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MEMORANDUM

To: Andy Bennett

Copy: James Fox

From: Lynelle Beinke

Date: June 18th, 2015

Subject: Joplin Review

SUMMARY

Review of the 2011 electromagnetic and magnetic data over the Joplin prospect shows that there is a coincident conductive and susceptible body, potentially sulphide mineralisation and associated pyrrhotite, which has not been tested by drilling. It is recommended that this target be drill tested as a high priority.

1. INTRODUCTION

The Joplin prospect is located in the Pine Creek Orogen of the Northern Territory, in the vicinity of the Mt Bonnie and Iron Blow copper deposits, Figure 1. It has previously been identified as an area of interest and a single drillhole, MBEXD001, drilled in 2011, intersected sulphides from 29.3m to 93.1m (EOH). A review of the existing geophysical data has been undertaken to determine if there remains any potential for untested sulphide mineralisation.

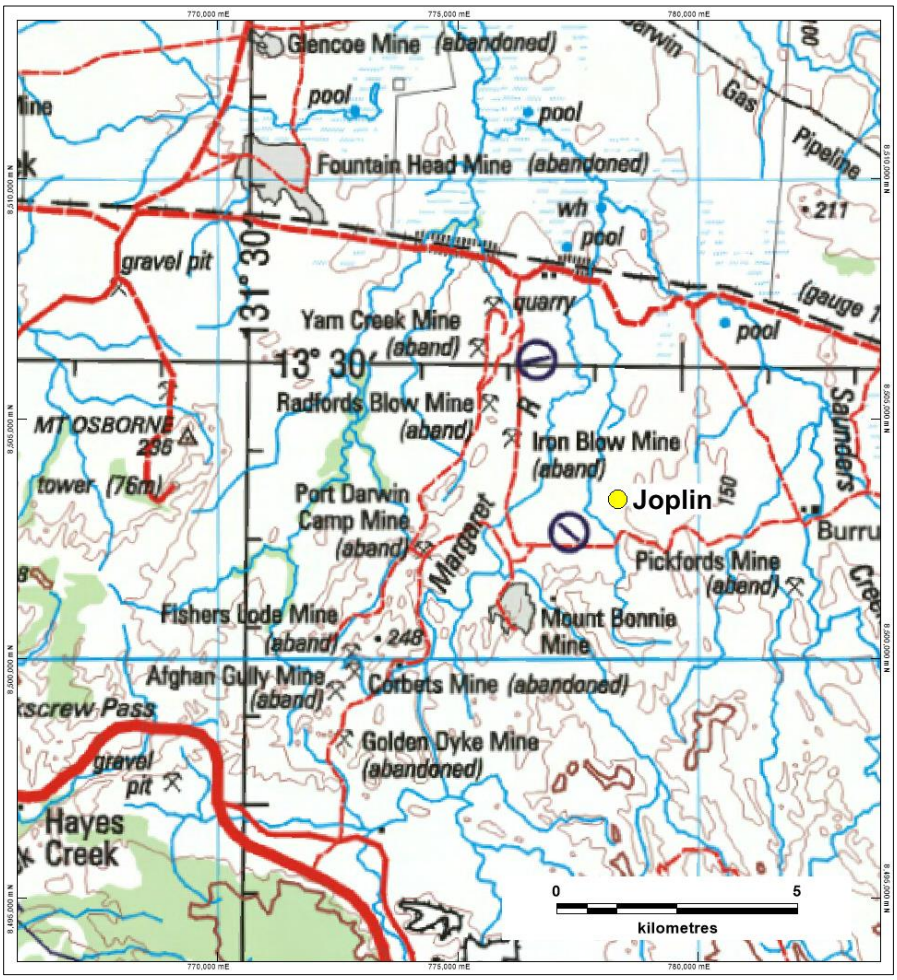

Figure 1. Location of the Joplin prospect.

2. DATASETS

The focus of this review is the 2011 VTEM dataset, containing both electromagnetic (EM) and magnetic data, with specification as outlined in Table 1. Further details can be found in Geotech (2011). A fixed loop ground EM (FLEM) survey that was undertaken in 2015 is also discussed.

Line spacing	150m
Line orientation	062-242°
EM terrain clearance	48m
Mag terrain clearance	70m
Configuration	In-loop
Frequency	25Hz
Peak Current	200A
Peak dipole moment	425000 NIA
Component	Measured Z, derived X
Contractor	Geotech Airborne

Table 1. 2011 VTEM survey specifications.

3. 2011 VTEM

3.1 ELECTROMAGNETICS

There is a strong EM response seen on lines 70330 and 70340 over the Joplin prospect, Figures 2 and 3. Plate modelling was undertaken using EMIT's Maxwell software. A single plate was used to model the X and Z component responses on lines 70330, 70340 and the lines either side. The results are shown in Figures 4 and 5 and the plate properties are outlined in Table 2.

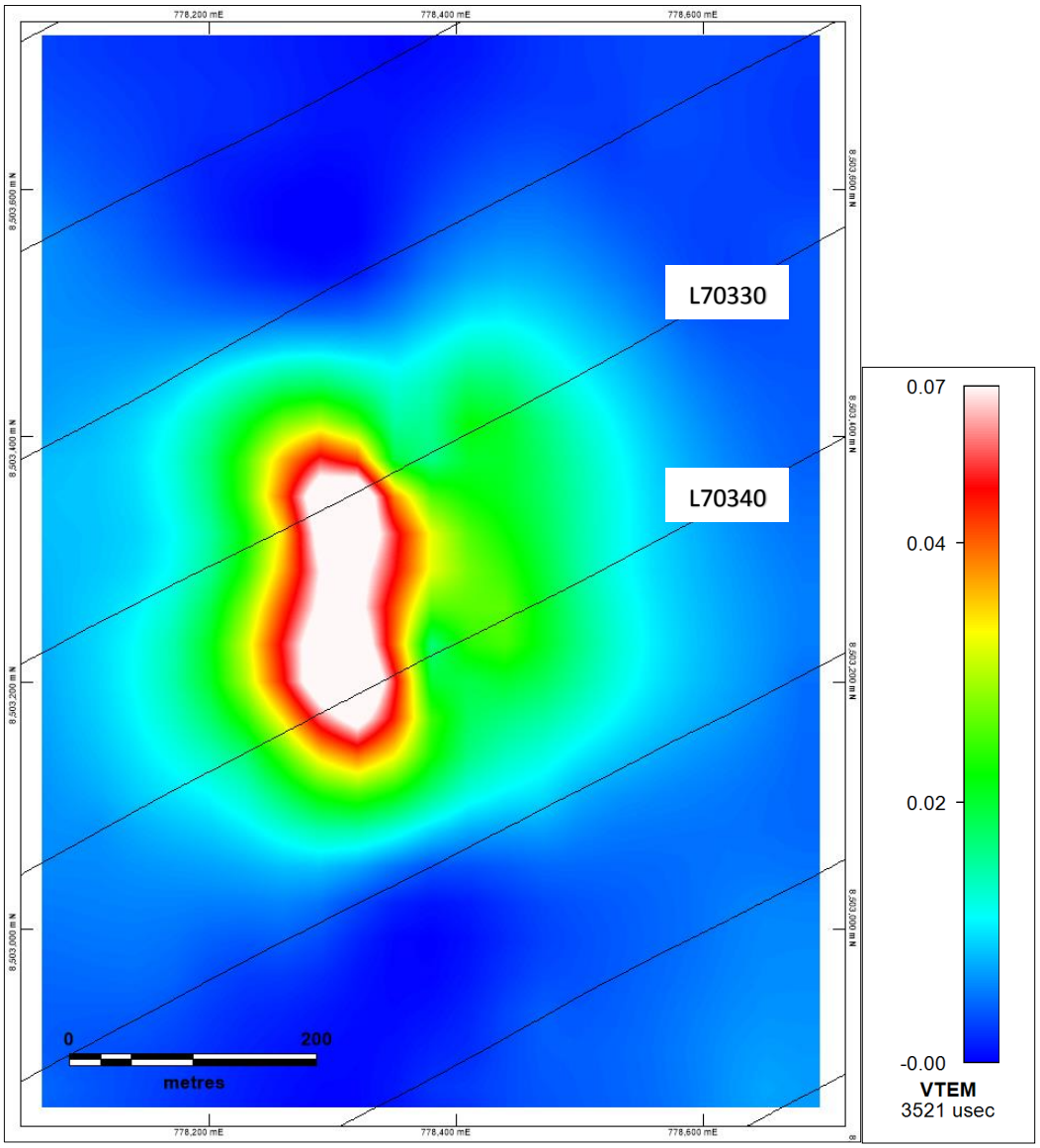

Figure 2. VTEM 3521 µsec time channel (with flight lines) over the Joplin prospect.

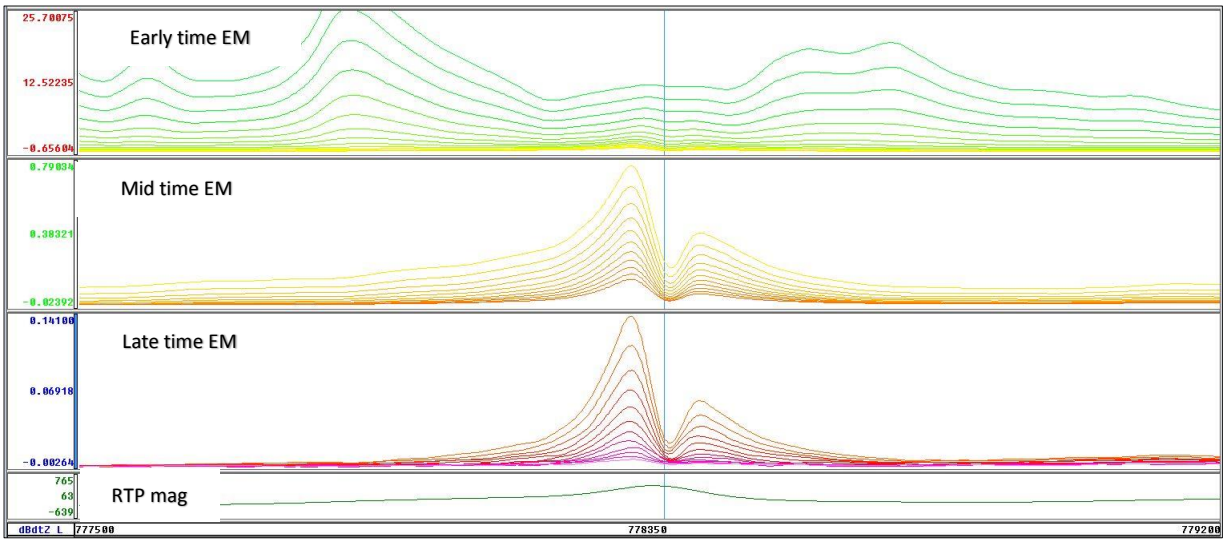

Figure 3. VTEM line 70340 Z component and magnetic profile with location of the Joplin anomaly (vertical blue line).

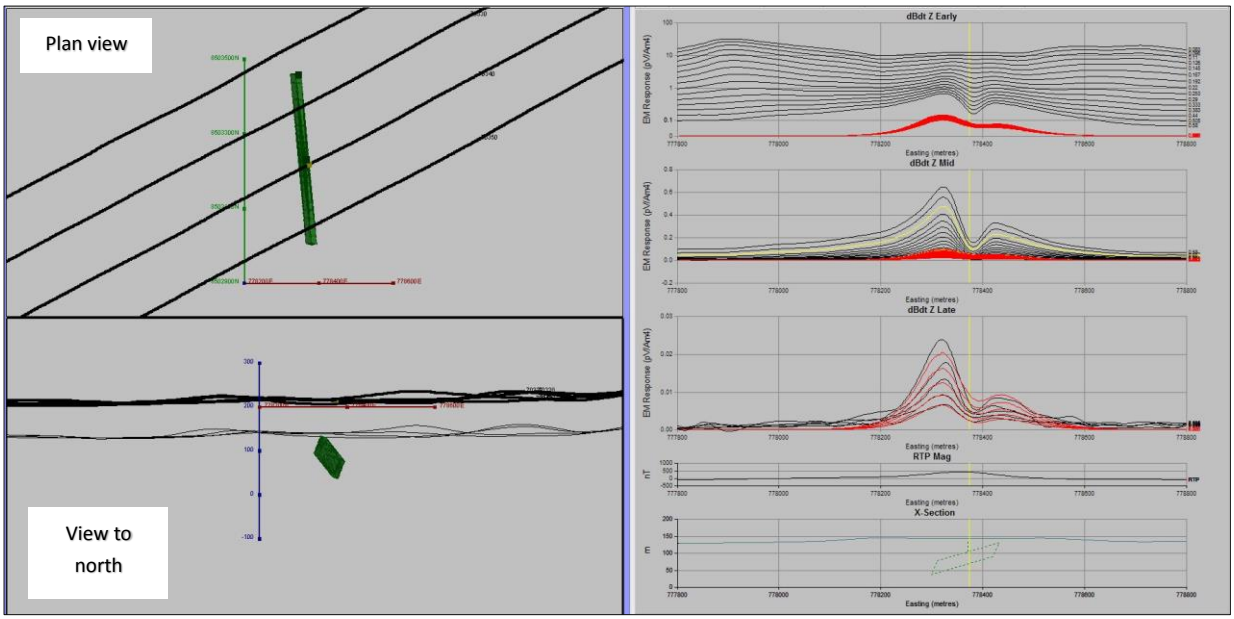

Figure 4. LHS – Modelled plate and flight lines. RHS - Observed (black) and model (red) data for line 70340 Z component.

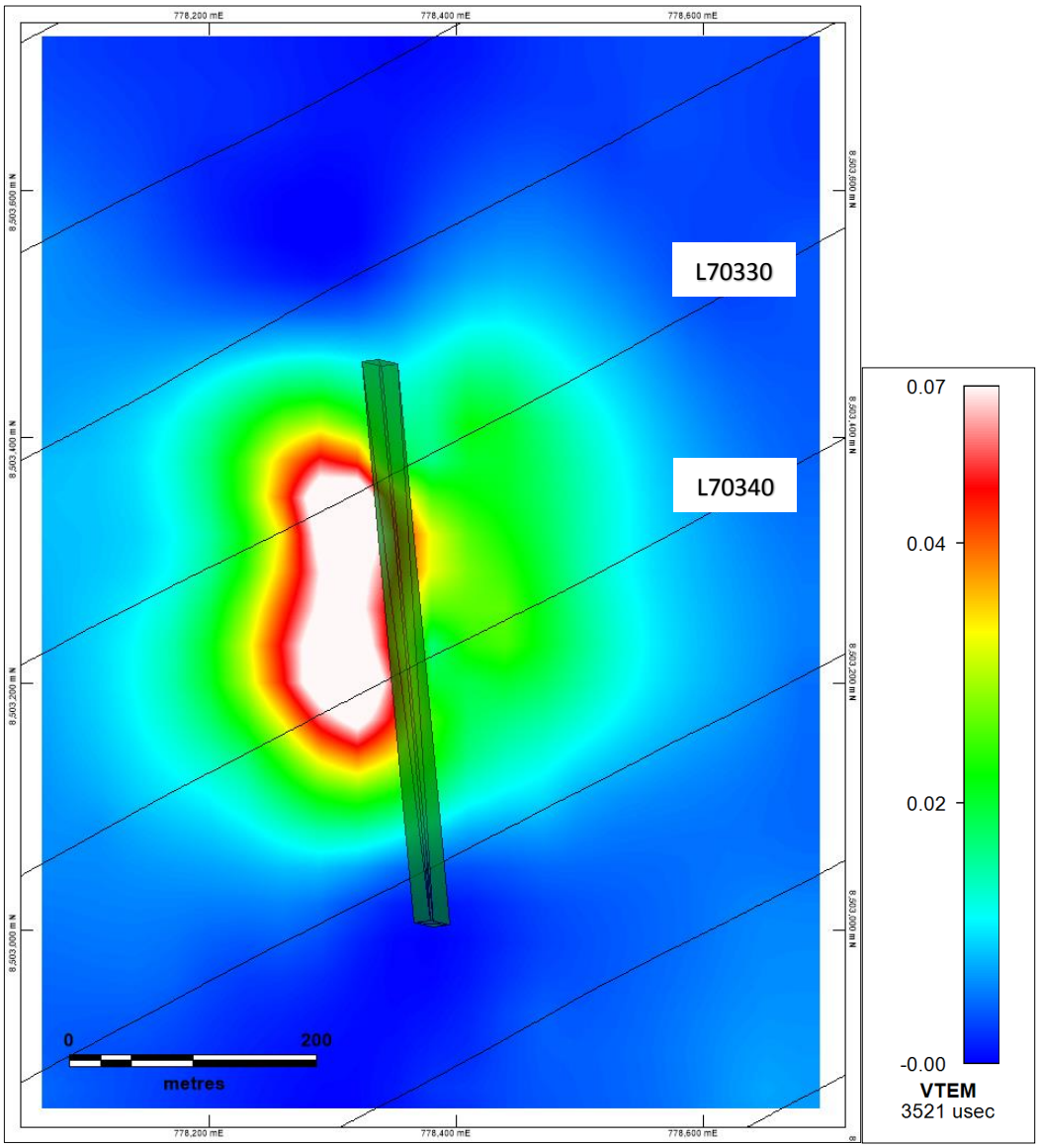

Figure 5. Modelled conductor shown over VTEM 3521 µsec time channel and flight lines.

Easting	778367
Northing	8503231
Depth to top	106m
Strike length	460m
Depth extent	43m
Dip	70° → 262°
Rotation	-7°m
Conductance	924S
Thickness	14.5m
Conductivity	64S/m

Table 2. Modelled plate properties (centre top).

3.2 MAGNETICS

The Joplin prospect has a well defined discrete magnetic anomaly, Figure 6. Both the Mt Bonnie and Iron Blow deposits have discrete magnetic anomalies that are due to pyrrhotite that is associated with sulphide mineralisation. Both standard magnetic inversion and magnetic vector inversion (MVI) were undertaken using Geosoft's VOXI Earth Modelling software. Inputs into the modelling were residual total magnetic intensity (TMI) and a DEM grid derived from the VTEM data. Prior to inversion the TMI line data was gridded using a bidirectional algorithm to minimise line effects and a residual calculated. A top of basement constraint was applied at a depth of 30m to simulate the effects of surface weathering. The result of the modelling is a 3D earth model of the spatial distribution and magnitude of susceptibility, Figures 7 and 8. It should be noted that the final model obtained is only one of many possible models that fit the data equally well.

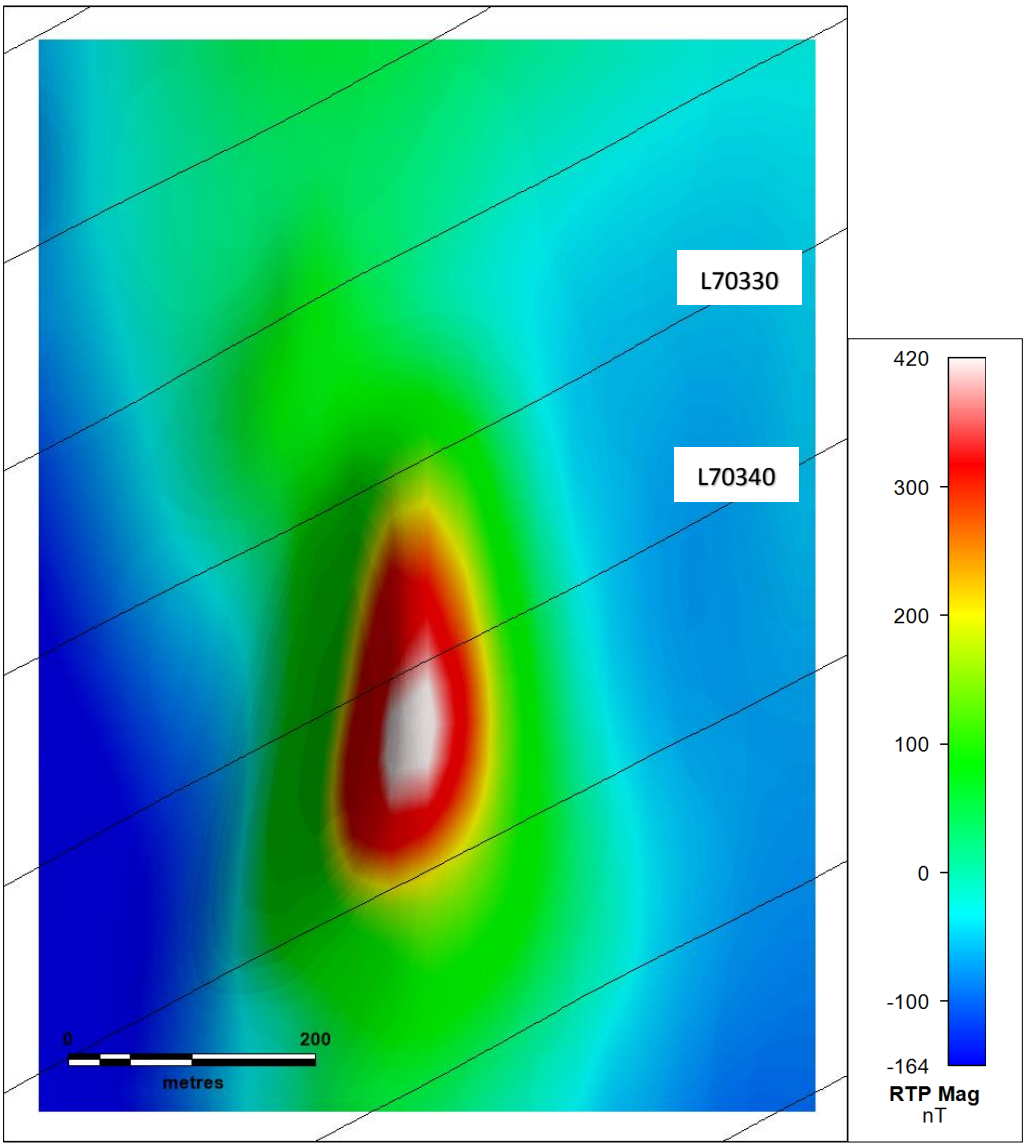

Figure 6. Residual RTP magnetics over the Joplin prospect with flight lines.

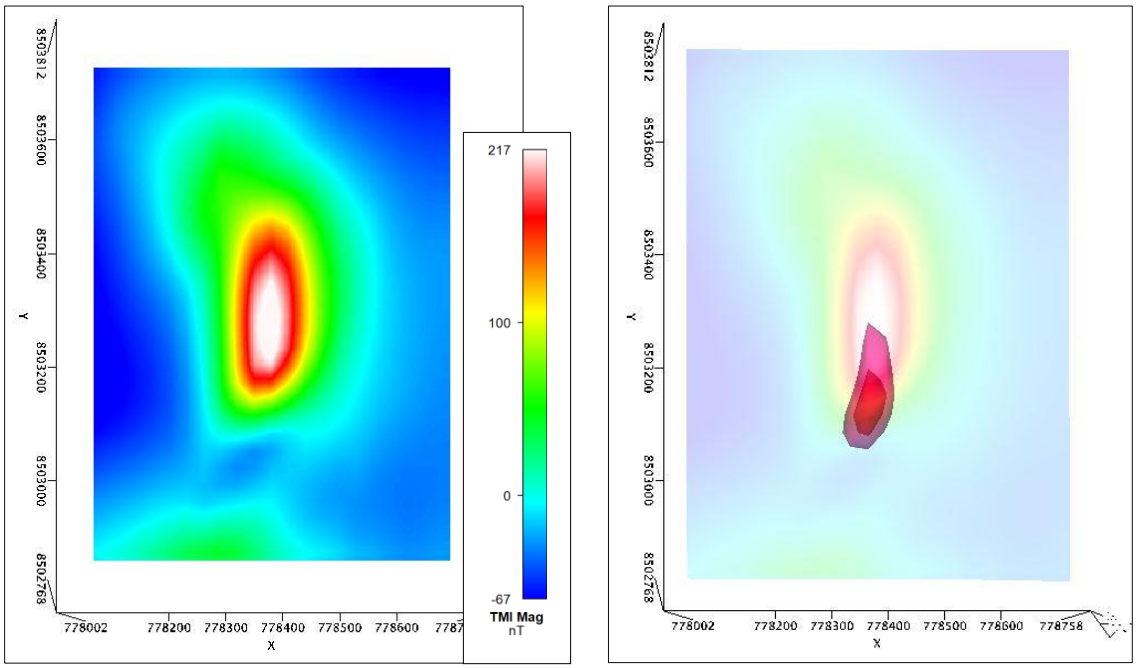

Figure 7. LHS - Residual TMI used for 3D inversion. RHS – Residual TMI underneath +0.15 SI (red) and +0.1 SI (pink) susceptibility isosurfaces from constrained standard inversion.

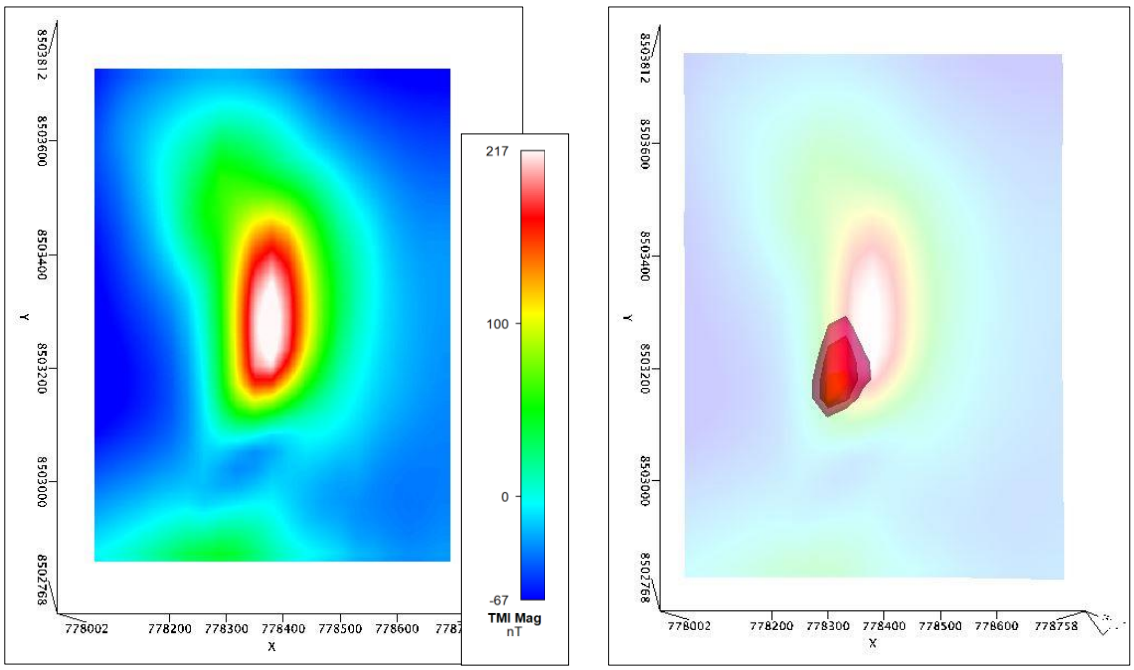

Figure 8. LHS - Residual TMI used for 3D inversion. RHS – Residual TMI underneath +0.03 SI (red) and +0.025 SI (pink) susceptibility isosurfaces from constrained MVI.

4. 2015 FLEM

This survey was planned to target the VTEM anomaly and provide drill targets. Unfortunately the local geology rendered the survey unsuccessful in this regard. Highly conductive Koolpin Formation approximately 1km to the east of the survey area effectively masked any response from other smaller conductors within resistive host lithologies, Figures 9 and 10.

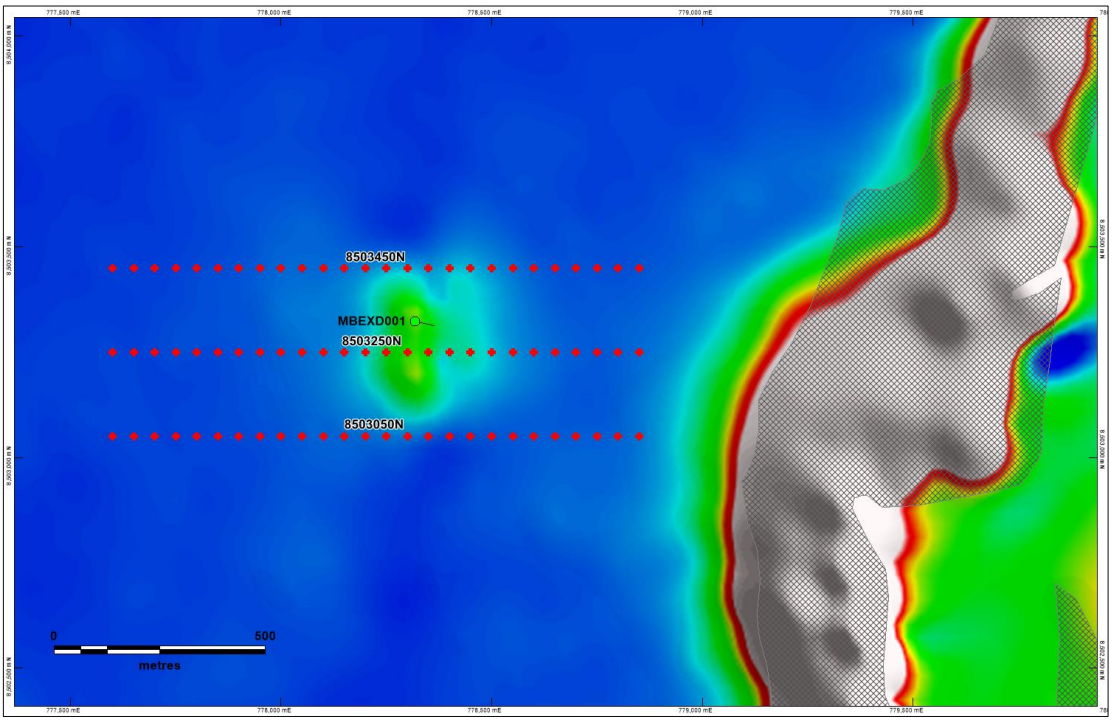

Figure 9. Joplin FLEM stations (red crosses) and mapped Koolpin Formation (grey hash). Background image is EM 3521µsec time channel.

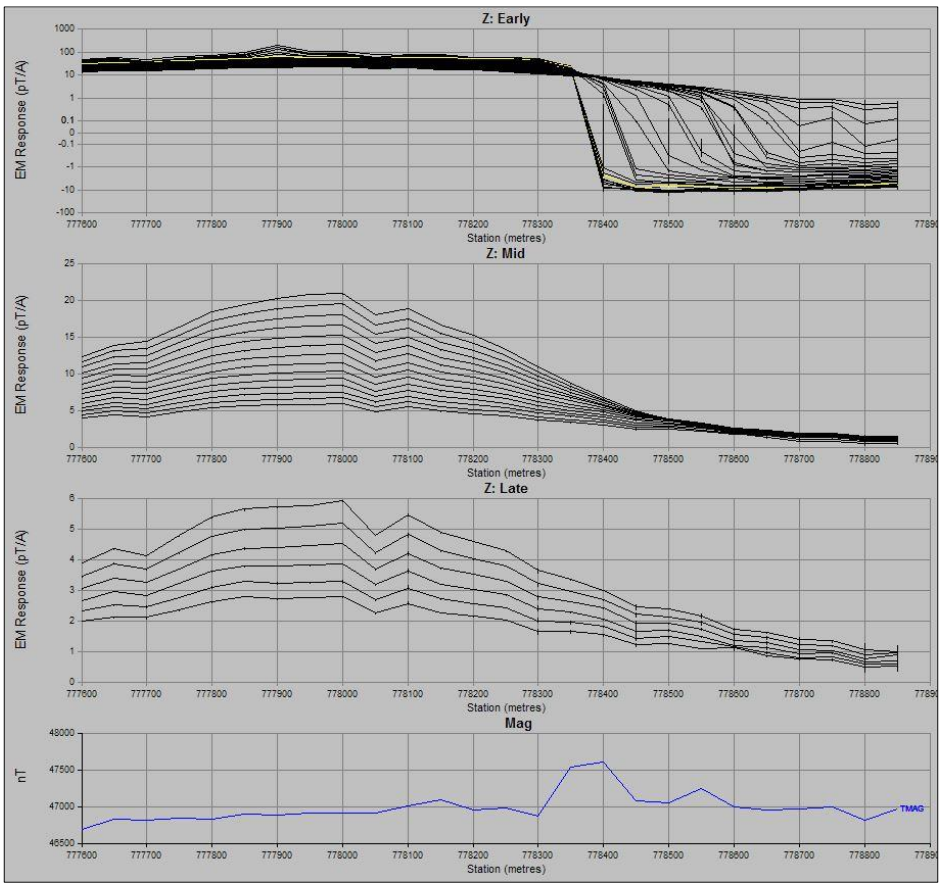

Figure 9. FLEM 8503250N Z component data. The location of the Joplin prospect is shown by the magnetic high (bottom panel).

5. RESULTS AND DRILL TARGETING

Modelling of the EM and magnetic data shows that there is a conductor with a coincident highly susceptible body located on the southern half of the conductor. While MBEXD001 intersected the modelled conductor it was located to the north of the susceptible body, Figure 11. As it is possible that the cause of the susceptibility high is pyrrhotite associated with mineralisation, this area is considered highly prospective and untested. Three drillholes have been designed to test the area of coincident conductivity and susceptibility. They are outlined in Table 3 and shown in Figures 12 and 13. Drillhole VTEM_01 is located close to a flight line and should be drilled first with the results used to refine and prioritise any subsequent drilling. Note that these holes also test the results of the constrained MVI.

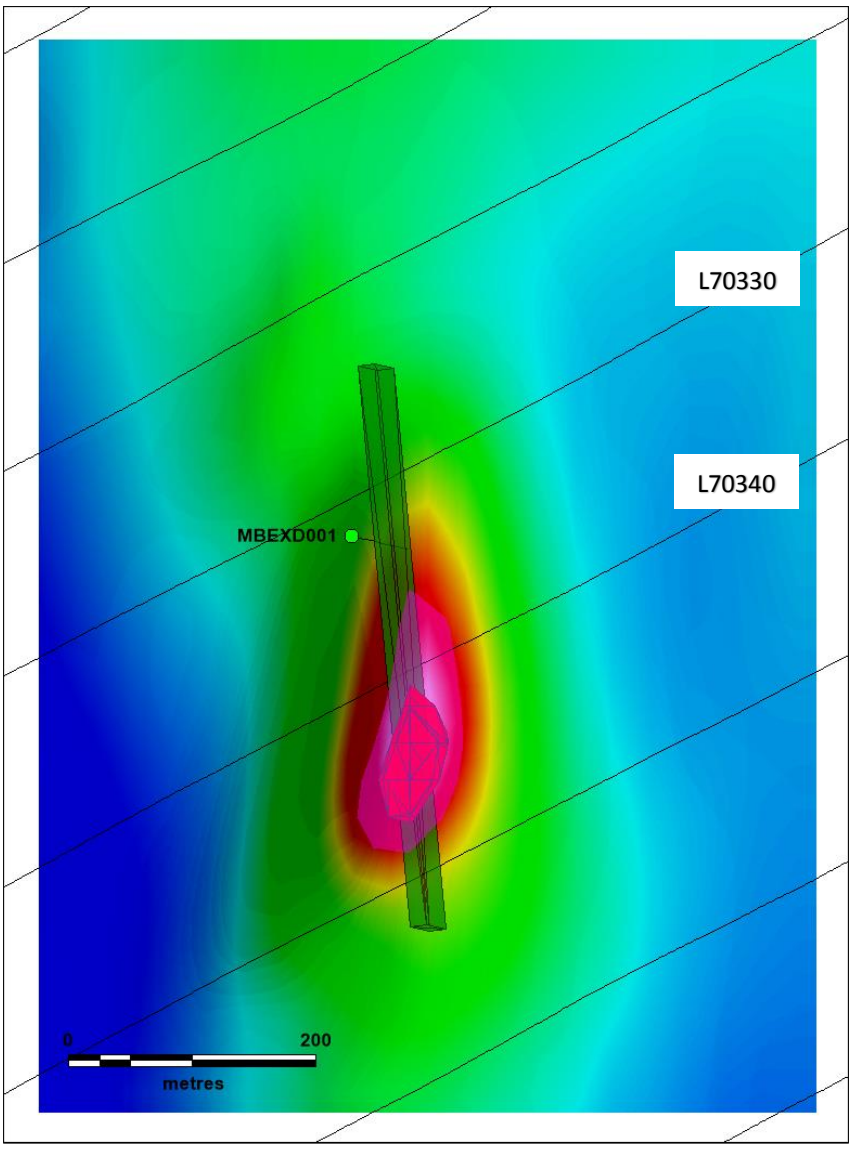

Figure 11. MBEXD001 shown over modelled conductor (green) and on +0.15 SI (red) and +0.1 SI (pink) susceptibility isosurfaces. Background is residual RTP magnetics and flight lines.

Hole ID	East	North	RL	EOH	Dip	Azi
VTEM_01	778320	8503165	141.4	150	-60	90
VTEM_02	778310	8503095	140.6	150	-60	90
VTEM_03	778310	8503235	141.5	125	-60	90

Table 3. Planned drillholes.

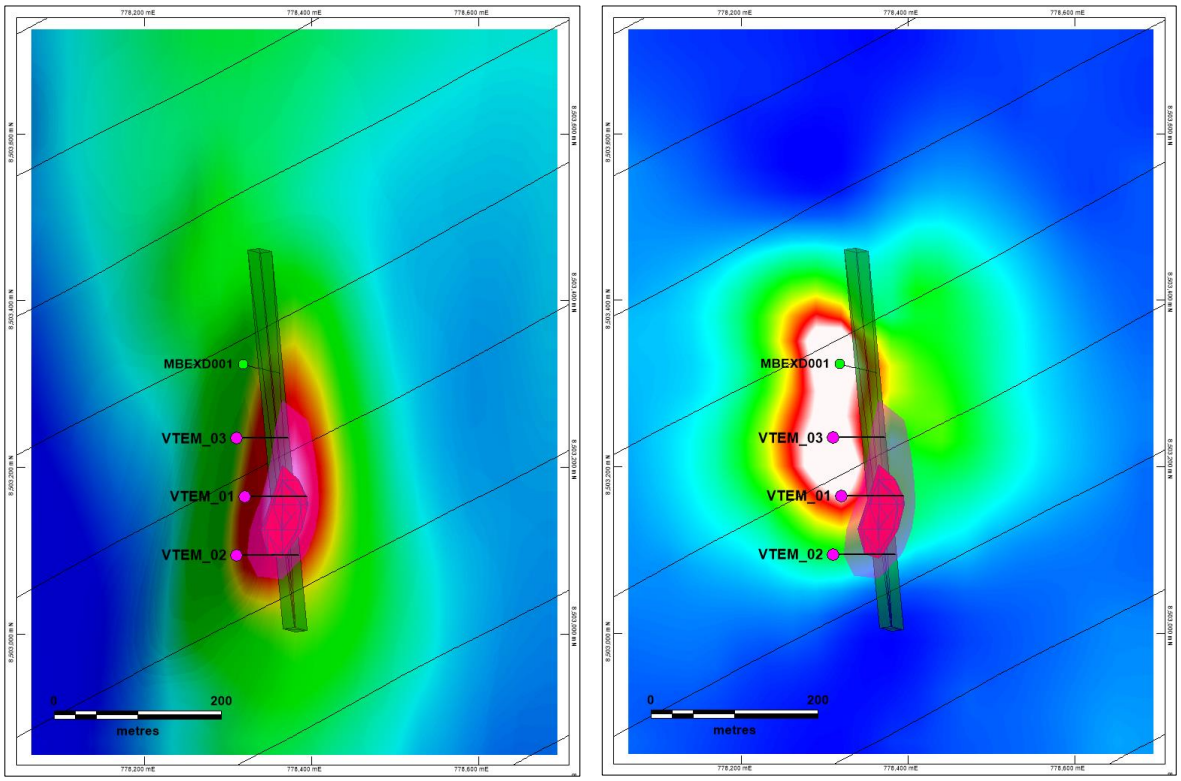

Figure 12. Planned drillholes, modelled conductor (green) and +0.15 SI (red) and +0.1 SI (pink) susceptibility isosurfaces. Background is: LHS - residual RTP magnetics and flight lines. RHS - VTEM 3521 µsec time channel and flight lines.

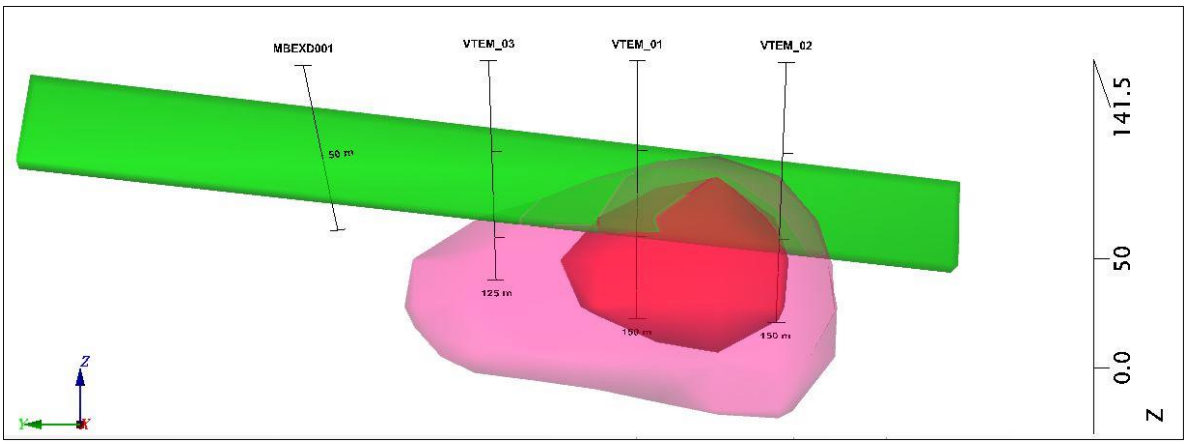

Figure 13. Planned drillholes, modelled conductor (green) and +0.15 SI (red) and +0.1 SI (pink) susceptibility isosurfaces. View to east.

CONCLUSIONS

Review of the EM and magnetic data from the 2011 VTEM survey over the Joplin prospect shows that prospect has not been fully tested to date. The existing drillhole, MBEXD001, intersects the modelled conductor but not the susceptibility body. The area of coincident conductivity and susceptibility body is potentially caused by pyrrhotite associated with sulphide mineralisation and so is a high priority target.

RECOMMENDATIONS

It is recommended that this target be test by drilling. Three drillholes have been proposed to test the target area. The results of the first hole should be used to refine and prioritise any subsequent drilling. It is also recommended that downhole EM (DHEM) be undertaken on all holes drilled.

REFERENCES

Geotech, 2011. Survey and logistics report on a helicopter borne versatile time domain electromagnetic (VTEM) survey on the Burnside, Moline and Maud areas, Australia, for Crocodile Gold Operations. AA1057_Report.pdf.