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# Frome airborne electromagnetic data Phase 2 release

Geoscience Australia has recently released the Phase 2 data package for the Frome airborne electromagnetic (AEM) survey. The Phase 2 data release contains new inversion and interpretation products developed from data in the Phase 1 data package (contractor supplied data) released in March 2011 (see *AusGeo News* 102).

The Frome AEM survey was flown between May and November 2010 and covers 95 450 square kilometres in South Australia's outback. The survey aircraft acquired 32 317 line kilometres of data using Fugro Airborne Surveys' TEMPEST™ system. The aircraft flew along east-west lines spaced 2.5 kilometres and 5 kilometres apart at a nominal height of 100 metres above ground. The survey was a collaborative project involving Geoscience Australia, the Department of Primary Industries and Resources South Australia (PIRSA) and a consortium of exploration companies.

The Phase 2 data includes products developed from the Phase 1 data using Geoscience Australia's layered earth inversion algorithm (GA-LEI; Brodie and Sambridge 2006). These value-added products include two new inversions: a sample-by-sample (SBS) inversion of the whole data set; and, a line-by-line (LBL) inversion of the dataset which excludes the Olary Range and the Murray Basin. The SBS inversion, where each of the samples is inverted independently, is particularly useful in areas where the geology is not flat-lying, such as the Olary Range and northwestern Flinders Ranges. The LBL inversion, where a whole line is inverted simultaneously, favours laterally continuous geological models and is particularly useful in the Cenozoic stratigraphy of the Frome Embayment area. Together, they represent a powerful way to present and interpret AEM data (figure 1).

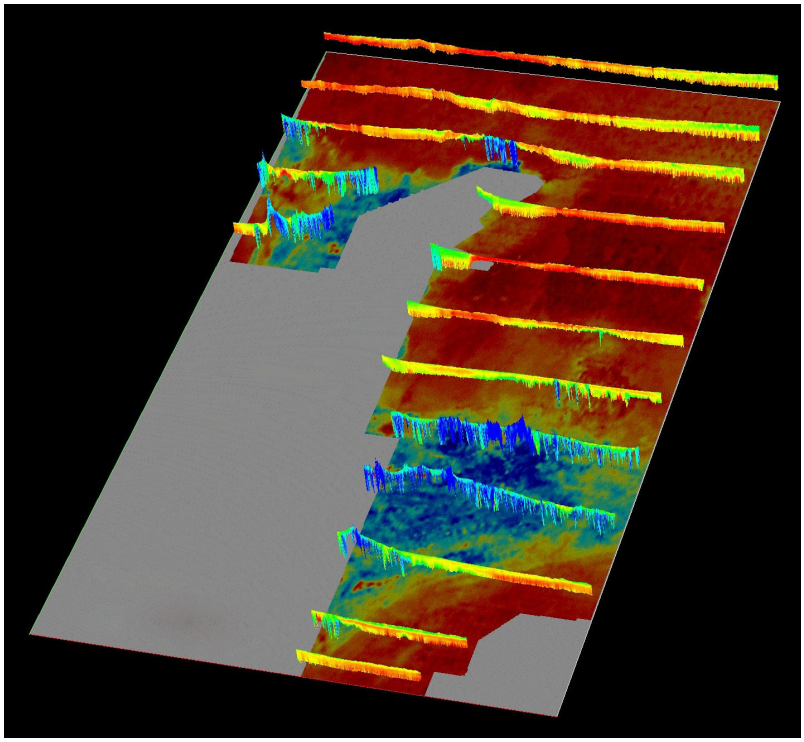

**Figure 1.** The Geoscience Australia layered earth inversion conductivity sections for some of the individual AEM survey lines, using 50X vertical exaggeration, over the 0 to 200 metre conductance grid for the Frome AEM survey.

The Phase 2 data release includes ASCII datasets of the two inversions together with PDF format multiplots of each survey line, geolocated JPEG images of each survey line for both inversions (for easy display in a GIS package), GOCAD™ triangulated surfaces of each survey line for both inversions, ER Mapper™ format and geolocated JPEGs of gridded data (depth slices, elevation slices, conductance and depth of investigation) and ancillary data including ArcGIS shape files, metadata and explanatory notes.

A workshop to discuss the data will be held in the Mawson Theatre, Department of Geology and Geophysics, University of Adelaide, between 9:00 am and 3:00 pm on 30 November 2011. Scientists from Geoscience Australia and PIRSA as well as invited industry personnel will present interpretations based on the dataset and discuss the implications for the uranium, gold, copper and lead-zinc mineral potential of the Frome Embayment-Murray Basin

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region. This workshop will coincide with the Sprigg Symposium (1 December) and the South Australian Explorer's Conference (2 December). An interpretation report, highlighting geological features and written by staff from both agencies will be published in late 2012.

The data are available for free download through the Geoscience Australia website or on DVD ROM for $99.00 from the Geoscience Australia Sales Centre.

### References

Brodie R & Sambridge M. 2006. A holistic approach to inversion of frequency domain airborne EM data. Geophysics 71: G301–313.

### For more information

**email** ausgeomail@ga.gov.au

### To reserve a seat at the Frome AEM survey interpretation workshop on 30 November 2011

**email** aem@ga.gov.au

### Related articles/websites

Frome Embayment TEMPEST AEM Survey: Inversion Report and Data Package (Phase 2 data)

https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=72589

Frome Embayment TEMPEST AEM Survey, South Australia, 2010 Final Data (Phase 1 data)

https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=71624

Geoscience Australia's Airborne Electromagnetics Project

www.ga.gov.au/energy/projects/airborne-electromagnetics.html

## Heat flow determinations for the Australian continent

Geoscience Australia has recently released the second and third reports in a planned series of reports of heat flow determinations across Australia. The second report contains data for seven boreholes including four in the Eastern Goldfields region of Western Australia and three in the Lake Frome region of South Australia. The third report contains an additional 24 heat flow determinations from across Australia including: Western Australia (Boddington, Kalgoorlie, Kambalda, Southern Cross), Victoria (Benambra), New South Wales (Braidwood, Cobar, Nyngan, Trangie), Queensland (Cloncurry, Maryborough) and the Northern Territory (Tennant Creek).


Currently heat flow data across the Australian continent are very sparse with the latest publicly available compilation containing less than 150 data points. To date, Geoscience Australia has increased the number of publicly available heat flow determinations across Australia by 41.

Geoscience Australia's Geothermal Energy Project has been recording temperature logs in existing boreholes across Australia as well as collecting drill core samples for laboratory analysis. Temperature logging is performed downwards in each hole with temperature recorded at 20 centimetre intervals. Drill core samples taken from the boreholes are measured using a divided bar thermal conductivity instrument in the Geoscience Australia laboratory.

The data and samples are used to calculate vertical heat flow, or the amount of heat energy passing vertically through the earth at any point, which helps to determine geothermal potential at each sample location. Heat flow is calculated by the product of the thermal gradient (change in temperature with depth) and

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the thermal conductivity of the rock. Thermal conductivity varies as a result of a range of factors such as rock type and grain size.

These ongoing releases of new temperature and heat flow data are designed to support the emerging geothermal energy industry and encourage the development of a new low emission power generation technology.

### *For more information or to download a copy visit*

Heat Flow Determinations for the Australian Continent: Release 2
https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=71773

Heat Flow Determinations for the Australian Continent: Release 3
https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=71774

Geoscience Australia's Geothermal Energy Project
www.ga.gov.au/energy/geothermal-energy-resources.html

## New Isostatic Residual Gravity Anomaly Map of Australia (First Edition)

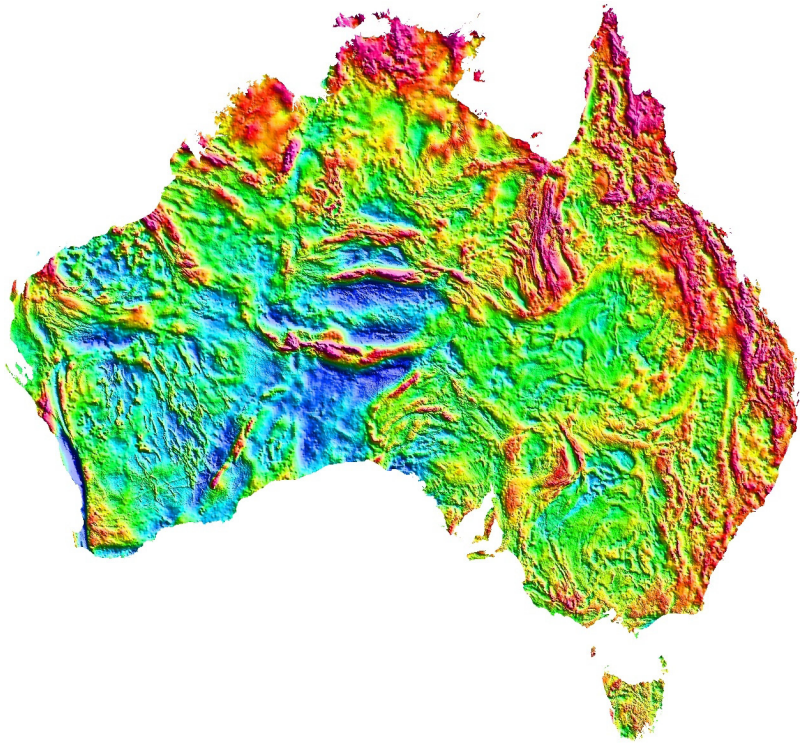

**Figure 1.** The new Isostatic Residual Gravity Anomaly Map of Australia.

A new printed version of the Isostatic Residual Gravity Anomaly Map of Australia at 1:5 million scale was recently released by Geoscience Australia. The map shows isostatic residual gravity anomalies across onshore Australia. Analysis of gravity anomaly values shows a relationship between terrain-corrected Bouguer anomaly values and the terrain height. This relationship is less evident after the isostatic correction which improves the resolution of anomalies.

The dataset is derived from observations recorded at approximately 1 500 000 gravity stations (or reference points) held in the Australian National Gravity Database (ANGD) by Geoscience Australia. The onshore data were acquired by the federal, state and territory governments, the mining and exploration industry, universities and research organisations over the six decades since the 1950s.

Continental Australia has a basic station spacing coverage of 11 kilometres; South Australia, Tasmania and part of New South Wales are covered at a spacing of 7 kilometres while Victoria has station coverage of approximately 1.5 kilometres. Recent government initiatives at state and federal level have funded systematic infill at a grid station spacing of 2, 2.5 or 4 kilometres to provide improved coverage in areas of scientific or economic interest. Other areas of detailed coverage have been surveyed by private companies for exploration purposes.

The depth-to-mantle model and subsequent isostatic

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corrections were produced using a modified version of the United States Geological Survey program AIRYROOT (Simpson et al 1983) provided by Intrepid Geophysics. Geoscience Australia's 2009 Bathymetry and Topography Grid (Whiteway 2009) was used to calculate the depth-to-crustal bottom following the Airy-Heiskanen crustal-root model. The isostatic corrections were then applied to the complete Bouguer anomalies (Tracey and Nakamura 2010) to produce the Isostatic Residual Gravity Anomaly Grid of Australia. The gravity anomalies are based on the Australian Absolute Gravity Datum 2007 and the 1994 Geodetic Datum of Australia (Tracey et al 2008).

A crustal density of 2670 kilograms per cubic metre (kg/m$^3$) was used for the calculation, with an assumed density contrast between the crust and mantle of 400 kg/m$^3$. A depth-to-mantle at sea level of 37 kilometres was used in the calculation. This was derived from the average Australian depth to the Mohorovičić discontinuity (Moho) at sea level using data from seismic studies around Australia (Goncharov et al 2007). The depth-to-Moho at sea level determined by the seismic velocities showed variations from 23.4 kilometres to 50.0 kilometres. This variability suggests that the assumption of isostasy may not be valid in certain areas. This is certainly the case in the Mount Isa region where seismic studies show a depth to Moho greater than 55 kilometres which does not occur in the Airy-Heiskanen model. However, the two models are broadly similar and the seismic data is too sparse for a national-scale crustal root model.

The complete Bouguer anomalies were gridded using a nearest neighbour gridding technique provided by the Intrepid Geophysics software package. The data were gridded to a cell size of 800 metres using Lambert Conic Conformal Projection Coordinates with standard parallels of 18° and 36° south and a central meridian of 134° east.

The geodetic version of the grid and the original onshore point located data can be downloaded free-of-charge in ERMapper format from the Australian governments' Geophysical Archive Data Delivery System (GADDS).

## References

Goncharov A, Deighton I, Tischer M & Collins C. 2007. Crustal thickness in Australia: where, how and what for? Extended Abstracts, 19th International Geophysical Conference and Exhibition. Australian Society of Exploration Geophysicists.

Nakamura A, Bacchin M, Milligan PR, Wynne P & Tracey R. 2011. Isostatic Residual Gravity Anomaly Map of Onshore Australia, scale 1:5 000 000. Geoscience Australia, Canberra. Available at: GEOCAT 69878

Simpson RW, Jachens RC & Blakely RJ. 1983. AIRYROOT: A FORTRAN program for calculating the gravitational attraction of an Airy isostatic root out to 166.7 km. United States Geological Survey Open File Report 83–883.

Tracey R, Bacchin M & Wynne P. 2008. AAGD07: A new absolute gravity datum for Australian gravity and new standards for the Australian National Gravity Database. Extended Abstracts, 19th International Geophysical Conference and Exhibition. Australian Society of Exploration Geophysicists.

Tracey R & Nakamura A. 2010. Complete Bouguer Anomalies for the Australian National Gravity Database: Extended Abstracts, 21st International Geophysical Conference and Exhibition. Australian Society of Exploration Geophysicists.

Whiteway TG. 2009. Australian Bathymetry and Topography Grid. Geoscience Australia Record 2009/21.

## For more information

**email** ausgeo@ga.gov.au

## Related articles/websites

Geophysical Archive Data Delivery System (GADDS).

www.geoscience.gov.au/gadds

INTREPID geophysical processing software

www.intrepid-geophysics.com/ig/index.php?lang=EN&menu=products-intrepidsoftware

# New geophysical datasets released

Data from eighteen airborne magnetic/radiometric, electromagnetic and gravity surveys have been released since December 2010. These datasets can be interpreted to reveal the sub-surface geology of the survey areas and will be a valuable tool in assessing their mineral potential. The marine gravity and magnetic data over the Capel and Faust basins and the southwest margin (table 4) will greatly improve the understanding of Australia's marine jurisdiction.

**Table 1.** Details of the airborne magnetic, radiometric and elevation surveys.

| Survey | Date | 1:250 000 map sheets | Line spacing/ terrain clearance/ orientation | Line km | Contractor |
|---|---|---|---|---|---|
| AWAGS Magnetic Line Data | March–December 2007 | Not applicable | 75 km/ 80 m/ north–south | 156 763 | Aeroquest Airborne Pty Ltd |
| South Canning 1 WA | July 2010–February 2011 | Runton (pt), Morris (pt), Madley (pt), Warri (pt), Herbert (pt) | 400 m/ 60 m/ north–south | 95 592 | Aeroquest Airborne Pty Ltd |
| Eucla Basin 5 (North) WA | June 2010–February 2011 | Forrest (pt) | 200 m/ 50 m/ north–south | 73 472 | Fugro Airborne Surveys Pty Ltd |
| Eucla Basin 5 (South) WA | July 2010–April 2011 | Eucla (pt), Noonaera (pt) | 200/400 m/ 50 m/ north–south | 80 247 | Fugro Airborne Surveys Pty Ltd |
| Eucla Basin 2 WA | June 2010–April 2011 | Loongana (pt), Forrest (pt), Madura (pt), Eucla (pt) | 200 m/ 50 m/ east–west | 114 562 | Fugro Airborne Surveys Pty Ltd |
| Eucla Basin 4 WA | July 2010–April 2011 | Naretha (pt), Madura (pt), Eucla (pt), Burnabbie (pt), Noonaera (pt) | 200 m/ 50 m/ east–west | 103 420 | Fugro Airborne Surveys Pty Ltd |
| SE Lachlan NSW | March 2010–October 2010 | Canberra (pt), Bega (pt), Mallacoota (pt) | 250/500 m/ 60 m/ east–west | 107 533 | Fugro Airborne Surveys Pty Ltd |
| South Canning 2 WA | July 2010–April 2011 | Morris (pt), Ryan (pt), Warri (pt), Cobb (pt) | 400 m/ 60 m/ north–south | 130 033 | Aeroquest Airborne Pty Ltd |
| East Canning 3 WA | August 2010–January 2011 | Lucas (pt), Stansmore | 200/400 m/ 50 m/ north–south | 122 591 | Thomson Aviation Pty Ltd |
| Offshore East Tasmania | February–June 2011 | Not applicable | 800 m/ 90 m/ east–west | 30 895 | Fugro Airborne Surveys Pty Ltd |

**Table 2.** Details of the gravity surveys.

| Survey | Date | 1:250 000 map sheets | Station spacing/ orientation | Stations | Contractor |
|---|---|---|---|---|---|
| West Arunta NT | June–October 2010 | Mount Solitaire (pt), Lander River (pt), Highland Rocks (pt), Mount Theo (pt), Mount Peake (pt), Lake Mackay, Mount Doreen (pt), Napperby (pt) Mount Rennie (pt), Mount Liebig (pt) Hermannsburg (pt) | 1, 2 & 4 km/ north–south, east–west grid | 12 427 | Atlas Geophysics Pty Ltd |
| Albany–Fraser North WA | October 2010–March 2011 | Rason (pt), Neale (pt), Minigwal (pt), Plumridge (pt), Cundeelee (pt), Seemore (pt) | 2.5 km/ north–south, east–west grid | 9255 | Atlas Geophysics Pty Ltd |
| Sandstone WA | August 2010–April 2011 | Glengarry (pt), Sandstone (pt), Youanmi (pt), Barlee (pt) | 2.5 km/ north–south, east–west grid | 5760 | Integrated Mapping Technologies Pty Ltd |
| South Gascoyne WA | August 2010–April 2011 | Turee Creek (pt), Mount Egerton (pt), Glenburgh (pt), Robinson Range | 2.5 km/ north–south, east–west grid | 8932 | Integrated Mapping Technologies Pty Ltd |

**Table 3.** Details of the airborne electromagnetic surveys.

| Survey | Date | 1:250 000 map sheets | Line spacing/ terrain clearance/ orientation | Stations | Contractor |
|---|---|---|---|---|---|
| Frome (TEMPEST®) SA | May 2010–April 2011 | Marree (pt), Callabonna (pt), Copley (pt), Frome (pt), Curnamona, Olary, Chowilla (pt) | 2500 & 5000 m/ 120 (aircraft), 90 (sensor)/ east–west | 32 730 | Fugro Airborne Surveys Pty Ltd |

*Table 3 continued over page*

| Survey | Date | 1:250 000 map sheets | Station spacing/ orientation | Stations | Contractor |
|---|---|---|---|---|---|
| Pine Creek–Kombolgie | August–November 2008; April 2009 | Cobourg Peninsula (pt), Junction Bay (pt), Alligator River (pt), Millingimbi (pt), Mount Evelyn (pt), Katherine (pt). | 1600 and 5000 m/ 80 (aircraft), 45 (sensor)/ east–west. | 8780 | Geotech Airborne Pty Ltd |

**Table 4.** Details of the marine magnetic and gravity surveys.

| Survey | Date | 1:250 000 map sheets | Station spacing/ orientation | Km | Contractor |
|---|---|---|---|---|---|
| Capel and Faust Basins | November–December 2006 | Not applicable | Ship track | 9126 | CGG Marine |
| Southwest margin surveys | 1960–2009 | Not applicable | Ship track | 241 000 | Various |

## For more information

**email** ausgeomail@ga.gov.au

## Related articles/websites

Geophysical Archive Data Delivery System (GADDS)
www.geoscience.gov.au/gadds

Airborne electromagnetic survey data Kombolgie Phase-2 VTEM AEM survey final inversion data and conductivity models
https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=71372

Frome Embayment Phase-2 TEMPEST™ AEM survey final inversion data and conductivity models
https://www.ga.gov.au/products/servlet/controller?event=GEOCAT_DETAILS&catno=72589

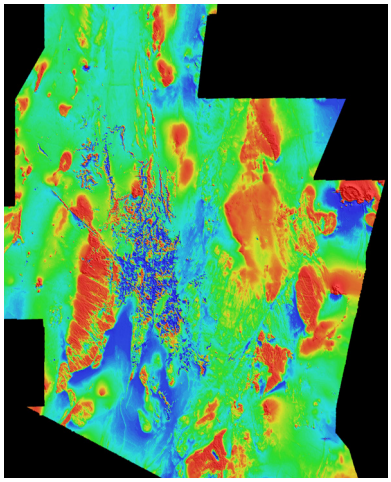

**Figure 1.** Total Magnetic Intensity image of a section of the southeast Lachlan airborne survey area.