres, and (3) we should develop research strengths in two key areas of critical future importance to the minerals industry: exploration geophysics and geometallurgy.

In July the ARC announced a new round of Centres of Excellence, with applications due in late October and funding to commence in mid 2005. There will be about ten new Centres with ARC funding in the range of $1 million to $3 million per year. This provides an ideal opportunity for CODES to continue as a first-class international research centre and to expand into the fields of exploration geophysics and geometallurgy to compliment our current strengths. The competition for Centre of Excellence funding will be very strong, and we are under no illusions that we will need to put forward the best possible case for a new centre, with strong support from our stakeholders, to have a chance of success. The University of Tasmania is strongly behind our bid as it is fully aware of the need to maintain and grow those areas in the University that have developed world-leading research status, as well as supporting others that are growing to that position. The Tasmanian Government will also be contributing financial support to enable an enhanced research effort in the targeting of deep mineral resources in the world-class Mount Read Volcanic Province.

***Participants in the CODES–JKMRC workshop held at the JK Centre, Brisbane, 9-10 September. Left to right: Ying Gu, Tim Napier-Munn, Debra Burrows, J-P Franzidis, Emmy Manlapig, Mike Roach, Ross Large, Andrew Rae, Wally Herrmann, Nenad Djordjevic, Martin Smith, Ron Berry, Peter Fullagar, Rob Morrison, Steve Walters and Bruce Gemmell.***

Discussions have been underway with AMIRA International and CODES corporate industry sponsors to support the Centre of Excellence bid. Industry is strongly supportive of our plans and we hope to develop a package of funding that will match the requested ARC Centre of Excellence grant. In collaboration with the JK Minerals Research Centre at University of Queensland we are developing a major new research thrust in the area of geometallurgy that is being enthusiastically received by the minerals industry. This development, which

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## CODES RELODED

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will become a core program in the new centre, is highlighted elsewhere in the newsletter ('a GEM of a project').

In the area of exploration geophysics, we plan to build-up our team to a similar level of expertise and international standing as that in ore deposit geology and geochemistry at CODES. Currently the UTAS School of Earth Sciences teaches a full BSc (Hons) degree in geophysics with academic staff Mike Roach and James Reid specialising in the areas of electrical geophysics, magnetics and petrophysical properties of ore deposits. Expansion of our capability in geophysics will be done by key collaborations with other national and international groups and by establishing a chair in exploration geophysics. Our focus will be on the geophysical attributes that can be modelled to improve exploration success, mineral processing and mine planning of different types of ore deposits.

The proposed Centre of Excellence will also involve focussed collaborations with other national institutions (University of Melbourne, ANU, CSIRO and GA), and international groups (UBC/MDRU/GIF, CSM and JHU) in areas of mutual benefit. Our plan is for CODES to emerge over the next five years as a more diverse cross-disciplinary centre, retaining an ore deposit focus, but with enhanced strengths in geophysics and geometallurgy to match the needs of the evolving Australian minerals industry.

# Staff news

**Zhaoshan Chang** was appointed in June 2004 as a Research Fellow in Economic Geology. He joins the CODES AMIRA project P765 to research 'Transition and zoning in porphyry-epithermal districts: indicators, discriminators and vectors.' His research background includes research on Mesozoic magmatic rocks and skarn deposits in China and magmatic-hydrothermal transition and hydrothermal deposits associated with granitoids, especially skarn deposits, porphyry deposits, and epithermal deposits. He is also interested in geochronology and isotope geochemistry applied to ore deposit research.

Zhaoshan was awarded his Bachelor of Science and PhD from the Peking University, China, in 1992 and 1997 respectively, and was awarded another PhD in 2003 from Washington State University.

**Katrina Keep** was appointed as Personal Assistant to the Director of CODES in June 2004. Katrina joins the CODES team having worked at the University of Tasmania for the past five years — her previous role was Personal Assistant to the Dean of the Faculty of Commerce.

***Garry Davidson, Owen Hatton (PhD), Andrew Stewart (PhD), Paul Davidson (PhD), Tony Crawford, Nalin Shah (M Econ Geol) and Matthew Hope (M Econ Geol) share a Crawford joke after the August 2004 graduation ceremony.***

***Participants in the June 2004 'Ore Deposit Models and Exploration Strategies' short course, held at CODES following the 24 ct Au Workshop. Front row: Mannie Mehu, Ailsa Woodhouse, Peter Pring, Steve Brown, Steve Hoare, Prima Hillman, Allan Ignacio, Rene Gonzales. Back row: Yee Krumpkhin, Michael Schwarz, Kim Denwer, Steve Lewis, Steve Groves, Len Kolff.***

# Eritrean short course

Associate Professors Bruce Gemmell and Jocelyn McPhie presented a short course in Eritrea from 31 July to 6 August this year. They were invited by Sanu Resources to give the six-day short course, which comprised four days of lectures and two days in the field, and covered physical volcanology and VHMS alteration and mineralisation. The short course was held at the University of Asmara, with up to 75 participants from the Eritrean Department of Mines, the University of Asmara, and three mining companies in the region: Sanu Resources Ltd, Sub-Sahara Resources and Nevsun Limited.

Eritrea is a northern African country bordered by Ethiopia, Sudan, Dijbouti and the Red Sea. The capital, Asmara, a city of approximately 400,000 people, sits atop the Eritrean highlands at 2350 m. Jocelyn and Bruce visited in the middle of the wet season; the weather was cool and rainy — not quite what one would expect in sub-Saharan Africa.

The two days of field trips took the group to two base-metal prospects being explored by Sub Saharan Resources: Debarwa south of Asmara and Adi Nefas to the north. Both of these prospects are hosted by deformed and metamorphosed Neoproterozoic formations of the Arabian-Nubian shield. The mineralisation at Debarwa occurs in steeply dipping, mafic and felsic volcanic successions and is marked by outcropping gossan and barite. At Adi Nefas, the volcanic succession is dominated by mafic volcaniclastic rocks intruded by rhyolitic dykes. The town of Adi Nefas is partly built on a gossan.

The Sanu Resources Ltd website describes the area and its significance: *Eritrea offers a unique opportunity for significant discovery of greenstone shear-hosted gold and volcanogenic massive sulfide deposits in Neoproterozoic volcanic arc terranes. Eritrea contains one of the largest, under-explored prospective areas of this type remaining in the world. The high prospectivity of this geologic terrane is shown by the Mahad al Dahab (approx. 700 Koz @ 11 g/t Au) and Al Amar mines (approx. 700 Koz @ 7 g/t Au) in Saudi Arabia, Ariab district (1.3 Moz @ 8.1 g/t Au) in Sudan, and Lega-Dembi mine (approx. 1 Moz @ 2 g/t Au) in Ethiopia. The recent discovery of Nevsun's Bisha gold-copper-zinc deposit adjacent to Sanu's Kerkebet license reinforces this prospectivity.*

This short course drew unreserved positive feedback. The Eritrean geologists are very competent but they have very little experience or formal training in VHMS geology.

There are enormous opportunities for further research and mineral exploration in Eritrea. It is under-explored territory, especially the Neoproterozoic basement rocks, and offers significant potential for success in mineral exploration.

Bruce and Jocelyn would like to extend their thanks to their principal hosts, Demetrius Pohl and Estephanos Ogbazghi, both from Sanu Resources, and Mengist Teklay, from the University of Asmara.

***Participants in the short course on volcanology and VHMS deposits, presented by Bruce Gemmell and Jocelyn McPhie at the University of Asmara, Eritrea.***

***Bruce Gemmell, lecturing to a very attentive audience comprising exploration geologists, survey geologists and university staff and students.***

***Bruce, Jocelyn and course participants in the field at Adi-Nefas prospect, north of Asmara.***

***Mengist Teklay (University of Asmara, left), Demetrius Pohl (Sanu Resources, centre left), Estephanos Ogbazghi (Sanu Resources, right) organised and hosted the short course.***

# IN THE FOOTPRINTS OF GIANTS

A new CODES research initiative to study sediment-hosted gold systems is gaining momentum. The three-year study will investigate variations in the level of trace-element and gold enrichment in sulfides in the host successions to major sediment-hosted gold deposits in Nevada, Victoria and Siberia. The study will include some of the largest gold deposits in the world, including the 2000 t Au Post-Betze-Screamer in the Carlin district, NE Nevada (pictured) and the Bendigo goldfield in central Victoria, which has combined production and reserves exceeding 900 t Au. Through collaboration with Professor Valeriy Maslennikov from the Russian Academy of Sciences, Miass, the researchers also hope to again access to another giant, Sukhoi Log, a large black-shale-hosted deposit in Siberia (approx. 1500 t Au). To date, four companies (Barrick, Newcrest, Newmont and Placer Dome) have agreed to support the study and CODES is actively seeking further industry sponsors.

***Post-Betze-Screamer deposit, northern Carlin trend, NE Nevada. Photo: Poul Emsbo (USGS)***

The research will capitalise on recent advances in laser ablation mass spectrometry pioneered at CODES that allow low-level quantitative analysis of over 40 trace elements in sulfides with spatial resolution down to 5 microns. Variations in gold and other trace metals in sulfides, as well as their lead and sulfur isotopic compositions, will be used to investigate local and district-scale zonation around sediment-hosted gold deposits. Sulfides (particularly pyrite and arsenopyrite) are minor to locally abundant components of gold ores and the related alteration mineral assemblages. Pyrite is also widespread within the sedimentary host rocks to many of the deposits as a syn-sedimentary or diagenetic phase. By stepping out from the deposit margins, across the adjacent haloes of hydrothermally altered rock and into the surrounding country rocks, the researchers hope to identify changes in the chemistry or isotopic composition of the sulfides that reliably indicate proximity to ore. Low-level trace-element analysis of sulfides by laser ablation ICPMS enables detection of subtle enrichments (and depletions) of particular diagnostic trace elements that are strongly partitioned into sulfides where total sulfide abundances are too low for anomalies to be apparent in whole-rock geochemical data. Accordingly, this method has the potential to significantly expand the recognised dimensions of the deposit footprints. The micro-analytical work will be integrated with whole-rock geochemical, structural and stratigraphic studies of the deposits and their host successions.

An important component of the research will be to investigate the extent to which pre-concentration of gold within the host rocks is a factor in the formation of epigenetic deposits. Recently, USGS geologist Dr Poul Emsbo and co-workers have recognised syngenetic gold-pyrite mineralisation within the Palaeozoic sedimentary rocks that host the younger (middle Tertiary) world-class 'Carlin-type' carbonate-replacement deposits. The spatial coincidence of these contrasting styles of gold mineralisation is intriguing. It may simply be a coincidence or it could reflect episodic tapping of a common gold source at depth. It is also possible that a significant proportion of the gold concentrated in the younger Carlin-type deposits was recycled from the immediate host-rocks. The latter has clear implications for exploration, as it suggests identifying and tracking the horizons of syngenetic gold enrichment may be a powerful means of targeting areas with the greatest potential for economic gold accumulations. The CODES team will work with Dr Emsbo and local industry geologists to better constrain the extent of gold enrichment within the host succession to the Carlin deposits, and determine whether there is any systematic relation to the distribution of the known Carlin-type deposits.

**For further information contact: Ross Large <Ross.Large@utas.edu.au> or Robert Scott <Robert.Scott@utas.edu.au>.**

## PhD SUBMISSIONS

Congratulations to Neil Martin, Andrew Wurst, Kieren Howard, James Cannell and Tony Webster who have submitted their PhDs, and to Christian Schaardt who was recently awarded his PhD.

## MT BISCHOFF PhD SCHOLARSHIP

CODES is proud to announce a scholarship for a PhD project on the Mt Bischoff tin deposit, western Tasmania. This project will consider the geochemical, physical and microbiological controls on zinc mobility and implications for bio-remediation strategies in an acid mine drainage system in western Tasmania. The scholarship is worth $23,556 per annum (tax free).

*Acid drainage at Mt Bischoff.*

Supervisors of the project are Dr David Cooke, Dr Garry Davidson, Dr James Reid (CODES) and Dr John Bowman (School of Agricultural Science).

The Mt Bischoff tin deposit was the first major mineral discovery in western Tasmania (1871). The site had a protracted mining history, until the extraction of tin ores by open pit and underground mining methods ceased in 1978. The principal legacy of this historic mining activity has been a significant acid drainage pollution problem. With respect to toxicity, zinc is the primary pollutant emanating from the Mt Bischoff site, with copper, arsenic, aluminium and iron also significant contaminants. It is estimated that an order of magnitude reduction in zinc concentration would be required to improve biodiversity in the local receiving waters. An unexpected outcome of the protracted period of abandonment of the site has been the establishment of a natural aquatic ecosystem that is thriving in the heavy metal-contaminated and strongly acidic (pH ~2) mine drainage waters. This biological community is growing on a substrate of secondary Fe-oxyhydroxide precipitates including arsenian jarosite, and the biota appear to have potential for natural biofixation of trace metals into the sediment substrate.

This PhD project will investigate the potential for natural bioremediation using these *in situ* microbial communities to ameliorate acid and high zinc and other metal loads at Mt Bischoff. Controlled laboratory experiments will seek to optimise the precipitation of zinc and other heavy metals across a range of pH, carbon sources, and water activities. The geochemical and microbiological processes controlling loads of zinc and other metal contaminants will be assessed under a range of climatic conditions, including wet, dry, and storm flow events, to inform remediation strategies. A high-acid, high-metal site will be compared with a near-neutral, high-metal site within the Mt Bischoff complex in order to evaluate the mobility of Zn under different geochemical and microbiological regimes, and to assess the transferability of bioremediation technologies. A hydrogeological and geophysical survey will also be conducted to evaluate the sources and extent of surface and shallow subsurface mine drainage on the site.

**For more details contact: Dr David Cooke <d.cooke@utas.edu.au>, phone +61 3 6226 7605, fax: +61 3 6226 7662.**

# Peperites and perspiration in Portugal

Associate Professor Jocelyn McPhie was a guest of the University of Lisbon, Portugal, from 16 to 30 July. The purpose of the trip was to supervise CODES PhD student Carlos (Cazé) Rosa in the field and also to run a field workshop that involved the University of Lisbon, INETI (the Portuguese Geological Survey), geologists from the University of Huelva in Spain and Clive Boulter from the University of Southampton, UK.

The field trip provided an opportunity to present the results of Cazé's PhD research on the volcanology of the Iberian Pyrite Belt in Portugal. This project is generously supported by both INETI and the University of Lisbon and is of considerable interest to researchers working on the Iberian Pyrite Belt in Portugal and Spain. Another purpose was to discuss some very controversial outcrops of sediment-matrix breccia, some of which have been interpreted to be peperite. The trip, undertaken during a heat wave (temperatures up to 45°C during the day and not falling much below 35° at night), was very successful and provided the catalyst for some vigorous discussion at a meeting held at the University of Lisbon after the field trip. Clive Boulter presented results of his work in the Rio Tinto area in Spain, Cazé discussed the findings of his PhD studies and Jocelyn gave an overview of peperite and false-peperite and their significance in the Iberian Pyrite Belt.

Cazé is currently finishing his final field season in Portugal before returning to CODES where he will concentrate on writing up his thesis. His project is under the umbrella of a large research project called *Archimedes*, led by Fernando Barriga and Jorge Relvas, both from the University of Lisbon. Archimedes focuses on the massive sulfide deposits of the Iberian Pyrite Belt and is funded by the Portuguese Science and Technology Fund.

Jocelyn went straight on to Eritrea after this trip. See elsewhere in this edition of *Ore Solutions* for more about that story.

***Cazé (Carlos) Rosa explaining the formation of* in situ *hyaloclastite at Albernoa in the Iberian Pyrite Belt, Portugal.***

# 24 carat Au Workshop Review

CODES hosted an international workshop, *24 Carat Gold*, in June 2004, supported by the Minerals Council of Australia (MCA). There was excellent feedback from the 111 attendees, some of whom came from such far-flung places as Canada, USA, Philippines, Indonesia and Ghana.

Thirteen of the participants undertook the workshop as part of the Masters in Economic Geology degree, including four students from UWA doing the course under the National Masters umbrella.

Nine lucky participants took part in the pre-workshop field trip which visited Mount Lyell and Rosebery mines and went underground at Henty. They also enjoyed a night at the Cradle Mountain Lodge. Trip leaders Ross Large and Kim Denwer provided in-depth information about the geology of western Tasmania, with deposit descriptions from industry geologists Andrew McNeil and Don Macansh.

The workshop presenters gave a range of up-to-date, informative talks about a variety of styles of gold mineralisation including lode Au, porphyry Cu-Au, low sulfidation epithermal Au, VHMS Au, high sulfidation epithermal Au and carbonate replacement Au. In addition to a bevy of world-class international speakers, past CODES graduates Andrew Davies, Alan Wilson and Adrian Byass gave presentations. Workshop participant John Walsh asked lots of challenging questions and prompted considerable discussion to supplement the talks.

Dinner at the Wrest Point Casino was sensational, made more enjoyable by MC Andrew Tunks making a very public but no doubt false confession. Ross Large, President of the Society of Economic Geologists (SEG), gave a stirring after-dinner speech ('I had a dream') about his vision of an industry unaffected by the metal-price cycle and how good it would be to see everyone in full employment and geologists in demand. A transcript of this talk was published in the July SEG newsletter.

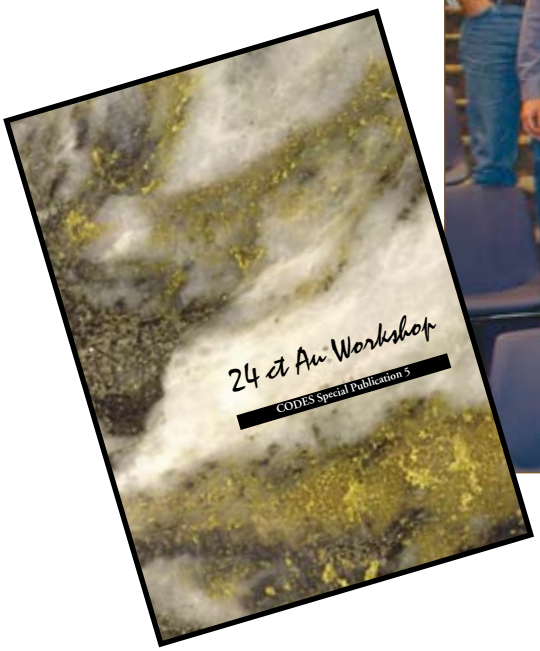
If you missed this workshop, 13 of the one-hour keynote presentations from selected industry and academic specialists have been published in *24 Carat Gold – CODES Special Publication 5*. The presentations addressed the following issues:

- Characteristics of a hydrothermal gold deposit type
- Anatomy of a giant gold deposit discovery.

Seven of the papers contained within this volume summarise the characteristics and origins of gold deposits: lode gold (Robert), porphyry copper-gold (Cooke), low and intermediate sulfidation epithermal gold (Gemmell), volcanic-hosted massive sulfide gold (Hannington), high sulfidation epithermal gold (Hedenquist), gold skarns (Meinert) and Carlin-type gold (Cline). There is also one overview paper on the structural architecture of porphyry and epithermal deposits (Tosdal). Five papers deal with the anatomy of giant ore deposit discoveries, and characteristics of those deposits (Tarkwa/Damang–Tunks; Oyu Tolgoi–Ivanhoe Mines; Kelian–Davies; La Ronde–Gosselin; Pueblo Viejo–Kesler). This volume also contains papers summarising the characteristics of four deposits discussed in the exploration forums: Cadia Quarry (Wilson), Teresa and Victoria (Garcia), Golden Grove (Pring) and Martabe (Levet).

The volume, edited by David R. Cooke, Cari Deyell and June Pongratz, is available for $AUD75.00 each (plus postage, packing and GST).

To obtain copies of this book, please email <publications@codes.utas.edu.au> or go to the CODES website Publications page <www.codes.utas.edu.au> to download the order form.




***Speakers at the 24 ct Au workshop. Back row (L to R): Andrew Tunks, Doug Kirwin, Dick Tosdal; fifth row: Alan Wilson,Peter Pring; fourth row: Mark Hannington, Brian Levett, Guy Gosselin, David Cooke; third row: Noel White, Francois Robert, second row: Bruce Gemmell, Steve Kesler, Larry Meinert, Joey Garcia; front row: Jeff Hedenquist, Andrew Davies, Jean Cline.***

# A 'GeM' of a Project

As reported in the previous edition of *Ore Solutions*, CODES is developing a new research theme in the area of ore deposit characterisation. This will address the cross-discipline interface between geology, mining and mineral extraction. Dr Steve Walters is leading the project development and reports that significant progress has been made. The most important development has been the establishment of a formal collaboration between CODES and the Julius Kruttschnitt Mineral Research Centre (JKMRC), University of Queensland. JKMRC is widely recognised as a world leader in mining and mineral processing research and this is the first time the two high-profile groups have worked together. According to Steve, given the nature of the challenge, the first aspect to address was genuine cross discipline collaboration between the major research providers.


JKMRC, led by Professor Tim Napier-Munn and CODES, have been working closely together to develop a major new research initiative. This has emerged as the GeM$^{III}$ Project — Geometallurgical Mapping and Mine Modelling — which is being coordinated by AMIRA (P843). GeM$^{III}$ will address new approaches to the definition of mineralogy, element deportment and texture linked to process performance testing. The aim is to create new attributes that can be embedded in current block models, which more closely reflect true economic value and optimal mineral extraction parameters. This is likely to involve new automated approaches to core logging: integrated use of automated micro-analytical techniques; mineral mapping techniques including SEM-based, electron microprobe and laser ablation ICP-MS instruments; and mathematical classification of textures linked to processing performance.

JKMRC Director Professor Tim Napier-Munn warmly welcomed the dialogue between CODES and the JKMRC over the GeM$^{III}$ project. 'We had for some time been working on a strategy to develop our Mine-to-Mill methodology beyond the prediction and optimisation of fragmentation in the mine', he said. 'The geological connection proved to be the missing link, and we were delighted to find kindred spirits in the CODES group who could teach us much about the value and application of the geologist's approach to rock and ore classification'.

Prof. Napier-Munn said that the skills and resources of the two groups were complementary, and the synergy very strong. GeM$^{III}$ was seeking nothing less than a paradigm change in the way mining companies optimise minesite performance, through improved mine planning and scheduling using new orebody attributes. In coming together to conduct the GEM research, he felt that CODES and the JKMRC, together with the JK's sister groups in UQ's Sustainable Minerals Institute, would be able to drive both the science and the implementation necessary to deliver the new paradigm to the industry.

Project development has included extensive consultation with industry. This has involved discussions with over 20 companies in Australia, South Africa and North America. The feedback is being used to define key research activities and required outcomes within the project. The work culminated recently in a two-day workshop in Brisbane including members of JKMRC and CODES. The AMIRA P843 GeM$^{III}$ proposal will be forwarded to potential sponsors in late September, with expectations of a high level of support.

It is hoped that a successful outcome will lead to a long-term collaborative 'platform' for geometallurgical research that delivers a number of projects to the industry. An important aspect of this vision includes the provision of education and training that breaks down the current cross-discipline divides within the mining industry and inspires the next generation of more multi-skilled mining professionals.

**For more details contact: Dr Steve Walters <Steve.Walters@utas.edu.au>, phone +61 3 6226 2804.**

# Lao PDR: Land of mountains and gold

Work continues on the ARC Linkage Project entitled 'Geochronology, metallogenesis and deposit styles in the Loei Fold Belt of Thailand and Lao PDR', supported by its three industry partners, Kingsgate, Oxiana and Pan Australian. Extensive field work on the Thailand segment of the Loei Belt was completed earlier this year (*Ore Solutions*, CODES Newsletter 16, June 2004).

The studies continued with a visit to the Phu Kham deposit in central Laos led by Khin Zaw, Senior Research Fellow, involving Sebastien Meffre and student Derek Backhouse. Dr Ralph Child, General Manager–Geology, of Pan Australian, organised the trip, including the special working entry visas the research team required for the project in Laos.

The field trip began at Vientiane, the capital city of Laos, with the help of personnel from Pan Australian. Laos is a densely forested, mountainous country with breathtaking scenery. The country has only 5.4 million people and a population density of 23/km$^2$, one of the lowest in Asia (second only to Mongolia).

The Phu Kham Cu-Au deposit is located in dense rainforest in a sparsely populated region. The trip was very interesting because the group travelled in a 4WD convoy under army escort. The deposit, whose name means 'mountain of gold' in Laos, is located in the heartland of the Hmong homeland near the notorious Long Chieng airfield where American bombers operated in the late 60s and early 70s. The deposit, currently undergoing feasibility studies, consists of a deep oxide gold cap on top of a porphyry and skarn style deposit.

The friendly company geologists and camp staff provided a great deal of assistance and made for a pleasant visit at the picturesque exploration camp. The trip culminated with drinking Beer Lao on the banks of the Mekong River in Vientiane.

Special thanks go to Nick Tate, John Poulsen and Sisouphane Thadavong.

To provide some background information, the Mekong River is the tenth longest in the world and forms an 1800 km-long border with Thailand. The Australian Government funded and built the Mekong River Bridge ('Friendship Bridge') that was completed in 1994 to link Vientiane and Nong Khai in NE Thailand.



*Phu Kham visit, from left: Sebastian Meffre, Khin Zaw, armed guard, Nick Tate and Derek Backhouse.*

*Happy field workers at the Sepon Mine, Laos, from left: Paul Cromie, Bounoum Bouttathep, Khin Zaw, Dan Oldberg, Doug Morris and Stuart Smith.*

This field trip provided a regional metallogenic understanding of the Loei Belt for the CODES research team, and preliminary geochronological work by the team is already changing the conceptual and genetic models for the Phu Kham deposit. Further field work at Phu Kham is planned for 2005 involving other team members, Wally Herrmann, Anthony Harris and a PhD student.

After the Phu Kham visit, Khin Zaw went on to Sepon to supervise Paul Cromie, a PhD student working on the geological setting and mineralisation characteristics of the gold and copper deposits in the Sepon Mineral District (SMD) at the western part of the Lao PDR, near the border of Vietnam. This project is being undertaken on a one-to-one basis with Oxiana Limited. The SMD occurs along the NW-trending Truongson Fold Belt in Savannakhet Province, southeastern Lao. Four broad alteration/mineralisation styles are recognised in the SMD: quartz stockwork; porphyry Mo, Cu-Au skarn; Cu-Au carbonate replacement and sediment-hosted Au.

Khin Zaw's Sepon trip was made possible with the help of Antony Manini, General Manager–Exploration and Resources, Oxiana Limited. The trip began with a one-day short course given by Khin Zaw and Paul Cromie to local Laotian and expatriate geologists at a mine site, focusing on the characteristics and exploration significance of sediment-hosted gold deposits with examples from Nevada, China and SE Asia.

Intensive exploration programs in the SMD conducted by CRA/Rio Tinto (1993–99) and Oxiana Limited (2000–03) resulted in the discovery of a new mineral field containing 4.1 million ounces of gold and 1.2 million tonnes of contained copper. The SMD represents one of the largest repositories of copper and gold in SE Asia.

The deposit is near the Ho Chi Min Trail in Laos, the most bombed nation on Earth. During the Indochina war the Lao PDR was subjected to both ground assault and aerial bombing. A total of 580,344 bombing missions were launched and more than two million tonnes of ordnance was dropped. This equates to one planeload of bombs being dropped every eight minutes for nine years. For this reason, unexploded ordnance (UXO) can be a problem for mining companies. Oxiana and previous owner CRA/Rio Tinto easily and efficiently manage UXO: during almost 12 years of exploration and mining there have been no UXO-related incidents in the SMD. Their simple rules are effective: if you find any UXO in the field don't touch it, put a yellow marker near it and immediately report it to the UXO officer.

The trip to Sepon would not have been as fruitful without the intellectual input and heated discussions at the Sepon mine site with previous CODES graduates, Stuart Smith, Dan Oldberg, Doug Morris (consultant) and Laotian geologists with their excellent local knowledge.

The trip to Laos also allowed Khin Zaw to meet Mr Jonathan Thwaites, Australian Ambassador, Mr Thongphath Inthavong, Acting Director General of Department of Geology and Mines, and Mr Souksavanh Sinouvong, Head of Mine Division, Polytechnic School in Vientiane, to discuss further collaborative research and training of Laotian personnel. Mr Sinouvong mentioned that Laos has a severe shortage of locally trained staff for the exploration and mining sector.

# A Word from the SEG Student Chapter

***Guest speaker: Mike Solomon.***

The UTAS Student Chapter of the Society of Economic Geologists hosted a wine tasting on 16 June to mark the end of the *24 Carat Gold* Workshop. The evening was attended by 70 people and was a tremendous success. Stuart Bull was master of ceremonies for the evening and Mike Solomon was our well-received guest speaker. As well as providing a forum for conference delegates to reflect on the recent three day workshop, the evening also provided the wine connoisseurs with a chance to test their knowledge; the mystery wines competition was presided over by Stuart Bull and won by François Robert. It must be noted that there were some very willing participants.

Six members of the student chapter will be attending the SEG *Predictive Mineral Discovery Under Cover* conference in Perth, WA (27 September to 1 October). As well as presenting posters, the members will attend a mentoring event as part of the conference social program. A report on this event will feature in the next edition of *Ore Solutions*.

***Winner of the mystery wines competition: François Robert.***

Following the success of the *Tassie Tiger Geo-explorer* tour in February, plans are being made for a Chapter excursion in mid 2005. Suggestions so far include the Northern Territory or New Zealand and it is intended that other SEG student chapters (from Australia and abroad) be involved.

Closer to home, a weekend retreat (possibly in conjunction with the UTAS Student Geology Club) is also being planned. Activities for this weekend are likely to include prospecting or caving, as well as the obligatory socialising.

An end-of-year dinner (in either late November or early December) is also in the preliminary stages of organisation.

Bryan Bowden, President
SEG Student Chapter, University of Tasmania

# Exciting Drill Intersection at Elliott Bay

TasGold, a local junior exploration company, has recently announced a significant massive sulfide intersection at the Wart Hill prospect in the Mount Read Volcanics at Elliott Bay in southwest Tasmania. The diamond drill intersection was 3.9 m at 12.1% Zn, 7.3% Pb, 124 g/t Ag and 0.6 g/t Au, and is the best drill intersection ever recovered in the southern part of the Mount Read Volcanics, 90 km south of Mount Lyell.


CODES staff Ross Large and Wally Herrmann have had a long association with the Elliott Bay area since the late 1970s. Ross, while working as the Supervising Geologist for Geopeko, was the first to map and recognise the significance of the altered volcanics in the Wart Hill area. This resulted in detailed geochemical and geophysical surveys being conducted by Geopeko in the early 1980s and the discovery of surface lenses of base-metal-rich massive sulfides at Voyager 19. Subsequent geological, geochemical and Pb-isotope research was written up as a exploration case study of the Elliott Bay area for publication in *Economic Geology* (Large, Herrmann and Corbett, 1987; Gulson, Large and Porritt, 1987). Drilling at Wart Hill by Geopeko and subsequently Cyprus minerals failed to find a significant VHMS deposit, however the area was considered to hold considerable potential and a number of student research projects were carried out in the mid to late 1980s by the team from University of Tasmania (Lea, 1985; Callaghan, 1989; Garrett, 1989). These studies suggested that the small massive sulfide lenses exposed at surface were rafts within a sequence of rhyolitic mass flow volcaniclastics, and that the source VHMS deposit remained undiscovered. The latest hole by TasGold has revealed the best intersection to date, and opens the door for a significant massive sulfide discovery. CODES researchers are once more involved, with an honours student, Nate Allen, studying the various styles of alteration at Wart Hill and the gold prospect to the south at Sassy Creek (Voyager 24).

***Looking south from the top of Wart Hill.***


Callaghan, T. J., 1989, Structure and mineralisation of the Wart hill prospect. Unpublished BSc (Hons) thesis, University of Tasmania.

Garrett, S. D., 1989, Geology and gold drainage geochemistry of the Lewis River volcanics, Elliott Bay, SW Tasmania. Unpublished BSc (Hons) thesis, University of Tasmania.

Gulson, B.L., Large, R.R., & Porritt, P.M., 1987. Base metal exploration of the Mount Read Volcanics, western Tasmania: Pt. III Application of isotopes at Elliott Bay. *Economic Geology*, v. 82, p. 308-327.

Large, R.R., Herrmann, W. & Corbett, K.D., 1987. Geology and exploration of the Mount Read Volcanics: Pt. I Elliott Bay, southwest Tasmania. *Economic Geology*, v. 82, p. 267-290.

Lea, J. A., 1985, The geology and mineralisation of the Wart Hill area.


## News for international PhD applicants

**CODES, at the University of Tasmania, is a world leader in ore deposit research and plans to expand its efforts in the PhD area by attracting the next generation of leaders in Economic Geology research. To facilitate this, CODES is offering four new scholarships to international students to attract top quality PhD candidates to our program.**

**These scholarships will be flexible and may be used to cover living allowances or international student fees depending on the project you wish to pursue.**

**To take advantage of this opportunity you should:**

**1. Review our list of PhD projects on our website <www.codes.utas.edu.au/Courses and Training/Education Programs/PhD Projects.**

**2. Download the PhD Application Form. If you have difficulty downloading the form, please email <Andrew.Tunks@utas.edu.au> and he will email a copy of the form to you.**

**3. Fill in the application form and fax it to the Director of CODES, Professor Ross Large, on +61 3 6226 7662.**

**Please provide the full contact details (preferably email addresses) of your referees so we can contact them as soon as possible.**

**Good luck with your application and we hope to welcome you to CODES in the near future.**

INTERNATIONALLY-RENOWNED

**CODES/SCHOOL OF EARTH SCIENCES**
**INDUSTRY-RELATED PhD PROJECTS**
**WITH SCHOLARSHIPS**

### Geology and geochemistry of the footwall phyllite, Greens Creek VHMS deposit, Alaska

The aims of this PhD project are to characterise the geologic and structural setting of the footwall phyllite and associated lithologies; architecture of the footwall phyllite and its relationship to massive sulfide formation; describe the alteration mineralogy, assemblages and textures; and determine the geochemical (major and trace elements) characteristics and signature of the footwall phyllite. The industry partner is Kennecott Greens Creek Mining Company.

### Geologic, genetic and exploration implications of syndeformational, structurally-controlled, sediment-hosted copper deposits: Investigation of the Mt Oxide deposit, Queensland

This PhD project will apply geological and geochemical methods to investigate the stratigraphy, structure, mineralogy and fluid geochemistry of the Mt Oxide deposit. This information will be used to develop a genetic model for the deposit, and criteria for further exploration. The industry partner is Perilya Limited.

### Mineralised and barren lithocaps from the SW Pacific and the South American Andes

This PhD project will involve geological and structural mapping of alteration domains in selected lithocap environments. Detailed mineralogical and geochemical investigations will be used to help discriminate between barren lithocaps and those associated with high-grade porphyry and epithermal ore. This project is funded through AMIRA project P765 – *Transitions and zoning in porphyry-epithermal districts: transitions, discriminators and vectors.*

### Peripheral mineral deposits and propylitic alteration surrounding the Batu Hijau porphyry Cu-Au deposit, Sumbawa, Indonesia

This PhD project will investigate the mineralogy, mineral chemistry and whole-rock geochemistry of the propylitic alteration, as well as investigating the district scale mineral deposit/prospect zonation surrounding the Batu Hijau porphyry Cu-Au deposit, Indonesia. This project is funded through AMIRA project P765 – *Transitions and zoning in porphyry-epithermal districts: transitions, discriminators and vectors.*

### Geophysical characterisation of altered rocks within porphyry-epithermal mineral districts

This PhD project will investigate the detailed petrophysical and geophysical properties of altered rocks from selected porphyry and epithermal mineral districts in the SW Pacific and the South American Andes, based on detailed field surveys and laboratory analysis. This project is funded through AMIRA project P765 – *Transitions and zoning in porphyry-epithermal districts: transitions, discriminators and vectors.*

**Applicants for the above five projects should possess a strong (I or 2A) honours degree in geology, geochemistry or geophysics. Tax-free stipends of $23,000 per annum plus a relocation allowance of up to $2000 are available for the successful candidates, along with support for fieldwork, laboratory analyses and travel.**

**Enquiries and application form requests to:**
**Associate Professor J. Bruce Gemmell on (03) 6226 2893 or e-mail bruce.gemmell@utas.edu.au or Dr David Cooke on (03) 6226 7605 or e-mail D.Cooke@utas.edu.au**

CODES SRC

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# Next generation recruitment tool

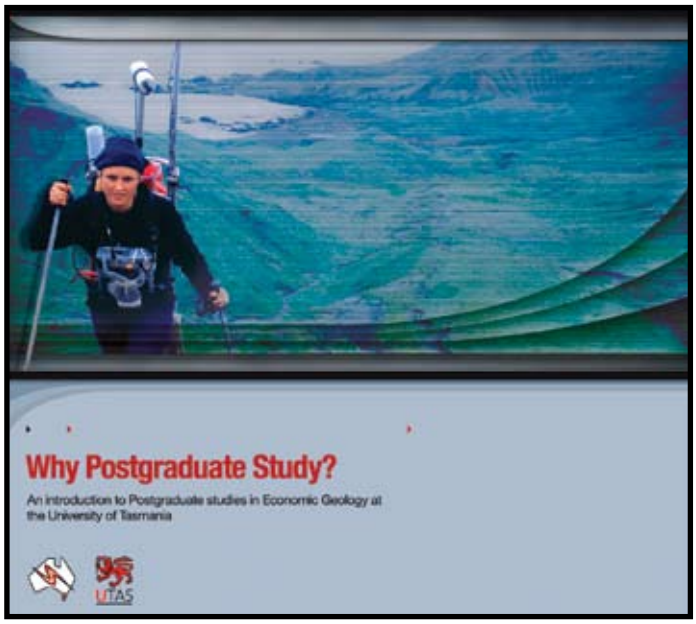
Late September will see the release of our newest recruitment tool: a one-stop-shop CD-ROM to advertise our Masters and PhD courses. It includes interviews with previous students and our world-class research staff, information about courses and scholarships and application forms — all bundled into the ultimate convenience of a CD. The format provides simple, easy-to-follow interactive screens, and addresses the four main reasons people choose to undertake post-graduate studies: for their professional development, to provide a change and explore different career options, to focus on pure research, and to enjoy a lifestyle change by moving to Tasmania.

Did you know that:
- almost all management positions in the mining industry are held by people with post-graduate qualifications?
- all CODES' 2003 PhD graduates who sought employment in the exploration industry were successful?
- research at CODES is grounded in industry-relevant science, supported by industry and government sponsors?

The variety of information on this CD reinforces the message that post-graduate study at CODES allows you to ***Focus*** on pure research, ***Grow*** as you undertake professional development, ***Expand*** your personal and professional experiences and ***Change*** your lifestyle by studying in Australia's wilderness island state, Tasmania.

The CD follows the success of the *Why Earth Science* CD which has been used over the past two years to attract first-year student enrolments.

Copies of the CD will be available in late September 2004. To register your interest in receiving a copy of this CD contact Andrew Tunks <Andrew.Tunks@utas.edu.au>.



# CODES SHORT COURSE PROGRAM

## Brownfields Exploration

**8–19 November 2004**

Exploration in data-rich environments close to existing mines has become the preferred method of increasing company resources over the last several years. With this change in exploration philosophy in mind, CODES is proud to announce a new Masters-level short course that is designed to bring students up to date with the latest techniques. The course will cover cutting-edge technologies in geophysics, geochemistry and 3D visualisation and will use real data from world class mineralised districts. Expert teaching staff are drawn from both within CODES and within industry to deliver a high-quality learning experience. Students will have access to their own PC with advanced 3D viewing software to manipulate the data as they choose. This, however, means that numbers are strictly limited.

Don't miss the opportunity to secure your place.
Contact: Andrew Tunks <Andrew.Tunks@utas.edu.au>, phone +61 3 6226 2374.

The Brownfields Exploration course is offered as part of the National Masters Program in Mineral Exploration and Mining Geology.

For more information about this short course or about the National Masters Program, see the CODES website <www.codes.utas.edu.au>.

*Ore Solutions banner: The glassy groundmass of this quartz latite exhibits classical perlitic fractures comprising intersecting and overlapping arcuate cracks. Amygdales are filled with zeolites. Wereldsend Formation, Etendeka, Namibia.*

***Elvis' #1 fan, Jocelyn McPhie, in Asmara, Eritrea.***

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