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PREVIEW

AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS

NEWS AND COMMENTARY

23rd IGC: ASEG-PESA 2013 update

ASEG Honours & Awards for 2013

TESEP & ESWA: call for case studies

FEATURE ARTICLE

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FRONT COVER

Mosaic of historic geophysical instruments (see article p. 21; images courtesy of National Museum of Australia and Geoscience Australia).

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John A. Theodoridis

This year seems to be rapidly developing into a hectic one for all. Our incumbent ASEG president, Kim Frankcombe, is set to handover office to president elect Koya Suto. Kim took up his current role not long before I did mine in *Preview* and in the 2013 ASEG-PESA conference organising committee. However, in that short time we quickly developed an effective working relationship by virtue of our demanding roles. More recently, my interactions in both roles between Kim and Koya have been shared. So as I say thank you to Kim, I bestow Koya a warm welcome.

The conference organising committee for the ASEG-PESA 2013 IGC is now running at full steam. Continuing the analogy of those glorious steam engines of old: our faces and hands are already blackened as we furiously shovel coals into the relentlessly consuming fires in a desperate bid to maintain steam; all performed under constant fear of blowing the boiler! Rest assured that each chair is working hard to ensure their preparations contribute to a successful event. Please refer to p. 13 for a detailed update on the conference, which includes a complete listing of all workshops currently on offer. Early registrations are imperative so as to secure a place in the more popular workshops and to help ensure those of interest to you aren't withdrawn due to under subscription. If that weren't enough, one final motivation for early registration is the early bird rate at $995, be mindful that this offer closes on 26 April.

I would like to extend a gentle reminder to all ASEG members that nominations for the 2013 ASEG Honours and Awards are now being received. Andrew Mutton, Chairman on the ASEG Honours and Awards Committee, canvases the award categories and outlines the nomination procedure on p. 7 of this issue. These prestigious awards rightfully give recognition to our most talented and dedicated members.

All those in industry are encouraged to flip to the general announcements section of this issue. Here you will read about the exciting collaboration between TESEP and ESWA that aims to compile case studies to augment the Earth and Environmental Science (EES) textbook. Case studies, rich with information, are sought within Australia to serve as examples throughout the book while being in line with the curriculum. This is an excellent opportunity for those in industry and research to integrate directly with the education system. Like any geophysicist, students value the importance of theory, but also relish any opportunity to see it applied in the field – authenticity makes for a wondrous learning experience.

Finally, I hope you enjoy our feature article by retired curator Denis Shephard as he takes us on a fascinating tour of historic geophysical instruments. In so doing, we take pause from the mad rush for the latest and greatest gadgets and reflect on the progression of geoscience as defined by each artefact. Indeed, the preservation of science history is vital, not merely for the sake of sentimentality, for witnessing the evolution of thought and technology gives us direction and, in some sense, reassurance that small contributions in science shall accumulate to form a greater understanding.

Swan song

Have you renewed you membership for 2013 yet? If not, this may be your last *Preview* as we move to tighten up our membership database. If you want to continue to receive all the benefits of being an ASEG member you should renew now, if you have not already done so. If you have decided not to renew then I'd be keen to hear your reasons in the hope that we might improve our service for others. Don't worry, there won't be any hard sell, just a set of listening ears!

In February I signed a memorandum of understanding with the Brazilian Geophysical Society, SBGf. You may not be aware that we have similar arrangements in place with the Indian, Korean, Japanese, Chinese and South African Geophysical societies. We also have slightly different arrangements in place with the SEG and EAGE. The agreements allow for mutual publicity of conferences and events of interest, website links, society booths at conferences and importantly for you, member rates on any special publications the society may produce. Note however that the latter arrangement does not extend to the SEG or EAGE publications. These inter-society agreements are important for building cooperation and enable us to share ideas and borrow successes. To help publicise their activities and introduce you to their part of the world we are planning on running a series of articles in *Preview* from each of the groups above.

The Federal Executive has been discussing ways in which we might productively put some of our reserves to use. Through the hard work of conference committees and special commitment by sponsors over several years we have built up a comfortable cash reserve. We occasionally get criticised for sitting on an excess balance but we need to be prudent as the society is not cheap to run and without the income from conferences we would quickly find ourselves in trouble. However, having these reserves allows us to take risks we could not have considered a few years ago. To that end we have decided to run our own version of the SEG's Distinguished Instructor Short Course (DISC). We are hoping that these will be close to revenue neutral but are prepared to support them if not. The SEG and EAGE courses are generally aimed at cutting-edge technology. The ASEG courses, for which we are still looking for a name, perhaps even tied to a sponsor if we get the right offer, will aim to fill the gap between university and practical experience for younger geoscientists. Initially we plan to run one minerals and one oil theme this year. The courses will target geologists as well as geophysicists but as you would expect ASEG members will receive a discounted registration fee. More information will be available shortly as Mark Tingay and Koya Suto work with the Education Committee to build a program.

I'm writing this in March, but it will arrive in your in-trays and mailboxes in April around the time of the society's AGM on the 17th in Brisbane. I hope to see as many of you that are able to make the occasion. At the AGM I'll be handing over the Presidency so this will be my last *Preview* piece as President. I'd especially like to thank those of you that took time out during the year to answer my various calls, through these articles, to tell me what you thought. Being so close to the day-to-day action of the organisation it is always refreshing to have to step back and respond to questions from people who see the end product, for better or worse.

I'll close by borrowing from one of my client's email signatures. Formula for success: rise early, work hard, strike gold!

Cheers.

Kim Frankcombe
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ASEG website update

The ASEG website (www.aseg.org.au) is undergoing continued development. Improvements to the profiles section and the addition of new forums and employment & scholarships sections will occur over the coming months. The web committee welcomes all feedback and comments, please submit via email: asegwebmaster@gmail.com.

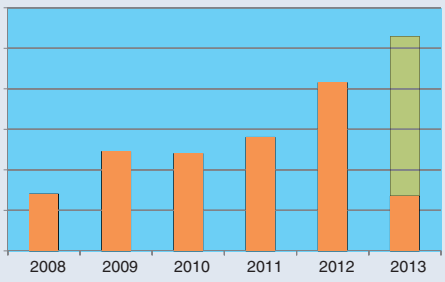
The successes of *Exploration Geophysics*

Exploration Geophysics, the ASEG's research publication, will be familiar to all readers of *Preview*. The observant may have noticed a recent change of cover, but much, much more is happening behind the scenes. And if you're new to the ASEG, *Exploration Geophysics* is online at www.publish.csiro.au/journals/eg and in your postbox quarterly.

The internet makes access to research simpler but the day is still no longer than 24 hours. The main task of CSIRO PUBLISHING is to strive to raise the profile of the *Exploration Geophysics* brand, so readers know that their time spent with the journal and its papers will be worthwhile. This in turn feeds into seeking ever better and relevant papers, higher profile authors, and timely publication throughput. Most critically, a journal needs a dedicated and skilled editorial team* as currently led by Mark Lackie at Macquarie University, Joongmoo Byun of Hanyang University, and Toshiyuki Yokota of the Geological Survey of Japan.

Exploration Geophysics has been a component of a formal strategic alliance between the ASEG and its sibling societies SEGJ and KSEG, and you can read more about that in *Preview* issue 158 (June 2012). All three societies can see the full contents of the journal through the respective members-only section of their society websites, and many research institutions and companies throughout the world subscribe to the journal for their staff.

One demonstration in the rise of the journal's profile is the number of manuscripts presented to the journal for potential publication. In just the period 2008 to 2012 the raw number of papers has tripled, and we're on track to a quadrupling for 2013.

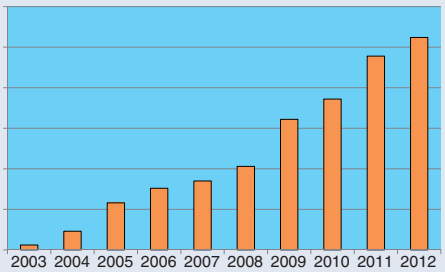


Annual submissions to Exploration Geophysics.

The Asia-Pacific is increasingly the natural home of *Exploration Geophysics*. Hits on the journal's website show this rise in regional usage: from 2008 to 2012 website hits from India rose from 5% to 7%, from Japan from 1% to 6%, and from China from 2% to 9%, while hits from Australia and New Zealand remain steady at about 30%, USA and Canada at about 18%, the UK at about 5%, and Germany at 2%.

Similarly the number of papers received from authors based in Asia is also increasing. In 2008 nearly half of the papers came from Australia and New Zealand-based authors. By 2012 this proportion was 20%, with now 10% of the papers from Japan-based, 7% from Korean-based, and 20% from China-based authors. The world, and most especially the Asia-Pacific region, is taking increasing notice of the ASEG's journal.

In scholarly publishing, content is key. A greater number of papers allows the editorial team to make the strategic decision on whether to publish more papers or become ever pickier and select only the best for publication. Citation by other researchers is a proxy for quality, and we can see the dramatic rise in the number of citations the journal gathers in a year.



Annual citations to Exploration Geophysics.

From the citation rates we can calculate the equally loved-and-hated measure of the impact factor (IF); for *Exploration Geophysics* it will be about 0.7. By way of context that puts the journal well ahead of *Applied Geophysics* (IF 0.446) and *Marine Geophysical Researches* (IF 0.450), and within striking distance of the *Journal of Environmental and Engineering Geophysics* (IF 0.794) and *Near Surface Geophysics* (IF 0.945).

CSIRO PUBLISHING was chosen in 2007 to assist the ASEG with *Exploration Geophysics*. It's been a good start, and the future is looking bright. Should you have a paper of interest, or an idea for a focussed collection, appropriate for a diverse and international readership of applied geophysicists, *Exploration Geophysics* is, more than ever, a worthy choice for your research.

Richard Hecker
CSIRO PUBLISHING
Email: richard.hecker@csiro.au

Phil Schmidt
ASEG Publications

Mark Lackie
Editor, Exploration Geophysics

**Exploration Geophysics*' editorial team: thank you one and all.

Les Beard (Zonge International), Aaron Davis (CSIRO), Mike Dentith (University of Western Australia), Sydney Hall (University of Queensland), Brett Harris (Curtin University), Michael Hatch (University of Adelaide), Graham Heinson (University of Adelaide), James Lee (Ti-Willa Technologies), Xun Luo (CSIRO), Tim Munday (CSIRO), Dariush Nadri (CSIRO), Marina Pervukhina (CSIRO), Roman Pevzner (Curtin University), Nick Sheard (Carpentaria Exploration), Yoonho Song (Korea Institute of Geology, Mining, and Materials), Greg Street (International Geoscience), Lindsay Thomas (University of Melbourne), Mark Tingay (University of Adelaide), Julian Vrbancich (DSTO), Jeff Wynn (US Geological Survey), Binzhong Zhou (CSIRO).

Nominate a colleague for an ASEG Honour or Award for 2013

NOMINATIONS CLOSING SOON

The ASEG acknowledges the outstanding contributions of its individual members both to the profession of geophysics and to the ASEG, through the presentation of the Society's Honours and Awards across a range of categories. The next Awards are scheduled to be presented at the ASEG-PESA Melbourne Conference 11–14 August 2013.

The ASEG awards are made through nominations from the membership at large, as well as through State and Federal executives. The available awards are:

- **ASEG Gold Medal**

For exceptional and highly significant distinguished contributions to the science and practice of geophysics, resulting in wide recognition within the geoscientific community.

- **Honorary Membership**

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

- **Grahame Sands Award**

For innovation in applied geophysics through a significant practical development in the field of instrumentation, data acquisition, interpretation or theory.

- **Lindsay Ingall Memorial Award**

For the promotion of geophysics to the wider community.

- **Early Achievement Award**

For significant contributions to the profession by a member under 36 years of age.

- **ASEG Service Awards**

For distinguished service by a member to the ASEG,

ASEG members are eligible for all award categories. Non-members also are eligible for the Lindsay Ingall and Grahame Sands awards. Under exceptional circumstances, the other awards may be offered to a non-member of the ASEG who has given appropriate service to the ASEG or to the profession of geoscience, and who has been duly nominated by the Federal Executive.

Nomination procedure

Any member of the Society may submit nominations for an award to another ASEG member. These nominations are to be supported by a seconder, and in the case of the Lindsay Ingall Memorial Award by at least four geoscientists who are members of an Australian geoscience body (e.g. ASEG, GSA, AusIMM, AIG, PESA, or similar).

The awards carry considerable prestige within the ASEG and the geoscience profession. Therefore appropriate documentation is required to support the nomination. Nominations must be specific to a particular award and all aspects of the defined criteria should be addressed.

Further details of the award categories and nomination criteria are available on the ASEG website. Proforma nomination forms and further information on the nomination procedures are available from the Chairman, Andrew Mutton.

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

Andrew Mutton
Chairman, ASEG Honours and Awards Committee
Email: andrew.mutton@bigpond.com

Nominations close Friday 21 June 2013.

New members

The ASEG extends a warm welcome to seven new individual members to the society (see table). Members were approved at the Federal Executive meeting held on 28 February 2013.

Name	Organisation	State/Country	Member grade
Tom Agar		VIC	Student
Robert Hearst	Areva Resources Canada Inc	SK	Active
Muhammed Hossain		WA	Student
Sureyya Kose		WA	Student
Aizawa Takao	Suncoh Consultants Co	Tokyo	Active
Anna Toomath	Santos	SA	Active
Jay Van Berlo		WA	Student

Geophysicists in society: Guy Holmes

Image courtesy of Polar Explorers.

In April 2013, Guy Holmes will battle arctic winds during a 13-day trek to the North Pole. The trip was planned from two angles – his love of geophysics and the environment and also to raise funds for HeartKids WA and awareness for Donate Life.

Guy, who will travel with a small group of explorers from many countries, will depart Perth for Norway on 6 April 2013 to undergo climate preparation and equipment testing prior to the official expedition commencing 11 April 2013.

Holmes will travel by charter aircraft to the Russian research camp 'Barneo' located approximately 89 degrees north latitude to the polar ice cap. The rest of the trip will be done on foot, by cross-country ski while pulling a 60 kg sled over the next 10–14 days. During that time Guy will manoeuvre around spectacular open water leads and over ice pressure ridges that resemble small geological structures made of ice. The official end to the expedition is expected around 23 April 2013.

Guy is motivated to undertake the trek for both professional and personal reasons:

> *I've always wanted to give back to the community, particularly the medical community. Two years ago, I joined the HeartKids WA Board and after seeing first-hand how they help thousands of families affected by childhood heart disease each year, I wanted to do my bit to raise much needed funds. In addition, as a geophysicist, I get to track down the magnetic pole as it wanders around at the top of the earth.*

Guy's support for DonateLife is more personal:

> *Knowing that my son Owen will one day need a new kidney after his initial transplant when he was just 2 years old, and understanding the crisis that typically comes with waiting for an organ transplant drives my passion to try and raise awareness for DonateLife*

and

> *I simply want my son to grow old with me – to be my best mate, a great brother and a part of our dynamic family and community for years to come.*

Further information about his trip and on how you may help can be obtained online at https://guyholmesnorthpoletrek.everydayhero.com/au/guy-holmes.

Guy is a long-standing member of the ASEG and a contributing author for Preview. *In addition, he is Chairman of HeartKids WA and he has a personal stake in the DonateLife campaign.*

Australian Capital Territory

On 2 February 2013 the ACT Branch, together with PESA, hosted the EAGE course on 'Seismic Geomechanics' by Jörg Herwanger (WesternGeco Research and Engineering Group). Twenty-three attendees, including several from over the border, enjoyed a well-presented and thoroughly educational course that both laid out the fundamentals of seismic geomechanics and gave useful insight into the use and application of this burgeoning business. Like SEG Lecturer Rick Miller before him, Jörg also managed an encounter with Australian wildlife – he met a sociable red-belly black snake during a post-course tour of Tindbinbilla Nature Reserve.

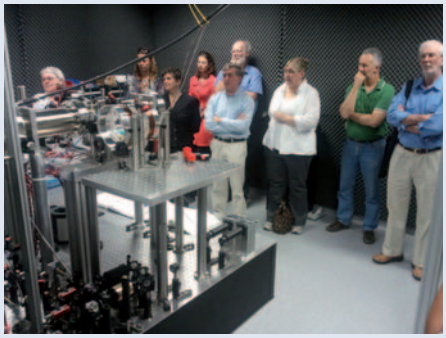
The branch AGM was held on 22 February 2013. Prior to the AGM, 21 members visited ANU's Quantum Sensors and Atom Laser Group in the Department of Quantum Science. There we viewed instrument set-ups (see photos) in the Quantam Gravity Lab where Professor John Close and his colleagues are working on high-precision gravity measurements using cold-atom lasers. The tour was a follow on from John Close's talk last December. Thanks are due to Johnny Debs, Gordon McDonald and Kyle Hardman for answering all our questions, and to Nick Robbins for organising the tour.

After four years in their respective roles, President and Secretary Ron Hackney and Marina Costelloe, stepped down at the subsequent AGM. Carina Kemp was then voted in as ACT Branch President and Millie Crowe as Secretary. Tim Jones will continue as Treasurer. The 2013 committee comprises Marina Costelloe, Ron Hackney, Bill Jones, Eva Papp, Ned Stolz and Ray Tracey.

To celebrate responsibilities new and relinquished, the past and present committees joined with members and their partners for a relaxing and enjoyable social event at the Ivy Café in Old Canberra House at ANU. Among canapés and refreshments, all enjoyed a movie, *Catching geophysicists in the ACT*, with highlights of ACT geophysical activities from the past year.

In the coming months, ACT Branch members Ross Costelloe, Ron Hackney, Carina Kemp, Peter Milligan and Yvette Poudjom-Djomani will be busy as they contribute to organising the program for the 23rd ASEG/PESA Conference and Exhibition in Melbourne in August 2013. Many other ACT members will contribute during March by reviewing extended abstracts. We will also be hosting SEG Pacific South Honorary Lecturer, David Isles, in early May 2013. ASEG stalwart, Koya Suto, is also due to visit in May 2013. This year will also see the first offering of an ACT Branch Student Scholarship.

Ron Hackney



New South Wales

In February, we held our AGM and two of the usual suspects (myself and Roger Henderson) were elected to the roles of President and Treasurer respectively. Sherwyn Lye from Bridgeport Energy was elected as Secretary. We thank Bin Guo for all his efforts over the past few years as Secretary.

Following the AGM, Roger Henderson, from Thomson Aviation, gave a talk on the status of exploration geophysics in Australia 86 years ago. Roger discussed a 1927 report by E.C Andrews (Government Geologist of the NSW Dept Mines) on 'Geophysical Prospecting for Ore Bodies'. Roger discussed the status at that time of various geophysical techniques and showed the equipment that was used and the ideas for using those techniques in Australia – much reminiscing by the audience. Mike Smith also gave a short illustration on controlling a bushfire on his property in the Southern Monaro. Not that much geophysics, but quite interesting.

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

Mark Lackie

Queensland

Our Brisbane branch is kicking off 2013 with the ASEG Federal AGM on 17 April. The evening will include a presentation on 'Geophysical site investigation techniques' by Tariq Rahiman. In June we look forward to hosting the SEG Honourary Lecturer Dave Isles. We are currently on the lookout for presenters to fill the 2013 program – this invitation is also extended to those passing through Brisbane. If you wish to present, please contact Queensland branch president, Fiona Duncan, via email: fiona.duncan@bg-group.com.

Fiona Duncan

South Australia/Northern Territory

We kicked off the year with a joint PESA and ASEG luncheon followed by an informative EAGE presentation by Dr Jorg Herwanger looking at Seismic Geomechanics. Dr Hellwanger was kind enough to share detailed information on the various points involved and was a thoroughly engaging speaker.

On 12 February the SA branch held its AGM in which we elected a new committee, including myself as president. I would like to acknowledge the tremendous work over the past few years of our outgoing President Phil and to our other outgoing committee members who have moved onto jobs outside of South Australia.

Kelly Keates spoke about the new electrical standards from the Ground Geophysical Surveys Safety Association (GGSSA) following the AGM. Further information and the draft review of these standards are available at http://ggssa.org/. Michael Wenz from the University of Adelaide, Australian School of Petroleum was our technical speaker for the evening and demonstrated useful techniques in analysing unconventional plays on his talk 'Unconventional

ASEG News

Source Rock Potential of the Goldwyer Formation, Canning Basin, Western Australia: Application of the Delta Log R Technique'.

Applications for the SA/NT student scholarship for students starting their honours year are now open. For application forms please contact me at erin.shirley@beachenergy.com.au. The upcoming event in March will be a student barbeque located at the University of Adelaide. This is an excellent opportunity for students to talk to geophysicists working in the industry. This event will be held at the Mawson building on Tuesday 26 March from 5:30 pm.

2013 as always will be a great year of social and technical events. I encourage everyone to come along to the student barbeque and our regular monthly technical presentations that will resume in April. Please feel free to contact me for more information or if you have a presentation that you would be interested in giving to the SA branch.

Erin Shirley

Victoria

On 6 February the ASEG Victorian Branch co-hosted the 'Annual ASEG-PESA-SPE Summer Social' with drinks, nibbles and plenty of networking opportunities at the riverside Terrace@ Feddish by Federation Square.

The technical side of our autumn program commenced on 13 March with a big turn-out of local ASEG and PESA members when we hosted the presentation 'The Zeppelin 3D rocks the Vulcan sub-basin', jointly presented by Jarrod Dunne, Seda Rouxel and Stephanie Gray from MEO Australia Ltd. The trio delivered a fine presentation that was enjoyed by all, leading to many follow-up questions.

On Wednesday 17 April we are pleased to announce the 2013 SEG Honourary Lecturer Dave Isles presenting 'Aeromagnetics – a driver for discovery and development of Earth resources' at the Kelvin Club. Prior to the presentation we will hold the Annual General Meeting for the ASEG Victorian Branch. Asbjorn Norlund Christensen and John Theodoridis are seeking re-election as President and Secretary, respectively, and we fully endorse the candidacy of Theo Aravanis, who is seeking election as Treasurer.

On Thursday 16 May incoming Federal ASEG President Koya Suto will present 'Multichannel analysis of surface waves and its applications in Australia'.

All technical meetings are held at the Kelvin Club, Melbourne Place, off Russell Street in Melbourne's CBD. Meetings start at 6:00 pm (drinks and nibbles) for a 6:30 pm start of the technical presentation. For catering purposes RSVP is mandatory to John Theodoridis, ASEG Victorian Branch secretary, at jthe1402@bigpond.net.au by the Friday prior to the meeting – at the very latest.

We look forward to seeing many ASEG Victorian Branch members at the upcoming meetings of the 2013 autumn season.

Asbjorn Norlund Christensen

Western Australia

The holiday season is well and truly behind us as we now reach the end of the first quarter of 2013. First, I'd like to welcome all our new WA committee members: Mohammad Khoshnavaz (Curtin University), Tim Dean (Schlumberger), Mahesh Raghvani and Matthew Kovacevic (Curtin University

student reps), Heather Carey (Fugro Airborne) and Regis Neroni (Rio Tinto).

This year so far we've already held four technical events. We welcomed SEG/AAPG Fall Distinguished Lecturer Manika Prasad in mid-January who presented to a capacity crowd on 'Shales and imposters: understanding shales, organics and self-sourcing rocks'.

Dr Jörg Herwanger from WesternGeco presented his EAGE Education Tour one-day workshop on 'Seismic geomechanics: how to build and calibrate geomechanical models using 3D and 4D seismic data' on 25 January.

Our first official Tech Night for 2013 kicked off on 13 February with Andrew Duncan's talk on 'Downhole EM for highly conductive targets'. Thank you to EMIT (www.electromag.com.au) for sponsoring the evening.

March's Tech Night was jointly held with the WA branches of the AIG and GSA, and saw Dave Isles present his SEG Pacific South Honorary Lecture on 'Aeromagnetics: a driver for discovery and development of Earth resources'. The night was at capacity once again drawing attendees from across the societies. Thank you to Southern Geoscience (www.sgc.com.au) for their sponsorship.

We're very pleased to be hosting Tariq Alkhalifah from the King Abdullah University for Science and Technology in Thuwal, Saudi Arabia. Tariq will be in Perth in early April and has kindly offered to give a special presentation to WA members on 'Unravelling waveform inversion with an eye on the near surface', which I'm sure will be very well attended. Thank you to PGS (www.pgs.com) for sponsoring this event.

As for the rest of 2013, our calendar is almost full. Check out the upcoming events in the table (right).

In addition to our monthly Tech Nights, we're looking forward to hosting the second Junior Geophysicists Forum later this year as well as being joint organisers of the annual Geoscience Careers Night for high school and university students that will be held at Technology Park on 27 August.

All WA events are now being posted on the ASEG website so keep a look out and follow the links for full event details as well as to register online. You can also sign up to our mailing at http://eepurl.com/nleOD to receive email notifications for WA events and news.

Anne Tomlinson

Date	Event	Presenter	Time	Venue
2 April	Special Tech Night: Unraveling waveform inversion with an eye on the near surface	Tariq Alkhalifah, KAUST, Thuwal, Saudi Arabia	1730 – 1930	City West, West Perth
10 April	Tech Night: Geophysics for mineral exploration	Dr Peter Kovac, Fugro, Perth	1730 – 1930	City West, West Perth
8 May	Tech Night: MASW method	Koya Suto, Brisbane	1730 – 1930	City West, West Perth
12 June	TBC		1730 – 1930	City West, West Perth
10 July	Tech Night: Seismic illumination on tight reservoir fractures and faults	Vincent Kong, WesternGeco, Perth	1730 – 1930	City West, West Perth
8 August	Tech Night: 4D seismics	David Johnston, ExxonMobil, Houston	1730 – 1930	Technology Park, Bentley
9 August	SEG DISC: Making a difference with 4D: Practical applications of time-lapse seismic data	David Johnston, ExxonMobil, Houston	0800 – 1700	Technology Park, Bentley
11 September	Tech Night: TBC		1730 – 1930	City West, West Perth
9 October	Tech Night: TBC		1730 – 1930	City West, West Perth
13 November	Student Presentation and ASEG WA Awards Night		1730 – 1930	City West, West Perth
11 December	AGM and Christmas Party		1730 – 2100	TBC

ASEG to present Australia's own DISC

ASEG Federal Executives have decided to run the equivalent of DISC courses in all state branches that express interest: one each for petroleum and minerals every year.

Background

The SEG Distinguished Instructor's Short Course (DISC) is a highly successful global project, in which every year the SEG sends a lecturer to deliver a one-day course to venues located throughout the world. In Australia, sessions are typically held at two or three locations. Although ASEG invites the SEG DISC lecturers to present at all state branches, presentations are limited by their hectic schedule.

Quite often the SEG DISC is focussed on the cutting-edge technology in petroleum exploration.

Initiative

In a new initiative by the ASEG, one-day courses will be created to service explorers in both the minerals and petroleum sectors. These courses shall be aimed at bridging the gap between:

- academic studies and industry practice;
- the study of geology and geophysics and application in exploration; and
- geologists and geophysicists.

Thus, this initiative forms a bridge of communication: for geophysicists to understand what geologists want and can provide, and for geologists to read and understand geophysical data in terms of their geological knowledge.

The first of the ASEG DISC seminars will occur later in 2013. This is in addition to the SEG DISC at the Conference in Melbourne and two venues in August: Perth and Brisbane.

Further information

Given that we do not as yet have a nice acronym for our DISC, we welcome suggestions from our members. For those with a good idea please contact the chairman of the Education Committee, Mark Tingay, by email: mark.tingay@adelaide.edu.au.

ASEG announcement for all members

Considering retirement?

A geophysicist is a geophysicist for life, regardless of whether or not you are working in geophysics for a living. We continue to learn geophysics and to meet geophysicists. Retirement from the work force does not stop these commitments.

Eligibility and benefits

- ASEG has a membership category for retired geophysicists with a discounted fee. To be eligible for this special membership rate, you have to be a member for 10 years. The retired membership fee for 2013 is $84.
- A retired member also has the option to bulk pay the membership fee for life with a heavy discount. This is a tax-effective way of paying membership if you opt in your last year of employment.
- Retired members are also entitled to discount registration for ASEG Conferences. The registration fee for retired members for this year's 23rd ASEG Conference in Melbourne is $600 (Members' full registration is $1150).

Further information

If you are about to retire, please contact the ASEG Secretariat:
Email: secretary@aseg.org.au
Tel: (08) 9427 0838

Australian Government
Geoscience Australia

Airborne electromagnetic data for the National Airborne Geophysical Database

Do you have historical airborne electromagnetic (AEM) data sitting in the back of your filing cabinet, on old hard drives or worse on CDs?

Are you the owner of AEM data and/or have permission to release datasets to Geoscience Australia?

Please consider supplying the data to GA for archiving to help build a national repository of AEM data for the benefit of the nation. Auxiliary data including logistics reports, technical metadata, conductivity logging and interpretation reports are also sought if available.

Geoscience Australia is the custodian of the most comprehensive publicly available Australian airborne magnetic, gamma-ray, elevation model, electromagnetic and gravity databases.

Geoscience Australia is embarking on a project to upgrade the National Airborne Geophysical Database (NAGD) to better manage the data from AEM surveys. Geoscience Australia has commenced work on an AEM data repository as a subset of the National Airborne Geophysical Database. Geoscience Australia in its role as the national geoscience agency is looking to collect and archive AEM datasets acquired using public funds in a format that is maintainable and accessible. In addition, available open file AEM datasets will be archived in the repository.

The immediate aim is to develop an AEM survey index map suitably attributed with relevant metadata in conjunction with a view to releasing AEM data on the web. The long-term aim is to create coherent regional compilations to be used to reduce exploration risk, support the work of the various industries that use AEM data and contribute to the development of government policy.

If you have data or would like to discuss this venture please don't hesitate to contact Marina Costelloe via email at marina.costelloe@ga.gov.au or telephone on (02) 6249 9347.

Conference update

The organising committee and our many helpers are working hard to deliver a conference that we hope will provide you with your very own eureka moment! The 22 high-profile keynote speakers, more than 300 submitted papers and posters, up to 20 workshops and 102 exhibition booths are sure to make your attendance worthwhile. In this update we will focus on the latest developments ahead of the final program being announced in the next edition of *Preview*.

Technical program

We received a record number of 'Expressions of interest' (to submit a paper or poster) that should enable the technical committee to build a strong and focussed technical program. At the time of writing, the deadline for submission of the 'Expanded Abstracts' has just passed and our volunteer reviewers are about to get busy. Authors will be notified of the final status of their submission by 5 April.

Workshop title	Workshop leader	Date (in August 2013)	$AUD (incl. GST)
Petroleum and Unconventionals Workshops			
Rock Physics Workflows Forum	DuG, Ikon, David Lumley, Jarrod Dunne	Thursday 15th	165
Seismic P-wave Anisotropy: Hands On	Leon Thompson	Sunday 11th	550
All Things Microseismic	Julie Shemata, Murray Roth	Thursday 15th	605
Structural geology and seismic stratigraphy – West Gippsland field trip	Mike Hall, Alan Tait	Thursday 15th, Friday 16th	440
OpendTect – HorizonCube and SSIS training	Paul de Groot, Jan Stellingwerff	Sunday 11th	330/660/990
Madagascar (open source processing) workshop	Jeff Shragge, Sergey Fomel	Thursday 15th	110
Making a difference with 4D	David Johnston	Sunday 11th	165/275/380
Planning and operating a land 3D survey	Andreas Cordsen	Sunday 11th	220
Minerals Workshops			
Remanent Magnetisation and Self-Demagnetisation Estimation	Dave Pratt, Clive Foss, Phillip Schmidt	Sunday 11th	165
Geophysical Processing, Analysis and Visualisation in Encom PA	Dave Pratt/Pitney Bowes	Friday 16th	275
Precision Interpretation with ModelVision Using Different Inversion Techniques	Dave Pratt/Pitney Bowes	Thursday 15th	275
Inversion Forum	Terry Ritchie, Richard Lane	Saturday 10th	165
Exploration Undercover; the challenge of seeing deep and staying focussed	Ken Witherley, Graham Ascough	Thursday 15th	220
MT/AMT for Mineral Exploration	Mike Hatch	Friday 9th, Saturday 10th	715
Introduction to Hard Rock Seismic Workshop	Tristan Kemp (GA)	Saturday 10th	275
Geophysical Interpretation, Modelling and Inversion in Gocad	Glen Pears, Peter Fullagar, James Reid, Tim Chalke	Sunday 11th	660
A Forum – Using Regional Data Sets to Drive Discovery	Kevin Tuckwell, Richard Lane	Sunday 11th	275
General Workshops			
A one day workshop in Ground Penetrating Radar	Hugh Rutter, Jan Francke	Thursday 15th	330
Geohazards	Tim Rawling, Gary Gibson	Sunday 11th	70
Gradiometry in Exploration for Minerals and Energy Resources	Intrepid Geophysics	Sunday 11th	275

News

If you haven't done so, it might be worth perusing the list of confirmed keynote speakers on our conference website. Following the example set by the Brisbane organising committee, we've assembled a stellar line up, headed by Stephen McIntosh from Rio Tinto. Where possible, the keynotes will lead sessions within the technical program with broad-ranging presentations of up to 45 minutes in length.

Workshops

The workshops committee has finalised a list of 20 candidate workshops (as shown in the accompanying table), which will be led by skilled educators and cover a broad range of hot topics in exploration geophysics. The prices have been set to provide exceptional value to ASEG and PESA members making it easier to justify training in a time when many companies are seeking to cut costs.

We urge our members to register early to secure a place in the more popular workshops. Please note that some workshops may be withdrawn if undersubscribed; thus providing another reason not to leave your workshop registration to the last minute. Students are particularly encouraged to attend as many workshops as possible to supplement their education ahead of entering the workforce.

Conference dinner

We are very excited to announce Professor Geoffrey Blainey AC as the Conference Dinner speaker. Professor Blainey is widely regarded as Australia's most prominent historian and undoubtedly will impress all who attend with his lucid depiction of Australia's economic growth that has been underpinned by the quest for mineral resources. The dinner will be held in the Great Hall at the National Gallery of Victoria. Dinner tickets for delegates and guests can be purchased for $150 per person when registering for the conference.

Student night

The Wharf Hotel, located on the north bank of the Yarra, has been selected as the venue for the student night. Attendance is free for students that are registered for the conference and the night offers a chance to network with peers and meet industry representatives in a relaxed and informal setting.

Honours and Awards nominations 2013

The conference provides an important opportunity to recognise and thank members who contribute to the profession and to our society. There are a range of categories covering contributions to the science, practice, innovation and promotion of geophysics as well as recognition of distinguished service by members. See this current issue of *Preview* (p. 7) for more details.

Early bird registration

Discounted registration (at $995) for early birds and authors closes on **26 April** so be quick to take advantage of this special offer. Students are offered a heavily subsidised fee of only $150 (proof of student ID must be submitted).

Please visit our website to secure your conference registration, in addition to signing up for workshops, purchasing tickets for the gala dinner and to book accommodation.

We look forward to seeing you in Melbourne!

Suzanne Haydon and Jarrod Dunne
On behalf of the Organising Committee
www.aseg-pesa2013.com.au

Near-surface geophysics

The majority of ASEG members are engaged in resource exploration in either minerals or petroleum. Publications and conference presentations are dominated by development and application of these areas. Yet, the ground we stand on is another subject of geophysics. It is the domain of human activity: we need firm ground to build our homes, and we need those buildings to be safe against natural hazards like earthquakes, landslides and tsunami.

The geophysical techniques developed for resource exploration are often tried in engineering and environmental applications for near-surface investigation. For example, the frequency domain electromagnetic survey technique is often used for groundwater surveys, specifically modified for near-surface applications with a high-frequency transmitter.

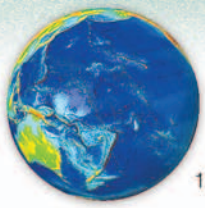
Near-surface applications of conventional geophysical methods can be problematic. To use the seismic reflection method for very shallow investigation, the geophone interval must be extremely small to achieve high fold to combat the noise, hence the survey will be very expensive.

On the other hand, geophysical methods like ground-penetrating radar are specifically developed for near-surface application.

For those who explore deeper targets, near-surface disturbance is often a problem. Thus, understanding near-surface anomalies may help to improve imaging the earth at greater depths.

The first Asia-Pacific Near-Surface Conference aims to address these unique features of near-surface geophysics. It is organised by the SEG and the Chinese Geophysical Society with cooperation of the ASEG, SEGJ and KSEG. Held in Beijing in July 2013, it offers an opportunity to learn and discuss the near-surface application of geophysical methods (see p. 15 for full announcement).

Koya Suto
President Elect & Research Foundation



Near Surface
Asia Pacific Conference
17–19 JULY 2013 • BEIJING, CHINA

1st Near Surface Asia Pacific Conference and Exhibition

17–19 July 2013 • Beijing, China

The Society of Exploration Geophysicists and the Chinese Geophysical Society along with co-sponsors The Australian Society of Exploration Geophysicists, the Society of Exploration Geophysicists, Japan and the Korean Society of Earth and Exploration Geophysicists announce the first conference on Near Surface geophysics and related topics to be held in Beijing, China in 17–19 July 2013.

The conference will focus on near surface issues within the Asia Pacific region and will bring new technology and the application of various techniques to advance near surface geophysics in the fields of engineering, construction, hydrogeological, environmental and humanitarian areas.

Technical Program

The event will provide the participants an opportunity to present and discuss the latest scientific results, issues and research within the Asia Pacific region.

Sessions will cover the following topics:

- Near-Surface Geophysics and Human Activities
- Shallow Seismology
- Ground Penetrating Radar
- Electric, EM, and NMR Methods
- Engineering Geophysics
- Mining and Geothermal Exploration
- Remote Sensing and Lidar Applications
- Hydrogeophysics
- Rock and Soil Properties
- Borehole Geophysics
- Modeling and Inversion
- Geophysical Instruments

Exhibition

The exhibition will feature companies displaying the latest in sensing equipment, ground penetrating radar, instruments and service companies.

Cosponsored by:
Australian Society of Exploration Geophysicists
Korean Society of Earth and Exploration Geophysicists
Society of Exploration Geophysicists of Japan

For additional information, awatson@seg.org

News

Update on Geophysical Survey Progress from the Geological Surveys of Western Australia, South Australia and WA Department of Water (Information current at 12 March 2013)

Tables 1–3 show the continuing acquisition of the airborne magnetic, radiometric, gravity and AEM data of the Australian continent. Accompanying locality maps for Table 2 can be found in Figures 1 and 2, and for Table 3 in Figure 3. All surveys are being managed by Geoscience Australia (GA).

Table 1. Airborne magnetic and radiometric surveys

Survey name	Client	Contractor	Start flying	Line (km)	Spacing AGL Dir	Area (km²)	End flying	Final data to GA	Locality diagram (*Preview*)	GADDS release
South Pilbara	GSWA	GPX	14 May 12	136 000	400 m 60 m N–S	42 500	100% complete @ 22 Jan 13	TBA	150 – Feb 11 p21	TBA
Mt Barker (South West 4)	GSWA	GPX	24 Apr 11	120 000	200 m 50 m N–S	20 000	100% complete @ 27 Jan 13	TBA	150 – Feb 11 p22	TBA
Marree	GSSA	UTS	29 Oct 12	130 473	400 m 80 m N–S	46 169	53.8% complete @ 7 Mar 13	TBA	160 – Oct 12 p16	TBA
Widgiemooltha – Norseman	GSWA	Thomson	15 Nov 12	131 900	100 m 50 m E–W	11 520	79.7% complete @ 10 Mar 13	TBA	161 – Dec 12 p16	TBA

TBA, to be advised.

Table 2. Gravity surveys (also see Figures 1 and 2)

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
Esperance	GSWA	TBA	TBA	TBA	2.5 km and 1 km along roads/tracks	TBA	TBA	TBA	158 – Jun 12 p23	The survey is expected to proceed but will not be conducted until the 2013/14 fiscal year
Woomera Prohibited Area	DMITRE	TBA	TBA	34 500	1 km/2 km regular grid	TBA	TBA	TBA	This issue	Quotation request closed on 4 March 2013
North Perth – Gingin Brook	WA Dept of Water	TBA	TBA	1230	1.5 km regular grid	TBA	TBA	TBA	This issue	Quotation request closed on 7 March 2013

TBA, to be advised.

Table 3. AEM surveys (also see Figure 3)

Survey name	Client	Contractor	Start flying	Line (km)	Spacing AGL Dir	Area (km²)	End flying	Final data to GA	Locality diagram (*Preview*)	GADDS release
Swan/Scott Coastal Plain and Albany/ Esperance	WA Dept of Water	Fugro Airborne Surveys	Est. 25 Mar 13	8607	300/600 m	TBA	TBA	TBA	This issue	Contract executed by GA on 4 March 2013

TBA, to be advised.

Further information on these surveys is available from Murray Richardson at GA via email at Murray.Richardson@ga.gov.au or telephone on (02) 6249 9229.

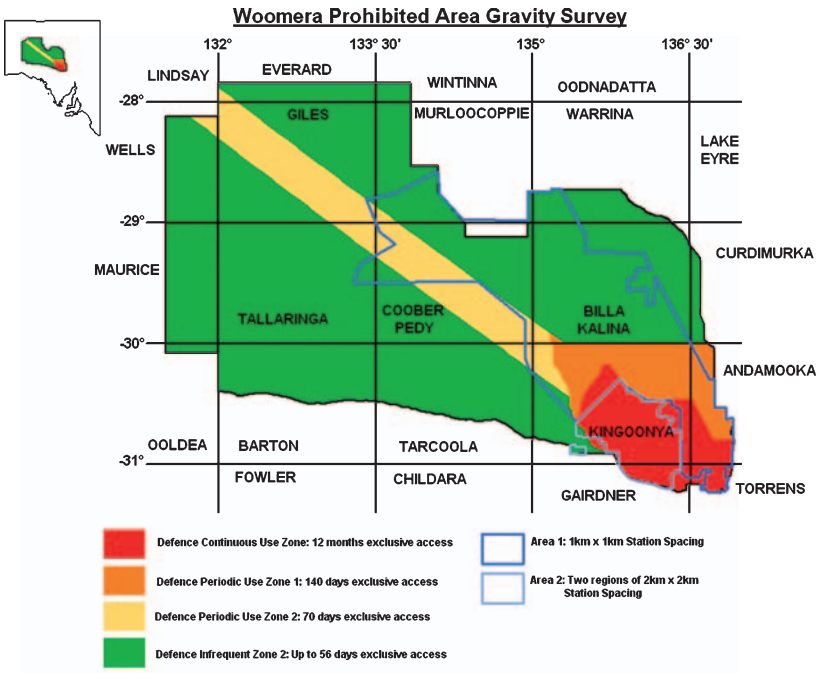


Fig. 1. *Locality map for the Woomera Prohibited Area Gravity Survey (also see Table 2).*

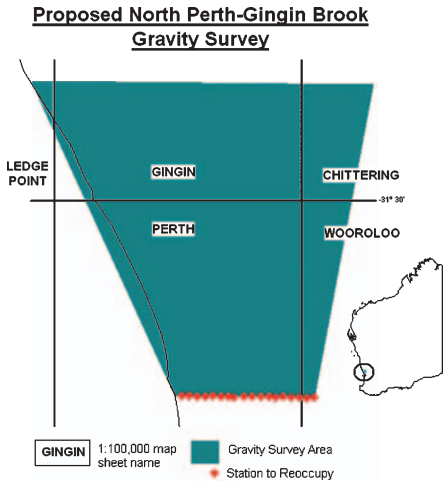


Fig. 2. *Locality map for the Proposed North Perth-Gingin Brook Gravity survey (also see Table 2).*

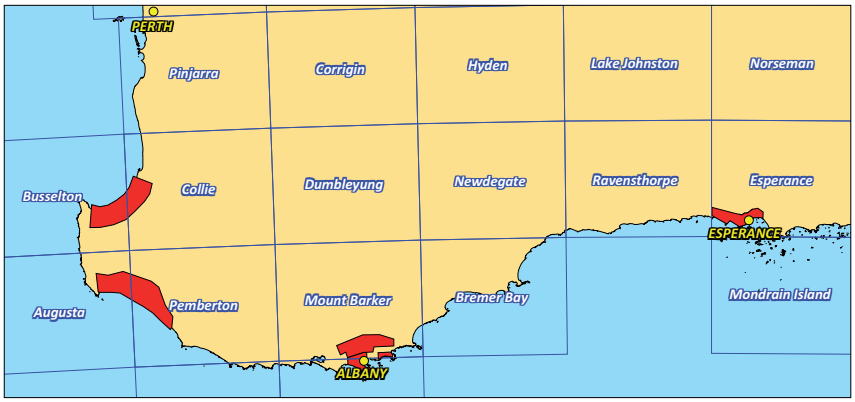


Fig. 3. *Locality map for the Swan/Scott Coastal Plain and Albany/Esperance AEM survey (also see Table 3)*

The Geoscientific Data Warehouse: accessing and delivering NSW geoscience data

D. Collins, P. Gilmore, J. Greenfield, T. Barlin and S. Meakin

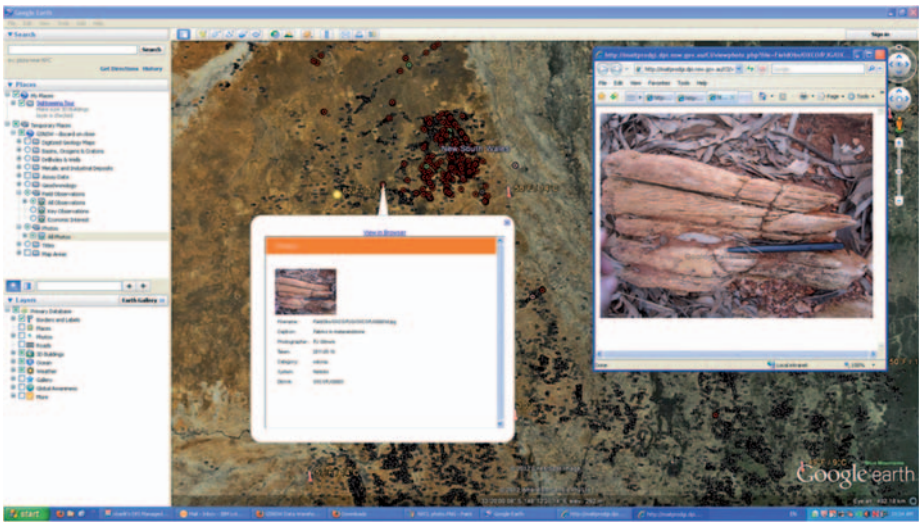
Geological Survey of New South Wales
NSW Trade & Investment
516 High Street, Maitland, NSW 2320

This article is an excerpt from a draft paper for the internal publication 'Quarterly Notes of the Geological Survey of New South Wales'.

Introduction

In September 2012, the Minerals Resources unit of NSW Trade & Investment first released its new Geoscientific Data Warehouse (GDW) on the internet. The GDW is the culmination the COGENT II project (2008–2012) to identify, validate, consolidate and store geoscientific datasets of the highest data integrity secured in perpetuity. This represented the first step in fulfilling the vision of 'providing on demand access to all validated (non-confidential) corporate geological data stored by Mineral Resources from a single spatial-based interface'. The GDW provides access to geoscientific information to attract investment for mineral and petroleum exploration and development and helping inform land use decision-making, a major role of the Mineral Resources unit.

The COGENT I project (1995–1999), funded by the NSW Government's *Discovery 2000* initiative, started the transfer of data to a central, secure environment. The COGENT II project is a major project of the continuing initiative now called *New Frontiers*, which continues the government program of pre-competitive geophysical surveys, data compilation and delivery, frontier mapping and interpretation.



How it works: the GDW is a new online service that provides free, on-demand access to validated, non-confidential, geological data for NSW. The data is discoverable through display in Google Earth™ and also by using simple queries within web pages.

The GDW is the delivery vehicle for data captured and stored in the geoscientific database application system. Now that this system is in place, users of the GDW will see a steady stream of new and updated datasets from nightly replication.

How it works

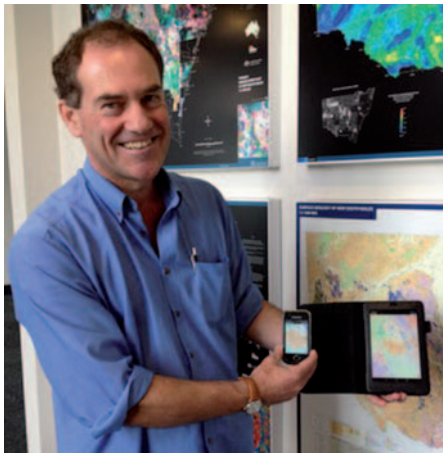
The GDW uses Google Earth™ technology to enrich the functionality and experience of discovering geoscientific data in NSW. Integrating the 3D and layer transparency features of Google Earth™ with geo-referenced field photos and microphotographs provides a 'virtual field' experience for the user.

The geoscientific data held in the new database is primarily point data, such as field observations, structural readings, geochronology, and non-confidential data from exploration reporting. However, the GDW spatial interface also has layers for geological and metallogenic maps and geophysical imagery (geolocated at all zoom levels), current mineral, coal and petroleum titles as well as title applications for minerals, coal and petroleum. The GDW also contains a link to the new Geoscience Product Catalogue and to DIGS database (of exploration and geoscience reports and maps).

For those who wish to bypass the spatial interface, comprehensive text-based search facilities are available, including geoscientific database data and reports as well as data and images stored in the DIGS database. These are all complemented by a download facility that supports download in multiple formats including shape files, TAB files and CSV.

Maps for mobile devices

A new feature in November 2012 was the addition of a facility to download



Dave Collins, Senior Geoscientist (Data Systems), Geological Survey of New South Wales, demonstrates the new maps for mobile devices.

Exploration applications: a wealth of drill hole data for NSW is available via the GDW (Photo: an exploration company drilling near Koonenberry).

free statewide geological maps and geophysical imagery to smartphones and tablets. This is a one-off file download via an internet connection. However the feature does not require an internet connection to display, therefore making these maps available in areas without internet reception. GPS technology embedded in smartphones allows the user to instantly view maps or imagery at their location. Maps used are NSW 1:1 500 000 surface geology, Total Magnetic Image and ternary radioelement image. This has proven to be a very popular facility and more maps will be made available for download on an ongoing basis.

Access

Public access to the GDW is via the entry page http://dwh.minerals.nsw.gov.au/CI/warehouse. At this site links can be found for demonstration videos, feedback and request forms and map support for mobile devices.

Data

Data migration was prioritised with respect to value and risk. For example, radiogenic isotopes were considered the highest priority due to the cost of recollection and reanalysing samples, along with storage of records in multiple versions of spreadsheets on the computer network and on individual computers. Resources were allocated to compile, model and migrate data based on their priority. All data has been secured and has a work plan for implementation into the GDW. As a result of finite resources, not all data has been implemented in the GDW at this stage (Tables 1 and 2).

Case study: drill hole data

The GDW provides access to non-confidential stratigraphic, coal, mineral and petroleum drill hole information from across NSW. Currently all drill hole data, with assay analysis from drilling is stored using Micromine's Geobank geological data management software. All data is stored in tables in Geobank that allow migration of data from both historic sources and the current data template. Non-confidential data is replicated nightly from Geobank to the GDW.

The first priority of COGENT II is to store location information for drill holes. Data captured includes coordinates, title, company, date, purpose, end-depth, and GS report number for further information via DIGS. The next priority is to capture down-hole information such as assay, lithology, geophysical and survey data. The focus to date for capture of these data for minerals drilling has been the Cobar Peneplain Bioregion, to assist mineral explorers and land use planning.

In the GDW, drill hole locations may be viewed by type (coal, mineral, petroleum), whether they are stored in department core facilities (WB Clarke

Table 1. Data implemented as of 28 February 2013

Dataset	Description	Records
Radiogenic isotopes (except Pb–Pb)	Sample and analytical data for U–Pb, K–Ar, Ar–Ar, Re–Os and Sm–Nd isotopic studies.	2169 samples
Petrological collection	Catalogue and description of thin sections of rock samples	93 126 thin sections
Drill holes: minerals	Minerals drilling (mostly industry exploration data plus department stratigraphic) including collar, survey, lithology data	44 117 collars
Drill holes: petroleum	Petroleum wells – department and industry (CSG, oil, gas) including collar, survey, lithology, other downhole data	864 collars
Drill holes: coal	Coal drill holes (department and industry) including collar, survey, lithology, other downhole data	56 303 collars
Exploration geochemistry: down hole assay	Analytical data for down drill hole assays reported by exploration companies	2 668 997 samples (represents data from 96 717 drill hole collars compiled from industry exploration reporting)
Exploration geochemistry: surface samples (stream sediments, soils, rock chips, NITON)	Sample and analytical data for geochemical surveys reported by exploration companies	773 817 samples
Photographs: field photos	Embedded location and metadata for image bank.	2500 photos
Field observations	Geological observations, measurements and sample data by department geologists	114 140 locations

Table 2. Data planned for implementation

Dataset	Description	Records
Seismic	Shot points, line coverage, SEGY and imagery from onshore and offshore seismic surveys (~2500 surveys for ~45 000 line km)	~45 000 line km (2500 surveys)
3D geology	Vector data representing geological (geophysical) features below the earth's surface in 3D space	
Petrophysics	Petrophysical properties of rocks (magnetic susceptibility, density, radioelements)	~5000 records
Whole rock geochemistry	Sample and analytical data for whole rock geochemical samples	~25 000 records
Palaeontology	Sample and descriptive data for fossil samples in NSW to aid stratigraphic and age discriminations	~65 000 records
Stable isotopes	Sample and analytical data for S, O and other stable isotopic systems	~3500 records
Polished blocks	Sample and descriptive data for polished blocks of mineral samples	~1775 records
Economic rocks	Sample and descriptive data for economic mineral samples in NSW	~30 000 records
Radiogenic isotopes (Pb–Pb)	Sample and analytical data for Pb–Pb isotopic studies	~2000 records

Geoscience Centre at Londonderry and EC Andrews Core Facility at Broken Hill), whether they have been hyperspectral scanned, or have associated lithology data. As with other GDW datasets, the data can be queried, viewed in Google Earth™, and downloaded into GIS or database software.

The availability of drill hole data will allow exploration companies to easily access existing drill hole and associated assay and lithology information for their area of interest, and similarly allow department staff access to sub-surface geological information across NSW.

Department drilling

Holes drilled by the department include coal resource evaluation drilling, petroleum wells and regional stratigraphic programs. For example:

(1) A regional drilling programme was conducted by the department under the *Discovery 2000* initiative to assess petroleum potential of the Darling Basin;
(2) 138 shallow air core holes were drilled east of Cobar in the late-1990s as part of the *Exploration NSW* initiative to improve geological understanding of the area.

Exploration drilling

Reporting of exploration drilling on coal, mineral and petroleum titles to the department is mandatory. Since the late 1990s, reporting of minerals drilling activity has been via digital submission in data templates in line with the 'Australian Requirements for the submission of Digital Exploration Data'. This data is now uploaded to Geobank routinely, with all minerals exploration drilling now stored in Geobank. Pre-digital submission, exploration drilling was submitted in hard-copy reports, scanned into raster format and archived in DIGS. Under the *New Frontiers* initiative, contractors have been extracting drilling information from DIGS and populating Geobank.

Ongoing work

The GDW simplifies the discovery and accessibility of free geoscientific information to aid mineral and energy exploration, inform land use decision-making, and enhance ongoing geoscientific research in NSW. To enable future enhancements, a key feature of the GDW is a feedback form for users to provide comments and suggestions for improving the site and data available.

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Call for case studies to complement the ESWA Earth and Environmental Science textbook

The following TESEP article has been reproduced from the TESEP website and the March edition of 'The Australian Geologist' (TAG) published by the Geological Society of Australia (GSA).

Dear geoscience colleagues,

The highly successful Teacher Earth Science Education Programme (TESEP) is seeking your assistance**.**

We are collaborating with Earth Science Western Australia (ESWA) to produce case studies that complement their fantastic Earth and Environmental Science (EES) textbook.

By updating with Australia-wide examples, the book will more effectively help all Australian teachers when the new Australian Curriculum EES course for years 11–12 is rolled out in the next couple of years. TESEP is encouraging nation-wide adoption of this text and by providing additional complementary case studies we are helping to ensure it is of maximum use across the country.

The book has 19 chapters and we are looking for excellent Australian examples for many areas of text. Each case study will consist of 2–6 pages, including research, diagrams, maps and activities. The chapters address minerals, fossils, geological time, plate tectonics, geohazards, energy, resources and the three rock types, but also embrace soils, water, weather, climate change, human activity, ecosystems and biodiversity. A complete overview is available on the TESEP website: www.tesep.org.au.

However, we are not seeking to rewrite the curriculum! You may think there are sections of the book missing, but it is written to meet the WA EES curriculum requirements. It will also be revised to meet the national EES curriculum even better in due course, but either way it will not cover all possible content. Consequently, if you think you have material that does not fit the chapter headings do not be discouraged. The content touched on under those headings is wide ranging and many less obvious connections can be made as a result.

I will be personally contacting those in the geoscience community I know that may be able to provide or easily develop some of the material required, but I encourage one and all to help.

If you have anything of your own or are aware of materials that might suit our needs please contact me as soon as possible. Obviously, we need to be sure that there are no copyright restrictions on the materials you provide, but even if you just have one classic photo of a particular geological phenomenon that you are willing to send, the Australian teaching fraternity and all future students will be very grateful and your contribution will be acknowledged.

Needless to say, in order to ensure national appeal the case studies will need to have national geographic spread. This means we may have the unenviable task of choosing some over others for the first batch of case studies that we hope to have finalised by October 2013. However, since they are likely to be delivered online we should be able to continually add them to the ESWA and TESEP websites as they are written up and inform teachers by email and newsletters.

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Geophysical instruments in the National Historical Collection

Denis Shephard

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This article summarises and updates presentations made at the '400 Years of Mapping Australia' conference in Darwin in 2006, the Scientific Instrument Symposium at Lisbon in 2008 and to a meeting of the Australian Society of Exploration Geophysicists at Canberra in 2009.

Shephard, Denis. 'Tools of surveying and mapping in the National Historical Collection.' Presentation to 400 Years of Mapping Australia Conference, Darwin, August 2006.

Shephard, Denis. 'Places and cases. Some geoscientific surveying instruments from the collection of the National Museum of Australia'. Presentation to XXVII Scientific Instrument Symposium, Lisbon, September 2008.

Shephard, Denis. 'Some geoscientific surveying instruments from the National Historical Collection'. Presentation to meeting of Australian Society of Exploration Geophysicists, Canberra, 2009.

In 1978, geology and geophysics staff from the Bureau of Mineral Resources went about assembling a collection of historical geophysical equipment, described by Peter Sydenham to be '...the most extensive assembly of historic geophysical apparatus in Australia' (Sydenham 1978, p. 243).

Since that time the collection has become part of the National Historical Collection and has been significantly expanded through the addition of instruments from the Australian Geological Survey Organisation and Geoscience Australia. Today, it comprises over 800 instruments and archival items representing the full range of Australian Government geophysical activity through the 20th Century and into the 21st Century.

The National Museum of Australia (originally Museum of Australia) was established by the National Museum of Australia Act of 1980 'to develop and maintain a national collection of historical material…in the national interest' which was to be known as the 'National Historical Collection'. The act provided for the transfer of existing Commonwealth collections, such as the Australian Institute of Anatomy Collection, the National Ethnographic Collection and collections held by the departments of Home Affairs and Transport to the National Historical Collection (Hansen 2005, pp. passim). After a series of discussions between National Museum and Bureau of Mineral Resources staff, the Bureau of Mineral Resources Collection was also transferred to the new museum, in July 1986. This material comprised superseded equipment that had been saved from the normal stores disposal process by Max Allen and colleagues, from the early 1950s to the early 1980s. Most had been made obsolete by technological advances in survey techniques or simply replaced by more modern equipment (Shephard 1999).

The National Museum names its collections for the donor or the transferring government body. Thus, the geophysical equipment in the National Historical Collection is found in six different individual collections – Bureau of Mineral Resources Nos 1 and 2, Dr Liz Truswell, Australian Geological Survey Organisation and Geoscience Australia Nos 1 and 2.

Australia's National Geological Survey

The earliest recorded Commonwealth Government involvement in the geological sciences was examination of the site for Canberra in 1910 by Edward Fisher Pittman (1849–1932) of the New South Wales Mines Department (Vallance 1988). The first Commonwealth geological staff appointment, however, was that of Evan Richard Stanley (1885–1924) as Government Geologist in Papua in 1911 (Smith 2007). Despite representations from scientific and other professional bodies about the importance of a national scientific investigation of Australia's mineral resources the Commonwealth of Australia was nearly five decades old before a Commonwealth Geological Survey was formed. Prior to this, however, the Carnegie Institution of Washington's Department of Terrestrial Magnetism established a magnetic observatory at Watheroo in Western Australia; the Imperial Geophysical Experimental Survey was formed in 1928 to test the applicability of various geophysical survey methods under Australian conditions; and from 1934 to 1941 the Aerial, Geophysical and Geological Survey of Northern Australia investigated selected areas of promise for mineral discovery including the testing aerial photography methods in Western Australia (Wilkinson 1996, pp. 12–27; Crespin 1971, pp. 29–46).

There are instruments from each of these initiatives in the Bureau of Mineral Resources Collection, including magnetometers, an Oertling gradiometer and two Hilger & Watts variometers that were used by Jack Rayner (1906–82) (McCracken 2012), who later became Director of the Bureau of Mineral Resources (Figure 1).

The Bureau of Mineral Resources, Geology and Geophysics was established in 1946. Its primary aim was the systematic geological and geophysical mapping of Australia to assist informed mineral exploration. The new agency also assumed responsibility for the Watheroo Magnetic Observatory previously operated by the Department of Terrestrial Magnetism. In the early 1970s, with the systematic mapping of Australia nearing completion, the Bureau of Mineral Resources turned its attention to mapping the continental shelf and slope. Onshore work focussed on detailed geological, geophysical and geochemical studies of specific mineralised areas (Wilkinson 1996, passim).

Fig. 1. *Watts variometer no. 15887, dating 1935. Implementation: Used on AGGSNA survey of Tennant Creek (1935) and later on Cocos Island (1946) and Macquarie Island (1950–52). Image: National Museum of Australia, 2007.*

In 1978, the Bureau of Mineral Resource's primary role moved toward strategic research, with an emphasis on the search for offshore petroleum reserves, and away from surveying and mapping. During the early 1980s, it developed its expertise in remote sensing and groundwater investigations and commenced nuclear monitoring and geohazard assessment. The Bureau became the Australian Geological Survey Organisation in 1992. Geoscience Australia was formed in November 2001, combining the previously separate agencies of Australian Geological Survey Organisation, the Australian Surveying and Land Information Group (formerly Australian Survey Office and National Mapping) and the Australian Centre for Remote Sensing (Geoscience Australia 2012). All of these agencies are represented in the National Historical Collection.

Bureau of Mineral Resources Collections Nos 1 and 2 and Dr Liz Truswell Collection, 1986–1999

It is difficult to quantify the number of instruments transferred to the National Museum in 1986 as no consolidated listing was made at the time, although the Receipt Authority Vouchers and Crate Lists did give some idea of its extent. Reference was made to 58 crates containing about 650 types in storage at Oaklands, north of Mulwala, as well as to items in store at Fyshwick and in the BMR building at the time of transfer. The only instruments mentioned either individually or generally were those of obvious historic significance (National Museum of Australia collection file – Bureau of Mineral Resources No. 1).

In May 1977 Dr Peter Sydenham and a team from the University of New England examined 110 items stored at Oaklands. He prepared catalogue sheets recording the physical description, condition, purpose and past use (when known) as well as placing a label on each of the instruments. Eight years later, in September 1985, Max Allen and four members of the Bureau of Mineral Resources Historic Collection Committee inspected a representative sample of the collection over two days. The results of this review are outlined in two reports prepared by Max Allen who, in part, recommended that 'a reappraisal and stocktake of the collection should be made' to ensure that all systems were complete and to remove items which had no value for 'geophysical museum purposes'. He went on to recommend that the instruments should be grouped into categories covering the various geophysical techniques. These recommendations were not acted on until after the collection was transferred to the National Museum and then only in part.

The collection has been developed since 1986 by adding equipment and removing items that were duplicated, degraded to a point where they could not be restored or of unknown origin.

In 1991 and 1992, two petrological microscopes and a swivel chair used by Irene Crespin were added to the National Historical Collection (National Museum of Australia collection files – Bureau of Mineral Resources No. 2 and Dr Liz Truswell). Irene Crespin (1896–1980) was Assistant Commonwealth Palaeontologist from 1927 to 1936 and Commonwealth Palaeontologist from 1936 until her retirement in 1961. From 1946 her position was attached to the Bureau of Mineral Resources in Canberra. Crespin was heavily involved in the search for oil for three decades (Bartlett 1993).

The first attempt to provide a consolidated listing of the collection was made in 1997 when National Museum staff examined, identified and labelled individual and grouped items from it. They were greatly assisted in their work of identifying instruments by a set of *Vocabulary of Stores* books – these list instruments with an identifying number, which is generally marked on individual instruments – and the catalogue sheets prepared by Peter Sydenham in 1978 (Shephard 1999; Department of National Development 1962).

Fig. 2. *Oertling gradiometer no. 21636, dating 1928. Implementation: Used on the Imperial Geophysical Experimental Survey. Image: National Museum of Australia, 2006.*

Fig. 3. *Sharp personal torsion magnetometer. Image: National Museum of Australia.*

Fig. 4. *Hunting Adastra Gulf airborne magnetometer. Image: Denis Shephard, 2012.*

Electrical and electromagnetic equipment in the collection includes an electromagnetic compensator system built by Bureau of Mineral Resources to the basic design of original instrumentation used by the Aerial Geological and Geophysical Survey of Northern Australia; several sets of Slingram and Turam equipment manufactured by the Electrical Prospecting Company of Sweden; and a Hunting-Canso airborne electromagnetic system used by Adastra-Hunting in the late 1950s and the 1960s that was given to the Bureau for the collection in 1983. It is possibly that the latter was used in Australia under contract to Rio Tinto Exploration Company in Western Australia and Queensland circa 1956-57.

Gravity equipment in the collection includes Askania torsion balances presented to the Bureau of Mineral Resources by Vacuum Oil in the 1970s; an Oertling gradiometer used by the Imperial Geophysical Experimental Survey during 1929–30 (Figure 2); and Holweck-Lejay inverted pendulums used for gravity base work by Shell (Queensland) Development Pty Ltd in southwest Queensland in 1940–42.

There are about 80 magnetic instruments in the collection, illustrating the evolution from mechanical to electronic equipment. They include a Sharp personal torsion magnetometer (Figure 3); dip circles; absolute magnetometers; a Watts variometer that was one of three used in exploratory magnetic surveys by the Aerial, Geological and Geophysical Survey of Northern Australia (Figure 3); variometers of British

Fig. 5. *CAE Model 965 scintillometer. Image: National Museum of Australia, 2012.*

and German design dating 1935 to 1955; and a fluxgate magnetometer of the type developed by Gulf Oil in 1951 and used by Hunting Adastra during contract aeromagnetic work for the Bureau of Mineral Resources from about 1956 until the early 1960s (Figure 4).

Fig. 6. *Surveying using plane table and alidade. Image: Geoscience Australia, no date.*

Radiometric equipment in the collection includes a Chalk River scintillometer used by the Bureau in the radiometric surveys of Rum Jungle and other uranium provinces of the Northern Territory; a CAE Model 965 scintilometer (Figure 5); and portable geiger counters and ratemeters developed and marketed by Austronic Engineering Laboratories in Melbourne and used throughout Australia.

Seismic equipment in the collection includes a Cambridge Institute sound-ranging set with telephones dating from around 1916; and a Mid-Western reflection set for marine used from the 1960s.

This initial transfer also included theodolites, plane tables, alidades (Figure 6); sextants; and a chronometer that was used on Heard Island in 1947 (Figure 7). Another interesting item is a vehicle odograph, with its components still in their original packaging. The odograph was developed by the United States of America's Corps of Engineers during WWII as a vehicle navigation system. It could plot to any scale between 1 to 20 000 and 1 to 500 000, making it possible to draw a route map showing all the roads in a specified area to the same scale as a topographic map, to an accuracy of one to three percent. Its proposed use by the Bureau is still being investigated.

Two years later, in 1999, following the first systematic examination of the items stored at Oaklands by museum staff, a large number of duplicate representative instruments and miscellaneous unidentifiable items were removed from the

Fig. 7. *Remains Heard Island Base, February 1980. The collection includes a chronometer and theodolite-magnetometer used on the first scientific expedition to Heard Island in 1947. Image: Geoscience Australia.*

Fig. 8. *Scintrex DHP-4 electromagnetic drill-hole probe. Image: National Museum of Australia.*

National Historical Collection. At the same time the collection was transferred from Oaklands to the National Museum's repository at Mitchell in Canberra.

Australian Geological Survey Organisation Collection, 1999

In 1999, the Australian Geological Survey Organisation transferred 85 instruments plus 79 technical manuals and some archival material to the National Museum (National Museum of Australia collection file – Australian Geological Survey Organisation). The instruments included McPhar Model P650 induced polarisation equipment; a Scintrex DHP-4 electromagnetic drill hole probe (Figure 8); a Littlemore Type 781 magnetometer; a Type 1183A dosimeter, Serial No. 1274; BMR Type KSS-1 salinity sampler; two Topoplastic circular slide rules ($V = V_o + at$ and $V = V_o + K_z$); a Unicom electronic microscope (Figure 9); and a Waterworth plotting stereoscope.

The plotting stereoscope was designed and built by Eric Newham Waterworth (1905–90), optical and scientific instrument maker of Hobart, in consultation with Professor Samuel Warren Carey (1911–2002) of the Geology Department at University of Tasmania in the early 1950s. It was used for geological photo-interpretation work but was also suitable for forestry work. The stereoscope was purchased by CSIRO Forest Research at Yarralumla and transferred to the Bureau of Mineral Resources in 1983.

Geoscience Australia Collections Nos 1 and 2, 2004–2008

In 2004, Geoscience Australia transferred a Sun 2 computer system, plus associated manuals to the National Museum (National Museum of Australia collection file – Geoscience Australia No. 1). Nicknamed 'Annie', it was installed in the Bureau of Mineral Resources' seismological centre in Canberra in 1984 where it played a key role in the Bureau's nuclear explosion monitoring program until being decommissioned in 2002. 'Annie's' role was to retrieve and analyse data from the Alice Springs seismic array, which was jointly run with the United States of America Air Force. By 2002, however, it was no longer able to meet the storage demands of the work and was replaced by a system of larger capacity.

Finally, in 2008, Geoscience Australia transferred 71 instruments used in a range of geomagnetic, seismic and laboratory work to

Fig. 9. *Part of Unicam electronic microscope no. 398522. Image: National Museum of Australia, 2012.*

the National Museum (National Museum of Australia collection file – Geoscience Australia No. 2). They included a dip circle, magnetometers, a Benioff seismometer and survey chronometers.

The Lloyd Creek dip circle, serial no. 149 (Figure 10), was made sometime prior to 1904 and was purchased from Sir Douglas Mawson in 1950 for use on Heard Island. However, following testing at Toolangi Magnetic Observatory by RE Ervin, it was found to be unserviceable. Verification of the general, but not universal, acceptance of its use by Mawson in Antarctica continues. The Carnegie Institution of Washington magnetometer serial no. 7, made by Bausch, Lomb and Spegmuller of Rochester in New York in 1908, was used as a standard instrument in the Watheroo Magnetic Observatory from 1919 to 1953.

The Benioff seismometer, comprising a set of three instruments (Vertical, North/South and East/West) was imported from the United States of America in about 1956 and installed in the old Melbourne Observatory. Subsequently, it was shifted to

Fig. 10. *Lloyd-Creak dip circle no. 149. Acquisition: Purchased by Bureau of Mineral Resources from Douglas Mawson in 1950. Image: National Museum of Australia.*

Green Mount near Toolangi in 1962. Before the station went automatic in the 1980s Ron Biggs, a local farmer, would take daily readings for the seismic section of the Bureau of Mineral Resources. Mr Biggs monitored both the magnetic and seismic observatories at Toolangi for over 50 years, from 1952.

Survey chronometer 18786, a standard two-day survey chronometer made by Thomas Mercer in about 1949/50, was used at Mawson Magnetic Observatory, Antarctica, in the 1970s. Like the other Mercers with Antarctic connections in the National Historical Collection, this machine was used as a laboratory time-reference, after being set by radio time signals. On at least one occasion, in January 1976, its time was checked against a reference signal broadcast from Radio VNG. The receiving and broadcasting equipment of Radio VNG are also now part of the National Historical Collection.

Also transferred was an EDA FM-105B fluxgate magnetometer that was used in the search for the South Magnetic Pole in the Southern Ocean on MV *Icebird* in 1985 and MV *Hubert Wilkins* in 2000 (Barton 2001, pp. 26–27); Mawr 2006, pp. 260–265); Askania horizontal variometer 520313 used at Mundaring Magnetic Observatory; and LFE Plasma Asher used in the Organic Geochemistry Laboratory of Offshore Petroleum Exploration in the analysis of sediments to assist in the offshore search for petroleum deposits.

Geophysical instruments and the National Historical Collection

The result of these various transfers and removals is a collection of individually significant and generally representative instruments that illustrates the work of the Bureau of Mineral Resources and its predecessors and successors through the 20th century. The collection also documents the history of significant Australian geophysical survey equipment; documents Australian innovation and inventiveness in geophysical survey equipment; and contributes to an understanding of the evolution of scientific instruments generally.

Several instruments and/or systems in the collection relate directly to Australian relations with the international scientific community. For example, there are about 20 instruments from Watheroo Observatory, including chronometers, magnetometers a spectrohelioscope and a Toepfer earth inductor. Watheroo was established by the Carnegie Institution of Washington in 1919 and transferred to the Bureau of Mineral Resources in 1947. It played a central role in Australia's participation in the International Geophysical Year of 1957–58 in which over 50 countries combined in an international project of universal scientific exploration and research designed to increase knowledge of Earth and the physical forces that influence it (Wilkinson 1996, p. 141). These 20 instruments may constitute the single largest holding of out-of-use magnetic equipment used by the Carnegie Institution. By comparison, the Smithsonian Institution's website indicates that its collection contains only five or six items relating to the geomagnetic work of the Carnegie Institution. One important instrument missing from the collection is the Eschenhagen magnetograph that is currently on display in the foyer of the Geoscience Australia building at Symonston. This instrument operated continuously at Watheroo and Mundaring observatories from 1919 to the 1980s.

The Bureau of Mineral Resources' observatories on sub-Antarctic islands and on Antarctica have also played important

roles in international geophysical research activities. There are items from these observatories in the collection, including survey chronometers, a marine chronometer, a magnetometer and variometers.

As a whole the collection generally reflects the working lives of field and laboratory geophysicists employed by the Australian government. Some instruments and/or systems can also be related to specific people. For example, Seitz Waterlander who worked as a geophysical observer with the Holweck-Lejay inverted pendulums on gravity surveys in southwest Queensland in 1940–42.

A number of other Australian collecting institutions have small but important holdings of geophysical surveying instruments. In 1999, for example, the Australian Museums On-Line database (AMOL) showed three records under 'geophysics' and 15 records under 'magnetometer' as well as 215 under 'geology'. None of these collections, however, covered the full range of geophysical prospecting techniques. Nor did they have a national provenance. The successor to AMOL - Collections Australia Network - shows nil relevant entries when searched on these terms. More research is needed to provide an exhaustive consolidated listing of holdings throughout Australia.

Conclusion

In May 1978, Dr Peter Sydenham argued that the collection he examined was a

> *...significant part of Australia's technological heritage... [should] be made more available to the public, for it presents a significant amount of national activity in the more modern era of the earth science* (Sydenham 1978, p. 243)

Fig. 11. *EDA fluxgate magnetometer displayed in Quest for the South Magnetic Pole, at the South Australian Maritime Museum, July 2009. Image: South Australian Maritime Museum.*

As outlined above, the collection has grown significantly since then. It is only in recent times, however, that Sydenham's plea has been acted upon. About 500 instruments from the collection are currently displayed on the National Museum's homepage (http://www.nma.gov.au, verified 7 March 2013), but with only minimal information about each. Unfortunately, there is no reference to the richness of stories behind either the collection as a whole or of individual instruments within the collection. Beyond the website, only about 10 instruments from the collection have ever been placed on display. The 'Rocks to Riches' module of the Museum's Nation Gallery (now closed) included about eight instruments while the 'Quest for the South Magnetic Pole' travelling exhibition developed by the South Australian Maritime Museum in 2010 included the EDA fluxgate magnetometer (Figure 11) and dip circle 149.

Much more could be done to increase public access to this nationally significant collection of geophysical equipment.

In following articles I will examine aspects of the collection in more detail, commencing with equipment brought to Australia by the Carnegie Institution of Washington's Department of Terrestrial Magnetism.

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The Continental Drift Controversy

by Henry R. Frankel
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2012, Vol. I 632 pp., Vol. II 544 pp.
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The Continental Drift Controversy by Henry R. Frankel is a tetralogy beginning with Vol. I *Wegener and the Early Debate*, followed by Vol. II *Paleomagnetism and Confirmation of Drift*, Vol. III *Introduction of Seafloor Spreading* and concluding with Vol. IV *Evolution into Plate Tectonics*. These works document, as fully as possible for one individual, the trials and tribulations of Earth Scientists last century to synthesise geological information gleaned from earlier centuries and the more refined data as it became available through to the 1960s. Frankel's works cover the separate stages of the continental drift controversy, from the early suggestions by Wegener and others that the Atlantic continents, i.e. their continental shelves, fit together too well for it to be simply chance, to the truly amazingly rapid development and success of paleomagnetic methods in the 1950s, to the realisation that seafloor magnetic and seismic data were screaming out to be recognised as evidence of seafloor spreading (the missing sibling of continental drift) in the 1960s and the last volume tops off these developments with the crowning jewel of Plate Tectonics, every bit as consequential as Evolution, Relativity and Quantum Mechanics.

This astonishing saga by a few ringleaders is often compared with Darwin's and Wallace's contributions to Life Science and Planck's, Einstein's and others' contributions to the Physical and Chemical Sciences. It is on a par with these. The personal conflicts are similar in all these great revolutions, with typically elder stalwarts refusing to budge. Just as in the 19th century the natural philosophers were divided between 'Neptunists' and 'Plutonists', the early 20th century Earth Scientists were divided between 'Fixists' and 'Mobilists'. However, within a short period of few decades, a complete revolution occurred in favour of 'Mobilism' and newcomers to Earth Science late last century and later imagined it had never been different. The socio-philosophic interplay is filled with intrigue and enlightenment. The debates are exemplary of the scientific process reminiscent of the great experimentalists, Bacon, Boyle and Hooke who held peer review and reproducibility of results above all else. Frankel puts a microscope on the past, with the benefit of hindsight, and retrospective interviews with the surviving ringleaders of the revolution, he reconstructs the key tipping points that inexorably led to Plate Tectonics as we know it today. In this review I hope to give the reader a flavour (to attempt more would be foolhardy) of the contents of Vols I and II, and in a subsequent article I will review Vols III and IV.

Vol. I is divided into nine chapters covering (1) *The mobilism debate*, (2) *Wegener and Taylor*, (3) *Sub-controversies of drift: 1920s–1950s*, (4) *The mechanism: 1921–1951*, (5) *Arthur Holmes: 1915–1955*, (6) *Mobilism in South Africa, India and South America: 1920s to early 1950s*, (7) *Mobilism in North America: 1920s through 1950s*, (8) *Mobilism in Europe: 1920s through 1950s*, and (9) *Fixism in Australia: 1920s to the mid-1960s.* Alfred Wegener's evidence for continental 'displacement', as he referred to it, did not stop with congruency of continental shapes. He also amassed much palaeontological evidence, especially from land plant fossils and, unsurprisingly since he was a meteorologist, published much on palaeoclimates, particularly with his father-in-law, Wladimir Köppen. It was the translation of his books into English in the 1920s that threw down the gauntlet to the fixist orthodoxy. Harold Jeffrey's life-long objections to drift are well known, and stated early that drift was 'out of the question' because the sima is too strong. Vol. I p. 59 states that 'All these observations suggest that sima is plastic…… and that the sialic rind possesses a considerably greater strength without lacking plasticity altogether' (Wegener, 1912). Wegener also stated that 'the Mid-Atlantic Ridge ... zone in which the floor of the Atlantic, as it keeps spreading, is continuously tearing open and making space for fresh, relatively fluid and hot sima [rising] from depth' (Wegener, 1915), but while the majority was against drift, Wegener did not pursue seafloor spreading further. Wegener was clearly ahead of his time.

After the single American edition of Wegener's work was published in 1925, the American Association of Petroleum Geologists held a symposium to oppose the dangerous notion of continental drift. This strong negativism of US workers may play a part in their belated acceptance of drift, and the puzzling trouble John Graham, Carnegie Institution, took to trash his own work to which I'll return later.

Unfortunately Wegener did not live to see his work vindicated. Vol. I p.45 states Wegener 'died in Greenland leading a scientific exhibition' (obviously *expedition*, one of the few typographical errors I found). Frankel also discusses in some detail hypotheses of Frank Taylor (continental creep), Eduard Suess, James Dana (contractionism), Alex Du Toit (disjunct biota/glacial stratigraphy), John Joly (thermal cycles) and others beyond the scope of this review.

Like Wegener, Arthur Holmes (whose textbook that I bought in 1969 was the best valued book I ever purchased, 1288 pages @ 0.54c per page), was also aware that rocks could 'flow' under heat and pressure and developed his theory of *substratum convection*. Jeffreys 'grudgingly admitted that…. [it] moved mobilism from the impossible to the highly unlikely' (Vol. I p. 203). Holmes was instrumental in the development of the radiometric determination of rock ages. He clearly had a good grasp of radioactive decay and its thermal consequences on the behaviour of rocks deep in the Earth. Frankel devotes a whole chapter (5) to Holmes, such was his immense contributions to geology.

Chapters 6 to 8 of Vol. I discuss how mobilism was received around the world up to 1950s, when the game suddenly changed with the rise of paleomagnetism. In the last chapter (9) Frankel views

Australia as a nest of fixists. A brief (pp.497–502) section (9.2) headed 'Geologists working on Australia's geology favourable to mobilism' is followed by a long tract (pp.503–545) of sections 9.3 to 9.6 headed 'Geologists against mobilism', 'Paleontologists…. in Australia reject mobilism', 'Biologists.. in Australia disagree' and 'Regionalism in Australia'. Five pages 'for' and over 40 'against'. I do remember my first year structural geology class being taught geosynclines and the 'Steinmann Trinity' in first term. The lecturer came in after a good read over Easter and stated we would be taught plate tectonic in second term. This department was 'Geology & Geophysics' and the head of geophysics was none other than Ron Green and it was almost 1970 so, recalling the title of chapter 9 *Fixism in Australia: 1920s to the mid-1960s*, perhaps Frankel has a point!

In the (small) mobilist camp Edgeworth David receives singular treatment but others favouring mobilism were Leo Cotton (who inspired, some would say incited, Sam Carey) and Douglas Mawson (Antarctic expedition). Mawson went to Antarctica to examine the coastal geology to compare to that of South Australia, and while things went awry, he clearly took Wegener's ideas seriously. In a section (9.3) headed 'Geologists against mobilism' Frankel lists Ernest Andrews (of Broken Hill fame), as 'the most outspoken Australian anti-mobilist'. Andrews was an early student of David's, either before his teacher decided where he stood on the issue or strongly disagreeing with his teacher. The naysayers include Walter Bryan (of Mining and Geology Research Centre, UQ fame), Edwin Sherbon-Hills (University of Melbourne), William Browne, who laboured for years to finish David's *The Geology of the Commonwealth of Australia*, but disagreed with him on mobilism and Curt Teichert, who thought the lack of Permian land animals in Australia, so abundant in South Africa and South America, was a problem for mobilism. Browne also helped Ted Irving and Ron Green on fieldwork when in his late 70s, but did not accept their findings, even rejecting a manuscript of Irving's submitted to the Journal of the Geological Society of Australia.

Moving onto Vol. II, which describes the incredible discoveries of the 1950s, the reader is introduced to more quandaries, True Polar Wander (TPW) versus Apparent Polar Wander (APW), the latter inferring another cause for polar movements, such as drift, and Geomagnetic Reversals versus Self-reversal. Both these issues were shrouded in baffling ambiguities that were only fully unravelled after new evidence came to light. In both these debates Australian researchers were to play a central role. Vol. II is divided into eight chapters covering (1) *Geomagnetism and paleomagnetism*: *1946–1952*, (2) *British paleomagnetists: summer 1951 to fall 1953*, (3) *Global paleomagnetic test: 1954–1956*, (4) *Runcorn shifts to mobilism*, (5) *Refinement of paleomagnetic support: 1956–1960*, (6) *Earth expansion*, (7*) Criticism of paleomagnetism: late 1950s and early 1960s*, (8) *Reaction against the paleomagnetic case and the radiometric reversal timescale: 1958–1962*. Below I pick the eyes out of these juicy morsels.

Some may be surprised to learn that the first group to study paleomagnetism was at the Department of Terrestrial Magnetism, Carnegie Institute in Washington, DC, in the late 1930s. John Graham is best remembered for devising the fold test and conglomerate test, which before the advent of laboratory 'cleaning' techniques were essential to demonstrate reliability. It is truly ironic that Graham found directions strongly oblique to the local geomagnetic field direction in folded strata that satisfied his fold test but dismissed them, preferring directions from flat lying strata aligned with the field. The director of Terrestrial Magnetism was a fixist and did not believe in geomagnetic reversals. It seems that to keep his job Graham had to spirit away his perfectly reliable results. Graham tortured himself for the remainder of his career bringing forth all kinds of spurious reasons why rocks can show oblique magnetisation direction, even reversals. To further confound matters, in 1951 Japanese workers, Seiya Uyeda and Takesi Nagata, published results from the Haruna dacite demonstrating self-reversal. This dacite begins cooling with its (net) magnetisation aligned with the field, but after cooling further the previously subordinate sub-lattice becomes dominant and the (net) magnetisation is reversed. One can imagine how this set a cat among the pigeons!

Meanwhile, Jan Hospers in Cambridge was accumulating results from Iceland that showed normal and reverse basaltic layers held a consistent stratigraphic relationship. Evidence for geomagnetic reversals became stronger as various groups began systematic studies of young piles of volcanics. Hospers was fortunate to have Ron Fisher in Cambridge to show him how to apply statistics to his results. Fisher statistics introduced order and consistency to the reporting of paleomagnetic results.

In 1950 Keith Runcorn was in Manchester, studying under Patrick Blackett, who had developed a magnetometer to test his theory about the fundamental origin of magnetism. Although his experiment proved negative, Runcorn realised the magnetometer could measure the weak remanence of rocks. Runcorn was interested in secular variation of the geomagnetic field, as a means to study the mechanism behind it. Runcorn thought a thick sedimentary sequence would be ideal to record such variations. In 1951 Runcorn moved to Cambridge and hired Ted Irving to give him the geological guidance he needed. Ted was a mobilist and interested in palaeomagnetism to detect polar motions. Ken Creer also joined this group and 1952 to 1954 was such a prolific period of determining basic paleomagnetic results their full interpretation and meaning was not immediately appreciated, certainly not by Runcorn. Irving and Creer knew their results better than anyone else, they knew that the armchair critics were fooling themselves. But Irving failed his PhD, only because his examiners would not fully appreciate his results. Creer had a better run, with Blackett as one of his examiners. This did not concern John Jaeger, who was setting up geophysics at ANU, and when offered Irving jumped at the chance to test drift using Australian rocks. Irving was sent a few samples of Deccan Traps for his Ph D and he realised the secret to differentiating between TPW and APW lay in studying the magnetisation of Gondwana continents. By 1956/57 Irving, with his student Ron Green, had proved the point and although the fixists still outnumbered the mobilists the latter camp was growing, even Runcorn switched camps.

In a twist of fate Irving's results from the Deccan Traps caused Allan Cox at the USGS Berkeley labs to reject mobilism and concentrate on the study of reversals. John Clegg from Blackett's group confirmed Irving's result so the Deccan Traps pole position could not be spirited away as Graham had sought to do to his results. Cox had sampled the Eocene Siletz River Volcanics in Oregon

and found a similar pole to that of the Deccan Traps. Although Irving suggested that Oregon may be rotated, which in fact turned out to be correct, Cox was unconvinced, his mind closed. Irving and Cox did not always enjoy a convivial relationship, especially when Irving and another of his students, Don Tarling, began working on reversal stratigraphy of Pacific islands, including Hawaii, with Ian McDougall as geochronologist. Irving never saw this as a competition but Cox apparently did, claiming that the USGS would only allow them to work on the Hawaiian Islands. It was years later when Irving was awarded AGU's 1979 Bucher Medal that Cox made amends with a conciliatory citation. Vol. II ends with a postscript describing latter-born mobilists justifying their early recalcitrance on various grounds, dissembling and revising history to suit. Clearly this was not confined to the US and Australia.

As if the profusion of quotes and citations throughout the text are not enough to support Frankel's reconstruction of events, each chapter is followed by copious and detailed notes carefully written to explain arcane scientific concepts and interesting asides that put various ideas into their societal and scientific context. Read and studied cover to cover the reader is assured of a solid grounding in historical geology and geophysics. The new word I learnt from Frankel is *consilience*, which I could not find in my 1690 page Collins English Dictionary. However, from Wikipedia all becomes clear – 'consilience (also convergence of evidence or concordance of evidence) refers to the principle that evidence from independent, unrelated sources can 'converge' to strong conclusions.' Most apt.

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Remote geophysical consulting

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With the skyrocketing cost of Perth office space, and the global trend of remote staffing, I thought I would try an experiment and work remotely from head office within my humble abode.

The technology available for working remotely is really very good. I thought that aside from a few technical hurdles, it would be easy to work from home so that I could see my kids off to school in the morning and help pick them up at the end of the day – maybe take some pressure off of my wife? In between, I could get in a full day of uninterrupted work – and start to eat regular meals (win–win).

I am a person that does not work well with interruption. I tend to end up working on the last thing I was asked to do and my priorities go out the window. Working from home would allow me to shut out office distractions and focus more on the priority tasks – plus I could leave NHL.com open on my second screen all day and keep track of the ice hockey scores without fear of anyone seeing me use the internet inappropriately.

When working at the office, I used to get in early, check my mail and then complete as much as possible before the 'Good morning's' of staff arriving and the sound of the grinder on the espresso machine distracted me from my duties.

In my line of work, technology is a big essential to being productive. Internet access, a solid connection to my virtual private network back at the office, printing capabilities, voice and video communication and good coffee simply go hand in hand. With any one element missing, my entire ability to work is marginal at best.

For voice and video I use Skype mainly because it is ubiquitous, and free. With Skype, I can still stay in touch with everyone at the office, attend meetings, plus you get the added upside of emoticons to express dissatisfaction or do the odd breakdance, followed by a beer, martini and a headache (or regurgitate – love that one): 🕺🍺🍸🤢. I also discovered that Skype allows me, free of guilt, to interrupt anyone at head office, while making it near impossible for them to deny they are there.

So off I went to start the experiment. My cardboard box (with the bottom that always falls out) of desk essentials under one arm, and my laptop and 'Don't Mess with Texas' coffee mug in the other.

Game plan

1. Get up early.
2. Knock out a bit of work and some communications before kids get up.
3. Feed kids and get them to school.
4. Return to desk with third cup of coffee and check NHL.com over breakfast.
5. Work until lunch.
6. Attend regular management meetings during the day via Skype.
7. Then help pick up kids from school.

Obstacle 1: five kids in four schools

I forgot that I have five kids in four different schools. Their school days start within 15 minutes of each other, so the race to get everyone to their schools on time is fairly demanding (let's not lie – it is impossible). The kissing my wife on the cheek and heading out of the driveway to the office in the morning has been replaced with two nappy changes, three kids showers, five bowls of cereal, four school lunches, four episodes of *SpongeBob*, 10 pairs of shoe laces to tie, the occasional extra nappy change, and a lost shoe or hockey stick, or swimming goggles that MUST be located.

In the first few weeks, I don't think anyone in the office missed me. We had five key data management projects on in three different countries so my schedule was quite busy and staying on top of my duties was not easy, but I managed. Then it happened…

Obstacle 2: school holidays

Did I mention that I have five kids?

The two nappy changes, three kids showers, five bowls of cereal, four school lunches, four episodes of *SpongeBob*, 10 pairs of shoe laces to tie, the occasional extra nappy change, and a lost shoe or hockey stick, or swimming goggles was replaced with a living hell like I have never known.

I never knew that an 8 year old could eat his bodyweight in corn flakes and still manage to utter the words, 'what do we have to eat?'. And now, by 8:00 am (when I should be about to get stuck into my day), the voices start. At first I thought they were in my head, but no they were at my feet: 'What are we going to do today?; 'Can I have XYZ over for a play date?; 'Have you seen my Lego Batman Bat Mobile service station?'. By 8:30 am, when I would normally be working so hard that veins would stick out of my neck, I hear 'I'm bored, I'm hungry, Lucy took my Lego Batman Bat Mobile service station', and of course, the mildly entertaining *SpongeBob* theme song as the sultry tones underpinning all of the banter (how many episodes did they make of that show!?).

The results

1. Technology: performed well and was in no way linked to a downturn in productivity.
2. Meetings: I attended 100% less.
3. Time management: I learned skills that would not have been possible at the office (like building a Lego castle with a 6 year old while talking to the exploration manager of a large multinational oil company).
4. Sales skills: I picked up new sales skills like getting five kids into one car without arguments by offering (or 'selling them on') a choice of ice cream or icy pole when they get home from school).
5. Pseudo-geophysical skills: I learnt that dirty nappy odours are non-linear – steeply logarithmic over time and also omnidirectional irrespective of wind direction or speed of infant travel.

Conclusion

The overall desired outcome of helping my wife out by being at home during the day while still being productive – an impossibility.

The demise of ASEG polarity

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I would like to dispatch to the annals of history the term ASEG polarity or Australian SEG polarity when referring to seismic data displays. There is no ASEG polarity standard.

Seismic data polarity is a common source of confusion for many interpreting geophysicists (Simm and White 2002), including me. As a joint venture representative I attend meetings and presentations with several companies and to fully understand the presentation material it is necessary to confirm the display polarity because it determines how an increase (e.g. intrusives) or decrease (e.g. gas sand) in acoustic impedance appears.

The only definition of normal or standard polarity I know is given in the SEG *Encyclopedic Dictionary of Applied Geophysics* (Sheriff 2002) – here is an excerpt from the online version (http://wiki.seg.org/index.php/Dictionary:Polarity_standard):

'…for a zero phase wavelet, a positive reflection coefficient is represented by a central peak, normally plotted black on a variable area or variable density display. This convention is called **positive standard polarity**…' (an increase in acoustic impedance produces a positive reflection coefficient). There is also a definition for minimum phase wavelets but I will stay with zero phase because most seismic processing aims to output a zero phase wavelet – a symmetrical wavelet with a maximum value at zero time.

The SEG Dictionary also describes dual polarity displays as 'Troughs may be colored red and peaks blue or black, or some other combination of colors may be used.' This is more like a suggestion but is an extension of the polarity definition – if the peaks are coloured black a contrasting colour, commonly red, was used to colour troughs.

The SEG Positive polarity definition makes sense because an increase in impedance produces a positive reflection coefficient which is displayed by a positive number or black peak. With this definition the mathematics is consistent and AVO analysis and seismic inversion is simpler with no need to swap sign.

But in Australia and Europe the opposite convention is often used. The correct name for this convention is SEG Negative standard polarity, not ASEG polarity. The SEG polarity standard is quite clear and is illustrated below (Figure 1) along with the polarity conventions used by an Australian operator, an international operator working in Australia and a European service provider. To confuse interpreters even further Operator A displays AVO (Figure 2) and inversion results with the opposite polarity to their display of standard seismic data. They do this to avoid the situation shown in Figure 3. Even industry leaders Schlumberger (2013) have no consistent usage, with their excellent web-based Oilfield Glossary correctly describing Positive polarity while their Petrel software defaults to something else.

Figure 3 is an example of AVO modelling from a recent prospect presentation that I attended. This company displays seismic data as SEG Negative polarity (an increase in impedance is displayed as a trough) while their seismic modelling results are displayed with SEG Positive polarity. To enable the modelled and actual curves to be compared directly one of the displays has been flipped. In this case the model display was flipped and the curves can be compared but the text and labels are difficult to read.

So what has brought about this confusion?

We can blame it on computers – the introduction of digital recording brought about the need to define polarity and this led to the SEG polarity standard published in 1975 (Thigpen *et al*. 1975).

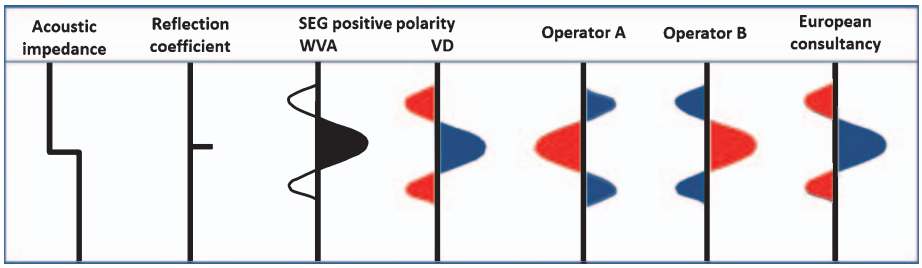

Fig. 1. *The SEG positive polarity standard for zero phase wavelets. From left, an increase in acoustic impedance ptroduces a positive reflection coefficient that is displayed on wiggle variable area displays as a black peak or blue on a variable density colour display. The three right wavelets illustrate the variety of conventions used by three companies operating in Australia. Only one uses the SEG standard.*

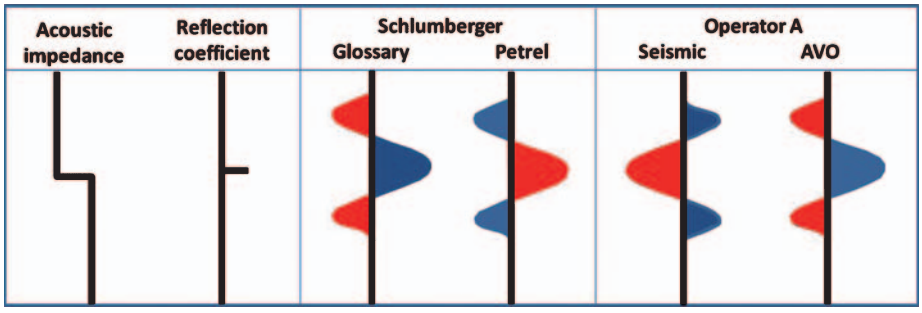

Fig. 2. *Even companies with well-defined standards have internal variation. The Schlumberger glossary of oil field terms (internet) correctly describes the SEG standard, but their interpretation software (Petrel) defaults to something else. A major operator uses SEG Negative polarity for seismic displays but reverts to SEG Positive polarity for QI and AVO displays.*

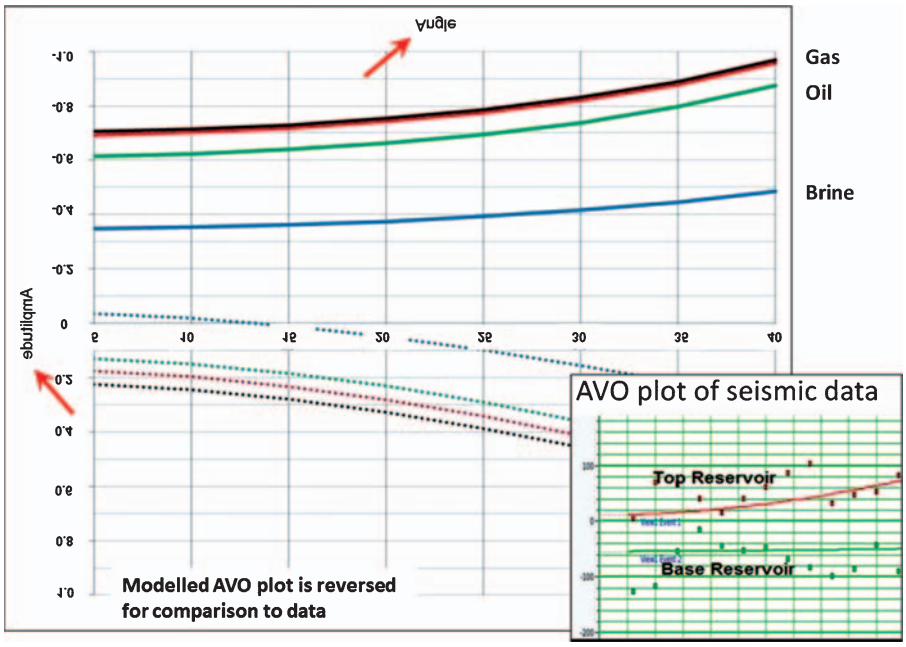

Fig. 3. *Example of AVO modelling results presented by an Australian operator. For comparison the display of modelled results has been inverted to account for the negative polarity convention of the seismic data (lower right). Inverting the graphical display to match the measured seismic response results in unreadable text (arrows).*

This document provided details of tests and standards for seismic acquisition and included this text '… An increase in acoustic impedance … recorded as a negative number on tape…'. I understand this was a pragmatic decision because most manufacturers at the time wired their sensors in this way. But the standard was for acquisition standards and did not contain a definition for displaying the data on paper or computer screens. About 1988 John Denham (Chief Geophysicist BHP) queried the authors of the 1975 standard and they replied confirming that the standard did not include displaying the recorded data for interpretation. It was not until the mid-90s that the later editions of the SEG *Encyclopedic Dictionary* defined polarity without any fanfare – the definition just appeared. The intervening gap of approximately 20 years was plenty of time for various companies to implement their own polarity definition. Generally, the US went for SEG positive and Europe and Australia went negative or reverse polarity.

There are a number of reasons for the negative polarity convention becoming common place. Here are three.

Probably the simplest is that a negative number on tape is simply displayed as a trough on paper.

The second reason harks back to seismic refraction records. Refraction seismic uses first arrivals which are refracted along a boundary across which the seismic velocity (impedance) increases and commonly refraction instruments were wired to display first arrivals as a deflection downwards. This convention carried over into seismic reflection records.

All very technical but my favourite explanation is an anecdote from the days when seismic interpretation was drawn on paper sections using coloured pencils to pick reflectors which were most commonly at major increases in acoustic impedance. If the increase in impedance was displayed as a trough (an unfilled wiggle deflecting to the left) the coloured pencil line was easier to see. This convention also had the added bonus that the coals (common in the Gippsland and Cooper Basins) were displayed as black peaks and hence looked 'coally'.

This brings me back to my opening – for consistency we should all be using the SEG Positive polarity standard and terms such as ASEG or Australian polarity should be replaced with the correct term SEG Negative polarity. Unfortunately I haven't seen any evidence of willingness in the industry to move in this direction and there will be more confusion when 4D seismic and shear wave data becomes more commonplace.

Finally I'll finish with an extract from a Schlumberger Petrel users guide . The Polarity and colour conventions described in Petrel manuals are '…the default color scale displays troughs as 'cold' blue colors and peaks as 'hot' red and yellow colors. This appears to be against another popular convention used, whereby positive amplitudes are usually displayed in blue tones…. Whatever convention is chosen, it is up to each user to make this clear in any resulting map or display showing amplitude related information.' Thanks for that – this is exactly why the confusion continues.

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May			**2013**
10–13 May	SEG/AAPG African Geosciences Student Conference http://www.agsc2013.org/	Lagos	Nigeria
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8–11 Sep	Near Surface Geoscience 2013 http://www.eage.org	Bochum	Germany
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6–11 Oct	SAGA 13th Biennial Conference and 6th international AEM 2013 http://www.saga-aem2013.co.za/	Mpumalanga	South Africa
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November			**2013**
18–20 Nov	The 11th SEGJ International Symposium: Geophysics for establishing a sustainable secure society http://www.segj.org/is/11th/	Yokohama	Japan
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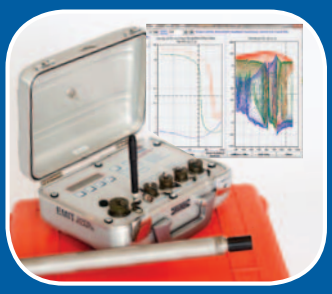

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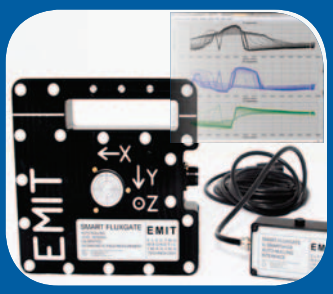

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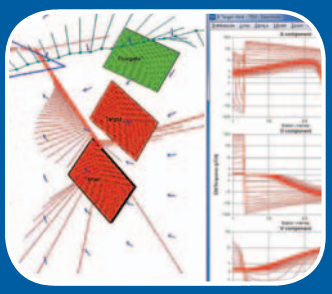

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