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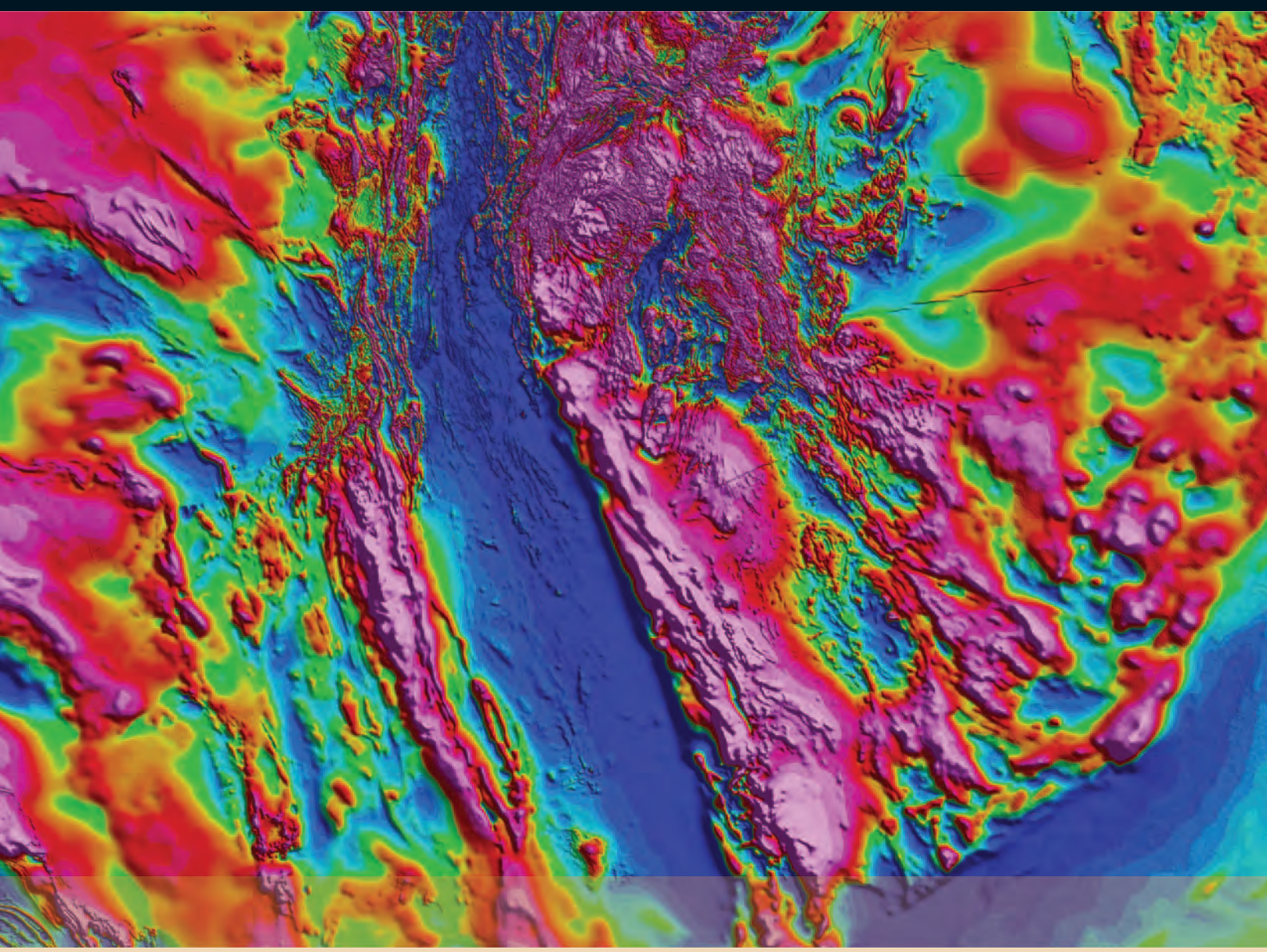
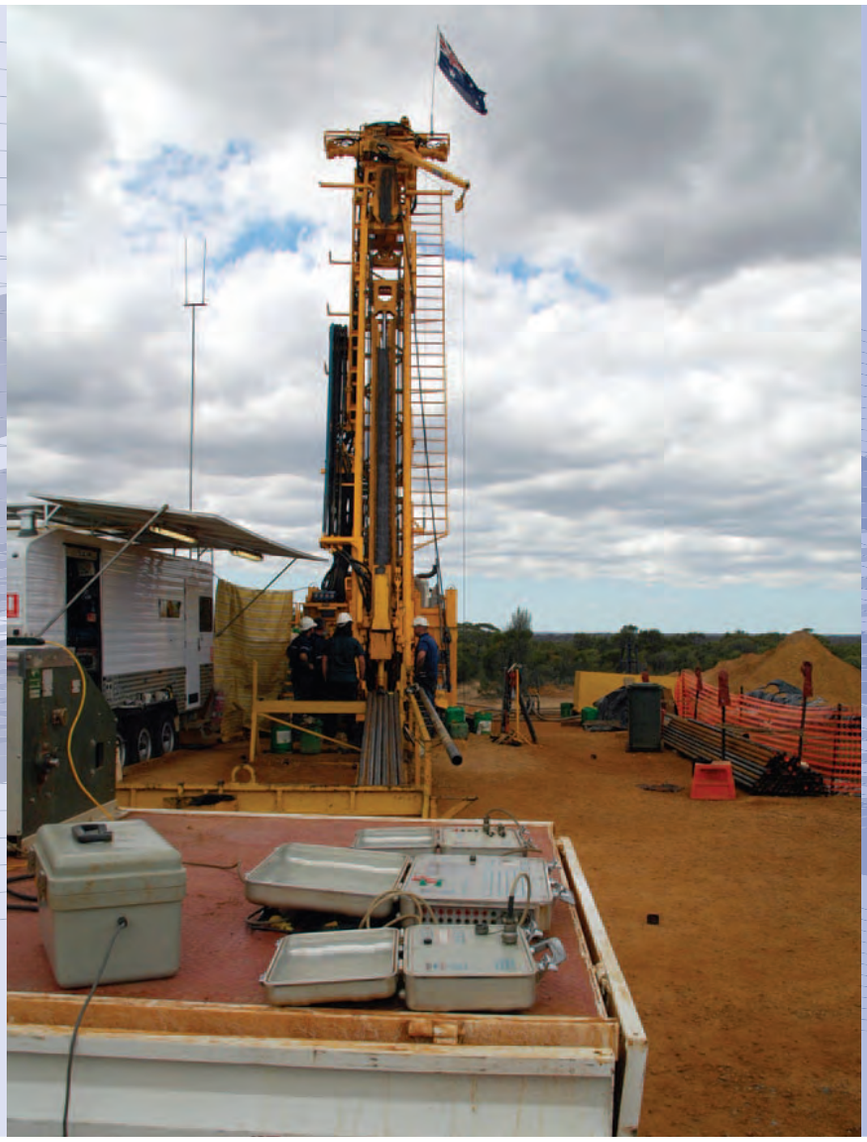
PREVIEW

AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS



NEWS AND COMMENTARY

ARTICLES AND REPORTS



Downhole EM, MMR Surveys

- Atlantis B-field probe, 33mm diameter
- Measure 3 components in a single pass
- 2000m winch available
- High power transmitter system

Surface EM, MMR Surveys

- High power transmitter system

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EMIT
ElectroMagnetic Imaging Technology

Maxwell 4

Modeling, Presentation and Visualisation of Electrical Geophysical data

EMIT's Maxwell EM Software - the industry-standard software for processing, visualisation and interpretation of any type of EM geophysical data - ground, airborne, borehole, time and frequency domain.

NEW

EMIT is the distributor of the **Australian CSIRO / AMIRA Advanced EM Modeling Algorithms**

The Australian CSIRO has been developing Advanced EM Geophysical Modeling algorithms for approximately 25 years as part of an AMIRA project.

Maxwell provides a user friendly interface from which to execute these algorithms for forward and inverse modeling. Maxwell allows the user to define, display and edit model parameters through drag-and-drop mouse operation. Layered earth, thin-sheet, plate, prism and mesh models can be built in Maxwell's 3-D visualisation environment.

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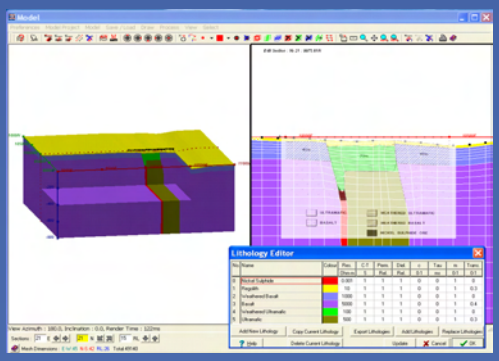
Leroi & LeroiAir for plates in layered earth
Marco & MarcoAir for prisms in layered earth
Arjuna & ArjunAir for 2D mesh with topography
Loki & LokiAir for 3D mesh with topography
Samaya & SamAir for 3D mesh with topography within a uniform halfspace



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A Absolute Geophysics

SAMSON - a low noise TEM system for highly conductive targets

SAMSON is a total field EM system

The advantages of SAMSON over other systems include:

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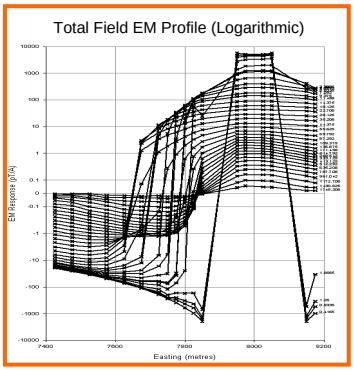
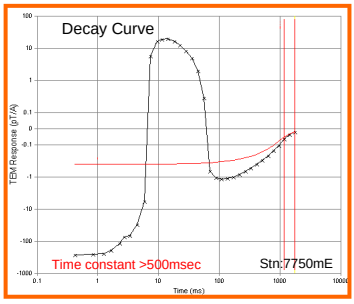
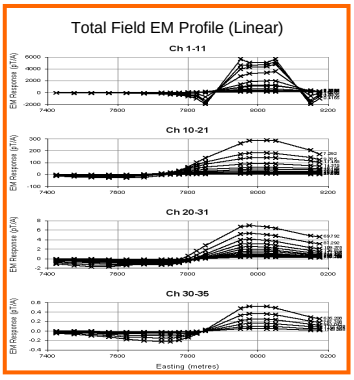
- Station setup and occupation time is low.
- In-built navigation.
- Total field EM responses are easily modeled with EMIT's Maxwell software.
- Moving loop or fixed loop configurations.







Fixed Loop Total Field EM at Wedgetail nickel deposit, Western Australia.

Absolute Geophysics Pty Ltd is a Joint Venture between two of Australia's foremost geophysical instrument developers to provide SAMSON services —

ElectroMagnetic Imaging Technology Pty Ltd and

Gap Geophysics Pty Ltd.

Total Field EM surveys

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Industry Standard Products for Mineral Exploration

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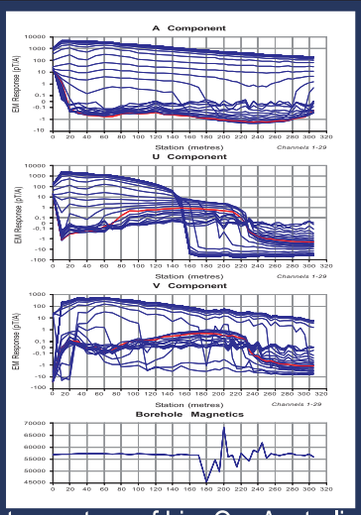
- Superior to dB/dt for detecting good conductors further from the borehole.
- The cross-hole components have the same noise level as the axial component.
- Automatically measures the rotation of the probe and the borehole orientation.
- Measures off-time and on-time response.
- Automated interface with SMARTem.
- The same sensor commonly used in surface EM.



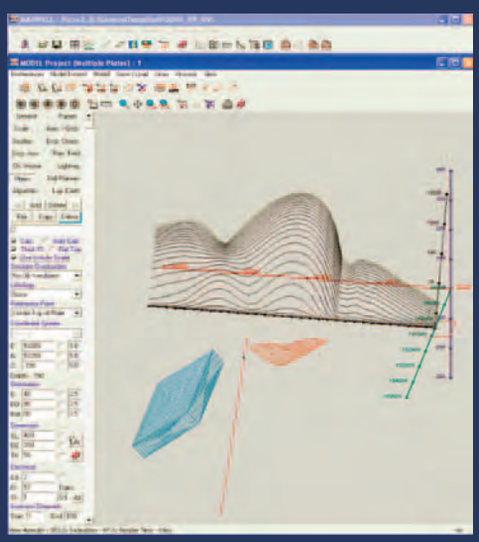
Data courtesy of LionOre Australia

SMARTem receiver system

- 8 Channel multi-purpose receiver system for EM, IP & other electrical geophysical techniques.
- PC-based system with hard disk, VGA graphics, QWERTY keypad, USB and Windows OS.
- User friendly QC software – display profile, decay, oscilloscope, spectrum analyzer, and more.
- Record and process full time series.
- Powerful signal processing for noise reduction.
- Use with any transmitter system and receiver antenna.
- Industry standard file formats.
- Optional transmitter controller with crystal sync.
- Comprehensive PC processing & display software.

Maxwell EM processing software

- Processing, visualisation, interpretation and plotting software for any type of EM geophysical data - ground, airborne, borehole, time and frequency domain.
- Constrained multiple plate inversion and approximate prism modeling.
- Display profile, decay, spectrum, plan, 3-D model and primary fields.
- Compute B-field and on-time response.
- Import/export industry-standard file formats for EM data and interface with Geosoft's OM6 and EMAX.
- Drill planning, decay analysis, MMR modeling, database of system configurations, gridding, contouring, extensive online help and many more features.



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FRONT COVER

New Total Magnetic Intensity image of the North West Queensland Mineral Province, see p. 26.

Preview is available online at:
www.publish.csiro.au/journals/pv

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David Denham

It's been a busy time in Canberra for the last few weeks. The ***2020 Summit*** happened over the 19–20 April weekend, when the Prime Minister Kevin Rudd invited 1000 Australians to help shape long term strategies for the nation's future, to tackle the long-term challenges confronting Australia by thinking in new ways. The attendees focused on 10 themes, of which the following four are probably those most relevant to our members:

- The productivity agenda – education, skills, training, science and innovation
- The future of the Australian economy
- Population, sustainability, climate change, water and the future of our cities
- Australia's future security and prosperity in a rapidly changing region and world

It was relatively easy for the participants to set goals. For example, for the Australian economy it was simply:

- Increasing GDP per capita so that Australia is among the top 5 countries in the world on this measure, with strong, stable economic growth and
- Inflation between 2% and 3%.

The big questions are how can these goals be realised? And with oil and food prices rising globally, the second goal is probably already unachievable.

There were also some fiery arguments on the third theme. With the official account stating that:

> The points of contention during the discussion were the respective merits of clean coal versus renewables, population restrictions versus reductions in per capita footprint, the transfer of all Commonwealth funding to public transport (rather than roads), and GM crops.

So it was not all plain sailing.

My own view on this type of exercise is that the benefits are not so much from the words in the reports but the networks that the participants can develop. When you have 1000 of the best and brightest working together there are bound to be valuable synergies. For those who would like to read the 39 page Initial Report go to: http://www.australia2020.gov.au/report/index.cfm

After the 2020 Summit, we had the ***2008–09 Budget*** and this is discussed by Eristicus in this issue. More words, kilograms of documents and thousands of pages were produced and delivered on time on budget night. No wonder the bureaucrats were burning the midnight oil in Canberra to publish the documents and post them on the web.

And while this was going on, the wide ranging review of ***Australia's National Innovation System*** is being carried out by an expert panel chaired by Terry Cutler, Principal of Cutler and Company and a member of the Board of the CSIRO. The government stated that 'The establishment of the review recognises the vital role innovation plays in boosting productivity and international competitiveness, and re-iterates the Rudd Government's commitment to fostering innovation across the economy'. At the time of writing over 600 submissions have been made and these can all be viewed at http://www.innovation.gov.au/innovationreview/Pages/home.aspx. A Green Paper will be received from the panel by the end of July 2008, and this will be followed by a White Paper response from the Government. So hopefully money will start flowing in the 2009–10 budget, if not before.

At the same time Denise Bradley, former Vice-Chancellor and President of the University of South Australia was appointed in March 2008 to undertake a major review of ***Australia's Higher Education System***, which will examine and report on the future direction of the higher education sector, its fitness for purpose in meeting the needs of the Australian community and economy and the options for ongoing reform. More information can be obtained from the website: http://www.dest.gov.au/sectors/higher_education/policy_issues_reviews/reviews/highered_review/default.htm

Between the 2020 Summit and the Budget, I attended an excellent symposium organised by the Australian Academy of Science. The theme was: 'Is dangerous climate change inevitable?' And I must admit that I came away feeling very pessimistic. From Neil Hamilton's description of what is happening in the Arctic, where the sea ice and the Greenland ice sheet are melting at rates significantly faster than predicted, through to coral reefs, carbon cycles and over population, the news is not good for the future of humans on Earth. In fact the pressure on energy and food supplies, with a global population of over 6 billion is of enough concern without climate change. It seems to me that climate change may just be the last straw on the camel's back – and it's a rather heavy straw.

Finally, three things of note that are very relevant to *Preview*. The first is to thank Martin Ferguson, the Federal Minister for Resources and Energy, for his guest editorial contribution in this issue. He clearly emphasises the importance the government attaches to resource exploration. The second is to welcome a new President, Peter Elliot of Elliot Geophysics International, a new Treasurer, Dave Cockshell from Department of Primary Industries and Resources of South Australia and a new President-Elect, Michael Asten from Flagstaff GeoConsultants – part of a very strong team to lead the ASEG forward. And the third is to bring members' attention to the fact that *Exploration Geophysics* is now part of the Thomson Scientific assessment stable. So researchers can use *Exploration Geophysics* for their citation index and we can use it to estimate the Impact Factor of *Exploration Geophysics* as a journal (see Phil's words on page 5 of this issue). Congratulations are in order to Phil Schmidt, the Chairman of the ASEG Publications Committee, Lindsay Thomas, the Editor of *Exploration Geophysics*, and Richard Hecker of **CSIRO** PUBLISHING for working to make this happen.

Resource exploration high on government agenda

The Hon Martin Ferguson AM, MP
Minister for Resources and Energy;
Minister for Tourism
Email: martin.ferguson.mp@aph.gov.au

The Australian Government recognises the ongoing importance for Australia to encourage development of its minerals and petroleum industries. It is continuing efforts to attract investment by providing the mining and hydrocarbon exploration industry with quality pre-competitive geological and geophysical data and information.

The mineral and petroleum industries are Australia's main export earners and underpin the nation's economy. The country's future prosperity will depend on these industries remaining healthy, innovative and internationally competitive. There are huge challenges in energy supplies as well as climate change.

In recognition of its responsibility to ensure these challenges are addressed, the Rudd government has made a commitment to clean energy. As part of the 2008–09 Budget, the government announced the creation of a $150 million Energy Innovation Fund, a $500 million National Clean Coal Fund and a $500 million Renewable Energy Fund to commence in 2009–10. There has been considerable demonstrated potential for geothermal energy already, and $50 million will be directed to a drilling program for proof-of-concept in known resource areas.

The government also continues to support the acquisition of pre-competitive data and information to underpin the search for new energy resources through the Offshore and Onshore Energy Security Programs at Geoscience Australia.

Onshore, the agency is carrying out a 5-year program designed to deliver reliable, pre-competitive geoscience data and scientifically based assessments of the potential for energy resources, including oil, gas, hot rocks, uranium and thorium.

So far Geoscience Australia has completed an Australia-wide airborne geophysical tie-line survey and is continuing to acquire deep seismic, radiometric, electromagnetic and gravity data in recognised provinces and in greenfield areas.

Geoscience Australia also is working in conjunction with State and Northern Territory Geological Surveys to conduct a nationwide geochemical survey at around 1400 sites to help improve the existing knowledge of the concentrations and distributions of energy-related elements such as uranium and thorium at the national scale.

The government continues to encourage offshore exploration and investment through the New Petroleum Initiative, begun in 2003, to acquire, interpret and synthesise geophysical and geological data. During its first phase from 2003–07, a total of seven geological and geophysical sampling surveys were carried out, 8600 kilometres of new 2D regional seismic data were collected and 12 basins and sub-basins were investigated. The new information and research contributed to the uptake of exploration acreage in the Bremer and Vlaming sub-basins, off Australia's south west, and in the Arafura Sea. Important new data sets, which will underpin exploration in the future, were also acquired in the Capel and Faust Basins of the Remote Eastern Frontier region, the Great Australian Bight and in the offshore Canning Basin.

The Offshore Energy Security Program (2007–11) builds on the earlier initiative and benefits from a new round of increased funding of $75 million over 5 years. It also takes place in the context of an additional 2.5 million square kilometres of extended continental shelf under Australian marine jurisdiction following a recent decision by the United Nations Commission for the Law of the Sea.

The new work program involves marine survey collection of geological and geophysical datasets and sea floor sampling. The potential field (gravity and magnetics) multibeam sonar and sub-bottom profiler geophysical datasets acquired are used to map the sea floor and delineate the broad shape of underlying basins prior to acquisition of 2D seismic. Industry standard 2D seismic surveys collect geophysical data to image basin shape and sediment architecture beneath the sea floor.

The sea floor sampling of marine benthos, sediment, pore waters and outcropping rocks, coupled with water column samples provides base-line data to assist with marine zone management and constrain the age and composition of sedimentary basins.

In late 2007, Geoscience Australia returned to the Remote Eastern Frontiers of the Capel and Faust Basins for a major marine reconnaissance survey which covered part of the new extended continental shelf areas.

Up-coming surveys will investigate under-explored offshore areas on the southwest margin, including the Mentelle and north Perth Basins and the Wallaby Plateau. These surveys will include both marine reconnaissance and industry standard 2D seismic surveys and will take place in areas of extended continental shelf.

Australia's southern margin remains a focus for the new phase of the program with major synthesis of the current knowledge underway. This study incorporates the analysis of recently acquired aero-magnetic data offshore from Tasmania and exciting new sample analyses of oil source rocks from the Great Australian Bight.

The work being carried out offshore and onshore will create an improved understanding of the architecture of the geology beneath the continent and its extended shelf and provide valuable pre-competitive data for future energy and resource exploration.

Firstly, I thank the members of the Australian Society of Exploration Geophysicists for electing me to the position of President. I will do my best to fill the position with the esteem that it deserves. I also thank Joe Cucuzza, now immediate Past-President, for the excellent effort he put in over the last 12 months and for setting a course that can easily be followed. I welcome onto the new Federal Executive (Fedex) Committee David Cockshell from Adelaide, who is replacing John Watt as Treasurer, a role that John has filled for the last 6 years. John has done an excellent job and will long be remembered for his efforts and his dedication to the ASEG. Also joining the Fedex is Mike Asten as President-Elect, Koya Suto is continuing as First Vice-President, and Troy Herbert as Honorary Secretary. David Denham and Lindsay Thomas will continue as the driving force behind our publications: *Preview* and *Exploration Geophysics*.

Over the next few months we will be following through on an innovation introduced by Joe Cucuzza during his term, which is a full review of the ASEG, where it is at, and where we expect it to be in 5 years from now. This will be a full business review during which we will critically look at how to best serve our members and provide future guidance to succeeding Fedex committees. The world is changing and the ASEG has to change with it, but this must be done in a healthy and sustainable fashion. There may be the possibility of the ASEG eventually employing a full time executive manager to oversee the day to day activities of the ASEG and fill the gaps that a team of volunteers may have difficulty encompassing.

On our committee again this year is Wayne Stazinowsky in Sydney, who is the ASEG Webmaster. Wayne has made great strides over the last 12 months in restructuring our website and turning it into a practical database for membership and publications. This will be the foundation on which major advances will be made in communication and access for our members. Once finished, the ASEG website will be equal to or better than those of any sister societies.

In November 2007, we had a very successful conference in Perth. It was well prepared and well run. The Perth Conference Committee deserves a standing ovation for the effort put in and the success of the conference. Following this, we have the ASEG Conference in Adelaide being prepared already by the Adelaide-based Conference Committee. The conference is scheduled for February next year and promises to be as good as, if not better, than any we have had in the past, if that is possible. The conference will service both hard rock and soft rock sectors as well as the growing environmental sector and I hope to see a majority of our members there again in February 2009.

Thank you again to all members and as President I look forward to an active prosperous year at the helm of a very robust and exciting ASEG.

Peter Elliott
elliottgeophysic@aol.com

Exploration Geophysics accepted into Thompson ISI

CSIRO PUBLISHING recently announced that after due consideration Thompson ISI has now agreed to index *Exploration Geophysics*. It may be several more months before an Impact Factor can be determined for the journal depending how far back it is indexed.

The Impact Factor is a tool for evaluating academic journals, and a measure of the frequency with which the 'average article' in a journal has been cited in a given period of time. It is often used as a proxy for the importance of a journal to a field of research.

This is a significant step in the evolution of *Exploration Geophysics* and bodes well for its future.

Phil Schmidt
ASEG Publications Chairman

ASEG Federal Executive 2008–09

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New members

The ASEG welcomes the following 37 members to the Society and congratulates Lachlan Gibbons who is now a full member of the ASEG. Their membership was approved at the Federal Executive meetings held on 26 March and 30 April 2008.

Name	Organisation	Location
Peter Graham Betts	Monash University	Vic
Peter John Boult	PIRSA	SA
Lynsey Brett	BHP Billiton Petroleum	WA
Peter T F Chia	CGG Veritas	WA
Enkelberth Takawire Chinwada	Fugro Ground Geophysics	Botswana
Judy Doedens	Fugro Airborne Services	WA
Mathew James Dorling	Origin Energy	Qld
Nicholas Joseph Ebner	Newexco Services Pty Ltd	WA
Abraham Emond	Rio Tinto	Utah
Lachlan Henry Gibbins	APG	SA
Dayle Thorpe Gilliatt	RISC	WA
Brent Maxwell Haines	Consultant	Qld
Max Halkjaer	Skytem	Denmark
Bruce Alan Hobbs	PGS	Edinburgh, UK
Chester Maynard Hobbs	University of NSW	NSW
Scott Keenan	Orion Petroleum Ltd	NSW
Brodie Klye	The University of Auckland	NZ
Cori Lambert	Self-Employed	WA
Laurent Langhi	CSIRO Petroleum	WA

Name	Organisation	Location
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Glenn Christopher Nyein	Westterngeco	India
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Alexey Trusov	Aerogeophysica Inc.	Russia
Syd J Visser	SJ Geophysics	Canada
Valeriya Zadorozhnaya	Council for Geoscience	South Africa

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, February 22–26, 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

Australian Civil Honour Awards

Distinguished ASEG members may also be nominated for one of the following Australian Civil Honour Awards

- Companion in the Order of Australia (AC)
- Officer in the Order of Australia (AO)
- Member in the Order of Australia (AM)
- Medal of the Order of Australia (OAM)

Any nominations should be made directly using the following website: http://www.itsanhonour.gov.au/about/medal_descriptions/order_of_australia.html

ASEG News

Australian Capital Territory

At the ACT Branch 2008 AGM on 28 February, the 2007 Committee was re-elected with one change. Ron Hackney has taken over from Hugh Tassell as Branch Secretary. Hugh is moving interstate and the ACT Branch thanks him for his contribution over the last few years and wishes him well in his new pursuits. Matt Purss continues as President and Leonie Jones as Treasurer. The committee also includes Adrian Hitchman, Nick Rawlinson and David Robinson.

On 8 May, the ACT Branch, supported by the local PESA Branch, hosted Tad Ulrych, Professor Emeritus at the University of British Columbia and the SEG 2008 Spring Distinguished Lecturer. Canberra was fortunate to have the opportunity to host Tad. Around 35 people attended his lecture at Geoscience Australia and enjoyed a lively and enlightening presentation on the role of amplitude and phase in processing and inversion – who would have thought that Wagner's Tristan and Isolda had an intimate phase relationship?! It was clear to all that Tad's talk was well rehearsed – 33 times in 11 countries prior to coming to Canberra. A robust discussion took place after the talk and, following a vote of thanks from Ted Lilley, continued during the afternoon at the Kingston Hotel.

The ACT Branch is grateful to David Robinson for ensuring that Tad was well received, adequately entertained and given a good impression of the nation's capital.

Ron Hackney and Adrian Hitchman

New South Wales

In March, Bob Musgrave from the NSW Department of Primary Industries gave a talk on potential field inversion and 3D modelling of complex geology on the regional scale. Bob highlighted the advantages and disadvantages of inverting potential field data when you have limited mapped geology. Bob's area of interest was the Koonenberry Belt in western NSW, where initial geological controls on cross-sections were limited and hotly disputed between the geologists. The final sections, and 3D model, owe much of their definition to inversion of the magnetic and gravity data, and have led to a substantial revision of the tectonic understanding of the region.

In April, Dietmar Muller from the University of Sydney gave a talk on the plate tectonic and palaeo-stress field evolution of Australia since the Early Cretaceous. Dietmar explained how he used a digital 2D finite element model of the (Indo-) Australian Plate that distinguishes cratons, fold belts, basins, and oceanic crust in terms of their relative differences in mechanical stiffness to assess Australian intraplate stress patterns. Dietmar explained the stress patterns and how they related to the tectonic activity around the Australian plate. Dietmar focussed on the structural history of the Bass Strait and the Adelaide Fold Belt to ground-truth his models.

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

South Australia

After a Christmas hiatus, the SA Branch started 2008 with our AGM in February. John Joseph, of the CRC-LEME presented 'Geophysical Signatures of Palaeochannels – a case study from Tanami Desert, NT'. The usual healthy AGM crowd also voted in the new committee, including Luke Gardiner and Mike Hatch as President and Secretary respectively for a second term, and a new treasurer, Jenni Scott. The outgoing secretary, David Cockshell, has since taken up the same role on the Federal Executive. David leaves with the thanks of the SA Branch and Committee for his distinguished years of service, which were acknowledged at the ASEG Conference in Perth in 2007 with the ASEG Service Certificate.

At the AGM, and in following committee and executive meetings, the proposed merger between the SA and NT Branches was approved, with Jon Sumner taking on the role of NT Representative on the SA Branch Committee. We welcome Jon and all the NT members.

In April, Andrew Fitzpatrick, from the CSIRO spoke on 'The use of airborne electromagnetics for salinity and groundwater studies', with examples from the Victorian Murray–Darling Basin. As expected, this talk was well attended, due to both the technical content and current heightened awareness of salinity implications this side of the border. In the same month, a joint ASEG/PESA hosted student BBQ at the University of Adelaide was well attended, with the next generation of geoscientists getting a feel for the industry.

Events on the farther horizon include the Melbourne Cup Luncheon, to be held at the Wine Centre again, on 4 November, and the ASEG 2009 Conference, to be held at the Adelaide Convention Centre from 22–25 February 2009.

The SA Branch holds technical meetings monthly, usually on a Thursday night at the Historian Hotel, from 5:50 pm. New members and interested persons are always welcome. Please contact Luke Gardiner (luke.gardiner@beachpetroleum.com.au) for further details.

Luke Gardiner

Northern Territory Branch amalgamates with South Australia

The NT Branch of the ASEG has now amalgamated with the SA Branch. Due to declining membership and lack of branch activity a proposal to amalgamate was put to the SA Branch last November at the ASEG Conference in Perth. The SA Branch accepted the proposal at a Committee meeting in February with the endorsement of the Federal Executive. The dissolution of the NT Branch was documented at the ASEG's AGM held in May 2008 in accordance with Item 10.5. Jon Sumner is now the Northern Territory representative on the South Australian Branch Committee.

SAGEEP 2008, Philadelphia, USA

SAGEEP 2008, the 21st annual meeting of the Environmental and Engineering Geophysical Society (EEGS), was held in Philadelphia, Pennsylvania, which is called the birthplace of America, at least in terms of political history.

My first SAGEEP was the third in 1990, when there were about 50 delegates and the venue was the halls of the Colorado School of Mines. Through my successive attendance over the years since, I have witnessed this conference grow to its current size of just under 400 delegates and 40 exhibitors. It is held every year in a different US city.

This year was notable for the number of overseas delegates, some 30% of the total, and apart from visitors from Europe there were several from Brazil, Japan and at least six from Australia. I think this growth of foreign delegates is a deliberate policy of EEGS and they encourage it by a pro-active association with similar societies such as the near-surface divisions of SEG and EAGE. For example, one technical session was devoted to the four best papers from last year's EAGE-NSD held in Istanbul, a practice that ASEG could well copy.

Some years ago, I recommended that ASEG have one of its collaborative arrangements with EEGS and we now exchange space for each to display at the other's conference. This time, ASEG received publicity regarding this from the President in the plenary session and our display this year distributed a large number of sample copies of *Preview* and the *ASEG Bulletin*. This was well worthwhile and may result in some new memberships for ASEG.

In total, 110 papers were presented in three parallel sessions over three days and 27 posters were displayed in two sessions. Each poster author was given 5 minutes to summarise their work in a technical session period, another good practice for ASEG to adopt. Special courses were held on the prior two days and one day afterwards. Australian presenters were Bob Whiteley, Mike Asten, Anton Kepic, Milan Urosevic and Tristan Campbell. All papers are available on CD, as are past years' proceedings, together with a number of handbooks compiled by well-known exponents of their particular subject. The contact to order these is www.eegs.org.

A feature of SAGEEP has been the outdoor demonstrations put on by equipment vendors. For my first, in 1990, I demonstrated SIROTEM in the Colorado snow. This year, as the conference was held in a big city hotel, the nearest green space was the Independence Park adjacent to the building housing the famous (but cracked!) Liberty Bell.

The next SAGEEP will be held in Fort Worth Texas from 29 March to 2 April 2009.

Roger Henderson

Equipment demonstrations at SAGEEP in front of Independence Hall – home of the Liberty Bell – Philadelphia.

ASEG and PESA Conference 2009 Update – Adelaide, 22–25 February 2009

As organisation for the next ASEG Conference continues to ramp up, the level of involvement by the organising committee continues to increase. By the time this article is published, the call for papers will have been completed and the successful abstracts selected. To date the response from potential presenters has been strong and the diversity of papers has assured that the technical component of the conference will be stimulating and encompass many different fields.

On the sponsorship side of things we have been encouraged by the level of support for the conference. This being said we are still actively seeking additional sponsorship.

The demand for exhibition space has been very strong, to such an extent that if you are thinking about taking up a booth it would pay to get in straight away to give yourself the best opportunity to gain a space.

More details of the conference such as available workshops will be available in the registration brochure which will be out soon. For more information please consult the website: http://www.sapro.com.au/ASEG/home.htm.

Andrew Shearer and Tony Hill
(Co-Chairs)

A mixed bag in the 2008 Budget

The Rudd Government's first budget focused on election promises, cuts to public expenditure, growth of about 1% in real terms, and banking billions of dollars for the future education, health and infrastructure needs of the country. However, for a government that promised much for innovation and science before the election, the results were decidedly patchy. There are some pluses and some minuses, but the general overall trend follows the investments of the previous government. Maybe we will have to wait for the many reviews to be completed before more progress will be made.

Table 1 (taken from numbers in the budget papers) and Figure 1 show the changes in government investment as a percentage of government expenditure and also as a percentage of GDP. As can be seen the percentage of government expenditure on innovation and science has remained remarkably constant over the last 10 years with, if anything, a small downward trend.

However, as a percentage of GDP the situation is unimpressive and it declines from 0.62% in 2001–02 to 0.53% in 2008–09. So while Australia's GDP has approximately doubled in the last 10 years, the investment by the Australian government has essentially remained the same.

Some of the good points

The honouring of election commitments and the establishment of three new funds, the Building Australia Fund, the Education Investment Fund, and the Health and Hospital Fund, are signs of a Government developing long term goals for Australia, and of a willingness to place today's returns from the resource sector into long term national investments.

Election commitments

The Government honoured its election commitments. The four key ones for science and higher education are:

- 1000 mid-career fellowships (starting in calendar year 2009)
- Phasing out of domestic full fee places
- Halving HECS for science and mathematics students and reducing HECS payments by 50% for 5 years for science and mathematics graduates in key areas, notably teaching
- Doubling scholarships for undergraduates and postgraduate research; however, there appears to be no increase in the value of stipends, which remain critically low.

$500M Building Better Universities Fund

This is a one off grant from the 2007–08 surplus allocated to universities on the basis of a 70% share of total domestic student load and a 30% share of research income. Money is for infrastructure/facilities in five priority areas: ICT, laboratories, libraries, teaching spaces and student amenities.

Education Investment Fund

An $11 billion fund that adds $5 billion from 2007–08 and 2008–09 surpluses to existing $6 billion Higher Education Endowment Fund. The Fund will be established by 1 January 2009 and the first payments from the fund will be made in July 2009, after the Bradley Review into Australian Higher Education[1] and Cutler Review Review of the National Innovation System[2] have reported and considered in the framing of the 2009–10 Budget.

Table 1. Australian Government investment in science and innovation

Year	Government investment ($ billion)	% Government expenditure	% GDP	GDP ($ billion)
1999–2000	4.025	2.57	0.624	645
2000–01	4.231	2.69	0.614	689
2001–02	4.579	2.75	0.622	736
2002–03	4.754	2.78	0.608	782
2003–04	5.365	2.95	0.638	841
2004–05	4.917	2.52	0.548	898
2005–06	5.548	2.70	0.574	967
2006–07	6.022	2.75	0.575	1047
2007–08	6.203	2.63	0.541	1146
2008–09	6.371	2.56	0.528	1206

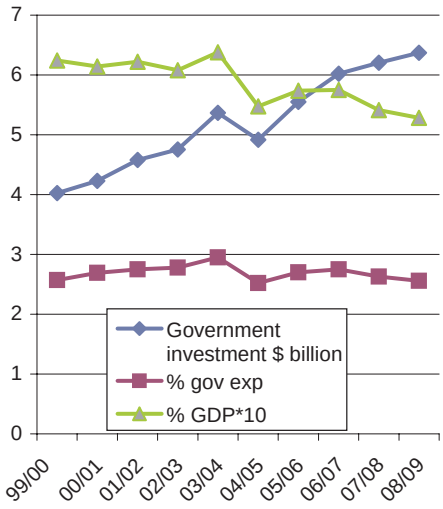

Fig. 1. *Changes in government investment in science and innovation over the last 10 years. The left hand axis shows investment in $ billion (in blue), as a % of GDP × 10, in green and as a % of total government expenditure in brown. Note the decline in the % GDP over the 10-year period.*

Health and Hospitals Fund

This is similar to EIF. $10 billion from surpluses in 2007–08 and 2008–09. Future surpluses may be allocated from time to time. Some will go to medical research and infrastructure. Key priorities will include capital expenditure, renewal and refurbishment of hospitals, medical technology equipment, major medical research facilities and projects.

Climate change

$2.3 billion funding over 5 years has been identified for reducing greenhouse gas emissions, adapting to climate change, and developing renewable energy resources. Projects supported by this allocation are distributed over a number of portfolios and will be co-ordinated by the Climate Change Department headed by Penny Wong.

Clean Coal and Renewable Energy Funds

A commitment of $150 million over 5 years to the **Energy Innovation Fund**. $100 million will support the creation of

[1] http://www.dest.gov.au/sectors/higher_education/policy_issues_reviews/reviews/highered_review/

[2] http://www.innovation.gov.au/innovationreview/Pages/home.aspx

an Australian Solar Institute and support solar thermal and solar photovoltaic research and development; and $50 million will be provided through the Clean Energy Program. This is a new program targeted at general clean energy research and development, including energy efficiency, energy storage technologies and hydrogen transport fuels. The Energy Innovation Fund will operate from 1 July 2008 for 4 years until 30 June 2012 and grants will be allocated on a competitive merit-based application process.

$500 million is committed to the **Renewable Energy Fund**. This includes: $50 million for the Geothermal Drilling Program and $15 million over 3 years for the Second Generation (Gen2) Biofuels Research and Development Program. The Renewable Energy Fund will start on 1 July 2009 for 6 years until 30 June 2015. Funding will be subject to competitive, merit-based processes and the first round of applications will be called in the first half of 2009.

A $500 million **National Clean Coal Fund** will be established to support the National Clean Coal Initiative. This fund will support activities and investments worth $1.5 billion in cooperation with the industry's Coal21 initiative and support from other stakeholders including State Governments, researchers and industry. The National Clean Coal Initiative will start 1 July 2008, will operate for 7 years until 30 June 2015 and support deployment strategies for low emission technologies out to 2030.

And some of the not-so-good points

Most of the government's agencies did not do well in the budget, largely because of the 2% efficiency dividend. For example CSIRO's budget was cut by $44.4 million over 4 years including $39.8 million as an efficiency dividend and $3.0 million for the Southern Surveyor. How this was supposed to help science and innovation was never made clear. Table 2 shows the funding provided for some of Australia's key scientific research organisations. These numbers are taken from the budget papers, including the forward estimates for future years.

Notice that the National Health and Medical Research Fund now has more money than the ARC, which covers all disciplines. Geoscience Australia's budget and the Bureau of Meteorology's budget are consistent with forward estimates from last year, but one would have thought that with the importance of climate change the BoM's budget would have been increased to improve the observational network and the forecasting capabilities. Likewise AIMS seems set to wither on the vine because its budget is the same in dollars for the next 4 years!

CSIRO appears to be going back to having to raise millions of dollars by the provision of goods and services. As shown in Table 3, the target for the percentage of external earnings has fallen from 75% in 2003–04 to a more manageable 47% in 2007–08. However, the target is starting to rise again and is set at 54% for 2011–12. How long term high quality strategic research of national importance can be undertaken in these circumstances, beggars belief.

In addition to the main science agencies, both the National Library and the Australian Bureau of Statistics were hammered by the 2% efficiency divided. One might have thought that when innovation and science were high on the government's agenda both these agencies would have done better – but it was not to be.

Other not so good news were the delay in the start of the $500 million **Green Car Innovation Fund** being postponed until 2011 and restricting the solar panel government grants to families who earn less than $100 000 per year. Not a good encouragement for people to go solar.

However, the biggest bit of bad news was probably reserved for Woodside because the condensate produced as a by-product of natural gas will now attract the same level of excise as oil. As a result the North-West Shelf liquefied natural gas consortium will have to pay about $94 million in this financial year, rising to about $625 million in 2010–11. On anyone's scale of things this is big money.

However, the tax will only apply after 30 million barrels have been produced, so all the Australian onshore production of condensate will escape the excise.

Table 2. Appropriation from Government for key science agencies

Agency	Appropriation from Australian Government in $ million							
	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
CSIRO[A]	577	594	610	664	**668**	691	717	728
					682	703	730	
ARC	482	582	575	577	**603**	676	717	775
NH & MRC	426	457	466	541	**632**	722	734	748
DSTO	287	320	341	365	**352**	390	399	407
CRC Program	194	208	189	212	**183**	197	152	
BoM	191	211	214	235	**245**	254	261	265
ANSTO	111	118	142	153	**164**	153	153	152
Geoscience Australia	102	107	125	145	**139**	129	123	100
Antarctica	87	101	102	107	**105**	110	108	105
AIMS	22	23	24	27	**28**	28	29	29
Climate Change[B]					**384**	707	715	653

[A]The bottom row of the CSIRO numbers were the forward estimates in the 2007–08 budget
[B]Most of the climate change funding will be allocated to other departments such as DIISR and EWHA. The Department of Climate Change will not carry out these programs.

Table 3. Estimates of [goods & services income]/[government funding] for CSIRO in % for eight financial years

Budget year	2004–05	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12
2003–04	62	67	75					
2004–05	55	60	71	69				
2005–06	49	51	53	55	55			
2006–07		50	50	51	54	55		
2007–08			50	46	48	50	52	
2008–09				**47**	**48**	**50**	**52**	**54**

Australia's resource area increases by 2.5 million square kilometres

The United Nations Commission on the Limits of the Continental Shelf has confirmed Australia's jurisdiction over an additional 2.5 million square kilometres of seabed, according to a statement by the Minister for Resources and Energy Martin Ferguson on 21 April 2008. The Commission's findings confirm the location of the outer limit of Australia's continental shelf in nine distinct marine regions and Australia's entitlement to large areas of shelf beyond 200 nautical miles. This decision gives Australia the rights to what exists on and under the seabed, including: oil, gas and biological resources.

As the Minister stated: 'This is a major boost to Australia's offshore resource potential and also to our ability to preserve the marine environment on the seabed' and 'The Government will move quickly to proclaim the outer limits of the Australian continental shelf into law on the basis of the recommendations of the Commission.'

This has been a long, drawn-out process, starting when Australia ratified the 1982 Convention on the Law of the Sea and culminating in over 15 years of work by officers from a range of Government agencies including Geoscience Australia, the Department of Foreign Affairs and Trade and the Attorney-General's Department, in preparing Australia's detailed submission to the Commission.

Australia now has jurisdiction over a total of 18.39 million square kilometres, apart from Antarctica and its continental shelf. The total comprises a land area (including the island territories) of 7.69 million square kilometres, the original exclusive economic zone of 8.15 million square kilometres and the new area of 2.55 million square kilometres. The diagram below shows where all these areas are situated.

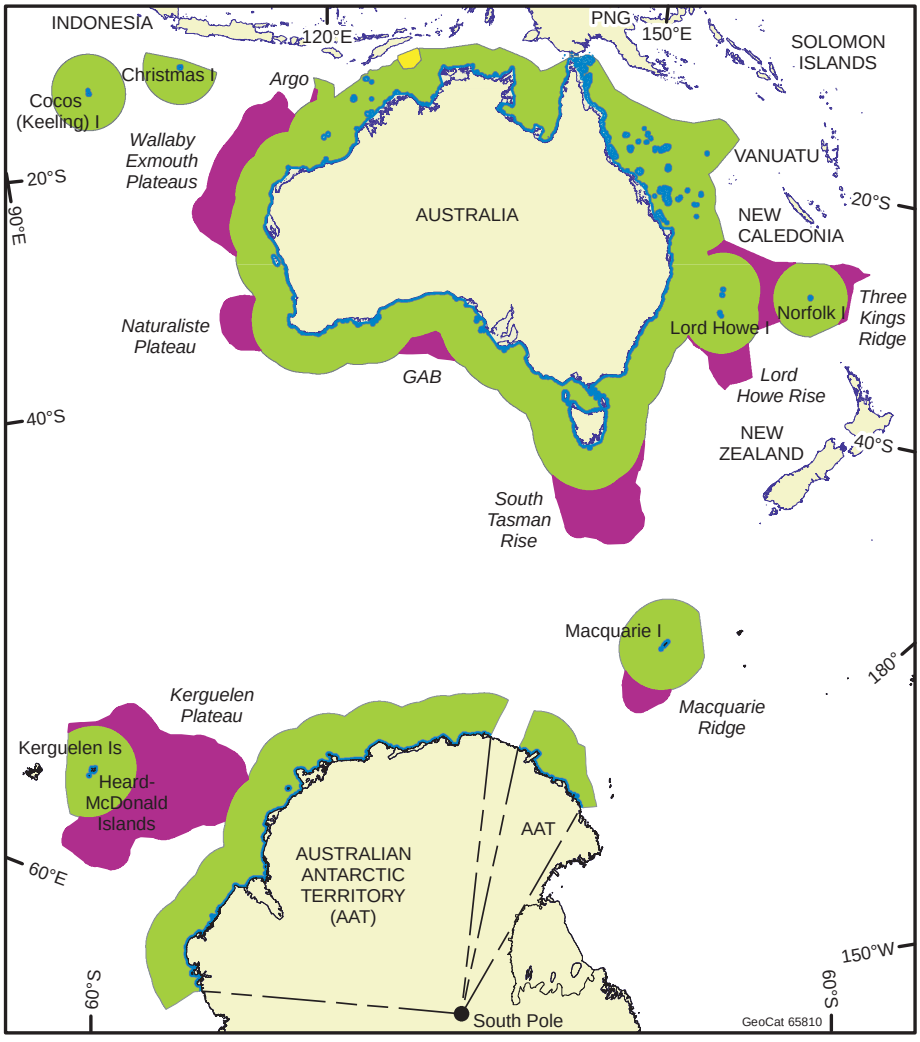

Fig. 2. *Map showing Australia's offshore jurisdictions. The purple colour indicates the recently added areas which are essentially extensions of the continental shelf beyond the 200 mile limit.*

Carbon capture project commissioned in Victoria – Australia joins the global club

The first carbon dioxide storage or geosequestration project in the southern hemisphere was launched on 2 April by the Federal Minister for Resources and Energy, Martin Ferguson, and the Victorian Minister for Energy and Resources, Peter Batchelor, near Port Campbell in south-western Victoria.

The project involves extracting CO_2-rich gas (80% CO_2; 20% methane) at a depth of about 1500 m from an existing well (Buttress-1, in the Otway basin); processing and compressing this gas at a newly built surface plant and transporting the gas via a new, underground, 2.25 km long stainless steel pipeline to a new injection well (CRC-1). There are no plans to separate the CO_2 from the methane at this stage. The maximum design temperature and pressure parameters for the pipe are 50°C and 15 MPa respectively.

Over the next two years, up to 100 000 tonnes of the CO_2-rich gas stream at supercritical state will be injected into a depleted gas reservoir (the Waarre C Formation) at a depth of 2050 m. The CO_2 will migrate up-dip within the 31 m thick sandstone reservoir capped by an impervious thick seal rock (the Belfast Mudstone).

CO_2 will be detected 6–9 months after the start of injection, at the existing Naylor-1 well (located ~300 m from CRC-1) by geochemical and geophysical downhole sensors. Previously this well produced 3.965 BCF of natural gas from the Waarre formations and was patched and suspended in early 2004.

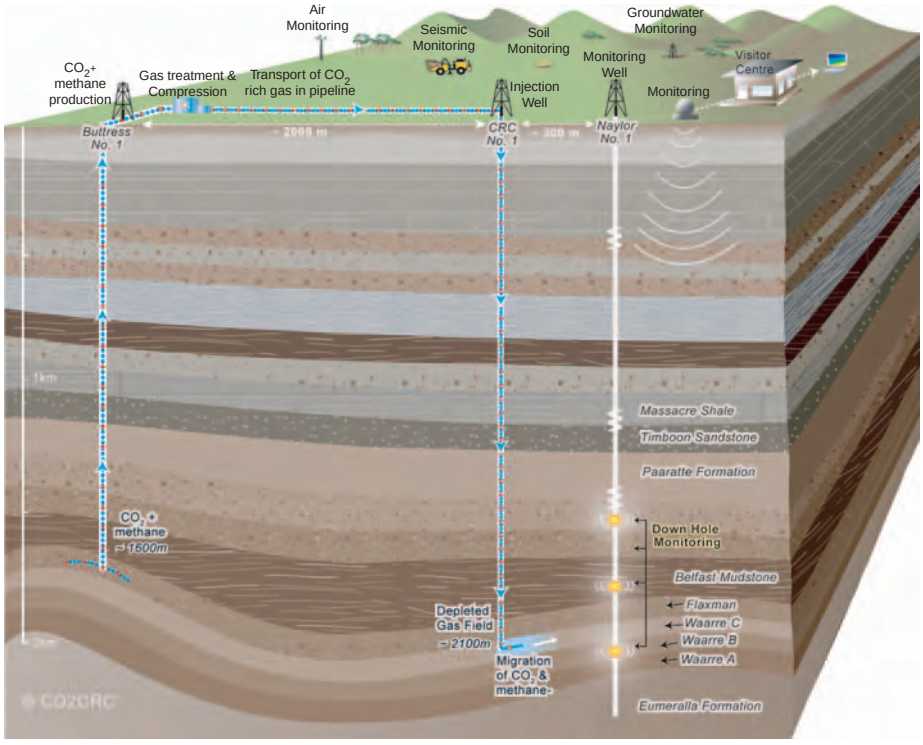

Fig. 1. *A schematic diagram showing the CO2CRC Otway Project: the first CO_2 storage project in Australia (figure provided courtesy CO2CRC). The site is situated between Warrnambool and Port Campbell close to the coast.*

The Otway CO_2 project is being conducted by the Cooperative Research Centre for Greenhouse Gas Technologies (the CO2CRC), using $40 million in funding from federal and state governments, research organisations and industry. If successful, the technology is expected to be used to reduce CO_2 emissions from coal fired power stations not only in Australia but throughout the world. For more information visit: http://ictpl.com.au/otway/.

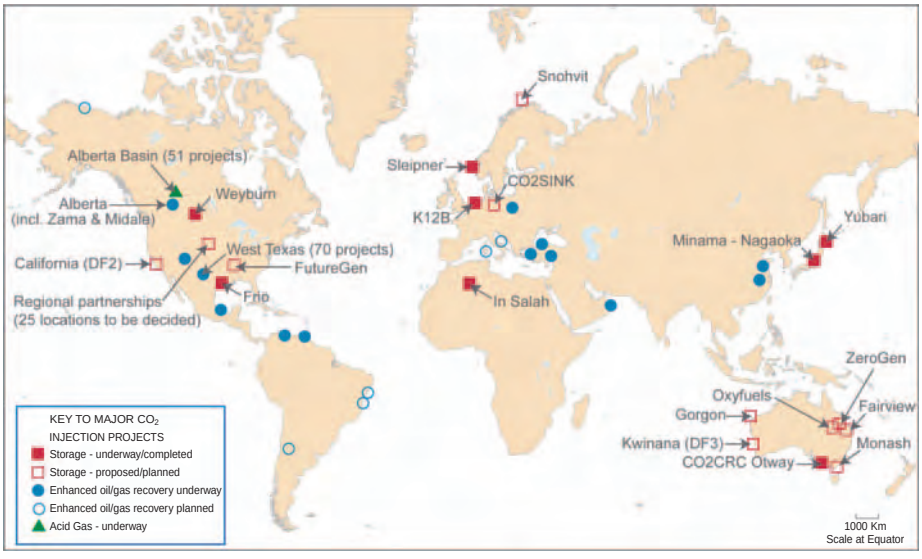

Fig. 2. *CO_2 storage demonstration projects around the world (figure provided courtesy CO2CRC). Summaries of these projects are given below. The information was taken from their websites. See also http://uregina.ca/ghgt7/PDF/papers/nonpeer/529.pdf.*

Other world storage projects

K12-B – The Netherlands

K12-B is the first site where CO_2 was injected into the same reservoir from which it came, together with the methane produced. The feasibility of CO_2 injection and storage in depleted natural gas fields is being investigated and the corresponding monitoring and verification is being undertaken.

See: http://www.k12-b.nl/

In Salah – Algeria

The In Salah Industrial Scale Demonstration of CO_2 Geological Storage

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Geoscience Australia Geomagnetism web application now online

In the October 2007 issue of *Preview*, on pages 18–21 and 24, the article 'Activity of magnetic total intensity across continental Australia' described the development of a new method of displaying data from Geoscience Australia's six permanent Australian continental magnetic observatories in the form of the rate-of-change in magnetic total intensity, dF/dt, contoured over Australia.

To examine how well data from the observatories could represent the behaviour of dF/dt over continental Australia, charts produced using data from the observatory sites alone were compared with those produced using data acquired by the Australia Wide Array of Geomagnetic Stations experiment (AWAGS). Although limitations brought about by the existence of conductivity anomalies were found to exist, the information from the permanent observatories was considered adequate in providing a useful tool to gauge the activity of the magnetic field over the continent. Near to real-time dF/dt contours are now available on the Geoscience Australia website: http://www.ga.gov.au/geomag/widereamag/.

On the new web page a contour display of the rate-of-change of magnetic total intensity, F, over the continent, based on data from the six Australian continental magnetic observatories, is displayed. Both real-time and historic data can be displayed in this format on the web page. All the maps are generated from a period of 15 minutes of observatory data and available at 15 minute intervals. A link to an abridged version of the *Preview* article is also available on the new web page.

Maps based on 15-minute windows of data acquired within the previous six hours are automatically available for viewing either individually or as an animation. The latest of these maps is initially displayed by default. On account of data-processing overheads and the 15 m data window, there is a 10–25 minute delay before current-time data can be displayed.

The maps are produced using the GMT mapping package, with a modified colour palette that shows more colour variation near zero than at larger absolute values, up to a limit of 50nT/hr beyond which no colour is displayed.

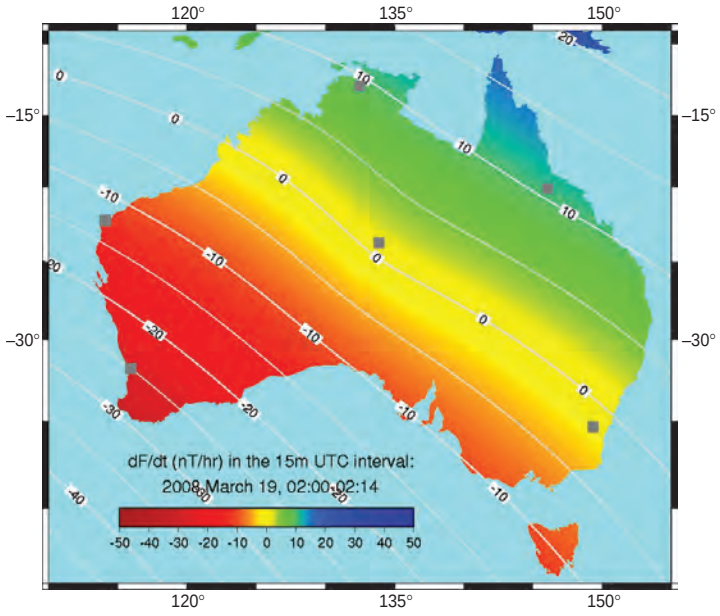
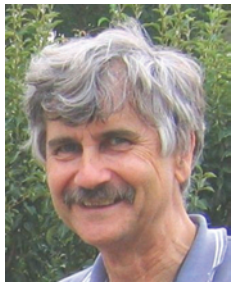


Fig. 3. *A recent example of a dF/dt contour map .*



Peter Hopgood
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Continued from p. 14

Project is managed by BP. Storage started in August 2004 and so far 1 Mt of CO_2 has been buried. It is expected to store 17 Mt in total. The estimated storage costs are about $100 million and the incremental cost of storage is about $6/t$CO_2$. It therefore delivers no commercial benefit but is seen as a test-bed for CO_2 monitoring technologies.

See: www.cdm-saudiconference.com/cdm/web-resources/docs/1%20-%20OPEC%20CCS%202b%20In%20Salah%20Wright.ppt

Sleipner – Norway

Carbon dioxide extracted from gas produced from Statoil's Sleipner West Field in the Norwegian North Sea is stored 1000 m below ground. About 2800 tonnes of CO_2 are separated daily and injected into the Utsira sandstone formation. This has been in use since the field came on stream in the autumn of 1996. But in 2000, a saline aquifer carbon dioxide storage (Sacs) project demonstrated that the injected gas remains in place rather than leaking out. With a thickness of 250 m, the formation can store 600 billion tonnes of carbon dioxide. That compares with a mere million tonnes being injected annually from Sleipner West. The entire carbon dioxide emissions from all the power stations in Europe could be deposited in this structure for 600 years. Sleipner West is currently the only place in the world where large volumes of carbon dioxide are injected for underground storage. It represents a relatively expensive approach. Generally speaking, a coal- or gas-fired power station which converted to this disposal method would see its costs rise by 50–80%.

See: http://www.statoil.com/statoilcom/svg00990.nsf/web/sleipneren?opendocument

Weyburn – Canada

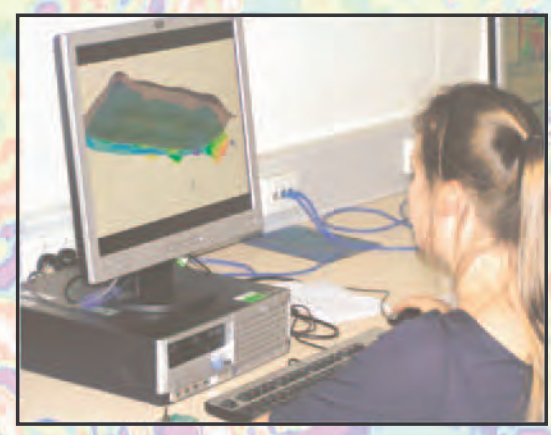
Weyburn-Midale CO_2 Project claims to be the world's first CO_2 measuring, monitoring and verification initiative. It was launched in 2000 and is an 8-year, $80 million international project studying CO_2 injection and storage underground in depleted oil fields. The project is operated in conjunction with $2 billion commercial CO_2 floods in Saskatchewan, Canada,

Continued on p. 25

Australian Society of Exploration Geophysicists Research Foundation

"Helping Exploration Geophysics Students Achieve their Research Goals"

Providing professional development of Exploration Geophysicists by supporting research projects in Exploration Geophysics



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How long can the current mineral resources boom last?

In recent issues of *Preview* we have been shown the spectacular growth in mineral and petroleum exploration, lately reaching all-time records. Accompanying this growth have been large increases in commodity prices. In *Preview* Issue 132 (Feb 2008), the question was asked: 'How long can these trends continue?'

To answer this, we must first ask what is driving the growth. The answer, I believe, is one word – **China**. China is currently undergoing spectacular growth, described by some as its own industrial revolution. It is, however, occurring ten times faster than the growth in North America and Europe after World War II and involves the greatest housing boom in history and the world's greatest ever road and railway construction boom (John Garnaut, SMH, 17 Mar 2008).

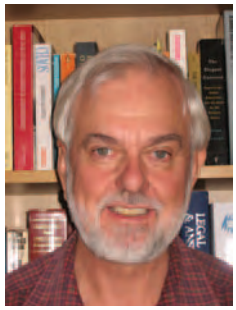
The plethora of statistics that illustrate China's growth are mind-boggling. For example, it is estimated that of all the construction that will occur in the world in the next 20 years, 50% will take place in China. This includes millions of apartments to house 1.5 million new urban dwellers every month. Where Australia has about 10 true subway stations and three more planned, Shanghai, to name just one of 37 cities in China that have or plan to have a subway system, intends to build 136 more underground stations this year alone! Just imagine how much concrete, steel and copper wiring that will consume. With a growing middle class (albeit still a small percentage of the total population), increasing by 40 million persons per year, comes the rapidly growing demand for cars, air travel and household appliances. There are, in Beijing alone, 1000 new cars on the road every day. (Such statistics are increasing daily too). Thus, China's consumption of oil and electricity is now the second largest in the world after the USA, and closing fast.

To service this phenomenal growth, China is now the biggest consumer of the world's raw materials. It accounts for up to 30% of the world demand for copper, zinc, tin, lead, nickel and aluminium (just 20 years ago it was only 5%). US demand by comparison is currently about 15%. China accounts for more than 50% of the world demand growth for most commodities. In the case of copper, it buys 60% of all new production. On the whole, producers can barely keep up with this surge in demand. Inventories are at historically low levels. Hence commodity prices have quadrupled in the past 7 years. For many commodities, a large proportion of this demand is sourced from Australia as we have them in abundance and are close by to keep transport costs low. For example, 35% of China's iron-ore requirement comes from Australia. Hence, as reported in *Preview* Issue 132, Australia's resource companies are riding high and exploration expenditure continues to peak.

So to the question of how long Australia's boom will last? This is dependent on how long China's demand for our resources will last. There are two schools of thought on this: one that it is not about to slow any time soon and another that its economy must implode. The former include John Garnaut, correspondent for the *Sydney Morning Herald*, who believes (SMH, 17 Mar 2008) China's growth is due to an industrial revolution akin to the British, and more recently, Japanese revolutions and it is therefore a major structural change and not just a cyclical event. Garnaut believes the change is pushing Australia's economy to the limits and yet it is just in its infancy. On the other hand, Rowan Callick, correspondent for *The Australian*, is concerned (31 Jan 2008) at the possibility of internal factors substantially dampening the growth. Such factors include the deteriorating environment, power outages in 13 of the 31 provinces, civil disruption due to, among other things, the enlarging wealth gap and soaring inflation. Elizabeth C. Economy (yes, that's her name) titled her paper on the subject in *Foreign Affairs*, Sep/Oct 2007, 'The Great Leap Backward'. Elizabeth cites similar issues to Callick plus the spreading of deserts, contamination of agricultural land, severe water shortages in two-thirds of the 660 cities and the fact that China has 16 of the world's 20 most polluted cities.

One can believe that the demand will continue if these negative factors can be overcome. China does need to solve its own problems. For the Chinese economy to be sustained, the countries it derives most of its income from will also have to remain viable. Many believe that the current slowdown in the US economy will not have much effect. As individual Australians, perhaps we should continue to buy our hardware from Bunnings.

And if all that fails, there is always **India** in the wings.



Roger Henderson
(A China watcher since his first visit there in 1974)

Mineral and petroleum exploration both go to record levels

Minerals

Figures released by the Australian Bureau of Statistics in March 2008 show that the trend estimate for total mineral exploration expenditure increased by $39.7 million (7.4%) to $574.5 million in the December quarter 2007. The estimate is now 38.8% higher than the 2006 December quarter and has reached an all-time high yet again. It is now 42% higher (in CPI adjusted terms) than the golden days of 1997 and the numbers have increased continually for 17 consecutive quarters since September 2003. Figure 1 shows the expenditure estimates from December 1999 through December 2007. Both the trend and the seasonally adjusted estimates are powering ahead, although the rate of increase is starting to flatten off.

The largest contributions to the increase this quarter were in Western Australia – up $23.5 million or 8.7% to a massive $314 million – another all-time record. Queensland also recorded a large increase, up $6.3 million or 7.6% to a record $99.9 million and South Australia increased by $6.3 million or 3.8% to another record of $93.5 million. Tasmania, which dropped from $9.0 to $7.0 million, was the only state to register a decline in activity. As to be expected, Western Australia dominated the national figures and contributed 50.1% to the total.

The trend estimate for metres drilled increased by 4.9% this quarter to 2432 km. The current estimate is now 15.8% higher

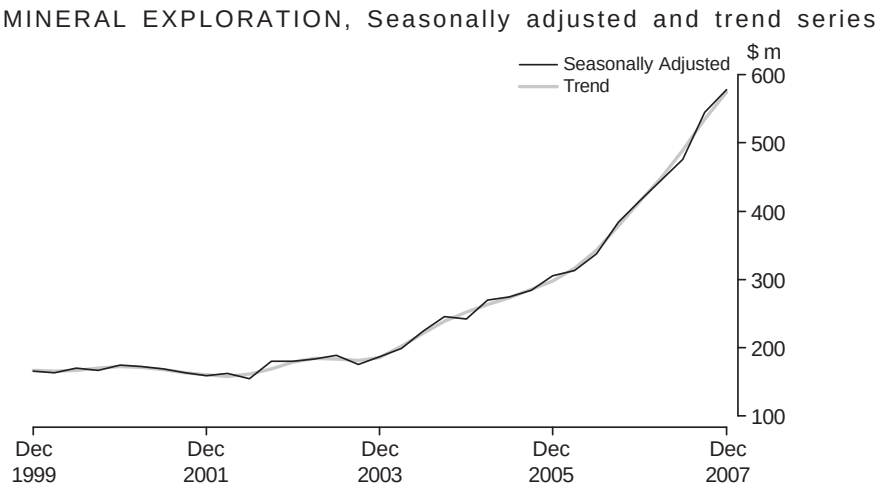


Fig. 1. *Trend and seasonally adjusted quarterly mineral exploration expenditure from December 1999 through December 2007 (provided courtesy of the Australian Bureau of Statistics).*

than the December quarter estimate for 2006.

The greenfield investment is almost unchanged, at a healthy 40% of the total. It is now at $274 million, compared to the December quarter for 2006 of $160 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. A quite remarkable situation, but how long can the trend continue?

Petroleum

The petroleum sector also turned in record performance, but the increase was not as dramatic as in the mineral sector. Expenditure on petroleum exploration for the December quarter 2007 increased by $71.7 million (10.3%) to $770.0 million. Expenditure on exploration in production leases decreased by $10.8 million (7.1%) to $142.3 million, while exploration in all other areas increased by $82.4 million (15.1%) this quarter to $627.6 million. There was an increase of $25.3 million (4.3%) in offshore exploration to $610.2 million, while onshore exploration expenditure increased significantly by $46.4 million (40.9%) to $159.8 million.

In the December quarter 2007, Northern Territory had the largest increase in petroleum exploration expenditure of $79.8 million (238.2%). Western Australia had the largest decrease of $33.8 million (6.2%). However, Western Australia still dominated the December quarter with a total expenditure of $512.7 million (66% of the total); Northern Territory was second with $113.3 million.

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 about US$120 per barrel are having the desired effect of encouraging petroleum exploration. In real terms the level of expenditure is now 75% higher than the previous record in June 1998 quarter.

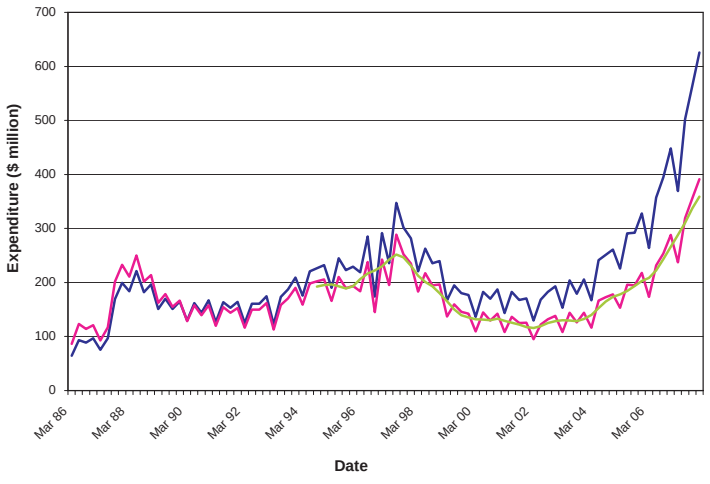


Fig. 2. *Quarterly 'actual' mineral exploration expenditure from March 1986 through December 2007 (from ABS data). The black curve represents actual dollars spent, the purple curve shows the CPI adjusted numbers to 1998/99 levels and the pale green line is the trend line (ABS data).*

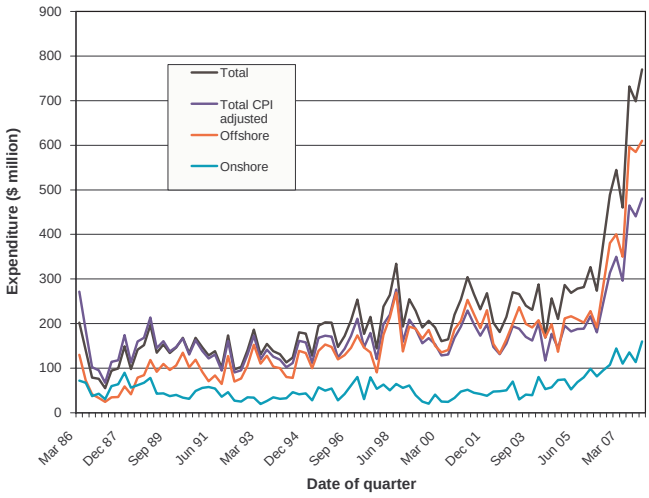


Fig. 3. *Quarterly petroleum expenditure from March 1986 through December 2007. The individual offshore and onshore numbers are actual numbers spent at the time, not CPI adjusted. The black graph shows the contemporary dollars spent and the blue curve shows the CPI adjusted number to 1989–90 dollars for the total of the petroleum exploration expenditure.*

BHP Billiton buys big in Gulf of Mexico

With oil prices nudging US$130 a barrel, the scramble for prospective new ground to explore is intense. In March this year, the US Department of Interior's Mineral Management Service received 1057 bids from 85 companies on 615 tracts, each with an area of about 20 km^2 and resulting in US$3.678 billion in high bids. The small rectangle in the diagram below shows the location of the areas of interest. BHP Billiton acquired four tracts at a total cost of US$21 million in Sale 224, where the water depths range from 810–3113 m. The total area of these leases is about 80 km^2. So at more than

$262 000 per km^2, it should be good real estate.

In total BHP Billiton Petroleum (Deepwater) Inc bid $47 858 420 for 27 tracts in the recent sale.

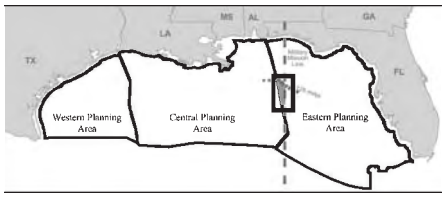


Fig. 4. *Location of the area where the recent petroleum exploration tracts were sold is identified by the small rectangle.*

Green light for $20 million clean coal trial

Through a Joint Venture with CSIRO and Carbon Energy Pty Ltd, Metex Resources has reinforced its position at the forefront of clean coal technology development having received all necessary approvals to proceed with a large-scale A$20 million Underground Coal Gasification syngas trial at Bloodwood Creek in the Surat Basin, located 55 km west of Dalby in southeast Queensland.

The approvals – granted by the Minister of Mines and Energy for Queensland and the Environmental Protection Agency – represent the final step before development and construction of the surface and underground components can proceed for what will be the world's first commercial scale oxygen-injected UCG trial.

The trial will involve drilling boreholes from surface to the underground coal seam, and gasifying the coal in-situ. This will produce a syngas suitable for conversion into feedstock for power generation or for conversion into ultra-clean liquid fuels and chemical. We will watch with interest.

Oxiana targets late 2008 production

Oxiana Limited has confirmed in May that it will move into production at its copper and gold mine at Prominent Hill in northern South Australia in the fourth quarter of 2008. Oxiana's Operations Manager, Brian Kilgariff said the company was aiming to produce 110 000–120 000 tonnes of copper and about 2.5 tonnes of gold at Prominent Hill during the first year of operation in 2009. He also indicated that approximately $30 million will be spent on exploration at Prominent Hill, during 2008. So the future looks bright for Oxiana in SA.

What's all this about a sub-prime mortgage crisis?

Economics is a very strange discipline. The economic commentators on television, in the newspapers and even in parliament have been waxing lyrically about the sub-prime problem in the US as though the end of the world is nigh. However, it does not seem to have affected the resource industries in any way. In fact the non-correlation between resources stocks and the so-called sub-prime crisis has to be seen to be believed.

Look at Figure 5. The brown line, which represents the total market capital of the resource companies listed in the top 150 of the ASX companies, continues to climb relentlessly (at least at the time of writing). Even the All Ordinaries Index only shows a small dip in the long term trend. So why should we worry too much about over-extended financial institutions that should have known better?

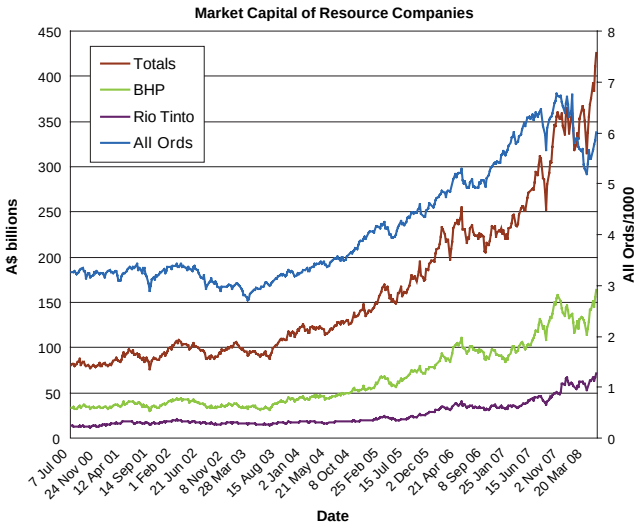


Fig. 5. *The brown line represents the total market capital of the resource companies listed in the top 150 of the ASX registered companies. The blue line represents the All Ordinaries Index and the other two curves shown the numbers for BHP Billiton and Rio Tinto.*

It's time to make our metadata machine-readable – let's go to GDF

For everyone who buys, acquires or supplies located data, it is time to convert it to GDF. All standard software now routinely exports and imports GDF. Furthermore, all government repositories now require it when explorers submit data.

GDF is the geophysical data exchange format prepared for the ASEG – championed mainly by Dave Pratt – and its use is endorsed by the Government Geoscience Information Committee. SEG, the ASEG's American sister society, has also adopted the GDF standard.

Each dataset is supplied with a set of three files, *.dat, *.dfn and *.des. The data file (*.dat) has the data in flat ASCII columns, the corresponding definition file (*.dfn) contains machine-readable definitions of the columns, and the description file (*.des) has human-readable text that explains the survey.

GDF is designed for exchange of located data with accompanying machine-readable metadata, so that unrelated software packages can read each other's outputs. Consequently, the data remains readable longer than the software which created it. Software, deep in the future, will still be able to read today's data with its metadata. The plain text structure of all files ensures that it can survive corruption and can be deciphered by librarians and others into the future.

At their 2005 meeting, the Chief Government Geologists' Committee endorsed standard guidelines for digital reporting, including use of the GDF standard for all located data supplied to government bodies. In particular, when an explorer submits located data from an expiring Exploration Tenement, it must be submitted in GDF.

The logic was that somebody acquiring data after that date would request GDF files from the contractor as well as any other preferred version, and then ultimately submit these to the local Geological Survey at the time of relinquishment. Confidential data, submitted before expiry, would also be in GDF. Similarly, anybody reprocessing open file data would import and export it in GDF as a matter of routine.

Whenever a government body refers to transfer of ASCII data, GDF is implied. For example, selecting the 'ASCII' download on GADDS provides a GDF version of the data requested. Government airborne surveys acquired using the GA Deed[1] get the data in GDF as part of the contract (point located data are to be delivered in ASEG-GDF2 format using a latitude/longitude coordinate system).

Geological surveys have been accepting data older than 2005 as is, but are now requiring that more recent data be supplied in GDF. There is a catch to that: submission may be years after the data is acquired and many exploration companies did not look that far ahead. Much of the data collected since then is currently arriving at the Government Surveys and Mines Departments without its metadata in proper GDF form. Legally, the problem is the explorer's. In practice, workers in the government body finding non-GDF data, have to phone or email for resupply in GDF format.

What are the options for an explorer about to lodge data, finding that it does not include a GDF set – that is a trio of *.dat, *.dfn and *.des files? With access to processing packages such as Intrepid, Geosoft, or ChrisDBF, the data can be re-loaded, the metadata keyed in and the 'export' facility used to create the three GDF files. As the exported description file is often inadequate, the description of the survey should be edited in, most easily by taking an existing readme.txt file and inserting the four characters 'COMM' into the leftmost columns. Alternately, if such a package is not handy, the data can be sent to someone who can do the job for a fee. Contractors can be found in the 'Professional Directory' section of the ASEG Membership Directory. John Brett, for example, has prepared hundreds of GDF file sets. A forthright option is to download the freeware version of Geosoft Oasis Montaj, key in the metadata and export the data to GDF that way. Thanks to Geosoft, it provides a neat way of checking that files do conform to the GDF standard.

So what sort of data must be submitted in GDF? All located data, where each measurement is located by a pair of coordinates, must be submitted in GDF. Already, all airborne magnetic and radiometric data, airborne electromagnetic and all gravity data are supplied on demand by acquisition contractors in GDF. Gravity contractors who have been supplying data in comma separated files are also able to supply GDF. However, it is up to the explorer to ask explicitly for GDF as well. IP and ground EM are supposed to be supplied as GDF, but that has yet to be invigilated.

There is one thing that is always possible and now has become necessary:

Check that you have the GDF set whenever you handle data.

When acquiring fresh data, ask the acquisition contractor to supply a GDF version. When importing older line data, check that the metadata is complete and then export a GDF set. Similarly, when colleagues import your located data for modelling or to create grids, ask them to export a GDF set.

The full version of the GDF standard can be obtained from http://www.reid-geophys.co.uk/ASEG-GDF2-REV4.pdf. The Australian Governments' Digital Reporting Guidelines can be downloaded from http://www.geoscience.gov.au/geoportal/ARSDEData.pdf.

Roger Clifton
roger.clifton@nt.gov.au

[1]See DEED 2004/158 between Geoscience Australia and (Company Name) in relation to the acquisition and supply of airborne geophysical data.

Northern Territory – for the record

NTGS advises that its distribution of Tennant Creek 1998 airborne magnetic and radiometric survey data has been erroneously shifted 200 m north-east since July 2002. For resupply of corrected data for this survey, please email: geoscience.info@nt.gov.au. Products derived from the previous data need to be shifted south-west by the vector (–128.8 m E and –163.1 m N). The same survey data on GADDS is not affected.

Update on Geophysical Survey Progress of Queensland, Western Australia, Northern Territory, Tasmania and Geoscience Australia (Information current at 13 May 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. There are three new magnetic and radiometric surveys in this issue and all are being managed by Geoscience Australia. Locality diagrams for the Cooper Basin North, Balladonia and Esperance airborne magnetic and radiometric surveys are shown below (Figures 1–3).

For more information on any of the above surveys contact:
Tony Meixner of Geoscience Australia at: tony.meixner@ga.gov.au

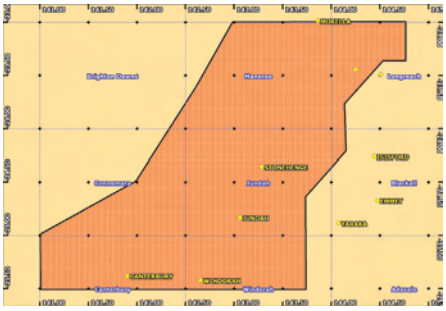


Fig. 1. *Location of the Cooper Basin North aeromagnetic and radiometric survey (see Table 1).*

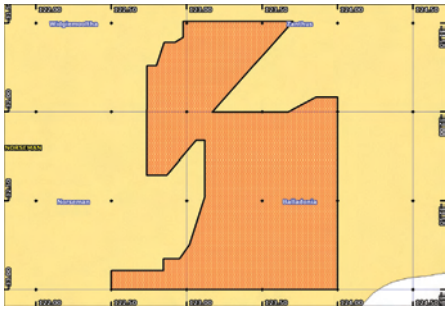


Fig. 2. *Location of the Balladonia aeromagnetic and radiometric survey (see Table 1).*

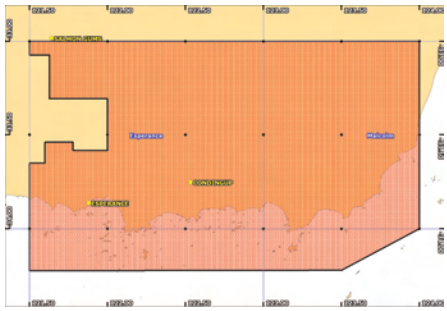


Fig. 3. *Location of the Esperance aeromagnetic and radiometric survey (see Table 1).*

Table 1. Airborne magnetic and radiometric surveys

Survey Name	Client	Contractor	Start Flying	Line (km)	Spacing AGL Direction	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	TBA	124 – Oct 06, p. 15	TBA
South Kimberley	GSWA	GPX	24 Jan 08	163 000	400 m, 60 m N–S	57 920	51.7% Complete @ 11 May 08	TBA	128 – Jun 07, p. 26	TBA
Westmoreland	GSQ	Fugro	2 Sep 07	59 753	400 m, 60 m N–S	21 010	100% Complete @7 Dec 07	23 Apr 08	129 – Aug 07, p. 33	13 May 08
Cooper Basin East	GSQ	UTS	8 Jan 08	214 352	400 m, 60 m N–S	76 980	36.3% complete @ 11 May 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	55.1% complete @ 11 May 08	TBA	130 – Oct 07, p. 29	TBA
Normanton	GSQ	Thomson	25 Apr 08	114 487	400 m, 80 m E–W	74 410	22.1% complete @ 11 May 08	TBA	132 – Feb 08, p. 23	TBA
Cooper Basin North	GSQ	TBA	TBA	166 373	400 m, 80 m E–W	59 480	TBA	TBA	This issue	TBA
Bass Strait	MRT	Thomson	28 Jan 08	70 856	800 m, 90 m E–W	44 325	100% complete @ 10 Mar 08	28 Apr 08	133 – Apr 08, p. 20	13 May 08
Offshore NW Tas	GA	Fugro	21 Jan 08	43 824	800 m, 90 m E–W	27 512	100% complete @ 6 Apr 08	TBA	132 – Feb 08, p. 24	TBA
Offshore NW Tas	MRT	Fugro	15 Jan 08	26 554	800 m, 90 m E–W	16 745	100% complete @ 3 Mar 08	TBA	132 – Feb 08, p. 24	TBA
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 N–S and 400 m, 60 m N–S	7783 total (100 m lines: 5948; 400 m lines: 1835)	40% complete @ 11 May 08	TBA	132 – Feb 08, p. 24	TBA
Byro	GSWA	GPX	3 Apr 08	83 855	400 m, 60 m E–W	29 750	38.5% complete @ 11 May 08	TBA	133 – Apr 08, p. 20	TBA
Balladonia	GSWA	TBA	TBA	43 449	400 m, 60 m E–W	14 960	TBA	TBA	This issue	TBA
Esperance	GSWA	TBA	TBA	82 674	400 m, 60 m E–W	29 200	TBA	TBA	This issue	TBA

Table 2. Airborne EM 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 theRudall River NP	33 950	32% complete @ 30 Nov 07 demobilised for the summer to recommence May 17/18 '08	TBA	130 – Oct 07, p. 30	TBA
South-West Catchment Council: Darkan–Wagin	GSWA, DAFWA and SWCC	Geoforce	May 08	1127	300 m N–S	288.6	TBA	TBA	133 – Apr 08, p. 20	TBA
Pine Creek	GA	TBA	TBA	29 058	1666 & 5000 m for GA; 200 m – 1000 m company infill; E/W flight lines; Flying height to be confirmed	72 412	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
Charters Towers	GSQ	Fugro	22 Aug 07	15 310	2 and 4 regular	133 950	Survey 92.7% complete @ 6 Dec 07	4 Apr 08	128 – Jun 07, p. 26	15 Apr 08
Westmoreland–Normanton	GSQ	Integrated Mapping Technologies	TBA	5977	4 regular	95 620	TBA	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	4.6% complete @ 11 May 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	8% complete @ 6 May 08	TBA	133 – Apr 08, p. 21	TBA

TBA: To be advised

Seismic surveys

As part of the Onshore Energy Security Program (OESP) and in conjunction with the New South Wales Department of Primary Industries, Geoscience Australia conducted a deep crustal seismic reflection survey in the **Rankins Springs** and **Yathong Troughs** of the Darling Basin. The survey area is interpreted as an extensive sediment-filled structural low, a large part of which attains basements depths in excess of 3500 m, and has been identified as having a high petroleum prospectivity within the Darling Basin. Seismic coverage in these troughs is virtually non-existent and this survey will provide important data on the basin architecture across the region.

Two traverse lines totalling 234 km of deep crustal reflection seismic data were acquired by Terrex Seismic (Figure 4) in March 2008. Preliminary field stacks look encouraging (Figure 5) and data are currently being processed in-house by Geoscience Australia's geophysicists. The results of survey are planned for release at the Eastern Australian Basins Symposium (EABSIII) in Sydney in mid-September this year.

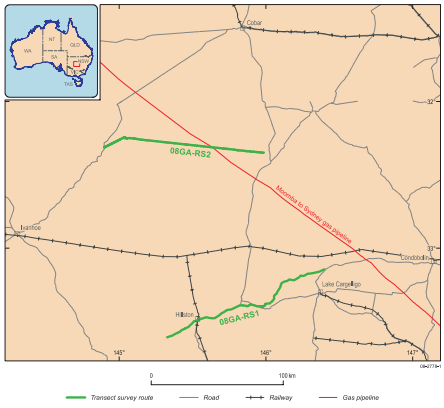


Fig. 4. *Rankins Springs seismic survey traverse line location map.*

The next seismic survey to be acquired under the OESP is located in south-eastern South Australia and is scheduled to commence in mid June. This 600 km survey consists of three traverse lines (Figure 6), one across the Gawler Province, one across the Curnamona Province and one in the Arrowie Basin. This survey will help in the assessment of uranium, geothermal energy and hydrocarbon resource potential in this region of South Australia.

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

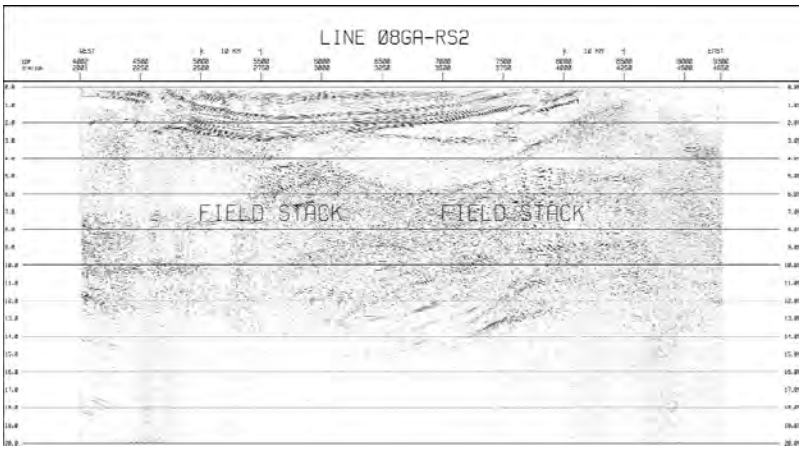


Fig. 5. *Preliminary field stack of 08GA-RS2.*

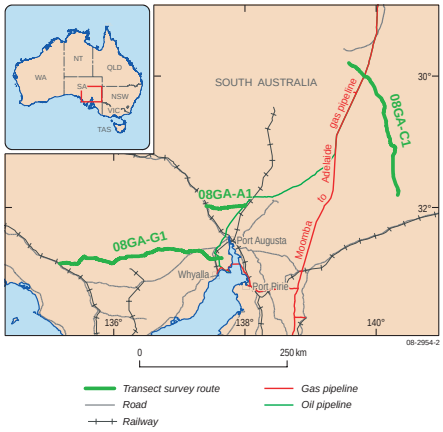


Fig. 6. *Gawler–Curnamona–Arrowie seismic survey proposed traverse line location map.*

GeoScience Victoria 3D visualisation facility

3D visualisation of complex geological structures and basin architectures has become a standard tool in the petroleum industry over the past decade.

In February 2008, GeoScience Victoria commissioned a new 3D visualisation suite for research in its geological projects. GeoScience Victoria has taken advantage of the advances in computing power, dramatic improvements in the technology and lower costs to establish a 3D visualisation facility at its office in Melbourne. With the increased focus on developing 3D geological models, the 3D visualisation facility and associated technologies will become a standard part of the way that these models are generated. These are produced as part of Geoscience Victoria's geological projects to help scientists better understand and interpret their data. They provide a useful interactive tool to communicate often complex geological relationships to other scientists and the wider community.

GeoScience Victoria has installed a passive stereo system running on a desktop PC with dual head graphic cards and a large amount of memory. It uses dual INFITEC 3500 lumen projectors, projecting onto the rear of a flat screen measuring two metres by five metres and a controller desk for manipulating the models. INFITEC displays stereoscopic images where the left and right eye images are transmitted in different wavelength triplets of the visible spectrum of light.

The viewers then wear special glasses to enable the brain to interpret them as a 3D image. This system has an advantage over similar systems in that the image is retained irrespective of the viewer's head position and location within the room. The configuration is simple to maintain but gives enough computer power to manage larger models.

The facility will have a significant impact on the ability to visualise and understand models. The image can be manipulated by an operator to turn data layers on and off and manipulate the models by rotating, zooming and panning to explore relationships between parts of the model from any aspect.

For more information contact:
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Ross Cayley (left) and Fons Vandenberg (right) study Victoria's geology in the new 3D visualisation facility.

GeoScience Victoria – Bendigo–Mitiamo gravity survey

GeoScience Victoria's new semi-regional gravity survey in the central Victoria region north of Bendigo has now been completed and the data are available to the public.

A total of 8050 new gravity stations were acquired north of Bendigo by Fugro Ground Geophysics during May to September 2007. The data were acquired on an infill basis to improve the post-1979 station interval from about 1.5 kilometres to 500 metres along roads and tracks (Figure 7).

A gravity survey consists of a series of measurements of the gravitational field of the earth at a large number of different locations over an area of interest. The objective in exploration work is to associate variations with differences in the distribution of densities and hence rock types which can help provide clues to the possible location of valuable mineral deposits.

It is envisaged that interpretation of gravity data (see Figure 8) between the Mount William and Avoca faults will show new movements on old faults which were possible conduits for gold mineralisation, and the location of old, buried topographic highs which are possible sites of silicification/gold mineralisation.

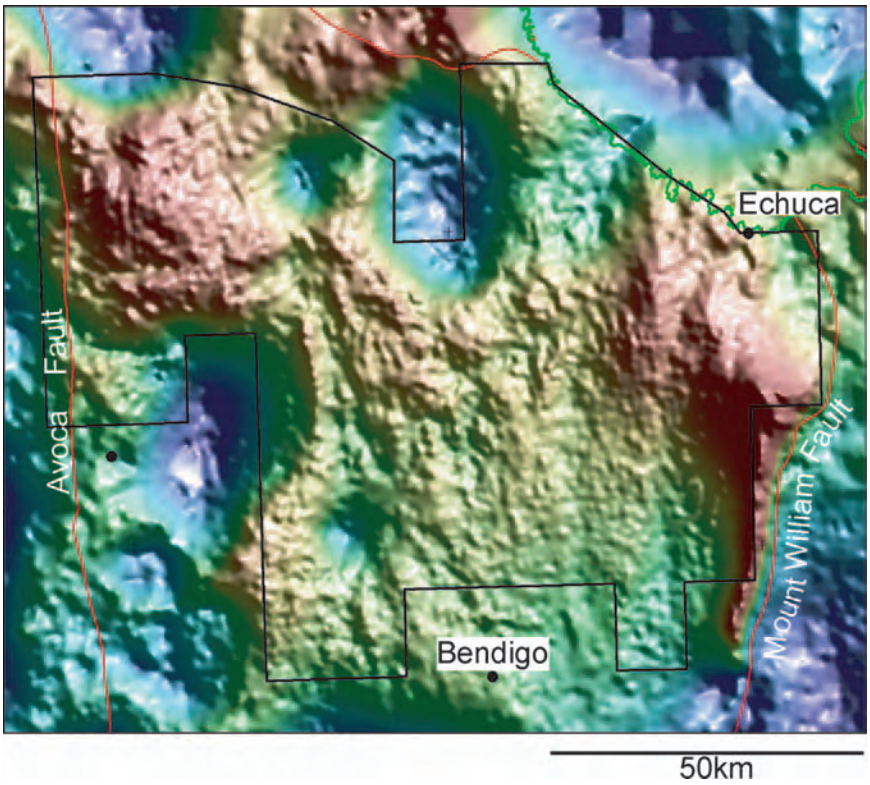

Fig. 7. *Locality map of Victoria showing 1 : 4 million geology, Victorian border in green, geological zone boundaries in red, Bendigo–Mitiamo gravity survey outline in black, gravity station locations as blue dots and major towns.*

The report and data are available from DPI's online store at www.dpi.vic.gov.au/minpet/store as part of the Gold Undercover Report series.

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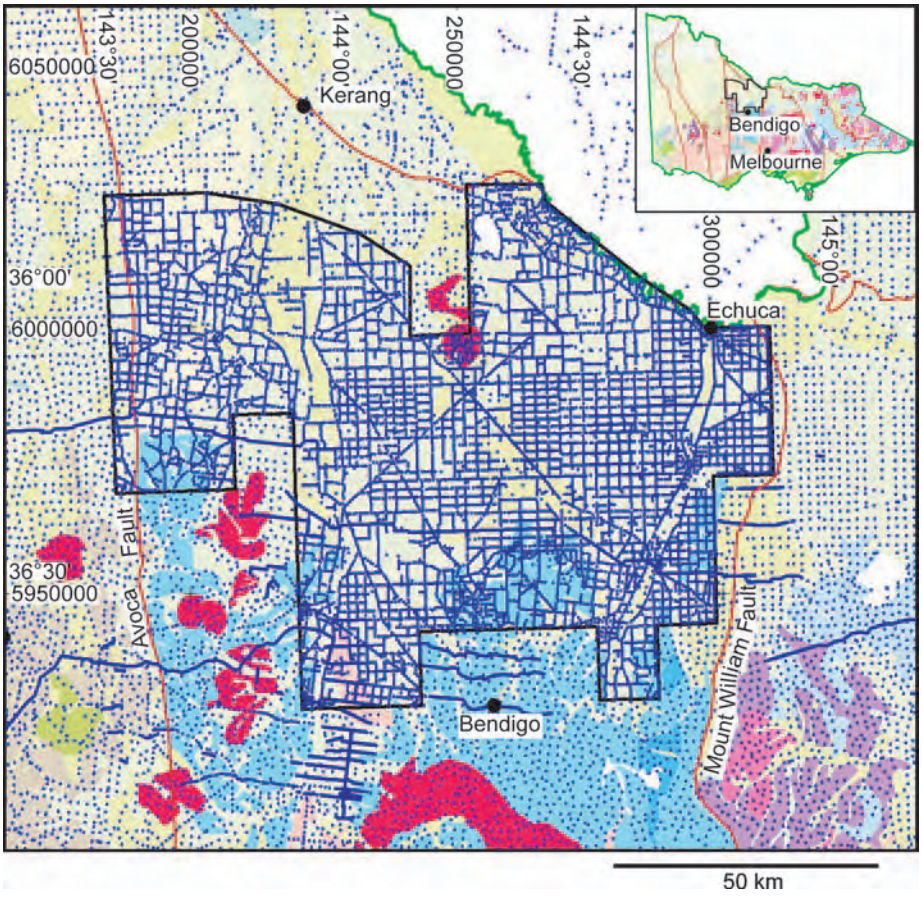

Fig. 8. *Pseudocolour image of terrain-corrected Bouguer gravity data with Victorian border in green, geological zone boundaries in red, Bendigo–Mitiamo gravity survey outline in black, and major towns.*

Continued from p. 15

where huge volumes of the gas are captured from an industrial source and injected to revive oil production.

See: http://www.ptrc.ca/weyburn_overview.php

Frio – USA

From 4–14 October 2004, the Frio Brine Pilot team injected 1600 tons of CO_2 1500 m below the surface into a high permeability brine-bearing sandstone of the Frio Formation beneath the Gulf Coast of Texas, USA. Eight months into the post-injection phase of the study, the study claims to have made substantive progress toward accomplishing the four major project objectives:

1. Demonstrate to the public and other stakeholders that CO_2 can be injected into a brine formation without adverse health, safety, or environmental effects
2. Measure subsurface distribution of injected CO_2 using diverse monitoring technologies
3. Test the validity of conceptual, hydrologic, and geochemical models
4. Develop experience necessary for development of the next generation of larger-scale CO_2 injection experiments

See: http://www.beg.utexas.edu/environqlty/co$_2$seq/fieldexperiment.htm

New information boosts exploration near Mt Isa

The Queensland Government has collected a diverse range of pre-competitive geoscientific data through its $20 million ***Smart Exploration*** Program, which started in 2005. Smart Exploration was designed to encourage exploration in prospective regions throughout the State and to assist with the discovery of the next generation of mines in Queensland. The geophysical component of the data acquisition for the program was predominantly focused on the North West Queensland Mineral Province (NWQMP), a highly prospective region that includes the globally renowned, resource-rich Mount Isa region. Data acquisition from the Smart Exploration program has included collection of airborne magnetic and radiometric data, gravity data and hyperspectral data as well as deep crustal seismic reflection and magnetotelluric profiles. One of the major aims of the program has been to focus on mapping basement rocks and structures to encourage explorers to search for and identify prospective targets in areas undercover.

The release of the Westmoreland survey in May 2008 signified the completion of the recent airborne magnetic and radiometric data acquisition program over the NWQMP, and will result in the entire area having 400 m line spaced or better data. The completion of the Westmoreland–Normanton gravity survey later this year will also signify the completion of the current gravity acquisition program over the area. Once finalised there will be a 4 km or better spaced gravity dataset throughout the whole NWQMP area with a 2 km or better spaced data over the Mount Isa outcrop geology. Two stages of Airborne Hyperspectral data collected in 15 m swaths with a resolution of 5 m have also been acquired. Stage one was released in July 2007 and focussed on known mineralised structures and adjacent deposits in the Mount Isa region. The second stage will be released in July 2008 and will provide new information over additional areas in Mount Isa as well as other prospective regions. Several deep crustal seismic reflection profiles have also been

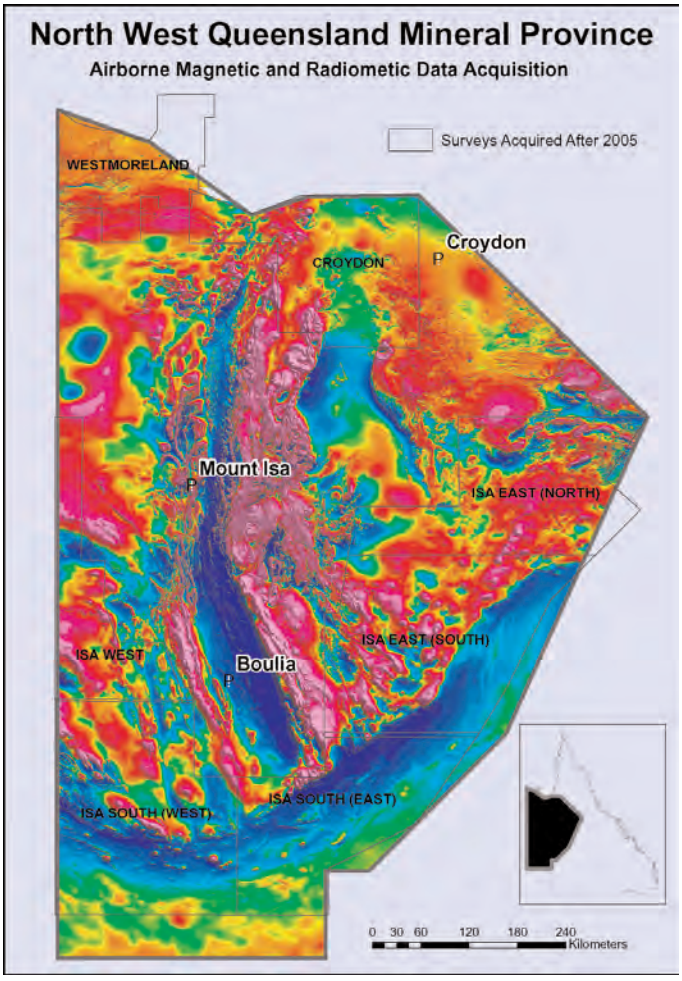

Fig. 9. *Total Magnetic Intensity image of the North West Queensland Mineral Province (NWQMP). The image was compiled from data collected by the State and Federal Governments combined with the Mt Isa Mines Open Range Dataset. The image highlights the seven surveys acquired by the Queensland Government in the last three years, during which almost 900 000 line kilometres of data were collected over an area of more than 250 000 square kilometres. Following the acquisition of these surveys the entire NWQMP now has 400 m or better line spaced data. Notice how the Mt Isa Craton extends both to the north and south under shallow cover.*

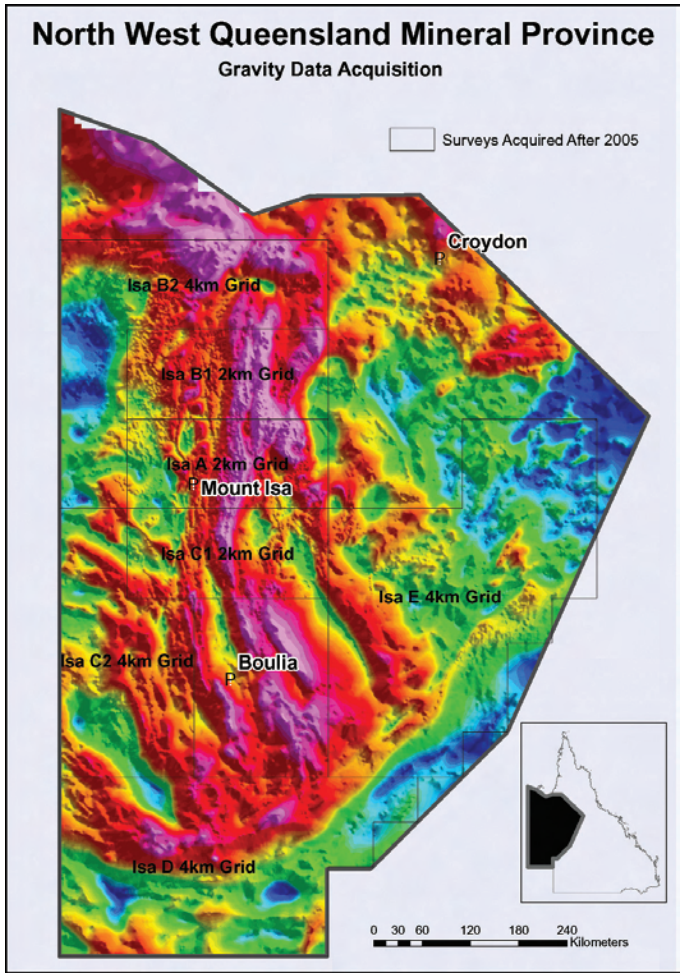

Fig. 10. *Bouguer Gravity Anomaly image of the NWQMP. Data from over 130 000 gravity observations were used to obtain this image. The image highlights areas where the Queensland Government acquired data on 2 × 2 km and 4 × 4 km grids over the past three years. This data set can now be combined with the magnetic data and other information such as seismic lines and drill hole data to produce simple 3D models in the region.*

acquired to provide a better understanding of the underlying regional structures and complexities associated with mineralisation in the area. Gravity data and rock property information were also collected along the seismic lines. Magenetotlluric data have been collected along some of the seismic lines with additional data collection planned in 2008–2009. Results from the first set of deep seismic lines will be released in June 2008 with a workshop planned in Mount Isa on 24 June.

The success of the acquisition program has already become evident with several new targets being identified from anomalies in the airborne magnetic and radiometric data and a new sedimentary basin being identified from one of the deep seismic lines.

The strategy of creating temporary Restricted Areas over areas with interesting geophysical signatures, the preparation of a data package over the areas and then releasing the Restricted Areas has also encouraged both local and international explorers to apply for tenure in underexplored areas of the State.

Since the recent phase of acquisition commenced in 2005 under the Smart Exploration program, there has been a marked increase in exploration tenements throughout Queensland, with tenement approvals increasing 40% for the period between July 2005 and 2007 and the applications for tenements more than doubling over the same period. This has also translated to an increase in exploration expenditure, with ABS figures showing an increase in expenditure from $354 million in 2005–06 to $464 million in 2006–07.

The Queensland Government is continuing to collect new geophysical data throughout the State through its ***Smart Mining – Future Prosperity*** program. Current and future acquisition programs are being focused on the Cooper Basin in southwest Queensland and the Cape York region in north Queensland.

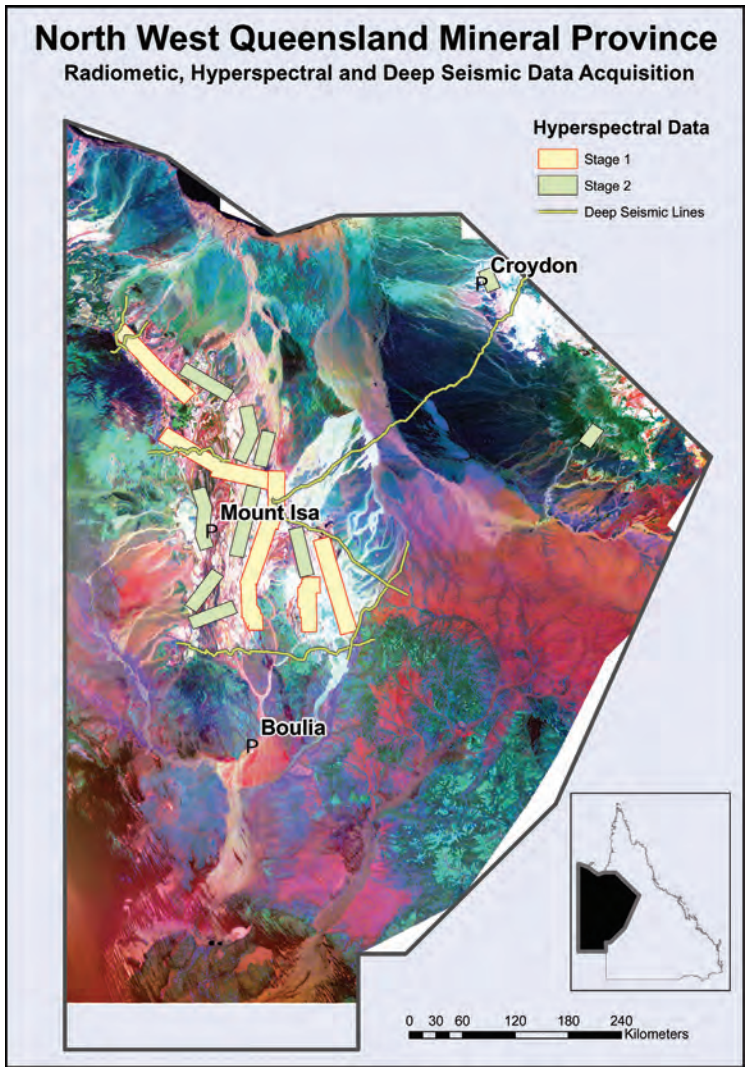

Fig. 11. *Ternary Radiometric image of the North West Queensland Mineral Province. The image is produced by merging a ratio of potassium (red), thorium (green) and uranium (blue), and shows the relative spatial distribution of these three radioactive elements at the surface of the earth. This image also illustrates the location of the two stages of hyperspectral data and deep seismic lines recently acquired by the Queensland Government. Notice how well the current drainage patterns show up.*

All airborne magnetic and radiometric geophysical survey data acquired for Queensland are released online at Geoscience Australia: www.geoscience.gov.au/gadds, as they become available, or on DVD from sales@dme.qld.gov.au.

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Central Victorian deep seismic survey

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The ~400 km long Central Victorian deep crustal reflection seismic survey was conducted in 2006 as a collaborative project between the ***pmd****CRC*, Geoscience Australia, the Victorian Government, Northgate Minerals Corporation, Gold Fields Australasia Pty Ltd and Lihir Gold Ltd, using the facilities of ANSIR. The aim of the survey was to cross several basement zones (Figure 1) and provide information on the crustal architecture, particularly across the highly prospective Palaeozoic rocks occurring along strike to the north of the major Victorian goldfields.

In the seismic section (Figure 2), the Moyston Fault is interpreted as a major east-dipping fault forming the eastern boundary of the Grampians–Stavely Zone. It cuts through the entire crust to the Moho. The boundary between the Stawell Zone and the Bendigo Zone farther to the east is the Avoca Fault, which appears to be a west-dipping listric fault that links to the Moyston Fault at a depth of about 7 s TWT (~22 km), forming a Y-shaped geometry. Internal faults in the Stawell and Bendigo zones are almost entirely west-dipping listric faults, which cut the highly reflective lower crust of these zones. The boundary between the Bendigo and Melbourne zones, the Heathcote Fault Zone, forms a zone of strong west-dipping reflections about 3 km wide to a depth of at least 20 km, and possibly to the Moho. The Governor Fault, separating the Melbourne Zone from the Tabberabbera Zone, dips to the north at about 10° where the survey crosses it.

The seismic character of the lower crust below the Melbourne Zone (the 'Selwyn Block') is significantly different to that observed below the Bendigo and Stawell Zones and contains several very strong subhorizontal reflections about 5–6 km thick starting at about 18 km depth, with a less reflective zone both above and below the reflective zone.

The new seismic data will help validate regional cross-sections being constructed concurrently for 3D interpretation and the building of a meaningful 3D geological map of Central Victoria. The seismic data and the 3D map will significantly enhance our understanding of the geological evolution of Victoria, and the regional-scale controls on gold mineralisation.

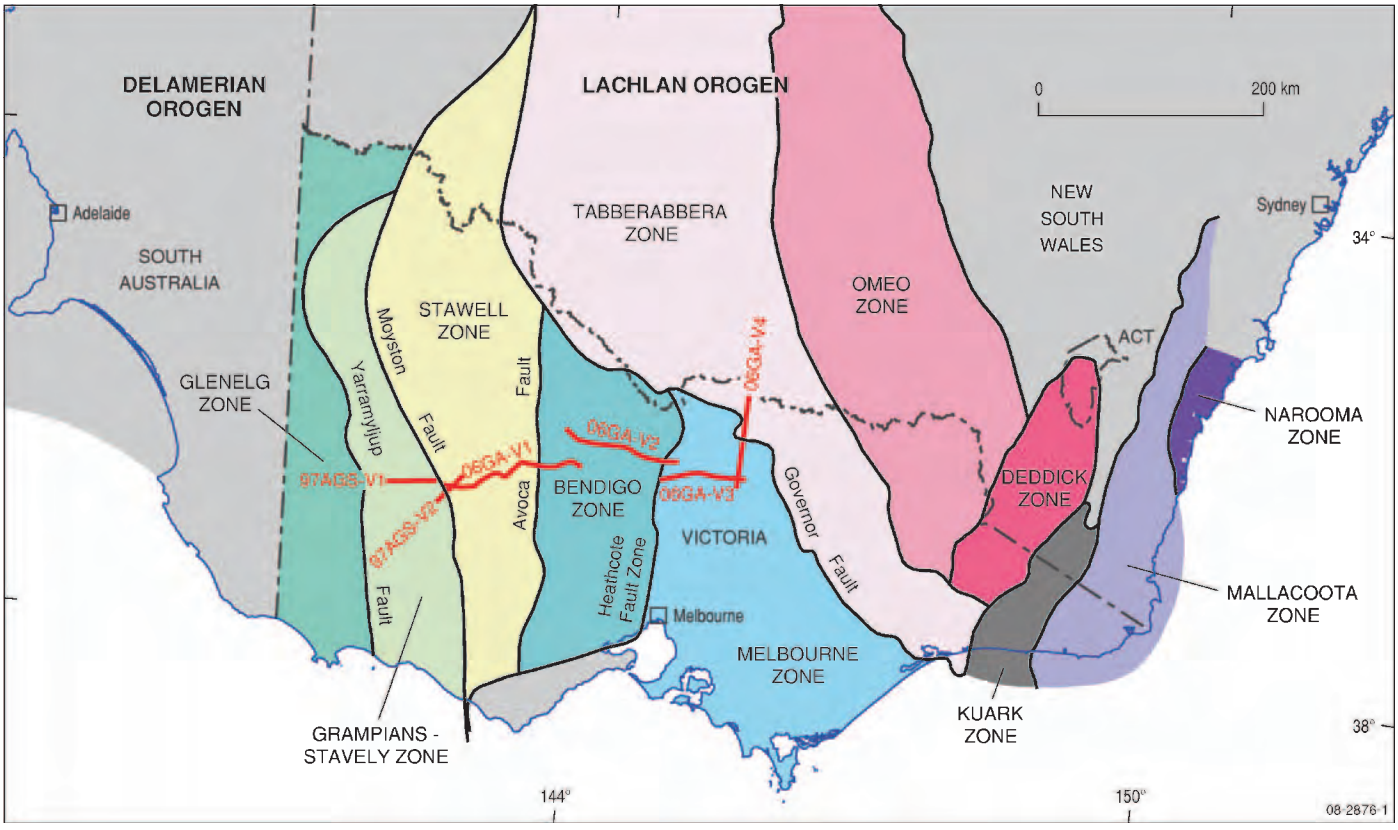

Fig. 1. *Basement zones and boundary faults in Victoria showing locations of seismic lines collected in 1997 (97AGS-V1 & V2) and in 2006 (06GA-V1 to V4).*

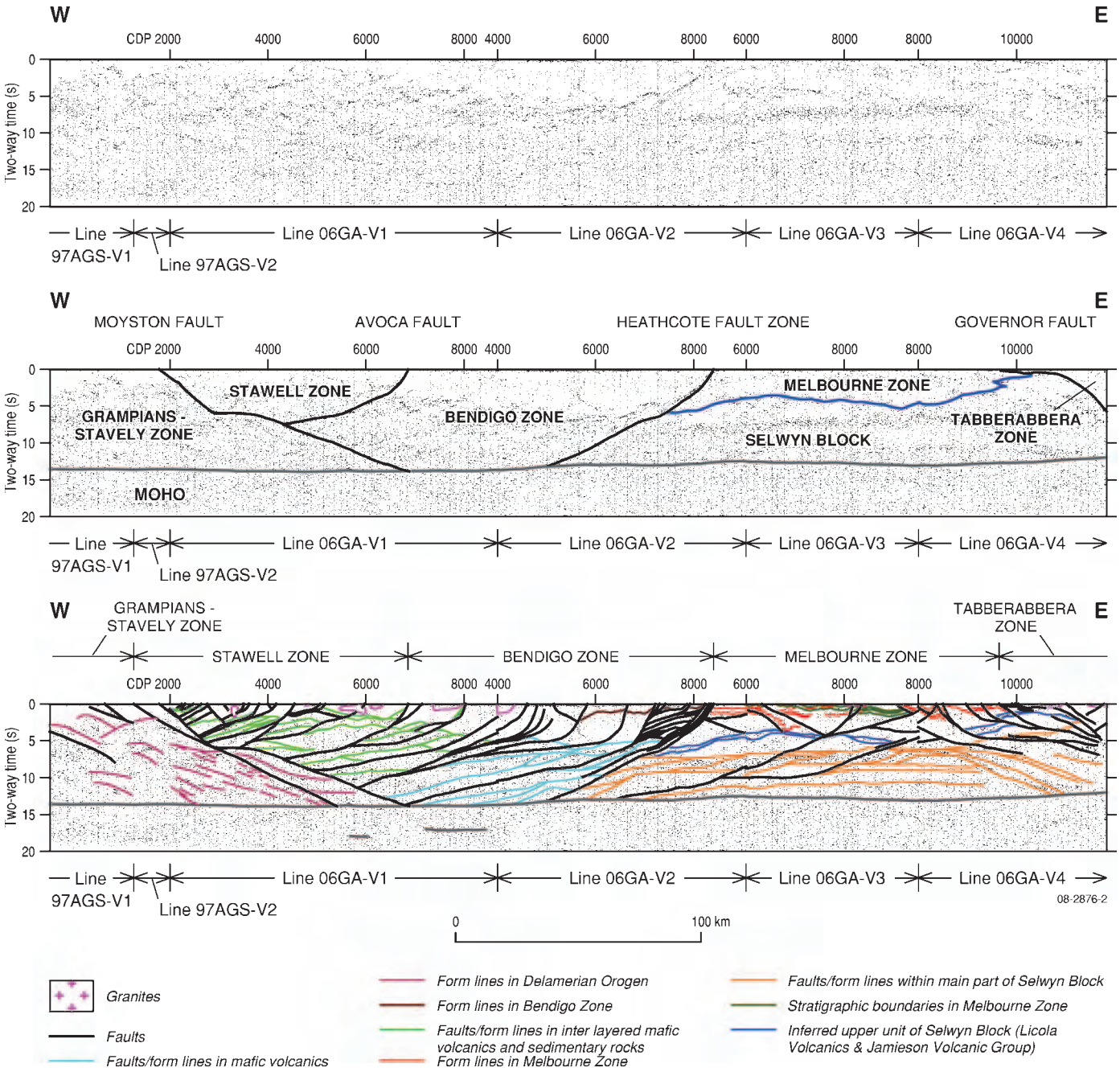

Fig. 2. *Top: Semblance filter display of migrated data for the six seismic lines spliced together to form a continuous section. Centre: Interpretation of the boundary faults in central Victoria, showing the geometry of the major basement zones. Bottom: Interpretation of the seismic data showing more detailed architecture of the basement zones.*

Exciting times for New Zealand petroleum exploration

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The big news in the New Zealand petroleum sector is that New Zealand is well on the way to self-sufficiency. Figures published last month show that New Zealand is now 70% self-sufficient in oil, due, in the main, to exports from the Tui cluster. Other significant contributions come from the old stalwarts, Kapuni and Maui as well, as small volumes of onshore production from McKee and now Cheal. Maari still waits in the wings, although work is proceeding at a furious pace and production is expected to start later this year. A possible increase in reserves was suggested earlier this year with the original 50 million barrels upgraded perhaps to 87 million. The Maari FPSO, the 250 m long Raroa graced Wellington Harbour last month before moving offshore to await completion of wells and riser systems. Pohokura reserves include some 42 million barrels of liquid hydrocarbons and when Kupe comes onstream next year, it will add production of its 15 million barrels of oil to the total. When all of these contributions are summed, around an additional 140 million barrels of oil will become available on the market and New Zealand will become a net oil exporter. The question now is 'does OPEC do monthly membership?'

New Zealand is that small country somewhere off to the east of Sydney, but our offshore territory makes us about half the size of Australia. Many permits around New Zealand are actually the size of small European countries. This is not really appreciated by the exploration community at large, so to emphasize the scale of things I'm introducing the 'Wales Standard' for licence blocks. One standard Wales is 20 779 km^2 and the unit I suggest should be called the CU (short for 'Cymru' Units; Welsh for Wales and nothing to do with my initials!).

Exploration highlights (and a few lowlights!)

It's been a busy year both on- and offshore. The Ocean Patriot semi-submersible drilled seven wildcat wells in Taranaki in addition to the Tui area production wells. The Great South Basin occupied two ships, the Discoverer 2 and the Western Trident for six months each and wells were also drilled in the East Coast, Southland and West Coast basins (see Figure 1 for the basin locations).

Chris Uruskia

Taranaki Basin

Taranaki, still New Zealand's only producing basin, saw the lion's share of drilling activity. Sadly, none of AWE's wildcat wells proved economic, though three, Taranui-1, Tieke-1 and Kopuwai-1 had significant oil columns, but poor reservoirs. Onshore, Austral-Pacific's Cheal development (PMP 35156) is now producing at 700 barrels per day. Origin and Contact have purchased Swift's assets and Todd's Mangahewa gas reserves received a boost.

In deepwater Taranaki, Hyundai HYSCO has farmed in with Global for a 30% interest. It was hoped to acquire the 3100 km 2D commitment by the end of June, but TGS-NOPEC had other plans for the Discoverer 2 and they took it away to play in another pond. Global and Hyundai are also in the process of relinquishing the outer part of the PEP 38451 permit. The relinquishment is around 40% of the original 55 830 km^2, making it 1.13 CU in area. The area of the permit underlain by Rakopi Formation source rock then becomes 0.9 CU.

Great South Basin

Both ExxonMobil and OMV, with their respective partners, will soon be awash in new seismic data from the Great South Basin. The ExxonMobil permit (PEP 50117) has an area of 16 390 km^2 (0.79 CU) and the OMV/PTTEP/Mitsui holdings (PEP 50119, 120 and 121) amount to a total of 2.35 CU. We hope to see a good number of prospects worked up in the near future and drilling in the next couple of years. Recent (2005) data acquired by Crown Minerals in the Great South Basin show that the sedimentary section is thicker than previously imaged. This rift basin still has a large number of undrilled structures, known from existing data. Kawau-1A, drilled in 1977 was a sub-commercial discovery, variously estimated at 461 BCF of gas up to 2 TCF, plus condensate. Although such a small offshore discovery may be difficult to bring into production, and certainly is not the sort of strategic reserve that majors would find interesting, its current value on the market would be around a billion dollars for the lower volume, which is a lot of money to leave in the ground. Perhaps the most important thing about Kawau-1A is that it proves the presence of an active petroleum system.

Greymouth holds PEP 50122 (0.78 CU) on the flank of the Great South Basin. This permit is on the migration route from the basin kitchen to the east and the oil seep on Stewart Island. Gentle Neogene inversion structures and stratigraphic traps are probably present within

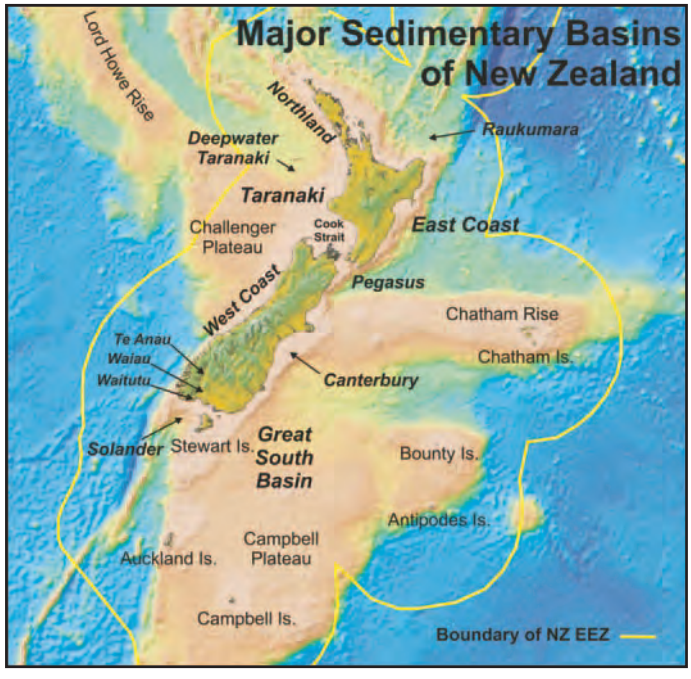

Fig. 1. *Locations of basins in the New Zealand region.*

this permit, but Greymouth will have to wait for a while to map them as it was hoped that the Discoverer 2 would be available this year.

Although strictly a different type of beast from the Great South Basin, the neighbouring Western Southland Basins, Te Anau, Waiau, Waitutu and Solander, are also receiving attention. These basins have a complex tectonic and depositional history, with rifting, wrench faulting and inversion all adding interest to thick sedimentary cover. L&M (PEP 38226, 230, 237 and 238; total area 0.31 CU) has been teased by Sharpridge Creek, which, despite several shallow wells, refused to yield commercial quantities of hydrocarbons despite good oil and gas shows. Other wells drilled are Eastern Bush-1, which was dry and Dean-1A which had gas shows. L&M has also acquired coal seam gas rights in the region. The offshore Waiutu and Solander Basins are promising, with a number of known structures, some with good AVO anomalies. Greengate has taken a bold move for a relatively small company by acquiring a new permit (PEP 50237) covering the deeper part of the offshore Solander Basin (0.55 CU).

Canterbury

Following the disappointing results from Cutter-1, TAP pulled out of the Canterbury Basin and AWE relinquished the larger part of their permit, leaving all of the shallow water part of the basin unlicenced. However, Origin has maintained a strong position in the deeper water to the east of the shelf with their permits PEP 38262 and 264 (total area 1.75 CU) and has worked up several large prospects, some with billion barrel potential. Galleon-1 in 1985 proved an active petroleum system in this region too. Galleon-1 flowed gas and condensate at a rate of 2000 barrels/day, but the structure was thought to be charge limited and sub-commercial, with recoverable reserves of only 12 BCF of gas and 590 000 barrels of condensate. The location of Origin's permits, immediately above the hydrocarbon kitchen, suggests a greater likelihood of more complete charge to their structures.

Onshore, the Kate-1 well has now been spudded by Greengate and partner Gas2grid. This well has an unconventional history, being sited on an anticline after the discovery of an oil seep when excavating during construction of a landfill site. If successful, this well will have us all scratching our heads as the kitchen for the basin lies about 100 km to the east. So, either what we now see as 'basement' will be shown to contain a source rock, or hydrocarbons would have to migrate a long way. Long-range migration is feasible as the Stewart Island oil seep shows. A third possibility is that the sparse seismic coverage has so far failed to reveal a deep depocentre. The significance of this well is that, if successful, it would show the way in other basins that have until now been considered marginal. In particular, the Wanganui and West Coast basins would have to be re-assessed.

East Coast

Plains E&P (once Pogo) have been absorbing and mulling over their new 2D data set from their challenging permit (PEP 38344; 1.03 CU), the offshore East Coast Basin. They have located around 30 leads and are presently upgrading the best leads to prospect status. In Cook Strait, Discovery Geo is planning more 2D acquisition for PEP 38343 (0.29 CU) with a well due by December 2008.

Onshore, the situation is more crowded but a little quieter, Discovery Geo holds two permits in the Wairarapa (PEP 38342 and 50189; area 0.21 CU). Discovery Geo recently drilled Ranui-1, but have declined to comment on the results. Lakes Oil (Australia's oldest oil company) holds PEP 38350 (0.1 CU). Lakes Oil is not due to drill until 2010, but we have it on good authority (the writer observed an aircraft with a magnetic anomaly detector flying above his property in the Wairarapa a couple of weekends ago!) that they have conducted an airborne geophysical survey. David Bennett is back in the East Coast, this time leading Trans-Orient with permits PEP 38348 on the Raukumara Peninsula and 38349 in southern Hawke's Bay. The two permits have a total area

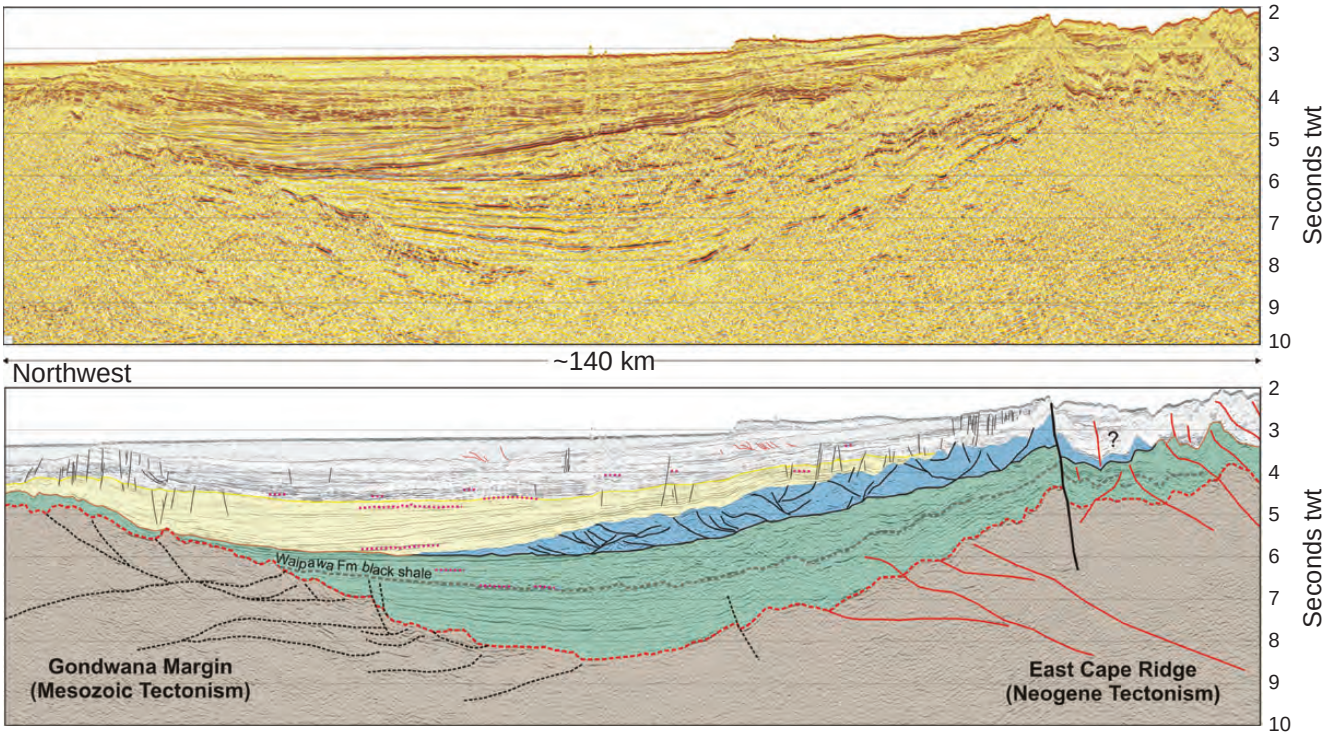

Fig. 2. *Seismic line RAU07-03 across the Raukumara Basin, East Coast North Island, New Zealand. The brown unit is economic basement, the green unit is the Late Cretaceous and Paleogene succession containing source rocks, the blue wedge is the East Coast Allochthon emplaced around 25 million years ago. The yellow and white succession are of Neogene age and include a range of turbidites with depositional mounding and associated with stratigraphic traps.*

of 0.42 CU (Dr Bennett might empathise with this standard) and each has a well commitment due in 2009.

The final permit is 38346 (0.27 CU), where Westech have previously drilled a dozen or so wells with only sub-commercial gas to show for their efforts. Westech's early policy was to drill wells rather than acquire seismic data, but this has changed as they have drilled most of the large highs in the permit and those proved to be generally devoid of good reservoir facies. The current theory is that piggy-back basins channel turbidite flows, so secondary structures within the axes of the basins may contain better sands. Westech are planning a 3D survey onshore prior to drilling one of these secondary structures.

For what it's worth, my opinion on the work programs for all East Coast permits except for 38346 (Westech) and 38344 (Plains) is that they need much more seismic. Coverage is sparse at present and the region is tectonically active and has been for the last 25 million years. Westech is showing the way to understand their permit's complex geology. Such understanding needs 3D seismic tied to regional 2D data, neither of which we have at present. I know that even small volumes of onshore seismic are an expensive item for a small company, but spending on seismic would greatly decrease the gamble taken in siting yet more expensive wells.

Northland

There are still three permits operating in the Northland region. PEP 38618 and 38619 are held by Origin and OMV and operated by Origin (0.56 CU) with one well in each due in 2009. Their 3D Nimitz survey and 2D Pantheon and Akira surveys have highlighted some exciting prospects. In the eastern block, PEP 38619, the Nimitz survey shows the Korimako and Kokako prospects with potential for multiple stacked pay, both with associated amplitude anomalies. The Akira survey in PEP 38618 outlined very large sub-Oligocene prospects. The third licence is PEP 38602, which, at only 244 km^2 is the smallest permit, mentioned so far. Todd, sole licensee and operator, has applied for an extension to evaluate the gas discovery made at Karewa-1 in 2002 by Conoco, Inpex and Todd.

Crown Minerals are planning to gazette the remaining part of the Northland Basin in the next month or so. Source rocks range from Jurassic coal measures to black Paleocene marine shales, a thick sedimentary succession is almost ubiquitous and most source rocks are buried deeply enough to be mature for oil and gas. A great number of possible structural traps are present.

Raukumara

This basin shows how immature petroleum exploration really is in New Zealand. To all intents and purposes, this basin has just been discovered despite lying just a stone's throw offshore. In fact, the presence of a sedimentary basin off the north end of the Raukumara Peninsula has been known for a long time from single-channel seismic work by New Zealand's DSIR (now GNS Science).

Last year, Crown Minerals were sufficiently convinced that a thick sedimentary section is likely to be widespread in the basin that they undertook a new 1200 km 2D survey. This reconnaissance survey has now been interpreted and the region will shortly be offered in a new licensing round.

Up to 13 000 metres of sediments are seen on seismic data. They are subdivided into three packets:

- An oldest package that appears to prograde to the east;
- A middle unit that thins to the west and contains numerous thrusted blocks, and;
- A more recent package that includes a number of channelled and slumped units.

The basal unit is interpreted as a Late Cretaceous and Paleogene succession that prograded across the Gondwana margin following cessation of subduction. The eastern part of the basin was uplifted as the modern plate boundary was initiated and sheets of the older sediments slid back towards the centre of the basin. These are correlated with the East Coast Allochthon seen at outcrop in the nearby Raukumara Peninsula. The third and youngest package is correlated with Neogene cover sequences as seen onshore. The Cretaceous and Paleogene succession includes marine source rocks buried deeply enough to be generating oil and gas and a number of leads is apparent on every line. This exciting basin needs a good level of investment as it lies in average water depths of up to 2000 m, however, returns could be great, with several structures identified that could be capable of trapping a billion barrels or so of oil each.

Conclusion

New Zealand is soon to become a net oil exporter and continued exploration effort will be needed to maintain that position. The good news is that we have the raw ingredients to achieve that aim and we've barely scratched the surface yet. So far I've accounted for more than 10 times the area of Wales, or more than the total area of the United Kingdom, that is being actively explored around New Zealand. My list is by no means exhaustive and, when other permit holdings are added, we get up to the area of Norway. Add the new areas to be offered and who knows? The point is that possibilities are very great. We shall continue to make discoveries in and about basins we know something about and will find basins we don't yet know exist. This is exploration in all its phases.

Climate Change 2007: The Physical Science Basis

by the Intergovernmental Panel on Climate Change (IPCC)

Publisher: Cambridge University Press, 2007, 996 pp.
RRP: $130.00 (pbk, incl. CD), ISBN: 978-0-521-70596-7

An early introduction to this 'truly weighty tome' is to note the requested full reference to this report: IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change – followed by the names of the eight primary editors and then the publisher details as above. Thus it is the report of one of the three working groups to the Fourth Assessment Report of the IPCC under the overall umbrella title, 'Climate Change 2007'. The other volumes in this report, all available from Cambridge University Press, are 'Climate Change 2007: Impacts, Adaption and Vulnerability (Working Group II)' and 'Climate Change 2007: Mitigation of Climate Change (Working Group III)'. A fourth volume, 'The Synthesis Report', provides a synthesis of the IPCC's overall findings. The Fourth Assessment Report follows the 'Third Assessment Report – Climate Change 2001', and the 'Second Assessment Report – Climate Change 1995'. Full details of the IPCC and all of its reports, including how they are compiled are at: www.ipcc.ch/.

Quoting from the report's own fly sheet: 'The Intergovernmental Panel on Climate Change (IPCC) was set up jointly by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) to provide an authoritative international statement of scientific understanding of climate change'. And 'simply put, this latest assessment of the IPCC will again form the standard scientific reference… (for) students and researchers… and policy makers…worldwide'.

The list of contents and chapter headings are at: www.ipcc.ch/ipccreports/ar4-wg1.htm. Its 996 densely packed pages contain: a Foreword by the heads of the WMO and UNEP; a Preface outlining the scope and structure of the report with acknowledgements (and superlatives) by the Chairman and Co-Chairs of the IPCC; a Summary for Policymakers (18 pages); a Technical Summary (73 pages); 11 Chapters on specific topics written by 152 lead authors from 30 countries (848 pages); a Glossary ; a list of Contributors to the chapters and their addresses (600 in all); a list of Reviewers to the Report arranged by country (over 200 with 32 from Australia); a list of Acronyms; and an Index. The figures are numerous and make excellent use of colour. Effort has clearly been put to ensure uniformity of style throughout, making it is easy to navigate the report once familiar with it.

I have belaboured the statistics above in an attempt to illustrate the sheer scale and scope of this publication. It is almost A4 size, 4 cm thick and weighs over 5 kg. It must surely be the 'bible' of the science of global warming. It is packed with information. The entire book is arranged in a logical sequence from Introduction to Conclusion as are the individual chapters within themselves. The order of the chapters is also logical from overview to detail. It is therefore designed to be read from start to finish but I doubt if many will read it all, at least in one session. It also suits just delving into certain sections according to interest or research needs, as I did. For this purpose it is very accessible. The index serves this well and the extensive numbering of sections helps too. For example, I was keen to see what is known about CO_2 emissions from aircraft. This can be found in the Index as Aircraft/aviation which directs to aviation aerosols and contrails. Aviation aerosols are also found under the general index heading of Aerosols, and Contrails is also listed separately. Either way, leads to the same relevant pages.

Every chapter names the particular two coordinating lead authors, lead authors (as many as 10), contributing authors (40–50), review editors (2 or 3) and how it should be cited. Each has its own Table of Contents, Executive Summary, a final Summary, References and sometimes a number of Appendices of supplementary material. Each has Frequently Asked Questions (FAQ) and often 'boxes' to explain a background topic or material in more detail. The boxes and the titles of the FAQs stand out with a distinctive background colour. An example of an FAQ is: 'Is sea level rising?' and of a box is: 'Tropical cyclones and changes in climate'. In each chapter, extensive use is made of tables and figures, which are clear and graphic. The references often extend to 15–20 pages with over 40 per page. Each chapter could be monograph in its own right.

The 11 chapter titles are in a logical sequence from a historical overview (Ch. 1) to observations of all the changes taking place (Chs 2–5), followed by an entire chapter on models (Ch.8) and then global and regional projections (Chs 10–11). The Preface attempts to help the reader find the relevant chapter for a particular matter of interest by posing eight questions and issues and naming the chapter that deals with them. For example, the question: 'What is known about the natural and anthropogenic agents that contribute to climate change, and the underlying processes that are involved?' directs the reader to Chapter 2: Changes in Atmospheric Constituents and Radiative Forcing, Chapter 6: Palaeoclimate, and Chapter 7: Coupling Between Changes in the Climate System and Biogeochemistry.

The immense content makes it virtually impossible to summarise the report's findings and predictions here. To take one isolated case, Australia appears only under Climate Projections (Ch. 11) occupying just five pages and two figures. The report defines standard terminologies for levels of confidence in its predictions and admits to uncertainties. The final summary in Technical Summary lists for each conclusion what it considers 'robust findings' and 'key uncertainties'.

How current is the report? Since it is peer-reviewed, the time from completion of the research (said to be 2005, at the latest) and publication is too long for some. This is a not-unreasonable point, especially considering that new facts are emerging all the time and that the science is in a state of rapid change. For example, recent research indicates that processes such as the melting of ice-sheets are accelerating faster than the report's predictions. Even in the month that I have had this report, some of its specific numbers has been updated. Some eminent scientists in a recent article in New Scientist (3 May 2008, pp. 8–9) claim that the report's 'forecasts, especially for regional climate change are immensely uncertain'. By acknowledging key uncertainties and that modelling is still very immature, the report accepts this criticism, in general. There is some concern that politicians and others, not well versed in this science, will regard this report as definitive and make policy and set targets based on these three-year-old results. Perhaps the best way to use this report is a 'source' book to form the basis for research and to build on it as more recent facts are revealed.

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Physical Geodesy, 2nd Edition

by Bernard Hofmann-Wellenhof and Hemut Moritz

Publisher: SpringerWien, New York, 2006, 403 pp.
RRP: $125.95, ISBN-13 978-3-211-33544-4

This book on physical geodesy follows the book of the same name by Heiskanen and Moritz that was released in 1967, a classic text that is still quoted frequently today. As noted in the foreword by Hoffman-Wellenhof, 'Have the clocks been stopped since then? Not at all, time has flown as fast as usual….Excellent quality is correlated with a long life expectation'. Geodesy has indeed progressed in leaps and bounds since the 1960s, with the development of very long baseline interferometry, satellite laser ranging, satellite altimetry, the global positioning system and its recent counterparts (Glonass, Galileo) and, of course, the space gravity missions. The second edition is a corrected version of the first edition (printed in 2005), with only minor grammatical and formatting changes.

Physical geodesy deals with the size and shape of the Earth and its gravity field. The relation between geometrical and gravitational measurements is given a thorough investigation, including demonstrating how modern space geodetic measurements now provide possibilities for tackling some of the fundamental problems from directions that were not available in the 1960s. Thus, this book updates the theories to the modern space era. Anyone with a mathematical bent will find plenty to challenge them because the authors use the mathematics of potential theory to weave a trail through gravity and gravity reductions, spherical harmonics, isostasy and height systems as well as brief descriptions of some of the space geodetic missions.

The first chapter provides an introduction to potential theory, including introducing spherical harmonics, Legendre functions and boundary value problems. This chapter provides the tools on which much of the following chapters rely for both explaining and tackling supplementary problems.

Chapters 2 and 3 deal with the gravity field of the earth and the classic gravity reductions of the free-air, Bouguer etc. Most of the explanations are mathematically based and without proof, in a free-flowing informal style and readers may find many of the 'rule of thumb' approximations that are in common use.

There is a good explanation in Chapter 4 of the different 'heights' that appear in geodesy and surveying, along with how they are related mathematically and which observation techniques actually measure what quantities. This includes conventional levelling, GPS levelling and the role of gravity observations, potential and orthometric heights.

Chapter 5 is in three parts and looks at reference frames after GPS, three-dimensional geodesy and local geodetic datums. This is one of the more descriptive parts of the book but also includes coordinate transformations and the reduction of historical terrestrial observations (made with theodolites and distance measuring equipment) to an ellipsoid in the more classic-style of geodetic computations. It deals specifically with the relation of geometric and physical aspects including the complexities of working in three dimensions simultaneously rather than separating height from horizontal coordinates.

Chapters 6, 7 and 8 start looking outward to gravity outside the Earth and the space gravity missions of CHAMP, GRACE and GOCE. There is some succinct information here on the mission goals and how they are to be achieved. Chapter 8 also includes a perspective on how boundary value problems might be solved in the modern era when we can measure heights relative to the reference ellipsoid directly with GPS.

The final chapters deal with statistical methods in physical geodesy as well as computational methods such as least-squares collocation.

In Chapter 8, the authors offer a €500 prize, the 'Molodensky prize' for the first excellent review paper on the various aspects of free-air reductions of gravity. I wonder if it has been claimed or whether the challenge is still open …

Copies can be ordered directly from http://www.springer.com or through your local book store.

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Copies can be ordered directly from Cambridge University Press: Tel. (03) 8671 1400 or www.cambridge.edu.au.

Reviewed by Roger Henderson
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July			**2008**
20–25 Jul	19th AGC, The Australian Earth Sciences Convention 2008 Joint Geological Society of Australia and Australian Institute of Geoscientists Meeting www.gsa.org.au/events/calendar.html	Perth	Australia
August			**2008**
5–14 Aug	33rd International Geological Congress www.33igc.org	Oslo	Norway
September			**2008**
14–17 Sep	EABS III Energy Security for the 21st Century www.pesa.com.au/pdf/eabs_call_for_papers.pdf	Sydney	Australia
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
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

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