10.1071/PVv2018n196newsp15

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 on 3 October 2018)

Further information on these surveys is available from Dr Yvette Poudjom Djomani at GA via email at Yvette.PoudjomDjomani@ga.gov.au or telephone on (02) 6249 9224.

Table 1. Airborne magnetic and radiometric 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
Tasmanian Tiers	MRT	GA	TBA	TBA	Up to an estimated 66 000	200 m 60 m N–S or E–W	11 000	TBA	TBA	TBA	The National Collaborative Framework Agreement between GA and MRT is being updated
Tallaringa N (1A)	GSSA	GA	Thomson Aviation	26 Oct 2017	97 922	200 m 60 m E–W	17 320	26 Mar 2018	TBA	190: Oct 2017 p. 26	TBA
Tallaringa S (1B)	GSSA	GA	Thomson Aviation	26 Sep 2017	145 367	200 m 60 m E–W	26 010	12 May 2018	TBA	190: Oct 2017 p. 26	TBA
Coober Pedy (8A)	GSSA	GA	Thomson Aviation	18 Sep 2017	90 425	200 m 60 m N–S	16 140	21 Dec 2017	TBA	190: Oct 2017 p. 26	TBA
Billa Kalina (8B)	GSSA	GA	MAGSPEC Airborne Surveys	10 Oct 2017	90 353	200 m 60 m N–S	16 140	18 Dec 2017	27 Jul 2018	190: Oct 2017 p. 26	TBA
Childara (9A)	GSSA	GA	MAGSPEC Airborne Surveys	5 Nov 2017	134 801	200 m 60 m N–S	23 910	2 May 2018	TBA	190: Oct 2017 p. 26	TBA
Lake Eyre (10)	GSSA	GA	MAGSPEC Airborne Surveys	2 Oct 2017	91 938	200 m 60 m E–W	16 180	22 Mar 2018	TBA	190: Oct 2017 p. 26	TBA
Streaky Bay (5)	GSSA	GA	GPX Airborne Surveys	21 Jun 2018	90 630	200 m 60 m E–W	15 966	28 Sep 2018	TBA	194: Jun 2018 p. 19	TBA
Gairdner (6A)	GSSA	GA	GPX Airborne Surveys	31 Jul 2018	105 075	200 m 60 m N–S	18 307	TBA	TBA	194: Jun 2018 p. 19	21% complete at 1 Oct 2018
Spencer (7)	GSSA	GA	MAGSPEC Airborne Surveys	11 Jun 2018	50 280	200 m 60 m E–W	8716	6 Aug 2018	TBA	194: Jun 2018 p. 19	TBA
Kingoonya (9B)	GSSA	GA	MAGSPEC Airborne Surveys	5 Aug 2018	150 565	200 m 60 m N–S	26 651	TBA	TBA	194: Jun 2018 p. 19	42.7% complete at 30 Sep 2018
Cloncurry North	GSQ	GSQ	GPX Surveys	Mid-May 2018	101 597	100 m	8687	8 May 2018	8 May 2018	This issue (GSQ section – Figure 1). For more information about this survey please contact geophysics@dnrme.qld.gov.au	31 May 2018
Tanami	NTGS	GA	Thomson Aviation	14 Jul 2018	275 216	100/ 200 m 60 m N–S/E–W	48 267	TBA	TBA	195: Aug 2018 p. 16	63% complete at 2 Oct 2018

TBA, to be advised.

Table 2. Gravity surveys

Survey name	Client	Project management	Contractor	Start survey	No. of stations	Station spacing (km)	Area (km²)	End survey	Final data to GA	Locality diagram (*Preview*)	GADDS release
Kidson Sub-basin	GSWA	GA	CGG Aviation (Australia)	14 Jul 2017	72 933	2500 m line spacing	155 000	3 May 2018	TBA	The survey area covers the Anketell, Joanna Spring, Dummer, Paterson Range, Sahara, Percival, Helena, Rudall, Tabletop, Ural, Wilson, Runton, Morris and Ryan 1:250 k standard map sheet areas	TBA
Lawn Hill	GSQ	GA	Atlas Geophysics	21 May 2018	7240	1000 m line spacing	8024	8 Jul 2018	9 Aug 2018	194: Jun 2018 p. 19	13 Sep 2018
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 line spacing	129 400	W Block: 3 Jun 2018 E Block: 2 Sep 2018	TBA	195: Aug 2018 p. 17	TBA
Kimberley Basin	GSWA	GA	Sander Geophysics	4 Jun 2018	61 960	2500 m line spacing	153 400	15 Jul 2018	TBA	195: Aug 2018 p. 17	TBA
Warburton-Great Victoria Desert	GSWA	GA	Sander Geophysics	Warb: 14 Jul 2018 GVD: 27 Jul 2018	62 500	2500 m line spacing	153 300	Warb: 31 Jul 2018 GVD: 3 Oct 2018	TBA	195: Aug 2018 p. 17	GVD: 100% complete on 3 Oct 2018

TBA, to be advised.

Table 3. AEM surveys

Survey name	Client	Project management	Contractor	Start flying	Line km	Spacing AGL Dir	Area (km²)	End flying	Final data to GA	Locality diagram (*Preview*)	GADDS release
East Kimberley	GA	GA	SkyTEM Australia	26 May 2017	13 723	Variable	N/A	24 Aug 2017	Nov 2017	TBA	TBA
AusAEM (Year 1)	GA	GA	CGG	TBA	59 349	20 km with areas of infill	TBA	31 Jul 2018	2 Oct 2018	186: Feb 2017 p. 18	TBA
Surat-Galilee Basins QLD	GA	GA	SkyTEM Australia	2 Jul 2017	4627	Variable	Traverses	23 Jul 2017	Nov 2017	188: Jun 2017 p. 21	TBA
Stuart Corridor, NT	GA	GA	SkyTEM Australia	6 Jul 2017	9832	Variable	Traverses	12 Aug 2017	Nov 2017	188: Jun 2017 p. 22	TBA
Olympic Domain	GSSA	GA	SkyTEM Australia	14 Nov 2017	3181	1.5 & 3 km E–W	33 200	21 Nov 2017	Preliminary final data received by GA 16 Mar 2018	190: Oct 2017 p. 27	Data released via the GA website on 30 Jul 2018
Fowler Domain	GSSA	GA	SkyTEM Australia	Early Dec 2017	3057	5 km NW–SE	15 000	5 Dec 2017	Preliminary final data received by GA 16 Mar 2018	190: Oct 2017 p. 27	Data released via the GA website on 30 Jul 2018

TBA, to be advised.

Table 4. Magnetotelluric (MT) surveys

Location	State	Survey name	Total number of MT stations deployed	Spacing	Technique	Comments
Northern Australia	Qld/NT	Exploring for the Future – AusLAMP	232 stations deployed in 2017–18	50 km	Long period MT	The survey covers the area between Tennant Creek and Mount Isa. The 2018 field season commenced in May 2018.
AusLAMP NSW	NSW	AusLAMP NSW	5034 stations deployed in 2018 to date	50 km	Long period MT	Covering the state of NSW with long period MT stations at approximately 50 km spacing.
Olympic Domain	SA	Olympic Domain	320 total	Varied 1.5 to 10 km	AMT and BBMT	The survey area extends west of Lake Torrens and covers mineral prospects such as Carrapateena, Fremantle Doctor, Red Lake, Punt Hill, Emmie Bluff and Mount Gunson. The survey was completed to Jul 2018.

Table 5 Seismic reflection surveys

Location	State	Survey name	Line km	Geophone interval	VP/SP interval	Record length	Technique	Comments
South East Lachlan	Vic/ NSW	SE Lachlan	Approx. 450	10 m	40 m	20 seconds	2D – Deep crustal seismic reflection	The survey covers the South East Lachlan Orogen crossing the Victorian–New South Wales border. The data acquisition phase of the survey commenced on 5 Mar 2018 near Benalla in Victoria. The survey completed data acquisition south of Eden in NSW on 29 Apr 2018.
Kidson	WA	Kidson Sub-basin	Approx. 900	TBA	TBA	TBA	2D – Deep crustal seismic reflection	Within the Kidson Sub-basin of the Canning Basin extending across the Paterson Orogen and onto the eastern margin of the Pilbara Craton. The survey completed acquisition on 8 Aug 2018.

Editor's note: Murray Richardson, who was a regular and very reliable contributor to *Preview* on behalf of Geoscience Australia, has retired. The *Preview* team will miss him and wish him all the best for the future.

Geological Survey of Victoria: updates on the Stavely Project and the Victorian Gas Program

Stavely Project: A new geological understanding

A new geological understanding for the Cambrian Stavely Arc in western Victoria has been developed as part of the Stavely Project, a pre-competitive collaborative geoscience work program undertaken by the Geological Survey of Victoria (GSV) and Geoscience Australia. The knowledge generated through a systems approach has greatly expanded the mineral exploration search space for arc-related mineral systems in an area of approximately 20 000 km^2. Historical and current mineral prospects for copper and associated metals are known to be associated with Cambrian volcanic belts exposed at surface; however, the majority of the arc, concealed by sedimentary and volcanic rocks, remains untested.

The geoscientific outcomes of the project, with emphasis on their impact on mineral prospectivity and application to mineral exploration, have been summarised in a series of reports published by Geoscience Australia and the Geological Survey of Victoria. The findings were publicly presented at a technical workshop held over two days in Melbourne and at GSV's Werribee Core Library on 27 and 28 June 2018. The workshop was very well attended (Figure 1) with over 150 participants showing great interest in the new regional 3D model demonstration and the examples of the stratigraphic drilling undertaken as part of the project and the mineralised core kindly provided by current explorers for the day – presentations are available online. There was also renewed interest in the Geophysical Signatures of Base Metals in Victoria volume (Willocks et al., 1999), jointly published by GSV and ASEG in 1999!

http://earthresources.vic.gov.au/earth-resources/geology-of-victoria/gsv-projects/the-stavely-project

To download reports, go to the Earth Resources online store at http://earthresources.vic.gov.au/earth-resources/maps-reports-and-data.

Figure 1. *Stavely Project Technical Workshop participants at GSV's Werribee Core Library.*

Victorian Gas Program: Otway Basin Airborne Gravity Survey

The Otway Basin Airborne Gravity Survey covers approximately 16 000 km^2 of southwestern Victoria from the edge of the Otway Ranges to the Victorian/South Australian border. It includes Victorian coastal waters offshore (Figure 2).

CGG Aviation (Australia) Pty Ltd is flying Full Spectrum Falcon® and magnetics at 500 m line spacing and 150 m minimum clearance with the line direction approximately parallel to the coast. Production flights began in August and GSV expects data acquisition to be completed by November 2018. Located data and grids will be publicly released as soon as processing/QC of the survey data is complete.

The new airborne gravity and gravity-gradient data will provide a significant improvement in gravity coverage compared with the existing ground gravity stations on unevenly-spaced detailed lines and at 1.5 km regional spacing onshore and the sparse ship-track gravity offshore.

The Otway Basin Airborne Gravity Survey is a substantial part of the scientific research being carried out as part of the Victorian Gas Program. The results of the survey will support the 2018 Victorian Offshore Acreage Release and help inform GSV's geoscience studies into the potential for further discoveries of onshore conventional gas in the Otway Basin.

http://earthresources.vic.gov.au/earth-resources/victorian-gas-program/airborne-gravity-survey

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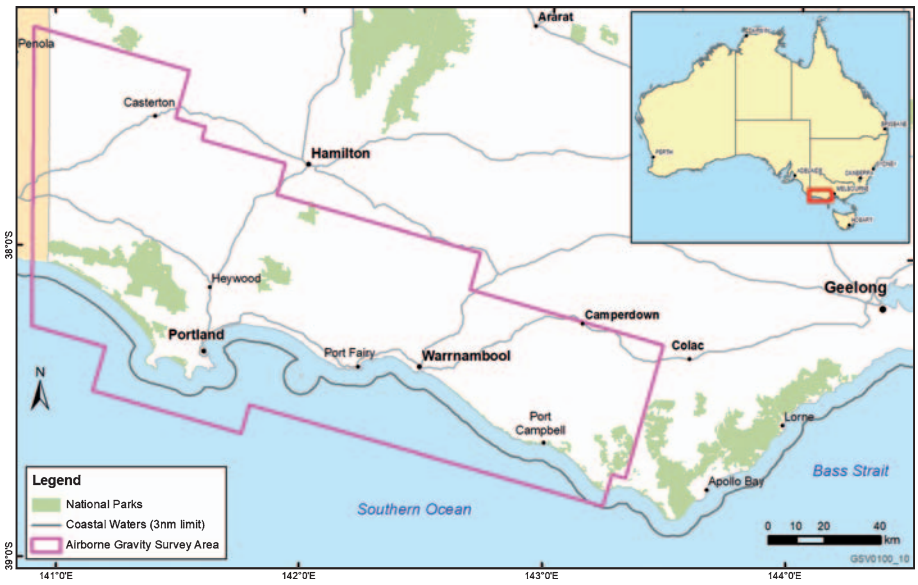

Figure 2. *Otway Basin Airborne Gravity Survey area.*

Reference

Willocks, A. J., Haydon, S. J., Asten, M. W., and Moore, D. H., 1999, Geophysical signatures of base metal deposits in Victoria. Geological Survey of Victoria Report 119 and Australian Society of Exploration Geophysicists Special Publication 11.

Geological Survey of South Australia: New data and upcoming events

First release of enhanced geological structure and depth to magnetic sources from the Gawler Craton Airborne Survey

The Geological Survey of South Australia, in collaboration with CSIRO, have released the first of sixteen data packages that are the result of an ongoing study to enhance the expression of geological structure in geophysical images and derive depth to magnetic sources, at regional scales. The 2017–18 Gawler Craton airborne geophysical survey (GCAS) provides a higher resolution and more consistent mapping of the magnetic field than is available from the previous multi-survey coverage. The advantages of the new survey data are clear on examination of the total magnetic intensity (TMI) data, but it is after enhancement of that TMI data to assist recovery of detailed geological information that the advantages are most clearly expressed.

The result of this study is a collection of images and data products, incorporating studies of the gravity field and magnetic source depths, released to facilitate geological interpretation (Figure 1, Table 1, and Figure 2).

In the source depth study a 'sweet-spot' analysis was used for source depths, which attempts to optimise the precision of individual depth estimates by selecting only the data most appropriate for source depth estimation, and then applying intensive, multi-pass inversions to simultaneously optimise all source parameter estimates from each data selection individually. For Region 2A (Figure 1), 322 source depth solutions were computed. Source depths were compared with known basement drillhole intercepts and a subset of the source depth estimates was used to interpolate basement surfaces (Figure 3).

On 4 December, The Geological Survey of South Australia are holding a GCAS workshop at the Tonsley Drill Core Facility, Adelaide as part of Discovery Week. The workshop will feature presentations from GSSA and CSIRO on the GCAS, all of the available data, case studies and enhancements. You can register your interest by contacting the GCAS Project Leader Laz Katona at Laz.Katona@sa.gov.au.

All available data for the Gawler Craton Airborne Survey, including the data package for GCAS 2A, can be found on the GCAS community information website: http://energymining.sa.gov.au/minerals/gcas.

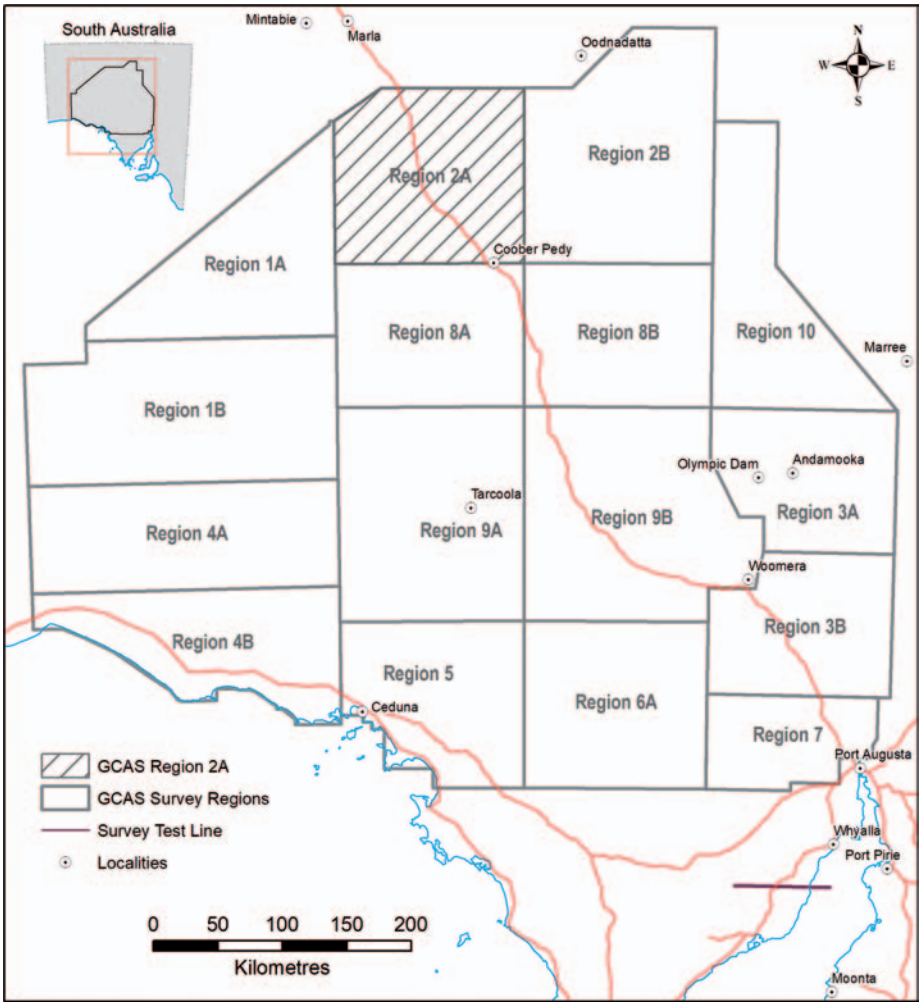

Figure 1. *Detail of the GCAS regions. Region 2A (Murloocoppie) is the first of 16 regions of value added data and magnetic models to be released.*

Table 1. List of enhanced images and depth modelling products released

Enhanced images included in package	Depth modelling products included in package
Bouguer gravity/Vertical Derivative	Basement Elevation
Bouguer gravity pseudo magnetic	Basement intersecting drillholes
Bouguer gravity worms	Cover thickness
TMI Bzz	Magnetic basement surface
TMI Pseudo gravity	Magnetic 3D depth products
TMI RTP/TMI RTP 1VD/ TMI RTP 2VD	Magnetisation models
TMI RTP Tilt	Model sections
TMI total gradient	Model session files (Model Vision)
TMI Trend	Magnetic Source solutions
TMI Trend Consistency	
TMI worms	

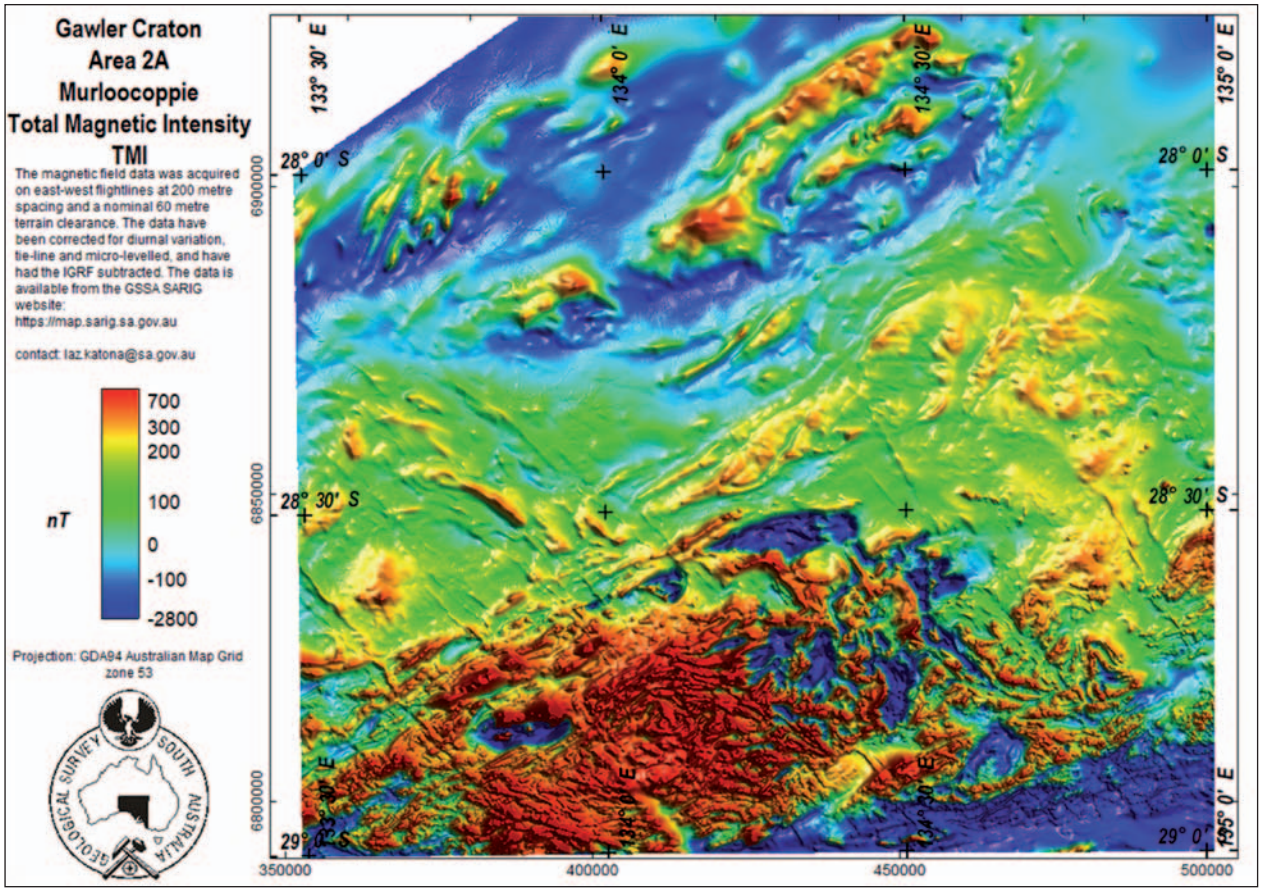

Figure 2. *TMI of GCAS Region 2A.*

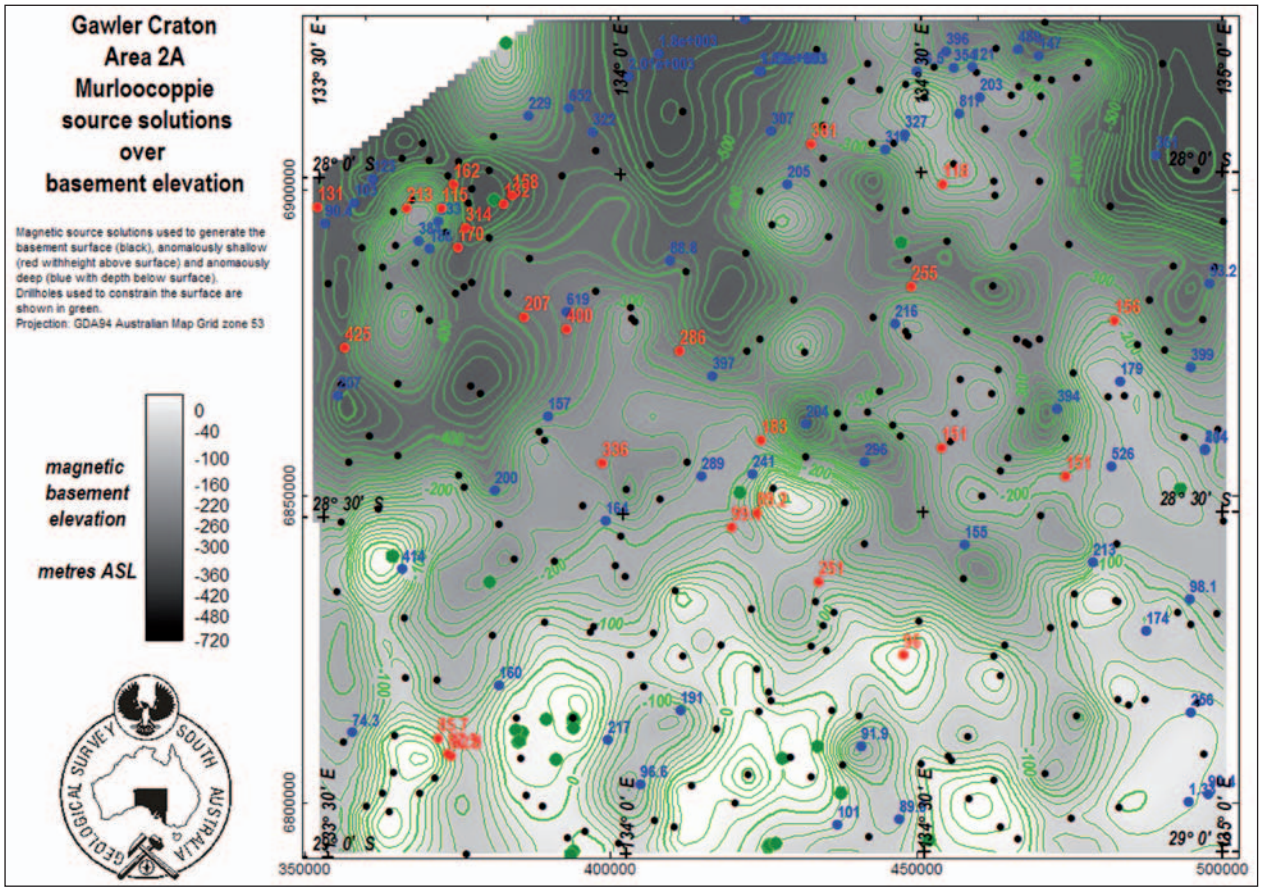

Figure 3. *Basement elevation surface derived from a combination of magnetic source depth solutions and drillhole stratigraphy for GCAS region 2A.*

Other upcoming events in South Australia

Keep your calendar free in early December for a series of workshops and data releases hosted by the Geological Survey of South Australia, followed by the South Australian Exploration and Mining Conference run by the AIG, ASEG, AusIMM and GSA (Table 2).

Gawler Craton Airborne Survey workshop 2018

The aim of this workshop is to demonstrate the utility of the new GCAS datasets and value added products by bringing the principal project participants together with industry and other agencies who have an interest in the project and products to discuss methodologies, interpret the results and deliver the roadmap for the remainder of the GCAS acquisition and data releases.

Attendees will be a mix of GSSA staff, the GCAS team, industry representatives, CSIRO and possibly Geoscience Australia personnel. While still in the early planning stages, we are hoping for contributions from Brian Minty and Clive Foss, and GSSA's GCAS team will deliver a number of presentations. There is scope for an interactive session where some of the new data can be interpreted interactively, in hardcopy.

National MT workshop and AusLAMP SA release day

Magnetotellurics has the capacity to provide an unprecedented insight into the architecture of the Australian continent and its mineral systems. This insight is revolutionising the way in which mineral exploration is conducted. The National UNCOVER strategy identified the collection of a national network of magnetotelluric data as one of the highest priorities for the Australian geoscientific community. The Australian Lithospheric Architecture Magnetotelluric Project (AusLAMP) is a collaborative national magnetotelluric (MT) project focused on acquiring long-period MT data at approximately 2800 sites across Australia at approximately 50 km spacing.

The aim of this workshop is to celebrate the success of AusLAMP by bringing the MT community of Australia together with all interested in understanding the lithospheric architecture of the continent, to discuss the methodology, the interpretation and future progress of this important geophysical method and associated data sets. The workshop will also celebrate the completion of the South Australian portion of AusLAMP and the release of this new MT data.

Discovery Day

Themed 'Discover: New Data, New Technology, New Insights', the South Australian Government's Geological Survey of South Australia (GSSA) Discovery Day will showcase the latest innovative work of the GSSA staff and key collaborators and deliver new insights and opportunities for mineral exploration and discovery in South Australia. Online registration here prior to the event is mandatory to gain entry. Catering will be included in your free registration.

Kate Robertson, Stephan Thiel, Laszlo Katona, Philip Heath
Geological Survey of South Australia, Department of Energy and Mining

Table 2. Upcoming events in South Australia

Event	Date	Location	Cost	More information
Gawler Craton Airborne Survey Workshop 2018	Tuesday 4 December	SA Drill Core Reference Library, Tonsley	Free	Laz Katona Laz.katona@sa.gov.au
National MT Workshop and AusLAMP SA Release Day	Wednesday 5 December	SA Drill Core Reference Library, Tonsley	Free	Stephan Thiel Stephan.Thiel@sa.gov.au
Discovery Day	Thursday 5 December	Adelaide Convention Centre	Free- register here	See the website for more information, or email: resources.customerservices@sa.gov.au
South Australian Exploration and Mining Conference	Friday 6 December	Adelaide Convention Centre	Registration $200, students $50 here	http://www.saexplorers.com.au/ info@saexplorers.com.au

Geological Survey of New South Wales: Palaeomagnetism and magnetic petrophysics – oroclines and arcs

Bob Musgrave, Senior Research Geophysicist, manages the Geological Survey of NSW (GSNSW) PALM Lab (for Palaeo- Archaeo- Litho-Magnetic Laboratory). This palaeomagnetic/magnetic petrophysics facility is based at the University of Newcastle and operates in collaboration with the Centre for Geoscience in the Newcastle Institute for Energy and Resources (NIER). First set up in 2012, the lab has grown from a basic facility supporting 'classic' palaeomagnetic studies of tectonics, to embrace a diverse range of research, ranging from magnetostratigraphy and magnetic petrophysics studies of volcanosedimentary sequences, to tracking the accumulation and migration of gas hydrates in marine sediments. The lab also provides fundamental support to the NSW petrophysics database, by providing measurements of saturated density, high precision magnetic susceptibility, the Königsberger ratio, and remanence polarity and direction (for oriented samples). The equipment and capabilities of the PALM Lab are summarised in Figure 1 and Table 1.

Following a recent upgrade involving the purchase of a high-sensitivity spinner magnetometer (AGICO JR-6A), refurbishment of the vibrating sample magnetometer, and the installation of a purpose-built parallel diamond saw, the lab is now engaged in a palaeomagnetic test of the Lachlan orocline hypothesis (Cayley, 2015; Musgrave, 2015), a new model for the late Ordovician to early Devonian tectonic evolution of eastern Australia (Figure 2). The project, which forms part of GSNSW's contribution to the ARC Linkage project 'Ore deposits and tectonic evolution of the Lachlan Orogen, SE Australia', involves PhD students Umer Habib and Tom Schaap from the University of Tasmania.

In a nutshell, the Lachlan orocline hypothesis explains the apparent repetition of terranes in the Lachlan Orogen in Victoria as the result of a pair of oroclines – vertical-axis folds penetrating through the lithosphere and extending laterally for hundreds of kilometres. The driving mechanism for the folding is thought to be rapid south-eastward retreat of the palaeo-Pacific subduction zone due to roll-back of the slab after its southern end was pinned by the arrival of the continental

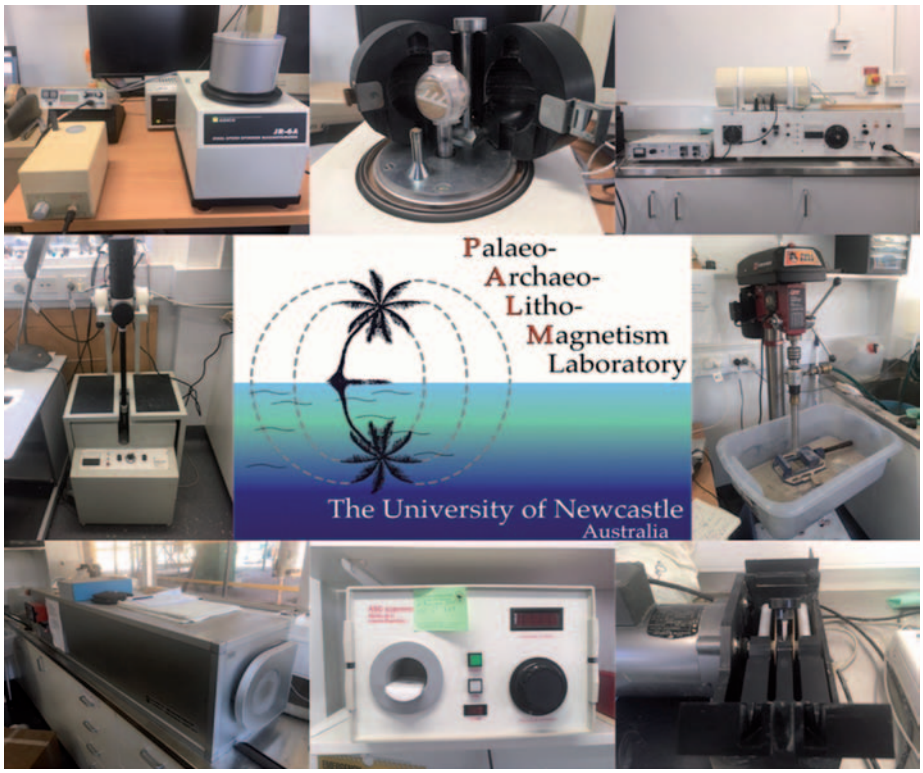

Figure 1. *Montage of PALM lab equipment. Clockwise from top left: magnetic susceptibility well sensor and AGICO spinner magnetometer; inside the AGICO, showing automated specimen holder; alternating field demagnetiser; diamond drill; parallel-blade specimen saw; pulse magnetiser; thermal demagnetiser; vibrating sample magnetometer.*

Table 1. Equipment at the PALM Lab

Instrument	Function
AGICO JR-6A high-sensitivity spinner magnetometer	Remanence direction and intensity: range 2.4 μA/m to 12.5 kA/m
Molspin spinner magnetometer	Remanence direction and intensity: range 100 μA/m to 2.5 A/m
Magnetic Measurements thermal demagnetiser	Stepwise thermal demagnetisation: imposition of controlled partial thermal remanent magnetisation
Molspin alternating field demagnetiser, with partial anhysteretic remanent magnetisation add-on box	Stepwise alternating field demagnetisation: imposition of controlled partial anhysteretic remanent magnetisation
IM-10 pulse magnetiser	Isothermal remanence acquisition and DC demagnetisation
Molspin Nuvo vibrating sample magnetometer	Magnetic hysteresis analysis
Bartington MS-2 magnetic susceptibility, with well and stratigraphic sensors	High sensitivity, accurately calibrated magnetic susceptibility
Fluxgate and Hall-effect magnetometers	Low- and high-field test equipment
Mu-metal cans	Low-field specimen storage
Degaussing 'wand'	Degaussing of magnetic shields
Archimedes scale and vacuum saturator	Saturated density and specimen volume
Water-cooled diamond bit on drill press mount	Preparation of palaeomagnetic and petrophysics samples
Parallel blade diamond saw	Preparation of palaeomagnetic and petrophysics samples
Freezer for marine sediment storage	Storage of marine sediment samples, to minimise alteration of iron sulfides

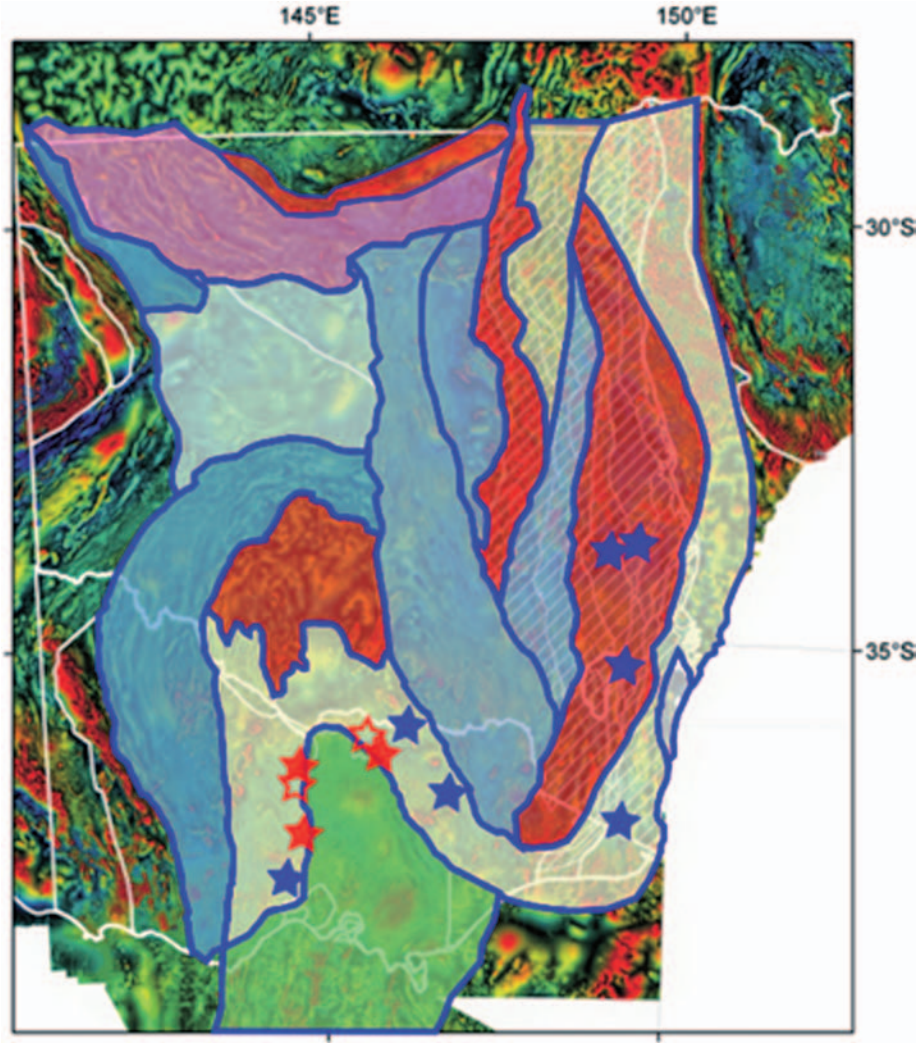

Figure 2. *Sample localities (stars) on a map showing elements of the Lachlan orocline hypothesis superimposed on a tilt-filtered total magnetic intensity image of eastern Australia. Each locality comprises multiple sites. Blue stars = late Ordovician–Silurian, red stars = Cambrian. Open symbols are localities from an earlier study (Tetley et al., 2014).*

Selwyn Block, which extends Tasmanian crust under the Melbourne Zone in Victoria (Moresi et al., 2014). Rotation of palaeomagnetic declination in sympathy with an oroclinal fold has been employed to validate similar structures in Europe (Van der Voo, 2004).

A proof-of-concept study using the PALM Lab of a related orocline hypothesis for the origin of curvature of the Dundas–Fossey in Tasmania was recently completed as a BSc Honours project by University of Tasmania student Kat Job (Job and Musgrave, 2018). Bob and Umer have recently returned from a reconnaissance sampling survey around the Lachlan Orocline, collecting over 180 oriented cores from 34 sites (Figure 3).

Other work at the PALM Lab is currently focussed on assembling and measuring a representative suite of rock specimens from the highly prospective Macquarie Arc, to supplement the existing rather patchy dataset of field- and core-based measurements. The specimens, all standardised in dimensions (2.5 cm diameter, 2.2. cm long) to fit the range of instruments in the lab, will be archived for any future additional studies.

Figure 3. *PhD student Umer Habib coring siltstone in the Rockley Volcanics.*

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