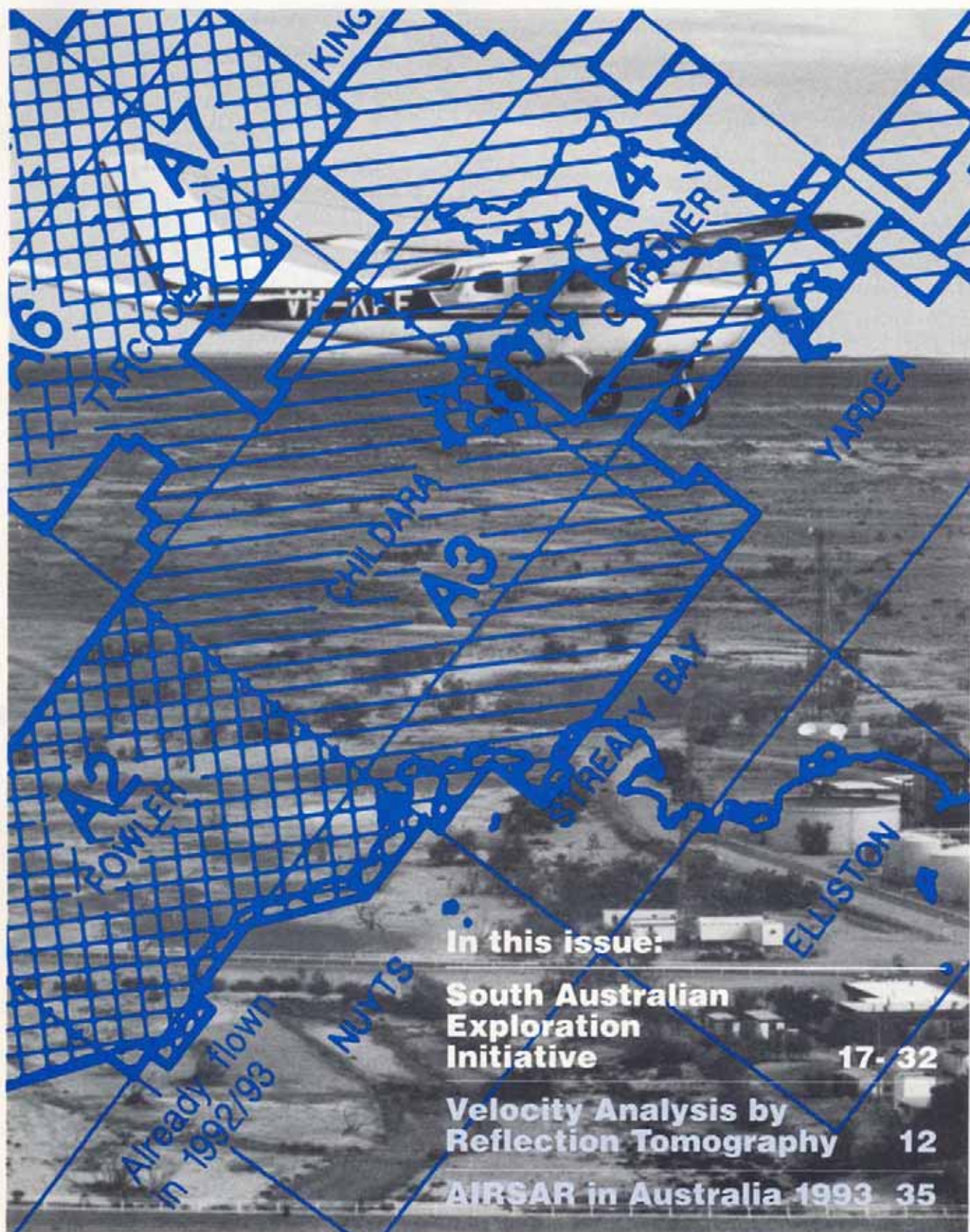


# Preview



Issue No.45





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## Editors Desk

The new look Preview, (produced with design help of Mark Littler Design) is one effort supported by the ASEG Executive to improve the standard of communication within the society. A newsletter is the circulatory system of this body we call the ASEG and a new look newsletter gives the body a chance to revitalize itself.



Looks are fine but what about the quality of "blood" that flows through the circulatory system? At the heart of the newsletter the Preview team are working hard to pump new blood into the body. Blood must continue to flow back from the extreme capillaries of our profession for the circulatory system to work properly and the body to grow. You are a vital part of the ASEG body and your participation in keeping the blood flowing through this newsletter is valued.

Continuing in this metaphorical vein (sic), I am concerned, as Editor, that perhaps ASEG Preview is not always catering adequately in particular for seismic-oriented members of our profession. Petroleum geophysicists we need your help to solve this - Please send blood to the heart regularly!

ASEG Corporate sponsor, the South Australian Department of Minerals and Energy made a large donation to the body in this issue (p17-32) with news of exploration initiatives, much of it using geophysics, to stimulate exploration activities in their State. A particular thankyou goes to SA DME and staff for sponsoring and preparing this colour feature for Preview.

David Gamble who arranged for the SA DME feature gives his forthright views on the Government role in exploration in the VIEWPOINT article (p4).

*Geoff Pettifer, Editor*

## Preview Deadlines

Issue	Deadline
October '93	October 9, 1993
December '93	November 27, 1993
February '94	February 4, 1994
April '94	April 1, 1994
June '94	May 27, 1994
August '94	July 29, 1994
October '94	September 30, 1994
December '94	November 25, 1994



## President's Piece

### Professorial Positions in Geophysics

The Australian Research Council (ARC) requested a strategic review of the research strategies in the discipline of earth sciences. This was undertaken by the Australian Geoscience Council (AGC) who invited ten representatives from industry, government institutions and academia, to form a Working Party. The conclusions of the working party were published in August 1992 under the title "Towards 2005: A Prospectus for Research and Research Training in the Australian Earth Sciences". I will present a summary of this document in a forthcoming edition of Preview, but at the moment I would like to comment on one aspect outlined in the conclusions of the document, and the possible implications to the ASEG.



Within the broad umbrella title of "earth sciences", geophysics is one of component sub-disciplines (along with geochemistry, petroleum geology, economic geology, mineralogy, etc; geology as such does not appear as a sub-discipline and seems to be regarded as synonymous with earth sciences!). Geophysics and in particular, exploration geophysics were clearly identified as a weakness. In the context of the report this is stating that tertiary education and research in geophysics is not well established or implemented; and that a strategy to improve the situation is not yet in place. This is not aiming at individuals and implying that they are not doing their job. We have a number of top quality people in the Tertiary education system and the CSIRO who are doing excellent work, but their efforts are often fragmented and unsupported both financially and morally. The recommendation for the Working Party was for the implementation of a strategy which included the integration of existing resources in to a number of more cohesive entities e.g. VIEPS, and to increase funding for geophysical teaching and research at these establishments.

Possibly as a result of the report by the Working Party, or possibly encouraged by it, there has been an increase in the number of proposed professorial positions in geophysics being established in Australia, e.g. Macquarie, Curtin, New South Wales, Adelaide (see advert p46) and later in Monash. The ASEG has been approached and our opinion sought as to the level of moral and financial support the society might give to one or more of these positions. There is an opportunity here for the ASEG to nurture a university department which will produce high quality graduates in the field of exploration geophysics. But a number of questions will have to be answered within the ASEG before this can happen. Such as:

- should the ASEG be involved in supporting a university department;

- if so, which one (or two);
- what should be the extent of our involvement;
- should we be represented on a selection committee;
- what level of funding would we be willing to provide;
- and many others.

This is an opportunity we should not disregard, as provides us with the ability to improve the quality of our profession and set a world standard of exploration geophysics in Australia. We may not have a second chance and therefore it is important at this stage to make the right decisions.

*Hugh Rutter, President*

## Executive Brief

### Your ASEG Executive at work...

A new standing committee, the Publicity/Promotions Committee has been set up under the Chairmanship of Koya Suto, (See report p7) comprising Koya, Kim Forward, Mike Dentith and Peter Clark.

There has been a lot of discussion regarding Preview. Apparently some members don't read it! and most of us get a bit lost distinguishing between editorial, articles and ads. Rather than run competitions to encourage reading this noble rag, Geoff, Greg and Janine have implemented some major layout improvements in this issue (please read it!).

Brian Evans has stepped down as Chairman of the Student Education Committee and Norm Uren has volunteered his services in this capacity. The Federal Executive would like to thank Brian for his considerable time and effort put into this committee over the last few years.

We have received a few nominations for Honorary Membership in the last couple of months which are currently under review. Members are reminded that they can nominate a fellow member at any time for life membership via a brief citation. Nominees should in general be long standing members of the ASEG, have served in an official capacity for the ASEG and be a significant contributor to Australian geophysics.

Andrew Sutherland has done a lot of legwork on the "History of Geophysics in Australia" book suggestion. Unfortunately it seems production costs will be prohibitive as circulation would be fairly limited. A scaled-down version utilising Preview may be proposed and alternative ways of addressing this suggestion are invited (see p37).

Further discussion points have included:

- Reports from the Treasurer, Preview Editor and Business Manager
- Exploration Geophysics publishing schedule

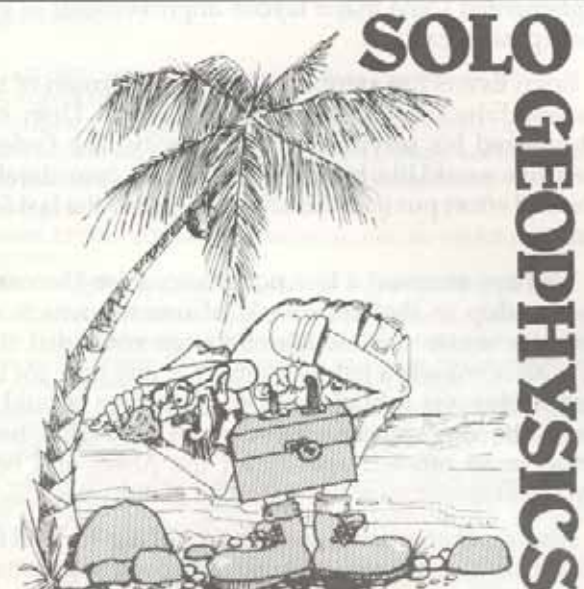


- Advertising rates
- Updates on arrangements for the Perth Conference
- New member applications
- A "Geophysics for Geologists" course textbook
- An ASEG position on Chairs of Geophysics at Australian universities (p3)
- The next SEG Conference in Washington DC
- Membership questionnaires
- Standing committee formation, reporting and personnel changes
- ASEG sponsorship proposals
- Journal exchanges with overseas geophysical societies and ASEG Library (p37)

*Brenton Oke, ASEG Secretary*  
Ph: (03) 652 6625, Fax: (03) 652 7315

## Photo's Wanted

Do you have any interesting, informative or amusing photos relating to geophysics/exploration? If so, please send them to Preview C/o ASEG Secretariat Office as they may be useful for educational purposes and/or publishing in Preview.



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## Viewpoint

### Has SADME launched a lifeboat?

Mineral products contribute to over 40 per cent of Australia's Gross Domestic Product. In these times of massive national debt, high unemployment, and falling exchange rate, mining offers the economy a lifeboat to cling to. Every assistance should be given to assist the industry that gives so much to the economy of Australia.

Good quality regional data sets are the key to any successful exploration program and this should be a prime objective for state and federal surveys. Yet for our three major mineral producing areas, Kalgoorlie, Mt. Isa and Broken Hill, the only good quality detailed airborne magnetic surveys are privately owned. The gravity data base is predominantly 10 km spacing and the geochemical atlas is virtually non-existent.

South Australia, with a struggling economy and a very small mining base, believes that a modest investment will be rewarded handsomely with increased exploration expenditure and new mines.

Key features of the SADME plan are:

- Doubling SADME budget
- Appointing a Director with excellent industry credentials
- Detailed airborne magnetic surveys in key areas
- Compilation of digital data bases and integration into a Geographic Information System (GIS)
- Release of data at a reasonable price, in formats suitable for low cost GIS systems.

SADME is to be congratulated on their initiative and hopefully they will be soon emulated by other state and federal governments.

*David Gamble, ASEG Committee member*

### Preview: Next Issue

*Petrophysics.  
Environmental  
Geophysics.  
Software from  
e-mail.  
1993 Membership  
Listing.*



## ASEG People Profiles

Four ASEG members who are making significant contributions both here in Australia and internationally to the activities of geophysical societies are Mike Asten, Bob Smith, Roger Henderson and Brian Spies.

Mike Asten of BHP Minerals, 1st Vice President of the ASEG, (see profile in August 1992 Preview, p10) is active in the SEG as international Mining Geophysics Associate Editor for the SEG journal *GEOPHYSICS*. Mike edits several papers per year, and this task falls on his capable shoulders in recognition of both his and the Australian geophysical fraternities expertise in Mining Geophysics.



Bob Smith, Chief Geophysicist of CRAE, is playing an important part as Chairman in building up the ASEG Research Foundation (see report p10). Currently Bob is a member of the Technical Program Committee of the Moscow '93 - SEG International Exposition, an important geophysical

conference at an historic time for opening up new horizons in exploration in the former USSR. Bob is also a former Associate Editor of *GEOPHYSICS*.

Roger Henderson, Manager of Geo-Instruments, has recently joined the inaugural international committee of the US-based EEGS (Environmental and Engineering Geophysical Society) reflecting his commitment to this important, growing area of geophysics. Roger was instrumental in the ASEG affiliation with the EEGS. Roger who chairs the ASEG Geophysical Activity Committee is also a prolific and valued correspondent on many subjects, to *Preview* and the ASEG Executive.



Brian Spies, Research Associate, Schlumberger-Doll Research, expatriate Australian and ASEG member in the US, is very active in the SEG as Editor of the SEG Cumulative Index and is a Past Chairman of the SEG Leading Edge Editorial Board.

## ASEG Geophysics Promotion Committee

In the April issue of *Preview*, we asked for expressions of interest in promoting geophysics to the general community and secondary students. Thanks for those who responded. The committee is formed by four members:



**Mr Koya Suto:** Chairperson; Principal Geophysicist of Pacific Oil and Gas Pty Limited. See biography on Page 2 of April 1993 issue of *Preview*.

**Dr Mike Dentith:** Lecturer at the University of Western Australia where he teaches all aspects of geophysics. His main research interests are mineral and petroleum exploration geophysics especially seismic reflection, gravity and magnetic methods. He is currently editing UWA Key Centre Publication 26/ASEG Special Publication 7: "Geophysical Signatures of WA Mineral Deposits".

**Mr Kim Forward:** Head of the Science Faculty of Wesley College. He is a graduate of Adelaide University and worked for BHP Minerals in S.A., NSW and NT. He holds a Dip. Ed and M.Ed and is actively involved in teaching and curriculum development.

**Dr. Peter Clark:** Geophysical Research Institute, University of New England, Armidale.



The first undertaking by the committee will be the creation of a slide set to present to schools and meetings of various community clubs. If you have suitable slides of geophysical equipment, field operations or illustration of principles, please contact:

Koya Suto:  
Ph: (03) 895 3041;  
Fax (03) 890 0029.





## ASEG Branch News

### Western Australia

A branch meeting was held on July 22 to take advantage of the presence of Dr John Walsh from the Fault Analysis Group of the University of Liverpool. Cathy Norman of World Geoscience also delivered a paper entitled "High Resolution Aeromagnetics for Sedimentary Basin Exploration".



John's talk was entitled "Fault Analysis from Seismic Data, from Quality Control of Seismic Interpretation through Reservoir Modelling". Although seismic data was referenced in the title, the principal theme of John's talk was more general ... to examine the attributes of faults which can be used as QC tools in their interpretation. Application of the concepts and ideas presented is relevant to all scales, from small fractures all the way to crustal bounding faults. The talk was therefore of interest to all.

Cathy's talk focussed on the capabilities of high resolution aeromagnetic data to resolve features and discontinuities within sedimentary sections, with numerous fascinating examples of the expression of intra-sedimentary anomalies. Only relatively recently have advances in technology enabled the adequate measurement and display of such subtleties. Thank you Cathy for an interesting and informative presentation.

The meeting was followed by ample sustenance and refreshments, all of which was enjoyed in the convivial atmosphere of the Celtic Club, the most likely site for future branch meetings in the coming year.

Next committee meeting is planned for August 10th at which we will be discussing future talks and the timing of branch meetings. .... Watch the mail box for upcoming events.

Cathy Norman has, due to work reasons, resigned from her position on the committee. We will miss her presence and energy on the committee, and wish her well in the new assignment. Any replacement volunteers would be greatly accepted.

*Andy Padman, Secretary*

### ACT

The ACT Branch of ASEG held a meeting and seminar on the 7th July in the AGSO ground floor meeting rooms, with Richard Haworth (Chief of Geophysics, Sedimentary and Marine Geoscience Branch, Geological Survey of Canada (GSC), Ottawa) presenting a seminar on "Geophysical Programmes of the Geological Survey of Canada". The geophysical aspects of the Geological Survey of Canada were far ranging and included topics such as earthquake studies, the effects of magnetic storms on power transmission line networks and



corrosion of pipeline systems, and doing contract gravity observations in the Canadian Rockies on behalf of the US Department of Defence.

*Kevin Wake-Dyster, Secretary*

### New South Wales

The NSW ASEG general meeting, held on 4th August at the Bowlers Club, Sydney was well attended for Jim Montalbetti's (Command Petroleum Holding) presentation on Seismic Processing and joint gravity interpretation. Jim delivered an excellent talk with a case history of the Southern Taranaki Boundary Fault Zone - New Zealand. Food and drinks were enjoyed by all those present.

*Shane Wright, Secretary*

### South Australia

The SA Branch has had a fairly quiet winter period this year with our last meeting held on 19 July 1993. Dr John Walsh, the 1993 Esso-Pesa Distinguished Lecturer presented some of the work he and his colleagues at the Fault Analysis Group have been doing on fault geometry and kinematics. This was very well received by the 35 members and students who were present at this meeting.

To date, no meeting has been finalised for August, though the committee is trying to organise an aeromag evening. More information will be sent out to members as it becomes available. Other events for the remainder of '93 are a talk by Mike Lansley in October and the students night in November. Unfortunately, we had to cancel the Melbourne Cup Luncheon this year.

Finally, the 1993 ASEG wine has been selected. Order forms can be found in this edition of Preview (p5).

*Ashley Duckett, Secretary*

### Victoria

Time has approached again this year for a beer tasting evening. This will be held in September at an approximate cost of \$25 per head. Please look out for flyer to obtain details of specific date and venue. Next ASEG technical evening will be held in October due to the September beer tasting function. Speakers welcome for October and future meetings. Please contact any member of the committee for information.

Mad Hatters Ball (combined ASEG, SPE, GSA, PESA, AusIMM) will be held on October 9th. Please stay tuned.

*Zis Katelis, Secretary*





## ASEG Research Foundation

### 1993 Annual Report

During 1992, the ASEG Research Foundation supported five B.Sc. Hons. projects in exploration geophysics. The projects were as follows:

- Title:** The Seismic Reflection Process in Anisotropic Media  
**University:** Curtin University  
**Supervisor:** Dr B.J. Evans, Ma. pp. Sc.  
**Student:** Mohammed Norozi, B.Sc. Geophysics  
**Amount:** \$5,000 - primarily used for modelling materials.
- Title:** The Development of Large Biotherms on the Shelf Edge in Relation to Sequence Stratigraphy and the Potential for Hydro Carbon Entrapment.  
**University:** University of Sydney  
**Supervisor:** Dr J.J. Steinstra  
**Student:** Frank Sugiaman, M. Sc.  
**Amount:** \$5,000 - was for part funding for an A3 Seiko Ethernet Plotter.
- Title:** Metamorphic and Geochemical Controls on the Magnetic Signatures of Western Australian Belts  
**University:** University of Western Australia  
**Supervisor:** Dr A. Trench and Dr J. Ridley  
**Student:** Barry Bourne  
**Amount:** \$4,145 - primarily used for vehicle costs and accommodation.
- Title:** Noise Reduction in Downhole TEM Surveys  
**University:** Monash University  
**Supervisor:** Dr J. Cull  
**Student:** Duncan Massie  
**Amount:** \$4,482 - primarily used for local TEM surveys (central Victoria), borehole tests (Broken Hill) and geophysical correlations with TEM data.
- Title:** Application of Reflection Tomography to Determining Velocity in Surface Reefs on North West Shelf Seismic Data.  
**University:** The University of Melbourne  
**Supervisor:** Dr G. Beresford  
**Student:** Steven J. Carroll  
**Amount:** \$4,100 - primarily used for maintenance of VISTA software and contract programming.

All projects were completed successfully.

In 1993, the ASEG Research Foundation is currently supporting another five projects, as follows:

- Title:** Magnetic Susceptibility Variations over Hydrocarbons, Sydney-Gunnedah-Bowen and Surat Basins  
**University:** University of Sydney  
**Supervisor:** Dr R.A. Facer  
**Student:** Khamphira Viravong, B.Sc.  
**Amount:** \$4,280 - primarily used for travel, accommodation and analyses.
- Title:** Evaluation of Seismic Trace Inversion in the Surat Basin, Queensland  
**University:** University of Queensland  
**Supervisor:** Dr S. Hearn  
**Student:** Natasha Hendrick, B.Sc. App. (Geoph) (Hons).  
**Amount:** \$4,800 - primarily used for unlimited access to the University of Queensland's seismic facility for 9 months.
- Title:** A Study of the Relationship between the Different Tectonic Styles which Controlled the "Skua Horst" in the Vulcan Sub-basin and the Application of Sequence Stratigraphy in Relation to the Potential for Hydrocarbon Entrapment  
**University:** University of Sydney  
**Supervisor:** Dr J.J. Steinstra  
**Student:** Jane Johnson  
**Amount:** \$5,000 - for part funding for A3 size Seiko Ethernet Plotter.
- Title:** Removal of EM Coupling Effects from both Time and Frequency Domain IP Data  
**University:** University of Adelaide  
**Supervisor:** Dr P.I. Brooker, Dr K.L. Zonge and Dr S. McInnes  
**Student:** Gerard M. McNeill, B.Sc. (Hons).  
**Amount:** \$5,000 - primarily will be used for hiring of field equipment and crew.
- Title:** Application of Multichannel Aeroradiometric Data  
**University:** University of Adelaide  
**Supervisor:** Dr S. Rajagopalan  
**Student:** John Caon  
**Amount:** \$3,000 - primarily will be used for travel and accommodation.

We understand that they are all progressing satisfactorily.

In the near future we will be inviting proposals for 1994 projects and expect to be able to offer support to at least six.

The ASEG Research Foundation is currently supported financially by several major companies and ASEG. We are in good financial shape and could



support more projects if good proposals are received and good students can be identified to take them on.

The ASEG Research Foundation Committee was recently expanded; current members are:

Prof. D. Boyd	The University of Adelaide
Mr J. Cucuzza	AMIRA Ltd
Mr J. Denham	BHP Petroleum
Dr B.J.J. Embleton	COSSA
Dr D.W. Emerson	Consultant
Dr N.J. Fisher	Digital Exploration Ltd
Dr S. Hearn	The University of Qld
Mr N. Hungerford	Billiton Australia Ltd
Mr W. Jamieson	Bridge Oil Limited
Dr D. King	Baron Partners Ltd
Mr S. Mudge	RGC Exploration Pty Ltd
Mr P.W. Priest	Chartered Accountant
Mr D.C. Roberts	SAGASCO Resources
Mr M.J. Sayers	West Australian Petroleum Pty Limited
Mr N. Sheard	MIM Exploration Pty Ltd
Mr R. J. Smith	CRA Exploration Pty Ltd
Mr N. Uren	Department of Exploration Geophysics, Curtin Uni
Dr T. Whiting	BHP Minerals
Mr P. Williams	Western Mining Limited

The support offered by ASEG Research Foundation has encouraged a number of good students to pursue a career in geophysics. A number of ASEG publications have resulted from projects supported by ASEG RF. These include papers published in "Exploration Geophysics - ASEG 9th Geophysical Conference and Exhibition" and Preview as listed below:

**Kylie Paish** University of WA  
Mapping the Regolith using Seismic Refraction and Magnetic Data: Results from the Southern Cross Greenstone Belt, Western Australia.

**Michael House** University of WA  
Three-dimensional structure of Greenstone Belts in Western Australia: Implications for Gold Exploration.

**Rick Valenta** Monash University  
Geophysical Interpretation and Modelling of Three-dimensional Structure in the Duchess Area, Mt Isa, Australia

**Steven Carroll** University of Melbourne  
Using Layer Replacement to Improve Velocity Analysis Beneath Near-Surface Reefs.

*R.J. Smith*

*Chairman - ASEG Research Foundation*

## ASEG Research Grants Guidelines



The ASEG RF Committee developed the following guidelines for grants:

1. Funds will be granted in support of research projects, primarily at B.Sc.Hons. & M.Sc. level
2. Grants will be made to projects rather than people, ie. they will not be "Scholarships".
3. The funds are to be used in support of the project, e.g. for travel costs, rental of equipment, etc. Funds must be accounted for and, if not used, should be returned to the ASEG Research Foundation.
4. The project supervisor will be responsible for drawing the funds as required and for managing the expenditure. He/She should ensure that a research report and financial reconciliation is provided to the ASEG Research Foundation on completion (or cessation) of the project. Confidential research is therefore inappropriate for the ASEG Research Foundation.
5. Projects will be selected by the relevant ASEG Research Foundation sub-Committee. They will select projects in applied geophysics with an emphasis on practical or applied research. Expenditure will be spread approximately equally between petroleum and minerals exploration research - unless there is a strong bias in contributions.
6. On completion of the project, abstracts will be published in Preview and publication as a paper in "Exploration Geophysics" will be encouraged. The supervisor would normally be expected to be a co-author and will be responsible for submission of a publication.
7. Interim (e.g. six monthly) progress reports will be required and should be forwarded to the Chairman/Secretary of the ASEG Research Foundation. For each project, the ASEG Research Foundation will appoint a liaison officer, who should be a member of ASEG (but not necessarily of the ASEG Research Foundation Committee), and who will keep in touch with the project and report to the committee on progress. This would involve at least one and preferably more visits to the Institution where the project is being carried out.
8. Three members of the ASEG Research Foundation Committee will be responsible for checking the final report from each project. Copies of the report (eg. thesis) will be available to any interested members, on request.
9. Project supervisors should submit a short list of suggested projects by 30th September of the proceeding year. These lists should include a project description, name of the supervisor and the purpose of the funds requested.

Submissions for 1994 grants are now being sought from Institutions. The deadlines for applications is 30th September 1993.



# Velocity analysis by reflection tomography: application to near-surface reefs in the Browse Basin.

Steven Carroll

Department of Geology  
University of Melbourne

(Report on 1993 ASEG Research Funded  
Program. Supervisor: Dr G. Beresford)

## Introduction

Reefs in the Browse Basin of the Australian North West Shelf typically have strong lateral velocity inhomogeneity on the reef flanks, and an irregular sea-floor topography, which combine to make the use of conventional velocity analysis difficult. Conventional analysis is not accurate enough to resolve the velocities of the reef flanks. An accurate velocity structure is needed for these reefs if seismic data are to be correctly migrated.

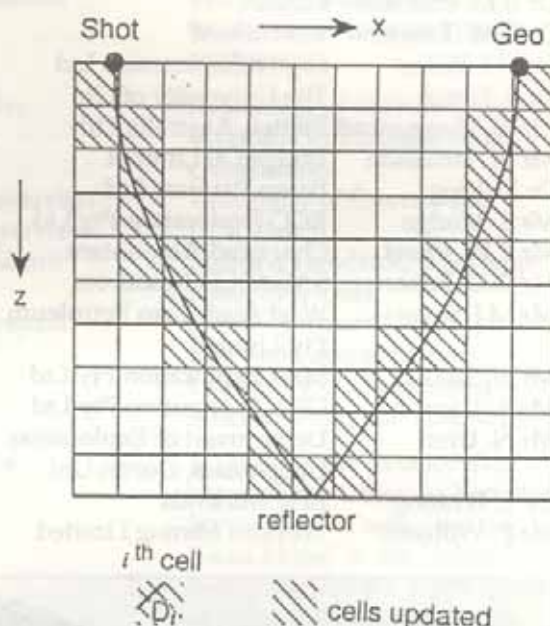
Tomographic velocity analysis, using a simultaneous iterative reconstruction technique (SIRT), was found to improve the velocity analysis obtained for the reef, compared to conventional analysis. The reef's profile and rapid internal velocity gradients prevent accurate ray path determination, limiting the use of this approach. Tomographic velocity analysis combined with layer replacement improves the ray-path calculations, since layer replacement removes the sea-floor topography of the reef which is responsible for most of the ray-path distortion. The velocities obtained from this method do give an accurate picture of the reef's internal velocity structure, and the lower portion of the seismic section below the reef.

Reef structures projecting above the sea-floor, cause seismic data in these regions to be significantly distorted. The velocity determination of these structures is a critical step in correcting for this distortion.

## Formulation of the technique

The initial data sets comprise the coordinates of the sources and geophones, and the travel-times of the first arriving reflected seismic energy between all possible pairs,  $T_{SG}$ . Reflection tomography was performed on the data set by way of a SIRT algorithm (Figure 1), which basically determines all possible rays that passed through a certain cell. The corrections that the cell would have been given from each of these rays to give the correct travel time, is summed, and the cell value adjusted.

Successive cells are covered, and one iteration is complete when all cells have been considered. Other iterations follow until an acceptable degree of convergence is reached.



$T_{SG}$  measured time

$\hat{T}$  model estimate

$C_i$  cell correction slowness

$D_i$  cell path length

$$\text{Slowness Update } C_i = \frac{D_i (T_{SG} - \hat{T})}{\sum D_i^2}$$

Figure 1. Cell velocities are adjusted using a SIRT algorithm.

Layer replacement is applied to the data by replacing the water velocity with an average velocity for the reef. This reduces ray path bending at the interface between the water and the reef. Also, CMP gathers become more hyperbolic, making the determination of the reflector easier, and aiding the picking of travel times.

## Model data example

Using a model of a typical reef from Browse Basin, seismic data were generated using non-zero offset ray tracing, with a fold about half that of normal production. The spread consisted of 60 channels with maximum offset 3 km, shot interval 50 m, and the group interval 50 m. There were 239 shots, with the first at 0 m and number 239 at 11.9 km. A horizontal reflector was included in the model at a depth of 1600 m, as shown in Figure 2. This model was chosen to be in agreement with



the data from a recently recorded seismic survey in the area.

Both conventional velocity analysis and reflection tomography were performed on the reef model. The conventional velocity analysis using gathers, stacks and semblance, was able to determine the topography of the reef's structure and the presence of high velocity flanks, but tended to underestimate velocity. It also failed to adequately determine the velocities in the deeper section.

By applying reflection tomography alone, the velocities obtained are closer to the reef's velocities compared with those obtained by conventional analysis. The topography of the sea-floor is present, as it was with the conventional analysis, although smearing of the reef's velocities into the water layer has occurred with reflection tomography.

Layer replacement of the water with a velocity close to that of the reef's average velocity (2500 m/s), reduced the smearing of the reef's velocities at the reef/water replaced interface. This resulted in a better estimation of the velocity field, both in the reef and below it as can be seen in Figure 3.

Further improvement on this result was achieved by constraining the water-replaced layer (making it constant), at the value of the replaced velocity. SIRT makes corrections only to non-constrained cells for a given ray, after removing the known effect of the constrained cells. The constrained cells are not adjusted after each iteration. Velocity smearing over the boundary between the reef and the replacement layer has been removed, with the reef's topography now a sharp interface.

### Field data example

Data obtained from the Browse Basin was pre-processed to aid travel-time picking of a marker reflector at about 1600 m. The pre-processing consisted of first break muting, mild velocity filtering to suppress direct waves and interactive selection of a gate for the automatic event picker. Picks on far offsets beyond about 2 km were discarded due to interference from direct waves.

Although the true velocity field of the reef is not known, we would expect the resulting velocity field to show characteristics similar to that of the model which we proposed in Figure 2. Conventional velocity analysis could not delineate the strong velocity contrast and irregular sea-floor topography of the reef. Reflection tomography was applied to the data set alone, to determine the velocity structure. The resulting analysis provided an insight into the complex velocity structure of the reef, clearly showing the large velocity anomalies on the reef's flanks (as we expected). The sea-floor profile is present but velocity smearing from the reef's flanks degrade its positioning.

Combining layer replacement and reflection tomography improved the velocity estimation within the reef itself (Figure 4), and reduced the smearing effect across the reef's boundary into the replaced layer, which we again chose to replace with a layer of velocity 2500 m/s. The flanking regions of the reef that appear to be

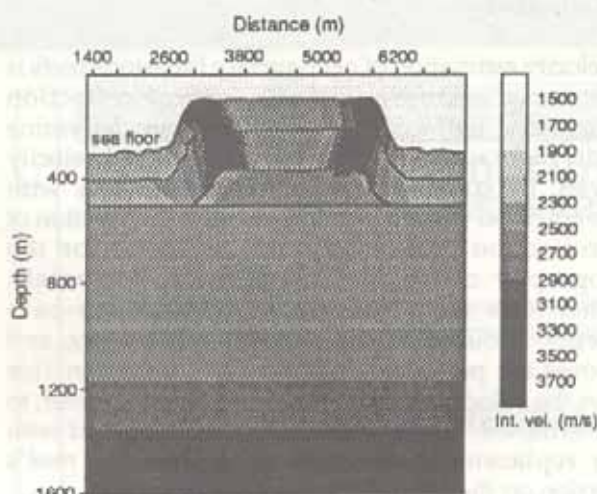


Figure 2. A model of a typical limestone near-surface reef in the Browse Basin. The reef's topography, was chosen to correspond with a field data example from the area. High-velocity flanks are present, with a reflector positioned at a depth of 1600 m.

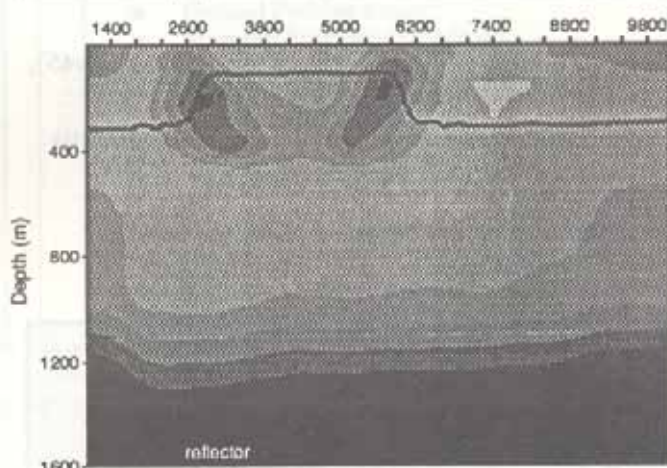


Figure 3. The velocity field estimation, with wave-equation water layer replacement prior to reflection tomography, of the model in Figure 2. Reef flanks are present, but smearing of the reef's velocities into the replacement layer has occurred. The reef profile from Figure 2, is superimposed on the result.

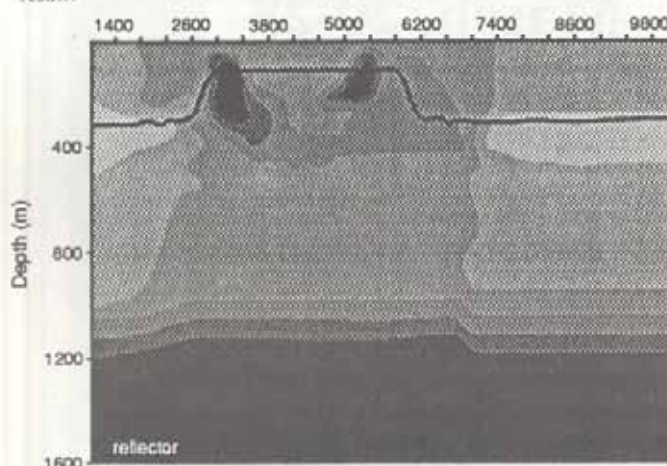


Figure 4. The velocity field estimate of a reef in the Browse Basin, that was record on seismic data from the area. The velocity estimation using wave-equation water layer replacement prior to reflection tomography. The profile shown, is that from Figure 2, which is known to be correct.

misplaced may be the result of the non-symmetrical nature of the reef. This is also suggested in the proposed model that we developed earlier.



## Conclusion

Velocity estimation of near-surface limestone reefs is made more accurate with the aid of reflection tomography. Reflection tomography can determine velocity more accurately than can conventional velocity analysis. By combining reflection tomography with wave-equation water layer replacement, the position of the reflection marker horizon essential for the tomography can be positioned more accurately. Furthermore the replacement reduces ray-path distortion induced at the reef-water boundary, and improves the performance of the SIRT inversion. This allows the velocities, both within and below the reef, to be determined. These velocities can then be used with layer replacement methods to remove the reef's distortion on the seismic section below the reef.



## People Moves

In addition to the changes of address (p45), imminent moves include:

Dr Tom Whiting, BHP to BHP Minerals California.

Bill Ashby, Ampolex to Buenos Aires

David Spring, Petrofina to Petrofina Brussels

Know of others? Send details to Preview.

## APEA 1994 Conference & Exhibition March, 20-23



The APEA 1994 Conference & Exhibition will be held at the Sydney Convention & Exhibition Centre, Darling Drive, Darling Harbour, Sydney from 20-23 March, where 76 exhibition booths will be available and 5 concurrent technical sessions are planned. Registration brochures will be available in October.

To receive a brochure or obtain further details about the exhibition or sponsorship, contact:

Danelle Baxter,  
Conference Manager,  
APEA Limited,  
P.O. Box H172,  
Australia Square NSW 2000,  
Tel: (02) 221 4899,  
Fax: (02) 221 4592

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# MINES AND ENERGY SOUTH AUSTRALIA



Mines and Energy in South Australia has its Adelaide based Head Office just outside the city centre and operates regional offices at Andamooka, Coober Pedy and Crystal Brook, Mintabie and Peterborough in the north and Mount Gambier and Naracoorte in the South.

As a government agency the organisation is task oriented and sharply focussed towards compact lean operations even by South Australian standards. Its emphasis on skilled staff is evident with more than two thirds holding professional or technical support positions in a total complement of 350 personnel.

In more recent times, under the direction of Director General Dr Ross Fardon, appointed in 1992, the organisation has taken a particularly aggressive approach towards the marketing of investment opportunities and the agency itself.

The South Australian government has continually acknowledged the value and independence which ensues from adequate energy resources for community requirements and infrastructure development for industry. It is a generally accepted fact that without sustained exploration activity wealth generation, and ultimately, standards of living, move into decline. The South Australian State Government has accelerated exploration funding with the injection of \$16 million spread over the 1992-1994 financial years. With continuing financial commitments the South Australian Exploration Initiative (SAEI) is rapidly uncovering the largely unexplored regions, which in total, cover almost 50% of the State. Data collection will be complete by the end of 1993 with approximately 40% of data already processed and released. Further processing and release of remaining black and white, colour pixel maps and data tapes will continue throughout 1994.

Bolstered with the new generation aeromagnetic data the Department aims to attract a wave of exploration to South Australia. To supplement local interest, senior executives have already journeyed to the United States, and, later this year will initiate an ongoing marketing programme for Europe designed to attract large, new players into the State.

The Department of Mines and Energy in South Australia has, since its origin in 1894 as Department of Mines always been customer oriented to the minerals and energy industries. As a Government Agency it has upheld the traditional role of regulatory, inspection and legislative activities as well as offering information services, comprehensive data bases and one of the most extensive core libraries to be found anywhere. As a consequence of the state's geography and climatic conditions, the government has continually funded a sustained effort to gather information for geological

mapping purposes and engaged in an ongoing programme of groundwater search, evaluation and management.

According to Dr Fardon the quality of data gathered and significance of many of the geological structures justifies a concerted marketing thrust to major Australian and overseas based exploration companies.

Running concurrently with the exploration push of the SAEI, Mines and Energy has taken the initiative to promote the Upper Spencer Gulf Region of South Australia as a downstream resource processor. The region includes the cities of Whyalla, Port Augusta and Port Pirie and already boasts a high level of infrastructure and processing activities of renown (BHP Steel Long Products Division at Whyalla and Pasminco refinery facilities at Port Pirie). Mines and Energy South Australia has now embarked on a major promotion push of exploration and processing for the State.

Dr Fardon is convinced that the packaged approach of offering opportunities in both mining and processing will enhance interest from the international mining community. He reflects the view held by many in South Australia that wealth generation through resources holds the key to economic recovery for the State.

As such the Department in recent times has extended its role way beyond its traditional activities.

"We see ourselves no longer constrained to the role as managers of our underground resources. We also accept the responsibility of communicating to all the communities involved, particularly the special interest groups who see themselves affected by exploration activity. These include city communities, traditional native land owners and conservation groups."

The Department is deeply committed to promoting the maximum activity possible which in turn results in royalties, employment and exports.

The Department firmly believes it now has all the right reasons why exploration and mining investment interests should be taking a closer look at South Australia.

## KEY EXECUTIVES:

<b>DIRECTOR GENERAL:</b>	Dr Ross Fardon
<b>DIRECTOR, MINERAL EXPLORATION:</b>	Ric Horn
<b>DIRECTOR, OIL GAS &amp; COAL:</b>	Bob Laws
<b>DIRECTOR, MINING POLICY AND OPERATIONS:</b>	Peter Hill
<b>DIRECTOR, RESOURCE PROCESSING AND MARKETING:</b>	Graham Haddow





## Databases

### Integration of Geological Data Using GIS

One of the most important roles of a Geological Survey is efficient management of geoscientific information; collecting, collating, synthesising, presenting and disseminating technical data to support exploration for, and management of, groundwater, mineral and hydrocarbon resources. Australia leads the world in effective resource exploration primarily because of the legislative requirement for exploration companies to lodge technical information with State Geological Surveys. Subsequent public release of this information greatly advances the exploration process for all concerned.

Traditional methods of information location, retrieval and compilation are time consuming and costly. Hard copy maps are fixed in format and scale, and quickly go out of date as further data are collected. Vital information can be missed completely if time is not available to undertake historical searches. Even the

explosion of desk top computers over the past decade has not helped as stand-alone data bases became the preserve of sectorial groups.

Spatial databases are particularly well suited for managing geological information as, in almost all cases, such data are geographically based. Development of multi-user, State-wide databases based on Geographic Information System (GIS) and Relational Data Base (RDBMS) software has advanced significantly in the past two years. To some extent, this has been due to advances in the capabilities of, and reduction in prices for, computer hardware and software. In South Australia, GIS development initially concentrated on digital capture and presentation of geological map data.

GIS development has accelerated in new directions over the past twelve months, driven by the commercial realities of having to make information available faster and more reliably. In particular, the production of high resolution aeromagnetic images as part of the South Australian Exploration Initiative has created unprecedented demand for supportive digital geological information. Many types of data are required, both for "ground truthing" magnetic features, and to allow rapid and accurate area and target selection by explorationists. This has focussed attention on the digital integration of different data sets in a GIS environment.

The South Australian Department of Mines and Energy (DME), with the assistance of GISolutions, has developed an integrated geoscience information system to support both exploration and associated land management. State-wide geological, geophysical and geochemical data sets have been brought together as seamless, spatial coverages, in a GIS where they can be digitally overlain and interrogated. The system, known as SA\_DISPLAY, uses ArcInfo and Oracle Software on a distributed UNIX network. A version has simultaneously been developed for desktop PC's using commercially available PC ArcView software.

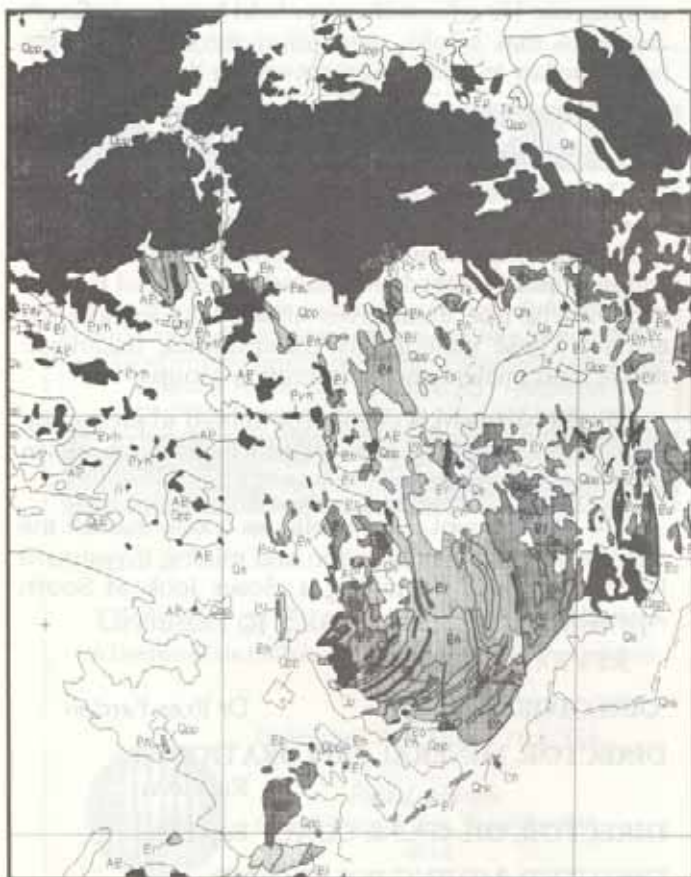


Figure 1. Digital geological maps in full colour are available for key regions of South Australia

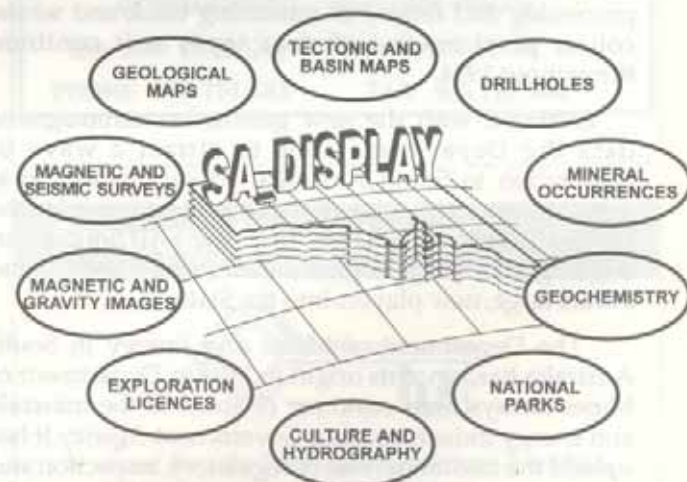


Figure 2. SA\_DISPLAY integrates key geoscience data bases using ArcInfo and ArcView GIS software.



Both UNIX and PC systems have a similar "look and feel" and operate on identical or slightly modified data sets. By consolidating its key technical data sets in ArcInfo, DME has been able to develop both UNIX and PC based systems simultaneously, thereby maximising access to a major GIS database for even the smallest exploration group.

In both systems, data are organised as layers or themes, each of which superficially resemble a traditional map. Locational information may be points (eg drillholes, samples sites), lines (eg faults, roads) or polygons (eg geological units, exploration tenements). Descriptive information are stored as attributes against each point, line or polygon. Raster images can also be included as layers or themes which can be switched on or off.

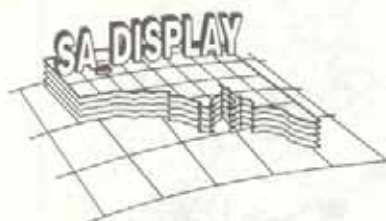
Themes currently in SA\_DISPLAY include:

- Coastline
- Cultural Features
- Map Sheet Boundaries
- Geology, Tectonic and Basin Maps
- Magnetic and Gravity Images
- Aeromagnetic Flight Lines and Survey Boundaries
- Seismic lines
- Drillholes
- Stratigraphic Drillholes

- Mineral Occurrences
- Rock Samples/Geochemistry
- Current Mineral Exploration Licences
- Petroleum Exploration and Production Licences
- National Parks, Reserves and Restricted Areas

Prior to SA\_DISPLAY, clients needed many points of contact within DME to compile all available technical information for an area of interest. Mineral explorationists would often be unaware that seismic data was available for their area of interest. Conversely, petroleum explorationists would often be unaware of water bores, mineral drillholes or magnetic data in their area of interest. Even when all sources of information were exhausted, manual integration was required to bring the pieces of information together. SA\_DISPLAY has not replaced these "custodians" of information, it has merely brought their information together on one computer screen.

With SA\_DISPLAY it is possible to rapidly and easily select, query and overlay different data sets or themes. For example, Precambrian outcrop and drillhole locations can be superimposed over portion of an aeromagnetic image (eg Plate 1). Attribute information is available for a single feature through a "point and click" operation, can be selected through SQL query, and can be output in spreadsheet format for an area of interest. This gives an instant insight to available data that previously would have taken weeks to locate by



## Affordable Geological GIS for exploration, teaching and research on desktop PC's

ArcView allows novice users to easily interrogate and manipulate ArcInfo spatial and attribute data and images. The following data sets are available in ArcView format for Dos-based 386 and 486 PC's.

South Australia State-Wide Data Set.....	\$1500
(requires 65 Mb of disk space)	
KIMBA 1 : 250 000 map sheet data set.....	\$ 300
(requires 9 Mb of disk space)	
Stuart Shelf Data Set.....	\$350
(requires 4 Mb of disk space)	

**For further information and order forms, contact**  
**Tony Belperio**  
**Regional Geology Branch**  
**Department of Mines and Energy**  
**South Australia**

Ph. 08 - 2747616 Fax 08 - 2727597

### State - wide themes in PC ArcView format:

Coastline, Map Sheets, Cultural Features  
 State Geology, Tectonic and Basins Maps  
 Rock and Geochemical Samples  
 Seismic Lines  
 Drillholes  
 Mineral Occurrences  
 Magnetic and Gravity Images  
 Aeromagnetic Survey Boundaries  
 Mineral & Petroleum Exploration Licences  
 Parks, Reserves and Restricted Areas



traditional means. Land access information such as existing exploration tenements, parks and reserves and aboriginal lands can also be added and queried (eg Plate 2).

Other information that can be overlain include lithological/geochemical data (from RS/GEOCHEM data base) (eg Plate 3), major and minor mineral occurrence data (from MINOCC data base), geological, tectonic and basin maps (from SA\_GEOLOGY data base), seismic data (eg Plate 4) and magnetic, gravity, Spot and Landsat (raster) imagery. All data are viewed as part of a seamless, state-wide information system, even though individual data sets continue to reside with, and are managed and updated by traditional custodians. Each data set can also be accessed or purchased individually through the appropriate custodian. SA\_DISPLAY provides the integrated, spatial view. Active data capture and update programs means the user has, at all times, access to the most up to date information.

### PC-ArcView Data Sets

Of particular interest amongst the many visitors to DME over the past few months has been the version of SA\_DISPLAY for desktop PC'S. For the first time, individuals can access a statewide GIS data base without specialist knowledge, hardware, software and the expense previously required to utilise corporate GIS systems. ArcView is a cheap and very easy to use windows-based GIS that accesses ArcInfo coverages. It operates on 386 and 486 PC's and, together with the State data set, effectively provides a complete, mobile geoscience information system for South Australia. ArcView gives novice users the ability to interrogate and manipulate data without any knowledge of complex ArcInfo commands. The complete StateWide PC data set is available for just \$1500, a price traditionally charged for individual GIS themes. This is to maximise the availability of GIS data to small and medium exploration groups, and for teaching and research. Updates are available, and are recommended, because ongoing data capture programs and upgrading of archived data are continually adding to the data base.

PC ArcView data sets have also been prepared for the Stuart Shelf (eastern Gawler Craton) and the KIMBA 1:250 000 map sheet area (Eyre Peninsula). These have a similar variety of themes, but the province approach allows more detailed data sets to be utilised. In particular, geological map data captured at 50 000 to 100 000 scale allow the user to zoom in to much greater detail. Additional data sets are planned for the western Gawler Craton, coinciding with areas for which high resolution magnetic imagery is being released.

The Stuart Shelf data set includes open - file basement drillhole information integrated with aeromagnetic, gravity, geology and topographic data. Drillhole attributes include lithological, stratigraphic, alteration and mineralisation summaries. Depth to basement contours, interpreted basement geology and tectonic elements are additional themes. This ArcView data set includes the master drillhole database in ASCII format and a comprehensive report.

ArcView allows spatial and attribute SQL queries to be made, with output to a variety of printer, plotter and spreadsheet formats. In many instances, it is faster than the UNIX version which does its SQL queries "on-the-fly" to distributed data bases. Both UNIX and PC versions of SA\_DISPLAY are available for inspection/trial or use at DME, preferably by appointment. (Contact Tony Belperio (08) 274 7616 or Barry Van der Stelt (08) 274 7684). Individual data bases can also be purchased (P.O.A.) as ArcInfo and Oracle export files or in appropriate cases, as ASCII or spreadsheet files.

### Drillhole Database

The Drillhole Data base within DME contains over 130 000 drillhole records. Almost 25% of these have a geological log available on microfiche or in hardcopy records. With SA\_DISPLAY, drillholes that fit certain criteria can be easily selected and output, providing a much improved means of reducing unwanted information. Queries can also be made through Oracle. A separate coverage (4000+) has been created for stratigraphic drillholes for which summary logs have been collated. Active data capture continues with emphasis on open-file Company drillhole data.

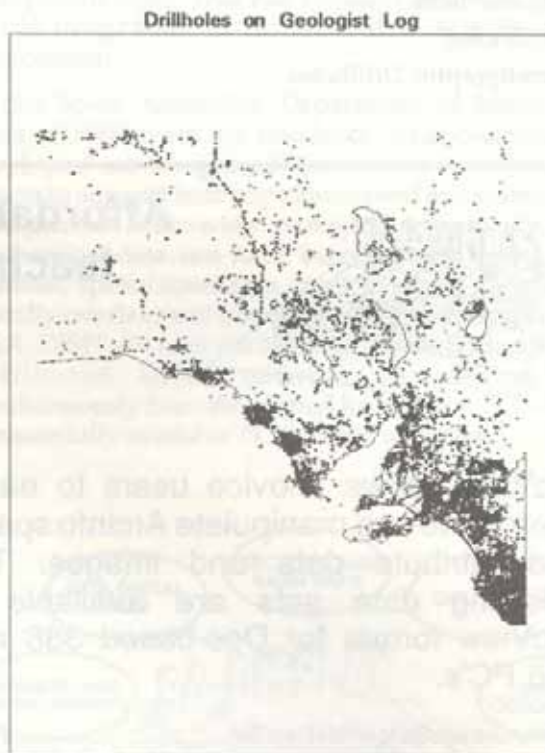


Figure 4. Over 29,000 drillholes have a geological log available.

### RS/Geochem Database

This data base contains lithological/stratigraphic information on 50 000 rock samples collected around South Australia. Over 14,000 have some form of geochemical analysis. Those with major oxide or base metal analyses (8000+) have been included on the PC database. With ArcView, selection and display can be made based on values of specific elements.





### Plate 1:

Integration of data in SA\_DISPLAY. Grey scale TMI image of part of the FOWLER map sheet with "ground truth" information (basement outcrop and drillholes) superimposed.

Outcrop key:

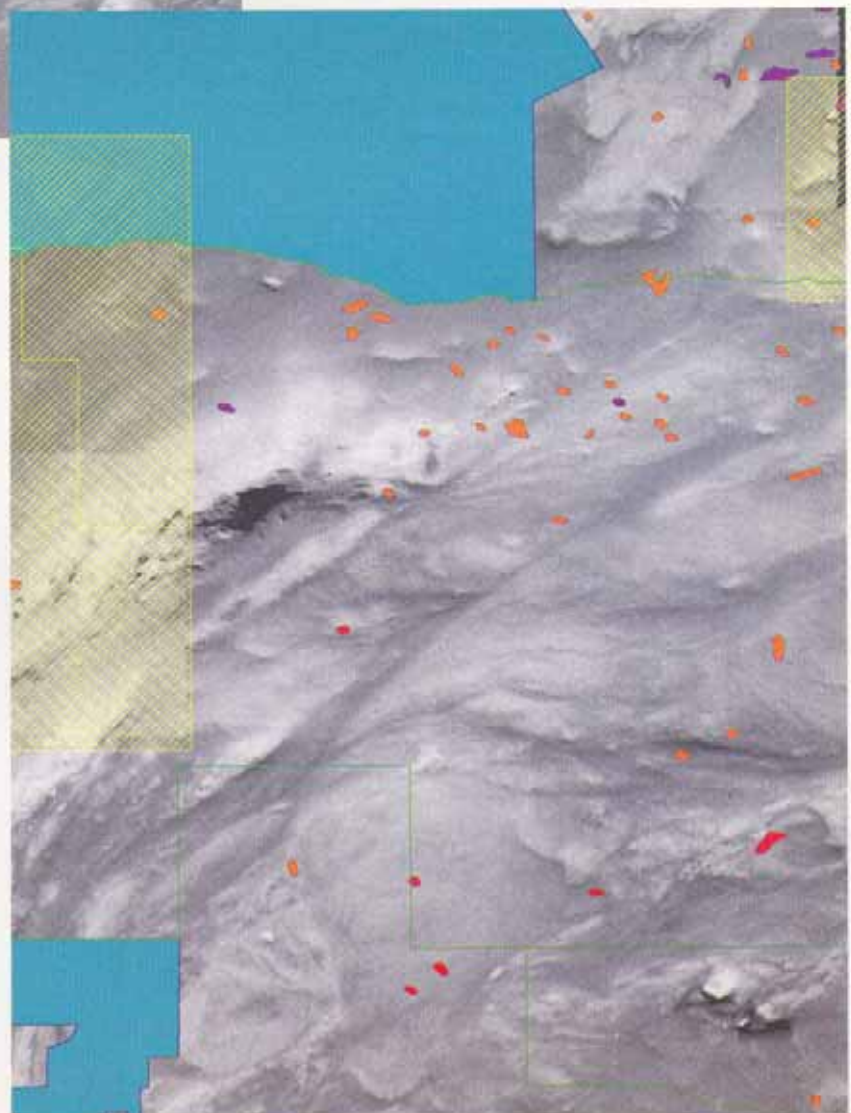
red = Mesoproterozoic Hiltaba Suite granitoids;

orange = Palaeoproterozoic Lincoln Complex;

purple = Archaean Mulgathing Complex.

### Plate 2:

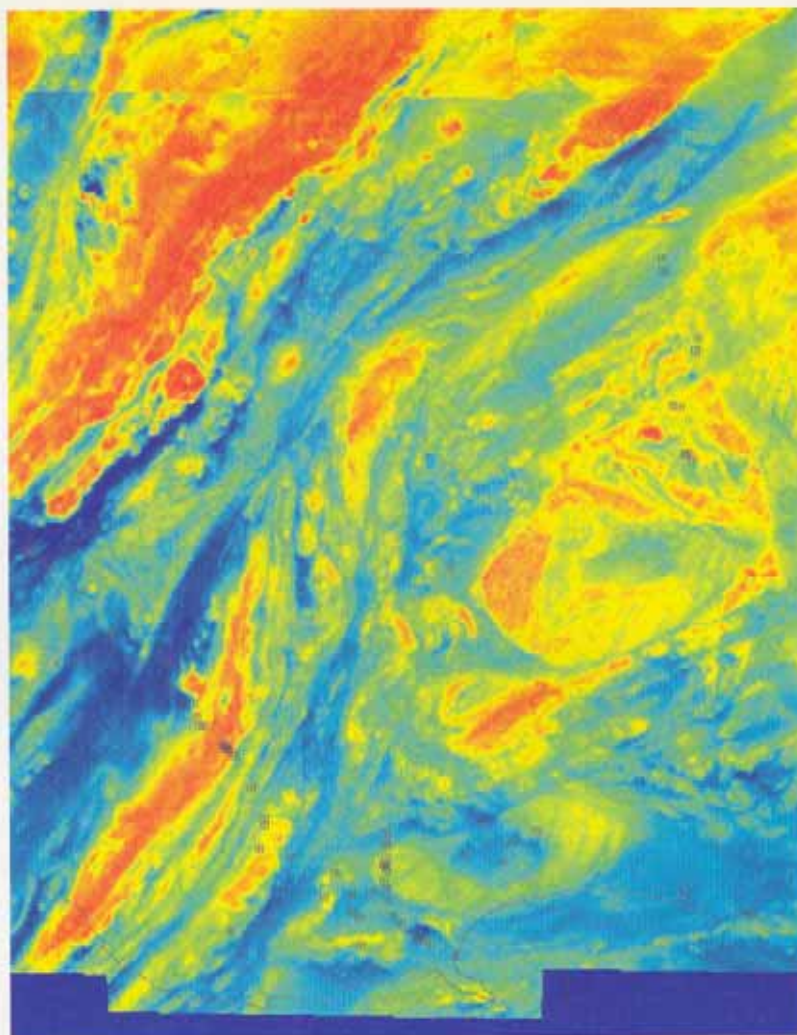
Same view as in Plate 1 but with land access information superimposed. Mineral exploration licence areas in yellow, National Park and Reserve boundaries in green, Aboriginal Lands in blue. Any of these themes can be switched on or off and queried as required. Note that in South Australia, access for exploration can be negotiated for multiple land use Reserves and Aboriginal Lands.





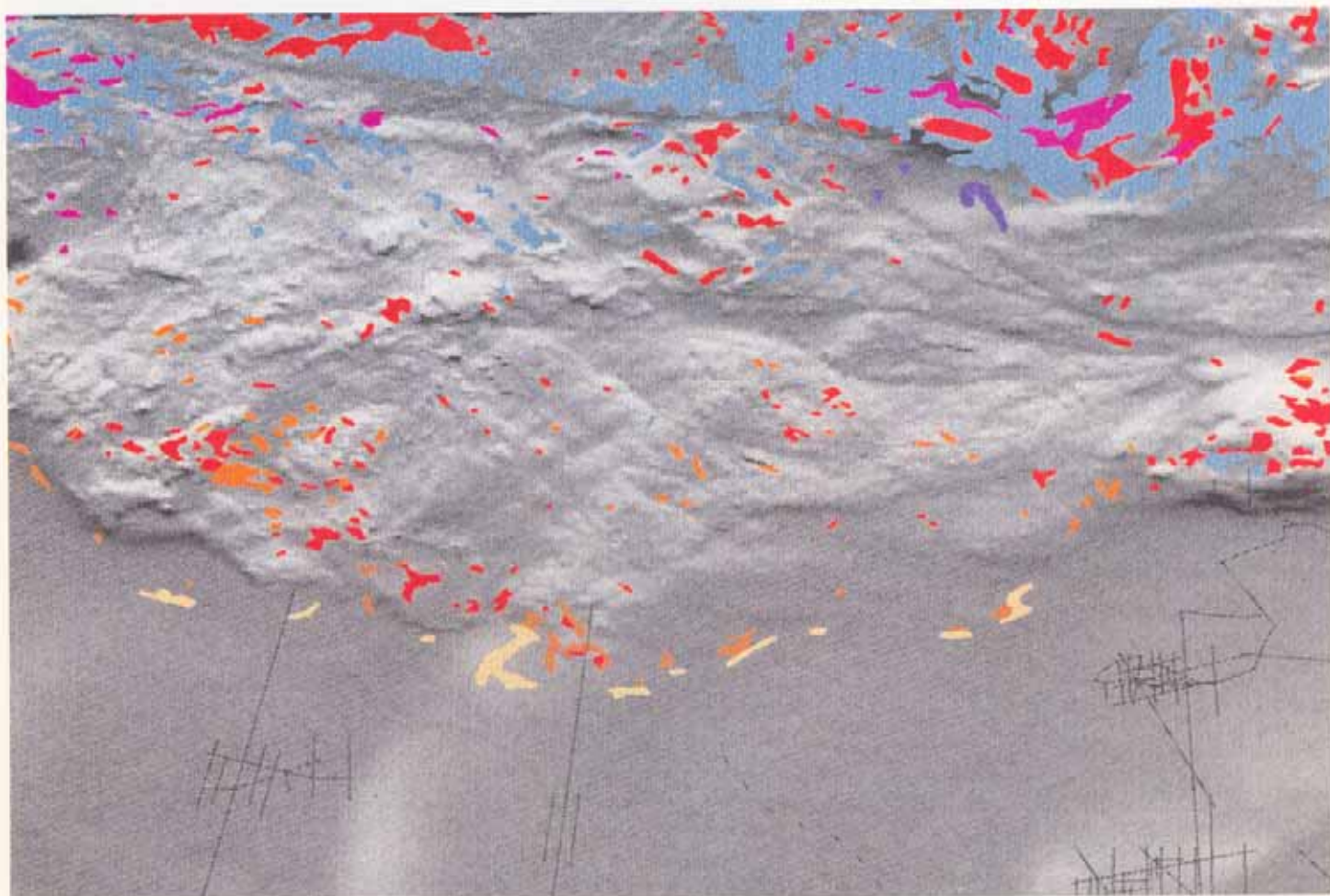
**Plate 3:**

SA\_DISPLAY output for the Fowlers Bay area showing sample sites with lithological, petrological or geochemical information superimposed on an aeromagnetic image (TMI pseudocolor). Each sample site can be queried interactively or the data output in spreadsheet form.



**Plate 4:**

Example of integration of disparate mineral and hydrocarbon - related data sets required for geo-tectonic interpretation. The grey scale TMI image with superimposed basement outcrop and seismic lines clearly outline the internal and marginal structural elements of the Musgrave Block and Officer Basin.





## Cu and Au Occurrences

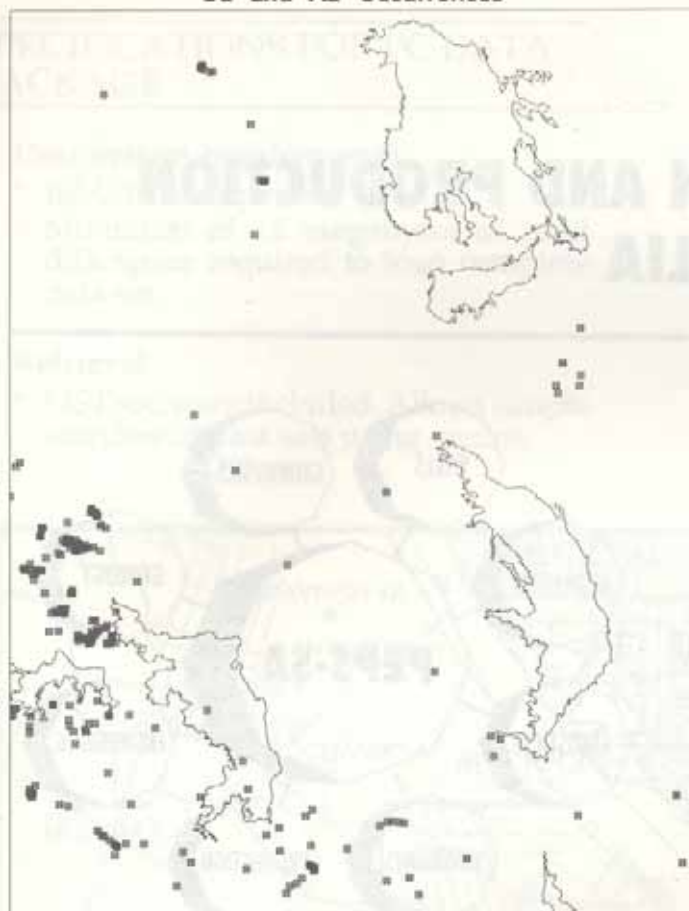


Figure 5. Cu and Au analytical sample sites for the Stuart Shelf

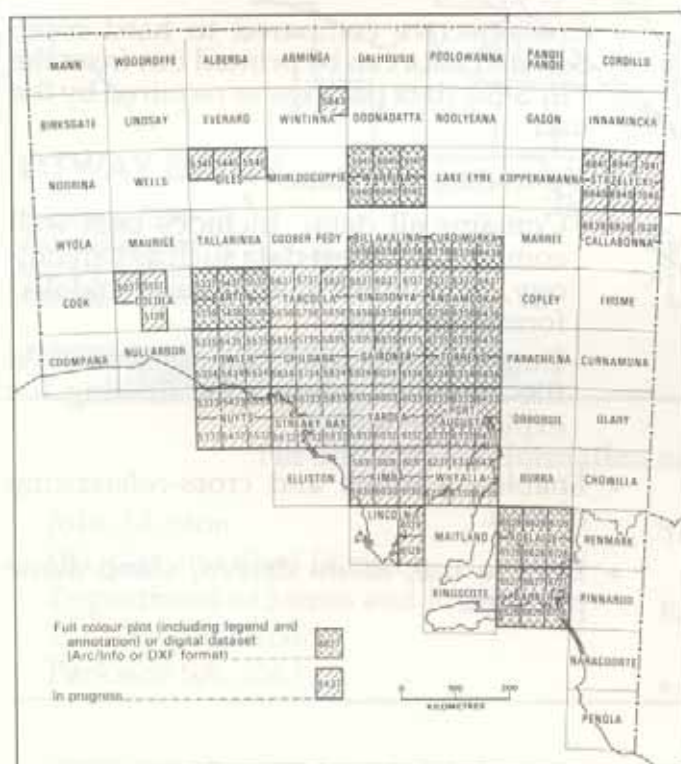


Figure 6: Digital geological map index

## SA\_Geology Database

The digital geological maps database in DME leads the world in quality and detail. The state geological map sourced at 1:2 million scale with Australian standard colour look up and stratigraphic units tables is available in ArcInfo and DXF format for \$950.

Over 50, new full-colour 1:50 000 and 1:100 000 geological maps are available either as laminated colour plots (\$50 each) or as digital files in ArcInfo or DXF format (at \$100 per 100 000 map area). These represent the most detailed and up-to-date geological information available for these areas. Production of this number of maps by traditional means would have been prohibitive. Active data capture continues, as is conversion to ArcView format to provide even easier and cheaper access to data.

## Minocc Database

This is a database of all known, worked and unworked mineral occurrences in South Australia. Approximately 50% of the State has been completed and data capture continues. Locality, commodity, importance, geological setting and mineralization setting are some of the attributes. This data set can be queried through Oracle screens as well as through SA\_DISPLAY.

## SAMREF

SAMREF, DME's reports database, contains over 19 000 references of Company open-file and Departmental reports. On-line searches may be made by locality, map sheet and subject terms. On-line access through SA\_DISPLAY is currently being established. SAMREF is also available through INFO-ONE International as an online service and on CD-ROM.

*Dr Tony Belperio  
Principal Geologist  
Regional Geology Branch*

(Continued page 26)



Major airborne surveys have been carried out as part of the South Australian Exploration Initiative to assist and encourage exploration and aid geological mapping (see p29).



# Geophysical Databases

## Petroleum

### *Petroleum Exploration And Production System - South Australia*

The DME's Oil and Gas Division has developed a comprehensive database of South Australian petroleum exploration and production data. Known as PEPS-SA, this database is now for sale in a variety of formats including as a PC data package or hard copy.

PEPS-SA comprises eight key data sets - wells, geophysics, geology, engineering, production, statistics, tenements and addresses - each of which is subdivided into modules.

Customers may purchase the entire data set or only modules of interest. Data may be selected for specific areas or for all of South Australia. Development of PEPS-SA is ongoing. Purchase includes quarterly updates for a full year.

Present cost to buy all modules for wells in a specific basin is \$50/well up to a maximum of \$2000. PEPS-SA is available in a range of digital formats including ASCII, SAS and dBase.

**Well modules-** well and petrophysical log data. Basic well data for confidential wells is included.

**Geology modules-** cores and cuttings, formation tops, palynology and source rock analyses. It includes results from analyses post dating the well completion report and records recent revisions to stratigraphy.

**Geophysics modules-** seismic survey and seismic line data.

**Engineering modules-** abandonment, casing and perforation details and drill stem, liquid evaluation and well tests.

**Production-** is separated into gas, oil and water recorded on a monthly basis for each completion.

**Statistics-** provides a quick reference to annual statistics on petroleum exploration and production (expenditure, sales, annual LPG/condensate production per field etc).

**Tenements-** exploration, production and pipeline licence summaries.

**Addresses-** contains a complete listing of addresses of all petroleum companies with licence interests in South Australia.

## Seismic Database

A comprehensive index of all seismic lines recorded in the State has been prepared on a survey by survey basis. This index is stored in PEPS-SA as well as a manual system. It includes survey summary data, shotpoint ranges and line lengths.

A digital seismic shotpoint database has also been compiled. It covers the whole of South Australia and

adjacent waters to 40 degrees South latitude.

The database contains co-ordinate data for 447 known seismic surveys ranging in age from 1955 - end 1992.

The total coverage presently stored is 215,847km which represents 99.9 percent of all seismic known to have been recorded. Of this total, there is 112,483km of onshore reflection and 3873km refraction data together with 948,135km of offshore reflection and 1360km of refraction data. Some of the atomic bombs detonated in the Maralinga area were used as energy sources for test refraction surveys. Although the location of the energy source is known (and in some cases, still obvious), the location of the receivers is uncertain, and these surveys have not been entered on the database.

Eighteen surveys remain outstanding representing four percent of surveys within the State but only 0.1 percent of the State's line kilometres. These surveys were mainly equipment testing or experimental in nature.

Co-ordinates of end points of lines are stored along with inflexion points along the line for a total volume in excess of 3 Mbytes. Complete survey data where supplied are archived separately.

Digital data are available on tape or disk as either raw data dump or interpolated data in UKOOA format for a nominal cost. Alternatively, hard copy outputs are available on film or paper.

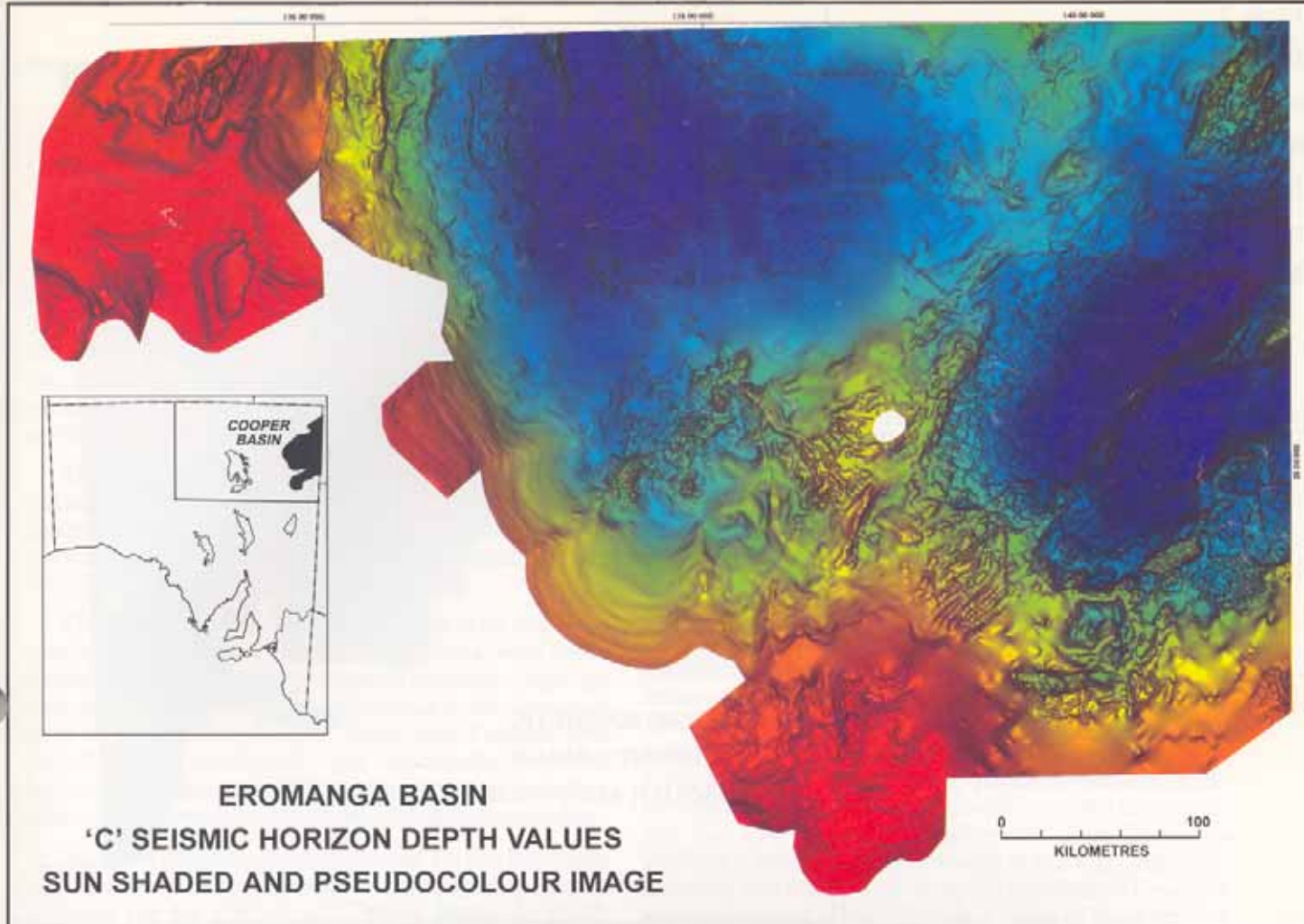
## Seismic Mapping Databases

Developments with image processing techniques are providing the means for presenting fine detail information over a wide area at a manageable map scale. Initially developed for satellite remote sensing, image processing has become the main presentation mode for aeromagnetic data in mineral exploration. It has only recently been used in petroleum exploration, on both aeromagnetic data and horizon time/depth data from seismic and well interpretations.

The Department of Mines and Energy has used this technology to produce an image from the Eromanga Basin illustrated in Plate 5. The image is the 'C' seismic horizon (top Cadna-Owie Formation) which occurs near the base of the Cretaceous sequence. The horizon is a major seismic event over the region and reflects the structure of the underlying oil prone Jurassic sediments.

The base data used in this project comprised 42 time contour maps interpreted by Santos Ltd and Sagasco Resources Ltd. The maps were edited to provide continuity at map boundaries, then digitised. Individual map sheets were gridded (at 200m mesh) contoured and checked against the originals. The grids were then combined to cover the South Australian portion of the Eromanga Basin. These phases used Petroseis software package on a SUN workstation. The gridded data was then exported to an ER Mapper image processing package. Here the dataset was enhanced by illuminating with a northwest sun angle. This emphasised the northeast trending features, with high

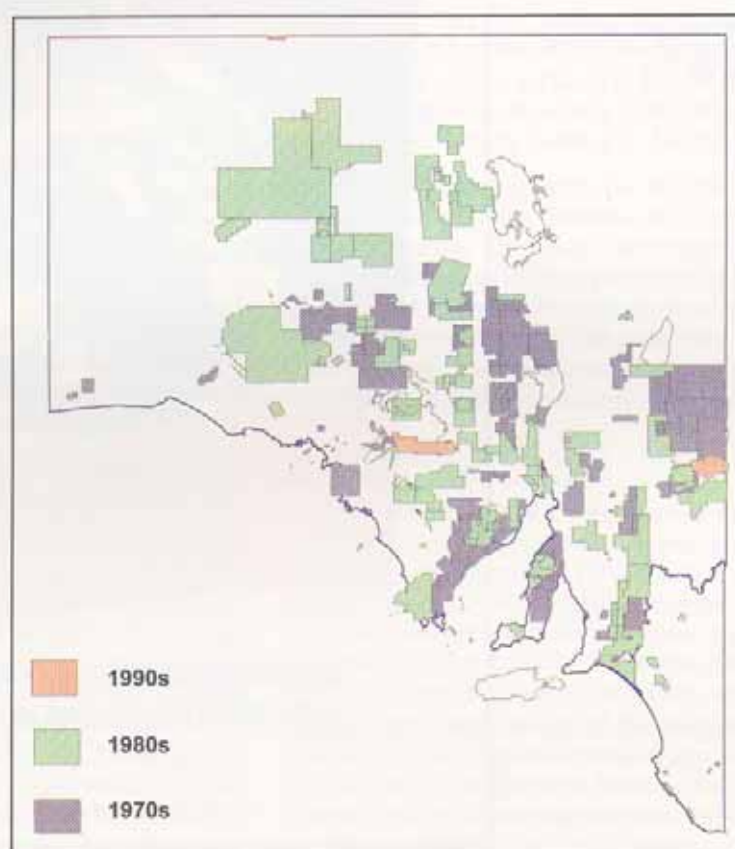




**Plate 5:** EROMANGA BASIN, 'C' Seismic horizon depth values. Sun shaded and pseudocolour image.

**Plate 6:**

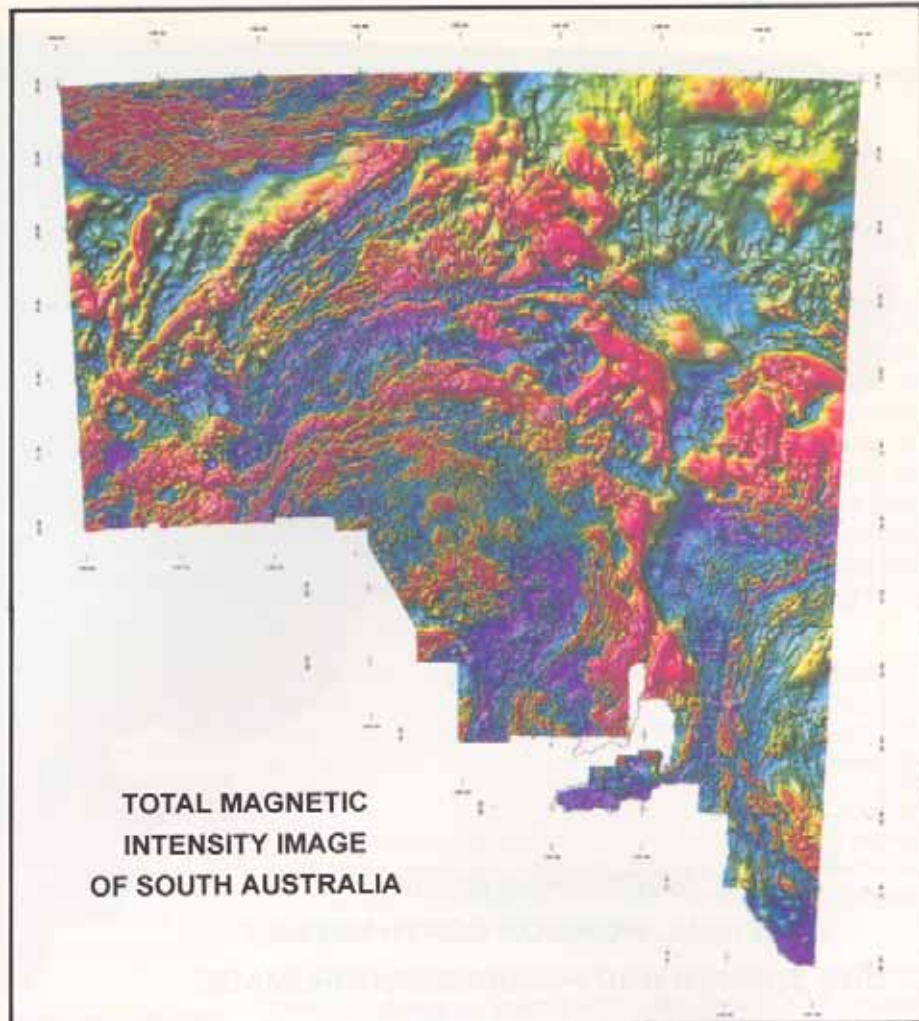
Coverage of company  
detailed airborne  
geophysical surveys.  
(Flight line spacing less than  
or equal to 800 metres).





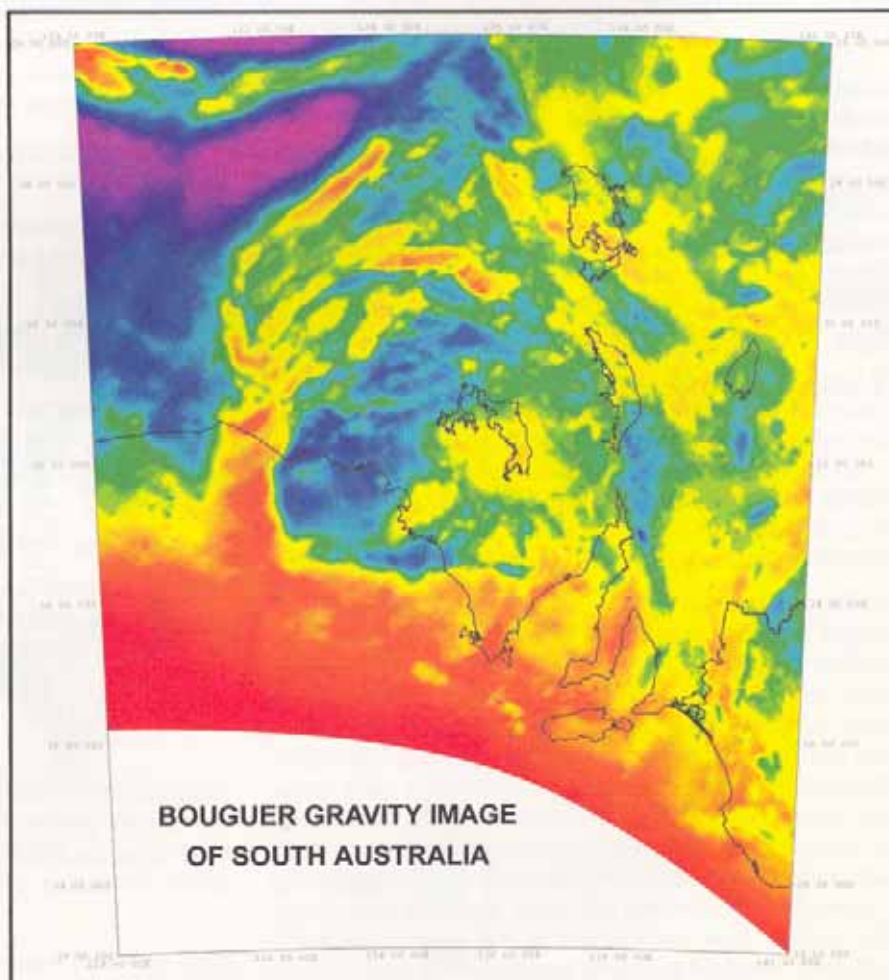
**Plate 7:**

Data sets from all regional airborne (AGSO) surveys have been gridded and joined to produce a 1:2 million scale image of Total Magnetic Intensity.



**Plate 8:**

Over 125,000 readings have been gridded to produce a 1:2 million scale image of the bouger gravity map of South Australia.





trends showing up with bright side toward the sun and shadows on the other. Colour draping according to depth shows the regional structure of the horizons.

The image covers an area approximately 650km wide by 350km high. This 228000 square kilometres represents over one fifth of the state of South Australia. The information is derived from the 92000 line kilometre of seismic data within the region. Although the image depicts seismic reflection time, further processing is expected to convert the data to depth, using 1150 wells in the area.

The grid of the 6 million gridcells is contained in a digital file 66 Megabytes in size, while the presented image file is 23 Megabytes in size. A contour file of the same dataset is contained in a file of 83 Megabytes (for 10 milliseconds contour interval).

The presentation power of the image is its ability to display large complex areas in great detail. Such detail requires large size contour maps or isometric displays. Such detail is exemplified in the image by the structure over the southern Cooper Basin and Patchawarra Trough to the northwest. The relationship of these features to the rest of the Eromanga Basin is also visible, although subtleties are lost in areas of little seismic data.

A similar dataset is being prepared for the basement horizon in the same region. Similar studies are in progress for the Otway and Officer Basins in South Australia where a number of seismic horizons are being mapped. Both contour and image datasets will be available for purchase. Further datasets will be prepared in other basins and made available to industry as an ongoing program.

## Airborne Geophysical Surveys

### Airborne Geophysical Survey Index

Data tapes from over one hundred and fifty airborne geophysical surveys have been archived by the DME over the last twenty years. Each survey has been assigned a unique code which includes the year it was flown.

DME has developed a database to store reference information on each survey, including flight line spacing, line kilometres flown, client, acquisition and processing contractors, parameters recorded, equipment specifications, archive tape numbers, etc. The Airborne Geophysical Survey Index database operates on a PC through the SUPERBASE 4 and MAPINFO software packages. Digitised coordinates of the boundaries of each survey are also stored in the database to enable screen displays of the locations of surveys situated within geographical limits designated by the user. A printout from this database showing the locations of detailed surveys (those with line spacing less than or equal to 800 metres) for the whole State is illustrated in Plate 6. A similar MAPINFO database of the digitised coordinates of current Exploration License boundaries in South Australia will soon be available. Overlaying these two images on the screen will enable a comparison of the geographical relationship between

current Exploration License areas and areas for which 'open - file' airborne survey data are available. A 1:2 million scale hard copy map of all survey boundaries, identified by their respective survey codes, is also available.

Colour images of total magnetic intensity, grey-scale images of magnetic gradient and flight line plots are available as digital 'PCX' files for selected surveys. The complete set of database files including the 'PCX' images are for sale.

### Data Reprocessing

In mid 1991, DME commenced a major programme to verify and progressively update the quality of the airborne geophysical datasets held in archive. The programme is being conducted under contract by Pitt Research in Adelaide.

A basic objective of this programme has been to establish that a valid located data set is available for each known digital airborne survey. Through the 1970s and 1980s, survey data tapes submitted to the DME were seldom checked for data integrity and as a result, some tapes are now found to be only partially readable or the data formats incomplete. Degradation of the tapes with age has also caused difficulties. As each survey is verified, a hard copy colour image of the Total Magnetic Intensity and a grey scale image of the Vertical Gradient are produced at 1:250 000 scale. Copies of these images are available from the Mineral Geophysics Section of the DME.

The gradient images identify the condition of the datasets in terms of the need for further levelling. The quality of many of these ten-year-old surveys can be raised to a level approaching modern day survey standards with the aid of the latest microlevelling techniques. Microlevelling of the archive datasets has proceeded on a priority basis. The status of reprocessing on each survey is recorded in the Airborne Geophysical Survey Index PC database.

Located data sets can be ordered from the DME Mineral Geophysics Section and supplied on either EXabyte tape, streamer cartridge or 9-track tape. Gridded datasets (ERMMapper format) are also available for selected surveys. To date, approximately two-thirds of the airborne survey datasets held in archive have been verified. The remaining datasets are scheduled for verification during the next twelve months.

### State Map

Concurrent with the programme for upgrading the quality of the detailed company surveys held in archive, considerable progress has been made towards producing a located TMI data set of the entire state. Data sets from all regional surveys flown by the BMR (flight line spacings typically 1600 metres) have been gridded and "butt joined" to produce a TMI colour image (Plate 7) and a grey scale image of the magnetic gradient at 1:2 million scale. Copies of these maps are available from the Mineral Geophysics Section for \$140 each. The composite flight line map for this State regional dataset is also available for no charge. The digital grid (ERMMapper format) of the State regional magnetic



dataset is available in three parts corresponding to the three geographic Zones occupied by South Australia (Zones 52, 53, and 54).

The next stage in the evolution of the State TMI image is to microlevel the complete dataset as a whole to remove the level shifts which have arisen from the "butt joining" of the individual regional surveys. Microlevelled detailed surveys will then be sequentially integrated into this reference surface until all available public domain data (both regional and detailed) is eventually contained in the one State dataset.

A similar programme is envisaged for the radiometric data from both BMR regional and company detailed surveys, although to date most of the effort has been concentrated on magnetic data.

### South Australian Exploration Initiative

The proportion of South Australia covered by detailed airborne geophysical surveys has nearly doubled during the last twelve months by virtue of the government funded South Australian Exploration Initiative.

Over 480 000 survey line kilometres have been flown at a flight line spacing of 400 metres and a cost of \$5 million. During the same period, AGSO flew a further 90 000 line kilometres at the same survey specification

covering the Wintinna and Murloocoppie Map Sheet areas in the far north of the state.

A second phase of the Exploration Initiative to be undertaken in 1993/94 will include the acquisition of an additional 150 000 survey line kilometres of airborne geophysical data.

The areas covered by the 1992/93 SAEI surveys and those planned for the 1993/94 program are indicated on the map opposite. These SAEI Areas have been designed to mesh with the boundaries of public domain detailed surveys for which datasets are already available from the DME archive.

Prior to the Exploration Initiative the only airborne geophysical data available for these areas was from regional surveys with flight line spacings of 1500 metres or greater. The improvement in the quality of the images obtainable from the 400 metre spacing data is illustrated in Figure 7.

Magnetic and radiometric datasets from each SAEI survey Area are available as either colour images at 1: 250 000 scale, "black and white" contour maps at 1: 250 000 and 1: 100 000 scale or in digital form as microlevelled located or gridded (ERMMapper format) data. The cost of the digital datasets is in the order of one cent per survey line kilometre. For further inquiries in regard to the purchase of these datasets, contact Mr. Peter Dunne at the DME Document Storage Centre (Phone 08 - 379 7244).

## 1972 Regional Airborne Magnetics Line spacing 1.5 km EW

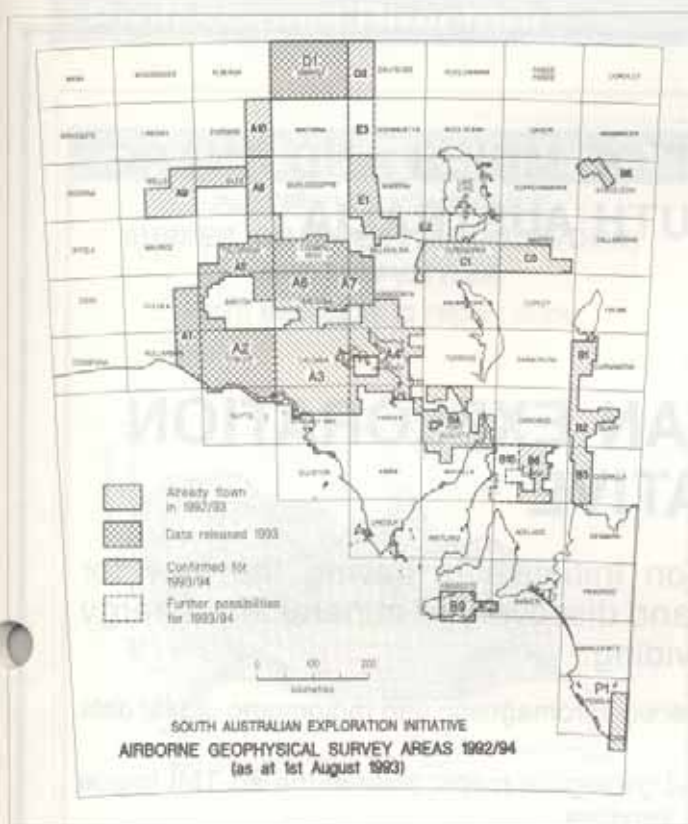


## 1992 SAEI Area A2 Line spacing 400 m EW



Figure 7. The additional information available from surveys with closer line spacing (right) is shown in this comparison of the images of total magnetic intensity from two surveys of the same land surface near Fowler, SA (approximately 60 km<sup>2</sup>)





## The Gravity Database

In recent years there has been a resurgence of interest in the gravity method, mainly due to the increased elevation accuracy attainable by GPS and digital barometers. Under the Exploration Initiative the gravity database is being upgraded after a number of years of neglect. It is now installed on a PC (486) using Superbase software, with gridding, contouring and image display performed on a Sun workstation using Petroseis software.

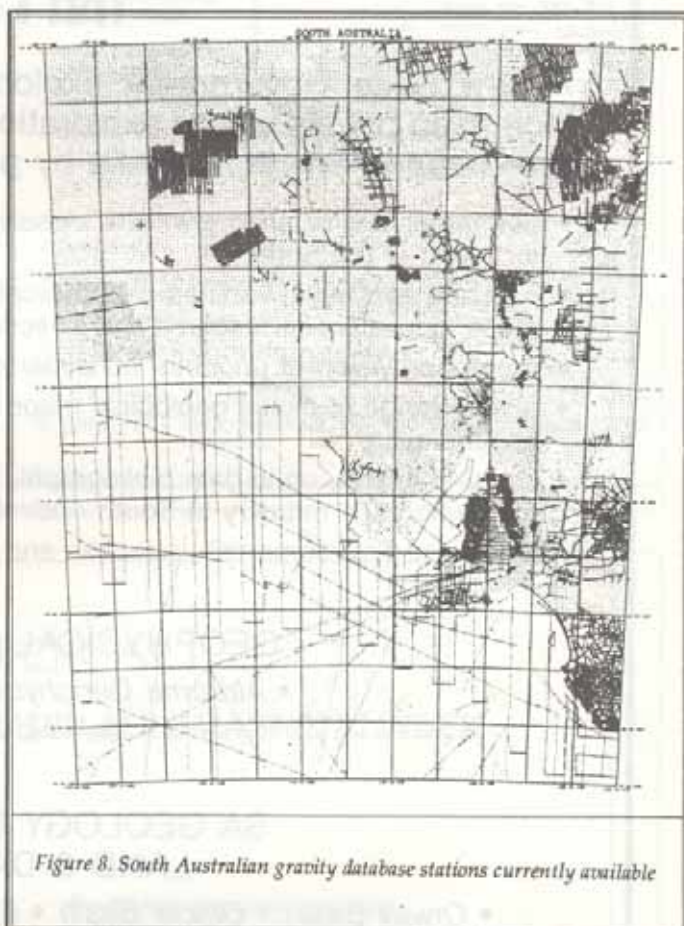
Previously the database was in two parts: a catalogue of surveys, and a list of principal facts (located gravity readings). These will be combined in the present system when inconsistencies have been resolved. Currently only the principal facts are available for sale. There are now 126,800 gravity stations on the file in South Australia, from 375 surveys. These entries have locations in both latitude-longitude and Easting-Northing, elevation, observed gravity and Bouguer value. Benchmark numbers or grid positions are sometimes listed, and it is intended eventually to include station accuracy and permanent mark status. Another 60,000 stations are expected to be added in the next 12 months, mainly on the Stuart Shelf. Major bullseye errors have been corrected or removed, and surveys are checked before being added.

The first large gravity meter surveys were at Leigh Creek in 1948. During the formative days of the gravity database many of the very early surveys were successfully recovered, and tied to other more recent surveys. The peak year for gravity appears to have been around 1970, but this may have been eclipsed by the surge of activity following the Olympic Dam discovery.

The regional helicopter coverage in South Australia is at 4 Mile (6.5Km) spacing instead of the usual 7 mile (11.3Km) spacing across the rest of the continent. The department will attempt to incorporate into the database all gravity undertaken in the State, including student projects, engineering site investigations, groundwater studies, mineral and petroleum exploration, and mine definition surveys, provided the additional data will improve the overall

State gravity image, or is likely to be of interest to a client.

The principal facts are available for purchase at \$950 with the next two updates priced at \$350 each (estimated January 94 and July 94).



The original survey catalogue has about 805 entries. The very first survey listed is a series of pendulum measurements from 1937, followed by a gradiometer survey at Leigh Creek in 1946. Many surveys are small in area (eg. site investigations) or small in number (eg. isogal surveys). Every effort has been made to ensure that a search on a particular survey will yield some information. Where surveys duplicate the same area, both survey entries are listed to avoid searching for the same survey twice! The reference information listed for each survey is highly variable, but may include survey name, company name, contractor's name, observer's name(s), number of stations, station density, data source, tie points for gravity and elevation, accuracy, instruments or method, method of replotting etc. This catalogue will be available for sale at a later date





## DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

# SOUTH AUSTRALIAN EXPLORATION INITIATIVE

A new State Government exploration initiative is paving the way for increased private sector exploration and discovery of mineral and energy resources in South Australia by providing:

- new generation detailed, low-level, closely spaced aeromagnetic and radiometric digital data for much of the State
- new and constantly updated geophysical and geological maps, state-of-the-art TMI image maps, geoscientific research and specialist services
- prompt provision of unpublished departmental and open file exploration company data
- a wide range of digital geological maps and associated datasets including drillholes and geochemistry
- comprehensive, up-to-date bibliographic indexes of all maps and publications relevant to the exploration industry in South Australia
- advice on environmental protection and occupational safety

### GEOPHYSICAL DATA & DATABASES:

- *Airborne Geophysical Survey Index* • *Gravity*
- *Seismic Survey Coverage*

### SA GEOLOGY DIGITAL STATE MAP LAND & DATA PACKAGES:

- *Otway Basin* • *Officer Basin* • *Eyre Peninsula* • *Murray Basin Basement*
- *Northwest Gawler Craton* • *Kangaroo Island* • *Pitjantjatjara Lands*
- *MVT deposits, Flinders Ranges* • *Kanmantoo Trough*

### NEW RELEASES

- *Curdimurka 1:250,000 Geological Map and Explanatory Notes*

For orders and further information contact:

TERRY CRABB

INFORMATION SERVICES BRANCH

PO BOX 151 Eastwood SA 5063

191 Greenhill Road Parkside SA 5063

Phone 08 274 7619

Fax 08 272 7597



# AIRSAR Deployment in Australia, September 1993

## Management and Objectives

A.K. Milne

Centre for Remote Sensing and GIS  
University of New South Wales  
P.O. Box 1  
Kensington NSW 2033



I.J. Tapley

CSIRO Division of  
Exploration and Mining  
Private Bag, P.O.  
Wembley WA 6014



## Introduction



Past co-operation between the NASA Earth science and Applications Division and the CSIRO and Australian university researchers has led to a number of mutually beneficial activities. These include the deployment of the C-130 aircraft with TIMS, AIS, and NS001 sensors in Australia in 1985; collaboration between scientists from the USA and Australia in soils research which has extended for the past decade; and in the development of imaging spectroscopy where CSIRO and NASA have worked closely together and regularly exchanged visiting scientists. In May this year TIMS was flown in eastern Australia on board a CSIRO-owned aircraft together with a CSIRO-designed CO<sub>2</sub> laser spectrometer.

The Science Investigation Team for the Shuttle Imaging Radar (SIRC-C) Program includes one Australian Principal Investigator and ten Australian co-investigators who will work on nine projects related to studying land and near-shore surfaces after the shuttle flight scheduled for April 1994.

This long term continued joint collaboration will be progressed further with the deployment of AIRSAR downunder in September 1993. During a five week period, the DC-8 aircraft will fly in all Australian states and collect data from some 65 individual test sites.

## Management

The deployment preparations were directed by a management team comprising representatives of the CSIRO Office of Space Science Applications (COSSA); CSIRO Division of Exploration and Mining; the University of New South Wales and the Australian Mining Industry Research Association, with NASA HQ and COSSA acting as the signatories for the mission.

In April 1993 a five-day Radar Image Processing and Applications workshop was held in Sydney for the participating investigators. In addition to presenting a theoretical background to the processing of multi-polarised data sets, the workshop sought to outline SAR calibration and ground sampling procedures; evaluate current applications of SAR in geology, vegetation, soils and soil moisture and sea-state investigations; examine the interferometric mode of SAR for surface mapping and to provide participants with hands on experience in basic image processing of radar data. Guest speakers and workshop leaders included Craig Dobson from the University of Michigan, Anthony Freeman from JPL and Fred Kruse from the University of Colorado.

During the deployment data will be acquired for:

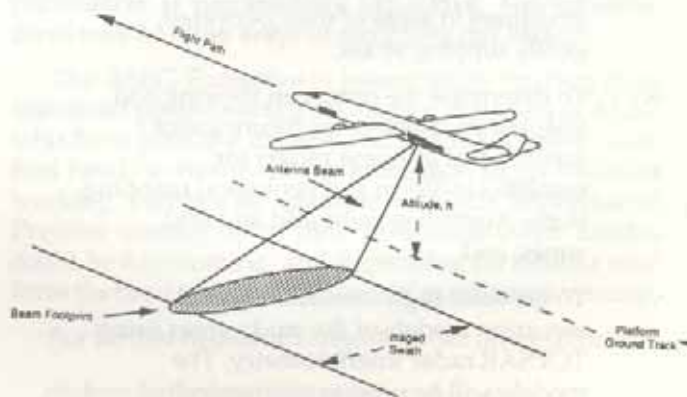
- NASA/Australian collaborative projects;
- SIR-C calibration investigations;
- specific CSIRO based research programs; and
- a series of individual investigations for government agencies and private sector sponsors.

Towards the end of 1994 an evaluation workshop will be held to discuss the results of the mission and allow individual investigators to present their findings.

## Science Objectives

Radar remote sensing technology is comparatively untried, unresearched and unproven in Australian terrains. SIR-A and SIR-B data in the early 1980's did provide limited opportunities to investigate and map selected geological and vegetational patterns (Richards et al 1987).

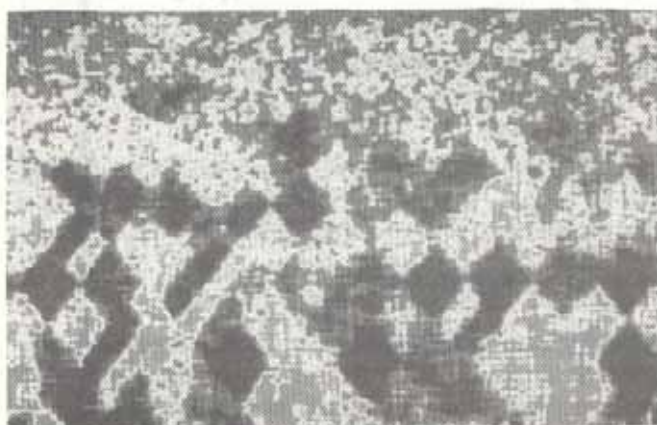
One of the major objectives of this deployment is to determine the contribution of AIRSAR and TOPSAR datasets to landform determination and structural mapping in regolith dominated terrains. One CSIRO research project sponsored by mineral exploration companies has the following aims:



Side-looking radar geometry



- i) To differentiate surficial regolith materials on the basis of their surface roughness and dielectric characteristics, especially weathered rock outcrop, lag gravels, soils and vegetation in both mafic and felsic terrains, and to quantitatively analyse the radar frequency information and the polarimetric signatures that describe each land component. Information describing these surface variables should allow recognition of the three fundamental regimes of a weathered landscape, that is residual, erosional and depositional. It is anticipated that the processed radar data will provide significant information concerning the degree of weathering, wind and/or water erosion processes, and on interpretation of patterns of sedimentation and relative disposition within the dispositional units;



Dielectric constant mapping using SAR imagery. In this agricultural example the dielectric constant ranges from 1.96 to 19.45 (Dark areas <3.0 light areas typically between 3.0 and 4.5)

- ii) To display subtle geomorphological features (micro-relief) involving relief escarpments, drainage and various landforms which may be surface indicators of subsurface geological structures of exploration significance;
- iii) To investigate the capability of polarimetric radar data to map sub-surface geometries and subtle hidden structures in areas of thinly-covered, gently dipping strata;
- iv) To determine the optimum viewing and imaging parameters for future use of satellite and airborne radars for regolith-landform and geological mapping in the Australian semi-arid and arid zones; and
- v) To generate high resolution digital elevation models of the study areas using TOPSAR radar interferometry. The models will be used to geometrically rectify the AIRSAR polarimetric and ERS-1 SAR data respectively and to assist



RGB imagery is used to display various attributes of radar data (e.g. L-Band multi-polarisation image with back scattering co-efficients for VV, HH and HV polarisation in RGB respectively).

definition of landform regimes, regolith characteristics, sources of materials and local regolith stratigraphy. These topographic datasets will be registered to other remotely-sensed, geological, geophysical and geochemical datasets and used for fault mapping and identification terrain analysis and terrain processes analysis, and establishing geochemical dispersion processes and patterns.

Another major objective includes investigating the use of radar for vegetation mapping in forests, woodlands and rangeland environments and for testing models developed to account for the full interaction of backscatter from different tree morphologies over diffuse ground. A number of investigations are centred in the Northern Territory extending along a transect



#### NASA DC-8-72 AIRBORNE LABORATORY

<b>Description:</b>	Crew:	Two Pilots, Flight Engineer, Navigator
	Length:	157 feet
	Wingspan:	148 feet
	Engines:	Four CFM 56-2-C1 High Bypass Turbofan Jet
	Base:	Ames Research Center, Moffett Field, California
<b>Performance:</b>	Altitude:	1,000 - 41,000 feet
	Range:	5,400 nautical miles
	Duration:	12 hours
	Speed:	425 - 490 knots True Air Speed (cruise)
	Payload:	30,000 lb.
<b>Scientific Modifications &amp; Facilities:</b>	Sensor Viewports at Nadir, Zenith, 8° and 62° Elevations	
	Wing Pylons	
	Optical Windows	
	19 inch-Panel Equipment Racks	
	Gym Stabilized Mirror System	
	Dropscale Delivery Tube	
	Air and Aerosol Sampling Probes	
	Laser Chiller Unit	
<b>Support Facilities:</b>	DADS - Data Acquisition and Distribution System (Navigation Flight and Environmental Data)	
	Weather Radar	
	Inertial Navigation with DME Update	
	Time Code Generator	
	Closed Circuit Television	
	Dual Intercom System	
	Stand-alone GPS	
	APT Weather System	
	Both 400 Hz and 60 Hz Power	
	Ten to Twelve Stations Available for Investigators	
<b>Sensors:</b>	Dew/Frost Point Hygrometers	
	Radar Altimeter	
	Surface Temperature Radiometer	
	Metro, Panoramic, and Video Cameras	



from near Darwin in the north to Katherine in the South. This transect provides a climatically determined gradient which brings a transition from wetlands, tropical forests and woodlands, savanna grassland to semi-arid and deserts. The accurate discrimination of these biomes and their boundary effects are seen as crucial to the spatial modelling of ecosystems at both a local and a global scale.

Land degradation processes associated with salinity and altered groundwater conditions will be studied in a number of sites throughout Australia. One site, Kerang in Central Victoria, will be used as a major calibration site for the forthcoming SIR-C mission as well as for hydrogeology.

A joint NASA/Australia project in the Great Sandy Desert region of Western Australia will use both AIRSAR and TOPSAR data for detailed reconstruction of Australia's palaeoclimate and palaeohydrology during the Late Quaternary period. It is anticipated that these datasets will assist in:

- mapping ancient shoreline ridges defining the extent and height of former lakes;
- mapping lacustrine units and distinct flood sedimentation units such as slackwater deposits; and
- identifying levee systems of prior streams and the presence of strandline deposits within dunal corridors.

TOPSAR will be crucial for determining local slope, reconstructing the drainage network and modelling flood estimation and extent, surface run-off and landform development.

## Conclusions

The Australian deployment has provided a core group of Australian researchers an exciting opportunity to exploit the unique capabilities of both AIRSAR and TOPSAR datasets. The benefits of radar remote sensing technology to earth system sciences now depends on the regular availability of these precision datasets from operational spaceborne systems.

## References

Richards, J.A., B.C. Forster, A.K. Milne, J.C. Trinder, and G.R. Taylor, 1987, "Australian multi-experimental assessment of SIR-B (AMAS). Final report to NASA and JPL, March 1987," pp. 11 plus appendices.



## Company News (see page 41)

Does your company have news of significance - a product release, new exploration, a discovery, new staff?

Send details to Preview:

Geoff Pettifer Tel: (03) 412 7840;

Fax: (03) 412 7803

## ASEG Library at AMF

The ASEG Library is now established and housed in a corner of AMF Building, Coningham Street, Glenside, SA. It is managed by AMF, and open to all the ASEG and AMF members. The library currently holds some recent issues of "Geophysical Prospecting" and "First Break", and soon include all the ASEG publications. The expansion plans of the library includes reports and theses of research supported by ASEG Research Foundation and journals from fellow geophysical societies through journal exchange schemes. We have approached geophysical societies in Brasil, Canada, China, Egypt, India, Japan and South Africa.



Suggestions and donations of books and journals are welcome. Have you got a CD-ROM copy of the complete "Geophysics" and are you wondering what to do with the old journals? Your donation will be acknowledged on the journal.



Contact:

Koya Suto

Tel: (03) 895 3041;

Fax: (03) 890 0029.

## History of Geophysics

The ASEG Executive recently made a preliminary assessment of the financial feasibility of production of a book on the history of geophysics in Australia.

The idea has merit but production of a high quality publication is prohibitively expensive. Nevertheless, there may be other ways of recording our history.

The ASEG Executive is interested in hearing from interested people particularly senior members of ASEG who have both the interest and access (in many cases first hand) to history of the profession to get this idea working. Perhaps for example with our 50th issue of Preview coming up in June 1994 some major articles could be forthcoming, and depending on interest may form the basis of a more substantial publication venture.

For further details or to register your interest contact:

Andrew Sutherland, Schlumberger Seaco Inc

Tel: (03) 696 6266;

Fax: (03) 690 0309



## ASEG Committee Reports

### Corporate Affairs Committee

There has been no activity to report on during the last year. A summary of relevant information for members is as follows:

1. Since 1 January 1991 the Australian Securities Commission (ASC) became the sole national authority responsible for the administration of companies and securities law throughout Australia. We are obliged to lodge an annual return to the ASC within one month following our Annual General Meeting.
2. Our registered office is located at:  
Webeck Farland Pender  
incorporating Simons & Baffsky Solicitors  
Level 18, State Bank Centre  
52 Martin Place  
Sydney NSW 2000
3. Our Australian Company Number is 000 876 040. This must be shown on the Common Seal and is also required on every public document with the company name that is signed, issued or published.

*Lindsay Ingall, Chairman*

### Honours and Awards Committee

There is no item of significance to report. The last series of Honours and Awards were presented at the 9th ASEG Conference in October 1992 and these were published in the October 1992 issue of Preview.

A call for nominations for ASEG and SEG awards was published in February 1993 issue of Preview. The 10th ASEG Conference will be held in February 1994 and the next series of awards will be presented then.

*Lindsay Ingall, Chairman; Barry Long; Bill Peters*

### Conference Advisory Committee

The ASEG Conference Advisory Committees (CAC) roles are:

- a. To advise the Federal Executive on all Conferences Matters;
- b. To monitor the State Conference Organising Committee (COC) and give advice if required/where appropriate;
- c. To plan future Conference strategies; and
- d. To keep reports, records and statistics of ASEG Conferences.

The CAC is made up of one chairman from the past five Conferences and includes the following people: Timothy Pippett (Sydney 1991), Dick Irvine (Melbourne 1989), Greg Street (Perth 1988), Richie Huber (Brisbane

1992), Steve Mudge (Past Chairman of CAC) and Robert Singh (Federal Executive).

### Gold Coast Conference (October 5-8 1992)

The Gold Coast conference was a great success and our thanks go to Richie Huber and Hank Van Paridon and their very enthusiastic committee and a very professional Conference Organiser in Intermedia Conference and Event Management Pty Ltd. The conference generated a healthy financial surplus which will assist the ASEG in delivering further benefits to its members.

### Perth Conference (February 20-24 1994)

The planning for the Perth Conference under the co-chairmanship of Kim Frankcombe and Norm Uren, is well underway and a very high standard of technical program is being put together. The conference will be at the Burswood Convention Centre. There has also been a good response from exhibitors and it is anticipated that there will be a full exhibition when the conference opens in February.

### Adelaide Conference (September/October 1995)

Planning is underway for the Adelaide Conference in late 1995 and the appointment of a Conference Organiser is presently being selected. Full details of this conference will be available in Perth in early 1994.

### Next Conference (February/March 1997)

No decision has been made at this point concerning the 1997 venue. All state branches will be contacted shortly requesting them to submit proposals for this conference. A decision will be made at the Perth Conference as to the successful state branch.

### Conference Organisers

With the Adelaide conference will come a trial, of the CAC selecting a Conference Organiser, with the aim of that Conference Organiser taking on future conferences. This is to try and get more of a general administration of the conference off the committee and give some continuity from one conference to another without the ASEG committee having to go through a 'learning curve' for each conference.

### Updating Conference Guidelines

The CAC have over the last five years developed a set of Guidelines for the running of the ASEG conferences. As after each conference, these Guidelines are presently being updated with input from the Gold Coast conference experience. These should be made available to all interested parties by September.

*Timothy Pippett, Chairman*



## ASEG 9th Conference & Exhibition

Official Final Report of the 9th Conference and Exhibition Gold Coast October 1992

1. The conference budget was conservatively based on 250 delegates.
2. There were 514 registered delegates as follows -
  - Fulltime members - 267
  - Fulltime non-members - 121
  - Fulltime students - 33
  - Fulltime guests - 12
  - Daily delegates - 74
  - Daily guests - 2
  - Daily student delegates - 5

The number of non-member delegates was substantial and the Society should endeavour to increase its membership by continuing communication with this group.

3. Almost all papers submitted were refereed and published in the conference volume of Exploration Geophysics.

However, the refereeing process needs to be handled more efficiently for future conferences. (i.e. the special conference editor forwarded papers to referees before confirming their availability. This resulted in delays and at one stage special assistance was sought for the SCE to ensure the papers were processed in time).

4. It has been recommended to offer fewer Workshops based on current industry issues.

Two of the five planned were cancelled due to lack of numbers.

5. The trade exhibition comprised 91 booths. The budget was originally based on 50 booths.

### 6. Recommendations -

- (a) The CAC should consider letting a 3 consecutive conference contract to a Professional Conference Organising Company to add consistency to the conferences.
- (b) The ASEG Conference Manual should be used as a guide, not a "bible".
- (c) 4 - 6 workshops, mostly pre-conference with a cancellation/refund policy to be clearly communicated on the workshop advertising material.
- (d) The special conference editor (SCE) should be in close proximity to the organising committee.
- (e) Public relations - require a "good media talent" - someone integrally involved in the conference who is readily accessible to the media and can provide good, lucid media interviews.

### 7. Finance and Budget -

(a) Conrad Jupiters was different from previous conference venues in that no venue costs were incurred. This was due to a rebate system against monies spent at the hotel via accommodation and catering. Rebate value - \$32,000.

By contrast the venue costs for the trade exhibition was \$47,000.

- (b) Budget was for
- |                                    |
|------------------------------------|
| -250 delegates                     |
| 50 booths                          |
| \$82,500 sponsorship & advertising |

These figures were easily exceeded

-512 delegates
92 booths
\$98,000 sponsorship & advertising

(c) Workshops were budgeted on a "break even" basis - however \$17,000 profit was made mainly due to the Airborne Geophysics Workshop which attracted a large following.

It has been suggested that the "break even" principal for workshops could be changed where some subsidy for courses could be made by other conference incomes as a service to members.

(d) Finally, the surplus for this conference was \$126,489.

*Richie Huber, Conference Co-Chairman*



ASEG 9th  
Geophysical  
Conference  
and  
Exhibition

## Apology

In the June '93 Preview (p20) we incorrectly reported the demise of the Finnish susceptibility meter.

ABEM Instruments inform us that the Finnish instrument is alive and well and now being manufactured by the ABEM group.

Preview apologises to ABEM Instruments and readers for this error and regrets any inconvenience. We hope to publish news of the outcome of the privatization of ABEM (Preview, December 1992, p29) in coming issues.



## Company News

### Kimberleys - Kevron Kountry

Kevron Geophysics, Perth based airborne Geophysical company, has commenced flying a large area of the Kimberley which will fill in some of the map-sheets not covered by regional AGSO surveys. The data from this project will be available for sale on a multi-client basis in approximately five (5) months time.

The area to be covered comprises most of the map sheets: Ashton, Mt. Elizabeth, and parts of Londonderry, Drysdale and Cambridge Gulf. More than 150,000 line km of survey will be flown at a line spacing of 400 metres in North-South direction. The data from some older surveys over some of these sheets will also be available for sale.

Kevron also announces the commissioning of its third twin-engined Aero-Commander aircraft, which has now been in service for a couple of months. This aircraft is equipped with identical survey gear to its earlier aircraft, except for the spectrometer, which is the latest model G.R. 820 by Exploranium.

*David Gibson, Manager, Kevron Geophysics*

## DHEM Workshop

A workshop on drillhole electromagnetics (DHEM) was recently held at the Cooperative Research Centre for Australian Mineral Exploration Technologies (CRCAMET), Macquarie University, Sydney. A total of thirty two geophysicists attended, including three from Canada. John Bishop is to be congratulated for its organisation.

Twenty four papers plus discussion sessions were squeezed into two long days, the papers covering the whole range of survey techniques, interpretations, successes, failures, frustrations, etc. The discussions were continued with some enthusiasm over dinner (to the dismay of two unfortunate restaurant owners).

The papers will be submitted for publication in a special volume of Exploration Geophysics in late 1994 with the workshop organisers, John Bishop and Roger Lewis, as guest editors.



*Continuing education is alive and well.*

## UWA Geophysics

The Department of Geology at the University of Western Australia has recently changed its name to the Department of Geology and Geophysics. The change reflects the greatly increased amount of geophysical work being undertaken in the Department since the appointment of new staff in 1990. Geophysical courses are now undertaken by the majority of undergraduate students and geophysical projects comprise a significant proportion of the Department's research.

Under the direction of Dr Mike Dentith the programme of teaching and research in exploration geophysics has been expanded and the first students undertaking the mathematical geophysics major have graduated. Current research projects include the three-dimensional structure of greenstone belts in W.A., the structure of the Darling Fault and adjacent Perth Basin and regional controls on Pb-Zn mineralisation in the Canning Basin.

The Department also has a new palaeomagnetic laboratory established by Professor Chris Powell and Dr Z. Li. The laboratory is equipped with cryogenic magnetometer and thermal and AC and demagnetising equipment. Current research projects include the improved definition of the Palaeozoic apparent polar wander path of Australia, and rock magnetic studies of the Precambrian iron ores of the Pilbara region.

For further information contact:

Mike Dentith or Chris Powell  
The University of Western Australia  
Department of Geology & Geophysics  
Nedlands Perth WA 6009  
Ph: (09) 380 2666; Fax: (09) 380 1037



### PREVIEW NEEDS NEWS

Do you have technical item news or ideas you could contribute to Preview? These could be:

- Company's news items
- Brief technical articles
- An old or recent poster paper waiting for a publishing venue
- Tutorial - type items
- Ideas for articles
- A case history
- News of members

If so please send them to Preview

Contact: Geoff Pettifer;  
Tel: (03) 412 7840; Fax: (03) 412 7803;  
email: [grp@mines.wic.gov.au](mailto:grp@mines.wic.gov.au)



# Remote Delineation Of The Orebody

## Application Of Geophysics To The Mining Environment

Joe Cucuzza  
AMIRA

An important problem facing miners today relates to their inability to determine the location of the orebody/host interface to the desired accuracy prior to mining. This interface may be defined by a geological boundary or it may be a particular cut-off grade. Other problems include defining geological features, such as faults, fractures, cavities and related structures and underground openings that effect the mining process. The openings can be natural or man made such as old workings, which may or may not contain water.

The miners may define the problem in terms of dilution. It has been suggested that losses due to dilution may be as high as 25% of all costs. It was not totally unexpected therefore that recent industry surveys have identified orebody delineation as a top priority for research.

The exploration industry has over the years developed and applied many different geophysical methods to remotely detect orebodies. Some of these methods are very well advanced in the S curve and some do not have the inherent resolving power to be able to overcome the problem discussed herein. The geophysical methods which may have potential are seismic (includes cross-hole), radar, radio imaging method (RIM), and conventional EM. This list is not meant to be exhaustive.



Winning the ore by men or  
machine - the question remains:  
What guides them to the ore and  
can geophysics help?



To establish which of these methods is to likely to provide the information required quickly, accurately and cost effectively, Dr Ken McCracken, a geophysical consultant, and Dr Andy White, from the University of Queensland, were commissioned by AMIRA to carry out a world-wide study. The goal of the study was to assess the role that modern geophysical techniques can play as a contribution to the reduction of ore dilution, and to better overall mine design.

The study was supported by nine major mining companies and had three distinct phases:

- Consultation with people at the "coal face" to define the nature of the need.
- Discussion with technology providers and R&D organisations both in Australia and overseas.
- Analysis and reporting.

Dr Ken McCracken and Dr Andy White each delivered a paper at the AMIRA Annual Technical Meeting in Kalgoorlie, on September 8th and 9th, 1993. The theme of the meeting explored the impact of the new technologies of continuous hard rock excavation and the use of geophysics underground for remote orebody delineation.

The first day of the AMIRA technical meeting was devoted to two top priority issues of orebody delineation and continuous excavation. Joint presenters of three papers under the first heading were Peter Williams, Chief Exploration Geophysicist and Greg Jones, Chief Geologist of WMC. The second paper presented by Dr Ken McCracken, geophysical consultant, was titled "Geophysics for orebody delineation: The facts and the feasible". He was followed by Dr Andy White's contribution titled "Taking Geophysics from the Black Box to the Mine Workface".

The three papers presented under the topic of continuous excavation were by Bryan Davis, General Manager Mining, Pasminco, Wojciech and Richard Laufman who respectively are Senior Mining Engineer and Underground Manager of WMC's Kambalda nickel operations. Dr Mike Hook, Director of the Centre for Mining Technology and Equipment discussed the rock breaking technologies for the mines of tomorrow.

The final day of the technical meeting was reserved for visits to the operations of Kalgoorlie Consolidated Gold Mines and St Ives Gold Mines and Newcrest's New Celebration Mine.

AMIRA through this initiative hopes that all those professionals who are committed to Australia regaining the lead in underground metalliferous mining to attend and be challenged by the opportunities discussed.

The detailed program and further details of the 1993 AMIRA Annual Technical Meeting in Kalgoorlie can be obtained from:

Michael Slifirski,  
AMIRA,  
9/128 Exhibition Street,  
Melbourne, 3000.  
Telephone (03) 654 8844  
facsimile (03) 654 8661.

# AMIRA





# Mineral Exploration Research in Australia

## Major new initiative on EM Research by the CRC for Mineral Exploration Technologies

The Australian Mineral Industries Research Association (AMIRA) has recently secured support for the \$4 million dollar project to be undertaken by the Co-operative Research Centre for Australian Mineral Exploration Technologies (CRCAMET). This AMIRA project is the first from the CRCAMET to receive Industry support and will look at deep penetration EM systems and interpretation tools for exploration in regolith dominated terrain.

The CRCAMET has a primary goal of dramatically improving exploration technology and has targeted electromagnetic (EM) exploration techniques as a priority. The poor success of airborne EM techniques in Australia's regolith dominated terrain (as compared to North America and Scandinavia) is the reason for this focus.

The inhomogeneous regolith acts both as a screen and as a source of local anomalies that make deep target detection very difficult. Within six years the CRCAMET aims to achieve accurate physical property mapping and hence geological mapping in 3-D, and the detection of 300m deep targets even in regolith covered areas. To achieve this, temporal noise must be virtually eliminated, and methods developed for the reliable geological interpretation of all the information contained in vast amounts of EM data. The CRCAMET also intends to contribute to the development of airborne EM hardware.

The AMIRA project is a part of this overall vision and consists of three sub-projects which will be managed within the CRCAMET's Geophysical Methods program:

- **Sferics Elimination** has the goal of reducing sferic noise to negligible levels through remote or local reference techniques, the developed instrumentation from the project will likely be suitable for ground and airborne EM magnetic field gradient measurements.
- **Regolith Electrical Properties** will take advantage of the strong regolith geology component of the CRCAMET's resources to produce a set of conductivity models essential for both the understanding of (geological mapping) and stripping (deep target detection) of regolith EM responses.
- **AutoInterpretation** will provide a set of automatic and interactive tools for the physical modelling of EM data as 3-D bodies within a variable host covered by inhomogeneous regolith. The software is planned

to allow for the easy incorporation of geological constraints such as observed geology and regolith structure.

All of these sub-projects will provide useful results to geophysics and geologists in mineral exploration in the short term as well as contributing to the long term goals of the CRCAMET. Products will be of relevance to existing ground and airborne systems, and potentially the interpretation of borehole data. Useable software and models are expected to commence delivery within six months of project commencement.

The project team is being led by Dr. J. Macnae who has been appointed as Professorial Fellow at Macquarie University. The project will involve CSIRO, Macquarie University, Curtin University of Technology and the Geological Survey of W.A.

The current industry sponsors are:

BHP Minerals  
CRA Exploration Pty Limited  
Geopeko  
MIM Exploration Pty Ltd  
Pasminco Exploration  
World Geoscience Corporation

The Project is still opened for support. The more companies join the consortium the lower the individual sponsorship costs.

For further information please contact Joe Cucuzza at AMIRA on (03) 654 8844 or Jim Macnae at the CRCAMET on (02) 906 6221.



### COOPERATIVE RESEARCH CENTRE FOR AUSTRALIAN MINERAL EXPLORATION TECHNOLOGIES

#### MASTERS IN MINERAL EXPLORATION TECHNOLOGIES

This is a new course in contemporary techniques for mineral exploration in Regolith-dominated terrane, taught by geologists, geochemists and geophysicists who are employed in the exploration industry, in exploration research and in the universities. The course is part-time over two years. It will be offered in two segments of three 1-week units each year, in February and July. The same course is offered at Curtin University of Technology (Perth) and Macquarie University (Sydney), with the two out of phase by a year so that individual units which might be missed in one offering can be done the following year at the other institution. In 1993 the course will be done at Curtin University.

The units are Regolith Geology, Exploration Geochemistry, Orebody Models, Gravity and Magnetic Techniques, Electromagnetic Techniques, Resistivity and Induced Polarisation Techniques, Radiometrics and Remote Sensing, Data Processing, Imaging and Image Processing, Numerical Modelling and Inversion, Borehole Methods, and an Interpretation Project. Lecturers in the first year include Dr. Tom Whiting (Chief Geophysicist, BHP Minerals), Prof. Ray Smith (CSIRO and Curtin University), Prof. Ross Large (University of Tasmania), Dr. Jim Macnae (Macquarie University and Lamontagne Geophysics) and Dr. Art Raiche (CSIRO). The first three units begin 8 February (Regolith Geology), 15 February (Exploration Geochemistry), and 22 February (Techniques in Exploration Geology, on orebody models), 1993.

The fee for the full Course is \$12,000 for Australian residents, and \$14,000 for others. Units can be done individually if desired, subject to availability of places, and will be charged on a pro rata basis.

For further information and application forms please write The Director, Cooperative Research Centre, Macquarie University, NSW 2109 or fax (02) 805 8428. (From overseas, fax +61-2-805 8428.)



## Membership

### New Members

We welcome the following new members to the Society. Their details need to be added to the relevant State Branch database:

#### Victoria

**Ian CAMERON**  
6/8 Bracken Avenue  
Thornbury VIC 3071

**William DOWNEY**  
Victorian Geophysical  
Contractors  
84 Altona Street  
Heidelberg Heights 3081

**Yanghua WANG**  
Monash University  
Dept of Earth Sciences  
Clayton VIC 3168

#### ACT

**Donna CATHRO**  
AGSO  
GPO Box 378  
Canberra ACT 2601

#### South Australia

**Kim CHATFIELD**  
129 Walkerville Terrace  
Walkerville SA 5081

**Wendy WATKINS**  
45 Railway Terrace  
Warradale SA 5046

**Paul DRAPER**  
19 Angas Crescent  
Marino SA 5049

**Phillip HAWKE**  
2/20 Charles Street  
Plympton SA 5038

#### Western Australia

**Urpo KURONEN**  
Outokumpu Exploration  
Australia  
1st Floor  
141 Burswood Road  
Victoria Park WA 6100

**Paul MUTTON**  
70 Walpole Street  
St James WA 6102

**Matthew COOPER**  
3A Mandora Way  
Riverton WA 6148

**Tony DANZI**  
Lot 816 Francais Road  
Pickering Brook WA 6076

**Sue DOWNIE**  
27 Enfield Street  
Lathlain WA 6100

**Chris GOLDING**  
6 Aleppo Drive  
Kardinya WA 6163

**Stuart HARPER**  
3 Whitley Crescent  
Karrinyup WA 6018

**Kurt HOSGOOD**  
25 Bridge Street  
Wilson WA 6107

**Anthony KNAPTON**  
C/- Post Office  
Balingup WA 6253

**Kostas KONSTANTINOS**  
52 Lewis Road  
Wattle Grove WA 6107

**Adam O'NEILL**  
17 St Andrews Way  
Duncraig WA 6023

**Tara ROBERTS**  
1795 Great Eastern Highway  
Sawyers Valley WA 6074

**Darren UREN**  
100 Stone Street  
Bayswater WA 6053

**Chris WALTON**  
11 Virgilia Street  
Duncraig WA 6023

**Nicholas EATON**  
10 Linthorn Crescent  
Greenmont WA 6056

#### Overseas

**Don LAWTON**  
University of Calgary  
Dept of Geology & Geophysics  
2500 University Drive, N.W.  
Calgary, Alberta T2N 1N4

**Andrew WILLIAMS**  
Monopros Limited - Waterpark  
Place  
Suite 1510, 10 Bay Street  
Toronto Ontario P7B 5N2  
Canada

**Michael WATTS**  
C/- Geosystem srl  
Viale Abruzzi 170131 Milan  
Italy

**William McLENNAN**  
Private Bag X018  
Garborone Village  
Botswana

**Dr Maher MAKLAD**  
Suite 2020 633-6 Avenue S.W.  
Calgary, Alberta T2P 2Y5,  
Canada

**Alan TRIPP**  
University of Utah  
Dept of Geology & Geophysics  
717 Browning Bldg  
Salt Lake City  
Utah 84112, USA

### Change of Address

The following changes need to be made to the relevant State Branch database:

#### Victoria

**David SPRING**  
From: L2/ 476 St Kilda Rd  
Melbourne Vic 3004  
To: 7 Maxine Court  
Mentone Vic 3194

**Shaun WHITAKER**  
From: Lot 16 Hubbard Rd  
Yarra Glen Vic 3775  
To: 2 Monica Street  
Burwood Vic 3125

**Joe CUCUZZA**  
From: AMIRA  
9F1/128 Exhibition St  
To: 113 Grand Boulevard  
Montmorency Vic 3094

**Michael MOORE**  
From: C/- 52 Ferguson St  
Forestville NSW 2087  
To: Western Mining  
P.O. Box 157  
Preston Vic 3072

#### Queensland

**Darren RUTLEY**  
From: 4/61 Depper St  
St Lucia Qld  
To: 24 Pendula Circ  
Forest Lake Qld

**Andrea SORBIE**  
From: 4/61 Depper St  
St Lucia Qld  
To: 24 Pendula Circ  
Forest Lake Qld

**Paul HYDE**  
From: 10 Pumile Street  
Eight Mile Plains  
To: 7 Robyne Place  
Kuraby Qld 4112

**Troy PETERS**  
From: U4, Cintra Manor,  
18 Cintra Rd  
Bowen Hills Qld  
To: 33 Redgrave St  
Stafford Heights

**John RYNN**  
From: Queensland Uni  
Queensland 4072  
To: 421 Pullenvale Rd  
Pullenvale Qld

**Walter MUIR**  
From: AGL Petroleum  
GPO Box 1010 Brisb  
To: Petroz NL  
GPO Box 842  
Brisbane Qld 4001

**Michael SHARRY**  
From: P.O. Box 88  
Cooroy Qld 4563  
To: 21 Sundridge Street  
Taringa Qld 4068

#### Northern Territory

**Kenneth EVANS**  
From: University of Qld  
Dept Mining  
St Lucia Qld 4072  
To: P.O. Box 427  
Jabiru NT 0886

#### South Australia

**Peter EAGLETON**  
From: 45/2 Goodlet Street  
Surry Hills NSW  
To: North Flinders Expl  
25 Greenhill Road  
Wayville SA 5034

**David FARQUHAR-SMITH**  
From: P.O. Box 1171  
Cloverdale WA 6105  
To: Geopeko  
P.O. Box 57  
Melrose Park SA 5039



## ACT

### Ian GALLOWAY

From: Day Cullen Limited  
GPO Box 663  
Adelaide SA 5001  
To: C/- CFM Ltd  
GPO Box 1921  
Canberra ACT 2601

## New South Wales

### Kerry SLATER

From: 125 Bedford Street  
Newtown NSW 2042  
To: 9 Warruga Crescent  
Berowra Heights 2082

### Tony HOWLAND-ROSE

From: P.O. Box 1222  
Chatswood NSW 2067  
To: 130 Fullers Road  
Chatswood NSW 2067

### Shane WRIGHT

From: Mackie Martin & Assoc  
14 Edgeworth David Ave  
Hornsby NSW 2077  
To: PPK Consultants Pty Ltd  
P.O. Box 248  
Concord West NSW 2138

## Western Australia

### Kevin TUCKNOTT

From: 100 Hutt Street  
Adelaide SA 5000  
To: Poseidon Exploration  
8 Kings Park Road  
West Perth WA

### Raymond Paul TEAKLE

From: 3 John Street  
Norwood SA 5067  
To: 8 Aranda Place  
Leederville WA 6007

### Jean GRAINDORGE

From: 8 Pergola Place  
Edgewater WA 6027  
To: 25 Quarry Ramble  
Edgewater WA 6027

### Sam BULLOCK

From: World Geoscience Corp.  
17 Emerald Terrace  
West Perth WA 6005  
To: 2 Dunbar Road  
Claremont WA 6010

## Overseas

### Richard WEST

From: BHP-UMI  
550 California Street  
San Francisco USA

To: BHP Minerals  
200 Fairbrook Drive  
Suite 204  
Herndon, VA 22070 USA

### Sami KHAN

From: Digital Exploration Ltd  
54-56 Brookes Street  
Bowen Hills Qld 4006  
To: Digicon Exploration Ltd  
37 Jalan Pemimpin  
Union Building, U#06-01  
Singapore 2057

### Colin REEVES

From: AGSO  
GPO Box 378  
Canberra ACT 2601  
To: Department of Earth  
Resources Surveys  
ITC  
Kanaalweg 3  
2628 EB Delft  
The Netherlands

### Prof Horst RUETER

From: HERNERSH 45  
4630 Bochum Germany  
To: DMT-Institute of  
Deposits, Surveying  
& Applied Geophysics  
Herner Straße 45  
D-4630 Bochum 1  
Germany

## Where Are They?

Does anyone know the new  
address for the following  
members?

### Mr T. SCHWARTZ

Last known address:  
Water Resources Group  
GPO Box 1096  
Darwin NT 0801

### Ms J. BAUER

Last known address:  
Lasma Oil (Australia) Ltd  
P.O. Box 1135  
West Perth WA 6872

### Mr S.M. KHAN

Last known address:  
Digital Exploration Ltd  
54-56 Brookes Street  
Bowen Hills Qld 4006

## Calendar of Events

For Calendar of Events  
See June 1993 Preview

## THE UNIVERSITY OF ADELAIDE SOUTH AUSTRALIA

Applications are invited from both women and men for this position:

### CHAIR IN PETROLEUM GEOPHYSICS

(Ref: 9200) A position is available for an experienced Basin Analyst/Geophysicist to be based at the NATIONAL CENTRE FOR PETROLEUM GEOLOGY AND GEOPHYSICS (NCPGG) at The University of Adelaide in South Australia. The NCPGG is a joint venture of The University of South Australia, The Flinders University of South Australia and The University of Adelaide, and is a member of the Australian Petroleum Cooperative Research Centre (APCRC) which is Australia's leading research group for the petroleum industry.

The Chair in Petroleum Geophysics is a new position resulting from a decision to expand significantly the research capacity of the NCPGG. The successful candidate will be responsible to the Director of the NCPGG and will be required to provide strong academic leadership and supervision for staff and post-graduate students whilst developing academic and research directions leading to the establishment of new methods and technologies applicable to basin analysis with consequent benefits to the petroleum industry. Further, in addition to some lecturing duties and industrial short courses the appointee will be responsible for the recruitment of high quality postdoctoral staff and postgraduate students. There may also be a requirement to act as a Program Manager on APCRC industry supported projects in the Australasian region.

The appointee will have internationally recognised skills in seismic stratigraphy and seismic 3D interpretation with knowledge of petrophysics and other geophysical techniques utilising the most up-to-date technology. Familiarity with sequence stratigraphy, various depositional systems and petroleum basins of diverse tectonic settings will be regarded as an advantage. Although the position is strongly research oriented some industrial experience will be advantageous as will evidence of administrative ability.

The position is available immediately for five years with the possibility of appointment for a further period. Further information concerning the duties of the position may be obtained from Dr WJ Stuart, Director, NCPGG, tel.(618) 303 4299, fax (618) 303 4345.

INFORMATION about the general conditions of appointment and selection criteria may be obtained from the Director, Personnel Services at the University.

SALARY PER ANNUM: A\$77,900 Level E Academic (Professor) APPLICATIONS, IN DUPLICATE, quoting reference number 9200 and giving full personal particulars (including whether candidates hold Australian permanent resident status), details of academic qualifications and names and addresses of referees should reach the Director, Personnel Services, University of Adelaide, South Australia 5005, Telex UNIVAD AA 89141, Facsimile (618) 303 4353 not later than 15 October 1993.

The University reserves the right to make enquiries of any person regarding any candidates suitability for appointment, not to make an appointment or to appoint by invitation.

THE UNIVERSITY OF ADELAIDE IS AN EQUAL OPPORTUNITY EMPLOYER.