CODES Newsletter

Centre for Ore Deposit and Exploration Studies, University of Tasmania October 1992

New AMIRA–ARC Collaborative Project: Proterozoic sediment-hosted base metal deposits

Negotiations are completed for the commencement of a new research project on Proterozoic sediment-hosted base metal deposits.

The project was selected in the first round of ARC Collaborative projects announced in June 1992. The eleven AMIRA sponsor companies are: Aztec, BHP Minerals, Billiton, Geopeko, MIM Exploration, Outokumpu, Pancontinental, Plutonic, Poseidon, RGC Exploration and WMC. The BMR and the NT Geological Survey are also supporting the project. Annual contributions from AMIRA and ARC are $165,000 and $130,000 respectively.

This is a multi-disciplinary project involving the integration of sedimentary basin analysis, brine geochemistry and deposit halo studies to develop a spectrum of models for ore genesis and mineral exploration. Work this field season has commenced on regional stratigraphic and structural studies in the southern McArthur basin and deposit halo studies in the Lawnhill platform associated with the Lady Loretta and the Kamargu Dome mineralisation.

CODES researchers involved in the project are Dr Peter McGoldrick (deposit halos), Dr Richard Keele (regional structure), Dr David Leaman (regional geophysics and basin structure), Dr David Cooke (basin geochemistry) and Professor Ross Large (Team leader, exploration models).

For information contact David Tucker (AMIRA ph. 03 6548844) or Ross Large (CODES, ph. 002 20247).

CODES highlights 1991/2

Outside support for research and teaching in the Key Centre has reached a level of $1.1 million for 1992. This funding included support from the Tasmanian Government ($158,000), ARC ($312,500), and the mining industry ($383,000).

In 1991 our research effort was directed toward studies of base metal and gold mineralisation in Tasmania and northern Australia. Twenty-two research projects are in progress, involving collaborative agreements with the Tasmanian Mines Department, various mining and exploration companies, the BMR, NTGS and the CSIRO Division of Exploration Geoscience.

The reputation and profile of the Key Centre has risen sharply over the past three years, so that we are now attracting over 50% of our students from interstate.

The growth of student numbers in the Key Centre is currently on target, with six Honours, 23 Master of Economic Geology, four MSc and 11 PhD students enrolled in CODES.

A major effort has been directed toward developing the Master of Economic Geology degree into one of the best regarded coursework Masters in Australia. A balanced program of lectures from 55 academic, industry and government specialists selected from around Australia has been co-ordinated to provide a top-class teaching program.

Industry support for Honours field projects has continued at a high level and two new APRA–Industry scholarships have been awarded for PhD projects sponsored by WMC and Renison.

INSIDE

Introducing new CODES staff members...

• **Dr Peter McGoldrick** was appointed as Research Fellow in June 1991, to work on the Proterozoic sediment-hosted base metal project. Peter brings a range of expertise relating to the geochemistry and geological setting of stratiform ore deposits, having undertaken his PhD on the Mt Isa deposit.

• **Dr David Cooke** was appointed as Research Fellow in November 1991, to develop computer models for ore fluid generation and metal carrying capacity within sedimentary and volcanic environments. David recently completed his PhD at Monash University on the Acupan epithermal gold deposit.

• **Dr Steven Walters** has joined the Key Centre for 12 months as a BHP Visiting Research Fellow. Steven is an experienced industry researcher who is undertaking a BHP-funded project on sediment-hosted Pb-Zn mineralisation.

• A visitor to CODES in 1992 is **Mohammad Karimpour**, Associate Professor of Economic Geology at Ferdowsi University in Mashhad, Iran.

Whilst at CODES he is continuing work on three projects:

1. The mineralogy, paragenesis, trace element isotopes and fluid inclusions of the Qaleh-Zari Cu–Au deposit, 153 km south of Birjand, in eastern Iran. The deposit is a vein type hosted by Tertiary andesite and dacite and some Jurassic shale. The ore grade is 2–9% Cu, 0.1–30 ppm Au and 30–200 ppm Ag.
2. The petrogenesis of the Mashhad granitic rocks with particular reference to establishing their tectonic setting and potential for Sn and W mineralisation.
3. The genesis of Sangan magnetite deposit, a high grade Fe deposit which is located in eastern Iran.

He is accompanied by his wife and two children.

• **Christine Higgins** has transferred to Administrative Assistant duties within CODES.

• **Kirsty Whaley** is the new CODES Secretary.

Members of staff of the Centre for Ore Deposit and Exploration Studies. Back row L to R: Dr Peter McGoldrick, Dr Joe Stolz, Kirsty Whaley, Dr David Huston, David Cooke, Dr Bruce Gemmell, June Pongratz, Dr Richard Keele. Front row: Mark Doyle, Christine Higgins, Dr Jocelyn McPhie, Professor Ross Large, Dr Steven Walters, Dr Khin Zaw, Dr Mohammad Karimpour.
INSERT: (Top to bottom) Dr Garry Davidson, Dr David Leaman, Dr Ron Berry.

New student projects

New PhD projects in 1992

Six PhD and three MSc students have commenced research at the Key Centre this year.

Lachlan Heasman, who obtained his Honours degree at Macquarie University, is studying petrophysical properties of the Mount Read Volcanics, and their bearing on the volcanic petrogenesis and mineral exploration. This project is funded by the Tasmanian Government Mining Scholarship Scheme.

Jamie Rogers is undertaking a project on the structure, stratigraphy and tectonic development of the southern McArthur River Basin. Jamie obtained his Honours degree from Adelaide University and his project forms part of the CODES/AMIRA project on Proterozoic sediment-hosted Pb/Zn deposits.

Andrew Tunks has returned from working with WMC at Kambalda to undertake a study of the geology and mineral paragenesis of the Tanami gold deposit. This project is funded by Zapopan NL. Andrew completed his Honours degree at Monash.

Matthew White has commenced research on volcanic facies analysis of the Tyndall Group in the Mount Read Volcanics of western Tasmania. Matthew obtained his Honours degree at the University of Technology, Sydney. His project is funded from an ARC grant to Jocelyn McPhie.

Mike Roache is planning to study the geology and geochemistry of the Mennine Dam Pb-Zn deposit on the Eyre Peninsula, SA. Mike obtained an MSc from Auckland University and has eight years experience in the exploration industry. The project is supported by Aberfoyle.

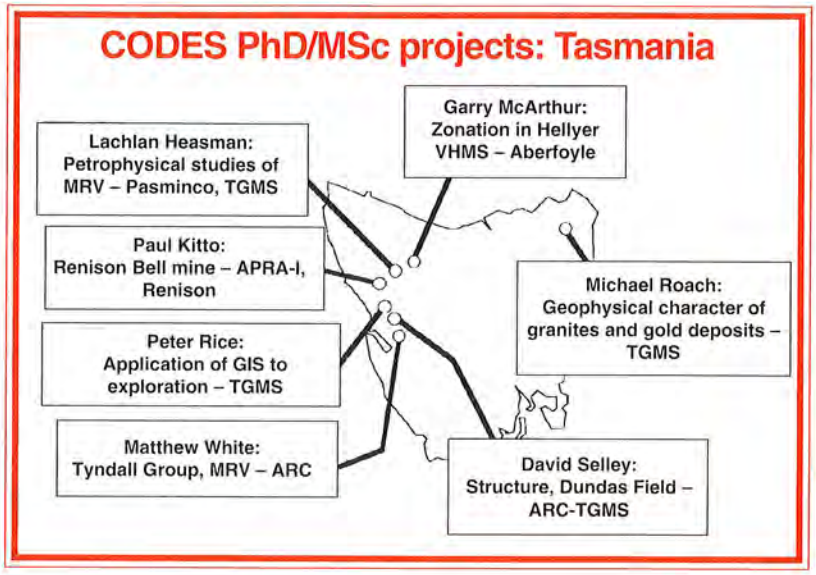
Stuart Smith is studying the geology and genesis of the Warrabarty Pb-Zn prospect, Throssell Ranges, WA. Stuart came from RGC (PNG) where he worked as an exploration geologist for two years. The project is supported jointly by an APRA (Industry) Scholarship and WMC.

1992 MSc projects

Karin Orth: Style and setting of massive sulphide mineralisation at Koongie Park, Halls Creek, WA. This project is supported by Billiton.

Peter Rice: Application of GIS to mineral exploration. Supported by the Tasmanian Government Mining Scholarship Scheme.

Steven Hunns: Volcanic environments of the Mt Chalmers VMS deposit. Supported by Outokumpu.



1992 BSc Hons students

Six students are undertaking Honours degrees at the CODES Key Centre in 1992. Industry and State Government support for the Honours program is very encouraging.

Paul Abbott: Geology and mineralisation of the Anthony Power Tunnel (Tas Govt Mining Schol).

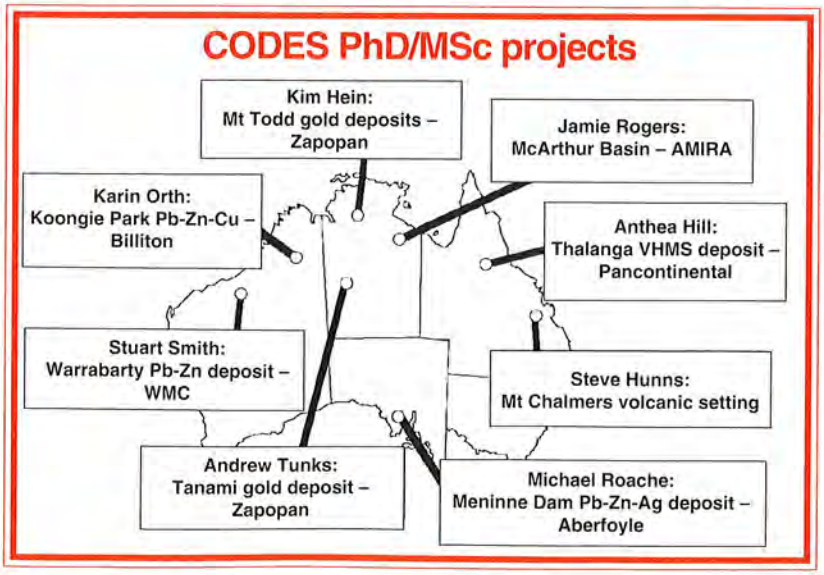
Matthew Dell: Regolith-landform relationships and geochemical dispersion about the Kanowna Bell Au deposit, WA (CSIRO/Geopeko).

John Donaldson: Structure, mineralogy and geochemistry of the Union Reef gold deposit, NT (RGC Exploration).

Mark Duffett: Geophysics of Scamander mineral field (Tas Govt Mining Schol).

Jim Dugdale: Geology of White Spur Formation (Tas Govt Mining Schol).

Bruce Taylor: A structured section through the Mathinna beds (AusIMM).



Summary of our major research projects

CODES staff and postgraduates are currently involved in a range of research projects, funded from a diversity of sources, with major contributions from ARC, AMIRA and the mining industry.

Many of our most successful projects involve a multidisciplinary team approach to research bringing a range of expertise to tackle specific problems in a given mining district. A very brief summary of important research progress and achievements for a few of the projects is given below.

Project 1: Proterozoic gold-copper research (NT, Qld)

This project, which was sponsored by eleven mining companies and NT Geological Survey, has developed new geochemical and geological models relating to exploration for gold and copper deposits associated with ironstones. The final research meeting was held in Hobart in June 1991 to present our research results and conclusions to sponsor companies. (*Project Leader: Ross Large*)

Project 2: Sediment-hosted Pb–Zn deposits

This is a new ARC–AMIRA Collaborative Research Project to study the environment and genesis of Proterozoic Pb–Zn deposits in northern Australia. The project involves an integrated multidisciplinary approach using geological, geophysical and structural studies, combined with brine chemical modelling and halo geochemistry, to provide a framework on which to build a network of exploration criteria for major sediment-hosted base metal deposits. (*Project Leaders: Ross Large, Peter McGoldrick, David Leaman, Richard Keele*)

Project 3: Controls on ore deposition in the Mt Windsor Volcanics (Qld)

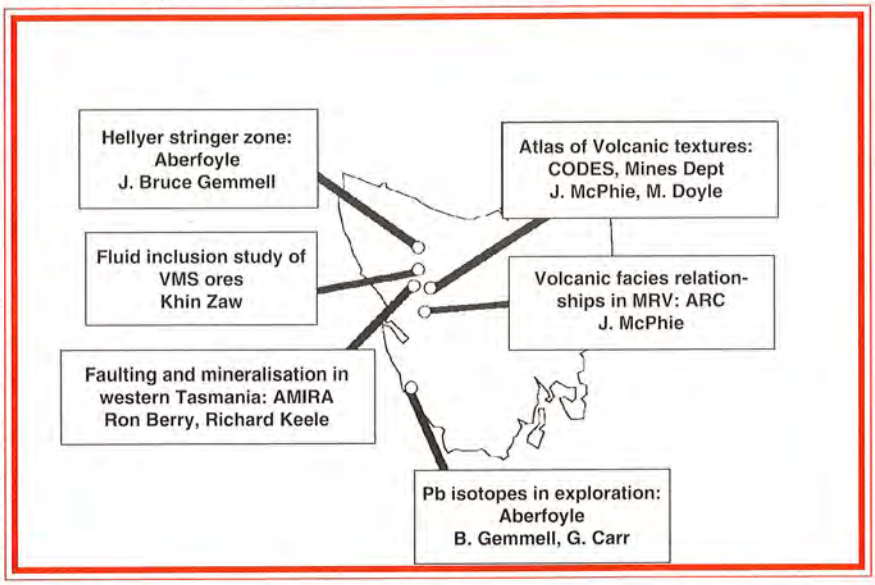
Funded by Pancontinental Mining and Outokumpu, this project was completed in May 1991. A new regional interpretation of the structure, volcanic stratigraphy and mineral potential of this important Cambrian volcanic province was presented to a field meeting of the sponsors in Charters Towers. Anthea Hill is continuing aspects of this research in a PhD project on the Thalanga mine. (*Project Leader: Ross Large*)

Projects 4: Applications of stable isotopes to ore genesis and exploration

This project, sponsored by CODES, the University of Tasmania, ARC and the Tasmanian Department of Mines, is aimed at developing techniques for the microanalysis of sulphide and carbonate minerals for isotopes of sulphur, carbon and oxygen. A laser ablation system, which comprises a Quantronix model 117 Nd:YAG laser and an extraction line, has been mounted on a binocular microscope with video camera. Preliminary results indicate that a 150 μm spot, 100 μm deep, provides adequate SO_2 for analysis on the new VG Sira II mass spectrometer. The system is currently being modified for on-line analysis and to improve safety. This is the first system of its type in Australia and gives CODES the capacity to be at the forefront of sulphur isotope research in economic geology. (*Project Leader: David Huston*)

Project 5: Structure and mineralisation in western Tasmania

This project, funded by the Australian Mineral Industry Research Association, completed its second year of operation in 1991 with a further two structural sections across the Dundas Trough completed. Progress continues in defining Cambrian structure related to VMS deposits and fault controls to Devonian mineralisation. Research reports were submitted to the sponsor companies at two meetings held in May and November. (*Project Leaders: Ron Berry and Richard Keele*)



Project 7: Lead isotope research applied to exploration in the Mt Read Volcanics

This two year project, in collaboration with Aberfoyle Resources and the CSIRO Division of Exploration Geoscience, is investigating the Pb isotope signatures and variations of the Hellyer deposit and the Elliott Bay and Mackintosh district prospects. A second part of the project is to determine the Pb isotope signature of the potential source rocks for the VMS mineralisation of western Tasmania. Pb isotope signatures of exploration prospects, in combination with a potential Pb isotope stratigraphy of the source rocks, will be used to discriminate mineral prospects for exploration. Initial sample collection and analyses are currently underway. (*Project Leader: Bruce Gemmell*)

Project 9: Facies architecture of the Cambrian Mt Read Volcanics

In 1990 Dr Jocelyn McPhie 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 volcaniclastic 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 volcaniclastic sequences in the Mount Read Volcanics. The project will be supported by an ARC large grant from 1992–94. (*Project Leader: Jocelyn McPhie*)

Project 10: Source-rock sulphur isotope study (Tasmania)

This project, partially funded by ARC, will investigate the magmatic sulphur isotope characteristics of the potential source rocks for the VMS mineralisation in western Tasmania. Laser ablation technology will be utilised. (*Project Leader: Bruce Gemmell*)

Project 13: Tectonic settings of massive sulphide deposits (supported by ARC)

Geochemical studies are being undertaken on basic and intermediate volcanics from several Palaeozoic VHMS-bearing belts in eastern Australia with the objective of providing a better understanding of the specific tectonic settings in which volcanic-hosted massive sulphides form. This project builds on the results of research on the Mt Windsor Volcanic Belt, and initially sampling has focussed on the Permian Berserker Beds and the Devonian sequence which hosts the Mt Morgan Cu–Au deposit. It is intended to extend the study during 1992 to include the Silurian Enano Group rocks which host the Wilga and Currawong deposits, and Proterozoic volcanics and metasediments that host the Koongie Park mineralisation near Halls Creek. (*Project Leader: Joe Stolz*)

Project 14: Isotopic and rare earth element geochemistry of ores and their host-rocks (ARC funded)

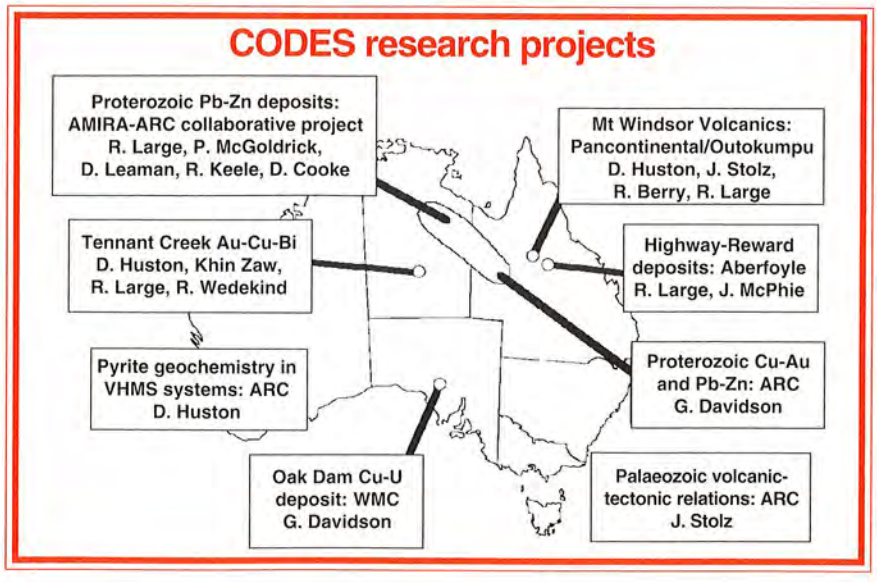
This project presently is examining (1) stable isotope geochemistry of the Dugald River shale-hosted Pb–Zn deposit, Queensland; (2) chemistry and morphology of tuff beds in and around the HYC Pb-Zn deposit, NT; and (3) chemical and textural variation in a single hematite chert exhalite in the Mount Windsor Volcanics, Queensland. In each case the work is being carried out with company collaboration, but not financial support. (*Project Leader: Garry Davidson*)

Project 15: The partitioning of trace elements in minerals from precious metal-bearing deposits

This project, which is supported by the ARC and CODES, is aimed at determining the distribution of trace elements among sulphide minerals in gold- and silver-bearing deposits. Results indicate that the partitioning of gold between electrum, gold-bearing tellurides, arsenopyrite and pyrite in VMS deposits depends strongly on the temperature of formation, the method of gold transport, the position in the massive sulphide lens and the relative intensity of deformation. Studies of pyrite in VMS ores indicate consistent variation in trace element concentrations with distance from ore, and differences in composition between Cu-rich and Zn–Pb-rich deposits. Studies of the partitioning of silver in VMS ores are currently underway. (*Project Leader: David Huston*)

Project 16: Textures of submarine volcanic rocks in VMS districts

This project is funded by the Key Centre industry sponsors to produce a manual of volcanic rock textures specifically for application by geologists exploring for massive sulphide deposits in volcanic terrains. It typifies our commitment to the transfer of CODES research results to our industry sponsors. (*Project Leaders: Mark Doyle and Jocelyn McPhie*)



For further information on any of these projects please contact the Project Leaders listed.

Major research projects 1990–92

	Project Title	Sponsors	Researchers
1	Controls on Proterozoic sediment-hosted base metal deposits, NT, Qld	AMIRA/ARC	R. Large, P. McGoldrick, R. Keele, D. Leaman, D. Huston D Cooke, J. Rogers (PhD)
2	Controls of ore deposition in the Mt Windsor Volcanics	Pancontinental, Outokumpu, Agip	R. Large, R. Berry, J. Stolz, D. Huston, 1 PhD student, 1 Hons student
3	Application of stable isotopes to ore genesis and exploration	ARC, University of Tasmania	R. Large, B. Gemmell, D. Huston
4	Application of ore genesis research to exploration	ARC	R. Large, D. Huston, Khin Zaw
5	Structure and mineralisation in western Tasmania	AMIRA, ARC	R. Berry, R. Keele, D. Selley (PhD)
6	Hellyer stringer zone	Aberfoyle	B. Gemmell, R. Large
7	Pb isotopes: application to exploration in the MRV	Aberfoyle	B. Gemmell, G. Carr, (CSIRO), R. Large
8	Golden Ridge project, NE Tasmania	Billiton, Aureole	G. Davidson, M.Roach (PhD)
9	Facies architecture of the Mt Read Volcanics	ARC	J. McPhie, M. White (PhD) plus several Honours students
10	Source rocks for Tasmanian ore deposits	ARC	B. Gemmell, J. Stolz
11	The Batman gold deposit, NT	Billiton	K. Hein (PhD), R. Keele, R Large
12	Renison Bell tin deposit, Tasmania	Renison Ltd	P. Kitto (PhD), R. Berry, R. Large
13	Tectonic setting of massive sulphide deposits	ARC	J. Stolz
14	Isotopic and REE geochemistry of ores and their host rocks	ARC	G. Davidson
15	Trace elements in precious metal sulphide ores	ARC	D. Huston, Soey Sie (CSIRO)
16	Manual of textures of submarine volcanic rocks	CODES sponsors	M. Doyle, J. McPhie, R. Large
17	Warrabarty Pb-Zn-Ag project, WA	ARC, WMC	B. Gemmell, R. Large
18	Union Reef gold deposit, NT	Billiton	R. Keele, K. Hein, Honours student
19	Structure and mineralisation of the Tanami Au deposit, NT	Zapopan	R Keele, A. Tunks (PhD)
20	Fluid inclusions in ore genesis and exploration	ARC, CODES	Khin Zaw, B. Gemmell, R. Large
21	Mineral deposits and exploration potential of Burma	AMIRA	Khin Zaw, M. Roach
22	Volcanology and mineralisation at Koongie Park, WA	Billiton	J. McPhie, J. Stolz, K. Orth (PhD)

Interested in Master of Economic Geology?

Twenty-three industry geoscientists are currently enrolled for the CODES Master of Economic Geology course, which consists of six units covering the spectrum of metalliferous economic geology plus a short research thesis. The Masters course is rapidly becoming recognised for the quality and up-to-date nature of each unit. We have achieved this result by:

- enlisting the best available academics and industry professionals to lecture
- ensuring that the course content is at the forefront of science and technology, and is relevant to the needs of the exploration and mining industries.

Each unit is offered as a two-week extended short course. The 1992 units are:

- Volcanology and mineralisation in volcanic terrains (January)
- Ore deposit styles and exploration models (July)
- Tectonic and structural controls on ore deposits (November)

If you are interested to find out more about this course, please contact Ross Large or Christine Higgins (Ph. 002 202472 or fax 002 232547).

A list of lecturers involved in the MEconGeol program is presented below.

University of Tasmania
Dr Ross Large — CODES
Dr Jocelyn McPhie — CODES
Dr Ron Berry — CODES
Dr Joe Stolz — CODES
Dr Bruce Gemmell — CODES
Dr Garry Davidson — CODES
Dr David Huston — CODES
Dr Rod Allen — CODES
Dr Khin Zaw — CODES
Dr David Leaman — CODES
Mr Michael Roach — CODES
Dr Roger Lewis — Geology
Dr Sarah Jennings — Economics
Prof. S.W. Carey — Geology
Dr Chris Ballhaus — Geology
Dr Tony Crawford — Geology

Industry
Dr Neil Williams — CEC Exploration, Qld
Dr Bob Beeson — Shell Metals, Vic
Dr Peter Muhling — BHP Minerals, WA
Mr Paul Heithersay — Geopeko, NSW
Dr Dick Henley — Epithermex, ACT
Dr Ken Cross — WMC, SA
Mr Simon Gatehouse — RGC, ACT
Dr Michael Asten — BHP, Vic
Dr John Bishop — Mitre Geophysics, Tas
Dr David Isles — World Geoscience, WA
Dr Eric Swarbrick — EIS, NSW
Mrs Vivian Snowden — Snowden Assoc., WA
Mr David Whitrow — AMIC, ACT
Mr Ian Wood —RGC, Tas
Mr Hugh Skey — Aberfoyle, Vic
Mr Jacob Rebec — CRA, NSW
Dr Chris Blain — BHP, Vic
Dr Steven Walters — BHP Qld
Dr Gregg Morrison — Consultant, Qld

Other Universities
Prof. D. Groves — UWA Key Centre
Dr Peter Pollard — JCU Key Centre
Dr Rick Valenta — Monash/VIEPS
Mr Ed Malone — Key Centre for Mines, NSW
Dr Andrew White — Univ of Qld
Dr Phillip Brown — Univ of Wisconsin
Dr Caroline Perkins — RSES, ANU
Dr Stuart Simmons — Auckland University NZ
Prof. Barry Maynard — Univ of Cincinnati

Government
Dr Keith Corbett — DMMR, Tas
Dr Geoff Green — DMMR, Tas
Dr Bill Baker — DMMR, Tas
Dr Bruce Hobbs — CSIRO, Qld
Dr Bruce Houghton — DSIR, NZ
Dr Lesley Wyborn — BMR, ACT
Prof. Ray Smith — CSIRO, WA
Dr Graham Taylor — CSIRO, NSW
Dr Vanessa Guthrie — DEP, Tas
Mr Warren Jones — DEP, Tas
Mr Brad Cartwright — DEP, Tas

MEconGeol students

Name	Company	Research thesis topic
1990 Intake		
Greg Cozens	Poseidon Gold (NT)	Geology and zonation, White Devil mine, NT
Sam Garrett	Cyprus Gold (Qld)	Geology of the Mt Elliott Cu–Au deposit
Simon Henderson	Beta Limited (NZ)	Mineralisation of the western Kauaeranga Valley, NZ
Ken Morrison	Contract geologist (Tas)	Application of water geochemistry to exploration
Roger Poltock	Contract geologist (Tas)	Volcanic/tectonic setting of the Cambrian Henty Fault wedge
Robert Rutherford	Aztec Mining (WA)	Structural study of the Bounty gold mine, WA
Katrina Virgo	Geopeko (NSW)	Exploration in the western Cobar Trough
1991 Intake		
Kim Denwer	RGC Exploration (PNG)	An epithermal gold deposit, PNG
Richard Downs	Aberfoyle (Tas)	Faulting and structure at Hellyer mine
Steven Cooper	Livre Holdings (Vic)	Genesis of zeolite deposits
Ian Hart	Contract geologist (Tas)	Timing of the North Lyell Cu deposits
Stuart Jeffrey	Cobar Mines (NSW)	Geochemistry and geophysics of the CSA deposit
Greg Lear	Contract geologist (Tas)	GIS applied to diamond exploration
Lachlan Reid	Pasminco (Tas)	Structure of the Rosebery north end lenses
Marcel van Eck	Mt Leyshan Mine (Qld)	Geology, geochemistry of Mt Windsor Volcanics
1992 Intake (to date)		
Tracy Kerr	BHP (WA)	Magnetic character of BHT deposits
Greg Ebsworth	Contract geologist (Vic)	The Currawong massive sulphide deposit
Kim Grey	RGC Exploration (WA)	to be decided
Nick Langsford	Newcrest	Archean lode gold deposits
Bruce McQuitty	RGC	to be decided
Stephen Lynn	Mt Kersey Mining	to be decided
Andrew Graham	BHP	to be decided
Michael House	RGC	to be decided

Volcanology and ore deposit short courses 1992

Two very successful short courses were conducted in the first half of 1992 as part of CODES Master of Economic Geology program.

The physical volcanology course included a week in New Zealand studying recent subaerial volcanics and related geothermal/epithermal systems followed by a week in western Tasmania experiencing the problems in mapping ancient submarine volcanics and hydrothermal alteration associated with massive sulphide deposits. Twenty-two geologists, including eleven MEconGeol students, participated in the course. Highlights in New Zealand included a vigorous climb to the summit of Mt Tarawera to explore the 1886 eruption products, more climbing in the rain and cloud at Ruapehu and a detailed analysis of the Taupo 186AD ignimbrite eruption. Visits to the Champagne Pool gold–arsenic precipitates and the Martha Hill epithermal deposits provided additional excitement for the exploration contingent.

Contrary to all predictions, the sun shone for us during the second week in western Tasmania. The legendary Mount Read Volcanics provided endless challenges and there were numerous opportunities for participants to practice new skills in observation, description, logging and interpretation. This part of the course also addressed the special needs of exploration geologists, by including instruction in carpark football, bagpipe playing, and how to cope with the HEC staff house desserts.

Crossing a Lahar path, Mt Ruapehu, 29 January 1992

Jocelyn McPhie provided inspirational leadership from start to finish. Somehow all participants survived, several admitted learning something about volcanics, and most enjoyed the experience. (Next offering of the course will be in November–December 1993.)

In July, the short course on Ore Deposit Styles and Exploration Models covered a range of topics including porphyry copper and epithermal deposits (Paul Heithersay and Gregg Morrison), tin deposits (Paul Kitto), Proterozoic copper–gold (Garry Davidson), Archean gold and nickel (David Groves), sedimentary deposits (Barry Maynard), Broken Hill type (Steven Walters), MVT deposits (Peter Muhling), Proterozoic Pb–Cu–Au (Peter McGoldrick) and VMS deposits (Ross Large, Bruce Gemmell and David Huston). The course combined lectures with practical exercises to provide hands-on experience in exploration and research for each deposit style. The "gold star" for the best performance went to Dr Steven Walters, Senior Geologist BHP and Research Fellow at CODES, for his excellent lecture presentation and practical exploration exercise on Broken Hill type Pb–Zn–Ag deposits. Forty-six geologists attended the course.

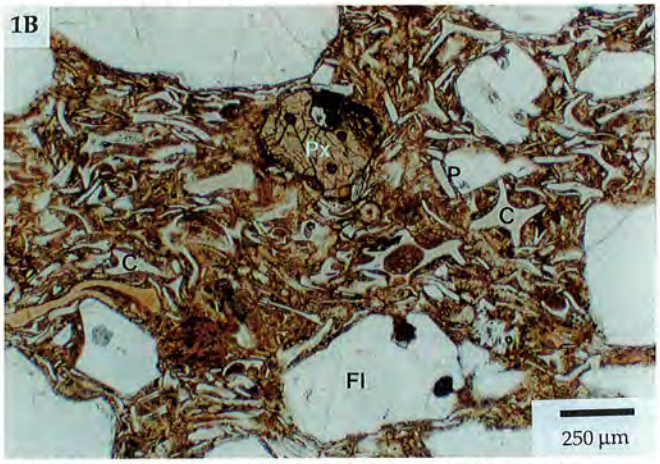
More hot air from Bruce Gemmell

Atlas Of Textures In Volcanic Host Rocks To Massive Sulphide Deposits:

The Cambrian Mount Read Volcanics and younger analogues

Successful exploration for volcanic-hosted massive sulphide deposits is in part dependent on an understanding of the geometry of volcanic units, and on recognising appropriate submarine palaeoenvironments.

The geometry of volcanic units is strongly controlled by eruption style and emplacement mechanisms. These processes may be deciphered from primary textures and structures preserved in the volcanic units. Correct interpretation of palaeoenvironments involves identification of diagnostic facies and facies associations, and also requires appreciation of the significance of particular characteristic textures. Many of the most important textures are subtle, but with practice, can be confidently recognised in outcrop and drill core. In an attempt to help exploration and other geologists working in volcanic sequences, CODES researchers are currently compiling a coloured atlas of the most significant and challenging volcanic textures likely to be encountered.



Slightly welded (sintered) ignimbrite in thin section. *Shards with cuspate (C) and platy (P) shapes are largely uncompacted and undeformed, typical of non-welded and sintered ignimbrite. Other components are feldspar (F) and pyroxene (Px) crystal fragments, glassy fine ash matrix, and drusy vapour phase crystallisation minerals. Ongatiti Ignimbrite, 750 Ka: Hinuera Stone Quarry, Hinuera, New Zealand.*

The atlas illustrates textures occurring in both subaerial and subaqueous volcanic rocks of mafic to felsic composition, although the emphasis is on subaqueous volcanics because these dominate the host sequences to VHMS deposits. Examples of textures from the Cambrian Mount Read Volcanics and other ancient volcanic sequences elsewhere are compared with younger analogues from around the world, including material from New Zealand, Japan, Italy, USA and the Manus Basin. The atlas incorporates examples of textures at outcrop, handspecimen and thin section scales, each accompanied by a non-genetic lithological description, a discussion of diagnostic features and, where appropriate, a genetic interpretation. In some cases, the context of textures within volcanic facies or facies associations is outlined, with reference to facies models based on young, well-exposed volcanic sequences.

In many prospective submarine volcanic sequences, primary volcanic textures are modified by hydrothermal alteration, metamorphism and deformation. Correct interpretation demands an even more careful and painstaking search for significant primary textures, and discrimination of false from primary textures. The atlas shows textures produced in the Mount Read Volcanics: lava and volcanic breccia from Hellyer; and pumice breccia from Hercules.

Flow folds in rhyolite. *Continuous, even flow bands in rhyolite define asymmetrical flow folds that suggest a dextral sense of relative movement. Rhylolite dyke, Bulgonunna Volcanics, Late Carboniferous; Oaky Creek, Queensland.*

The atlas will be completed by November, 1992.
Enquiries: Jocelyn McPhie ph. (002) 202892; Mark Doyle ph. (002) 202788

EXPRESSION OF INTEREST

Atlas of Textures in Volcanic Host Rocks to Massive Sulphide Deposits:
The Cambrian Mount Read Volcanics and Younger Analogues

Please send me further information the Atlas

Name: _____

Institution: _____

Address: _____

_____

Please return this form to: CODES Key Centre
University of Tasmania
GPO Box 252C
Hobart, Tasmania 7000

A new perspective on old rocks

Facies analysis of the Cambrian Mount Read Volcanics, western Tasmania

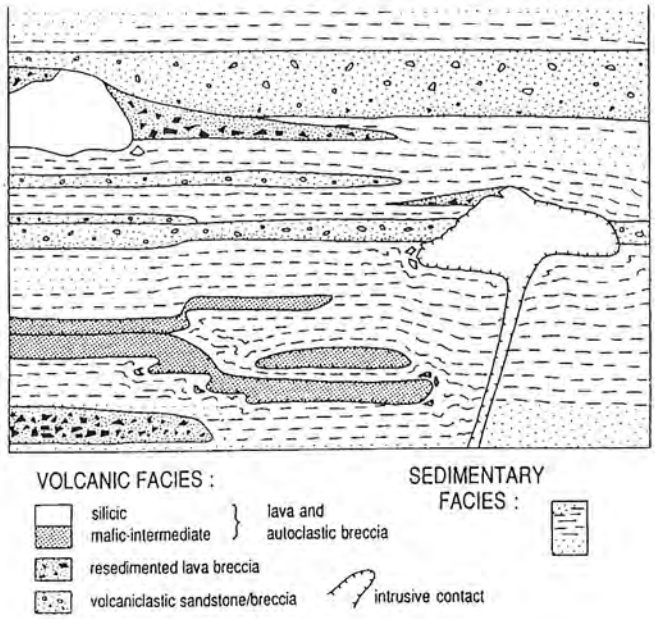
The rich deposits of massive sulphides for which western Tasmania is famous are all contained within Cambrian volcanic rocks. Studies of the sulphide ore bodies show that they were formed on the ancient sea floor at the same time as the enclosing volcanics. Evaluation of the temporal and spacial relationships between volcanic processes and ore forming processes thus depends on correct interpretation of the character and setting of the host volcanic sequences. Accurate definition of the context of sulphide deposition is critically important in exploration for new sulphide deposits, and is also dependent on understanding the physical volcanology of the host volcanic rocks.

The host rocks to the western Tasmania sulphide deposits, the Mount Read Volcanics, have proven to be particularly difficult to decipher. The volcanics are deformed, metamorphosed, and locally strongly altered, especially near the ore bodies. Mapping has been hampered by the dense vegetation cover, poor outcrop and western Tasmania's notorious weather. However, systematic 1:25000 geological maps of the volcanics, produced by the Mines Department of Tasmania, are now available, and provide the context for further research on the Cambrian volcanism.

A new, three-year research project, funded by the ARC, began this year, focussing on the volcanic facies architecture of the Mount Read Volcanics (see figure). The emphasis in this research is on the correct interpretation of the original emplacement processes of the volcanic facies, and on the recognition of distinctive facies associations that may enable correlations among the established lithostratigraphic formations. Emplacement processes are critically important in determining facies geometry. For example, silicic lavas are commonly constructional and rarely widespread, whereas volcaniclastic mass-flow deposits usually form extensive sheets that infill sea floor topography. One of the most complex facies in the Mount Read Volcanics is intrusive, and consists of sills and invasive lava flows that were emplaced in unconsolidated, wet sediments.

CODES researchers involved in this project are Jocelyn McPhie (Chief Investigator), Rod Allen (Visiting Research Fellow) and Matthew White (PhD student). The research is field based and mainly involves detailed field mapping and logging of selected drill core. Jocelyn has concentrated on the northern part of the Mount Read Volcanics, around Hellyer and Sock Creek. Rod has detailed knowledge of the Rosebery–Hercules area, gained during post-doctoral studies while at Monash University. Matthew has begun field work and petrographic studies on one of the youngest formations in the sequence (Tyndall Group).

This research has received a great deal of support and interest from mining companies exploring the Mount Read Volcanics. In particular, the assistance of geologists and technical staff from RGC, Aberfoyle and Pasminco has been invaluable.



Cartoon reconstruction of the volcanic facies architecture for part of the Mount Read Volcanics. The principal volcanic facies are mass-flow volcaniclastic sandstone-breccia sheets, lavas and related breccia, and syn-volcanic intrusions.

Master of Economic Geology

Short Course Program

November 1992
Tectonics and structural controls on ore deposits
June 1993
Exploration geophysics and image processing
July 1993
Exploration geochemistry and hydrothermal geochemistry
November–December 1993
Volcanology and mineralisation in volcanic terrains

Degrees conferred

Congratulations to Khin Zaw, PhD and Richard Wedekind, PhD, whose degrees were conferred at the Graduation Ceremony at the University of Tasmania on 1 May 1992. Richard's thesis is entitled "Geology and geochemistry of the Warrego Au-Cu-Bi mine, Tennant Creek, Northern Territory, Australia". Khin Zaw's thesis is entitled "The effect of Devonian metamorphism and metasomatism on the mineralogy and geochemistry of the Cambrian VMS deposits in the Rosebery-Hercules district, western Tasmania".

Research papers for special issue of *Economic Geology*

Key Centre researchers have been heavily involved through 1990-91 writing papers for a special issue of *Economic Geology* on "Australian Volcanic-Hosted Massive Sulfide Deposits, and their Volcanic Environment".

This project has been a collaboration between researchers at CODES, the Department of Earth Sciences at Monash University, the Tasmanian Department of Mines and the CSIRO Division of Exploration Geoscience. The special issue contains an excellent collection of papers that will be of major interest to both academic and industry geologists. The full list of published papers is given below. Thirteen of the twenty-four papers have been contributed by staff from CODES. *Economic Geology* is recognised as the top international journal in this field and therefore the release of this special issue is certain to enhance the international research reputation of the Key Centre.

The volume was released in June 1992.

Papers in *Economic Geology* Special Issue

1 Introduction

2* **Ross Large** — Australian volcanic-hosted massive sulfide deposits: features, styles and genetic models.

3 **Ray Cas** — Submarine volcanism: eruption styles, products, and relevance to understanding the host rock successions to VMS Deposits.

4* **David Huston, Ralph Bottrill, Robert Creelman, Khin Zaw, Tony Ramsden, Sven Rand** and **Ross Large** — Geological and geochemical controls on the mineralogy and grainsize of gold-bearing phases, eastern Australian volcanic-hosted massive sulfide Deposits.

5 **Keith Corbett** — Stratigraphic-Volcanic Setting of Massive sulfide deposits in the Cambrian Mt Read Volcanics, Tasmania.

6* **J. McPhie** and **R. Allen** — Facies architecture of mineralized submarine volcanic sequences : Mount Read Volcanics, Cambrian, Western Tasmania.

7 **Anthony Crawford** and **Keith Corbett** — Geochemistry of the Cambrian VHMS-rich Mount Read Volcanics, Tasmania, and some Tectonic Implications.

8* **J. Bruce Gemmell** and **Ross Large** — Stringer system and alteration zone underlying the Hellyer volcanic-hosted massive sulfide Deposit, Tasmania, Australia.

9 **John Waters** and **David Wallace** — Volcanology and sedimentology of the host succession to the Hellyer and Que River VHMS Deposits, Western Tasmania.

10 **Robin Offler** and **David Whitford** — Wall-rock alteration and metamorphism of a volcanogenic massive sulfide deposit at Que River, Tasmania: petrology and mineralogy

11* **David Huston** and **Robert Smith** — Trace element distribution in the Rosebery VHMS deposit, western Tasmania.

12* **Joe Stolz** and **Ross Large** — Evaluation of the source-rock control on precious metal grades in VHMS deposits from western Tasmania .

13* **Ron Berry, David Huston, Joe Stolz, Anthea Hill, Simon Beams, Urpo Kuronen** and **Alex Taube** — The stratigraphy, structure and volcanic-hosted mineralization of the Mt Windsor Subprovince, North Queensland, Australia.

14* **Nathan Duhig, Joe Stolz, Garry Davidson** and **Ross Large** — Cambrian microbial and silica gel textures in silica-iron exhalites of the Mt Windsor Volcanic Belt, Australia : their petrography, geochemistry and origin.

15* **David Huston, Terry Taylor, John Fabray** and **David Patterson** — A comparison of the geology and mineralization of the Balcooma and Dry River South volcanogenic massive sulfide deposits, Northern Queensland.

16 **Rodney Sainty** — hallow-water stratigraphy at the Mount Chalmers VHMS deposit, Queensland.

17 **Rod Allen** — Reconstruction of the tectonic, volcanic and sedimentary setting of strongly deformed Zn-Cu massive sulfide deposits at Benambra, Victoria.

18 **Mark Barley** — A review of Archean volcanic-hosted massive sulfide and sulfate mineralization in Western Australia.

19 **David Whitford** and **Paul Ashley** — The Scuddles volcanogenic massive sulfide deposit, Western Australia: geochemistry of the host rocks and evaluation of lithogeochemistry for exploration.

20* **Garry Davidson** — Hydrothermal geochemistry and ore genesis of seafloor volcano-genetic copper-bearing oxide ores.

21 **John Bishop** and **Roger Lewis** — Geophysical signatures of Australian VHMS deposits.

22* **Peter McGoldrick** and **Ross Large** — A gold-enriched stringer zone at Que River mine, Tasmania: epithermal gold mineralization related to a submarine exhalative VHMS deposit?

23* **Khin Zaw** and **Ross Large** — Sub-seafloor replacement origin for the precious metal-rich South Hercules deposit, Western Tasmania: evidence from mineralogy, metal zonation, stable isotopes and fluid inclusions.

24 **David Whitford, M.D. Korsch** and **Mike Solomon** — Strontium isotopic studies of barites : Implications for the origin of VHMS deposits in Tasmania.

* *papers contributed by CODES researchers.*

Contact Christine Higgins (Fax 002-232547) if you wish to order a copy. Cost is around $50, plus postage.

Master of Economic Geology

The CODES M.Econ.Geol. is a program of course work (60%) with research thesis (40%), designed to bring industry and government geologists up-to-date with recent advances in economic geology.

The six units of course work are spread over two years. Each unit is taught in an extended short-course format consisting of an intensive program of lectures, seminars and practicals of two weeks duration. Three units are offered each year.

Course work units

- Ore deposit studies and exploration models (this short course)
- Tectonic and structural controls on ore deposits
- Volcanology and mineralisation in volcanic terrains (field work in New Zealand and western Tasmania)
- Exploration geophysics and remote sensing
- Exploration geochemistry and hydrothermal geochemistry
- Exploration management and mineral economics

Entry requirements

Normal entry requirement is BSc (Hons). Applicants without a BSc (Hons) degree will require the following:

- BSc or BSc (Applied)
- A minimum of two years experience working as a geologist in the mining industry or a government institution.
- Completion of a significant geological company report or paper based on some aspect of work carried out during employment as a geologist.

Enquiries and requests for application forms to:

Ms Christine Higgins, Administrative Assistant,
CODES Key Centre, University of Tasmania,
GPO Box 252C, Hobart, Tasmania 7001.
Ph. (002) 202472 or fax (002) 232547.

Scholarships for PhD & MSc Research

The Key Centre for Ore Deposit and Exploration Studies at the University of Tasmania is widely recognised as one of the foremost research centres in Economic Geology in Australia. The Centre currently has a research staff of 8 geoscientists and 16 postgraduate students. Equipment at the University of Tasmania for ore deposit research is second to none in Australia. CODES scholarships are available for top line students with the equivalent of a first class or good upper second class Honours degree to undertake PhD or MSc research at the Key Centre.

- Annual stipend is in the range $12,734 to $18,000 (tax exempt) dependant on previous academic record and project support from industry.
- Overseas students must also apply for an Australian Government Overseas Postgraduate Research Award.
- Topics available for research include:
- Volcanic processes and environments of base metal and gold deposits.
- Structural controls and fluid processes in hydrothermal systems.
- Genesis of massive sulphide ore deposits.
- Hydrothermal geochemistry of base metal ores.
- Geophysical interpretation of mineral districts.
- Development of isotopic and fluid inclusion studies of ore deposits.

Tasmania is a great place to live and to study geology. Not only do we have a wide variety of world-class ore deposits close at hand, but we offer a spectacular natural environment combined with the lowest housing and accommodation costs of any major city in Australia. Hobart has most of the benefits of other capital cities and there is close access to a variety of leisure pursuits—including bushwalking, skiing and water sports.

Applications and requests for further information:

Dr Ross Large, Director of CODES
University of Tasmania
GPO Box 252C, Hobart, Tasmania, Australia 7001
Telephone (002) 202472 or facsimile (002) 232547

Closing dates for applications: July & October each year

Short Course: 23 November–28 November

A short course dealing with **tectonic and structural controls on ore deposits** is offered by CODES to geologists from industry and academia. The course will include lecture and practical sessions which will examine the broad tectonic setting and magmatism associated with the various types of ore deposits.

It will be shown how information about modern tectonic processes can be applied to the interpretation of ancient terrains and incorporated into exploration models

The course will also cover more detailed aspects of structural and fluid processes related to mineralisation.

PROGRAM

Monday: Metamorphic fluid and mineralisation — Prof. Neil Phillips

Wednesday: Modern Settings — Extensional terrains, intraplate settings and wrench tectonics: magmatism, structure and mineralisation — Joe Stolz, Ron Berry and Richard Keele

Thursday: Modern Settings — Convergent margin and collision settings: magmatism, structure and mineralisation — Joe Stolz, Ron Berry and Richard Keele

Friday: Proterozoic and Archaean tectonics, magmatism and mineralisation — Lesley Wyborn, Garry Davidson, Peter McGoldrick and Richard Keele

Saturday: Lachlan Fold Belt tectonics, magmatism and mineralisation — Dick Glen, Ron Berry and Joe Stolz

West Coast ores on display in rock garden

Twenty-five tonnes of rock have been donated by West Coast mining companies for display in a rock garden being established in the grounds of the University. The individual rock samples, which vary from three to six tonnes each, have been kindly donated by Mount Lyell, Pasminco, Renison and Hellyer mines. Each rock has been cut and polished at J. Dunn, stonemasons of Launceston, to display its mineral textures to best advantage. The purpose of the rock display is two-fold:

- to emphasise the collaboration between the University and West Coast mining companies in planning for the future of mining and Tasmania; and
- to provide large samples for teaching.

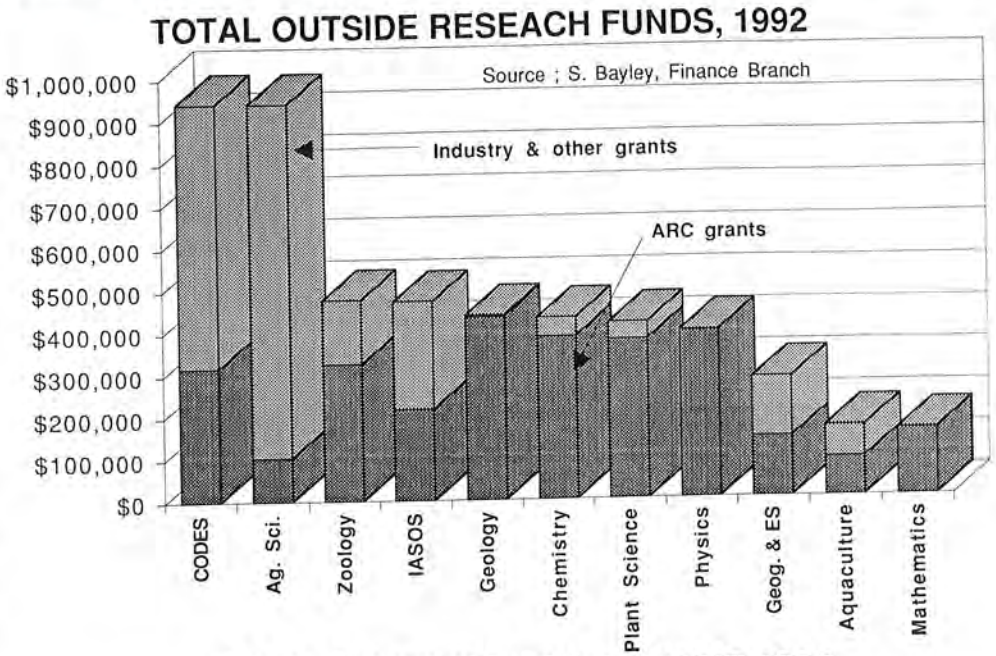
Please come and see the rocks; they provide a spectacular display of the textures, structures and mineralogy of our Tasmanian wealth.

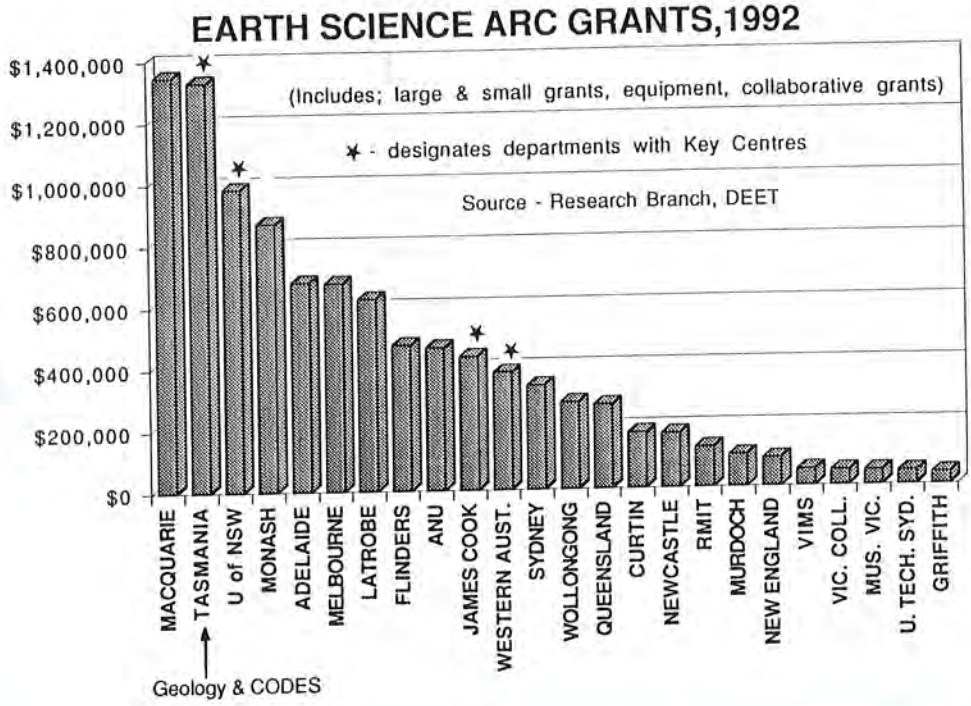
Top rating for Tasmanian Earth Sciences departments

The University of Tasmania Geology Department and Key Centre have performed extremely well in 1992 with regard to ARC and industry research grants funding levels.

As shown in the figures adjacent, Tasmania ranks second to Macquarie University in total ARC grants for 1992. This performance is even more spectacular when it is realised that Tasmania has an academic teaching staff of only nine compared to Macquarie's 29.

Within the School of Science and Technology, at Tasmania, CODES ranks with Agricultural Science as the major earners of outside research funds for 1992 (figure below). With the development of new collaborative research projects over the last year it is likely that Geology and CODES will maintain these high levels of industry and ARC support.





International Base Metal Association

Membership: Open to anyone with an interest in base metal (nominally regarded as Cu, Pb, Zn, Ni and Sn) mineralization. Membership is $A15 per annum for individuals, but this fee is waived for persons who cannot obtain the necessary foreign currency. Companies, research organizations and libraries pay a corporate subscription of $A50. Bank drafts and money orders are payable to "IBMA" and should be made by international money order or cheque drawn on an Australian bank account.

Newsletter: The Newsletter will be published twice yearly. Volunteers are called for to act as national contacts who will assist in collecting material for inclusion in the newsletter. However, contributions from any source covering any aspect of the geology of base metal mineralization are welcome. Descriptions of new and/or lesser known deposits are particularly welcome, as are summaries of research being undertaken at Universities and Government agencies. Unpublished thesis abstracts are also requested. All items for the first issue should reach the Editor before 31 November.

Advertising: Advertisements should be submitted camera-ready typescript with final artwork, in either A4 or A5 format, before 31 November to ensure inclusion in the first issue of the Newsletter. Cost of a single, full-page (A5) advertisement will be $A50 with a reduction for multiple inclusions. Monies to be made payable to "IBMA".

Correspondence: Please address correspondence and contributions for publication to the editor. Computer readable copy or e-mail contributions are particularly welcome. It is envisaged that a list of national contacts will be developed in time to whom material for inclusion in the newsletter can be directed.

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Mine geology workshop at Hellyer

A two-day workshop, organised by Hellyer (Aberfoyle Resources Ltd) chief geologist Gary McArthur and his staff in conjunction with Bruce Gemmell of CODES, was held at the Hellyer mine.

Thirteen students, enrolled in the economic geology course, learnt about mining geology and the role and duties of a mine geologist.

Students attended lectures on mine geology, on being a mine geologist and on the basic principles of underground mapping and core logging. They also spent approximately 10 hours mapping an underground development and logging drill holes, and were then given mine geology plans and cross sections on which they plotted and interpreted their data. Additional lectures covered sampling, ore reserves, computer applications and ore beneficiation. Later 'homework' was accompanied by a few Boags at the Mt Bischoff pub in Waratah.

The workshop was a resounding success and gave the students an appreciation of mine geology and the role of the mine geologist. Another workshop is being planned for later this year. CODES would like to thank Aberfoyle Resources Ltd for their time and effort in organising and running the workshop.

Participants at the mine geology workshop.
Standing (left to right): *Garry McArthur (Hellyer), Matt Bell, Steve Varga, Henry Kurth (Hellyer), Brendan Dower, Dave Barwick, Dave Adams (Hellyer), Stuart Capp, Bevan McWilliams (Hellyer), Graham Howard (Hellyer), Dave Jenkins, Richard Downs (Hellyer), Robert Gibson, Bruce Taylor.*
Sitting: *Michael Blake, Nigel Wilson, Andrew Ezzy, Justin Haines, Robina Sharpe.*

Peter's peripatetic pussy or McGoldrick's misplaced moggy

12 June 1991, Kalgoorlie, WA

The day the McGoldricks left Kalgoorlie to drive east to Van Diemen's Land via the promised land. The plan was for Bo (short for Rambo!) the dog, Splodge (short for Splodge-Roy-Big O) the cat and Erin (not short for anything) the teenage daughter to be placed in foster homes in Kalgoorlie. Erin and Bo would fly to Hobart at a later date, and Splodge would stay in Kalgoorlie to live out her days with a new family.

All went well until the removalist arrived with a sea container on the back of a semi-trailer to load the house contents for shipping to Hobart. On cue, for the first time in seven months it started raining (20 mm in three hours!). When the truck finally departed and the time came to hit the road east there was no sign of the cat! We assumed amongst all the commotion she had 'gone bush', and would return to be fed later in the day. Erin was come back to the house each day to put food out for her until her new foster family returned from holidays and could pick her up. The rest of the family hit the road and got rained on all the way to Port Augusta!

Three weeks later, 53 Grosvenor St, Sandy Bay, Tasmania

The sea container arrives to be unloaded at McGoldrick's new lodgings. The last item out of the container was an old brown couch. Three burly removal men deposit the couch on its back in the lounge room and depart. At this point, Peter detects the unmistakable odour of cat coming from the couch and closer inspection reveals a pair of brown cat eyes staring from a hole in the bottom. Splodge had made it to Hobart the hard way; three weeks by road and sea without food and only condensation to drink. She was very pleased to see the bowl of water proffered to her! Seventy-two hours later she was back to her old neurotic self with no apparent ill-effects. Nearly a year later she seems happier (and fatter) than ever.

Postscript: I believe the record survival time for a cat in a container is seven weeks on a trip from the UK to Australia; the moral to this story is that there may be more than one way to kill a cat but a long sea journey without food or water isn't one of them!

CODES adventures in the west Pacific

Drs Bruce Gemmell and Garry Davidson participated in the Pacmanus CSIRO-University of Toronto expedition, aboard the *R.V. Franklin*, to explore the Woodlark and Manus Basins in the west Pacific during October 1991.

These areas are immediately east of New Guinea and New Britain. The program was designed to complete research begun in the Western Woodlark Basin (Paclarks 1-3, Supaclark; 1986–1990), and then to enter the eastern Manus Basin and explore an area of juvenile volcanic crust on the sea bottom. A prime CODES interest was to participate in the search for hydrothermal activity, a search initiated in this region by Steve Scott and Ray Binns, following the success of other cruises in recent years. (Jocelyn McPhie of CODES was a member of the scientific party of the Zona during the German investigation of massive seafloor deposits in the western Manus Basin in 1990.)

The program was extremely successful, discovering a hydrothermal plume, characterised by elevated turbidity and methane contents, above a very large area of sulphide, barite and anhydrite chimneys, built upon dacitic volcanic crust. Some chimneys stood at least 5 m high, and were surrounded by a prolific chemosynthetic fauna and its associated food-chain. The felsic source rock means the "Pacmanus" deposit may be the best example yet found of active Kuroko-style (lead-rich) hydrothermal activity. To ascertain this, a future expedition will need to obtain further sulphide samples, which was not possible with the equipment on board. Unfortunately a chain-bag dredge meeting a semi-consolidated chimney is a good imitation of sampling flour with a sieve, and doesn't result in retention of sulphides. However, two thumbnail size samples which returned on the camera sled after it collided with a chimney — all caught on video — have been carefully analysed by Ray Binns of CSIRO, and found to be chalcopyrite-anhydrite-barite rocks, with 2 to 10 ppm Au and 1 to 3 ppm Pd, amongst other elements. A submersible program will probably occur at the site in 1993 to obtain further samples.

Although the many viewers of the slides of Gemmell and Davidson now think that seaboard life is exotic and pleasurable, Gemmell and Davidson would like to invite these people to the 4 am watch on a rough night as the third dredge goes out, in tropical drizzle! Activities on scientific cruises are scheduled with military precision to maximise the information collected: the agenda is not interrupted for tidal waves, or cyclones. Each cruise member stands two four hour watches every twenty-four hours, during which time activities might include dredging, water sampling, sediment coring, seafloor mapping, or camera towing. The trick is to sleep regularly (off watch) to avoid becoming very weary as the weeks go by. Other advice for the would-be cruiser — compliment the cook on the food so as to obtain more of it, take the sea sickness pills supplied, keep exercising to avoid becoming a lard, and stay up to date on the data logging, because it can close over one's head very quickly.

Other cruise members included: Ian Clark, U. of Toronto, camera specialist; Dave Edwards, CSIRO, electronics; Melissa Fellows, ANU, sedimentologist; Kaul Gena, U. of PNG, geology; Alex Ortega-Osorio, U. of Toronto, geochemist; Don Ribby, CSIRO, geochemist; Chris Taylor, CSIRO, photographer; Graeme Wheller, CSIRO, petrologist.

Bruce Gemmell drags the chain, on-station in the Manus Basin.

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