



CODES Newsletter

Centre for Ore Deposit and Exploration Studies, University of Tasmania

December 1993

CODES Highlights

- CODES outside funding for research continued at a level of \$1.1 million for 1993. This was provided by grants from industry (43%), ARC (43%) and the Tasmanian Government (14%).
- Fourteen major research projects are currently under investigation with particular focus on base metal provinces in both volcanic and sedimentary terrains (see Research Facts centrefold).
- Postgraduate student numbers continued to show a steady increase with 12 Honours, 17 coursework Masters, 4 MSc and 14 PhD enrolled in 1993.
- CODES staff members have performed exceptionally well in attracting ARC funding in the 1994 round. Two ARC Large Grants, one ARC Collaborative Grant and four APRA-I scholarships were granted for a total of \$741,000 over the period 1994-96.
- A text book on the interpretation of volcanic textures, published by CODES, will be available in December 1993. The book is based on research by the authors Dr Jocelyn McPhie (CODES lecturer), Mark Doyle (PhD student) and Dr Rod Allen (Consultant).

CODES success in 1994 ARC Grants

Ron Berry, Bruce Gemmell, Khin Zaw, Ross Large and David Cooke were winners in the recent ARC round. Overall the University of Tasmania obtained 22 new Large Grants and three Collaborative Grants, which amounts to a major improvement in our ranking compared to other universities.

Ron's project is an ARC Collaborative Grant of \$160,000 over three years to study the relationship between tectonics and mineralisation in western Tasmania (see p. 2).

Bruce Gemmell and Khin Zaw were granted an ARC Large Grant of \$150,000 over three years to study the nature and composition of fluids which form Cu and Pb-Zn massive sulfide deposits. Their work will concentrate on the Hellyer deposit (western Tasmania) and the Mt Chalmers deposit (Queensland). This is a collaboration with Chris Heinrich (AGSO) and Chris Ryan (CSIRO) and will utilise equipment from the CSL, AGSO and CSIRO.

Ross Large, David Cooke and Paul Kitto obtained an ARC Large Grant to research metal zonation around mesothermal granitoids. This project is funded at \$50,000 p.a. for three years and will investigate the three-dimensional zonation around Devonian granitoids in the Dundas Trough in order to determine the chemical and structural controls on mineralisation. Detailed isotopic studies and thermodynamic modelling of fluid processes will form the basis of the project. **Ross Large**

1994 CODES Short Course Program

5-18 March

Volcanology and mineralisation in volcanic terrains

4-16 July

Ore deposit studies and exploration models

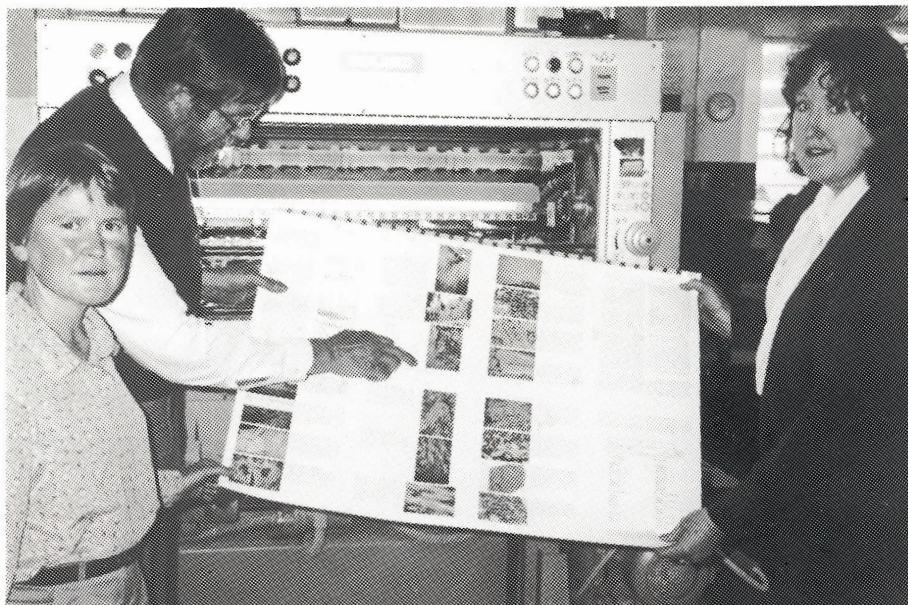
14-26 November

Tectonic and structural environments related to ore deposits



The recently completed second-floor extensions to the CODES building.

Volcanic Textures



Franz Steinhauser, of the Tasmanian Government Printing Office, with Jocelyn McPhie (left) and June Pongratz of CODES, with some of the first pages of *Volcanic Textures* to come off the printing press.

The fullness of time finally arrived at the end of October 1993 when *Volcanic Textures* was delivered to the printers. The book is based on the 20 combined years of field experience in volcanology between Jocelyn McPhie and Rod Allen [are they really that old? Ed.], augmented by the painstaking efforts of research assistant Mark Doyle, during the two-year design, writing and production phase. It is published by CODES, and is the first in a series designed to communicate the latest results of research on ore deposits and their geologic environments.

The book provides a practical guide to the description and interpretation of important textures in lavas, syn-volcanic intrusions and a wide variety of volcanoclastic deposits. Many examples come from the Cambrian Mount Read Volcanics, the submarine volcanic host sequence to several world-class polymetallic massive sulfide ore deposits in western Tasmania. These are compared with younger analogues and contrasting subaerial sequences in the USA, Japan, New Zealand, Italy, Central America, and South America.

Volcanic Textures contains 46 thematic plates comprising 330 colour photographs, each accompanied by a description and, where appropriate, an interpretation. The plates are complemented by text that reviews relevant genetic processes and facies relationships.

Part 1 gives an introduction to terminology, field identification techniques and classification. Part 2 describes selected textures, components and structures in volcanic deposits. Part 3 focusses on lavas, shallow intrusions, and related autoclastic deposits. Part 4 covers pyroclastic and other volcanoclastic deposits with emphasis on transport and depositional processes. Part 5 outlines the textural effects of hydrothermal alteration, especially in the vicinity of massive sulfide ore deposits, using examples in the Mount Read Volcanics.

Volcanic Textures can be ordered through CODES by contacting Ms Sue Hinksman (002 202476, fax 002 207662); the cost is \$75 (+ \$9 postage within Australia).

Jocelyn McPhie

Faulting and mineralisation in western Tasmania

Ron Berry and Richard Keele have recently received funding to extend their project on faulting and mineralisation in western Tasmania into a second three-year period. The original project from 1990 to 1992 aimed to produce a synthesis of fault history in the Mount Read Volcanics and its relationship to folding. The program included a study of six regional sections which were representative of the Mount Read Volcanics and their environment. More detailed studies were carried out on the Rosebery and Mt Lyell mine leases. The aim was to understand the regional structure of the Dundas Trough and to apply this understanding to ore deposit and exploration models. A model was put forward linking VHMS mineralisation in western Tasmania to the structure.

The renewal is an ARC collaborative research grant. The industry sponsorship is through AMIRA as with the initial project. The new funding for three years from 1994 to 1996 will allow detailed structural, sedimentological, geochemical and isotopic testing of the models put forward in the initial project. The staffing of the project has been widened to bring in expertise in the volcanological, sedimentology and stable isotopes areas. Stuart Bull and Paul Kitto will be working actively on the project in the new year. Ron Berry

Our happy wanderer

At the time of going to press, Bruce Gemmell was on a field trip somewhere in Mexico, having presented papers at the Geological Society of America Annual Meeting in Boston and at the Underwater Mining Institute meeting in Denver, and also visiting colleagues at his alma mater, Dartmouth College. Or so he says.

New Face Behind the Phone



Noticed the voice has changed on the end of the line at CODES? That's the bright happy tones of Ms Sue Hinksman (pictured left), who has taken on the job of CODES Secretary since Kirsty Whelan departed in March. Sue got the job when she outperformed a class field in special CODES Secretary Performance trials — typing 3200 words per minute, successfully negotiating the snake pit and finding the carefully hidden lost files, and going on to win the marathon in 2 hrs 20 minutes.



International Volcanology Conference, Canberra, September 1993

For the first time, in 1993 Australia hosted the General Assembly of IAVCEI (International Association of Volcanology and Chemistry of the Earth's Interior). The conference was held in Canberra during the last week of September, preceded and followed by field trips in Australia, Papua New Guinea, Vanuatu and New Zealand.

CODES and Geology made significant contributions both in organisation and as a strong, highly visible contingent among the participants. Collectively, we presented 15 papers (9 oral, 5 posters, 1 plenary

address), convened three symposia, led two field trips, ran a Short Course, had two members on the Organising Committee, and most importantly fielded four starters in the Fun Run. The uniformly high standard of presentations by our post-graduate students was especially noteworthy, and promises a rich crop of forthcoming theses and publications. All the hot air aside, the conference provided an international showcase for the recent achievements of CODES-Geology volcanology and petrology research groups.

Jocelyn McPhie

Achtung, Joe!

Joe Stolz, ARC Research Fellow with CODES, has been awarded a Fellowship by the Alexander von Humboldt Foundation to research various aspects of subduction-related volcanic geochemistry. The period of the Fellowship is 12 months from July 1994, and the research will be undertaken at the Max Planck Institut für Chemie in Mainz, Germany in collaboration with Professor A. Hoffmann, a widely respected geochemist. This research will focus on modern volcanics from Indonesia and the SW Pacific and will attempt to help understand the processes that make subduction-related volcanics geochemically distinctive from those erupted in other tectonic settings.

The results of this research will help in interpreting the geochemistry of mineralised ancient volcanic packages from the Palaeozoic fold belts of eastern Australia which have been the focus of Joe's research for the past two and a half years, and will be again on his return to CODES in 1995.

Veil Glück, Herr Doktor Stolz!

Master of Economic Geology — designed to produce ore finders

Did you know that about 28% of industry geoscientists have a Masters or PhD qualification? It is considered that this figure will increase to over 50% during the next decade. At the CODES Key Centre we offer you the opportunity to undertake a top-class Masters degree course which is designed specifically to produce exploration geologists at the cutting edge. The M.Econ.Geol. is a program of course work (60%) and research thesis (40%), covering recent advances in economic geology, ore deposit modelling and field mapping procedures, with special emphasis on applications to mineral exploration and mine geology. The course is recognised as the best of its type in Australia.

The six units of course work are spread over two years to enable candidates to continue their employment while undertaking the course. Each unit is taught in an extended short-course format consisting of an intensive program of lectures, seminars and practicals of two weeks duration. The course leaders are specialists selected from industry and universities who are well recognised in their fields. The course work units are:

- Volcanology and mineralisation (New Zealand and Tasmania).
- Exploration geophysics and remote sensing.
- Advanced ore deposit studies and exploration models.
- Exploration geochemistry and hydrothermal geochemistry.
- Tectonic and structural controls on ore deposits.
- Exploration management and mineral economics.

Entry requirements

Normal entry requirement is BSc (Hons). Applicants with other than a BSc (Hons) degree will also be considered.

Enquiries and requests for application forms to:

Professor Ross Large or Ms Christine Higgins, CODES Key Centre, University of Tasmania, GPO Box 252C, Hobart, Tasmania 7001.
Ph. (002) 202472 or fax (002) 207662.



Successful McArthur Basin Field Season

CODES was involved in an extensive field program in the McArthur Basin from May to June this year as part of the AMIRA/ARC Proterozoic sediment-hosted base metal project. Participants included post-docs Richard Keele, David Cooke and Stuart Bull, PhD student Jamie Rogers and Honours students Serena Donovan, Karen Mathews and John Wright.

Jamie's first (some say major) contribution was to drive the Toyota Hilux up from Hobart. He is trying to amass points for a rumoured Toyota frequent drivers program and already has enough for new

Mallapunyah Dome. Karen Mathews' study area was 40 km to the north in part of the McArthur and Nathan Groups.

Conditions for fieldwork were generally excellent, and the Honours mapping program went smoothly on a healthy bush tucker diet of Snickers and Coke. A minor medical emergency occurred when Serena intercepted a flake of geological hammer head with her forearm (magnetic susceptibility reading of 2.8!). Her intestinal fortitude so impressed the doctor at Borrooloola that he implored her to stay on, stating that "the Darcys could use some new blood".

A trip to the Murphy Inlier by Drs Bull, Keele and Cooke proved several things: (1) NW Queensland has the worst roads in the known universe; (2) Pasminco exploration camps have the best bush showers (thanks to Ian Kelso); and (3) while the Murphy Inlier is a beautiful place, it is probably not worth the effort of going to visit on a day trip.

Tragedy struck during the journey when Richard's close personal friend and field companion of many years (his hat) disappeared into a cloud of bulldust. Motorists on the Borrooloola-Wollogorang 'highway' are asked to please keep their eyes out for this piece of geological memorabilia.

After the trip to the Murphy Inlier, Dave Cooke returned to Darwin and the rest of us split up to look at different areas. Richard Keele mapped north of the base camp in the area of the Four Archers Fault and maintains that he spent no time at/in Lorella Springs. Jamie Rogers and Stuart Bull worked in the Batten, Tawallah and Scrutton Ranges, ably assisted by Karin Coppens, a second year geology student from Darwin. Karin was in the right place at the wrong time asking about field experience with the NTGS when we were getting the gear together in Darwin. As a result she ended up with us for most of the season as a field assistant. Remarkably,



"Moses" Bull leading sponsor reps into the wilderness.

Karin still intends to complete her studies and become a geologist.

In the Ranges we used Bauhinia Downs as a base camp thanks to the generosity of the manager John Moira. We returned to Bauhinia once or twice a week for a shower, a beer and some fresh meat (a welcome change from no shower, tepid water and Jamies' braised steak and onions). Some intensive fieldwork was occasionally carried out in the hot spring on the escarpment behind Bauhinia Downs in order to remind us of the potential of the ridge-forming sandstones as aquifer systems.

The season concluded with the Gulf Classic field trip run jointly by the NTGS, AusIMM, AGSO and the GSQ. Considering the potential for geographic embarrassment that existed, with up to nine 4-wheel drives and two buses chasing each other frenetically across the gulf, everything ran like clockwork. This was aided by the threat of a two case penalty for losing the vehicle behind. Dave Cooke deserves a place in history for staking a tyre having driven only 100 m across a cleared camp site first thing in the morning. Seriously, though, the Gulf Classic trip was perfectly timed, enabling us to expand our horizons from the McArthur Basin into the Isa Inlier, and was a great success.

Stuart Bull



Peter Haines and Stuart Bull and the CODES vehicle at the end of a long field season.

golf clubs. The remainder of the party flew into Darwin, where two more Toyotas and field gear provided by the Northern Territory Geological Survey were collected..

A base camp for the honours students was established on Mallapunyah Springs Station with the kind permission of the Darcy family. Resupply and the occasional shower and hamburger were organised through the Cape Crawford Roadhouse ("Heartbreak Hotel" to the locals), approximately 50 km north. Serena Donovan and John Wright mapped units of the Tawallah and basal McArthur Group exposed in the



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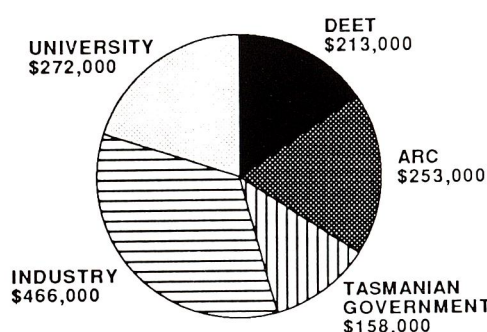
Research Facts

The Centre for Ore Deposit and Exploration Studies (CODES) is a National Key Centre established in 1989 to expand the teaching and research excellence developed in the field of Economic Geology at the University of Tasmania.

FUNDING

The Key Centre is jointly funded by the Federal Government, Tasmanian Government, University of Tasmania and a select number of major Australian mining companies, including Aberfoyle, Pasminco, RGC, BHP-Utah, CRAE, Geopeko, Pancontinental and WMC.

CODES FUNDING 1993



GOALS

- To undertake an interdisciplinary approach to teaching and research across the spectrum of economic geology, with strong emphasis on the training of Honours, Masters and PhD graduates to meet the demands of the exploration and mining industry.
- To conduct leading-edge research in close collaboration with the mining industry for the purpose of developing exploration models and improved exploration techniques.
- To build on our reputation as a major national and international centre for teaching and research in economic geology.
- To assist the State Government and the Tasmanian mining and exploration industry to maintain mining as a corner stone industry for the Tasmanian economy.
- To ensure the successful growth and continuation of the Key Centre over the next decade, and particularly after the special DEET funding terminates

CURRENT RESEARCH STANDING OF CODES

- CODES ranks as one of the three centres of excellence in teaching and research in economic geology in Australia. The other Key Centres are located at the University of Western Australia and at James Cook University.
- In a recent review of Earth Science departments and their relevance to Industry by the Australian Institute of Mining and Metallurgy, Geology/CODES was ranked as the top Australian department out of a total of 26 departments.
- CODES academic teaching staff have performed exceptionally well in attracting both ARC funding and industry funding for research in the last three years. Even though the Key Centre has only 3.5 academic teaching staff we have attracted six competitive ARC grants, three ARC Research Fellowships and one major Collaborative ARC grants in the 1990-93 period.
- In 1993 CODES received the top ARC grant allocation of the School of Science and Technology, and in turn the top ARC grant allocation for the University.
- In the 1994 ARC round CODES has received a further two large grants, an additional Collaborative grant and four APRA-Industry awards.
- In terms of industry funding to the University, CODES is second only to the department of Agricultural Science. Based on figures compiled by the Finance Branch, CODES total outside research funding for 1993 was \$997,423, with Agricultural Science and CODES standing out as the top departments.
- CODES staff and post-graduate students have a strong record of research output as published papers, industry reports and conference abstracts. In 1992 we produced 27 published papers, 28 confidential reports to industry and 12 conference abstracts.

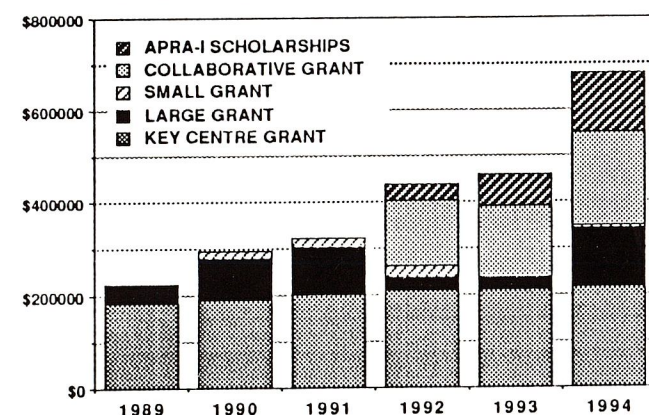
INDUSTRY LINKS

- A major strength of the Key Centre is the extensive links we have developed with the mining and exploration industry Australia-wide. Over 25 companies are involved.
- These links help to secure industry research funding, and provide better job opportunities for our students.
- Industry provides 43% of the average annual funding to the Key Centre, supporting collaborative research, PhD and Honours projects.

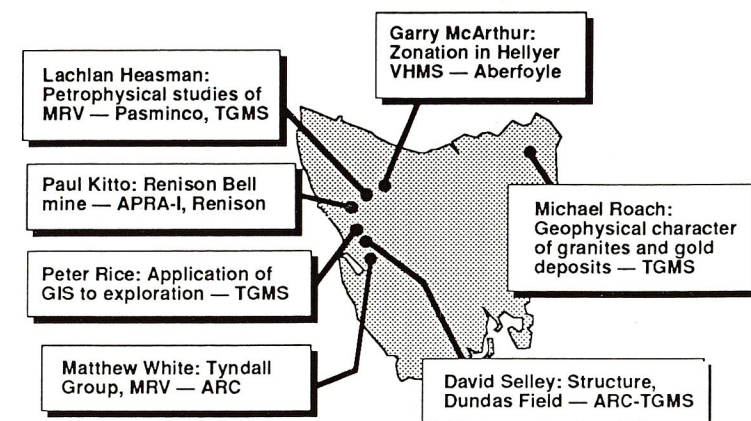
MAJOR TASMANIAN RESEARCH PROJECTS

Project	Co-Sponsors	Researchers	Annual funding
1 Tectonics and mineralisation, western Tasmania	AMIRA ARC collaborative	R. Berry, R. Keele S. Bull D. Selley (PhD)	\$98,000
2 Application of GIS to mineral exploration, western Tasmania	Mineral Resources Tasmania	R. Large, M. Roach P. Rice (PhD)	\$50,000
3 Facies architecture of the Mount Read Volcanics	ARC Large Grant	J. McPhie, M. White (PhD)	\$25,000
4 Pb isotope applications to exploration in the Mount Read Volcanics	Aberfoyle CSIRO	J.B. Gemmell G. Carr	\$23,000
5 Mineral zonation in the Dundas Trough	ARC Large Grant	R. Large, D. Cooke, P. Kitto	\$50,000
6 Fluid sources for massive sulphide deposits	ARC Large Grant	J.B. Gemmell, Khin Zaw	\$50,000

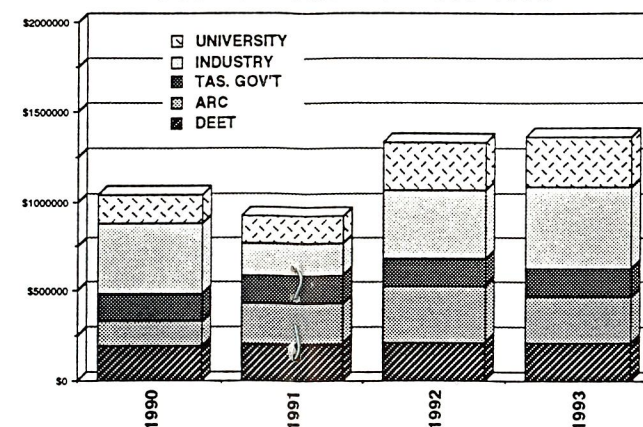
CODES KEY CENTRE ARC GRANTS



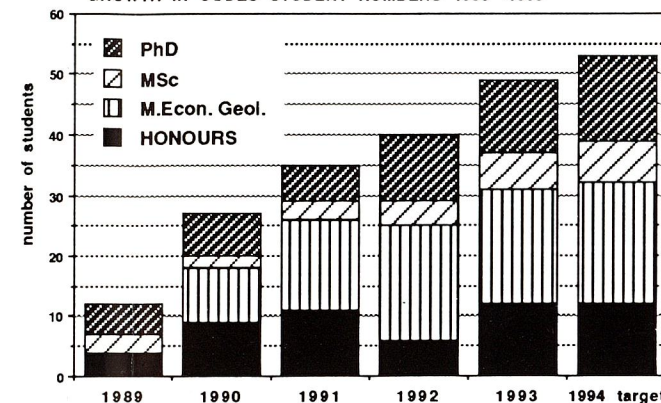
CODES PhD and MSc Projects: Tasmania



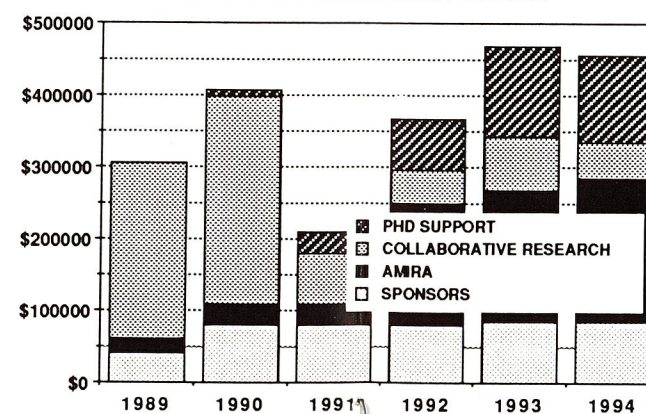
CODES FUNDING 1990-1993



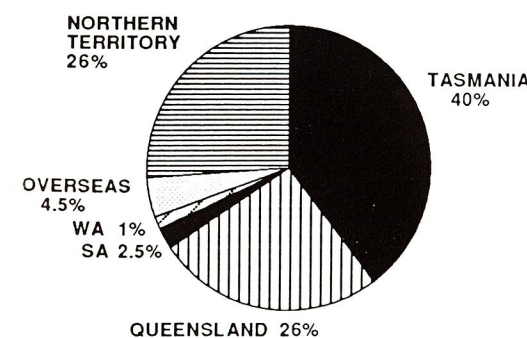
GROWTH IN CODES STUDENT NUMBERS 1989-1993



CODES INDUSTRY RESEARCH FUNDING



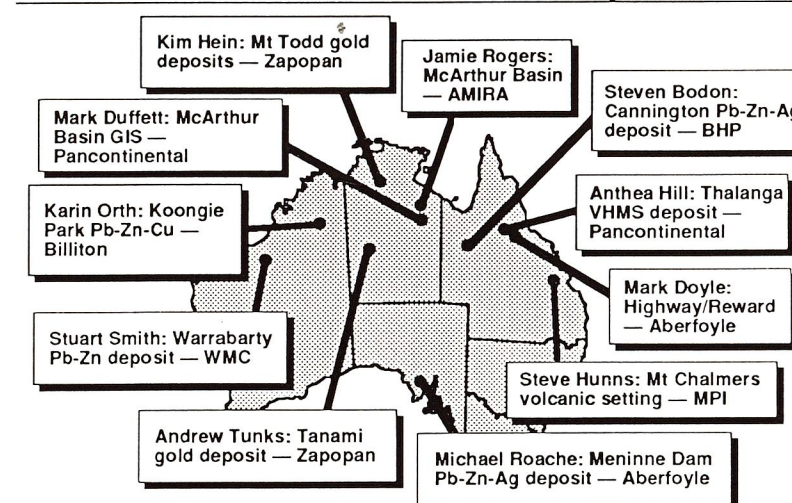
DISTRIBUTION OF RESEARCH EXPENDITURE



TASMANIAN GOVERNMENT MINING SCHOLARSHIP PROJECTS

Project	Award	Student
1 Geology and geophysics of NE Tasmanian granites and gold deposits	PhD	Michael Roach
2 Petrophysics of the Mount Read Volcanics, Rosebery district	PhD	Lachlan Heasman
3 Structure of the Dundas mineral Field, western Tasmania	PhD	David Selley
4 Geology and geochemistry of the Mt Lyell deeps orebody	MSc	Oliver Rayomnd
5 Application of GIS to geochemical exploration in western Tasmania	MSc	Peter Rice
6 Geophysics of the Tiers fault system, central Tasmania	Honours	Andrew Johnstone
7 Solutions to acid mine drainage problems on King Island	Honours	Shelley Innes
8 Structure and mineralisation in the Farrell Slates, western Tasmania	Honours	Josephine Rafferty
9 Geology of the Darwin Granite, western Tasmania	Honours	Andrew Jones

CODES PhD and MSc Projects



CODES Key Centre Staff 1993

Name	Position	Specialisation
Professor Ross Large Dr Ron Berry	Director Senior Lecturer	Economic Geology Structural Geology (joint appt with Geology Dept) Volcanology
Dr Jocelyn McPhie	Lecturer	
Dr Bruce Gemmell Dr David Leaman Dr Joe Stolz Dr Garry Davidson Dr Richard Keele	Lecturer P/t Senior Lecturer Research Fellow Research Fellow Research Fellow	Ore Deposits Geophysics Geochemistry Proterozoic ores Structural Geology
Dr Peter McGoldrick	Research Fellow	Ore Deposits
Dr David Cooke Dr Khin Zaw Dr Stuart Bull Dr Valerie Bendel June Pongratz	Research Fellow Research Fellow Research Fellow Research Fellow Senior Technical Officer	Ore Fluids Fluid Inclusions Sedimentology Mineralogy Drafting, Publishing, Resources
Christine Higgins Nilar Hlaing Simon Stephens Sue Hinksman Gerrit Kuipers Naomi Deards	Admin Assistant Research Asst. Technical Officer Secretary Research Asst Laboratory Asst	Geochemistry/Admin Lapidary Isotopes

OTHER MAJOR RESEARCH PROJECTS

	Project	Co-Sponsors	Researchers	Annual funding
1	Controls on Proterozoic sediment-hosted base-metal deposits (Qld, NT)	AMIRA ARC collaborative	R. Large, P. McGoldrick R. Keele, D. Leaman D. Cooke, S. Bull J. Rogers, M. Duffett	\$290,000
2	Tectonic setting of massive sulphide deposits, eastern Australia	ARC Fellowship	A.J. Stolz	\$60,000
3	Copper-gold deposit styles in the Cloncurry district (Qld)	BHP Minerals	G. Davidson	\$50,000
4	Geology and mineral deposits of Burma	AMIRA	Khin Zaw	\$25,000
5	Pacmanus seafloor hydrothermal copper-zinc deposits (PNG)	CSIRO	J.B. Gemmell, R. Binns S.D. Scott	-
6	The character and setting of the Camboon Volcanic Arc (Qld)	ARC University of Qld	J. McPhie T. Ewart	\$80,000

Gulf Classic NETGOLD

On Tuesday 3rd August a caravan of 60 geologists (including five from CODES) assembled in Mount Isa for the start of a trek through NW Queensland and the Northern Territory. The convoy included two 4WD buses, sundry delegate's vehicles and a mobile kitchen that over the subsequent ten days travelled 1200 km visiting key exposures of the 'Carpentarian' (late Palaeoproterozoic) rocks along the way.

The trip was organised by the Darwin and Mount Isa branches of the AusIMM and led by geologists from the Geological Survey of Queensland (Laurie Hutton), AGSO (Ian Sweet) and the NT Geological Survey (Barry Pietsch, Dave Rawlings, Peter Haines, Andrew Wygralak and Masood Ahmad).

Proceedings commenced in Mount Isa at CRAE's office with talks about Century and a core display. After the thunderous clicking of camera shutters and noisy debate about water depths had subsided the group set off to visit several exposures of Mount Isa Group sediments before heading north to Gunpowder Resort and a visit to the innovative leaching operation at the old Mammoth Cu mine.

The next three days were spent looking at examples of most of the formations in the McNamara Group and underlying volcanics. The debate about water depths continued at bush camps in the evenings, fueled by beer and an overnight minimum



No arguments about water depth here, Andrew!

Dr Richard Keele is currently completing a three-month contract with Tasmania Development & Resources (the reorganised Mines Department) to work on the NETGOLD project recently initiated by the state government. The project is designed to entice industry to explore for gold in NE Tasmania. He is contributing his expertise in structural controls and ore deposits. The field work has involved spending considerable amounts of time mapping and sampling the old exploration adits that dot the country between Mangana and Alberton. Many of these adits (see photograph) are up to 100 years old and are still in surprisingly good shape despite the passage of time; in fact the greatest hazards are often to be associated with the wildlife that now frequent these tunnels, e.g. wombats, owls, ticks, spiders etc. In the early part of the century, the Golden Gate mine at Mathinna produced about as much gold as the new Henty mine on the West Coast is planned to produce over the next five years or so. It is for this



The entrance to the Long Struggle Mine, Alberton.

of -5° on the second night! Interesting sidelights of this section of the trip were visits to Lawn Hill Gorge and one of the world famous Riversleigh fossil localities.

Day five and the push around the Murphy Tectonic Ridge (interestingly, a topographic low!) and into the Northern Territory was on in earnest. In transit a detour was made to CRA's Namalangi U prospect for a core display and to examine the Westmoreland Conglomerate in outcrop. Although highway #1 leaves a bit to be desired near the Queensland border, all parties arrived shaken but not stirred at Wollongorang just after dark.

Hospitality at Wollongorang was fantastic and next morning after skirmishes with cane toads during the night it was out into the foggy dew for a traverse through the Wollongorang Formation (and no arguments about water depth!). The latter

reason that mining companies are expected to be interested in exploring for further deposits in the region. A report on the project will be produced in March 1994.

part of that day was spent at the Redbank Cu deposits.

Wollongorang HS was left behind at the start of day seven and the remaining nights were spent at the camping ground at Heartbreak Hotel near Cape Crawford. Day trips from Heartbreak visited several excellent sections covering most of the formations of the McArthur Group and the upper parts of the Tawallah Group. Some highlights were the long Scrutton Range traverse on Day Nine (Rowdy's effort was exceptional), the fantastic tour and displays at HYC on Day Eight, and practical demonstrations of mass wasting at Archies Creek.

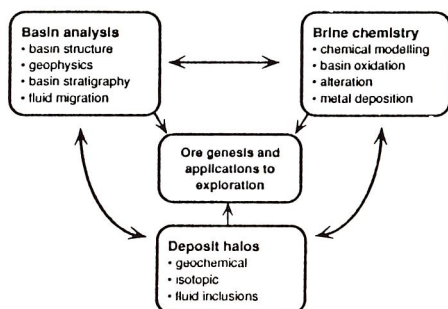
The organisers and leaders are to be congratulated for running such an excellent trip in one of the more remote parts of this continent. Well done to all!

Peter McGoldrick



Research into Sedimentary Base Metal Deposits at CODES

This important area of research is supported by CODES and through AMIRA (Australian Mineral Industry Research Association) and the ARC (Australian Research Council). Most of our work in this area is carried out as part of ARC/AMIRA Project P384: Geological and geochemical controls on Proterozoic sedimentary base metal deposits. Ten staff and research students are engaged full or part-time in this project.



The project has 11 corporate sponsors, and support from the Australian Geological Survey Organisation and the Northern Territory Geological Survey. To date, results have been presented at three sponsors meetings in Hobart (November 1992, May and November 1993), and a field meeting is planned for next year.

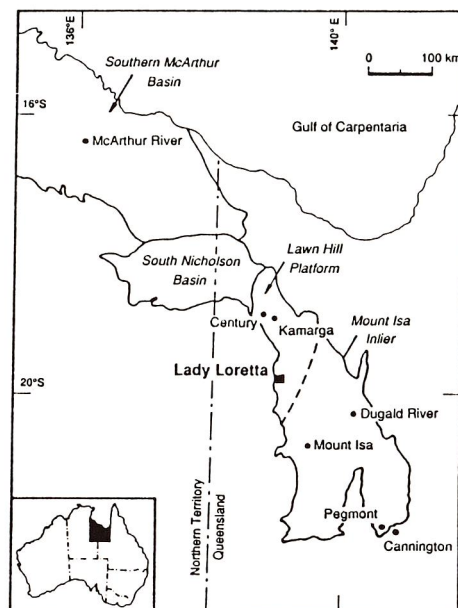
The focus of project activity has been in northwest Queensland and the Northern Territory. Jamie Rogers and Richard Keele both spent time in the southern McArthur Basin during the 1992 field season, but the 1993 season has seen a major field program involving up to eight staff and students at various times. Jamie Rogers and Stuart Bull wintered in the Territory (see accompanying story), and Richard Keele, David Cooke and Garry Davidson were all involved in field work in the McArthur Basin or core logging in Darwin. This years field season also saw three honours mapping projects undertaken as part of P384. Karen Mathews carried out detailed sedimentological work on McArthur Group rocks near Mallapunyah Homestead, while Serena Donovan and John Wright mapped

inliers of Tawallah Group sediments and volcanics further south.

Work in the basin analysis module of the project has concentrated in three areas. David Leaman has carried out geophysical modelling, using gravity and magnetic data, to produce sub-surface interpretations for most of the southern McArthur Basin and into northwest Queensland. On a different scale, detailed structural and sedimentological work by Jamie Rogers, Richard Keele and Stuart Bull, using NTGS/AGSO 1:100 000 maps as a base, is revealing new insights into the pre-Roper Group tectonic history of the southern McArthur Basin.

For the chemical modelling module, David Cooke has simulated potential mineralising scenarios. The modelling is constrained and refined using information collected during the field program, and geochemical data from the halo studies module.

The focus for halo studies has been the Lady Loretta deposit north of Mount Isa. Detailed geochemical studies (Peter McGoldrick and Ross Large) of barren hangingwall and footwall sediments have resulted in a halo model with immediate applications to exploration for similar Zn-Pb deposits. In related work Garry



Davidson is documenting geochemical variations in tuffaceous sediments associated with mineralisation at McArthur River, and throughout the McArthur Group.

By the end of the project (mid-1995) we hope to understand what processes were important for forming the giant northern Australian Zn-Pb deposits, and to develop exploration guidelines at a variety of scales to aid the search for new deposits.

Peter McGoldrick

Seen around ...



Mapping accord and general geological co-operation in the Kimberley (WA). Pictured are Donna Sewell (Billiton), Piers Bairstow (AGSO), Karin Orth (CODES) and Kerry Turnock (Monash University) enjoying the day at the Halls Creek races.

Submarine volcanology overseas

At the end of August 1992, Jocelyn McPhie embarked on 11 months overseas as an Alexander von Humboldt Research Fellow, accumulating valuable experience in well-exposed submarine volcanic sequences. This experience will greatly augment her Australian-based research in volcanic host sequences to massive sulfide deposits.

After IAVCEI workshops at Izu and Asama on Honshu, Japan, she travelled

north to Hokkaido for fieldwork hosted by Hiromitsu Yamagishi (Geological Survey of Hokkaido) and Yoshihiko Goto (University of Hokkaido). Dr Yamagishi is a world-renowned expert on submarine volcanism associated with Kuroko deposits, especially felsic hyaloclastite and pillow lava.

Subsequent studies were conducted from a base at GEOMAR in Kiel, north-

ern Germany. The Vulkanologie and Petrologie group at GEOMAR, led by Professor Hans Schmincke, is the foremost centre for field-based and experimental physical volcanology in Europe. Much of the group's research focusses on oceanic islands in the east Atlantic, especially Gran

Canaria. The complex volcanic geology of Gran Canaria is exposed in spectacular coastal cliffs and inland canyons. Most of the sequence records the subaerial emergence and growth of the volcano, including the formation of Tejedra caldera.

On other older islands in the east Atlantic, the submarine stage of volcanism is preserved. One of the best exposed and least studied is Porto Santo of the Madeira Archipelago. This small Portuguese island consists of Miocene submarine and subaerial volcanics that have been deeply dissected following Pliocene-Quaternary uplift. The submarine sequence is a complex association of basaltic pillow lava and hyaloclastite, resedimented pyroclastic units, rhyolitic lava domes and resedimented autoclastic breccia, locally interbedded with in situ coralline limestone and calcarenite. The limestone provides constraints on water depth of emplacement of the volcanic facies, and allows detailed reconstruction of the stages of growth and denudation as the seamount finally emerged to become an oceanic island.

From Kiel, it was a short step north to Sweden for a taste of the Swedish Proterozoic with colleagues Rod Allen, Ingmar Lundstrom and Magnus Ripa (Swedish Geological Survey). Rod is currently leading volcanological research in the Bergslagen and Skellefte regions, world-famous base metal mining districts. The volcanics pose extremely difficult challenges for interpretation (worse than the Mount Read Volcanics!), being strongly deformed, metamorphosed to amphibolite grade and poorly exposed.

Apart from intensive volcanological study and research, there were ample opportunities to partake in the many pleasures of life in northern Europe: beer gardens and barbecues in summer, beer gardens and snow in winter, the legendary Kieler Woche (Kiel Week) of international sailing competitions (beer gardens at sea), unfailing Deutsche hospitality, and at the top of the list, the Hamburg Marathon.



Pico do Castelo (rear) is a felsic plug intruding resedimented trachytic pyroclastic deposits, basaltic hyaloclastite and pillow lava that form most of the northern part of Porto Santo, Madeira Archipelago.

APRA—Industry Scholarship Scheme

Following the dismal results in 1992 when CODES received no scholarships from eight applications, this year has been far more successful, with a result of four successful applications out of five. In addition, two of the 1992 projects which were on the reserve list have also been granted.

The successful APRA-I projects were:

• **Dr Jocelyn McPhie**

Billiton: Geology and mineralisation at Basin Lake — western Tasmania

• **Dr Richard Keele**

Zapopan: Proterozoic gold deposits — Tanami, NT.

• **Dr Peter McGoldrick**

Pancontinental: Sedimentology of the host rocks to Proterozoic stratiform lead-zinc deposits.

• **Dr Garry Davidson**

BHP: Genesis of Broken Hill Style deposits — Cannington, Qld

• **Dr Jocelyn McPhie**

Aberfoyle: Relationship of volcanic facies and mineralisation — Highway/Reward, Qld

• **Dr David Leaman**

Pasminco: Petrophysical properties of the Mount Read Volcanics — Tasmania

The projects on which these scholarships are based involve collaboration and funding from ARC and industry partners. The ARC provides a scholarship at \$18,700 p.a. and the company provides research funding (\$5000 p.a.) and in-kind support.



Volcanology and mineralisation in volcanic terrains

A two-week Short Course on volcanology and mineralisation in volcanic terrains is offered to geologists interested in a review of current approaches to mapping, facies analysis and mineralisation in ancient and modern volcanic sequences. The course provides an introduction to the processes and products of different eruption styles, contrasts in scale and structure of volcanoes, identification of key volcanic facies associations, and interpretation of facies variations. In addition, the course covers mineralisation and alteration processes related to hydrothermal systems in subaerial and submarine volcanic sequences, and implications for mineral exploration.

COURSE LEADERS

Dr Rod Allen — Consultant geologist and Visiting Research Fellow at CODES, with special expertise in the effects of alteration and deformation on textures in silicic volcanic rocks.

Dr Bruce Gemmell — Lecturer in economic geology at CODES, involved in research on epithermal vein systems, VHMS deposits, alteration processes and active volcanoes in Central and South America.

Dr Jocelyn McPhie — Lecturer in volcanology at CODES, specialises in facies analysis of volcanic sequences drawing on research experience involving calderas, ignimbrites, and the products of submarine volcanism.

Dr Stuart Simmons — Lecturer at the Geothermal Institute, University of Auckland, and an expert on modern geothermal and epithermal systems, particularly fluid inclusion and alteration studies.

Dr Colin Wilson — Volcanologist at the Institute of Geological and Nuclear Sciences, Wairakei, engaged in research on eruption processes with particular expertise in the products of large, silicic, explosive eruptions.

PROGRAM

Part 1: New Zealand, 5–12 March

Saturday 5th	Assemble in Auckland
Sunday 6th	Scoria cones and tuff rings of the Auckland basaltic volcanic field. Miocene submarine pillow lavas and volcanoclastic sequences (J. McPhie)
Monday 7th	Distal to proximal facies associations of rhyolitic caldera volcanoes: Mamaku Ignimbrite, Rotorua Caldera, Ngongotaha Lava Flow (J. McPhie)
Tuesday 8th	Taupo volcanic centre; ignimbrite and fall deposits from the AD 186 Taupo eruption (C. Wilson and J. McPhie)
Wednesday 9th	Facies architecture of composite andesitic volcanoes: Ruapehu volcano (J. McPhie and B. Gemmell)
Thursday 10th	Epithermal alteration at Ohakuri and the active geothermal system at Waiotapu (S. Simmons)
Friday 11th	Tarawera AD 1886 eruption and the active geothermal system at Waimangu. Kaharoa rhyolite lava domes and pyroclastic deposits (S. Simmons, C. Wilson, J. McPhie)
Saturday 12th	Departure from Auckland

Part 2: western Tasmania, 13–18 March

Sunday 13th	Assemble at CODES, travel to Queenstown
Monday 14th	Introduction to the style and setting of Cambrian volcanism in western Tasmania: Anthony Road traverse (J. McPhie)
Tuesday 15th	Textural effects of alteration on mineralised silicic volcanic rocks: Mount Read to Hercules traverse (R. Allen)
Wednesday 16th	Resedimented syn-eruptive volcanoclastic deposits: Newton Dam Spillway and Hall Rivulet Canal (J. McPhie and R. Allen)
Thursday 17th	Character and setting of volcanic host rocks to the mound-style polymetallic massive sulfide deposit at Hellyer (B. Gemmell and J. McPhie)
Friday 18th	Silicic lava-dominated sequences in the Mount Read Volcanics: Mount Lyell and Jukes Road (J. McPhie). Return to Hobart.

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Eyre Peninsula Excursion

Last summer was absolutely glorious in South Australia and there was no better way to appreciate its splendour than an action-packed eight-day tour of the Eyre Peninsula beaches. The lure of sun, warm water and friendly locals was beyond temptation for Michael Roache, Peter McGoldrick and Bruce Gemmell, so, under the guise of a geological excursion we managed to ensnare a few good drinking mates from industry, including Chris "Beer Can" Drown and Brett Rava "be having a ..." from Aberfoyle, Dave Borton and Chris Creagh from Billiton and a horde of rowdy Honours students from Adelaide Uni under the "control" of Mike Sanderford.

John Parker from SADME was the tour guide with a 20-year history of chaperoning similar groups around some of the finest watering holes the Eyre Peninsula has to offer. Between drinks we developed an uncanny interest in the local geology — anticipating this, John Parker introduced us to some of his favourite coastal exposures beginning in the south with the Archean Sleaford Complex at Cape Carnot and migrating north through a succession of Proterozoic Hutchinson Group metasediments and Lincoln Group granitoids culminating in the expansive and picturesque mid-Proterozoic Gawler Range Volcanics. The Eyre Peninsula must have some of the best coastal exposure in Australia. Particularly fascinating is the Kalinjala Mylonite Zone including the development of mylonitic schistosity in granitoids and the macroscopic swirling around large amphibolite boudins.

On a more serious note, I can recommend the accommodation and cheer at the Franklin Harbour Hotel, a grandiose turn-of-the-century establishment only 50 m from some of the tastiest and freshest oysters around. After a hard day, it is pure pleasure relaxing on the upstairs balcony watching the sun go down while devouring cool ales and fresh oysters to the background banter of contented geologists. It was here also that CODES upheld its hard won reputation and beat all comers at pool in the wee small hours. However the CODES commitment to excellence lost out on the golf course and we were forced to concede to Aberfoyle. Peter McGoldrick did not excel in this event. **Michael Roache**

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