

Australian Society of Exploration Geophysicists OCTOBER 2023 • ISSUE 226 ABN 71 000 876 040 ISSN 1443-2471

# PREVIE



### **NEWS AND COMMENTARY**

*Vale* Ron Green and Bob White Exploration investment

Allison Hortle on Australia's potential leadership role in climate mitigation Seismic stratigraphy reducing risk

### FEATURE

Artificial intelligence vs intelligence lost





### ASEG federal executive 2023–24

Eric Battig: President Tel: +61 408 993 851 Email: president@aseg.org.au

Janelle Simpson: President Elect (Branch liaison) Tel: +61 730 966 138

Email: president-elect@aseg.org.au

Emma Brand: Immediate Past-President (Diversity Committee Chair) Tel: +64 272 983 922

Email: past-president@aseg.org.au

Asmita Mahanta: Secretary Tel: +61 467 745 968 Email: fedsec@aseq.org.au

Yvette Poudjomi Djomani: Treasurer (Finance Committee Chair) Tel: + 61 2 6249 9224 Email: treasurer@aseg.org.au

Steve Hearn (Publications Committee Chair) Tel: +61 7 3376 5544 Email: publications@aseg.org.au Mark Duffett (Technical Standards Committee liaison) Tel: +61 3 6165 4720 Email: mark.duffett@stategrowth.tas.gov.au Ian James (Web Committee Chair) Tel: +61 488 497 117 Email: webmaster@aseg.org.au Suzanne Haydon (Membership Committee Chair) Tel: +61 417 882 788 Email: membership@aseg.org.au Mosayeb K. Zahedi (Communications Committee Chair) Tel: +61 421 874 597 Email: communications@aseg.org.au Michelle Thomas (Education Committee Chair) Tel: +61 457 663 138 Email: education@aseg.org.au Randall Taylor (International Affairs Committee Chair) Tel: +61 419 804 105 Email: international@aseg.org.au Kate Brand (Professional Development Committee Chair) Tel: +61 432 642 200 Email: continuingeducation@aseg.org.au

#### The ASEG Secretariat

The Association Specialists Pty Ltd (TAS) PO Box 576, Crows Nest, NSW 1585 Tel: +61 2 9431 8622 Fax: +61 2 9431 8677 Email: secretary@aseg.org.au

#### Standing committee chairs

Finance Committee Chair: Yvette Poudjom Djomani Tel: +61 2 6249 9224 Email: treasurer@aseg.org.au Membership Committee Chair: Suzanne Haydon

Tel: +61 417 882 788 Email: membership@aseg.org.au

Branch Liaison: Janelle Simpson Tel: +61 7 3096 6138 Email: branch-rep@aseg.org.au

Conference Advisory Committee Chair: Michael Hatch

Email: cac@aseg.org.au Honours and Awards Committee Chair: Marina Costelloe Email: awards@aseg.org.au Publications Committee Chair: Steve Hearn Tel: +61 7 3376 5544 Email: publications@aseg.org.au

Technical Standards Committee Chair: Tim Keeping Tel: +61 8 8226 2376

Email: technical-standards@aseg.org.au History Committee Chair: Roger Henderson

Tel: +61 406 204 809 Email: history@aseg.org.au

International Affairs Committee Chair: Randall Taylor Tel: +61 419 804 105 Email: international@aseg.org.au

Professional Development Committee Chair: Kate Brand Tel: +61 432 642 200 Email: continuingeducation@aseg.org.au Education Committee Chair: Michelle Thomas Tel: +61 457 663 138 Email: education@aseg.org.au

Web Committee Chair: Ian James Tel: +61 488 497 117

Email: webmaster@aseg.org.au Research Foundation Chair: Philip Harman Tel: +61 409 709 125

Email: research-foundation@aseg.org.au

Communications Committee Chair: Mosayeb K. Zahedi Tel: +61 421 874 597 Email: communications@aseg.org.au

### Specialist groups

Near Surface Geophysics Specialist Group Chair: Vacant - enquires to fedsec@aseg.org.au Email: nsgadmin@aseg.org.au Young Professionals Network Chair: Jarrod Dunne Email: ypadmin@aseg.org.au

#### ASEG branches

#### Australian Capital Territory

President: Wenping Jiang Email: actpresident@aseg.org.au Secretary: Mike Barlow Tel: +61 439 692 830 Email: actsecretary@aseg.org.au

New South Wales President: James Austin (Jim) Email: nswpresident@aseg.org.au

Secretary: Harikrishnan Nalinakumar Email: nswsecretary@aseg.org.au

Queensland President: Nick Josephs

Email: qldpresident@aseg.org.au Secretary: Tim Dean Email: qldsecretary@aseg.org.au

### ASEG honorary editors

Exploration Geophysics: Editor in Chief Mark Lackie Email: eg-editor@aseg.org.au

#### South Australia & Northern Territory

President: Paul Soeffky Email: sa-ntpresident@aseg.org.au Secretary: Vacant Email: sa-ntsecretary@aseg.org.au

NT Representative: Tania Dhu Tel: +61 422 091 025 Email: nt-rep@aseg.org.au

Tasmania

President: Tjaart de Wit Email: taspresident@aseg.org.au Secretary: Matt Cracknell Tel: +61 409 438 924 Email: tassecretary@aseg.org.au

#### Victoria

President: Thong Huynh Tel: +61 438 863 093 Email: vicpresident@aseg.org.au Secretary: Vacant

Email: vicsecretary@aseg.org.au

Western Australia President: Michel Nzikou

Email: wapresident@aseg.org.au

Secretary: Timothy Hill Email: wasecretary@aseg.org.au

Preview: Editor Lisa Worrall Tel: +61 409 128 666 Email: previeweditor@aseg.org.au

### **ADVERTISERS INDEX**

ASEG Member Flyer	1,42
Bartington	11
Groundwater imaging	28
AirGeoX	33
CoRMaGeo	41
Tensor Research	41
EMIT.	BC

### **ASEG CORPORATE PLUS MEMBERS**

Tel: +61 7 3376 5544 Email: info@velseis.com Web: https://www.velseis.com/

Email: info@totalseismic.com Web: https://www.totalseismic.com/



Santos

### ASEG CORPORATE MEMBERS

Tel: +61 8 8116 5000 Web: https://www.santos.com

Email: goophysics@sgc.com.au Web: http://sgc.com.au/

Transparent Earth Geophysics Tel: +61 (0) 409 887 459 Wayne Hewison or +61 (0) 412 844 216 Andy Gabell Email: info@transparentearth.com.au Web: http://www.transparentearth.com.au

DUG Technology Tel: +61 8 9287 4100 Email: sales@dug.com support@dug.com Web: https://dug.com/

Contact: Pierre Gaucher Tel: +1 418 877 4249 Email: gdd@gdd.ca Web: www.gddinstrumentation.com

HiSeis Pty Ltd Tel: +61 8 9470 9866 Email: admin@hiseis.com Web: http://www.hiseis.com.au/

SKYTEM Tel: +61 8 9249 8715 Email: sjo@skytem.com Web: https://skytem.com/

Planetary geophysics Tel:+61 7 4638 9001 Email: info@planetarygeophysics.com.au Web: https://www.planetarygeophysics.com/

#### **FRONT COVER**



participants on the Fitzroy Island jetty. See AEM 2023: Reflections in this issue for





### **CONTENTS**

Editor's desk			2
ASEG news			
President's piece			3
Executive brief			4
New Members			4
Branch news			5
ASEG national calendar			9
News			
People	Vale:	Ron Green	10
		Bob White	12
Conferences and events:	AEM 2023:	Reflections	13
	CAGE23:	The ASEG recognises sponsors and in-kind support	14
Geophysics in the Surveys	GA:	News	15
		Update on progress of all geophysical surveys	17
	MRT:	New state-wide 3D geological model	20
	GSV:	Update on progress of airborne and ground	
		gravity surveys	21
	GSWA:	Deep-crustal seismic survey 2023–24 — Southwest, Great Southern and Mid-West	22
Commentary			
Canberra observed	Exploration	investment	23
	Research pr	riorities	23
	The Product	tivity Index: Is it important? How is it measured?	24
	Governmen	It encourages offshore greenhouse gas storage	24
Education matters	Allison Hort global lead	tle on the potential for Australia to become a er in climate mitigation	25
Environmental geophysics	AEM 2023	2	29
Mineral geophysics	Safety first:	A personal view	31
Seismic window	Reducing ri	sk with seismic stratigraphy	32
Data trends	Australian e	elevation cheat sheet	34
Webwaves	Australian ii	nternet	36
Feature			
Artificial intelligence vs int	elligence los	t	37
Crossword			40
Business directory			41
International calendar of e	vents		48

Editor Lisa Worrall Email: previeweditor@aseg.org.au

**Assistant Editor** Theo Aravanis Email: taravanis2011@gmail.com

Associate Editors Education: Marina Pervukhina Email: continuingeducation@aseg.org.au Government: David Denham Email: denham1@iinet.net.au Environmental geophysics: Mike Hatch Email: michael.hatch@adelaide.edu.au Minerals geophysics: Terry Harvey

Email: terry.v.harvey@glencore.com.au Petroleum geophysics: Michael Micenko Email: micenko@bigpond.com Geophysical data management and analysis:

Tim Keeping

Email: Tim.Keeping@sa.gov.au

#### Book reviews: Email: previeweditor@aseg.org.au

**ASEG Head Office & Secretariat** Alison Forton The Association Specialists Pty Ltd (TAS) Tel: (02) 9431 8622 Email: secretary@aseg.org.au Website: www.aseg.org.au

Publisher T&F Publishing Tel: +61 3 8842 2413 Email: journals@tandf.com.au Website: www.tandfonline.com

**Production Editor** Jacqueline Wolfs Tel: Email: TEXP-production@iournals.tandf.co.uk

Advertising Brenna Rydzewski Email: advertising@taylorandfrancis.com





SKYTEM

ry Geophysics Pty. Lto

**Transparent Earth** GEOPHYSICS



Australian Society of Exploration Geophysicists

Join our diverse network of geoscientists from over 40 countries, foster your professional network and receive a wide range of member benefits.

### Free access to publications

- · Exploration Geophysics high-quality international technical journal
- Preview Magazine stay up to date with current trends in exploration geophysics

### **Professional & Networking Development opportunities**

- · Reduced registration fee to the Australasian Exploration Geoscience Convention
- Short courses
- Technical Events
- Social Events

### Huge range of online content

- Webinars
- Workshops
- Job advertisements

### Students

- Free membership, support through the ASEG Research Foundation
- Travel scholarships and funding support available

### **Exclusive member-only discounted wines**

### Visit ASEG.org.au or email secretary@aseg.org.au for more details





### Editor's desk

Well, AEM 2023 is done and dusted. Next stop Sicily 2026 - so, if you are at all AEM inclined, you should get that into your calendar now. As Mike Hatch (Environmental geophysics) reflects in his column in this issue, the AEM 2023 workshop had all the elements that used to make the ASEG conferences great - lots of interesting geophysics, lots of interesting geophysicists, (many of whom were from overseas), and a great venue that provided lots of opportunities to get together to shoot the breeze. On top of all that, it would seem that the workshop has delivered a heathy profit to the ASEG. Mike thinks that perhaps it is time for the powers that be in the ASEG to reconsider the Society's engagement with mega conferences such as the AEGC, and to re-focus on smaller conferences. Mike is not Robinson Crusoe in this regard – although he was on an island whilst he was writing his column. I heard similar opinions expressed on multiple occasions during the workshop.

Whilst on the subject of opinions, Phil Schmidt, the ASEG's 2022 Gold Medal recipient, gives us a serve in this issue's feature article. Phil is seriously concerned about the continuing collapse of STEM education, just as new and exciting opportunities arise in geophysics. I suspect his concerns were shared by one of his mentors, Professor Ron Green, whose obituary appears in this issue of *Preview*. Phil tells me that Ron died whilst tutoring one of his great grandchildren in mathematics – an educator to the very end! Sadly, Bob White's obituary also appears in this issue of *Preview*. Bob was one of our industry's quiet achievers - although maybe not so quiet with a glass of red wine in his hand! He will be particularly remembered for his kindness to junior colleagues, and leaves a Bob-shaped hole at SMEDG (the Sydney Mineral Exploration Discussion Group).

In other news and commentary, in this issue of *Preview* David Denham (*Canberra observed*) reviews the latest figures on mineral exploration investment. Marina Pervukhina (*Education matters*) interviews Dr Allison Hortle, the newly appointed Energy Business Unit Science Director in CSIRO. Allison is remarkably upbeat about Australia's potential to become a global leader in climate mitigation. Terry Harvey (*Mineral geophysics*) reminds us that safety is personal. Mick Micenko (*Seismic window*) demonstrates risk reduction using seismic stratigraphy. Tim Keeping (*Data trends*), considers height datums, and Ian James (*Webwaves*) reviews the Australian internet.

Enjoy!

Lisa Worrall Preview Editor previeweditor@aseg.org.au



Michael Whitford from IGO holding the attention of the room at the AEM 2023 workshop on Fitzroy Island.

### **Richard Lane Scholarship 2024**



Richard Lane (1962-2021)

An ASEG Scholarship has been established to support geophysics Honours and Masters students and to commemorate the life and work of ASEG Gold Medal recipient Richard Lane. The scholarship is open to all BSc (Hons) and MSc geophysics students at an Australian University and consists of a grant of \$5000 to the best ranked student for the current year. Ranking will be based on a 200 word discussion, overview of a geophysics project and on an academic transcript. For 2024 we acknowledge and thank Jayson Meyers and Resource Potentials Pty Ltd for the initial concept and ongoing donation.

All Honours (BSc) and Masters (MSc) students with focus predominantly in exploration geophysics are invited to apply. The closing date will be in April 2024 and the application details and form are at www.aseg.org.au/foundation/richard\_lane

The scholarship is an annual event and donations to support the continuation of this scholarship are sought from institutions, companies and individuals. Information on donations via the ASEG Research Foundation can be found at

www.aseg.org.au/foundation/donate Please mark donation specifically "Richard Lane Scholarship"

### ASEG news

### President's piece



Eric Battig

R U OK? Four letters to start a conversation that could change a life. Today, as I put pen to paper (or finger to keyboard), is R U OK? Day 2023 and I am reminded of the importance of taking the time to ask that question and to listen, to hear the conversations that it hopefully sparks. Many of us work remotely, be it in WFH arrangements still in place following the COVID-19 pandemic, or FIFO to remote operations and exploration projects.

I have been in a WFH arrangement for over three years now, which has presented plenty of opportunities for focussed work and to be present for those special moments with my loved ones. However, it has also taught me the importance of spending time connecting with my work colleagues, be it online (with the camera on whenever possible) or in person at one of our offices or sites.

For those of us working in remote operations or projects, it may be our work colleagues that notice changes before other friends and family at home. Noticing that someone might need support and starting a conversation to ask them if they do.

If you haven't stopped to ask yourself, or people in your world recently, I would encourage you to create the opportunity to do so. You don't have to be an expert, R U OK? provides tips, guides and resources (www.ruok.org.au) that you might find useful to start a meaningful conversation. Turning to the ASEG, as a society run by volunteers, we are not immune to this. Be it through serving on the Federal Executive, one of our State Branches, Committees or Conference Organising Committees, our volunteers go above and beyond juggling their full-time occupations with their society commitments. I know first-hand that this can be stressful and am pleased to share with you that we are looking to introduce a Volunteer Assistance Programme to provide support to our volunteers. Improving the volunteer experience must continue to be a key focus area for the ASEG, and such a programme, coupled with improved onboarding resources and administrative support, will help make significant contributions to it.

September was a month packed with events offering opportunities for geophysicists from a broad range of experience levels and employment sectors to learn and interact. Firstly, we co-hosted, with CSIRO, the 8th International Workshop on Airborne Electromagnetics, or AEM 2023. Nearly one hundred delegates, from across Australia, Africa, Europe and North America gathered to listen to AEM talks in the relaxed, tropical environment of Fitzroy Island. No suits or ties were to be seen, but plenty of shorts and T-shirts as delegates made the most of the technical and networking opportunities. The event is expected to return a healthy surplus, which will be re-invested back into Members' programmes.

Secondly, Dr Mark E Willis, Chief Scientific Advisor of Borehole Seismics at Halliburton, delivered his Distinguished Instructor Short Course (DISC) "Distributed acoustic sensing (DAS) for seismic measurements – what geophysicists and engineers need to know". Registration numbers were high, helped by the virtual format, and attendees increased their knowledge on the value of DAS seismic measurements, data acquisition and processing. Thirdly, and towards the end of September, early career geoscientists and leading applied geophysics practitioners descended on Forrestania for the second Camp for Applied Geophysics Excellence (CAGE). Building on the success of the inaugural camp in 2022, I have no doubt this will have been a tremendous experience for the successful applicants and facilitators alike, and I am looking forward to hearing their stories and reflections.

The ASEG's voice on the international stage continues to grow, as demonstrated by recent events at the recent SEG Council meeting when a vote was cast on the priorities the Council should concentrate on during 2023/24. It's worth noting that the Council serves as advisors to the SEG Board of Directors, and of the five shortlisted topics the two that received the most votes were proposed by ASEG Members Kim Frankcombe and Geoff Pettifer. Their proposed topics on "The next generation of geophysicists" and "Strategies for growing nearsurface geophysics", respectively, are directly aligned with the ASEG's current strategic priorities and as we strengthen our ties with the SEG we will leverage outcomes from the SEG back into the ASEG.

Finally, by the time this edition of *Preview* goes to print you will have hopefully seen the announcement of our 2024 Hobart conference. The ASEG's DISCOVER. together will showcase workshops, short-courses, 'best-of' oral presentations and posters as well as a packed social programme. Our Organising Committee has been busy laying solid foundations to help make this event a success, and I would love to hear from you if you would like to contribute.

As always, please reach out to me with any thoughts, comments or feedback.

Eric Battig ASEG President president@aseg.org.au

### **Executive brief**

The Federal Executive of the ASEG (FedEx) is the governing body of the ASEG. It meets once a month, via teleconference, to see to the administration of the Society. This brief reports on the meeting held in July and August. We hope you find these short updates valuable. If there is more that you would like to read about on a regular basis, please contact Asmita Mahanta on fedsec@aseg.org.au.

#### Finances

The financial report presented in the August meeting covered reporting as of 31 July 2023. The July 2023 operating income was \$36 600, which included MAG 23 sponsorship income of \$13 452 and \$10 909 Branch sponsorship income (from Corporate and Corporate Plus Members). The July 2023 operating expenses were \$18 512, which included TAS management fees, insurance, and publication costs. For the month of July 2023, the ASEG was running at a profit of \$18 088. The YTD profit for the Society was \$35 661.

	July 2023	YTD
Total income	\$36 600	\$248 895
Total expenses	\$18 512	\$213 234
Net profit	\$18 088	\$35 661
Net assets		\$993 635

#### Membership

As of 3 August 2023, the ASEG had 805 Members, compared to 774 at this time last year. We welcomed eight new Members in July. Our Corporate Plus Members are Velseis and Total Seismic. Corporate Members are HiSeis. Transparent Earth, Santos, Southern Geoscience and SkyTEM. We would like to ask Corporate Members, who are yet to renew their membership, to please consider renewal, as your support is valued. Welcome to all our new Members, and thanks to all our renewed Members, Corporate Plus and Corporate Members, and local sponsors of our local Branches for their continued support in 2023.

#### Events

All upcoming events are listed in *Preview* and the ASEG Newsletter, and on the ASEG website. Please keep an eye on the notifications via emails regarding events held by local state branches. There are also some excellent webinars coming up, and links to the past webinars are available in the ASEG website on our YouTube channel https://www.youtube. com/@ASEGVideos/videos.

The SEG DISC lectures were held on September 12 and 13 and CAGE 2023

was held between September 24 and October 1. The CAGE 2023 venues were Forrestania and Hyden in Western Australia for the field and theory components respectively. We extend our thanks to the CAGE sponsors BHP, AuScope, Rio, CSIRO, Teck and GBG Group, and to others who provided in kind sponsorship.

### Communications

There are many avenues to stay connected with ASEG including *Preview* magazine, the ASEG Newsletter, the ASEG website, and via various social media fora such as LinkedIn, Twitter and Facebook. There have been continuously increasing Facebook and LinkedIn views in the recent months. Top posts have been ASEG ACT Branch event alert on July 20 on Facebook, Twitter and LinkedIn. The August ASEG Newsletter had also more than 75% views on 99% deliveries. Please consider using social media to promote ASEG events and publications.

Please contact Asmita for more information about any of the above.

Asmita Mahanta ASEG Secretary fedsec@aseg.org.au

### Welcome to new Members

The ASEG extends a warm welcome to 19 new Members approved by the Federal Executive at its August and September 2023 meetings (see table).

First name	Last name	Organisation	State	Country	Membership type
Riley	Elstermann	University of Western Australia	WA	Australia	Student
Xihao	Gu	China University of Petroleum	Shandong	China	Student
Muhammad	Hossain	Geoscience Australia	ACT	Australia	Associate
Wanting	Hou	China University of Petroleum	Shandong	China	Student
Muhammad	lqbal	Rio Tinto	WA	Australia	Active
Junjun	Jiao	Curtin University	Beijing	China	Student
Hyunwook	o	JeonBuk National University	Gyeonggi-Do	South Korea	Student
Defina	Kastono	University of Western Australia	WA	Australia	Student
Jiabin	Liang	CSIRO	WA	Australia	Associate
David	Lyonga	University of Buea	Garoua	Cameroon	Student
Matthew	McAuliffe	University of Western Australia	WA	Australia	Student
Cir Alfred	Milaor	University of New South Wales	NSW	Australia	Student
Haroon	Rasheed	Geoscience Australia	ACT	Australia	Active
Sahala	Siahaan	Fender Geophysics Pty Ltd	NSW	Australia	Active
Alicia	Strother	Rio Tinto	WA	Australia	Active
Nandhinie	Supramanian	University of Western Australia	WA	Australia	Student
l Gusti Agung Aditya	Surya	University of Western Australia	WA	Australia	Student
Bradley	Waterson	Protest Engineering	Qld	Australia	Associate
Christopher	Yule	CSIRO	Tas	Australia	Associate

#### **Branch news**

### ASEG branch news

#### Tasmania

The Tasmanian Branch of the ASEG held its Annual General Meeting on Wednesday 23 August 2023 in the CODES Conference Room in the School of Earth Sciences at the University of Tasmania. At the meeting we voted in a new President, **Tjaart de Wit**. Tjaart takes over the role from **Gerrit Olivier**. Matt Cracknell (Secretary) and Tara Martin (Treasurer) were reappointed in their roles. Mark Duffett gave a short presentation on the importance of pre-competitive geophysics data collected and managed by government geological surveys. After Mark's presentation we adjourned to the AIG and GSA networking event at the Shambles Brewery.

Meeting notices, details about venues and relevant contact details can be found on the Tasmanian Branch page on the ASEG website. As always, we encourage Members to keep an eye on the seminar/webinar programme at the University of Tasmania / CODES, which routinely includes presentations of a geophysical and computational nature as well as on a broad range of earth sciences topics.

#### Matt Cracknell tassecretary@aseg.org.au

### Victoria

For as long as I can remember, I have had nothing to write about. No, it's not writer's block. I've waited and waited for something to happen, but nothing has happened. I've asked myself, is there nothing worth writing about? The answer, quite obviously, is 'yes'. Yes, it's true. I have absolutely nothing to write about, so let's write about nothing. Here goes...

Apparently, the Dutch have a word for the art of doing nothing – *niksen*. But what is nothing? Bega cheese is made in Bega. That is probably obvious and adds nothing to my nothingness. How do you dig half a hole? Nope, still nothing. How did our universe evolve from nothing and continue to expand to this day? If I shined a laser while in space, will that laser return from behind henceforth tens of billions of years from now? Still, I have gained nothing.

Let's try quoting someone famous to fill the void of nothingness - the point being quotes make the writer sound educated and informed without having to be either . "If you tell the truth, you don't have to remember anything" Mark Twain. Is nothing anything and anything nothing? How perplexing. What a mind job.

What about using common sense? Can one make common sense...uncommon? Ordinarily, people will often say something that is actually common sense or common knowledge, yet somehow is taken as expert advice. Thanks Captain Obvious. "Check both ways before crossing the road, dress up for a job interview, don't hammer your thumb, use oven mitts"...you get the picture. But as French writer and philosopher, Voltaire, once said "Common sense is not so



*Revellers at the ASEG Victorian Branch's annual Winter Social, held in conjunction with the Victorian Branches of PESA and SPE.* 

common." He's right. We don't all perceive logic the same way in every situation. Still, I have nothing.

when the product of the program and the production of the producti

I have almost nothing to report in relation to Branch news other than the ASEG Victorian Branch hosted our annual Winter Social with sister chapters of PESA and SPE on the night of August 16 at Henry and The Fox. I did not attend for personal reasons, so I have nothing to report on the event. I was sent a picture taken at the event. Make of it what you will. I'm sure you got a lot of nothing from all this ©

Thong Huynh vicpresident@aseg.org.au

### Western Australia

As part of the ASEG's continuing education and outreach programmes, the ASEG WA Branch attended the National Science Week at Kelmscott High School on 17 August 2023. The in-person event hosted various groups of robotics students showcasing their talents. During this event, the ASEG WA President, Michel Nzikou, focused on introducing geophysics to students, which was surprisingly a new field to most of them. This highlights the importance of these outreach programmes, especially in the coming years, to help bridge the gaps in geoscience education at universities by boosting intake or even delivering customised geophysics courses focusing on what the industry requires. This year, the ASEG WA Branch has been actively involved in several career events, starting with a four-day Careers Expo between 16-19 May at the Perth Convention and Exhibition Centre, followed by two school career events at Trinity College and St Marys/Hale School on 13 June and 19 July, respectively.

The Western Australian Branch of the ASEG hosted a technical night talk on July 17 as part of its monthly technical talk series. The guest on this night was **James (Jim) Dirstein,** who studied geology and geophysics at the University of Toronto. For more than 40 years, Jim has enjoyed working as a geophysicist on many resource projects in Australia and overseas.

In addition to his project work, Jim has played a role in commercialising several transformative technologies. During

### ASEG news

#### **Branch news**

Conference and Exhibition, held in Melbourne, Australia. The presentation and extended abstract were entitled "Digital Surface Analysis: A new approach using differential geometry". While the 2013 publication provides the background and several examples, Jim's technical talk discussed several new examples and workflows from our use of this technology over the last decade. The WA Branch's technical night talk for the month of August was given by **Barry Bourne**. Barry is a leading geophysicist with almost 20 years experience in the mining and resources sector. He began



The WA Branch's technical night talk for the month of September was presented by Maxim Lebedev. Maxim, who is a professor at Edith Cowan University, was awarded BS, MS and PhD degrees from the Moscow Institute (State University) of Physics and Technology in Russia. He has over 30 years of research experience in physics, material science and rock physics, working at leading research organisations in Russia, Japan, New Zealand, and Australia. In 2007 he joined Curtin University, and during 16 years at this University, he built a rock physics laboratory from scratch and became the head of the experimental rock physics programme. Recently Maxim moved to the Edith Cowan University. His current research is focused on the properties of subsurface reservoir rocks and minerals, including elastic and inelastic properties of rocks at tele-seismic, seismic and ultrasonic frequencies; digital rock physics; mechanical properties of rocks at microlevel (nanoindentation); and direct observation of multiphase fluid distribution inside rocks at reservoir conditions (microCT).

Maxim's talk was entitled "Digital rock under stress", and in this talk, Maxim showed how modelling the physical properties of rocks based on microstructure derived from X-ray microtomographic images (known as digital rock physics) is an important technology in geophysical rock characterisation. However, these images

Glimpses into several ASEG WA Branch outreach activities.

his career, these efforts have involved working as an early adopter, angel investor or collaborator in the fields of time series analysis, and digital surface analysis, along with a patented airborne acquisition system and a fully trained and patented Artificial Intelligence (AI). Outside of the realm of geophysics, Jim has presented papers at metallurgy conferences on the role of microbes for *in-situ* mining, mine site remediation, carbon capture and using microbes for permeability enhancement and the production of hydrogen.

Jim's talk was entitled "Automating digital surface processing and object delineation using differential geometry". Since a fundamental property of any surface is its geometric characteristics, identifying and extracting these properties can reveal features and objects not easily identifiable by visual analysis alone. In 2013 a new method for digital surface analysis was introduced to address some of the limitations of traditional surface analysis methods. This mathematical solution applies a completely different approach without the use of existing techniques or algorithms. With this method, analysing a digital surface involves calculating a complete set of morphometric properties defined by differential geometry (e.g., Dupin Indicatrix). The resulting database of geometric elements is query-able using a GIS-style interface, providing an attractive means to simplify and accelerate the data mining process.

This analytical technique was introduced to the ASEG at the 23<sup>rd</sup> International



Jim Dirstein engaging with the WA audience during his presentation.



### Branch news



Barry Bourne addressing the WA audience at the beginning of his well-attended and inspiring talk.

are most commonly obtained at room pressure and temperature conditions. Consequently, most digital rock physics models are not representative of the rocks at depth.

Reservoir rocks experience high stresses and temperatures at considerable depths. The thermodynamic properties of the fluids inside the reservoir are pressureand temperature-dependent; therefore, transport properties are also temperature and pressure dependent. Moreover, it is well established that elastic rock properties of rocks are strongly affected by stress and/or fluid distribution. Thus, to acquire realistic pore network structures and fluid distributions (including, but not limited to, residual saturation) and reliably estimate transport and elastic properties from micro images, rocks containing fluids have to be imaged at reservoir pressure and temperature conditions. In this lecture, Maxim discussed how to obtain 3D images under elevated temperature and stress conditions, and the challenges with imaging and further image processing. Finally, he demonstrated how the microstructure of the rocks can be linked to the transport and elastic properties of rocks measured on bigger samples.

Emad Hemyari WA Branch Communications Officer emad.hemyari@gmail.com

### Australian Capital Territory

On July 20, the ACT Branch hosted a talk by **Babak Hejrani** from Geoscience Australia entitled "Scalable streamlining of ambient noise tomography: A simple automated approach for dispersion curve estimation and quality control in the era of Big Data". Babak highlighted the advances that had been made in ambient noise tomography, including the development of a semi-automatic technique to enhance the accuracy and reliability of ambient noise tomography, contributing to advancements in Earth lithospheric imaging important in our understanding of mineral systems. Well done, Babak!

On September 27, 2023, we welcomed **Clive Foss** from CSIRO Mineral Resources. He talked about "What we can and cannot know from unconstrained inversion of regional magnetic field data". His talk was much appreciated!

Wenping Jiang actpresident@aseg.org.au

### New South Wales

In August the ASEG NSW Branch president, **Dr Jim Austin** (CSIRO Mineral Resources), gave a joint presentation to Members of the ASEG and Members of the Sydney Mining and Exploration Discussion Group

(SMEDG). The presentation was entitled "The seven deadly sins of scale: why petrophysics + structure + mineralogy can solve the scale paradox". Jim explored relationships between geology, petrophysics and geophysics. The first half was devoted to exploring some of the seven of the most common petrophysical pitfalls that lead to misinterpretation of magnetic data, including lightning induced and drilled induced magnetisation. He then outlined the integrated petrophysics approach and illustrated how to integrate and use petrophysical data to upscale mineral system knowledge from the sample scale to drilling scale and beyond, citing case histories on IOCG, magnetite and magmatic nickel deposits across Australia.

Jim was under strict instructions to stick to the time limit so that attendees could watch the Matildas vs England match, but a few of the SMEDG Members hung around to chat IOCG and Cobar type geophysics after the presentation.

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 generally held on the third Wednesday of each month from 17:30 at Club York. News, meeting notices, addresses and relevant contact details can be found at the NSW Branch website.

Stephanie Kovach and Jim Austin Treasurer and President (NSW) nswpresident@aseg.org.au

### Queensland

It's been a quiet couple of months up here in Queensland, with the local branch taking it somewhat easy to avoid clashes with the Women's World Cup and to allow members to enjoy



Babak Hejrani presenting to the ACT Branch.

### ASEG news

#### **Branch** news



Jim rushing through way too many slides to engaged group of geophysicists and mineral explorers.

Other recent events in Queensland include the SEG DISC course on DAS, 'Brisbane brews' at Brewtide Albion on September 15, the student and early career industry mixer on October 11 and finally, what promises to be an excellent presentation from **Kelsey Lowe** on "CrossRiverRail - Geophysics meets archaeology" (for those unaware and/or too lazy and/or disinterested to google, the CrossRiverRail is a new 10.2 km rail line that goes under Brisbane).

As always, if you're passing through Brisbane and have something interesting to say, or are just looking for a friendly conversation and a few cold beverages, please get in touch. For those who enjoy this (albeit somewhat brief this time) column please send your feedback to qldsecretary@aseg.org.au,

all the delights of the Sunshine State (what's not to love about 30° days during 'winter'?). August's technical talk was "A high-productivity land impulse source" by William Davie from Precision Impulse who was visiting Australia as part of a UK trade mission. Taking a break from our usual venue of the Stock Exchange Hotel in central Brisbane, we ventured to the Redbrick Hotel in Woolloongabba. For those who think that this is vying for Australia's least imaginative pub name (it is, after all, constructed from red bricks), it is actually named after the red 10-pound notes (known as bricks) that were used by the local bookies when taking bets at the bar. Built in 1890 the hotel features some beautiful federation touches (check out that chandelier in one of the photos of the event) as well as an unforgiving wooden beam at the top of the stairs to punish those who have the temerity to grow beyond the average height in Australia (currently 1.765 and 1.618 m for men and women respectively, for those who were wondering).

Following some welcome (complimentary!) food and drinks, those in attendance settled down to enjoy William's presentation; particularly relevant given the renewed enthusiasm for lower environmental impact seismic sources. Following the formal proceedings (and the compulsory photo-op with local influencer and Branch President **Nick Josephs**) a lively (and somewhat well lubricated) discussion took place (if only we could remember the brilliant ideas that were developed).



William Davie from Precision Impulse presenting at the Queensland technical night.



Queensland ASEG members (and a local lumberjack) at the recent ASEG Queensland technical night.



#### **Branch news**



Contractually required photo of perma-happy Queensland President Nick Josephs presenting William Davie with his speaker's gift.



ASEG Wine Tasting Event on September 15

for those who feel otherwise, the appropriate email address is qldpresident@aseg.org.au.

Tim Dean qldsecretary@aseg.org.au

### South Australia and Northern Territory

The SA/NT Branch committee has been busy getting things organised for the back end of the year. The 2023 Melbourne Cup event will be held, once again, in the Premiership Suite at the beautiful Adelaide Oval. This venue offers views over the oval towards the heritage scoreboard and North Adelaide. Tickets are available through Eventbrite for anyone wishing to attend. In September we held the Annual Wine Tasting event at Ginger's Vintage Lounge. It was a highly successful event with 35-40 people judging the 22 red, 16 white and 6 sparkling wines. The winners have been included in the ASEG Wine Offer. There were some outstanding wines this year, which made it difficult to come up with the winners. Keep your eyes peeled for the offer in the coming weeks through email and on the website.

And lastly, we couldn't host any of our fantastic events without the valued support of our sponsors. The SA-NT Branch is currently sponsored by **Beach Energy, Borehole Wireline, Oz Minerals, Vintage Energy, Minotaur Exploration,** the **Department for Energy and Mining, Zonge, Santos** and **Heathgate**.

Paul Soeffky sa-ntpresident@aseg.org.au

### ASEG national calendar

Time Venu

ASEG Branches hold face-to face meetings and webinars. Registration for webinars is open to Members and non-members alike, and corporate partners and sponsors of state branches are acknowledged before each session. Recorded webinars are uploaded to the ASEG's website (https://www.aseg.org.au/aseg-videos), as well as to the ASEG's YouTube channel (https://bit.ly/2ZNglaZ). Please monitor the Events page on the ASEG website for the latest information about events.

Presenter

11 Oct	Qld	Student and Early Career, Industry Mixer	Brisbane Geo-societies	17:30	Warehouse 25, 25 Finchley St, Milton
17 Oct	Qld	Tech talk	Kelsey Lowe	17:00	Cross-River Rail Experience Centre, Level 1/151 Elizabeth St, Brisbane City
26 Oct	WA	Tech night	Mick Micenko	17:30	The Shoe Bar and Café, 376-420 Wellington St., Perth
7 Nov	SA_NT	36th Annual ASEG Melbourne Cup Lunch	Various	12:00	Premiership Suite, Adelaide Oval, War Memorial Drive North Adelaide
9 Nov	WA	Tech night	Ruth Murdie	17:30	The Shoe Bar and Café, 376-420 Wellington St., Perth
15 Nov	WA	MAG23	Various	08:00	Fraser's Kings Park, Perth

People

### Vale: Professor Ron Green 1930-2023



Ron Green

#### Table 1. Ron Green's legacy: Some achievements of some of his former students.

It is with great sadness that we announce the passing of Ron Green (FIEAust, CPEng, College ITEE) on 9 July 2023. Ron was born in Brisbane on 22 July 1930 and graduated with BSc (Hons Physics); U of Q, 1953. From 1953 to 1955 Ron worked at the Bureau of Mineral Resources, Canberra, on magnetic surveys in WA. He then undertook research in geophysics at ANU with a PhD awarded in 1961, followed by a lecturing position in geophysics at the University of Tasmania, 1961-66.

Ted Irving was Ron's PhD supervisor, and one of their first findings was that at the time the Jurassic Tasmanian Dolerite was intruded, Tasmania was very close to the South Pole. This finding opposed the conventional polar wander interpretation of results from Europe and North America and was probably one of the outcomes of Sam Carey's "Continental Drift Symposium" in Hobart in 1956, setting earth sciences in the southern hemisphere well ahead of elsewhere.

In 1967 Ron was appointed to the UNE as Associate Professor and given the task of establishing an independent Department of Geophysics. The department Ron established primarily

SEG Gold Medal2019Irru Per2020Mal Catcha	Award	Year	Recipient	Citation detail
ASEG Grahame Sands Award       201       Mal Cattach         400       Hillip Schmidt         ASEG Grahame Sands Award       198       John Stanley and Malcolm Cattach       The TM-3, Caesium Vapour magnetometer         190       Terry Lee       Theoretical research into transient electromagnetics         190       Juncan Massie and Jun Cull       Advances in TEM methods and instrumentation         2006       Duncan Massie and Jim Cull       Advances in TEM methods and instrumentation         2007       Balcolm Cattach, Keith Matthews, Bourman       Development of the HPTX-70, high power (70 kW) transmitter         2018       Adriew Duncan and Greg Street       Development of the Loupe electromagnetic (EM) system         ASEG Laric Hawkins Award       101       Adriew Duncan, Malcolm Cattach         2018       Andrew Duncan, Malcolm Cattach       Development of the Loupe electromagnetic (EM) system         ASEG Laric Hawkins Award       102       Andrew Duncan, Malcolm Cattach         2019       andrew Duncan, Malcolm Cattach       Development of the Loupe electromagnetic (EM) system         2019       andrew Duncan, Malcolm Cattach       Development of the Loupe electromagnetic (EM) system         2019       andrew Duncan, Malcolm Cattach       Malcolm Cattach, Christopher Parker         2019       andrew Duncan, Malcolm Cattach       Malcolm Cattach	ASEG Gold Medal	2015	Terry Lee	
ASEG Grahame Sands Award       Pi080       Ionit Stanley and Malcolm Cattado       The TA-3, Cassium Vapour magnetometer         P1990       Tery Lee       The Oreitical research into transient electromagnetics         P1090       Malcolm Cattado and John Stanley       The TM-4 magnetometer and its application to Sub Audio Magnetics method         P1090       Duncan Massie and Jim Cull       Advances in TEM methods and instrumentation         P1090       Malcolm Cattado Magnetics       Development of the PTX-70, high power (70 kW) transmitter         P1090       Nalive Duncan and Greg Street       Development of the Co-Meter         P1090       Andrew Duncan, Malcolm Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Andrew Duncan, Malcolm Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Andrew Duncan, Malcolm Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Andrew Duncan, Malcolm Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Malcolm Cattado Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Malcolm Cattado Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Malcolm Cattado Cattado       Development of the Loupe electromagnetic (EM) system         P1091       Malcolm Cattado Cattado		2021	Mal Cattach	
ASEG Grahame Sands Award1988John Stanley and Malcolm CattachThe TM-3, Caesium Vapour magnetometer1991Terry LeeTheoretical research into transient electromagnetics1995Malcolm Cattach and John StanleyThe TM-4 magnetometer and its application to Sub Audio Magnetics method for simultaneous acquisition of TMI, TFMMR, TEEM and TFMMIP data2006Duncan Massie and Jim CullAdvances in TEM methods and instrumentation2012Malcolm Cattach, Keith Matthews, BouwmanDevelopment of the HPTX-70, high power (70 kW) transmitter Edward Campbell and Symon 		2023	Phillip Schmidt	
1991Terry LeeTheoretical research into transient electromagnetics1995Malcolm Gattach and John StanleyThe TM-4 magnetometer and its application to Sub Audio Magnetics method for simultaneous acquisition of TMI, TFMMR, TFEM and TFMMIP data2006Duncan Massie and Jim CullAdvances in TEM methods and instrumentation2012Malcolm Cattach, Keith Matthews, BowumanDevelopment of the HPTX-70, high power (70 kW) transmitter Sub outwant Campbell and Symon Bowuman2015Pillip SchmidtDevelopment of the Q-Meter2026Andrew Duncan, Malcolm CattachDevelopment of the Loupe electromagnetic (EM) systemASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach2018Malcolm Cattach, Christopher Parker and Russell MortimerDevelopment of the Loupe electromagnetic (EM) system2019Gregory Street20192021Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community" with the publication of <i>Geophysics for the Mineral Exploration Geosenitist</i> ".ASEG Service Medal2019Pillip SchmidtASEG Service Medal2019Millip SchmidtASEG Service Medal2019Pillip SchmidtASEG Service Medal2019Pillip SchmidtASEG Service Medal2019Pillip SchmidtASEG Service Medal2019Pillip Schmidt2019John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"	ASEG Grahame Sands Award	1988	John Stanley and Malcolm Cattach	The TM-3, Caesium Vapour magnetometer
1995Malcolm Cattach and John StanleyThe TM-4 magnetometer and its application to Sub Audio Magnetics method for simultaneous acquisition of TMI, TFMMR, TFEM and TFMMIP data2006Duncan Massie and Jim CullAdvances in TEM methods and instrumentation2012Malcolm Cattach, Keith Matthews, Edward Campbell and Symon BouwmanDevelopment of the HPTX-70, high power (70 kW) transmitter2015Phillip SchmidtDevelopment of the Q-Meter2016Andrew Duncan and Greg StreetDevelopment of the Loupe electromagnetic (EM) systemASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach2018Malcolm Cattach, Christopher Parker and Russell MortimerPortein and Russell MortimerASEG Lindsay Ingall Memorial Award2019Gregory Street2015Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community" with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".ASEG Service Medal2019Philip SchmidtComenius University Medal2019John Stanley and Malcolm Cattach		1991	Terry Lee	Theoretical research into transient electromagnetics
2006Duncan Massie and Jim CullAdvances in TEM methods and instrumentation2012Malcolm Cattach, Keith Matthews, Edward Campbell and Symon BouwmanDevelopment of the HPTX-70, high power (70 kW) transmitter Development of the Q-Meter2015Phillip SchmidtDevelopment of the Q-Meter2026Andrew Duncan and Greg StreetDevelopment of the Loupe electromagnetic (EM) systemASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach and Stephen Griffin2018Malcolm Cattach, Christopher Parker and Russell MortimerForegory StreetASEG Lindsay Ingall Meeming2019Gregory Street2015Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".ASEG Service Medal2012Philip SchmidtComenius University Medal2008John Stanley and Malcolm Cattach		1995	Malcolm Cattach and John Stanley	The TM-4 magnetometer and its application to Sub Audio Magnetics method for simultaneous acquisition of TMI, TFMMR, TFEM and TFMMIP data
2012Malcolm Cattach, Keith Matthews, Edward Campbell and Symon BouwmanDevelopment of the HPTX-70, high power (70 kW) transmitter2015Phillip SchmidtDevelopment of the Q-Meter2023Andrew Duncan and Greg StreetDevelopment of the Loupe electromagnetic (EM) systemASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach and Stephen Griffin2018Malcolm Cattach, Christopher Parker 		2006	Duncan Massie and Jim Cull	Advances in TEM methods and instrumentation
2015Philip SchmidtDevelopment of the Q-MeterASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach and Stephen GriffinDevelopment of the Loupe electromagnetic (EM) systemASEG Lindsay Ingall Memorial Award2007Andrew Duncan, Malcolm Cattach and Stephen Griffin		2012	Malcolm Cattach, Keith Matthews, Edward Campbell and Symon Bouwman	Development of the HPTX-70, high power (70 kW) transmitter
2023Andrew Duncan and Greg StreetDevelopment of the Loupe electromagnetic (EM) systemASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach and Stephen GriffinDevelopment of the Loupe electromagnetic (EM) systemASEG Lindsay Ingall Memorial Award2010Gregory StreetFor Street2015Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".ASEG Service Medal2012Philip Schmidt"for advances in geophysical exploration technologies"Comenius University Medal (Bratislava)208John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"		2015	Phillip Schmidt	Development of the Q-Meter
ASEG Laric Hawkins Award2007Andrew Duncan, Malcolm Cattach and Stephen Griffin2018Malcolm Cattach, Christopher Parker and Russell MortimerASEG Lindsay Ingall Memorial Award2010Gregory Street2010Gregory Street20152011Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".ASEG Service Medal2012Phillip SchmidtComenius University Medal (Bratislava)208John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"		2023	Andrew Duncan and Greg Street	Development of the Loupe electromagnetic (EM) system
2018Malcolm Cattach, Christopher Parker and Russell MortimerASEG Lindsay Ingall Memorial Award2001Gregory Street2010Gregory Street"for their combined effort in promoting geophysics to the wider community with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".ASEG Service Medal2012Phillip SchmidtComenius University Medal (Bratislava)2008John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"	ASEG Laric Hawkins Award	2007	Andrew Duncan, Malcolm Cattach and Stephen Griffin	
ASEG Lindsay Ingall Memorial Award2001Gregory Street2015Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community with the publication of Geophysics for the Mineral Exploration Geoscientist".ASEG Service Medal2012Philip SchmidtComenius University Medal (Bratislava)2008John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"		2018	Malcolm Cattach, Christopher Parker and Russell Mortimer	
2015Mike Dentith and Steve Mudge"for their combined effort in promoting geophysics to the wider community with the publication of Geophysics for the Mineral Exploration Geoscientist".ASEG Service Medal2012Phillip SchmidtComenius University Medal (Bratislava)2008John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"	ASEG Lindsay Ingall Memorial Award	2001	Gregory Street	
ASEG Service Medal       2012       Phillip Schmidt         Comenius University Medal       2008       John Stanley and Malcolm Cattach       "for advances in geophysical exploration technologies"         (Bratislava)       2008       John Stanley and Malcolm Cattach       "for advances in geophysical exploration technologies"		2015	Mike Dentith and Steve Mudge	"for their combined effort in promoting geophysics to the wider community with the publication of <i>Geophysics for the Mineral Exploration Geoscientist</i> ".
Comenius University Medal2008John Stanley and Malcolm Cattach"for advances in geophysical exploration technologies"(Bratislava)	ASEG Service Medal	2012	Phillip Schmidt	
	Comenius University Medal (Bratislava)	2008	John Stanley and Malcolm Cattach	"for advances in geophysical exploration technologies"

targeted post graduate activities. While geophysics subjects including crustal and inner Earth physics and near surface exploration and mapping were also taught at third year undergraduate level, Ron focussed his attention upon an Honours Year course, complemented by Masters and PhD programmes. He recognised that to solve future problems in geophysics, students primarily had to have a solid understanding of physics and mathematics. While the application of geophysics may well have been to assist geological investigations for which a knowledge of geological subjects was an advantage, knowledge

and understanding of maths/physics was imperative.

In 1980 Ron was awarded DSc from UQ for "Geophysical investigations" and he retired from the University of New England in 1987. Ron's department only survived at UNE for 16 years between 1967 and 1983. However, the accomplishments of his students during this time speak for themselves (see Table 1). In over 50 years the ASEG has awarded 14 Gold Medals. Three have been made to graduates of Ron's department. In 1988 the ASEG inaugurated the "Grahame Sands Award for Innovation in Applied Geoscience". Of the 18 Grahame Sands Award recipients to date, seven were graduates of Ron's department.

Ron Green will be remembered for his outstanding intellect, extraordinary sense of humour, devotion to the wellbeing of his students, and his immense contribution to Australian geophysics.

See also "A tribute to Ron Green", on the occasion of Ron's 90<sup>th</sup> birthday, *Preview* **207**, August, 2020

Phillip W Schmidt and John M Stanley (Former students of Ron Green) phil.magneticearth@gmail.com

### **INNOVATION IN GEOPHYSICS**

### MS3 Magnetic Susceptibility System

- ·Wide range of laboratory and field sensors
- Resolution to 2×10<sup>-6</sup> SI
- Range 26 SI
  - Measurement period down to 0.1 s

Australian distributor sales@cormageo.com.au cormageo.com.au



### Vale: Robert (Bob) M.S. White 1948 - 2023



Bob White

Bob White played a significant role in the mineral exploration industry in Australia over a period of nearly five decades.

Bob started studying economics at Macquarie University in 1967, the first year that the University accepted students, but after having taken some geology courses in his first year, he switched to geology and geophysics. In his words, he realised "that the earth sciences people seem to have a more realistic view of what mattered in life".

During his undergraduate years Bob played an active role in university life particularly through the ski club. He finished an MSc and, in the process, developed "a good appreciation of red wine". He intended to go on to do a PhD - to continue the research on non-linear electrical conduction in ore minerals that he had undertaken for his Master's thesis. However, while working for Cominco Exploration (later to become Aberfoyle), he was sent to western Tasmania to follow up an airborne EM anomaly that was to become the Que River mine. The ensuing flurry of exploration activity meant that he never got to go back to university.

In 1977 people with both technical expertise and computing skills were in

short supply, and Bob was enticed to move back to Sydney to work for Getty Oil, in their minerals division. Those were interesting times, working for companies with relatively large budgets for exploration, research and long lunches. However, all good things must come to an end, and in 1986 Getty was taken over and the staff laid off. During his time at Getty, Bob was involved not only with exploration geophysics, but also with ore reserve evaluation, feasibility financial modelling, and computer programming and management.

In 1986 Bob joined with fellow geophysicists, including Phil McSharry, to have a go at what now would now be called a .COM, *i.e.*, a hardware and software company start-up. Unfortunately, the crash of 1987 finished off this venture on the eve of its grand opening, when the banks withdrew funding from all start-up companies.

In late 1987 Bob moved into geophysical contracting through Surtec Geosurveys, while also working as an exploration consultant via his own company Tooronga Resources. He spent the next three years planning and running surveys all over Australia. After leaving Surtec in 1990, he continued with his consulting career in exploration geophysics. For the last 34 years he has been consulting in geophysics and computing for a large number of companies in Australia and overseas. This included lengthy stints working in Spain and Oman.

In the year 2000, armed with the then brand-new tool of three dimensional inversion modelling, Bob and Steve Collins investigated new and more efficient ways of running IP surveys in conjunction with 3D IP and resistivity inversion software. In association with contracting company Scintrex, they tried different survey geometries for IP, to optimise the survey coverage while maintaining or increasing the information content of the results. This culminated in the design of offset transmitter IP surveys which are still in use world-wide. Several conference presentations and papers resulted from this endeavour.

Upon retirement, Bob rued the fact that he had never completed the research he started for his MSc, and that no one else had continued with the work. In conjunction with Steve Collins, Keith Leslie and Andrew Sloot, he decided to continue this investigation into developing a method of looking for sulphide minerals in the presence of black shales and clays. Thus, the work that started as an MSc research project some 50 years earlier was restarted and continues to this day. Just days before his death, Bob was commenting and making suggestions for work on this project. Field tests are ongoing.

Bob has been an active Member of ASEG since its inception and has served on the ASEG Federal Executive a number of times.

He was also actively involved in the Rural Fire Service and was well regarded among his colleagues at the local Terrey Hills RFS station.

Bob was diagnosed with pancreatic cancer and battled with the disease for nearly two years before passing away quietly at home in the presence of his family. He is survived by his wife Sally and children Tom and Janie.

Bob will be remembered as a quiet but active participant and innovator in the exploration geophysics community.

#### Steve Collins scollins@arctan.com.au



### AEM 2023 8th International Airborne Electromagnetics Workshop: Reflections

Wow! What an event we had on Fitzroy Island in tropical North Queensland. The workshop was well attended with 95 delegates from 13 countries (Figure 1). We had 60 papers presented, covering all aspects of airborne electromagnetics.

Some of our invited speakers shared the history of airborne EM. Although its origins are rooted in the mineral exploration industry, the use of airborne EM has grown substantially, with groundwater studies now dominating its application. During the event, we witnessed exciting innovations, including the development of a fully airborne drone EM system. The videos showcasing some test flights amazed and captivated the audience. Therefore, it came as no surprise when it was announced that this innovation had won the award for the best paper:

"Developing a fully airborne drone TEM system" by Nicklas Skovgaard Nyboe and Kristoffer Skovgaard Mohr from SkyTEM Surveys ApS.

The best poster went to:

"Adaptive correction for airborne electromagnetic measurements" by Andrey Volkovitsky and Evgeny Karshakov, from the Institute of Control Sciences.

We encourage all workshop presenters to consider publishing their work as full papers in *Exploration Geophysics*. We aim to have papers submitted within the next twelve months to prepare for a special issue. If presenters don't feel that their work is quite ready or quite right for a full paper in *EG*, we would also encourage them to consider publishing in *Preview*.

Part of the conference's charm lay in its island setting, where participants could explore the wonders of the



Figure 1: AEM 2023 delegates by country.

local reef and embark on a steep hike to the lighthouse or, for the more adventurous, to the island's highest peak. In the evening, numerous social events provided opportunities for attendees to further foster relationships within this international community. As is often the case, we would often outlast the staff, creating our own music with guitars and vocals well into the late evening.

One of the anticipated highlights of the workshop was the competitive bid to host the next workshop. An unexpected turn of events occurred when a proposition to host the workshop every three years, instead of every five, was approved by vote. Italy was then selected as the host for the 2026 workshop, with the chosen location being an island off Sicily. I'm already in the process of drafting a paper for this upcoming event!

I would like to extend our heartfelt gratitude to our sponsors: **Xcalibur Multiphysics, Geotech Airborne, Skytem, Geoscience Australia, CGG, NRG, Intrepid Geophysics** and **Spectrem Air**. Your support was instrumental in making the workshop a truly memorable experience.

We also want to express our sincere thanks to our co-hosts, CSIRO and ASEG,

for their valuable contributions to the success of the event.

A special thanks is due to our dedicated committee members for their tireless efforts over the past several years. They were:

### Committee

- Andrew Fitzpatrick IGO, Co-Chair
- James Reid Mira Geoscience, Co-Chair
- Aaron Davis CSIRO, Technical
- Tim Munday CSIRO, Sponsorship
- Astrid Carleton GSNSW, ASEG Liaison
  Lisa Worrall Protean Geoscience, Local Liaison
- Torres Webb CSIRO, Indigenous Liaison
- David Annetts CSIRO, Extended Abstracts

### Technical sub-committee

- Aaron Davis CSIRO
- James Macnae CT3D / RMIT
- Yusen Ley Cooper Geoscience Australia
- Andrew King CSIRO
- Shane Mule CSIRO
- Tania Dhu NTGS

Andrew Fitzpatrick AEM 2023 Co-Chair Andrew.Fitzpatrick@igo.com.au



AEM 2023 Workshop participants on the Fitzroy Island jetty.

News

### CAGE23: The ASEG recognises sponsors and in-kind support

This year the #ASEG's Camp for Applied Geophysics Excellence (#CAGE23) will bring enthusiastic students and early career geoscientists from across Australia together at the WA geophysics test range, staying at the IGO camp in Forrestania. Over a week attendees will gain handson in-field experience in a range of geophysical methods including induced polarisation (IP), seismic, magnetics and electromagnetics (EM).

Attendees will learn to acquire, process, model and interpret in a real-life scenario

from technique experts. The importance of safety, environmental impacts, and the skills required to plan a geophysical campaign will all be covered.

This incredible once-in-a-career experience would not be possible without all the generous sponsors and volunteers that have contributed to this prestigious event. ASEG would like to recognise and celebrate these entities for their unwavering support which has allowed the ASEG to continue to deliver high quality, hands-on training and education in geophysics, which is becoming scarcer and more sought-after.

Please contact continuingeducation@ aseg.org.au for more information regarding sponsorship and in-kind support packages for future CAGE events.

To our platinum, gold, silver and bronze sponsors and in-kind sponsors for providing the support that enabled #CAGE23, Thank you!



### Geoscience Australia: News

Recent highlights of Geoscience Australia's geophysical programmes, as conducted under the Australian Government's Exploring for the Future (EFTF) project, and in collaboration with our State and Territory survey partners, are summarised below. Details of all current and recently completed programmes and survey locations can be found in Figure 1 and the tables that follow this section.

### NTGS Pedirka ground gravity survey

Geoscience Australia, in collaboration with the Northern Territory (NT)

Government's Geological Survey (NTGS), have recently completed the acquisition of ground gravity in the southeast corner of the NT adjacent to the Queensland and South Australian borders. The survey was helicopter assisted and acquired gravity data on a 4 x 4 km grid over an area of 61 370 km<sup>2</sup>, with infill in selected areas at 2 km spacing. Approximately 13 000 gravity stations were acquired as part of this survey, and the data is currently undergoing QA before release. This survey forms part of the NTGS's Resourcing the Territory Initiative, which aims to support resource exploration

in the NT. Current gravity coverage in the Pedirka survey area is of an age and density unsuitable for the goals of this programme.

For further information on these surveys, please contact Tania Dhu, Senior Geophysicist – Northern Territory Geological Survey, at Tania.Dhu@nt.gov.au

### GSV Shepparton Numurkah ground gravity survey

Geoscience Australia in collaboration with the Geological Survey of Victoria



**Figure 1.** 2021-2023 geophysical surveys – in progress, released or for release by Geoscience Australia as part of EFTF, and in collaboration with State and Territory agencies. Projects that are partially or wholly funded by state government agencies are identified by the bracketed contributors. Background image of national magnetics compilation (first vertical derivative of the reduced to pole magnetics), Geoscience Australia, 2019 (see http://pid.geoscience.gov.au/dataset/ga/144725).

(GSV), have started acquisition on the Shepparton Numurkah ground gravity survey in central north Victoria. The survey is infilling the existing ground gravity network at approximately 500 m spacing along existing public roads and tracks. As part of this survey previous survey nodes and base stations have been included to assist merging of the new gravity stations with existing gravity data.

For further information on this survey please contact Suzanne Haydon at Suzanne.Haydon@ecodev.vic.gov.au.

### Resistivity structures derived from AusLAMP magnetotellurics data in Queensland

Under Exploring for the Future, Geoscience Australia continues to acquire data and develop models for AusLAMP, with a current focus on Queensland. The most recent release (https://dx.doi. org/10.26186/1486330) is of a preferred 3D resistivity model projected to GDA94 MGA Zone 54 and processed MT data for 99 sites in western Queensland. This release complements publication of the northern Australia model in 2021 (http:// dx.doi.org/10.11636/Record.2021.021), with associated data split across two releases in 2020 (http://dx.doi. org/10.11636/134997) and 2022 (https:// dx.doi.org/10.26186/146312).

The Australian Lithospheric Architecture Magnetotelluric Project (AusLAMP) is a collaborative, multi-year project with GA, State/Territory governments, and research organisations. This project aims to acquire long-period magnetotellurics (MT) data at approximately 3000 sites across the Australian continent at a nominal halfdegree spacing. This national-scale MT survey aims to map the electrical resistivity of the continent in three dimensions and can be used as a reconnaissance tool for mapping lithospheric architecture across very broad areas. This new model has provided our first look at major conductivity features in the Croydon, Georgetown and Greenvale areas.

Land access for AusLAMP-EFTF was provided by in-kind contributions from the NTGS and the GSQ. GA provided the funding and managed the project and data acquisition, with modelling



**Figure 2.** Slice of Queensland resistivity model at approximately 40 km depth. Black triangles are the newly released sites and red circles are sites released in 2021.

undertaken with resources from the National Computational Infrastructure. The outputs of this project will improve the understanding of lithospheric structure in northern Australia. They will also assist in highlighting frontier regions for mineral potential in underexplored and under-cover regions.

The processed MT data were stored in EDI format, which is the industry standard format defined by the Society of Exploration Geophysicists. The preferred 3D resistivity model was derived from previous EFTF AusLAMP data acquired from 2016-2019 and recently acquired AusLAMP data in Queensland. The model is in SGrid format and geo-referenced TIFF format. The Queensland model and new sites released (Figure 2) are available from Duan *et al.* 2023. https://dx.doi. org/10.26186/148633.

For further information on the Queensland AusLAMP MT model, please contact Jingming Duan, Geophysicist – Onshore Seismic and Magnetotellurics, at Jingming.Duan@ga.gov.au

Donna Cathro Geoscience Australia Donna.Cathro@ga.gov.au

an and the second of the secon

### Update on geophysical survey progress from Geoscience Australia and the Geological Surveys of Western Australia, South Australia, Northern Territory, Queensland, New South Wales, Victoria and Tasmania (information current 11 September 2023)

The survey details are provided for information only, and on the understanding that the Australian Government is not providing advice. Further information about these surveys is available from Adam Bailey Adam.Bailey@ga.gov.au (02) 6249 5813 or Donna Cathro Donna.Cathro@ga.gov.au (02) 6249 9298 at Geoscience Australia.

#### **Table 1.** Airborne magnetic and radiometric surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Line spacing Terrain clearance Line direction	Area (km²)	End flying	Final data to GA	Locality diagram (Preview)	GADDS release
Eastern Tasmania	MRT	GA	MAGSPEC	Mar 2022	57 000	200 m	11 600	Jun 2022	Sep 2022	See Figure 1 in previous section (GA news)	Dec 2022 - http:// pid.geoscience. gov.au/dataset/ ga/147455

TBA, to be advised.

#### Table 2. Ground and airborne gravity surveys

Survey name	Client	Project management	Contractor	Start survey	Line km/ no. of stations	Line spacing/ station spacing	Area (km²)	End survey	Final data to GA	Locality diagram ( <i>Preview</i> )	GADDS release
Canobie	GSQ	GA	Xcalibur Multiphysics	Nov 2021	~5000	1–2 km	5300	Dec 2021	Mar 2022	See Figure 1 in previous section (GA news)	Released by GSQ and GA, Apr 2022 https://dx.doi. org/10.26186/146760
Brunette Downs Ground Gravity	NTGS	GA	Atlas Geophysics	Oct 2021	~ 12 000	2 x 2 km grid	55 000	Apr 2022	May 2022	See Figure 1 in previous section (GA news)	Released by NTGS and GA in Jun 2022 https://dx.doi. org/10.26186/146941
Melbourne, Eastern Victoria, South Australia	AusScope GSV DEL WP	e GA	Sander Geophysics	TBA	137 000	0.5–5 km	146 000	Expected Jun 2023	~ Oct 2023	See Figure 1 in previous section (GA news)	Late 2023
Kidson Sub-basin	GSWA	GA	Xcalibur Multiphysics	14 Jul 2017	72 933	2500 m	155 000	3 May 2018	15 Oct 2018	See Figure 1 in previous section (GA news)	Dec 2022 http://pid. geoscience.gov.au/ dataset/ga/147481
Little Sandy Desert W and E Blocks	GSWA	GA	Sander Geophysics	W Block: 27 Apr 2018 E Block: 18 Jul 2018	52 090	2500 m	129 400	W Block: 3 Jun 2018 E Block: 2 Sep 2018	Received by Jul 2019	195: Aug 2018 p. 17	Oct 2022 https:// ecat.ga.gov.au/ geonetwork/srv/ eng/catalog.search#/ metadata/147066
Kimberley Basin	GSWA	GA	Sander Geophysics	4 Jun 2018	61 960	2500 m	153 400	15 Jul 2018	Received by Jul 2019	195: Aug 2018 p. 17	Oct 2022 https:// ecat.ga.gov.au/ geonetwork/srv/ eng/catalog.search#/ metadata/147066
Warburton- Great Victoria Desert	GSWA	GA	Sander Geophysics	Warb: 14 Jul 2018 GVD: 22 Jul 2018	62 500	2500 m	153 300	Warb: 31 Jul 2018 GVD: 3 Oct 2018	Received by Jul 2019	195: Aug 2018 p. 17	Oct 2022 https:// ecat.ga.gov.au/ geonetwork/srv/ eng/catalog.search#/ metadata/147066
Pilbara	GSWA	GA	Sander Geophysics	23 Apr 2019	69 019	2500 m	170 041	18 Jun 2019	Final data received Aug 2019	See Figure 1 in previous section (GA news)	Nov 2022 https:// ecat.ga.gov.au/ geonetwork/srv/ eng/catalog.search#/ metadata/147265
SE Lachlan	GSNSW/ GSV	GA	Atlas Geophysics	May 2019	303.5 km with 762 stations	3 regional traverses	Traverses	Jun 2019	Jul 2019	See Figure 1 in previous section (GA news)	Set for incorporation into the national database in 2023

TBA, to be advised

News

### Table 3. Airborne electromagnetic 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
Western Resources Corridor	GA/ GSWA	GA	Xcalibur Multiphysics	May 2022	~ 38 000	20 km	760 000	Oct 2022	Dec 2022	See Figure 1 in previous section (GA news)	Mar 2023 https://dx.doi. org/10.26186/147688
Musgraves	GA	GA	Xcalibur Multiphysics	Jun 2022	~ 22 000	1 – 5 km	~ 100 000	Aug 2022	Dec 2022	See Figure 1 in previous section (GA news)	Mar 2023 https://dx.doi. org/10.26186/147688
Upper Darling River	GA	GA	SkyTEM	Mar 2022	25 000	.25 – 5 km	14 509 line km	Jun 2022	Oct 2022	See Figure 1 in previous section (GA news)	Oct 2022 http://pid. geoscience.gov.au/ dataset/ga/147267
Darling- Curnamona- Delamerian	GA	GA	SkyTEM	Jun 2022	14 500	1 – 10 km	25 000 line km	Oct 2022	Dec 2022	See Figure 1 in previous section (GA news)	Feb 2023 https://dx.doi. org/10.26186/147585
Eastern Resources Corridor	GA	GA	Xcalibur Multiphysics	Apr 2021	32 000	20 km	640 000	Jul 2021	Oct 2021	See Figure 1 in previous section (GA news)	Oct 2021 http://pid.geoscience. gov.au/dataset/ ga/145744
AusAEM20	GSWA	GA	Xcalibur & SkyTEM	Aug 2020	62 000	20 km	1 240 000	Nov 2021	Dec 2021	See Figure 1 in previous section (GA news)	Released Mar 2022 - http://pid.geoscience. gov.au/dataset/ ga/146345

TBA, to be advised

### Table 4. Magnetotelluric (MT) surveys

Location	Client	State	Survey name	Total number of MT stations deployed	Spacing	Technique	Comments
Northern Australia	GA	QId/ NT/ WA	Exploring for the Future – AusLAMP	500 stations deployed 2016-23	50 km	Long period MT	The survey covers areas of NT, Qld and WA. Data acquired 2016-19 and related model released 2020. Data package: http://pid.geoscience.gov.au/ dataset/ga/134997 Model: http://pid.geoscience.gov.au/dataset/ ga/145233 News article: http://www.ga.gov.au/news- events/news/latest-news/exploring-for-the- future-takes-a-deeper-look-at-northern- australia Queensland model update and data release: https://dx.doi.org/10.26186/148633 Data acquired 2020–23.
AusLAMP NSW	GSNSW/ GA	NSW	AusLAMP NSW	~300 stations deployed 2016-21	50 km	Long period MT	Covering the state of NSW. Acquisition is essentially complete with fewer than 10 sites remaining to be acquired or reacquired. Phase 1 data release: http://pid.geoscience.gov. au/dataset/ga/132148.
Curnamona Province- Delamerian Orogen	GA/GSNSW/ GSSA/ University of Adelaide	NSW/ SA	Exploring for the Future - Curnamona Cube Extension	~100 stations deployed 2023	25-12.5 km	Audio and broadband MT	This survey will extend the University of Adelaide-AuScope Curnamona Cube MT survey from the Curnamona Province into the Delamerian Orogen. Data was released in May 2023, https://doi.org/10.26186/147904. and related model published Aug 2023: https://dx.doi.org/10.26186/148623
AusLAMP Qld	GSQ/GA	Qld	AusLAMP Qld	6 stations deployed 2023	200+ km	Long period MT	Adding to the coverage in Queensland undertaken as a part of EFTF. Ultimate coverage planned at 50 km spacing.

TBA, to be advised



### **Table 5.**Seismic reflection surveys

Location	Client	State	Survey name	Line km	Geophone interval	VP/SP interval	Record length	Technique	Comments
Darling – Curnamona – Delamerian deep crustal reflection survey	GA	SA, NSW, VIC	Darling – Curnamona – Delamerian deep crustal reflection survey	~1275	10	10/40	20	2D Deep Crustal/ high resolution vibroseis seismic survey.	This survey will create an image of important crustal boundaries including the structure of the Delamerian margin, which runs through NSW, SA and Vic, separating older rocks of the Gawler Craton and Curnamona Province from younger rocks of the Lachlan Fold Belt (Tasmanides). Acquisition commenced in Jun 2022 and concluded in Aug. Raw data for this survey are available on request from clientservices@ga.gov.au Quote eCat# 147423. Data processing is complete and the data package is planned for release in late 2023.
Central Australian basins	GA	QId/ SA	Shallow legacy data	~1257	Varies	Varies	3-20 sec	2D shallow & deep legacy data, explosive, vibroseis	GA commissioned reprocessing of selected legacy 2D seismic data in Qld and SA, as part of Exploring for the Future, Australia's Future Energy Resources Project. The objective is to produce a modern industry standard 2D land seismic reflection dataset to assist in imaging the subsurface. Reprocessing of these data is complete and the data package will be released in early 2024.
Adavale Basin	GA	Qld	Deep and shallow legacy data		Varies	Varies	3-20 sec	2D shallow & deep legacy data, explosive, vibroseis	GA commissioned reprocessing of selected legacy 2D seismic data in the Adavale Basin, Queensland Australia, Data driven Discoveries Initiative. The objective is to produce a modern industry standard 2D land seismic reflection dataset to assist in imaging the subsurface. Reprocessing of the legacy data is complete and the data package will be released in the second half of 2023.

### **Table 6.**Passive seismic surveys

Location	Client	State	Survey name	Total number of stations deployed	Spacing	Technique	Comments
Australia	GA	Various	AusArray	149 temporal seismic stations	~200 km spacing	Broad- band ~18 months of observations	The survey covers all of Australia to establish a continental- scale model of lithospheric structure and serve as a background framework for more dense (~50 km) movable seismic arrays. Deployment of this national array was completed in June 2023. Data will be acquired over 12-18 months.
Northern Australia	GA	Qld/NT	AusArray	247 broad-band seismic stations	50 km	Broad-band 1-2 years observations	The survey covers the area between Tanami, Tennant Creek, Uluru and the WA border. The first public data release of the transportable array was in 2020. See: http://www.ga.gov.au/eftf/minerals/nawa/ausarray Various applications of AusArray data are described in the following Exploring for the Future extended abstracts:
							<ul> <li>AusArray overview: http://pid.geoscience.gov.au/dataset/ ga/135284</li> <li>Body wave tomography: http://pid.geoscience.gov.au/ dataset/ga/134501</li> <li>Ambient noise tomography (including an updated, higher resolution model for the Tennant Creek to Mount Isa region): http://pid.geoscience.gov.au/dataset/ga/135130</li> <li>Northern Australia Moho: http://pid.geoscience.gov.au/ dataset/ga/135179</li> </ul>
Australia	GA	Various	AusArray, semi- permanent	12 high-sensitivity broad-band seismic stations	~1000 km	Broad-band 4 years observations	Semi-permanent seismic stations provide a back-bone for movable deployments and complement the Australian National Seismological Network (ANSN) operated by GA, ensuring continuity of seismic data for lithospheric imaging and quality control. Associated data can be accessed through http://www.iris.edu
AusARRAY Victoria Collaborative	Project	GA/GSV	Victoria	21 temporary seismic stations	~100 km	Broad-band ~12-18 months of observations	Data acquired from the movable array sites will add to the scientific understanding of the Earth's lithosphere on the national and regional scale. Phase 1 of the deployment (~100 km) was undertaken in Mar 2023.

### Table 7. Survey technical requirements

Survey type	Author	Contributors	GA Release
Magnetics, radiometrics and horizontal magnetic gradiometry	James Goodwin	Brian Minty, Ross Brodie, Mark Baigent, Yvette PoudjomDjomani, Matt Hutchens with acknowledgements	Mar 2023 http://pid. geoscience.gov.au/dataset/
		to Peter Milligan, Laz Katona and Mike Barlow	ga/147457

### Mineral Resources Tasmania: New state-wide 3D geological model

Mineral Resources Tasmania has produced a new version of its state-wide 3D geological model (Figure 1).

When originally released in 2004, incorporating a range of complementary data sets in addition to 3D geological objects, the model package was the first such construction for an entire jurisdiction anywhere in the world. This 2023 revision adds several new geophysical data sets and models that have been developed in the meantime.

These include:

- The Tasmanian leg of AusLAMP MT, a resistivity model spanning from surface through to lithospheric mantle depths (Ostersen 2021)
- Two regional shear wave velocity models derived from ambient seismic noise measurements (Young *et al.* 2013; Mineral Resources Tasmania in prep.)

• A refined top surface of granitoids in eastern Tasmania from new 2D modelling based on significant revisions to the regional gravity model (Leaman 2012).

The model package, a Geoscience Analyst .geoh5 workspace, also contains updated gravity and magnetic grids, including the major 2021 and 2022 extensions of modern magnetic data coverage to eastern and southern Tasmania.

Geological objects in the model have also been updated with current stratigraphic nomenclature and clearer fault names.

The package can be downloaded from the MRT website, https://www.mrt.tas. gov.au/products/database\_searches/3d\_ model\_data.

Mark Duffett and Daniel Bombardieri Mineral Resources Tasmania mark.duffett@stategrowth.tas.gov.au

### References

- Leaman, D. E., 2012. An interpretation of the granitoid rocks of eastern Tasmania. Mineral Resources Tasmania GPCR2012\_01.
- Ostersen, T.C.H., 2021. Geoelectric structure of the Tasmanian lithosphere from multi-scale magnetotelluric data. PhD thesis, University of Tasmania. Also available via Mineral Resources Tasmania (GPCR2019\_01).
- Young, M., Rawlinson, N. and T. Bodin, 2013. Transdimensional inversion of ambient seismic noise for 3D shear velocity structure of the Tasmanian crust. *Geophysics* **78**: WB49-WB62. 10.1190/geo2012-0356.1



Figure 1. A view of the new edition of the Tasmanian 3D geological and geophysical model, including elements of the newly added MT and passive seismic components.



# Geological Survey of Victoria: Update on progress of airborne and ground gravity surveys

### Airborne gravity survey update and release of preliminary grids

The Geological Survey of Victoria (part of the Department of Energy, Environment and Climate Action), the Surveyor-General Victoria (part of the Department of Transport and Planning) and Geoscience Australia (GA) have been working with Sander Geophysics Ltd to collect airborne gravity data across Greater Melbourne and eastern Victoria including coastal and alpine areas (Figure 1). The objective of the project is to collect consistent and evenly distributed gravity measurements to improve height determination from GPS positioning and advance the understanding of Victoria's geological architecture and earth resource potential.

The survey has now extended beyond 50% completion (see progress map on the project website - https://www.land. vic.gov.au/surveying/projects-and-initiatives/airborne-gravity-survey).

The project partners are releasing preliminary grids of the first stage of the project (see Figure 1). The first stage of the project was flown with a singleengine aircraft at 1 km line spacing over the Hume, Otway and West Gippsland regions. The preliminary grids of free air gravity, Bouguer gravity and first vertical derivative of Bouguer gravity have been prepared using a 6-km full wavelength filter.

The grids will be available for download from the Geological Survey of Victoria's online catalogue at www.gsv.vic.gov. au/rid/171723. If you wish to be notified when the grids become available, please email gsv\_info@ecodev.vic.gov.au to record your interest.

A final data package of located data, grids and an operations report will be available at conclusion of the project.

### Ground gravity survey begins in northern Victoria

The Geological Survey of Victoria has partnered with GA and Daishsat



**Figure 1.** Map showing the location of the Greater Melbourne and eastern Victoria airborne gravity survey with preliminary Bouguer gravity grids. and the location of the Shepparton-Numurkah regional ground gravity survey.



**Figure 2.** Photos of Daishsat's gravity crew observing gravity on the roadside. Credit: Daishsat Geodetic Surveyors.

Geodetic Surveys to acquire ground gravity observations across the Victorian Riverine Plain between Seymour, Echuca and Wodonga (Figure 1). Comprising approximately 20 000 new stations, the survey will infill the existing gravity coverage to around 500 m along public roads and tracks. The survey began in August 2023 and is making good progress, despite recent wet ground conditions and ongoing repairs to regional roads and infrastructure, damaged after the major 2022 flooding event.

The survey covers a wide variety of road types from bush tracks and unused

roads to rural and dual-lane highway to suburban streets. Daishsat have developed detailed traffic management plans and procedures to ensure the safety of the surveyors and other road users (see Figure 2)

See here for more information and a printable fact sheet https:// earthresources.vic.gov.au/projects/ eastern-victoria-geoscience-initiative/ shepparton-numurkah-regional-groundgravity-survey.

Suzanne Haydon Geological Survey of Victoria Suzanne.Haydon@ecodev.vic.gov.au



### Geological Survey of Western Australia: Deep-crustal seismic surveys 2023–24 — South West, Great Southern and Mid-West regions

The Geological Survey of Western Australia will be conducting a programme of up to 1200 km of deep crustal reflection seismic surveys in the south and mid-west of the State to image the crustal structure and geological domains in one of the oldest parts of the Australian landmass (Figure 1). The surveys will be conducted by HiSeis Pty Ltd. Survey specifications are:

- Source: 3 x INOVA AHV-IV Vibroseis trucks @ 40 m vibration point spacing, 1 x 24 s sweep
- Receiver: 1600 x INOVA Quantum 5 Hz nodes @ 10 m spacing (nominal 200fold), 20 s listen time

Acquisition on line SW1 is programmed to commence in September 2023.

David Howard Geological Survey of Western Australia David.HOWARD@dmirs.wa.gov.au



Figure 1. Paths of deep crustal reflection seismic surveys proposed in the south and mid-west of Western Australia.



### Canberra observed



David Denham AM Associate Editor for Government denham1@iinet.net.au

### **Exploration investment**

### *Mineral exploration investment continues* to grow

The latest information provided by the Australian Bureau of Statistics (https:// www.abs.gov.au/statistics/industry/mining/ mineral-and-petroleum-explorationaustralia/latest-release) on exploration investment shows that for minerals, the overall trend shows a gradual increase (see Figure 1). The \$1 billion per quarter is a healthy situation.

Figure 2 shows that gold remains the main target, but that investment in gold has declined significantly from the peak of \$430 million in June 2022 quarter to \$315 million in the June 2023 quarter. Note that the investment "all others" and the "some base metals" is steadily increasing because of the demand for copper and battery components.

#### Petroleum exploration is stagnant

Petroleum exploration expenditure is still very low because of the absence of any significant offshore investment. The total investment in the June quarter was only \$231 million and the onshore component was \$145 million.

The war in Ukraine has resulted in a gradual increase in the price of Brent Crude, which has risen steadily to about US\$90/bl. Unfortunately, the value of the Australian dollar compared to the US dollar had fallen from 0.71 in February 2023 to about \$0.64 in September. And we all know that this has made large changes in the price at the pumps – and that is starting to hurt.



**Figure 1.** Quarterly investment in mineral and petroleum exploration 2005-22 in September A\$. Source: https://www.abs.gov.au/statistics/industry/mining/mineral-and-petroleum-exploration-australia/latest-release



Figure 2. Quarterly investment in exploration for the main mineral commodities. Source: https://www. abs.gov.au/statistics/industry/mining/mineral-and-petroleum-exploration-australia/latest-release

### Research priorities

The Department of Industry Science and Resources is asking the public to have their say on the Government's research priorities (*https://www.industry.gov.au/ news/australias-draft-national-scienceand-research-priorities-have-your-say*). Hundreds of submissions have already joined the conversation on revitalising Australia's National Science and Research Priorities and National Science Statement.

The Department is now continuing the discussion with the release of the draft priorities. These priorities have four core aims:

 Ensuring a net zero (greenhouse gas?) future and protecting Australia's biodiversity

- Supporting healthy and thriving communities
- Enabling a productive and innovative economy
- Building a stronger, more resilient nation.

Feedback on the shape on the final form of Australia's refreshed priorities and statement is invited (see https://consult. industry.gov.au/sciencepriorities2). The window of opportunity to provide feedback was from 7-29 September, but if anyone wants to contribute, the closing date may be flexible.

### The Productivity Index: Is it important? How is it measured?

Governments and industries have used the Productivity Commission to support their arguments on wages, economic reform and working conditions for many years. So, when Michael Brennan, who has just stood down as the Chair of the Commission, gave his talk at the National Press Club, I thought it might be useful to go along and learn more about productivity.

The basic argument is that Australians have grown steadily richer due to productivity growth. But how do you measure productivity? At first blush it sounds simple.

It is the ratio of the quantity of output produced to some measure of the quantity of inputs used (see https://www.pc.gov.au). The standard example is that in 1901 it took 18 minutes of the 'average' workers time to afford a loaf of bread. Now it takes about 4 minutes.

According to the Productivity Commission, productivity has been the driver of long-term improvements in living standards and Australians have grown steadily richer due to productivity growth.

Figure 3 indicates the productivity growth over the first 115 years after federation.

Unfortunately, GDP per capita is not a good measure of wellbeing. Economic activity and labour productivity is only counted when items are made for sale or use, such as a car or a house.

What is missing is an appropriate measure of productivity in the



**Figure 3.** GDP per capita and labour productivity growth since Federation until 2016. Source: https:// www.pc.gov.au

service sector. For example, some measure of the contribution of teachers in schools or medical staff in hospitals. Good educational or health outcomes are often dependent on low student and patient staff ratios, but on current measures, if staff numbers go up, productivity goes down, even though the service would improve.

It is like the number of tellers accessible in a bank (if one still exists in your neighbourhood). Productivity goes up and bank profits increase if there are fewer tellers, but the wellbeing of the public is not taken into consideration.

Consequently, whilst increasing productivity gains using current measures may have been a useful target in the 20<sup>th</sup> century; it may no longer be an appropriate target in an economy increasing dominated by the service sector.

### Government encourages offshore greenhouse gas storage

The Government has identified ten areas that are available for work programme bidding in the latest release. These areas are offshore of Western Australia, Victoria and Tasmania across seven basins see (https://www. industry.gov.au/news/2023-offshoregreenhouse-gas-storage-acreagerelease-now-open#:~:text). The areas are in the Bonaparte, Browse, Northern Carnarvon, Perth, Otway, Bass and Gippsland basins.

Bidding is open until 28 November 2023 and according to Minister King, companies must pay to use these sites from their profits. The latest Quarterly Update of Australia's National Greenhouse Gas Inventory for the March 2023 was released in August 2023 (https://www.dcceew.gov.au/ climate-change/publications/nationalgreenhouse-gas-inventory-quarterlyupdate-march-2023). The report shows emissions were 465.9 million tonnes (Mt) of carbon dioxide equivalent in the first quarter of 2023. This is flat compared with the previous year, with emissions estimated to be up 0.1% (0.3 Mt CO<sub>2</sub>-e).

The trend over the year reflects movement across the sectors, including:

- Ongoing reductions in electricity emissions (down 3.9%; 6.3 Mt CO<sub>2</sub>-e) as renewable energy uptake continues to displace fossil fuel power sources
- Decreased fugitive emissions (down 1.1%; 0.6 Mt CO<sub>2</sub>-e), reflecting a fall in coal production of 4.6%;
- Decreased emissions from stationary energy (excluding electricity) (down 0.8%; 0.9 Mt CO<sub>2</sub>- e), driven primarily by decreased activity in the manufacturing sector
- Increased transport emissions (up 6.4%; 5.9 Mt CO<sub>2</sub>-e), reflecting the ongoing recovery from COVID related travel restrictions; and
- Increased emissions from agriculture (up 3.2%; 2.6 Mt CO<sub>2</sub>-e), returning to pre-drought levels because of increases in livestock populations and crop production.

Emissions in the year to March 2023 were 24.4% below June 2005 levels – the base year for Australia's 2030 Paris Agreement target, but we have a long way to go to reach our zero-emission target by 2050.

### **Education matters**



Marina Pervukhina Associate Editor for Education Marina.Pervukhina@csiro.au

### Potential for Australia to become a global leader in climate mitigation

In this issue, we continue publishing a series of interviews with the industry and government leaders. Our new guest, Allison Hortle, a newly appointed Energy Business Unit Science Director in CSIRO, shares her thoughts about the energy transition challenges and what leaders in governmental institutions expect today from tertiary education in the field of earth sciences.



Allison Hortle

MP: Allison, can you share with our readers your path to the CSIRO Energy Business Unit Science Director position, please?

AH: I was born in South Australia, and I went to James Cook University in Queensland. I did a double degree in geology and inorganic chemistry, followed by with an Honours degree in inorganic chemistry where I was looking at designing molecules to

purify wastewater. The combination of chemistry and geology was quite unusual at the time. However, I found it very interesting because it considered two extreme parts of the physical spectrum. Geology is very much about the large scale and looking at landscape formations through millennia. So, from thousands of millions of years ago, how landscape forms, rivers and lakes and volcanoes and how you build that story from the remnant geology that remains, from sand grains to volcanoes. And then you have chemistry, which is really about the molecular scale, looking at how molecules interact, the physics that bind them together and how the kinetics and thermodynamics control those interactions. It ended up being an interesting combination, of finding the connection between the macro and the micro to see how all things are interrelated.

### "With all the online resources at our fingertips, the ability to think critically, to be adaptable and open minded and willing to learn is crucial."

Soon after I left university, I moved to Melbourne to join CSIRO. It sounds rather dull, but I have been at CSIRO for a very long time, I joined soon after I left uni, and I've just received my Certificate of 30 Years of Service. During that time, I've undertaken some interesting and guite fundamental research and worked with a hugely diverse group of colleagues and collaborators. I've had an enormous variety of roles in a number of different capacities, ranging from bespoke applied research to managing large groups of people and research portfolios. CSIRO has always been a very interesting and very challenging place to work and that's what has kept me here.

I began my research working in petroleum hydrodynamics, looking at how fluids moved through subsurface geological formations and the interactions between the fluids and the rocks, it was chemistry and geology combined, trying to predict where oil and/or gas would accumulate. Then CSIRO shifted the focus of its energy research to Western Australia, and my husband and I took the opportunity to move to Perth. One of the first projects I was involved in was investigating the

possibility of returning (or injecting) carbon dioxide captured from stationary sources into geological formations. We know geological formations accumulate and store vast amounts of fluids for millions of years, so it seemed a logical solution for climate mitigation, and I was excited by the possibilities. So, that initial research project has led my research for most of my career, the injection, monitoring and storage part of carbon capture and storage. Once again, this is chemistry and geology combined. Large scale injection of carbon dioxide into a geological structure under the surface, at least 1000 m under the surface, requires understanding of that landscape: how the different sediment layers relate to each other, how ancient riverbeds can change from sandstones into clays, and back again, how faults form from earthquakes and how uplift and erosion can turn the whole thing upside down. And, you have to do this indirectly, because you're trying to "see" 1000 m below your feet. Then, the chemistry comes into play, understanding how the fluids move and accumulate through this landscape, how the water or carbon dioxide molecules react with the rocks and the fluids already there, over what time frame and with what impacts. And most importantly, how to monitor and predict that behaviour. I like to think of it as the plumbing system.

### "Unexpected intersections between disciplines can provide real disruptive innovation."

That initial project was part of one of the very first cooperative research centres (CRCs). It started off being the Australian Petroleum CRC and later evolved into the CO<sub>2</sub>CRC, which is still active today. It was a very interesting experience, because it was a strong collaboration between researchers like me, from many disciplines and at all stages of their careers. So, although I was very young and just starting out, I was able to engage with researchers from universities all over the world who were very well established and very experienced and knowledgeable, but at the same time, very happy to share their experience and knowledge.

The CO<sub>2</sub>CRC also had close collaborations with the different industry and government partners. They were the people who were on the ground, who

were doing the operational activities; planning, designing, costing, and implementing the engineering or the policies to put the research outcomes into practice. The collaboration between the science, government and industry really taught me how to make that connection between the work that we do in the labs, and the importance of aligning that with practical solutions to really solve the problem being addressed.

"One of the key qualities we need for a smooth transition is open mindedness, willingness to question your own assumptions and the flexibility to totally reimagine our energy systems."

Consequently, my time in the CO<sub>2</sub>CRC was really very important, and quite formative for me because of that collaboration aspect. We worked very smoothly across multiple organisations, multiple disciplines, and multiple expertise and levels of knowledge, across the globe. As a hydrogeologist and chemist, I was working with reservoir modellers, engineers, chemists, geologists, reservoir engineers, petroleum engineers, community engagement people, mathematicians, petrophysicists and many other professionals. We were all happy to work together and produce exciting research and to share the outcomes. Sharing outcomes, through conferences and papers, was a very strong part of the collaboration. We'd get together every year for a week and everybody would share what they'd been doing, we'd find new projects to work on and new ways to work together. It was really a very exciting, informative time.

MP: Sounds like a perfect environment to work in.

AH: Well, it wasn't perfect, but it was fun.

My current role is as the Deputy Director and the Science Director for Energy. It's two roles really. The Deputy Director role supports the Director and it's about setting the strategy and making sure that we have the right environment for our research to operate in. The Science Director represents Energy within the greater CSIRO science strategy. The two go together, really, you can't have one without the other. Our leadership team work together to make sure everything runs smoothly and that we have the right people, the right science infrastructure and laboratories, and the right funding arrangements with the right partners to keep the wheels turning.

MP: As a governmental organisation, what does CSIRO expect from tertiary education nowadays?

AH: I think it's important to continuously have new recruits and new students coming in. Apart from intellectual curiosity, the influx of the enthusiasm, excitement, and new ways of thinking and approaching problems brings a whole new energy to our research, so that in itself is exciting and reinvigorating.

For example, I remember about ten years ago a friend of mine asking me about capturing carbon dioxide directly from the air, and I just laughed and said: "No, that's a silly idea. Nobody would ever do that." But here we are and now it's a rapidly developing technology and a key part of our portfolio of climate solutions. So, remembering to check your biases, and reminding yourself that the impossible can become possible and freeing your imagination is an important part of our innovation landscape, and something our graduates do very well.

"We are in danger of forgetting about the enormous resources contained in the subsurface and the enormous dependence that energy transition will have on those resources, particularly in the mineral industry, but also in other forms of subsurface storage, such as hydrogen, compressed air and carbon capture and storage."

Although the world is very different now than it was when I went to university, some things are the same. We used to say that we didn't go to uni to read textbooks, we went to learn how to think, and I believe that is still true. With all the online resources at our fingertips, the ability to think critically, to be adaptable and open minded and willing to learn is crucial. The types of knowledge available at university is much more diverse today, but the ability to think critically is fundamental.

I also think it's harder these days to be totally focused on just one thing. The world is so much more complicated. One of the key things I enjoy about CSIRO (although it can also be frustrating) is you simply don't have the opportunity to just do the one thing all day. However, you do have the opportunity to be able to see the big picture and see how all the different parts fit together. To see and be able to understand where your piece of the puzzle fits into the whole problem that you're trying to solve. So, for a graduate coming into CSIRO, having that opportunity to think holistically is attractive.

More specifically, I think that it is important to understand data and how to engage deeply with computers in an immersive digital environment. For my generation, computers were still a novelty, a learned thing. But for my kids and current generations, it's just second nature. It's natural to them, there has never been a world without computers. That's just how they interact, and there is still so much to learn and understand in that space. For me that's a really different way of being, and it's exciting and perhaps a little scary.

MP: What do you think changed in recruitment process in the last 10-20 years?

AH: It's changed an awful lot. And for the better in many ways. When I am reviewing CVs I try to be aware of my own unconscious bias, and make a point of not looking at names, titles, age, addresses, and I don't like to see photos. I try to focus only on what is written on the screen (I don't print them out anymore).

There's a growing recognition about the value of diverse teams and I'm a strong believer in the benefits that brings. I believe the natural tendency of people is to move towards something that is familiar. So, if you have a particular group of people, and they're all very similar, whatever their traits may be, if they're interviewing somebody they will naturally gravitate towards someone that is like them. Learning to actively overcome those unconscious biases by having a diverse panel of people at interview is the first step to building diverse teams.

We also try to ask behavioural or openended questions, to understand the person more broadly than just their academic ability, because there's so much more that you need to bring to a job these days. You need to bring flexibility and a team ethos, as well as your actual skill set. One thing about contemporary science is the growing understanding of the interconnectedness of all systems and managing that interaction. In addition, unexpected intersections between disciplines can provide real disruptive innovation. Having someone who is open to those possibilities can be very valuable in a research team.

### "It's important to remember, that we are not simply replacing the energy we currently use, our energy consumption will continue to grow."

So, yes, recruitment has changed a lot and for the better. If you make sure that your hiring protocols are robust and have integrity, I believe you will naturally evolve towards having more diversity in your teams and then the benefits will start to flow. I lived through the time when teams were almost always nondiverse, the same age, the same style, same background, and experience. Tracking our progress away from that model is exciting. I must admit too, that although I was always employed on merit, there was sometimes a slight perception from some people that maybe I got the job just because I am a woman. I was proud to be one of the early women in leadership, but I always found that attitude rather annoying.

MP: What specialists do we need to ensure a smooth transition to clean energy?

AH: I think we are going through not only the energy transition, but also an education transition. I don't really think the way I was taught is very relevant now. When you have instant access to information on your phone, primarily you need to know how to find what you're looking for. Once you've found it, you need to know how to critique it, to sift through multiple resources to decide what is fact and what is opinion. ChatGPT is a good example. ChatGPT will find you an answer to any question you ask, but knowing if the answer is correct, is a different matter. Again, one of the key qualities we need for a smooth transition is open mindedness, willingness to question your own assumptions and the flexibility to totally reimagine our energy systems.

The energy transition will also change the subjects being taught as priorities change. For example, when we were entirely powered by hydrocarbon

related industries, there were many subsurface geologists, geophysicists, hydrogeologists, reservoir engineers, etc. These were lucrative industries and very popular. Now, we have very few geophysics schools left, and very few students thinking about what is happening beneath our feet. Consequently, we are in danger of forgetting about the enormous resources contained in the subsurface and the enormous dependence that the energy transition will have on those resources, particularly in the mineral industry, but also in other forms of subsurface storage, such as hydrogen, compressed air and carbon capture and storage (CCS).

### "The energy transition is going to be different for every country, every region and every place."

Australia has enormous reserves of the minerals critical for the energy transition, but we need to develop smarter, more sustainable mining technologies, using fewer toxic chemicals, with a smaller footprint and integrated with ecological, environmental and community values. Increasingly, we find people want to be involved in the decisions being made around them. Finding ways to provide accessible and relevant information to communities is an enormous challenge for science communicators. There's an awful lot of research to be done around the nexus of all of these interactions.

So, I guess the short answer to your questions is we need everybody.

MP: What is the role of digitalisation in the process of transition to clean energy transition?

AH: Digital is an integral part of the energy transition. Taking an electricity distribution grid from a few large single point sources of electricity (*e.g.*, coal fired power plant, hydro) to distributed point sources (*e.g.*, rooftop solar panels) is technically very complex. Transforming the grid requires new and sophisticated data management systems, algorithms, and data handling to make sure that the electrons continue to flow smoothly.

It's important to remember, that we are not simply replacing the energy we currently use, our energy consumption will continue to grow. For example, our homes currently have up to three sources of energy (electricity, gas, petrol) that we will replace with just one. Managing this transition at a system level down to consumer level will be underpinned by digital technologies and computing power which will come with its own energy demands.

In addition, our world is becoming more and more digital and so much of our day-to-day activities are controlled by algorithms and data flows. So, what does that interface between humans and data look like, how does it evolve, and where will we still need the human ability to make judgments on instinct?

MP: What kind of specialists do we need to ensure a successful hydrogen economy in Australia?

AH: Similar to the previous discussion, hydrogen has been around for a very long time, but not in the volumes we are currently proposing. The knowledge required to generate, store, transport, utilise and monitor hydrogen at scale and as an energy carrier is new territory. For example, in the utilisation space, hydrogen generated from water can be combined with carbon dioxide captured from the atmosphere to create new, low emissions alternatives to many things we use every day, including aviation fuel and plastics. However, we can't yet do this efficiently, making it expensive to produce these alternatives. So, we need the expertise and innovative thinking to scale these technologies, to generate sufficient knowledge, and the confidence for rapid global deployment and climate mitigation.

MP: How do you think Australia can help other countries?

AH: I think we need to make sure that the conversation is around energy and on Australia's role as a global citizen. The transition that we need to make is around energy in all its forms as electrons, as molecules, maybe even wireless. The challenge is to create energy and energy flows that are sustainable and affordable for everybody. The energy transition is going to be different for every country, every region and every place. Every country is on its own decarbonisation and energy transition journey. Some will be able to transition quickly, others will take much longer, depending on their economic development, geopolitical circumstances, environmental and social pressures. What we do know is that for all of us, it will take enormous amounts of investment and capital, across the board, in new infrastructure, new technologies, new resources, new regulations and new skills and expertise.

In Australia we have significant opportunities because, unlike many of our nearest neighbours and our major trading partners, we have access to land and space, we have access to sunshine and water (including saline aquifers) and therefore the ability to generate vast amounts of renewable energy. We also have the right sort of geology to be able to inject and permanently store many, many gigatonnes of carbon dioxide in offshore, subsurface reservoirs, more capacity than any other country in our region.

Although we are investing in alternative energy carriers (ammonia, undersea cables, hydrogen), it is likely that our neighbours and trading partners will need to continue to import energy for several decades to come and may therefore have an ongoing carbon dioxide emission

GROUNDWATER

problem. We also know, even if we stop emitting carbon dioxide tomorrow, there is still too much carbon dioxide in the atmosphere, which we will need to capture and permanently remove from the system.

"In Australia we have access to land and space, we have access to sunshine and water (including saline aquifers) and therefore the ability to generate vast amounts of renewable energy."

It's possible to imagine a scenario where direct air capture facilities are developed in combination with geological sites for permanent carbon dioxide storage, with the system powered by cheap renewable energy and supported by new industries

**Transient** 

Mapping

**Electromagnetic** 

to maintain and regulate these activities. In this scenario, there is potential for Australia to become a global leader in climate mitigation, by providing solutions for our emissions and those of our region, while supporting our transition away from being a net exporter of emissions.

In a world competing for resources, in a changing climate with supply chain pressures and political uncertainty, how do we prepare for which of the many possible future scenarios we will find ourselves in? How do we set up our universities to fill the technology and knowledge gaps, and to support communities, industries, and politicians to make informed and timely decisions that benefit us all?

MP: Thank you for sharing your insights with *Preview*'s readers.

**AgTEM Wallaby** 



Slingram & null-coupled receiver loops.



At cluttered sites, dense coverage separately resolves, hydro-geology otherwise masked by metal artefacts. Target focused surveys are aquired in hours

Dr David Allen, Dubbo, Australia David@GroundwaterImaging.com +61(0)418 964097

### Environmental geophysics



Mike Hatch Associate Editor for Environmental geophysics michael.hatch@adelaide.edu.au

### AEM 2023

Welcome readers to this issue's column on geophysics applied to the environment. For this issue, I am reporting to you on my recent attendance at the 8<sup>th</sup> International Airborne Electromagnetics Conference: officially AEM 2023. It was hard slog, but I got through it somehow. It was held from the 3<sup>rd</sup> through the 7<sup>th</sup> of September ... off the coast of Cairns on Fitzroy Island. Now let's not get too far ahead of ourselves here, a) it was hard work and b) it was actually the perfect place for a dedicated workshop. The ~95 attendees ate breakfast, lunch and dinner (along with a few rounds of beverages) cheek-by-jowl for four full days, with no place else to get away from AEM but up the local mountain for a view from the lighthouse, or off to Nudey Beach (not so nude): about a 3 km hike from AEM central (i.e., the local resort hotel – Figure 1). There were 49 talks and 11 posters, all presented in a single stream from about 9:00 to 16:00 or 16:30 each day. Attendance to all sessions was really good - right to the end - and even the morning after the conference dinner (truth - I wouldn't lie to you). Figure 2 shows the international affiliation of the attendees interestingly, Aussies sit at under 50% of attendees, so a really good international mix of attendees. Hard work, but somebody had to do it.

Slightly more seriously, this was a fantastic collaboration effort between the ASEG and CSIRO to put together this conference. And is just the sort of show that reminded me of ASEG conferences of old - more on that later.



Figure 1. AEM central on Fitzroy Island, off the Queensland coast near Cairns.

One of the most interesting streams was on First Nations issues, which was kicked off by an excellent presentation by Bradley Moggridge from CSIRO in Canberra. Bradley is a well-known hydrogeologist working mostly in the freshwater lake space. His talk really emphasised the (ethical, if not always strictly legal) need to make First Nations Peoples part of the design and implementation of geophysical surveys. Maiwenn Herpe from the GNS in New Zealand (roughly the equivalent of the CSIRO here in Australia) presented the effort that the GNS has made along these lines, - most impressive, but they have been working on this issue (mostly successfully?) for more than a century. Paul Bedrosian presented on what has been happening in the USA. And Yusen Ley Cooper presented on what Geoscience Australia (specifically the AusEM programme, *i.e.*, the AEM survey that will eventually cover the entire country) has done in this space. They (GA) have some fantastic "cartoon" resources available for anyone to download (https://www.eftf.ga.gov. au/how-airborne-electromagneticaem-surveys-work and https://www. youtube.com/playlist?list=PL0jP\_ahe-BFkwzINgRTR-sWDg5ZMDAtu8). I hadn't appreciated it but they do these in multiple (western and Aboriginal languages) and cover much of the geological/geophysical exploration space with them.

On to the winners of the Best Paper and Best Poster. There were so many good presentations and posters, but one presentation was the obvious winner -SkyTEM for showing their first efforts in the drone AEM space – it's like the big Shiraz at a wine tasting – nobody gets past this one. Figure 3 is a shot of the prototype drone that is being developed for their programme by ACC Innovation from Sweden. Bigger than any civilian drone I've ever seen, it is petrol powered, and will eventually have a two- to threehour range, flying 6 to 8 m off the deck. If you ask me, it's got potential to be the ultimate in near-surface EM geophysics. Yes, there will be issues getting that big a drone to fly legally in many jurisdictions, but we can always hope (and write support letters to the appropriate ministers when the time comes).



**Figure 2.** The International mix of the ~95 international attendees at AEM 2023.





**Figure 3.** That's not a drone, THIS is a drone! The UAV that will be carrying the new SkyTEM drone mounted AEM antenna. Photo courtesy of SkyTEM.



**Figure 4.** Co-author Evgeny Karshakov (Andrey Volkovitsky was the lead author), showing off the winning poster at AEM 2023. They are both from the of Institute of Control Sciences, based in Moscow.

The winner of Best Poster was Andrey Volkovitsky and Evgeny Karshak (Figure 4), and their efforts to improve the signal stability using adaptive filtering in AEM data sets. System stability is affected by a number of factors including system temperature and drift, etc. These are usually corrected by taking the system to higher altitude and calibrating the system – the method described in the poster is an effort to reduce the frequency of calibrations. This technique involves adding EM information at the receiver at frequencies that are "invisible" to the data frequencies (we are working in the frequency domain here). By taking advantage of the stability of the added signal, it is possible to use this information to digitally filter the received signal, and thereby stabilise the signal of interest. By the way, it was interesting to see a good turnout from various Russian institutes. They are doing some really good science, so good to see them attend.

So now we come to the crux of the problem for me and a number of the participants that I spoke to (over a beer or two) at AEM 2023. We agreed that this event had everything that we liked about the ASEG conference of old. Lots of interesting geophysics, a reasonable (<<∞) number of attendees, great venue, serious international attendance, lots of opportunities to get together over drinks and dinner to talk about the day, and so on. I have heard from many that they feel that at our last few big conferences the geophysics is getting lost in the noise. And by the way, reports are that, even given the remote location, this event will be able to contribute surplus funds to the ASEG. A more focused geophysical conference with something like five times the delegates, about five times the geophysical content, with a limited number of streams, etc., just sounds more fun, and can be set up, using the surplus of experience still kicking around in the ASEG. And maybe, the conference could even be held in exotic locations like Adelaide, Melbourne and Sydney (at least every now and then).

By the way, I'm hearing rumours that something like what I am hoping for is already happening. I for one will support this.



### Minerals geophysics



Terry Harvey Associate Editor for Minerals geophysics terry.v.harvey@glencore.com.au

### Safety first: A personal view

Safety should be the prime consideration in any activity in our industry. Some of the things we do (for example airborne surveys and ground electrical surveys) have inherent dangers with potentially fatal consequences should things go wrong. Attitudes to safety have evolved dramatically in mineral exploration over the past twenty years. But are we going about safety in the most appropriate way? How can we ensure involvement and compliance? Could we be doing things better?

In my early days in mineral exploration, safety was considered a personal matter. We were aware of some of the risks and the consequences involved, but it was mainly left to our 'common sense' (defined in the Oxford dictionary as "the ability to think about things in a practical way and make sensible decisions") to keep each of us from harm. The prevailing attitude was somewhat more considered than the fatalistic 'she'll be right', but 'production foremost' did dominate the conduct of most surveys. Risk-taking to achieve this, while not actively encouraged, was certainly not discouraged.

With the advent of formal safety systems, all this changed. Safe behaviours were prescribed. The responsibility for safety nominally remained with the individual, but the system was what had to be followed. However, with such a strong emphasis on the system, there was a real danger of an attitude developing that the system itself would look after you, relieving you of much of the responsibility. In some early safety systems, 'common sense' was downplayed or even demonised, further exacerbating the lack of appreciation for the role of personal responsibility. We've moved on. Safety systems now emphasise that there must be a personal responsibility for safety. Safe behaviour is mandated, and this is reinforced by focussing on the consequences to a person from un-safe behaviours.

As systems developed, so too did the paperwork. Safety systems became more bureaucratic, with not entirely unexpected consequences. Most of us have seen the 'tick and flick' approach to, say, daily vehicle pre-start checklists where repeated use of a checklist leads to people just ticking all the boxes without doing the actual checks. They would then justify this by arguing that the procedures were too involved for daily checking, i.e., 'overkill', and thus seen as onerous and unwarranted. Safety systems stress compliance with procedures, but this doesn't necessarily address the perception that some procedures are inappropriate.

As a further example, consider the development and application of risk assessments and procedures.

### One size fits all

Is a comprehensive risk assessment or procedure designed to cover every possible eventuality in every possible situation the best approach? Do we run the risk of swamping people by addressing all manner of hazards, many of which are clearly not appropriate to their particular circumstances? A comprehensive risk assessment requires an exhaustive listing of every possible hazard and the procedures to mitigate them. Once developed, their application is guite convenient - the same risk assessment can be applied every time. But the participants actually doing the assessment, the very ones that the risk assessment is designed to protect, then have to wade through a plethora of possible hazardous situations, many of which are clearly inappropriate. There is a real risk of fatigue, particularly if this process has to be repeated frequently.

Presenters can struggle to keep the presentation pertinent, and participants just switch off.

### The tailored approach

Are personnel more likely to follow through with risk assessments or procedures where they are clearly tailored to their situation? A tailored assessment would have to be individually and carefully developed for each situation, requiring sustained effort from the developers. Arguably, the participants will be more appreciative and involved, with less chance of fatigue. However, the danger in the tailored approach is that the fatigue is transferred to the developers and there is the chance of omission of a pertinent hazard. Rather than developing a tailored risk assessment or procedure from scratch every time, each could be based, at least as a starting point, on a selective version of a much more comprehensive generic version. Input from potential users should be sought, both for relevance to the situation and to foster a sense of involvement.

I have wondered whether imposition of a system by management, particularly if participants have little or no input into the design phase, exacerbates issues of non-involvement. There may also be a lack of confidence in the efficacy of a system if it is seen as something imposed by outside 'experts' who have little or no experience with local conditions. This is particularly relevant where sections of the system are clearly not appropriate to conditions at the workplace. The last thing we want is resentment, which will hamper adoption and usage. To encourage participation and relevance, some safety system developers go out of their way to seek opinions and ideas from potential users.

The dual aims of any safety system, including procedures and risk assessments, should be fit-for-purpose and participant involvement. A safety system will only be effective if it covers all the relevant eventualities, and is one that participants actually believe in, use and abide by. Human behaviour must come into consideration. The end purpose is to keep people safe, but we must keep them involved to achieve this.

### Seismic window



Michael Micenko Associate Editor for Petroleum *mick@freogeos.com.au* 

### Reducing risk with seismic stratigraphy

In this issue I am returning to a prospect on Western Australia's NW Shelf which was described in *Preview* Issue 220, October 2022. The prospect is assigned a high risk because it is a stratigraphic trap, which is more complex to describe and riskier than structural traps.

Risk assessment is usually based on four or five risk elements - source, seal, charge, reservoir and trap. To be successful a prospect needs to have all these elements in place. In this case the source, charge and seal are confirmed by surrounding wells and the trapping mechanism works in nearby discoveries where it is fairly well understood. So, the remaining risk is the presence and quality of reservoir rocks. And here's the crunch - the nearest well intersected poor quality reservoir rocks, and this has adversely affected the perceived prospect risk. However, the prospect has excellent 3D seismic coverage that can be used to reduce the reservoir risk by applying some simple seismic stratigraphy principles to create an environment of deposition (EOD) map (Figure 1). The EOD map shows a number of fan lobes prograding to the north-west with Well A located on the fringe of the northernmost lobe. The prospect is situated in a location that is more proximal than Well A (4-5 km to the north).

The seismic line in Figure 2 shows the reservoir section thins to the north-west largely due to erosion at the unconformity surface, but there is a component of thinning to the west with



**Figure 1.** Environment of deposition map showing a number of overlapping lobes prograding to the NW. Well A is located on the distal fringe of a lobe which is more likely to be shale prone than the prospect area.



**Figure 2.** Seismic dip line (A-A') across prospect (in the ellipse). The reservoir section thins to the NW towards Well A. Green arrows indicate the top reservoir unconformity. The box outlines the approximate area shown in Figures 3 and 4.



**Figure 3.** Seismic dip line flattened on horizon below the base of the reservoir. Flattening the section enhances the internal stratigraphic features of the reservoir. Down lap shown by yellow arrows.





**Figure 4.** Sketch of interpretation of the flattened seismic of Figure 3. Well A is in a more distal location than the prospect which is interpreted to be more sandy and hence less risky compared to Well A.

beds progressively downlapping on to the base reservoir surface.

As they prograde the reservoir units have a characteristic sigmoidal shape and downlap to the north-west. By picking the downlap on a selection of seismic lines across the area of interest the limits of each lobe can be defined. The task is not as easy as it appears with correlation across faults difficult but not insurmountable. The seismic line (Figure 2) shows the nearest well (Well A) is located on the distal fringe of one of many interpreted lobes. A useful tool to aid in the mapping is flattening on an appropriate surface (Figure 3) to improve continuity of internal reservoir reflections across faults.

The resulting interpretation places the prospect in a much better location in the centre of a lobe, which is likely to be much more sandy than the fringe location tested by Well A. The prospect risk is significantly improved by upgrading the reservoir risk to reflect the more favourable environment.

Finally, a sketch of the interpretation (Figure 4) can be used to make the results manager-friendly and support the reduced reservoir risk factor.

# **Drone Magnetics**

- >> Ultra high resolution
- >> Detect more geological structure
- >> Higher quality for clear interpretation
- >> Safe operations

www.airgeox.com ⊕ Adam.Kroll@airgeox.com @ +61 417 029 001 ℃



### Data trends



Tim Keeping Associate Editor for geophysical data management and analysis technical-standards@aseg.org.au

### Australian elevation cheat sheet

Recently the ASEG's Technical Standards Committee discussed calculating gravity with GPS heights (ellipsoid) instead of AHD (ellipsoid – geoid), which led to the question - what are the various height datums we would need to convert? Ideally all surveys would come with original GPS heights, but when they do not, do we have the lineage to backcalculate?

GPS values from ground gravity, airborne radar and laser altimeter, NASA shuttle radar (SRTM) and LiDAR can pass through transformations before we see them. Measurements can be tied to increasingly obscure survey markers, a mix of six global navigation systems, and base stations that may have been further constrained by AUSPOS. Since the Herculean effort to produce AHD 1971, the height datums have been updated more frequently, with the new Australian Vertical Working Surface (AVWS) incorporating refinements from airborne gravity. The ICSM website link below shows how diverse the Australian coordinates landscape has become https://icsm. gov.au/australian-datums-and-howmove-between-them (Figure 1).

Let's start with ellipsoids and geoids and their symbiotic relationship. Ellipsoids are the smooth, squashed spheroidal shapes that allow us to calculate an XY position. Geoids are a similar volume and shape, but with the surface moved up or down to represent where gravity would be equivalent to that at mean sea level. Heights reported in survey data can be relative to either,



**Figure 1.** ICSM diagram of the prominent spatial systems in use in Australia. Source: https://www.ga.gov. au/scientific-topics/positioning-navigation/australian-geospatial-reference-system

but an ellipsoid height would not need to be derived before converting to other geoids. Geoids change in response to factors such as earthquake displacements and seasonal shifts in water loading.

Luckily for datum calculations, the GRS80 ellipsoid is commonly used (Table 1). Geoids have evolved quickly with computing power and satellites, and now integrate points from the International Terrestrial Reference Frame (ITRF/ATRF). The ITRF, which is maintained by the International Earth Rotation and Reference Systems Service (https://www.iers.org) is itself frequently updated. The latest geoid in Australia is the Australian Gravimetric QuasiGeoid (AGQG) which claims to increase accuracy again by up 1 m.

Elevation products can be confusing due to similar names.

- DSM (Digital Surface Model) measured from above and can include top of canopy
- DEM (Digital Elevation Model) are grids referenced to a datum and are meant to be ground instead of canopy
- DTM (Digital Terrain Model) is usually a DEM but can also mean a vector dataset with extra points between the DEM points
- GPS is WGS84 with EGM96 but devices can output relative to local geoids

**Table 1.** Short list of geodetic datums, their ellipsoids with names of geoids and height datums relevant to Australian surveying. List is in chronological order according to year in the suffix.

Datum	Ellipsoid	Geoid	Vertical datum
AGD66	Local spheroid		
			AHD71
	GRS80		
AGD84	Local spheroid		
WGS84	GRS80	EGM84	
GDA94	GRS80		
		EGM96	
		AUSGeoid98	AHD
		AUSGeoid09	AHD
ATRF2014			
		AGQG2019	
GDA2020	GRS80	AUSGeoid2020	AUSGeoid2020 or AVWS



### **Table 2.** List of some elevation products, their geodetic datum and geoid.

Product	Datum	Elevations
GPS	WGS84	EGM96
Shuttle Radar	WGS84	WGS84 ellipsoid fit to EGM96 Geoid
GLONASS	PZ 90 (WGS84 with a north pole tweak)	
AUSPOS	WGS84 with ITRF2014	AHD AUSGeoid2020
Australian Vertical Working Surface	GDA2020	AGQG

 SRTM from NASA is a DSM in WGS84 and heights relative to EGM96 https:// www.usgs.gov/centers/eros/science/

usgs-eros-archive-digital-elevationshuttle-radar-topography-missionsrtm-1. GA's version is mostly a DEM after removing natural canopy and horizontal positions tweaked by ATRF.

• LiDAR (Light Detection and Ranging) produces a DSM referenced to a datum.

This summary raises questions about how precise we can be with historical data and how well would knowing the age, origin and settings of a GPS help inform heights. A more practical question already raised is can we see examples of the various calculated heights that a single position has had over the last 40 years? That would be a great exercise, and if you know of any such data, please contact the Committee at technicalstandards@aseg.org.au.

### Henderson Byte: Earthquake prediction and controversy

For decades, early warning signs of impending earthquakes better than a shaking sensation under your feet have not been reliable. Some such signs have involved unusual electromagnetic effects in the upper atmosphere, changes in the geochemistry of groundwater, and even changes in animal behaviour (horses agitated, snakes exiting the ground, etc.). These signs are difficult to explain scientifically, and events with a physical basis are preferred.

A reliable early warning system based on the use of seismic signals is *ShakeAlert*. It is operated by the USGS and was developed initially on the USA West Coast, a particularly high-risk area associated with the San Andreas Fault. It identifies early seismic P-wave events and issues alerts before more serious events occur. Using microseismometers alone, 1675 units are needed to be effective just for the West Coast. The addition of GPS data in conjunction with the seismic data may be about to begin.

A universal precursor of quakes independent of region is needed, ideally defining the location and time of the onset, and preferably with enough warning to enable evacuation of humans to safety. It should be applicable to individual quakes.

A recent paper in *Science* (Bletery and Nocquet 2023) claims to have found a reliable precursor, better than seismographs, using precise GPS to detect movement on faults. By analysing the changes in the horizontal position of 3026 geodetic stations measured using GPS near 90 different earthquakes, they found that, on average, movement of plate slip accelerated exponentially in the last two hours before the ground ruptures. The odds that this increase is merely a coincidence was found to be negligible. However, detection of this precursor by this global analysis of 90 quakes is not yet able to be used for individual quakes. That would require GPS sensors that are 100 times more precise than those in use today and many more GPS stations. This is a demanding requirement as many of the world's earthquake zones are just not instrumented in this way. Nevertheless, the analysis has at least shown that the quakes are predictable in nature.

Bletery and Nocquet's analysis has sparked controversy in the literature among other geophysicists in the field. For example, there is some concern that contamination of the GPS data from small foreshocks has not been successfully removed. There is also the concern about how the 'arbitrary' time scale of two hours was derived, given the diversity of earthquake behaviour.

Thus, until GPS positioning becomes much more precise, the search for a usable precursor for individual earthquakes is still on-going.

### Reference

Bletery, Q. and J-M. Nocquet, 2023. The precursory phase of large earthquakes, *Science*, **381** (6655), 20 July 2023, p.297-301. doi.org/gshpgs.

Roger Henderson rogah@tpg.com.au

### Webwaves



lan James ASEG Webmaster webmaster@aseg.org.au

#### Australian internet

In *Preview* issue 179 (2015), Dave Annetts discussed "How good is your access to the internet?" where, after a recent trip to the field, he despaired at the lack of coverage outside our metropolitan areas and the impact it has on exploration and general life outside of the city. An Editor's note in the article agreed with this, citing the difficulty in compiling *Preview* while living in a coverage dead spot.

Eight years on, how have things changed? The year 2015 placed us squarely within the national broadband network (NBN) rollout, initially proposed in 2007 and subsequently butchered into a hodgepodge of technologies (the multi-technology mix - MTM for short). This included:

- Fibre to the node (FTTN) with up to ~300 m of copper connecting to the property. Anyone marooned on this was promised minimum connection speeds of 25 Mbit/s (slower than the average speeds in Madagascar in August 2023)
- Fibre to the curb (FTTC) with a copper stretch running from the property boundary to the house.
- Fibre to the premises (FTTP) with optical fibre directly into the residence.

While a complaint about the NBN rollout is well warranted, moving to NBN from our appalling ADSL 2+ offered a large upgrade in internet speeds. Our FTTC connection provides a stable 95+ Mbit/s download speed, although it remains frustratingly shaped with asymmetric upload speeds capped at 20 Mbit/s. An



**Figure 1.** February 2023 global internet speeds (from https://www.reddit.com/r/Maps/comments/11sv0lw/global\_median\_fixed\_broadband\_internet\_speeds/).

annoyance when trying to move 10s of GB of geophysical data into the cloud. But the NBN has proven to be incredibly valuable considering the COVID-19 lockdowns and the move to working from home, something that would have been difficult if we were still using ADSL 2+.

Part of the motivation for writing about the current state of the internet in Australia is that I have recently received notification that I am eligible for a fibre upgrade from FTTC to FTTP. This promises faster internet speeds of 250/25 Mbit/s, 250/100 Mbit/s or 1000/50 Mbit/s. Still disappointingly shaped with slower upload speeds, but finally offering globally competitive internet. Speedtest by Ookla (https://www.speedtest.net/global-index) ranks global download speeds and paints a disappointing picture of the current state of Australian fixed broadband, with Australia languishing in 84<sup>th</sup> position with average download speeds of 53.88 Mbit/s. As a further sign of how far behind our international peers we are, even if we were able to access stable 100 Mbit/s download speeds (the highest generally available under current, standard NBN plans) this would only lift Australia to 39th, behind Trinidad and Tobago in 38<sup>th</sup>. Singapore currently tops international download speeds, with an average of 247.44 Mbit/s and the top 10 countries all have speeds above 175 Mbit/s. Other global internet speed comparisons have variable figures but similar trends.

Speedtest by Ookla (https://www. speedtest.net/global-index) also ranks global mobile internet speeds and Australia performs strongly, ranking 14<sup>th</sup> with average download speeds of 91.22 Mbit/s, likely indicating the performance of Australian 5G networks. Despite this, coverage is limited, with mobile reception patchy away from population centres.

With regards to remote fieldwork in Australia, another change since 2015 is the April 2021 Australia-wide rollout of Starlink. SpaceX provides the Starlink internet service through a constellation of thousands of satellites in low earth orbit. For a fixed, low-cost (<\$200 / month) fee, Australians have access to unlimited data transfer while in remote areas, a major boon to remote field crews. Further developments include newer Apple devices offering satellite-based SOS services in locations without mobile coverage. The latest announcement is Optus partnering with SpaceX to provide satellite-based SMS (in late 2024) and later voice and data (in 2025) services Australia-wide, thereby providing a further boost to accessibility and safety for the exploration industry... and even for remote *Preview* editors<sup>1</sup>.

#### References

Annetts, D., 2015. How good is your access to the internet? *Preview*, **179**:45 https://www.speedtest.net/globalindex, accessed 7 September 2023

<sup>1</sup> Editor's note: Starlink has changed my life 😂

Feature

# water while the second of the

### Artificial intelligence versus intelligence lost



Phil Schmidt phil.magneticearth@gmail.com

Like most of the Preview "retiree" readership, I try to keep up with developments in our field and follow various publications to see what everyone is up to. It is with mixed feelings that I write this article because on the one hand there are some very exciting advances coming along (and I'll highlight a few of my personal favourites later in this piece), but on the other hand the education system is failing to produce young professionals to carry these advances through to their next stage. It is even more concerning because the education malaise extends into secondary schooling where STEM (Science, Technology, Engineering and Mathematics) subjects as a whole have lost their following. This trend has been picked up on by Australia's Chief Scientist (see Figure 1) and she is hoping to be able to make a difference all power to her arm.

Boone et al. (2021) record that "the Australian geosciences community was shocked to learn that the globally recognised School of Earth and Planetary Science at Macquarie University in Sydney had been culled as part of the university's efforts to deal with pandemic-related revenue losses" (i.e., the university's income had become dependent on fullfee paying foreign students). While this affected CSIRO North Ryde staff directly in a number of ways, and the ASEG NSW Branch with the loss of President Dr Mark Lackie, Macquarie University was not alone as geoscience departments across Australia have all suffered drastic cuts. How much was due to loss of revenue from overseas students and how much was due to low science enrolments is debatable. They probably both were factors.

University cuts to geology are also being made across the ditch https://www.



**Figure 1.** The teaching 'out of field' (outside teachers' training) and decline in maths and science students in high school according to the Chief Scientist's website https://www.chiefscientist.gov.au/)

odt.co.nz/news/dunedin/campus/unigeology-department-next-line-cuts. I know our industry has always been cyclical (one of the reasons some students, including myself, strayed into

students, including myself, strayed into post-degree education was the Poseidon collapse), but what has transpired over the last few years seems to be a function of factors beyond the industry's control.

I believe that a revival will come in time, it has to. Meanwhile we can only hope exploration will meet the demand for critical minerals by making the most of the incredible advances that have been made over the past decade but are only now being put together in formats that observers, such as myself, can comprehend and appreciate.

One advance that has been brewing for a few decades and is now being nationally recognised is GPlates. Under the guidance and foresight of Professor Dietmar Müller, Sydney University, the EarthByte team (also see Education Matters by Michael Asten, Preview 195, August 2018) has been focussed on "seeing deep into the earth in four dimensions" and "combining geology with complex data analysis using machine learning". GPlates is a plate tectonics computer program that allows hypothetical reconstructions of geological and palaeogeographic features while simultaneously allowing vector, raster and volume data to be visualised.

Recently GPlates was one of the three finalists for the Australian Museum Eureka Prize for Excellence in Research Software (EarthByte Group: Maria Seton Sabin Zahirovic Ben Mather Michael Chin John Cannon #GPlates #pyGPlates #GPlately).

# Last year, the inaugural issue of *Future Mining* https://future-mining.partica.online/future-mining/vol-

1-no-1/flipbook/60/ shows GPlate reconstructions from a billion years ago (Ga) to present-day with porphyry copper deposits overlain. Most known porphyry copper deposits were formed in the last 100 million years along the Tethys and the Americas. However, the reconstructions also highlight some Proterozoic, Palaeozoic and early Mesozoic deposits.

Under the Exploring for the Future programme, using machine learning and big number crunching on the National Computational Infrastructure in Canberra, Geoscience Australia (GA) has released "what is thought to be the world's first national predictive maps of 10 major oxides. The 10 major oxides with their own predictive maps are for Si, Al, Fe, Ca, Mn, Mg, K, Na, Ti and p". These maps contain valuable pre-competitive information for greenfield regions where actual data coverage is poor. The Exploring for the Future programme is a \$225m investment by the Australian Government which

### Artificial intelligence vs intelligence lost

### Feature





Figure 2. A thumbnail map of the Australasia/Tasman area (https://lnkd.in/dC9qcsGC)

commenced in 2016 and finishes next year (Wilford *et al.* 2023).

Another GA project under the Exploring for the Future banner has produced a mineral potential map for highly soughtafter sediment-hosted copper (Cloutier *et al.* 2023). This map includes a data uncertainty layer that improves on the older Ni-Cu-PGE maps. The maps can also be updated as uncertainty changes as more data becomes available and are fed into the input layers.

The sediment-hosted copper mineral potential model maps are freely available for download for users to manipulate and experiment with the uncertainties. Cloutier et al. (2023) describe how they have experimented with three models. The predictive ability of their three models were tested against 31 known sediment-hosted copper deposits and occurrences and readers are encouraged to read for themselves how the models performed, noting that the "high prospectivity in the northeast of South Australia and the Officer Basin was a little unexpected, and elevated prospectivity in the Etheridge region in northeast Queensland was a bit of surprise".

The NSW Geological Survey, Newcastle University and others (Senanayake *et al.* 2023) have used machine learning algorithms to produce Cu-Au and Pb-Zn prospectivity maps over the Cobar Basin. These show good agreement with known mineral deposits and existing mineral prospectivity maps based on the weights-of-evidence (WofE) method. Like GA's oxide predictive maps these are particularly useful for greenfields evaluation.

Another project that has been bubbling away for a decade is a new tectonic interpretation and model of the Earth incorporating many/most of the available geophysical and geological datasets (van Dijk 2023).

Van Dijk has included some "11,000 tectonic elements such as faults and thrusts, transform faults, rift zones, passive margins and oceanic extension ridges and numerous other features have been mapped, and classified following the geological literature. The complete surface of the Earth has been subdivided into 1,180 larger and smaller tectonic terranes, in the domains of continental blocks, oceanic plates and mobile zones. Numerical multiscale statistical fabric analyses on orientation, length and area are presented on the digitised tectonic elements and the classified terranes using the first Digital Twin of the Earth. Graphical representation through maps with different projections and viewpoints, and planetary views, are presented to illustrate the new subdivision. Some important implications for plate tectonic reconstructions are being discussed." Van Dijk (pers. comm.) says that Australian government portals are the best in the world for the availability of data and believes that new MT (AUSLamp) survey data from the Geological Survey of South Australia is a valuable addition to magnetics and

gravity, especially regarding the lower mantle/lithosphere. As new geophysics data sets become available the older layers of data can be updated along with analyses.

Speaking of national databases, in the near future we should also expect cloud computing to adopt AI as a key component. This will potentially have a transformative impact on systems such as MyLogger and the ability to extract the huge amount of information stored in the National Virtual Core Library (NVCL). For instance, see: https:// www.linkedin.com/posts/carstenlaukamp-a1176012\_introducingmylogger-a-new-tool-for-interpretingactivity-7107601687183323136-Y6gL?utm\_source=share&utm\_ medium=member\_iosN

So, where does all this leave us? I'm sure AI will make many tasks easier, analysing large data sets etc., and when Dietmar Müller and Janpieter van Dijk combine forces using machine learning to crossvalidate their approaches who knows what might transpire. Nevertheless, my gut feeling is that without the element of human foresight/miss-step/error truly big breakthroughs will not happen. The situation reminds me of one such event that, in the 1950s, led to the new science of palaeomagnetism. Professor Ron Green (whose sad obituary is in this issue of Preview) introduced me to rock magnetism/palaeomagnetism in 1972, having studied this himself in the 50s for his PhD under Prof Ted Irving at ANU (I was fortunate to undertake my PhD under the supervision of Dr Brian Embleton (a past ASEG President) and Prof. Mike McElhinny at ANU in the 70s).

However, the big event that happened in the early 1950s was the publication by Prof Patrick Blackett (Blackett 1952) of what is universally known (in geophysics) as The Negative Experiment. The discovery of the magnetism of rapidly rotating stars led Blackett to wonder if their rotation and magnetism were intrinsically related. He duly developed a very sensitive laboratory magnetometer to measure any magnetism of a spinning golden orb. None was detected, hence the experiment was negative. However, the sensitive magnetometer could measure the extremely weak magnetic remanence carried by rocks, which led to the field of palaeomagnetism! I do not think AI would have led to that!

Therefore, in the interests of the future of geophysics we should all support

#### Feature

the Chief Scientist, Dr Cathy Foley, in her endeavours to return teaching of STEM in schools to what it was like before the current decline (https://www. chiefscientist.gov.au/STEMeverywhere).

I'll now climb down off my soapbox!

### References

- Blackett, P.M.S., 1952. A negative experiment concerning Magnetism and the Earth's Rotation. *Philosophical Transactions of the Royal Society A*, **245**:309–370, 16 Dec., 1952 https:// doi.org/10.1098/rsta.1952.0024
- Boone, S., M. Quigley, P. Betts, M. Miller, and T. Rawling, 2021.

## Australia's unfolding geoscience malady, *Eos*, **102**, https://doi. org/10.1029/2021EO163702

- Cloutier, J., Ford, A., Huston, D., Doublier, M., Schofield, A., Waltenberg, K., de Caritat, P., Fraser, G., Beyer, E., Bastrakov, E. and Czarnota, K., 2023. National mineral potential assessment for sediment-hosted copper mineral systems in Australia Version 1.0 (Geoscience Australia, Canberra). Precompetitive Review, https:// precompetitive-review.com/couldthere-be-a-julimar-equivalent-inthe-new-mineral-potential-map-forsediment-hosted-copper/ Senanayake, I.P., Kiem, A.S., Hancock, G.R.,
- Metelka, V., Folkes, C.B., Blevin, P.L.,

Budd, A.R., 2023. A Spatial Data-Driven Approach for Mineral Prospectivity Mapping. *Remote Sens.*, **15**, 4074. https://doi.org/10.3390/rs15164074

- Van Dijk, J., 2023. The new global tectonic map – Analyses and implications. *Terra Nova*, 2023, 1-27, https://doi. org/10.1111/ter.12662
- Wilford, J., P. de Caritat and S. Basak, 2023. Predictive grids of major oxide concentrations in surface rock and regolith over the Australian continent (Geoscience Australia, Canberra), Precompetitive Review, https:// precompetitive-review.com/worldfirst-predictive-map-of-major-oxidesgives-greenfield-explorers-an-entirelynew-dataset/

### Free subscription to Preview online

Non-members of the ASEG can now subscribe to *Preview* online via the ASEG website. Subscription is free. Just go to https://www.aseg.org.au/publications/PVCurrent to sign up. You will receive an email alert as soon a new issue of *Preview* becomes available. Stay informed and keep up-to-date by subscribing now!!

NB: ASEG Members don't need to subscribe as they automatically receive an email alert whenever a new issue of Preview is published.



### Preview crossword #28



#### Across

- **4.** An underpaid, overqualified, and dispirited high-school chemistry teacher who becomes a ruthless kingpin in the local methamphetamine drug trade [8,3]
- 7. Who killed Laura Palmer? [4,5]
- 8. A Song of Ice and Fire [4,2,7]
- **10.** Science fiction horror anthology dealing with often disturbing or unusual events [3, 8, 4]
- **11.** The opening sequence is one of the show's most memorable hallmarks [3, 8]
- 13. Mockumentary that depicts the everyday work lives of office employees [3, 6]
- 14. A womanising former relief pitcher for the Boston Red Sox

Down

1. Marginalised, unsolved cases involving paranormal phenomena [3,1,5]

- 2. Central Perk coffee shop
- 3. Fictional hotel in the seaside town of Torquay on the English Riviera [6, 6]
- 5. Column published in The New York Observer [3,3,3,4]

**6.** Satirical mother-daughter relationship and the habits and values of modern suburban Australians [4,3,3]

- 9. "Oh, my God! They killed Kenny!" [5,4]
- 12 A show about nothing

### Play to win!!

Send your answers to *previeweditor@aseg.org.au*. The first correct entry received from an ASEG Member will win two Hoyts E- CINEGIFT passes. The answers will be published in the next edition of *Preview*.

Good luck!

### Preview crossword #27 solution



### **Business directory**



Training, consulting, research & development **RPD Mapping** - *a new service for* large scale magnetic rock property & depth mapping

support@tensor-research.com.au www.tensor-research.com.au

# **CoRMaGeo**

### 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



Australian Society of Exploration Geophysicists

Join our diverse network of geoscientists from over 40 countries, foster your professional network and receive a wide range of member benefits.

### Free access to publications

- · Exploration Geophysics high-quality international technical journal
- Preview Magazine stay up to date with current trends in exploration geophysics

### **Professional & Networking Development opportunities**

- Reduced registration fee to the Australasian Exploration Geoscience Convention
- Short courses
- Technical Events
- Social Events

### Huge range of online content

- Webinars
- Workshops
- Job advertisements

### Students

- Free membership, support through the ASEG Research Foundation
- Travel scholarships and funding support available

### **Exclusive member-only discounted wines**

### Visit ASEG.org.au or email secretary@aseg.org.au for more details







### **AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS**

A.B.N. 71 000 876 040

PO BOX 576, CROWS NEST NSW 1585 AUSTRALIA Phone: +61 2 9431 8691 Fax: +61 2 9431 8677 Email: <u>secretary@aseg.org.au</u> Website: <u>www.aseg.org.au</u>

### Application for Active & Associate Membership 2023

INSTRUCTIONS FOR APPLICANTS

1. Determine the membership level you wish to apply for, according to the eligibility criteria outlined in Section 2.

 Fill out the application form. Note that applicants for Active Membership must nominate a proposer and a seconder who are Active Members of ASEG. Under exceptional circumstances the Federal Executive Committee may waive these requirements. 3. Submit the two pages of your application to the Secretariat at the address shown on the top of this page, retaining a copy for your own records. The Secretariat will generate an invoice for payment that includes payment instructions.
The invoice will be cert electronically as places about your ompile.

The invoice will be sent electronically so please check your email inbox and spam folders.

#### Section 1. Personal Identification

Sur	name		Date of Birth			
Giv	en Names		Title			
Add	dress					
Cou	untry	State	e Post Code			
Org	anisation					
E-m	ail					
E-m	ail (alternate)					
Mobile		Phone (W)	Phone (H)			
Section 2.		Choice of Membership Grade (Active or Associate)				
	<ul> <li>Active Please complete all sections</li> <li>Associate Please complete all sections apart from Section 4 (Nominators)</li> <li>Graduate Please complete Active or Associate application and also check this box</li> <li>Student Please complete the separate Student Membership Application Form</li> </ul>					

Active – an applicant must be actively engaged in practising or teaching geophysics or a related scientific field. Conditions for Active Membership include a relevant academic qualification. Any person who does not have such qualifications, but who has been actively engaged in the relevant fields of interest of the Society for at least five years, shall also be eligible for Active Membership upon the discretion of the Federal Executive Committee.

Associate – an applicant must be actively interested in the objectives of the Society. Associate Members are automatically eligible for election to Active Membership after five years as an Associate Member.

Graduate – Active or Associate membership is subsidized by 50% for no more than two years after completion of studies. Members accepting the graduate grant are expected to contribute to society activities and publications with the goals of raising their profile in the society and showing ASEG's support of young professionals.

Student – an applicant must be a full-time graduate or undergraduate student in good standing, registered at a recognised university or institute and working towards a degree in geophysics or a related field. Eligibility for Student Membership shall terminate at the close of the calendar year in which the Student Member ceases their graduate or undergraduate studies. The duration of a Student Membership is limited to five years.

#### Section 3. Academic and Professional Qualifications

Month/Year (From – To)	Organisation/Institution	Position/Degree (incl. Major)	Professional Record Only: Years of Independent Work

#### Section 4. Nominators of Active Membership applicants must be ACTIVE Members of ASEG

Nominator	Name	Postal or e-mail address	Phone/Fax
Proposer			
Seconder			

www.vh/www.m	www.hv	1. Marina Waana	uunlanaha	4WhowNa	un himilith	hina dalama halata	Hillinhalamin	MINIAMIA				ASEG me	nbership
	1		handel h	lidio dell	anan bibi k		Andre die 15	14.1.1				Applica	tion form
Section 5.		Mem	bership	o of O	ther Soc	ieties							
Australian: Aus IMM International:		Grade			AIG	Grade		GSA	Grade	_ □	PESA	Grade	
AAPG	C	Grade			EAGE	Grade		SEG	Grade		SPE	Grade	-
Others													
Section 6.		ASEG	6 Memb	oer Re	ecord								
Include me in	the A	ASEG M	lember S	Search	on the Se	cure Member Area c	of ASE	G's Web	site (search is only	availab	e to curre	ent ASEG members	who opt-in)
Yes		No											
Please comple	ete th	nis sectio	on for the	e ASE	G member	ship database.							
Employment Industry Educatio	area	:			Contract/ S Consulting	Service Provider		Gove Othe	ernment r		Student		
Type of Busin	ness	:			Ground Wa	ater/ Environmental		Coal Rese	earch/ Education		Survey Data A	/ Geotechnical/ En	gineering

Membership Grades and Rate	es
	Membership Grades and Rate

Solid Earth Geophysics

Active/Associate (Australia) - \$193.00 (incl GST)	Active/Associate 5 Year Membership (Australia) - \$965.00 (incl GST)
Active/Associate (Group IV Countries) - \$175.50	Active/Associate 5 Year Membership (Group IV Countries) - \$877.50
Active/Associate (Group III Countries) - \$52.70	Active/Associate 5 Year Membership (Group III Countries) - \$263.50
Active/Associate (Group I & II Countries) - \$19.30	Active/Associate 5 Year Membership (Group I & II Countries) - \$96.50

Computer/ Data Processing

Other

Associate-Graduate (Australia) - \$97.00 (incl GST)

#### Section 8. Preview & Exploration Geophysics

The ASEG produces a magazine called Preview and a peer-reviewed journal called Exploration Geophysics. Please read and agree to the following in order to receive ASEG publications:

1) I grant permission for the ASEG to provide my email and postal address to the Taylor & Francis Group so that I can receive copies of the ASEG publications. Taylor & Francis will not use the member list for any purpose other than advertising and for distributing Exploration Geophysics and Preview.

2) I understand and agree that online access to Exploration Geophysics is for my private use and the articles shall not be made available to any other person, either as a loan or by sale, nor shall it be used to substitute for an existing or potential library or other subscription.

3) I understand and agree that Exploration Geophysics articles shall not be networked to any other site, nor posted to a library or public website, nor in any way used to substitute for an existing or potential library or other subscription.

4) I understand and agree that any member who is discovered by the publisher to be in breach of these conditions shall have their subscription access immediately terminated, and the publisher shall have the right to pursue recompense at its discretion from that member.

#### 🗋 Yes 🛄 No

Preview is published bi-monthly and is available for open-access at www.aseg.org.au/publications/PVCurrent.

Archaeology/ Marine Salvaging

ASEG members can elect to have hardcopy Preview delivered to their nominated address (offer does not apply to Student members).

I would like to receive hardcopy Preview as part of my ASEG membership.

🗋 Yes 🛄 No

#### Section 9. Promotional Opportunities

The ASEG provides opportunities for special category listings (eg. Consultants, Contractors) from the ASEG Internet Web Page.

I (or my business) am interested in having a link from the ASEG Internet page. Rates will be advised when links are implemented. (Corporate and Corporate Plus Members get a complimentary link.)

□ I (or my business) am interested in advertising in ASEG's publications.

#### Section 10. Declaration

I, \_\_\_\_\_\_ (name), agree for the Australian Society of Exploration Geophysicists to make all necessary enquiries concerning my application and suitability to become a Member. By lodging this Application and upon being accepted in my membership, I agree to be bound by the Constitution of the Australian Society of Exploration Geophysicists, including its ethical and professional standards.

Signature:

Date:\_\_\_\_\_



### ASEG CODE OF ETHICS

Clause 4 of the Articles of Association of the ASEG states that "Membership of any class shall be contingent upon conformance with the established principles of professional ethics":

- A member shall conduct all professional work in a spirit of fidelity towards clients and employees, fairness to employees, colleagues and contractors, and devotion to high ideals of personal integrity and professional responsibility.
- A member shall treat as confidential all knowledge of the business affairs, geophysical or geological information, or technical processes of employers when their interests require secrecy and not disclose such confidential information without the consent of the client or employer.
- A member shall inform a client or employer of any business connections, conflicts or interest, or affiliations, which might influence the member's judgement or impair the disinterested quality of the member's services.
- A member shall accept financial or other compensation for a particular service from one source only, except with the full knowledge and consent of all interested parties.
- 5. A members shall refrain from associating with, or knowingly allow the use of his/her name, by an enterprise of questionable character.
- A member shall advertise only in a manner consistent with the dignity of the profession, refrain from using any improper or questionable methods of soliciting professional work, and decline to accept compensation for work secured by such improper or questionable methods.

- 7. A membership shall refrain from using unfair means to win professional advancement, and avoid injuring unfairly or maliciously, directly or indirectly, another geophysicist's professional reputation, business or chances of employment.
- A member shall give appropriate credit to any associate, subordinate or other person, who has contributed to work for which the member is responsible or whose work is subject to review.
- 9. In any public written or verbal comment, a member shall be careful to indicate whether the statements or assertions made therein represent facts, an opinion or a belief. In all such comments a member shall act only with propriety in criticising the ability, opinion or integrity of another geophysicists, person or organisation.
- 10.A member will endeavour to work continuously towards the improvement of his/her skills in geophysics and related disciplines, and share such knowledge with fellow geophysicists within the limitation of confidentiality.
- 11.A member will cooperate in building the geophysical profession by the exchange of knowledge, information and experience with fellow geophysicists and with students, and also by contributions to the goals of professional and learned societies, schools of applied science, and the technical press.
- 12.A member shall be interested in the welfare and safety of the general public, which may be affected by the work for which the member is responsible, or which my result from decisions or recommendations made by the member, and be ready to apply specialist knowledge, skill and training in the public behalf for the use and benefit of mankind.



AUSTRALIAN SOCIETY OF EXPLORATION GEOPHYSICISTS

A.B.N. 71 000 876 040

PO BOX 576, CROWS NEST NSW 1585 AUSTRALIA Phone: +61 2 9431 8691 Fax: +61 2 9431 8677 Email: <u>secretary@aseg.org.au</u> Website: <u>www.aseg.org.au</u>

### **Application for Student Membership 2023**

INSTRUCTIONS FOR APPLICANTS

 Student Membership is available to anyone who is a full-time student in good standing at a recognised university working towards a degree in geophysics or a related field.

their graduate or undergraduate studies.

Eligibility for Student Membership shall terminate at the close of the calendar year in which the Student Member ceases

Student Membership must be renewed annually. The duration of a Student Membership is limited to five years.

Fill out the application form, ensuring that you provide contact details for your supervisor or coordinator

Submit your application to the Secretariat at the address shown on the top of this page, retaining a copy for your own records.

#### Section 1. Personal Details

Surname		Date of Birth			
Given Names		Mr / Mrs / Miss / Ms / Other (list)			
Address					
Country		State Post Code			
E-mail					
E-mail (non-University alternative)					
Mobile	Phone (W)		Phone (H)		
Section 2. Student Declaration					
Institution					
Department					
Major Subject		Expected Yea	ar for completion of studies		
Supervisor/Lecturer		Supervisor E	mail		

#### Section 3 Membership Grades and Rates

Student (Australia & Group IV Countries)	FREE
Student (Group III Countries)	FREE
Student (Group I & II Countries)	FREE

#### Section 4 Preview & Exploration Geophysics

The ASEG produces a magazine called Preview and a peer-reviewed journal called Exploration Geophysics. Please read and agree to the following in order to receive ASEG publications:

1) I grant permission for the ASEG to provide my email and postal address to the Taylor & Francis Group so that I can receive copies of the ASEG publications. Taylor & Francis will not to use the member list for any purpose other than advertising and distributing Exploration Geophysics and Preview.

2) I understand and agree that online access to Exploration Geophysics is for my private use and the articles shall not be made available to any other person, either as a loan or by sale, nor shall it be used to substitute for an existing or potential library or other subscription.

3) I understand and agree that Exploration Geophysics articles shall not be networked to any other site, nor posted to a library or public website, nor in any way used to substitute for an existing or potential library or other subscription.

4) I understand and agree that any member who is discovered by the publisher to be in breach of these conditions shall have their subscription access immediately terminated, and the publisher shall have the right to pursue recompense at its discretion from that member.

🗋 Yes 🔲 No

#### Section 5 Declaration

I, \_

\_ (name), agree for the Australian Society of Exploration Geophysicists to make

all necessary enquiries concerning my application and suitability to become a Member. By lodging this Application and upon being accepted in my membership, I agree to be bound by the Constitution of the Australian Society of Exploration Geophysicists, including its ethical and professional standards.

### ASEG CODE OF ETHICS

Clause 4 of the Articles of Association of the ASEG states that "Membership of any class shall be contingent upon conformance with the established principles of professional ethics":

- A member shall conduct all professional work in a spirit of fidelity towards clients and employees, fairness to employees, colleagues and contractors, and devotion to high ideals of personal integrity and professional responsibility.
- A member shall treat as confidential all knowledge of the business affairs, geophysical or geological information, or technical processes of employers when their interests require secrecy and not disclose such confidential information without the consent of the client or employer.
- A member shall inform a client or employer of any business connections, conflicts or interest, or affiliations, which might influence the member's judgement or impair the disinterested quality of the member's services.
- A member shall accept financial or other compensation for a particular service from one source only, except with the full knowledge and consent of all interested parties.
- 5. A members shall refrain from associating with, or knowingly allow the use of his/her name, by an enterprise of questionable character.
- A member shall advertise only in a manner consistent with the dignity of the profession, refrain from using any improper or questionable methods of soliciting professional work, and decline to accept compensation for work secured by such improper or questionable methods.

- 7. A membership shall refrain from using unfair means to win professional advancement, and avoid injuring unfairly or maliciously, directly or indirectly, another geophysicist's professional reputation, business or chances of employment.
- 8. A member shall give appropriate credit to any associate, subordinate or other person, who has contributed to work for which the member is responsible or whose work is subject to review.
- 9. In any public written or verbal comment, a member shall be careful to indicate whether the statements or assertions made therein represent facts, an opinion or a belief. In all such comments a member shall act only with propriety in criticising the ability, opinion or integrity of another geophysicists, person or organisation.
- 10.A member will endeavour to work continuously towards the improvement of his/her skills in geophysics and related disciplines, and share such knowledge with fellow geophysicists within the limitation of confidentiality.
- 11.A member will cooperate in building the geophysical profession by the exchange of knowledge, information and experience with fellow geophysicists and with students, and also by contributions to the goals of professional and learned societies, schools of applied science, and the technical press.
- 12. A member shall be interested in the welfare and safety of the general public, which may be affected by the work for which the member is responsible, or which my result from decisions or recommendations made by the member, and be ready to apply specialist knowledge, skill and training in the public behalf for the use and benefit of mankind.

### International calendar of events 2023-25



October	2023		
16–19	18th International Congress of the Brazilian Geophysical Society & Expogef https://sbgf.org.br/congresso/	Rio de Janeiro	Brazil
17–20	Seventh International Conference on Engineering Geophysics (ICEG)	Abu Dhabi	UAE
25–27	Offshore Technology Conference (OTC) https://otcbrasil.org/	Rio de Janiero	Brazil
29 Oct–3 Nov	Mexican Geophysical Union (UGM) Annual Meeting: RAUGM2023 https://www.raugm.org.mx/?lang=en	Puerto Vallarta	Mexico
November	2023		
3–5	14th Biennial International Conference (SPG 2023) https://spgindia.org/spg2023/index.php	Kochi	India
7–8	EAGE/Aqua Foundation Second Indian Near Surface Geophysics Conference & Exhibition https://www.nearsurfacegeophysics.in/	New Delhi	India
15	Modern Applications of Geophysics: Mineral Case Studies (MAG23)	Perth	Australia
December	2023		
1	South Australian Exploration and Mining Conference 2023 https://www.aig.org.au/events/south-australian-exploration-and-mining-conference-2023/	Adelaide	Australia
5–7	Latin America URTeC https://urtec.org/latinamerica/2023/	Buenos Aires	Argentina
February	2024		
27 Feb-01 Mar	Offshore Technology Conference Asia (OTC Asia) https://2024.otcasia.org/	Kuala Lumpur	Malaysia
Мау	2024		
7–8	International Mining Geology 2024 https://www.ausimm.com/conferences-and-events/mining-geology/	Perth	Australia
6–9	Offshore Technology Conference (OTC) https://2024.otcnet.org/	Houston	USA
13–15	6th Asia Pacific Meeting on Near Surface Geoscience and Engineering https://eage.eventsair.com/6th-asia-pacific-meeting-on-near-surface-geoscience-and-engineering/	Tsukuba	Japan
June	2024		
10–14	85 <sup>th</sup> EAGE Annual Conference & Exhibition	Oslo	Norway
August	2024		
18–23	Goldschmidt2024 https://conf.goldschmidt.info/goldschmidt/2024/meetingapp.cgi	Chicago	USA
25–31	International Meeting for Applied Geoscience & Energy (IMAGE) https://www.imageevent.org/	Houston	USA
September	2024		
8–12	EAGE Near Surface Geoscience Conference & Exhibition 2024		
August	2025		
24–29	International Meeting for Applied Geoscience & Energy (IMAGE)	Houston	USA

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

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 proposed contributions should be submitted to the Editor by email at previeweditor@aseg.org.au

For style considerations, please refer to the For Authors section of the *Preview* website at: https:// www.tandfonline.com/toc/texp20/current

*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 month of issue. The deadline for the December issue is Friday 10 November 2023.

For the advertising copy deadline please contact the Publisher on advertising@taylorandfrancis.

# Is it down there?





of helping you find out



SMARTem24

Rugged and reliable PC-based, 16 channel, 24-bit electrical geophysics receiver system with time-series recording, powerful noise rejection, GPS sync and an optional separate Transmitter Controller. Works seamlessly with a wide range of transmitter systems and most sensors for EM and IP. The SMARTem24 application plots decays, profiles, maps and pseudosections providing powerful QC capabilities. Hotswappable batteries, touch-screen, solid-state HDD and water/dust protection make this an instrument for serious electrical geophysics. Compatible with EMIT's Transmitter Multiplexer and other tools for increasing productivity.



### **DigiAtlantis**

3-component digital borehole fluxgate magnetometer system in a 33mm tool for EM and MMR with simultaneous acquisition of all components, time-series recording and powerful noise rejection. Compatible with a wide range of transmitter systems and EMIT's Transmitter Multiplexer for increasing productivity. Samples the whole waveform providing on and off-time data. Magnetometer DC signals are recorded to give 3-component and total-field geomagnetic data. Orientation data gives hole inclination and azimuth in real-time without additional surveys. Designed to be used with industry-standard winches with 2-core and 4-core cable.



### **SMART Fluxgate**

Rugged, low noise, calibrated, 3-component fluxgate magnetometer with recording of geomagnetic fields, digital tilt measurement and auto-nulling.



SMARTx4

Intelligent and safe 3.6 kW transmitter for EM surveys using standard generators. Clean 40A square wave output, inbuilt GPS sync and current waveform recording.

Advanced electrical geophysics instrumentation, software and support



Maxwell

Industry standard software for QC, processing, display, forward modelling and inversion of airborne, ground and borehole TEM, FEM and MMR data. Training workshops available.

> 23 Junction Parade Midland WA 6056 AUSTRALIA >+61 8 9250 8100 info@electromag.com.au

ELECTRO MAGNETIC **IMAGING TECHNOLOGY**