Preview

Australian Society of Exploration Geophysicists

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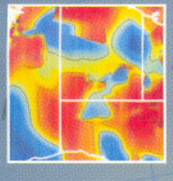

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In this issue

The main feature article in this issue is by Bruce Hobbs, Deputy CEO of CSIRO, who is looking at where we might be in the next 20-25 years. To plan effectively, in this fast moving world we find ourselves in, we need to have goals for where we want to be and ways of getting there. Both the goals and the routes are likely to change but at least with a plan we have something to change. Bruce has taken the bold step of outlining where we should be and what we should do to get there. He paints a fascinating series of scenarios and I hope you enjoy reading these as much as I did.

His article is timely because the Minister for Science, Peter McGauran, has been charged with the task of setting priorities for research and development programs funded by the Commonwealth Government, and papers like Bruce's form necessary background material in this process. As you will see in Eristicus's column the geosciences did not make the priority list for the ARC funding but further input is required in the whole of government approach to this issue and there will be opportunities for us all to contribute to this very complex issue. The Department of Education Science and Training is providing the administrative support for the process, if any member wishes to make an input this is the Department to contact.

We welcome back Natasha Hendrick's Web Waves after a short break, with a very interesting feature on the Linux operating system, and start a new feature on company profiles. In this issue we provide some background information on Newmont Mining Corporation, which was successful in its take over of Normandy Mining and is now supposedly the world's largest gold producer. We will feature a different company in subsequent Previews.

Visit to Ian Macfarlane, Minister for Industry, Tourism and Resources

With my Australian Geoscience Council hat on, and accompanied by Evan Leitch of the GSA and Greg Corbett of the AIG, I visited Ian Macfarlane early in March.

Essentially we were lobbying for government action to ensure we have a healthy and competitive resource industry in Australia and took five key issues to the Minister where we considered the government could make a significant difference. These were:

Identify the Geosciences as a priority area for research funds

At present, in spite of the economic contribution made by these industries the necessity to explore to find and develop new resources, the government has not identifies the geosciences as a priority area for the allocation of government research funds. We wanted this changed.

Provide appropriate financial incentives to encourage mineral and petroleum exploration, particularly in greenfield areas and by the smaller companies

There is intense global competition for exploration investment as mineral and petroleum resource companies are operating more and more on a global scale. It is important that, in Australia, we have an appropriate taxation/financial environment in place to attract both Australian and overseas investment in exploration. The government should do more to make Australia a more attractive place to invest in the resource industries.

Geoscience Australia must be strong and effective

We need a strong national geoscience institution, which has the resources to effectively co-operate with the State and Territory Geological Surveys on regional onshore programs. At present it does not have the resources for theses programs.

We need a GA Board responsible to the Minister, comprising key stakeholders and clients, to provide formal feedback/advice on its programs. This does not exist at present.

Simplify Land Access procedures for Exploration and Resource Development

Presently, access to land by the mining industry is restricted by Native Title legislation, which allows for the 'Right to Negotiate' at the start of exploration. Current Native Title legislation inhibits exploration in new regions. The Government should convene a meeting of all stakeholders to develop uniform procedures to expedite exploration, and make this apparent to the international investment community.

Encourage major minerals and petroleum resource companies operating in Australia to increase their R&D investment here

In the last three years there has been a huge decrease in the R & D investment by minerals and petroleum resource industries operating in Australia. The Government should hold talks with the major multinationals operating in Australia to reverse this trend. At present Australia is losing its basic geoscience research capacity and capability in an alarming way.

The delegation was impressed with the Minister's enthusiasm for this part of his portfolio and his knowledge of what the main issues are that are inhibiting progress for mineral and petroleum exploration. We have been asked to follow-up on issues relating to Geoscience Australia and on developing an Action Agenda for mineral and petroleum exploration.

Electronic publishing

The goal of providing books on line in a useful form has been difficult to achieve. Everyone seems to find it more convenient to turn the pages of the book from the shelf than to stare at the screens and become square eyed in the process. However, in the case of expensive reference books that might only be used on an irregular basis, the

argument for electronic publication is much stronger, particularly if access is free.

The American Geophysical Union has recently made available free of charge its Handbook of Physical Constants, a three volume set edited by Thomas J. Ahrens. The purpose of the Handbook is to provide, in highly accessible form, selected critical data for professional and student solid Earth and planetary geophysicists. These volumes represent the third version of the Handbook of Physical Constants. They were first published in hard copy in 1995 are still very relevant to the professional geophysicist. The volumes are titled:

- Global Earth Physics;
- Mineral Physics and Crystallography, and;
- Rock Physics and Phase Relations

In hardback form the 1000 page publication costs US$160 to purchase for a non-AGU member but is available free at the AGU's website: http://www.agu.org/pubs/pubs.html.

The first volume contains 24 chapters essentially reviewing the state of knowledge in 1995. I won't list the titles of all these chapters but they cover a wide range of issues relating to global geophysics including:

- Global Magnetic Field by *Jeremy Bloxham*;
- Crustal Structure of the Earth by *Toshiro Tanimoto*;
- Fundamental Physical Constants and Conversion Factors by *W. R. Van Schmus* and;
- Present Plate Motions and Plate Boundaries by *Richard G. Gordon*.

A real success in electronic publishing and an excellent set of reference material.

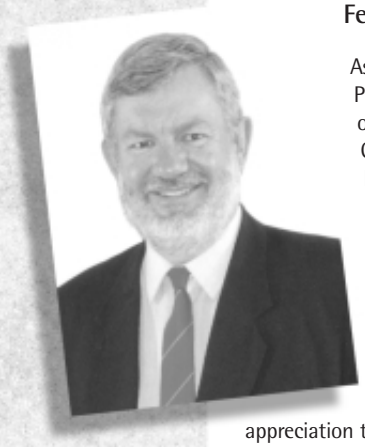
Death of a Giant

I am ending with a sad note, to mention the death of Sam Carey on 20 March this year aged 90. Professor Carey made a huge impact on the geosciences both in Australia and overseas. For me he was an intellectual rebel all his life. When Harold Jeffreys held sway with his 'Static Earth' models, Sam proposed subduction at the trenches (his first paper proposing subduction, to the Journal of Geophysical Research was rejected as being too way out), and when Plate Tectonics was main stream geoscience Sam gave away subduction and argued for an expanding Earth. Some of us will remember his talk at an early ANZAAS meeting in Port Moresby.

The topic was the expanding Earth and during the talk a balloon on stage slowly expanded until it was at least a metre in diameter by the time he had finished his presentation. Then at the climax of his talk he plunged a hatpin into the balloon, which duly exploded with a huge bang! What a showman, what an intellect, he will be missed.

In 1998 Sam was awarded the ASEG Gold Medal for Distinguished Service to Geophysics. A full obituary and an edited citation for his Medal are included in this Preview.

David Denham



It has been some time since I have put pen to paper in the President's Piece due to work commitments overseas in South East Asia, more of this later.

Federal Executive

As this is my last contribution to Preview as the President of the Society, I would like to take this opportunity to thank the Federal Executive Committee members for the effort each one has contributed during the last twelve months. In particular, I would like to thank David Robson, who has been the Honorary Secretary of the Society for the last 3 years, for the tireless effort he has put into the position. This role is not easy and Dave has undertaken it during this period with dedication and has been a great support to the Past President and myself. I would also like to express my appreciation to Bob White, the ASEG Treasurer, who has put in long hours in maintaining the Society's accounts in a very professional and thorough manner. The work of the other committee members should not be forgotten, as they have all assisted in making the Federal Executive function.

The Federal Executive this year has become a national body with representatives from Queensland, Victoria, Western Australia and NSW, where the President, Secretary and Treasurer resided. The next Federal Executive will have the President, Vice President and Secretary based in Perth, with representatives from Queensland, NSW and Victoria.

ASEG Constitution

For some time the Federal Executive has been concerned about the present Constitution or Memorandum and Articles of Association of the Society, as they do not meet the needs of the present Society. It is planned, before the next ASEG Conference in Adelaide, to have a draft of a new document that will meet the needs of the Society in this century. Ray Shaw has spent considerable time on reviewing and drafting the documents and the new Federal Executive will have the job of fine-tuning them before presentation to the members. When it is available, I would encourage you all the read it and give the Federal Executive your comments so it can meet the needs of the ASEG.

Overseas Travels

As I stated earlier I have been overseas in SE Asia, using geophysics for the location of buried ordnance or as most people describe it as Unexploded Ordnance (UXO). This is one field of geophysics that has had little emphasis in the ASEG but is being undertaken on a regular basis throughout the world. The projects that I was working on included a beachfront in Taiwan that had been heavily contaminated with anti-personnel, anti-tank mines, bombs, projectiles and any other ordnance that could be placed on the site. Although it sounds dangerous, we were fortunate as the mines were all steel cased and gave a very good magnetics response. For this project, we used a caesium vapour total field magnetometer to provide 0.1 m sampling along line and 1 m line spacing (something unheard of in exploration geophysics). During the cause of the project, somewhere in the vicinity of 4000 mines, 35 bombs and numerous other ordnance items were located.

As you can see geophysics has a wide variety of applications other than the traditional petroleum and mineral exploration.

Volunteering to the ASEG

The ASEG basically functions on volunteers who give their time and energy to the Society for the betterment of the members. It is my belief that the ASEG still has a lot of untapped potential and we would like to encourage as many fields of geophysics to be represented in the Society. If you have time and energy, please put up your hand to stand on the State Branch Committee, Conference Committees (we need people in Sydney to put up their hands), Standing Committees or the Federal Executive.

I would like to thank you all for giving me the privilege of being President of the Society over the last 12 months and I wish the incoming committee all the best in the year ahead.

Tim Pippett
President

Aims and Scope

Preview is published by the Australian Society of Exploration Geophysicists. It contains news of topical advances in geophysical techniques, news and comments on the exploration industry, easy-to-read reviews and case histories of interest to our members, opinions of members, book reviews, and matters of general interest.

Contents

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Contributions

All contributions should be submitted to the Editor via email at denham@atrax.net.au. We reserve the right to edit all submissions; letters must contain your name and a contact address. Editorial style for technical articles should follow the guidelines outlined in *Exploration Geophysics* and on ASEG's website www.aseg.org.au. We encourage the use of colour in Preview but authors will be asked in most cases to pay a page charge of $440 per page (including GST for Australian authors) for the printing of colour figures. Reprints will not be provided but authors can obtain, on request, a digital file of their article, and are invited to discuss with the publisher, RESolutions Resource and Energy Services, purchase of multiple hard-copy reprints if required.

The text of all articles should be transmitted as a Word document. Tables, figures and illustrations should be transmitted as separate files, not embedded in the Word document. Raster images should be supplied as high resolution (300 dpi) tiff files wherever possible. Vector plots can be supplied using software packages such as Corel Draw or Illustrator. Illustrations produced in any other software packages should be printed to postscript files. Authors are encouraged to contact the publisher, RESolutions, for information to assist in meeting these requirements.

References

References should follow the author (date) system. When reference is made in the text to a work by three or more authors, the first name followed by et al. should be used on all occasions. References should be listed in alphabetical order at the end of the paper in the standard form:

Blackburn, G. J., 1981, Seismic static corrections in irregular or steeply dipping water-bottom environments: Exploration Geophysics 12, 93-100.

Abbreviations and units

SI units are preferred. Statistics and measurements should always be given in figures e.g. 10 mm, except where the number begins a sentence. When the number does not refer to a unit of measurement, it is spelt out, except where the number is greater than nine. Confusing mathematical notation, and particularly subscripts and superscripts, should be avoided; negative exponents or the use of a solidus (i.e. a sloping line separating bracketed numerator and denominator) are acceptable as long as they are used consistently. The words 'Figure' and 'Table' should be capitalised (first letter) and spelt in full, when referred to in the text.

Deadlines

Preview is published bi-monthly, February, April, June, August, October and December. The deadline for submission of all material to the Editor is the 15th of the month prior to issue date. Therefore, the deadline for editorial material for the **June 2002 edition** is **15th May 2002**.

Advertisers

Please contact the publisher, RESolutions Resource and Energy Services, (see details elsewhere in this issue) for advertising rates and information. The ASEG reserves the right to reject advertising, which is not in keeping with its publication standards.

Advertising copy deadline is the 22nd of the month prior to issue date. Therefore, the advertising copy deadline for the June 2002 edition is 22nd May 2002. A summary of the deadlines is shown below:

Preview Issue	Text & articles	Advertisements
98 Jun 2002	15 May 2002	22 May 2002
99 Aug 2002	29 Jun 2002	13 Jul 2001
100 Oct 2002*	**15 Sept 2002**	**22 Sept 2002**
101 Dec 2002	15 Nov 2002	22 Nov 2002
102 Feb 2003**	**20 Dec 2002**	**22 Jan 2002**
103 Apr 2003	15 Mar 2003	22 Mar 2002

**Centenary Edition **Conference Edition, abstracts of papers to be submitted by 2 December 2002.*

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Email: kirsty_beckett@uts.com.au

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Tel: (08) 9321 1788
Email: guy@encom.com.au

2002

May 12-17
International Groundwater Conference, Darwin, Australia
Theme: Balancing the Groundwater Budget
Sponsored by: IAH, Australian National Chapter
Contact: Gary Humphreys, Email:
Gary.Humphreys@nt.gov.au,
Website: www1.octa4.net.au/iahnt/conference.htm

May 27-30
64th EAGE Conference & Technical & Exhibition
Florence, Italy
Website: www.eage.nl

May 28-June 1
2002 AGU Spring Meeting, Washington, DC, USA
Contact: AGU Meetings Department,
Email: meetinginfo@agu.org
Website: www.agu.org/meetings

June 30-July 5
16th Australian Geological Convention
Theme: Geoscience 2002: Expanding Horizons
Adelaide Convention Centre, Adelaide SA
Email: info@16thagc.gsa.org.au
Website: www.16agc.gsa.org.au

July 9-12
Western Pacific Geophysics Meeting
Wellington, New Zealand
Sponsor: American Geophysical Union (AGU)
Contact: AGU
Email: meetinginfo@agu.org;
Website: www.agu.org/meetings

July 29-31
ASEG 2nd Conference and Workshop on Salinity, Land Management & New Technologies, Katanning, WA
Themes: Demystify emerging technologies to catchment and land managers and to convey to the technologists and researchers what the land managers actually require.
Contacts: Ann-Marie Anderson-Mayes
Tel: (08) 9203 7231
or Greg Street
Tel (08) 9268 9672
Email: ama.mayes@bigpond.com
Website: www.salinity.org

September 22-25
Applied Structural Geology for Mineral Exploration and Mining Symposium, Sponsor: Australian Institute of Geoscientists
Venue: WMC Conference Centre, WASM, Kalgoorlie, WA
Contacts: Julian Vearncombe
Email: vearncom@iinet.net.au
or Jocelyn Thomson
Email: aigwa@iinet.net.au

October 6-11
SEG International Exposition and 72nd Annual Meeting,
Salt Lake City, Utah, USA
Website: www.seg.org

October 20-23
West Australian Basins Symposium (WABSIII)
Burswood Convention Centre, Perth
Organised by PESA
Contact details: Peter Baillie
Tel: 0417 178764
Email: peterb@tgsnopec.com.au

December 6-10
2002 AGU Fall Meeting, San Francisco, California, USA.
Contact: AGU Meetings,
Email: meetinginfo@agu.org; Website:
www.agu.org/meetings

2003

January 6-10
Deep seismic profiling of the continents and their margins (10th International Symposium), Taupo, New Zealand
Organised by Institute of Geological and Nuclear Sciences, Victoria University of Wellington and Geoscience Australia.
Website: www.gns.cri.nz/news/conferences/seismix2003
Email: seismix2003@gns.cri.nz

January 20-23
International Conference On Soil and Groundwater Contamination and Cleanup in Arid Countries
Sultan Qaboos University, Muscat, Sultanate of Oman
Contact: Anvar Kacimov, Department of Soil & Water Sciences
Email: anvar@squ.edu.om, arkasimov@yahoo.com
Website: www.squ.edu.om

February 16-19
Australian Society of Exploration Geophysicists
16th International Conference and Exhibition
Adelaide, SA
Theme: Growth through Innovation
Contact: Rob Bulfield
Tel: (08 8227 0252)
Email: rob@sapro.com.au
Website: www.aseg.org.au

April 7-11
Joint Meeting: European Geophysical Society (EGS) XXVIII General Assembly and the American Geophysical Union (AGU) Spring 2003 Meeting, Nice, FRANCE
Contact: EGS office
Email: egs@copernicus.org;
Website: www.copernicus.org/EGS

June 2-6
65th EAGE Conference and Exhibition, Norway.
www.eage.nl

October 26-31
SEG International Exposition & 73rd Annual Meeting,
Dallas, Texas, U.S.
Email: meetings@seg.org

Australian Capital Territory - by David Robinson

The ACT Branch AGM was held on the 27th February. The President's and Treasurer's reports were delivered and accepted. A formal vote of thanks and a gift were presented to Peter Milligan, our long serving Treasurer who stood down from the position this year. The new office bearers for the ACT Branch are:

President: Nick Direen
Vice President: David Robinson
Treasurer: Trevor Dhu
Secretary: Nick Rawlinson

Committee Members:
Prame Chopra, Terry Crabb, Peter Milligan, Alice Murray, Eva Papp and Jacques Sayers.

After the AGM, Ted Lilley (RSES ANU) gave a presentation entitled: *The Carpentaria Structure of High Electrical Conductivity in Western Queensland: a talk in tribute to W.D. Parkinson. W. Dudley Parkinson* passed away in Hobart last year, and was a pioneer of the EM methods that Ted described (see Preview 96, p.11).

A committee meeting was held over lunch at the Brassey Hotel on the 4th March. Conversation largely revolved around upcoming events - ACT members should expect to see a provisional calendar in the near future. The meeting was also used to discuss how the committee will operate to best serve its ACT members, in accord with the program outlined by Nick Direen in his President's report at the AGM.

New South Wales - by Steve Webster and Mike Moore

The NSW Branch continued its sequence of interesting monthly meetings with Peter Gunn addressing the October gathering with a presentation that had a longer title than the talk. It, naturally, covered the role of magnetic interpretation in explaining and understanding the mega-geological features associated with most large-scale oil and mineral deposits.

At the other end of the magnetic spectrum, Tim Rolph, from Newcastle University, enlightened the November meeting with his research into: *The interpretation of the environmental record of magnetic minerals*. At this end of the magnitude scale simple measuring and analysis techniques are used to examine the amount of magnetite secreted by microscopic bugs in the geological record, or the amount of magnetic residue on pine needles after exposure to airborne pollution plumes.

Keeva Vozoff presented his recent research findings at the December meeting. Keeva informed the attendees of the physical, political and scientific perils involved with recording collapse events in underground coalmines.

The New Year agenda began with a presentation (in February) by Andy Green on: *Mixing politics with pico-teslas in the realm of airborne techniques for salinity detection.*

A joint ASEG-SMEDG meeting has been planned for March to allow Steve Collins and Bob White to present their IP array experiments to a wider group of explorationists. The NSW Branch and Federal AGM's will be the focus of the April meeting.

The Branch will be assisting SMEDG with the organisation of its annual Symposium in October. The theme of: *Exploration in the shadow of the headframe* will look at case histories from Australasian mines that, hopefully, will include some geophysical studies.

Queensland - by Kathleen Oliver

The Queensland Branch will be holding its Annual General Meeting on the 10th April 2002 at the Irish Club in Brisbane. All committee positions are open for re-election and we look forward to seeing some new faces on the committee for 2002/2003.

The Branch will be hosting the 2002 SEG/EAGE Distinguished Instructor Short Course in Brisbane on the 9th May 2002. The short course, given by Dr Leon Thomsen, is entitled "*Understanding Seismic Anisotropy in Exploration and Exploitation*". The course will examine the way anisotropy affects data and how considering anisotropy when designing a seismic survey can greatly improve the results of the acquisition. The course will be held in the Clarence Room of the Lennons Hotel and registration is crucial as numbers are limited. Please contact Kathlene Oliver at ksoliver@optusnet.com.au for registration details.

The Branch President (Troy Peters) and Secretary (Kathlene Oliver) would like to take this opportunity to thank the current Committee for their dedicated efforts throughout the year. Without the help of these volunteers we would not be able to provide the geophysical community with relevant and informative technical meetings and courses such as the up coming DISC.

Western Australia - by Megan Evans

The first technical meeting for 2002, held in February, was coordinated under the theme of downhole sonics. The first speaker, Zach John from Schlumberger, provided us with an excellent background to borehole acoustics, before demonstrating the multiple benefits that can be attained through the technique, not only in the petroleum field, but for any down-hole measurements including permeability and stress field direction.

The second speaker was visiting professor and Chairman of Acoustical Sensor and Detection from the Institute of Acoustics, Chinese Academy of Science, Dr Hailan Zhang. Dr Zhang introduced the Chinese Academy of Science and the facilities available for acoustic work, including work on 'making your fridge quieter'. He then demonstrated the complexity involved in obtaining 3D borehole sonic measurements. Both talks were thoroughly enjoyed and led to a greater understanding of borehole sonics.

The PowerPoint slides covering the basics from Zach John's talk will be displayed on the WA Branch ASEG website.

What has happened to Geoscience Research?

Geoscience excluded from government research priorities

In one of the more bizarre and controversial decisions, the new Minister for Education, Science and Training, Dr Brendan Nelson, announced in late January that 33 percent of the Australian Research Council's (ARC's) 2003 funds for research grants would be allocated to four priority areas. These are:

- Nano and Bio-materials
- Genome/Phenome Research
- Complex/Intelligent Systems, and
- Photon Science and Technology

I don't think anyone would argue against the application of a prioritisation process for the allocation of funds for publicly funded research. Australia is too small to attempt world leadership in all disciplines. However, the selection of these four areas appears to have been done behind closed doors by those with no known names.

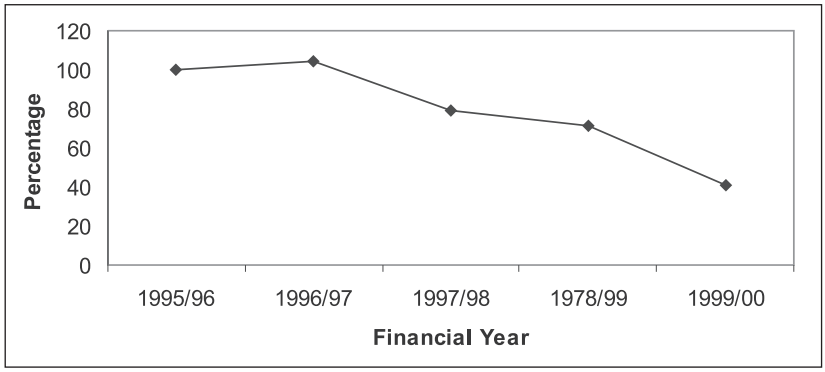
The irony is that in Dr Nelson's statement he said that Australia should "focus its research effort on particular areas in which we have world class, leading edge capabilities" and which "have the potential to deliver significant economic and social benefits to the Australian community."

Given these words, it is surprising that research in the geosciences was not identified as a priority area. The mineral and petroleum industries are the main export earners for Australia and underpin our national wealth. The geosciences are needed to discover, develop and manage these resources, and our future prosperity will depend on these industries remaining healthy, innovative and competitive. Consequently, we need a strong research base to make this happen.

Furthermore, we are faced with huge challenges in respect of land degradation and deteriorating water quality across the whole continent. We must aim to ensure that our land and water management practices will sustain productive and profitable land and water uses, as well as our natural environments. This issue must rank as one of the most important for the nation, and yet it did not make the list.

There may have been good reasons why these two areas were not identified as priorities, but without the selection process being transparent and the selection criteria made public one never knows.

I don't think anyone would have had any problems with identifying the four areas as important areas for research investment but the 33% allocation for those sectors is likely to distort the basic research program too much. In any case basic research is probably the last link in the research chain that should be sharply focused; better to start with the applied end and work backwards. Narrowing the focus for basic research could be counterproductive in trying to nurture innovation.



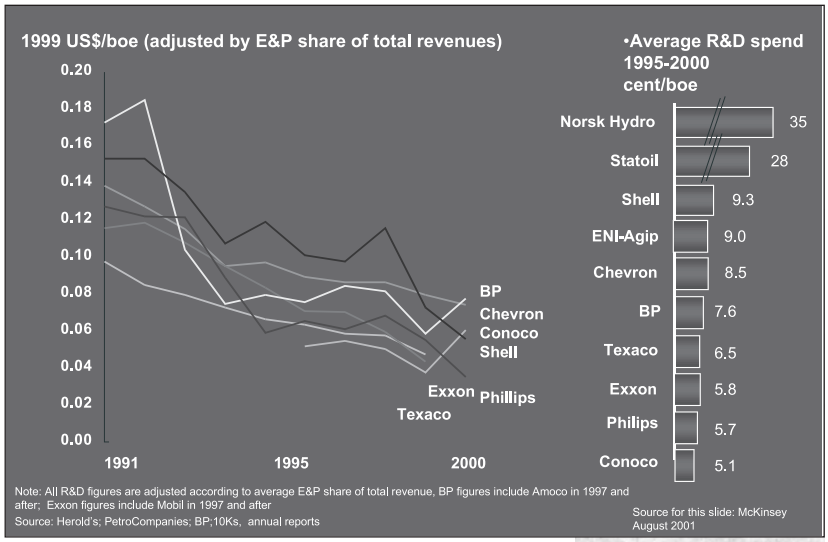


Fig. 1. (Above) Australian Mining Industry's investment in R&D with 1995/96 as a standard.

Fig. 2. (Top) Decline in R&D investment by the major petroleum companies per BOE (Barrel of Oil Equivalent). E&P is Energy and Petroleum

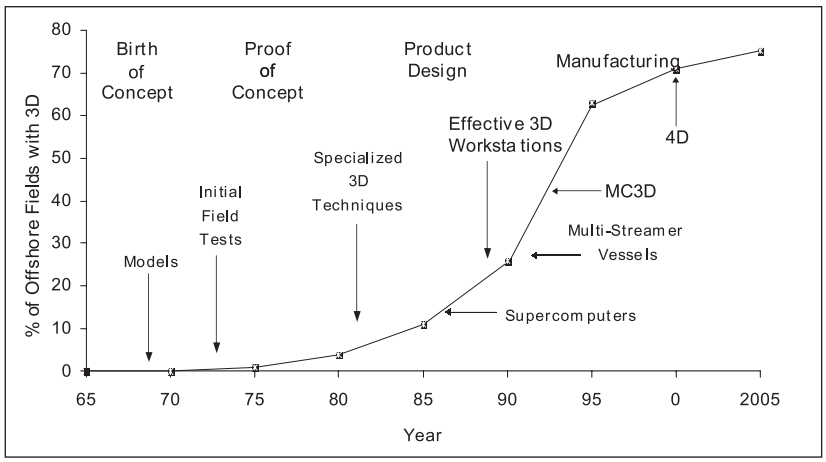
I understand that the Minister for Science, Peter McGauran, is currently investigating ways to improve the prioritisation process, a very necessary but not an easy task.

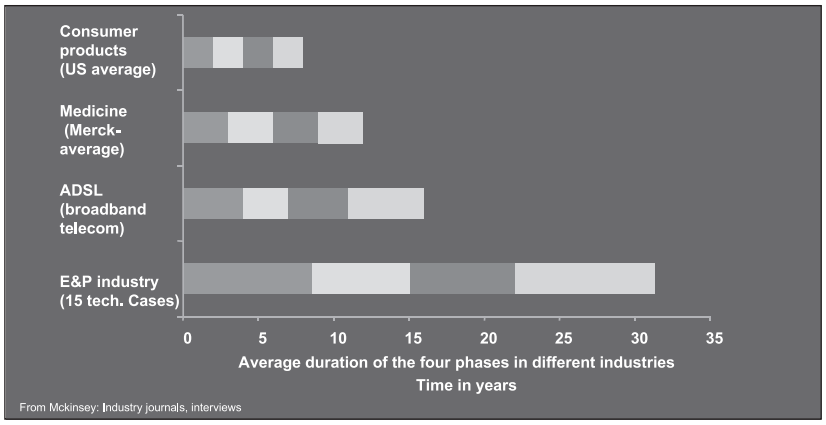
Industrial R & D in geoscience continues to decline

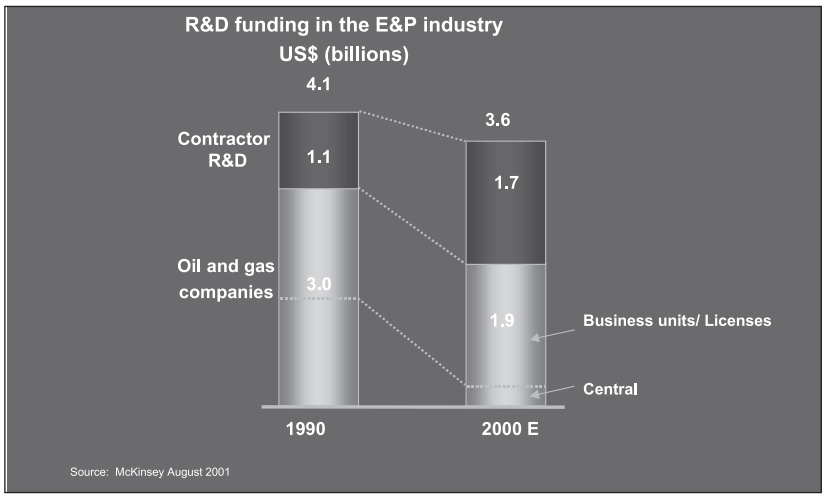
The Government's decision to exclude the geosciences from the basic research might not have been so bad if the industrial R & D had been healthy. However, according to figures released by the Australian Bureau of Statistics, this is not the case.

Figure 1 shows the ABS's results in terms of percentage changes in R & D funding by industry since 1995/96. For calibration purposes, the investment for 1997/98 was $537 million. The picture is not good.

In the petroleum industry the situation is similar. Bill French, the Haydn Williams Fellow at the Curtin University







of Technology, showed the diagram below in a public lecture he gave in 2001.

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Essentially, in the last ten years the research investment by the multi-national majors has been halved. It also turns out that at present most of the research being carried out is of a tactical nature and basic research has been reduced to almost zero.

Professor French argues very persuasively that there are four stages in most commercial applications from Birth of Concept through Proof of Concept to Product Design and Manufacturing. The history of the 3D technology for offshore seismic surveys is shown above in Figure 3. Relative to other industries the lead-time is comparatively long, as shown in Figure 4.

In other words we need to invest more in basic research in the resource industries than in many other of the major sectors.

Finally, the R&D investment by the oil and gas companies has also declined relative to those by the contracting companies. Figure 5 shows a summary of the trends in the decade from 1990-2000. At the same time the number of seismic contractors has fallen from eight to three, so things are not looking good for major breakthroughs. In the context of current investment strategies it is clear we can only expect incremental improvements in proven and well-established technologies.

This is clearly not a healthy state and more needs to be done to encourage private sector R&D.

Eristicus
March 2002

Fig. 3. (Top left) History of the development of 3-D technology for offshore seismic surveys.

Fig. 4. (Middle left) Duration of four phase of R&D for different industries.

Fig. 5. (Left) Change in R&D investment contributions between oil and gas companies and seismic contractors.

New Federal Executive for ASEG

At the Society's AGM held in April this year, several new office bearers were appointed to the Federal Executive. The full Committee is listed on the ASEG Officer's page and we plan to introduce the new Committee to our members, starting with the President, Kevin Dodds. We would also like to wish them well in the discharge of their very important duties.

Kevin Dodds, President of ASEG

Kevin Dodds is the Program Manager for the Abnormal Geopressure Prediction Program in the Australian Petroleum CRC and Research Manager for Geophysics for CSIRO Petroleum, based at the Australian Resources Research Centre in Perth.

He joined CSIRO in 1998 after twenty years with Schlumberger, having worked in Kuwait, Iraq, Saudi Arabia, Egypt and Dubai. In 1986 he was transferred to Paris where he coordinated borehole seismic and sonic marketing and development in partnership with the research groups, and then in London as Unit Geophysicist for UK and Europe based in London and Aberdeen. Through his career he has been involved in application development for a number of borehole seismic technologies including VSPs, 3DVSPs, crosshole tomography and single well imaging, a paper on which received honorable mention at SEG 1997.

He started life after completing a BSc Hons in Upper Atmospheric Physics at the University of New England, spent three years with the Antarctic Division including one year as Auroral Physicist at Mawson Base Antarctica (1975) and then after sinking a yacht in the Torres Strait, travelled to the UK where he completed an MSc in Applied Geophysics at Birmingham University.

Since arriving back in Australia he has been actively involved in the ASEG, being Secretary and then President of the Western Australian Branch, Technical Program Chairman for ASEG2000, co-chairman for HAGI Yogyakarta2003, and is on the committee for the SEG Summer Research Workshop on Pore Pressure Prediction. He is married with four very robust children. Kevin is a member of EAGE, SPE, SEG and ASEG.

Kevin Dodds

Falcon Team receives Clunies Ross National Science and Technology Award

At a ceremony in Melbourne on 7 March, the President of the Australian Mathematical Society, Alan Carey presented Edwin van Leeuwen, the leader of BHP-Billiton's Falcon Team, with the 2002 Clunies Ross National Science & Technology Award.

The citation recognised the use of advanced mathematical techniques, by the Falcon Team, to develop the first practical airborne gravity system for mineral exploration.

As Edwin said at the presentation: "The Falcon Project would have been impossible without the use of advanced mathematics and digital signal processing. In the survey aeroplane, we use some 450 million floating point operations per second to control the gravity instrument, and to record the data for later processing.

This is an extremely complex task and there are many second order effects in the data. A great amount of real time mathematics is necessary to compensate for these effects and to reduce the data to the point that we can begin to see the gravity signals from geological structures below the Earth's surface. And that is the easy bit.

The sheer volume of data from each flight meant that the data processing and analysis had to be fully automated. Unique mathematical algorithms have been developed to solve problems associated with 3D topographic features in the data."

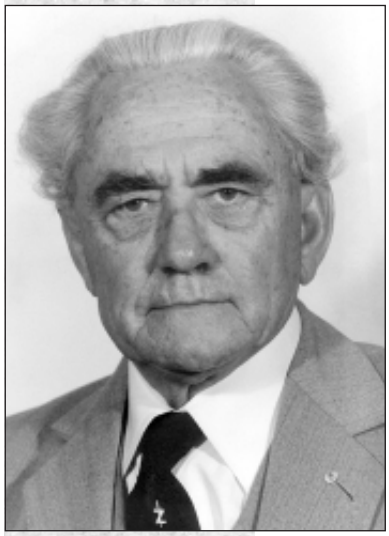
Professor Carey said: "Dr van Leeuwen has solved a complex physical problem. He assembled an excellent team of mathematicians, physicists, system engineers and geophysicists to address the problem of measuring a gravity signal from a moving platform and exceeded technical specification by some 300%. It is a remarkable achievement, which once again highlights the role of mathematics in scientific innovation."

Well-done Team Falcon.

New Members

Name	Affiliation	State
Nicholas Adams	Oil on Film	Qld
Les Beard	Oak Ridge National Lab.	USA
Nigel Cantwell	Curtin University	WA
Cameron Crook	Woodside	WA
Matthias Densley	Santos	SA
Adam Kroll	Curtin University	WA
Mika Pirttivaara	Helsinki University	Finland
Satyavan Reymond	Schlumberger	WA
Luise Sander	Sander Geophysics	Canada
Steffi Schwarz	WesternGeco	WA

Obituary



Samuel Warren Carey AO, 1911-2002

Professor S. Warren Carey died peacefully on 20 March 2002 at Hobart Private Hospital.

He will be missed by a large community of Australian geologists who were either his students, those who worked for or with him, or who were influenced by his many ideas on the way the earth works.

Samuel Warren Carey was born near Campbelltown, New South Wales on 1 November 1911. His schooling was at Campbelltown and later at Canterbury High School where he was a high achiever. From here, he entered the University of Sydney in 1929, during the Depression years, enrolling in chemistry, physics and mathematics, taking geology as a fourth, fill-in subject on the advice of one of his high school teachers James ('Jerry') Jervis. Here he came under the influence of the retired Sir T.W. Edgeworth David, a leading participant in Ernest Shackleton's 1907-1909 Antarctic expedition. Carey graduated with First Class Honours in geology in 1932 and received the Science Research Scholarship, which allowed him to go to a Master of Science degree. This was conferred in 1934 for work in the Werrie Basin of northern New South Wales. In addition to his studies, he was a member of the University regiment and active in rowing. He founded the Students' Geological Society and was its first president.

This obituary was assembled by a group of his friends and supplied by Patrick Quilty.

From academia, he joined Oil Search in Papua New Guinea and explored many areas where white men had not been seen. He was an outstanding field geologist, very concerned for the welfare of his field staff, the local people and his equipment. He showed in this period his dedication to the small details that made the exploration effort successful. This was a lifetime attitude. His activities in New Guinea convinced him of the dynamic nature of the earth and stirred the lifelong interest in tectonics (science of large-scale movements of the earth - continental drift and the like. He moved from Oil Search to the Australasian Petroleum Company and wrote a thesis entitled "Tectonic Evolution of New Guinea and Melanesia" which earned him a Doctor of Science degree from the University of Sydney. The drama of the transport of this thesis overseas for examination is a story in itself and reflects the transport and communications problems of a world at war.

During this time, in June 1940, he married Austral Robson. He remained in industry until 1942 when events in New Guinea led to evacuation of the Careys to Melbourne. He joined a special unit - Z-Force - and returned to Port Moresby to recruit and train personnel for work behind enemy lines and in preparation for a raid on Rabaul. He also became a paratrooper. Here again, his attention to detail in design of boats and field equipment came to the fore. He was involved in the famous dummy limpet mining of ships in Townsville Harbour, written up in R. McKie's "The Heroes" and dramatised some years ago by ABC radio.

With the winding down of the war effort, Carey returned to Melbourne and moved to Tasmania to take up the position of Chief Government Geologist for Tasmania. He retained this position until 1946 when he was appointed the Foundation Professor of Geology at the University of Tasmania. It was from this position that he made his name, building on all the earlier experiences.

While the University of Tasmania was a small university in an isolated state of small population, it developed an outstanding reputation and large geology student body, due almost entirely on the drive of Carey and a very few well-chosen initial staff. Carey insisted on giving the first year lectures and in consequence had a very high recruitment to second year because of the quality of his teaching. Many distinguished geologists were attracted to the discipline through Carey's approach to teaching. He was the God-Professor and drove his department rather than simply managing. He was a real leader in the academic environment and a respected thorn in the side of many a vice-chancellor.

He ensured that there were good working relationships between the University, Geological Survey, the Geological Branch of the Hydro-Electric Commission and industry. This led to co-operative development of research projects for the many students who went on to higher degrees. But his interest in Papua New Guinea remained and in the 1960s he had a group of PhD and Honours students who conducted a series of complementary research projects covering a large area of that part of the world.

At about the same time, Australia recognised the need to find its own hydrocarbon resources. Lewis Weeks, based on his knowledge of the Lakes Entrance Oil Shaft and Carey's sketch map of anticlines extending in to the offshore Gippsland Basin, led BHP to take up exploration acreage. At a meeting in Launceston in 1984, Geoffrey Blainey pointed out that the Weeks/Carey association was of historical significance.

He retired as Professor of Geology in 1976 and was made an Officer of the Order of Australia (AO) in 1977.

He was not a narrow scientist but one who saw geology as the great integrating science and used this philosophy to pull together a vast amount of knowledge into his tectonic theories. These theories commonly were controversial and not fully accepted internationally but they have stimulated a large professional interest and study. Many of his ideas are now mainstream and are used by scientists who may not even realise the source of a concept they employ on a daily basis.

He was an extrovert and enjoyed the controversial limelight.

He convened a series of international symposia at the University of Tasmania. The driving force behind each one was the existence of a geological debate that was best addressed by calling the various schools of thought together. Perhaps the most influential of these was the

Continental Drift Symposium of 1956 (results published in 1958), that influenced many of the workers in the field and helped cement his international reputation.

While concerned mainly with large scale geological features, Carey never lost sight of the human dimension. He was an active participant in Legacy, and ready to speak to any small group of people who wanted a talk on geology, or weather, or any area of science in which he felt qualified to speak. He was a great publicist for science in communities beyond the normal scientific arena.

He is renowned as a provocative generator of new major integrative hypotheses that are revolutionary but highly credible and concern the dynamics of our earth. In addition he made major contributions to our understanding of deposition of sediments in a glacial marine environment. Many of his ideas were well ahead of their time and influenced the direction of tectonic studies globally. Idea generation was supported by a very strong personality dedicated to promotion of those ideas.

He will be remembered as one who initiated ideas, stimulated students at all levels and produced an impressive community of leading scientists in geology and geophysics. Many came from leading overseas universities. All speak glowingly of the influence of Carey in their scientific development.

He 'retired' in 1976 but retained a very active scientific lifestyle. He is recognised by many awards nationally and internationally.

He pursued enthusiastically the promotion of science to the public through personal involvement with organisations such as the Geological Society of Australia, Royal Society of Tasmania, and the Australian and New Zealand Association for the Advancement of Science, to which he dedicated very significant energy over many years.

The scientific world was very much the better for his presence.

He is survived by wife Austral, their four children Tegwen, Harley, Robin and David, grandchildren Krista, Sam, Warren, Sarah, Eleanor, Sean and Geoffrey. And great grandchildren Caitlin and Phoebe.

ASEG Gold Medal Citation

Professor Sam Carey held a position as a 'founding father' of geology and geophysics in Australia. His enormous breadth of interests, from engineering geology to global and cosmological geology, bestrode the traditional boundaries of geology and geophysics, so that he repeatedly, throughout his career, led or inspired the use of geophysical methodology where many others in the profession have been less adventurous. By his example and inspiration he has furthered the profession of geophysics immeasurably as a discipline integrated with geology in engineering, exploration and global geoscience.

As a champion of geophysics he introduced it into the Geology Department, University of Tasmania, in the early 1950s. Throughout his time as Head of Department he expanded its undergraduate and graduate geophysical activities by appointing two full-time geophysical lecturers, a comprehensive set of equipment and several support staff. Many geophysical theses were inspired, especially in the fields of electromagnetism, magnetotellurics, gravity and crustal seismology.

Inspired, partly by the need to monitor seismic risk around the developing Hydro Electric scheme, he established the Tasmanian Seismic Net in 1957, and continued its development to incorporate Worldwide Standard Seismographs into the network. A multiplexing system using Hydro transmission lines was set up, so that the signals from 6 stations could be recorded on a 24-hour drum recorder placed in the foyer of the Geology Department. Technicians were trained to maintain and develop the net, and to interpret events recorded. Students were obliged to take part in these processes.

Professor Carey's major contributions to geology and geophysics were in the fields of structure and tectonics, especially as a world expert and proponent of continental drift. A major plank in his work was the concept of major Earth expansion and he carried out an exhaustive analysis of palaeomagnetic and other geophysical and geological data to provide support for his theories. In recent years, through the publication of a number of books, he explored some of the more fundamental geophysical consequences of an expanding Earth, for example, the behaviour of 'little g' through geological time.

Presented to Professor Sam Carey at Hobart, November 1998.

ASEG Research Foundation: project results

The ASEG Research Foundation has been supporting students for studies in all facets of Applied Geophysics at the BSc (Honours), MSc, and PhD (or equivalent) levels for 12 years. Members may not be fully aware of the research outputs from these projects, so we will be giving some of the results in this and subsequent Previews. The first four are Honours projects completed at Adelaide and Flinders Universities and the University of Western Australia.

Brian Barrett: Ground Penetrating Radar and EM Studies of Near-Surface Groundwater and Salinity.

Host Institution:	Adelaide University
Supervisor:	Graham Heinson
Industry Mentor	Michael Hatch, Zonge Engineering and Research Organisation

Project Summary

The effectiveness of ground-based, non-invasive geophysical tools for the delineation of stratigraphy and hydrology in saline ground-water environments has been tested in an area covered by a salt interception scheme, near the town of Waikerie, South Australia. A fast and informative tool is required for monitoring salinisation effects around the Stockyard Plains Disposal Basin (SPDB), which is used as a storage lake for salt water pumped from aquifers close to the River Murray. Such salinisation effects include the formation of a perched saline water-table close to the SPDB with consequent threats to local fresh-water lenses. Ground penetrating radar (GPR), direct current (DC) resistivity, transient EM (TEM) and low induction number (LIN) frequency domain EM (FEM) were compared in terms of efficiency and quality at two survey locations near the SPDB. LIN FEM measurements were found to be fast to implement but suffered from a non-linear response with ground conductivity in high conductivity areas. GPR methods were found ineffective in this project, due to high signal attenuation. Fast time-sampling TEM successfully depicted a perched saline water-table related to leakage from the SPDB, and was found to be the most useful technique for delineation of hydrogeology due to a high vertical resolution. DC resistivity was the slowest technique, but was found useful in imaging a fresh-water lens. Results from this study suggest that TEM and DC Resistivity methods are useful tools for both fresh-water detection and hydrogeology monitoring in saline groundwater environments.

Volmer Berens: Three-Dimensional Marine Magnetotelluric Imaging of Salt-Domes in the Gulf of Mexico

Host Institutions:	Flinders University and Adelaide University
Supervisors:	Graham Heinson
Mentors	Michael Hatch, Zonge Engineering and Research Organisation and Steven Constable, Scripps Institution of Oceanography, USA

Project Summary

The Gulf of Mexico is region of extensive salt diapiritic activity, and deformation of sediments due to intrusions is the source of structural petroleum traps below and around the salt bodies. Seismic methods have difficulty in locating the base of salt structures due to attenuation and scatter of signal within the salt body. An alternative method is to use seafloor magnetotellurics (MT). This is a natural-source electromagnetic (EM) exploration technique that is beginning to be used in salt imaging for petroleum exploration. Independently, MT is able to resolve gross salt structures, and when complimented with seismic constraints, is able to define base and horizontal salt boundaries.

A marine MT experiment conducted in the northern Gulf of Mexico in 1998 (GOM98) was part of a seafloor EM initiative to develop and test marine MT for the purpose of petroleum exploration. Time-series EM data were collected at seven marine sites (and three land magnetometers for remote reference) along a 20 km long north-south transect in the northern Gulf of Mexico, off the coast of Louisiana in 1 km water depth. MT responses were obtained from robust multi-station processing in the bandwidth 1 - 1000 s. Long period estimates (100-1000 s) were noisy and were not included in modelling, but at short periods (1-100 s), errors were typically 1% or less. Two-dimensional (2D) inversions the Occam's inverse code of deGroot-Hedlin and Constable, (1990) produced models that located the salt body at depths of between 2.1 and 5 km depth, but it was difficult to interpret boundaries due to the smoothing. To improve the resolution of the boundaries, especially that of the base salt, a priori seismic constraints to the top of the salt were added. By constraining the top of the salt by incorporating a resistivity discontinuity in an otherwise smooth model, the base salt boundary is much better resolved.

Hashim Carey: The optimum location of Mise-à-la-Masse electrodes in mineral exploration

Host Institution:	Adelaide University
Supervisor:	Graham Heinson
Industry Mentor	Michael Sexton, Normandy Mining Ltd.

Project Summary

Mise-à-la-Masse (MALM) is an inexpensive method for electrical resistivity exploration of subsurface conductivity contrasts. The principle of the MALM method is to measure surface potential variations when current is injected into a buried conducting body. The primary aim of the project was to investigate the case where the current electrode is not in direct contact with conductive mineral; the "near-miss" scenario. This is of interest because measured equipotentials frequently delineate subsurface anomalies. The project was conducted in association with Normandy Mining Ltd, who provided MALM data from a copper VMS deposit in Western Australia to aid in this investigation.

A variety of methods were used to model the response of a near-miss scenario, including 3D Finite Element Method (FEM) forward-modelling, magnetic and gravity inversions, and an image source location method, known as image

reconstruction (IR). The 3D FEM modelling allows for accurate constraints of a modelled ore-body, and easy comparison of calculated and original MALM data. Magnetic and gravity data were inverted to aid in the understanding of the MALM data. The IR method delineates mineralisation by generating correlation coefficients for a 3D distribution of source points that outline the body when contoured. An association between the depth of the electrode, distance from the ore-body and the resulting surface potentials was developed for current electrodes that are not in contact with the conducting body. By determining this association, the placement of current electrodes in boreholes which do not intersect mineralisation can be optimised such that they still provide extremely useful data for ore body delineation.

Tom Wilson: Fractured Rock Hydrogeophysics at Clare Valley, South Australia

Host Institutions:	Flinders University and University of Western Australia
Supervisors:	Graham Heinson (FU) and Anthony L. Endres (UWA)
Industry Mentors	Peter Cook, Centre for Groundwater Studies, CSIRO and Andrew Love, Department for Water Resources

Project Summary

Groundwater in the Clare Valley, South Australia is drawn from fractured rock aquifers. The irregular distribution and orientation of fractures complicate acquiring reliable groundwater sources in fractured rock aquifers and bedding planes, causing large spatial variation in bore yield. With the rapid development of new vineyards in recent years expected to continue for some time, the issue of sustainable resource utilisation is of utmost importance. The primary goal of the project was to develop geophysical field techniques and data interpretation to assist in defining preferential flow paths due to hydraulically conductive fractures, and thus assist defining capture zones of irrigation bores in the Clare Valley.

A range of geophysical and geological field surveys was undertaken in the Clare Valley during 1999-2000. Most of these were centred on CSIRO boreholes drilled to depths of 100 m or more in a number of locations on the western side of the valley:

- Detailed surface azimuthal-resistivity surveys utilising DC resistivity and EM induction methods were performed at a number of locations to determine electrical (and thus hydraulic) anisotropy and heterogeneity. The orientation, density and connection of fractures were estimated based on the electrical resistivity.
- A downhole mise-à-la-masse survey was also carried out at one site with a downhole current source in one of the CSIRO boreholes and a roving potential electrode.
- Ground penetrating radar (GPR) profiling was used in two locations to directly image sub-horizontal fractures. At one location, a GPR survey was carried out during a pumping test, and detailed images of fluid-extraction from fractures were imaged on a number of repeated lines.
- Bedding plane orientations and fracture densities were measured at a number of surface exposures to correlate with observed geophysical data.
- Bore log geophysical data from CSIRO drill holes in the Clare Valley were collated and incorporated into the analysis.

Modelling studies of the geophysical inversions were carried out, including 1D and 2D resistivity inversions, 1D EM modelling and GPR forward hypothesis studies. Results clearly indicate the utility of geophysical methods for mapping hydrogeological properties in fractured rock environments. They are rapid, inexpensive, non-intrusive, and potentially provide information of fracture density and orientation that cannot be obtained in any other way.

Hashim Carey and Brian Barrett concentrating on the regolith

ASEG 16th Conference and Exhibition
Growth Through Innovation

16-19 February 2003, Adelaide Convention Centre

The ASEG 2003 conference organising committee is proud to announce the major conference sponsors. Our Platinum Sponsor is Santos and our Gold Sponsors are WesternGeco/Schlumberger and Newmont Australia. Given the support of these sponsors we are confident the Conference will be a significant geophysical success.

The conference organising committee for ASEG 2003 has been hard at work and this issue of Preview includes the call for papers, an invitation to exhibit, and opportunities for silver and bronze conference sponsorship. We hope you will take advantage of the opportunities offered by ASEG 2003. There is still the opportunity for additional gold sponsorship of the conference provided sponsors are not offering similar goods and/or services to the above gold sponsors. The details of the gold sponsorship package were outlined in the December 2001 issue of Preview.

The silver and bronze sponsorship packages are as follows. If you have any questions or suggestions regarding ASEG 2003 'Growth Through Innovation', feel free to contact the conference co-chairs, Richard Hillis (rhillis@ncpgg.adelaide.edu.au) and Mike Hatch (zongeaus@ozemail.com.au), or the conference organiser, Rob Bulfield of SAPRO (aseg2003@aseg.org.au). If you have any questions about sponsorship please feel free to contact the sponsorship sub-committee of John Hughes (john.hughes@santos.com.au) or Mike Sexton (mike.sexton@normandy.com.au).

Silver Sponsors
$11,000 (includes GST)

1. Naming rights to a technical program session
- Acknowledgment of session sponsorship in the registration brochure and handbook
- Verbal acknowledgment of your sponsorship by the session chairman
- Slides of your corporate logo projected in the session room at the commencement of the session

or

Sponsor's logo on the conference satchels
- This would be in addition to the platinum and gold sponsor's logo

or

Naming rights to a conference lunch
- The sponsor would have the opportunity of providing merchandising material and corporate signage at the lunch
- The sponsor's support would be formally acknowledged during the lunch and the sponsor's representative would have the opportunity to respond
- The sponsor would be acknowledged on the lunch tickets and appropriately wherever the lunch is mentioned in all conference print material. The sponsor would be provided with 2 additional lunch tickets

or

Naming rights to the pocket program
- The sponsor would be acknowledged on the pocket program

or

Naming rights to the conference's student day
- The sponsor would be acknowledged whenever the student day is mentioned in all conference print material.

In addition to one of the above alternatives, sponsors would also be entitled to:

2. One complimentary full-time registration
3. One complimentary trade booth in a prime location
4. Acknowledgment (logo) in registration brochure
5. Acknowledgment (logo) in handbook and conference proceedings on CD-ROM
6. Logo incorporated on conference slides
7. Complimentary satchel insert
8. Conference endorsement
9. Detailed delegate list

Bronze sponsors
$6,600 (includes GST)

1. Naming rights to a morning tea or afternoon tea
- The sponsor's support would be formally acknowledged by the session chairman and a session room slide just prior to the morning or afternoon tea
- The sponsor would be acknowledged wherever the morning or afternoon tea is mentioned in all conference print material

or

2. Two complimentary full-time registrations

or

3. One complimentary trade booth

In addition to one of the above alternatives, sponsors would also be entitled to:

4. Acknowledgment in registration brochure
5. Acknowledgment in conference handbook and conference proceedings on CD-ROM
6. Logo on conference slides
7. Complimentary satchel insert
8. Conference endorsement
9. Detailed delegate list

Further sponsorship opportunities exist for organisations wishing to diversify their involvement in the conference. Please note that some packages are subject to availability. Contact the secretariat for further details and prices.

Call for Papers

The 16th Conference and Exhibition of the ASEG will be held in Adelaide in late summer. Take advantage of the lovely weather to visit some of South Australia's famed tourist destinations, and enjoy Adelaide scenery, hospitality and cuisine at the time of the Conference.

The theme of the Conference is "Growth Through Innovation". Reserves growth, company growth, personal professional growth, discipline growth - all require to be underpinned by innovation.

Technical papers are invited in all areas of theoretical and applied geophysics (minerals, petroleum, groundwater, engineering, and environmental). Special sessions are being organised on the following themes:

- Geophysical Inversion (Minerals)
- Forensic & Military Geophysics
- Seismic Attributes, including AVO
- From Solid Earth Geophysics to Exploration
- Challenges in Petroleum Geophysics
- Groundwater & Salinity Mapping Applications
- Challenges in Mineral Geophysics
- Geophysical Signatures of South
- Southern Margin Basins
- Australian MineralDeposits

Additionally, there will be trade exhibits/displays; workshops/short courses on geophysical exploration; and, invited keynote speakers. Given the commitment of our Platinum Sponsor, Santos, and our Gold Sponsors, WesternGeco/Schlumberger and Newmont Australia, we are confident the Conference will be a significant geophysical success.

Santos

NEWMONT AUSTRALIA

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Abstracts (no more than 300 words) are due by June 30, 2002. Extended abstracts of papers accepted for inclusion in the Conference CD ROM will be required by October 31, 2002. Full papers are invited for publication in *Exploration Geophysics*.

For information about the Conference please visit the ASEG web site:
www.aseg.org.au
or contact:
Technical Papers Chairman
Stewart Greenhalgh
Adelaide University, North Terrace, Adelaide SA 5005
Email: stewart.greenhalgh@adelaide.edu.au
Fax +61 8 8303 4347

Invitation to Exhibit

The 16th Geophysical Conference and Exhibition is expected to attract over 500 delegates from Australia and overseas. A vital component of the Conference will be the trade exhibition, which will feature the latest products, services and state-of-the-art information technology available to exploration geophysicists.

To acknowledge the Exhibition's importance, the Welcome Reception, all lunches, morning and afternoon teas, as well as two happy hours, will be held in or adjacent to the trade area. Lunches will be included in the registration for Conference delegates and will be served adjacent to the exhibition area, encouraging delegates to remain in the Exhibition during this important break. Booths will be positioned adjacent to the main session rooms in the Adelaide Convention Centre.

Given the commitment of our Platinum Sponsor, Santos, and our Gold Sponsors, WesternGeco/Schlumberger and Newmont Australia, we are confident the Conference will be a significant geophysical success.

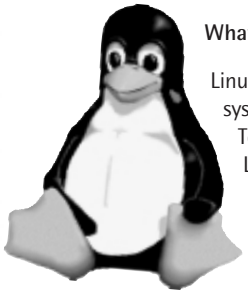
An extensive list of exhibitor benefits and floor plan is included in the Trade Exhibitor invitation, which has been sent to known and prospective trade exhibitors. If you have an interest in being an exhibitor but have not received a Trade Exhibitor invitation please contact the Convention Secretariat.

ASEG2003 Convention Secretariat
PO Box 6129, Halifax St, Adelaide, SA 5000, Australia
E-mail: aseg2003@aseg.org.au Phone: 61 8 8227 0252
Fax: 61 8 8227 0251

For information about the Conference please visit the ASEG web site:
www.aseg.org.au

The Conference is also now offering silver and bronze sponsorship opportunities. Details of these opportunities can be obtained from the Convention Secretariat.

All you wanted to know about Linux and more!



What is Linux?

Linux is a free Unix-type operating system created originally by Linus Torvalds in 1991. Development of Linux has continued with the assistance of developers from around the world. Developed under the GNU General Public License, the source code for Linux is freely available to everyone. Due to its functionality and availability Linux has become quite popular, with an estimated 12 million + users around the world.

Reasons to Consider Linux

There are several advantages to using Linux. These include:

1. ***Cost***: The Linux OS is free; the only expenses are involved with hardware and maintenance;
2. ***Stability***: Linux is very stable and rarely crashes; Linux is virtually immune to DOS/Windows viruses;
3. ***Support***: Linux support is freely available online and through Linux users' groups;
4. ***Portability***: originally developed for 386/486 PCs, Linux now also runs on ARMs, DEC Alphas, SUN Sparcs, PowerPCs etc.;
5. ***Power & Customisation***: Linux makes full use of your computer and can be tailored to your specific hardware and software needs; and
6. ***Interface***: there are a variety of graphical user interfaces, which can be tailored to suit each users needs (including Windows look-alike interfaces).

Perhaps the only disadvantage is that there are many Linux features that require patience to learn, and experience to fully understand. Linux requires that you perform basic administration tasks like adding new users and installing software. These functions are not always well documented. As there is no central body to which one can go for support, prompt replies for help are not always forthcoming. However, if you are keen to extend your computing skills, curious about this powerful operating system, and ready for a little adventure at your desk then Linux might just be for you ... read on!

Linux Online: www.linux.org

This website is a one-stop-shop for finding out all you wanted to know about Linux. There is an online beginner's course "Getting Started with Linux". Want to know more about the Linux mascot? - You can read about the penguin here! You can check whether your hardware is compatible with Linux, and delve into the wealth of online help available through the Linux Documentation project (with links to HOWTOs, Mini-HOWTOs and FAQs). There is also a comprehensive list of Linux applications, and links to free software available for Linux. Some applications you may find particularly useful include Octave (a mathematical program similar to MATLAB); GNU Plotutils (for plotting scientific data); Geomview (3D geometric visualisation software); Vis5D+ (volumetric visualisation program for scientific data in 3+ dimensions); AbiWord (fully featured word processor); Gnumeric (spreadsheet development); Work Flow Management Tools (collection of web-based tools for work flow management) ... the list goes on.

The Linux FUD Factor - FAQ: www.geocities.com/SilliconValley/Hills/9267/fud2.html

As Linux grew in popularity, it found its way into everyday conversation and the media. Unfortunately much of the initial publicity of Linux was tainted with mis-information. This site presents some of the more frequently cited myths about Linux, and open source software in general. You will also find links to the Linux Myth Dispeller and "The Cathedral and the Bazaar" - an analysis of how and why the Linux development model has worked.

Corporate Linux Advocate Homepage: www.geocities.com/SilliconValley/Haven/6087/

If you manage to find your way through the initial jumble of information on this site, you will come across a comprehensive list of interesting Linux links (about two pages in to the site). Here you will find information for the new Linux user - covering 'Frequently Asked Questions' (FAQ), and HOWTOs. There is also a comprehensive collection of Linux journal articles, and white papers and reports produced to help people understand Linux in the marketplace. If you can't find documentation to solve your problem, the next best thing is to search through the archives of Linux newsgroups and user forums - a list of which you will also find on this site.

And if you still need convincing that Linux is an operating system to be taken seriously, check out what a couple of the computer industry heavyweights are doing with Linux: www-1.ibm.com/linux/ and **www.hp.com/product1s/linux/**. You can also take a peek at the "Halloween documents" - leaked Microsoft documents detailing their strategy against Linux and open-source software (**www.opensource.org/halloween/**).

Distributions

The first thing you need to do to get started with Linux is choose which distribution is right for your needs. There are many Linux distributions, each with its own unique flavour. Before making a decision visit the websites of some of the providers:

Red Hat Linux: www.redhat.com

Red Hat Linux is one of the most popular distributions in the world. It is geared towards all levels of users. The beginner will find ease of installation and configuration. The advanced user will find a robust and highly configurable computing environment adaptable to any need.

Caldera OpenLinux: www.calderasystems.com

OpenLinux is a multi-tasking, multi-user OS that gives you power and reliability. It is surrounded with utilities, graphical interfaces, installation procedures, third party applications, and much more. OpenLinux is ideal for

companies who must optimise their investment in existing systems, hardware and training.

Debian GNU/Linux: www.debian.org

Debian is a free distribution of Linux, maintained and update through the work of many users who volunteer their time and effort. Along with its large selection of prepackaged software, it contains advanced package management tools that allow for easy installation and maintenance. Extensive pre-release testing is done to ensure the highest degree of reliability possible.

Linux Mandrake: www.linux-mandrake.com

Linux-Mandrake is a friendly Linux OS that comes with KDE, Gnome, WindowMaker, Enlightenment and other graphical interfaces. It provides ease of use for both home and office. It is freely available in many languages.

Slackware Linux: www.slackware.com

Slackware Linux is compatible with most Intel PC hardware. Slackware will provide stellar performance on high-end systems, including support for symmetric multi-processing, PCI and special code-optimisations for the 486, Pentium and Pentium Pro, and AMD Athlon.

SuSE Linux: www.suse.com

The current version is SuSE Linux 7.3. It contains 7 CD-ROMs (or 1 DVD) with more than 1500 applications. SuSE can be installed and maintained easily with their YAST program. SuSE Linux is available for Intel computers, IA32, IA64, PowerPC, Alpha and S/390.

For the more advanced user ...

If you have already dabbled in the use of Linux, perhaps you're ready for some more serious stuff.

The Linux Resource Exchange: www.linuxrx.com

This site features Linux kernels, updates and patches. Independent search engines help the visitor through the Linux HOWTOs. Of particularly use are the more than 700 Linux-related mailing lists and Usenet newsgroups sorted to make it easier for you to find the right networking group for you. You can also compare the capabilities of a selected number of operating systems.

The Beowulf Project: www.beowulf.org/

A Beowulf is a high-performance, massively parallel computer built primarily out of commodity hardware components, running a free software system like Linux. It consists of a cluster of PCs or workstations dedicated to running computationally intensive computing tasks. Beowulf clusters are growing in popularity in the seismic processing industry. This site provides answers to FAQs about Beowulfs, presents an overview on the Beowulf project, and provides details on how to build a Beowulf. There are also links to information on Beowulf networking drivers and system software, as well as other Beowulf related sites.

Linux Today: linuxtoday.com

A great site to keep abreast of all the latest news about Linux applications and releases around the world.

Linux on Laptops: www.linux-laptop.net/

This site is an index of information and documentation of interest to anyone considering using the Linux operating system on a notebook or laptop computer.

Linux Applications and Utilities Page: home.xnet.com/~blatura/linapps.shtml

This site is a listing of Linux open source, commercial, shareware and freeware applications, utility programs, development tools and servers having their own webpages. All of the programs listed have either a Linux native binary available, or source code available which has been successfully compiled to run under Linux. From here you can find web browsers, games, software languages, multimedia software, file managers, printer utilities, device drivers, daemons, X servers and network tools.

Embedded Linux Portal: www.linuxdevices.com

Embedded Linux has already established itself as one of the most important technologies to enter the embedded computing market. This site provides a quick reference guide to assist companies and developers in efficiently getting up to speed on embedded Linux, and to help those who already use it to keep up with the latest developments from both a technology and market perspective. Read more on how to use Linux in embedded systems and smart devices. Comprehensive information on specific topics is available via numerous online 'Quick Guides'. You will also find links to relevant news articles and promotion material for embedded Linux events around the world.

GNU Home Page: www.gnu.org

It should be recognised that much of the Linux OS is in fact GNU software - variants of the GNU operating system that use the Linux kernel should more accurately be referred to as GNU/Linux systems. On this site you will find a comprehensive list of freely available GNU software (such as gcc (C, C++, Fortran compiler); GIMP (Image Manipulation Program); Gnumeric (spreadsheet); Ghostview (PostScript and PDF viewer) and emacs (text editor)). You can read more about the GNU Project, and find out how to contribute. You will also find a link to the Free Software Directory - the Free Software Foundation's Directory of free software.

Scientific Applications on Linux: sal.kachinatech.com/index.shtml

Scientific Applications on Linux is a collection of information and links to software that will be of interest to scientists and engineers. Search through topics covering

Continued on Page 20

How rare are IP fires?

A recent grass fire incident near Cadia, during a pole-dipole IP survey, has emphasised the point that fires, while rare, do happen. Although the incident did not result in property loss, the potential for property damage in a farming area such as the central Lachlan Fold Belt is significant.

It appears as though a small section of insulation on the pole Tx wire was damaged, allowing the bare wire to spark to Earth, starting the fire. This damaged section of insulation may have been an old join where the insulation tape had come off, or a section recently chewed by livestock. It is also interesting to note that the area experienced several inches of rain the previous day, resulting in the top of the grass stubble being dry, but the bottom still damp. These conditions may have contributed to the incident, and fire risk should not be thought of as just being high during hot and windy conditions.

As a result of the incident the following procedures apply to future Newcrest electrical surveys, regardless of array type, in addition to existing safety procedures:

- Contractor to provide full Job Safety Analysis to be reviewed by Newcrest before survey is awarded. This JSA must address the fire risk and fire fighting procedure
- New transmitter wire specified for each job (up to $ 2 000 extra per job)
- The entire length of Tx wire to be inspected each morning (not a small job when dealing with a 5 km infinity electrode wire with pole-dipole arrays)
- Arrangements to be made for firefighting equipment, such as a 600 litre water tank and pump on a tray back vehicle (if necessary, the contractor may have to provide the equipment, and demonstrate an ability to use it at job start)
- If any fire is spotted by anyone, the transmitter to be shut down immediately until the fire source is ascertained
- Fire extinguishers checked for currency and serviceability before each job, as well as first aid kits
- Standby on days of total fire ban, i.e. very high or extreme fire danger (while these conditions did not exist at the time of the incident, it is a prudent measure)
- Possession of local fire service telephone numbers by all personnel
- Emphasise potential lethal voltages to people peripheral to the survey (e.g. farmers) in addition to existing signage.

It may be helpful if contractors/clients in the industry adopt some or all of these measures, if they have not already.

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mathematics, numerical analysis, parallel computing, visualisation, scientific data processing and computer graphics.

Integrating Windows and Linux ...

While work is advancing on a number of office productivity tools compatible with Linux and capable of importing Microsoft Office file formats (such as StarOffice - see supportforum.sun.com/staroffice), realistically many Linux users still require access to Windows. There are a number of ways to take advantage of both the Windows and Linux operating systems in your home/work office. Linux PCs can be networked with Windows PCs, or you can partition your computer HDD and build a dual boot machine, running both Windows and Linux. The following two sites describe alternative methods for providing access to both operating systems.

NeTraverse Win4Lin 3.0:
www.netraverse.com/products/win4lin30/index.php

NeTraverse Win4Lin enables Linux users to run popular Windows programs at native speeds without additional hardware or the need to dual boot. Windows 95/98 effectively runs within the Linux environment. Windows application failures will not crash the Linux system. Find out the necessary system requirements and purchase Win4Lin via this website.

WinLinux 2001: www.winlinux.net/2001/

WinLinux is 100% compatible with Windows 95, 98, Me, and Red Hat Linux 7. Installation and configuration tasks are performed directly from Windows using graphical tools. WinLinux effectively runs within the Windows environment, and is used just like any other Windows application.

If you have any of your own favourite Linux sites (or websites covering other relevant topics) that you'd like to share with our ASEG members, please contact me (natasha.hendrick@mim.com.au) and I'll include them in future editions of Preview. May the source be with you ... and happy Linux'ing!

NTGS

Barkly and Eromanga Survey data released

The Northern Territory Geological Survey has released approximately 302 000 line-km of located and gridded magnetic, radiometric and elevation data from the ***Barkly Survey***, flown on behalf of NTGS by Tesla Airborne Geoscience during 2001.

The survey was flown at 80 m MTC along 400 m spaced N-S flight lines. A 33-litre spectrometer crystal was used to acquire the new data. These comprise approximately 35% of the Barkly survey area. Reprocessed existing private sector airborne data (300-500 m line spacing; 1983-1997 vintage) have been incorporated over the remaining 65%. Several geological terranes were overflown by the Barkly survey: the SE McArthur, eastern Dunmarra, north and central Georgina, and Nicholson Basins, as well as the Murphy Inlier. The survey data cover the following 1: 250 000 Sheet areas: Wallhallow, Calvert Hills, Brunette Downs, Mount Drummond, Alroy, Ranken and Avon Downs.

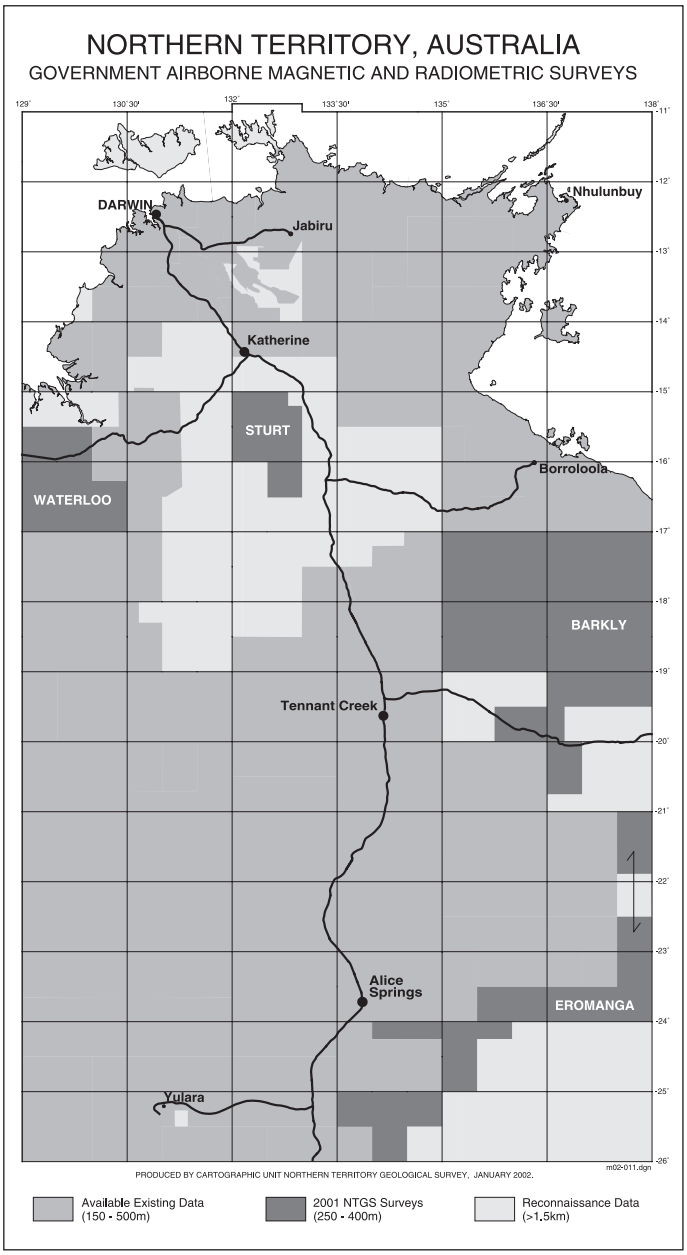
The NTGS has also released approximately 131 000 line-km of located and gridded magnetic, radiometric and elevation data from the ***Eromanga Survey***, flown by Kevron Geophysics on behalf of NTGS during 2001.

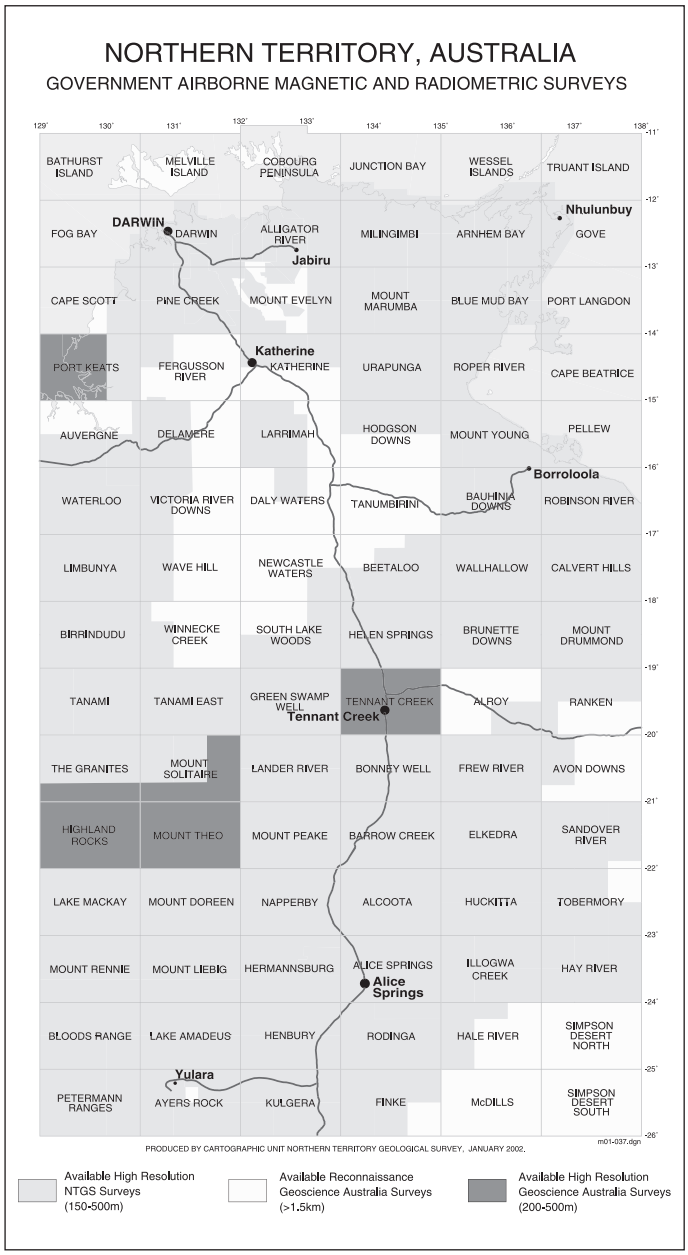
The Eromanga survey was flown at 80 m MTC along 400 m spaced N-S flight lines. A 33-litre spectrometer crystal was used to acquire the new data. Several geological terranes were overflown by the Eromanga survey: central Georgina, eastern Amadeus, western Pedirka and northern Eromanga Basins, as well as the SE Arunta Province. The survey covered the following 1: 250 000 Sheet areas: Sandover River, Tobermory, Hay River, Illogwa Creek, Hale River, Rodinga and Finke.

Continued on Page 22

Fig. 1. (Below left) Location of the two new surveys and the current coverage of the Northern Territory by airborne geophysical surveys.

Fig. 2. (Below) Magentic Map of the Northern Territory, comprising all datasets.





by Mark Russell
Email:
mark.russell@geosoft.com.au

Software Technology Review

What is DAP

DAP (Data Access Protocol) is a technology that enables you to **find and download spatial data** from a DAP Internet data server using a DAP enabled client like the Oasis montaj Interface.

This interface enables you to select the area (using coordinates), projection and type of data you want before you download. So, unlike other data access methods, there is no need to search for the data in the correct format or download large tiles of data - DAP ensures that you only get the data you want.

What the DAP client software does

The Oasis montaj Interface is a *thick* client software application that you install on your computer. It is called a thick client application because it downloads and saves the actual data to your hard drive, so you can use the data in any GIS or spatial data processing program. This is different than other browser-based applications that only provide a view of the data.

The Oasis montaj Interface lets you do much more than just download data. Once you download a grid from a DAP server, you can **view** it in a map, **email** as a Geosoft *emap*, **print** it, or **convert** it for use with another program. A dynamic projection engine enables you to display data with different projections on a single map.

DAP benefits

DAP provides a number of advantages over the traditional method of finding and accessing data over the Internet:

- **Stream large volumes of data** and associated meta data.
- DAP is **spatially aware**, enabling users to specify and download projected data in the format they require. Downloaded data are displayed in a map for you to **view**, **email**, or **print**.
- Data are **compressed** to ensure safe and efficient data transfer while maintaining data integrity.
- **Download the actual data** - not just a view of it. Save grids in the format you require and use them in other GIS applications.

Compare the DAP experience to traditional data access methods

The only way most people can look for data is to use a search engine to browse the Internet. If a dataset is available, often you must download all the data or selected tiles, increasing the time it takes to download. If the data are not in a compatible file format, you then have to find or purchase a conversion tool.

DAP eliminates these problems by providing a single tool that enables you to easily find and download only the data you need, in the format you require. The section below compares the DAP process to a traditional data search.

The traditional data experience

- **Find a data source** - contractor or government database (browse the web).
- **Choose the data type and size** (tile area) from a list of data products.
  Save compressed data as a file or order a CD.
- **Check data** for viruses.
- **Convert** downloaded data into a compatible format.
- **Identify the area of interest** and create a subset file.
- **Georeference data** using either a world or local coordinate **system**.
- **Total time: 2-3 hours**

Continued From Page 21

Survey location, specifications and located images for the Barkly and all previous NTGS surveys are available on the NTGS Image Web Server at:
http://www.dbird.nt.gov.au/ntgs/geophysics/air_map/air_geo_map.html

2002 Magnetic Map of the Northern Territory released

This product was released in March 2002. It is available in both digital (100 m grid in ERS [ER Mapper] format on CDROM) and hardcopy (1:2.5M scale) format.

Also included on the CDROM is a spatial index outlining full specifications of all component airborne datasets.

The Magnetic Map of the Northern Territory comprises all datasets as indicated on the diagram below so that for the first time complete airborne magnetic coverage of the NT is available to all clients:

The digital product is provided in GDA94 MGA53. The hardcopy version is in an Albers Equal Area projection.

The 2002 Magnetic Map of the Northern Territory can also be viewed on the NTGS Image Web Server at: http://www.dbird.nt.gov.au/ntgs/ecw/NT_magnetics.htm

Geoscience Australia

Geoscience Australia has released the 2002 edition of the National Gravity Base. This contains about 1 million gravity observations made on the Australian mainland. These data have been collected from 1814 surveys dating back to 1937.

The 2002 release has approximately 28 000 new stations added from the 2001 edition. These data were obtained mainly from the Tennant Creek area of the Northern Territory and the Yilgarn Craton in Western Australia. All data are provided in GDA 94 co-ordinates and are supplied on one CD-ROM for a cost of $99. The CD also includes an ER-Mapper gravity grid of Australia, produced at a cell size of 0.5 minutes of arc (~800 m), previously released in June 2002.

The DAP data experience

- **Identify the area of interest** using lat/long coordinates.
- **Connect to a DAP server** using DAP client software.
- **Choose the data format** and location to save the data (data are automatically converted to this format during download). See below for a list of grid formats.
- **Download the data** (data streaming and compression ensure a secure and efficient transfer).
- **Total time: 20-30 seconds**

DAP Grid formats

Choose any one of these grid formats and Oasis montaj automatically converts the data as you download:

- Geosoft default (*.grd)
- Geosoft color grid (*.grd)
- Geosoft Comp default (*.grd)
- Arcview Binary Raster Grid (*.flt)
- BIL with *.ini header (*.*)
- ER Mapper data (*.ers)
- ER Mapper RGB Color (*.ers)
- Geopak (*.grd)
- GXF Compressed (*.gxf)
- GXF Text (*.gxf) o Landmark Zmap (*.dat)
- ODDF PC (*.*)
- ODDF UNIX (*.*)
- PCIDSK (*.pix)
- Surfer v6 (*.grd)
- Surfer v7 (*.grd)
- USGS PC (*.*)
- USGS UNIX (*.*)
- World Geoscience (*.H)
- GeoTIFF Color (*.tif)

More file formats

The Oasis montaj Interface also enables you to covert grids to a variety of map and image formats for use in reports or other applications.

Experience DAP for yourself

The Oasis montaj Interface DAP software is available as a free download from Geosoft. Geosoft also currently provides a number of complimentary datasets that you can download using DAP, as below:

Complimentary DAP Data Sources

The following data sources are available on the Geosoft DAP server, at www.geodap.com:

Magnetic Data (South Australia) South Australia magnetic data coverage at 100 m. (Available for a limited time only).

Topographic Data (World Land) 1 km resolution Global Land One-km Base Elevation (GLOBE) digital elevation model (DEM) covering the world's continents.
These topographic data have a latitude-longitude grid spacing of 30 arc-seconds (30").

Magnetic Data (North America) Total Magnetic field of North America sampled at 2 km.
The data were uniformly gridded at a 2-kilometer spacing based on a spherical North American Transverse Mercator projection. The entire data set contains over 2 million grid values, covering an area from 80-degrees North to northern South America. Large amounts of marine magnetic data are also included.

Gravity Data (North America) Bouguer Anomaly of North America sampled at 6 km.
The gravity anomaly data, based on the same projection as the magnetic data, were gridded at 6 km and contain over 5 million grid values. The data represent Bouguer gravity anomalies on land and free-air anomalies over the oceans.

Magnetic Data (Canada) 2 km magnetics grid of Canada.
This gridded data set represents residual total field magnetic intensity over Canada. Aeromagnetic maps are useful for geological mapping and have applications in mineral, oil, and gas exploration

Gravity Data (Canada) This 2 km resolution gridded data set represents Bouguer gravity anomalies on land, and free-air gravity anomalies offshore over Canada.
This database contains 670 000 gravity observations and 5500 gravity control stations. Data are provided in a variety of formats in consultation with clients

How to access these datasets

You can access the data using a DAP software client like the Oasis montaj Interface. The DAP client software and data are provided at no charge

by Bruce Hobbs
Email:
bruce.hobbs@csiro.au

This article is an edited and updated version of the 16th Brodie Hall address presented in Perth by Dr Bruce Hobbs, Deputy CEO of CSIRO.

What Kind of Australia do you want? A strategy to get Australia to 2025

Introduction

I want to make three points in this presentation:

- The minerals and energy industries make a fundamental contribution to the wealth of Australia but these industries are under severe threat. However, these threats create their own opportunities and I will explore some of these in this presentation.

- In the face of declining resource prices, and increasing social and environmental pressures, productivity must go up and costs go down. This can only happen through technology. I want to highlight some of these technologies and indicate how they can create increased wealth for Australia.

- There are a number of crunch decisions to be made in the near future. These are concerned with six key issues:

1. Population,
2. Energy,
3. Greenhouse/Climate Change,
4. Mineral Resources,
5. Water, Salinity and Biodiversity, and
6. Land Use and Land Rights

Educated decisions in these areas provide enormous leverage for Australia as a nation in the coming two decades.

My 2025 Scenario

I propose a scenario for Australia in 2025 that looks like this:

- The profile of the population will be approximately in a steady state at total of about 25 million but rising slowly.
- The minerals and energy sector will be thriving and characterised by zero emissions and zero waste.
- Greenhouse emissions will be well below the Kyoto target.
- A diverse energy supply system will be available comprising: *Geothermal, Hybrid Solar/Hydrogen, Wind and Solar.* Clean conventional coal will still be a major contributor, but with underground sequestration of CO_2. There will be a transition in place to a dominant hydrogen economy.
- 20% of water will be supplied by desalination of seawater and inland saline water.
- Most automobile transport will be powered by hydrogen in the next generation of the hybrid car.
- A thriving service sector will account for 20% of GDP (and growing) based on the above technologies.
- Complete harmony between Aboriginal People and the rest.

Six Key Issues

The six key inter-related, fundamental issues identified above must be resolved if Australia's wealth is to increase. These will now be considered in turn.

1. Population

The world's population will increase by 33% between 2000 and 2025 from 6 to 8 billion. The populations of most developed countries will slowly begin to decrease from 2020 onwards. However, there will still be enormous pressures on the resources of planet Earth in 2025.

The estimated population of Australia depends on net immigration intakes and fertility rates. Figure 1 indicates that by 2025 Australia's population will be approximately 25 million. With a fertility rate of 1.6 and an immigration intake of about 80 000 per year Australia's population will never be much greater than 25 million.

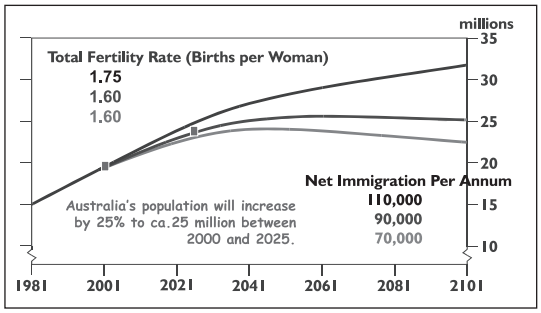


Fig. 1. Projections for Australia's population.

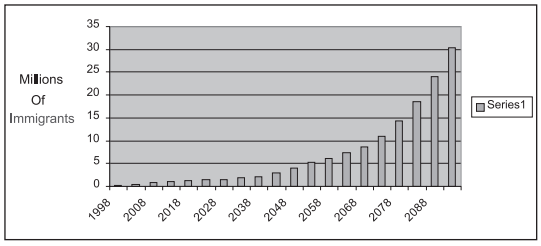


Fig. 2. Number of immigrants required to keep proportion of people 65 years and older at 12.2% of the population.

Whatever population we finish up with by 2025, the age profile will indicate an ageing population. Some politicians and business leaders have used this fact to argue for increased immigration but this concept is flawed because migrants also get older and therefore achievable immigration rates cannot solve the ageing problem. As shown in Figure 2 the number of immigrants required to keep the proportion of people 65 years and older at 12.2% of the population would require Australia to have a population of ~1 billion by 2100!

However, the widespread belief that an "ageing crisis" will result from an ageing population is probably not justified. Recent studies (see Kinnear, 2000) have shown that at present the majority of older Australians enjoy healthy, active and independent lives with only 7% in residential care. Quite apart from being a burden on the community they make significant contributions of time and money to their families and the general community. Furthermore, on

present trends the life expectancy at birth in 2025 will be ~87 for females and 82 for males, so the aging of the population is inescapable.

We are therefore faced with a situation where in 2025 the global population will be approximately 8 billion and Australia's will only be about 0.3% of this figure at around 25 million. Furthermore we will still be a considerable distance from the economic action centres of Europe, Asia and North America.

2. Energy

Perhaps the most important factor relating to the energy supplies of the future relates to the global production of petroleum products. According to some authors (see Deffeyes, 2001), global oil production will peak and begin to decline by the end of the decade. This follows from King Hubbert's well-known work in mid-1950s, when he claimed that, American oil production would peak in 1972. Many within the oil industry derided his predictions but in fact he was proved right and US production peaked in 1970. Hubbert argued that oil was a finite resource and its exploitation would follow predictable patterns. Figure 3 shows the US production and Figure 4 the global estimates.

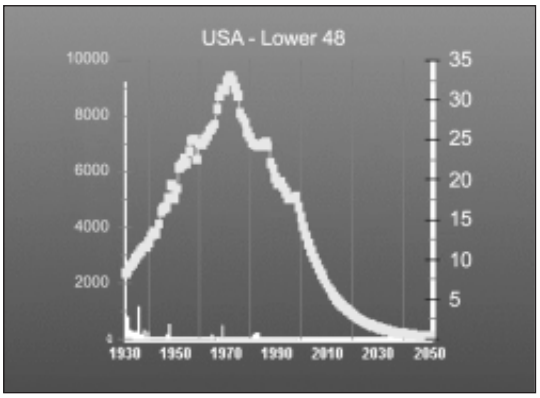


Fig. 3. Estimates of oil production in the US from 1930-2050 in thousands of barrels/day. Note the time lag between the discoveries, represented by the vertical spikes and the production peak nearly 40 years later.

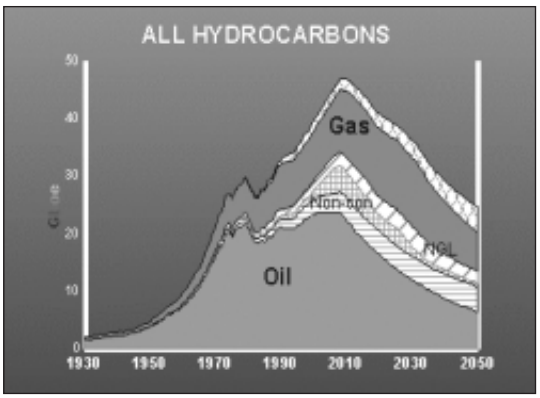


Fig. 4. Estimates of global production of petroleum products in Giga barrels oil equivalent/year.

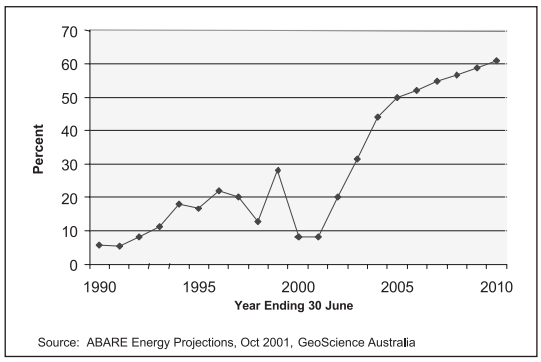


Fig. 5. Percentage of Australia's oil and petroleum products consumption sourced from imports (Akehurst, 2002).

Figure 5 shows the extent to which Australia is dependent on oil production in the Balance-of-Payments scenario. It is noteworthy that a 1% increase in oil imported is equivalent to $100 million/yr in the Balance-of- Payments. Figure 6 shows Geoscience Australia's 2001 estimate of our production rates. Up to the mid-1980s most of Australia's oil production came from the Gippsland Basin, but since then these fields have been in decline and several other smaller developments have been needed to maintain production at 500-600 barrels/day. In other words, liquids self sufficiency is expected to decline from an average of 80-90% over the past decade to less than 40% by 2010.

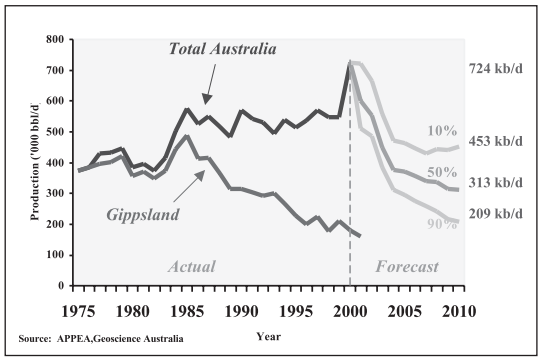


Fig. 6. Australian oil and condensate production 1975-2000 and projections of production by Geoscience Australian 2001.

It is evident that conventional global oil production will peak in or around 2005 and there will be significant price adjustments when the Middle East share exceeds 35%, due to the decline in non-Middle-East production. The bottom line is that globally we are consuming more oil than we are finding and have been doing this since about 1985. At present for every barrel of oil discovered we are consuming between 4 and 9 barrels, depending on how the numbers are estimated.

The production of all hydrocarbons will peak in 2010 with gas production peaking a little late in 2020.

The post-peak decline is about 3% a year and this will clearly lead to great tensions in the world, particularly as the world's population will be continuing to increase at the same time. The important point here is that we must start planning now to deal with these changes.

3. Greenhouse gases and climate change

In the current global environment, greenhouse emissions are essentially directly dependent on global energy

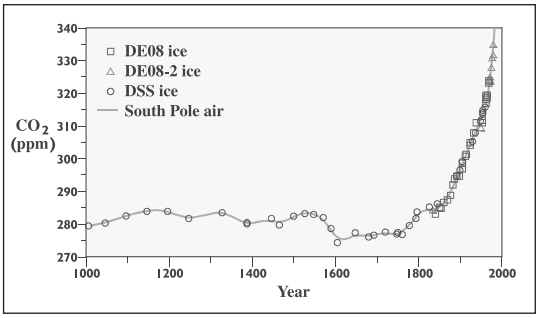


Fig. 7. Historical concentations of CO_2 in the atmosphere over the past 2000 years.

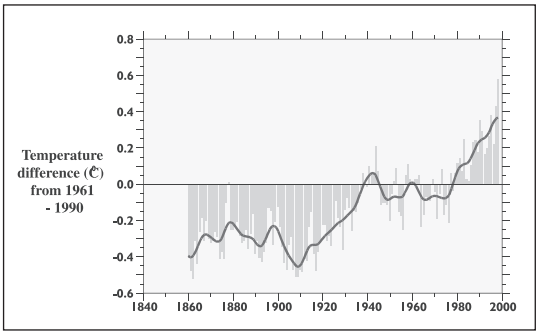


Fig. 8. Combined global land, air and sea surface temperatures for the period 1860-1998.

consumption, which is in turn dependent on the global population. The burning of fossil fuels has resulted of large increases in the main greenhouse gases, methane and carbon dioxide in the atmosphere during the last 200 years (see Figure 7, a similar result is obtained for methane). The net effect has been a global warming, a rise in sea level and climate changes throughout the world (see Figure 8)

If countries continue to increase greenhouse gas emissions at the current rate global stability could be threatened as a result of climate changes and sea level rises. It is therefore important that the Kyoto protocols are adhered to.

Although Australian greenhouse gas production is small compared to the US and several other countries, it is important that we keep to our Kyoto targets. However, current projections indicate that by 2020 we will 40% over our targets. This is equivalent to 125 Mt CO_2 per year or more than twice the present road transport CO_2 production of 60 Mt/yr. At present the 'stationary energy' production of CO_2 is 230 Mt/yr. This is more than the other sources put together (~180 Mt/yr), hence it would seem that the obvious route to solving our greenhouse problem is to adopt nuclear energy as our dominant energy source. If we elect not to go down this route we must ***rapidly*** develop and implement other technologies.

4. Mineral Resources

The demand for mineral resources correlates strongly with the global population. However, as industry becomes global, only the efficient mines will survive and consequently commodity prices will continue to fall. In the long term, however we will need to explore successfully to maintain our resource stocks. Lack of exploration success will inevitably lead to Balance of Payment difficulties. There are also problems with environmental, land rights and regional to complicate the current state of the mineral industry in Australia.

Firstly let me emphasise the importance of this industry as a contributor to our national wealth. It contributes about 10% of Australia's GDP and 53% of Australia's total merchandise export earnings (in 2000/01 this amounted to about $54 billion). At the same time it consumes little more than 0.02% of Australia's land area. We should therefore encourage environmentally sound mining, if for nothing else but to maintain our standard of living. According to World Bank estimates Australia was ranked sixth in the world in 1994 with an estimated wealth per person of US$297k. This was 26% less than that of the US (US$400k) but similar to that of Norway, Japan, France and Norway. A critical factor in the World Bank assessment was that Australia ranked 2nd (after Norway) in wealth per person derived from mineral and energy resources. A new major ore body such as a new Broken Hill would have taken Australia from the 6th to 5th wealthiest nation back in 1994. According to Stoeckel (1999), mining related assets have grown faster than those in other sectors since 1990 (Figure 9).

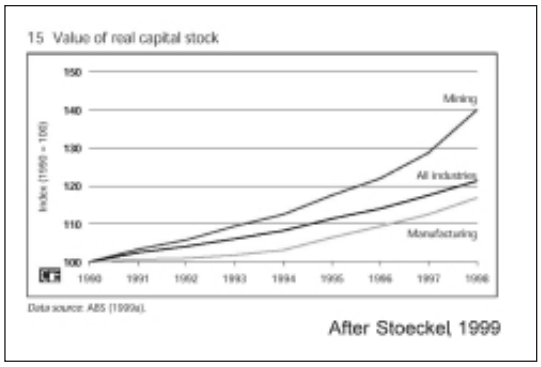


Fig. 9. Growth of assets in the Minerals, Manufacturing and Agricultural sectors.

Unfortunately, the lack of exploration success over the past decade means this rate of growth is slowing. This has been coupled with a fall of investment in new projects during the past few years and of course the relentless drop in prices, which is itself driven by technology, particularly in the extraction and processing activities. If we look at the discoveries over the past sixty years on a global scale the results look remarkably like the King Hubbert curves for oil (see Figures 10, & 11). Notice that in Figure 11, in spite of the huge amounts of money invested in exploration the discovery rate was very poor. In Australia for example there has not really been a giant discovery since Olympic Dam. However, the fundamental difference between petroleum and minerals is that new giant metal deposits still remain to be found but new science is needed to discover them. If new deposits are not discovered, metal prices will cease

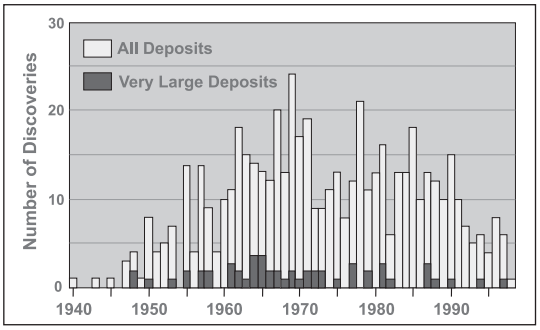


Fig. 10. Mineral discoveries globally, 1940-1999.

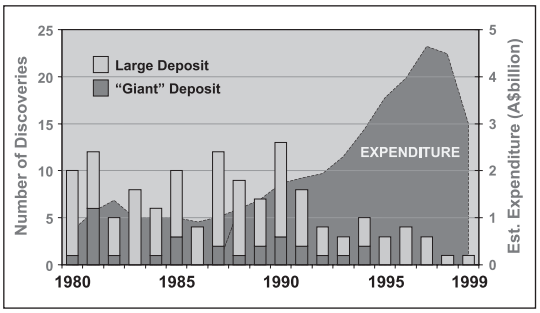


Fig 11 Discoveries & Exploration Expenditure 1980-9.

their historical long-term downward trend and rise sharply just as petroleum prices are now.

5. Water, Salinity and Biodiversity

Australia has critical salinity and water quality problems demanding urgent attention:

- At least 2.5 million hectares (5% of cultivated land) is currently affected by dryland salinity - this could rise to 12 million hectares (22%) at the current rate of increase.
- One third of Australian rivers are in extremely poor condition - within 20 years Adelaide's drinking water will fail World Health Organisation salinity standards in 2 days out of 5.
- Volumetric production of irrigated commodities will increase with a move north to where more water is available for production systems such a move places pressures on the relatively intact northern ecosystems.
- Land and water degradation, excluding weeds and pests, is estimated to cost up to $3.5 billion per year. Possibly 17 million hectares in the WA wheat/sheep zone by 2050 (NLWA Report)
- Collateral damage to biodiversity through habitat loss and fragmentation, 400 plant species at risk in WA and an estimated resultant reduction in bird species of 50% in agricultural areas.
- Infrastructure (buildings, roads, etc) is being severely damaged in many rural urban centres by salt invasion.

The challenges here are enormous.

6. Land use and land rights

The Australian community must understand the fundamental, and very special nature of the Australian Aboriginal People.

These people have been here for at least 60 thousand years. They have seen enormous fluctuations in sea level in that time documented in their paintings; they witnessed the Great Barrier Reef start to grow 8 thousand years ago; they existed during the last ice age when the whole of Europe was a cold desert almost devoid of people and they existed when the last Neanderthal person died perhaps 20 thousand years ago.

Australian Aboriginal People represent one of the very few links on Earth back to our Homo Sapien' origins. They may not have invented the wheel but they did invent the aerofoil, the mechanical lever and ecological engineering.

The Australian Community must understand that the Australian Aboriginal People have a culture and history that was alive and well and already long lived when the present European culture was venturing out of a bleak, cold cave somewhere in Europe only 10 thousand years ago. The Australian community must learn to hold these people in awe. Education (of both parties) is the only way this can happen.

The most probable areas for discovery of new, giant ore deposits now lie in areas traditionally occupied by Aboriginal People. In northern Canada mineral titles belong to the Inuit. Is there a message there for us? It is crucial to the future of Australia that we resolve the present issues with respect to land rights and the rights of the Australian Aboriginal People. This cannot be done in isolation of the other issues facing Australia. It must be part of a total, integrated view of our continent.

Summary: trends and drivers

- In the next 25 years the world's population will increase by 33% to 8 billion and Australia's population will increase by 25 % to 25 million.
- Energy is a fundamental component of a nation's competitive advantage. In the next 25 years the energy demand on Australia will increase by at least 40%. On the same time scale our proportion of imported liquid hydrocarbons will increase from 18% to over 40%. This happens whilst pressures on the global supply of liquid hydrocarbons increases.
- At the same time as Australia's and the world's population increases, the proportion of people older than 65 will increase; in Australia the proportion will grow from 12% to 25% placing additional strains on the health care system. Australia has a healthy population but efforts need to be placed on improved diet to further decrease deaths due to circulatory diseases.
- Population increase drives increases in greenhouse gas emissions unless massive abatement technologies can be implemented. The present increasing levels of greenhouse gases in the atmosphere will drive substantial climate change over the next 100 years. We will not begin to solve the problem without some audacious changes in behaviour.
- For Australia climate change means average decreases in rainfall of 0.5 mm/day; India and Africa will suffer far greater decreases-up to 3mm/day! In the 25-year time frame climate change will result in up to 10% decrease in crop yield unless water supply can be increased and drought and salt resistant crops are developed.
- Fresh water supply will become an increasing problem for many parts of the world including Australia.

- The next 25 years, increases in population and increased standards of living will necessitate a supply of resources-energy, water, metals, food, and infrastructure-at least as large as has so far been produced in historical times on Earth.
- Population increase drives increases in the number and size of cities; this places pressure on biodiversity, inherited infrastructure, transport, communications, and issues to do with pollution and quality of life. Australia will need the equivalent of another city the size of Sydney by 2025.
- On the same time frame the world's population will expect greater freedom, access to IT and advanced technologies, communications, education, equity, standard of living and quality of life.

For Australia these trends create the following three challenges and opportunities:

1. Sustainability and sustainable economic growth; success will lead to a positive feedback loop.
2. Pressing environmental issues including, in particular, greenhouse gases and issues arising from climate change.
3. Australia's place in the world; the generation of new industries and vastly increased productivity for existing industries. The challenge is to make Australia attractive to global investment.

Five opportunities: exploration success and technology development in the mining industry

2D Mineral Chemistry Mapping

Multispectral remote sensing will be developed to provide new information on the regolith and its mineralogical properties. These techniques will be used in areas where prospective rocks are buried. Figure 12 shows a recent image showing aluminium substitution in white micas, which indicates what can be achieved already.

Airborne Gravity and gravity modelling

The use of airborne gravimetry will be very significant in the next few years. The Falcon team at BHP-Billiton has demonstrated the practical use of an airborne gravity gradiometer (van Leeuwen, 2000), and I expect further developments in the next few years from other groups including CSIRO's. At the same time, the use of gravity information to provide subsurface information offers exciting possibilities using new interpretation techniques. The use of gravity 'worms' for both regional structural interpretations and detailed prospect scale analysis indicates one of the new procedures now available (see Figure 13).

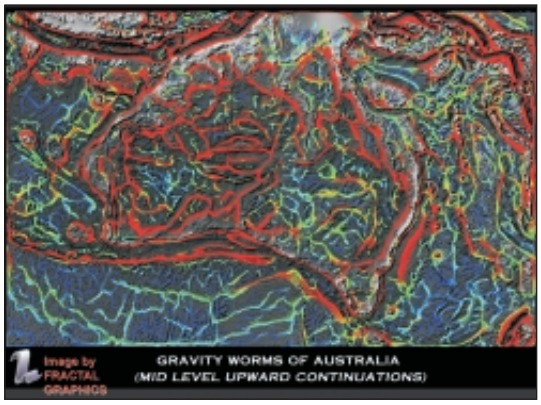


Fig. 13. Gravity worms over the Australian continent, indicating key tectonic trends and boundaries.

Remote controlled mining

Mining is essentially a dangerous and complex activity because the Earth, particularly in and around ore-bodies is very complicated in terms of both structure and rock composition. We can now use, 3D seismic sections, geophysical logs and support leg-pressure mapping techniques to provide 3D models for mine planning. In the future we should be able to use these models to drive remote controlled mining operations. The long-term goal would be to develop unmanned techniques to efficiently mine ore bodies.

Alternate uses of gas

Efficient gas to liquid conversion technologies are a high priority because they will result in lower CO_2 emissions and better use of our scarcer liquid petroleum resources. Figure 14 shows what may be achievable with a Hydrogen Economy and Figure 15 shows a solar hybrid facility being developed by CSIRO. Clearly there are several input options leading to a national technology program, which assures integrated, sustainable supply of energy.

Geothermal power

The potential of geothermal energy is enormous. It is larger than any other renewable source of energy and could provide up to 3000 GWhr/yr of electricity generating capacity.

Sequistration of CO_2

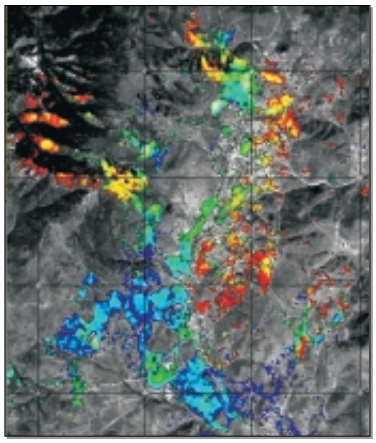
The problem of reducing CO_2 in the atmosphere will have to be addressed if global warming is to effectively tackled. Figures 18-25.

CO_2 sequestration into coal seams is a very attractive option because one methane molecule should be produced for every two carbon dioxide molecules injected.

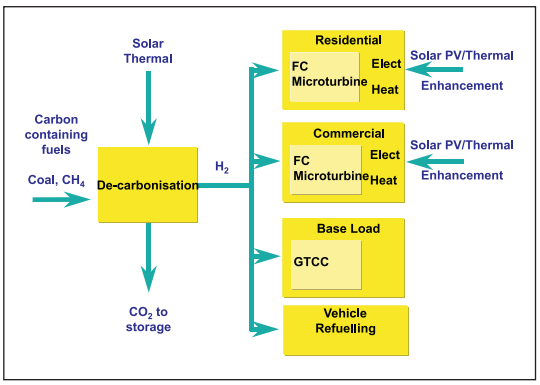
Fig. 12. Mineral chemistry mapping.

Single mineral phase, variable chemistry can be mapped; indicating variable temperatures and fluid chemistries within a single mineralising system.

Aluminium substitution in white micas



Red = Al-rich, Blue = Al-poor, Green=Intermediate



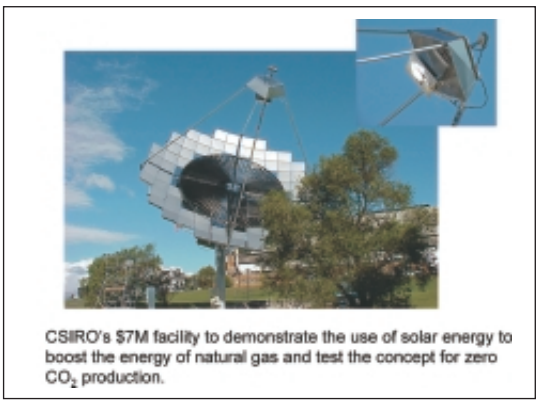


Fig. 14. (Far left) A model for a hydrogen economy.

Fig. 15. (Left) CSIRO's hybrid solar/fossil fuel research facility.

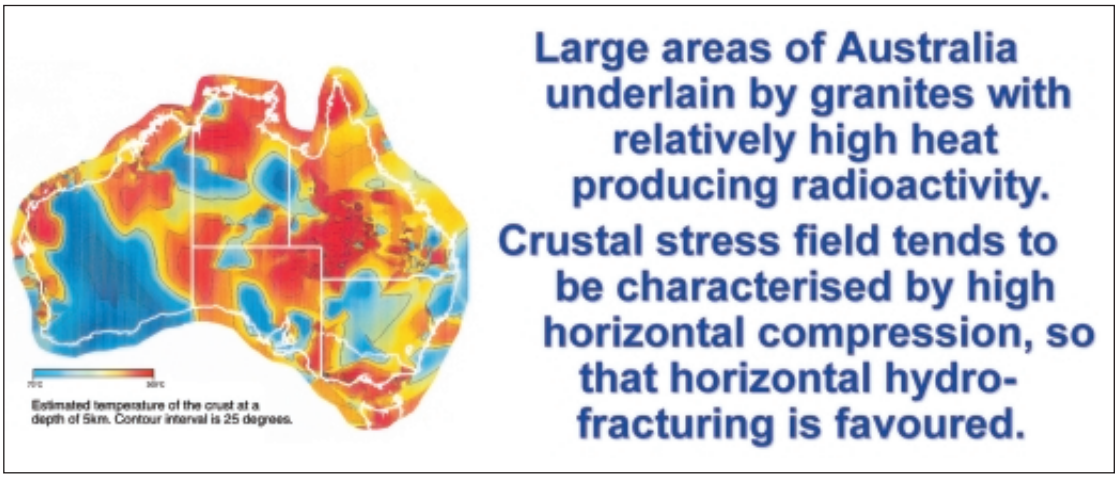


Fig. 16. Geothermal Energy potential for Australia.

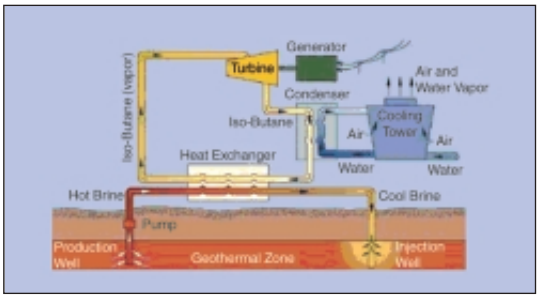


Fig. 17. Model of binary cycle power plant.

Furthermore the carbon dioxide can be stored until accessed in the future by *in situ* gasification. It also possible to inject CO_2 into depleted oil fields to increase residual production.

It is also possible to investigate the possibility of an emission free future similar to the model show in Figure 20.

Salinity-Titanium-Desalination

An opportunity exists in the heavily salinated Murray-Darling Basin to utilise the salt, together with enormous rutile and zircon deposits, to generate a new $billion Titanium metal and Zirconia industry for Australia.

Titanium alloys are corrosion resistant and hence are fundamental to developing an economic sea and saline water desalination process.

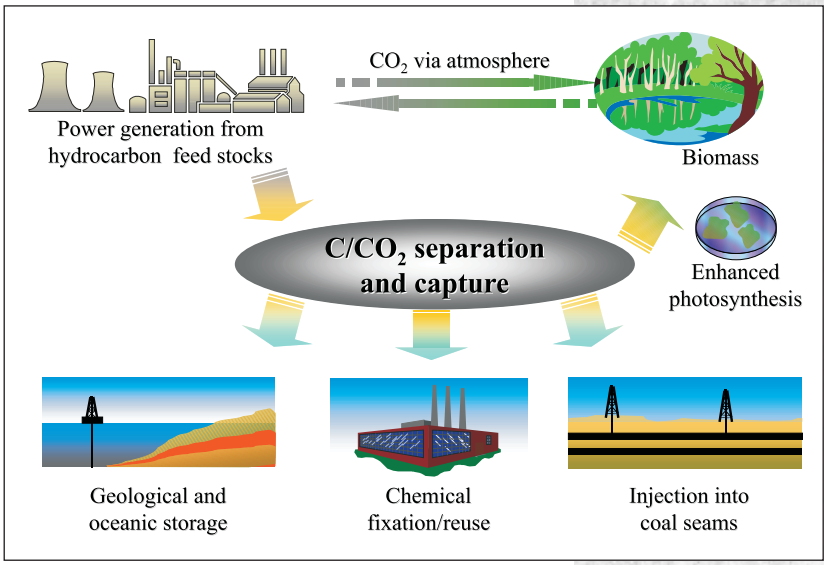


Fig. 18. Options for C/CO_2 separation and capture.

Leftovers from the Titanium production process have a range of other uses. An opportunity exists for a Zirconia production industry as well.

Figure 21 indicates the type of chemical processes that can be used to build-up major industries in the region.

New minerals and energy industries

The goals are zero emissions and zero waste by 2025. Figure 22 shows some of the interlinked processes needed to implement this model.

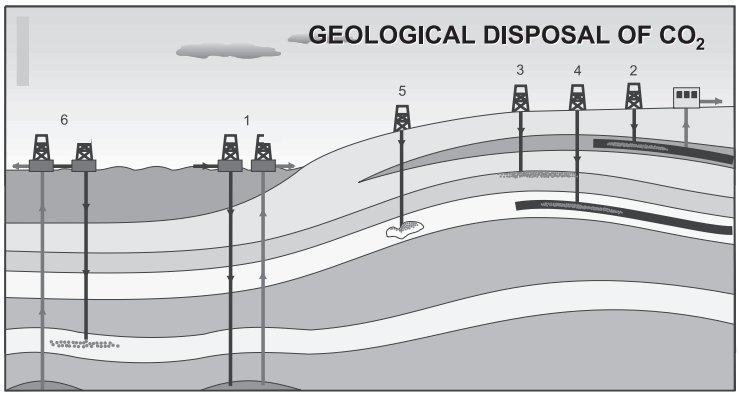
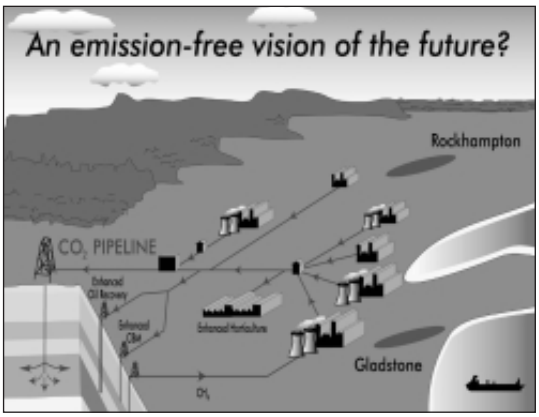


Fig. 19. (Above) Geological disposal of CO_2.

Fig. 20. (Right) An emission-free vision for the future in Queensland.



Sustainable collection/ extraction	Zero emissions	Green energy	End Use Efficiency
Keyhole mining	CO_2 sequestration	Fuel cell power generation	Life cycle analysis
In situ leaching	Hybrid energy systems	Microturbine development	Processing and transport
Ecotoxicity	Large scale energy storage	Geothermal energy	Hybrid cars
Rehabilitation	Hydrogen economy	Other renewables	Energy amenity integration
Enhanced automation		Environment credit trading	
Emissions control			

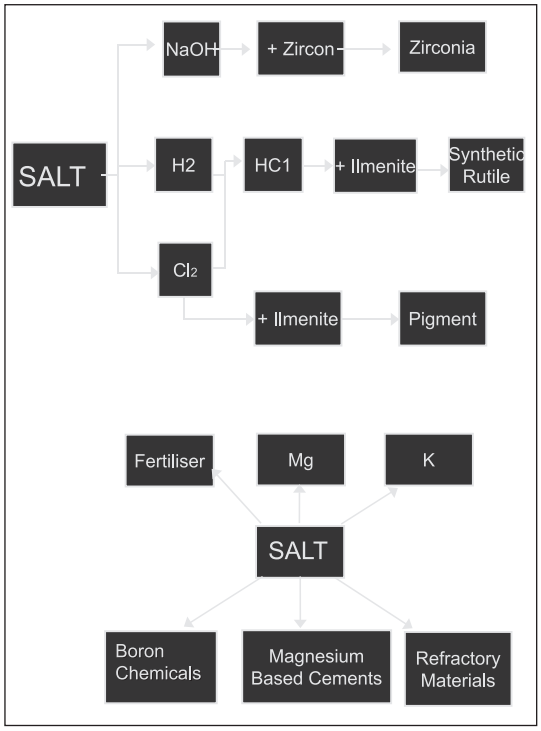


Fig. 21. The use of salt in possible future chemical industries.

In tabular form the new environment can be summarised below left.

Summary

The mining industry makes a fundamental contribution to the wealth of Australians.

However, lack of exploration success in the past decade means that the rate of wealth generation will slow in about 5 years.

Only advances in science can overcome this problem. A new Broken Hill would move us from 6th to 5th in wealth in the world. These days, one refers to the minerals industry as part of the "old economy" but its future and that of Australia, over at least the next decade, depends solely on it driving technological advances through the 'new' economy - automation and renewable energy are examples.

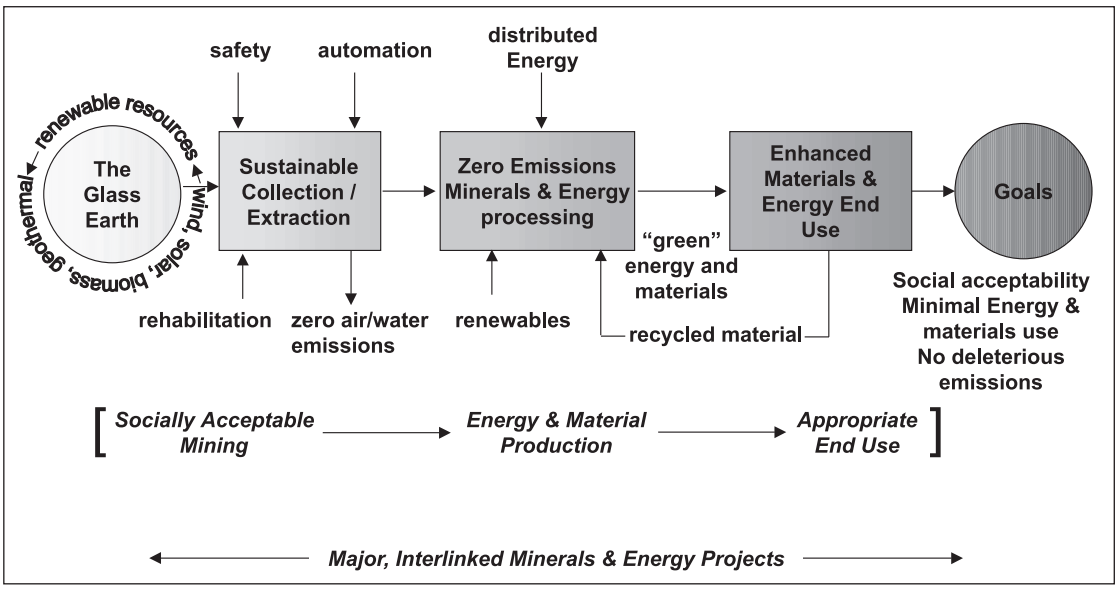


Fig. 22. The new minerals and energy economy.

I therefore propose a scenario for Australia in 2025 that looks like this:

- Population approximately steady state in profile,
- Population of 25 million but rising slowly,
- A thriving minerals and energy sector characterised by zero emissions and zero waste,
- Greenhouse emissions well below the Kyoto target.
- A diverse energy supply system comprised of: Geothermal; hybrid solar/hydrogen, wind, solar, clean conventional coal with underground sequestration of CO_2, but, in transition to a dominant hydrogen economy.

Enjoy 2025

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SQUID technology developed for mineral exploration

CSIRO says it has now developed transient electromagnetic technology to an economically-viable stage where it is being used in mineral exploration to locate conducting ore bodies.

The development, which began back in 1990, has been tested during more than 20 trials and surveys. The technology uses high-temperature SQUIDS (or superconducting quantum interference devices) as Transient Electomagnetic receivers. These replace induction coils to measure a decaying induced magnetic field in order to locate large highly-conducting ore bodies.

One of the most spectacular results from the CSIRO research has been the contribution to the discovery of the Cannington silver mine near Mt Isa by BHP-Billiton. Mining is under way with the prospective deposit estimated at $A2 billion. Several nickel sulphide deposits considered to be "massive" have also been discovered with the assistance of this technology.

CSIRO project leader, Cathy Foley, who has been working on this project for fourteen years at the Lindfield Telecommunications and Industrial Physics Division, says there's been a lot of interest in the mining industry in these ground-based electromagnetic systems

"Until now we've leased the technology to exploration companies, but, having established its viability, we're now able to send out systems to contractors for standard field surveys without the need for CSIRO staff. This is the first commercialised system in the world being used this way," Foley says.

"It's expected to bring benefits to Australia with the discovery of new ore deposits, assisting a resurgence in mineral exploration through the use of this advanced technology," she says.

"This has been the first real commercial use of high-temperature superconductors as SQUIDS outside the laboratory in the world."

For more information contact Cathy Foley on (ph) 9413 7413, or email cathy.foley@csiro.au.

Alpha Geoinstruments formed

Alpha Geoinstruments, a Division of Alpha Geoscience Pty. Ltd. has been formed for the sales, service and rental of geophysical instruments in Australia and New Zealand. The company has been appointed agents for a full range of geophysical instrumentation including ground-penetrating radar, resistivity, seismic, EM, magnetics, radiometrics, gravity, well logging and an extensive range of software for most geophysical techniques. A range of rental instruments is available. For further information, visit the website at www.alpha-geo.com.

Newmont finally captures Normandy

On 20 February 2002, Newmont announced that it had acquired Normandy Mining Ltd by purchasing 79% on Normandy's shares. This is the end of a long bidding war for the Australian gold producer that has been waged over the last year or more.

The affect on the ASX was immediate. At the end of February both Newmont (Market Capitalisation of $2.55 billion) and Normandy ($5.05 billion) were listed in the Top 150 Companies. By the 8th March we only have Newmont listed at a value of $3.02 billion, so we have apparently lost an Australian investment of around $4.5 billion! Not a happy outcome.

Santos $642 M bid for Orogen Minerals and the PNG pipeline fails

Santos has failed in its last minute $642 million takeover bid in March for Orogen Minerals. This would have given it control over the proposed Papua New Guinea-to-Queensland gas pipeline. However, the PNG Government has rejected the offer in favour of the $1.4 billion merger with Oil Search (see Preview, 96, p30).

The Government will now sell its 51% holding in Orogen to Oil Search and Santos will have serious competition in Australia's eastern gas market when PNG gas starts to flow in 2006.

The current plan is for 50 petajoules of gas from the pipeline to be sold to AGL, and as Santos is currently a major supplier to AGL the new pipeline will put pressure on Santos to retain its profitability levels.

At present Santos supplies AGL with gas primarily from its dwindling Cooper Basin fields. By 2006 it may be facing a margins/profitability situation, which would not have arisen if it could have used the PNG gas sources.

However the situation is far from being finalized. The Combined Orogen/Oil Search company will still have to raise its share of the $4.5 billion needed to build the pipeline and with ExxonMobil as the other major partner, the whole facility could finish up foreign owned.

Risk Ratings of Mining and Metal Companies in 116 Countries

The PRS Group, based in East Syracuse, New York, has just published a 130 page assessment of risk ratings for 116 Mining and Metal Companies throughout the world.

The book costs US$999 so it is unlikely to be seen on many consultants desk but the resume makes interesting reading.

The top five most risky companies for mining are: Congo DR, Sierra Leone, Zimbabwe, Sudan and Yugoslavia.

The top five least risky countries are: Sweden, Ireland, Norway, Chile, and Finland.

The five most risky mining companies are: Freeport McMoran, PT Timah, PT Aneka Tamgbang, Ashanti Goldfields and the Samsung Group.

The five least risky mining companies are: Luossavarra Kiirunavaara AB, CAP SA, Codelco, ExxonMobil and Boliden.

Maybe it's not a surprise, but Australia does not appear in top ten of the least risky countries. So now you know, and for US$999 you can find out more.

Minerals exploration continues to decline, Petroleum increases

Minerals

Figures released in March 2002 by the Australian Bureau of Statistics showed a continuation of the downward trend evident over the last few quarters.

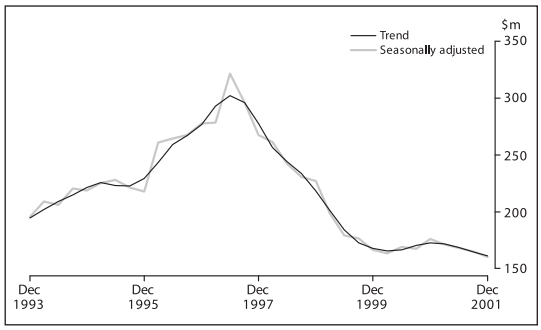
The trend estimate for total mineral exploration expenditure in this quarter decreased by 2% from the previous quarter to $161 million. This is 7% lower than the trend estimate of $173 million in the same quarter of 2000 and is the lowest level since 1992. Figure 1, which shows the numbers for the last eight years, tells the story, with a steady downward trend in the numbers. The main reduction was in Western Australia, where actual investment levels dropped by $3.2 million to $97.5 million. There were smaller decreases in New South Wales, South Australia, Tasmania and Victoria and small increases in Queensland and the Northern Territory. Queensland exploration showed an unexpected increase of $2.2 million in seasonally adjusted terms and at $25 million it was at the highest level since June 1998. Almost all this increase was for gold.

Between the September and December quarters 2001, exploration expenditure for iron ore increased by $3 million (up 57%), coal also up $3 million (21%) while gold decreased by $2 million (2%). Exploration for base metals remained almost unchanged at $36 million.

As usual Western Australia dominated the national expenditure by accounting for 61% of the raw total of $171 million.

The trend estimate for metres drilled also fell in the December 2001 quarter by 2% or 23 km from the previous quarter and was 1300 km or 18% lower than the December quarter 2000, not a good sign.

In terms of a commodity focus, gold dominated the scene with a total expenditure of $84 million or about half the exploration invested in all the other commodities except petroleum.



Figures 1 was provided by the Australian Bureau of Statistics.

Fig. 1. Mineral exploration expenditure, from December 1993 to December 2001.

Petroleum

Reported expenditure on petroleum exploration in the December quarter of 2001 was $268 million. This was 16% ($37M) higher than the September quarter for 2001 and 6% ($16M) higher than the December quarter for 2000. The increase in expenditure was primarily due to the 21% ($40M) decrease in the offshore expenditure, which again dominated the statistics and accounted for nearly 86% of the total investment.

Western Australia was the main contributor with a reported expenditure of $142M for the quarter. This amounts to nearly 55% of the national total.

Figure 2 shows the levels of petroleum exploration from the start of 1998. These indicate a long-term consistency in the figures, unlike the mineral exploration data.

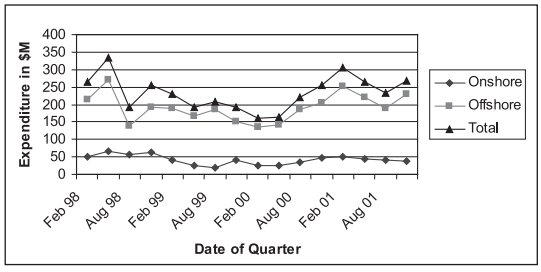


Fig. 2. Petroleum exploration expenditure, from the start of 1998.

New Newmont largest in the world

The new Newmont Mining Corporation has now acquired Normandy Mining Ltd and the Canadian Franco-Nevada Mining Corporation Ltd to become the world's largest gold producer. In 2001 it would have produced 269 t of gold and had reserves of about 3000 t. It has 22 mines on five continents and claims to have average cash costs of US$5.44/g. This made Normandy a great buy for Newmont because it had lower production costs than either Franco-Nevada or Newmont itself.

Two representatives from Normandy have been invited to join the new expanded board but there will be three from Franco-Nevada and 12 from the 'old' Newmont company. It looks like Normandy had a raw deal because both its reserves and production rates dwarf the Canadian Company.

More information is provided below from the Newmont website.

The transactions consolidate these strong company attributes

Newmont (U.S.)

- Largest gold producer in both North and South America
- Discoveries resulted in Carlin Trend in Nevada and Yanacocha District in Peru;
- Global operating capabilities with operations in Uzbekistan and Indonesia; and
- Recognized R&D leader in exploration and metal extraction

Normandy (Australia)

- Australia's largest gold producer;
- Additional operations in U.S., Europe, Africa and South America;
- Recognized exploration and development capabilities;
- Portfolio of promising development projects; and
- Leader in environmental protection and sustainability

Franco-Nevada (Canada)

- Leading precious minerals royalty company with interests in major gold, platinum and diamond mines;
- History of superior returns to investors;
- Strategic focus and merchant banking skills; and
- Strong balance sheet with no debt

Terms of the transactions

Normandy transaction

- 0.0385 of a Newmont common share per Normandy ordinary share (to be tradeable in Australia), plus A$0.50 per ordinary share cash payment;
- Implied offer price per share of A$1.94 based on closing stock prices and the A$ exchange rate on January 2, the day prior to the announcement of the revised transaction*;
- 50.1% minimum acceptance condition, including 19.9% owned by Franco-Nevada; and
- No capital gains tax for scrip, provided 80% of shares accepted

Normandy shareholders initially to own approximately 18% of New Newmont.

Franco-Nevada transaction

- 0.8 of a Newmont common share, or Canadian exchangeable share, per Franco-Nevada common share;
- Implied price of C$28.36 on November 13, the day prior to announcement of the transaction*;
- Exchange for Newmont shares intended to be tax-free;

New Newmont Gold Interests

- Exchangeable shares to trade on Toronto Stock Exchange; and
- Exchangeable shares intended to be Canadian property

Franco-Nevada shareholders initially to own approximately 32% of New Newmont.

**Will vary depending on current market price. Shareholders should obtain updated quotes on Newmont share price.*

Leadership

Wayne W. Murdy, Chairman, President and Chief Executive Officer of Newmont, to be Chairman and CEO. Pierre Lassonde, President and Co-Chief Executive of Franco-Nevada, to be President

Board of Directors

New Newmont's Board of Directors will initially consist of 17 members, including the current 12 directors of Newmont, the two Co-Chief Executive Officers of Franco-Nevada (Seymour Schulich and Pierre Lassonde), one additional nominee from the Franco-Nevada board, and two nominees from the Normandy board. Robert Champion de Crespigny, Chairman and Chief Executive Officer of Normandy, will be invited to fill one of the Normandy positions.

	Newmont	*Normandy*	*Franco-Nevada*	***New Newmont***
Proven & probable gold reserves (mm oz)(2)	66	26	4(3)	**97**(3)
Production (mm oz)	5.8	2.4	0.3(3)	**8.6**(3)
Cash costs per oz	$ 179	$ 160	$ 228(3)	**$ 175**(3)
Total costs per oz	$ 209	$ 224	$ 291(3)	**$ 217**(3)
EBITDA(4)	$ 573	$ 276	$ 123	**$ 972**
Cash $	98	$ 193	$ 547	**$ 288**(5)
Debt	$ 1,282	$ 672	$ 0	**$ 2,068**(5)
Net book capitalization(6)	$ 2,874	$ 876	$ 428	**$ 7,339**
Diluted shares outstanding (mm)	197	2,238	160	**394**

(1) Average exchange rates used for the Australian dollar and Canadian dollar were US$0.515 and US$0.653, respectively
(2) Latest public filings.
(3) Reflects proportional 49.5 per cent ownership of Echo Bay and equivalent ounces attributable to Franco-Nevada's royalty interests.
(4) EBITDA is defined as revenues minus the cost of sales plus depreciation, depletion and amortization plus amortization of mining cost plus amortization of put options minus general and administrative costs minus exploration and research.
(5) Net of transaction adjustments including transaction costs of estimated US$90 million and payment of A$0.50 per ordinary share to Normandy shareholders; pro forma debt includes mark to market adjustment to Normandy debt.
(6) Net book capitalization is defined as net debt plus minority interest plus book equity plus preferred stock. The purchase price for calculation of book equity was determined by using the average price of Newmont's common stock for the two days before and the two days after the announcement of the revised Newmont bid for Normandy on January 2, 2002. Such average price was US$19.01.

New Newmont snapshot

Geo-Eng and Gutteridge Haskins & Davey Pty Ltd (GHD) to merge

GHD a well-known Australian company with over 70 years of engineering and scientific consulting experience and a rapidly expanding global presence has merged with Geo-Eng which also provides scientific consulting services both in Australia and overseas. The new company will be called GHD-Geo-Eng.

According to the GHD Executive Chairman John Phillips: "The synergies between the two companies are significant and new areas of practice have been added from Geo-Eng in mining and geology, and capabilities are substantially strengthened in dams, geotechnical, water resources, hydrogeology, environment and contaminates sites.
The merger will be seamless, with Geo-Eng staff continuing to service current clients and projects, and integration with GHD occurring over the next few months. The addition of approximately 100 Geo-Eng staff will boost staff numbers to 1600."

Wholly-owned by senior staff, GHD is one of Australia's largest multi-disciplinary consulting companies, with more than 1600 people employed in 44 offices, 20 of them overseas. Earnings last year were $164 million.

Parilya buys Pasminco's Broken Hill Mine

Perilya Limited, a Perth Based mineral and petroleum exploration company, has entered into a conditional agreement to acquire the Lead-Zinc-Silver Broken Hill Mine from the collapsed Pasminco company.

The mine currently treats annually 2.8M t of ore and produces approximately 0.36M t of zinc concentrate containing 0.18M t of zinc metal, 0.13M t of lead concentrate containing 90 000 t of lead metal and 90 t of silver.

Perilya proposes to operate the mine at a rate of 2.45M t per annum and produce 0.33M t of zinc concentrate, 0.12M t of lead concentrate and 70 t of silver. Under this plan it expects to see operations of the Broken Hill Mine extended until at least 2011. This will involve a major restructuring of the workforce but will ensure the presence on an active mine in Broken Hill for several more years.

To acquire the mine, Perilya will make a fixed payment of $25M on settlement with a further $10M being paid in two $5M tranches over the following six months. There could be additional payments of up to $55M, depending on the price of Zinc.

This is the first significant asset disposal by Pasminco since it went into administration last year owing creditors an estimated $3 billion. The sale of its main asset, the Century zinc mine in Queensland is yet to be completed.

Edited by Victor Gostin

Reviewed by Mike Smith

This stimulating volume is published is available from the GSA, Suite 706, 301 George St, Sydney 2001 at the price of $71.50 (including GST & postage) or $60.50 for GSA members (email misha@gsa.org.au).

Gondwana to Greenhouse – Australian Environmental Geoscience

The Geological Society of Australia has just published *Gondwana to Greenhouse - Australian Environmental Geoscience* as Special Publication No. 21 catalogued as ISBN 1 876125 22 5.

The editor of the volume, Victor A Gostin from the Department of Geology and Geophysics, University of Adelaide, provides a comprehensive review of the issues in his Introduction, where he advises "This book is written for all science-trained people, from students to professional, but it will also appeal to interested non-scientist wishing to inform themselves about environmental earth science, specifically relevant to Australia. The title *Gondwana to Greenhouse* is intended to convey the concept of an ancient land that has been subject to millennia of environmental change, which currently incorporates human-generated climatic instability and sea-level rise".

The book contains 28 papers (as individual chapters) written by 57 authors on a diverse range of topics which have been grouped under six major themes:

Theme 1 - Ancient Australia and environmental changes (5 Chapters)
Theme 2 - Geohazards in urban communities (2 Chapters)
Theme 3 - Mining and radioactivity (3 Chapters)
Theme 4 - Water and sedimentary basins (5 Chapters)
Theme 5 - Coastal and nearshore environments (11 Chapters)
Theme 6 - Marine geoscience (2 Chapters)

The presence of 11 chapters on the fifth theme might suggest that life is a beach for environmental geoscientists. The potential for the environmental sector to provide employment opportunities for new geoscience graduates is well supported in this volume. The Chief of the Land and Water Resources Division of the Bureau of Rural Sciences makes a telling point in the Foreword "Geological knowledge is fundamental to managing sustainability ... of our natural-resource base and environments". One author states "Geoscience has a valuable role to play in the amelioration of one of Australia's most significant environmental issues, that of land and water salinisation". Another author advises that "understanding landscape shaping and regolith-forming processes is of vital importance to mineral exploration". It is certainly encouraging to see the breadth of involvement of Australian universities in environmental geoscience.

Geophysicists interested in expanding their professional activities into urban and environmental geophysics will gain from studying the detailed characterisation of near-surface earth structures in many papers. The mysterious terminology of the regolith, and of fluvial landforms is well illustrated in Chapter 2 "Regolith: its history and environmental importance with particular reference to some engineering examples". The 3rd chapter addresses soil-related engineering problems, while palaeodrainages and landforms are addressed in subsequent chapters.

Airborne and ground electromagnetic surveys are valuable for mapping acidic groundwater. Practitioners in this field will appreciate the discussion of the contamination of rivers by mining activity, and an explanation of the various sources of acid drainage at mine sites. They may also argue successfully that rapid systematic surveying might prove more reliable in determining the distribution of acid drainage than the two strategies of "acid-base accounting" or mathematical modelling of oxidation rates discussed in this volume. The applications of geophysical technologies are not featured strongly in this particular publication and ASEG members could assist by presenting case histories, which demonstrate success in addressing environmental problems.

One highlight for this reviewer is the excellent Chapter 10 "Natural radioactivity, hazards, wastes and the environment in Australia", which explains the levels of radioactivity in Australian homes, radiation doses from the atmosphere, from soils, and from the food we eat. A useful discussion covers the selection criteria for a radioactive-waste repository site to store the small quantity of low-level and short lived intermediate-level radioactive waste, which we create in Australia.

All of the papers are very readable and address many of the environmental issues facing Australia. Several papers include useful glossaries. The geographic coverage is most impressive. The book includes 16 pages of excellent colour plates, which (presumably for cost control) are located at the end of the book. Among other topics of interest to many ASEG members will be a concise statement of the salinisation issue; cooperating with Aboriginal communities to identify water resources; coal extraction and land subsidence; causes of rockfalls, slumps and mudflows, a geological time scale of high and low sea levels; the distribution of copper in sediments offshore from a capital city; soil-related engineering problems; septic tanks and rising water tables; our shipwreck heritage; and much more.