



Australian Government

Geoscience Australia



Government of **Western Australia**
Department of **Mines and Petroleum**

**Yilgarn – Officer – Musgrave (YOM)
Magnetotelluric Survey Report**

Onshore Seismic and Magnetotelluric Section

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1. Introduction

In June - July 2011 as part of the Australian Government's Onshore Energy Security Program (2006-2011) Geoscience Australia in collaboration with Geological Survey of Western Australia acquired magnetotelluric (MT) data along the deep crustal seismic reflection transect across the Yilgarn Craton, Officer Basin and Musgrave Province in Central Western Australia.

The aim of the MT survey is to map the electrical resistivity distribution and improve scientific understanding of the crustal and upper mantle structure in this region. This information is complementary to that obtained from deep crustal seismic reflection, seismic refraction, potential field and geological data, which together provide new knowledge of the crustal architecture and geodynamics of the region. It is important for helping to determine the potential for both mineral and energy resources.

2. Survey Details

2.1 Project Name: Yilgarn Craton - Officer Basin - Musgrave Province (YOM) magnetotelluric survey (2011GA_YOM, L199 seismic reflection line)

2.2 Acquisition Period: 3rd June – 10th July 2011

2.3 Survey Type: two dimensional MT profile

2.4 Survey Map: see Appendix A and Appendix B for survey location and MT sites.

2.5 Data Acquisition

Geoscience Australia had taken a major role in the planning, design and operation of the survey. The YOM MT data were acquired at the 73 broadband and 31 long period sites with station spacing 5 - 20 km along ~487 km profile in the Great Central Road. See Appendix C for detail of site location.

3. Acquisition Specifications

3.1 Acquisition Equipment

AuScope MT equipment (broadband and long period) was used for data acquisition through ANSIR (National Research Facility in the Earth Sciences) agreement. Data were recorded on high dynamic range Earth Data Recorder with GPS timing synchronization. The instrumentation used for sensing magnetic data included two induction coils for the higher frequencies (broadband) and three component fluxgate magnetometers for the lower frequencies (long period). Electric field measurements were using three non-polarising copper/copper sulphate electrodes with wires. Data QA/QC was conducted during the acquisition.



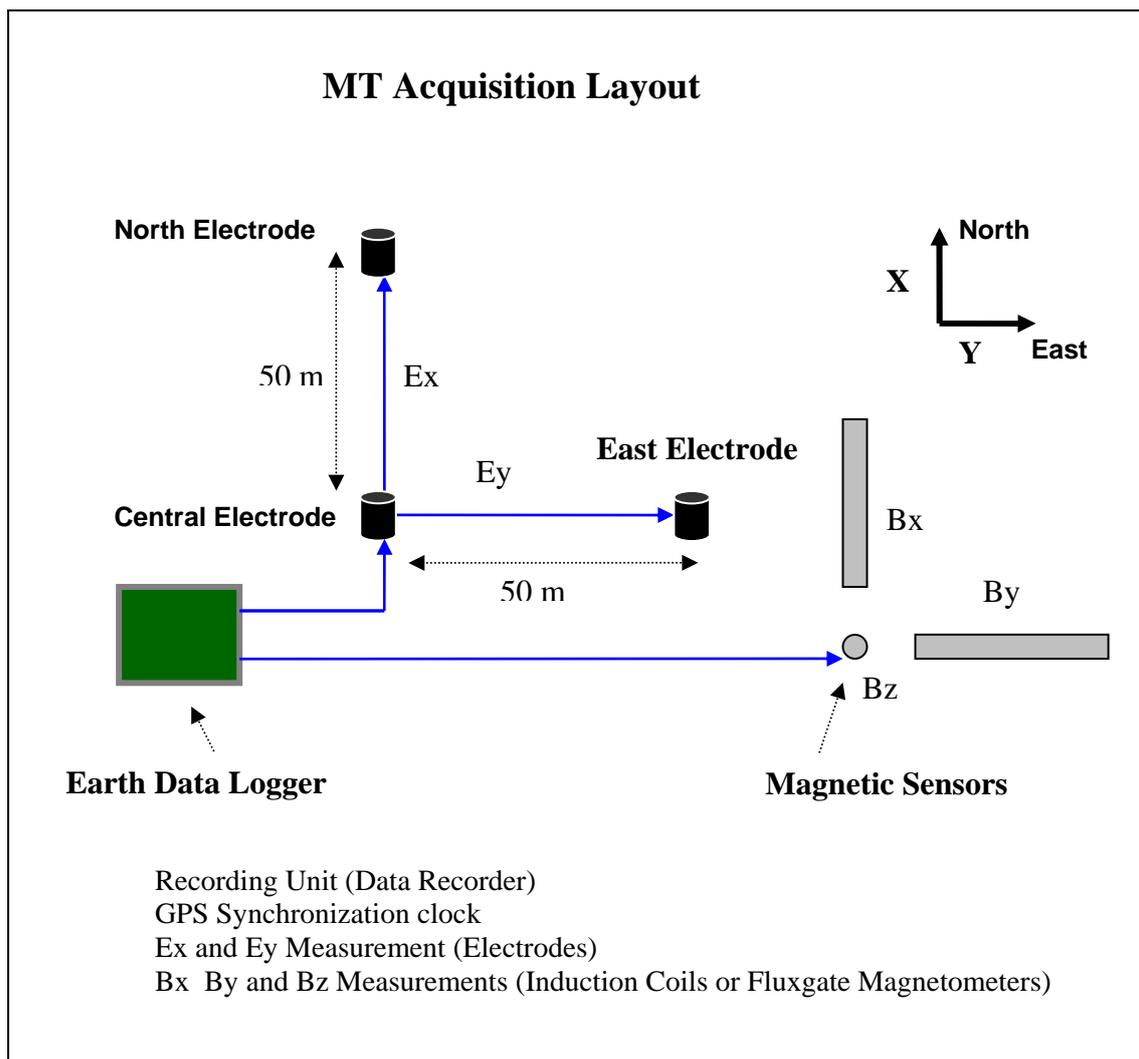
3.2 Acquisition Layout

The equipment was deployed at each site as depicted in the acquisition layout 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 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.

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.

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



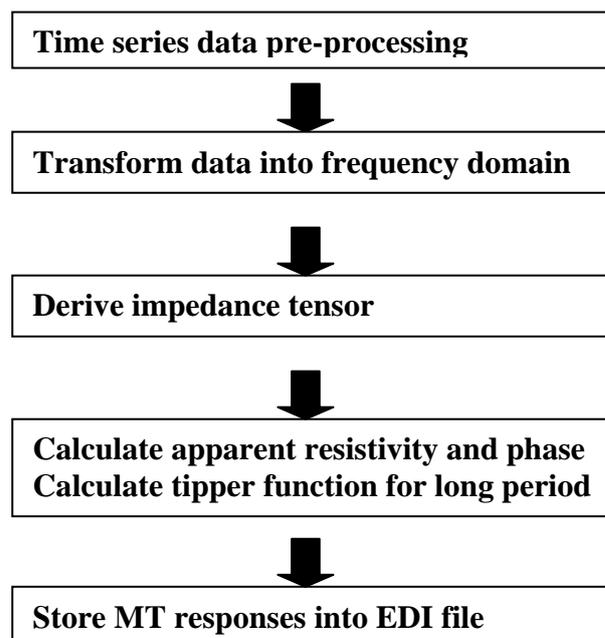
3.3 Acquisition Parameters

Table 1:

	Broadband	Long period
Model of data recorder	Earth Data Recorder PR 6-24	Earth Data Recorder PR 6-24
Data format	ASCII	ASCII
Sampling rate	1000 Hz	10 Hz
Record time	30 - 60 hours	4 - 7 days
Site spacing	5 - 10 km	10 - 20 km
Remote-Base Synchronization	GPS clock (10 μ sec accuracy)	GPS clock
Sensor type	LEMI-120 Induction Coil	Bartington Mag-03MS Fluxgate magnetometer
Effective frequency Bandwidth	200 - 0.01 Hz	0.2 - 0.0002 Hz

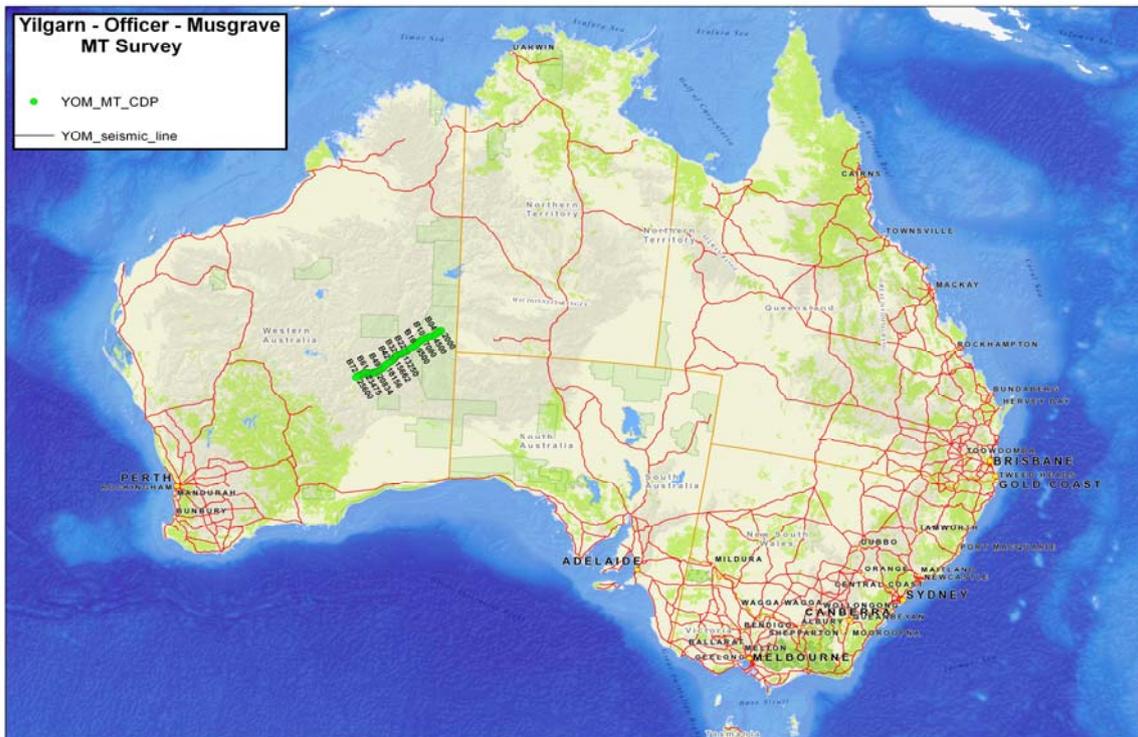
4. Data Processing

The MT data were collected in time series measurements with reasonable quality. Time series data were processed using the robust algorithm BIRRP (Chave and Thomson 1987 and 2004) with remote reference data when available. The aim of the process was to remove outliers in the time series measurements 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. Then the apparent resistivity and phase as a function of frequency were calculated. The impedance tensor estimates and other fundamental quantities are stored in a standard Electrical Data Interchange (EDI) file.



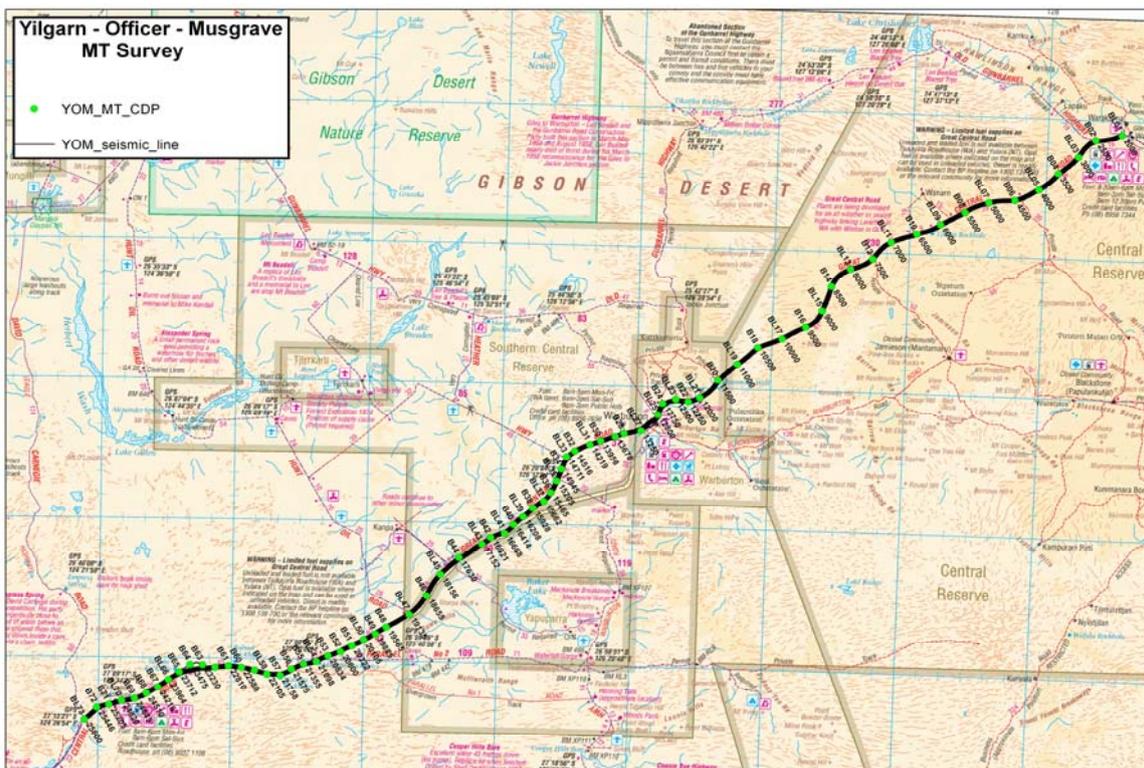
Appendix A: Survey location map

MT survey sites plot on topographic map. Green points – broadband MT sites.



Appendix B: Survey location map with MT sites

MT survey sites plot on topographic map. Black line – deep crustal seismic reflection traverse. Green points – broadband MT sites.



Appendix C: MT sites location

The sites are located in Map Grid of Australia (MGA) zone 51 and zone 52, and positions are referenced to the Geocentric Datum of Australia 1994 (GDA94).

The MT broadband sites denoted with prefix B* and MT long period sites denoted with prefix L*.

Site Name	Latitude (degree)	Longitude (degree)	Elevation (m)	Magnetic declination
B01 (L01)	-25.04820	128.27279	581	3.644
B02	-25.06974	128.17672	559	3.619
B03 (L02)	-25.13284	128.11526	574	3.604
B04	-25.19512	128.04230	568	3.586
B05 (L03)	-25.25565	127.97280	532	3.568
B06	-25.29591	127.88555	541	3.546
B07 (L04)	-25.30696	127.78885	540	3.520
B08	-25.34453	127.70198	572	3.497
B09 (L05)	-25.39045	127.61269	575	3.474
B10	-25.42702	127.52538	572	3.451
B11 (L06)	-25.45921	127.43154	536	3.426
B12	-25.52063	127.36492	537	3.408
B13 (L07)	-25.55944	127.28452	526	3.386
B14	-25.62224	127.21481	570	3.367
B15 (L08)	-25.70971	127.18316	562	3.359
B16	-25.77061	127.12383	553	3.342
B17 (L09)	-25.81448	127.03721	524	3.318
B18	-25.84861	126.94801	488	3.293
B19 (L10)	-25.91132	126.87330	518	3.272
B20	-25.96985	126.80329	543	3.252
B21 (L11)	-26.03469	126.73714	518	3.233
B22	-26.04859	126.69429	506	3.221
B23 (L12)	-26.04256	126.64720	502	3.208
B24	-26.05819	126.59951	486	3.194
B25 (L13)	-26.09605	126.57928	426	3.189
B26	-26.13869	126.56546	464	3.178
B27 (L14)	-26.15721	126.52079	450	3.171
B28	-26.16838	126.45762	456	3.153
B29 (L15)	-26.17979	126.42449	474	3.143
B30	-26.19726	126.37143	474	3.128
B31 (L16)	-26.21113	126.33083	451	3.116
B32	-26.23457	126.27482	432	3.101
B33 (L17)	-26.25614	126.24546	478	3.092
B34	-26.29953	126.22616	455	3.085
B35 (L18)	-26.34256	126.20992	484	3.079
B36	-26.38508	126.18915	495	3.073
B37 (L19)	-26.41608	126.16372	460	3.064
B38	-26.44169	126.12315	439	3.052



B39 (L20)	-26.47282	126.08773	451	3.041
B40	-26.50200	126.05204	477	3.030
B41 (L21)	-26.53519	126.01940	442	3.020
B42	-26.55163	125.96765	415	3.005
B43 (L22)	-26.57665	125.93569	435	2.995
B44	-26.62651	125.85054	437	2.969
B45 (L23)	-26.68758	125.78217	472	2.947
B46	-26.76426	125.73206	483	2.930
B47 (L24)	-26.83239	125.66759	482	2.909
B48	-26.87940	125.58256	446	2.882
B49	-26.90398	125.54202	409	2.870
B50 (L25)	-26.92520	125.49794	416	2.856
B51	-26.94725	125.45454	421	2.843
B52	-26.96921	125.41185	446	2.829
B53	-26.98469	125.36461	444	2.815
B54 (L26)	-27.00591	125.32142	438	2.801
B55	-27.01493	125.27299	439	2.787
B56	-27.03441	125.22780	443	2.773
B57	-27.05705	125.18572	450	2.759
B58 (L27)	-27.05349	125.13576	461	2.745
B59	-27.04015	125.08801	453	2.732
B60	-27.03109	125.03929	428	2.718
B61	-27.02565	124.98965	463	2.704
B62 (L28)	-27.03209	124.93981	471	2.689
B63	-27.02397	124.89193	456	2.676
B64	-27.02351	124.84477	449	2.662
B65	-27.05059	124.80448	456	2.649
B66 (L29)	-27.07745	124.76398	450	2.636
B67	-27.10529	124.72434	450	2.623
B68	-27.12698	124.68100	457	2.609
B69	-27.14586	124.63665	451	2.595
B70 (L30)	-27.15513	124.58788	441	2.580
B71	-27.16858	124.53989	443	2.565
B72	-27.17930	124.49425	439	2.551
B73 (L31)	-27.22293	124.44778	387	2.535

Appendix D: References

Chave A.D. Thompson D.J. and Ander M.E. 1987. On the robust estimation of power spectra coherences and transfer functions. *Journal of Geophysical Research-Solid Earth* **92** 633-648.

Chave A.D. and Thomson D.J. 2004. Bounded influence magnetotelluric response function estimation. *Geophysical Journal International* **157(3)** 988–1006.

