AGSO
AUSTRALIAN
GEOLOGICAL SURVEY
ORGANISATION

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

RK PROGRAM 1993/94

ch Organisation of the Department of Primary Industries and Energy

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

WORK PROGRAM

1993/94

AGSO Record 1993/76

A Research Organisation of the
Department of Primary Industries and Energy

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources: Hon. Michael Lee, MP
Secretary: Greg Taylor

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Harvey Jacka

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Foreword by

the Hon Michael Lee, MP

Minister for Resources

On 17 August 1993, the Government announced its response to the Richards Review of AGSO. The Richards Review provided a sound basis for Government decision making about the future of AGSO and the thrust of the Report gained much support from governments and the petroleum and minerals industries.

Information concerning the Government's response appears elsewhere in this publication but, in summary, these were the major points.

- I want to see AGSO take its place as the premier Australian geoscientific information agency and one of Australia's flagship scientific institutions.
- It should play a central role in making Commonwealth, State, and private sector geoscientific mapping efforts more co-ordinated and mutually reinforcing.
- It must move towards greater effectiveness, efficiency and accountability by demonstrating that it provides an economical service and building closer linkages with customers, particularly through the new planning and priority setting processes.
- The traditional AGSO values of scientific excellence will need to be complemented by a more business-like approach, greater flexibility and a more outward orientation.
- The relevance of its work will be demonstrated by the achievement of new external earnings targets.
- Above all AGSO will, in the terms of its new mission statement, ''build a vigorous, client-driven national geoscientific mapping effort to encourage economically and environmentally sustainable management of Australia's minerals, energy, soil and water resources''.

AGSO's 1993/94 Work Program is something of a transitional document between the past and the future. Next year's document will reflect the new consultation, planning and priority setting arrangements which will be put in place over the next few months. I believe that these changes will lead to a work program which best meets the needs and priorities of all of AGSO's customers.

Michael Lee

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INTRODUCTION

As the Minister has indicated in his comments, the 1993/94 Work Program is a transitional document between the AGSO of the past and the AGSO of the future.

Last year the Government established a review, under the chairmanship of Dr Max Richards, of the composition, structure and administrative arrangements of AGSO. The Review reported to the Government on 3 June 1993 in time for consideration in the context of the 1993/94 Budget. It provided a sound foundation for decisions by the Government on the future role and operation of AGSO. The Government's response was announced in the Budget brought down on 17 August 1993.

Overall the response represented a carefully integrated package of reforms which offers lasting solutions to some of the key issues raised by AGSO's stakeholders. Additional funds will be made available to AGSO's major programs, the National Geoscience Mapping Accord (NGMA) and the Continental Margins Program (CMP) and to initiate programs in land and environmental mapping and geoscience information. These core programs will be sustainable at a higher level of activity into the future, with appropriate proportions of the funding contributed by the beneficiaries of the programs. In this respect, the Government decided that AGSO's programs of a "public interest" nature should be funded by appropriations, those which primarily benefit industry should be funded by industry, and those which benefit both industry and the wider community should be jointly funded.

Additional Funding

AGSO's key activities will receive additional funding to improve services to its client groups.

1. The Continental Margins Program (CMP) will receive an additional $1.5 m a year commencing in 1993/94, to restore core cruise capacity to the RV "*Rig Seismic*" enabling better utilisation of the vessel and more data to be collected, processed and made available.

   The Government has decided that because the CMP benefits both the industry and the wider community, this should be reflected in its funding arrangements. Accordingly, the Government has decided that half the cost of the CMP, about $10 million in 1993/94, should be funded by the offshore petroleum industry. It is proposed that these funds will be raised from an annual user-charge placed on Commonwealth offshore exploration permits and retention leases commencing in 1994/95.

2. The Government has committed $1.5m in 1993/94 to the Bureau of Resource Sciences to address the tape deterioration and retrieval problems being experienced with the industry data collected under the Petroleum (Submerged Lands) Act 1967, and currently stored at the Villawood archives, near Sydney.

   This will help ensure that this precious national storehouse of data will be preserved and made available to industry and other users through modern data retrieval methods.

3. AGSO's contribution to the NGMA will be enhanced by an additional $0.5 m in 1993/94 and $2.0 m a year commencing in 1994/95 as an incentive to attract increased State contributions. This will accelerate the pace of the NGMA, allowing coverage of the continent with a new generation of geoscientific maps with prioritised delivery within 30 years.

   It is proposed also to renegotiate the NGMA through the Australian and New Zealand Minerals and Energy Council to provide a sound basis for an enhanced and accelerated mapping effort in future years.

AGSO's contribution to the NGMA benefits both government and industry. The Government has decided that the multiple benefits arising from this program should be reflected in its funding arrangements, and States and Territories will therefore be encouraged to apply a user charge on State petroleum and minerals exploration permits.

4. In recognition of community concerns over such issues as the loss of agricultural top soil and salinity problems, the Government has provided $0.5 m a year commencing 1994/95 as seed money for a National Environmental Geoscience Mapping Accord, with further activity dependent on external funds from appropriate agencies.
5. A further $0.5 m a year from 1994/95 has been provided to develop the National Geoscience Information System which will be linked with the NRIC and ERIN national databases, giving greater and easier access to AGSO data.

As an outcome of the Prime Minister's Environmental Statement — 1992, AGSO will be receiving an additional $2.3 m over 3 years to initiate a National Groundwater Quality Assessment Program.

Finally, the Government has provided an opportunity for AGSO to increase the level of funding available to support its activities and has set a minimum external funding target. This has been set at 30% of its 1994/95 Budget appropriations to be achieved in 1995/96, and an interim target of 25% to be achieved in 1994/95.

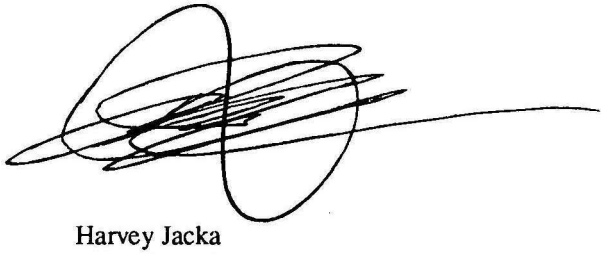
A Refocused AGSO

The external funding target will only be met if the services which AGSO provides are seen by its customers as being relevant and providing value for money. The years since the Woods Review have seen the Organisation make considerable efforts to understand the needs of industry, and its programs have been directed towards meeting those needs. In future, we will be making greater efforts to ensure that our work programs reflect the needs and priorities of all of our customers.

To achieve this we will be setting up new or enhanced consultative arrangements. These will be of a formal nature and will be designed to provide full and timely input into a revised planning process and will provide input into a new and visible priority setting process. We will thus ensure that our efforts go towards satisfying the priority needs of our customers.

Of course, it is not enough that our programs be the right ones. It is equally important that what we do is done in the most efficient and effective manner. We will therefore be looking at what we do to see whether it is something that we should continue to do and, if so, whether it is the best way of doing it. We will look for opportunities to build up those activities that we do best and to improve our operations and the value that we provide our customers.

We are developing a Strategic Plan to identify the changes required and to help put them into effect. Next year's Work Program will reflect a new NGMA, the new consultative arrangements with all of our customers and the new priority setting process. I would expect that all this will lead to some change in direction, some sharper focus and a Work Program better meeting our customers' needs. It will reflect the new directions of AGSO.



Harvey Jacka
Executive Director

October 1993

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

ORGANISATIONAL STRUCTURE

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

CORPORATE MANAGEMENT (AGSO EXECUTIVE)

CORPORATE SUPPORT & SERVICES

PROGRAM MANAGEMENT

EXECUTIVE DIRECTOR
Mr H Jacka

ADVISORY COUNCIL

Associate Director
Dr T Powell

- Information Systems Branch
  Mr D Berman
- Cartographic Services Unit
  Mr I O'Donnell A/g

MINERALS & ENVIRONMENT GROUP

- Minerals & Land Use
  Dr L Jaques
- Environmental Geoscience & Groundwater
  Mr C Simpson
- Geophysical Observatories & Mapping
  Dr D Denham

Associate Director
Dr DA Falvey

- International Programs Unit
  Vacant
- Engineering Services Unit
  Mr N Esau A/g

PETROLEUM & MARINE GEOSCIENCE GROUP

- Marine Geoscience & Petroleum Geology
  Dr C Pigram A/g
- Onshore Sedimentary & Petroleum Geology
  Dr T Loutit

- Business Management Branch
  Ms J Wolf
- Corporate Relations, Information & Planning Branch
  Mr A Nicolson

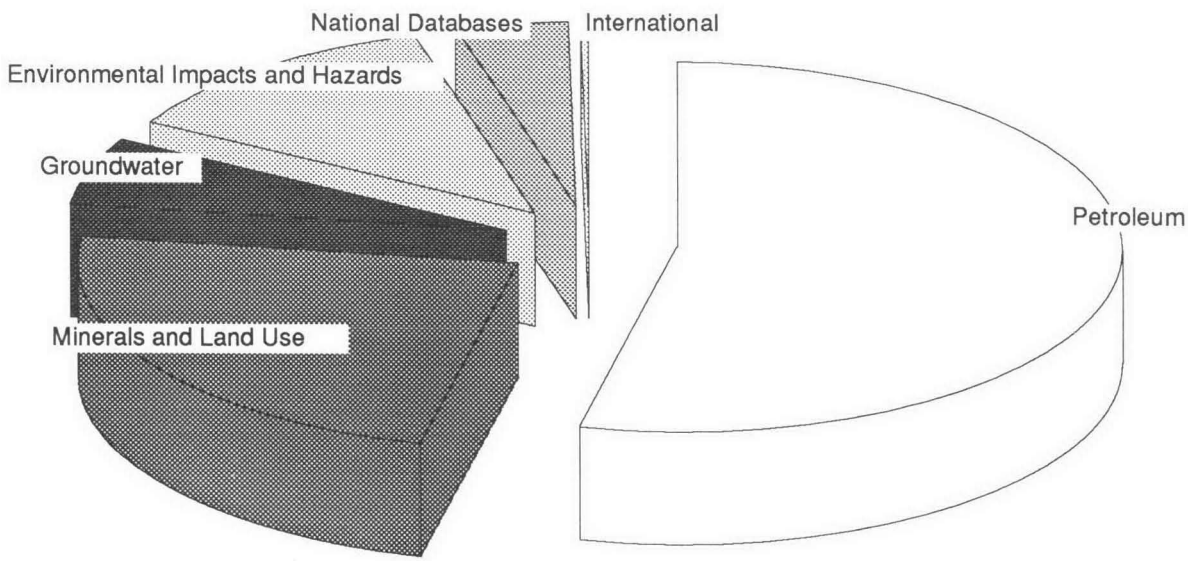
PLANNED SCIENTIFIC PROGRAM 1993/94

	$'m	%
PETROLEUM	**28.07**	**53.63**
110: Onshore Sedimentary Basins (1)	9.24	
120: Continental Margins	18.83	
MINERALS AND LAND USE	**12.47**	**23.82**
210: Mineral Provinces (1)	8.61	
221: Geophysical Mapping (1)	3.86	
GROUNDWATER	**3.03**	**5.75**
241: Groundwater	3.03	
ENVIRONMENTAL IMPACTS AND HAZARDS	**6.47**	**12.36**
120: Continental Margins Program (2)		
222: Australian Seismological Centre	3.02	
224: Geomagnetism	1.65	
242: Environmental Geoscience	1.80	
NATIONAL DATABASE COORDINATION AND RESEARCH	**2.22**	**4.24**
261: National Database Coordination and Research	2.22	
INTERNATIONAL DEVELOPMENT ASSISTANCE AND COOPERATION	**0.08**	**0.15**
120: Continental Margins Program (2)		
242: Environmental Geoscience (3)		
317: International Programs Unit	0.08	
TOTAL	**52.34**	

(1) Largely National Geoscience Mapping Accord
(2) Resources included under Petroleum, Continental Margins Program
(3) Resources included under Environmental Impacts and Hazards, Environmental Geoscience

These figures exclude external funding.

Planned Scientific Program 1993/94



110: BASIN RESOURCES — ONSHORE

Objectives

Underpin onshore petroleum and minerals exploration activity in sedimentary basins by reducing investment risk.

Provide information to government, industry and the public in an appropriate form *through:*

- geological research and provision of advice and information, based on
- identifying the location, and mapping the characteristics of, sedimentary basins;
- defining the geological processes that control the formation and alteration of petroleum systems and other sedimentary resources;
- predicting/defining the potential of petroleum systems in each basin; and
- developing an integrated approach to basin evaluation that incorporates "state of the art" geological concepts, exploration methods and tools, and information management science.

Relevance

Petroleum is essential to the nation's energy and transport needs. In order to generate wealth for the nation and minimise a future economic impact of imported oil, Australia needs to maintain and, where possible, enhance current relatively high levels of domestic production commensurate with the efficient use of economic resources.

To achieve this, Australia needs a dynamic and successful petroleum exploration industry. One of the roles of AGSO's Petroleum and Marine Geoscience Group is to provide information to help reduce investment risk.

The Basin Resources program at AGSO makes an important contribution by providing information to government, industry and the public that supports informed decision making on:

- exploration investment, and
- sustainable development policies

by providing the basis for effective, efficient, and environmentally sensitive exploration.

The program comprises a number of projects that can be conveniently grouped into four levels that are primarily concerned with increasing industry activity and land-use issues within an overall strategy of ecologically sustainable development (Fig. 1.)

New data acquisition that involves integretated, multidisciplinary framework studies of the geology of the continent and its sedimentary basins. In the onshore area, these studies are primarily National Geoscience Mapping Accord (NGMA) projects conducted with state geological surveys or mines departments in the relevant states.

Capture of geologic and petroleum-related data/information on all of Australia's sedimentary basins. The information required to document the petroleum potential of Australia's basins is to be systematically captured within a procedure-based information system.

Interpretation of new, and re evaluation of existing, information to generate new concepts. The Australian Petroleum Systems (APS) project is evaluating the petroleum potential of a number of basins, primarily on the North West Shelf. The project is jointly sponsored by AGSO and the Australian Petroleum Industry Research Association (APIRA).

Dissemination of geologic and petroleum system information. It is important that the information generated from all types of projects within the Petroleum and Marine Geoscience Group at AGSO be easily accessible and in a form that is required for basin evaluation.

Discipline-based studies that transcend basin boundaries, including the development of a Phanerozoic timescale for Australia and a study of the organic geochemical systematics of Australian oils and gases support the regional evaluation projects.

Output from the program will be in the form of a range of geographically located datasets, databases, maps and publications related to the formation of fossil fuels and the age and evolutionary history of onshore sedimentary basins.

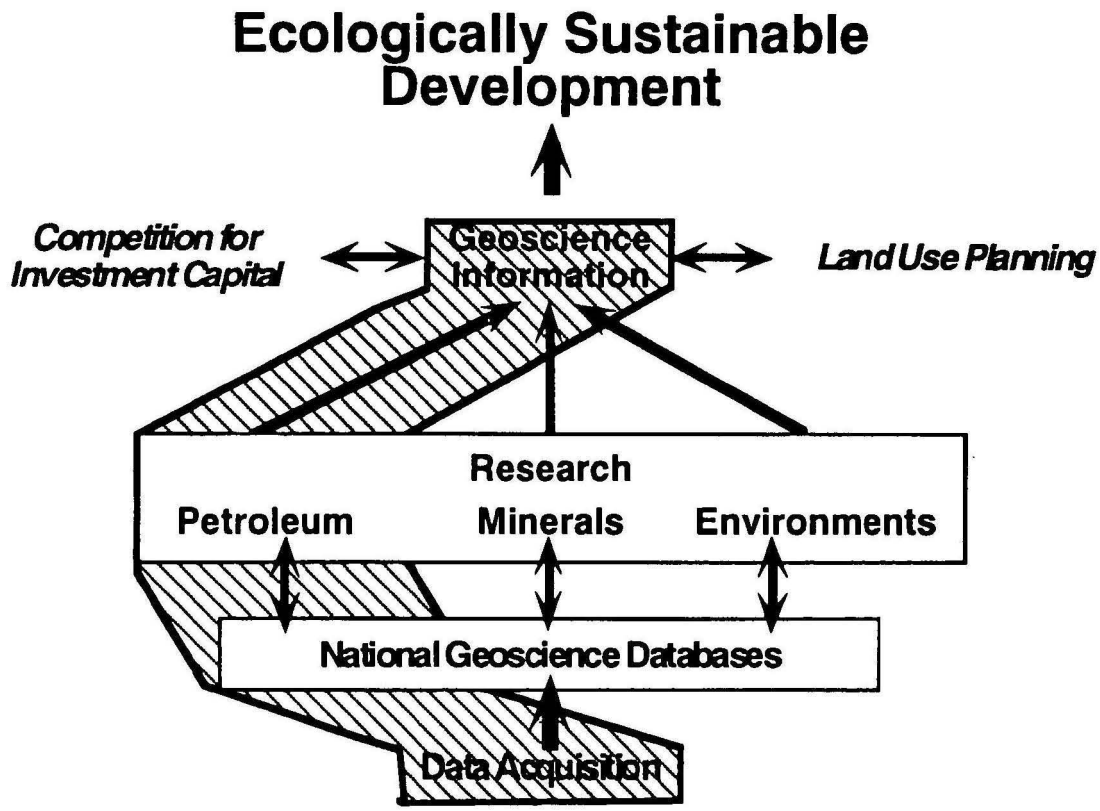


Fig. 1. Schematic illustrating the flow of information from data acquisition into national geoscience databases. The results of interpretation and analysis of data housed in national geoscience databases is stored in a series of derived information databases that are available to help evaluate land use and petroleum-related issues. The vision is to have a nationally accessible collection of coordinated and standardised petroleum geoscience databases to more effectively implement a plan for ecologically sustainable development.

Activities

Generate knowledge and understanding of the geological framework of onshore sedimentary basins. Disseminate the information efficiently and effectively.

Define onshore petroleum potential in conjunction with the Bureau of Resource Sciences.

Develop models of geological processes that create, modify and destroy sedimentary basins and related petroleum systems.

It will achieve this by:

- mapping the geology and resource potential of Australian onshore sedimentary basins
- contributing to innovative petroleum and sedimentary resource exploration concepts
- developing and maintaining comprehensive and accessible geoscience databases

Highlights for 1992/93

New Data Acquisition

AGSO's seismic crew has begun an NGMA survey in the Officer Basin in the north west of South Australia with SADME. While preliminary tests point to a successful attempt to collect good quality data across this portion of the Officer Basin, the major breakthrough has been in the negotiation of access for the crew with the traditional owners. Ours is the first seismic crew to work in the area since 1966. While the traditional owners have specifically stated that permission for AGSO to undertake its research-oriented seismic survey should not be seen as an indication that they favour petroleum exploration, all parties agree that the new data will provide a valuable database with which to build new resource assessments of the region that are fundamental for framing decisions on multiple land use.

Radiometric SHRIMP dates produced in the Carboniferous-Permian of eastern Australia and in the Mesozoic of the North West Shelf.

Data Capture/Storage

STRATDAT updated with data generated by the APS project

ORGCHEM updated with new "open file" data that became available during 1992/93.

New prospectivity database developed and filled with data from the Browse and Dampier Basins.

Interpretation and Analysis

Completed first two modules of the Australian Petroleum Systems Project — Dampier and Browse basins. Modules have been delivered to industry sponsors.

Sequence stratigraphic interpretation completed in area north of 26°S in the Eastern Australian Basins NGMA Project.

Completed over half of the review of the evolution of the Canning Basin and the events and processes that produced the three petroleum systems in the Basin

The recognition that Surat Basin oils are primarily derived from the Permian is an important result for the Eastern Australian Basins NGMA Project.

Information Dissemination

AGSO's seismic reflection survey of the Eastern Goldfields of Western Australia that was reported last year has continued to have impact on several fronts. The data have successfully imaged for the first time major faults that cut the crust in the region, providing pathways for the fluids that carried the mineralisation from deep in the crust. This will have a major impact on fluid-flow models used in both the minerals and petroleum industries to frame exploration strategies.

The well-based Oracle database STRATDAT that provides information on biostratigraphically derived age data is operational and available.

The program also:

- developed and held two Petroleum Systems workshops for the petroleum industry and AGSO researchers,
- completed Stage I of the Canning Basin NGMA project. Sequence-stratigraphic play concepts developed during this project are being tested by industry,
- released a folio of preliminary maps on the area north of 26°S in the Eastern Australian Basins NGMA Project,
- developed and presented an Organic Geochemistry training module for AGSO and the petroleum industry,
- released PEDIN Version 4.0, PEDIN Surveys Version 2.0 (new release) and Arc/wells Version 1.0 (new release),
- collaborated with BRS in the initial development of a prototype GIS-based Petroleum Information System, PETROINFO; a number of coverages were produced including a new Australian sedimentary basin outlines map.

Goals for 1993/94

Data Acquisition

Acquire seismic reflection data in Officer Basin and Mt Isa regions.

Complete digitising of new data for new 1:2 500 000 geological map of Australia.

Data Capture/Storage

Continue to update STRATDAT, ORGCHEM, and RESFACS (a new petroleum prospectivity database).

Develop new reservoir and seal databases and populate with Canning well data.

Capture data/information on play elements, plays and petroleum systems.

Interpretation and Analysis

Complete Papuan and Barrow/Exmouth modules, commence the Petrel and Beagle/Offshore Canning modules in the Australian Petroleum Systems project.

Complete tasks identified in Canning, Officer, East Australian and Otway basin NGMA projects. These tasks include:

- acquisition, processing and interpretation of seismic reflection data (Officer),
- construction of a model of the early rift phase processes of the Otway Basin,
- a re-evaluation of the petroleum potential of the Canning Basin,
- completion of the Queensland portion of the Eastern Australian Basins project.

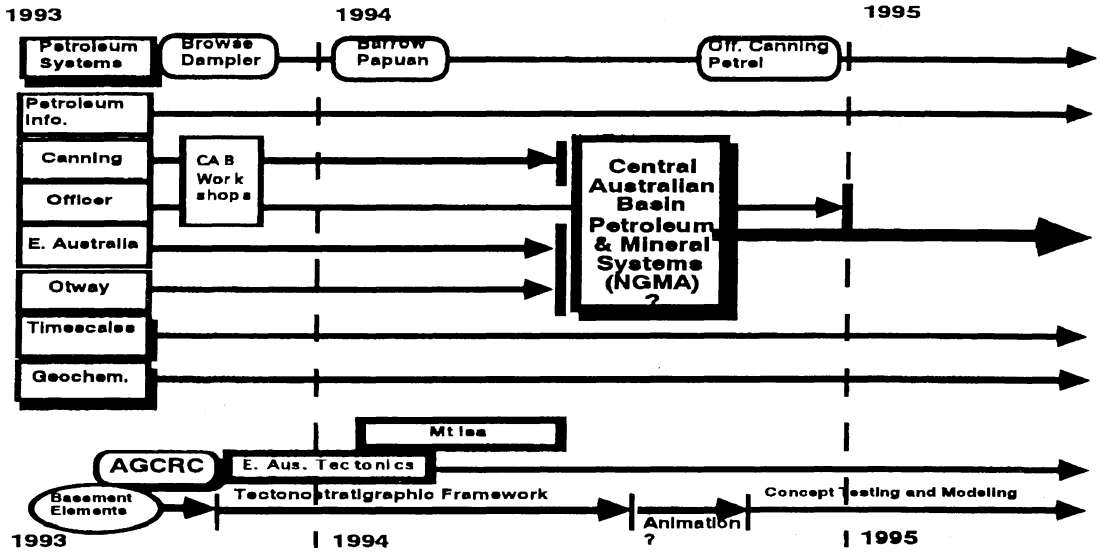


Fig. 2. Outline of work program and planning workshops to be undertaken onshore within the Basin Resources Program (BRP).

Define and plan potential new NGMA projects.

Undertake new projects within the Australian Geodynamics Cooperative Research Centre.

Information Dissemination

Produce Phanerozoic Timescales volume.

Further develop a prototype petroleum geoscience information system.

Disseminate information from NGMA and APS projects.

Strategic Direction

Current Commitments

The onshore component of AGSO's Petroleum and Marine Geoscience Group will complete its current National Geoscience Mapping Accord commitments during 1994, with most projects finishing at the end the 1993/94 fiscal year. The Canning (Larapintine System), Otway (Austral System) and Sedimentary Basins of Eastern Australia (Gondwanan System) projects will meet the bulk of their commitments during this period.The Officer Basin (Larapintine System) interpretation will continue until the end of 1994.

Stage II of the Canning Basin NGMA Project that will finish at the end of 1993/94 will have important ramifications for both the petroleum and minerals industry. New insights into the sequence of events that have influenced the evolution of three petroleum systems and the distribution of minerals in the basin have been developed. The Canning Basin is a possible candidate for future projects under the scenario discussed below.

The Otway Basin study, in conjunction with its NGMA partners, will provide some valuable data to help understand the early rift history of the region. It will also complement future efforts (see below) on the south east margin to further refine the understanding of the tectonic evolution of this area and the Austral petroleum system.

The Sedimentary Basins of Eastern Australia (NGMA) project will be the first study to generate a regional structural and stratigraphic framework through the Bowen, Surat, and Gunnedah basins. It will have significant implications for the evaluation of the hydrocarbon potential for the area and may positively influence assessment of the region. This will also be the first time that a significant portion of the Gondwanan petroleum system and sub systems will be documented.

The Officer Basin (NGMA) study is providing the first glimpses of the deep structural architecture of a basin that has been explored only lightly. The Officer Basin is a possible candidate for future studies under the scenario outlined below.

Future Directions

In order to effectively evaluate all of Australia's sedimentary basins on a 15 to 20 year cycle it is imperative that all of AGSO's ac-

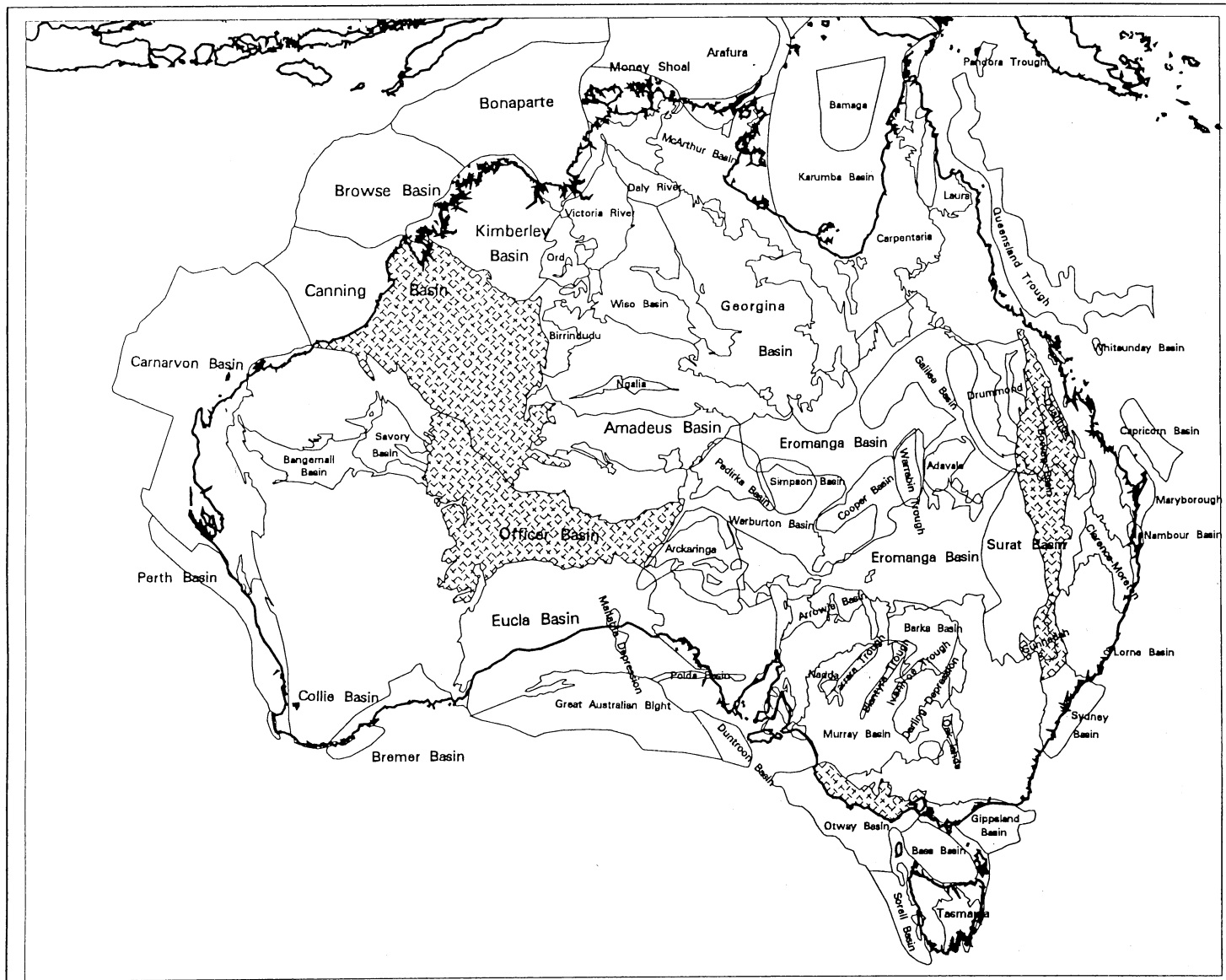
tivities are well coordinated with potential partners such as the BRS, other geoscience institutions and the minerals and petroleum industry.

One of the main questions to be addressed during 1993/94 is to develop a plan for basin resource evaluation projects over the next 5–10 years. As part of a balanced program within the Basin Resources Group, we believe that the onshore portion of the program, over the next 2–3 years, should be within the Centralian to Larapintine (Late Proterozoic to Palaeozoic) petroleum and mineral systems within sedimentary basins. An open planning process involving representatives from all the mainland state and territory surveys, universities and industry is underway during the latter part of 1993 to define the nature of potential projects. The success of these projects will depend on our ability to mount integrated and coordinated multidisciplinary projects that test methods, topics and areas in a timely manner.

The onshore work will balance a major effort by the marine component of the Basin Resources Group planned on the Westralian Petroleum System in the North West Shelf. The marine program at AGSO has concentrated on establishing the tectonic framework of the North West Shelf during the past two years. A series of projects concerned with regional aspects of the Westralian petroleum system are planned for the next two to three years to capitalise on the deep seismic-based margin architecture studies. The tectonic framework studies of the south east margin of Australia during 1994/95 and 1995/96 will similarly form the basis for studies of the various aspects of the Australia petroleum systems in the future.

An additional factor that must be considered for onshore Australia are significant changes in acreage lease agreements such as in the Cooper–Eromanga basin in 1998. We may want to undertake a resource evaluation of the Cooper-Eromanga region beginning in 1996. This would be the first regional project undertaken on the Murta petroleum system.

The Basin Resources Group is also involved in the Australian Geodynamics Cooperative Research Centre with projects in the Mount Isa region and the tectonostratigraphic framework of the eastern Australian region during the first couple of years. The AGCRC is scheduled to last seven years and AGSO has committed a number of resources during that time framework.



SEDIMENTARY BASINS OF AUSTRALIA

Current Onshore NGMA Projects

Canning Basin 112.04
East Australian Basins 112.05
Officer Basin 112.07
Otway Basin 112.09

September 1993

Project 111.02B Australian Petroleum Systems

Project manager	John Bradshaw	06 249 9659 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	February 1992–1995	

Objective

Determine the controls on hydrocarbon occurrence in several petroleum systems, and disseminate this information to the project clients as an aid in exploration.

Relevance

The project is a cooperative research project between AGSO and APIRA, the Petroleum Division of the Australian Mineral Industries Research Association, funded on a 50/50 basis between government and industry.

The Palaeogeographic Maps and Phanerozoic History projects have laid the foundation for the Australian Petroleum Systems project. One result of these earlier projects was the recognition that at least seven petroleum super-systems, all prospective for hydrocarbons, have formed on the Australian continent. A petroleum super-system consists of a mature source rock and all its generated accumulations. The petroleum system approach provides a unifying concept that effectively helps to focus this research effort on the key processes and elements that control the evolution and preservation of petroleum systems.

The Australian Petroleum Systems project has a modular structure focussing on individual basins within specific petroleum systems. Each basin or module is evaluated with respect to its petroleum potential and in relation to the major petroleum systems. Companies can choose to sponsor the entire project for the three years or individual basin modules. The choice of basins is decided jointly by participants, with consideration for the planned timetable of acreage release outlined in the Government's Offshore Strategy document.

Expected outcomes

A better understanding of the factors that control hydrocarbon accumulations in each basin. A method for predicting the timing, nature and distribution of hydrocarbons in each basin within major petroleum systems.

Activities

Complete up to nine basin modules in the three years of the project. The first six modules to be studied are the Dampier/Rankin, Browse, Papuan, Barrow/Exmouth, Petrel and Beagle/Offshore Canning Basins. Future modules to be studied will be decided at sponsors' meetings which are held on a regular basis.

The biostratigraphic timeslice approach developed in the earlier projects remains the key to the success of the Australian Petroleum Systems project. This will maintain a link to the products of the previous projects and enable easy comparison of different areas. Predictive analysis based on results from well studied areas, can be applied in those areas where there is poor or little control. New approaches and ideas will be identified in more mature areas.

Develop a relational database of biostratigraphic zone and depth pairs, in conjunction with databases of prospectivity information, such as reservoir data, hydrocarbon shows and total organic carbon content. These databases will be linked to the PEDIN database. A series of palaeogeographic data and interpretative maps will be prepared for selected time-slices, as well as regional cross-sections.

Expected products

The anticipated products for each basin module are:

- regional location map
- well location and hydrocarbon occurrence map
- regional cross-sections including orthorhombic diagrams, generalised structural element and subcrop maps
- interpreted and uninterpreted repre-

sentative seismic lines that focus on specific problems

- summary stratigraphic column tabulating reservoir, source and hydrocarbon show information by timeslice
- timeslice data maps compiled from well, seismic and outcrop information, showing lithology, thickness, depth to top of timeslice, reservoir and source parameters and hydrocarbon occurrence
- timeslice interpretation maps showing depositional environments and isopachs overlain on regional structure
- timeslice palaeogeographic maps of Australia showing palaeoenvironments in colour and annotating significant features of the petroleum geology in more explored coeval basins
- global plate reconstructions for selected timeslices showing the location of significant petroleum occurrences in more explored coeval basins
- well analysis data sheets
- well summary time(age)/depth plots
- table of hydrocarbon occurrences
- table of well information
- table of play types
- computer database of information compiled for module study
  - reservoir and source parameters
  - biostratigraphic age control
  - timeslice picks
  - environmental interpretation from log, core and cuttings
- maturation profiles along regional cross-sections
- descriptions and flow charts of the petroleum systems identified

Highlights for 1992/93

Completed Dampier/Rankin and Browse modules and established methodology and database format for remaining modules.

Compiled data and commenced interpretation for Papuan and Barrow/Exmouth modules.

The biostratigraphic database STRATDAT, established on AGSO's Oracle system. Steps taken to develop STRATDAT into a national database with the structure disseminated to State Geological Surveys, other international geological research organisations and consultants.

The Prospectivity database developed in a spreadsheet format.

Held workshops on Australian Petroleum Systems in-house at AGSO, and in Melbourne for industry group in November 1992.

Presented results of project at two sponsors' meetings in Canberra, 10–11 August 1992 and 25–26 March 1993.

Presented two papers at AAPG International Conference in Sydney — August 1992.

Overview paper on Australian Petroleum Systems submitted to PESA Journal and presented at PESA meeting in Melbourne.

Paper on Cainozoic oil in Papua New Guinea submitted to 2nd PNG Petroleum Conference

Paper on bitumen stranding in Northern Territory submitted to PESA Journal.

Goals for1993/94

Complete the Papuan and Barrow/Exmouth modules.

Commence the Petrel and Beagle/Offshore Canning modules.

Establish a relational format for the Prospectivity database (to be called RESFACS).

Conduct a workshop for industry on Australian Petroleum Systems in Perth in August 1993.

Hold sponsors meeting in Canberra 16–17 November 1993 and again in mid 1994.

Present papers at the 2nd PNG Petroleum Convention in Port Moresby (June 1993), the Central Australian Basins Workshop in Alice Springs (September 1993), and the AGSO Petroleum Seminar in Canberra (November, 1993).

Prepare major papers for presentation at West Australian Basin Symposium in Perth.

Customers

The companies sponsoring the project at present are:

Ampol

Amoco Production Co.

BHP Petroleum

British Petroleum

Bridge Oil Ltd.

Canadian Occidental Petroleum

Conoco Australia Ltd

Esso Australia

Sagasco

Mobil New Exploration Ventures Co.

Santos

Texaco Oil Development Co.

Union Texas Co.

Western Mining Co.

Woodside Petroleum

These companies are also the target audience for the products.

Other stakeholders include:

Petroleum Division of the Australian Minerals Industry Research Association

Papua New Guinea Department of Minerals and Energy, Petroleum Division

State and Territory Geological Surveys

Marine Geoscience and Petroleum Geology, AGSO

Petroleum Resource Branch, BRS, DPIE

Robin Helby, Consultant Palynologist

Kevin Hill, Alan Partridge, Latrobe University

Bruce Wyatt, Consultant computer programmer

Project 111.03 Phanerozoic Timescales

Project manager	John Shergold	06 249 9410 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	Ongoing	

Objectives

Develop an integrated chronological framework for Australian Phanerozoic sedimentary sequences using palaeontological, geochronological, magnetostratigraphic and geochemical techniques.

Apply the time framework to the solution of geological and resource exploration problems.

To define the chronologic framework of the Australian Petroleum Systems.

Relevance

There is a strong and ongoing demand for an integrated chronological framework in order to understand the sequence and timing of events in the history of sedimentary basins and, on a broader scale, provide a framework for continent wide studies of Australian earth history.

Expected outcomes

An improved Australian Phanerozoic timescale, leading to better age control for exploration and other geological studies.

Activities

Produce a revised Phanerozoic Timescales series to provide a basis for an improved Australian timescale, through both discipline-based research to provide new data, and the synthesis of existing data from the latest biostratigraphic and geochronological research.

Provide client services requiring biostratigraphic, biogeographic, palaeoenvironmental information, age dating and thermal maturation analysis in support of basin studies, NGMA projects, the Continental Margins Program, and various national agencies and international collaborative research activities.

Manage the national fossil collections and Phanerozoic biostratigraphic and geochronologic databases (GEOTIME, PALEO, STRATDAT, STRATAGE) as an information resource.

Expected products

Review of the biostratigraphy of sedimentary

basins to support basin studies.

Catalogues of fossils held in the national collections.

Scientific papers, reports, posters and public material.

Highlights for 1992/93

Phanerozoic Timescale contributions:

- Study of Late Cambrian Iverian Stage in western Queensland (AGSO Journal).
- Review of stratigraphic subdivisions and correlation of the Prices Creek Group (Ordovician) in Canning Basin (AGSO Journal)
- Devonian vertebrates from the Eastern Sector of Australian Antarctic Territory (Records, Australian Museum)
- Devonian Canning Basin brachiopods (AGSO Record)
- Capabilities of SHRIMP 1 for Phanerozoic dating demonstrated with publication of a new international timescale for the Early Carboniferous and revision, by 20 million years, of the onset of the Kiaman reversed magnetic interval in Australia.
- Middle Palaeozoic macrovertebrate biostratigraphy of eastern Gondwana (in book ed. John Long)
- Edited the book Ostracoda in the Earth and Life Sciences (Balkema, Rotterdam)
- Examined Permian foraminiferal species from Australia and the Urals (Russia) [international collaboration effort].
- Review of Palaeozoic palaeontology of Antarctica (in book ed. R. J. Tingey)

Customer Services:

- Palynology of Bus Swamp No. 1 stratigraphic hole in the Otway Basin (Victorian Geological Survey)
- Palynology of eleven water bores from Cape York (Queensland Water Resource Commission)
- Summary of Phanerozoic biostratigraphy and palaeontology of the Lennard Shelf (Canning Basin) W.A. Petroleum Companies (AGSO Canning Basin Project).
- Canning Basin Ordovician Conodont Biostratigraphy (Petroleum Companies, AGSO Canning Basin Project)

Collections & Databases

- STRATDAT fully operational and capable of producing isopach maps of time slices at all levels of resolution
- Catalogue of the Archaeocyatha, Porifera and Coelenterata in the Commonwealth Palaeontological Collections (AGSO Report 307)

Goals for 1993/94

Phanerozoic Timescale contributions:

- Produce a unified Australian Phanerozoic Timescale volume
- Continue to review Phanerozoic timescale with growing emphasis on post-Palaeozoic
- Continue commitment to Canning Basin Palaeozoic studies including completion of taxonomic and biostratigraphic analyses of the Ordovician Emanuel Formation and an analysis of Palaeozoic microvertebrates of the subsurface
- Provide SHRIMP zircon dates constraining the late Palaeozoic timescale of Australia and its international correlation
- Complete Permian palynology of Cranky Corner Basin and contribute to zonation of the Permian of the Carnarvon Basin
- Correlate Australian Permian with international stages

Customer Services:

- Review the Permian of Gunnedah Basin for the Sedimentary Basins of Eastern Australia NGMA project.
- Continue palaeontological analysis of the Canning Basin

Examine Triassic conodonts from the North West Shelf

Complete morphologic keys to fossil spore pollen genera and acritarch genera

Collections & Databases

Produce catalogues of the conodont and vertebrate collections in the Commonwealth Palaeontological Collection

Continue data entry and integration of palaeontologically related databases.

Initiate a national and international reference collection of radiometric dating samples for constraining the Phanerozoic timescale of

Australia and its international correlation.

Customers

Companies involved in Australian petroleum and exploration industries.

Working palaeontologists, geochemists, magnetostratigraphers

Other AGSO programs and projects (MLU, Marine, 111.02B, 112.04, 112.05, 112.07, 112.09, 121.23, 121.26, 121.31, 224.03)

IUGS Commission on Stratigraphy, various subcommissions; IGCP.

Cooperating agencies

State geological surveys

NZ Geological Survey

CALTECH

Nanjing Institute of Geology & Palaeontology, Academica Sinica

Weizmann Institute, Israel

University of Southampton

University of Iowa

University of Texas

Free University, Berlin

Ruhr Universitat, Bochum, Germany

University of Hamburg, Germany

Institute of Vertebrate Palaeontology and Palaeoanthropology, Academica Sinica

Institute of Geological Sciences, Beijing

University of Adelaide

Australian National University

Macquarie University

Melbourne University

Monash University

University of New England

Newcastle University

University of New South Wales

University of Queensland

South Australian Institute of Technology

Sydney University

University of Tasmania

University of Western Australia

Australian Museum

Queensland Museum

Western Australian Museum

Santos Ltd.

Western Mining Corp. Ltd.

Union Texas (South East Asia) Inc.

Bligh Oil and Minerals Ltd.

Geomar, Kiel, Germany

Shell Australia

BHP/Utah

Project 111.04 Controls on Oil and Source Rocks Occurrence

Project manager	Roger Summons	06 249 9515 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	1987–ongoing	

Objectives

Develop an understanding of the factors which control formation, degradation, preservation and maturation of hydrocarbon-prone organic matter with emphasis on the essential role of microbes in early diagenesis. Particular importance is placed on Australian circumstances and Australian exploration objectives.

Develop predictive models of source rock distribution based on depositional setting, geochemical signature and thermal maturation.

Provide an accessible database of organic geochemical information for AGSO and for the petroleum industry.

Relevance

Understanding the distribution of source rocks and controls on the composition of hydrocar-

bon-prone organic matter is fundamental for determining the potential of Australia's petroleum systems. Basic and applied research is undertaken through analyses of source rocks, oils, gases and the parent organic matter.

The project is developing conceptual models and diagnostic geochemical tools to be used in petroleum exploration and field development.

All geochemical analyses are stored in an Oracle relational database, for use by the exploration industry. The database is continually updated.

Individual work priorities are determined by the requirements of current AGSO basin studies and by collaborative projects with customers in the exploration industry.

Expected outcomes

An improved understanding of how oil occurrence and composition are influenced by:

- the nature of the primary organic matter
- depositional setting
- maturation history
- biodegradation

More effective correlation of oils with their source beds, particularly in the East Australian Basins and the North West Shelf.

More effective use of geochemical tools in petroleum exploration.

A more integrated ORGCHEM module within the National Petroleum Database (NPD).

Activities

Characterise Australian oils and source rocks, including materials from frontier areas.

Collaborate with Australian explorationists in studies of immediate relevance.

Participate in local and international studies of major source rock sequences which are pertinent to evaluation of Australian petroleum systems.

Identify new biomarkers and develop new correlation and analytical methods.

Develop diagnostic correlation tools based on combinations of carbon isotopic and molecular signatures.

Continue isotopic analysis of lipids from geologically significant microbes.

Continue to support Antarctic CRC.

Prepare reports and data releases on these topics.

Expected products

Characterisation of organo-facies of the Tertiary. Application to PNG oils and source rocks and for customers in New Zealand, Indonesia, Philippines and the south Pacific.

Database of oil and source rock characteristics.

Comprehensive reports describing hydrocarbon characteristics of principal oils and source horizons.

Training programs.

Research papers.

Industry sponsored client reports.

Highlights for 1992/93

Oils and condensates from Permian and Triassic reservoirs in the Bowen and Cooper basins show very similar geochemical signatures. However, Mesozoic petroleum from the Eromanga Basin is characterised by a contribution from local source rocks as detected by the presence of biomarkers from pines of the genus Araucariaceae. This signal is absent from all Surat Basin oils so far studied suggesting that they may have exclusively Permian sources.

A combination of maturity assessments using both triaromatic and diaromatic hydrocarbons is required to distinguish "immature" from "high temperature" condensates. Condensates in the Bowen and Surat Basins can be classified as relatively "immature" and are generated at the same maturity levels as the oils. The application of the aromatic biomarker parameters for both source and maturity has proved most effective and has been shown to be applicable across basin boundaries (see also below).

Results of a correlation study of Carnarvon Basin source rocks, condensate and oils (Hadson and partners) have been supplied to the customer companies. Details have not yet been approved for open release. However, in general terms we feel we have made some significant findings about how variability in source rock quality can be measured and how it affects the nature of the generated fluids (i.e.

proportions of gas, condensate and oil).

A maturity/migration study in the McArthur Basin for Pacific Oil and Gas P/L found that aromatic biomarker maturity parameters work well in very old oils and source rocks. This enabled us to compare the maturity of source rocks and entrained bitumens, thus showing where migrated oils are presently reservoired, as distinct from oils that have not migrated from their source horizons.

Papers on the nature and origins of bitumen strandings from the Arafura sea coastline and seep oils from the Goroka region of PNG, work done in collaboration with BHPP and the Petroleum Systems Project have been accepted for publication.

Work aimed at determining the petroleum potential and depositional environment of the Tasmanian tasmanite oil shale has been carried out in collaboration with CSIRO Oceanography (Hobart) and the University of Tasmania. One paper on this topic, drafted for submission to Geochemica Acta, summarises the geological and geochemical evidence for deposition in a glacial marine system.

ORGCHEM has been updated with new data which became "openfile" during the 92/93 year.

Lipids from methanotrophic bacteria have been studied using batch cultures of specific organisms and also using a "cold-vent" symbiosis between bacteria and mussels. The origins of the major fractionations have been shown to result from the principal methane oxidising enzyme methane monooxygenase (MMO). Major differences in isotopic compositions of methane-derived biomass result from different forms of MMO induced by the grown conditions. Isotopic analysis of methane/CO2 pairs from coal seams in the Illawarra Coal Measures show characteristics to suggest that methane oxidation has been an active process and an important control on the composition of the gas.

Goals for 1993/94

Maintain collaborative work with AGSO customer projects including NGMA, CMP and APIRA projects.

Maintain the currency of the ORGCHEM database with in-house and company generated geochemical data. Release into the public domain half yearly updates.

Modify ORGCHEM structure to record rock type abundances and improve ease of communication with other NPD modules and the host DG AViiON computer.

Access various modern angiosperm families that are sources of geologically important triterpanes.

Characterise molecular and isotopic profiles of the Tertiary and across the Mesozoic/Cainozoic boundary.

Provide in-house and client-funded, external training in geochemistry.

Customers

Petroleum exploration companies in Australia and overseas

Specific research projects are underway with:

Pacific Oil and Gas

David Francis, consultant geologist, New Zealand

BHP Petroleum Ltd and BHP Collieries

Petrocorp Indonesia (Fletcher Challenge)

AIDAB

MIM Holdings Ltd.

Canadian Occidental Petroleum(Asia)

Cooperating agencies

Pacific Oil and Gas

Hadson Energy Ltd

BHP Petroleum Ltd and BHP Collieries

Chevron Petroleum Technology Company

PNG Department of Petroleum

SOPAC (South Pacific Commision)

Department of Energy, the Republic of Phillipines

Victorian Environment Protection Agency

JK Volkman, PD Nichols, Division of Oceanography, CSIRO, Hobart

R Capon and students, Chemistry Department, Melbourne University

D McKirdy and students, Geology Department, Adelaide University

R Alexander, R Kagi and students, Applied Chemistry, Curtin University

J M Hayes and associates, Biogeochemical

Laboratories, Indiana University California

LL Jahnke, NASA Ames Research Center

Project 112.04 Canning Basin Stage II (NGMA Project)

Project manager	Jim Jackson	06 249 9205 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	1989–1994	

Objective

Improve knowledge of the structural and stratigraphic evolution of the Canning Basin and the characteristics of the main petroleum systems to provide a framework for more effective and efficient exploration for resources, especially petroleum.

Relevance

Despite more than 20 years of active exploration in the Canning Basin (one of Australia's largest onshore basins) results have generally been disappointing; hydrocarbons, base metals and evaporites have been discovered, but exploited to only a small extent. Some assessments of prospectivity suggest that the Basin has not yet realised its potential. This was emphasised by the results of Stage I of the project (1989–92) which identified new petroleum plays in the Devonian Petroleum System along the northern margin of the Fitzroy Trough. Publication of these results has led directly to a new phase of petroleum exploration and confirmed the value of research conducted in Stage I.

The initial phase of Stage II of the project will focus on understanding the geological processes that control the evolution of the Basin's petroleum systems. The main aim is to more clearly define the relative resource prospectivity of the various systems and to identify the more promising play concepts in the Basin as an aid and stimulant to exploration. This will enable better prioritisation of key factors or areas within which to undertake subsequent more detailed research of specific petroleum systems. These results will also be relevant to adjacent basins with similar geological histories and comparable petroleum systems.

This project, in cooperation with the Geological Survey of Western Australia, is part of the National Geoscience Mapping Accord.

Expected outcomes

Improved definition of the Basin's petroleum systems and an enhanced assessment of their relative petroleum prospectivity, leading to more effective exploration.

Activities

Define basement elements.

Define nature and timing of inter- and intraplate tectonic events that may have influenced the evolution of the Basin.

Define basement structure, grain/fabric of underlying basement elements and crustal thickness.

Establish first and second order stratigraphy through the Basin.

Establish subsidence/uplift history and map results.

Define Basin phases and characterise the fill history of each phase.

Refine palaeogeographic reconstruction.

Determine areas of higher potential for hydrocarbons.

Define character, timing and distribution of petroleum system elements e.g. source maturation, migration, traps, seals, reservoirs and plays.

Disseminate information in maps, cross sections, interpreted seismic data, digital databases, etc. that document the concepts and ideas developed during the project.

Expected products

Evaluation of the petroleum systems that have formed in the Canning Basin and associated products required to document the evaluation.

Highlights for 1992/93

Release and sale of integrated data packages:

- basinwide shot point database,
- seismic, well and map folios, with explanatory notes from Stage I area (Lennard Shelf);

Publication of research papers in APEA, AAPG and GEOLOGY journals.

International and Australian petroleum exploration companies undertaking exploration of newly identified plays and applying for new exploration permits influenced by the output of Stage 1 of the project.

Positive responses of support from most companies approached with plans for Stage II studies. Extensive seismic and well data supplied by three co-operating groups.

Presentations of results at conferences and workshops at several universities.

Goals for 1993/94

Produce a uniform Basin-wide data set of geological information, to assist resource exploration planning.

Revise understanding of stratigraphic and tectonic history of the Basin.

Define, characterise and map the distribution of petroleum systems in the Basin, identify the most prospective.

Re-assess existing petroleum plays.

Complete publication of the detailed biostratigraphic zonation for the Ordovician from the Prices Creek area (continued from Stage 1).

Complete the central basin transect commenced in Stage 1 (Lamont-Doherty) with subsidence models.

Customers

Exploration companies in petroleum and mineral industries (especially current and prospective lease holders in the Canning Basin).

Cooperating agencies

Dr P E Playford, Geological Survey of Western Australia, Perth.

Professor C. Powell, Geology Department, University of Western Australia, Perth.

Dr N. Christie-Blick, Lamont-Doherty Geological Observatory of Columbia University, New York, USA.

Dr B. Goldstein, Bridge Oil Ltd., Sydney, NSW

M. Wiltshire, Wiltshire Geological Services, Adelaide

R. Weedon, Western Mining Corporation, Perth.

P Chesterman, Bow Valley Industries, Calgary, Canada.

Earth Science Departments of Australian universities.

Project 112.05 Sedimentary Basins of Eastern Australia (NGMA Project)

Project manager	Russell Korsch	06 249 9495 fax 06 249 9972 *email rkorsch@agso.gov.au*
Program responsibility	Basin Resources	
Timeframe	1990–1994	

Objectives

Enhance our knowledge of, and develop models for, the origin and evolution of the Gunnedah, Surat, southern Bowen and associated basins in eastern Australia.

Relate these models to potential hydrocarbon occurrences as a basis for future exploration and assessment of resources.

Update the understanding of the geology of the basins.

Provide information to explain the distribution of known, potential and undiscovered occurrences of fossil fuels.

Relevance

The late Palaeozoic Bowen and Gunnedah Basins and the Mesozoic Surat Basin contain vast coal resources and are moderately prospective for hydrocarbons, being close to major markets.

There is considerable uncertainty as to the geometry of the basins, the mode of formation (extension, transtension, foreland loading), the relation of basin development to tectonic events in the adjacent orogen, and the implications for the timing of hydrocarbon generation and accumulation. There is also considerable uncertainty as to the timing of events because of poor time control on local biozones.

The area of interest includes southern Queensland and northern New South Wales and there is a requirement to rationalise geological concepts across the border.

The project is being undertaken under the NGMA in cooperation with the Geological Survey of Queensland and the New South Wales Department of Mineral Resources (NSW Geological Survey and Coal & Petroleum Geology Branch).

Expected outcome

Enhanced exploration for fossil fuels in the Bowen, Gunnedah and Surat Basins.

Activities

Define basement elements.

Define nature and timing of inter- and intraplate tectonic events that may have influenced the evolution of the basins.

Define basement structure, grain/fabric of underlying basement elements and crustal thickness.

Establish first and second order stratigraphy through the basins.

Establish subsidence/uplift history and map results.

Define basin phases and characterise the fill history of each phase.

Refine palaeogeographic reconstruction.

Determine areas of higher potential for hydrocarbons.

Define character, timing and distribution of petroleum system elements e.g. source maturation, migration, traps, seals, reservoirs and plays.

Identify work that could be undertaken in future studies.

Disseminate information in maps, cross sections, interpreted seismic, digital databases, etc. that document the concepts and ideas developed during the project.

Expected products

First digital (3-D) database to be constructed for a large area of eastern Australia.

Map folio (1:1 million and larger scales) of various stratigraphic, structural and geochemical features; the maps will be available in hard copy and digital formats.

Digital database, especially of seismic information.

Initial reports as AGSO Records and interim maps of selected areas, followed by a comprehensive volume which will provide an up-to-date synthesis of the regional geological history of the Bowen, Gunnedah and Surat Basins with emphasis on the stratigraphic, structural and petroleum geology.

Research papers summarising the petroleum potential of the East Australian Basins.

Highlights for 1992/93

Major advances in the seismic stratigraphic interpretation of the Bowen and Surat Basins in Queensland were made, with the completion of the area north of 26°S, which covered major parts of the Nebine Ridge, Denison Trough, Comet Platform, Taroom Trough of the Bowen Basin, as well as the overlying northern part of the Surat Basin. An oral paper, a poster and an excursion guide book were prepared for the 5th International Conference on Fluvial Sedimentology.

The main results from the preliminary interpretation of the Gunnedah Basin deep seismic data were presented in an Invited Keynote Paper at the 1993 New England Orogen Symposium. An invitation to present a paper at the PESA — NSW Petroleum Symposium in June 1993 resulted in the preparation of a written paper for the symposium volume. A paper on coalbed methane in eastern Australia was prepared in conjunction with S. Miyazaki (BRS) and presented at the 1993 APEA Conference.

Palynological investigation of samples from Cranky Corner 3 well (northern Sydney Basin) is complete. A lithological log and a core-gamma log has been compiled. The palynofloras equate with those from the oldest Permian from Western Australia, enabling accurate intra-continental correlation. These results will be presented in an AGSO Record.

Carbon-13 isotopic analysis of individual gaseous hydrocarbons from 11 wells were completed. Interpreted maturity levels suggest that the main phase of gas generation is from kerogen decomposition and comes after peak oil generation but before significant oil cracking.

Goals for 1993/94

Interpret a regional network of industry seismic lines in Queensland between 26° and the New South Wales border (in collaboration with GSQ).

Evaluate the nature, timing and distribution of petroleum system(s) in the area between 26° and the NSW border and release a folio of maps including explanatory notes.

Complete geological and geophysical interpretation of deep seismic data from Bowen Basin and commmence preparation of report.

Continue enhanced processing of deep seismic data across the Gunnedah Basin and New England Orogen.

Complete report on systematic study of the Early Permian Cranky Corner palynofloras.

Continue documentation of Gunnedah Basin palynofloras, including the entry into STRATDAT of NSWGS data.

Prepare AGSO Record on 'Geochemical characteristic of gas, condensate and oil in the Bowen and Surat Bowen Basins: Implications for source, maturation and migration'.

Complete Rock Eval and TOC analysis for the Permian Blackwater and Back Creek Groups. In collaboration with GSQ, prepare source-richness and maturity maps for these formations.

Complete biomarker analysis and tabulate results of Surat Basin potential source rocks.

Finalise pilot remanence and magnetic fabric studies on Carboniferous–early Permian volcanics of the Tamworth Belt and define Late Palaeozoic APWP for the belt.

Define the upper and lower boundary of the Kiaman Reversed Polarity Interval (Late Carboniferous–Permian) as a means of regional and global correlation. Prepare publication of initial results.

Customers

The Australian petroleum and coal industries

Current and prospective lease holders in the Bowen, Gunnedah and Surat Basins

Academic and geological research institutions and the public

Cooperating agencies

Geological Survey of Queensland

New South Wales Department of Mineral Resources (NSW Geological Survey and Coal & Petroleum Geology Group)

Department of Geology, La Trobe University

Department of Geology, Australian National University

Department of Geology & Geophysics, University of New England

Department of Geology, University of Adelaide

Department of Applied Geology, University of Technology, Sydney

Petroleum companies with leases in the study area

Project 112.07 Officer Basin (NGMA Project)

Project manager	John Lindsay	06 249 9428 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	1990–1994	

Objectives

Improve the understanding of the setting, stratigraphy and evolution of the Officer Basin.

Assess the potential of the basin for petroleum and minerals occurrences.

Relevance

The Officer Basin area is the least explored region of South Australia. Its mineral and petroleum prospectivity have been inadequately assessed and its setting and geological evolution are poorly known.

Should traditional owners, the State Government, and the exploration industry agree on conditions for exploration in the area, information on basin thickness, style, structure, type of sediments, stratal geometry and timing of sediment fill will attract the exploration industry to work in such a remote and logistically difficult area.

Expected outcomes

Improved understanding of the prospectivity, morphology and evolution of the Officer Basin.

Increased exploration industry interest in the Officer Basin, demonstrated by enquiries from petroleum companies.

Activities

Synthesise the subsurface information from industry seismic surveys and drilling programs, to supplement the 1:250 000 scale geological surface mapping.

Record a grid of regional seismic traverses.

Interpret other AGSO and industry geophysical and well data to develop a depositional and post-depositional model.

Expected products

An up-to-date regional synthesis of the geology of the Officer Basin in South Australia.

A folio of geological and geophysical and well-log data of the South Australian part of the Officer Basin specifically oriented towards the search for petroleum resources. A network of regional seismic lines in the central Officer Basin.

A basin model to aid in the prediction of petroleum source and reservoir rocks.

An assessment of the potential for petroleum and mineral accumulations.

Specialised papers and publications concerning the evolution of the basin and its sediment fill.

Highlights for 1992/93

Framework of existing industry seismic lines interpreted with significant seismic horizons mapped.

Agreement reached with the Maralinga and Pitjantjatjara Aboriginal communities to acquire seismic data on their lands.

Seismic acquisition begun.

Presentations outlining program objectives and preliminary results were made to petroleum companies. Active involvement of major petroleum companies.

Goals for 1993/94

Complete acquisition of new regional seismic traverses and begin processing of this data.

Interpret newly acquired seismic reflection data when processed.

Complete reprocessing of Serpentine Lakes Seismic data and release the reprocessed digital data in industry format.

Produce a preliminary 1:1 million map of the eastern part of the study area based on the interpretation of existing seismic and well data.

Make presentations to petroleum exploration companies on project progress.

Customers

South Australian Department of Mines and Energy

Petroleum industry

Cooperating agencies

South Australian Department of Mines and Energy. Primary contacts are Dr. D Gravestock and Mr G Krieg,

Petroleum industry

Project 112.08 National Petroleum Maps — New Geological Map of Australia

Project manager	David Palfreyman	06 249 9465 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	1992–1996	

Objectives

Provide information to assist in the sustainable development of the natural, particularly petroleum and mineral, resources of the country.

Relevance

The project is part of AGSO's contribution to national geoscience cooperation. It will synthesise advances in geological knowledge since the first edition map was published in 1976 and thus improve the overall understanding of the geology of Australia.

Expected outcome

Synthesis of the geology of Australia as an aid to exploration and geoscientific research.

Activities

New data on the geology to be digitised and synthesised with data from the first edition map.

Expected products

A digital second edition of the 1:2 500 000 scale geological map of Australia linked to smaller scale maps and observations.

A Tectonic Map of the Tasman Fold Belt System.

Goals for 1993/94

Digitise new data and commence matching with first edition data

Commence new map legend design

Customers

Mineral and petroleum exploration companies

Secondary and tertiary education institutions

Government and semi-government bodies

Geoscientific research bodies

Cooperating agencies

State and Territory geological surveys which will provide data and local geological expertise.

Project 112.09 Otway Basin (NGMA Project)

Project manager	Doug Finlayson	06 249 9761 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	July 1991–1994	

Objectives

As part of the National Geoscience Mapping Accord (NGMA), develop a better understanding of the early Otway Basin evolution and associated basement structures and the way in which their evolution/reactivation has influenced fluid migration paths and the formation of structural traps for petroleum.

Relevance

The Otway Basin is one of a number of basins in the Austral petroleum system formed on the southern Australian margin at the time of its breakup with Antarctica. Its exploration for hydrocarbons has not lived up to the expectations realised in the Gippsland and Bass Basins, partly because of structural complexity recognised in the basin sequences and also because of limited knowledge of the early basin forming events.

Near-surface geology (limestones, volcanics) make seismic data acquisition difficult. To date, industry standard data using vibrator seismic sources commonly do not image features below 3.5 s two-way time (about 7–8 km). Using AGSO deep seismic techniques, the project will examine the deepest basin sequences and the structures within basement that have influenced their deposition.

The value of aeromagnetic and gravity data and images for constraining the interpretation of important structural features within basins has not been fully realised. Potential field data will be acquired and imaged to form a basis for basin-wide interpretations.

Expected outcomes

A better understanding of the style of early Otway Basin evolution as a contribution towards petroleum exploration in the region.

An improved knowledge of seismic data acquisition techniques in areas of complex near-surface geology.

An improved appreciation of the value of aeromagnetic and gravity data and images in petroleum exploration.

Activities

In cooperation with NGMA partners, seismic profiling methods using explosive sources will be used to improve our knowledge of the early Otway Basin sequences by acquiring new deep seismic data. In addition, there will be reviews of industry data along key corridors to develope a better understanding of the geometry of early basin faulting. Other geophysical (gravity and magnetic) data will be acquired and used in complementary interpretations.

Expected products

Models of the extensional processs that formed the early rift phase of the Otway basin.

Interpreted seismic reflection profiles along a number of key corridors.

An integrated data base of interpreted seismic reflection information.

Structural element maps.

Images and maps of aeromagnetic and gravity data.

Seismic test results comparing seismic acquisition methods in areas of complex near-surface geology.

Appropriate and timely publications and presentations.

Highlights for 1992/93

Seismic data from seven regional lines within the basin (a total of 450 km) were processed and released for sale. The data were an important contribution towards resolving problems in four key areas of the basin, a) Colac Trough, b) Port Campbell Embayment–Warrnambool

High, c) Penola Trough, and d) Gambier Embayment. Along most lines, imaging of the deeper parts of the sedimentary sequences and imaging of structures within basement down to Moho depths (about 30 km) was achieved.

A consolidated Otway Basin seismic line database was available as a working tool by NGMA partners. This was updated as required.

In cooperation with State and university NGMA partners, structural elements mapping was begun in three parts of the basin, western Otway (SADME), central Otway (GSV), and eastern Otway (AGSO and VIEPS).

Some ideas are being developed on evolutionary models for the development of the early basin sequences in co-operation with students at Monash and LaTrobe universities.

AGSO completed aeromagnetic surveying of the western Otway Basin, including part of the offshore Crayfish Platform. The data were processed and released at the March 1993 APEA conference. The data highlight the significance of aeromagnetic data in identifying fundamental basement features relevant to the petroleum exploration industry.

Two planning and consultative meetings of the NGMA partners were held in Melbourne (Sept. 1993 and April 1993).

The development of a unified stratigraphic nomenclature across the basin by NGMA partners. This is progressing using a series of well logs and core analyses.

AGSO gravity mapping group integrated U.S. Seasat data for the Southern Ocean with the onshore gravity data. The resulting image of gravity features highlighted in spectacular fashion the nature of fracture zones in the oceanic lithosphere and their possible onshore correlations. The Otway–Sorrel microplate has been tentatively identified and further ideas on basin history are being explored.

AGSO provided palynology and geochemical analyses for cores from the GSV stratigraphic hole Bus Swamp No. 1 drilled in December 1992 on the northern margin of the Penola Trough.

Goals for 1993/94

Interpret AGSO seismic data in conjunction with other geological and geophysical data and integrate results into models of basin evolution within the Austral petroleum system along the southern Australian margins.

Production of potential field maps and images across the basin and analyses to integrate the data with seismic profiling results.

Interpretation of seismic horizons in the eastern Otway Basin and the integration with data from VIEPS into mapping products.

Making the results of the NGMA project available to customer groups through presentations and papers at appropriate conferences and the running of a one-day workshop in Melbourne.

Ensure that datasets resulting from the project are archived in a form suitable for further analysis in the future.

Customers

Petroleum exploration companies

Cooperating agencies

S.A. Department of Minerals & Energy (SADME)

- Contract mapping of seismic horizons in the western Otway Basin
- Revision of the stratigraphic nomenclature
- Management and provision of seismic data to NGMA partners

Geological Survey of Victoria (GSV)

- Mapping of seismic horizons in the central Otway Basin
- Revision of stratigraphic nomenclature
- Provision of eastern Otway Basin data and interpretations to NGMA partners
- Drilling of stratigraphic holes and subsequent analysis
- Acquisition of gravity data

Victorian Institute of Earth and Planetary Sciences (VIEPS) at Monash and LaTrobe Universities

- Mapping of seismic horizons in the eastern Otway Basin
- Fission track analysis and interpretation
- Interpretation of seismic profiles in the western Otway Basin and Otway Ranges
- Interpretation and modelling of geophysical and geological data

Exploration companies

- Access to data and interpretations throughout the Otway Basin on a needs basis
- Financial support for stratigraphic drilling

Petroleum Group Information Management

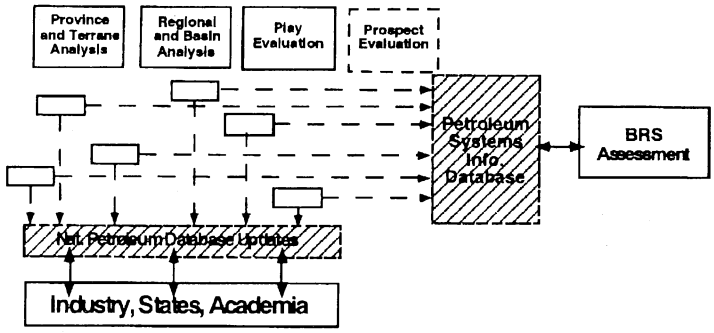


Fig. 1. Schematic diagram illustrating the concept of a National Petroleum Information System and the flow of geological data/information (vertical lines) from projects (small boxes in middle of figure) via National Petroleum Databases to industry, states and academia and petroleum system data/information (horizontal lines) from projects via the Petroleum System Information database to BRS. Although shown as separate databases, the NPD and Petroleum System Information database should be intimately linked.

Project 113.01

Petroleum Group and Industry Information System

Project manager	Tom Loutit	06 249 9397 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	Ongoing	

Objective

Develop, in conjunction with BRS, state geoscience agencies and industry, an integrated National Petroleum Information System to assist in the storage, retrieval, management and dissemination of digital and hardcopy geoscience data and information related to the petroleum industry.

Relevance

Geological and petroleum data/information is gathered and utilized by a wide variety of groups in Australia including industry, consultants, and state and federal agencies. An effective national geological and petroleum information system must cater for and include all of these groups.

AGSO, in partnership with BRS, state agencies and industry, is ideally positioned and staffed to play a lead role in the development and implementation of a national petroleum geoscience information system. A national petroleum geoscience information system (Fig. 1) must contain geological information required to support the ranking of exploration targets (e.g. basins), documentation of proven and unproven petroleum systems and their components (plays, play elements, etc.), the capability to rapidly access geological data required for exploration and access to historical data on production and reserves by field or basin or system. In other words, the system should intimately associate assessment-related historical data and geologic attributes within a geologic (time, process related) and geographic (space) framework.

Expected outcomes

To enable petroleum geoscientists to:

- have access to the critical information when decisions are being made,
- produce a quantitative estimate of the quality of the work done,
- produce a quantitative estimate of the adequacy of attributes such as seal,
- document the reasoning behind the interpretation,
- document the source of the data used in the interpretation, and
- document petroleum systems and plays and play elements.

Information management is a key component of exploration and must be tied to the exploration process to define the critical information for both geological and business analysis and the flow of this information to both the explorer (industry) and assessor (BRS). Significant increases in the efficiency of information management will have a major impact on the productivity of AGSO geoscientists.

Activities

Actively seek partners, both within AGSO and outside, with the appropriate expertise, such as NRIC, to help in the development of prototype GIS-based petroleum-related geoscience information systems that are customised to the resource evaluation process.

Undertake an examination of the methods employed at AGSO to evaluate the resource potential of Australia's sedimentary basins. Key issues to address include data and information requirements, bottlenecks and gaps in the process and the types of products that should be generated.

Contribute to the investigation of mass storage methods to store and maintain accessiblity to all geophysical data used to interpret the geology and resource potential of Australia's sedimentary basins

Receive, catalogue and store petroleum exploration reports and associated data and well-samples (cores, cuttings and fluid samples) provided to the Commonwealth under petroleum legislation. Implement and maintain systems to more efficiently curate data and sample information.

Provide facilities and technical support to AGSO and BRS programs and the petroleum industry for the examination and borrowing of cores, cuttings and other related information in the Core and Cuttings Laboratory.

Expected products

Expansion and implementation of the national well- and sample-based databases (PEDIN/STRATDAT/ORGCHEM, etc.) Implementation involves establishment of a data model, transfer of data to users, construction of data input guidelines and interface, establishment of "ownership", and establishment of rules for transfer of data between facilities.

Establishment of a National Petroleum Information System based on earth system processes and a hierarchy of time-space units ranging from tectonostratigraphic provinces through basins and basin phases to higher order accommodation cycles. The system must include links between the timing, distribution and character of play elements, and unique combinations of elements to form plays, and geological processes. Information on the location and type of geological samples and reports available at storage facilities around Australia is a critical component within the system.

Seamless access to PEDIN-related databases and the Petroleum Information System (managed jointly by the Bureau of Resource Science and AGSO).

Efficient management of petroleum data held by AGSO on behalf of BRS.

Development of a system for acquiring, manipulating, displaying and distributing biostratigraphic and geochronologic data/information.

Online access to PEDIN Oracle and Arc/Info database for AGSO and BRS users.

PEDIN Wells Version 5.0, PEDIN Surveys Version 3.0, ARC/Wells Version 2.0 and Arc/Survey Version 1.0.

Generate an implementation plan, in coordination with industry and state agencies, for a national petroleum geoscience information system.

Implement a coordinated effort to install STRATDAT in state geoscience agencies and industry and establish guidelines for the effect

ive maintenance of the database as a national facility. Serve as a model for future systems.

A report on status of management of data and information required for the evaluation of the resource potential of Australia's sedimentary basins.

A prototype GIS-based Petroleum Information System — PREDICT.

Help with the development of Australian Petroleum Systems databases.

Highlights for 1992/93

Data releases:

- PEDIN Wells Version 3.0
- PEDIN Surveys Version 2.0 (new release)
- Arc/wells Version 1.0 (new release)

Sale of PEDIN to three new industry clients.

Completed conversion of PEDIN and related databases (ORGCHEM, PORPERM, STRATDAT, etc), including database redesign, software re-writes, database migration and testing to ORACLE Version 6.0 running on the Data General AViiON UNIX platform.

Provided up-to-date information for AGSO/BRS and the public by ongoing data entry and development of the PEDIN database.

Initial development of software interfaces between PEDIN and the STRATDAT database completed.

Collaborated with BRS in the initial development of a prototype GIS-based Petroleum Information System, PETROINFO. A number of coverages were generated to test the capability of the system to handle petroleum related datasets including:

- PEDIN well information from ORACLE
- Petroleum Titles map from Intergraph
- Tectonic elements and shot-point data from Petroseis
- Digitised depth-to-basement contours
- Production of a digital sedimentary basins outline map

Goals for 1993/94

Continue development, maintenance, marketing and implementation of PEDIN and related databases (ORGCHEM, STRATDAT, etc.)

Begin development, in conjunction with ISB, of new databases to handle prospectivity, reservoir and seal data.

Interface PEDIN geophysical data with the proprosed Marine Sample database.

Establish a prototype GIS-based Petroleum Information System to handle general information on petroleum systems in Australia's sedimentary basins — PREDICT.

Assist in the development of procedure-based information systems for the Australian Petroleum Systems and Phanerozoic Timescales projects.

Customers

Marine Geoscience and Petroleum Geology Program, AGSO

Petroleum Resources Branch, BRS

Petroleum Division, DPIE

Petroleum Industry

State and Territory geoscience agencies

Academic institutions and the public

Cooperating agencies

Petroleum Resources Branch, BRS

National Resource Information Centre, BRS

State and Territory geoscience agencies

Petroleum Industry

Academic Institutions

Project 113.02 Australian Geodynamics Cooperative Research Centre

Project manager	Barry Drummond	06 249 9381 fax 06 249 9983
Program responsibility	Basin Resources	
Timeframe	1993–1999	

Objectives

Enhance the capacity of Australia's exploration companies to explore sedimentary basins and mineralised terrains both within Australia and overseas.

Involve Australian industry by encouraging the application of the CRC results to their exploration strategies.

Enhance the knowledge base on which rational decisions can be made on multiple land use issues.

Provide, by the training of post-graduate students, a significant pool of Australian scientists who are expert in the integration and interpretation of multiple geological and geophysical datasets.

Relevance

Australia has a large and efficient minerals and energy industry. The industry has an excellent technological base and is a world leader in research and development in exploration, mining and extractive metallurgy. Australia has large reserves of energy and minerals which will be important in satisfying the demands of world wide economic growth. In order to convert this potential into reality, the industry must continue to discover world class mineral and energy deposits that will produce significant economic return. To do this, the Australian explorer must develop an enhanced understanding of the processes which formed the Earth and focussed the mineral and energy deposits.

The Australian Government has approved the establishment of a Cooperative Research Centre to study the geodynamic evolution of the Australian continent.

The CRC will have four research programs that will integrate the skills that the four partners bring to the CRC. The four programs are:

- Lithospheric and Crustal Structure,
- Regional Structure, and Geochronology,
- Geodynamic Synthesis,
- Education.

The Australian exploration industry is providing considerable support for the CRC, either as financial support, or support in kind.

Expected outcomes

Enhanced understanding by the exploration industry of the processes that focus and concentrate major mineral and energy deposits.

AGSO seen as a major intellectual contributor to the CRC.

International leadership for the Australian energy and minerals industries into the next century as the result of improved exploration based on understanding the architecture and dynamics of the Earth's crust on the continental scale.

Activities

Study the geodynamic evolution of the Earth's crust.

Integration of existing and new geological and geophysical datasets, particularly gravity and remotely sensed magnetic and radiometric data.

Deep seismic reflection and refraction profiling across key structures and 3D tomographic imaging at a range of scales.

Undertake research into the management and synthesis of geological and geophysical data through studies of the non-linear dynamics of natural systems.

Integration of all results through the application of quantitative geodynamic modelling.

Geochronological studies through precise dating of major events and rock suites, and fission

track dating of neo-tectonic events.

Provide an education program at post graduate level that includes a significant component of distance education.

Expected products

New methods for manipulating and storing geological and geophysical images and datasets.

Contributions to national and international journals.

An annual conference at which results of the CRC work will be presented.

Goals for 1993/94

Establish the CRC.

Undertake tectonostratigraphic framework study of Australia (see proposed Project 1 below).

Plan and begin a seismic reflection profile, or network of profiles, across the Mt Isa Inlier, or elsewhere as directed by the Science Advisory Council of the CRC.

Prepare, for consideration by the Science Advisory Council of the CRC, a proposal for the purchase and deployment of seismic tomography equipment.

Establish a project to prepare (possibly 4), transects of the Australian continent, to be used as a means of integrating the results of the four programs of the CRC.

Begin work on a number of components of the transects, particularly on the North West Shelf.

Design a geochronology program for the CRC

Customers

The Australian Government, through the Co-operative Research Centres Program of the Department of the Prime Minister and Cabinet

The Australian Exploration Industry, and particularly the companies that have pledged support, viz.,

MIM Exploration

BHP Minerals

Shell Development

Placer Exploration

Aberfoyle

Pasminco Exploration

Western Mining Corporation

BHP Petroleum

CRA Exploration

Learning Curve Pty Ltd

World Geoscience Corporation

Port Mineral and Mining Services

Silicon Graphics

Other contributors to the CRC:

The Government of Western Australia

The Victorian Education Foundation

Cooperating agencies

CSIRO Division of Geomechanics

CSIRO Division of Exploration Geoscience

The Victorian Institute of Earth and Planetary Sciences, comprising Monash University, Latrobe University, and the University of Melbourne

Digital Equipment Corporation

120: CONTINENTAL MARGINS

Objectives

Provide geoscientific information and advice, consistent with the principles of ecologically sustainable development, in order to:

- improve offshore petroleum and mineral exploration efficiency and effectiveness
- support Government decision making on offshore petroleum and mineral exploration and development
- maximise and sustain Australia's legal continental shelf claim in preparation for when UNCLOS comes into force
- support inter-governmental negotiations between Australia and its nearest neighbours on the delineation of sea-bed boundaries
- assist with resource and environmental advice in relation to marine parks and protected areas.

Relevance

The Continental Margins Program (CMP) is an important element in the Government's strategy to promote the efficient exploration of Australia's offshore petroleum resources commensurate with the efficient use of other resources (labour and capital) for the benefit of all Australians. At present, 90% of Australia's petroleum production is derived from sedimentary basins of the contin- ental margins and future large discoveries are most likely to come from offshore basins. However, in recent times there has been a narrow focus on those offshore basins currently perceived to be more prospective. In the long term, it will be necessary to encourage exploration in areas now considered frontier, but which are believed to hold the resources which Australia will need next century. The CMP aims to expand the offshore area undergoing exploration. New geological, geochemical and geophysical data relevant to petroleum exploration and prospectivity assessment are acquired on a regional basis from offshore areas. The area under investigation is almost 12 million square kilometres.

The CMP aims to assist petroleum exploration by:

- locating and studying new basins in poorly explored shelf areas, upper slope areas adjacent to producing/explored areas, and remote deep water areas.
- developing and applying new approaches and ideas to rejuvenate exploration in areas of declining interest and to increase exploration efficiency in active exploration areas.

Current priority has been given to new basins on the shelf that can be explored with existing and conventional technology such as the northern margin of Australia in the Arafura Sea, and to the North West Shelf as a whole (Barrow Island to Timor Sea) where, despite extensive exploration effort, there are major gaps in our understanding of critical aspects of structure and basin evolution. A series of projects are being undertaken using deep seismic acquisition, targeted at particular aspects of regional and structural evolution of interest to the petroleum industry. The combined results of these projects will enable the CMP to define the primary margin architecture and its reactivation history.

The CMP has an important responsibility in the establishment and management of Australia's seabed jurisdiction. It provides government with relevant geoscientific advice, information and expertise related to the definition of Australia's continental shelf and to delimitation of seabed boundaries with adjacent coastal states. Priority is currently being given to the Lord Howe Rise area, at the request of the Department of Foreign Affairs and Trade, and to other areas where currently no seabed boundaries have been agreed with adjacent states, especially with Indonesia.

The CMP also has a role in developing models of the geological processes which have formed the continental margin, led to economic accumulations of petroleum and minerals and which also contribute to the

understanding of Australia's offshore environment as it relates to marine parks and protected areas. Cooperative work is currently underway through the Cooperative Research Centre for Antarctica and the Southern Ocean Environment, and with the Technical Research Centre of Japan National Oil Corporation, Sydney University, Sydney Water Board and NSW Geological Survey.

Activities

Acquire new data using the dedicated research vessel RV *Rig Seismic* which is equipped for modern seismic acquisition, deep sea sampling and the recording of other geophysical and geochemical data.

Process and analyse seismic data and samples to a state ready for interpretation.

Interpret data and integrate it with existing exploration industry data to provide new basin analyses incorporating new ideas and understanding of petroleum generation and entrapment.

Provide geoscientific advice related to the definition of seabed boundaries, the extent of Australia's offshore jurisdiction and marine parks.

Develop concepts and understanding of the impact of offshore developments and the history of sea level and climate change.

Release RV *Rig Seismic* data for industry and public use as soon as practical after completion of processing and basin analyses and assessment of petroleum prospectivity within 2–3 years.

Maintain and develop data acquisition, sampling and processing systems aboard RV *Rig Seismic* and processing facilities and laboratories in AGSO.

Highlights for 1992/93

The CMP has expanded and vessel utilisation has become more efficient through establishment of the following joint projects or additional projects:

Completed a survey across the Lord Howe Rise and Norfolk Ridge to define the major tectonic fabric of the region. The project was undertaken in the context of future negotiation on the unresolved boundary between New Zealand and Australia and to assist with the definition of Australia's legal continental shelf.

Initiated a cooperative research project with the Sydney Water Board.

Completed the acquisition phase of four region deep seismic projects totalling approximately 10 000 km of data from the North West Shelf.

Processed and released seismic data sets from North West Shelf, Arafura Sea and southern Queensland Shelf.

Reprocessed and released seismic data sets from Perth Basin and Vulcan Sub-basin.

Compiled and published first North West Shelf Tectonic Elements Map and database.

Completion of second year of cooperative project with the Technical Research Centre Japan National Oil Company.

By mutual agreement between JNOC and AGSO, further research cruises were cancelled and the project brought to an early conclusion by September 1993.

Completion of second year of AIDAB funded Philippines project.

A new model for the development of the Petrel Sub-basin.

Participation in the Cooperative Research Centre for Antarctic and Southern Ocean Environment.

Seismic acquisition system to 240 channels.

Convex 3420 installed in processing centre.

The deep seismic work on the North West Shelf has produced a very high level of industry interest reflecting the effort placed in upgrading the seismic systems.

Goals for 1993/94

Complete all projects and publish results of surveys commenced before 1991. Conduct the following RV *Rig Seismic* cruises:

June/July	Project 121.28 — Browse Basin deep seismic
Aug/Sept	Project 121.17 — Southern NW Shelf (offshore Canning Basin) — deep seismic
Sept/Oct	Trials and refit
Oct/Nov	Project 121.41 — Sahul Shoals modern process study — sampling and high resolution seismic

Nov/Dec	Project 121.42 — North West shelf — deep seismic infill
Dec/Jan	Project 121.44 — West Tasmania — South Tasman Rise swath-mapping
Jan/Feb	Project 121.43 — Macquarie Ridge swath-mapping
May/June	Project 121.42 — Timor Sea/Browse Basin seismic — deep seismic.

Complete processing and release of following data sets:

- Lord Howe Rise 3191 kms of deep seismic (S114)
- Malita Graben 3000 kms seismic data
- Browse Basin 3000 kms seismic data
- Carnarvon 3000 kms seismic data

Associated navigation, gravity, bathymetry and magnetic data processing will be completed.

Cooperate in joint programs and cooperative studies with the following agencies:

- NOPEC a.s.;
- Technical Research Centre, Japan National Oil Company;
- Sydney University;
- Sydney Water Board;
- NSW Geological Survey;
- AIDAB;
- Philippines Office of Energy Affairs;
- ORSTOM/IFREMER (France).

CONTINENTAL MARGINS

Component manager Chris Pigram (a/g) 06 249 9327 Fax 06 249 9986

Component projects active in 1993/94

121.11(1)	Structure, stratigraphy, evolution and regional framework of the Marion Plateau, Townsville Trough and Queensland Plateau
121.17(2)	Regional structural framework of the southern North West Shelf and offshore Canning Basin
121.20(1)	Surface geochemistry and application to offshore exploration for hydrocarbons
121.21(1)	Offshore Maryborough Basin: structure and stratigraphy
121.22	Vulcan Graben and Petrel Sub-basin: deep crustal structure, structural reactivation and hydrocarbon migration
121.23(1)	Distribution of Triassic and Jurassic reefs in the offshore Canning Basin and northern Exmouth Plateau
121.27	Southern margin geological sampling
121.29(1)	Tropical and temperate marine carbonate systems of Eastern Australia: facies, climate and sea level (revised title)
121.30	Lord Howe Rise and Norfolk Ridge geological framework study
121.32	Seabed morphology and offshore resources around Christmas Island
121.34(2)	North West shelf regional structure and stratigraphy
121.39	Northern Bonaparte Basin: deep-basin architecture, structural reactivation and hydrocarbon potential
121.40	Organic enrichment in the Sydney Basin
121.41(2)	Timor Sea shelf processes: tectonics and Cainozoic environments
121.42(2)	Tectonic evolution, basin development and hydrocarbon potential of the Browse Basin region
121.43	Tectonic evolution of the Macquarie Ridge and Law of the Sea study
121.44	West Tasmania — South Tasman Rise Tectonic development and Law of the Sea study.

(1) due for completion in 1993/94 (2) cruise planned in 1993/94 on RV *Rig Seismic*

Evaluation of the Continental Margins Program

The CMP Evaluation Process

Submissions on the evaluation were sought from a wide range of client groups and cooperating agencies. All members of the AGSO Advisory Council, all AGSO staff and 75 external stakeholders were formally invited to make a submission to the Panel; these external stakeholders included both Commonwealth and State/Territory Government departments, representatives of the oil industry both within and outside Australia, service companies and universities.

37 written submissions were received; some relating to one specific aspect of the CMP, others giving more wide ranging comment. 6 submissions originated from overseas, 31 from Australia; 6 from industry (including a composite submission from APEA representing its members); and 16 from AGSO (including 9 from within the Marine Geoscience and Petroleum Geology Program).

The draft evaluation report was tabled and discussed at the AGSO Advisory Council meeting on 6 November 1992 where it was concluded that the report needed to be reviewed by stakeholders, additional material required by the Department of Finance (although not specifically dealt with by the Evaluation Panel) needed to be added and more attention needed to be paid to quantification of the benefits of the CMP.

The final draft was prepared by AGSO staff for the March meeting of the Advisory Council at which stage it was endorsed, subject to the further views of the Evaluation Panel being sought; where there is disagreement between Panel members, the divergence of views is recorded. The Report has now been finalised and endorsed by the Minister for Resources, the Hon Michael Lee MP. It is now publicly available through the AGSO Bookshop for the cost of reproduction, postage and handling.

The Findings of the CMP Evaluation

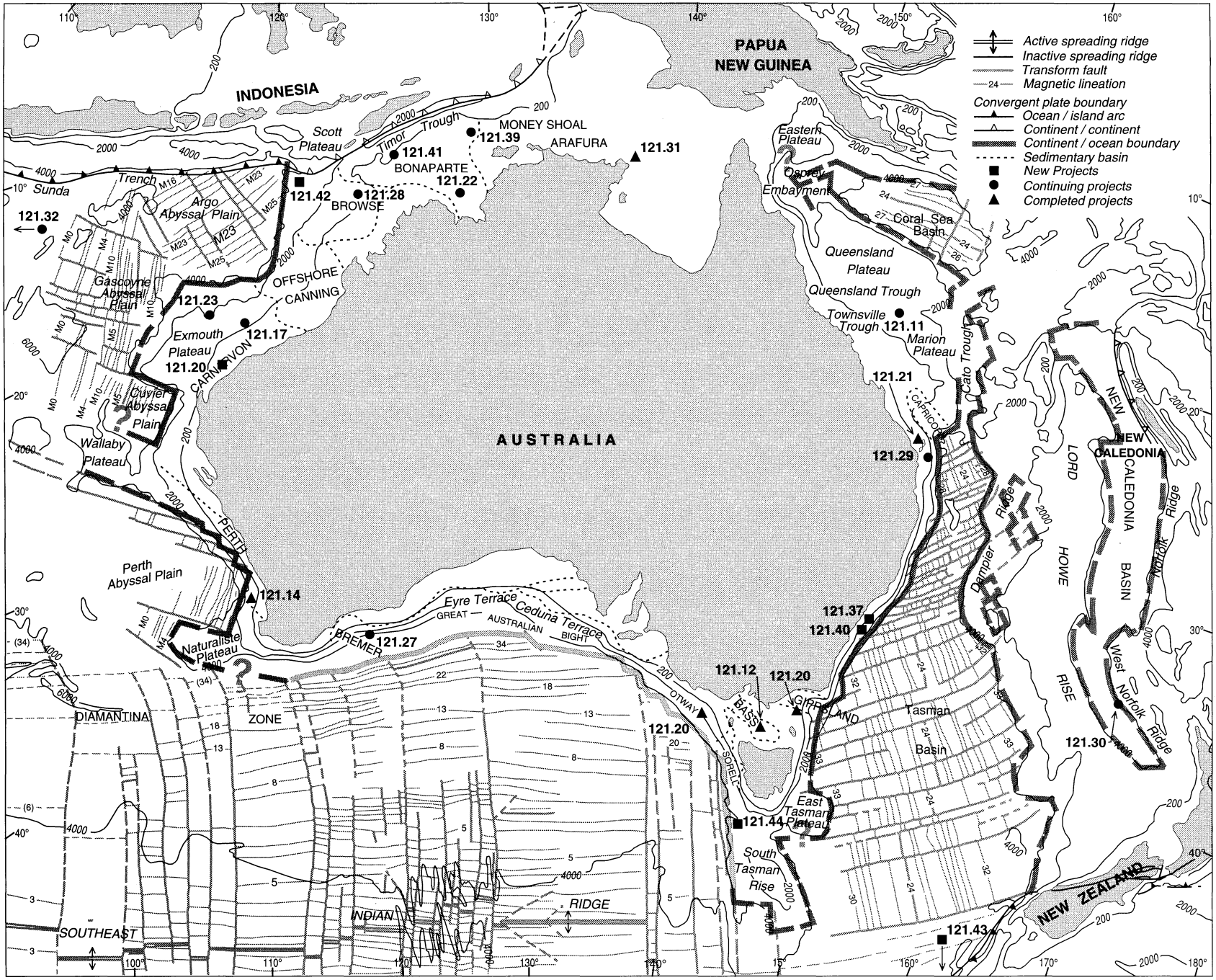
The Evaluation Panel consider, and the Advisory Council agree, that the CMP gives the Government and Australia value for money and is well directed and managed. The main findings of the evaluation are that:

- the CMP has been particularly effective in improving the efficiency and effectiveness of offshore petroleum exploration activity by gathering geoscientific data and undertaking research in "frontier" areas important to assessing the potential for petroleum in Australian waters
- the CMP has made, and will increasingly need to make, an important contribution to the delineation of Australia's maritime boundaries and the definition of the limits of Australia's jurisdiction under the 1982 UN Convention on the Law of the Sea
- although there are considerable benefits flowing to the private sector, the CMP should be funded by Commonwealth Government appropriation; the Panel also concluded that the CMP should be regarded as a national priority
- the CMP objectives are relevant to needs but need to better reflect the primary focus of the CMP and incorporate provision of information in relation to marine parks and protected areas
- the CMP lacks adequate core funding; the need to obtain extra funding to make the ship operations cost effective is pushing, or had the capacity to push, the CMP away from fulfilling its core objectives
- the CMP could be expanded to meet other objectives, subject to the appropriation of additional resources, however, the focus of the CMP should remain on the agreed objectives
- under current circumstances, the RV *Rig Seismic* is the most effective and efficient option for fulfilling the data acquisition objectives of the CMP; however, it is not cost efficient for the RV *Rig Seismic* to spend less than 150 days (5 cruises) each year acquiring data
- although steps have been taken to address the seismic processing issues identified, specific additional action is required to improve throughput, quality control and costs consistent with maintenance of research capability
- the CMP has developed significantly since its inception and has a proven track record in achieving technical and efficiency improvements; however, this situation needs to be continually monitored to ensure optimum efficiency.

The AGSO Advisory Council has unanimously concluded that the need for the CMP and the benefits it provides are not in doubt, but that its future direction will be dependent on the availability of adequate government funding to undertake a viable program to meet defined core objectives. The Government decision in the context of the 1993/94 Federal Budget to provide additional funds to restore the core cruise program is therefore clearly a very favourable outcome. The Advisory Council considers that, of those made, several other recommendations were of immediate priority. These were to:

- continue the CMP for at least the next five years
- continue the contract for the RV *Rig Seismic* for at least one more year until June 30 1994
- improve strategic planning
- implement an action plan to improve seismic processing.

The Council believes that implementation of the recommendations of the Report will improve the CMP's performance and its relations with key clients, other research agencies and funding agencies. However, any future implementation is naturally dependent upon the implementation of the Government's response to the Richards Review.


AUSTRALIA
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PAPUA NEW GUINEA
NEW ZEALAND
NEW CALEDONIA
Active spreading ridge
Inactive spreading ridge
Transform fault
Magnetic lineation
Convergent plate boundary
Ocean / island arc
Continent / continent
Continent / ocean boundary
Sedimentary basin
New Projects
Continuing projects
Completed projects
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Scott Plateau
Timor Trough
MONEY SHOAL
ARAFURA
BONAPARTE
BROWSE
Sunda Trench
Argo Abyssal Plain
Gascoyne Abyssal Plain
Cuvier Abyssal Plain
Wallaby Plateau
Exmouth Plateau
OFFSHORE CANNING
CARNARVON
PERTH
Perth Abyssal Plain
Naturaliste Plateau
BREMER
Eyre Terrace
Ceduna Terrace
GREAT AUSTRALIAN BIGHT
OTWAY
BASS
GIPPSLAND
SORELL
DIAMANTINA ZONE
SOUTHEAST INDIAN RIDGE
Eastern Plateau
Osprey Embayment
Coral Sea Basin
Queensland Plateau
Queensland Trough
Townsville Trough
Marion Plateau
Cato Trough
CAPRICORN
Dampier Ridge
LORD HOWE RISE
Norfolk Ridge
BASIN
West Norfolk Ridge
Tasman Basin
East Tasman Plateau
South Tasman Rise
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Project 121.11

Structure, stratigraphy, evolution and regional framework of the Marion Plateau, Townsville Trough and Queensland Plateau

Project manager	Phil Symonds	06 249 9490 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1987–1994	

Objectives

Establish the geological framework, tectonic development, and broad environmental significance of the north east Australian margin as a basis for environmental management.

Develop and evaluate models describing the evolution and setting of carbonate platforms and margin depositional systems off northeast Australia, and examine their significance as recorders of environmental change, particularly Neogene sea level and climatic change.

Relevance

The north east Australian margin is a relatively rare modern analogue of an important structural and sedimentological association — barrier reef/adjacent rift trough/marginal plateau — which has occurred many times in the geological record.

The north east Australian margin is internationally recognised for its unique variety of depositional systems, which contain clues to understanding ocean history, passive margin evolution, carbonate platform development and environmental change.

The Townsville and Queensland Troughs are large, poorly known rift features, which are fully intact within the margin and are therefore of significant geological interest

Expected outcomes

A regional seismic grid over the Townsville Trough, which will provide the primary database for future assessments of its geology.

The first synthesis of basin framework for the Townsville Trough and Marion Plateau, and a new understanding of the relationship of these features to the tectonic development of the north east Australian margin.

Models, based on the huge ODP and AGSO sampling data base in the region, showing the interaction of structural, palaeotemperature, palaeogeographic, and sea level controls on carbonate platform evolution and continental margin sedimentation in a rift basin/marginal plateau setting.

Improved understanding of the history of sedimentation off north east Australia and its significance as a recorder of Neogene climate and sea level change.

Activities

Four RV *Rig Seismic* research surveys, primarily using multichannel seismic and sampling techniques, have been conducted off north east Australia (September/December 1985 and September/November 1987).

Processing of 1987 north east Australia seismic, non-seismic and sampling data within AGSO, to produce a comprehensive geological database for the region.

Plan and conduct ODP scientific drilling Leg 133 off north east Australia to gain direct information on the structural, palaeoclimatic, palaeoceanographic and relative sea level controls on carbonate platform development, and margin depositional systems.

Undertake an integrated analysis of the structural style and seismic stratigraphic framework of the Townsville Trough:

- map the extent of major depocentres and determine their structural style as an aid to understanding the geological development of the Trough
- synthesise AGSO and company data from the Queensland Trough to understand the

tectonic relationship between the Townsville and Queensland Trough rift systems.

Integrate the direct information on lithofacies and processes from ODP Leg 133 off north east Australia with other seismic stratigraphic and sedimentologic studies to:

- enhance understanding of margin deposition in the region
- define structural and sedimentological factors affecting margin evolution in an attempt to gain an insight into the relative subsidence histories of the major structural elements.

Complete an integrated study of the Marion Plateau to determine its geological framework, understand its carbonate platform evolution.

Integrate and analyse data from the four RV *Rig Seismic* surveys off north east Australia, supplemented with other regional data, to deduce the general geological framework and tectonic development of the whole north east Australian margin province.

Expected products

Seismic data on a regional grid over the Townsville Trough.

'High resolution' watergun seismic data over the Marion Plateau, the Queensland Trough, and the margins of the Queensland Plateau.

Navigation, bathymetry, gravity and magnetic digital data package over the Townsville Trough and Marion Plateau.

Townsville Trough report and map package based on integration and analysis of the 1985 and 1987 RV *Rig Seismic* data.

AGSO Record on the geological framework of the Marion Plateau.

Large sample and well-log data base from ODP Leg 133 off north east Australia, and the published results of scientific studies on these data by about thirty international scientists — these results will initially be reported on in ODP publications.

Report containing well summaries, biostratigraphic review and geohistory analyses for all exploration wells and DSDP holes off north east Australia (BMR Record 1990/07).

Reports/papers on basin, margin and carbonate platform development, and climate and sea level change.

Highlights for 1992/93

Papers were published on absolute magnitude of Miocene sealevel fall and Miocene to Pleistocene foraminiferal biostratigraphy of dredge samples from the Marion Plateau.

Sixteen papers with authorship by AGSO scientists have been submitted and accepted for publication in ODP Scientific Results volume, Leg 133. The papers cover topics such as foraminiferal biostratigraphy, isotope studies, sealevel, oceanographic and climatic change, seismic and sequence stratigraphy, the nature of Queensland Plateau basement, underway geophysical data, and carbonate diagenesis.

Papers on the geological development of the Townsville Trough, and the tectonic controls on major play types in the Papuan Basin, PNG, were presented at the 1992 AAPG International Conference at Sydney, 2–5 August 1992.

Paper titled 'Eastern Papuan basin — tectonic development, and implications for petroleum prospectivity', was prepared, published and presented at the 2nd PNG Petroleum Convent ion at Port Moresby, 31 May–2 June 1993.

A paper titled 'Architecture of the Queensland Trough: implications for the structure and tectonics of the N E Australia region' by D Scott was submitted to the AGSO Journal of Australian Geology and Geophysics.

Completed interpretive study on the geological framework of the Marion Plateau.

About 50% of the interpretation of the Townsville Trough seismic data has been completed, and tied into the Leg 133 ODP sites in the area.

Goals for 1993/94

Publication of Proceedings of the Ocean Drilling Program, Scientific Reports, for Leg 133.

Completion of seismic interpretation and mapping over the Townsville Trough, and an AGSO report on the results of the study.

AGSO Record on the geological framework of the Marion Plateau.

Revised ODP drilling proposal to examine sealevel change, carbonate platform development and the tropical/temperate transition on the Marion Plateau prepared and submitted to the JOIDES Office.

Customers

P.J. Davies, Department of Geology and Geophysics, University of Sydney (Cooperation on studies of Leg 133 ODP results and environmental change).

Ocean Drilling Program, Texas A&M Uni., College Station, USA (Editorial responsibility and publication of results of ODP Leg 133).

A. Droxler, Rice University, Houston, USA (Cooperation on studies of carbonate platform development — peri-platform ooze).

J. McKenzie and others, Swiss Federal Institute of Technology, Zurich, Switzerland (Cooperation on studies of Leg 133 ODP results, particularly strontium isotope and palaeoceanographic work).

D. Scott, Australian National University (Main carriage of Queensland Trough study).

Cooperating agencies

Geological Survey of Queensland

DPIE

Great Barrier Reef Marine Park Authority

Project 121.17

Regional structural framework of the southern North West Shelf and offshore Canning Basin

Project manager	Howard Stagg 06 249 9343 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	January 1990–December 1996

Objective

Enhance exploration strategies in the southern North West Shelf and offshore Canning Basin through an improved understanding of the nature and history of the major structural features in the region.

Relevance

Although the southern North West Shelf is one of the most prospective areas of Australia for hydrocarbons, there has been little recent revision of its regional structural framework using modern concepts of extensional tectonics, and large parts of the region, particularly the offshore Canning Basin, remain relatively under-explored.

This project is acquiring a regional grid of deep seismic transects throughout the region which complements the conventional data collected by industry. These transects are improving our understanding of the relationships between the major structural elements, allowing revision of the gross structure, and providing the basic data to assist in definition of new petroleum plays and the timing of petroleum generation and accumulation.

Expected outcome

Enhanced exploration strategies through an improved understanding of the nature and history of the major structural controls in the region.

Activities

The core data for the project is provided by a number of cruises of the RV *Rig Seismic*. The first cruise (SNOWS-I), in May–June 1991, acquired 1654 km of 16 s record-length seismic data from the Barrow and Dampier Sub-basins and inner flank of the Exmouth Plateau. The second cruise (SNOWS-2), acquired a further 2868 km of deep seismic data that was concentrated in the Beagle Sub-basin but also included extensions to the SNOWS-1 program in the Barrow and Dampier Sub-basins and the Exmouth Plateau. Further cruises planned for 1993/94 include a survey in the offshore Canning Basin (SNOWS-3), a fill-in survey on the eastern Exmouth Plateau/offshore Canning Basin (SNOWS-4), and a survey in the Exmouth/Gascoyne Sub-basins (SNOWS-5, in 1994/95).

Determine the broad regional structural framework of the northern Carnarvon and off-

shore Canning Basins and Exmouth Plateau by examining the boundaries between major structural elements along seismic transects.

Determine the deep crustal structure of these basins and their relationship to the development of the continental margin adjacent to the Argo and Gascoyne Abyssal Plains.

Determine the control of deep structure on the development of the major hydrocarbon fields and plays in the region, and in particular the structural and depositional effects resulting from reactivation of these structures.

Provide seismic ties between wells on the principal structures in the region to allow basin-wide seismic correlations.

Expected products

Pre- and post-cruise reports for each of the SNOWS surveys.

1654 km of processed deep seismic data (16s records) from SNOWS-I, acquired from 4800 m streamer with 3000 cu in airgun source; released in March, 1992.

2868 km of processed deep seismic data from SNOWS-2 (Beagle, Dampier, and Barrow Sub-basins, and Exmouth Plateau); released at end of 1992.

2000+ km of processed deep seismic data from SNOWS-3 (offshore Canning Basin); release date dependent on survey date and processing arrangements, but probably first half of 1994.

2000+ km of processed deep seismic data from SNOWS-4 (eastern Exmouth Plateau/offshore Canning Basin); release date dependent on survey date and processing arrangements.

2000+ km of processed deep seismic data from SNOWS-5 (Exmouth/Gascoyne Sub-basins); release date dependent on survey date and processing arrangements.

AGSO interpretation report(s) containing crustal cross-sections illustrating the main structural elements in the region, selected reduced scale seismic sections, an upgraded structural elements map, burial and thermal geohistory analyses of key wells, and other relevant information.

Reports and papers on the structural framework, the structural and depositional effects arising from reactivation of deep structures, and new play concepts and exploration strategies in the region, in industry-related journals and conferences such as PESA, APEA, and AAPG.

Highlights for 1992/93

The second survey in the program, SNOWS-2, was completed in July 1992 and saw the acquisition of 2868 km of high-quality deep seismic data. As with SNOWS-1, these data were processed by a commercial contractor, under the direct supervision of Nopec Australia. Data processing was completed by late 1992 and the data were subsequently released to industry. Since the release date, many active companies on the North West Shelf have purchased the data. In addition to providing interpretable deep reflections to 10–12s two-way time, the data have proved to have resolution in the top part of the section which is at least as good as recent industry data recorded in the same area.

In March 1993, AGSO and Nopec Australia jointly announced the release of a tectonic elements map and digital data base covering the North West Shelf, Arafura Sea, and adjacent ocean basins. Information for this project has been assembled from MGPGP investigations in the region, published maps and papers, and open-file company reports. The package aims to provide a contemporary regional data base of geological, exploration, and cultural information of value both to active explorers in the region and to overseas companies new to Australia. The data base is available in a variety of formats, including a geographic information system.

Goals for 1993/94

Complete the third cruise (SNOWS-3) in the program and produce pre- and post-cruise reports.

Arrange processing of the SNOWS-3 data with the aim of releasing processed data to industry in time for the May 1994 exploration acreage gazettal.

Write pre-cruise proposal for SNOWS-4 and complete the cruise (dependent on the timing of other cruises that have external involvement).

Complete main interpretation phase for SNOWS-1 and SNOWS-2 data. Prepare draft

papers for PESA symposium on Western Australian basins in second half of 1994.

Prepare and deliver paper on the value to industry of deep seismic profiling on the North West Shelf at AGSO Petroleum Seminar in November 1993.

Customers

Petroleum exploration companies

National Centre for Petroleum Geology and Geophysics, Adelaide

Cooperating agencies

Petroleum exploration companies

WA Department of Mines

Petroleum Division, DPIE

Petroleum Resource Assessment, Bureau of Resource Sciences

Nopec a.s. (marketing)

Project 121.20 Surface geochemistry and application to offshore exploration for hydrocarbons

Project manager	David Heggie 06 249 9589
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1993–1995

Objective

Evaluate the bottom-water Direct Hydrocarbon Detection (DHD), technique and its application to offshore petroleum exploration, principally around Australia but also in South East Asia, by conducting both calibration, reconnaissance and prospect scale surveys in a variety of offshore sedimentary basins.

Relevance

Surface geochemical techniques have not been widely used as an accepted exploration tool worldwide. This program provides a systematic evaluation of bottom-water geochemical techniques and their application to offshore hydrocarbon exploration from a variety of sedimentary basins around Australia but including select basins from the Philippines. The program includes a Joint Research Agreement with Transglobal Environmental Geoscience (TEG) USA.

The areas surveyed represent those with known hydrocarbon accumulations to those considered frontier areas where the application of new experimental geochemical methods (combined with traditional exploration methods) may contribute new insights into hydrocarbon migration and habits.

Expected outcomes

An evaluation of the application of surface geochemical techniques, including both underway DHD and also seafloor sampling combined with hydrocarbon headspace analyses of sediments, to offshore petroleum exploration around Australia and elsewhere in southeast Asia.

Clients from each of the projects and surveys conducted will be provided with DHD data, hence new information on the generation and migration of thermogenic hydrocarbons (at both reconnaissance and prospect scales) in the areas covered by those surveys listed below.

Activities

Two surveys aboard RV *Rig Seismic* have been conducted in south east Australian sedimentary basins including the Gippsland Basin, Otway basin, Bass Basin, Torquay Sub-basin and Durroon Basin utilising the bottom-water DHD method. In addition two surveys, prior to 1991, collected seafloor samples and conducted hydrocarbon headspace analyses on sediments from the Otway and Gippsland basins and Torquay Sub-basins.

A calibration survey was conducted (with TEG) in the Barrow Sub-basin and a detailed

combined DHD and high resolution seismic survey was conducted in the Dampier Sub-basin (Project 121.19) of the North West shelf.

A combined DHD and seismic survey was conducted in the Arafura Sea.

A combined DHD and high resolution seismic survey was conducted in the Vulcan Graben (Project 1121.19).

Combined DHD and seismic survey were conducted in the Bonaparte Basin including the Petrel Sub-basin and Malita Graben (Project 121.22).

A combined DHD survey was conducted in several sedimentary basins in the Philippines.

Production of DHD data releases and appropriate AGSO Records and communication of results directly to the offshore exploration community.

Expected products

AGSO Records from each survey, DHD data releases and a database including all sediment (hydrocarbon-headspace) data from Australian basins.

Information provided to clients on the presence/absence of thermogenic hydrocarbons and the gas/liquids potential of parts of the basins surveyed.

Highlights for 1992/93

Public release of the DHD geochemical data from RV *Rig Seismic* surveys 89 and 104 to south eastern Australia; surveys 99 and 100 to the Bonaparte Basin; surveys 97 to the Vulcan Graben and Dampier Sub-basin and also the calibration survey conducted with TEG in the Barrow Sub-basin, and the data from the Arafura Sea.

Release of DHD data from the Philippines.

Publication of overview papers on the status and application of surface geochemistry techniques to offshore exploration on the Australian margin in the PESA Journal and in the Proceedings of the 1st Offshore Australia Conference, held in Melbourne.

Presentation of DHD results at the AAPG International Conference in Sydney.

Goals for 1993/94

Complete a sediment geochemical (hydrocarbon-headspace) database, analyse data and combine DHD with seismic data from appropriate surveys and communicate results to the exploration community via a variety of publications. This work will complete this Project.

Customers

Shell Australia Ltd; Cultus; Esso-BHP; Petrofina; Western Mining Corporation; Bridge Oil

Other petroleum explorers working in the offshore areas of Australia and southeast Asia.

Cooperating agencies

B Hartman, TEG–USA

Australian petroleum explorers, State Geological Surveys

Project 121.21

Offshore Maryborough Basin, southern Queensland continental margin and northern Tasman Basin: structure and stratigraphy

Project manager	Peter Hill	06 249 9292 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1989–1993	

Objective

Establish the basin framework, structure and stratigraphy of this region as a basis for environmental management.

Relevance

The geology of the offshore Maryborough Basin is poorly understood. This project is designed to help define the region's geology for future planning purposes.

Expected outcomes

First modern multichannel seismic data set in the region.

The project will establish the structural and seismic stratigraphic framework of the offshore Maryborough Basin, the deep-water Capricorn Basin and northern Tasman Basin. The results of the study will provide information vital for future planning in the region.

Activities

A research survey primarily using multichannel seismic techniques aboard RV *Rig Seismic* conducted in December 1989 (Survey 91).

Tie the stratigraphy of the Maryborough Basin region to the exploration wells in the Capricorn Basin thus improving the geological knowledge of the area.

Process seismic, navigational and non-seismic (bathymetry, magnetics and gravity) data.

Interpret data and undertake basin analysis incorporating all existing data sets.

Publish results.

Expected products

Processed geophysical data: 2900 km multichannel seismic data, 10 sonobuoy seismic refraction experiments, 2450 km magnetic profiles, 3600 km gravity and bathymetric profiles. The multichannel seismic data will be available as field tapes, stack tapes and as processed sections on paper and film.

Reports, maps and papers on the geology and geophysics of the southern Queensland offshore basins.

Highlights for 1992/93

All Survey 91 seismic, gravity, magnetic and bathymetry data released as AGSO Data Release 31.

Paper on Maryborough Basin presented at the 1992 AAPG Conference (Sydney).

Paper on Capricorn/northern Tasman Basins presented at the ASEG Conference (Gold Coast, October 1992).

Goals for 1993/94

Complete final report (AGSO boxed Record) and end project by end August 1993.

Customers

Geological Survey, Queensland Department of Resource Industries

Cooperating agencies

Queensland Department of Resource Industries

Great Barrier Reef Marine Park Authority

Project 121.22

Vulcan Graben and Petrel Sub-basin: deep crustal structure, structural reactivation and hydrocarbon migration

Project manager	Geoffrey O'Brien 06 249 9342
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1991–1994

Objective

Improve exploration efficiency in the Timor Sea, specifically within the Petrel Sub-basin, Vulcan Sub-basin, Sahul Syncline and Cartier Trough and assist in the assessment of the region's prospectivity. To use deep crustal, industry, and high-resolution seismic data and image-processed aeromagnetic and other potential field data to characterise the deep crustal architecture of the region, and thereby determine the control that this deep architecture exerts on structuring in the shallow, hydrocarbon-prospective sedimentary section.

Relevance

The Timor Sea, which is located on the northwestern Australian margin between the Kimberley Block and the island of Timor, is one of Australia's most promising hydrocarbon provinces. The region is, however, structurally complex, with a multi-phase rifting history spanning from the Late Devonian to the Middle Jurassic. More recently, collision between the Australian and Eurasian plates in the Late Tertiary has switched the area from a passive (divergent) margin to an oblique collisional (convergent) setting. This involved geological history has produced a region comprised of a number of sub-basins, platforms and grabens which are often of vastly different age, orientation and structural style. The complex overprinting of one structural grain by another dominates the area, produces complex geometries and makes well-constrained tectonic interpretation extremely difficult.

To help unravel the region's complexities, and thereby improve exploration efficiency, AGSO is carrying out a major research program within the Timor Sea. The principal scientific focus of AGSO's study is to understand the deep crustal architecture and the principal basin-forming processes in the Timor Sea and, consequently, to understand the control that the deep crustal architecture has on structural reactivation in the relatively shallow (≤4 km), hydrocarbon-prospective sedimentary section. To this end, a grid of 4100 km of regional, deep crustal (14 sec TWT) seismic reflection data were acquired during 1990 and 1991, with an additional 6000 km to be acquired in 1993. To assist in understanding the structural reactivation in the shallow sedimentary section, AGSO also acquired high resolution seismic and water column geochemical (DHD) data within the Timor Sea.

Expected outcomes

Establishment of the deep crustal architecture of the Timor Sea, with associated implications for structural reactivation and source rock distribution.

An understanding of the tectonic relationships between the NW-trending, Late Devonian-Early Carboniferous Petrel Sub-basin and the younger NE-trending elements, such as the Vulcan Sub-basin, which overprint it.

An understanding of the relationships between the Palaeozoic and older structural grain onshore and its control on structural development throughout the Mesozoic and Tertiary.

An improved understanding of the role of structural reactivation in hydrocarbon entrapment in the Timor Sea, particularly the nature of and controls on structural reactivation throughout the Palaeozoic and Mesozoic

Integration of image processed aeromagnetic data with conventional and deep crustal seis-

mic, Landsat, and potential field data to produce a new understanding of the tectonic development of the Vulcan Sub-basin and, in particular, to determine the role of transfer faults in hydrocarbon entrapment.

Delineation of hydrocarbon migration pathways in the Timor Sea.

Establishment of the usefulness of the DHD technique in the Timor Sea.

Activities

Two research surveys were conducted within the Vulcan Sub-basin using RV *Rig Seismic* (Surveys 97 and 98) in late 1990, and a high resolution aeromagnetic survey was flown in late 1989.

- 2730 km of simultaneously acquired high resolution seismic and water column geochemical (DHD) data were acquired in October–November 1990 (Survey 97). A total of 34 dip lines and 10 strike lines were acquired between the southernmost Vulcan Sub-basin and the Sahul Syncline to the north. In addition, 56 vibro-cores were taken for the analysis of hydrocarbon gases within the sediments.
- 1894 km of deep crustal seismic data were acquired during Survey 98.
- 20 000 km of high resolution aeromagnetic data were acquired in late 1989.

Acquisition in the Petrel Sub-basin began with Survey 99, which collected a total of 3446 km (29 lines) of high resolution seismic and remote sensing (DHD) data in February–March 1991. A second survey in April–May 1991 collected 2200 km (8 lines) of deep crustal seismic data and 2828 km (11 lines) of DHD data.

Image processing of high resolution aeromagnetic data.

Image processing of gravity and bathymetric data

Integration of relevant industry seismic data into the AGSO aeromagnetic, seismic and DHD data-sets.

Modelling of the thermal and tectonic histories of relevant wells.

Integration and interpretation of disparate data-sets such as aeromagnetic, water column geochemical direct hydrocarbon detection (DHD), high resolution, conventional and deep crustal seismic data.

Interpretation of AGSO and industry seismic data sets.

Expected products

Image processed high resolution aeromagnetic data from the Vulcan Sub-basin at 1:250 000, 1:500 000 and 1:1 000 000 scale. Integrated aeromagnetic and Landsat imagery. Image processed seismic data integrated with aeromagnetic imagery. Interpreted aeromagnetic images. Maps showing integrated interpreted aeromagnetic and seismic interpretations.

Regional deep crustal seismic sections showing the main structural elements of the Vulcan Sub-basin and their relationship to the surrounding structural elements.

High resolution seismic data with particular emphasis on the resolution of structural features in the Vulcan Sub-basin at the Intra-Valanginian Unconformity level and shallower. Maps over selected structural features. Regional maps of the distribution of light hydrocarbons in the water column and in the surficial sediments, and the relationship of any detected geochemical anomalies to subseafloor geology

Basin-wide burial and thermal geohistory analyses of relevant exploration wells (and synthetically-generated locations) in the Vulcan Sub-basin to constrain the timing of hydrocarbon generation and likely migration pathways.

2200 km of deep crustal seismic reflection data from the Petrel Sub-basin interpreted and released.

Regional deep crustal seismic sections showing the main structural elements of the Bonaparte Basin and their relationship to the surrounding structural elements; revised regional tectonic elements, maps and structural sections.

6274 km of Direct Hydrocarbon Detection (DHD) data from the Petrel Sub-basin interpreted and released.

Regional maps of the distribution of light hydrocarbons in the water column within the Petrel Sub-basin and the relationship of any detected geochemical anomalies to subseafloor geology.

Basin-wide burial and thermal geohistory analyses of relevant exploration wells (and synthetically generated locations) to constrain the timing of hydrocarbon generation and likely migration pathways; integration of these data with DHD data.

Highlights for 1992/93

Preliminary interpretation of the deep crustal seismic data has revealed that the initial rifting in the Timor Sea took place in the Late Devonian to Early Carboniferous, with the development of the NW-trending Petrel Sub-basin. This rift system was compartmentalised by NE-trending accommodation zones which divided the sub-basin into discrete segments. In each segment, a lower plate rift margin, characterised by large displacement, low angle extensional faults, lay opposite an upper plate, or ramp, rift margin, characterised by small displacement, high angle flexural faults. Switching in the 'polarity' of the rift system took place across major, NE-trending accommodation zones.

Integration of the deep crustal seismic data with image-processed gravity data has shown that the north eastern margin of the Petrel Sub-basin rift system extended out under the eastern two-thirds of the Sahul Platform. The south-western margin extended out through what is now the Vulcan Sub-basin, with the region between the Skua oil-field and the Paqualin salt diapir probably being a terrace area, somewhat akin to the Berkley Terrace within the Bonaparte Gulf region. Part of this rift system was overprinted in the Late Carboniferous to Early Permian by the Westralian Super-Basin rift system, which developed on a NE trend, orthogonal to that of the underlying Petrel Sub-basin. The entire Vulcan Sub-basin and Sahul Platform region developed as part of an upper plate rift margin, with the Vulcan Sub-basin, and possibly also the Malita Graben, probably forming initially as small flexural features in the inboard part of the upper plate rift margin.

Significantly, the deep crustal data have revealed that many of the structures which traditionally have been interpreted as salt diapirs or turtleback (salt withdrawal) structures are probably Late Triassic inversion structures which have been subsequently modified by salt diapirism.

The Westralian (Permo-Carboniferous) rift margin consisted of a linked array of NW-trending accommodation zones and NE-trending normal faults; pre-existing, NW-, NE- and NS-trending ?Proterozoic fracture systems controlled, at least to some extent, the geometry of the rift system that developed. What is now the island of Timor probably developed as a major infra-rift high or possibly as a marginal plateaux, at this time.

Three major reactivation events affected the Timor Sea during the Mesozoic. These were: compression in the Late Triassic to Early Jurassic, extension in the Late Callovian to Early Oxfordian (late Middle to early Late Jurassic) and compression in the Tithonian/Berriasian (Late Jurassic/Early Cretaceous). These events all reactivated the pre-existing ?Proterozoic/Petrel Sub-basin/Westralian Super-Basin structural architecture in a variety of ways.

The large displacement, through-going rift faults on the lower plate rift margins within the Petrel Sub-basin reactivated readily during these Mesozoic tectonic events, resulting in the formation of large structures in the overlying post-rift section. In contrast, the opposing upper plate rift margins, which contain small displacement, high angle flexural faults, react ivated only slightly during the Mesozoic.

In the Vulcan Sub-basin, all of the significant hydrocarbon discoveries appear to be preferentially located either along, or at the intersect ion of, NW- and NS-trending fault sets with the NE/ENE-trending grain. This is probably because the intersections of these Proterozoic/Late Carboniferous-Early Permian fault sets respond in a particularly complex fashion to the varying Mesozoic stress directions.

Results from this project were presented in poster form to the 1992 APEA Conference in Perth, and as oral presentations during the 1992 AAPG Conference in Calgary, Canada, the 1992 AAPG International Conference in Sydney, and the 1993 APEA Conference at Surfers Paradise. In addition, largely as a result of his work on the Vulcan Sub-basin, Dr O'Brien was invited to be the 1992 PESA Australian Lecturer, and he presented aspects of the study during an Australia-wide lecture tour in late 1992. Results from the study have been published in the 1993 APEA Journal, with another paper to appear in the PESA

Journal. Some results from this project were presented as an oral presentation during the 1993 Earth Resources Foundation Workshop on Indonesian Geology.

Part of this project's results were published in the 1993 APEA Journal, while two other written publications will appear shortly in the 5th International Symposium on 'Seismic Reflection Probing of the Continents and Their Margins', and also in the Australian Journal of Mining.

During 1992/93, image-processing of the aeromagnetic data was completed, as was image-processing of regional gravity and bathymetric data for the Timor Sea. The gravity and bathymetric data are proving to be very valuable in establishing the regional architecture of the Timor Sea area.

Geohistory analysis of key wells within the Timor Sea was completed.

All Direct Hydrocarbon Detection (DHD) data acquired within the Timor Sea were interpreted and released during 1992/93.

Agreements between AGSO and both Louisiana State University and Sydney University to participate in processing and interpretation of Survey 97 high resolution seismic data.

Reprocessing of the Survey 98 deep crustal seismic data in collaboration with Nopec has produced dramatic improvements in seismic data quality. These data will be completely reprocessed by late May.

Reprocessing of part of the Survey 100 deep crustal seismic survey is being carried out in collaboration with Nopec.

Goals for 1993/94

Interpret the reprocessed deep crustal seismic data from the Timor Sea and thereby gain an improved understanding of the deep crustal architecture of the region and, in particular, the mechanisms by which this architecture has been reactivated.

Processing and interpretation of priority high resolution seismic lines.

Relate the tectonics of the Vulcan Sub-basin to the regional geology by integrating the data with surrounding deep crustal data-sets as well as potential field data.

Publish a paper in AAPG Bulletin which deals with the integration of image-processed aeromagnetics and deep crustal data.

Finalise interpretation of the deep crustal seismic data and thereby gain an improved understanding of the deep crustal architecture of the Petrel Sub-basin rift system.

Relate the Petrel Sub-basin rift system to the tectonics of the wider Timor Sea by integrating the data with surrounding deep crustal data-sets as well as potential field data.

Develop an integrated structural framework for the region which relates the reactivation of the basin-forming structures in the offshore Bonaparte Basin to the various periods of structural reactivation from the Palaeozoic to the Late Tertiary, and thereby understand the relationship of such reactivation to hydrocarbon habitat in the region.

Publish a paper in the AAPG Bulletin which deals with the deep crustal and potential field data from the Petrel Sub-basin.

Customers

Petroleum industry

Cooperating agencies

Current leaseholders in the Timor Sea

Louisiana State University

Sydney University

Project 121.23 Distribution of Triassic and Jurassic reefs in the offshore Canning Basin and northern Exmouth Plateau.

Project manager	Neville Exon	06 249 9327 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1989–1994	

Objective

Develop an understanding of the distribution of Triassic–Jurassic reefs on the North West Shelf and particularly in the Browse and Bonaparte Basins, as a guide to their exploration for petroleum.

Relevance

The discovery of a late Triassic reef in ODP Site 764 (ODP Leg 122) on the Wombat Plateau north of the Exmouth Plateau, and the realisation that a reef complex was visible on the seismic profiles, led to a new North West Shelf petroleum exploration play. The 1989 seismic and sampling cruise showed that Late Triassic to Middle Jurassic carbonate buildups are common on the northern Exmouth Plateau, and probably occur in the outer Canning Basin as well.

This study will better evaluate the new play in the region near the initial discovery, and enable its expansion by AGSO and exploration companies to other areas on the north West Shelf.

Expected outcome

An understanding of the distribution of Triassic-Jurassic reefs on the North West Shelf and strategies for their exploration for petroleum.

Activities

Process and interpret new and existing seismic and geological data to refine the geological history of the region, pertinent to Triassic-Jurassic carbonates.

A research survey using seismic and sampling techniques aboard RV *Rig Seismic* (Survey 95, May 1990).

Petrological, sedimentological and palaeontological studies of Triassic, Jurassic and Cretaceous dredge samples completed in 1993.

Series of papers on results of Exmouth Plateau ODP Leg 122 printed in Initial Reports(122A) and Scientific Results (122B) in 1992.

Expected products

Regional and local structure contour and isopach maps.

Palaeogeographic maps.

Papers in national and international literature on aspects of tectonics, geophysics, heatflow, sedimentology, palaeogeography, etc, including special North West Margin volume of AGSO Journal to be published in December 1993.

Processed seismic data.

Contributions to ODP Volumes for Legs 122 and 123.

Highlights for 1992/93

Processed seismic data released; interpretation started.

Review paper of Exmouth Plateau ODP results published by American Geophysical Union.

Papers for AGSO Journal special volume commenced.

Paper delivered at AAPG Conference in Sydney in late 1992.

Presence of both Late Triassic and Early Jurassic carbonate buildups now proven on northern Exmouth Plateau.

Goals for 1993/94

Interpret seismic data and integrate them with geological information.

Complete papers outlining results (late 1993).

Demonstrate to our key clients that Triassic-Jurassic reef complexes are likely to be widespread on the North West Shelf.

Customers

Petroleum exploration companies

Universities

Cooperating agencies

Bundesanstalt füer Geowissenschaften und Rohstoffe, Hannover, Germany

Geological Survey of Western Australia Department of Mines.

Project 121.27 Southern margin geological sampling

Project manager	David Feary	06 249 9246 Fax 06 249 9986
Program responsibility	Marine Geosciences and Petroleum Geology	
Timeframe	1991–1997	

Objectives

Provide stratigraphic control for the evaluation of the prospectivity of the deeper part of the Ceduna Sub-basin, as a component of the Great Australian Bight region framework study.

Investigate the geological origin of the Diamantina Fracture Zone and the Naturaliste Plateau.

Develop and evaluate models of passive margin tectonic evolution, high energy cool water carbonate deposition, and mantle magmatism.

Relevance

The Mesozoic Great Australian Bight Basin off southern Australia contains a number of potentially prospective sedimentary basins, but remains inadequately explored for hydrocarbons. Stratigraphic control on seismic interpretation is limited due to lack of wells. Dredging of samples along the margin provides material for dating and stratigraphic analysis.

Australia's southern margin is recognised internationally as being of critical importance in developing and evaluating models of passive margin tectonic evolution, cool water carbonate deposition and mantle magmatism.

Expected outcomes

A comprehensive understanding of southern margin depositional environments through time, that will be of relevance to the petroleum exploration of the region as well as the scientific community.

An evaluation of southern margin climate and sea level change for the late Quaternary.

Improved understanding of southern margin tectonic development.

Activities

Plan and execute cruises to collect samples by dredging to illustrate the stratigraphy and nature of the margin.

Evaluate biostratigraphic and sedimentological facies data from the southern margin of Australia in order to complement and constrain seismic interpretation of the tectonic and exploration aspects of the study.

Determine the prospectivity of the deep Great Australian Bight Basin sequence in the Ceduna Sub-basin area as part of the Bight Basin framework study.

Develop appropriate high energy, cool water carbonate reservoir models base on the sedimentary characteristics of Cenozoic carbonate deposits on the Eucla Shelf-Eyre Terrace.

Document the Late Quaternary palaeochemistry of the southern margin, in order to evaluate the nature and extent of glacial/interglacial cyclicity as the control on sea level variation, organic carbon fluxes, sea floor mineral accumulation and continental weathering.

Determine the geochemical characteristics of Southern Ocean magmatism between the continent-ocean boundary and magnetic anomaly 13.

Develop accumulation and diagenetic models

for cool water shelf and slope carbonates in view of their potential as hydrocarbon reservoirs.

Expected products

AGSO Reports, AGSO Records and scientific journal publications describing depositional environments, climate/sea level changes and tectonic/magmatic development.

Highlights for 1992/93

New biostratigraphic data from both nannoplankton and foraminifera have been published and are in press.

Studies of Quaternary foraminifera have indicated significant shifts in water masses and currents along the southern margin.

Post cruise report has been compiled and is ready for publication in early 1993/94.

Implications for the significance of this study for the reevaluation of carbonate sediments, particularly with respect to the previously presumed tropical origin of many ancient shallow water carbonate accumulations throughout the world.

Indications from isotopic studies that oceanic crust along the southern margin is derived from two distinct magma sources.

Goals for 1993/94

Develop models of cool water carbonate deposition which will be of international significance.

Provide statements of past climatic variability for the southern margin for the late Quaternary, that will be of relevance to studies of past variability by the Cooperative Research Centre for the Antarctic and Southern Ocean Environment.

Plan a sampling cruise over the Naturaliste Plateau and Diamantina Fracture Zone to take place possibly in late 1994.

Customers

Australian Petroleum Exploration Industry

Cooperative Research Centre for the Antarctic and Southern Ocean Environment

Cooperating agencies

University of Adelaide (Dr Y. Bone, Dr B. McGowran)

Queens University, Ontario, Canada (Prof. N.P. James)

University of Tasmania (Dr A. Crawford)

Project 121.29 Tropical and temperate marine carbonate systems of Eastern Australia — facies, climate and sea level

Project manager	John Marshall 06 249 9536 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1991–1995

Objectives

Develop models of carbonate accumulation related to variations in facies, climate and sea level.

Relevance

The differences between tropical and temperate build-ups in terms of geometry, composition, diagenesis, and structural and stratigraphic location can aid in the definition of new exploration concepts and new play types in ancient carbonate depositional environments. These sediments also record a history of recent climate and sea level which can be used to assess controls and extent of climate change in the past.

The project represents the winding up of a

cooperative research study between AGSO, the Technology Research Center of the Japan National Oil Corporation, and the Department of Geology and Geophysics of the University of Sydney aimed at studying the outer shelf and upper slope sedimentary facies of the east Australian margin along critical and contrasting subtropical transects.

Expected outcome

A model for sub-tropical and temperate carbonate build-ups to assist with the development of new concepts for cool water carbonate reservoirs in international exploration.

Activities

Project management committee meetings twice yearly, alternately in Canberra and Chiba, for project duration. Negotiate agreements with Japanese counterparts.

Investigate the Recent to Tertiary subtropical to warm temperate carbonate sequence off southern Queensland.

Carry out analysis of results obtained from the cruises, in particular seismic interpretation, sedimentological analysis, seaflooor current regime, and palaeoenvironmental variability. Prepare and report results at workshops and seminars in Australia and Japan.

Define the facies distribution of the outer shelf and upper slope off southern Queensland, and their three-dimensional geometry, particularly with respect to tectonics, subsidence, climate and sea level.

Understand the post depositional factors affecting the physical and chemical properties of the sediments, in particular those factors affecting porosity and permeability.

Relate sediment characteristics and changes in their properties to the understanding of ancient limestones.

Expected products

Both multichannel and single channel (boomer) high resolution seismic data that delineates sea level related sediment packages and carbonate depositional facies.

Facies maps of temperate, subtropical and tropical carbonate sediments that relate their depositional systems to principal allocyclic and autocyclic factors.

Highlights for 1992/93

A series of six current meters were successfully deployed on the shelf off Fraser Island for a period of one month. The results indicate that current strengths are strong enough for bedload transport to occur.

Goals for 1993/94

Carry out additional current meter work, in addition to a 800 km of high resolution (boomer) seismic reflection survey off Fraser Island.

Develop models for the evolution of temperate to sub-tropical carbonate platforms, using the southern Queensland margin as a key area (ongoing).

Elucidate the palaeoenvironmental signals from cores of the upper continental slope of southern Queensland so as to determine the effects of past global and local climatic and oceanographic variations on the development of carbonate platforms in sensitive sub-tropical regions (ongoing).

Complete compilation of all data from the project before its official termination at the end of September, 1993.

Prepare manuscripts according to the publication schedule outlined at the Fourth Research Committee Meeting.

Customers

Great Barrier Reef Marine Park Authority

General public

Cooperating agencies

Technical Research Center, Japan National Oil Corporation (Mr Y. Tsuji)

Department of Geology and Geophysics, The University of Sydney (Prof. P: Davies)

Project 121.30 Lord Howe Rise and Norfolk Ridge geological framework study

Project managers	Phil Symonds	06 249 9490 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1992–1995	

Objectives

Investigate the structure, stratigraphy and basin development of the southern Lord Howe Rise, southern New Caledonia Basin, and West Norfolk Ridge in the Australia/New Zealand boundary zone, as an aid to assessing its petroleum resource potential.

Determine the tectonic framework, crustal characteristics and evolution of the region, and, in particular, the nature of crust (continental or oceanic) underlying the New Caledonia Basin.

Relevance

This project is of direct relevance to the definition of the seabed boundary between Australia and New Zealand, as well as having long-term resource implications and the potential to increase our understanding of the evolution of the whole Tasman Sea-western Pacific margin region. It will also provide information to assist with the definition of Australia's legal continental shelf on the southwestern margin of the Lord Howe Rise.

Expected outcomes

Enhanced understanding of the geological framework and resource potential of the area likely to be the subject of seabed boundary negotiations between Australia and New Zealand.

Background technical input to future seabed boundary negotiations, and for definition of Australia's legal continental shelf on the southwestern margin of Lord Howe Rise.

Activities

Compile, review and analyse seismic and DSDP data in the region for survey planning purposes.

Conduct RV *Rig Seismic* survey over the southern Lord Howe Rise/West Norfolk Ridge region in November/December 1992, and acquire about 3200 km of deep (16 sec record length) seismic reflection data, plus associated bathymetric, gravity and magnetic data. These data will tie into DSDP Site 207, and other regional seismic data in the area, including RV *Rig Seismic* survey 46 to the north.

Process seismic and non-seismic data. Some key processed seismic lines will be available during the last half 1993.

Determine the regional structure, stratigraphy and basin development of the central and southern Lord Howe Rise, southern New Caledonia Basin and West Norfolk Ridge, and assess the resource potential of the region.

Determine the tectonic framework, crustal characteristics and evolution of the region, and attempt to understand the processes that have produced narrow strips of thinned and extended continental lithosphere (ribbon continents), separated by narrow ocean basins.

Analyse data and prepare maps to assist with the definition of Australia's legal continental shelf on the southwestern margin of Lord Howe Rise.

Expected products

Approximately 3000 km of regional seismic data and associated bathymetric, gravity and magnetic data.

Data relevant to seabed boundary negotiations and legal continental shelf definition.

Various scientific papers and reports.

Highlights for 1992/93

Preparation and distribution of pre-cruise AGSO Record (1992/97)

Successful completion of southern Lord Howe Rise/West Norfolk Ridge RV *Rig Seismic* survey, during which about 3200 km of 16 sec record length, 30 fold seismic reflection data were collected using a 3000 m long, 120 channel streamer. The data were collected on two long transects (800–1000 km long) across the Lord Howe Rise–New Caledonia Basin–West Norfolk Ridge system, as well as on a series of shorter lines to the north and south of the potential seabed boundary. Data quality appears good and seismic processing has commenced.

Goals for 1993/94

Produce post-cruise AGSO record.

Complete processing of seismic data.

Complete processing and release of non-seismic data.

Commence preliminary interpretation of key seismic lines and inclusion of some aspects of the study in a presentation on Australia's deep water petroleum prospects at the AGSO Petroleum Group Seminar on 18–19 November, 1993.

Collate seismic data over the Lord Howe Rise (including the Sonne data collected over the central Lord Howe Rise during a co-operative Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) and BMR survey in 1985), as a prelude to a regional framework study of the southern/central Lord Howe Rise.

Customers

Department of Foreign Affairs and Trade.

Attorney General's Department

Policy Divisions of Department of Primary Industries and Energy

Bureau of Resource Sciences, DPIE

Petroleum exploration companies (long term)

Cooperating agencies

New Zealand Institute of Geological and Nuclear Sciences Ltd

Project 121.32 Seabed morphology and offshore resources around Christmas Island

Project manager	Neville Exon	06 249 9327 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1991–1994	

Objectives

Define seabed morphology and sediment thickness around Christmas Island as an aid to seabed boundary delimitation discussions between Australia and Indonesia.

Assess the non-living resources of the seabed adjacent to Christmas Island, especially manganese nodules and cobalt-rich manganese crusts.

Determine the nature and age of the Christmas Island volcanic pedestal and other volcanic rises, and their relationship to the adjacent oceanic crust.

Relevance

The Department of Foreign Affairs and Trade (DFAT) specifically requested AGSO to undertake work to define the seabed resources of the area around Christmas Island, before finalising negotiations between Australia and Indonesia on the seabed boundary between Christmas Island and Java.

The project provides valuable information on the manganese nodule and crust potential of part of Australia's future Economic Exclusion Zone (EEZ).

By sampling volcanic seamounts, the project provides information on the age of formation of Christmas Island, the larger submarine Christmas Rise, and other seamounts in the area.

Expected outcomes

Advice to DFAT on seabed morphology and non-living resource potential of the area around Christmas Island.

Input into the definition of the seabed boundary between Christmas Island and Java.

Better understanding of the geology and mineral potential of the Christmas Island offshore area.

Activities

RV *Rig Seismic* research cruise completed in February 1992 involved high-resolution seismic (and associated bathymetric, magnetic and gravity data) and sampling (freefall grabs, corers, dredges).

Geochemical analysis of nodules and crusts recovered completed 1992.

Description and interpretation of shallow marine carbonates dredged from seamounts completed late 1992.

Dating and description of volcanic and volcaniclastic rocks dredged from seamounts completed in 1992.

Synthesis and reporting, well underway.

Expected products

AGSO Record 1993/6, the initial post-cruise report, completed in mid 1993.

Cruise report, as a synthesis of results.

Scientific papers and reports.

Highlights for 1992/93

Post cruise AGSO Record completed.

Advice to DFAT as Professional Opinion.

ANU Honours Thesis on petrology of dredged rocks completed.

Manganese nodules shown to have little economic potential.

Goals for 1993/94

Submit cruise report and scientific papers for publication.

Provide advice to DFAT and AGs on sea bed boundary.

Customers

Department of Foreign Affairs and Trade

Attorney-General's Department

Mineral exploration companies

Cooperating agencies

Adelaide University

Australian National University

University of Tasmania

Project 121.34 North West Shelf regional structure and stratigraphy

Project manager	Neville Exon	06 249 9347 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1991–1996	

Objectives

Understand the structural and stratigraphic framework of the North West Shelf sedimentary basins, the timing of critical development phases, the processes that formed the basins, and the relevance of the above to petroleum exploration.

Relevance

The north western margin of Australia is known to contain viable hydrocarbon source rocks, reservoirs and seals, and is a major gas and oil province. However, exploration is diminishing in some areas because of the structural complexity of plays and the small size of many oilfields. Furthermore, the relationship between structural history, source rock maturation and oil migration is often not well understood.

The development of the basins on the North West Shelf is intimately related to its breakup and collisional history, and shows both similarities and differences along the margin. The margin broke up as part of the breakup of Gondwana, with initial stretching in the

Permo-Triassic, and rifting and breakup in the Triassic, Jurassic, and Early Cretaceous. The nature, age and direction of stretching, rifting and breakup varied along the margin, as did the results of the Cainozoic collision with Timor. The precise timing and character of the various events are generally rather poorly defined, and there are various models extant for both breakup history and collisional events. The rifting and breakup history controlled the formation of depocentres and petroleum source rocks, and the collisional history controlled the final phase of structural reactivation, which is seen as having played a key role in hydrocarbon migration and entrapment along the North West Shelf.

This project aims to assist in addressing the above problems by using the appropriate data sets (e.g. deep crustal seismic, stratigraphic information, potential field data) to define the nature and age of the original basin-forming structures, their response to subsequent reactivation phases, and the history of basin formation.

Expected outcomes

A better understanding of the regional structure, megasequences, geological history and controls on petroleum potential of the North West Shelf.

Activities

Assemble a regional geophysical database which, in conjunction with existing well and other geological data, forms the basis for this study.

Compile map and database of Tectonic elements of the North West Shelf; update as appropriate.

Provide geological information on poorly-sampled parts of north west continental margin through dredging and coring.

Map the regional megasequences and structures, and prepare maps of structural framework, structure contours and sediment thickness.

Prepare illustrative regional cross-sections and interpreted seismic profiles.

Collect seismic refraction data along key transects to provide velocity control for deep reflection seismic

Carry out modelling and analysis of the effects of the Timor collision.

Prepare geohistory analyses of wells in the region.

Participate in regional stress studies based on borehole breakouts.

Revise and refine the biostratigraphic and lithostratigraphic framework.

Synthesize all these results, and those of other more local North West Shelf projects, into a coherent geological history of the region.

Expected products

Digital seismic shotpoint data base

Structural elements map and database

Time-structure maps

Isopach maps

Structural cross-sections, prepared by local projects

Interpreted composite seismic sections, prepared by local projects

Well geohistory diagrams, prepared by local projects

Models of passive margin formation

Models of marginal flexuring

Scientific papers and reports

Regional synthesis

Completion and publication of North West Shelf structural elements map and associated database.

Highlights for 1992/93

Completed and published Tectonic Elements of North West Shelf Map.

North West Shelf data base released.

Goals for 1993/94

Revise tectonic elements database as interpretations of current deep seismic projects proceed

Continue preliminary geohistory studies

Publish results of geological sampling.

Collect seismic refraction data along key seismic reflection lines (shot as part of current projects) using RV *Rig Seismic* and OBS's.

Customers

Petroleum exploration companies

Western Australian and Northern Territory Mines Departments

Universities

Cooperating agencies

Petroleum exploration companies

State geological surveys

National Centre for Petroleum Geology and Geophysics

Universities

NOPEC a.s.

Project 121.39

Northern Bonaparte Basin: deep-basin architecture, structural reactivation and hydrocarbon potential

Project manager Chris Pigram 06 249 9636 Fax 06 249 9980

Program responsibility Marine Geoscience and Petroleum Geology

Timeframe 1992–1995

Objective

Encourage petroleum exploration and enhance exploration strategies in the northern Bonaparte Basin through a better understanding of the deep structural framework, early basin evolution and Cainozoic structural reactivation mechanisms.

Relevance

This project is a part of AGSO's current integrated Australian north west margin mapping and research program, which will result in the development of a comprehensive regional synthesis on the geological framework, evolution and petroleum potential of this section of the Australian continental margin, from the Carnarvon to the Arafura Basins.

The northern Bonaparte Basin study covers the Sahul Syncline, Sahul High, and Malita and Calden Grabens. It includes the Australian Indonesian Joint Development Zone including Zone of cooperation A which is being actively explored. The Malita Graben region has been under explored compared to other areas of the Timor Sea, despite gas and condensate shows in Troubadour 1, Sunrise 1 and shows in other wells including Evan Shoals 1. Acquisition of deep crustal data (not generally collected by industry) and seismic ties to wells and seismic grids outside the area is a timely complement to present renewed exploration activity.

The study will provide a better understanding of foreland development associated with Eurasian/Indo-Australian plate convergence and collision in the Timor region.

A tie to the deep crustal transect recently completed by the British BIRPS expedition across the plate boundary east of Timor will enhance the value of the proposed data set by helping to place the study area in the context of tectonic processes taking place on a broad regional scale.

The study provides the link between the existing and proposed Timor Sea deep crustal data sets (projects 121.19, 121.22, 121.28, 121.36) and the Arafura Sea data sets (project 121.31).

Expected outcomes

Definition of the deep crustal architecture of the northern Bonaparte Basin and associated structural elements (such as the Sahul Platform, Sahul Syncline, Malita and Calder Grabens and an improved understanding of the evolutionary history of the basin dating back at least to the Devonian.

Predictive models for hydrocarbon migration pathways and accumulations in the northern Bonaparte Basin.

An understanding of how the deep basin-forming structures in the Timor Sea area have controlled shallow (less than 4 km deep) reactivation processes and hydrocarbon entrapment related to foreland development and

lithospheric flexure.

Improvement in exploration efficiency in the region.

Activities

Compile, review and analyse existing geophysical and well data.

Complete processing of seismic, navigational and non-seismic geophysical data.

Complete negotiations with Indonesian National Oil Company — PERTAMINA — for a joint study of Zone of Cooperation C and adjacent regions.

Begin interpretation of data sets.

Publish results.

Expected products

6458 km of processed deep crustal multichannel seismic data and associated bathymetric, magnetic and gravity profile data of which 2590 km was collected during Survey 116 in the Sahul Syncline and western Malita Graben and 3868 km in the areas to the east of the JDZ.

Regional seismic stratigraphic ties between exploration walls and main structural elements.

Revised regional structural and stratigraphic maps and cross-sections; reports and papers on the structure, evolution, new play concepts and petroleum potential of the northern Bonaparte Basin.

Highlights for 1992/93

Planned and carried out multichannel seismic cruise (Cruise 116 and 118) in which 6458 km of geophysical data was collected.

Commenced processing this data set.

Goals for 1993/94

Complete acquisition of seismic data in the Timor Trough.

Produce post-cruise operational report.

Complete processing of seismic and other geophysical data.

Complete processing of navigation and bathymetry data.

Begin data analysis.

Market data and ideas.

Customers

Australian petroleum industry (including BHP Petroleum)

Current and prospective permit holders in the Bonaparte Basin

Petroleum Division, DPIE

NT Department of Mines and Energy

Geological Survey of Western Australia

Joint Development Authority

Cooperating agencies

Current permit holders in the Bonaparte Basin and JDZ.

NT Department of Mines and Energy

Geological Survey of Western Australia

BIRPS Group (Cambridge University)

Project 121.40 — Effects of organic enrichment on sediments in the Sydney Region: Implications for environmental monitoring and management

Project managers	Gary Bickford and David Heggie
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1993–1996

Objectives

To assess the impacts of organic enrichment on coastal sediments. To evaluate if geochemical processes (and parameters) in sediments are sensitive indicators of environmental

change. To develop methods for on-going monitoring programs, to evaluate the impact of carbon and nutrient inputs to the coastal zone.

Relevance

In co-operation with the Sydney Water Board, a joint research survey was conducted offshore Sydney during September 1993, RV *Rig Seismic* Survey 112 (see AGSO project 121.37 for additional information on this survey). This survey was designed to collect baseline data to begin to understand the effects of anthropogenic inputs of metals, nutrients and organic carbon to the sediments offshore Sydney. A component of this survey was to measure the flux rates of nutrients and oxygen in one of the end-member sediments types, the muddy sands. This project will provide data that will input into the Water Board strategic plan and also input into the decision making process within the Board, specifically the necessity for sewage treatment plant upgrades. This data and the methods developed will have application around Australia and elsewhere.

Expected outcomes

Documentation of the nutrient status of sediments in the Sydney region. An understanding of sediment geochemical processes and the development of methods for environmental monitoring procedures.

Activities

Two field programs planned during the first twelve months of the project.

The first field program will collect sub-cores from boxcores that will be returned to the laboratory for analysis. Ambient nutrient and oxygen fluxes will be measured on the sub-cores and other cores will be loaded with the various amounts of organic material derived from sewage effluent to measure the environmental changes in sediments resulting from organic enrichments. Various other metals, chemical species including carbon isotopes and organic matter composition, will be tested as tracers of sewage effluent.

The second field program will determine the nutrient and oxygen status of the other end-member sediment type offshore Sydney; the sandy sediments. This experiment is designed to complement the nutrient measurements conducted on RV *Rig Seismic* during Survey 112, which measured the nutrient status of the muddy sands.

Process and interpret the data.

Expected products

Interpretive data reports will be produced. Monitoring guidelines will be developed. Various scientific papers will be written.

Resources

The AGSO and the Water Board will both provide technical support to the project. Laboratory facilities will be utilised within Sydney University, the Water Board and AGSO. Analytical services will be provided to the project by AGSO, AIMS, University of Stockholm and Sydney University.

Goals for 1993/94

Complete the field programs.

Complete the two laboratory experiments associated with the field program

Write a interpretative report on the fields programs and associated laboratory work.

Customers

Water Board (Sydney)

Citizens of Sydney

Cooperating agencies

Water Board (Sydney)

University of Sydney; Department of Geology and Geophysics

Project 121.41 Timor Sea shelf processes: tectonics and Cainozoic environments

Project manager	John Marshall	06 249 9536 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1993–1996	

Objectives

Elucidate the depositional processes and geohistory of the continental shelf with a view to understanding the seismic stratigraphy and velocity structure of the underlying Tertiary and Quaternary sediments.

Investigate the neotectonic regime on this incipient collisional continental margin, in order to determine the potential for structural closure and migration pathways within the Tertiary sequence.

Determine the nature and history of the shelf edge carbonate platforms of the Timor Sea, and their relationship to previous platform development in the area.

Relevance

The basins beneath the Timor Sea form one of the major hydrocarbon provinces of Australia.

Successful exploration in the area has been hampered substantially by the lack of knowledge regarding structuring within the basins and depth resolution of reservoirs because of the complex velocity composition of the overlying Tertiary carbonates. The project aims to investigate the latter problem, by a combination of high resolution seismic reflection profiling and sampling and coring of the seafloor.

Collisional reactivation of the margin during the Tertiary and Quaternary has had a profound affect on reservoir integrity within the region. The project aims to determine the effects of collision on carbonate depositional processes, and to investigate the nature of connate fluids at the seafloor.

The continental shelf of the Timor Sea, while being a tropical carbonate environment, is notably almost devoid of coral reefs; particularly when compared to its eastern counterpart, the Great Barrier Reef. The project intends to investigate the causes for the lack of reef growth, and to investigate the nature of the present carbonates as modern analogues to underlying Tertiary examples.

Expected outcomes

A regional understanding of the major processes controlling the deposition and accumulation on this incipient collisional continental margin, and to relate and compare this to depositional environments in the Tertiary and Quaternary.

An understanding of the velocity structure of the Tertiary carbonates as a means to determine the true depths of Mesozoic horizons.

Activities

Compile maps and relevant scientific and industry information of the study area and prepare a pre-cruise report.

Expected products

Approximately 800 km of processed multichannel and 350 km of single channel high resolution seismic data.

Structure contour and isopach maps of significant seismic horizons in the Late Cretaceous to Quaternary section.

AGSO record and reports, plus publications in international scientific journals.

Highlights for 1992/93

Future program committee and Executive endorses project as part of Marine Program.

The Department of Geology and Geophysics of the University of Sydney agree to cooperate in the project.

Goals for 1993/94

Plan and conduct a one month long cruise on RV *Rig Seismic* in October/November 1993,

using both single channel and multichannel high resolution seismic reflection profiling, sidescan sonar, dredging, coring and underwater photography.

Commence processing and analysis of data and samples collected during the marine survey.

Prepare a post-cruise report.

Customers

The petroleum industry

The Hydrographic Office, Royal Australian Navy

DPIE

DEST

Cooperating agencies

The Department of Geology and Geophysics, University of Sydney

Project 121.42

Tectonic evolution, basin development and hydrocarbon potential of the Browse Basin region

Project manager	Philip Symonds	06 249 9490	Fax	06 249 9986
	Jim Colwell	06 249 9346	Fax	06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology			
Timeframe	1993–1996			

Objectives

Improve understanding of basin and margin evolution to stimulate petroleum exploration interest in the Browse Basin area and the development of new exploration strategies.

Investigate the deep structure and tectonic development of the Roti Basin/west Timor Trough sector of the Australia-India/Eurasia plate boundary adjacent to the Browse Basin, and the influence of collision along the plate boundary on the region's late-stage tectonic development and, consequently, hydrocarbon migration.

Relevance

Despite five gas/condensate discoveries in the Browse Basin, including the large Scott Reef field, and two encouraging oil occurrences confirming that hydrocarbons have been generated and trapped within the basin, exploration and drilling has generally been less intensive than in other major North West Shelf basins. It seems highly likely that the basin has not realised its full potential.

The Browse Basin lies between Australia's two most currently active exploration areas — the Vulcan Sub-basin and the Barrow/Dampier Sub-basins. The time is right to build on improvements in regional understanding resulting from this exploration to reassess the Browse Basin's petroleum potential, and thus promote renewed exploration interest beyond the active areas.

The Roti Basin/west Timor Trough sector of the Australia-India/Eurasia plate boundary adjacent to the Browse Basin is of considerable importance because of its unique tectonic setting involving the transition from ocean basin subduction in the southwest to continent collision in the north east. Plate interactions in this zone are likely to have produced a range of structures on both sides of the plate boundary, as well as having an influence on late-stage hydrocarbon migration in the Timor Sea/North West Shelf through their effect on the regional stress field. The study will extend existing AGSO deep-seismic data sets on the North West Shelf to the plate boundary providing a series of continent-oceanic crust and continent-collision zone crustal transects for geodynamic modelling of the plate margin.

Expected outcomes

Improved understanding of the tectonic development of the Browse Basin and its relation-

ship to major adjacent structural elements.

An up-to-date synthesis of the geological framework of the basin and adjacent Scott Plateau, as an aid the development of enhanced petroleum play concepts and exploration strategies.

Definition of the crustal structure in an area of ocean basin subduction (eastern end of Java Trench), in the transition zone from oceanic to continental crust (western Roti Basin), and in an area of continent/continent collision (western Timor Trough).

Enhanced understanding of how the plate boundary interactions have influenced late-stage hydrocarbon migration.

Activities

Compile, review and analyse seismic and well data in the region for cruise planning purposes.

Conduct a RV *Rig Seismic* cruise (Survey 119) in the Browse Basin region, in mid 1993, and acquire about 2500+ km of deep (16 sec record length) seismic reflection data, and possibly some crustal refraction data, plus associated bathymetric, gravity and magnetic data. These data will tie all major wells in the basin, as well as the 1990/91 AGSO data in the Vulcan Graben, and planned deep seismic data in the Rowley Sub-basin to the south, and will include one full-margin transect across the Scott Plateau to the Argo Abyssal Plain. A further seismic acquisition phase over the northern Scott Plateau (about 1000 km of data) is planned for late 1993, and some extra infill seismic lines may be recorded over the Browse Basin during 1994.

Undertake, in conjunction with Indonesian scientists, a RV *Rig Seismic* survey in mid 1994 over the Roti Basin and western Timor Trough involving the collection of approximately 22000 km of deep (16 sec record length) seismic reflection data.

Process Browse Basin Survey 119 seismic data for expected release in early 1994.

Determine the regional structural style and stratigraphic framework of the Browse Basin and its relationship to adjacent features such as the Vulcan and Rowley Sub-basins, and Scott Plateau.

Develop a model explaining the tectonic, subsidence and thermal history of the Browse Basin in relation to the development of the continental margin and adjacent ocean basin, the Argo Abyssal Plain.

Determine the control of deep structure on the development of the major petroleum fields and play in the Browse Basin area, and improve understanding of its petroleum potential.

Determine the nature of interactions occurring along the Australia-India/Eurasia plate boundary adjacent to the Browse Basin s and their influence on tectonic development and hydrocarbon migration.

Expected products

About 2500+ km of processed deep seismic data tying wells in the Browse Basin, as well as other AGSO deep seismic data over adjacent basins.

About 1000 km of deep seismic data over the northern Scott Plateau.

Approximately 2200 km of deep seismic data over the Roti Basin and western Timor Trough.

Processed non-seismic (navigation, bathymetry, gravity and magnetic) digital data package, partly in image format.

AGSO interpretation report(s) containing regional crustal cross sections, maps and seismic sections illustrating the regional structural and stratigraphic framework of the Browse Basin; an upgraded structural elements map; well summaries, and basin-wide burial and thermal geohistory analyses; and information on revised/new play concepts and exploration strategies, and petroleum potential.

Reports and papers containing ideas on the tectonic development, deep structure, structural style, reactivation history and petroleum potential of the Region in industry-related and scientific journals, and at conferences such as APEA and AAPG.

Highlights for 1992/93

Positive exploration company support for the Browse Basin deep seismic program.

Browse Basin survey commenced (June-July).

Goals for 1993/94

Successfully complete Browse Basin RV *Rig*

Seismic survey (July 1993), and survey of the northern Scott Plateau area (late 1993).

Complete processing of deep seismic data over the Browse Basin for planned release in early 1994.

Complete processing and release of non-seismic data over the Browse Basin.

Commence a well review and a basin-wide burial and thermal geohistory analysis of the Browse Basin.

Commence preliminary interpretation of the Browse Basin deep seismic data.

Undertake planning for the mid 1994 Roti Basin/ West Timor Trough RV *Rig Seismic* cruise.

Customers

Australian petroleum industry

Current and prospective lease holders in the Browse Basin

Petroleum Division, DPIE

Bureau of Resource Sciences

Geological Survey of Western Australia

Department of Foreign Affairs and Trade

Universities

Cooperating agencies

Bureau of Resource Sciences

Geological Survey of Western Australia

Australian Geodynamics Cooperative Research Centre

Relevant Indonesian agencies including Marine Geological institute (MGI) in Bandung

Project 121.43 Tectonic evolution of the Macquarie Ridge and Law of the Sea study

Project manager	David Falvey 06 249 9328 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	July 1993–1995

Objective

Determine the structure and nature of plate interaction along the Macquarie Ridge portion of the Australian/Pacific Plate boundary, in a enigmatic zone which is thought to show elements of an arc-trench system, crustal accretion, and strike-slip/transform faulting. Define the potential jurisdictional limits under UNCLOS generated by the Australian territory of Macquarie Island.

Relevance

The formation of plate boundaries has been a key element in geoscientific research. Considerable effort has been devoted to studies of the transition from rifting to seafloor spreading and to formation of strike-slip margins, but relatively little is known about the initiation and development of subduction zones. The latter are the main margin type in the Timor Sea region of northern Australia and an understanding of their evolution is critical in assessing the petroleum potential of such margins.

Also, in order determine a seabed boundary around Macquarie Island, and to conduct negotiations with New Zealand regarding a bilateral boundary to its north, more detailed mapping of the bathymetry of the region is required.

This project has been developed as part of a 3-way exchange of shiptime proposed by AGSO and the United States National Science Foundation (NSF). A swath-mapping survey operation in the Macquarie Ridge region would be conducted under an NSF proposal in 1994, using the HAWAII MR1 system installed aboard AGSO's RV *Rig Seismic*. Gravity data and six-channel reflection seismic data will also be collected. Data from this operation and participation in publication would be available to AGSO. Reciprocal shiptime would be provided, on a 4:3 basis, with the French vessel RV *L'Atalante* which has a shiptime deficit with the US. It is proposed

that *L'Atalante* will conduct a SIMRAD swath-mapping cruise on the Otway/west Tasmania margin, as part of a tectonic evolution study. This arrangement has the advantage that the vessels concerned are strategically positioned for these operations.

Expected outcome

Enhanced knowledge of the development of subducting (active) margins, and bathymetric (swath-mapping) data to be utilised in defining Australia's seabed boundaries.

Activities

The core data for the project will be provided by a 40-day RV *Rig Seismic* cruise using the HAWAII MR1 system.

Analysis of the swath-mapping data will be carried out by Dr Millard Coffin at University of Texas in Austin with participation from an AGSO scientist. Maps associated with seabed boundaries and for use in forthcoming negotiations with New Zealand will be prepared within AGSO.

Expected products

Data:

- Approximately 135 000 km^2 of swath-mapping coverage, comprising images, bottom character maps
- Swath bathymetry maps
- 5 x 400 km gravity profiles
- Seismic profiles

Scientific papers dealing with the evolution of the Macquarie Ridge and subducting margins in general.

Maps of potential seabed boundaries as per UNCLOS Article 76.

Highlights for 1992/3

Detailed planning and completion of RV *Rig Seismic* cruise.

Goals for 1993/94

Complete RV *Rig Seismic* Cruise over Macquarie Ridge

Customers

Department of Foreign Affairs and Trade

Attorney General's Department

Cooperating agencies

University of Texas/National Science Foundation

University of Tasmania cooperating through University of Texas

Government of Tasmania

Department of Foreign Affairs and Trade

Attorney-General's Department

Policy Divisions, DPIE

Scientific Community

Project 121.44 West Tasmania — South Tasman Rise: tectonics and Law of the Sea study

Project manager	Neville Exon 06 249 9347 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1993–1995

Objectives

Map the structure of the continental margin along the southern Otway Basin, the Sorell Basin and the western South Tasman Rise, plus the adjacent abyssal plain, in order to help clarify the structural pattern and the tectonic history of this region, which was greatly affected by the separation of Australia and Antarctica.

Map bathymetry, and large-scale sedimentary structures and patterns, firstly to help elucidate the Tertiary sedimentary history of the continental margin, and secondly to help define Australia's Legal Continental Shelf in the context of the Law of the Sea.

Use the results to help plan forthcoming

RV *Rig Seismic* deep crustal seismic and sampling cruises.

Combine previous results, *L'Atalante* results and future results, to give a better geological understanding of the region and its petroleum potential.

Relevance

The geological history of this region bears on the history of the entire southern margin of Australia, which is already a major producer of petroleum in the Gippsland Basin, and has encouraging exploration results in several other basins. The Otway Basin and Sorell Basin are both included in this survey, and the Otway Basin, in particular, is the scene of major recent offshore petroleum discoveries. The very accurate bathymetric maps and sonar images arising from this survey of a huge area (at least 200 000 square kilometres) will provide an unequalled source of structural information of great value to AGSO and the petroleum exploration industry.

The maps arising from this survey will define the bathymetry and surface texture of the continental margin and adjacent abyssal plain with a degree of accuracy and rate of coverage unobtainable in any other way. This will greatly aid definition of Australia's legal continental shelf, and be of considerable value to the nation when it ratifies the Law of the Sea Convention (expected within two years).

The SIMRAD EM12D system, that provides the bathymetric maps and imagery in real time, is one of the most advanced sidescan sonar systems in the world, mapping an area up to 20 km wide at 20 km/hour, and would be a serious contender as key equipment for the replacement for RV *Rig Seismic*. This will be an excellent test of its potential value to AGSO program.

The mapping of rocky outcrops, sedimentary structures, and sedimentary patterns will be invaluable in planning future sampling along the margin. This sampling will target old harder rocks to provide information on the early history of the margin, and younger sediments to provide information on Neogene and Quaternary changes in oceanic circulation and climate, as Australia separated from Antarctica and moved northward.

Expected outcomes

Vital information on the continental margin for AGSO's own studies and future planning, and for the petroleum exploration industry as it searches for oil and gas.

Unequalled regional maps for the purposes of the Law of the Sea, deepwater fisheries, and climatic research covering terms of thousands to millions of years.

Activities

Finalisation of cruise plans late in 1993.

Research cruise of RV *L'Atalante* in December 1993 and January 1994

Preparation of initial reports and maps soon after cruise.

Final processing of sidescan sonar data in 1994.

Interpretation of data and preparation of final reports, maps and research papers in 1994–1995.

Expected products

Post-cruise report in early 1994.

Data analyses to aid planning of forthcoming RV *Rig Seismic* sampling and deep seismic cruises.

Release of published maps in late 1994.

Final report and scientific papers in 1994–1995.

Goals for 1993/94

Finalise cruise plans

Carry out cruise successfully

Post-process sidescan sonar data if necessary

Coordinate research activities of participating groups

Release initial post-cruise report as an AGSO Record

Customers

Petroleum exploration companies

University researchers

Department of Foreign Affairs and Trade, and Attorney General's Department

Department of Defence

Fisheries research agencies and deep sea fishing industry

Cooperating agencies

French research institutions

Australian universities including CRCs

211: MINERAL PROVINCE STUDIES

Objective

Optimise the environment for mineral exploration through the provision of geoscientific data sets, maps and exploration models.

Provide a reliable information base for the assessment of mineral resource potential.

Improve the geoscientific knowledge base to facilitate sound environmental management and land use planning.

Relevance

The National Geoscience Mapping Accord (NGMA), endorsed by the Australian (now Australian and New Zealand) Minerals and Energy Council in August 1990, is a joint Commonwealth–State/Territory initiative to produce a new generation of geoscientific maps, datasets and other information using modern technology of strategically important regions of Australia over the next 20 years.

Under the NGMA, AGSO and State and Territory geological surveys have identified areas of high priority for mineral and petroleum exploration and/or where significant issues of land use exist. AGSO is involved in collaborative 5 year work programs in six mineral provinces — North Queensland, Eastern Goldfields, Arnhem Land, Kimberley–Arunta, Lachlan–Kanmantoo Fold Belts, and the Musgrave Block. This year work will commence on a seventh NGMA project through a geochronology program in northern Tasmania.

Following the recommendations of the Richards Review for additional resources to accelerate the NGMA program, the Government has allocated increased funding to AGSO and will be opening negotiations with the States and Territories to formalise an accelerated NGMA and encourage States and Territories to apply additional funding to match the increased Commonwealth contribution. The Minerals and Land Use program in 1993/94 will therefore be aimed at completing existing NGMA projects in the most expedient manner with a view to commencing new NGMA projects with State/NT counterparts in 1994/95 and onwards.

The focus of the NGMA is to produce a new generation of geoscience maps and datasets which will underpin mineral and petroleum exploration and at the same time provide a sound basis for resource assessment and for the development of sustainable land use management strategies.

Output from the NGMA will include digital maps and datasets with the emphasis on 1:250 000 scale geological maps and related datasets, geochemical maps and datasets, regolith maps and datasets, geochronological data, Geographic Information System packages, predictive models of mineral resource potential, and descriptive and interpretive reports and papers.

Activities

Carry out, in collaboration with the State/NT geological surveys under the NGMA, multidisciplinary studies of mineral provinces based geological mapping using airborne magnetic and radiometric data and other remotely sensed datasets.

Undertake specialist research in geochronology, geochemistry, regolith studies, petrology and mineral deposit studies in support of the mapping in NGMA project areas.

Use the latest technology to produce a new generation of geological maps in digital format and contribute to national digital geoscience databases.

Build databases of information on the factors influencing the development of major mineral deposits and undertake metallogenic analyses to determine mineral resource potential.

Develop comprehensive GIS package of geoscientific data in both NGMA areas and other mineral provinces.

Improve the geoscientific information base in order to provide a basis for sound environmental management and land use planning.

Highlights for 1992/93

Release of a significant number of new products of relevance to the minerals industry including:

- Mt Isa Geographic Information System (GIS) containing comprehensive regional coverages of geology, geochemistry, geochronology, mineral deposits and geophysics. This has demonstrated the applicability of GIS in metallogenic analysis on a province-wide basis. A three volume atlas (geology, geochemistry and geophysics) of hard copy derived from the GIS was also released.
- Bulletin 243 — Detailed studies of the Mt Isa Inlier — together with a new 1:250 000 scale transect map and 22 geological maps at scales ranging at scales from 1:5000 to 1:100 000 scale.
- Metallogenic map at 1:500 000 scale and database of mineral deposits of the Mt Isa region.
- Geophysical interpretation maps of the southern Yilgarn at 1:1 million scale (Kalgoorlie and Esperance).
- Preliminary 1:250 000 (and 1:100 000) basement geology and regolith landform maps of Ebagoola (Qld), and preliminary 1:100 000 digital geological maps of the Eastern Goldfields (Mt Mason, Leonora, Yerilla).
- Bulletin 242 — Petrology and Platinum Group Element Geochemistry of Archaean Layered Mafic/ultramafic intrusions, West Pilbara Block, WA.

Winning the AGSO Advisory Council Outstanding Merit Award and the Exhibition Excellence Award at the Australian Society of Exploration Geophysics 9th Geophysical Conference and Exhibition in October.

Establishment of an industry-funded program for digital capture of all existing 1:100 000 geological maps of the Mt Isa Inlier.

Development of new mapping technologies, employing airborne gamma-ray spectrometric data, in regolith landform and land degradation mapping. New high resolution airborne gamma-ray spectrometric data has enabled recognition of different weathering profiles in relation to age of landforms and led to development of the concept of 'activity maps' identifying stable landforms with deep weathering and younger landforms undergoing active erosion. Results based on work done in North Queensland NGMA project are being extended to other AGSO programs.

Restructure of the REGMAP field data management system originally developed by GSQ to a more structured format to enable more rapid and systematic recording in the field and to support GIS. The new NGMA field database has been linked with existing AGSO Oracle laboratory databases and authority tables developed to facilitate data entry and ensure data integrity. The SITES table is pivotal to the NGMA schema and is where the site position and data lineage are stored. It has a one-to-many relationship with ROCKS, LITHDATA, PETROGRAPHY, ROCKCHEM, OZCHRON etc. The latter databases comprise varying amounts of data with entries from most projects. There are currently just under 49 000 entries in the SITES table. Significant progress was made towards the adoption of NGMA-wide data storage and retrieval.

Completed mapping of the basement geology and released digital geological map of the Wagga–Kyeamba region at 1:100 000 scale in a collaborative project for the Murray–Darling Basin Commission involving AGSO, CSIRO Division of Soils, New South Wales Conservation and Land Management, and the ANU Centre for Resource and Environmental Studies aimed at determining appropriate mapping strategies for areas of dry land salinity

Release of more than 20 Records in the Mineral Province and Surficial Geology series.

Contributed geological, regolith and mineral resource information to the Shoal Water Bay–Land Use Inquiry.

Goals for 1993/94

In collaboration with State/Northern Territory counterparts undertake the following basement mapping programs:

- North Queensland — complete mapping of Hann River, Walsh and Red River 1:250 000 Sheets.
- Eastern Goldfields — complete mapping of Laverton 1:250 000 Sheet.
- Kimberley–Arunta — complete mapping of Dixon Range and Gordon Downs 1:250 000 Sheets.
- Lachlan–Kanmantoo — complete mapping of Bathurst and Ballarat 1:250 000 Sheets and commnence mapping of Dubbo 1:250 000 Sheet.

Compile and publish maps generated from previous mapping results.

Undertake regolith landform mapping in:

- North Queensland (Hann River, Walsh, Red River, Mossman, Atherton, Cairns, Innisfail, Galbraith and Normanton 1:250 000 Sheets),
- Eastern Goldfields (Kurnalpi or Kalgoorlie 1:250 000 — in conjunction with the Australian Mineral Exploration Technologies Cooperative Research Centre (AMETCRC),
- Arnhem Land (Arnhem Bay–Gove and Blue Mud Bay–Port Langdon 1:250 000 Sheets),
- Lachlan–Kanmantoo (Dubbo 1:250 000 Sheet).

Undertake geochronological, petrological, geochemical, and mineral deposit research in support of the NGMA mapping and release results in databases, reports and research papers.

Acquire stream sediment geochemical data over the basement and adjacent regions of the Hann River, Walsh and Red River (northern part) Sheet areas and prepare for release.

Negotiate new NGMA agreements with States and the Northern Territory and plan for finalisation of existing projects in the most expedient and effective manner and the development of new NGMA projects in strategically important mineral provinces.

Continue developments in GIS and its application to metallogenic studies and analysis of resource potential both through NGMA projects and Precambrian Mineral provinces. Develop (with NTGS) and release a GIS on the Pine Creek Geosyncline.

Complete the 1:5 million basement tectonic elements map.

Contribute to Cooperative Research Centres for Australian Mineral Exploration Technologies (AMETCRC) and Australian Geodynamics (CRCAG).

Complete the digital capture of 1:100 000 scale geological maps of the Mt Isa Inlier.

Complete work program for the Cape York Peninsula Land Use Strategy (CYPLUS).

Continue development and release of Oracle databases for the standarising, storage and manipulation of field and laboratory data.

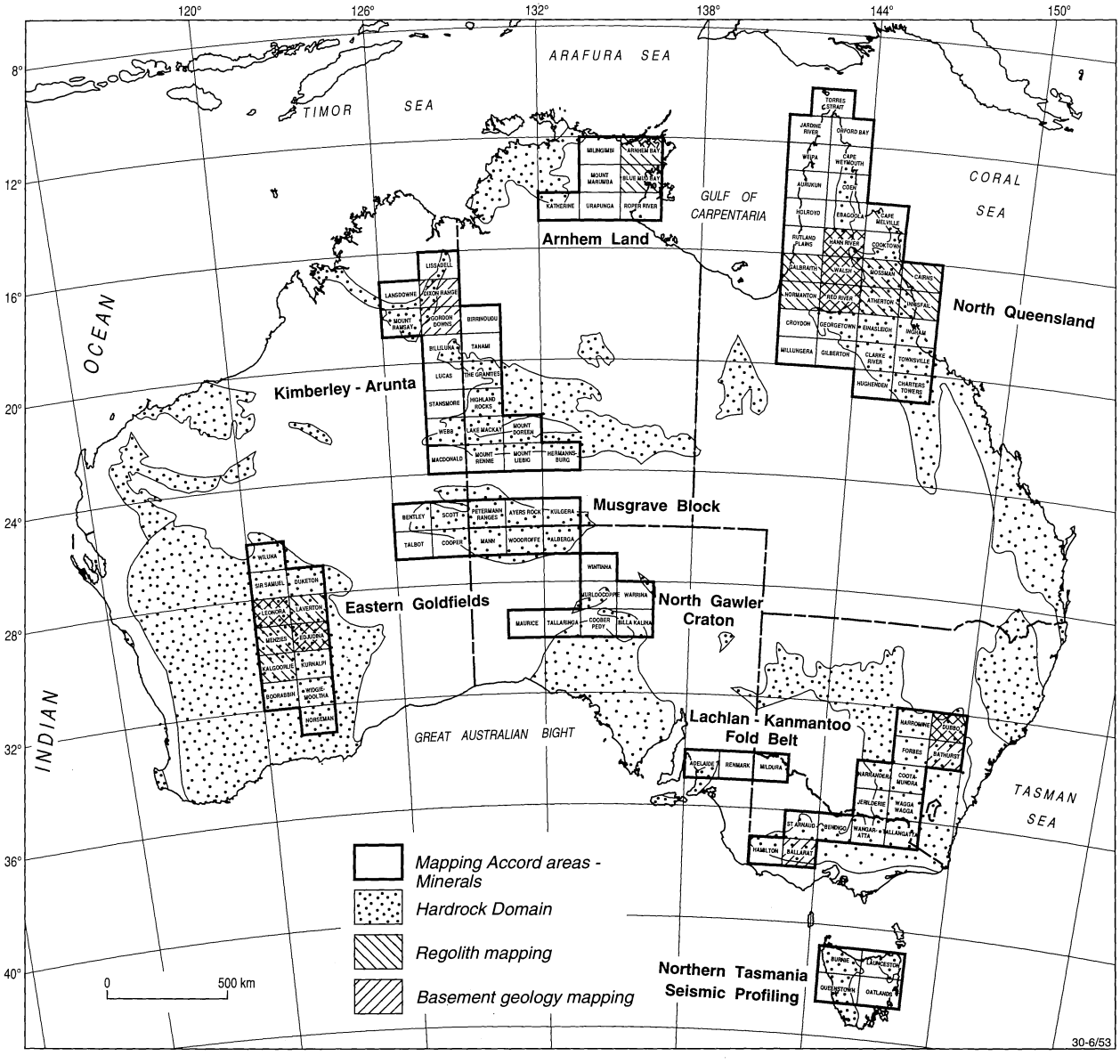
Contribute to the organisation of, and present papers at, the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) General Assembly (Canberra, September) and Kalgoorlie '93 (Kalgoorlie, September).

MINERAL PROVINCES

Component manager Lynton Jaques 06 249 9745

Component projects

211.06	Precambrian metallogeny
211.09	North Queensland Mapping Accord Project
211.10	Eastern Goldfields Mapping Accord Project
211.11	Arnhem Land Mapping Accord Project
211.12	Kimberley–Arunta Mapping Accord Project
211.13	Lachlan–Kanmantoo Fold Belts Mapping Accord Project
211.14	Musgrave Block Mapping Accord Project
211.15	North Tasmania Accord Project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ARAFURA SEA
TIMOR SEA
GULF OF CARPENTARIA
CORAL SEA
TASMAN SEA
INDIAN OCEAN
GREAT AUSTRALIAN BIGHT
Arnhem Land
Kimberley - Arunta
North Queensland
Musgrave Block
Eastern Goldfields
North Gawler Craton
Lachlan - Kanmantoo Fold Belt
Northern Tasmania Seismic Profiling
Mapping Accord areas - Minerals
Hardrock Domain
Regolith mapping
Basement geology mapping
0
500 km
30-6/53

Project 211.06 Precambrian metallogeny

Project manager	Lesley Wyborn 06 249 9489
Program responsibility	Minerals and Land Use Program
Timeframe	1991–1996
Resources	

Objectives

Develop a comprehensive understanding of the geological evolution of Australian Precambrian provinces and their metallogeny.

Relevance

The Precambrian provinces of Australia host many world class mineral deposits. Although many of these provinces have similar tectonostratigraphic histories, in detail the metallogeny of each province is distinctive. This project will provide regional syntheses, digital data sets and databases of the geology and metallogeny of individual Precambrian Mineral Provinces with the aim of defining what makes each province distinctive. The project will also develop new mineral deposit models in support of the NGMA projects.

Expected outcomes

A more comprehensive understanding of the geological and metallogenic evolution of the Precambrian provinces of Australia to enable more efficient and effective exploration.

A better understanding of the mineral potential of Australian Precambrian provinces.

Activities

Synthesise existing data, and where necessary acquire new primary data, relevant to metallogenesis on the geological, stratigraphic and geochemical development of Precambrian provinces, particularly in poorly known regions not covered by the NGMA.

The project will work in close collaboration with the metallogenic research and syntheses being undertaken as part of the NGMA projects in Precambrian provinces. As necessary, limited field work will be carried out in relevant Precambrian provinces, particularly those provinces where geochemical and metallogenic information is sparse.

Undertake specialist multidisciplinary studies of the essential geological controls on the localisation and grade of major Precambrian mineral deposit types, with emphasis on their relationship in space and time to regional scale petrologic, geochemical, geophysical and structural features.

Systematically record all data digitally on AGSO data bases and store within a centralised Geographical Information System (GIS); sets to be incorporated include:

- digital geological maps
- syntheses of information on mineral deposits, prospects and occurrences, with particular attention to geochemical, geophysical and geological features
- regional whole rock geochemical data, with emphasis on regional alteration patterns known to be associated with mineralisation
- regional geophysical surveys, with emphasis on signatures around known deposits and associated alteration zones (magnetics, radiometrics, gravity)
- mineralogical maps showing the distribution of at least eight of the metallogenically significant minerals (graphite, sulphide, magnetite, hematite, feldspar, carbonate, sericite/muscovite and fluorite)
- geochronological data with emphasis on the age of mineralisation and regional-scale alteration patterns

The project will also develop hard copy metallogenic maps and atlases of key Precambrian provinces

Expected products

A catalogue of key parameters (geological, geochemical, geophysical) for the charac-

terisation of the geological setting and formation of major Precambrian ore deposits.

Province-wide and continent-wide GIS packages in which individual coverages will highlight the geographical distribution of features of metallogenic importance for specific major deposit types including such features as:

- mineralogically and chemically distinctive host rocks (e.g. iron-rich rocks, graphite-bearing rocks)
- regional alteration types (e.g. reduced zones, alteration zones)
- major structures and lineaments
- potential source rocks for certain elements
- regional geophysical images (magnetics, gravity, radiometrics)
- metallogenically important igneous rock associations (e.g. fractionated granite suites, layered mafic intrusives).
- metallogenically important sedimentological features (e.g. unconformities, growth faults)
- information on thermal evolution of a province in space and time (e.g. magmatism, metamorphic grade distribution)
- Metallogenic province maps, atlases, databases and syntheses.
- Scientific research papers.
- Synthesis reports summarising the essential genetic and empirical criteria for major deposit types.

Highlights for 1992/93

A trial GIS package in ARC/INFO was completed on the Mount Isa Inlier/Lawn Hill Platform/Murphy Tectonic Ridge. Coverages developed included digital geology (based on the published 1:500 000 scale map), magnetics, gravity, geochemistry, and mineral deposits. From these primary coverages a series of interpretative coverages were developed and included solid geology, metamorphic zones, tectonic subdivisions, and interpretative subdivision of the geological polygons based on geological attributes such as relative age, sedimentary package, dominant lithology, metallogenically significant minerals (carbonate, feldspar, fluorite, graphite, hematite, magnetite, muscovite, sulphide) and geochronology. A series of whole rock geochemical maps were constructed by averaging the value for each individual element within a specific polygon. Various integrations of these data layers within the GIS provided new insights into the regional controls on the distribution of mineral deposits (for example, in the area surrounding the Williams Batholith, graphite, magnetite and sulphide-bearing rocks host most of the Cu-Au deposits: carbonate-rich sediments host few).

The data was released both as a digital package and also as a hard copy metallogenic atlas. In view of the favourable reaction from industry to the Mount Isa GIS project, a preliminary proposal was put to AMIRA in April 1993 to seek additional company funding to accelerate the development of these regional GIS packages to other Precambrian provinces.

Release of the Mount Isa 1:500 000 Metallogenic Map

Release of the Mount Isa and environs mineral deposit database in both digital and hard copy format.

Research completed on the timing and structural controls on base-metal mineralisation in the McArthur Basin (MIM/AGSO Collaborative Research Project).

Preliminary results have confirmed a correlation between mine and district scale hydrothermal alteration processes related to Mount Isa Cu mineralisation.

Evaluation of the Palaeoproterozoic polar wander path concluded that palaeomagnetism offers a new tool to delineate the ages of major regional alteration and hydrothermal events in the Pine Creek, McArthur, Mount Isa areas, particularly those known to be associated with mineralisation.

Data on lead-lead model ages was compiled, and new samples for further lead-lead work were targeted.

Release of the Proterozoic OZCHRON database.

A suite of granites, sediments and felsic volcanics were collected from the Eastern Fold Belt, Mount Isa Inlier for geochronological studies.

Goals for 1993/1994

In collaboration with the NTGS, complete a GIS at 1:500 000 scale on the Pine Creek

Inlier (including Litchfield Block) by June 1994. Other GIS projects will be dependent on the success of the AMIRA proposal.

Complete a study of correlation between mine and district scale hydrothermal alteration processes related to Mount Isa Cu mineralisation (by June 1994).

Complete a study of the regional controls on Cu and Au mineralisation in the area surrounding the Williams and Naraku Batholith, Mount Isa Inlier (by March, 1994).

Undertake research on the chemical controls on base-metal mineralisation in the McArthur Basin (MIM/AGSO Collaborative Research Project).

Participate in CODES/AMIRA/ARC research project on Proterozoic base metal mineralisation (on going).

Participate in ANU/AMIRA/ARC research proposal on K-Ar and Ar-Ar dating of late alteration events in the Mount Isa Inlier (on going).

Reinterpret lead-model ages, in conjunction with samarium- neodymium and uranium-lead isotopic data, from sequences hosting Proterozoic stratiform base-metal deposits: evaluation of data available on a continent-wide basis to facilitate stratigraphic correlation of sequences hosting stratabound massive sulphides (in collaboration with CSIRO/industry) — to be completed by June 1994.

Calculate, finalise and enter all completed U-Pb zircon analytical data from the Mount Isa, Davenport, Pine Creek, West Kimberley and Granites–Tanami regions in preparation for Proterozoic release 2.0 of OZCHRON.

Continue a program of uranium-lead zircon dating of granites and sedimentary units from the Eastern Fold Belt of the Mount Isa Inlier.

Customers

Minerals industry

Government

University geoscience departments

Cooperating agencies

Northern Territory Geological Survey

Geological Survey of Queensland

Geological Survey of Western Australia

South Australian Department of Mines and Energy

Mount Isa Mines

CSIRO, Division of Exploration and Mining

Centre for Ore Deposit and Exploration Studies (CODES), University of Tasmania

Project 211.09 North Queensland (NGMA Project)

Project managers	John Bain	(AGSO)	06 249 9282
	John Draper	(GSQ)	07 237 1413
Program responsibility	Minerals and Land Use		
Timeframe	1990–1996		

Objectives

Provide a sound geoscientific knowledge base for the development of land use management options for the North Queensland region.

Provide a better understanding of the metallogeny and the mineral potential of the region.

Relevance

North Queensland has important mineral resources, including world-class bauxite deposits at Weipa, gold, base-metals, tin, tungsten, limestone, and silica sand. It also has areas of world heritage value. The region is subject to land use demands that range from preservation as a wilderness area and Aboriginal lands to grazing, mining, and tourism. Resolution of these potentially conflicting demands requires sound information on the land, including resource potential and conservation values.

The North Queensland Project is designed to provide geoscientific information through the regional synthesis of data acquired by AGSO and GSQ in the southern parts of the project

area over the last 20 years, and the compilation of new maps and data sets using modern concepts and techniques for Cape York Peninsula where the existing knowledge base is deficient. The project is being undertaken under the NGMA jointly by AGSO and GSQ. Results from the project will also provide input to the joint Commonwealth and State funded Cape York Peninsula Land Use Strategy (CYPLUS).

Expected outcome

A better understanding of regional mineral resource potential.

Activities

Review current databases containing geoscience information for the project area, assess future data handling requirements and develop appropriate new databases where necessary.

Review exploration company reports in GSQ Library for exploration history of Cape York Peninsula and enter relevant mineral occurrence information into MINLOC and MINOCC databases.

Image processing and interpretation of new colour aerial photographs, LANDSAT TM, and 400 m line spaced airborne radiometric and magnetic data.

Field check interpreted image maps, collect geological, geophysical and geochemical data and samples, enter information into computer databases, and prepare final maps.

Develop spatial data sets in ARC/INFO GIS for integration, interpretation, and new special map generation.

Elucidate relationships between mineral deposit types and geochemical and structural characteristics, ages, modes of emplacement, and petrogenesis of associated Palaeozoic igneous rocks.

Develop quantitative models of landscape evolution for the region.

Carry out an analysis of the mineral potential of the region using a multidisciplinary team applying standard USGS techniques of evaluating the regional data sets for the presence or absence of diagnostic and/or permissive criteria for a range of defined mineral deposit types.

Prepare a comprehensive regional geological synthesis, including tectonic and metallogenic history.

Prepare interpretive reports, research papers and provide professional advice.

Expected products

A modern comprehensive geoscientific knowledge base for North Queensland in terms of maps and data sets and significant new information on mineral resources and the physical environment.

Environmental data for land management and for State and National resource and heritage inventories.

Integrated, computer-based and multidisciplinary geoscientific data sets for North Queensland comprising new 1:250 000 scale maps for Ebagoola, Hann River, Walsh, and Red River (hard copy and GIS) and commentaries; a thematic atlas of regional maps (geology, geophysics, stream sediment geochemistry, regolith terrains, morpho-tectonics, metallogeny, and resource potential) at appropriate scales for the entire region (e.g. 1:1 million).

Improved models for regolith development and landscape evolution.

Revised geological maps at 1:1 million, 1:250 000 and 1:100 000.

Early release of field compilation sheets for geological map data at field mapping scale (e.g. 1:50 000 basement, 1:100 000 regolith).

Mineral occurrence maps at 1:250 000 and 1:100 000.

Computer databases containing geological, geophysical, geochemical, geochronological, and mineral resource data (e.g. ROCKCHEM, STREAMCHEM, OZMIN, OZCHRON, RTMAP, MINLOC, MINOCC, REGMAP).

A GIS containing all available digital geoscience information for the project area.

Descriptive and interpretive reports and specialist research papers to accompany maps and data releases.

Highlights for 1992/93

Release of full colour Preliminary Editions of the Ebagoola 1:250 000 scale basement geology and regolith landforms maps, together with a commentary and nine associated data

Records. Both maps are innovative prototypes of a new generation of 1:250 000 scale maps to come from NGMA mapping projects. The regolith map won an industry computer cartographic prize, and the total package of maps and reports was produced in record time — 12 months from completion of fieldwork.

Transfer of all 2 500 Ebagoola field observation data records, initially entered into the Qld REGMAP system to ORACLE databases for linkage with the image and vector GIS datasets.

Confirmation by Sm-Nd & U-Pb isotopic data of aeromagnetics-based predictions that the Permo–Carboniferous North Queensland Volcanic and Plutonic Province extends westwards to the Gulf of Carpentaria overprinting the northern part of the Mount Isa Orogen.

Recognition of the value of gamma ray spectrometric and satellite imagery in discriminating soils, showing areas of geomorphic activity, and indicating the relative degree of weathering for regolith landform mapping. The gamma ray spectrometric imagery was also invaluable in subdividing the granitoids.

Completion of pre-field mapping of Hann River, Walsh and Red River by interpretation of the geophysical data, satellite imagery and air photographs.

Release in digital format of new multi-element (40 elements) stream sediment geochemical data for the Ebagoola 1:250 000 Sheet which indicate areas of known and potential mineralisation.

Completion of a stream sediment geochemical survey of most of the basement areas of Red River 1:250 000 sheet area and two thirds of the 21 000 chemical analyses (XRF).

Integration of regional oxygen isotope data and stream sediment geochemistry has highlighted an under-explored area with epithermal gold potential in the Pascoe River–Temple Bay area of the northern Coen Inlier.

Goals for 1993/94

Carry out fieldwork associated with the mapping of Hann River, Walsh, and Red River 1:250 000 basement geology and regolith landform maps, and Mossman, Atherton, Cairns, Innisfail, Galbraith and Normanton 1:250 000 regolith landform maps (June to September).

Carry out stream sediment geochemical survey of the basement and adjacent areas of the Hann River, Walsh, and northernmost part of Red River 1:250 000 sheets (June to September) and prepare data for release.

Prepare preliminary edition geological and regolith terrain maps and commentaries of the Hann River, Walsh, and Red River 1:250 000 sheet areas, scheduled for completion & issue in 1994/95.

Complete delivery of geological and regolith information to CYPLUS as contracted.

Prepare associated data Records scheduled for completion and issue in 1994/95.

Commence data compilation, analysis and interpretation phase of the regional synthesis aspect of the north Queensland project scheduled for completion in 1995/96 (some chapters drafted, maps compiled).

Issue coloured brochure describing the geological features of the Iron Range National Park.

Prepare final editions of Ebagoola 1:250 000 Geology and Regolith Landforms maps and commentaries for publication.

Prepare the North Queensland Igneous Rocks GIS and associated atlas for release.

Customers

Commonwealth, Queensland and Local Government departments and organisations involved in Cape York Peninsula Land Use Strategy (CYPLUS)

Minerals industry

University geoscience departments

The community

Cooperating agencies

Geological Survey of Queensland, Department of Minerals and Energy

Canberra Institute of Technology (10 students, 3 months)

United States Geological Survey (a regolith specialist, 2–3 months)

National Resource Information Centre, BRS, DPIE (as part of CYPLUS)

Project 211.10 Eastern Goldfields (NGMA Project)

Project managers	Alastair Stewart	(AGSO)	06 249 9666
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Program responsibility	Mineral and Land Use		
Timeframe	1987/88–1995/6		

Objective

Provide a better understanding of the metallogeny of the Province.

Relevance

The Eastern Goldfields Province of the WA Yilgarn Craton has long been and remains one of Australia's most important mineral provinces. The region hosts a wide variety of deposit types, and is Australia's main source of gold and nickel. A regional overview of the area will provide an important contribution to the national resource knowledge base.

The project has a high priority established by the Chief Government Geologists Conference under the NGMA. The Eastern Goldfields Province continues to be one of the most actively explored areas of Australia.

Expected outcomes

More effective exploration in the Eastern Goldfields.

An improved understanding of the Yilgarn regolith environment.

Activities

Determine the major structural elements of the Eastern Goldfields, including crustal structure.

Develop new predictive models for the tectonic evolution of the Eastern Goldfields and environs by determining the major structural and stratigraphic elements of the province and establishing their continuity at depth in the crust and beneath surface cover.

Determine the local and regional structural and chemical controls on gold mineralisation.

Establish the major regolith components, their inter-relationships and landscape evolutionary history.

Review and compile existing geological information

Interpret airborne geophysical and remotely sensed data, airphotos, seismic information and gravity data.

Identify field areas for detailed studies and carry out appropriate geological mapping.

Collation of geoscience data into integrated digital geoscientific spatial databases.

Fluid inclusion and geochemical studies of selected mineralised areas to better define ore-forming processes.

Regional whole-rock geochemical analyses and synthesis to constrain models of tectonic and geochemical evolution of the region.

Regolith mapping and interpretation of landscape evolutionary history.

Expected products

A geoscientific database to facilitate reliable resource assessment.

A geoscientific database to facilitate decisions on resource development strategies.

Ten updated 1:250 000 geological maps with accompanying geophysical and metallogenic maps where appropriate.

Four summary regolith maps at 1:250 000 scale with map commentaries.

Twenty four 1:100 000 regolith compilation sheets.

New 1:100 000 geoscience thematic maps over approximately 24 1:100 000 map areas.

Appropriate geoscientific maps and images over selected 1:250 000 map areas.

Digital geological information systems, incorporating geological, geophysical, geochemical, mineral deposit and regolith datasets, with appropriate analysis of those sets as resources permit.

Seismic reflection profiles and interpreted crustal cross sections.

Updated process models of gold ore deposition, particularly in relation to Mount Charlotte deposit.

Aeromagnetic and gravity interpretation maps and models as appropriate.

Reports and specialist papers.

Highlights for 1992/93

Production of three complete 1:100 000 digital geological maps for the Eastern Goldfields integrated digital spatial database.

Publication of Kalgoorlie and Esperance 1:1 million geophysical interpretation maps.

Completion of interpretation of geophysical datasets over Leonora and Edjudina 1:250 000 map areas.

Completion of regolith mapping of the Menzies, Edjudina, Leonora and Laverton 1:250 000 sheet areas and the recognition of the importance of ancient fan systems in the regolith. Work is continuing in cooperation with the Australian Mineral Exploration Technologies CRC.

Completion of Menzies 1:250 000 regolith GIS coverage.

First release from ROCKCHEM of 2274 whole-rock analyses from the Yilgarn Craton, and another 2700 collated.

Completion of geological and regolith mapping of Leonora and Edjudina 1:250 000 map sheets.

Completion of reconnaissance whole-rock geochemical sampling and analyses of granitic rocks of Leonora and Laverton 1:250 000 sheet areas

Release of Minerie 1:100 000 geological map (June).

Completion of report on reconnaissance fluid inclusion study of high-temperature deposits in the Kalgoorlie–Menzies area.

Release of the regional seismic line sections and presentation at industry workshops in Perth and Kalgoorlie.

Discovery and mapping of gneiss terranes and publication of models for their tectonic evolution.

Publication of Kalgoorlie Regolith Terrane Map Commentary and unit data descriptions.

Release of AMIRA/CSIRO discussion paper: "Regolith landform mapping in the Yilgarn Craton, WA — towards a standardised approach".

Goals for 1993/94

Complete geological mapping of the Nambi, Mount Varden (Erlistoun) and Burtville 1:100 000 sheets — December 1993.

Complete compilation of Leonora 1:250 000 sheet — August 1993.

Complete digital map databases for Laverton, Nambi, Burtville and Mount Varden 1:100 000 sheet areas — April 1994.

Complete data records for Leonora, Ballard, Mount Mason and Yerilla 1:100 000 sheets — January 1994.

Complete first draft of data record for Minerie 1:100 000 sheet — June 1994

Complete compilation of Edjudina 1:250 000 sheet area — June 1994.

Complete revision of Yerilla 1:100 000 compilation for publication — September 1993

Prepare a final report of the results of the regional seismic reflection profile — June 1994.

Complete interpretation of the Wiluna 1:1 million regional airborne geophysical data — June 1994.

Complete magnetic interpretation layers for Sir Samuel 1:250 000 sheet area — April 1994.

Complete regolith landform mapping of Kalgoorlie or Kurnalpi 1:250 000 sheet area - October 1993.

Complete GIS layers and preliminary colour maps of Leonora, Laverton and Edjudina regolith terrain — March 1994

Assist with planning for 4 km station spacing gravity survey of Sir Samuel 1:250 000 sheets area.

Interpret and report on whole rock granite geochemical data from the Leonora–Laverton areas — December 1993

Finalise a design and produce a prototype GIS for the northern part of the Eastern Goldfields Province — September 1993.

Commence compilation of Laverton

1:250 000 sheet areas.

Continue mineral deposit, fluid inclusion and fluid chemistry studies of selected sites, including Sand King and Mount Charlotte.

Present papers and posters, run excursions, edit excursion guides and abstract volumes for Kalgoorlie 93, an AGSO–GSWA–UWA sponsored conference on the geology of the mapping accord areas in Kalgoorlie in September 1993.

Customers

Mineral exploration companies

Government organisations involved in land use, resource development and resource assessment activities.

Geological research community

Cooperating agencies

Geological Survey of Western Australia

Key Centre for Research and Teaching of Strategic Mineral Deposits, University of Western Australia.

CSIRO, Division of Exploration and Mining, Floreat Park and North Ryde

Project 211.11 Arnhem Land (NGMA Project)

Project manager	Ian Sweet	(AGSO)	06 249 9307
	Barry Pietsch	(NTGS)	089 895 214
Program responsibility	Minerals and Land Use		
Timeframe	1990–1996		

Objectives

Enhance our understanding of the geology of Arnhem Land, and develop a more comprehensive geoscientific knowledge base of the region as a contribution to the development of land use and natural resource strategies.

Relevance

Arnhem Land, a region larger than Tasmania, has two producing mines — Gove bauxite, and Groote Eylandt manganese. Several hundred kilometres to the south, the major McArthur zinc-lead-silver deposit, and several promising hydrocarbon shows, have been located in rocks the same age as those in Arnhem Land. Arnhem Land was systematically geologically mapped by BMR in 1962, but little work has been carried out there since. This project is being undertaken under the National Geoscience Mapping Accord jointly by AGSO and the NTGS.

The Aboriginal people of Arnhem Land were granted freehold title to their land in 1976. No exploration has been carried out in north-eastern Arnhem Land since then. Following extensive negotiations by the NTGS with the Northern Lands Council and local Aboriginal communities, access to the region was granted to AGSO and NTGS for the purpose of scientific study, to allow upgrading of the geoscientific knowledge base. This will assist governments and communities to make considered decisions, should issues of land use and resource development arise in the future.

Expected outcome

A better understanding of the geology and resource potential of Arnhem Land.

Activities

Develop a comprehensive understanding of the Palaeoproterozoic to Mesoproterozoic evolution of the Arnhem Land region.

Geological mapping and specialist geological studies including:

- Sedimentological studies (including measurement of stratigraphic sections and stratigraphic drilling, as appropriate) to document the sedimentary evolution of the region;
- Petrological and geochemical studies to document the igneous and metamorphic evolution of the region;
- Structural studies to document the structural and tectonic evolution of the region.

Image processing and interpretation of aeromagnetic and radiometric data, and integration with geology.

Geochronology of selected rock units to facilitate regional correlation of major rock units and events, and to enhance our understanding of the geological evolution of the region.

Regolith Landform mapping, and specialist studies on aspects of regolith and geomorphology, to determine the nature and distribution of regolith types, weathering history, and landscape evolution.

Capture of primary data in digital format.

Expected products

A geoscientific database to facilitate informed land use decisions.

New 1:250 000 geological maps of Arnhem Bay–Gove, Blue Mud Bay–Port Langdon, Katherine, Milingimbi, Mount Marumba, Roper River–Cape Beatrice, Urapunga, and part of Mount Evelyn.

Regolith Landform maps, also at 1:250 000 scale, of the map sheets above.

Geophysical interpretation maps at appropriate scales of the above areas.

Databases of geological, geochronological, regolith, and geochemical data, based on a regional sampling program.

Reports and papers on various aspects of the regional geology.

GIS packages incorporating the geological, regolith, field observation, sample, stream sediment and other geochemical, geophysical, and geochronological data sets as appropriate.

Highlights for 1992/93

Release of Record 1992/55, *The geology of Arnhem Land, Northern Territory*, containing updated interpretations based on previously unpublished data collected during the 1962 mapping of the region, and thus providing an appropriate starting point on which to build new results.

Continued access to most of northeastern Arnhem Land during the 1992 field season was granted as a result of sustained effort by NTGS in negotiating and liaising with the Northern Lands Council and traditional owners. Geological mapping and sampling was completed in those parts of the Arnhem Bay/Gove and Blue Mud Bay/Port Langdon sheets to which continuing access was granted.

Laboratory studies of samples collected during mapping of the Waterhouse Region (Waterhouse and Mataranka 1:100 000 sheet areas) were completed.

Integration of three geological map data sets was completed for incorporation into the second edition Katherine 1:250 000 geological sheet. Draft chapters were prepared for inclusion in the Explanatory Notes by the NTGS.

Mapping and U-Pb geochronology using SHRIMP I has permitted significant revision of the stratigraphic framework of northeastern Arnhem Land:

- SHRIMP U-Pb zircon dating of basement rocks in the Bradshaw Complex has confirmed an age of 1860–1870 Ma, similar to the Nimbuwah Complex of western Arnhem Land.
- Inliers of Spencer Creek and Fagan Volcanics and the Giddy and Caledon Granites of eastern Arnhem Land, hitherto thought to be basement to the McArthur Basin sequence, and the upper Katherine River Group of western Arnhem Land, are all around 1700 Ma in age and are equated with volcanics and sub-volcanic intrusives at the top of the Tawallah Group in the southern McArthur Basin.
- The Ritarango beds, which underlie the Fagan Volcanics, may be Tawallah Group equivalents.
- The Parsons Range Group, which overlies the Fagan Volcanics, cannot be equivalent to Tawallah Group in the southern McArthur Basin, but may represent the earliest phase of rift-related McArthur Group sedimentation.
- Tuffs in the uppermost McArthur Group, the Bath Range Formation, are about 1600 Ma old, significantly younger than the lithostratigraphically similar 1640 Ma upper McArthur Group in the southern part of the basin.
- Nathan Group equivalents have been identified throughout the region.
- The changes in our understanding of the geological evolution of the region result in a downgrading of the uranium potential of

the Ritarango beds-Fagan Volcanics, since they are no longer regarded as basement and Pine Creek Geosyncline equivalents. The base metal potential of the McArthur and Nathan Groups cannot yet be fully assessed, but are still regarded as high, as the sequence has similar tectonic and sedimentologic characteristics as the southern McArthur Basin.

Regolith Landform mapping commenced in the Arnhem Bay-Gove and Blue Mud Bay-Port Langdon 1:250 000 sheet areas.

Goals for 1993/94

Complete Regolith Landform mapping of Arnhem Bay–Gove and Blue Mud Bay–Port Langdon 1:250 000 sheets, and prepare a draft report and preliminary maps at 1:250 000 scale of the Regolith Landform units.

Complete photoscale geological compilation sheets and capture the data in digital form. Prepare draft plots of the Arnhem Bay–Gove and Blue Mud Bay–Port Langdon 1:250 000 sheets.

Release a preliminary geological map of the Arnhem Bay–Gove sheet, and take Blue Mud Bay-Port Langdon preliminary map to final stages of preparation.

Complete interpretation of aeromagnetic and radiometric data from Arnhem Bay–Gove and Blue Mud Bay–Port Langdon, and prepare geophysical interpretation maps as elements of GIS packages.

Prepare and interpret TM and geophysics images of the Milingimbi 1:250 000 sheet in advance of 1994 field work.

Continue laboratory studies, and refine databases of mineral deposits, rock geochemical, regolith, and geochronological data.

Commence development of GIS packages integrating geological, geophysical, and regolith map data with point data from field observation, geochemical and geochronological databases.

Prepare preliminary reports as appropriate.

Customers

Commonwealth and NT government departments

Mineral exploration companies

University geoscience departments

Aboriginal groups

Cooperating agencies

Northern Territory Geological Survey

Canberra University

Project 211.12 Kimberley–Arunta (NGMA Project)

Project managers	David Blake	(AGSO)	06 249 9667
	David Young	(NTGS)	089 515 662
	Tim Griffin	(GSWA)	09 222 3606
Program responsibility	Minerals and Land Use		
Timeframe	1990–1995		

Objectives

Develop a better understanding of the geology and mineral potential of the region.

Provide geological and mineral resource information necessary for land use decisions.

Relevance

The Kimberley–Arunta region is crucial for developing models for the tectonic evolution of northern and central Australia. Although highly prospective for metals and diamonds, the region has not been subjected to systematic geological mapping using modern concepts and techniques (existing maps are based on work done more than 20 years ago). This project is being undertaken under the National Geoscience Mapping Accord jointly by AGSO, GSWA and the NTGS.

The East Kimberley and The Granites-Tanami provinces in particular have been, and continue to be, high profile areas for mineral exploration companies. The region contains

operating mines at Argyle (diamonds), Bow River (alluvial diamonds), Tanami (gold) and The Granites (gold). The region is overlapped by parts of the Canning, Ord, Amadeus, Ngalia, Georgina, and Wiso sedimentary basins, which are prospective for hydrocarbons and base metals. The region includes aboriginal land and national parks, and has an increasing potential for tourism.

Expected outcomes

A better understanding of the geology, and hence of the mineral and hydrocarbon potential, of the region.

More effective mineral exploration in the region.

A comprehensive geoscientific database to facilitate land use decision making.

Activities

Determination of the nature, timing, and distribution of significant geological events in and between the East Kimberley, The Granites–Tanami, and western Arunta areas.

Determination of the nature of boundaries between major tectonic units.

Determination of the extent of prospective basement beneath thin cover.

Review and compilation of all existing geological information.

Detailed geological mapping (including specialist structural, geochemical, metamorphic and sedimentological studies) of well-exposed parts of the region.

Interpretation of existing regional and detailed geophysical data; acquisition and interpretation of new regional and detailed airborne aeromagnetic and gamma ray spectrometric data and gravity data.

U-Pb zircon, Sm-Nd, Rb-Sr, K-Ar and Ar-Ar geochronology to establish timing of igneous and metamorphic events.

Petrological and geochemical studies of key igneous rock-units.

Image processing and interpretation of remotely sensed data (satellite imagery) to assist geological mapping.

Studies of mineralisation styles and settings.

Compilation of geoscientific databases to form part of a GIS package.

Expected products

Digital and hard copy geological and geophysical maps at scales ranging from 1:25 000 to 1:1 million

Digital databases

GIS packages for 1:250 000 maps, where appropriate

Descriptive and interpretative reports.

Appraisal of mineral resource potential.

Appropriate scientific papers.

Highlights for 1992/93

Hermannsburg 1:250 000 geological sheet, 2nd edition map and explanatory notes completed to final edit stage.

New Sm/Nd isotopic data from Hermannsburg 1:250 000 Sheet area used to constrain crustal evolution models for the Arunta Block (paper in press).

Mount Doreen 1:250 000 sheet area: final report on the Vaughan 1:100 000 sheet area (AGSO Record 1993/28).

Gordon Downs and Dixon Range 1:250 000 sheet areas:

- successful completion of 1) major fieldwork in Ruby Plains, Halls Creek, Dixon, and McIntosh 1:100 000 sheet areas; digitising of compilations of Ruby Plains and Dixon maps; and 3) preliminary reports to accompany Ruby Plains and Halls Creek maps;
- completion of AGSO Record (1993/32) summarising available geoscientific information on Gordon Downs and Dixon Range 1:250 000 Sheets;
- identification of 3 major types of layered mafic and mafic-ultramafic intrusions with economic potential;
- establishment of correlations between rock units being mapped and airborne magnetic and spectrometric data, and also Landsat TM data, for the Dixon Range and northern half of Gordon Downs 1:250 000 sheet areas.

U-Pb zircon ion-probe dating of granite in SE Mount Ramsay 1:250 000 Sheet area at ~1790 Ma, which is younger than the Kimberley Group (older than 1800 Ma) and hence younger than granite and gabbro of the Lamboo Complex.

Commencement of 1993 field season in the

East Kimberley.

Goals for 1993/94

Complete geological fieldwork and ground-truthing of airborne geophysical and remotely sensed (satellite) data in the Gordon Downs and Dixon Range 1:250 000 sheet areas, with emphasis on determining relationships between key rock units and between tectonic events (by September 1993).

Complete digital compilation of the second edition (new generation) Gordon Downs 1:250 000 geological map and the accompanying explanatory notes (May 1994).

Complete AGSO commitment to the digital compilations of the second edition Dixon Range 1:250 000 geological map, first edition McIntosh and Turkey Creek 1:100 000 geological maps, and accompanying reports being prepared by GSWA (by May 1994).

Release completed digital 1:100 000 geological maps and accompanying reports for Halls Creek and Ruby Plains by March 1994 and for Dixon by June 1994.

Prepare preliminary report on the geology and geochemistry of the mafic-ultramafic intrusions in the Dixon Range 1:250 000 sheet (by June 1994).

Prepare cross-sections using gravity traverse data being acquired June–July 1993 to constrain interpretations on the nature of the boundaries between the major tectonic units of the region — Kimberley Basin, Halls Creek Mobile Zone, The Granites–Tanami Block, and Arunta Block (by March 1994).

Prepare preliminary 1:1 000 000 interpretative maps of airborne magnetic and spectrometric data for Tanami, The Granites, Highland Rocks and Mount Theo 1:250 000 sheets when full data set is acquired and gridded by GOMP (by June 1994).

Improve the geochronological data base for the East Kimberley to constrain interpretations of the geological history — obtain up to 10 U-Pb zircon ages for key volcanic and intrusive rock units in Gordon Downs and Dixon Range 1:250 000 sheet areas and for comparable units in Lennard River 1:250 000 sheet area (by June 1994) for entry into OZCHRON.

Integrate about 20 new Sm/Nd and Pb isotope data on key rock units with geochemical, geochronological and field information for draft report on models of crustal evolution and magma genesis in the East Kimberley (by June 1994).

Prepare preliminary 1:500 000 map of the Arunta Block to show distribution of granite types of different economic potential (by June 1994)

Customers

Mineral exploration companies

Petroleum exploration companies

Geoscience consultants

Commonwealth, WA and NT governments

CSIRO (Division of Soils)

Tourist industry (Macdonnell Ranges in Hermannsburg 1:250 000 Sheet, Bungle Bungles — Purnapurla — Nat Park in Dixon Range 1:250 000 Sheet)

Environmental agencies

Traditional land owners — Yuendumu area, Hermannsburg area, Halls Creek area

Educational institutions

Cooperating agencies

Geological Survey of Western Australia (GSWA) — NGMA partner

Northern Territory Geological Survey (NTGS) — NGMA partner

Northern Territory Power and Water Resources — data on water bores

CSIRO (Divisions of Wildlife & Ecology and Exploration and Mining)

Monash University — 2 MSc students; metamorphic, structural, and geophysical studies, East Kimberley

Australian National University

University of Tasmania (CODES) — MSc student; stratigraphic and mineral deposit studies, East Kimberley

University of Western Australia

James Cook University of North Queensland — Ph.D student; structural and metamorphic studies, East Kimberley

Edinburgh University

University of Minnesota

University of Newcastle

Canberra Institute of Technology

Project 211.13 Lachlan–Kanmantoo Fold Belts (NGMA Project)

Project managers	Doone Wyborn	(AGSO)	06 249 9386
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	Tony Belperio	(SADME)	08 274 7616
Program responsibility	Minerals and Land Use		
Timeframe	1990–1996		

Objectives

Provide governments, industry, and the community with essential information for sound decision-making on resource, land use and environmental issues.

Provide a better understanding of metallogeny and mineral potential of the region as a basis for exploration and development.

Relevance

The Lachlan-Kanmantoo Fold Belt region has had a long history of mineral production including gold, copper, lead, zinc, silver, and tin. The geoscientific knowledge base of this most prospective but often poorly known terrain needs substantial revision to incorporate geological and geophysical data which has become available in the last two decades. The project is being undertaken under the National Geoscience Mapping Accord jointly by AGSO, NSWGS, GSV, and DME, SA.

The project will emphasise relations of rock and structural associations with known ore deposits such as the Ordovician magmatic rocks in NSW (copper, gold, platinum), Gilmore Fault Zone (gold), Sn granites of the Wagga Metamorphic Belt (tin, tungsten, bismuth), Bendigo Slate Belt (gold), Victorian Greenstone Belt (gold, copper, lead, zinc), and volcanic or carbonate associated mineralisation in the Kanmantoo Fold Belt (copper-lead-zinc massive sulphide deposits).

Expected outcomes

New geoscientific maps and data for improved decision-making on resource, land use and environmental issues.

More effective mineral exploration.

Activities

Determine the geologic evolution of the Lachlan and Kanmantoo Fold Belts.

Provide a new generation of digital geological data on the Kanmantoo,and especially the Lachlan Fold Belt, supported by tectonic, metallogenic and geomorphic/regolith interpretations based on the new data. Geological mapping of the most prospective parts of the fold belts using new technologies to produce 1:100 000 and 1:250 000 scale maps and other map and digital products.

Acquisition of new low-level aeromagnetic and associated geophysical data combined with application and interpretation of modern airborne and satellite remote sensing techniques including image processing and spatial analysis (GIS).

Petrological and geochemical studies of important rock units.

Geochronological studies of key rock units.

Regolith terrain mapping to produce 1:250 000 maps.

Expected products

Digital magnetic, radiometric, geological, regolith and thematic maps at appropriate scales.

Integrated databases of geochemical, structural, petrographic, mineral deposit and regolith information. Descriptive and interpretive reports, review documents and specialist papers.

New editions of 1:100 000 and 1:250 000 scale geological and regolith maps to be published in collaboration with the State Surveys. Map sheets (1:250 000) to be covered are

Bathurst, Forbes, Dubbo, and Ballarat. Work will also be carried out on Cootamundra, Narromine, Wagga Wagga, Bendigo, St Arnaud, Pinaroo, Adelaide, Barker and Kingscote sheet areas.

A GIS of the granite plutons of the Lachlan Fold Belt, with associated digital database of 3000 geochemical analyses of the plutons (geochemical data supplied by ANU).

Highlights for 1992/93

Completion of digital maps ready for publication of Blayney and Oberon 1:100 000 sheets. The project has provided a sound scientific basis for the Cu/Au mineral potential of Ordovician volcano-plutonic complexes. As a result, exploration effort has intensified, for example one large mining company has committed to expend over $3 million on exploration over a single complex.

The new mapping on the Oberon sheet has increased the area of Ordovician Rockley Volcanics which are prospective for Au, and on the Blayney 1:100 000 sheet two buried complexes have been recognised.

Geochemical sampling has demonstrated high (5ppb) primary Au contents of Ordovician volcanics, and a loss of Au from rocks with increasing metamorphic grade.

The regolith map of Bathurst is nearing completion and has generated interest by groups in environmental, exploration and agricultural fields.

Commenced mapping on the Ballarat 1:250 000 sheet (with GSV) where an early result is the recognition of more extensive greenstone belts than previously believed.

Mapping continued in the Kanmantoo Trough, two deep stratigraphic drillholes were drilled on northern Kangaroo Island, and seismic work was undertaken in Backstairs Passage (DME, SA).

Goals for 1993/94

Release of digital geological maps and accompanying point databases of the Blayney and Oberon 1:100 000 sheets; and for incorporation into the new edition of the Bathurst 1:250 000 — July 1993.

Integrate results of NSWGS and AGSO geological mapping on Bathurst 1:250 000 sheet.

Prepare, with NSWGS, final edition ready for printing of Bathurst 1:250 000 geological sheet.

Complete Records on the geology of Blayney and Oberon 1:100 000 sheets — July 1993.

Complete digital regolith map of Bathurst at 1:250 000 scale — January 1994

Complete research paper on the geology, age and isotopic systematics of the Forest Reefs volcano/plutonic complex — March 1994.

Complete research paper on the origin and economic significance of zoned granite plutons — June 1994.

Complete digital geophysical interpretation maps of three 1:100 000 sheets on Dubbo — December 1993.

Complete regolith fieldwork on southern half of Dubbo 1:250 000 sheet — June 1994.

Complete contribution to mapping of Ballarat 1:250 000 sheets, and prepare digital geological map of the Willaura 1:100 000 sheet — June 1994.

Commence compilation of a digital map of the Ballarat 1:250 000 sheet.

Undertake preliminary dating (U-Pb method) of volcanics of the Staveley Greenstone Belt (February 1994).

Commence geological fieldwork on Dubbo 1:250 000 sheet.

Continue mapping in Kanmantoo Trough (DME, SA).

Organise field workshop (March) jointly with NSWGS to present results of Bathurst geological mapping.

Customers

Mineral exploration companies, particularly those active in the Lachlan Fold Belt

CSIRO

State government departments and organisations (land conservation, forestry, public works, road and rail transport)

Local government agencies

Environmental agencies and groups

Prospectors

Farmers

Developers

Geoscience departments at universities

Cooperating agencies

Department of Mineral Resources, NSW Geological Survey

Department of Energy and Minerals, Victoria

Department of Mines and Energy, SA

Geology Department, ANU

Geology Department, University of New South Wales

CSIRO Division of Exploration and Mining, CSIRO

Project 211.14 Musgrave Block (NGMA Project)

Project manager	Andrew Glikson	(AGSO)	06 249 9591
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	Nigel Duncan	(NTGS)	089 503 663
	Peter Dunn	(GSWA)	09 222 3333
Program responsibility	Minerals and Land Use Program		
Timeframe	1990–1995		

Objective

Provide a regional geological and surface deposits data framework as a basis for decisions concerning mineral resources, the environment and land management by government and by the aboriginal communities and aboriginal land councils.

Relevance

The Musgrave Block in central Australia is a major geological province (750X300 km) extending over three States and mostly occupied by aboriginal reserves managed by the Anangu-Pitjantjatjarra Council Inc. (S.A.), Ngaanyatjarra Council Inc. (W.A.) and Central Lands Council Inc. (N.T.). This geological province is one of the less well documented in Australia and its current knowledge is based on reconnaissance mapping in the 1960s and more detailed studies of small areas by universities. The project is being undertaken under the National Geoscience Mapping Accord jointly by AGSO, SADME, NTGS and GSWA.

The Musgrave Block has potential for base metal (chromium, nickel and vanadium) and platinum group metals. The province includes the Uluru National Park — of major tourist interest. The mapping program provides significant information for assessment of mineral and groundwater resources and for land use decisions by Government and Aboriginal communities.

Expected outcomes

Comprehensive documentation of the geology and resources of the Musgrave Block.

New geoscientific maps and databases for improved decision making by government authorities and aboriginal land councils on resources, land use and environmental issues.

Development of scientific insights into the crustal structure and evolution of this important part of central Australia.

Activities

Conduct multidisciplinary geological mapping of the western Musgrave Block and outlying areas combining field and remotely sensed geophysical and multispectral data for the western part of the Musgrave Block (AGSO: Cooper and Scott 1:250 000 sheets).

Document the Quaternary surface deposits of the Western Musgrave Block, on the basis of field correlations established in the western Musgrave and extrapolated to other parts of the province through application of remotely sensed imagery.

Prepare a series of 1:100 000 geological maps.

Document and provide an in-depth petrological, geochemical and isotopic/geochronological understanding of the layered basic/ultrabasic Giles Complex and associated granulite facies country rocks.

Define the tectonic history, pressure/temperature history and timing of key events inherent in the crustal evolution of the Western Musgrave Block.

Expected products

1:100 000 geological/environmental maps within the Petermann Ranges and Oodnadatta 1:1 million sheets.

Geoscientific data bases for the above terrains.

New geochemical and geochronological data.

Publications and reports accompanying the above maps and databases.

Highlights for 1992/93

Completion of field work in the Umbeara 1:100 000 sheet (with NTGS) aimed at documenting the basement geology southeast of the Amadeus Basin.

Compilation of the Tomkinson Ranges 1:100 000 environmental map and explanatory notes.

Release of a Record on the petrology of the Giles Complex — providing a comprehensive database and petrogenetic interpretation of the origin of this major mafic-ultramafic complex.

Release of a Record on the structure of the Hinckley Ranges and adjoining areas, providing an understanding of the tectonic evolution of host rocks of the Giles Complex.

Publication of several papers on the Tomkinson Ranges, including papers on the geochronology, petrology and tectonic evolution of this terrain, developing an insight into crustal evolution of the western Musgrave Block.

Compilation of data for the Bates, Blackstone, Holt, Finlayson and Umbeara 1:100 000 geological maps, extending the mapping of the Musgrave Block.

Production of Thematic Mapper and Geoscan images for the Tomkinson Ranges, including processing of ratio, log residual and principal component images, as a major tool for the documentation and tracing of hitherto unrecognised rock units and structures in the western Musgrave Block.

Development of a ROCKCHEM database for the western Musgrave Block, as a basis for petrogenetic and mineral potential analyses.

Goals for 1993/94

Complete compilations of the geology for production of Bates, Blackstone, Holt, Finlayson and Umbeara 1:100 000 maps.

Design a 1:50 000 map of the Giles Complex in the Tomkinson Ranges.

Complete explanatory notes for the Tomkinson Ranges, Bates and Umbeara, and 50% of Blackstone, Finlayson and Holt 1:100 000 sheets — completing the reporting of field work to date.

Complete report on LANDSAT TM processing and interpretation of the Tomkinson Ranges.

Customers

Commonwealth, Northern Territory, South Australia and Western Australia governments

Ngaanyatjarra Aboriginal Council Inc.

Anangu–Pitjantjatjarra Aboriginal Council Inc.

Mineral exploration companies

University geoscience departments

Cooperating agencies

Northern Territory Geological Survey

South Australia Department of Mines and Energy

Western Australia Geological Survey

University of Tasmania

University of Sydney

University of Melbourne

Geoscan Pty Ltd

Project 211.15 North Tasmania (NGMA Project)

Project manager	Lance Black	(AGSO)	06 249 3125
	Tony Brown	(Tas Dept Mines)	002 33 8333
Program responsibility	Minerals and Land Use Program		
Timeframe	1993–1996		

Objectives

Improve understanding of the structurally complex but economically prospective parts of northern and western Tasmania.

Relevance

The geology of northern and western Tasmania is complicated and stratigraphic and structural relationships are not well understood, especially at depth. The region is host to several operating mines and has a long history of production of tin, tungsten, copper, lead, zinc, silver, and iron ore. This project is being undertaken as the first phase of a larger project under the National Geoscience Mapping Accord jointly with AGSO and TDM.

Resolution of the geochronology and structural relationships will enable a better understanding of the geology and metallogeny of the region and provide basic information relevant to assessment of resource potential and the development of land use strategies.

Expected outcomes

A better understanding of the geology and mineral potential of northern Tasmania.

A better geoscientific database to facilitate informed land use decisions.

Activities

Determine the ages of formations of volcanic and intrusive rocks in the structurally complicated geology of northern and western Tasmania.

Define, using seismic reflection profiling, the subsurface geology of northern Tasmania.

Undertake U-Pb zircon dating of key volcanic and intrusive units in three stages focussing on:

- the late Precambrian to Cambrian successions
- the Mt Read Volcanics and possibly related successions
- Devonian–Carboniferous granitoids

Proposed — undertake a seismic reflection profiling program in northern Tasmania.

Expected products

Publications and reports presenting new geochronological data and tectonic/stratigraphic interpretations.

Geochronology database

Highlights for 1992/93

New project

Goals for 1993/94

Define agreed program for U-Pb zircon dating.

Undertake U-Pb zircon dating of key units in the poorly fossiliferous Late Precambrian to Cambrian successions.

Enter data into OZCHRON.

Commence draft of publication of results.

Customers

Mineral exploration companies

State government departments

University geoscience departments

Cooperating agencies

Tasmanian Department of Mines

221: GEOPHYSICAL MAPPING

Objective

Establish, maintain and make publicly available the best possible national coverage and database for gravity anomaly, magnetic anomaly and gamma-ray spectrometer surveys, as an important element to the geoscientific knowledge base of Australia, for the benefit of the Australian exploration community, for sustainable resources management, for resolving environmental issues, and for national and international geoscience.

Relevance

The products of Geophysical Mapping are a strategic element in advancing Australia's resource wealth and can make significant contributions to resolving environmental issues.

Regional geophysical data and maps are of fundamental importance in the development of a comprehensive understanding of the geology of a region. This regional information provides the framework necessary for both Government and industry to assess resource potential, determine land use and environmental management policies, and plan more detailed exploration activities. Geophysical data sets are crucial in establishing the geological framework of the continent, and in particular are essential for the National Geoscience Mapping Accord. Good quality geophysical maps and data sets therefore have an important role in a wide range of Australian geoscience issues.

From the standpoint of the national economy, geophysical techniques and the resulting data sets become an increasingly important part of the geoscientific information base required to attract mineral and petroleum capital to Australia. This is particularly true in the geological setting of Australia where the solid geology of large areas is obscured by surficial cover which limits the application of direct geological mapping, conventional photogeology and remote sensing methods. Geophysical information is vital to sustain Australia's international competitiveness in maintaining a successful exploration industry in competition with other countries.

Activities

Ensure that the information in the national database is in a readily accessible and useful format in the public domain, for those involved in mineral and petroleum exploration and resource assessment, including the National Geoscience Mapping Accord (NGMA), and all other users.

Expand the database through systematically conducting, contracting out and purchasing onshore and offshore airborne magnetic and gamma-ray spectrometer surveys and ground gravity surveys.

Prepare newly acquired data for publication and be responsible for their release into the public domain

Investigate and develop new methods for data acquisition, reduction, processing, enhancement, presentation, analysis and interpretation to improve the quality and usefulness of the data.

Develop an integrated magnetic anomaly map of Australia and near-shore regions.

Use magnetometer array studies to investigate transient and diurnal variations of the field over Australia as an aid to aeromagnetic exploration.

Stimulate and support full and effective use of geophysical data sets both within and external to AGSO.

Highlights for 1992/93

New airborne geophysical digital data made available for the equivalent of four 1:250 000 map sheets at 400 m line spacing for the NGMA (Hann River, northeast Walsh, Murloocoppie, Wintinna, Ballarat), the Wagga Wagga 1:100 000 map sheet (400 m line spacing), and 11 map sheet areas at reconnaissance spacing (Penola, Maurice, Paterson Range, Yarrie, Anketell, Sahara, Joanna Spring, Crossland, Dummer, Percival, Helena). Aeromagnetic data from the Bass Strait–Encounter Bay area were digitised, reprocessed and released in collaboration with the GSV, SADME and the Tasmanian Division of Mines; digitised and reprocessed data from the Gulf of

Carpentaria were released.

A record production of 191 900 line kilometres recorded by AGSO's aircraft in 1992/93. Airborne geophysical data acquired by AGSO's aircraft for the equivalent of three and a half 1:250 000 sheets at 400 m flight line spacing and less (Murloocoppie, Wintinna, Forbes, Sir Samuel), and the equivalent of two 1:250 000 sheet areas at reconnaissance spacing (Maurice, Penola).

Acquired by contract jointly with (and funding by) Queensland's Department of Minerals and Energy one and a twelfth 1:250 000 sheet areas (east Walsh, central and east Red River).

Added 50 000 stations to the National Gravity Database and released an update to the digital data set and new maps at 1:10 million and 1:25 million scales.

Published magnetic anomaly maps of Australia at 1:5 million, 1:10 million, and 1:25 million scales.

Released new generation gamma-ray spectrometric map of Dubbo.

Introduced efficiencies into processing and presentation of data by initiating a thorough re-engineering of data processing software to latest technical standards.

Completed an interpretation of new airborne geophysical data from the western Otway Basin to demonstrate the effectiveness of airborne geophysics in mapping in petroleum basins.

Goals for 1993/4

Acquire at least two and a half 1:250 000 sheet areas in support of the NGMA and acquire the equivalent of at least one 1:250 000 sheet area of airborne geophysical data under contract or by purchase. (The equivalent of 10 sheets a year at 400 m line spacing is required by the NGMA and other projects to meet mapping demands).

Fill two of the remaining three gaps in the reconnaissance aeromagnetic coverage of Australia (Kimberley district and Highland Rocks/Mount Theo).

Improve the fundamental gravity base network of Australia through station maintenance and re-measurement where possible.

Generate draft new digital terrain model and map of topography at 1:5 million scale for the whole of Australia in cooperation with AUSLIG.

Accelerate the process of release of digital data and paper maps at a low price through acquisition, development, and integration of new processing system software, and upgrading documentation of the entire acquisition and processing system.

Expand the national gravity database by acquiring and checking existing gravity data from State survey organisations and industry where possible, including an expansion and updating of the marine gravity database.

Complete an interpretation of the magnetic and gravity maps of Australia in collaboration with MLUP and OS&PG.

Improve the quality of aeromagnetic data by correcting for the effects of micro-pulsations, and gamma-ray data sets by analysis of spectra.

Obtain a 'standard' surface for fitting magnetic anomalies over the whole continent by using the two concentric long traverse circuits flown in 1990.

Produce an Aeromagnetic Risk Map of Australia, estimate diurnal corrections to the two concentric long traverse circuits of the country flown in 1990 and develop a long-to-intermediate wavelength total field model for the Australian region.

GEOPHYSICAL MAPPING

Component manager Ian Hone 06 249 9306

Component projects

221.01	National airborne magnetic and gamma-ray spectrometric surveys and databases
221.02	National gravity database
221.05	Australia-wide compilation and analysis of the magnetic field

Project 221.01 National airborne magnetic and gamma-ray spectrometric surveys and databases

Project manager	Ian Hone	06 249 9306
Program responsibility	Geophysical Observatories and Mapping	
Timeframe	1951–ongoing	

Objectives

Develop, expand, and maintain the national data base for airborne magnetic anomaly and gamma-ray spectrometer surveys through the acquisition of as much new survey data as possible. Release the data acquired into the public domain in a readily accessible and useful format for those involved in minerals and petroleum exploration, environmental and land use issues, resource assessment and management, and the NGMA.

Relevance

Regional airborne geophysical data are vital to advancing Australia's resource wealth and can make a large contribution to solving environmental issues.

Regional geophysical data and maps are of fundamental importance in the development of a comprehensive understanding of the geology of a region. This regional information provides the framework necessary for both Government and industry to assess resource potential, determine land use and environmental management policies, and plan more detailed exploration activities. Data collected form an integral part of establishing the geological framework of the continent, and in particular are essential for the NGMA. Good quality geophysical maps and data sets therefore have an important role in a wide range of Australian geoscience issues.

From the standpoint of the national economy, geophysical techniques and the resulting data sets become an increasingly important part of the geoscientific information base required to attract mineral and petroleum capital to Australia. This is particularly true in the geological setting of Australia where the solid geology of large areas is obscured by surficial cover which limits the application of direct geological mapping, conventional photogeology and remote sensing methods. Geophysical information is vital to sustain Australia's international competitiveness in maintaining a successful exploration industry in competition with other countries.

Expected outcomes

Steady upgrading of the quality of airborne survey coverage acquired and available for release to the user community, and greater coverage of the Australian continent.

An enhanced and more effective mineral and petroleum exploration industry in Australia, better management of our sustainable resources and improved environmental studies and management, for land use planning.

A better understanding of the geology of the Australian continent.

Activities

Conduct and contract-out systematic airborne geophysical surveys. Release the data acquired into the public domain in a readily accessible and useful format.

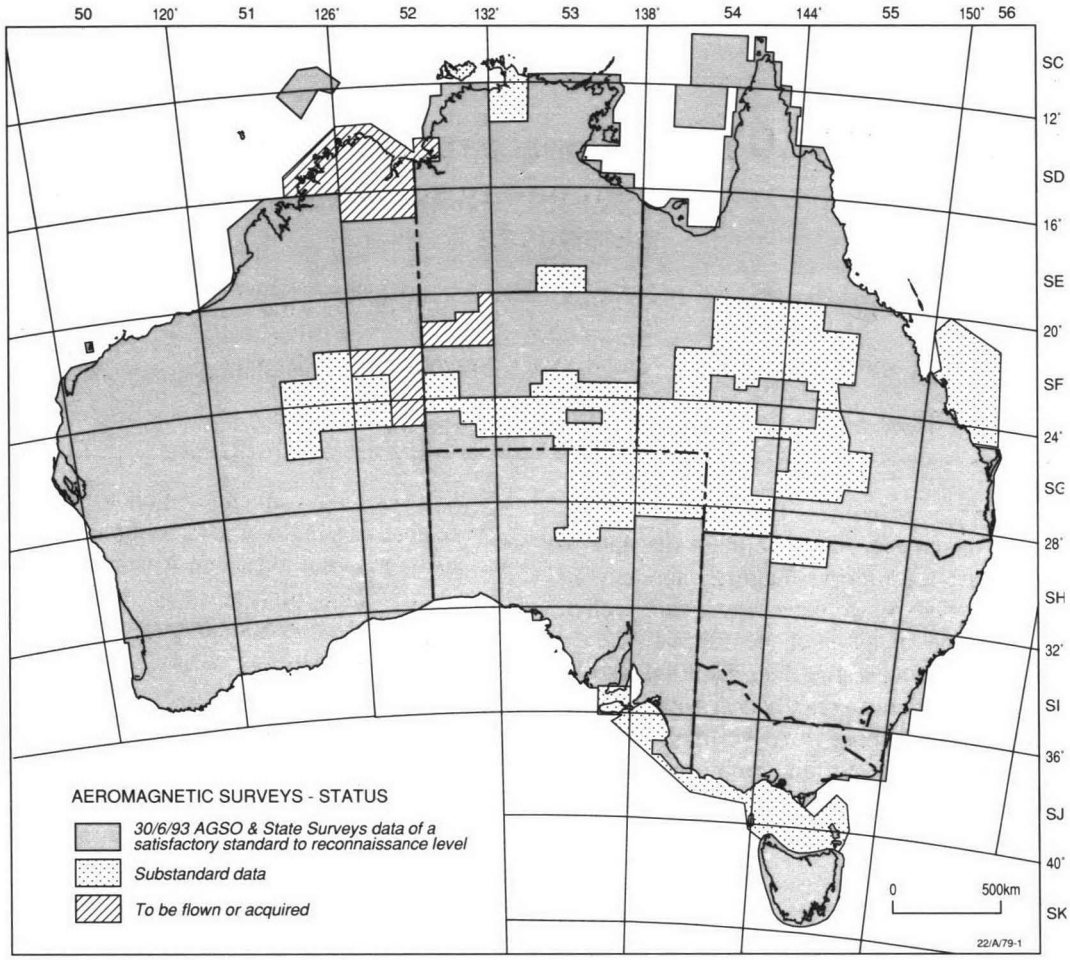
Develop and expand the national database for airborne magnetic anomaly and gamma-ray spectrometer surveys through acquisition of as much new survey data as possible.

Investigate, develop and implement improvements in acquisition, processing, enhancement, presentation, and analysis of airborne survey data.

Expected products

Digital data sets of airborne surveys on magnetic media.

Contour and profile maps of total magnetic intensity and gamma-ray abundances at scales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AEROMAGNETIC SURVEYS - STATUS
30/6/93 AGSO & State Surveys data of a satisfactory standard to reconnaissance level
Substandard data
To be flown or acquired
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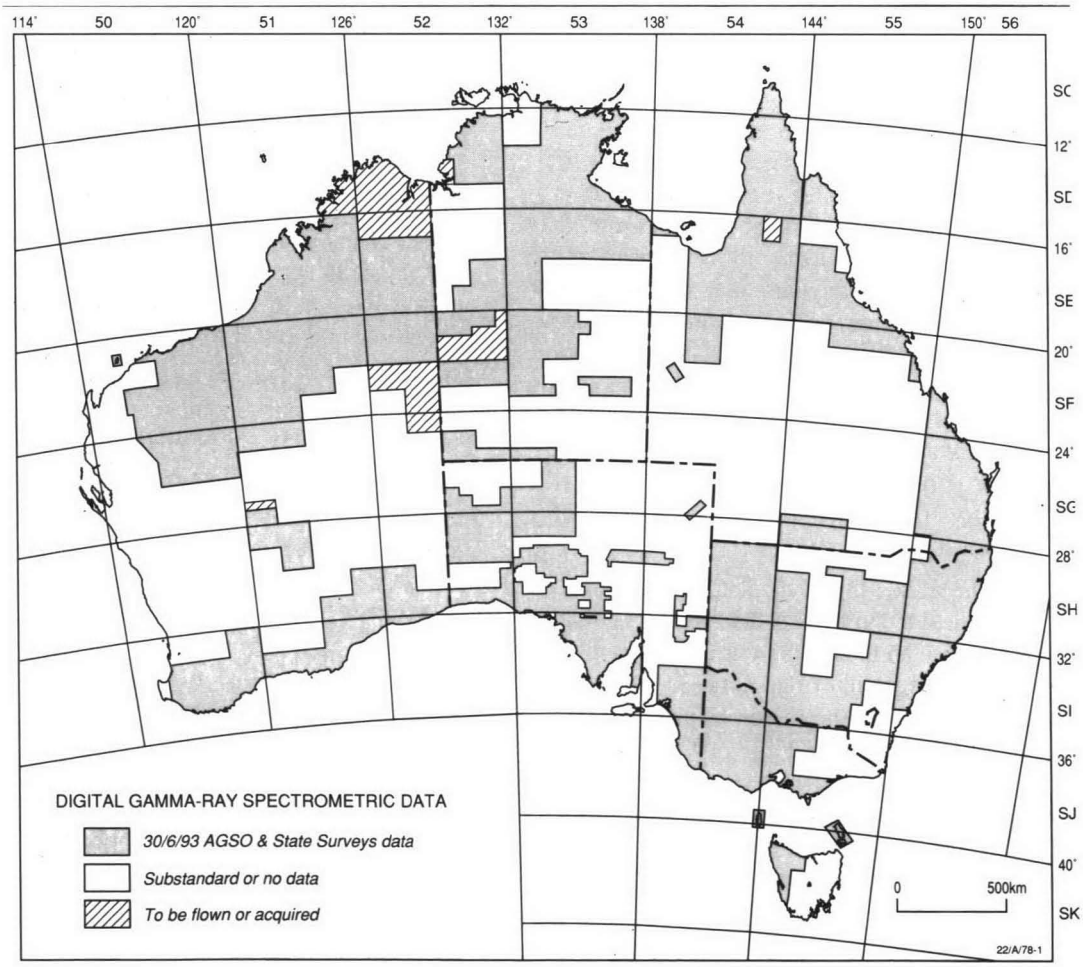
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DIGITAL GAMMA-RAY SPECTROMETRIC DATA
30/6/93 AGSO & State Surveys data
Substandard or no data
To be flown or acquired
0
500km
22/A/78-1

appropriate to flight-line spacing, organised on the basis of 1:250 000 scale sheet outlines.

New map and computer-compatible products based on enhancements of airborne survey data through image processing and geographic information system (GIS) techniques.

Digital terrain data sets.

Highlights for 1992/93

Data acquisition

Airborne geophysical surveys totalling 191 900 line km carried out over the following 1:250 000 sheet areas: Murloocoppie (central and west), Wintinna, Forbes, and Sir Samuel (≤400 m spacing), Maurice and Penola (1500 m spacing).

Contract airborne geophysical surveys comprising 54 100 line km over the Walsh (east) and Red River (east) 1: 250 000 sheet areas in conjunction with, and funded by, Queensland's Department of Minerals and Energy.

Data releases

Airborne geophysical digital data and maps released for the following 1:250 000 sheet areas:

Northern Territory — Victoria River Downs (1500 m spacing)

Queensland — Hann River, Walsh (Mount Mulgrave 1:100 000 Sheet area), Ebagoola (400 m spacing)

South Australia — Murloocoppie, Wintinna (400 m spacing); Penola, Maurice, Elliston, Kimba, Streaky Bay, Yardea, Lincoln (1500 m spacing)

Victoria — Ballarat, St Arnaud (400 m spacing)

New South Wales — Wagga (1:100 000 sheet area), Dubbo (400 m spacing)

Western Australia; Paterson Range, Sahara, Yarrie, Anketell (1500 m spring), Joanna Spring, Crossland, Dummer, Percival, Helena (2000 m spacing).

Digitised and reprocessed aeromagnetic data released for the following areas:

Bass Strait–Encounter Bay and Gulf of Carpentaria.

Total traverse distance of digital data released was 370 100 km.

General highlights

Efficiencies introduced to processing and presentation of airborne geophysical data by initiating re-engineering of data processing software.

Generation of a portfolio of images from airborne magnetic data of the western Otway Basin, and interpretation of airborne geophysical data from the western Otway Basin to demonstrate the effectiveness of airborne geophysics in mapping in petroleum basins.

Implementation of acquisition every second of 256 channel gamma-ray spectrometer data, and their use in processing.

Re-calibration of the aircraft gamma-ray spectrometer.

Study partly completed of the effects of micropulsations on high resolution, high sensitivity airborne magnetic data.

Continued involvement in the Cape York Peninsula Land Use Study.

Supervision of Aerodata's airborne survey for the Ministry of Petroleum and Minerals, Sultanate of Oman, and provision of advice to other foreign governments, including the United Arab Emirates and Iran.

Goals for 1993/94

The NGMA requires the acquisition of detailed airborne survey data (magnetic and gamma-ray spectrometric) at 400 m line spacing and 100 m flying height over ten 1:250 000 scale map sheet areas per year.

The priority for data acquisition is given below. With the 1992/93 resource base it is likely that data can only be acquired over the areas italicised.

- *Sir Samuel* — 400 m line spacing, AGSO's aircraft, NGMA Eastern Goldfields project
- *The Granites (south), Mount Solitaire (east and south), Lissadell* (part), *Highland Rocks, Mount Theo* — 400 m & 500 m line spacing, AGSO's aircraft, NGMA Kimberley–Arunta project
- *Bendigo* / Narromine, — 400 m line spacing, AGSO's aircraft, NGMA Lachlan–Kanmantoo project
- Wiluna — 400 m line spacing, contract, NGMA Eastern Goldfields project

- Billiluna, Mount Ramsay — 400 m line spacing, contract, NGMA Kimberley–Arunta project
- Two sheet areas for new NGMA projects.

Acquire reconnaissance airborne survey data (magnetic and gamma-ray) at 1500 m line spacing and 100 m height over the following 1:250 000 scale map sheets where surveys of this standard are not available in the national database:

- *Mount Elizabeth, Ashton, Drysdale, Londonderry (S)*, Camden Sound, Prince Regent, Montague Sound — reconnaissance survey (1500 m line spacing), purchase or AGSO's aircraft
- Wilson, Webb, Macdonald, Rawlinson (contract)

Release airborne geophysical data for the following areas:

- Lachlan–Kanmantoo project; Forbes 1:250 000 sheet, Dubbo magnetic pixel map (NSW), St Arnaud, Ballarat pixel maps (Vic)
- Eastern Goldfields project; Sir Samuel 1:250 000 sheet (WA)
- Kimberley-Arunta project; The Granites (south), Mount Solitaire (east and south), Highland Rocks, Mount Theo 1:250 000 sheets; and in cooperation with the NTGS,
- The Granites, Mount Solitaire pixel maps
- North Queensland project; Hann River, Ebagoola pixel maps
- Gawler Block project; Murloocoppie, Wintinna pixel maps (SA)

Develop and publish prototypes of new image presentations of aeromagnetic and gamma-ray spectrometer survey data.

Demonstration of significant improvements to quality of airborne geophysical data by correcting for the effects of micro-pulsations.

Conduct a feasibility study on the best way of producing a national gamma-ray spectrometer map grid.

Publish and report on a digital terrain model of the Wagga 1:100 000 Sheet area; prepare digital terrain models for Sir Samuel.

Publish index and database of AGSO's airborne surveys.

Increase production efficiency by acquisition, development and integration of new processing software and upgrading documentation of the entire processing system. The software is being re-engineered into a more open, object oriented mode (*Intrepid project*).

Supervise Aerodata's airborne survey in Oman; develop and oversee future programs.

Compile, upgrade and present in appropriate forms airborne magnetic, gamma-ray spectrometric data and Digital Terrain Models for the Cape York Peninsula Land Use Strategy.

Investigate questions of VLF data acquisition, processing, and presentation with respect to land-use, regolith, and salinity studies.

Make significant developments to the aircraft geophysical acquisition system by upgrading the gamma-ray spectrometer, and rewriting the software of the data acquisition system.

Customers

AGSO's mapping programs

Exploration companies

State and Territory mines departments

Tertiary educational institutions

Organisations concerned with environment, conservation, water resources, and land management.

Other government agencies (e.g. CSIRO, AUSLIG)

Cooperating agencies

State and Territory mines departments

Exploration companies

Universities

State organisations concerned with environment, conservation, water resources, and land management

Other Commonwealth and State government departments

Project 221.02 National gravity database

Project manager	Michael Morse 06 249 9251
Program responsibility	Geophysical Observatories and Mapping
Timeframe	1965–oongoing

Objectives

Ensure the availability of gravity information for the Australian region (the Australian National Gravity Database) for exploration, geodetic and mapping purposes by developing and maintaining the Australian National Gravity Database and ensuring that gravity data therein are comprehensive, accurate and readily accessible.

Sustain gravity standards throughout Australia by ensuring that the network of precise gravity stations in Australia (the so-called 'Isogal stations') is properly maintained.

Relevance

Gravity information contains the basic data for investigations of the shape of the Earth and the structure and composition of its outer layer. Gravity anomaly data over the whole continent and its adjacent seas constitute a fundamental data set for systematic geological mapping, mineral and petroleum exploration and resource assessment.

The national gravity network stations are the link between AGSO's national gravity coverage, the local surveys conducted by State geological surveys and the exploration industry and global networks.

Detailed gravity surveying over areas the size of 1:250 000 scale Sheet areas is becoming increasingly valuable to the NGMA and other geological studies for mapping and modelling geology.

Fundamental gravity determinations are essential for geodetic levelling purposes and gain a new significance for the general public with the advent of GPS technology for which accurate determination of the geoid over Australia is required. This is also important for Australia's contribution to monitoring of global sealevel change.

Expected outcome

Steady improvement in the quality and quantity of data in the National Gravity Database and an increase in the range of user-products derived from the Database so that the geology of the Australian continent is better understood.

Activities

Maintain a register of national gravity network stations, repair stations, install new stations as necessary.

Check, maintain and install national calibration ranges.

Acquire, check, validate and incorporate data from State Mines Departments and private companies into the national gravity database.

Carry out surveys as part of the NGMA and in joint projects with States.

Investigate, develop and implement improvements in acquisition, processing, analysis, enhancements, presentations and interpretations of gravity data.

Expected products

Data sets on tape and diskettes containing gravity information for sale for the whole of Australia or for regions based on 1:1 million sheets areas and special areas.

Contour maps of Bouguer anomaly values at 1:1 million and 1:250 000 scales.

Various new map and computer compatible products based on enhancements of gravity data using image processing and geographic information system (GIS) techniques.

Highlights for 1992/93

An upgrade of the gravity digital database including 50 000 new stations was released.

Colour and grey-scale image-maps of Australia were released showing Bouguer anomalies

at scale 1: 10 million and 1: 25 million.

Precise gravity stations were installed in association with absolute gravity measurements made by the Japan Institute of Polar Research at the National Measurement Laboratories in Sydney. Precise gravity stations were installed at Coober Pedy, and Mt Hope, near Cobar.

Gravity survey of Laverton and Leonora 1:250 000 sheet areas was completed in a joint project with the Geological Survey of WA, and processed and released for the NGMA Western Australia Eastern Goldfields Project.

Gravity survey of the Dubbo 1:250 000 Sheet area was commenced in cooperation with the NSW Geological Survey.

Gravity measurements along seismic lines were made in the Officer Basin.

Efficiencies were introduced into the processing and presentation of gravity data by integrating commercial and in-house software packages.

Goals for 1993/94

Release a low-cost gridded version of the Bouguer anomaly data set for use on simple image processing hardware to encourage use of these data sets for geological interpretation purposes.

Acquire and integrate several thousand gravity stations from State Mines Departments and company data to expand the national gravity database.

Through cooperation with the South East Asia Gravity Project, incorporate reprocessed profile data for offshore gravity traverses around Australia into the National Gravity Database.

Check, repair and install Isogal stations in northwest Australia, and other locations on an opportunity basis.

Carry out detailed gravity surveys and release data sets for the following 1:250 000 scale sheets in support of the NGMA: *Sir Samuel, Dubbo* and, if resources are available, Ballarat, Forbes, and Narromine. Conduct traverses in northern WA, and along seismic lines in the Officer Basin.

Release data for the *Sir Samuel* and *Dubbo* 1:250 000 sheet areas.

Develop a draft digital elevation model of onshore and offshore Australia in cooperation with AUSLIG.

Improve processing efficiency by upgrading software and documentation through software purchases where possible.

Complete, upgrade and present in appropriate form gravity data for the Cape York Peninsula Land Use Strategy.

Customers

Other AGSO programs

Exploration companies

State and Territory mines departments

Tertiary education institutions

Other government organisations

Cooperating agencies

AUSLIG

Exploration companies

State and Territory mines departments

Universities

Other government agencies

Leeds University, England

Bureau Gravimetrique International, France

Defense Mapping Agency, USA

USGS

Project 221.05 Australia-wide compilation and analysis of the magnetic field

Project manager	Chris Tarlowski (with Charles Barton)	06 249 9265 06 249 9611
Program responsibility	Geophysical Observatories and Mapping	
Timeframe	1993–1996	

Objectives

Maintain and extend a consistent digital grid of magnetic anomaly values across onshore and offshore Australia to provide a framework for understanding the geology of the continent.

Determine long-to-intermediate wavelength magnetic anomalies using large-scale regional datasets, suitably corrected using diurnal information, to enable a better understanding of the Earth's crust.

Characterise the short-term temporal and spatial variations of the geomagnetic field over the Australia continent to improve the accuracy of anomaly maps.

Relevance

The magnetic method can be used to map solid geology below cover sequences, the continent-wide digital grid provides a framework for geological and tectonic interpretation, consistent with data sets published or in preparation for other continents. This provides strategic advantages in regional petroleum and mineral exploration both directly within Australia and indirectly through comparison with data sets from other countries.

The project will provide a national framework against which to validate longer wavelength magnetic anomalies, allowing preparation of consistent aeromagnetic maps and gridded data sets from sheet area to sheet area and state to state.

To optimise the use of magnetic survey data, particularly aeromagnetic exploration data, it is necessary to correct for time-variations of the geomagnetic field. Knowledge about daily and natural transient variations of the field provide the basis for such corrections. The spatial variability of transient (induction) effects, together with intermediate wavelength magnetic anomaly data, provide information about the large-scale crustal structure of Australia.

The magnetic anomaly map of reconstructed Gondwana will provide information and constraints on the palinspastic reconstruction of the southern continents and the mechanisms of their break-up — relevant to petroleum and mineral exploration.

Expected outcomes

Ongoing availability of an up-to-date and internally consistent digital grid of magnetic anomaly values for all Australia as new profile data are added to the National Airborne Geophysical Database. This information is important to the mineral and petroleum exploration industries to obtain a better understanding of the geology of the continent.

The ability to make more efficient use of base stations during aeromagnetic surveys.

A continent-wide picture of the spatial and seasonal dependence of the quiet daily variation (Sq), magnetic storms and disturbances, and coastal induction effects.

Improved understanding of the geological structure and tectonics of Australia and its relation to the other southern continents, their pre- and post-break-up evolution and resource potential.

Activities

Provide a focus for international cooperation for magnetic mapping of Gondwana.

Incorporate further (new and old) magnetic survey data, particularly offshore data, check for and correct errors, link and level adjacent grids, and maintain current a continental master grid for the user community, particularly in

AGSO (CT).

Compare the first edition (1993) grid with the Australian Geomagnetic Reference Field (AGRF) to investigate the validity of long wavelength components and to obtain a continent-wide reference surface (CT).

The result from the Australia-Wide Array of Geomagnetic Stations (AWAGS), undertaken jointly with Flinders University of South Australia, will be analysed to produce an Aeromagnetic Risk Map of Australia, estimate diurnal corrections to the two concentric long traverse circuits of the country flown in 1990 and develop a long-to-intermediate wavelength total field model for the Australian region (CB).

Cooperate with other organisations in incorporating the Australian data into a magnetic anomaly map of reconstructed Gondwana to help elucidate the evolution and disruption history of all the southern continents as an aid to mineral and petroleum exploration in the region (CT).

Expected products

A new long-wavelength total field intensity model for Australia to serve as a reference surface for the Magnetic Anomaly Map of Australia (CB).

A long-traverse data set for 1990 corrected for diurnal variations (CT).

A consistent digital grid of values at about 400 m intervals for the whole continent, also available on a 1:1 million sheet basis (CT).

A broader grid at about 2 km intervals for the whole continent (CT).

A preliminary depth to basement map over the whole continent (CT).

An "Aeromagnetic Risk Map" of Australia indicating the expected reliability of magnetic survey base-station data for different parts of the country (CB).

Highlights for 1992/93

Finalisation of the first edition master grid of the Australian continent (land area).

Publication of printed image maps in colour at scales 1:5 million, 1: 10 million (A3) and 1:25 million (A4) using processing sequences designed to enhance the representation of the geological information in the dataset.

Draft maps were displayed at ASEG Biennial Conference and Exhibition (October 1992), Science Week and the Civic Library (Canberra, April 1993), AusIMM Conference (Adelaide, April 1993), APEA Conference (Gold Coast, April 1993).

The first version of the "Aeromagnetic Risk Map of Australia" was produced.

The AWAGS data were used to model diurnal patterns and make corrections to some of the 1975/76 long traverse aeromagnetic data for the country.

Goals for 1993/94

Identify and quantify likely errors in long wavelength components through comparison of the first edition grid with (a) AGRF and (b) diurnally corrected AWAGS long airborne traverse data (CT).

Incorporate available offshore data, and onshore data as they become available (including Bass Strait–Encounter Bay, Gulf of Carpentaria, Arafura Sea, Barrier Reef) (CT).

Prepare and release results from the 1990 long traverses corrected for preliminary diurnal variations to obtain a 'standard' surface for fitting magnetic anomalies (CT).

Start to undertake absolute baseline and time calibration of the AWAGS data set with a view to preparing images and time-animations of field variations over the country (CB).

Refine and publish the Aeromagnetic Risk Map of Australia (CB).

Prepare a total field intensity model as a reference surface for the Magnetic Anomaly Map of Australia (CB).

A preliminary depth to basement map over the whole continent (CT).

Draw up plans for the magnetic anomaly map of Gondwana in collaboration with other organisations studying the geology of the southern hemisphere (CT).

Customers

Other AGSO programs

Exploration companies

State and Territory mines departments

Tertiary educational institutions

Other government agencies

International Association for Geomagnetism and Aeronomy

Cooperating agencies

International Institute for Aerospace Survey and Earth Sciences (ITC), The Netherlands

International Association for Geomagnetism and Aeronomy

University of Capetown, Department of Geology

Antarctic Division

Flinders University of South Australia

Research School of Earth Sciences, Australian National University

241: GROUNDWATER

Objectives

Contribute to ecologically sustainable development of the nation's natural resources by providing scientific and technical analysis, assessment and advice on strategic national issues relating to groundwater. Participate in the coordination of national groundwater activities.

Relevance

Groundwater is one of Australia's most important resources. Over half the continent is totally dependent on it. The flow and quality of groundwater are closely linked in large sedimentary systems. An understanding of the availability and quality of groundwater and its role in salinisation of agricultural land can only be obtained from the study of its composition and the direction and speed of groundwater flow in relation to basin geometry.

The Component is primarily concerned with multi-disciplinary regional studies of the whole or key parts of major groundwater systems. The areas studied were chosen because of their economic and environmental priority. The Murray–Darling Basin study is a joint Commonwealth-State venture under the aegis of the Murray–Darling Basin Ministerial Council.

AGSO Groundwater Program is currently responding to a number of national issues relating to groundwater as identified by the National Landcare Policy Branch of the Department of Primary Industries and Energy. These priorities include:

- continuing support for the Murray–Darling Basin initiative
- groundwater contamination in areas of economic significance
- groundwater aspects of dryland salinity
- irrigation induced salinity (waning)
- extractive use of groundwater (mainly urban)
- conjunctive use
- recharge/waste disposal

The research combines regional mapping of aquifer systems and properties and geochemical studies of water and their host rocks.

Output is in the form of major sets of maps as both hard copy and GIS format, hydrogeological and hydrochemical models and publications and concepts relevant to the availability and composition of groundwaters.

Highlights for 1992/93

Formation of the National Groundwater Scientific Consultative Group in May 1993. The NGSCG comprises representatives from State groundwater agencies, CSIRO and AGSO. The aims of the NGSCG are to maximise national and regional benefits of groundwater research through better alignment of programs with strategic needs and to provide high level scientific advice on groundwater issues to government.

Release of a further nine maps in the 1:250 000 scale Murray Basin Hydrogeological Map Series bringing the total produced in this series to 13.

Preparation of a major review report *Murray–Darling Basin — Status of Groundwater 1992* for the Murray–Darling Basin Commission.

Receipt of special funding to support the Australian Groundwater Quality Assessment Project.

Convening the successful *Aquifers at Risk* Conference in Canberra 15–17 February.

Goals for 1993/94

Developing as part of the portfolio priority, national perspectives on water quality in association with State water and land management agencies.

Develop projects on groundwater aspects of land degradation and management.

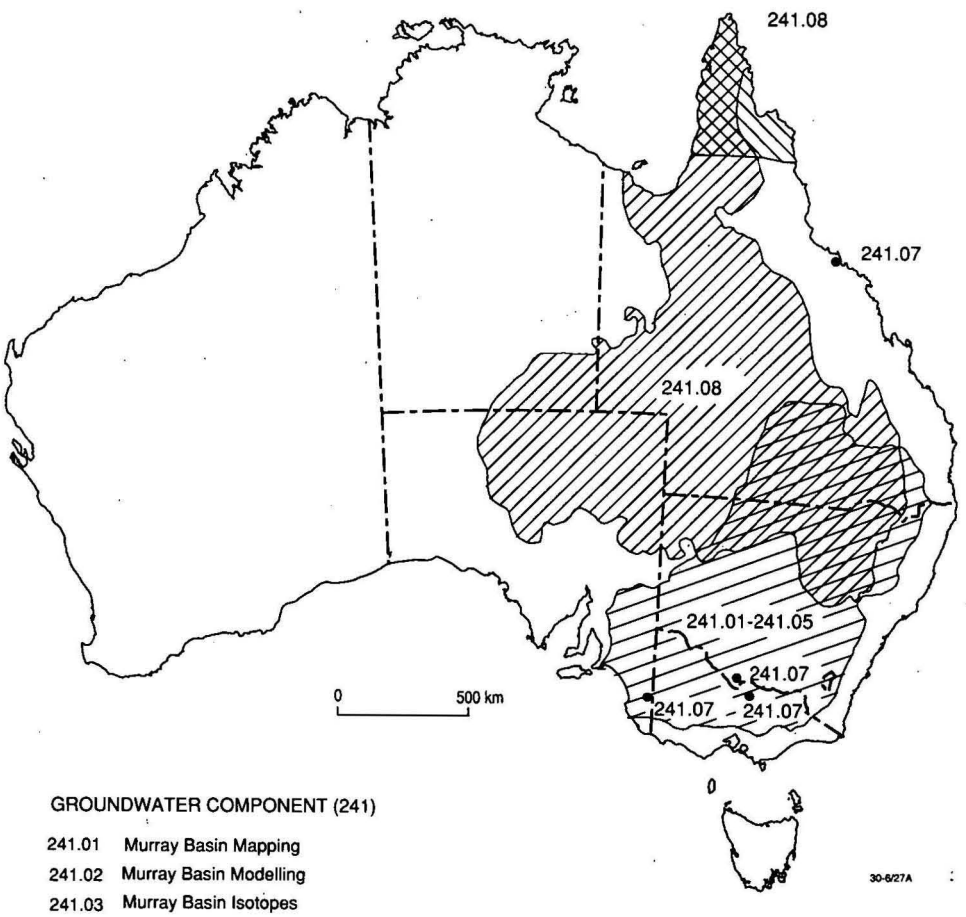
Develop a project to assess groundwater resources in parts of Aboriginal lands in support of the International Year of Indigenous Peoples.

GROUNDWATER

Component manager Colin Simpson 06 249 9368 Fax 06 249 9980

Component projects

241.01–241.05	Hydrogeology of the Murray–Darling Basin
241.07	Australian Groundwater Quality Assessment
241.08	Hydrogeology of the Great Artesian Basin



GROUNDWATER COMPONENT (241)

241.01 Murray Basin Mapping
241.02 Murray Basin Modelling
241.03 Murray Basin Isotopes
241.04 Murray Basin Discharge Zone
241.05 Darling Basin Mapping
241 07 Australian Groundwater Quality Assesssment
241.08 Hydrogeology of the Great Artesian Basin

Projects 241.01–241.05 Hydrogeology of the Murray–Darling Basin

Project manager	Ray Evans	06 249 9738
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1979–1996	

Objective

Provide high level technical and scientific advice relating to groundwater issues in the Murray–Darling Basin to contribute to ecologically sustainable development of the Basin's natural resources.

Relevance

The most important water catchment in Australia is the Murray–Darling Basin which covers four states, accounts for 75% of irrigation water used in Australia and each year produces between 30 and 40%, (around $10 000m) of the total production from Australia's natural resource based industries.

Groundwater-related land degradation is conservatively estimated to be annually costing around $150 million. Rising groundwater tables have caused the salinisation of at least 1 million hectares of land in the southern part of the Basin; this area is expected to double in the next 20 to 50 years. The four Governments that are party to the Murray–Darling Basin Agreement have undertaken to cooperate to improve the management of the Basin's natural resources, and have enacted legislation to establish the Murray–Darling Basin Ministerial Council and the Murray–Darling Basin Commission.

The Government has expressed its commitment to ameliorating the problems regarding natural resource degradation in the Murray–Darling Basin including land salinisation and deteriorating surface water quality. The underlying control on these problems is groundwater processes.

Therefore one of the major strategic data needs for managing the natural resources of the Basin is an understanding of the processes. This understanding will provide the natural resource managers not only with an interpretation of the groundwater process upon which they can make immediate natural resource management decisions but will also provide them with a predictive capability.

Expected outcomes

The water and land resources in the Basin will be managed within a long-term sustainability framework.

Activities

Produce the Murray Basin Hydrogeological Map Series at 1:250 000 scale and a Basin-wide database.

Produce numerical simulation models of regional groundwater flow systems in the Murray Basin.

Produce the Darling River Catchment Hydrogeological Map at 1:1 000 000 scale and associated report.

Analyse and interpret regional hydrogeochemical and isotopic patterns to identify recharge and discharge processes; this may feed into the Quaternary climates study (242.02).

Assess contamination of groundwaters underlying irrigated agriculture by agro-chemicals and microbes of public health significance.

Study the dynamics and geochemistry of selected groundwater discharge features as analogues for evaporative disposal of saline waste waters.

Expected products

A hydrogeological map series for the Murray Basin.

A hydrogeological map and report for the Darling River Catchment.

A conceptual model for groundwater processes and their impact on surface water and land resources for the Darling River Catchment.

Numerical groundwater simulation model for the Murray Basin.

An understanding of controls on the distribution of concentrated brines under groundwater discharge zones and below saline waste water disposal basins.

Conceptual models of groundwater processes operating within the regional unconfined aquifer at a Basin-wide scale, specifically regional recharge patterns.

Highlights for 1992/93

The release of the following publications and maps:

- Further maps in the Murray Basin Hydrogeological Map Series - Swan Hill, Ouyen, Hay, Jerilderie, Horsham, Deniliquin, St Arnaud, Pinnaroo, Ana Branch;
- Research papers in Water-Rock Interaction Conference, Applied Geochemistry, AWWA Journal;
- Murray–Darling Basin - Status of Groundwater, 1992, a report to the Murray–Darling Basin Commission.

Compilation of the Naracoorte, Balranald, Bendigo and Booligal sheets in the Murray Basin Hydrogeological Map Series.

Continued technical review of the joint Commonwealth/State groundwater modelling effort in the Murray Basin.

A steady state version of the Lachlan Fan/Ivanhoe Block groundwater model was completed and a comprehensive report written.

A number of collaborative projects commenced at the instigation of outside agencies — Lake Tutchewop Salt Lake Study and the Deniliquin Deep Drainage Study.

Data from the Discharge Zone Study was used by a private company to assess commercial salt harvesting opportunities.

The provision of scientific advice and information, at a level acceptable for national and international fora; invitation to display at the National Farmers Federation Annual General Meeting.

A number of invitations to address Landcare Groups on local issues involving groundwater.

Extensive use of the published Hydrogeological Maps by external management agencies — particularly local government.

Goals for 1993/94

Complete the Murray Basin Hydrogeological Map Series by releasing the remaining 14 maps.

Complete the transient Lachlan Fan/Ivanhoe Block groundwater model; complete the data compilation for the Scotia groundwater model.

Quantify the changes in the $^{36}Cl/Cl$ ratio over the last 18 000 years or so, as a means of defining the input function for other isotopic studies.

Compile the final report on the Discharge Zone Study for submission to the Murray–Darling Basin Commission.

Publish the Darling River Catchment Hydrogeological Map and accompanying booklet.

Customers

Murray–Darling Basin Ministerial Council

National Landcare Program, DPIE

State and Federal natural resource managers and policy advisors

Murray–Darling Basin Community — Landcare Groups; Land and Water Management groups; Total Catchment Management Committees

Cooperating agencies

National Landcare Program, DPIE — funds

Murray–Darling Basin Commission — funds

Rural Water Corporation — funds, in-kind support, data

Department of Water Resources, NSW — funds, in-kind support, data

South Australian Department of Mines and Energy — in-kind support, data

Centre for Environmental Mechanics, CSIRO — in-kind support, scientific collaboration

Engineering and Water Supply Department, SA — data

Department of Conservation and Natural

Resources, Vic — data

Division of Water Resources, CSIRO — scientific collaboration

Department of Primary Industry, Qld — in-kind support, data

Project 241.07 Australian Groundwater Quality Assessment

Project manager	John Bauld	06 249 9778
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1992–1996	

Objective

Provide groundwater resource managers and policy makers with the scientific advice necessary to ensure protection and quality of the nation's groundwater resources.

Relevance

Groundwater is an important resource in rural and urban Australia where increasingly it is extracted for drinking, industrial, and agricultural purposes. About 20% of the nation's total water requirements are presently met by ground water, though this proportion may be as high as 50–100% in large areas of inland Australia.

Consequently, the quality of the nation's groundwater resources is of growing concern to water managers in all States. Groundwater quality (ie its acceptability as judged by domestic, industrial, agricultural or environmental criteria) is determined by both natural processes and human activities. Groundwater quality may be assessed not only by factors such as salinity but also by nutrient, toxic chemical and microbiological loads.

There is a disquieting lack of information about the quality of Australia's groundwater resources. For example, the application of agrichemicals (including insecticides, herbicides, fungicides and fertilisers) continues to be extensive and widespread in key areas of irrigated agricultural production throughout the nation. Groundwater resources underlying these areas are commonly exploited for domestic and town water supplies, as well as for irrigation, and/or pumped to adjacent surface waters for disposal. The impact of these activities is essentially unknown yet potentially of far-reaching health, environmental and economic significance to resource management.

The Australian Groundwater Quality Assessment Project, operating within the framework of the National Landcare Program, will make a major contribution to:

- the initiation and establishment, in cooperation with the appropriate State and Commonwealth agencies, of a National Groundwater Quality Database
- the scientific knowledge base required to underpin the National Water Quality Management Strategy (which includes National Guidelines for Groundwater Protection), and of the Natural Resource Management Strategy of the Murray–Darling Basin Commission.

Expected outcomes

A knowledge of groundwater quality in vulnerable aquifers to allow rational implementation of the National Water Quality Management Strategy.

Improved management of groundwater leading to improved protection of human and animal health.

The establishment of a National Groundwater Quality Database and the provision of value-added interpretation based on a knowledge of subsurface processes.

A firm scientific basis on which to decide groundwater resource management options.

Activities

Assess contamination of groundwaters underlying key areas of irrigated agriculture, and other priority catchments, by agrichemicals

and microbes of public health significance.

Assess levels of naturally occurring elements, metals or compounds of public health concern in key groundwater resources.

Establish validation criteria for reliability assessment of both historical and contemporary groundwater quality data.

Assess the role of indigenous microbial and geochemical processes in determining the quality of ground waters and examine their resilience to environmental insult.

Integrate findings within appropriate hydrogeological framework.

Expected products

Comprehensive baseline information on conditions of groundwater quality in key irrigation areas, and other priority catchments, together with accumulating data sets which monitor subsequent changes.

Easily accessible data bases and GIS for resource management decisions.

A comparative evaluation of various 'minimum data sets' which might be used to measure the impact of changes to resource management practices.

Reports and presentations to water resource managers and other clients and stakeholders.

Advice to DPIE land and water policy groups.

Scientific papers of international standard.

Highlights for 1992/93

A successful bid under the water quality initiatives of the Prime Minister's Statement on the Environment will provide additional funding ($2.3M during the period 1993–96) for *the assessment of groundwater quality in key areas of national priority.*

Completion of reconnaissance field work in the Burdekin Irrigation Area in collaboration with QDPI Water Resources.

Completion of further field work in the Shepparton Irrigation Area following discussion with the Rural Water Corporation of an earlier reconnaissance study.

Presentation of Shepparton reconnnaissance study findings at an International Workshop on Groundwater and Environment.

Goals for 1993/94

Reach agreement with appropriate State agencies and the Murray–Darling Basin Commission on priority catchment areas for AGSO groundwater quality assessment investigations during 1993–96.

Implement substantially expanded field sampling program, incorporating agreed priority catchments, including acquisition and training of staff (4 major field trips are planned).

Complete comprehensive reports on reconnaissance studies carried out prior to 1 July 1993.

Devise and commence field and laboratory experimental program to determine role of groundwater quality in borehole corrosion (requested by, and in collaboration with, QDPI Water Resources).

Customers

Land Resources Division, DPIE

Bureau of Resource Sciences, DPIE

Murray–Darling Basin Commission

Department of Water Resources, NSW

Rural Water Corporation of Victoria

Department of Agriculture, Victoria

Department of Mines and Energy, SA

Engineering & Water Supply Dept, SA

Department of Agriculture, SA

DPI Water Resources, Queensland

Water Authority, WA

Geological Survey, WA

Cooperating agencies

Department of Water Resources, NSW — information

Rural Water Corporation of Victoria — information, staff

Department of Agriculture, Victoria — information, laboratory facilities

Department of Mines and Energy, SA — information, staff

Engineering & Water Supply Dept, SA — information

Department of Agriculture, SA — information, laboratory facilities

DPI Water Resources, Queensland — infor-

mation, staff

DPI Land Resources, Qld — laboratory facilities

Geological Survey, WA — information

United States Geological Survey — staff, laboratory facilities, analyses

Project 241.08 Hydrogeology of the Great Artesian Basin

Project manager	Rien Habermehl 06 249 9426
Program responsibility	Environmental Geoscience & Groundwater
Timeframe	1984–1995

Objectives

Provide high level technical and scientific advice relating to groundwater issues in the Great Artesian Basin to Commonwealth and State Authorities to contribute to ecologically sustainable development of the Basin's natural and economic resources.

Investigate the nature, extent and availability of groundwater resources to support the Cape York Peninsula Land Use Strategy.

Relevance

The Project has been endorsed by, and is for the most part a response to, a strong demand expressed by Commonwealth and State Organisations through:

- the Australian Water Resources Council (AWRC)
- the AWRC — Water Resources Management Committee
- the Interstate Committee on the Great Artesian Basin
- the Great Artesian Basin Groundwater Working Group

The Great Artesian Basin is Australia's largest groundwater basin and contains some of the nation's most important groundwater resources.

AGSO has extensive Basin-wide hydrogeological knowledge and expertise from past and present studies which enables it to contribute to the joint study with State Water and Geological Authorities, and to provide the basis for the assessment of groundwater resources in the Great Artesian Basin, and to contribute to the development of management strategies and options for groundwater related problems.

Expected outcomes

Scientific and technical information to allow sustainable management of the groundwater resources of the Great Artesian Basin.

Groundwater quality information and an understanding of regional hydrochemical processes required by groundwater managers.

The Cape York Peninsula Groundwater Investigation will provide reports and maps assessing groundwater quantity and quality, and provide information on the potential for the sustainable development of the groundwater resources in Cape York Peninsula.

Activities

Update and complete the hydrogeological databases and wire-line logs of waterbores of the Great Artesian Basin, implement GIS.

Update, refine, calibrate and apply the computer-based simulation models of the Great Artesian Basin, and complete the well model for use in the Great Artesian Basin Bore Rehabilitation Program, the Monitoring Network and the Management Program of the artesian groundwater resources of the Great Artesian Basin.

Review the Great Artesian Basin Monitoring Network and prepare proposals for the measurements of artesian pressures, flows and hydrochemistry.

Prepare an independent framework based on regional hydrochemistry processes and groundwater quality information using data from State Government Authorities and

AGSO databases.

Compile hydrogeological data and prepare a Hydrogeological Map of the Great Artesian Basin for publication using Intergraph CAD-CAM facilities.

Carry out detailed groundwater investigations in Cape York Peninsula during 1992–1994 as part of the Cape York Peninsula Land Use Strategy — Natural Resources Analysis Programme (CYPLUS — NRAP), a joint Commonwealth and Queensland Governments initiative. Investigations included: the collection of existing data, a bore census, drilling of several test and observation holes, hydrochemistry and isotope hydrology sampling programs, remote sensing analysis, data compilation, analysis and interpretation, and preparation of reports and maps.

Expected products

Publications, reports and databases showing detailed data and results of hydrogeological, groundwater quality and hydrochemical studies in the Great Artesian Basin.

Basin-wide and regional computer simulation models of groundwater hydraulics.

Digital dataset of the AGSO collection of wire-line logs from waterbores in the Great Artesian Basin.

Reports on the regional groundwater quality and hydrochemistry data and processes in the Great Artesian Basin.

Reports on the recharge and discharge in the Great Artesian Basin.

Hydrogeological Map of the Great Artesian Basin at scale 1:2 500 000.

Reports and hydrogeological maps of Cape York Peninsula.

Highlights for 1992/93

Hydrogeological data and results continued to be requested from AGSO and have been applied by State Authorities in regional and detailed projects and in problem solving.

The Great Artesian Basin (GAB) hydrogeological databases have been completed, and PC and Workstation based PARADOX and ORACLE databases have been used in the model data input preparation using ARC/ORACLE and ARC/INFO GIS. A shared GAB model ARC/INFO work area and an ARC/ORACLE link were established. Hydrogeological model layer surfaces were prepared in ARC/INFO for use in the computer based groundwater flow simulation model GABMOD, which is an adapted version of the USGS MODFLOW finite difference code. The GIS/MODFLOW pre- and post processor code to support parameter modification and display has been completed.

Complete the digitising of all the natural gamma-ray, temperature, differential temperature, flowmeter, caliper, spontaneous potential and resistivity logs for waterwells in the Great Artesian Basin held by AGSO. Digitising of other logs is in progress. Compilation of well and log data, and lithostratigraphic data for the wells is continuing.

The review of the Great Artesian Basin Monitoring Network is in progress. Data for all proposed monitoring wells has been retrieved and is being reviewed.

Recharge studies commenced with the sampling of specially drilled holes in the recharge area, and piezometers in a discharge area were sampled for hydrochemistry and isotope hydrology. Monitoring of flowing artesian spring discharges is continuing, and programs for datalogger maintenance and data processing have been completed.

Waterbores were sampled for hydrochemistry and isotope hydrology, and test, investigation and observation holes were drilled for the Cape York Peninsula Groundwater Investigation.

Goals for 1993/94

Implement the GIS/MODFLOW pre- and post processor, complete the model geometry and the model input data, calibrate and optimise the model.

Provide a quantitative understanding of, and provide a predictive capability for, the artesian groundwater systems of the Great Artesian Basin.

Provide a digital package of wire-line logs and well data of waterwells in the Great Artesian Basin.

Continue work on the hydrochemistry, isotope hydrology, recharge and discharge projects.

Carry out the detailed work program of the Cape York Peninsula Groundwater Investigation, including hydrochemistry and isotope

sampling programs, and data compilation, analysis, and report and map preparation.

Customers

Commonwealth Department of Primary Industries and Energy, Land Resources Division — National Landcare Policy Branch

State Water and Geological Authorities of Queensland, New South Wales, South Australia and the Northern Territory

Other State Government Departments and Authorities, including SA Department of Environment and Planning, National Parks and Wildlife Service

Water Industry

Pastoral Industry

Petroleum and Mining Industry

Scientific Institutions, including CSIRO, Universities, Museums

Educational Institutions, National and International Hydrogeological Scientific Community

General Public

Cooperating agencies

State Water and Geological Authorities of Queensland, New South Wales, South Australia and the Northern Territory — information

Australian Nuclear Science and Technology Organisation — analyses

Australian National University (Department of Nuclear Physics) — analyses

Australian National University (Research School of Earth Sciences) — staff

Adelaide University — staff

CSIRO Division of Water Resources — staff

SA Department of Environment and Planning — service

SA National Parks and Wildlife Service — service

Petroleum and Mining Industries — information

University of Connecticut — staff, funding

New Mexico Tech, USA — staff

Technical University, Berlin — staff

University of Berne, Switzerland — staff

Cape York Peninsula Land Use Strategy — funding

Queensland Dept of Primary Industries — Water Resources — funding, staff.

222: AUSTRALIAN SEISMOLOGICAL CENTRE

Objectives

Reduce the damaging effects of future Australian earthquakes.

Contribute data from seismographic stations in Australia and Antarctica to fulfil international obligations for global hazard reduction and global studies of earth structure and tectonic activity.

Detect and provide information and advice on underground nuclear explosions as a contribution to the attainment of a Comprehensive Nuclear Test Ban Treaty.

Develop an understanding of the structure and tectonics of the Australian region.

Relevance

Earthquakes are a global phenomenon and cause damage throughout the world. Significant and potentially damaging earthquakes occur in Australia. To understand them it is necessary to use information from both national and international seismographic stations.

Australia has a responsibility to operate seismographs on its territory and make the data available internationally for the study of world seismicity patterns and earth structure. In return, seismological information obtained overseas is required to improve our understanding of Australian earthquakes, improve earthquake hazard assessment and hence reduce the damaging effects of future earthquakes.

The monitoring of nuclear explosions is part of the Government's policy to limit the spread of nuclear weapons by developing appropriate treaty verification systems so that the threat of nuclear war is reduced.

Activities

Operate a network of seismographic stations in Australia and Antartica to monitor earthquakes and underground nuclear explosions.

Investigate significant Australian earthquakes by monitoring aftershock activity, studying ground movement associated with large earthquakes and assessing damage caused by earthquakes.

Investigate historical and pre-historical earthquakes to improve the database and estimates of earthquake hazard.

Operate a network of strong ground motion recorders to estimate ground motion during significant earthquakes.

Provide information on earthquakes and nuclear explosion to clients within Australia and overseas.

Analyse seismic recordings to detect and locate underground nuclear explosions.

Provide technical advice to the Department of Foreign Affairs and Trade both directly and at the U.N. Conference on Disarmament (through the Groups of Scientific Experts).

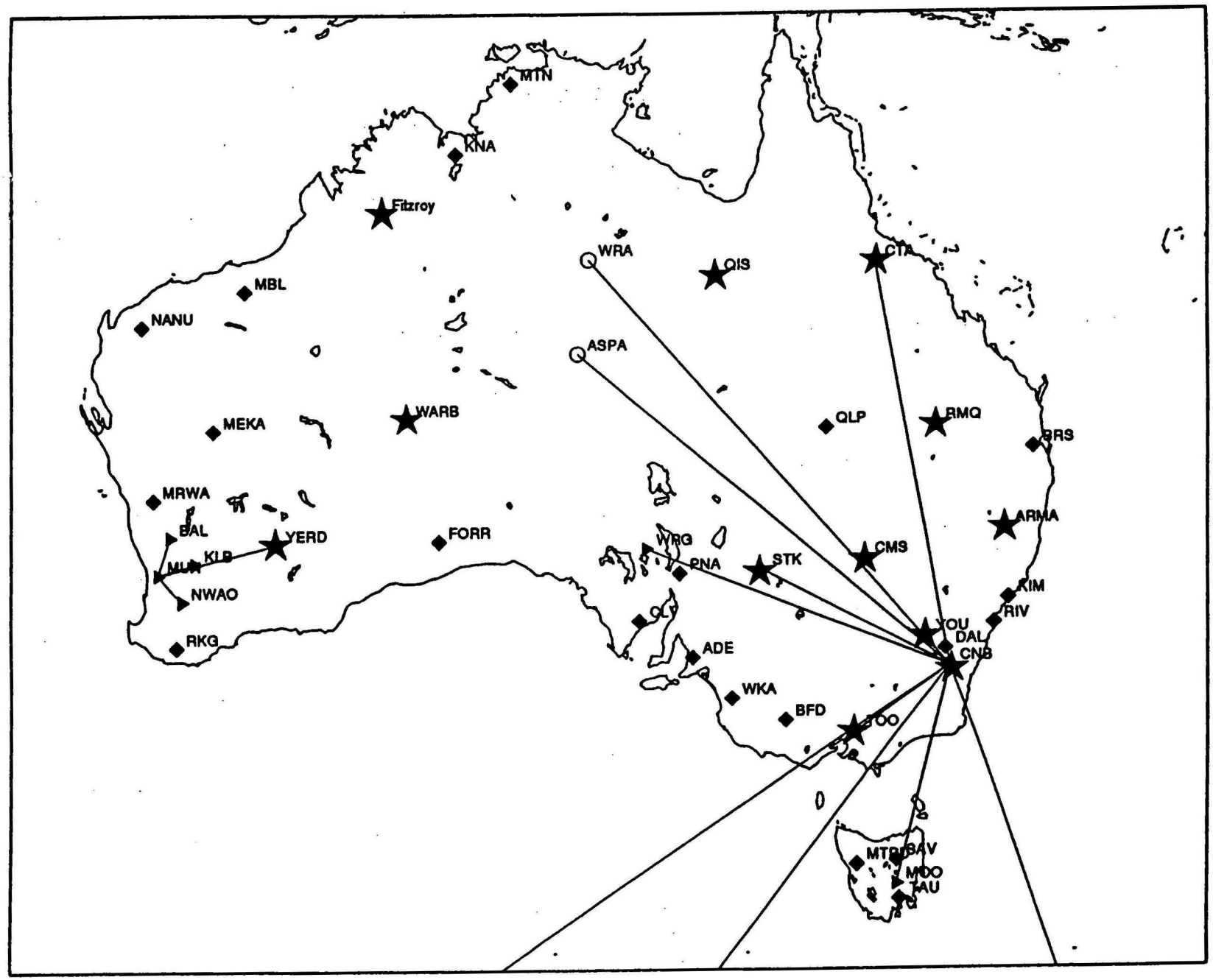
Cooperate with Research School of Earth Sciences, ANU to optimise the use of seismic arrays in the analysis of earthquakes and nuclear explosions, and to improve procedures used to locate seismic events.

AUSTRALIAN SEISMOLOGICAL CENTRE

Component manager Ken Muirhead 06 249 9481

Component projects

222.01	Earthquake seismology
222.02	Nuclear explosion seismology



Planned satellite upgrade to Australian National Seismograph Network

Project 222.01 Earthquake seismology

Project manager	Kevin McCue 06 249 9675
Program responsibility	Geophysical Observatories and Mapping
Timeframe	1950–ongoing

Objectives

Improve assessments of earthquake risk throughout the Australian continent, especially the major population centres, to mitigate the damaging effects of earthquakes.

Develop an understanding of the structure and tectonics of the Australian region, with particular emphasis on intra-plate seismicity, as a contribution to national and international seismology.

Provide information on global earthquake activity.

Locate all earthquakes in the Australian region with magnitudes of three and greater and adequately monitor smaller earthquakes in regions of high population density where the identification of seismically active fault zones will enable significant improvements in earthquake risk assessments to be made.

Relevance

Although the level of seismicity in the Australian continent is lower than in countries such as Japan and Chile, which are situated on active plate boundaries, large and potentially damaging earthquakes do occur in the Australian region.

In March 1954, a magnitude ML5.4 earthquake caused damage of about $100 million in Adelaide SA and in December 1989, a magnitude 5.6 earthquake close to Newcastle (NSW) resulted in 13 deaths and at least $1500 million damage. Earthquakes are quite clearly of major importance to Australians, and the risk increases yearly as the population grows, yet there is at present no model that accounts for intra-plate earthquakes.

Studies of seismicity patterns, earthquake focal mechanisms, fault scarps, associated with recent earthquakes, pre-instrumental earthquakes and the regional crustal stress field are therefore essential to improve our knowledge in this area of earth science.

The August 1992 budget contained a Government commitment of $500 000 per year over three years to upgrade the earthquake monitoring program. In co-operation with the States, these supplementary funds are being used to improve the monitoring of the main urban areas and to increase the coverage of the national seismographic network.

Accelerographs are needed to measure the ground motion during strong earthquakes so that appropriate building design rules can be formulated to cater for earthquake shaking.

Expected outcomes

Better understanding of Australian earthquakes and improved earthquake monitoring coverage of Australia and its major population centres.

Improved knowledge of global seismicity due to information from Australian and Antarctic seismographs.

Safer and more cost-effective buildings through improved assessments of earthquake risk.

Timely advice to State Emergency Services, Emergency Management Australia and the media following significant earthquakes.

Activities

Monitor and interpret seismic waves from near and distant earthquakes, as a contribution to national and international seismology, with emphasis on the Australian region.

Add data from AGSO's Seismographic Network and from State, university and international cooperative programs to AGSO's earthquake database at monthly intervals; analyse, interpret and publish that data to provide information and a contribution to national and international seismology.

Ongoing study of historical (pre-instrumental) and pre-historical Australian earthquakes to enlarge the database.

Operate a network of 29 permanent seismographs and 24 accelerographs (for strong ground motion) throughout the Australian continent and the Australian Antarctic Territory and a four-station network near Newcastle (NSW).

Undertake microzonation studies in Australian cities and develop new methods to upgrade the Australian Earthquake Hazard Map and Loading Code.

Update and improve AGSO's world earthquake database and make it publicly available.

Inspect damage, monitor aftershocks, measure ground deformation and prepare reports on significant Australian earthquakes.

Continue crustal stress mapping of the Australian continent using focal mechanism solutions of the larger earthquakes.

Monitor, with the University of Queensland, crustal strain near Dalton (NSW) in this active intra-plate seismic zone.

Provide specialist advice to planners, engineers and disaster personnel.

Expected products

Updated earthquake risk maps of the Australian continent at five yearly intervals.

Bulletins of earthquake phase data for distribution nationally and overseas.

Research papers on Australian seismicity, historical earthquakes, tectonics and significant Australian earthquakes. Produce extracts for clients from the Australian and world earthquake databases.

Highlights for 1992/93

As a result of a Government initiative to improve the earthquake monitoring facilities in Australia, a strategy was developed to upgrade the national seismographic network and monitor the major cities with accelerographs. A prototype satellite telemetry station was developed and accelerographs were purchased and installed in Sydney, Melbourne, Adelaide, Perth, Brisbane and Rockhampton.

An updated hazard map was provided to Standards Australia and contributions made to the new earthquake Loading Code. Planning for proposed harmonisation with the New Zealand earthquake code commenced.

Seismologists from China visited Australia 7–14 Nov 1992 under the MOU signed on 26 April 1990. They provided earthquake data from Australian recorders installed near Tangshan as part of the joint study of intraplate earthquakes.

The results of the micro-zonation of Newcastle NSW were published.

An Earthquake Seismology Conference was held in Sydney on 25 September 1992 and the Proceedings were published.

Under the cooperative project with the University of Central Queensland, two additional seismographs were installed in the Rockhampton region.

A draft earthquake hazard map of the southwest Pacific was prepared under the auspices of the International Decade of Natural Disaster Reduction.

The Antarctic seismograph telemetry links were reconfigured following re-routing of the satellite terminal from Sydney to Hobart.

Goals for 1993/94

Monitor earthquakes in the Australian region down to magnitude 3, maintain the National Earthquake Database and the strong ground motion instruments in Eastern and Western Australia.

Provide information to national and international clients from the network of seismographs and accelerographs in Australia and Antarctica.

Continue the three year program to upgrade the national network over the next two years with the new prototype telemetry stations installed as shown on page 103. Install accelerographs in cooperation with the State Governments, in Geelong, Darwin, Gold Coast/Tweed Heads, Wollongong, Launceston, Whyalla/Port Pirie and Newcastle.

Mundaring scientists to co-operate with GSWA and Eastern Goldfields mining companies to investigate rockbursts in underground mines.

Provide specialist seismological advice as consultants to Australian Dam Safety Com-

mittee, Standards Australia, and Insurance Companies.

Process the Newcastle aftershock seismograms to estimate the groundmotion time-history during the mainshock in Newcastle.

Publish the 1990 and 1991 Annual Seismicity Reports and Part III of the Isoseismal Atlas. Continue research into Australian seismicity including the study of widely felt historical earthquakes.

Trench the Lake Edgar fault scarp in Tasmania and date its last movement.

Send a delegation of scientists to the State Seismological Bureau in the PRC under the MOU signed in 1990 to develop cooperative projects of mutual interest.

Prepare a commentary on the hazard map of the Southwest Pacific for IDNDR committee.

Contribute to the preparation of a conference on Australian seismicity/earthquake engineering in Melbourne in October 1993.

Customers

The Australian public

The Australian Government

The media

International Seismological Centre, UK

National Earthquake Information Centre, USA

Other international agencies

Standards Australia

The insurance industry

Engineering companies.

Australian Dam Safety Committee

Australian Emergency Management Institute

Pipeline Authority

Cooperating agencies

Australia

Antarctic Division, DEST

Australian National University

Australian Nuclear Science and Technology Organisation

Emergency Management Australia

Seismology Research Centre, Royal Melbourne Institute of Technology

Department of Minerals and Energy, South Australia

St Ignatius College, Riverview, New South Wales

University of Queensland

University of Tasmania

University of Central Queensland

International

International Seismological Centre, UK

National Earthquake Information Centre USA

University of California, Berkeley USA

International Association for Earthquake Engineering, Japan

Russian Academy of Science

State Seismological Bureau, PRC

Project 222.02 Nuclear explosion seismology

Project manager	Ken Muirhead 06 249 9481
Program responsibility	Geophysical Observatories and Mapping
Timeframe	1984–ongoing

Objectives

Operate a national facility to detect and provide information on underground nuclear explosions,and to provide input to an international seismological monitoring network, as contributions to the attainment of a Comprehensive Nuclear Test Ban Treaty (CTBT).

Relevance

This work is part of the Government's policy to limit the spread of nuclear weapons by developing appropriate treaty verification systems so that the threat of nuclear war is reduced.

Expected outcomes

A national facility to monitor and report on underground nuclear explosions.

Australian participation in an international seismic network to monitor a CTBT.

Australian contributions to the work of the UN Conference on Disarmament (through the Group of Scientific Experts) on the design and implementation of a modern global seismic monitoring network.

Activities

Operate a national detection facility to monitor underground nuclear explosions with a sufficiently brief response time; this requires the real time transmission of seismic signals from the major Australian seismic stations to the Australian Seismological Centre (ASC).

Analyse data recorded at seismic stations in Australia and Antarctica to detect and provide information on underground nuclear explosions.

Exchange basic data, techniques and results with overseas agencies.

Provide technical advice (under contract) to the Department of Foreign Affairs and Trade, other government agencies and the Group of Scientific Experts (GSE), an *ad hoc* group of the Conference on Disarmament; Australia has been a member of the GSE since its inception in 1976 and has provided important input to the efforts to achieve a global seismological system for monitoring a CTBT.

Advise Government and the media of the occurrences of underground nuclear explosions.

Expected products

Timely information on underground nuclear explosions.

Quarterly bulletins of nuclear explosions.

Highlights for 1992/93

Advised Government and the media of the occurrences of underground nuclear explosions.

Analysed data acquired during GSETT-2 and provided input to the GSE's scientific report on this international technical test.

Participated in the 34th and 35th Session of the GSE in Geneva.

Improved algorithms to detect and then locate seismic events.

Participated in Canadian workshop on the design and implementation of a global monitoring system for CTBT verification.

Provided technical input to the Department of Foreign Affairs and Trade.

Developed a prototype seismic data acquisition and satellite telemetry system.

Goals for 1993/94

Provide technical input (under contract) to the Department of Foreign Affairs and Trade on various CTBT monitoring methods.

Advise relevant government agencies and the media of all underground nuclear explosions which are recorded by the Australian seismic network.

Assist the GSE with site selection and the network design of a global monitoring system.

Contribute to the development of a prototype International Data Centre by providing continuous online data from the Alice Springs seismic array and other Australian digital stations, and by providing input to event detection and location algorithms.

Cooperate with Project 222.01 in installing equipment to telemeter digital data by satellite from Australian seismic network stations to the Australian Seismological Centre.

Investigate sites and array geometrics for optimum seismic monitoring network configurations.

Develop algorithms for use with the new telemetred seismic stations.

Participate in the 36th and 37th sessions of the GSE in Geneva.

Customers

Department of Foreign Affairs and Trade

Australian public

The media

Peace groups

Cooperating agencies

Australian Research School of Earth Sciences,

Australian National University

United States Air Force Technical Applications Centre (joint operation of seismic array at Alice Springs)

United States Defense Advanced Research Projects Agency (exchange of software)

National Agencies participating in the Group of Scientific Experts within the Conference on Disarmament

224: GEOMAGNETISM

Objectives

Provide accurate information about the temporal and spatial variations of the geomagnetic field over the Australian region and the Australian Antarctic Territory in response to client needs.

Fulfil international obligations for monitoring the geomagnetic field in the Australian and Antarctic regions.

Develop understanding of the nature and origins of internal contributions to the field (core, crustal and induced).

Apply palaeomagnetic and rockmagnetic techniques: to help solve geological problems associated with continental reconstructions, tectonic history and evolution of sedimentary basins, identify and date fluid movements and mineralisation phases; as a dating and stratigraphic tool; and for investigating past environmental (climatic) changes.

Relevance

Information about the direction and strength of the Earth's field is used for navigation, direction-finding, directional drilling, magnetic detection systems, processing of aeromagnetic and marine magnetic survey data, levelling and updating magnetic survey data, identifying and modelling crustal magnetic anomalies, and for monitoring natural magnetic disturbances and associated hazards. Information is required in the form of digital datasets, mathematical models of the field, and as magnetic field charts. Principal Customers are mapping and survey organisations, aviation authorities and airlines, mariners and yachtsmen the petroleum and mineral industries, the Defence Forces, the Ionospheric Prediction Service the Australian Antarctic Division (Auroral and Space Physics), the electronics industry, and universities.

The program is undertaken to develop and exploit applications of geomagnetic, palaeomagnetic and rockmagnetic phenomena. It also contributes to databases essential for fundamental research in geomagnetism and palaeomagnetism, both on a regional (Australian) and a global scale.

Characterisation of the present-day and past behaviour of the geomagnetic field leads to an understanding of its origins — internal, crustal and external. This not only provides the basis for predicting the behaviour of the field and developing the applications of geomagnetic phenomena, but is also an important fundamental problem in its own right.

Transient fluctuations of the geomagnetic field pose problems for airborne, marine and ground magnetic surveys, particularly as transients have a strong spatial dependence related to crustal and oceanic electrical conductivity properties. Characterising these "diurnal" variations over the region is important for making appropriate corrections to magnetic survey data. These natural variations of the geomagnetic field can also be used to obtain useful information about the geological structure of the crust via its internal electrical properties. The work that was being carried out under Project 224.02. "Spatial and Diurnal Variations of the Geomagnetic Field" is of increasing relevance to the aeromagnetic mapping program and has now been merged into Project 221.05, "Australia-wide Compilation and Analysis of the Magnetic Field."

Monitoring and analysis of the Earth's magnetic field must be carried out on a global as well as a regional scale. Australia's role in maintaining a global network of magnetic observatories and repeat stations is critical for obtaining coverage of the southern hemisphere and a large sector of Antarctica including the South Magnetic Pole. It is in our interests to ensure that global models of the field, particularly the International Geomagnetic Reference Field (IGRF), are accurate over this region.

The observatory group has the expertise and facilities for calibration of magnetic compasses and certain types of magnetic survey equipment, for training observers, and for providing advice on aspects of geomagnetism and related applications. These functions are provided as a national service.

Palaeomagnetic research has three major directions. The first is to improve our under-

standing of the tectonic evolution of the Australian and Antarctic plates within a global plate tectonic framework. The second is to develop a framework for dating and correlating of basement sedimentary cover and the regolith, and to aid in studies of fluid movements and mineralisation phases. The third is to identify and date major environmental (hence climatic) changes both onshore and offshore. The palaeomagnetic laboratory is supported not only to satisfy AGSO's needs, but also as a national facility.

Activities

Operate a national network of permanent magnetic observatories in Australia, and in the Australian Antarctic Territories, and conduct magnetic repeat station surveys to determine the secular variation of the field.

Support a program of semi-monthly absolute observations at Casey and Davis. The absolutes are used to calibrate the Antarctic Divisions' variometers at those stations.

Modernise and streamline the magnetic observatories, telemetry communications, and data processing methods.

Provide regional field models, particularly the Australian Geomagnetic Reference Field (AGRF), covering the continent and offshore areas of interest to Australia. This entails the acquisition and updating of ground, airborne, marine and satellite survey datasets.

Contribute towards producing global field models, particularly IGRF, and improve their accuracy over the Australian region.

Investigate the nature and origins of the present and past geomagnetic field (core, crustal and induced).

Apply palaeomagnetic and rockmagnetic techniques to geological problems associated with continental reconstructions, tectonic history, evolution of sedimentary basins, dating and stratigraphy, fluid movements and mineralisation phases and for investigating past environmental (climatic) changes.

Develop and maintain appropriate databases of geomagnetic and palaeomagnetic information; provide geomagnetic data to the relevant national Customers and the international community via the World Data Centres.

Collaborate with neighbouring countries whose efforts in geomagnetism and palaeomagnetism complement our own.

Maintain the national geomagnetism and palaeomagnetism services and facilities; provide advice to Government and other stakeholders.

Promote interaction with stakeholders to ensure relevance and effectiveness of the program, and investigate client-funding for additional program.

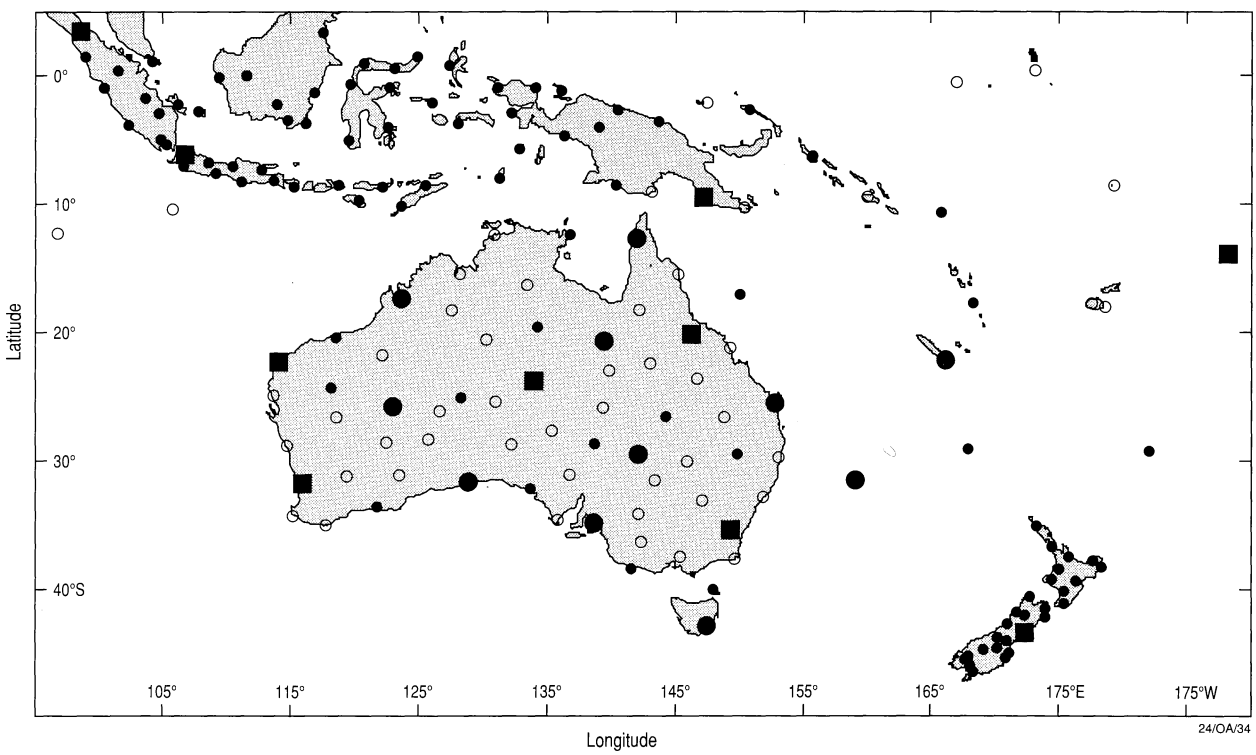
GEOMAGNETISM

Component manager Charles Barton 06 249 9611

Component Projects

224.01 Monitoring, analysis and modelling of the geomagnetic field

224.03 Palaeomagnetism



Distribution of magnetic repeat stations in the Australian region under the revised repeat station scheme. Squares denote magnetic observatories. Large dots denote the "super-repeat stations" to be occupied annually by AGSO, medium-size dots are repeat stations to be occupied every 5 years. Small open circles are repeat stations to be occupied on an ad-hoc basis (nominally every 10 years). The medium-size dots in Indonesia and New Zealand are repeat stations that are occupied every 5 years by those countries.

Project 224.01 Monitoring, analysis and modelling of the geomagnetic field

Project manager	Charles Barton 06 249 9611
Program responsibility	Geophysical Observatories and Mapping
Timeframe	1946–ongoing

Objectives

Better understanding and utilisation of geomagnetic phenomena — for direction-finding, surveying, magnetic detection, space physics, and studies of the Earth's crust and deep interior.

Relevance

The information is used for direction finding (navigation), reduction of aeromagnetic and marine magnetic survey data, levelling and correcting survey data to common epochs, delineating and modelling long-wavelength magnetic anomalies, and for studies of solar-terrestrial relationships.

Expected outcomes

Improved understanding of the origins of the geomagnetic field and its secular variation.

Activities

Provide information on the morphology and variations of the Earth's magnetic field in the Australian and Antarctic regions.

Provide numerical models and charts of the field and its secular variation over the Australian region, and offshore areas of interest to Australia.

Operate a network of permanent magnetic observatories and repeat stations; start construction of the Kakadu Magnetic Observatory.

Provide geomagnetic observatory data, mean values, indices of magnetic disturbance, and storm and rapid variation information to the World Data Centres, national and international agencies, and to other Customers.

Develop and maintain regional and global models of the geomagnetic field, particularly the "Australian Geomagnetic Reference Field" (AGRF), and provide field-model software.

Provide geomagnetic information services, calibrations, training and advice.

Investigate the nature and origin of the geomagnetic field.

Maintain and develop appropriate databases of current and historical geomagnetic data, and long secular variation records (including geomagnetic excursions and reversal transitions).

Liaise and collaborate with neighbouring countries with mutual interests.

Liaise with national and international customers with the aim of improving the relevance and effectiveness of the existing program, and investigate interest in client-funded expansion of the program.

Expected products

A geomagnetic data and information service, training courses, and instrument calibration and testing facilities.

Supply of observatory data, indices and survey results to the World Data Centres and other customers.

Reference field models, charts and software products.

Publications: the annual Australian Geomagnetism Report; operations/observatory reports; research papers and magnetic field charts.

Highlights for 1992/93

Magnetic observatories were operated continuously at Canberra, Gnangara, Charters Towers, Learmonth, Alice Springs, Mawson and Macquarie Island, with telemetry links to central offices. Teething problems at the new Alice Springs observatory have been overcome and the observatory achieved full oper-

ating status from the middle of the year onwards.

Preparations for an observatory at Kakadu are underway and an environmental impact statement has been prepared.

The quality of data from Maquarie Island has improved significantly as a result of the presence of the (⅓) dedicated observer. The new procedure for pre-processing Casey and Davis data by our Mawson geophysicist has improved the quality of monthly means.

Significant progress has been made in clearing backlogs of data to be sent to World Data Centres.

Gradual replacement of obsolete systems at observatories has continued, and new generation ring-core fluxgate magnetometers are now operative at Alice Springs, Macquarie Island and Mawson. The data acquisition system at Learmonth was upgraded and a digital dial-up telemetry system installed. Further improvements and standardisation of processing methods have been introduced and test transmissions from Canberra observatory into the INTERMAGNET global satellite communication system have been made successfully. A breakin at the Gnangara observatory in May resulted in the loss of several instruments. The observatory has been forced to revert to the old classical analogue methods in order to maintain operation, until replacement instruments are procured.

A colour chart showing all the elements of the AGRF90 regional magnetic field model has been released. A PC graphics interface, 'MAGSHOW', for displaying dynamically 3 - D AGRF surfaces has been produced and is proving popular in educational institutions and the user-community.

The current round of magnetic repeat station occupations on the mainland was completed. A new strategy for conducting repeat station surveys has been adopted. This has been forced partly by funding cuts and partly in order to obtain more accurate (though fewer) determinations of the secular variation. A relatively small number of stations will be occupied annually, others will continue to be occupied at 5-yearly intervals and many will be relegated to 10-yearly re-occupations (Figure page 111).

Close links with geomagnetism groups in Indonesia, Papua New Guinea and New Zealand have been maintained. Assistance was provided throughout the year to the Port Moresby Observatory to help process and publish data.

Insight into reversal processes and boundary constraints has been gained through statistical analysis of the reversal chronology; an appropriate test of reversal transitions indicates that the available data are inadequate to prove the existence of preferred transition paths.

The monthly publication of the Australian Geomagnetism Report, which started in 1953, was stopped in December 1992. In future a single annual report will be produced in order to save effort and reduce costs. Special arrangements have been made to satisfy customers who continue to need information on a monthly basis.

A third 'Australian Geomagnetism Workshop' was organised in April 1993 to bring together the providers of geomagnetic information, practical users and research workers. The meeting was an outstanding success and attracted twice the number of people expected. The proceedings are being published in a special issue of Exploration Geophysics.

Goals for 1993/94

Operate continuously the seven permanent magnetic observatories in Australia and Antarctica; analyse the results and make information available for use in modelling the Earth's magnetic field and reporting on short term disturbances.

Continue streamlining the magnetic observatory and repeat station networks, processing methods, data dissemination and communication links, including routine INTERMAGNET transmissions of data from Canberra observatory. Re-establish Gnangara as a digital observatory with improved security.

Obtain final clearance for the Kakadu Observatory and start construction of the buildings in April 1994.

Publish 1992 Australian Geomagnetism Report.

Compile and evaluate the algorithms recommended by IAGA for computing K-indices, and start producing computer-generated indices of magnetic disturbance.

Complete the regional magnetic repeat station

survey in Papua New Guinea and islands in the SW Pacific. Implement the new scheme for repeat station occupations with annual re-occupations of mainland super-repeat stations.

Prepare and update datasets for use in AGRF1995, including marine, airborne and POGS satellite scalar data.

Continue fundamental research in geomagnetism; co-author monograph 'The Magnetic Field of the Earth'; co-author the 'IAGA guide for Magnetic Repeat Stations' to be published by IUGG.

Maintain databases: obtain further international funding for the global secular variation database and help compile datasets (joint with Project 224.03).

Discuss with Defence Department, Civil Aviation Authority and the aeromagnetic exploration industry, the need for additional geomagnetism services (more accurate runway bearings; 10s or 1s data from observatories).

Customers

Mineral exploration and petroleum industries

Civil Aviation Authority and commercial airlines

AUSLIG

Department of Defence

Ionospheric Prediction Service

AGSO's airborne and marine magnetic programs

Other users: surveyors, mariners, electronics industry

World Data Centres and the international scientific community

Polar Research Institute, Japan

Cooperating agencies

Australia

Australian Antarctic Division

Physics Department, Universities of Queensland

Physics Department, La Trobe University

Division of Wildlife and Rangelands Research, CSIRO

Ionospheric Prediction Service (Solar Observatory at Learmonth)

National Parks and Wildlife Service, N.T.

Research School of Earth Sciences, Australian National University

Mathematics Department, University of Sydney

School of Earth Sciences, Flinders University of South Australia

International

STEP program, Japan

DSIR Geomagnetic Observatory, New Zealand

Geological Survey, Papua New Guinea

Meteorological and Geophysical Agency, Indonesia

S.W. Pacific Island nations

U.S. Navy (Project Magnet, POGS satellite)

U.S. Geological Survey (INTERMAGNET, global field models)

British Geological Survey, Edinburgh, U.K (INTERMAGNET, production of global indices)

Canadian Geological Survey, Ottawa

Prof. R.T. Merrill, University of Washington

International Association of Geomagnetism and Aeronomy

Project 224.03 Palaeomagnetism

Project manager	Chris Klootwijk 06 249 9324
Program responsibility	Geophysical Observatories and Mapping
Time frame	1976–ongoing

Objectives

Improve our understanding of the tectonic evolution of the Australian and Antarctic plates, particularly with respect to orogenic, fluid movement, and mineral plumbing phases within regional and global plate tectonic frameworks.

Develop a magnetostratigraphic and chronostratigraphic framework for Australian sedimentary successions, and other rock units including the regolith.

Identify, correlate, and date major environmental (hence climatic) changes both onshore and offshore.

Relevance

Palaeomagnetic, rockmagnetic, magnetic fabric, and environmental magnetic studies provide unique contributions to the resolution of a wide range of geological problems related to the establishment of a geological framework for mineral and petroleum exploration and sustainable development.

The palaeomagnetic laboratory serves as a national facility as well as providing for the needs of AGSO. Maintenance and development of palaeomagnetic databases is essential for palaeomagnetic interpretations and investigations of the behaviour of the geomagnetic field.

Expected outcomes

The ability to date geological events such as periods of volcanism and sedimentation is important for mineral and petroleum exploration. Palaeomagnetic studies will result in additional dating techniques by determining improved Apparent Polar Wander Paths (APWPs) for different epochs and correlating on the basis of magnetic reversals.

Palaeomagnetic techniques can also be applied to determine past tectonic movements. These can be used to obtain a better understanding of the evolution of the Australian plate.

The main outcome is therefore an improved capability to analyse and understand the geological processes in the Australian region.

Activities

Carry out palaeomagnetic, rockmagnetic, magnetic fabric, and environmental magnetic investigations in support of AGSO projects and relevant external programs.

Undertake palaeomagnetic framework studies to enable reliable palaeomagnetic interpretations.

Maintain the Australian and Global palaeomagnetic databases. Seek international funding for development of a secular variation/polarity database.

Develop, upgrade and maintain palaeomagnetic data acquisition and analysis techniques.

Start investigating the importance of biogenic magnetite in marine sediments and coastal environments.

Provide a palaeomagnetic information and training service.

Maintain the Black Mountain palaeomagnetic laboratory as a national facility.

Expected products

Publication of research papers.

Special volume of extended abstracts of the Palaeomagnetism Seminar and the Third Geomagnetism Workshop in Exploration Geophysics.

Databases of Australian and global palaeomagnetic data and secular variation data.

Highlights for 1992/93

Results from the McArthur Basin study have

continued to attract attention as they indicate a promising technique for dating regional plumbing systems associated with mineral deposits. The palaeomagnetic technique can pick up events below the temperature threshold of current conventional radiometric methods. This makes the method highly relevant to the Proterozoic of northern Australia as the likely temperature field of sediment-hosted base metal deposits is less than 250°C. The potential of the method to identify distinct magnetization episodes, *ie* fluid movement phases, in a multi-component magnetization system, has been increased significantly through development of a cluster-analysis technique in conjunction with blocking temperature analysis.

Palaeomagnetic results from the Bird's Head (Kemum terrane), Irian Jaya, in conjunction with an upgraded late Palaeozoic reference APWP for Australia, confirmed geological arguments that favour derivation of the Kemum terrane from the north eastern margin of the Australian craton. They rule out models favouring a fixed position or large clockwise rotation in the Neogene.

The late Palaeozoic APWP for Australia has been updated through a new analysis of previously available data. Preliminary results from late Palaeozoic volcanics from the Tamworth Belt in conjunction with new SHRIMP dates have shown great promise for determination of the magnitude and timing of the Carboniferous southward movement of the New England Fold Belt, presumably as part of Neocratonic Australia.

Upgrading of the late Mesozoic–Cainozoic APWP for Australia has continued. Comparison with results from ferruginised glacigenic sediments from Western Tasmania suggests a pre-Pliocene, probably mid-Tertiary age for the ferruginisation, which is taken as a minimum age constraint for glaciation.

Magnetostratigraphic and mineral magnetic variations in sediment cores from ODP Leg 133, Great Barrier Reef slope region, have been interpreted with other ODP Leg 133 results to provide a comprehensive record of sedimentological responses to glacio-eustatic sealevel fluctuations and climate change during the past 1.4 Myr.

Palaeomagnetic studies of glacial sediments in Tasmania have helped to delineate three major periods of glaciation during the Late, Middle and probably Early Pleistocene — the *Margaret*, *Henty* and *Linda*. Sediment cores from Lake Johnson have provided an improved Holocene record of vegetation change in Tasmania.

A successful seminar on "Palaeomagnetism in Australasia: Dating, Tectonic, and Environmental Applications" was held at AGSO in conjunction with the Third Geomagnetism Workshop. The well attended and highly informative event brought together many users of palaeomagnetic data and the Australian palaeomagnetic community in two days of inspired discussions on the potential and limitation of palaeomagnetic methods and the needs and expectations of users of palaeomagnetic data.

Goals for 1993/94

Tectonic studies

Improve understanding of the tectonic framework of the hydrocarbon prospective Eastern Indonesian region by completing the study of the late Palaeozoic–Cenozoic APWP for the Bird's Head of Irian Jaya and elucidating the drift history of the Bird's Head.

Study Carboniferous and Permian ignimbrites from the Tamworth Belt, in order to constrain the tectonic evolution of the New England Orogen versus the Lachlan Orogen and to further define the late Palaeozoic APWP for Australia (see Project 112.05).

Age dating studies.

Study pilot samples from weathered profiles in the Gove region of Arnhem Land, from the east Kimberleys, from North Queensland, and from the Yilgarn craton in order to date these rocks (Regolith) whose ages cannot be otherwise constrained (see Projects 211.09, 211.10, 211.11 & 211.12).

Constrain the late Mesozoic-Cenozoic APWP for Australia as a means for dating the regolith by completing studies of the Strzelecki Group and the Browns Creek Clays.

Define the upper and lower boundary of the "Kiaman" Reversed Polarity Interval as a means of regional and global correlation, particularly for the Upper Permian Coal Measures of the Sydney and Gunnedah Basins. Write-up preliminary results (see Project 111.03).

Environmental Studies (see Project 242.02)

Constrain the climatic history of Antarctica and the Southern Ocean through palaeomagnetic studies of Prydz Bay cores.

Publish further palaeomagnetic results from ODP Leg 133, and undertake limited follow-up biomagnetic and rockmagnetic studies.

Collect cores from Tasmanian lakes to span the time interval between the Lake Johnson and Lake Selina records (Holocene, Last Glacial Maximum and previous interstadials) and undertake palaeomagnetic and rock magnetic analysis.

Reference Apparent Polar Wander Paths

Continue studies on Middle–Late Silurian volcanics and Early–Middle Devonian sediments of the Molong High and Cowra Trough. Results from these studies are important to solve the riddle of the Middle Palaeozoic APWP for Australia.

Upgrade the Palaeo-Mesoproterozoic APWP for Australia by study of Arnhem Land igneous rocks and the Stuart dykes of the Arunta Block, Central Australia as a basis for dating and correlation of rock sequences that cannot be otherwise constrained (see Projects 211.06 & 211.11)

Initiate studies in the McArthur Basin of 1700 Ma volcanism and the Roper Group, in order to constrain as yet badly defined segments of the Palaeo-Mesoproterozoic APWP for Australia (see Project 211.06).

Improve the late Palaeozoic APWP for Australia by publishing the results from the Mount Eclipse Sandstone of the Ngalia Basin.

Constrain the late Permian reference pole for Australia as a basis for interpreting the Bird's Head (Irian Jaya) data by studying the Milton Monzonite and Gerrigong Volcanics.

Complete the study of dyke sequences from the Vestfold Hills; Antarctica in order to constrain the Proterozoic APWP for Antarctica and Australia. Publish results.

Complete study of the NE Queensland volcanics to further constrain the late Palaeozoic APWP for Australia and to obtain a better understanding of overprinting and dating problems in regions with prolonged mineralisation activities. Publish results.

General Goals

Secure further international funding for the global secular variation/polarity transition database; begin accumulating records for the database and for analysis of zonal drift of the geomagnetic field.

Publish papers and extended abstracts of the Palaeomagnetism Seminar in a special volume of Exploration Geophysics.

Acquire and install an automated Alternating Field demagnetizer on the 2G–Enterprises cryogenic magnetometer.

Transfer the Global and Australian Palaeomagnetic Poles databases from PC–Oracle to the Corporate AViiON/Oracle platform to facilitate access by other AGSO program areas and interested users nationally

Customers

AGSO projects

Mineral Exploration Industry

Tertiary Institutions

Cooperating agencies

University of New South Wales, Prof John Roberts and Dr Paul Lennox

University of New England, Prof Brian McKelvey and Dr Peter Flood

Australian National University, Prof Mike Rickard

Newcastle University, Prof Brian Engel, Prof Klaus Diessel, Prof Konrad Moelle, and Prof Eric Calhoun

University of Wollongong, Prof Brian Jones, Dr Paul Carr, Dr Adrian Hutton

CSIRO, Dr Phil Schmidt, Division of Exploration Geoscience

University of Cergy-Pontoise, Dr Charlie Aubourg

University of Paris, Dr Herve Theveniaut

Geological Survey of New South Wales, Dr Erwin Scheibner and Dr Dick Glen

Geological Survey of Victoria, Dr Karin Orth

Geological Survey of Queensland, Dr Cec Murray

Australian Antarctic Division, Dr Pat Quilty

University of Sydney, Dr Mike Barbetti

University of Tasmania in Launceston, Dr Paul Augustinus,

Tokyo Institute of Technology, Dr Hidefumi Tanaka

International Association of Geomagnetism and Aeronomy

Institute for Antarctic and Southern Ocean Studies

Cooperative Research Centre for Antarctic and Southern Ocean Environment

242: ENVIRONMENTAL GEOSCIENCE

Objectives

Acquire the baseline geoscientific information necessary to understand and advise on the natural environment, including the land, prior climates and sealevels of Australia and its Territories.

Use this information to support ecologically sustainable development and management of the impacts of environmental change.

Relevance

BMR's strategic plan, developed in response to the 1988 Woods Review, listed among the purposes of the organisation *to participate in monitoring and developing an understanding of the natural environment.* This environmental concern was expressed in the Prime Minister's Statement on the Environment (issued in July 1989) which focussed on the need for accurate information on environmental issues.

The 1991 ASTEC Review of Environmental Science in Australia stressed the need for long-term strategies in providing baseline data necessary to manage key environmental issues.

The Richards Review gave strong endorsement to the activities of the Environmental Geoscience component. The Government accepted the Review Recommendation 3.3 by providing additional funding — to commence 1994/95 — to expand the scope of the NGMA to include a regolith and environment mapping accord.

Directives for compiling information on the coastal zone, on Antarctica, and for land degradation issues are treated separately under individual project headings.

Activities

Identify new environmental geoscience program directions for AGSO and establish a range of new clients.

Contribute to the CYPLUS program including coastal geoscience field operations along the east coast of Cape York Peninsula.

Development of the Cainozoic palaeoclimatic database.

Collaborative research with CSIRO to develop faster, more reliable methods of land degradation mapping using the Wagga Wagga 1:100 000 sheet area as the type target area.

Development of methodology to establish salt budgets involved in dryland salinity.

Compilation of Antarctic onshore geoscientific information and participation in the Cooperative Research Centre on the Antarctic and Southern Ocean Environment.

Compilation of the geology of selected National Park areas.

Highlights for 1992/93

Development of a new and more effective method of mapping near-shore submarine environments using LANDSAT Thematic Mapper data.

Significant progress in developing applications of airborne gamma spectrometric data for mapping aspects of surficial materials and land degradation.

Completion of coastal environmental geoscience data collection along the east coast of Cape York Peninsula as part of the CYPLUS project.

Pioneered development of a new geological map of Bunger Hills, Antarctica, incorporating Landsat imagery as the base.

Significant progress in compiling the Cainozoic palaeoenvironmental data of Antarctica and surrounding oceans.

Publication of the *Geology of the Canberra 1:100 000 sheet area*, Bulletin.

Three new publications in the geology of National Parks series:

- Uluru and Kata Tjuta — a geological history
- Geology of the Jim Jim Walking Trails, Kakadu National Park
- Geology of the Nourlangie Walking Trails, Kakadu National Park

Goals for 1993/94

Continue development of the geoscience component of a coastal zone database as a foundation for an integrated information resource that can be used to underpin policies on coastal zone management at a national level.

Produce an overview of the coastal environments of Cape York as a key element in the Cape York Peninsula Land Use Strategy.

Continue development of the relational database to bring together palaeoclimatic information from the Australian Cainozoic from a range of disciplines.

Continue development of a program of surficial mapping and research that will provide the baseline data essential to understand the value of airborne geophysical data for mapping soils and land degradation.

Lift the public profile of the earth sciences through the provision of maps, brochures, and posters featuring the geology of National Parks and prominent landforms.

Produce geological maps of selected areas of onshore Antarctica as a framework for the understanding and management of the region.

Implement programs relating to the history of the Antarctic environment, in order to better understand its role in global change.

ENVIRONMENTAL GEOSCIENCE

Component managers Colin Simpson 06 249 9368 Fax 06 249 9980
Chris Pigram (A/g) 06 249 9327 Fax 06 249 9986

Component projects

121.33	Cooperative Research Centre for the Antarctic and Southern Ocean Environment
121.37	Offshore Sydney Basin and NSW continental margin geochemistry and sedimentology
121.38	Continental margin processes and environmental change: framework studies of continental margin sediments
124.01	Australian Antarctic Territory continental margin
242.05	Antarctic onshore geoscience
242.01	Geological environment and resources of the coastal zone
242.02	Climate change, biostratigraphy and palaeoenvironments in the Australian Cainozoic
242.03	Land degradation studies
242.04	Geology of Australian National Parks
242.09	Cape York Peninsula Land Use Strategy [CYPLUS]

Project 121.33 Cooperative Research Centre for the Antarctic and Southern Ocean Environment

Project manager	John Marshall 06 249 9536 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1992–1998

Objectives

Achieve substantial improvements in the simulation of global climate and the prediction of climate and environmental change through the analysis of palaeoenvironmental processes in the Southern Ocean and Antarctica.

Enhance the knowledge base on which rational decisions can be made for Australian and international management and protection of the Southern Ocean and Antarctica.

Provide, by training post-graduate students, a significant pool of Australian scientists who are expert in the research fields associated with Antarctica and the Southern Ocean, and with broad environmental issues in general.

Involve Australian industry to the extent possible in commercial development of technical spin-offs from the CRC's research.

Relevance

Antarctica and the Southern Ocean hold fundamental keys to questions of global change. Records of the past preserved there provide information on the limits of variability in oceanic and atmospheric systems, and provide baselines against which to assess the impacts of human activity on the current environment. The Natural Variability Subprogram aims to provide statements of the Antarctic environment for time intervals back to about 5 million years, and to relate sedimentological and geochemical processes to past ocean circulation and climate.

The Australian Government has approved the formation of a number of Cooperative Research Centres, the first of which is the Cooperative Research Centre for the Antarctic and Southern Ocean Environment. One of the seven subprograms of the CRC is Natural Variability, which is involved with palaeoenvironmental investigations of the Antarctic continental margin and the Southern Ocean. AGSO, through the Marine Processes and Environment Group, and as one of the partners to the CRC is committed to this subprogram.

Expected outcomes

AGSO seen as providing a significant contribution to the CRC.

A definitive statement on past natural variability of the Antarctic and Southern Ocean environment is produced.

Activities

Setting up of infrastructure for AGSO participation in the CRC.

Recruitment of AGSO personnel to the CRC.

Equipment design and installation of marine geological gear on *Aurora Australis*.

Participation in research cruises of *Aurora Australis* in 1993 and 1995.

Setting up and running of laboratories in the Natural Variability Subprogram.

Expected products

Contributions to both national and international scientific journals on aspects of Antarctic and Southern Ocean environmental geoscience.

Highlights for 1992/93

CRC positions for a biogeochemist and micropalaeontologist were appointed.

AGSO position for a palaeoceanographer was filled.

A coring cradle was constructed and installed on the stern of RV *Aurora Australis*.

A corer and several grabs were manufactured for Antarctic work.

The Voyage 7 marine geoscience program collected 35 grab samples and 34 gravity cores. The number of cores was more than twice the number anticipated.

Preliminary stable isotope and biomarker results of the water column and sediments from Ellis Fjord show it to be a unique geochemical environment.

Results of isotope and trace element analysis of southern margin cores indicates significant changes in productivity between the last glacial maximum and the present.

A sea surface temperature calibration for cold water environments was determined from alkenone analysis.

Goals for 1993/94

Log and analyse cores collected from Voyage 7.

Interpret AGSO, plus Japanese and Russian seismic reflection data from Prydz Bay.

Analyse the water column and bottom sediments within Ellis Fjord, particularly with respect to stable isotopes and biomarkers.

Continue alkenone sea surface temperature calibration of water column and core tops from the Southern Ocean.

Determine changes in time of the Subtropical Convergence from the analysis of cores from the Chatham Rise and Kerguelan Plateau for stable isotopes and organic geochemistry (alkenones).

Analyse cores collected by RV *Rig Seismic* from the Southern margin of Australia for palaeoclimate and palaeoproductivity using stable and radiogenic isotopes and trace elements.

Prepare an ODP proposal for Southern Ocean palaeoclimate, including planning a site survey.

Interpret gravity, magnetics and ice thickness in the Enderby Land to Princess Elizabeth Land area.

Determine the relative age of moraines from colour air photography.

Compile offshore gravity and magnetic maps of eastern Antarctica.

Increased awareness of marine geoscience making a significant contribution to Antarctic environmental research.

Customers

Scientific community

Government departments developing policies on climate change, environmental matters and Antarctica (DPIE, DFAT, DEST)

Cooperating agencies

Australian Antarctic Division, DEST

Division of Oceanography, CSIRO

Bureau of Meteorology

University of Tasmania

Project 121.37 Offshore Sydney Basin and NSW continental margin geochemistry and sedimentology

Project manager	David Heggie 06 249 9589
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1992–1994

Objectives

Develop an understanding of the sedimentological and biogeochemical processes controlling the distributions of continental shelf and slope sediments and their chemical composition, with special reference to anthropogenic hydrocarbons and heavy metals.

Trace the distribution and dispersion, in seawater, of anthropogenic hydrocarbon inputs to the coastal waters offshore from a major population centre.

Contribute new information on stratigraphy

and petroleum source rock potential of the offshore Sydney basin.

Relevance

The coastal waters of Australia are, with population growth, under increasing stress because of increased discharges of industrial and urban wastes.

This program will use the continuous geochemical tracer and seafloor sampling capabilities aboard RV *Rig Seismic* to examine and document anthropogenic loadings of heavy metal and organic compounds into the coastal zone off Sydney, hence provide baseline data for environmental management purposes.

New information on the offshore Sydney Basin stratigraphy will contribute to new hydrocarbon exploration.

Expected outcomes

An understanding of the sedimentological and biogeochemical processes that control the distributions of sediments and their chemical compositions on the continental shelf offshore Sydney.

An understanding of estuarine/ocean exchange processes, and their implications for the dispersion of anthropogenic inputs into the coastal zone.

New information on the hydrocarbon prospectivity of the offshore Sydney Basin.

Activities

Consult with cooperating agencies to develop a survey program of direct hydrocarbon detection, vibrocoring and chemical analyses which will be conducted aboard RV *Rig Seismic* during 1992.

Processing and analysis of data and samples collected during the marine survey.

Production of AGSO Records and joint publications with cooperating organisations, using the results of the 1992 survey.

Dissemination of results to the Australian public through the AGSO publications series and other publications.

Expected products

AGSO Records

Joint publications (including maps) with Sydney Water Board, Sydney University and the NSW Geological Survey, on geochemical and sedimentological processes and the distributions of anthropogenic hydrocarbons, and heavy metals on the continental shelf.

Joint publications, with cooperating organisations, in the scientific literature.

Highlights for 1992/93

Demonstration of the continuous geochemical tracer capability aboard RV *Rig Seismic* to document the dispersion of anthropogenic hydrocarbons in coastal waters around major population centres.

Goals for 1993/94

Plan and conduct a survey aboard RV *Rig Seismic*.

Customers

State and Commonwealth Government agencies

Australian public

Sydney Water Board

Cooperating agencies

P Fagan, Dr J Hansen, Dr P Tate, P Schneider Environmental Projects Unit, Sydney Water Board

Dr G Birch, Dr C Jenkins, Dr J Keene, Sydney University

Dr P Roy, NSW Geological Survey

Project 121.38 Continental margin processes and environmental change: framework studies of continental margin sediments

Project manager	John Marshall 06 249 9536
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1992–ongoing

Objectives

Develop a sedimentological/geochemical framework and database to understand the major processes controlling deposition of continental margin sediments around Australia and its territories, particularly where they pertain to facies models, climatic change, environmental geochemistry and seafloor mineral occurrences.

Provide advice and information to both government and non-government agencies on marine environmental geoscience.

Relevance

The Continental Margins Program (CMP) has an extensive holding of core and dredge samples that can be used as a basis for research related to climate change, depositional facies, geochemical cycles, oceanography, pollution and seafloor minerals. The project aims to create a database to facilitate access to samples and information. Cooperative projects will be developed with universities and outside agencies using these samples and information as a resource.

The information and samples in the database will provide a resource for the provision of advice on marine environmental geoscience.

Synthesis of data collected in specific projects is required to answer questions of regional climatic change.

Expected outcomes

A regional understanding of the major processes controlling the deposition and accumulation of continental margin sediments, and their significance for climatic variability, pollution, and formation of seafloor mineral deposits.

A database of marine geology samples and analyses.

Advice to government and non-government agencies on marine environmental geoscience.

Activities

Establish and maintain a geological sample and core database of CMP samples and analyses.

In cooperation with universities, conduct palaeoenvironmental research on the continental margin utilising samples collected in CMP.

Provide advice on marine environmental geoscience issues.

Expected products

Maps, reports and publications relating to marine environmental geoscience investigations.

A database for continental margin sediments that can be utilised for facies analysis, environmental geochemistry, climate change, oceanography and seafloor minerals.

Goals for 1992/93

Design and implement a CMP sample database.

Prepare initial results on the palaeoceanography of the north eastern Indian Ocean.

Prepare advice as required.

Customers

Department of the Environment, Sport and Territories

Hydrographic Office, Royal Australian Navy

Australian universities

National Resource Information Centre, BRS, DPIE

Cooperating agencies

Y Tsuji, Technology Research Centre, Japan National Oil Corporation

J Hensen, Sydney Water Board

PJ Davies, Department of Geology and Geophysics, University of Sydney

Cooperative Research Centre for the Antarctic and Southern Ocean Environment

W H Veeh, Department of Earth Sciences, Flinders University of South Australia

D McCorkle, Woods Hole Oceanographic Institution

Project 124.01 Australian Antarctic Territory continental margin

Project manager	Howard Stagg	06 249 9343
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1982–ongoing	

Objective

Develop models of past and current processes which have operated in the offshore Australian Antarctic Territory (AAT), which are relevant to resource assessment and environmental management.

Provide geoscientific advice to support the resource and environmental management of the offshore AAT.

Relevance

This project is the principal Australian contribution to cooperative international geoscientific research in offshore Antarctica. The data which are compiled and interpreted also provide valuable background information for the environmental geoscience research of the Cooperative Research Centre for the Antarctic and Southern Ocean Environment.

Expected outcome

An understanding of the factors controlling the Antarctic environment and an ability to respond to requests for geoscientific advice relating to the resource and environmental management of the offshore AAT.

Activities

Develop an understanding of the structure, stratigraphy, and climatic evolution of the AAT, in particular the eastern sector of the AAT, which forms the conjugate feature to Australia's southern and southeastern margins.

Expected products

An established branch of the Antarctic Seismic Data Library System (SDLS) in Australia as a facility for Australian Antarctic researchers.

Collaborative scientific papers with Australian and overseas co-workers.

Highlights for 1992/93

Establishment of an Australian branch of the SDLS in AGSO. The SDLS is intended to incorporate all Antarctic offshore multichannel seismic (MCS) data into a digital library on CD-ROM that will facilitate national and international research in offshore Antarctica. The library has received the support of all nations acquiring MCS data in Antarctica. The first CD-ROMs, containing data from the Ross Sea, were received in AGSO in early 1993.

Data exchanges with Japan and Russia were finalised.

Goals for 1993/94

Expand the SDLS branch in AGSO with the incorporation of new data as they are transferred to CD-ROM.

Complete digital navigation data base for Prydz Bay region.

Continue involvment with Antarctic Offshore Acoustic Stratigraphy Project (ANTOSTRAT).

Customers

Cooperative Research Centre for the Antarctic and Southern Ocean Environment.

Cooperating agencies

Antarctic Division

US Geological Survey

Geological Survey of Japan

SEVMORGEOLOGIYA (St Petersburg)

Project 242.05 Antarctic onshore geoscience

Project manager	Bob Tingey	06 249 9608
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1954–ongoing	

Objectives

To develop and document a comprehensive geoscientific understanding of areas of bedrock exposure in the Australian Antarctic Territory, and to apply this towards achieving a broad appreciation of the geology of the much more extensive icecovered parts of the continent, and of geological relationships with Australia.

To develop an improved understanding of the geological history of the Antarctic icecap, and its role in global change.

Relevance

This project contributes to the scientific program of the Australian National Antarctic Research Expeditions (ANARE) in accordance with guidelines approved by the Antarctic Science Advisory Committee for its *Natural Environment* priority area. It also contributes to the Antarctic-wide programs of the Working Groups on Geology and Solid Earth Geophysics of SCAR (the international Scientific Committee on Antarctic Research) and related Groups of Specialists. Field and research activities in the Australian Antarctic Territory are a tangible expression of Australia's presence in its Antarctic Territory and to its commitments under the Antarctic Treaty.

Expected outcome

A better understanding of the geological framework of Australian Antarctic Territory.

The provision of baseline geoscience information necessary to monitor changes in the environment of Antarctica.

Activities

No Antarctic fieldwork is planned for AGSO geologists in the 1993/94 summer field season.

The Project Manager will be involved full-time on Antarctic work and will deal with administration and co-ordination as well as compiling maps and writing, reviewing and editing publications.

Expected products

Regional geological maps and appraisals of outcrop areas in the AAT published as AGSO bulletins, and drawing together the results of AGSO and University research. Papers of particular scientific interest will be published in national and international journals.

Databases: geochemical, geochronological, and palaeomagnetic data are archived in appropriate databases.

Highlights for 1992/93

The monograph *The Geology of Antarctica* edited by the Project Leader and published late in 1991 by Oxford University Press [see 1992/93 Work Program] has been reviewed favourably in several journals.

Successful drafting with the Intergraph computer-aided drafting facility of the 1:250 000 scale geological map of the Bunger Hills–Denman Glacier area on to a base of rectified Landsat MSS digital data.

Acquisition and reinterpretation of Soviet Antarctic Expedition geophysical data from the Enderby Land/Prince Charles Mountains region. The former Soviet Antarctic Expedit-

ion had the capability to acquire geophysical data over large areas of Antarctica. However, AGSO can apply its superior computing facilities to produce a more sophisticated interpretation of the data..

Substantial progress with a sub-project on the Cainozoic Palaeoenvironment of the Antarctic region. Data from a very wide range of sources has been compiled in Stratigraphic columns that will permit the selection of time slices that are particularly suitable for the preparation of Palaeogeographic maps. To date, emphasis has been given to the Pliocene to Quaternary interval because of the controversial nature of its glacial history and its relevance to possible anthropogenic climate change.

Goals for 1993/94

Publication of a regional geological map and appraisal of the Bunger Hills–Denham Glacier area.

Substantial progress in compiling a regional geological map and appraisal of the northern Prince Charles Mountains by drawing together the results of detailed studies undertaken in the past several years by AGSO and University geologists.

Compile and arrange publication of a geoscience transect extending from the Gamburtsev subglacial Mountains to Prydz Bay via the Lambert-Amery Graben and Prince Charles Mountains as a contribution to the work of the SCAR Group of Specialists on the structure and evolution of the Antarctic Lithosphere and to the Geoscience Transects project of the International Lithosphere Program.

Publish results of reinterpretation of Soviet airborne geophysical data over the Enderby Land/Prince Charles Mountains region in cooperation with geoscientists of the organisation that will replace the former Soviet Antarctic Expedition.

Contributions to the operation of the ASAC research grants scheme, the work of AREG (the Antarctic Research Evaluation Group), ANCAR (the Australian National Committee for Antarctic Research), and SCAR.

Provision of geoscientific advice on Antarctic matters as required.

Customers

Australian National Antarctic Research Expeditions

Australian Antarctic Division (DEST)

Antarctic Science Advisory Committee (ASAC)

The international and national Antarctic and geoscientific communities

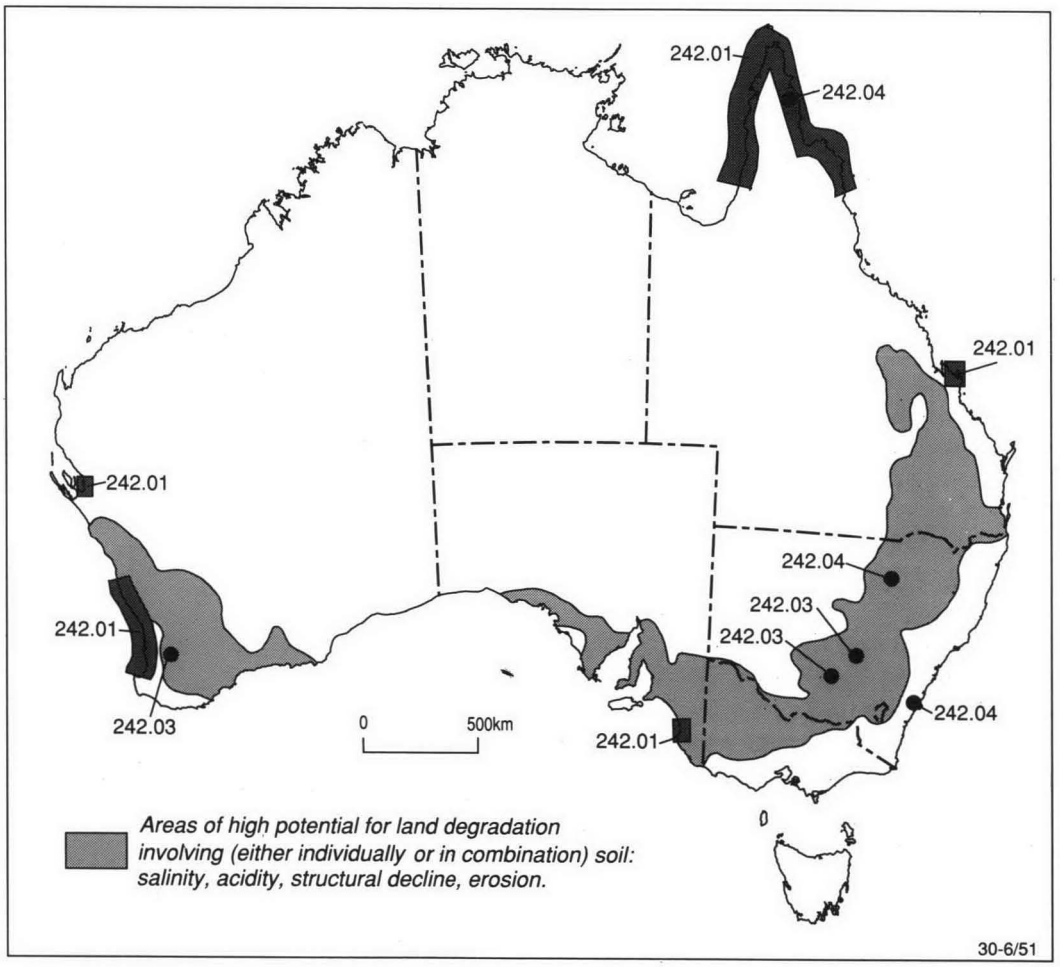
Cooperating agencies

Australian Antarctic Division — logistic support for fieldwork

Cooperative Research Centre on the Antarctic and Southern Ocean Environment — information, joint research

The following universities provide data, information and samples:

- Australian National University
- University of Adelaide
- Edinburgh University
- Macquarie University
- Melbourne University
- Newcastle University
- University of New England
- University of New South Wales
- Sydney University
- University of Tasmania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500km
Areas of high potential for land degradation involving (either individually or in combination) soil: salinity, acidity, structural decline, erosion.
30-6/51

Project 242.01 Geological environment and resources of the coastal zone

Project manager	Bob Burne	06 249 9291
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1990–ongoing	

Objectives

Provide the baseline geoscientific data and interpretations necessary for integrated management of the Australian coastal zone, including conservation, the impacts of resource use, developmental and recreational pressures, and environmental change.

Relevance

The need for basic data compilation and research to underpin management of the coastal zone was recognised in the Prime Minister's Statement on the Environment [1989]. Following the 1988 Woods Review, the BMR strategic plan included responsibility for the study of geoscientific aspects of the environmental impacts of resource development in the Australian Coastal Zone.

The Committee report of the House of Representatives' Inquiry into the Protection of the Coastal Environment [1991] made recommendations pointing to the need for national and regional databases to allow for better decision making, planning and management of the coastal zone.

Similar recommendations were made by the 1985 Workshop on Coastal Geoscientific Studies and by the 1989 IGBP Planning Meeting on Sea Level Change. The development of such national information systems is a priority recommendation of international organisations such as UNEP, IUCN and IPCC.

Expected outcomes

Geoscientific data and knowledge relating to the Australian coastal zone (defined to include inner shelf areas offshore and Quaternary and Tertiary tracts of marine and coastal origin onshore) to facilitate the development of management and environmental policies at the national level.

Activities

Research on the geoscientific evolution of the Australian Coastal Zone. In addition to new research, existing information on coastal zone geology is being compiled. Areas where existing information or understanding is inadequate for management needs are being identified and programs of geological mapping to fill information gaps will be designed and implemented as funds permit.

Assessment of the extensive body of existing coastal geoscience data, held by Commonwealth, State and academic organisations, for its relevance in understanding coastal geoscience nationwide.

Classification and modelling studies of aspects of coastal environments.

Development of methodology to make full use of the advanced image processing and GIS capabilities of AGSO, particularly the ability to integrate processed satellite imagery directly into GIS.

Processing of satellite image data for the entire Australian coastline as part of a longer term program to produce enhanced imagery of coastal geology, vegetation and environments. Emphasis is on water penetrating characteristics to reveal offshore substrate variation to a depth of 40 m in clear water, suspended sediment transport, and organic material in the water column. The 30 metre pixel resolution of Landsat TM allows information to be displayed to a maximum scale of 1:50 k. This information is being augmented by imagery from other satellites and aircraft scanners as appropriate.

Classification of enhanced satellite images to provide inventories of ecosystems or resources of particular interest (eg, sea grass, mangroves, reefs, sand and gravel deposits). The long-term aim is that in conjunction with

co-operating organisations other information levels will be compiled for bathymetry/topography; hydrology; geomorphology; ecology; vegetation; oceanography; lithology; stratigraphy and anthropogenic structures. Classifications will be verified by field ground-truth studies.

Expected products

GIS of the geoscience component of the Australian coastal zone and key areas of topical interest.

Maps, datasets and scientific papers on specific areas.

Advice to policy-making sections of Government.

Highlights for 1992/93

Field operations along the east coast of Cape York Peninsula as part of the CYPLUS project were successfully completed.

Resource Assessment Commission GIS feasibility study successfully completed and compilation of trial material continuing.

Further developed shallow water sea floor mapping and bathymetric mapping using remote sensing.

Goals for 1993/94

Undertake a detailed investigation of selected study areas on the west coast of Cape York Peninsula as part of the CYPLUS coastal zone investigations.

Advance development of the national coastal and marine geoscience information system.

Develop research techniques for image processing and GIS applications relevant to coastal geoscience.

Develop strategies for research into the geoscientific evolution of the Australian Coastal Zone.

Continue development of geoscientific guidelines for management strategies for the Shark Bay World Heritage area.

Provide research publications and educational and information materials for the general public.

Customers

NRIC

RAC

CSIRO

Western Australian government agencies

South Australian government agencies

Geological Survey of New South Wales

Queensland Department of Resource Industries

Cooperating agencies

NRIC

CSIRO

DEST

Resource Assessment Commission

Western Australian Government agencies

- Department of Conservation and Land Management
- Department of Planning and Urban Development
- Geological Survey
- Marine and Harbours
- Environmental Protection Authority

South Australian Government agencies

- Department of Environment and Planning
- Department of Mines and Energy

Geological Survey, New South Wales

Mines Department, Queensland

Sydney University

Australian National University

Curtin University

University of Western Australia

Queensland University of Technology

Flinders University

Project 242.02 Climate change, biostratigraphy and palaeoenvironments in the Australian Cainozoic

Project manager	Liz Truswell	06 249 9427
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1990–2000	

Objective

To enhance understanding of the processes of climate change through reference to the geological record and to provide time control on processes operating in the Cainozoic.

Relevance

Concern about the impacts of global change has been expressed in the development of range of government policies, including the National Greenhouse Strategy and Ecologically Sustainable development. Both policies have stressed the need to improve the information base relating to predicted climatic change and its impacts. At the international level, the International Geosphere–Biosphere Program (IGBP) has been established to improve scientific understanding: Australia is a participant in that program. The National Greenhouse Advisory Committee was established to advise on priorities for relevant research. Project 242.02 is part funded, to 1994, through a grant to an ANU–CSIRO consortium. Further funding is being sought for the triennium to 1996.

Expected outcomes

An enhanced understanding of the range of natural climatic variability in the Australian region, and an improved ability to predict the nature of change under enhanced greenhouse conditions.

A better understanding of environments in the Australian Cainozoic, and of the manner in which these affected a range of geological problems, including landscape development and groundwater issues.

Activities

Use past records of change to determine the natural range of climatic variability.

Use data from the recent geological past to test and improve the performance of current climate models.

Develop and apply biochronologic frameworks for the Cainozoic.

Develop a relational database to integrate chronological, palaeoclimatic, palaeobiological and palaeohydrological data for a number of time intervals in the Quaternary and Tertiary: translate this information into map formats to test climatic models.

Examine impact of volcanism on climatic change.

Expected products

Database of past climate change, bibliography, research papers, palaeoclimatic maps, inputs to policy issues.

Highlights for 1992/93

Overall database structure developed: pilot scheme moved to AViiON.

Database plan presented at Australian and international workshops aimed at focussing Australian input to IGBP subprojects PASH (Palaeoclimates of the Southern Hemisphere) and PANASH (Palaeoclimatic correlation of Northern and Southern Hemisphere).

Links established with NOAA World Data Centre A [palaeoclimatology].

Review of Australian Tertiary vegetation history and climatic influences presented as the Burbidge Memorial Lecture.

Papers published on Quaternary records from Tasmanian lakes, from work commenced in 1991.

Goals for 1993/94

Complete database design and undertake major data input.

Establish formats for palaeoclimatic maps, and place of database activity in Australian program for the IGBP core program PAGES.

Synthesise a palynostratigraphic scheme for the Tertiary Murray Basin, in support of groundwater projects.

Undertake preliminary analyses of Cainozoic biostratigraphy and environments in central Australian basins.

Develop discussion paper on the contribution of the earth sciences to understanding climate change.

Continue monitoring of lake levels in Lakes Bathurst and George and complete overview of the history of Lake Bathurst.

Extend the Quaternary record of environmental and geomagnetic change in Tasmanian lakes.

Customers

Policy makers within DPIE and other government departments including DEST and DEET.

Climatic modellers within academic institutions.

International climate-related programs including IGBP.

Biologists in university and government departments.

Cooperating agencies

Dept of Geology, ANU — information, staff.

Dept Biogeography and Geomorphology, ANU — information

Division of Water Resources, CSIRO — information

Dept Geography and Environmental Science, Monash University — information

Dept Geography, University of Newcastle — information

National Greenhouse Advisory Committee — funding

Project 242.03 Land degradation studies

Project manager	Colin Simpson	06 249 9368
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1990–ongoing	

Objective

Provide baseline geoscience data essential to understanding land degradation processes.

Relevance

Losses due to soil degradation are estimated at around $600 m annually. The Prime Minister's Statement on the Environment (1989) noted the need for improved resource management and instituted a variety of programs (National Soil Conservation Strategy, Landcare, Natural Resources Management Strategy of the Murray Darling Basin) to mitigate impact of degradational processes. AGSO's program provides geoscientific understanding necessary to develop appropriate management strategies.

Expected outcomes

An enhanced understanding of the way in which human activity interacts with geological processes leading to land degradation.

An ability to predict the distribution of attributes of land degradation within particular landscapes.

Understanding of potential salt budgets in lands of the Darling River Catchment.

Activities

Morphostratigraphic and regolith mapping emphasising geomorphological, hydrogeological and stratigraphic relationships of surficial deposits, weathered profiles and soil cover in areas of land degradation. Initial areas of focus will be in the Murray–Darling Basin.

Investigation of airborne radiometrics and remote sensing as aids to mapping and monitoring land degradation.

Expected products

Improved methods of rapid mapping and monitoring of degraded lands.

Geoscientific advice to allow development of appropriate management strategies for alleviation and prevention of land degradation.

Geomorphic maps, including GIS format, at scales to be determined.

Methodology for rapid mapping and degradation assessment.

Highlights for 1992/93

Continuation of co-operative project with CSIRO Division of Soils, NSW Conservation and Land Management, Charles Sturt University and Centre for Resource and Environmental Studies at ANU in the Wagga Wagga 1:100 000 Sheet area.

Identification of potentially valuable relationships between specific land degradation and signatures on airborne radiometrics.

Continuation of the regolith component of the Cape York Peninsilua Land Use Strategy, including assessment of land degradation potential and the role of airborne geophysics, collaboratively with BRS.

Goals for 1993/94

Build a long-term strategy for coordinated land degradation mapping.

Advance the soils-related project in the Wagga Wagga 1:100 000 sheet area.

Advance the Boorowa River Catchment dryland salinity study.

Customers

NSW Conservation and Land Management

Commonwealth departments (DPIE, DEST) concerned with strategic planning and policy development in land use

CSIRO Division of Soils

Educational institutions with research programs requiring geomorphic information

NSW Forestry Commission

Cooperating agencies

Division of Soils, CSIRO — staff, funds

Bureau of Resource Sciences — information

NSW Dept of Conservation and Land Management — staff, information

Project 242.04 Geology of Australian National Parks

Project manager	Liz Truswell	06 249 9427
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1990–ongoing	

Objectives

Lift the public awareness of geology, and of the earth sciences as a positive contributor to environmental issues.

Provide information for use in park management and educational programs.

Relevance

The Convention concerning the Protection of the World Culture and Natural Heritage (the World Heritage Convention) was ratified by Australia in 1974. To qualify for World Heritage listing, nominated properties must satisfy four criteria: of these, two are primarily geological. In addition to provision of information in this context, ongoing public education in geology will provide a more informed debate on land use issues. National parks provide a key point of contact with the public on geological issues.

Expected outcomes

Increased public awareness of the geological foundations of Australian wilderness areas.

Increased recognition of the role and particular perspectives of geology in environmental

issues.

Activities

Provide well-written accounts, in a popular style, of the geological framework of Australia's national parks, including booklets, brochures and maps with accompanying text.

Provide baseline information on geology for use in park management.

At present the project is drawing on information already gathered in the course of mapping and research projects. Considerable effort has been expended in putting this information into an attractive, readable format.

Expected products

Booklets, brochures, posters, maps and videos, designed to reach a wide audience.

Geological information in formats appropriate for park management.

Highlights for 1992/93

The book on the geology of Uluru and Kata Tjuta was published in January 1992 and, on numbers sold, has topped AGSO's publication sales since its release. It was widely reviewed in the press.

The book on the Warrumbungle Volcano has been published.

The brochure on the Iron Range National Park has been published.

Two Records were produced on the geology of the walking trails in Kakadu — that is, on the Jim Jim Falls and Nourlangie areas.

The geological map of Jervis Bay is being drafted.

Two chapters were written as a contribution to a book on the environment of Jervis Bay.

Goals for 1993/94

Publish the map on the geology of Jervis Bay.

Continue with development of an effective marketing strategy for products already published or close to publication.

Develop a popular book on Kaputar National Park, NSW.

Produce poster on Warrumbungles (contingent on joint funding with NSW National Parks).

Explore geological needs of Queensland Wet Tropics World Heritage area

Develop input into Lake Eyre Basin (if the Basin is nominated for World Heritage listing)

Convene a workshop with park managers to develop future directions for project

Customers

Australian Nature Conservation Agency [formerly Australian National Parks and Wildlife Service] — advice, assistance in marketing

NSW National Parks and Wildlife Service — advice, marketing assistance, joint funding proposal

Qld Wet Tropics Management Authority — joint funding proposal

DEST — Information on Lake Eyre

Cooperating agencies

The public

Tourist industry, especially tour operators

ANCA (ANPWS)

Environmental organisations

World Heritage Unit, DEST

Project 242.09 Cape York Peninsula Land Use Strategy (CYPLUS)

Project manager	Liz Truswell	06 249 9427
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1992-1994	

Objective

To develop the baseline geoscientific data necessary to evaluate the potential resources of Cape York Peninsula, and present the information in formats, including GIS, that can be used by policy makers in framing a strategy for sustainable land use in the Peninsula.

Relevance

The Cape York Peninsula Land Use Strategy was developed jointly between the Commonwealth and Queensland governments as a means of determining future land use options for the region. The first phase of the project commenced in January 1992, with the collection of baseline data under the Natural Resources Assessment Program (NRAP), with funding by the Commonwealth and Queensland. AGSO's major involvement is in this phase. During 1992, a Task Force was established to manage the program, under the Queensland Dept of the Premier and Economic Development.

A program of Public Participation has been set in place to channel public input into program directions. Programs to be developed under Phases II and III will involve assessments of resources, conservation aspects, and the development and implementation of the land use strategy.

Expected outcome

An understanding of the physical environment and resources of the Cape York Peninsula, including economic and conservation resources, as a basis for future land use planning.

Activities

Activities undertaken by AGSO, under the NRAP program, include, with their aims:

Project No:

- NR05 — Bedrock Geological Data; Digitising and Integration

  To provide a digital geological map database using existing geological data, and incorporating NGMA information as this becomes available [refer 211.09].

- NR12 — Regolith Terrain Mapping

  To enhance the AGSO Regolith Terrain Mapping program with the addition of digital data and field mapping of the Rutland Plains, Hann River and Cooktown 1:250 000 sheets [refer 211.09].

- NR14 — Coastal Environment Geoscience Survey

  To produce a geoscientific synthesis of the evolution and character of the coastal zone of Cape York [refer 242.01].

- NR15 — Airborne Geophysical Survey

  To compile airborne magnetic and gamma-ray spectrometrics and gravity data into forms suitable for insertion into GIS [refer 221.01].

- NR16 — Water Resource Investigation (Jointly with Queensland Water Resources Commission)

  To investigate the nature, extent and availability of groundwater resources in CYP and relate these to surface water resources [refer 241.08].

Expected products

Digital map data for Cape York, on regional geophysics, bedrock geology, regolith, groundwater, and the coastal geology. Appropriate layers within a GIS being developed by NRIC (and by Queensland Dept of Lands): written reports on aspects of this information.

Highlights for 1992/93

Commencement of the projects with the release of funds in February 1992.

Substantial progress made in digitising existing maps of bedrock geology; draft achieved of levelled data for magnetics and gamma-ray spectrometrics.

Field work undertaken for regolith and groundwater projects.

Cruise completed in support of coastal geology project, September 1992, jointly with QDRI.

Participation in CYPLUS reporting and planning workshop, December 1992.

Memorandum of Understanding relating to data management signed, April 1993.

Goals for 1993/94

Completion of field work for regolith, coastal zone projects.

Completion of all digital map products, including bedrock geology and regolith, and entry of data into GIS.

Completion of levelling for all airborne geophysical and gravity data.

Completion of groundwater survey in conjunction with Qld Water Resources Commission.

Customers

Commonwealth Govt, including DEST & DPIE

Queensland State Government and agencies

Cape York community

Cooperating agencies

The CYPLUS Steering Committee (to be replaced by the Intergovernmental Management Committee) — funding

The CYPLUS Task Force — Management and direction, especially through the Director, NRAP (Natural Resource Assessment Program)

DPIE Land Resources Branch — financial management

Queensland Dept of Resource Industries — staff

Queensland Dept of Primary Industry — information

Queensland Water Resources Commission — joint operations

NRIC — GIS applications

DEST — Joint policy development

A wide range of agencies and groups are involved in 20 projects, with good information exchange between them.

261: DATABASE COORDINATION AND RESEARCH

Objectives

Better coordination of AGSO database activity with other government geoscience organisations in Australia.

Liaison with other appropriate national and international organisations.

Improved use and integration of geoscience databases through appropriate research.

Relevance

The activities within this component are designed to satisfy two broad requirements. Firstly, data from AGSO's research projects must be readily available in a useable format to government, industry and researchers. Secondly, geoscience database activity in government organisations in Australia must be coordinated so as to avoid unnecessary duplication of effort.

A key element in these activities is the development and use of standards both in relation to AGSO's national databases, and also in relation to the geoscience data themselves. This is to facilitate the exchange and effective use of data for exploration, research and resource assessment, such as is required under the NGMA.

Proper coordination of AGSO's data also assists in increasing the organisation's income through the sale of databases and value added products which are targeted at clients' needs.

Activities

Promote the use of the national resources data directory, the custodianship and integration of databases, and database standards for government geoscience data projects.

Support better institutional arrangements at the policy level for information management.

Liaise with overseas, State and Territory geoscience agencies, through direct contact, committee work and technical meetings.

Conduct research into integrating procedures for various geoscience data types.

Highlights for 1992/93

The Information Systems Branch (ISB) provided technical and managerial advice to the Richards Review Committee on the structure and management of the nat-ional Oracle geoscience databases, which needed to be administered by AGSO and BRS in some coordinated manner. The ISB continues to manage geoscience databases on behalf of both AGSO and BRS.

AGSO was represented at several national and international geoscience database/computing meetings, and contributed to committee work.

Geoscience data standards were pursued through GGDPAC, continuing sponsorship of the AMIRA AMDEX project, and membership of AUSDEC and POSC.

AGSO contributed to the development of the CSDC's draft Commonwealth Spatial Data Transfer Policy and the draft ANZLIC National Policy for Transfer of Land Related Data.

Staff contributed to the design, enhancement and documentation of many national geoscientific databases.

Procedures were developed for integrating images, maps, and data from GIS and relational databases on workstations and PCs.

Goals for 1993/94

Undertake planning and client contact associated with developing a strategic plan and an implementation plan for the newly announced National Geoscientific Information System Program, in consultation with an Advisory Committee.

Assist the BRS where possible in its newly funded task to set up a digital management and preservation system to give access to the Commonwealth's geophysical data holdings in the Villawood Archive.

Continue representation on national and international geoscience data-related committees (ICGSECS and COGEOINFO), to contribute to data standards development and to monitor

software technology developments. Attend the GeoInfo V conference, Prague.

Represent AGSO at relevant national forums and conferences relating to database coordination and research. Participate in AURISA seminars.

Update the geoscience database directory, through the National Resource Information Centre's NDAR system.

Refine methods for the routine integration of image, GIS and mapping data between systems.

Develop draft data standards for geoscience data, in conjunction with States/industry.

Develop new and existing Oracle databases (standards, NGMA, environmental), and provide online external access.

Develop a unified interface to AGSO's databases.

Develop a project for the digital capture and management of inaccessible and at-risk geoscience records, images and maps of value.

DATABASE COORDINATION AND RESEARCH

Component manager David Berman 06 249 9602 Fax 06 249 9977
email dberman@agso.gov.au

Component projects

261.01	Database Coordination and Liaison
261.02	Integration of Geoscientific Data Sets
261.03	Data Management
261.04	Database Administration
261.05	National Geoscience Database Development

Project 261.01 Database Coordination and Liaison

Project manager	David Berman	06 249 9602 Fax 06 249 9977 *email dberman@agso.gov.au*
Program responsibility	Information Systems	
Timeframe	1984–ongoing	

Objectives

Improve geoscience database development, coordination and liaison at three levels:

- within AGSO, so as to maximise the usefulness of AGSO's geoscience data, and to facilitate the integration of different data types by AGSO scientists and external clients;
- among government, industry, research, education and interest groups in Australia, to avoid duplication of effort, to promote the development of standards, and to facilitate access to geoscience data held by various groups;
- at the international level, to be the focus for Australian cooperation with organisations involved in geoscience data.

Relevance

Effective mineral and petroleum exploration, research, and informed decision-making on natural resource management issues relies on the ready availability of a wide range of geoscientific data.

BMR was given the responsibility in 1984 for "coordinating government geoscience database activities" by AMEC (now ANZMEC). AGSO is now the lead agency for Commonwealth geoscience data and custodian for many national geoscience databases.

In 1993 Budget, the Government reacted to a recommendation of the Richards Review of AGSO by funding the establishment of a National Geoscientific Information System Program, commencing 1994/95 (recommendation 3.4, Appendix A).

Expected outcomes

Nationally and internationally agreed standards and procedures for the definition of, and access to, geoscience data will be developed.

Activities within the project, such as the coordination and development of national databases, also facilitate the development of quality database-related products by other programs, agencies and clients.

The project also contributes to enhancing AGSO's national and international standing in geoscience database and related computer applications.

Activities

Within AGSO, coordination is undertaken to promote the development of consistent, interdependent databases, and systems that can access these in an integrated manner.

The project liaises with counterpart State Survey developments in database and related information systems developments. The primary mechanism is through the Government Geoscience Database Policy Advisory Committee (GGDPAC).

Consultation is also undertaken with other natural resource and environment database related activities of government (NRIC, ERIN), industry, and internationally.

Expected products

A strategic plan will be developed and implemented for the delivery of the NGIS Program, to commence in 1994/95, in accordance with the considered views of stakeholders.

Presentations, workshops, articles, and reports to clients on developments in national geoscience databases, and planning for an Australian National Geoscientific Information System (ANGIS), as the primary output of the NGIS Program.

GGDPAC advice to Chief Geologists on questions of database coordination and liaison, data storage and standards.

Commonwealth policy on questions of spatial

data pricing, transfer and custodianship, related to AGSO and DPIE needs and priorities.

Highlights for 1992/93

AGSO continued to be represented on the GEOPAC Advisory Council, its Executive Committee, and on the AESIS Advisory Committee. It also maintained its substantial financial support of AESIS (managed by the AMF), and contributed to the financial sponsorship of AMIRA's AMDEX project (mining data exchange standards).

AGSO continued to chair GGDPAC and to provide its secretariat. GGDPAC promoted 'open systems' principles and the development of data-type standards through its working group on geoscience data standards, and through the GEODEX proposal. The committee also considered an issues paper on contingency plans for maintenance of the AESIS database.

AGSO represented Australia in 1993 at meetings in Germany of ICGSECS, and COGEOINFO and in Sri Lanka at an ESCAP workshop on mineral and commodity databases.

During the year AGSO joined the Petrotechnical Open Software Corporation (POSC), began contributing to POSC working groups, and publicising POSC activity.

Coordination visits to the NSW, NT and Victorian Geological Surveys were also undertaken, to discuss database and GIS issues.

Goals for 1993/94

Undertake planning and client contact associated with developing a strategic and implementation plan for the newly announced National Geoscientific Information System Program, in consultation with an Advisory Committee.

Continue to assess the long term storage problems of geoscientific data held by governments, and suggest strategies for its preservation, based on developments in mass storage systems, through GGDPAC.

In particular, assist the BRS where possible in its newly funded task to set up a digital management and preservation system to give access to the Commonwealth's geophysical data holdings in the Villawood Archive.

Coordinate Australia's contributions to the new IUGS COGEOINFO subcommission; in particular chair the working group on Exchange of Geoscience Information.

Update and extend the coverage of geoscience data in the National Directory of Australian Resources. Encourage AGSO data custodians to maintain their own entries in NDAR.

Set up technology agreements and coordinate database development with ERIN and NRIC.

Foster the development of national geoscientific databases, particularly those supporting geoscience standards.

Open some AGSO geoscience standards databases and authority tables to on-line access from outside AGSO.

Promote support for the industry AMDEX project, the proposed GEODEX geoscience data attribute standards project, and the forthcoming Australian Spatial Data Transfer Standard.

Coordinate the ongoing introduction of GIS technology to AGSO and improve its integration with other AGSO computing systems.

Support the development and implementation of government policy in the areas of custodianship, cost recovery, and access to resource and environmental databases.

Customers

AGSO Programs

Chief Government Geologists Conference

State Geological Surveys/Mines Departments, and AGSO projects

Industry, research, educational and private interest group organisations.

Cooperating agencies

Commonwealth Spatial Data Committee (CSDC)

Coordinating Committee on Science & Technology (CCST, in PM&C)

- working group on Coordination of Resource & Environmental Databases

National Resource Information Centre (NRIC)

Environmental Resources Information Network (ERIN)

Bureau of Resource Sciences (BRS)

State Geological Surveys/ Mines Departments

Australian Mineral Foundation (AMF)

Australian Mineral Industry Research Association (AMIRA)

Australian Geoscience Information Association (AGIA)

AUSDEC

ESCAP

USGS

IUGS Subcommission COGEOINFO

International Consortium of Geological Surveys for Earth and Computer Sciences (ICGSECS)

Petrotechnical Open Software Corporation (POSC)

Project 261.02 Integration of Geoscientific Data Sets

Project manager Prame N Chopra 06 249 9540 Fax 06 249 9977
email pchopra@agso.gov.au

Program responsibility Information Systems

Timeframe 1988–ongoing

Objectives

Develop methodologies for the integration of geoscientific information held in AGSO's corporate database computer, image processing centre, geographic information system, digital cartographic facilities, and other computing devices. Provide effective procedures for exchanging different data types between the facilities. Provide techniques for integrating, querying, displaying and editing of the information on a variety of local workstations.

Relevance

The integration and consequent interpretation of geoscientific datasets is necessary, firstly for the development of new concepts which may lead to the discovery of new mineral and petroleum occurrences and, secondly, as an aid to decision-making in the resolution of land-use issues. The development of methodologies for the integration of different types of spatially-related datasets is thus a significant objective of AGSO's geoscience database research. These datasets can be very large (e.g. satellite data), dynamic, and of variable quality. The development of effective methodologies therefore requires a multi-disciplinary approach involving geoscientific, computing, mathematical and statistical expertise.

Expected outcomes

Standard procedures being used by AGSO Programs to integrate AGSO's geoscience data and manipulate AGSO's main spatial IT systems remotely over AGSOnet.

AGSO Programs developing new integrated products based on the methods demonstrated and prototypes produced — for example, the Ebagoola 1:250 000 integrated dataset.

Activities

Methodologies for the integration of AGSO's existing spatial information technology systems, and the data that they hold are being researched. These methodologies will be trialed through pilot projects conducted jointly with other AGSO Programs.

New developments are evaluated as they arise and those of potential value to AGSO will be implemented as needs dictate.

The current status of 3D data models will be further investigated as a basis for planning AGSO's future involvement.

Expected products

Prototype integrated products, including a new digital terrain model based on airborne data. New procedures documented for combining geoscience data in AGSO.

Highlights for 1992/93

Procedures were developed to integrate the ER Mapper image processing system into

AGSO's spatial IT environment (Record 1992/99). These procedures were demonstrated in a pilot project using data from the Ebagoola 1:250 000 mapsheet (Record 1993/37).

Data links between AGSO's corporate GIS and relational database systems were established using the Oracle SQL*Net software module (Record 1993/12). The capabilities of current 3D GIS systems were explored (Record 1992/86).

Issues raised in integrating geoscience datasets stemming from conflicts in data structure, differences in processing requirements and contrasts in the level of sophistication of current hardware and software systems were canvassed in a paper.

A practical example of data integration using AGSO data on Canberra was demonstrated to the public during the National Science Festival.

Goals for 1993/94

Investigate the value of scientific data visualisation software in developing new AGSO data products.

Evaluate the potential for installing distributed image and parallel processing software within AGSOnet (Khoros, PVM).

Evaluate the potential for integrating expert system software with AGSO's GIS system.

Set up pilot data integration projects with other AGSO Programs leading to prototype AGSO integrated products.

Assist in the development of a new digital terrain model product from AGSO NGMA airborne survey data.

Develop continuous-tone output techniques for the Optronics raster plotter to give AGSO high-resolution image hard-copy capabilities.

Re-evaluate network access options for AGSO's principal spatial IT systems.

Customers

AGSO Programs (MLUP, GOMP, OSPG, MGPG, EGG)

Bureau of Resource Sciences

State & Federal land-use organisations

Mineral & petroleum exploration companies

Cooperating agencies

National Resource Information Centre, BRS, DPIE

Earth Resource Mapping Pty. Ltd. (beta testing)

USGS

Project 261.03 Data Management

Project manager	Geoff Wood	06 249 9398	Fax 06 249 9977
		email gwood@agso.gov.au	
Program responsibility	Information Systems		
Timeframe	1991–ongoing		

Objectives

Facilitate access to critical data required for cross-program and inter-disciplinary projects and integrated products under the National Geoscience Mapping Accord, Continental Margins and Environmental Geoscience Program.

To develop policies and procedures on corporate data management.

To coordinate national geoscience data standards activities.

Relevance

The project ensures that internal data standards and management principles (such as custodianship) are coordinated within AGSO, and related to developments in the wider standards community, and meet industry needs for accessing geoscience data.

Expected outcomes

Better mechanisms for consultation and access to geoscience data

Improved exchange of geoscience data between the Commonwealth, States and Territories, industry and the public.

More efficient use of corporate and national geoscience data

Activities

Provide geoscience standards development advice to AGSO, DPIE and the CSDC.

Represent AGSO at interdepartmental data coordination meetings.

Provide a secretariat for the GGDPAC Working Group on Geoscience Data Standards and coordinate AGSO contributions to geoscience standards development projects, including AMDEX, GEODEX, POSC and those of COGEOINFO.

Continue development of a data standards database in geochemistry for the GGDPAC Working Group.

Expected products

Reports and briefing papers to clients

Contributions to AMDEX, GEODEX, POSC and other standards development projects

Delivery of software products from the AMDEX and POSC projects to major user groups

Highlights for 1992/93

Initial preparations were completed for a feasibility study on options for a national geoscience data storage facility.

Draft AGSO guidelines for digital data products were developed.

Briefing papers on AGSO datasets were prepared for the CSDC.

Secretariat support was provided to the GGDPAC Working Group on Geoscience Data Standards.

A paper on AGSO data transfer issues was presented to an AMDEX workshop in Perth. A final report on the first phase of the AMDEX project was distributed within AGSO and circulated widely to other geoscience data users.

AGSO joined the international Petrotechnical Open Software Corporation (POSC), contributing inputs to POSC working groups.

Goals for 1993/94

Represent AGSO at meetings relating to geoscience data management, definition and interchange standards

Promote development of draft Australian Standards for geoscience data, in conjunction with cooperating national, State/Territory agencies and industry groups

Promote the adoption of AMDEX, POSC and other suitable geoscience data standard products by major user groups.

Promote development of a core geoscience data dictionary required for the effective use of SDTS by the geoscience community.

Undertake a data inventory within AGSO, and catalogue relevant entries in NRIC's national directory.

Contribute to the development of the NGIS strategy.

Liaise with BRS on the implementation of the Villawood Archives data management project.

Assess the relevance of the British Geological Survey's data model for use within AGSO.

Customers

AGSO programs, components and projects

GGDPAC Working Group on Geoscience Data Standards

Commonwealth Spatial Data Committee

DPIE

Cooperating agencies

AUSDEC — information exchanges about spatial data standards (SDTS)

AUSLIG — information exchanges about topographic standards

AMIRA — information exchanges about geoscience data standards

AUAOS — information exchanges about open systems standards

BRS — information exchanges about geoscience data standards

CSDC — information exchanges about government spatial data policy and practice

Mining Research Associates — collaboration on AMDEX project

Mineral exploration companies — collaboration on AMDEX project

Petroleum exploration companies — information exchanges on POSC

State and Territory geoscience agencies — information exchanges

Standards development organisations in Australia and overseas — information exchanges on geoscience-related standards development

Project 261.04 Database Administration

Project manager	Mirek Kucka	06 249 9685 Fax 06 249 9977 *email mkucka@agso.gov.au*
Program responsibility	Information Systems	
Timeframe	1991–ongoing	

Objectives

Provide a stable, responsive relational geoscience database environment, in order to facilitate data sharing and the integration of attribute and networked spatial data.

Keep abreast of current Oracle versions, and manage their implementation.

Investigate options for broader development of Oracle based geoscience database applications and provide secure access for a wider range of clients.

Relevance

This project aims to maximise the benefits from using open relational database technology in terms of availability, flexibility, security and manageability. It will also position AGSO corporate scientific databases to take advantage of new technologies, such as client-server or fully distributed architectures, to better serve AGSO Programs.

The project was recommended by the 1990 Information Systems Study, and endorsed by the then BMR Information Resources Management Committee.

Expected outcomes

Stable, responsive, secure and managed dual Oracle Test and Production database environment, accessible through the corporate ethernet network, for GIS and other interactive applications.

Functionally enhanced database environments, allowing Programs to take advantage of features such as referential integrity and group security.

Adherence to DPIE and Audit Office standards for system security.

Adoption of methodologies/products giving developmental opportunities/possibilities for Oracle based geoscience database applications, and an understanding of possibilities and implications in providing access to a wider range of clients.

Activities

Continue to monitor and enhance the dual Test and Production Oracle database environments.

Lock remaining Oracle Production database applications from structural changes, and migrate changes from Oracle Test to Production through change control management.

Accumulate corporate database statistics for all database applications, and disseminate appropriate statistics.

Set up new Oracle version environments as they become available, and plan the migration of all database applications.

Expected products

Faster, more reliable database access for clients.

Highlights for 1992/93

Formalised a more secure Oracle database environment, with change control management procedures, in Record 1992/85: 'Dual Oracle Database Environment and Change Control Management'.

Dual Oracle Test and Production environments set up on the AViiON, with change

control management in place.

All Oracle database applications migrated from the MV machine (Oracle version 5), to the AViiON database server to Test or Production Oracle environments (version 6).

SQL*Menu and SQL*Net installed allowing greater functionality and accessibility to both Oracle environments (such as GIS access into Oracle).

Goals for 1993/94

More developmental opportunities for AGSO's geoscience databases, and to gain an understanding of possibilities and implications in providing access to a wider range of clients.

Build Oracle user and data lineage databases.

All Oracle based database applications running on Oracle version 7.

Customers

AGSO and BRS Programs using the Oracle RDBMSs to manage geoscience databases.

Industry requiring better, secure access to geoscience data.

Cooperating agencies

BRS

Project 261.05 National Geoscientific Database Development

Project manager	Rod Ryburn	06 249 9605 Fax 06 249 9977 *email rryburn@agso.gov.au*
Program responsibility	Information Systems	
Timeframe	1991–ongoing	

Objectives

Implement or assist with design and development of computer based national geoscience databases pertaining to AGSO's geoscientific mapping and research, natural resource management and geological hazard mitigation.

Develop corporate and national standards databases.

Coordinate the development of AGSO's scientific databases.

Advise AGSO programs on geoscience database matters.

Relevance

A growing reliance on automated methods of data analysis and presentation demands that data be stored and managed as systematically as possible, and that classification schemes be standard at the corporate, national and international level. Without standards it is difficult to combine data from several sources in the one product, such as is required under the NGMA.

Industry and State government bodies are looking to AGSO to provide national geoscience data standards. As well as providing a pool of expertise to help AGSO's scientific program with their database requirements, this project is concerned with the development of national standards databases and the promotion of their use.

Expected outcome

Much better democratic control of, access to, and use of, existing AGSO data sets, and a revolution in methods of analysing, presenting and selling geoscience information to AGSO's clients and the nation as a whole.

Activities

Advice is provided, in response to queries on geoscience database schema design and authority table usage, to State Geological Surveys and other interested clients.

AGSO Programs are requested to nominate database projects, which are then prioritised by the Information Resources Management Committee.

Client discussions are followed by design and execution of a prototype database, which then undergoes modification and further development after client testing.

Publication of a manual is a major milestone, usually followed by further hands-on training, more applications as required, and extraction of data sets for sale.

Development of standards databases requires custodian selection, liaison with other geoscience organisations, research into classification schemes and terminology, and collation of available data.

Client training and education as required.

Expected products

Completed infrastructure for databases, including tables, views, indexes, menus, screen forms, report programs, SQL script files, export facilities and help systems.

User documentation for completed databases — usually published as AGSO Records.

Standards databases and authority tables made more readily available to all clients, including external clients via dial-up access.

Posters and published papers on AGSO's geoscientific and standards databases.

Highlights for 1992/93

The following databases were transferred from Oracle version 5 on the older DG MV/20000 computer to Oracle version 6 on the UNIX-based DG AViiON server — GEOPROV, GEOTIME, STRATLEX, SITES, PETROG, STRUCTURE, GEOCHEM, OZCHRON, EABASIN, GEORGEPAL, JOHNPAL, STRATAGE, IGBA, GEODX, QUAKES, NUCEXP, RTMAP, PALEO, RGMAG, SEISMIC, INFO and QUATDB.

At the same time the opportunity was taken to rationalise the ownership, structure and UNIX directories for many of these databases, and to convert the older screen forms to SQL*Forms version 3. Front-end menus were also set up using SQL*Menu 5.

In collaboration with Mineral and Land Use Program, NGMA databases, including the Field Database (SITES, STRUCTURE, OUTCROPS, ROCKS), Stratigraphic Authority Database (STRATLEX, GEOPROVS, GEOTIME) and laboratory data-bases (ROCKCHEM, OZCHRON), were refined and integrated under the one menu system. Field data from the old ROCKCHEM database and the Geological Survey of Queensland REGMAP database were processed into the new NGMA tables. The Petrography Database was implemented and a working prototype of the OZMIN mineral deposits database ("MINDEP II") generated.

User guides were prepared for the Field Database, the Stratigraphic Authority Database, OZCHRON and NUCEXP — the Nuclear Explosions Database.

In conjunction with the Environmental Geoscience Program, phases 1 and 2 of the ongoing QUATDB Quarternary Climates Database were completed. Refinements to PALEO, AGSO's fossil collection database, were undertaken with Onshore Petroleum, as was further work on GEODX with the Australian Stratigraphic Index.

An options paper on online external access to national geoscience databases was prepared to pave the way for public online access to free data.

R. Ryburn represented Australia at an ESCAP conference on mineral databases in Sri Lanka in July 1992, delivering a paper on 'Mineral-Related Databases in the Australian Bureau of Mineral Resources — Strategies and Methods'. S. Lenz co-authored a poster with K. McCue of the ASC on AGSO's World Earthquakes Database.

Goals for 1993/94

Gather independent bibliographic reference tables, including GEODX, into a unified reference database (AGSREF) shared by all Oracle databases and users.

Upgrade the stratigraphic index (GEODX) and integrate with the Stratigraphic Lexicon (STRATLEX) - investigate direct entry of data by state custodians.

Further develop the PALEO database of AGSO's fossils with Onshore Petroleum Program - investigate image management using SQL*Forms 4 and X terminals.

Complete NGMA field and laboratory databases, including OZMIN, SPECPROPS and STREAMCHEM, in collaboration with the Minerals and Land Use Program.

Complete phase 3 of Quaternary Climates Da-

tabase in cooperation with the Environmental Geoscience Program.

Give an in-house course on SQL for AGSO Oracle database users and publish the course notes as an AGSO Record.

Make a start on public online access to free AGSO data, as far as may be allowed by DPIE security policies.

Liaise with NGMA partners in achieving compatible database schemas and common authority tables.

Prepare a paper on AGSO database developments for the 1994 GeoInfo conference in Prague.

Customers

AGSO Programs, components and projects

State & Federal geoscience and land-management organisations

Mineral and petroleum exploration companies

Cooperating agencies

BRS

Queensland Department of Resource Industries

South Australia Department of Minerals & Energy

Geological Society of Australia

317: INTERNATIONAL DEVELOPMENT ASSISTANCE AND COOPERATION

Objectives

Promote the availability and sale of geoscientific services, both from and through AGSO, to overseas customers, particularly in the Asia–Pacific region.

Further Australia's foreign policy, trade and overseas development assistance objectives through promotion of, and commercial participation in, petroleum, mineral and groundwater resource assessments, geoscientific mapping and environmental programs; and related training.

Participate in global geoscientific programs that directly contribute to AGSO's program objectives.

Relevance

AGSO's international program aims to develop closer links with Australian and overseas Government agencies, other organisations and industry with a view to participating, on a commercial basis, directly or under joint ventures in developing the groundwater, mineral and petroleum resources of developing countries, particularly in the Asia–Pacific region, in an environmentally sustainable manner; and improving their geoscientific capabilities.

International geoscientific contact is important for maintaining high standards for the effective prosecution of AGSO's programs.

Activities

AGSO, as the Commonwealth's principal technical adviser on geoscience matters, represents Australia in various international geoscientific organisations, including those under United Nations auspices, aimed at assisting developing countries. It also assists in various bilateral and multilateral projects initiated through Commonwealth agencies such as the Department of Foreign Affairs and Trade.

AGSO's international activities may be broadly categorised into:

- involvement of AGSO directly, or as joint ventures, with Australian or other organisations, in international consultancies and cost recovery projects, mainly in developing countries and funded by development assistance agencies;
- regional cooperation in projects which, although development assistance oriented and funded, bring substantial benefit to AGSO programs;
- global geoscience involving contributions to the coordination of, or participation in, international research, including those under S&T Agreements, which arise from AGSO's specialist knowledge of the Australian and Antarctic regions;
- support of Australia's foreign policy and related commercial objectives.

Arrangements are in place for cooperation with several countries and international organisations, mainly through development, on a cost recovery basis, of geoscientific knowledge and groundwater, mineral and petroleum resources, particularly in the Asia–Pacific region, including:

- cooperation with the South Pacific Applied Geoscience Commission (SOPAC) in its various activities. AGSO's main contribution is in the provision of geophysical data storage, funded by AIDAB;
- bilateral cooperation with China under Memoranda of Understanding with the Ministry of Geology and Mineral Resources (MGMR), the Chinese National Nonferrous Metals Industry Corporation (CNNC), and the State Seismological Bureau (SSB) in a variety of geoscientific topics of mutual interest;
- bilateral cooperation with the Indonesian Government in a project for the publication in colour of twelve 1:250 000 geological maps of Kalimantan produced in preliminary form under the former Indonesia–Australia Geological Mapping Project;
- development of proposals for assistance in upgrading the capabilities of the Indone-

sian RV "*Baruna Jaya II*", conducting offshore seismic framework studies in eastern Indonesia, developing an "Openfile" petroleum database, and high tech geoscientific mapping of the Central Ranges of eastern Irian Jaya;

- bilateral cooperation with AIDAB and the Philippines Government in a joint seismic framework study in Philippine offshore areas;
- multilateral cooperation with several countries in the production of geoscientific maps of the Australia and Pacific region;
- participation in commercial ventures relevant to furthering geoscientific knowledge of the mineral resources of the Sultanate of Oman;
- development of a requested aid project for evaluating, monitoring and managing water resource quality for Kathmandu, Nepal;
- development of links with PetroVietnam and the Geological Survey of Vietnam leading to possible development assistance in coastal zone environmental studies, offshore seismic surveys, high tech geoscientific mapping of a mineral prospective region, and water resource studies.

Initiate links with organisations in other countries aimed at developing commercial programs relevant to AGSO's program areas; such as:

- pursuing links with ASEAN countries in developing a proposal for maritime and offshore resources operations under the ASEAN–Australia Economic Cooperation Program — Phase III;
- sending an AGSO fact-finding mission to Argentina later this year to evaluate geoscientific and database needs in response to an agreement reached during the visit of a high level Argentine mining mission in March 1993;
- exploring links with the Geological Survey of Chile (SERNAGEOMIN) following visits by senior SERNAGEOMIN and Mining Investment missions, which could lead to commercial involvements in Chile.

Develop the International Programs Unit, which was established in July 1991, as a fully functional, substantially self sufficient section responsible for:

- coordinating AGSO's international cooperative activities relevant to the Government's international objectives and policies;
- developing consultative links and closer working relations with relevant Australian Government and other organisations, and industry; and appropriate Australian and international funding agencies;
- developing relevant databases — such as a register of Australian petroleum exploration and development services, international project opportunities etc;
- promoting international commercial involvement of AGSO programs and, where appropriate on a cost recovery basis, other Australian organisations.

Highlights for 1992/93

Visits to AGSO by high level geoscientific/mining missions from Indonesia (September), Vietnam (November) and Argentina (March) leading to identification of possible commercial projects.

Separate requests by the Philippine and Omani Governments for development of additional projects in view of the successful results obtained from initial programs in each country.

Coordination of, and participation in, cost recovery training programs in resource assessment, sustainable environment and information systems for Malaysian and Pakistani groups.

INTERNATIONAL DEVELOPMENT ASSISTANCE AND COOPERATION

Component manager David Falvey 06 249 9328

Component projects

122.01	Law of the Sea and seabed boundary activities
122.02	Offshore resource map series
123.01	SOPAC geoscience projects: petroleum and mineral resource framework of south west Pacific island arcs and basins; coastal and nearshore studies
123.02	Rabaul Harbour heat flow survey
123.03	Philippines offshore seismic project: regional petroleum exploration and evaluation of basin potential
242.06	Natural hazards mapping in the Australian Region
317.02	China–MOU cooperation
317.03	International geoscience mapping
317.04	Geoscience program in the Sultanate of Oman
317.05	Volcanism, tectonics and metallogeny of western Melanesia
317.06	Kalimantan geological maps project

Project 122.01 Law of the Sea and seabed boundary activities

Project manager	Phil Symonds	06 249 9490 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology	
Timeframe	1988–ongoing	

Objectives

Provide independent scientific and technical advice and information to government on the geology and non-living resource potential of areas under consideration for the creation of marine parks and reserves.

Compile the necessary technical and scientific data to define the legal continental margin and shelf around Australia and its territories using the various international conventions, and provide advice to government on the area and resource ramifications of the various approaches.

Relevance

AGSO's Marine Geoscience and Petroleum Geology Program holds the main technical expertise and regional database on the morphology and resource potential of Australia's continental margin and adjacent ocean basins, and is well placed to provide independent advice to government on these matters. It also has the only research vessel capable of acquiring the range and quality of data necessary to fully define a legal continental shelf around Australia and its territories, and to assess its petroleum and mineral resource potential.

This project fulfils an important AGSO role of providing independent and timely advice and information to government to facilitate the formulation and implementation of policies, and the effective management of Australia's offshore petroleum and mineral resources.

Expected outcomes

Government decisions, policy formulation and implementation, and offshore petroleum and mineral resource management are based on the best available scientific and technical information.

Optimum definition of the legal continental shelf around Australia and its territories.

Improved understanding of the morphology, geology and resource potential of Australia's offshore territory and adjacent ocean basins.

Activities

Provide scientific and technical assessments, advice and information on the geomorphology, geology, and mineral and petroleum potential of the continental margin and adjacent ocean basins around Australia, its island territories and the Australian Antarctic Territory.

Improve knowledge of morphology and non-living resource potential of the continental margin of Australia and its territories.

Promote collection of new data in areas that will be the subject of future seabed boundary negotiations and deliberations, such as the Christmas Island area (Project 121.32), and the southern Lord Howe Rise/Norfolk Ridge region (Project 121.30).

Serve on interdepartmental committees and working groups concerned with Law of the Sea, maritime boundary delimitation, and non-living marine resource matters.

Expected products

AGSO reports, professional opinions and publications on the morphology, resource potential and other maritime boundary considerations around Australia and its territories.

Maps showing the various morphological features and parameters used to define a legal continental shelf around Australia and its territories.

Maps showing Australia's various maritime and resource related boundaries.

Highlights for 1992/93

Provision of advice and map to DPIE showing Australia's legal continental shelf and other seabed boundary information, for use by Parliamentary Drafting Office to accompany Minerals (Submerged Lands) legislation.

Involvement in inter-departmental committee on Australia/Indonesia maritime boundaries in preparation for a new round of delimitation talks. Three professional opinions were prepared and submitted to DFAT on the geology, morphology and resource potential of the areas under consideration, plus six coloured computer drafted maps at 1: 4 and 1: 12 million scale, showing various maritime boundaries and other relevant information.

Participated, as Australia's representative, in the United Nations meeting of the Group of Experts on the Definition of the Continental Shelf in New York from 10–12 March 1993.

Goals for 1993/94

Continue provision of advice and information to government agencies and departments on Law of the Sea matters, maritime boundaries, offshore petroleum and mineral potential, and general morphology and geology of the continental margin of Australia and its territories.

Coordinate technical advice (based on data and interpretations from Projects121.32 and 121.30) to DFAT related to seabed boundary delimitation between Australia/Indonesia in the Christmas Island region, and Australia/New Zealand in the southern Lord Howe Rise/West Norfolk Ridge region.

Provide technical advice and information to DFAT, and participate on the inter-departmental committee and negotiating team during ongoing talks on the delimitation of maritime boundaries between Australia and Indonesia.

Produce draft Australian Maritime Boundaries map in consultation with DFAT, A-G's, DPIE and AUSLIG. This will be dependent on obtaining software to allow accurate construction of lines at set distances from base points.

AGSO position paper on the definition of Australia's legal continental shelf.

Customers

Policy Divisions, Department of Primary Industry and Energy

Department of Foreign Affairs and Trade

Attorney-General's Department

Australian Land Information Group

Cooperating agencies

Policy Divisions, Department of Primary Industry and Energy

Department of Foreign Affairs and Trade

Attorney-General's Department

Bureau of Resource Sciences, DPIE

Other government departments and agencies

Project 122.02 Offshore resource map series

Project manager	Chris Johnston 06 249 9353
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	January 1989–1996

Objective

Provide a continental margin planning base for research, survey and industry operations, and margin management in relation to geoscience, fisheries, oceanography and the 1983 United Nations Convention on the Law of the Sea (UNCLOS) covering the proposed Australian Adjacent Offshore Area (Legal Continental Shelf).

Relevance

The map series will provide fundamental bathymetric and sediment-type information in support of resource exploration and development (i.e. petroleum and fishing) and environmental monitoring, both on the shelf and extending into deeper waters within the Australian Adjacent Offshore Area.

Expected outcome

A mapping and seabed information base for activities around the margin including exploration (petroleum and minerals), Australian jurisdiction requirements (UNCLOS), fisheries (grounds and licensing), environmental issues and research.

Activities

Compile and publish a series of contoured bathymetric sheets covering the proposed Australian Adjacent Offshore Area (Legal Continental Shelf).

Develop a comprehensive digital database of water depths, by integration of data sets from the Hydrographic Service, General Bathymetric Map of the Oceans (GEBCO) plotting sheets, AGSO and other sources. The GEBCO data are only available in analogue form and so those data required must be digitised.

Machine contour the data using an algorithm that best handles the unique characteristics of bathymetric data and modify the machine contours so that they are geomorphologically realistic.

Add to the database other required data sets such as seismic lines, well locations and seabed sampling localities including sediment type.

Present these data in map and digital form so that they are of maximum benefit to clients. The maps are being produced using Mercator projection at 1:1 000 000 scale with 50 m contours to 300 m depth and 100 m contours below 300 m.

Expected products

An initial series of 33 sheets will be published progressively over the next four years.

Digital data will be released in a form that best suits the needs of client groups.

Highlights for 1992/93

Two sheets were published, two were fully compiled and four were partially compiled.

Goals for 1993/94

Complete compilation of eight sheets from north west Australia and commence compilation on a further two sheets; one from north west Australia and one from south Lord Howe Rise (see figure below). Sheet compilation goals are as follows:

Christmas Island	October
Broome	October
Rowley Shoals	November
Argo	December
Exmouth	January
Darwin	February
Arafura	April
Timor	June

Assist efficient publication of sheets for the International Bathymetric Chart of the Western Pacific (IBCWP) by active participation on the Editorial Board 'selling' Australian technology and procedures. The IBCWP is a new Intergovernmental Oceanographic Commission (IOC) project. The inaugural meeting of the Editorial Board will be held in October 1994.

Customers

Fishing industry

Petroleum exploration industry

Department of Foreign Affairs and Trade (Australian Jurisdiction)

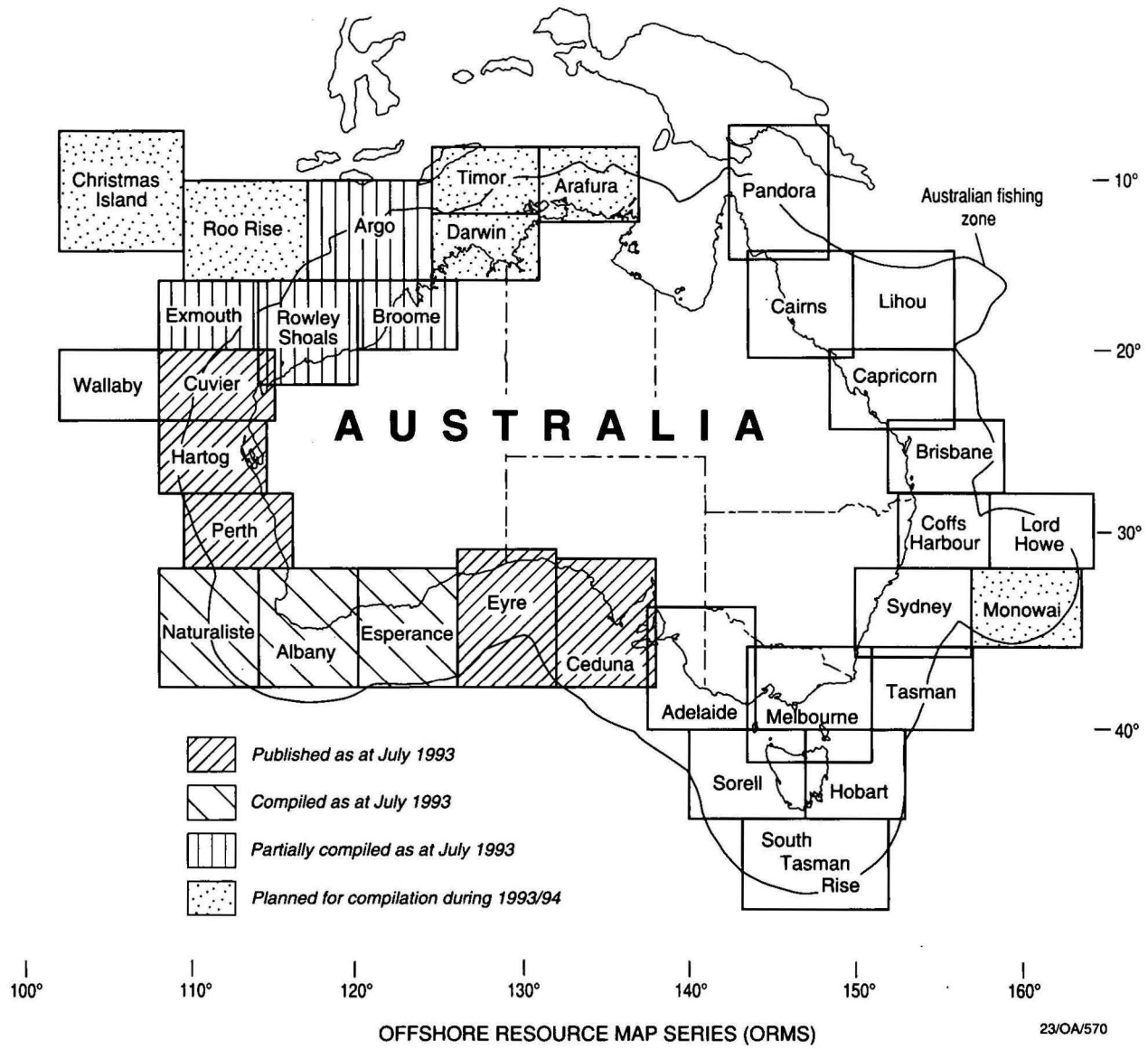
Environmental study centres

Marine research centres

Cooperating agencies

Commander John Leech, Royal Australian Navy Hydrographic Service, Canberra

Joe Doyle, Royal Australian Navy Hydrographic Service, Sydney



OFFSHORE RESOURCE MAP SERIES (ORMS)

23/OA/570

Project 123.01

SOPAC geoscience project: petroleum and mineral resource framework of south west Pacific island arcs and basins; coastal and nearshore studies

Project manager Neville Exon 06 249 9347 Fax 06 249 9986

Program responsibility Marine Geoscience and Petroleum Geology

Timeframe 1982–ongoing

Objectives

Assist in exploration and development of petroleum and mineral resources of the region, by supporting the South Pacific Applied Geoscience Commission (SOPAC).

Advise on coastal problems.

Relevance

Petroleum and seabed mineral potential are poorly known in the south west Pacific. The SOPAC geoscience project is an Australian initiative to help the Pacific island nations assess their petroleum and mineral seabed potential, in particular, as part of a general geoscience program.

Expected outcome

Enhanced economic potential for, and resource knowledge of, the south west Pacific island nations.

Activities

Help SOPAC Technical Secretariat assess the petroleum and mineral potential of the active convergent plate margins, marginal basins and oceanic regions offshore from the Cook Islands, Western Samoa, Tonga, Fiji, Vanuatu, Solomon Islands, Papua New Guinea, Tuvalu Kiribati, Marshall Islands, Guam and Federated States of Micronesia.

Provide advice on and help SOPAC study geological factors involved in sea level change, coastal change and shoreline protection in Pacific island nations, and their implications.

In conjunction with the SOPAC Technical Secretariat, compile and publish summary volumes and papers on manganese nodules, cobalt-rich crusts and petroleum prospects of the region.

Continue provision of storage and retrieval facilities for Tripartite and other south west Pacific data tapes, in conjunction with Australian Archives.

Continue source rock and other studies on Pacific island cores, as appropriate.

Provide technical advice at SOPAC Annual Sessions.

Expected products

Summary volumes and papers on manganese nodules, cobalt-rich crusts and petroleum prospects of the region.

Highlights for 1992/93

Participation in Coastal Processes Workshop to develop 5-year strategic plan for coastal management in the region.

In conjunction with SOPAC Technical Secretariat, continued improvement and expansion of data bases.

Release of first (Solomon Islands) petroleum data package catalogue.

Publication of results of the RV *Moana Wave* manganese nodule and crust studies.

Publication of final results from the RV *Cook* swath-mapping work around Western Samoa.

Goals for 1993/94

Release Vanuatu and Tonga petroleum data catalogues.

Publish results of PNG palaeomagnetic study.

Prepare proposals and reports dealing with coastal processes on Pacific Islands.

Customers

Island nations of the south west Pacific.

AIDAB

SOPAC

IOC

Cooperating agencies

AIDAB

United States Geological Survey

Hawaii Institute of Geophysics

New Zealand Oceanographic Institute

New Zealand Geological Survey

South Pacific Applied Geoscience Commission

Australian Defence Force Academy

Pacific Island national geological surveys

Australian Universities

Inter-government Oceanographic Commission

Project 123.02 Rabaul Harbour heat flow survey

Project manager	Trevor Graham 06 249 9341 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1989–1993

Objective

Assess the heat distribution in the submarine environment of Rabaul caldera, in order to further constrain geological and geophysical models.

Relevance

Human welfare — understanding the thermal regime of the Rabaul caldera will assist greatly the assessment of volcanic hazards in the region, which have already led to devastating loss of life in the region.

More detailed identification of 'hot spots' may lead to strategies for the permanent monitoring of magma activity.

Geophysical — the 1990 heat flow survey produced an intriguing insight into a complex heat regime in the caldera, with strong convectional transfer from extremely positive heat-flow locations to very negative heat flow sinks, suggesting the presence of large convection cells driving pore fluid exchange.

Sedimentological — sediment cores extracted from the harbour reveal the Holocene record of caldera subsidence, marine invasion and volcanic eruptions.

Expected outcome

A more reliable assessment of the volcanic hazards posed by the Rabaul caldera.

Activities

Design, manufacture and trial of new system of heat flow equipment to meet the exacting demands of measurement in unstable shallow water environments.

A major heat flow survey was conducted in Rabaul Harbour in 1990, and results presented in a final report to AIDAB in 1991.

Second generation equipment was manufactured by AGSO and successfully trialed in Sydney Harbour.

A second major heat flow survey was conducted in Rabaul Harbour in November, 1992.

Initial data processing from this survey is completed.

Expected products

A better understanding of the Rabaul caldera's heatflow pattern.

A new technique that could be used in other volcanic calderas around the world where volcanic hazards are present.

A more detailed map of heat distribution and convectional cells within Rabaul caldera, constraining present geological models and aiding in volcanic hazard assessment.

A state-of-the-art shallow-water heatflow system, totally AGSO conceived and manufactured and leading world design, capable of

being used in other AGSO programs.

Training of Papua New Guinea geologists and geophysicists in marine heat flow and vibrocoring techniques.

Possible development of a strategy for permanent monitoring of sites to aid in volcanic hazard prediction.

Highlights for 1992/93

Collection of high quality heat flow data during 1992 survey made possible by the state-of-the-art equipment designed and manufactured by AGSO.

Goals for 1993/94

Complete heat flow data processing and modelling.

Complete sedimentology on suite of 17 long cores retrieved during the 1992 survey.

Submit a final report of the 1992 survey to AIDAB.

Assess possible long term monitoring strategies.

Customers

AIDAB

SOPAC

Papua New Guinea Geological Survey (incl. Rabaul Volcanological Observatory)

University of Papua New Guinea

Cooperating agencies

Papua New Guinea Geological Survey

Project 123.03 Philippines Marine Seismic Survey Project — regional petroleum exploration and evaluation of basin potential

Project manager	Chao–Shing Lee 06 249 9439 Fax 06 249 9986
Program responsibility	Marine Geoscience and Petroleum Geology
Timeframe	1991–1994

Objectives

To upgrade the knowledge of petroleum prospectivity of selected areas in the Philippines and thus promote potential opportunities for future Philippines — Australia joint venture exploration; and to assist the Philippines Government to acquire the skills to plan, obtain and interpret seismic data and other petroleum resource related information and use these to focus future petroleum exploration in Philippine waters.

Relevance

This is an Australian development assistance program, funded by AIDAB, for the Government of the Philippines to help promote petroleum exploration activities in the Philippines.

In September 1991, the Memorandum of Understanding between the Australian and Philippine Governments was signed. In March–May 1992, AGSO's RV *Rig Seismic*, was in the Philippines to acquire the new seismic and geochemistry data. Data processing and interpretation have continued since then.

There are 34 companies in the consultative group of which 17 are Australian and 17 Filipino companies. The Department of Energy (DoE) has made a commitment that these Australian and Philippine companies will be given opportunities to work together under the joint venture arrangement to apply for geophysical service and/or service contracts over the project survey areas.

Because of the success of this current project, DoE has formally requested AIDAB for a new Phase II project in other sedimentary basins of the Philippines. Initial discussions on project strategy, survey areas, timetable (March to May 1994) and budget have been carried out between these cooperating agencies (i.e. DoE, AIDAB and AGSO).

Expected outcomes

Enhanced understanding of the petroleum potential of selected offshore areas of the Philippines.

A core of Filipino scientists with improved skills in petroleum basin analysis.

More cost-effective exploration strategies, and further exploration and drilling in the survey areas.

Activities

Process 2750 km of newly acquired seismic, gravity, magnetic and bathymetric data in Ragay, Tayabas, Cuyo and north east Palawan areas.

Recover and re-process 450 km of World Bank data in Ragay Gulf.

Process nearly 5000 km of newly acquired Direct Hydrocarbon Detection "sniff" data and eight geochemistry vertical profiling data.

Carry out 28 gas samples for C_{13} and C_{14} isotopic analyses.

Interpret and integrate the newly processed data with existing data in Ragay Gulf.

Train six Filipino scientists in the application of modern data processing, geochemistry data analyses and petroleum basin modelling.

Conduct two consultative workshops for the Australian and Philippine oil companies one each in Australia and in the Philippines.

Participate in four petroleum conferences in Manila, Kuala Lumpur, Singapore and the Gold Coast and publish the results of the project in scientific and technical literature to increase general awareness of exploration opportunities in the Philippines.

Expected products

New processed seismic and underway geophysical data in Ragay (950 km), Tayabas (490 km), Cuyo (730 km) and north east Palawan areas (580 km), and re-processed World Bank data in Ragay (450 km).

A complete analysis of geochemistry "sniffer", vertical profiling and isotopic data.

Two (2) workshop promotional information for the 34 consultative Australian and Philippino oil companies.

Three (3) scientific papers in the proceedings of GEOCON '92 Conference in Manila, the South East Asia Offshore Petroleum Conference in Singapore and the Circum Pacific Energy Minerals Resources and Conference in Kuala Lumpur.

Highlights for 1992/1993

Completed project component 1 for data acquisition and processing.

Organised workshops in Gold Coast and Manila to appraise companies of project's progress and thereby attract the interest of Australian and Philippine oil companies in the survey areas.

Developed new activities to enhance the understanding of petroleum systems in the Philippines, including a new onshore oil seep analysis, a new palynology study of the well samples and two new short training courses in Manila.

Initiated the Phase II project in other petroleum basins of the Philippines.

Goals for 1993/1994

Complete the current project.

Develop petroleum prospectivity models and produce folios of interpreted maps and data.

Conduct two more consultative workshops for Australian and Philippine oil companies.

Present results at the petroleum conference in Manila in 1993 and the APEA Conference in 1994 and write more scientific papers.

Negotiate the Phase II project with AIDAB, prepare the plan and carry out the cruise in March/May 1994.

Customers

Department of Energy, Republic of the Philippines (DoE)

Australian International Development Assistance Bureau (AIDAB)

Cooperating agencies

In Australia

Ampolex Limited

Austin Oil N.L.

Australian Worldwide Exploration Pty. Ltd.

Australasian Oil Exploration Ltd.

Bligh Philippines, Inc.

Bridge Oil Philippines Inc.

BHP Petroleum Pty. Ltd.

Claremont Petroleum N.L.

Command Petroleum Holdings N.L.

Coplex Resources

Crusader Ltd.

Flower and Associates Pty. Ltd.

Loman Pty. Ltd.

MIM Petroleum Exploration Pty. Ltd.

SANTOS Ltd.

Stirling Resources Ltd.

Woodside Petroleum Ltd.

In the Philippines

Anglo-Philippines Oil & Mining Corporation

Alcorn Petroleum & Mineral Corporation

Balabac Oil Exploration Company

Basic Petroleum & Mineral Inc.

Oriental Petroleum & Mineral Corporation

Petrofields Exploration & Development Company, Inc.

Philex Mining Corporation

Philippine National Oil Company

The Philodrill Corporation

San Jose Oil & Mining Corporation

Seafront Petroleum & Mineral Resources, Inc.

South China Sea Petroleum

Terra Grande Resources

Trans-Asia Oil & Mineral Development Corporation

Ultrana Nuclear & Mineral Corporation

Unioil Exploration & Mineral Development Compnay, Inc.

Vulcan Industrial & Mining Corporation

Project 242.06 Natural hazards mapping in the Australian region

Project manager	Wally Johnson	06 249 9377
Program responsibility	Environmental Geoscience & Groundwater	
Timeframe	1991–2000	

Objective

Focus attention on the vulnerability of different parts of the Australian region to particular groups of natural hazards through the production of digital databases, Geographic Information Systems, and maps.

Relevance

Natural hazards in the Australian region have accounted for the deaths of thousands of people, the loss of billions of dollars of property, and the destruction of lands in both Australia and neighbouring countries — from Thailand in the north west, through Indonesia, the Philippines, and Papua New Guinea, to the Solomon Islands, Vanuatu, New Caledonia, Fiji, Tonga, and New Zealand.

The Prime Minister in 1989 called for the establishment of an Australian Coordinating Committee for the International Decade for Natural Disaster Reduction (IDNDR) that began in January 1990. The attention of the Committee is focused on the disaster-preparedness needs of developing countries in the Australian region as well as of Australia itself. AGSO is participating in the IDNDR and collaborates with the Coordinating Committee. AGSO's primary interest is in establishing a knowledge base for the following geological hazards: earthquakes (see in particular Project 222.01), landslides, tsunamis, volcanoes, and natural geochemical hazards.

The primary task of the Project is to produce databases, maps, and accompanying reports on the nature and distribution of natural hazards in association with other groups in Australia and overseas, and to explore ways of

enhancing assessments of natural hazard potential in neighbouring countries through development assistance programs.

The Project operates through participation in two working groups. One of these is the Natural Hazards Map Working Group (NHMWG), consisting of 13 people mainly from government agencies and universities, which meets annually at the Australian Emergency Management Institute, Mount Macedon (supported by Emergency Management Australia). The NHMWG is producing a 1:10 million-scale map of natural hazards in the South West Pacific quadrant. The second group is the Natural Hazards GIS Working Group, consisting of eight members from AGSO, the Bureau of Meteorology, and NRIC. This group is devising ways of establishing a national GIS network of databases and users, that might be expanded to include the needs of neighbouring countries.

Collaboration is also underway with the Australasian Urban and Regional Information Systems Association (AURISA) Public Safety Network, and with the Circum–Pacific Map Project.

Expected outcome

Improved hazard assessments, leading to improved hazard awareness and preparedness.

Activities

Chair the activities of the Natural Hazards Map Working Group and the Natural Hazards GIS Working Group.

Produce a 1:10 million map and accompanying Explanatory Notes of geological and meteorological hazards of the South Western Pacific Quadrant (Circum–Pacific Map Project series).

Collect digital databases on natural hazards, and compile them for use in a GIS format.

Develop ways of establishing a national GIS network for natural hazard data.

Participate as a member in meetings of VULCAN-AUS (Volcanological/Airspace Liaison Committee Australia Indonesia — Australian Working Group).

Highlights for 1992/3

The NHMWG met on 24–26 February and arranged to complete by May 1992 the program of data collection for the 1:10 million-scale hazards map, prior to digitisation of the data at AGSO and publication by the Circum–Pacific Map Project and United States Geological Survey in 1994.

The Natural Hazards GIS Working Group was established. A pilot project was initiated, based on the importing of a dataset on earthquake hazards from the Australian Seismological Centre and a datasets on cyclone hazards from the Bureau of Meteorology, into a GIS environment at NRIC.

Funding support was awarded by the Australian Coordinating Committee for the IDNDR, Emergency Management Australia, and the Circum–Pacific Council for Energy and Mineral Resources.

Contact was made with the Geological Survey of Japan and the Philippines Institute of Volcanology and Seismology with regard to future collaboration in regional natural hazards mapping and GIS development.

Goals for 1993/4

Complete production of 1:10 million map of natural hazards in the South West Pacific Quadrant, and complete draft of Explanatory Notes.

Complete GIS pilot project in association with NRIC on national datasets for earthquakes and cyclone hazards, and complete draft of report.

Complete integrated, digital database on the nature of landslides and their consequences in Australia, Indonesia, and the Philippines.

Develop concept of a national GIS network for natural-hazard management, including assistance with the organising of, and participation in, a planned AURISA Hazard Information Forum.

Develop proposed development assistance project in Philippines on GIS natural hazards management.

Customers

State Emergency Services

Emergency Management Australia

Insurance industry

Land-use and development planners

General public

Hazard management agencies in neighbouring countries

Cooperating agencies

Bureau of Meteorology — staff, information

National Resource Information Centre — staff, GIS facilities

Macquarie University — information

University of New England — information

Port Moresby Geophysical Observatory — information

Asian Institute of Technology, Bangkok — information

Circum–Pacific Council for Energy and Mineral Resources — funding

International Decade for Natural Disaster Reduction — funding

Project 317.02 China MOU cooperation

Project manager	David Newham	06 249 9571
Program responsibility	International Programs Unit	
Timeframe	1983–ongoing	

Objectives

To develop cooperative research programs with appropriate Chinese organisations in a variety of geoscientific topics of mutual benefit and interest.

Where possible, to identify opportunities for commercial involvement of Australian industry in assisting with the development of China's minerals and petroleum resources.

Relevance

The development of closer links with relevant Chinese research organisations will promote a greater understanding and appreciation of the geology and groundwater, mineral and petroleum resources in both countries.

AGSO's links with Chinese Government agencies, particularly MGMR, facilitate the identification of ways in which Australia can assist China in developing its groundwater, minerals and petroleum resources in an environmentally sustainable manner.

Expected outcomes

A greater understanding of the geoscientific aspects in both countries relevant to each program.

The development of closer working relations between AGSO and the relevant Chinese institutes.

Greater AGSO assistance in promoting Australian industry involvement in the development of China's minerals and petroleum industries.

Activities

AGSO involvement relates directly to topics identified in its work program.

Exchange visits between both countries have taken place in the following programs:

- Comparative study of the Murray–Darling and Huang–Huai–Hai basins (MGMR)
- Comparative study of the geology and mineral resources of Southeast China and eastern Australia (MGMR)
- Seismology (SSB)
- Cambro-Ordovician boundary study (MGMR)

Further cooperative exchanges will take place in the above and other identified programs with MGMR, CNNC and SSB.

Liaise with Australian industry and relevant Chinese authorities in expediting Australian assistance in the development of China's minerals and petroleum industries.

Expected products

Joint final reports will be published on completion of the above programs and, for seismology, on completion of relevant phases of the program.

Highlights for 1992/93

Publication of the final report of the "Resource assessment and management in the mineral industry program".

Completion of the final report on the "Comparative study of the Sichuan and Amadeus Basins program".

Completion of the "Comparative study of the Murray–Darling and Huang–Huai–Hai basins program".

Recording in July of an MS 4.9 earthquake on the program's accelerometer at Tangshan which was devastated by an MS 7.8 earthquake in 1976.

Goals for 1993/94

Complete the final report for the "Comparative study of the Murray–Darling and Huang–Huai–Hai basins program".

Completion of the "Comparative Seismicity program" with SSB, and its replacement by a "Study of seismicity patterns in China and Australia".

Proposed visit to Australia by the Minister for MGMR.

Continue exchange visits in the cooperative programs, particularly the "Cambro–Ordovician boundary program" and "Comparative study of the geology and mineral resources of Southeast China and eastern Australia program" with MGMR, and the seismology program with SSB; and initiate exchanges in new programs, including hydrogeology.

Develop AGSO's role in assisting China with the development of its minerals and petroleum resources through involvement of Australian companies.

Customers

People's Republic of China

Exploration and mining industry

State geological surveys

Commonwealth agencies

Cooperating agencies

International

Peoples Republic of China

China Ministry of Geology and Mineral Resources (MGMR)

PRC State Seismological Bureau (SSB)

Australia

Relevant Commonwealth, State and tertiary organisations, and industry

G Gregson, Philips Institute of Technology, Melbourne

Project 317.03 International geoscience mapping

Project manager	David Palfreyman 06 249 9465
Program responsibility	Onshore Sedimentary and Petroleum Geology
Timeframe	1950s–ongoing

Objective

Contribute to international projects concerned with regional geoscience mapping, particularly in the South East Asian and the South West Pacific region.

Relevance

The project is part of Australia's contribution to international geoscience cooperation. It will improve understanding of the geology of the southwest Pacific as a part of a global study aimed at assisting countries in the sustainable development of their natural, particularly petroleum and mineral, resources.

The results of geoscience mapping and resource assessment in Australia are used in the compilation of geoscience and resource maps for larger areas that portray Australia in its regional and global context, especially its geological relationship with neighbouring countries in the southeast Asian and the southwest Pacific region.

AGSO has been involved with the work of the Circum–Pacific Map Project (CPMP), a major

activity of the Circum–Pacific Council for Energy and Mineral Resources (CPCEMR) since its inception in 1973.

Expected outcomes

Improve appreciation of the regional context of Australian geology, mineral and petroleum resources.

AGSO meets its obligations in international geoscience mapping.

Activities

Compile 1:10 million scale maps and prepare explanatory notes for the South West Quadrant of the CPMP.

Attend the annual CPMP meetings.

Participate in other international map-compilation activities relevant to AGSO's program.

Expected products

South West Quadrant colour maps and Explanatory Notes published by the USGS for CPMP.

Highlights for 1992/93

Completion of a draft compilation of the CPMP

Energy Resources map.

Goals for 1993/94

Proof-check CPMP Energy Resources map.

Prepare a draft of the Explanatory Notes for the CPMP Energy Resources map.

Publish the CPMP Natural Hazards map (Southwest Quadrant); this activity is a contribution to the IDNDR (see 242.06).

Customers

Mineral and petroleum industries, in Australia and overseas.

Governments and geoscientific organisations in neighbouring countries.

Cooperating agencies

Circum–Pacific Council for Energy and Mineral Resources (CPCEMR)

USGS

Overseas geological surveys

Project 317.04 Geoscience program in the Sultanate of Oman

Project managers	David Denham	Geophysics	06 249 9267
	Lynton Jaques	Geology	06 249 9745
	David Newham	Coordination	06 249 9571
Program responsibility	Geophysical Observatories and Mapping		Geophysics
	Minerals and Land Use		Geology
	International Programs Unit		Coordination
Timeframe	1990–1993		

Objective

As consultants to the Omani Ministry of Petroleum and Minerals, supervise a program for the geophysical and geological mapping of the Batinah coastal region (north of Muscat) and the Raki-Hayl As Safil area of the Sultanate of Oman.

Relevance

Establish AGSO and other Australian geoscientific expertise as a desirable commodity to the Omani Government for improving understanding of the geology of Oman, and assisting in the development of its mineral resources.

Expected outcomes

Consolidate working relations with the Geological Survey of Oman.

Establish Australia's geological/geophysical

expertise in the region.

Gain full cost recovery for services performed.

Activities

Supervise and check Aerodata's geophysical data, and interpretations as draft geomagnetic and solid geology maps, and associated reports.

Prepare proposals for additional geophysical mapping projects in four areas at the request of the Omani Government.

Expected products

Published geomagnetic and solid geology maps and associated report on the Batinah Coast and Raki-Hayl As Safil.

Highlights for 1992/93

Completion by contractor of survey and preparation of pixel maps.

Intersection of sulphides in drilling in the Raki-Hayl As Safil area following a ground geophysical program based on the airborne survey early results.

Goals for 1993/94

Complete the contract to the satisfaction of the Omani Government.

Customers

Omani Ministry of Petroleum and Minerals

Cooperating agencies

Geological Survey of Oman

Al Bassim Enterprises, Muscat

Aerodata Australia.

Project 317.05 Volcanism, tectonics and metallogeny of western Melanesia

Project manager	Wally Johnson 06 249 9377
Program responsibility	Minerals & Land Use Program
Timeframe	1991–1996

Objective

To determine the relationships between volcanism and tectonics of the Papua New Guinea and western Solomon Islands region as a basis for assessing volcanic hazards and the metallogeny of the region.

Relevance

AGSO has had a long association with Papua New Guinea and since 1969 has accumulated a vast amount of geological and rock-geochemical data on the late Cainozoic volcanism of western Melanesia, including the western Solomon Islands. Much of these data remain unsynthesised and some uninterpreted. These data will contribute to a major assessment of the volcanism, tectonics, volcanic hazards, and metallogeny of this high-profile region.

An existing rock-powder collection also provides an excellent opportunity to obtain new gold and platinum group elements analytical data as a basis for the examination of possible relationships between the pristine gold and platinum group elements concentrations of fresh volcanic rocks and major, minor, and other trace-element contents.

Expected outcomes

Improved understanding of the basic controls of magma generation in island arcs, particular in the west Melanesian region.

Provision of an improved base for hazard assessments and mineral exploration in the region.

Activities

Finalise a major geochemical analytical set of west Melanesian whole-rock samples (about 1500) on AGSO's ROCKCHEM database.

Assess and analyse existing data and write reports.

Complete a major synthesis of the relationships between volcanism and plate tectonics in the late Cainozoic of the region.

Highlights for 1992/93

Acceptance for publication of paper on New Britain isotope geochemistry.

Acceptance for publication of paper on the U/Th disequilibria data for historical lavas from the Bismarck volcanic arc.

Completion of preliminary report on isotopic data for the New Georgia Group.

Collection of new isotopic data for lavas from western Bismarck volcanic arc.

Discussions held with staff from Research School of Earth Sciences, ANU, regarding analysis of West Melanesian rocks for the platinum group elements.

Goals for 1993/94

Develop ROCKCHEM database subset for Western Melanesia.

Prepare outline for major synthesis.

Complete reports in association with co-workers.

Customers

Exploration companies

Government agencies of Papua New Guinea and the Solomon Islands

General geoscientific community

Cooperating agencies

Rabaul Volcanological Observatory (Papua New Guinea) — information

Australian National University — information

Project 317.06 Kalimantan Geological Maps Project (KGMP)

Project manager	Peter Pieters	06 249 9310
Program responsibility	Minerals and Land Use	Geology
	Cartographic Services Unit	Cartography
	International Programs Unit	Coordination
Timeframe	1992–1993	

Objective

Using computer-assisted cartographic technology, publish twelve 1:250 000 coloured geological maps of central-western Kalimantan which were produced in preliminary form under the former Indonesia–Australia Geological Mapping Project; and associated explanatory notes.

Relevance

To further AGSO's geoscientific expertise as a desirable, high technology commodity to the Indonesian Government for producing high quality maps to attract international companies interested in developing the mineral and energy resources of Kalimantan.

Expected outcomes

Enable Government of Indonesia to identify prospective areas for detailed exploration for mineral and energy sources.

The advanced standard of maps and earth resource data will assist in the general development of Kalimantan.

Activities

Transfer of geological and geophysical data from manually drafted maps onto Intergraph computer system, upgrading the maps and preparing them for printing.

Compilation and writing of Explanatory Notes in English and Indonesian.

Preparing statistical models.

Training of Indonesian earth scientists.

Expected products

Twelve 1:250 000 coloured geological maps and twelve explanatory notes.

Highlights for 1992/93

Three maps were printed and another six maps were drafted to colour electrostatic plot stage. The write-up in English and Indonesian of eight explanatory notes was completed.

Goals for 1993/94

The preparation and publication of twelve 1:250 000 geological maps and accompanying explanatory notes before the end of 1993.

Customers

Indonesian Ministry of Mines and Energy

AIDAB

Indirectly

Mineral and Petroleum exploration companies

Government agencies of Indonesia

General geoscientific community

Cooperating agencies

Geological Research and Development Centre, Bandung, Indonesia

Program Delivery

Engineering Services

Program manager	Neville Esau	06 249 9243
Key managers	Malcolm Gamlen	Electronics Services
	Virginia Musitano	Resource Manager
	Mike Burns	Mechanical Services

Objective

To contribute to AGSO programs by providing high quality engineering services and products.

Highlights for 1992/93

Installation and Commissioning of the Series 2 Marine Data Acquisition system completed.

Development, testing, and commissioning of a major upgrade (Series 2) to the MSDAS Analog-Digital Converter System completed.

Major maintenance and upgrade operations to the Sercel data acquisition system completed.

Commissioning of the AF Demagnetiser at the Black Mountain Paleomagnetic Laboratory completed.

Development, testing, and commissioning of the three prototype remote earthquake data acquisition and transmission systems completed. System performance evaluation proceeding.

Installation, testing, and commissioning of major upgrades to the OSPG field communication systems for the Officer Basin Survey completed.

Development, testing, and commissioning of a real-time GPS data link to upgrade data quality and productivity on airborne surveys.

Marine, Onshore, Airborne, Earthquake, Geomag, and Antarctic field support operations maintained at programmed levels.

Design and fitting out of a new mobile workshop and laboratory to support airborne field operations completed.

Development, installation, and testing of the Intermagnet Global Network instrumentation completed. Calibration and final commissioning in progress.

Design, manufacture, installation, and commissioning of a gravity coring system for the research vessel Aurora Australis completed.

Design and manufacture of a new heat-flow lance, inclinometer, and penetrometer for the Rabaul survey completed.

Design, manufacture, and installation of a new acid-buffer storage and supply system for the OSPG Sedimentary Acid Laboratory completed.

Goals for 1993/94

Contribute to the Continental Margins Program especially through implementing new and upgraded mechanical, data acquisition, and other electronic equipment for RV *Rig Seismic*.

Contribute to the upgrading of the Eastern and Western Seismograph Networks through the development and implementation of high quality remote data acquisition and transmission systems.

Develop and implement a new data acquisition and storage system to support the Airborne Geophysical Mapping Program.

Review the support services provided to MGPG and OSPG for field operations. Review the structure of the ESU groups providing these services to prove the efficiency and effectiveness of these support services.

Contribute to the implementation of the Government's response to the recommendations of the Richards Review. Contribute to the development of the AGSO strategic plan arising from the Richards Review.

Develop and implement strategies for more effective project management within ESU.

Develop and implement appropriate database, networking, and consultative processes to facilitate project and financial management within ESU.

Further develop and implement training programs for ESU staff to improve service delivery and quality. Develop technical and general training programs to enhance ESU staff work satisfaction and career opportunities.

Enhance productivity through the application of new upgraded CAD, simulation, and ATE systems.

Complete the development, installation, and commissioning of the ESU PC LAN to improve overall productivity and efficiency for staff, especially in document, drawing, and PC layout operations, access, and storage.

Within ESU, foster higher quality management, technological leadership, and focus on service, to facilitate service and product delivery, and allow ESU to prosper under financial and resource constraints.

Customers

AGSO Programs:

Marine Geoscience and Petroleum Geology

Onshore Sedimentary and Petroleum Geology

Minerals and Land Use

Environmental Geoscienceand Groundwater

Geophysical Observatories and Mapping

Antarctic CRC

Cartographic Services Unit

Program manager	Ian O'Donnell	
Key managers	Philip Ryan	Information technology
	Jon Stirzaker	Production manager
	Rainer Swoboda	Technical services

Objective

Provide cartographic and related services in support of AGSO objectives and AGSO's clients.

Highlights for 1992/93

Production:

Published the first of the new generation National Geoscience Mapping Accord (NGMA) map products.

Completed GIS coverage for Bedrock Geology, based on the 1:250 000 scale printed geological maps for CYPLUS Project area.

Publish 10 full-colour lithographic maps printed as part of the Murray Basin Hydrogeological Series.

Participated in a working group to examine methodologies for enhanced integration between ARC/INFO GIS and Intergraph CAD/CAM environment.

Publish six maps and graphics to support AIDAB-funded projects.

Cartographic input to six Petroleum Prospectivity Packages.

Graphic design of material for 38 displays, culminating in 180 sq. metres of exhibits.

Released ArcInfo version of Symbols Used on Geological Maps.

Contribute a diverse range of cartographic services to the Shoalwater Bay Investigation.

Production of multicolour maps for the negotiation of maritime boundaries between Australia and Indonesia.

Approbation:

Awarded 2nd prize, 'Mapping' category in the Intergraph 1993 Golden Mouse Awards Computer Competition, Alabama, USA, for Ebagoola Regolith, one of the new generation map products.

Won the prestigious Cartographic Excellence Award at the 1st Australian Conference on Mapping and Charting and a Judges' Commendation in the Thematic Mapping category.

Won two Conference awards for excellence for our display material.

Other:

Introduced a work employment scheme for Canberra Institute of Technology students.

Facilitated the relocation of AGSO's extensive airphoto collection to more appropriate accommodation at NRMA House.

Goals for 1993/94

Maintain the application of advanced CAM and GIS techniques to provide a comprehensive and timely service to AGSO Programs and AGSO's external clients.

Work towards the strenghtening of relationships with our external customers.

Assist the organisation in meeting the objectives of the NGMA through enhanced co-operation between CSU and State/NT cartographic counterparts through the exchange of information and provision of services.

Continue to play a proactive role in the development of national digital geoscientific data sets necessary for informed decision making on resources and land management issues.

Allocate 2% of resources in support of a research and development strategy for improved products/practices, including investigation and development of methodologies for integrating data between Intergraph and ArcInfo systems.

Refine the programming and production information systems necessary to meet the requirements of AGSO's new objectives.

Transfer our hard copy data holdings information system to NDAR.

Catalogue and incorporate the airphoto collection within the Map Library through a shared resource arrangement between CSU and AGSO Library.

Continue to play a significant role in meeting AGSO's external revenue targets.

Maintain a healthy, participative and equal opportunity work environment.

Provide opportunities for technical and personal development of staff so that they have the right skills to meet our customer's future needs.

Corporate Relations, Information and Planning

Program manager	Alex Nicolson	06 249 9411
Key managers	Ian Hodgson	Corporate publications
	Anne Franklin	Library
	Gillian Tidey	Marketing and information
	David Bailey	Policy, planning and evaluation

Objectives

Provide information services and support to AGSO Executive, Advisory Council and Programs.

Facilitate AGSO's communication with clients.

Coordinate AGSO's Planning and Liaison Cycle.

Highlights for 1992/93

Sales turnover from scientific bulletins, records, reports, maps and other publications exceeded $1 000 000 — the highest turnover on record. Agreement was reached with three States to sell State Geological Survey products.

The Evaluation of the Continental Margins Program was completed. Methodology for the proposed Evaluation of Commonwealth Input to the National Geoscience Mapping Accord was developed. New approaches to evaluation of benefits, and development of terms of reference have been introduced to improve the rigour and usefulness of program evaluations.

Coordinated the preparation of major organisational submissions to the RAC Coastal Zone Inquiry, the ASTEC Inquiry into Research and Development in Tropical Australia, the review of ASTEC itself and the Richards Review of AGSO.

Continued growth in demand for *AUS.GEO*

News and the AGSO Research Newsletter, and the database of customers seeking information on these and other AGSO products rose to over 4500. A catalogue of publications was produced on disk. Style links between AGSO corporate publications were improved to emphasise their inter-relationships.

Improved library operations by establishing AARNet access to Australian Bibliographic Network, completing Stage 1 of implementation of Online Public Access Catalogue, and by holding a seminar for AGSO staff to increase awareness of library services and improved searching facilities.

Improved support to AGSO Advisory Council which held its three regular meetings during the year, and two extraordinary meetings to consider its input and responses to Richards' Review deliberations.

Raised the standard of AGSO's support for the Minister and its contribution to the policy process; implemented a quality assurance program for Ministerial correspondence and AGSO Records.

Commenced planning for AGSO Jubilee in 1996. Planning for a major national conference has started with assistance from associations of geoscience professionals.

Provided planning and evaluation assistance to areas outside AGSO, including facilitation of meetings of the Groundwater Working Group of the Murray–Darling Basin Commission and DPIE's Countrylink Program Evaluation Team and a cross-DPIE Workshop on Evaluation. Ran two Seminars within AGSO on the planning, evaluation and reporting cycle in AGSO and on evaluation in AGSO.

Introduced a program of awards for postgraduate students of the geosciences and made initial awards. Revised assessment procedures for the awards during the year and completed second cycle of awards.

Held five Open Days as part of Australian Science Festival and organised major exhibits at a number of key national and international conferences.

Reduced average staffing level (ASL) of the Branch from 32 staff to 30 and made major progress in correcting Branch operating deficit.

Goals for 1993/94

Assist in implementation of the Government's response to the recommendations of the Richards Review. Integrate this process into the ongoing development of a strategic plan for the organisation.

Complete Publications Review and implement its recommendations. Improve support to programs by developing procedural and editorial guidelines.

Finalise overall marketing strategy for AGSO and commence major marketing effort for AGSO Journal of Australian Geology and Geophysics.

Complete all phases of implementation of Online Public Access Catalogue in Library and expand CD–ROM information services.

Expand cataloguing and information retrieval system currently used in Map Library as resources permit.

Commence curatorial action to integrate AGSO's collection of airphotos into the Map Library.

Assist in the introduction of new mechanisms for priority setting, and help improve performance measurement and evaluation methodologies.

Continue to provide high level of administrative support to the AGSO Advisory Council and the AGSO Executive.

Business Management Branch

Program manager	John Cahill	06 249 9473
Key managers	Peter Cook	Finance and Services
	Amanda Dixon	Personnel Management

Objectives

Provide corporate management support and services to AGSO people and programs by:

- recruiting, servicing and developing AGSO's personnel
- acquiring and, in conjunction with operational program areas, managing AGSO's financial and related resources
- acquiring and managing AGSO's property, facilities and related assets
- providing advice on corporate management issues, particularly resource management.

Highlights for 1992/93

Favourable end of financial year budget outcome.

Successful negotiation and transfer of resources to BRS.

Successful implementation of the Prophecy FMIS.

Successful implementation of the Sun Systems asset package.

Contribution of resource information to the Richards Review.

Satisfactory assessments arising from external and internal audit.

Release of several internal papers aimed at streamlining resource management practices and processes, and increasing accountability:

- credit cards, hiring of consultant/contractors, and senior officer work related expenses.

Successful negotiation with DoF on a range of Budget related matters.

Resource management skills within the Branch show a significant improvement as a result of greater interaction with Program Heads and Resource Managers.

Performance Appraisal and Pay arrangements and Senior Officer package implemented for Research Scientist, Professional Officer and Senior Officer grades.

OH&S Agreement finalised with AGSO unions.

New first aid arrangements finalised including training of first aid officers, stocking of first aid kits and arrangements for a first aid room.

"EEO in AGSO" and "Eliminating Workplace Harassment" brochures developed.

Development and implementation of field conditions of service packages and policies promoting better human resource management practices in AGSO.

Accelerated AGSO's cultural change through a number of activities including team development activities, participation in corporate mobility and development schemes and client service programs.

Promotion of consultative work practices in AGSO.

Continued improvement and development of practices and procedures focussing directly on client needs.

Goals for 1993/94

Management

Implement Government decisions arising from the Richards Review.

Incorporate corporate vision and goals into program objectives.

Improve communication links with Minister's office and areas of DPIE.

Encourage a motivated, goal oriented working environment within the Branch.

Further develop client focus in AGSO.

New Building

Achieve favourable outcome from submission to Public Works Committee.

Finalise acquisition of site.

Commence site establishment and civil engineering packages.

Personnel Management

Manage Senior Officer and SES performance appraisal and pay arrangements.

Assist in the management of workplace bargaining and further promote consultative arrangements within AGSO.

Assist with and advise on change management, including developments arising from Government decisions on the Richards Review.

Further develop human resource management policies and practices to encourage continuous management and administrative improvement.

Coordinate and implement designated work groups and training of elected OH&S representatives in line with the OH&S Act.

Maintain links with key clients, stakeholders and others through networks, working parties and committees.

Finance and Administrative Services

Support and manage change arising from Government decisions on the Richards Review, including activities associated with a 30% revenue target.

Develop more effective and efficient corporate reporting systems.

Develop an external charging policy.

Review storage arrangements.

Develop and implement an appropriate stocktake program for AGSO assets.

Assess requirements for a new Records Management system.

Develop revised guidelines for the use of AGSO vehicles.

Implement a motor vehicle driver safety program.

Prepare an energy management program for AGSO.

Identify designated security assessed positions and positions of trust and obtain relevant security clearances.

Information Systems

Program manager	David Berman	06 249 9602 Fax 06 249 9977 *email firstinitialsurname@agso.gov.au*
Key managers	John Creasey	Image Processing
	David Downie	Networks and Communications
	Mirek Kucka	Database Administration
	Rod Rybum	Database Coordination
	Geoff Wood	Data Management

Objectives

Provide an appropriate corporate computing environment for AGSO.

Improve connectivity between Program and Corporate level systems.

Provide advice to senior management on information technology issues.

Deliver effective training in the use of corporate computing facilities.

Manage the implementation of corporate information technology projects.

Maintain an updated AGSO Information Management and Information Technology Strategy, in consultation with program managers, and in line with the Departmental strategy.

Activities

Develop and implement operational plans in line with the IM&IT Strategic Plan.

Manage corporate administrative systems, e-mail, voice/data facilities, Oracle databases, image processing and GIS facilities.

Help users develop appropriate network, hardware and software solutions.

Establish effective computing environments for corporate information systems.

Consult with senior management on corporate information systems and data management

priorities.

Service the Information Resources Management Committee.

Highlights for 1992/93

The impact of the split that resulted from the removal of NRIC, PRAB and MRAP functions from BMR to BRS was addressed. A plan for the continued joint operation and management of the national geoscience databases under AGSO's Oracle environment was developed. The split resulted in a loss of salary and of administrative funds from the Branch. To date, general services are being made available as before, but the Branch has lost its major planning capability.

The Branch continued to participate in DPIE IT planning and management, through both the DPIE IT Committee and Technical Working Groups. A major effort was also taken to address the 15 recommendations directed specifically at BMR by the Audit Office, following its review of DPIE IT security.

A quad processor Data General AViiON 6240 Unix system was commissioned in June 1992. This system is configured with 128MB of memory, 8GB of disk storage set up as a redundant (RAID 5) array, cartridge and 6250 tape units, 72 serial ports and Ethernet network ports. The system was installed to take over the Oracle databases and some other applications previously run on a Data General MV/20000 system.

Connection of the AViiON system to the existing Sytek broadband terminal network, printers, plotters, modems and other peripherals and the conversion of software packages took place in parallel to the migration of Oracle databases.

In November the MV/20000 processor was replaced with a much smaller interim MV9300 system. The MV/20000 system had supported Oracle and several large technical data processing applications since 1986. With the installation of the AViiON Oracle database server and the migration of the other major applications to Program level Unix systems, substantial maintenance savings were realised by moving to a current generation CPU and by removing peripherals no longer required on this system. Although CPU power was almost halved, the MV9300 was able to handle production Oracle work while applications were being tested and moved to the AViiON system.

The Branch also assisted in the implementation of the Prophecy financial management system. Following installation of a Pyramid MIS–1/1 system in June 1992, network, serial terminal and printer connections were developed to allow access for users in the Finance area and for AGSO project managers generally. A test version of Prophecy was installed for test and training purposes in November. The cut-over to the live Prophecy system running on AGSO's Pyramid took place in February.

The AGSO electronic mail environment is still evolving. With the installation of new Macintosh PCs in the Executive came Quickmail connectivity with DPIE headquarters. Lotus cc:Mail, installed on the MLUP Novell LAN, was upgraded and brought back into use. Access to and use of Unix e-mail through ARRNet increased significantly, as the service was promoted, and a higher capacity Departmental link was connected. Although the CEO X.400 gateway link to DPIE PC e-mail systems continued via the small MV9300 system, selection of a replacement system was delayed pending the resolution of several standards based issues, being examined by DPIE corporately.

The number of nodes connected to the AGSO ethernet backbone (AGSOnet) increased dramatically over the year. This reflects the growth in the number of Unix workstations, a continuing trend to move existing PC systems to network connection, and the installation of new ethernet in several areas. The latter included conversion of the existing Apple localtalk network in BMB and CRIP to ethernet, the installation of new desktop systems in the Executive, the extension of the Sales and Information network and the installation of a Novell LAN in the Library.

A high-performance multi-port router was installed to both remove restrictions on IP node address space and to increase overall network performance. A smaller router and ISDN link was installed at Fyshwick, providing AGSOnet connectivity for the Apple and PC systems via an upgraded Novell LAN in the Purchasing and Stores groups.

After developing a 5 year Communications Strategic Plan for AGSO in 1992, the communications consultants assisted in the purchase

by tender and installation of a new PABX system. An Ericsson MD110 system was selected and successfully installed in July. The new PABX has provided a much improved level of service with features such as voice mail. It has also lead to significant cost savings with improved management facilities, rationalisation of fax and other dedicated exchange lines, access to Fednet and ISDN services and the integration of voice and data services on a private microwave link between the main AGSO building and NRMA House.

Technical support of the GOM Airborne Mapping program continued with the development of software to record 256 channel gamma-ray spectrometer data and with an investigation of appropriate hardware and operating system software for future development of the aircraft's data acquisition system.

In the Spatial Data Processing Centre, major upgrades of the GIS and image processing computing systems were funded from savings in the MV systems. The SUN 4/280 was replaced by a 4/690 dual CPU, supporting IIS and ER Mapper software. The SUN 4/470 was upgraded to a 4/670 quad CPU, supporting Arc/Info. This improved performance by 4 and 6 times respectively. The Branch also took over formal responsibility for system support of the corporate GIS machine, and coordinates networked SUN machines over AGSOnet.

Major software upgrades on both systems were also carried out, and the currency of software that resulted has improved processing capability. The Centre also installed increased disk capacity and system backup to cope with increasing disk storage demands by Programs.

Increased utilisation of image processing continued to be pursued through user assistance and advice and via the activities of the Working Group on Remote Sensing and Image Processing. The group organised a 2 day workshop on image processing of geophysical data to review the principles and processing strategies for AGSO geophysical datasets. The working group submitted a proposal on the future of remote sensing in AGSO to Executive and Program Heads for consideration. A GIS user group has likewise been encouraged.

Contract image processing work was organised to facilitate short term project work for Programs, particularly the MPGP–NOPEC North West Shelf project, and MLUP's remote sensing related projects.

Advanced visualisation continued to be demonstrated with the production of an animation sequence using AGSO datasets.

Goals for 1993/94

In general, there will be continuing support of and improvements to existing corporate administrative and scientific computing platforms, for AGSO and relevant BRS staff, subject to resource agreements.

In particular, there is a need to address the complexities arising from the decision to relocate AGSO and BRS staff by late 1993, and a need to plan in detail for the communications and physical needs of the new AGSO building, so that it will be operational by 1997.

Two major new initiatives are proposed. One will see the development of a mass storage system to support valuable digital and archival material required by many program areas, in conjunction with a plan to move to on-demand electronic publishing of material currently held as bookshop and map printed stock. In particular, an early introduction of a CD–ROM production capability is envisaged.

The other initiative is based on the need to plan for an associated Information Facility as a physical site for clients to access much AGSO data, through a unified computer interface and access to supporting databases, bibliographic, imagery and textual material. Specialist workstation, input, storage and output devices, and project definition and management services will need to be funded for both initiatives.

There will be a continuation of the existing levels of service, despite resource cuts. This includes managing the corporate computing infrastructure; including the provision of operator services, user assistance, file system maintenance, magnetic tape management, system development and general technical consulting services. In providing these services, the Branch will:

- Manage the Prophecy financial management information system environment, including developing expertise in supporting the underlying Ingres database management system. Planning for the replacement of the current Departmental personnel system will also commence.

- Investigate and implement alternatives for applications currently supported in the AOS/VS environment on the MV9300 system, particularly replacements for the CARMS records management system and the CEO office package. It is intended to cease supporting the MV early in 1994, for financial reasons.
- Deliver appropriate network support to programs, and advice on related software and hardware issues. In particular, a corporate view on PC operating systems strategies, and IT security policy will be implemented.
- Further develop internal e-mail systems and install a new external gateway to provide universal connectivity, based on X.400 and X.500 standards, in accordance with Government open systems policies, and DPIE corporate decisions.
- Upgrade the ISB Novell file server to provide LAN support to PC and Macintosh users in ISB, ESU, CRIP and EGG. Continue development of LAN based systems in BMB, CRIP and the Executive and promote rationalisation of the many Novell servers operated throughout AGSO.
- Manage the PABX, and further rationalise voice and data services, including investigation of voice/data links to remote sites and the need for a high capacity microwave link with other areas of the Department. Emerging opportunities in satellite and GPS systems, to support remote field parties, will also be investigated.
- Manage the AGSOnet usage, partitioning it as necessary. The emergence of high speed network technologies, such as FDDI, CDDI, ATM, and fast Ethernet will also be monitored. Systems will be designed and installed to meet anticipated increases in performance and connectivity requirements.

The main image processing SUN 690 server will be further upgraded to bring it in line with the capability of the corporate GIS server. This will alleviate, and keep pace with the increased load on the 690 server. The X-Windows capability in the Centre will be expanded by adding a dual monitor workstation. This will provide a large 24-bit monitor that will enhance the display of X-based software packages, particularly ER-Mapper.

The SUN servers will be upgraded with the installation of the Solaris operating system. This upgrade is necessary to keep the administration of the servers up-to-date, and to standardise on a common Unix SVR4 systems environment, along with the other main AGSO servers. X-Windows software developments will be re-assessed, particularly for image processing, as part of an ongoing policy to develop distributed processing and display capability in the organisation.

The development of spectral remote sensing will be facilitated with the purchase of an IDL software licence and associated spectral software packages. This work will be carried out under the auspices of the Working Group on Remote Sensing and Image Processing.

Software development for image processing and system administation will continue, as will research to demonstrate the visualisation of AGSO image data using ray tracing and animation methods.

GLOSSARY OF DATABASES AND COMPUTING APPLICATIONS

AESIS:
AMF's Australian Earth Sciences Information System. [Contact: David Berman 06 249 9602]

CORE AND CUTTINGS:
BRS's repository which houses material from AGSO's own stratigraphic drilling, subsidised drilling (1959–74), all offshore drilling and some material donated by exploration companies; inspection and testing facilities are available on site. [Contact: Joe Staunton 06 239 1890]

GABDAT:
Hydrogeological data, including waterwell data, from the Great Artesian Basin, from the State Water and Geological Authorities of Queensland, New South Wales, South Australia and the Northern Territory, and from AGSO. [Contact: Rien Habermehl 06 249 9426]

GABLOG:
Wire-line log data from AGSO's collection of wire-line logs from 1250 waterwells in the Great Artesian Basin. Digitising of the logs is in progress, and the digital log data and basic well data will be made available on CD-ROM. [Contact: Rien Habermehl 06 249 9426]

GEODX:
A Central Register of Australian Stratigraphic Names including usage, geological provinces, geographic locations and full bibliographic references; also stored are names reserved by geologists for future definition and use. [Contact: Cathy Brown 06 249 9123]

GEOPAC:
A public online set of earth sciences databases managed by INFO-ONE international Pty. Ltd. which includes the AMF AESIS database. [Contact: David Berman 06 249 9602]

HARDCORE:
BRS's loans and inventory system containing well completion reports acquired under the Petroleum (Submerged Lands) Act and the Petroleum (Search Subsidy) Act and any other reports donated by the petroleum exploration industry. [Contact: Danny Britten 06 239 1899]

ISMS:
Interactive Seismic Modelling System (software package for Cogniseis)
[Contact: Mike Sexton 06 249 9791]

LIBRARY:
Australia's premier geoscientific library with holdings including 20 000 monographs, 3000 serial titles, a complete collection of AGSO/BMR publications and a large number of maps, map series, and air photos. [Contact: Anne Franklin 06 249 9369]

MINDEP:
Fully referenced database on the name, location, regional setting, geology, resources, production history and ownership of known mineral deposits for mineral resource assessment studies.
[Contact: Brian Elliott 06 272 4433]

MINLOC:
BRS's fully referenced database on the name, location and commodity of economic interest for over 30 000 Australian mineral occurrences. [Contact: Brian Elliott 06 272 4433]

MINOCC:
A Queensland Geological Survey database which records mineral occurrence information roughly equivalent to OZMIN; used by the North Queensland joint NGMA Project.
[Contact: Brian Elliott (06) 249 9502, Greg Ewers 06 249 9580]

MURBO:
Interpreted stratigraphic and hydrogeological information for Murray–Darling Basin.
[Contact: Ray Evans 06 249 9738]

ORGCHEM:
A petroleum source rock database linked to PEDIN; it contains open file source rock analyses of samples from hydrocarbon exploration, including organic carbon, Rock Eval, extract, elemental analysis and organic petrography data (maceral composition, vitrinite reflectance and spore colour index). [Contact: Chris Boreham 06 249 9488]

OZCHRON:
A national database of isotope geochronology including sample data and bibliographic references as well as analytical and pooled results from the K-Ar, Ar-Ar, Rb-Sr, Nd-Sm and U-Pb mineral and SHRIMP methods for samples from Australia, Antarctica and Papua New Guinea.
[Contact: Rod Page 06 249 4261]

OZMIN:
A new NGMA database of Australian mineral deposits and occurrences that is intended to take over from the older MINDEP database. It is a simpler but more tightly structured database that will initially concentrate on deposits in NGMA mapping areas. [Contact: Greg Ewers 06 249 9580]

PALDAS:
A palaeomagnetic data acquisition system installed at AGSO's Black Mountain Palaeomagnetic Laboratory which controls data acquisition from most measuring instruments.
[Contact: John Giddings 06 249 9319]

PALEO:
A database of AGSO's fossil collection which includes the provenance, geology, biostratigraphy, bibliography, nomenclatural status, and storage of each identified specimen.
[Contact: Des Strusz 06 249 9416]

PALSYS:
A PC-based palaeomagnetic data processing and interactive interpretation system.
[Contact: John Giddings 06 249 9319]

PEDIN:
A national petroleum exploration data index containing basic information and statistics on petroleum exploration and development drilling, and geophysical surveys which have been carried out in Australia and its Territories. Jointly managed by AGSO and BRS.
[Contact: Sandy Radke 06 272 5258]

RESFACS:
Relational Oracle database which relates to PEDIN. It stores values such as porosity, permeability, hydrocarbon shows and depositional environment. [Contact: John Bradshaw 06 249 9659]

RTMAP:

A regolith terrain mapping database containing information from Eastern Goldfields, Cape York, East Arnhem Land and Lachlan Fold Belt which will eventually cover the Australian continent. [Contact: Colin Pain 06 249 9469]

ROCKCHEM (FORMERLY PETCHEM):

A national database of whole rock geochemistry including major and trace element data and bibliographic references from 25 000 samples from Australia, Antarctica and Papua New Guinea. [Contact: Leslie Wyborn 06 249 9489]

STRATDAT:

An interpretive biostratigraphic database which relates fossil zones and absolute time scales for selected onshore and offshore exploration wells. [Contact: John Bradshaw 06 249 9659]

STREAMCHEM:

A national database of stream sediment geochemistry that is being developed in conjunction with the activities of the National Geoscience Mapping Accord. [Contact: Bruce Cruikshank 06 249 9286]

STRUCTURE:

A database of Australian structural geology for all current NGMA Projects being undertaken by Minerals and Land Use Program. [Contact: Richard Blewett 06 249 9713]

LIST OF ACRONYMS

AAPG	American Association of Petroleum Geologists
AAT	Australian Antarctic Territory
ABARE	Australian Bureau of Agricultural and Resource Economics
ADFA	Australian Defence Force Academy
AGC	Australian Geoscience Council
AGRF	Australian Geomagnetic Reference Field
AGSO	Australian Geological Survey Organisation (formerly BMR)
AIDAB	Australian International Development Assistance Bureau
AIMS	Australian Institute of Marine Science
AMDEX	Australian Mining Data Exchange format
AMF	Australian Mineral Foundation
AMIC	Australian Mining Industry Council
AMIRA	Australian Mineral Industries Research Association Limited
ANARE	Australian National Antarctic Research Expeditions
ANARESAT	ANARE satellite link between the Antarctic and Canberra
ANCA	Australian Nature Conservation Agency (formerly Australian National Parks and Wildlife Service)
ANCAR	Australian National Committee for Antarctic Research
ANSTO	Australian Nuclear Science and Technology Organisation
ANTOSTRAT	Antarctic Offshore Acoustic Stratigraphy project
ANU	Australian National University
ANZMEC	Australia and New Zealand Minerals and Energy Council
APEA	Australian Petroleum Exploration Association
APIRA	Australian Petroleum Industry Research Association
APS	Australian Petroleum System
APWP	Apparent Polar Wander Path
AREG	Antarctic Research Evaluation Group
ASAC	Antarctic Science Advisory Committee
ASC	Australian Seismological Centre (AGSO)
ASEG	Australian Society of Exploration Geophysicists

ASTEC	Australian Science and Technology Council
AUAOS	Australian User Alliance for Open Systems
AUSDEC	Australasian Spatial Data Exchange Centre
AusIMM	Australasian Institute of Mining and Metallurgy
AUSLIG	Australian Surveying and Land Information Group
AWAGS	Australia Wide Array of Geomagnetic Stations
AWRC	Australian Water Resources Council
BIRPS	British Institutions' Reflection Profiling Syndicate
BMR	Bureau of Mineral Resources, Geology and Geophysics (now AGSO)
BRR	Bureau of Rural Resources (now BRS)
BRS	Bureau of Resource Sciences
CAD	computer assisted design
CCOP	Committee for the Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas
CCST	Coordinating Committee on Science & Technology
CMP	Continental Margins Program
CNNC	China National Nonferrous Metals Industry Corporation
CODES	Centre for Ore Deposit and Exploration Studies, University of Canberra
COGEODATA	IUGS Commission on Global Data Management and Information Systems
COGEODOC	IUGS Commission on Geological Documentation
COGEOINFO	IUGS Subcommission on the Management and Application of Geoscience Information
CPCEMR	Circum–Pacific Council for Energy and Mineral Resources
CPMP	Circum–Pacific Map Project (CPCEMR)
CRC	Cooperative Research Centre
CSDC	Commonwealth Spatial Data Committee
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTBT	Comprehensive [Nuclear] Test Ban Treaty
CYPLUS	Cape York Peninsula Land Use Strategy
DEET	Commonwealth Department of Employment, Education and Training
DEST	Commonwealth Department of the Environment, Sport, and Territories
DFAT	Commonwealth Department of Foreign Affairs and Trade

DHD	direct hydrocarbon detection
DPIE	Commonwealth Department of Primary Industries and Energy
DSDP	Deep Sea Drilling Program
DSIR	Department of Scientific and Industrial Research, New Zealand
EEE	Energy Economics and Environment
EEZ	Economic Exclusion Zone
ERIN	Environmental Resources Information Network (DASET)
ESCAP	Economic and Social Commission for Asia and the Pacific
GAB	Great Artesian Basin
GEBCO	General Bathymetric Chart of the Oceans
GEODEX	Proposal for an Australian Geoscience Data Standard
GGDPAC	Government Geologists Database Policy Advisory Committee
GIS	geographic information system
GOMP	AGSO's Geophysical Observatories and Mapping Program
GPS	global positioning system
GSA	Geological Society of Australia
GSE	Group of Scientific Experts
GSETT2	Group of Scientific Experts Technical Test–2
GSQ	Geological Survey of Queensland
GSV	Geological Survey of Victoria
GSWA	Geological Survey of Western Australia
HAZMAP	A Working Group of the IDNDR Committee producing maps in the Australian region showing the distribution of areas affected by earthquakes, volcanic eruptions, tsunamis, landslides, and other geological hazards, as well as tropical storms, floods, bushfires, wave heights, sea ice and other climate related hazards.
HIG	Hawaiian Institute of Geophysics
IAEA	International Atomic Energy Agency
IAGA	International Association of Geomagnetism and Aeronomy
IAGMP	Indonesia–Australia Geological Mapping Project
IBCWP	International Bathymetric Chart of the Western Pacific
ICOG	International Conference on Geochronology, Cosmochronology and Isotope Geology
IDNDR	International Decade for Natural Disaster Reduction

IEA	International Energy Agency
INFREMER	Institut Français De Recherche Pour L'Exploitation De La Mer
IGBP	International Geosphere Biosphere Program
IGCP	International Geological Correlation Program
IGBP	International Geosphere–Biosphere Program
IGRF	International Geomagnetic Reference Field
INTERMAGNET	Global interchange of geomagnetic observatory data in real time by satellite
IOC	Intergovernmental Oceanographic Commission
IPCC	Intergovernmental Panel on Climatic Change
IUCN	International Union for the Conservation of Nature and Natural Resources
IUGG	International Union of Geodesy and Geophysics
IUGS	International Union of Geological Sciences
JNOC	Japan National Oil Corporation
LANDSAT	Land satellite
LOS	Law of the Sea [see UNCLOS]
MCS	multichannel seismic
MGMR	Ministry of Geology and Mineral Resources, PRC
MLA	Member of the Legislative Assembly
MOU	Memorandum of Understanding
MP	Member of Parliament
NASA	National Aeronautics and Space Administration
NDAR	National Directory of Australian Resources
NGMA	National Geoscience Mapping Accord
NOAA	National Oceanic and Atmospheric Administration (US)
NOPEC a s	Norwegian Petroleum Exploration Consultants
NRAP	Natural Resources Assessment Program
NRIC	National Resource Information Centre (BRS, DPIE)
NSW	New South Wales
NSWGS	New South Wales Geological Survey
NT	Northern Territory
NTGS	Northern Territory Geological Survey
NZGS	New Zealand Geological Survey

NZOI	New Zealand Oceanographic Institute
ODP	Ocean Drilling Program
OEA	Office of Energy Affairs, Republic of the Philippines
OECD	Organisation for Economic Cooperation and Development
Oracle	A relational database (RDBMS) widely used within AGSO
ORSTROM	Institut Français De Recherche Scientifique Pour Le Developpement En Cooperation
PANASH	Palaeoclimates of the Northern and Southern Hemispheres
PASH	Palaeoclimates of the Southern Hemisphere
PESA	Petroleum Exploration Society of Australia
PGE	Platinum Group Elements
PNG	Papua New Guinea
POSC	Petrotechnical Open Software Corporation
POGS	Polar Orbiting Geomagnetic Survey
PRC	Peoples' Republic of China
QLD	Queensland
QDPI	Queensland Department of Primary Industry
RAC	Resource Assessment Commission
RAN	Royal Australian Navy
RDBMS	Relational Database Management System
RH&BNC	Royal Holloway and Bedford New College; Egham, Surrey, United Kingdom
RSES	Research School of Earth Sciences, ANU
RVO	Rabaul Volcanological Observatory
SA	South Australia
SADME	South Australian Department of Mines and Energy
SAE	Soviet Antarctic Expedition
SCAR	Scientific Committee on Antarctic Research
SDLS	Seismic Data Library System (Antarctic)
SDTS	Spatial Data Transfer Standard
SGDMIS	COGEODATA Sub-commission on Global Data Management and Information Systems
SHRIMP	An ion microprobe facility at the Australian National University
SOPAC	South Pacific Applied Geoscience Commission

SSB	State Seismological Bureau, PRC
TAS	Tasmania
TEG	Transglobal Environmental Geoscience
TM	Thematic Mapper
TMI	total magnetic intensity
TRC	Technical Research Centre (JNOC)
UNCLOS	United Nations Convention on Law of the Sea
UNEP	United Nations Environment Program
USBM	United States Bureau of Mines
USGS	United States Geological Survey
VIC	Victoria
VICGS	Victorian Geological Survey
VIEPS	Victorian Institute of Earth and Planetary Sciences
WA	Western Australia
WALIS	Western Australian Land Information System