Magnetotelluric Survey Report for KUTh Exploration Pty Ltd

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Summary

During the period 17/5/2009 to 28/06/2009 broadband data was collected at 158 of the proposed ~160 sites along three profiles for KUTh Exploration Pty Ltd. Transient electromagnetic (TEM) soundings were performed at 191 sites including some sites from the 2008 survey in an attempt to correct for static shift. It was originally planned to perform the TEM soundings at the same time as the MT sounding but unfortunately because of instrument problems the TEM sounding were done after the MT survey was completed.

Acquisition

The red dots in Figure 1 show the locations where MT data were collected. The data were collect predominantly along three profiles. Outliers were also collected with the aim of identifying 3D structures within the survey area.

The Phoenix-made MTU-5A data recorders and MTC-50 induction coils were used to record MT data for this survey. Three components of the magnetic field (Hx, Hy and Hz) and 2 components of the electric field were recorded at all sites except for a few sites where the Hz component was omitted because of difficult digging conditions (see figure 2 for a typical site setup). Times series data were recorded for a average of ~16 hours at each site in an effort to resolve apparent resistivity and phase to a period of 100 seconds.

At the commencement of the survey all of the induction coils were calibrated to calculate the response of each coil to a known signal over a range of frequencies. The calibration files were then used for processing. Parallel tests were also performed to ensure all induction coils were measuring the same signal.

Figure 1: MT site locations from 2008 (blue) and 2009 (red).

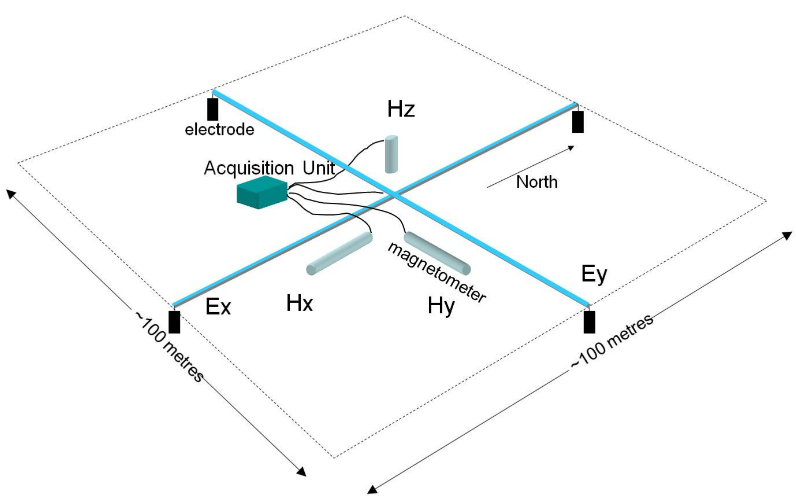

Figure 2: Typical Site layout.

Processing and Data Quality

The function of data processing is to take the raw time series and produce MT impedance responses, as a function of frequency, from which interpretations and inversions can be performed. This is achieved by extraction of frequencies from the time series using Fourier transforms. In a homogeneous or horizontally-layered Earth, and in the absence of noise, the procedure for calculating the apparent resistivity is simply to square the ratio of a set of orthogonal E and H pairs at a certain frequency and then multiply by the appropriate constant. The time series data is processing by the Phoenix SSMT software to produce apparent resistivity and phase values (which are calculated from the impedance response). The apparent resistivity and phase values are stored in EDI files. The EDI format is the industry standard format for processed magnetotelluric data as define by the SEG. The Phoenix processing software is based on the robust processing jackknife approach of Jones and Jodicke (1984). In most cased the remote reference processing technique of Gamble et al, 1979, was also employed to reduce biasing on spectral impedance estimates.

Because the 2009 survey was run in a similar area to the 2008 survey many of the same technical issue were experienced. The data quality during the survey was quite variable. Poor data quality is due to two reasons; 1) low signal and 2) the presence of electrical noise. Generally, in the field a qualitative assessment is made of the data is made by inspecting the continuity of the time series data. Smooth continuous times series generally indicates high quality data (e.g. figure 3). Spikes and edges within data usually degrade the quality and are usually from a cultural or atmospheric source (e.g. figure 4). During the 2009 survey the main source of cultural noise was from electric fences. Atmospheric noise was coincident with rain periods and resulted and spiking in the time series but this was not a common occurrence. The signal that is utilized in MT at periods greater than 1 second come from solar radiation and is roughly coincident with the number of sunspots (the greater the number of sunspots the better the signal). The number of sunspots generally varies through an 11 year cycle and at present we are in the minimum of the cycle so the signal has been quite low. Low signal is particular problematic in the period range 5-50 seconds. As was the case with the 2008 survey, the signal strength during the 2009 survey was low which made acquire good quality data challenging.

The TDEM data was generally OK. Smooth decay curves were generally obtained out to ~3msec which will allow for overlap with the MT data. Poor data appeared to be associated with higher elevations around the Lake Leake area. This may be due to the outcropping electrically resistive dolerite in the area giving a very small secondary response in the TDEM receiver.

Deliverables

Time Series is recorded at 3 sample rates, 15, 150 and 2400 Hz and written to 3 separate files (*.TS3, *.TS4 and *.TS5) as well as a table file (*.TBL) containing recording parameters. These 4 files for each site will be delivered to KUTh. I would expect that the consultant interpreting these data would have the capabilities to read these data. I can organize for the time series data to be converted to ascii format if required.

Prior to the commencement of the survey all of the magnetic sensors were calibrated. The calibration files will also be delivered.

The time series data is processed to produce apparent resistivity and phase curves and is written to one *.EDI file for each site and will be delivered to KUTh. The data have been processed using the Phoenix proprietary processing software. Every effort was made to improve the quality of the processed data through cross power editing and the exclusion of contaminated data.

TDEM data are delivered as a *.tem file. Appendix 1 described the format of the *tem files.

Two text files will be included to provide actual locations for each of the sites that were surveyed. This information is also contained within the EDI files.

References

Gamble, T.D., Goubau, W.M., and Clark, J., 1979, Magnetotellurics with a Remote Reference: Geophysics, **44**: 53.

Jones, A.G. and Jödicke, H., 1984. Magnetotelluric transfer function estimation improvement by a coherence-based rejection technique. *54th* Society of Exploration Geophysics Annual General Meeting. Atlanta, Georgia, U.S.A., December 2-6. Abstract volume pages 51-55.

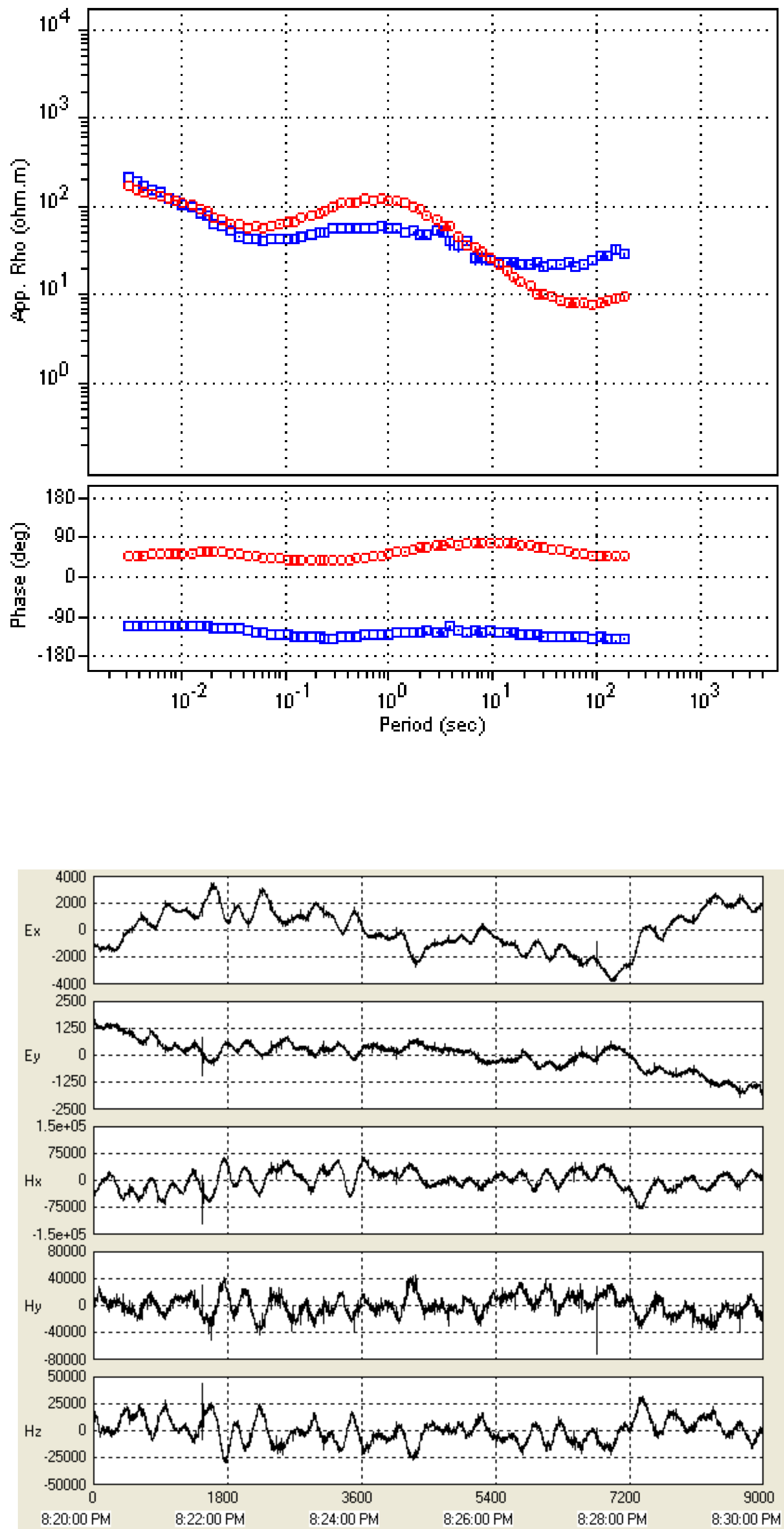

Figure 3: Example of high quality processed data (top) and time series (bottom) from site EWO007.

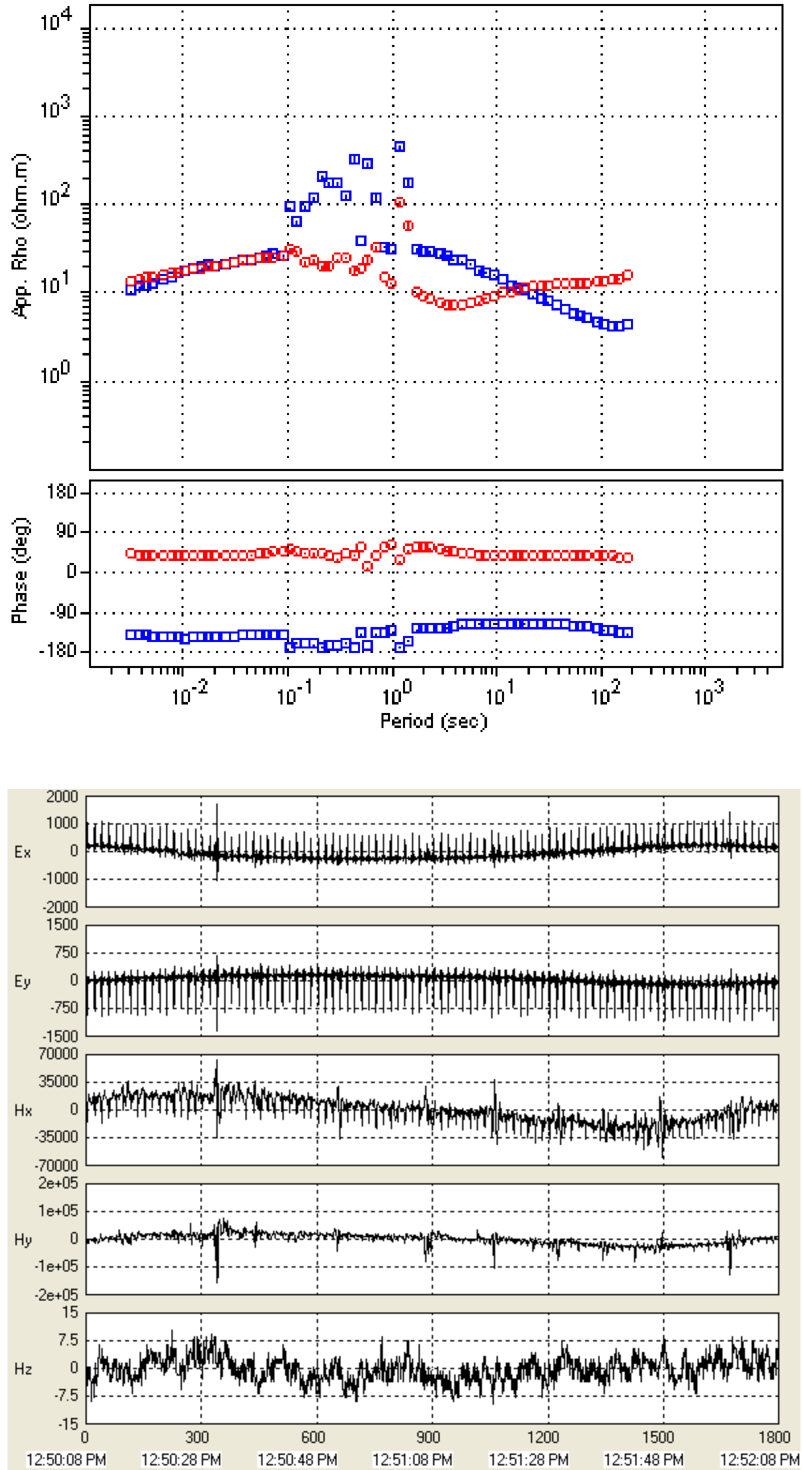

Figure 4: Example of processed data (top) and time series data (bottom) contaminated by electric fence noise from site EWA022.

APPENDIX 1

TerraTem Intermediate Time Series

NUMTIMES:116

Delay	Width	Delay	Width	Delay	Width
0.0015	0.002	0.4165	0.032	13.8085	1.024
0.0035	0.002	0.4485	0.032	14.8325	1.024
0.0055	0.002	0.4805	0.032	15.8565	1.024
0.0075	0.002	0.5285	0.064	17.3925	2.048
0.0095	0.002	0.5925	0.064	19.4405	2.048
0.0115	0.002	0.6565	0.064	21.4885	2.048
0.0135	0.002	0.7205	0.064	23.5365	2.048
0.0155	0.002	0.7845	0.064	25.5845	2.048
0.0185	0.004	0.8485	0.064	27.6325	2.048
0.0225	0.004	0.9125	0.064	29.6805	2.048
0.0265	0.004	0.9765	0.064	31.7285	2.048
0.0305	0.004	1.0725	0.128	34.8005	4.096
0.0345	0.004	1.2005	0.128	38.8965	4.096
0.0385	0.004	1.3285	0.128	42.9925	4.096
0.0425	0.004	1.4565	0.128	47.0885	4.096
0.0465	0.004	1.5845	0.128	51.1845	4.096
0.0525	0.008	1.7125	0.128	55.2805	4.096
0.0605	0.008	1.8405	0.128	59.3765	4.096
0.0685	0.008	1.9685	0.128	63.4725	4.096
0.0765	0.008	2.1605	0.256	69.6165	8.192
0.0845	0.008	2.4165	0.256	77.8085	8.192
0.0925	0.008	2.6725	0.256	86.0005	8.192
0.1005	0.008	2.9285	0.256	94.1925	8.192
0.1085	0.008	3.1845	0.256	98.2885	8.192
0.1205	0.016	3.4405	0.256	106.4805	8.192
0.1365	0.016	3.6965	0.256	114.6725	8.192
0.1525	0.016	3.9525	0.256	122.8645	8.192
0.1685	0.016	4.3365	0.512	131.0565	16.384
0.1845	0.016	4.8485	0.512	147.4405	16.384
0.2005	0.016	5.3605	0.512	163.8245	16.384
0.2165	0.016	5.8725	0.512	180.2085	16.384
0.2325	0.016	6.3845	0.512	204.7845	16.384
0.2565	0.032	6.8965	0.512	221.1685	16.384
0.2885	0.032	7.4085	0.512	237.5525	16.384
0.3205	0.032	7.9205	0.512	253.9365	16.384
0.3525	0.032	8.6885	1.024	278.5125	32.768
0.3845	0.032	9.7125	1.024	311.2805	32.768
		10.7365	1.024	344.0485	32.768
		11.7605	1.024	376.8165	32.768
		12.7845	1.024		