PREVIEW

AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS
A.C.N. 000 876 040

April 1993, Issue # 43

Special PREVIEW Feature:

Reservoir Geophysics 11-16

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Special Features

Regular Features

HEAD OFFICE: Suite 5, 672B Glenferrie Road Hawthorn Vic 3122
TEL:(03)818 1272 FAX:(03)818 1286
PRESIDENT: Mr Hugh Rutter, Tel:(03) 818 1272 Fax:(03) 818 1286
HON SECRETARY: Mr Brenton Oke, Tel: (03) 652 6625 Fax:(03) 652 6684
EDITOR: Mr Geoff Pettifer, Tel:(03) 412 7840 Fax:(03) 412 7803
email: grp@mines.vic.gov.au
NEWSLETTER PRODUCTION: Ms Janine Cross, Tel: (03) 818 1272 Fax: (03) 818 1286
ADVERTISING: Mr Greg Turner, Tel: (03) 881 1279 Fax: (03) 803 2052
PREVIEW ADVERTISING RATES (6 ISSUES): Business Card $100; ¼ Pg $200; ½ Pg $330; Full Pg $530; Back Pg (¾ Pg) $750; Colour Advertising Approx $1,000 per page per issue depending on demand. Special rates available for advertisements accompanied by colour review articles
Registered by Australia Post, Publication No. WBG 2390, PREVIEW is a publication of the Australian Society of Exploration Geophysicists, circulated to a membership of approximately 1,000.
Artwork by Geophysical Exploration Consultants Pty Ltd
Printed by Snap Printing

From the Editor

The ASEG is fortunate to have the services of visiting Curtin University Haydn Williams Fellow, Professor Bob Sheriff for the ASEG Distinguished Lecture/Workshop Tour on Reservoir Geophysics scheduled for early May (details p16) in Brisbane, Sydney and Melbourne. ASEG local Branches are assisting the ASEG Continuing Education Committee and Curtin University in organising this ASEG sponsored tour and your support of the tour will be of mutual value. Professor Sheriff gives us a foretaste of the material to be presented at the workshop and at local Branch meetings (pp11-16).

The ASEG Executive recently approved several initiatives to put your ASEG's funds to work for members and the earth science fraternity in Australia (p5). Continuing Education figures highly in spending priorities. At the AGM further financial planning and budgeting procedures for ASEG Committees will be outlined by ASEG Treasurer Lindsay Thomas.

PREVIEW continues to endeavour to improve and we want you to play a part. Read what is planned and how you can help on page 23. An updated list of ASEG office bearers appears on page 25.

The ASEG Technical Standards Committee chairman Paul Wilkes reports (p17) that CSIRO Exploration Geoscience, airborne contractors, SADME and AGSO have been busy with a major initiative to standardize airborne radiometric survey calibrations and facilitate merging of surveys in Australia.

Have you as a geophysicist considered the benefits of membership of the Australian Institute of Geoscientists (AIG)? Prominant ASEG office bearer Lindsay Ingall, has no doubts, he runs the AIG Secretariat and has arranged for an article outlining AIG membership benefits, from AIG President Michael Leggo (p5).

Is time running out for this Geophysical contractor or can he survive? Read all about it in the great contractor fees debate (p21).

President's Piece

Robert Sheriff is currently in Australia and during his visit will be giving a number of talks on Resevoir Engineering. He is one of a number of distinguished lecturers from the United States or Canada, who will visit Australia providing us with an insight into other aspects of geophysics. But it does bring to mind the words of Sven Treitel at the recent ASEG conference held at the Gold Coast when he said that most of the recent developments and current research in the field of mineral geophysics is resident in Australia. We are taking up this challenge and will be organising a number of specialist courses that can be presented by our own distinguished people in Australia. These will be given in Australia initially but there is no reason why we cannot "export" these courses in the same maneer that the American do through the SEG and other organisations.

Henk Van Paridon, the chairman of the Continuing Education Committee has already started the ball rolling and you will find further words from Henk in this issue of PREVIEW.

If you think you have something to offer, or are willing to assist, or know of someone who has special knowledge which can be presented well, contact Henk and help him keep the ball rolling. It will be wonderful to see Australian geophysicists visiting the Americans in the same manner that Robert Sheriff is visiting Australia.

Hugh Rutter
President

ASEG People Profile

ASEG Committee Member 1993, Koya Suto

Even eighteen years after landing in Australia for the first time, our Committee member Koya Suto is often asked "How long have you been in Australia?" He answers with a smile "I spent half of my life in Australia. Well, we have no choice where we are born and brought up for the first five years ... and I have lived in Australia for half of the rest".

Koya is also frequently asked what brought him to Australia. "When I was a Master's student in the Mining College of Akita University, I saw a poster on the campus notice board about a scholarship available for an international student exchange scheme. The scheme was established between Adelaide University and Akita University with the support of the Japanese Government by Professor Rudd and (the late) Professor Watanabe of those universities. So I applied. It turned out that I was the only applicant, and I got it".

Koya graduated from Akita University in 1974 with a BE and in 1976 with an ME. His Bachelor's work was on earth tides; measuring the tidal variation of gravity to estimate rigidity of the earth's crust. "The university had a Facom computer (in a special building of its own) with 16K memory which took a couple of hours to run Fourier transform analysis of 256 data points. I guess that only reveals my age", he laughs. Koya's Master's thesis was on aeromagnetic interpretation of the Broken Hill area. He continued his studies in airborne data, incorporating radiometrics for his PhD. But, before finishing he took a job with Esso, where he started his petroleum career. Asked why he joined an oil company after studying minerals techniques, Koya answers "It was a time of depression in the minerals industry and oil exploration was booming. Well, whatever the target is, geophysics is geophysics".

In Esso, Koya worked in the Otway, Gippsland, and Canning Basins, as well as in software development and velocity studies groups. He now works for Pacific Oil and Gas Pty Limited, a small petroleum division of the large minerals company CRA. Initially he interpreted seismic data from joint venture areas of the Gippsland, Carnarvon, Browse, Bonaparte and Canning Basins. But, when the company's emphasis shifted to Precambrian basins of onshore Australia, Koya began working in the McArthur Basin, both in acquisition and interpretation of seismic data. When asked about spending time with seismic crews in the Northern Territory Koya comments "The work is OK .... the only problem is that it takes about twelve hours just to get there. You know, this distance is longer than London to Moscow".

About exploration Koya says, "However hard you work, what does not exist cannot be found. But if it is there, I will find it".

Koya is married with two children. On weekends you may find him gardening or playing the recorder with his daughter, if he is not contouring Precambrian structures. "My real hobby is classical music. But I seldom get to go to the concert hall these days", he says as he shrugs his shoulders.

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PREVIEW Deadlines 1993

Copy Deadline	Publication Month
June 12	June, 1993
August 14	August, 1993
October 9	October, 1993
November 27	December, 1993

ASEG Publicity/Promotions Committee

The ASEG would like to establish a committee to improve the promotion of geophysics and the ASEG.

We are seeking ASEG members to form this committee.

Possible activities for publicity and promotions could include:

- Preparation of ASEG slide sets for ASEG/industry speakers to promote geophysics to schools, community groups (eg Rotary).
- Sponsorship of an earth-science competition.
- Sponsorship of a school essay competition on geophysics.
- National/State geophysics demonstration days for secondary students/teachers.

Expressions of interest in joining this committee and ideas are welcome.

Contact:
Hugh Rutter
Tel: (03) 818 1272
Fax: (03) 818 1286

ASEG Branch News

Victoria

AGM meeting (Federal and State) is set for the 20th of April. Nomination forms will be sent out in April mail out. Negotiations underway for a possible talk by Prof. Sheriff in May while in Victoria.

March meeting included a talk on Median filters by Guy Duncan from Melbourne University. Second committee meeting held on the 31st March to discuss possible structure change to the Vic Branch. Further information will be put forward during the AGM with a scheduled talk by the Federal President. Forthcoming presentations by Alan Anderson (BHPP) and Peter Arditto (BHPP).

Zis Katelis
Secretary

ACT

At late notice, the AGSO/ASEG Autumn Golf Classic was held on the 5th March 1993 with very pleasant weather conditions, and again Alan Hogan won the ASEG Golf Champions cap. A meeting of the branch was held on the 25th March 1993 with pre-seminar drinks and nibbles, with the seminar beingn given by Deborah Scott (RESE, ANU) on a topic titled "Is there a straight line on a sphere?". The talk covered oblique structures in the East African Rift System with several Australian examples thrown in for good measure.

The ACT Branch will be holding an Annual General Meeting sometime towards the end of April, with nominations currently being sought for the executive and committee members for 1993.

Kevin Wake-Dyster
Secretary

South Australia

The ASEG SA Branch on Tuesday 6 April co-ordinated with the Student Geophysical Society at Adelaide University to conduct a student information and awareness evening. Invitations were extended to maths and physics students at Flinders University and University of South Australia as well as to geology and geophysics students. Four speakers were invited to address the following questions for 10 minutes each.

1. How I got into Geophysics
2. How my career developed
3. Current views on employment opportunities
4. Future directions (& hints for getting into the industry).

The speakers were:

John Hughes	(SANTOS)
Rod Lovibond	(SAGASCO Resources)
Chris Anderson	(Placer Pacific)
Professor David Boyd	(Consultant)

About 50 students and 15 invited ASEG members were present and enjoyed a lively exchange of information prior to and after the talks. It is hoped to conduct a similar event next year at a different tertiary institution.

We acknowledge SADME for sponsorship of the refreshments.

Shanti Rajagopalon
Doug Roberts
Student Liaison, ASEG SA Branch

Western Australia

The local branch AGM is to be held shortly. If you've found yourself cursing your local committee for lack of action, or believe you have a contribution to make - then now is your chance to do something completely positive about it. Get a

collegue (an ASEG member) to nominate you for a position on the local committee - or nominate each other!

The following offices are available for nomination and/or renomination:

President
Vice President
Secretary
Treasurer
General Committee Members

I don't think there is a limit on the maximum number of committee members we can have!

The position of President has been held for a number of recent years by a minerals type. Although in no way do we wish to discourage other minerals types from seeking nomination of this position - the outgoing President and Secretary agree that it might be refreshing for the local branch membership to have an Oily type in the seat.

Now is your chance to enhance your professional standing and do something for your local Geophysics Community - for the fun of it.

Nominations can be made in writing to myself C/- Geco Prakla, P.O. Box 1286, West Perth WA 6872 or phone: (09) 321 5477 or fax: (09) 321 3047.

Don't delay. Take action. Do it now.

Andie Lambourne
Secretary

Queensland

The first meeting of the year was the AGM on March 3. There was a mass coup with all bar one of the executive changing. Our thanks to Mike Barlow for persevering in the treasurer's portfolio. Guest speaker for the meeting was Nick Sheard from MIM Exploration who gave us a potted history of geophysics starting with Captain Cook. Nick also extolled his views on where geophysics is headed.

The new committee wasted no time in scheduling a second meeting on March 23 to take advantage of a visit from Dr Easton Wren. Dr Wren presented a very interesting and stimulating talk on combining seismic field parameters with processing parameters.

With one meeting for both minerals and petroleum sides geophysics, the total combined attendance was about 50 members. This augurs well for the participation level at our local branch. We hope to continue the diversity of speakers and ask for members assistance to inform us if they know of visiting people suitable for guest speakers.

Our next meeting will hopefully have Prof. Robert Sheriff who will be in Brisbane to deliver a lecture on 13 and 14 May. Notices for the lecture on reservoir geophysics have been circulated to Queensland Branch members.

ASEG Queensland Branch Committee 1993

	Phone	Fax
President:		
Wayne Stasinowsky	(07) 279 1928	(07) 279 1705
Vice President:		
Noel Moriarty	(07) 858 0600	(07) 369 7840
	Phone	**Fax**
Secretary:		
Howard Bassingthwaighte	(07) 279 0400	(07) 279 0743
Treasurer:		
Mike Barlow	(07) 867 1703	(07) 867 1775
Committee:		
Steve Hearn	(07) 365 2179	(07) 870 4993
Ritchie Huber	(07) 237 1511	(07) 229 7770
Voya Kissitch	(07) 854 1488	(07) 257 1561
Andrew Mutton	(07) 854 1488	(07) 257 1561
Troy Peters	(07) 279 0400	(07) 279 0743
Robyn Scott	(07) 834 7663	(07) 834 7678
Mark Taylor	(07) 252 5212	(07) 252 3796
Henk Van Paridon	(07) 221 6516	(07) 221 2068
Joe Williams	(07) 864 2445	(07) 864 1535

Howard Bassingthwaighte
Secretary

AIG

The Australian Institute of Geoscientists - Its Relevance to Geophysicists

The relevance of the AIG is that geophysicists are necessarily part of a larger geoscientific community and it is AIG's function to support and promote geoscience and geoscientists of all specialisations and from all secctors - private, public, research, teaching, contracting and consulting. It is a body promoting professional rather than technical aspects of our profession and is not seeking to compete with specialist technical groups such as the ASEG, learned bodies such as the Geological Society of Australia, or specialist industry groups such as the AusIMM. The niche, if you like, is pushing the broad geoscientific barrow in terms of public acceptance and the promotion and welfare of its members.

A major issue, which has been revived by AIG members and other organisations after a long period of dormancy, is that of registration of geoscientists. This is a complex issue, members' views on this are diverse and emotions can run high. Some would argue that acceptance for membership in the AIG with its review panel and ethics committee should provide professional status and adequate "protection" for the public. Others believe a more rigorous approach (including examinations, on-going eduction, etc) is required. What is firmly agreed is that a self-regulating body is better than one imposed by government (or possibly governments if individual States get into the act) and the AIG is a suitable vehicle for registration if it becomes inevitable.

Membership of the AIG is in excess of 800 and growing rapidly, partly because of recent accreditation by the ASC of the AIG for reporting purposes and partly, with this as a catalyst, because of a significant increase in activity. This is reflected in its lively quarterly AIG News, involvement (often jointly with, for example, SMEDG, The AusIMM or the GSA) in low cost, very well supported one and two day symposia, social functions (e.g. the AIG - SMEDG Christmas cruise) and lectures. That's a thought - have your booked yet for the symposium on recent advances in the Mt Isa Block, 21 May 1993?

The AIG is represented on the Joint Ore Reserves and MINVAL committees; made a comprehensive submission on AGSO to the review committee (as well as writing to the Prime Minister and relevant Ministers); produces a Consultant's Directory; advises (through AIG News) on matters as varied as worker's compensation insurance for consultants/contractors, malaria prevention and helicopter safety; takes up individual member's professional complaints where appropriate; has commenced a Handbook series and is to pursue environmental geoscience issues in 1993-94.

The AIG keeps its annual membership fees modest ($35 for Members; $45 for Fellows) and relies heavily on the energetic efforts of its voluntary State and Federal Councillors and the participation of its members. For those of you in Sydney on May 20 you can check us out at the AGM to be held at the Rugby Club, Crane Place in the city, at 5.30pm. Also Dr Bill Ryall is to talk on "Why geoscientists can contribute to environmental management - opportunities for employment". Alternatively you may wish to contact Lindsay Ingall (Tel. No. (02) 955 1788) for more information and/or a membership form.

Michael Leggo
President
Australian Institute of Geoscientists

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ASEG Funding Initiatives Approved

The ASEG Executive has approved funding for the following initiatives:-

- ASEG Research Foundation; 2 year funding - 1993 and 1994 - $30,000
- Underwriting R. Sheriff Lecture tour (depends on support of workshops) - up to $10,000
- ASEG GDF Airborne Data Exchange Software - $10,000
- AMF - "Geophysics for Geologists" Course notes rewrite and publication (royalty return to ASEG) - $20,000 (less royalties $10,000 estimated)
- Free one year ASEG membership to first year graduate students - $2,000 / year estimated
- PREVIEW Colour Budget (Sponsor Shortfall) for Continuing Education Purposes - $5,000/year
- ASEG Library (to be housed at AMF) - $2,000 initially ($600/year)

Other ideas under investigation include:-

- ASEG Publicity/Promotion initiatives
- Unemployed geophysicists support scheme (similar to SEG)

Further ideas for funding initiatives are sought from members. At the AGM all ASEG subcommittees will be asked to submit an annual plan and budget for approval.

For ideas or details contact:

Geoff Pettifer Tel: (03) 412 7840 Fax: (03) 412 7803
email: grp@mines.vic.gov.au

ASEG Research Foundation News

Report on the ASEG Research Foundation 1991 funded project: Geophysical Studies of the Regolith, Near Nevoria, Southern Cross Greenstone Belt, Western Australia

By Kylie Paish,
Department of Geology,
University of Western Australia,
Nedlands, WA 6009

The aim of the project was to investigate whether geophysical techniques can define the base and internal structure of the regolith. If the geophysical response of the regolith can be defined this response can be removed from the data thus enhancing the signal from deeper sources. Seismic, gravity, and magnetics data were collected along a 4.7km traverse 1km west of the Nevoria Gold Mine in the Southern Cross Greenstone Belt, WA (Figure 1). The traverse crosses a granite-greenstone contact and a series of thick pegmatitic horizons within the greenstone succession. The interpretation of the geophysical data is constrained in two ways i) geologically using RAB drill hole information from seismic shot holes and ii) petrophysically by measuring the properties of nearby rocks.

The seismic shot hole depths are between 10 and 20m and their drill chips were logged and magnetic susceptibility measured. Figure 2(i) illustrates the geological cross-section from this data. The granite-greenstone contact was marked by a change in susceptibility from greenstone (about 0.3x10-3SI) to granite (about 0.05x10-3 SI).

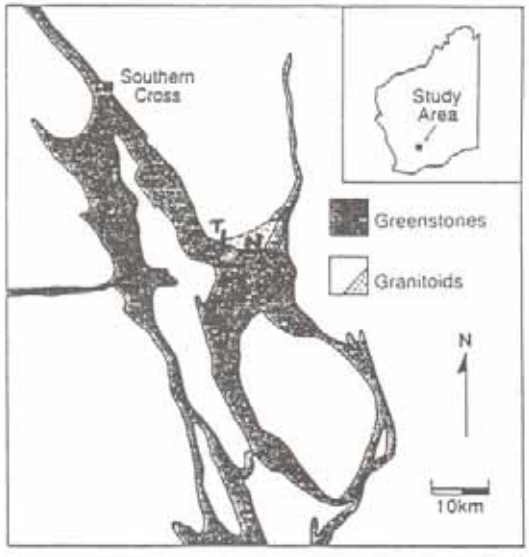

Figure 1 Simplified geological map of part of the Southern Cross Greenstone Belt.
N – Nevoria Gold Mine
T– Geophysical Traverse

ASEG RESEARCH FOUNDATION

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Peter Priest, 39 Ningana Ave, KINGS PARK, SA 5034

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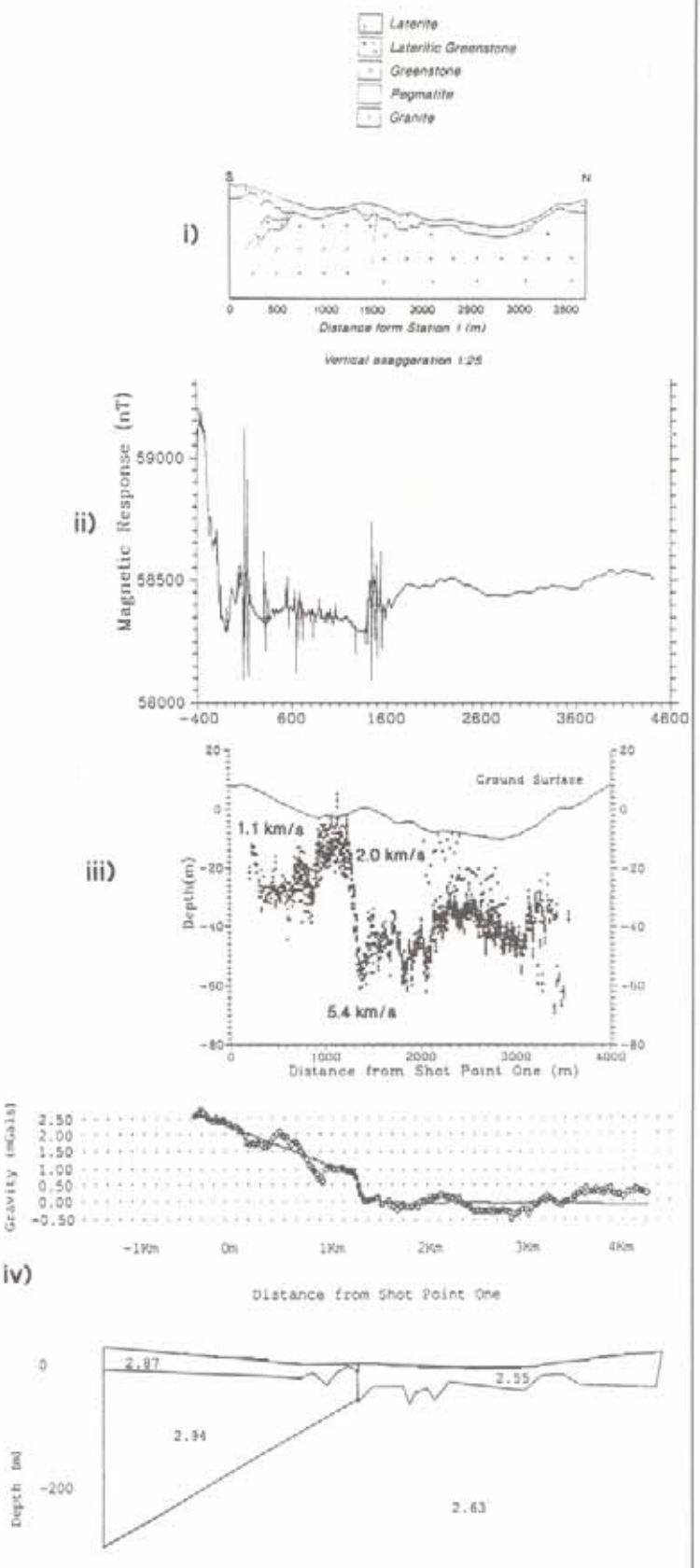

Fig 2.

i) Summary of geological cross section

ii) Ground magnetic profile

iii) Depths calculated using the plus minus method

iv) Gravity profile and model

Vertical variations of density and susceptibility, through the regolith and into the protolith, were measured in Bottle Dump Pit at the Nevoria Gold Mine. Greenstones, banded iron formations, pegmatites and their contacts were measured. It is assumed that the geology does not vary between the traverse and the Pit. The base of the regolith is at about 50m depth in the Pit and coincides with an increase in both density (0.5g/cm3) and susceptibility (about 30 x 10-3 SI in the banded-iron-formation). Pegmatites within the Pit have a relatively low density (about 2.55g/cc) and a very low susceptibility (about 0.03 x 10-3 SI). Lateritised greenstones at pegmatite-greenstone contacts have high susceptibilities (about 6x10-3 SI).

Consistent with the rock properties measured the magnetic profile (Figure 2(ii)) has a change in frequency and strength corresponding to the granite-greenstone contact. Depth to magnetic source was calculated using Werner Deconvolution and a technique based on the autocorrelation function of the magnetics data. Calculated depths, for different wavelengths, were clustered around three levels in the greenstones; less than 1m, about 20m and about 50m. The shallowest source is within the lateritic cover. The intermediate source is interpreted as a lateritic greenstone at the base of a pegmatitic intrusion. The base of the regolith is at 50m in Bottle Dump Pit so the deepest source is interpreted as the regolith-protolith contact.

Assuming that density and seismic velocity are related, features defined by density contrasts should be located using seismic refraction. Shot-gathers, obtained as part of a seismic reflection profile along the traverse, were processed to enhance first-breaks. First-arrivals from 31 shots were picked and the resulting time-distance graphs contained two travel-time branches. The first arrivals have an apparent velocity of 1.1km/s on greenstones and 2.4km/s on granite. The second branch is highly irregular, indicating an undulating refractor, and has an apparent velocity of about 5.6 km/s along the whole traverse. First-arrival data were interpreted using the plus-minus method and a new wavefront based method recently proposed by Ali Ak. Depths to the refractor calculated by both methods show considerable scatter, especially Ali Ak's method. The refractor is located between 0 and 40m in the greenstones increasing to 20m to 60m in the granite (Figure 2(iii)). The refractor is interpreted as the regolith-protolith contact. The sudden increase in refractor depth at 1300m from station 1 is interpreted as the granite-greenstone contact in the regolith. Large velocity variations within the regolith may have caused the range of calculated depths. This probably also prevented a change in velocity being detected in the protolith between the granite and the greenstone.

Consistent with the density values measured in the Pit and local outcrops of granite, gravity data collected along the geophysical traverse show Bouguer gravity values about 30 gravity units higher for greenstones than the granite (Figure 2(iv)). Modelling of the profile was constrained using the depth of the regolith defined by the plus-minus method and measured densities. The resulting granite-greenstone contact in the protolith dips at 8 degrees to the south (towards the greenstone belt). Low-amplitude, short-wavelength variations superimposed on the main anomaly are probably due to density contrasts within the regolith.

The base of the regolith in the greenstones was mapped by both the magnetic and seismic methods, but only the seismic method detected the granitic regolith base. The magnetics data defined the internal structure of the regolith where there was a susceptibility contrast at the greenstone-pegmatite contact. All three methods located the granite-greenstone contact in the regolith but only gravity (with constraints from the seismic data) defined the contact in the protolith.

Magnetics is therefore the most viable technique for mapping the extent and structure of the regolith. If no susceptibility contrasts are present the seismic method can be used to define the regolith but this is a much more expensive option.

☆☆☆☆☆

Successful Applicants for the ASEG Research Foundation Grants, 1993

The ASEG Research Foundation formally commenced its function in September 1989. The aim of the Foundation is to support research into applied geophysics via approved research projects at B.Sc (Hons) and M.Sc. level in Australian Tertiary Institutions.

In 1992 The Foundation provided grants to five projects. This year another five projects have been successful, three in petroleum and two in mining. The successful projects are briefly outlined below.

Petroleum

Dr J J Steinstra, University of Sydney - M.Sc, grant to cover cost of computer equipment.

"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".

Dr S Hearn, University of Queensland - B.Sc. App. grant to cover computing costs.

"Evaluation of Seismic Trace Inversion in the Surat Basin, Qld".

Dr R Facer, University of Sydney - BSc (Hons.) grant for field expenses.

"Magnetic Susceptibility Variations as Possible Guide to the Presence (or Previous Presence) of Hydrocarbons".

Mining

Dr S Rajagopalan, University of Adelaide - BSc (Hons.) grant for field expenses and computer support.

"Applications of Multichannel Aero-radiometric Data".

Dr P I Brooker, University of Adelaide - M.Sc. grant for expenses for field work and software.

"The Removal of EM Coupling Effects from Frequency Domain IP Data".

The ASEG Research Foundation Committee congratulates the successful applicants and wishes to acknowledge the hard work of the two sub-committees in what was a very difficult decision.

Applications for 1994 grants will be requested from Institutions in the near future. The deadline for applications will be 30th September, 1993.

Joe Cucuzza
Secretary
ASEG Research Foundation

Since the last issue of PREVIEW the following ghave contributed to the ASEG Research Foundation:

MIM Exploration $3,000

The Role of Reservoir Geophysics

By Robert E. Sheriff,
Professor, University of Houston and
Haydn Williams Fellow
Curtin University, Perth.

Geophysics can help answer some of the questions about how to develop and produce a hydrocarbon discovery, thus increasing the profitability of hydrocarbon fields and preventing unprofitable expenditures.

Communication among geophysicists, development geologists, and reservoir engineers has almost always been minimal, although the situation is improving somewhat today. Frequently geophysicists do not know what engineers need to know and engineers do not appreciate the information which geophysics could contribute. The objective of the new book from the S. E. G., *Reservoir Geophysics*, is to help disseminate this needed information mainly through case histories where geophysics has had a major impact.

Reservoir geophysics is often subdivided into three sub-areas. The first of these is reservoir delineation, which is concerned with outlining field limits more precisely and especially detecting faults or other features which subdivide a field into disconnected pools. This is the area where geophysics usually can make a big impact by indicating better locations for producing and injection wells.

The second area where geophysics can contribute to profitability is in describing the horizontal variations of reservoir properties and shales or other barriers to fluid flow. Wells provide detailed vertical information at the well locations but geophysics provides the only method of seeing how conditions vary horizontally. While extensive reservoir pressure testing can often determine whether wells are hydrologically connected, it is very expensive and cannot pinpoint the locations of the property changes which limit the connectivity.

The third area of geophysical contribution is in helping monitor the flow of fluids within a reservoir as they are produced. This becomes especially important where secondary or enhanced oil recovery is under way. Today geophysics can make some contributions in this area but most of the technology is being developed and the big promise is still in the future.

Decisions about fields usually are based on reservoir simulation models which are always very incomplete because of inadequate information. Geophysical contributions can help make the models more complete and accurate and thus improve predictions based on them.

Among the applicable geophysical technologies (see table 1), three-dimensional seismic methods is the major contributor. Vertical seismic profiling (VSP) and other seismic methods also make critical contributions. The display of data plays an important role in detecting subtle seismic features which otherwise may not be detected, along with inversion and other seismic attributes. Geostatistical, crosshole, and tomographic methods can be important in reservoir description. Time-lapse methods involving repeated crosshole or 3-D surveys provide the added dimension of changes with time required for reservoir surveillance. Shear-wave birefringence may assist in determining fracture orientation and abundance.

Table 1: GEOPHYSICAL TECHNOLOGIES

3-D to map reservoir configuration and locate faults Time slices, arbitrary lines, and composite displays Horizon slices to determine changes in reflectivity Fault slices to determine traping and sealing qualities
Display methods and use of work stations Amplitude and phase Color Dip, azimuth, and artificial illumination displays Attribute displays
Measurement of amplitudes to determine lithology, bed thickness, porosity, and fluid content
Hydrocarbon indicators, including AVO
Inversion to display acoustic impedance or velocity
Geostatistical methods
VSP
S-wave studies as hydrocarbon indicator or birefringence to define anisotropy because of fracture orientation or density
3-component geophones in surface or borehole studies
Crosshole techniques
Time-lapse 3-D, VSP, or crosshole methods to determine changes because of fluid flow or enhanced oil recovery methods
Tomography
Seismic patterns to tell stratigraphy or depositional environment
Borehole logs
Borehole gravity

3-D surveys were run across the Northeast Viboras Field in Texas in 1983 (fig. 1) because the field was considered so well known that it could provide a test case for the methods. The surveys revealed important changes in the faulting throughout the field, resulting in the discovery of new pools not previously known, and in changing the original plan for drilling additional wells, which would have been failures.

A second case history involves data over the crest of the Ekofisk Field in the North Sea. Seismic data were virtually unusable because gas has leaked from the chalk reservoir and is unevenly distributed in the overlying sediments. Seismic acquisition was discontinued once this was recognized and over fifty wells have been producing from this structure, considered to be a simple unfaulted anticline. Before new wells were drilled as part of a waterflood program, walkaway VSP surveys were run in one well. They produced data in the region obscured by the gas (fig. 2) and indicated previously unknown faults with 45 m throws. This explained problems which had been encountered with earlier wells, leading to further VSP surveys and seismic surveys on tangential lines, which defined a number of faults and altered the waterflood program. The discovery of the faulting also caused concern that it might become a hazard to surface structures since the seafloor at

Ekofisk is actively subsiding. A high-resolution 3-D survey with bins 2.5 m x 10 m sampled at 1 ms (about 1 m) indicated that the faults do not extend to near the surface and incidentally revealed features of glacial erosion.

At the Nun River Field in Nigeria (fig. 3) fault slicing was employed to help determine where faults would provide seals for the reservoir and where they would not interrupt the flow of fluids. These studies were based on determining the nature of the rock adjacent to the reservoir across the fault, but also partly on applying empirically-developed formulae about clay smearing.

Micromodelling is one of several geostatistical techniques which combine seismic and well data to determine porosity-thickness (fig. 4) and fluid content. They allow for unknown variables which alter the relationships among the measurable parameters. Level-of-confidence plots (fig. 4b) indicate the reliability of various values in a Java Sea study.

A crosshole tomogram (fig. 5) shows the lowering of velocity produced by heating (the red zone); steam injected at the base of the reservoir sand concentrates at the up-dip top of the sand. Tomographically-determined velocities (the red circles) generally agree with sonic log measurements.

These and other examples taken from *Reservoir Geophysics* illustrate some of the ways in which geophysical methods can now assist in making better reservoir management decisions. Since 60-70% of the mobile oil is presently left in the ground when a field is considered depleted (estimate by the U. S. Department of Energy), we hope that a result of improved use of geophysics and more communication between geophysicists and engineers will be the more profitable production of hydrocarbons.

References:

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Butters, D., J. Dickinson, S.W.Fagin, G.H.Weisser, and O.E.Gilbert, 1992, New prospects in an old field: The Northeast Viboras Field, Brooks County, Texas: p.80-85 in R.E.Sheriff, Ed., 1992, *Reservoir Geophysics*: Soc. Explor. Geophys.

Dangerfield, J.A., 1992, Ekofisk field development: Making images of a gas obscured reservoir: p.98-109 in R.E.Sheriff, Ed., 1992, *Reservoir Geophysics*: Soc. Explor. Geophys.

Justice, J.H., A.A.Vassiliou, M.E.Mathisen , S.Singh, P.S.Cunningham, and P.R.Hutt, 1992, Acoustic tomography in reservoir surveillance: p.321-335 in R.E.Sheriff, Ed., 1992, *Reservoir Geophysics*: Soc. Explor. Geophys.

Poggiagliolmi, E., V.R.Checka, R.C.Roe, and R.Purantoro, Reservoir petrophysics of Bima Field, Northwest Java Sea: p. 235-242 in R.E.Sheriff, Ed., 1992, *Reservoir Geophysics*: Soc. Explor. Geophys.

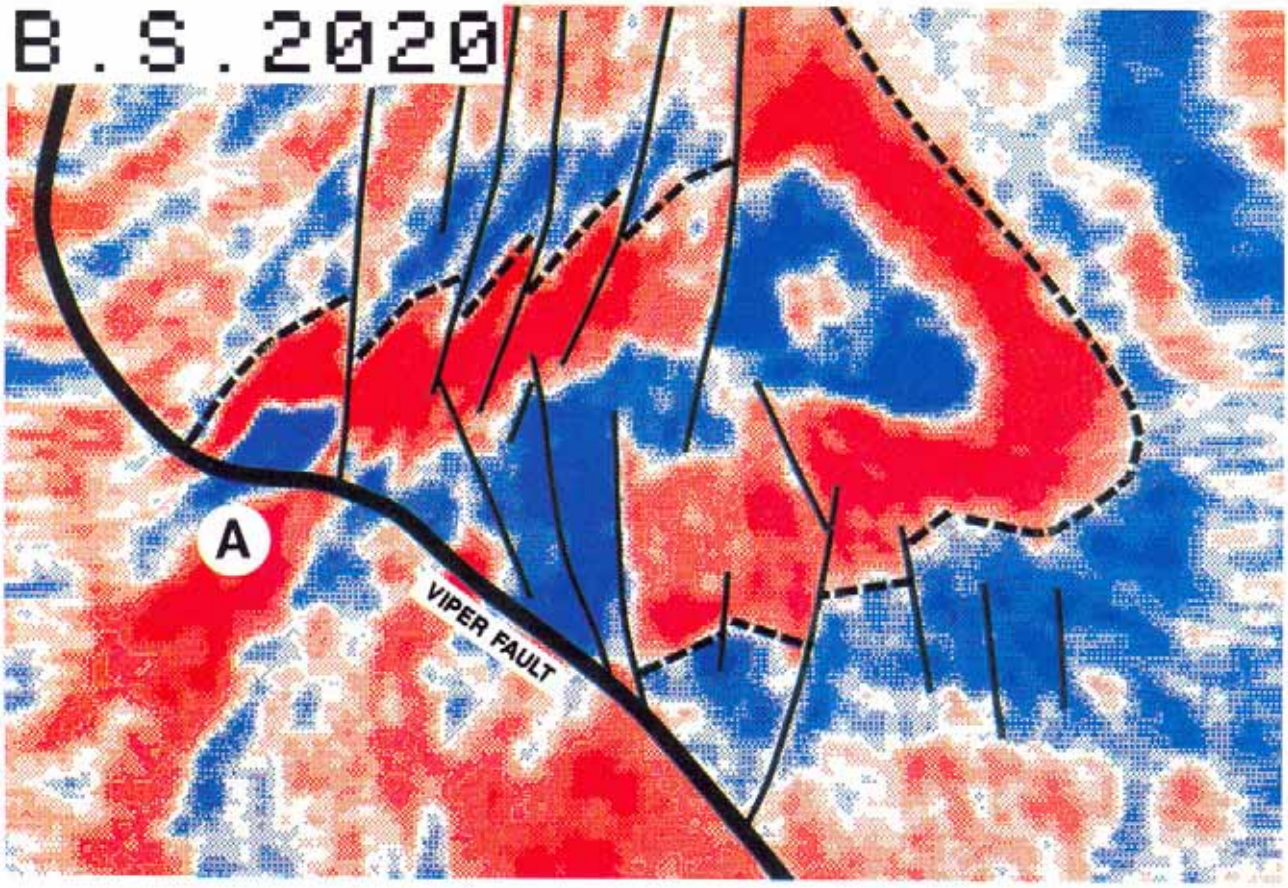


Fig. 1. Time slice at 2.020 s over the Northeast Viboras Field, Texas. Interpreted faults are shown by solid lines, the edge of the hydrocarbon accumulation by the dashed lines. The leftmost fault block had not been interpreted from prior surveys or well control; a well in it subsequently encountered hydrocarbons at original reservoir pressure. The two fault systems had previously been interpreted as one series of splinter faults from the main Viper fault. (From Butters et al., 1992: 83.)

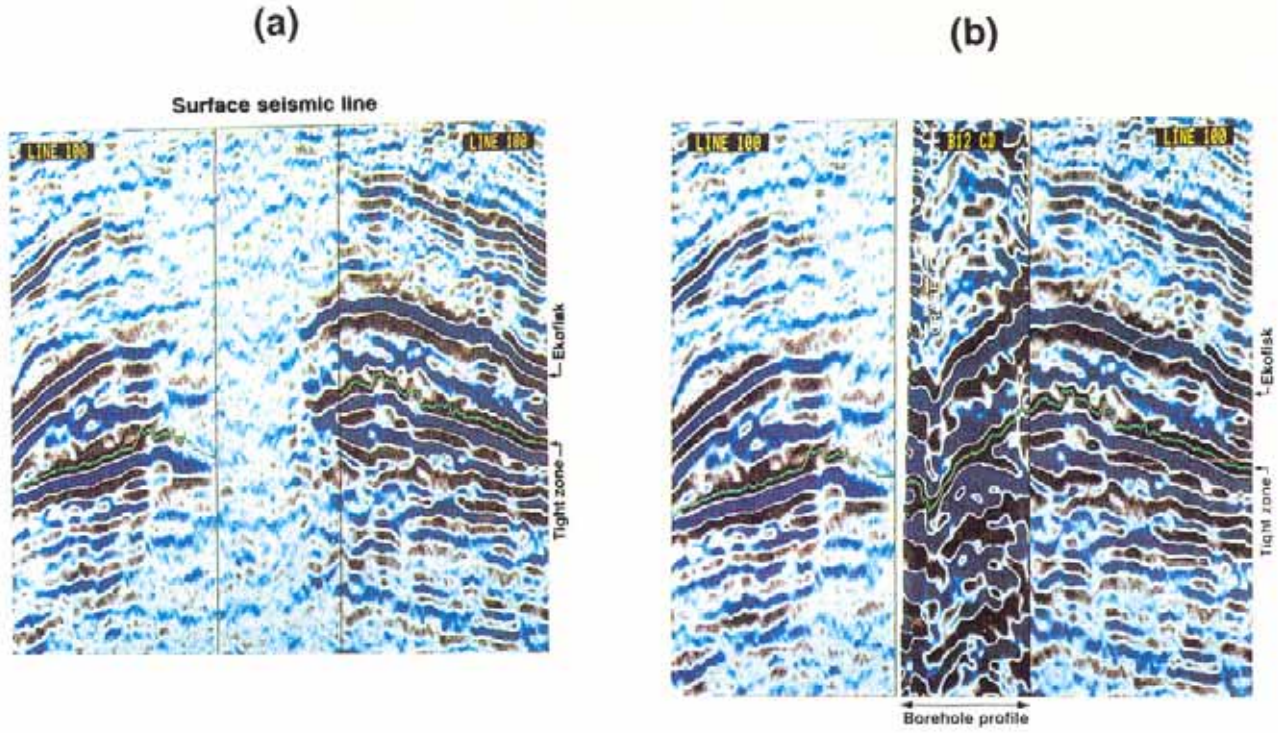
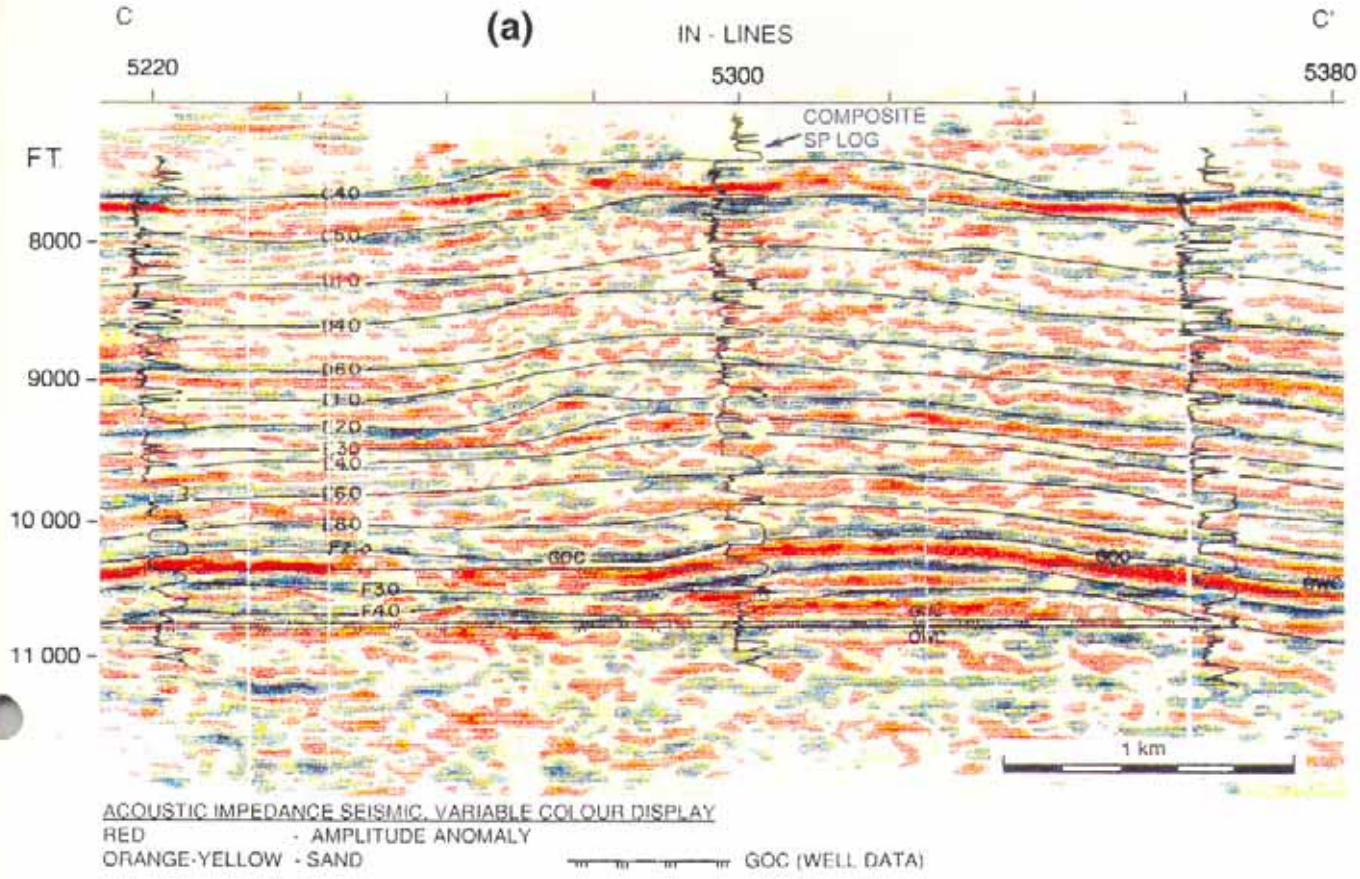


Fig. 2. Seismic line across the Ekofisk Field, North Sea. (From Dangerfield, 1992: 101.) (a) Portion of surface seismic line showing the dead zone and events dipping toward it are attributed to the obscuring and time delay effects of gas which has leaked from the Ekofisk reservoir. (b) Walkaway VSP inserted into the line shown in (a), showing superior definition of the VSP and evidences for a graben cutting the reservoir.



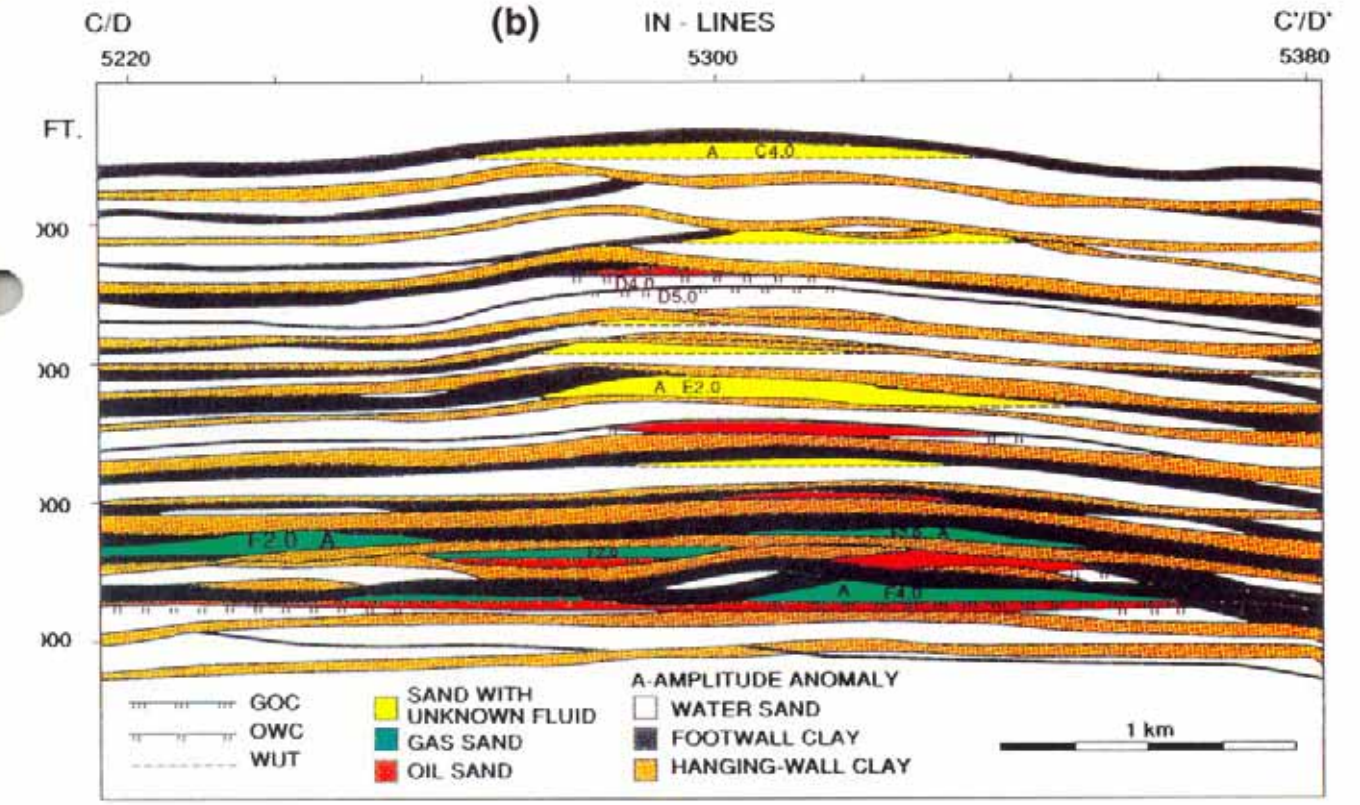


Fig. 3. Study of the sealing qualities of the K fault in the Nun River Field, Nigeria. (From Bouvier et al., 1992: 145, 146.) (a) Fault slice 75 m upthrown from the fault; SP logs from three wells have been superimposed. (b) Interpreted reservoirs and the rocks which provide, or fail to provide, seals across the fault.

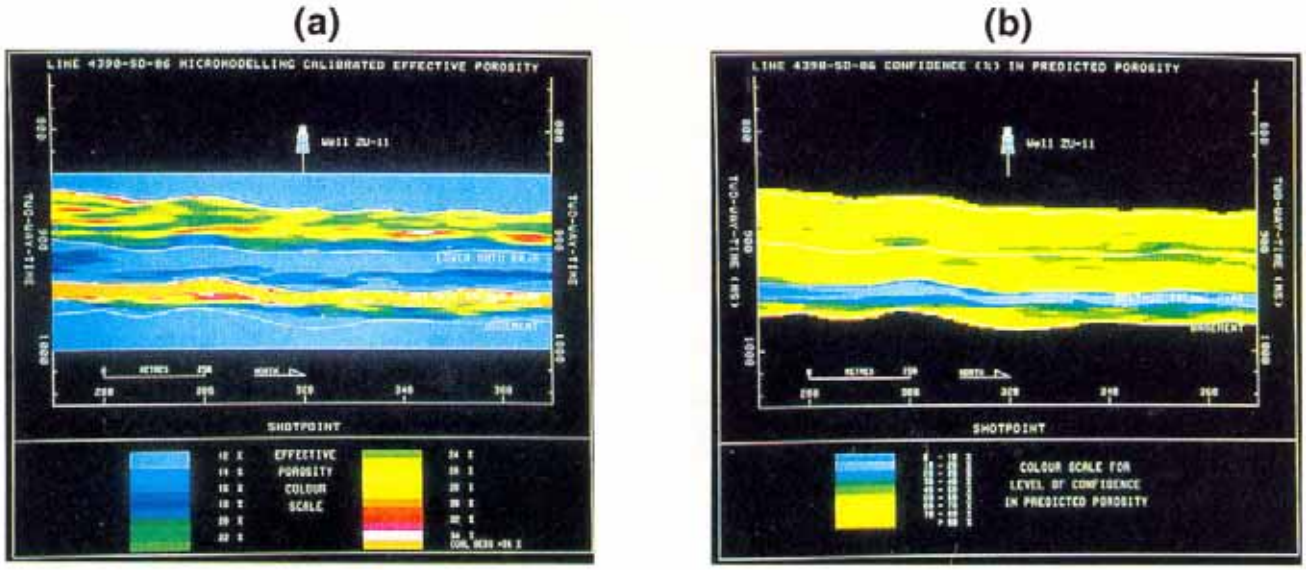


Fig. 4. Porosity determination from combined seismic and well data, Bima Field, Offshore Java. (From Poggiagliolmi et al., 1992, 240.) (a) Reservoir porosity distribution along a seismic line; (b) level of confidence in porosity values.

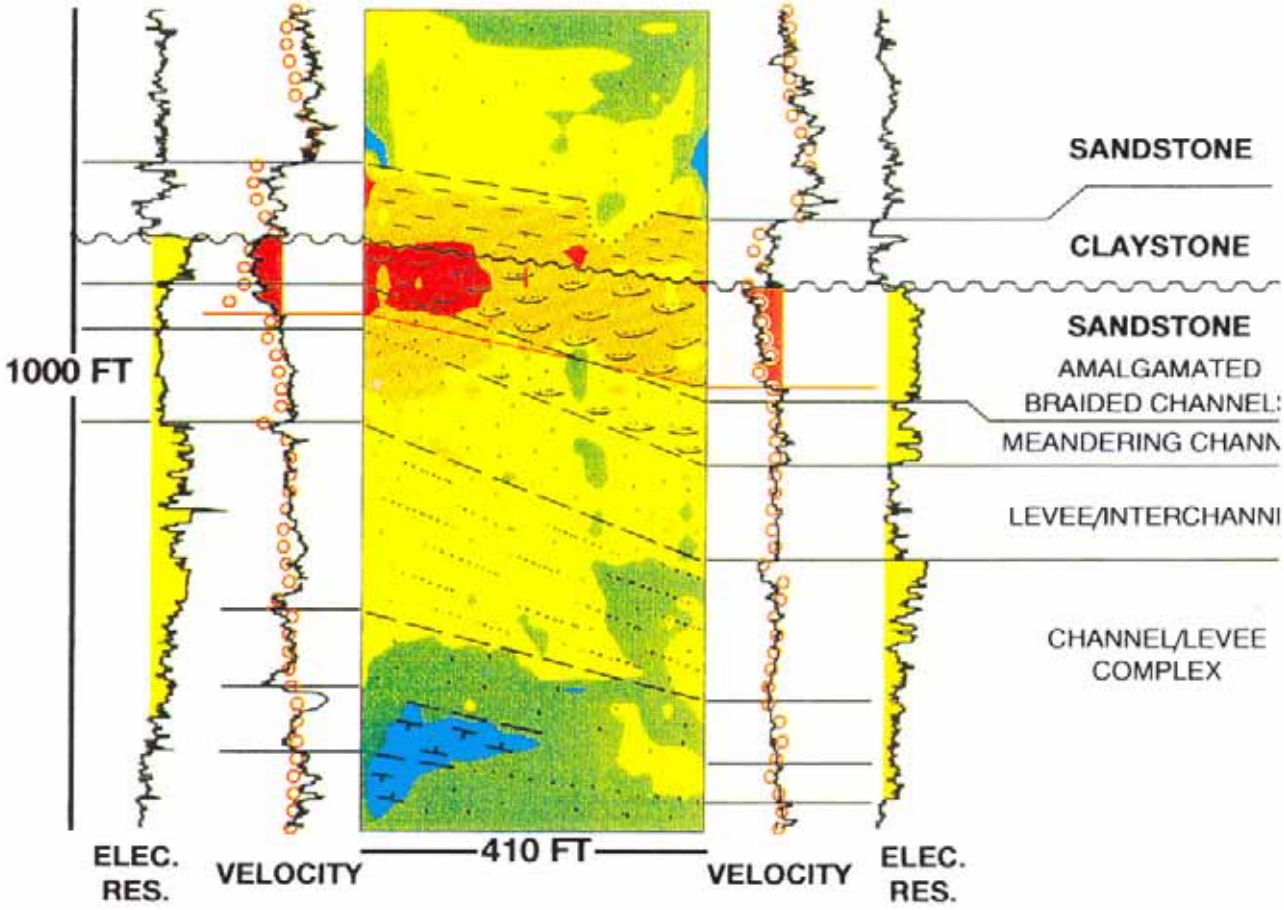


Fig. 5. P-wave tomogram involving steam injection into the base of a heavy oil sand interval (near the base of the yellow zone, 6200-7000 ft/s). A single crosswell survey over a 300 m (1000 ft) interval in two boreholes 130 m (410 ft) apart showed velocity lowering (orange color indicates 5000-6200 ft/s) at the top of the sand with the highest temperatures (red color, <5000 ft/s) in their highest part. Green indicates 7000-8000 ft/s, blue 8000-9000 ft/s. (From Justice et al., 1992: 331.)

Radiometric Calibration Pads

Airborne and Ground Gamma Ray Spectrometers

Four new sets of concrete radiometric calibration pads were purchased and commissioned in the last quarter of 1992 by Geoterrex, Kevron, AGSO and SADME. The pads were built by Dr Bruce Dickson (CSIRO Division of Exploration Geoscience, North Ryde) and helpers in Sydney. The greatly increased availability of calibration facilities is a big step forward in improving the use of airborne radiometric data.

Each set of pads consists of four square pads each 1.0 x 1.0 metres by 0.3 metres thick. The pads are clad in marine ply and sit on wooden palettes. These new pads are similar in size and concentrations of Potassium, Uranium and Thorium to pads which have been constructed in Canada by Dr Bob Grasty (Geol. Survey of Canada). Grasty's pads have become the standard design over the last 5 years around the world and government organisations and companies from a number of countries have purchased pads from Grasty.

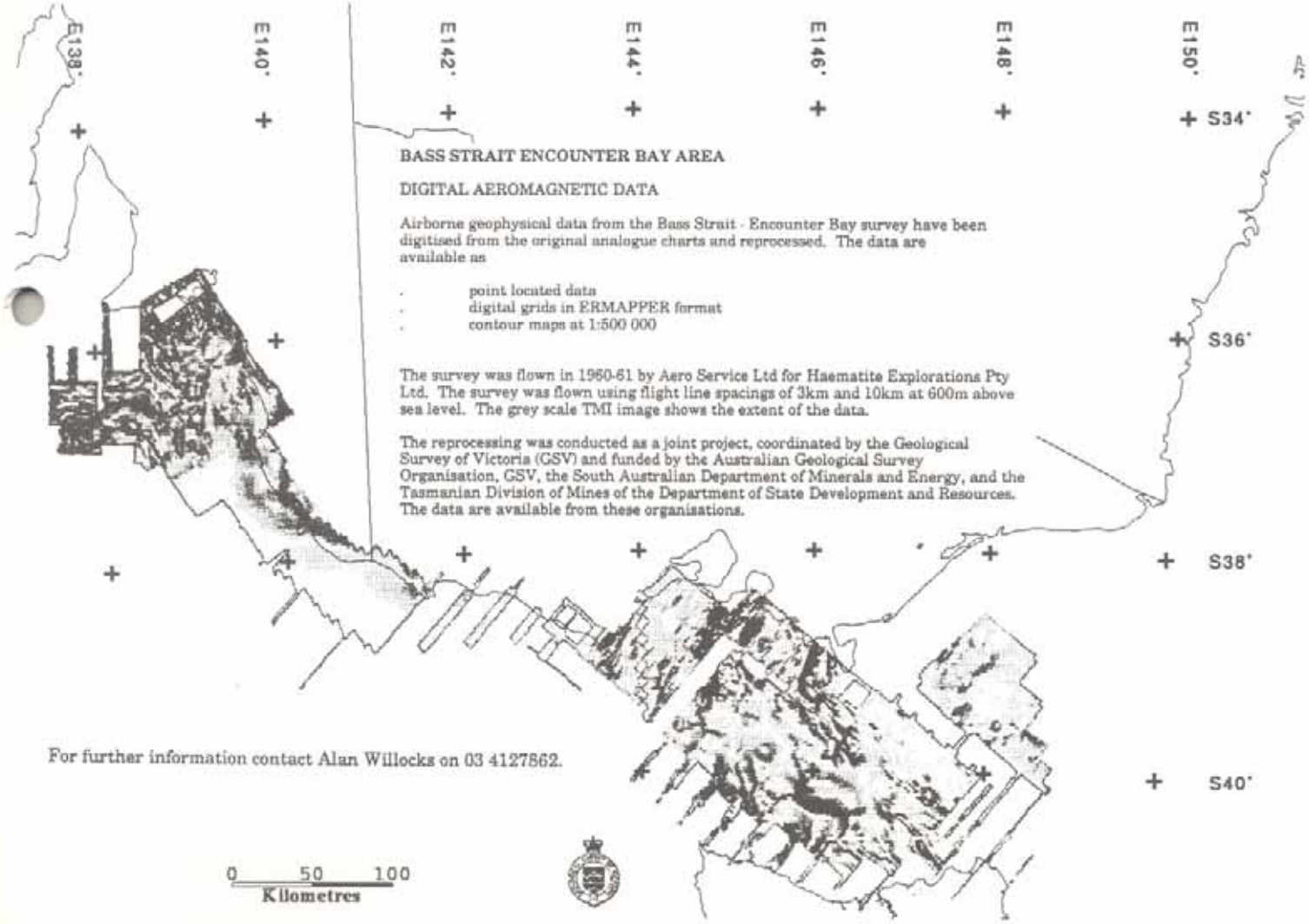
The new Australian pads were built following recommendations by the Technical Standards Committee of ASEG and the increasing awareness of the value of calibrating airborne and ground systems e.g. the large airborne geophysical programs flown for MIM in the Mt Isa area and the current large airborne contracts being flown for SADME in South Austrtalia.

The calibration pads enable accurate calculation of stripping ratios and provide a convenient means of monitoring long term performance of systems. They also provide an experimental facility for investigation of new systems.

The second requirement for calibrating airborne systems is the availability of test areas taht can be overflown accurately. These are required to be sampled and their radioelement concentrations measured. From these test areas airborne data can be converted back to ground concentrations of radioelements and data from different airborne radiometric systems combined to produce regional geochemical maps. The value of regional magnetic maps has long been recognised and now with increasing attention to radiometric calibration we can make similar progress with radiometric data.

Paul Wilkes
Chairman
ASEG Technical Standards Committee

*****



Geophysical Contractors Fees - Debate Rages in AIG

The following two letters, reprinted with permission of the editor of AIG News, raise issues of concern to ASEG members contractors and client alike. What do you think? Write to PREVIEW.

Roger Henderson,
348 Rocky Point Road,
Ramsgate, NSW 2219

Re: Geophysical Contractors' Schedule of Fees

It is my observation from many years of experience, that geophysical contractors in Australia are only just 'making a go of it'. (Some have not!) Who knows of a contractor driving a new model Mercedes, or even an old model for that matter? And yet, lawyers do. Why is this?

Lawyers have a schedule of fees and they don't charge any less. For that matter, so also do engineers and surveyors, whose activities are much closer to that of geophysicists.

Without an established minimum fee, contractors are too often tempted, especially in desperate times (and they can be all too frequent in our profession), to quote a 'bare bones price' just to be employed. Often then, their price does not cover overheads. As the fortunes of the various contractors fluctuate, at least one of them can be in this position almost every time a tender is let. Since, unfortunately for them, lowest price is usually the deciding factor, it means that most work is done for a price which would not allow contractors to pay their overheads, let alone make provision to replace equipment or otherwise stay competitive. (With rapid developments in instrumentation and software, this is a real burden, especially when clients are always wanting the latest technology). Actually, making a profit is a rarity.

As a result, Australian geophysical contract prices are some of the lowest in the world. Certainly airborne magnetometry prices are the lowest by far. Of course, the individual client on each occasion is pleased to enjoy these less than appropriate prices, but it is really only a short-term gain nd if it results in the ruination of the contractor concerned or contributes to it, there will soon be no one left to perform the work required.

Therefore, I believe it is in the best interests of the profession, for both contractor and client, to have a fixed fee schedule. This will at least ensure that a desperate contractor or a 'maverick' does not contribute to the lowering of standards. To make this effective will, I realise, require some form of policing by a relevant organisation which has the ability to pull offenders into line. Whether the ASEG is the appropriate organisation, the AIG, or some other body , is open to discussion. As the contractor pool is small, I don't believe it is necessary to instigate any form of licensing to achieve compliance.

As an aside, we could see more work for contractors in future in the growing field of environmental decontamination and for this different type of client, it would be best to have a fee schedule already established.

*****

Reply

R J Smith, CRA Exploration,
31 Osmond Terrace,
Norwood, SA 5067

Re: Geophysical Contractors' Schedule of Fees

The recent letter from Roger Henderson (October 1992) on the above subject makes some valid points but, I feel, is somewhat misleading. I believe it is reasonable to compare fees charged by lawyers, engineers, surveyors (and perhaps accountants) with those charged by geologists and geophysicists - for consulting time. Unfortunately, geologists and geophysicists can rarely command fees comparable with those other professions mentioned above - however they are usually retained for longer periods and don't have the burden

A scene from the real-life drama "The Geophysical Contractor, the C(r)ook and the Client"?

of maintaining a new model Mercedes and a fancy office in the CBD. Nevertheless, I believe they are underpaid (or undervalued) and it would be reasonable to try to establish a minimum fee schedule.

Geophysical contract prices should not be compared with consulting fees. These fees are usually charged for some form of routine data collection, the cost of which is closely linked to the instruments and technology employed. Whether the actual work is done by a professional geophysicist or not is often irrelevant as a well trained operator is likely to be much more efficient and effective than an untrained graduate. Some professional supervision is often (but not always) required and this may be provided by the client or the contractor. If it is provided by the contractor it should be either charged for at professional rates or built into the contract fees as an overhead. In either case it should be truly professional supervision, not merely a marketing exercise. Clients can choose whether they want this service or not and I believe they will often be prepared to pay for it, if they are convinced that value can be provided.

Geophysical contracting is a highly competitive industry and it is quite true that Australian contract prices are some of the lowest in the world. This reflects some natural advantages (e.g. good flying conditions) and also efficient contractors who usually employ or adapt imported technology. We certainly want the latest technology and will pay for it if we are convinced it will give us better data. Similarly, if it can deliver the same data for a lower cost, then the contractor should pay for it and increase his profitability.

Contract rates are determined by many factors and I don't believe it is practical for AIG, ASEG or any other body to try to set minimum fees for such a variety of activities. Even if the fees could be set, it would be difficult, if not impossible, to police them.

It is reasonable to establish a minimum fee structure for consulting activities (either based on time or some other criterion), these should be realistic and should recognize the real value of the experience of a consultant geoscientist (geologist or geophysicist).

I don't believe it is appropriate to do so for contracting and think we should leave this for the marketplace to determine.

*****

Federal Executive

President: Hugh Rutter
Geophysical Exploration Consultants
Suite 5, 672B Glenferrie Road
HAWTHORN VIC 3122
Bus PH: 818 1272 Fax: 818 1286

1st Vice President: Mike Asten
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801 Glenferrie Road
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Secretary: Brenton Oke
BHP Petroleum
BHP Petroleum Plaza
120 Collins Street
MELBOURNE VIC 3000
Bus PH: 652 6625 Fax: 652 6282

Committee: Koya Suto
Pacific Oil & Gas
826 Whitehorse Road
BOX HILL VIC 3128
Bus PH: 895 3041 Fax: 890 3031

Preview Editor: Geoff Pentifer
Geological Survey of Victoria
Department of Energy & Minerals
Lower Ground Floor
115 Victoria Parade
FITZROY VIC 3065
Bus PH: 412 7840 Fax: 412 7803

Dave Gamble
Billiton Australia
Level 22
1 Spring Street
MELBOURNE VIC 3000
Bus PH: 666 5051 Fax: 666 5839

Preview Advertising: Greg Turner
CSIRO
Division of Geomechanics
Kinnoull Grove
SYNDAL VIC 3149
Bus PH: 881 1279 Fax: 803 2052

Andrew Sutherland
Schlumberger Seaco Inc.
Level 3
312 St Kilda Road
MELBOURNE VIC 3004
Bus PH: 696 6266 Fax: 690 0309

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SADME
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3 Griver Street
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348 Rocky Point Road
RAMSGATE NSW 2219
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Lindsay Ingall
Wongela Geophysical Pty Ltd
22 Kurraba Road
NORTH SYDNEY NSW 2060
Ph: (02) 955 1788 Fax: 957 6788

Editor - Exploration Geophysics
Prof. Don W. Emerson
Box 6001
Dural Delivery Centre
NSW 2158
Ph: (045) 791 183 Fax: (045)791 290

Technical Standards Committee
Paul Wilkes
Paul Wilkes & Associates
46 Griver Street
COTTESLOE WA 6011
Ph: (09) 384 8772 Fax: (09) 384 7883

Assistant Editor-Exploration Geophysics
Richard Facer
Richard Facer & Associates
97 Spencer Road
KILLARA NSW 2071
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66 Hawker Street
TORRENS ACT 2607
Ph: (06) 286 2145 Fax: (06) 286 2145

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CRA Exploration
31 Osmond Terrace
NORWOOD SA 5067
Ph: (08) 362 8871 Fax: (08) 363 1795

Assistant Editor-Exploration Geophysics
Joe Odins
Department of Water Resources
P.O. Box 3720
PARRAMATTA NSW 2150
Ph: (02) 895 7542 Fax: (02) 891 5884

Assistant Editor-Exploration Geophysics
Edward Tyne
NSW Geological Survey
P.O. Box 536
ST LEONARDS NSW 2065
Ph: (02) 901 8342 Fax: (02) 901 8256

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BHP Petroleum
BHP Petroleum Plaza
120 Collins Street
MELBOURNE VIC 3000
Ph: 652 6238 Fax: 652 6282

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Level 3, 312 St Kilda Road
MELBOURNE VIC 3004
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GPO Box 320D
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Ph: (002) 44 1233 Fax: (002) 44 6674

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Geological Survey of PNG
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Port Moresby
Papua New Guinea

Victoria

Ms Corri FOX
Western Mining Corp (Frank Lindeman)
P.O. Box 157
Preston Vic 3072

Dr Graham CREER
BHP Research
P.O. Box 264
Clayton VIC 3168

Emily NEIL
36 Balwyn Road
Canterbury VIC 3126

Western Australia

Simon CROSATO
Central Norseman Gold Corp Ltdd
P.O. Box 56
Norseman WA 6443

Ron CREAGH
Aerodata Ltd
17 Emerald Terrace
West Perth WA 6005

Conor BYRNE
6 Red Wattle Place
Churchlands WA 6018

Prof John De LAETER
Curtin University of Technology
School of Physical Sciences
GPO Box U1987
Perth WA 6001

John HART
28 Potts Street
Melville WA 6156

New South Wales

James Reid
University of Sydney
Dept of Geology & Geophysics
Sydney NSW 2006

Nigel BROWN
71 Denison Street
Rozelle NSW 2039

Andrew GREEN
8 Lawley Crescent
Pymble NSW 2073

Stuart HANKIN
Locked Bag 14, Post Office
Lidcombe NSW 2141

Tully RICHARDS
21 King Street
Glenbrook NSW 2773

South Australia

James WOMACK
Western Mining Corp
P.O. Box 114
Daw Park SA 5041

Mark DUFFETT
7 Highfield Avenue
St George SA 5064

Queensland

Mark FAWKES
Sons of Gwalia Ltd
P.O. Box 412
Aitkenvale Qld 4814

Bohdan BURBAN
P.O. Box 860
Kenmore Qld 4069

Patricia HAMDORF
169 Sterculia Avenue
Holland Park QLD 4121

Dr William LAING
11 MvcLauchlan Crescent
Kelso QLD 4815

Paul REEVE
169 Sterculia Avenue
Holland Park QLD 4121

Overseas

Thomas THAYYIL
Digicon (M) Son BHD
P.O. Box 93
Lutong
Sarawak 98107, Malaysia

Hajime HISHIDA
Metal Mining Agency of Japan
Tokiwa Bldg. 1-24-14
Toranomon
Minato-Ku
Tokyo 105, Japan

CHANGE OF ADDRESS

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

Victoria

Gary GIBSON
From: Philip Institute of Technology, Bundoora Vic
To: Seismology Research Centre
RMIT University
Plenty Road
Bundoora VIC 3083

Tasmania

Peter EDWARDS
From: Esso Indonesia Inc
P.O. Box 2096,
Jakarta Indonesia
To: 18 Bourke Street
Launceston 7250

South Australia

Danny BURNS
From: Lasmo Oil (Aust) Ltd
P.O. Box 1135,
West Perth 6872
To: C/- Schlumberger/ Geoquest
P.O. Box 545
Nth Adelaide 5006

John PITT
From: 377 Seaview Rd,
Henley Beach 5022
To: P.O. Box 281
Port Adelaide 5015

Bernie MILTON
From: 35 West Tce
Strathalbyn SA
To: 54 Marchant Road
Strathalbyn 5255

Gregory PASS
From: Lasmo Oil,
West Perth
To: Sagasco Resources
GPO Box 2576
Adelaide SA 5001

Graham STAKER
From: 12 Sundale Ave
Para Hills SA
To: Western Mining
168 Greenhill Rd
Parkside 5063

Western Australia

Lisa Jane VELLA
From: 30 Talbot Rd,
Swan View WA
To: 49 Kadina Road
Gooseberry Hill

Ms Ping ZHAO
From: Macquarie University
North Ryde
To: Department of Explor. Geophysics
School of Physical Sciences
Curtin University of Technology
GPO Box U1987
Perth WA 6001

Matthew LAMONT
From: 22 Park St Como Wa
To: 32 Helena Street
Guildford WA 6055

New South Wales

Olusoga A. ADEPOJU
From: School of Earth Sciences
Macquarie University
To: 2/15 Templeman Cres
Hillsdale NSW 2036

Maki PETKOVSKI
From: 199A Wentworth Av
Pendle Hill NSW
To: Ampolex Ltd
P.O. Box A323
Sydney South 2000

Queensland

Roald BROTHERTON

From: 38 Matingara St
Chapel Hill 4069
To: 5 Dolyie Close
Chapel Hill 4069

Overseas

Dr Peter FULLAGAR
From: WMC, St Marys SA
To: Dept. of Mineral Engineering
Ecole Polytechnique
P.O. Box 6079
Station A, Montreal
Quebec H3C 3A7
Canada

John BURGESS
From: Kennecott Expl
GPO Box 471, Sydney
To: Suite 4700,
Canada Trust Tower
161 Bay Street
Toronto,
Ontario. M5J 2S1

Buddy DOYLE
From: Kennecott Explorations
GPO Box 471, Sydney
To: Suite 4700,
Canada Trust Tower
161 Bay Street
Toronto,
Ontario. M5J 2S1

RESIGNATIONS

John WILSON
2722 Colman Street
Ottawa Ontario K1V 8J9
Canada

Bill Kendall
White Lanterns Motel
2121 Gold Coast Highway
Miami QLD 4220

Ultramar Australia Inc
Suite 2402, 44 Market Street
Sydney NSW 2000

WHERE ARE THEY?

Mr P J CAMERON
Last known address:
12 Monomeath Avenue
Toorak Vic 3142

Mr M C NOBLE
Last Known Address:
6 Tyndall Street
Surrey Hills Vic 3127

Mr A R HOLMES
Last known address:
16 Hall Street
Aberdeen NSW 2336

Mr R G Cowley
Last Known Address:
2/49 Norman Street
Ivanhoe Vic 3079

Mr J M Woodward
Last Known Address:
29 The Bulwark
Castlecrag NSW 2068

Mr D A Regenspurger
Last Known Address:
Esso Exploration Dept
GPO Box 4047
Sydney NSW 2001

Email -oops! Sorry!

Please correct e-mail addresses given last PREVIEW No. 42. (p25) to:

Geoff Pentifer:
gep@mines.vic.gov.au

Lindsay Thomas:
lindsay_thomas@mowayf.unimelb.edu.au

Calendar of Events

May 4-6 1993

Canadian Society of Exploration Geophysicists (Annual Convention): Geophysical Integration - the path to success, Calgary, Alberta, Canada.
For further details: (1993 CSEG, 406, 206-7th Avenue SW, Calgary, Alberta T2P OW7, Canada)

June 7-11 1993

EAEG 55th Annual Meeting & Exhibition/EAPG 5th Conference
Stavanger, Norway
For further details:
Evert Van der Gaag,
EAEG
P.O. Box 298
3700 AG Zeist
The Netherlands

June 21-22 1993

DHEM Workshop/Seminar
Macquarie University, NSW
For further details:
Dr John Bishop
Mitre Geophysics P/L
121 Nelson Road
Mt Nelson Tas 7007
Tel: (002) 254 479

July 11-16 1993

Mathematical Methods in Geophysical Imaging (part of Symposium on Optical Applied Science/Engineering). San Diego Marrion Hotel/San Diego Convention Centre.
For further details:
(San Diego 93. SPIE, 1000-20th st., Bellingham, WA 98225, USA.

July 13-16 1993

SEG/China Explor. Expo 93 (Conference and Exposition). Beijing
For further details:
(Technical Programme Chairman, Beijing 1993. SEG, Box 702740, Tulsa, OK 74170-2740. USA)

August 12-16 1993

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Moscow, Russia
For further details:
Moscow '93
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P.O. Box 70240
Tulsa Ok 74170-2740
USA
Tel: +918 493 3516
Fax: +918 493 2074

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Geoffrey Dorn
ARCO E & P Technology
Plano, Tx 75075-8427
Tel: +214 754 6528

September 13-16 1993

International Workshop on Airborne Electromagnetic Methods (AEM)
For further details:
Ben Sternberg
Laboratory for Advanced Subsurface Imaging
Dept of Mining and Geological Engineering
University of Arizona
Tucson, AZ 85721
Tel: +602 621 8376
Fax: +602 621 8330

September 26-30 1993

SEG 63rd Annual International Meeting and Exhibition
Washington D.C.
For further details:
SEG
P.O. Box 70240
Tulsa Ok 74170-2740
USA

February 20-25 1994

ASEG 10th National Conference and Exhibition
Increasing the Resolution: Clearing the haze.
Burswood Convention Centre
Perth, WA
For further details:
Don Pearce
Promaco Conventions
Uni 9a Canning Bridge Commercial Centre
890-892 Canning Highway
Applecross WA 6153
Tel: (09) 364 8311
Fax: (09) 316 1453

April 25-30 1994

Continental Processes
A decade of Drilling Discoveries
Sante Fe, New Mexico, USA
For further details:
Dr Barry Drummond
AGSO
GPO Box 378
Canberra ACT 2601
Tel: (06) 249 9381

August 14-17 1994

West Australian Basins Symposium PESA (WA) Branch
For further details:
Jim Durrant
Tel: (09) 299 7175

September 26-30 1994

Geoscience Australia - 1994 and Beyond. 12th Australian Geological Convention Geological Society of Australia
For further details:
The Secretary
12AGG
P.O. Box 119
Connington WA 6107