PASMINCO EXPLORATION

INTERPRETATION OF DOWNHOLE ELECTROMAGNETIC DATA ON MS11 AT THE BEATRICE PROSPECT JANUARY 2000

EL 6/98

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Melbourne Report No:	VC 304

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1. SUMMARY

During December 1999 down-hole electromagnetic data (DHEM) using the CRONE PEM system were acquired on diamond drill-hole MS11 at the Beatrice Prospect. The Beatrice Prospect is situated in Western Tasmania within EL 6/98 approximately 7 kilometres north of the town of Queenstown. Outer-Rim Exploration Services were commissioned to complete the DHEM survey for Pasminco Exploration who are currently exploring the ground for Rosebery style Zn-Pb-Ag-Au mineralisation. Data were acquired using the CRONE DHEM time domain electromagnetic system.

The aim of the DHEM survey was to delineate anomalous EM response that could be attributed to massive sulphide mineralisation for the purpose of defining further drill targets in the vicinity of drill-hole MS11. It is estimated that the DHEM technique would effectively explore within a 200 metre radius of the current drill-hole position. When interpreting DHEM data and reviewing this SUMMARY it must be kept in mind that economic sulphide mineralisation may not necessarily provide a recognisable response (eg Hercules, Western Tasmania) and that some geological conditions provide anomalous EM response that is not associated with economic sulphide mineralisation (eg graphitic/pyritic black shales).

DHEM data were acquired in the time-domain using an impulse response (square-wave signal) CRONE PEM system. Data were acquired on 18 separate channels (including the "Primary Field" or PP measurement) on a 10 msec timebase. Three-component data were collected at 10 m intervals for the entire length of the 600m drill-hole. Two transmitter loops were used for logging MS11.

DHEM results from MS11 indicate the presence of an EM response centred at approximately 390 m down-hole. The response is observed with both transmitting loop energisations and shows a separation of responses from galvanic current flow at early time to inductive current flow at late time. The anomaly has been modelled using FILAMENT modelling software and data analysed in profile form. Time constant analysis suggests a target with a time constant of approximately ##### msec. Modelling places the source of the EM anomaly above the MS11 drill trace and to the south. It is difficult to accurately estimate the size of the conductive source but initial indications are of a plate like body (a sheet) of dimension 100 m x 100 m. A pessimistic view of this response could explain the source as a more conductive part of the Itat Creek Shale (than has previously been intersected) adjacent to the Itat Creek Fault at depth. A more optimistic view is that the conductor is a large sulphide accumulation associated with the shallow mineralised intersections in MS1 and MS11. The latter would obviously be a more favourable outcome. It is recommended that this target be drill tested. A target coordinate and depth are provided in the following report to plan a drillhole that would intersect the modelled source. It is most likely that such a drillhole could be collared at the MS11 site or within the Itat Creek.

2. INTRODUCTION

The Beatrice Prospect is situated within EL6/98 approximately 7 km's north of the town of Queenstown in Western Tasmania (Figure 1). The ground is currently being explored by Pasminco Exploration for its potential to host Rosebery style Zn-Pb-Ag-Au mineralisation within Palaeozoic volcanics and volcaniclastic sediments of the Central Mt Read Volcanics. The region also has potential for Mt Lyell style Cu-Au mineralisation.

This report presents results of a down-hole electromagnetic (DHEM) survey on diamond drill-hole MS11 conducted by Outer Rim Exploration Services for Pasminco Exploration during December 1999. The aim of the DHEM survey was to delineate anomalous conductivity response that would be directly associated with massive sulphide mineralisation, and thus provide a target for further exploratory drilling. Previous DHEM logging conducted on nearby drillholes (MS07, MS08, MS09, and MS10 Dauth 1999) during 1999 indicate that the host lithologies at Beatrice do produce anomalous DHEM response. This needs to be taken into account when interpreting the data to avoid targeting of host rock EM responses.

3. LOCAL GEOLOGY AND PREVIOUS WORK

This summary of the geology and previous work is taken from the previous report on DHEM results on MS08 (Dauth 1999).

The Beatrice Prospect comprises a prospective horizon of the Cambrian Mt Read Volcanics at the top of the Central Volcanic Complex (CVC). The CVC comprises predominantly felsic volcanics and volcaniclastics and is typically overlain by a sequence of shales, siltstones, and sandstones (interpreted to be Lower Tyndall Group). It is conceptual that this contact provides a focus for mineralisation either by acting as a fluid trap and favourable geochemical position via the overlying shales, or as the sea-floor position for Koroko style VHMS mineralisation deposited during a period of quiescence. A quartz-feldspar porphyry has intruded, possibly as a sill, along this contact and is a prominent feature of the local geology (the Mt Sedgewick Porphyry). The Ordovician Owen Conglomerate forms topographic ridges and scree slopes that abut onto the prospective ground. Remnants of eroded Permian sediments as horizontal layered clay/silt/sand beds are also evident in the region.

The simplified local geology comprises a gently folded to steeply dipping north-south striking black shale horizon situated at the contact between overlying porphyry and underlying volcaniclastic and felsic volcanic units. Locally the black shale is intercalated with both the overlying porphyry and the underlying ashy volcanics. The black shale outcrops along a fault expressed as a present day drainage (Itat Creek) and is interpreted to dip steeply to the west and then gently fold to form an anticline in the west underlying the Mt Sedgewick Porphyry. Minor Pb-Zn mineralisation is observed in outcrop and in drill intersections within the black shale and underlying siliclastics. The two areas with potential for further mineralisation are considered to be the steeply dipping shale in the Itat Creek and the extensions of this shale (and ashes-shales-ignimbrites) that underlie the Mt Sedgewick Porphyry to the West and East of Itat Creek.

Exploration to date has focused upon the black shale units that are situated strike parallel with the Itat Creek Fault. Previous work has been summarised by Denwer (1998) in an unpublished report for Pasminco Exploration. This work is further summarised into point form as follows:

- Stream sediment sampling and geological mapping – 1975
- Establishment of over 40 km's of gridding - 1976-present
- 38 line km's of gradient array IP surveying – 1976
- Additional soil sampling - 1977-78
- Drilling MS1, MS2, and MS3 – 1978
- EIP, DHIP, dipole-dipole, and pole-dipole IP geophysical surveys (SCINTREX) – 1978
- Drilling MS4, and MS5 – 1979
- Ground magnetics, gradient array IP, pole-dipole IP, dipole-dipole IP – 1979
- Fixed loop UTEM – 1989
- Drilling MS06 – 1996
- Drilling and DHEM logging; MS07, MS08, MS09, and MS10 - 1998-99

Drillhole MS11 was drilled to test a surface geochemical anomaly. The hole is collared at 385491mE, 5347730mN, 762mRL and was drilled to a depth of 602.3m. The hole survey details are provided below.

Hole	Depth	Mag_Azimuth	AMG_Azimuth	Dip
MS11	0	284	296	-72
MS11	15	284	296	-72
MS11	60	289	301	-71.5
MS11	112	291	303	-70
MS11	167	297	309	-69.5
MS11	230	304	316	-68.5
MS11	260	305	317	-68
MS11	293	305	317	-68
MS11	323	305	317	-68
MS11	353	306	318	-68
MS11	383	309	321	-67.5
MS11	413	309	321	-67
MS11	443	311	323	-66.5
MS11	473	314	326	-65.5
MS11	523	317	329	-64.5
MS11	575	321	333	-63.5
MS11	602	322	334	-63

A summary geological log follows (provided by the project geologist team):

MS11

From	To	
0.0	127	Ash volcaniclastic, minor volcaniclastic sandstone; variably chlorite±sericite altered; weak base metal+pyrite mineralisation with exception of 59-63m weak- moderate base metal veining.
127	150.1	Volcaniclastic sandstone with minor ashy volcaniclastic; variably chlorite or silica-hematite-chlorite altered, weakly mineralised; pyrite >galena>sphalerite.
150.1	151.4	Abrupt contact to semi-massive sulphide; Galena > pyrite > sphalerite; gangue strongly chlorite altered; sulphide content decreases downhole.
151.2	185	Volcaniclastic sandstone; strongly chlorite altered below 167m; increasing Kfeldspar below 180m . Weak Pyrite>galena>sphalerite mineralisation.

185	197.3	Variably silica-Kfeldspar altered ashy volcaniclastic; faulted contact to:
197.3	248.3	Green-pink volcaniclastic sandstone-breccia; pumice, limestone and felsic lava clasts; only trace pyrite.
248.3	338	Strongly chlorite-Kfeldspar/hematite altered volcanic; appears more like a lava breccia than volcaniclastic sandstone. Essentially un-mineralised.
338	486	Volcaniclastic sst to breccia interbedded with minor ash volcaniclastic; clasts of limestone (to 3-4cm diameter), pumice and felsic lava; narrow zones of k-feldspar alteration; essentially un-mineralised.
486	602.3	Ash volcaniclastic and minor volcaniclastic sandstone. Trace base metals (sphalerite +/- galena).

The drill-hole is interpreted to drill through the hanging wall of the easterly dipping Itat Creek Fault. The hole did not intersect the Itat Creek Fault and remained in hanging wall lithologies. A section of mineralised rock (1.4 m) was intersected shallow in the hole at 150 m. It is thought that a large intersection of this material (+5 m) might comprise an economic intersection. It is also highly likely that such a thickness of sulphide mineralisation over a lateral extent could provide good EM response. Qualitative resistance measurements made with a multi-meter indicate that this mineralised section is moderately conductive. Experience taking resistance measurements would suggest a resistivity in the order of 10’s of ohm.m’s for the mineralised intersection.

4. SURVEY SPECIFICATIONS

The survey conducted by Outer Rim Exploration Services using the CRONE PEM system.

The survey specifications are tabulated below:

Date of Survey:	December 2 to 6 1999
Contractor:	Outer Rim Exploration Services
Survey Type:	DHEM
System:	CRONE PEM
No. of Drillholes:	1 MS11
Components:	Axial (A) and cross-components (U and V)
Station Spacing:	10m (A, U, and V)
Time Base:	10 msec
Channels:	18 including the PP field
Ramp Time:	500 μsec
Synchronisation:	Cable
Transmitter Size:	300m x 400m
Current:	13A Amps

The method of data noise and repeatability control was as follows:

- Two readings were taken at every station and compared for repeatability. Additional readings were taken as required.

Two transmitter loop positions were utilised for MS11. For reference within the text of this report the loops have been labelled BEM5 and BEM6. The location of transmitter loops is presented in Figure 2. Transmitter loop corner coordinates for BEM5 and BEM6 (local and AMG) are provided below:

Loop	Corner	AMG East	AMG North	RL	Local East	Local North
BEM5	NW	385160	5348155	920	-1300	1800
BEM5	NE	385476	5347948	750	-850	1800
BEM5	SE	385318	5347588	675	-775	1400
BEM5	SW	385147	5347703	750	-950	1400
BEM6	NW	385476	5347948	750	-850	1800
BEM6	NE	385726	5347794	875	-550	1400
BEM6	SE	385559	5347444	770	-500	1400
BEM6	SW	385318	5347588	675	-775	1400

Time gates utilised by the CRONE PEM system are tabulated below (msec after ramp cessation):

NB. The contractor report (APPENDIX I) uses a system whereby the number 1 channel is the channel that follows the PP channel.

CHANNEL	DELAY	WIDTH
1 (PP)	-0.198	0.1
2	0.05625	0.01349
3	0.07425	0.02251
4	0.09900	0.02700
5	0.13280	0.04060
6	0.17790	0.04960
7	0.23635	0.06730
8	0.31500	0.09000
9	0.42075	0.12150
10	0.56020	0.15740
11	0.74470	0.21160
12	0.98975	0.27850
13	1.31350	0.36900
14	1.74550	0.49500
15	2.31950	0.65300
16	3.08000	0.86800
17	4.09000	1.15200
18	5.42900	1.52600

5. MODELLING PARAMETERS

Data were modelled using the FILAMENT modeling software invoked through the EMVISION EM modelling and visualisation package. The FILAMENT software is capable of inversion of results to provide minimum error between observed and modelled data, however computer inversion can have the undesirable outcome of producing non-geologically feasible results due to the non-uniqueness of solution. This is particularly the case whereby DHEM response is made complicated through superposition of response from multiple sources. It is for this reason that the software was used only in the forward modelling mode for modelling MS11.

6. DISCUSSION AND RESULTS

Stacked profiles of the down-hole response are presented in the contractor report as APPENDIX I. Results are discussed below

MS11

Axial and cross-component data show evidence for several DHEM responses.

A narrow weak in-hole response is observed at 160 m down-hole coincident with a mineralised zone indicated in the geological log. The data do not provide any evidence that this mineralised zone is the edge of a large conductor. Follow-up of this the DHEM response at 160 m downhole is not recommended based on the DHEM data.

A broad off-hole anomaly is detected at 380 m downhole. This has a wavelength in the order of 200 m and may provide a target for further exploration. The response is detected in all components (axial and cross-component) and with both transmitter loop positions. The energisation with the BEM5 transmitter loop produces a "classic" early time galvanic response (current channelling) migrating to a late time inductive response. This is characterised by a transition from negative polarity anomaly at early time to a positive polarity response at late time. The energisation with the BEM6 loop gave a good early time response (galvanic current channelling response) but no recognisable late time inductive response. This would suggest that the BEM6 loop was poorly coupled with the source in comparison to BEM5. This would indicate a westerly dip on the conductor.

The U component data (pointing upwards and perpendicular to the drill axis) clearly shows the conductor at early time is above the drillhole. This is represented by a current channelling response crossing over from negative to positive polarity in early time. The late time response is a broad positive to negative (once again providing evidence for a source above the MS11 drill hole. V component data (positive pointing perpendicular to the drill axis to the left looking down the hole) exhibit a broad negative early time (again diagnostic of an above hole source due to the orientation of the drillhole). The late time V data is barely within signal detection limits buts shows evidence of a positive to negative down hole cross-over. This would suggest a source that is situated to the south of the drillhole. The U component data from the BEM6 transmitting position data show an early time positive to negative cross-over (opposite to BEM5) which again points to a current channelling source above the MS11 drill trace. The late time response is difficult to determine through the noise. The V component shows a broad positive early time anomaly through to late time.

A time-constant was computed using residual graphing techniques revealing a time-constant in the order of 0.45 msec. This is relatively low and would represent quite a small or poorly conductively (coupled) conductor. Experience in Tasmania suggests that such conductors may still be good exploration targets.

Modelling of the response is conducted for the purpose of defining a position to drill an exploratory hole to intersect the source of the DHEM anomaly. Modelling is conducted on both the galvanic response (early times) and the inductive response (late times).

Early Time Galvanic Model

This was simulated using FILAMENT with a large (+500 m radius) ring filament representing a flow of current above the drillhole. This form of modelling does not allow for accurately defining the size of the target or the position north or south of the hole. Targets are defined as follows:

BEM6 Current Channelling Model
Target is a modelled line current centred at
385320mE
5347760mN
380mRL

Filament modelling results are presented below in Figure 3. The modelling presented in Figure 3 shows a relatively poor match between the observed and modelled responses but this is only due to a poor background model. The wavelength and wave shapes of the anomalies show good correlation.

Figure 3. *MS11* Channel 2 BEM6 FILAMENT Model of current channelling source.

BEM5 Current Channelling Model
Target is a modelled line current centred at
385320mE
5347750mN
395mRL

Filament modelling results are presented below in Figure 4. The modelling presented in Figure 4 once again shows a relatively poor match between the observed and modelled responses but this is only due to a poor background model. The wavelength and wave shapes of the anomalies show good correlation.

Figure 4. *MS11* Channel 3 BEM5 FILAMENT Model of current channelling source.

MORE IS TO FOLLOW

7. RECOMMENDATIONS

It is recommended to target the EM conductor at the following coordinates:

385320mE
5347760mN
390mRL

A drillhole should be designed so as to intersect the above point. The target most likely is a sub-vertical sheet. This is not a spectacular conductor (indicated by a time constant less than 1 msec) and it must be kept in mind that the source could be attributed to a more conductive part of the Itat Creek Shale caught up in the Itat Creek Fault. Whilst the most likely source of the EM anomaly is the shale it is considered, in the opinion of the author, that this target has a high enough possibility of being due to sulphide mineralisation to provide an exploration target that warrants testing.

8. KEYWORDS AND LOCALITY

Keywords

conductivity, down-hole, electromagnetics, orebody, pyrite, sphalerite, shale, sulphides

Locality

1:100K Sophia 8014

1:250K SK\55-SW Sheet

9. REFERENCES

Dauth, C., 1999, Modelling and interpretation of downhole electromagnetic data on MS08 at the Beatrice Prospect May 1999 EL6/98; Pasminco Exploration Internal Report No. VC246

Dauth, C., 1999, Modelling and interpretation of induced polarisation data from the Beatrice Prospect February - March 1999 EL 6/98; Pasminco Exploration Internal Report No. VC247

Dauth, C., 1999, Modelling and interpretation of downhole electromagnetic data on MS07 and MS09 at the Beatrice Prospect September 1999 EL6/98; Pasminco Exploration Internal Report No. VC

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APPENDIX I

Contractor Report on DHEM Survey