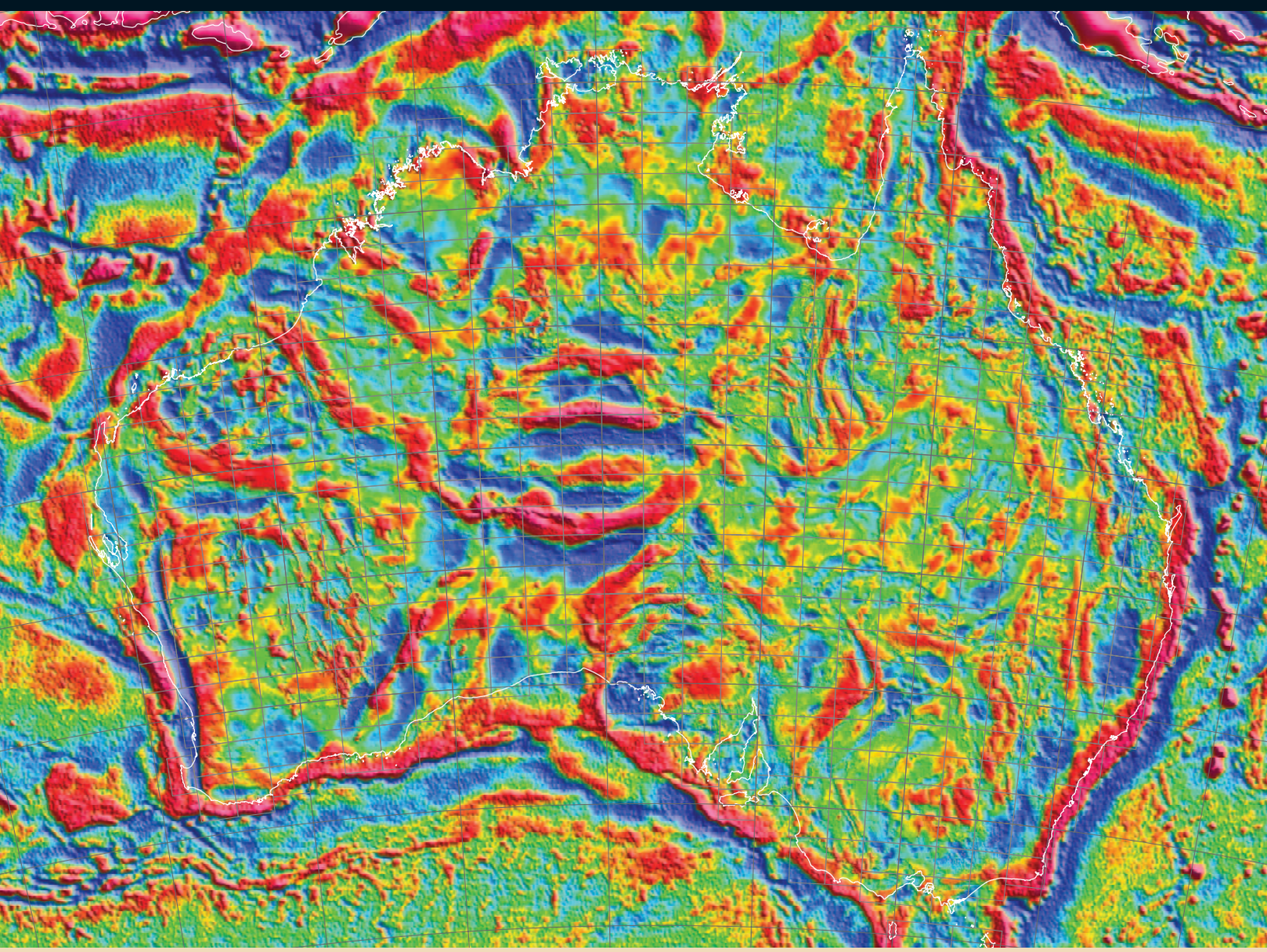
OCTOBER 2008 • ISSUE 136
ABN 71 000 876 040 ISSN 1443-2471

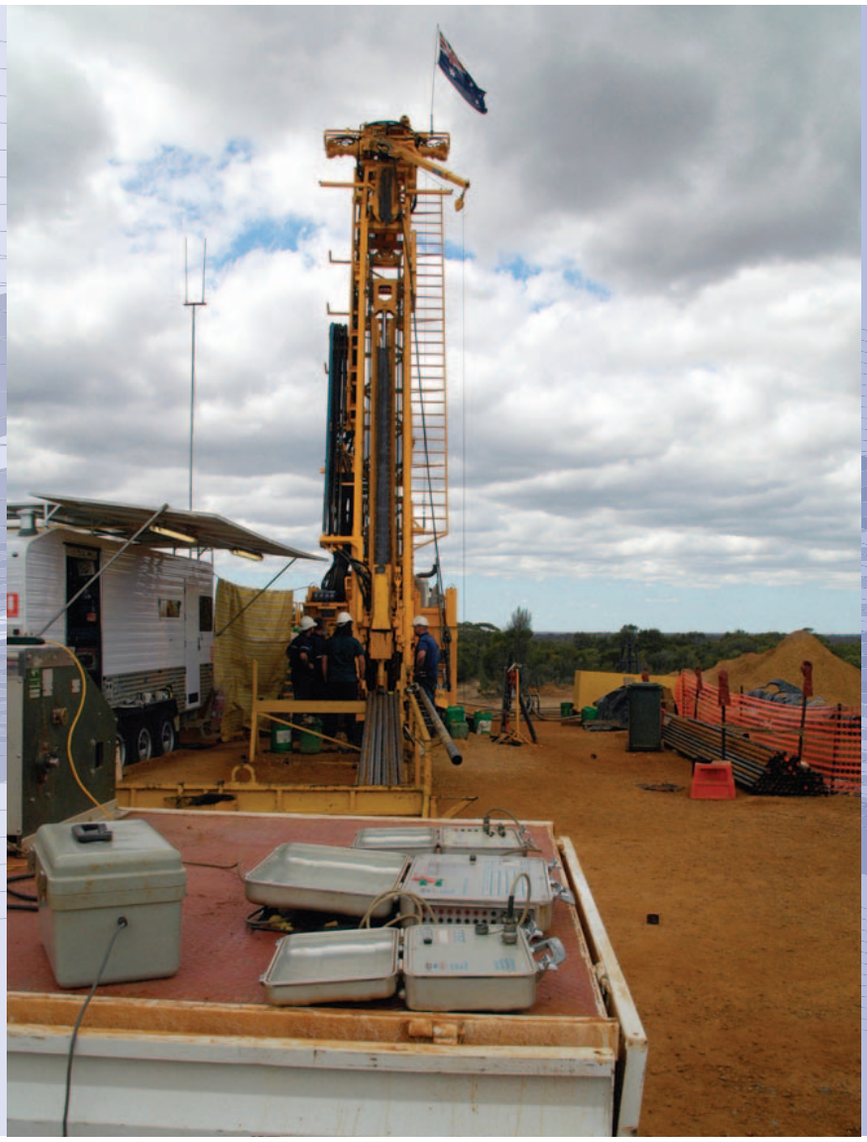
PREVIEW

AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS



NEWS AND COMMENTARY

FEATURE ARTICLES



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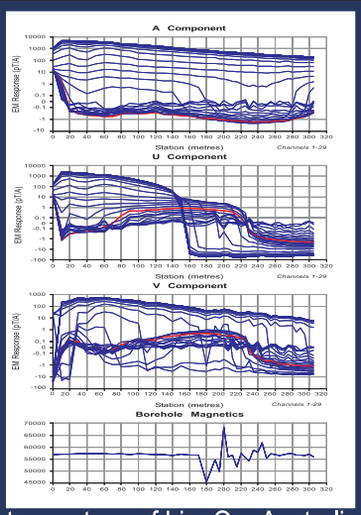

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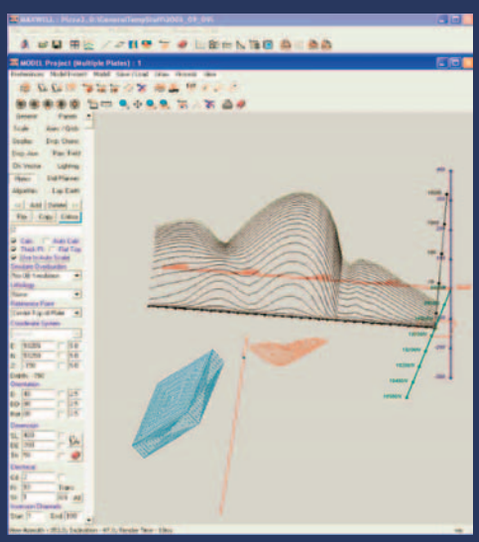

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FRONT COVER

Image from the new gravity map of Australia, produced by Geoscience Australia (see p. 22 for details)

Preview is available online at
www.publish.csiro.au/journals/pv
ISSN: 1443-2471 eISSN: 1836-084X

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David Denham

We live in interesting times

In a speech in Cape Town, South Africa, on 7 June 1966, Robert F. Kennedy said:

> *There is a Chinese curse which says, 'May you live in interesting times'. Like it or not, we live in interesting times...*

I wonder what he would have said today. Because we are facing challenges from all around us. And these aren't the small local dog fights; they are all big global issues.

First there is the ***rising global population***. If there were only one billion people on planet Earth, as in 1800, we could easily manage, but by the turn of the century there are likely to be close to 10 billion people here.

We will not have the luxury of being able to move them around to cope with a warming planet and sea level rise. A one metre sea level rise is probably unavoidable. It will affect about 100 million people and inundate about 1 million km^2 of land. Imagine the challenges of trying to move 100 million people to higher ground in the next 100 years.

And global warming is probably just a side-show. We need ever increasing supplies of ***energy*** to sustain our lifestyles. The world energy consumption is expected to quadruple from 1960 through 2030 from 4 billion tonnes of oil equivalent to 16 btoe.

This is due not just to the increase in global population, but also to the increase in per capita income globally and the expectations that this creates. The bottom line is that as wealth increases, so does the demand for energy. And the problem is that at present about 80% of the world's energy is derived from non-renewable sources (oil 34%, coal 25% and gas 21%) and these sources are getting scarcer by the year. We won't run out of these commodities, they will just become more expensive. And it will be very difficult for renewable resources to meet the extra demand.

Global 'Peak Oil' production is likely to be reached before 2020, with gas production to peak later in this century. Even coal production may well peak in a similar time frame. So the future for energy supplies is a serious issue.

The ***food*** scenario is very similar to that of energy. In the last two years the price of food has soared; for example, prices for both wheat, and oils and fats have doubled. The reasons for this are not hard to see. The global population is increasing rapidly, the wealth of most of the inhabitants is also increasing and therefore global demand is rising.

Although research outcomes have increased crop yields, they are not making any more arable land. In fact the area available for agriculture is diminishing with the relentless spread of urban areas. There is also strong competition in the food markets. Do you feed people or do you feed cars? And the farmer will always go for the highest price. So if we are not careful, the days of the forests are numbered: the pressure for food will just to be too much.

Then there is ***water***. We all know that we are not managing the world's water resources sustainably. And when we need 20 tonnes of water to produce one kilo of coffee, 11 tonnes to produce a hamburger and 7 tonnes to produce a T-shirt, the problems become more evident.

The supply of water is closely coupled to ***climate change***, and this is where global warming will make a huge impact, because the climates in the regions where food is grown are changing very rapidly. Perhaps the greatest impacts will be in areas where the glaciers are melting. In China, India and Pakistan, for example, the melting of the Himalayan glaciers will remove the water stored in the ice, so although there will be heavy rains during the monsoon periods, there will be drought in the winter months because of reduced flows in the rivers. In Australia we will miss out on the winter rains in the Sydney/Perth latitudes because the winter weather systems are being pushed farther south and are not making landfall.

Finally, there is the very ***financial system*** that we use every day and have grown to love. But, when the richest country in the world has a debt of more than three times its GDP, there is bound to be some serious restructuring. So our times are ***very*** interesting.

The positive side to this is that the world will still need the resources that we are very good at finding. And, with a really big research effort into food production and energy sources, we may have the knowledge to survive – but will we have the wisdom?

Further, higher and faster won medals at the recent Olympics in Beijing. Longer, stronger and deeper is often required for a geophysicist to make new discoveries. What is it that drives a geophysicist to be a champion or even want to compete? Just as the Olympians strive for the next gold medal geophysicists strive to make their next discovery, whether it is in the laboratory or out in the field. What keeps us going? Who are going to be the next generation of Olympian geophysicists? Who are going to be the next gold medalists?

It is important as a profession or discipline that we provide incentives for our younger members to compete and I believe that the ASEG has made the right moves in that direction. The Research Foundation, conceived in the time of Bob Smith's Presidency (1986–87) and established in 1988, has gone part of the way to providing incentives to researchers and graduates excelling in the various fields of geophysics. AMIRA similarly provides incentive for geophysicists to 'step outside the box' and have a go at their latest theory or advancement. However, I think it is time to support our universities and provide additional incentives for students to take up the baton and provide the next generation of Olympian geophysicists. We hope in some way to nurture interest in geophysics through establishing student chapters but we must also provide medals. Just as the Australian Institute of Sport trains our next generation of athletes so we must support our universities in their efforts to train the next generation of geophysicists.

Let us not leave it up to China, India, or South America to provide the succeeding generation of Olympian geophysicists, let us be there also winning the medals and setting the standard.

Peter Elliott
elliottgeophysic@aol.com

ASEG Federal Executive 2008–09

President: Peter Elliott
Tel: (08) 9258 3408
Email: elliottgeophysic@aol.com

President Elect: Michael Asten
Tel: 03 8420 6240
Email: michaelasten@flagstaff-ggeoconsultants.com.au

Vice President and International Affairs: Koya Suto
Tel: (07) 3876 3848
Email: koya@terra-au.com

Immediate Past President: Joe Cucuzza
Tel: (03) 8636 9958
Email: joe.cucuzza@amira.com.au

Secretary: Troy Herbert
Tel: (08) 9479 0503
Email: troy.herbert@bhpbilliton.com

Treasurer: David Cockshell
Tel: (08) 8463 3233
Email: cockshell.david@saugov.sa.gov.au

Membership: Reece Foster
Tel: (08) 9209 3070
Email: reece@geoforce.com.au

Publications: Phil Schmidt
Tel: (02) 9490 8873
Email: phil.schmidt@csiro.au

States' Representative: Megan Evans
Tel: (08) 9382 4307
Email: meganevans@mail.com

ASEG Research Foundation: Phil Harman
Tel: (03) 9909 7699
Email: phil.harman@gcap.com.au

Technical Committee: Vacant

Webmaster: Wayne Stasinowsky
Tel: 04 0017 5196
Email: stazo@bigpond.com

ASEG Branches

ACT

President: Matthew Purss
Tel: (02) 6249 9383
Email: matthew.purss@ga.gov.au

Secretary: Ron Hackney
Tel: (02) 6249 5861
Email: ron.hackney@ga.gov.au

New South Wales

President: Mark Lackie
Tel: 02 9850 8377
Email: mlackie@els.mq.edu.au

Secretary: Bin Guo
Tel: (02) 02 9024 8805
Email: bguo@srk.com.au

Queensland

President: Wayne Mogg
Tel: (07) 3630 3420
Email: wayne.mogg@upstream.originenergy.com.au

Secretary: Shaun Strong
Tel: (07) 3376 5544
Email: sstrong@velseis.com.au

South Australia

President: Luke Gardiner
Tel: (08) 8433 1436
Email: luke.gardiner@beachpetroleum.com.au

Secretary: Michael Hatch
Tel: (04) 1730 6382
Email: michael.hatch@adelaide.edu.au

Tasmania

President: Michael Roach
Tel: (03) 6226 2474
Email: michael.roach@utas.edu.au

Secretary: Vacant

Victoria

President: Hugh Rutter
Tel: 03 8420 6230
Email: hughrutter@flagstaff-geoconsultants.com.au

Secretary: Vacant

Western Australia

President: Reece Foster
Tel: (08) 9209 3070
Email: reece@geoforce.com.au

Secretary: Cathy Higgs
Tel: (08) 9427 0838
Email: cathy@casm.com.au

The ASEG Secretariat

Centre for Association Management (CASM)
36 Brisbane Street, Perth, WA 6000
Tel: Ron Adams or Louise Middleton (08) 9427 0800
Fax: (08) 9427 0801
Email: louise@casm.com.au

Megan Clark to head of CSIRO

Megan Clark has been appointed as the next Chief Executive of CSIRO. She will take over from Geoff Garrett, whose term ends on 31 December 2008.

Dr Clark began her career as a mine geologist and subsequently worked in mineral exploration, mine geology, R&D management, venture capital and technical strategy areas with WMC Resources over a 15-year period. From 2003 to June 2008, She was the Vice President Technology, BHP Billiton and since July 2008 has been Vice President, Health, Safety, Environment, Community and Sustainability, BHP Billiton.

Dr Clark is currently on the Advisory Board of the Ian Wark Research Institute and a member of the St Vincent's Hospital Foundation Board. She previously served on the Boards of the A J Parker Co-operative Research Centre, the Victorian Partnership for Advanced Computing, the Australian Research Council Collaborative Grants Committee in the areas of engineering and geosciences, and the CSIRO Minerals Advisory Council.

Dr Clark's extensive experience in both the development and application of technology and her understanding of science and how it delivers benefit to society has seen her recognised as a Fellow of the Australian Academy of Technological Sciences and Engineering, and she currently serves on the Expert Panel for the Review of the National Innovation System.

She is therefore well qualified to lead CSIRO. Her main challenge will be to persuade the government to increase CSIRO's budget allocation in 2009–10 so that the organisation can focus more effectively on long term strategic issues such as food and energy and not be distracted by short term tactical projects that provide cost recovery.

We wish her well, and as a geoscientist she couldn't have come from a better background.

Megan Clark, new CEO of CSIRO

Australian Society of Exploration Geophysicists, Honours and Awards 2009

ASEG members are invited to submit nominations for the next round of ASEG Honours and Awards. Nominations that are judged to be appropriate and are then subsequently selected will be presented at the 20th ASEG Conference, in Adelaide, 22–26 February 2009. Details of the available awards follow:

ASEG Gold Medal

For exceptional and highly significant distinguished contributions to the science and practice of geophysics by a member, resulting in wide recognition within the geoscientific community. The nominee must be a member of the ASEG.

Honorary Membership

For distinguished contributions by a member to the profession of exploration geophysics and to the ASEG over many years. Requires at least 20 years as a member of the ASEG.

Grahame Sands Award

For innovation in applied geophysics through a significant practical development of benefit to Australian exploration geophysics in the field of instrumentation, data acquisition, interpretation or theory. The nominee does not need to be a member of the ASEG.

Lindsay Ingall Memorial Award

For the promotion of geophysics to the wider community. This award is intended for an Australian resident or former resident for the promotion of geophysics, (including but not necessarily limited to applications, technologies or education), within the non-geophysical community, including geologists, geochemists, engineers, managers, politicians, the media or the general public. The nominee does not need to be a geophysicist or a member of the ASEG.

Early Achievement Award

For significant contributions to the profession by way of publications in Exploration Geophysics or similar reputable journals by a member under 36 years of age. The nominee must be a member of the ASEG and have graduated for at least 3 years.

ASEG Service Medal

For outstanding and distinguished service by a member in making major contributions to the shaping and the sustaining of the Society and the conduct of its affairs over many years. The nominee will have been a member of the ASEG for a significant and sustained period of time and will have at some stage been one of the following: Federal President, Treasurer or Secretary, State President, Conference Chairperson or Standing Committee Chairperson, Editor of Exploration Geophysics or Preview. Honorary Members are not eligible.

ASEG Service Certificate

For distinguished service by a member to the ASEG, through involvement in and contribution to State Branch committees, Federal Committees, Publications, or Conferences. Honorary Members or holders of the ASEG Service Medal are not eligible.

Nomination Procedure

For the first five award categories, any member of the Society may nominate applicants. These nominations are to be supported by a seconder, and in the case of the Lindsay Ingall Memorial Award by at least four geoscientists who are members of an Australian geoscience body

(e.g. GSA, AusIMM, AIG, IAH, ASEG or similar). Nominations for the ASEG Service Medal and the ASEG Service Certificates are to be proposed through the State and Federal Executives with their backing.

All aspects of the criteria should be addressed, and a nomination must be specific to a particular award. To gain some idea of the standard of nomination expected, nominees are advised to read past citations for awards as published in *Preview*.

Nominations including digital copies of all relevant supporting documentation are to be sent electronically to:

Roger Henderson
Chairman, ASEG Honours and Awards Committee
Email: rogah@tpg.com.au

The absolute deadline for applications is 19 December 2008.

International Award to ASEG Members

On 10 September 2008, Anton Gaplovsky, Dean of the Natural Sciences Faculty at the Comenius University Bratislava (Slovak Republic) awarded the Memorial Medal of the Faculty to John M. Stanley (Armidale, NSW) and Mal K. Cattach (Brisbane). This award was made in recognition of the important contributions that both have made to developments in the area of high-definition magnetometry and electromagnetics. The award also recognizes the long-term support that John and Mal have given to the University's Department of Applied and Environmental Geophysics and to G-Trend Ltd, a geophysical exploration company operating from Bratislava.

Delegation following the award to John Stanely at Comenius University Bratislava on 10 September 2008. From left to right: Dr R. Pasteka, Department of Applied and Environmental Geophysics; Dr E. Stloukal, Vice-Dean of the Natural Sciences Faculty; Prof. M. Bielik, Head, Department of Applied and Environmental Geophysics; Dr J. Mikuska, Director of G-Trend Ltd; Lt Col D. Hagara, Ministry of Defence; Mrs R. Stanley; Awardee Dr John Stanley; P. Seko, Head of Economy Department, Embassy of the Slovak Republic, Canberra.

The award citation highlighted the important contributions that John has made to Cs-vapor magnetometer sensor development and to its application in UXO detection and archaeological applications. It also highlighted the crucial advances in our understanding of high-definition magnetics that have been driven by Mal. Mal introduced methods incorporating very highly sampled magnetic fields with the aim of scanning electromagnetic effects (the sub-audio magnetics, or SAM, method). John and Mal's work was not only conducted at a theoretical level, but has also made a significant impact in geophysical exploration – the SAM method is now a state-of-the-art method for the mapping gold and other metal deposits.

Both John and Mal have been involved in cooperative projects with the Department of Applied and Environmental Geophysics and G-trend Ltd Bratislava over many years. They have provided Slovak geophysicists with opportunities to participate in, for example, UXO remediation projects in Montana (USA), projects involving development of SAM techniques and miniature sensor technology, and a NATO project working on the airborne detection of ordinance.

The award was followed by an enlightening seminar from John on the 'Evolution of High Definition Geophysical Technologies' and the talk was followed by an in-depth and inspired discussion. Faculty representatives thanked John and Mal for their ongoing support, expressed their pleasure in hosting world-renowned geophysicists and wished their colleagues and friends, John Stanley and Mal Cattach, good health and continued success.

Roman Pašteka (Comenius University Bratislava)
Jan Mikuška (G-trend Ltd, Bratislava)
Ron Hackney (Geoscience Australia)

New Members

The ASEG welcomes the following 25 Members to the Society. Their membership was approved at the Federal Executive meetings held on 31 July and 31 August 2008.

Name	Company	State	Membership Category
Mohamed Abubeker	RMIT	Vic	Student
Michelle Claire Byett	Curtin University	WA	Student
Danny Li	Curtin University	WA	Student
Efthymios Efthymiou	Curtin University	WA	Student
Adrian Mark Elsner	Curtin University	WA	Student
Richard Evans	BHP Billiton	WA	Associate
Jonathan David Griffin	Geoscience Australia	NSW	Associate
Youssef Hamad	RMIT	Vic	Student
Robert Hunn	Macquarie University	NSW	Student
Deborah Jeffrey	BHP Billiton	WA	Active
Merok James Kiele	SPI Exploration & Production Limited	Papua New Guinea	Associate
Leano Kotlhao	GeoBot (Pty) Ltd	Botswana	Associate to Active
Markus Krieger	Terrasys Geophysics	Germany	Associate
Maria Laura Loss	Santos Ltd	SA	Associate
John David Mitchell	Curtin University	WA	Student
Laura Jane Morrissey	Adelaide University	SA	Student
Phillip Charles Webb Neckers	Melbourne University	Vic	Student
Richard Neil Presser	Curtin University	WA	Student
Paul James Rogerson	Thomson Aviation	NSW	Associate
Katherine Lee Silversides	University of Sydney	NSW	Student
Sioni Sioni	SPI Exploration & Production Limited	Papua New Guinea	Associate
Christopher James Stancey	The University of NSW	NSW	Student
Andrew James Taylor	Curtin University	WA	Student
Ming Wen	Sino Gold Ltd	China	Associate
Jun Zhou	Curtin University	WA	Active

We would also like to welcome two new Corporate Members to the ASEG.

Elliott Geophysics International Pty Ltd is a new Corporate-Plus Member as of July 2008. It specialises in geology and geophysics for mining and mineral exploration and provides a wide range of services to the resource and geotechnical sectors. In particular, it provides, management of minerals projects, geological surveys, GIS bureau services, image processing of satellite and geophysical data, contract geophysical surveys, geophysical airborne surveys and geophysical consulting services, for the mining, coal, oil, and groundwater industries, anywhere in the world. It has worked in over 10 countries.

The company manufactures a specialised line of geophysical equipment for airborne geophysical surveys. It also acts as an agent for D&H Enterprises which manufacture airborne survey birds and airborne cable winders and also distributes high quality zeolite products.

Elliott Geophysics maintains an active R&D program with some of the latest innovations in airborne electromagnetic.

The contact details are:
Elliott Geophysics International Pty Ltd
PO Box 1049
Cannington, WA 6987
Tel: +618 9434 1250
Email: elliottgeophysic@aol.com

UTS Geophysics became a Corporate Member in May 2008. It is a modern airborne geophysical survey company, based in Perth Western Australia. UTS has been successful in the development of many new airborne geophysical techniques and have acquired and processed more than 5.0 million line-km of high resolution airborne geophysical data.

It provides a complete range of services, including airborne magnetics (single sensor and gradient), radiometrics, gravimetry and electromagnetics, from initial project definition and airborne data acquisition, through to the provision of high quality processed maps and images.

It operates fixed wing and helicopter aircraft to acquire magnetic, radiometrics and airborne gravity as well as providing in-house data processing, enhancement, mapping, imaging and data presentation services.

Contact details are:
UTS Geophysics
PO Box 126
Belmont, WA 6984
Tel: +618 9479 4232
Email: info@uts.com.au

Australian Capital Territory

The most recent ACT Branch technical talk was hosted jointly with the local branches of PESA and the GSA. On 20 August, more than 70 people came to a talk by *Preview* Editor, David Denham, entitled *How long can humans survive on Earth?* David presented sobering, but probably realistic, scenarios and discussed the potential problems related to declining resources, increasing population, increased competition for resources and economies based on growth rather than sustainability. David's arguments, based as always on thorough research, left everyone with plenty to think about. Most appeared to be quite convinced, but his ideas provoked some lively discussion.

Other talks over the last few months included dual presentations from David Robinson and Jono Griffin (new committee member) on the earthquake risk modelling that Geoscience Australia is undertaking in Australia and Papua New Guinea. The program of technical talks for the remainder of 2008 is filling nicely. On 17 September, the director of the Canberra Deep Space Communication Complex, Miriam Baltuck, spoke on *Space geoscience in Canberra's backyard*. On 22 October, Ted Lilley is organising a joint GSA/ASEG gathering to mark the 50th anniversary of the paleomagnetic hut at ANU.

Members may also be interested in the PESA Golf Day to be held at the Federal Golf Club on 30 October and a Canberra region wine tour is also under consideration. Anyone interested in more information on upcoming events is welcome to contact the Branch Secretary (ron.hackney@ga.gov.au).

Ron Hackney

New South Wales

In July, the 2008 NSW Branch dinner was held in a Chinese restaurant somewhere in Chinatown. Matters of great geophysical importance (and other less critical subjects) were discussed over a few bottles of red and the odd cleansing ale. A good time was had by all.

In August, Grant Taylor from Oil Search gave a talk on Petrophysical Data Acquisition and what it all means. Grant briefly went through all the different petrophysical tools that can be run down a borehole and what information that can be got out of them. A well attended meeting with a lot of questions and much discussion after Grant's talk.

An invitation to attend NSW Branch meetings is extended to interstate and international visitors who happen to be in town at that time. Meetings are held on the third Wednesday of each month from 5:30 pm at the Rugby Club in the Sydney CBD. Meeting notices, addresses and relevant contact details can be found at the NSW Branch website.

Mark Lackie

Queensland

Our AGM in February saw a change in office bearers with the election of Wayne Mogg as President, Shaun Strong as Secretary and Eric Battig as Treasurer. Thanks to the former Secretary and President, Emma Brand and Nigel Fischer. In conjunction with the AGM, members were treated to a double barrel presentation by Alan Meulenbroek on *An analysis of converted refractions for shear statics and near-surface characterisation* and Shaun Strong on *Multi-component seismic-resolution analysis using finite-difference acquisition modelling*.

In April we joined with the local chapters of the GSA and AIG for presentations from Mike Johnston, Craig Riley and Joel Jansen on *The underwater exploration and planned mining activities for seafloor massive sulphides being carried out by Nautilus Minerals in the Bismarck Sea north of PNG*. There was a good turn out from the GSA/AIG, but a relatively poor showing from ASEG, for these very interesting presentations.

We co-hosted the SEG distinguished lecturer, Tad Ulrych, with PESA in May. It was a lively and interesting presentation.

ASEG News

Most recently in August we sadly said goodbye to Emma Brand who departed sunny Brisbane to continue her studies at Memorial University, St John's, Newfoundland. We suspect she chose a location on the opposite side of the planet to escape all the work she does for ASEG. So we made sure she was busy to the end by having here present *A review of AVO modelling and analysis of the Trefoil Field, Bass Basin*. Thanks Emma.

Wayne Mogg

South Australian Branch sommeliers hard at work for our well being.

South Australia

We in the SA Branch are enjoying a bit of a mid-winter lull in our usually busy schedules so not as much to report as in other months. Not to worry, plenty on the horizon.

In late-August, David Love from PIRSA gave an interesting talk on the state of earthquake seismology in South Australia. We were interested to hear of David's plans to expand the SA seismological website. This looks like it will have good potential for educational outreach to the wider community as it will allow the general public (younger students?) to look at incoming earthquake information and try to locate them.

Also in August we held our annual wine tasting event. After an extended gathering process, your faithful SA Branch committee (along with sponsors and the conference committee) diligently assessed almost 50 wines and selected two excellent wines to be offered to the general membership. The winning red was the 2007 Kalleske's *Clarry's Grenache Shiraz*, and the winning white was the 2007 St. Hallett's *Poacher's Blend*. Please look at the advertisement in this edition of Preview for further details and get your order in early. The photographs show the tasters hard at work.

Looking to the future, the Melbourne Cup Luncheon will be held at the Wine Centre again, on the 4 November, and the 20th ASEG 2009 Conference will be held at the Adelaide Convention Centre from 22 to 25 February.

The SA Branch holds technical meetings monthly, usually on a Thursday night at the Historian Hotel, from 5:30 pm. New members and interested persons are always welcome. Please contact Luke Gardiner (luke.gardiner@beachpetroleum.com.au) for further details.

Mike Hatch and Graham Baines

Countdown for Adelaide going well

From 22–25 February 2009, Adelaide is shaping up as the place to be because ASEG's 20th International Conference and Exhibition takes place there and should not be missed.

The theme of **Brighter, Deeper, Greener; Geophysics in a Changing Environment**, will reflect not only changes in the natural environment but also the challenges facing the geoscientific community as we strive to operate with ever-changing expectations and targets. Never before has the management of our planet depended so much on what geophysics has to offer.

With increasing demand for resources and the threat of global warming we are now facing demands for more resources, and these have to be clean. No longer can we extract, walk away, and hunt for something new.

It is appropriate that the 20th Conference is taking place in Adelaide because the first Conference was held there in 1979. It will be interesting to see how many attendees from the first conference will be joining us in 2009.

It is also appropriate that this conference will be held jointly with PESA. The exploration industry is becoming more and more reliant on different skills and experiences and it is great that our colleagues from PESA will be joining us.

The number of technical papers received has been overwhelming, with the provisional program requiring five concurrent streams to accommodate all the selected technical papers and Keynote Speakers. The technical program is currently over-subscribed with a waiting list still growing.

Sponsorship to date has gone very well with a great response from a wide range of companies. Santos has been secured as a Platinum sponsor and it is very pleasing to have a local company in this position to support the conference. There are still sponsorship options available and Rob Bulfield (SAPRO Conference Management) is tracking these on behalf of the Conference Organising Committee (COC).

The Exhibition bookings are also going very well with over 100 booths booked. For those companies seeking a booth, be quick as there are still some spaces available. For enquiries contact Rob Bulfield (SAPRO) on +61 8 8352 7099 or admin@sapro.com.au.

Online registrations became active on Monday 15 September. The deadline for early bird registration plus payment being Friday 19 December.

The Keynote and Plenary Speakers have been confirmed and will surely add a sought after perspective on their speciality.

Plenary Speakers include:

Eric Finlayson is Head of Exploration for Rio Tinto, based in London. He joined Rio Tinto in 1989 after working for the Geological Survey in Papua new Guinea and as you might expect has now worked all over the world.

David Knox is Chief Executive Officer of Santos, on 29 July 2008. He was previously Managing Director for BP Developments in Australasia from 2003 to 2007. He previously held senior positions with BP in Australia, the UK and Pakistan, and has worked for ARCO and Shell.

The Keynote Speakers are:

Craig Beasley is Vice-President of WesternGeco. He was President of the SEG during 2004–05 and is serving as the Chair of the newly formed SEG Committee for Geoscientists Without Borders.

John Hughes is A consultant geophysical operations adviser running his own company, having retired from corporate life in 2007 after 20 years as Santos' Chief Operations Geophysicist.

Peter Malin is the Director of the Institute for Earth Science and Engineering, University of Auckland, Auckland, New Zealand. His research interests include borehole seismology for earthquake and geological investigations.

Lucy MacGregor leads the R&D group of Offshore Hydrocarbon Mapping, and has over 10 years' experience as a leading researcher in CSEMI and its application to the detection and characterization of fluids in the earth. She was one of the cofounders of OHM in June 2002

Max Meju is an expert in computational and applied electromagnetics. He wrote the book *Geophysical Data Analysis: Understanding Inverse Problem Theory and Practice*. He was awarded William Bullerwell Prize in 1996 and the Gerald W. Hohmann Prize in 2002.

We are fortunate that the SEG's 2009 Distinguished Instructor Short Course (DISC) speaker, ***Patrick Corbett***, will be there, and on 26 February he will be leading the DISC Workshop. Patrick was an EAGE Distinguished Lecturer in 1998 and an SPE Distinguished Lecturer in 1998–99. He was awarded the Wegener Medal by the EAGE in 2005 and has co-authored two books: the books *Statistics for Petroleum Engineers and Geoscientists* and *Cores from the Northwest European Hydrocarbon Province*. So it will be worth going to Adelaide just to hear him.

So get onto the web and register today, it's just a couple of clicks away at: **http://www.sapro.com.au/ASEG/registration.htm**

Research and Experimental Development, Government and Private Non-Profit Organisations

The estimated expenditure by government organisations on R&D (GOVERD) in 2006–07 was $2,954.1 million according to the release in July 2008 by the Australian Bureau of Statistics. GOVERD increased by 19% in current price terms and 10% in CPI adjusted terms from the 2004–05 numbers.

Figure 1 is a plot of the current spending by the Commonwealth and the States and Territories, as well as the CPI adjusted Commonwealth spending and the spending as a percentage of GDP. As can be seen the real amount in dollars increased slightly over the 8-year period but as a percentage of GDP it has gradually declined.

For more information, go to the ABS website (http://www.abs.gov.au/) and search for Catalogue Number 8109.0. It is a very comprehensive report.

Australia sits in the middle of the OECD table for government spending on R&D, as shown in the table below. The spending here relates just to the Commonwealth investment. Notice that Australia and New Zealand only produce these statistics every 2 years, whereas most countries calculate them annually. We should do better and catch up with the others.

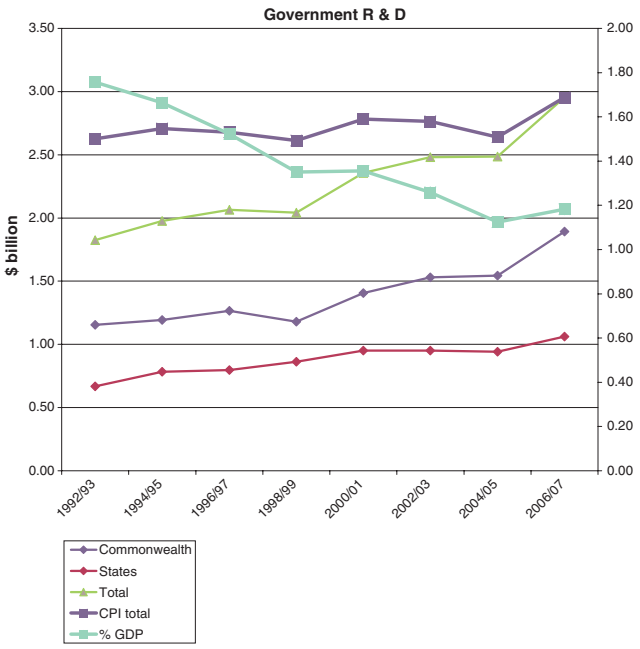

Fig. 1. *Plot of States and NT investment on R&D from 1992–93 through 2006–07. The lower three curves show the spending in current dollars. The purple curve shows the data adjusted to 2006–07 dollars and turquoise plot shows the total investment as a percentage of GDP.*

GOVERD/GDP ratios of selected OECD countries

	2002–03 (%)	2003–04 (%)	2004–05 (%)	2005–06 (%)	2006–07 (%)
Iceland	0.73	0.70	na	0.66	na
France	0.37	0.36	0.37	0.37	0.37
Korea	0.34	0.33	0.34	0.35	0.37
Germany	0.34	0.34	0.34	0.35	0.35
Finland	0.35	0.33	0.33	0.33	0.32
New Zealand	na	0.33	na	0.30	na
USA	0.32	0.33	0.32	0.31	0.29
Japan	0.30	0.30	0.30	0.28	0.28
Australia	**0.32**	**na**	**0.28**	**na**	**0.28**
Netherlands	0.24	0.25	0.26	0.24	0.24
Italy	0.20	0.19	0.20	0.19	0.19
Canada	0.21	0.19	0.18	0.20	0.18
UK	0.17	0.18	0.18	0.19	0.18
Sweden	na	0.13	0.11	0.18	0.17
Greece	na	0.12	0.11	0.12	0.12
Ireland	0.10	0.09	0.09	0.09	0.09
Turkey	0.05	0.06	0.05	0.09	0.09
Switzerland	0.03	na	0.03	na	0.02
Total OECD	**0.27**	**0.27**	**0.27**	**0.27**	**0.26**

New Global Institute on carbon capture and storage

The day before he left for New York the Prime Minister Kevin Rudd announced the establishment of a $100 million Global Institute to speed up the development of carbon capture and storage technology.

The government is offering to host this institute in Australia and to contribute up to $100 million per annum towards its operation. The government will work cooperatively with other countries to help reduce the amount of CO_2 released into the atmosphere and this initiative is seen as part of this plan.

The aim is to develop and commercialise this technology because of its importance for Australia's future, particularly with our dependence on burning coal to generate electricity (80% from coal) and also the value of our coal exports (~$43 billion in 2008–09). The media release stated that 'The Institute will aim to accelerate carbon projects through facilitating demonstration projects and identifying and supporting necessary research – including regulatory settings and regulatory frameworks'.

According to the media release, 'Australia has already held informal consultations with industry and foreign governments over a possible model for the Institute and its operations will now be the subject of further detailed discussions with parties that have an interest in carbon capture and storage, such as foreign governments, industry and various international bodies. This will pave the way for its commercial deployment across the world by the end of the next decade'.

At present the CSIRO and the CRC for Greenhouse Gas Technologies (CO_2CRC) are conducting active research on carbon capture and storage (CCS).

> 'The Government has also established the National Low Emissions Coal Initiative (NLECI), a

$500 million program to accelerate the development and deployment of technologies that will reduce emissions from coal use. It includes funding for research and to support the trial of different technologies.

The Government has already established a National Low Emissions Coal Council and Carbon Storage Taskforce. These bodies will play a leading role in helping to deliver this new global initiative.

Legislation to establish a regulatory framework for CO_2 storage under the seabed in Commonwealth waters is currently before Parliament. This legislation will allow Australia to offer the first carbon storage blocks for commercial development in early 2009.'

At present the site for the institute has not been selected, but it is clear that the coal industry has done well in attracting government research funds.

Government releases innovation review paper

On 9 September, Senator Kim Carr, Minister for Innovation, Industry, Science and Research, released the long awaited report of the Review of Australia's National Innovation System. The 224-page report titled ***Venturous Australia – building strength through innovation*** contains 71 recommendations for the government to deal with.

The Review was conducted by a panel chaired by Terry Cutler. The panel analysed Australia's innovation system and made a series of recommendations to revitalise it. The report can be found at: www.innovation.gov.au/innovationreview.

I didn't find the review very helpful and I suspect it was not what the government was looking for. Many of the recommendations are rather vague and as a consequence will be difficult to implement. Here are some typical examples:

Recommendation 6.2
Base the distribution of research block funding to universities on success in winning national competitive grants and on evidence of excellence in research, such as the research quality rankings to be produced by the Excellence in Research for Australia initiative.

Recommendation 6.3
Develop a strategy to support the strengthening of publicly funded research agencies (PFRAs) within the National Innovation System over time, including urgent restoration of funding levels.

Recommendation 11.1
National innovation priorities as set out in this Review, be a focus of innovation policy and activities and the National Innovation Council be charged with ongoing evaluation of the alignment of public innovation policy with National Research and Innovation priorities.

Recommendation 12.12
The Australian Government, with the guidance of the National Innovation Council, should establish rigorous and consistent evaluation processes for innovation programs in line with the principle that the function should be carried out on an arms-length and transparent basis.

Sir Humphrey would love these words, but pity the poor bureaucrats who have to analyse them and the poor minister who has to take something good to Cabinet. I just hope it can be made to work.

Collaborating to a purpose: review of the Cooperative Research Centres Program

In contrast the 80-page review by Mary O'Kane contains just 11 recommendations that are clear and relevant. For example:

Recommendation 1.2

i. Funding be injected into the Program to allow for annual rounds to take place over the next five years;
ii. There be a selection round at least once a year so that emerging market failure/creation and urgent public good issues can be addressed quickly; and
iii. The Program encourage CRCs of varying lifespan (typically 4–7 years but up to a maximum of 10 years where appropriate), with funding up to a maximum of $45M over the life of the Centre.

The minister can understand this and the bureaucrats can work out detailed financial estimates that the Minister can take to Cabinet.

The FASTS media release on this report stated that:

> 'The 22 recommendations, if implemented, would lead to more flexible, demand-driven CRCs. The key recommendations are:
>
> - Continue the program with some additional funding;
> - Position CRC research in the pre-competitive/pre-application space to encourage wide adoption rather than a narrow focus on commercialisation;
> - More flexible time frames (4–7 years) including a maximum funding life of 10 years;
> - CRCs to tackle significant risks and challenges *as identified by users*, and
> - Public good research re-instated as a selection criteria, where the need has been identified by Government, industry or other end-users.'

The recommendations make it clear that the purpose of the CRC program is to support collaborative research aimed at challenges identified by end-users within a fixed time frame, as distinct from building research institutions for their own sake. All good stuff.

Minister releases Questacon Review

Another very ordinary document is the Questacon Review, released on 18 September.

Questacon, Australia's National Science and Technology Centre opened in 1988 as a joint Australia–Japan Bicentennial Project with the Governments and business communities of Australia and Japan co-funding the cost of Questacon's building which provides the headquarters for Questacon's extensive national and international operations. This year, Questacon marks its 20th year as a national institution.

The review was conducted by a panel headed by John Simpson, Group General Manager, Corporate Affairs, National Australia Bank. It examined Questacon's role, priorities and resources, its governance, and options for sustainable future funding.

It contains 11 recommendations but unfortunately they are somewhat vague and require a lot more work to be done before the government can act. Words such as those that follow are not very helpful:

> 'To facilitate the achievement of Questacon's mission and key strategies into the future a significant increase in resources be provided to:
>
> - Refurbish and expand the building
> - Provide new programs to enhance its mission, and
> - Implement a more comprehensive outreach program'

There is no mention of how many dollars are involved so the Department of Finance will have no problems in arguing that it be knocked it back.

The review also recommends that Questacon become a Statutory Authority, but there is no analysis on how much extra this would cost. So much more work will have to be done before many of these recommendations can be acted upon.

And that's all for this issue – I am reviewed out.

Eristicus

Two new global information sets launched

Global data sets are becoming more accessible through the power of the internet, which enables large international projects to be undertaken in time spans that would have been unthinkable even 10 years ago. In recent months data sets have been released from two important projects. These are the ***OneGeology*** compilation and a new version of the ***World Stress Map***.

OneGeology

The OneGeology project was set up to: ***Make web-accessible the best available geological map data worldwide at a scale of about 1:1 million, as a geological survey contribution to the International Year of Planet Earth.***

The project was initiated at Brighton, UK in March 2007, when leading scientists from more than 43 countries around the world, assembled at a meeting convened by the British Geological Survey to plan the details of this international venture. Remarkably, the OneGeology web portal was opened on 6 August 2008 at the 33rd International Geological Congress, held at Oslo, after less than 18 months work. It was fitting that Simon Winchester, the author of 'The Map That Changed the World' was on hand to launch (or open) the portal website (http://www.onegeology.org/). And in poetic prose he said:

> *The idea of producing a digital map of our living planet's sinews and muscles – of the Earth's largely invisible structure, the support for all living creatures, humankind included – has a grand nobility and poetic elegance to it. History will judge this decade well if we manage to create a global cartographic venture of this scale and of such vision.*

OneGeology is supported by UNESCO and six other international umbrella bodies and is the flagship project for the UN International Year of Planet Earth 2008. The key results so far are:

1. Geological maps from around the globe that are accessible on the World Wide Web;
2. A new web language written for geology which allows nations to share data with each other and the public;
3. The know-how to do this exchange so that all nations across the world, regardless of their development status, can take part and benefit.

Fig. 1. *Nations participating in OneGeology. This map came from the website: http://www.onegeology.org/participants/interactive_map.html. If you hover over the countries at this site you can see their flags and go to the websites of their geological surveys.*

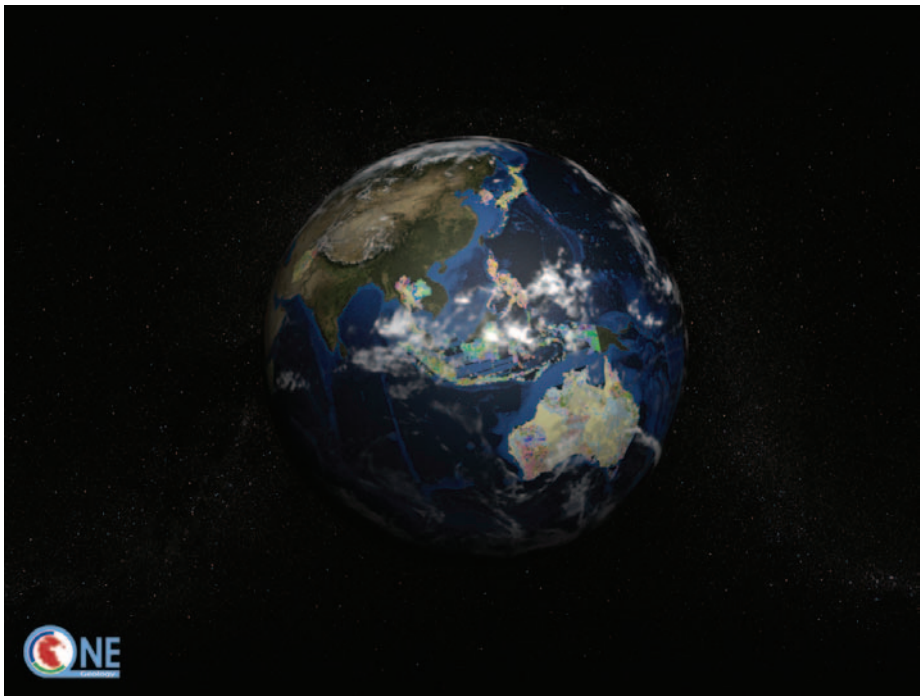

Fig. 2. *Geology of Australia on the globe from the website: http://www.onegeology.org/press_information.html.*

So far 84 nations (out of a total of 195), covering more than 70 percent of the Earth's land area, are participating in OneGeology. Figure 1 shows these countries. Geoscience Australia and CSIRO are the two participating agencies representing Australia.

Surfing through the OneGeology website provides an interesting set of images. In Figure 2 we can see the geology of Australia from outer-space and in Figure 3 the geological map of the world. There is even a YouTube video available.

A really impressive achievement in international collaboration and geoscience.

New edition of World Stress Map released

A new edition of the World Stress Map (WSM) was released in July 2008[1]. The

[1]Heidbach, O., Tingay, M., Barth, A., Reinecker, J., Kurfeß, D., and Müller, B., 2008, The release 2008 of the World Stress Map (available online at www.world-stress-map.org).

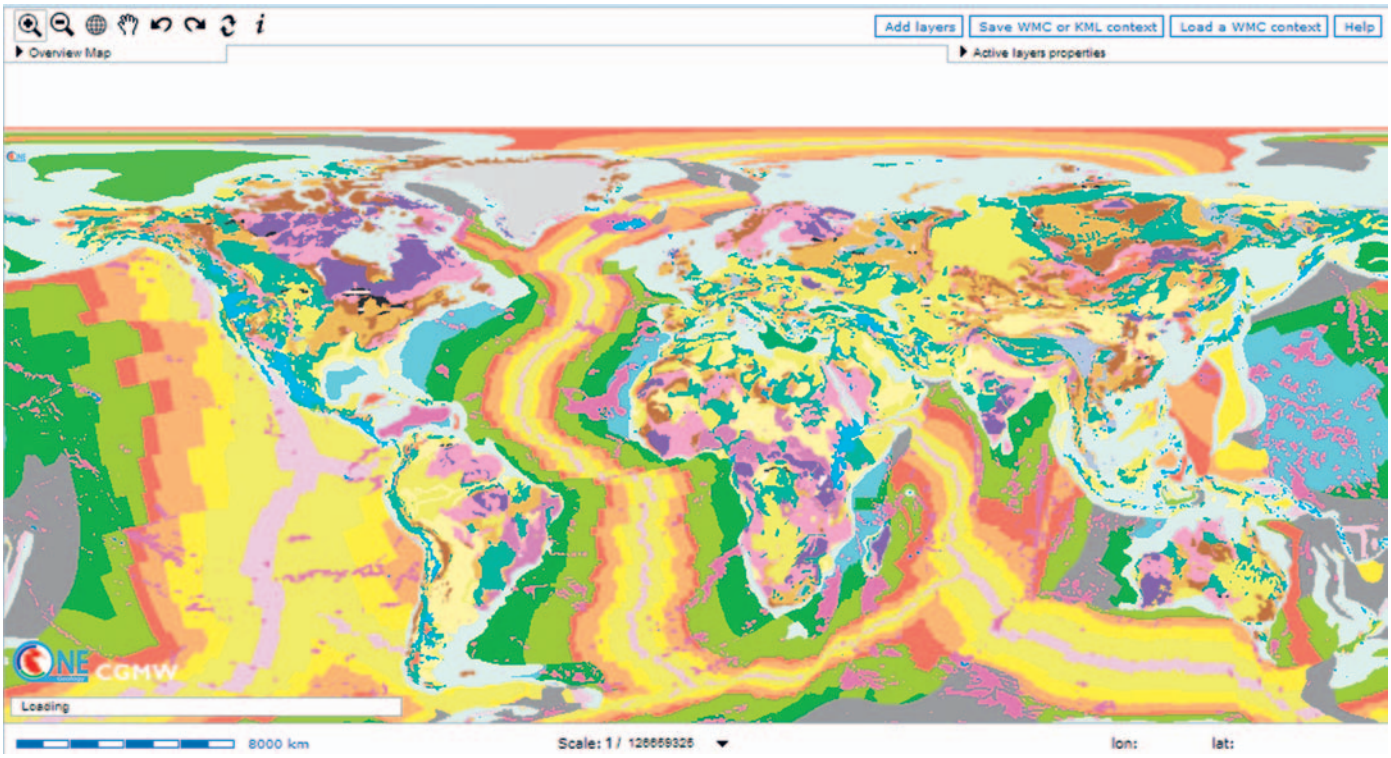

Fig. 3. *Geology of the world at 1:25 million scale also from the website: http://www.onegeology.org/press_information.html.*

WSM merges data, which otherwise would be fragmented in separate, often inaccessible archives. The project was started back in the 1980s as part of the International Lithosphere program, and since 1995 it has been managed by the Heidelberg Academy of Sciences and Humanities in collaboration with the Tectonic Stress Group at the Geophysical Institute of the Karlsruhe University.

Four different types of stress indicators are used to determine contemporary tectonic stress orientations in the Earth's crust. These are:

- Earthquake focal mechanisms
- Well bore breakouts and drilling-induced fractures
- *In-situ* stress measurements (overcoring, hydraulic fracturing, borehole slotter)
- Young geologic data (from fault-slip analysis and volcanic vent alignments)

There are now approximately 22 000 quality ranked data records in the WSM global database. This represents an increase of about 6000 over the previous edition. The uniformity and and quality is guaranteed through:

- quality ranking of the data according to international standards and
- standardised regime assignment

The WSM is used by various academic and industrial institutions working in a wide range of Earth science disciplines such as geodynamics, hydrocarbon exploitations and engineering. The main operational areas are:

- Basin modelling
- Geomechanical modelling
- Reservoir characterisation and management
- Stability of mines, tunnels and boreholes
- Fault-slip tendency
- Seismic hazard assessment

The WSM is an open-access database. It can be downloaded through the *Stress Data*

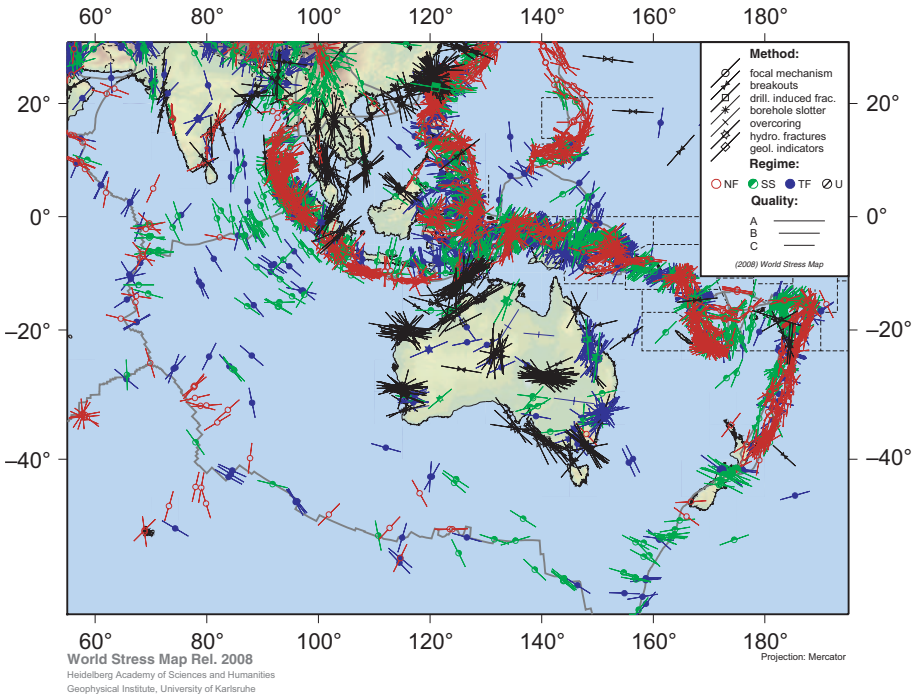

Fig. 4. *Contemporary stress data for the Australian Plate. The length of the stress symbols represents the data quality, with A being the best quality. Quality A data are assumed to record the orientation of SH to within 10°–15°, quality B data to within 15°–20°, and quality C data to within 25°. Quality D data are considered to give questionable tectonic stress orientations. The tectonic regimes are NF for normal faulting, SS for strike-slip faulting, TF for thrust faulting, and U for an unknown regime.*

subsection of the website (www.world-stress-map.org), which also provides details about the data, utilities for data plotting, stress maps for specific regions, and other useful information. WSM database 2008 is in Google Earth format and with the online tool CASMO, which can be used to generate one's own maps.

The standard maps available from the WSM website are spectacular. We show here in Figure 4 the results for the Australian Plate and in Figure 5 a more detailed plot of the Australian continent.

The WSM is calling out for more data so please contact them when you have new results available.

Australian Geoscience Thesis Database launched

The Australian Geoscience Thesis Database, which contains a listing of all geoscience theses from all Australian universities (over 10 500), including from those departments no longer in existence as well as all Honours theses is now accessible.

Database project began as an AMIRA International project P874 in December 2005 and concluding in January 2008. It involved the 18 sponsors and the cooperation of all Australian university geoscience departments. *Data Metallogenica* now owns the listing and will arrange future annual updates.

The database can be accessed in two ways:

1. Free public access to basic listings (searchable title, author, university, year, thesis level) (http://www.datametallogenica.com/ThesisWebsite/AccessLevels/dm_thesis_databaselink.html).
2. Access to the full database, including abstracts of over 1600 economic geology theses as well as more advanced search capabilities including mineral commodity and science discipline, is also available to subscribers of *Data Metallogenica* (http://www.datametallogenica.com).

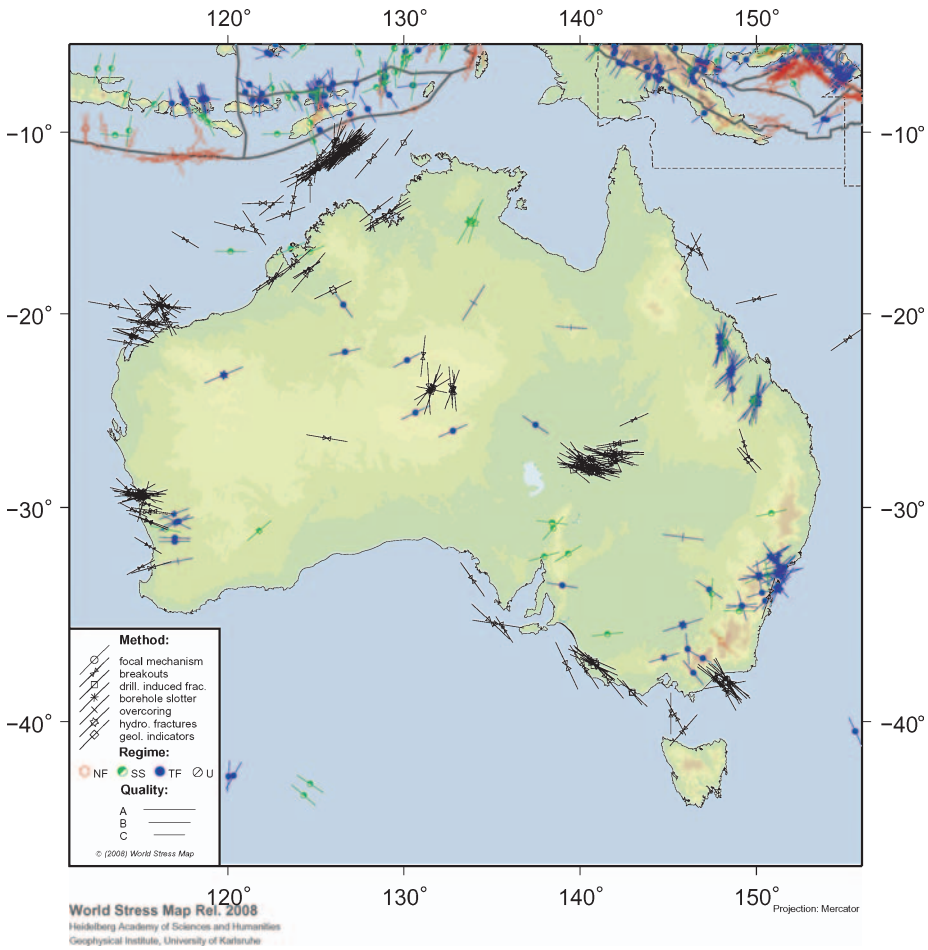

Fig. 5. *Contemporary stress data for continental Australia. See the caption for Figure 4. For explanations of the map legend.*

ASEG Members are encouraged to submit their thesis abstracts (if not already listed) or full digital theses, particularly on exploration technology or key regional studies, to be posted in the database for others to have simple access to the data they painstakingly collected. For further information contact Alan Goode, AMIRA International, Melbourne (alan.goode@amira.com.au).

Mineral and petroleum exploration both at record levels

Minerals – a record performance

Figures released by the Australian Bureau of Statistics in September 2008 show that the trend estimate for total mineral exploration expenditure increased by $42.1 million (6.5%) to $685.8 million in the June quarter 2008. The estimate is now 41.3% higher than the June quarter 2007 estimate and has continued to reach another all-time high.

It is now 44% higher (in CPI adjusted terms) than the golden days of 1997 and the numbers have increased continually for 18 consecutive quarters since September 2003. Figure 1 shows the expenditure estimates from June 2000 through June 2008. Both the trend and the seasonally adjusted estimates are powering ahead, although the rate of increase is now flattening off.

The largest contributions to the increase this quarter were in Western Australia – up $30.6 million or 9.3% to a massive $381 million – another all-time record. Queensland also recorded a large increase, up $8.3 million or 7.9% to a record $127 million. All other states and the Northern Territory either increased slightly or remained at similar levels. As expected, Western Australia continued to dominate the national figures and contributed 52% to the total with Queensland at 17% a clear second.

The seasonally adjusted estimate for metres drilled increased by 4.9% this quarter from 2437 km to 2591 km. This is an all time record and the estimate for this quarter is now 18% higher than the June quarter estimate for 2007.

The greenfield investment is almost unchanged, at a healthy 43% of the total. It is now at $305 million, compared to the June quarter for 2007 of $179 million.

Figure 2 shows the longer term trends from March 1986. It indicates that in real terms (CPI adjusted) the expenditure levels are far greater than ever recorded.

All the commodities except diamonds experienced increased investment with gold rising from $142 million in the March quarter to $173.9 million in June 2008 (24% of the total expenditure). The June 2007 quarter was only $123.0 million so there has been a large surge in gold exploration. Iron ore commands second place up from $91.9 million in March 2008 to $146.6 million in June 2008 (20% of the total) and back in June 2007 the expenditure for iron ore was only $88.8 million.

So the minerals sector is still very healthy.

Petroleum – another record

Performance in the petroleum sector was even more impressive than in minerals. Expenditure on petroleum exploration for the June quarter 2008 rose $147.8 million (20.8%) to $857.2 million. Expenditure on exploration on production leases rose $5.3 million (3.6%), while exploration on all other areas rose a massive $142.4 million (25.3%) this quarter.

Offshore exploration rose $116.4 million (18.9%) in the June quarter 2008, while onshore exploration expenditure rose $31.4 million (33.2%).

Western Australia had the largest rise in petroleum exploration expenditure of $118.2 million to $616.9 million (23.7%) and Northern Territory had the largest fall of $51.8 million (61.4%).

Western Australia's dominance continued. It attracted a massive 72% of the total exploration investment. The second placed Queensland at $55 million accounts for only 6.5%!

Figure 3 shows a plot of the quarterly petroleum exploration expenditure from March 1986. Notice that in the last year, there has been a significant increase in exploration expenditure. The government's Big New Oil Program, together with the increase in the crude oil price to over $100 per barrel are having the desired effect of encouraging petroleum exploration. In real terms the level of expenditure is now 88% higher than the previous record in June 1998 quarter.

Stock Market extremely volatile

While the investments in resource exploration have so far been immune from the frantic gyrations on Wall Street, the market capital of the resource industries and the All Ordinaries index have been, to say the least, volatile.

Figure 4 shows the total market capital of the resource companies listed in the top 150 of the ASX companies, continues to climb relentlessly until mid-May 2008. From then until the time of writing (22 September) the total market capital lost about 25 percent of its value; in other words $110.11 billion dollars in 17 weeks

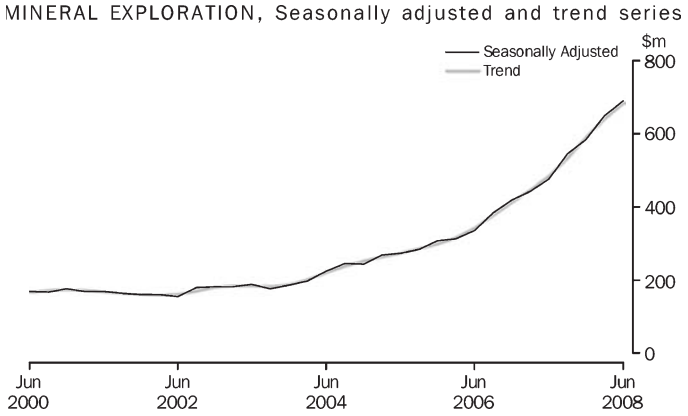

Fig. 1. *Trend and seasonally adjusted quarterly mineral exploration expenditure from June 2000 through June 2008 (provided courtesy of the Australian Bureau of Statistics).*

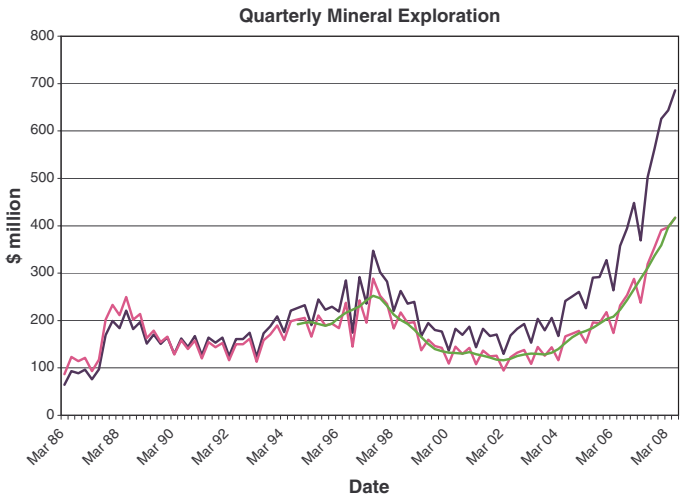

Fig. 2. *Quarterly 'actual' mineral exploration expenditure from March 1986 through June 2008 (from ABS data). The black curve represents actual dollars spent, the purple curve shows the CPI adjusted numbers to 1998/99 levels and the pale green line is the trend line (ABS data).*

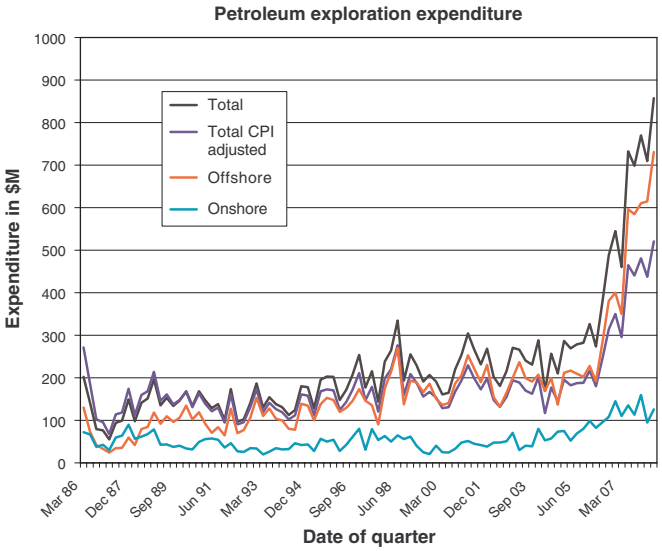

Fig. 3. *Quarterly petroleum expenditure from March 1986 through June 2008. The individual offshore and onshore numbers are actual numbers spent at the time, not CPI adjusted. The black graph shows the contemporary dollars spent and the blue curve shows the CPI adjusted number to 1989/90 dollars for the total of the petroleum exploration expenditure.*

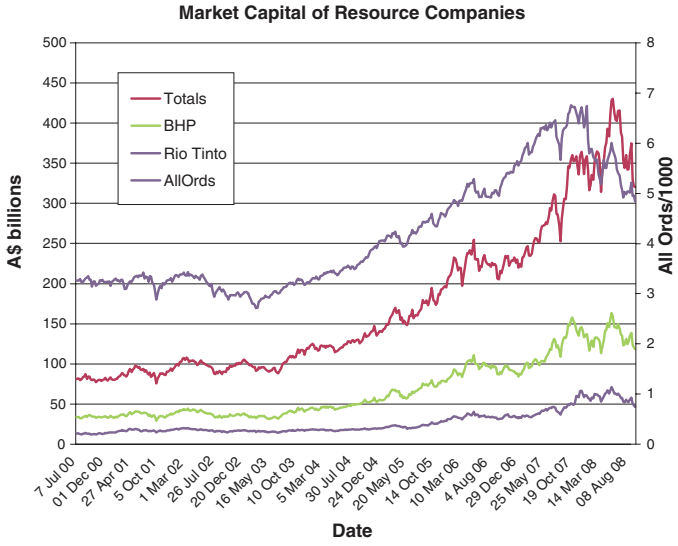

Fig. 4. *The brown line represents the total market capital of the resource companies listed in the top 150 of the ASX registered companies. The blue line represents the All Ordinaries Index and the other two curves shown the numbers for BHP Billiton and Rio Tinto. The data set goes up to 19 September 2008.*

or $925 million a day. The All Ordinaries declined by 28%, but this was over a 41-week period (7 December–19 September 2008).

So the general stock market has declined much more than the resource sector. As can be seen from Figure 4, the long term trends for the resource industries are much better than those for the overall market. However, both the top curves have shown a significant increase in volatility since mid-June 2007 and this is probably of greater concern for the future.

Maersk Oil drills world's longest well

In May 2008, Maersk Oil Qatar finished drilling the longest well (BD-04A) in the world with a length of 12.3 km, beating the 20-year-old record of the Russian Kola Peninsula exploratory well.

The well is located in the Al Shaheen Field, just offshore of Qatar in the Persian Gulf and was drilled within the reservoir target (about 1 km deep) along a horizontal section 10.9 km long and only 6 m thick.

Not only is this the longest well ever drilled, it is also the longest horizontal well ever drilled.

The well is located about 180 km north of Doha, which is on the Qatar peninsular.

Al Shaheen Field is now regarded as a mature reservoir. It has 18 permanent platforms, and 131 operational production and water injection wells. The capacity is now larger than 260 000 bpd but has been constrained by OPEC quotas. It could reach 400 000 bpd over the next 5–6 years. So the world's longest well looks like a good investment.

Origin turns methane into gold

Origin Energy's record deal with Conoco Phillips, in which CP will pay up to $9.6 billion for half of Origin's coal seam gas assets, has raised the profile of Coal Seam Gas. The agreement has also killed the $13.8 billion hostile takeover by British Gas.

The 50/50 joint venture would be composed of coal bed methane development, operated by Origin Energy, and a liquefied natural gas project, operated by Conoco Phillips. As planned, the joint venture would market the LNG, primarily targeted to Asian markets, with ConocoPhillips leading the marketing venture for the first 10 years.

The worldwide increase in demand for gas resources has led to companies such as BG, Shell, BP and Chevron, to scour the world for LNG and CSG. Origin shareholders should be very pleased with the way the company has performed in the last 2 years because its market capital has risen from $5 billion in September 2006 to about $15 billion today.

Who would have predicted this outcome 2 years ago?

Record resource export earnings in 2007–08

Australia's export earnings from mineral resources increased 11% to a record $116 billion in 2007–08, according to ABARE's Executive Director Phillip Glyde when he released the June quarter 2008 issue of Australian Mineral Statistics in September 2008.

'The record earnings reflect increased export volumes for most commodities and significantly higher prices for crude oil,

LNG, thermal coal, iron ore, copper and gold,' noted Mr Glyde.

Commodities that recorded large increases in export earnings included: iron ore, up $4.8 billion (31%) to $20 billion; crude oil and condensate, up $2.2 billion (26%) to $10.5 billion; thermal coal, up $1.6 billion (23%) to $8.3 billion; manganese ore, up $1 billion (218%) to $1.5 billion; liquefied natural gas (LNG), up $632 million (12%) to $5.9 billion; refined gold, up $582 million (6%) to $10.9 billion; and metallurgical coal, up $755 million (5%) to $15.8 billion.

Major commodities that recorded declines in export earnings in 2007–08 were: nickel, down $2.1 billion (33%) to $4.2 billion; zinc, down $932 million (22%) to $3.4 billion; aluminium, down $679 million (12%) to $5 billion; and alumina, down $432 million (7%) to $5.8 billion.

Of interest is the increase in energy exports and the decline in exports for commodities that require energy intensive processing.

For free downloads of ***Australian Mineral Statistics***, visit the ABARE website (www.abare.gov.au).

The Geothermal Drilling Program launched

The $50 million Geothermal Drilling Program (the GDP) is the first program to be launched under the Federal Government's $500 million Renewable Energy Fund, which was set up this year to accelerate the development, commercialisation and deployment of renewable energy technologies in Australia. The GDP will provide grants of up to $7 million on a matching funding basis for eligible 'proof-of-concept' geothermal energy projects.

Expressions of interest are currently being sought by the Federal Government for the first round of GDP funding, with a further funding round to be announced for the 2009–10 financial year.

Proof-of-concept projects involve activities necessary to establish the technical viability of an identified geothermal reservoir. Typical activities in a proof-of-concept project include the drilling and completion of geothermal production and injection wells, and the demonstration of fluid circulation for either electricity production or direct heat use.

For more information, contact: http://www.ret.gov.au/energy/energy%20programs/renewableenergyfund/geothermal_drilling_program/pages/geothermaldrillingprogram.aspx.

Indian Giant Tata Power invests in Geodynamics

Geodynamics Limited announced in September 2008 that India's largest integrated private power company Tata Power has agreed to become a cornerstone investor in the Company.

The $37 million deal gives India's Tata Power a 10% stake in the enhanced geothermal systems company, boosting Tata Power's presence in Australia. Tata Power is part of the Tata Group, India's largest industrial conglomerate, with annual revenue of over US$80 billion.

The Group's businesses are spread over seven business sectors and comprise 96 companies, which operate on six continents and employ 350 000 people.

Under the deal, Tata Power will get a seat on the board of Geodynamics. In addition to Tata's cornerstone investment, the companies have agreed to review the potential of geothermal prospects outside of Australia.

The agreement should strengthen Geodynamics as it enters the development phase of its Cooper Basin geothermal energy project in South Australia.

It should be noted that Origin Energy is another of Geodynamics' joint venture partners.

Geodynamics is the largest ASX-listed company in Australia whose focus is on developing hot fractured rock geothermal electricity. It has a market capitalisation in excess of A$350 million and has geothermal exploration interests in three Australian states including the license for exploring 2000 sq. km of area in the Cooper Basin.

440 workers made redundant at Broken Hill

As noted above, in ABARE's Australian Mineral Statistics publication for 2007–08, the exports of zinc fell by $932 million (22%) to $3.4 billion. At the same time the price of zinc in the past year has fallen from about US$3.1/kg to US$1.8/kg.

One of the fallouts from the low price has been a drop in production by Perilya at Broken Hill, forcing a reduction in the number of employees from 760 to 320.

Under the revised operating plan for Broken Hill, announced by Perilya in August 2008, ore production will be reduced from 1.8 million tonnes to 0.95 million tonnes per annum. As a result it is expected to produce annually 55 000 tonnes of contained zinc and 50 000 tonnes of contained lead.

The company expects that the mine will be financially viable at current metal prices for at least the next 2 to 3 years.

Let's hope the prices turn around to ensure the continuation of operations at Broken Hill for many years to come.

New gravity anomaly grid and map of the Australian region

Mario Bacchin, Peter Milligan, Ray Tracey and Phillip Wynne
Geoscience Australia
Email: mario.bacchin@ga.gov.au

Geoscience Australia has recently released new gravity anomaly grids and a new full-colour Gravity Anomaly Map of the Australian Region at a scale of 1:5 million. It is the third edition of the map and replaces the 1997 edition.

Continental Australia has a basic gravity station spacing coverage of 11 kilometres, with South Australia, Tasmania and part of New South Wales covered at a spacing of 7 kilometres. Victoria has station coverage of approximately 1.5 kilometres.

Over the last 10 years Australian, State and Northern Territory governments have funded exploration initiatives for the systematic infill of the on-shore part of the continent at a grid spacing of 2, 2.5 or 4 kilometres, to provide improved coverage in areas which are of scientific or economic interest. Figure 1 gives an indication of the current coverage over the land area.

The gravity grid used to create the new edition map was produced from 1.4 million onshore gravity stations, which represents 600 000 more stations than was used for the 1997 edition and 10.5 million offshore gravity stations derived from satellite altimetry. Many of these additional onshore gravity stations were established as a result of the government exploration initiatives mentioned above.

Two grids have been produced. One grid covers the region from 8ºS to 52ºS and 100ºE to 170ºE. The other, covering the offshore areas, was sourced from the satellite altimetry dataset provided by Scripps Institution of Oceanography. Both grids have a cell size of 0.008333333 degrees (approximately 800 m). Figure 2 shows the spherical cap Bouguer Anomaly image of continental Australia, using the 'first' grid.

The final grid is a combination of Bouguer gravity anomaly values for the onshore stations and free air gravity anomaly values for the offshore regions. Figure 3 shows the spherical cap Bouguer anomalies onshore and the Free Air anomalies offshore.

The gravity grid incorporates improvements made to the Australian National Gravity Database (ANGD). In 2008, data in the ANGD were changed to the new Absolute Gravity Datum 2007 (AAGD07), which superseded the previous ISOGAL84 datum. This new gravity datum was the end result of several years work by Geoscience Australia to create an absolute datum for the Fundamental Gravity Base Station Network. Other improvements to the ANGD involved the use of ellipsoid heights relative to the GRS80 ellipsoid (instead of geoid ground heights), the closed form of the theoretical gravity formula, the closed form equation for the Bouguer correction and a second order approximation for the Free Air correction. These improvements were made to provide more accurate Free Air and Bouguer anomalies and to remove long wavelength errors from the gravity data introduced when using geoid heights in place of ellipsoid heights.

Copies of the map may be obtained from the Geoscience Australia Sales Centre (phone: 02 6249 9966 or email: sales@ga.gov.au). The gridded dataset can be downloaded free-of-charge in ER Mapper format from the Australian Government's Geophysical Archive Data Delivery System (GADDS) download facility.

For further information, phone Mario Bacchin on +61 2 6249 9308 or email: mario.bacchin@ga.gov.au.

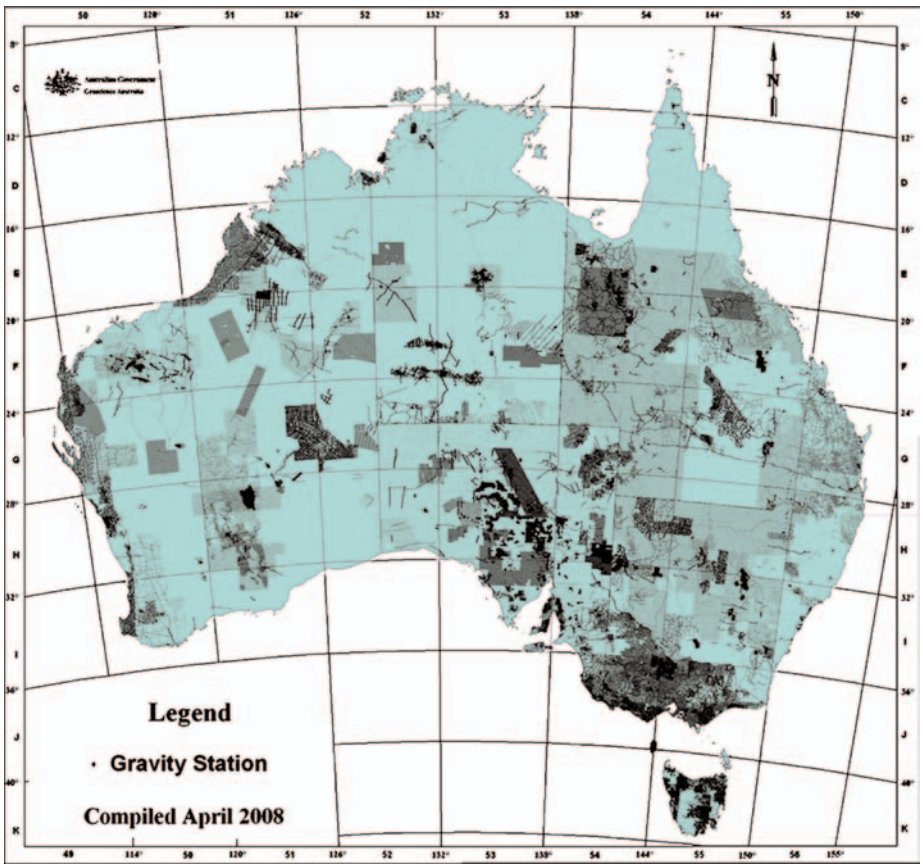

Fig. 1. *Onshore distribution of open file gravity stations at April 2008.*

Landsat Mosaic 2006 now available

Another valuable dataset recently released is the Landsat 2006 Mosaic. This unique visual record of landscape and vegetation changes in Australia now extends to 34 years, with the availability of 2006 data from the Landsat 5 and Landsat 7 satellites. Satellite images and data, spanning from 1972 to 2006, are now available from Geoscience Australia and Landsat distributors.

Data for several epochs within the 34-year time span are available in 1:1M scale tiles or as individual images of the Australian landmass. More information on the products can be found at the Landsat Mosaic (AGO) product suite page (http://www.ga.gov.au/acres/prod_ser/agosuite.jsp). AGO data has been produced by the Department of Climate Change.

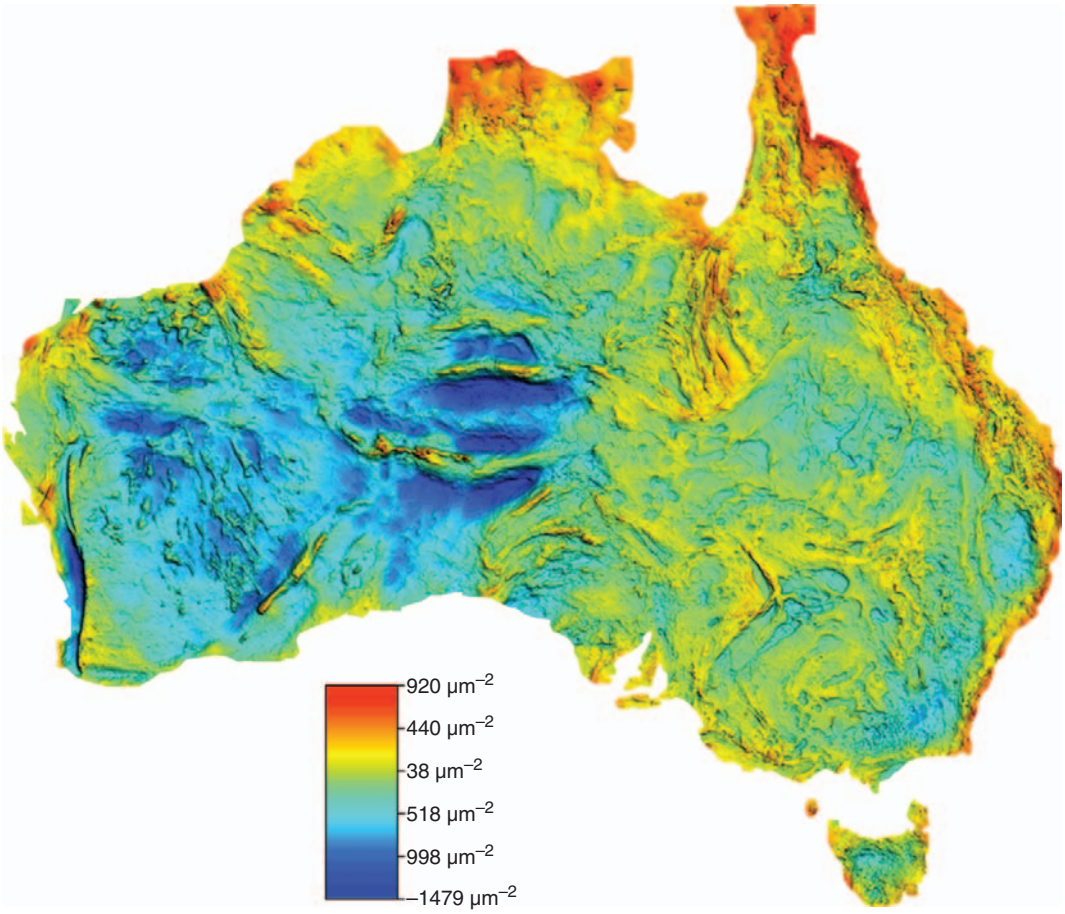

Fig. 2. *Spherical cap Bouguer Anomaly image of continental Australia. It uses a pseudo_colour colour scheme and the image is in GDA94 Geodetic Coordinates.*

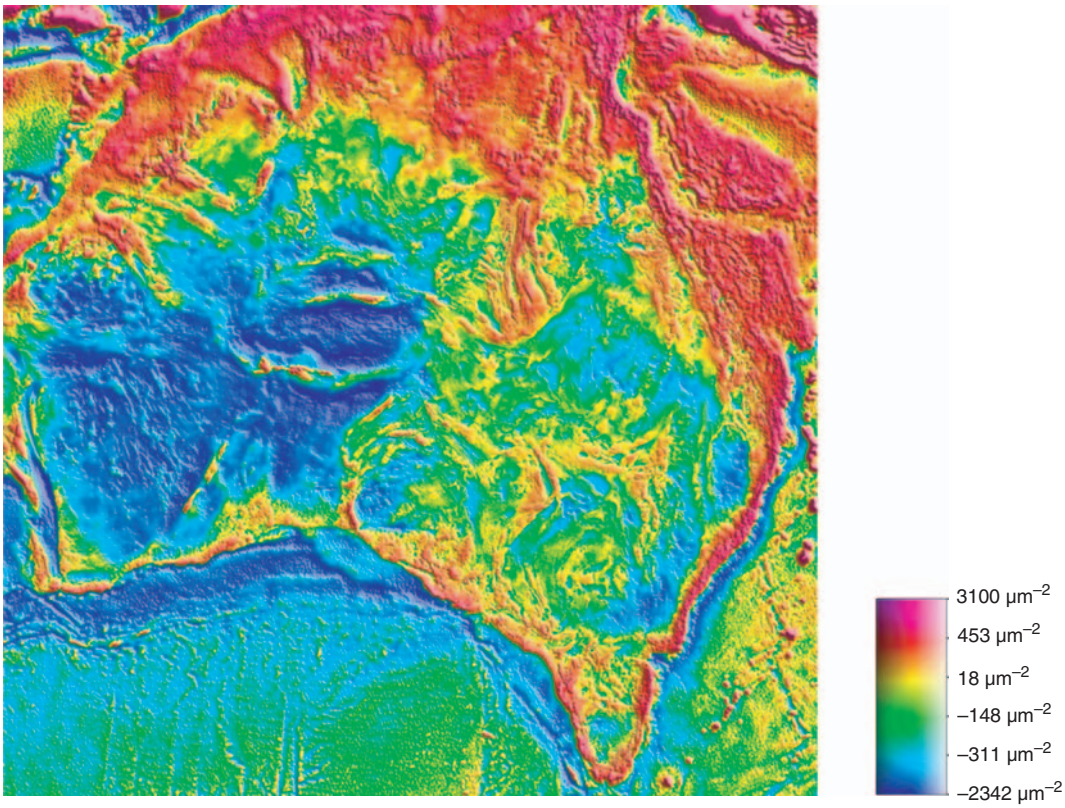

Fig. 3. *Gravity anomaly image showing Free Air anomalies offshore and spherical cap Bouguer anomalies onshore on a Lambert Conformal conic projection (see http://www.ga.gov.au/map/index.jsp#geophysics). It uses a rain-gomp colour scheme.*

News

New satellite images of Australia

For those doing any research on land surfaces, Geoscience Australia is now producing cloud-free satellite images of the whole of Australia using the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor on board the Terra and Aqua satellites.

A new image will be produced every 4 days, composed of the past 16 days worth of data, to create a single composite product of Australia. The processing of these data creates an image which is cloud-free, and has been corrected for view and sun angle effects. The composite products are available typically 3 days after the last acquisition. This period of time allows for the best available satellite positioning and atmospheric information to be used in generating the product. The product is updated every 4 days and map projections are customised so that MODIS data can be used with other spatial information.

An additional benefit of these MODIS composites of Australia is that they provide information about atmospheric conditions which can be used to improve atmospheric corrections for other imagery acquired at similar times.

MODIS composite images are available free of charge on GA's website for approximately 6 months after image acquisition. More information is available on the GA website (www.ga.gov.au).

Update on Geophysical Survey Progress from the geological surveys of Queensland, Western Australia, Northern Territory and Tasmania and Geoscience Australia (Information current at 7 September 2008)

Tables 1–3 show the continuing acquisition by the States, the Northern Territory and Geoscience Australia of new gravity, magnetic, airborne EM and radiometric data over the Australian continent. All surveys are being managed by Geoscience Australia. There are no new surveys but the Pine Creek AEM survey has now been split into two surveys.

Table 1. Airborne magnetic and radiometric surveys

Survey Name	Client	Contractor	Start Flying	Line-km	Spacing AGL Dir	Area (km²)	End Flying	Final Data to GA	Locality Diagram (Preview)	GADDS release
AWAGS2	GA	UTS	29 Mar 07	145 350	75 Km, 80 m N/S	7 659 861	100% complete @ 14 Dec 07	June 08	124 – Oct 06, p. 15	Dec 08
South Kimberley	GSWA	GPX	24 Jan 08	163 000	400 m, 60 m N/S	57 920	97.4% complete @ 7 Sep 08	TBA	128 – Jun 07, p. 26	TBA
Cooper Basin East	GSQ	UTS	8 Jan 08	214 352	400 m, 60 m N/S	76 980	98.0% complete @ 7 Sep 08	TBA	130 – Oct 07, p. 29	TBA
Cooper Basin West	GSQ	Fugro	8 Nov 07	N–S lines 161 088 E–W lines 47 993	400 m, 60 m N/S & E/W	N–S lines 57 700 E–W lines 16 710	71.5% complete @ 7 Sep 08	TBA	130 – Oct 07, p. 29	TBA
Normanton	GSQ	Thomson	25 Apr 08	114 487	400 m, 80 m E/W	74 410	76.4% complete @ 7 Sep 08	TBA	132 – Feb 08, p. 23	TBA
Cooper Basin North	GSQ	GPX	End Sep 08	166 373	400 m, 80 m E/W	59 480	TBA	TBA	134 – Jun 08, p. 22	TBA
Offshore NW Tas	GA	Fugro	21 Jan 08	43 824	800 m, 90 m E/W	27 512	100% complete @ 6 Apr 08	28 May 08	132 – Feb 08, p. 24	5 Aug 08
Offshore SW Tas	MRT	Fugro	15 Jan 08	26 554	800 m, 90 m E/W	16 745	100% complete @ 3 Mar 08	28 May 08	132 – Feb 08, p. 24	5 Aug 08
South-West Catchment Council – Dumbleyung	GSWA, DAFWA and SWCC	Fugro	7 Mar 08	74 360 total (67 583 @ 100 m spacing and 6777 @ 400 m spacing)	100 m, 30 m NS and 400 m, 60 m NS	7783 total (100 m lines: 5948; 400 m lines: 1835)	83% complete @ 7 Sep 08	TBA	132 – Feb 08, p. 24	TBA
Byro	GSWA	GPX	3 Apr 08	83 855	400 m, 60 m E/W	29 750	100% complete @ 7 Sep 08	25 Sep 08	133 – Apr 08, p. 20	TBA
Balladonia	GSWA	TBA	TBA	43 449	400 m, 60 m E/W	14 960	TBA	TBA	134 – Jun 08, p. 22	TBA
Esperance	GSWA	Thomson Aviation	End Sep 08	82 674	400 m, 60 m E/W	29 200	TBA	TBA	134 – Jun 08, p. 22	TBA

Table 2. Airborne electromagnetic surveys

Survey Name	Client	Contractor	Start Flying	Line-km	Spacing AGL Dir	Area (km²)	End Flying	Final Data to GA	Locality Diagram (Preview)	GADDS release
Paterson	GA	Fugro	8 Sep 07	28 367	1000 & 2000 m for GA; 200 m–666 m company infill; 120 m; E/W & SW/NE North & South, respectively of the Rudall River NP	33 950	99.2% complete @ 7 Sep 08 Recommence 27 May 08 after demobilising on 30 Nov 07	TBA	130 – Oct 07, p. 30	TBA
South-West Catchment Council: Darkan – Wagin	GSWA, DAFWA and SWCC	Geoforce	10 Jun 08	1127	300 m N–S	288.6	21 Jun 08	TBA	133 – Apr 08, p. 20	TBA
Pine Creek (Kombolgie)	GA	Geotech Airborne	21 Aug 08	9350	1666 & 5000 m for GA; 200 m–1000 m company infill; E/W flight lines; Flying height 30 m	28 884	TBA	TBA	133 – Apr 08, p. 21	TBA
Pine Creek (Woolner & Rum Jungle)	GA	TBA	TAB	20 820	1666 & 5000 m for GA; 200 m – 1000 m company infill; E/W flight lines; Flying height 120 m	43 528	TBA	TBA	133 – Apr 08, p. 21	TBA

Table 3. Gravity surveys

Survey Name	Client	Contractor	Start Survey	No. of stations	Station Spacing (km)	Area (km²)	End Survey	Final Data to GA	Locality Diagram (Preview)	GADDS release
Westmoreland – Normanton	GSQ	Integrated Mapping Technologies	TBA	5977	4 regular	95 620	100% complete @ 17 Aug 08	TBA	133 – Apr 08, p. 21	TBA
Central Arunta	NT	Atlas Geophysics	6 May 08	9958 in Area A & a possible 1128 in Area B	4 regular with selected areas for infill at 500 m to 2 km	97 600	100% complete @ 7 Aug 08	TBA	133 – Apr 08, p. 21	TBA
West Musgrave	GSWA	Daishsat	1 May 08	1674 in Area A & a possible 2277 in Area B	2.5 km regular	24 340	100% complete @ 6 June 08	July 08	133 – Apr 08, p. 21	7 Aug 08
Windimurra	GSWA	Atlas Geophysics	30 Jul 08	6066	2.5 km regular	~30 000	TBA	TBA	135 – Aug 08 p. 16	TBA

TBA: To be advised

Seismic surveys

As part of the Onshore Energy Security Program (OESP) and with the cooperation of Primary Industries and Resources South Australia (PIRSA), Geoscience Australia has carried out a deep crustal seismic reflection survey in South Australia. The seismic survey was completed on 23 July with a total of 576 km data acquired. The survey included three lines, one across the Gawler Province (254 km), one across the Curnamona Province (262 km) and one in the Arrowie Basin (60 km) (Figure 4). The wide-angle refraction seismic survey coincident with Gawler line and focused on the central section of this traverse was carried out to supplement a deep seismic reflection study. A Magnetotelluric survey was also completed along the Gawler line and is planned to be conducted along the Curnamona line at the end of October. The data collected will help to assess uranium, geothermal energy and hydrocarbon resource potential in these regions of South Australia.

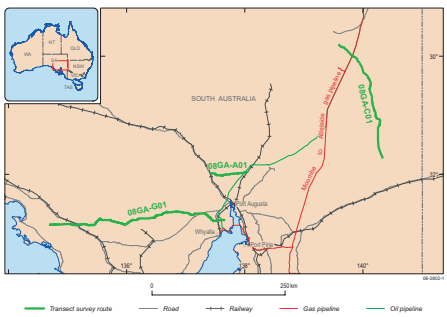

Fig. 4. *Gawler–Curnamona–Arrowie seismic survey location map.*

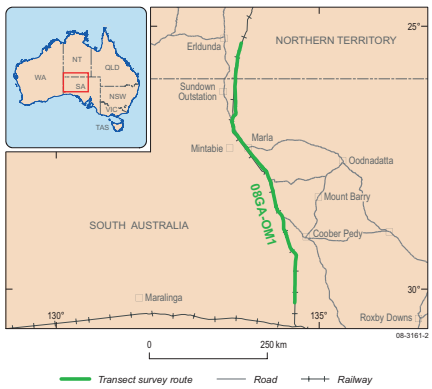

Fig. 5. *Location of the proposed traverse for the Gawler–Officer–Musgrave–Amadeus (GOMA) seismic survey.*

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The next survey to be conducted by Geoscience Australia is planned for October–November this year and will consist of one continuous traverse crossing from the Gawler Province, across the Officer Basin to the Musgrave Block and into the Amadeus Basin in the Northern Territory (Figure 5). This traversed is planned to be approximately 610 km in length and is jointly funded by GA, AuScope and PIRSA.

For more information contact Jenny Maher +61 2 62499896, jenny.maher@ga.gov.au

Victoria's resources sector on show

Victoria's resources sector and its potential for major mineral and energy discoveries were on show to the world at the Resources Victoria 2008 Conference in Melbourne in August. With world-class reserves of gold, natural gas, oil, coal, mineral sands and renewable energies, among a range of other high-potential minerals, Victoria is already attracting national and international investor interest.

In opening the Conference the Victorian Minister for Energy and Resources, Peter Batchelor, said the three day conference 'will provide a unique opportunity to showcase the abundant resources and investment opportunities available in Victoria to new and existing investors from Australia and around the world'. 'Victoria offers many opportunities for investors through great access to undeveloped resources and ready access to new technologies,' Mr Batchelor said. 'The exploration sector in Victoria has been strong in recent years and investors are looking at Victoria with great interest, as we have seen recently in significant developments such as Woodside's Otway gas, Origin's BassGas, Iluka's Douglas mineral sands and Lihir's Ballarat gold projects.'

The $5 million *Rediscover Victoria* initiative, in which early stage exploration data is being provided to the resources industry as a precursor to exploration, is already creating considerable interest. The program offers drilling assistance funds and innovative 3D data programs facilitating further developments.

Mr Batchelor said the resources industry was worth more than $3.4 billion to the Victorian economy and employed more than 10 000 people. 'Victoria still has many undiscovered and untapped resources available,' he said. 'Development of these resources, such as the emerging geothermal energy and mineral sands mining opportunities, not only benefit Victorian industry, but will also have more wide-ranging benefits to local economies and communities.'

The latest data and information from GeoScience Victoria and the *Gold Undercover* and *Rediscover Victoria* initiatives was released at the conference and is available from www.dpi.vic.gov.au/minpet/store.

Victorian MT survey

The basic principle of the magnetotelluric (MT) method relies on the propagation of plane-wave EM fields from the relatively non-conductive air into the comparatively highly conductive earth. The amplitude and phase relationships of the electric and magnetic fields at the surface are dependant on the electrical properties of the subsurface within which the EM fields propagate, thus allowing the conductivity of the underlying surface to be investigated. The technique therefore has little environmental impact, which is an appealing aspect of the MT approach.

The Korean Institute of Geoscience and Mineral Resources (KIGAM), the Japanese National Institute of Advanced Industrial Science and Technology (AIST) and Monash University carried out an MT survey north of Bendigo between 27 April and 9 May, as part of the Victorian Government's Gold Undercover Initiative 2007 (www.dpi.vic.gov.au/minpet/goldundercover) (Figure 6).

The MT survey was designed primarily to provide data to investigate the structural setting of gold mineralisation in Central Victoria by delineating subsurface structures based on resistivity profiles. At the same time, it provides an opportunity to compare the electromagnetic responses of subsurface structures with results from a seismic reflection survey carried out by GSV in collaboration with the predictive mineral discovery cooperative research centre (*pmd**CRC) in 2006.

MT data for 71 sites on three survey lines were obtained during an 11-day period. At

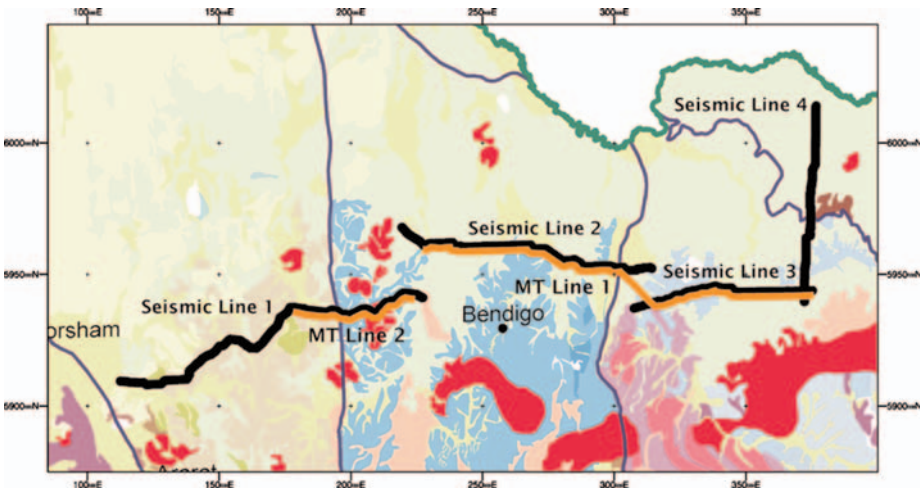


Fig. 6. *1:4 million scale geology with Structural Zone boundaries in blue, seismic/gravity/VTEM lines in black and MT lines in orange.*

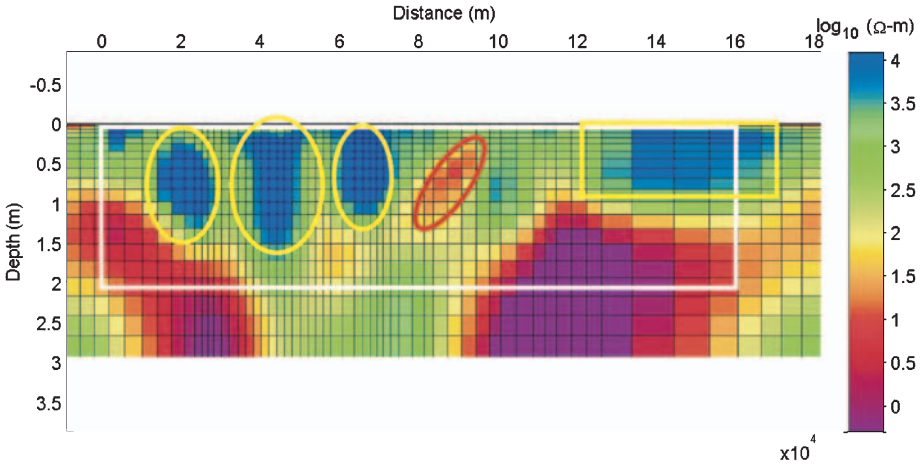


Fig. 7. *Example of a 2D inversion of MT data from Line 1.*

Continued on p. 27

Victorian Geophysics – a long line of results

Paul McDonald[1], James Macnae[2] and Bob Smith[3]
[1]*GeoScience Victoria, Department of Primary Industries (DPI)*
[2]*RMIT University*
[3]*Greenfields Geophysics*

Four helicopter-borne VTEM traverses (381 line kilometres in total) were recently flown in west/central Victoria (Figure 8) to map resistive/conductive geology, as part of the Victorian Government's Gold Undercover Initiative (www.dpi.vic.gov.au/minpet/goldundercover). The data were acquired coincident to a deep seismic reflection profile, which was conducted in June 2006 to define the geometry of major faults and provide a crustal scale context for mineralisation (see *Preview* 135, August 2008, pp. 17–18).

Fig. 8. *Location of VTEM traverses (red lines).*

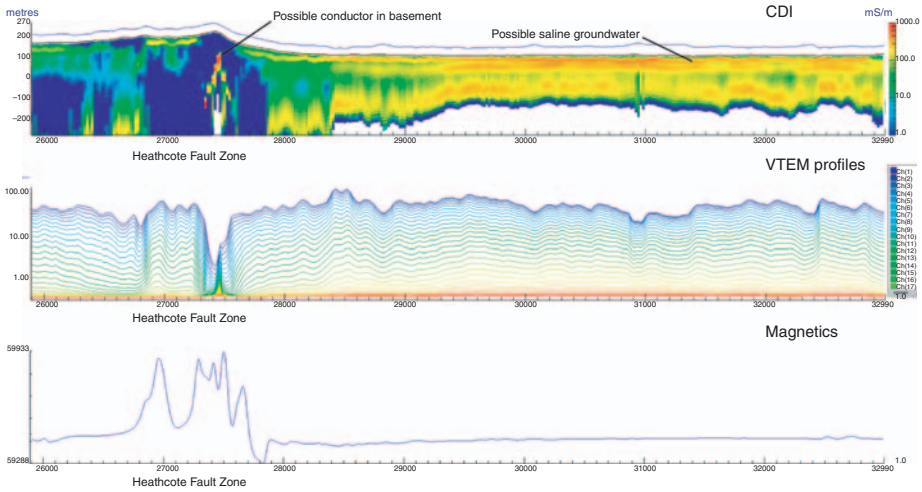


Fig. 9. *VTEM and magnetic data from part of Line 2.*

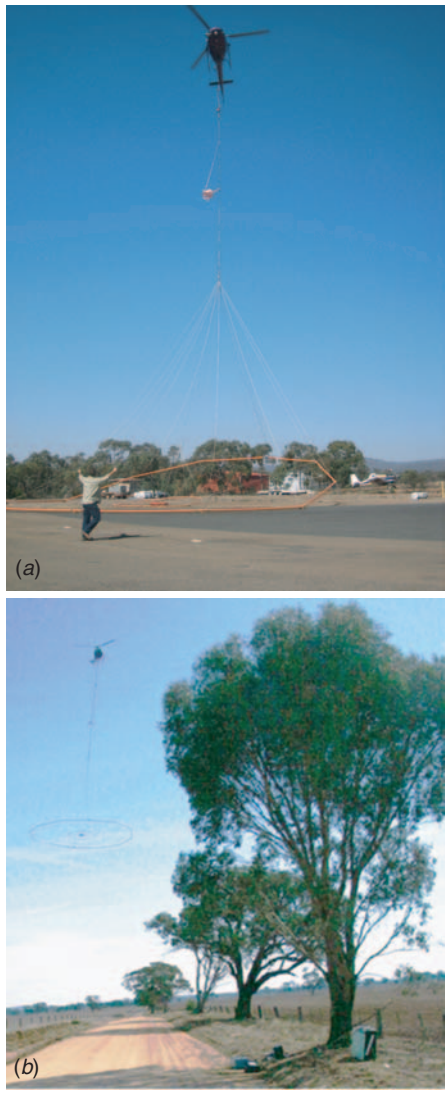


Fig. 10. *(a) VTEM takes off at Stawell Airport. (b) VTEM with its towed 26 m loop flies down Sweeney's Lane at the Eastern end of Line 1 with the RMIT monitoring station set up under the tree.*

Continued on p. 33

Continued from p. 26

each site, two electric field components (Ex, Ey) and three magnetic field components (Hx, Hy, Hz) were simultaneously recorded. Measurements were made for 15-hour periods on average, from 1700 to 0800 hours the next day in local time. The receiver system had an internal clock, which was synchronized with a GPS unit.

Structures associated with known faults are evident in the measured MT data indicating an adequate resolution of the subsurface structure. Numerous pseudo-sections and 2D inversion models have been produced showing local anomalies in the region, whilst also allowing an overall trend consistent with the seismic section (Figure 7).

Additional MT data are currently being collected to investigate possible extensions of the major fault structures and mineralisation under surface cover in the northern part of the Bendigo Zone.

An interim report on the MT data acquired to date is available from DPI's online store (www.dpi.vic.gov.au/minpet/store). For more information about this survey please contact Peter at peter.o'shea@dpi.vic.gov.au.

Peter O'Shea

GeoScience Victoria (GSV), Department of Primary Industries (DPI).

Hyperspectral and ASTER mineral maps of Queensland now available

Mal Jones[1,5], Tom Cudahy[2], Matilda Thomas[3] and Carsten Laukamp[4]

[1]*Geological Survey of Queensland*
[2]*CSIRO Exploration and Mining*
[3]*Geoscience Australia*
[4]*James Cook University*
[5]*Email: mal.jones@dme.qld.gov.au*

The Department of Mines and Energy is mid-way through the Smart Exploration and Smart Mining programs to collect new data to assist mineral exploration in Queensland. Hyperspectral surveys make up an important part of initiatives to improve the geological knowledge of the state. Other complimentary geophysical acquisition programs include new airborne radiometric and magnetic coverages, and ground-based deep seismic, magnetotellurics, and gravity data.

The hyperspectral surveys sponsored by the Department were flown in 2006 and 2007 by HyVista Corporation using their HyMap Short Wavelength Infra Red sensor. The data were processed by CSIRO Exploration and Mining in Perth, resulting in more than 20 mineral and other image products per survey block (Table 1). Twenty-five areas were surveyed, each comprising a swath 15 km wide, and ranging in length from 25 to 100 km (Figure 1).

Table 1. Image products from the hyperspectral survey, available in *ecw* and *jp2* formats from www.em.csiro.au/NGMM (select the 'Precompetitive Data Download' option)

Airborne HyMap images		
Natural colour	White mica abundance	MgOH content (abundance)
False colour	White mica composition	MgOH composition
Green vegetation	White mica crystallinity	MgOH and Ferric iron
Dry vegetation	Al smectite content (abundance)	MgOH and Ferrous iron
Ferric oxide content (abundance)	Al smectite composition	Amphibole-chlorite
Ferrous iron abundance (in silicates and carbonates)	Kaolin content (abundance)	Epidote content (abundance)
Opaque group	Kaolin crystallinity	Hydrated silica
Water and mica		

The 2006 survey collected over 8000 km^2 of data from the Mount Isa region. The resulting image maps (Table 1) are available for free download from www.em.csiro.au/NGMM. The 2007 survey provided additional coverage of the Mount Isa region, as well as extending further afield to the Georgetown, Hodgkinson and Charters Towers regions, comprising a total area of 16 750 km^2 (Figure 1). The images from this survey will be added to the website when they are completed in the last quarter of 2008.

Mal Jones

With a pixel size of 4.5 m, the hyperspectral surveys provide high resolution imagery, including natural and false colour landscape mosaics, and various derived products showing the distribution of minerals such as mica, kaolin, amphibole and epidote. Images showing compositional variations in minerals such as white mica are also available.

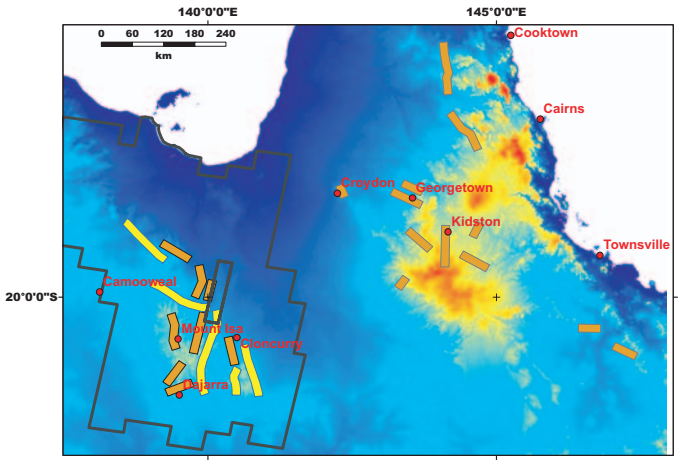


Fig. 1. *Hyperspectral coverage in north Queensland. Stage 1 surveys in yellow are now available. The remainder will be released in late 2008. ASTER mosaic extent shown in black.*

The survey lines are located along significant structural features such as the Termite Range, Pilgrim and Cloncurry Faults in the Mount Isa area. They also cover significant mineralised regions such as the iron oxide–copper–gold province south-west of Cloncurry, and the gold fields of the Croydon, Georgetown, Kidston and Pajingo areas. Skarn deposits such as Red Dome (Cu–Au–Ag) lie within the coverage area along the Palmerville Fault in north Queensland. Hence the coverage spans a range of geological provinces, ages and deposit types.

The images provide explorers with a mineralogical framework to assess their mineralisation models. Rather than looking for simple anomalies to target, the hyperspectral images allow the explorer to consider likely fluid pathways, temperatures and pressures of mineralising fluids, and fluid-host rock interactions that may be conducive to mineralisation.

The images derived from the survey data show the distribution (abundance) of various minerals across the landscape and can provide compositional information as well for some types. One of the most useful is the ability to map the cation substitution in white mica, which corresponds with the transition from paragonite (sodium rich), to muscovite (potassium rich), to phengite (iron–magnesium rich). Along the Cloncurry Fault (Figure 2), the mica composition image distinguishes the muscovite rich Soldiers Cap Group in the east, from the Squirrel Hills Granite in the west. Both of these units are shown to have high potassium content on the radiometrics image, but the hyperspectral data indicate that the potassium is contained in different minerals in each unit. The mica composition also shows a narrow area of phengitic mica in the Squirrel Hills Granite, which may relate to a previously unrecognised fault. This example demonstrates the usefulness of hyperspectral image maps on their own, and in conjunction with other datasets including airborne radiometrics, geological maps and structural features.

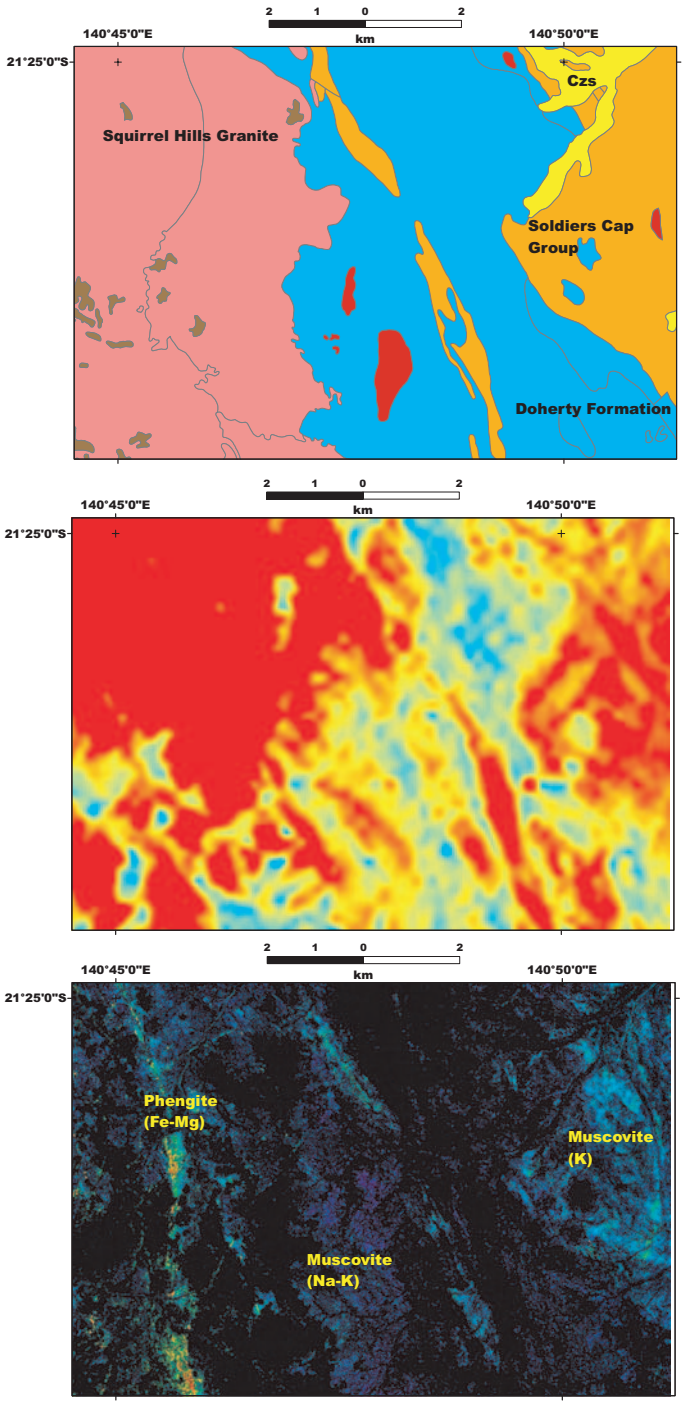


Fig. 2. *Geology (top), potassium image (centre) and hyperspectral mica composition (bottom) over the Cloncurry Fault south of Cloncurry. The mica composition image shows that the Soldiers Cap Group is rich in K muscovite (blue), whereas the Doherty Formation contains Na–K rich muscovite (purple). The Squirrel Hills Granite is low in K muscovite despite a high K radiometric response. It also contains a phengite–rich linear alteration zone (red-yellow) not shown on other data. The NNW oriented Cloncurry Fault passes through the centre of the region.*

Extending the value of the airborne surveys

The high resolution airborne surveys are somewhat restricted in ground coverage. However, in the Mount Isa area, the airborne data have been combined with ASTER satellite imagery to produce another set of products covering 225 000 km^2 (Figure 1). ASTER is a multi-spectral satellite with six bands in the Short Wavelength Infra Red region compared with the airborne HyMap sensor's 125. ASTER's much lower spectral resolution limits its use to identifying mineral groups rather than specific minerals that HyMap can detect. However, the recent airborne surveys provide an opportunity to validate the satellite data. The HyMap surveys in the Mount Isa region have been used to calibrate ASTER imagery and deliver 14 image map mosaics covering the Mount Isa Inlier and surrounding areas (Figure1; Table 2).

Table 2. List of image products from the ASTER mosaic of the Mount Isa Region, available in *ecw* and *jp2* formats from www.em.csiro.au/NGMM (select the 'Precompetitive Data Download' option)

ASTER satellite images		
False colour	Ferric oxide abundance	AlOH group
Green vegetation	Ferrous iron abundance	AlOH group composition
CSIRO regolith ratios	Opaque group	Advanced argillic group
Ferrous iron with MgOH	Fe-OH group	MgOH group
Ferric iron with MgOH		MgOH group composition

The image maps produced from the airborne and satellite data have generated much interest in the exploration community. Workshops held in Brisbane and Townsville in 2007, and in Perth in 2008 have been well attended. Explorers in the Mount Isa area have reported that the mineral maps have been very useful for tenement evaluation and exploration planning. When the Stage 2 data are released later in 2008, more explorers will be able to take advantage of this free information covering some of Queensland's most prospective mineralised terranes.

Web-based productivity tools for geoscientists – geoscience blogs[1]

Geoscience blogs are increasing in number as more Web-savvy geoscientists discover the portability and convenience of sharing information in this way. Blogs are websites that function like journals, allowing the blogger to frequently post text and graphics and, in most cases, allowing comments on these posts. Most blogs allow readers to search the text of all entries for keywords or tags and archive the entries for easy browsing.

Get more out of your Web experience by launching a blog in your specialty, then write news@seg.org so that we can help spread the word. To learn about starting a blog by using one of several free and simple-to-use blogging sites, do an Internet search or visit Blogger Forum (http://www.bloggerforum.com), a site dedicated to helping bloggers.

Geoscience blogs

Here are some of the geoscience-related blogs that are active on the Internet. It should be noted that these blogs are published by outside sources and SEG takes no responsibility for the content in them.

SEG Geo-Mentoring (http://geo-mentoring.blogspot.com) – updated frequently, this blog is written by Bill Barkhouse, long-standing member, former SEG President, and a major advocate for developing a geophysics cyber-culture for the Society's members.

Highly Allochthonous (http://scienceblogs.com/highlyallochthonous) – updated several times per week, this blog is written by Chris Rowan, a postdoctoral student at the University of Johannesburg specialising in paleomagnetism (check out his list of geology blogs to read too).

Antimonite (http://antimonite.blogsome.com) – a new blog updated several times per week by an anonymous Swedish student of geology at the department of Geoscience at the University of Lund.

Green Gabbro (http://scienceblogs.com/greengabbro) – updated several times per week, this blog is written by Maria Brumm, a graduate student at UC Berkeley studying groundwater in tectonically active settings.

Google Lat Long Blog (http://google-latlong.blogspot.com) is updated several times per week and is written by the Google Earth and Map team to encourage geoblogging. This allows the blogger to link specific geographic information to blog entries using geotags, resulting in a type of mashup (see 'State of the Net,' April 2008, The Leading Edge). Learn more about geoblogging at http://confluence.rave.ac.uk/confluence/display/SCIRC/Geo-Blogging.

Webware winners

CNET recently announced its Webware 100 winners, selected for multiple categories from more than 1.9 million reader votes. http://www.webware.com describes Webware as online applications or services, which enable people to network and work together. Ten winners were selected in each of the 10 categories: audio, browsing, commerce and events, communication, productivity, publishing and photography, search and reference, social, utility and security, and video.

Following are some of the top winners in the Productivity category, which received about 64 000 votes. The full report is available at http://www.webware.com.

- Basecamp (http://www.basecamphq.com), a Web-based project management tool from 37signals that includes productivity tools such as a task list, shared storage space, message boards, and calendaring. The service is known for fitting personal and group organisations together.
- Remember the Milk (http://www.rememberthemilk.com) beta, a task list that is well integrated with several mobile devices and Google Calendar and contacts. The list can be accessed online using a mobile device or a computer, and it can be exported for offline portability.
- I Want Sandy (http://iwantsandy.com), an automated email assistant that allows users to email 'Sandy' with a small message to set up an email reminder or calendar appointment. The service, which also works with the microblogging service Twitter, scans the text and converts it into an email reminder or appointment to be sent back to the user and any other users copied on the message at the right time.
- 30 Boxes (http://30boxes.com), an online calendaring tool that allows the user to create calendar events by typing sentences the tool converts into events through keyword recognition.
- Google Docs and Spreadsheets (http://docs.google.com), a Web-based collaborative office suite that allows creation and sharing of documents with other Google account holders and allows multiple users to work on the same document at the same time. Files are stored on the Internet so that they can be accessed from anywhere.
- Microsoft Office Live Workspace (http://workspace.officelive.com), a place to share Office documents and important files between multiple users. These documents can have various privacy controls and alerts when other users are editing them; they also can allow work on the same document at the same time.
- Zoho (http://zoho.com), a tool with more than 20 Web-based productivity applications similar to what Google is offering, and also with some SMB applications including a CRM tool, invoicing service, and a recruiting tool.
- Mint (http://mint.com), an online financial management service that can interface directly with bank and credit card companies to keep accounts up-to-date without having to visit multiple sites. The user can set up emails for low balances and other types of alerts.
- Google Calendar (http://google.com/calendar), an online calendar, which lets users add or share events in multiple calendars and access them on a mobile phone or using Google's Gmail.
- Yahoo Calendar (http://calendar.yahoo.com), a free day, week, month, and yearly planning tool that lets Yahoo account holders create their calendar and share it with others. The tool includes reminders to email and mobile phones.

[1]This article was compiled by Andrew Long, our Web Waves Editor, and is an excerpt from 'State of the Net', authored by Sylvie Dale (sdale@seg.org) in The Leading Edge, June 2008, 728–729.

Blast off: scientific adventures at the dawn of the Space Age

by Ken McCracken

Publisher: New Holland Publishers, 2008, 302 pp.
RRP: $24.95, ISBN: 78174110 6442 (paperback)

We can be very grateful to Ken McCracken for presenting us with this most enjoyable book of autobiographical reminiscences. For some, looking back, it will be a sentimental narrative, a period piece by which to gauge lives over the same period and to be reminded again about the remarkable developments of the second half of the 20th century in the exploration of space. For others, whose responsibility it is to look forward, there is a great amount to learn from the experience recounted. Especially at this time of reduced interest amongst the young in maths and physics, not to mention the dangers of a post-rational age amongst youngsters moulded by computer games, Harry Potter, and the fantasy of modern movies, what better way to lay out the excitement that the real world can offer, than in the amazing story which McCracken tells here.

McCracken is known to ASEG members for his science looking down into the solid Earth. He was appointed in 1970, about the time the ASEG was founded, to establish the new CSIRO Division of Mineral Physics. Early concentration was on time-domain electromagnetic methods. The considerable benefits of that Division and its outgrowths, and the people whose experience grew with it, have been a major factor in building the present strong mineral exploration reputation of Australia. McCracken's next step was as Director of the CSIRO Office of Space Science and Applications, with the speciality of remote sensing of Earth by satellite images. Later, he was a key contributor to the successful efforts in Australia to develop airborne gravity gradiometers. Thus the contributions of Ken McCracken to Australian science and technology have been huge, and he has been recognised by the award of medals and prizes at the highest level and by fellowships in prestigious institutions.

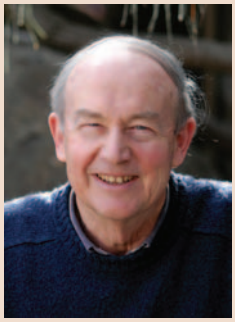
The book, however, focuses particularly on his time earlier in life, as a rocket scientist. Here the term means a scientist whose specially designed instruments are carried by rockets. Not that the young McCracken's interests did not also involve experiments with the basic hardware of home-made rockets, tested with home-made fuels; one of his many good stories is about one such experiment as a teenager, when all the fuel fired a little too simultaneously.

As an Honours student at the University of Tasmania in the mid 1950s, he became involved in cosmic ray research, and in particular the construction of equipment to detect cosmic rays. The hands-on ability which he had naturally, and which was developed more during this time, was to stand him in very good stead indeed, as within 10 years he was designing and constructing such equipment to go as far from Earth as any equipment had yet been. The launch in 1966 of the rocket carrying the Pioneer 7 spacecraft, on the front cover of the book, thus marks a climax of this part of his career. From the time he arrived at MIT in Boston as a young post-doctoral fellow in 1959, till his acceptance of the CSIRO job some 10 years later via university appointments in Dallas and Adelaide, he describes an amazing period in the circumstances of pioneering space research. This period was fertilised by the International Geophysical Year of 1957–58, fuelled by the competition between USA and the USSR in the conditions of the Cold War, and made possible by the rapid development of electronics and computers. Highlights for McCracken, described in non-technical language in the book, include the demonstration of the character of the solar wind by the arrival angle of the radiation guided by it to Earth. Another remarkable first was achieved later, in 1969, when McCracken could look out to an array of his radiation detectors spread around the solar system on the Pioneer spacecraft. Amongst these highlights are many others, including instruments carried by rockets from Woomera, and high-altitude balloons. The stories, told with a great sense of humour, have a serious message regarding how fertile a new field may be if the first people in it have the power to think clearly, laterally and fast.

McCracken says he was fortunate to be in the right place at the right time. To that I would add that he was also very strongly the right person to be in the right place at the right time. A lot of his good fortune has been of his own making, in his dedication to the task and to the people at hand, and through working very hard with a prodigious amount of energy. McCracken demonstrates how to get a lot out by putting a lot in; fortunate will be young people who can learn this principle from his very readable book.

One aspect of the style of presentation of the book worried me. At the start of each chapter, and throughout, the author's punch lines are taken out of context, and writ large in italics. Perhaps the publisher has done this to appeal to a potential buyer flicking thorough the book, but to me it is a distraction which does not do the book justice. The gems in the text are many, and all are best found in the normal context of reading.

There is a good Foreword by Barry Jones. Buy the book. Read it. Lend it. Give it. Spread the word. It is in everybody's interests to do so.



Reviewed by Ted Lilley
ted.lilley@anu.edu.au

Advances in discrete tomography and its applications

Edited by Gabor T. Herman and Attila Kuba

Publisher: Birkhauser, 2007, 302 pp.
RRP: $181.95, ISBN: 9780817636142

This recently published book on discrete tomography consists of 16 chapters, each written by a separate subset of authors drawn from a pool of 40 experts in the field. Unlike some edited volumes I have come across that purport to span a scientific discipline, this one is quite well structured, minimises repetition, and manages to present a coherent set of chapters that come together to form a well balanced book.

The definition of discrete tomography provided in the introductory chapter is very broad:

Determine some unknown function f, defined by a discrete set of (usually) real numbers, from weighted sums or integrals taken over subsets or subspaces of its domain.

In the case of seismic tomography, for example, the unknown function might be P-wave velocity, with travel-time corresponding to integrals taken over a subspace of its domain (i.e. the integral of slowness along a ray path). Despite this broad definition, the editors claim that the last 7 years have produced of the order of 200 papers on the subject, which seems surprisingly few. However, on reading through the book, it soon becomes clear that the term 'discrete tomography' in fact refers to quite a specific area of a much larger field, which would normally include various classes of geophysical imaging such as seismic tomography.

The underlying theory and applications presented in the various chapters of this book address the sort of problems that might be encountered in material science, image processing and biomedical imaging. Although much of the mathematics developed is relevant to geophysical problems, the approach that is taken is very different to what readers of *Preview* might be used to. In particular, I found much of the theory reminiscent of my time doing pure mathematics as a university student, with many theorems, lemmas and corollaries; I suspect that many geophysicists would find this tough going.

The book is divided into three parts: the first deals with the foundations of discrete tomography (essentially the theoretical section); the second with reconstruction algorithms, and the third with applications. The reconstruction techniques presented include decomposition algorithms, network flow algorithms, convex programming and variational reconstruction. These types of approach are used in medical imaging and computer science, but not directly in geophysical problems, although there is overlap. For example, in Chapter 11 on variational reconstruction with DC programming, the basic aim is to solve a large underdetermined linear system of equations $A\mathbf{x} = \mathbf{b}$. This problem would be familiar to many, but in this case, the vector of unknown $\mathbf{x}$ happens to be binary, which makes the problem more difficult to solve. On the other hand, the field of discrete tomography does not appear to deal with non-linear inverse problems, unlike seismic tomography which can be highly non-linear.

Five different applications of discrete tomography are presented in Part III of the book. These include image reconstruction in electron microscopy, generating grain maps of polycrystals, industrial non-destructive testing of objects (usually with X-rays), emission tomography (rays are emitted from the object, rather than transmitted through it), and computerised tomography (standard type of medical imaging). Although each of these chapters is fascinating in its own right, their relevance to geophysicists with no specialisation in tomography is limited. In fact, my general recommendation for this book, despite its many good points, is that it is simply too disconnected from the field of geophysical tomography to be of interest to most earth scientists.

Copies can be ordered online at http://www.springer.com or through your local bookstore.

Reviewed by Nick Rawlinson
nick@rses.anu.edu.au

Continued from p. 27

The VTEM data mapped the ground conductivity/resistivity across a broad swathe of northern Victoria, along the southern margins of the Murray Darling Basin. Areas of shallow basement were indicated by relatively high resistivities, while in other areas the data were mainly influenced by groundwater conductivity, possibly reflecting salinity. Basement conductors were detected (Figure 9).

Other geophysical datasets that already exist along this profile include; seismic reflection, ground gravity, detailed airborne magnetics, detailed airborne radiometrics and magnetotellurics.

The VTEM survey was conducted by GeoTech Airborne Pty Ltd (Figures 10 and 11) and supervised by Greenfields Geophysics in April 2008. The final data and report are available from DPI's online store (www.dpi.vic.gov.au/minpet/store).

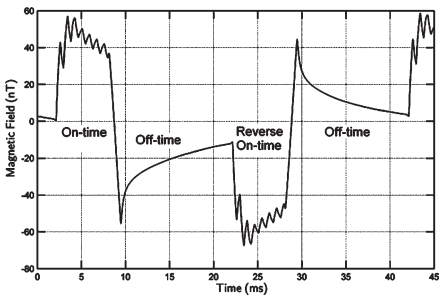


Fig. 11. *Magnetic field measured in the RMIT ground B field sensor as the VTEM system approaches. The slow decay seen in the transmitter off-times indicates the presence of very conductive sediments at this location.*

To add value to the VTEM dataset, RMIT University trialled prototype E field and B field sensors in association with the survey. These data were collected on the ground during an overflight (Figure 11) and will later be combined with the VTEM data to:

1. check the calibration of the VTEM system, thereby increasing confidence in the final results,
2. provide quantitative measurements of how distant (and by inference how deep) the VTEM can be detected, and
3. contribute to research aiming to increase the depth of penetration of AEM systems in future.

For more information about this survey please contact Paul McDonald at paul.a.mcdonald@dpi.vic.gov.au.

November			**2008**
9–14 Nov	SEG International Exposition and 78th Annual Meeting http://seg.org/meetings/	Las Vegas	USA
24–27 Nov	Pacrim Congress 2008 www.ausimm.com.au/main/events/docs/pacrim2008.pdf	Gold Coast	Australia
28 Nov	5th South Australian Explorers Conference www.pir.sa.gov.au/minerals/events	Adelaide	Australia
December			**2008**
15–19 Dec	American Geophysical Union, Fall Meeting www.agu.org/meetings	San Francisco	USA
February			**2009**
22–26 Feb	**ASEG's 20th International Conference and Exhibition** **www.aseg.org.au**	Adelaide	Australia
March			**2009**
29 Mar–2 Apr	22nd SAGEEP meeting (Symposium on the Application of Geophysics to Engineering and Environmental Problems) www.eegs.org/pdf_files/sageep09_abstractcall.pdf	Fort Worth	USA
April			**2009**
24–27 Apr	CPS/SEG Beijing 2009 International Geophysical Conference and Exposition http://seg.org/meetings	Beijing	China
May			**2009**
24–28 May	American Geophysical Union, Joint Assembly www.agu.org/meetings	Toronto	Canada
31 May–3 Jun	2009 APPEA Conference & Exhibition www.appea2009.com.au	Darwin	Australia
June			**2009**
8–11 Jun	71st EAGE Conference & Exhibition www.eage.org/	Amsterdam	The Netherlands
September			**2009**
7–9 Sep	EAGE: Near Surface 2009 www.eage.org/	Dublin	Ireland
October			**2009**
25–30 Oct	SEG International Exposition and 79th Annual Meeting http://seg.org/meetings	Houston	USA
December			**2009**
14–18 Dec	American Geophysical Union, Fall Meeting www.agu.org/meetings	San Francisco	USA

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

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All editorial contributions should be submitted to the Editor by email at denham@webone.com.au. For style considerations, please refer to the For Authors section of the Preview website at: www.publish.csiro.au/journals/pv.

Preview is published bi-monthly in February, April, June, August, October and December. The deadline for submission of material to the Editor is usually about the 15th of the month prior to the issue date. The deadline for the December 2008 issue is 7 November 2008. Advertising copy deadline is usually about the 22nd of the month prior to issue date. The advertising copy deadline for the December 2008 issue will be 14 December 2008.

ASEG 2007 WINE OFFER

The ASEG SA Branch is pleased to be able to present the following wines to you after tasting a field of wines in an acceptable price range. These wines were found by the tasting panel to be enjoyable drinking and excellent value. The price of each wine includes bulk delivery to a distribution point in each capital city in late November/early December. Stocks of these wines are limited and orders will be filled on a first-come, first-served basis.

Please note that this is a non-profit activity carried out by the ASEG SA Branch committee and is **only available to ASEG Members**. The prices have been specially negotiated with the wineries and are not available through commercial outlets. Compare prices if you wish but you must not disclose them to commercial outlets.

Hardys Nottage Hill 2006 Cabernet Shiraz

The Nottage Hill 2006 Cabernet Shiraz is dark crimson with a red rose hue, this wine displays bright cassis and dark cherry notes with subtle hints of bay leaf mixed with cigar box oak on the bouquet.

This Cabernet Shiraz blend enters the palate with intense, yet smooth, dark berry fruits of blackcurrant and cherry. These primary fruit flavours are integrated with hints of mint and vanillin oak characters. The fruit sweetness carries through the palate to merge with balanced, velvety tannins. Overall, this is a well balanced wine with integrated fruit sweetness, oak characters and fine tannin structure

3 medals won on Australian Wine Show Circuit **Retails at around $150/case**

Chain of Ponds 2005 "White Fig" Adelaide Hills Viognier

White Fig Adelaide Hills Viognier is pale straw in colour with brilliant green hues. The wine is rich and full flavoured showing ripe fig and grapefruit through the initial palate, followed by citrus and green melon towards the end. The sweet nutty oak influence is well integrated with fruit flavours producing a well balance style perfect with antipasto, white meat dishes or Asian cuisine. The finish lingers on for several minutes with a creamy yet crisp aftertaste.

International Wine Challenge 06 – Silver Award.

Retails at around $200/case

2007 ASEG WINE OFFER: orders close NOVEMBER 9th 2007

Please supply:

Number of dozens	Wine	Price per Dozen	Total
	Hardys Nottage Hill 2006 Cabernet Shiraz	**$120**	
	Chain of Ponds 2005 "White Fig" Adelaide Hills Viognier	**$110**	
		TOTAL	

Name: _____ Daytime telephone: (___) _____ Email address _____

Address: _____ Capital city for collection: _____

I would like to pay by: [ ] Cheque – payable to ASEG SA Wine Offer (enclosed)

Through on-line ordering and credit card payment at www.aseg.org.au (click on Wine Offer on Home Page); or

[ ] Visa [ ] Mastercard Card Expiry date: __ __ / __ __

Card Account number: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ Signature: _____

Note: this offer is only available to ASEG Members

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Enquiries: Jasi Watson, Fax: 08 8116 7258, email: jasi.watson@santos.com