Airborne electromagnetics in Pilbara manganese exploration – a case study

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SUMMARY

Airborne electromagnetic methods have been used for manganese exploration in parts of the Pilbara since 2002 when the first Hoistem survey was flown for Pilbara Manganese. A XTEM survey was commissioned by Montezuma Mining to test the effectiveness of the technique in a new manganese province near Kumarina, WA.

A series of test lines was flown over areas of known manganese ore deposits and revealed a successful correlation between the electromagnetic conductors and the known manganese zones. In addition the test lines revealed new zones of conductivity where traces of manganese had been found but not yet drilled. Based on the preliminary results the complete Butcherbird tenement was flown in December 2010.

The survey successfully mapped the extent of the known manganese zones and assisted in the identification and mapping of several new targets which were subsequently drilled and found to bear manganese oxide. The shape of the Electromagnetic (EM) anomaly maps the resource outline and the strength of the EM signal correlates strongly with the grade of the resource.

Key words: Airborne, Electromagnetic (EM), manganese, Pilbara, exploration

INTRODUCTION

In 2010 Montezuma Mining contracted GPX Surveys to fly our XTEM system over their Butcherbird tenement near Kumarina, Western Australia. A drilling program had already commenced based on expressions of surface manganese oxide and had found ore below the surface.

As no airborne EM data had been flown in the area Montezuma wanted to test the effectiveness of the technique by first flying a series of test lines over known manganese deposits. The test lines confirmed the known deposits and revealed several new anomalies. Based on these the complete tenement was flown at 200m North-South line spacing with 200m East-West ties. Magnetic and Digital Terrain Model (DTM) data were collected in conjunction with the EM data.

METHOD AND RESULTS

The time-domain XTEM system, was used to fly the Butcherbird tenement. The rig has an in-loop transmitter-receiver geometry and is towed 30m below a helicopter. The system generates a moment of 103200, operates at 25Hz and windowing 30 channels of EM. XTEM was chosen because the known manganese deposits were shallow – usually in the first 30m – and XTEM was designed to provide detailed mapping up to 300m deep.

The manganese oxide in this region occurs in sheets and is known as the Yanneri style mineralisation. Drill results had already indicated the sheet like nature of the mineralisation and that the deposits were longer than 400m – 500m. For this reason the survey was designed at 200m line spacing. If the style of mineralisation were more like the discrete pod-type manganese deposits found in Woodie Woodie, Pilbara, then a closer line spacing may be considered.

Results and Interpretation

The EM program helped to map the size and extent of known manganese deposits and find new deposits.

Primary interpretation was done on grids of EM channels 10-20, corresponding to window centre times of 353us to 1605us after transmission turnoff. Conductivity Depth Images (CDI) were generated and modelling conducted to help define the character of the anomaly.

Based on the channel grid information the Yanneri resource outline was defined and subsequent drilling confirmed this. Anecdotally the magnitude of the EM signal correlated to the grade of the resource.

Other drill targets were also defined using the EM data. The highest priority targets were those that correlated to trace expressions of surface manganese. Subsequent drilling of these targets confirmed the manganese mineralisation.

An image of channel 15 with manganese targets before and after the EM survey is displayed in Figure 1.

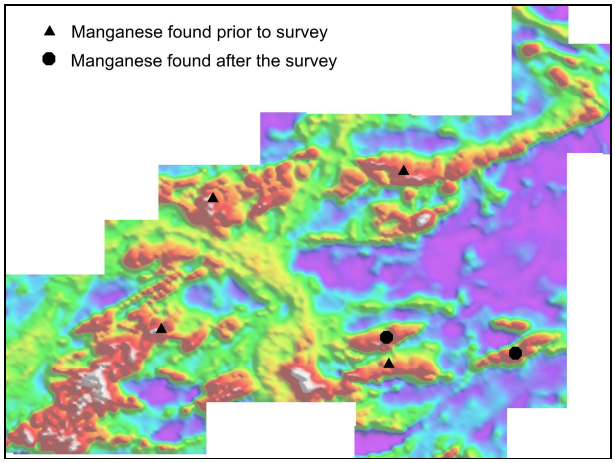

Figure 1. Channel 15 showing locations of known manganese deposits prior to survey and after survey.

A drawback of the EM technique is that it can show up other conductive units such as pyritic shale. This is also an issue in other manganese deposits such as Woodie Woodie (Hashemi, 2002). The magnitude of the EM signal from the shales in the Butcherbird tenement tended to be larger than the manganese and occur into the late time. This helped to distinguish shale targets from manganese oxide deposits but was not always a perfect indicator.

The EM also mapped the clays in what was interpreted to be ground water channels. Several holes were drilled in these zones and confirmed the presence of water which could be used in a future mine.

Because the EM data clearly defined the targets Montezuma highlighted several key benefits:

1. No need for ground geophysics follow-up because the targets are shallow and drill results confirm the validity of the airborne EM data
2. Allows excellent prediction of cost of a drilling program because you can see the resource outlines.
3. Easier and quicker to acquire clearances from Traditional Owners and other land stakeholders because you can show them the outlines of your target areas.
4. Reduces the time to define targets, commence drilling and get assay results.
5. 200m line spacing was perfect for the style of deposit in this region – if the survey had been flown at 300m more money would have been spent on drilling.

CONCLUSIONS

Airborne EM is a valuable tool in the search for manganese ore deposits. It provides quick and cost effective results to help explorers define targets for drilling. Sometimes targets can respond to other conductive features such as pyritic shales and these need to be carefully distinguished from manganese targets, though this is not always possible.

The survey was a huge success for Montezuma to help them find high priority targets for follow up drilling. The drilling program is ongoing but at time of publication over 75% of the targets drilled confirmed manganese oxide mineralisation.

ACKNOWLEDGMENTS

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REFERENCES

Hashemi, A. 2002, Inversion of time domain helicopter electromagnetics data for exploration of manganese ore, East Pilbara Western Australia: MSc Thesis, Curtin University of Technology.

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