PREVIEW

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

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Contents

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Introduction

The Treasurer for the last two years, Craig Dempsey, will soon be leaving Australia to take up a posting in Djakarta. Craig has been an invaluable committee member and the Society would like to wish him all the best in his new job. Laurence Hanson of Hadson Petroleum will be taking over as Federal Executive Treasurer for the rest of the year.

☆☆☆☆

Roger Henderson has been renominated as the 1991 ASEG representative on the Advisory Board of Macquarie University's Centre for Geophysical Exploration Research. Once again, Roger will be an asset to the Board.

☆☆☆☆

The profit from the 1991 ASEG Sequence Stratigraphy Workshop held in February at the 1991 Conference in Sydney has been submitted as a donation to the Society, split $2714 to the ASEG Research Foundation and $2714 to the Continuing Education Foundation.

Editor.

Branch News

ACT

The ACT Branch has been relatively inactive over the last couple of months, and has yet to elect a new executive as stated in the last issue of Preview. The main task in the next month will be to elect a new executive and inject some new enthusiasm into the ASEG ACT Branch as a whole.

If any interstate or overseas visitors are in Canberra, the ACT Branch would be delighted to hear from them in advance, so that they may wish to address the Branch at a monthly meeting. Please contact Kevin Wake-Dyster ☎ (06) 49 9410 or Fax: (06) 249 1954.

Kevin Wake-Dyster
Secretary

NEW SOUTH WALES

The May meeting was held in the Nelson Brasserie at the Lord Nelson Hotel, The Rocks. Professor S K Runcorn from the University of Newcastle-on-Tyne, UK, presented a most interesting talk on "What Can Geophysicists Learn from Planetary Exploration?" The talk was refreshing and provided plenty of food for thought.

The Branch has again given financial support to a student attending the "Summer of Applied Geophysical Experience" in the USA. David Masters, an Honours Student from Macquarie University, will present a short talk to the Branch on his time spent in the States on his return. We wish David a most fruitful stay in the USA.

After more than 2 years as President of the NSW Branch, Chris Hodge has resigned from the position. During his term Chris has enthusiastically worked to achieve numerous Branch successes. Many changes for the better have been made during this time and these improvements will be maintained into the future. While Chris's enthusiasm will be sorely missed, he has handed the reins of the President into the equally-capable hands of Nigel Jones. Chris will continue to maintain an active role on the Committee of the Branch.

The NSW Branch is currently working towards presenting a joint Earth Resources Foundation - ASEG seminar on "Geophysical Techniques in Studies of Urban, Industrial and Rural Environments". This will most likely take place in November of this year. A final date will be confirmed in the near future.

Scott Gagen
Secretary

SOUTH AUSTRALIA

The SA Branch held its May evening meeting on Wednesday 29 May. The meeting was moderately well attended. Mark Tyminski of SSL gave a presentation on "Personal Financial Planning - The Key Areas". Mark has recently returned to the oil industry after a period in the financial planning industry. His subject generated more questions and discussions than is normal at our evening talks, obviously finances are closer to a geophysicist's heart than geophysics is! Mark also showed a short humourous video on the subject which was well received.

The SA Branch will be taking a mid year break as no evening meeting is scheduled for June. The next meeting is to be held on 24 July where the speaker will be Dr A J Parker of the SA Department of Mines and Energy. His topic will be "Integration of Geophysical and GIS Data Sets: Exploration Opportunities".

Dr Parker is to be a key speaker at the National Conference on the management of geoscience information and data. The Conference is being held on the same week as our evening meeting occurs.

Nick Fitzgerald
Secretary

WESTERN AUSTRALIA

Thanks are extended to Charles Ramsden (Digicon Singapore) and Dave Isles (World Geoscience Corp) for their presentations at the May technical meeting. A good crowd turned up at 5pm to look and listen. Undisclosed sources report that some of them were still going strong in the downstairs bar at close to midnight!

The Beer Tasting night was well attended again. For those of you who still think you can tell one beer from another (without seeing the can it comes in) we look forward to seeing you next year! Special commendation is awarded to Matt Lamont (Curtin) who won 2 out of 3 rounds, and attributes his success to hours of training. Some of the others who could do with some of that training, but were still awarded prizes (mostly for being SO wrong!), were Gigi Ewing (Curtin), Greg Reudavey (Aerodata) and Bill Peters (Southern Geoscience). Thanks to everyone who turned up and had a good time. Thanks to Aerodata for providing the venue.

Best of luck to our treasurer, Mike Brumby, who's shortly leaving behind the sun drenched beaches and cloudless skies of Perth to make his millions in Adelaide.

The technical meeting for July will be put together shortly. Stay by the phone in case we ring YOU!

Andie Lambourne
Secretary.

Scitech Discovery Centre

Geoscience Exhibit Competition

☆☆☆ **WIN** ☆☆☆

two cases of premium ASEG Wine

The WA Scitech Discovery Centre has established a Resource Section as a priority area for future exhibits; to place Geoscience and Geophysics within the general community's ambit of experiences. Costs per exhibit start at $10 000 and reach $100 000.

Members are asked to submit ideas with sketches for suitable exhibits incorporating the following criteria:

The exhibit:

- ☞ **must extend knowledge**
- ☞ **should be interesting throughout the age range**
- ☞ **must be more than just a button to push or a read of a didactic panel**
- ☞ **must involve some sort of activity**

Any exhibit created by Scitech for the WA region could be either shipped to other States for use or duplicated under ASEG sponsorship.

A select panel of ASEG members will judge the entries to submit to Scitech.

Closing date for exhibit ideas (with sketches) is 30 September 1991. Entries to be forwarded to:

M Micenko
Hadson Energy Limited
35 Ventnor Avenue
West Perth WA 6005

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Plans for a Gravitational Observatory in Australia

By D G Blair and P Bretton
Department of Physics
University of Western Australia

In the past virtually all information about our Universe has come by way of electromagnetic radiation and the need to develop techniques for obtaining it has been a major stimulus to scientific and technological advance. It has recently become technically just possible to develop another window of information - gravitational radiation. Australia has been prominent in the early stages of gravitational radiation research through the development of a niobium bar antenna at the University of Western Australia. Now a team of Australian Physicists is proposing the construction of a huge gravitational observatory which, as part of a world wide array of detectors, should create the third gravitational telescope.

The generation of gravitational waves or "ripples in spacetime curvature" by astrophysical processes such as the gravitational collapse of a star in a supernova is predicted by the General Theory of Relativity developed by Einstein in 1915. Gravitational waves are the gravitational analogue of electromagnetic waves such as radio waves and light, but are much more difficult to detect. Rapid progress in astrophysics in the 1960s led to the recognition that our galaxy contains a large population of neutron stars, and an unknown, but probably smaller, population of neutron stars take the form of radio pulsars, x-ray pulsars, x-ray bursters, γ-ray burst sources and other neutron star binary systems. Black holes have been identified in several x-ray binaries: cygnus X-1 is the best known example. Each of these systems is the result of a past gravitational collapse event which would have produced a powerful burst of gravitational waves.

A most important discovery in the 1970s was that of the binary pulsar PSR 1913 + 16. This system, consisting of two neutron stars in a close orbit (7 $^{3/4}$ hour period), has allowed detailed testing of Einstein's General Theory of Relativity, and proof of the existence of gravitational waves. The rate of energy loss of PSR 1913 + 16 is exactly as predicted by Einstein's theory, and allows one firm prediction: the binary pulsar system will coalesce producing a massive burst of gravitational radiation, in approximately 300 million years. When it coalesces it will probably collapse to form a black hole. Two more similar systems have been discovered in the last year.

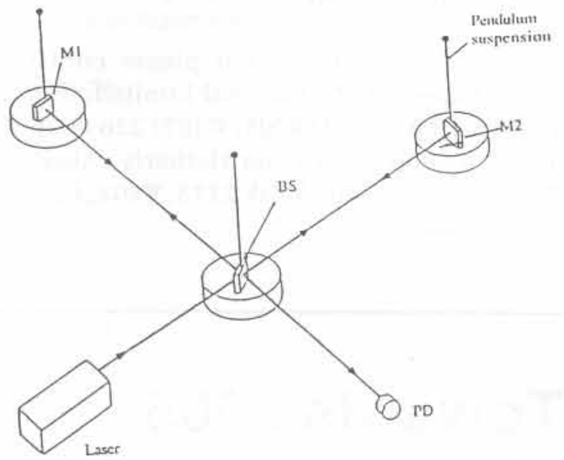
The existence of gravitational waves from the coalescence of binary pulsars leads to the confident expectation that, at sufficient sensitivity, a gravity wave telescope will be able to observe the frequent "rippling of spacetime" as violent gravitational events occur in the universe. Proposed observatories in Australia and overseas will allow a large volume of the universe including up to a million galaxies to be continuously monitored for gravitational collapse, and will allow a detailed study of the ways in which stars die, giving birth to black holes and neutron stars.

Gravitational waves cause space and all matter in it to distort, typically creating fractional changes in the distance between objects of 10^{-20}. That is, over 1 km, the spacing between two mirrors will typically be altered by 10^{-17}m, or about 10^{-7} of an atomic diameter.

Over the past ten years techniques for such precision measurements have been developed at UWA using microwave transducers. In laboratories in Europe, USA and ANU optical methods have been developed with similar sensitivity.

Physicists around the world are now proposing the development of a world wide network of gravitational observatories. In Australia physicists at ANU and UWA have proposed the construction of the Australian International Gravitational Observatory (AIGO). This would be situated on sand plain 60km north of Perth. The Observatory would consist of a laser interferometer having a baseline of 3km and an initial strain sensitivity of 10^{-20}, which would be increased to 10^{-22} over a ten year period of research and development. To achieve this the Observatory must combine state of the art laser technology, optical manufacturing, large scale high vacuum technology and precision stabilisation techniques. The opportunity of developing these technologies has already proved to be of great interest to Australian industry, especially because a broad range of industrial spin-offs can be expected from the project. The principles of a laser interferometer detector are shown in Figure 1. A laser beam is split at a beam splitter, and directed down long vacuum pipes to mirrors. A gravitational wave causes a fluctuation in the interference pattern seen in the output beam.

Figure 1: Gravitational wave detector using the standard Michelson interferometer layout. BS, beam Splitter, M1 and M2, mirrors: PD, photodiode



To achieve the desired sensitivity new laser and optical techniques are required. Specifically, lasers are required with power outputs ~ 100W, and frequency stability of the order of 1 part in 10^{18}. Newly emerging diode pumped Neodymium YAG lasers should be ideal. They are very small but have spectacular efficiency, typically ~ 50%, and are very stable. They are likely very soon to have enormous applications, including 3 colour large screen projector television to all forms of cutting, from steel to textiles. Australia's only expertise in the field will therefore have enormous commercial implications. Already Professor J Piper's Centre for Lasers and Applications has small scale working models. Power output is currently quadrupling each year as labs in the USA and Europe develop improved devices.

Another key aspect of the technology is in low loss optics. High optical powers cannot be utilised without low loss mirrors. The field has already stimulated the development of mirrors with losses of less than 10 parts per million. To get maximum sensitivity the interferometer is set up so that it resonates. The light inside it is reflected back on itself many times, waste light is recycled, and using these techniques sensitivities to motions of less than 10^{-19} metres will be achievable.

Should this proposed project come to fruition it will provide a focus for scientific activity in Western Australia which will involve no less than 18 research groups (university, government and industry) across Australia with collaboration with the UK, USA, Italy, West Germany, Japan and USSR.

The impact therefore on the scientific community will not only be in terms of increased knowledge of our universe but also in terms of increased opportunities for research scientists, growth of research groups in Australia, attraction of international researchers and science and technology transfer.

The Western Australian Government has announced $5 million support for the project but a report on the proposal by the Australian Science and Technology Council recently tabled in Parliament has concluded that, while the project is scientifically attractive, it does not qualify for Government support as a national project funded entirely by Australia. An international partner would have to meet at least 50% of the estimated cost of $38 million before the proposal would be considered further. The proposers disagree with ASTEC's conclusion, because an overseas partner would need to supply the more portable and more technologically important parts of the project. Australia would lose its advantage in being at the cutting edge of the new technologies. While this would not diminish the scientific interest, it would diminish the economic advantages to Australia.

At present the proposers are vigorously continuing their research. At ANU an advanced optical technique called squeezing has been successfully demonstrated. At Perth prototype isolators for the big project have been successfully tested. In the meantime the niobium antenna is being refurbished to give improved sensitivity. It will continue to be valuable until the big new detectors come on line, probably about 1997.

Workshop to Develop R&D Priorities for Underground Coal Mining Exploration Techniques

By agreement with the Commonwealth Department of Primary Industries and Energy the Australian Coal Association (ACA) will assume responsibility for the coal research activity of NERDDP. The new arrangement will continue to fund coal research, but funding will now be administered by ACA.

A large portion of the money will be directed towards funding industry identified research projects. To identify appropriate avenues of research, a workshop will be held later this year - which will itself be funded by NERDDP.

This workshop is to cover the field of exploration for underground coal mines, both in greenfield projects and in operating mines. The workshop will be held over two days at the Mayfair Crest Hotel in Brisbane commencing Thursday 7th November 1991. Three of the eight workshop sessions have been allocated to the consideration of geophysical methods. Future R&D spending will be influenced by the workshop findings.

The organising committee is endeavouring to gather information on projects that broach new developments and research initiatives relevant to exploration for underground coal mines. In particular, we would like to hear from organisations which are currently involved in any such projects and would be prepared to contribute a topic paper to the workshop either as a presentation or as a contribution to the volume. Details of any suitable projects, possibly in a different discipline, which could be adapted to coal exploration would also be welcome.

The scope of topics will be very broad and will certainly include case histories (both successful and otherwise) of application of well established technology; details of current research projects; and research proposals.

A technical and trade display will be incorporated in the workshop with emphasis on the equipment and services currently available to the underground coal mining industry, and research organisations currently or potentially active in these fields.

For further information please contact Mr Alan Davies, BHP Utah Coal Limited, GPO Box 1389, Brisbane QLD 4001, ☎ (07) 226 0616, Fax: (07) 229 2333 or Dr Peter Hatherly, ACIRL, PO Box 83, North Ryde, NSW 2113, ☎ (02) 887 3777, Fax (02) 888 9912.

Towards 2005

An Introduction to the Submission - Towards 2005 - A Prospectus of Research and Research Training in the Australian Earth Sciences

G J Street

This submission was prepared by The Australian Society of Exploration Geophysicists and, as such, is aimed at addressing the particular problems of research in Geophysics and, in particular, Exploration Geophysics in Australia.

In this submission we have attempted to address the terms of reference as set out by the working party of the AGC (and have followed the numbering system). In addition, we have prefaced the submission with some introductory remarks in an attempt to define some of the fundamental problems that exist in the teaching and research of geophysics in Australia.

Depending upon definition there are approximately 2000 geophysicists employed in Australia. An estimated 1200 of these are actively involved in the earth sciences as opposed to oceanography, atmospheric physics etc. Around 900 of these are members of the ASEG.

Research in exploration geophysics is widespread but at a limited scale. Main centres are (in no particular order):

1. Universities and, in particular, Sydney, Macquarie, Tasmania, Queensland, Flinders, Adelaide, Monash, Melbourne, New England and Curtin.
2. CSIRO Division of Mineral Physics.
3. Bureau of Mineral Resources.

4. State Geological Surveys.
5. Exploration companies.
6. Contractors.

Teaching in geophysics is carried out at 17 universities in Australia. These are:

- Adelaide
- ANU
- Curtin
- Flinders
- Latrobe
- Monash
- Macquarie
- Melbourne
- NSW
- New England
- Queensland
- Queensland University of Technology
- Sydney
- Tasmania
- Western Australia
- Wollongong

Australia's mineral wealth has become a major contributor to our standard of living. Boom times in Australian history have resulted largely from mineral wealth. The early gold booms were driven by eager gold seekers in search of instant wealth which they could easily do by scratching at the surface. In recent times the search has become more difficult and science and technology has played a greater part. Consequently, Australia has come to rely on geoscientists to continue to locate further buried wealth without which our standard of living will necessarily decline.

To maintain our mineral exports Australia has become a world leader in the application of geoscientific principles for mineral exploration and, in particular, a world leader in the application of geophysics for mineral exploration. A recent worldwide survey showed that there are over 550 mineral exploration geophysicists active in Australia compared to around 300 in Canada and less than 100 in the USA. This high figure is due primarily to the special problems of exploration in Australian deeply weathered terrain. However, our research efforts do not reflect this excellence. While we have made rapid strides in the fields of data collection, processing and analysis, we have remained in the dark ages in instrumentation research and mathematical geophysics appears to be actively discouraged in some institutions.

Despite our local expertise we still feel a need (perhaps part of our Australian character) to bring in overseas 'experts' to our conferences. Partly this reflects our lack of development and the fact that we have not created centres of excellence to foster the development and recognition of our own experts.

With proper development of our skills and with good research we have the opportunity to create a significant international market for our expertise in exploration particularly in the areas to Australia's near north. This market should include not only personal skills but the sale of equipment and instrumentation as used by the Australian experts.

Geoscience departments and institutions are usually dominated by geologists just as this working party is also dominated by geologists representing their member organisations. The working party therefore must first and foremost address themselves to the fundamental questions of where are we going in geoscience in this country. We believe that geophysics already plays a vital role in exploration and will become indispensable in the future as more exploration is carried out under areas of deep weathering and surface cover. The role of the geophysicist is already reflected in the larger mineral exploration companies where the ratio of geologists to geophysicists is around 8 to 1 and in petroleum companies where it is closer to 1 to 1.

Geological Surveys

NT

Northern Territory Department of Mines and Energy announce a mid-May release of aeromagnetic and radiometric data for six 1:100,000 sheets in the MITCHELL RANGE are of the Northern Territory.

Source: Ted Findhammer of NTDME via A Lebel.

SA

Geophysical maps now available - 1:250 000 Scale Contoured TM1Data (50 nT contour interval): ALBERGA Map No. S1 53-2, BMR Plan No. SA22-1/953-9/1, SADME Plan. 90-665.

Commercialisation of IGRF - What is your view?

By C E Barton
Australian National Delegate to IAGA
BMR Geology & Geophysics

The International Association of Geomagnetism and Aeronomy (IAGA) is embroiled in a debate about whether to charge commercial enterprises a licensing fee for the use of the International Geomagnetic Reference Field. A decision about Commercialisation will probably be made by IAGA at the Conference of Delegates to be held during the IUGG meeting in Vienna next August. The purpose of this article is to summarize some of the arguments for and against commercialisation, and to canvass opinions to ensure that Australian views are fairly represented in Vienna.

As chairman of the Fund Raising Committee of IAGA, Bill Stuart of the British Geological Survey has proposed selling IGRF as the only way of raising enough support for the many magnetic observatories facing imminent closure in developing countries (IAGA News, No. 28, March 1990; August 14, 1990 and February 19, 1991 issues of EOS Trans. Am. Geophys. Un.). Under the scheme commercial organizations, such as oil-drilling and mineral exploration companies, would pay for using IGRF according to some appropriate scale of charges. Academic and non-commercial users would continue to have free access to IGRF as in the past, except that the coefficients would not be published in the usual literature. The scheme would be administered and policed through IAGA, probably with national magnetic observatory groups, such as BMR, acting as retail outlets.

Questions regarding the legal rights of IAGA to sell IGRF, and contentious issues concerning the administration, pricing and policing of the scheme, though of considerable importance, are secondary to the central question of whether such a scheme will best serve the interests of the scientific community and associated commercial enterprises.

Arguments for Commercialisation

- Nobody has come up with a better scheme for providing the financial support needed to maintain third-world magnetic observatories currently facing difficulties. Several important observatories have already stopped producing data within a useful time-frame and are in imminent danger of closure. A world-wide network of reliable magnetic observatories is crucial for maintaining the accuracy of global field models such as IGRF.
- Commercial organisations are ready and willing to pay for IGRF as a means of ensuring its accuracy. Dr Stuart states that seven British companies have contracted to pay $1M "as an expression of the concern of the commercial world to maintain a high standard of accuracy in IGRF."
- The scheme would not compromise the free interchange of information within the international scientific community since it only restricts the access of commercial users to the IGRF coefficients. The academic community, non-profit making organisations, and agencies that contribute data to IGRF would continue to get IGRF free of charge
- Selling IGRF would add to its popularity as a reference field standard by improving the world-wide observatory database. Putting a price on IGRF might even add to its prestige!
- Commercial users favour a formal licensing arrangement, rather than voluntary contributions, in order to prevent their unscrupulous competitors obtaining a market advantage by avoiding contributions to IGRF.
- Commerce wants a geomagnetic reference field endorsed with IAGA's "seal of approval" in order to cover themselves legally in the event of any mishap arising from the use of sub-standard geomagnetic information. It is argued that the use of IGRF, recommended by, and marketed through IAGA will achieve this purpose.

Arguments against commercialisation

- Commercializing IGRF goes against one of the most fundamental and binding principals on which international science is based, namely the principal of free exchange of scientific information and results. The present production and administration of IGRF epitomises this principle and stands as one of the most successful examples of international collaboration.
- The scientific basis for marketing IGRF, with IAGA's "seal of approval", as a reference standard for direction-finding is unsound. Current offers of payment for IGRF are from

several oil companies who will, presumably, use the information primarily for directional drilling purposes. IGRF is not a suitable model for this purpose and carries with it the caveat that it is not appropriate for direction-finding applications. Companies requiring accurate directional information about the geomagnetic field must resort to regional or local-scale models.

- IGRF has achieved tremendous success as a universally accepted global reference field standard, and is greatly valued as such (see for example Patrick Taylor's article int he April 16th, 1991 issue of EOS Trans. Am. Geophys. Un). Any restrictions on universal free access to IGRF can only compromise this position. For example, Bill Stuart suggests that the IGRF coefficients should o longer appear in the scientific literature in order to restrict unauthorized usage.
- Deriving financial benefit from IGRF will encourage governments to charge for the data they provide to the international scientific community. In recent years the support for science has become increasingly predicated on economic payoffs and cost-recovery, often to the detriment of fundamental research. IAGA should not encourage this process.
- Providing significant finance through IAGA for magnetic observatories will further discourage some governments from supporting observatory science, and possibly undermine the position of their own scientists.
- Income derived from selling IGRF, while presently very tempting, has an unknown future and is unlikely to be adequate to provide the long-term support needed to maintain the present observatory system.
- Commercialising IGRF for the sake of perpetuating the existing observatory system is a short-sighted policy. The present network arose by historical accident rather than by scientific design and suffers from the twin problems of an extremely uneven spatial distribution, and unsuitable siting of many observatories. Future needs will be better served by a smaller, well-distributed network of observatories with modern instrumentation and communication systems, complemented by regular satellite missions. Moves in these directions are already taking place.
- Enforced payments for IGRF are not necessary. If commercial organisations are serious about maintaining or improving the accuracy of global field models then it would be in their interests to volunteer support (probably tax-deductible) for observatories. IAGA could administer such a scheme and devise a recommended scale of contributions. Official recognition could be published in IAGA literature.

The above arguments, both for and against the proposal, are by no means exhaustive, but are intended to stimulate thought and discussion on the issue. The arguments do not carry equal weight, sot he fact that I have listed fewer arguments for the proposal should not be taken as an attempt to slant the debate. A detailed description of Dr Stuart's proposal is available on request. Please let me know if you have any opinions you would like to be incorporated into the Australian view to be presented at the Conference of Delegates in Vienna. Views expressed earlier by some persons in response to the circular sent out in November 1990 by Bob Vincent, IAGA National Correspondent, have already been noted and will be incorporated into our submission.

The 1990 Revision of IGRF

By C.E. Barton
BMR Geology & Geophysics, Canberra
Tel: (06)2499611 ; Fax (06)2576041

Time has come for the next revision of the International Geomagnetic Reference Field. Since its inception in 1968, IGRF has been updated at 5-yearly intervals. The 1990 revision will become the 5th generation of IGRF. The term IGRF is the generic name for all the sets of spherical harmonic coefficients adopted by the International Association of Geomagnetism & Aeronomy (IAGA) as defining the international standard for the Earth's main field. This should not be confused with the names of some of the individual models, eg the current IGRF1985, or the obsolete IGRF models (IGRF1965 etc.).

The pattern of each revision of IGRF has now become standardized. The 5th generation IGRF will define the spherical harmonic coefficients for 1945.0 up to 1995.0 as follows.

DGRF1945-DGRF1985: nine definitive models for discreet 5-yearly epochs form 1945.0 to 1985.0. These are main field models only and do not include any secular variation coefficients.

For intermediate dates the "definitive" IGRF is obtained by linear interpolation of coefficients between neighbouring 5-yearly DGRF epochs.

IGRF1990: a model containing coefficients for the main field at epoch 1990.0, together with a set of coefficients representing the annual change of the field to be used to extend IGRF1990 up to epoch 1995.0.

PGRF 1985-1990: a "Provisional Geomagnetic Reference Field" within the internal 1985-1990, obtained by linear interpolation of coefficients between DGRF1985 and IGRF1990.

New models in the 5th generation of IGRF will be DGRF1985 (main field only) and IGRF1990 (main field and secular variation). The earlier DGRF models remain the same - that's why they are definitive! All the main field models are truncated at degree and order ten; the secular variation model is taken up to degree and order eight.

Several agencies have submitted candidate models: the U.S. Goddard Space Flight Centre, the U.S. Geological Survey, the Soviet Institute of Terrestrial Magnetism, Ionospheric and Radio Wave Propagation (IZMIRAN), and a joint U.S. Naval Oceanographic Office/British Geological Survey group. The candidate models are presently being tested by different institutions around the world. Denis Winch (University of Sydney) and I have carried out a preliminary comparison for the Australian region, and found that all the models are quite similar. The main reason for this is that very few new survey data are available and all the models are therefore based on the same old set of field observations (dominated by MAGSAT) update to the present time using a common magnetic observatory dataset.

Final assessment of the candidate models and the choice of the new models for IGRF will be made at the meeting of IAGA Working Group V-8 (Analysis of the Main Field and Secular Variations), to be held during the forthcoming IUGG General Assembly in Vienna, August 1991. The new coefficients will be available after soon thereafter. Please let me know if you would like to receive notification. Bear in mind that the outcome of the debate about commercialisation of IGRF (see accompanying article in this issue) might influence the conditions under which IGRF is made available in future.

Specialist Group on Solid Earth Geophysics

Reprinted from "The Australian Geologist, March 1991"

A contribution on the current activities of the GSA Specialist Group on Solid-Earth Geophysics (SG2).

Specialist groups, by their very nature tend to be rather cliquey groups who basically speak the same scientific language. To the outsider they are rather secretive. These occasional contributions to TAG are designed to "open up" SG2 to the general GSA membership and highlight those aspects of our activities which should have wide appeal.

Let me trumpet as loud as I can the latest issue of our twice yearly newsletter edited by Jim Dooley:

This issue (Dec 1990) had as its chosen theme, PALAEOMAGNETISM, and contains a number of articles by the leading exponents of the art (?)/science in Australia. I list the titles below because you will not find a better collection of review articles for the non-specialist earth scientist.

Using Palaeomagnetism to Study the History of Climatic Change ... Charlie Barton

Pacific Palaeomagnetism and Tropical Tectonics ... Bob Musgrave

Palaeomagnetism at University of WA: Present Research and Future Directions ... Zhengxiang Li & Chris Powell

A New Interpolative Method of Palaeomagnetic Dating for the Precambrian ... Mart Idnurm

Using Environmental Magnetism in Sediment Tracing ... G Caitcheon

Global Palaeomagnetic Database nearing Completion ... Mike McElhinny and Jo Lock

Palaeomagnetic and Rock-Magnetic Research in the CSIRO ... Phil Schmidt

The Evolution of the India-Asia Collision: Palaeomagnetic Results from the Ninety East Ridge, ODP Leg 121 ... Chris Klootwijk

I recommend this issue of Geophysics Down Under to you (Price $6 including postage - from J C Dooley, 66 Hawker St, Torrens ACT 2607).

Other articles in the same issue include reports on: Symposium on Intraplate Seismicity (Perth, WA, Sept 1990); Fourth International Symposium on Deep Seismic Reflection Profiling of the Continental Lithosphere (Bayreuth, Germany, Sept 1990); Permeability, Fluid Pressure and Pressure Seals in the Crust (Denver, Aug 1990); Glacial Isostacy, Sea-level and Mantle Rheology (Erice, Italy, Aug 1990); Workshop on Electromagnetic Induction in the Earth (Ensenada, Mexico, Aug 1990)

The June 1991 issue of Geophysics Down Under will feature impact structures throughout Australia as well as the usual chit-chat one finds in newsletters. If you have opinions please write to the editor; he has the usual "Letters to ED".

Doug Finlayson, BMR

AWAGS

- Towards an 'aeromagnetic risk' map of Australia, and a basis for regional magnetic field surveys

Reprinted from "BMR Research Newsletter" 14/4/91

Fifty-seven recording stations comprising the Australia-Wide Array of Geomagnetic Stations (AWAGS) were used to record natural variations of the geomagnetic field at one-minute intervals between November 1989 and July 1990. Preliminary results are giving unprecedented insight into the large-scale magnetic induction properties of the crust (reflecting its subsurface electrical conductivity structure), and the effect this has on the accuracy of base-stations used for correcting aeromagnetic surveys. AWAGS is also giving us a more detailed picture of the diurnal pattern of field variations over Australia than has hitherto been possible. Several airborne and satellite survey activities are taking advantage of this for mapping the regional magnetic field over the continent.

Aeromagnetic surveyors must contend with the temporal (diurnal) variations of the geomagnetic field, and the complications arising from the heterogeneous nature of crustal induction effects that distort the diurnal variation on a local as well as a regional scale.

AWAGS is a magnetometer array study designed to address these problems. It is the first continent-wide experiment of its kind ever undertaken. The array provides a detailed picture of how the diurnal pattern and transient disturbances vary across the continent and how they evolve with time. It can be used to look downwards to probe the large-scale electrical conductivity structure of the continent, or upwards to investigate the current systems that are responsible for external contributions to the geomagnetic field. In addition the array data provide excellent diurnal control for regional airborne and satellite magnetic surveys.

A knowledge of the induction properties of the crust can be used to identify regions subject to large (or small) variability in the diurnal field variation. Hence it is possible to construct contour maps depicting the errors inherent in using a base-station for making corrections to aeromagnetic survey data. This concept of an 'aeromagnetic risk' map of Australia is being developed through AWAGS.

Fieldwork

The AWAGS stations, which include four permanent magnetic observatories (Fig. 19), were deployed over the whole continent at an average spacing of about 275km. Three components of the field, together with temperature and time, were recorded at one-minute intervals. In addition a north-south line of instruments was maintained from Darwin through Alice Springs to Adelaide for a full 12-month period in order to achieve complete seasonal information about undisturbed diurnal (Sq) patterns of geomagnetic variation.

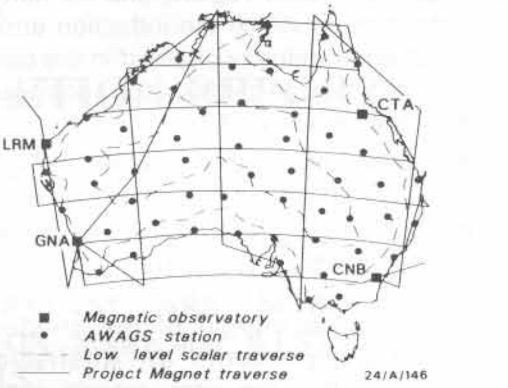


Fig. 19. Station locations for AWAGS, permanent magnetic observatories, track lines for the low-level scalar traverses, and track lines for the new high level Project Magnet vector traverses.

Design and development of the magnetometers was carried out a Flinders University. Each instrument package is completely self-contained, and comprises an orthogonal set of three Kelvin-Hughes fluxgates, control electronics, a solid state memory card for logging the data, and a battery pack. The magnetometer is housed in a PVC cylinder, 16 cm diameter and 68 cm long, and can run unattended for four months with a one-minute sampling rate. Instruments are buried to achieve temperature stabilisation, and can be tested, re-programmed and interrogated in the field using a portable PC. The instruments performed very successfully; the data recovery rate exceeded 85%. Data losses were due mainly to premature battery failure and to the disappearance of two instruments.

Induction results

Induction effects can be represented conveniently by 'Parkinson' induction vectors that are computed for a particular periodicity of the field fluctuations during an interval of high disturbance. In broad terms, the induction vectors should point towards an electrical conductor. They are small either directly over the conductor, or far away from the conductor. The lengths of the vectors reflect the strength of the induction effects, which relate to both the scale and electrical conductivity of the conducting region. So far only a cursory analysis of the AWAGS data for induction effects has been completed. It shows that major distinct zones of electromagnetic induction behaviour can be identified. Induction vectors (Fig. 20) can be grouped into three regions:

- a coastal region, in which the vectors point towards the conducting oceans (the 'coast-effect') and decrease in amplitude away from the coast:
- a central craton region, and its northwards extension, in which the induction arrows are small and randomly directed in the centre but - towards the rim of the craton - point outwards from the centre: and
- an intermediate region (shaded in Fig. 20), in which the induction arrows are either small or point towards the central craton and away from the coast.

The northern margin of the shaded area apparently represents an Australia-wide conducting path - the inter-cratonic conductive zone - which traverses the eastern Canning Basin, the Officer Basin south of the Musgrave Block, and the western margins of the Eromanga and Carpentaria Basins. Within the main crystalline basement areas, induction effects are moderately subdued, apart from the well defined coast-effect. Work is in progress to delineate the conductor path in more detail by incorporating the results from previous small-scale array studies.

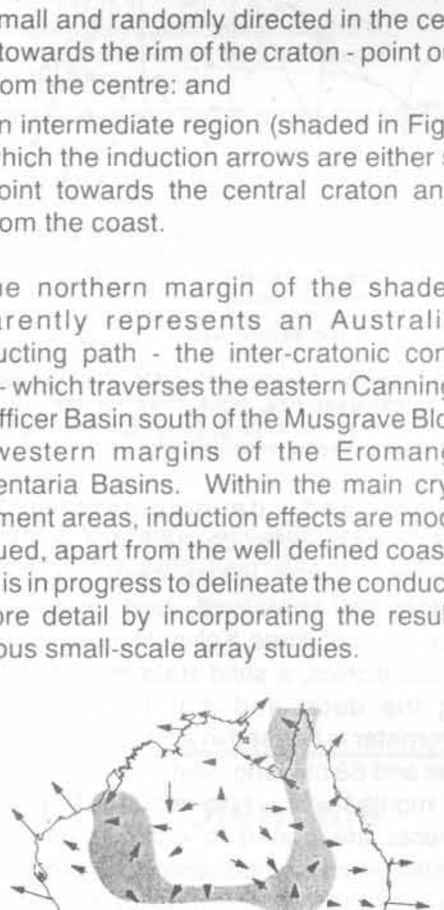


Fig. 20. Magnetic induction vectors corresponding to a period of 42.7 minutes computed at AWAGS stations from a magnetic storm on 29 December 1989. Areas where the induction vectors show large variability in size and direction are characterized by heterogeneous induction properties, and are therefore liable to large base-station errors.

'Aeromagnetic risk' maps of Australia

Because few areas in Australia are free from induction effects (cf. Fig. 20) there are few areas where the assumption of spatial homogeneity of the fluctuating field - extensively applied in aeromagnetic data reduction - holds in detail. Anyone deploying base-stations for aeromagnetic (or marine) survey work needs to have a feel for the differences between the diurnal signal at a base-station and the corresponding signal at a remote survey point. The AWAGS study provides the first country-wide basis for generating this base-station error information, allowing the possibility of drawing a contoured 'aeromagnetic risk' map of Australia. In fact a set of maps will be required because the base-station error, as a function of distance away from the base-station, is expected to be frequency-dependent.

The induction arrows (Fig. 20) are not directly related to base-station errors, but nevertheless do provide a crude 'aeromagnetic risk' map. The figure delineates areas where large base-station errors can be expected (high variability between induction vectors), and areas where they are going to be small (short or uniform patterns of arrows).

AWAGS-related surveys

Several important developments in regional magnetic field surveying have been timed to take advantage of the opportunity afforded by AWAGS. Firstly, two low-level traverse circuits were flown around the country in January and February 1990, recording the scalar field (ie, total intensity at an elevation of 150m (Fig. 19)). The data will be used for levelling individual aeromagnetic maps to assemble a magnetic anomaly map for the whole of Australia.

Secondly, as part of the US Navy's Project Magnet a set of traverses was flown across the continent measuring the vector (3-component) field at 20,000 feet (6,000 m) elevation (Fig. 19) This data set will lead to a substantial improvement in the accuracy of future regional field models (eg the Australian Geomagnetic Reference Field. AGRF).

Thirdly, the US Navy's magnetic-field survey satellite, POGS, was successfully launched on 11 April 1990, and is operating reliably. It is equipped with MAGSAT instrumentation, although it does not have sufficiently accurate attitude control to give good vector data. The AWAGS array will provide one of the best ground-truth data sets for the satellite. POGS data will also be used in future AGRF models.

For further information, contact Dr Charles Barton, BMR, or Dr Francois Chamberlain, School of Earth Sciences, Flinders University of SA.

Reflection Seismic Processing Seminars

Dr Jacob Fokkema, Delft University of Technology, Faculty of Mining and Petroleum Engineering presents the following seminars:

Reflector Imaging

Thursday June 27, 1991

4.00 pm

Macquarie University

Building C5A, Room 301

A method is presented to image a reflecting discontinuity of the earth parameters. As model data we take the boundary integral representation in which we employ a locally plane reflector approximation. We separate the horizontal phase from the vertical phase in the data by employing a Radon transform with respect to the horizontal source and receive conditions. Carrying out a high frequency analysis and taking the vertical slowness as independent variable, the resulting Fourier Integral is inverted to the space-time domain. We arrive at a funcion with a laterally variant vertical travel time that represents a space-time image of the profile of the interface as the envelope of the first arrivals. The method shows clearly how the data in the source-receiver domain have to be collected.

Hierarchical Decomposition and Inversion

Friday, June 28, 1991

11.00 am

University of Sydney

Carslaw Lecture Theatre 10

In inverse scattering one attempts to reconstruct the material composition of a domain whose interior is inaccessible to direct measurement by probing it from the outside. To this end the domain is considered as a contrasting domain in a known background configuration. The probing is carried out by exciting the object with a number of sources, while the resulting wavefield is detected at a number of receiver positions. In the corresponding mathematical description of the experiment the wavefield quantities are subject to a spatial-temporal differential operator, and to the boundary conditions such as, for example, source conditions and the radiation conditions.

In general terms inversion can be formulated as a non-linear expression where the measurements are related to the contrast-function in the medium. This representation is equivalent to a volume integral over the contrasting domain where the contrast function together with the actual field act as weights of the kernel function.

This kernel function depends on the position of two points in the contrasting domain and is known as the Green's function. The Green's function represents the inverse of the differential operator. In the usual formulation of the inverse problem the wave-theoretical character of the inverse operator is predetermined, only the constitutive parameters are allowed to vary. In this sense inversion is equal to inverse forward modelling. However, this approach leads to a restriction on the inversion process. The data to be inverted are harnessed due to this assumption. The parameters do not have enough flexibility to compensate for the discrepancies between observed and calculated data when the observed data cannot be attributed to such a wave problem. In the hierarchical approach it is proven that any wave problem can be decomposed into a set of subproblems. By arranging this set of subproblems in increasing order of complexity the associated inverse process is divided into two steps. The first step consists of determining the contribution of the sub-set members to the whole data set. In the second step a linear inversion is performed to each sub-set member. In this process the influence of less complex and previously determined members is taken into account. This procedure is not equal to inverse forward modelling.

For further information call P Buchen ☎ (692 2965) or F Wenzel ☎ (805 8434)

ASEG Research Foundation

In the last issue of Preview I reported on the successful projects which received an ASEGRF grant for 1991.

A total of 9 applications were received. Four of the applications were reviewed by the Mining Sub-committee and 3 by the Petroleum Sub-committee. The remaining two were received well past the deadline and could not be reviewed. The project from the University of Queensland entitled "Combined P wave/S wave Seismic reflection for Coal" was reviewed by both sub-committees because it has affinities with both petroleum and mining.

Presently formal guidelines for the next round of applications are being finalised. These will be circulated to all tertiary institutions with an invitation to submit projects for the 1992 grants.

Donations

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

- Norcen International

As noted in the Introduction, the split profit of $2714 from the Sequence Stratigraphy Workshop held at the 1991 Conference has been submitted, via Rob Kirk, as a donation to the ASEGRF.

Joe Cucuzza
Secretary

The Encyclopedia of Solid Earth Geophysics

Reprinted from "The Australian Geologist, March 1991".

Edited by David E James. The Encyclopedia of Earth Sciences Series, edited by Rhodes W Fairbridge. Published by Van Nostrand Reinhold, NY. Distributed in Australia by Thomas Nelson Aust., PO Box 4725, Melbourne Vic 3001, 1328p, 1989. $319.95 (hard cover).

This massive volume is written and edited in a style that is not typical of encyclopedias and probably for this reason it succeeds where others have failed. The features that struck me, particularly in comparing it with Pergamon's two volume International Dictionary of Geophysics and the geophysical volumes of the Landolt-Bornstein series, are:

1. In spite of having nearly 150 authors, the articles have a remarkably uniform level of presentation - a sure sign of a strong editorial hand.

2. The articles are generally very similar in length. There are no two-line definitions and no very extended articles.

3. Very few of the authors are responsible for more than one article and it appears that those who are, including the editor himself, were brought in at the last minute to fill gaps left by intended authors who failed to meet deadlines.

4. Rather few of the authors are the recognised grey-beards of their subjects (who too often more or less repeat their standard review lines). The editor has mostly selected members of the next generation, perhaps in many cases still young enough to be flattered by the request to write an article and willing to put in the effort to write a genuinely new one.

5. There is an index, which is a useful part of the book, although quite unconventional for an encyclopedia.

The range of topics covered embraces what is generally recognised as fundamental geophysics with only incidental coverage of problems of exploration interest. It is obvious also that territorial boundaries were drawn by the series editor to exclude anything that could be regarded as geochemistry, or atmospheric physics, which are the subjects of other volumes in the series. With these restrictions David James has woven his patchwork to cover the selected field very well. Just how well is not immediately obvious from the contents list of titles of the articles, which do not invariably indicate their full scope. Using the index I found discussions of topics that I had at first supposed were missing.

Acknowledgements in the preface indicate the editor's first-stage carve-up of the field into four generalised topics, geodesy/gravity, geomagnetism/paleomagnetism, tectonophysics and seismology. This turns out to be a remarkably good first cut. Although geophysics includes topics that are not obviously encompassed by these four headings, in fact they are covered. Exceptions appear to be mostly intended omissions. The origin of the Earth and its place in the solar system is given rather slight treatment because to do this subject justice would tread on geochemical toes. For the same reason a serious discussion of isotapes was evidently out-of-bounds, although there is a rather cursory and isolated article on radiometric dating. There is a good article on irregularities of rotation, rather concealed by the title "Earth Orientation", and another on "Earth Tides", although the word tides does not appear in the index. The only obviously accidental omission that I have noticed fell down the crack between these two. There is no mention of tidal friction and the long-term slowing of rotation.

There are many very good articles and the range of topics is so wide that a selection of highlights would necessarily reflect the reviewer's biases and interests. However, I should comment that I found the coverage of magnetic problems particularly effective. The article on seismic monitoring of nuclear tests is also especially good to have, if partly because, being outside the field, I have never felt entirely confident that there was not some essential information hidden in classified data sets.

This is a valuable reference work. The price will be an inhibition to individual purchasers, but it is a must for every science library, not just for earth science libraries. For the next decade anyway, it will be widely quoted as the source of an enormous range of information.

Frank Stacey
Physics Department, The University of Queensland

Letters

Dear Anita

I am responding to a question raised in the Federal Executive column of the April issue of PREVIEW regarding the scheduling of ASEG Conferences and Technical Exhibitions.

ASEG Conferences are currently held at periods of 18 months.

The Conference Advisory Committee (CAC) and previous Federal Executives believe this to be the appropriate period for recognising the levels of geophysical activity and development in Australia and for gathering of the relatively small ASEG, whose membership generally totals about 1 000. The larger SEG has a membership of about 20 000, and are therefore confident in attracting sufficient technical material and registrants to ensure the success of their annual event.

The CAC and previous ASEG Federal Executives felt that a biennial meeting schedule would not permit timely reporting of Australian geophysical activity and developments. Consequently, the 18 month schedule was adopted as policy by the Federal Executive during the mid 1980s and, upon recommendation of the CAC, has been maintained by all successive Executives. We expect this to remain policy until geophysical activity and Society membership increase to levels that permit us to confidently plan financially and technically rewarding annual events.

The current schedule is the sequence: Melbourne in October 1989, Sydney in February 1991, Gold Coast in October 1992, Perth in February 1994 and then October 1995, February 1997 and so on.

Incidentally, the CAC is unaware of a question being directed to it regarding the conference schedule and consequently we have no knowledge of such questions being left unanswered. Furthermore, we are equally unaware of "successive committees" (which committees?) having recommended a schedule greater than 18 months.

I trust that this answers "the question" and clarifies the matter for the succession of recommending committees.

Yours faithfully
Stephen Mudge
Chairman, Conference Advisory Committee

Membership

The following members should renew their membership by 30/6/91 otherwise they will be removed from the ASEG mailing list:

Mr Stephen ABERNETHY	
Mr Ken ALLEN	
Mr Vadim ANFILOFF	BUREAU OF MINERAL RESOURCES
Mr Craig ANNISON	
Mr Lim Hock BENG	
Ms Nancy BOSCHETTO	
MR PETER BRAZIER	HALLIBURTON GEOPHYSICAL SERVICES
Dr Peter BROOKER	DPT GEOLOGY & GEOPHYSICS
Mr Roald BROTHERTON	DELHI PETROLEUM
Mr William BURGETT	AMOCO PRODUCTION CO
Mr Danny BURNS	LASMO OIL (Australia) LTD
Mr Christopher CAMPBELL	c/- Aqua Terra International Inc
Mr Peter CLARK	
Mr David CLOSIER	
Mr IAN COOK	WORLD GEOSCIENCE CORP. LTD
Mr Joe CUCUZZA	AMIRA
Dr Gianni D'ADDARIO	
Mr Karl DRIML	DIGITAL EXPLORATION
Dr Venedict ERKHOV	GEOPHYSICAL DPT
Mr Andrew FOLEY	
Mr Graham FRASER	
Mr Michael GILES	
Mr Ian GORDON	
Mr Phillip GOURLAY	
Mr Bob GRAEBNER	G.S.I.
Mr Phil HARMAN	BHP-UTAH MINERALS INTERNATIONAL
Mr Klaus HELBIG	UNIVERSITY OF UTRECHT
Mr Tom HEWITSON	
Mr Anthony HOWELL	
Mr Richard JESSOP	C/- RICHARD JESSOP & ASSOCIATES
Mr Victor JOHNSON	
Dr Richard KELLETT	ZONGE ENGINEERING & RESEARCH
Mr Koo Sing KUANG	
Dr Aksheya KUMAR	
Dr Brian LAST	UN DEVELOPMENT PROGRAMME
Dr Roger LEWIS	TASMANIA UNIVERSITY
Mr William LODWICK	
Mr Steven MACKIE	QUESTA AUSTRALIA PTY LTD
Mr Robert MAHONY	SYSTEM ENGINEERING - A.N.U.
Prof Mark MANDELBAUM	MINISTRY OF GEOLOGY
Dr S.P. MATHUR	
Ms Katherine McCALL	
Ms Laura McCAMMACK	c/- UNOCAL Science & Technology
Mr Timothy McCONACHIE	
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Mr Peter MILLS	
Mr Yutaka MURAKAMI	GEOLOGICAL SURVEY OF JAPAN
Mr Jean-Marie NOEL	WOODSIDE OFFSHORE PETROLEUM
Mr PALMER	
Mr Derecke PALMER	NSW GEOLOGICAL SURVEY
Mr Ron PALMER	AERODATA
Dr John PARKER	SADME
Mr John PATERSON	
Mr Robert PAUL	
Dr William PELTON	
Mr Troy Findlay PETERS	
Mr Steven PHILLIPS	DAMES AND MOORE
Mr John PINCHIN	GAFFNEY CLINE & ASSOCIATES
Mr Paul PREVEDOROS	
Mr Timothy PRITCHARD	UNIVERSITY OF SYDNEY
Ms Judith PRITCHARD	CULTUS PETROLEUM NL
Dr Art RAICHE	CSIRO
Ms Shanti RAJAGOPALAN	NAT. GEO. RESEARCH INST. INDIA
Mr M RAWANCHAIKUL	UNIVERSITY OF NEW SOUTH WALES
Mr Dennis ROMPOTES	
Mr Anthony SAITTA	
Dr Narayanan SAMPATH	BUREAU OF MINERAL RESOURCES
Mr Michael SANDERS	SCHLUMBERGER OVERSEAS S.A.
Ms Susanna SCARANO	
Mr Cameron John SCHUBERT	
Mr Jose Luis SEARA	
Mr Willie SENANAYAKE	DPT PHYSICS
Dr Anatolii SHAMAL	MINISTRY OF GEOLOGY
Miss Susan SHOEMAKER	
Mr Wayne SIEB	
Mr Dennis STEVENS	GEOSCIENCE ASSOCIATES AUSTRALIA
Mr Peter STICKLAND	
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Mr Andrew THOMAS	SANTOS LIMITED
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Mr Mark THOMPSON	
Dr Edward TYNE	NSW GEOLOGICAL SURVEY
Mr Chris WILKINSON	WILKINSON SEISMIC PTY LTD
Mr Russell WILLIAMS	PLACER PACIFIC PTY LTD
Mr Philip WOLTER	LASMO ENERGY
Dr Iain YOUNG	SHELL COMPANY OF AUSTRALIA LTD

New Members

The following new members' details need to be added to the relevant State Branch database:

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BOWEN HILLS QLD

Sylvia MICHAEL (Active) 111 Payne Street
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Steven CARROLL (Student) University of Melbourne
School of Earth Sciences
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Dr Rick VALENTA c/- Monash University
Dept of Earth Sciences
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Western Australia

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GLEN FORREST WA

Shaun GREGORY (Student) 36 Dalston Court
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Jaroslaw KICINSKI (Active) 7 Cygnet Court
YANGEBUP WA 6164

Kim McINERNEY (Student) 20 Horley Street
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To: 21 Steelcon Parade
MOUNT ISA QLD 4825

J T FRAZER
From: Santos Limited, Adelaide
To: c/- Petromer Trend
Wisma Atria 16-06
435 Orchard Road
SINGAPORE 0923

M C GILES
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101 Grenfell Street
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PESA LIMITED (Federal Executive)
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