

one solutions



UNIVERSITY OF TASMANIA

**Newsletter of the Centre for Ore Deposit Research
at the University of Tasmania**

This Issue:

December 1997

CODES overview

Maintaining the edge

Over the last decade, Australia's reputation as a leader in mineral exploration and ore deposit research has grown substantially. CODES is one of a range of Australian research centres designed to ensure that Australia maintains its position in the international research community. Here we profile our main industry-collaborative projects and the latest round of successful grants from the Australian Research Council.

AMIRA Projects

AMIRA aims to facilitate technological advancement for its members through collaborative research in exploration, mining and processing. Research findings provide sponsors with new methods, tools and technology to improve their competitive position in the industry.

P384A: Sediment-hosted base metal deposits

Sponsors: Aberfoyle, BHP Exploration, Cominco, Inco Exploration, MIM Exploration, Noranda, Normandy Exploration, North, Pasminco Exploration and RGC Exploration plus support from the ARC.

Key Contact: Dr Peter McGoldrick
Commenced: June 1995
Duration: 3 years

To scientifically underpin the search for new base metal deposits, P384A continues major research into fundamental aspects of brine hydrology and basin analysis, metal solubility and ore deposition mechanisms.

This is a multidisciplinary project focussing on the geological, geophysical and geochemical characteristics of ore-bearing sedimentary basins in the Australian Proterozoic.

Consolidating previous advances, the project integrates gravity, magnetic, structural, sedimentological and geochemical studies from the southern McArthur Basin and the Western Succession of the Mt Isa Basin to develop models and vectors for sediment-hosted (SEDEX-style) Zn-Pb-Ag deposits. AGSO and the NTGS in their North Australian Basins Resource Evaluation project are important contributors.

P390A: Geological, tectonic & metallogenic relations of mineral deposits in mainland southeast Asia

Sponsors: Falconbridge, Gencor, Homestake Gold of Australia, Noranda, Normandy Exploration, North, Padaeng Industry, Pasminco Exploration, Placer Exploration, Phelps Dodge Australasia, PT Rio Tinto Indonesia and WMC Resources.

Key Contact: Dr Khin Zaw
Commenced: September 1995
Duration: 3 years

Following the GIS compilation of the geology and mineral deposits of Myanmar (Burma) in P390, this project includes an extension of the GIS work to cover the geology and mineralisation of prospective contiguous areas of mainland SE Asia, including Thailand, Laos, Cambodia and Malaysia. The research involves a regional tectonic, structural and metallogenic analysis based on the new geological compilation.

P439: Studies of VHMS-related alteration: geochemical and mineralogical vectors to mineralisation

Sponsors: Aberfoyle, Rio Tinto Exploration, Denehurst, Normandy Exploration, Pasminco Exploration, Queensland Metals Corporation, RGC Exploration plus support from an ARC Collaborative Research Grant.

Key Contact: Prof Ross Large
Commenced: March 1995
Duration: 3 years

continued on page 4

From the Editor

This issue of **ore solutions** is dedicated to 'bringing people up to speed' because it has been some time since we last produced a newsletter or provided a comprehensive program overview.

In this first edition, we provide a special lift-out summary of the CODES research structure under our new Special Research Centre status, plus a listings of all the key contacts within the Centre.

Elsewhere, we provide a summary of our successful ARC grant applications for 1998 plus news about our major collaborative Australian Minerals Industry Research Association (AMIRA) projects – as well as a range of other news and information about our achievements and plans for the forthcoming year.

In future editions, profiles of programs, individual projects and people will be regular items, and work with our major industry sponsors and key supporters will receive top billing.

We plan for **ore solutions** to be the keystone in our communication program alongside our web site, which will be revamped in the first half of 1998 with new information and a range of new services.

Please pass on your reaction to **ore solutions** and any ideas for content so that the 'round file' isn't the only regular recipient!

Ed

News

PhD scholarship: Gunpowder (Qld)

CODES recently advertised for a PhD student to work on the origin of ore fluids and the controls on deposition of primary Cu mineralisation at the Gunpowder Deposit, 100km north of Mt Isa in north west Queensland. The ore bodies are structurally controlled, brecciated sediment-hosted Cu deposits within the Western Succession of the Mt Isa Block. Supergene copper sulphides extend to 600m and grade into the primary chalcopyrite-pyrite mineralisation at around 16mt @ 4% Cu.

The joint CODES-Aberfoyle study aims to increase our understanding of geological and geochemical characteristics of the primary Cu mineralisation and will lead to more refined exploration models for this style of mineralisation.

A \$20,000 tax-free scholarship with full logistical support has been provided by Aberfoyle Resources Ltd. For more information, contact Dr Bruce Gemmell
Tel: (03) 6226 2893.

Tasmanian enrolments boom

The University of Tasmania has recorded one of the highest levels of growth in student enrolments for geology and mining-related courses, outstripping those of high-profile mining states Western Australia and Queensland.

In figures released in the *Australian Journal of Mining* '1996/1997 Survey of Mining Education', the

estimated number of graduates for 1997 from Tasmanian geology-related courses showed a 59% increase compared to 1996 figures.

Enrolments were down for all other states except Western Australia (up 17%) and New South Wales (up 25%), with the most dramatic drop recorded for South Australia (down 40%), the result of a departmental closure at Flinders University.

CODES to host national conference

Tony Crawford is spearheading plans to hold a November 1998 national conference on the tectonic and metallogenic evolution of south eastern Australia.

The conference will update industry, geological survey and academic earth scientists on exciting new developments in our understanding of the Late Proterozoic-Early Proterozoic geological evolution of western and central Victoria, New South Wales, eastern South Australia and Tasmania.

Tony hopes that the conference will showcase results from new-generation geophysical databases compiled by the Australian Geological Survey Organisation (AGSO), the state geological surveys and the Australian Geodynamics Cooperative Research Centre. It will also present the latest tectonic and metallogenic models, spatially and temporally transitional, from the Adelaide to the Tasman Fold Belt System. The exploration potential of this region will be a key focus of

the meeting and a workshop will provide a refresher course in tectonics as part of the CODES Master of Economic Geology 'Tectonics, Structure & Ore Deposits' short course.

Preliminary plans are to hold the conference preceding a major ASEG meeting to be held in Hobart during November 1998.

Geophysics research group awards scoop

At the 12th Australian Society of Exploration Geophysicists Conference and Exhibition in February, the CODES group won two out of four awards for technical excellence. Dr Michael Roach, Dr Roger Lewis and Wieslaw Jablonski were awarded the Laric Hawkins Award for Technical Innovation featured in the paper 'Scale-dependent Electrical Properties of Sulphide Rocks: new methods and techniques'. Nick Direen and Dr David Leaman were also presented with an award for the best poster-paper, titled 'Geophysical Modelling of Structure & Tectonostratigraphic History of the Longford Basin, northern Tasmania'.

Top Fellow

Dr Leonid Danyushevsky has been awarded a QEII Postdoctoral Fellowship by the ARC. This highly competitive scheme attracts outstanding researchers from around the world and encourages Australian postdoctoral researchers with exceptional promise or proven capacity for original work. **OS**

From the Director

Now in our ninth year of operation as a research centre, 1997 saw a successful transition from National Key Centre to Special Research Centre.

The applied aspects of CODES ore deposit research have now been integrated with fundamental research expertise in igneous petrology, tectonics and volcanology to produce an expanded team capable of undertaking research across a spectrum of mineral environments.

In becoming an SRC, we have secured a firm funding base on which to grow and develop. We receive funding from the ARC (\$825,000 a year for nine years) and a consortium of sponsor companies (\$210,000 per year) as well as the Tasmanian State Government (\$68,000 per year). We also work on industry-funded projects under AMIRA grants and a range of other industry collaborative projects.

We are continuing our tradition of strong links with the mining industry and for fundamental, strategic and applied research.

Our traditional research continues on volcanic-hosted and sediment-hosted base metal deposits and their environments, particularly in Tasmania, Queensland and Northern Territory.

As part of our new direction, we are making a major commitment to our research into porphyry Cu-Au and epithermal Au-Ag systems and their related magmatic and volcanic environments. This means expanding our research into other regions, particularly NSW, SA and the South West Pacific.



A new project on Ordovician magmatism, tectonics and porphyry copper-gold deposits in NSW, jointly with the Geological Survey of NSW, and funded by several mining companies, is due to commence in early 1998. As well, several new PhD-industry collaborative projects will focus on the porphyry-epithermal environment in NSW at North Parkes with North, at Cadia with Newcrest and in Indonesia at Kelian with Rio Tinto. PhD research is also continuing in collaborative porphyry Cu-related projects in the Philippines at Didipio with Climax and at the Palimpinon geothermal field.

Another initiative will be to develop our research capacity in fluid flow and fluid chemistry in sedimentary basins and volcanic arcs. We are currently seeking to appoint a leader for this important program.

Ultimately, our objective is to have a major impact on exploration within the first three or four years and to contribute to major discoveries in Australia.

Ross Large
Director

Maintaining the edge*continued from page 1*

This multidisciplinary project aims to develop geological alteration halo models useful in exploration for deep massive sulphide deposits. Research concentrates on deposits in the Mt Read Volcanics (Tas), the Mt Windsor Volcanics (Qld) and the Murchison Volcanics (WA) and integrates regional and local-scale volcanic facies analysis, chemostratigraphy, mineral chemistry and isotope chemistry.

ARC grants

Dr Garry Davidson: Sulphur geochemistry of hydrothermally altered oceanic crust (Macquarie Island): \$101,000 over 3 yrs.

Dr Jocelyn McPhie: Physical volcanology and facies architecture of large-volume felsic volcanic provinces (Gawler Range Volcanic Belt, SA): \$170,000 over 3 yrs.

Strategic Partnerships With Industry: Research & Training (SPIRT) Grants

Dr Garry Davidson: Basin configuration, volcanology, sedimentology and pre-deformational alteration of the Toole Ck Volcanics (Mt Isa, Qld): \$62,268 over 3 yrs.

Assoc Prof Tony Crawford: Origin and metallogensis of Ordovician volcanics in central western NSW: \$218,403 over 3 yrs.

Dr Michael Roach: Scale-dependent electrical properties of sulphide rocks: \$146,868 over 3 yrs.

Dr David Cooke: Geological setting, geochemistry and genesis of carbonate base metal enriched epithermal gold mineralisation, Kelian Gold Mine (Indonesia): \$62,268 over 3 yrs.

For more information about AMIRA, see their web site at www.amira.com.au.

OS

Research Profile**Melt inclusion studies to focus on porphyry Cu-Au genesis from Assoc Prof Tony Crawford**

As crystals grow from a magma, tiny portions of the magma are trapped and are commonly preserved in volcanic rocks. These portions retain key information on primary magma compositions, even for elements that are normally mobile during hydrothermal alteration and metamorphism, such as K, Ba and Rb and the chalcophile elements.

CODES petrologists Assoc Prof Tony Crawford, Dr Dima Kamenetsky and Dr Leonid Danyushevsky are developing new techniques based on melt inclusion studies that will provide valuable information about:

- the volatile compositions and budgets of magmas associated with porphyry Cu-Au and VHMS ore deposits
- the primary geochemistry of altered volcanic rocks.

The project focuses on studies of porphyry-Cu and VHMS-related host rocks – both ancient and modern – and a key theme is to locate specific compositional features that may identify certain volcanic belts as ‘fertile’ for mineralisation. In typically altered

rocks around ore deposits, this data may be otherwise inaccessible, and the research will help focus the search area for porphyry Cu-Au exploration.

The research involves heating populations of melt inclusions in fresh silicate minerals and oxides using a custom-built heating stage to homogenise them to glass.

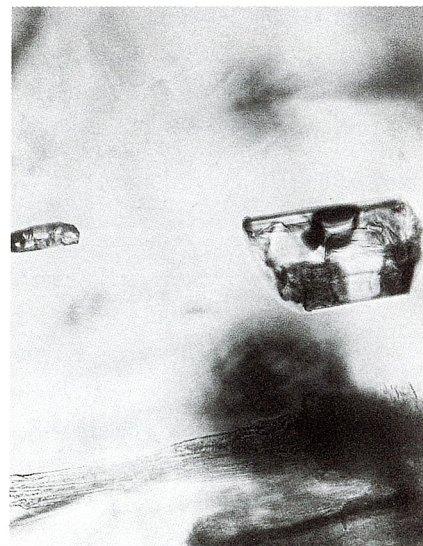
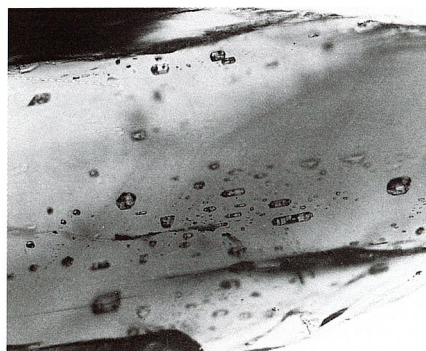
Preliminary observations of intrusive porphyries from Didipio and Far South East (both in the Philippines) indicate that melt inclusions may be preserved in porphyries, and could assist in monitoring the magmatic and volatile evolution of fractionating magmas in mineralised versus barren porphyry systems.

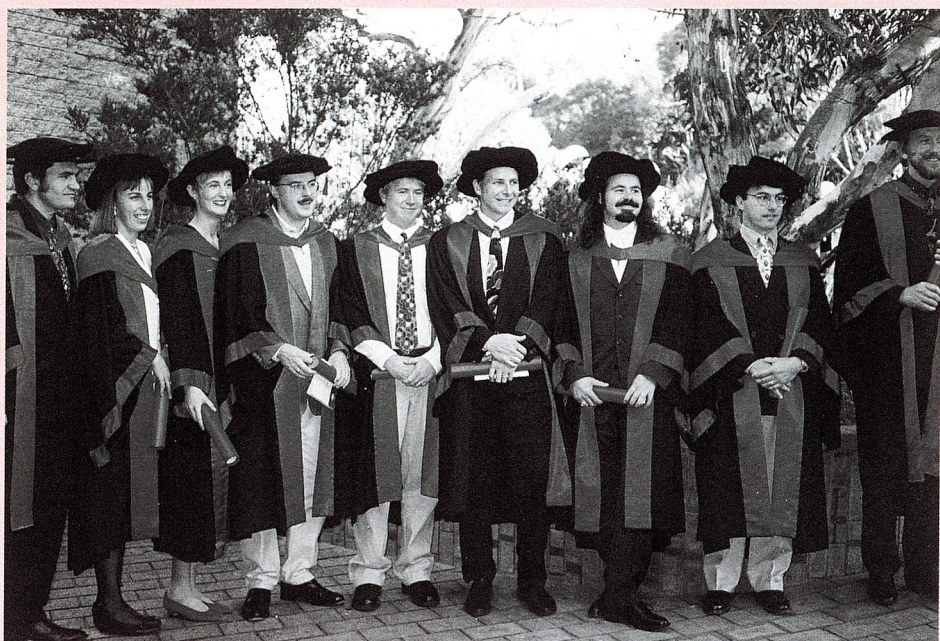
Similarly, determining magma compositions using melt inclusion-based electron microprobe and laser ablation ICP-MS studies in high-K and shoshonitic rocks, should provide valuable clues as to why these magma series appear to be more commonly associated with Cu-Au mineralisation, for example, than arc tholeiitic or typical calc-alkaline magma series.

OS

(below) A zone of salt-silicate melt inclusions in clinopyroxene from the Balut Dyke in Didipio porphyry Cu.

(right) Closeup showing a melt inclusion with salts (lighter areas), silicate, ore mineral and fluid bubble (darkest area).





1997 PhD graduates (left to right)

Dr Andrew Tunks. Paladin Resources

Dr Alicia Verbeeten. Aberfoyle Resources

Dr Anthea Hill. WMC

Dr Marcel Kamperman. BHP

Dr Jamie Rogers. RGC Exploration

Dr Matthew White. BHP Exploration

Dr David Selley. North

Dr Stuart Smith. North

Dr Gary McArthur. Aberfoyle Resources

Bumper crop of PhD graduates

Nine PhD graduates from CODES and the Department of Geology (see above) formed part of a bumper crop of science graduates from the University of Tasmania in April 1997. Thirty-four graduates gained their PhD in science – itself one of the highest figures ever at the University. The CODES group represented an extraordinarily high number from a single department, reflecting an excellent performance on completion rates. **OS**

A time for thinking?

from Prof Ross Large

It has been 13 years since I left the exploration industry to join the academic ranks. I have always viewed study leave as an unnecessarily generous perk to be avoided. However, I succumbed this year for the first time, with a ten-week program to tour of some of the major base metal mining districts in Europe (in particular the Iberian Pyrite Belt, Bergslagen District and Irish Zn-Pb deposits) and to discuss potential collaborative research projects. I was based at the University of Southampton, hosted by Clive Boulter and Bob Foster.

The purpose of the visit to the Iberian Pyrite Belt (IPB) was two-fold: to attend the SEG Neves Corvo Conference and to go into the field at Rio Tinto with Clive Boulter, Noel White and Fernando Tornos. Clive Boulter has done an excellent job in demonstrating that many of the 'volcanic rocks' in the Rio Tinto district are in fact intrusives, and that the giant massive sulphide deposits are hosted by sediments with associated

intrusive sills of dolerite and rhyolite porphyry. The abundance of well-documented peperite contact relationships indicate that we have much to learn about magma intrusion into wet sediments, and the link between related hydrothermal activity and massive sulphide formation.

The Neves Corvo conference was excellent, bringing together a cross-section of academic and exploration geologists to discuss the characteristics and genesis of VHMS deposits. I came away feeling that the IPB massive sulphides are certainly not 'typical' of the VHMS group and have major differences with Australian VHMS deposits and Japanese Kuroko deposits.

Later in June, I joined Rod Allen (consultant volcanologist based in Norway) and two CODES research team members, Peter McGoldrick and Stuart Bull, to present a three-day workshop at Lulea University in northern Sweden on sediment-hosted and volcanic-hosted base metal sulphide deposits. This successful event, attended by 25-30 Scandinavian geoscientists, was followed by visits to the Skelefte and Bergslagen mining districts, organised by Boliden AB and North. Zn-Pb deposits in the Bergslagen district have previously been compared to Broken Hill type deposits, although a complete spectrum of deposits is apparent from skarn to VHMS to SEDEX to BHT (and other types that we have yet to contemplate). This is a place where the standard ore deposit models need to be thrown away and a 'back to geological basics' approach is obviously necessary.

continued on page 7

New to the team

Wally Hermann recently joined CODES as a Research Fellow in economic geology. His special interests are in VHMS-related alteration systems and applications to exploration. Over the next two years he will be working on AMIRA project P439 and the SPIRT project on porphyry Cu-Au in the NSW Ordovician volcanic belt.

Dr Rob Scott recently accepted the position as CODES Research Fellow in structural geology. Rob completed his PhD at Monash University and has been at the Research School of Earth Sciences on a post-doc studying Archean Au deposits.

Dr Sharon Allen will join CODES under a Postdoctoral Fellowship in January 1998 to undertake research into young and old submarine pumice deposits in Greece and Australia with Jocelyn McPhie.

Darren Turner has joined CODES as computer programmer and computer support, focusing on programming for geochemical modelling with David Cooke. Darren was previously at the Australian Antarctic Division.

Jess Tyler joined CODES as Public Relations Officer to coordinate our communication activities. She was previously Writer & Communication Manager at a communication consultancy.

Di Steffens is CODES Secretary and manages general enquiries, administration and book sales. She was previously Administrative Secretary at the University of Tasmania in Launceston.

OS

Visitors

Dr Fernando Tornos from the Instituto Tecnológico Geominero de España visited during August to discuss possible collaboration on IPB and Mount Read Volcanics. He also gave a lecture title 'The Iberian Pyrite Belt: geology and geochemistry of the massive sulphides'.

Dr John Thompson, Director of the Mineral Deposit Research Unit (University of British Columbia) visited between September and October to co-present the 'Porphyry and Epithermal Deposits of the Circum-Pacific' short course (25-26 September 1997). During his stay, collaborative research projects were discussed at length, and many CODES staff and students took the opportunity to discuss aspects of their research with John. He also gave an excellent and well-attended talk on the Eskay Creek deposit to the Geological Society of Australia (Tasmania Division) meeting.

Prof Grant Garven from Johns Hopkins University (USA) will visit CODES in 1998 for 12 months to work with our group on modelling basinal fluid flow related to the formation of Proterozoic stratiform Zn-Pb-Ag deposits.

Prof Eugen Stumpfl from the Institute of Geological Sciences (Leoben, Austria) will spend four weeks at CODES during March 1998 on study leave under the Visiting Fellowship Scheme.

Dr Yoshi Goto, research fellow at the University of Hokkaido (Japan), will visit during 1998 to undertake research into volcanic facies with Jocelyn McPhie.

Prof Stephen Self from the University of Hawaii will visit during April 1998 to undertake research on pyroclastic deposits with Jocelyn McPhie.

Dr Rod Allen, a consultant based in Norway, will visit during 1998 as part of his contribution to AMIRA project P439.

Bon voyage

Dr Joe Stolz, a key member of the CODES team, has left for Sydney, where he is contracting to RGC Exploration on their Mt Windsor project.

Dr Paul Kitto will take up a Principal Geologist position as Group Geochemist at RGC in Western Australia in the new year. He will be greatly missed by colleagues and students.

Prof Rick Varne has retired from the Department of Geology and plans to continue his many research projects, dividing his time between Hobart, France and Italy.

Assoc Prof Prasada Rao has retired from the Department to pursue commercial contractual work and to publish new titles in his series of technical books.

Dr Roger Lewis has retired from the Department and is now an active geophysics consultant and farmer.

Mr Vagn Jensen retires from his position as Technical Manager of the Tasmania Seismic Net, an earthquake monitoring program run by the Department of Geology. He will take up a range of personal and professional interests.

OS

CODES home to new SEG Student Chapter

CODES is now home to a new Student Chapter of the Society of Economic Geologists (SEG).

The new Chapter kicked off its campaign with a Polynesian-style Luau, when over 100 members of the Tasmanian geoscientific community enjoyed a party in conditions best described as sub-Antarctic!

The Student Chapter aims to encourage membership at a grass-roots level within undergraduate and postgraduate ranks and to encourage interaction between earth science students and the mining and exploration industry. Activities will include scientific field trips, symposia and workshops and a resource centre for staff and students of the Geology Department, as well as for visitors, will also be established. It also aims to broaden the public perspective of earth sciences through events such as public lectures.

The Student Chapter is sponsored by CODES and is a non-profit group, operating on funds raised from membership, profits from its various activities and contributions from the geological community. Any contribution, either financial or technical, would be greatly appreciated and will be acknowledged in the SEG and Chapter newsletters.

For more information, contact:

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A time for thinking?

continued from page 5

Leaving Sweden, we travelled to Ireland to sample the Guinness and learn about Irish-style carbonate-hosted Pb-Zn-Ag deposits. Our underground visit to Navan was certainly the highlight of my study leave. I am now happy to admit that not all stratiform carbonate-hosted Pb-Zn-Ag deposits are syngenetic.

John Ashton (Chief Geologist at Navan) gave us an unbiased tour that provided convincing evidence of the importance of replacement and open-space fill processes in deposit formation. However, there is some room left for exhalative Zn-Pb processes contributing to the uppermost boulder conglomerate ores.

In between these various field trips, I managed to develop further academic linkages with Eugen Stumpfl's group at Leoben, Peter Hertzog's group in Freiberg, Uros Herlec's group at Ljubljana and Tony Falick's group at East Kilbride.

Before returning to Australia, I made a second visit to Spain to link up with John and Anne Thompson (Mineral Deposit Research Unit, University of British Columbia) to present a joint two-day workshop to Rio Tinto geologists in Seville. This completed the loop and brought us back to speculating on where the IPB massive sulphide deposits fit within the ore deposit spectrum.

After ten weeks of visiting and thinking about a range of ore deposits in Europe, ones that I had previously only read about, my conclusions can be summarised very simply:

- Our standard approach of pigeon-holing ore deposits into particular classification schemes or 'models' is very limiting, and in some cases misleading.
- There is no substitute for a field or mine visit to get a feel for a particular deposit or district. Study leave has its merits after all!



1998 SEG Calendar

March

Visit by Malcolm Walter, an eminent researcher on the NASA Early Life project, to give a public lecture and a series of talks on 'Life on Mars'. He will also discuss VHMS environments and their potential as sites of early life.

March-April

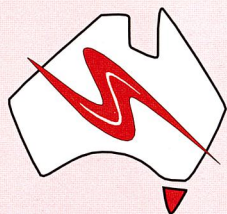
Field trip to picturesque King Island to explore the exciting volcanology, structural geology and tungsten skarn mineralisation. This island is not frequently visited, but has superb exposures of late Precambrian volcanics, Precambrian metamorphics and garnet skarn deposits.

June

Basin Fluid Modelling workshop at CODES coinciding with the Master of Economic Geology 'Ore Deposit Studies & Exploration Models' short course.

September

Field trip to the Proterozoic Arthur Mobile Zone in north western Tasmania. This area has significant gold exploration potential and the trip is to elucidate possible exploration plays and to generate future honours and PhD projects.



CODES SRC

Centre for Ore Deposit Research

Contributions

Contributions welcome but not guaranteed to run. Send to:

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University of Tasmania



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Short course dates for 1998

volcanology & mineralisation in volcanic terrains

8-22 March 1998. Leaders Dr Jocelyn McPhie and Dr Bruce Gemmell

Covers current approaches to mapping, facies analysis and mineralisation in ancient and modern volcanic sequences. It provides an introduction to the processes and products of different eruptions styles, contrasts in scale and structure of volcanoes, identifies key volcanic facies associations and interprets facies variations. The course also covers mineralisation and alteration ore processes related to hydrothermal systems in subaerial and submarine volcanic terrains and the implications for mineral exploration.

ore deposit studies & exploration models

15-26 June 1998. Leaders CODES and international experts

Covers all the major classes of ore deposits: volcanogenic massive sulphides, sediment-hosted Pb-Zn-Cu, carbonate-hosted Pb-Zn, Broken Hill type, Proterozoic Cu-Au, Sn-W, porphyry Cu, epithermal Au-Ag, Archean Au, Ni and PGE deposits. Features of the deposits relating to their genesis and exploration are discussed, and exploration models are presented.

tectonics, structure & ore deposits

2-14 November 1998. Leaders Dr Ron Berry and Assoc Prof Tony Crawford

Deals with tectonic and structural controls on ore deposits and includes field trips to north eastern and western Tasmania. Sessions examine structural techniques and the broad tectonic setting and magmatism associated with ore deposits. The course emphasises applications of structural techniques to geological problems in exploration and mining geology and explores the relationship between modern tectonics, structure and ore deposits.

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