

# ore solutions

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



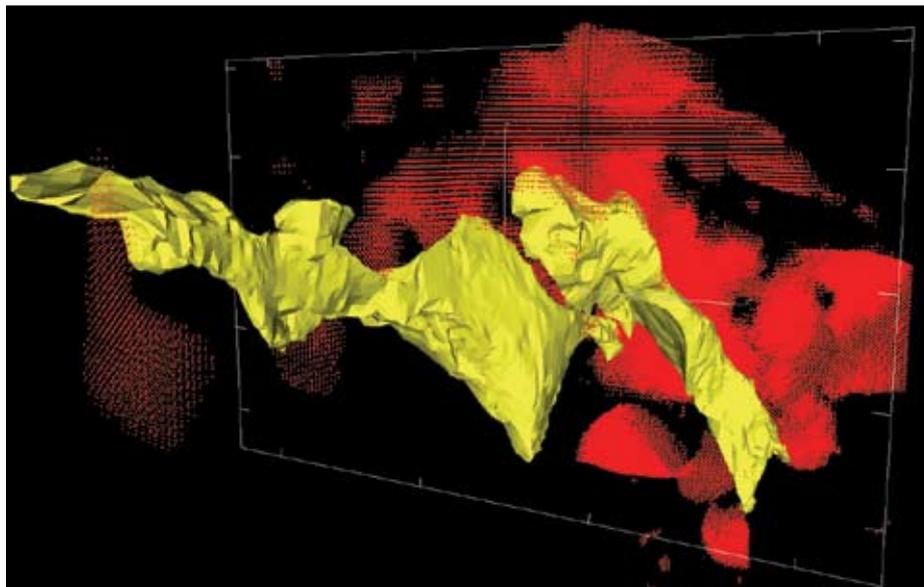
## CODES 'ore deposit characterisation' research initiative

CODES has engaged Dr Steve Walters to develop a new research strand in the area of 'ore deposit characterisation' – the interface between exploration, mine scale geology and mineral processing. This interface is widely recognised as a cross-discipline divide that is not adequately addressed by current research and teaching initiatives. This new research will further support CODES in developing its strategic plan for new research initiatives to support the Centre of Excellence bid to be submitted in late 2004.

Dr Steve Walters reports that meetings are underway with company in-house and research-based centres of mineral processing expertise to assess current trends in geometallurgy and identify key areas for collaboration. Several areas with the potential for cross-discipline breakthroughs have already been highlighted. These include pragmatic application of the emerging capabilities for 3D common earth modelling that can be extended to integration of mineral processing data; and more widespread adoption of automated mineralogy technologies such as SEM-based QemSCAN or MLA in economic geology research.

Initial feedback from the mining industry confirms there is significant company support for new ore deposit characterisation research initiatives. There is also a longer-term vision to elevate 'geometallurgy' into a formalised discipline with a dedicated undergraduate degree course.

CODES has the potential to become a key global player in this emerging discipline, which would extend its



Ore deposit model of Hellyer VHMS (yellow) showing the distribution of fuchsite in the hangingwall (red).

currently recognised capabilities. Expressions of interest are invited from any groups in the mining and exploration industries that would like to be included in this ongoing process of consultation. If you are interested in new research initiatives that intend to:

- take an end-to-end approach to exploration, mining and processing
- foster cross discipline collaboration in the emerging area of geometallurgy
- provide more effective methods of using and integrating existing mine-based data
- give companies access to multi-disciplinary experienced research teams that can be used in a short-term task force type approach for mine-scale problem solving, contact either:

Dr Steve Walters on phone: +61 3 6226 1863, email: [steve.walters@utas.edu.au](mailto:steve.walters@utas.edu.au) or Prof. Ross Large on phone: +61 3 6226 2819, email: [ross.large@utas.edu.au](mailto:ross.large@utas.edu.au)

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We welcome Dr **Steve Walters** to CODES. Steve has joined the team as Adjunct Associate Professor and is developing a potential new core program that aims to address the interface between regional geology, mine geology and mineral processing. The emerging discipline of 'ore deposit characterisation' represents a cross-discipline challenge with direct economic relevance. See the article in this issue 'New Research Initiative'.

Many of you will know Steve from the work he has done as a presenter at CODES workshops and seminars. He is an experienced industry geologist with applied research and consultancy skills. Steve is internationally recognised for his study and exploration of complex Broken Hill-type deposits and served as the SEG International Exchange Lecturer for 2001-2002. He is a direct communicator with a large network of industry contacts who can provide a pragmatic perspective on industry trends and needs.

We farewell **Kylie Kapeller**, PA to the Ross Large for the last 12 months, who has transferred to the UTAS Launceston campus. She has been promoted to Faculty Officer in the Faculty of Arts.

Dr **Andrew Tunks** was recently awarded a 2003 Teaching Merit Certificate by the Teaching and Learning Committee in recognition of his teaching at the University of Tasmania.

Associate Professor **Bruce Gemmell** has been appointed to the Editorial Board of *Mineralium Deposita* for a three-year term beginning in mid 2004.

Congratulation to Dr **Alan Wilson** who has been awarded the *Dean's Commendation Award for Outstanding Doctoral Theses*. This highly prestigious award has nominations based on the following criteria — reference by both external examiners to the level of excellence attained and reference to the explicit and substantial contribution that has been made to the field of research.

Alan's thesis title is 'The geology, genesis and exploration context of the Cadia gold-copper porphyry deposits, New South Wales, Australia'.

## New UTAS Logo

You may have noticed a new UTAS logo on the front cover of this edition of *Ore Solutions*. The University of Tasmania has developed a new branding model to communicate the University's brand values, some of which are: strategic partnerships, a nationally distinctive, world-class reputation, achieving excellence, global perspectives — values that CODES has already attained and strives to maintain. The contemporary, up-beat logo incorporates the State lion from the University coat of arms and links it with the UTAS marketing label.



## Devilishly popular CODES in Toronto

PDAC 2004—Prospectors and Developers Association of Canada—International Convention, Trade Show and Investors Exchange

CODES was well represented at PDAC 2004 in Toronto, Canada, with our very animated Director, Ross Large, Dr Steve Walters, student Tim Ireland, and an assortment of inanimate Tasmanian wildlife in attendance. The CODES booth, with its prime position near the Royal Canadian Mounted Police booth, attracted a steady stream of visitors.

Attention-getters at our booth included a selection of CODES' excellent publications, posters, a competition to guess the grade of a sample of Tasmanian ore, and the ever-popular toys: a Tasmanian devil, wombat, platypus and kangaroo.

The winner of the competition was Christy Campbell from Northwest Territories. Christy took home one of the stuffed animals and some books.

### **Erratum/clarification – A new vision of western Tasmania**

CODES would like to clarify some information contained in an article entitled 'A new vision of western Tasmania', from the last edition of this newsletter (*Ore Solutions* 15).

The article described the contribution made by CODES to a project to compile a 3D model of Tasmanian geology. The project was commissioned by Mineral Resources Tasmania (MRT). CODES researchers contributed volcanic, alteration facies and whole-rock geochemical data for the Cambrian Mount Read Volcanics in western Tasmania.

To clarify the roles played by various stakeholders in this project:

The Tasmanian 3D model was commissioned by MRT from the pmd\*CRC. Geoinformatics Exploration Australia Pty Ltd built the 3D model using data provided by pmd\*CRC, MRT and CODES about alteration and whole-rock geochemistry. Fractal Technologies provided a promotional video for the launch of the product in October 2003 and are suppliers of the software package FracSIS that demonstrates and allows analysis of the digital product to best advantage. For a copy of the 3D model package contact Geoff Green at MRT, phone 03 62338335, email [ggreen@mrt.tas.gov.au](mailto:ggreen@mrt.tas.gov.au)

# Innovative research for sediment-hosted gold deposits

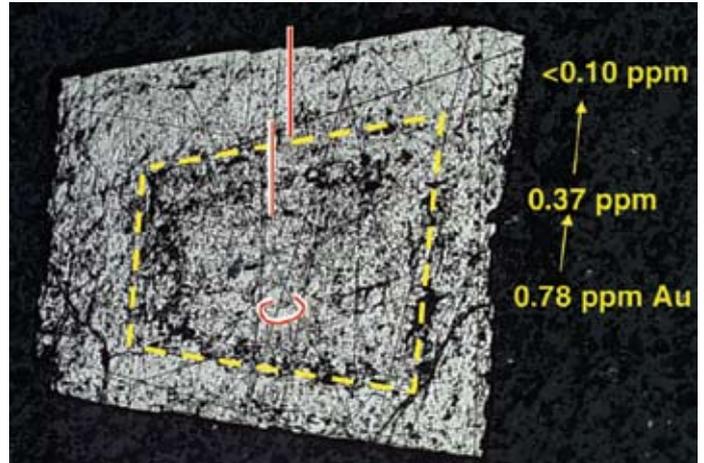
CODES is seeking sponsorship for an innovative research program into sediment-hosted gold deposits

The Victorian Goldfields have produced approximately 2500 t (80 Moz) of gold (primary and placer deposits) since mining began in the 1850s. Most of the primary deposits are hosted by fault- and fold-controlled quartz vein arrays, within late Cambrian to Devonian turbidites. The ultimate source of the gold contained within the vein arrays, however, remains the subject of considerable uncertainty. It is estimated that 80% of the total Victorian gold production, including the gold subsequently accumulated and won from placer deposits, was from vein-hosted deposits within Lower to lower Middle Ordovician black shale-bearing successions of central Victoria. Previously this strong stratigraphic control on the distribution of gold deposits has been interpreted to reflect either closer proximity to potential gold sources (at greater depth in the crust), such as the underlying Cambrian greenstones, and/or the role of reduced black shales as chemical traps promoting gold deposition. A third possibility is that the gold in the veins was actually sourced from the turbiditic host-rocks themselves.

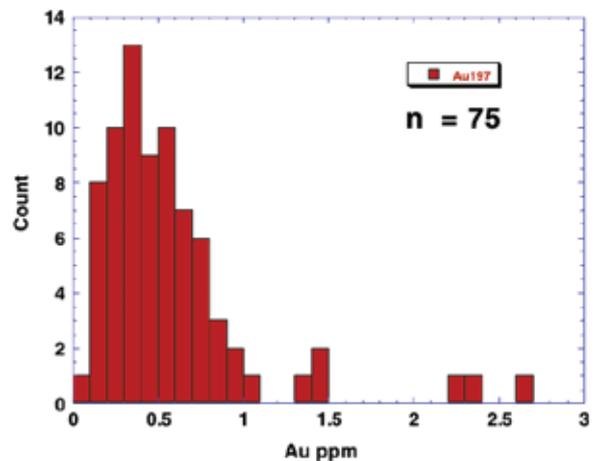
Recent research utilising the Laser Ablation ICPMS system at CODES, provides support for a host rock source for at least some of the gold in the Victorian deposits. Initial studies suggest that syn-diagenetic pyrite within the lower Ordovician black shales is enriched in gold (up to 2.7 ppm) and contains other anomalous elements including As, Bi, Sb, Pb, Te and Se (see figures, right). Dr Poul Emsbo, from the United States Geological Survey (USGS), has identified even greater gold enrichment in syn-sedimentary pyrite (up to 1000 ppm) within the host succession to the economically important Carlin-type carbonate-replacement gold deposits of northern Nevada. These results raise the possibility that pre-concentration of gold-in-pyrite by syn-sedimentary and syn-diagenetic processes may be critical to the formation of some world-class epigenetic sediment-hosted gold deposits. This has important ramifications for exploration, as it suggests that either the gross chemistry of the basin, or that of specific horizons within it, may distinguish fertile terranes from those more poorly endowed with epigenetic gold deposits.

In collaboration with Dr Poul Emsbo from the USGS we plan to undertake a detailed study of the Victorian Goldfields, the Carlin District, and one other sediment-hosted gold province to test the source bed concept and, in doing so, develop strategies useful for exploration for sediment-hosted gold deposits. The proposed research will capitalise on the recent developments in laser ablation mass spectrometry, pioneered at CODES, that enable in situ, low-level determinations of up to 40 trace elements (including gold) within sulfides. CODES is seeking ten industry sponsors at AUD\$25,000 per annum to support the research.

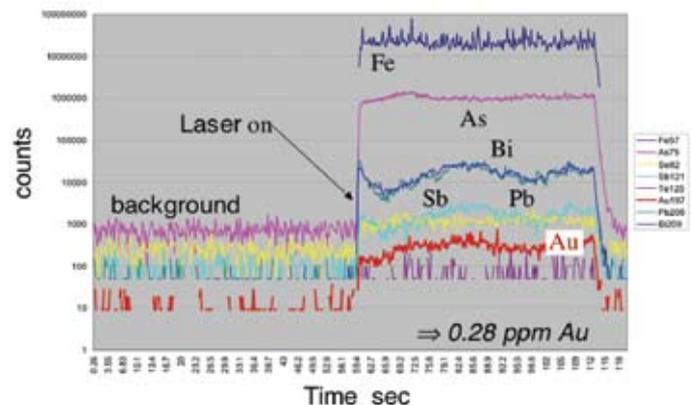
For further details and a copy of the research proposal contact Professor Ross Large (email: ross.large@utas.edu.au) or Dr Robert Scott (email: robert.scott@utas.edu.au).



Three laser ablation 'burns' across the surface of a pyrite grain (traces shown) reveal a decrease in gold concentration from core to rim.



Histogram showing variation in the gold content of pyrite from four indicator bed and black shale samples from the Lower Ordovician in central Victoria (75 analyses).



Laser ablation traces for Fe, As, Pb, Bi, Au and Te in diagenetic indicator bed pyrite from the East Ballarat Mine. Flat to smoothly varying traces indicate all elements are in solid solution within the pyrite structure. Note sympathetic variation of Au-Te-As, and Pb-Bi within the grain.

# Welcome to new students

This year we are very pleased to welcome 16 Honours students, two of whom started in mid-2003, one who will start in mid-2004, and 13 who began in February 2004. Honours students and their projects are listed below:

Name	Project
<i>Mid-year finish 2004</i>	
David Kratzman	Volcanology of the Sterling Valley Volcanics, Western Tasmania. Supv: Jocelyn McPhie.
Aaron Scollard	Seismic stratigraphy of Frederick Henry Bay, Tasmania. Supv: Mike Roach.
<i>Calendar year 2004</i>	
Michael Bavea	Groundwater delineation and chemistry of the Smithton Dolomite karst aquifer. Supv: Garry Davidson.
Derek Backhouse	Economic geology of the Phu Thap deposit, Laos. Supv: Khin Zaw, Clive Burrett.
Kate Bromfield	Palaeoenvironmental reconstruction of mid Mesozoic plant fossil site, Tasmania.
Teera Kamvong	Economic geology of an epithermal Thailand prospect. Supv: Khin Zaw, Clive Burrett.
Ned Howard	Alteration facies at the Darwin South orebody, Henty Gold Mine, Western Tasmania: Using spectral analysis and mineral geochemistry to define patterns in alteration mineralogy. Supv: Bruce Gemmell, Wally Herrmann.
Trent Strickland	Origin and significance of copper-bearing breccia at the E42 gold deposit, New South Wales. Supv: David Cooke.
Grace Cummings	Volcanology of a Thailand site. Supv: Khin Zaw, Clive Burrett, Sharon Allen.
Nicholas Fitzpatrick	Controls on intrusive gold-related mineralisation in the Lisle/Golconda area, NE Tasmania. Supv: Garry Davidson, Anthony Harris.
Hugh Tassell	A geophysical investigation into the structure and composition of the Amery Ice Shelf, Eastern Antarctica. Supv: Mike Roach, James Reid.
Kerrin Gale	The geology and paragenesis of Au-As-Cu mineralisation at the Backdoor Prospect, Telfer District, Paterson Province, Western Australia. Supv: David Cooke.
Richard Chopping	St Ives Gold Mine geophysics (WA). Supv: Mike Roach, James Reid.
John Stephenson	Geophysical (gravity) investigation of the Frances Creek region, Northern Territory. Supv: Mike Roach, James Reid.
Jacki O'Donnell	Geochemistry of pyrite in black shales. Supv: Peter McGoldrick and Ross Large.

Nate Allen will join us in the middle of this year to undertake a Tasmanian Economic Geology Honours project.



*David Kratzman, Ned Howard, Michael Bavea, Aaron Scollard, Kate Bromfield, Jacki O'Donnell, Richard Chopping, Hugh Tassell, Kerrin Gale — from the Honours class of 2003–4.*

Welcome to the new Masters students who have begun their studies at CODES in 2004. We are pleased to introduce:

Rene Gonzales—Master of Exploration Geoscience  
 Steven Groves—Master of Economic Geology  
 Bronto Sutupo—Master of Economic Geology

We also welcome three new PhD students:

Claire McMahon—Claire has recently moved to Hobart from Perth and will be supervised by Garry Davidson in her project that will involve laser ablation studies.  
 Lee Robson—Lee has just commenced his PhD at CODES, after completing his Honours year here. His PhD title is: Applications of remote sensing for geological mapping in western Tasmania.  
 Tim Ireland—Tim began his PhD towards the end of 2003 and the working title of his project is: Geology and structural evolution of the Collahuasi District, Northern Chile.

Several exciting PhD projects and associated scholarships are available for motivated students to join the CODES team. See page 6 for details.

# Dynamic Earth: Past, Present and Future - The 17th Australian Geological Convention (AGC)

The 17<sup>th</sup> AGC was held in Hobart from 8–13 February 2004. This biennial event, hosted by the Geological Society of Australia, was attended by over 600 delegates and had a diverse program of seminars, field trips, social events, workshops and exhibits. The convention theme—Dynamic Earth: Past, Present and Future—was chosen to reflect the importance of the geological sciences in documenting the history of Planet Earth, its current dynamism, and possible future directions. The theme also highlighted the pioneering work of Professor S. Warren Carey AO, Foundation Professor of Geology at the University of Tasmania. Professor Carey was a proponent of many unorthodox hypotheses in the field of global tectonics.

The University of Tasmania Society of Economic Geologists Student Chapter incorporated the conference theme in the design of some eye-catching labels for a set of commemorative bottles of wine, labelled *Past*, *Present* and *Future* (see below). These were available for sale at the AGC and proved very popular, confirming the widely-held opinion that geologists don't mind a drink on a hot day—or indeed on any other kind of day. A competition at the CODES booth generated considerable debate. Entrants were asked to guess the zinc grade of a slab of massive sulfide ore from the Rosebery mine on Tasmania's west coast. The answer, for those who entered

and didn't find out, was 18.2%. The lucky winner, Katie Dowell from CRC LEME, took home two bottles of specially-labelled AGC commemorative wine, kindly provided by our SEG Student Chapter, and a copy of Solomon and Groves', *The Geology and Origin of Australia's Mineral Deposits*.

Nilar Hlaing, our publications salesperson, was happy to report that many people, including past students and affiliates, stopped by the CODES booth to chat, enter the competition and to buy the CODES publications on sale. *The Geology and Origin of Australia's Mineral Deposits* was one of the most popular books at the booth—priced at AUD\$108.90 (inc. GST) it was, and remains, a terrific bargain.

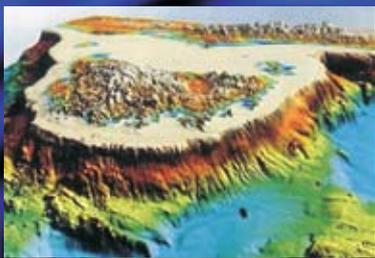
Professor Carey's book *Earth, Universe, Cosmos* has become something of a cult item, with a second edition released in 2000. This book has been in steady demand, no doubt due to its author's somewhat contentious hypotheses. The book's blurb describes it as:

"...a 'must read' for all cosmologists and earth and planetary scientists."

A full list of CODES publications and an order form are available on the Publications page of our website: [www.codes.utas.edu.au](http://www.codes.utas.edu.au).

The next AGC is scheduled for 2006 and will be held in Melbourne.

**Dynamic Earth - The Future**



**2001 Swan Hill Cabernet Sauvignon**  
Celebrating the 17th Australian Geological Convention

Spectacular potential arises from mysterious origins in this rich & spirited blend. The complex berry and savoury oak palate provide distinctive charm and perfectly complement a black currant and peppermint aroma. Careful cellaring will further enhance the complexity of this well-structured and elegant wine.



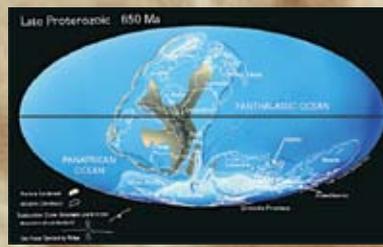
Dominion Wines  
Upton Road, Avenel  
Strathbogie Ranges  
Victoria, Australia



[www.seg.org.au](http://www.seg.org.au)

An initiative of the SEG student chapter of the University of Tasmania

*Dynamic Earth - The Past*



Late Proterozoic: 650 Ma

**2001 Swan Hill Shiraz-Cabernet**  
Celebrating the 17th Australian Geological Convention

This bold and mature red has a unique and complex origin. Subtle earthy tones complement the generous influence of rich berry and spice aromas. Sit back, relax, and savour the spectacular history that lies deep within.



Dominion Wines  
Upton Road, Avenel  
Strathbogie Ranges  
Victoria, Australia



[www.seg.org.au](http://www.seg.org.au)

An initiative of the SEG Student Chapter of the University of Tasmania

**Dynamic Earth - The Present**



**2003 Strathbogie Chardonnay**  
Celebrating the 17th Australian Geological Convention

A vibrant and cheeky young wine of exceptional distinction. The rich peach and melon bouquet derives from an eruptive maturation process. Exceptionally clean & natural the fine balance of this wine is best enjoyed now.



Dominion Wines  
Upton Road, Avenel  
Strathbogie Ranges  
Victoria, Australia



[www.seg.org.au](http://www.seg.org.au)

An initiative of the SEG student chapter of the University of Tasmania

## Research profile: Len Kolff van Oosterwijk



Len Kolff van Oosterwijk is doing some ground-breaking research on the Pic de Fon iron ore deposit, West Africa. Len started his Master of Economic Geology study at CODES in July 2003 and is supervised by Dr Andrew Tunks, with co-supervisors Drs Ron Berry and Garry Davidson. His Masters project is titled 'Geology and controls on high-grade hematite

mineralisation at the Pic de Fon deposit, Simandou Iron Ore Project, Democratic Republic of Guinea, West Africa'.

During 1997–2002 Len worked in greenfield and near-mine exploration for Rio Tinto, mainly in Africa, including the Bushveld in South Africa, Central Tanzania, Eastern Zambia and Guinea. He has also worked in the Iberian Pyrite Belt in Spain and Portugal, explored platform carbonates in northern Greenland for copper-lead-zinc mineralisation, and worked most recently in Northparkes, NSW.



Pic du Fon

Len chose to study at CODES because it is well regarded within the industry. He considered the Master of Economic Geology option as a good way to combine coursework with focused research during a short time frame. He wanted to expand his professional network in Australia and also liked Tasmania, so the decision to study at the University of Tasmania was very easily made.

Little geological research has been completed on the Pic de Fon deposit and very little has been published regarding the geology of the area. Len was among the first group of geologists to carry out detailed geological mapping of the Simandou mountain range and to complete drilling in this area. The Pic de Fon deposit lies within the southernmost section of the Simandou Range, a large, unexploited Lower Proterozoic banded iron formation that has the potential to become a major producer of high-grade hematite ore. Mineralisation is characterised by friable hematite with discrete hard hematite bodies developed within a sheared and deformed sequence of BIFs, phyllites and quartzites that unconformably overlie Archaean basement rocks of the West African Craton.

Outcomes of Len's research will benefit Rio Tinto, allowing more effective exploration for high-grade hematite mineralisation along the Simandou mountain range with possible downstream mining and metallurgical benefits.



INTERNATIONALLY-RENOVED

CENTRE FOR ORE DEPOSIT  
RESEARCH (CODES-SRC) – AN ARC-FUNDED  
SPECIAL RESEARCH CENTRE.  
INDUSTRY-FUNDED PHD PROJECTS

### 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. Where appropriate, geophysical techniques will be used to help map alteration domains and structures. 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 P785 *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 all projects should possess a strong (1 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 email [bruce.gemmell@utas.edu.au](mailto:bruce.gemmell@utas.edu.au)  
or Dr David Cooke  
on (03) 6226 7695 or email [D.Cooke@utas.edu.au](mailto:D.Cooke@utas.edu.au)



# Macquarie Island – a year in the cold

Mike Roach, Bronwyn Kimber and Andy Wakefield left Hobart on 17 February to conduct some exciting research for CODES on Macquarie Island. Mike returned to Hobart on 12 March and Bronwyn and Andy are expected to return in April 2005, after spending the year as volunteers collecting magnetic data on the island.

The trip to Macquarie Island was made via Antarctica where Mike conducted some magnetic surveys for the Australian Antarctic Division to find rubbish buried under ice at the old Wilkes station. There is a considerable amount of rubbish buried here, produced during 12 years of occupation. The Wilkes station was abandoned in 1969 when operations moved to Casey Station, across the bay, and is now almost permanently frozen.

Macquarie Island is part of the state of Tasmania, located 1500 kilometres southeast of the island and 1300 kilometres north of the Antarctic continent.

In 1996 Macquarie Island was nominated by the Australian Government for inscription on the World Heritage Register, mainly for its unique geological features. The island is the exposed crest of the undersea Macquarie Ridge, raised to its present position where the Indo-Australian tectonic plate meets the Pacific plate. It is the only place on Earth where rocks from the Earth's mantle (6 km below the ocean floor) are exposed above sea level. These unique exposures include excellent examples of pillow basalts and other extrusive rocks.

Kate Godber (Honours, 2003) and Steve Lewis (current PhD) are CODES students who have studied the area. These studies are part of a larger program focused on the hydrothermal



*Mike Roach and Andy Wakefield downloading magnetometer data to a laptop in the field*

history of MI and ocean crust in general, led by Garry Davidson and Mike Roach. In turn, this is part of a wider collaboration with Duke University (USA, Dr Jeff Karson) and the USGS (Dr Carol Finn), one of several collaborations that also include U. Southampton and U. Michigan.

The current phase of the work on Macquarie Island is a ground magnetic survey, using magnetometers carried in backpacks. The work builds on a pilot study by Kate Godber in 2003. Aeromagnetic data at a useful resolution for magnetic mapping cannot be obtained as a permit cannot be issued—flying an aircraft over the island at the required height would disturb the wildlife. However, the next phase of the study will include helicopter-based aeromagnetic work offshore, to forge a link between the regional ship-based oceanic data and the new high-resolution ground-based data. This is necessary because navigation hazards have prevented near shore magnetic work to date. Also with consideration for wildlife, Bronwyn and Andy are working during winter so they can avoid the bird and seal breeding season, which would otherwise restrict access to much of the island.

The multiple objectives of this research are: (1) to map hydrothermal alteration patterns (both magnetically destructive and enhancing types); (2) refine the stratigraphies; and (3) constrain the position of the island with the regional tectonics. The results of the current phase of the study will be a magnetic image of the island with a 200 m line spacing. The island is 35 km long and up to 5 km wide, so Bronwyn and Andy are in for a great deal of walking.

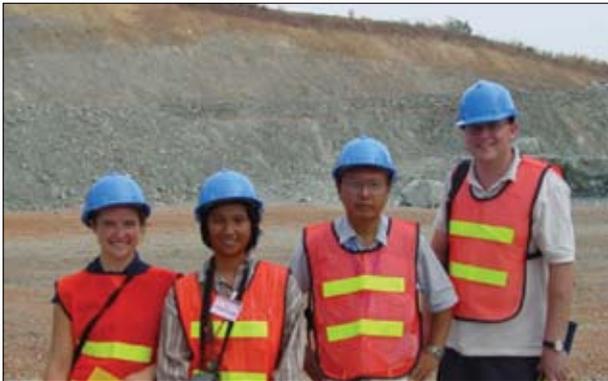
Recent papers derived from this research effort include: Davidson et al. (2004) *Terra Nova*, 16: 9-15  
Rivizzigno and Karson (2004) *Geology*; 32: 125-128  
Alt et al. (2003) *Geology*, 31: 549-552.



*Bronwyn Kimber conducting a magnetic survey on the steep southern end of the island*

## The Loei-down: a new CODES project in Thailand

The Loei Fold Belt in Thailand was the destination for a research trip, led by Khin Zaw, as part of the new CODES ARC Linkage project, from 17 February to 11 March 2004. The ARC project 'Geochronology, metallogensis and deposit styles of the Loei foldbelt in Thailand and Laos PDR' was initiated this year with funding from three sponsor companies, Oxiana Limited, Kingsgate Consolidated Limited and Pan Australian Resources NL. The Loei volcanic-plutonic belt occurs between the Shan-Thai and Indochina terranes in mainland SE Asia. Although several skarn-type Cu-Au, porphyry-related Cu and vein Au deposits are distributed along the belt these deposits are not well documented and their metallogenic relationships are poorly understood. This project will study the age, origin and styles of these deposits and will aim to unravel new exploration criteria vital to future discoveries of world class Cu-Au resources in the region.



Khin Zaw was accompanied on the research trip by Anthony Harris (Research Fellow), Masters student Kamaporn Khronkum, and Honours students Grace Cummings and Teera Kamvong. Sharon Allen and Jocelyn McPhie each contributed for part of the trip, assisting Grace Cummings with her Honours research and providing their expertise in volcanology.

The trip involved a great deal of travel, mostly by 4WD, from the far northeastern part of Thailand, near the border with Laos (an area where new Honours student Teera Kamvong will be studying the Phu Lon Cu-Au skarn) through Khoa Sai (where Kamaporn is researching the Chatree gold deposit), south along the Loei Belt, before taking a ferry to Ko Chang Island. The trip allowed regional outcrop reconnaissance, sampling and detailed core logging of significant ore deposits along the Loei Belt. It wasn't all work, though—there were some opportunities to meet the local wildlife and enjoy some fantastic food.

This excursion provided the opportunity to meet the Deputy Director General of the Department of Mineral Resources (DMR), and to attend a USGS-CCOP meeting on SE Asian porphyry and sediment-hosted Cu deposits. Ron James and Mike Garman of Kingsgate/Akara Mining, George Brech of Pan Australian and Ian Cameron of Thai Goldfield-Oxiana joint venture added valuable insights into specific areas along the Loei Belt, and their friendliness and helpfulness were greatly appreciated.

The Loei Fold Belt project represents one of the most significant geochronologic studies undertaken in this region. It will use leading-edge technology including the LA-ICPMS U-Pb zircon geochronology facilities at CODES. Additional geochronologic studies will be undertaken in collaboration with Sue Golding and Mark Barley of the Universities of Queensland and Western Australia.

The DMR in Thailand provided a great deal of assistance, and Dr Khin Zaw thanks them sincerely for their help, with special thanks to Mr Somboon Khositantont for sharing some of his comprehensive geological knowledge and for acting as translator. The DMR kindly provided a vehicle and driver, maps, digital data, literature, and also introduced Zaw to their senior personnel to facilitate further research work along the Loei belt and other areas in Thailand.

Other researchers working on this project include Sebastian Meffre and Wally Herrmann. Data collected from the research are being prepared for geochronologic and geochemical studies. Collected samples will ultimately improve our knowledge about the timing of key tectonic events, epochs of magmatism and the nature of related mineralisation in the evolution of the Loei Fold Belt.

Work will continue in Laos during 2004, with Khin Zaw, Sebastian Meffre and Honours student Derek Backhouse investigating the northernmost reaches of the Loei Fold Belt.

**TOP:** *Jocelyn McPhie explaining flow banding and autobreccia in rhyolite on Ko Chang Island, southern Thailand.*

**MIDDLE:** *Grace Cummings, Kamaporn Khronkum, Khin Zaw and Anthony Harris at Chatree gold mine.*

**BOTTOM:** *Jocelyn McPhie sharing her lunch.*

## A Word from the SEG Student Chapter President

The post-AGC Tassie Tiger Geo-Explorer Tour was a huge success and was attended by more than 20 geologists from five countries. Our thanks go to Steven Lewis and Alan Chester for what was a memorable excursion.

During 2004, the UTAS Student Chapter of the Society of Economic Geologists aims to:

- host a wine tasting evening on 16 June (to mark the end of the 24 Carat Gold Workshop)
- promote a strong presence at the 'Predictive Mineral Discovery Under Cover' conference in Perth, WA (27 September to 1 October)
- organise a variety of social functions (in addition to our weekly Friday afternoon gatherings) to welcome new members and promote discussion among existing members
- strengthen our links with the University of Tasmania Student Geology Club
- develop and maintain links with other SEG Student Chapters (both within Australia and internationally)
- produce further quality fund-raising merchandise. Following the stubbie holders and calendars marketed the previous year, suggestions thus far include wall planners, mouse-pads and field clothing
- possibly organise another field excursion!

Overall, I anticipate an active and fruitful year for the UTAS Student Chapter of the SEG.

Bryan Bowden  
President, SEG Student Chapter, University of Tasmania



Participants of the Tassie Tiger Geo-Explorer Tour at the Beaconsfield Gold Mine, pictured with mine geologist Grant MacDonald. The old Beaconsfield mine headframe for the shaft is seen in the background.



Tassie Tiger Geo-Explorers with Kim Denwer (CODES PhD student and main guide for the Mt Lyell surface tour) and the two Mt Lyell geologists, Colin and Damien. This photo shows the Haulage Unconformity exposed at the Mt Lyell mine.

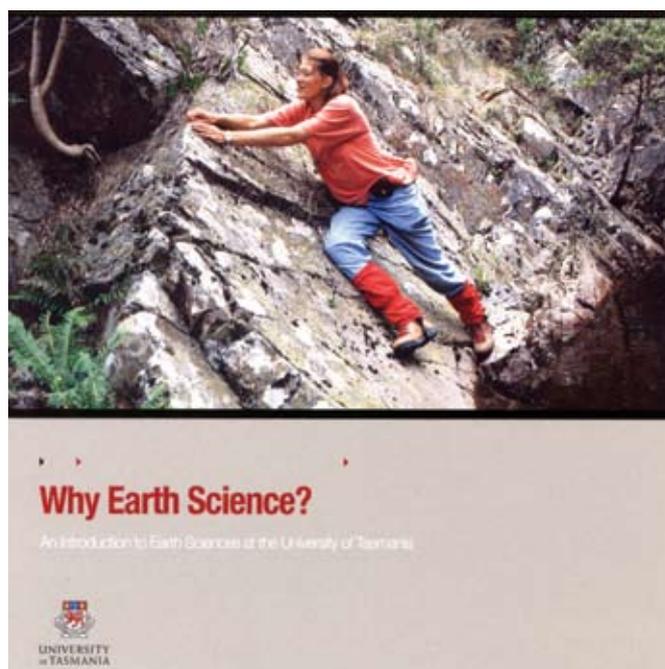
## WHY EARTH SCIENCE?

First year and honours enrolments in Earth Science are looking very healthy, thanks in no small part to the revamped *Why Earth Science?* CD and the efforts of Mike Blake and Andrew Tunks, the MTEC lecturer. Bruce Gemmell, Head of the School of Earth Sciences, is delighted to have 120 first-year enrolments in Hobart and 12 enrolments for a mid-year start at Launceston.

*Why Earth Science?* is a multimedia presentation aimed at students enrolled in a Bachelor of Science degree at UTAS, encouraging them to consider the advantages of taking Earth Science as a first year subject.

The edgy, modern CD was developed with funding from the Minerals Council of Australia, CODES and the School of Earth Sciences. It includes interviews with first-year students and working professionals, as well as a large amount of content provided by CODES and the School of Earth Sciences, and will appeal to students with different interests.

For a copy of the CD, please contact the secretary at CODES: secretary@codes.utas.edu.au; phone: (03) 6226 2472.



# Ore Deposits of South America (week two)

**Andrew Tunks** continues to recount the events of the 'Ore Deposits of South America' shortcourse, held in Peru in November 2003.

The last instalment, in *Ore Solutions* 15, the group of 24 geologists travelled from Lima to Huaraz to visit the Antamina Cu-Zn skarn deposit and Barrick's Pierina high-sulfidation gold deposit. The group then travelled back to Lima then on to Tarma. Along the way they visited the giant Cerro De Pasco system – drawing names out of a hat for the privilege of going underground there – and the Colquijirca Pb-Zn mine. The intrepid group bravely faced breakfasts of giant frog, refreshing drinks of the local cerveza (beer) and fantastic views of the Andes and Incan ruins.

In the second week the group travelled south to Chile and flew straight to Antofagasta where they all had a well-earned day off. This was particularly fortuitous because after a Saturday night spent trawling the 'hotspots' of Antofagasta many were in desperate need of a sleep-in. However it was not all beer and skittles; even though it was a day off there were still presentations from the Masters students.

The Mantos Blancos mine was visited on Monday with the group taking a mine tour and inspecting core from the mine's iron-oxide copper system. It was fascinating to see the incredibly complex ore management system this mine has employed to handle the many varieties of ore. Mantos Blancos is an unusual system that does not fit neatly into any on the major ore deposit models. Many thanks to Jorge Pizarro and his team of geologists.

On the way from Mantos Blancos to Calama we stopped to visit the Spence Prospect. This prospect, owned by BHP Billiton, is currently undergoing feasibility studies and we were able to inspect and sample the ore that has been collected from the decline for metallurgical test work. Spence is a classic porphyry copper system and we are grateful to John Larson and Louis Moreno for giving us the opportunity to include it in our trip.

Arrival and navigation through the complex one-way streets of Calama created considerable amusement for the group, particularly when we realised we had booked into the wrong hotel.

Tuesday morning saw an early start with a field traverse of the Cordillera Domeyko, north of the giant Chuquicamata Copper mine. This was a chance to inspect the stratigraphy and structure of a famous region that hosts several of the world's largest copper deposits. The day was ably led by Dr Jorge Skarmeta of Codelco who completed his PhD in the area. Jorge has reinterpreted the

structural history of the geology from large-scale strike-slip to thrusting. The highlight of the day occurred when we managed to get one of the vehicles bogged in the Atacama Desert, the driest desert in the world, when we ran into the only groundwater soak in 2000 km. With 25 experts in vehicle extraction, you can only imagine the chaotic scene that ensued.

The last outcrop of the day is a classic illustration of some of Jorge's ideas about compressional tectonics. Here the Jurassic limestones are thrust over recent gravels of the Sical Formation with spectacular folds developed in the footwall. It was a long journey into this site but everyone who made it thought it was worth the effort.

Chuquicamata is the world's largest open-pit mine and our visit on Wednesday morning highlighted the variety of ore types developed in this system. Alejandro Faunes, of Codelco, introduced us to the geology of the mine and the abundant prospectivity of the region, while also giving us a gentle introduction to the difficulties in managing the 50-odd

geologists who work at the mine. A late flight out of Calama saw us back in Santiago for a night out in Providencia where several of the group decided to test the local supplies of Pisco Sour and despite earnest efforts

were not able to deplete these alcoholic reserves.

Another early start saw us make the trip south to El Teniente with many pasty-faced geologists moaning in the bus. El Teniente is the world's largest underground mine and, as always, we had a fantastic underground tour. Patricio Zuniga and his team of geologists conducted us

on a traverse from the Braden Breccia Pipe out into the main ore body where we saw excellent examples of porphyry copper mineralisation in strongly biotite-altered host rocks. This trip was capped off by an excellent lunch in an underground cafeteria and a visit to a huge underground cavity filled with gypsum crystals up to 6 m long.

We headed north and east out of Santiago on the final day of the trip before arriving at the township of Los Andes where the Codelco-owned Rio Blanco mine headquarters are based. Luis Serrano and the team took the group up to the La Union open pit, situated 4000 m above sea level. Having a glacier flowing into your open pit creates difficulties we are not often faced with in Australia, although it does make for some spectacular scenery. The ore at Rio Blanco is hosted in a complex array of breccias, which we were able to examine during a thorough visit to the core shed. Thanks to all the participants of the trip and to the companies and individuals who hosted our visits. Their time, efforts and enthusiasm were greatly appreciated and assisted in making this a special trip.



# Volcanology field trip: New Zealand and western Tasmania

The CODES short course on 'Volcanology and mineralisation in volcanic terrains' was held recently (last two weeks of March, 2004) and very successful. The course aims to provide a field-based introduction to volcanology, and mineralisation and alteration styles common in volcanic successions, using young examples in New Zealand and Cambrian examples in western Tasmania.

The course was attended by students in the national Masters program, CODES Honours and PhD students and post-doctoral fellows, and led by Jocelyn McPhie, Bruce Gemmell and Kim Denwer. Excellent weather prevailed in New Zealand, allowing for comfortable enjoyment of the volcanoes around Auckland and in the Taupo Volcanic Zone, not to mention the west coast beaches, hot pools, scree runs and forest walks. One of the many memorable sights was in Rotorua where small phreatic eruptions have occurred as recently as last November, right downtown (opposite the hospital). The active geothermal systems at Waiotapu, Waimangu and Craters of the Moon provided a perfect venue for Bruce to explain the virtues of hot, smelly water (aka 'hydrothermal fluid'). Jocelyn and Bruce presented PowerPoint summaries some evenings, emphasising aspects of the volcanology and geothermal activity. Bright orange safety vests proved to be surprisingly popular among the participants, and very quickly became the attire of choice, with some unexpected results.

After a spell overnight in Hobart, the group travelled to Queenstown for four days of fieldwork in the richly mineralised Cambrian Mount Read Volcanics. Being deformed, metamorphosed, altered and generally poorly exposed, these



*The CODES group at Champagne Pool, Waiotapu.*

volcanic rocks present special challenges in description and interpretation. One of the most spectacular sections occurs on the western flank of the highest mountain of the west coast range, Mount Read. Our visit coincided with the worst possible weather – cold, rain, wind, low cloud, greatly impressing participants from Thailand, Papua New Guinea and the Philippines (sorry ...). Kim Denwer helped Jocelyn unravel the complex geology and alteration in the Mount Read Volcanics, especially at Mount Lyell which is the subject of Kim's PhD research.

In summary, the course was very well received, and equally enjoyed by the presenters and participants. The next course is scheduled for March 2006 – don't miss it!!!

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## *Ore deposit workshop in Santiago, Chile*

In collaboration with the University of Chile, David Cooke and Ross Large delivered a one-day ore deposit workshop in Santiago on 17 March. The workshop was well attended by 30 industry geologists and 20 students from the University of Chile. The course covered recent research advances in VHMS, SEDEX, porphyry Cu and epithermal Au deposits. The response from participants was very positive and plans to run a week-long course in June/July 2005 are underway. Special thanks to Victor Maksaev, Head of the Geology Department, University of Chile, for assisting and facilitating the course.

*David Cooke, Ross Large and Victor Maksaev (Head of Geology, University of Chile) at the Santiago ore deposit workshop in March.*



## CODES SHORT COURSE PROGRAM

### Brownfields Exploration

8–19 November 2004

The compilation of large datasets in areas of significant previous exploration. This course is a laboratory- and field-based unit that looks at exploration in and around mine sites where there is often abundant data. The course covers GIS applications, and the interpretation of geochemical and geophysical data at various scales. This information will be enhanced by practical exercises involving the integration of multiple datasets from world-class mineralised districts. There will be field excursion to the west coast of Tasmania to examine real life exploration issues at several mine sites.

*These courses form part of the National Geoscience Teaching Network, supported by the Minerals Council of Australia and DETYA. The course is offered jointly between CODES, the University of Western Australia, James Cook University, Monash University (VIEPS) and CRC LEME (University of Canberra).*

Units offered by University of Western Australia:

Ore deposit models  
Computer applied exploration techniques  
Management for exploration and mining  
Applied structural geology and field mapping  
Ore deposit field trip to South Africa

Units offered by James Cook University (EGRU):

Advances in ore genesis  
Resource definition: Theory and practice  
Business and financial management  
Advanced field training  
Exploration techniques in ore search



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*Ore Solutions banner: Intense spheroidal chlorite +carbonate in footwall andesite, Hellyer.*



*And the winner is ... Andrew Tunks!*

