# National science agencies feel force of government cuts

The effects of annual efficiency dividends of 2.25% across all government departments from July 2014 (introduced by the former government), and the drive by the current government to have a smaller public service, is now hitting the main national science agencies.

A service-wide cut is the lazy way to reduce the size of the public sector. There is no need for a process to assess the priorities of government programmes or to identify national goals – it's just cuts all round. Not a good way to govern a mature developed country, but very easy to implement. I would have thought that as Australia grows and society becomes more reliant on science and technology skills we should be increasing our investments into organisations like Geoscience Australia and CSIRO, but this seems not to be. Both organisations are really suffering. Even the Australian Bureau of Statistics, which provides invaluable data for socioeconomic planning, is feeling pain from budget cuts.

## $40 million cut from Geoscience Australia's budget

According to a report in the *Sydney Morning Herald* on 21 February 2014, GA's annual budget of $180 million will be cut to $140 million. As a result, there will be significant job losses. According to CEO Chris Pigram, $6 million of the cuts will come from the efficiency dividend and remainder from income previously derived from other government agencies, such as Defence and Environment and who are also battling with the efficiency dividend.

Assuming that approximately half of the $40 million would be made up of staff reductions; it follows that 50–100 staff may have to be shed from the ~740 currently employed.

These cuts are likely to have a major impact on Australia's national capability and capacity to develop and manage our mineral, petroleum, ground water and other earth based-resources. It is also likely they will affect the hazard management programs of floods, landslides, earthquakes and tsunamis.

Australia relies heavily on the wealth of our resource industries to maintain our prosperity. This prosperity will require a pool of highly skilled geoscientists, which we hope will be trained in Australia. The loss of jobs at Geoscience Australia will do little to encourage young scientists to take up geoscience as a career. And it is difficult to see how it will do anything to increase our national prosperity.

## CSIRO to lose up to 600 jobs

In November 2013 Assistant Treasurer Arthur Sinodinos indicated that the job cuts in CSIRO would be between 500 and 600. More recently, CSIRO Staff Association Secretary Sam Popovski said (in February 2014) that the number employed in CSIRO had fallen from 6477 in June last year to 6143 as at the end of January 2014. That's bad news for science. Perhaps more importantly, those affected will be the younger part time contract workers, who may find it very difficult to find other jobs in other science related areas.

## Australian Bureau of Statistics faces $50 million funding cut

The Australian Bureau of Statistics (ABS) has to tackle a $50 million funding cut that could lead to 70–100 redundancies (*Sydney Morning Herald*, 5 March 2014). The ABS employs approximately 3300 workers. According to the *Sydney Morning Herald* report the acting chief statistician Jonathan Palmer said 'We are going into next financial year with an increased efficiency dividend, so we need to find about $50 million over the next three years.'

How these cuts will affect the delivery of ABS statistics has not yet been decided, but compared with other OECD countries our coverage is not that good. For example the UK and the US produce CPI data monthly, while the ABS only manages quarterly data releases. I would have thought that good data would have been vital for governments to make good decisions, and that ABS resources should be increased – but then there must be others who disagree with this argument.

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# Update on the Geophysical Survey Progress from the Geological Surveys of Western Australia, South Australia, Northern Territory, Queensland and WA Department of Water (information current at 7 March 2014)

Tables 1–3 show the continuing acquisition of the airborne magnetic, radiometric, gravity and AEM data of the Australian continent respectively. All surveys are being managed by Geoscience Australia (GA). Further information on these surveys is available from Murray Richardson at GA via email at Murray.Richardson@ga.gov.au or telephone on (02) 6249 9229.

Table 1. Airborne magnetic and radiometric surveys

| Survey name | Client | Contractor | Start flying | Line (km) | Spacing AGL Dir | Area (km²) | End flying | Final data to GA | Locality diagram (*Preview*) | GADDS release |
|---|---|---|---|---|---|---|---|---|---|---|
| Browse Basin | GA | Thomson Aviation | 21 Aug 13 | 189 361 | 800 m 80 m ASL N–S | 123 187 | 100% complete @ 7 Nov 13 | 29 Jan 14 | Issue 164 (Jun 13) p. 19 | Final data released via GADDS on 5 Mar 14 |
| Menzies North | GSWA | GPX Surveys | 7 Aug 13 | 93 386 | 100 m 50 m E–W | 8200 | 100% complete @ 26 Nov 13 | 29 Jan 14 | Issue 165 (Aug 13) p. 11 | Final data released via GADDS on 20 Feb 14 |
| Kalgoorlie East and Kurnalpi North | GSWA | Thomson Aviation | 5 Aug 13 | 122 000 | 100 m 50 m E–W | Kalgoorlie: 11 000; Kurnalpi N: 11 000 | 92.1% complete @ 2 Mar 14 | TBA | Issue 165 (Aug 13) p. 11 | TBA |
| Widgiemooltha North | GSWA | UTS Geophysics | 25 Jul 13 | 92 000 | 100 m 50 m E–W | 8200 | 100% complete @ 27 Jan 14 | TBA | Issue 165 (Aug 13) p. 11 | TBA |
| Menzies South | GSWA | GPX Surveys | 28 Nov 13 | 92 000 | 100 m 50 m E–W | 8200 | 82.8% complete @ 2 Mar 14 | TBA | Issue 165 (Aug 13) p. 11 | TBA |
| Kurnalpi South | GSWA | UTS Geophysics | 28 Jan 14 | 92 000 | 100 m 50 m E–W | 8200 | 20.8% complete @ 2 Mar 14 | TBA | Issue 165 (Aug 13) p. 11 | TBA |
| Coompana | GSSA | TBA | TBA | TBA | Survey design is underway | The proposed survey may cover all or part of Noorina, Wyola, Cook, Coompana, Nullarbor, Ooldea, Maurice, Wells and Birksgate standard 1:250 000 standard Map Sheets | | | | |

*ASL, above sea level; TBA, to be advised.*

Table 2. Gravity surveys

| Survey name | Client | Contractor | Start survey | No. of stations | Station spacing (km) | Area (km²) | End survey | Final data to GA | Locality diagram (*Preview*) | GADDS release |
|---|---|---|---|---|---|---|---|---|---|---|
| North Perth – Gingin Brook | WA Dept of Water | Atlas Geophysics | 9 Apr 13 | 1230 | 1.5 km regular grid | 3900 | 100% complete @ 7 Jun 13 | 29 Jul 13 | Issue 163 (Apr 13) p. 17 | Final data released via GADDS on 20 Feb 14 |
| Goldfields, WA | GSWA | Atlas Geophysics | 8 Nov 13 | 8100 | 2.5 km regular grid | 51 140 | 100% complete @ 13 Dec 13 | 20 Jan 14 | Issue 166 (Oct 13) p. 34 | Final data released via GADDS on 20 Feb 14 |
| WA Reconnaissance Gravity Surveys Stage 3 | GSWA | TBA | TBA | Approx. 53 900 in total across 7 proposed surveys | 2.5 km regular grid and 2 km road traverses | TBA | TBA | The Quotation Request opened on 28 Jan 14 and closed on 27 Feb 14 | The proposed surveys are located in: 1. Ngururrpa Region, 1 survey: Stansmore and surrounds 2. NE Yilgarn, 4 surveys: Herbert-Robert, Throssel, Sir Samuel and Wiluna-Nabberu 3. SW Yilgarn, 2 surveys: Perth and Albany | |
| West Amadeus | NTGS | TBA | TBA | TBA | 4 km regular with areas to be defined for 2 km infill | 45 050 | The proposed survey may cover all or part of Mount Rennie, Bloods Range, Petermann Ranges, Ayers Rock, Lake Amadeus and Mount Liebig standard 1:250 000 standard Map Sheets | | | |

*TBA, to be advised.*

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 13 | 8607 | 300/600 m | TBA | 100% complete @ 15 May 13 | Final data to GA 20 Jan 14 | Issue 163 (Apr 13) p. 17 | TBA |
| Capricorn Orogen | GSWA | GA | CGG Aviation (Australia) | 19 Oct 13 | 29 697 | 5 km N–S | 146 300 | 100% complete @ 9 Jan 14 | 24 Feb 14 | Issue 166 (Oct 13) p. 34 | TBA |
| Southern Thomson Orogen | GA/ GSNSW/ GSQ | GA | TBA | At the time of updating this table the survey was expected to commence in mid-late March | 4198 (3327 in survey and 871 in traverses) | 5 km E–W | 16 270 | TBA | TBA | Issue 168 (Feb 14) p. 24 | TBA |

*TBA, to be advised.*

News

# New airborne magnetic data covering the Browse Basin

Ron Hackney and Marina Costelloe

*Geoscience Australia*

In late 2013, Geoscience Australia acquired airborne magnetic data over a large part of the Browse Basin (Figure 1). The Browse Basin is a northeast-trending Palæozoic to Cænozoic depocentre located offshore in the Timor Sea region of Australia's North West Shelf. The basin contains a Palæozoic, Mesozoic and Cænozoic sedimentary succession in excess of 15 000 m thick (Struckmeyer et al, 1998). The main structural elements of the basin include the Barcoo and Caswell sub-basins and the Leveque and Yampi shelves (Figure 1), which lie in water depths of up to 2000 m. The Caswell Sub-basin hosts several large gas fields planned for Liquefied Natural Gas (LNG) and condensate development. The outboard and frontier parts of the basin include the Scott Plateau and Seringapatam Sub-basin in water depths of up to 5000 m.

Government-funded pre-competitive regional-scale airborne magnetic data have an important role in understanding energy and mineral systems. The data help to reduce exploration risk and provide a framework for detailed studies that seek to identify energy and mineral resources. In recognising the benefits of airborne magnetic data to regional basin studies, Geoscience Australia contracted Thomson Aviation to acquire the new data over the Browse Basin. From late August to early November 2013, two aircraft acquired approximately 190 000 line km of data along north–south traverses spaced 800 m apart, east–west tie lines spaced 4000 m apart, all at a nominal flying height of 80 m above sea level. These data were made available for download from the Geophysical Archive Data Delivery System (GADDS; www.geoscience.gov.au) on 5 March 2014.

The Browse Basin airborne magnetic survey was conducted as part of the National $CO_2$ Infrastructure Plan (NCIP; www.ga.gov.au), which aims to acquire, interpret and integrate new and existing pre-competitive data to assess the suitability of various basins for the geological storage of $CO_2$. Geoscience Australia's current focus on the Browse Basin as a potential area for $CO_2$ storage is the precursor to more regional studies of the North West Shelf that aim to identify, characterise and map structural events and variations in structural architecture, as well as to regionally examine the role of structural inheritance and controls on the distribution of volcanics. This mapping will aid the interpretation of the structural fabric of the basin and the nature of its basement. The new airborne magnetic data will be a key component of this mapping as the data will facilitate the mapping of strongly-magnetised volcanic rocks and basin structure.

Better knowledge of the distribution of volcanic rocks is a key part of assessing the suitability of any given reservoir for storing $CO_2$ or holding hydrocarbons. If a reservoir is adjacent to or contains volcanic rocks, the reservoir's storage capacity could be reduced by mineral precipitation within pore space. This precipitation arises from the chemical reactions driven by the heating and fluid flow induced at the time the hot volcanic rocks were emplaced.

Structures mapped from the new airborne magnetic data can also be used to assist in assessing the integrity of the geological seal above reservoirs deemed suitable for $CO_2$ storage or that have the potential to store hydrocarbons. When faults cut through a geological seal above a potential reservoir, the seal can be breached and, depending on the permeability of the fault, $CO_2$ or hydrocarbons in the underlying reservoir may migrate into overlying rock formations.

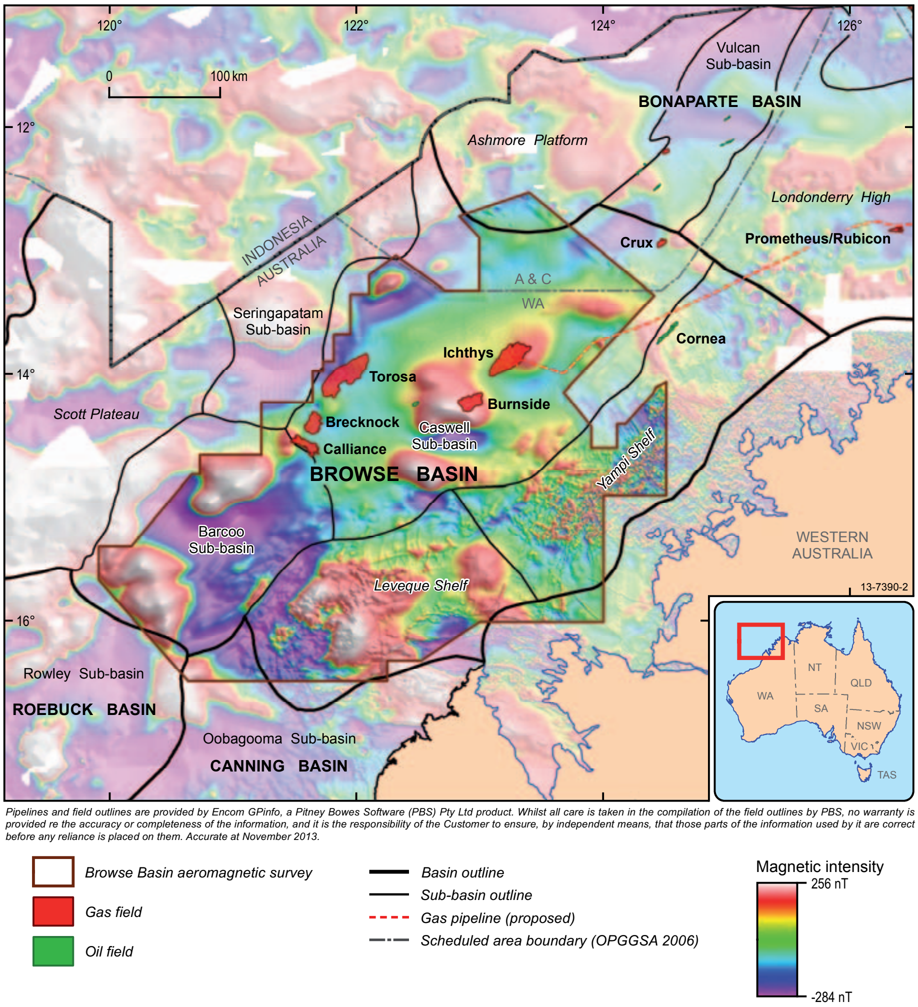


**Fig. 1.** *Map of the Browse Basin showing the new aeromagnetic data after a preliminary merge with existing airborne and marine magnetic data. The main structural elements and gas fields of the basin are also shown. Key: A&C denotes Territory of Ashmore and Cartier Islands.*

The new magnetic data will ultimately be merged with existing data to produce updated national magnetic anomaly maps that will help future resource exploration.

For further information on the new Browse Basin airborne magnetic data, contact Ron Hackney (ron.hackney@ga.gov.au) or email GADDS (gadds@ga.gov.au).

## Reference

Struckmeyer, H. I. M., Blevin, J. E., Sayers, J., Totterdell, J. M., Baxter, K., and Cathro, D. L. 1998. Structural evolution of the Browse Basin, North West Shelf: New concepts from deep-seismic data. In: Purcell, P.G. and Purcell, R.R. (Editors), The Sedimentary Basins of Western Australia 2: Proceedings of the Petroleum Exploration Society of Australia Symposium, Perth, 1998, 345–367.

# News from the surveys: SA

## *The 2013 Woomera Prohibited Area gravity survey*

The northern Gawler Craton, South Australia, hosts the world class Olympic Dam Cu-Au-U deposit, as well as mines such as Prominent Hill (Cu-Au), Challenger (Au), Cairn Hill (Fe-Cu-Au) and Peculiar Knob (Fe; Figure 1). The highly prospective region of the Gawler Craton that hosts these deposits is also the location of a Department of Defense military testing range, the Woomera Prohibited Area (WPA).

In order to assist mineral exploration in the WPA a major regional gravity survey was recently undertaken by the Geological Survey of South Australia and Geoscience Australia. This region had previously been surveyed by only regional 7 by 7 km spaced points acquired in the 1970s and was consequently lacking in detail; the type of detail that is vital for area selection within this region of the Gawler Craton that is largely covered by Phanærozoic sediment.

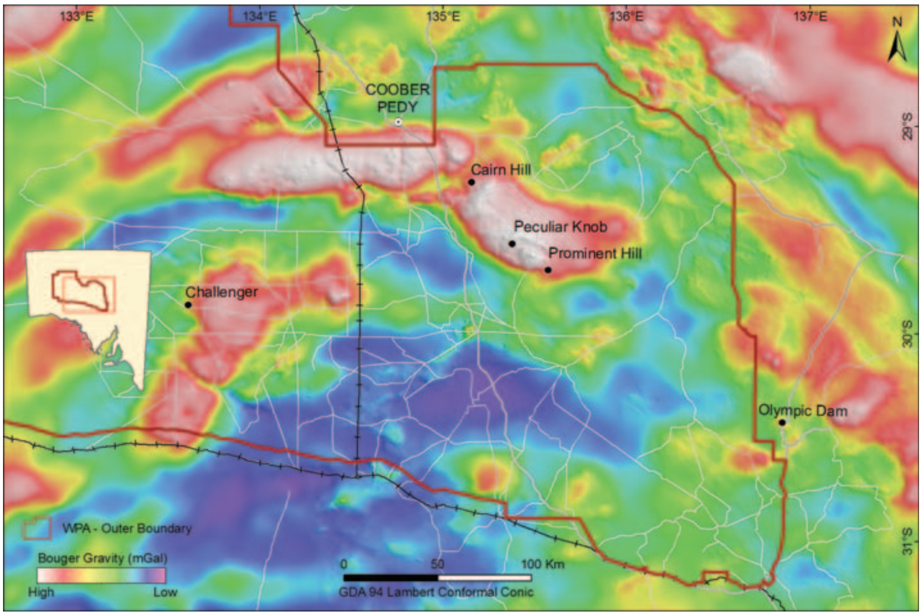


**Fig. 1.** *The regional gravity in the WPA area prior to the 2013 survey is shown here.*

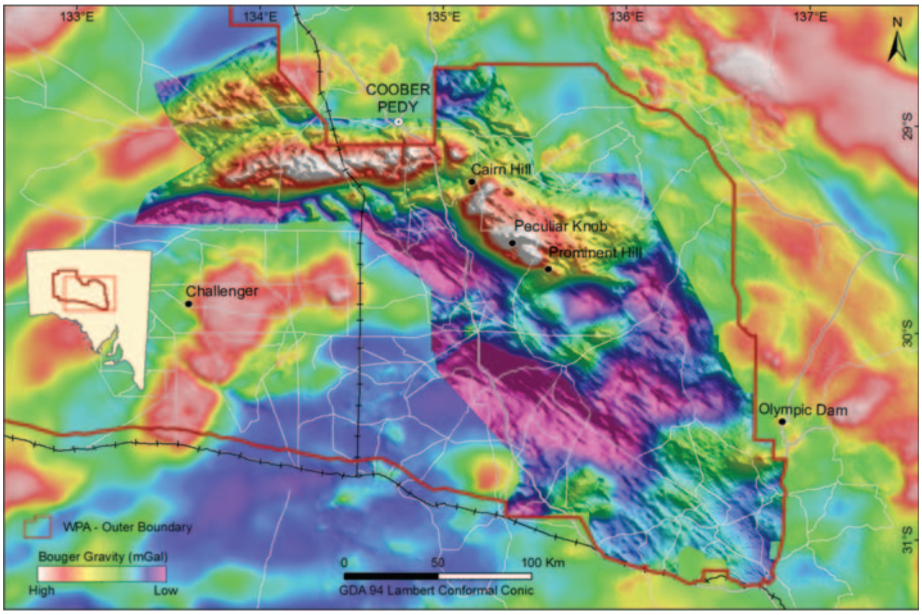


**Fig. 2.** *The new survey has provided valuable insight into the geology of the region.*

Between 2 May and 18 September 2013, DaishSat Geodetic Surveyors undertook a major gravity survey covering a large portion of the WPA (Figure 2). The survey included 34,541 new gravity stations: 33,132 stations at a regular spacing of 1 km by 1 km resolution, and 1409 stations at a spacing of 2 km by 2 km resolution within the continual use zone of the WPA.

The shape of the survey was chosen to cover the northwestern Olympic Domain (Figure 3). The survey also covers adjacent domains that are considered prospective for IOCG deposits (the Coober Pedy Ridge, the Mt Woods Domain and parts of the Christie and Nawa Domains).

Gaps were left in the survey area to tie in pre-existing gravity surveys that had the same (or better) resolution. Some points were offset by 500 m to allow improved resolution of the gravitational response of the region.

Data from the survey has been combined with pre-existing gravity surveys to produce a single grid of the area. This grid exhibits many new features, as well as highlighting known features at a higher resolution.

The Coober Pedy Ridge is the major gravity high south of Coober Pedy in the central north of the survey area. Much of the structure and faults seen here were not visible prior to this survey. A major NW-SE fault appears to cross-cut through the middle of the Coober Pedy Ridge and into the Nawa Domain to the NW. Further short wavelength features can be seen in the Mt Woods domain, the high gravity region hosting Cairn Hill, Peculiar Knob and Prominent Hill.

South of the Coober Pedy Ridge and Mt Woods Domain is the Christie Domain. The Christie Domain exhibits a broad low-magnitude gravitational response in the survey area, and the new data shows a prominent boundary between the areas. This apparent boundary is likely to be the Karari shear zone which separates the Christie Domain and Nawa Domain to the west.

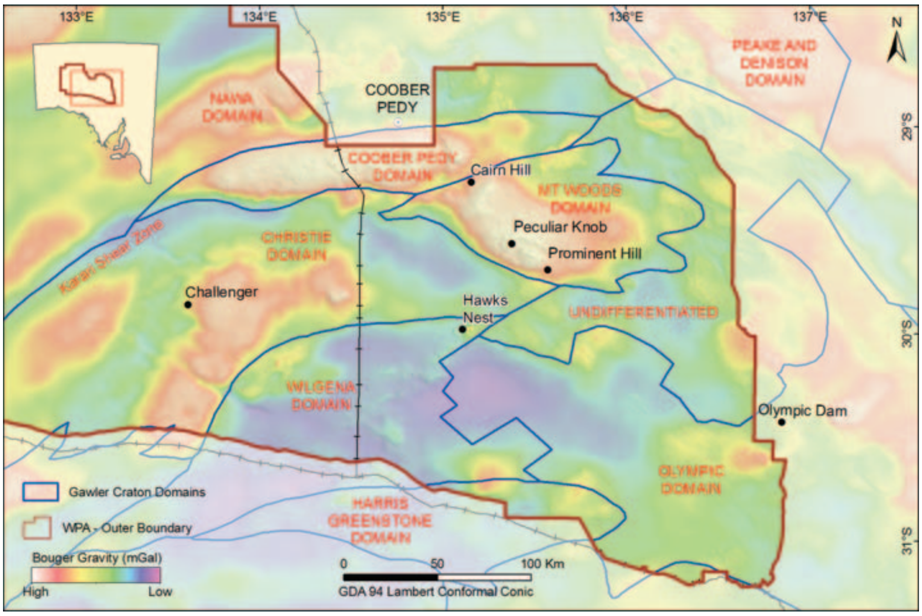


**Fig. 3.** *For reference, this image shows the domains of the Gawler Craton in the WPA.*

There are subtle gravity highs in the vicinity of the Hawks Nest Fe deposit (Figure 3). These highs are probably partly because the basement is shallower in these regions. This new data gives improved resolution of the structure of that basement. These features are really well expressed in the new gravity data and are regions of some IOCG potential.

The new data also shows up significant new zones in a similar structural position to the south of the eastern end of the Coober Pedy Ridge. These regions might be good places to consider the intersection of NE trending shear zones in this region with potential Hiltaba Suite or Gawler Range Volcanics magmatic rocks.

Noticeable also are the dykes of the Gairdner dolerites. These are the linear features striking NW-SE. These features are also prominent in the magnetics in the area and some have been dated to 827 Ma.

The data can be downloaded through SARIG (sarig.pir.sa.gov.au).

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*Geological Survey of South Australia*
*Resources and Energy Group*
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News

# Constrained magnetic modelling of the Hawsons Iron Deposit, western New South Wales

Ristch (Rusty) Camille

ASEG Research Foundation Project RF12M04. Honours student, Ristch (Rusty) Camille. Supervisor, Dr Mark Lackie, Macquarie University. Industry contact, John Donohue, Carpentaria Exploration Limited.

## Project summary

Hawsons Iron Deposit is a folded, bedded Neoproterozoic iron formation, situated approximately 60 km south-west of Broken Hill, New South Wales. The magnetite rich prospect overlies rocks of the folded, bedded Neoproterozoic iron formation of the Nackara Arc in the Adelaidean Fold Belt. The Hawsons Iron Deposit is separated into three domains: Core, Fold and South Limb.

The project investigated the size of the resource of magnetite at the Hawsons Iron Deposit by interpreting newly acquired ground magnetic data and petrophysical measurements in conjunction with existing magnetic susceptibility and drillhole data. This was achieved by developing 2.5D and 3D magnetic models using various geophysical software packages and comparing them to the Davis Tube Recovered (DTR) models developed by Carpentaria Exploration Limited.

The magnetic signature of a rock is dependent on the concentration, orientation and specific type of magnetic mineral present within the rock or unit. Magnetite is the most naturally magnetic occurring rock that exhibits permanent magnetism, which is characteristically ferromagnetic. Magnetic data suggests that there is limited structural disturbance within the Hawsons magnetite rich deposit (Figure 1). The prospect is dominated by a large intense magnetic anomaly of up to ~7000 nT.

Samples from sixteen drillholes were selected over various locations of the Hawsons Iron Deposit and drilled and cored for petrophysical analyses. Petrophysical measurements were applied as constraints for magnetic modelling. Newly acquired bulk *k* magnetic susceptibilities obtained from the petrophysical analyses and magnetic susceptibilities measured with a hand held meter were used to constrain 2.5D and 3D models. Forward models and sensitivity analysis was undertaken to determine the depth to the basement and the thickness of the cover sequence; the vertical extent of the deposit; and the effect of self-demagnetisation. All magnetic bodies are subjected to a degree of self-demagnetisation, this becoming significant when greater than 10% of the body is magnetite (k > 0.1SI). In the Hawsons Iron Project, many samples have a magnetic susceptibility greater than 0.1 SI.

The software packages ModelVision and UBC Mag3D were used for modelling

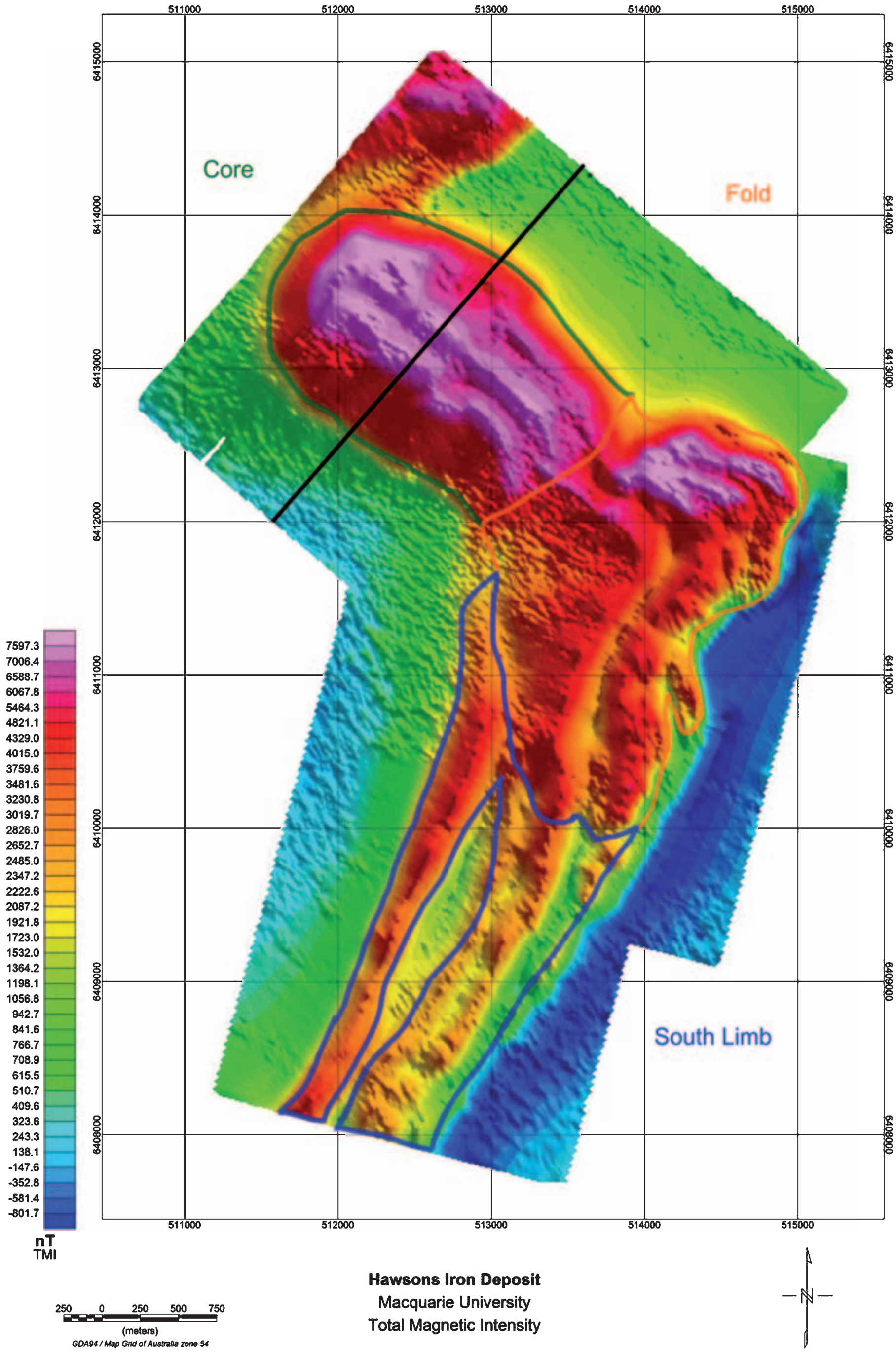


**Fig. 1.** *Total Magnetic Intensity (TMI) map of the ground magnetic data of the Hawsons Iron Deposit. Black line is Line 27 (Figure 2).*

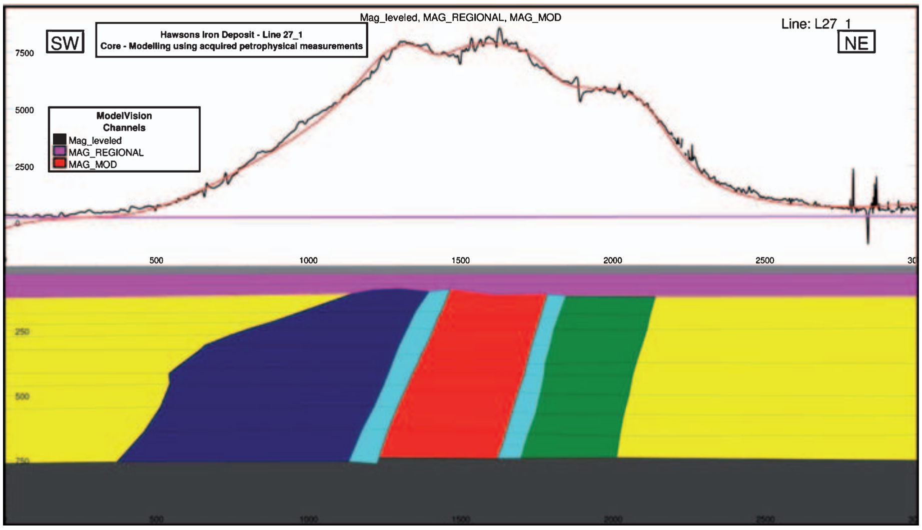


**Fig. 2.** *Forward modelled cross section along the Core of the Hawsons Iron Deposit. Cover sequence (0.0005–0.02 SI). Non deposit rocks (yellow) (0.05–0.1 SI). Deposit (blue, red, green) (0.1–1.2 SI).*

the Hawsons Iron Deposit (Figure 2). Modelling high resolution ground magnetic data shows that the polygons representing the magnetite-rich limbs in the Core and Fold are dipping to the southwest and striking at a northwest-southeast direction, consistent with drilling data. The study suggests that it is possible to predict the resource of magnetite at Hawsons Iron Deposit provided that geological and geophysical constraints are available to assist with the forward modelling of the deposit. Geological, geophysical and petrophysical constraints were used to delineate and map the thickness of the cover sequence and base of the magnetite deposit. Based on the results of the sensitivity analysis of the base of the mineralisation, the magnetite deposit could be modelled with a cover sequence ranging from 30 to 110 m thick, and with the magnetite mineralisation being 700 m to 1100 m in extent.

When self-demagnetisation was considered in ModelVision, the resultant models indicate that the magnetite mineralisation may have greater depth extent and still be consistent with the data. However, this is only indicative as more robust analyses of the effect of self-demagnetisation using numerical models would need to be done and this was beyond the scope of this Honours Project.

The three-dimensional inversion models of the Hawsons Iron Deposit share some resemblance to the DTR resource model. Based on the results of the 3D magnetic model, the depth extent of the magnetite mineralisation lies between 200–800 m. However, the inversions produced were different to the forward models. At the Core, the deposit has a strike direction towards the northwest, however, the dip of the magnetite body was difficult to define, when 3D inversion alone was used.

The 2.5D and 3D models produced using ModelVision and UBC CODE were used to develop a representation of the geological and magnetic response of the Hawsons Iron Deposit. However, the models produced were inconsistent with Carpentaria's DTR Model. The modelled magnetite deposit from the 2.5D and 3D models had a large depth range, based on the sensitivity analysis of the models, indicating that the extent of mineralisation was not well defined. Therefore, further geological and geophysical constraints are required to comprehensively model the geological structure and basement of the Hawsons Iron Deposit.

## Project outcomes

The main outcomes of the studies were:

1. It is possible to model the Hawsons Iron Deposit using data obtained from hand held magnetic susceptibility meters and bulk *k* magnetic susceptibilities obtained from laboratory measurements. However, sensitivity analysis shows that the extent of magnetite mineralisation is not well defined and that the more data from drill core that is incorporated in the modelling, the better the model.
2. Modelling applying various constraints and parameters to delineate and map the thickness of the cover sequence as well as the base of the magnetite deposit is possible.