

ore solutions



UNIVERSITY
OF TASMANIA

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

CODES Receives Top Marks from ARC

The six-year review of the Centre for Ore Deposit Research (CODES), undertaken by an Australian Research Council (ARC) panel in July 2002, has produced a very positive report on the Centre's activities. The Review Panel spent a full day at the Centre talking to staff, students and mining and exploration industry collaborators, and reviewing the facilities.

In their report, the Review Panel concluded that "CODES is performing exceptionally well. Its achievements on a global scale are outstanding. The Centre has a well-deserved reputation as the premier international research institute for ore deposit research. It continues to enhance its profile through focusing on high quality communications outputs and collaborations with national and international industry and research organisations."

"The Review Panel was impressed by the research publications and other output of

CODES. In 1997–2001 CODES produced 168 refereed publications in international journals and 96 industry reports. Notably, 39 of these refereed publications involved international research collaborators. During the 1999–2000 period CODES staff made 228 presentations at national and international conferences."

"In 2002 CODES undertook an internal publication benchmarking exercise, assessing its publication outputs against those of 25 research centres, university departments and geoscience institutes which specialised in one of the three key areas of CODES research (ore deposit geology, volcanology and petrology). The exercise found that CODES performed extremely well relative to the other organisations surveyed. It generated the largest number of first-authored articles in the top two international ore deposit journals and the third largest number of first-authored articles in the top two volcanology journals."

The report continued ... "The Panel believes that CODES is probably the world leader in the field of ore deposit research and considers its visibility and reputation exemplary. The Centre currently collaborates with 63 national and international research organisations and 65 mineral exploration companies. It is involved in 34 major research projects conducted at over 70 sites nationally and internationally."

"CODES has established strong links with the mineral industry and with AMIRA International, the mineral industry's research association. AMIRA and industry representatives provided the Panel with extremely positive feedback about the Centre, consistently identifying it as the premier research institute of its kind in the world. Industry's enthusiastic view of CODES is reflected in the level of corporate sponsorship and project funding that the Centre has attracted — \$5 million since 1997."

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and more



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Season's
Greetings
from all at
CODES



Giant Ore Deposits Explored

A Giant Ore Deposits (GODs) workshop hosted by CODES attracted strong international interest with 164 delegates, including 43 students and 28 international delegates from the United States, Canada, the Philippines, Chile, Russia, India, China, South Africa, Fiji and Ghana.

CODES Program 5 Leader and workshop convenor, Dr David Cooke, said the response to the third GODs workshop, held at Wrest Point Casino, Hobart, Tasmania, Australia, was excellent.

Giant ore deposits are generally defined as the largest economic accumulations of a particular ore type, based empirically on the amount of contained metal.

"Giant ore deposits hold a fascination for exploration geologists and ore deposit researchers, due to their extreme value as resources, and also because of the important unresolved questions regarding their origins," Dr Cooke said.

Dr Cooke said the third GODs workshop aimed to help maintain the high level of interest in giant ore deposits that exists amongst industry and academic geologists.

"We hope that some of the insights gained from the workshop will help geologists in their quests for new giant deposits, and in understanding the origins of the deposits that have already been discovered," he said.

The workshop consisted of 12 one-hour keynote presentations from selected industry and academic specialists, who, where possible, addressed the characteristics of the giant ore deposits and the anatomy of a giant ore deposit discovery.

Each half-day session concluded with a one-hour forum that dealt with exploration strategies for future discoveries of giant deposits. These forums included informal presentations by invited industry geologists on recent discoveries of giant



Jorge Skarmeta (Codelco), Gloria Lopez (Codelco) Phil Uttley (SRK Consulting) and Francisco Camus (Codelco).

Glen Masterman (CODES), Andrew Stewart (CODES), Richard Moore (Falconbridge), Emma Masterman, Charles Carnie (Pasmaenco) and Rob Bills (WMC).

and small ore deposits (GODS and SODS), which were followed by group discussions on the requirements for finding new giant ore deposits.

CODES published *Giant Ore Deposits: Characteristics, genesis and exploration*, edited by David Cooke and June Pongratz, for the workshop. It contains detailed papers contributed by each of the keynote presenters.

Eight of the papers in the special publication summarise the characteristics of giant deposits — porphyry copper (Francisco Camus, Manager Exploration Strategies, Codelco, Chile); iron-oxide copper-gold (Douglas Haynes, Director Douglas Haynes Discovery Pty Ltd, and Garry Davidson, CODES); sediment-hosted zinc-lead (Ross Large, Stuart Bull, David Selley, Jianwen Yang, David Cooke, Peter McGoldrick, all from CODES, and Grant Garven, Johns Hopkins U); Carlin-type gold (Tommy B. Thompson, Director, Center for Research in Economic Geology, Mackay School of Mines, Nevada); magmatic nickel-copper

(Tony Naldrett, University of Toronto); lateritic nickel (Mick Elias, Mick Elias Associates, Perth, Western Australia); and Witwatersrand gold (H.E Frimmel and W.E.L. Minter, University of Cape Town).

Four papers deal with the anatomy of giant ore deposit discoveries — Collahuasi (Richard Moore, Falconridge Ltd, and Glen Masterman, CODES); Red Dog (Scott Jennings and Adrian King, Teck Cominco); Goldstrike (Keith Bettles, Exploration Manager, Barrick Goldstrike); and Witwatersrand (Nick Fox, Chief Geologist, AngloGold Limited)

While the special publication does not contain papers relating to the informal industry presentations, four exploration proforma are included for porphyry copper-gold, iron oxide copper-gold, sediment-hosted zinc-lead, and Carlin-type gold deposits. These proforma formed the basis for group discussions in the exploration forums.

To obtain a copy of *Giant Ore Deposits: Characteristics, genesis and exploration* (CODES Special Publication 4) log on to our website www.codes.utas.edu.au

Home-grown student travelled far for porphyry thesis

Study took PHD student Rohan Wolfe (pictured) to lands of extreme, from doing his PhD research in the jungles of the Philippines, to exploring the arid mountains of Iran, following an Honours project in Parkes, New South Wales.

The Centre for Ore Deposit Research (CODES SRC) at the University of Tasmania attracts students from around the world. However, Rohan was home-grown and did his Bachelor of Science degree and Honours with the University's School of Earth Sciences and PhD with CODES. Rohan grew up prospecting in Tasmania, firing an interest in ore deposit geology that continues today.

The PhD project at CODES was a great opportunity to study the Dinkidi porphyry copper gold deposit in the Philippines. It's one of the only a few alkaline porphyry deposit to have been discovered outside British Columbia, and it has one of the highest gold-grades known from any porphyry deposit.

Researching the thesis involved living in the jungle in the Philippines for ten months, with only a couple of expatriates and several dozen locals. The thesis took a holistic overview of how porphyry and epithermal mineralisation forms, placing the formation of the Dinkidi deposit into

the wider context of the volcanic and igneous development of the region. To do this required not only a lot of detailed drillcore logging, but also extensive



regional mapping in quite remote jungle, wading along streams in areas that hadn't been explored before, even by the few Ifigou people who lived in the region.

"There's never a dull moment when doing this kind of field work. I really loved the challenge that working in such an environment presents. It was certainly a big change to North Parkes, in New South Wales, where I did my Honours research," Rohan said.

"Iran was another extreme from the jungles of the Philippines. It was a completely different environment and culture. I loved Iran and conducted several successful exploration programs there during 1999 and 2000, working in the mountains near the Afghanistan and Azerbaijan borders," he said.

CODES Program 5 Leader, Dr David Cooke, said that Rohan's PhD thesis was well-received by the examiners, passing without any corrections being required, with one examiner commenting that the thesis was one of the best, if not the best, studies of an alkaline porphyry system that he has ever read.

Rohan has had a well-earned break after completing his PhD, and is currently looking to commence a career in the exploration industry.

TASMANIA'S CURSE ON ROCKY GROUND

Prominent geologist and author David Leaman recently released *The Rock Which Makes Tasmania*. According to Leaman, it's time for Tasmanians to once again look at the dolerite – also called bluestone or iron stone – that dominates the surface of Tasmania.

"A successful living in a place depends on knowing your rock. Tasmanians know very little about the State's dolerites, known 50 years ago as 'the curse' for their association with soil problems, coal mining problems, water problems and general engineering problems," he said.

"Misunderstanding and ignorance of dolerite has led to massive problems like water damage to ground floors of homes, or costly and wasteful construction practices."

Nevertheless, Dr Leaman says, dolerites are also the basis for Tasmania's magnificent and unique scenery.

"No other place on earth has the spectacular dolerite spires that form the landmarks we are so familiar with" he says.

Dr Leaman has devoted almost 40 years researching dolerite for this latest book.

"I can become quite emotional about the issues involved with dolerite. This

book was written as a record of essential information as ideas about – and solutions to handling of – the rock and its problems should not have to be re-invented at some future time" he explains.

"*The Rock Which Makes Tasmania* will be of interest to many professionals including geologists, geophysicists, engineering geologists, hydrologists, pedologists, and geographers, but every Tasmanian needs to know this story," Dr Leaman said.

Other titles on Tasmania's geology and history by Dr Leaman include *Walk into History in Southern Tasmania* and *Step into History in Tasmanian Reserves*.

SEG Chapter 'on the road again'

The Student Chapter of Society of Economic Geologists recently completed the "2002 Road Trip – Charters Towers to Mt Isa" field trip. This trip visited a range of world-class base-metal and gold deposits and traversed the diverse and complex early Proterozoic to mid-Phanerozoic sequences hosting these deposits in northern Queensland.

This year's field trip was a first in some ways for a Student Chapter, with financial support from the SEG, in inviting an overseas academic to join the field trip. Professor Zbigniew Sawlowicz, Head of Institute for Geological Sciences, Jagiellonian University, Krakow, Poland joined the 2002 field trip. As well as attending the field trip, Professor Sawlowicz presented several lectures on the Kupferschiefer copper and silver deposits of Poland at James Cook University and at CODES.

Over 5000 km of driving in 10 days, with outside temperatures regularly above 40°C, was involved in the visit to seven active mining sites and several abandoned mining operations. The trip exposed the participants to the diverse range of mineralisation styles within northern Queensland and the huge potential which still exists within this region for both small and large discoveries to be made, as well as the need for ongoing research to answer many fundamental questions related to ore genesis at the various sites.

Deposits visited included the epithermal Au Pajingo Mine, 80 km south of Charters Towers, three Fe-Oxide Cu-Au systems within the Eastern Succession including Ernest Henry, Sellyn and Osborne, BHT Pb-Zn-Ag mineralisation at Cannington,

skarn hosted U mineralisation at the abandoned Mary Kathleen site, Cu and Pb-Zn mineralisation at Mt Isa itself and finally the Pb-Zn Century mine.

The success of the trip hinged on the support of the hosting companies and personnel. The student chapter wishes to thank Shaun Schneider and Vernica Brown at the Newmont's Pajingo site, Joshua Byrant from MIM's Ernest Henry mine, David Sleigh, Colin Sinclair and Stuart Mathews from Sellyn Mining, Stephen Guy at BHP Billiton's Cannington mine, Damien Keys from MIM's Mt Isa operations, Alan Blackburn and Phil Agnew at Placer Domes Osborne site, from Pasminco's Century Mine Paul Habermann and to Matt Brown and Dr. Nick Oliver at James Cook University. The time and excellent tours given by these persons was greatly appreciated by all participants. Financial support was received from Society of Economic Geologists, CODES, the Geological Society of Australia and through fund raising activities undertaken during the year.

The major fund raising activity undertaken by the Student Chapter in 2002 was assisting with several functions associated with the Giant Ore Deposit Workshop held at CODES in June 2002. A special thanks goes to Glenn Masterman, Andrew Stewart and Nicole Pollington who were unable to attend the field trip, however their tireless work at the workshop made this a very successful fund-raising venture for the Chapter. Assistance from CODES staff members and other postgraduate students is also acknowledged.

TASMANIAN MINERALS SCENE SET FOR NEW DISCOVERIES

Earth Science Week 2002 marked the end of a large, three-year project at the University of Tasmania that will help explorers to find new and rich gold, copper-gold and zinc-lead-silver ore bodies on Tasmania's west coast.

The project was initiated in 1999 by the Centre for Ore Deposit Research, Pasminco Exploration, Aurion Gold and Mineral Resources Tasmania and was supported by the Australian Research Council, to investigate the western Tasmania mineral province that is the backbone of the State's minerals industry.

According to principal co-researcher Garry Davidson, this province ranks well against Australia's mineral belts, and is even more important worldwide.

"We have learned in the past that there is large-scale depletion of different elements in the rocks around particular ore deposit clusters, and that these 'halos' of depletion connect directly to these types of deposits," he explained.

"This project set out to construct a new database from the many small studies already done on this aspect of the west coast's minerals over many years, scouring university theses, unpublished reports, and published scientific papers."



Michael Blake sampling at Hellyer core shed, Tasmania

"We also wanted to determine how useful the rock record of these depleted elements could be as pointers to the main ore bodies. We also aimed to provide methods that help explorers to discriminate one mineralisation style from another using only small outcrops."

Although the findings are confidential to the project partners for 18 months, Dr Davidson said that the key finding was that some isotopes appear to be less useful than previously thought, while others provide exciting discovery potential.

The industry partners will now use the commercial advantage of the 18 months confidentiality period to apply the results of the work to their own exploration.

"Once that time is up," Dr Davidson says, "the results will be published in international scientific journals, to be available to any company. This will stimulate more companies to invest in exploration on Tasmania's west coast."

P544 field work

CODES researchers working on AMIRA/ARC SPIRT Project P544 *Proterozoic Sediment-Hosted Copper Deposits* have recently completed a third season of fieldwork in the Zambian Copperbelt. The industry- and ARC-funded research project is a collaboration between CODES and the Colorado School of Mines (CSM) and is jointly lead by Drs Peter McGoldrick and Stuart Bull (CODES) and Professor Murray Hitzman (CSM). The project is sponsored by 13 companies and organisations, and receives matching funding through the Australian Research Council's Linkage program. Principal aims of the project are to compare Neoproterozoic sedimentary sequences with copper deposits in Zambia, South Australia and Western Australia, and to develop geological, geochemical and isotopic vectors that point toward ore. The research involves both detailed deposit studies and regional syntheses. Despite the long history of research in the Zambian

Copperbelt, the origin of the deposits within this richly endowed copper province remains highly controversial. In 2002, CODES researchers David Selley and Robert Scott and PhD students Mawson Croaker and Nicky Pollington joined forces with David Broughton (CSM) in an effort to resolve questions concerning the age of the deposits and stratigraphic and structural controls on their distribution.

Although conducting research in Zambia can present some unexpected challenges, the invaluable assistance of the Zambian-based sponsor companies ensured a successful season for all P544 team members. Results of the Zambian studies will assist the researchers in developing a more complete



PhD student Mawson Croaker (rear) points out aspects of the Copperbelt stratigraphy, superbly exposed at Mindola Pit, to Dick Sillitoe, and fellow PhD student David Broughton (CSM).

understanding of copper deposits in terms of basin architecture and evolution as well aiding assessment of the future exploration potential for similar Neoproterozoic basins in Australia.

Sharon Joins Editorial Board

ARC Research Fellow, Dr Sharon Allen, has been invited to join the Editorial Board of the *Australian Journal of Earth Sciences*. Sharon is a volcanologist and a key member of CODES' Volcanology Program. She is also on the Editorial Board of the *Journal of Volcanology and Geothermal Research*.

Graduation



Five CODES/School of Earth Sciences students were awarded PhD degrees at the August graduation ceremony in Hobart. Pictured (from left) are Zohra Amini, Rohan Wolfe, Sarah Jones and Andrew Rae. David Rawlings graduated in absentia.

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Bookshop at
www.codes.utas.edu.au**

STAFF NEWS

New Appointments

COMING to work for CODES was a smooth transition for **Sarah Gilbert**, a Bachelor of Science with Honours graduate from the University of Tasmania. Sarah has been appointed as a geochemist and prepares and analyses samples from the ICPMS. "It's great to get to use my degree," Sarah said.



Cari Deyell has been appointed postdoctoral Research Fellow and will be working with Dr David Cooke and Assoc Prof Bruce Gemmell to help develop a new AMIRA project on porphyry and epithermal systems.

Cari graduated with a PhD from the Mineral Deposit Research Unit at the University of British Columbia, Canada, in December 2001, where she worked on high sulfidation systems in the El Indio-Pascua belt in Chile and Argentina.

Cari has worked for the Canada-Nunavut Office and the Geological Survey of Canada in the Canadian Arctic doing regional mapping in Archean greenstone terrains and evaluating gold occurrences within banded iron formation.



Cari studied for her Bachelor of Science degree at Queens University, Ontario, Canada, with a focus on environmental geosciences.

Anthony Harris recently joined CODES as a postdoctoral Research Fellow working with Tony Crawford, Dima Kamenetsky and David Cooke on melt inclusions and porphyry mineralisation. He obtained his PhD from the University of Queensland working on the genesis of the Bajo de la Alumbrera deposit in northwest Argentina.



New PhD

Carlos Paulino Rosa, of Portugal, will study for his PhD at CODES.

Carlos' career has included teaching at the University of Evora, in Portugal; exploration for Rio Tinto, and working for Portugal's IGM (Mining and Geological Institute). Carlos gained his university qualifications from the University of Lisbon.

Carlos' PhD thesis about the volcanic facies architecture in the Iberian pyrite belt is being supervised by Assoc Prof Jocelyn McPhie.



Departures

Jianwen Yang has taken a faculty position at the Department of Earth Sciences at the University of Windsor in Canada.

Tanzi Lewis has left CODES to join Greening Australia.

Volcanology at the 16th AGC

Volcanology researchers from CODES SRC were well represented at the 16th Australian Geological Convention, at Adelaide, in July.

Associate Professor Jocelyn McPhie and Research Fellow, Dr Sharon Allen, presented papers in the Gawler Craton symposium. Jocelyn and Sharon co-authored a third paper on Gawler Craton felsic volcanism by Dr Carol Simpson. Sharon was also a co-author of a poster by CODES PhD student, Paul Davidson and Research Fellow, Dr Dima Kamenetsky, in the symposium on defining processes in modern arcs.

PhD student Greg Ebsworth presented a paper on his PhD research at the LAVA symposium, and poster presentations were made by PhD student Kate Bull, and Research Fellow Dr Khin Zaw, with Dr Fernando Della-Pasqua.

The general meeting of the GSA Volcanology Specialist Group (LAVA) was held during the AGC. Sharon Allen will continue as Chairperson of the LAVA committee and Greg Ebsworth was elected Treasurer. A Tasmanian presence on the committee was seen as desirable as the next AGC is to be held in Hobart.

The following papers and posters presented at the AGC were published in *GSA Abstracts* Volume 67.

- Allen, SR, Simpson, CJ, and McPhie, J, 2002. Stratigraphy, distribution and geochemistry of three widespread felsic volcanic units in the Mesoproterozoic Gawler Range Volcanics, South Australia.
- Bull, K, 2002. Origin of fiamme-sediment breccia in the Early Devonian Ural Volcanics, NSW.
- Davidson, P, Kamenetsky, VS and Allen, SR, 2002. Volatile phase exsolution — how it happens in nature? An insight from rhyolitic magmatic inclusions, Taupo Volcanic Zone, New Zealand.
- Ebsworth, GB, 2002. Submarine record of widespread andesitic volcanism: magnetic sandstones in the Tyndall Group, Mount Read Volcanics, Tasmania.
- Khin Zaw & Della-Pasqua, FN, 2002. Chemical affinities of Loei belt volcanic-intrusive rocks, Central Thailand.
- McPhie, J, Allen, SR and Simpson, CJ, 2002. Voluminous felsic volcanism in the Mesoproterozoic Gawler Range Volcanics, South Australia.
- Simpson, CJ, McPhie, J, and Allen, SR, 2002. Evaluation of possible emplacement mechanisms for the widespread Yardea Dacite, South Australia.

Getting to the Core

Being awarded an Australian Research Council Research Fellowship, in 1999, made Dr Dima Kamenetsky feel like he'd won the lottery and was able to use this prize to move into unexplored earth science territories.

Dr Kamenetsky is researching the burgeoning field of magma genesis, with direct and important links to the origin of magmatic ore deposits, focussing on the study of melt inclusions in silicate minerals.

"Melt inclusion is a research tool that can be applied across the spectrum of geological disciplines. When a crystal grows from a melt or a fluid, tiny portions of the parental substance are trapped inside the crystal as inclusions and thus can be preserved forever. The researcher examines the crystal and learns about the processes that may have happened millions or billions of years ago," he said. "Inclusions not just double the amount of information but increase it by orders of magnitude."

The melt inclusion method, which Dr Kamenetsky has been developing since 1984, is all about going inside the rock — zeroing in — by heating melt inclusions in silicate minerals and oxides using a heating stage on the microscope to see what happens inside these small 'magma chambers'.

Dr Kamenetsky believes melt inclusion studies are exciting new developments in the study of magmatic processes and compositions of ancient and modern rock types from around the world. His research project aims to provide information about the primary geochemistry of altered volcanic rocks and volatile compositions and budgets of magmas associated with porphyry Cu-Au and VHMS deposits and identifies certain compositions and processes that may be potentially favourable for mineralisation.

"Melt inclusions provide valuable snapshots of the compositional evolution of coexisting magmas and fluids throughout crystallisation history," Dr Kamenetsky said.

Dr Kamenetsky has been focussing on elucidating processes of magmatic volatile phase evolution, and the links between this process and the formation of porphyry-style, and VHMS ore bodies.

A number of exciting new melt inclusion projects have commenced recently, including a melt and fluid inclusion study of exsolution of 'salt' melts and brines from typical felsic magmas like granites and rhyolites, and volatile and metallic element partitioning between magmas and immiscible non-silicate phases; and a study of crystals decorating fluid bubbles in melt inclusions in phenocrysts and in submarine glasses in a diverse array of lavas from different tectonic settings.



Dima Kamenetsky working at the CODES melt inclusion heating stage microscope.

Coupled with heating stage homogenisation experiments, laser ablation ICPMS analysis of different inclusions in magmatic minerals can provide important new information on the behaviour of ore metals during late magmatic crystallisation and fluid evolution.

Dr Kamenetsky is passionate about his research. "Although melt inclusion studies are in their infancy, they are turning igneous petrology upside down with surprising new information," he said.

"For example, we recently published a

study of a basaltic lava dredged from a seamount adjacent to the Valu Fa Ridge in the Lau Basin, only 40 km behind the Tongan arc volcano of Ata. Melt inclusion studies demonstrated unequivocally that three distinct components, a mantle wedge, a slab-derived melt, and a fluid, contributed to the bulk rock composition. A typical Sr-Nd-Pb isotopic analysis of this basalt might therefore be meaningless.

"I feel I am doing something nobody can see or do. I take a sample and know that nobody has looked inside this rock. It's a whole new world inside. I'm penetrating new frontiers. It's research that takes a lot of effort and time but eventually you retrieve information."

Russian-born Dr Kamenetsky believes his life in Moscow and Russian heritage has a lot to do with his focus and determination for this type of research.

"Life in Russia is very different from other parts of the world. People are not relaxed and are driven and don't anticipate life to be easy or fun."

Discussions between the former Head of the University of Tasmania's Department of Geology, Prof David Green, and Prof Alex Sobolev and Dr Leonid Danyushevsky, both at Vernadsky Institute of Geochemistry, in Moscow, in the late-1980s, established important links and introduced Tasmanian petrologists to the art of melt inclusion studies.

In 1990, CODES' Associate Prof Tony Crawford, (now Professor and CODES' Deputy Director) visited the Institute of Geochemistry in Moscow where he met Dr Kamenetsky.

"Tony saw that I was obsessed with work and thought it would be good to have me in Australia to boost research and enthusiasm," Dr Kamenetsky said.

In 1992, Dr Kamenetsky joined the Department of Geology at the University of Tasmania. Fifteen months later he took a post-doctoral research position in the Centre d'études de Saclay in France.

Dr Kamenetsky returned to Tasmania in 1995 and became an Australian citizen in 1999.

PROSPECTORS GAIN NEW EXPLORATION TOOL

Tasmanian geologists at the University of Tasmania's Centre for Ore Deposit Research have produced a world-first guide to volcanic rocks that draws on Tasmania's unique geology and exploration expertise that could well boost exploration in the State.

According to principal author Cathryn Gifkins, with resources at Tasmania's west coast mines in decline and exploration at a 30-year low, "Tasmania's mineral prospectors need all the insight they can get," she said.

The book, *Altered Volcanic Rocks*, brings together the collective expertise of internationally-acclaimed researchers at the Centre for Ore Deposit Research in a practical guide designed to help geologists unravel the often complicated geological history of ancient volcanic rocks.

This unique book describes how mineral deposits in these rocks are formed

by hydrothermal fluids — hot water that circulates in the earth's crust, reacting with the rocks and altering their texture, chemistry and mineralogy. Often this alteration produces mineralised rock, which is the focus of mineral exploration.

"Zones of altered rock record the path of these mineralising hydrothermal fluids and they are often much larger than the mineral deposits themselves," she explained.

"This means that finding altered rocks, being able to recognise the right sort of rocks and knowing which way to follow them towards mineralised rock greatly increases our chances of finding new mineral deposits."

Altered Volcanic Rocks presents information across a range of scientific disciplines to establish and compare alteration styles from around the world, making it a valuable exploration tool for

prospectors world wide.

It features case studies from world-class Australian deposits including the Rosebery, Hercules, Henty and Mount Lyell deposits in western Tasmania's rich mineral zone, which Cathryn said will put Tasmania's geology on the world scene.

"Much of the expertise at the Centre comes from our long connection with Tasmania's world-class ore deposits," Cathryn said. "The guide provides geologists with alternative ways of looking at altered rocks in prospective areas and this may see new mineral deposits being discovered in Tasmania and around the world."

Altered Volcanic Rocks was written by Cathryn Gifkins, Wally Herrmann and Ross Large. It follows the Centre's internationally successful guide *Volcanic Textures* published in 1993.

CODES Short Course Program 2003

Ore Deposit Geochemistry, Hydrology and Geochronology

30 June–11 July 2003

The basic principles of ore fluid chemistry, ore fluid hydrology, fluid-rock interaction, stable isotopes and geochronology are covered in week one. The second week starts with lead isotopes and fluid inclusion basics, and is followed by a series of case studies which discuss the applications of the various geochemical, isotopic and dating techniques to the genesis and exploration of the three important ore deposit styles.

Ore Deposits of South America

3–14 November 2003

An exciting field-based course in the Andes covering the major ore deposit styles of South America — deposit types include porphyry Cu-Mo, high sulfidation epithermal Au and iron-oxide Cu-Au. Mines visited include El Teniente (the world's largest underground mine) and Chuquibambilla (the world's largest open pit). A



Breccia-hosted Cu-Mo mineralisation, La Union sector, Rio Blanco, Chile

series of presentations by researchers and exploration geologists working in South America will address the geology, tectonic setting and important exploration criteria for each deposit style.

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

The Last Voyage of the RV *Franklin*



by Christian Schardt

The last cruise of the RV *Franklin* from Papua New Guinea via the Solomon Islands to Sydney was, in many respects, a voyage worth remembering. Being normally confined to the computer, modelling seafloor hydrothermal systems, I happily traded the computer screen for a hard hat and life vest, in March and April, to sail the Solomon Sea and South Pacific, recover rock and sediment samples and have a say in naming previously undiscovered seafloor features.

Before sailing out of Rabaul, we had the opportunity to climb the active Tavurvur volcano and experience the forces of nature first hand. The next 25 days saw the *Franklin* sail from Rabaul, Papua New Guinea and the Solomon Islands to meet the scientific objectives: to study seafloor hydrothermal ore-forming activities in order to develop improved methods of exploring for ancient mineral deposits on land. This was accomplished by deploying a range of instruments such as a rock dredge, sediment corer or CTD transmissometer to take rock and water samples, measure methane concentrations and catch hydrothermal activity and submarine biota on film. Having superb weather conditions, mirror-calm sea for most of the duration and 12 scientists from universities, government research organizations and industry on board made for excellent working progress, stimulating conversation and input from a diverse range of scientific backgrounds.

Without doubt the highlight of expeditions was the discovery of four new previously unsurveyed hydrothermally active submarine seamounts. The first, Grover occur in the central portion of the San Cristobal magmatic arc while the other two, Stanton and Starfish are located in the northern New Hebrides volcanic arc near Vanikoro. They were

discovered using a combination of echosounding, CTD-hydrocast, on board methane analysis, video tows and seafloor dredging. They are all associated with hydrothermal activity, locally focussed methane-rich and carbon dioxide-rich hydrothermal plumes and weak to strong sericitic-clay-pyrite-silica hydrothermal alteration. While Grover and Stanton have abundant iron oxide hydrothermal precipitates with abundant vent biota, truly 'massive' sulfide in the form of pyrite-marcasite and native sulfur was dredged from Stanton.

It was an exciting feeling to see results predicted from computer models being produced and recovered in real life and name newly discovered hydrothermal submarine seamount in honour of scientists outstanding in their field. A by-product of the research has also been the location and preliminary documentation of the diverse biota that surrounds seafloor hydrothermal systems.

Besides hard science there are always other interesting things occurring during a 24-day voyage. Just as the *Franklin* made it's way past Bougainville the local government had finally decided to become independent from Papua New Guinea. Having a scientist from Papua New



Tavurvur volcano, Rabaul Harbour.



Dredging seafloor volcanic rocks in the Solomon Islands.

Guinea onboard made this event all the more accessible.

After discovering a blind passenger ('Basil the rat'), two centrally organized rat hunts were organized, bringing out the bizarre and weird in some people, but to no avail.

After braving some swell, we made our way into Sydney to find that one of the scientists we named a newly discovered feature after (Stanton) was on the wharf to greet us! It was an appropriate finish to a very successful cruise and we all felt privileged to be on the last voyage of this fine ship!

Wake-Up Call or Did the Earth Just Move?

Sleepers wake! It was as if the late-Professor Samuel Warren Carey had issued a wake up call when an earthquake rocked Tasmania on 16 June 2002, the date set aside for a memorial reunion in honour of the founding Professor of Geology at the University of Tasmania.

Former staff and students of Prof. Carey, couldn't get over the strange coincidence as they assembled near the seismograph installed by Prof. Carey, who led the Geology Department from 1946–1976. After all, most agreed he was 'larger than life'.

One of the first two Geology Honours students to graduate from the University of Tasmania was John Elliston, of Elliston Research Associates in Sydney, who spoke about the Prof Carey philosophy: "We are blinded by what we think we know, therefore disbelieve if you can".

"Prof Carey was first seen as teaching radical concepts. He was regarded as a revolutionary and was puzzling to geologists of the day. However, he encouraged unlimited investigation of all possibilities," Mr Elliston said.

Prof. Carey was, in fact, ahead of his time. His theories about continental drift and expanding earth are now considered mainstream, but his proposal on the expanding earth is yet to be accepted.

"Let's not forget that the revolutionary and advanced thinking is often where the advances come from. Step-by-step these ideas must be nurtured in order to make progress," Mr Elliston said.

"Testing unorthodox ideas can be fun. Converting them into orthodoxy is hard work," he said.

The first academic staff member to be appointed by Prof. Carey was Dr Max Banks, in 1946, who related how the Department of Geology was established and prospered during the Carey era.

"The function of a Professor in 1946 was to be the administrative head, to teach, makes and propagate new discoveries, discover new subjects and increase awareness of his subject in the community. To do this you need staff, students, space (laboratories, lecture



*Mrs Austral Carey,
Roy Pallett and
David Leaman*



*Guest speakers (l to
r): David Groves,
Ross Large, Paul St
John, John Elliston,
Max Banks, Pat
Quilty and David
Leaman*

*Lesley Wyborn,
Anita Andrew,
Tony Crawford and
Graham Carr*



theatres), collections, books and equipment. At the time Prof. Carey was appointed, he had none of these," Dr Banks said.

Working conditions, in those early days, were limited. Lectures were held in old army huts and students were taken far-and-wide on field trips in an ex-army signal van known as the 'blitz buggy'.

Another former colleague, Prof. Pat Quilty, paid tribute to what Prof. Carey built in terms of facilities and a sense of community between staff and students in the Department of Geology.

"This building (School of Earth Sciences) and the displays are a testimony to his attention to detail," Prof. Quilty said.

"Prof. Carey knew where he stood in the Australian spectrum of professors. He would pat everyone on the back and call them 'my boy' and included all students

as part of the community in the Department of Geology," he said.

Although, Prof. Carey is well-known among the male students and staff for addressing them as "my boy", former student, Ruth Wilson, said Prof. Carey gave equal encouragement to women students and didn't just treat them like individuals who were filling in time at university before marriage and motherhood.

Former PhD student, Paul St John, spoke about Prof. Carey's contribution to tectonics. "Quite apart from his global reconstructions, Prof. Carey's meticulous work on the behaviour of earth materials within different time and spatial scales has been pervasive in structural interpretation in the petroleum industry. Many of his former students have become educators who've gone into universities and put his ideas out-there. He's been an extra-

*Marj Eshuys,
Rob Skreczynski
and Geoff
Green`*



*Ruth Wilson, David
Wilson, Philip
Sansom and Mark
Taylor*



*Ross Large,
Roma Hickman
and John
Hickman*

ordinary influence," Dr St John said.

The cover of the recently released book *The Rock which makes Tasmania* by David Leaman, was presented by the author, also a former student and PhD student.

"Prof Carey's work was far-reaching and he was concerned about mundane and real life issues. He organised, for example, a symposium in 1957 to assist with the resolution of Tasmania's curse — the Jurassic dolerites. I hope my book will be a monument to Prof. Carey, like the 1957 symposium on the same subject was," Dr Leaman said.

The Director of the Centre for Global Metallogeny, at the University of Western Australia, Prof. David Groves, gave some humorous recollections of life as an undergraduate and Honours student in the early 1960s by stressing the magnetism and vibrancy displayed by 'The Prof' and the fact that he was held

in the highest esteem by the students.

However, he also indicated that the students recognised the extremely competitive side of the Prof.'s personality: 'in your face' in modern parlance.

Prof Groves narrated a series of slightly embellished stories of student 'pranks' to try to get one up on the Prof.

"Success was rare — we were up against a high-calibre commando — but it was VERY sweet and remembered for 40 years! The owner of the Lonah Guest House near Ulverstone probably has nightmares to this day of one of the few occasions that we outsmarted the Prof, although he made us pay in blood for our rare triumph," Prof. Groves said.

Over 70 guests travelled from far and wide to attend. One guest even flew in from Nevada, United States of America, that day.

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Banner: Black rhyolitic obsidian with bands and nodules of devitrified and spherulitic rhyolite, Ngongotaha lava dome, Rotorua, New Zealand.

*Blandfordia grandiflora (Christmas bells)
illustration from Australian National Botanic
Gardens website.*

UNIVERSITY OF TASMANIA
SCHOOL OF EARTH SCIENCES and CENTRE FOR ORE DEPOSIT RESEARCH

PhD Scholarships

- **Time-lapse geophysical monitoring of acid mine drainage at Savage River Mine, North-western Tasmania**

The School of Earth Sciences, Australian Bulk Minerals and the Department of Primary Industries, Water and Environment invite applications for an APA(I) funded PhD research project.

The project will apply geophysical methods to image and monitor the subsurface distribution, and short and long-term temporal variations in ground conductivity associated with acid mine drainage (AMD) at the Savage River iron ore mine, Tasmania. The major outcomes of this project will be development of appropriate geophysical methods and interpretation techniques for delineation and monitoring of AMD at sites characterised by high seasonal rainfall and significant topography.

- **Application of the multichannel self-potential method to detection of seepage from mine tailings impoundments**

The School of Earth Sciences and Pasminco Rosebery Mine invite applications for an APA(I) funded PhD research project.

This project will use a modern multichannel geophysical data acquisition system to study short and long-term variations in self-potential measurements at a tailings dam at the Rosebery Zn—Pb—Ag mine. The project will use the self-potential method to detect fluid seepage paths through the dam wall, and will use numerical models to make quantitative estimates of seepage rates. The major project outcomes will be a rigorous appraisal of the utility of the self-potential method for mapping seepage in an operating mine environment, and construction of fluid flow paths through the dam which can be used to guide future remediation work.

Applicants for the above two positions should possess a First Class Honours degree in Geophysics, Engineering or the Physical Sciences. Experience in field acquisition and modelling of electrical or electromagnetic data would be an advantage. Tax-free stipends of \$23,294 pa (to be confirmed) plus a relocation allowance of up to \$2000 will be available for the successful candidates, along with support for fieldwork, computer facilities, software and conference travel.

Enquiries regarding positions 1 and 2 should be directed to Dr James Reid, School of Earth Sciences, telephone (03) 6226 2477, fax (03) 6223 2547 or email James.Reid@utas.edu.au

- **Geology, geochemistry and genesis of the Mount Lyell Cu—Au deposit, western Tasmania**

CODES, Copper Mines of Tasmania and Mineral Resources Tasmania invite applications for a Tasmanian Government Mining Scholarship research project.

The Mount Lyell Cu—Au deposit is a world-class resource that has been mined for over 100 years, but remains an geological enigma. There are many features that do not conform with the standard interpretation of Mount Lyell as a VHMS stringer system, and it does not fit neatly into standard ore-deposit classification schemes. Is it an unusual sub-seafloor VHMS deposit, a variant of porphyry Cu—Au-style mineralisation in submarine volcanics, a type of FeOx—Cu—Au—REE deposit comparable with Olympic Dam and Ernest Henry, or a



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large metamorphosed submarine high-sulfidation epithermal deposit? The aim of the project is to establish the geological, chemical and isotopic character of the Cu—Au ores and alteration halo, to use these data to interpret the conditions of ore formation and to develop models for further exploration.

A tax-free stipend of \$20,000 pa, plus a relocation allowance of up to \$2000 is offered. A top-up of \$5000 pa is available for a candidate with an exceptional academic record and/or strong industry background.

Enquiries to Professor Ross Large, CODES, telephone (03) 6226 2819, email Ross.Large@utas.edu.au

- **Sedimentology, basin evolution and metallogenesis, Rocky Cape Group, northwestern Tasmania**

CODES and Mineral Resources Tasmania invites applications for a Tasmanian Government Mining Scholarship research project.

The Rocky Cape Block in northwestern Tasmania is dominated by the Mesoproterozoic(?) Rocky Cape Group, a poorly studied siliciclastic sequence that was affected by strong extension, rifting and tholeiitic magmatism around 600 Ma. The project will focus on a detailed sedimentological analysis of the Rocky Cape Group. In addition, new 200-m-spacing aeromagnetics and detailed airborne EM flown over the region by Mineral Resources Tasmania provide an opportunity to re-evaluate the geological evolution and mineral potential of the Rocky Cape Block.

A tax-free stipend of \$20,000 pa, plus relocation allowance of up to \$2000 is offered.

Enquiries to Dr Stuart Bull, CODES, telephone (03) 6226 7634, fax (03) 6226 7662, or email Stuart.Bull@utas.edu.au

MSc Scholarship

- **What controls trace-element levels in distal alteration zone sulfide and oxide minerals?**

CODES and a consortium of industry sponsors invite applications for an APA(I) funded MSc research project, to begin within 2003.

The project will use laser ablation ICPMS analysis and radiogenic (Pb, Nd) isotopes to track the sources of elements in sulfides and oxides within the outer halo of alteration at one of the project ore deposits. The project will involve interaction with industry, fieldwork, mastering of the principles of LA-ICPMS, and reporting to industry meetings. The aim will be to develop exploration vectors to ore, and gain a fundamental understanding of element transfers between minerals in the outer margins of hydrothermal systems.

A tax-free stipend of \$23,294 pa is available to the successful candidate.

Enquiries to Dr Garry Davidson, CODES, telephone (03) 6226 2815, fax (03) 6226 7662, or email Garry.Davidson@utas.edu.au

Scholarship application and PhD enrolment forms are available from Kylie Kapeller, Research Scholarships Officer (03) 6226 2766, kylie.kapeller@utas.edu.au For more information about research opportunities at the University of Tasmania, visit <http://www.codes.utas.edu.au>



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