OCTOBER 2010 • ISSUE 148
ABN 71 000 876 040 ISSN 1443-2471

PREVIEW

AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS

NEWS AND COMMENTARY

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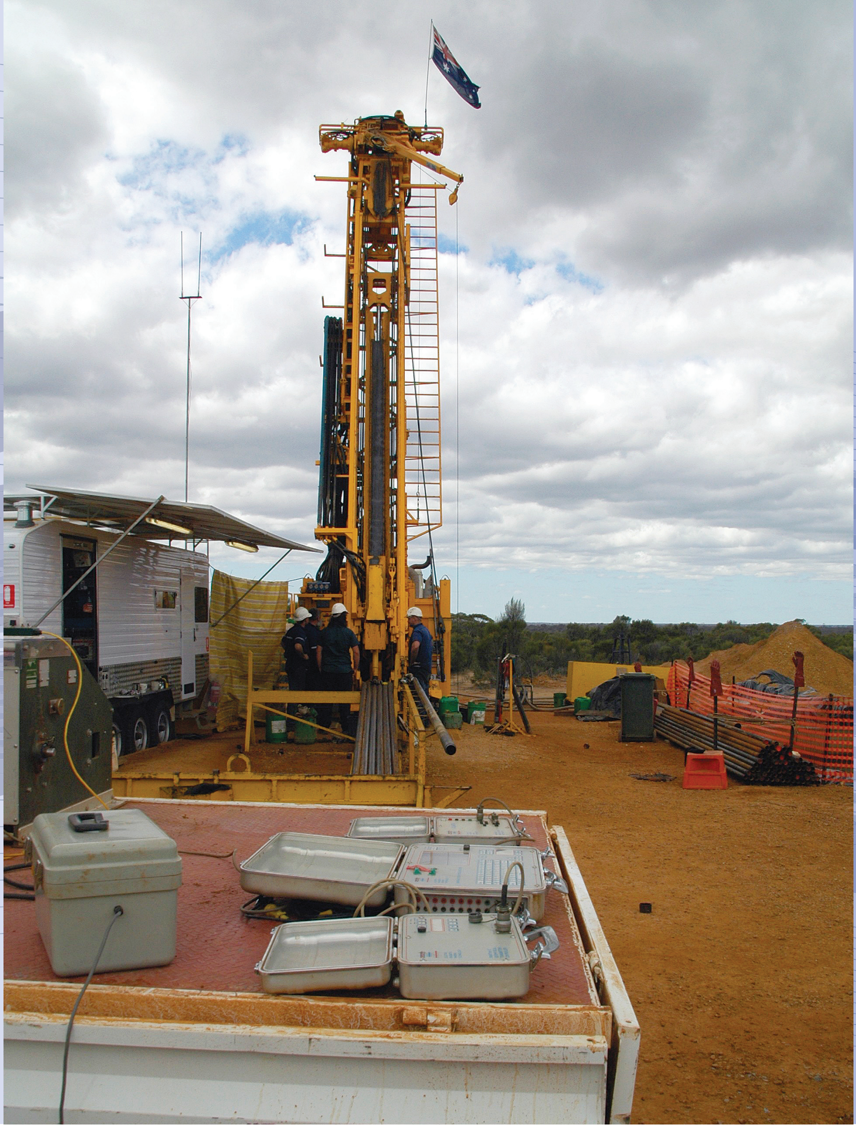

PREVIEW

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FRONT COVER

IP generator and transmitter operating for MMG – Minerals and Metals Group at Century QLD. Photo courtesy of Zonge Engineering and Research Organization.

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

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Ann-Marie Anderson-Mayes

Just a couple of weeks before our own very successful ASEG–PESA 2010 Conference was held in Sydney, the Walkley Media Conference 2010 took place, also in Sydney. One of the keynote speakers at that conference was John Nichols, a US journalist, blogger, media commentator, and author. His presentation, 'The Death and Life of American Journalism', was based on material from his latest book of the same name. I watched a video clip of this speech via the ABC's *Big Ideas* program and was struck by a couple of the statistics which Nichols highlighted (if you are interested, go to http://www.abc.net.au/tv/bigideas/browse and look under John Nichols).

First, in 1960 the ratio of journalists to public relations people in the USA was 1 to 1. In 1980 there were 1.2 public relations people for every journalist, and now, there are **four** public relations officers for every journalist. At the same time, a study of the source of the news content across a wide range of media outlets in Baltimore, Maryland found that 96% of the new, breaking news stories were coming through 'old' media, i.e. TV, radio and newspapers – only 4% were coming through new internet-based media forums. However, the problem was the source of this content. The study found that 86% of stories came from information generated by government and corporations for media consumption (i.e. press releases and the like) whilst only 14% came from the traditional journalism model of a journalist sourcing and researching a story. These statistics could be replicated across cities in the USA. Nichols' point is that the quality and independence of American journalism has suffered badly and this has significant implications for effective democracy.

So, why did I think this might be of interest to *Preview* readers? A correspondent recently suggested to me that *Preview* should be very careful not to publish articles that might be construed as advertising. I was quick to reply that I spend a lot of time thinking about this very problem in relation to our magazine. In our industry, a lot of excellent research and technical progress occurs in private companies and is used immediately for the advantage of clients in a range of applications. If someone working for that company writes an article on their new instrument, technique or innovation for publication in *Preview*, I am fully aware that at least part of their motivation is to let the industry know what they are doing and possibly source some new clients from that exposure. However, if I chose not to publish any articles from corporate sources, your exposure to new science in our industry would be much the poorer. Similarly, public relations officers from a range of organisations have added me to their email lists. Occasionally a piece of Industry News might evolve because a media release has piqued my interest and I feel it might be of general interest to *Preview* readers. At the recent ASEG–PESA 2010 conference, a very large Exhibition took place, and many representatives of these Exhibitors gave technical presentations to gain exposure for their particular technologies. Was the science any less valid or interesting because it came from a source with commercial interest in its development? I thought not – but you are of course welcome to disagree with me.

This is a fine line in our industry and I would welcome your feedback. Let me know if you think that the integrity of *Preview* is compromised by these corporate contributions, just as the quality of American journalism has declined due to the huge imbalance between independent journalists and corporate public relations personnel. Or is it a reality of our industry which we all know and understand? Fortunately, we read *Preview* knowing the source of the content, unlike the Baltimore citizen who is usually not informed of the difference between the news that has come from a powerful PR unit and the news generated by an independent investigation on the part of a local journalist.

Future discoveries are still in our hands

I am writing this after attending our very successful 21st conference in Sydney, which we jointly shared with the PESA. On behalf of all of us in the ASEG, thank you to chairman Mark Lackie and his PESA co-chair, Phil Cooney, along with the Sydney organising committee, for holding such a great event. We all came away with a sense that good things are happening in our business and that, as a profession, we are capable of rising to the challenges of a growing world.

The theme of the conference was, 'FUTURE DISCOVERIES ARE IN OUR HANDS'. One thing that I have learned is that no one has any idea of what the future will look like. In spite of our best efforts, the modern Nostradamuses have all been ineffective at predicting even the simplest of changes. The big ones are often 'left field' paradigm shifts that no one sees coming, they actually creep up on us. In these days of populism, our view of the future seems to be driven more by our 'henny penny' fears. However, if you think about it, we are actually living in the future right now… it is yesterday's future. So how are we doing in this future?

The first ASEG conference was held in Adelaide in 1979. There were no cell phones, internet, PCs or GPS, just to name a few. It was the first time that I gave a paper at a conference. The subject was the application of high resolution seismic reflection surveys to detect faults in coal seams. The method had been used before, but this was about challenging conventional thinking and tweaking the parameters, so that we could detect seam thickness faults. At the time, it took a lot of desperation from the miners to stump up the high cost of doing such a survey.

This industry was slowly recovering from the bad rap it gained as a result of Canadian techniques applied in Australia during the 60s nickel boom. CRA and BHP had both decided to rebuild geophysical expertise in their exploration groups and appointed their first modern era Chief Geophysicists, Bob Smith and Hugh Rutter.

TEM was emerging from its Russian roots and the CSIRO and industry (through AMIRA) were developing SIROTEM. Aussie geophysicists were committed to building systems and expertise relevant to the Australian environment, in spite of the fact that interest in new nickel discoveries, like the nickel price, was low.

Magnetotellurics was a method that was transitioning from fundamental earth geophysics, where experts drew curves of best fit through scattered data points, and the rest of us scratched our heads.

The oil industry had not so long ago gone digital and John Claerbout's group had 'cracked' the wave equation. 3D was a pipe dream and in any case, we didn't have the navigation technology or the computer power to do it.

In airborne surveys, planes really didn't know where they were in space and the most advanced airborne EM system was a pseudo time domain system called Input, mounted on a World War II reconnaissance sea plane. Airborne gravity gradiometry was a pipe dream.

At the time everyone was worried about where our future geophysicists would come from.

Yet here we are today in the future (tomorrow's yesterday).

There have been vast changes in the world and it has just crept up on us! In our industry: coal miners regularly carry out 3D seismic surveys as critical precursors to mine planning; TEM was the key component of a raft of new nickel discoveries in a modern nickel boom; MT has come of age and is finding wide application to a number of exploration problems in minerals, petroleum and geothermal exploration; the oil industry not only shoots 3D, but 4D surveys and the computer power employed is beyond what anyone could have envisaged; airborne systems know where they are with the pinpoint accuracy of GPS; and airborne TEM and the processing that goes with it has turned into a sophisticated geological tool rather than a bump finder; high resolution airborne gravity gradiometers have been flying for over ten years….

And we are still saying where 'are the people of the future coming from' and complaining about our boom–bust industry…some things never change.

So in 1979…'FUTURE DISCOVERIES **WERE** IN OUR HANDS'…and as I see it we have delivered it beyond our wildest dreams. Who knows what the future holds from here?

For sure the world is in a new phase of growth with the emerging economies. The challenge for us to deliver new discoveries is as great as ever and from what I saw at our conference, we have the capacity and enthusiasm to do it. We have emergent technologies and enthusiastic young people to take us forward.

Somehow I believe that in the future, as we look under cover we will be forced to address the 'geo' in geophysics more than the 'physics'. We will have excellent techniques to see into the earth but targeting will rely on us being able to pick 'blind' targets…we will need to understand their 'geological' context to do this effectively.

I have very much enjoyed our 21st get together and look forward to Brisbane in February 2012 as we roll back the future.

Phil Harman
President
phil.harman@bigpond.com

ASEG News

ASEG Awards in Sydney

Conferences are the ideal forum to present Awards to members who have made special contributions to the ASEG and the community in general. The following awards were presented at the Opening Session of the Conference on Monday, 23 August. Our warmest congratulations go to all the worthy recipients.

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.

James Macnae

Professor James Macnae is an internationally recognised and acclaimed researcher and teacher in electromagnetic (EM) methods for applied geophysics. Jim received his Doctorate from the University of Toronto in 1981. While in Canada, he was part of a team inspired by Yves Lamontagne and Professor Gordon West at the University of Toronto which developed and applied the highly successful UTEM time-domain EM system. Jim moved to Australia in the early 1990s to take up a professorship at Macquarie University. Since moving to Australia he has been a leading researcher and teacher not only in Australia, but on the world stage.

He led a program developing airborne EM software development within the Cooperative Research Centre for Australian Mineral Exploration Technologies from 1992 to 2000, developing with his students a package which is now commercially available and is an industry standard. Since joining RMIT University in Melbourne in 2001 he has pursued a vigorous research program, attracting some $2 million research funding from the Australian Research Council, AMIRA and mining company sources.

In addition to his core interests of airborne EM methods, Jim has a record of pushing the envelope on a range of geophysical technologies such as inductive source resistivity, the use of capacitative and charge coupled electrodes for EM methods, magnetic data acquisition from unmanned airborne vehicles, and the conceptual development of an airborne induced polarisation method.

Jim has taught numerous courses both for universities and private industry and is widely regarded as a teacher with deep insight into the science and methodology which he imparts. He has received numerous journal and conference 'Best Paper' awards from the SEG and ASEG and is a regular choice for providing a 'key note' talk at conferences, including the Fifth Decennial International Conference on Mineral Exploration held in Toronto, September 2007.

Some of Jim's key contributions to the profession include:

- Program leader of multiple industry, AMIRA and ARC-funded research projects in air EM and ground EM methods, which have attracted support from exploration companies world-wide, and which have delivered state of the art commercial software for EM interpretation.
- Co-authorship of two chapters of the Society of Exploration Geophysicists' text *Electromagnetic Methods in Applied Geophysics*, which contains contributions from eminent EM geophysicists from around the globe.
- Co-authorship of three major reviews of the state of the art in electrical and electromagnetic methods, published in *The Leading Edge* (2005), and presented at the Fourth and Fifth Decennial International Conferences on Mineral Exploration (Exploration 97, 2007) in 1997 and 2007.
- Presentation of short courses on practical interpretation of surface, drillhole and airborne EM in Australia, South America and South Africa.
- The large number of citations to his publications in international books and journals covering surface, airborne, drillhole and marine electromagnetic methods.

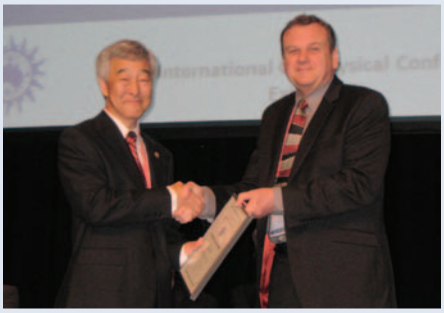
In addition to his research and teaching activities, Jim has been active in the affairs of the ASEG, acting as Technical Program Co-Chairman of the 18th ASEG–GSA conference 2006, and Technical Co-Chairman and Co-Editor of Proceedings of the Third 3D-EM Workshop, Adelaide, 2003 and Co-Editor, referee and author of many ASEG publications and papers.

Jim has always been extremely generous with his time to discuss any aspects of EM theory or to examine problematic data sets. He has also been a patient, tireless, and passionate supporter of tertiary geophysics education, teaching and supervising numerous undergraduates and post-graduates that have gone on to apply geophysics to the benefit of Australia.

It is fitting that Jim now be recognised with the ASEG Gold Medal for exceptionally and highly significant distinguished contributions to the science and practice of exploration geophysics.

Honorary Membership of the ASEG

For distinguished contributions by a member to the profession of exploration geophysics and to the ASEG over many years.



Koya Suto

Koya Suto is well known to most members of the ASEG through his long-standing membership of the ASEG Federal Executive, and his editorship for many years of the ASEG Membership Directory.

Koya graduated in 1974 from Akita University in Japan with Bachelor of Engineering in Geology and in 1976 received his Master of Engineering in Exploration Geophysics. Following this, he came to Adelaide University to further his research interests in airborne magnetic and radiometric surveys in the Broken Hill area.

He was subsequently employed as an exploration geophysicist over a 20 year period by several companies, including Esso Exploration, CRA Exploration and Origin Energy. His main work during this period was seismic data interpretation and supervising data acquisition and processing in many Australian basins including the Otway, Gippsland, Canning, Carnarvon, Timor Sea, Macarthur, and the Surat/Bowen Basins. He helped decide drilling locations for many exploration and development wells and used several other geophysical techniques for minerals, coal and petroleum resources exploration.

In 2003, Koya established Terra Australis Geophysica Pty Ltd, a geophysical consultancy group providing high-resolution geophysical services to the engineering, environmental, agricultural and resource industries. With Terra Australis, Koya has been studying and using the MASW (Multi-channel Analysis of Surface Waves) method since 2003. He is one of the longest users of this method in Australia.

He translated a textbook *The Microtremor Survey Method* by Hiroshi Okada. This was published by SEG as Monograph Series 12 in 2003.

Koya has served the ASEG with distinction. He has been a member since 1975 and has served continuously on eighteen Federal Executives, from 1992 to 2010 – probably longer than anyone else – and has been a Vice-President since 2006. Throughout this extended period Koya has made an enormous contribution over a whole range of portfolios.

His initial responsibility was in the critical area of membership. He was responsible for maintaining the Society's membership records, and his renowned tenacity and determination ensured that what used to be a somewhat chaotic arrangement was transformed into a properly maintained system; and perhaps more importantly, that renewal notices were distributed on time. During that time he was also involved with the development of the ASEG's website.

From 1998 to 2007 he was responsible for most of the compilation and production of the annual ASEG Membership Directories. This required a huge amount of work, particularly interacting with State Branch Committees, to ensure that the Directory was up-to-date, comprehensive and accurate. As a result the Directory is one of our most used and respected publications.

In the last few years, with his responsibility for International Affairs, he has been the main driving force behind the successful collaborations ASEG has developed with our sister organisations in Japan and South Korea.

As a result we now publish annually joint issues of *Exploration Geophysics* with the Korean SEG and SEG Japan. Koya was not just involved in the planning and implementation of this initiative. After the decision was made to publish in English, Koya himself translated many of the abstracts into Japanese and was seemingly always available to check or proofread this component of our publication. For this effort Koya was awarded SEGJ's 55th Anniversary Award in 2002. The momentum is in place now to develop further collaboration in the publication area.

Koya has represented the ASEG very effectively at several overseas meetings and his good personal relations attributes have made him an excellent negotiator where joint projects are involved.

Currently he heads up the Education Committee and is tackling this important issue with the same energy and dedication that he has applied throughout the ASEG over the last twenty years.

Koya was awarded an ASEG Service Certificate in 2000 for distinguished service to the ASEG. Since then, his on-going contributions to the ASEG, his energy and persistence has continued to serve the ASEG well and he is most deserving of the award of Honorary Membership.

Grahame Sands Award 2010

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.

David Pratt

This award is based on an endowment made by members of the ASEG and the geoscience profession in memory of the late Grahame Sands, who was tragically killed at the prime of his life and career in an aircraft crash in 1986, whilst developing and testing new equipment for geophysical survey aircraft. Because of Grahame's abilities to turn scientific theory into innovative application, the award is made 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 recipient of the Grahame Sands Award in 2010 is David Pratt. Dave graduated with first class honours in geophysics at The University of Sydney in 1968, and completed a PhD in remote sensing of ground thermal properties at the University of Newcastle in 1979. At that time, he started consulting under the name of Geospex Associates, developing a range of software applications for mining and petroleum explorers on PDP11, Unix, and VAX platforms.

In 1984, he and Ian Grierson co-founded Encom Technology. Under Dave's direction and with the support of a dedicated team, including Steve Mann, Clive Foss, Blair McKenzie, Tony White, Sam Roberts, Alex Shamin, Peter Gidley and Kerryn Parfrey, Encom developed a series of magnetic and gravity processing and modelling applications, which subsequently led to the successful ModelVision software.

This period also saw Encom complete commercialisation of several other software routines developed by the CSIRO, university and industry groups, including CSIRO's Siro-Ex TEM software into Encom commercial application EM Vision; beginning of QuickMag development; identified EM tool kit concept in BHP proprietary application GEMEX; by arrangement with Macquarie University developed commercialisation path for EMFlow EM processing software.

Over the last 10 years, Encom pursued the rapid development of Profile Analyst into a versatile 'work bench' environment that allowed an interpreter to process and assess large amounts of line and grid data in 2 and 3D; added interfaces to major modelling programs such as University of British Colombia GIF magnetic and gravity codes; through collaborative R&D with CSIRO and major mining companies continued to develop functionality of ModelVision Pro to handle gravity and magnetic gradient data to support new equipment development, i.e. Falcon and SQUIDs.

In 2009, Dave retired from Encom Technology (then part of Pitney Bowes Business Insight) and formed Tectomet Exploration Pty Ltd.

Overall, the major contribution Dave has made through his career was to capture ideas or concepts (not always his own) and provide working technology that the global geophysical community could then use to solve practical exploration problems. Dave provided the vision and leadership over three decades to develop and successfully commercialise software applications which have become an important part of the processing and interpretive environment of exploration geophysicists in Australia and around the world.

Editor's Note: Upon receipt of this Award, David Pratt immediately donated the cash component of $2500 to the ASEG Research Foundation with a commitment to match it with his own personal contribution.

Lindsay Ingall Memorial Award

For the promotion of geophysics to the wider community.

Steve Collins

The Lindsay Ingall Memorial Award honours the memory of Lindsay Ingall for his capacity to cross geoscience boundaries and for his enduring commitment to assist geoscientists across Australia. It is awarded to an individual who has actively promoted geophysics to the wider community. The award this year is made to Steve Collins for his energetic and enthusiastic promotion of the science and benefits of applied geophysics within the broader geological community, in particular through his involvement for over 10 years with the Sydney Minerals Exploration Discussion Group (SMEDG), and as Convener of several highly practical and successful SMEDG symposia.

To the many non-geophysicists who have worked with Steve over the years, or benefitted from presentations given by Steve, he projects a very clear understanding of the capability of geophysical technologies to provide beneficial information for resource projects. His detailed knowledge of a wide range of geophysical methods is consistently communicated in straight-forward and clear language. He provides an honest and accurate assessment of the benefits of the geophysical approach to data gathering and is meticulous in ensuring that data is collected with the highest standards of quality control and verification.

Steve recognised early in his career that it was not triple integrals that impressed geologists and managers but easy to understand diagrams and images. Steve was far more interested in making the results available to geologists in a form they could understand and use. This made geophysics, no matter how complex, accessible not only to geologists but to non-technical people and hence usable and relevant.

As well as his interaction with the geological fraternity, Steve produced extensive practical notes on safety in IP surveys, many of the points having been adopted by contractors. He was also involved in the development of a 'Standard Format for the Transmission of Gridded Data'. He has given many talks to geological symposia on various applications of geophysics, and has published many technical papers which are mostly in the style of practical case histories, often co-authored by geologists.

Some examples of Steve's practical publications/presentations include:

- 'Modern 3D IP Surveying', Steve Collins, AIG–SMEDG Symposium, September 2009;
- 'Geological and Geophysical Exploration for Girilambone and Tritton Copper Deposits', Steve Collins and Mike Fogarty, SMEDG Presentation 1997;
- 'Tritton Copper Deposit, Girilambone NSW. A Geophysical Discovery', Steve Collins, 15th ASEG Geophysical Conference 2001;
- 'Case history of geophysical surveys over the Golden Cross gold silver deposit', Steve Collins, *Exploration Geophysics* Volume 20(2), pp. 75–79, 1989.

Steve is a consultant to many junior and mid-tier companies listed on the ASX, and he is acknowledged as an expert in his field. He provides an honest and accurate assessment of the benefits of the geophysical approach to data gathering and is meticulous in ensuring that data is collected with the highest standards of quality control and verification. He also provides realistic predictions of the contribution of more sophisticated data processing and presentation.

Steve has been an enthusiastic member of geoscientific committees, most notably the NSW SMEDG, where he has been a committee member with an active team of geologists for a decade, and has acted as convener for several of the highly practical AIG–SMEDG symposia. He created and then maintained the SMEDG website to assist communication on SMEDG events.

His capacity to communicate effectively to geologists, engineers, managers and accountants has resulted in an increase in the implementation of the discipline of geophysics throughout Australia. His reasoned and realistic portrayal of the role and effectiveness of geophysics in many environments and applications does great credit to him, the profession and the ASEG.

He has also been an enthusiastic supporter of the ASEG since becoming a member in 1973, and has attended every ASEG conference. Steve is a most deserving recipient of the ASEG Lindsay Ingall Award.

ASEG Service Certificate

For distinguished service by a member to the ASEG, through involvement in and contributions to State Branch committees, Federal committees, publications, and conferences.

Richard Hillis

Richard Hillis receives this award for his long record of work for the ASEG since 1989, primarily through the South Australian branch. He was a member of the SA Branch Committee from 1996 to 2002, and Branch President from 2000 to 2001. Of particular note, as Co-Chair of the 16th ASEG Conference held in Adelaide in 2003, Richard played a major role in the smooth planning and running of this very successful conference.

Richard received his PhD in 1988 from the University of Edinburgh. He joined the ASEG in 1989, while still on a post doctoral fellowship, before finally moving to Australia permanently in 1992. Since then he has worked in various roles at Flinders University and then the University of Adelaide, finishing as Head of the Australian School of Petroleum and the PIRSA (SA State Government) Professor of Petroleum Geology. He is now the Chief Executive Officer of the recently set up Deep Exploration Technologies Cooperative Research Centre. His teaching and motivation of students at the University of Adelaide is well recognised, with many local geophysicists inspired by Richard's passion for geophysics and the ASEG.

Richard has enthusiastically and energetically embraced the ASEG in many of its aspects for many years. Richard has continued his long association with the ASEG through his continuing support of local branch activities, and his on-going promotion of the society to undergraduate students.

Andrew Mutton
Honours and Awards Committee

ASEG News

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ASEG HISTORY COMMITTEE
CALL FOR ASSISTANCE

During the last ASEG Conference held in Sydney, an ad-hoc committee met to establish an ASEG History committee to document the origins and continuing evolution of the ASEG.

Several 'elder' members of the ASEG met and discussed the way forward for completing this task. Subsequent to this initial meeting, the ASEG Fedex has ratified the committee and hence work will commence to document the ASEG History.

Initially the emphasis will be on the first 10 years of the ASEG from its inception. This means we need members who have relevant information to come forward and assist the committee. Material including photos of early conferences and ASEG Courses; geophysical field work and equipment; stories of the founding members and early ASEG officers; how ASEG was operated; membership statistics etc will be what is required.

If you have any materials you feel may be of assistance please initially send an email to either

Barry Long, Chairman – History Committee blong@jafss.com
Koya Suto, Fedex Liaison – History Committee koya@terra-au.com

with details of the information you have available.

Please **DO NOT SEND** actual documents until the committee corresponds and screens the material available.

New members

The ASEG extends a warm welcome to 41 new members to the Society (see table below). These memberships were approved at the Federal Executive meetings held in May, June, July and September.

Name	Organisation	State/Country	Member grade
Babak Ahmaoi	University of Adelaide	SA	Student
Charles James Ash	Shell	WA	Associate
Matthew Ian Blomfield	Fugro Airborne Surveys	WA	Associate
Peter Caffi	Coffey Geotechnics	NSW	Active
Eva Caspari	Curtin University	WA	Student
Adam Star Davey	Occam Technology Pty Ltd	SA	Active
Daniel Difrancesco	Lockheed Martin	USA	Associate
Matthew Richard Kib Fargher	University of Adelaide	SA	Student
Robert Matthew Fedineiz	University of Adelaide	SA	Student
Jodi Maree Fox	MMG	QLD	Associate
Neil James Godber	University of Queensland	QLD	Student
Ashraf Hanna	ANU	ACT	Student
Chadwick Jon Hewson	Teck Resources	Canada	Active
John Hickin	University of Adelaide	SA	Student
Geoffrey Raymond Hodge	Australian National University (ANU)	ACT	Student
Daniel Johnson	MM Mining	QLD	Active
Timothy Jones	Macquarie University	NSW	Student
Nitipan Kaewla	Austhai Geophysical Consultants (Thailand) Co. Ltd	Thailand	Active
Stephen Daniel Kuhn	Goldfields Exploration	WA	Associate
Boris Lum	Teck Resources	Canada	Associate
Joseph Miller	CGG Veritas	WA	Active
Ajay Varghese Nalonnil	Schlumberger	Malaysia	Associate
Sirikam Narongolrikul	University of Adelaide	SA	Student
Hayan Nasreddin	Curtin University of Technology	WA	Student
Megan Jennifer Nightingale	University of Queensland	QLD	Student
Jessica Roe	UNSW	NSW	Student
Angelino Josua Iko Sagala	University of Adelaide	SA	Student
Elyse Schinella	Macquarie University	NSW	Student
Richard O'Brien Sean	Beach Energy Ltd	SA	Active
Heather Jane Skeen	Newmont	WA	Active
Adam Smith	PGS	WA	Active
Correia Lopes Sofia Alexandra	Curtin University of Technology	WA	Student
Andrew Peter Squelch	Curtin University of Technology	WA	Active
David Stannard	Resource Potentials	WA	Associate
Victoria Athena Sterritt	Teck Resources	Canada	Active
Ernest Swierczek	University of Adelaide	SA	Student
Nikolas Sykiotis	University of Adelaide	SA	Student
Rajat Taneja	Macquarie University	NSW	Student
Ziviko Terzic	GHD Pty Ltd	VIC	Associate
Francis Tong	Macquarie University	NSW	Student
Shane Westlake	Finder Exploration	WA	Associate

Shanti Rajagopalan
25 December 1960, Coimbatore, India – 7 May 2010, Melbourne, Australia

by David Boyd

Dr Shanti Rajagopalan was one of the best known and respected members of the ASEG. She was also one of the most all round talented members whether it be straight geophysics, her grasp of mathematics, her bursts of originality or the bubbling personality and sense of fun which delighted all who knew her.

In addition Shanti had a wide range of experience. She had been a visiting research fellow at the prestigious National Geophysical Research Institute in Hyderabad; she was a lecturer in the University of Adelaide; she worked for a short while with the airborne survey unit of the Bureau of Mineral Resources (BMR, now Geoscience Australia); she spent four years working for CRA/Rio Tinto in exploration geophysics working in Australia and South East Asia; and then as an independent consultant with her own company Earth Geobytes, she was a member of the BHP Billiton team which interpreted the results obtained by the revolutionary Falcon airborne gravity gradiometer unit. Wherever she worked she left her mark of fresh ideas and improved processing and interpretation procedures.

Shanti combined her enormous talent with the ability to think and act quickly. When a student in an adjacent room spilled strong acid in his face it was Shanti who took control although there were more senior people present, got the student under the emergency shower and sent a message to the University medical office.

Shanti obtained her BSc with 1st Class Honours from the University of Madras; her MSc from the Centre of Exploration Geophysics, Osmania University, Hyderabad; and her PhD from the University of Adelaide in South Australia.

C. C. Babu, a classmate from Hyderabad, wrote

> *She is from a family known for its academic brilliance. She comes from Coimbatore in Tamil Nadu State. Her love of geophysics brought her all the way from Coimbatore to the Centre of Exploration Geophysics, Osmania University, Hyderabad headed by Prof. VLS Bhimasankaram. …She was the only girl student in our class but she had no worry about it as her passion was geophysics. She was well known in the department among the senior professors and fellow students. Normally girl students hesitate to go on field works. But such a question did not arise in the case of Shanti because of her love of Geophysics… She was simple and very social. We all enjoyed her company. She was the topper in our batch. But she did not have any air of being top.*

Shanti continued to carry on as she started; she just became more experienced. Twenty years later Mark Dransfield describes vintage Shanti when he writes,

> *Shanti worked for BHP Billiton in the FALCON airborne gravity gradiometer interpretation team for four years from October 2004. She worked across a wide variety of commodities and geological settings and her considerable technical skills meant she was able to contribute new ideas and excellent interpretations to every project she worked on. Equally important was Shanti's skill in communicating her new ideas and her obvious joy and enthusiasm in her endeavours. She made our workplace more interesting and enjoyable. Personally, I was always impressed by Shanti's unusual combination of a very strong mathematical ability and geological and geophysical understanding.*

Greg Walker the interpretation team leader echoed this opinion.

> *From my side the thing that struck me about Shanti was her continued drive to innovate in everything she did. In every Falcon interpretation project that she worked on, she introduced a new method in treating or visualising data, or a fresh approach to the exploration problem. She constantly questioned the status quo.*

One of Shanti's special concerns was the quality presentation of magnetic data. If this is done badly the opportunity to see subtle signals in the images created from the data is lost. She taught her students the significance of colour and on one occasion she told them that 'Brown is not a good colour' and then in an afterthought, and with a typical smile in her eye 'except for skin'. Those students never forgot her message about presenting data; she was a born teacher.

Michael Morse tells of her activites during her short period of employment with BMR.

> *Shanti worked with Peter Milligan and me on the first pixel maps we released and together we published a paper on the subject, 'Pixel map preparation using the HSV colour model'. Shanti was dynamic, and for the short time she worked at BMR she influenced the way we thought and worked as scientists and had a lasting impact on the methods that were used for publication of the geophysical pixel maps.*

> *I met her at the 2009 ASEG conference and she was the same Shanti I remember stirring up our science and in some ways our lives...I will always remember Shanti as a dynamic insightful and good person who challenges me and made me a better person and scientist.*

It was around the turn of the century that Shanti became very active in ASEG affairs. She was president of the Melbourne branch in 2001 and 2002 and was involved in organising the first and so far only ASEG conference held in Hobart. She was an Associate Editor of *Geophysics* from 1998 to 2009 and the editor of *Exploration Geophysics* in 2000 and 2001. She won the best paper at the conference in 1997, a best poster at the conference in 2000, so that with the Laric Hawkins award at the 5th conference in Perth, Shanti joined the exclusive group of members who have received three awards from the Society.

It was at the 5th ASEG conference in Perth in 1987 that Shanti established herself as a rising star in the field of mineral exploration. By noon on the first day delegates at the conference had registered the presence of Shanti. This was not surprising for you could hardly overlook a graceful young woman wearing a sari in the group which was predominantly male: but it was clear to all who talked to her that she was not only a pretty figure but also very well informed on technical matters. This was confirmed to all in the final session of the Perth conference when she received the Laric Hawkins Award for the most innovative paper with the title 'The use of "automatic gain control" to display vertical gradient data'.

Shanti was overcome at the announcement and her typically modest response was 'It was obvious'. Of course it was obvious to somebody as bright as Shanti.

The method is widely used today and is regarded by many as a standard procedure used in processing data to such an extent that many of the postgraduate students use it without attributing it to its original creator. This is probably typical of much of her work which was very practical and readily applied, and because it was developed in the course of teamwork it has not always been recognised specifically as her contribution.

At the 21st ASEG Conference in Sydney, held 23 years after the 5th conference in Perth, several people could remember Shanti's contribution to the Perth conference and a few could remember the topic of the paper for which she received the award. However no one could remember the principal overseas speakers and visitors – Dr Stan Ward, Dr Tony Barringer and Dr John Bonniewell – such was the strong impression that Shanti made on people.

There were two important consequences of Shanti's success at the Perth conference, apart from her being widely recognised in the mineral exploration community.

Until 1987 there were a few very competent women working in the mineral exploration industry but they maintained a low profile. It was being gradually appreciated within the community that women had the potential to make a greater contribution but it was a slow matter for this to be accepted. When Shanti received the Laric Hawkins award, senior managers within the industry were made aware of the talent going to waste. At the same time as Shanti's reputation became high-profile and her success at the Perth meeting became known to the next generation of women students, other women were encouraged to persevere with studies in geophysics. It was from the early 1990s that more women joined the industry following the lead given by Shanti. Although not many of them may be aware of it, Shanti's confidence, enthusiasm and talent changed the attitude of their male colleagues and paved the way for their professional achievements.

Shanti was concerned with the problems that remnant magnetisation introduced into the interpretation of magnetic data. Phil Schmidt writes,

> *Shanti was acutely aware of the effects of remnant magnetisation in magnetic interpretation. She interpreted magnetic anomalies of magnetite bearing sediments in the Mt Lofty Ranges to indicate that the sediments were remagnetised during the early Delamerian Orogeny, before significant folding had occurred. Subsequent laboratory studies at CSIRO in Sydney of these sediments fully support her interpretation, results of which will be published posthumously in a special volume of the Australia Journal of Earth Sciences as 'Magnetic overprinting of the Brachina Formation/Ulupa Siltstone, Southern Adelaide Foldbelt, prior to Delamerian deformation' by Shanti Rajagopalan, Phillip W. Schmidt & David A. Clark. An oral paper of the same title was given at the Australian Earth Science Convention in Canberra last July.*
>
> *In 2000 Shanti presented a paper at the 14th ASEG conference in Perth with her co-author Asbjorn Christensen extolling the virtues of magnetic tensor gradiometry: as always at the cutting edge. The last sentence of their 2000 abstract reads 'Just as with airborne gravity surveys, the measurement of the gradient tensor of the magnetic field is likely to prove the next major breakthrough in magnetic surveys'. This is why the session on the magnetic gradient tensor and innovation was dedicated to her memory at the 21st ASEG Conference.*

Such was Shanti and her contribution to geophysics in Australia and in India. Her loss to the science as a source of fresh ideas will be lamented but she will not be forgotten by those of us who met her and were inspired by her example.

Shanti is survived by her husband, Andrew Trevorrow, and her daughter, Janaki, in Melbourne and by her mother, her brother and three sisters in India.

ASEG News

Australian Capital Territory

Since a flurry of activity at the end of May and early June, the ACT Branch experienced a bit of a lull in the lead up to the Sydney conference.

SEG Distinguished Lecturer Pat Connolly (BP Corp., London) squeezed in a stop in Canberra during the height of the Gulf of Mexico oil spill drama. Challenging questions on that event didn't eventuate, but there was plenty of appreciation for his clear and captivating presentation on workflows for seismic reservoir characterisation. A key aspect of his presentation was the challenges posed by seismic averaging of geology. Via an analogy with the length and weight of carp and roach caught in the Basingstoke Canal, Pat eloquently explained the improved understanding, robustness, uncertainty estimation and ability to integrate data in seeking to better characterise reservoirs.

On 20 May, the local branch coordinated a student event for second-year geophysics students at the ANU. Several local geophysicists summarised their careers in geophysics and the drivers behind their interest in geophysics. Paul Tregonning spoke on the wonders of space-based geophysics, Michelle Salmon on her seismology field work and research, Bill Jones on the challenges and joys of field work in nice places, Ian Moffat on the surprising benefits of geophysics-for-archeology and Leonie Jones on where you end up when doing deep-crustal seismic work.

The ACT Branch also offers a prize for the best results in the second-year introductory geophysics course at ANU. The prize for 2009 was presented in early June to Katherine Holland (see photo). Katherine maintains an interest in geophysics and was very appreciative of the ASEG's encouragement and support. The prize will be offered again for the best results in 2010.

The upcoming program highlight will be the visit by Prof. Alan Green as an ASEG Distinguished Lecturer. Alan will be in Canberra on 25 and 26 October to present a talk on active faulting in New Zealand (a topical theme given recent events in Christchurch) and a short-course on the application of electromagnetic methods. The ACT Branch web site will soon be updated to include further information on this and hopefully other events.

Finally, the ACT Branch would like to publicly express its thanks to Wayne Stasinowsky for his substantial efforts in sorting out the ASEG web site. The new functionality is impressive and certainly worth the wait!

Katherine Holland receives the 2009 ASEG (ACT Branch) Prize for Geophysics from Branch President, Ron Hackney (photo courtesy of ANU Photography).

Ron Hackney

New South Wales

In June, John Bishop from KUTh Energy Ltd gave a talk on 'Geophysics Adding Value: A Geothermal Example'. John discussed how most geothermal projects in Australia have been based on legacy data from previous oil and gas surveys. John then discussed the work that KUTh Energy was doing in Tasmania, discussing historic heat flow measurements, interpretation of gravity data and how this has led to a tentative theoretical model which has been developed and refined several times with the addition of new 'layers' of geophysical data and that there is potentially a very prospective geothermal reservoir with the potential to produce more than a Gigawatt of electrical power.

In July, the 2010 NSW branch dinner was held in a Chinese restaurant in Chinatown. Matters of great geophysical importance, and the upcoming conference (and other less critical subjects) were discussed over a few bottles of white and red. A good time was had by all.

In August, for some reason we did not hold a meeting, but I remember it being a very busy month.

In September, Cara Danis from Macquarie University spoke about Geothermal exploration in the Sydney Basin: extrapolation versus modelling and the implications for targeting potential anomalies. Cara spoke about how geothermal exploration programs require accurate subsurface temperature information and currently this information primarily comes from temperature maps created from the extrapolation of shallow down-hole temperature measurements. Cara presented a case study for the Sydney basin where she discussed temperature maps at 5 km created from extrapolated equilibrated and non-equilibrated borehole measurements and from modelled basin temperatures and the implications for targeting potential geothermal anomalies. Many questions and much discussion followed.

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/Northern Territory

The South Australian/Northern Territory Branch recently held their first Computer Night. The purpose of the night was to show off free (and nearly free) software and downloads available for geophysicists, and geoscientists in general. The speakers showed off numerous tools and programs including SARIG, GADDS, free GIS programs/plug-ins and the Virtual Seismic Atlas. A couple of impromptu talks from members of the audience contributed greatly to the evening. A list of links can be found from the SA/NT section of the ASEG website.

We welcomed Dave Tassone from the Australian School of Petroleum who gave a talk in late July entitled 'Quantification of Cretaceous–Cenozoic exhumation in the Otway Basin using sonic velocities and implications for hydrocarbon exploration'. The talk was well received and attracted many interesting questions.

Prior to the conference, Adelaide welcomed Colin Sayers, the presenter of the 2010 SEG/EAGE DISC. His day-long course entitled 'Geophysics Under Stress: Geomechanical Applications of Seismic and Borehole Acoustic Waves' was well attended and excellent feedback was received.

There was no August technical meeting, as many of us travelled to Sydney for the conference. After the conference we held our annual wine tasting event. Look out for the wine flyer on p. 52 of this issue of *Preview*.

The SA branch holds technical meetings monthly, usually on a Tuesday or Thursday night at the Coopers Ale House beginning 5:30 pm. New members and interested persons are always welcome. Please contact Philip Heath (philip.heath@sa.gov.au) for further details.

Philip Heath

ASEG News

New ties between the ASEG and the Chinese Geophysical Society

At the recent Conference in Sydney, the ASEG signed an agreement of mutual interest with the Chinese Geophysical Society (CGS). This agreement defines the terms under which the two societies will cooperate in a number of different areas. The agreement was signed by Phil Harman, ASEG President, and Guo Jian, CGS Secretary-General.

In a short speech following the signing ceremony, Phil Harman said:

> *In modern times, there has been a long association between the earth science communities of Australia and China. This goes back to the formal recognition of the Peoples Republic of China by the Australian government in the early 1970s. As a result of this, a large delegation of Chinese geologists attended the IGC in Sydney in 1975 and contacts have been growing ever since.*
>
> *In fact, in 1985 I travelled to China as part of a geological delegation consisting of government and industry representatives. It was quite an adventure and although the landscape was dominated by Mao suits and bicycles, it was clear then that the 'giant was awakening'. I returned to China in the late 1990s and the change was amazing with major new developments in every city I travelled to. I believe it is even more so now.*
>
> *It is clear from recent developments that the economic destinies of our two nations are intertwined, based principally on the products of Australia's mineral industry. It is fitting then, that the professionals involved in this industry should move towards closer cooperation with one another. It gives me great pleasure to take this first step.*

Guo Jian then addressed the audience with the following speech:

> *Ladies and Gentlemen,*
>
> *Today in the beautiful country of Australia, the Chinese Geophysical Society (CGS) and the Australian Society of Exploration Geophysics (ASEG) will sign an agreement to recognise the mutual interests of their members, and to advance the common goals and objectives of each Society. My name is GUO Jian, the Secretary-General of CGS. I'm pleased to be representing CGS at this important event.*
>
> *First of all, let me say a few words about the Chinese Geophysical Society (CGS). CGS is a first-class institution of the China Association for Science and Technology. It was founded in Shanghai in August 1947 and Mr Chen Zongqi was the founding president of the CGS council. After new China's foundation, CGS was moved to the capital city Beijing in 1954.*
>
> *The President of the CGS Council is Chen Yong, an academician of the Chinese Academy of Sciences. The past presidents of the CGS Council include Chen Zongqi, Zhao Jiuzhang, Guo Gongxu, Weng Wenbo, Liu Guangding and Wang Shui in turn, all of them are internationally recognised scientists in the field of geophysics.*
>
> *Over the past 60 years, CGS members have been involved in celestial geophysics, atmospheric geophysics, solid geophysics, marine geophysics and exploration geophysics. CGS members play an important role in national economic development, such as in energy exploration, resource reconnaissance, minerals production, environmental monitoring and protection, disaster prevention and control, and civil engineering.*
>
> *CGS is sponsored by the Chinese Academy of Sciences (CAS), the Ministry of Land and Resources China (MLRC), the China Earthquake Administration (CEA), the China National Petroleum Corporation (CNPC), the China Petroleum and Chemical Corporation (SINOPEC), the China National Offshore Oil Corporation (CNOOC), and the China National Administration Coal Geology (CNACG). CGS has more than 1600 supporting member companies and organisations. These institutional members of CGS can provide a comprehensive range of services in exploration, surveying, engineering, and research to meet the needs of a rapidly developing nation.*
>
> *CGS has a total of more than 14 000 registered members, including 54 academicians of the Chinese Academy of Sciences and Chinese Academy of Engineering. The Society has 15 sub-committees, and publishes four scientific journals, including the Chinese Journal of Geophysics (cited by SCI), Applied Geophysics (cited by SCI), Progress in Geophysics, and the Annual Report of Chinese Geophysical Society, with the goal of promoting the development of geophysical science and technology and information exchange. It has also seven federal committee members in charge of organising and coordinating cooperation and exchange between sub-committees as well as other domestic and international activities.*
>
> *The Society makes great efforts to carry out continued education and scientific dissemination to raise the quality and standards of our geophysical community. To encourage and support creativity, innovation, and pioneering work of all the members, the Society has set up the Geophysical Development Foundation and the Science Foundation. The Society has branches in every province, autonomy and municipality of China, as well as a branch in North America. CGS holds a comprehensive convention each year to provide a forum for discussions and a platform for reporting new results of technical development as well as to promote the transfer of scientific ideas and collaboration.*
>
> *China is currently one of the largest resource consumers in the world and resource exploration is one of the most important tasks undertaken by geophysicists in China. Australia has developed many leading edge technologies in exploration and environment geophysics to explore beneath the extensive cover of young sediments found across much of the continent. Australia's advanced airborne geophysical technologies are well-known to the Chinese geophysical community. We would like to learn about other new technologies and their application from our Australian*

colleagues. The signing of the CGS and ASEG agreement will enhance this communication and learning, and increase the interaction between the members of both societies. CGS will regularly send a delegation to attend the International Geophysical Conference and Exhibition of ASEG. At the same time, the CGS will invite members of ASEG to join CGS's conferences.

I hope our collaboration between CGS and ASEG will be a success.

Thank you.

Phil Harman and Guo Jian shake hands after signing the agreement.

Members of the ASEG and CSG at the Signing Ceremony.

ASEG News

Safety issues for geophysical surveys using electrical transmitters

David Robson

Chief Geophysicist, Geological Survey of New South Wales, Industry and Investment NSW. Email: david.robson@industry.nsw.gov.au

Unsafe practices and breaches of the Mining Health and Safety Act and Regulation in the conduct of geophysical surveys using electrical transmitters (e.g. induced polarization, TEM, NMR and ERI/ERT) have been observed in New South Wales. It is hoped that by developing a sound Code of Practice (COP) for this industry, exemptions from some NSW legislation may be considered where the intent of that legislation is satisfied through an adherence to this yet to be developed COP. The ASEG is envisaged to be the most appropriate body to develop, publish and control this COP.

Overview

In New South Wales, the Mine Safety Operations Branch of Industry and Investment NSW overviews the safety of all persons working on mine sites. Since September 2008, all exploration sites are declared to be mine sites, and so fall under the Mine Health and Safety Act and associated Regulation. When an Electrical Inspector of Mines became aware of IP exploration at a NSW mine, he made a site visit to gain an understanding of the issues relating to the safety of such operations. Through this visit and subsequent meetings with other people in the geophysical industry, the Inspector formed the opinion that some of the practices common to the industry were potentially unsafe, and the associated hazards not well understood. Similarly, the inspector formed the opinion that the safety standard of equipment used across the industry varied significantly. Common to all IP surveys at exploration sites was the additional problem of non-compliance with one or more legislative requirements of the Australian Standards AS/NZS 3000 & AS 3007. This last issue was not necessarily the result of a lack of willingness to comply with these standards but in some cases, it was not commercially viable to do so in a constantly moving test environment.

The inspector formed the opinion that given the lack of any significant safety incidents having being reported from this sector, it was possible to recommend to his fellow electrical inspectors, and ultimately to the Chief Inspector of Mines, that a period of time be given for the industry to re-assess the electrical hazards involved, and from there to develop a code of practice to enhance the safety of the industries procedures and equipment.

Such a COP would have to be suitable for the full gambit of geophysical surveys using an electrical transmitter. It would need to be satisfactory for the small operator and the large corporation and the great diversity of equipment that they use. This said, however, the range of safety issues to address is limited and fairly generic to these different systems.

One major obstacle that needs to be overcome is the lack of hard safety controls in some transmitter systems. Electrical systems should instantly detect unsafe conditions and automatically shut down to a safe condition. Reliance of soft systems (procedures and practice) should not be the primary safe guard against personal injury or even death.

High voltage (HV) is defined as AC voltages above 1000 V and DC voltages above 1500 V. Industry wide there is a strong distinction made between HV and low voltage (LV) equipment and operating procedures. This is because the hazards of HV systems become more complex and are less easily understood than LV hazards. Any COP would have to clearly make this distinction. It is unlikely that an operator will ever gain an exception from compliance with any Australian Standard for HV systems.

Only once the electrical inspectorate is satisfied that a satisfactory COP has been developed and adopted by the IP industry, would the electrical inspectorate be in the position to recommend to the Chief Inspector that certain exemptions from current legislated safety standards be granted for those in the industry applying that approved COP.

In the intervening period of time, a significant safety incident could require the electrical inspectorate in NSW to immediately take enforcement action which could prove quite disruptive to this important exploration work.

In 2002, the Government of Western Australian, Department of Commerce, Energy Safety, introduced a permit scheme for the electrical transmission for ground geophysical surveys. Such a permit scheme does not satisfy the requirements of current NSW legislation.

Current situation

A discussion paper on IP safety standards has now been circulated to contractors and companies that use electrical transmitters in geophysical surveys. Copies of this paper are available through David Robson (david.robson@industry.nsw.gov.au) or Steve Collins (scollins@arctan.com.au).

During the recent ASEG/PESA Conference in Sydney, a lunchtime forum on 26 August discussed IP safety issues. It was chaired by David Robson, Chair of the ASEG Standards Committee with presentations by Bernard Gittins, Inspector Electrical Engineering, Industry and Investment NSW and Steve Collins, Consultant. Over the coming months, a technical paper for submission to the NSW DII will be prepared by Steve Collins and David Robson on safety using electrical transmitters and is expected to include the following:

- defining minimum fit for purpose equipment safety requirements,
- guidelines on voltage and power limitations,
- improved earthing systems with minimum acceptable standards,
- guidelines for safe working procedures – particularly in the area of isolation control, and
- protocols in avoiding electric shock.

If you would like to keep abreast with ongoing developments in this endeavour, please email scollins@arctan.com.au so your name can be added to the contact list. Both Steve Collins and David Robson would also appreciate input from all interested parties in preparing this submission to the NSW DII.

A contractor's viewpoint

Terry Ritchie

Director, Geophysical Resources & Services Pty Ltd, Queensland
Email: tjritchie@consultgrs.com.au

Like most other contractors, I attended the meeting held in Sydney during the recent ASEG conference at which Bernard Gittins, Inspector Electrical Engineering, Minerals with the NSW Dept of Primary Industries, spoke of the need to introduce a code of practice to cover the use of controlled electrical sources in ground geophysical surveys (i.e. induced polarisation and electromagnetic). My immediate reaction is that there are two issues; one that falls largely to the service providers (contractors) to attend to and one that may be of more concern to the wider industry.

Firstly, for the contractors, it is clear that we have to improve and standardise our current practice. At the moment, there are as many operating procedures as there are contractors and despite the fact that they are probably sound, it is not an ideal situation. The practices may all be adequate but they can't all be the best.

However, they undoubtedly share a great number of similarities and as was pointed out at the meeting, these procedures have been very effective in preventing major injury for a large number of years. It is reasonable to conclude that we can create a new and standard code from them by reviewing and adopting the best and most workable parts.

Lock out devices and other hardware to monitor current flow were also spoken about at the Sydney meeting. Collectively we have some expertise in those areas too.

Mention was made at the meeting of the need to understand the value of the 'step potentials' in the vicinity of current injection points. These we measure and record in their thousands every day. Collectively the industry has funded research over a number of years that produced software dedicated to the calculations of these potentials in almost every conceivable situation. I doubt that there is a group of people in any other industry that knows more about step potentials than us.

Once the standard has been adopted I think that life will be the easier for us because at present we comply with so many systems across so many sites. A great benefit of this new code should be that it has sufficient status that is will be accepted automatically. It would be an even better outcome if it lead to a National standard.

The second issue surrounding compliance with the two Australian standards, if exemptions cannot be secured, is not so clear to me. As opposed to the above which are all apparently relatively straight forward and low cost in their implementation, compliance with these standards may require a significant commitment from the entire industry.

Terry Ritchie would like to thank Phil Harman for organising this opportunity for him to comment on the possible changes to IP safety requirements from a contractor's point of view.


SWISSCO SOVEREIGN

Successful Sydney Conference

ASEG Conferences provide opportunities to learn about new developments, to explore an exhibition of the industry's wares, to discover what new things the resource service companies are doing, to network with friends and colleagues and to discuss future plans for the ASEG. This conference delivered on all those counts.

Everyone is aware that the application of geophysics, whether it is in the exploration and production of our energy resources, the exploration and production of our mineral resources, the detection and maintaining of our water resources, infrastructure engineering or the solving of environmental problems is vital to the successful completion of those projects. Thus the conference theme: 'Future Discoveries are in Our Hands' reflects our belief that well-applied geophysical approaches will be needed to find the next world-class resources and contribute to new wealth creation. The conference theme provides a challenge to our profession to demonstrate how we have responded to the world financial situation and achieved major commercial and technical outcomes for our industries. This conference gave the leading professionals, explorers, managers, educators and service providers, the opportunity to actively participate in this discussion.

A total of 864 delegates and exhibitors from 38 countries attended with the number of overseas delegates about 25%, which gave the Conference a truly international flavour. A total of 189 papers were presented, of which 121 were in the non-petroleum streams and 68 in the petroleum streams. Students presented 13 papers and we had 70 student delegates, which is an excellent sign for the future of our society. In addition there were 66 posters displayed throughout the Conference, ten workshops attended by approximately 280 people of which 140 attended the gravity workshop and of course the magnificent exhibition where 90 exhibitors filled the Exhibition Hall.

The Conference dinner was a great success with about 350 attendees. 45 secondary students and teachers visited the Conference as well as 25 third year university students from the local universities.

Plenary session

After Mark Lackie, the conference co-chair, and Phil Harman, the ASEG President, welcomed everyone, the society awards were presented to worthy recipients (see pp. 4–7 of this issue). Then, the two Plenary speakers, Chris Pigram, Chief Executive Officer of Geoscience Australia, and John McGagh, Head of Innovation, Rio Tinto gave excellent talks, with Chris focusing on the role of Geoscience Australia and John on the innovation that Rio Tinto undertakes throughout its operations. An article based on Chris Pigram's presentation can be found on pp. 31–33 of this issue.

Conference Awards in Sydney

Best Non-Petroleum Presentation

Jared D. Abraham – *Quantitative hydrogeological framework interpretations using heliborne electromagnetic surveys for the North Platte Valley, Western Nebraska groundwater model*

Best Petroleum Presentation

Russell J. Korsch – *Geological interpretation of the 2008 seismic reflection, refraction and magnetotelluric data from the Northern Eyre Peninsula, Gawler Craton*

Honourable Mentions

Petroleum: Eric Saenger – *The virtual rock physics lab*

Non-petroleum: David M. Johnson – *Discovery case history of the moran massive nickel sulphide deposit, Kambalda, Western Australia*

Best Student Presentation

Cara Danis – *3D thermal modelling versus down-hole temperature extrapolation in the Sydney Gunnedah–Bowen Basin and the implications for targeting potential geothermal anomalies*

Best Poster

Phil Schmidt, Suzanne McEnroe, Peter Robinson, Karl Fabian, Jerome Gattacceca, Fatim Hankard and Florian Heidelbach – *Magnetic moments of fine particles from micromagnetic surveys*

Honourable Mentions

Julian Vrbancich, Bob Whiteley and Don Emerson – *Marine seismic profiling and shallow marine sand resistivity investigations in Jervis Bay, NSW Australia*

Julian Vrbancich, Bob Whiteley and Don Emerson – *Marine seismic profiling and shallow marine sand resistivity investigations in Broken Bay, NSW Australia*

Laurent Ailleres, Peter Betts, Helen Williams and David Milton – *3D combined gravity and magnetics inversion modelling as a guide to target haematitic iron ores – an example from the Koolanooka South (WA) Prospect*

Jim Macnae and Stuart Baron-Hay – *Reprocessing strategy to obtain quantitative early time data from historic VTEM surveys*

Best Exhibit

Alpha Geoscience

Best Large Booth Exhibit

CGG Veritas

Exhibition Honourable Mentions

GeoKinetics
Petroleum Geo Services

Laric Hawkins Award

For the most innovative use of geophysics in a paper presented at the Conference.

M. Andy Kass, Kristofer Davis and Yaoguo Li – *Rapid gravity and gravity gradiometry terrain corrections via a quadtree mesh discretization*

Honourable Mention

Kyle Blay, Keith Leslie, D. Tilbrook, S. Billings and L. Pasion – *Precision geolocation of active electromagnetic sensors using stationary magnetic sensors*

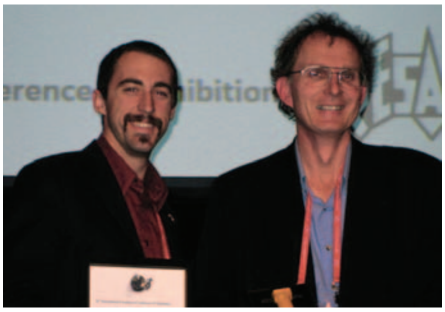
Student Day

Every conference has a student day where high school students are invited to attend the conference to listen to talks by industry geophysicists and view the exhibition and this conference was no different in that aspect. The talks were well received posing questions such as "can bears really fit in windows that small" and "are magnetometer surveys worse than roller coaster rides". However the highlight of the day were the hands-on activities where students found that concrete does have rebar and they can easily find it and that concrete also makes scintillators tick. The students also discovered that rocks are not all they seem to be and that it is easy to decide what is ore and what is not, with geophysical equipment. The geophysical quiz was well answered showing that the next generation of geophysicists will be very capable.

Mark Lackie
Conference Co-Chair

Cara Danis – Best Student Presentation.

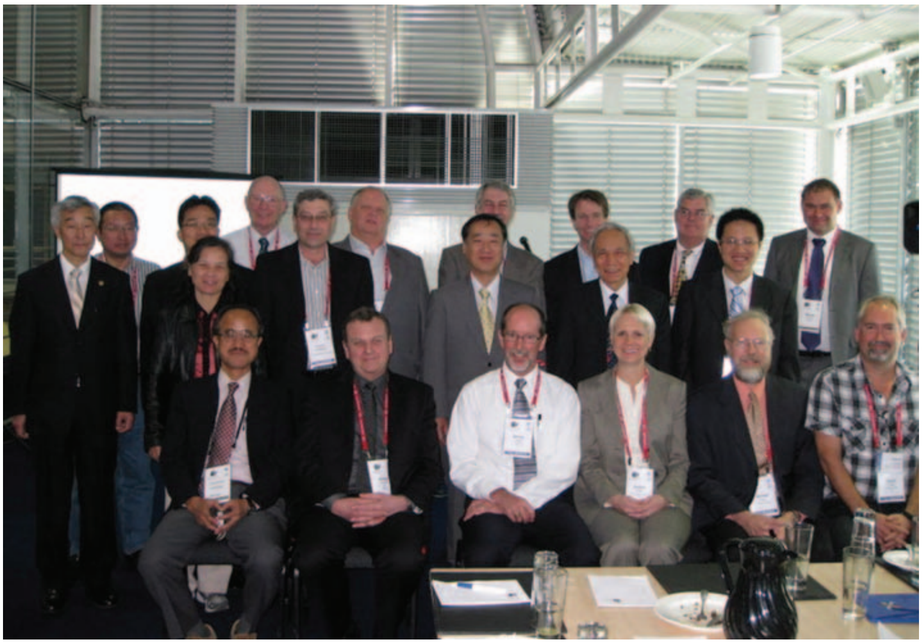
Peter Milligan for Russell Korsch – Best Petroleum Presentation.



M. Andy Kass – Laric Hawkins Award.

Jared D. Abraham – Best Non-Petroleum Presentation.

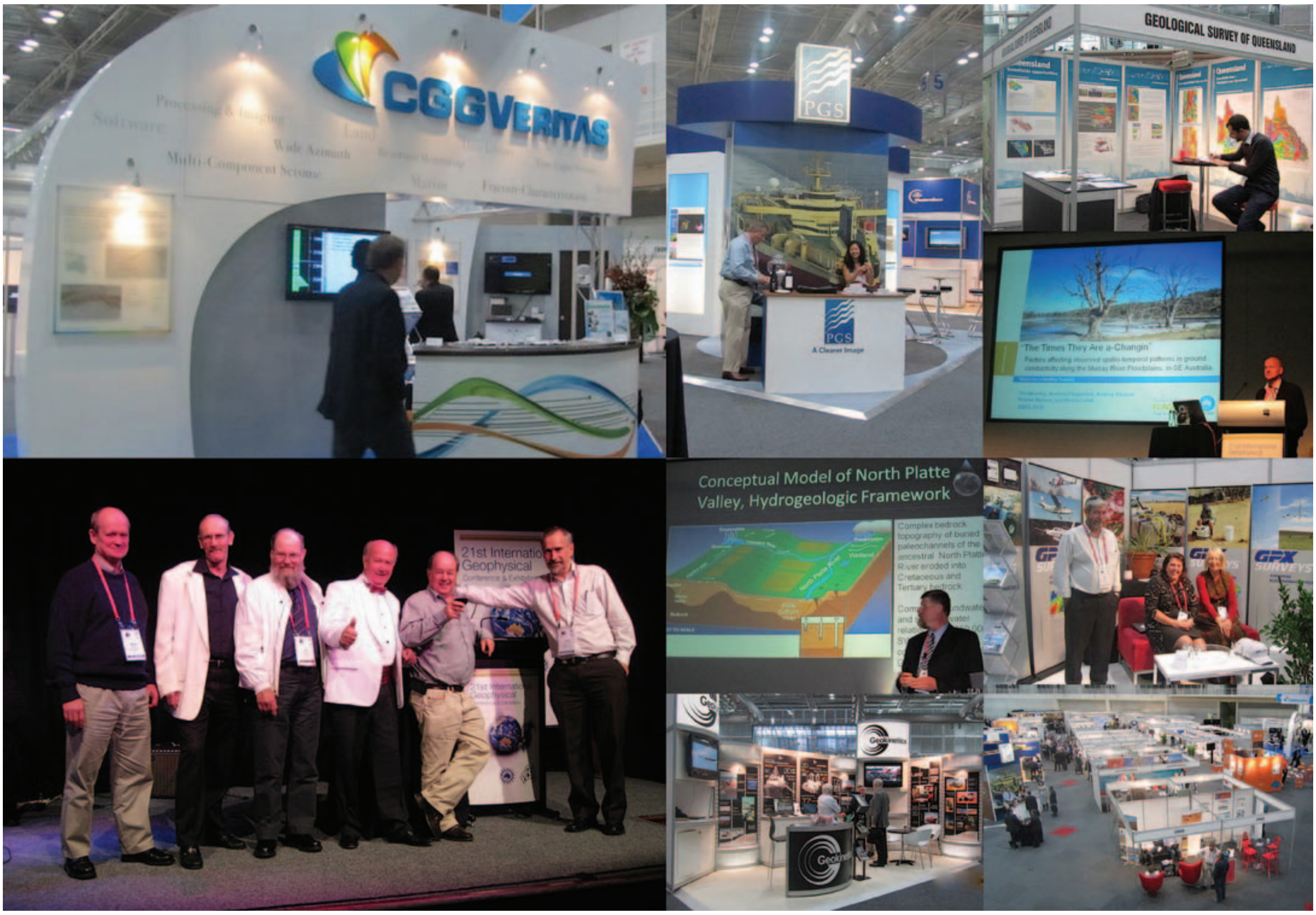
Phil Schmidt – Best Poster.



Guests at the Inter-Society Luncheon.

Kurt Strack (left) opened the day-long EM & MT Symposia in honour of Keeva Vozoff (right).

Pictures from Sydney



ASEG 2012: 22nd ASEG Conference and Exhibition news update (01)

Many thanks to the Sydney Conference Organising Committee for yet another successful ASEG/PESA conference. I know from experience how exhilarating the conference can be, followed by the inner calm knowing it's all over.

This is the first *Preview* update for the Brisbane 2012 conference. The COC was formed earlier this year and has been busy catching up with the conference schedule. The PCO, ARINEX, has been appointed and the initial conference web-site www.aseg2012.com.au has been set up where you can register your interest.

When forming the Brisbane COC we tried to include people from a wide variety of geophysical disciplines, including petroleum, minerals, coal, environmental and engineering. Hopefully you will know at least one of the following people. By the time the conference comes around you definitely will!

Co-Chairs: Wayne Mogg and Andrea Rutley
Technical: Binzhong Zhou
Sponsorship: Ron Palmer and Howard Bassingthwaighte
Exhibition: Gary Butler and Dave Burt/John Donohue
Finance: Noll Moriarty
Workshops: Koya Suto
Publicity: Henk van Paridon
Students: Shaun Strong
Social: Janelle Kuter

The conference theme 'Unearthing New Layers' was chosen to highlight how resources can exist in places that we have already explored and how geophysical data can be re-examined to help see them. The logo is a stylised map of Queensland with a standard colour look-up showing the sea in blue and the earth in red.

News

Update on Geophysical Survey Progress from the Geological Surveys of Western Australia, Northern Territory, New South Wales and Geoscience Australia (information current at 16 September 2010)

Tables 1–3 show the continuing acquisition by the States, the Northern Territory and Geoscience Australia of new gravity, airborne magnetic and radiometrics, and airborne EM over the Australia continent. All surveys are being managed by Geoscience Australia.

There are ten new airborne magnetic and radiometric surveys reported in this issue, all funded under the WA Exploration Incentive Scheme – Phase 2. Figure 1 shows the locality diagram for these new surveys, with Figures 2–11 showing detailed survey boundaries.

In total, more than 1.1 million line kilometres of data will be collected over an area of approximately 307 000 km^2 with line spacings of either 200 m or 400 m.

Table 1. Airborne magnetic and radiometric surveys

Survey name	Client	Contractor	Start flying	Line (km)	Spacing AGL Dir	Area (km^2)	End flying	Final data to GA	Locality diagram (*Preview*)	GADDS release
South Officer 1 (Jubilee)	GSWA	Thomson	1 Jun 10	180 000	200 m 50 m N–S	32 380	TBA	TBA	This issue (Figure 2)	TBA
South Officer 2 (Waigen – Mason)	GSWA	Thomson	28 Jun 10	113 000	400 m 60 m N–S	39 890	TBA	TBA	This issue (Figure 3)	TBA
East Canning 3 (Stansmore)	GSWA	Thomson	14 Jul 10	114 000	200 m (east) 400 m (west) 50 m N–S	25 934	TBA	TBA	This issue (Figure 4)	TBA
Eucla Basin 2 (Loongana)	GSWA	Fugro	20 Jun 10	113 000	200 m 50 m N–S	20 320	TBA	TBA	This issue (Figure 5)	TBA
Eucla Basin 4 (Madura)	GSWA	Fugro	1 Jul 10	102 000	200 m 50 m N–S	18 220	TBA	TBA	This issue (Figure 6)	TBA
Eucla Basin 5N (Forrest)	GSWA	Fugro	16 Jun 10	75 000	200m 50 m N-S	13 040	12 Sep 10	TBA	This issue (Figure 7)	TBA
Eucla Basin 5S (Eucla)	GSWA	Fugro	6 Jul 10	87 500	200 m (onshore) 400 m (offshore) 50 m (onshore) 100 m (offshore) N–S	16 100	TBA	TBA	This issue (Figure 8)	TBA
South Canning 1 (Madley – Herbert)	GSWA	UTS	19 Jul 10	95 000	400 m 60 m N–S	33 520	TBA	TBA	This issue (Figure 9)	TBA
South Canning 2 (Morris – Herbert)	GSWA	UTS	1 Jul 10	125 000	400 m 60 m N–S	45 850	TBA	TBA	This issue (Figure 10)	TBA
North Canning 4 (Lagrange – Munro)	GSWA	UTS	20 Sep 10	103 000	400 m 60 m N–S	36 680	TBA	TBA	This issue (Figure 11)	TBA
Southeast Lachlan	GSNSW	Fugro	1 Mar 10	107 533	250 m (NSW) 500 m (ACT) E–W	24 660	100% on 9 Sep 10	TBA	144 – Feb 10 p15	TBA

TBA, to be advised.

Table 2. 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
Gascoyne North	GSWA	Atlas	16 Mar 10	7400	2.5 km regular	45 410	100% on 19 May 10	2 Jul 10	144 – Feb 10 p15	15 Jul 10
Albany – Fraser North	GSWA	Atlas	7 Oct 2010	9200	2.5 km regular	50 980	TBA	TBA	146 – Jun 10 p17	TBA
Sandstone	GSWA	IMT	Early Oct 2010	6300	2.5 km regular	35 640	TBA	TBA	146 – Jun 10 p17	TBA
South Gascoyne	GSWA	IMT	9 Aug 2010	9700	2.5 km regular	55 760	26.7%	TBA	146 – Jun 10 p17	TBA
West Arunta	NTGS	Atlas	6 Jun 2010	12 426	4, 2 and 1 km	89 985	100% on 15 Sep 2010	TBA	146 – Jun 10 p18	TBA

TBA, to be advised.

Table 3. AEM surveys

Survey name	Client	Contractor	Start survey	Line (km)	Spacing AGL Dir	Area (km²)	End survey	Final data to GA	Locality diagram (*Preview*)	GADDS release
Frome	GA	TBA	22 May 10	34 986	5000 and 2500 100 m E–W	95,450	65.3% on 12 Sep 2010	TBA	146 – Jun 10 p18	TBA

TBA, to be advised.

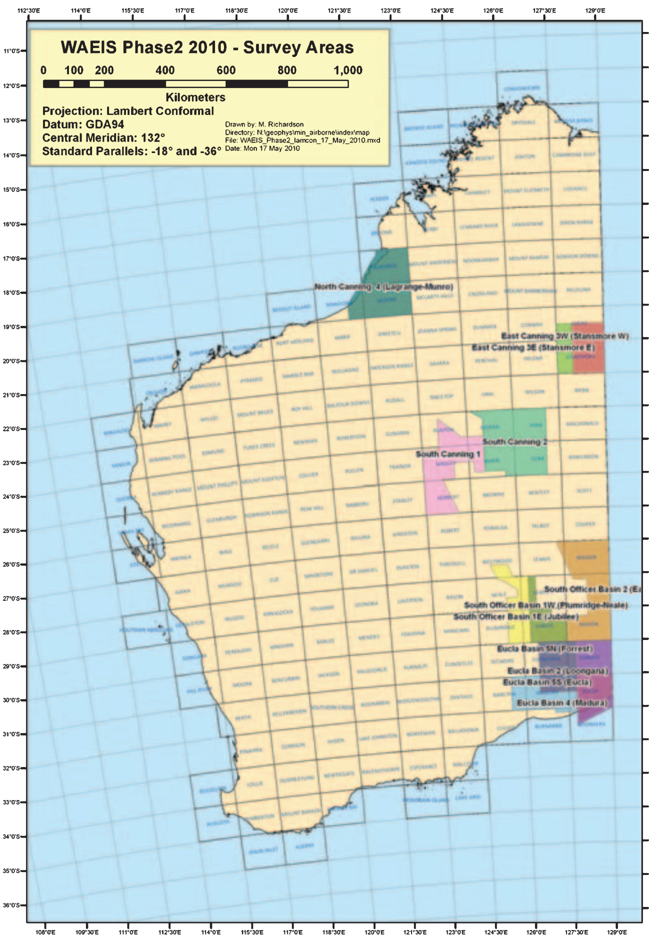


Fig. 1. *Locality diagram for ten new surveys in WA funded under the Exploration Incentive Scheme – Phase 2.*

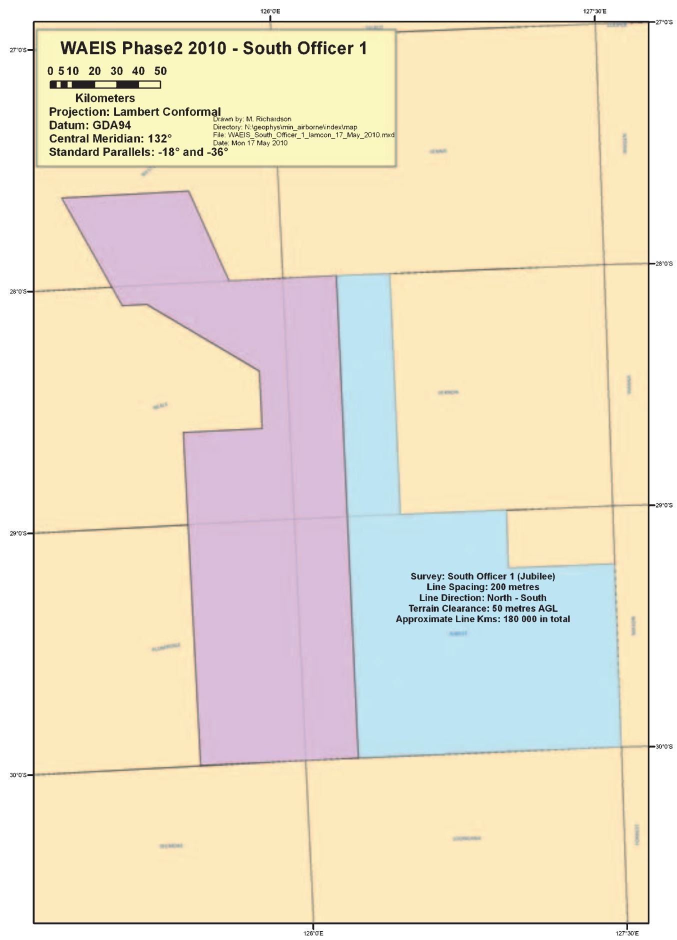


Fig. 2. *Locality diagram for the South Officer 1 airborne mag/rad survey.*

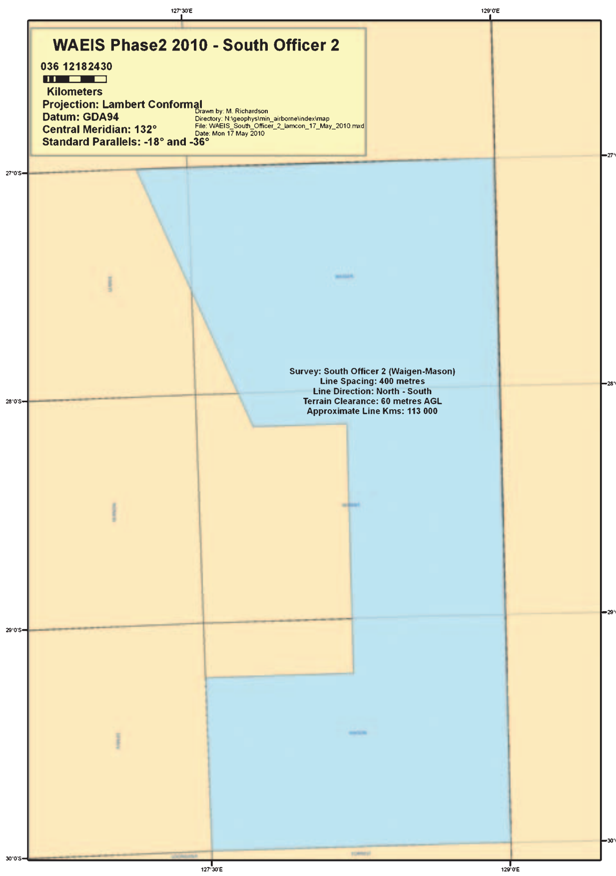


Fig. 3. *Locality diagram for the South Officer 2 airborne mag/rad survey.*

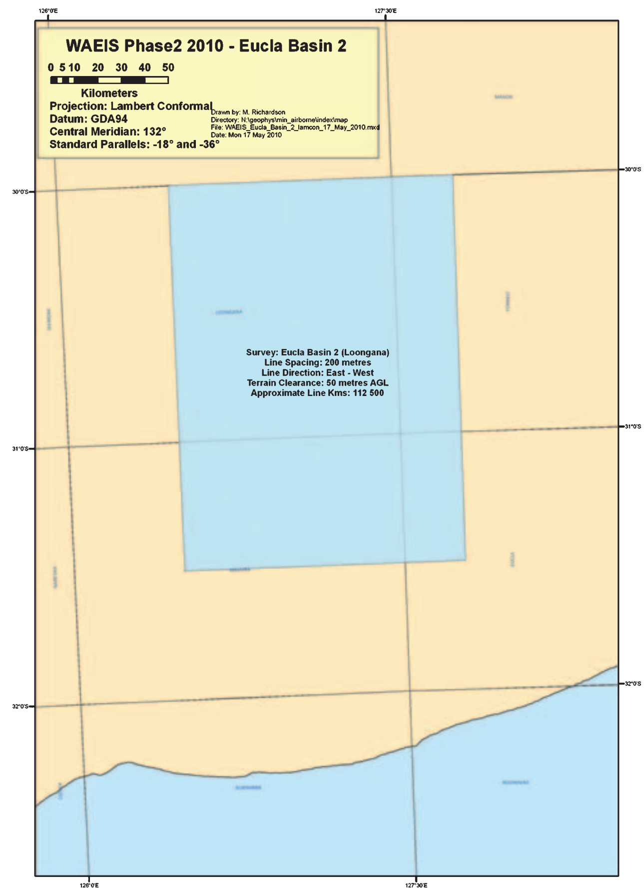


Fig. 5. *Locality diagram for the Eucla Basin 2 airborne mag/rad survey.*

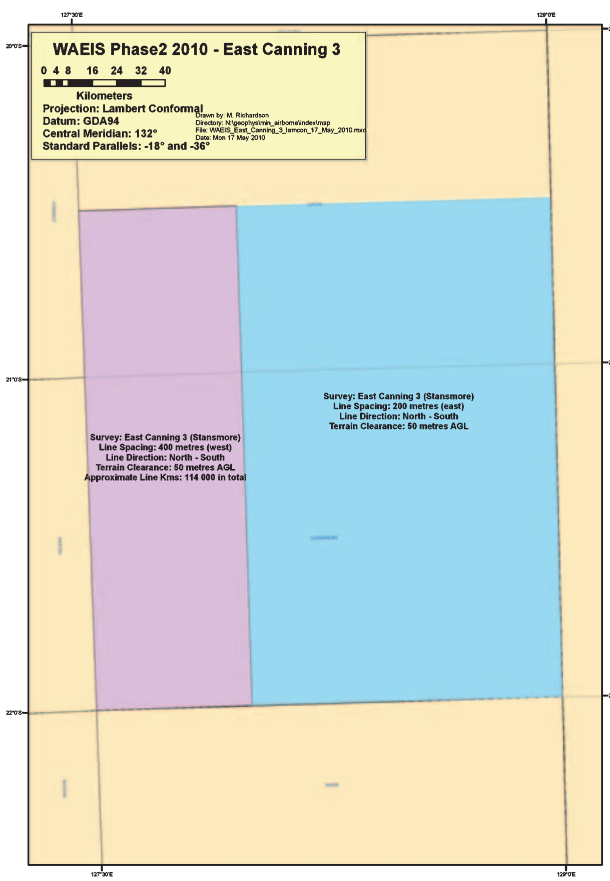


Fig. 4. *Locality diagram for the East Canning 3 airborne mag/rad survey.*

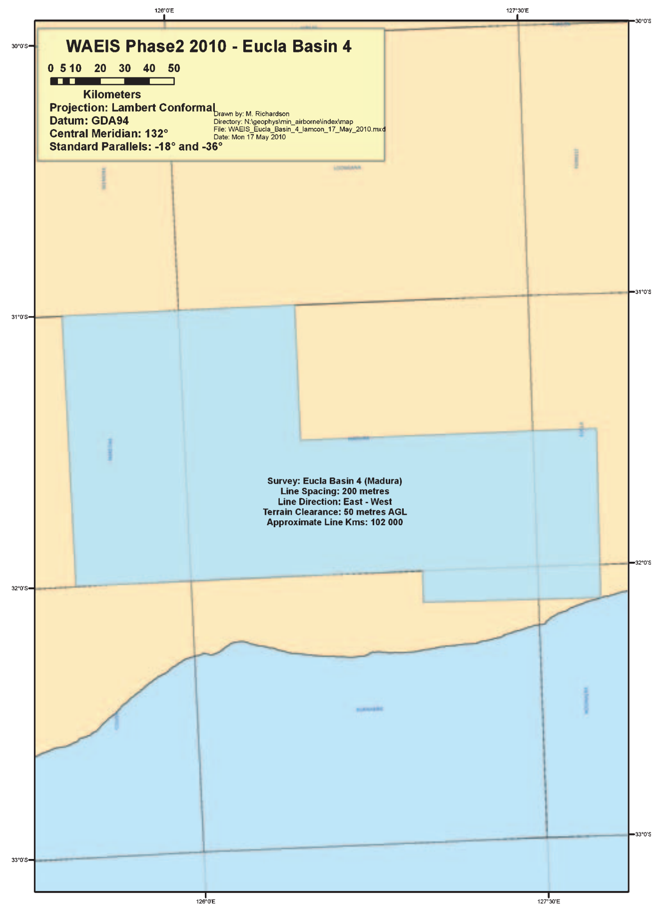


Fig. 6. *Locality diagram for the Eucla Basin 4 airborne mag/rad survey.*

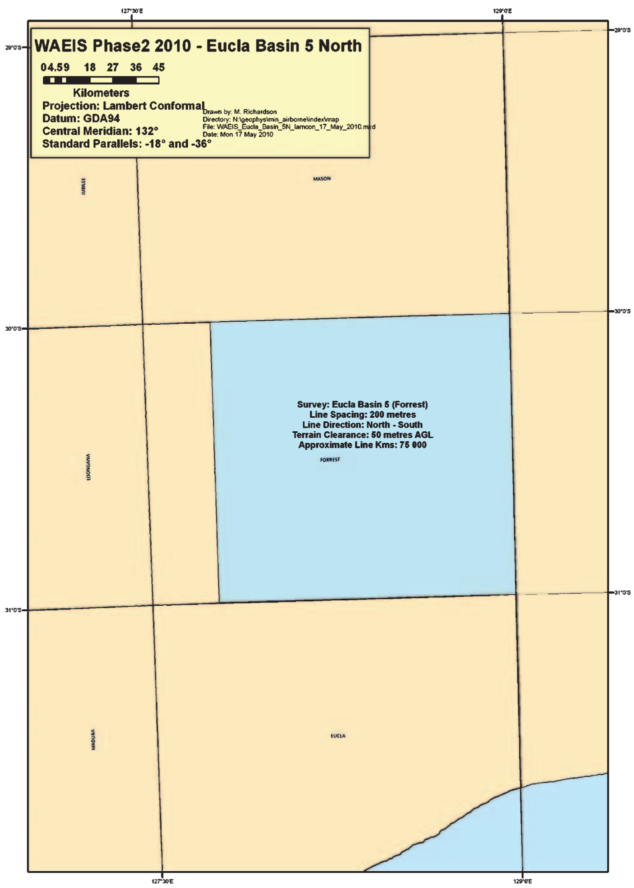


Fig. 7. *Locality diagram for the Eucla Basin 5N airborne mag/rad survey.*

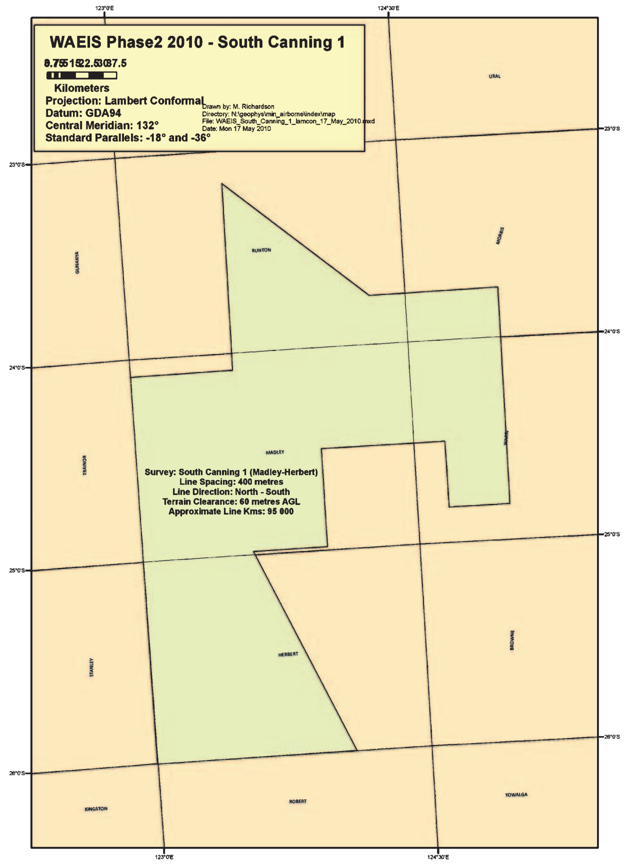


Fig. 9. *Locality diagram for the South Canning 1 airborne mag/rad survey.*

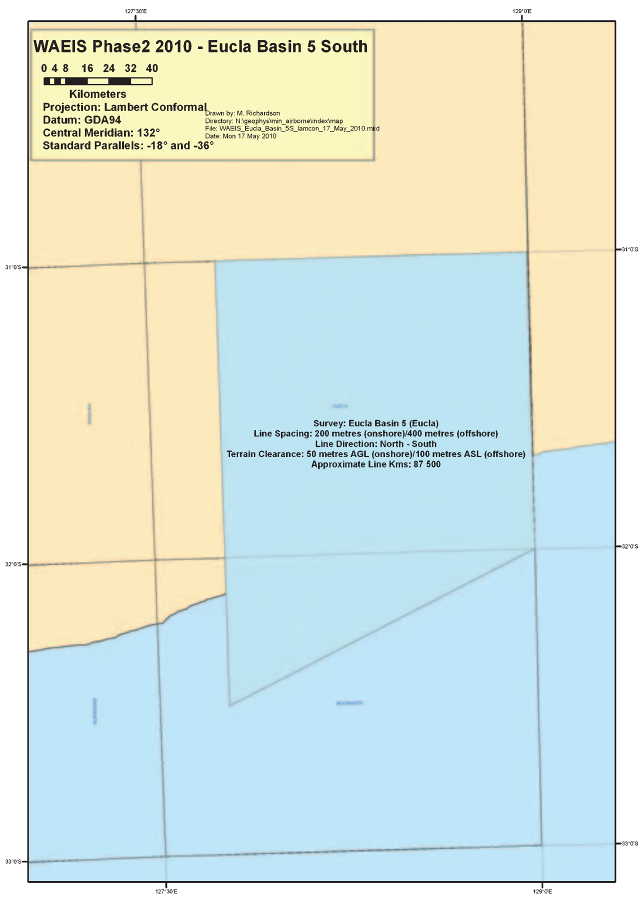


Fig. 8. *Locality diagram for the Eucla Basin 5S airborne mag/rad survey.*

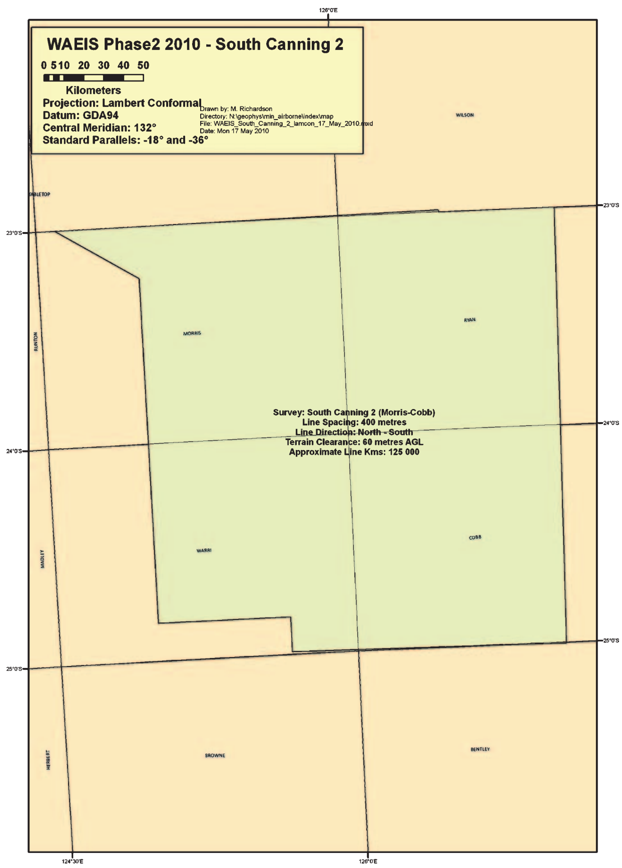


Fig. 10. *Locality diagram for the South Canning 2 airborne mag/rad survey.*

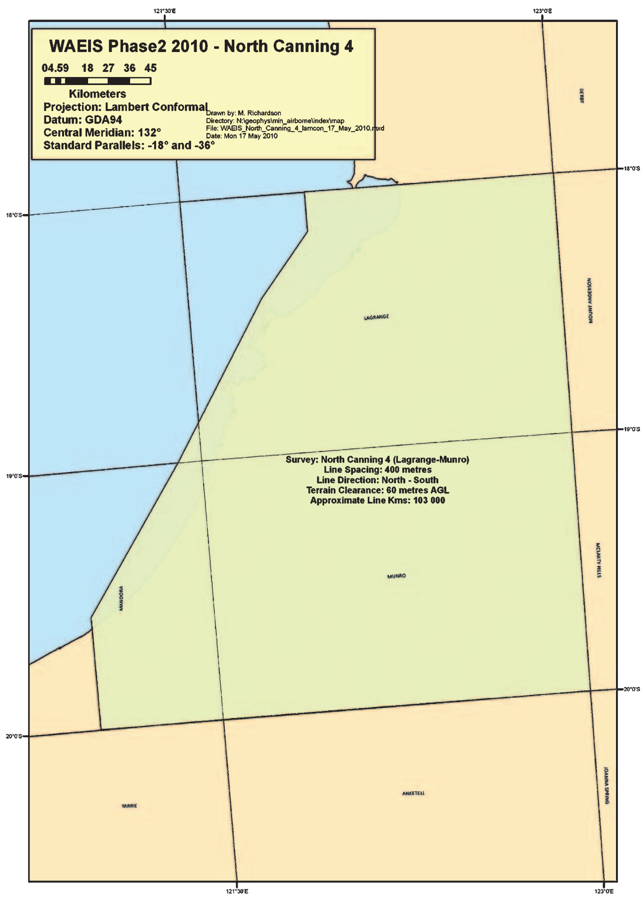


Fig. 11. *Locality diagram for the North Canning 4 airborne mag/rad survey.*

Mineral prospectivity mapping in South Australia

Laszlo Katona[1,2], Martin Fairclough[1] and Philip Heath[1]

[1]*Primary Industries and Resources South Australia, Adelaide, SA*
[2]*Email: laz.katona@sa.gov.au*

The Geological Survey of South Australia (GSSA), as part of Primary Industries and Resources South Australia (PIRSA), has a proactive program to reduce exploration risk through a systematic program of regional mineral potential modelling that provides both the tools and information for prospective area selection. Exploration strategies vary from terrain to terrain, depending largely upon the commodity (or deposit type) being explored for, the degree of outcrop and the distribution of sampled data. In particular, an understanding of which processes are critical (or at least desirable) to ore formation, and how they are manifested in geological and geophysical datasets, allow a predictive approach to exploration targeting. Prospectivity modelling for the northern Flinders Ranges and Musgrave Province regions has been completed, with a third project underway in the eastern Olympic Domain of the Gawler Province. These regions are shown in Figure 12.

Due to the exposed nature of the target lithologies in the northern Flinders Ranges, there is a long history of exploration and discovery. This body of knowledge enabled the project team to model nine commodity classes, incorporating 45 mineral styles. Stratigraphy hosting known mineral styles is the primary geological control, with mapped linear structure and diapirs enhancing prospectivity for certain mineral styles (Cowley and Preiss, 1997; Fabris et al., 2005; Preiss and Robertson, 2006).

The Musgrave Province, located in central Australia, spans three states (South Australia, Western Australia and Northern Territory). In this isolated region there is less historical exploration and fewer known mineral occurrences. The main focus of the project was assessing the prospectivity of mineralisation related to the mafic/ultramafic intrusives of the Warakurna large igneous province. For the fuzzy logic analysis (Bonham-Carter, 1996) a larger number of predictors were used (when compared with northern Flinders Ranges) including mineral occurrences, geochemistry from a number of sources, as well as mapped and interpreted geological features. Aeromagnetic interpretation was an integral part of the knowledge driven modelling process. Among the predictors interpreted from TMI were mafic plugs, magnetic intrusives, basal sequences, mafic sills and linear structures. Magnetic depth to basement and gravity (representing high/low density) were also used.

In the Olympic Domain of the eastern Gawler Province, where thick cover obscures target lithologies and structures, there is a much greater reliance on potential field data and its derivatives.

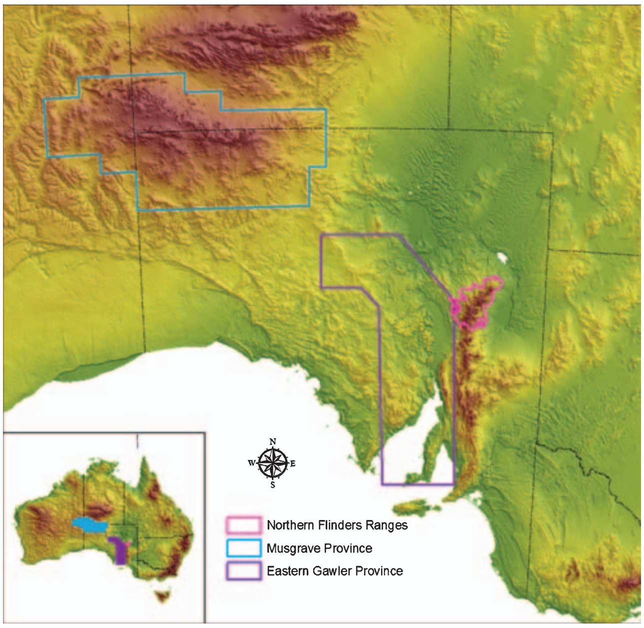


Fig. 12. *Areas targeted by current prospectivity modelling projects.*

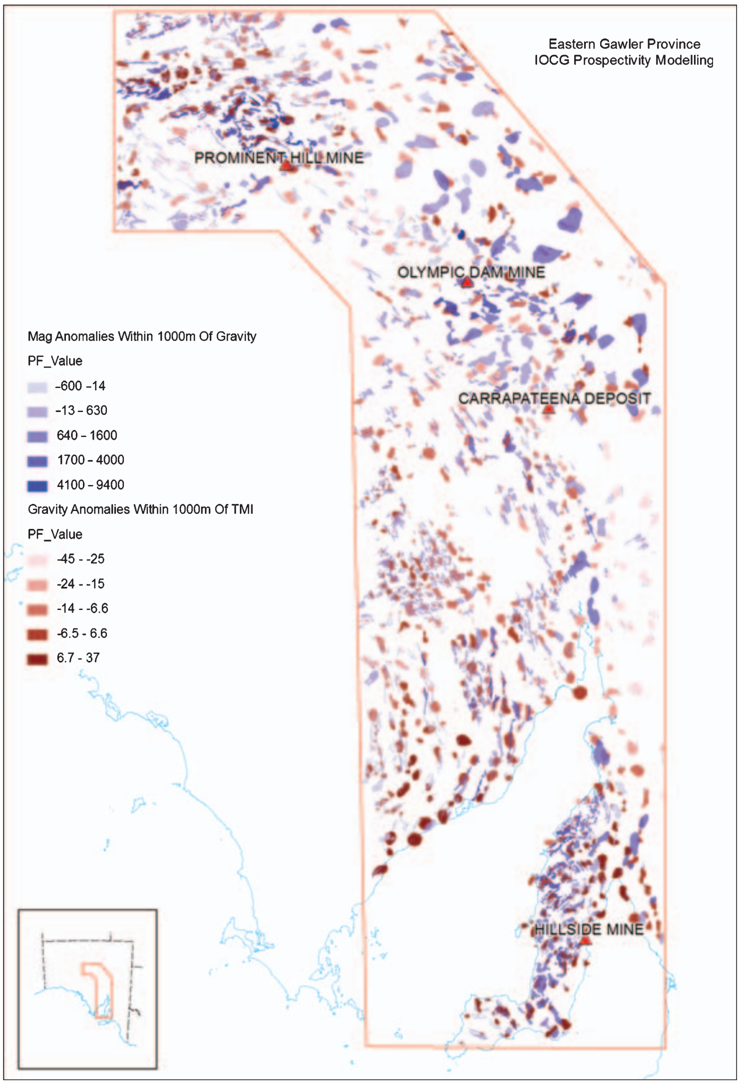


Fig. 13. *Coincident residual TMI and gravity highs.*

The major targets in this region are iron oxide-copper-gold ± uranium (IOCG ± U) deposits. A fundamentally accepted predictor of these deposits is broadly spatially coincident (although generally offset in detail) gravity and magnetic highs. GIS processing has delineated and mapped the coincident highs from residual RTP TMI and residual gravity datasets, as shown in Figure 13. Gravity and magnetic data will be processed to generate apparent susceptibility and density, used for alteration mapping (Chopping and Henson, 2009). Spectral analysis (HyLogger) of drill core will also be used to map alteration. Proximity to uraniferous sources, used in tandem with gravity and magnetic gradient strings (representing structure and possible fluid conduits) will be used to model structural connectivity. Finally, magnetic data enable the analyst to model depth to crystalline basement, where the IOCG deposits usually occur. Together, these datasets will be used in both knowledge driven and weights of evidence modelling.

As depth of cover increases, the reliance on potential field data and its derivatives also increases. High level decision makers are able to utilise prospectivity maps for both land use decisions and exploration planning, however it is of vital importance that the assumptions, methodologies and conclusions of the modelling process be incorporated into any map product that is released to avoid misinterpretation. These products should not be used in isolation from the supporting data and information. The practice of releasing the maps as a part of a complete information package incorporating report and maps addresses this issue.

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Chopping, R., and Henson, P. A. (Eds), 2009, 3D map and supporting studies in the North Queensland region: Geoscience Australia, Record 2009/29.

Cowley, W. M. and Preiss, W. V., 1997, Geology and Mineral Potential of Diapiric Inliers in the Northern BURRA 1 : 250 000 Map Area: *MESA Journal* **5**, 37–45.

Fabris, A., Constable, S., Woodhouse, A., Hore, S., and Fanning, M., 2005, Age, origin, emplacement and mineral potential of the Oodla Wirra Volcanics, Nackara Arc, central Flinders Ranges: *MESA Journal* **37**, 44–52.

Preiss, W. V., and Robertson, R. S., 2006, Adelaide Geosyncline and Stuart Shelf. In: Cooper, B. J., and McGeough, M. A. (Eds), 2006, South Australia mineral explorers guide, 2nd edn, South Australia, Department of Primary Industries and Resources, Mineral Exploration Data Package, 11, Ch. 7.

AuScope awarded $23 million for Australian Geophysical Observing System (AGOS)

Congratulations to AuScope, which was awarded $23 million in June this year by the Australian Government, to develop a new Australian Geophysical Observing System (AGOS).

AuScope Limited is a non-profit company comprising 23 universities, government bodies and research organisations. It was established with a government grant of $42.8 million in 2006 under the National Collaborative Research Infrastructure Strategy (NCRIS) to develop a world-class infrastructure system for earth science in Australia. In addition to its NCRIS funding, over $70 million in co-investment has been committed by the participants in AuScope.

The six components of the original program are:

- AuScope grid and interoperability – *computing and data access*
- Earth composition and evolution – *geochemistry*
- National virtual core library – *rock core information*
- Earth imaging and structure – *seismic and MT equipment*
- Earth simulation and modelling – *inversion and visualisation*
- Geospatial framework and earth dynamics – *geodesy*

AuScope's work has been significantly boosted by the $23 million new funding, which was obtained through Round 3 of the Education Investment Fund (EIF).

The new AGOS infrastructure will include:

The ***Geospatial Observatory*** – involving a Global Navigation Satellite System instrumentation pool of ~100 GPS stations, high precision monuments, corner cube reflectors, establishment of new monitoring sites, a library of remote sensed data, and robotic antenna systems all designed to improve precision and accuracy for geospatial science.

The lead nodes are the Australian National University (ANU) and Geoscience Australia; the equipment budget is ~$5.2 million.

The ***Earth Sounding Network*** – will build new generation seismic recorders, and purchase or build a pool of ~20 ocean-bottom seismometers, ~20 earth data recorders and electric field multichannel loggers for MT research. It will make available 100 new temporary seismometers and a host of other scientific instruments to provide new capability exploring new realms of the continent. All equipment will be made available to the scientific community through ANSIR.

The lead nodes are the ANU and University of Adelaide; the equipment budget is ~$4.0 million.

The ***Subsurface Observatory*** – including infrastructure to facilitate access to deep drill holes and establish equipment for downhole tests, including a downhole logging toolkit, the facility for *in situ* stress measurement and laboratory equipment for acquiring petrophysical measurements on material recovered from depth.

The Universities of Melbourne and Adelaide are the lead nodes; the equipment budget is ~$2.3 million.

The ***Geohistory Laboratory*** – infrastructure for automated thermochronology e.g. AFTA and U-Th-Pb-He analysis by double-dating techniques and an ICP mass spectrometer.

The lead nodes are at the University of Melbourne and the John de Laeter Centre at Curtin University; the equipment budget is $1.3 million.

The ***Inversion Laboratory*** – will create two classes of inversion software for analysing and modelling the physical state of the crust and to allow solution of generic inversion problems.

The lead nodes are the University of Queensland and the ANU; $1.6 million has been allocated for the acquisition of software and equipment.

The ***Geophysical Education Observatory*** – will develop digital real time connection to existing teaching laboratories through the seismometers-in-schools program to use the national observatory. It will provide a unique opportunity for integrating scientific research and education by engaging students, teachers, and the public in a national experiment that is going on across the country.

The lead node is Macquarie University; $1.2 million has been allocated for the acquisition of seismometers and GPS equipment for secondary schools.

These facilities will provide opportunities for new research projects in the geosciences throughout Australia. For example ARC proposals will be able to include the new facilities, provided the operating funding is available. But perhaps the most important factor is that AuScope has provided the environment for integrated multidisciplinary geoscience. All the main players in the game are in Auscope, so if you are a researcher, or prospective researcher at a tertiary institution, get on to the field and start to play.

For more information contact Bob Haydon the CEO of AuScope at rhaydon@unimelb.edu.au, visit the website www.auscope.org.au, or read Bob Haydon's article in the June 2010 *Preview* (Issue 146), pp. 21–24.

Arrow Energy swallowed by Shell and PetroChina

In August 2010, LNG (Liquefied Natural Gas) company Arrow Energy was acquired by Shell and PetroChina. The takeover followed an offer in March to purchase all the shares of Arrow on a 50/50 basis.

Shell and PetroChina can now proceed with their plans for a major LNG facility (named Arrow LNG) on Curtis Island, alongside British Gas QGC (Queensland Curtis LNG), Santos (Gladstone LNG) and Origin/Conoco Phillips (Australia Pacific LNG).

If Shell and PetroChina decide to go ahead, they will use gas resources supplied from the Surat and Bowen basins in South-East and Central Queensland. A pipeline would bring gas from the tenements to the Curtis Island LNG plant, where it would be processed and exported to international markets.

It is of interest to look at the Arrow Energy share price while all this was going on. Figure 1 shows market capital rising steadily from February 2008 until the takeover was initiated in March 2010.

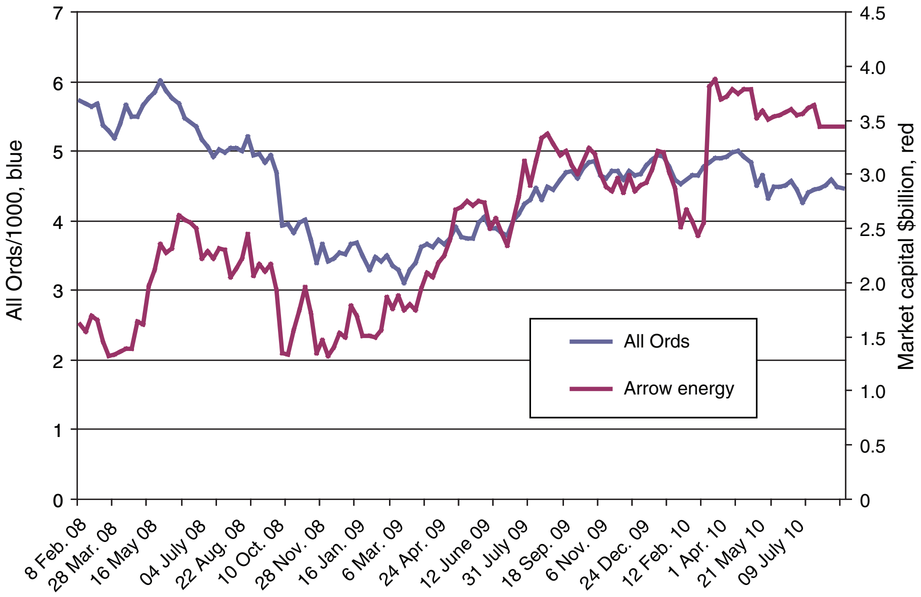

Fig. 1. *Market capital of Arrow Energy on the ASX in A$ billions (in red with right hand axis) and All Ordinaries Index/1000 in blue (left hand axis).*

It then rose dramatically from about $2.5 billion to $3.8 billion in one week; before declining to about $3.4 billion when the takeover was finalised. Arrow Energy was then de-listed from the ASX. Easy money if you knew what was going to happen.

Gold production soars in June quarter 2010

The 2010 June quarter delivered a bonanza production result for gold.

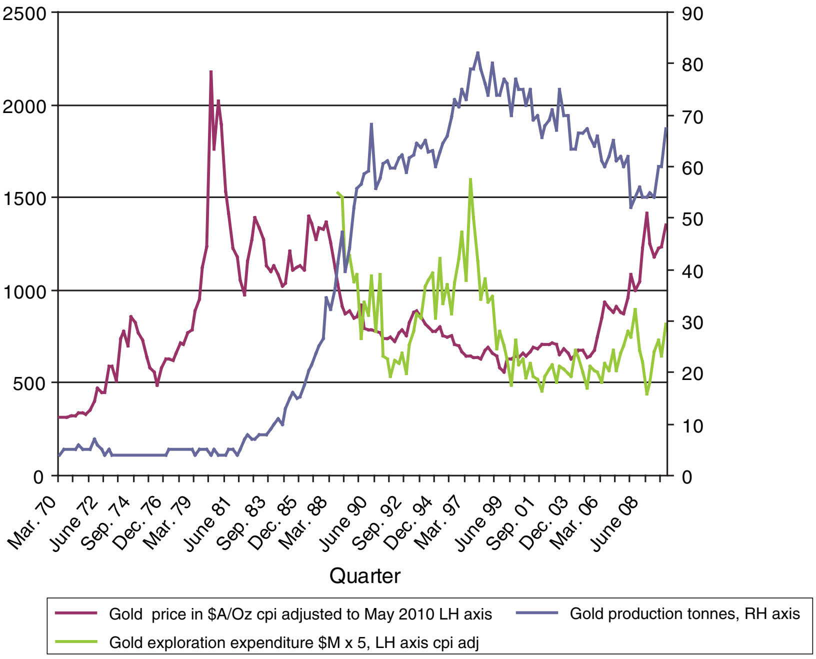

Fig. 2. *Australian quarterly gold production in tonnes from ABARE and USGS (blue and right hand axis); gold price in $A/Oz, adjusted to June 2010 cpi (red and right hand axis); quarterly exploration expenditure for gold from ABS in $million × 5 (green and left hand axis).*

According to Surbiton Associates, quoted by AAP in September, approximately 67 tonnes of the precious metal were produced in that period. This is the highest level since the fourth quarter of 2003 but still short of the 82 tonnes produced in the fourth quarter of 1997.

Figure 2 shows the variations in the price of gold (A$), gold production (tonnes) and gold exploration quarterly expenditure, as given by the Australian Bureau of Statistics (ABS). There appears to be very little correlation between exploration investment for gold and how many tonnes were produced. However, there may be a correlation between the price of gold and the level of production, with a time lag of approximately 10 years between the increase in the price and the rise in production.

One other interesting statistic is that the maximum price for gold (in May 2010 dollars) was over $2000 during the March 1980 quarter. So in real terms, the current price has plenty of space to move up.

Energeo expands its Brisbane Office

Cameron Hamilton, ASEG Membership Officer, has this month joined Energeo as its first full time employee. Energeo is a geophysical and geological consultancy set up to service New Guinea Energy and GeoSolve. Cameron joins former ASEG President Henk van Paridon and NGE technical director Dan Kendrick along with two other consultants, Simon Atkinson (data management) and Brett Godden (IT services). Energeo has salubrious offices in Spring Hill, a short walk from the Brisbane CBD. Energeo provides services to the petroleum, coal seam gas and coal industries, specialising in seismic interpretation. Drop in and see us some time.

Australia as a competitive manufacturer of geophysical instruments

There seems to be a view held within the Australian community, often reinforced by gloomy comments from the media, that Australia's manufacturing base is declining and high-value jobs are being lost to overseas competitors. Alpha Geoscience, a local supplier to the Australian geophysical community, put this to the test and decided to commence production of a geophysical instrument previously only offered as an imported product. The instrument is a hand-held magnetic susceptibility meter called the magROCK, a basic meter of the type many geologists and geophysicists would own.

Alpha had a reasonable amount of technical knowledge within its organisation but when it came to laying out a printed circuit board and producing a design which would meet the needs of its customers; this was beyond Alpha's skill base. Alpha found a strong technical partner in Geo Equipment and a 50–50 joint venture partnership was formed.

The team then identified three developers by word-of-mouth recommendation. Each developer submitted a proposal as to how they would achieve the end result: a cutting edge magnetic susceptibility meter. There was a range of both pricing and approaches offered but Alpha decided to go with an individual operator who offered expertise in both designing hardware and writing software. This combined skillset was seen as offering a unique advantage – being able to coordinate these two vital areas and translate technical capability into user benefits.

It is fair to say that from this point not everything went to plan. The technical development proved to be much more complex than originally anticipated and the project timeline doubled. However, having the software and hardware development combined in a single person did lead to some additional benefits. For example, novel ways were found to deliver additional end user features.

Once Alpha had a design with which it was happy, a series of three prototypes were produced, with 'bugs' eliminated at each stage. With development completed, an online search revealed six potential manufacturing companies. Each potential manufacturer responded to a brief and Alpha was amazed at the number of highly professional and flexible manufacturing partners within a 45 minute drive from their location.

Manufacturing subsequently commenced. However, not everything went smoothly as a last-minute design flaw was identified and this meant that the entire production run had to be reworked. (The lesson learned from this experience: make your first production run small – there may be unforseen problems!)

With stock now available, Alpha started the process of marketing the magROCK. The first batch of instruments, 25 in total, sold out quickly using Alpha's database of geophysical customers and some local promotion. A second production run of instruments has commenced with the challenge now to appeal to the international market. The internet is proving useful in this regard, as well as some key agency relationships in various countries.

The pleasant surprise for Alpha Geoscience from this exercise is that there is no shortage of technical or manufacturing skills and means to produce high-value added scientific instruments in Australia. This rings true not only for the magROCK but also the terraTEM, a transient electromagnetic system designed, developed and manufactured by Monex Geoscope in Melbourne. Also, even with a strengthening Australian dollar, Australian manufacturing is cost competitive.

The constraint, as Alpha sees it, is controlling the development cost and time commitment required from key personnel. These can certainly put a strain on any organisation. However, Alpha and its partners stand to reap a long term benefit from their investment in the magROCK and Australian geophysics.

Timothy Pippett
Managing Director, Alpha Geoscience

Geophysics at Geoscience Australia: now and in the future

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The following is based on the Plenary Address delivered by Geoscience Australia CEO, Dr Chris Pigram, to the ASEG–PESA 2010 Conference in Sydney on 23 August 2010.

Introduction

Following the global financial crisis, our region is driving strongly towards another major cycle in the development of and demand for resources. While all booms have cycles, there is no doubt that as very large populations of our region develop we will see a sustained demand for energy and resources. Accompanying this is a strong message coming out of China that the future has to be green and sustainable.

In this context, geophysics will be at the forefront of Australia's exploration and mining industry as they tackle the challenge to extract more and better quality geological information and knowledge from new and existing data sources to enable Australia to meet the demand for energy and mineral resources.

As one of the largest employers of geophysicists in the country, Geoscience Australia will seek to utilise its skills to improve our knowledge of the Australian continent, at a range of scales, to sustain a resources pipeline and to understand the intra-plate processes which drive the occurrence of natural hazards. The challenge we face is great but it is clear that any real breakthrough in characterising and understanding the Australian continent will only come from an understanding of the depth dimensions. That is, we have to be able to begin understanding the continent, and all the processes which have shaped it, in 3D and 4D.

Geophysics is a fundamental component in 3D earth models and mathematically rigorous methods will underpin the work Geoscience Australia does to achieve this understanding. Ultimately, when applied in a holistic way, this approach will help to advance Australia's resource discovery rate.

The success of pre-competitive datasets in Australia is well documented, but the future for organisations such as Geoscience Australia rests in combining traditional geoscientific data collection with rigorous mathematical modelling and inversion techniques and ever increasing computer power. This will allow us to map the Australian crust in the depth-dimension and thereby obtain a far better understanding of the geological evolution of the continent and, consequently, the processes which have influenced our massive natural resource endowment. It will provide opportunities also to exploit new energy sources such as geothermal power.

National datasets

During the past 60 years, enormous quantities of high quality geophysical and geological data have been acquired over the Australian continent and offshore jurisdictions by Geoscience Australia and its partners in the States and Northern Territory as part of a systematic mapping of the Australian continent. This has resulted in the production of a series of fundamental national datasets which provide the highest quality national coverage in the world.

Through its Onshore Energy Security program, Geoscience Australia commissioned the Australia Wide Geophysical Survey (AWGS) which was the largest single airborne geophysical survey ever flown. It covered the Australian land mass with north–south flight lines spaced 75 kilometres apart, and east–west lines spaced 400 kilometres apart. The survey baseline results allowed 640 separate airborne radiometric surveys to be levelled and merged together to produce a new Radiometric Map of Australia.

Because the new Radiometric Map has been calibrated to the International Atomic Energy Association datum, researchers and explorers can now make quantitative assessments and comparisons of radiometric anomalies. Results from the AWGS have been used also to improve the quality and detail of the Magnetic Anomaly Map of Australia, with Geoscience Australia recently releasing the 5th edition (see Figure 1).

This new map and associated grid database has increased the accuracy of the continental-scale of the Magnetic Anomaly Map by matching and merging 795 individual survey grids, and includes an additional 155 individual grids acquired since publication of the previous edition.

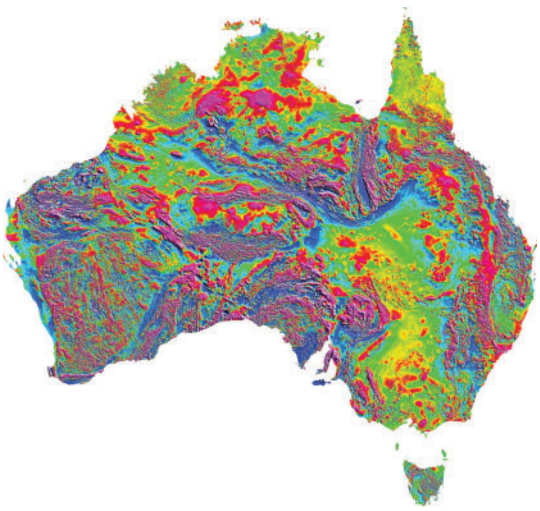


Fig. 1. *Magnetic Anomaly Map of Australia (5th edition).*

As well as the new composite digital grid of the total magnetic intensity of Australia at a resolution of 80 metres, a range of new digital derivative magnetic products at the same resolution will be released shortly. These will include variable reduction-to-the-pole of the TMI, the first vertical derivative of the TMI and various others.

Seismic surveys

Seismic reflection surveys are a primary tool to image Australia at depth and Geoscience Australia has obtained more than 5000 kilometres of deep crustal reflection seismic and magnetotelluric traverses to date. These data target uranium/thorium and geothermal potential in the Mt Isa province and the Gawler craton as well as hydrocarbon potential in the Officer, Amadeus, Georgina, and Darling Basins.

In North Queensland, the work resulted in the discovery of the previously unknown Millungera Basin beneath the more recent Carpentaria Basin to the east of the Mt Isa province. The work also revealed a fundamental crustal suture at the eastern edge of the province, a thinning of the crust towards the Georgetown province and a world class faulting of the Moho. These discoveries together have changed the understanding of the geological evolution of the region and its crustal processes.

AEM for regional depth imaging

Geoscience Australia also has begun pioneering the use of airborne electromagnetic (AEM) surveys as a regional depth imaging technique. Regional-scale AEM surveys have been flown in the Paterson province of Western Australia, the Pine Creek province of the Northern Territory and a third survey is underway in the Frome Embayment region of South Australia (see Figure 2). This is the first time that entire geological provinces have been covered by a single regional AEM survey using line spacing of up to 5 kilometres.

Geoscience Australia is flying AEM to reduce risk in uranium exploration by imaging large scale geological structures such as unconformities, faults and paleochannel systems, as well as providing baseline information about the penetration and resolution of AEM surveys, particularly geological terrains, which will assist industry when designing more detailed surveys.

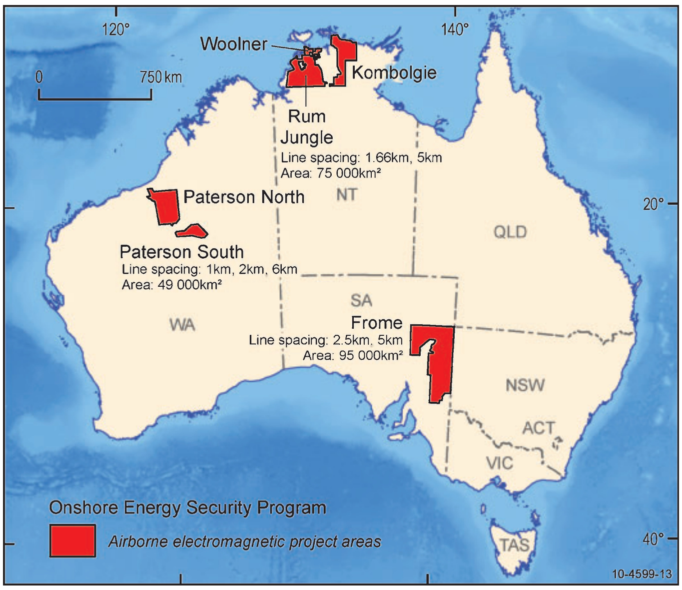


Fig. 2. *Location map showing major regional airborne electromagnetic surveys.*

Geodesy programs

It is timely to remember that these great datasets are possible only because of precise, high quality navigation, a benefit in which Geoscience Australia plays a vital role through its Geodesy programs. The agency operates the National Geospatial Reference System which can be used during acquisition of geophysical data to ensure precise spatial location information.

Geoscience Australia is moving to improve the Geodetic Reference Frame to millimetre accuracy, which will provide a

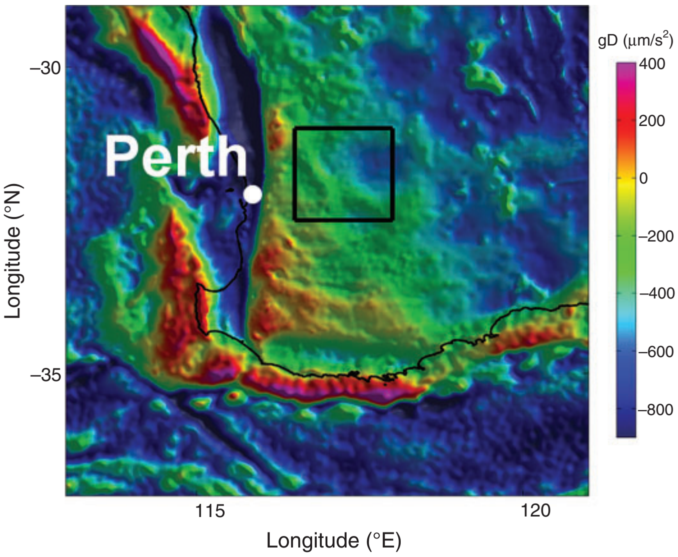


Fig. 3. *Kauring geophysical test site northeast of Perth, Western Australia.*

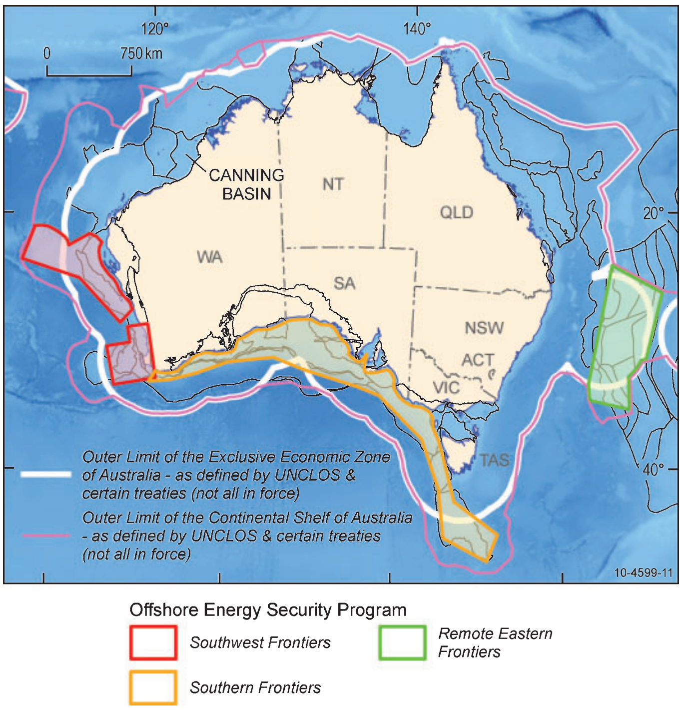


Fig. 4. *Areas of activity under the Offshore Energy Security program.*

positioning capability of less than two centimetres across the whole of the continent.

When complete this high precision reference frame will allow the measurement of deformation in the Australian continent and begin to understand for example the intra-plate deformation which is occurring in Australia and, subsequently, better understand the drivers and causes of the earthquake hazard in Australia.

Kauring geophysical test site

As a further step to improve data acquisition and interpretation, the Kauring geophysical test site (see Figure 3) has been set up 100 kilometres from Perth to fully test and evaluate available and future exploration technology.

Established as a collaboration involving Geoscience Australia, the Geological Survey of Western Australia, Rio Tinto and the aerial survey company, Fugro, the test site has been covered by detailed ground gravity surveys which will provide an excellent level of accuracy for researchers, industry and service companies to ground-truth and compare airborne systems.

Researchers and companies can acquire data along standard test profiles and compare outputs to the high quality ground observations, and the results of trials carried out by other organisations. The geoscientific research community will be able to download data for analysis and comparison to determine their suitability for different applications.

Offshore Energy Security program

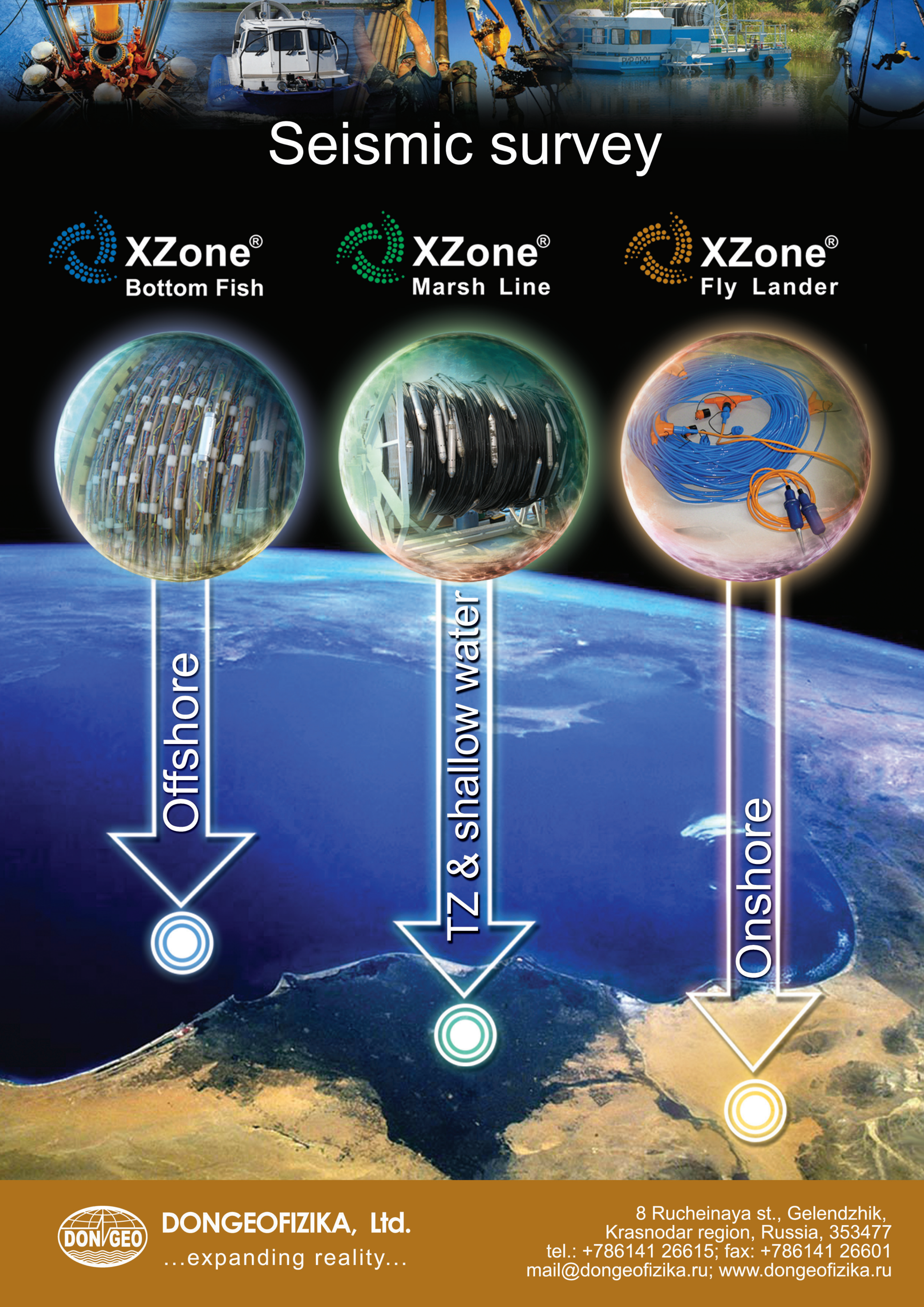
Geoscience Australia's Offshore Energy Security program also obtained 2D seismic reflection, swath bathymetry and gravity and magnetic seismic data offshore from Western Australia in support of the Australian Government's acreage release program (see Figure 4 for locations). That work involved the acquisition of more than 7300 line kilometres of 2D seismic reflection, 230 000 square kilometres of swath bathymetry and some 25 000 kilometres of gravity and magnetic data. The agency also acquired high quality reflection seismic, gravity and magnetic data along with refraction data using sonobuoys, over the Capel and Faust Basins off the east coast.

Data integration

Combining gravity anomaly data, magnetic and radiometric datasets with earth imaging data such as seismic reflection and refraction, magnetotelluric and AEM data is the first step in preparation for computer simulation and modelling applications to help us better understand the 3D potential in greenfields and underexplored areas.

All of these advances will enhance the attractiveness of Australian geological terrains to the global exploration industry and ensure future investment in Australia's resource industries to sustain prosperity for future generations.

These outcomes can be achieved only through the use of geophysical techniques and the employment of geophysicists to interpret and integrate these potentially vast datasets. The challenge that sector now faces is to provide high quality pre-competitive geological information to expedite exploration successes.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Geotechnical hazards and seafloor stability of the northwest shelf

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Introduction

Australia's vast undeveloped hydrocarbon reserves are located along remote parts of the coast, in water depths approaching 1500 metres, and at distances up to 1000 km from land. The safe, economical and reliable development of these reserves demands research into seabed characteristics, as well as new engineering techniques and technologies. This research is needed to assure that the offshore structures and pipelines necessary to enable production of these resources are engineered, designed, and constructed to perform adequately in these difficult environments.

Challenges

Two principal challenges related to exploitation of Australia's deep water oil and gas reserves are:

(i) to establish geohazard knowledge and engineering practices for this frontier region; and,
(ii) to create robust models for the near-seabed behaviour, where the infrastructure – pipelines or foundations – interacts with the ocean and weak seabed sediments.

Figure 1 illustrates the changing infrastructure requirements as hydrocarbon field development moves from shallow to deep water. In shallow water, production facilities are often located on fixed leg platforms and seabed sediments are commonly composed of sandy or cemented materials with favourable engineering properties. However, in deep water environments, production facilities are located on floating platforms that are anchored in place, pipelines and risers encounter very weak sediments and are susceptible to deep burial, and export lines must cross the continental shelf, where slope stability issues are common.

The engineering requirements for deep water developments shown on Figure 1 are representative of current trends off the coast of Australia and in most other major petroleum-producing regions. New projects off the Northwest Shelf are facing challenges associated with: (a) characterisation of the soft deep water carbonate sediments (presenting particular challenges); (b) characterisation of unstable zones of seafloor, including active faulting, landsliding and other geohazards; and (c), designing pipelines to cross steep, rugged and potentially unstable slopes, whilst accommodating thermal and pressure-induced expansions. At the ASEG Geophysics and Geohazards seminar in Perth, held in April 2010, we presented two key areas of research underway at COFS, which are addressing seabed pipeline design and seafloor stability.

Key research areas

The design methodologies to tackle each of these challenges are in their infancy, and beyond the regime of conventional engineering analysis. For example, an emerging technique to accommodate the in-service expansion and contraction of pipelines is controlled lateral buckling. In this design solution the pipeline is permitted to sweep back and forth across the seabed at engineered buckle locations, relieving the changes in length that occur during startup and shutdown. Industry guidelines are under development, through the SAFEBUCK Joint Industry Project (www.safebuck.com). COFS has contributed to the development of this guideline, through numerical and physical modelling of the interaction between pipelines and the seabed. Unlike conventional pipelines, which are designed to remain stationary once installed, seabed pipelines are required to move significant distances across the seabed, to safely alleviate stresses created during operation. We have developed new techniques for assessing the interaction forces when pipelines move across the seabed. These new techniques capture the changes in both seabed geometry and soil strength, which can fall and rise through episodes of remoulding and reconsolidation (Figure 2).

A second key research area within our group is the assessment of seafloor stability on the North West Shelf. In collaboration with the Western Australia Energy Research Alliance (WA: ERA), COFS is undertaking a multi-year project to improve our knowledge of geological hazard processes occurring along the

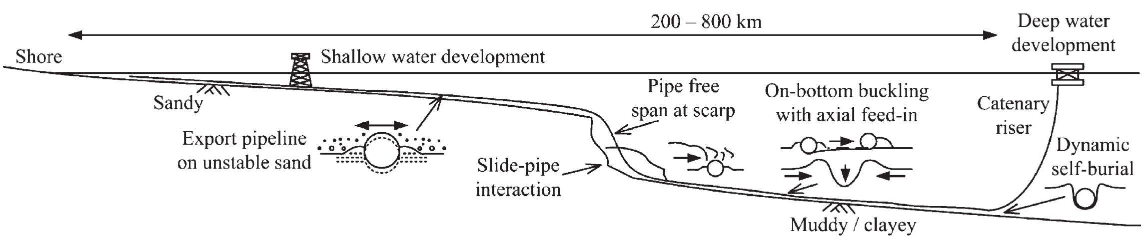

Fig. 1. *Changing infrastructure as hydrocarbon developments move into deeper water.*

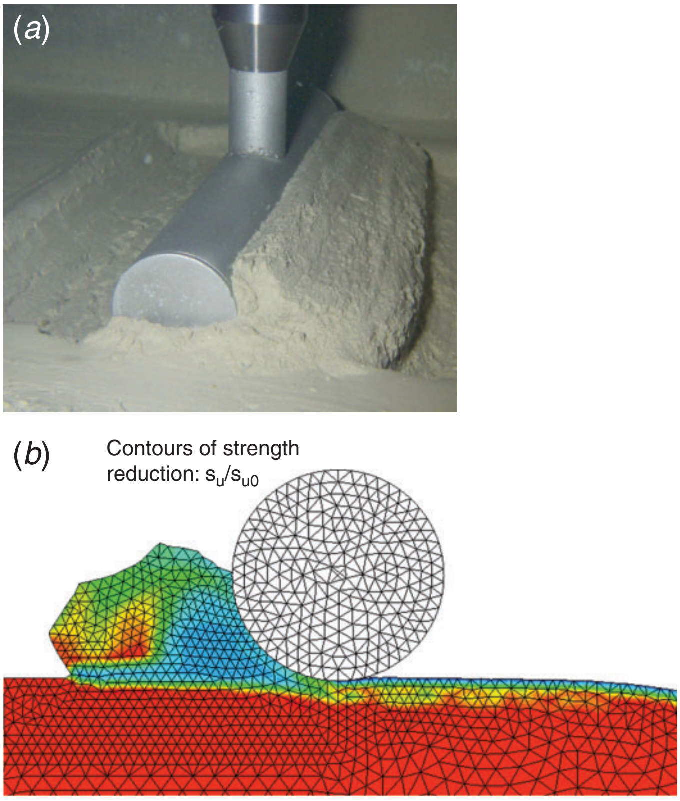

Fig. 2. *Physical and numerical modelling of pipeline-seabed interaction. (a) Geotechnical centrifuge modelling (Gaudin and White 2009). (b) Large deformation finite element analysis (Wang et al. 2010).*

Northwest Shelf. This is being achieved through the compilation and integration of both publically and privately held data related to seafloor morphology, geological structure and stratigraphic environments, geotechnical soil properties, and results from both laboratory and physical testing programmes. The results of the project will provide other researchers and industry with a comprehensive model of hazard processes along the Northwest Shelf.

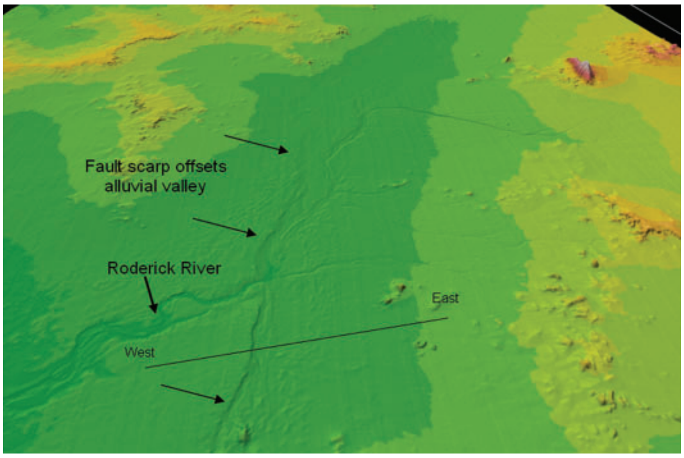

Fig. 3. *Digital elevation model showing recent fault scarps across Roderick River, Western Australia. Reproduced by permission of the Western Australian Land Information Authority (Landgate 2009).*

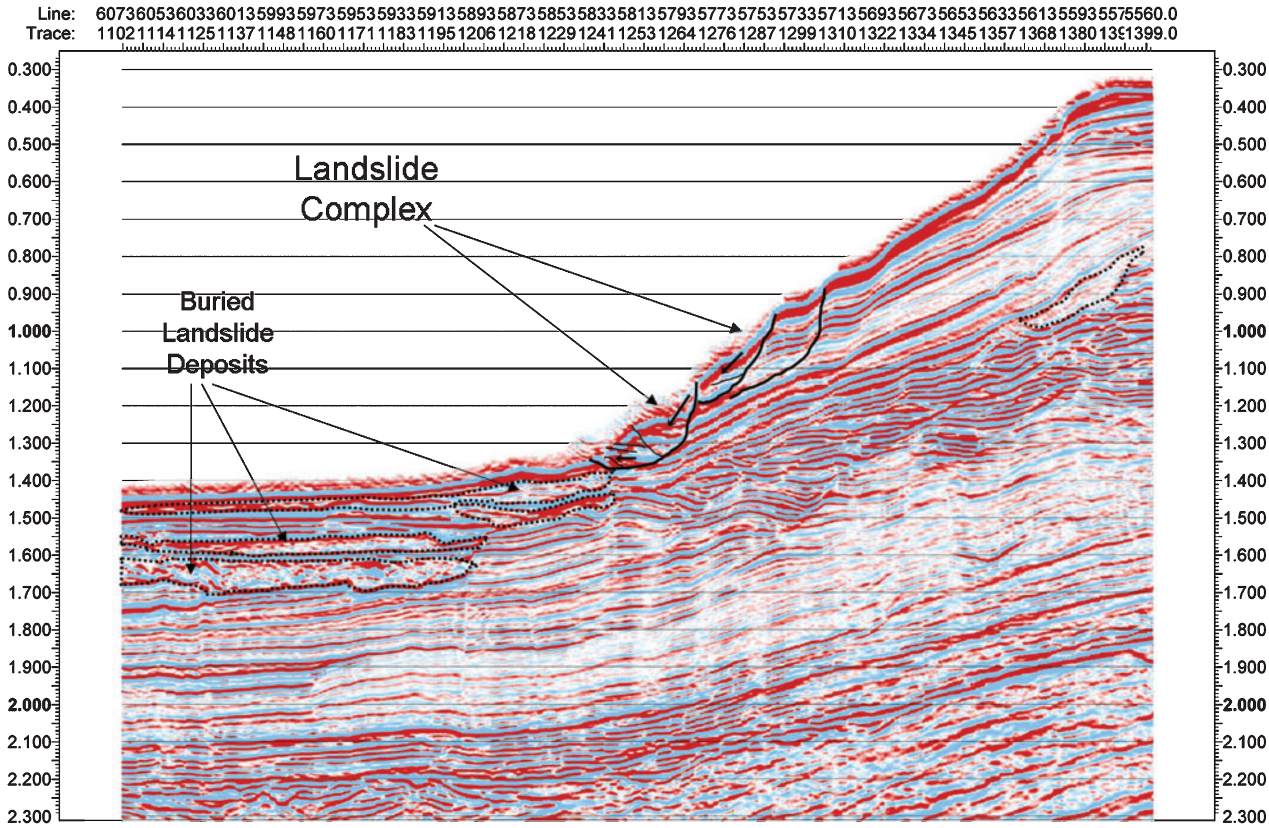

Fig. 4. *Landslide complex across the continental slope, Northwest Shelf, Australia.*

The Seafloor Stability Project involves three primary concentrations, including:

(1) ***Tectonic deformation and seismic hazards.*** Activities include: (i) documenting the location, style and rates of tectonic deformation (Figure 3); (ii) revising and updating the seismic source model for Australia's Northwest Shelf to improve inputs to ground motion assessments; and (iii) providing source parameters for assessment of site amplification, soil liquefaction and landslide triggering.

(2) ***Regional geomorphic analysis and landslide mapping.*** Activities include: (i) integrating seafloor data from multiple 3D seismic surveys to develop a composite high-resolution bathymetric map extending from the continental shelf across the continental slope to approximately 1500 m water depth; (ii) conducting detailed geological and geomorphological mapping to assess seabed processes, and locations and characteristics of marine geohazards (Figure 4); and (iii) developing a landslide inventory map and slope process model to assess slope process rates.

(3) ***Stability analysis and run-out modelling.*** Activities include: (i) documenting the length, width, height and thickness characteristics of submarine landslides; (ii) evaluating landslide triggering mechanisms; (iii) documenting slide run-out and flow pathways; and (iv) using field data to update and revise numerical models of landslide run-outs.

We anticipate that the integrated multidisciplinary approach to assessing conditions and processes in the deep marine environment off the Northwest Shelf will lead to significant developments in engineering that will improve the safety and reliability of oil and gas developments in these challenging environments.

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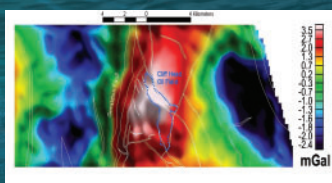

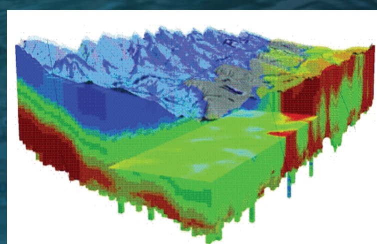

Vessel based solutions for the acquisition of geotechnical data in subsea site investigations

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This extended abstract describes a presentation that was given at the Society for Underwater Technology/ASEG 1st Joint Technical Seminar, 25 March 2010, Perth. It discusses the role and technical capability of multi-purpose support vessels in providing solutions in performing comprehensive geotechnical site investigations. There is a growing awareness of the benefits to be gained in being able to integrate geotechnical results with the geophysical data during the later acquisition phases of seabed investigations. This presentation highlights the growing trend to want to integrate and be able to easily access the various existing desk top study findings and the geophysical data sets right through to the geotechnical phase offshore. This is being made easier by the current and future adoption by oil and gas operators of seabed survey GIS data models. Having data accurately stored in a universally recognized format by means of GIS will make it much easier to display and use seabed visualisation systems to get the best benefits of data integration.

Introduction

Geotechnical site surveys on subsea developments test our ability to acquire geophysical and geotechnical data safely, efficiently and without damage to the environment, offshore contractor's equipment, the oil and gas operator's subsea assets, and their good reputations. Key to this is the sound management of the many planning aspects of the various operations; taking into account risk mitigation, efficiency, environmental considerations, the offshore operators' ultimate needs with relation to the seabed data. At all stages there is a need to be able to make use of every bit of information that is available. This gives rise to the requirement of being able to effectively manage data sets in an efficient and integrated manner. This is of great benefit to operators at all stages, from looking at their preliminary site assessment data to choose a suitable location, to deciding what structures are best to be considered, down to what their ultimate foundation designs and engineering requirements may be in their subsea developments.

The solution to achieving full integration of the many diverse seabed data sets lies with everyone promoting information sharing. This includes the custodians of the information and the manufacturers and users of the systems and software that log, process and store survey data. This requires us to have recognised industry standardised formats that can easily enable the flow of digital data between the more commonly used information systems and platforms.

The growth in the use of broadband internet, high speed communication systems etc. help us to share information more easily. Being able to do this both onshore and offshore gives us the ability to better understand and manage offshore programs while they are actually in progress. There have also been developments in the capabilities of PPP (precise point positioning GPS) systems; GIS (geographical information systems) and our ability to use 3D visualisation systems to display and examine spatial data sets. This gives us the platform to share a multitude of data sets to better enhance our ability to meet our objectives with a better understanding, efficiency, safety and improved risk mitigation. Visualisation is a fast means of transferring and understanding information to give us better use of our survey data bases for the benefit of all.

Geophysical data sets

To name the many different survey data sets we start by looking at the early phase of seabed site surveys, phase 1, which entails acquiring information that might include bathymetry (e.g. LIDAR, swathe or multibeam sonar); surface characterisation (side scan sonar or acoustic backscatter and snippets); seismic (reflection and/or refraction); magnetics; resistivity; and visual data from cameras.

Survey data in shallow and deep water is acquired from survey vessels either using surface/hull mounted or towed sensors (see

Fig. 1. *DOF Subsea's bathymetric survey vessel, Geograph.*

Fig. 2. *Hugin autonomous underwater vehicles about to be launched.*

Figure 1), or from AUVs (autonomous underwater vehicles). Data acquisition rates during geophysical surveys where the vessel is fitted with multibeam sonar, shallow seismic profiler, and side scan sonar in shallow water can acquire 170 line km/day at 4 knots and 65 line km/day at 1.5 knots with a deep tow, exclusive of any delays such as for line turns, deployment, etc. The deep water surveys are therefore not efficient using such an approach.

In deep water an AUV such as the Hugin (see Figure 2) can be used to acquire more than 113 line km/day in water depths down to 3000 msw, inclusive of launching and recovery, data downloads, battery recharges etc. The longest dive to date is 69 hours. Besides AUVs being significantly more efficient they are able to provide extremely high quality data.

Geotechnical data sets

The 2nd phase, a geotechnical seabed investigation, takes place from a large geotechnical vessel. Geotechnical survey data is obtained in a phase 2 survey and entails acquiring information with geotechnical tools (see Figures 3 and 4 for examples) such as marine drillship rigs; seabed sampling systems; box and grab coring systems; visual systems; and cone penetration testing systems.

For deep water site surveys large dynamic positioning 2 vessels, such as DOF Subsea's Skandi Bergen, are an alternative to using a drill ship. These are used as the platform for remote seabed sampling systems. These vessels can operate safely with a large weather window, using an integrated dynamic positioning with survey sensor systems that are stable and efficient.

The benefits in deep water investigations of using remote seabed drilling rigs are that they can combine other survey tasks such as AUV work with seabed deployed drilling systems; there is a deep water efficiency over surface drilling rigs; can provide excellent depth accuracy; the remote handling of the seabed drill string has health, safety and environment advantages.

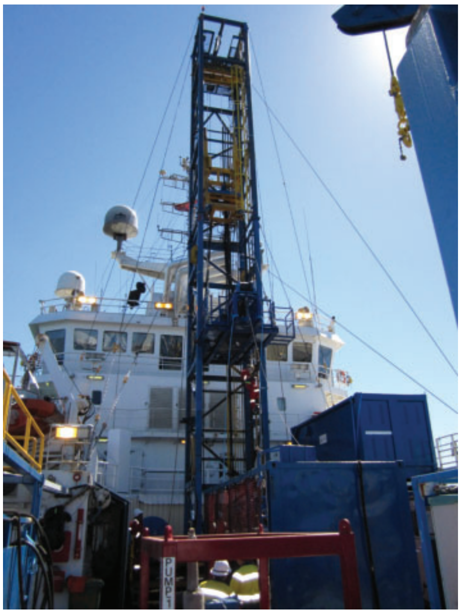

Fig 3. *The geotechnical drill rig mounted over the Geosea's moonpool.*

Precise point positioning GPS

It is important to have accurate decimeter level position accuracy in three dimensions (x, y, z) which is possible with global GPS systems such as the Veripos Ultra PPP GPS. Accurate Seabed Sampling Results with decimetre spatial high accuracy provides a reliable framework for visualisation giving seamless 3D and 4D representation of data in true geographical position and to scale.

Integration of geophysical and geotechnical information

Figure 5 shows an example of a screen image on ESRI's GIS of integrated geophysical and geotechnical information. The integration of geophysical data entails being able to access and compare information such as:

- Seabed bathymetry
- Lists of seabed hazards
- Seabed geomorphology
- Subsurface seismic layers
- Limited geotechnical information

The integration of the geotechnical survey data entails accessing and comparing the

- Refined geological model geomorphology
- Ground conditions and variations

Fig. 4. *Cone penetrometer testing being launched off side of the Geobay.*

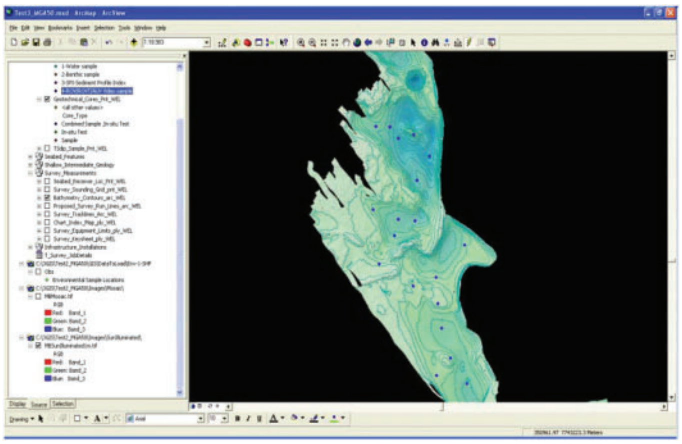

Fig. 5. *A GIS screen display of integrated geophysical and geotechnical information showing relief contours and core locations.*

- Detailed *in-situ* soils and rock information
- Geotechnical parameters needed for foundation design
- Geotechnical hazards

In doing the integration it is important to be able to get a clear picture of all the geotechnical investigation objectives such as the:

- Thickness and properties of seabed layers
- Complexity of geological model
- Presence and distribution of hazardous layers
- Variability

Benefits of using GIS and integrated data quality control

With GIS and good survey quality data it is possible to maximise the understanding of geohazards. The use of GIS helps minimise the dangers of misunderstanding multiple data sets in having data viewed in isolation, with a lack of standardisation, or having data of unknown accuracy. In an offshore industry that has a shortage of experienced geophysicists and interpreters these are real problems, as is having the geotechnical survey team divorced from the 1st phase geophysical and shore based expert office teams.

Some benefits of data visualisation

By using a visualisation package such as Fledermaus IVS during the planning stage as well as the data acquisition stages, the following benefits can be achieved:

- Helps speed up the whole process of sharing information and the interpretation of existing information
- Comparison of multiple surveys over time: bathymetry data comparisons – quality, changes, artefacts, reliability and volumes of sediment movement
- Comparison of multiple data sets: bathymetry/backscatter/ seismic data comparisons – overlays and interpretation
- Reprocessing raw x, y, z data with similar bin sizes to achieve a comparable comparison
- Provide 3D and 4D visualisations
- Determine seabed slopes
- Create 3D fly through visualisations
- Better study the seabed features and conditions by means of multiple views

Conclusions

The improved vessel based solutions available to us through better communications and technology provide the following benefits:

- High speed broadband Internet technology and high quality video enables a 'Telepresence'
- More use will be made of 3D and 4D visualisation in risk mitigation, positioning and mapping
- Standardisation in GIS geodatabase file structure specifications will enable better data sharing adoption by oil and gas companies of the OGM's (International Association of Oil & Gas Companies) Seabed Survey Data Model
- Remotely operated systems in geoscience activities in deep water is growing
- Console based geoscience activities can be run using onboard and shore based resources
- The 'digital download' generation's entry into our industry will speed up the impact of new technologies offshore

The graphic capabilities of modern 3D visualisation systems will open up all sorts of future benefits towards 'making the ocean transparent' to show us what lies on and below the seabed.

A multi-disciplinary site investigation for the assessment of drilling geohazards and environmental impact within the northern Bonaparte Basin

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Introduction

TOTAL E&P Australia (TOTAL) is a leading multinational oil company which has only recently entered into the Australian energy exploration market. Two exploration wells named Durville and Laperouse are programmed for 2010 in the northern Bonaparte Basin, off the north-western cost of Western Australia in water depth of approximately 100 m (see Figure 1). In the frame of this exploration program, and in order to comply with TOTAL company rules and Australian regulation, TOTAL has contracted FUGRO Survey Pty Ltd (FUGRO) to provide geophysical and environmental baseline surveys. The first objective of this survey was to assess the seabed conditions and the shallow geology for the installation of a drilling rig. The second objective was to assess the environmental conditions of the drilling sites. The area is known to contain shoals and fossil reefs, and it was mandatory to map them in detail and to assess whether they are still actively growing, via a visual inspection.

Regional setting

The Bonaparte Basin is a predominantly offshore sedimentary basin which covers an area of approximately 270 000 square kilometres off the north-western coast of Western Australia (Kraus and Laws, 1974; Cadman and Temple, 2003). The basin contains an approximately 15 km thick sequence of Phanerozoic marine and fluvial sediments. The Bonaparte Basin adjoins the Browse Basin to the south, and the Arafura and Money Shoal Basins to the Northeast, along the Darwin Shelf. The northern margin of the basin is the Timor Trough, where water depths exceed 3000 m.

Numerous phases of sedimentation have occurred within the basin during various tectonic events and glacial/interglacial sea level cycles. The most recent sedimentary environment of the Late Cretaceous and Cainozoic typically comprised prograding sequences of shelf carbonates, forming thick sequences of sandstones, mudstone and limestones.

Previous studies have found the seabed in this part of the Timor Sea to comprise numerous carbonate reefs and/or shoals which have developed periodically over a number of glacial and interglacial sea level changes. The reefs are likely to consist of both hard coral growth and carbonate sediment deposits. During the last sea level regression the sea-surface was 100 to 140 m below the present level, resulting in both the sub-aerial erosion and compaction of these reefs. This was followed by a reef-building episode as sea level began rising again approximately 18 000 years before present (b.p) (Camoin et al., 2004). Sea level then rose rapidly between 15 000 and 13 000 years b.p., inundating the reefs. Corals grow through a symbiotic relationship with photosynthetic algae, and thus do not grow at depths below the lower limit of the photic zone, approximately 50 m below the sea surface. The current water depth in the survey area is approximately 100 m, which suggests that reefs would not be actively growing (Kleypas and Gattuso, 2010).

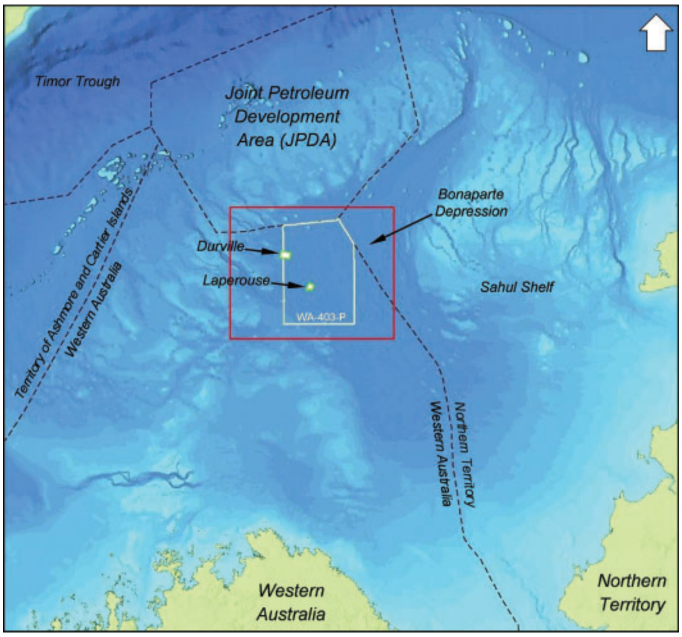

Fig. 1. *General location diagram showing the location of the study areas.*

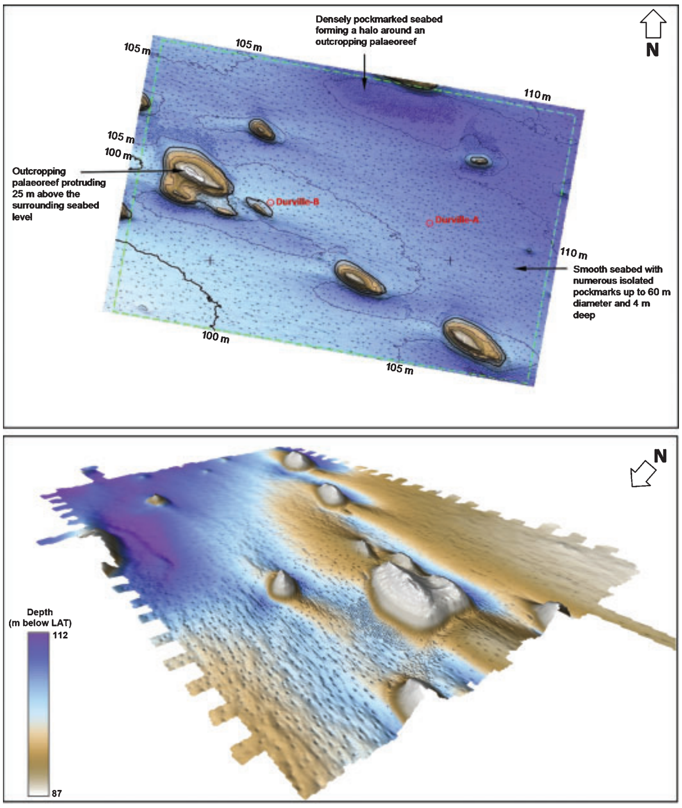

Fig. 2. *Shaded relief bathymetric digital terrain model and 3D perspective view of the Durville site.*

The Bonaparte Basin is a proven petroleum hosting province, with over 70 identified petroleum accumulations. The basin contains the necessary prerequisites for further discoveries, with mature source rocks, good quality reservoirs, and traps over wide areas of the basin. Numerous papers are available summarising the petroleum potential of the basin (Colwell and Kennard, 1996; McConachie et al., 1996; Kennard et al., 2003).

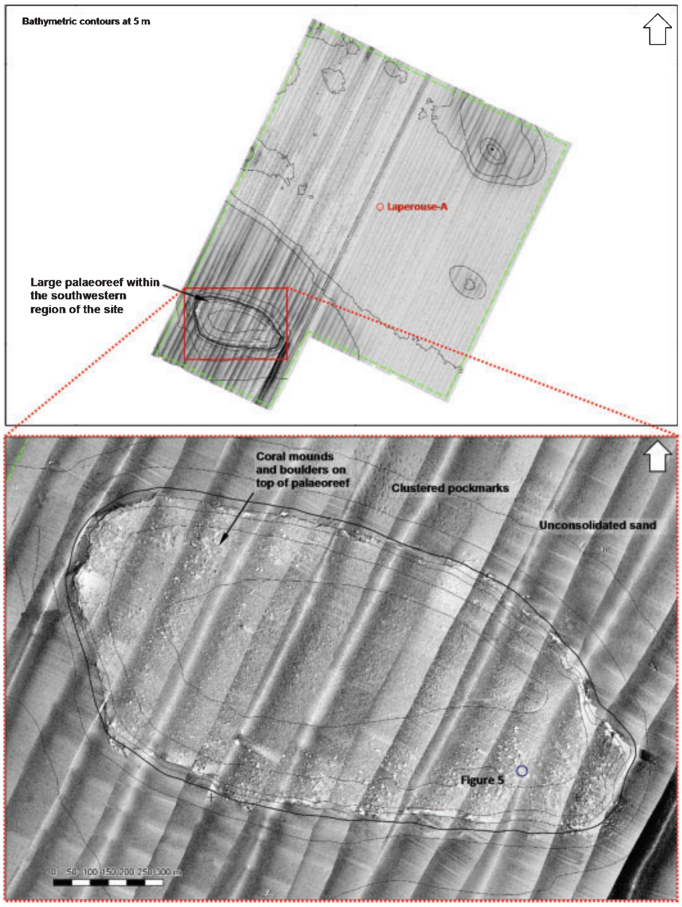

Fig. 3. *Side scan sonar mosaic of a palaeoreef in the southwest Laperouse site.*

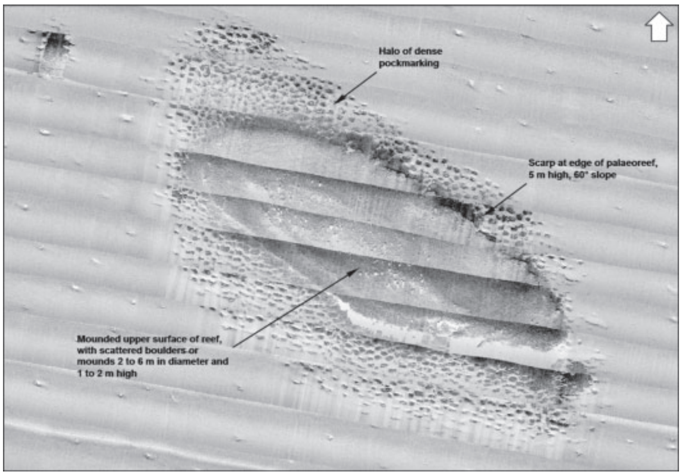

Fig. 4. *Densely pockmarked seabed surrounding a palaeoreef in the Durville survey area.*

Survey operations

The survey work was conducted between October and November 2009. The survey equipment involved conventional geophysical sensors including a high resolution multibeam echo sounder, a dual-frequency (120/410 kHz) digital side scan sonar, chirp and boomer sub-bottom profilers and assorted peripheral systems. Based on the findings of the geophysical survey an environmental baseline study was conducted which involved a soil and water sampling program as well as several video transects. The use of these high resolution systems aboard FUGRO's dedicated offshore geophysical survey vessel, the *M.V. Southern Supporter*, combined with a calm weather period during the survey, allowed very high quality data to be acquired.

Survey findings

The present day seabed conditions are clearly revealed by multibeam and side scan sonar data. A digital terrain model from the Durville site, and a side scan sonar mosaic from the Laperouse site are shown as Figures 2 and 3 respectively. The seabed at both sites is generally flat, with numerous pockmarks and a number of outcropping palaeoreefs, the largest of which protrudes 35 m above the surrounding seabed.

Pockmarks form as a result of fluid or gas escape from marine sediments. Isolated pockmarks across the two sites typically have diameters of up to 20 m, and are generally up to 2.5 m deep. Around the flanks of the outcropping palaeoreefs, the pockmark density increases dramatically (Figure 4). These pockmark halos around the palaeoreefs may indicate that the reefs are acting as channels for the release of shallow fluid and gas escape, or may be the result of thinner sediment cover over buried cemented material resulting in a faster rate of fluid/gas release in the overlying sediments. Previous studies have noted gas seepage from pockmarks within the Timor Sea (O'Brien et al., 2002); however, no evidence of such activity was seen during this survey.

The palaeoreefs within the Durville site range between 80 m and 1500 m in length, and are elongate with WNW/ESE orientation.

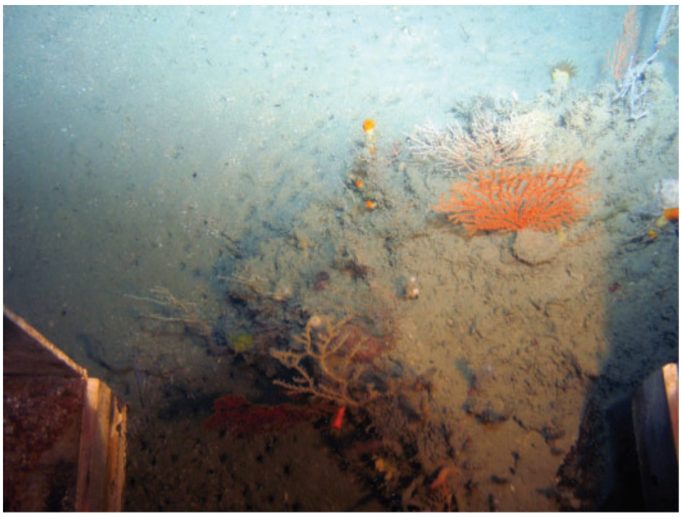

Fig. 5. *Photo of a coral boulder on top of the palaeoreef in the southwest Laperouse site. The boulder has several live gorgonian corals, however the palaeoreef is covered in a layer of sandy silt and clay, and is not actively growing.*

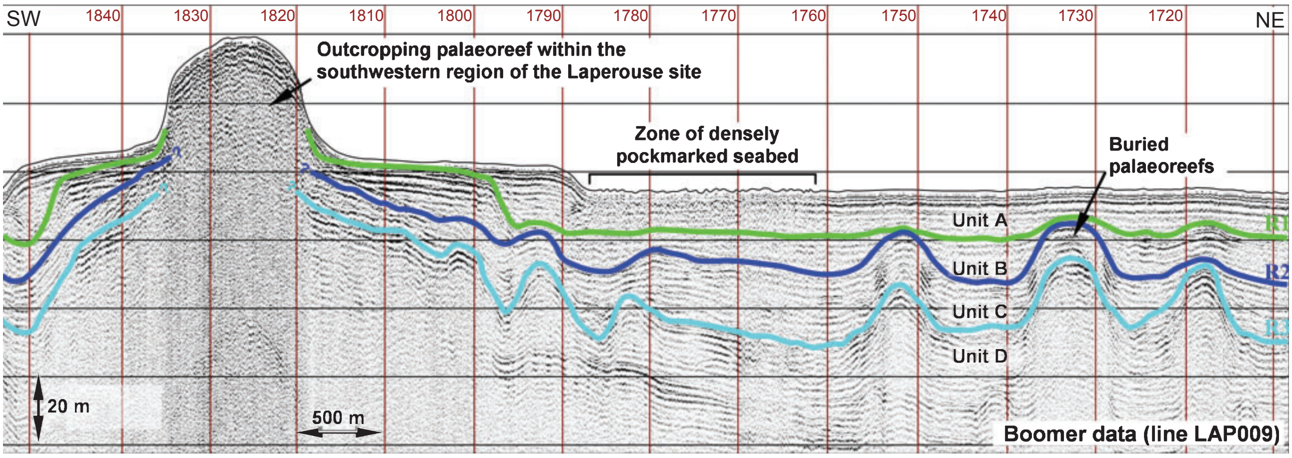

Fig. 6. *Boomer sub-bottom profiler data on survey line LAP009 showing interpreted major reflectors indicating changes in reef building episodes and depositional environment.*

The top of the largest reef is approximately 35 m above the surrounding seabed level.

The reefs are less numerous in the Laperouse site, with only two outcropping palaeoreefs. However, a high number of palaeoreef outcrops (>100) are observed within the permit area. The outcropping reef in the northeast of the site is approximately 500 m long and 200 m wide, and a large reef 1500 m long and 800 m wide is located in the southwest corner of the site. Several other low seabed mounds are observed within the site, which may indicate buried palaeoreefs below a layer of unconsolidated sediments.

The morphology of the reefs in both sites is similar, with steep reef edges up to 60°, and broad, low gradient reef tops with scattered boulders and mounds up to 2 m high.

A number of seabed photographs taken over the top of the large palaeoreef in the southwestern Laperouse site show that the palaeoreefs are covered with a layer of unconsolidated, i.e. recent, sandy clay and silt (Figure 5; location shown in Figure 3). The rugged, coralline nature of the palaeoreef remains evident but the hard, reef-building corals appear to have ceased activity, leaving gorgonians as the primary sessile organism.

In addition to the outcropping palaeoreefs at the seabed, there are a number of smaller, fully buried palaeoreefs which were identified in the boomer sub-bottom profiler data. Seismic

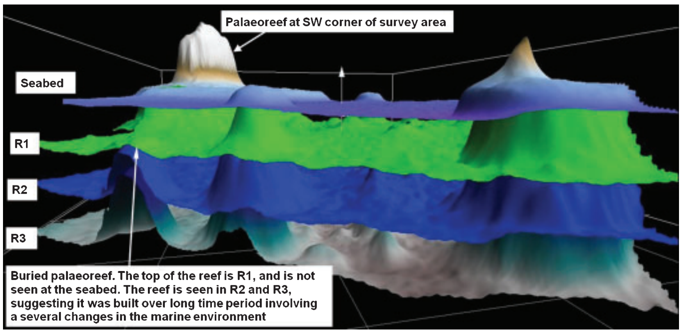

Fig. 7. *3D model showing below LAT to reflectors R1, R2 and R3. View is from NE to SW. Vertical exaggeration is 30 : 1.*

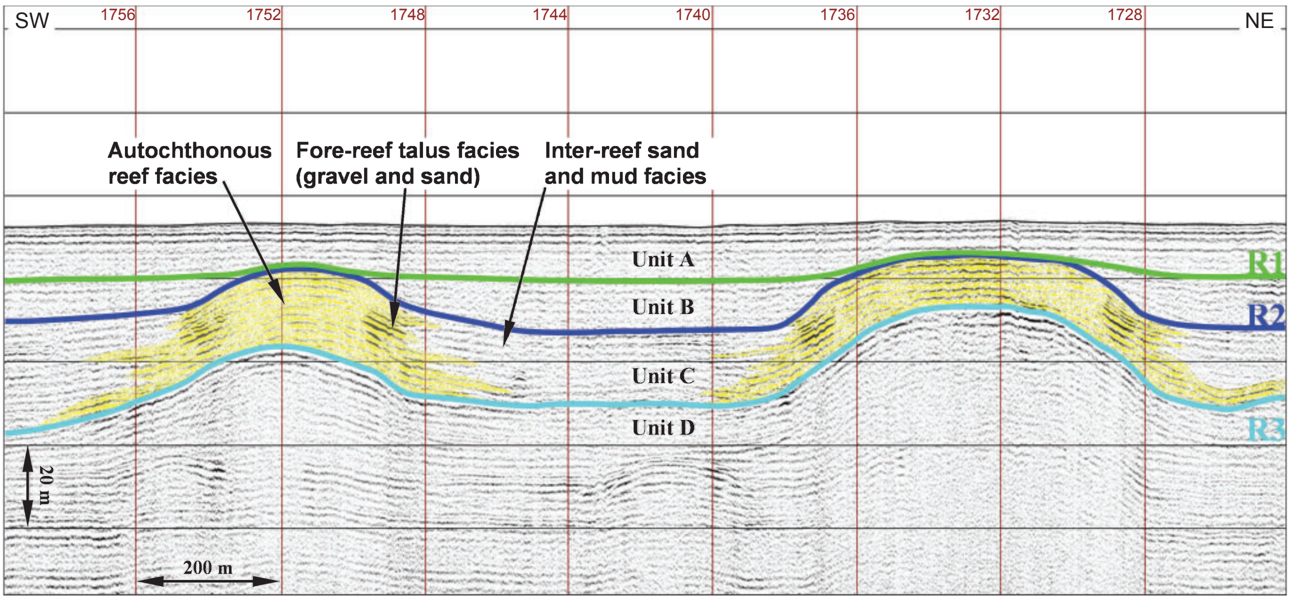

Fig. 8. *Boomer sub-bottom profiler data example showing facies change at the flanks of palaeoreefs.*

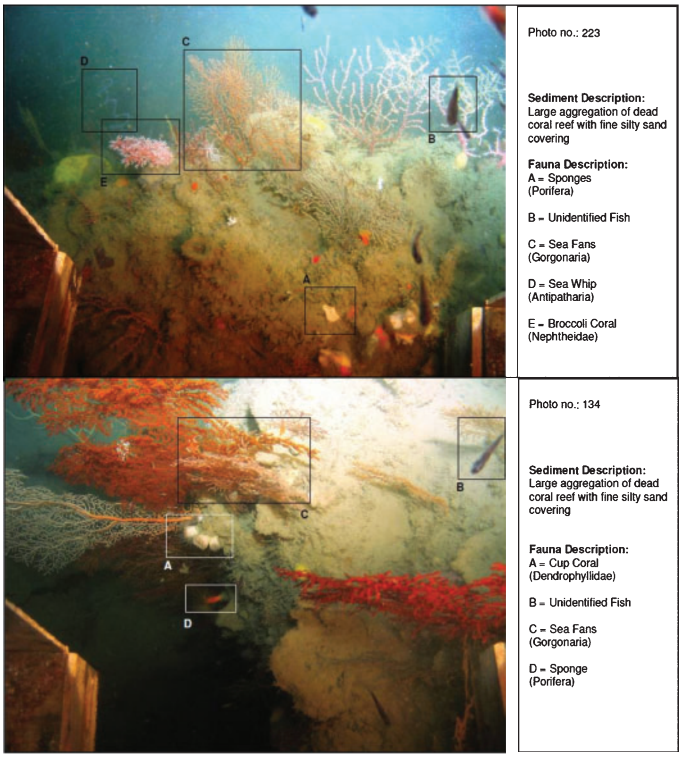

Fig. 9. *Drop camera photos from the Laperouse site showing typical marine organism assemblages.*

penetration through the cemented palaeoreefs is often poor. However the data shows that the palaeoreefs have built up over successive sea level cycles (Figure 6). Several acoustic reflectors are identified which are interpreted as marking the top of reef building/sedimentary episodes. The interpreted reflectors are likely to represent depositional hiati or erosional surfaces formed during previous sea level lowstands. Reflector R1 may be representative of the seabed and/or land surface as it was 18 000 years before present, while reflector R2 or R3 may represent the sea level lowstand of 150 000 years before present.

The depth to the tops of Reflectors R1, R2 and R3 (m below LAT) was mapped to determine the location and extent of the buried reefs within the Laperouse site (Figure 7).

In several seismic profiles, there is evidence to suggest that the edges of the buried reefs show interleaving and grading down from coral to gravel/sand fore-reef talus type facies, and finally down to inter-reef sands and muds (Figure 8). This evidence would support the interpretation that the reef grew periodically with changes in the marine environment.

Environmental baseline survey

To complement the geophysical data, TOTAL commissioned an environmental baseline study. The study comprised physical samples from ten locations within each site, as well as water sampling and profiling and underwater photography. From each sample site, three samples were retained for macrofaunal analysis, and one sample for physio-chemical analysis.

Throughout the survey areas, readings were generally consistent with unpolluted seawater baseline standards for contaminants, such as heavy metals and hydrocarbons. The exception to this was elevated zinc levels recorded across both sites. Zinc levels in seawater are typically less than $0.1\,\mu g\,L^{-1}$; however, across the two survey areas, zinc levels of 15 to $29\,\mu g\,L^{-1}$ were recorded suggesting a regional influence, although the origin of the elevated zinc level is unknown. Measured water column conductivity, temperature and salinity were consistent with regional data from CSIRO.

A towed drop-camera was used to record a series of images to aid interpretation of seabed morphological features and gain an understanding of the biodiversity within the sites. The images support the conclusions that the reefs are no longer actively growing. Figure 9 shows several images from the camera transects of the Laperouse site, showing the diversity of marine life, which is predominantly concentrated on top of the palaeoreef. Little abundance or diversity of life is observed elsewhere.

Conclusion

The findings of this survey corroborate the findings of other studies about the Bonaparte Basin, supporting the hypothesis that a barrier reef complex extended from the Sahul platform through to the Ashmore reef area approximately 18 000 years ago, during the last sea level regression. These reefs appear to have grown periodically with changes in the marine environment. When sea levels began to rise rapidly approximately 15 000 to 13 000 years b.p., the majority of the reef-building corals became extinct and were buried beneath successive layers of unconsolidated marine sediment. The present survey highlights the magnitude of the challenges that may encounter during a drilling campaign.

Conducting safe offshore operation whilst reducing the environmental impact of its activities is a key priority for TOTAL. The geophysical and environmental baseline survey conducted by FUGRO allows TOTAL to plan the forthcoming drilling campaign in a safe and environmentally friendly manner.

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My first shot

In December 1964, five days after receiving my final BSc results, BHP sent me to northeast Tasmania to lead a seismic refraction crew. Our objective was to delineate palaeochannels containing cassiterite (tin). I was given a brand new seismic recording unit (still in the box and never tested) and a crew who had never even heard of seismic refraction before the project. I had at least done a university practical class using a seismic refraction unit.

I showed the crew how to lay out the cable and how to attach the geophones. I then told them to auger a 3 metre hole for the shot charge. Next, I taped three sticks of gelignite together, primed the gelignite with a detonator and, after lowering the primed gelignite down the shot hole, we filled in the shot hole to tamp the anticipated explosion. Finally, I connected the shot wire to the recording unit and pressed the shot button. Nothing happened. Figure 1 shows what was recorded. The recording medium was a type of Polaroid film. The bigger oscillations are probably due to raindrops (it rained for most of the survey).

To check why the shot did not go off we dug up the primed gelignite and tested the detonator by firing it with a car battery. After a lot of experimentation we figured out that the firing unit of our seismic recorder was only capable of making detonators go off if the shot cable was relatively short (about 25 metres). Normally this would have been manageable but there was a gain problem with the recording unit so we had to use much larger charges than normal to be able to record signals at our farthest offsets. What should have taken about 6 sticks of gelignite required about 30 sticks of gelignite. I was not really aware of this and thought the situation normal.

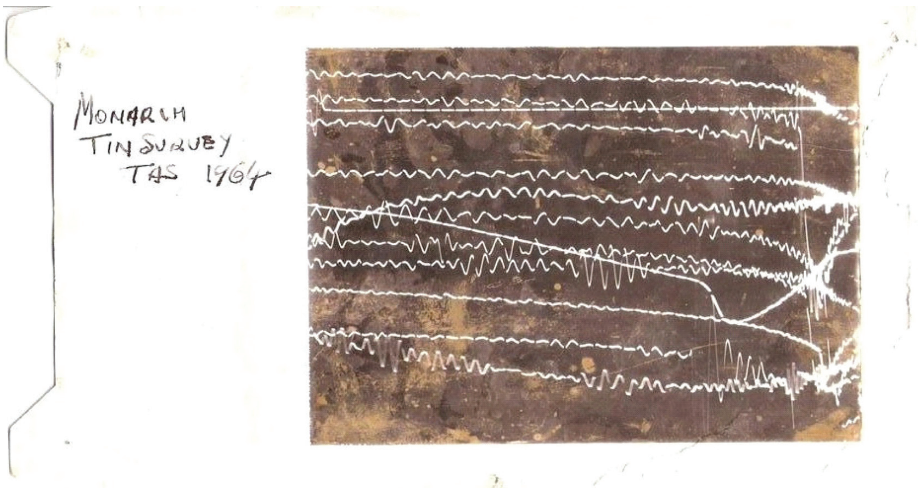

Fig. 1. *My first shot. The faint jagged line on the right of the image is where a mouse has started eating the record.*

The blasts were very spectacular as we were working in a peat bog. The resultant craters were about 4 metres deep and 6 metres across. Huge lumps of peat would fly up in the air and provide a lot of excitement for the shot firer who had to be close to the shot because of the problems with the firing unit. Because of the tremendous consumption of gelignite I spent a lot of time driving to Launceston and filling the company Landrover with fresh supplies.

Just as we finished our first line a fat man arrived from head office in Melbourne and cancelled the project for reasons not connected with the seismic survey. Forty years later, an exploration company contacted me to see if I still had a copy of my interpretation report. It seems that someone had ripped the page showing my interpretation from the copy lodged with the Tasmanian Mines Department.

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Geophysics at CSIRO

In a previous edition of *Preview* I commented on how easily one can be overwhelmed by the vastness of the CSIRO internet resources. Thanks to Merrin Fabre and Ben Clennell, the following attempts to unravel some of the online CSIRO resources related to 'geophysics'.

CSIRO's geophysics capabilities (http://www.csiro.au/science/geophysics.html) perform a number of activities to aid in:

- mineral exploration;
- increasing recovery rates of oil and gas reservoirs;
- monitoring and verification of carbon dioxide storage; and
- geological modelling of sedimentary sequences for exploration.

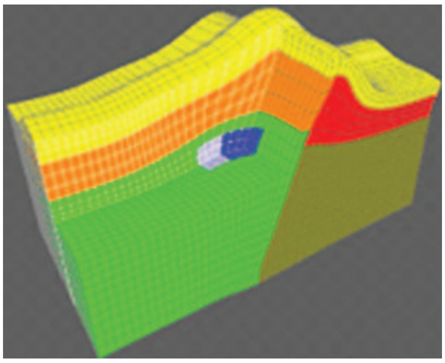
Initiated by CSIRO in 2003, the National Research Flagships program (http://www.csiro.au/partnerships/NRF.html) is one of the largest scientific research endeavours ever undertaken in Australia, with the total investment to 2010–11 expected to be close to A$1.5 billion. Ten Flagships are currently in operation, and form the umbrella to many CSIRO enterprises. As one example, the Centre of Excellence for 3D Mineral Mapping (http://www.csiro.au/partnerships/C3DMM.html) within the Minerals Down Under Flagship has partnered with government and industry to form a centre of excellence to develop three-dimensional mineral maps of the Australian continent. Those seeking existing geophysical data should visit the Geophysical Archive Data Delivery System (http://www.geoscience.gov.au/bin/mapserv36?map=/public/http/www/geoportal/gadds/gadds.map&mode=browse). This system provides magnetic, radiometric, gravity and digital elevation data from Australian National, State and Territory Government geophysical data archives.

I admit I found it confusing trying to establish via the vast CSIRO web area which Flagships contained what geophysical activities, but a few geophysical topics are touched upon below.

The pursuit of practical three-dimensional electromagnetic inversion for exploration has culminated in the P223F, or Practical Three-Dimensional (3D) Inversion for Exploration project (http://www.csiro.au/science/Practical-3D-Electomagnetic-Inversion-For-Exploration.html). P223F was the ninth project for AMIRA International, an industry association which manages collaborative research for members of the global minerals industry. In 2010 it was made open source (http://p223suite.sourceforge.net/).

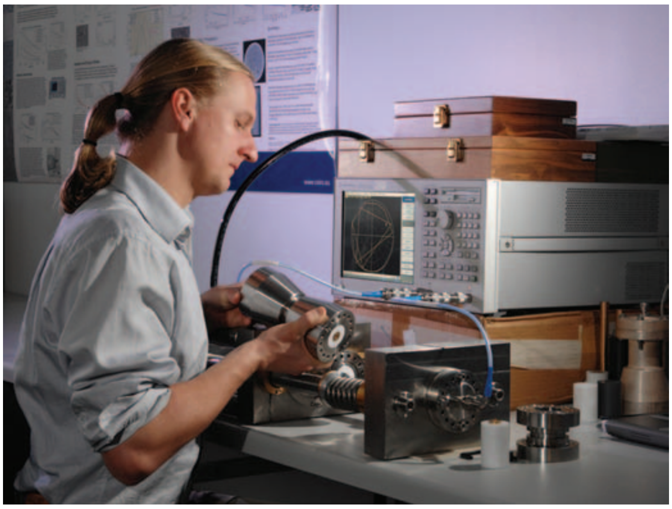
Other lesser-known but interesting activities within the CSIRO umbrella relate, for example, to the use of radar for gold exploration (http://www.csiro.au/resources/using-radar-assist-exploration.html) or near-surface mapping (http://www.csiro.au/science/Siropulse-Radar.html), and seismic-while-drilling (http://www.csiro.au/news/ElectronicEars.html).

The section on 'Energy' (http://www.csiro.au/science/Energy.html) begins with a mission of 'Helping Australia move to a clean, secure energy future and maximise the wealth from our resources'. 'Energy from oil and gas' (http://www.csiro.au/science/OilGas.html) addresses four topics: petroleum systems, enhanced oil recovery, flow assurance and unconventional gas. Notable pages include 'Petroleum geosciences' (http://www.csiro.au/science/Petroleum-geoscience.html) and 'Technologies to improve drilling performance' (http://www.csiro.au/resources/Drilling-performance-technologies.html).

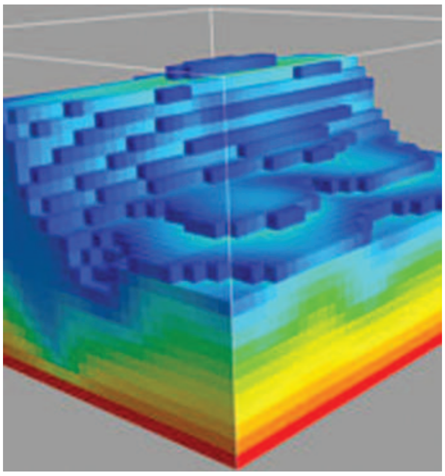


3D finite element mesh for complex earth EM modelling.

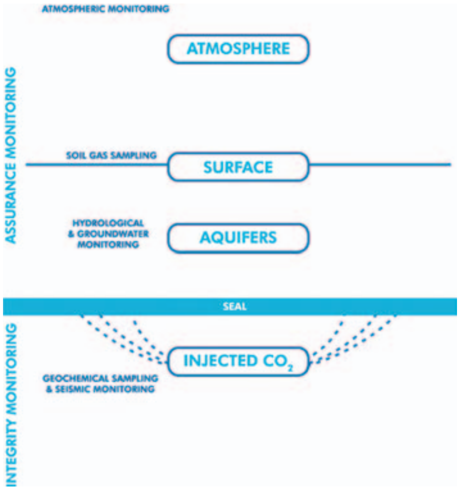
CSIRO is the largest single participant in the Australian Government's Cooperative Research Centres (CRC) Program which is helping advance the commercialisation and utilisation of Australian research and development (http://www.csiro.au/org/CSIRO-and-CRC-Program.html). The 'CO2CRC' is one of 26 CRCs (of 48) in which the CSIRO participates. Reducing greenhouse gas emissions through carbon dioxide storage (http://www.csiro.au/science/CO2-geological-storage.html) is probably an area in which Australia



Dielectric rock testing at CSIRO laboratories.



Geothermal 3D model of heat flow.



Schematic of the various elements of CO_2 monitoring.

leads the world. The CO2CRC Otway Project (http://www.csiro.au/science/CO2-geological-storage--ci_pageNo-7.html and http://www.co2crc.com.au/otway/monitoring.html#monitoring) is Australia's first demonstration of the deep geological storage or geosequestration of carbon dioxide (CO_2).

On the 'clean' energy front, geothermal (http://www.csiro.au/science/Geothermal-energy.html and http://www.csiro.au/org/geothermal.html) is an emerging science with many efforts underway. Based at the Australian Resources Research Centre (ARRC) in Perth, the Western Australian Geothermal Centre of Excellence (WAGCOE: http://www.csiro.au/partnerships/WAGCOE.html) is a joint venture partnership between CSIRO, The University of Western Australia and Curtin University of Technology. It was established in February 2008 with funding support of A$2.3 million from the Government of Western Australia.

Indeed, a visit to the ARRC building in Perth is recommended. Any visitor will be impressed by the size and facilities for rock mechanics and testing (http://www.csiro.au/resources/Rock-mechanics-testing.html). Several other laboratories are also present, including of course many highly qualified CSIRO personnel. Maybe they can help you navigate the CSIRO web resources, which I still find overwhelming and confusing. But the rewards to anyone sufficiently motivated are a cornucopia of geophysics-related information.

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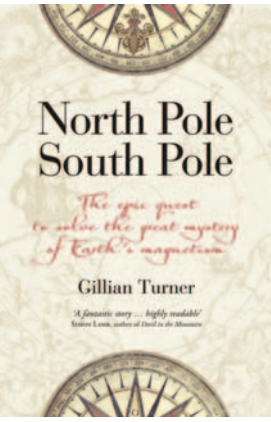
North Pole, South Pole: The epic quest to solve the great mystery of earth's magnetism

by Gillian Turner
Publisher: AWA Press, Wellington, New Zealand, 2010, 274 pp.
RRP: $35.00 (paperback),
ISBN: 9780958275002



Gillian Turner, the author of this book, has made a career in geophysics at the Victoria University of Wellington, New Zealand, initially upon the basis of research in paleomagnetism. Over the years she has been a frequent visitor to the paleomagnetic laboratory at Black Mountain developed in Canberra by the Australian National University, and also used extensively by Geoscience Australia and others. In terms of academic influence (very much one of the threads of the book) Turner was a research student of Roy Thompson and Ken Creer at the University of Edinburgh, Scotland. Creer in turn, earlier in the 1950s, was a student of Keith Runcorn at the University of Cambridge in England. Gillian Turner herself was an undergraduate at Cambridge; indeed in an essay she wrote there on 'our magnetic planet' one can see the genesis, decades later, of this fine book.

Gillian Turner has thus walked on paths where many of the past giants of geophysics have walked. This familiarity perhaps gives her the feeling of friendliness with them which comes through in this book. She has a great interest in, knowledge of, and gift for writing about the history of science. The depth of research and understanding in the book carries a great enthusiasm with it. It cannot help but teach the reader much about modern geophysics. It is just the book to enthuse a young person, interested in the physics of the world around them.

It is a book on geomagnetism, and indeed wider geophysics, quite like no other. It is aimed at a wide audience, and maintains a high level of academic rigour. Its purpose is to tell a remarkable story about the discoveries and observations of magnetic fields. The story can be traced back to mankind's earliest recorded history, and the story covers the full sweep of human history, and especially the development of science. There is the profound sub-plot of a phenomenon, for centuries shrouded in superstition and magic, being brought into the light of explanation by modern science.

Before the Introduction there is a list of 'Main Characters'. This feature is like the programme notes of good theatre, and sets the strong literary and artistic theme of the book. In the alphabetical order of this list, Petrus Peregrinus (13th century) is followed by Paul Roberts (born 1929), illustrating beautifully how this book seamlessly joins the past and the present.

The book then very naturally tells the story in historical order. Fifteen chapters start with the myth of Magnes, and end with a very non-mythical Chapter 15 on the geodynamo. In between, we meet a whole series of giants. They come alive so well because the author has clearly done her own research regarding them, and not relied on others' accounts.

Thus, to give examples, accounts of the contributions of Gilbert (physician to Queen Elizabeth I), Halley, Maxwell, Gauss and Faraday are just some of the mileposts which lead on to the contributions, in the last fifty years, of Bullard, Irving, Morley, Vine and Glatzmaier.

At the end of the book there is an Epilogue, a Glossary and a Short Bibliography. A beautifully selected collection of historical illustrations grace the text.

The author reflects her natural outstanding teaching abilities in the apparently informal nature of the book, and its appeal to the general reader. However behind the very friendly text, with quite complicated physics explained without equations, is the firm grip of learned research, and the great care taken in the book's production.

In summary, the book breaks new ground in grafting the remarkable developments of 20th century geophysics on to the well-established history of classical electromagnetic physics. The earlier pioneers, whose names are so well known as to be perpetuated in the names of electromagnetic units, are introduced in a very likeable and human way. Then many of the 20th century scientists, who made the discoveries of continental drift, geomagnetic reversals, sea-floor spreading, and plate tectonics, are known personally to the author. These modern-day giants pick up the story which started millennia ago with the mythical figure of Magnes, and carry it through to the satisfying culmination of the (numerical) demonstration that a dynamo in the core can produce Earth's magnetic field, and its reversals.

Most people familiar with the history of geomagnetism will have their background knowledge significantly deepened from this book. The student will gain a wonderful perspective of the development of science, by following the thread of magnetism through much of the recorded history of mankind.

This book is very timely. We are now one decade into the 21st century, and the 1900s are 'last century'. It is indeed time for the historic developments in geomagnetism, which occurred particularly in the latter half of the 20th century, to be welded-on to the established physics which last century's students knew well: the physics of Coulomb and Ampere and company. This book does this welding-on in a very learned and seamless way. The research behind the history has been painstaking.

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November			2010
11–13 Nov	5th International Conference on Applied Geophysics http://www.sc.psu.ac.th/Department/physics/Geophysics2010.html	Phuket	Thailand
15–17 Nov	KazGeo 2010: Where Geoscience Meets the Silk Road http://www.eage.org	Almaty	Kazakhstan
21–24 Nov	GeoNZ 2010 – Joint Conference of the Geoscience Society of New Zealand and the New Zealand Goethermal Workshop http://www.geonz2010.co.nz	Auckland	New Zealand
December			**2010**
8–10 Dec	GEO India 2010: 2nd South Asian Geosciences Conference and Exhibition http://www.aeminfo.com.bh/geoindia2010	Greater Noida	India
13–17 Dec	AGU Fall Meeting 2010 http://www.agu.org/meetings	San Francisco	USA
January			**2011**
16–19 Jan	Borehole Geophysics Workshop: Emphasis on 3D VSP http://www.eage.org	Istanbul	Turkey
April			**2011**
3–8 Apr	European Geosciences Union General Assembly 2012 http://meetings.copernicus.org/egu2011	Vienna	Austria
10–14 Apr	SAGEEP 2011: Information Exchange for Near-Surface Geophysics http://www.eegs.org/sageep	Charleston	USA
May			**2011**
23–26 May	73rd EAGE Conference & Exhibition incorporating SPE EUROPEC 2011 http://www.eage.org	Vienna	Austria
June			**2011**
22–24 Jun	International Workshop on Advanced Ground Penetrating Radar 2011 http://www.congressa.de/IWAGPR-Workshop-2011	Aachen	Germany
August			**2011**
28 Aug – 2 Sep	Geosynthesis 2011: Integrating the Earth Sciences Conference & Exhibition http://www.sbs.co.za/geosynthesis2011	Cape Town	South Africa
September			**2011**
12–14 Sep	Near Surface 2011 http://www.eage.org	Leicester	UK
18–23 Sep	SEG International Exposition and 81st Annual Meeting http://www.seg.org	San Antonio	USA
October			**2011**
24–26 Oct	IGCP 5th International Symposium: Submarine Mass Movements and Their Consequences http://landslide.jp	Kyoto	Japan
February			**2012**
26–29 Feb	22nd ASEG Conference and Exhibition 2012: Unearthing New Layers http://www/aseg2012.com.au	Brisbane	Australia
August			**2012**
5–10 Aug	34th International Geological Congress http://www.34igc.org	Brisbane	Australia

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

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For style considerations, please refer to the For Authors section of the *Preview* website at: www.publish.csiro.au/journals/pv.

Preview is published bi-monthly in February, April, June, August, October and December. The deadline for submission of material to the Editor is usually before the 15th of the month prior to the issue date. The deadline for the December 2010 issue is 10 November 2010. Advertising copy deadline is usually before the 22nd of the month prior to issue date. The advertising copy deadline for the December 2010 issue will be 15 November 2010.

ASEG 2010 WINE OFFER

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

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

Hugo 2008 Shiraz - McLaren Vale

"Deep red hues with shades of plum and indigo. Attractive lifted plum and spice characters on the bouquet with just a suggestion of silky vanilla oak. This full bodied wine is well balanced with a good length of palate. Approachable now with the promise of opulence as it develops. " - WinelistAustralia

"Fully captivating, intense palate, a riveting shiraz of eminence and style!" -Cellarfreaks.com

"Big, mouthfilling style has a distinctive red pepper edge to the rich plum, blueberry and sweet spice flavors, hinting at pomegranate on the long, focused finish!" -Winespectator.com

ASEG Price $140/case (usually retails at around $228/case)

Bremerton 2009 Verdelho - Langhorne Creek

"There is little point in searching for this variety unless you are committed to finding a perfect example. Bremerton's pineapple chunk and Mohito-tang Verdelho awakens the senses and punctures your taste buds with innocent enthusiasm and unbridled *joie de vivre*. This grape rarely refreshes as well as it does in this wine and there is nothing more to add. So call off the search party, you have found your quarry." - Matthew Jukes 100 Best Australian Wines 2010

"This lively and bouncy wine from Langhorne Creek is consistently one of Australia's best verdelhos. It's brimming with tropical fruit and a zippy acid citrus tang. Great palate structure with fine acid and a lingering finish. A tighter style of verdelho." - Ray Jordan Top 100, The West Australian

ASEG Price $120/case (usually retails at around $204/case)

2010 ASEG WINE OFFER:

orders close FRIDAY NOVEMBER 5th 2010

Please supply:

Number of dozens	Wine	Price per Dozen	Total
	Hugo 2008 Shiraz	$140	
	Bremerton 2009 Verdelho	$120	
		TOTAL	

Name: _______________ Daytime telephone: (___) _______________ Email address _________________________

Address: ____ Capital city for collection: _______________

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

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

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

Card Account number: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ __ Signature: ____________________

Order and payment by mail or fax to:

ASEG Wine Offer, c/o. Philip Heath, PO Box 489, Marden, SA 5070
Telephone: (08) 8463 3087, Fax: (08) 8226 3200, email: philip.heath@sa.gov.au

Enquiries: Sean O'Brien, email: sean.obrien@beachenergy.com.au

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