Interpretation of Balfour
2001/2002 Tasmanian Geological Survey
Helicopter EM data
EL 27/2005
Temma

For

JAGUAR MINERALS

By

Jovan Silic Ph. D.

Flagstaff GeoConsultants

(JSA Pty Ltd)

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Analysis of 45 responses within the Balfour 2001/2002 helicopter electromagnetic data over EL 27/2005 had identified 7 targets as potentially representing conductors that require further geological and/or geophysical ground follow up. Most of these targets are good/excellent quality conductors and appear to be isolated 3D conductive bodies. Some are within or at the contacts to shallow magnetic lithologies, whereas two or the targets are in area that may contain lithological conductors. The conductivity and geometry of the identified targets is variable and in some cases complex. As a result accurate targeting of these conductors may require collection of ground EM data, depending on which part of the EM conductor is identified for targeting.

Analysis of the HEM system noise levels has also demonstrated that even in very clean EM backgrounds the maximum penetration of the system for 3D EM targets was between 50 – 75 meters.

INTRODUCTION

A total of 15600 line kilometres of regional helicopter electromagnetic (HEM) data were acquired in four separate areas during 2001 and 2002, as part of the Western Tasmanian Regional minerals Program (Reid 2003). The survey areas are prospective for a wide range of mineralization styles; including Palaeozoic VHMS replacement tin skarns, vein lead-zinc silver, gold, nickel and copper.

The purpose of this report however is to give the results of the analysis of the HEM data from one of the four flown areas, namely the Balfour survey which encompasses the Temma exploration licence or EL 27/2005 of Jaguar Minerals Ltd (Figure 1) .

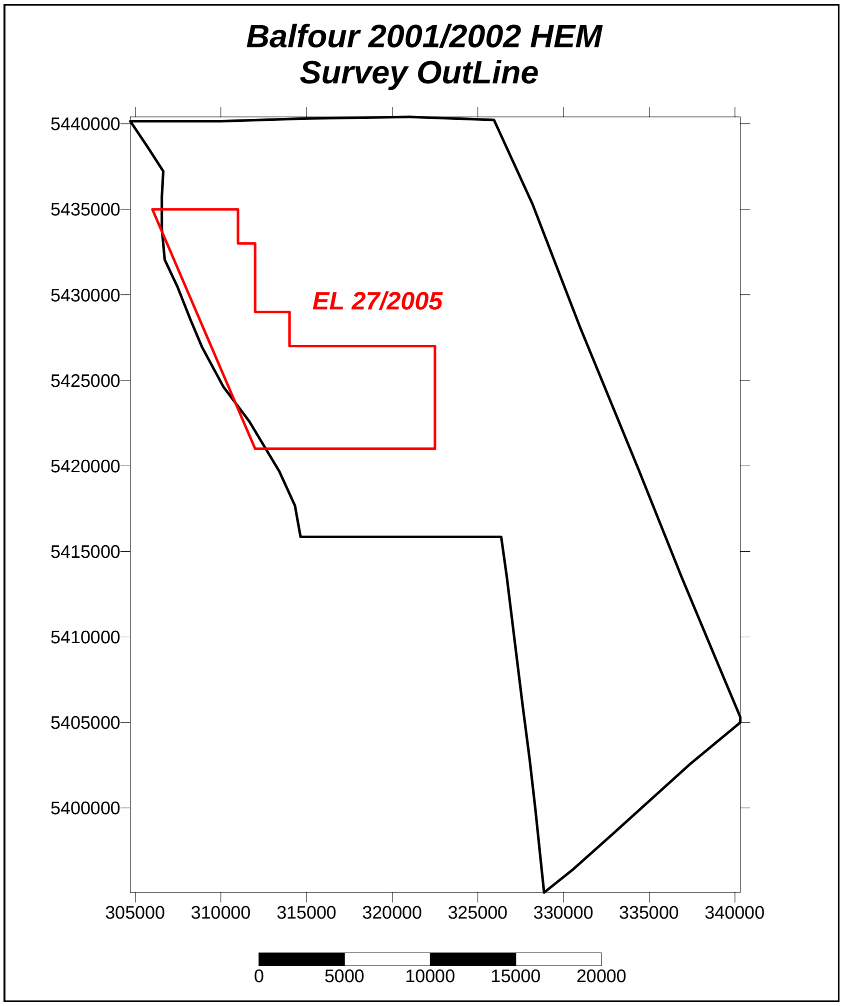


Figure1: Balfour 2001/2002 HEM Survey Outline.

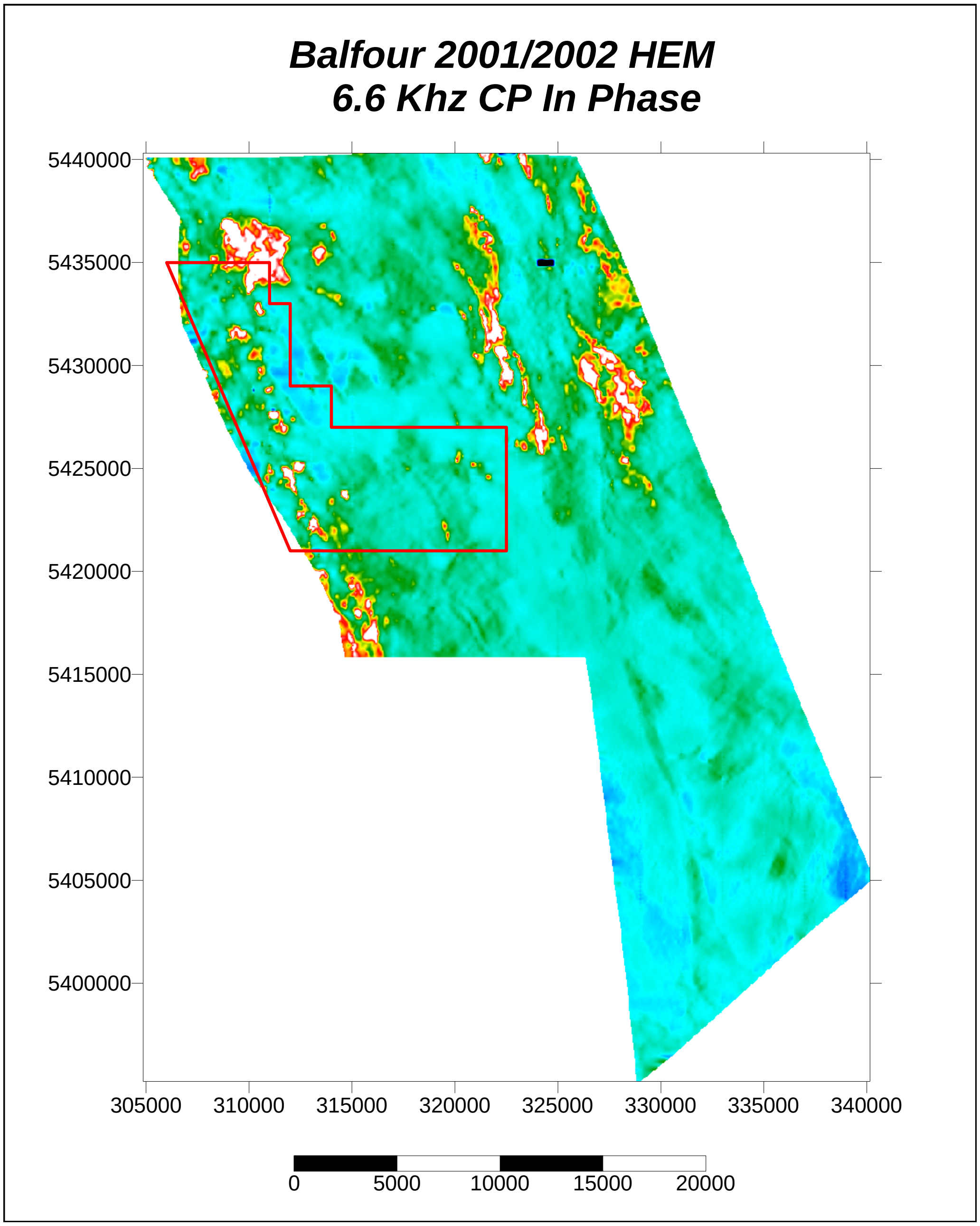


Figure 1a: ***Balfour 2001/2002 HEM 6.6 Khz In Phase***

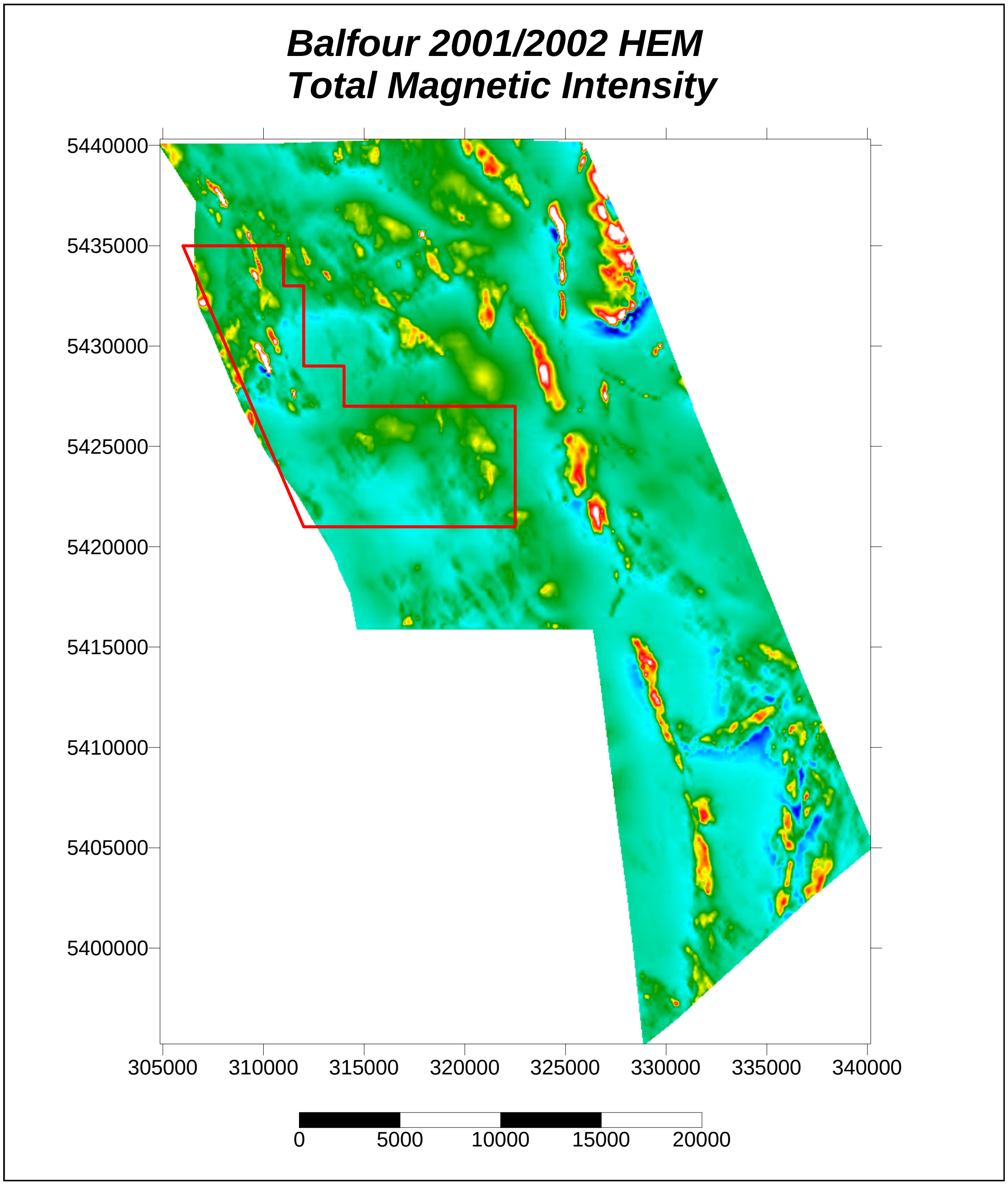


Figure 1b: Balfour 2001/2002 HEM Total Magnetic Intensity

DATA ACQUISITION

Data were acquired using the Geotech Hummingbird HEM system. The survey contractors were Geo Instruments Ltd (January 2001) and Fugro Airborne Surveys (Late 2001 – 2002).

The Hummingbird HEM system employs both horizontal coplanar (HCP) and vertical coaxial (VCX) transmitter receiver geometries. Typical system parameters are listed in table 1.

Table 1.

Hummingbird System Parameter		
Frequency (Hz)	Coil Separation (In)	Orientation
34111	5.10	HCP
7004	6.29	VCX
6600	6.29	VCP
985	6.03	VCX
880	6.03	VCP

Nominal bird height for the survey was 30 m, although actual heights were often greater than this due to the rugged and heavily forested terrain. Flight lines at 200 meter line spacing were directed east-west in the Balfour survey area.

HEM RESPONSE OVER CONDUCTIVE TARGETS

To illustrate the nature of HEM responses of the Hummingbird system a number of theoretical models were generated for a 200 x 200 meters plate (thin) like conductor with a conductivity thickness product of 50 siemens and variable depth to top and dip. This target was set within a relatively resistive basement of 500 ohm-meters. The **target's conductivity- thickness product controls the ratio of in-phase to out-phase response; larger values better the conductor.**

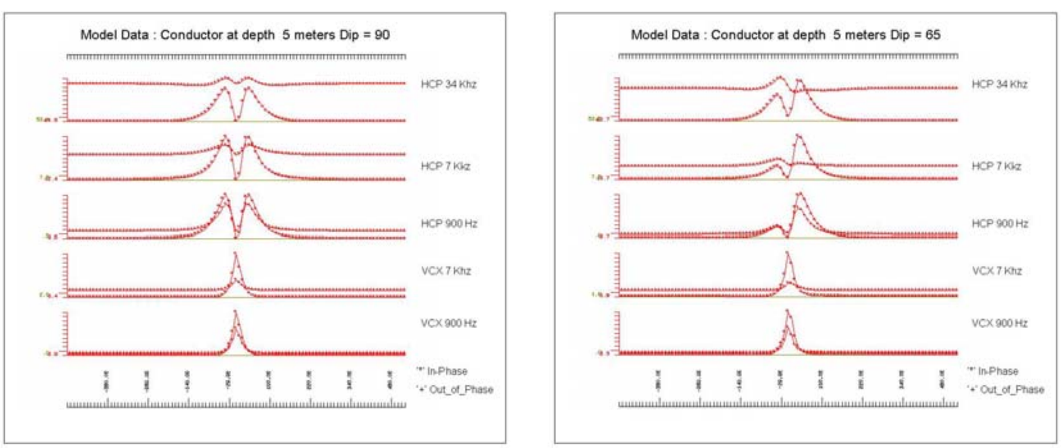


Figure 2 & 2a: *Model Data: Conductor at depth 5 meters Dip 90 and 65*

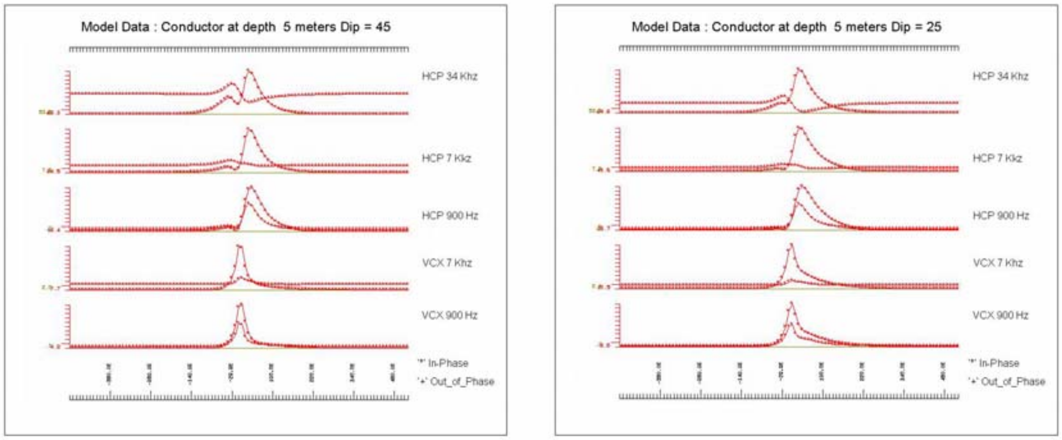


Figure 2b & 2c: *Model Data: Conductor at depth 5 meters Dip 45 and 25*

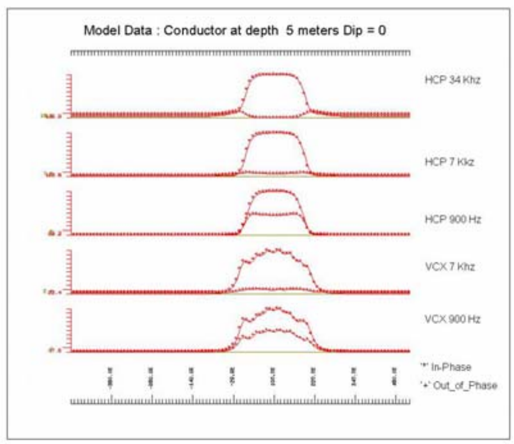
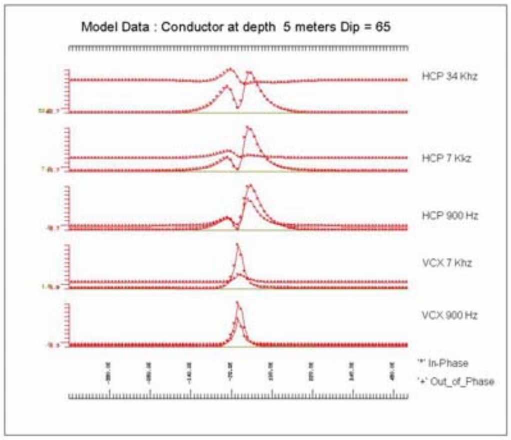


Figure 2d: *Model Data: Conductor at depth 5 meters Dip 0*

As is evident from profiles in the Figure 2 to 2d, the response over plate like targets are invariable characterised by a localised minimum in the coplanar (HCP) response over the top of the target and a peak in the coaxial (VCX) anomaly at the target location. T**he peak in the coplanar anomaly generally does not correspond or coincide to the maximum in the coaxial response**. This offset between the coplanar and coaxial anomaly peak is related to the dip of the target (Figures 2 – 2c). These is true for all the conductors with dips significantly greater than zero (or flat) and as is evident in Figure 2d, over the relatively flat laying targets the profile shapes of the coaxial and coplanar anomalies are indeed similar. These modelling results than essentially illustrate that the analysis of the relationship between the coaxial and coplanar responses can be used to determine or at least estimate the geometry of the conductor causing the response.



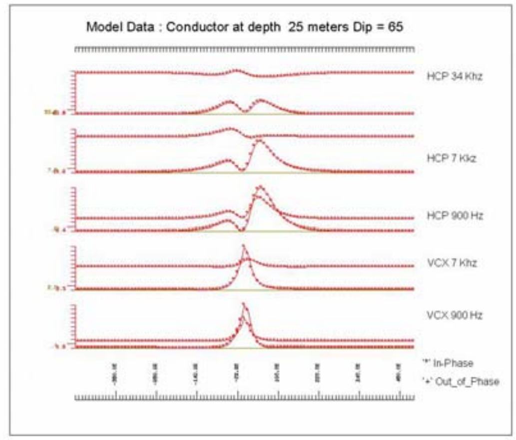
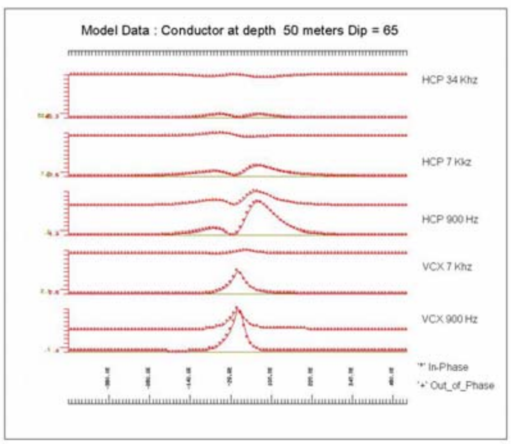


Figure 3 & 3a: *Model Data: Conductor at depth 5 and 25 meters Dip 65*



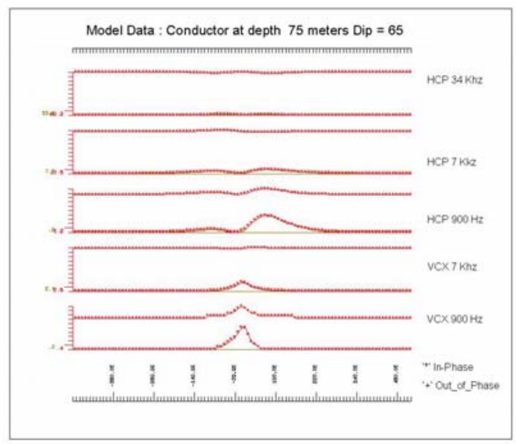


Figure 3b & 3c: *Model Data: Conductor at depth 50 and 75 meters Dip 65*

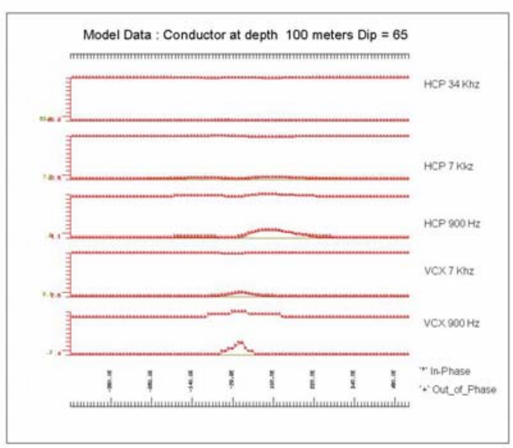


Figure 3d: *Model Data: Conductor at depth 100 meters Dip 65*

Profiles of modelled data as shown in Figures 3 to 3c, however illustrate the “dramatic” decrease in the target response with target depth. In fact considering the noise levels for the Balfour survey and using these results it can be estimated that the penetration of the Hummingbird HEM system for isolated 3D conductive targets was not more than 75 meters, and in some cases not more than 50 meters.

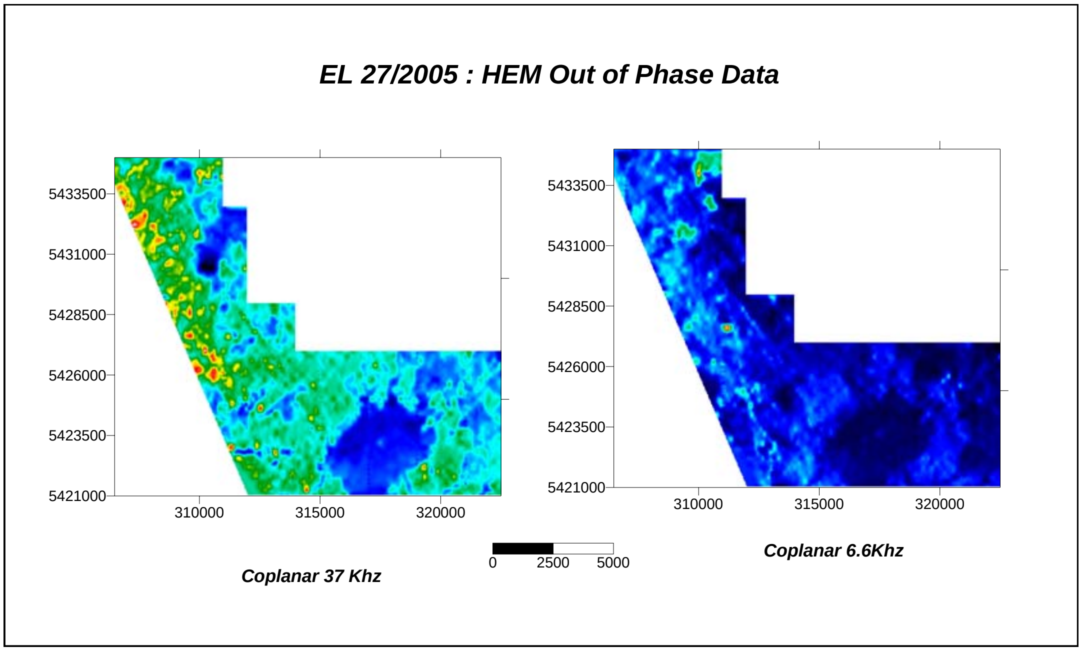


Figure 4: EL 27/2005: HEM Out of Phase Data

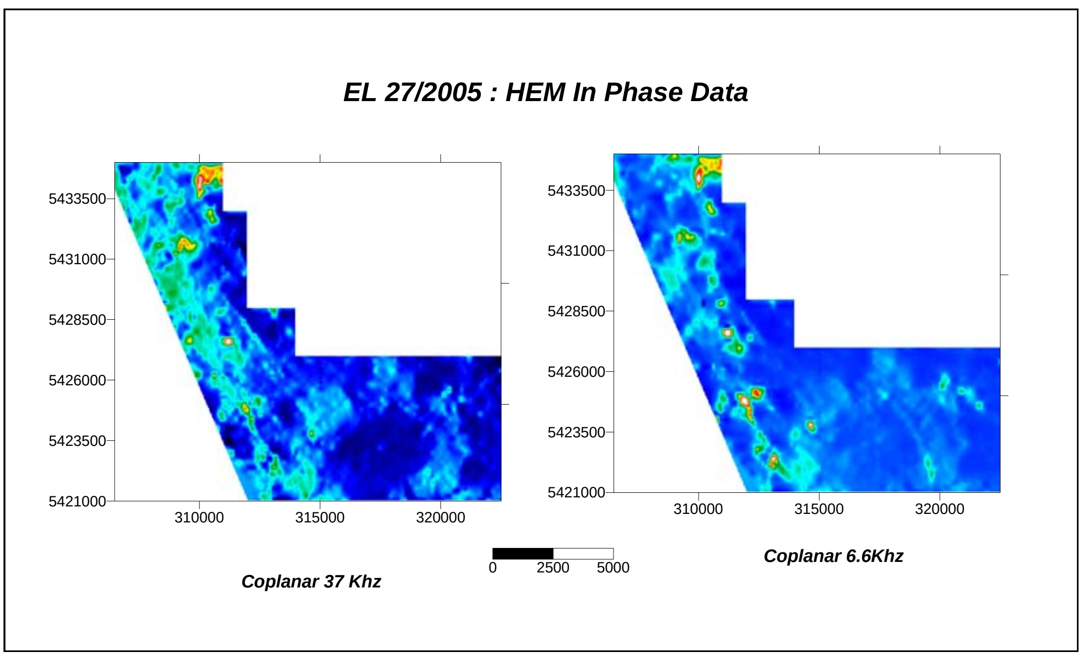


Figure 4a: EL 27/2005: HEM in Phase Data

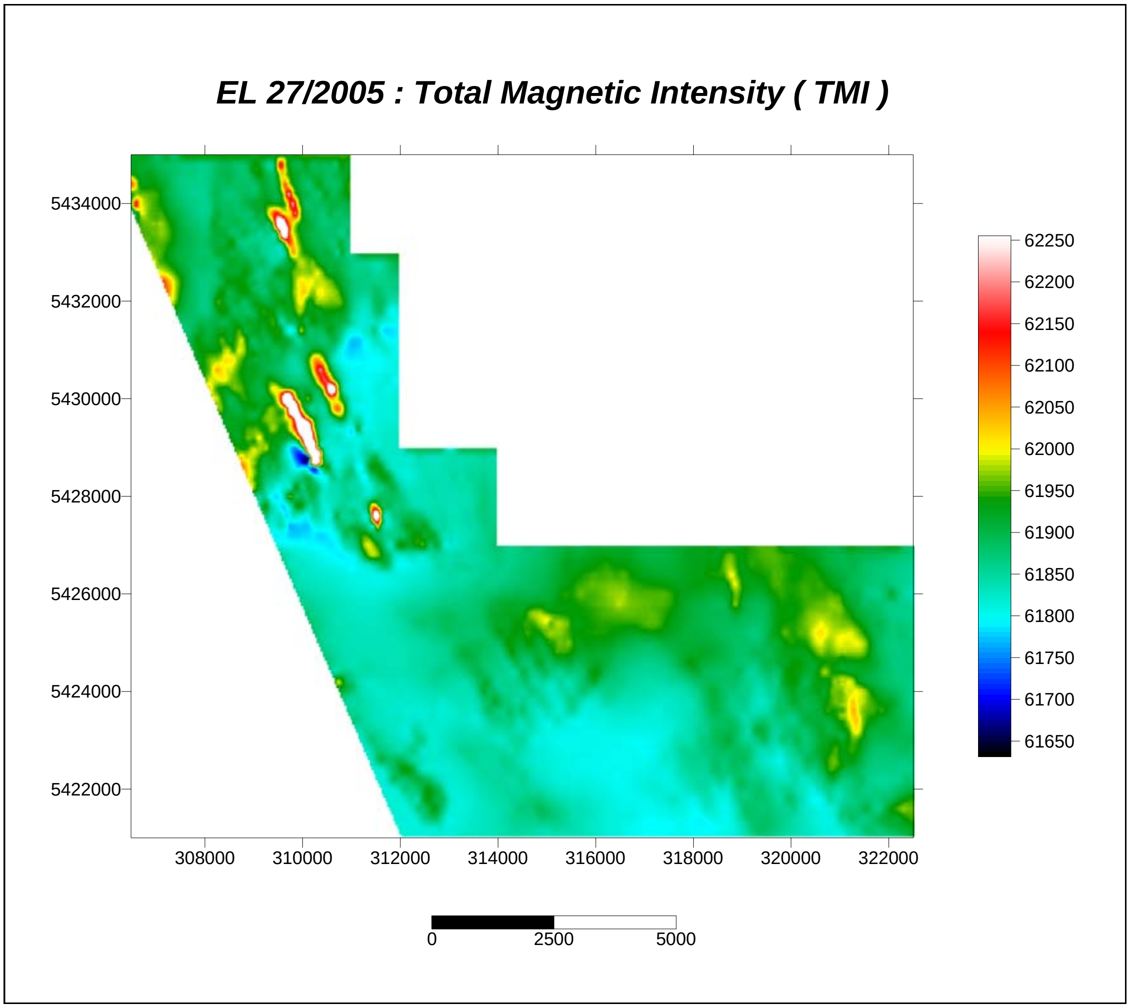


Figure 4b: EL 27/2005: Total Magnetic Intensity (TMI)

INTERPRETATION OF BALFOUR HEM OVER EL 27/2005 .

Interpretation of Balfour HEM data essentially consisted of careful analysis of some 46 responses and listed Appendix II and shown in Figure 5 and 5a .

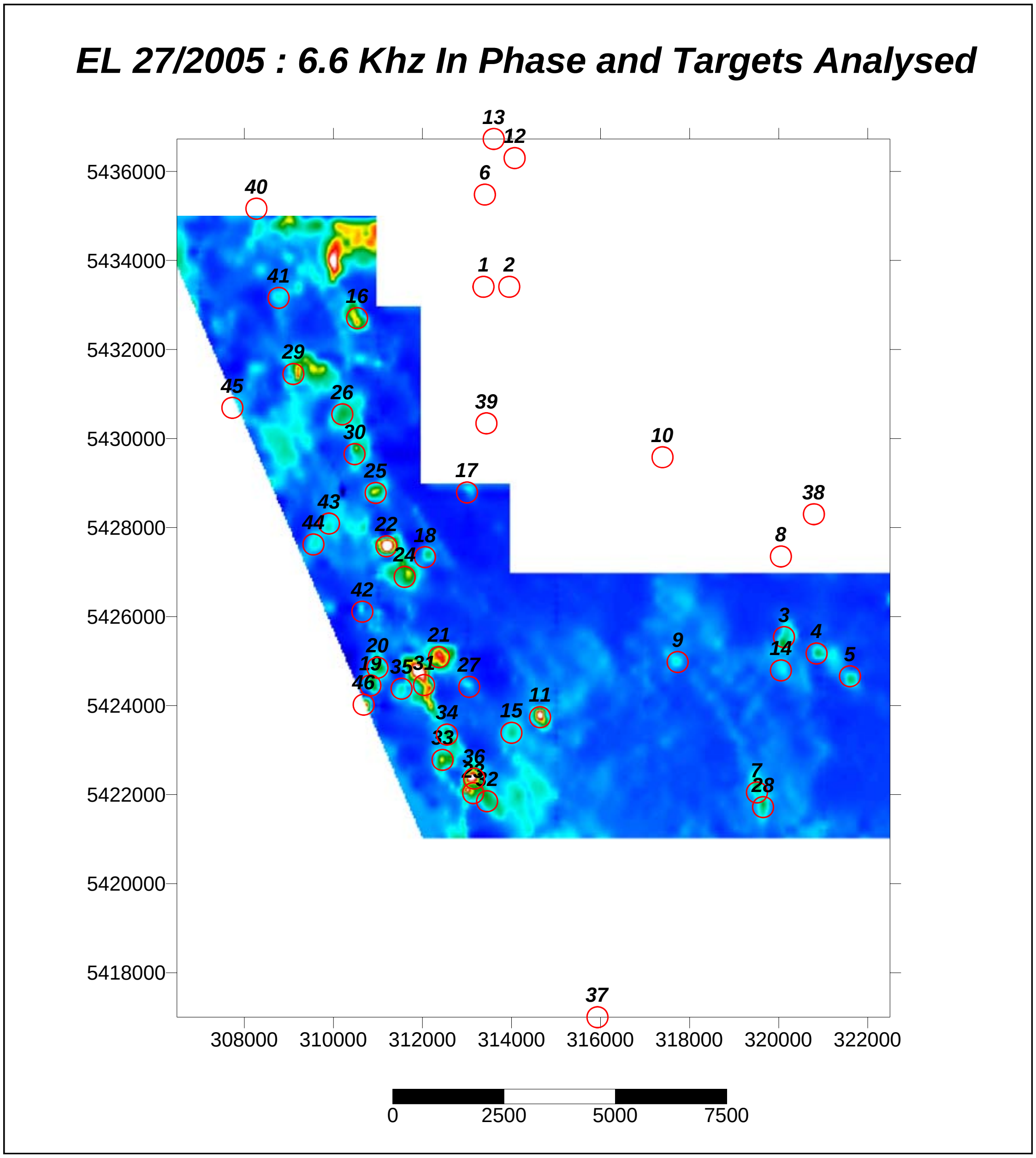


Figure 5. *EL 27/2005: 6.6 Khz in Phase and Targets Analysed*

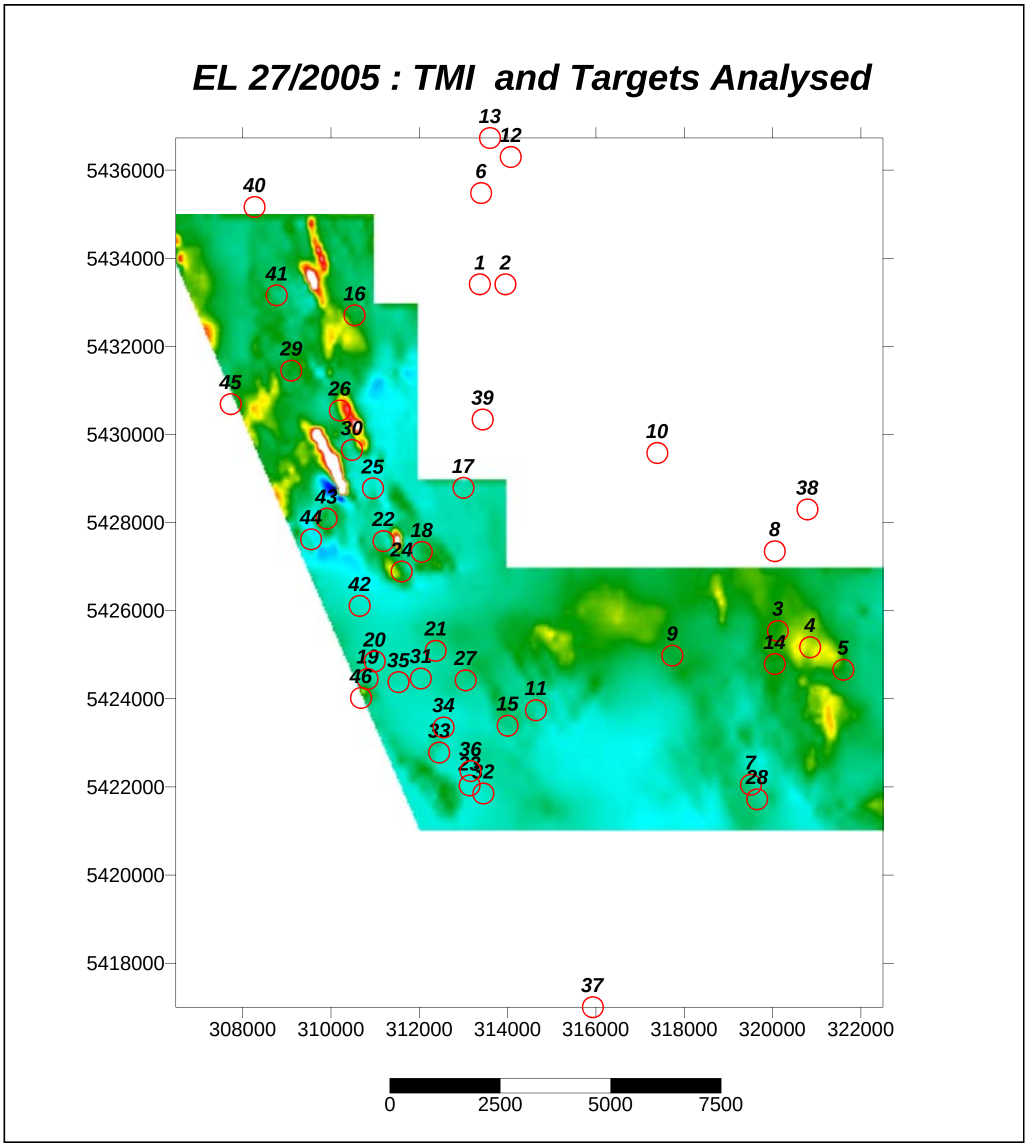


Figure 5a: EL 27/2005: TMI and Targets Analysed

These locations were essentially chosen on the basis of analysing the imaged data and decomposition of the HEM responses into its anomalous constituents as for example described in Silic 2004 (Appendix III). For the purpose to illustrate the numerous HEM responses that within the Balfour data set, Figure 4 to 4c shows the imaged data over EL27/2005 . Some of the magnetic responses within the survey area are related to magnetite / iron deposits and in the eastern parts of the exploration licence a set of possible ithological conductors of unknown origin.

Of the 46 responses analysed most of these were rejected on the bases that they most likely represent overburden, transported cover or broad litho logical units in particular the conductive shale units known to exist within the Balfour survey area. Analysis of the relationship between the coplanar and coaxial anomalies as briefly discussed in the previous section was an important factor in this decision or elimination process. The amplitude of the in-phase signal also played a crucial role in the selection process .The targets kept using these selection criteria are listed in Table 2.

As Table 2 shows a number of recommended targets are over or in proximity to magnetic anomalies or shallow magnetic complexes and some of the targets are within the area of possible lithological conductors (see Figure 6) . These targets are discussed in Appendix I where images and profiles of EM and magnetic data are over these targets are also shown. In-phase responses at all frequencies in the profiles shown correspond to the "thin lines ". However as pointed **previously because the magnetite content of the target has the potential to reduce the in-phase response at all frequencies the conclusions regarding the quality of some targets have to be treated with caution .**

Table 2: EL 1/2004 : Recommended Targets

Target Number	East AGD 66	North AGD 66	Conductor Quality	Dip	Magnetic Association
3	320120	5425540	Good/Excellent	West/Vertical	Shallow Magnetic Complex
4	320850	5425170	Good/Excellent	?	Shallow Magnetic Complex
5	321600	5424660	Moderate/Good	West ?	Shallow Magnetic Complex
7	319510	5422050	Good/Excellent	West	At contact
11	314640	5423740	Good/Excellent	East ?	Shallow Magnetic Complex
31	312035	5424460	Good/Excellent	?	No
36	313160	5422360	Good/Excellent	?	No

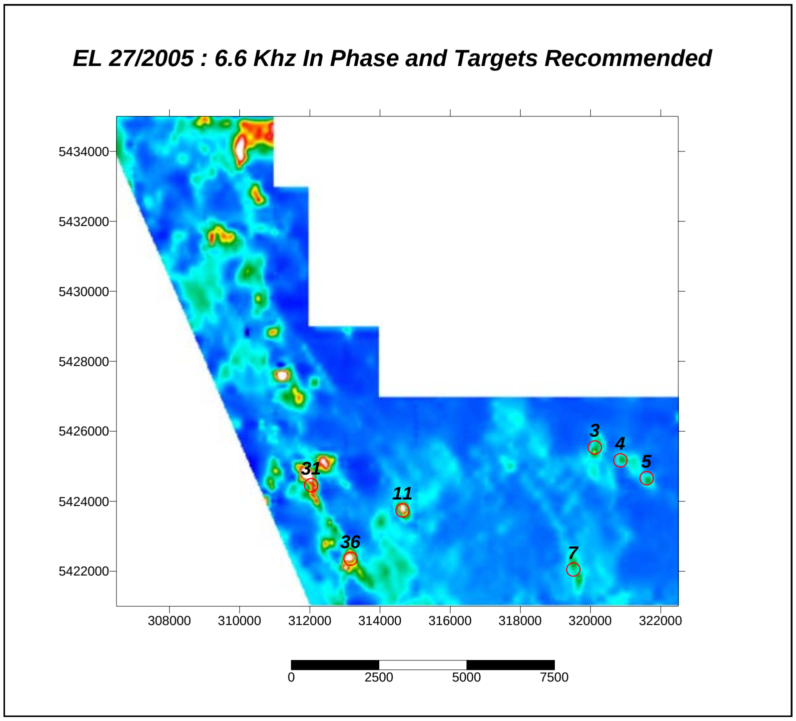


Figure 6. *EL27/2005: 6.6 KHz in Phase and Targets Recommended*

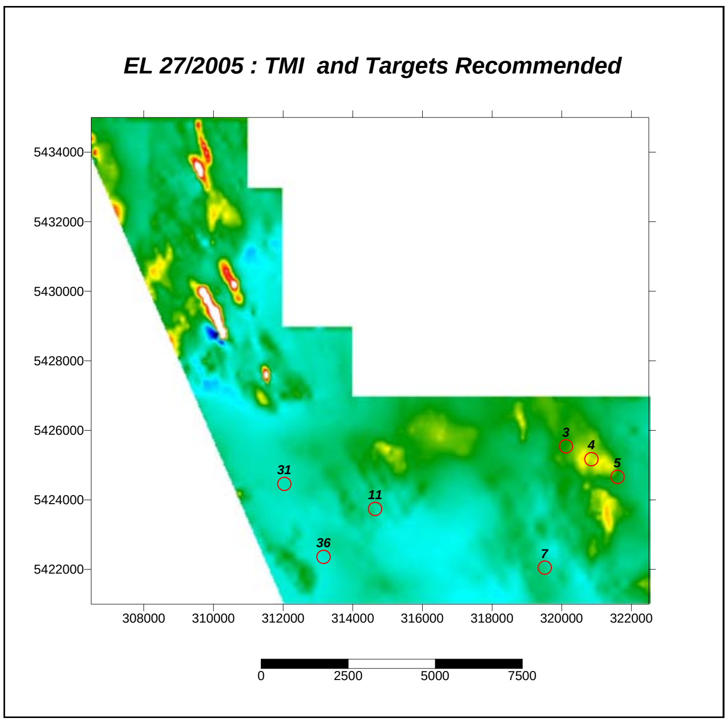


Figure 6a. *EL 27/2005: TMI and Targets Recommended*

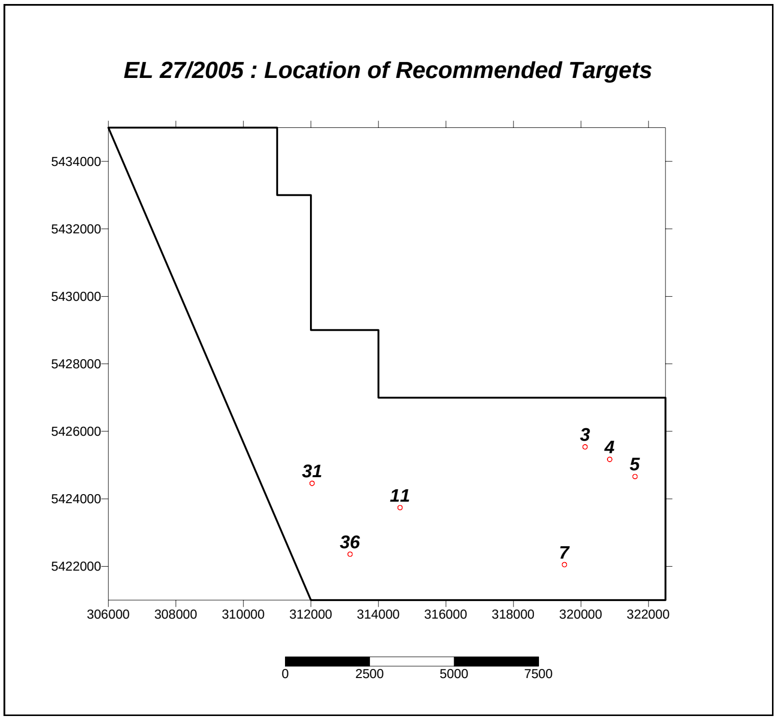


Figure 7. EL 27/2005 Location of Recommended Targets

CONCLUSION

Analysis of 45 responses within the Balfour 2001/2002 helicopter electromagnetic data over EL 27/2005 had identified 7 targets as potentially representing conductors that require further geological and/or geophysical ground follow up. Most of these targets are good/excellent quality conductors and appear to be isolated 3D conductive bodies. Some are within or at the contacts to shallow magnetic lithologies, whereas two or the targets are in area that may contain lithological conductors. The conductivity and geometry of the identified targets is variable and in some cases complex. As a result accurate targeting of these conductors may require collection of ground EM data, depending on which part of the EM conductor is identified for targeting.

Analysis of the HEM system noise levels has also demonstrated that even in very clean EM backgrounds the maximum penetration of the system for 3D EM targets was between 50 – 75 meters.

APPENDIX I

EL 27/2005 Targets

TM 03

Conductor TM 03 strike in on approximate N-S direction, plunges to the north and strikes over a distance of some 400 – 600 meters. (Figure TM 03_1). The increasing in-phase to out of phase ratios on the northern lines suggests that the conductivity increases in a northerly direction (Figure TM 03_2 and 2a). As a result it is recommended that drill testing of this conductor is carried out on line 5425600N. There is no direct association between target TM 03 and a shallow magnetic body , although the conductor appears to be sited within a shallow magnetic complex (Figures TM 03 _3 and 3a) .

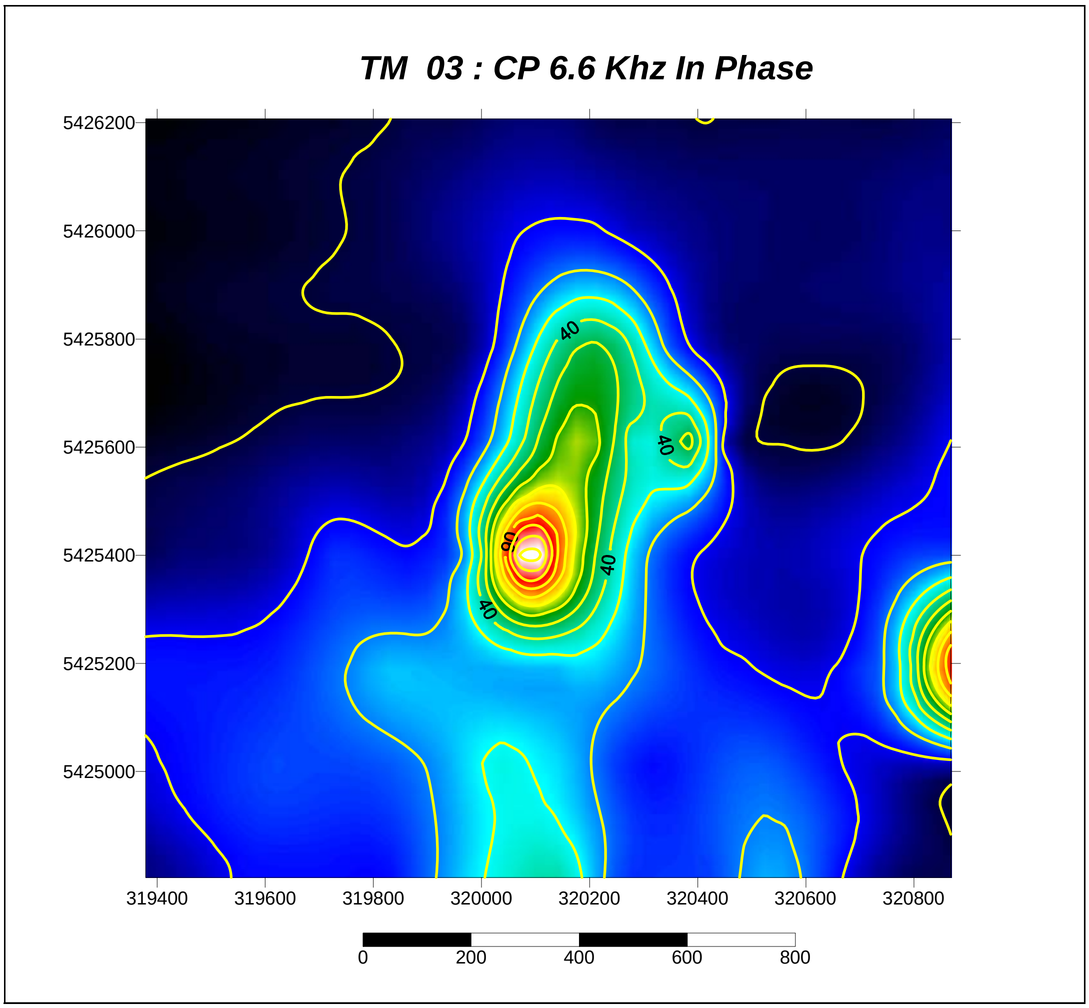


Figure TM 03_1: CP 6.6 Khz In Phase

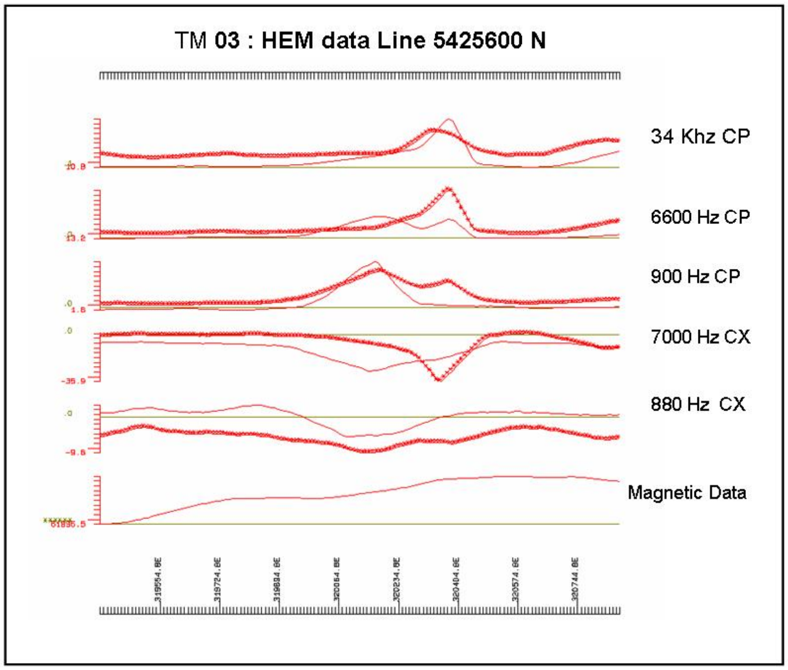


Figure TM 03_2: *HEM data Line 5425600 N*

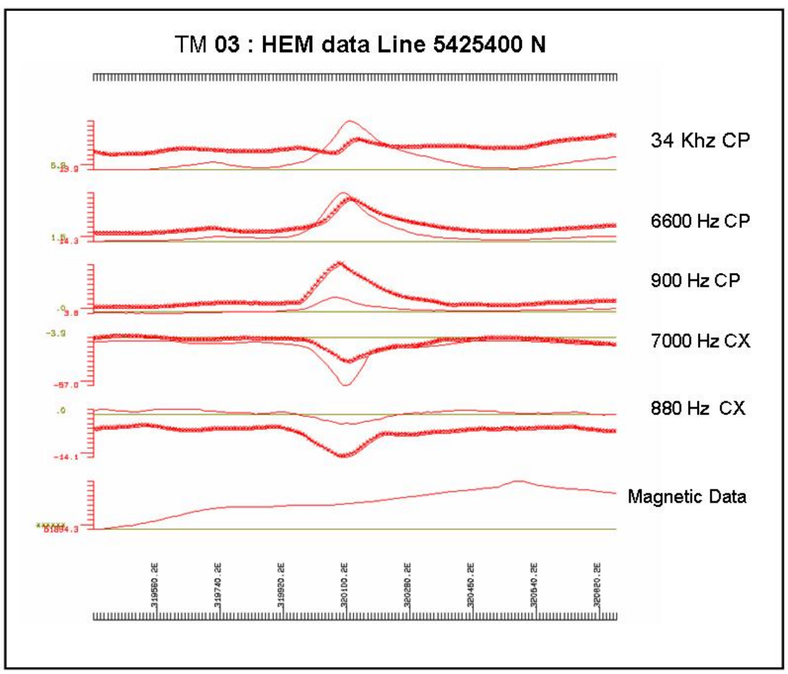


Figure TM 03_2a: *TM 03 HEM data Line 5425400 N*

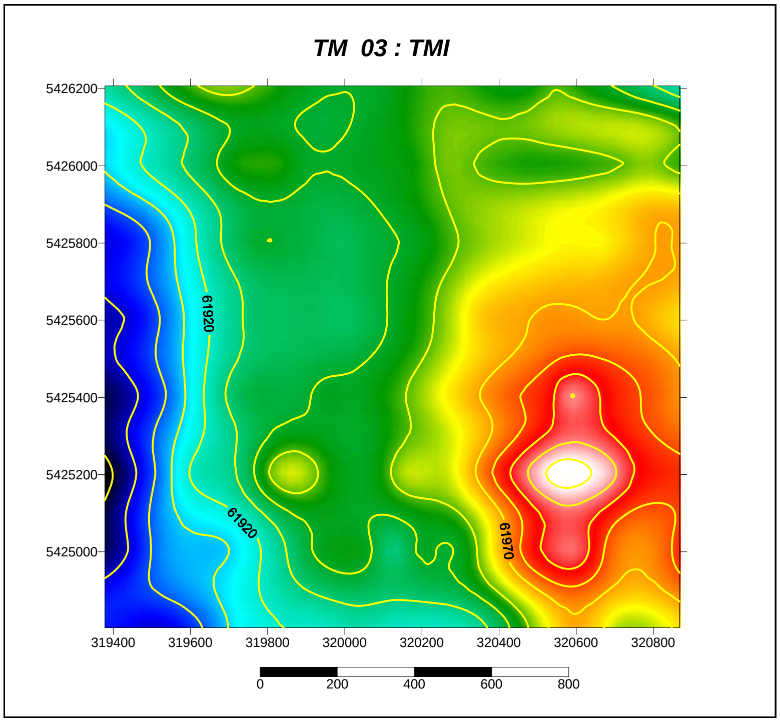


Figure TM 03_3: *TM 03 TMI*

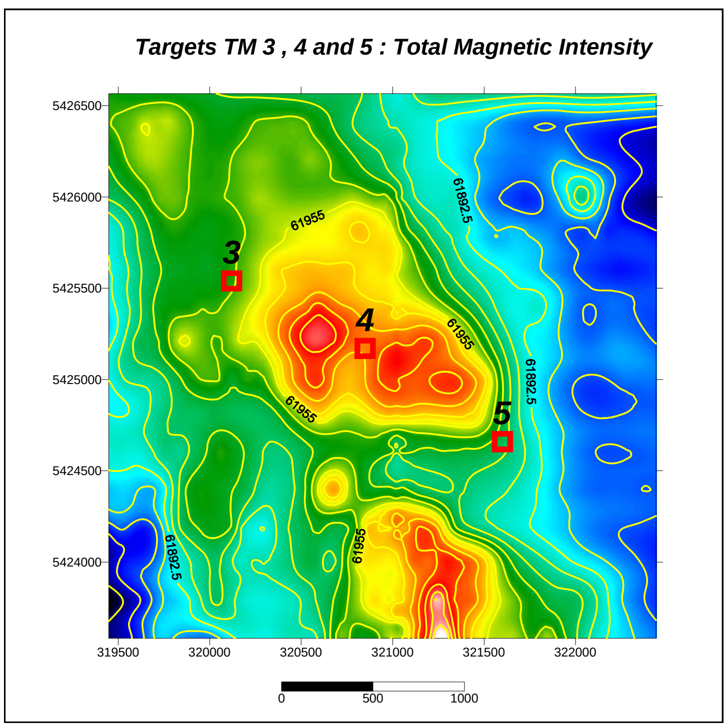


Figure TM 03_3a: *TM 3, 4 and 5: Total Magnetic Intensity*

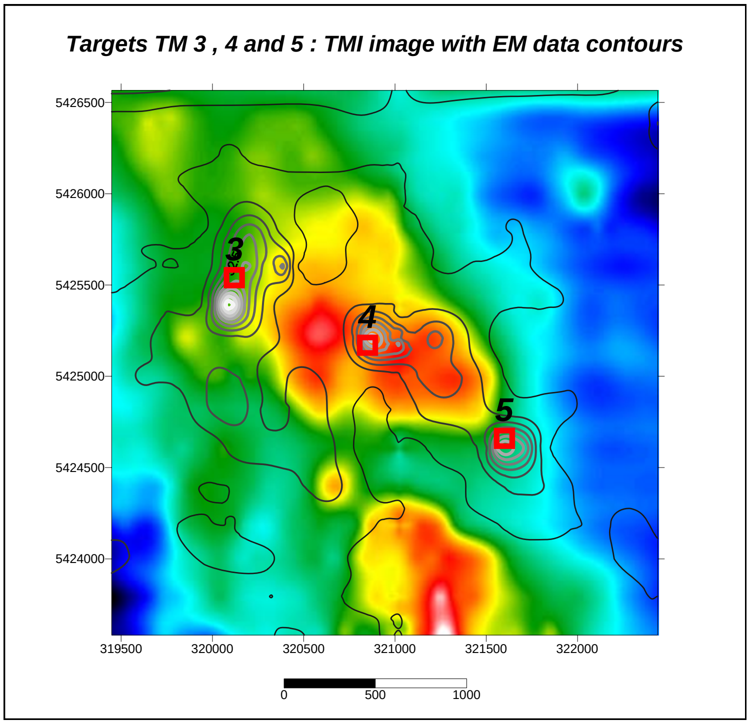


Figure TM 03_3b: TM 3, 4 and 5 TMI Image with EM data countours

TM 04

Target TM 04 appears to strike in an almost EW direction parallel to the survey flight direction (Figure TM 04_1), with possible extension to the SE or is a broad conductor as implied in the image of the EM data . Higher in phase to out of phase EM signal rations to the east suggest that the conductivity of the conductor increases to the east (Figure TM 04_2 and 2a). The decreasing amplitude of the response to the east and suggest that the target is at greater depth to the east. The conductor is confined to, but not co-incident with the shallower sources of a broad magnetic complex (Figure TM 04_3 and 3a).

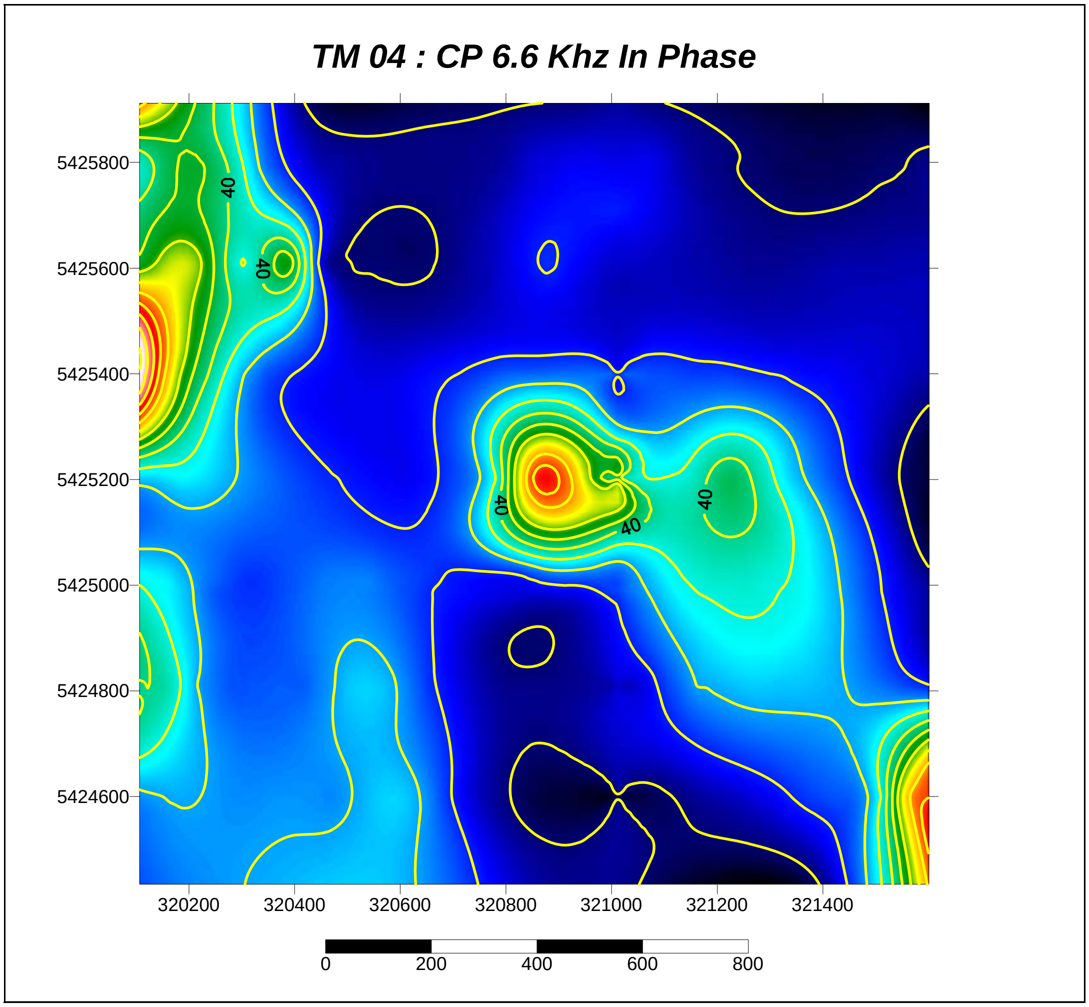


Figure TM 04_1: CP 6.6 Khz In Phase

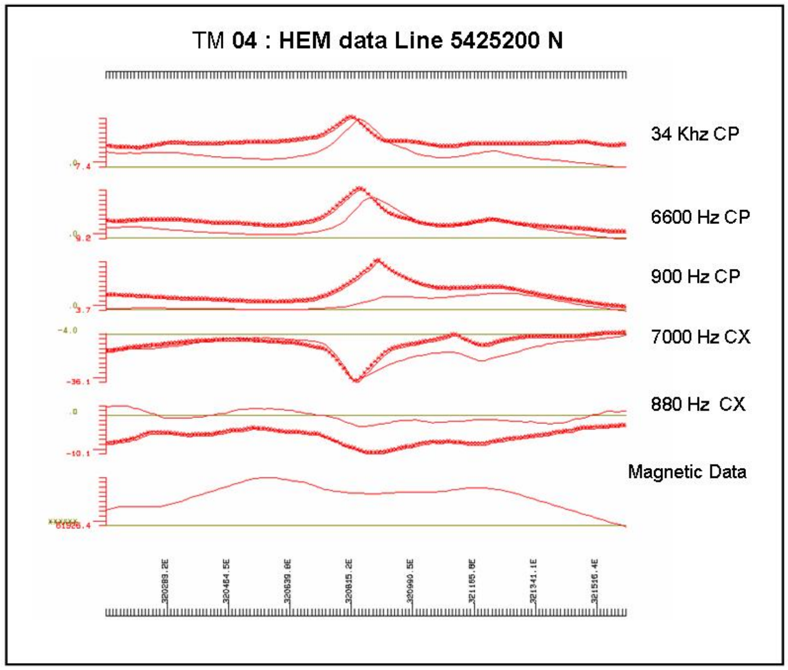


Figure TM 04_2: *HEM data Line 5425200 N*

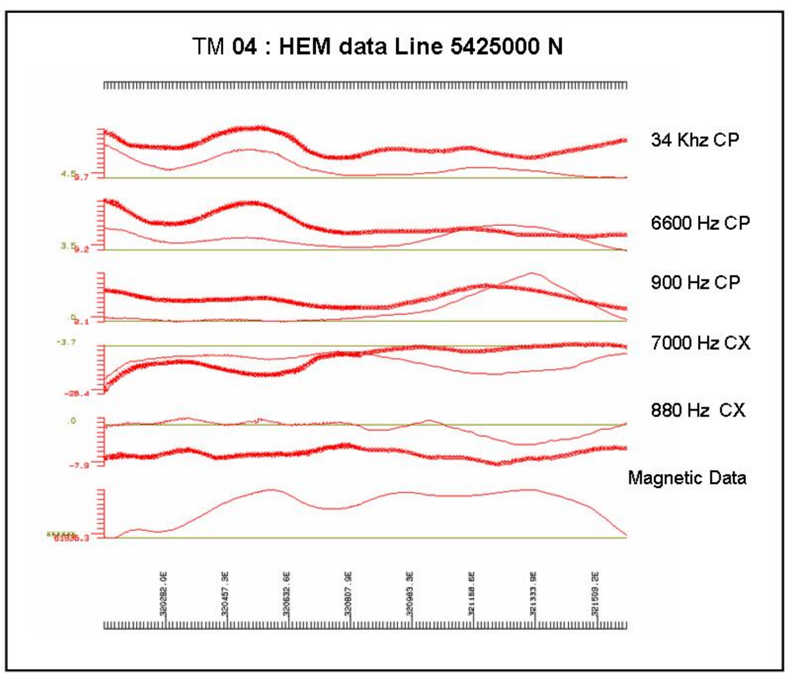


Figure TM 04_2a: *TM 04 HEM data Line 5425000 N*

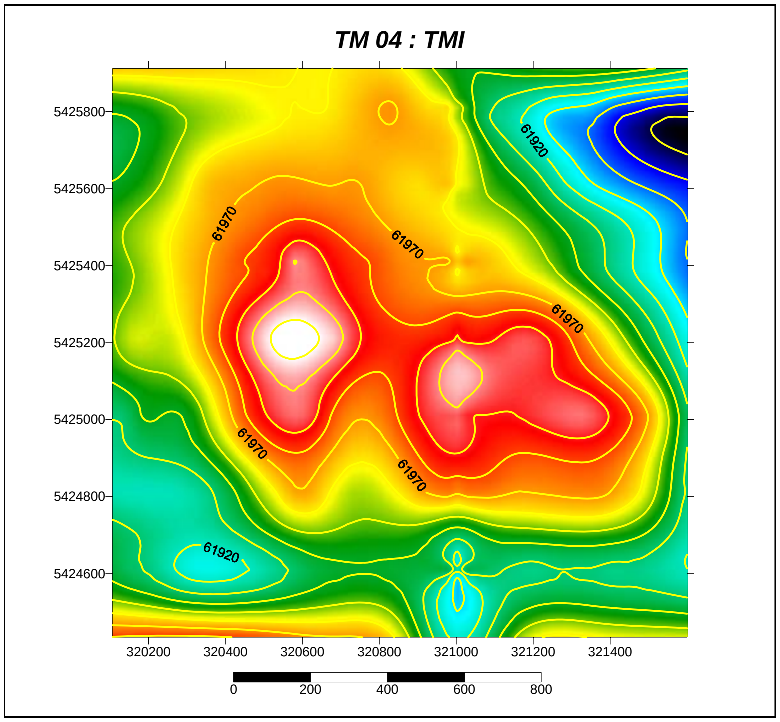


Figure TM 04_3: *TM 04 TMI*

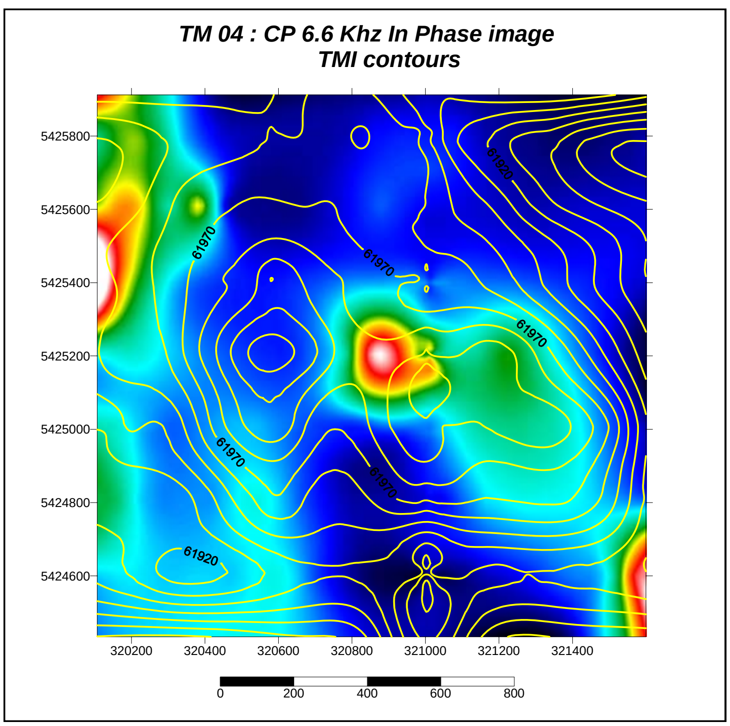


Figure TM 04_3a: *TM 04 CP 6.6 Khz in Phase image TMI contours*

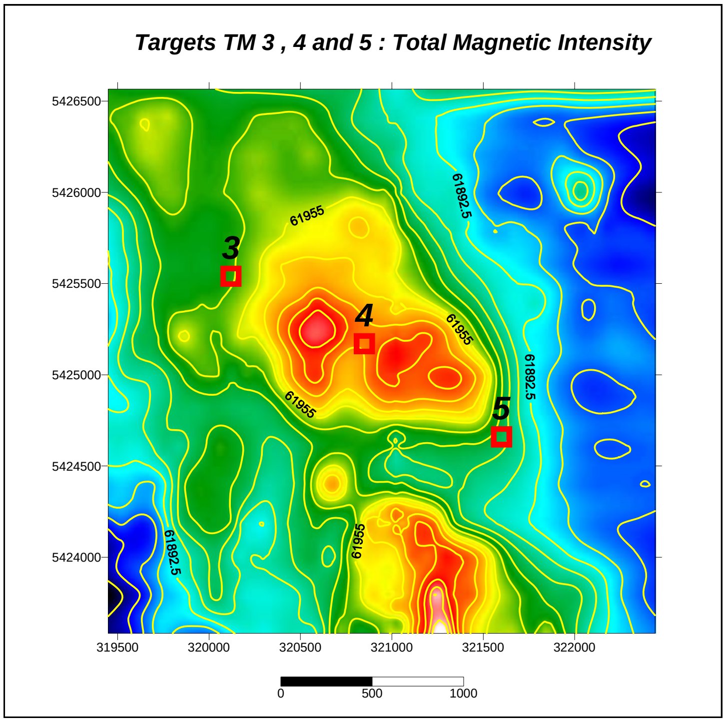


Figure TM 04_3b: *TM 3, 4 and 5 Total Magnetic Intensity*

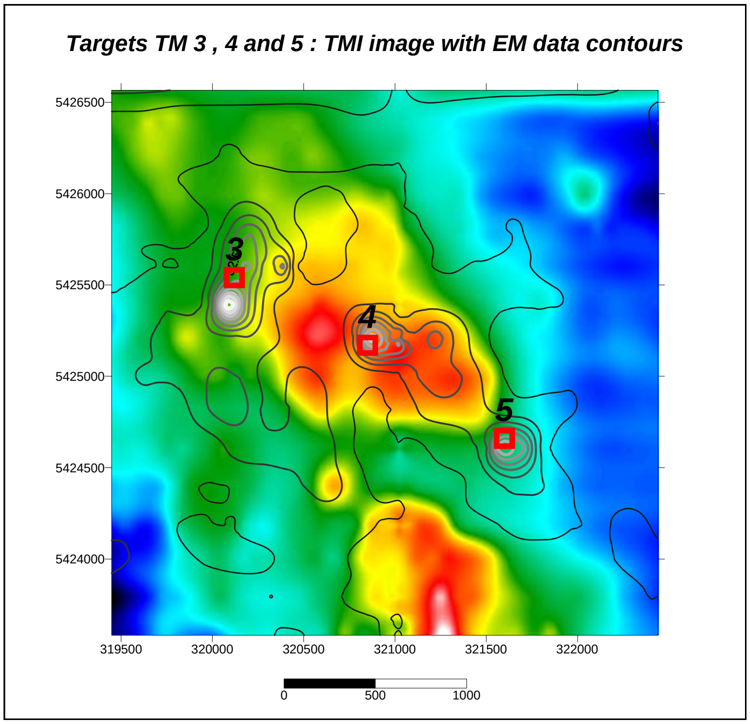


Figure TM 04_3c: *Targets TM 3, 4 and 5 TMI Image with EM data contours*

TM 05

Target TM 05 with increasing conductivity towards northern extremity may be the extension of the conductive target TM 04 (Figure TM 05_1). At these northern extremities and with possible extension to target TM 04 , the conductive body appears to be wide and at depth (Figures TM 05_2 and 2a). As is the case with TM 04 the target appears to be confined to a broad moderately magnetised shallow magnetic complex (Figure TM 05_3 and 3a).

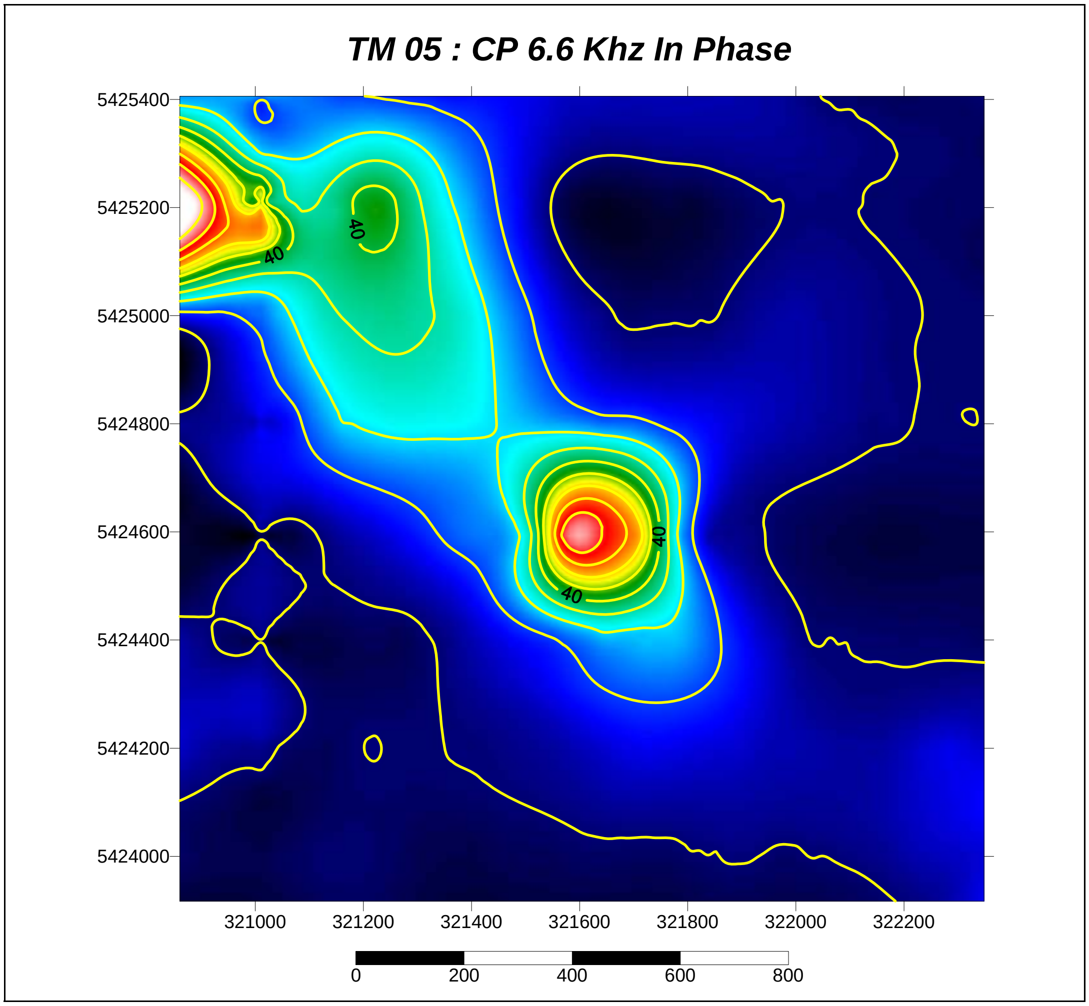


Figure TM 05_1: CP 6.6 Khz In Phase

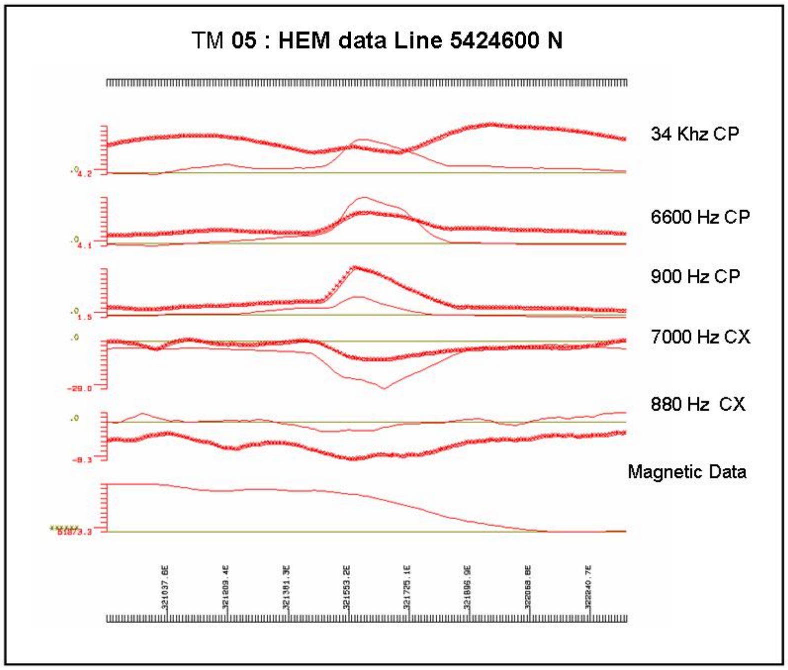


Figure TM 05_2: *HEM data Line 5424600 N*

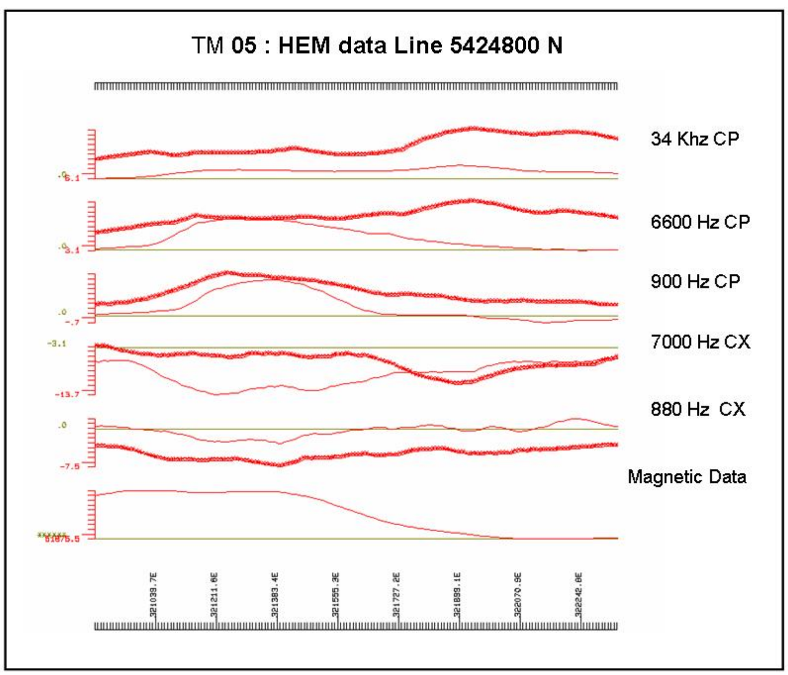


Figure TM 05_2a: *TM 05 HEM data Line 5424800 N*

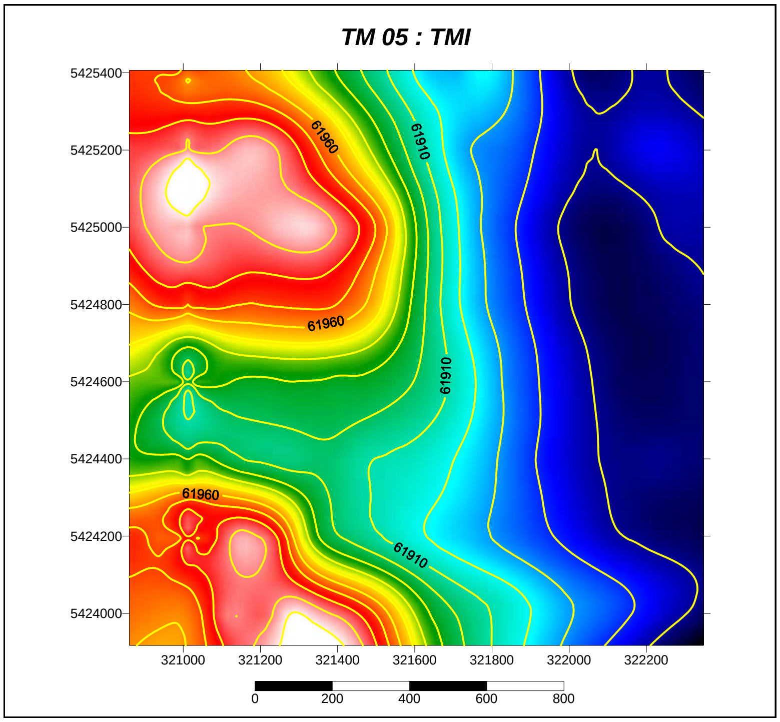


Figure TM 05_3: *TM 05 TMI*

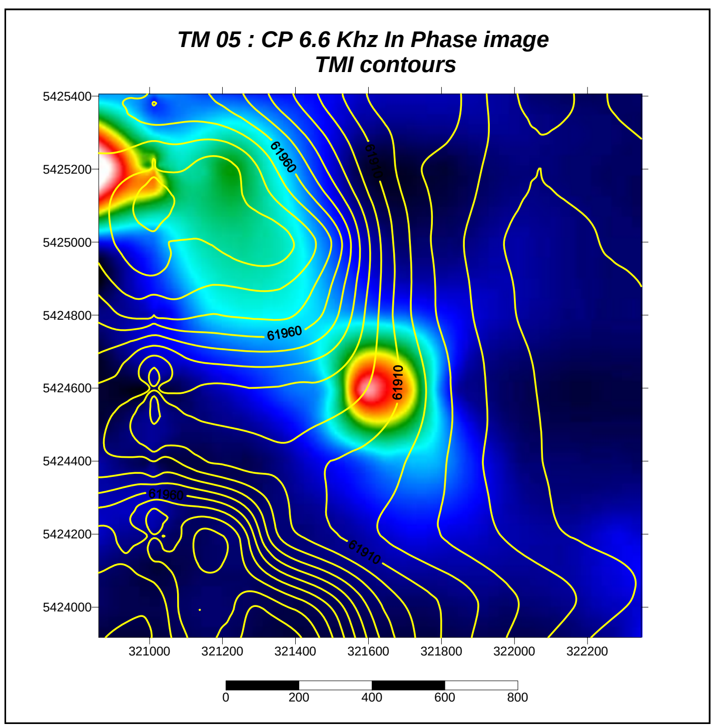


Figure TM 05_3a: *TM 0 5 CP 6.6 Khz in Phase Image TMI Contours*

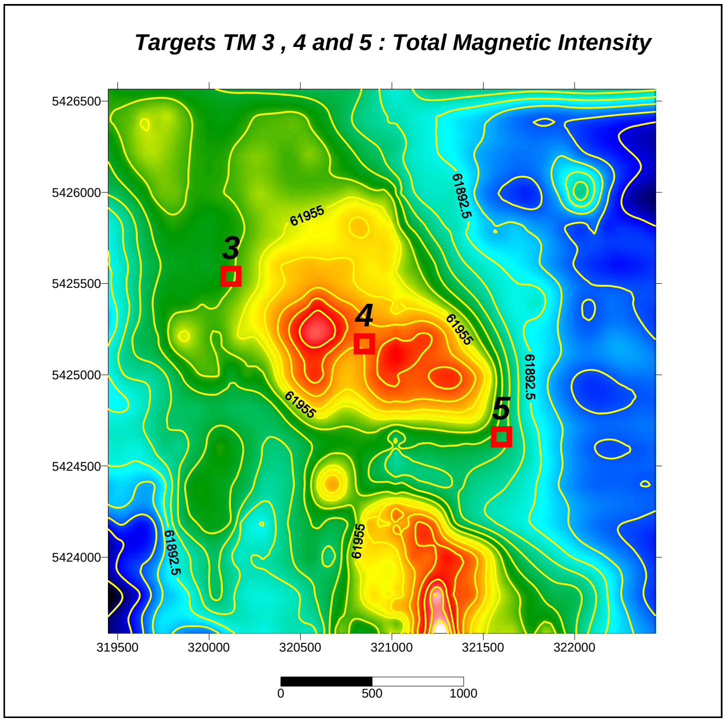


Figure TM 05_3b: *TM 3, 4 and 5 Total Magnetic Intensity*

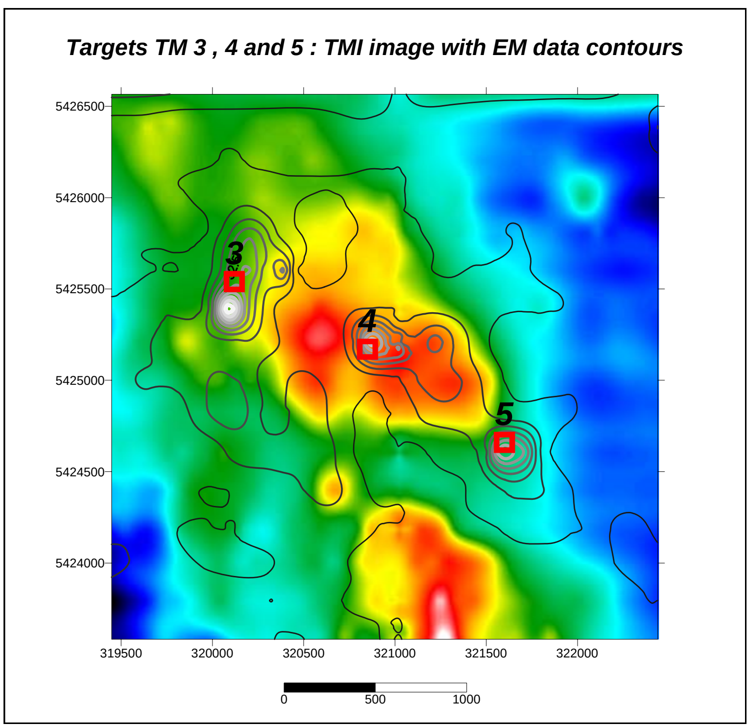


Figure TM 05_3c: *Targets TM 3, 4 and 5 TMI Image with EM data contours*

TM 07

Target TM 07 strikes over a length in excess of 800 meters (Figure TM 07_1). It may however to be made up of two separate conductors, to the north and south 542200 N (approximately). High in phase to out of phase EM signal ratios, suggests this to be good to excellent conductive target (Figure TM 07_2 and 2a). Lack of or small amplitude responses at the high frequency of 34 kilo hertz indicates that on number of survey lines this conductor is not outcropping. From magnetic data though it is apparent that target TM 07 is within and/or close to the edge of similarly striking moderately magnetised unit (Figures TM 07_3 and 3a).

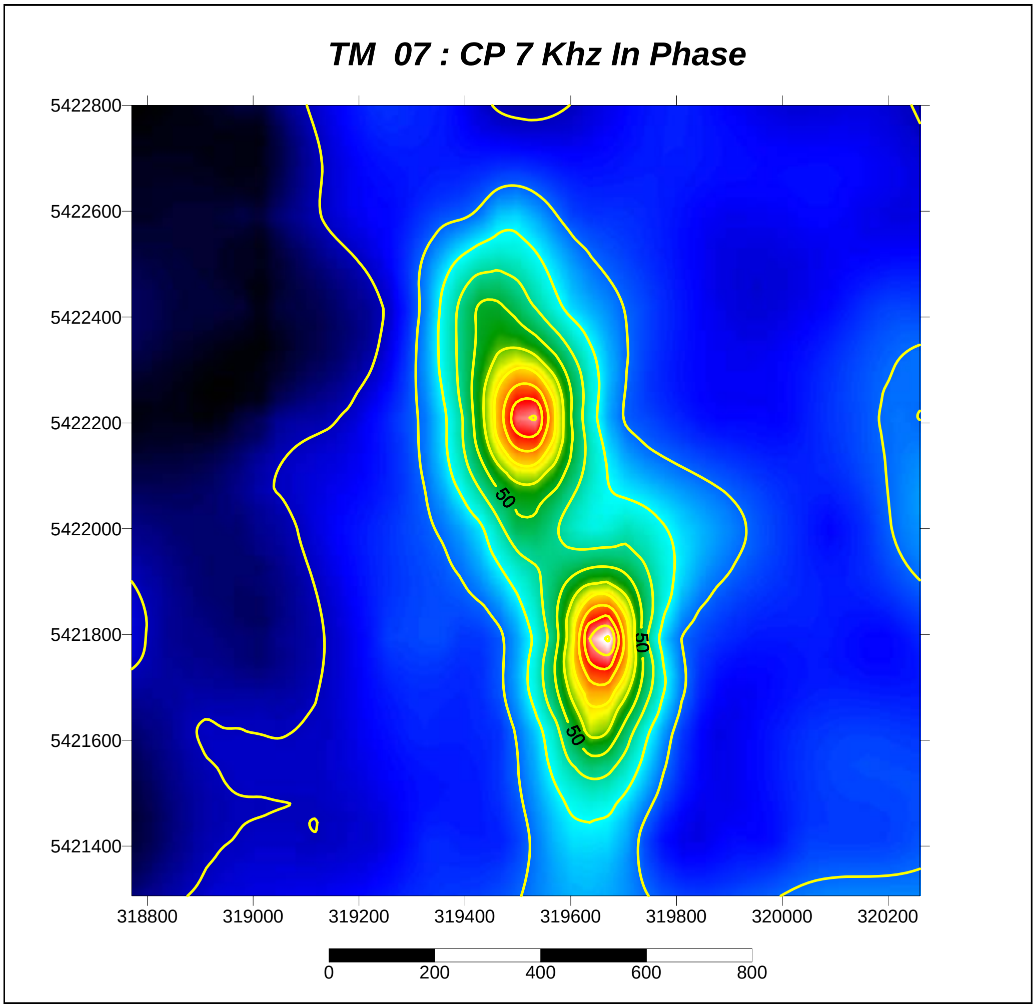


Figure TM 07_1: *CP 6.6 Khz In Phase*

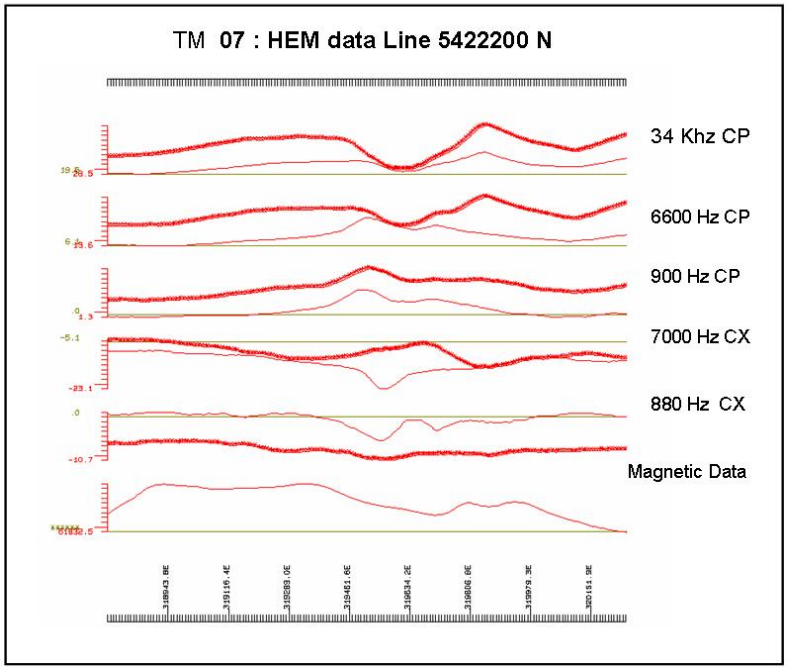


Figure TM 07_2: HEM data Line 5422200 N

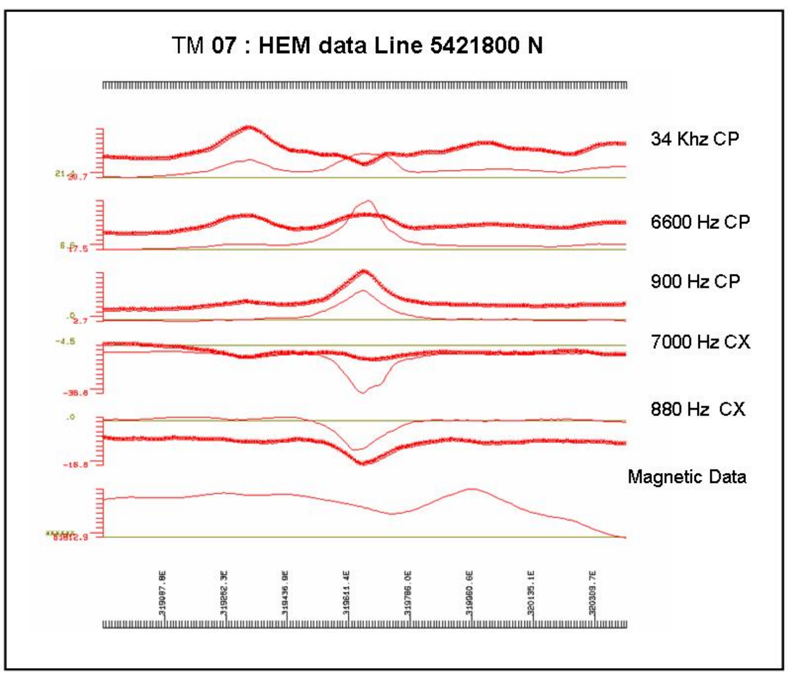


Figure TM 07_2a: TM 07 HEM data Line 5421800 N

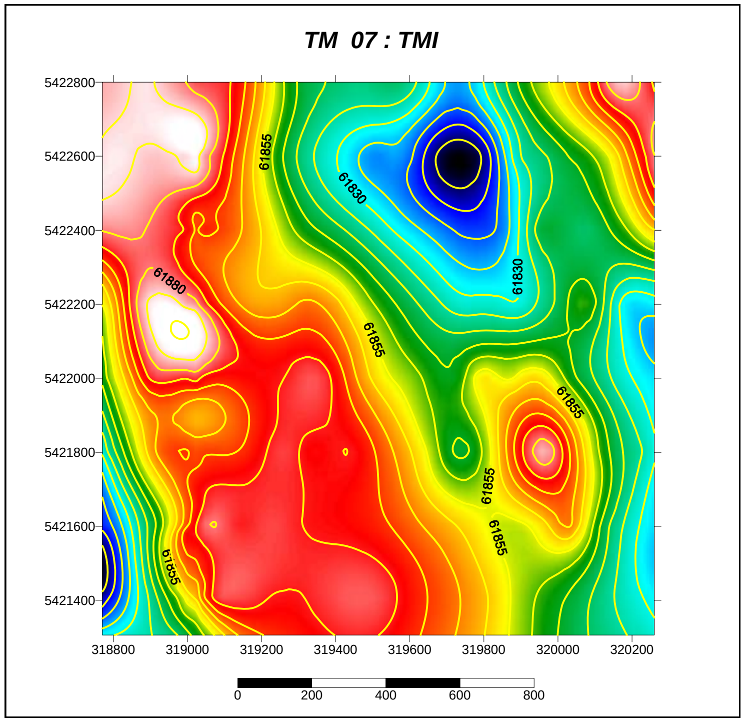


Figure TM 07_3: TM 07 TMI

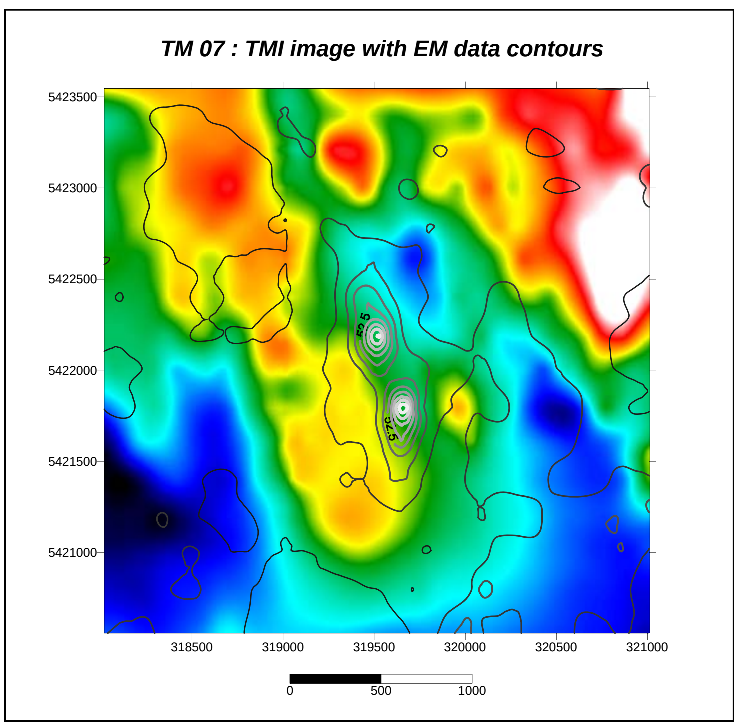


Figure TM 07_3a: TM 07: TMI Image with EM data contours

TM 11

Target TM 11 is an isolated short strike length (approximately 400 meters) good to excellent conductive body (Figure TM 11_1). There is no direct association between this conductive target and magnetic anomaly (Figure TM 11_2). The conductor however appears to be within a broad weakly magnetised complex, and may in fact be hosted by similar lithologies which host target 3, 4, 5, and 7.

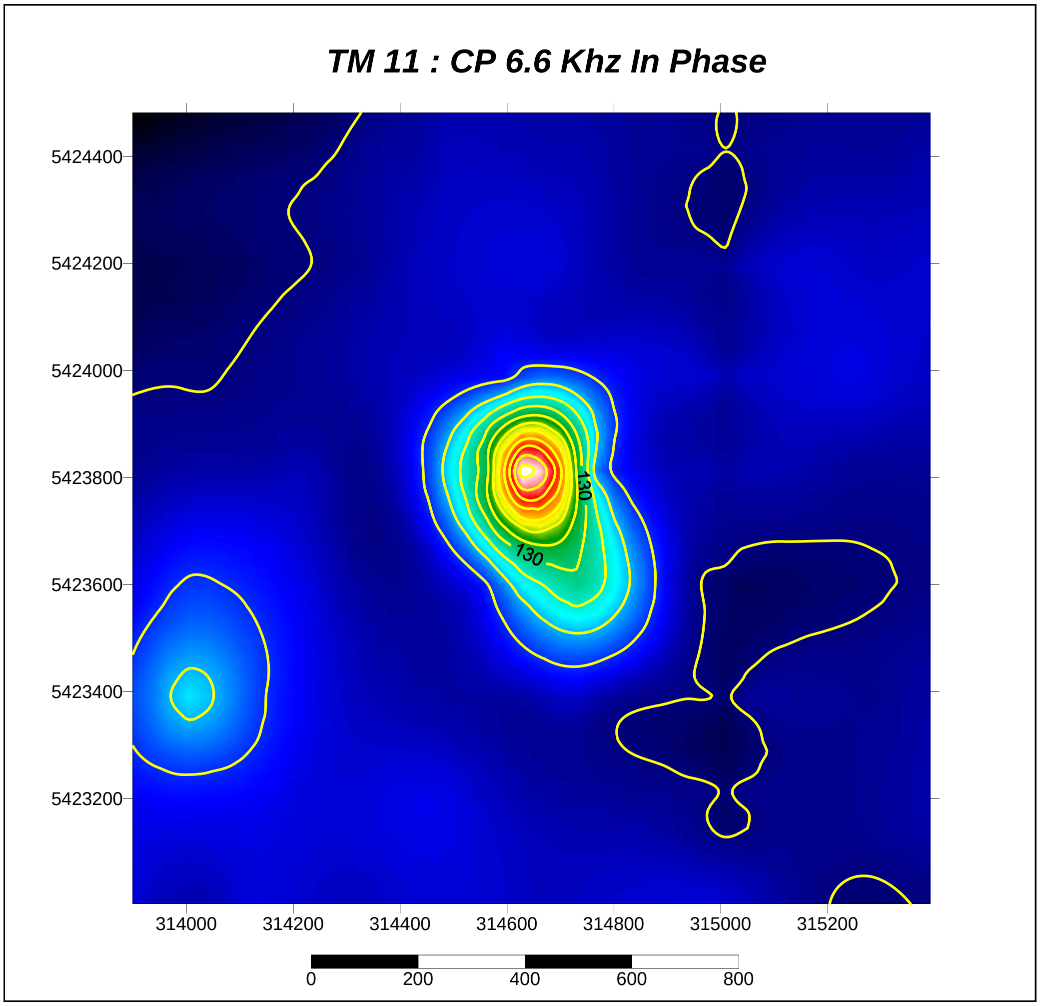


Figure TM 11_1: *CP 6.6 Khz In Phase*

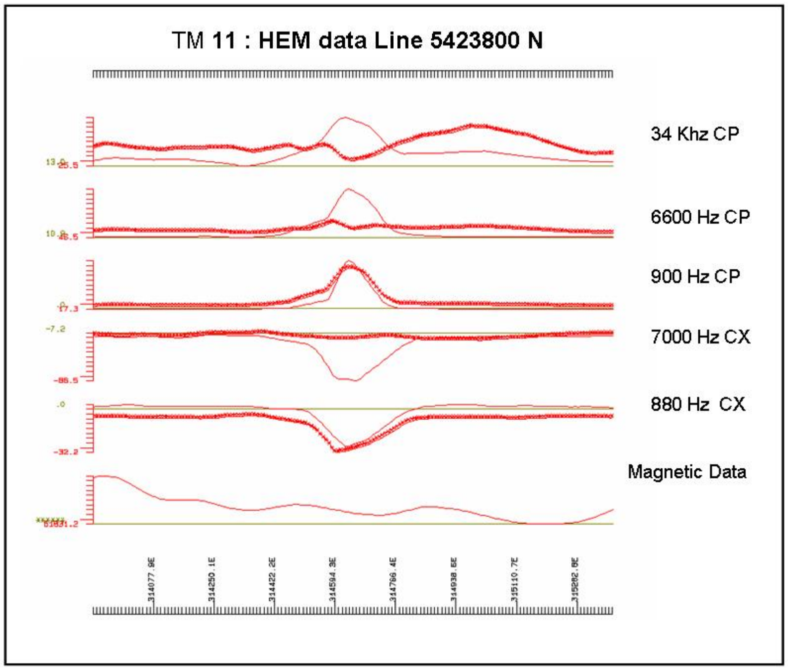


Figure TM 11_2: *HEM data Line 5423800 N*

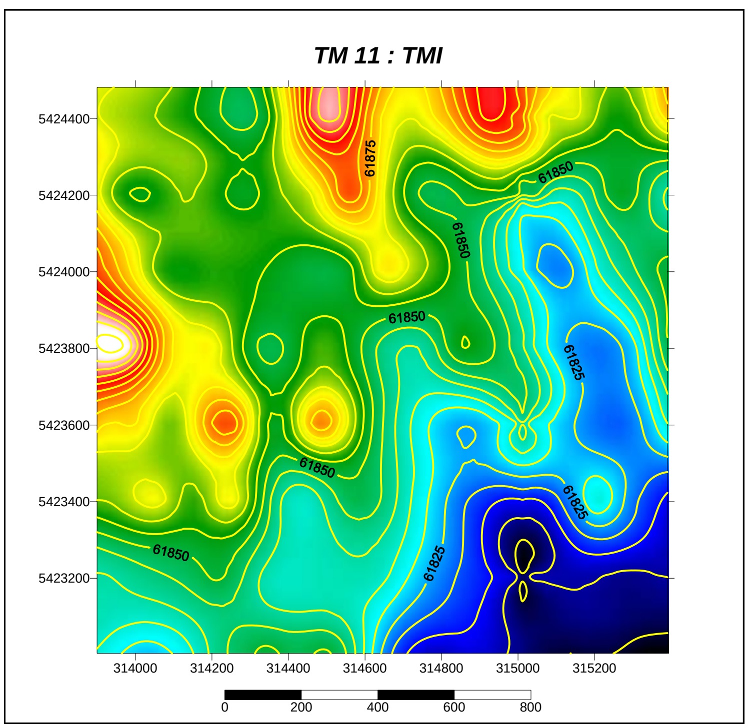


Figure TM 11_3: *TM 11 TMI*

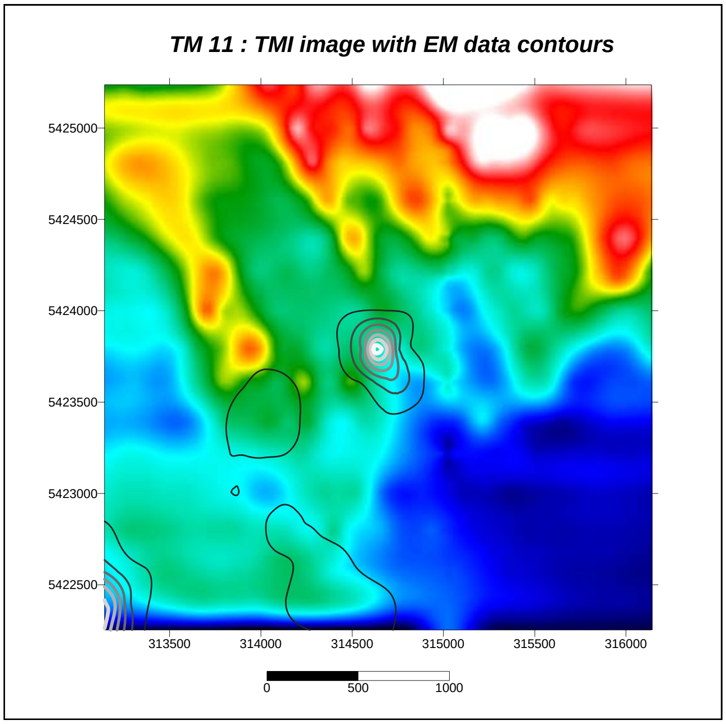


Figure TM 11_3a: *TMI Image with EM data contours*

TM 31

Target TM31 as a good to excellent conductor target with a strike length of some 800 – 1000 meters (Figure TM 31_1) . Its conductivity is variable along its strike length and most likely represents a series of conductors or one single conductor whose conductivity varies both across and along its strike length (Figure TM 31_2). TM 31 target is set within a zone that contains a number of less conductive targets, as can for example be seen on Figure 7 in the main text. There is no association between this target and any magnetic anomaly. It is essentially located in a magnetically quiet zone (Figure 31_3).

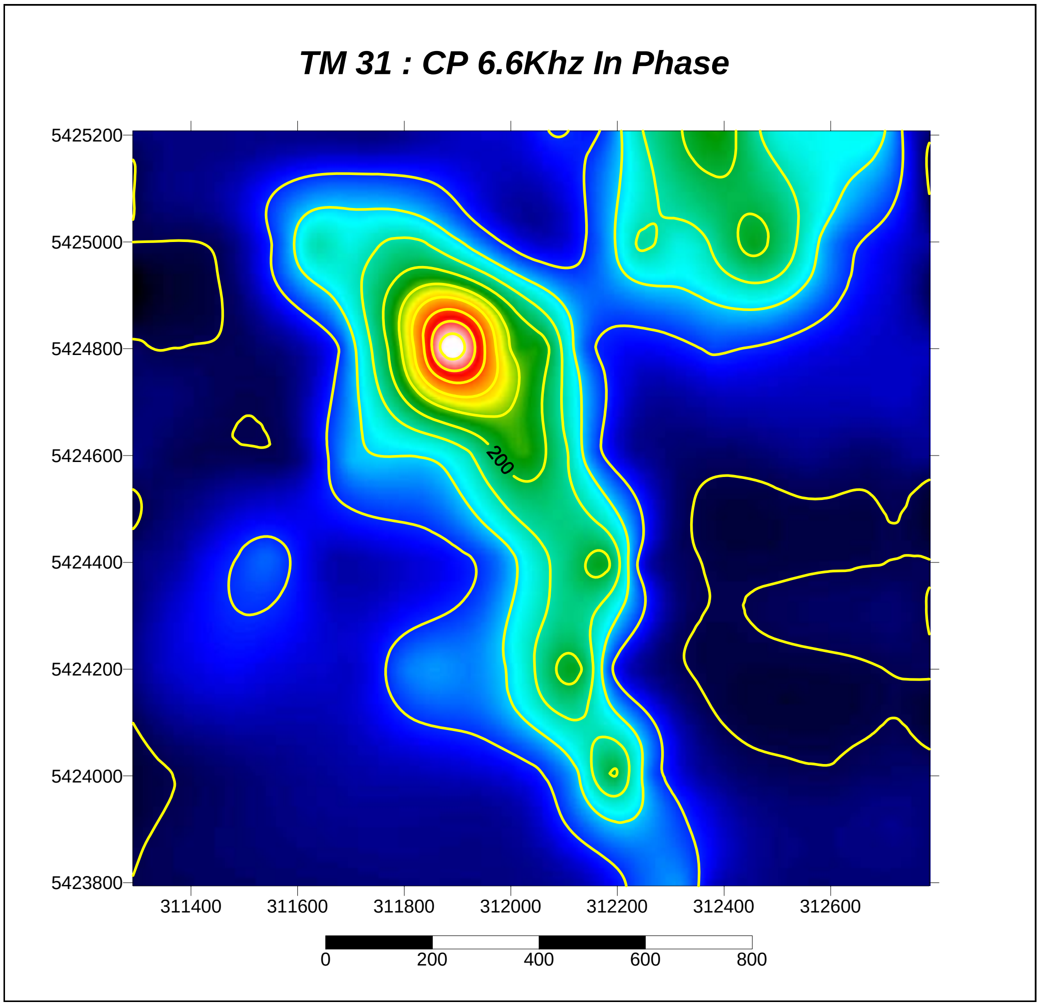


Figure TM 031_1: CP 6.6 Khz In Phase

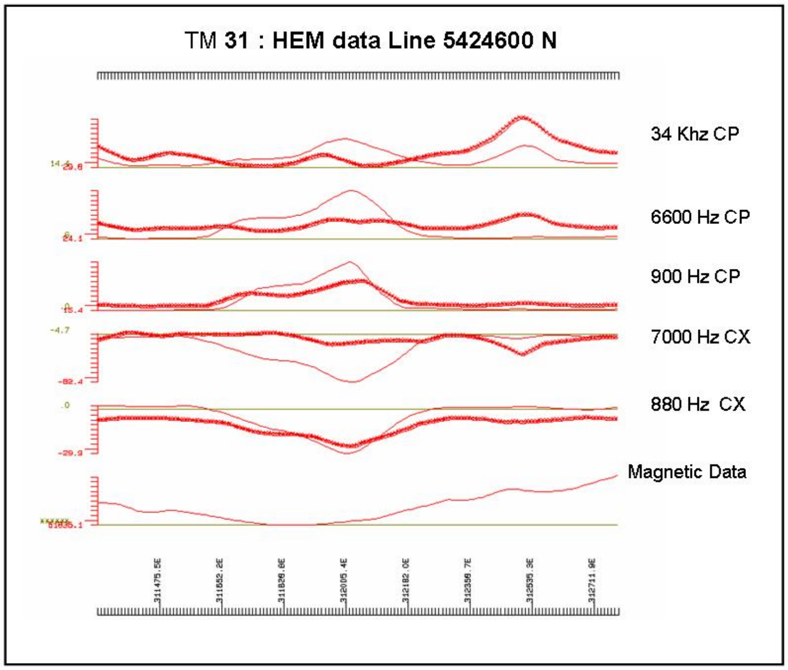


Figure TM 31_2: *HEM data Line 5424600 N*

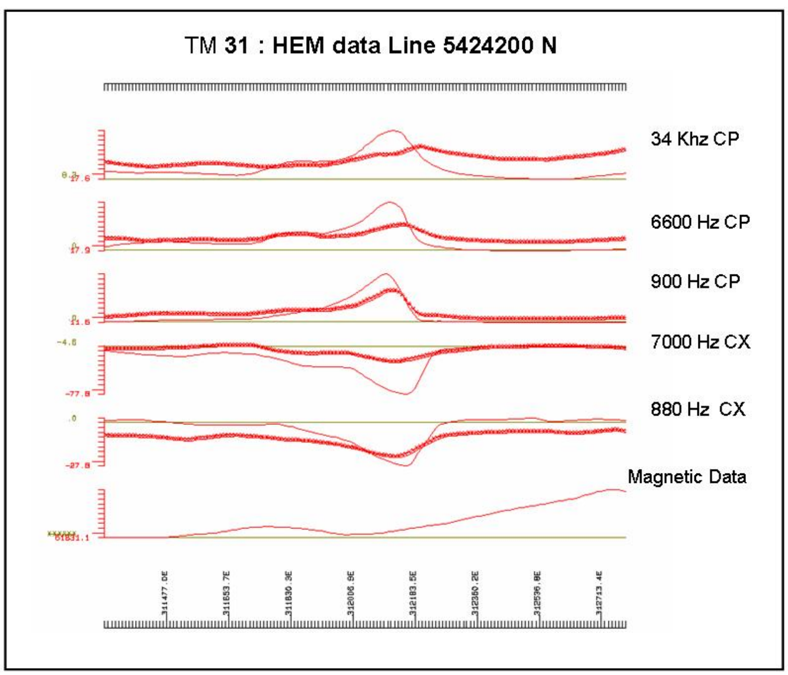


Figure TM 31_2a: *TM 31 HEM data Line 5424200 N*

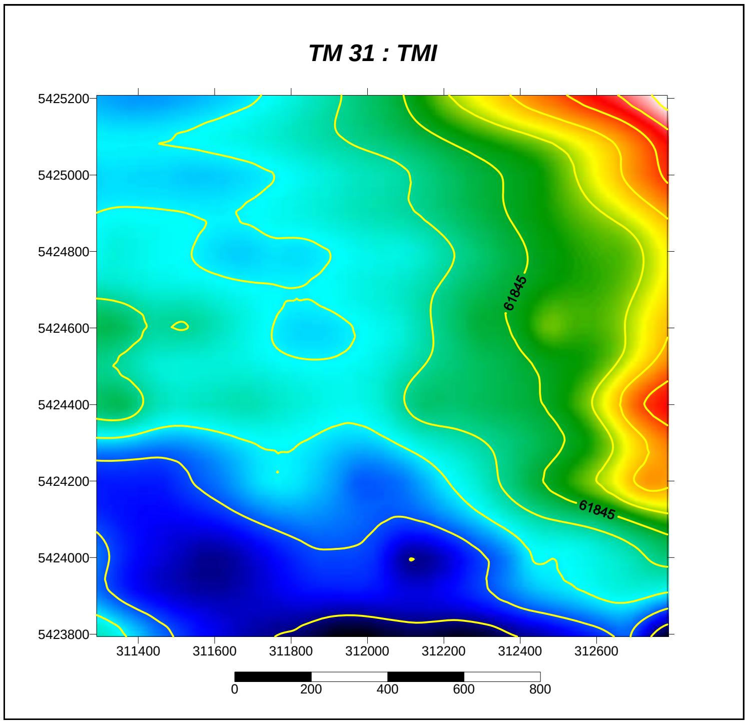


Figure TM 31_3: TM 31 TMI

TM 36

Target TM 36 is good to excellent although complex conductive body (Figure TM 36_1). The target may represent a series of conductors or one wide conductive body with a variable conductivity both along and across its strike length (Figure TM 36_2). This conductor is located within a much more strike extensive conductive zones which strikes in a NNW direction (Figure 6 in the main text) and essentially represents the more conductive parts of this elongated although discontinuous conductive trend. No magnetic anomaly can be associated with TM 36 conductor. It is essentially located in a magnetic quite zone (Figure TM 36_3).

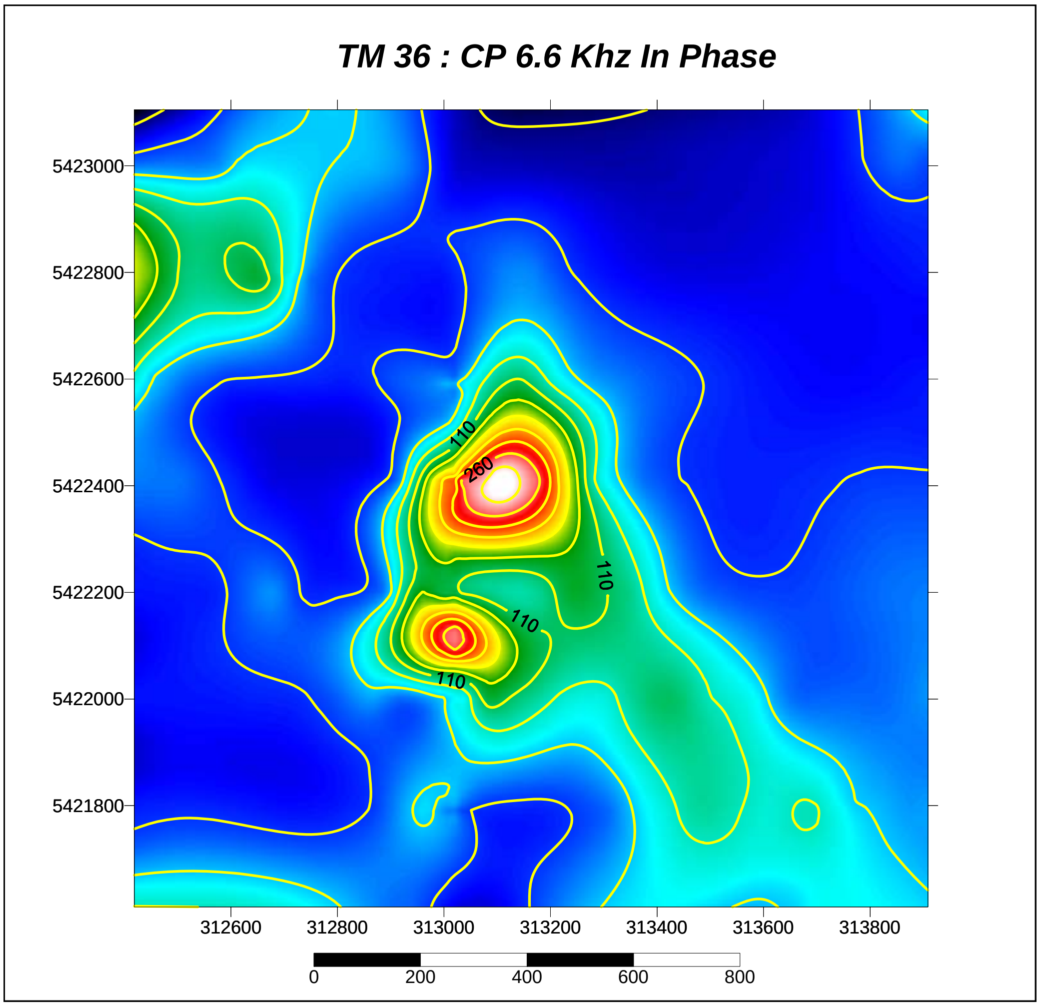


Figure TM 36_1: *CP 6.6 Khz In Phase*

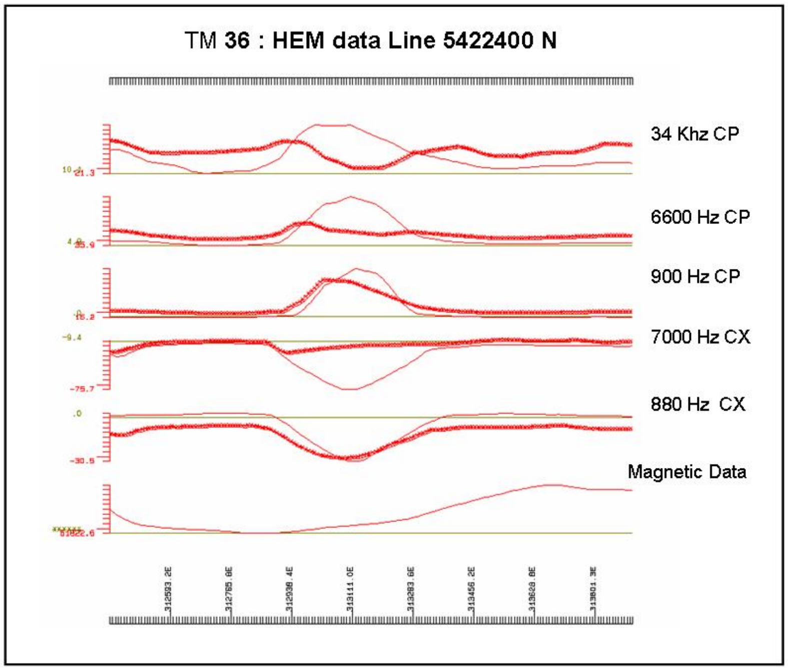


Figure TM 36_2: *HEM data Line 5422400 N*

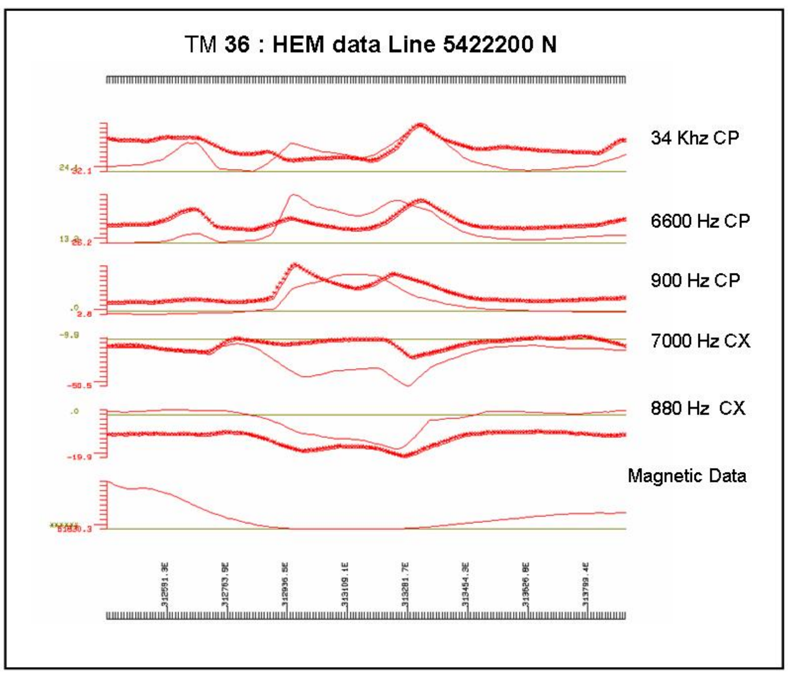


Figure TM 36_2a: *TM 36 HEM data Line 5422200 N*

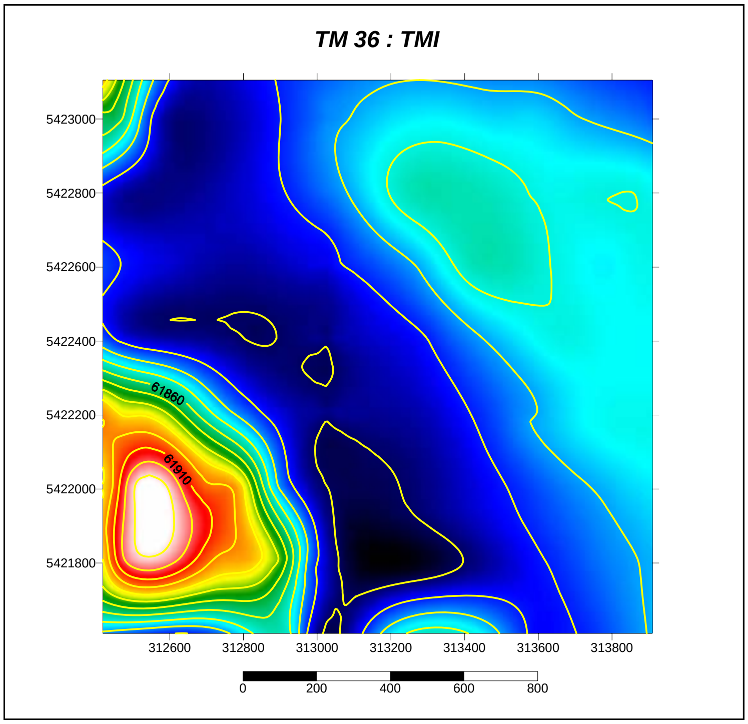


Figure TM 36_3: *TM 36 TMI*

APPENDIX II

List of Targets Analysed

Target Number	East (AGD66)	North (AGD66)
1	313370	5433410
2	313950	5433410
3	320120	5425540
4	320850	5425170
5	321600	5424660
6	313400	5435480
7	319510	5422050
8	320050	5427350
9	317730	5424980
10	317390	5429580
11	314640	5423740
12	314070	5436300
13	313600	5436730
14	320050	5424790
15	314000	5423390
16	310533	5432705
17	313000	5428790
18	312055	5427336
19	310830	5424450
20	310990	5424850
21	312370	5425090
22	311190	5427580
23	313140	5422035
24	311600	5426890
25	310950	5428780
26	310200	5430545
27	313050	5424420
28	319650	5421720
29	309100	5431450
30	310475	5429650
31	312035	5424460
32	313450	5421850
33	312450	5422780
34	312550	5423350
35	311530	5424380
36	313160	5422360
37	315930	5417000
38	320790	5428300
39	313435	5430340
40	308270	5435165
41	308770	5433160
42	310650	5426110
43	309900	5428090
44	309550	5427620

Target Number	East (AGD66)	North (AGD66)
45	307730	5430690
46	310680	5424020