

Vale Don Gray (1931–2014)



Don Gray, the founder of the Australian Landsat Station, passed away on Tuesday 4 November 2014. Don Gray is a significant figure as it was through his vision and leadership that the Australian Government invested in the Australian Landsat Station in 1979. In subsequent years this facility grew and was renamed the Australian Centre for Remote Sensing, widely known as ACRES, before becoming part of Geoscience Australia through the amalgamation of AUSLIG and AGSO in 2001.

Don Gray's contribution and achievements have left Australia with a

tremendous legacy; a ground station in Alice Springs that is still operational and acquiring Landsat 7 & 8 imagery today (operated by OSS), and over 35 years of Landsat observations (under NEMO's stewardship). This archive has provided an incredible Australian continental baseline dataset that spans through space and time and has become the foundation of the Australian Geoscience Data Cube.

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Vale Trevor Jones (1949–2014)



Trevor Jones passed away on Tuesday 5 November. Trevor had a distinguished career first as a seismologist, then as a seismic hazard specialist, a multi-hazard

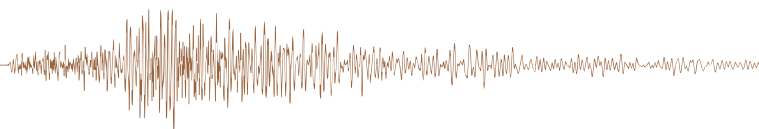
risk analyst and finally as a technical advisor to government.

Trevor played a central role in breathing life to the establishment of Geoscience Australia's geohazard capability. Trevor's passion for work was contagious and the future state he imagined created excitement among his peers. Trevor was a true mentor to his staff and a champion for bringing science to policy making across government. Trevor's leadership resulted in milestones such as the National Risk Assessment Guidelines, the now 'Risk Assessment, Measurement and Mitigation Sub-Committee' and the 'National Situational Awareness Tool' which recently received AGD's highest honour, winning the Secretary's Award.

Trevor helped improved methods for earthquake hazard assessment in urban areas by assessing techniques for determining shallow sediment structure particularly in Perth. Trevor contributed to the science and practice of geophysics resulting in wide recognition within the geophysics community.

Trevor's legacy and his vision continue to inspire many across government. He is remembered in particular for his warmth, enthusiasm and resilience in an at times challenging bureaucratic environment. He will be deeply missed.

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King Coal sends mixed messages

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With coal as a keystone in the Abbott government's energy mix we are getting mixed messages on how the carbon emissions are going to be reduced.

On 4 November the Prime Minister was quoted as saying: 'For now and for the foreseeable future, the foundation of Australia's energy needs will be coal. The foundation of the world's energy needs will be coal.'

At the same time the planet's atmospheric carbon dioxide concentration continues to rise and exceeded 400 ppm between May and July 2014. This level is the highest it has been in the last 800 000 years. It is a third higher than it was at the turn of the 19th and 20th centuries and is still increasing at approximately 2 ppm/year.

Consequently, if we are to continue to burn coal there should be ways of reducing its impact on CO₂ levels in the atmosphere. The carbon capture and storage method has been actively developed in Australia. The plan is to capture the CO₂ at the coal fired power station and store the gas underground, hopefully in liquid form. A CO₂ Co-operative Research Centre was

established in 2004 to find suitable storage sites in Australia and develop appropriate technologies. Unfortunately, rather than encourage this research the government, in the May Budget, cut \$459 million over 3 years, leaving \$192 million to continue existing projects for the next 7 years. One might have thought that this research would have been top priority but the slash and burn appears to continue without any prioritisation.

Instead the government is investing in DICE. According to an ABC transcript from 20 July 2014, DICE – or Direct Injection Carbon Engine – is based on a modified diesel engine running on a mix of coal and water. It has just received \$9 million in funding for stage one trials, including \$1 million from the Victorian and Commonwealth governments. According to John White, chairman of the DICE Network and co-founder of Ignite, Ministers Hunt and Macfarlane 'are very interested in DICE, because it offers the opportunity of reducing CO₂ emissions for electricity from brown coal by 50 per cent, and it offers the opportunity to reduce CO₂ emissions from black coals by around 30 per cent'. At present, however, DICE technology exists only as a prototype single-cylinder diesel 16 kw, 3.9-litre engine in a lab at the

CSIRO in Newcastle. It's clear that the technology, which the government hopes will be rolling out in 3–5 years, is a long way from commercial viability. How this technology reduces greenhouse gases significantly is not yet clear, but I guess the proponents will be hoping for a share of the Direct Action funds to advance the technology.

In the meantime the government and the Labor party have not been able to come to an agreement over the Renewable Energy Target, and at the time of writing the solar and wind power generators are projecting a huge loss of investment and jobs as a result of the uncertainty. Ironically, it turns out that in the ACT, which has the lowest electricity prices in the country, 64 per cent of the ACT's electricity consumption was met with accredited 'GreenPower' through ActewAGL purchasing 383 734 kWh in 2012–13 against the supplied total consumption of 595 227 kWh (ACTEW AGL Annual Report).

So for me, I would go for wind, solar and nuclear – coal would only be in the mix if carbon capture and storage can be applied. We must reduce the pollution from coal fired power stations if our planet is to provide an acceptable climate for humans. But that's just my view.

Growth in coal-fired power generation on the cards

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Prime Minister Abbott's comment on coal being the foundation of world energy needs has been underscored by the recent US–China CO₂ emissions agreement, whereby China's total emissions will continue to increase until 2030, with 80% of its energy being supplied by fossil fuels. The comments are further supported by proposals by two Indian companies to build major coal mines in the Galilee Basin, Qld. As Indian Prime Minister Narendra Modi said recently, Australia is 'a major partner' in his new government's drive to educate Indian youth, put a roof over the heads of the nation's poor and connect electricity to every household. I suggest that China and India are not sending mixed messages;

rather, the messages are unequivocal, and Mr Abbott is stating the obvious. It is not in Australia's interests, nor is it our right, to suggest these countries should do otherwise.

It follows that CO₂ levels in the atmosphere are going to increase, probably on the IPCC's RCP8.5 'business as usual' scenario regardless of what action we in Australia may take (that does not necessarily imply that the consequences of such emissions will follow the RCP8.5 projections of global temperature and sea-level increase; observational evidence is increasingly at variance with climate model predictions, but that can be a debate for another day). Should we now redouble efforts in carbon capture and storage technology? I doubt it, since the pipeline distribution and injection technology on any effective

scale would demand infrastructure at least equal to pipeline infrastructure for all our existing oil and gas distribution, and arguably the requirement would be several-fold larger given the tonnages of coal being oxidised to CO₂.

I don't regard wind and solar energies as scaleable to a large fraction of our total energy demands (the Chinese target is 20% by 2030) since every unit of solar and wind capacity must be matched by a duplicate investment in fossil fuel technology to ensure continuity in energy supplies. Whether limitation of development of solar and wind technology genuinely represents a 'huge loss in investment and jobs' I leave the economists to argue, but given the large subsidies of public money required for such projects to be viable, I question the assumptions. We slashed subsidies for the

textile clothing and footwear industries decades ago, and we are ending subsidies to our car-manufacturing industries, for reasons both major political parties endorse. Our economy is stronger if we lose inefficient industry and generate new industry capable of competing in a real world. The disastrous lesson of Spanish investment in renewable energies since 2000 is that for every 'green' job created by subsidies, 2.2 jobs are lost in other industries (higher energy prices and redirection of capital put other industries out of business).

None of this argument is intended to suggest we ignore increasing CO₂ emissions, which probably have played a part, along with natural cycles, in warming the Earth since the Little Ice Age. Natural cycles have been little studied in climate science and until they are better understood we will not be successful in modelling effects of the rising CO₂ emissions that will surely accompany the development of China, India and other non-western nations.

I am, however, in furious agreement with David Denham's call for nuclear power. A fission reactor on Spencer's gulf would provide a triple synergy. It would provide energy to SA and in particular the major mining developments to the north, it would power a desalination plant pumping water into the dry hinterland to up agricultural output (our Chinese friends want to eat as well as build houses and factories), and it would provide a boost in employment and technology in a state that is seeking to reinvent itself after closure of last-century's car and ship-building construction sites. And by the way, while we think about our first nuclear power station, China has 22 nuclear power stations in operation, and a further 26 under construction.

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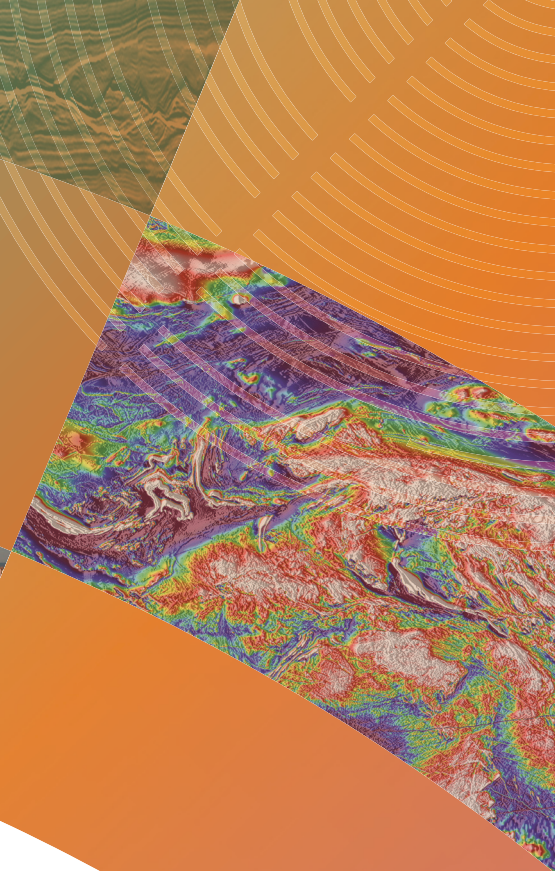
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Update from the Ground Geophysical Survey Safety Association Ltd (GGSSA)

Members of the Ground Geophysical Survey Safety Association (GGSSA) are invited to attend the inaugural AGM and Technical Meeting, which will be held in conjunction with the ASEG Conference in Perth on Friday 13 February 2015.

GGSSA was formed in 2011 with the purpose of promoting safe and effective ground geophysical survey practices and to serve as a centre for exchange of safety information. The formation of the Association was in response to NSW Government concerns about electrical ground surveys and compliance with the Australian Standards AS/NZ3000 and AS3007. Specifically, the concerns centred on electrical protection, isolation and insulation.

The goal of the association is NOT to be a regulatory body, but rather an association that facilitates the design and practice of safe procedures for ground geophysical surveys. Membership of GGSSA opened following the 2013 ASEG conference in Melbourne. Since that time the association has attracted 35 members (14 active and 21 associate) from Australia and overseas. Active members are defined as any commercial or industrial enterprise engaged in ground geophysical surveys. Associate members are any enterprise including education faculties, government departments, manufacturers, consultants or exploration companies with an interest in the objectives of GGSSA. GGSSA values the support of the following five sponsors: Rio Tinto, MMG, Huby Minerals, Fortescue Metals Group and AngloGold Ashanti.

GGSSA has developed industry guidelines for electrical geophysical surveys, which require active members to:

- Implement safe operating procedures compliant with the requirements documented in the guidelines
- Implement equipment maintenance schedules and maintain records of service history
- Implement appropriate training programs and assessment for personnel working on electrical geophysical surveys

- Ensure transmitters are fitted with safety features outlined in the guidelines
- Conduct regular compliance audits (both internal and external).

In the future, the focus of GGSSA will, in part, be directed by members. As an example, the association has released a *Working with Lightning Guidance Note* in response to one member request. The GGSSA Technical Committee, made up of representatives from the various members, is currently working on further guidance notes for members, covering fatigue management, manual handling and vehicles and driving.

The direction of GGSSA will also be driven by data. Active members are requested to submit monthly safety statistics on a quarterly basis to an independent group contracted by GGSSA. It is expected that over time meaningful trends will emerge. The member information will be analysed with the highest levels of discretion so as to determine where hazards are actually

occurring and to understand the incident types that may occur, without breaching confidentiality. For example, when are incidents more likely to occur; during mobilisation and demobilisation or while surveying, during winter or summer operations?

The benefit to members will be two-fold. Firstly, the results will allow them to compare their risk pattern with that of all members. Secondly, GGSSA will be able to direct its Technical Committee to areas within the guidelines that require modification and also prioritise the release of guidance notes to mitigate the risks identified.

Details regarding the inaugural AGM and Technical Meeting (agenda, time and location) will be available early next year. For further information about GGSSA, including a full list of benefits to members, or to log your interest in attending the AGM in Perth, please visit our website www.ggssa.org or email exco@ggssa.org.



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New areas released for petroleum exploration and greenhouse gas storage

In October 2014, the National Offshore Petroleum Titles Administrator invited bids for 18 offshore areas for petroleum

exploration and three areas for greenhouse gas storage. Most areas are situated off shore Western Australia.

Table 1. Four areas available for cash-bidding on 5 February 2015

Area	Basin	Sub-basin	Figure number
W14-20	Northern Carnarvon	Rankin Platform	1
W14-21	Northern Carnarvon	Barrow	2
W14-22	Northern Carnarvon	Exmouth Plateau	3
W14-23	Browse	Caswell	4

Table 2. Fourteen areas available for cash-bidding on 2 April 2015

Area	Basin	Sub-basin	Figure number
AC14-1	Bonaparte	Vulcan	5
W14-1	Bonaparte	Petrel	6
W14-6	Northern Carnarvon	Rankin Platform	1
W14-8, W14-9, W14-10, W14-11, W14-12, W14-13, W14-17, W14-18 and W14-22	Northern Carnarvon	Exmouth Plateau	3
W14-19	Bight	Eyre	7
Re-release areas			
W14-3 and W14-4	Browse	Caswell	4

Table 1 shows the four areas available for cash bidding at the auction on 5 February 2015. Table 2 shows the areas available for bidding by 2 April 2015. Bidding for the three greenhouse gas storage areas, all in the Gippsland basin, closed on 27 November 2014. Detailed information about the location of all areas can be obtained at <http://www.petroleum-acreage.gov.au/>.

The price of Brent Crude dropped sharply from around \$110 to \$80/bbl in the period June–November 2014. This price change is unlikely to encourage more exploration so it will be interesting to see how many bids are made for the areas that have just been released.

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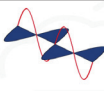


Season's Greetings



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Update on Geophysical Survey Progress from the Geological Surveys of Western Australia, South Australia, Northern Territory, Queensland, New South Wales, Victoria and WA Department of Water (information current on 17 November 2014)

Tables 1–3 show the continuing acquisition by the States and the Northern Territory of new airborne magnetic, radiometric, gravity and AEM

data over the Australian continent. All surveys are being managed by Geoscience Australia (GA). Further information is available from Murray

Richardson at GA via email at murray.richardson@ga.gov.au or telephone on (02) 6249 9229.

Table 1. Airborne magnetic and radiometric surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Spacing AGL Dir	Area (km ²)	End flying	Final data to GA	Locality diagram (Preview)	GADDS release
Coompana	GSSA	GA	TBA	Not before 31 Jan 2015	249 600	400 m 80 m E-W	The proposed survey (Figure 1) may cover all or part of Noorina, Wyola, Cook, Coompana, Nullarbor, Ooldea, Maurice, Wells and Birksgate standard 1 : 250 000 standard map sheets The Quotation Request closed on 19 Nov 2014 and responses are being assessed by GA and GSSA				
Dunmarra	NTGS	GA	GPX Surveys	28 Jun 2014	103 985	400 m 80 m N-S	36 280	100% complete at 10 Oct 2014	Raw data were supplied to GA on 24 Oct 2014 Final processed data were received for assessment in Nov 2014	PV 170 – Jun 2014 p. 24	TBA

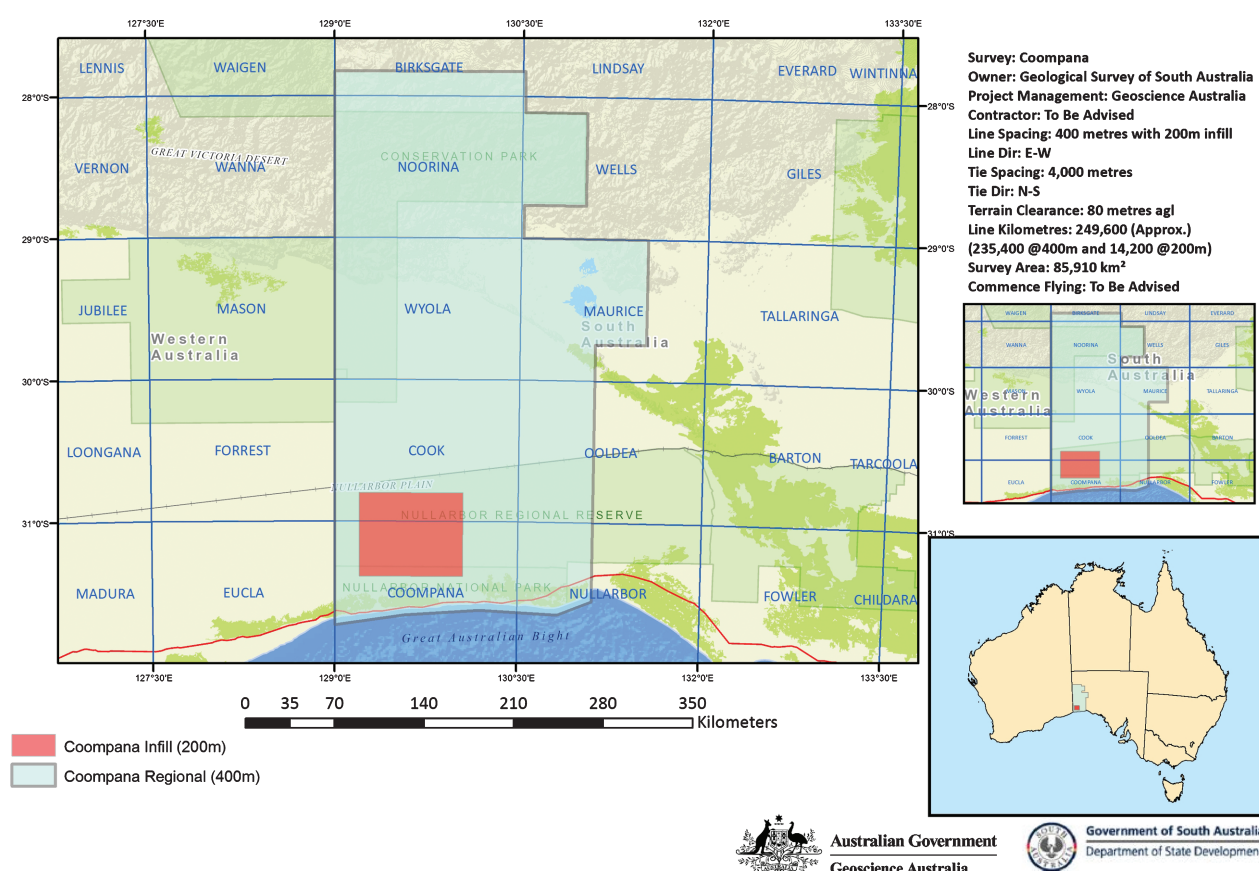


Figure 1. PACE 2020 – Coompana SA Airborne Magnetic and Radiometric Survey 2014–2015.

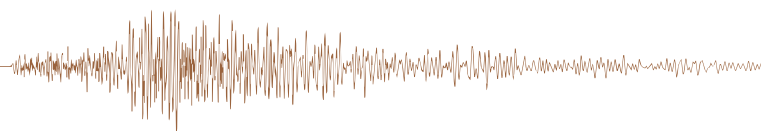


Table 2. Gravity surveys

Survey name	Client	Project management	Contractor	Start survey	No. of stations	Station spacing (km)	Area (km ²)	End survey	Final data to GA	Locality diagram (Preview)	GADDS release
Sir Samuel – Throssel	GSWA	GA	IMT	19 Jun 2014	11 702	2.5 km regular grid	73 800	100% complete at 7 Sep 2014	Final data expected to be released via GADDS before the end of 2014	PV 171 – Aug 2014 p. 39	TBA
West Amadeus	NTGS	GA	Atlas	29 Jun 2014	8127	4 km regular with areas of 0.5, 1 and 2 km infill	45 050	100% complete at 11 Aug 2014	Final data expected to be released via GADDS before the end of 2014	PV 171 – Aug 2014 p. 39	TBA
Southern Thomson	GA/ GSNSW/ GSQ	GA	Atlas	17 Jul 2014	3660	8 traverses at 333 m station spacing	TBA	100% complete at 17 Sep 2014	Final data expected to be released via GADDS before the end of 2014	PV 170 – Jun 2014 p. 24	TBA
Gippsland	GSV	GA	Atlas	30 Jun 2014	1440	12 traverses at 500 m station spacing	8358	100% complete to 21 Jul 2014	Final data expected to be released via GADDS before the end of 2014	PV 170 – Jun 2014 p. 25	TBA
North McArthur Basin	NT	GA	Atlas	16 Sep 2014	7175	4 km regular grid with areas of 2 km infill; 1 area of traverses spaced 4 km apart with a station spacing of 1 km	71 030	100% complete at 4 Nov 2014	Preliminary final data were supplied to GA at the end of Nov 2014	PV 171 – Aug 2014 p. 39	The survey covers all or part of Arnhem Bay, Gove, Mt Evelyn, Mt Marumba, Blue Mud Bay, Katherine, Urupunga and Roper River standard 1 : 250 000 standard map sheets

Table 3. AEM surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Spacing AGL Dir	Area (km ²)	End flying	Final data to GA	Locality diagram (Preview)	GADDS release
Swan/Scott Coastal Plain and Albany/ Esperance	WA Dept of Water	GA	CGG Aviation (Australia)	25 Mar 2013	8607	300/ 600 m	TBA	100% complete to 15 May 2014	Final data to GA 20 Jan 2014	PV 163 – Apr 2013 p. 17	The data were released by GA on 3 Oct 2014 via http://www.ga.gov.au/search/index.html#/
Southern Thomson Orogen	GA/ GSNSW/ GSQ	GA	Geotech Airborne Ltd	8 Apr 2014	4198 (3327 in survey and 871 in traverses)	5 km E–W	16 270	100% complete at 5 May 2014	Additional work (traverses) over the Paroo and Darling Rivers to examine the potential for new groundwater resources was completed on 5 Jun 2014	PV 168 – Feb 2014 p. 24	The final point-located data were accepted by GA in Nov 2014

TBA, to be advised.

2014 roundup of geophysical activity at the Geological Survey of South Australia

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2014 has been a busy year for the geophysicists in the Geological Survey of South Australia (GSSA). Some of the major projects are briefly described here.

- A gravity survey was undertaken in the Musgrave Ranges, on the Alcurra, Agnes Creek and Tieyon 1 : 100 000 mapsheets. This semi-regional survey filled in some of the holes in the coverage in that area of the state, and brought to light some new gravity anomalies. Details of this gravity survey can be found in RB2014/018 (Government of South Australia publication).
- Radiometric streaming is a technique used to level airborne radiometric surveys. With the completion of the Marree magnetics and radiometrics survey, the GSSA geophysicists have undertaken radiometric streaming in the Marree and Warinna area to provide optimum leveled data.
- A new report compiling all the Australian Fundamental Gravity Network sites in South Australia has been written, containing the latest observations at all sites in South Australia. 70 Australian Fundamental Gravity Network sites in South Australia remain usable, and 75 have been destroyed. More details can be found in RB2014/013 (Government of South Australia publication).
- The geophysicists are currently working on a geophysical database, containing information on all mineral geophysical surveys undertaken in South Australia. While the database is still in early stages, once complete it will greatly reduce the time taken in locating individual surveys, simplify customer requests, and provide the team with a

stable environment to store the data. Petrophysical data are also being stored in a database and can be accessed directly through SARIG. The data can be found by following links to drillhole information.

- For its next major regional survey, the GSSA is planning to re-fly much of the aeromagnetics and radiometrics in the far west of the state, including the Coompana anomaly. Look out for this data next year!
- Recent changes to the South Australia Mining Act include the introduction of a sunset clause for geoscientific data. The latest releases of geophysical data are announced bimonthly in the MESA journal, and are made available online at that time.
- Recently, Stephan Thiel has joined the team bringing in expertise in the magnetotelluric method. Stephan previously worked at the University of Adelaide and is still working on the Australia Wide MT survey.
- Our vacation student programme commences shortly, and we look forward to working with a student geophysicist to help with data delivery.
- Finally, we've undertaken detailed ground magnetic and gravity surveys investigating palaeochannels and magnetic remanent anomalies north of Yunta in SA. We'll be presenting the results at the ASEG conference in Perth 2015, and we look forward to seeing you there!



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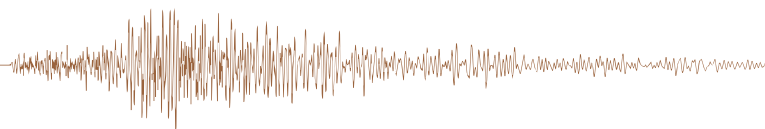
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Updated 40 m magnetic compilation map for Western Australia

In September 2014 the Geological Survey of Western Australia (GSWA) released an updated 40 m resolution magnetic anomaly grid for onshore Western Australia. The new grid is a compilation of more than 1100 individual survey grids made from aeromagnetic datasets registered in GSWA's MAGIX database and the national Geophysical Archive Data Delivery System (GADDS) hosted by Geoscience Australia.

In 2009, as part of the state government's five-year Exploration Incentive Scheme, GSWA embarked on an accelerated program of airborne magnetic and radiometric surveys to acquire data at a line spacing of between 200 m and 400 m over the approximately 30% of the area

of Western Australia that still had only 'first-generation' coverage with a survey line spacing of 1600 m.

By 2013, with the support of Geoscience Australia, this phase of the project was completed with the acquisition of almost 3.5 million line kilometres of new magnetic and gamma-ray spectrometric data. Western Australia was able to boast of complete 'second-generation' coverage of the state with publicly available data with a line spacing of 500 m or better. An updated state composition TMI grid was released with a cell size of about 80 m – optimal for the representation of data at a line spacing of 300 m – 400 m.

In 2013 and 2014, GSWA commenced a new program of more detailed surveys with a line-spacing of 100 m over selected areas of the state. The first area to be surveyed at this resolution was in the Goldfields, increasing quite substantially the area of Western Australia that is covered by regional data at a line spacing of 300 m or less.

However, Western Australia's very active mineral exploration sector means that GSWA also holds data from many detailed surveys submitted by exploration companies in accordance with the requirements of the WA Mining Act. Data submitted under these conditions are released to the public after a specified period of confidentiality. Currently the

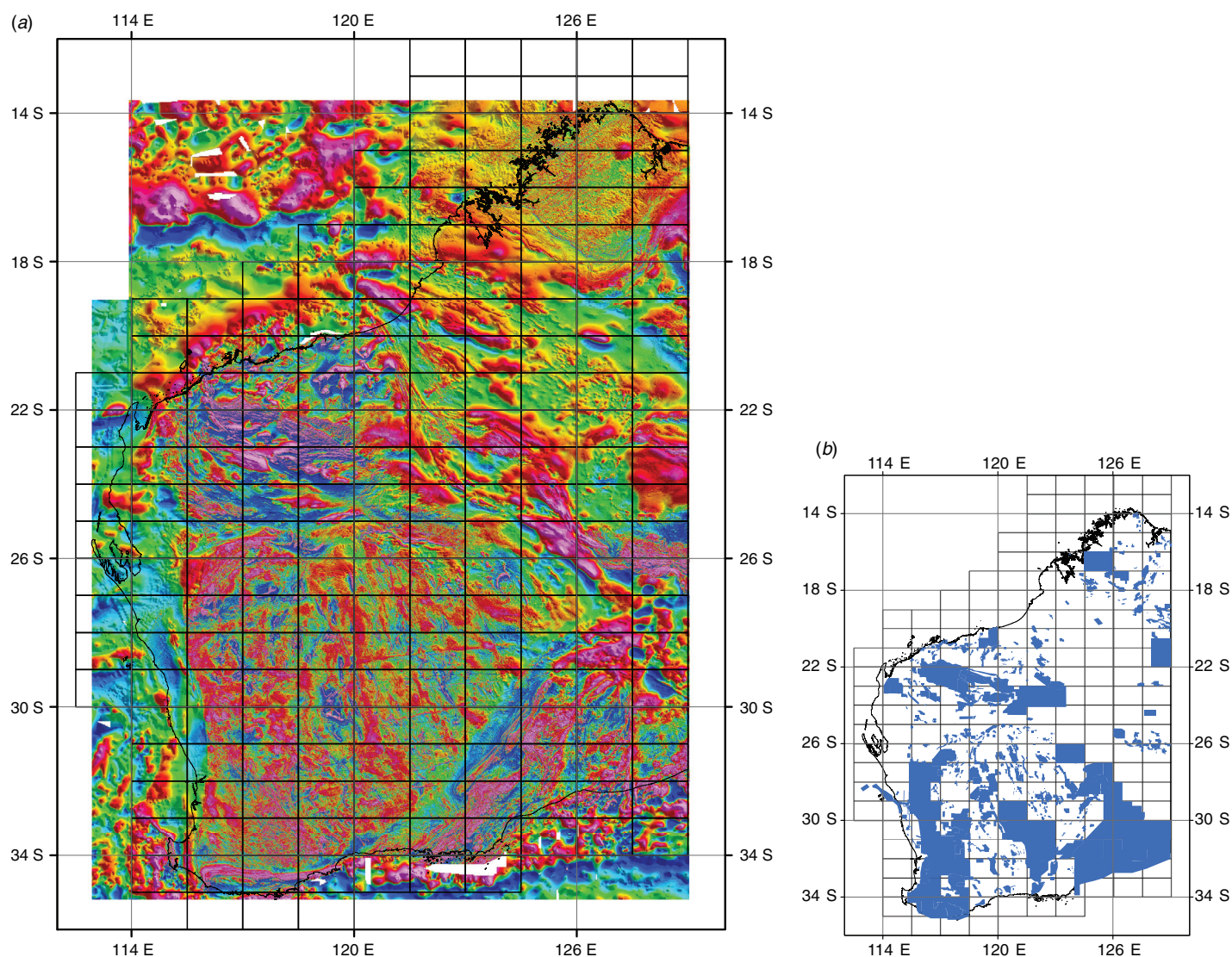


Figure 1. (a) Image of 40 m compilation TMI grid of Western Australia. (b) Publicly available aeromagnetic survey coverage of Western Australia with line spacing of 300 m or less.

MAGIX database holds approximately 11 million line-km of company datasets, many of which are available for inclusion in the state compilation.

With the combination of non-confidential higher-resolution company and regional datasets, a significant area of Western Australia, particularly in the south-western half of the state, is now covered by aeromagnetic data at a line spacing of 300 m or less.

To adequately represent these data densities, a grid of resolution higher than 80 m is required. A grid cell size of 40 m represents an adequate compromise between data resolution and manageable file size.

In 2013, GSWA produced the first state compilation with a cell size of 0.000416 degrees, approximately 40 m. The magnetic grid of Australia V5 2010 (Milligan *et al.*, 2010) with a cell size of 0.000833 degrees was used as the base reference for the new compilation. This is the same reference that was used for the earlier 80 m state compilations.

The latest release of the 40 m grid in September is a new compilation that includes the recently completed Goldfields 100 m surveys as well as all available company data to date. The merged grid was created using Intrepid Geophysics' GridMerge program installed on the iVEC supercomputer Fornax (iVEC is an unincorporated joint venture between CSIRO, Curtin University, Edith Cowan University, Murdoch University and The University of Western Australia and is supported by the Western Australian and Federal Governments).

Compared to the 80 m grid compilation, the 40 m grid contains improved detail in areas of survey line spacing of 300 m or less – shown in the shaded areas in Figure 1b. In other areas there will be no difference in frequency content from that of the 80 m grid; however, image pixelation will be less apparent at larger viewing scales.

The latest 40 m grid in ER Mapper format is available for download from the GSWA website <http://www.dmp.wa.gov.au/16942.aspx>, as is a geo-

referenced image in JP2 format. Images for individual 1 : 250 000 map sheets based on the same dataset can also be downloaded.

The iVEC supercomputing facilities are now being used by GSWA for all the state grid compilations, resulting in faster turnaround as well as the potential to make higher resolution grids. GSWA shortly expects to release a state 20 m compilation grid to display detail in areas of surveys with lines spaced at 100 m or less. A 20 m grid compilation has already been released for the area of the Goldfields 100 m surveys.

References

Milligan, P. R., Franklin, R., Minty, B. R. S., Richardson, L. M. and Percival, P. J., 2010, *Magnetic Anomaly Grid of Australia (Fifth Edition)*: Geoscience Australia, Canberra.

For more information and advice contact John Brett, Department of Mines and Petroleum, Government of Western Australia (john.brett@dmp.wa.gov.au).



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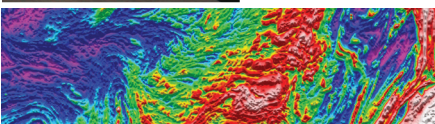
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