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Report on IP Surveying

at the Helene and Millers Projects, Frances Creek, NT

for Territory Iron Limited.

December 2005

by

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Resource Potentials Pty Ltd

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Summary

Gradient array induced polarization (GAIP), dipole-dipole induced polarization (DDIP) surveying, and time domain electromagnetics (TEM) were trialed over Territory Iron's Frances Creek iron ore prospects in the Northern Territory. The highly conductive nature of the graphitic beds within the Wildman Siltstone prevented the GAIP from obtaining any useable data over both the Millers and Helene survey areas. Similar problems encountered with the GAIP were encountered with the DDIP. The highly conductive nature of the graphitic beds within the Wildman Siltstone prevented the DDIP from obtaining useable data at a depth greater than N=3 using 50m A spacing. However the chargeability data obtained from N levels 1 to 3 is also considered unreliable due to electromagnetic coupling and the graphitic siltstone absorbing the chargeability response, and masking the response from the hematite mineralisation. The TEM surveying was able to confirm the highly conductive nature of the basement as well as define the target iron ore as a resistor within a conductive host rock background. It is recommended that a HoistEM helicopter EM survey be carried out over Helene to detect pods of relatively resistive iron ore against a conductive background.

Introduction

In November 2005 Resource Potentials were engaged to assist in planning and implementation of ground induced polarisation surveys over the Helene and Millers prospects in the Northern Territory. Resource Potentials also provided on site field supervision, quality control and data processing during the acquisition of the data.

The Frances Creek Iron field lies approximately 25 km north of the Pine Creek Township. The iron ore prospects at Frances Creek are known to lie within a series of outcropping ridges comprised of hematitic and carbonaceous shales and slates of the lower Wildman Siltstone (Ferenczi, 2001).

Physical property work carried out by Systems Exploration Pty Ltd in November 2004 indicated that the iron ore mineralization is chargeable and geophysical techniques would be useful for mapping, if not for direct detection of the hematite.

Gradient array induced polarization (GAIP) surveys where designed to highlight shallower chargeable responses associated with hematite. Dipole-dipole induced polarization (DDIP) surveys were also planned to define depth extents of the iron ore and test for deeper chargeable zones and resistors which may have failed to show in the GAIP.

While on site, a single line of moving loop time domain electromagnetism (TEM) was carried out to diagnose possible geological features which may have caused problems with the GAIP and DDIP, as well as test the suitability of this method for future exploration.

This report briefly outlines the field parameters, acquisition and results of the induced polarisation surveys and the TEM line.

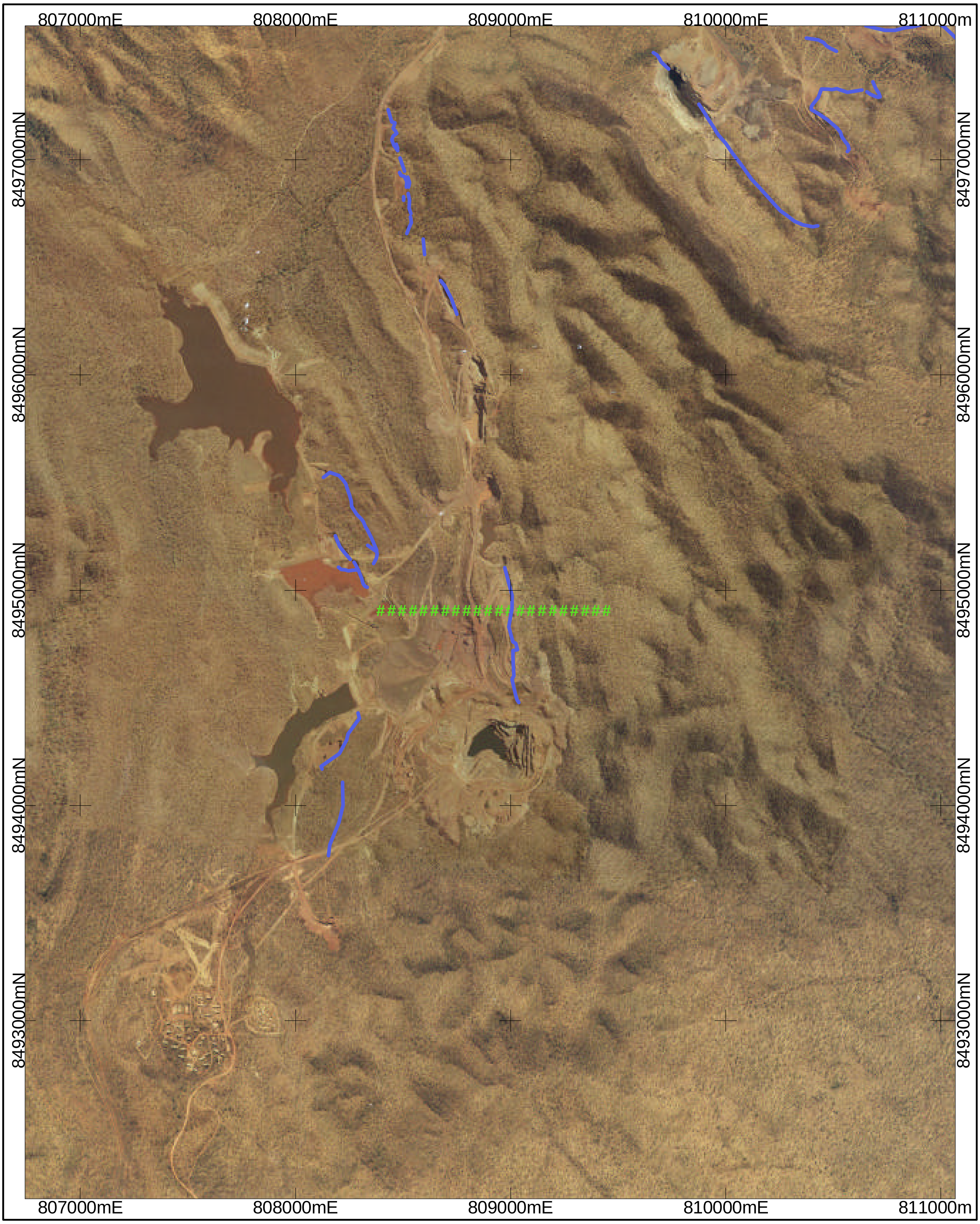
Location

The Helene and Millers prospect areas are located north of Pine Creek, within the Frances Creek iron field in the Pine Creek Orogen. One GAIP survey grid was planned for Millers and 3 GAIP survey grids were planned for the Helene area. The GAIP surveys were not completed, because it was found that this technique would not work over the graphitic shale in the Wildman Siltstone. Only 1 survey line of DDIP was completed at Helene. A location map of the Helene survey line is shown in Figure 1.

Survey Parameters

Millers Project Area

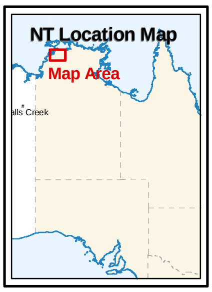
Gradient array induced polarisation (GAIP) data were acquired over 1.5 lines of approximately 500m long, using a 50m A spacing and 25m station spacing. A Zonge GDP-32 receiver and Zonge GGT-25 transmitter were used with a base frequency of 0.125 Hz and nominal current of 6A was usually achieved. Only 1.5 lines were collected as insufficient signal was being detected to collect useable data over the entire grid. Figure 2 shows a profile of chargeability and primary voltages over line 800, the southern



LEGEND

FIMCO Ironstone

\# DDIP and TEM Stations



N

Scale 1:25 000

0 200 400 600

Metres

GDA94, MGA Zone 52

Territory Iron Ltd

France Creek Project

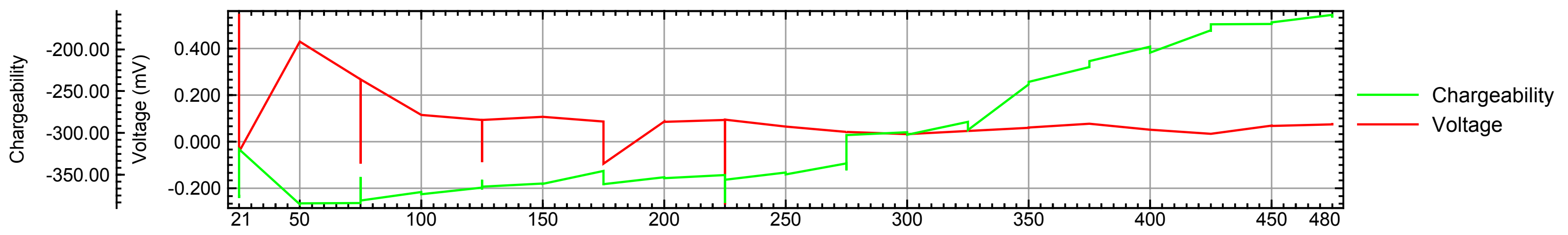
DDIP and TEM Stations
on
Air Photo
with FIMCO Ironstone Locations

Compiled By: Resource Potentials

Plot Name: Figure 1 Date: 15/12/05

mikew/frances_ck_ip

Millers Line 800



database: d:\projects\territory_iron\millers\data\gaip\geosoft\Millers_GAIP.gdb line/group: L800

2005/12/19

Figure 2

most line in the grid. This is illustrating the low voltages recorded and unreasonable chargeability values. Vertical lines and level shifts represent duplicate readings and highlight the non repeatability of various stations.

Helene Project Area

GAIP data were planned to be collected over a portion of the Helene iron ore deposit trend, though due to a lack of signal, no useable data was collected. Similar acquisition parameters as used at Millers were attempted at the Helene project area, but the lack of useable signal was thought to be either equipment malfunction or unusual geological issues.

A single line of DDIP data was collected over the Helene project area. These data were collected using 50m A spacing and 50m station spacing, only reading down to N=3 due to lack of signal at higher N values. A base transmitter frequency of 0.125 Hz was used, with current ranging from 0.5 to 13 Amps achieved using a Zonge GGT-25 transmitter.

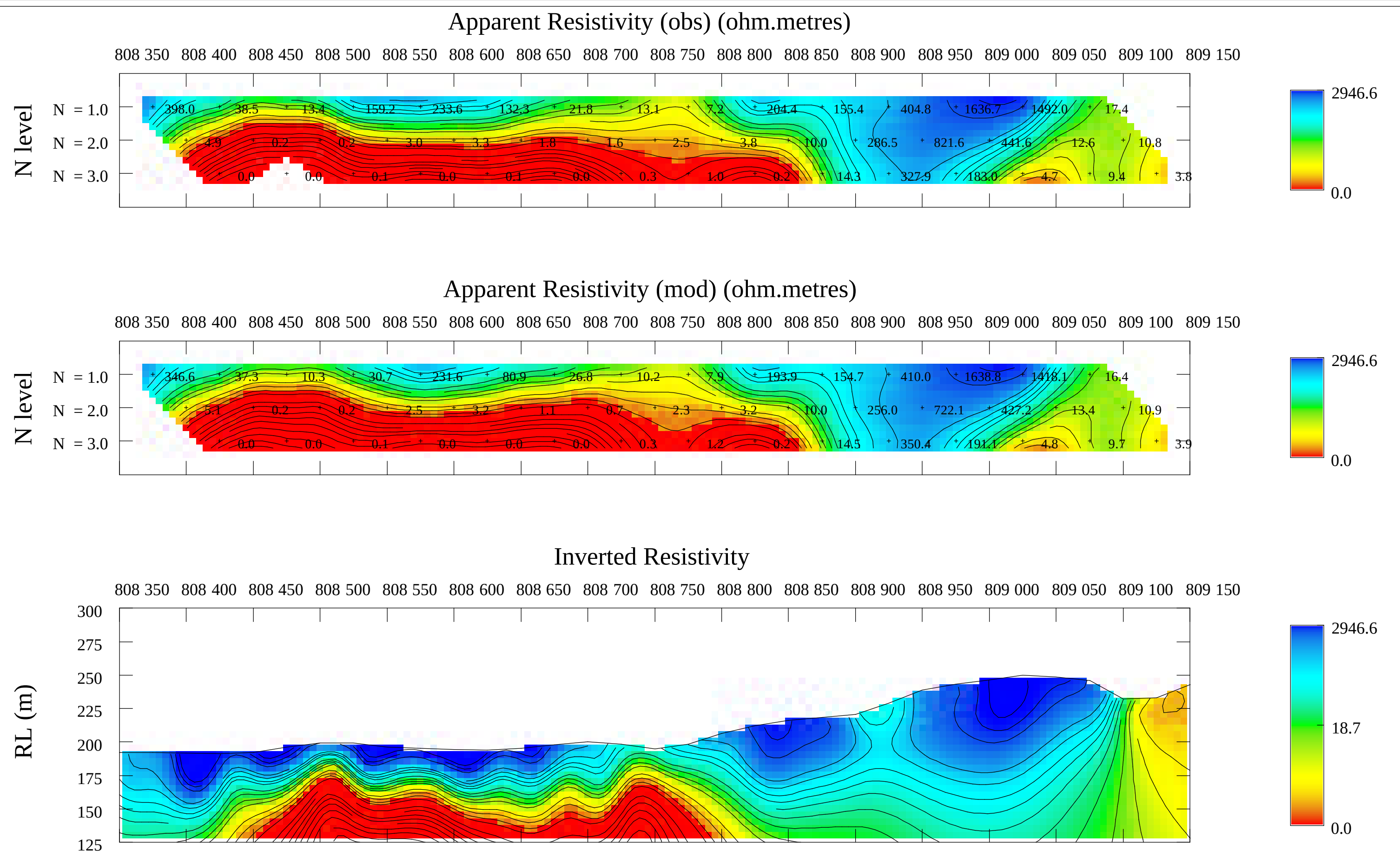
For both Millers and Helene, a varying amount of stacks and readings were taken for the GAIP and DDIP. This was done in order to keep the errors associated with each reading to an acceptable level. Readings were taken near a GAIP transmitter electrode at Helene to test the equipment, and the signal was good near the electrode, but went to zero at about 250m from the electrode. At first the lack of signal was thought to be caused by malfunctioning equipment. This was ruled out following tests. Tests carried out over the granite terrain south of Helene showed that the equipment was in working order, and it was deduced that the lack of signal was caused by electron absorption in the graphitic shales.

A single line of TEM was also collected over the same DDIP line at Helene. For this line data were collected using a 2 turn 100m by 100m loop. A current of 20 amps was transmitted into each turn for a total of 40 amps. A transmitter frequency of 0.5Hz was used due to the conductive nature of subsurface. In conductive terrains, long decays are experienced. As such lower frequencies are used as they provide longer off times to collect data later in time, correlating to deeper features. Again with the TEM, varying numbers of stacks were used in order to maximize data quality.

Data Processing

The GAIP data from the GDP-32 were dumped and imported Geosoft where the data were quality controlled, edited, and spurious readings removed.

The DDIP data were imported in to Geosoft, where spurious readings were removed and the data quality controlled, and then exported into Windisp for final inversion. The data were then inverted using UBC code to produce resistivity and chargeability pseudo-depth sections shown in Figures 3 and 4, respectively. The inversion parameters were varied for each line until the relative errors were low and a best possible fit with the field data was achieved.

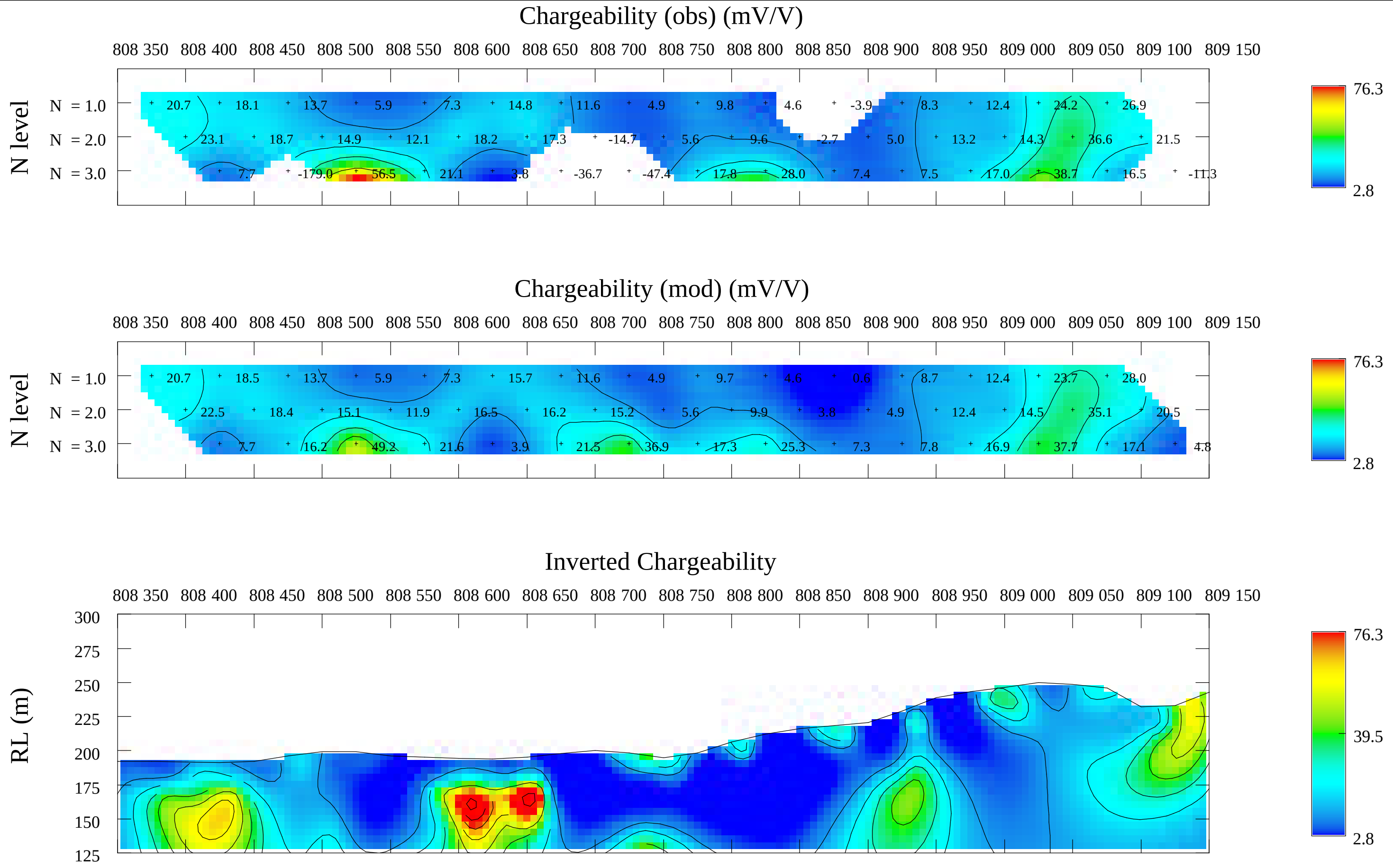


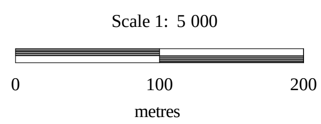
Scale 1: 5 000

0 100 200

metres

Territory Iron	
Frances Creek Helene Dipole Dipole Survey	
50m Dipole Seperation UBC Resistivity Inversion Line 8494900	
Author : mikew	Datum: GDA94
Drawn :	Projection: MGA Zone 52
Date : 14-Dec-2005	Report No :
Scale 1: 5 000	Figure 3





Territory Iron

Frances Creek

Helene Dipole Dipole Survey

50m Dipole Seperation
UBC Chargeability Inversion
Line 8494900

Author : mikew	Datum: GDA94
Drawn :	Projection: MGA Zone 52
Date : 14-Dec-2005	Report No :
Scale 1: 5 000	Figure 4

The first pass quality control of the TEM data was done at a field level by the Resource Potentials representative as the data was being collected. The TEM data from the GDP-32 were then dumped and then sent to the Zonge office in order for them to provide the data in a format that could be used in the Maxwell processing software which is used by Resource Potentials. Final quality control was then done on the data, which was then inverted using the EMAX 1-D inversion software (Figure 5). Zonge also provided a 1-D smooth inversion using Zonge proprietary software (Figure 6).

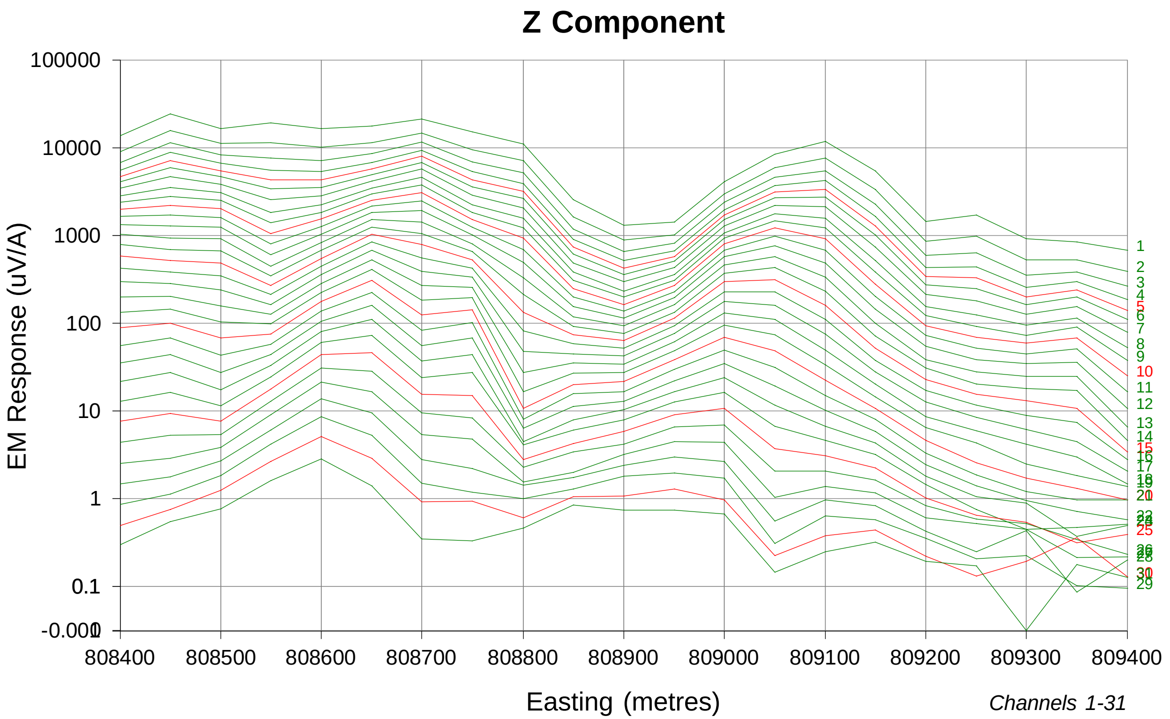
Results

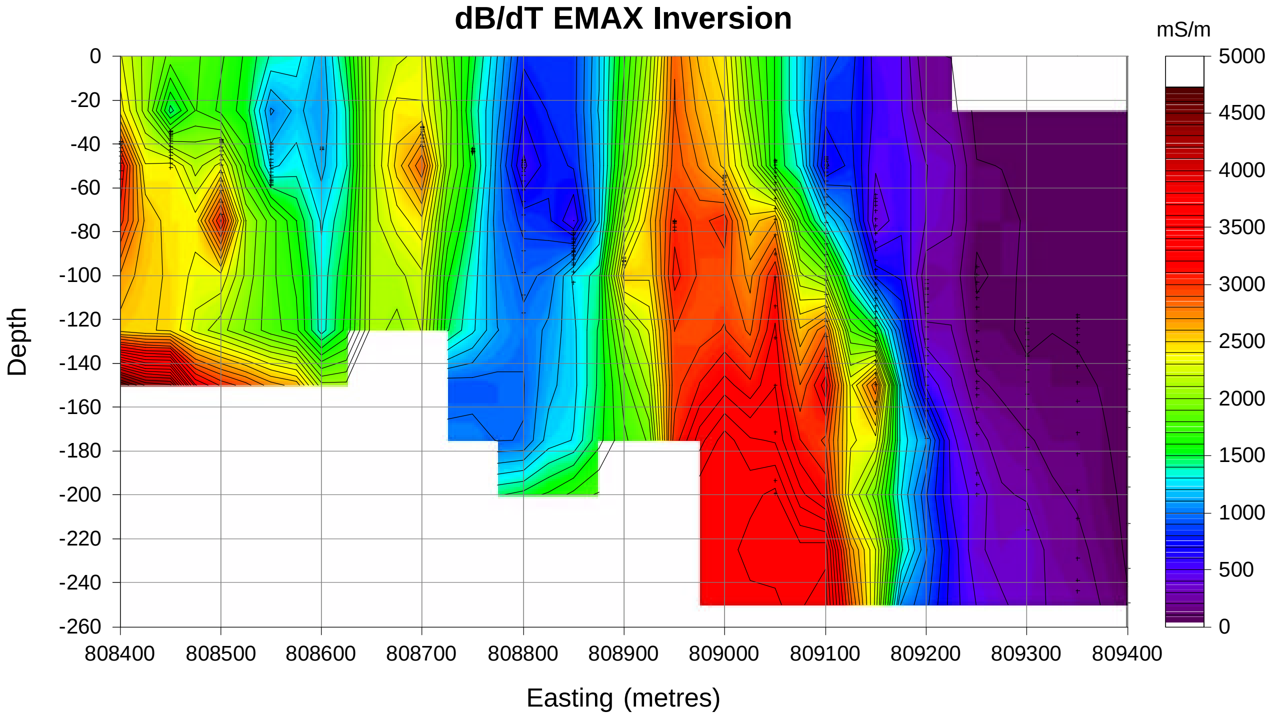
Millers Project Area

GAIP

The GAIP experienced problems that prohibited the completion of this survey. An acceptable current of 6.5 amps was able to be achieved, though signal strength was extremely poor.

The GAIP survey uses porous pots filled with a super saturated copper sulphate solution to measure the potential difference between the two porous pots which were separated by 50m for this survey. Data is collected with the current on to obtain resistivity data, and then the current is switch off to obtain the IP data. The average potential difference between the two porous pots when the current is on is known as the Vp. For good data to be obtained, typical Vp values will be at the bare minimum of 1mV, with better data





WINDOW TIMES (ms)
From the start of the Ramp

1	: 0.3594	17	: 15.65
2	: 0.6036	18	: 19.77
3	: 0.8477	19	: 24.87
4	: 1.092	20	: 31.18
5	: 1.336	21	: 39.06
6	: 1.580	22	: 49.11
7	: 1.942	23	: 61.86
8	: 2.431	24	: 77.63
9	: 2.920	25	: 97.50
10	: 3.524	26	: 122.7
11	: 4.258	27	: 154.4
12	: 5.218	28	: 194.3
13	: 6.555	29	: 244.6
14	: 8.137	30	: 307.7
15	: 10.08	31	: 387.4
16	: 12.51		

SURVEY PARAMETERS

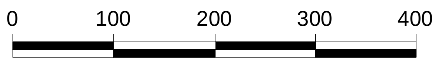
Configuration : In-Loop
Station Spacing : 50 m

RECEIVER

Receiver : Zonge GDP
Frequency : 0.5
Component : Z
Rx Coil : TEM 3

TRANSMITTER

Transmitter : GGT-25
Turn Off : 0.24 ms



Scale 1:7500

Territory Iron Ltd

Helene Prospect

In-Loop EM Survey

PROFILES OF
EM RESPONSE
Line 8494900N

Drawn : RESPOT	Figure 5
Job	

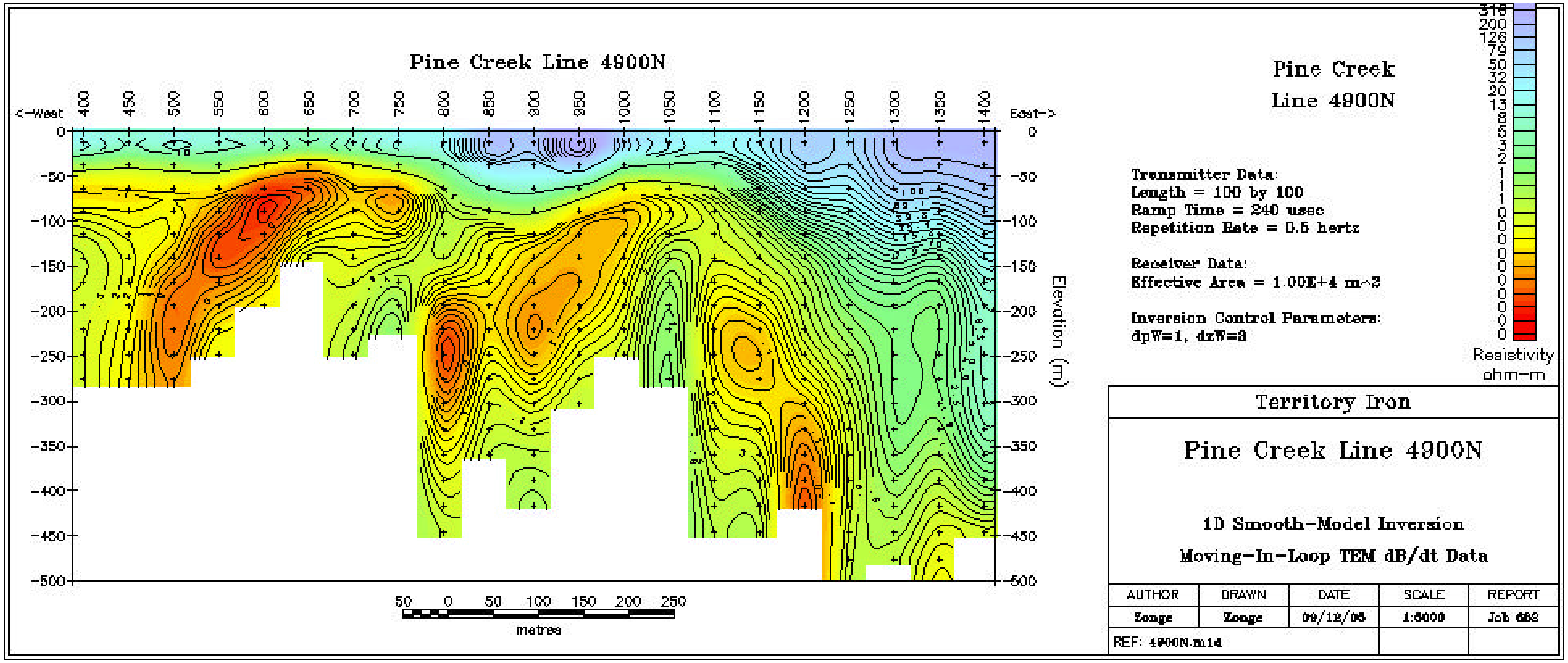

Pine Creek Line 4900N
<-West
East->
400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400
0 -50 -100 -150 -200 -250 -300 -350 -400 -450 -500
Elevation (m)
50 0 50 100 150 200 250
metres
Pine Creek
Line 4900N
Transmitter Data:
Length = 100 by 100
Ramp Time = 240 usec
Repetition Rate = 0.5 hertz
Receiver Data:
Effective Area = 1.00E+4 m^2
Inversion Control Parameters:
dpW=1, dzW=3
Resistivity
ohm-m
Territory Iron
Pine Creek Line 4900N
1D Smooth-Model Inversion
Moving-In-Loop TEM dB/dt Data
AUTHOR
DRAWN
DATE
SCALE
REPORT
Zonge
Zonge
09/12/08
1:5000
Job 682
REF: 4900N.m1d

Figure 6

being collected at higher Vp values of 50 mV or more. Low Vp values are typical of very conductive geology.

The GAIP over the 1.5 lines collected all showed very low Vp values, with the highest Vp approximately 0.5 mV with typical values around 0.08 mV. These low Vp values provided unreliable and unrealistic chargeability values.

Helene Project Area

GAIP

GAIP surveying at Helene provided the same low IP signal and unreliable data as experienced at the Millers area. At Helene, a current of 4.5 Amps was able to be achieved. When this low signal was experienced testing of the equipment was undertaken to try to improve the signal. The tests showed that the equipment was in working order, so another test was tried. Receiver pots were placed at the current electrodes and moved towards the survey area to see how far from the electrodes signal was lost, and asses the potential for the DDIP survey to go ahead. It was found that signal was lost at approximately 250m away from the current electrode. With this discovered, it was decided to abandon the GAIP surveying and attempt DDIP surveying.

DDIP

Initially, recording of the DDIP data was trialed to read to a depth of N=6. This equates to receiver pots placed at a furthest distance of 350m from the current electrode. This provided unusable low Vp values for the deeper N values. The survey progressed, eliminating an N value with each reading, until a suite of useable N values were obtained. The highest N value that was able to be recorded was to N=3. With this configuration, the furthest receiver pot is located 200m from the current electrode. Beyond this distance signal was lost, similar to the GAIP test mentioned above.

A test of the equipment was made in the granites to make sure the loss of signal at 200m separation was caused by geology and not equipment problems. The granites occur approximately 3km to the south of Helene. A suitable site was chosen and the electrodes were separated from N=1 to N=6. Here it was found that a strong signal could be detected at the deeper N values. This proved that the problem with signal loss was caused by electron absorption in the graphitic shales.

Problems with the DDIP were also experienced to the east of the line. It was found that the contact resistance of the current electrodes was too high to transmit a signal. When this was encountered two more electrodes were dug at each location and large quantities of water were used to try and decrease this. However on the very eastern electrodes, this had a limited effect and no data was able to be collected here. As such the DDIP line was shortened by approximately 250m on the eastern side. The high resistance was probably caused by Mundogie Sandstone.

Inversion of the DDIP resistivity data recorded to N=3 showed a generally resistive surface sitting on top of a highly conductive basement, becoming more resistive to the east. The highly conductive basement shown in the inversion is likely to be the carbonaceous beds within the Wildman Siltstone, with the more resistive basement likely to be to Mundogie Sandstone. This is shown in Figure 3. Terrain incorporated into the inversion in Figures 3 and 4 was obtained from the DTM extracted from aeromagnetic surveying.

Negative chargeability values can be seen in the chargeability pseudosection in Figure 4. It is thought that these negative chargeability responses are likely caused by electromagnetic (EM) coupling. EM coupling is known to be a problem for IP surveying in areas of high conductivity (Grant and Hohmann, 1989). Grant and Hohmann also suggest that using low frequencies and small dipole separations can reduce the effect of the EM coupling. In the case of the Helene DDIP a low frequency of 0.125Hz and small dipole separation of 50m was used, though this did not remove the EM coupling in the data.

The inversion of the chargeability data provided a number of chargeable targets. The chargeable response at 808 600m E is known to correlate with the stockpile of iron ore on surface, though chargeability values seem unrealistically high. The chargeability response detected at 808900m E, correlates well with the known mineralisation, though the depth of the anomaly is on, perhaps slightly deeper than, the limits of the inversion. The chargeable response found at surface at station 808900m E correlates with known mineralisation.

It is suggested that the graphitic shale absorbed the chargeability response, given that the graphite at Helene is extremely more chargeable than the target hematite. Due to the graphitic shale, combined with the EM coupling present in the data, it is thought that the chargeability inversion is unreliable. The EM profile showed that the graphitic shale had an extremely high conductivity of greater than 4000 mS/m (see below).

TEM Line

TEM data was collected over the same DDIP line at Helen, though the full 1km long traverse was able to be completed.

Two inversions were conducted on the Helene TEM data. Zonge provided a smooth 1-D inversion using the Zonge inversion routine, shown as Figure 6, while Resource Potentials also inverted the TEM data using the EMAX 1-D inversion routine, shown as Figure 5. These two methods showed broadly similar responses, with both highlighting the highly conductive nature of the basement in the middle to western part of the line. Due to the highly conductive nature of the basement, which ranged from about 1000 mS/m to 4500 mS/m, the iron ore target is likely to show up as a resistor in a conductive background. Both the Zonge and the EMAX inversions highlight a surficial resistor extending from 808800m E to 809000m E. It is suggested that this shallow resistive response correlates to the known iron mineralisation from ground observations and drill hole location.

Conclusions

GAIP surveying at Millers and Helene failed to provide useable data. This is due to the highly conductive nature of the bedrock geology. As the geology is so conductive a strong enough signal cannot be obtained to collect reliable data. Furthermore, contact resistance is very high over the Mundogie Sandstone.

DDIP surveying over the Helene prospect highlighted the highly conductive nature of the basement.

TEM surveying over the Helene DDIP line confirmed the highly conductive nature of the basement and explained all previous problems encountered in the GAIP and DDIP surveying. It also shows the iron ore sits within a resistive zone in conductive graphitic sediments. This method provided the most reliable data, with the low error values obtained. This method of data acquisition also enables the collection of data in highly conductive environments, such as Frances Creek. It is also not susceptible to high contact resistances, such as for IP surveys.

Recommendations

It is recommended that no further GAIP or DDIP surveys be attempted within the Frances Creek iron field. Both the GAIP and DDIP surveys experienced problems with small signal strength due to the conductive nature of the graphitic shales in the basement, which occur coincident to all iron deposits in the area.

Results from the TEM surveying at Helene indicate that it is possible to detect the iron ore as resistive pods within a conductive host rock. It is therefore recommended that further TEM work be conducted. It is also suggested that a smaller loop be used for future work. Logistic problems were encountered with the equipment available on site prevented a smaller loop size being used in this instance. Low resistance in the 50m loop prevented it being used in this instance, though with a more suitable transmitter a 50m loop would be achievable. Rugged terrain also prevented this survey progressing rapidly with the equipment used in this instance.

Detailed airborne EM should be used to detect the resistive iron ore sitting within the conductive sediments. Orientation HoistEM time-domain helicopter electromagnetic surveying should be used to collect detailed EM data over Helene quickly and at relatively low cost. The along line data separation of this system would provide much higher along line resolution than the ground based TEM survey. Lines should be separated by about 80m. The low flying height of this system also allows for good depth resolution. Due to the shallow location of the iron ore, and the high bandwidth of HoistEM, make this system ideal. If this orientation survey proves effective, then other prospects could be explored in the same way.

References

Ferenczi, P.A., 2001, iron ore, manganese and bauxite deposits of the Northern Territory, Northern Territory Geological Survey Report 13,113 pp.

Grant, T.W., and Hohmann, G.W., 1989, Interpretation and removal of EM coupling in IP data: Exploration Geophysics, **20**, 105-110.