



CODES Highlights

- The CODES Key Centre has completed a very successful second year of growth and development in both the research and teaching segments of its program.
- The Federal Government Key Centre Grant has been supplemented with strong financial support from the mining industry, the Tasmanian Government and the Australian Research Council.
- There has been a steady growth in student numbers over the past two years with 13 Honours students and 22 postgraduate students enrolled in 1991.
- The outside research funding has been concentrated on 12 major projects involving 17 separate mining and exploration companies, the CSIRO, the BMR and State Government Surveys (Tasmania and NT).
- The major focus of our research has been on zinc-lead-copper massive sulphide deposits and their host volcanic sequences (Mt Read Volcanics in Tasmania and Mt Windsor Volcanics in Queensland) and Proterozoic copper-gold deposits (Tennant Creek district in the Northern Territory, Mt Isa Eastern Succession in Queensland, and the Stuart Shelf in South Australia).
- In 1990 results from our research at the Key Centre were presented in 14 international publications, 17 confidential reports to industry and 21 conference abstracts. Six major research meetings/workshops were held with sponsor companies during the year to facilitate technology transfer of our research findings.
- The highly successful Proterozoic copper-gold research project is due to finish in mid-1991. Preliminary discussions with industry geologists indicate considerable support for a new Proterozoic base metal research project to be established in late 1991.
- The new Master of Economic Geology degree by coursework and research has generated widespread interest with 13 enrolments by industry geologists in 1991. The practice of running the coursework units as short courses for industry has proved very successful, and provided much needed financial support to the program.

AusIMM Scholarships

Four University of Tasmania students have been awarded Australasian Institute of Mining and Metallurgy scholarships for 1991.

They are first-year student Hugo Connery, second-year student Daniel McKeown, third-year student Bruce Taylor and fourth-year student Robert Lewis.

These scholarships were established in 1990 by the AusIMM Education Endowment Fund to encourage the study of geoscience, mining and metallurgy in Australian tertiary institutions. The scholarships are valued at \$4000 for 1st and 2nd year and \$7000 for 3rd and 4th year students.

The awards were presented at the Annual General Meeting of Tasmanian Division of the AusIMM which was held at the Salamanca Inn, Hobart on 4 April. Michael Weldon, Minister for Resources and Energy, delivered the after-dinner address, "The long term availability of mineral and power resources to the mining and metallurgical industries".



The Minister for Resources and Energy, Mr Michael Weldon (centre) presented the 1991 AusIMM Scholarship Awards to (from left) Hugo Connery, Daniel McKeown, Bruce Taylor and Robert Lewis.

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Introducing CODES staff members

- **Ross R Large PhD**
Director
 - mineral exploration technology, ore deposit models, hydrothermal geochemistry, massive sulphide deposits and Proterozoic ores
- **Ron F Berry PhD**
Senior Lecturer in Structural Geology
 - structure of ore deposits, faults and shear zone fabrics, metamorphic petrology
- **Garry Davidson PhD**
ARC Research Fellow
 - genesis of Proterozoic ore deposits
- **Naomi Deards**
Laboratory Assistant
 - lapidary assistant
- **J Bruce Gemmell PhD**
Lecturer in Economic Geology
 - geology, geochemistry and genesis of ore deposits. Fluid inclusions and isotope applications
- **Christine Higgins**
Secretary
 - secretarial duties and more
- **Laura Hurd**
 - part-time drafting
- **David L. Huston PhD**
ARC Research Fellow
 - hydrothermal geochemistry, isotope geochemistry and mineral paragenesis
- **Richard Keele PhD**
AMIRA Research Fellow
 - structure of ore deposits
- **Khin Zaw MSc**
CODES Research Fellow
 - fluid inclusion studies
- **Gerrit Kuipers PhD**
Graduate Research Assistant
 - oxygen isotope extraction laboratory supervisor
- **David Leaman PhD**
Visiting Lecturer in Geophysics
 - gravity and magnetic signatures of ores and their environments
- **Peter McGoldrick PhD**
Industry Research Fellow
 - sediment-hosted Pb-Zn deposits
- **Jocelyn McPhie PhD**
Lecturer in Volcanology
 - physical volcanology of ancient and modern volcanic sequences
- **June Pongratz**
Senior Technical Officer
 - everything else
- **Simon Stephens BSc**
Senior Laboratory Assistant
 - lapidary workshop supervisor
- **A Joe Stolz PhD**
ARC Research Fellow
 - petrology and geochemistry of ancient and modern volcanics

CODES Short Courses for Industry

1-14 July

**Exploration geochemistry
and hydrothermal
geochemistry**

14-27 October

**Exploration geophysics and
image processing for geolo-
gists**

11-24 November

**Mineral economics,
exploration management and
the environment**

Enquiries regarding these courses
should be directed to —

Ms Christine Higgins

CODES

University of Tasmania

GPO Box 252C

Hobart Tasmania 7001

Phone (002) 202472

Fax (002) 232547

PhD Scholarships/Projects

CODES is currently organising a number of PhD projects for 1992. The projects, which will each be supported by a mining company, are in the following areas:

- * Ore deposit research on sediment-hosted lead-zinc deposits (Northern Australia)
- * Submarine volcanic processes and the environment of VMS deposits (Queensland and Tasmania)
- * Application of the laser microprobe to sulphur isotope research

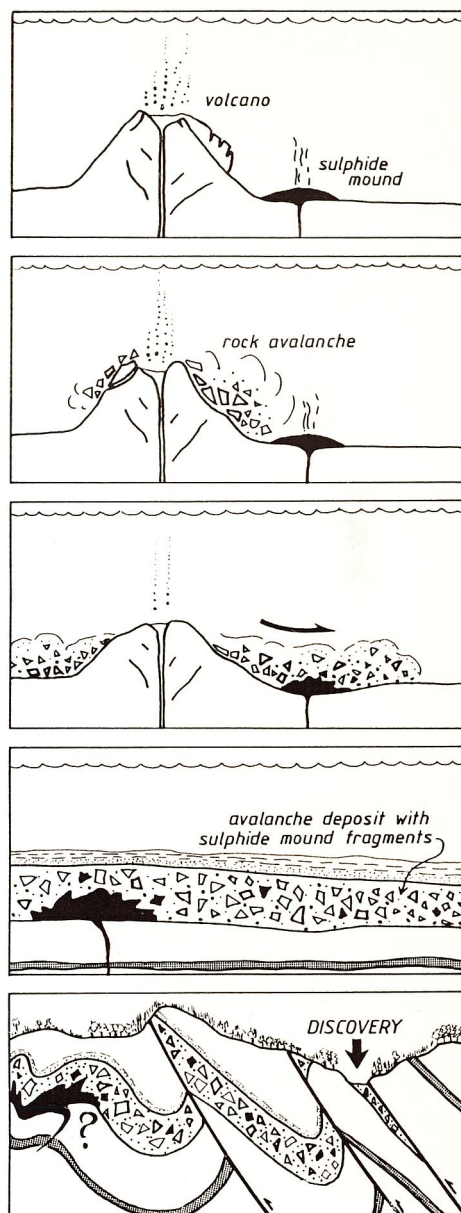
Enquiries to Dr Ross Large, Director, CODES, University of Tasmania, GPO Box 252C, Hobart, Tasmania 7001

Sulphide clasts exposed — new ore deposit on West Coast?

Andesitic lava and breccia of the Mount Read Volcanics is well exposed on the Anthony Road, and in HEC excavations nearby. These rocks occur within the field research area of CODES Honours student, Robert Gibson. The breccia is mostly composed of angular lava clasts. However, Robert has also identified clasts of massive sulphide minerals (galena and sphalerite) in an outcrop of the breccia. There are only about half a dozen sulphide clasts in the outcrop, ranging from 8 to 40 cm across, but they are very rich in lead and zinc. The minerals and textures in the sulphide clasts are the same as those found in sulphide ore bodies elsewhere in the Mount Read Volcanics, such as Rosebery, Que River and Hellyer. It is likely that the sulphide clasts in the breccia have come from a similar sulphide deposit nearby but concealed by overlying rocks.

The breccia unit that contains the sulphide clasts may be an avalanche deposit, formed when the steep and unstable slopes of a submarine volcano collapsed (see diagram). Such avalanches travel very rapidly down slopes, commonly eroding fragments of rock and sediment from the underlying surface. In this case, the avalanche moved across the top of a massive sulphide mound (see diagram). Pieces of sulphide torn from the deposit were transported in the avalanche, with all the other rock fragments, until it came to rest.

Robert's discovery of massive sulphide clasts has particular significant implications for mineral exploration in the area, since the clasts indicate the possibility that there is a large massive sulphide deposit nearby. Current and future research will focus on the breccia unit and the enclosing rocks in an attempt to predict the location and character of the concealed massive sulphide deposit.



ARC Fellowship for CODES Researcher

Joe Stolz has recently been awarded a Research Fellowship by the Australian Research Council to undertake research into the relationships between volcanic geochemistry, tectonic setting and massive sulphide deposits.

The research project stems from preliminary studies on the Cambrian Mount Read Volcanic Belt in western Tasmania, and the Mount Windsor Volcanic Belt in North Queensland. It is intended to extend the study to include VMS-bearing volcanic belts of varying ages (Archean to Permian) from Australia.

The principal aims of the project are

to, first, clarify the relationship between volcanogenic massive sulphide deposits and their host volcanic packages. An important aspect of this is to determine if mineralisation events are related to specific stages in the magmatic evolution of volcanic suites.

The second principal aim of the project is to re-examine the relationship between the volcanic geochemistry and the tectonic setting in which volcanogenic massive sulphides are deposited. Many Archean and Phanerozoic VMS deposits are hosted by volcanics with similar compositions to modern convergent margin volcanics. This implies deposition

in a similar compressional tectonic setting which is at variance with some models for Archean and Proterozoic tectonics.

The research is largely of a fundamental nature but has the potential to produce results which will be useful to the mineral exploration industry. An understanding of the tectonic setting in which VMS deposits form has important implications for the generation of regional exploration targets, and more detailed information about the host stratigraphic packages of known deposits may yield important criteria for focusing exploration within specific volcanic belts.

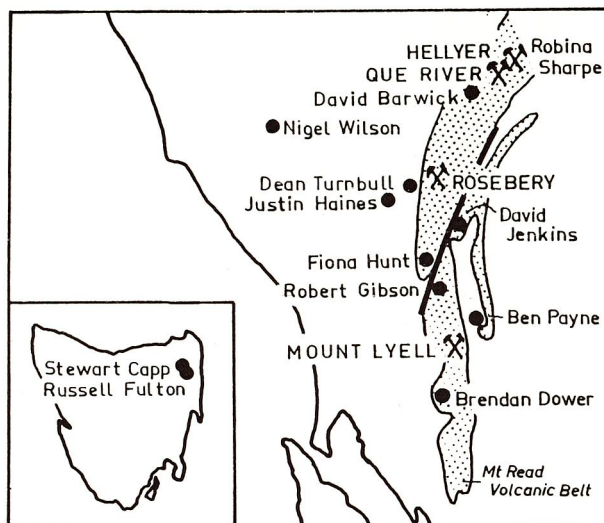
Student Research in 1991

Honours Students

Thirteen students are undertaking an Honours degree at the CODES Key Centre in 1991. Industry and government financial support for these students totals \$51,000.

The students and their research projects are listed below:

- **David Barwick** — Geology and mineralisation of the Soc Creek/High Point area, western Tasmania
- **Stewart Capp** — Geology and geochemistry of the Golden Ridge area, northeastern Tasmania
- **Brendan Dower** — Geology of the Miners Ridge area, Mount Read Volcanics
- **Russell Fulton** — Devonian granites, northeastern Tasmania
- **Robert Gibson** — Tyndall Group and andesites on the Anthony Road, western Tasmania
- **Justin Haines** — Stratigraphy and sedimentology of the Crimson Creek Formation and relationship to gabbro intrusives, Renison Mine



- **Fiona Hunt** — Application of immobile elements and REE to exploration geochemistry
- **David Jenkins** — Alteration, mineralisation and volcanology of the Red Hills prospect, Mount Read Volcanics, western Tasmania
- **Ben Payne** — Interpretation of the gravity and magnetic data of the Mt Sedgwick area western Tasmania
- **Robina Sharpe** — Geology and geochemistry of the barite cap, Hellyer mine, western Tasmania
- **Dean Turnbull** — Mineralisation at Colebrook Hill, western Tasmania
- **Nigel Wilson** — Geology and mineralisation of the southern Arthur Lineament, Tasmania
- **Andrew Harvey** (part-time)

Master of Economic Geology

The Master of Economic Geology degree course, which commenced in July 1990, has attracted wide interest amongst industry geologists around Australia. The course is a combination of coursework (60%) and research thesis (40%) designed to bring industry and government geologists up-to-date with recent advances in economic geology, ore deposit modelling and field mapping procedures.

The first three units of the course-work component for the Masters were run in July, November and December 1990, each in a two-week extended short course format and were also offered as short courses for industry and government geologists.

The courses were run by a group of specialists selected from the Key Centre, industry and other universities.

Details of the 1991 course work units are listed on page 2 of this newsletter.

Short Course Units 1990

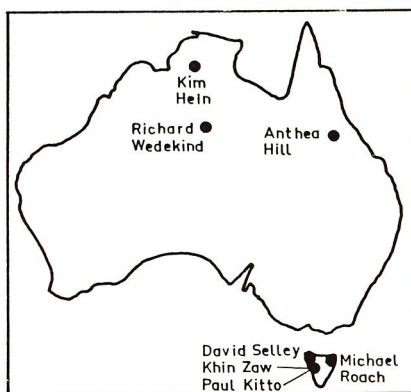
- 1 Ore deposit studies and exploration models
- 2 Tectonic and structural controls on ore deposits
- 3 Volcanology and mineralisation in volcanic terrains

Lecturers in the CODES Masters Program 1990

Large, Dr Ross	CODES	Williams, Dr Neil	CEC Exploration
McPhie, Dr Jocelyn	CODES	Beeson, Dr Bob	Shell Metals
Berry, Dr Ron	CODES	Muhling, Dr Peter	BHP Minerals
Stolz, Dr Joe	CODES	Heithersay, Mr Paul	Geopeko
Gemmell, Dr Bruce	CODES	Henley, Dr Dick	Epithermex
Davidson, Dr Garry	CODES		
Huston, Dr David	CODES	Groves, Professor David	UWA Key Centre
Allen, Dr Rod	CODES	Pollard, Dr Peter	JCU Key Centre
Hobbs, Dr Bruce	CSIRO	Simmons, Dr Stuart	University of Auckland
Houghton, Dr Bruce	DSIR	Carey, Professor SW	University of Tasmania
Wyborn, Dr Lesley	BMR	Ballhaus, Dr Chris	University of Tasmania
		Crawford, Dr Tony	University of Tasmania

PhD Projects

- **Richard Wedekind** — Genesis of the Warrego gold-copper deposit, Tennant Creek, NT (supported by Geopeko)
- **Khin Zaw** — Geochemical study of the Rosebery South and Hercules ores, Tasmania (supported by Pasminco)
- **Michael Roach** — Geology and geophysics of NE Tasmanian granites and associated gold mineralisation (supported by Tasmanian Government Scholarship and Billiton)
- **Anthea Hill** — Geology and geochemistry of the Thalanga massive sulphide deposit, Qld (supported by Pancontinental and Outokumpu)
- **Kim Hein** — Structure and geochemistry of the Batman gold deposit, NT (supported by Billiton)
- **Paul Kitto** — Structural and geochemical controls on tin deposition at Renison Bell (supported by Renison Ltd)
- **David Selley** — Structure and mineralisation in the Dundas Trough (supported by Tasmanian Government Scholarship and AMIRA)



GAC-MAC 1991

Bruce Gemmell will be attending the Joint Annual Meeting of the Geological Association of Canada-Mineralogical Association of Canada in Toronto from May 23 to June 1, 1991. He will be presenting a paper entitled *Evolution of the Alteration Zone and Stringer System beneath the Hellyer Volcanogenic Massive Sulphide Deposit, Tasmania, Australia*. In addition, Bruce will be attending a pre-conference short course, *Major Sediment-hosted Ore Deposits: Basin Analysis and Sedimentary Processes in Mineral Exploration*, and a post conference field trip, *Massive Sulphide Deposits at Manitowadge and Winston Lake — Stratigraphy and Alteration*. Bruce will be visiting Dartmouth College, NH, USA to give a talk on his Hellyer research, and the Mineral Deposit Research Unit at the University of British Columbia to discuss the potential for collaborative research on Canadian and Australian VMS deposits.

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Library donation

CODES was the recent recipient of a large collection of economic geology text books and journals. We thank Mr R. Camprell for his generous gift.

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Base Metal Symposium

Ross Large was one of the invited Keynote speakers at the Base Metal Deposits Symposium held in Townsville from 17–19 April. His talk was entitled *Ore deposit styles and exploration models for Australian VMS deposits*.

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Congratulations DIG

Last month, David Groves was awarded the Silver Medal by the Society of Economic Geologists for his outstanding research contributions to economic geology. David, who graduated from the University of Tasmania BSc(Hons) 1962 and PhD (1969), is currently Professor and Director of the WA Key Centre for Strategic Minerals.

M. Econ. Geol. Students

- **Greg Cozens** — Geology and zonation White Devil Mine NT
- **Sam Garrett** — Geology of the Mt Elliot Cu-Au deposit
- **Simon Henderson** — Mineralisation in the western Kauaeranga Valley, NZ
- **Ken Morrison** — Application of ICP technology to streamwater geochemistry
- **Roger Poltock** — Volcanic/tectonic setting of the Cambrian Henty Fault wedge
- **Robert Rutherford** — Structural study of the Bounty gold mine, WA
- **Katrina Virgo** — Mineral potential of the Rocky Cape Group in NW Tasmania
- **Brad Wake** — Alteration zones in the Mt Windsor Volcanics (Qld)

Tasmanian Government Mining Scholarships

Honours	\$8000
MSc	\$16,000
PhD	\$20,000

Applications are invited from students wishing to undertake an Honours, MSc or PhD degree at CODES in 1992, on a project related to the development of the Tasmanian mining industry.

Closing date: 31 October

New laser ablation stable isotope micro-analytical facility for the Central Science Laboratory

A significant new development in isotopic analysis of individual mineral grains is currently being developed by CODES researchers in collaboration with the CSL staff, which will place us at the forefront of sulphur isotope research related to ore deposits and exploration.

Over the past three years, the development of micro-inlets on stable isotope mass spectrometers and laser based micro-sampling techniques has allowed the analysis of stable isotopes at a scale of ~100 μm with precision comparable to that of conventional analysis. At present, systems for sulphur, carbon and silicate oxygen have been developed in Europe and North America, but similar systems have not been proven in Australia.

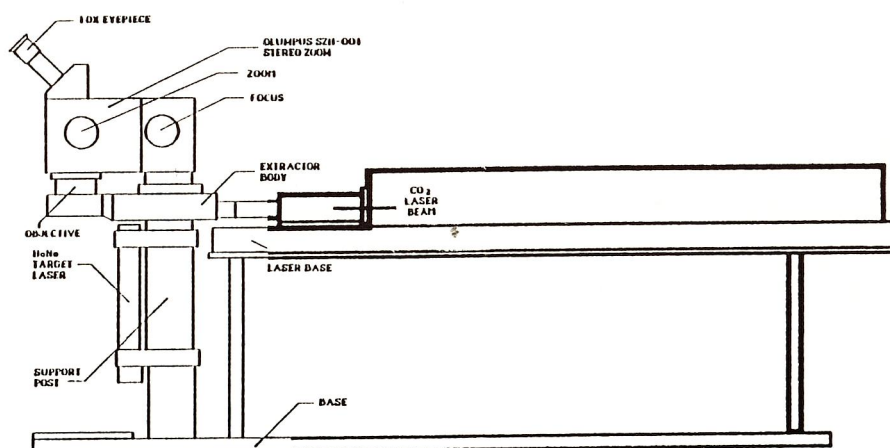
Following visits by David Huston to a number of North American laboratories that are developing laser ablation capability, CODES has purchased a Nd:YAG laser and optical delivery system from Lapp Enterprises in California. Lapp Enterprises was chosen as they have designed laser ablation systems for several labs in Canada and U.S.A. The Nd:YAG laser was chosen over the CO_2 laser as it offers both a smaller beam diameter (30 μm) and a proven capability for stable isotope, particularly sulphur, analysis.

The laser ablation microprobe is currently being shipped from California, and it should arrive in early June. A cryogenic cleaning line and sample chamber has been designed and built in conjunction with Michael Power and John Ladru of the Central Science Laboratory in anticipation of the arrival of the laser microprobe. Upon arrival, emphasis will be given to developing techniques for microanalysis of sulphur isotopes using the newly purchased Sira 10 Series II mass spectrometer. Analysis of 100 μm spots is anticipated initially, but further developmental work may significantly decrease this size. After the technique is developed for sulphur isotopes, analysis of carbonate minerals for C-O isotopes

will be attempted, as well as analysis of diamond and graphite for C isotopes.

Development of this technique allows detailed examination of the variation of isotopes within individual mineral grains as well as the determination of high resolution mineral pairs for geothermometry. In combination with pixeprobe and microprobe analyses, this new technique will substantially help our understanding of the fine details of ore formation, and maintain the University of Tasmania's facilities for stable isotope research among the best in Australia.

Contact: David Huston (002) 202804



Special Issue of Economic Geology

Ross Large is currently organising a collection of research papers for a Special Issue of the journal *Economic Geology* on Australian volcanic-hosted massive sulphide deposits and their volcanic environment. A total of 22 papers has been submitted for the issue, which cover descriptions and research developments on a range of deposits including Hellyer, Que River, Rosebery, Balcooma, Thalanga, Mt Chalmers, Benambra, Teutonic Bore and Scuddles. Additional papers describe the volcanology, geochemistry, stratigraphy and tectonic environment of VMS districts in Australia. The Special Issue is expected to appear in Australia about mid-1992.

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DO YOU HAVE ANY RESEARCH REQUIREMENTS?

If you have any exploration areas or projects that require advanced research to better define exploration models or geological parameters, please contact us. We are looking for new Honours, MSc and PhD projects for students as well as collaborative industry-funded projects that require an experienced multi-discipline research team approach. Enquiries should be directed to Ross Large (002) 202472 or Ron Berry (002) 202456.

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Research matters

Nine students undertook Honours field projects in 1990 most of which were supported by individual Tasmanian exploration and mining companies. Some important research findings have resulted from these projects that are relevant to future mineral exploration in the state, and company geologists are encouraged to visit the CODES Key Centre and to review the theses. For example, research by Ben Coutts and Robert Reid has demonstrated stratigraphic and geochemical similarities between the andesite/rhyolite/sediment sequence of the Central Volcanic Complex of the Pinnacles-Burns Peak area with the andesite/dacite/basalt/sediment package in the Que-Hellyer region. The obvious conclusion, that certain parts of the Central Volcanic Complex are stratigraphically equivalent to the Que-Hellyer sequence, clearly has important implications for VMS exploration.

Volcanic facies analysis and correlations in the Mt Read Volcanics

Dr Jocelyn McPhie has received funding from the University of Tasmania's Priming Grant Scheme to start a project aimed at understanding the volcanic facies architecture of the Cambrian Mount Read Volcanics in western Tasmania. Jocelyn has spent a full summer season in the field mapping and logging drill core covering an area from north of Hellyer, south to an area west of Hercules. The project is focussed on a distinctive volcanoclastic facies association that may be useful for correlation. Results to date are very encouraging and have major implications for the relative ages of known ore deposits, and prospectivity of volcanoclastic sequences in the Mount Read Volcanics.

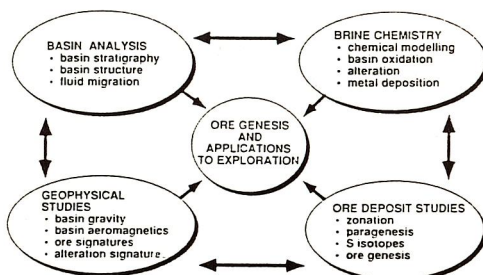
Enquiries — Jocelyn McPhie (002) 202892

Structure and Mineralisation in Western Tasmania

A field meeting was held in the Queenstown area in early May to discuss results of research by Ron Berry and Richard Keele on Devonian and Cambrian structural history in the Mt Lyell and Howards Road region. The meeting was attended by fifteen company geologists from Aberfoyle, Pasminco and RGC, and apart from the rain, hail and freezing wind proved to be a very worthwhile two days. The final stop on the excursion was at the Henty Dam spillway where Honours student Robert Gibson has recently discovered and mapped a number of high-grade massive sulphide clasts (10–40 cm across) within an andesitic mass flow volcanoclastic horizon (see story on page 3). The excitement of this discovery and implications for exploration in the immediate area, finished the excursion on a high note.

Proterozoic sediment-hosted Pb–Zn deposits

In order to underpin the search for base metal mines in the Australian Proterozoic, CODES researchers have proposed a major research effort which combines AMIRA, ARC and Key Centre funds. The project will tackle both the fundamental aspects of brine hydrology, metal solubility and deposition chemistry and the applied aspects of structural focussing, stratigraphic control, geochemical features and exploration implications. The research program (see diagram) will be undertaken by a multi-



disciplinary team led by Dr Ross Large and including a number of researchers from the Key Centre who have experience working on base metal ores and their host rocks (Drs Garry Davidson, Peter McGoldrick, David Huston, Bruce Gemmell and Richard Keele). This project is the logical extension to our recently completed research project on Proterozoic copper–gold deposits. Copies of this research proposal are available from Ross Large (002) 202472 or Jeff Bailey of AMIRA (03) 6548844.

Jolly Jaunt for Geologist

Dr Richard Keele, a Research Fellow in Structural Geology at the CODES Key Centre, is taking a trip to Northern Australia during May and early June. The first four days will involve supervising Kim Hein's PhD project in the field, in which she is studying the regional setting and geochemistry of gold-bismuth and tin mineralisation in the Pine Creek Geosyncline. This project is sponsored by Billiton and takes in an area around Mt Todd in which extensive deposits have already been proven up. Then he travels to Mount Isa to undertake a period of consulting work for a major mining company in his area of expertise, namely, regional structural compilation and target selection. The next leg of the journey takes him to Townsville, to visit James Cook University and one of the other Key Centres devoted to the study of ore deposits in Australia. A visit to ACM Gold's Wirrilie mine, SW of Townsville, with one of the company geologists who is enrolled for a masters at JCU, is to establish cooperation and interchange between the two centres. Thence the journey will take him back to Hobart, via Sydney.

SGEG Ore Fluids Conference — Canberra

CODES was well represented at the SGEG Ore Fluids Conference which was held in Canberra from 31 January to 2 February 1991. Eight talks and/or poster sessions were given by CODES staff and students. Bruce Gemmell, Dave Huston, Anthea Hill, Kim Hein and Paul Kitto also attended the pre-conference field trip which visited the Ardlethan, Gidginbung, Goonumbla, Browns Creek and Sheahan-Grants deposits.

A post-conference highlight was the loss by Kodak of Bruce Gemmell's photographic record of the field trip (and subsequent offer by Kodak to finance a return visit to the field trip area)!

Talks/poster sessions

Paul Kitto & Ron Berry

History of brittle deformation and related mineralisation at Renison tin mine, western Tasmania

Bruce Gemmell

Geology and geochemistry of the stringer zone underlying the Hellyer deposit

Oliver Raymond

Pyrite paragenesis and trace element composition at the Prince Lyell copper deposit, Queenstown, Tasmania

Anthea Hill

Structure and metal zonation of the Thalanga VMS deposit, North Queensland

David Huston & Ross Large

Distribution of gold in volcanogenic massive sulphide deposits: implications for ore genesis and metallurgical recovery

Ross Large & Garry Davidson

Controls of brine chemistry on the spectrum of Proterozoic sediment-hosted base metal deposits

Bruce Gemmell, H. Zantop & L.D. Meinert

Genesis of the Aguilar Zn-Pb-Ag deposit, Argentina

Kim Hein

An introduction to Batman

Degree conferred

Congratulations to Garry Davidson PhD, whose degree was conferred at the Graduation Ceremony at the University of Tasmania on April 23.

His thesis is entitled "Starra and Trough Tank: Iron-formation-hosted gold-copper deposits of northwest Queensland, Australia."

Garry and his supervisor, Ross Large, are pictured.

