



# PREVIEW



## NEWS AND COMMENTARY

Vale Chris J. Wiles

The 2015 ASEG Research Foundation awards  
Education Matters: Timely advice for students  
Environmental Geophysics: Mythbusters  
needed

Minerals Geophysics: Is this downturn  
morphing into a Black Swan event?

Seismic Window: Save the bees

Data Trends: The good, the bad and the ugly

## FEATURES

The Australian Geoscience Council in 2015  
Extracting three component magnetic data  
from down hole surveys: magnetic data  
for free

# Freedom to imagine.

**Geometric Freedom™** lets you focus strictly on your ultimate goals, obtaining the highest quality data despite any geological or operational challenge.

Nodal technology illuminates subsurface mysteries like never before. No one knows that better than we do. We pioneered the technology and have more experience with it, by far, than anyone else around. Our nodal systems, acquisition, proprietary nodal processing techniques and licensing expertise come together to solve the world's most daunting seismic challenges. What can we do for you?

[fairfieldnodal.com](http://fairfieldnodal.com)

 **fairfield**nodal



# PREVIEW

## ADVERTISERS INDEX

Alpha Geoscience . . . . .	42
Archimedes Financial Planning. . . . .	42
Fairfield Nodal . . . . .	IFC
CoRMaGeo . . . . .	42
Daishat Aerosystems. . . . .	IBC
EMIT. . . . .	OBC
GBG Australia . . . . .	42
GEM Geophysics . . . . .	2, 36
Geophysical Software Solutions . . . . .	42
Geosensor . . . . .	42
Geosensor Wireline . . . . .	42
GPX Surveys. . . . .	28
Groundwater Imaging . . . . .	42
Magnetic Earth . . . . .	43
MagSpec. . . . .	6
Minty Geophysics . . . . .	43
Mira Geoscience . . . . .	43
Quantec Geoscience . . . . .	43
Systems Exploration. . . . .	43
Tensor Research . . . . .	19, 43
Thomson Aviation . . . . .	11
Vortex Geophysics. . . . .	30
Zonge. . . . .	12

## 2015 ASEG CORPORATE MEMBERS CORPORATE PLUS MEMBERS

Velseis Pty Ltd

## CORPORATE MEMBERS

Beach Energy  
Geotech Ltd  
Papuan Oil Search Limited  
Petrosys Pty Ltd  
Quantec Geoscience Pty Ltd  
Rio Tinto Exploration Pty Ltd  
Santos Ltd  
Seismic Asia Pacific Pty Ltd  
Southern Geoscience Consultants Pty Ltd  
Terrex Seismic  
Wireline Services Group  
Zonge Engineering

## FRONT COVER



Delegates to the Near Surface Geophysics AP 2015 Conference in Hawaii emerging from a lava tube. Photo: Greg Street.

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

## CONTENTS

Editor's Desk . . . . .	2
<b>ASEG News</b>	
President's Piece . . . . .	3
New Members . . . . .	4
Table of Officeholders . . . . .	5
Executive Brief . . . . .	6
• The 2015 ASEG RF awards . . . . .	6
• Technical Standards Committee news . . . . .	7
Branch News . . . . .	8
National Calendar: technical meetings, courses and events . . . . .	13
<b>News</b>	
People . . . . .	14
• Vale Chris J. Wiles . . . . .	14
Conferences and Events . . . . .	15
• Near Surface Geophysics AP Conference 2015 . . . . .	15
Geophysics in the Surveys . . . . .	16
• GA: Update on geophysical survey progress . . . . .	16
• GSQ: New geophysical data acquisition and release . . . . .	19
• GSSA: News . . . . .	22
<b>Education Matters</b>	
• Seminar time: Seven steps to selling your project . . . . .	23
• Forthcoming lecture tours for professional development and continuing education . . . . .	24
<b>Environmental Geophysics</b>	
• Mythbusters needed . . . . .	28
<b>Minerals Geophysics</b>	
• The minerals industry downturn: a Black Swan event or just part of another cycle? . . . . .	29
<b>Seismic Window</b>	
• Save the bees . . . . .	31
• 2015 Offshore Petroleum Exploration Acreage Release . . . . .	32
<b>Data Trends</b>	
• The good, the bad and the ugly . . . . .	33
<b>Features</b>	
The Australian Geoscience Council in 2015 . . . . .	35
Extracting three component magnetic data from down hole surveys . . . . .	38
Business Directory . . . . .	42
International Calendar of Events . . . . .	44

### Editor

Lisa Worrall  
Email: [previeweditor@aseg.org.au](mailto:previeweditor@aseg.org.au)

### Associate Editors

Education: Michael Asten  
Email: [michael.asten@monash.edu](mailto:michael.asten@monash.edu)

Government: David Denham  
Email: [denham1@inet.net.au](mailto:denham1@inet.net.au)

Environmental Geophysics: Mike Hatch  
Email: [michael.hatch@adelaide.edu.au](mailto:michael.hatch@adelaide.edu.au)

Minerals Geophysics: –  
Email: –

Petroleum Geophysics: Michael Micenko  
Email: [micenko@bigpond.com](mailto:micenko@bigpond.com)

Geophysical Data Management and Analysis:  
Guy Holmes

Email: [guy.holmes@spectrumdata.com.au](mailto:guy.holmes@spectrumdata.com.au)

Book Reviews: Ron Hackney

Email: [ron.hackney@ga.gov.au](mailto:ron.hackney@ga.gov.au)

### ASEG Head Office & Secretariat

Ben Williams  
The Association Specialists Pty Ltd (TAS)  
Tel: (02) 9431 8622  
Email: [secretary@aseg.org.au](mailto:secretary@aseg.org.au)  
Website: [www.aseg.org.au](http://www.aseg.org.au)

### Publisher

CSIRO Publishing

### Production Editor

Helen Pavlatos  
Tel: (03) 9545 8472  
Email: [helen.pavlatos@csiro.au](mailto:helen.pavlatos@csiro.au)

### Advertising

Doug Walters  
Tel: (03) 9545 8505  
Email: [doug.walters@csiro.au](mailto:doug.walters@csiro.au)



Lisa Worrall

One of my daughters recently graduated from ANU with a PhD in the biosciences. I attended the graduation ceremony and was pleasantly surprised to find that a well-known Australian geologist was addressing the new graduates – including graduates in the geosciences. He had an optimistic message: they all had a good degree from one of the best universities in the world and the future was theirs.

'Typical of a baby boomer' was my daughter's response, 'they have no idea'. I probed a little deeper and discovered that she, and her cohort, were of the view that individuals who graduated in science in Australia in the 60s and 70s had graduated during a golden era. Today's graduates think that the employment landscape back then was so different to the employment landscape today that the baby boomers may as well have been graduating on the moon. They did not

have to 'manage' their career, to wrestle it into existence. They had their careers gifted to them on a plate – along with their generous superannuation salaries and lucrative redundancy payments.

Now, my daughter is managing her career very well. She has already been first author on a number of papers in prestigious journals, including *Nature*, and has a well-funded post doctoral position at Oxford University. But I take her point, and wonder if we are doing enough to prepare geoscience students for the vicissitudes of our profession. Are we being honest or overly optimistic in our advice – particularly to those just starting out? I am regularly asked for career advice. I was approached by a UQ student after a talk I just gave to the local chapter of the AusIMM so I thought I'd test her understanding of her prospects by saying something about the current downturn. I was astonished to discover that this student had no idea that the minerals industry was subject to boom bust cycles. None of her career advisors or her lecturers had discussed the matter with her. It was all travel and adventure and astronomical salaries – never mind put half your salary aside as you could be unemployed half the time you're out there! The profession might lose her – or it might not – either way, with a better understanding of the industry she is better informed and better able to shape her future.

Concern about the impact of the downturn on the availability of qualified and experienced professionals to serve the industry in boom times is expressed by Bill Shaw and Jon Hronsky in the feature on the AGC published in this issue of *Preview*. Ken Witherly expresses similar concern in his commentary on the downturn, also published in this issue of *Preview*. He suggests, however, that elements of this downturn portend a radical change in the nature of the industry. If he is right, the nature of the advice we offer to students will have to change dramatically.

Innovation and creativity are hallmarks of our profession, especially in difficult times, and Kim Frankcombe's work on extracting three component magnetic data from downhole surveys, which is published in this issue of *Preview*, is typical. Free data are good. Free, albeit basic, software packages for analysing and interpreting data are also good. Now, if only the AGC could corral state and federal governments, and related organisations, into providing access to equipment and facilities for underemployed industry professionals through some kind of fellowship scheme, graduates planning to join the industry could be less concerned about their future.

Lisa Worrall  
Preview Editor  
[previeweditor@aseg.org.au](mailto:previeweditor@aseg.org.au)



Specialists in ground Electro Magnetic Surveys  
for mineral exploration Australia and International

**NEW**



## The Jessy Deep HT Squid

### Capabilities:

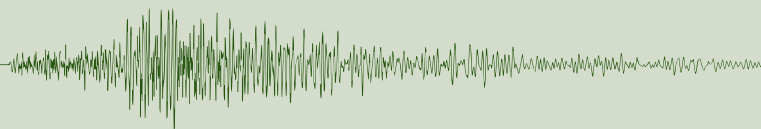
- Ultra sensitive receiver for ground transient electromagnetic (TEM) measurements
- Data recorded 10 times longer or 3 times deeper
- Ideal for measuring targets covered by a conducting overburden
- Direct measurement of the magnetic field
- High magnetic field resolution at low frequencies
- Flat frequency response from dc up to 10 kHz

Please contact Ben Morgan for more information.

p: +61 8 9739 2011  
f: +61 8 9739 2012

e: [gem@gemgeophysics.com.au](mailto:gem@gemgeophysics.com.au)  
w: [www.gemgeophysics.com.au](http://www.gemgeophysics.com.au)





## How the ASEG compares to sibling associations

Having been a member of the ASEG Federal Executive for 10 years you would think that I would know a lot about the like-minded organisations in other countries, but I'm finding out quickly that I do not. I learnt a fair bit about publishing, being the Publications Chairman, but that only really exposed me to the SEG, to SEG Japan (SEGJ) and the Korean SEG (Korean Society of Earth and Exploration Geophysicists, KSEG). Notwithstanding our august parent body, SEG, this article considers our siblings, most of whom have a shared parentage, and how we might better interact.

The SEGJ is considerably older than ASEG. It was established in 1948 with objectives relating to the promotion of the science and technology of geophysical exploration. SEGJ has had up to 1500 Active Members, 150 Corporate Members and 60 Student Members, although those figures have diminished a little of late. The first issue of their journal, *Butsuri-Tanko* ('Geophysical Exploration'), was published just a month after the Society was established.

The KSEG was established in 2007 by the merger of the Korean Geophysical Society and the Korean Society of Exploration Geophysicists, which brought together more than 700 members interested in both pure and applied geophysics with the Korean language publication *Jigu-Mulli-wa-Mulli-Tamsa* ('Earth and Exploration Geophysics').

While *Butsuri-Tansa* (the journal was renamed in 1986) primarily publishes papers in Japanese, many Japanese authors wanted to reach more readers internationally by publishing their papers in English. So, in October 2001, when SEGJ held its conference in Fukuoka, Koya Suto was asked if it would be possible to establish a joint journal between SEGJ and ASEG. Since ASEG was contemplating expanding its activities to Southeast Asia a joint journal covering the western Pacific was considered to be an ideal vehicle to promote geophysics in the region. The proposal was put to the ASEG Federal Executive and it was decided that such a publication would make a positive contribution towards international collaboration.

SEGJ and KSEG delegates met with ASEG executives at the ASEG

Conference in Adelaide 2003 and the idea of a yearly joint issue of the regular journals emerged as the preferred option. To facilitate page numbering of the different journals we began with the first issue of each in 2004: *Exploration Geophysics* (vol. 35, no. 1) of the Australian SEG, *Butsuri-Tansa* (vol. 57, no. 1) of the SEG of Japan, and *Mulli-Tamsa* (vol. 7, no. 1) of the Korean SEG. The papers were peer-reviewed within each Society and each Society nominated an Editor for the first issue each year to work with the ASEG Managing Editor, Lindsay Thomas. The ASEG Managing Editor also helped refine the English in papers of Japanese and Korean origin. Following this successful launch the three Societies have since extended the agreement to cover all four issues. The commencement date for the combined journal was January 2012 with Mark Lackie as Managing Editor.

Several ASEG Members have raised the possibility of expanding *Exploration Geophysics* to include other societies, which is the point of this article. What other societies have been suggested and, indeed, which have raised the issue themselves?

Himpunan Ahli Geofisika Indonesia (HAGI) have, in fact, asked SEGJ about a joint English publication. Naturally SEGJ's response was to approach ASEG. Many Australians work in Indonesia so a joint publication would assist in publicising their work for the benefit of both Australian and Indonesian geophysicists. But what of HAGI? Their main technical publication, called *Jurnal Geofisika*, is published every two months. Besides their technical journal they also publish a magazine called *Buletin Resonansi*, which discusses less formal topics, not unlike *Preview*. In 2013 HAGI began a bi-weekly electronic newsletter, *TechWatch E-Newsletter*, which covers technical news of a more urgent nature. I have not been able to determine their total membership numbers, but given the numbers of offices spread across the archipelago and elsewhere it would seem to be quite large.

Another region many Australians are drawn to is Africa, so naturally the South African Geophysical Association (SAGA) has been suggested as a possible collaborator. SAGA was founded in 1977

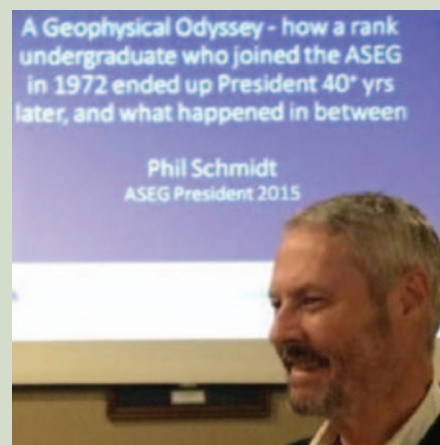
to foster and encourage the development of geophysics in South Africa and has since grown to over 350 Members worldwide. SAGA publish a newsletter but no peer-reviewed journal.

Another like-minded organisation, but without a peer reviewed journal, is the Canadian Exploration Geophysicists Society (KEGS), which was established in 1953 to support, nurture and promote geophysics at university, governmental and industry levels, in a spirit of kinship and openness for scientific advancement (much the same as ASEG). KEGS reaches out to more than 900 geoscientists worldwide, although their membership numbers are unclear.

Then there is the Sociedade Brasileira de Geofisica (SBGf) for those working in South America, well, some areas anyway.

I suggest ASEG Members get along to their local Branch Meetings to discuss possible further expansion of *Exploration Geophysics*. Are you happy with the ASEG-SEGJ-KSEG amalgam? Are you in favour of the inclusion of other organisations? Let your Branch President know so they might better inform the Federal Executive. It is your association!

Nothing too much happened with the drone in the past couple of months; such is R&D.



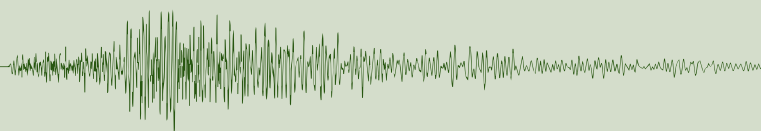
Phil Schmidt  
ASEG President  
[president@aseg.org.au](mailto:president@aseg.org.au)

## Welcome to new members

The ASEG extends a warm welcome to 35 new members approved by the Federal Executive at its May, June and July meetings (see table).

First name	Last name	Organisation	State	Country	Membership type
Zubair	Ahmed	Curtin University	WA	Australia	Student
Xavier	Amblard	CGG	WA	Australia	Active
Jeremy	Barrett	Southernrock Geophysics S.A.	Metro	Chile	Active
Samuel	Connell	University of Adelaide	SA	Australia	Student
Manon	Dalaison	The Australian National University	ACT	Australia	Student
Aidan	Fitzallen	Coffey	NSW	Australia	Active
Matthew	Greenwood	Queensland Department of Natural Resources and Mines	QLD	Australia	Active
Shakira	Heffner	University of Queensland	QLD	Australia	Student
Bonnie	Henderson	Adelaide University	SA	Australia	Student
Jacob	Jackson	Curtin University	WA	Australia	Student
Sam	Johnston	University of Queensland	QLD	Australia	Student
Anthony	Jumeau	Senex Energy Limited	WA	Australia	Active
Ben Vincent	Kay	University of Adelaide	SA	Australia	Student
Adrian Misael	Leon Sanchez	Education Superior de Ensenada, Mexico	Baja, CA	USA	Student OS
Yong	Ling	Curtin University	WA	Australia	Student
Angus George	Love	University of Adelaide	SA	Australia	Student
Christopher	Mathews	University of Queensland	QLD	Australia	Student
Jiajia	Miao	Jilin University	Jilin	China	Student
Sophie Marie	Monnier	University of Western Australia	WA	Australia	Student
Muhammad	Muhammad	Dawood University of Engineering and Technology		Pakistan	Student OS
Aime	Nganare	James Cook University	QLD	Australia	Student
Stephen David	Oniszk	University of Adelaide	SA	Australia	Student
Dane	Padley	Curtin University	WA	Australia	Student
Yanfu	Qi	Jilin University	Jilin	China	Student
Liam	Reidy	University of Adelaide	SA	Australia	Student
Yan	Ren	Jilin University	Jilin	China	Student
Elyse	Schinella	Freehills Patent Attorneys	NSW	Australia	Associate
Victoria	Seesaha	Monash University	VIC	Australia	Student
Jordan	Sheehan	Beach Energy	SA	Australia	Active
Jacob	Smith	ffA – Geo Teric	WA	Australia	Associate
Matthew	Smith	Macquarie University	NSW	Australia	Student
Elliot	Steel	University of Queensland	QLD	Australia	Student
Deepika	Venkataramani	University of Newcastle	NSW	Australia	Student
Steven	Wiseman	Schlumberger	WA	Australia	Active
Dahai	Zhang	University of Queensland	QLD	Australia	Student





## ASEG Federal Executive 2014–15

Phil Schmidt: President (Honours and Awards Committee)  
Tel: 0410 456 495  
Email: [president@aseg.org.au](mailto:president@aseg.org.au)

Katherine McKenna: President Elect (Membership Committee Chair)  
Tel: (08) 9477 5111  
Email: [membership@aseg.org.au](mailto:membership@aseg.org.au)

Barry Drummond: Secretary  
Tel: (02) 6254 7680  
Email: [fedsec@aseg.org.au](mailto:fedsec@aseg.org.au)

Theo Aravanis: Treasurer (Finance Committee Chair)  
Tel: (03) 9242 3327  
Email: [treasurer@aseg.org.au](mailto:treasurer@aseg.org.au)

Greg Street: Past President (Publications and History Committees)  
Tel: (08) 9388 2839  
Email: [pastpresident@aseg.org.au](mailto:pastpresident@aseg.org.au)

Koya Suto: Vice President (International Affairs Committee Chair, Research Foundation)  
Tel: (07) 3876 3848  
Email: [vicepresident@aseg.org.au](mailto:vicepresident@aseg.org.au)

Kim Frankcombe: Past President (AGC Representative, Conference Advisory Committee and Technical Standards Committee)  
Tel: (08) 6201 7719  
Email: [kfrankcombe@iinet.net.au](mailto:kfrankcombe@iinet.net.au)

Wendy Watkins (Education Committee Chair)  
Tel: (02) 9921 2010  
Email: [continuingeducation@aseg.org.au](mailto:continuingeducation@aseg.org.au)

Tania Dhu (State Branch Representative, Specialist and Working Groups Liaison)  
Tel: 0422 091 025  
Email: [branch-rep@aseg.org.au](mailto:branch-rep@aseg.org.au)

David Annetts (Web Committee Chair)  
Tel: (08) 6436 8517  
Email: [david.annetts@csiro.au](mailto:david.annetts@csiro.au)

Marina Costelloe  
Tel: (02) 6249 9347  
Email: [marina.costelloe@ga.gov.au](mailto:marina.costelloe@ga.gov.au)

Danny Burns  
Tel: (08) 8338 2833  
Email: [danny.burns@beachenergy.com.au](mailto:danny.burns@beachenergy.com.au)

## Standing Committee Chairs

Finance Committee Chair: Theo Aravanis  
Tel: (03) 9242 3327  
Email: [treasurer@aseg.org.au](mailto:treasurer@aseg.org.au)

Membership Committee Chair: Katherine McKenna  
Tel: (08) 9477 5111  
Email: [membership@aseg.org.au](mailto:membership@aseg.org.au)

State Branch Representative: Tania Dhu  
Tel: 0422 091 025  
Email: [branch-rep@aseg.org.au](mailto:branch-rep@aseg.org.au)

Conference Advisory Committee Chair: Michael Hatch  
Email: [cac@aseg.org.au](mailto:cac@aseg.org.au)

Honours and Awards Committee Chair: Andrew Mutton  
Tel: (07) 3278 5733  
Email: [awards@aseg.org.au](mailto:awards@aseg.org.au)

Publications Committee Chair: Peter Hatherly  
Tel: 0417 463 832  
Email: [publications@aseg.org.au](mailto:publications@aseg.org.au)

Near Surface Geophysics Committee Chair: Greg Street  
Tel: (08) 9388 2839  
Email: [pastpresident@aseg.org.au](mailto:pastpresident@aseg.org.au)

Technical Standards Committee Chair: Tim Keeping  
Tel: (08) 8226 2376  
Email: [technical-standards@aseg.org.au](mailto:technical-standards@aseg.org.au)

ASEG History Committee Chair: Roger Henderson  
Tel: 0408 284 580  
Email: [history@aseg.org.au](mailto:history@aseg.org.au)

International Affairs Committee Chair: Koya Suto  
Tel: (07) 3876 3848  
Email: [vicepresident@aseg.org.au](mailto:vicepresident@aseg.org.au)

Education Committee Chair: Wendy Watkins  
Tel: (02) 9921 2010  
Email: [continuingeducation@aseg.org.au](mailto:continuingeducation@aseg.org.au)

Web Committee Chair: David Annetts  
Tel: (08) 6436 8517  
Email: [david.annetts@csiro.au](mailto:david.annetts@csiro.au)

Research Foundation Chair: Philip Harman  
Tel: 0409 709 125  
Email: [research-foundation@aseg.org.au](mailto:research-foundation@aseg.org.au)

Research Foundation – Donations: Peter Priest  
Email: [wpriest@senet.com.au](mailto:wpriest@senet.com.au)

## ASEG Branches

### Australian Capital Territory

President: Marina Costelloe  
Tel: (02) 6249 9347  
Email: [actpresident@aseg.org.au](mailto:actpresident@aseg.org.au)

Secretary: Millie Crowe  
Tel: (02) 6249 9846  
Email: [actsecretary@aseg.org.au](mailto:actsecretary@aseg.org.au)

### New South Wales

President: Mark Lackie  
Tel: (02) 9850 8377  
Email: [nswpresident@aseg.org.au](mailto:nswpresident@aseg.org.au)

Secretary: Sherwyn Lye  
Tel: (02) 8960 8417  
Email: [nswsecretary@aseg.org.au](mailto:nswsecretary@aseg.org.au)

### Queensland

President: Fiona Duncan  
Tel: (07) 3042 7502  
Email: [qldpresident@aseg.org.au](mailto:qldpresident@aseg.org.au)

Secretary: Megan Nightingale  
Tel: (07) 3839 3490  
Email: [qldsecretary@aseg.org.au](mailto:qldsecretary@aseg.org.au)

### South Australia & Northern Territory

President: Joshua Sage  
Tel: 0438 705 941  
Email: [sa-ntpresident@aseg.org.au](mailto:sa-ntpresident@aseg.org.au)

Secretary: Michael Dello  
Tel: –  
Email: [sa-ntsecretary@aseg.org.au](mailto:sa-ntsecretary@aseg.org.au)

NT Representative: Tania Dhu  
Tel: 0422 091 025  
Email: [nt-rep@aseg.org.au](mailto:nt-rep@aseg.org.au)

### Tasmania

President: Mark Duffett  
Tel: (03) 6165 4720  
Email: [taspresident@aseg.org.au](mailto:taspresident@aseg.org.au)

Secretary: Anya Reading  
Tel: (03) 6226 2477  
Email: [tassecretary@aseg.org.au](mailto:tassecretary@aseg.org.au)

### Victoria

President: Asbjorn Christensen  
Tel: (03) 9885 1378  
Email: [vicpresident@aseg.org.au](mailto:vicpresident@aseg.org.au)

Secretary: Seda Rouxel  
Tel: 0405 821 575  
Email: [vicsecretary@aseg.org.au](mailto:vicsecretary@aseg.org.au)

### Western Australia

President: Kathlene Oliver  
Tel: 0411 046 104  
Email: [wapresident@aseg.org.au](mailto:wapresident@aseg.org.au)

Secretary: David Farquhar-Smith  
Tel: 0409 840 503  
Email: [wasecretary@aseg.org.au](mailto:wasecretary@aseg.org.au)

### The ASEG Secretariat

Ben Williams  
The Association Specialists Pty Ltd (TAS)  
PO Box 576, Crows Nest, NSW 1585  
Tel: (02) 9431 8622  
Fax: (02) 9431 8677  
Email: [secretary@aseg.org.au](mailto:secretary@aseg.org.au)

## The 2015 ASEG Research Foundation awards

The ASEG Research Foundation is pleased to announce the 2015 ASEG Research Foundation supported projects (see Table 1). \$100 700 has been awarded to 5 projects over three years.

UWA is the big winner with four of the five projects supported being carried out by students at this institution. The ASEG congratulates all of the winners.

Doug Roberts  
ASEG Research Foundation Secretary  
[dcrgео@tpg.com.au](mailto:dcrgео@tpg.com.au)

Table 1. 2015 ASEG RF Supported Projects

University	Supervisor	Student	Degree	Field	\$/Year	Years	Topic
UWA	Dr Sandra Occhipinti	Heta Lampinen	PhD	Minerals	\$8200 \$6000 \$3000	3	Defining mineral systems footprints in the Edmund Basin of the Capricorn Orogen
RMIT	Prof James Macnae	Joseph Hamad	PhD	Minerals	\$8000 \$8000 \$5500	3	A compact EM transmitter for use in boreholes and for portable surface applications
UWA	Prof Mike Dentith, Dr Marco Fiorentini	Cameron James Adams	PhD	Minerals	\$8500 \$8500 \$6000	3	Understanding of the petrophysical properties of altered rocks: implications for geophysical exploration
UWA	Prof David Lumley	Sophie Monnier	PhD	Petroleum	\$8000 \$8000 \$8000	3	Ocean Bottom Seismology (OBS) offshore Australia: enhanced wavefield imaging and inversion for exploration at both hydrocarbon reservoir and crustal tectonic scales
UWA	Dr Julien Bourget	Victorien Paumard	PhD	Petroleum	\$5000 \$5000 \$5000	3	Linking seismic to the rock scale: new insights for the petroleum prospectivity of the Barrow Group using basin-scale 3D seismic geomorphology integrated with well core/log data (Northern Carnarvon Basin, North West Shelf of Australia)



**MAGSPEC**  
AIRBORNE SURVEYS

**Ultra low level and regional survey specialists.**

**Global reach**





**SERVICES**

- Airborne radiometric, magnetic and gravity surveys.
- Ultra detailed, ultra low level and regional surveys.
- Specialists in magnetic gradiometer survey and processing.
- Processing, quality control and reprocessing service.

**BENEFITS**

- Fleet comprises of PAC 750 XLs and Cessna 210s.
- Latest state of the art technologies.
- Highest production rates.
- Quality results and faster delivery.

Follow us on Facebook 

**+61 8 6260 2041 | 21 Triumph Avenue, Wangara, Western Australia | [info@magspec.com.au](mailto:info@magspec.com.au) | [www.magspec.com.au](http://www.magspec.com.au)**



# ASEG Technical Standards Committee news

The ASEG Technical Standards Committee has begun documenting all airborne calibration and test ranges for the benefit of contractors across Australia. Information on the operational radiometric and airborne gravity ranges in Western Australia is currently available on the committee’s web page (<https://aseg.org.au/aseg-technical-standards>).

Details of documentation and, rumours of, other radiometric and EM test ranges are still underway.

Version 1 of the ASEG Electrical Standards Format (ESF) for industry data exchange is also available on the Committee’s web page (Figure 1). Thanks to the tireless work of Kim Frankcombe,

the ESF enables all electrical surveys, including downhole and MT, to be stored in a common format. Example data files and Fortran source code for writing to ESF are available on the web page.

Tim Keeping  
Technical Standards Committee Chair  
[technical-standards@aseg.org.au](mailto:technical-standards@aseg.org.au)

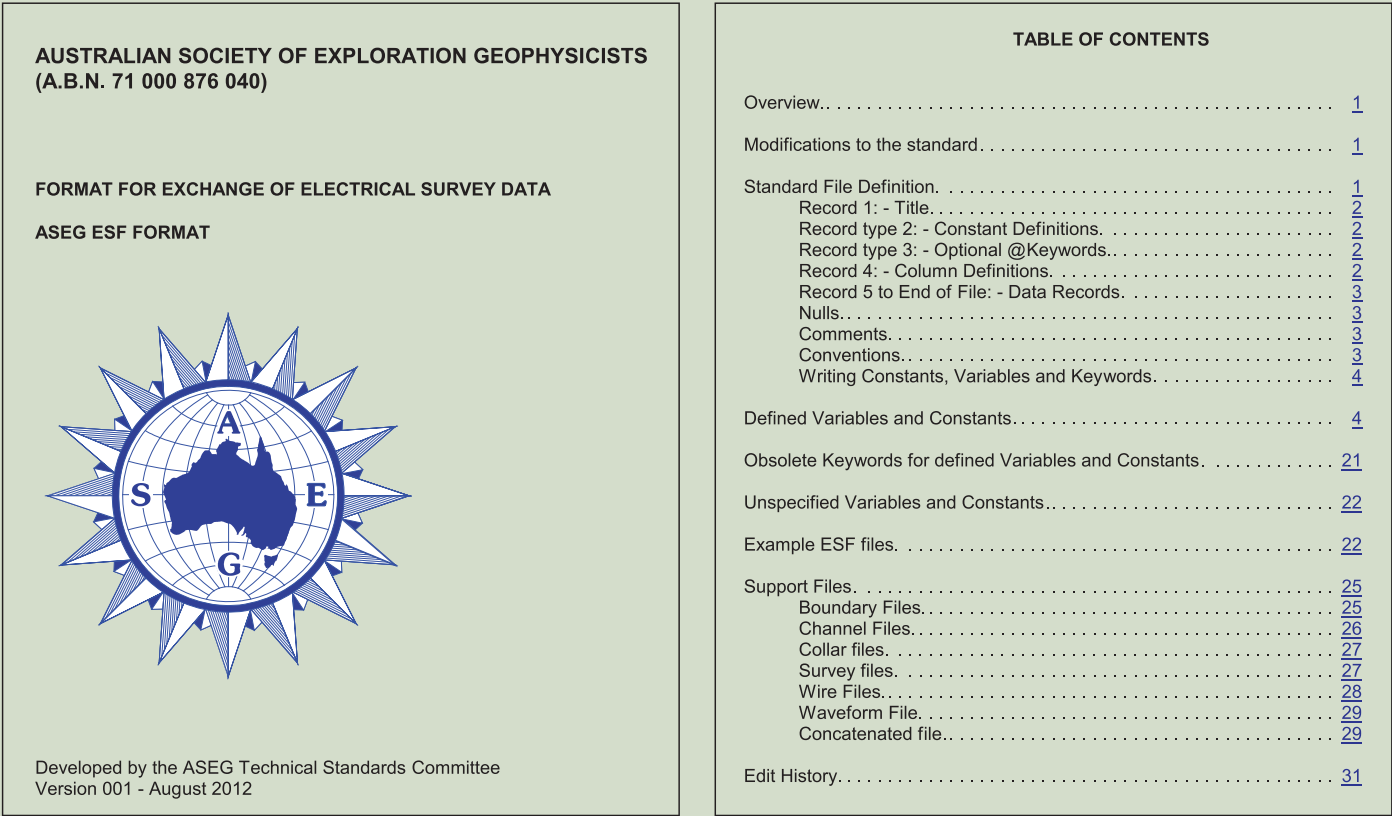


Figure 1. Cover and contents page of the guide to the ASEG Electrical Standards Format (ESF), <https://aseg.org.au/aseg-technical-standards>.



Subscribe now to our FREE email early alert or RSS feed for the latest articles from *PREVIEW*

[www.publish.csiro.au/earlyalert](http://www.publish.csiro.au/earlyalert)

## Western Australia

After a busy start to the year the WA Branch skipped a technical evening in April and hosted fewer events, but replaced the technical evening with a well attended BBQ for networking amongst Members. Given the current state of the mining and exploration industry in WA this social event was welcomed by all Members.

Technical sessions returned in May with a variety of talks presented by the following:

- **Chris Wijns** (First Quantum Minerals Ltd – Gold Sponsor of Technical Sessions) ‘Geophysical mapping for mine planning’ (13 May).

*Airborne electromagnetic surveys with near-surface resolution provide rapid and comprehensive coverage of a mine site ahead of infrastructure planning. Post-survey, EM results may also be compared with 3D seismic tomography and pre-strip excavation depths over the pit.*

- **Geoff Pettifer** (GHD) ‘Factors in transforming geophysical factors into hydrogeological and engineering parameters – empiricism, scalability, resolution, uncertainty, clay, experience’ (18 June).  
*Recommendations were made for a suggested way forward to improve the practice and acceptance of transformation of geophysical properties into hydrogeological and engineering parameters including working to get wider acceptance of geophysical approaches, engagement and further collaborative research efforts with client professional societies and standards bodies.*



The audience for Chris Wijns.

- **Andrew Long** (PGS) ‘Imaging and characterizing the earth using seismic multiples’ (17 July).

A two-day seminar entitled ‘Water management for shale and tight gas’ was also held in June. The key note speakers included **Nina Triche** (DMP), **Joe Lima** (Schlumberger), **Geoff Barker** (RISC) and **Jim McGowen** (Halliburton). Case studies were reviewed and regulatory changes affecting unconventional gas exploration in WA were highlighted. The event attracted plenty of interest, which was not surprising given the topical nature of the matters being discussed.

The WA Branch calendar is more or less full for the rest of 2015. Events include monthly technical evenings, seminars, SEG lectures, EAGE EET9 and OzSTEP workshops. The latter are clustered in the months of October and November and details will be available on the ASEG website. Mail outs will also provide information.

This year the WA Branch will, once again, provide financial support to well-deserving geophysics students in Western Australia through the ASEG WA Branch Student Award program. Nominations for the award will open on 2 August and close on 16 August 2015.

*Prue Leeming  
(WA Branch Preview correspondent)*

## Australian Capital Territory

In July the ACT branch of the ASEG hosted Dr **Jon Clarke** speaking on ‘Exploration geophysics - the final frontier’. Dr Clarke’s talk covered magnetics, gravity, radar, gamma ray spectroscopy, neutron spectroscopy, seismic (active and passive) and EM, all technologies used from orbit or on the surface of historical Moon, Venus, Mars, Comet 67P/Churyumov-Gerasimenko missions and future missions to Mars. With nearly 60 in attendance from school students, university students right through to professionals and retired professionals Dr Clarke’s talk had something interesting and new for everyone on how important geophysics is in extra-terrestrial exploration. Dr Clarke spoke about how difficult exploration is on other planets and how simple instruments can be used to collect complex geophysical information.

Dr Clarke is currently the President of the Mars Society Australia ([marsociety.org.au](http://marsociety.org.au)), he has worked on marine surveys in the Southern and Indian Oceans, explored for base metals, nickel and gold in Archaean and Proterozoic terranes in Australia, as well as in the Philippines and Chile. Dr Clarke has been researching terrestrial (Hanksville area in Utah and the Arkaroola region in South Australia) analogues of Martian



Chris Wijns presenting to the WA Branch.



landscapes and developing exploration strategies for human missions to Mars. Developing exploration strategies for human missions involves integrated field research of instruments (spectrometers, data capture, geophysical tools), methodologies (scouting, navigation) and exploration technologies (suits, living modules, rovers, field robotics), at appropriate levels of simulation fidelity.



*Dr Jonathon Clarke President of the Mars Society Australia.*

In other news the branch will be co-hosting the annual Geo-Societies Quiz Night on 19 August, at the Spanish Club Narrabundah, starting at 5:30 pm. Cost \$15. **Millicent Crowe** is putting a geophysical brains trust together so if you would like to join the ASEG table please email [Millicent.Crowe@ga.gov.au](mailto:Millicent.Crowe@ga.gov.au).

*Marina Costelloe  
(ACT Branch President)*

## New South Wales

In May **Peter Hatherly** from the Rio Tinto Centre for Mine Automation (University of Sydney) presented a case history on 'Geophysical Logging in the blastholes of an open pit coal mine'. Peter spoke about how he compared monitor-while-drilling (MWD) data from blast hole drill holes with geophysical logs from the same holes in an open-cut coal mine. Peter demonstrated that models based on interpolation of the MWD data between blast holes show the same geological features as a model based on the geophysical data. Given the well-established link between sonic velocity and Uniaxial Compressive Strength (UCS), the results of this study clearly demonstrated that MWD data can

be used for rock mass characterisation and that will allow improved blast design.

Also in May we presented the 2015 ASEG NSW Branch Student Scholarship to **Alexandre Lemenager** from Macquarie University. Alexandre is undertaking finite element geothermal modelling of the Sydney Basin using temperature dependent thermal conductivity measurements.



*NSW ASEG President **Mark Lackie** presenting Alexandre Lemenager with his ASEG Student Scholarship.*

In June, the current ASEG President, **Phil Schmidt** gave a talk entitled 'A Geophysical Odyssey - how a rank undergraduate who joined the ASEG in 1972 ended up President 40+ years later, and what happened in between'. Phil spoke about what inspired him to undertake geophysics and once hooked, where his interests and research led him.

An invitation to attend NSW Branch meetings is extended to all interstate and international visitors who happen to be in town at the 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  
(NSW Branch President)*

## Queensland

On 7 July the Queensland Branch hosted **Andrew Long** who presented a talk entitled 'Imaging and characterizing the earth using seismic multiples'. There was a great turn-out of approximately 30 people who came to gain new insights

into the world of marine acquisition and processing. Queensland put on a great show for Andrew at the State of Origin the following evening with a 46 point victory against NSW – Andrew is very welcome to return next year as Queensland's lucky charm!

Our annual Zoeppritz Night Pub Crawl propagated through Brisbane's craft brewery scene on 24 July. A great night was had by all.

The annual ASEG/PESA Trivia Night is scheduled for Wednesday 5 August with none other than our very own Branch Treasurer Mr **Henk van Paridon** donning the Quiz Meister hat.

We also have **Emma Brand** from Origin Energy presenting on Tuesday 25 August. Her talk 'From UQ to the US and back: A story of one UQ grad's international adventures' is sure to be a hit.

**Noll Moriarty** will present his talk 'Predicting timing of commodity prices booms & busts: a scientific approach' to the Queensland Branch on 24 September. This talk should be of interest to many geophysicists in Brisbane given the current resources climate.

Brisbane will also host three OzSTEP courses later this year; two petroleum based and one minerals based. On 14 October **David Lumley**'s course will focus on reservoir monitoring including discussions primarily on 4D seismic, but also passive seismic and 4D seafloor gravity. On 30 October **Bob Musgrave**'s course will cover all things potential fields including a theory refresher, remanence, gravity and magnetic gradiometry, filtering, layer separation, interpretation of short- and long-wavelength signals, edge analysis, and inverse and forward modelling. On 4 November **Brian Russell** will cover concepts of AVO and Inversion. We will also be holding local branch meetings around the workshops.

Keep your eye on the Queensland events calendar on the ASEG website for updates and registration details closer to the date.

*Megan Nightingale  
(QLD Branch Secretary)*

## South Australia & Northern Territory

In May the South Australia and Northern Territory Branch of ASEG hosted the annual Student/Industry night at the University of Adelaide, featuring



SA/NT Branch student night.

presentations by **Danny Burns** of Beach Energy and **Kelly Keates** of Zonge Engineering, both of whom shared information about their career journeys including lessons learnt along the way. The night had a good turnout from students, many of whom signed up for ASEG membership.

The inaugural YPP/ASEG/PESA Trivia Night was hosted by the Young

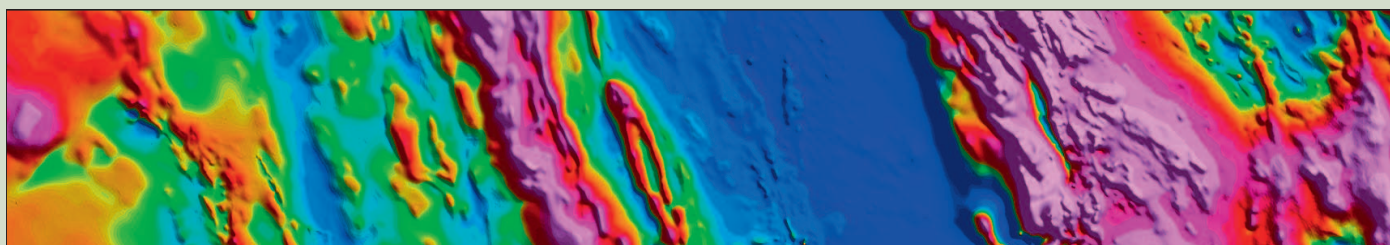
Petroleum Professionals at the German Club with a turnout of over 150 petroleum professionals, students and others! The night was a great success and will certainly be repeated next year.

In June we were given an excellent presentation on the 'Multi-functional borehole logging tool based on pulsed-neutron generator technology' by **Jonathan Ross** (Project Geologist,

Heathgate Resources) at the Coopers Alehouse. The diversity of functions integrated in this one tool has enabled highly efficient logging, potentially entirely replacing the need to use several conventional logging tools. Food and drink were in abundance, encouraging many hours of discussion into the night after the talk.

The next technical presentation will be held at the Coopers Alehouse on 4 August at 5:30 pm for a 6:15 pm start. Other upcoming events include two OzSTEP courses on 16 and 28 October. The first course will be given by **Dave Lumley** on '4D Reservoir Monitoring', and the second will be given by **Bob Musgrave** on 'Potential fields: a (re) introduction for geophysicists and geologists'. Registration for the OzSTEP courses is expected to open in August, with ASEG Member prices from \$220 and reduced rates for Student Members.

The annual wine tasting event will take place in mid-August; stay tuned for more details via email. This event is always a huge success with wine from several local vineyards and good company making a great night. On 19 November



## Exploration Geophysics

The Journal of the Australian Society of Exploration Geophysicists

### Preview

The Magazine of the Australian Society of Exploration Geophysicists

### Stay informed

Keep up to date with industry news by subscribing to our email alerts or registering for RSS feeds.

[www.publish.csiro.au/earlyalert](http://www.publish.csiro.au/earlyalert)



[www.publish.csiro.au/journals](http://www.publish.csiro.au/journals)





## ASEG News

we will be hosting the SEG Near Surface honorary lecturer Dr **Hansruedi Maurer**, who will give a talk on 'The curse of dimensionality in exploring the subsurface'.

If you or anyone you know is interested in giving a technical presentation to the ASEG SA membership, please get into contact at either [mdello@hotmail.com](mailto:mdello@hotmail.com) or [Joshua.matthew.sage@gmail.com](mailto:Joshua.matthew.sage@gmail.com).

*Michael Dello*  
(SA/NT Branch Secretary)

## Tasmania

The Tasmania branch will be hosting **Bob Musgrave**'s OzSTEP course 'Potential fields: a (re)introduction for geophysicists and geologists' on 15 October in the CODES Conference Room at the University of Tasmania, Sandy Bay. Details of this one-day course, covering physical properties, data presentation, filtering and inversion can be found in this edition of *Preview*. Tasmania will be squeezing Bob pretty dry, as later that same evening (15 October) he has kindly

agreed to back up to address a joint meeting of the ASEG and Geological Society of Australia about the new Tasmanide oroclinal tectonic evolution interpretations, informed by long wavelength geophysical signatures. This presentation will get under way from 6 pm in the UTas School of Earth Sciences lecture theatre, preceded by drinks and nibbles at 5:30 pm.

30 November will see the Tasmania branch hosting the SEG 2015 Near Surface Honorary Lecturer, Dr **Hansruedi Maurer** of ETH Zurich, on 'The curse of dimensionality in exploring the subsurface', illustrated by several examples from near-surface geophysics including 3D tomographic inversions. This lecture will be held at noon in the CODES conference room.

Interested members and other parties should also keep an eye on the seminar program of the University of Tasmania's School of Earth Sciences, which regularly delivers presentations of geophysical as well as general earth science interest. Contact Mark Duffett [taspresident@aseg.org.au](mailto:taspresident@aseg.org.au) for further details.

*Mark Duffett*  
(Tasmanian Branch President)

## Victoria

We are planning a busy meeting schedule for winter and spring 2015.

On Wednesday 12 August it is time to network with the local geoscience and exploration community at the joint PESA-ASEG-SPE Mid-Winter Social. Following last year's success, the event will again be held at the Duke of Wellington Hotel, 146 Flinders Street, Melbourne, from 5:30 pm onwards. This is a joint event with SPE and PSEA, so we hope to see you there for a night of networking and stimulating geoscientific discussions over drinks and nibbles. This is a Members-only event and pre-registration via the ASEG events website is mandatory.

On Thursday 3 September the ASEG Victoria Branch will host a technical meeting with **Andrew Button**, Caistor Geoscience, presenting 'Empirical geologic-geophysical search model for

## AIRBORNE GEOPHYSICAL SURVEY SPECIALISTS

**THOMSON AVIATION**  
Airborne Geophysical Survey



Highest quality & resolution Magnetics, Radiometrics, Electromagnetics and Gravity  
Fixed Wing & Helicopter Platforms



David Abbott [david@thomsonaviation.com.au](mailto:david@thomsonaviation.com.au)

Paul Rogerson [paul@thomsonaviation.com.au](mailto:paul@thomsonaviation.com.au)

+61 2 69603800  
[thomsonaviation.com.au](http://thomsonaviation.com.au)



bulk mineable platinum-palladium-base metal deposits of the Platreef type'. The meeting will be held at the Kelvin Club, 14–30 Melbourne Place (off Russell Street) in Melbourne's CBD, starting at 6:00 pm (drinks and nibbles) for a 6:30 pm presentation.

On Wednesday 7 October the ASEG Victoria Branch will host a technical evening meeting at the Kelvin Club with **Bill Lodwick**, recently returned from Malaysia. A title of the talk is yet to be confirmed, but I know that Bill would like talk about his experiences with the interactions in petroleum exploration – and the sometimes lack thereof – between petrophysicists and geophysicists. The meeting will be starting at 6:00 pm (drinks and nibbles) for a 6:30 pm presentation.

On Friday 9 October we will be hosting the all-day OzSTEP course on '4D reservoir monitoring' presented by **David Lumley** from the University of Western Australia.

On Tuesday 13 October we will be hosting the all-day OzSTEP course on 'Potential fields: a (re)introduction for geophysicists and geologists' presented by **Bob Musgrave** from the Geological Survey of New South Wales.

On Friday 6 November we will be hosting the all-day OzSTEP course on 'AVO and inversion methods in exploration seismology' by **Brian Russell**, Hampson-Russell/CGG.

Make a big mark in your calendars for the Annual Joint PESA-ASEG-SPE Christmas Luncheon on Wednesday 9 December – as always there will be an interesting talk from one of the remote coal faces of exploration (TBA), along with games, quizzes, excellent food and drink and even better company!

On Thursday 10 December the ASEG Victoria Branch will host a technical meeting with **Dr Hansruedi Maurer**, ETH Zürich and SEG Honorary Lecturer, presenting 'The curse of dimensionality in exploring the subsurface'. The meeting will be held at the Kelvin Club, starting at 6:00 pm (drinks and nibbles) for a 6:30 pm presentation.

We look forward to seeing many ASEG Victoria Branch members at the meetings in the coming months.

*Ashjorn Norlund Christensen*  
(Victorian Branch President)

## Helping to target your resources

Next time you need a survey, call Zonge.

- use our **high powered** systems and latest technology for:
  - surface 2D and 3D IP/EM/NanoTEM/CSAMT/AMT/NMR
  - downhole IP/EM/MMR/NMR
- experienced, safe teams in any location
- efficient survey design
- quality data second to none
- highly responsive service

**Call Zonge today +61 8 8371 0020**

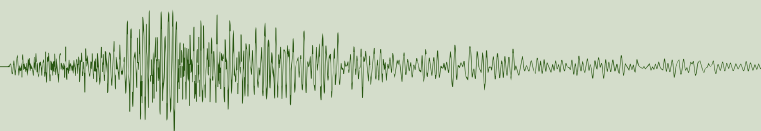
e [zonge@zonge.com.au](mailto:zonge@zonge.com.au)

w [zonge.com.au](http://zonge.com.au)

### Electrical geophysical solutions

*Resource exploration, environmental  
and geotechnical applications*





## ASEG calendar: technical meetings, courses and events

Date	Branch	Event	Presenter	Time	Venue
<b>2015</b>					
31 Aug – 1 Sep	WA	EAGE Education Days: Borehole Seismic: Advanced Analysis and Integration	Jacques Blanco	TBA	TBA
3 Sep	VIC	Technical Night: Empirical geologic-geophysical search model for bulk mineable platinum-palladium-base metal deposits of the Platreef type	Andrew Button	1800–2000	The Kelvin Club, 14–30 Melbourne Place (off Russell Street), Melbourne
7–8 Sep	WA	EAGE Education Days: Deepwater Reservoirs: Exploration and Production Concepts	Dorrik Stow	TBA	TBA
9 Sep	WA	Technical Night	TBA	1730–1900	City West, Function Centre, Perth
10–11 Sep	WA	EAGE Education Days: Full Waveform Inversion for High Resolution Reservoir Characterization	Dries Gisolf	TBA	TBA
24 Sep	QLD	Technical night: Predicting timing of commodity prices booms & busts: a scientific approach	Noll Moriarty	TBA	TBA
7 Oct	VIC	Technical night: Interaction between petrophysicists and geophysicists - or not	Bill Lodwick	1800–2000	The Kelvin Club, 14–30 Melbourne Place (off Russell Street), Melbourne
7 Oct	NSW	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	Rugby Club, off 31 Pitt Street Sydney
9 Oct	VIC	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	5 on 505, Level 5, 505 Little Collins Street, Melbourne
12 Oct	ACT	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	Geoscience Australia, Symonston
13 Oct	VIC	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	5 on 505, Level 5, 505 Little Collins Street, Melbourne
14 Oct	QLD	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	TBA
14 Oct	WA	Technical Night	TBA	1730–1900	City West, Function Centre, Perth
15 Oct	TAS	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	TBA
16 Oct	SA/NT	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	TBA
19 Oct	ACT	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	Geoscience Australia, Symonston
21 Oct	NSW	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	Rugby Club, off 31 Pitt Street Sydney
26 Oct	WA	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	TBA
28 Oct	SA/NT	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	TBA
30 Oct	QLD	OzSTEP: Potential fields for mineral exploration	Bob Musgrave	0900–1700	TBA
30 Oct	WA	OzSTEP: Reservoir Monitoring/4D Seismic	Prof David Lumley, UWA	0900–1700	TBA
2 Nov	WA	OzSTEP: AVO and Inversion	Brian Russell	0900–1700	TBA
4 Nov	QLD	OzSTEP: AVO and Inversion	Brian Russell	0900–1700	TBA
6 Nov	VIC	OzSTEP: AVO and Inversion	Brian Russell	0900–1700	5 on 505, Level 5, 505 Little Collins Street, Melbourne
6 Nov	WA	ASEG-PESA Golf Day	ASEG/PESA	TBA	Joondalup Golf Course
11 Nov	WA	Technical Night	Student Presentations	1730–1930	City West, Function Centre, Perth
18 Nov	WA	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	TBA	City West, Function Centre, Perth
19 Nov	SA/NT	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	TBA	TBA
20 Nov	WA	EAGE (EET9) Workshop: Satellite InSAR Data: Reservoir Monitoring from Space	Alessandro Ferretti	0900–1700	CSIRO, Perth
23 Nov	QLD	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	TBA	TBA
24 Nov	WA	AGM and Christmas Party		1730 till late	TBA
25 Nov	ACT	EAGE (EET9) Workshop: Satellite InSAR Data: Reservoir Monitoring from Space	Alessandro Ferretti	0900–1700	Geoscience Australia, Symonston
30 Nov	TAS	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	TBA	TBA
9 Dec	VIC	Annual Joint PESA-ASEG-SPE Christmas Luncheon	TBA	1200–1700	TBA
9 Dec	ACT	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	TBA	Geoscience Australia, Symonston
10 Dec	VIC	SEG HL Near Surface: The curse of dimensionality in exploring the subsurface	Hansreudi Mauerer	1800–2000	The Kelvin Club, 14–30 Melbourne Place (off Russell Street), Melbourne

TBA, to be advised (please contact your state branch secretary for more information).



## Vale Christopher J. Wiles (1947–2014)

*Geophysicist, nature and wildlife artist and photographer*



Christopher J. (Chris) Wiles passed away suddenly whilst holidaying with his wife Gwen in Clearwater, Florida on 5 December 2014.

Chris was born and raised in Southern Rhodesia (Zimbabwe). He graduated from Rhodes University with a BSc in Physics and Applied Mathematics in 1969. Chris worked for Geotrex, from 1970 to 1981, undertaking geophysical surveys around the world, including South Africa, Australia and Canada.

In 1981 Chris joined Newmont Mining Corporation's geophysical department in Tucson, Arizona and shortly afterwards took a short term assignment in Melbourne, Australia. This turned out to

be a much longer transfer lasting almost 10 years, during which time Chris worked on exploration projects throughout Australia and Southeast Asia.

During this time Chris played a major role in the efforts to re-vamp exploration in the Telfer district in the early-mid 1980s. He undertook high resolution aeromagnetic and gravity surveys, which generated a number of skarn-style targets and, as a direct outcome, led to the discovery of the large O'Callaghans tungsten-base metal deposit in 1985.

Chris also worked extensively on Newmont's exploration areas near Kalgoorlie, work that ultimately led to the development of the gold mine at New Celebration.

In 1991, upon the formation of Newcrest Mining Ltd, Chris returned to the Newmont geophysical department in Denver and was Chief Operations Geophysicist until taking on roles in exploration management in the mid 1990s. These included challenging international assignments in Burma, Kazakhstan, the Philippines and Tanzania during a period of low gold prices and tight exploration budgets where he performed exceptionally well under difficult circumstances in these varied cultural settings.

In 2001 Chris was responsible for exploration in the Great Basin, USA and following the Newmont-Normandy-Franco-Nevada merger he returned to Denver to work with the new business opportunities group. In 2004 Chris returned to Perth and set up Newmont Australia's Airborne Services, which he managed until retiring in 2006.

Throughout his long and fruitful career of 36 years as a geoscientist and manager he was known as a likeable, thoughtful gentleman who was highly respected by his colleagues and friends. Chris is recognised for his hard work, integrity, discipline, and cultural sensitivity.

Chris was a very keen and accomplished photographer; and upon retirement took up painting, primarily African bush and wildlife. He came from a long line of artists starting with his great grandfather. Chris loved Africa and its wildlife and returned as often as he could to collect new reference material. A number of his photos and works of art can be viewed on his website [www.chrisjwiles.com](http://www.chrisjwiles.com) along with his genealogy and other interesting aspects of his life.

On behalf of his professional associates and friends in the mining industry, we offer our most sincere condolences to his wife Gwen and the family.

We honour and salute Chris Wiles's outstanding service and legacy to the mining industry.

Mike Sexton, Dave Royle, Brian Levet and other friends and associates from years gone by.

[mike.sexton@planetarygeophysics.com.au](mailto:mike.sexton@planetarygeophysics.com.au)

# Near Surface Geophysics Asia Pacific Conference 2015

Around 15 Australian delegates made the trip to the big island of Hawaii for the second Near Surface Geophysics Asia Pacific Conference. This conference was jointly organised by the SEG, ASEG, SEG Japan, Chinese and Korean Geophysical Societies. The first conference was hosted by the Chinese Society in Beijing in 2013 and the ASEG will host the next one in Cairns in July, 2017.

The range of papers was eclectic with topics from forensics through to volcano geophysics. The content of the papers from different countries was interesting. Most papers from China were theoretical studies with some excellent development of new ideas but little practical experience. Chinese geophysicists, it seems, are highly trained but struggling to get geophysics adopted into engineering investigations. Japanese presenters, however, showed how their work is beginning to be adopted into mainstream engineering studies in a country with high degree of natural hazards. The Australian papers were mostly case histories.

Unfortunately US Immigration was particularly vigilant and more than 20 presenters could not obtain a visa to attend the conference. This left many holes in the programme and only 176 delegates plus a small exhibition. Some lessons were learnt that can usefully be applied to holding the next Near Surface Geophysics Conference in Cairns.

A keynote presentation on volcano geophysics whetted our appetite for the volcano tour on the day after the conference. Forty-six delegates and family members bussed around the island to scenic sites as well as to the volcano observatory on the crater rim of Kilauea, currently the most active volcano in Hawaii. Sensitive seismometers around the crater pick up not only the rumblings of the ancient Hawaiian Volcano god Pelehuma, but also the passing of tourist helicopters, distinguished by the change in frequency as aircraft approached and departed. The Hawaiian Volcano Observatory is in the process of producing lava hazard maps for the island. These will be an essential asset for

intending land buyers because once land is inundated by lava it is considered new land and title reverts back to the government.

The newly formed ASEG Near Surface Group (NSG) will be taking the lead in organising the next Near Surface Geophysics Asia Pacific conference in Cairns. If you would like to get involved please contact Greg Street ([pastpresident@aseg.org.au](mailto:pastpresident@aseg.org.au)), Geoff Pettifer ([Geoff.Pettifer@ghd.com](mailto:Geoff.Pettifer@ghd.com)) or your state representative on the NSG Committee (see table below)

*Greg Street*  
[pastpresident@aseg.org.au](mailto:pastpresident@aseg.org.au)

ASEG Near Surface Group Committee (elected on 20May 2015)	
Chairperson	Greg Street
Vice-Chairperson	Ron Palmer
Secretary	Geoff Pettifer
Treasurer	Romney Rayney
Overseas ASEG NSG Members Representative	Meng Heng Loke
ACT ASEG NSG Members Representative	Marina Costelloe
NSW ASEG NSG Members Representative	Timothy Pippett
NT ASEG NSG Members Representative	Tania Dhu
QLD ASEG NSG Members Representative	Binzhong Zhou
VIC ASEG NSG Members Representative	Zivko Terzic
WA ASEG NSG Members Representative	Lee Tasker
SA ASEG NSG Members Representative	Position Vacant – no nominations/volunteers
TAS ASEG NSG Members Representative	Position Vacant – no nominations/volunteers

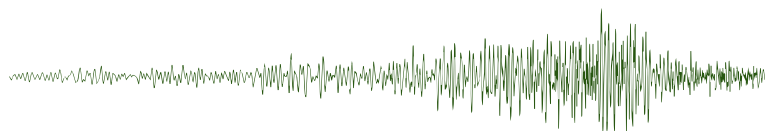


Koya learning to dance the Hula.



Conference delegates emerging from an Hawaiian lava tube.





## Update on Geophysical Survey Progress from the Geological Surveys of Western Australia, South Australia, Northern Territory and Victoria (information current on 13 July 2015)

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

Table 1. Airborne magnetic and radiometric surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Spacing AGL Dir	Area (km <sup>2</sup> )	End flying	Final data to GA	Locality diagram (Preview)	GADDS release
Coompana	GSSA	GA	GPX Surveys	7 Feb 2015	255 265	400 m 80 m E-W	85 910	47.2% complete at 13 Jul 2015	TBA	173: Dec 2014 p. 24	TBA
Delamere/Spirit Hills	NTGS	GA	Thomson Aviation	20 Jul 2015 pending completion of Defence flying operations in the survey area	96 500 est.	400 m 80 m N-S	33 690	TBA	TBA	176: Jun 2015 p. 22	TBA
Yalgoo	GSWA	GA	MAGSPEC Surveys	30 May 2015	110 516 est.	100/200 m 50 m E-W	11 200	32.3% complete at 12 Jul 2015	TBA	176: Jun 2015 p. 23	TBA

TBA, to be advised.

Table 2. Gravity surveys

Survey name	Client	Project management	Contractor	Start survey	No. of stations	Station spacing (km)	Area (km <sup>2</sup> )	End survey	Final data to GA	Locality diagram (Preview)	GADDS release
Gippsland	GSV	GA	Atlas	30 Jun 2014	1440	12 traverses at 500 m station spacing	8358	100% complete at 21 Jul 2015	Final data expected to be released via GADDS when permission to do so is received from GSV	170 – Jun 2014 p. 25	TBA
North McArthur Basin	NTGS	GA	Atlas	16 Sep 2014	7175	4 km regular grid with areas of 2 km infill; 1 area of traverses spaced 4 km apart with a station spacing of 1 km	71 030	100% complete at 4 Nov 2014	Preliminary final data were supplied to GA at the end of Nov	171: Aug 2014 p. 39	The survey covers all or part of Arnhem Bay, Gove, Mt Evelyn, Mt Marumba, Blue Mud Bay, Katherine, Urupunga and Roper River standard 1:250 k map sheets
Ngururpa	GSWA	GA	Atlas	10 May 2015	5000	2.5 km regular grid	30 700	100% complete at 13 Jun 2015	TBA	176: Jun 2015 p. 23	TBA
Northern Wiso Basin	NTGS	GA	Atlas	18 Jun 2015	5020	4 km regular grid with areas of 2 km and 1 km infill	83 240	29.5% complete at 5 Jul 2015	TBA	176: Jun 2015 p. 24	TBA
SW Yilgarn WA	GSWA	GA	Atlas	12 Jun 2015	28 678	2 km along public roads and tracks	175 000	10.3% complete at 12 Jul 2015	TBA	176: Jun 2015 p. 24	TBA
Victoria Basin	NTGS	GA	TBA	Survey Quotation request released on 29 June	6300	4 km regular grid	99 170	TBA	TBA	The proposed survey covers parts of the Port Keats, Delamere, Larrimah, Fergusson Range, Katherine, Waterloo, Victoria River Downs, Daly Waters, Wave Hill and Newcastle Waters standard 1:250 k map sheet areas (Figure 1)	TBA
Stavelly	GSV	GA	TBA	Survey Quotation Request in preparation	Approx. 8000 in 9 separate areas	500 m regular grid in 8 areas and 500 m station interval along one traverse	TBA	TBA	TBA	The proposed survey covers parts of the Horsham, Hamilton, Ballarat and Colac standard 1:250 k map sheet areas (Figure 2)	TBA

TBA, to be advised.



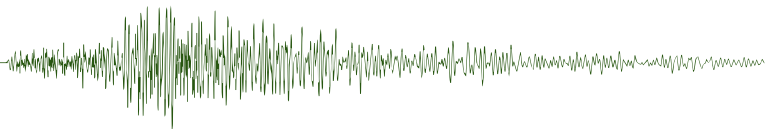


Table 3. AEM surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Spacing AGL Dir	Area (km²)	End flying	Final data to GA	Locality diagram (Preview)	GADDs release
Musgrave Region	GSSA	GA	TBA	TBA	TBA	TBA	TBA	TBA	TBA	The technical specifications of the survey are being planned between GA, GSSA and CSIRO	Since Preview 176 the National Collaboration Framework Agreement was executed between GA and GSSA on 2 Jul 2015

TBA, to be advised.

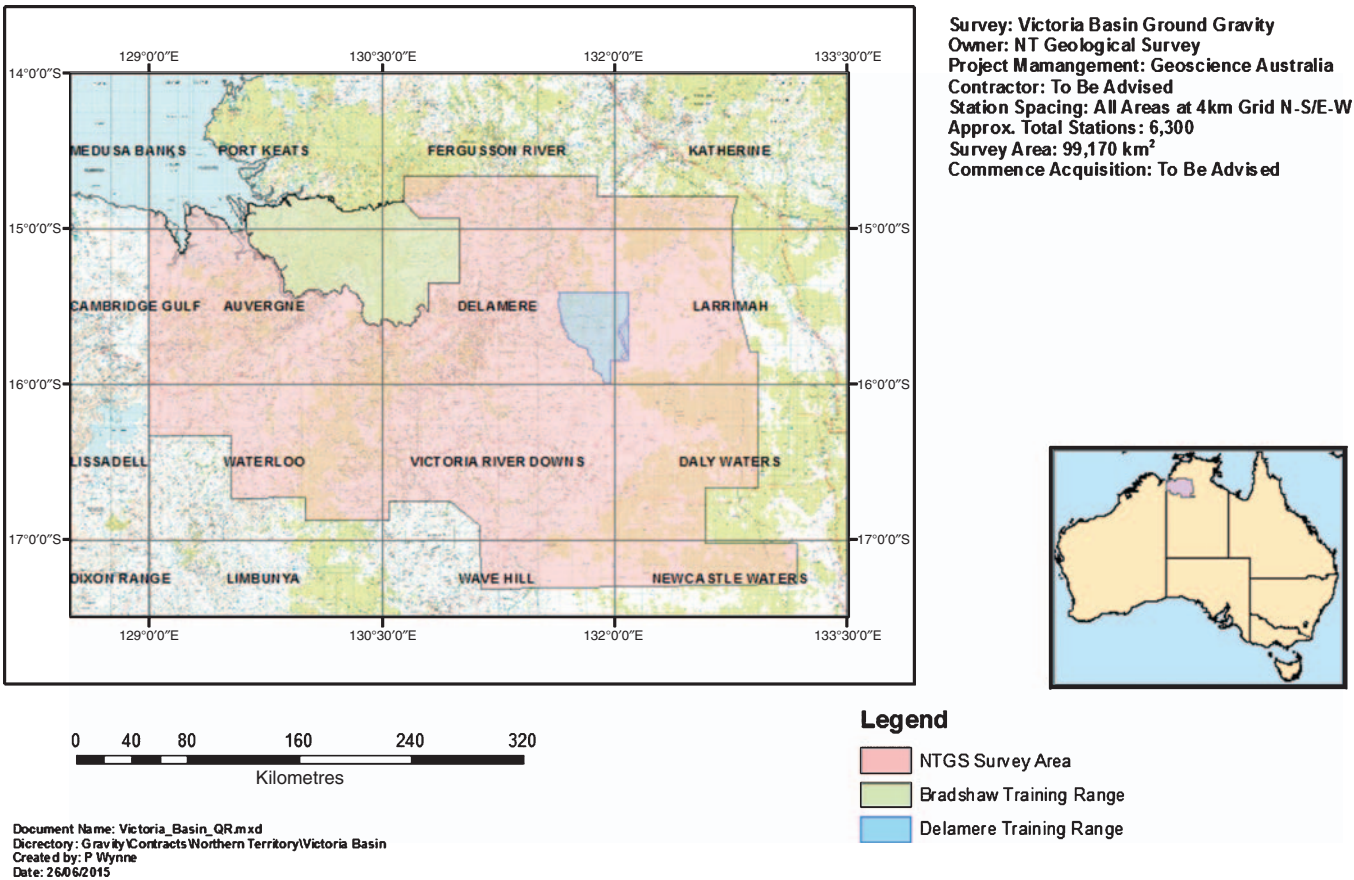


Figure 1. NTGS Victoria Basin gravity survey 2015.

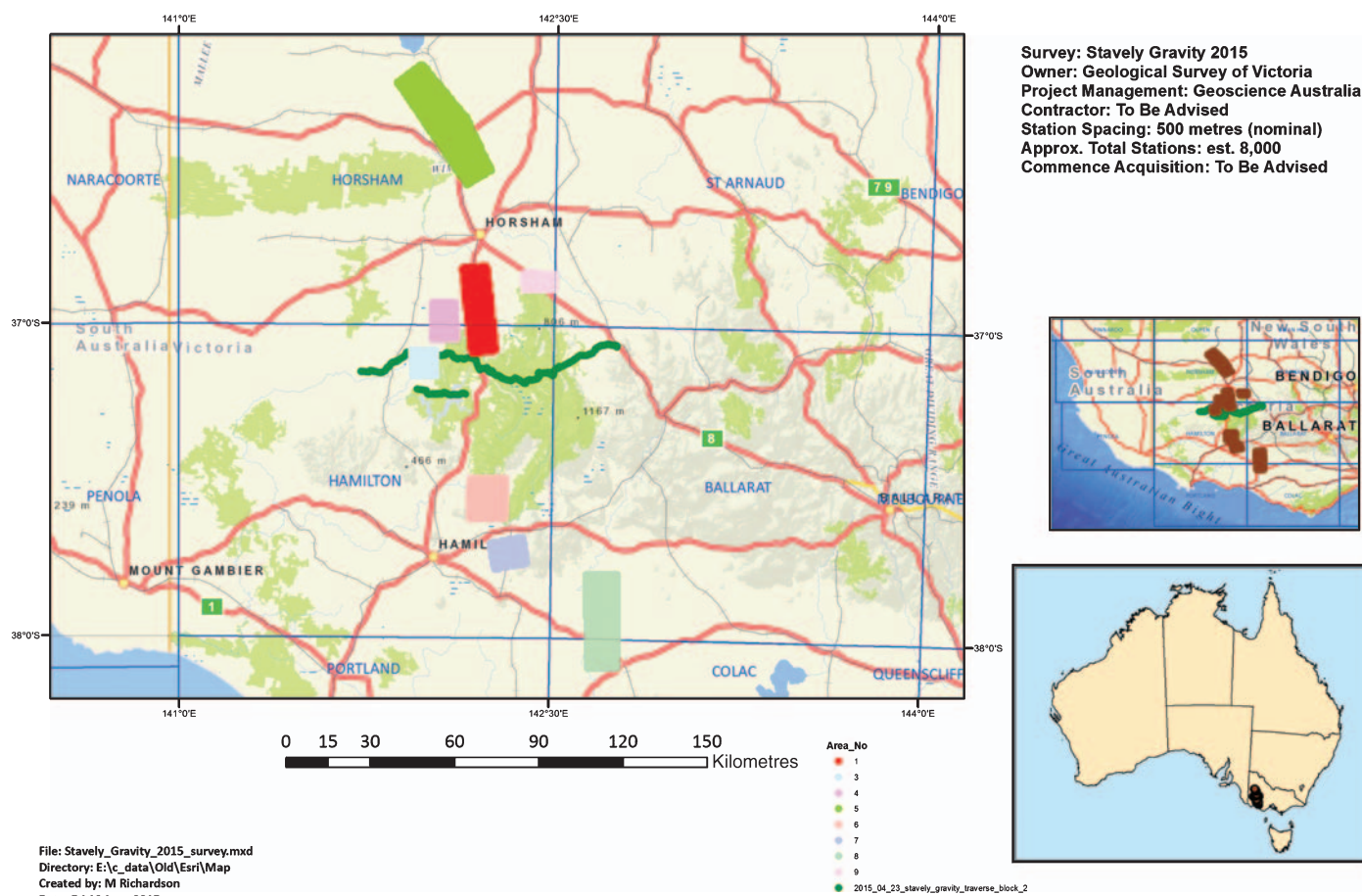


Figure 2. GSV Staveland Region proposed gravity survey 2015.



Subscribe now to our FREE email early alert or RSS feed  
 for the latest articles from *Exploration Geophysics*.

[www.publish.csiro.au/earlyalert](http://www.publish.csiro.au/earlyalert)

## New geophysical data being acquired and released by the Geological Survey of Queensland

In 2013, the Queensland State Government announced a 3 year \$30 million exploration industry assistance package, the Future Resources Programme, to be implemented by the Geological Survey of Queensland (GSQ). A portion of this funding was dedicated to collection of geophysical data in the Mount Isa Region through initiatives such as the Mount Isa Geophysics Initiative and the Industry Priorities Initiative, which implements selected projects suggested by industry. This funding, in conjunction with remaining funds from the Greenfields 2020 Programme, underpins all of the geophysical data collection undertaken and planned by the GSQ from 2013–2016.

The Isa Extension Magnetotelluric (MT) Survey was proposed during the first round of the Industry Priorities Initiative. The original proposal was to use magnetotelluric data to investigate possible extensions of the prospective Mount Isa shale basins to the south of the Mount Isa Inlier. The survey was expanded from the original proposal to also capture broader crustal-scale information. The survey comprised more than 800 broadband (BBMT) stations on a 2 km × 5 km grid and approximately 800 audio magnetotelluric (AMT) stations with a station spacing of 500 m along traverses (Figure 1). The final AMT station data recording will begin in August, with the BBMT and most of the AMT collected late in 2014. Release of the complete MT data set and contractor processed sections will occur soon after acquisition is complete. The GSQ is undertaking a 3-year programme (starting 2015) to process and interpret this data in an effort to demonstrate what MT surveys can accomplish for explorers.

A trial of Geotech's high power VTEM Supermax system was proposed in the second round of the Industry Priorities Initiative. The focus of the trial was to collect data to the east of Osborne Mine, in an area where conductive sediments of the Eromanga basin have historically reduced the effectiveness of airborne electromagnetic (AEM) systems. The

survey, named Osborne East, has a line spacing of 1 km close to outcrop with the line spacing extending to 2 km further from outcrop (Figure 2). Data from this trial survey is freely available on the QDEX Data website (<https://www.business.qld.gov.au/industry/mining/mining-online-services/qdex-data>), enabling explorers to make an assessment of the value of the data collected by the system.

The GSQ has invested a considerable amount of money in furthering the understanding of the large scale crustal architecture of the Mount Isa Province through the collection of three new deep crustal seismic lines (Figure 3). The surveys provide new information about the location and nature of major crustal features, while also capturing useful information about the overlying basins. This data was collected in three phases starting with 14GA-CF1 in July 2014 with the final phase of data acquisition completed in May 2015 creating a linked network of deep crustal seismic lines over north west Queensland. Processing and interpretation is well underway on GA14-CF1 with products expected later in 2015. Processing on GA14-CF2 and GA14-CF3 will start in the upcoming months with interpretation to follow. Field data for GA14-CF2 and GA14-CF3 will be made available in the near future. Please contact the GSQ geophysics team ([geophysics@dnrm.qld.gov.au](mailto:geophysics@dnrm.qld.gov.au)) if you would like to be notified when this data is available.

The upcoming 2015–2016 work programme is designed to provide additional precompetitive geophysical data to support explorers as they expand their operations into undercover areas. Data collection will focus on the area around Cloncurry where the prospective rocks of the Eastern Succession are covered by younger sediments. Initial planning includes a magnetotelluric survey, an infill gravity survey and a regional AEM survey.

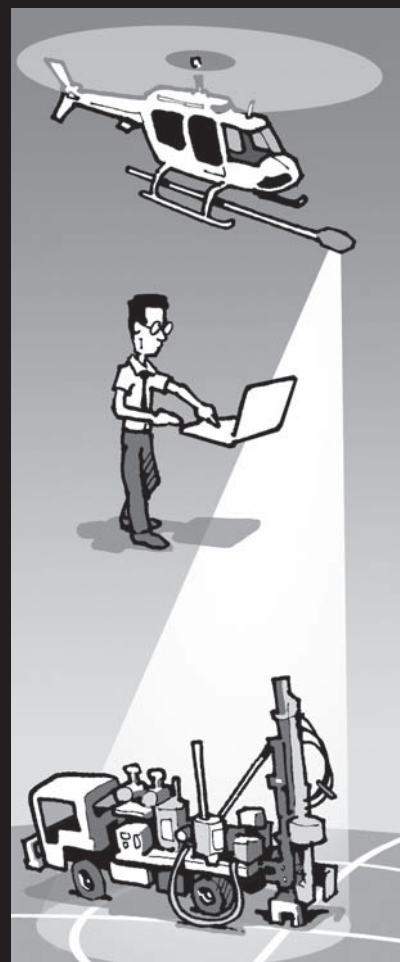
Janelle Simpson  
[janelle.simpson@dnrm.qld.gov.au](mailto:janelle.simpson@dnrm.qld.gov.au)

## ModelVision

### Magnetic & Gravity Interpretation System

with 30 years of applied research

All sensors	Minerals
Processing	Petroleum
3D modelling	Near Surface
3D inversion	Government
Visualisation	Contracting
Analysis	Consulting
Utilities	Education

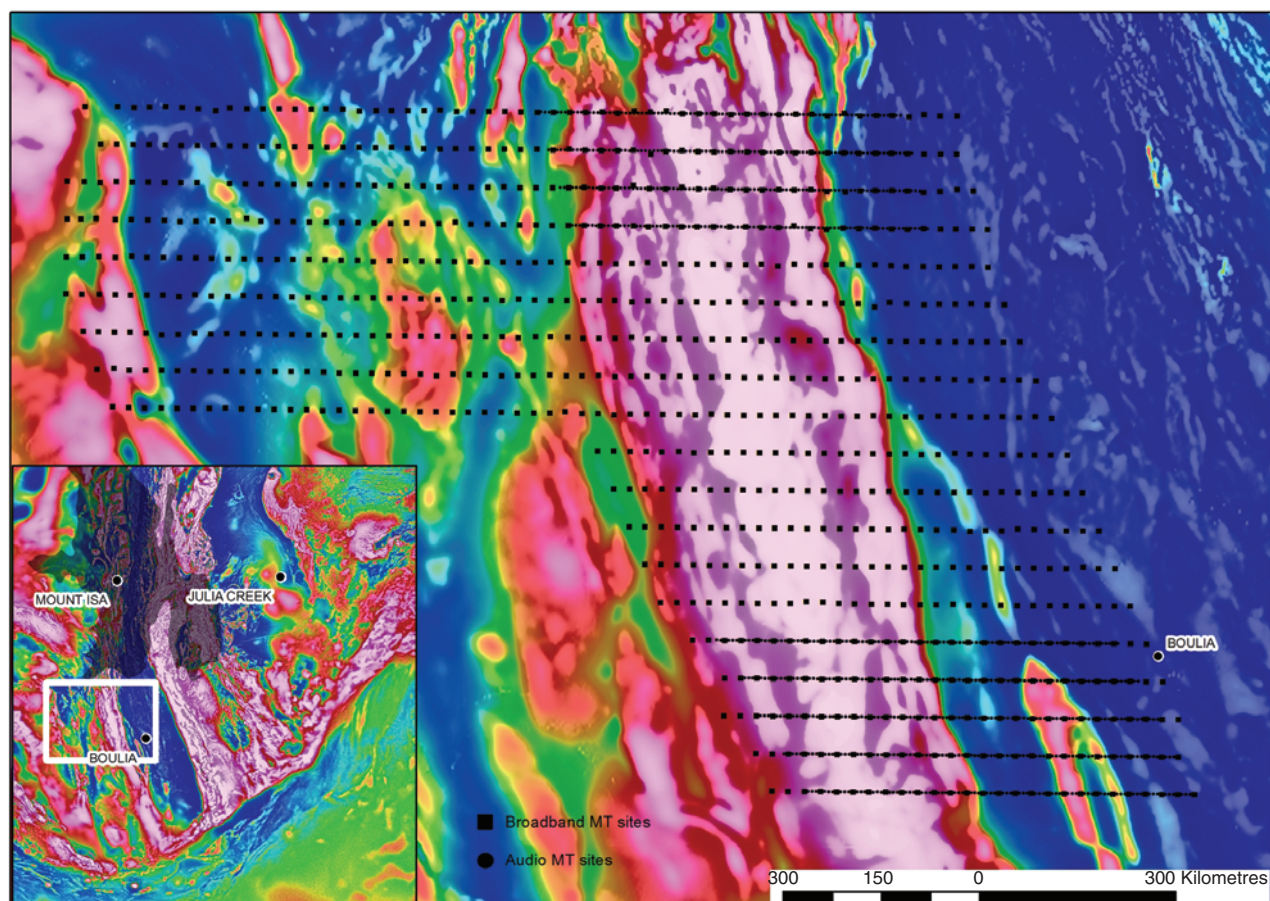
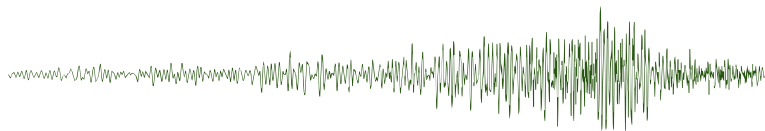


**Tensor Research**

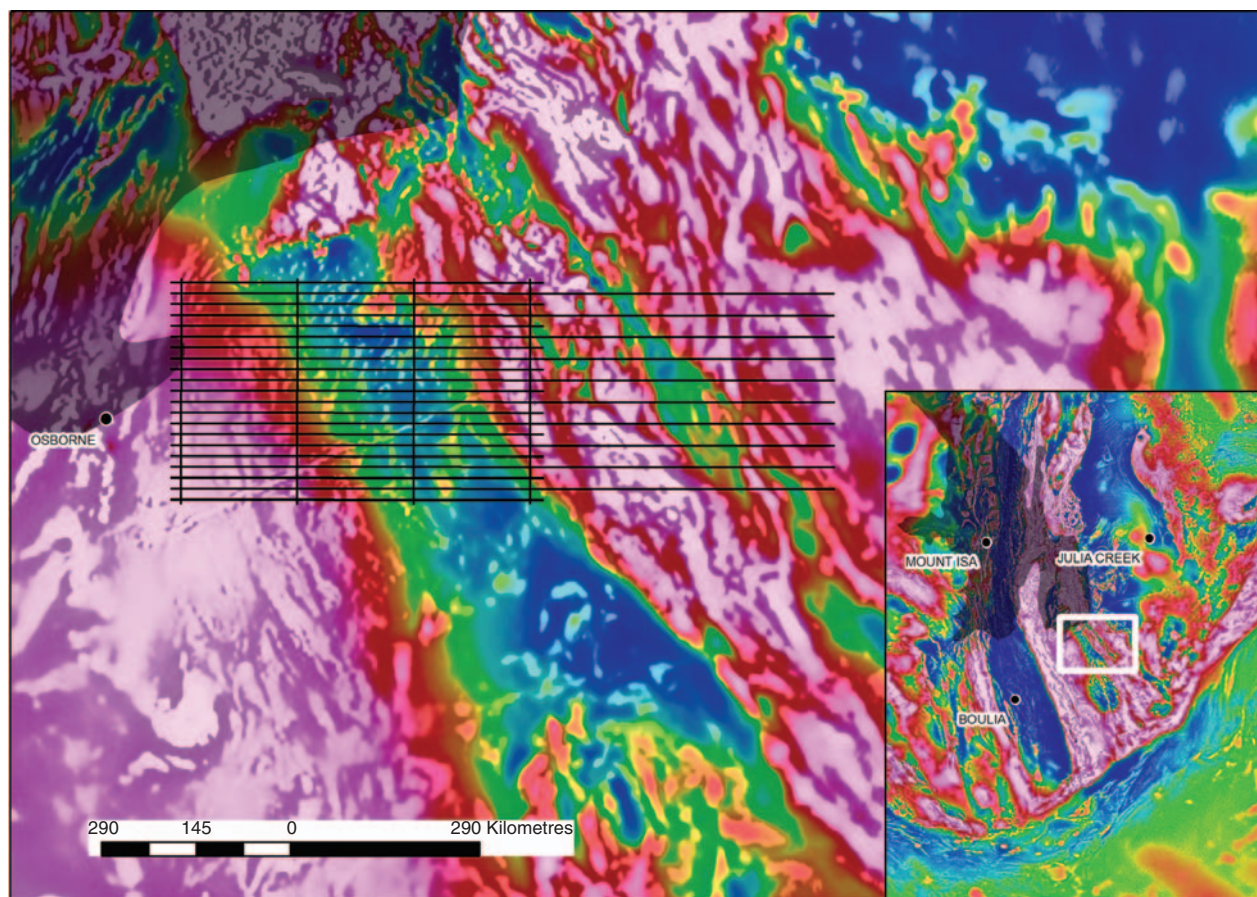
Geophysical software & services  
[www.tensor-research.com.au](http://www.tensor-research.com.au)

Tel: +61 404 064 033





**Figure 1.** Location of the Isa Extension MT survey. Shaded black area in inset represents the extent of the Mount Isa Inlier.



**Figure 2.** Location of the VTEM Supermax trial survey. Shaded black area in inset represents the extent of the Mount Isa Inlier.



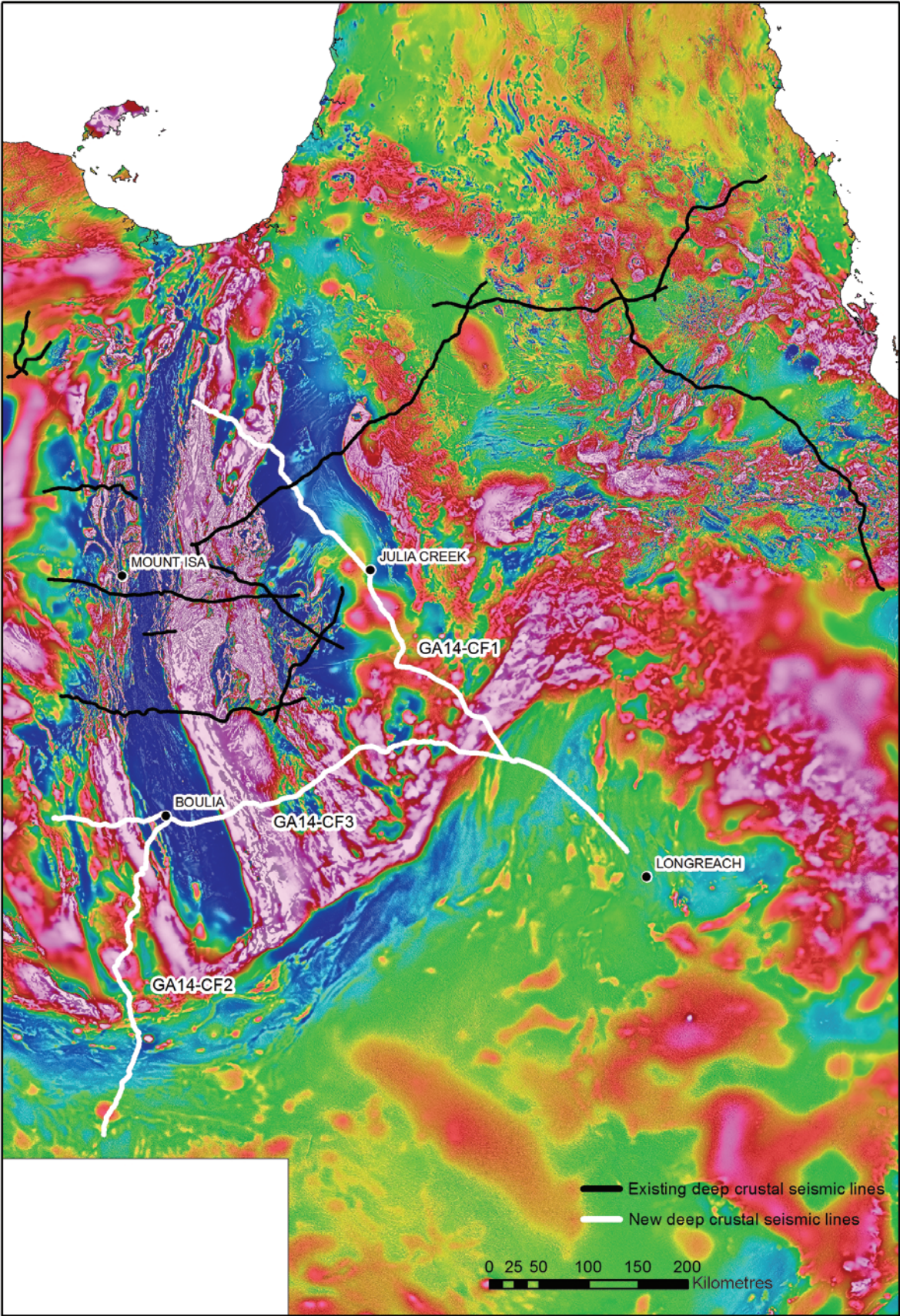
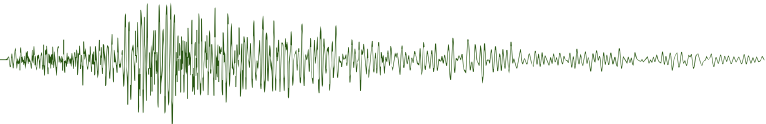


Figure 3. Location of the new deep crustal seismic lines.



## News from the Geological Survey of South Australia

A visit in April by BHP Olympic Dam's principal geometallurgist Kathy Ehrig resulted in the collection of a small amount of rare but interesting petrophysics from mineralised rocks in the Olympic Domain. Magnetic susceptibility and density measurements from drill holes WRD33 and WRD50A are available through the petrophysical layer on SARIG (<https://sarig.pir.sa.gov.au/Map>).

The AusLAMP magnetotelluric programme is still underway in South Australia, led by Stephan Thiel in collaboration with the University of Adelaide (Figure 1). The 104 new long-period sites have been combined with previous MT data to produce an image of the electrical resistivity distribution of the crustal and mantle lithosphere and constrain the geodynamic history of the Gawler Craton and its

margins. Early results indicate a resistive Gawler Craton in the upper crust, lower crust and upper mantle with significantly lower resistivity in the lower crust and upper mantle along the mineralised eastern margin of the Stuart Shelf.

GSSA geophysicists are also currently working on new gravity and magnetic state images. Unlike previous gravity images, the next gravity image will likely involve a further levelling of surveys in areas where multiple surveys overlap. It will also remove artefacts previously seen where adjacent surveys overlap. The new magnetic image will comprise data from over 100 new magnetic surveys. Stay tuned for news on these new grids later this year.

*Tim Keeping, Philip Heath, Stephan Thiel and Gary Reed*

*[Philip.Heath@sa.gov.au](mailto:Philip.Heath@sa.gov.au)*

### SA NF & AusLAMP

Status as at 23 June 2015

#### Legend

- **Yellow** - sites planned.
- **Lime Green** - sites currently deployed.
- **Dark Green** - sites currently re-deployed.
- **Aqua** - sites picked up but pending info on data quality.
- **Red** - sites that need redeploying
- **Orange** – sites with OK data but would benefit from redeployment
- **Blue** – sites completed

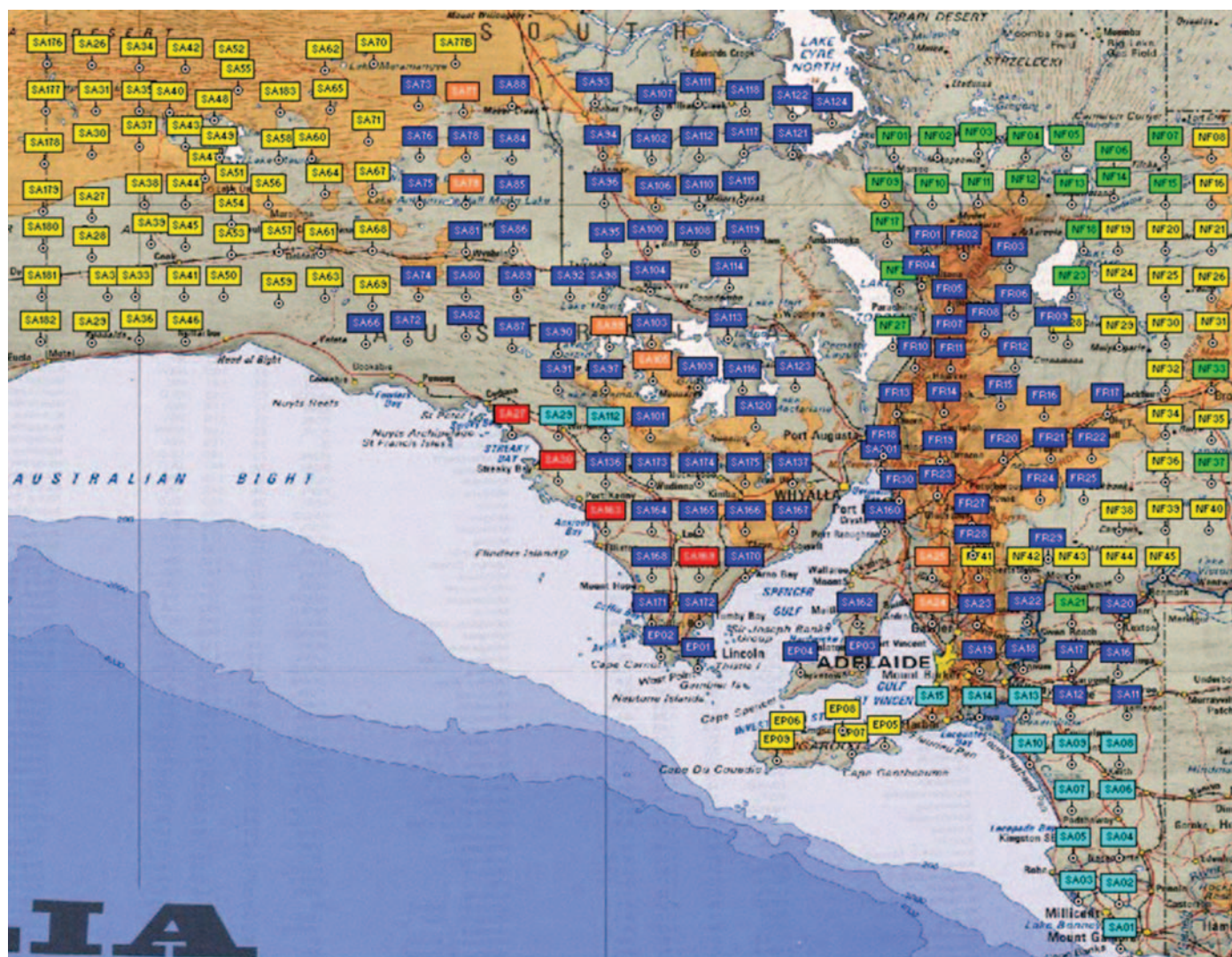
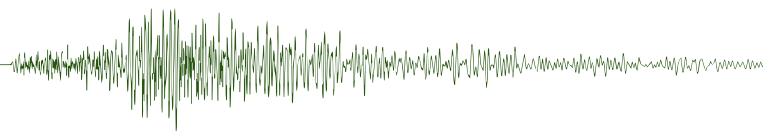


Figure 1. AusLAMP magnetotelluric stations as of 23 June 2015.





## Education Matters



Michael Asten  
Associate Editor for Education  
[michael.asten@monash.edu](mailto:michael.asten@monash.edu)

### Seminar time: Seven steps to selling your project

Honours students around Australia are now on the home straight with their theses – and that all-important seminar presentation is a vital part of demonstrating to staff and colleagues that the year has been fruitful. That 20 minute presentation is probably going to account for 10% of your thesis mark, so it is worth weeks not hours of preparation.

One of the greatest challenges – and a speakers greatest skill – is in deciding what to include when summarising a year of work into that brief presentation, and equally important is deciding what to leave out. A scientific talk should contain a proposition which the speaker proves (or in some important cases, will disprove).

**Rule 1: Select three points you would like your listeners to remember from your talk.** Shape an introduction and a conclusion which emphasize these points. Your audience will include 75% of students and staff who know little about your speciality, but it is your job to introduce them to the topic in a way that they learn from your detailed study, and hopefully they will also be convinced that you are now an expert.

Presenting that overview to the non-specialists must be balanced with some detail or insight which convinces the ultimate expert (your supervisor, or

maybe a self-opinionated graduate student who is one year ahead of you) that you have made your own contribution to the subject. After covering a selected point of detail, ensure the logic in your presentation allows you to return to the general points, thus picking up that fraction of the audience for whom the detail is complex. Acquiring that balance and logical development is a skill reflecting years of practice, but make it a goal from your very first presentation.

**Rule 2: Keep to your allocated time.** If the Chair has to skip question time because you are over time, you have lost an important part of your opportunity to show your command of the subject.

**Rule 3: A PowerPoint presentation is not a thesis presentation.** Figures which may look good on the printed page are often poor on a screen, due to details of drafting and annotation. A slide on the screen must be comprehensible to a non-expert in the space of a fraction of a minute. The screen presentation is most useful to your audience when it is uncluttered and immediately highlights your key point. If using a map or an image, make a simplified key which highlights only the features relevant to your talk. A beautiful feature of PowerPoint is the ability to add arrows or highlighting features which appear at a mouse-click, thus giving visual emphasis to match which-ever verbal emphasis you seek to make.

**Rule 4: Practice the presentation so that you can speak with minimal reading of notes.** Making eye-contact with the audience is a vital part of holding their attention. In particular, being able to present your introduction and conclusion with direct eye contact is helpful in engaging your audience and in asserting your authority. Most students will need to use some notes for the body of the presentation, but ensure you know your presentation sufficiently well that you do not read large sections of it.

A practice run with a few friends in the intended seminar room is especially helpful, as it provides a ‘feel’ for the audio-visual system and the acoustics you will use on the day.

**Rule 5: Use a microphone if you need one.** When presenting in a large seminar

room speakers with quiet voices are at a disadvantage. Get familiar with the audio capabilities before your talk, and if in doubt ensure that you have a microphone (preferably a lapel device) set up so that you can move and point at the screen without losing amplification.

**Rule 6: Project with confidence and authority.** As any actor knows, body language is a vital part of communication, and there are many subtleties here. A few worth mentioning:

- Dress up from your audience; if your peer group is used to T-shirt and jeans, go smart casual. If smart casual is the norm, go for business attire for your presentation.
- Stand confidently alongside rather than behind a lectern.
- Control the butterflies. Nervousness can cause first-timers to lean on a desk, make unnecessary hand gestures, or adopt awkward postures such as swaying, foot-tapping, or a cross-legged stance, to name a few. A rehearsal with a colleague may identify these and help avoid them.

Practising your presentation aloud and thinking about how two or three key audience members will receive it will enable you to hone your presentation. For example imagine that you are your supervisor, a fellow honours student or another staff member – what would you think of the presentation? What key messages would you take away?

**Rule 7: Answer questions succinctly.** If there is a dumb question, take the opportunity to provide a recap of a point not understood. If there is a barbed question from the above-mentioned graduate student, play a straight bat; spirited argument can be kept for the tea-room later.

Good luck to all our students presenting their work this year, and we hope to see many of you presenting again at local ASEG Branch meetings. Most importantly we expect the best to be presenting at the ASEG Conference in Adelaide in 12 months time. As Cicero, the silver-tongued orator of Rome 2060 years ago said, constant practice devoted to one subject often outdoes both intelligence and skill.

## Forthcoming lecture tours for professional development and continuing education

Wendy Watkins

Continuing Education, ASEG Federal Executive

[continuingeducation@aseg.org.au](mailto:continuingeducation@aseg.org.au)

We have distinguished lecturers from both the SEG and the EAGE visiting Australia later this year. Watch your local branch newsletters or contact Wendy Watkins on the ASEG Federal Executive, for details ([continuingeducation@aseg.org.au](mailto:continuingeducation@aseg.org.au)).

## World Class 'Education Days' is coming to Perth

From 31 August to 11 September 2015, EAGE is organising for the first 'Education Days' event in Perth, Australia. A variety of two-day short courses will cover most recent specific knowledge in geophysics, geology and related engineering areas.

**Jacques Blanco (PhySeis/Pau University)** will present 'Borehole Seismic: Advanced Analysis and Integration' (31 August–1 September). The course will cover advanced methods assessment of borehole seismic parameters from 3C VSP and 3D/4D VSP techniques, which create more positive 'vision' of the geological setting, including a precise rock-type characterisation and a good understanding of hydrocarbon flow paths.

**Prof Dorrik Stow (Heriot-Watt University)** will continue the Perth sessions with his course on 'Deepwater Reservoirs: Exploration and Production Concepts' (7–8 September) providing insight for geophysicists, geologists and petroleum engineers involved in deepwater exploration. One theme is that by keeping pace with new technology and complex geological structures of the deep marine environment in SE Asia and Australia, participants can overcome the pitfall of interbedded mudstones and variety of deepwater play in pursuit of reserves replacement in potential larger-sized fields.

**Dries Gisolf (Delft Inversion)** on 'Full Waveform Inversion for High Resolution Reservoir Characterization' (10–11 September) will complete the 'Education Days' event with his master-class on full waveform inversion. As full waveform inversion is identified as a critical tool to perform quantitative full waveform seismic-to-well matches, participants can expect to benefit by becoming more familiar with making better calls on when and how inversion of seismic data for reservoir properties is feasible and meaningful.

As a gesture of appreciation to ASEG as an associated society, the EAGE has offered to extend the same EAGE membership price to ASEG members. For more information on the 'Education Days Perth' event, refer to [lg.eage.org](http://lg.eage.org) and click Education Days Perth under Classroom Training button. For registration, please send an email to [rmo@eage.org](mailto:rmo@eage.org). A Certificate of Attendance endorsed by EAGE, and lunch, will be provided for attending this course. See you in Perth!

## SEG and EAGE Distinguished Lecturer Presentations

As advertised in the June issue of *Preview*, we also have the following presentations scheduled.

18 November, Perth; 19 November, Adelaide; 23 November, Brisbane; 30 November, Hobart; 9 November, Canberra; 10 November, Melbourne:

**Hansreudi Maurer**, Professor of ETH exploration and engineering geophysics at ETH Zürich, Switzerland, is the SEG's 2015 Near Surface Honorary Lecturer. His topic is 'The curse of dimensionality in exploring the subsurface, with particular application to tomographic inversions of 2D and 3D seismic data.'

<http://www.seg.org/education/lectures-courses/honorary-lecturers/2015/maurer/abstract>

20 November, Perth, and 25 November, Canberra:

**Alessandro Ferretti**, CEO of Tele-Rilevamento Europa, Milan, Italy, is the EAGE's visiting lecturer in its international continuing education and training program. His topic is Satellite InSAR Data: Reservoir Monitoring from Space, a one-day seminar in radar interferometry (InSAR), which is becoming a standard tool for monitoring surface deformation phenomena. This EET course is intended as a guided tour of InSAR and its applications.

<http://lg.eage.org/?evp=10266>



Subscribe now to our FREE email early alert or RSS feed for the latest articles from *PREVIEW*

[www.publish.csiro.au/earlyalert](http://www.publish.csiro.au/earlyalert)



Australian Society of  
Exploration Geophysicists

## Australian Specialist's Travelling Education Programme (OzSTEP)

### ***4D Seismic Reservoir Monitoring***

**Date:** October 2015

**Who Should Attend:** Managers and staff on development and production asset teams; geophysicists, geologists, and reservoir engineers; any others with a science or engineering background, including university students, who are interested in time-lapse techniques to monitor fluid flow in the earth.

#### **Instructor: Prof David Lumley, UWA**

David Lumley is a Winthrop Professor and Chair in Geophysics, jointly appointed to the School of Physics, and School of Earth & Environment, at the University of Western Australia (UWA). He is also the founding Director of the UWA Centre for Energy Geoscience research. Prof. Lumley has published 150+ refereed journal papers and expanded abstracts, and is the lead or senior Chief Investigator for over \$130 Million in competitive research grants. He is a physicist with a focus on geophysical energy and environment applications, with prior research and operations roles in industry (including Chevron Research), and academic institutions (including Stanford University, PhD '95, and the University of Southern California). David has significant business owner experience as the Founder and Chief Scientist of 4th Wave Imaging Corp., a 4D seismic technology company purchased by Fugro in 2007. Prof. Lumley actively participates with international scientific societies such as ASEG, SEG and AGU, where he has served as a chairman and organizer of various scientific committees and workshops, and was elected as First Vice President of the SEG (2009-10) representing 35,000 members worldwide. David has served as an international Distinguished Lecturer for the SEG, SPE and AAPG societies, and has received several scientific honors including the first SEG Karcher Award for his "pioneering work in developing time-lapse 4D seismology" to image subsurface fluid flow. Prof. Lumley serves as an expert adviser to industry and government organizations, including the Western Australia state government for regional exploration and development of hydrocarbons, geothermal energy and CO<sub>2</sub> storage, and the US National Academy of Sciences.

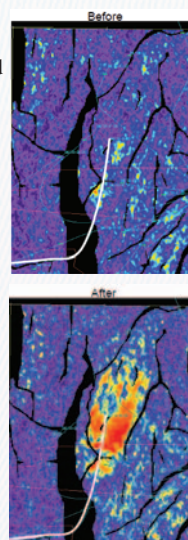


#### **Course Outline:**

This 1-day course is a practical overview of the most important theory, concepts and methods used in the modeling, design, acquisition, processing and quantitative interpretation of time-lapse 4D seismic data. Lecture topics include:

- 4D Rock and Fluid Physics, and various approaches to time-lapse 1D/2D/3D Seismic Modeling, to quantify how physical changes in the reservoir respond as changes in seismic data. This is useful for predicting the strength of the 4D signal, designing 4D seismic surveys and processing flows to enhance 4D signal and reduce 4D noise, and quantitatively interpreting 4D seismic data in order to estimate changes in reservoir properties such as fluid saturation and pore pressure.
- 4D Seismic Acquisition and 4D Processing techniques, to quantify non-repeatable 4D noise and suppress it, and to enhance real 4D seismic signal in the reservoir.
- 4D Quantitative Interpretation techniques to detect and analyze reservoir fluid flow anomalies, and to quantify them in terms of changes in pressure/saturation and other reservoir properties, using both qualitative and quantitative methods, including inversion.
- Monitoring aquifer drive and injected fluids such as water, gas, steam and CO<sub>2</sub>, locating bypassed hydrocarbons, identifying reservoir compartmentalization, and quantifying the hydraulic properties of faults (seals, leaks, baffles).
- Integration of 4D seismic information with geologic and engineering data to update the reservoir fluid flow model so that predictions of hydrocarbon recovery and fluid injection match the actual production data better ("4D seismic history matching").
- Time permitting... advanced 4D seismic topics including compaction, geomechanical stress, anisotropy, 4D FWI (full waveform inversion), passive and ambient noise seismology, 4D gravity.
- Many case study examples from around the world, both onshore and offshore, including primary depletion, water or gas injection, steam flood, and CO<sub>2</sub> storage.

**4D Seismic  
Pressure Anomaly**







Australian Society of  
Exploration Geophysicists

## Australian Specialist's Travelling Education Programme (OzSTEP)

### ***Potential fields: a (re)introduction for geophysicists and geologists***

**Date:** October 2015

**Who Should Attend:** geophysicists who wish to update/expand their appreciation of the use of potential field techniques; geologists who use gravity and/or magnetic data in mapping, exploration or interpretation (or who should do so!).

**Instructor:** Bob Musgrave, Geological Survey of New South Wales

Bob Musgrave is the Research Geophysicist with the Geological Survey of NSW. Bob graduated with a BSc (Hons) from the University of Sydney in 1981, majoring in geology and geophysics. Bob went on to complete a PhD (1987) at the University of Sydney in palaeomagnetism. Bob's interests in tectonics, palaeomagnetism and magnetic petrophysics led him through post-doctoral fellowships at Victoria University of Wellington (1987), the Australian National University (1988-89), and the University of Tasmania (1989-91). Bob went on to join the Ocean Drilling Program, based at Texas A&M University (1991-93), and to date has sailed on 5 ODP/IODP expeditions, the most recent in 2014. Returning to Australia, Bob was a Senior Lecturer in geophysics at La Trobe University until 2003. Bob was then a Senior Research Fellow at Macquarie University, before joining the Geological Survey of NSW in 2005. Bob is currently also a Conjoint Senior Lecturer at the University of Newcastle and an Honorary Associate of the University of Sydney. Bob's initial interest in palaeomagnetism has broadened over the years into a diverse range of applications, from magnetostratigraphic dating and tectonics, to magnetic petrophysics studies of hydrocarbon migration, gas hydrate accumulation, and the relationship of mineralisation processes to remanence-dominated magnetic anomalies. His work with GSNWS has emphasized applications of magnetic and gravity studies, including novel data filtering and presentation, long-wavelength interpretation and integration with passive seismic datasets, and joint magnetic and gravity inversion of complex tectonic settings. His research has yielded more than 50 peer-reviewed publications.



#### **Course Outline:**

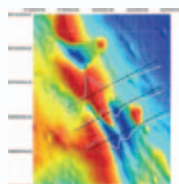
**Prerequisites:** basic geology. No prior geophysical training is necessary, and the maths will be kept "light", so the course should be accessible to all geoscientists – but there will be the opportunity for more sophisticated discussion for those with established skills in geophysics.

##### **Session 1 - Basics:**

- Course overview and scope
- Basic form of potential field anomalies
- Data acquisition
- Scalar, gradient and tensor data. Earth's gravity and magnetic fields

##### **Session 2 - Physical properties :**

- Density and magnetic susceptibility
- Remanence
- Magnetic properties and mineralisation
- Microbes and magnetic diagenesis

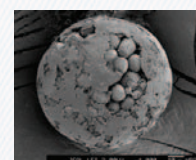
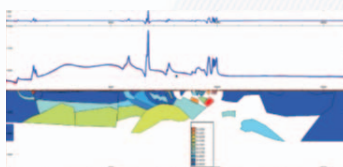


##### **Session 3 - Data presentation and filtering :**

- Derivative filters; phase filters and the tilt filter.
- Edge analysis ("worming").
- Euler depths; spectral depths. Curie depth.
- Isostatic correction.
- Tensor and gradient data interpretation.

##### **Session 4 - Potential field inversion :**

- Source mapping; derivative maps; inferring lithology.
- Direct inversion, and its limitations.
- Geologically constrained inversion.
- Remanence and inversion.
- Case studies.





Australian Society of  
Exploration Geophysicists

## Australian Specialist's Travelling Education Programme (OzSTEP)

### ***AVO and Inversion Methods in Exploration Seismology***

**Dates:** 2nd Nov (Perth), 4th Nov (Brisbane) and 6th Nov (Melbourne)

**Who Should Attend:** Geoscientists with a solid background in exploration seismology who wish to broaden their knowledge of AVO and inversion methods and their applications.

#### **Instructor: Dr Brian Russell**

Brian Russell graduated from the University of Saskatchewan (BSc) in 1973 with a major in physics, and received a BSc (Hons) (1975) at the same university, a MSc in geophysics from Durham University (1978), U.K., and a Ph.D. from the University of Calgary (2004), all in exploration geophysics. He joined Chevron as an exploration geophysicist in 1976 and subsequently worked for Teknica and Veritas before co-founding Hampson-Russell Software with Dan Hampson in 1987. Hampson-Russell is now a subsidiary of CGG, where Brian is Vice President, GeoSoftware and a CGG Fellow. Brian is involved in the development of new AVO, rock physics, inversion and seismic attribute techniques as well as presenting courses throughout the world. He is a past-President of both the SEG and Canadian SEG (CSEG) and has received Honorary Membership from both societies, the CSEG Medal and the Cecil Green Enterprise Award from SEG. He is currently Chairman of the Board of the Pacific Institute for the Mathematical Sciences (PIMS), an Adjunct Professor in the Department of Geoscience at the University of Calgary and at the School of Energy Resources at the University of Wyoming, and is registered as a Professional Geophysicist (P.Geoph.) in the Province of Alberta.



#### **Course Outline:**

- Part 1: The rock physics basis of AVO and inversion
- Part 2: Post-stack seismic inversion and wavelet analysis
- Part 3: Pre-stack inversion and AVO methods and case studies.
- Part 4: Azimuthal amplitude and velocity analysis for fracture determination.
- Part 5: Stochastic inversion methods.
- Part 6: Applications to unconventional plays.



## Environmental Geophysics



Mike Hatch  
Associate Editor for  
Environmental Geophysics  
[michael.hatch@adelaide.edu.au](mailto:michael.hatch@adelaide.edu.au)

### Mythbusters needed

In this *Preview* issue I would like to start a discussion about something that has been bothering me more and more lately, but is not necessarily part of my remit as the Associate Editor for Environmental Geophysics. I am concerned about the growing number of companies that are promoting (and making money from) geophysical exploration based on false science. In the last two years I have seen a company make extraordinary claims about its ability to discriminate minerals at pretty much impossible depths; a rehash of the old micro-lepton scam (see this item from *Physics World* debunking this – with some interesting comments: <http://physicsworld.com/cws/article/news/2002/jul/03/oil-companys-microlepton-technology-dismissed>); and two different companies promoting two, different, ‘new’ technologies to find water. All are obviously set up by people who have some knowledge of science, but use their knowledge to create impossible extensions to the known science, and then go on to sell and promise miracles. It only takes one or two explorers not to do the due-diligence that needs to be done and agree to run test surveys for these companies to make money.

The difficult thing here is that we don’t want to stifle creativity and actual technical advancement. The development of ground penetrating radar (GPR) starting in the 60s, the transient electromagnetic method (TEM) in the 80s, and nuclear magnetic resonance (NMR) in the 80s and 90s are examples

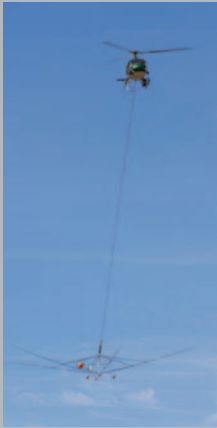


of legitimate innovation. All were great ideas, based on solid physics. Initial attempts at collecting data didn’t necessarily work so well but, with improvements primarily in electronics and then in software, each of these progressed and are now recognised as powerful geophysical techniques. Unfortunately for the scammers (and their claims of revolutionary insights to the science) the basic tenets of most of geophysics were established a long time ago (~1880 for Maxwell’s Equations), and the basics of how energy interacts with the earth is relatively well understood. Truly revolutionary changes in our understanding of these interactions will be recognised as such and will be published.

Why should the ASEG and its members care about these scams? It all comes down to the one sentence that the scammers are able to put on their

websites or in boardroom presentations that has the potential to lend some credibility to the companies’ claims. That sentence is: ‘As presented at ASEG’. Note that this is not even an endorsement by the ASEG, but that results were presented at a recognised, prestigious conference, with world-wide credibility.

Maybe the ASEG needs to set up a ‘Mythbusters Unit’ (thank you Graham Heinson for this great name) to investigate and expose these companies for what they are. I think it’s a great idea in the longer run, but maybe for now at least all Members of the ASEG should be on the lookout for this type of false science. We can all act in the front line to make sure that the scammers don’t get the oxygen that they need to thrive. Remember the old adages (slightly modified): ‘There are no silver bullets’; and: ‘When a company makes claims that sound too good to be true they usually are’!

**AEROMAGNETICS**  
**GRAVITY**  
**X-TEM HELI TDEM**  
**CSAMT**  
**AIRBORNE RADIOMETRICS**  
**DOWNHOLE EM**  
**INDUCED POLARISATION**

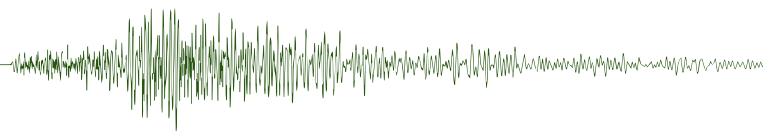




www.gpxsurveys.com.au

**GFX SURVEYS**  
 Airborne & Ground Geophysics  
 Greg Reudavey or Katherine McKenna  
 4 Hehir Street, Belmont WA 6104  
 T +61 8 9477 5111 F +61 8 9477 5211  
[info@gpxsurveys.com.au](mailto:info@gpxsurveys.com.au)

Africa | Australia | Asia | Middle East | Europe





## Minerals Geophysics



Ken Witherly  
Condor Consulting Inc.  
[ken@condorconsult.com](mailto:ken@condorconsult.com)

### The minerals industry downturn: a Black Swan event or just part of another cycle?

The recently released AIG membership employment statistics (Figure 1) is another brutal metric describing the tough times the minerals exploration industry is going through. Funding for all levels of exploration is down and doesn't appear to have bottomed out. Projections from the majors also suggest a long term slowdown in the consumption of major

commodities. The iron ore and coal markets are in clear oversupply whereas copper, the other mainstay, seems to flutter between pending shortages and imminent oversupply. The gold world created a special hell for itself because of its profligate ways during the last decade and now mops around looking for friends as it mutters the punch line of a 1980s American comic Rodney Dangerfield 'I don't get any respect'.

As is often the case in the minerals exploration sector, we seem to be awash with huge amounts of data and commentary that purport to explain current milieu. But, we still struggle to synthesize this information into meaningful trends, whether this is for the industry as a whole or for the individual. One of the industry pundits who specializes in the junior sector is Brent Cook. In a recent article (<https://www.explorationinsights.com/pebble.asp?relid=32671>) Cook built on an earlier opinion piece about how we arrived at this point in the industry and what we can look forward to. As Cook was an exploration geologist with considerable experience prior to going into the fiscal advice business, his commentary carries both an investor's bent as well as some realistic comments about the geoscience factors that underlies the challenge.

A posting of Cook's piece on the SEGMIN list server mid-July prompted a number of replies which, depending on the reader's perception and time in the industry, ranged from considerable concern at the personal level to advice to the group to 'hang in' and this has all happened before.

In my own take of Cook's commentary I saw some reinforcement of trends that I felt have been emerging for some time, and that suggest there are both repetitive components to the current story (*déjà vu* all over again) but also some decaying components which together make up a damped oscillation that suggest that this cycle looks very different from past ones. Does this mean we have a *defacto* Black Swan event in the making? A Black Swan event is defined as 'a surprise, has a major effect, and is often inappropriately rationalized after the fact with the benefit of hindsight' (shamelessly lifted from Wikipedia). In this case, a surprise could simply be what the majority of pundits see as 'very unlikely'.

Not to be side-tracked too much by definitions, I would suggest that the current scenario has three major components that would certainly have an impact individually but together could well produce a 'surprising' outcome. I define these as (1) the Great Crew Change (a term adapted from the oil and gas business), (2) transition from shallow to deep exploration (necessary in order to follow the targets of merit) and (3) changes to corporate governance (a global event not limited to mining companies).

The first two components have been subject of considerable discussion in our professional societies. Programmes such as the DETCRC and Uncover Initiative in Australia and CMIC Footprints in Canada are major efforts attempting to deal with the transition to deep exploration. As often is the case, we can expect to get part of what we wish for and, with history as a guide, we should expect some clever new technologies to emerge from these programmes. The critical issue might be, however, whether enough of the right people are around to use these technologies. Given that the exploration and mining industry is unlikely to change its cyclical nature, how attractive is this business to young people?

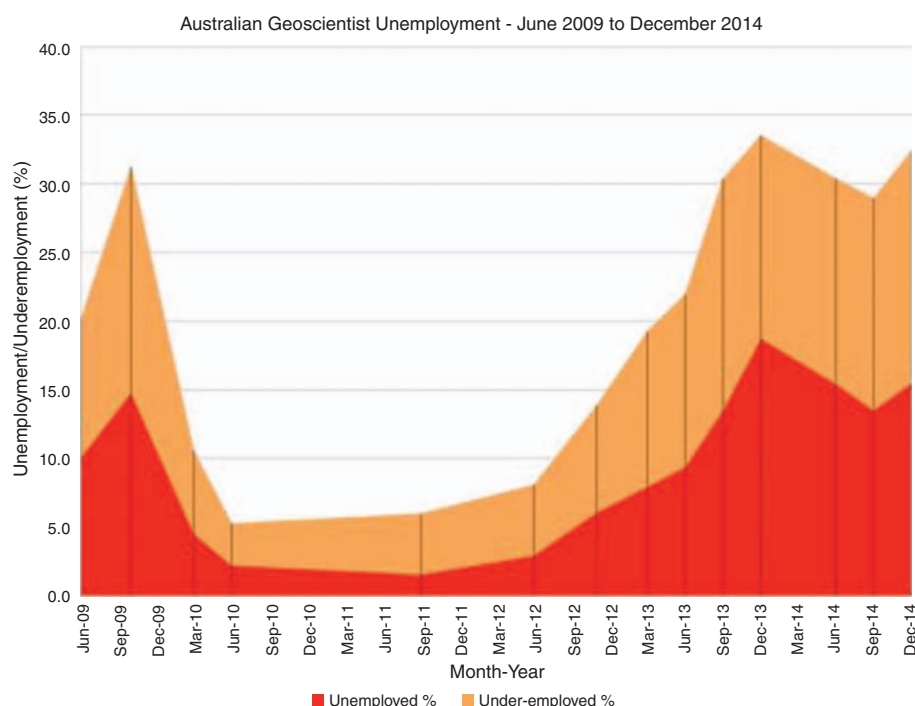


Figure 1. Results of the 2014 AIG Australian geoscientist employment survey <http://aig.org.au/>.

The third component expresses itself in almost all publically traded Western companies in that they are taking much shorter time lines to judge corporate performance. Long term strategic plans are all but gone and it is hard to see this changing in the near-medium term in the mining sector given the ragged balance sheets that many of the majors have inherited from the 'poor choices' made during the past decade. Not only do they need to rebuild their balance sheets but they must re-establish confidence and trust with their shareholders and this, by and large, means conservative fiscal policies, even at the expense of growth. While mining companies don't have to grow, they do, by definition, have to replenish what they mine or they will cease to exist. While some companies are well positioned with good resources that will support decades of production, others are truly burning the candle at both ends. This factor could result in a Black Swan 'surprise' that could see the industry going from 50–60 players to 10 or less in a decade or two; creating a landscape for the mining industry that would look a lot more like the landscape in the oil and gas industry.

Times of turmoil are also inherently times of greater opportunity since much of what was *status quo* gets swept away and new business models are embraced that are seen as 'fresh and relevant'. The geoscientist who can handle this as 'the new normal' will likely fare quite well technically and commercially but may need a good supply of Valium or single malt Scotch.

**Downhole EM, MMR and IP Surveys**

**Surface EM and MMR Surveys**

**High Power (100A) EM Surveys**

**Surface IP Surveys including 3D**

**Geophysical Consulting**

**Instrument Repair**



4/133 Kelvin Rd, Maddington  
Western Australia 6109

PO Box 3215, Lesmurdie  
Western Australia 6076

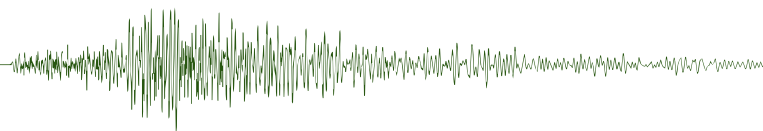
**p.** (08) 9291 7733

**f.** (08) 9459 3953

**e.** [sales@vortexgeophysics.com.au](mailto:sales@vortexgeophysics.com.au)



**VORTEX GEOPHYSICS**  
[www.vortexgeophysics.com.au](http://www.vortexgeophysics.com.au)



## Seismic Window



Michael Micenko  
Associate Editor for Petroleum  
[micenko@bigpond.com](mailto:micenko@bigpond.com)

### Save the bees

As geoscientists we are all very aware of environmental issues and, being responsible individuals, we want to minimise damage that may be caused by our activities at home or at work. So, with this in mind, I recently went to the local Eco Fair organised by our council hoping to learn more about recycling, LED lights, solar hot water and other useful things we can do to minimise our use of resources. There were over 70 stalls but two in particular caught my attention – I'll call them 'get fracked' and 'save the bees'. Both stalls had petitions to sign. Many people simply signed the petitions on request, but very few discussed the issues or asked questions about what they were signing.

The 'get fracked' group was petitioning against hydraulic fracture stimulation and contamination of aquifers with toxic chemicals. When I challenged the petitioner they backed away from the aquifer contamination assertion (it is not defensible because there are no known cases of fracking causing aquifer contamination in Australia) but persisted with the toxic chemicals argument. Well these chemicals or similar can be found in almost everyone's kitchen and probably in stronger concentrations. Two recent publications, one for the SA Government and another for the US Congress, have confirmed the safety of fracking. As an aside, in the well-known Australian book, *A town like Alice*, written by Nevil Shute, there is a description of the local inhabitants heading out to an artesian bore and lighting the water for amusement (Box 1). This book is set in the late 1940s and

published in the 1950s, long before any hydrocarbon exploration in the area and yet it documents gas in the bore water.

I found an even more misleading diatribe at the 'save the bees' booth. As I approached a young gentleman asked me if I'd like to sign a petition to save the bees. Well I like bees, even though they are Australia's most dangerous animal, so I asked what was happening to the bees. Well apparently 'they' are going to do a seismic survey in a bee keepers reserve over several hundred square kilometres just north of Perth and will build a road every 400 m, bulldozing all the trees, ripping up the roots and top soil and the bees will die.

Now I know enough about seismic surveys to suggest that the process is benign and the vegetation will simply be rolled flat or, at worst, cut above ground level to maintain root stock, and would be rehabilitated. 'But I've got photographs' responded the bee's advocate. So I asked to see them. Unfortunately they were not available. I suggested that if they existed they were not modern photographs but could date back to the 60s when bulldozing lines was the norm. But we have moved on from those days and seismic acquisition is no longer so destructive.

Here are some facts about the Arrowsmith Seismic Survey, which was recorded earlier this year in Perth Basin

#### Box 1. Quote from *A town like Alice*, Nevil Shute 1950

*As the light faded Pete and Al went out and lit the bore for Jean. They struck half a dozen matches and got it to light; a flame shot upwards from it and lit up the whole town, playing and flickering amongst the water and the steam till finally extinguished by a vomit of water. They lit it again, and Jean admired it duly; it was clear that this was the one entertainment that the town provided, and they were doing their best to give her a good time. 'It's wonderful', she said, 'I've never seen anything like that in England'.*

*They were duly modest. 'Most towns around here have a bore like that, that you can light.' they said.*

permit EP413 for Norwest Energy (Figure 1). This is the survey referred to by the bee's saviour and interestingly it completed recording on the day of the Eco Fair. The survey covered 106 km<sup>2</sup> of which only 2% was disturbed and this is being rehabilitated. About 25% of the survey area was in the Beekeepers Nature Reserve, which forms part of the greater Beekeepers Lesueur-Coomallo area, and Nambung National Park, which has an area of 1350 km<sup>2</sup>. There were no roads built, the topsoil was left in place and access lanes were created by cutting the vegetation above ground. Detours were made around large trees and the surface mulched to aid rehabilitation. Less than 0.55 km<sup>2</sup> of the Beekeepers Reserve was disturbed.

After explaining this the stall holder informed me that 'seismic may be safe but it leads to drilling and fracking'. The bees are being used as pawns in a greater game (Figure 2).

### Suggested reading

The facts about fracture stimulation in South Australia: The South Australian Department of State Development: <http://www.statedevelopment.sa.gov.au/resources/the-facts/fracture-stimulation-in-south-australia>



**Figure 1.** Location map showing Arrowsmith seismic survey area EP413 (blue outline), area of 3D survey (red) and beekeepers reserve (green).



Environmental Protection Agency report on fracking for US Congress: Article in *The Australian*, 5 June 2015: <http://www.theaustralian.com.au/business/news/fracking-causes-no-widespread-harm-to-water-but-questions-remain/story-e6frg906-1227384414702>



**Figure 2.** Examples of quasi-scientific literature distributed at my local Eco Fair. The exploration industry needs to counter these false claims in similar public forums.

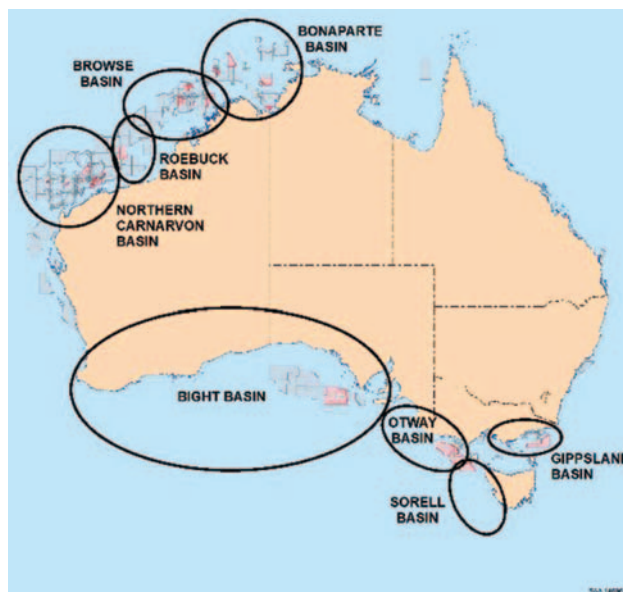
## 2015 Offshore Petroleum Exploration Acreage Release

Michael Micenko  
[micenko@bigpond.com](mailto:micenko@bigpond.com)

On 18 May 2015, the Hon Ian Macfarlane MP, Minister for Industry and Science, launched the 2015 Offshore Petroleum Exploration Acreage Release. Those of us actively involved in petroleum exploration are aware of all the details, however for those interested but less active individuals some pertinent points are included below.

The release comprises 29 areas across eight basins in Commonwealth waters; offshore the Northern Territory, Western Australia, the Territory of Ashmore and Cartier Islands, South Australia, Victoria and Tasmania (Figure 1). Twenty-three areas are available for work programme bidding and six areas are available for cash bidding.

Yes, cash bidding is back but in a slightly different form to the system used last century. Another change, announced by the Minister at this year's APPEA Conference, was the amalgamation of the primary term work commitments into one three-year block. Previously the primary



**Figure 1.** Map showing areas of 2015 petroleum exploration acreage release. Detailed maps can be seen on the Geoscience Australia acreage release website: <http://petroleum-acreage.gov.au/2015/2015-release-areas>.

term of a permit consisted of three years with a work commitment separately specified for each year. Now the primary term commitments can be carried out at any time in the three year period. This change is viewed as a flexible approach for exploring in offshore areas and reduces the administrative burden on explorers and the overseeing body – NOPTA (National Offshore Petroleum Titles Administrator).

In addition three areas not attracting bids in previous rounds have been re-released for bidding.

The 2015 release consists of three rounds – two work programmes and one cash bid round with the following closing dates:

Round	Bid close
Round 1 work programme: 12 areas	Thursday 29 October 2015
Re-release areas: 3 areas	Thursday 29 October 2015
Cash bid round: 6 areas	Prequalification: Thursday 15 October 2015 Cash bid*: Thursday 4 February 2016
Round 2 work programme: 11 areas	Thursday 21 April 2016

\*Only prequalified applicants will be invited to submit a cash bid.

### Cash bidding

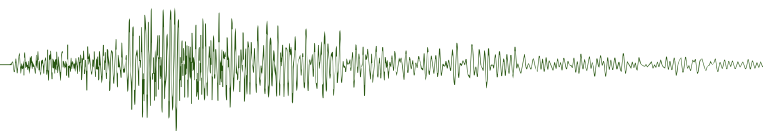
The guaranteed work programme system is fairly well understood but the cash bidding process is new. Here's how it works. Firstly each applicant who intends to place a bid for a cash bid area must prequalify with the Joint Authority by

providing evidence of their technical and financial competence. One prequalification application can be submitted for all cash bid acreage release areas that the applicant intends to bid on. The applicant may be a joint venture comprised of more than one company. An electronic copy of the prequalification application for each applicant, along with the relevant application form and application fee, must be received by NOPTA on behalf of the Joint Authority by 4:00 pm (WST) on Thursday 15 October 2015.

Applicants who satisfy the prequalification criteria will be advised of their eligibility to submit a cash bid application for the area or areas. Cash bid applications must be received before 4:00 pm (WST time) on Thursday 4 February 2016. Details of how to submit a cash bid, including the process for payment of the 10 per cent deposit (in AUD), will be provided in the notice of invitation to bid following prequalification. More details of the cash bidding process can be viewed on the NOPTA website: [http://www.nopta.gov.au/\\_documents/guidelines/cash-bidding-guidelines-20140624.pdf](http://www.nopta.gov.au/_documents/guidelines/cash-bidding-guidelines-20140624.pdf)

In general the cash bid blocks are small with good coverage of seismic or wells that make the work programme system inappropriate.

Full details of the block offer, including instructions on how to bid and a brief synopsis of each area, can be found at the acreage release website: <http://petroleum-acreage.gov.au/2015>



## Data Trends



Guy Holmes

[guy.holmes@spectrumdata.com.au](mailto:guy.holmes@spectrumdata.com.au)

### The good, the bad and the ugly

For the old timers in the industry, the good the bad and the ugly brings up memories of the 1966 Spaghetti Western starring Clint Eastwood. The movie became known for its unique use of long shot and close-up cinematography, as well its distinctive use of violence, tension and stylistic gunfights (kind of sounds like most analyst reports on the oil price).

In the movie, Clint Eastwood is a gun slinger ('the good' from the title), competing against 'the bad' and 'the ugly' to find buried gold in New Mexico.

I caught a 10 minute segment of this movie the other morning at 2am while researching technology trends and completing my design of a 10Tb storage platform that can be etched onto the back of a grain of rice. It instantly dawned on me that the movie and its characters were a pretty good allegory for the trends we are seeing (or have seen) in the data storage industry.

As with all commercial technology ideas, there are good ones, bad ones and downright ugly ones. In fact many can become all three given the right amount

of time, or some can be all three at the same time. Take the Ford Pinto for instance. It was good in that it was kind of sporty, it was bad because it was not the most reliable car and it was ugly because it had the tendency to explode when involved in a rear end collision.

For the oil industry, and the technology it uses to store its valuable data, I thought I would take a look at the past and present to see which main storage technologies found the buried Confederate gold in New Mexico and which ones were slain in the gun fights of time.

The first cab off the rank is the first commercial storage medium ever produced in the industry – the humble reel to reel tape. This one has become all three over time.

Good – in that it was a revolution that kick started a new industry and opened new avenues for sharing data. Bad – because with hindsight it did not hold much data in comparison to the technology we see today. And ugly – because in many cases the tapes have disintegrated, putting at risk the valuable data recorded on them.

The second wave of storage media in the industry came in the late 1980s when it moved to closed cartridge media. The fundamental design of these media is still in use today, and the evolution from 3480 to 3590 to 3592 was seamless and driven by a single manufacturer (IBM). To be fair it is a stretch to find the bad and the ugly in this technology. Even after 25 years the medium is stable and almost always readable. When push comes to shove, I can always find something bad to say about anything – but on this occasion I am going to follow my mum's advice – 'if you don't have anything nice to say about something, then don't say anything at all'. *Editor's note: Guy's mum must have been watching Disney movies whilst Guy was watching*

*Westerns as this immortal line comes from the movie Bambi and is now known as 'Thumper's rule' ... unless Guy really is Thumper all grown up.*

Running in parallel to developments in tape storage and vying for oil industry dollars was disk storage. This one was good, bad and ugly all at once and over time. It was good in that its capacity and speed quickly overtook tape allowing rapid access to data without the need for a tape drive or additional hardware. But it was also bad in that it became unreliable when put through the sorts of read/write pressures put to it in the oil and gas industry with its large files and continuous use patterns. It took some time, but it has also eventually become downright ugly due to the sheer number of manufacturers of this storage medium trying to create lower cost higher performing devices that now seem designed to fail.

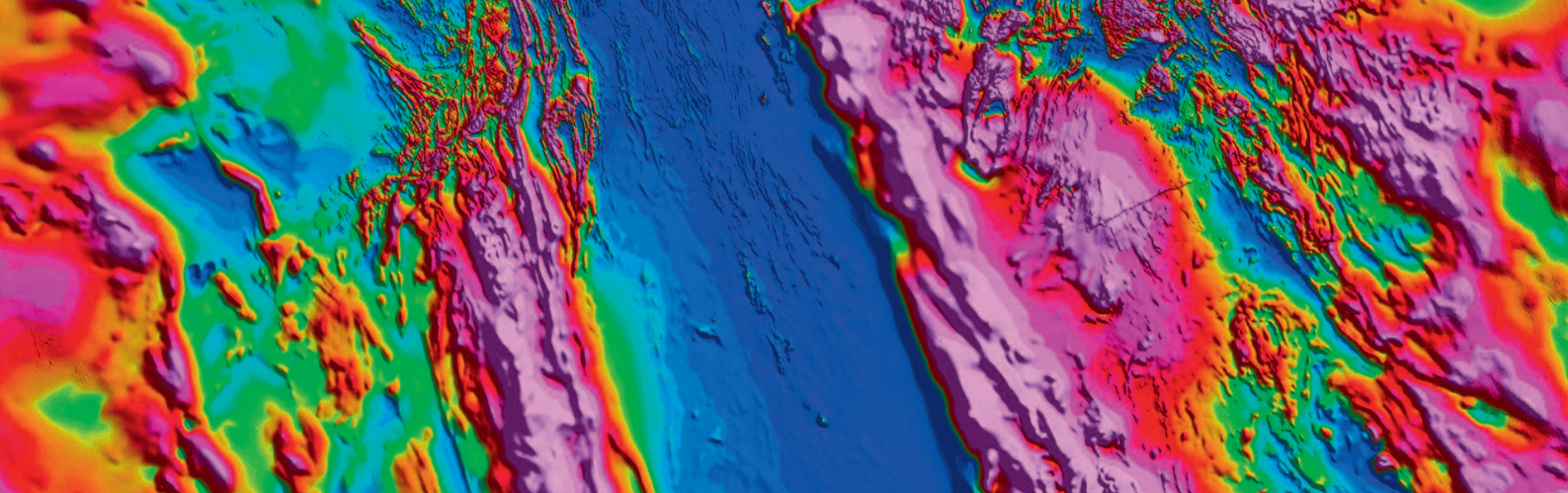
I think it is safe to say that the reel to reel technologies of the 1980s were killed in action - with their last words before Eastwood took them out being the horrible high pitched scream of a severely deteriorated tape passing over a tape drive head.

Hard disk technology has seen its share of fights as well, but continues to battle on the reliability vs cost battle fields of New Mexico.

It is only closed cartridge technology that, in my book, has found its way to the chest of Confederate gold – both metaphorically and commercially. Whilst I believe that tape storage in general is doomed to lose ground in the coming years, it is only so because of competing technologies, and not because it has major faults.

I had better wrap this up. The garage just called and said my Ford Pinto is ready for collection.

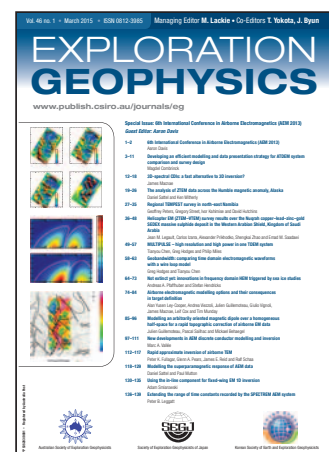




# Exploration Geophysics

The Journal of the Australian Society of Exploration Geophysicists

Publishing excellent research, technical papers, case histories, advances in data interpretation and theoretical developments in applied geophysics.



# Preview

The Magazine of the Australian Society of Exploration Geophysicists

News and reviews on the exploration industry, advances in geophysical techniques and communication among ASEG members.



# Stay informed

Keep up to date with industry news by subscribing to our email alerts or registering for RSS feeds.

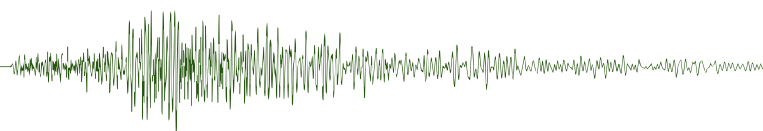
[www.publish.csiro.au/earlyalert](http://www.publish.csiro.au/earlyalert)



[www.publish.csiro.au/journals](http://www.publish.csiro.au/journals)







## The Australian Geoscience Council in 2015



Bill Shaw



Jon Hronsky

Bill Shaw<sup>1</sup> and Jon Hronsky<sup>2</sup>

<sup>1</sup>*President, Australian Geoscience Council*  
[president@agc.org.au](mailto:president@agc.org.au)

<sup>2</sup>*Chairman, Australian Geoscience Council*  
[chair@agc.org.au](mailto:chair@agc.org.au)

This report is based on the President's and Chairman's Reports to the Annual General Meeting of the AGC on 4 June 2015.

### Knowing who we are

The Australian Geoscience Council has eight major Australian geoscientific societies as its Members. These organisations are considered to collectively represent most of Australia's geoscientists, a number we believe to be around 7000 individuals, after considering that many are members of more than one organisation. As the peak body for these individuals we have interests in representing industry, government and academic professionals in the fields of geology, geophysics, geochemistry, minerals, petroleum, hydrogeology, environmental and all other aspects of geoscience.

Our Member Organisations have particular interests, summarised here from their websites (in alphabetical order). Details are on the AGC website at <http://www.agc.org.au>. We note that there is significant overlap between those organisations that focus on the geoscientists, on the geoscience and/or on both:

- The Association of Applied Geochemists (AAG) is an international organisation founded in 1970 and specialising in the field of applied geochemistry. Its purpose is primarily to advance the science of geochemistry as it relates to exploration and the environment.
- The Australasian Institute of Mining and Metallurgy (AusIMM) has a Geoscience Society that supports geoscientists working in the mining industry. Including the disciplines of mining engineering, metallurgy and others, AusIMM represents 14 000 individuals working in the global minerals industry and provides leadership and opportunities for minerals industry professionals.
- The Australian Geoscience Information Association (AGIA) is a national group made up of people and organisations working in any area of the geosciences at the professional level, and acts as a medium of communication for all those interested in geoscience information.

- The Australian Institute of Geoscientists (AIG) is a professional institute representing geoscientists employed in all sectors of industry, education, research and government throughout Australia.
- The Australian Society of Exploration Geophysicists (ASEG) is a learned society of professional earth scientists specialising in the practical application of the principles of physics and mathematics to solve problems in a broad range of geological situations.
- The Geological Society of Australia (GSA) was established as a non-profit organisation in 1952 to promote, advance and support earth sciences in Australia.
- The International Association of Hydrogeologists (IAH) is a professional association for those within disciplines related to groundwater, its occurrence, utilisation, testing and management. The Executive Presidency position of the Australian National Chapter is rotated annually through the State Branches.
- The Petroleum Exploration Society of Australia (PESA) is a national organisation representing the interests of all professionals and practitioners in the upstream petroleum industry.

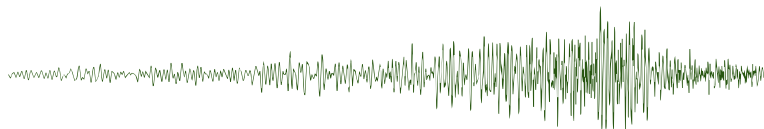
### Knowing where we are going

At this time last year, the AGC was just at the inception of the process of building our Strategic Plan. Through the good work of many we now have this completed and it provides a coherent framework to guide the activities and priorities of the AGC through the coming years. This plan has been succinctly summarised in a flyer that we recommend as a tool to communicate widely with all those interested in advancing the cause of geoscience in Australia. It is attached to this report and can be accessed on the AGC web site (<http://bit.ly/1MsNy4y>).

This Strategic Plan is particularly important because the AGC is in the fortunate position of currently being well-resourced through the results of the very successful International Geological Congress in Brisbane (the 34th IGC). With this however comes the obligation to proactively and responsibly use these resources to support Australian geoscience. We have been given a great opportunity to make a difference and we must make sure we take advantage of it. We felt that the most important way to start this process was to ensure we could see all of the issues and needs so that we can prioritise our efforts in a balanced and objective way.

Given that our Mission is defined in our Constitution we started with our Vision. This maps our path forward and gives us guidance at each step in making decisions. The Vision we agreed on is appropriately challenging: We will raise the profile of Geoscience to be pre-eminent in Australia and to be recognised as one of the great fields of general science with Physics, Chemistry and Biology.

To maintain our focus on this Vision we have developed three Strategic Pillars: Geoscience Education, Geoscience Advocacy and Geoscience Sustainability. We consider these almost self-explanatory, the third pillar focusing on actions that enable us to ensure the first two continue to be developed long into the future. For each of the Strategic Pillars we have defined Strategies and within each of the Strategies we have defined Targets. Full details of our Strategic Plan are on our website.



The most important challenge now is to effectively implement our Strategic Plan. We need to translate the aspirations in the plan into concrete actions and outcomes. This is being done through the development of a Business Plan and Budget that guides us for the current year. We also need to recognise that implementation of this plan cannot rest solely on the shoulders of our hard-working Executive. To this end, we have initiated committees to drive the plan forward in our key strategic areas such as Geoscience Education and Geoscience Advocacy. These committees will play an increasingly important role. We have also recognised the need for an Administration Officer to support the implementation process, and this is now in place.

An interesting outcome of our Strategic Plan is that the AGC has been invited to participate in the Australian Academy of Science subcommittee that is developing a 10 year plan for geoscience in Australia. The last such decadal plan was extremely successful in helping provide coordinated funding for government, academia and organisations such as Geoscience Australia, the CSIRO, university departments and Centres of Excellence. We have already been asked to specifically help with the Education aspects of the new plan, which fits well with our first Strategic Pillar of Geoscience Education.

### Our achievements

During the past 12 months our focus has been on the following strategies:

- In Geoscience Education we have focused on supporting the excellent online publication *GeoEdLink*, which was issued in September and December 2014 and April this year.
- In Geoscience Advocacy we have focused on supporting the UNCOVER initiative. We made this a major issue in a recent mission to Canberra, at the Science Meets Parliament event that Bill Shaw attended with Brad Pillans. We also see this as a focus for Science and Technology Australia (STA) where we have emphasised that this is an issue of singular economic importance to all Australians.
- In Geoscience Sustainability we have found common ground amongst our Member Organisations, and clarified the role that the AGC can play for them and that they must play for us if we are all to achieve our Vision.

- We would also like to report the successful completion of negotiations with the Australian Academy of Science (AAS) to set up a travel fund for young geoscientists. This fund will be administered jointly by the AGC and AAS and will represent a long term positive legacy arising from the 34th IGC.

### Our concerns

We would be remiss not to mention that the collapse of the mining boom and commodity prices has put many of our geoscience colleagues under pressure. This is one of the hardest times we have seen in the boom and bust cycle, as it affects not just one or two commodities but all of the mining and the hydrocarbon industries.

We must all ensure at every opportunity that we argue for a rational long-term approach to supporting the people and the technologies that enable us to do good geoscience, irrespective of the drivers behind economic rationalism. Cutting costs should not mean cutting capabilities. Our industries continue to fail to learn this lesson.

### Acknowledgements

We thank our Secretary Dr Ron Hackney and our Treasurer Mrs Miriam Way, who is assisted by Mr Brad Clements of the AusIMM. These are important roles that take up a lot of voluntary time.

We also thank the representatives of our Member Organisations who have provided constant support, encouragement and clarity in guiding the AGC towards making a difference for geoscience in Australia. We consider that we now have a strong team that understands and whole-heartedly supports what we are all trying to achieve.

*Editor's note: The official ASEG AGC representative is Kim Frankcombe. The Secretary of the AGC, Dr Ron Hackney, is also a Member of the ASEG and Preview Associate Editor: Book Reviews.*



Specialists in ground Electro Magnetic Surveys  
for mineral exploration Australia and International

**NEW**



## The Jessy Deep HT Squid

### Capabilities:

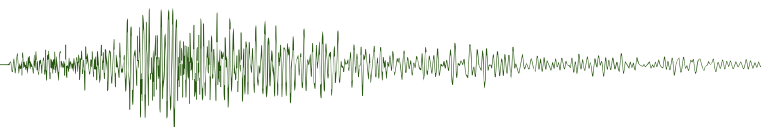
- Ultra sensitive receiver for ground transient electromagnetic (TEM) measurements
- Data recorded 10 times longer or 3 times deeper
- Ideal for measuring targets covered by a conducting overburden
- Direct measurement of the magnetic field
- High magnetic field resolution at low frequencies
- Flat frequency response from dc up to 10 kHz

Please contact Ben Morgan for more information.

p: +61 8 9739 2011  
f: +61 8 9739 2012

e: [gem@gemgeophysics.com.au](mailto:gem@gemgeophysics.com.au)  
w: [www.gemgeophysics.com.au](http://www.gemgeophysics.com.au)





**Australian Geoscience Council Inc.**  
The Council of Earth Science Societies in Australia



**STRATEGIC PLAN**  
**2015 – 2020**  
with  
**Examples of Specific Initiatives**

[www.agc.org.au](http://www.agc.org.au)

The Australian Geoscience Council comprises the following Australian Geoscience societies:



**VISION**

We will raise the profile of Geoscience to be pre-eminent in Australia and to be recognised as one of the great fields of general science with Physics, Chemistry and Biology.

**MISSION**

The role of the AGC is to foster close relations between Geoscience learned societies and professional associations in Australia and to take concerted action for promoting Earth Sciences and their applications in the best interests of both our constituent organisations and the nation as a whole.



## THE STRATEGIC PILLARS OF THE AGC

**1. GEOSCIENCE EDUCATION**

**1.1 Support Public Education about Geoscience**

- Initiate "Mawson Day" to recognise geoscience achievements
- Support the National Rock Garden
- Identify and promote geoscience champions as National Treasures

**1.2 Support Primary School Education**

- Identify and support outstanding programs and their champions

**1.3 Support Secondary School Geoscience**

- Australian Earth & Environmental Science Olympiad
- Teacher Earth Science Education Program and Earth Science Western Australia
- GeoEdLink newsletter for teachers
- Support the use of the Geoscience Australia Education Centre as a resource

**1.4 Support Tertiary Geoscience Education**

- Manage the AGC/AAS Travel Fund for Young Geoscientists
- Support Australasian University Geoscience Educators Network

**1.5 Support continuing Education in Geoscience**

- Encourage communication, consistency and mutual support between member organisations

**1.6 Policy Framework for Geoscience Education**

- Collect and promote survey data on the status of geoscience education


**2. GEOSCIENCE ADVOCACY**

**2.1 Proactive advocacy on key issues**

- Endorse and promote the UNCOVER initiative
- Raise awareness at State and Federal level regarding geoscience training, employment and research funding issues. Gain leverage from member surveys
- Initiate touring speaker series for public lectures

**2.2 Assist member organisations to communicate with the broader community**

- Retain a media advisor who can be used by the AGC on behalf of membership groups
- Develop a policy for communication of issues that considers:
  - Apolitical representation
  - Advocacy to governments
  - Raising public awareness
  - Facilitation, coordination, leadership
  - Social media
- Identify spokespersons with relevant expertise who can provide objective commentary on issues such as:
  - Climate change
  - Long-term water security
  - Dry-land salinity and soil loss
  - Geotourism
  - Fracking and coal-seam gas
  - Long-term resource security

**Australian Geoscience Council Inc.**  
The Council of Earth Science Societies in Australia 

**3. GEOSCIENCE SUSTAINABILITY**

**3.1 Facilitate synergy between member organisations**

- Provide a forum for sharing of issues and information between member organisations
- Identify and develop leverage points for member organisations
- Explore and facilitate opportunities for resource sharing between member organisations
- Provide leadership, opportunities and forums to further the interests of Geoscience in Australia
- Improve connections and support between AGC, member organisations and academia
- Coordinate communication about third-party funding requests

**3.2 Governance of the AGC**

- Review AGC operations (roles, constitution, etc.)
- Website content and social media presence

**3.3 Ensure the viability of the AGC**

- Maintain financial resources above a sustainable level and develop a regular income stream

**3.4 Promote alignment with key stakeholder groups**

- Young professionals, women in geoscience, other special interest groups (e.g. indigenous)
- Geoscience projects in developing countries; e.g. IUGS Resourcing Future Generations
- Collaboration with other overseas volunteer schemes; e.g. Engineers Without Borders

# Extracting three component magnetic data from down hole surveys or Survey for nothing and your mag for free (with apologies to Dire Straits)



Kim Frankcombe  
ExploreGeo  
[kim@exploregeo.com.au](mailto:kim@exploregeo.com.au)

Most drill holes deeper than 100 m are now routinely surveyed using some form of down hole survey tool in order to recover the true hole path. If the survey tool relies on the earth's gravitational and magnetic field to recover azimuth and dip then it generally also provides three component magnetic data. These data are currently underutilised, principally because users are either unaware that the data exist, or do not have the software tools to easily convert the data into an interpretable format. This short note aims to address both these hurdles.

Magnetic survey tools contain a three component fluxgate to measure the magnetic field and a three component accelerometer to measure gravity as shown schematically in Figure 1.

Before anyone goes off on a tangent, NO, these accelerometers are not of sufficient accuracy to be used as gravity meters! In Figure 1 the components are labelled with x, y and z subscripts using a right hand rule in order to match the trigonometry that follows, however different tool manufacturers have different right hands and all that can be assumed with real data is that the three components are orthogonal and that the gravity and magnetic components are parallel and will occasionally have opposite signs. Remember that convention has both the magnetic field and gravity field as positive down.

The software provided with the survey tool, or firmware within it, use these six readings to derive the magnetic azimuth of the hole and its dip, which is why the tool was used by the driller in the first place. The driller passes the data on to the geologist and generally the data stop there. However, the majority of survey tools can also provide either the raw data for the six measurements, or a processed version of them that can be used by a geophysicist to create a three component down hole magnetic survey – free data!

We'll quickly work through the trigonometry required to recover the data but, in essence, if the two radial accelerometers are used to determine the tool roll, R, the ratio between the total radial and axial accelerometers then provides Dip. The tool roll computed from the accelerometers can then be applied to the

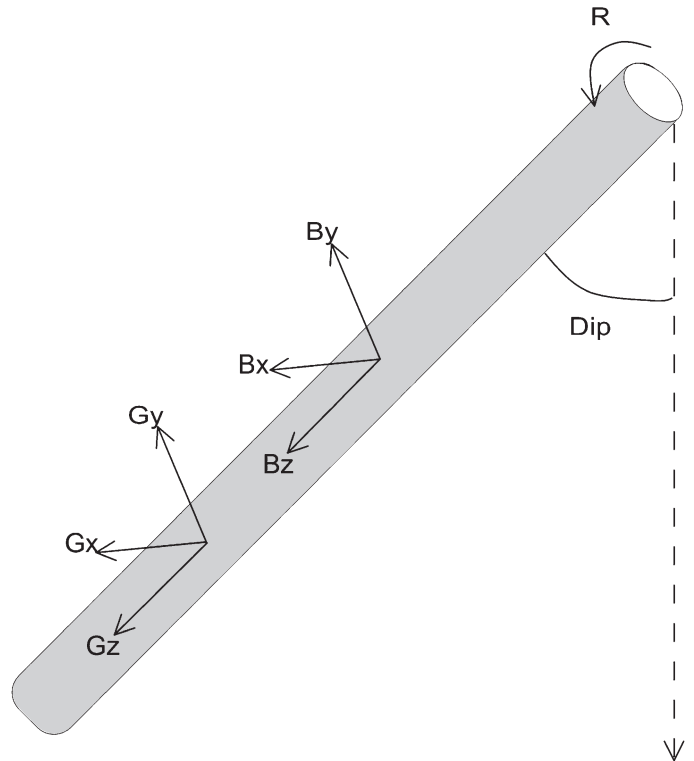


Figure 1. Component labelling notation.

magnetometers to recover total radial magnetic field, which using the hole dip and axial magnetic field can then be rotated to provide horizontal and vertical magnetic fields. The horizontal field is assumed to be pointing to magnetic north and the rotation between it and the vector normal to the hole, in the vertical plane through the hole, is the magnetic azimuth. Local disturbances in declination away from the regional can be mapped if we either have an independent non-magnetic measure of azimuth, for example from a gyro tool, or assume that long wavelength variations in the azimuth are due to hole deviation and short wavelength variations are due to local magnetic sources and apply a low pass filter to the azimuth to approximate what we hope is the hole azimuth. Armed with both the hole and the apparent magnetic azimuths we can separate the horizontal magnetic field into its east and north components.

Here is the same thing algebraically.

First, assume that the gravitational field is vertical and use the accelerometers to derive inclination and tool roll.

$$G_r = \sqrt{(G_x^2 + G_y^2)}$$

$$R = \Pi - \text{Atan}(G_y/G_x)$$

$$\text{Dip} = \text{Atan}(G_r/G_z)$$

Mineral exploration convention has dip negative down from horizontal so to convert this dip to something more familiar to a minerals explorer we need to subtract 90° from it. The Dip used



in the following equations is the Dip in the equation above not the typical mineral dip.

Now, rotate the magnetic components into horizontal and vertical fields.

$$M'_x = M_x \cos(R) - M_y \sin(R)$$

$$M'_y = M_x \sin(R) + M_y \cos(R)$$

$$M''_x = M'_x \cos(\text{Dip}) + M_z \sin(\text{Dip})$$

$$B_v = -M'_x \sin(\text{Dip}) + M_z \cos(\text{Dip})$$

$$B_h = \sqrt{(M''_x)^2 + M''_y^2}$$

Now, compute the apparent magnetic azimuth, total field and magnetic inclination

$$\text{Azimuth} = \text{Atan}(M'_y / M'_x)$$

$$B_t = \sqrt{(M_x)^2 + M_y^2 + M_z^2}$$

$$B_i = \text{Atan}(B_v / B_h)$$

Because we are dealing with three component data it is a powerful interpretation aid to be able to display these as vectors in 3D. However, in nearly all cases, the anomaly of interest is only a small fraction of the earth's field and the vectors of  $B_v$  and  $B_h$  are so dominated by the earth's field that the anomaly is lost. A background or regional is therefore subtracted from the data to produce residual components. The choice of background is entirely up to the user and will depend on the target being sought. Because drillholes are generally relatively short, compared to comparable ground or airborne survey lines, most workers start by subtracting a constant from the data as removal of a varying value automatically involves interpretation and we need to see the data before interpreting it. A typical background value can be derived from looking at  $B_t$  and  $B_i$  and trying to pick a non anomalous part of the profile, although some workers use the IGRF values for the area. The latter approach assumes that all tools are well calibrated and clear of all magnetic interference, a courageous assumption.

From the Total Field and inclination background values we can compute background values for the horizontal and vertical fields ( $B_{hr}$  and  $B_{vr}$ ) and thus derive anomalous north and down component fields

$$B_n = B_h - B_{hr}$$

$$B_d = B_v - B_{vr}$$

The east component of the magnetic field at this stage is zero as the anomalous field is assumed to have the same declination as the earth's field. If, however, we now introduce a new version of the magnetic azimuth that is free from local magnetic effects, (we will call this the hole Azimuth) we can break the horizontal field into its two components using simple trigonometry.

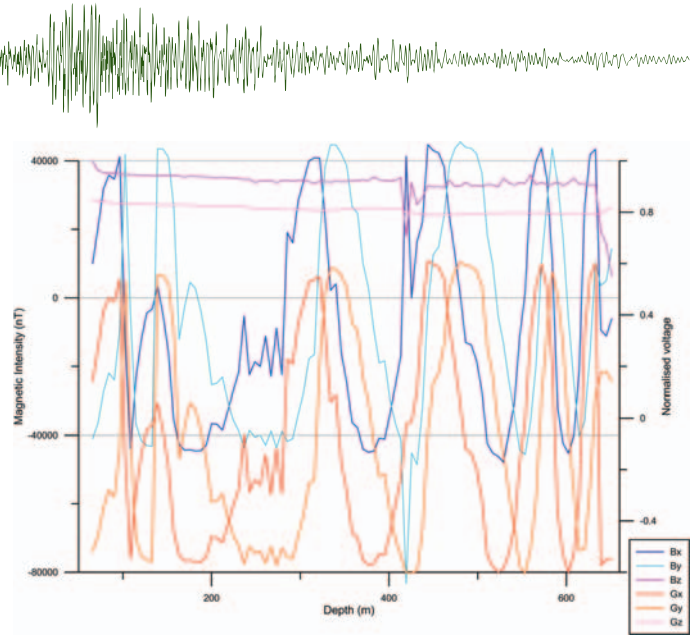
$$B_e = B_n \sin(\text{hole Azimuth} - \text{apparent Azimuth})$$

$$B_n = B_n \cos(\text{hole Azimuth} - \text{apparent Azimuth})$$

Remember that at this stage everything has been referred to magnetic north, in order to use the data in a 3D package it will need to be rotated to true north or local grid north if not using UTM co-ords.

$$B_{ge} = B_e \cos(\text{Decl}) + B_n \sin(\text{Decl})$$

$$B_{gn} = B_n \cos(\text{Decl}) - B_e \sin(\text{Decl})$$



**Figure 2.** Plot of raw data against depth down hole.

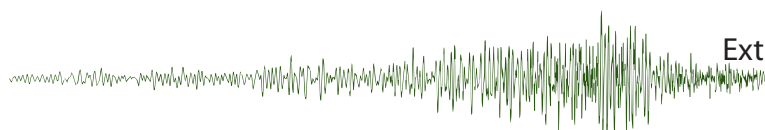
Where Decl is the declination between grid and magnetic north, positive east.

In the absence of purpose written magnetic reduction software these calculations are easily performed in a spreadsheet. As noted above, some manufacturers output all six raw components, others output  $B_t$  and  $B_i$ , and yet others output  $B_h$  and  $B_v$ . The latter two data types also require azimuth and dip from the same tool, but these are nearly always provided in the same file.

So what does this data look like? Figure 2 shows a plot of the raw data from the 6 components for a hole in the northern hemisphere.

The axial components are generally easy to spot as they are relatively well behaved. The radial components, on the other hand, can be seen to change wildly as the tool rolls in the hole. Note that the two X components are in phase as are the two Y components. In the southern hemisphere, because the regional magnetic field is pointing up, matching components will generally be 180 degrees out of phase. Clearly in this state the data are not particularly useful as an interpretation aid, although there are obvious magnetic anomalies around 430 m down hole and at the end of this hole. Note, however, that the anomaly at around 430 m coincides with a flexure in  $G_z$  indicating a change in dip. It is likely that the magnetic anomaly here is due to a metal wedge, information that is not always passed on with the data. The anomaly at the bottom of the hole is also accompanied by a change in  $G_z$ , possibly due to the twisting sideways in the hole. While for most surveys picking the axial component is relatively easy, it is not generally possible to tell which pair is X and which is Y. A new tool type therefore requires a trial and error calculation, swapping components and signs until a calculation using the formulae given here derives a dip and apparent azimuth in agreement with those provided by the tool's software. Note the signs of the gravity and magnetic sensors on the axial component as these may also need to be flipped. Table 1 lists tools and adjustments required for some of the tools used by the author.

Having established which component is which, it is a simple matter to compute apparent azimuth, dip, total magnetic field, magnetic inclination and the horizontal and vertical component of the field. A background value can then be subtracted from these to provide the north and down magnetic residuals.

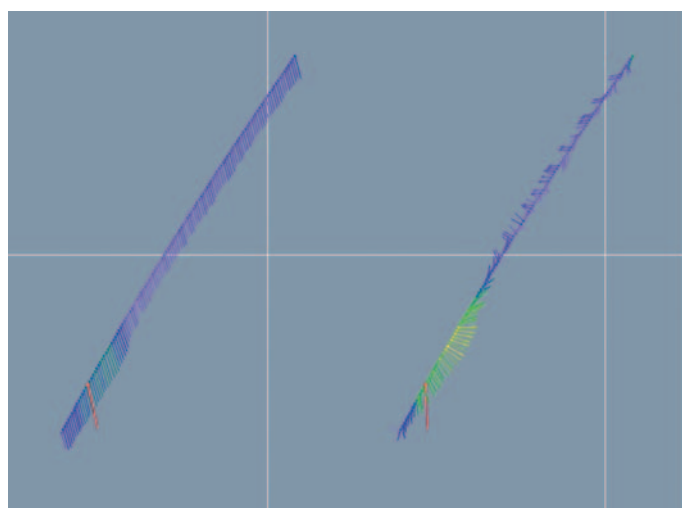


**Table 1.** Tools and adjustments required for some of the tools used by the author

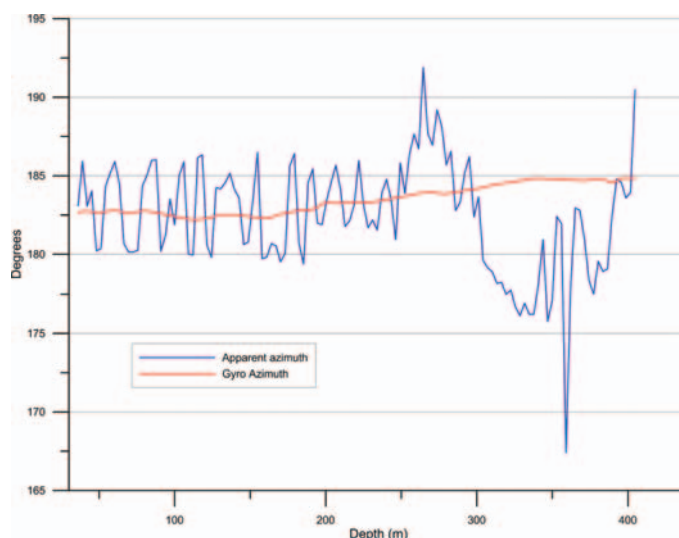
Tool	Adjustment
Champ	None
TBS Russel – Subsurface Systems	Swap X and Y
Scintex Auslog	Swap X and Z
Reflex EZ Track	Swap X and Y
Flexit	Swap X and Y
Direct Systems DMU	Swap X and Y Mag is in $\mu\text{T}$
Geoscience Televiewer	Does not output $G_z$ . Calculate using $G_z = (1 - \sqrt{(G_x^2 + G_y^2)})$ Mag is in $\mu\text{T}$ and multiply $B_z$ by $-1$
Crone Rad Tool	Swap X and Z
Globaltech Pathfinder	Swap X and Y and multiply all G by $-1$
EMIT Atlantis Analogue	Multiply all mags by $-1$
EMIT Digi-Atlantis	Outputs magnetic data in standard EM U,V and A convention so rotate using azimuth and dip only

Figure 3 shows vector plots of the  $B_h$  and  $B_v$  on the left and the residuals  $B_n$  and  $B_d$  on the right. The hole has a roughly southerly azimuth and is also in the northern hemisphere at a place where the regional inclination is about  $73^\circ$  as is evident from the left hand plot. Clearly the removal of a background value makes the data more interpretable. Can you guess where the magnetic body is?

Remember that at the moment we have assumed the east component of the magnetic field is zero. Because the holes were drilled towards a strongly magnetic target they were also surveyed with a gyro tool, which only relies on an assumption that gravity is vertical down and that the driller has entered the correct starting azimuth and dip for the tool. North seeking gyros go a step further to remove the driller uncertainty, relying instead on a gyrocompass to compute a rotation axis of the earth and then determine which is the north and south rotational pole relative to the survey point. Figure 4 shows a comparison plot for the apparent magnetic azimuth computed from the multishot



**Figure 3.** Comparison between a vector plot of  $B_h$  and  $B_v$  on the left and the residuals  $B_n$  and  $B_d$  on the right.



**Figure 4.** Comparison of the magnetic azimuths computed by the multishot tool (blue) and gyro (red).

survey tool and the magnetic azimuth generated from by gyro, assuming the regional value for magnetic declination. The magnetic field here is clearly very variable and has strong local anomalies affecting the east component with local declination anomalies of over  $15^\circ$ .

We don't always have a gyro or other non-magnetic survey to determine the hole azimuth and in these cases we have to assume that long wavelength changes in azimuth are due to hole deviation while short wavelength changes reflect local magnetic anomalies. While clearly a flawed assumption, it is often the best we can do.

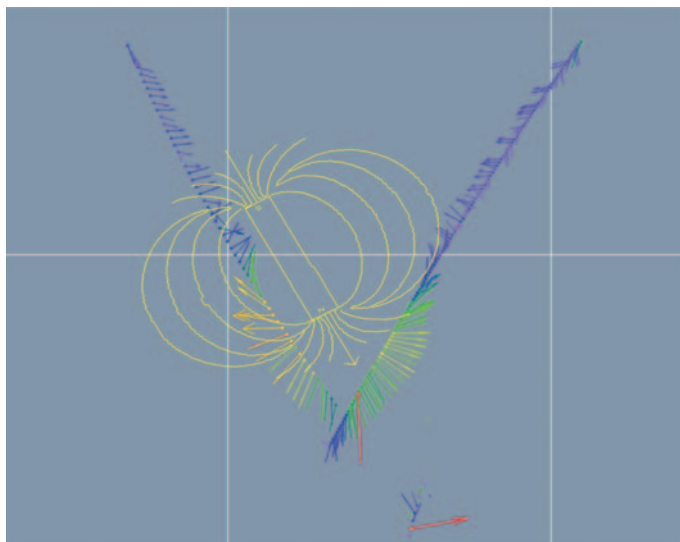
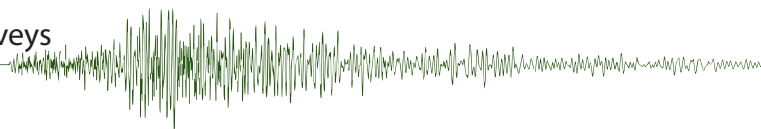
Using the angle between the hole azimuth and the apparent azimuth we can separate the east and north components to recover full three component data.

Interpreting a single hole of three component data is similar to interpreting a single line of ground magnetic data, you have a lot of room to move! In the absence of evidence from surface magnetic surveys we start by assuming the anomalous field is induced rather than dominated by remanence. However, even in cases of remanence, the vectors can be used to visualise where the body is. If we go back to the hole shown in Figure 3 and add its scissor pair the interpretation becomes even easier. Figure 5 shows the residual magnetic vectors with a schematic bar magnet aligned parallel to the earth's field overlain to simplify the interpretation even further.

As a confirmation of the interpretation above, Figure 6 shows a section through the ore shells of the deposit computed from all drilling.

The surveys shown above were acquired at 6 m intervals and taken at rod breaks on the final trip out from the hole. The core barrel is removed, the tool attached to a non-magnetic sub and pumped to the bottom of the drill stem, through the diamond bit, and set to take readings at a fixed interval. The driller then ensures that whenever the magnetic 'camera' is taking a shot that the rods are stationary. This occurs during rod breaks and so the survey just requires the driller to be able to synchronise the trip out with the stop watch marking 'camera' shots. Single shot surveys are also taken as the hole is drilled, generally at 30–50 m intervals. If the hole is long enough these too are a





**Figure 5.** Anomalous magnetic field plotted for two scissor holes with a schematic bar magnet field overlain as an interpretational aid.

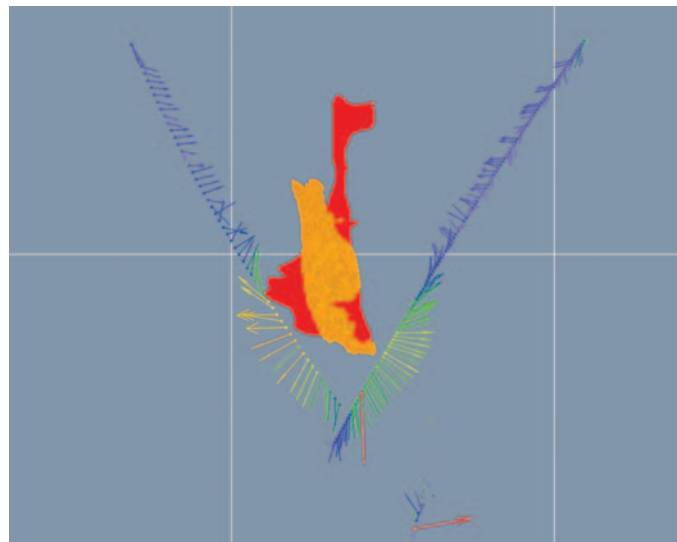
valuable source of magnetic data, although the coarse sample interval allows for a lot of aliasing.

Figure 7 shows vectors from nearly 100 RC precollars that have been surveyed at 40 m intervals from an example in the southern hemisphere. Because the target was a magnetic ironstone and the geologist was unaware that the multishot could still provide useful information, the diamond tails were unfortunately only surveyed with a gyro. No attempt was made to try and clean up single point anomalies in these data and because of the large number of holes and small number of readings per hole a single average background constant has been removed, rather than trying to estimate a background from just a few points or in some cases just one point. Clearly the background used is not correct for several of the holes in the left of the figure. Nevertheless, from the curvature of the anomaly shown by the vectors, it is clear that the ironstone continues to greater depths than indicated by the ore reserve wire frame.

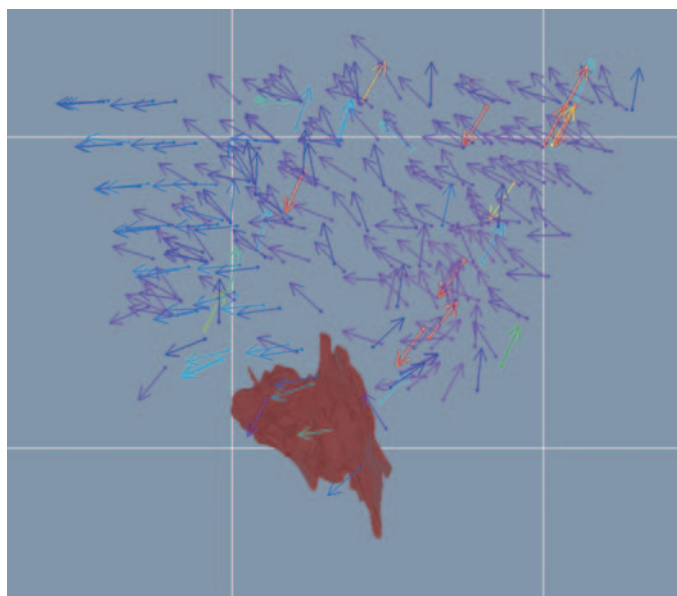
RC holes can be surveyed inside the rods if a long non magnetic sub is used and the tool pulled far enough away from the bit. In practice the results carry around 100 nT of noise so surveying inside RC rods is not ideal and only recommended where the target is very magnetic and expected to be close to the hole or if there is no other option.

One great advantage of these down hole magnetic data is that they are immediately available. They are available as the hole is being drilled and whilst the rig is still onsite. Decisions can be made to extend the hole before the rig moves, and decisions about follow up EM and the casing that may have to go down the hole can be made on the spot – potentially saving money or adding value depending on whether an EM survey had already been planned or not.

Hopefully this short note will result in data that are currently ignored by most geophysicists and geologists being used to



**Figure 6.** Vector plot of anomalous magnetic field with ore shells in the same section overlain. Red = massive sulphide ore, orange = semi massive sulphide ore.



**Figure 7.** Section looking west showing anomalous magnetic field vectors from around 100 RC pre-collars. Wire frame of ironstone from drilling shown in brown.

guide drilling and add a touch of geophysical class to what might otherwise be labelled as a boring geochemical discovery!

## Acknowledgements

Eagle Mine and Lundin Mining are thanked for permission to present the data for the northern hemisphere example shown here. The data were originally provided by Rio Tinto who are thanked for encouraging me to put this note together.



**Alpha GeoScience**  
Viewing the Earth

**magROCK**  
Magnetic Susceptibility  
Meter

+61 2 (0) 95847500  
info@alpha-geo.com  
alpha-geo.com



**ARCHIMEDES**  
FINANCIAL PLANNING

"Using a scientifically principled approach  
to improve financial buoyancy"

**Noll Moriarty, M.Sc(Hons), CFP®**

Specialising in detailed financial advice  
required by discerning professionals

Australian & International Clients

www.archimedesfinancial.com.au  
3/1315 Gympie Rd, Aspley, QLD. Phone 1300 387 351 or (07) 3863 1846  
Archimedes Financial Planning Pty Ltd: AFSL No. 437294 | ABN 68 094 727 152



**CoRMaGeo**  
INSTRUMENTS

**SALES AND SERVICE FOR YOUR  
GEOPHYSICAL EQUIPMENT REQUIREMENTS**

Agent for:  
AGI | Bartington | Geometrics | Geonics | Radiation Solutions  
Robertson Geologging | Sensors & Software | Terraplus

**John Peacock** DIRECTOR  
T: +61 411 603 026 E: sales@cormageo.com.au

www.cormageo.com.au



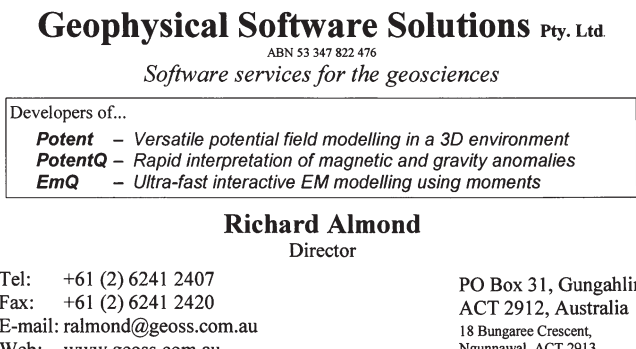
**GBG Australia**

Engineering & Environmental  
Geophysics  
Consulting Services  
Geophysical Equipment Rental

**ADVANCED SUBSURFACE INVESTIGATIONS**

Phone: +61 2 9890 2122 / +61 8 64361591 / +61 3 83183212  
Fax: +61 2 9890 2922  
E-mail: info@gbgoz.com.au  
Web: www.gbgoz.com.au

Sydney Perth Melbourne



**Geophysical Software Solutions Pty. Ltd.**  
ABN 53 347 822 476  
Software services for the geosciences

Developers of...

- Potent** – Versatile potential field modelling in a 3D environment
- PotentQ** – Rapid interpretation of magnetic and gravity anomalies
- EmQ** – Ultra-fast interactive EM modelling using moments

**Richard Almond**  
Director

Tel: +61 (2) 6241 2407  
Fax: +61 (2) 6241 2420  
E-mail: ralmond@geoss.com.au  
Web: www.geoss.com.au

PO Box 31, Gungahlin,  
ACT 2912, Australia  
18 Bungaree Crescent,  
Ngunnawal, ACT 2913



**GEO SENSOR**

**SALES & RENTALS**

Ground & Airborne Instruments – Gravity, Magnetics, IP, Spectrometers & more.

P +61 (0)407 608 231 W www.geosensor.com.au

Garden City Office Park, Corporate House  
Building 6, 2404 Logan Rd, Eight Mile Plains  
Brisbane QLD Australia 4113



**Geosensor Wireline**  
Advanced Logic Technology

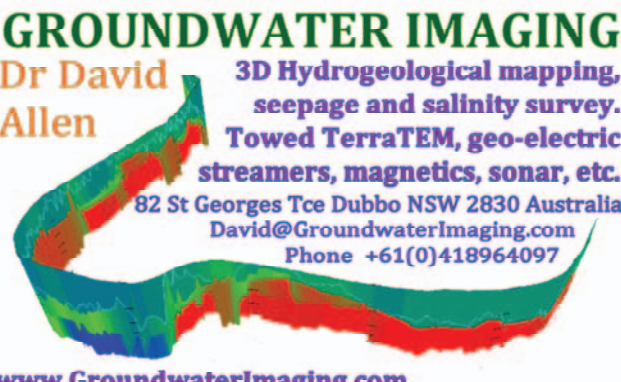
**BOREHOLE LOGGING SYSTEMS** • Sales • Rentals • Training

Specialising in:

- Acoustic and Optical Televiwers
- WellCAD Software
- Quick Link Logging Tools
- Back up support, repairs, training

**Matt Edmonds**  
P +61 (0) 407 608 231  
W geosensorwireline.com

Technical Workshop, 20 Oborn Rd MOUNT BARKER SA 5251



**GROUNDWATER IMAGING**

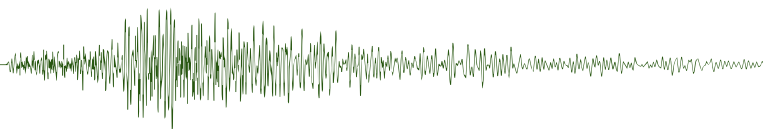
**Dr David Allen**

3D Hydrogeological mapping,  
seepage and salinity survey.  
Towed TerraTEM, geo-electric  
streamers, magnetics, sonar, etc.


82 St Georges Tce Dubbo NSW 2830 Australia  
David@GroundwaterImaging.com  
Phone +61(0)418964097

www.GroundwaterImaging.com

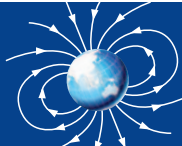





**Remanence problems? +61(0)410 456 495**



**Phil Schmidt MAIG RPGeo**  
**Magnetic Earth Pty Ltd**  
 email phil@magneticearth.com.au  
 web www.magneticearth.com.au

Geophysical consulting  
 Research services  
 Training courses  
 Data processing  
 Interpretation


**Brian Minty, PhD**

GAMMA\_Plus™ - enhanced multichannel gamma-ray data processing  
 GAMMA\_Grid™ - 3D inversion of airborne gamma-ray data  
 GAMMA\_Target™ - automatic gamma anomaly detection  
 LINEAMENT\_Filter - enhancement of linear features in gridded data

**www.mintygeophysics.com**

+61 (0)404083087  
 Brian.Minty@mintygeophysics.com

PO Box 3229  
 Weston Creek ACT 2611  
 Australia

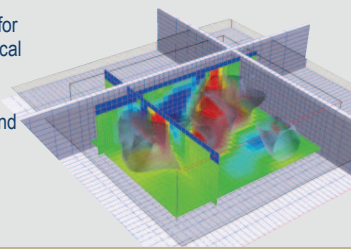


**Mira Geoscience** ...modelling the earth





Software and consulting services for  
 mineral exploration and geotechnical  
 hazard assessment

Advanced 3D and 4D modelling and  
 data management solutions

Geophysical data interpretation,  
 forward modelling and inversion



**www.MiraGeoscience.com info@mirageoscience.com**

Geophysical industry leaders in acquiring, processing, modelling  
 and interpreting high resolution, deep resistivity, IP, MT and real 3D  
 resistivity, IP and MT data

**Contact us today:**  
 David Farquhar-Smith E: auinfo@QuantecGeoscience.com  
 M: +61 (0) 409 840 503 W: www.QuantecGeoscience.com

**Leaders in Deep Exploration**

**ROCK PROPERTIES**

MASS - Density, Porosity (permeability also avail.)  
 MAGNETIC - Susceptibility, Remanence; Aniso.  
 ELECTRICAL - Resistivity, Anisotropy; IP effect [galvanic]  
 ELECTROMAGNETIC - Conductivity, mag k [inductive]  
 SEISMIC - P, S Wave Velocities, Anisotropy  
 DIELECTRIC - Permittivity, Attenuation (by arrangement)  
 THERMAL - Diffusivity, Conductivity (by arrangement)  
 MECHANICAL - Rock Strength (by arrangement)

**SYSTEMS EXPLORATION (NSW) PTY LTD**  
**Contact - Don Emerson** *Geophysical Consultant*  
**Phone: (02) 4579 1183 Fax: (02) 4579 1290**  
 (Box 6001, Dural Delivery Centre, NSW 2158)  
 email: systemsnsw@gmail.com



**Tensor Research**  
 Geophysical Software Research and Services

Encom ModelVision - development, support, sales  
 Encom QuickMag - sales  
 Encom PA - sales  
 Training, consulting research & software development

**David A Pratt** Mob +61 414 614 117 Tel +61 2 9404 8877  
 david.pratt@tensor-research.com.au  
 www.tensor-research.com.au



Subscribe now to our **FREE** email early alert or RSS feed  
 for the latest articles from *Exploration Geophysics*.

**www.publish.csiro.au/earlyalert**

September 2015				
6–9	South African Geophysical Association 14th Biennial Conference and Exhibition <a href="http://www.saga2015.co.za">www.saga2015.co.za</a>	Drakensburg Mountains	South Africa	
6–10	1st European Airborne Electromagnetics Conference and 21st European Meeting of Environmental and Engineering Geophysics – Near Surface Geoscience 2015 <a href="http://eage.org/event/index.php?eventid=1325&amp;Opendiv=s3">http://eage.org/event/index.php?eventid=1325&amp;Opendiv=s3</a>	Turin	Italy	
13–16	AAPG/SEG International Conference and Exhibition 2015 Incorporating PESA's Eastern Australasian Basins Symposium <a href="http://www.aapg.org/events/conferences/ice/">http://www.aapg.org/events/conferences/ice/</a>	Melbourne	Australia	
October 2015				
5–8	8th Congress of Balkan Geophysical Society <a href="http://www.eage.org/event/index.php?eventid=1313&amp;Opendiv=s3">http://www.eage.org/event/index.php?eventid=1313&amp;Opendiv=s3</a>	Chania	Greece	
7–9	Bowen Basin Symposium <a href="http://www.bbsymposium.com.au">www.bbsymposium.com.au</a>	Brisbane	Australia	
18–23	SEG International Exhibition and 85th Annual Meeting <a href="http://www.seg.org">http://www.seg.org</a>	New Orleans	USA	
November 2015				
15–18	International Conference on Engineering Geophysics <a href="http://conferences.uaeu.ac.ae/iceg/en/">http://conferences.uaeu.ac.ae/iceg/en/</a>	Al Ain	UAE	
18–20	12th SEGJ International Symposium <a href="http://www.segj.org/is/12th/">http://www.segj.org/is/12th/</a>	Tokyo	Japan	
December 2015				
7–9	9th International Petroleum Technology Conference <a href="http://www.iptcnet.org">http://www.iptcnet.org</a>	Doha	Qatar	
May 2016				
30 May–2 June	78th EAGE Conference and Exhibition <a href="http://www.eage.org/">http://www.eage.org/</a>	Vienna	Austria	
June 2016				
26–30	Australian Earth Sciences Convention <a href="http://aesc2016.gsa.org.au/">http://aesc2016.gsa.org.au/</a>	Adelaide	Australia	
August 2016				
21–24	ASEG-PESA-AIG 2016: 25th Geophysical Conference and Exhibition <a href="http://www.conference.aseg.org.au/">http://www.conference.aseg.org.au/</a>	Adelaide	Australia	
October 2016				
16–21	SEG International Exhibition and 86th Annual Meeting <a href="http://www.seg.org">http://www.seg.org</a>	Dallas	USA	
June 2017				
12–15	79th EAGE Conference and Exhibition 2017 <a href="http://www.eage.org/">http://www.eage.org/</a>	Paris	France	
July 2017				
17–19 (TBC)	3rd Near-Surface Geophysics Asia-Pacific Conference (website TBA)	Cairns	Australia	

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

Advertising and editorial content in *Preview* does not necessarily represent the views of the ASEG or publisher unless expressly stated. No responsibility is accepted for the accuracy of any of the opinions or information or claims contained in *Preview* and readers should rely on their own

enquiries in making decisions affecting their own interests. Material published in *Preview* becomes the copyright of the ASEG.

Permission to reproduce text, photos and artwork must be obtained from the ASEG through the Editor. We reserve the right to edit all submissions. Reprints will not be provided, but authors can obtain, on request, a digital file of their article. Single copies of *Preview* can be purchased from the Publisher.

All editorial contributions should be submitted to the Editor by email at [previeweditor@aseg.org.au](mailto:previeweditor@aseg.org.au).

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

*Preview* is published bimonthly in February, April, June, August, October and December. The deadline for submission of material to the Editor is usually the second Friday of the month prior to the issue date. The deadline for the October 2015 issue is 11 September 2015. For the advertising copy deadline please contact Doug Walters on (03) 9545 8505 or [doug.walters@csiro.au](mailto:doug.walters@csiro.au).



# GRAVITY

DAISHSAT is the leading provider of GPS positioned gravity surveys in Australia with the latest acquisition equipment and most experienced staff, resulting in the highest quality data for our clients. Contact David Daish for your next gravity survey.

---

Ground and helicopter borne gravity surveys

---

Precision GPS surveying

---

Image processing

---

Terrain corrections

---

Operating Australia wide with support bases in Western and South Australia

---

Specially developed vehicles for safe efficient cross country surveying

---

T: 08 8531 0349 F: 08 8531 0684

E: [info@daishsat.com](mailto:info@daishsat.com)

[www.daishsat.com](http://www.daishsat.com)



**DAISHSAT**  
GEODETIC SURVEYORS



World first piston engine helicopter stinger installation for low cost, high quality airborne radiometric and magnetic data collection

#### Helicopter

- 30% the cost of existing helicopter platforms
- Close transect spacing
- Safe operations in rugged terrain
- Accurate terrain draping
- Remote site operations

#### Fixed wing

- High efficiency large area coverage
- Remote airstrip operations

Contact us for your next airborne survey

T 08 8532 5973 F 08 8531 0684

E [info@aerosystems.com.au](mailto:info@aerosystems.com.au)

[www.aerosystems.com.au](http://www.aerosystems.com.au)



AEROSYSTEMS



AEROSYSTEMS





# Is it down there?

## Find out.



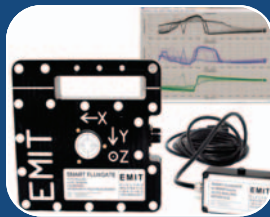
### **SMARTem24**

16 channel, 24-bit electrical geophysics receiver system with GPS sync, time series recording and powerful signal processing



### **DigiAtlantis**

Three-component digital borehole fluxgate magnetometer system for EM & MMR with simultaneous acquisition of all components



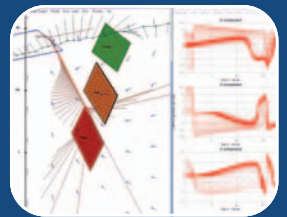
### **SMART Fluxgate**

Rugged, low noise, calibrated, three-component fluxgate magnetometer with recording of Earth's magnetic field, digital tilt measurement and auto-nulling



### **SMARTx4**

Intelligent and safe 3.6 kW transmitter for EM surveys, clean 40A square wave output, inbuilt GPS sync, current waveform recording, powered from any generator



### **Maxwell**

Industry standard software for QC, processing, display, forward modelling and inversion of airborne, ground and borehole TEM & FEM data

**EMIT**  
[www.electromag.com.au](http://www.electromag.com.au)

ELECTRO  
MAGNETIC  
IMAGING  
TECHNOLOGY

3 The Avenue  
Midland WA 6056  
AUSTRALIA  
☎+61 8 9250 8100  
info@electromag.com.au

Advanced electrical  
geophysics instrumentation  
and software