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Report

to

Macquarie Harbour Mining Ltd

on

Interpretation of VTEM Survey, Sorell Peninsula and Macquarie Harbour, Western Tasmania

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Summary

This report contains anomaly picks from the VTEM surveys flown in the Macquarie Harbour region between 1 – 16 March 2010, on behalf of Macquarie Harbour Mining Ltd. (MHM).

Preliminary anomaly picks based on preliminary VTEM data were delivered to MHM on 19th April 2010.

Following receipt of the final VTEM data from Geotech Ltd on 23rd April 2010, the preliminary anomaly picks were reviewed, and final anomaly picks are included with this report in digital format (MapInfo TAB files). A number of preliminary anomaly picks were discarded as they were clearly due to non-geological sources (seawater, Abt railway etc)

VTEM anomalies have been prioritised according to the strength of the EM response (time constant), and the likelihood of the anomaly being due to a localised bedrock conductor (as opposed to an extensive 'stratigraphic' conductor). Anomalies have been ranked from 3 (best) to 1 (worst). Anomaly rankings should be reviewed on the basis of any additional geological or geochemical information. Generally, those anomalies ranked 2 or 3 are due to bedrock conductors and may be worthy of follow-up. However, even the lowest-ranked conductors could be significant if there are additional geological critera which make them of interest.

Given the large number of anomalies detected, quantitative modelling has not been conducted as this would be prohibitively time-consuming. It is recommended that modelling be conducted on those VTEM anomalies considered to be of most interest to MHM based on all available geophysical, geological and geochemical datasets.

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1 Introduction

The survey areas are shown in Figure 1.1. Time-domain helicopter electromagnetic and magnetic data were acquired over all areas using the VTEM system operated by Geotech Airborne Ltd. A total of 1437 line km of data were acquired over the period 1 – 16 March, 2010. Flight line spacings ranged from 100 – 200 m.

The major datasets supplied include:

- Vertical component of voltage response (dB/dt).
- Vertical component of magnetic induction, obtained via integration of the voltage response (B-field). B-field data emphasises the response of very good conductors in comparison with the voltage response.
- Total magnetic intensity (TMI).
- Digital terrain model (DTM), obtained by subtracting the radar altitude from the GPS elevation.

The Cape Sorell survey areas have been previously explored using a variety of airborne and surface geophysical methods by a number of companies. Previous electromagnetic surveys at Cape Sorell have included frequency-domain helicopter EM (DIGHEM, Jones, 1986), fixed-wing time-domain GEOTEM (Reid and Close, 1997), and ground IP (Morritt, 1999; Newnham, 2001). None of these surveys identified any very strong anomalies. The 1996 GEOTEM survey conducted by Plutonic Operations Ltd 'did not define any high-priority targets considered to be related to VHMS mineralisation' (Reid and Close, 1997). The 1986 DIGHEM survey of Muddy Cove identified 'no first class anomalies' but did map a number of isolated conductors, mostly of 'intermediate' quality (Jones, 1986). Ground IP surveys by Pacific-Nevada Ltd identified a number of chargeable and/or conductive zones, but drilling did not intersect any significant mineralisation (Morritt, 1999; Newnham, 2001).

The King River survey area (Area 6 of the VTEM survey) was previously flown by GEOTEM in 1990 (Read, 1990). The survey did not identify any bedrock conductor responses.

The VTEM system is capable of mineral exploration to depths of hundreds of metres in resistive environments. The high power, low flight height and low noise levels of the VTEM system should provide improved depth of investigation and spatial resolution to those obtained in earlier fixed-wing TEM and helicopter frequency-domain EM surveys conducted in the Cape-Sorell – Macquarie Harbour region.

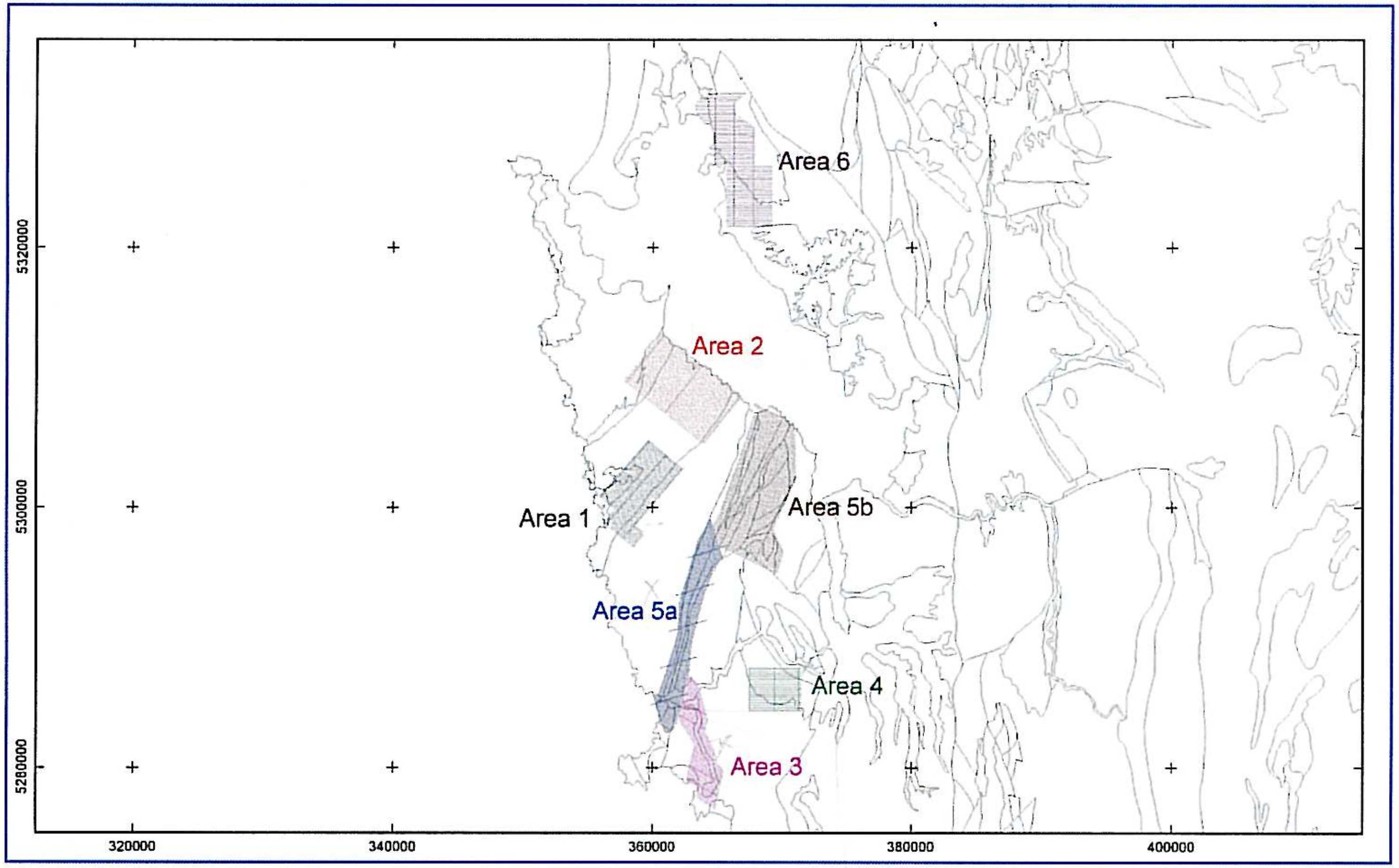

***Figure 1.1** – Macquarie Harbour VTEM survey areas. Coordinates are MGA Zone 55.*

2 Methodology

The steps used in the interpretation were as follows:

A brief QC was carried out on the final VTEM data. All essential system parameters are adequately described in the acquisition report by Geotech Airborne Ltd, included as Appendix D of this report. Noise levels for dB/dt and B-field data are considered to be within the ranges quoted by the contractor, and the dB/dt noise levels are comparable to those in other VTEM surveys commissioned by Geoforce or available in the public domain.

2.1 Bedrock conductors

Profiles of the VTEM dB/dt and B-field response were examined for anomalies due to bedrock conductors. Both local bedrock conductors and larger stratigraphic conductors were picked. Although the latter are not of direct economic interest, they may reveal structure such as faults via discontinuities in extensive conductor trends.

Qualitative properties of each conductor were recorded, including

- **Estimated dip**. For double-peaked anomalies, this estimate is based on the asymmetry of the two peaks (the larger peak is on the down-dip side). It is not possible to easily estimate a dip for single-peaked anomalies, although the dip direction can sometimes be inferred from the direction of migration of the anomaly peak with time.
- **Dip direction**. This is a rough dip direction only, and indicates which end of the survey line the conductor dips towards.
- **Time constant**. This is a measure of conductor quality, and depends on both the conductance (conductivity-thickness product) of the conductor and on its physical dimensions. A conductor with a high time constant will exhibit a slow decay, with high signal level at the latest delay times. Economic mineralisation typically has time constants greater than 0.5 ms. The longest time constants that can be detected with the VTEM system at 25 Hz base frequency are ~6.5 milliseconds. A high time constant does not necessarily indicate mineralisation – graphitic 'stratigraphic' conductors often have large time constants as a result of their high conductivity and large strike and dip extents. However, the time-constant does provide some means of discriminating between conductors.
- **Ranking**. Anomalies have been ranked from 1 (worst) to 3 (best), based on their time constant and on anomaly character. For example, very wide double-peaked anomalies which are continuous from line to line over distances of kilometres were considered most likely to be of stratigraphic origin, and have generally been assigned a low ranking.
- **Anomaly type** (single or double-peaked). The anomaly type sometimes also includes a comment on anomaly quality (e.g., Doubtful), or the likely source

(e.g., Strat = likely stratigraphic conductor). Some examples of the main anomaly types are given in Appendix A.

- Presence of **induced polarisation** (IP) effects (see comments on IP effects below)
- Whether the anomaly is present in **dB/dt or B-field data**, or both. Apparent anomalies in B-field data with no expression in dB/dt data are considered to be doubtful and have been assigned a low rank.

2.2 Induced polarisation anomalies

A large number of IP anomalies were observed in the VTEM data. These IP anomalies are characterised by EM decays which change sign from positive to negative at late delay times, whereas the response from purely-conductive targets should be positive at all delay times. IP effects in EM data may arise due to the presence of polarisable material in the near-surface (e.g., clays) or from disseminated sulphide mineralisation or graphite. Examples of some IP anomalies from the Macquarie Harbour survey are shown in Appendix B.

Strong IP anomalies have been picked and are supplied as a separate MapInfo layer to the EM bedrock conductors. It is unknown whether the IP anomalies are due to clays, graphite or disseminated sulphides. However, there is evidence that some of the IP anomalies may be due to bedrock sources rather than clays, as many of the IP anomalies clearly lie on the same trends as stronger bedrock conductors (e.g., Area 2), and the IP anomalies are sometimes closely associated with magnetic trends (e.g., Area 5a).

3 Interpretation

Anomaly picks for the seven VTEM survey areas are discussed in this section, with reference to anomalies identified by previous work in the area. **All maps and figures in this report use MGA55 coordinates.** Appendix C contains images showing the VTEM anomaly picks, annotated with Ranking, superimposed on images of the dB/dt response at Channel 40 (30 for Area 4), and on the total magnetic intensity.

3.7 Area 6

Flight line spacing in this area was 200 m. Most of the preliminary anomalies picked in this area were spatially associated with the Abt railway track, and have been excluded from the final anomaly picks (Figures 12, C13 and C14).

Only one of the final picked anomalies (Anomaly 6_20) is considered likely to be due to a bedrock source. Anomaly 6_20 is a narrow, single-peaked mid-time response visible in both dB/dt and B-field profiles on Line 60120. The anomaly is very narrow and has no expression on adjacent profiles, and has been assigned a low ranking. This anomaly was also detected by the 1990 BHP-Utah GEOTEM survey (Anomaly MH15, Read, 1990). Geological reconnaissance by BHP-Utah suggested that this anomaly was due to the contact between conductive Tertiary sediments and resistive Cambrian andesites. However, the weak VTEM anomaly does not appear to be a contact-style response.

Anomaly	Line	East_MGA55	North_MGA55
6_20	60120	367395	5323844

Two of the final anomaly picks (6_6 and 6_8) are not directly coincident with the railway line, but are very close to it. These anomalies are considered most likely to be due to infrastructure (sheds, houses, rail infrastructure etc), and have been assigned the lowest ranking (1).

Anomaly 6_9 on tie line 96010 is located at the shoreline of Macquarie Harbour and is likely to be due to conductive seawater. The anomaly does not occur on flight line 60290, which crosses directly over the same location. This discrepancy is likely because the tie line crosses perpendicular to the shoreline, whereas the flight line was parallel to it. The former geometry will give rise to a stronger response.

Area 6 Final VTEM anomalies on image of dB/dt at 3.52 ms (Ch 40) White symbols are strong IP responses

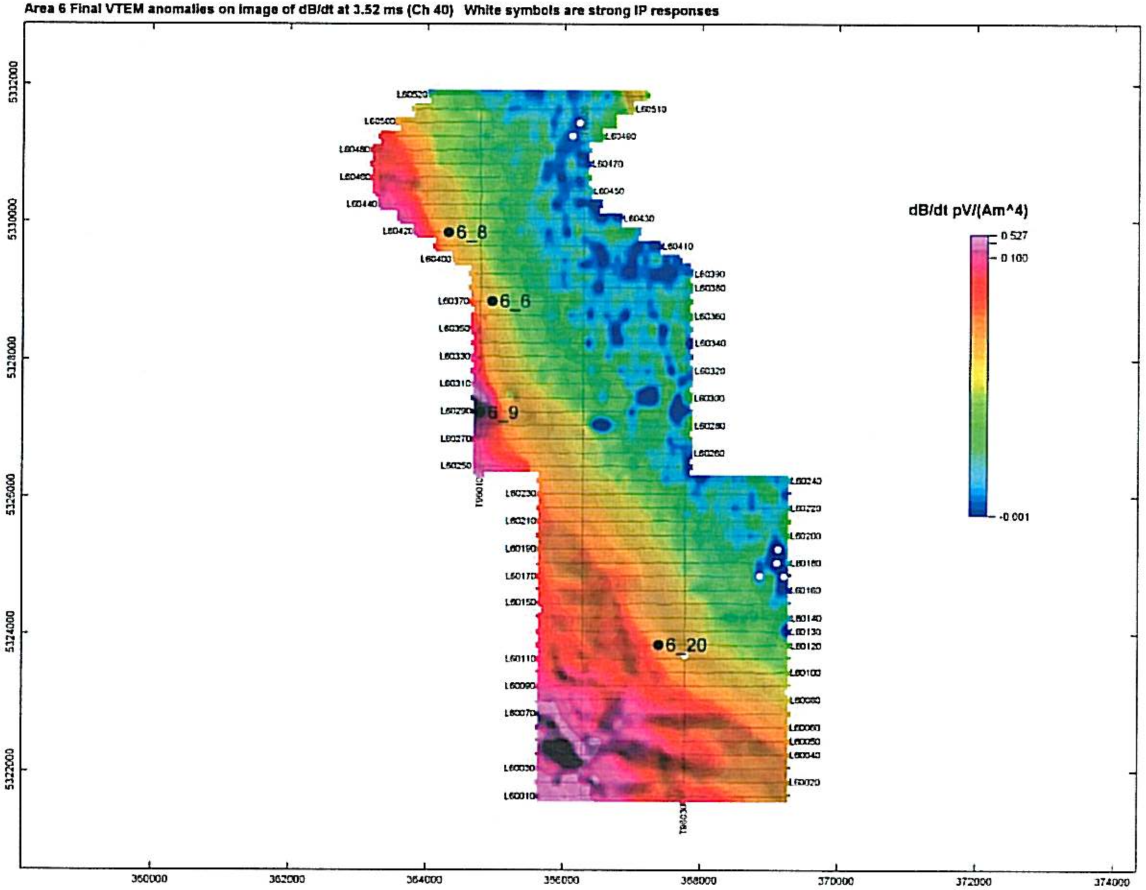

Figure 12 Area 6 VTEM anomalies (black dots) superimposed on an image of the Channel 40 dB/dt response. White dots are VTEM IP anomalies.

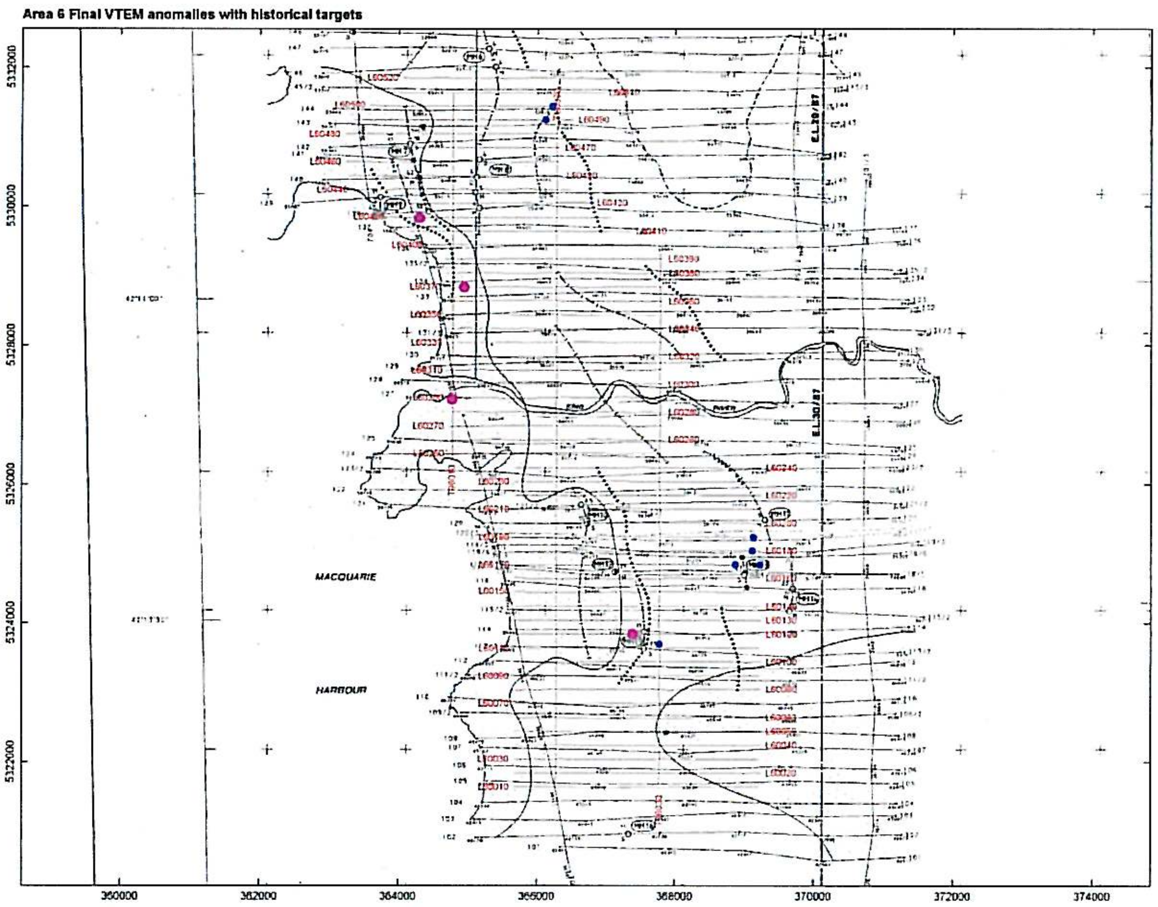

Figure 12 Area 6 VTEM anomalies (pink dots) with anomalies and targets from previous work in the area. Blue dots are VTEM IP anomalies. Numbered ovals are GEOTEM anomalies from the 1990 BHP-Utah Minerals GEOTEM survey (Read, 1990).

6 References

Geotech Airborne Ltd., 2010, Survey and logistics report on a helicopter borne versatile time domain electromagnetic (VTEM) survey on the Sorrell, Tasmania area Australia.

Jones, P., 1986, Progress Report 12 months to September 1986, Sorell Peninsula, Exploration Licenses 35/83, 36/83, 37/83, Tasmania: Cyprus Minerals Australia Company Report 500.

Morritt, R., 1999, Pelias Cove (EL10/97) and Hill 99 (EL9/98) diamond drilling program, May-June 1999, Cape Sorell, Tasmania, Vol. 1: Pacific-Nevada Limited Partnership.

Newnham, L., 2001, EL9/1998 Cape Sorell area, Relinquishment Report: Pacific-Nevada Limited Partnership.

Read, J., 1990, Final report EL30/87, King River, Western Tasmania: BHP-Utah Minerals International Report CR7119.

Reid, R., and Close, R., 1997, Exploration Licenses 4/92 and 7/92 Sorell Peninsula, Annual report on exploration activity to September 1996: Plutonic Operations Ltd Report 97-3989.

7 Disclaimer

The interpretations contained in this report are based on the training and experience of the author and information passed on during the course of the investigation. As with all geophysical data, multiple interpretations are possible. The client is advised to consider information from all available sources prior to making a decision on how to proceed.

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Appendix D

VTEM Data Acquisition Report
(Geotech Airborne Ltd.)