AGSO

AGSO MINERALS DIVISION OPEN DAYS

27 - 28 November 1997

Record 1997/56

AGSO
AUSTRALIAN
GEOLOGICAL SURVEY
ORGANISATION

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J. Lindsay, R. Blewett, D. Huston, A. Murray, G. Gibson,
T. Meixner, T. Mackey, B. Drummond, L. Wyborn, P. Gunn,
J. Wilford, T. Mernagh, M. Hazell, D. Denham, A. Whitaker, M. Idnurm

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Australian Geological Survey Organisation

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Primary Industries and Energy: Hon. J. Anderson, M.P.
Minister for Resources and Energy: Senator the Hon. W.R. Parer
Secretary: Paul Barratt

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Neil Williams

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AGSO Minerals Division Open Days
Program

Thursday 27th November

Time	Project and Future Directions Presentations	Speaker	Chair
9:00-9:10	Welcome and introduce Minister	Neil Williams, (Executive Director, AGSO)	Neil Williams
9:10-9:25	Opening address, and launch of NQ Book & Atlas	Senator Warwick Parer, (Minister for Resources & Energy)	
9:25-9:35	Minerals Program Developments	David Denham, (Chief, Minerals Division)	
9:35-9:55	North Queensland NGMA	John Bain	
9:55-10:00	*Information about remainder of program*	Chairman	
10:00-11:00	*Morning tea/view Posters & demonstrations*		
11:00-11:20	Kimberley-Arunta NGMA	David Blake	Lynton Jaques
11:20-11:40	Tasmania (TASGO) NGMA	Tony Yeates	
11:40-12:00	Lachlan NGMA	Morrie Duggan	
12:00-12:20	North Australian Basin Resource Evaluation (NABRE) NGMA	Peter Southgate	
12:20-12.30	Using a basin framework to constrain regional and focussed fluid flow (a new project proposal —concept)*	Peter Southgate	
12.30-12.40	Hamersley Basin (a new project proposal —concept)*	John Lindsay	
12.40-2:00	*Lunch/ view Posters & demonstrations*		
2:00-2:20	Pilbara NGMA	Richard Blewett	Lesley Wyborn
2:20-2:40	Yilgarn NGMA	Alan Whitaker	
2:40-2:50	Archaean massive sulphides (a new project proposal —plan)*	David Huston	
2:50-3:10	National Gravimetry	Alice Murray	
3:10-4:10	*Afternoon tea/Posters & demonstrations*		
4:10-4:30	Broken Hill Exploration Initiative (BHEI) NGMA	George Gibson	Peter Gunn
4:30-4:40	Delamerian mineral province (a new project proposal —idea)*	George Gibson	
4:40-5:00	Deep seismic surveys in mineral provinces	Barry Drummond	
5:00-5:05	*Information about the dinner, tomorrow's program etc*	Chairman	
7:00-10:00+	*Dinner: 'Chairman & Yip Restaurant', Bunda Street*		

***AGSO project planning stages:** project **idea** > **concept** development > project outline > project **plan** > project implementation > project completion > project evaluation

Day 2	Friday 28th November		
Time	**Project and Future Directions Presentation**	**Speaker**	**Chair**
9:00-9:30	Australian Mineral Systems	Lesley Wyborn	Chris Pigram
9:30-9:40	Tanami regolith (a new project proposal —plan)*	John Wilford	
9:40-9:50	Application of fluid inclusion studies	Terry Mernagh	
9:50-10:00	Taking Mount Isa under cover (a new project proposal —plan)*	Mart Idnurm	
10:00-10:10	Capturing Australia's mineral province heritage (a new project proposal —plan)*	Lesley Wyborn	
10:10-10:40	*Morning tea/ view Posters & demonstrations*		
10:40-11:05	Airborne geophysics	Peter Gunn	David Denham
11:05-11:15	Depth to basement maps	Tony Meixner	
11:15-11:25	Results of Boulia -Springvale survey	Tim Mackey	
11:25-11:40	National databases	Lesley Wyborn	
11:40-11:55	Next generation databases	Murray Hazell	
11:55-12:20	Closing remarks & final opportunity for discussion/input	David Denham	
12:20-2:00	*Lunch/ view Posters & demonstrations*		
2:00-5:00	Optional informal discussions with project staff in AGSO building (about 500m down the road)		

***AGSO project planning stages:** project **idea** > **concept** development > project outline > project **plan** > project implementation > project completion > project evaluation

MINERALS PROGRAM DEVELOPMENT

David Denham
Chief, Minerals Division

Welcome to AGSO's Minerals Open Days. Over the next two days we aim to provide a forum for the presentation of the main results of recent work carried out in AGSO's Minerals Program, and a look into the future in the context of projects, products and activities. The presentations will cover a mixture of new results from current projects, a review of products and databases, future plans for our project activities, databases and data sets, and our research capabilities.

In essence our objective is:

- To provide geoscience information to encourage minerals exploration and assist responsible resource management.

Our strategy is:

- To understand the geological processes involved in the formation and distribution of resources in Australia by:
  - establishing a broad four dimensional geological framework of Australia, its landscape and minerals systems.

Our key actions are to:

- develop and maintain continent-wide data sets and databases,
- undertake mapping projects under the National Geoscience Mapping Accord,
- undertake strategic research projects, and,
- maintain and develop geoscience research capabilities.

These actions are clearly not carried out in isolation. We collaborate with State and Northern Territory Geological Surveys, Mineral Exploration Companies, Tertiary Institutions, Co-operative Research Centres, CSIRO and for some projects AMIRA. In fact, one of the main aims of the next two days is to develop better networks so that we can focus our limited resources to maximum effect by collaborative actions with other parties.

By the end of 1998 the Lachlan, North Australian Basins Resource Evaluation (NABRE) and the Broken Hill Exploration Initiative (BHEI) projects are scheduled to be completed. This will provide an opportunity to redirect resources to new projects and to strengthen key areas of the Minerals Program.

With the end of the extra money provided by the government following the Richards' Review we have to make sure we maximise our resources.

My own personal view of the future is that we must ensure that we maintain and develop continent-wide data sets and databases. As a national geological survey this activity is the core of our business. We also need to maintain and develop frontline research capabilities, whether these are laboratories such as the Palaeomagnetic/Rockproperty

facility we share with the RSES at the ANU, or image processing capabilities that break new ground in interpreting geophysical data sets, we must maintain our leadership in key riches.

We also need to apply these facilities to develop and carry out top quality projects. We will be discussing some of the options in the next two days. We have to strike a balance between classified NGMA-type mapping activities and fully funded research projects.

We would therefore appreciate frank and open discussion either in this forum or by the display booths on these issues. We would also appreciate you taking the time to complete the questionnaire that we have distributed. This will provide a valuable input to our planning process.

Finally, I would like to repeat our invitation for you to visit AGSO tomorrow afternoon and take a closer look at the work areas.

I look forward to a valuable and worthwhile two days.

North Queensland

A National Geoscience Mapping Accord Project

Project Managers

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Paul Brugman	Technical support
David Champion	Igneous geology
Bruce Cruikshank	Stream sediment geochemistry
John Dohrenwend*	Regolith
Gregg Ewers	Economic geology
Jan Knutson **	Petrology and geochemistry
Doug Mackenzie	Igneous geology
Colin Pain	Regolith
John Pyke	Stream sediment geochemistry (lab & field)
Shen Su Sun	Isotope geochemistry
David Trail **	Regional geology
Peter Wellman	Geophysics
John Wilford	Regolith

*= whilst on exchange from USGS, now ex USGS, **= recently retired from AGSO

Partner Geological Survey of Queensland (GSQ)

Objectives

- Provide a sound geoscientific knowledge base for the development of land-use management options for North Queensland.
- Provide a better understanding of the metallogeny and the mineral potential of the region.

Overview

The main focus of the project has been to establish an improved understanding of the essential character, age, architecture and mineral potential of the various pre-Mesozoic components (both outcropping and concealed) of the geological basement of the region. Activities have also focussed on the nature and regional variability of the regolith and its integration with stream sediment geochemical information.

The project commenced in 1990 and is now in its concluding stage. The primary task over the past year has been to complete a regional synthesis that summarises the results of government, industry and university research carried out in the region over the last 40 years.

The project has expanded and updated existing maps and datasets, collected new data types, and made data readily accessible in digital format. The results of the project will provide governments, industry and the community with essential information for sound decision making on development

and conservation strategies in a region of strategic national importance. New information and ideas will provide an impetus for new exploration and reduce exploration risk.

Project outputs and highlights

A brief summary of the main outputs and highlights from the project are provided below.

- **Regional synthesis**
  A major component of the work program has been to produce a regional synthesis for the entire project area. The resulting book, *North Queensland Geology* (AGSO Bulletin 240/ Queensland Geology 9), is an up to date synthesis of the geoscientific knowledge for North Queensland that summarises the results of government, industry and university research carried out in the region over the last 40 years. Features of *North Queensland Geology* include chapters that provide:
  - an overview of the geological and geophysical framework
  - descriptions for each of the nine regional geologies that make up the area
  - discussion of the regolith of Cape York Peninsula
  - consideration of the applied isotope geochronology and geochemistry for the area
  - a review of relationships between the geological provinces and basins
  - discussion of the mineral and energy deposit styles and potential resources
  - a brief geological history

  The book is accompanied by a 1:1 million geological map of North Queensland and has a companion Atlas (*Atlas of North Queensland Geology* at 1:3 million scale). The atlas contains 45 A3-size full colour plates, including timescale and geological legend foldouts, and includes themes covering relief, climate, vegetation, culture and land categories; geology (including the regions, basins, provinces and a sequence of time slices); regolith; geophysical images; groundwater; mineral deposits and occurrences; and surficial geochemistry.

  All three publications provide essential information that will assist sound decision making on exploration, development and conservation strategies in a region of strategic national importance. They update and expand much of the information in the 'Geology and Geophysics of Northeastern Australia' which was published by the Geological Society of Australia in 1980. The book is approximately 700 pages in length, includes 64 pages of colour plates, makes extensive use of tables to summarise relevant information for geological units and is comprehensively referenced. It is an essential reference work for geoscientific information relating to North Queensland.

- **New 1:250 000 scale maps, commentaries and reports**
  A series of 1:250 000 scale geological maps that extend in a continuous line from the southern Coen Region to the Georgetown Region have been produced. These include second edition full-colour lithoprinted geological maps for EBAGOOLA, HANN RIVER and WALSH and a preliminary edition full colour print-on-demand geological map for RED RIVER. Print-on-demand solid geology-basement maps and regolith-landform maps are also available for EBAGOOLA and HANN RIVER. Comprehensive map commentaries are available for each sheet area with the exception of RED RIVER.

  The maps have been compiled through the integration of multidisciplinary data from detailed basement and regolith mapping, U-Pb zircon geochronology, high-quality airborne magnetic and gamma-ray spectrometric mapping, regional gravity and stream sediment geochemistry. In addition to the geology at the surface, these maps show the main geophysical anomalies

interpreted from gravity and magnetic data. These maps are of considerable interest to mineral explorationists, environmentalists, government agencies involved in land-use decisions, land owners and academics.

- **North Queensland Igneous Rocks GIS**
  The 'Igneous rocks of North Queensland' map (1:500 000 scale), atlas, report, and GIS, prepared with material and financial assistance from Placer Exploration Pty Ltd and information from GSQ, were released in February 1994. This package provides comprehensive information about the Proterozoic to Permian igneous rocks of the Townsville-Cairns hinterland (latitudes 16°30' to 21° S), one of the most intensely mineralised regions of Australia. Geological boundaries were digitised from the latest available AGSO and GSQ 1:25 000, 1:100 000, and 1:250 000 geological maps, and interpretative geological and geochemical coverages constructed from these map data, and from point data sets such as ROCKCHEM, MINOCC, and MINLOC. Aeromagnetic byte images were extracted from AGSO's national coverages. The 1:500 000 scale map shows 530 intrusive and 146 extrusive rock units, and documents their age. geochemical classification, fractionation state, redox state, and potassium content. The atlas comprises 23 thematic maps at 1:1.5 million scale generated from the GIS.

  This package of information reveals a close chemical association between mineral deposits and I-type rocks - particularly those that are fractionated. It also highlights a strong geochemical and spatial relationship between mineralisation and a major volcanic complex, the Featherbed Cauldron Complex. The GIS also helps to highlight some structural associations: the margins of volcanotectonic subsidence structures (faults, ring dykes, etc.; e.g. Kidston), major cross-cutting fractures, and the intersection of these and other major geological features that have controlled the localisation of deposits (e.g., Mount Leyshon).

- **Stream sediment datasets**
  Since the mid 1970s, more than 7,700 stream sediment samples have been collected in the project area. The early datasets were compiled for the Georgetown Region and each sample was analysed for up to 24 elements. During the life of the current project, stream sediment sampling has been extended north from RED RIVER to the northern Coen Inlier with analysis for up to 42 elements per sample.

- **Mineral occurrence mapping and metallogenic reports**
  The systematic compilation of mineral occurrence data using the MINOCC database was commenced in 1985 by the Geological Survey of Queensland. At the conclusion of the North Queensland Project, the coverage of the region is almost complete with more than 10,700 mineral occurrences entered. During the project, qualitative assessments of the mineral resource potential of the CYPLUS area (north of 16°S) and the Georgetown-Croydon areas have been made and published in the Queensland Resource Industries Review series. They combine knowledge of the geology, geophysics, geochemistry, and mineral deposits and occurrences of the respective regions with current theories on mineral deposit formation and the results of exploration.

- **Contributions to CYPLUS (Cape York Peninsula Land Use Strategy)**
  Early in the life of the project, a single integrated digital geological map of the CYPLUS area (north of 16°30'S) was constructed from original film separates of the 16 previously published 1:250 000 geological series maps of Cape York Peninsula. A digital regolith-landforms information map was also compiled for the area north of 16°S: the thirteen 1:250 000 maps that make up this area were digitised. The resulting GIS, in Arc/Info format, and full colour

maps at 1:2.5 million and 1:1 million scales printed from the GIS were delivered to CYPLUS in June 1994.

- **Iron Range National Park brochure**
  A coloured brochure describing the geological features of the Iron Range National Park was released in 1993/94 and is being issued to visitors by the Park authorities.

- **New sedimentary basins defined**
  A Permian-?Triassic basin called the Lakefield Basin has been identified under the Laura Basin. The Lakefield Basin is composed of indurated sediments with some igneous rocks: it is up to 10 km thick, 70 km wide and at least 200 km long. Lakefield Basin rocks have been seen in core from four oil exploration wells, one stratigraphic hole, one exposure on Bathurst Head, and from samples from the base of 9 coal exploration holes in the Bathurst Ranges area. Before erosion, the Lakefield Basin was likely to have been of similar size to the Laura Basin, but about 12 km thick.

  Two, apparently fault-bounded, northwesterly trending zones of possible sedimentary rocks have been delineated in the subsurface of eastern WALSH: the name Gamboola Basin is proposed for the larger of the two zones.

- **Extent of Permo-Carboniferous magmatism (TMIB)**
  Most of the mineral deposits of North Queensland are associated with Permian-Carboniferous igneous rocks. Geophysical data show that these igneous rocks are not associated with the Permian-Carboniferous continental margin as previously thought, but are part of a previously unrecognised major intraplate igneous belt extending from Townsville, on the northeast Queensland coast, to Mornington island, in the Gulf of Carpentaria. The igneous rocks have been referred to as the Townsville Mornington Island Belt (TMIB) and their chemistry suggests an intraplate origin. The belt is a diffuse band of felsic granitoids and volcanics, commonly forming cauldron structures. Most of the mineral deposits are associated with I-type rocks, especially those that are fractionated. The recognition of this igneous belt extends the area of highly prospective rocks 500 km westwards beneath the Carpentaria Basin.

  Reconnaissance whole-rock oxygen isotope data for Permo-Carboniferous volcanic rocks that extend from north of 14°S in Cape York Peninsula to Torres Strait indicate an extensive area of ^{18}O depletion in the northern Coen Inlier. This is similar to the regional whole-rock ^{18}O depletion observed in the northern Drummond Basin - an area known since 1984 for its epithermal gold potential. The isotopic data and As, Sb, Au, and Ag anomalies indicated by an AGSO regional stream sediment survey carried out in 1990 suggest that high level igneous rocks in the northern Coen Inlier may have a similar, but as yet poorly recognised, potential for epithermal gold mineralisation.

- **Dating the depositional age of the Proterozoic metamorphic rocks**
  Until very recently the age(s) of deposition of the Proterozoic metasedimentary rocks of North Queensland has/have eluded direct measurement. Now with U-Pb SHRIMP analysis linked with detailed cathodoluminescence studies of individual zircon crystals obtained from mafic and felsic igneous rocks within the sequence it has been possible to place maximum age constraints on these rocks and facilitate correlations with other Australian Proterozoic rocks.

  These sediments were deposited during a 100 Ma period starting at about 1700 Ma and have been substantially modified by intrusion and metamorphism at various times from about 1580

Ma to 1550 Ma. These geochronological constraints provide a close link with substantially mineralised rocks in the Mount Isa Region.

- **Dating of igneous events**
  Significant effort has been directed at SHRIMP U-Pb zircon dating of Late Palaeozoic rocks in the vicinity of the Georgetown Inlier. Previously, the ages of these rocks had been derived almost exclusively from other, intrinsically less robust, isotopic systems. This had not favoured direct chronological comparison with roughly contemporaneous igneous rocks (dated by SHRIMP at about 285 Ma) in the Coen Inlier. Representatives of the Scardons and Galloway Volcanics yield indistinguishable ages of 289±2 Ma and 290±3 Ma respectively. In contrast, an age range of 30 million years has been documented for the Featherbed Volcanic Group, the oldest rocks of which are late Carboniferous (308±3 Ma). By the early Permian this I-type activity had been replaced by A-type magmatism which continued until 278±3 Ma. Also included in the study was a granite intersected in a drillhole at Mornington Island, and which gives an age of 297±3 Ma This age is similar to that of many of the I-type igneous rocks in and adjacent to the eastern part of the Georgetown Inlier, but is younger than granites intersected beneath the Carpentaria Basin along the western side of Cape York Peninsula.

- **Crustal models**
  Those parts of the eastern margin of the Palaeoproterozoic crust in North Queensland cropping out the Georgetown and Coen Regions, and the subcropping basement between them have similar east to west ranges in metamorphic grade and structural style. Thus, the effects of a major deformational, metamorphic, intrusive, or erosional event in the east decrease in intensity westward, and are negligible west of about longitude 143° E. Events causing these changes are both Mesoproterozoic (mainly in the south) and Silurian-Devonian (mainly in the north) Structures vary from intensely deformed in the east to largely unfaulted open folds in the west. Metamorphic grade is granulite or upper amphibolite in the east, and greenschist-lower amphibolite in the west. Granitoids are largely restricted to east of longitude 143° E, and have an apparent westerly dip. Structural models that are consistent with these observations include crustal thickening, the effect of a mantle plume, and crustal extension.

  A crustal extension model has been developed to explain the relationship between two major adjacent north-trending Silurian-Devonian tectonic belts in the Coen and Cairns Regions. The western belt (Coen Orogen), is characterized by intense deformation, high~temperature/low-pressure metamorphism, and extensive late-kinematic intraplate felsic intrusions, whereas the eastern belt comprises a roughly contemporaneous sequence (Hodgkinson Basin) of thick turbiditic siliciclastic sedimentary rocks and minor volcanics. The model developed suggests about 100 km of extension occurred on a west-dipping lithospheric detachment in the Siluro-Devonian, that heating and plutonism in the Coen Orogen are a consequence of the removal of the lower part of the lithosphere in the west, and that the thick sedimentation of the Hodgkinson Basin is a consequence of the removal of the upper part of the lithosphere in the east. Earlier and later compressional events caused prior folding in the Coen Orogen, and later folding in the Hodgkinson Basin.

- **Geochemistry of Proterozoic metamorphic rocks**
  Petrographic and geochemical studies show that:
  - ♦ Major and trace element distributions reflect the importance of a granitic protolith for a significant proportion of the metamorphic rocks in North Queensland.
  - ♦ Granodioritic/tonalitic orthogneiss dominates the geochemical characteristics of the Coen, Newberry, Yambo and Dargalong Metamorphic Groups. First or second-cycle intermediate and felsic igneous detritus is an important component of the other metamorphic groups.

- Geochemical characteristics of the Holroyd Group rocks, including higher Al_2O_3 and lower CaO and Na_2O contents, suggest that they have undergone a greater degree of alteration and/or recycling than most other metamorphic groups studied.
- Geochemical characteristics for orthoamphibolites and dolerites suggest their derivation in an intraplate environment from large-scale melting at high temperatures and pressures.
- Depleted mantle model (T_{DM}) ages and εNd values suggest that there is a general younging of source rocks from south to north, ie from the Etheridge Group of the Georgetown Region northwards to the Sefton Metamorphics in the northernmost part of the Coen Region.

- **Featherbed Cauldron Complex**
  AGSO released a 1:100 000 full-colour map, 'Geology of the Featherbed cauldron complex, north Queensland', and an associated descriptive report of the eruptive rocks and post-volcanic sedimentary rocks. The map won first prize (a Golden Mouse Award) from the International Intergraph Graphic Users Group, Alabama, USA, for excellence in the imaginative use of technical capabilities in computer graphics arts.

- **Conference presentations**
  Over the course of the project papers have been presented at various conferences, notably 'New developments in the geology and metallogeny of the northern Tasman Orogenic Zone' held in Townsville in Febuary 1994; the 17th International Geochemical Exploration Symposium in Townsvillle in May 1995; and the 13th Australian Geological Convention in Canberra in February 1996.

Some Publications

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Mackenzie, D.E., & Champion, D.C., 1994 - Permian-Carboniferous magmatism in north Queensland - a new perspective. New Developments in Geology and Metallogeny: Northern Tasman Orogenic Zone. Extended conference abstracts, 67-68. *Key Centre in Economic Geology* and *Geology Department, James Cook University of North Queensland*, Townsville, Australia.

Bain, J.H.C. and the AGSO-GSQ project team, 1994 - Contrasts in the early geological histories of the Coen and Georgetown inliers, north Queensland. *In*, R.A. Henderson and B.K. Davis (editors), New developments in geology and metallogeny: northern Tasman Orogenic Zone. Extended conference abstracts, 65-66. *Key Centre in Economic Geology* and *James Cook University of Queensland*, Townsville, Australia.

Mackenzie, D.E., Wellman, P., & Champion, D.C., 1996 - The Townsville-Mornington Island Igneous Belt: A new perspective on Carboniferous-Permian magmatism in north Queensland, and implications for Metallogeny. Abstracts and Poster, 13th Australian Geological Convention, Canberra, February 1966.

Dohrenwend, J., Pain, C. & Wilford, J., 1993: Image processing on the desktop and in the field: applications of remote sensing to regional surficial geologic mapping in diverse geomorphic environments, *ERIM Meeting, Pasadena, Abstracts.*

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Pain, C.F. & Wilford, J., 1995: Regolith mapping on Peninsula, *Queensland Government Mining Journal*, January 1995: 13.

Wilford, J.R., Pain, C.F. & Dohrewend, J.C., 1992: Enhancement and integration of airborne gamma-ray spectrometric and Landsat imagery for regolith mapping - Cape York Peninsula, *Exploration Geophysics*, 23: 441-446.

Products 1991-1997

North Queensland Geology

Map $25

- 1:1 million scale, full colour map, covers area from Torres Strait to Bowen and west to Karumba (plus tax)

Atlas $100

- 1:3 million scale, 45 colour plates (plus tax)
- geology, geochemistry, geophysics, mineral occurrences, groundwater & more

Book $200

- Latest regional synthesis, 700 page (incl)100 pages of stratigraphic tables (plus tax)
- Covers Cairns, Carpentaria Lowlands, Charters Towers, Clarke River, Coen, Coral Sea, Georgetown, Gulf of Carpentaria, Quinkan, and Torres Strait Regions

Igneous Rocks

Comprehensive coverage of the igneous rocks of the Townsville-Cairns hinterland (16°30'S to 21°S)

Map

- 1:500 000 scale, full colour map, 679 map units, in 2 sheets, plastic laminated (+ 82p report - Record 1994/11) $200

Atlas

- 1:1.5 M scale, full colour atlas containing 23 views derived from the GIS covering the above area.
  (package includes 1:500k map + 82p report) $600

GIS Datasets

Digital information covering the above area in ARC/INFO & MAPINFO formats; can be used together to build a comprehensive GIS and generate composite maps such as those in the above atlas.

- geology (679 map units, 5044 polygons, classified according to age), including faults and dykes and derived geological coverages - igneous type, fractionation state, redox state, potassium content and averaged whole-rock geochemistry (15 major & 20 trace elements) for 471 units $4000
- mineral deposit data (from the Geological Survey of Queensland's MINOCC and the Bureau of Resource Science's MINLOC databases) for 7258 sites $3500
- drainage,coastline, roads, railways and towns (1:1 mil data from AUSLIG) $500
- regional aeromagnetic coverage (TMI & east-west gradient) $1500

Complete North Queensland GIS, Map & Report Package

Complete digital GIS package of above listed datasets,and including 1:500 000 scale map and report $7500

Reports

- Explanatory notes for 1:500 000 igneous rocks map (Record 1994/11) $35

Featherbed Cauldron Complex

- Geology of the Featherbed Cauldron Complex, North Queensland: Part 1
  - eruptive rocks and post-volcanic sediments (Record 1993/82 $60 (+tax)
  - includes 1:100 000 scale full colour map)
- Map only $35 (+tax)

Ebagoola 1:250 000 sheet area (SD54-12)

Maps

Paper (1:250 000 scale, full colour lithoprints, revised Nov 1994)

- Geology (1 sheet) **prelim ed** available Dec 1994 $50
- Pre Mesozoic basement geology (1 sheet) edition 1 $50
- Regolith-landforms (1 sheet) edition 1 $50
- 1:100 000 scale prints from above maps (6 sheets per 1:250 000 sheet) each $50

Digital GIS (vector data with topology - ARC/INFO, MAPINFO formats)

(data capture at 1: 50,000 scale)

Only geological polygon, fault, lineament, dyke, & point data such as structural measurements, mineral occurrence locations etc; does not include the map surrounds info provided on the printed maps (such as rock relationships, sections etc), but includes readme file and AML to facilitate simple reference and printing.

- 1:100,000 sheet area: *(normal issue unit)* $100
- 1:250,000 sheet area: *(discount rate for entire sheet area)* $500

Reports

- Preliminary map commentary (Record 1992/71) $50
- Interpretation of aeromagnetic and gravity data (Record 1992/76) $20

- Structural and metamorphic geology (Record 1992/67) $20
- Stratigraphy of the metamorphic rocks (Record 1992/74) $25
- Igneous rocks : field, petrographic, and geochemical data (Record 1992/75) $30
- Regolith-landforms (Record 1994/7) $25
- Regolith mapping using integrated landsat TM imagery and high resolution gamma-ray spectrometric imagery (Record 1992/78) $20
- Stream sediment geochemistry :
    - atlas and explanatory report (Record 1994/8) $600
    - report only (Record 1994/8) $50
- Geology of the Coen-Ebagoola shear zones (Record 1991/14) $35

Hann River 1:250 000 sheet area

Maps

Paper (1:250 000 scale, full colour electrostatic prints, to be released Dec 1994)

- Geology (1 sheet) **prelim ed** available Dec 1994 $50
- Pre Mesozoic basement geology (1 sheet) edition 1 $50
- Regolith-landforms (1 sheet) edition 1 $50
- 1:100 000 scale prints from above maps (6 sheets per 1:250 000 sheet) each $50

Digital GIS (vector data with topology - ARC/INFO, MAPINFO formats)

(data capture at 1: 50,000 scale)

Only geological polygon, fault, lineament, dyke, & point data such as structural measurements, mineral occurrence locations etc; does not include the map surrounds info provided on the printed maps (such as rock relationships, sections etc), but includes readme file and AML to facilitate simple reference and printing.

- 1:100,000 sheet area: *(normal issue unit)* $100
- 1:250,000 sheet area: *(discount rate for entire sheet area)* $500

Coen & Cape Weymouth 1:250 000 sheet areas

- Granitic rocks : reconnaissance field, petrographic, and geochemical data (Record 1994/9) $30
- Geological reconnaissance of the Coen Inlier, 1990 (Record 1991/99) $35

Geochronology

- U-Pb analytical results for granitic rocks from the Coen Inlier, north Queensland (Record, 1992/64) $15

Metallogenic and Mineral Deposit Studies

- Preliminary mineral occurrence data for Cape York Peninsula (Record 1991/78) $175
- Cape York Peninsula: comments on mineral potential and availability of data as at January 1990 (Record 1991/74) $35
- Sample, fluid inclusion, stable isotope and geochronological data for epithermal gold prospects in the northern Drummond Basin (Record 1992/21) $25
- Epithermal gold mineralisation in the northern Drummond Basin, Queensland Record (Record 1992/72) $60

Regional Geophysical Interpretation

- A geological interpretation of the regional gravity and magnetic features of north Queensland (Record 1992/77) $20

Palaeomagnetism

- Palaeomagnetic reconnaissance of Upper Palaeozoic volcanics, northeastern Queensland (Record 1993/36) $25

Whole-rock Geochemical Data

- Northeast Queensland, ROCKCHEM whole rock data, (Record 1991/38 and dataset) $3800
- Record only $10

Stream Sediment Geochemistry Digital Datasets

Digital data sets (ASCII format):	samples	elements	price
• Coen Inlier north of 14°S (8000km^2) (1991 release)	428	42	$4000
• Ebagoola 1:250k sheet area (1992 release)	744	40	$7000
• Hann-Walsh-Red R northern (18000km^2) (scheduled for release May 1995)	1191	40	$12000
• Red River 1:250k southern (9500km^2) (1994 release)	843	40	$8000
• Forest Home 1:100k sheet (Re-released)	470	24	$1000
• North Head "	456	24	$1000
• Georgetown "	1200	17	$1000
• Gilberton "	1220	17	$1000
• Forsayth "	1217	17	$1000

Aerial Photographs

Southern Half of Coen Inlier and Yambo Inlier

1:50,000 scale colour, flown for AGSO 1991 P.O.A.

Geophysical Data and Maps

Airborne Magnetic and Gamma Ray Spectrometric Data

NGMA Surveys (400 line spacing)

1:250 000 sheet areas: Ebagoola, Hann River

1:100 00 sheet areas, Mt Mulgrave

- **Digital data - point located**

1:25 000 sheet areas (4-15 sheets)	$150 each
1:25 000 sheet areas (16-91 sheets)	$130 each
1:100 000 sheet area	$2080
1:250 000 sheet area	$10750

- **Digital data - grids**

Unit	TMI	Radiometric (4 grids)
1:100 000 sheet area	$500	$500
1:250 000 sheet area	$2500	$2500

- **Printed Maps**

Map Type	Dyelines	Transparencies
Profiles (1:50k and 1:100k)	$15	$45
Flight paths	$15	$45
Contours (1:50k NS 1:100k)	$40	$120
Contours (1:250k)	$100	$250

Magnetic pixel maps - Ebagoola - greyscale $50 (+$3.35) colour $75 (+$5.00), both maps in one order $100 (+$6.65)

Reconnaissance surveys (mostly 1.5km line spacing)

- **Point located digital data -** $750 per 1:250 000 sheet area
- **Maps**

Profiles dyelines $5 transparencies$15

Flight path dyelines $5 transparencies$15

Contours dyelines $25 transparencies$75

Total Magnetic Intensity Pixel Maps

Cape York Region - 1:1M colour $150, greyscale $100, East-West gradient $100
Townsville Region - 1:1M colour $150, greyscale $100, East-West gradient $100, North-South gradient $100 (all 4 maps $400)

Gravity Data

- **Digital data**
  1:1 000 000 sheets $350 each
- **Maps**
  1:1 000 000 sheets - contour maps dyelines $25 transparencies $75

Products and further information available from: AGSO Sales Centre
GPO Box 378, Canberra ACT 2601

Telephone (06) 249 9519/9642

Facsimile (06) 249 9982

Prices quoted are in Australian dollars: additional postage and handling charges apply.
(+$) = Sales Tax to be added where applicable.

product

North Queensland Geology
- bulletin, atlas, and 1:1 million map

North Queensland Geology (AGSO Bulletin 240/ Queensland Geology 9) is an up to date synthesis of the geoscientific knowledge for North Queensland that summarises the results of government, industry and university research carried out in the region over the last 40 years. It is a joint AGSO/GSQ National Geoscience Mapping Accord (NGMA) product and covers the northern half of Queensland east of 141°E and parts of the Gulf of Carpentaria and Coral Sea.

This book is accompanied by a 1:1 million geological map of North Queensland and has a companion Atlas (Atlas of North Queensland Geology at 1:3 million scale). All three publications provide essential information that will assist sound decision making on exploration, development and conservation strategies in a region of strategic national importance. They update and expand much of the information in the 'Geology and Geophysics of Northeastern Australia' which was published by the Geological Society of Australia in 1980.

Features of *North Queensland Geology* include chapters that provide:

- an overview of the geological and geophysical framework
- descriptions for each of the nine regional geologies that make up the area
- discussion of the regolith of Cape York Peninsula
- consideration of the applied isotope geochronology and geochemistry for the area
- a review of relationships between the geological provinces and basins
- discussion of the mineral and energy deposit styles and potential resources
- a brief geological history

The book is approximately 700 pages in length, includes 64 pages of colour plates, makes extensive use of tables to summarise relevant information for geological units and is comprehensively referenced. It is an essential reference work for geoscientific information relating to North Queensland.

The *Atlas of North Queensland Geology* contains 45 A3-size full colour plates, including timescale and geological legend foldouts, and covers the following themes:

- relief, climate, vegetation, culture and land categories
- geology - including the regions, basins, provinces and a sequence of time slices
- regolith
- geophysical images
- groundwater
- mineral deposits and occurrences
- surficial geochemistry

Sales Information	**Cost (A$) plus sales tax**
North Queensland Geology (AGSO Bulletin 240) (includes folded 1:1 million scale map)	$200 plus $1-50
Atlas of North Queensland Geology (1:3 million scale)	$100 plus $6-60
North Queensland Geology Map (1:1 million scale, flat)	$25 plus $1-50

http://www.agso.gov.au/minerals/

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product

North Queensland 1:250 000 maps

AGSO and GSQ as part of the National Geoscience Mapping Accord (NGMA) project in North Queensland have produced four 1:250 000 scale geological maps that extend in a continuous line from the southern Coen Region to the Georgetown Region. These maps are of considerable interest to mineral explorationists, environmentalists, government agencies involved in land-use decisions, land owners and academics.

The maps have been compiled through the integration of multidisciplinary data from detailed basement and regolith mapping, U-Pb zircon geochronology, high-quality airborne magnetic and gamma-ray spectrometric mapping, regional gravity and stream sediment geochemistry. In addition to the geology at the surface, these maps show the main geophysical anomalies interpreted from gravity and magnetic data.

The products and pricing for each sheet area are listed below:

EBAGOOLA (SD54/12)	
Second edition (1996) full-colour lithoprinted geological map	$25 plus $1-50 sales tax
Ebagoola 1:250 000 series commentary	$25
Full colour solid geology-basement map (print-on-demand)	$50
Full colour regolith-landforms map (print-on-demand)	$50
Digital version of second edition geological map (ARC/INFO or Mapinfo)*	
1:100 000 sheet area (normal issue unit)	$100
1:250 000 sheet area (discount rate for entire sheet area)	$500
HANN RIVER (SD54/16)	
Second edition (1996) full-colour lithoprinted geological map	$25 plus $1-50 sales tax
Hann River 1:250 000 series commentary	$25
Full colour solid geology-basement map (print-on-demand)	$50
Full colour regolith-landforms map (print-on-demand)	$50
Digital version of second edition geological map (ARC/INFO or Mapinfo)*	
1:100 000 sheet area (normal issue unit)	$100
1:250 000 sheet area (discount rate for entire sheet area)	$500
WALSH (SE54/04) - available through GSQ	
Second edition (1996) full-colour lithoprinted geological map	POA
Walsh 1:250 000 series commentary	POA
RED RIVER (SE54/08)	
Preliminary edition (Aug 1996) full-colour print-on-demand geological map	$50
Digital version of preliminary edition geological map (ARC/INFO or Mapinfo)*	
1:100 000 sheet area (normal issue unit)	$100
1:250 000 sheet area (discount rate for entire sheet area)	$500

- Data capture at 1:50 000 scale. Only geological polygon, fault, lineament, dyke and point data such as structural measurements, mineral occurrence locations, etc. It does not include the map surrounds information provided on the printed maps (such as rock relationships, sections, etc) but does include readme file and AML to facilitate simple referencing and printing.

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product

North Queensland Igneous Rocks
Digital GIS Package, Atlas, 1:500 000 Map

The North Queensland Igneous Rocks GIS brings together comprehensive information on the Proterozoic to Permian igneous rocks of the Townsville-Cairns hinterland (16^0 30' S to 21^0 S), one of the most intensely mineralised regions of Australia. It was developed from a joint project between the Australian Geological Survey Organisation (AGSO), the Geological Survey of Queensland (GSQ), and Placer Exploration Limited. The outputs are a digital GIS package, an atlas at 1:1.5 million scale and a 1:500 000 scale wall map.

The geological boundaries in the North Queensland Igneous Rocks GIS (NQIRGIS) were digitised from the latest available AGSO and GSQ 1:100 000,1:250 000 and 1:25 000 scale geological maps. A series of interpretive geological and geochemical coverages were derived from these map data, and from point data sets such as ROCKCHEM, MINOCC, and MINLOC. Aeromagnetic images were extracted from AGSO's national coverage.

The ***NQIRGIS*** is available in ARC/INFO or Mapinfo formats and comprises:

- geology (more than 670 map units; 5 044 polygons, classified according to age), faults, dykes
- derived coverages (igneous type, fractionation state, redox state, potassium content) and
- averaged whole-rock geochemistry (35 elements for 471 units)
- mineral deposit data (7258 sites)
- culture (drainage, roads, towns, railways, coastline)
- regional aeromagnetics (E-W gradient, TMI)

The ***NQIR Atlas*** contains 23 thematic maps generated from the GIS and comprises introductory notes, culture and index maps, and colour image maps (1:1.5 million scale). Image maps include:

- igneous type, fractionation state, redox state and potassium content
- mineral commodities plotted with various rock types, geochemical parameters and superimposed on aeromagnetics

The ***NQIR map*** is a full colour, laminated 1:500 000 scale wall map (in two sheets) with 529 intrusive units and 146 extrusive units that shows:

- rock unit age
- geochemical classification
- fractionation state
- redox state
- potassium content

It includes an explanatory report (AGSO Record 1994/11)

Sales Information	**Cost (A$)**
NQIRGIS	
• geology and derived coverages and averaged whole-rock geochemistry	$4,000
• mineral deposit data	$3,500
• culture (AUSLIG Data Licensing Agreement required)	$500
• regional aeromagnetics	$1,500
Complete digital package (includes NQIR map and explanatory report)	$7,500
NQIR Atlas (includes NQIR map and explanatory report)	$600
NQIR Map (includes explanatory report)	$200

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North Queensland Stream Sediment Datasets

AGSO has the following surficial geochemical (stream sediment) datasets available for North Queensland.

- **HANN RIVER REGION** (centred on the HANN RIVER and WALSH 1:250 000 sheet areas collected 1993) 1192 samples analysed for Ag, As, Au, Ba, Be, Bi, Ce, Cd, Cr, Cu, Fe, Ga, Ge, Hf, La, Mn, Mo, Nb, Nd, Ni, P, Pb, Pd, Pt, Rb, Sb, Sc, Se, Sn, Sr, Ta, Th, Ti, Tl, U, V, W, Y, Zn and Zr.

  CY93A - northern Hann River Region (CY93ASGD) $7,000
  CY93B - southern Hann River Region (CY93BSGD) $5,000

- **RED RIVER REGION** (centred on the RED RIVER 1:250 000 sheet area collected 1992 and 1993) 843 samples analysed as for CY93A and CY93B minus Ag.

  GT92/2SGD $8,000

- **EBAGOOLA** 1:250 000 sheet area (collected 1991) 744 samples analysed as for CY93A and CY93B.

  CY91SGD $7,500

- North COEN INLIER on parts of **COEN** and **CAPE WEYMOUTH** 1:250 000 sheet areas (collected 1990) 428 samples analysed as for CY91SGD plus Co and Li.

  CY90SGD $4,000

- **FOREST HOME** 1:100000 sheet area (collected 1980) 470 samples analysed for Ag, As, Ba, Be, Bi, Ce, Co, Cr, Cu, Fe, Li, Mn, Mo, Nb, Ni, Pb, Rb, Sn, Th, Ti, U, W, Y and Zn.

  FH80SGD $1,000

- **NORTH HEAD** 1:100 000 sheet area (collected 1980) 456 samples analysed as for FH80SGD.

  NH80SGD $1,000

- **GEORGETOWN** 1:100 000 sheet area (collected 1976) 1200 samples analysed for As, Bi, Ce, Co, Cu, Fe, Mo, Nb, Ni, Pb, Rb, Sn, Th, U, W, Y and Zn.

  GT76SGD $1,000

- **GILBERTON** 1:100 000 sheet area (collected 1976) 1220 samples analysed as for GT76SGD.

  GB76SGD $1,000

- **FORSAYTH** 1:100 000 sheet area (collected 1974) 1217 samples analysed as for GT76SGD.

  FS74SGD $1,000

The ASCII data files, containing sample number, sample site location (AMG in metres or Lat/Long in degrees and decimal degrees) and element values, are available as MS-DOS files on 3.5" (1.44M) disks.

For more information on these datasets contact:
Dr Bruce Cruikshank (tel +61 2 6249 9286, fax +61 2 6249 9983)

http://www.agso.gov.au/minerals/

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Kimberley-Arunta

A National Geoscience Mapping Accord Project

Project Managers

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Cooperating Agencies

Geological Survey of Western Australia (GSWA)
Northern Territory Geological Survey (to 1996)
Industry Participants
University Participants

Objectives

To develop a better understanding of the geology and mineral potential of the Kimberley to the Arunta region, enabling more efective mineral exploration in the area, and to provide geological and mineral resource information necessary for land use decision making.

Overview

The project commenced in 1990 and is scheduled for completion in 1997/98
Major activities include

- Review and compilation of existing geological information
- Detailed geological mapping (including specialist studies) of well-exposed parts of the region
- U-Pb zircon and Sm-Nd geochronology
- Petrological and geochemical studies of key igneous rock units
- Interpretation of regional and detailed airborne magnetic and gamma-ray spectrometric data and gravity data
- Processing and interpretation of remotely sensed data (satellite imagery)
- Studies of mineralisation styles and settings

Recent Project Highlights

- Linking the geology of central Australia and the East Kimberley, thus providing an improved understanding of the mineral and hydrocarbon potential of the region.
- Determining the geological history of the East Kimberley through geological mapping and geochronological studies.

- Resolving age relationships by U-Pb zircon geochronology of key units in the East Kimberley, with results indicating almost continuous felsic and mafic magmatism from 1915 Ma to 1790 Ma and major deformation and metamorphism at around 1860 Ma, 1850 Ma, and 1830 Ma in the East Kimberley.
- U-Pb zircon dating of exposed late Archaean rocks in The Granites-Tanami region.
- Publication of articles on mineralisation, mafic-ultramafic intrusions, thrust tectonics, and geomorphology of the East Kimberley in AGSO Research Newsletters .
- Publication of 2nd Edition 1:250 000 geological maps and accompanying explanatory notes for Hermannsburg (1995) and Mount Doreen (1996).
- Release-on-demand (1996) of preliminary East Kimberley hardcopy and digital 1:100 000 geological maps - Halls Creek, Ruby Plains, Antrim, Cow Creek, Nicholson, Gordon Downs.
- Publication of East Kimberley 1:100 000 geological maps (by GSWA) for Mount Remarkable (1996), McIntosh (1997) and Turkey Creek (1997) Sheet areas and explanatory notes for Mount Remarkable (1997).
- Completion, for publication, of East Kimberley 1:100 000 geological maps and accompanying explanatory notes for Ruby Plains (AGSO, in press), Halls Creek (AGSO, editing completed), and Dixon (GSWA, in press).
- Completion of Gordon Downs 1:250 000 map and explanatory notes to editing stage.
- Preparation of AGSO Bulletin on mafic-ultramafic intrusions of East Kimberley nearing completion.
- Preparation of report on geophysical interpretation of East Kimberley region nearing completion.
- Widespread approval of guidebook, published in October 1997, on the Bungle Bungle Range, Purnululu National Park, East Kimberley.

Future plans:

Finalise Gordon Downs 1:250 000 map and explanatory notes and Bulletin on mafic-ultramafic intrusions of East Kimberley for publication by AGSO in 1998. Contribute to GSWA publications as required.

Products

AGSO Reports

Notes on Halls Creek, WA, 1:100 000 Sheet area (Record 1991/94)	$20
Preliminary report on Vaughan, NT, 1:100 000 Sheet area (Record 1991/65)	$20
Final report on Vaughan, NT, 1:100 000 Sheet area (Record 1993/28)	$15
Geoscientific information for Dixon Range and Gordon Downs, WA (Record 1993/32)	$18
Koongie Park Formation, Halls Creek, WA (Record 1997/25)	$15
Structure of Mount Doreen 1:250 000 Sheet area, NT (Record 1994/54)	$30
Armanda Sill area, Halls Creek, WA (Record 1992/70)	$20
Dixon, SE McIntosh and northernmost Halls Creek areas, WA (Record 1997/26)	$20

Guidebook

Bungle Bungle Range, Purnululu National Park, East Kimberley	$19.95

Full-colour hardcopy maps

Antrim, Western Australia, preliminary 1:100 000 geological map (sheet 4561)	$50
Cow Creek, Western Australia, preliminary 1:100 000 geological map (sheet 4560)	$50

Gordon Downs, Western Australia, preliminary 1:100 000 geological map (sheet 4660)	$50
Halls Creek, Western Australia, 1:100 000 preliminary geological map (sheet 4461)	$50
Nicholson, Western Australia, preliminary 1:100 000 geological map (sheet 4661)	$50
Ruby Plains, Western Australia, preliminary 100 000 geological map (sheet 4460)	$50
Images of Landsat and geophysical data for 1:100 000 sheets, Dixon Range-Gordon Downs area, WA; each	$300
Mount Remarkable, WA, 1:100 000 geological map (sheet 4562) (GSWA publication)	$10
McIntosh, WA, 1:100 000 geological map (sheet 4462) (GSWA publication)	$10
Turkey Creek,WA, 1:100 000 geological map (sheet 4563) (GSWA publication)	$10

Digital maps

Antrim, Western Australia, preliminary 1:100 000 geological map (sheet 4561)	$100
Cow Creek, Western Australia, preliminary 1:100 000 geological map (sheet 4560)	$100
Gordon Downs, Western Australia, preliminary 1:100 000 geological map (sheet 4660)	$100
Halls Creek, Western Australia, 1:100 000 preliminary geological map (sheet 4461)	$100
Nicholson, Western Australia, preliminary 1:100 000 geological map (sheet 4661)	$100
Ruby Plains, Western Australia, preliminary 100 000 geological map (sheet 4460)	$100

Maps and accompanying notes

Ruby Plains 1:100 000 Sheet area (4460), WA	$50
Mount Remarkable 1:100 000 Sheet area (4463), WA (GSWA publication)	$20
Hermannsburg 1:250 000 Sheet area (SF 53-13), NT, 2nd edition (NTG/AGSO)	$20
Mount Doreen 1:250 000 Sheet area (SF 52-12), NT, 2nd edition (NTGS/AGSO)	$20

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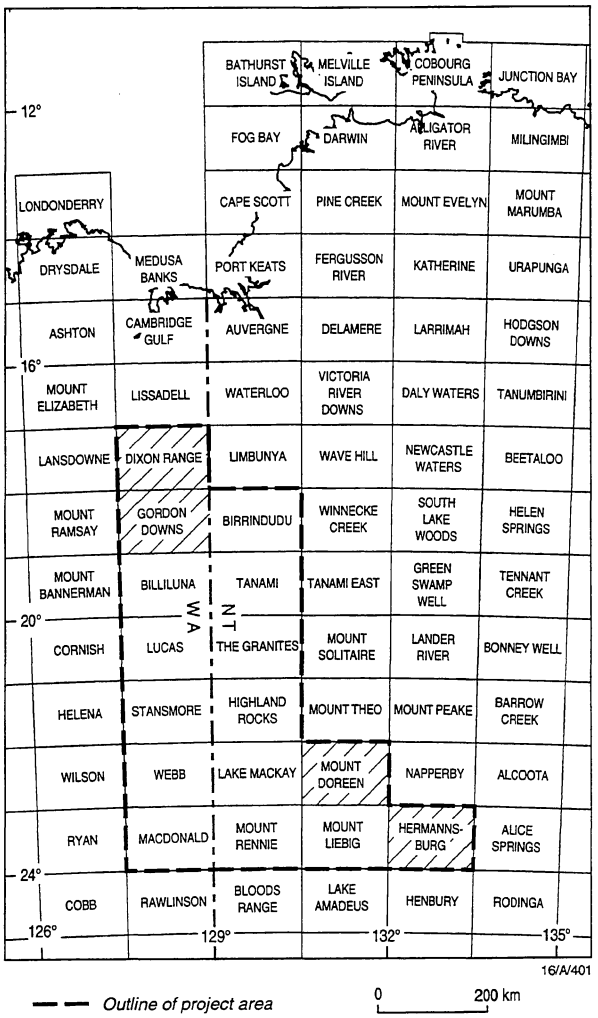
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WEBB
LAKE MACKAY
MOUNT DOREEN
NAPPERBY
ALCOOTA
RYAN
MACDONALD
MOUNT RENNIE
MOUNT LIEBIG
HERMANNS-BURG
ALICE SPRINGS
24°
COBB
RAWLINSON
BLOODS RANGE
LAKE AMADEUS
HENBURY
RODINGA
126°
129°
132°
135°
16/A/401
Outline of project area
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200 km

product

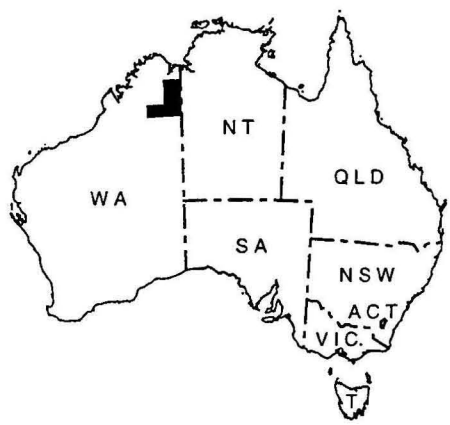
New 1:250 000 Geological Maps Of The East Kimberley

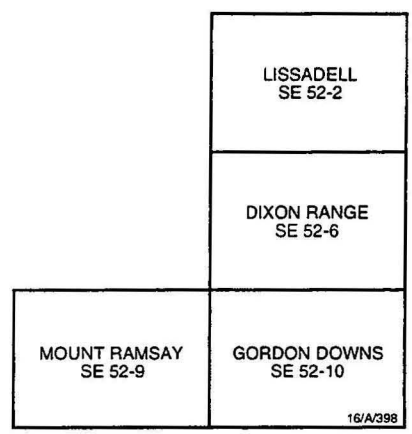
Second edition geological maps of the Gordon Downs and Dixon Range 1:250 000 Sheet areas in the East Kimberley are in preparation and are expected to be published in 1998, together with accompanying explanatory notes, as outputs of the Kimberley-Arunta National Geoscience Mapping Accord (NGMA) project. Major objectives of this project are to increase the understanding of the geology and mineral potential of the region, enabling more effective mineral exploration, and to provide geological information necessary for land use decision making.

The Gordon Downs and Dixon Range maps, which cover a major part of the highly prospective Halls Creek Orogen, present the results of field mapping by geologists from the Minerals Division, AGSO, and the Geological Survey of Western Australia (GSWA) between 1990 and 1994, and incorporate interpretations of airborne geophysical data obtained in 1991.

AGSO map data for the 1:250 000 sheet areas are stored digitally in topologically structured ARC/INFO export format, which may be suitable for transfer to other digital systems; site data are stored in the AGSO Oracle NGMA Field Database.

The 1:250 000 map and accompanying explanatory notes for Gordon Downs are being published by AGSO, and those for Dixon Range are being published by GSWA. (GSWA is also publishing new 1:250 000 geological maps for the adjoining Lissadell and Mount Ramsay Sheet areas). The maps will be available for purchase as hardcopy and as digital datasets from the AGSO Sales Centre, GPO Box 378, CANBERRA, ACT 2601, and the Mining Information Centre, Department of Minerals and Energy (Government of Western Australia), 100 Plain Street, EAST PERTH, WA 6004.





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Geological Survey of Western Australia
100 Plain Street East Perth WA 6004 Australia

http://www.agso.gov.au/minerals/

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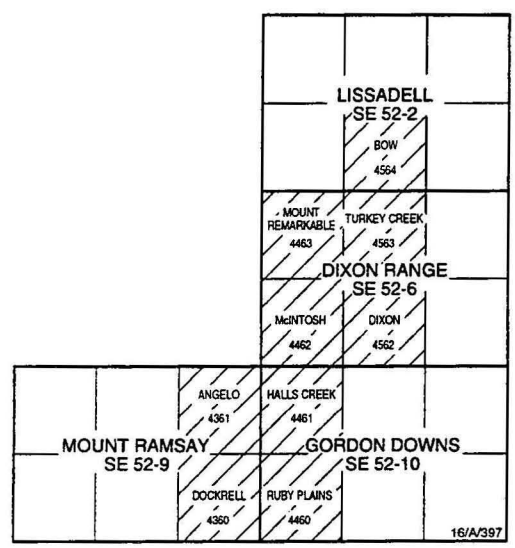
product

New First Edition 1:100 000 Geological Maps Of The East Kimberley

Nine First edition 1:100 000 geological maps, covering most of the highly prospective Halls Creek Orogen of the East Kimberley, have been published or are in the process of being published by AGSO and the Geological Survey of Western Australia. Six of these maps, in the Gordon Downs and Dixon Range 1:250 000 Sheet areas, are outputs of the Kimberley-Arunta National Geoscience Mapping Accord (NGMA) project. Major objectives of this project are to increase the understanding of the geology and mineral potential of the region, enabling more effective mineral exploration, and to provide geological information necessary for land use decision making.

The NGMA 1:100 000 maps incorporate the results of field mapping by geologists from the Minerals Division, AGSO, and the Geological Survey of Western Australia (GSWA) between 1990 and 1994, and interpretations of airborne geophysical data obtained in 1991. AGSO map data are stored digitally in topologically structured ARC/INFO export format, which may be suitable for transfer to other digital systems; AGSO site data are stored in the AGSO Oracle NGMA Field Database.

Name of 1:100 000 Sheet	*Status of map*	*Status of accompanying notes*
Halls Creek	Publication 1998	Publication 1998 (by AGSO)
Ruby Plains	In press 1997	In press 1997 (by AGSO)
Mount Remarkable	Published 1996	Published 1997 (by GSWA)
Turkey Creek	Published 1997	Publication 1998/99 (by GSWA)
McIntosh	Published 1997	Publication 1998/99 (by GSWA)
Dixon	Publication 1998	Publication 1998/99 (by GSWA)
Angelo (not NGMA)	Published 1994	Publication 1998/99 (by GSWA)
Dockrell (not NGMA)	Published 1994	Publication 1998/99 (by GSWA)
Bow (not NGMA)	Published 1997	Publication 1998/99 (by GSWA)



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Maps and notes published by AGSO are priced at $25 each, or $50 per package; those published by GSWA are priced at $10 each or $20 per package. They can be purchased from either the AGSO Sales Centre (see over) or GSWA. Postage and handling charges are extra: $5 within Australia and $15 overseas.

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Preliminary 1:100 000 Geological Maps Of The East Kimberley

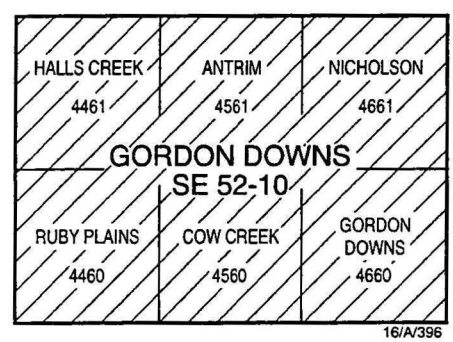
AGSO has released preliminary maps (subject to geological amendment and cartographic refinement) of six 1:100 000 geological maps for the East Kimberley as an output of the Kimberley-Arunta National Geoscience Mapping Accord (NGMA) project. These maps, available as both hardcopy (printed to order, in colour) and digital, are for the following 1:100 000 Sheet areas:

* Halls Creek (4461)
* Ruby Plains (4460)
* Antrim (4561)
* Cow Creek (4560)
* Nicholson (4661)
* Gordon Downs (4660)

These 1:100 000 Sheets make up the Gordon Downs 1:250 000 Sheet (SE/52-10), which covers part of the highly prospective Halls Creek Orogen.

The preliminary maps are products resulting from field mapping by geologists from the Minerals Division, AGSO, and the Geological Survey of Western Australia between 1990 and 1994, and incorporate data entered into AGSO's NGMA Oracle databases. Major objectives of the mapping are to increase the understanding of the geology and mineral potential of the region, enabling more effective mineral exploration, and to provide geological information necessary for land use decision making.

Paper copies of the maps cost $50 each, and digital data (in ArcInfo and MapInfo export formats) $100 per Sheet, + postage and handling charges. Orders should be sent to the AGSO Sales Centre (see over).



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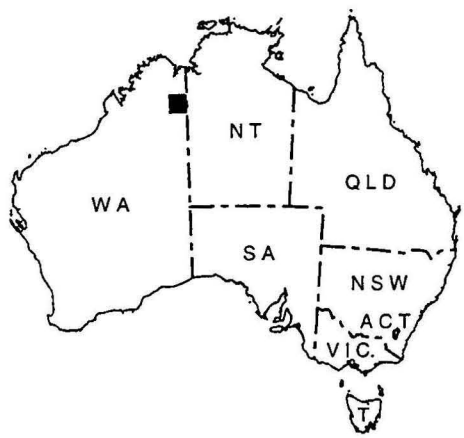
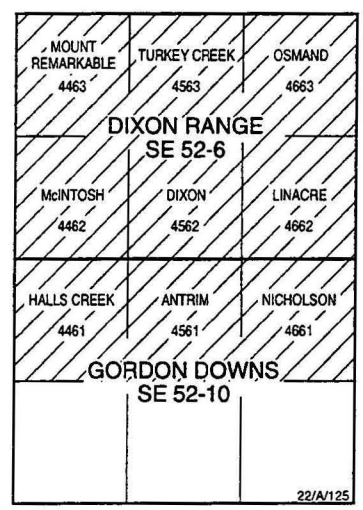
Images Of Airborne Geophysical And Landsat Data For 1:100 000 Map Sheets Of The East Kimberley

AGSO has prepared images from airborne magnetic and gamma-ray spectrometric and Landsat-Thematic Mapper (TM) digital datasets for nine 1:100 000 map sheets in the East Kimberley:

Halls Creek (4461), Antrim (4561) and Nicholson (4661), comprising the northern half of Gordon Downs 1:250 000 Sheet area (SE/52-10), and

Mount Remarkable (4463), Turkey Creek (4563), Osmand (4663), McIntosh (4462), Dixon (4562), and Linacre (4664), comprising all of Dixon Range 1:250 000 Sheet area (SE/52-6).





The datasets can be enhanced in various ways and combined and integrated with each other and with digital geological data, on request. The resulting enhancements, combinations and intergrations are available as hardcopy images at 1:100 000 scale from the Minerals Division Image-processing Group via AGSO Sales Centre (see over) at $300 each. Requests for hardcopy images at other scales can be negotiated.

The airborne magnetic and gamma-ray spectrometric data were acquired in 1991 during a survey of the Dixon Range and northern half of the Gordon Downs 1:250 000 Sheet areas. Flight lines were east-west, with a spacing of 400 m, and tie-lines were spaced 4000 m apart. Flying height was a nominal 100 m above ground level.

The Landsat TM images used are parts of two Landsat-5 TM Standard-Frame scenes: path 110, row 072 of 2 May 1981 and path 110, row 073 of August 1986, geo-rectified to AMG co-ordinates.

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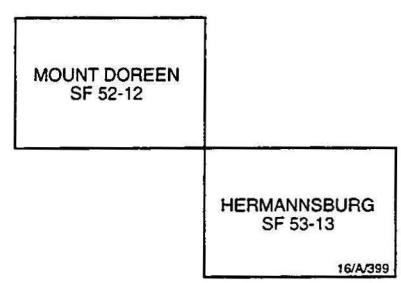
Hermannsburg And Mount Doreen (NT) 1:250 000 Geological Maps And Explanatory Notes (Second Edition)

AGSO and the Northern Territory Geological Survey (NTGS) have released second-edition full-colour geological maps of the Hermannsburg (SF 53-13) and Mount Doreen (SF 52-12) 1:250 000 Sheet areas and accompanying explanatory notes. Products of the Kimberley-Arunta NGMA (National Geoscience Mapping Accord) project, they address major aims of the project - linking the geology of central Australia with that of the East Kimberley in order to provide an improved understanding of the mineral and hydrocarbon potential of the region, and providing geological information necessary for land use decision making.

The Hermannsburg 1:250 000 Sheet area straddles the northern Amadeus Basin/Arunta Block boundary and covers the heart of the Macdonnell Ranges. The adjoining Mount Doreen 1:250 000 Sheet area covers the central part of the Ngalia basin and - to the north and south - parts of the Arunta Block currently being explored for metals.

The second-edition maps incorporate the results of recent mapping by AGSO, NTGS, and are considerably revised versions of the first edition maps, which were published more than 25 years ago. Small-scale maps on the map sheets emphasise the solid geology and structure, metamorphic facies (Hermannsburg only), Bouguer gravity anomalies, magnetic anomalies (Mount Doreen only), and digitally derived elevations (Hermannsburg only). The A4-size explanatory notes present detailed descriptions of the geology complemented by black and white photographs, many of which relate the geology to the landscape, as well as line drawings and tables.



The maps and notes can be purchased as a package from either the AGSO Sales Centre (see over) or NTGS. At only $20 + $1.35 sales tax, each package represents great value! Postage and handling charges are extra: $5 (in Australia) and $15 overseas.

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New Release: Guidebook On The Bungle Bungle Range

The Bungle Bungle Range of the Purnululu National Park, in the remote East Kimberley of northern Western Australia, is famous for its spectacular beehive-shaped towers of banded sandstone and its deep gorges. The park has become one of Australia's premier scenic attractions, rivalling other famous symbols of outback Australia, such as Uluru (Ayers Rock) and Kata Tjuta (The Olgas), and is currently being promoted by the Government of Western Australia for World Heritage listing. Part of the mystique of the Purnululu region is that, until the early 1980s, it was known only to the local Aboriginal people and a few pastoralists, stockmen, and others. Only after widespread media promotion in 1983 was this 'hidden jewel' of the East Kimberley uncovered.

The Australian Geological Survey Organisation (AGSO), in collaboration with the Geological Survey of Western Australia (GSWA), and the Western Australian Department of Conservation and Land Management (CALM), has published (October 1997) an 83 page full-colour guidebook on the Purnululu National Park. This publication, which features the photography of Ian Oswald-Jacobs, describes the:

- geology;
- geomorphology;
- flora and fauna;
- Aboriginal cultures; and
- exploits of the explorers and pastoralists in this spectacular part of Australia.

The guidebook illustrates and explains many features of geological interest along the main access tracks and all the walking trails in the park. The descriptions of the walking trails are complemented by specially drawn coloured maps and also by corresponding scale colour aerial photographs. Suggested itineraries for visits lasting from one day to several days are included. Since over 75 per cent of all visitors see Purnululu National Park from the air, some of the prominent features to be seen along flight paths to the park (Lake Argyle, Argyle diamond mine, Osmond Range, McIntosh layered intrusion, Ord River) are also described.

Written for the non-specialist and illustrated with more than 100 aerial and ground colour photographs and 20 coloured maps and drawings, the guidebook is both an essential reference and a colourful souvenir for all those fortunate enough to explore the park on the ground or from the air. It retails for $19.95 and is available from sales centres at AGSO (see over), CALM, GSWA, and also from bookshops and tourist information centres throughout Australia.

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Tasmania (TASGO)

A National Geoscience Mapping Accord Project

Project Managers

Tony Yeates AGSO 02 6249 9335(ph); 02 6249 9983 (fax)
E-mail: tyeates@agso.gov.au

Tony Brown TGS 03 6233 8365 (ph); 03 6233 8338 (fax)
E-mail: tbrown@mrt.tas.gov.au

Cooperating Agencies

Tasmanian Geological Survey within Mineral Resources Tasmania
Australian Geodynamics Cooperative Research Centre
Industry participants
University participants

Objectives

Provide new, comprehensive and diverse geological and geophysical data sets with which to re-evaluate Tasmania's minerals and petroleum potential, and to evaluate the relationship of known deposits to major crustal structures at depth.

Project Highlights And Products

New 1:500,000-scale Stratotectonic Map with geological synthesis of Tasmania, summarised in time-space format against the new AGSO Timescale, with Notes (160 references). This will get you started in Tasmania. See ***Mineral Resources Tasmania Report* 1995/01**. Contact: Dave Seymour, Tas. Geol. Survey, telephone (03) 6233 8331.

Seventeen new U-Pb zircon dates, and Cambrian and Ordovician faunas evaluated:

- Zircon dating reveals age of Tasmania's basement; minor Delamerian magmatism found; Mount Read Volcanics-equivalent confirmed in southwest; Tasmania's tectonic history better known; see Lance Black et al., ***AGSO Record* 1997/15 ($30).**
- Cambrian faunas examined; Mount Read Volcanics-equivalents determined; see John Laurie, ***AGSO Record* 1995/69 ($17)**; Ordovician faunas reveal magnitude of Delamerian unconformity: see John Laurie, ***AGSO Record* 1996/23 ($17).**

81,000 line kilometres of aeromagnetic data acquired at 800m line spacing (400m at King Island) over the inshore surrounds of Tasmania

- Data merged with many existing data sets; new colour and greyscale 1:500,000 and 1:1,000,000-scale Aeromagnetic Maps of Tasmania and Surrounds released:
  A set of 2 maps, colour and greyscale, is $500 for each of these map scales.
- Aeromagnetic data interpreted: Peter Gunn et al., ***AGSO Record* 1996/29 ($40).**
- Bass Basin aeromagnetics interpreted, Peter Gunn et al., ***AGSO Record* 1996/14, $75.**
- Sorell Basin interpreted, Hill et al., 1997- ***AJES***, 44, 579-596.

120 line km of land seismic data acquired and released: Dundas Element (Lines 1, 2 plus a 1.2-km high resolution line near Hellyer Mine), Northeast Tasmania Element (Line 3) and Tasmania Basin (Lines 4 and 5; can "see" through some dolerite intrusions).

- **Paper sections available at $5 per line km; film sections $10 per line km.**
- Operations Report (case history), Tim Barton et al., ***AGSO Record* 1995/72 ($26)**;

- Dundas Trough seismic interpretation, showing Arthur Lineament dipping to east at depth: Barry Drummond et al., ***AGSO Research Newsletter*** 25, 17-19.
- Hellyer area high-resolution interpretation (showing potential of seismic in minerals exploration below 500m): Tony Yeates et al., ***Geol. Soc. Aust. Abstracts*** 44, p. 78.
- Gravity along seismic lines: Bob Richardson, ***Tas. Geol. Survey Record*** 1995/7.
- Geochemistry of seismic shothole cuttings in AGSO's ROCKCHEM database.

1,758 line km of deep (20s) marine seismic data acquired over major structures extending offshore; data processed; interpretation in progress.

- Cruise proposal (contains useful background information): Peter Hill & Tony Yeates, ***AGSO Record*** **1995/13 ($35)**.
- Cruise report: Peter Hill et al., ***AGSO Record 1995/27*** **($42).**

Refraction Recordings of the *RV Rig Seismic's* airguns through a statewide network of 46 stations accomplished; digitising of data well advanced; modelling commenced; data with AGCRC for methodology development and future tomography.

- Operations Report: Ed Chudyk et al., ***AGSO Record*** **1995/74 ($20).**

Numerous geological studies completed

- Pilot acritarch search: Clinton Foster, ***AGSO Professional Opinion*** 1997/5.
- Pilot petroleum source rock and maturation study of Tasmanian strata: Chris Boreham, ***AGSO Professional Opinion*** 1996/12.
- Boat Harbour Fault study, northwest Tasmania: Dave Seymour TGS, ***Mineral Resources Tasmania Record*** 1997/09.
- Reconnaissance apatite fission track thermotectonic imaging of Tasmania (88 samples): Paul O'Sullivan & Barry Kohn, AGCRC, ***AGSO Record*** **1997/35 ($40).**
- C, O and Sr-isotope chemostratigraphy of Neoproterozoic and Early Cambrian carbonates, northwest Tasmania: Clive Calver, Tas. Geol. Survey publication in press.
- Geology of remote islands between Tasmania and King Island: John Everard et al., Tasmanian Geological Survey publication, in press.

Work in progress to 4-11-97: (results to be in AusGeo. News when completed)

- Marine seismic interpretation and data release: Barry Drummond AGSO, et al.
- Time-space plot for surrounds of Tasmania: Anne Walley, and Tony Yeates AGSO.
- North coast structural transect: Mike Hall, AGCRC Monash University.
- King Island gravity infill and physical properties: Mike Roach, Uni. of Tasmania.
- Nd-Sm isotopic analyses of 35 mafic rocks: Tony Brown, Tas. Geol. Survey.
- Pb isotope determinations on galenas from northeast Tasmania: Geoff Green TGS.

A TASGO Project Wrap-up Workshop is being planned, May 1998 in Hobart.

product

Total Magnetic Intensity Gradient-Enhanced Pixel Maps Of Tasmania

Colour and grey-scale pixel image maps of Tasmania and its immediate surrounds are available at 1:500 000 and 1:1 000 000 scales. The colour maps cost $300 each, the grey-scales $250 each, or $500 for a set of two at either scale. They are available from the AGSO Sales Centre.

The maps are a compilation of data from several surveys flown between 1981 and 1994. The basic data were acquired by AGSO and the following contractors to AGSO and Tasmania Development and Resources: Geoex Pty Ltd., Tesla Airborne Geoscience Pty Ltd., Geometrics Int. Corp., Geoinstruments Pty Ltd., and Kevron Geophysics Pty Ltd. Line spacing ranged from 120m to 1 500m.

The TMI images were compiled from processed total-field aeromagnetic data from which the IGRF for each epoch was removed. Profile data were gridded with minimum curvature and merged. The final grid has a cell size of 100m.

Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation. Pixel colours (magenta high, blue low) were chosen using histogram equalisation. The grey-scale image represents the east-west gradient of the TMI data.

These new generation maps were compiled as part of the Tasmania NGMA Project ("TASGO") to help provide a strategic framework for re-evaluating the State's minerals potential. An interpretation of Tasmania's basement elements utilising these maps (and other images derived from various data) is available from the AGSO Sales Centre as *AGSO Record* 1996/29 for $40 plus $5 postage and handling. Telephone: (02) 6249 9519.

http://www.agso.gov.au/minerals/

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Lachlan Fold Belt

A National Geoscience Mapping Accord Project

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Tim Mackey	Geophysics (part-time)

Partners

New South Wales Department of Mineral Resources
Victorian Department of Natural Resources and Environment

Cooperating Agencies

CRC LEME
Australian Geodynamics CRC
Australian National University
Industry participants

Objectives

Develop a modern framework for exploration for Au and base metals in the Lachlan Fold Belt that will enhance exploration potential and reduce exploration risk in highly prospective areas.

Develop knowledge and understanding of the geological and geodynamic evolution and metallogenesis of the Lachlan Fold Belt with particular focus on Au-Cu mineralisation associated with the Ordovician shoshonite suite, and base metals associated with Silurian volcanosedimentary sequences.

Define the nature and distribution of regolith materials in the region and develop an understanding of the landscape evolution and implications for mineral exploration and land management.

Overview

The Lachlan Fold Belt (LFB) has a long history of mineral production including gold, copper, lead, zinc, silver, and tin. The potential for new discoveries in the LFB is high, and the scientific input from the project will play a leading role in focussing exploration effort.

The project commenced in 1991 and the major activities are aimed to:

- acquire new high resolution airborne magnetic and gamma ray spectrometric data,
- undertake geological mapping and field data acquisition, and release geological maps at 1:100 000 and 1:250 000 scale,
- undertake consequent geochemical, petrological, and mineral deposit studies,
- develop comprehensive digital geological datasets ,
- map regolith components and develop models for landscape evolution, and
- obtain high precision U-Pb zircon geochronology using SHRIMP.

Recent Project Highlights

Bathurst 1:250 000 sheet

A comprehensive digital GIS package for the Bathurst 1:250 000 sheet was released in March 1997. The package includes layers for outcrop geology, derived geology (interpretive pre-Tertiary geology, cross-sections, etc.), geochemistry, site observation and structural data, petrology, and mineral occurrence, fossil, geochronology, and photographic databases. The printed version of the Bathurst sheet is in final colour design prior to publication. In the meantime, the preliminary ARCING edition of the Bathurst sheet and the six component 1:100 000 sheets are available. AGSO contributed to mapping on four of the six 1:100 000 sheets.

Dubbo 1:250 000 sheet

A field conference, organised by New South Wales Department of Mineral Resources with contributions from AGSO, was held in April 1997 to mark release of the preliminary ARCINFO edition of the Dubbo 1:250 000 sheet. The map and the six component 1:100 000 sheets are available. AGSO contributed to mapping on four of the six 1:100 000 sheets.

A comprehensive digital GIS of the Dubbo 1:250 000 sheet is currently in preparation by AGSO and NSW DMR.

A joint AGSO-NSWDMR study of the U-Pb zircon SHRIMP geochronology of the Dubbo sheet area is currently in progress following sample collection in June 1997.

Forbes 1:250 000 sheet

Current project activity is centred on the Forbes 1:250 000 sheet. Field mapping is complete for five of the six component 1:100 000 sheets. Preliminary editions of the Parkes and Grenfell 1:100 000 sheets have been released, the Bogan Gate sheet is being edited prior to release, and the Marsden and Wyalong sheets are being compiled. Fieldwork on the Condobolin 1:100 000 sheet area (by NSW DMR) is about to commence.

A comprehensive U-Pb zircon SHRIMP geochronology study has commenced, with the aim of determining the age of volcanic and associated sedimentary sequences, the timing of plutonic events, and the timing of major deformation events.

Goulburn 1:250 000 sheet

Airborne geophysical data for the Goulburn 1:250 000 sheet area were acquired and released in 1997.

Ballarat 1:250 000 sheet
Final editing of the Willaura and Skipton 1:100 000 geological maps, and associated explanatory notes, is in progress.

Seismic Studies
The Australian Geodynamics Cooperative Research Centre has just completed a deep seismic reflection acquisition program in the eastern Lachlan Fold Belt. Three reflection lines were acquired (total line length of about 105 km). A north-south line through the Lachlan Transverse Zone was designed to image north-dipping structures that escaped the subsequent strong east-west shortening. This line is located near the Cadia and Forest Reefs deposits and the Forest Reefs area. The other two lines (one through Molong and the other to the east of Orange) form part of an east-west section designed to provide structural details from the Cowra Trough in the west, across the Molong volcanic belt to the Mumbil Shelf, and Hill End Trough in the east. Line 2 is near the Mt Bulga and Lewis Ponds deposits, and Line 3 is just south of the Copper Hill deposit.

The AGCRC also carried out a crustal refraction experiment in the eastern Lachlan Fold Belt in July 1997. The 300+ km north-south profile from near Gundaroo, to east of Dubbo, followed the Molong volcanic belt and was designed to provide information on the distribution of mafic volcanic and sub-volcanic rocks in the crust, particularly comparing the nature of the crust in the Lachlan Transverse Zone with the crust to the north and south of this zone.

Preliminary results from the two surveys are expected to be available in April 1998.

Around 3000 samples were collected at half drill rod intervals (2.25 m) along all three reflection traverses. Vital information was obtained on regolith profiles over varying bedrock types in a range of geomorphic environments. Evidence for postulated palaeodrainage was gained, as was an indication of the pre-Mesozoic sedimentation over this part of the Lachlan Fold Belt.

Future Plans
During 1998, it is expected that the following milestones will be achieved:

- release of the lithoprinted second edition of the Bathurst 1:250 000 sheet and explanatory notes,
- preparation and release of a digital GIS for the Dubbo 1:250 000 sheet,
- release of preliminary editions of the remaining 1:100 000 sheets on the Forbes 1:250 000 sheet (Bogan Gate, Marsden, Wyalong, and Condobolin),
- compilation and release of a preliminary ARCINFO version of the Forbes 1:250 000 sheet,
- preparation of a digital GIS for the Forbes 1:250 000 sheet,
- release of the Willaura and Skipton 1:100 000 sheets and explanatory notes, and
- compilation of North Lachlan 1:500 000 regolith landform map

The current phase of activity under the National Geoscience Mapping Accord will conclude with the completion of mapping and release of products for the Forbes 1:250 000 sheet. However, airborne geophysical data are currently being acquired over the Cootamundra 1:250 000 sheet area and it is anticipated that a follow up program of geological reinterpretation will begin in 1998. This will build upon the existing second edition geological map published in 1996 by New South Wales Department of Mineral Resources.

Products

Geological Data

Bathurst 1:250 000 sheet area

- *1:250 000 scale geological map (2nd edition) - HP650C plot only* $50

- *GIS (Digital data package on CD)* $1,995

  Available in ARCINFO Export and Mapinfo formats. Point datasets also available as ASCII and EXCEL files. Includes the following digital datasets covering the 1:250 000 sheet area, which may be purchased separately:

  - Geological polygons and linework - digitised from 1:50 000 and 1:25 000 scale compilations. A 1 km AMG grid and annotated graticule are included. $600
  - Derived geology themes - including an extended geological attribute table, pre-Tertiary interpretive geology, buffered structures and intrusive bodies, and cross sections. $400
  - Whole rock geochemistry summary theme - including over 20 elements $300
  - Site observation data - over 9000 sites $100
  - Structural measurements - over 8000 readings $100
  - Mineral occurrence database * - over 1300 fully attributed occurrences $200
  - NSW DMR petrological descriptions * $180
  - AGSO petrological descriptions $50
  - Fossil database * - over 700 descriptions $130
  - Geochronology database - 24 SHRIMP zircon dates $240
  - Photographic database - point theme linked to over 130 images. $80
  - Regolith landform polygons and geomorphic data $100

  (* Also available from NSW DMR as maintained databases.)

- *1:100 000 scale geological maps (1st edition)* $50 each

  Cowra (8630)
  Molong (8631)
  Blayney (8730)
  Orange (8731)
  Oberon (8830)
  Bathurst (8831)

- *Digital data for each of the above 1:100 000 sheets* $120 each (or $600 for all 6 sheets)

- *1:100 000 scale regolith landforms maps (preliminary edition) for each of the above sheets* $50 each

- *Whole rock geochemical analyses*

  AGSO data - 396 analyses $792
  NSW DMR data - 185 analyses $85

Dubbo 1:250 000 sheet area

- *1:250 000 scale geological map (preliminary edition) - HP650C plot only* $50

- *1:100 000 scale geological maps (preliminary edition)* $50 each

Wellington (8632)
Dubbo (8633)
Euchareena (8732)
Cobbora (8733)
Mudgee (8832)
Gulgong (8833)

Forbes 1:250 000 sheet area

- *1:100 000 scale geological maps (preliminary edition)* $50 each
  Parkes (8531)
  Grenfell (8530) (to be released December, 1997)

Airborne Geophysical Data

Magnetic and Gamma-ray Data

Semi-detailed line spacing (400 m, 200 m)

Available for Ballarat, Bendigo, Dubbo, Forbes, Goulburn, Liverpool Plains, St Arnaud (S), Wangaratta (N)

Digital data

- *Point located data*

Unit	400 m	250 m	200 m
4 - 15 of 7.5'×7.5' areas	$150 ea	$240 ea	$300 ea
16 + of 7.5'×7.5' areas	$130 ea	$210 ea	$260 ea
1:100 000 sheet area	$2,080	$3,360	$4,160
1:250 000 sheet area	$10,750	$17,200	

- *Grids - TMI or 4-channel gamma-ray data*

Unit	400 m	250 m	200 m
1:100 000 sheet area	$500	$800	$1,000
1:250 000 sheet area	$2,500	$4,000	

Line maps

Map type	Dyelines	Transparencies
• *Profiles, flight path (1:100 000)*	$15	$45
• *Contours (1:100 000)*	$40	$120
• *Contours (1:250 000)*	$120	$250

Pixel image maps

Available for Bendigo, Dubbo, Forbes, Goulburn, Liverpool Plains, Wangaratta

- *Magnetic*
  Pseudocolour $300
  Greyscale $250
  Both $500
- *Gamma-ray*
  Pseudocolour $300

Reconnaissance Line Spacing (1 500 m)

Digital data

- *Point located* $750 per 1:250 000 sheet area

- *Grid data (magnetic only)* available on 1:1 000 000 sheet basis, 15" grid

Adelaide	$2,000	Canberra	$2,000	Sydney	$500
Armidale	$1,000	Hamilton	$1,000		
Bourke	$2,000	Melbourne	$1,500		

Line maps

Map type	Dyelines	Transparencies
• *Profiles, flight path (1:250 000)*	$10	$20
• *Contours (1:250 000)*	$25	$75

Elevation Data

Semi-detailed line spacing (400 m, 200 m)

Point located and gridded data

- *Ballarat, Bendigo, Dubbo, Forbes, Liverpool Plains, Wangaratta (N)* $1,000 per sheet
- *Goulburn* $1,600

Line maps (1:250 000)

- *Dyeline* $40
- *Transparency* $120

Pixel image maps (1:250 000)

Available for Bendigo, Goulburn, Wangaratta

- *Pseudocolour* $300

Digital Images on CD-ROM

- *Goulburn* $4,000

Gravity Data

Detailed Gravity data (ca. 4 km station spacing with some more detailed areas)
Available for Dubbo, Narromine, Bathurst, Forbes

- *Gravity - contours and station locations, per sheet (film)* $75
- *Gravity - contour and station locations, per sheet (dyeline)* $25
- *Digital data (single map sheet)* $200
- *Digital data (two map sheets)* $300
- *Digital data (all four sheets)* $500

Regional Gravity data

Available for all 1:250 000 and 1:1 000 000 sheet areas

- *1:250 000 gravity contours, per sheet (transparent film)* $75
- *1:250 000 gravity contours, per sheet (dyeline)* $25
- *1:1 000 000 gravity contours, per sheet (transparent film)* $75
- *1:1 000 000 gravity contours, per sheet (dyeline)* $25

Publications

(AGSO authors in bold font)

Colquhoun, G.P., Meakin, N.S., Krynen, J.J., Yoo, E.K., **Henderson, G.A.M. & Jagodzinski, E.A.,** 1997. Stratigraphy, structure and mineralisation of the Mudgee 1:100 000 geological map sheet. *Geological Survey of New South Wales, Quarterly Notes*, 102, 16p.

Glen, R.A. & **Wyborn, D.** (1997). Inferred thrust imbrication, deformation gradients and the Lachlan Transverse Zone in the eastern belt of the Lachlan Orogen, New South Wales. *Australian Journal of Earth Sciences*, 44, 49-68.

Huston, D.L., Scott, M. & Meares, R., 1996. Volcanic-hosted massive sulphide deposits of the eastern Lachlan Fold Belt. *SGEG post-conference field guide. Geological Society of Australia.* 19p.

Lawrie, K.C., 1997. Porphyry-epithermal deposits of the Lachlan Fold Belt. *SGEG pre-conference field guide. Geological Society of Australia.* 102p.

Lawrie, K. C. Mernagh, T. P. & Huston, D. 1997. New Developments in Research for ore deposit exploration. *SGEG 3rd National Conference. Geological Society of Australia, Abstracts*, 44, 82.

Lawrie, K.C., Mernagh, T.P. & Ellis, P. 1997. Host rock control on localisation of the Gidginbung epithermal high sulphidation Au deposit. *SGEG 3rd National Conference. Geological Society of Australia Abstracts*, 44, 45.

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Lawrie, K.C, Mernagh, T.P. & Kamprad, J., 1996. Alteration mapping with the laser Raman microprobe: a new technique. *AGSO Research Newsletter*, 25, pp. 14-16.

Mernagh, T. P. & Lawrie, K. C., 1997. Alteration and mineral identification with the laser Raman microprobe. *SGEG 3rd National Conference. Geological Society of Australia, Abstracts*, 44, 53.

Raymond, O.L., 1996. The Dulladerry Volcanics - Middle Devonian A-type volcanics from central-west New South Wales. *13th Australian Geological Convention. Geological Society of Australia, Abstracts*, 41, 359.

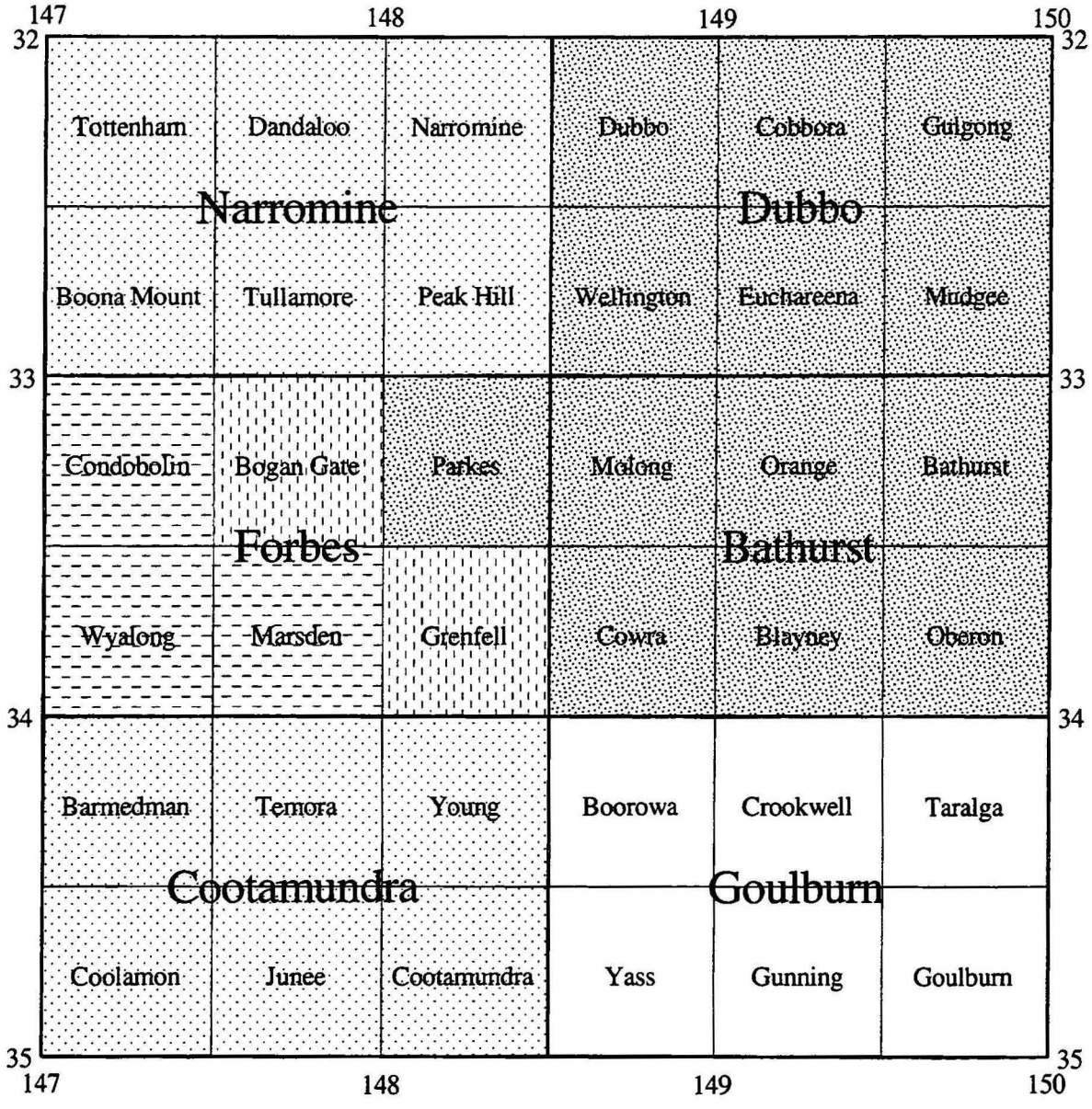
Raymond, O. & MacRae, G., 1997. Applications of the Bathurst 1:250 000 sheet GIS for mineral exploration. *SGEG 3rd National Conference. Geological Society of Australia, Abstracts*, 44, 60.

Wallace, D.A., Krynen, J., **Raymond, O.L. & Young, G., 1997.** Grenfell 1:100 000 Sheet 8530. *Preliminary edition geological map, AGSO* (in press).

Wallace. D.A., Raymond, O.L., Sherwin, L., **Wyborn, D. & Young, G., 1997.** Parkes 1:100 000 sheet 8531. *Preliminary edition geological map, AGSO.*

Wallace, D.A. & Wyborn, D., 1997. Precious metal abundances in Ordovician magmas of the Bathurst 1:250K sheet area - guides to mineral potential. *SGEG 3rd National Conference. Geological Society of Australia, Abstracts*, 44, 71.

Lachlan Fold Belt geological maps - availability



1:100 000 Preliminary edition released

1:100 000 Preliminary edition to be released by June 1998

1:100 000 Preliminary edition to be released December 1997

1:250 000 Second edition released (NSW DMR)

North Australian Basins Resource Evaluation (NABRE)

A National Geoscience Mapping Accord Project

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Chris Tarlowski:	Potential field image manipulation, depth to basement
	Basin Fill and Structural Studies
Kurt Barnett:	Stratigraphic dataset support
Barry Bradshaw:	Upper McNamara Group (Outcrop) & Bowthorn seismic interpretation
Jim Jackson:	Tawallah Group, Peters Creek Volcanics, Lower McNamara, McArthur & Nathan Groups (Outcrop)
Andrew Krassay:	Upper McNamara Group (Outcrop) & Geolog development
John Lindsay:	Fickling Group (Outcrop), McArthur seismic, chemostratigraphy
Graham Logan:	Organic biogeochemistry, McArthur Group
Doug Mackenzie:	Felsic and mafic igneous suites, geochemistry
Rod Page:	SHRIMP Zircon Geochronology
Deborah Scott:	Felsic and Mafic Volcanics (Outcrop), Bowthorn seismic interpretation
Peter Southgate:	Mt Isa, Lower McNamara, McArthur & Nathan Groups (Outcrop)
Inge Zeilinger:	Stratigraphic dataset support
Algis Juodvalkis:	Project Administration

Cooperating Agencies

Queensland Department of Mines and Energy
Northern Territory Geological Survey
Queens University, Ontario, Canada
Oxford University, UK
CODES, University of Tasmania

Objectives

Develop a time series predictive framework for Palaeoproterozoic and Mesoproterozoic basin evolution in northern Australia, to provide predictive geological models for the exploration of metals and energy resources in northern Australia.

Overview:

NABRE aims to provide Government, the resource exploration industry, traditional landowners and interested community groups with a state-of-the-art basin analysis for selected stratigraphic intervals in the Palaeo- and Mesoproterozoic basins of northern Australia. This analysis will define a range of new exploration strategies in northern Australia. It will also assist Government organisations and traditional land owners to Make better informed decisions on multiple land use issues.

The project is integrating potential field, remotely sensed, seismic, drill core and outcrop geoscientific inFormation to provide an analysis of the basement structure, its grain and fabric and thickness. At the same time integrated structural, stratigraphic, geochemical and palaeomagnetic studies are formulating a sequence stratigraphic framework aimed at understanding depositional architecture of the Mt Isa-McNamara-Fickling-McArthur-Nathan-Balma Groups. A strategy and research proposal to better understand the timing and possible pathways of regional fluid flow has been developed from the new understanding of basin evolution provided by the integrated sequence stratigraphic and structural framework.

At the March 1997 NABRE workshop project staff outlined current research results, discussed their implications for exploration and outlined proposed future directions. In the two months following this workshop financial constraints resulted in significant budget cuts to the NABRE project. Budget cuts included cancellation of the seismic acquisition program and significant reductions in the 1997 field program. Despite these setbacks the project has produced significant scientific results as well as developed techniques for a cost effective method for incorporating outcrop-derived stratigraphic and sedimentological data into a digital form.

Recent Project Highlights

Research results and interpretations outlined in this section have all been made since the MARCH 1997 NABRE workshop. For a complete outline of project results the reader should refer to AGSO Record 1997/12

- McArthur-Mt Isa Basin: correlations across the Murphy Inlier. Integrated interpretation of seismic and geopotential datasets from the Westmoreland and Lawn Hill 1:250,000 Sheets (Murphy Inlier and Bowthorn Block) resulted in two possible scenarios for correlations between the two basins. Fieldwork conducted in 1997 tested both hypotheses. The fieldwork was in collaboration with Rio Tinto Exploration. Based on these integrated studies it is now possible to significantly revise the Calvert Hills and Westmoreland 1:250,000 geological maps. Three major unconformities are now recognised in the Tawallah and Peters Creek Volcanics on the northern and southern flanks of the Murphy Inlier respectively. These surfaces are also visible on seismic data and have been used to construct geometric models from the potential field data. The results of this work were presented at a Penrose Conference in the USA (Scott et al 1997). The unconformity surface produced by the mid Tawallah Inversion (Rogers & Bull 1994 in Abstracts from the 12th AGC in Perth) is now recognised at the top of the McDermott Formation (Calvert Hills) and near, but not at the top, of the Buddawadda Basalt, Ptp 1 (Westmoreland). The upper unconformity marking the onset of probable doming and thermal activity associated with extension between 1725-1710 Ma lies in the middle of the Wollogorang Formation (Calvert Hills) and on top of Ptp 3 (Westmoreland). These two surfaces probably correlate with unconformities on top of the Lochness and Quilalar Formations in the Mt Isa region. SHRIMP Zircon ages from the Wollogorang Formation indicate ages of 1730±3 and 1723±4 for the lower and upper Wollogorang Formation respectively. This suggests an age break of approximately 5 Ma within this Formation

(Jackson et al 1997, AGSO Research Newsletter #26). Field examination of felsic igneous rocks from units Ptp 2, 5 & 7 indicates that they are intrusive.

- Sequence stratigraphic and SHRIMP zircon data collected since March permits further refinement of the Event Chart for the Mt Isa, McNamara, Fickling, McArthur and Nathan Groups. The B surface, initially recognised in the middle of the Gunpowder Creek Formation, as a subtle lithological change, is now known to represent a time break of approximately 30Ma. SHRIMP zircon ages from samples in the lower Gunpowder Creek Formation provide an age of 1694±3 Ma, those from near the base of the Paradise Creek Formation are 1659±3 Ma Laterally this surface incises to, and in some places through, the Torpedo Creek and Warrina Park Quartzites and is capped by a local conglomerate. A two-metre thick ferricrete developed at the B surface in the Gunpowder Creek Formation yields a palaeomagnetic pole that appears to be considerably younger than the 1694 Ma SHRIMP date, from this formation. This apparent contradiction is consistent with a 30 Ma long depositional break in the middle of the Gunpowder Creek Formation. The ferricrete pole plots close to a pole from the lower Masterton Formation. The lower Masterton pole was obtained from hematite cements now reinterpreted as precipitating during the time break associated with the unconformity at the B surface. This provides supportive evidence for a post-1694 Ma regional regression in northern Australia. SHRIMP zircon ages from the Sybella Granite and Carters Bore Rhyolite indicate felsic igneous activity during the period 1671-1680 Ma. These ages are consistent with the time break recorded by the B surface and suggest that thermal uplift associated with granite intrusion are indicative of a regional tectonic event that led to reduced accommodation rates and regional erosion.

- A composite section through the Lady Loretta Formation has been measured from outcrops near Kamarga Dome. This section completes the data gathering phase for composite sections through the McNamara Group. Shallow water inner ramp carbonate depositional cycles dominate the Lady Loretta Formation; there are two major deepening episodes with associated black shale deposition. Seismic interpretations from the Bowthorn region suggested the Walford Dolomite correlates with the Lady Loretta Formation. Composite sections for the Walford Dolomite and Lady Loretta Formations and recent SHRIMP zircon ages from both Formations confirm this correlation.

- Regional composite stratigraphic sections, and in key areas more closely spaced stratigraphic sections have been collected for the Mt Isa, McNamara, Fickling, McArthur and Nathan Groups. These sections incorporate lithological, grain size, grain type, sedimentary structure, bed thickness and gamma ray data. The composite sections facilitate better constrained genetic packaging for the successions and hence more reliable palaeogeographic maps and basin shapes. A rapid and cost efficient method has been developed for digital entry of this descriptive data. The method has been trialed using the software application Geolog 6 and NABRE is currently investigating methods by which this information can be entered directly into a corporate Oracle database. Rather than involving monotonous data entry as strings of abbreviated text, lithological information is captured via numeric grain size values linked to look-up tables. Sedimentary structure, bed thickness and grain type inFormation is entered using a point and click method whilst viewing the gamma ray and grain size curves and lithology. The stratigraphic data is being used to determine accommodation history, define sediment architecture and better define basin shape through time.

- Collaborative work with Mark Hinman at MIMEX has identified the surface associated with the mid Barney Inversion event, discussed in Hinman (1996, AGSO Record 1995/5). In some areas erosion and redeposition of lower Barney Creek Formation sediments took place during

uplift associated with deposition of the upper Barney Creek Formation. As a result the current outcrop limits of Barney Creek basins cannot be used to interpret their original shapes.

- Collaborative work with Oxford University on carbon and oxygen stable isotope stratigraphy is well advanced. The preliminary outline of the stratigraphy for both isotopes in the Mount Isa and McArthur Basins shows that the primary carbon curve is of low amplitude with a mean value of approximately -0.5‰. The data suggest that the passage of oxic mineralising fluids through the section lowers this ratio to approximately -6‰ producing a distinctive signature on the otherwise low amplitude curve. Oxygen isotope values are also lowered by the passage of fluids. The regional isotope curves thus provide a valuable baseline for fluid flow studies around major ore bodies. Work to date on trace element chemistry has paved the way for further analysis of strontium isotopes. It can now be shown that rubidium is tied strongly to the clay mineral fraction of the carbonate rocks. The primary radiogenic strontium in the carbonate fraction can probably be separated from the radiogenic strontium generated in the clay fraction. It should thus be possible to analyse the primary strontium isotope record for the two basins.

- A preliminary interpretation of seismic data from the Batten Trough has been completed. The data indicate that subsidence within the trough continued at an enhanced rate throughout deposition of the Tawallah and McArthur Groups. Sequences deposited during this time thin significantly to the north, consistent with facies relationships determined from outcrop studies. Roper Group deposition was considerably more uniform in thickness across the region.

- Biogeochemical investigations are being carried out in the McArthur Group using various organic and isotope geochemical techniques. A broad based regional study on biomarkers (molecular fossils) will be used to assess biological input to the preserved organic matter, with particular reference to the Barney Creek Formation. This study will also allow assessment of thermal maturity based on the alteration of the biomarkers. A specific study of the interaction of ore forming fluids with organic matter is being conducted in collaboration with Mark Hinman of MIMEX at the HYC deposit. The NABRE sequence stratigraphic framework has been used to guide a strategy to collect an extensive suite of samples from the mine, its immediate vicinity and in regional stratigraphic cores stepping out from the deposit. These samples are being analysed using both organic and inorganic geochemical techniques to identify zones of fluid - organic matter interaction and fluid flow pathways.

Future Plans:

The main phase of future stratigraphic project activities will involve digital data entry and its interrogation and interpretation. Concurrent geophysical project activities are aimed at regional potential field modelling along a series of north-south transects across the NABRE region as well as attempting to better define depth to magnetic basement. It is hoped that this will assist with the identification of basin shape beneath cover and the generation of a plate-scale basement architectural model for the NABRE region.

A draft fluid flow proposal, aimed at addressing fundamental issues concerning possible sources for the metals, timing of metal leaching, fluid flow and subsequent precipitation has also been developed. This work involves the collection of regional and deposit scale geochemical datasets within the NABRE framework and is in collaboration with Professor Kurt Kyser at Queens University and CODES. External funding will be required to implement this component of the project.

In conjunction with the fluid flow studies additional stratigraphic and structural studies will aim at better defining deposit scale sequence geometries as well as more regional stratigraphic architecture of the Haslingden and Tawallah Groups and Surprise Creek Formation. If there is sufficient interest from companies we will also conduct stratigraphic data collection in the Tennant Creek Block and Victoria River region.

Products:

Currently Available

- NABRE 1995 Field Survey: Measured field sections and gamma ray logs.
  AGSO Record,1995/77 $250

- NABRE Workshop - March 1997, Extended Abstracts.
  AGSO Record, 1997/12, $60

Scheduled for Progressive Release from June 1998

- Digital versions of the stratigraphic datasets will be released as a series of modules. Each module will capture data from a particular region over a designated stratigraphic interval. The datasets will include both primary and interpretive information derived from drill core and outcrop. Primary data fields will include: location information, lithological, grain size, grain type, sedimentary structure, bed thickness, geochemical sample sites and gamma ray data. Interpretive fields will include event surfaces, sequence and systems tract picks, depositional systems information and palaeoenvironment. Lithostratigraphic subdivision will also be included. As this is the first time AGSO has marketed a database of this type prices are indicative and will be subject to change. We envisage that costing of modules will be based on a rate of 20 cents per meter of stratigraphic section. The modules will be itemised as follows:

    - Lower McNamara Group, Torpedo Creek Quartzite to Lady Loretta Formation (including Muswellbrook Fmn, Upper Fish River Gp. & Walford Dolomite)
      Indicative Cost: $2,500

    - Upper McNamara Group, Upper Lady Loretta Formation to Lawn Hill Formation (including Mt Les Siltstone, Plain Creek, and Doomadgee Formations).
      Indicative Cost: $3,000

    - Mt Isa Group, Surprise Creek Formation to Magazine Shale
      Indicative Cost: $2500

    - McArthur & Nathan Groups, Masterton Sandstone to Looking Glass Formation, Amos to Dungaminnie Formations
      Indicative Cost: $1500

- CD Multimedia Product incorporating an integrated interpretation of geophysical and geological datasets from the Westmoreland and Lawn Hill 1:250,000 sheets. New interpretations of the Comalco seismic grid are planned to be released in 1998 as a report and CD multimedia product. The seismic grid shows clear details of the tectonostratigraphic packaging of the northern (relatively undeformed) Mount Isa Basin up to the southern margins of the Murphy Inlier. Geometries of packages associated with sediment-hosted mineralisation are clearly defined on the seismic grid and can be used as templates for reconstructing original geometries in more structurally deformed areas in the Lawn Hill Platform and Mount Isa Inlier. The report will include digital copies of interpreted seismic sections, correlations of seismic

sequences to outcrop and well log sequences, a chronostratigraphic chart for the northern Mount Isa Basin, 1:100 000 scale isopach and structural maps for key tectonostratigraphic packages, results of geopotential modelling of cross-sections in the Westmoreland and Lawn Hill 1:250 000 sheets, palinspastic reconstructions of key seismic lines, and a summary of the exploration potential of the northern Mount Isa Basin.

- GIS package of NABRE enhanced Northern Territory tiled 1:250 000 geological coverages. Attribute enhancements will include up dates of:
    1. Ages
    2. Group, Formation and Member nomenclature
    3. Incorporation of stratigraphic index number
    4. Rock type inFormation.

- Arnhem Land Subproject

Arnhem Land and adjacent areas to the southwest and south were remapped between 1990 and 1996 under the auspices of the NGMA, and new maps and Explanatory Notes are being released as joint NTGS/AGSO products.

The following products consist of hard-copy 1:250 000 geological maps and accompanying reports (expanded Explanatory Notes).

Sheet name	**Release date**
KATHERINE	November 1994
ARNHEM BAY/GOVE	November 1997
GROOTE EYLANDT SPECIAL MAP	early 1998
BLUE MUD BAY	March 1998
MILINGIMBI	June 1998
MOUNT MARUMBA	June 1998
URAPUNGA	June 1998
ROPER RIVER	June 1998

Map data are available in digital format (minus the surrounds) as part of the AGSO NTData project. Tiles are available in MicroStation DGN, ARC/INFO and MAPINFO formats.

KATHERINE	2nd edition	available
ARNHEM BAY/GOVE	2nd edition	available as separate tiles
GROOTE EYLANDT SPECIAL	2nd edition	available as separate tiles
BLUE MUD BAY	2nd edition	available
MILINGIMBI	2nd edition	available
MOUNT MARUMBA	2nd edition	December 1997
URAPUNGA	1st edition	available
	2nd edition	mid 1998
ROPER RIVER	1st edition	available
	2nd edition	mid 1998

Short Courses:

Following the March 1997 workshop several companies expressed interest in NABRE presenting basin analysis / sequence stratigraphy short courses. At present we plan to run these courses in Brisbane, Townsville, Mt Isa and Darwin in late April and May. Each course will be of two days duration and will have up to 20 participants. Exercises will use outcrop, seismic and potential field datasets from the Mt Isa and McArthur basins. If demand warrants we are prepared to run

company specific in-house courses. Registration forms and information fliers for these courses will be distributed in the new year.

Publications:

Because NABRE research is ongoing most project publications are as abstacts rather than papers. Rather than list all NABRE abstracts published in Australia only the abstract volumes are referenced.

AGSO Research Newsletter

- NABRE Research Team 1997, NABRE's first field season facilitates the discrimination of sequence boundaries and maximum flooding surfaces in the Mount Isa- Lawn Hill region. *AGSO Research Newslette,r* 23 pp8-10.
- Bradshaw B. E. et al 1996, Further constraints on sequence stratigraphic correlations in the Mount Isa, McNamara and McArthur Groups: The Shady Bore Quartzite-Riversleigh Siltstone transition in the 'NABRE'-hood of Riversleigh, northwest Queensland. *AGSO Research Newsletter*, 25 pp 21-22.
- Southgate P.N. et al 1997, Pieces of eight: Charting the event related surfaces of the Mount Isa and McArthur basins. *AGSO Research Newsletter,* 26 pp11-12.
- Jackson M.J. et al 1997, Why sequence stratigraphy and not lithostratigraphy. *AGSO Research Newsletter*, 26 pp20-22.
- February 1996, Abstract Volume, 41, 13th Australian Geological Convention, Canberra
- April 1996, Extended Abstracts from MIC 96: New Developments in Metallogenic Research: The McArthur - Mt Isa - Cloncurry Minerals Province, EGRU Contribution 55. James Cook University.
- Tarlowski, C Scott D.and.Martin S., 1997 Processing and Interpretation of Aeromagnetic Data at Regional Scale. In 8 th Scientific Assembly of International Association of Geomagnetism and Aeronomy, Uppsala, August 4-15, p 507.
- Tarlowski, C., Milligan P. and Mackey T. 1997 The Digital Magnetic Anomaly Map of Australia In 8 th Scientific Assembly of International Association of Geomagnetism and Aeronomy, Uppsala, August 4-15, p 517

NABRE Fluid Flow Study

A New Project Proposal, Minerals Division, AGSO

Rationale

This proposal uses the structural and sequence stratigraphic basin framework derived from the NABRE project to address five fundamental questions. The results from this work will enable explorers to better predict the location of base metal resources, particularly in areas beneath cover.

Questions

1. Which parts of the stratigraphy provide the source rocks for base metals?
2. At what depth of burial or at what temperature did the basinal brine(s) become enriched in base metals.
3. What is the timing of brine expulsion and sulphide precipitation?
4. Which pathways did the metal-bearing brines migrate along?
5. What are the relationships between metal bearing brine and organic matter at the site(s) of metal precipitation.

Techniques

These questions will be addressed through the collection of datasets necessary for burial history analysis and mineral paragenesis.

The dissolution and cementation histories of basin sediments record the interactions between basin fluids and host sediment. Careful examination on a regional scale facilitates an understanding of the relative timing of these interactions (mineral paragenesis), thus leading to a systematic ordering of the fluid flow events in the basin and the geochemical fingerprinting of each fluid phase. Only after this type of data is in hand is it possible to assess the role of basinal fluids in ore formation and predict where additional resources may be found.

Objectives

One of the key objectives of this study will be to constrain factors that controlled the time of generation of a metal-bearing brine. SHRIMP zircon and Pb/Pb model ages, combined with APWP data indicate that metalliferous brine expulsion is related to tectonic events. The sequence stratigraphic studies have identified the chronostratigraphic surfaces developed in response to these events. These surfaces are used as the building blocks for basin wide correlations, necessary prerequisites for geometric reconstructions of the basins through time. Through burial history analysis and mineral paragenesis studies we aim to better predict the timing of basinal brine metal enrichment for each compartment in the basin(s). This information will enable explorers to model both spatial and temporal fluid flow parameters at those tectonic event(s) most likely associated with brine expulsion.

Understanding the spatial and temporal relationships between metal-bearing brine generation and its expulsion will enable potential mineralised stratigraphies to be better targetted. For example, at any given location depletion of the metal source after brine expulsion at a tectonic event will render younger stratigraphic intervals significantly less prospective in that part of the basin. Furthermore, by relating brine maturity to burial history it should be possible to model which organic-matter rich reductant intervals in the overlying stratigraphy will have the greatest potential to react with the metal-bearing brines.

Where hot metal-bearing fluids react with shallow or near surface immature organic-matter rich rocks, maturation and hydrocarbon generation by the fluid may promote precipitation. Similarly where metal-bearing fluids intersect source rocks currently in the oil window metal precipitation may also be favoured.

Proposed Collaboration

The proposal is based on a collaborative strategy between staff at AGSO, Queens University in Canada, Oxford University in the UK, Queensland University and the University of Tasmania.

We are seeking funding to fully support two Postdoctoral Fellows and partial support for a Senior Research Fellow, a Postdoctoral Fellow and a graduate research assistant.
Partial funding for the costs of geochemical analyses and travel are also requested.
For the project objectives to be met we will require somewhere between $200,000-$225,000 per year of external funds for two to three years.

Some of the current NABRE staff will be incorporated in the study, specifically with guiding sampling strategies within the structural and sequenece stratigraphic framework and understanding basin shape and sediment architecture for rocks of 1760-1700Ma. (eg Surprise Creek Formation, Tawallah and Haslingden Groups). We envisage that AGSO will make a significant financial commitment to the project in terms of staff salaries.
A Commonwealth Governmet SPIRT Grant of approximately $75,000 per year for 2-3 years at the University of Queensland is currently being assessed.

The skills, level of experience and techniques necessary to undertake the proposed work require the identification of two senior researchers to drive this part of the project. A geochemist with significant experience in integrated basin-scale fluid flow analysis and an organic petrologist with experience in burial history analysis and modelling.

NABRE is currently collaborating with researchers at Queens University in Canada and CODES, University of Tasmania. Both research groups are currently working in the Palaeoproterozoic of northern Australia and both have significant experience in inorganic and isotope geochemistry. The University of Tasmania recently achieved the status of an ARC Special Research Centre in Ore Deposit Research and is currently looking for a hydrologist with experience in modelling crustal fluid flow (a'Garvan style' fluid flow modeller) to drive the fluid flow and fluid geochemistry part of their program. The SRC recognises that such expertise is unlikely to be found in Australia. Collaboration with Professor Kurt Kyser at Queens University in Canada, a basin-scale fluid flow geochemist will compliment the appointment of a fluid flow modeller at CODES, thereby optimising potential benefit to Australian exploration companies.

Professor Kurt Kyser is a world-class geochemist with extensive experience in basin-scale fluid flow analysis. He is currently supervising several post doctoral students analysing regional fluid flow in the Kombolgie Sandstone of northern Australia and comparing these results with similar studies in the Thelon and Athabasca basins of Canada. Professor Kyser has written landmark papers on the origin of Uranium Deposits of the Athabasca Basin and has significant experience in documenting basin scale fluid flow events in evaporites of the Devonian Elk Point basin of Western Canada. This unique range of skills will provide significant scientific leadership to this phase of NABRE work. Initial comparisons of fluid flow events in the Thelon and Athabasca basins of Canada and the Kombolgie Sandstone of northern Australia indicate that Palaeoproterozoic rocks in both countries have been subject to remarkably similar fluid flow events, suggesting the hydrology of these basins was related. Collaboration with the group at Queens University will enable Australian companies to target their exploration strategies at a

Palaeoproterozoic continental scale, factoring palaeogeographies operative at the time of basin development and fluid flow into their exploration strategies. It will also enable the project to provide insight into fluid flow associated with Uranium deposits of this age.

Drs Susan Golding and Miriam Glikson at the Department of Earth Sciences, Queensland University collectively bring considerable expertise to the project in areas of burial history analysis. Both have considerable experience working on aspects of thermal maturation and related fluid flow events in the McArthur and upper McNamara Groups of northern Australia. Their prime role will be to reconstruct the thermal history of Palaeoproterozoic rocks in the Mt Isa-McArthur region. Initial work will focus on the northern, thermally immature parts of the basins. The results from this work will be used to understand and predict thermal maturation history in the southern parts of the basin where later events have overprinted signatures believed crucial to understanding the origin of the base metal deposits.

Timetable for Consideration of Proposal

The proposal is a first draft. It will be circulated to regional exploration offices throughout Australia with the intent of soliciting constructive feedback. Revisions will be made to the proposal in early February and by late February we intend holding a meeting in Canberra to finalise the project plan with interested companies.

For further information on this proposal please read the accompanying brochure. Copies of the proposal can be obtained from:
Peter Southgate at AGSO, ph 02 62499206, fax 02 62499956 or Email: psouthga@agso.gov.au

The Hamersley Basin, Western Australia

New Project Proposal

Contact

John Lindsay 02 6249 9428 (ph) (02) 6249 9956 (fax)
Email: jlindsay@agso.gov.au

Rationale

The late Archaean to early Palaeoproterozoic Hamersley Basin is Australia's major source of iron ore and a major export earner for the country. Within the next 25 years new reserves of ore will need to be identified to maintain the industry. In spite of its significance the basin has never been subjected to a complete modern basin analysis. There has been a considerable improvement in our understanding of the evolution of intracratonic basins and of the evolution of the early biosphere in recent years. With this improved knowledge it is possible to develop comprehensive models as an aid in exploration.

Objectives

To carry out an integrated basin analysis of the Hamersley Basin and provide a framework for future mineral exploration. The study will consist of four components:

1. The development of a basin architecture (basin structure).

2. The development of a basin-fill architecture (sequence stratigraphy).

3. Develop a chemostratigraphy linked to the above frameworks.

4. Compile and integrate the results of the study into a single new generation digital dataset.

Ore mineralisation occurs when basin-fill architecture and basin architecture come into conjunction with suitable sedimentary facies. The time interval during which the Hamersley Basin was evolving is a critical period in earth history as the atmosphere was, for the first time, becoming oxygenated, a critical factor in the deposition of iron minerals. The study will look into the nature of the depositional environment in this unique setting through the use of stable isotopes (C and O in particular) and trace and major element geochemistry in association with sequence stratigraphy to provide an assessment of the effects of the evolving biosphere on the deposition of sediments. The work will provide a primary isotopic signature outlining the evolution of the carbon cycle. Background knowledge developed above will allow the development of fluid flow models. Both stable isotopes and trace elements are modified in a predictable way by the passage of fluids. In simplest terms fluids once injected into fault planes during tectonism move laterally along suitable pathways within the sediment fill. The fluid pathways within the fill are determined by basin-fill architecture, that is, sequence stratigraphy. Where fluids interact with suitable facies ore mineralisation or enrichment occurs. The multidimensional model described above allows regional predictions that will support development of new ore reserves.

Scope

AGSO has considerable recent experience in the analysis of intracratonic basins. These include petroleum oriented studies in the Amadeus, Officer, Georgina Basins and more recently mineral oriented basin studies in the Mt Isa and McArthur Basins (NABRE Project). This experience is directly applicable to the needs of the Hamersley Basin project.

The proposed project would be well focussed, relatively limited in scope and would be integrated with ongoing basin studies (see potential cooperating agencies above). We envisage the following program spread over three years:

1. Sequence stratigraphic study based on drill core and gamma logs where available. Where drill logs are not available we will measure and gamma-log outcrop sections.

2. Core and outcrop sampling will be carried out for SHRIMP dating of key units to be linked to the sequence stratigraphy.

3. Sampling of drill core (or outcrop where necessary) for chemostratigraphic studies (stable isotope and trace element) to be linked to sequence stratigraphy.

4. Regional structural and ore body definition using potential field and airborne gamma spectrometer data.

5. GIS and database development on CDROM.

Potential Cooperating Agencies

University of Western Australia
Geological Survey of Western Australia
Exploration Companies
Other Universities

North Pilbara

A National Geoscience Mapping Accord Project

Project Managers

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NGMA Partner

Geological Survey of Western Australia

Cooperating Agencies

Industry (Sipa, Lynas, Sons of Gwalia, Hamersley Iron)
University (Curtin, UWA, Muenster, Tokyo)

AGSO Staff

Richard Blewett	Structure & Tectonics
Peter Wellman	Geophysics
David Huston	Economic Geology
David Champion	Geochemistry
Shen-su Sun	Geochronology
Douglas Thost	Structural geology & metamorphism
Taro Macias	Multispectral studies
Mitch Ratajkoski	GIS and digital data management
Colin Johnson	Product development & cartography

Objectives

To provide the resources sector with timely and relevant new-generation geoscientific information to reduce investment risk in the North Pilbara. The objectives will be met by an integrated geoscientific mapping programme. We will produce a craton-scale synthesis and advanced GIS by utilising (1) regional airborne magnetic, gamma-ray spectrometric and gravity data, (2) remotely sensed multispectral images, (3) regional (1:100 000) and detailed geological and structural mapping, and (4) compilation of the geological characteristics of mineral deposits, combined with isotopic age data, mineral deposit descriptions, and geochemical data for igneous rocks. The data will be used to generate metallogenic and tectonic syntheses, and to develop empirical models of exploration for the North Pilbara. These programmes are intended to enhance exploration activity in the North Pilbara, and, so, increase the probability of significant mineral discoveries.

Overview

The project began in 1995 and is scheduled to be completed June 2000. AGSO's role has focussed on developing a multidisciplinary understanding of the entire North Pilbara craton — our activities include:

- Characterisation of North Pilbara's mineral deposits and definition of ore vectors;
- Acquisition, interpretation and presentation of geophysical data;
- Review and capture of existing data/information into North Pilbara GIS;
- Advanced Landsat-5-TM processing, interpretation and presentation;

- Specialist problem-solving fieldwork;
- Petrological and geochemical studies;
- Sm-Nd geochronology;
- Development of stratigraphic framework and tectonic models of crustal evolution.

Recent Project Highlights

- Increased number of project staff both in AGSO and GSWA;
- Compiled existing data and populated North Pilbara GIS with 1:250K geology (East Pilbara), geochronology, geochemistry, and mineral occurrences;
- Completed preliminary PIMA alteration study of VMS deposits, and defined whole-rock geochemical tracers for locating lode gold;
- Completed airborne geophysical acquisition;
- Stitched together airborne geophysical surveys, and released seamless craton-scale image maps;
- Significant advances in understanding granites (>50% of North Pilbara) using γ-ray and magnetic data;
- Recognised and defined lateral (along strike) variation in radioelements in Hamersley Basin rocks;
- Obtained company gravity data (5 km cell size) over part of North Pilbara and most of Hamersley Basin;
- Completed mosaic of North Pilbara Landsat-5-TM (mineral enhanced) image, and released 52 1:100K image maps and explanatory notes (AGSO Record 1997/20);
- Completed interpretation of 400 metre flight line-spaced magnetic data sets and completed preliminary solid geology map (in GIS);
- Completed fieldwork for 1:100K geological mapping in Wodgina;
- Published detailed stratigraphic, structural and geochronological studies in North Shaw and Tambourah 1:100K Sheet areas (AGSO Record 1997/23);
- Constrained tectonic models and recognised marginal processes (subduction).

Future Plans

- Analysis of major faults and unconformities, and place these structural elements into a regional context.
- Characterise structural and stratigraphic controls on mineralisation, and assess the temporal evolution (events) of differing classes of mineral deposits.
- Define flow paths of hydrothermal fluids by alteration mapping and use these data and detailed mineral deposit descriptions to construct exploration models for lode gold, VHMS, and mafic-ultramafic-hosted copper-nickel and PGE deposits.
- Establish timing and variation in metamorphic grade both regionally and near intrusions.
- Determine the geochemical characteristics of various major igneous units as a guide to their petrogenesis and tectonic setting, and as a baseline for alteration studies and their relationship to mineralising events.
- Integrate all geographically referenced digital data into a craton-scale GIS;
- Publish Bulletin and accompanying atlas as a regional synthesis;
- Apply sequence stratigraphic principles to the Hamersley Basin.

AGSO Publications

Glikson, A.Y. 1997. Mineral mapping in the North Pilbara craton: A directed principal components of band ratios method for correlating Landsat-5 Thematic Mapper spectral data with geology. *Australian Geological Survey Organisation, Research Newsletter*, 26, 1-4.

Van Kranendonk, M.J. in press. Timing and tectonic significance of Late Archaean, sinistral strike-slip deformation in the Central Pilbara Structural Corridor, Pilbara Craton, Western Australia. *Precambrian Research Special Issue on the Pilbara.*

AGSO Products

Landsat-TM-5 — prints:

Glikson, A.Y. 1997. 1:100 000 scale enhanced Landsat-5-TM images (52 in total) with explanatory notes. — $50 each; $1000 full set; postscript files: $300 each; $2500 full set

Glikson, A.Y. 1997. Explanatory Notes for a Landsat-5-TM image series according to an RGB directed principal components/band ratio formula North Pilbara craton, Western Australia. *Australian Geological Survey Organisation, Record* 1997/20, 11p. — $10; Free with above set of images

Macias, L. 1997. 1:500 000 scale enhanced Landsat-5-TM image map North Pilbara Craton, Western Australia. Australian Geological Survey Organisation. (digital data as ERMapper BIL file) — $ tba; $4000 BIL

Layered Mafic-Ultramafic Complexes

Hoatson, D.M., Wallace, D.A., Sun, S-s., Simpson, C.J. and Keays, R.R. 1993. Layered intrusions of the Pilbara Block. *AGSO Bulletin* 242. — $85

Regional Magnetic Map — $600

Mackey, T.E. and Richardson, L.M., 1997. Total magnetic intensity (reduced to the pole) with northeast illumination colour pixel-image map of the Pilbara Region, WA, scale 1:500 000, Australian Geological Survey Organisation. — $11000 grid; $4000 BIL

1:250 000 Magnetic Maps

Mackey, T.E., 1997. Total magnetic intensity (reduced to the pole) with northeast illumination colour pixel-image map of Nullagine/Yarrie, WA, scale 1:250 000, Australian Geological Survey Organisation. — $300

Mackey, T.E., 1997. First vertical derivative of total magnetic intensity (reduced to the pole) greyscale pixel-image map of Nullagine/Yarrie, WA, scale 1:250 000, Australian Geological Survey Organisation. — $250

Mackey, T.E. and Richardson, L.M., 1997. Total magnetic intensity (reduced to the pole) with westerly illumination colour pixel-image map of Marble Bar, WA, scale 1:250 000, Australian Geological Survey Organisation. — $300

Mackey, T.E. and Richardson L.M., 1997. East-west gradient of first vertical derivative of total magnetic intensity (reduced to the pole) greyscale pixel-image map of Marble Bar, WA, scale 1:250 000, Australian Geological Survey Organisation. — $250

Mackey, T.E. and Richardson, L.M., 1997. Total magnetic intensity (reduced to the

pole) with northwest illumination colour pixel-image map of Port Hedland, WA, scale 1:250 000, Australian Geological Survey Organisation. $300

Mackey, T.E. and Richardson L.M., 1997. Fractional vertical derivative of total magnetic intensity (reduced to the pole) greyscale pixel-image map of Port Hedland, WA, scale 1:250 000, Australian Geological Survey Organisation. $250

Mackey, T.E. and Richardson, L.M., 1997. Total magnetic intensity (reduced to the pole) with northwest illumination colour pixel-image map of Roebourne/Pyramid, WA, scale 1:250 000, Australian Geological Survey Organisation. $300

Mackey, T.E. and Richardson L.M., 1997. Fractional vertical derivative of total magnetic intensity (reduced to the pole) greyscale pixel-image of Roebourne/Pyramid, WA, scale 1:250 000, Australian Geological Survey Organisation. $250

1:250 000 scale gamma-ray Maps

Mackey, T.E., 1997. Airborne gamma-ray spectrometry colour composite pixel-image map of Nullagine/Yarrie, WA, scale 1:250 000, Australian Geological Survey Organisation. $300

Mackey, T.E. and Richardson L.M., 1997. Airborne gamma-ray spectrometry colour composite pixel-image map of Marble Bar, WA, scale 1:250 000, Australian Geological Survey Organisation. $300

Structural Geology

Van Kranendonk, M.J. 1997. Results of field mapping, 1994-1996, in the North Shaw and Tambourah 1:100 000 Sheet areas, eastern Pilbara craton, northwestern Australia. *Australian Geological Survey Organisation, Record* 1997/23, 44p. $46

Geochemistry $3300

Wyborn, L.A.I. 1995. ROCKCHEM - Pilbara Block digital dataset and Record. *AGSO Record,* 1995/026

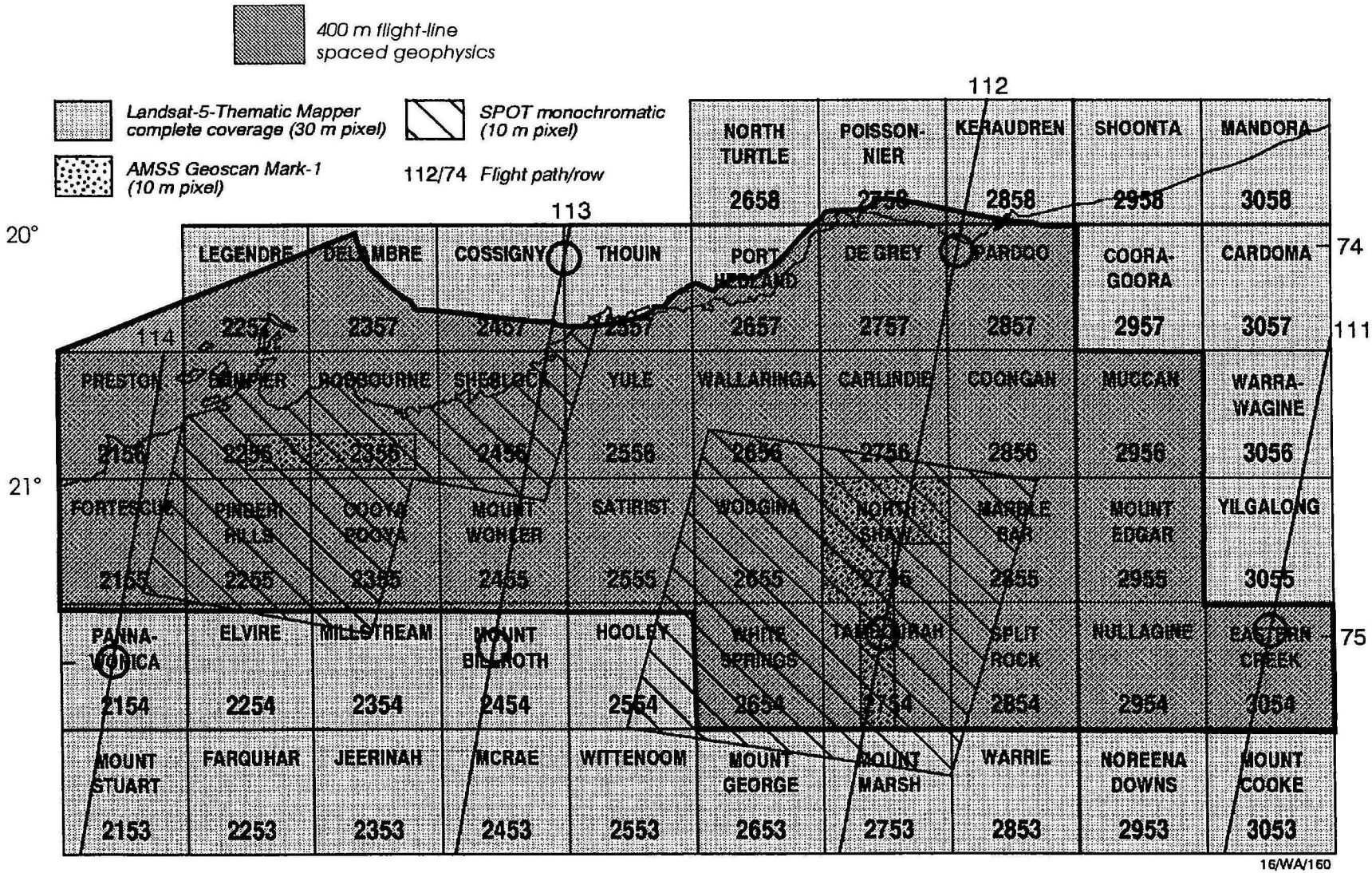
GIS

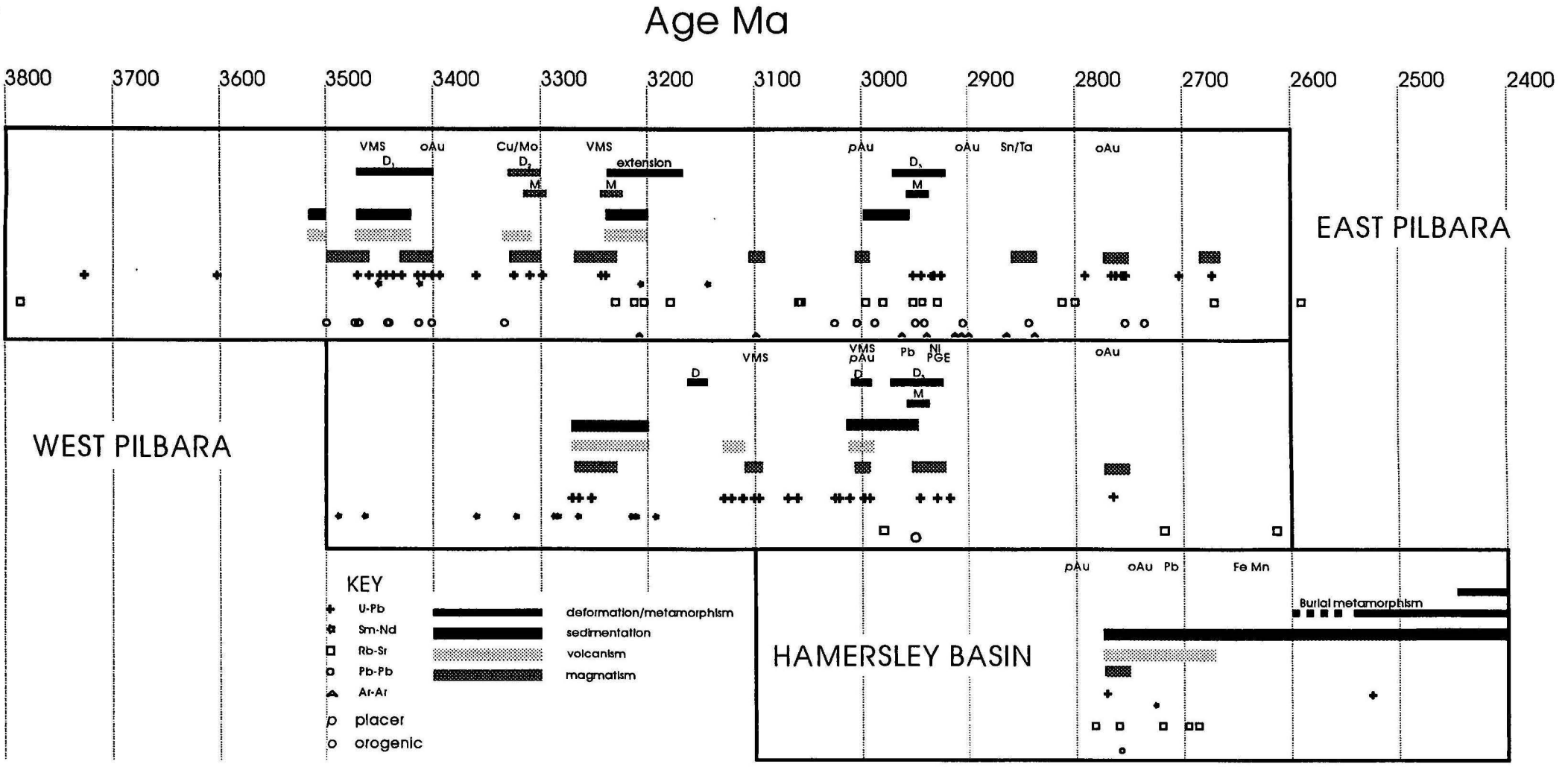
A craton-scale GIS package of existing geological maps, mineral deposits, magnetic, gravity, γ-ray, Landsat-5-TM, solid geology time-based, solid geology lithology-based, geochemistry, geochronology, structural elements will soon be available as ARC-INFO export, ARCVIEW or MapInfo datasets. tba

All map products are available as postscript plot files. Landsat TM data are available as ERMapper BIL files and grids are available of all geophysical products.

GSWA products and publications are not included in this list, please contact Dr Arthur Hickman regarding availability and price.

Remote sensing & geophysical data coverage for North Pilbara





Archaean Events of the Pilbara Block

pileven3.cdr

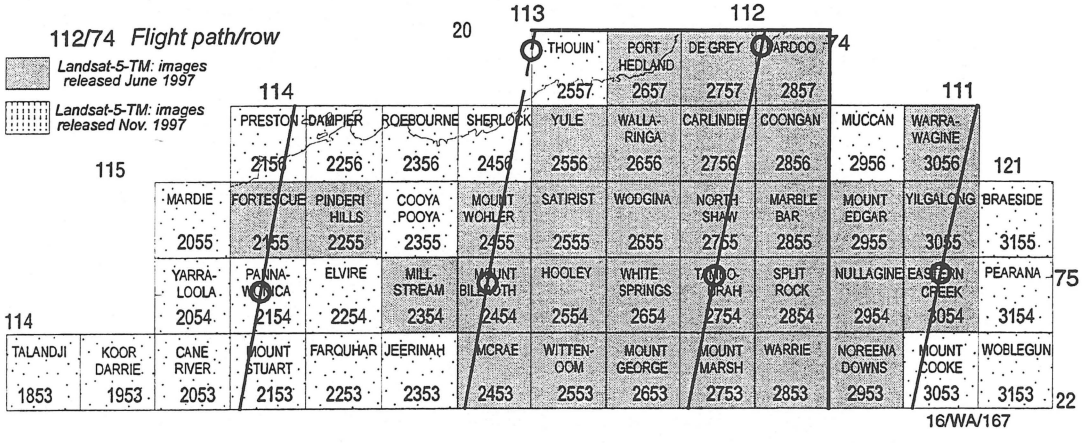
product

Remote Mineral/Lithological Mapping Using Landsat TM, The North Pilbara, Western Australia

The North Pilbara Craton is the most complete and best exposed Archaean terrane in the world, and constitutes a magnificent laboratory for spectral studies. It is endowed with a wide range of relatively fresh rock types, which are commonly little deformed and metamorphosed. In addition to our Pilbara-based clients, this multispectral study is of wide national and international interest in fields including Archaean geology, regional geological mapping, image processing, remotely-sensed mineral mapping, as well as environmental mapping and landuse planning.

A series of enhanced Landsat TM images have been prepared using the RGB pc2(4/3;5/7):5/4:1+7 formula on the basis of extensive analysis and field checking. This formula was selected to best represent the distribution of clay, iron oxides, and quartz and the expression of drainage in the landscape. The images thus offer remotely sensed mineral/lithological maps which can be used for geological and environmental mapping. The complete set includes images from the region's broad range of hard-rock geological (Patterson, North Pilbara, North Hamersley) and regolith terrains, with maps of the coastal strip to the inland arid regions. These images include economically important sheet areas such as Wodgina, Sherlock, Marble Bar, Eastern Creek. Details of the technique are outlined in the accompanying *AGSO Record 1997/20*.

The set was derived from eight Landsat-5-TM (185x185 km) scenes covering a total area of ca. 140 000 km^2, divided into fifty two 1:100 000 sheet areas. The digital data are also available.



The hardcopy maps are printed on a HP Designjet 650C and cost $50 +pp each or at a discounted price of $1 000 +pp for the entire set (fifty two maps). The price includes the Explanatory Notes, although the notes are available separately for $10 +pp. Digital data - ERMapper BIL file $4 000 entire area and postscript plot files $300 each sheet area.

For further information please contact Dr Richard Blewett on (02) 62499713 (rblewett@agso.gov.au).

http://www.agso.gov.au/minerals/

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Yilgarn

A National Geoscience Mapping Accord Project

Project Managers

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Partner

Geological Survey of Western Australia

Cooperating Agencies

Various Industry Participants
University of Western Australia
AGCRC

AGSO Staff

David Blake	Geological mapping
Kevin Cassidy	Mineral deposit and granite studies
David Champion	Geological mapping and granite studies
Mike Craig	Regolith mapping
Frank Kane	Technical assistance
Songfa Liu	Geological mapping
Aaron Sedgmen	Cainozoic mapping and digital data management
Alastair Stewart	Geological mapping
Penny Ursem	Regolith mapping, GIS, and remote sensing

Objectives

- Determine major structural elements and their controls on mineralisation.
- Establish degree of continuity of structure and stratigraphy beneath regolith cover.
- Determine relationships between underlying stratigraphy and regolith cover.
- Develop predictive models for local and regional controls on gold and base-metal mineralisation.

Major activities

The project began in 1990 as the Eastern Goldfields NGMA Project. This project was incorporated into a new project (Yilgarn Project) in 1997 to include new activities which have a more craton-wide focus. AGSO's role has focussed on the following acticities:

- Acquire new gravity and airborne magnetic and gamma-ray spectrometric data.
- Produce new orthophoto images and digital elevation maps from newly acquired aerial photography.
- Undertake geological mapping and associated research in Precambrian geology, and release geological maps at 1:250 000 and 1:100 000 scales.
- Determine structural elements of Eastern Goldfields.
- Develop predictive models for tectonic evolution of Eastern Goldfields.
- Map regolith components and their inter-relationships, and determine landscape evolution of Eastern Goldfields.
- Release selected 1:250 000 and 1:100 000 digital geological information systems, incorporating geological, geophysical, geochemical, mineral deposit and regolith data sets.
- Undertake mineral deposit, fluid inclusion and fluid chemistry studies of selected sites to determine controls on ore deposition processes and refine models of gold ore formation.

- Present results at conferences (e.g., Kalgoorlie 93, Kalgoorlie 97); organise and produce conference proceedings.

Recent scientific findings

Regional geophysics

- Analysis of the Yilgarn Deep Seismic Transect has revealed that major episodes of deformation recognised from surface mapping have affected the lower and middle crust as well, with the exception of D1 thusting, which is restricted to the greenstones. These are underlain by a major detachment fault, and so may have been transported into their present position from a considerable distance away. Shortening (at least 50 percent) of the mid and lower crust has produced major D2 thrusts and folds, which was followed by D3 and D4 faulting (possibly strike-slip). A large region of no reflections below the major mineralised zone of the goldfields may be the result of fluid alteration (Drummond et al. 1997; *AGSO Record 1997/41*, 15-20).

- Analysis of regional gravity and aeromagnetic data has shown that supposed crustal accretion boundaries and lineaments do not separate domains with different average magnetisation, gravity anomalies, or structural orientations, and so may not be as extensive and through-going as commonly thought (Whitaker 1997; *AGSO Record 1997/41*, 21-26).

Regional geology and geochemistry

- RAB-hole bottom sample analyses have enabled us to produce a solid-geology map of Lake Violet 1:100 000 Sheet area, in the north of the highly prospective Yandal greenstone belt (Stewart 1997). This is a new approach in AGSO's 1:100 000-scale mapping of the goldfields, and uses detailed company mapping, surface mapping, and aeromagnetic interpretation, as well as the drill samples.

- Our regional granite sampling and analytical work has produced a chemical classification of eastern Yilgarn granites – Low-Ca, High-Ca, High High-Field Element Strength (HFSE), Mafic, and Syenitic – which is being increasingly adopted for general use. Isotopic work indicates that the granites are sourced from old continental crust, particularly in the western half of the goldfields. This precursor crust was largely felsic, but also included mafic and sedimentary components, and was possibly a subducting slab (Champion 1997; *AGSO Record 1997/41*, 71-76).

Metallogeny

- Work on granite-hosted gold deposits has shown that they belong to the same coherent set of epigenetic deposits that occur in Yilgarn greenstones. All but two granite-hosted deposits are in small granite bodies in or adjacent to greenstones. The ore-fluid was derived from, or reached equilibrium with, quartzofeldspathic rock, but probably not the host granite itself (Cassidy 1997; *AGSO Record 1997/41*, 131-136).

- Assessment of the Yilgarn Craton using a set of mappable criteria and exploration guides indicates that the region has been under-explored for volcanogenic massive sulphide deposits (Huston 1997; *AGSO Record 1997/41*, 77-82).

Regolith

- In regolith work, we have published a scheme for identifying parent rocks from weathered equivalents using results of X-ray diffraction and portable infrared mineral analyser (PIMA) spectrometry on RAB-hole bottom samples (Stewart & Kamprad 1997; *AGSO Research*

Newsletter 26, 9-11). Automation of regolith mapping is increasing, and a new direction in this endeavour is production of thematic maps derived from multiple datasets. We are also beginning a regional synthesis of regolith development in the Yilgarn Craton. Looking to the future, we believe that GIS development of multi-dataset interactions to link regolith models, mineralisation models, geology, and geophysics to a preferred exploration model is the best way to maximise increases in understanding where gold may be found (Craig 1997; *AGSO Record 1997/41*, 183-186).

Goals for 1997/98

Produce Abstract volume, present lectures and product display at Kalgoorlie 97 Conference (October 1997).

Release Lake Violet 1:100 000 geology and solid-geology and Mount Keith geology maps (December 1997); and Yeelirrie geology 1:100 000 maps (June 1998).

Release Nabberu 1:250 000 solid-geology map (December 1997).

Produce and release regolith map of Kurnalpi 1:250 000 sheet area (December 1997).

Produce and release regolith map of Duketon 1:250 000 sheet area (June 1998).

Produce and release Laverton 1:250 000 geology map (June 1998).

Produce Sir Samuel 1:250 000 geology map (June 1998).

Produce record on Leonora 1:100 000 geology (June 1998).

Acquire and release 1:100 000 orthophoto images of Leonora, Melita, Minerie, Munjeroo, Nambi, Weebo, Wildara, and Yerilla sheets (December 1998).

Planned upgrade of Ballard, Lake Carey, Mount Celia and Mount Mason 1:100 000 geology maps.

Produce and release Meekatharra and Perth 1:1 000 000 geophysical interpretation maps based on regional 1500 m airborne geophysical data.

Future Plans

- Produce and release Barlee and Jackson 1:250 000 solid geology maps based on interpretation of newly jointed acquired AGSO-GSWA airborne geophysical data and compilation of existing geological data.
- **North-east Yilgarn Margin Project**
  - Acquire airborne geophysical data for 1:250 000 sheets on the north-east margin of the Yilgarn Craton.
  - Produce and release 1:250 000 solid geology maps based on interpretation of newly acquired data and compilation of existing geological data.

Products (Add postage and handling to prices stated, and sales tax to maps)

General

- Kalgoorlie 97: An International Conference on Crustal Evolution, Metallogeny and Exploration of the Yilgarn Craton – An Update: Extended Abstracts. Contains 240 pages of extended and illustrated abstracts of 45 papers on tectonics, geophysics, geochronology, regional geology (greenstones, structure and metamorphism, granitoids), mineralization (base metals, nickel, gold), and regolith geology, geochemistry and exploration of the Yilgarn Craton. *AGSO Record 1997/41*. $55
- Kalgoorlie 93: An International Conference on Crustal Evolution, Metallogeny and Exploration of the Eastern Goldfields: Extended Abstracts. Contains 255 pages of extended and illustrated abstracts of 55 papers on lithostratigraphy and Archaean petrogenesis, granitoids and their implications for gold mineralisation, regional tectonics, mineralisation models and controls, regolith evolution and $40

exploration significance, and the search for blind orebodies. *AGSO Record 1993/54*

- Kalgoorlie 93: An International Conference on Crustal Evolution, Metallogeny and Exploration of the Eastern Goldfields: Excursion Guidebook. *AGSO Record 1993/53*, 144 pp. $30

Gravity maps and datasets – see accompanying chart.

Aeromagnetic datasets and images – see accompanying chart. Data include:

- Dyelines or transparencies of total magnetic intensity (TMI) contours, total-count gamma-ray spectrometric contours, flight-line systems, and TMI profiles
- Pixel-image maps of TMI in colour or grey scale
- Digital point-located and gridded aeromagnetic and gamma-ray spectrometric data on magnetic tape (see AUSGEO News 35, for August 1996, p. 9)
- 1:500 000 image of the first vertical derivative (reduced to the pole) of the TMI (image intensity) combined with Bouguer gravity in colour, covering Wiluna, Sir Samuel, Duketon, Leonora, Laverton and Edjudina 1:250 000 Sheet areas (see AUSGEO News 36, for October 1996, p. 13)

Geophysical interpretation maps – see accompanying chart.

Orthophoto images and Digital Elevation Models – see accompanying chart.

Geology and tectonics

Maps and datasets – see accompanying chart.

Reports

- Archaean crustal structure from seismic reflection profiling, Eastern Goldfields, Western Australia. Results from the Kalgoorlie seismic transect. *AGSO Record 1993/15* $80
- Strain partitioning near the Keith-Kilkenny tectonic zones in the Yerilla area of the Eastern Goldfields, Western Australia. *BMR Record 1992/68* $20
- The nature of high-strain zones in the Laverton-Leonora area, Western Australia. *BMR Record 1992/53* $20
- Report on the geology of the Leonora area, Western Australia. *BMR Record 1990/59* $15

Mineralisation

Reports

- The relationship between gold mineralisation and metamorphic grade in the Menzies-Kambalda area, Eastern Goldfields, W.A.: Evidence from fluid inclusions. *AGSO Record 1993/27* $20
- Chemical implications of imperfectly channelized fluid flow in hydrothermal systems. II. Application to gold deposits. *BMR Record 1990/95* $20

Igneous rocks - petrology and geochemistry

Datasets

- Yilgarn Craton: ROCKCHEM dataset documentation (2274 whole rock analyses). *AGSO Record 1992/38* $4200*

*less one third for previous purchasers of complete ROCKCHEM database

Regolith

Maps – see accompanying chart. Also available:

- Regolith terrain map of Australia, 1:5 000 000 scale $6
- Kalgoorlie-Kurnalpi regolith landforms, 1:250 000 ($30 for sponsors) $50
- Regolith terrain map of Kalgoorlie, 1:1 000 000 scale, 1991 $25

Datasets – see accompanying chart. Also available:

- Regolith terrain map of Australia, 1:5 000 000 scale $200
- Kalgoorlie-Kurnalpi regolith landforms, 1:250 000 scale ($100 for sponsors) $250

Reports

- Kalgoorlie regolith terrain map commentary. *AGSO Record 1992/8* $36.65
- RTMAP, BMR regolith database field handbook. *BMR Record 1991/29* $20
- Regolith terrain data - Kalgoorlie 1:1 000 000 Sheet SH-51, Western Australia. *BMR Record 1988/3* (includes map) $23.60
- Regolith terrain map of Australia. *BMR Record 1986/27* $69.20
- A field evaluation of the application of Carr Boyd Geoscan-MSS imagery to regolith studies for an area southeast of Kalgoorlie, Western Australia. BMR *Record 1986/2* $21.60

Publications (most recent first)

Geology and tectonics

Stewart, A.J., 1997. Archaean geology of Lake Violet 1:100 000 Sheet area, Yandal greenstone belt, Eastern Goldfields Province, Western Australia. *AGSO Research Newsletter* 27, in press.

Williams, P.R., & Whitaker, A.J., 1993. Gneiss domes and extensional deformation in the highly mineralised Archaean Eastern Goldfields Province, Western Australia. *Ore Geology Reviews*, 8, 141-162.

Witt, W.K., Swager, C.P., Williams, P.R., and Whitaker, A.J., 1989. Accretionary tectonics in the Eastern Goldfields Province. BMR Research Symposium, Canberra, 7-9 November, 1989. Papers. Bureau of Mineral Resources, Geology and Geophysics, Canberra.

Igneous rocks - petrology and geochemistry

Champion, D.C. & Sheraton, J. W., 1997. Archaean granitoids of the northern Eastern Goldfields Province, Yilgarn craton, Australia: constraints on crustal growth. *Precambrian Research*, 83, 109-132.

Champion, D.C. & Sheraton, J.W., 1996. Archaean granitoids of the northern Eastern Goldfields province, Yilgarn craton, Australia: constraints on crustal growth. 13th Australian Geological Convention. *Geological Society of Australia, Abstracts* 41, 82.

Champion, D.C. & Sheraton, J. W., 1995. Archaean granitoids of the northern Eastern Goldfields Province, Yilgarn Craton, Australia. Programs & Abstracts, Precambrian' 95, International Conference on Tectonics & Metallogeny of Early/Mid Precambrian Orogenic Belts, 236.

Mineralisation

Cassidy, K.F., Kent, A.J.R. & Fanning, C.M., 1996. Gold mineralisation synchronous with the final stages of cratonisation, Yilgarn Craton, Western Australia: evidence from Sm-Nd and U-Pb ages of cross-cutting (post-gold) dykes. 13th Australian Geological Convention. *Geological Society of Australia, Abstracts* 41, 80.

Stewart, A.J., 1996 - Gold targets in the northeast Duketon 1:250 000 Sheet area, Eastern Goldfields, Western Australia. *AGSO Research Newsletter*, 24, 1-4.

Mernagh, T.P. & Witt W.K., 1994. Early methane-rich fluids and their role in Archaean gold mineralisation at the Sand King and Missouri deposits, Eastern Goldfields Province, Western Australia. *AGSO Journal of Australian Geology & Geophysics*, 15, 297-312.

Witt, W.K., Knight, J. & Mernagh, T.P., 1994. Gold mineralisation in the Archaean Kalgoorlie Terrane: Product of a 'giant' synmetamorphic hydrothermal system. 12th Australian Geological Convention. *Geological Society of Australia, Abstracts* 37, 468-469.

Regolith

Stewart, A.J. & Kamprad, J., 1997. Piercing the regolith veil – identifying parent rocks from weathered equivalents, Eastern Goldfields, Western Australia. *AGSO Research Newsletter* 26, 9-11.

Pain, C.F., and Craig, M.A. (Eds), 1995. Regolith special issue. *AGSO Journal of Australian Geology & Geophysics*, 16(3).

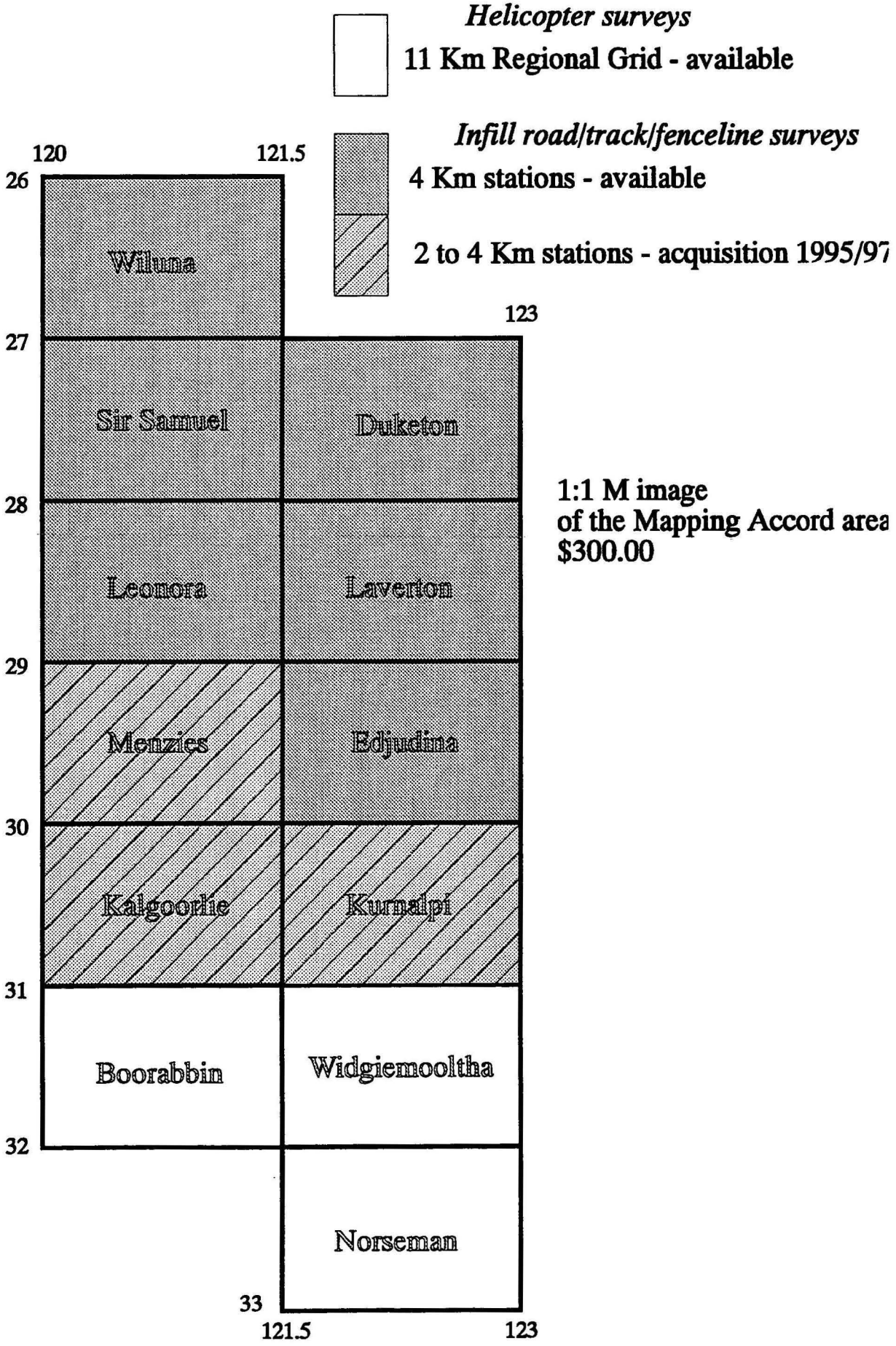
McQueen, K.G., and Craig, M.A. (Eds), 1995. Developments and new approaches in regolith mapping - proceedings of a two day workshop organised by the Centre for Australian Regolith Studies at the University of Canberra, 20-21 June, 1995. CARS Occasional Publication No 3.

Craig. M.A., Anand, R.R., Churchward, H.M., Gozzard, J.R., Smith, R.E.and Smith, K., 1993. Regolith-landform mapping in the Yilgarn Craton, Western Australia: towards a standardised approach. A discussion paper - *In* Craig, M.A. (ed.), CSIRO Report 338R, 43pp.

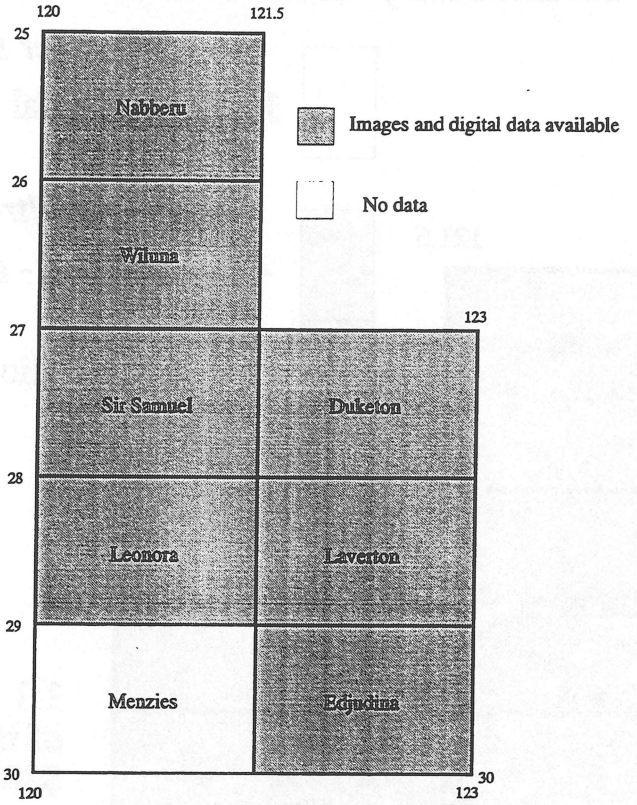
Anand, R. R., Churchward, H.M., Smith, R.E., Smith, K., Gozzard, J.R., Craig, M.A., and T.J. Munday, 1993. Classification and atlas of regolith-landform mapping units. CSIRO Restricted Report 440R, 87pp.

Ollier, C.D., Chan, R.A., Craig M.A., and Gibson, D.L., 1988. Aspects of landscape history and regolith of the Kalgoorlie region, W.A. *BMR Journal of Australian Geology & Geophysics*, 10, 309-321.

Eastern Goldfields
Gravity Data
Availability from AGSO



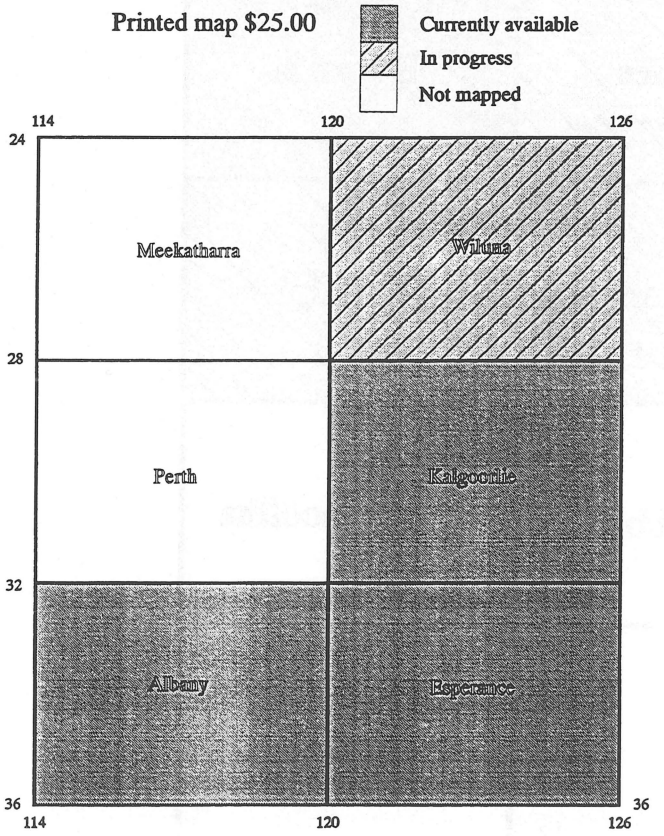
Eastern Goldfields
Aeromagnetic data and images (400 m, 1:250 K sheets)
Availability from AGSO



1:1 M images, Wiluna to Edjudina, $300.00

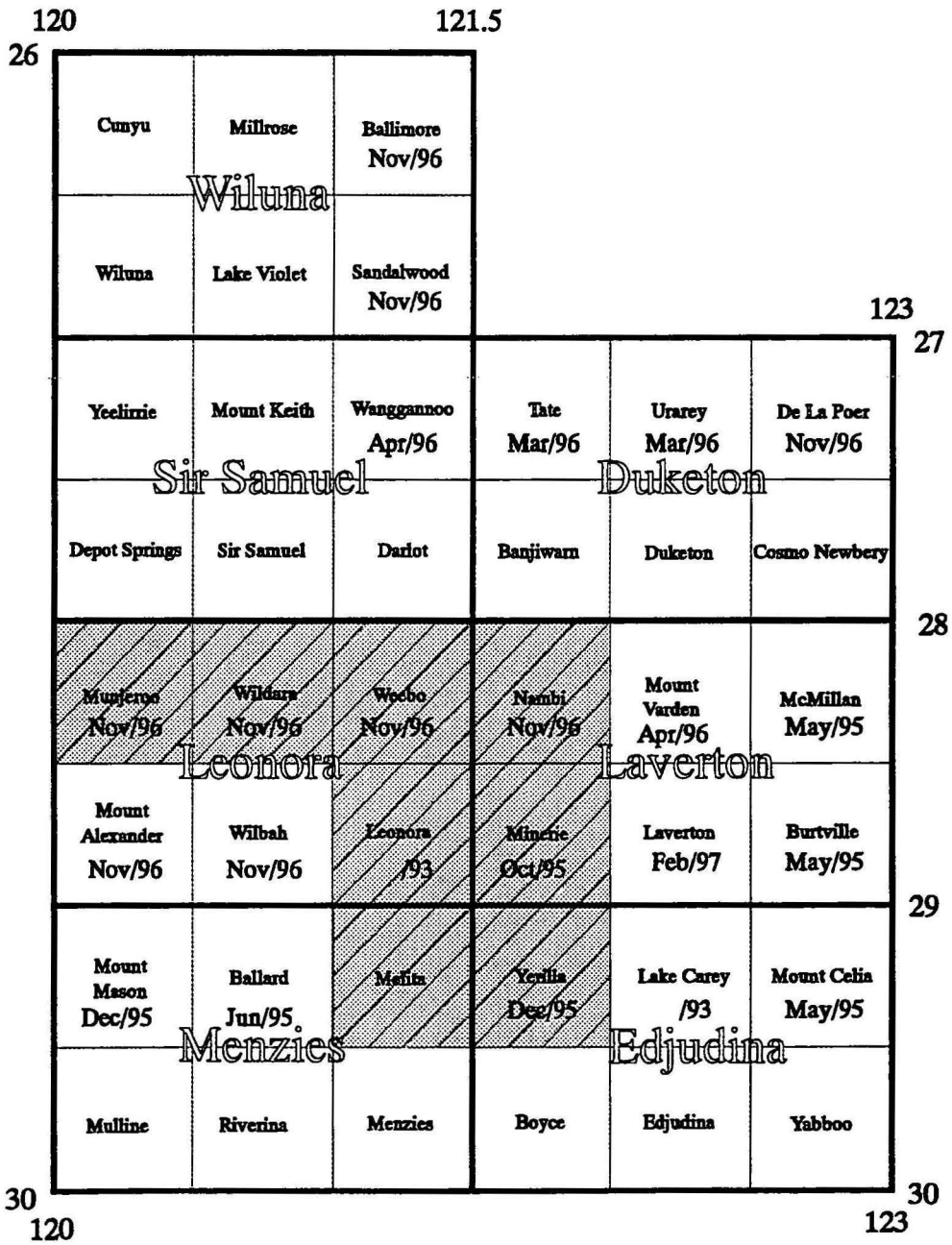
Yilgarn Craton
1:1 M geophysical interpretation maps
Availability from AGSO

Printed map $25.00

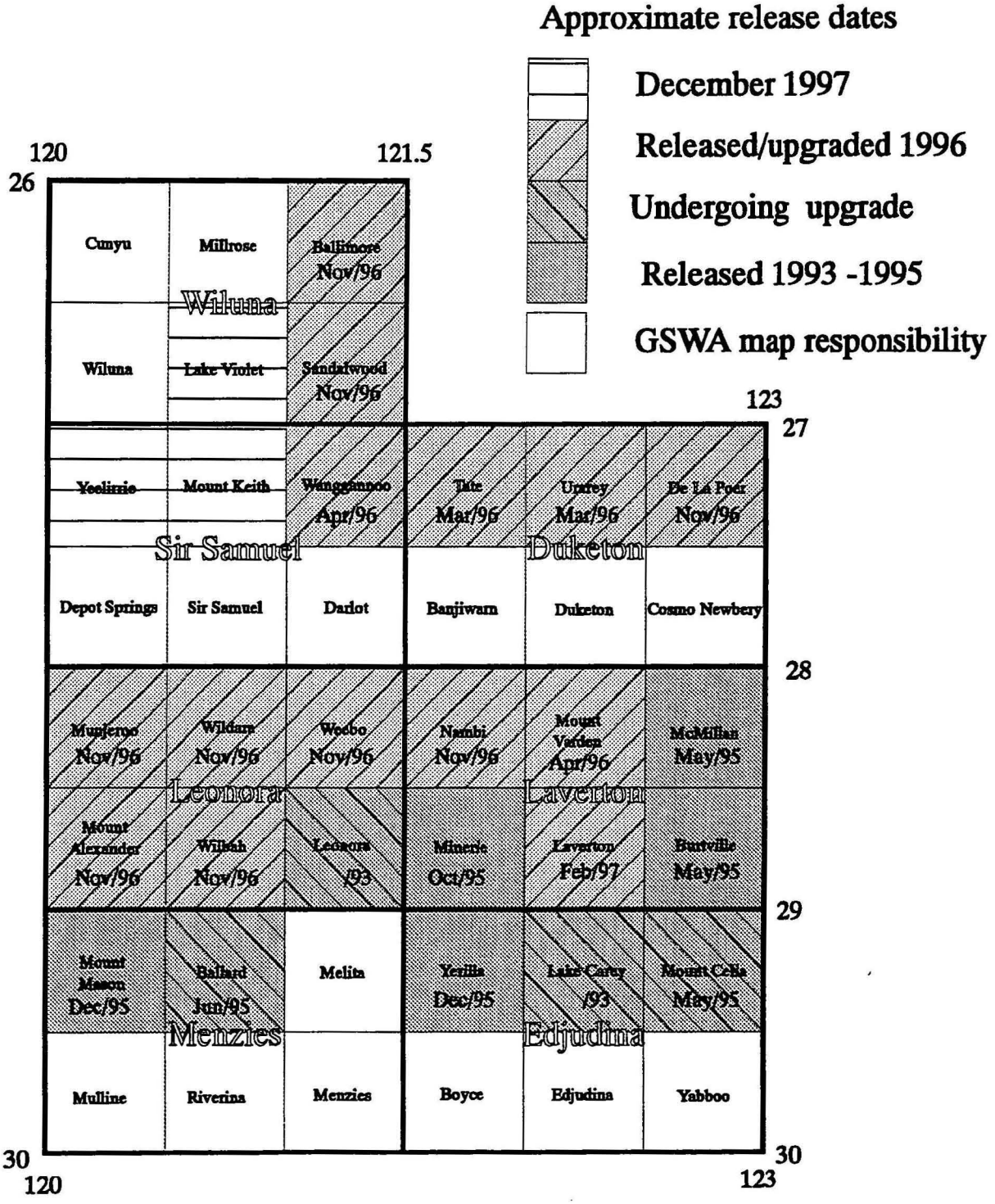


Northern Eastern Goldfields
1:100 000 sheet Ortho-Photo Images
& Digital Elevation models

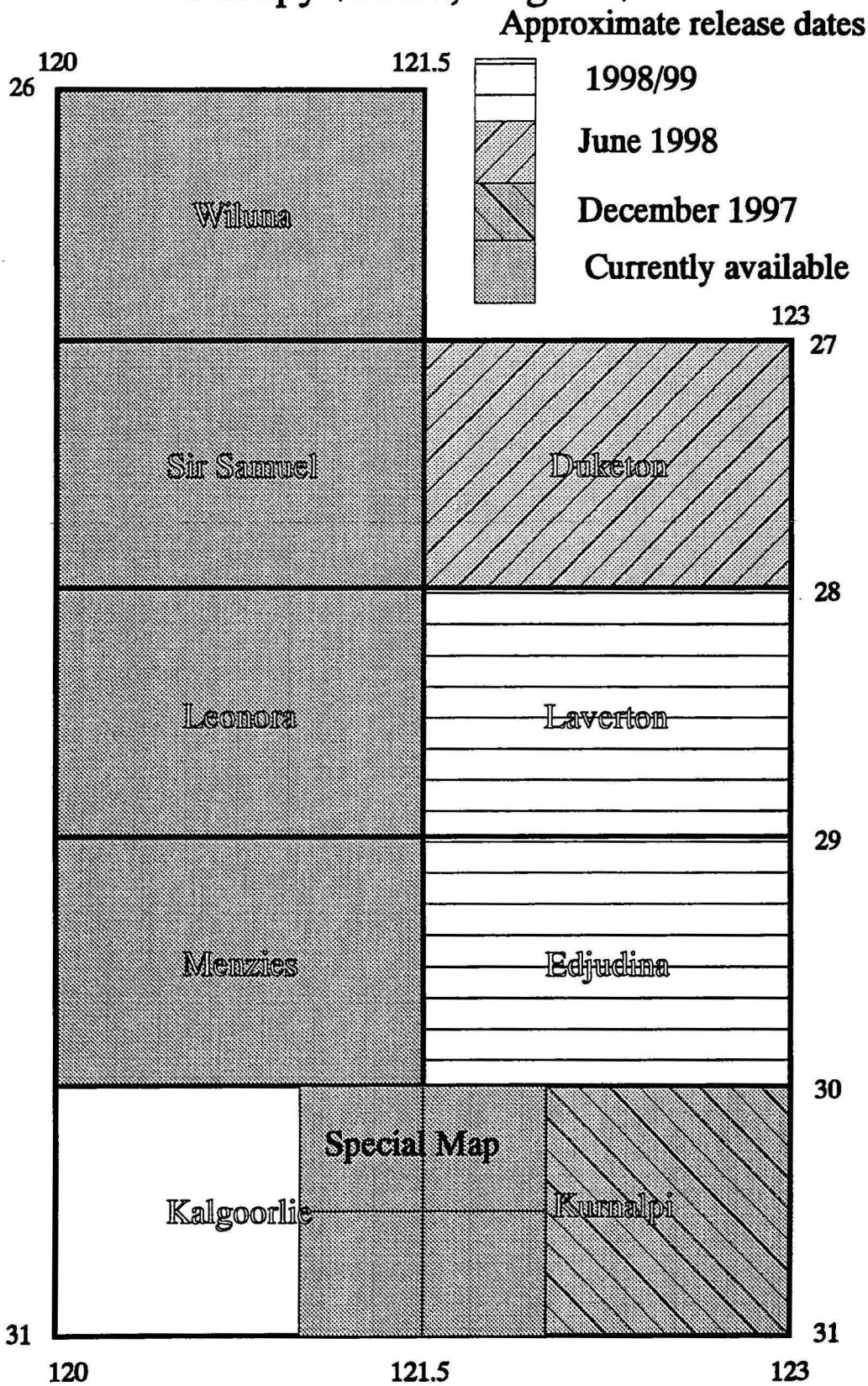
Planned Acquisition Aug-Sept 1997



Eastern Goldfields
1:100 000 Geological Maps
Availability from AGSO
Hardcopy $50.00, Digital $100.00



Eastern Goldfields
1:250 000 Regolith Maps
Availability from AGSO
Hardcopy $50.00, Digital $500



Characterisation and Metallogenic Significance of Archaean Granitoids of the Yilgarn Craton, Western Australia

AMIRA Project P482/MERIWA Project M281

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Partners

Centre for Strategic Mineral Deposits, Univ. Western Australia
Australian Mineral Industries Research Association (AMIRA)
Minerals and Energy Research Institute of Western Australia (MERIWA)

The three-year AMIRA P482/MERIWA M281 Project commenced in January, 1997, with funding from AMIRA, MERIWA and the ARC Collaborative Research Grants scheme. A total of 13 mineral exploration companies plus MERIWA have committed a total of over $500,000. In addition, an ARC CRG of $240,000 has been awarded to UWA. In combination with 'in-kind' support from AGSO (about $650,000) and the Centre for Strategic Mineral Deposits (about $260,000), the total value of the project is about $1.65 million over three years, with supporting companies deriving more than triple the value of their research dollar. Project results remain confidential to sponsors for 18 months after completion of the project. New sponsors are welcome to join the project until the end of the second year.

Granitoids of all ages are increasingly being seen as important in the development of hydrothermal mineral deposits as well as in understanding the fundamental evolution of the terranes they comprise. This research project will provide an immediately useful synthesis of the characterisation and metallogenic significance of Archaean granitoids in the Yilgarn Craton that can be readily accessed by project geologists working in the exploration of gold and other commodities throughout the Yilgarn Craton. In essence, the project provides the generation of major new digital data sets (e.g., geochemical, geochronological, maps) within a program that has two overarching goals:

- provide a fundamental understanding of the granitoids of the Yilgarn Craton, and
- determine if there is any potential relationship between granitoids and hydrothermal mineralisation.

The research strategy is to undertake an integrated multidisciplinary analysis of granitoids combining a variety of techniques within a GIS framework.

The project is essentially data-driven, with much of the research spent acquiring and developing a detailed knowledge base of the craton-scale granitoid variation in the 'granitoid-greenstone' belts of the Yilgarn Craton utilising geophysical, geological, geochemical, geochronological and isotopic techniques. In addition to providing a synthesis of existing data, this project will acquire geochemical analyses and selected geological, structural and geophysical attributes on over 600 granitoid samples and SHRIMP age determinations and radiogenic isotope tracer studies for 50 regionally significant granitoids throughout the craton.

An important component of the research strategy is to maximise the use of regional and local geological knowledge of the sponsors, as well as to communicate the results in a timely fashion.

Australian Archaean Volcanic-Hosted Massive Sulphide Deposits: Implication For The Base Metal Prospectivity Of Global Archaean Terranes

An AMIRA/ARC project proposal

The Archaean Cratons of Western Australia are anomalous in having relatively few known volcanic-hosted massive sulphide (VHMS) deposits relative to similar aged regions in North America. This difference has been ascribed previously to two possible reasons: (1) different tectonic settings for the Archaean Cratons of Western Australia, or (2) past exploration difficulties in the '60 and '70s related to regolith, saline groundwaters and a lesser understanding of regional geology, which effected geological mapping, geophysics and geochemistry. Recent discoveries at Trilogy, Panorama and Nimbus suggest perhaps that these cratons may not have been explored effectively in the past. Furthermore, average grades in the Australian deposits are significantly higher that those in the Canadian deposits, supporting concepts of fundamental differences between the regions.

In the past, exploration models for Archaean VHMS deposits have been developed based on deposits and districts largely in the Abitibi Subprovince of the Canadian Shield. However, the tectonic setting of the Yilgarn and Pilbara Cratons differs from that of the Abitibi Subprovince in having a significant early crustal basement. This difference implies that exploration criteria developed in the Abitibi, such as the lithogeochemical characteristics of volcanic belts, may be inappropriate for the Archaean of Western Australia. Although some research has been undertaken on volcanic architecture of VHMS-hosting volcanic belts (e.g. the Mt Read Volcanic Belt of western Tasmania), volcanic facies variations are presently not well incorporated into exploration models for VHMS deposits.

The aim of this proposed research project, which brings together a team of geologists, geochemists and geophysicists from the Australian Geological Survey Organisation, the University of Western Australia, the University of Tasmania and Monash University, is to provide volcanic architecture facies maps, geochemical data and practical descriptions of VHMS deposits that can be used by company exploration geologists to modify current exploration models to suit the Yilgarn and Pilbara Cratons. These aims will be achieved by:

- Compiling district- and deposit-scale geological, geochemical and geophysical data to establish how Archaean deposits in Western Australia differ from global Archaean deposits;
- Undertaking volcanic facies architecture mapping in VHMS-mineralised belts and compare these results with existing maps in VHMS-barren belts;
- Undertaking detailed lithogeochemical studies of VHMS-mineralised belts and use these data to develop lithogeochemical fertility criteria and to establish the geological environment in which the mineralised belts form;
- Producing integrated province-scale geographic information systems (GIS) and hard copy atlases for the Murchison, Eastern Goldfields and Southern Cross Provinces and the Abitibi Subprovince that highlight volcanic facies variations, syn-volcanic structures, alteration zones and sub-volcanic intrusions relative to VHMS deposits; and

- Investigating the relationship between volcanic facies architecture, syn-volcanic structures, sub-volcanic intrusions, and VHMS deposits using these GIS.

To achieve these aims this project will collaborate, wherever appropriate, with other research groups working in Archaean greenstone belts of Western Australia and with the Ministère de l'Énergie et des Ressources du Québec to develop the Abitibi GIS. This project will complement AGSO-GSWA NGMA projects in the Eastern Goldfields and North Pilbara and existing AMIRA/ARC research projects.

Funding for the proposed project will be sought from AMIRA and ARC through the SPIRT mechanism. Total funding of $2.35 million is sought over a period of three years, of which $679,000 is sought from AMIRA, $679,000 from ARC, and $992,000 as in kind support by the participating institutions. The supporting companies will derive more than triple the value of their research dollar. Project results will remain confidential to sponsors for eighteen months after completion of the project.

National Gravimetry

A Research Service Project

Project Manager

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AGSO Staff

Michael Morse
Ray Tracey
John Williams
Harry Reith
Phillip Wynne

Cooperating Agencies

State and Territory Geological Surveys

Objectives

- Maintain, augment and enhance the National Gravity Database
- Maintain, augment and enhance the Fundamental Gravity Network
- Establish, publish and promulgate the National Gravimetric Code
- Develop new techniques and products in gravimetry
- Promote the effective use of gravimetry as a key exploration tool

Overview

AGSO's Australian National Gravity Database contains data from more than 900 000 point gravity observations on the Australian mainland, over the continental margins, on the Australian Antarctic Territory, and other external territories of Australia. These data have been collected from nearly 1 000 gravity surveys dating back to 1937. This repository of gravity information is a valuable national asset with importance to the mineral and petroleum exploration industries, geodesy and the international scientific community. We are continually seeking data from State governments and private exploration companies to augment the Database. We also conduct or coordinate gravity in-fill surveys in strategic areas.

The Australian Fundamental Gravity Network provides a consistent and accurate set of gravity control points throughout Australia and its territories. These gravity control points, which are documented, are spaced at intervals of roughly 150 km over the continent. Ideally, all gravity surveys conducted in Australia should be tied into this network. We currently have a program to augment, refurbish and better document the Fundamental Gravity Network.

AGSO's Gravimetry Project has responsibility for providing national guidelines for gravimetry in Australia; in the past this has been provided to State and Territory governments and private industry on request, but a need for a more formalised code of best practice is now evident. To satisfy this need we are developing a National Gravimetric Code which will define the current best practice in gravimetry.

Recent Project Highlights

- Gravimetry on the Web - see us at www.agso.gov.au/geophysics/gravimetry
- Release of the Gravity Map of the Australian Region and the 1.5' gridded dataset
- Completion of the Kalgoorlie Gravity Project
  (in-fill mapping of Menzies,Kalgoorlie and Kurnalpi 1:250 000 sheets)
- Goulburn Gravity Survey (in-fill mapping of Goulburn 1:250 000 sheet) is underway

Future Plans

- Production of a new series of 1:1 000 000 gravity images in hardcopy and as a digital package including point data, ASCII grid and ERMapper files on a CD-ROM
- To organise high quality in-fill surveys in areas of strategic geological or exploration interest as joint ventures with industry and/or with the States and Territories
- To achieve cooperation and coordination between AGSO, State & Territory Governments and industry in matters relating to gravimetry
- To ensure that all useful gravity data ends up in the National Database
- Continue the expansion and upgrading of the Fundamental Gravity Network
- Cooperate with international organisations in absolute gravimetry
- Add value to our National Database by producing innovative products

Products

Release Date	Title	Price $A
In Press	Australian Fundamental Gravity Network 1992 - 1994 - Sydney Base Station Network by J.W.Williams	$50
Nov 1997	The Australian National Gravity Database by A.S.Murray. A review of the development of the database and base network. AGSO Journal 17(1)	$70
Sep 1997	Gravity Map of the Australian Region - a 1.5' (2.5km) pixel image in full colour at two scales: 1:5M (A0)	$150 (laminated $250)
	1:25M (A4)	$5
Sep 1997	Gravity grid of the Australian Region - grid mesh is 1.5' (2.5km) covering the area: 8° to 48°S and 106° to 162°E (~2700x1600 cells) ASCII and ERMapper available on CD-ROM or exabyte tape	$2 500
Sep 1997	Australian Fundamental Gravity Network 1992 - Coober Pedy - Mt Willoughby Gravity Tie SA' by J.W.Williams. Record 1997/32	$25
Sep 1997	Australian Fundamental Gravity Network 1993 - Cobar - Mt Hope Gravity Tie NSW, Australia' by J.W.Williams. Record 1997/33	$25
Feb 1997	Australian National Gravity Database - 1996 Release Point data for 830 000 + stations on exabyte, CD-ROM or tape	$7 500
	Point data for individual 1:1 000 000 sheets on floppy discs	$350
May 1996	'Australian Fundamental Gravity Network - 1994 Survey of Eyre Peninsula in South Australia'. A.S. Murray. Record 1996/5.	$40
Jan 1996	Station Location Map of Australian Gravity Stations - 1995 Edition. paper map	$25
	transparency	$75
Dec 1995	Australian Fundamental Gravity Network in Victoria - 1995 Re-establishment Survey. A.S. Murray. Record 1995/70.	$40
Jun 1995	Eastern Goldfields of Western Australia. Colour pixel image map.	$300
Various	Bouguer gravity anomaly contour maps of Australia at 1:1M and 1:250 000 scales - paper prints $25, transparencies	$75
Continuing	Diagrams and information on gravity base stations	Free

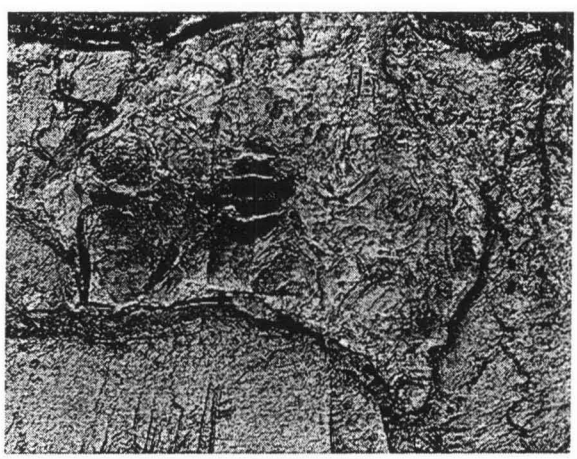
GRAVIMETRY

Gravity Map Of The Australian Region

product

The Australian Geological Survey Organisation announces the release of a new Gravity Anomaly Map of the Australian Region. This map combines, for the first time, accurate onshore gravity measurements with the recently released worldwide satellite gravity coverage over marine areas. The onshore gravity coverage of Australia and neighbouring islands comprises 700,000 point gravity observations with a point to point spacing ranging between 11 kilometres and 25 metres. The satellite data sample spacing is approximately 2 minutes of arc. The onshore data as well as the satellite data were gridded onto a 2.5 kilometre mesh covering the area of the map. The gridded data is also available for sale.

The image displayed on the map shows Bouguer gravity anomalies calculated at a density of 2.67 tm^{-3} onshore and free air gravity anomalies offshore. The pixel colour hue was chosen from the natural colour palette (red high, purple low). The map projection is simple conic with standard parallels at 18° and 36° S latitude and scale of 1:5 000 000 for the full size map and 1:25 000 000 for the A4 size map.



Gravity anomalies effectively show the density variations in the Earth's Crust with high anomalies indicating areas of above average crustal density or a thinner crust (the crust is lighter than the underlying mantle) and low anomalies showing below average crustal density or thicker crust. The depth of the crustal bodies having the anomalous density is indicated by the anomaly wavelength; finer, sharper anomalies indicate shallow bodies and broader, diffuse anomalies indicate deeper bodies.

The pixel image map is available in two formats at the prices indicated:

- an A0 wall chart at 1:5 000 000 scale at $150 (laminated copies are $250)
- an A4 page size at 1:25 000 000 scale at $5 (both plus post & sales tax)
- 1.5' gridded data are also available in ASCII and ERMapper format for $2 500

Copies of these maps may be obtained from:

AGSO SALES CENTRE
GPO Box 378
CANBERRA ACT 2601
AUSTRALIA

Phone: (02) 6249 9519 / 9642
Facsimile: (02) 6249 9982
E-mail: sales@agso.gov.au
Use the order form supplied.

For further information about the map and grid, contact: Ms Alice Murray
Telephone: (02) 6249 9264 E-mail: amurray@agso.gov.au

Release Date: 1 September 1997

http://www.agso.gov.au/minerals/

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

product

Gravity Grid Of The Australian Region

The Australian Geological Survey Organisation announces the release of a new gridded gravity dataset of the Australian Region. This grid combines, for the first time, accurate onshore gravity measurements with the recently released worldwide satellite gravity coverage over marine areas. The onshore gravity coverage of Australia and neighbouring islands comprises 700 000 point gravity observations with a point to point spacing ranging between 11 kilometres and 25 metres. The satellite data sample spacing is approximately 2 minutes of arc. The onshore data as well as the satellite data were gridded onto a 2.5 kilometre mesh covering the area between 8° and 48° South, 106° and 162° East.

Gravity anomalies effectively show the density variations in the Earth's Crust with high anomalies indicating areas of above average crustal density or a thinner crust (the crust is lighter than the underlying mantle) and low anomalies showing below average crustal density or thicker crust. The depth of the crustal bodies having the anomalous density is indicated by the anomaly wavelength; finer, sharper anomalies indicate shallow bodies and broader, diffuse anomalies indicate deeper bodies.

The 1.5' gridded data set is available in both ASCII and ERMapper format on CD-ROM or Exabyte tape for $2 500.

Copies of this grid may be obtained from:
Mr Duncan Souter Geophysical Mapping Section AGSO
GPO Box 378 CANBERRA ACT 2601 AUSTRALIA
Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986

For further information about the grid contact : Ms Alice Murray
Telephone: (02) 6249 9264 E-mail: amurray@agso.gov.au

http://www.agso.gov.au/geophysics/gravimetry/

Release Date: 1 September 1997

http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

product

Australian National Gravity Database

AGSO's Australian National Gravity Database contains data from more than 900 000 point gravity observations on the Australian mainland, over the continental margins, on the Australian Antarctic Territory, and other external territories of Australia. These data have been collected from nearly 1 000 gravity surveys dating back to 1937. This repository of gravity information is a valuable national asset with importance to the mineral and petroleum exploration industries, geodesy and the international scientific community.

The Australian Geological Survey Organisation (AGSO) has released the 1996 edition of the Australian National Gravity Database. This release contains almost 820 000 gravity point data values, both land and marine, in the area extending from 8° S to 48° S and 108° E to 162° E. The number of gravity stations added to the database in 1996 is relatively small; details of the changes in coverage listed by 1:1 000 000 map sheet are available, on request, from the address below. The usual $750 charge for the annual update has been waived for the 1996 edition which means that eligible customers (see below) may order the 1996 update free of charge.

The digital data are available from AGSO in two forms:

1. The complete database on SUN tar exabyte, CD-ROM or 9 track ASCII tape

   - New Purchase A$7 500, with optional updates for 5 years at reduced cost.

   - Update at no cost, available only to purchasers of 1991 to 1995 database and updates.

2. 1:1 000 000 sheet data sets (MS DOS format 3.5" or 5.25" DS-HD diskettes)

   - A$350 per sheet area (except for Tasmania - only available from Tasmania).

A 2.5 km gridded dataset is also available at A$2 500 - see separate brochure or find it on our web site.

Copies of these data may be obtained from:
Mr Duncan Souter Geophysical Mapping Section AGSO
GPO Box 378 CANBERRA ACT 2601 AUSTRALIA
Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986

For further information about the database contact: Ms Alice Murray
Telephone: (02) 6249 9264 E-mail: amurray@agso.gov.au
http://www.agso.gov.au/geophysics/gravimetry/

Release Date: 9 February 1997

http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Broken Hill Exploration Initiative

A National Geoscience Mapping Accord Project

Project Managers

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AGSO Staff

George Gibson	Full time; Structural geology & tectonics
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Matti Peljo	Part/time; Digital data management
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David Gibson	P/t; Regolith
Russel Shaw	P/t; Tectonics and geophysical modelling
Rod Page	P/t; Geochronology
Shen-su Sun	P/t; Geochemistry

NGMA Partners

Department of Primary Industries & Resources, South Australia
New South Wales Department of Mineral Resources

Co-operating Agencies

CRC LEME
(Colin Pain Ph 02 6249 9111)
CRC Australian Geodynamics
(Allen Nutman Ph 02 6249 3406)
Industry Participants
Universities

Objectives

- Establish a modern geoscientific framework for the Broken Hill-Olary crustal block in New South Wales and South Australia as a basis for more effective and efficient exploration by industry through the provision of high quality regional geological, geophysical, geochemical, metallogenic and geochronological data.
- Determine the structural, stratigraphic and tectonic relationships that controlled ore emplacement in the region, and provide regional metallogenic, solid geology and regolith interpretations based on field mapping, stable isotope studies and new high resolution airborne data.
- Determine the crustal structure of the Broken Hill- Olary block through deep seismic reflection profiling
- Compilation and release of Broken Hill geoscientific data in digital form for use by exploration industry

Completion Date: End 1998

Project Activities/Scope

- Acquisition and interpretation of high resolution airborne magnetic and radiometric data with a view to extrapolating known geology from outcrop below shallow cover
- Determine crustal structure and test existing structural/tectonic interpretations of Broken Hill region through deep seismic reflection profiling
- Determine the three-dimensional structural geometry, regional deformational history and tectonic framework of the Broken Hill-Olary block
- Provide high quality geochemical and geochronological data to constrain the age and character of various stratigraphic units/structural elements in the region
- Undertake regional study of metallogenesis in the Broken Hill-Olary block and evaluate controls on mineralisation in the light of the new structural/tectonic framework
- Integrate existing geological, geophysical, geochemical, and geochronological data sets for the Broken Hill-Olary region into a comprehensive GIS package for optimum use in exploration industry
- Undertake a rock properties study in conjunction with detailed structural mapping and geochronology to ascertain the age and origin of major aeromagnetic anomalies in the Broken Hill area. Both induced and remanent magnetism will be examined
- Expand detailed gravity coverage in the Broken Hill area in order to better constrain the distribution of structural elements and rock types at depth

Project Milestones/Highlights

- Broken Hill GIS package released on CD-ROM (includes geological, geophysical, geochemical, topographic and cultural features)
- Aeromagnetic data released at 1: 100 000 (Broken Hill) and 1:250 000 (Olary) scales
- Seismic data (180 km) released, and one -day workshop on their interpretation presented at May BHEI meeting
- New AGSO structural mapping combined with the seismic data demonstrate that the major structures and shear zones in the Broken Hill region dip southeast contrary to all previous expectations that they would dip northwest
- Significant late Proterozoic strike-slip component recognised on several retrograde shear zones, leading to re-evaluation of the structural history and late-stage Cu mineralisation in the Broken Hill area. Based on this structural re-evaluation, the line of lode is postulated to continue north of Stephens Creek. Effects of Delamerian orogeny in Broken Hill region more clearly drawn
- SHRIMP U-Pb zircon dating in collaboration with the Australian Geodynamics CRC has demonstrated that both granitic and mafic intrusives were important in the early history of the Broken Hill area
- Sampling for a complementary Ar- Ar dating program has been completed. The program is targetted at dating the metamorphic fabrics, shear zones and magnetic anomalies
- Rock properties study commenced in late July. Ground magnetometer and radiometric surveys and detailed structural analysis carried out in support of this sub-project completed in August/September
- Regional metallogenesis study commenced in September, focussing on Cu-Au mineralisation and alteration

Future Plans/Activities

- Complete U-Pb and Ar-Ar dating programs; results available by November 1998
- Metallogenic study of Broken Hill-Olary region in advanced stages; sampling, isotopic analyses, and mineral deposit database for Olary region completed by end of 1998
- Complete detailed structural analysis of key locations and present results in form of GIS package and geological cross-sections
- Conclude analytical component of rock properties study with a view to publishing results by end 1998
- Release CD-Rom incorporating new structural and geochronological data, geological cross-sections, seismic interpretation and results of rock properties study
- Expand and improve upon existing geochemical data base for Broken Hill through addition of new isotopic and chemical analysis obtained by latest techniques
- Release other map products - solid geology; 1:100 000 aeromagnetic interpretation

External Publications

Donaghy, A. G., Ehlers, K., Gibson, G.M., Maidment, D. W., Nutman, A.P. & Venn, C. J. (1997): Dating of multiple Proterozoic thermal events by SHRIMP U/Pb geochronology at Broken Hill, NSW, Australia. *Abstract V. M. Goldschmidt Conference Tuscon, Arizona.*

Gibson, D. L. (1996): Regolith-landform relationships from the Broken Hill area. *Regolith 96, Abstracts*, CRC LEME, p. 11.

Gibson, D. L. (1996): Cretaceous sediments, tectonics, and landscape evolution in the northern Barrier Ranges. *Regolith 96, Abstracts*, CRC LEME, p. 20.

Gibson, D. L. (1996): Regolith along the 1996 AGSO Broken Hill seismic transect. *Regolith 96, Abstracts*, CRC LEME, p. 21.

Gibson, G. M., Maidment, D. W., & Haren, R. (1997): Willyama Supergroup, Broken Hill, Australia: a 1600 Ma granulite terrane situated along the Neoprotereozoic margin of Gondwana following continental rifting and the breakup of Rodinia. *Terrane Dynamics '97*: 71-74. Christchurch, NZ.

Gibson, G. M., Maidment, D. W., & Haren, R. (1996): Shear-related deformation in the Willyama Supergroup and implications for mineral exploration in the Broken Hill-Olary regions. *Abstract Resources '96 Convention*: p. 63, Mines and Energy South Australia, Adelaide.

Gunn, P., Haren, R., Milligan, P., Mackey, T., Maidment, D. W., Murray, A. (in press) Geophysical mapping using the national airborne and gravity datasets: an example focussing on Broken Hill. *AGSO 50th Anniversary Publication.*

Haren, R., Gibson, G. M. and Jaques, L. (1997): The Broken Hill Exploration Initiative: a new geoscientific information base to support exploration. *Aust. Instn. Min. Metall. Publication Series* 1/97: 201-205.

Haren, R., Liu, S., Gibson, G. M., Maidment, D., and Gunn, P. (1997): Geological interpretation of high resolution airborne geophysical data in the Broken Hill region. *Exploration Geophys.* 28: 235-241.

Haren, R., Gibson, G. M., Maidment, D., Gunn, P. and Milligan, P. (1996): The geological and structural implications of fine scale airborne geophysical data acquisition over the Broken Hill/ Olary province, New South Wales and South Australia. *Geol. Soc. Aust. Abstracts* 41: p. 181.

Maidment, D.W., Brennan, T., Sedgmen, A., Wilford, J., Wyborn, L. (1996): Generating interpretive geological maps by integrating datasets within Arc/Info. *OZRI 10 Conference Proceedings,* Perth.

Wingate, T. D., Campbell, I. H., Compston, W., Gibson, G. M. (1997): Ion microprobe U-Pb ages for Neoproterozoic basaltic magmatism in south-central Australia and implications for the breakup of Rodinia.
Precambrian Research (in press).

Products

AGSO Records:
Abstracts, 1997 Broken Hill Exploration Initiative May Meeting. *AGSO Record* 1997/49, 46pp - **$50**

Maps:
1:25 000 Solid Geology Map (Lithological Interpretations)(refer to figure 1)
Mt Gipps, Stephens Creek - **$50 per map sheet**

Digital:
Broken Hill Geoscientific GIS on CD-ROM (includes geology, airborne geophysical data, geochemistry, topographic and cultural features, exploration tenements and much more) - **$1000.00 per CD**

Broken Hill Seismic Reflection Data
Available in digital form @ **$10 per km** (total data: 180 km). **Min. purchase 50 km**.

Magnetic & Gamma-ray Data
Broken Hill, Corona, Fowlers Gap, Mulyungarie, Redan, Taltingan, Thackeringa 1:100 000 sheet areas flown at mainly 100m line spacing (see figure 2)

digital data - point located

Unit	Price	
Line spacing	100m	200m
7½' X 7½'	**$2000**	**$1000**
1:25 000 sheet area	**$4000**	**$1500**
1:100 000 sheet	**$20 000**	

Eastern half of:
Mawarra, Yalcowinna - **$1000**
Glen Idol, Mundi Mundi Creek - **$1500**
Wahratta - **$2000**

- grids

Unit (Sheet area)	Price
1: 25 000 (15' X 7½')	**$1000**
1: 50 000	**$1500**
1:100 000	**$6000**

Glen Idol, Little Aller Creek
Mawarra, Mundi Mundi Creek,
Redan II (North & South), Redan III
South, Umberumberka, Yalcowinna - **$750**

Various Line maps as dyelines or transparencies from **$15 - $250 each**

Magnetic pixel maps

Broken Hill, Kalabity, Mulyungarie, Taltingan 1:100 000 sheets

Pseudocolour - **$300**; Greyscale - **$250**; Both - **$500**

Gamma-ray pixel maps

Broken Hill, Taltingan 1:100 000 sheets: pseudocolour - **$300**

Semi-detailed Line Spacing

Callabonna (S); Frome - 400m line spacing

1:100 000 sheet Digital data - point located: **$2080**; Grids (TMI or 4 -channel gamma-ray): **$500**

1:250 000 sheet - point located: **$10750**; Grids : **$2500**

Elevation Data

Detailed Line Spacing

Broken Hill, Corona, Fowlers Gap, Kalabity, Mulyungarie, Redan, Taltingan, Thackeringa 1:100 000 sheets flown mainly at 100m line spacing (see figure 2)

Point located and gridded data: **$500 per 1:100 000 sheet area**

Semi-detailed Line Spacing

Callabonna (S), Frome - 400m line spacing

Point and gridded data: **$1000 per 1:250 000 sheet area**

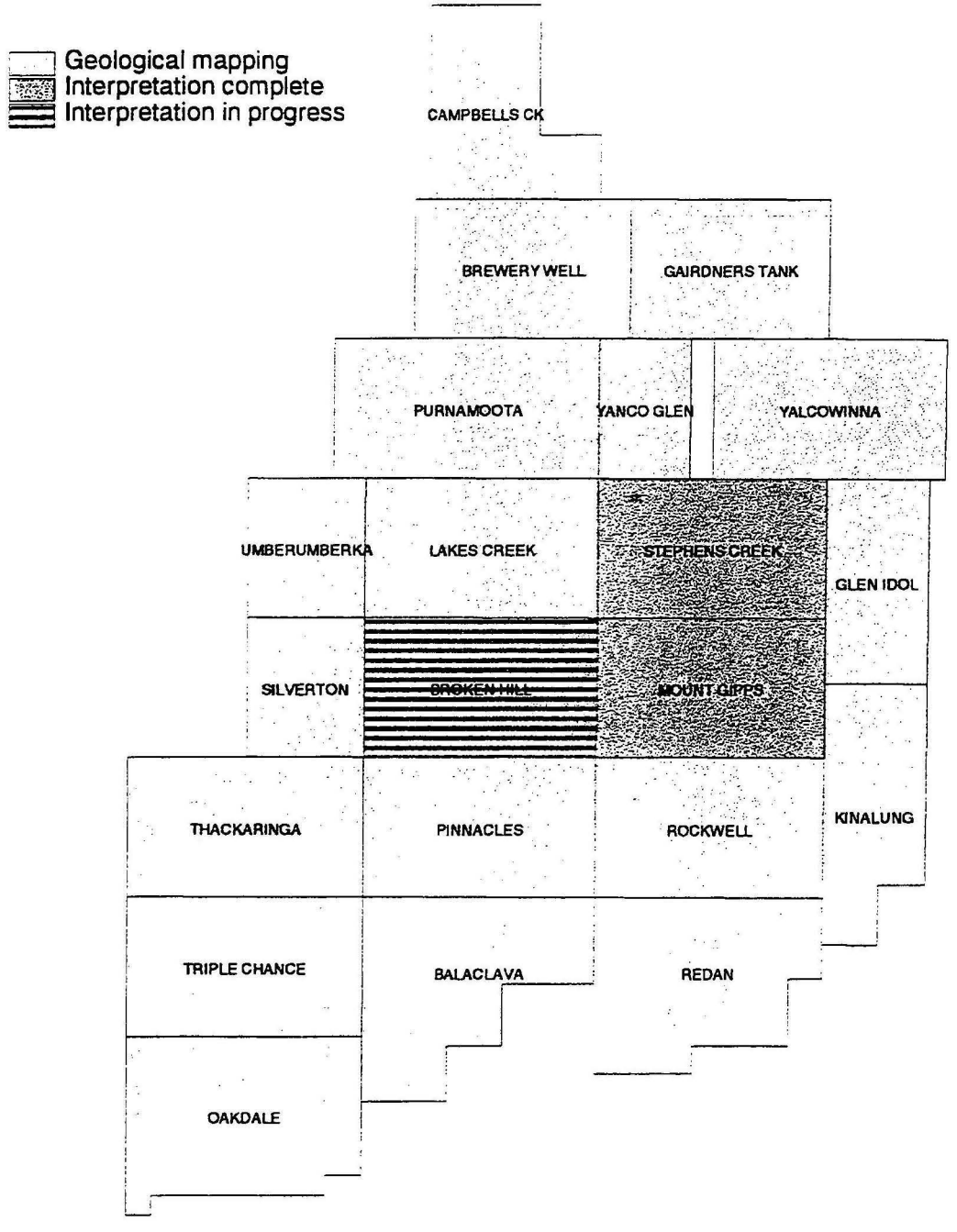

Figure 1: Availability of 1:25 000 solid geology (lithological interpretation) maps for Broken Hill Block. Map coverage from NSWDMR 1:25 000 geology

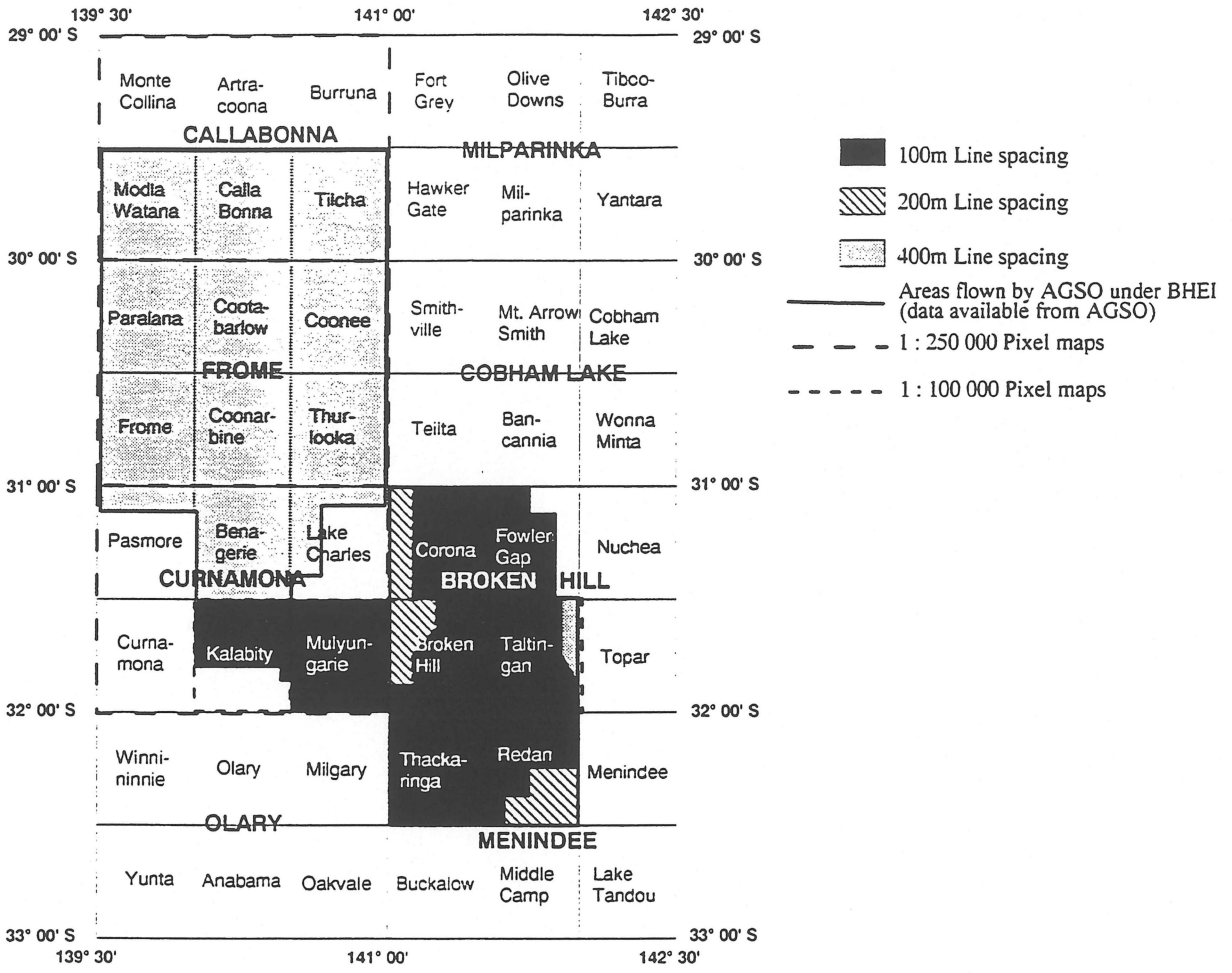

Figure 2 : Broken Hill - Olary map sheets for which airborne geophysical data are available

product

The Broken Hill Geoscientific Geographic Information System

The Broken Hill Geoscientific GIS is an integrated spatial database of geological, geophysical, geochemical and cultural data for mineral exploration and research. The area covered by the GIS comprises six 1:100 000 mapsheets, encompassing the outcropping portion of the Broken Hill and Euriowie Blocks; namely the Corona, Fowlers Gap, Broken Hill, Taltingan, Redan and Thackaringa mapsheets.

The GIS is available in ArcView or MapInfo format on CD-ROM incorporating a customised project file or workspace file (depending on format). Data access routines are included which display geochemical data, photographs with captions and N.S.W. Geological Survey report abstracts for tenements and drillholes.

The dataset features:

- 1:25 000 geological maps (21) and 1:100 000 stratigraphy.
- Two 1:25 000 lithological interpretations.
- Twenty-three thematic layers of selected lithologies, eg. amphibolite, Potosi gneiss, etc.
- Geophysical images (aeromagnetics, gravity and DEM).
- Geochemical (2 000+ samples) and petrological (8 200+ samples) databases.
- Geochemical images (copper, lead & zinc).
- Topographic and cultural data (eg. drainage, properties and topographic maps).
- Historical and current tenements.
- 3 500+ mineral occurrences.
- 1 400 drillholes and 260 water boreholes.
- 46 hotlinked outcrop photographs.

The cost of the CD-ROM GIS package, which includes a users manual, is $1 000 plus postage & packaging.

A version of the Broken Hill GIS incorporating high-resolution aeromagnetic data for one 1:25 000 sheet (Mount Gipps) is available for $1 200.

For further details contact:
AGSO Sales Centre
GPO Box 378 Canberra ACT 2601
Phone: (02) 6249 9519 / 9642
Fax: (02) 6249 9982

http://www.agso.gov.au/minerals/

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Delamerian Mineral Province

A New Project Proposal, Minerals Division, AGSO

Rationale

The Cambro-Ordovician Delamerian orogen, incorporating both the Adelaide and Kanmantoo fold belts and extending from Queensland through New South Wales and South Australia into Victoria and Tasmania and, ultimately into Antarctica (Ross orogen) and New Zealand, is host to several world class ore deposits (eg Cu-Zn-Pb in western Tasmania) and many smaller mineral occurrences (eg Cu in South Australia; Au in western Victoria). To date there have been few systematic studies of the orogen as whole. Rather, investigation has been piecemeal and directed towards specific regions and targets as determined by the political and exploration imperatives of the day. Yet the Delamerian orogen occurs on a scale comparable to the modern Andes and forms an important part of the globally-linked orogenic system widely known as the pan-African event. Like the Andes, the Delamerian orogen exhibits many features consistent with subduction and deformation at a convergent plate margin (voluminous granite magmatism; regional low P- high T metamorphism; craton-vergent fold and thrust belts; ?back arc extension) and as such should be prospective for an equally wide range of metalliferous deposits.

Objectives

- Determine the tectonic, structural, and magmatic evolution of the Delamerian orogen as a whole thereby providing an improved and more comprehensive geological framework for mineral exploration

- Compile and integrate the results of all current or recently completed NGMA projects (TASGO, BHEI) relevant to the Delamerian orogen into a single all-embracing geoscientific dataset, and undertake further detailed geological studies (geochronology, geochemical and metallogenic analysis) in less well known areas (eg Glenelg River complex) so that the available dataset is as comprehensive as possible

- Undertake deep seismic reflection studies to better understand crustal structure and the extent to which the major structural elements (shear zones, fault-bounded blocks, basement) continue beneath cover in areas of high mineral prospectivity but with little or no outcrop (eg Padthaway Ridge)

- Provide a new generation of digital geological data in priority areas and for the Delamerian fold belt as a whole

Scope

- Several NGMA projects impacting on our understanding of the Delamerian mineral province have just ended or are nearing completion (TASGO, BHEI; Lachlan). An opportunity exists to integrate the knowledge and expertise accrued to AGSO and the State Surveys from these earlier projects into a more comprehensive study of the Delamerian fold belt as whole, particularly if the project is carried out in collaboration with the AGCRC and other research centres (Centre for Seismic Studies).

- no single part of the orogen is likely to have all the necessary elements to allow a full and proper understanding of the metallogeny and tectonic evolution of the Delamerian orogen. This can only come from a thorough investigation of the orogen as a whole (Fig. 1).

- the relationship of one structural element to one another in the Delamerian orogen is often controversial and there is some doubt whether critical boundaries are structurally or stratigraphically controlled (eg boundary between Adelaide and Kanmantoo fold belts). Without more detailed knowledge of these relationships and the internal structure of the orogen, extrapolation of the known geology into areas beneath cover will be impaired.

- the degree to which strike-slip versus thrust faulting, or even extensional structures, have redistibuted the major structural elements/rock units. Comparisons with analogous but younger orogens such as the Andes and North American Cordilleras suggest strike-slip and extensional faulting should be more pervasively developed than is currently recognised with consequent implications for shear zone development, fluid flow, and mineralisation.

- the necessity of a west-east deep seismic profile across the orogen to delineate crustal structure, depth to basement, and the distribution of the major shear zones/structural elements.

- the need for structural studies combined with regional metallogenic mapping to better assess the extent to which particular rock types and/or structures have served as traps for mineralisation.

- lack of data on the age, geochemistry and tectonic setting of areas with potential for base-metal and Cu-Au mineralisation (eg Padthaway Ridge, Koonenberry area). AGSO's recognised expertise in geochronology and geochemistry combined with detailed knowledge of mineral potential in several adjacent mineral provinces (eg Cu-Au mineralisation in Olary-Broken Hill area) or other parts of the Delamerian orogen (eg through TASGO) will be important in this context as will be the local knowledge of the State Geological Surveys.

- in order that the project be completed within a reasonable time-frame, emphasis will be on the southern portion of the orogen (Fig. 1); the Queensland component of the Delamerian orogen will be investigated in collaboration with another AGSO project: CABGAS.

Co-operating Agencies

State Geological Surveys ?
Exploration Companies ?
Universities ?
CRC's and /or Special Research Centres ?

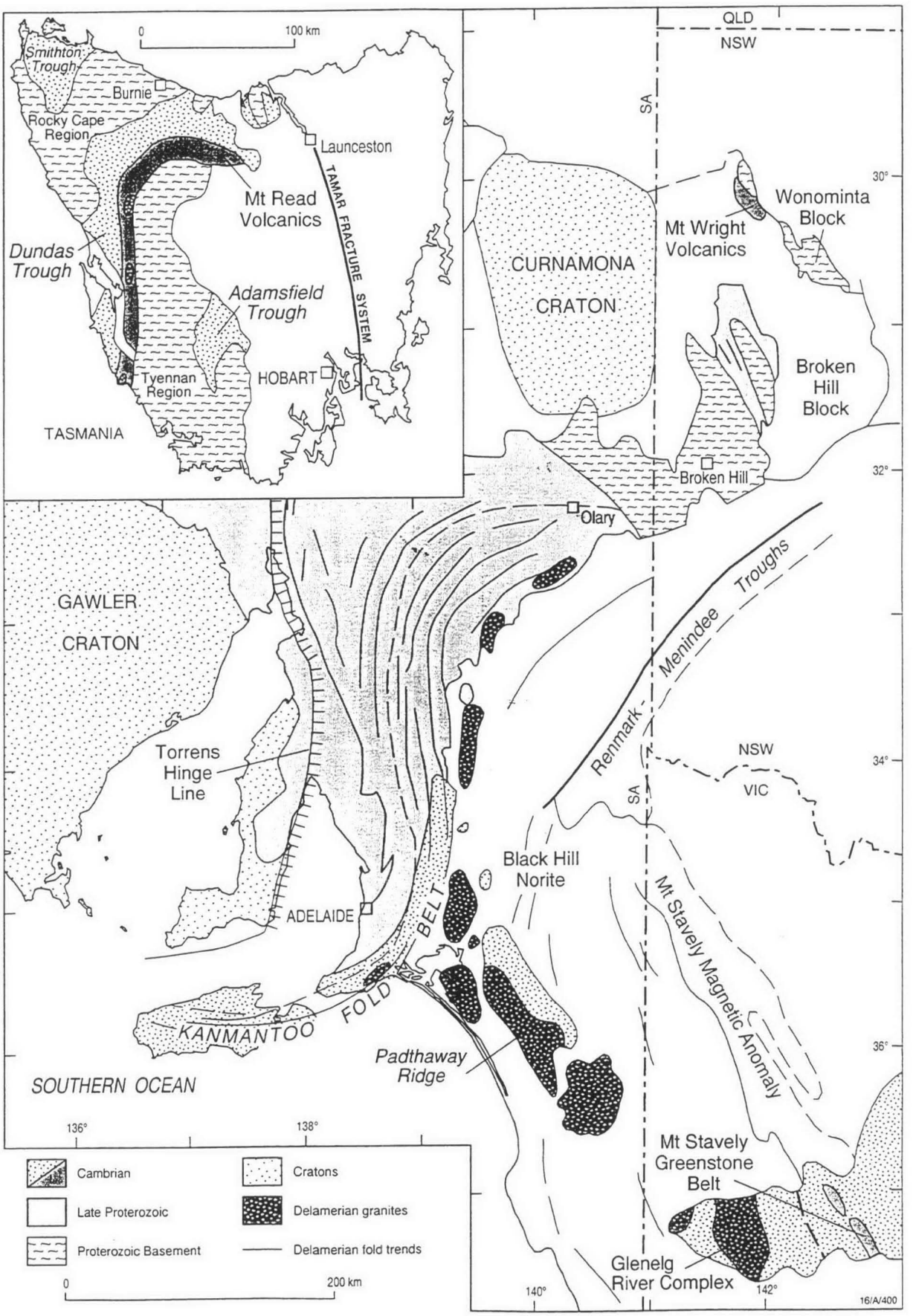

Figure 1 Distribution of major structural elements and rock units affected by the Cambro-Ordovician Delamerian orogeny

ANSIR

Australian National Seismic Imaging Resource
A Major National Research Facility

CAPABILITY STATEMENT

ANSIR is a joint venture of the Australian Geological Survey Organisation and the Research School of Earth Sciences at the Australian National University. It is Australia's first Major National Research Facility dedicated to the Earth sciences. ANSIR will

- create a centre of excellence in research and education in seismic imaging of the Earth;
- establish a pool of expertise and equipment capable of imaging the Earth at a range of scales, from continental to local;
- address research needs in the minerals and petroleum industries, and ground water, environmental and hazard questions;
- undertake global and exploration scale seismological research; and
- be available to researchers from all sectors, both within Australia and overseas, on the basis of merit.

OUR EXPERIENCE

AGSO has over 40 years' experience in seismic surveys, having imaged 28 sedimentary basins and several basement areas. Our staff have also worked in a number of overseas countries, including Africa, Myanmar, the Philippines and Papua New Guinea. AGSO has recorded 8,000 km of deep seismic reflection profiles onshore since 1980 and numerous 2D seismic refraction profiles, all imaging to below the Moho. The structures studied range from regional to ore body scale.

RSES has one of Australia's longest established and most prestigious seismological research groups, undertaking projects as diversified as regional and global tomography and practical and theoretical studies of seismic techniques relevant to the exploration industry.

Australia's network of onshore deep seismic reflection profiles

OUR PEOPLE

ANSIR staff have expertise in all aspects of seismic research.

- They can design surveys for both sedimentary basins and hard rock mineral provinces, and collect, process and interpret the data.
- They can advise on the best technique for the problem at hand (2D & 3D reflection, refraction, tomography; vibratory, explosive or earthquake energy sources).
- They can work at all geological scales, from the lithosphere to the regolith.
- They have considerable experience in negotiating land access in all states and territories.
- They work in accordance with modern environmental practice that minimises disruption and encourages natural regeneration.

OUR FACILITIES

ANSIR has begun operations with equipment currently available through AGSO, and is rapidly moving to replace it with bigger, more flexible state-of-the art systems. Its final configuration is likely to include:

- seismic reflection systems suitable for both regional scale studies and ultra high resolution groundwater, environmental and hazard studies;
- vibratory energy sources, some both P-wave and S-wave capable;
- drilling capacity for preparing explosive energy charges;
- up to 50 low power, 4-channel, portable seismographs for use in 2D and 3D tomography experiments, and for augmenting the number of channels on the regional scale seismic reflection equipment; and
- up to 15 broad band portable seismographs.

Accessing ANSIR:

For more information about ANSIR's Capabilities, how ANSIR can link into your research needs, or for information about any of our research projects, please contact:

Dr Barry Drummond - ANSIR Director
(tel +61 2 6249 9381; drummond@agso.gov.au) or
Mr Kevin Wake-Dyster - ANSIR Operations Manager
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Research School of Earth Sciences
Australian National University
Canberra 0200 ACT AUSTRALIA

November, 1997

Australian Mineral Systems

A National Geoscience Mapping Accord Project

Project Manager

Lesley Wyborn 02-62477467 (Phone) 02-62499971 (Fax) lwyborn@agso.gov.au

Cooperating Agencies

All State and Territory Surveys
CRCLEME
AGCRC
Various Industry Participants
CSIRO
Most Australian Universities

Objectives

To determine the regional controls on the distribution of Australian mineral resources through space and time.

Overview

The Australian Mineral Systems Project is one of the larger projects in the Minerals Division. It is essentially an overview project, all elements of which are focused on better understanding Australian Mineral Systems on a national scale. Not only is the project involved in primary research on mineral systems to better define their critical ingredients on a district to regional scale, the project is also focussed on developing continent-wide digital data sets and databases to search for the key expressions and mappable criteria (geophysical, geological, geochemical) of these various mineral systems. The project also compiles major databases and digital data sets to store primary information on aspects of geological aspects pertinent to minerals exploration.

To facilitate integration the work program is subdivided into 8 Subprojects which fall into 3 major groupings:

Group A: Developing National-scale digital databases and data sets to facilitate continent-wide metallogenic analysis

GIS Development Subproject	Manager: Ollie Raymond
National Digital Data Sets Subproject	Manager: Bruce Kilgour
National Minerals Database Subproject	Manager: Murray Hazell
Geological Units Subproject	Manager: Cathy Brown

Group B: Developing digital regional scale models of major Australian Mineral Systems

Delineating Australian Mineral Systems Subproject	Manager: Terry Mernagh
External Projects Subproject	Manager: Lesley Wyborn

Group C: Developing first class research capabilities for analysing whole rock and fluid inclusions

Economic Geology laboratories	Manager: Terry Mernagh
Whole Rock Geochemistry labs	Manager: John Pyke

Each subproject in Groups A and B will be described separately: Information on Group C Subprojects are elsewhere in this document.

GIS standards and technique development

Subproject Manager

Ollie Raymond 02 62499575 (Phone) 02 62499983 (fax) oraymond@agso.gov.au

AGSO Subproject Staff

Dmitar Butrovski	Divisional Data Administrator (SIMS)
Geoff Lawford	AGSO Corporate QA/QC Officer
Murray Hazell	Links from ORACLE to GIS
Laigee Bell	Links from ORACLE to GIS
Danny Haipola	Lachlan Project Data Officer
Bruce Kilgour	Australian Mineral Systems Project Data Officer
Matti Peljo	Broken Hill Project Data Officer
Mitch Ratajkoski	Pilbara Project Data Officer
Aaron Sedgeman	Eastern Goldfields Project Data Officer
Penny Ursem	CRCLEME Project Data Officer
John Wilford	Expert Systems
Lesley Wyborn	General GIS developments and standards
Irina Bastrakova	General GIS developments
Anthony Budd	General GIS developments

Cooperating Agencies

All State and Territory Surveys
CRCLEME
AGCRC
Various Industry Participants

Objectives

To coordinate all corporate aspects of GIS development and standards within the Minerals Division.

Overview

This subproject aims to integrate and standardise all GIS development within the Minerals Division. The subproject, in collaboration with the Spatial Information Mapping Services (SIMS) Group of AGSO, is responsible for developing digital data standards and ensuring that corporate digital data standards are adhered to. The project is constantly refining techniques for linking information held within the ORACLE database systems with digital map data. In the past this subproject has done much of the experimental GIS development and was responsible for the Mount Isa and Pine Creek Metallogenic 1:500 000 GIS packages and the Mount Isa 1:100 000 and Tanami 1:250 000 digital maps data sets.

Recent Project Highlights

- Appointment of a corporate data quality control/quality assurance officer in SIMS.
- Appointment of a divisional project data administrator.
- Appointment of a project data officer responsible for data development and GIS standards and developments in each project.
- Development of quality control/quality assurance procedures with SIMS

Future Plans

- Finalisation of the Minerals GIS Data Dictionary which will standardise all names and fields for those data sets that are specific to the Minerals Division and develop procedures for regularly updating it.
- Develop integrated techniques for displaying data from measured sections and drill holes stored in the SECTHOLES database within GIS.
- Developing an expert systems approach to integrating and modelling geoscientific data for geological/regolith mapping and prospectivity assessment.

Products

Note: All are available in either ARC/INFO(ARCVIEW) or MAPINFO formats. The GIS packages are multilayered, and all layers can be fully integrated with one another. The digital data sets are single layer digital map products which can be joined to form a single coverage and a common legend has been developed for each data set.

A) Digital Data

Product	*Components*	*Price*
Mount Isa Inlier 1:500 000 GIS	geology, solid geology, metamorphism, tectonic subdivisions, whole-rock geochemistry, regional magnetics and gravity	$4000.00
Pine Creek Inlier 1:500 000 GIS	geology, solid geology, metamorphism, tectonic subdivisions, whole-rock geochemistry, Landsat TM scene, regional magnetics and gravity	$4000.00
Granites-Tanami 1:250 000 Digital Geological Maps	A digital compilation of 15 1:250 000 geological maps as a seamless coverage with a common legend. Individual maps can also be purchased separately	$350per sheet, $4500 for full data set
Mount Isa digital geological maps	Digital versions of the 32 full or part sheet areas that cover the Mount Isa Inlier. Most were captured at 1:100 000 scale, the remainder at 1:250 000. A common legend was developed for all map sheets to facilitate joining as a seamless coverage	$500 full sheet $350 part sheet $9500 for full data set

B) Atlases, Records

Mount Isa Metallogenic Atlases: An A3 three volume set on Geology, Geophysis, Geochemistry	$600.00
Pine Creek Inlier Metallogenic Atlases: An A3 three volume set on Geology, Geophysis, Geochemistry	$980.00
Proceedings of the Second National Forum on GIS in the Geosciences AGSO Record 1995/46	$40.00
Proceedings of the Third National Forum on GIS in the Geosciences AGSO Record 1997/36	$25.00

Publications

Hazell, M., and Wyborn, L.A.I., 1995. The rigorous steps required in data capture for creating a useable GIS and the need for national data standards. Proceedings of the *Third National Conference and Trade Exhibition on the Management of Geoscience Information and Data, Adelaide, 1995, Australian Mineral Foundation, Glenside, South Australia,* 22.1-22.10.

Knox-Robinson, C.M. and Wyborn, L.A.I., 1997. Towards a holistic exploration strategy: using Geographic Information Systems (GIS) as a tool to enhance exploration. *Australian Journal of Earth Sciences,* 44, 453-463.

Maidment, D., Brennan, T., Sedgmen, A., Wilford, J., and Wyborn, L.A.I., 1996. Generating interpretative geological maps by integrating data sets within ARC/INFO. *OZRI annual proceedings.*

Pigram, C., Wyborn, L., Hazell, M., Stirzaker, J., Borissova, I., Bleys, E., Raymond, O., and Parvey, C., 1997. GIS initiatives in AGSO. Proceedings of the 3rd National Forum on GIS in the Geosciences. *Australian Geological Survey Organisation, Record,* 1997/36, 60-68.

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Wyborn, L.A.I., Gallagher, R., and Raymond, O.L., 1995b. Creating mineral province GIS packages - issues, problems, solutions, and opportunities. *Proceedings of the Second National Forum on GIS in the Geosciences, Australian Geological Survey Organisation, Record, 1995/46,* 199-211.

Wyborn, L.A.I., Jagodzinski, E.A., and Ratajkoski, M. 1995c. The Pine Creek Metallogenic GIS - Turning 45 Years of Geoscientific Paper Products into a more accessible and applicable digital package. *Proceedings of the Second North Australian Remote Sensing Geographic Information Systems Forum,* Darwin 18-20 July, Australia, 1995. Office of the Supervising Scientist and the Australasian Urban and Regional Information Systems Association, Incorporated, Monograph 11, 128-135.

Wyborn, L.A.I., Hazell, M.S., Brooke, G., and Gallagher, J., 1996a. Successful Implementation of GIS in Mineral Exploration. In: Mapping for Management, *Technical papers of the Mapping Sciences Conference of the Mapping Sciences Institute of Australia,* pp 259-269.

Wyborn, L.A.I., Gallagher, R., Goleby, B.R., and Kilgour, B., 1996b. Metallogenic applications of 3D GIS in Mount Isa. *Abstracts for the MIC'96 Conference, Townsville, April 1996,* 153-156.

Wyborn, L.A.I., Goleby, B.R., Drummond, B.D., and Gallagher, R., 1996c. A 2.5-D Metallogenic GIS analysis of the Mount Isa Inlier. *AGSO Research Newsletter,* 24, 10-12.

Wyborn, L.A.I., Hazell, M.S., Brooke, G., and Gallagher, J., 1996d. Fully utilising GIS in exploration. Innovations in Exploration Techniques and Technologies Conference, Perth, May 1996.

Australian National Digital Data Sets

Subproject Manager

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AGSO Project Staff

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Lesley Wyborn	National Digital Data Sets
Mart Idnurm	Australian Proterozoic Palaeomagnetic Data set
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Tony Yeates	1:5 000 000 Geological Map
Russell Shaw	1:5 000 000 Geological Map
Greg Ewesr	1:5 000 000, 1:10 000 000 Mineral Deposits Maps
Terry Brennan	1:5 000 000, 1:10 000 000 Mineral Deposits Maps
Vera Ashby	1:5 000 000, 1:10 000 000 Mineral Deposits Maps

Cooperating Agencies

All State and Territory Surveys

Objectives

To provide primary national scale digital data sets (mainly digital maps) of relevance to resource issues for industry, government and the general public.

Overview

This subproject has been set up recently to bring together all national scale digital data sets AGSO-wide. To date 32 digital data sets have been compiled using a common coastline, projection and central meridian (Table 1). The data sets are to be used for national-scale GIS analysis and a WWW version is planned where clients external to AGSO will be able to do their own data integration and then download the resultant digital data or else make a printed map (which will then be posted to the client). Version 1.0 of the digital data sets will be released on CD in 1998. It is intended that the digital data sets will become an 'active archive' and will be updated on a regular basis. In particular, as an AGSO project is finished all data collected by the project will be stored within either the existing national data sets or ones that are compatible with them. As the focus is on producing high quality digital data sets, any cartographic (hard copy) versions that are produced from these data will be made from separate digital coverages that are derived from the primary data set. These digital cartographic versions will be maintained separately from the associated primary data set. It is only intended to produce a limited number of the national data sets as hard copy maps, primarily as print-on-demand maps. For some themes, *e.g.*, Mineral Deposits of Australia a set of hard copy A3 atlases will be produced.

Recent Project Highlights

- Most of the preliminary digital data sets are available as GIF images on the WWW.
- The new 1:5 000 000 Geological Map of Australia has been compiled and has now reached the cartographic edit stage.
- In collaboration of the State and Territory Geological Surveys the Geological Provinces Map has been revised. AGSO Bulletin 181 (Geology of Australia) has been captured as searchable attributes attached to this map.
- The 1983 Metamorphic Map of Australia digitally captured and limited upgrading undertaken.

- Agreement has been reached with the Minerals Council of Australia to jointly produce a lithoprinted 1:5 million scale wall map of Australia's mineral deposits and a simplified 1:10 million scale version.
- Further additions to and refinement of the palaeomagnetic Australian Apparent Polar Wander Path to better define the path for the period 1800-1600 Ma.
- Release of the digital version of the Crustal Elements Map at 1:5 000 000 which delineates upper-crustal elements primarily based on geophysical domains.

Future Plans

- Continue development of national digital standards to ensure that new information gathered by geoscience groups in Australia can be readily incorporated into the existing digital data sets.
- Release of a limited number of maps as 'Print on demand' or as PostScript files.
- Continue to develop WWW access to include on-line analysis capability and print-on-demand facility.
- Production of OZMIN atlas primarily looking at deposit/host relationships
- Spatial analysis of the data sets to further enhance our knowledge of the regional to national controls on the distribution of Australian mineral deposits (e.g., attributing the geological coverage to highlight reactive rock and mineral occurrences and then relating the distribution of these anomalous rocks to mineral deposits types).
- Using GRID to rasterise the geochemistry coverage and analyse the relationship between regional scale geochemical anomalies and particular deposit styles.
- Integrating images with point data deposit types etc
- Refinement of the Australian Mesoproterozoic palaeomagnetic data set.

Products

Name		***Price***
1:5 000 000 Crustal Elements Map		
	Hard Copy Map plus 'A guide to using the Crustal Elements Map'	$90.00
	Hard Copy Map only	$15.00
	Digital Version in Microstation .dgn file	$250.00
	Digital Version in ARC/INFO format	$400.00
A CD of Australian National Digital Data Sets (to be released in 1998)		POA
1:5 000 000 Geological Map of Australia (to be released in 1998)		POA
1:5 000 000 Mineral Deposit Map of Australia (to be released in 1998)		POA

TABLE 1: LIST OF NATIONAL DIGITAL DATA SETS (as at 6.11.1997)

Images

- Magnetic image
- Gravity image
- Digital Terrain Model AUSLIG
- Depth to basement image
- Image of estimated crustal temperatures at 5km

Vector data sets

- Well data locations used to generate image of estimated crustal temperatures at 5km
- Specifications and coordinates of AGSO Airborne Surveys
- Geological regions of Australia based on AGSO Bulletin 181
  Crustal elements map
- Metamorphic Map of Australia
- Regolith Map of Australia
  Australian Geological Map
- Palaeomagnetic APWP + latitudinal positions
- ROCKCHEM
  OZCHRON
- OZMIN
  OZROXS
- RTMAP
- AGSO Onshore Deep Seismic lines
- Selected Onshore AGSO Seismic Sections
- AGSO Offshore seismic Lines
- Basins of Australia
- Earthquake risk
- Epicentres
- Australian Geomagnetic Reference Field
- Hydrogeological map of Australia
- Index of ages of AGSO geological maps
  Index of AGSO publications from GEODEX
  1:1m Coastline
  1:1 000 000 map sheet index of Australia
- 1:250 000 map sheet index of Australia
- 1:100 000 map sheet index of Australia

- Currently available on the WWW as a GIF file - see http://www.agso.gov.au/

National Minerals Databases Subproject

Subproject Manager

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AGSO Subproject staff

Laigee Bell	Development	
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Rod Ryburn	Development	
Lesley Wyborn	General Integration	
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Evgeniy Bastrakov	OZMIN	
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Sue Edgecombe	OZCHRON	(Custodian)
Lara Sedgeman	OZCHRON	
Richard Blewett	OZROX	(Custodian)
Morrie Duggan	MINERALS	(Custodian)
David Champion	PETROG	(Custodian)
Anthony Budd	ROCKCHEM	(Custodian)
Bruce Kilgour	ROCKCHEM	
Penny Ursem	RTMAP	(Custodian)
Julie Kamprad	PIMA, XRD	(Custodian)
Terry Mernagh	LASER RAMAN	(Custodian)

Cooperating Agencies

All State and Territory Surveys
CRCLEME
Various Industry Participants

Objectives

To develop and maintain the highest quality national scale primary and derivative digital databases of relevance to Australian mineral resource analysis.

Overview

This subproject is responsible for the development and maintenance of all databases relevant to the Minerals Division and in turn to the Minerals Exploration Industry. All databases are developed using the ORACLE relational database management system and all are interrelated (Figure 1). The use of authority tables is maximised and free text fields are minimised. Each attribute is carefully defined so that where possible it contains only one item type. Critical to the databases is spatial accuracy to ensure relocation of any observation point or section by any client. The databases are integrated wherever possible to ensure accuracy of data by setting up systems which ensure, that where possible the data are validated during entry. Although developed as part of the previous Regional Geology and Minerals Division to store information on rock types, geochemistry, geochronology, regolith and mineral deposits, this subproject is now actively exploring corporate and possibly departmental links. The ultimate aim is to achieve rationalisation across AGSO (if not DPIE) to ensure that each data type is entered only once and its currency is maintained by those designated as the primary custodian: other users of this data will then use the relational database model to port the data to their own data structure. The other primary consideration in database development is the concept of the corporate database system as the 'active archive' in that all AGSO projects as they capture primary field and laboratory data will

store it within the corporate data system and then export the required data to their own project-based systems. Any updates to data will be made in the corporate, rather than the project-based systems. Data releases will be made from the corporate data system, in recognised standard formats, via corporate quality control/quality assurance systems.

Recent Subproject Highlights

- The development of the Newton FieldPad for capturing field observations digitally. New developments include the ability to store raster images including magnetics, orthophoto or satellite imagery. This development was done in partnership with Resource Industries of Australia, Melbourne.
- Development of an ACCESS version of the OZROX database to facilitate automatic downloading of data from the Newton Field Pads onto laptops in the field. These data can be readily downloaded into the corporate ORACLE database housed in Canberra, allowing immediate capture of the field observations. As transcription errors are now eliminated, a far higher level of data accuracy is automatically achieved.
- The release of OZMIN2, which contains a compilation of ~ 950 major mineral deposits of over 50 commodities. The attributes cover deposit and host rock characteristics and depositional environment. In version 2 further deposits have been added to the data set and the attributes expanded. The database is GIS compatible. An ACCESS version of OZMIN has also been developed.
- The combining of the AGSO codes for the OZROX database for minerals, rock types, province names with the codes used by Terra Search of Townsville for their EXPLORER3 data set. These codes will be placed on the WWW for public access.
- The commencement of conversions of existing ORACLE forms into more user friendly ORACLE Forms 4.5.
- The release of ROCKCHEM3 which includes over 4000 new analyses. Highlights of this release include a suite of unmineralised sediments from the vicinity of the Century deposit, a suite of breccias from the Olympic Dam deposit and the data from the bottom hole samples taken from the shot holes of the Eastern Goldfields Seismic line.

Future Plans

- The revision of the ROCKCHEM database to store primary metadata on how each individual analysis was derived. The new database will be called OZCHEM and will combine into the one database all data currently housed in ROCKCHEM and STREAMCHEM.
- In collaboration with CRCLEME, upgrade the regolith database, RTMAP, and develop a Newton FieldPad equivalent for direct storing of field observation data.
- Complete development of an ACCESS version of RTMAP for downloading of data from the Newton FieldPad or for direct entering of field descriptions via the keyboard.
- The entering of all outstanding AGSO raw SHRIMP data into the OZCHRON database.
- The commencement of a new OZCHRON database structure which will facilitate the derivation of province-wide and continent-wide ages from the original data on individual ages in an 'audit-trail style' of database. The new OZCHRON database is to be a fully integrated information system which will have links to the Stratigraphic Index and also to the STRATDAT database of the Petroleum and Marine Division.
- Store within OZCHRON digital photos of analysed zircons and link the individual ion beam spot analyses to each age result via a mini "GIS".
- Upgrade the PETROG Thin Section description database to include photomicrographs and begin populating the database with descriptions of all rocks sampled for geochronology.
- Begin storing field sketches and photographs digitally within the OZROX field database.
- Development of a spectral database for storing PIMA and Laser Raman results.

- Development of a fluid chemistry and stable isotope database, which will be linked to OZMIN.

Products

A) Databases

Database	Description	Price
OZMIN Version 2	A compilation of commodity, resource and geological information for ~950 of Australia's largest mineral deposits.	$3000
OZCHRON Version 2	A compilation of geochronological information generated over more than 30 years from AGSO's field work and from literature. Includes over 400 SHRIMP, over 350 Sm Nd, 395 Sm Nd and 135 U Pb conventional ages.	POA
ROCKCHEM	A database of over 45 000 whole rock chemistry analyses, of which approximately 30 000 are available for purchase.	POA

B) Database Documentation

Product	*Price*
Ewers, G.R., and Ryburn, R.J., 1997. OZMIN Documentation. *Australian Geological Survey Organisation, Record,* 1944/43.	$25.00
Hazell, M., Kilgour, B., Wyborn, L.A.I., Sheraton, J.W., and Ryburn, 1995. ROCKCHEM data set Version 2 Documentation. *Australian Geological Survey Organisation, Record,* 1995/26.	$25.00
Page, R.W., Black, L.P., Sun, S-S, Wyborn, L.A.I., Kilgour, B., Hazell, M.S., and Ryburn, R.J., 1996.. OZCHRON2 Documentation. *Australian Geological Survey Organisation, Record*, 1996/6.	$25.00

C) Users Guides

Product	*Price*
Blewett, R.S., 1993a. The AGSO field geological note books a users' guide. *Australian Geological Survey Organisation, Record*, 1993/46	$10.00
Blewett, R.S, 1993b. The AGSO field geological note books recording system (set includes a record, 10 notebooks, 1 disk, 1 set of crib cards), *Australian Geological Survey Organisation, Record*, 1993/46	$50.00
Blewett. R.S., 1993c. The AGSO field geological recording system - record and 10 notebooks	$25.00
Blewett. R.S., 1993d The AGSO field geological recording system - cribcards	$9.00.
Blewett. R.S., 1993e The AGSO field geological recording system - disk only	$2.50
Ewers, G.R., and Ryburn, R.J., 1993. Users' guide to the OZMIN Mineral Deposits	$20.00

Database. *Australian Geological Survey Organisation, Record*, 1993/94.

Hazell, M.S., Lenz, S.L., and Ryburn, R.J., 1995. Users' guide to RTMAP Regolith Landform Mapping Database. *Australian Geological Survey Organisation, Record*, 1995/22. $28.00

Pain,C., Chan, R., Craig,, M., Hazell, M.S., Kamprad, J., and Wilford, J., 1991. RTMAP BMR Regolith Database Field Handbook. *Australian Geological Survey Organisation, Record*, 1991/29. $20.00

Ryburn, R.J., Page, R.W., and Richards, J.R., 1993. Users' Guide to the OZCHRON Database of Australian Geochronology. *Australian Geological Survey Organisation, Record*, 1993/11. $35.00

Ryburn, R.J., Blewett, R.S., Stuart-Smith, P.G., and Williams, P.R, 1993. Users' guide to the NGMA field Database. *Australian Geological Survey Organisation, Record*, 1993/49. $13.00

Ryburn, R.J., Knutson, J, Duggan, M.B., Bond, L.D., and Hazell, M.S., 1994. Users' guide to PETROG: AGSO's Petrography Database. *Australian Geological Survey Organisation, Record*, 1994/36. $15.00

Ryburn, R.J., Bond, L.D., and Hazell, M.S., *in press*. Guide to OZROX AGSO's field geology database. *Australian Geological Survey Organisation, Record*. POA

Publications

Blewett, R.S., and Hazell, M.S., 1996. Digital on-site capture using an Apple Newton palmtop computer. *Geological Society of Australia, Abstracts*, No. 41, 45.

Blewett, R.S. and Hazell, M., 1997. User's guide to MapPad and AGSO FieldPad for the Apple Newton Palmtop Computer. *Australian Geological Survey Organisation, Record*, 1997/10.

Hazell, M. and Blewett, R., 1997. Accurate and efficient capturing of field data for integration into a GIS - a digital field notepad system. Third National Forum on GIS in the Geosciences Canberra, March 1997. *Australian Geological Survey Organisation, Record*, 1997/36, 90-97.

Hazell, M.S., and Wyborn, L.A.I., 1996. Without structured, clean, validated databases your GIS is just a car without wheels. 13th Annual Geological Convention, Canberra, February, 1996, *Geological Society of Australia, Abstracts*, No. 41, 187.

Hazell, M.S., Peljo, M., and Wyborn, L.A.I., 1996a. So your GIS tells you that your GPS sites aren't where you thought they were ? 13th Annual Geological Convention, Canberra, February, 1996. *Geological Society of Australia, Abstracts*, No. 41, 186.

Hazell, M., Blewett, R. and Bailey, J., 1996b. If only Newton had had AGSO's FieldPad. *AGSO Research Newsletter*, 25, 3-5.

Ryburn, R.J., 1996. Sorry mate, your spreadsheet is not up to it. *Geological Society of Australia, Abstracts*, No. 41, 373.

Ryburn, R.J., 1997. Project versus corporate information and the electronic publication dilemma. Third National Forum on GIS in the Geosciences Canberra, March 1997. *Australian Geological Survey Organisation, Record*, 1997/36, 69-76.

AGSO's GEOLOGICAL DATABASE SYSTEM

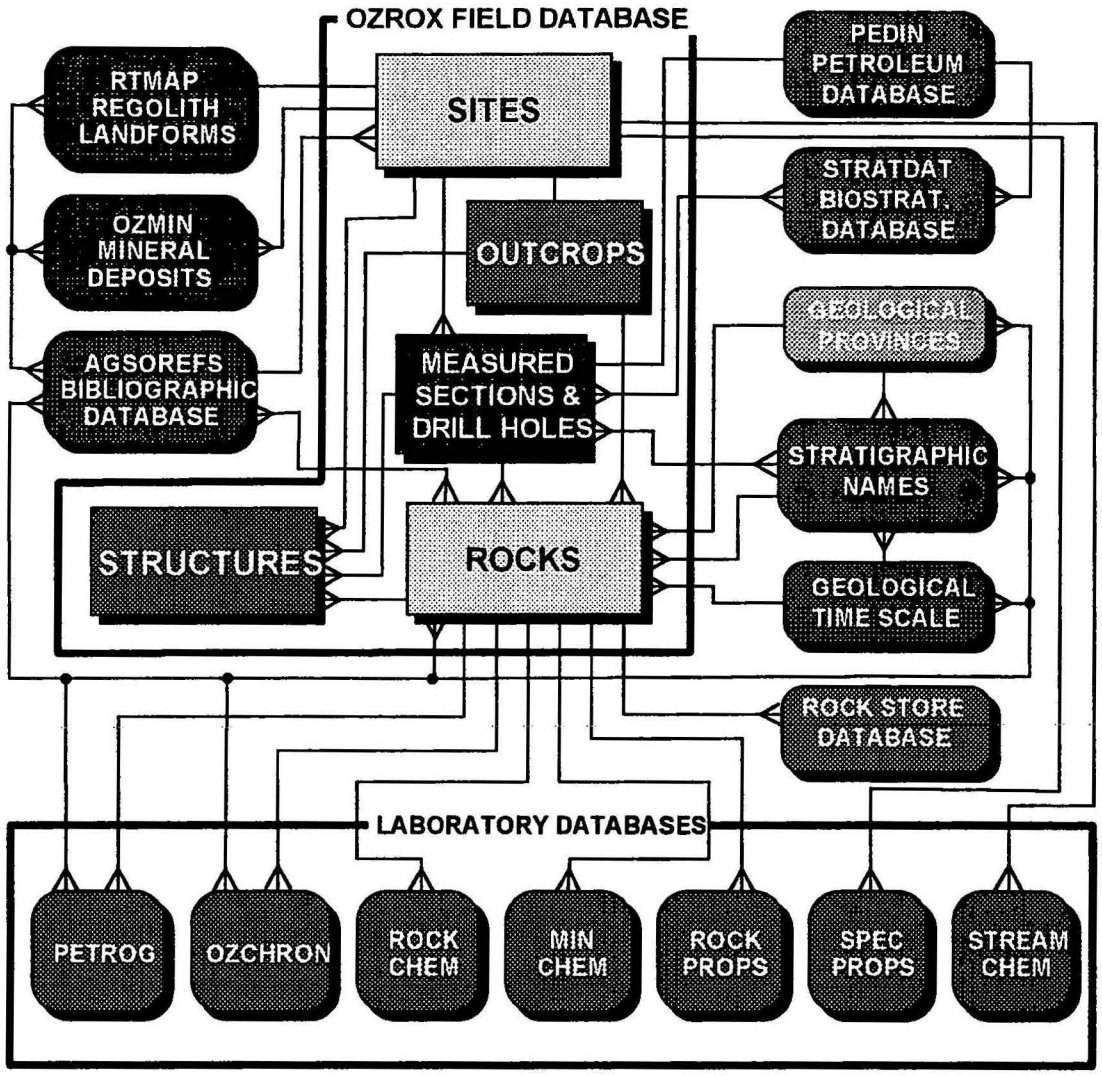

Figure 1. AGSO's interlinked field and laboratory database system

Geological Units Database

(Including the Australian Stratigraphic Names Register)

Subproject Manager

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AGSO Subproject staff

Albert Brakel	National Convener for the Stratigraphic Names Committee
Saskia Becher	References and Data entry
Sonja Lenz	Database design and development

Cooperating Agencies

All State and Territory Surveys
Various Industry Participants

Objectives

To provide the primary national standard for geological names in Australia and to improve the efficiency and effectiveness of communication of geological unit information.

Overview

AGSO is increasingly being recognised as the custodian of geological names data including stratigraphic units and province names. The most important database is the Stratigraphic Index of Australia (STRATINDEX), which was started in 1949 and provides a unique coding for all formally registered geological units in Australia. For many digital databases and digital geological maps it can act as an authority table with the potential to automatically provide information on the related parentage, age and province. The STRATINDEX also stores information on published references to these units and is the repository for definition descriptions. In order to ensure that all geological units on Australian maps and publications can be uniquely coded, the STRATINDEX will soon be modified to store information on granite suites and unnamed units. The STRATINDEX is not yet perfect; much information is still only stored on cards and has yet to be translated into the digital database. The digital data is freely accessible through the Services button on AGSO's WWW pages (http://www.agso.gov.au/). Suggestions for improvements are welcomed.

Recent Project Highlights

- WWW inquiries now averaging more than 17 per day
- Total number of stratigraphic names in database exceeds 30 000
- Total number of bibliographic references in database exceeds 24 000
- A regular column has been established in 'The Australian Geologist' to provide a discussion focus on the latest developments.
- 20% of the pre-1969 bibliographic references are now digital.

Future Plans

- To expand WWW access as a means of education and online access for geoscientists and the general public.
- To make use of the database easier by updating existing forms to graphical user interface (GUI) forms
- To develop a database table for definition cards and enter all unit definitions into it.

- In collaboration with the State and Territory Geological Surveys, to revise the Stratigraphic Guidelines, in particular, nomenclature on igneous suites and sequence stratigraphy
- To investigate direct links with the OZCHRON data base, to provide automatic entry of the latest age information into STRATINDEX.

Products

Product	*Price*
Stratigraphic names information is available as:	
A State-wide compilation listing all names in any given State (including those that are current, informal, superseded, misspelt and obsolete)	$50 per state
An Australia wide listing of all current names	$50.00
Lenz, S.L., Brown, C.E., Bond, L.D., Ryburn, R.J., 1996. Guide to the Australian Stratigraphic Names Database, *Australian Geological Survey Organisation, Record*, 1996/16.	$20.00

Publications

Brown, C.E., and Lenz, S.L., 1996. The Stratigraphic Names Database - Coming of age! *Geological Society of Australia, Abstracts*, No. 41, 62

Brown, C.E., Lenz, S.L., 1996. The Stratigraphic Names Database - Where to from here? *Geological Society of Australia, Abstracts*, No. 41, 63

Brown, C., Wyborn, L., and Hazell, M., 1997. The stratigraphic Index of Australia: is it a national treasure or a dinosaur. Proceedings of the 3rd National Forum on GIS in the Geosciences, *Australian Geological Survey Organisation, Record*, 1997/36, 60-68.

Ryburn, R.J., Lenz, S.L., Brown, C.E., Bond, L.D., 1995. The new Stratigraphic Names Database. Third National Conference and Trade Exhibition on the Management of Geoscience Information and Data, July 18-20, 1995, Adelaide, South Australia, Australian Mineral Foundation, 33.1- 33.9

Delineating Australian Mineral Systems

Subproject Manager

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AGSO Subproject Staff

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Irina Bastrakova	Proterozoic Granite-related mineralisation model
Anthony Budd	Proterozoic Granite-related mineralisation model
Lesley Wyborn	Proterozoic Granite-related mineralisation model
Greg Ewers	Stable Isotope tracers
Mart Idnurm	Palaeomagnetic tracers
Liz.Jagodzinski	Volcanic architecture, unconformity-related mineral system,
Shen-Su Sun	Lead Isotope tracers

Cooperating Agencies

All State and Territory Surveys
AGCRC
Various Industry Participants
CSIRO
Most Australian Universities

Objectives

To derive a catalogue of essential criteria and mappable ingredients for major Australian Mineral Systems and to ensure that digital data storage and manipulation systems developed in other subprojects will facilitate analysis for these systems in space and time.

Overview

With the rapid development of digital mapping technologies, regional mapping programs can now collect and digitally store essential criteria that can help define a district to regional scale mineral system. Important mappable ingredients in metallogenic analysis include the distribution of key minerals and rock types (e.g. Al-silicates, Fe-bearing minerals, evaporites, carbonates), significant granite types, regional alteration, thermal history, and the identification of specialised traps. Each of these mappable ingredients can define several components of any mineral system but will rarely uniquely define a specific mineral system. However, the aim is to produce mineral potential maps by querying AGSO's primary and derivative data sets to show the distribution of potential key ingredients related to a specific deposit type or style. By thinking of an ore deposit as part of a regional mineral system that involves the interaction of many common geological processes over tens to hundreds of kilometres, it is easier to determine what key processes are essential to the formation of major mineral deposits. Critical to the work of this subgroup are the databases developed for storing information on Mineral Deposits (OZMIN), geochemistry (ROCKCHEM), rock types (STRATINDEX) and geochronology (OZCHRON). Several collaborative projects have been developed with universities and CSIRO to enhance work on aspects related to various Australian Mineral Systems types.

Recent Project Highlights

- Compilation of 46 papers on aspects of Australian Mineral Deposits to be published as two issues of the AGSO Journal. The first volume was written by the State and Territory Geological Surveys and contains contributions on the geology of Australian Geological Provinces considered to have mineral potential. The second volume was written by

contributors from Australian Universities, Industry, AGSO and CSIRO and contains ~30 papers dealing specifically with major Australian ore deposit types.

- Development of the Mineral System Model for Australian Proterozoic Au ± Base metals Granite-Related deposits (confidential until 1998)
- Publication of the Mineral Systems Models for Unconformity U ± Au ± PGE base metal mineralisation and Mount Isa-Style Cu.

Future Plans

- Continue the development of the Australian Mineral Systems Catalogue: in particular further refinements of the Granite-related Au ± base metal, Archaean Gold, and VHMS mineral systems model mainly through externally funded projects.

Products

AGSO Journal volumes to be released in early 1998.

AGSO Journal volume 17/3

Part 1. Geology and mineralisation of Australian Metallogenic Provinces

Author	*Title*
Witt et al.	Mineral potential of the Archaean Pilbara and Yilgarn Cratons, WA
Tyler et al.	The geology and mineral deposits of the Proterozoic in Western Australia
Ahmad	Geology and mineral deposits of the Pine Creek Inlier and McArthur Basin, NT
Wygralak & Bajwah	Geology and mineralisation of the Arunta Inlier
Ferenczi & Ahmad	Geology and mineral deposits of the Granites-Tanami and Tennant Creek Inliers, NT
Daly et al	Tectonic evolution and exploration potential of the Gawler Craton
Robertson et al.	Reappraisal of the Proterozoic geology and mineral potential of the Curnamona Province in SA
Stevens & Burton	The Early to Late Proterozoic Broken Hill Province, NSW
Wallis et al	Mineral resources associated with Early to Middle Proterozoic rocks in Queensland
Draper	An overview of post-Proterozoic mineralisation in Queensland
Hocking et al	Western Australia: Phanerozoic geology and resources
Belperio et al	Tectonic and metallogenic framework of the Cambrian Stansbury Basin-Kanmantoo Trough
Suppell et al	The Palaeozoic in New South Wales - geology and mineral resources
Vandenberg	Palaeozoic geology and resources of Victoria
Pemberton et al	Mineral potential of Late Proterozoic and Palaeozoic provinces in Tasmania

AGSO Journal 17/4: contents

Part 2 Geological environments and regional events relating to mineral accumulation

Author	*Title*
Huston, David	The hydrothermal environment
Oliver & Rubenach	Precambrian metamorphism and metallogeny of Australia
Taylor & Butt	The Australian regolith
Wyborn, Lesley et al	The magmatic environment

Part 3. Concepts of and exploration criteria for major mineral deposit types - overview

Part 4. Exploration models for major Australian mineral deposit types

Part 5. New techniques for defining mineralisation environments on a regional scale

Publications

Heinrich, C.A., Bain, J.H.C., Mernagh, T.P., Wyborn, L.A.I., Andrew, A.S., and Waring, C.L., 1995. Fluid and mass transfer during metabasalt alteration and copper mineralisation at Mount Isa, Australia. *Economic Geology*, 90, 705-730.

Heinrich, C.A., Walshe, J.L., Harrold, B.P., and Ryan, C.G., 1995. Chemical mass transfer modelling and predictive mineral exploration. *Geological Society of Australia, 12 Australian Geological Convention, Abstracts*, 37.

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Wyborn, L.A.I., *in press*. The younger ~1500 Ma granites of the Williams and Naraku Batholiths, Cloncurry District, Mount Isa Inlier: geochemistry, origin, metallogenic significance and exploration indicators. *Australian Journal of Earth Sciences*

External Projects

Subproject Manager

Lesley Wyborn 02 62499489 (Phone) 02 62499971 (fax) lwyborn@agso.gov.au

AGSO Subproject Staff

Current or recently completed projects:	
Metallogeny of Australian Proterozoic Granites	Anthony Budd Irina Bastrakova Lesley Wyborn
User friendly Isotopes in exploration	Shen-Su Sun Lesley Wyborn
Victorian Slate-Belt Gold	Terry Mernagh
VHMS alteration project	David Huston
Proposed Projects	
Taking Mount Isa undercover	Mart Idnurm Evgeniy Bastrakov
Tanami Regolith	John Wilford, Murray Hazell Penny Ursem Dmitar Butrovski
Capturing Australia's Mineral Province Heritage	Cathy Brown Sue Edgecombe Terry Mernagh
Australian Archaean VHMS deposits: implications for the base metal prospectivity of global Archaean terranes	David Huston Elizabeth Jagodzinski
Low-sulfur iron-copper-gold systems	Roger Skirrow

Cooperating Agencies

All State and Territory Surveys
CRCLEME
AGCRC
Various Industry Participants
CSIRO
CODES, UWA, JCU.

Objectives

To develop external projects in collaboration with the Australian Mining Industry, State and Territory Geological Surveys, CSIRO and Universities to obtain data on and insights into Australian Mineral Systems.

Overview

This subproject is run in tandem with the Australian Mineral Systems Subproject. It seeks to undertake externally funded projects either as joint research projects with partners from Australian Universities, CSIRO, and/or State and Territory Geological Surveys or by running projects with AGSO as the sole operator. Each project developed or selected for support provides factual primary information for building into national scale-digital data sets on the regional to district scale parameters of the various major Australian ore deposit types. Projects that staff from the AMS project are currently collaborating on include:

- **AMIRA/CODES Project P384 (and its extension P384A) - Sediment Hosted Base Metals Deposits.** Since its inception, AMS has been a partner in-kind to this project and have provided digital data (geochemistry, maps) and has provided access to its Laser Raman, XRF and ICP-MS facilities.
- **AMIRA/James Cook University of North Queensland Project P438 - Cloncurry Base Metals and Gold.** AGSO acted as an adviser to this project and provided data in-kind and assistance in GIS expertise to the research groups at JCU for this recently completed 3-year project.
- **AMIRA/CSIRO/AGSO Project P480 - User friendly isotope technologies in mineral exploration.** AMS project is a research partner in this project which is building databases for Pb, Sr and S to provide a cost-effective and accurate method of assessing the potential of greenfields and/or more advanced prospects. This project focuses mainly on the Pb-Zn systems of the Mount Isa Inlier and the McArthur Basin, as well as the Cu-Au systems of the Eastern Fold Belt, Mount Isa.
- **AMIRA Project P439 - Studies of VHMS-related alteration: geochemical and mineralogical vectors to ore**. This project is studying the geochemical dispersion of trace elements and mineralogical variations in alteration zones associated with VHMS and related deposits in the Mt Read Volcanic Belt, Tasmania, the Mt Windsor Volcanic Belt, Queensland, and the Golden Grove district, WA. David Huston of AGSO has been a primary researcher, involved in establishing the geochemical dispersion of elements around the Western Tharsis deposit in the Mount Lyell field, Tasmania. The work will be extended to include mineral chemistry and PIMA work to determine mineralogical vectors to ore.
- **AGCRC Victorian Slate Belt Gold Subproject** which is part of the AGCRC Project No. 1053AO - VICGOLD. This subproject will compliment the recent AGSO seismic survey in Victoria by defining patterns of regional scale fluid flow. Regional geochemical sampling is to be carried out along the major structures in the western Lachlan Orogen to identify patterns of fluid-rock interaction and alteration. By combining the data from the seismic survey with data from a regional geochemical sampling program it will be possible to map fault systems and likely fluid paths and collectors. In combination with the regional scale studies, fluid tracer studies will also be carried out at the deposit scale in areas of known mineralisation in order to identify and characterise the ore bearing fluids.

Recent Project Highlights

- The development of a collaborative research licensing agreement to enable university researchers (both students and academics) to access AGSO proprietary data for specific research projects.
- Publication of results from **AMIRA Project P412 on 'The $^{40}Ar/^{39}Ar$ dating of Cu and Cu-Au mineralisation in the Proterozoic Mount Isa Inlier, northern Australia'**. AGSO was a principle collaborator on this project with Caroline Perkins of ANU.

- Completion of the databases for the **Metallogenic Potential of Australian Proterozoic Granites**. Using GIS techniques, this project investigated the spatial relationship between Australian Proterozoic Granites, host rock compositions and various mineral commodities. The project run totally by AGSO was sponsored by 20 companies. The results and GIS database will be available in December 1998.

Future Plans

AGSO will continue to collaborate wherever possible with other projects in Universities, CSIRO and State and Territory Surveys. Project plans are now available for:

- **Tanami Regolith-Landform Mapping**. This project will be led by John Wilford and will be run through the CRCLEME. The aim of Tanami project is to substantially improve geochemical methods for recognising the expression of base metal and gold deposits under cover or obscured by deep weathering over a selected area within the Tanami Region in central Australia. The three main components of the project are to 1) Develop an understanding of the distribution of regolith materials through district and broad scale regolith-landform mapping, 2. to producing a comprehensive data set and GIS package which will under-pin the interpretation and planning of regional surface and drill-hole geochemistry and 3) to generating a range of thematic maps to show the inter-relationships between regolith materials, geology, surface structure and sub-surface information.
- **Taking Mount Isa Undercover**. This project will be lead by Mart Idnurm and will focus on defining the geophysical rock properties of the major alteration systems surrounding the major ore-forming systems at Mount Isa.
- **Capturing Australia's Mineral Province Heritage.** This is a data-driven project which aim to build into a unified database primary information on the rock and mineral composition of Australian Geological Units, and where possible, their ages. A parallel component will also build a database of the composition and physical properties of the fluids at major Australian ore deposits. Most of this information is available in a plethora of Stratigraphic Index definition cards, bulletins, Ph.D theses, scientific papers and old Geological Survey records and reports. The aim is to centralise this primary information into a single digital information system which will assist in developing a data-driven catalogue of Australian Mineral Systems.
- **AMIRA Project Proposal P509 - 'Low-sulfur iron-copper-gold systems of the Gawler and Curnamona Cratons'.** This project aims to assess the ingredients that are critical in the formation of large low-sulfur Fe-Cu-Au deposits, with an emphasis on developing improved exploration models. Part-time involvement of Roger Skirrow is anticipated from mid-1998.

Products

Publications

Perkins, C., and Wyborn, L.A.I., 1996. The age of Cu-Au mineralisation, Cloncurry district, Mount Isa Inlier, as determined by 40Ar/39Ar dating. *AGSO Research Newsletter,* 25, 8-9.

Perkins, C., and Wyborn, L.A.I., *in press*. Age of Cu-Au mineralisation, Cloncurry District, eastern Mount Isa Inlier, Queensland, as determined by $^{40}Ar/^{39}Ar$ dating. *Australian Journal of Earth Sciences.*

Perkins, C., Heinrich, C.A., and Wyborn, L.A.I., *in review*. $^{40}Ar/^{39}Ar$ geochronology of Cu mineralisation and regional alteration, Mount Isa, Australia. Submitted to *Economic Geology*

Tanami Regolith-Landform Mapping

A New Project Proposal, Minerals Division, AGSO

The aim of this proposal is to substantially improve geochemical methods for recognising the expression of base metal and gold deposits under cover or obscured by deep weathering over a selected area within the Tanami Region in Central Australia. The aim of the project will be achieved by:

- Developing an understanding of the distribution of regolith materials through district and broad scale regolith-landform mapping. Regolith maps will be compiled from airphotos, geological maps, drill hole data and remotely sensed data sets including airborne geophysics and satellite imagery. Major landform features including palaeo-channels and erosional scarps will be delineated, and the distribution and orientation of major lineaments will be mapped.

- Producing a comprehensive data set and GIS package equivalent to three 1:250 000 map sheets which will under-pin the interpretation and planning of regional surface and drill-hole geochemistry. The GIS will include regolith-landform units, geological units, interpreted drill-holes, soil/regolith and drill-hole geochemistry, major structural lineaments, mineral occurrences and enhanced imaged data sets including radiometrics, magnetics, digital elevation models, Landsat Thematic Mapper (TM) and night time thermal AVHRR imagery.

- Generating a range of thematic maps to show the inter-relationships between regolith materials, geology, surface structure and sub-surface information (drill hole, thermal imagery and magnetics). Sampling strategy maps will be generated as a guide for sampling and interpreting geochemical survey data sets.

Key aims are to collaborate with industry in all stages of the project, and to address specific regolith related issues which fall within the scope of the project. Funding of about $46,000.00 over a 18 month period is sought from industry. The balance of $144,000.00 will be met by CRC LEME and AGSO. The data sets generated will be confidential to industry sponsors for 18 months from their release date, after which they will contribute to a proposed new geoscientific project on the Tanami.

The project commences in February 1998, and has a duration of 1 year. John Wilford leads the project team, and will have assistance from AGSO technical personnel. The total cost is $190 000, including salaries, of which $46 000 will be sought from industry sponsors.

Taking Mount Isa Under Cover

A New Project Proposal, Minerals Division, AGSO

Geochemical studies together with thermodynamic modelling lead to an understanding of the regional-scale hydrothermal regime in which an ore deposit formed. One way in which this knowledge may be applied to mineral exploration is through identification of the type of chemical alteration that was produced by the mineralising fluids along their flow paths: haloes and zones of this alteration type may be used to locate under cover the fluid pathways, which can then be followed to new ore deposits. The pattern of alteration is mappable by geophysical techniques, provided there is sufficient contrast between the physical properties among the altered and other rocks. Using the Mount Isa Inlier as a test case, this project will determine the rock properties related to the different types of regional alteration in order to find how much contrast exists between the properties and to create a rock property database for detailed modelling.

The project will focus on two major alteration systems at the opposite sides of the inlier:

- Western Fold Belt where the alteration is associated with Cu mineralisation (e.g., Mount Isa Cu deposit),
- Eastern Fold Belt where it is associated with Cu and Cu-Au economic deposits (e.g., Ernest Henry Cu-Au deposit).

In the Western Fold Belt, the alteration system is already well defined through several petrological and geochemical studies on the Eastern Creek Volcanics (e.g. Heinrich et al, 1995). Four main alteration types have been identified, including an oxidative alteration (calcite-Fe oxide type) at and around some of the fracture zones. This alteration is linked to the passage of the Cu-bearing fluids, providing a potential tracer for locating the fluid pathways.

Large-scale alterations both within the regional stratigraphy and the Williams Batholith in the Eastern Fold Belt have also been defined (de Jong and Williams, 1995). Hydrothermal fluid circulation related to the intrusion of post-tectonic granites resulted in an early, pervasive, sodic alteration which was overprinted by a late, fracture controlled, high-K event. The latter usually accompanies the mineralisation.

We will collect outcrop and, where available, drillcore samples for each alteration type in both the eastern and western parts of the inlier to determine the physical properties needed to interpret potential field data: magnetic susceptibilities, remanences and specific gravities.

The proposed project will be undertaken collaboratively with the James Cook University and will be carried out over a two year period. The team, to be led by Dr Mart Idnurm, will comprise a geophysicist specialising in rock magnetism, a petrologist specialising in chemical alterations, a thermodynamic fluid flow modeller, and technical support staff. To carry out this work we require sponsors and access to company drillcores.

References

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Capturing Australia's Mineral Province Heritage

A New Project Proposal, Minerals Division, AGSO

The aim of the project is to digitally capture and integrate vital components of the wealth of historical and recent hard copy geological information considered essential to understanding the distribution of mineral deposits in Australia's mineral provinces. For several years AGSO has been undertaking a 'mineral systems' approach to the identification of district to regional scale parameters that are considered essential ingredients for the formation of several major Australian ore deposit types. This work has only been possible because of the rapid development in GIS technology whereby multiple digital thematic layers critical to mineral systems analysis (host rock composition, fluids, alteration, ages, metamorphism) can be integrated on a district to regional scale to identify those ingredients essential to a particular deposit style. Digital data sets such as geological maps, geophysical data and granite maps are becoming common place. In contrast, digital data on elements critical to understanding the controls on the distribution of mineral deposits (*e.g.*, host rock composition, the composition of fluids at ore deposits, and the ages of both the host units and the deformation events associated with ore deposits) are often locked up in hard copy data such as historical literature (pre-1980), the definition cards of the Australian Stratigraphic Index, and unpublished Geological Survey records and University theses.

This project aims to digitally capture the hard copy heritage of Australian Mineral Provinces data into an integrated national scale, digital information system that will facilitate analysis of the essential ingredients and mappable criteria for Australian mineral deposit types. The project will take three years and will be run within AGSO's Australian Mineral Systems Project, using database standards/procedures pioneered by this group. A major aim is to ensure that databases developed can be incorporated in any of the sponsors proprietary data systems, to facilitate targeting, both in the conceptual phase and in the active exploration phase. The data will be captured in 3 separate, but closely related modules: Units, Ages and Fluids.

The Units Module (Coordinator Cathy Brown): This module seeks to build a comprehensive, GIS compatible database of Australian rock units which will focus on attributes that describe lithology and mineralogy, with an emphasis on delineating the presence of metallogenically reactive rock-types (*e.g.*, evaporites, carbonates) as well as reactive minerals (*e.g.*, graphite, sulphide, magnetite, calcite). The database will be an extension to the Australian Stratigraphic Index, and by using its unique unit numbering system and bibliographic reference links it will be possible to link the database to any geological map of Australia and hence readily spatially identify the location of these 'reactive' rock types and minerals.

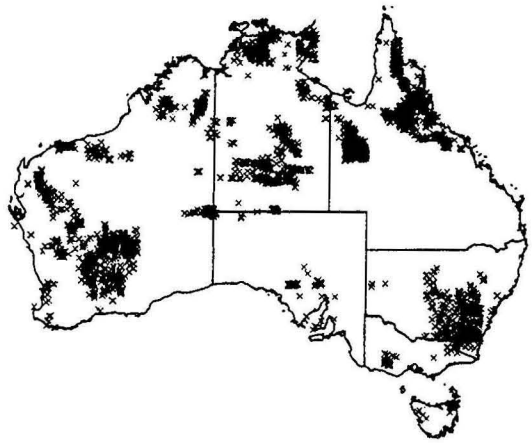
The Ages Module (Coordinator Sue Edgecombe): Critical to the analysis of a mineral system is a knowledge of the timing of the key igneous, deformation and metamorphic events. The Ages module aims to capture all published geochronological information, and any accessible unpublished information on the geochronology of Australia, into a single geochronological information system. AGSO is currently restructuring the OZCRHON database to house more information on the types of rocks dated and also to facilitate combining multiple age determinations into providing the 'best' age of an individual unit/event, as well as the combination of these individual 'best' ages into province-wide and continent-wide events.

The Fluids Module (Coordinator Terry Mernagh): A simple empirical database of fluid parameters, isotopic ratios, alteration and gangue minerals and trace-elements in ores at significant deposits is essential to enable characterisation of the composition of the ore-bearing fluids with respect to pH, redox potential, temperature and salinity. The source for much of this

data exists within the literature or as unpublished information within theses. The new database will be linked to AGSO's OZMIN database.

product

RockChem Database Release 3



Distribution of ROCKCHEM data

AGSO is releasing a third version of ROCKCHEM, its whole-rock geochemical database of major and trace element analyses of Australian rocks.

ROCKCHEM release 3 features data from over 25,500 samples from Australia, and includes data from about 3675 new analyses. Its highlights include the geochemical data from analyses of:

- *184 samples from drilling at the Century lead-zinc deposit, mostly of unmineralised black shales, sandstones and mudstones;*
- *73 samples of breccias, granites and mafic intrusives and dykes from the Olympic Dam deposit, from James Johnson's PhD thesis;*
- *approximately 880 geochemical analyses from the Eastern Goldfields - Southern Cross Seismic Traverse in the Yilgarn Craton. All analyses have a full suite of trace elements, however some have very limited major element analyses.*

As for the preceding releases, the data have been packaged into a series of regional and thematic data sets. These, and the new prices, are tabulated overleaf.

A 33% discount applies to purchasers of the complete database, which is available for $33,700. Previous purchasers of the complete database may purchase updates (about 3675 analyses) for $4900 plus postage. Customised datasets can be prepared on demand for $500, plus $2 per analysis plus postage. Customised data sets can be selected for a 1:100 000 Sheet area, 1:250 000 sheet area, geological province or stratigraphic unit.

Formats

The data are available in the following relational database formats:

- *Oracle export*
- *fixed length relational ASCII*
- *comma delimited relational ASCII*

For those who do not have relational databases, a fourth option - standard, comma-delimited (non-relational) ASCII format - is offered.

For further information contact:

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Dataset	New Analyses	Total Analyses	Price
North Queensland	312	3523	**$7,046**
Mount Isa Inlier, Georgina Basin	302	2739	**$5,478**
Pine Creek Inlier	7	2627	**$5,254**
Lachlan Fold Belt	662	2733	**$5,466**
South Australian Proterozoic	196	547	**$1,094**
Western Australian Proterozoic	151	1383	**$2,766**
Musgrave Block	37	656	**$1,312**
McArthur Basin	279	1480	**$2,960**
Arunta Block	141	1150	**$2,300**
Tennant Creek	0	1654	**$3,308**
Yilgarn Block	1463	4473	**$8,946**
Pilbara	125	1679	**$3,358**
Alkaline Rocks of Australia	0	914	**$1,828**
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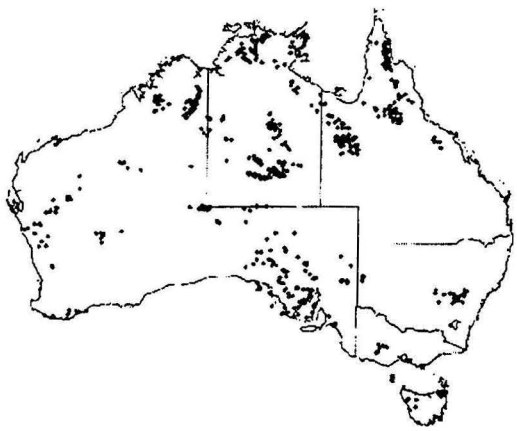

Distribution of OZCHRON data

AGSO has released a second version of OZCHRON, its national isotope geochronological database. The second release contains 358 new SHRIMP (ion microprobe) U-Pb ages and 376 Sm-Nd ages. The new release adds to 395 Rb-Sr ages, 135 conventional U-Pb ages and 53 SHRIMP U-Pb ages previously released in Version 1 of OZCHRON.

Most of the ages in Release 2 are derived from recent NGMA mapping projects in Archaean, Proterozoic and Palaeozoic terranes in Australia.

OZCHRON is one of AGSOs field and laboratory databases. Every age determination in OZCHRON includes information on location, lithology and stratigraphy. This information is stored in the OZROX field database which is the central pivot of the field and laboratory databases. OZROX provides a standard format for recording field observations and also provides links to other laboratory databases such as the ROCKCHEM whole rock database.

All age determinations in OZCHRON have locations recorded as both full Australian Map Grid and decimal latitudes and longitudes. Also included with each location is an estimated accuracy, and the spheroid under which the location was collected. The inclusion of this information allows OZCHRON data to be readily integrated with other datasets within a GIS.

Each geochronolgical technique represented in OZCHRON employs two tables. As a number of analyses contribute to each age determination, the analytical data are stored in the first table, and the pooled age result and interpretation are documented in the second table. For each age determination, comments are provided on the geological relevance of the age. The provision of the analytical data for each sample enables the purchaser of OZCHRON to recalculate or reinterpret any age determination.

In this release the data are available either as regional data sets, data sets based on age determination method or as the complete database. The data sets and pricing are tabulated over the page. The full dataset is available at a discounted price of $4500, and the cost of the upgrade from Release 1 is $2500.

Formats

The data are available in the following formats:

- *Oracle export*
- *Microsoft Access*
- *fixed length relational ASCII*
- *comma delimited relational ASCII*

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Regional Data Sets	SHRIMP U-Pb	Sm-Nd	Rb-Sr	Conv. U-Pb	Price
North Queensland	67	80	44	6	**$1,108**
Mt Isa Inlier	50	30	73	48	**$1,006**
Pine Creek Inlier	34		50	24	**$560**
Lachlan Fold Belt	50	55			**$720**
South Australian Proterozoic			91	18	**$272**
Western Australian Proterozoic	71	60	40	6	**$1,060**
Musgrave Block	11	50	19		**$348**
McArthur Basin, Murphy Inlier, Arnhem Land	32		9	3	**$353**
Arunta Block, Amadeus Basin	26	68	36	13	**$669**
Tennant Creek and Davenport Inliers	37	5	23	6	**$466**
Yilgarn Block	28				**$280**
Pilbara Block		28			**$112**
Broken Hill Block	5		10	11	**$125**
Total Analyses	411	376	395	135	
Price per Method	**$4,110**	**$1,504**	**$790**	**$675**	

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product

OZMIN - National Mineral Deposits Dataset

product

AGSO has released version 2 of its national mineral deposits dataset compiled as part of the OZMIN mineral deposit database. This version incorporates the latest production and resource information for existing deposits, includes revisions to and the addition of some further attributes, and has new entries for major deposits discovered since the initial release in late 1994. With the rationalisation of some deposits in version 1, about 60 new deposits have been added to the dataset. A Microsoft Access version of the database has also been developed for this release.

The dataset contains comprehensive information compiled from the literature for Australia's major and most significant mineral deposits. It has been compiled from published reference material and has been designed so that attribute information can be retrieved and analysed in relation to spatial data contained in geographic information systems (GIS).

Features of Version 2 of this OZMIN dataset include:

- compilation of data for almost 950 of Australia's major mineral deposits
- coverage of currently mined, undeveloped, and historically mined deposits
- Australia-wide coverage for more than 50 mineral commodities, including coal
- cumulative production and the latest total resource information
- over 6200 references cited
- GIS compatible

For each deposit OZMIN provides the following information:

Full Location Details geographic coordinates in decimal latitude/longitude or AMG, appropriate 1:100k and 1:250k sheets, geological region, etc

Deposit Characteristics:

name	gangue mineralogy
synonyms	relationship to deformation
mining centre	shape & orientation of deposit
operating status	relationship to host rocks
age of mineralisation	deposit expression
production & resources for each commodity	major ore controls
number of orebodies	mineralisation style
nature of workings	mineralisation texture
ore mineralogy	deposit classification

Host Rock Characteristics:

lithology	metamorphic grade & age
stratigraphic unit	common rock-forming mineralogy
depositional or emplacement age	alteration

Depositional Environment details of major structures and igneous bodies that may be genetically related to the mineralisation and their proximity to the deposit

The database is available on diskette in ORACLE export, Microsoft Access, or ASCII (comma delimited or fixed length) formats.

The documentation manual which accompanies the dataset has been completely revised to reflect the modifications and additions to OZMIN (*AGSO Record 1994/43* 'OZMIN Documentation'). It is supplied as part of any digital data package sale or can be purchased separately for A$25.

The complete digital data for the major mineral deposits dataset is available in the formats listed above for A$3,500 or as an upgrade to existing purchasers for A$500 (postage and handling extra).

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

For more information, contact Dr Greg Ewers (tel. +61 2 6249 9580, fax +61 2 6249 9983, or e-mail gewers@agso.gov.au) or Murray Hazell (tel. +61 2 6249 9375, fax +61 2 6249 9983, or e-mail mhazell@agso.gov.au).

http://www.agso.gov.au/minerals/

09/97

OZMIN Order Form

To: AGSO Sales Centre
GPO Box 378
CANBERRA ACT 2601 AUSTRALIA
Telephone: (02) 6249 9519 or 6249 9642
Facsimile: (02) 6249 9982
International prefix: (+ 61 6)

I wish to order the OZMIN version 2 release of the major Australian mineral deposits dataset:

Product format		**Cost A$**
ORACLE export format		
Microsoft Access format		
Relational ASCII format	comma delimited	
	fixed length	
OZMIN Documentation (AGSO Record 1994/43) (included in digital data price)		
Postage and handling extra		
	TOTAL	

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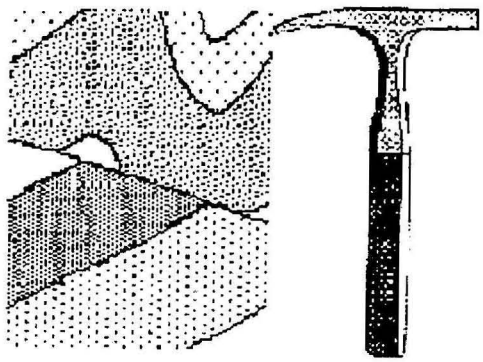
product

The Australian Stratigraphic Names Database



The Australian Stratigraphic Names database is the national authority of stratigraphic names in Australia. It constitutes a part of a suite of national geoscientific databases developed by AGSO and the Bureau of Resource Sciences.

Containing records for more than 30 000 names, (of which almost half are superseded, obsolete or misspelt versions of the nearly 15 000 current names), it is maintained by AGSO's Central Register of Australian Stratigraphic Names, on behalf of the Stratigraphic Names Committee of the Geological Society of Australia.

The database contains not only information about stratigraphic names and related geological details, but also a comprehensive bibliography on Australian geology.

A subset of the database, the stratigraphic lexicon of current names is used as a look up facility in conjunction with other AGSO databases and is now also available digitally for the use of outside organisations.

Data Packages

In response to growing demand mainly from exploration companies and State and Territory geological surveys, AGSO has compiled data packages containing information about stratigraphic units, for sale. These packages contain the following information for each stratigraphic unit:

- *the name's unique number*
- *currency and status (ie whether it has been defined, reserved for use, published, etc)*
- *any previous name for the unit and/or preferred spelling if the name has been superseded*
- *the State(s) and or Territory in which the unit and its type section and/or type area occurs*

and, where available:

- *the name of the geological province in which the unit occurs;*
- *the unit's maximum thickness;*
- *the names of parent, overlying and underlying units; and*
- *the unit's age range.*

AGSO is planning to make these data packages available on the World Wide Web, so that users can download data from the current version of the database themselves. In the interim, clients may purchase data packages on diskette ($50 each) in the following forms:

- *the Australia wide stratigraphic lexicon of current names; or*
- *all (current and superseded) stratigraphic names for a State or Territory.*

A database users guide is also available at a cost of $20 plus postage and handling.

For further information contact:

Ms Cathy Brown
Tel: 61 2 6249 9535
Fax: 61 2 6249 9971
email: cbrown@agso.gov.au
web: http://www.agso.gov.au - *Through the **SERVICES** button on AGSO's home page.*

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Australian Stratigraphic Names Database Order Form

To: AGSO Sales Centre
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CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

Australian Stratigraphic Names Database	**Price**
Australia wide Current Names Lexicon	$50
All names for a given State or Territory	$50
Record 1996/16: - *Guide to the Australian Stratigraphic Names Database*	$20

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product

product

Australian Crustal Elements Map

A new and innovative, full colour, crustal elements map at 1:5 000 000 scale is now available for purchase. The map delineates upper crustal elements primarily based on geophysical domains, each one depicting a distinctive pattern of magnetic and gravity anomalies arising primarily from basement thereby minimising the effects of the overlying sedimentary cover.

Boundaries between these elements are interpreted to mark crustal-scale changes in composition and/or structural pattern The identified elements are categorised according to their magnetic character. This process tends to place them in a tectonic context. By combining geological and geophysical criteria the elements have also been grouped into 8 mega-elements which appear to outline cratonic regions.

The new map delineates and classifies the geophysical domains and sheds new light on the tectonic development of the continent. The map identifies many abrupt or discordant boundaries in the upper crust, some of which may have been plate or subplate boundaries during the continent's history.

Among its uses the map provides:

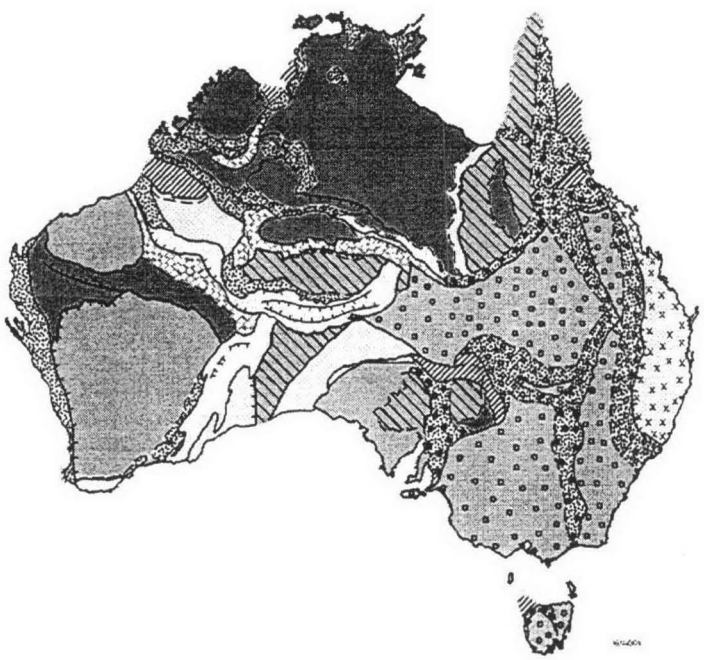
- *a regional starting point for examining evolutionary tectonic models;*
- *regional input for constructing various types of geological interpretations; and*
- *a basis for studying crustal processes associated with any geoscientific discipline.*

The map may be purchased by completing and faxing the order form overleaf. Brief notes to accompany the printed Microstation version of the map are available as AGSO Record 1996/30 "Guide to using the Australian Crustal Elements Map".

The map and notes package is available for $90. Extra copies (without notes) may be purchased for an additional $15 per map. Versions of the map in ArcInfo, MapInfo and Microstation format are also available, and pricing is tabled overleaf.

For further information contact:

Dr Russell Shaw
Tel: 61 2 6249 9665
Fax: 61 2 6249 9983
email: rshaw@agso.gov.au
web: http://www.agso.gov.au/minerals



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email: sales@agso.gov.au
web: http://www.agso.gov.au

Australian Crustal Elements Map	Price (A$)
Coloured 1:5 million Australian Crustal Elements Map *First copy including Record 1996/30* *additional copy of map (no notes)*	 $90 $15 ea
Australian Crustal Elements Digital Database *ArcInfo or MapInfo Format*	$400
Australian Crustal Elements Digital Database *Microstation Format*	$250

Preferred Format

ARC/INFO ☐ MAPINFO ☐ Microstation ☐

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product

product

The AGSO Field Notebooks

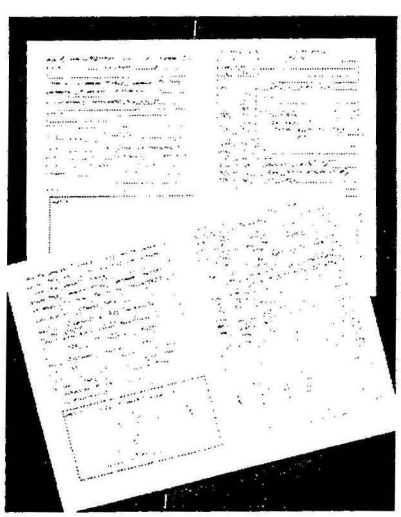
The AGSO Field Notebooks

A product in firm demand by the minerals-exploration industry

The release of AGSOs field notebook package late last year (see *AUS.GEO News 24* for September-October 1994, p. 6) has been a great success, and received widespread exploration-industry and survey interest. Of particular interest were the codes or standards used to describe rock and field attributes. As a consequence of consumer demands, we are making the separate parts of the package available individually.

The notes are available in a package ($50 plus postage) which includes 10 books,(50 sites can be entered into 1 book), a cover, a set of laminated codes, guide (AGSO Record 1193/46; see *AUS.GEO News 21*, for March-April, 1994, p. 3). The cost of individual items (excluding a postage and handling charge) is as follows:

- single notebooks - $2.50 (minimum order of 10);
- plastic cover - $10.00;
- *Record 1993/46* - $10.00;
- crib cards - $6.00; and
- 3.5" floppy disk of codes - $2.50.



The OZROX field data notebooks have been developed by AGSO to facilitate accurate and consistent capture of field data in a format that is easily transferable into a structured relational database designed to support an integrated geological information system with links to GIS or other geological software applications.

Each notebook comes with a series of coded data sheets that cover field attributes such as alteration, tectonic features, lithology, magnetic susceptibility, etc. The attributes are derived from the OZROX database and are expandable, allowing a variety of geoscientists to use the notebooks in a variety of geological regions.

The coding system promotes standards and ensures that all data are captured in a uniform style both within and between AGSO projects as well as cooperating organisations, to enable more effective data integration and analysis, ultimately on a continent wide scale.

For further information contact:

AGSO Sales Centre
Tel: 61 2 6249 9519
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au/minerals/

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AGSO Field Notebooks Order Form

To: AGSO Sales Centre
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CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

Fieldbook Components	Price
Complete set *- 10 notebooks, cover, laminated codes and users guide.*	$50.00
Single Notebooks *-minimum order of 10*	$2.50 ea
Plastic Cover	$10.00
Record 1993/46	$10.00
Crib Cards	$6.00
3.5" Floppy disk of codes	$2.50

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product

product

A GIS Package for the Mt Isa Inlier and Environs

Extract of the digital geology polygons

The GIS is based on the 'Mount Isa Inlier and Environs' 1:500 000 scale map (published in 1987), which was digitised and verified against Geochemical and Mineral Deposit point data.

A series of interpretive geological and geochemical coverages were derived from these map data and point datasets such as ROCKCHEM, OZCHRON and MINERAL DEPOSITS.

Geophysical byte images (clipped from AGSO's national coverage) provide broad regional views showing the concealed extent of the province.

Coverages

Geological coverages based on the 1:500 000 geological map:

- *geology*
- *faults*
- *folds*
- *lineaments*
- *frame*

Derived geological coverages:

- *solid geology*
- *inlier outline*
- *tectonic subdivisions*
- *metamorphic zones*

Coverages derived from AGSO datasets and point databases:

- *whole rock geochemistry derived from average whole rock data within each polygon. Two sets of coverages are available as:*
    - *a) only sampled polygons have a value; and*
    - *b) all polygons have a value with the value for unsampled polygons being the average value for that unit.*
- *interpretive geological coverages in which geological units are classified according to dominant rock type, mineralogy, sedimentary sequence, granite type etc.*
- *geophysical byte images from AGSO regional data*
    - *gravity*
    - *magnetics*

The data are available in atlas form. The atlas comprises three volumes:

- *Volume 1: Geology*
- *Volume 2: Whole Rock Geochemistry*
- *Volume 3: Geophysics*

The data are available either as component data sets, the individual pricing of which is tabulated over the page. The total digital package is being made available at the discounted price of $4,000. The atlases are also available both individually and as a set. The total atlas set is available for $600.

For further information contact:

Dr Lesley Wyborn
Tel: 61 2 6249 9489
Fax: 61 2 6249 9983
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Mt Isa GIS Order Form

To: AGSO Sales Centre
GPO Box 378
CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

GIS Components	Price
Geological Map	$650
Derived geological layers *-6 layers: interpretive geology, solid geology, interpretive solid geology, tectonic provinces, metamorphism, Inlier outline*	$1000
Regional geophysical byte images *- gravity (1' pixels)* *- magnetics (15" pixels)*	 $170 $650
Mineral Deposit Database *- includes some raw data fr4om AGSO Record 1992/66 - The Mount Isa Mineral Deposit Database*	$130
Geochemistry *- 27 elements, excludes raw data*	$1350
MINLOC extract *- 1800 point locations and commodities*	$130
Drainage *- vector file (AUSLIG)*	$200
Total Package	**$4000**

Atlases	
Volume 1: Geology	$160
Volume 2: Geochemistry	$340
Volume 3: Geophysics	$100
Three volume atlas set:	**$600**

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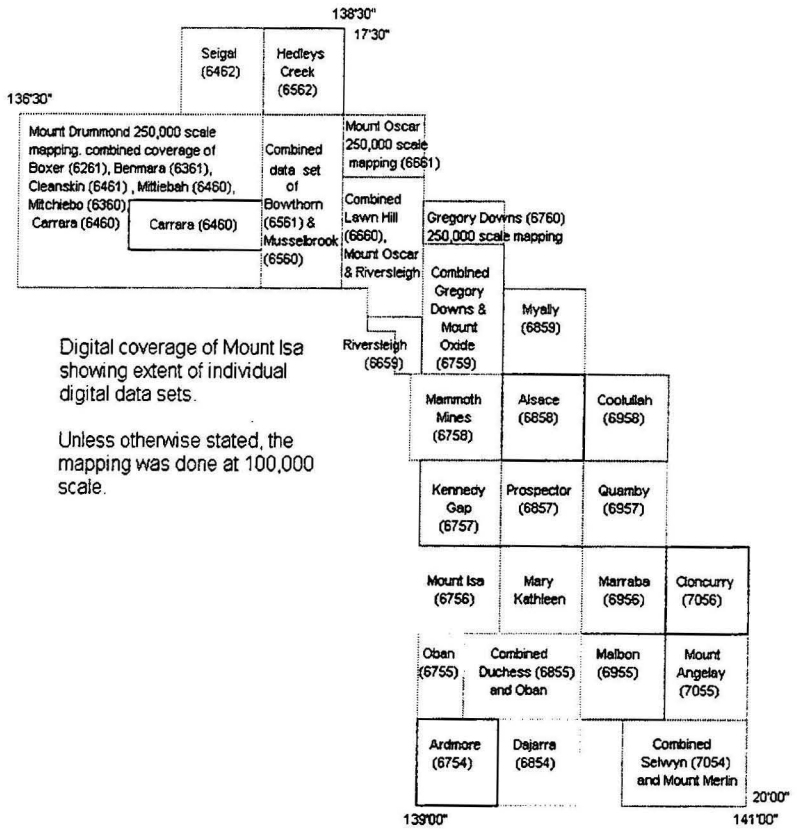
product

Mount Isa 1:100 000 Digital Map Release

product

In 1993, seven companies sponsored AGSO to digitally capture all 1:100 000 maps sheets in the Mount Isa region. The confidentiality period has now expired and the data are now released.



Digital coverage of Mount Isa showing extent of individual digital data sets.

Unless otherwise stated, the mapping was done at 100,000 scale.

The Dataset

All available 1:100 000 scale first edition and unpublished preliminary geological maps of the Mount Isa Inlier, Murphy Tectonic Ridge, South Nicholson Basin and southern McArthur Basin. It also includes parts of the Mount Drummond and Lawn Hill 1:250 000 sheets which have not been mapped at 1:100 000 scale. The complete data set covers 23 full and 11 part 100,000 scale map sheets (see map). As a a unique legend has been developed for the whole area the individual sheets can be joined into a full seamless coverage. All faults within this area have been coded uniquely to facilitate metallogenic analysis.

Data Capture

All of the original repromat plate copy separates were scanned using an Eagle Scanner and vectorised using Provec software to ensure the best possible accuracy. The geological polygon boundaries were verified using some 3500 points from the AGSO ROCKCHEM data base and the 'Mount Isa Inlier and Environs Mineral Deposits' Database. All polygons and linework are tagged and data layers created according to AGSO's digital data dictionary.

The data, currently version 2.1, can either be purchased as individual 1:100 000 sheet areas in either MapInfo or Arcinfo/Arcview formats. For Arcview, unique legends have been created for the geology layers of each individual dataset, uniform across the whole of the Mount Isa dataset.

The cost is $500.00 for a full 1:100 000 sheet, and $300 for a part sheet. The total package can be purchased at a discount price of $9500.

For further information contact:

Dr Lesley Wyborn
Tel: 61 2 6249 9489
Fax: 61 2 6249 9983
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Mount Isa 1:100 000 Digital Map Release Order Form

product

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GPO Box 378
CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

Mt Isa Digital Geological Map Set	Price (A$)
Complete Geological Map set *23 full and 11 part 1:100 000 map sheets* *(not including postage and handling)*	$9500
Individual Map Sheets *full sheet* *part sheet* *(not including postage and handling)*	 $500 $300

Preferred Format

ARC/INFO ☐ MAPINFO ☐

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product

A GIS Package for the Pine Creek Inlier

A Pine Creek GIS package has been prepared jointly by AGSO and the Northern Territory Survey for release in both digital and hard copy (atlas) formats. Based on the 1:500 000 geological map of the Pine Creek Geosyncline (2nd edition) published by BMR in 1984, the GIS has been supplemented where possible by recently acquired data from mapping in the Litchfield, Katherine, and South Alligator areas.

Digital coverages derived from this base map include solid geology, regional and contact metamorphism, and a number of interpreted layers featuring the distribution of the dominant lithologies and minerals such as carbonate, graphite, sulphide, haematite and magnetite. Geophysical layers feature the regional magnetic and gravity coverages in the digital data package, but incorporate data from both regional and detail surveys in the atlas. A set of geochemical layers has been prepared by averaging whole-rock geochemical data with individual units on the geological map. Two Landsat Thematic Manner (TM) mosaic images have been compiled: a greyscale image provides positional control, and a colour composite RGB (red, green, blue) image highlights areas dominated by clay, vegetation, iron oxides, or mixtures of these.

Components

The digital data package, which is available in Arc/Info and MapInfo formats, comprises the following components:

- *digital geology - 6 layers (geology, faults, joints, lineaments, frame, coast)*
- *derived geological layers - solid geology, interpreted geology (mineralogy, lithology, age, etc.), metamorphism (regional and contact metamorphic coverages), outline of the Pine Creek Inlier, depth to basement*
- *regional geophysical byte images of gravity and magnetics*
- *Landsat TM mosaic images (including a greyscale mosaic of band 5 with pixel size 30m, and a colour composite RGB image with pixel size 90m*
- *geochemical layers (16 elements, excludes raw data)*
- *mineral deposits database*

The Atlas comprises three volumes:

- *Volume 1: Geology*
- *Volume 2: Geochemistry*
- *Volume 3: Geophysics*

The data are available either as component data sets, the individual pricing of which is tabulated over the page. The total digital package is being made available at the discounted price of $4,000. The atlases are also available both individually and as a set. The total atlas set is available for $980.

For further information contact:

Dr Lesley Wyborn
Tel: 61 2 6249 9489
Fax: 61 2 6249 9971
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Pine Creek Inlier GIS Order Form

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Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

GIS Components	Price
Digital geology *- 6 layers (geology, faults, joints, lineaments, frame, coast)*	$500
Derived geological layers *- solid geology, interpreted geology (mineralogy, lithology, age, etc), metamorphism (regional and contact metamorphic coverages), outline of the Pine Creek Inlier, depth to basement, etc)*	$1000
Regional geophysical byte images *- gravity* *- magnetics*	 $250 $1000
Landsat TM mosaic images *- (including a grey scale mosaic of band 5 with a pixel size 30 metres, and a colour composite RGB image with a pixel size 90 metres)*	$1000
Geochemical layers *- 16 elements, excludes raw data*	$750
Mineral deposits layer	$500
Total Package	**$4000**

Atlases	
Volume 1: Geology	$270
Volume 2: Geochemistry	$320
Volume 3: Geophysics	$390
Three volume atlas set:	**$980**

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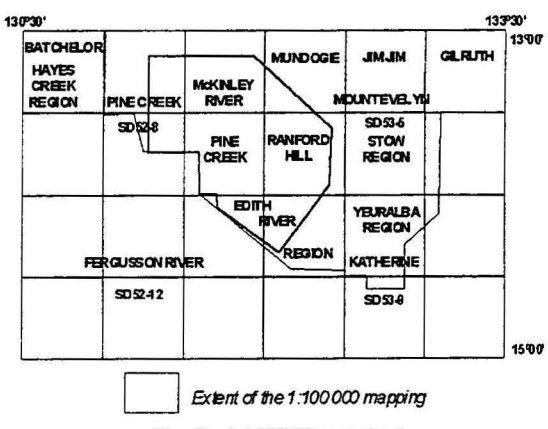
product

Geology and Mineral Deposits of the Cullen Mineral Field

The Cullen Mineral Field is a valuable gold producing area in the Northern Territory. In the past, silver, lead, coppoer, tin, and tungsten have also been won. The mineral field has been the recent focus of gold exploration. The Mount Todd gold deposits, with resources exceeding 66Mt @ 1.4 grams per tonne gold, are the latest in a series of mines to have gone into production in the last few years. The area is a classic example of a zoned mineral field contained within the contact aureole of a complex and highly fractionated Proterozoic granite batholith.

AGSO have released Bulletin 229, "Geology and mineral deposits of the Cullen Mineral Field, Northern Territory" by P. G. Stuart-Smith, R. S. Needham, R. W. Page, and L.A.I. Wyborn.



Index to published geological maps

Comprehensive synthesis

This bulletin presents a comprehensive synthesis of the geology and mineral deposits of the region with new detailed geochronolgical and geochemical data. Topics covered include:

- *regional geology, stratigraphy, structure and metamorphism;*
- *geochemistry and genesis fo the Cullen Batholith;*
- *geochronology of the batholith;*
- *role of granite intrusion in metalogenesis*
- *stratigraphic and structural controls on mineralisation.*

An essential geological database

The Bulletin comprises 145 pages, including 47 figures, 17 tables, an extensive bibliography of 265 references, and 35 pages of appendices devoted to geochronolgical, geochemical and mineral deposit data. It is accompanied by a full colour 1:250 000 scale special map of the Cullen Mineral Field (first published in 1987), and a microfische containing over 300 whole rock geochemical analyses.

The Bulletin and map are vital references for those involved in the exploration of granite-related precious and base metal vein deposits, the geology of the Pine Creek Geosyncline, and the study of granites in relationship to mineralisation.

For further information contact:

Dr Lesley Wyborn
Tel: 61 2 6249 9
Fax: 61 2 6249 9983
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

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Cullen Mineral Field Order Form

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web: http://www.agso.gov.au

Cullen Mineral Field Bulletin Packages	Price (A$)
Bulletin 229 and map sheet *(Sales tax $1.20 per package plus postage and handling $10 for Australia, $25 overseas)*	$85
Map Sheet *(Sales tax $1.20 per map plus postage and handling $5 for Australia, $15 overseas*	$18

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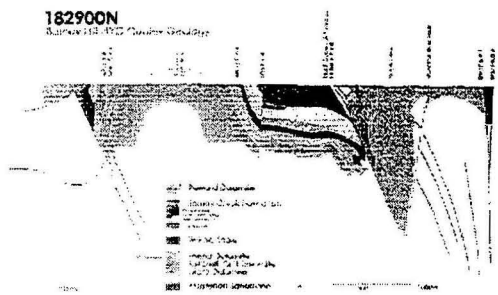
Structure and Kinematics of the HYC-'Cooley zone', McArthur River, NT



Barney Hill - HYC - Cooley Geology

AGSO have released a data package and record resulting from a collaborative Mount Isa Mines (MIM)-AGSO detailed structural study at HYC, McArthur River. The project was carried out by Dr Mark Hinman.

The objectives of this study were:

- *to establish the gross geometry of the 'Cooley zone' in relation to the Barney Creek Formation section at HYC, and in particular to clarify the distinction between the Barney Creek sedimentary breccias and the so-called 'Cooley breccias';*
- *within this framework, to determine the relative timing of the stratiform HYC Pb-Zn mineralisation and the 'Cooley breccia' copper mineralisation.*

This study, based largely on a detailed structural analysis of diamond-drillcore has resulted in the reinterpretation of the 'Cooley zone' as a folded block of the pre-Barney Creek Formation dolomitic succession which has been transpressively reverse faulted against and over the Barney Creek Formation. It has provided tight constraints on the timing of stratiform Pb-Zn mineralisation at HYC, which apparently occurred before a phase of syn-diagenetic, pre-lithification, gravity driven structuring and the transpressive inversion structuring the produced the 'Cooley zone' of the western fault block.

Data Package

The package comprises:

- *Record 1995/5, titled "Base metal mineralisation at McArthur River; structure & kinematics of*
- *the HYC-Cooley zone at McArthur River", containing an account of the detailed structure, geological tectonic history of the HYC-Cooley-Emu zone, coloured interpretive sections, and complete tabutaled drillcore structural data;*
- *a set of 27 detailed plans, sections, and overlays of geology (in colour), apparent dips, and structural data (as clear overlays) for the drillholes that have returned detailed quantitative structural data.*

Copies of the data package, which contains Record 1995/5 plus a set of 27 detailed plans, sections and overlays of the geology (in colour), apparent dips, and structural data (as clear overlays) for the drillholes that have returned detailed quantitative structural data are available for $600 plus courier charge. Record 1995/5 is available separately for $100 plus postage.

For further information contact:

Dr Lesley Wyborn
Tel: 61 2 6249 9489
Fax: 61 2 6249 9983
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Structure and Kinematics of the HYC-'Cooley zone', McArthur River, NT Order Form

To: AGSO Sales Centre
GPO Box 378
CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

HYC-'Cooley zone', McArthur River Data Set	Price (A$)
Record 1995/5 plus set of 27 detailed plans sections and overlays *(not including postage and handling)*	$600
Record 1995/5 only *postage and handling $5 for Australia, $15 for overseas*	$100

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product

product

A Digital Geological Map of the Granites-Tanami Area

AGSO has prepared a digital geological map of the Granites-Tanami Block by joining together as a seamless coverage 15 of the 1:250 000 geological maps which cover the province. The map has been prepared as a first step in developing a regional metallogenic GIS package of the Granites-Tanami area, similar to those already developed for the Pine Creek and Mount Isa areas.

To ensure that the data captured would be of high quality, the original separates of the maps that were prepared for printing were scanned and vectorised as Intergraph/Microstation files.

The Intergraph files have now been converted into ARC/INFO format and a common legend has been compiled for all 15 map sheets. All of the sheets have been edge-matched to form a seamless coverage. Where there were mismatches along adjacent map edges, original field photographs and compilation sheets were reinterpreted to give a better join.

Components

The data layers in the digital map include geology, faults, lineaments structural data, mineral deposits and AGSO drill hole locations. A common legend will be sold with each order regardless of who many sheet areas are purchased. Topographic and cultural layers are not included: these can be purchased separately from AUSLIG.

The digital map is available in ARC/INFO format at $350.00 per sheet area. The full digital map set (15 1:250 000 sheet areas) may be purchased for the discounted price of $4500. If a smaller number of sheets is required in ARC/INDFO format, a merged version of the requested subset will be prepared for an extra $100.00 per subset.

MAPINFO and ARC/INFO versions of either the individual maps or the complete dataset are also available.

For further information contact:
Dr Lesley Wyborn
Tel: 61 2 6249 9489
Fax: 61 2 6249 9971
email: lwyborn@agso.gov.au
web: http://www.agso.gov.au/minerals/

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Digital Geological Map of the Granites-Tanami Area Order Form

To: AGSO Sales Centre
GPO Box 378
CANBERRA ACT 2601
Australia

Tel: 61 2 6249 9519 or 61 2 6249 9642
Fax: 61 2 6249 9982
email: sales@agso.gov.au
web: http://www.agso.gov.au

Granites-Tanami Digital Geological Map Set	Price (A$)
Complete Geological Map set (ARC/INFO) *15 1:250 000 map sheets* *(not including postage and handling)*	$4500
Individual Map Sheet *(not including postage and handling)*	$350 ea

Preferred Format

ARC/INFO ☐ MAPINFO ☐

I wish to order the following: ☐ I would like further information on the following: ☐

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Airborne Geophysics

Airborne geophysics, research, processing, imaging and national databases

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Murray Richardson	Acquisition and processing
Ross Franklin	Acquisition and processing
Ross Brodie	Acquisition and processing
Tim Mackey	Processing, imaging and interpretation
Jane Mitchell	Processing imaging and interpretation
Tony Meixner	Processing, imaging and interpretation
Duncan Souter	Sales and archiving
Frank Simonis	Technical support
Rob Reitsma	Technical support
Lars Rickardsson	Technical support

Objectives

To develop, maintain and provide continent-wide databases of airborne magnetic and radiometric data and digital elevation models in formats to assist resource exploration and environmental management, and to improve the methodologies for the acquisition, processing, imaging and interpretation of such airborne geophysical data.

Funding

AGSO allocation plus external earnings

Overview

The AGSO Airborne Group is one of the most active concentrations of specialists engaged in acquisition, processing, enhancement, presentation, interpretation, training and research in the fields of aeromagnetics, gamma-ray specrometry and gravity in the world.

The hardware and software resources of the Airborne Geophysical Mapping Group are state-of the-art with the key elements being its own AeroCommander survey aeroplane plus industry standard software including the INTREPID processing system which AGSO helped develop.

The products and activities of the Airborne Geophysical Mapping Group are used by projects of AGSO Divisions engaged in geological mapping, mineral province studies, sedimentary basin

studies and land use and environmental projects, exploration companies, educational institutions and other government departments.

AGSO is the custodian of the most comprehensive publicly available Australian aeromagnetic, radiometric and databases. It contains approximately 10 million line kilometres of data. It would cost approximately $80 000 000 to duplicate these data at todays prices. All the Airborne Geophysical Mapping products and research results become publicly available for use by other government agencies, industry and research and educational institutions. The Airborne Geophysical Mapping Group is available for inter-governmental and private sector cooperative, acquisition, interpretation, research and training projects.

Activities since mid-1996

- Acquisition of 246 000 line kilometres of airborne geophysical data with AGSO aircraft plus 35,500 line kilometres under contract. Areas covered included the Boulia (Qld), Springvale (Qld), Goulburn (NSW), Innaminka (SA), Strezlecki (SA), Wangaratta (part), Marble Bar (WA), Grafton (NSW - part), Maclean (NSW - part) and Cootamundra (commenced) 1:250 000 Sheet areas.
- Interpretation projects on the Kimberley area of northwestern Australia and the Goulburn, Boulia and Springvale map sheets.
- Release of a new magnetic map of Australia
- Release of a thematic issue of the AGSO Journal of Australian Geology and Geophysics devoted to "Airborne Magnetic and Radiometric Surveys"
- Completion of the MAGMAGE Project (25 sponsors) researching new methods for enhancing aeromagnetic data
- Development of new techniques for enhancing radiometic data (downward continuation, multichanel spectral smoothing)
- Delivery of six external training workshops
- Management of airborne survey projects in Fiji and Oman
- Completion of a consultancy for the Asian Development Bank in Indonesia

Product Releases since mid-1996 (See attachments for prices)

Digital data and basic maps

Yilgarn:	Edjudina, Nabberu, Wiluna, Marble Bar, Pilbara area, East Pilbara area (southwest Yarrie, west and south central Nullagine), Port Hedland
Kimberley-Arunta:	Dixon Range, Gordon Downs (south), Macdonald, Ryan, (east),Cobb (northeast) DEM - Camden Sound, Montague, Sound,Prince Regent
Mount Isa area:	Boulia, Springvale
Otway Basin:	Offshore Otway Basin
Broken Hill area:	Curnamona, Corona, Fowlers Gap,
Lachlan:	Goulburn, Wangaratta Wagga (1:100 000)
Lachlan - Tumut area:	Green Hills - Bago Maragle Forests
Tasmania:	Northwest Tasmania

Pixel image maps

Yilgarn:	Nabberu, Wiluna, Northern Eastern Goldfields (1:500 000, magnetics plus gravity), Meekatharra 1:1 000 000
Pilbara area:	Nullagine/Yarrie, Marble Bar, Port Hedland, Roebourne/Pyramid, Pilbara 1:500 000 magnetic compilation
Braken Hill area:	Callabonna, Frome
Otway Basin:	Offshore Otway Basin

Kimberley-Arunta:	Dixon Range, Gordon Downs, Kimberley 1:1 000 000 magnetic compilation
Mount Isa area:	Boulia, Springvale
Lachlan:	Goulburn, Wangaratta
Australia - wide:	Magnetic Map of Australia - 1:5 000 000 and 1:25 000 000, Elevation Image of Australia - 1:5 000 000 and 1:25 000 000

Depth to basement maps

Yilgarn:	Rason, Throssell
Central Australia:	Lake Mackay, Mount Doreen
Mount Isa:	Boulia, Springvale

Digital images

Mount Isa:	Boulia, Springvale
Lachlan:	Goulburn

Interpretation maps - hard copy and digital

Mount Isa area:	Boulia, Springvale

Software

Diurnal monitoring
Airborne geophysical survey planning

Miscellaneous

Airborne survey index - hard copy and digital
Magnetic Anomaly Map of Australia grid

Publications since mid-1996

Grasty, R.L., Minty, B.R.S. and St. John Smith, B., 1997. New developments and techniques for airborne gamma-ray spectrometry. In Exploration '97, Proceedings of the Fourth Decennial International Conference on Mineral Exploration. Toronto, Canada, September 1997.

Gunn, P.J., 1997. Quantitative methods for interpreting aeromagnetic data: a subjective review. *AGSO Journal of Australian Geology and Geophysics*, 17, 105-114.

Gunn, P.J., 1997. Regional magnetic and gravity responses of extensional sedimentary basins. *AGSO Journal of Australian Geology and Geophysics*, 17, 115-132.

Gunn, P.J., 1997. Application of aeromagnetic surveys to sedimentary basin studies. *AGSO Journal of Australian Geology and Geophysics*, 17, 133-144.

Gunn, P.J and Almond, R., 1997. A method for calculating equivalent layers corresponding to large aeromagnetic and radiometric grids, *Exploration Geophysics*, 28, 72-79.

Gunn, P.J. and Dentith, M., 1997. Magnetic responses of mineral deposits. *AGSO Journal of Australian Geology and Geophysics*, 17, 145-158.

Gunn, P.J., Fitzgerald, Yassi, N., Dart, P. and Almond, R., 1997. New algorithms for visually enhancing airborne geophysical data, *Exploration Geophysics*, 28, 220-224.

Gunn, P.J., Mackey, T, Richardson, R.G., Seymour, D.B., McClenaghan, M.P. Calver, C., Roach, M.J., Yeats, T., 1997. The Basement Elements of Tasmania, *Exploration Geophysics*, 28, 225-231.

Gunn, P.J., Maidment, D. and Milligan, P. 1997. A methodology for interpreting aeromagnetic data in areas of little or no outcrop. *AGSO Journal of Australian Geology and Geophysics*, 17, 175-186.

Gunn, P.J., Minty, B.R.S. and Milligan P.R., 1997. Airborne gamma-ray spectrometric responses over arid Australian terranes. In Exploration'97, Proceedings of the Fourth Decennial International Conference on Mineral Exploration. Toronto, Canada, September 1997.

Gunn, P.J., Mitchell, J. and Meixner, A., 1997. Evolution and structuring of the Bass Basin as delineated by aeromagnetic data, *Exploration Geophysics*, 28, 214-219.

Gunn, P.J., Mitchell, J. and Temakon, S., 1997. The Vanuatu Airborne Magnetic/Radiometric Survey Project, *Exploration Geophysics*, 28, 209-213.

Haren, R., Liu, S., Gibson, G., Maidment, D. and Gunn, P., 1997. Geological interpretation of high resolution geophysical data in the Broken Hill region, *Exploration Geophysics*, 28, 235-241.

Hill, P.J., Meixner, A.J., Moore, A.M.G., and Exon, N.F., 1997. Structure and development of the west Tasmanian offshore sedimentary basins: results of recent marine and aeromagnetic surveys. *Australian Journal of Earth Sciences*, 44, 579-608.

Hone, I.G., Milligan, P.R., Mitchell, J. and Horsfall, K., 1997. Australian national airborne geophysical datasets. *AGSO Journal of Australian Geology and Geophysics*, 17, 11-22.

Horsfall, K., 1997. Airborne magnetic and gamma-ray data acquisition. *AGSO Journal of Australian Geology and Geophysics*, 17, 123-30.

Luyendyk, A., 1997. Processing of airborne magnetic data. *AGSO Journal of Australian Geology and Geophysics*, 17, 31-38.

Meixner, A. and Gunn, P.J., 1997. Three dimensional kinematic modelling of the magnetic field of the southern Joseph Bonaparte Gulf. *Exploration Geophysics*, 28, 260-264.

Milligan, P. and Gunn, P.J., 1997. Enhancements and presentation of airborne geophysical data. *AGSO Journal of Australian Geology and Geophysics*, 17, 63-71.

Minty, B.R.S., 1997. Fundamentals of airborne gamma-ray spectrometry. *AGSO Journal of Australian Geology and Geophysics*, 15, 30-50.

Minty, B.R.S., Luyendyk, A. and Brodie, R., 1997. Calibration and data processing for airborne gamma-ray spectrometry. *AGSO Journal of Australian Geology and Geophysics*, 15, 51-62.

Reeves, C.V., Reford, S.W. and Milligan P.R., 1997. Airborne Geophysics: old methods, new images. In Exploration '97, Proceedings of the Fourth Decennial International Conference on Mineral Exploration. Toronto, Canada, September 1997.

Tarlowski, C., Gunn, P.J. and Mackey, T., 1997. Enhancements of the magnetic map of Australia. *AGSO Journal of Australian Geology and Geophysics*, 17, 77-82.

Tarlowski, C., McEwin, A.J., Reeves, C.V. and Barton, C.E., 1996. Dewarping the composite aeromagnetic anomaly map of Australia using control traverses and base stations. *Geophysics*, 61, 696 - 705.

AGSO Records published since mid-1996

Gunn, P.J., Mitchell, J. and Meixner, A., 1996 Evolution and structuring of the Bass and Durroon Basins as delineated by aeromagnetic data. AGSO Record 96/14. $75

Gunn, P.J., Mackey, T, Richardson, R.G., Seymour, D.B., McClenaghan, M.P. Calver, C., Roach, M.J., Yeats, T., 1997 The Basement Elements Of Tasmania, AGSO Record 1996/29 $40

Mitchell, J.N., Milligan, P.R. and Souter, D., 1997 Index of geophysical Surveys, AGSO Record 1997/4 $25

Gunn, P.J., Mackey, T.E. and Mitchell, J.N., 1995 Offshore Otway Basin Interpretation, AGSO Record 1997/24. $300

Price List
Airborne Magnetic And Gamma-Ray Data

Semi-detailed surveys (Mainly 400 m line-spaced surveys, 500 m in NT, Medusa Banks)

Qld: Boulia, Ebagoola, Hann River, Springvale 1:250 000 Sheet areas; Mount Mulgrave 1:100 000 Sheet areas

NSW: Dubbo*, Forbes*, Goulburn** 1:250 000 Sheet areas; Wagga 1:100 000 Sheet area; Liverpool Plains area***

Vic: Ballarat*, Bendigo*, St Arnaud (S)* Wangaratta (N) 1:250 000 Sheet areas, offshore Otway Basin

SA: Callabonna (S), Curnamona****, Frome, Murloocoppie, Wintinna 1:250 000 Sheet areas

WA: Cobb (NE), Dampier, Dixon Range, Duketon, Edjudina, Gordon Downs (N), Laverton, Leonora, Lissadell, Macdonald, Marble Bar, Medusa Banks, Nabberu, Nullagine (W,CS), Port Hedland, Pyramid (N), Roebourne, Sir Samuel, Wiluna, Yarraloola (N), Yarrie (SW) 1:250 000 Sheet areas

NT: The Granites (S), Highland Rocks, Mt Solitaire (S & E), Mt Theo, Port Keats 1:250 000 Sheet areas

* Parts of Dubbo, Forbes, Ballarat, Bendigo and St Arnaud have been in-filled to 200 m line spacing

** Goulburn at 250 m line spacing, Wangaratta (N) at 200 m

*** Liverpool Plains area at 200 m line spacing

**** Southern Curnamona at 100 m spacing - see Broken Hill area

Digital data - point located

Unit	Price per area			
Line spacing	500 m	400 m	250 m	200 m
4 - 15 1:25 000 Sheet areas (7½' x 7½')	$120	$150	$240	$300
16 - 95 1:25 000 Sheet areas (7½' x 7½')	$95	$130	$210	$260
1:100 000 Sheet area	$1 500	$2 080	$3 360	$4 160
1:250 000 Sheet area	$8 500	$3 360	$17 200	

Digital data - grids

1:100 000 Sheet area - TMI				
Gamma-ray (4 grids)	$450	$500	$800	$1 000
!:250 000 Sheet area - TMI	$450	$500	$800	$1 000
Gamma-ray (4 grids)	$2 250	$2 500	$4 000	
	$2 250	$2 500	$4 000	

Maps

Map type	Dyelines	Transparencies
Profiles (1:50k and 1:100k)	$15	$45
Flight path	$15	$45
Contours (1:50k and 1:100k)	$40	$120
Contours (1:250k)	$120	$250

	Colour	Greyscale	Both maps - one area, one order
Magnetic pixel maps - 1:250k - Ebagoola	$75	$50	$100
Boulia, Hann River, Springvale, Dubbo, Forbes, Liverpool Plains, Bendigo, Wangaratta, Callabonna, Curnamona, Frome, Murloocoppie, Wintinna, Dixon Range, Duketon, Edjudina, Goulburn, Gordon Downs, Laverton, Leonora, Lissadell, Marble Bar, Medusa Banks, Nabberu, Nullagine/Yarrie, Port Hedland, Roebourne/Pyramid (N), Sir Samuel, Wiluna, Highland Rocks, Mount Theo, Port Keats	$300	$250	$500
	$600	$500	$1 000
1:500k - Pilbara (colour only), The Granites	$300	$250	$500
1:1M - Northern Eastern Goldfields, NE Goldfields + gravity			

Gamma-ray pixel maps - Dubbo $75
Boulia, Ebagoola, Hann River, Springvale, Forbes, Goulburn, Liverpool Plains, Bendigo, Wangaratta, Marble Bar, Nabberu, Nullagine/Yarrie $300

Special survey areas - 100 m - 200 m line spacing: Kakadu Conservation Zone - point located digital data, $1 000; Bago - Maragle - PLD $2 080, grids $500 each; Northwest Tasmania - PLD - $4 500, grids $ 1 000 each

Broken Hill area Broken Hill, Corona, Fowlers Gap, Kalabity, Mulyungarie, Redan, Taltingan, Thackeringa 1:100 000 Sheet areas flown mainly at 100 m spacing

Digital data - point located

Unit	Price	
	Line spacing	
	100 m	200 m
7½' x 7½'	$2 000	$1 000
1:25 000 Sheet area	$4 000	$2 000
1:100 000 Sheet area	$20 000	

Eastern half of: Mawarra, Yalcowinna - $1 000
Glen Idol, Mundie Mundie Creek - $1 500
Wahratta - $2 000

- TMI grids

Unit	Price
15' x 7½'	$1 000
1:50 000	$1 500
1:100 000	$6 000

Glen Idol, Little Aller Creek, Mawarra, Mundie Mundie Creek, Redan II (North and South), Redan III South,Umberumberka, Yalcowinna - $750

Maps

Map type	Dyelines	Transparencies
Profiles, flight path (1:25k - 15' x 7½')	$15	$45
Contours (1:25k - 15' x 7½')	$25	$75
Contours (1:50k)	$40	$120
Contours (1:250k)	$120	$250

Magnetic pixel maps: Pseudocolour - $300 Greyscale - $250 Both - $500
Gamma-ray pixel maps - Pseudocolour - $300

Reconnaissance surveys (Most of Australia - usually 1 500 m line spacing)

Digital data - point located
$750 per 1:250 000 Sheet area
Vulcan area, $18 500

TMI grids
1:1 000 000 Sheet areas $500 - $2 000
All Australia $24 000

Maps

Map type	Dyelines	Transparencies	
Profiles	$10	$20	
Flight path	$10	$20	
Contours	$25	$75	(1:250 000; and 1:1 000 000 compilations)

Magnetic anomaly map of Australia - colour	1:5M	1:25M
	$120	$5

Pixel maps, 1:1 000 000
Cape York magnetic, colour - $300; grey-scale - $250; both - $500; gamma-ray composite (colour) - $300
Tasmania magnetic, colour - $300; grey-scale - $250; both - $500 (also available at 1:500 000)
Albany, Cooktown, Esperance, Kalgoorlie, Melbourne, Newcastle Waters, Roper River (pt), Townsville: colour and greyscale TMI, greyscale N-S, E-W gradients of TMI. Colour - $150, greyscale - $100, set $400

800 m flight line spacing surveys Camden Sound (E), Montague Sound, Prince Regent (WA)

Digital data - point located	1:100 000 Sheet area	$600	
	1:250 000 Sheet area	$3 000	
Digital data - grids	1:250 000 Sheet area	TMI	$1 000
		Gamma-ray (4 grids)	$1 000

Offshore Tasmania: $750 - $6 500

Maps Prices as for 400 m / 500 m surveys

NOTE: All prices given are exclusive of sales tax, which may have to be added for some hard copy items. Postage and packaging extra. 7 November 1997

Magnetic Anomaly Map Of Australia Second Edition

A new, improved version of the Magnetic Anomaly Map of Australia is being released. This map provides the opportunity to review the magnetic anomaly pattern for the whole continent at once, enabling the tectonic structure of Australia to be studied, even in the large areas devoid of outcrop. This map supersedes the version published in 1993, and contains more and improved data for much of Australia. Long wavelength trends (which were introduced during the compilation process) have been removed from the data, enabling more subtle features to be identified than was previously possible. Colour, gradient enhanced pixel image maps are being released at scale 1:5 000 000 and 1:25 000 000. The digital data comprising the map are available with a cell size of 15 seconds of arc (approximately 400 m), either for the continent as a whole, or on an individual 1:1 000 000 sheet area basis.

MAP PRICES			Copies of this map may be purchased from the:
COLOUR, GRADIENT ENHANCED TMI	sales tax		**AGSO SALES CENTRE (Maps)**
	excluding	including	Telephone: (06) 249 9519 / 9642
1:5 000 000 scale (approx A0)	$120.00	$128.00	Facsimile: (06) 249 9982
1:25 000 000 scale (approx A4)	$5.00	$5.35	E-mail: sales@agso.gov.au using the order form supplied.

This second edition of the map contains improved data for many parts of Australia. Of the 528 1:250 000 map sheet areas which cover Australia, less than 2 remain unsurveyed, although many are substandard by current criteria in terms of line spacing and location accuracy. Regions in which data have been added include:

- Central Australia
- Tanami Area, N.T.
- Kimberley, W.A./N.T.
- Bass Strait
- Cape York
- Broken Hill, N.S.W.
- Arnhem Land, N.T.
- Pilbara, W.A.
- Central South Australia
- Northeast Tasmania
- Northwest Victoria

This total magnetic intensity (TMI) image was compiled from processed total-field aeromagnetic data from which the International Geomagnetic Reference Field for an appropriate epoch has been removed. The composite grid was created by minimising differences across overlapping sections of adjoining surveys. Spurious warps introduced into the grid during the compilation process were removed using data from three special control lines flown continuously around Australia. Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation, using information derived from a sun-angle routine applied to the initial composite grid. Pixel colours were chosen from the natural palette (magenta high, blue low) using histogram equalisation.

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

A subsampled (500x482) browse image of this map can be found on the internet at: http://www.agso.gov.au/map/images.html

Release date: 5 December 1996

http://www.agso.gov.au/minerals/

product

Magnetic Anomaly Map Of Australia
Second Edition
Gridded Digital Data

The 15-second mesh gridded data which were used to generate the Magnetic Anomaly Map of Australia can be obtained from AGSO, either for the continent as a whole, or on an individual 1:1 000 000 sheet area basis.

The data are available on CD-ROM or 8 mm exabyte tape. The gridded data are in ER Mapper format, with Geodetic (longitude/latitude) projection, AGD66 datum and cell size of 15" (approx. 400 m).

Digital data can be ordered through :

Mr Duncan Souter
Geophysical Mapping
AGSO
GPO Box 378 Telephone: (02) 6249 9223
CANBERRA ACT 2601 Facsimile: (02) 6249 9986

The price of the master grid is $24 000. Grids for 1:1 000 000 sheets are priced from $500 to $2 000, as shown below.

1:1 000 000 Sheet	Price (A$)	New data?	1:1 000 000 Sheet	Price (A$)	New data?
Hamersley Range (and Cloates)	1 500	✓	Newcastle Waters	2 000	
Meekatharra (and Carnarvon)	2 000	✓	Roper River (and Cape Wessel)	1 500	✓
Perth	1 500		Normanton	2 000	
Albany	1 000		Cloncurry	1 000	
Esperance	1 000		Cooper Creek	500	
Kalgoorlie	2 000		Broken Hill	1 500	✓
Wiluna	1 500		Adelaide	2 000	✓
Oakover River	1 500		Hamilton	1 000	✓
Broome	1 500		Tasmania	1 500	✓
Brunswick Bay	500	✓	Melbourne (and Bodalla)	1 500	✓
Darwin	1 500	✓	Canberra	2 000	
Halls Creek	2 000	✓	Bourke	2 000	
Lake MacKay	1 500	✓	Charleville	1 500	
Petermann Ranges	1 500		Clermont	1 500	✓
Nullarbor Plain (and Eyre)	2 000	✓	Townsville	1 000	✓
Port Augusta	1 000	✓	Cape York	2 000	✓
Tarcoola	2 000	✓	Brisbane (and Rockhampton)	1 500	
Oodnadatta	1 000	✓	Armidale	1 000	
Alice Springs	1 500		Sydney	500	

Ticks (✓) indicate 1:1 000 000 Sheet areas which contain data that supersede the edition published previously.

Upgrade Prices: Purchasers of the **entire** digital grid for the first edition of the map (released in 1993) will be able to purchase an update for $3 500. Purchasers of **some** first edition grid data will receive 85% credit towards purchasing the entire 2nd edition digital grid (minimum charge $3 500).

Release date: 5 December 1996

http://www.agso.gov.au/minerals/

product

product

Elevation Image Of Australia
First Edition

This is a high-resolution gradient-enhanced colour image of the elevation of the Australian continent, and is the first such product of its type to become available for Australia. It is being released at two scales, 1:5 000 000 and 1:25 000 000, and shows with amazing clarity both large-scale and subtle features of the topography of Australia. It is a valuable resource for research, land-use, education and recreation purposes.

The elevation image was derived from the GEODATA 9 Second DEM data product, a national digital elevation model (DEM) with a grid spacing of 9 seconds in longitude and latitude (approx. 250m). AUSLIG and AGSO provided the source data for the DEM. Height above sea-level is represented by colour in the image, which also displays the major lakes and river systems.

Production of the DEM was a collaborative effort involving the Australian Geological Survey Organisation (AGSO), the Australian Surveying and Land Information Group (AUSLIG), the Australian Heritage Commission (AHC) and the Centre for Resource and Environmental Studies (CRES) at the Australian National University (ANU).

The ANUDEM algorithm used to grid the data utilises drainage and waterbody information to improve terrain modelling, and also enforces surface drainage by removing invalid sinks. Tests of the DEM against more accurate data sets have indicated a standard deviation around 25 m for a sample area which varies from flat to rugged, with possible maximum point errors of up to 90 m.

MAP PRICES

COLOUR, GRADIENT ENHANCED ELEVATION

	sales tax excluding	including
1:5 000 000 scale (approx A0)	$18.60	$19.95
1:25 000 000 scale (approx A4)	$1.85	$2.00

These maps may be purchased from the:

AGSO SALES CENTRE (Maps)

Telephone: (02) 6249 9519 / 9642
Facsimile: (02) 6249 9982
E-mail: sales@agso.gov.au
using the order form supplied, or also from:

AUSLIG
Telephone: (02) 6201 4300
Facsimile: (02) 6201 4381
E-mail: mapsales@auslig.gov.au
or your nearest map retailer.

The image was derived from the original GEODATA 9 Second DEM data reprojected to a Simple Conic Projection with a cell size of 500 m. Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation, using information derived froma sun-angle routine. Pixel colours were chosen from a magenta high to cyan low colour palette.

The original grid data used for the preparation of the image are available from AGSO and AUSLIG in digital form for the whole continent and for individual 1:1 000 000 sheet areas. At larger scales the data show significantly more detail.

http://www.auslig.gov.au/products/digidat/dem.htm

Release date: 5 March 1997

http://www.agso.gov.au/minerals/

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

A Reference Text For Airborne Magnetic And Radiometric Surveys

A thematic issue of the *AGSO Journal of Australian Geology & Geophysics* (vol. 17, no. 2), edited by Peter Gunn, focuses on a series of invited papers by specialists in the various facets of airborne magnetic and radiometric surveys. Although this publication is not a textbook in the conventional sense, it does provide detailed explanations of the techniques for acquiring, processing, presenting, and interpreting airborne magnetic and radiometric surveys. The level of the papers is such that the material will be useful for both introductions to the topics and as revision for experienced geophysicists. Numerous colour images are included.
The contents of the thematic issue are (names of AGSO scientists are printed in *italics*):

- Preface; *Peter J. Gunn* (guest associate editor); p. 1;
- Airborne geophysics in Australia: the government contribution; *David Denham*; pp. 3–10;
- Australian national airborne geophysical databases; *Ian G. Hone, Peter R. Milligan, Jane N. Mitchell, & Ken R. Horsfall*; pp. 11–21;
- Airborne magnetic and gamma-ray data acquisition; *Ken R. Horsfall*; pp. 23–30;
- Processing of airborne magnetic data; *A.P.J. (Tony) Luyendyk*; pp. 31–37;
- Fundamentals of airborne gamma-ray spectrometry; *Brian R.S. Minty*; pp. 39–49;
- Calibration and data processing for airborne gamma-ray spectrometry; *Brian R.S. Minty, A.P.J. (Tony) Luyendyk, & Ross C. Brodie*; pp. 51–61;
- Enhancements and presentation of airborne geophysical data; *Peter R. Milligan & Peter J. Gunn*; pp. 63–75;
- Enhancements of the magnetic map of Australia; *Chris Tarlowski, Peter J. Gunn & Tim Mackey*; pp. 77–82;
- Magnetic petrophysics and magnetic petrology: aids to geological interpretation of magnetic surveys; D. A. Clark; 83–103;
- Quantitative methods for interpreting aeromagnetic data: a subjective review; *Peter J. Gunn*; pp. 105–114;
- Regional magnetic and gravity responses of extensional sedimentary basins; *Peter J. Gunn*; pp. 115–132;
- Application of aeromagnetic surveys to sedimentary basin studies; *Peter J. Gunn*; pp. 133–143;
- Magnetic responses associated with mineral deposits; *Peter J. Gunn* & M. Dentith; pp. 145–157;
- High-resolution geophysics in modern geological mapping; *A. Lynton Jaques, Peter Wellman, Alan Whitaker*, & D. Wyborn; pp. 159–174;
- Interpreting aeromagnetic data in areas of limited outcrop; *Peter J. Gunn, David Maidment, & Peter R. Milligan*; pp. 175–185;
- Interpretation of aerial gamma-ray surveys — adding the geochemical factors; B.L. Dickson & K.M. Scott; pp. 187–199;
- Application of airborne gamma-ray spectrometry in soil/regolith mapping and applied geomorphology; *John R. Wilford, Phil N. Bierwirth, & Michael A. Craig*; pp. 201–216.

AGSO Journal vol. 17, no. 2 is on sale now. It costs $90 + postage and handling charges of $10 (in Australia) or $25 (overseas). A standard 35 per cent discount on the sale price applies to educational institutions.

For orders and enquiries:
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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

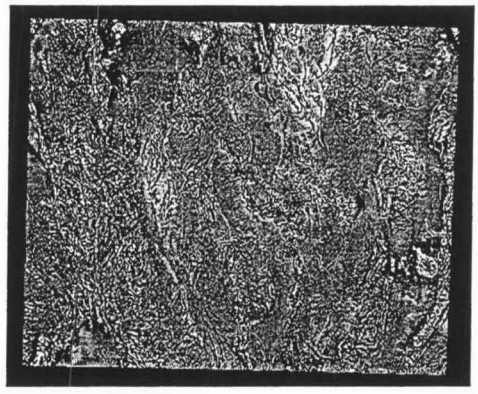
Release Date: 5 March 1997
http://www.agso.gov.au/minerals/

product

Goulburn N.S.W. - Airborne Geophysical Images - digital data on CD-ROM

product

New high quality digital image-processed grids are being released by AGSO for the 1:250 000 Sheet area of Goulburn in New South Wales. These data were acquired on lines spaced 250 m apart and 80 m above ground level during a survey flown between October 1996 and March 1997. The survey was jointly funded by AGSO and the Geological Survey of New South Wales. Detailed geological mapping, aided by the use of these digital images, will enhance the chances of future economic discoveries, and provide valuable information for environmental management.



The image-processed data are available from AGSO in RGB-BIL (8-bit integer) format on CD-ROM. Header files in ArcView and MapInfo format enable easy import of the data into ArcView and MapInfo. The following nine (9) images are included on the CD-ROM:

- colour, total magnetic intensity (TMI) reduced to the pole (RTP) with northeast illumination *
- greyscale, fractional vertical derivative of TMI (RTP) (illustrated above) *
- greyscale, automatic gain control of first vertical derivative of TMI (RTP)
- colour, digital elevation model (DEM) with northeast illumination *
- Gamma-spectrometric colour composite *
- colour, histogram equalised Dose Rate (total count)
- colour, histogram equalised Potassium
- colour, histogram equalised Uranium
- colour, histogram equalised Thorium
- colour, histogram equalised Bouguer Gravity
- These images were used to create the hardcopy pixel-image maps for the Goulburn survey, available from AGSO.

Airborne geophysical maps and digital data for the Goulburn survey are also available.

DIGITAL DATA **(9 x BIL format image processed grids on CD-ROM)**	
Introductory Price	$4 000
If all magnetic/radiometric/DEM grids have been purchased previously	$2 500
If all point-located data have been purchased previously	$500

Mr Duncan Souter,
AGSO Airborne Geophysical Data Sales

Telephone: (02) 6249 9223
Facsimile: (02) 6249 9986

using the order form supplied.

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

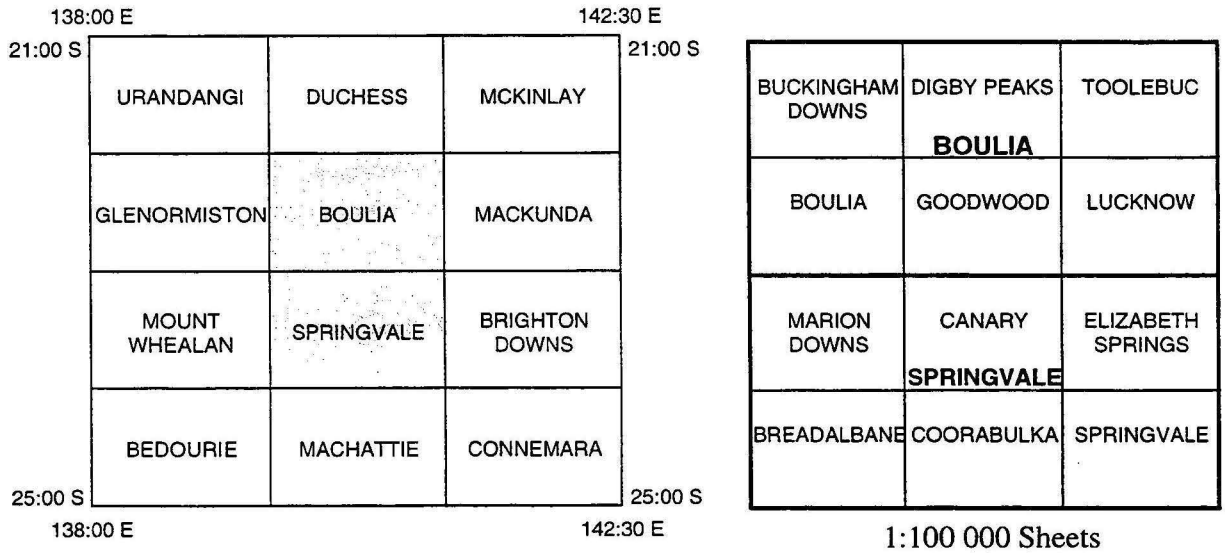
product

Boulia and Springvale 1:250 000 Sheet areas northwest Queensland. Magnetic, Gamma-ray and Elevation – Digital Data and Maps.

AGSO announces the release of new airborne magnetic, gamma–ray spectrometric and digital elevation model digital (point located and gridded) data and maps from the Boulia and Springvale 1:250 000 Sheet areas in northwest Queensland. See the diagram below for coverage details.

The airborne geophysical data for these sheets map the southern continuation of the various units of the Proterozoic Mount Isa Inlier beneath younger sediments. The area covered by the data is considered to have a high potential for containing mineral deposits similar to Mount Isa, Osborne, Cannington and Selwyn. The Osborne deposit, which occurs on the Boulia sheet is associated with a magnetic anomaly.

This release is part of a suite of products which will include pixel image, interpretation and depth to basement maps. Please refer to other Boulia and Springvale release notices for details.



1:100 000 Sheets

The survey was flown between 14 May and 12 August 1997 and produced 97 000 line kilometres of geophysical data. Flight lines were flown east–west at 80 metres above ground level and spaced 400 metres apart. Magnetic data were sampled every 0.1 seconds (~7 metres) and gamma–ray spectrometric data were sampled every second (~70 metres). Navigation as well as elevation data were provided by the satellite global positioning system (GPS) in real time differential mode via an Optus satellite link to a Fugro Omnistar Plus base station system. The GPS data were sampled every 0.5 seconds (~35 metres). Final position and elevation data were determined by post flight differential processing of the raw GPS data.

AGSO

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

Boulia and Springvale Queensland – Price List

Airborne Geophysical Maps

SCALE	MAP TYPE	COST	
		DYELINE	TRANSPARENCY
1:250 000	TMI Contours	$120	$250
	Dose Rate Contours	$120	$250
	DEM Contours	$40	$120
1:100 000	Flight Path Maps	$15	$45
	AGC TMI Profiles	$15	$45
	TMI Contours	$40	$120
	Dose Rate Contours	$40	$120

Airborne Geophysical Digital Data

Point located (PLD) magnetic, gamma–ray spectrometric and digital elevation model data and grids of same are released. PLD are available in units of 7.5' x 7.5' (1:25 000 sheet).

DATA COVERAGE	DATA TYPE	COST
1 to 15 1:25 000 Sheet areas	TMI & Gamma-ray PLD	$150
16 or more 1:25 000 Sheet areas	TMI & Gamma-ray PLD	$130
1:100 000 Sheet area	TMI & Gamma-ray PLD	$2080
1:250 000 Sheet area	TMI & Gamma-ray PLD	$10 750
Entire survey	TMI & Gamma–ray PLD	$21 500

TMI and gamma–ray spectrometric grids are available in units of 1:100 000 sheet areas.

DATA COVERAGE	DATA TYPE	COST
1:100 000 Sheet area	TMI grid	$500
	TC & K & U & TH grids	$500
1:250 000 Sheet area	TMI grid	$2 500
	TC & K & U & TH grids	$2 500
Entire survey area	TMI grid	$5 000
	T & K & U & TH grids	$5 000

Digital Elevation Model data are available in units of 1:250 000 sheet areas.

DATA COVERAGE	DATA TYPE	COST
1:250 000 Sheet area	DEM PLD + grid	$1 000
Entire survey area	DEM PLD + grid	$2 000

Point Located Data and grids may be purchased from:	Copies of maps may be purchased from:
Mr Duncan Souter, **AGSO Airborne Geophysical Data Sales** Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986 using the order form supplied.	**AGSO Sales Centre (Maps)** Telephone: (02) 6249 9519 / 9642 Facsimile: (02) 6249 9982 E-mail: sales@agso.gov.au using the order form supplied.

product

Boulia and Springvale 1:250 000 Sheet areas northwest Queensland. Magnetic, Gamma-ray and Elevation - Pixel Image Maps.

AGSO announces the release of new high quality colour and greyscale 1:250 000 scale airborne magnetic, gamma–ray spectrometric and digital elevation model pixel image maps from the Boulia and Springvale 1:250 000 Sheet areas in northwest Queensland. The images cover an area containing the southern continuation of the various units of the Proterozoic Mount Isa Inlier beneath younger sediments, which is considered to have a high potential for containing mineral deposits similar to Mount Isa, Osborne, Cannington and Selwyn. The Osborne deposit, which occurs on the Boulia sheet is associated with a magnetic anomaly. Detailed geophysical interpretation, aided by these images, will enhance the chances of future economic discoveries, and provide valuable information for environmental management. This release is part of a suite of products which includes digital (point located and gridded) data and interpretation and depth to basement maps. Please refer to other Boulia and Springvale release notices for details.

The survey which acquired the data for these images was flown between 14 May and 12 August 1997 and produced 97 000 line kilometres of geophysical data. Flight lines were flown east–west at 80 metres above ground level and spaced 400 metres apart. Magnetic data were sampled every 0.1 seconds (~7 metres) and gamma–ray spectrometric data were sampled every second (~70 metres). Navigation as well as elevation data were provided by the satellite global positioning system (GPS) in real time differential mode via an Optus satellite link to a Fugro Omnistar Plus base station system. The GPS data were sampled every 0.5 seconds (~35 metres). Final position and elevation data were determined by post flight differential processing of the raw GPS data. Final data were gridded on an 80 metre mesh for pixel map production.

The TMI grid was reduced to the pole (RTP). In the colour magnetic image, pixel colours were assigned via histogram equalisation and gradient enhancement was applied by artificial illumination of the 1st vertical derivative of the RTP grid. The greyscale image was produced by histogram equalisation of a fractional vertical derivative (of order 1.5) calculated from RTP grid.

The gamma–ray colour composite image was compiled by combining the Potassium, Thorium and Uranium grids into a single three–band Red, Green, Blue (RGB) composite image. The colour intensity and saturation were slightly modulated using the east–west gradient of total count data, to improve the definition of the short–wavelength information.

For the elevation grid a drainage controlled digital elevation model gridding algorithm (ANUDEM) was used. In the colour elevation image pixel colours were assigned via histogram equalisation and gradient enhancement was applied by artificial illumination of the initial grid.

Prices	
Colour gradient enhanced TMI reduced to the pole	$300
Greyscale vertical derivative of TMI reduced to the pole.	$250
Both TMI images for the same sheet in one order	$500
Gamma–ray spectrometric colour composite	$300
Colour gradient enhanced digital elevation model.	$300

Copies of maps may be purchased from:
AGSO Sales Centre (Maps)

Telephone: (02) 6249 9519 / 9642
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using the order form supplied.

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

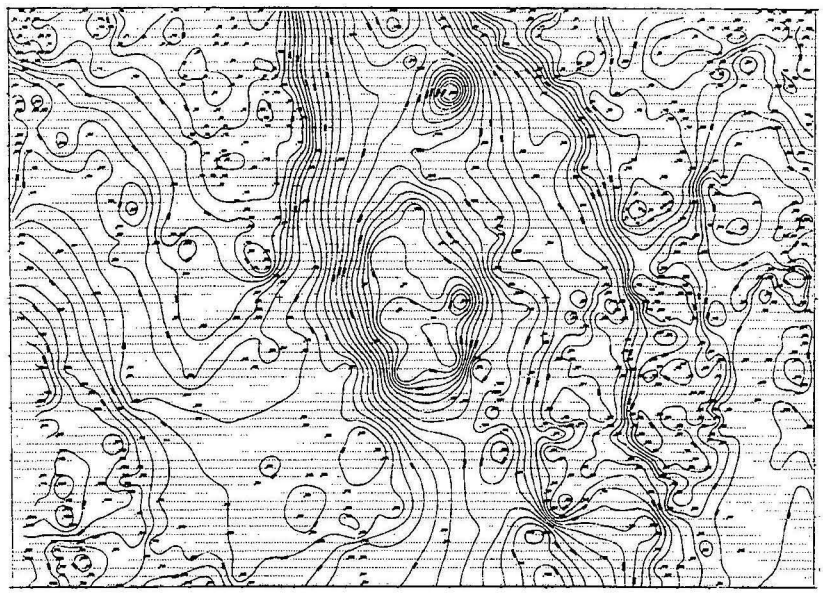
Release date: 4 December 1997

http://www.agso.gov.au/minerals/

product

Estimated Depths To Magnetic Basement Boulia and Springvale 1:250 000 Sheet Areas, Queensland

Maps of estimated depths to magnetic basement of the Boulia and Springvale 1:250 000 Sheet areas in Queensland are being released by AGSO. The individual maps contain over 400 depth estimates to magnetic sources displayed as values in metres below ground level. The depth estimates are contoured to provide a visual representation of the basement surface. The diagram below is a reduced version of the Boulia depth to magnetic basement map.



A large proportion of the Australian continent consists of basement geology obscured by deep weathering profiles, concealed by relatively shallow cover material or deep sedimentary basins. For both the minerals and hydrocarbon exploration industries, it is vital to know the depths of this cover material. A depth to basement map supplies an important data set to constrain prospective regions.

The Boulia and Springvale 1:250 000 Sheet areas contain the southern continuation of the various units of the Proterozoic Mount Isa Inlier. These Proterozoic units are considered to have a high potential for containing mineralisation such as the Mount Isa, Osborne, Cannington and Selwin deposits. Apart from a few scattered outcrops of Proterozoic geology in the extreme north of the Boulia Sheet area, the entire area is covered by younger sediments. The contoured depth estimates reveal a large area of shallow magnetic basement of less than 200 m depth in the north, which gradually increases in depth to the south. A northerly trending trough of deeply buried magnetic basement, up to 1800 m, dissects the Boulia Sheet area. The south west region of the Springvale Sheet area contains large regions of basement over 1000 m deep interspersed with shallower basement.

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

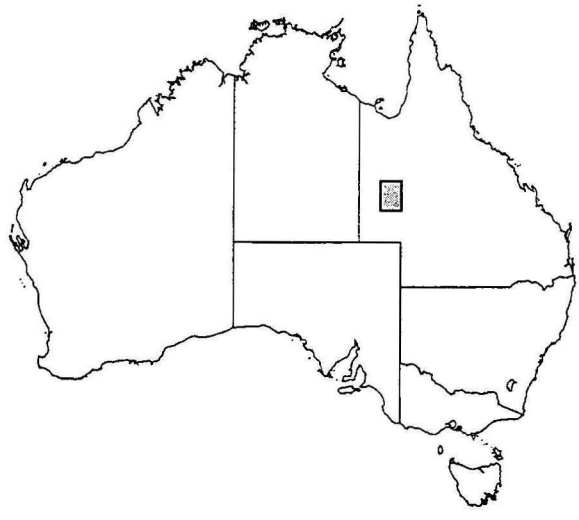
http://www.agso.gov.au/minerals/

Estimated Depths To Magnetic Basement Boulia and Springvale 1:250 000 Sheet Areas, Queensland

product

The depth estimates were produced using the AutoMag routine. AutoMag is a module of the ModelVision software package, developed by Encom Technology Pty. Ltd. The AutoMag routine is based on the Naudy technique (Naudy, H. 1971, Automatic determination of depth on aeromagnetic profiles: Geophysics, Vol. 36, 717-722) and further improvements to this method by Shi, Z. (1991, An improved Naudy-based technique for estimating depth from magnetic profiles: Exploration Geophysics 22, 357-362) and Shi, Z. & Boyd, D. (1993, AUTOMAG — An automatic method to estimate thickness of overburden from aeromagnetic profiles: Exploration Geophysics 24, 789-794). The Naudy technique identifies the position of individual anomalies along profile data and compares the anomaly from a theoretical body (dyke, edge or sheet) to the observed magnetic field.

PRICE **TRANSPARENCY** $150.00 each (postage and handling are extra)	Copies of this map may be purchased from the: **AGSO SALES CENTRE (Maps)** Telephone: (06) 249 9519/9642 Facsimile: (06) 249 9982 E-mail: sales@agso.gov.au using the order form supplied.

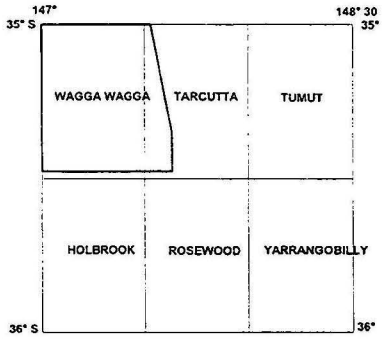


product

Elevation Data Release
Wagga Wagga 1:100 000 area NSW

Elevation data for the Wagga Wagga 1:100 000 area NSW have been computed from GPS and radar-altimeter data collected in the course of an airborne geophysical survey carried out in April and May 1992. Data were collected on east-west flight lines 400 metres apart. The survey was one of AGSO's first using a GPS receiver for navigation. The GPS data were recorded every 5 seconds and the radar altimeter every second. The GPS data were interpolated to 1 second intervals to make the elevation calculations.

The extent of the coverage is shown on the diagrams below.



The cost of products are:

Elevation contour map at 1:100 000	$40 (dyeline)	$120 (transparency)

The digital data for the area are available as point located data (PLD) and as grids.

PLD and grid A$500

Point Located Data and grid may be purchased from:	Copies of this map may be purchased from:
Mr Duncan Souter **AGSO Airborne Geophysical Data Sales** Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986 using the order form supplied.	**AGSO Sales Centre (Maps)** Telephone: (02) 6249 9519 / 9642 Facsimile: (02) 6249 9982 E-mail: sales@agso.gov.au using the order form supplied.

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

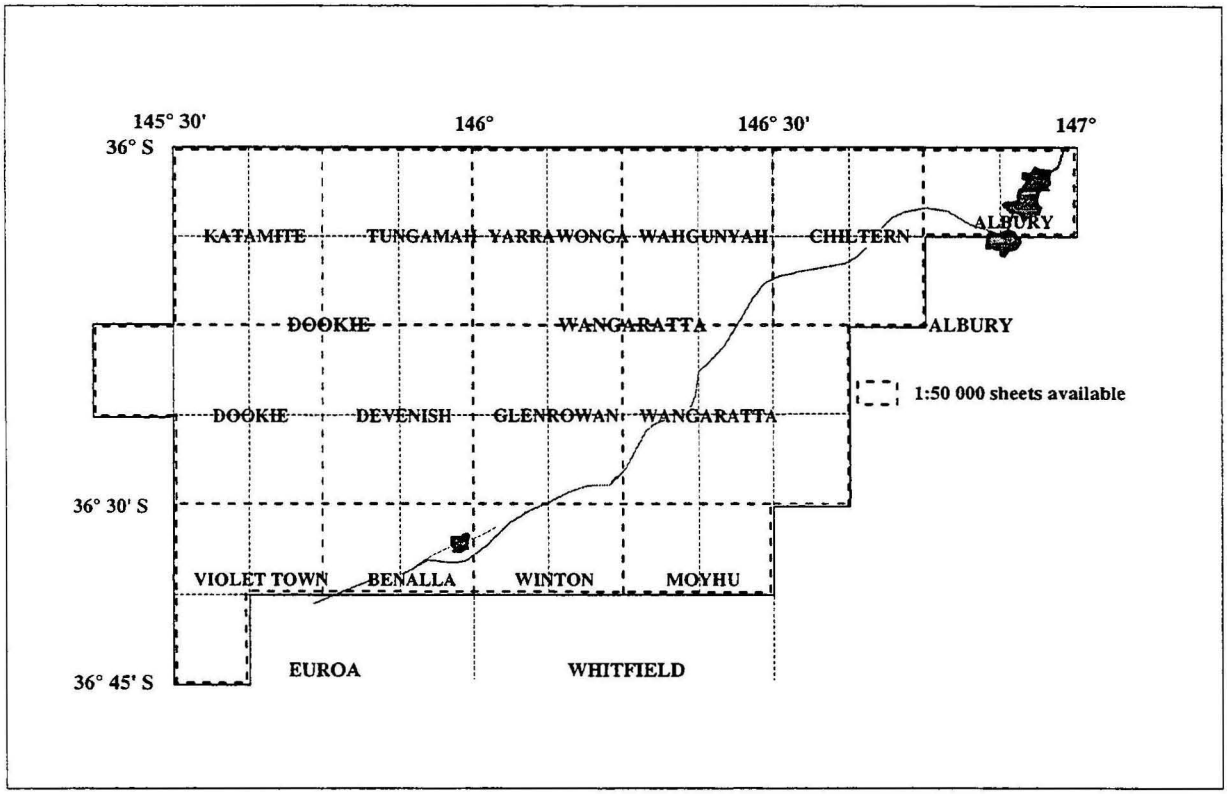
http://www.agso.gov.au/minerals/

product

Geophysical Data Release
National Geoscience Mapping Accord
Wangaratta Victoria

AGSO announces the release of new high resolution airborne magnetic, gamma–ray spectrometric and digital elevation model data from the Dookie, Wangaratta, Albury, Euroa and Whitfield 1:100 000 Sheet areas on the Wangaratta 1:250 000 Sheet area in northern Victoria.

This is a National Geoscience Mapping Accord project implemented by AGSO and the Geological Survey of Victoria. The survey is a continuation of a detailed geophysical mapping program undertaken in the Lachlan fold belt and the Murray Basin. Data collected during the survey provides the framework necessary for government and industry to assess resource potential, determine land use and environmental management policies, and aid in the planning of more detailed exploration activities. The survey area is shown in the diagram below.



The survey was flown between 18 March and 9 May 1997 and produced 45 459 line km of geophysical data. Flight lines were flown east–west at 80 metres above ground level and spaced 200 metres apart. Magnetic data were sampled every 0.1 seconds (~ 7 metres), gamma–ray spectrometric data were sampled every 1 second (~ 70 metres). Navigation as well as the digital elevation model data were provided by the satellite Global Positioning System (GPS) in real time differential mode via an Optus satellite link to a Fugro Omnistar Plus base station system. These GPS data were sampled every 0.5 seconds (~35 metres). Final position and elevation data were determined by post flight differential processing of the raw GPS data.

AGSO
AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

Wangaratta Victoria - Price List

Airborne Geophysical Maps

SCALE	MAP TYPE	COST	
		DYELINE	TRANSPARENCY
1:250 000	TMI Contours	$120	$250
	Dose Rate Contours	$120	$250
	DEM Contours	$40	$120
1:100 000	TMI Contours	$40	$120
	Dose Rate Contours	$40	$120
1:50 000	Flight Path Maps	$15	$45
	TMI Contours	$40	$120
	TMI Profiles	$15	$45
	Dose Rate Contours	$40	$120

Airborne Geophysical Digital Data

Point located magnetic (PLD), gamma–ray spectrometric and digital elevation model data and grids of same are to be released. PLD are available in units of 7.5' x 7.5' (1:25 000 Sheet).

UNIT	DATA TYPE	COST
1 to 15; 7.5' x 7.5' area	TMI & Gamma–ray PLD	$300/Sheet
16 or more; 7.5' x 7.5' area	TMI & Gamma–ray PLD	$260/Sheet
1:100 000 Sheet area	TMI & Gamma–ray PLD	$4160/Sheet
Entire AGSO survey	TMI & Gamma–ray PLD	$13 000

TMI and gamma–ray spectrometric grids are available in units of 1:100 000 sheet areas.

DATA COVERAGE	DATA TYPE	COST
1:100 000 sheet, full AGSO coverage	TMI grid	$1 000/sheet
	TC+K+U+TH grids	$1 000/sheet
1:100 000 sheet, partial AGSO coverage	TMI grid	$500/sheet
	TC+K+U+TH grids	$500/sheet
Entire AGSO survey area	TMI grid	$3 000
	TC+K+U+TH grids	$3 000

Digital Elevation Model data are available only for the entire AGSO survey area.

DATA COVERAGE	DATA TYPE	COST
Entire AGSO survey area	DEM PLD + grid	$1 000

Point Located Data and grids may be purchased from:

Mr Duncan Souter,
AGSO Airborne Geophysical Data Sales

Telephone: (02) 6249 9223
Facsimile: (02) 6249 9986

using the order form supplied.

Copies of maps may be purchased from:

AGSO Sales Centre (Maps)

Telephone: (02) 6249 9519 / 9642
Facsimile: (02) 6249 9982
E-mail: sales@agso.gov.au

using the order form supplied.

product

Wangaratta Victoria - Total Magnetic Intensity (Reduced To The Pole) and Gamma-ray Spectrometric - Pixel Image Maps

product

Colour and grey-scale pixel-image maps are being released by AGSO for the National Geoscience Mapping Accord 1:250 000 Sheet area of Wangaratta in Victoria. The data were acquired in surveys funded by AGSO and the Geological Survey of Victoria. Detailed geological mapping, aided by the use of these images, will enhance the chances of future economic discoveries, and provide valuable information for environmental management.

MAPS	
TMI (RTP)	
Colour	$300
Grey-scale	$250
Both TMI pixel-image maps (in one order)	$500
Gamma-ray spectrometric colour composite	$300

Copies of this map may be purchased from:

AGSO Sales Centre (Maps)

Telephone: (02) 6249 9519 / 9642
Facsimile: (02) 6249 9982
E-mail: sales@agso.gov.au

using the order form supplied.

The basic data were acquired in two separate surveys by AGSO and Geo Instruments between December 1996 and May 1997 on east-west flight lines flown 80 metres above ground level and spaced 200 metres apart. Navigation data were provided by the satellite Global Positioning System (GPS) in real-time differential mode, giving positional accuracy to better than 5 m.

TOTAL MAGNETIC INTENSITY: The TMI images were compiled from processed total-field aeromagnetic data from which the International Geomagnetic Reference Field has been removed. The profile data were gridded to a cell size of 40 m using minimum curvature. The grid was then reduced to the pole (RTP). Gradient enhancement of the colour image was achieved by modulating colour intensity and saturation, using information derived from a sun-angle routine applied to the initial TMI (RTP) grid. Pixel colours were chosen from the natural palette (magenta high, blue low) using histogram equalisation. The grey-scale image represents the fractional vertical derivative of the TMI (RTP) grid data.

GAMMA-RAY SPECTROMETRIC COLOUR COMPOSITE: The processed profile data for the three gamma-ray spectrometric bands of Potassium, Thorium and Uranium were gridded to a cell size of 40 metres using minimum curvature. The image was then compiled by combining the three grids into a single three-band Red, Green, Blue (RGB) composite image. Twenty percent of the intensity and saturation was derived from the east-west gradient of total count data, to improve the definition of short-wavelength information.

Airborne magnetic maps and digital magnetic data for the Wangaratta 1:250 000 Sheet area are also available.

Digital data enquiries may be made to: Mr Duncan Souter,
Geophysical Mapping
AGSO
GPO Box 378
CANBERRA ACT 2601
Telephone:(06) 249 9223
Facsimile: (06) 249 9986

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

Broken Hill Area
Airborne Geophysical Data

product

MAGNETIC AND GAMMA-RAY DATA

DETAILED LINE SPACING

Digital data - point located

Unit	*Price*	
Line spacing	100 m	200 m
7½' x 7½'	$2 000	$1 000
1:25 000 Sheet area	$4 000	$2 000
1:100 000 Sheet area	$20 000	

Eastern half of:
Mawarra, Yalcowinna - $1 000
Glen Idol, Mundie Mundie Creek - $1 500
Wahratta - $2 000

- grids

Unit	*Price*
(Sheet area)	
1:25 000 (15' x 7½')	$1 000
1:50 000	$1 500
1:100 000	$6 000

Glen Idol, Little Aller Creek, Mawarra, Mundie Mundie Creek, Redan II (North and South), Redan III South,Umberumberka, Yalcowinna - $750

Line Maps

Map type	*Dyelines*	*Transparencies*
Profiles, flight path (1:25 000 - 15' x 7½')	$15	$45
Contours (1:25 000 - 15' x 7½')	$25	$75
Contours (1:50 000)	$40	$120
Contours (1:100 000	$120	$250

Magnetic pixel maps

Broken Hill, Kalabity, Mulyungarie, Taltingan 1:100 000 Sheet areas
Pseudocolour - $300 Greyscale - $250 Both - $500

Gamma-ray pixel maps

Broken Hill, Taltingan 1:100 000 Sheet areas
Pseudocolour - $300

SEMI-DETAILED LINE SPACING

Callabonna (S), Curnamona (N) and Frome - 400 m line spacing (see map overleaf)

Unit	**Digital data - point located**	**Grids - TMI or 4-channel gamma-ray**
4 - 15 of 7½' x 7½' areas	$150 each	
1:100 000 Sheet area	$2 080	$500
1:250 000 Sheet area	$10 750	$2 500

Magnetic pixel maps: Callabona, Curnamona and Frome
Pseudocolour - $300 Greyscale - $250 Both - $500

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11/97

Broken Hill Area
Airborne Geophysical Data

ELEVATION DATA

DETAILED LINE SPACING

Broken Hill, Corona, Fowlers Gap, Kalabity, Mulyungarie, Redan, Taltingan, Thackaringa 1:100 000 Sheet areas flown mainly at 100 m spacing (see map)

Point located and gridded data

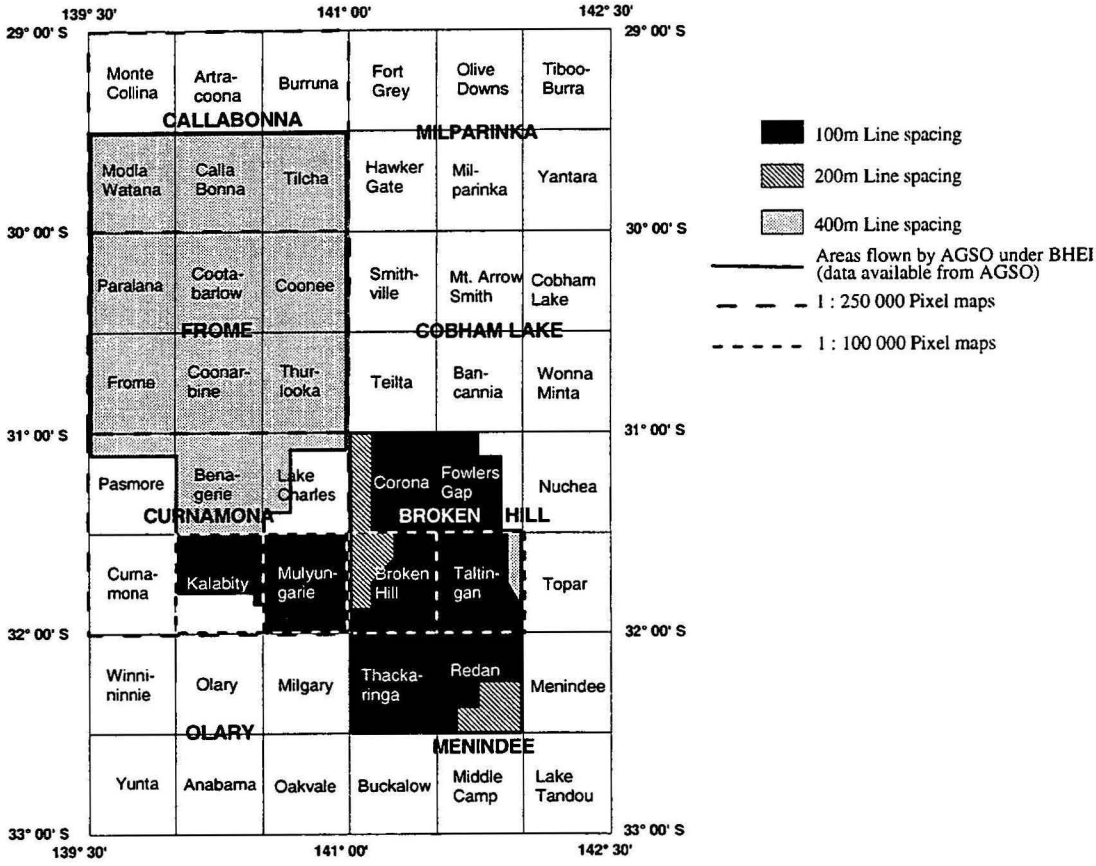
$500 per 1:100 000 Sheet area

SEMI-DETAILED LINE SPACING

Callabonna (S), Frome - 400 m line spacing (see map)

Point located and gridded data

$1 000 per 1:250 000 Sheet area



http://www.agso.gov.au/minerals/

product

Kimberley - Arunta Project
Airborne Geophysical Data

product

MAGNETIC AND GAMMA-RAY DATA

SEMI-DETAILED LINE SPACING - 400 m and 500 m (see map overleaf)

Digital data	**Point Located**		**Grids - TMI or 4-channel gamma-ray**	
	Line spacing			
Unit	400 m	500 m	400 m	500 m
4 - 15 of 7½' x 7½' areas	$150 ea	$120 ea		
1:100 000 Sheet area	$2 080	$1 500	$500	$450
1:250 000 Sheet area	$10 750	$8 500	$2 500	$2 250

Line maps

Map type	*Dyelines*	*Transparencies*
Profiles, flight path (1:100 000)	$15	$45
Contours (1:100 000)	$40	$120
Contours (1:250 000)	$120	$250

Magnetic pixel maps

1:250 000 - Dixon Range, Gordon Downs, Highland Rocks, Lissadell, Medusa Banks, Mount Theo and Port Keats
Pseudocolour - $300 Greyscale - $250 Both - $500
1:500 000 - Tanami area: Covers Tanami (east), The Granites, Mount Solitaire, Highland Rocks and Mount Theo - all at 500 m line spacing
Pseudocolour - $600 Greyscale - $500 Both - $1 000

RECONNAISSANCE LINE SPACING

800 m line spacing (see map overleaf)

Digital data	**Point located**	**Grids - TMI or 4-channel gamma-ray**
Unit		
1:100 000 Sheet area	$600	$200
1:250 000 Sheet area	$3 000	$1 000

Line maps - prices - as above

1 500 m line spacing

Digital data - point located - $750 per 1:250 000 Sheet area

Grid data (magnetic only) - available on 1:1 000 000 Sheet basis

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

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Kimberley - Arunta Project
Airborne Geophysical Data

Broome	$1 500	Darwin	$1 500	Lake Mackay	$1 500
Brunswick Bay	$500	Halls Creek	$2 000		

Line Maps

Map type	*Dyelines*	*Transparencies*
Profiles, flight path (1:250 000)	$10	$20
Contours (1:250 000)	$25	$75

ELEVATION DATA

SEMI-DETAILED LINE SPACING - 400 m and 500 m

Point located and gridded data

$1 000 per 1:250 000 Sheet area

Line maps (1:250 000)

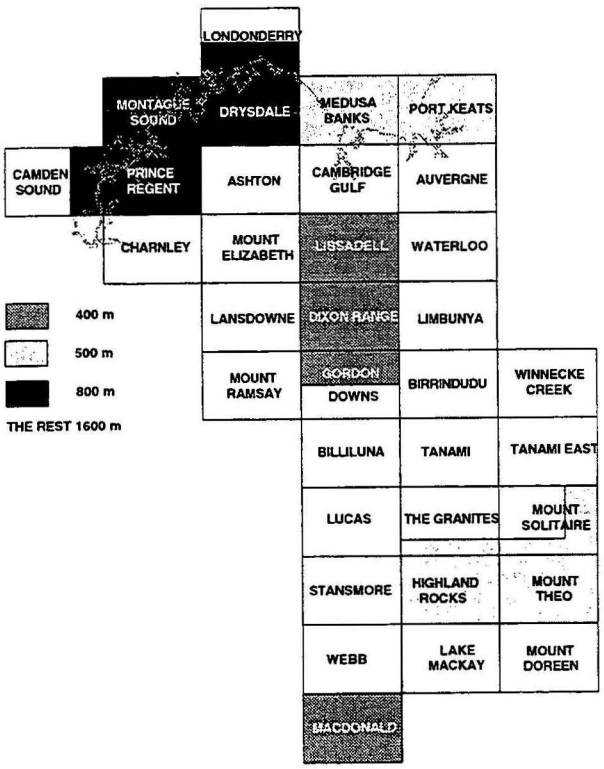
Dyeline - $40
Transparancy - $120

Pixel image maps (1:250 000)

Highland Rocks, Lissadell, Mount Theo
Pseudo colour - $300

RECONNAISSANCE LINE SPACING

Camden Sound (east), Drysdale, Londonderry (south), Montague Sound, Prince Regent - 800 m line spacing - to be released soon.



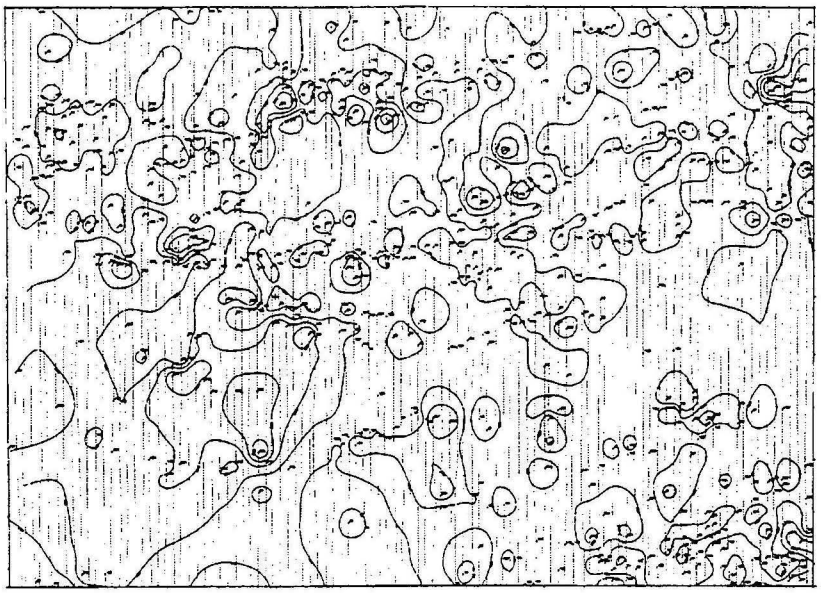
http://www.agso.gov.au/minerals/

product

product

Estimated Depths To Magnetic Basement Lake Mackay And Mount Doreen 1:250 000 Sheet Areas, Northern Territory

Maps of estimated depths to magnetic basement of the Lake Mackay and Mount Doreen 1:250 000 Sheet areas in the Northern Territory are being released. The individual maps contain over 500 depth estimates to magnetic sources displayed as values in metres below ground level. The depth estimates are contoured to provide a visual representation of the basement surface. The diagram below is a reduced version of the Lake Mackay depth to magnetic basement map.



A large proportion of the Australian continent consists of basement geology obscured by deep weathering profiles, concealed by relatively shallow cover material or deep sedimentary basins. For both the minerals and hydrocarbon exploration industries, it is vital to know the depths of this cover material. A depth to basement map supplies an important data set to constrain prospective regions.

The Lake Mackay and Mount Doreen Sheets areas are situated within the Proterozoic Arunta Complex of the Northern Territory. Basement outcrop is poor as much of the area is buried by Cainozoic cover material. The contoured depth estimates, for the Lake Mackay Sheet area, reveal a magnetic basement surface of variable depth, generally not exceeding 250 metres. The magnetic basement surface for the Mount Doreen Sheet area is also of variable depth, generally not exceeding 300 metres. Sediments of the east-west striking Ngalia Basin occur across the middle section of the Mount Doreen Sheet area. Depth estimates in this region reveal depths of greater than 3000 metres for the sedimentary basin.

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

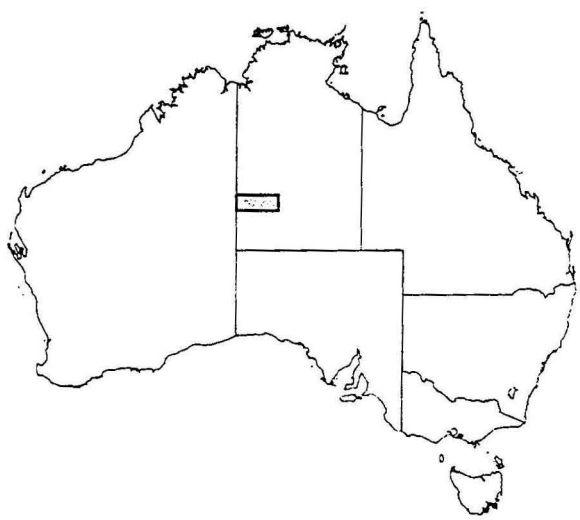
http://www.agso.gov.au/minerals/

Estimated Depths To Magnetic Basement Lake Mackay And Mount Doreen 1:250 000 Sheet Areas, Northern Territory

product

The depth estimates were produced using the AutoMag routine. AutoMag is a module of the ModelVision software package, developed by Encom Technology Pty. Ltd. The AutoMag routine is based on the Naudy technique (Naudy, H. 1971, Automatic determination of depth on aeromagnetic profiles: Geophysics, Vol. 36, 717-722) and further improvements to this method by Shi, Z. (1991, An improved Naudy-based technique for estimating depth from magnetic profiles: Exploration Geophysics 22, 357-362) and Shi, Z. & Boyd, D. (1993, AUTOMAG — An automatic method to estimate thickness of overburden from aeromagnetic profiles: Exploration Geophysics 24, 789-794). The Naudy technique identifies the position of individual anomalies along profile data and compares the anomaly from a theoretical body (dyke, edge or sheet) to the observed magnetic field.

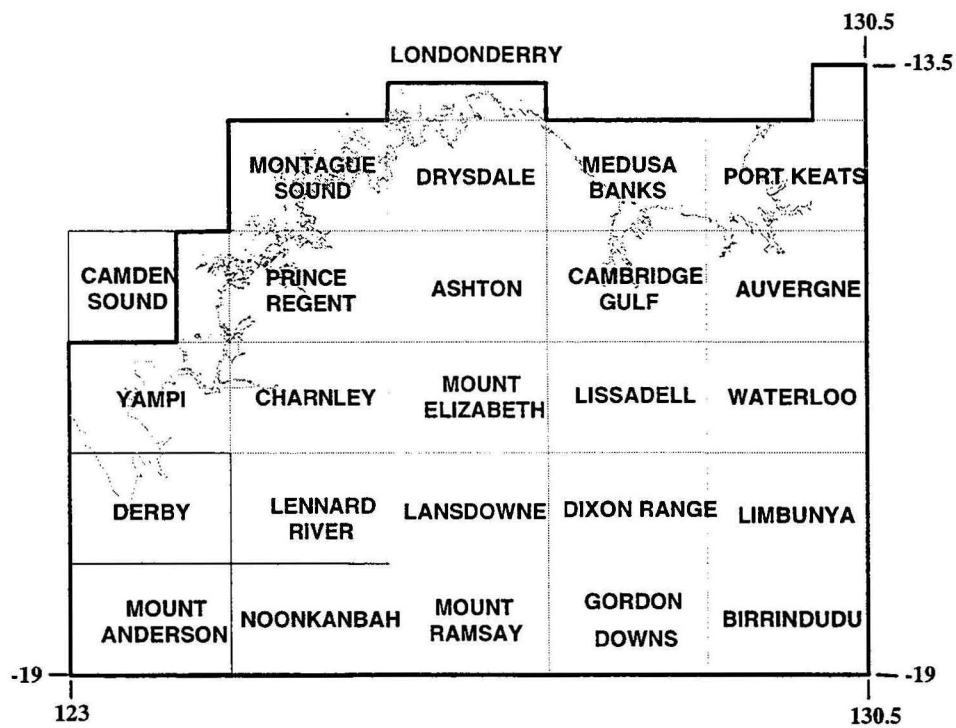
PRICE **TRANSPARENCY** $150.00 each (postage and handling are extra)	Copies of this map may be purchased from the: **AGSO SALES CENTRE (Maps)** Telephone: (06) 249 9519/9642 Facsimile: (06) 249 9982 E-mail: sales@agso.gov.au using the order form supplied.



product

Kimberley Region W.A. - Total Magnetic Intensity (Reduced to the Pole) - Gradient Enhanced Pixel Image Map

A new 1:1 000 000 scale high quality colour magnetic pixel-image is being released by AGSO for the Kimberley region of Western Australia. The extents of the map are shown in the diagram below. The map contains high resolution data in the 1:250 000 Sheet areas of Medusa Banks, Cambridge Gulf, Lissadell, Dixon Range, Port Keats and the northern half of Gordon Range. These data were acquired on lines spaced 400 m and 500 m apart during surveys flown between 1992 and 1994. The map also contains high quality regional data in the 1:250 000 Sheet areas of Camden Sound, Montague Sound, Prince Regent, Londonderry and Drysdale. These data were acquired in 1994, on lines spaced 800 m apart. The fringes of the map contain data from reconnaissance geophysical surveys flown between 1966 and 1989. The Ashton and Mount Elizabeth map sheets were acquired at 400 m line spacing. These data and that of Cambridge Gulf are owned by Kevron Geophysics and are displayed at 1600 m line spacing resolution.



The basic data were acquired by AGSO, Aerodata, Kevron Geophysics, Adastra Hunting Geophysics and World Geoscience between 1966 and 1994. The semi-detailed data were acquired in lines flown 400 m and 500 m apart, between 60 m and 100 m above ground level (AGL). Navigation data were provided by satellite Global Positioning System (GPS). The high quality regional data were acquired on flight lines spaced 800 m apart, 100 AGL and with navigation data provided by GPS. The reconnaissance data were acquired on flight lines spaced 1500 m and 1600 m apart, mostly 150 m AGL; Navigation data were provided by Doppler and aerial photography.

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

Kimberley Region W.A. - Total Magnetic Intensity (Reduced to the Pole) - Gradient Enhanced Pixel Image Map

The image was compiled from total field aeromagnetic data from which the International Geomagnetic Reference Field has been removed. The gridded data for the individual surveys were regridded to a cell size of 3 seconds of arc. These grids were combined by minimising differences across the overlapping sections of the surveys. The final grid was projection to a Lambert Conformal Conic projection, with a cell size of 80 m.

The composite grid was then reduced to the pole (RTP). Pixel colours were chosen from the natural palette (magenta high, blue low) using histogram equalisation. Gradient enhancement of the image was achieved by modulating colour intensity and saturation, using information derived from a sun-angle routine applied to the initial RTP grid.

MAP	Copies of this map may be purchased from:
1:1 000 000 scale map TMI (RTP) gradient-enhanced colour: $600 laminated $550 non-laminated	**AGSO Sales Centre (Maps)** Telephone: (02) 6249 9519 / 9642 Facsimile: (02) 6249 9982 E-mail: sales@agso.gov.au using the order form supplied.

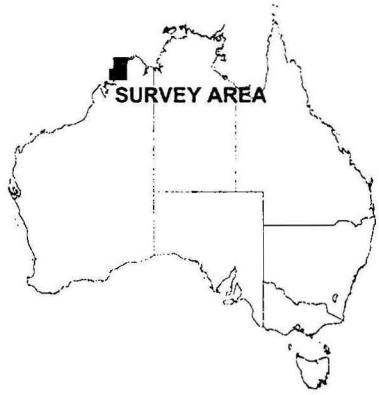
product

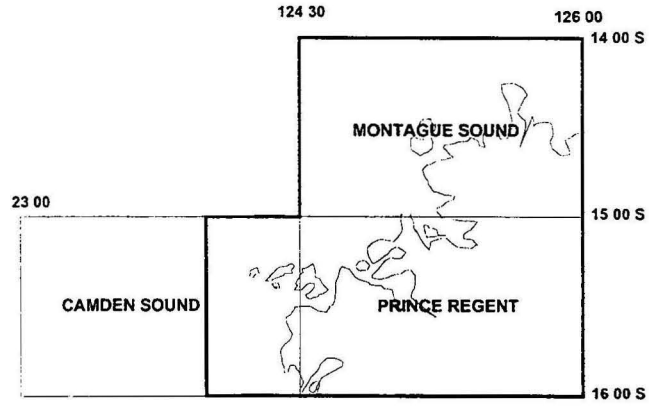
product

Elevation Data Release
Prince Regent, Montague Sound, and Camden Sound 1:250 000 areas WA

Elevation data for the Prince Regent, Montague Sound, and Camden Sound 1:250 000 areas WA have been computed from GPS and radar-altimeter data collected during the course of an airborne geophysical survey. The survey was carried out by World Geoscience Corporation under contract to AGSO in June and July 1994. Data were collected on north-south flight lines 800 metres apart. Elevations for offshore areas which comprise nearly half the survey area have been nulled for mapping.

The extent of the coverage is shown on the diagrams below.





The cost of products are:

Elevation contour maps at 1:250 000	**dyeline A$**	**transparencies A$**
Prince Regent	40	120
Montague Sound	40	120
Camden Sound	40	120

The digital data for the entire area are available as point located data (PLD) and as a grid.

PLD and grid A$1 000

Point Located Data and grid may be purchased from:	Copies of this map may be purchased from:
Mr Duncan Souter **AGSO Airborne Geophysical Data Sales** Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986 using the order form supplied.	**AGSO Sales Centre (Maps)** Telephone: (02) 6249 9519 / 9642 Facsimile: (02) 6249 9982 E-mail: sales@agso.gov.au using the order form supplied.

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

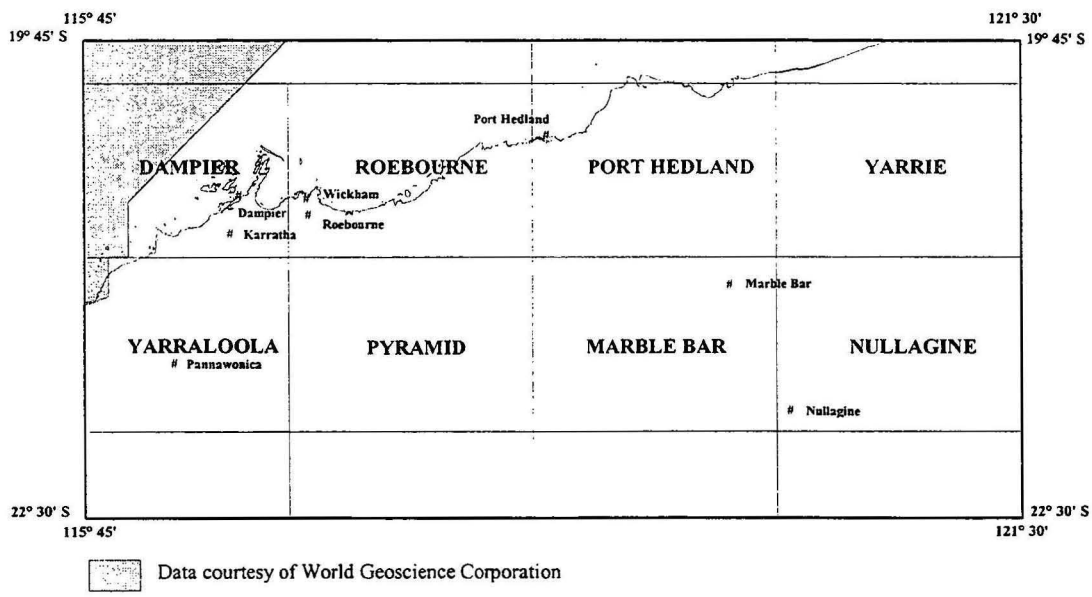
Release date: 4 December 1997

http://www.agso.gov.au/minerals/

product

Pilbara Region W.A. - Total Magnetic Intensity (Reduced To The Pole) - Gradient Enhanced Pixel Image Map And Digital Data

A new 1:500 000 scale high quality colour magnetic pixel-image map and digital grid data are being released by AGSO for the Pilbara region of Western Australia. The extents of the map are shown in the diagram below. Most of the map contains new high resolution data in the 1:250 000 Sheet areas of Nullagine, Yarrie, Roebourne, Pyramid, Dampier, Yarraloola, Port Hedland and Marble Bar. These data were acquired on lines spaced 400 m apart during surveys flown in 1995 and 1996. The north western offshore area of the map contains data courtesy of World Geoscience Corporation, acquired during a survey flown in 1993. Semi-detailed data over west Pilbara and east Pilbara were acquired jointly with GSWA. The fringes of the map contain data from reconnaissance geophysical surveys flown between 1984 and 1992. Detailed geological mapping, aided by the use of this image and data, will enhance the chances of future economic discoveries, and provide valuable information for environmental management.



This pixel map clearly illustrates several important features of the Pilbara which are critical to those exploring in the Pilbara as well as those interested in Archaean granite/greenstone tectonics and evolution. The features include:

- The first overview (at a useful scale) of the entire craton beneath late Archaean rocks and younger cover.
- The full extent of the fractures and shear zones in the Pilbara Region.
- The complex of the poorly understood granitoid complexes as revealed by marked textural and susceptibility contrasts within, and between, the complexes.
- The full extent of the mineralised greenstone sequences including under cover regions which can be correlated using differences in magnetic signatures.
- Display of the fine detail contained in the new high resolution geophysics, over a large area.

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Release date: 4 December 1997

http://www.agso.gov.au/minerals/

Pilbara Region W.A. - Total Magnetic Intensity (Reduced To The Pole) - Gradient Enhanced Pixel Image Map And Digital Data

The basic data were acquired by AGSO, Aerodata, Geometrics, Kevron Geophysics, Tesla Airborne Geoscience and World Geoscience Corporation between 1984 and 1996. The semi-detailed data were acquired on flight lines spaced 400 m apart, mostly 80 m above ground level (AGL). Navigation data were provided by satellite Global Positioning System (GPS). The World Geoscience Corporation survey data were acquired on flight lines spaced 1000 m apart, 80 m AGL. Navigation data were provided by GPS. The reconnaissance data were acquired on flight lines spaced 1500 m or 1600 m apart, mostly 150 m AGL. Navigation data were provided by Syledis UHF radio navigation or aerial photography.

The image was compiled from total field aeromagnetic data from which the International Geomagnetic Reference Field has been removed. The processed profile data for the separate semi-detailed surveys were gridded to a cell size of 3 seconds of arc using minimum curvature. These grids were combined by minimising differences across the overlapping sections of the surveys. The reconnaissance data were extracted from the Magnetic Anomaly Map of Australia (second edition) and micro-levelled. The final grid was created by merging the semi-detailed and reconnaissance data before reprojection to a Lambert Conformal Conic projection, with a cell size of 90 m.

The composite grid was then reduced to the pole (RTP). Pixel colours were chosen from the natural palette (magenta high, blue low) using histogram equalisation. Gradient enhancement of the image was achieved by modulating colour intensity and saturation, using information derived from a sun-angle routine applied to the initial RTP grid.

DIGITAL DATA:

The final composite total magnetic intensity grid data (full precision) are available from AGSO in ER Mapper format. The image-processed data (8-bit integer), as used in this map, are also available from AGSO in BIL format, suitable for use in ArcView or MapInfo. A 100% rebate will apply to persons/companies who have previously purchased data for any of the semi-detailed surveys which comprise this composite grid.

Airborne geophysical maps and digital data for the separate semi-detailed surveys are also available. Digital data for the separate reconnaissance surveys are also available.

These digital products do not include the World Geoscience Corporation survey data (shown in the diagram). Enquiries regarding these data should be made to World Geoscience Corporation.

MAP 1:500 000 scale map (approx. 128cm x 85cm) TMI (RTP) gradient-enhanced colour: $600 laminated $550 non laminated **The hardcopy map is of the highest quality, printed via a 4-colour separation technique using a large format commercial printing press.**	Copies of this map may be purchased from: **AGSO Sales Centre (Maps)** Telephone: (02) 6249 9519 / 9642 Facsimile: (02) 6249 9982 E-mail: sales@agso.gov.au using the order form supplied.
DIGITAL DATA ER Mapper format grid $11,000 (4-byte real data)* BIL format grid $4,000 (image processed, 8-bit integer data)* * Excludes WGC data	Mr Duncan Souter, **AGSO Airborne Geophysical Data Sales** Telephone: (02) 6249 9223 Facsimile: (02) 6249 9986 using the order form supplied.

Minerals Division Laboratory Facilities

Inductively Coupled Plasma - Mass Spectrometer (ICP-MS)

The Perkin Elmer Elan 6000 is AGSO's state-of-the-art ICP-MS which is used in conjunction with the X-ray fluorescence (XRF) spectrometer for the analysis of whole rock, stream sediment, soil, groundwater and other aqueous samples. The ICP-MS extends the range of trace elements and the detection limits (concentrations >50 ppb) which can be obtained by XRF analysis. These data are crucial to the National Geoscience Mapping Accord (NGMA) and the Australian Minerals System projects.

X-ray Fluorescence (XRF) Spectrometry

The Philips PW 1404 XRF spectrometer is used for analysing powdered samples for a suite of 11 major elements (concentrations >0.01%) and selected trace elements (> 0.5-5 ppm). These data are crucial to studies of genesis of rock units, stream sediment and resource potential assessments.

Camebax Electron Probe Micro-Analyser (EPMA)

The Camebax (Cameca) electron microprobe is a shared AGSO-ANU facility for the elemental analysis of minerals. It is equipped with both energy-dispersive and wavelength dispersive X-ray spectrometers. This instrument is primarily used for major element microanalysis (typical detection limits exceed 50-100 ppm) although detection limits may be extended into the trace element range by the use of longer counting times and precise background corrections.

Leco RC-412 Multiphase Carbon/Hydrogen/Water Determinator

The Leco RC-412 is used to determine both organic and inorganic forms of carbon and water (concentration range 0.2 to 20%) in pulverised samples. It uses an infrared detection system and has a state-of-the-art furnace which allows the temperature to be stepped and ramped. These data complement the elemental data obtained in the above mentioned techniques.

X-ray Diffraction (XRD) Spectrometry

The Seimens D500 XRD is used to identify and determine the of minerals in powdered samples. These data are used in petrological, marine, environmental and regolith studies.

Portable Infrared Mineral Analyser (PIMA)

The PIMA is a field-portable, shortwave infrared spectrometer that provides rapid data on rocks and minerals. It is extremely useful for delineating alteration systems and for understanding alteration-mineralisation relationships. Measurements can be made on all types of samples including, diamond drill core, RC and RAB chips, outcrop and soil samples.

Laser Raman Microprobe (LRMP)

The new laser Raman microprobe has a fully confocal microscope and is used for the rapid identification and non-destructive analysis of solids, liquids and gases. The high spatial resolution of this instrument (down to 1 Ωm) makes it particularly suitable for the identification of gases and solids in fluid inclusions. However, the Raman microprobe can also be used to rapidly identify minerals in thin sections, rock chips, or drill core. The advantages of this method include visual selection of each mineral, non-destructive spot analysis, little or no sample preparation, and the ability to identify mineral poplymorphs. This makes it a powerful method for the identification of very fine grained mixtures such as those commonly encountered in alteration zones surrounding hydrothermal mineral deposits.

Heating/Freezing Stages

AGSO's microthermometry laboratory contains the following heating/freezing stages:

- Linkam THM 600 stage (-196 to +600°C)
- ChaixMeca stage (-180 to +600°C)
- Fluidinc modified USGS gas flow stage (-180 to +700°C)
- Leica 1350 stage (25 to 1350°C)
- Linkam TS 1500 stage (25 to 1500°C)

This equipment is used to study melt and fluid inclusions and the data contributes to AGSO's ore deposit studies.

Fluid Inclusion Leachate Analysis

AGSO also has facilities for carrying out bulk leachate analysis of fluid inclusions. The small amount of fluid produced can be analysed by the Elan 6000 ICP-MS mentioned above. Only small samples of less than 100 mg are required to provide ratios of Mg, Ca, Fe, Mn, and Zn relative to Na. These data assist with ore deposit studies.

Micro-Photography and Image Processing

Fully automated colour or black and white print, 35mm slide and polaroid photomicrography can be carried out in both transmitted and reflected light on AGSO's Leitz Orthoplan microscope. Digital images can be captured using the Sony colour CCD camera and can be quantitatively analysed using the Quantimet 500MC Image Processing and Analysis system. This software allows images to be combined, added, subtracted, or given increased contrast and also incorporates a complete set of image measurements.

Isotope Geochemistry and Geochronology

AGSO has expertise in the application of the Sm-Nd and U-Pb systems in geochronological research related to the timing of stratigraphic, tectonic or mineralisation events of relevance to the National Geoscience Mapping Accord and the Australian Minerals System projects. Sm-Nd analyses are carried out on the Finnigan-MAT automated mass spectrometer and U-Pb analyses are carried out on one of two Sensitive-High Resolution Ion Microprobes (SHRIMP) housed at the Australian National University. This geochronological research is carried out in "real time" to enhance the second-generation mapping products. The data and geological overview of each of the results are available on AGSO's Ozchron database. AGSO's Organic Geochemistry Laboratory also carries out isotope ratio mass spectrometry for ^{13}C, ^{2}H, ^{18}O, ^{32}S and ^{15}N.

AGSO maintains advanced laboratory facilities for petrological, geochronological and mineralogical (including mineral deposit) studies to support its regional mapping and field based research programs. Our expertise and capabilities in these fields provides opportunities for additional projects which may be of particular interest to industry and other interested organisations. These short-term projects can be designed to meet immediate client needs and also to contribute to AGSO's regional research objectives. Please note that these facilities are only available through these collaborative arrangements and that the laboratories do not carry out routine geochemical processing as this can be done by other commercial laboratories.

For more information, talk to one of our geochemists:

John Pyke, Geochemistry
Phone: (06) 249 9288
Fax: (06) 249 9983
Email: jpyke@agso.gov.au

Rod Page, Geochronology
Phone: (06) 249 4261
Fax: (06) 249 0738
Email: rpage@agso.gov.au

Terry Mernagh, Economic Geology
Phone: (06) 249 9640
Fax: (06) 249 9983
Email: tmernagh@agso.gov.au

Rockproperty and Applied Palaeomagnetism Facility

A Research Service Project

Project Manager

Chris Klootwijk 02-6249 9324 (ph) 02 6249 9986 (fax)
Email: cklootwi@agso.gov.au

AGSO Project Staff

Charles Barton
John Giddings
Mart Idnurm
Chris Klootwijk
Peter Percival
Phil McFadden
Uros Rokvic

Cooperating Agency

Research School of Earth Sciences, ANU

Objectives

Provide efficient and high quality facilities and services for acquisition, analysis and interpretation of palaeomagnetic, rockmagnetic, magnetic fabric, environmental magnetic and rockproperty data.
Provide facilities and services for access and use of the in-house, Australian and global palaeomagnetic databases in conjunction with global reconstruction and tectonic analysis software.
Provide a palaeomagnetic and rockmagnetic training and information service.

Overview of Rockmagnetic and Palaeomagnetic Facilities and Services

The magnetism of rocks and its uses

Magnetism is the only geophysical property of rocks that can be evaluated over geological time. As a result it has become one of the most versatile tools that geoscientists have for studying and understanding geological processes. Magnetic methods can be used to: date and correlate rock units; date folding, faulting, and uplift; date and map fluid movement and chemical alteration; date magnetic by-products of mineralisation; map surface and subsurface geological boundaries; reconstruct ancient continental configurations and movements; determine palaeolatitudes; determine magnetic fabrics for use in magnetic anomaly modelling, and as indicators of ancient stress-fields, flow and palaeocurrent directions; act as a proxy for environmental change and as a tracer in provenance studies.

AGSO's capability

The magnetic signature and magnetic mineral content of practically all rocks can be determined quickly. AGSO operates a well-equipped, highly-automated, world-class laboratory for measuring and analysing the magnetic properties of rocks and offers a broad range of rockmagnetic and applied palaeomagnetic services with wide application throughout the exploration industry, mapping agencies and universities.

Laboratory and data-processing facilities

AGSO is the main partner in the joint AGSO-ANU palaeomagnetic-rockmagnetic laboratory at Black Mountain. AGSO will also operate a dedicated high-field rockmagnetic and rockproperty laboratory in its new building at Symonston. Emphasis in development of facilities has been focussed on efficiency and productivity in data-acquisition and analysis: automation and software design figure prominently in systems implementation. Instrumentation, sample preparation, and data-processing facilities include the following:

measurement of magnetic remanence

- ScT cryogenic magnetometer (2-axis, high sensitivity)

- 2G-Enterprises throughbore, cryogenic magnetometer for single samples and longcores (3-axis, high sensitivity)
- Molspin spinner magnetometer (reduced sensitivity, wide dynamic range)
- Digico spinner magnetometer (reduced sensitivity, wide dynamic range)

measurement of magnetic susceptibility and its anisotropy
- KLY-3 Kappabridge
- Digico susceptibility meter
- Digico anisotropy delineator
- Bartington susceptibility meter for single samples and longcores

demagnetisation equipment
- 2 large-volume, feedback-controlled, furnaces developed in-house
- Schonstedt thermal demagnetiser
- ASC thermal demagnetiser
- Fully-automated, AF demagnetiser with ARM capability, integrated with the 2G-Enterprises cryogenic magnetometer, that yields complete multi-step demagnetisations unattended (160 mT peak field)
- Schonstedt tumbling-specimen, AF demagnetiser (100 mT peak field)
- Tumbling-specimen, AF demagnetiser, developed in-house, with reverse action tumblers (200+ mT peak field)

rockmagnetic equipment
- Fully-automated KLY-3/CS-3 low-temperature/furnace unit (-190°C to 700°C) for quick magnetic mineral analysis
- Low-field and high-field electromagnets
- Magnetic hysteresis loop tracer

sample preparation facilities
- Full range of laboratory preparation and field-sampling equipment including: slabbing and cutting saws; wet and dry coring machines; sandblaster; diamond lapper; field-drilling and orientation equipment; soft-sediment Mackereth corer
- Frantz magnetic separator

data-processing facilities
- **Laboratory**: LAN-linked, PC workstations running in-house, menu-driven data-acquisition software connected to a central database for storage and real-time plotting.
- **AGSO**: ORACLE database of field and laboratory measurements; interactive analysis package; reconstruction and tectonic analysis software (ATLAS, GMAP, and PaleoGIS that runs under Arcview 3 GIS): MS-ACCESS databases (global palaeomagnetic poles, palaeointensities, polarity transitions and secular variation studies)

Rockmagnetic and applied palaeomagnetic services

AGSO is well-positioned to offer external clients use of the laboratory facilities and a broad range of rockmagnetic and applied palaeomagnetic measurement and interpretation services either on a consultative or collaborative basis. Services that we can provide include:

- Magnetic remanence and susceptibility (bulk, anisotropy) determination for single samples and logging of longcores
- Analysis of magnetic mineral content
- Directions of remanence for magnetic modelling using the pole path
- Dating and correlation of rock units using the pole path and magnetic polarity zonation
- Determination of the palaeolatitudinal evolution of source rocks
- Dating of fluid movement and magnetic phases during mineralisation using magnetic overprint chronology

- Sediment source tracing/catchment studies using magnetic mineral content
- Reviews and analyses of continental reconstruction models and pole paths
- Courses in palaeomagnetism, rockmagnetism and geomagnetism

Staff contacts

The palaeomagnetic-rockmagnetic group at AGSO comprises four full-time and two part-time staff who can be contacted for further information. Main areas of interest of group members are listed:

Dr Chris Klootwijk	Palaeozoic and Mesozoic applied palaeomagnetism, magnetostratigraphy, rockmagnetism, and regional geology. Tel: +61 2 6249 9324/6249 9554 Email: cklootwi@agso.gov.au
Dr John Giddings	Proterozoic and Palaeozoic applied palaeomagnetism, rockmagnetism, and software systems. Tel: +61 2 6249 9319/6249 9554 Email: jgidding@agso.gov.au
Dr Mart Idnurm	Proterozoic applied palaeomagnetism, rockmagnetism, and regolith dating. Tel: +61 2 6249 9314/6249 9554 Email: midnurm@agso.gov.au
Mr Peter Percival	Technical support and management of the laboratory AGSO operates. Tel: +61 2 6249 9325/6249 9554 Email: pperciva@agso.gov.au
Dr Charlie Barton	Environmental magnetism and geomagnetism. Tel: +61 2 6249 9611 Email: cbarton@agso.gov.au
Dr Phil McFadden	Statistical analysis and interpretation of palaeomagnetic and geomagnetic data Tel: +61 2 6249 9612 Email: pmcfadde@agso.gov.au

Recent Project Highlights

A major step forward has been achieved this year with completion of an in-house project for automation of routine data acquisition at the Black Mountain laboratory. The project concentrated on three instruments used for remanence and susceptibility measurement: ScT cryogenic magnetometer; 2G-Enterprises cryogenic magnetometer; Digico susceptometer. Automation involved development and implementation of integrated microengineering-software control systems within the laboratory's palaeomagnetic data-acquisition system (PALDAS).

Major benefits resulting from the automation project are: elimination of the risk of Occupational Overuse Syndrome (OOS); substantial improvement in the precision of measurement results; considerable improvement in sample throughput; elimination or reduction of operator involvement, depending on instrument; suppression of gyromagnetic noise effects and expansion of the range of lithologies to which AF-demagnetisation methods can be applied; development of a considerable arsenal of hardware and software modules with market potential; firm establishment of AGSO's Rockproperty and Applied Palaeomagnetism group on the global scene as a notable force in the development of innovative demagnetisation and measurement techniques following OH&S principles.

Future Development Plans

Overview

The main thrust of the Rockproperty and Applied Palaeomagnetism facility's continuing development will concentrate on extension and upgrading of AGSO's rockmagnetic capabilities into a state-of-the-art operational unit, providing efficient, timely and first-class response to external (industry) and internal (e.g. aeromagnetism) demands for service. Progress on acquisition of dedicated equipment for magnetic mineral analysis and logging of long cores depends on the future funding climate. It is intended that "high-field" rockmagnetic and rockproperty equipment be housed in the laboratory level of AGSO's Symonston building. Sensitive rockmagnetic and palaeomagnetic equipment will remain housed at the joint AGSO-ANU laboratory at Black Mountain.

The present high level of AGSO palaeomagnetic, laboratory-based, capabilities will be maintained with emphasis on: ongoing automation of the palaeomagnetic data-acquisition system (PALDAS); portage of the palaeomagnetic analysis and interpretation system (PALSYS) to the new UNIX (SUN) server with enhancement of graphic capabilities; development of a PC-based version of PALSYS to exploit commercial opportunities; finalising installation of the high-field AF-demagnetiser and the high-volume ASC furnace.

AGSO's past capability in rockproperties will be revived with provision of routine services for measurement of density and porosity parameters and in the longer term electrical conductivity and possibly induced polarisation parameters.

Rockmagnetic capabilities initiative

Demands for services from clients focus on enhancement of AGSO's capabilities in: (i) magnetic mineral analysis for applications such as aeromagnetic groundtruthing, dating of mineralisation phases and hydrocarbon movement, etc.; (ii) remanence and susceptibility logging of long cores. To service that demand will involve necessary expenditure on hardware acquisition and software development. Speed of realisation will be moderated by available finances. To enhance AGSO's service delivery in magnetic mineral analysis (i) and magnetic logging of long cores (ii) the following instruments will have to be acquired:

(i) *Pulse magnetiser*
This instrument represents a low-cost improvement over a conventional electromagnet. It provides an efficient method to determine IRM curves for magnetic mineral identification and for determination of the anisotropy of high-field susceptibility.

(i) *Spinner magnetometer*
Rockproperty studies require measurement of NRM intensity and direction on large quantities of samples. These measurements sometimes may have to be carried out on-site for external clients. This requires a dedicated magnetometer. The JR-5A spinner (AGICO, previously Geofyzika Brno) is well-suited for this task and is undoubtedly the leading conventional spinner magnetometer on the market. It is robust, well-engineered and PC-controlled with a wide dynamic range and is easy to operate and maintain.

(i) *Vibrating Sample Magnetometer (VSM) or Alternating Gradient Force Magnetometer (AGFM)*
Instruments of this type measure hysteresis parameters that are fundamental to rockmagnetic investigations, magnetic mineral identification, and magnetic granulometry. They are sufficiently sensitive to analyse marine longcore and other sediment samples. Highly automated VSMs and AGFMs have been available only during the last few years but are already the hallmark of leading rockmagnetism laboratories around the world.

(ii) *Automated longcore analysis facility*
The hardware of this facility consists of a PC-controlled transport system, three-axis in line AF-demagnetiser (100 mT peak field), Bartington susceptibility sensor (10cm), and an ARM bias-coil. Software will be developed in-house and implemented within the PALDAS system. The facility will be developed and operated initially by alternative part-time attachment of the hardware to the existing 2G-Enterprises 760R cryogenic

magnetometer (throughbore, 76mm) with the existing automated discrete-sample AF-demagnetiser.

(ii) *Automated scanning of longcore rockproperties*
Fast and non-destructive scanning of a variety of rockproperties is an essential requirement for many longcore studies. The integrated SCHULTEISEN system allows automated and simultaneous determination of susceptibility, gamma-ray and P-wave properties for large quantities of longcore material and has been developed for a dual, operational environment on-board ship (Rig Seismic or its successor, Franklin, any other drilling platform) and in the laboratory. It is well-suited to establish groundtruth for seismic profiling, local and regional correlation of cores, and sediment source patterns for environmental/climatic studies.

Products and Publications (past five years, selection: AGSO authors in bold text)

Aubourg, C., **Klootwijk, C.T.** and Korsch, R.J., 1995. Magnetic fabric and palaeomagnetic studies in the Texas and Coffs Harbour blocks, New England Orogen. *AGSO Record 1994/58*, 87pp.

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Palaeomagnetism And Rock Magnetism AGSO Records

AGSO Records describing comprehensive results from palaeomagnetic and rock magnetic studies carried out at the Australian Geological Survey Organisation are available from the AGSO Sales Centre, GPO Box 378 Canberra ACT 2601. For postal orders add $5 to the marked prices ($15 overseas).

Klootwijk, C.T. (Compiler), 1993. Palaeomagnetism in Australasia: Dating, Tectonic and Environmental Applications, Seminar Abstracts, AGSO Record, 1993/20, 94pp. *$15*

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Klootwijk, C.T.,1997. Phanerozoic configurations of Greater Australia: Evolution of the North West Shelf. Part two, Palaeomagnetic and geologic constraints on reconstructions. AGSO Record 1996/52, 85pp. *$35*

Klootwijk, C.T., 1997. Phanerozoic configurations of Greater Australia: Evolution of the North West Shelf. Part three, Palaeomagnetic Data Base. AGSO Record 1996/53, 148pp. *$25*

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Palaeomagnetism And Rock Magnetism Services

Service		(no sample prep.)
Susceptibility		
• Initial bulk susceptibility measurement	$40	$20
• Anisotropy of susceptibility determination	$50	$35
• Susceptibility/temperature determination 0 to 700°C	$95	
same, -200 to 0°C	$75	
same , -200 to 700°C	$150	
(for magnetic mineralogy and granulometry)		
• Susceptibility logging	$70	setup
(long cores up to 3m)	$30	per metre
Remanent (permanent) magnetisation		
• Initial NRM measurement	$40	$20
(direction, intensity of total remanence)		
• Progressive thermal demagnetisation (20 steps)	$195	$180
(direction, intensity of components of remanence)		
• Progressive AF demagnetisation (20 steps)	$130	$115
(direction, intensity of components of remanence)		
• Lowrie test (20 step IRM, 20 step thermal demagnetisation)	$350	$335
(for magnetic mineralogy)		
• NRM logging	$70	setup
(long cores up to 3m)	$30	per metre
Daily rates		
• Mackereth corer, equipment + operator	$1200	
all freight and field costs taken by hirer		
• Measurements by Technical Officer (8 hrs)	$350 + $200	(equipment access)
• Interpretation, reports by Research Scientist	$450	
by SES-equivalent scientist	$600	
Equipment hire (at laboratory)		
• Flat rate/hr	$25	
Bulk reduction (except long cores)		
• >10 samples	10%	
• >25 samples	20%	

For further information about services contact:

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Palaeomagnetism And Rock Magnetism Software

Software utilities have been developed at AGSO for reduction, analysis, and interpretation of palaeomagnetic data, by members of the Rock properties and Applied Palaeomagnetism group. The utilities are available from the AGSO Sales Centre, GPO Box 378, Canberra, ACT 2601. For postal orders add $5 to the marked price ($15 overseas).

GRIDCON, ***converts between eastings/northings and latitude/longitude. For MS-DOS PCs and Apple Macintosh. Fortran code included (C. Barton).*** ***$30***

SUNAZ, ***reduces solar observations to obtain true azimuth. For MS DOS PCs and Apple Macintosh. Fortran code included (C. Barton).*** ***$50***

HPGL VIEWER, ***utility to view and digitize HPGL files. For MS-DOS PCs with EGA or better video card. C code not included (P. McFadden).*** ***$50***

NEWCIRC, NEWFIT, ***palaeomagnetic analysis tools for fitting great circles and estimating ancient directions. For MS-DOS PCs with EGA or better video card. C code not included (P. McFadden).*** ***$100***

(McFadden, P.L. and McElhinny, M.W., 1988. The combined analysis of demagnetization circles and direct observations in palaeomagnetism. Earth and Planetary Science Letters, 87, 161-172)

FOLDTESTS, a ***suite of five different fold test programs. For MS-DOS PCs with EGA or better video card. C code not included (P. McFadden).*** ***$120***

(McFadden, P.L. and Jones, D.L., 1981. The fold test in palaeomagnetism. Geophysical Journal of the Royal Astronomical Society, 67, 53-58; McFadden, P.L., 1990. A new fold test for palaeomagnetic studies. Geophysical Journal International, 103, 163-169)

REVERSAL, ***classification of the reversal test. For MS-DOS PCs with EGA or better video card. C code not included (P. McFadden).*** ***$40***

(McFadden, P.L. and McElhinny, M.W., 1990. Classification of the reversal test in palaeomagnetism. Geophysical Journal International, 103, 725-729)

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