Australian Government
Geoscience Australia

Gawler Craton Magnetotelluric Survey Report

2008 / 2009

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1. Introduction

In August 2008 and September 2009 magnetotelluric (MT) data were acquired along 220 km of the east-west 08GA-G1 Gawler deep seismic reflection transect in South Australia from near Whyalla in the east to near Yaninee on the Princes Highway in the west (Figure 1). This was a collaborative project between the University of Adelaide (UA) and Geoscience Australia (GA); GA provided funding, as part of the Australian Government's Onshore Energy Security Program (2006–2011) for UA to acquire, process and model the MT data with participation at all stages also involving GA (Geoscience Australia, 2011).

The aim of the MT survey was to produce a two-dimensional image of electrical conductivity structure of the crust and upper mantle. This information is complementary to that obtained from deep seismic reflection, gravity, magnetic and geological data, which together provide new knowledge of the crustal architecture and geodynamics of the region, important for helping to determine the potential for both mineral and energy resources.

This report provides details of the logistics of the survey: the equipment, deployment details and processing method.

2. Survey Details

2.1 Project name: Gawler MT Survey (08GA-G1 seismic line)

2.2 Acquisition Periods: 12-17 August 2008; 11-14 September 2009

2.3 Survey Type: Two-dimensional MT survey

2.4 Site Spacing: 20 km for long-period; 5-10 km for broadband

3. Location Maps

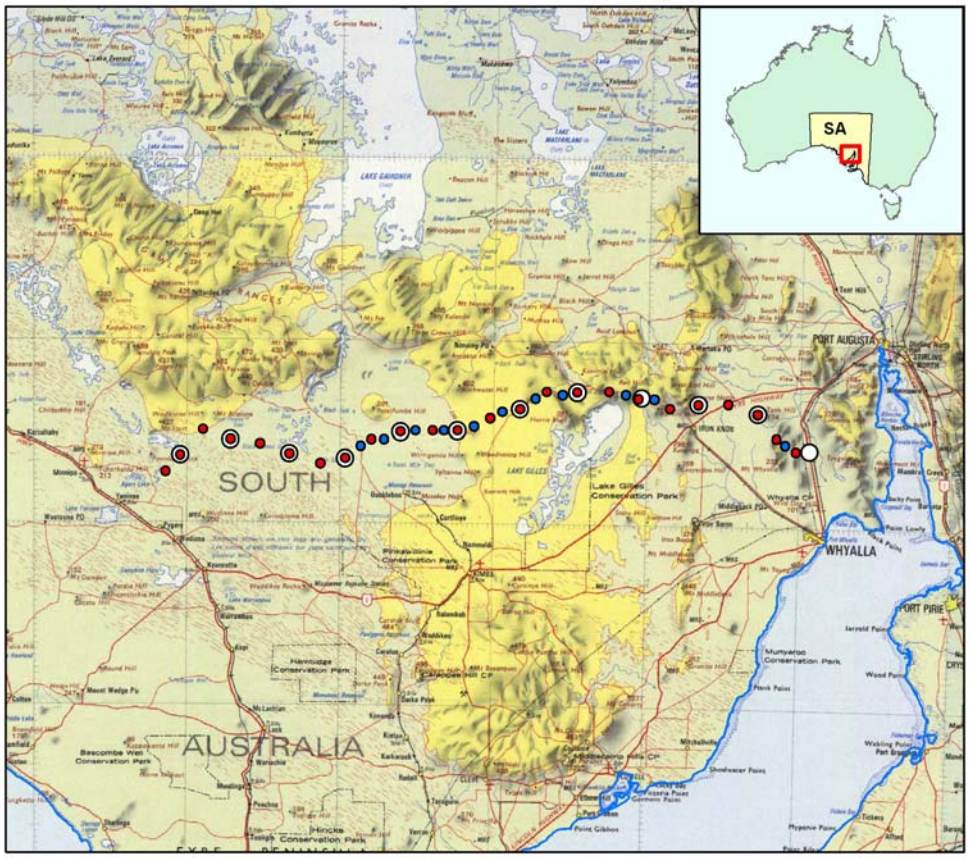

Figure 1. Locations of the magnetotelluric sites. Long-period sites in white, broadband sites in red and infill/repeat broadband sites in blue.

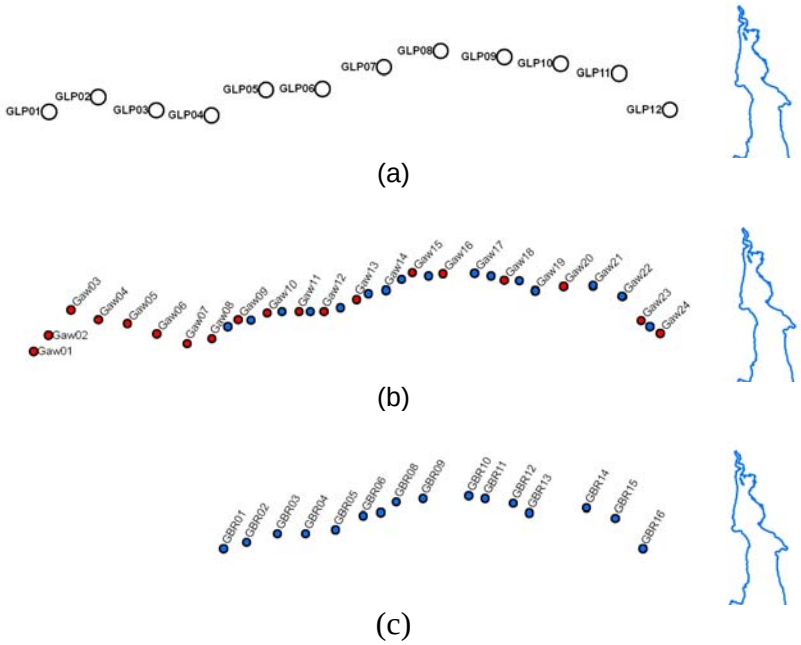

Figure 2. (a). Long-period sites, 20 km spacing, (b). Broadband sites, 5 km – 10 km spacing, (c) Broadband infill and repeat sites.

4. Acquisition Specifications

4.1 Acquisition equipment

AuScope equipment, based at the University of Adelaide, was used for the survey under ANSIR (National Research Facility in the Earth Sciences) agreement. The equipment for each site consisted of:

- One Bartington 3-axis fluxgate sensor for long-period measurements (Bartington *Mag*-01 Magnetometer).
- One Earth Data PR 6-24 Portable Field Recorder for all data logging with GPS timing synchronisation.
- Two KMS Technologies KMS LIC-120 broadband land induction coil magnetometer.
- Three non-polarising copper / copper sulphate electrodes with multi-strand connecting wires.
- One Gel-Tech 8G24M 74 AH sealed gel battery.

4.2 Acquisition field layout

The equipment was deployed at each appropriate site as depicted in Figure 3, with directions referenced to magnetic north by using a compass. This is adjusted in later processing by rotation of the data to true geographic directions by knowledge of the declination at each site.

At each long-period site the three-component Fluxgate magnetometer was deployed for measurement of magnetic field variations in three orthogonal directions (NS, WE and vertical directions). The magnetometer was buried for both stability and to minimise temperature variations.

At each broadband site two orthogonal induction coils were deployed to measure magnetic field variations in two orthogonal directions (NS and WE). The induction coils were buried in shallow trenches for stability.

The two orthogonal horizontal electric fields were measured at both long-period and broadband sites by using two orthogonal dipoles (NS and WE directions) having an average a length of 50 m each, and grounded with the three electrodes in an L-shaped configuration with an electrode in common..

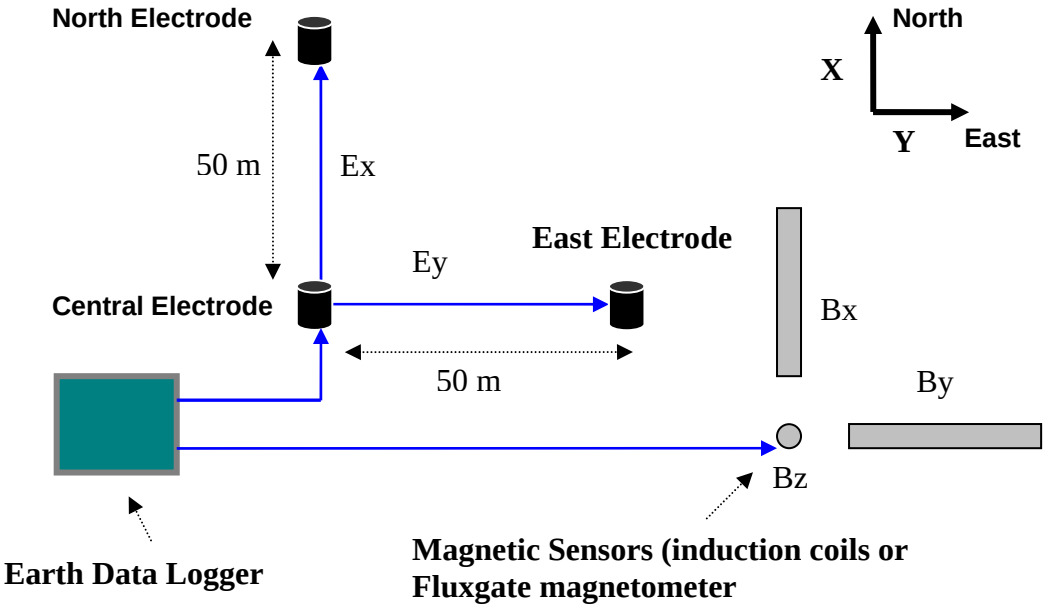

Figure 3. MT field acquisition layout.

4.3 Acquisition parameters

	Broadband	Long period
Type of data recorder	Earth data recorder (6 channels) with 30G removable hard disk	Earth data recorder (6 channels) with 30G removable hard disk
Data format	ASCII	ASCII
Sampling rate	250 Hz	10 Hz
Record time	30 - 60 hours	5 – 7 days
Site spacing	5 - 10 km	20 km
Remote-Base Synchronization	GPS clock (10µsec accuracy), 10 min correction in every hour	GPS clock (10µsec accuracy), 10 min correction in every hour
Sensor type	LEMI-120 Induction Coil	Bartington Mag-03MS Fluxgate magnetometer
Effective frequency Bandwidth	125 – 0.001 Hz	0.2 – 0.0001 Hz

Table 1. Acquisition specifications

4.4 Site locations

The sites are located in Map Grid of Australia (MGA) zone 53, and positions are referenced to the Geocentric Datum of Australia 1994 (GDA94).

Column values are:

Station Code, Date, Longitude (deg.), Latitude (deg.), Easting (m), Northing (m), Altitude (m)

Long Period

GLP01	17082008	135.48088	-32.81616	545015.78	6368990.15	103
GLP02	17082008	135.64388	-32.77350	560303.16	6373638.98	228
GLP03	16082008	135.83611	-32.81080	578273.44	6369377.37	201
GLP04	17082008	136.01897	-32.82283	595380.01	6367893.73	264
GLP05	15082008	136.19913	-32.75008	612336.72	6375782.29	168
GLP06	15082008	136.38491	-32.74508	629749.18	6376124.27	273
GLP07	13082008	136.58791	-32.68436	648870.48	6382589.75	253
GLP08	13082008	136.77388	-32.63644	666396.78	6387626.24	200
GLP09	13082008	136.98472	-32.65061	686147.45	6385705.40	208
GLP10	12082008	137.17038	-32.66525	703531.32	6383741.25	162
GLP11	12082008	137.36408	-32.68841	721642.19	6380783.97	131
GLP12	12082008	137.53486	-32.78661	737396.80	6369524.13	33

Broadband

GBB01	17082008	135.43226	-32.86106	540443.25	6364033.00	115
GBB02	17082008	135.48088	-32.81614	545014.96	6368993.11	101
GBB03	17082008	135.55405	-32.74638	551904.95	6376693.06	171
GBB04	17082008	135.64393	-32.77347	560307.03	6373642.28	225
GBB05	16082008	135.74003	-32.78345	569299.70	6372477.05	200
GBB06	16082008	135.83615	-32.81079	578277.09	6369379.06	201
GBB07	16082008	135.93753	-32.83744	587742.02	6366344.95	169
GBB08	17082008	136.01895	-32.82284	595377.92	6367893.01	259
GBB09	15082008	136.10409	-32.77071	603408.10	6373592.36	215
GBB10	15082008	136.19919	-32.75006	612341.54	6375784.82	171
GBB11	15082008	136.30421	-32.74542	622186.96	6376182.94	218
GBB12	15082008	136.38495	-32.74510	629752.27	6376122.38	270
GBB13	13082008	136.49169	-32.70999	639808.18	6379879.23	292
GBB14	13082008	136.58781	-32.68442	648860.38	6382583.37	250
GBB15	13082008	136.67454	-32.63580	657077.49	6387849.01	218
GBB16	13082008	136.77471	-32.63632	666474.04	6387638.75	204
GBB17	13082008	Replaced by GBR10				
GBB18	13082008	136.97507	-32.65177	685239.62	6385593.78	205
GBB19	13082008	137.07813	-32.67740	694851.59	6382567.23	182
GBB20	12082008	137.17059	-32.66547	703549.68	6383716.47	164
GBB21	13082008	Replaced by GBR14				
GBB22	12082008	137.36379	-32.68867	721614.05	6380756.49	123
GBB23	12082008	137.42754	-32.75453	727424.96	6373317.75	119
GBB24	12082008	137.49113	-32.78825	733295.89	6369439.73	114

Broadband infill/repeat

GBR01	11092009	136.06967	-32.78862	600164.13	6371639.89	236
GBR02	11092009	136.14606	-32.77127	607338.52	6373488.49	202
GBR03	11092009	136.24782	-32.74583	616903.08	6376201.14	165
GBR04	11092009	136.34126	-32.74507	625658.80	6376178.39	236
GBR05	12092009	136.43926	-32.73323	634858.75	6377370.56	293
GBR06	12092009	136.53096	-32.69276	643516.69	6381737.06	264
GBR07	12092009	136.58758	-32.68440	648838.85	6382585.91	251
GBR08	12092009	136.63827	-32.65467	653642.57	6385809.90	217
GBR09	13092009	136.72697	-32.64356	661982.23	6386909.85	200
GBR10	13092009	136.87803	-32.63329	676173.18	6387808.03	214
GBR11	13092009	136.93260	-32.64076	681277.99	6386887.90	229
GBR12	13092009	137.02555	-32.65232	689973.74	6385443.57	209
GBR13	14092009	137.07852	-32.67782	694887.25	6382519.95	185
GBR14	14092009	137.26799	-32.66122	712695.52	6383996.66	109
GBR15	14092009	137.36314	-32.68756	721555.84	6380880.94	109
GBR16	14092009	137.45564	-32.77027	730017.68	6371511.46	114

5. Data Processing

The raw MT data acquired in the field consisted of measurements of time series of the various components of the magnetic and electric fields. Data for each site were processed by using the robust algorithm BIRRP (Chave and Thomson, 1987 and 2004) with remote referencing to coincident data of other sites wherever possible. The aim of this process was to remove outliers in the time series measurements (e.g., from a passing train) and produced a robust estimation of the transfer function to obtain a series of power spectral estimates between the electric and magnetic fields for each MT site. The spectral estimates were converted into MT impedance tensor values, from which the apparent resistivity and phase as a function of frequency were calculated. The impedance values and other fundamental quantities are stored in a standard Electrical Data Interchange (EDI) file format.

6. References

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