



# SOUTHERN GEOSCIENCE CONSULTANTS

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## Memo

**To:** Greg Lear  
**From:** John Carew, Bruce Craven  
**Date:** August 30<sup>th</sup>, 2007  
**Company:** Stonehenge Metals Ltd.  
**Project:** Stonehenge Mag. Modelling

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The attached CD contains the following:

- A Windisp 3D compilation containing a UBC 3D magnetic model of the magnetic anomaly at Stonehenge.
- A driver to enable you to view the 3D model.
- PDFs showing depth slices and north-south sections through the UBC 3D magnetic susceptibility model.
- PDFs showing profiles of the models created by forward modelling of the magnetic data.

The raw total magnetic intensity (TMI) data that were used to make the models on this CD are from an airborne magnetic survey flown by GPX Airborne Ltd. in July, 2007. Routine processing/data reduction was carried out by GPX Airborne, including removal of diurnal variations in the magnetic field, subtraction of the earth's field (IGRF) from the recorded data, gridding and levelling. This routine processing along with the survey specifications are outlined in the file *Survey-Specifications.TXT* provided by GPX.

## Notes on 3D inversion modelling

The inversion modelling of the Stonehenge magnetic data was done using the University of British Columbia (UBC) MAG3D Version 4 program library. The UBC algorithm operates on gridded TMI data to produce a smoothed three dimensional model of the magnetic susceptibility. Various inversion settings were used to test, within the fairly basic limitations of the software, different geological scenarios; i.e. shallow and deep magnetic susceptibility models. The preferred model has been included in the Windisp 3D compilation. *Stonehenge-3D-MagModel.bin*.

To help evaluate the results of the inversions, the achieved misfit parameter is checked. This parameter represents how well the resultant model fits the observed data and, when plotted against the iteration number, how smoothly and rapidly the inversion converged to the final model. As a general comment, the inversion modelling process is primarily a mathematical fit to the observed data. Though some constraints can be applied, these are quite rudimentary in a geological sense. The inversion process is capable of generating a number of solutions for any one data set. A good mathematical fit to the data does not necessarily imply that this solution is the best approximation to the actual (unknown!) magnetic susceptibility distribution or geological setting.

The resolution of the 3D model is defined by the mesh cell size. For the inversion of the Stonehenge data a 50m x 50m x 25m mesh cell size was used for the x, y, z dimensions respectively. The model was then refined to give a final mesh cell size of 20m x 20m x 10m.

All elevations shown in the results of the inversion modelling are referenced to the WGS84 geoid and originate from a combination of measurements taken by the survey aircrafts GPS and radar altimeter. The collection and processing of the elevation data is outlined in the file *Survey-Specifications.txt* along with an outline of the reliability of the elevation data. In heavily vegetated areas, the altimeter data will be reflecting the vegetation canopy rather than the actual ground surface.

## Notes on forward modelling

As a check on the 3D inversion modelling, some forward modelling was also done along north-south lines across the main magnetic anomaly. In this type of modelling, magnetic bodies are created to represent the perceived geological source. Their theoretical magnetic response is calculated and compared to the observed values. The bodies used in the forward modelling are ellipsoids with homogenous susceptibilities. Such bodies are often fairly crude approximations to the natural source bodies and in order for these model bodies to produce a theoretical magnetic response that is smooth enough to fit the observed data, forward modelled depths are more likely to be over estimated than under estimated.

The elevations in the forward model are referenced to the depth from ground level which has a nominal value of 0 m.

## Results of Modelling

Two separate magnetic bodies were created by the inversion. The body in the south-west of the survey area is indicated by the model to be the shallowest. This modelled body is shown by Figure 1 to come within less than 10m of the surface with a susceptibility of 0.02 SI. This represents the highest susceptibility/depth ratio. No reliable forward model could be created for this part of the survey as the magnetic anomaly is not adequately covered by the data. However, the results of the inversion are still considered indicative of the bulk properties of the magnetic material in this part of the survey area. The high amplitude, short wavelength magnetic anomaly on the southern boundary of the survey area adjacent to the south-western body has been modelled as very shallow with little depth extent. This feature does not share the same orientation as the other magnetic material in the survey area and is considered unrelated and possibly cultural.

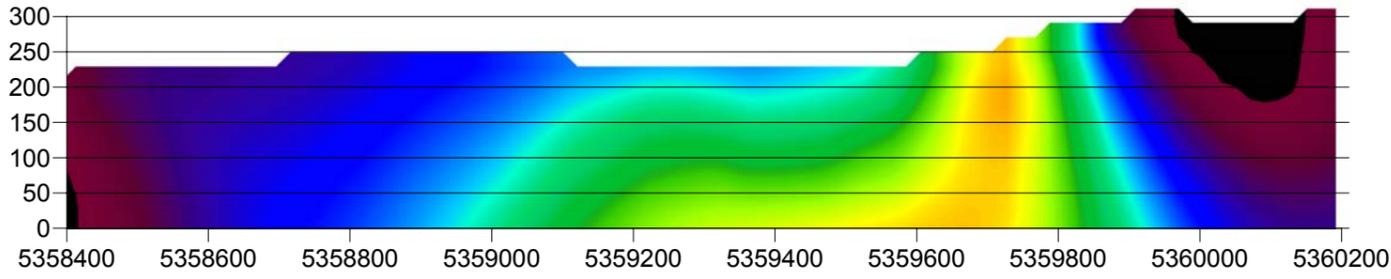
The depth to the top of the main magnetic body varies between < 10m and ~ 100m with three distinct zones of shallow (<25m) magnetic material. Two of these shallower zones occur towards the body's north-western side where two approximately equally sized and orientated zones (Figure 2.) with a susceptibility of ~0.015 SI come to within 10 m of the surface. The third shallow zone is at the south-eastern end of the body and is shown by Figure 2 to be larger and slightly less magnetic.

The forward model created for the main magnetic body is shown in Figure 3 and is consistent with the 3D inversion model, noting the x, y extents of the forward modelled bodies indicated by the plan view. The main differences between the two models are the thickness and susceptibility of the main magnetic body. The forward model shows a thickness and susceptibility for this body of 100-190m and 0.04 SI respectively and the inversion shows a thickness of over 400 m and a susceptibility that ranges from 0.01-0.02 SI. Both these sets of values are good fits to the observed data and from a purely geophysical perspective are considered equally possible. Also possible are thickness/susceptibility values for the main magnetic body that are interpolations or extrapolations of the above sets of values, e.g. a main body with a 200m thickness and susceptibility ranging from ~0.02-0.04 SI or a body with thickness of 50-100m and a susceptibility of ~0.1 SI. Another set of interchangeable parameters are susceptibility and depth, particularly for the material that is shown by the inversion model to protrude upwards from the main magnetic body. Instead of protruding upwards, the material in this area could maintain its depth but increase gradually and considerably in susceptibility.

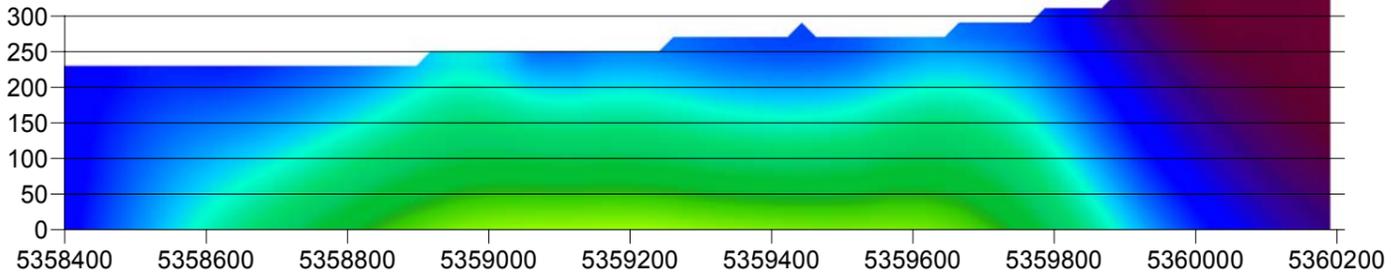
## Conclusions

Overall the combination of forward and inversion modelling has provided reasonable indications for a range of depth/susceptibility combinations. The modelled thickness and depth extent of the magnetic material, as is usually the case, remains relatively more ambiguous. From a targeting point of view, the models have provided three distinct zones that could be tested with fairly shallow drill holes (~50-125 m range). Furthermore, drilling results (homogeneity and susceptibility) could be used to refine the models and generate better estimates of the thickness of the main magnetic body and therefore provide a better indication of its style and geological setting.

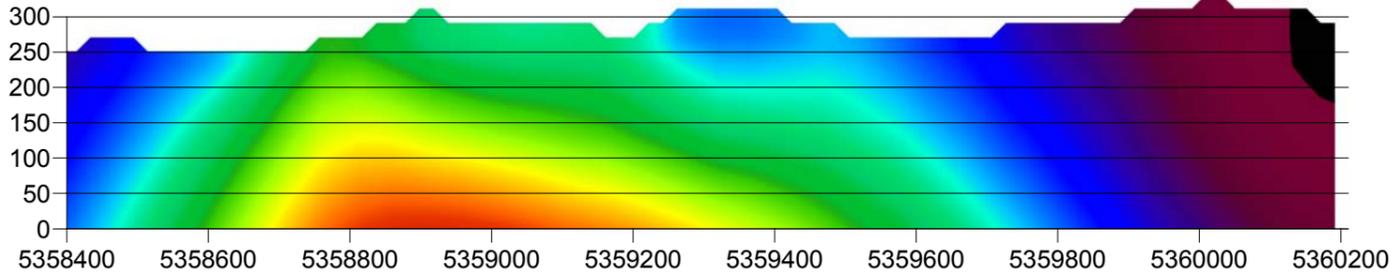
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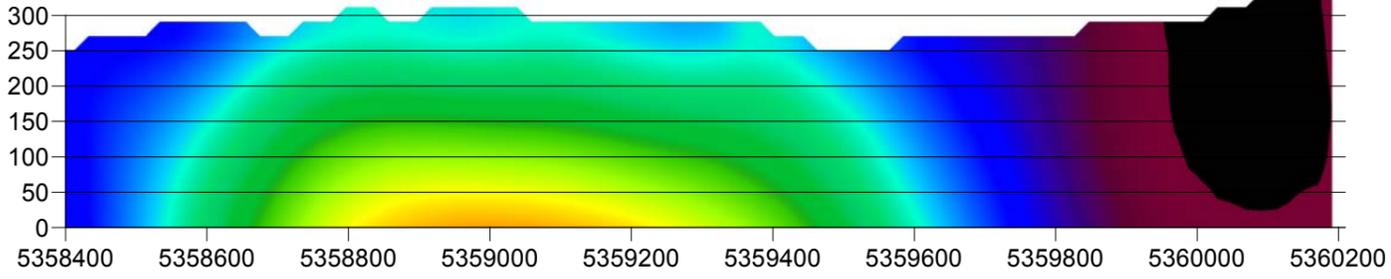
North-South Profile 359200E



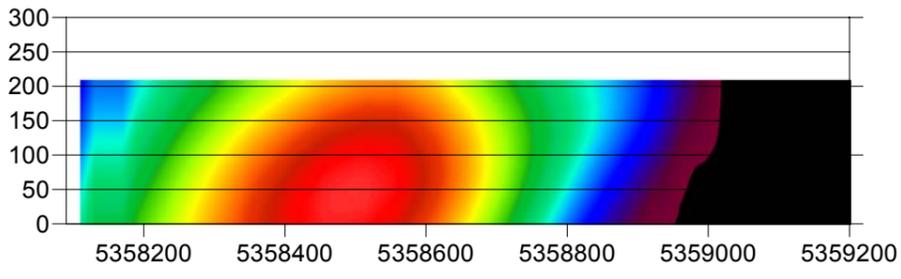
North-South Profile 359600E



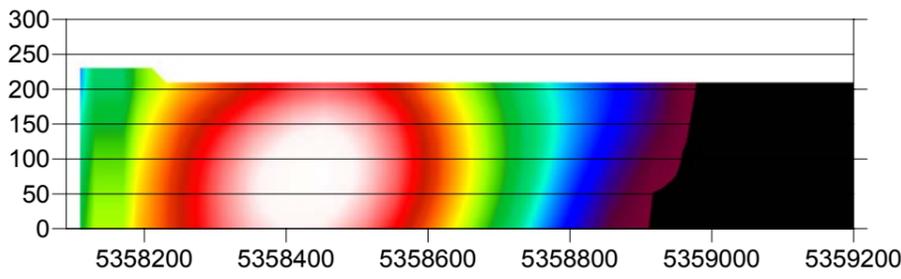
North-South Profile 360000E



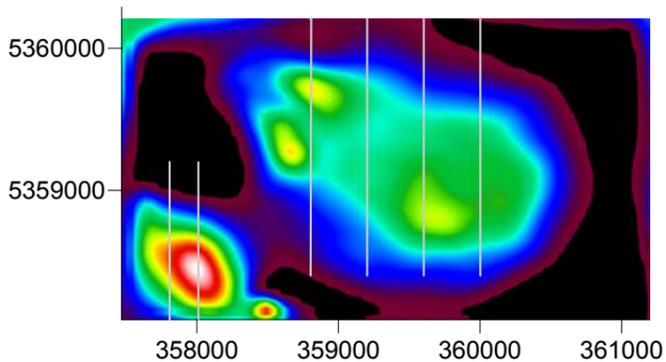
North-South Profile 357810E



North-South Profile 358000E



Plan at 125 m  
Scale 1:50000



**SURVEY SPECIFICATIONS**

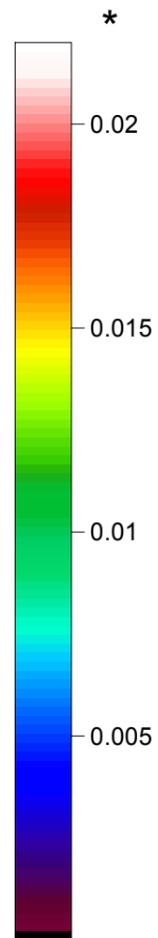
Contractor : GPX Airborne Pty Ltd  
Date : June 2007  
Survey type : Airborne Magnetic  
Line Direction : 000-180  
Line Spacing : 50/75 m  
Ground Clearance : 30 m  
Resolution : 0.001 nT

**MODEL SPECIFICATIONS**

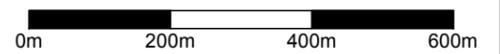
Type : UBC V4 3D Magnetic Inversion  
Data : 10 x 10 m Grid of TMI  
Model Cell Size : 50 x 50 x 25 m  
Data Error : 0.5%  
Error Floor : 20 nT  
Regional Field : 100 nT  
Refined Cell Size : 20 x 20 x 10 m

\*Colour shows values of magnetic susceptibility (inverted)

— Profile Locations



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PTY LTD - ACN 067 552 461



Scale 1:10000  
DATUM: GDA94  
GRID: MGA ZONE 55

**STONEHENGE METALS LIMITED**

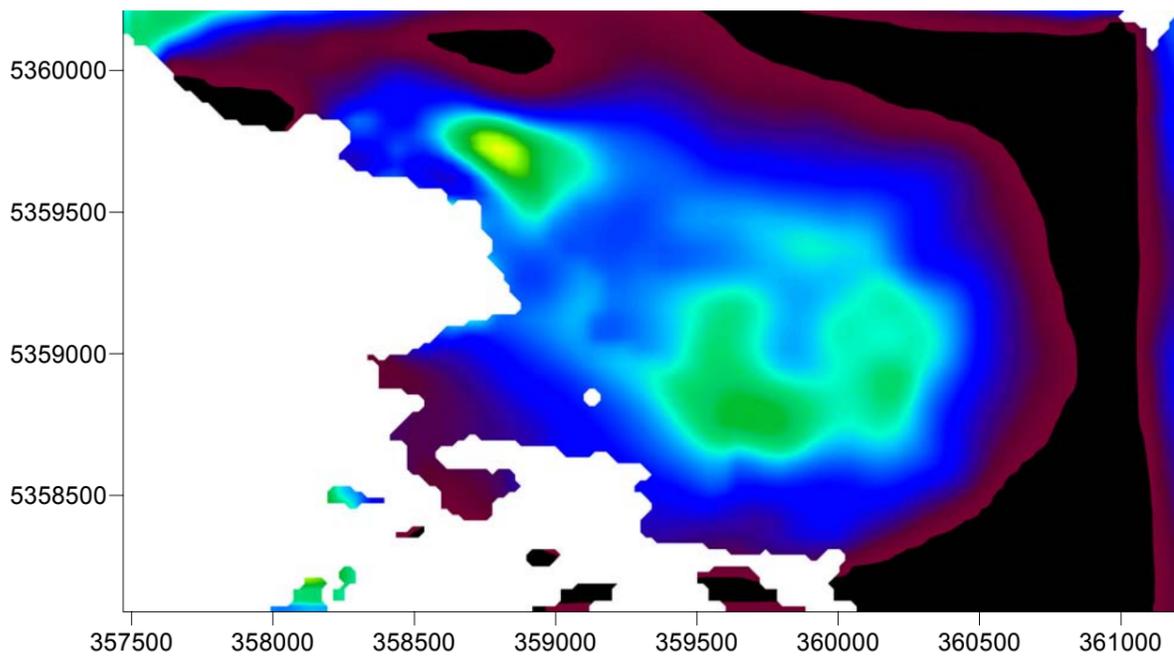
**STONEHENGE PROSPECT**

North-South Profiles of  
Inverted Magnetic Data

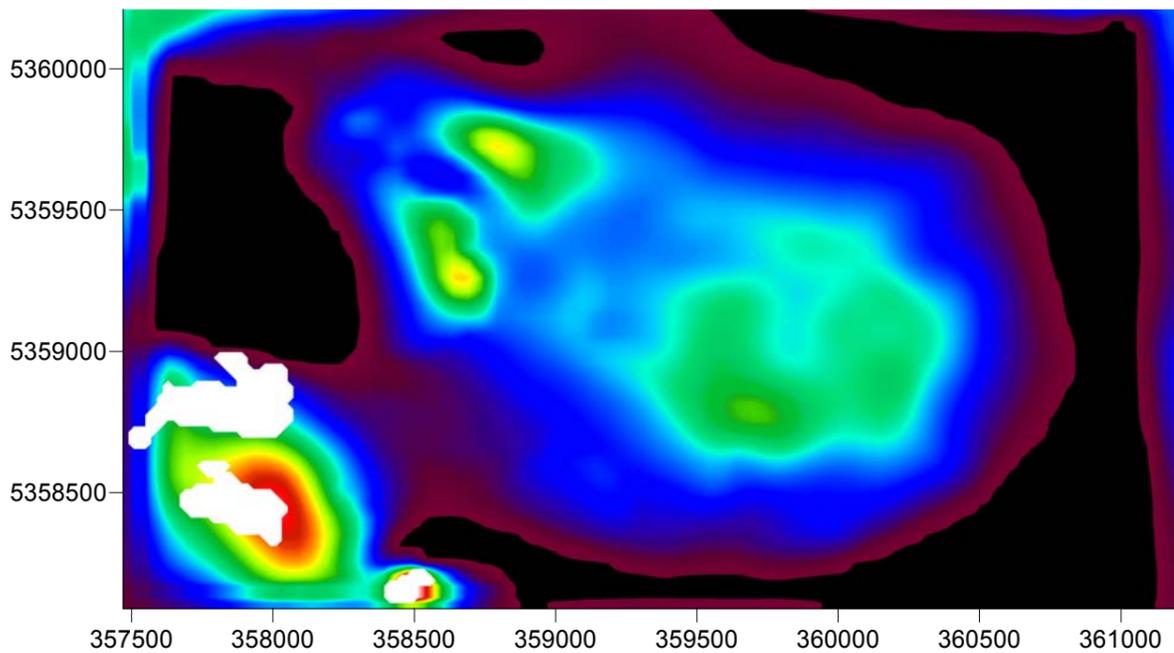
Date: 30/8/2007

J. Carew  
Figure No 1.

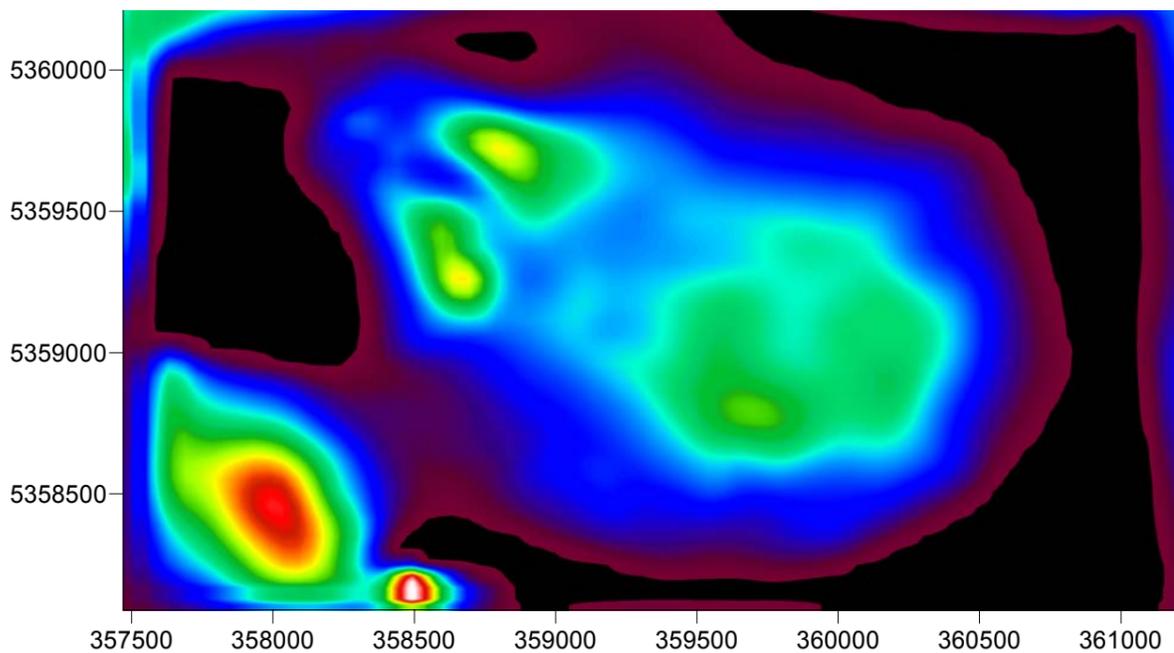
Plan at 225 m



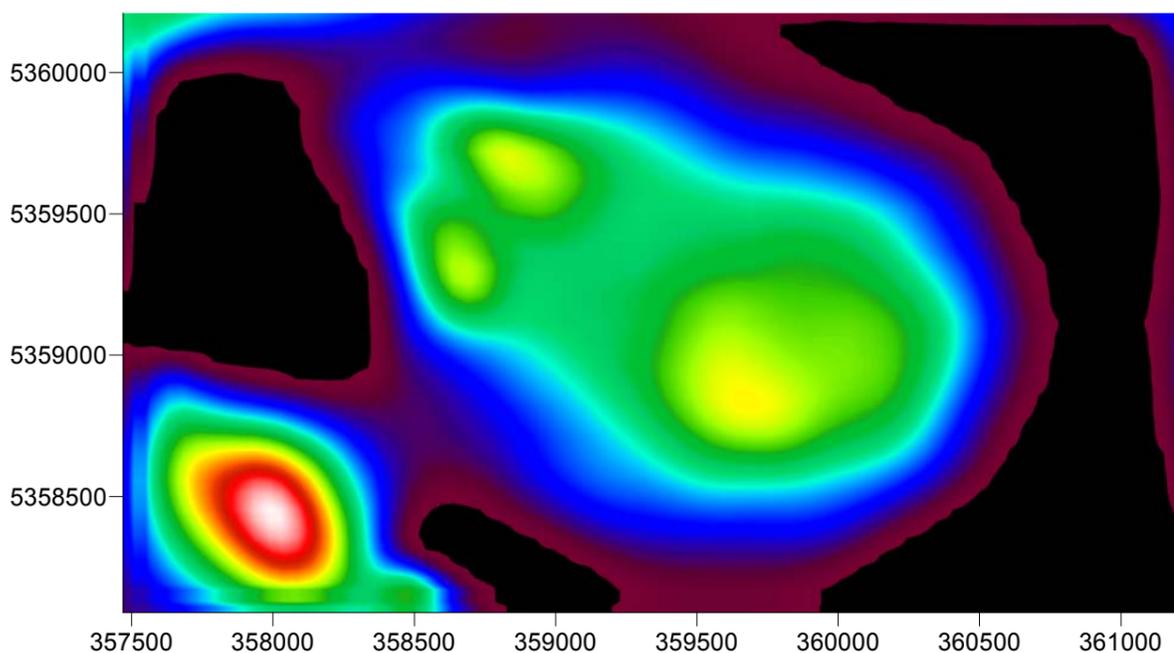
Plan at 205 m



Plan at 185 m



Plan at 165 m



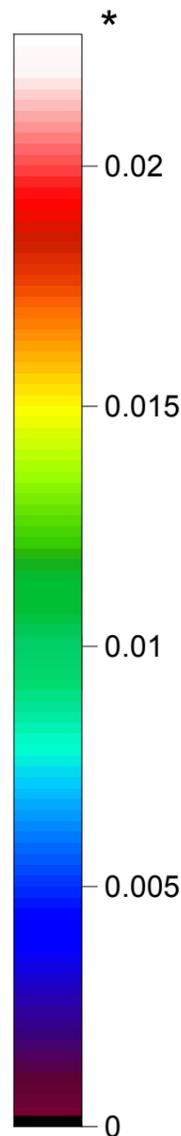
**SURVEY SPECIFICATIONS**

Contractor : GPX Airborne Pty Ltd  
 Date : June 2007  
 Survey type : Airborne Magnetic  
 Line Direction : 000-180  
 Line Spacing : 50/75 m  
 Ground Clearance : 30 m  
 Resolution : 0.001 nT

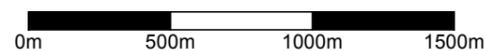
**MODEL SPECIFICATIONS**

Type : UBC V4 3D Magnetic Inversion  
 Data : 10 x 10 m Grid of TMI  
 Model Cell Size : 50 x 50 x 25 m  
 Data Error : 0.5%  
 Error Floor : 20 nT  
 Regional Field : 100 nT  
 Refined Cell Size : 20 x 20 x 10 m

\*Colour shows values of magnetic susceptibility (inverted)



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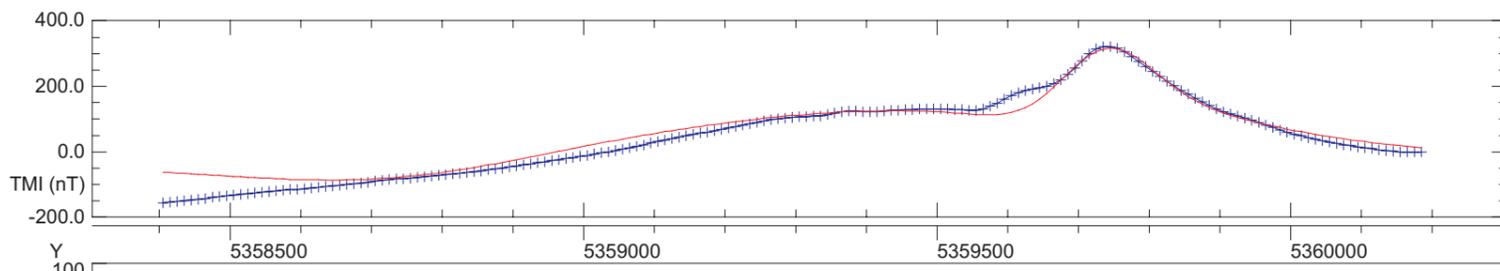


Scale 1:25000  
 DATUM: GDA94  
 GRID: MGA ZONE 55

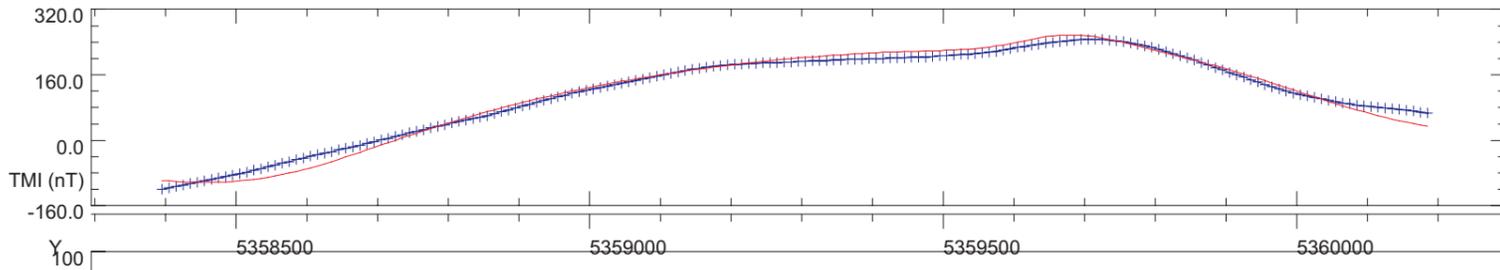
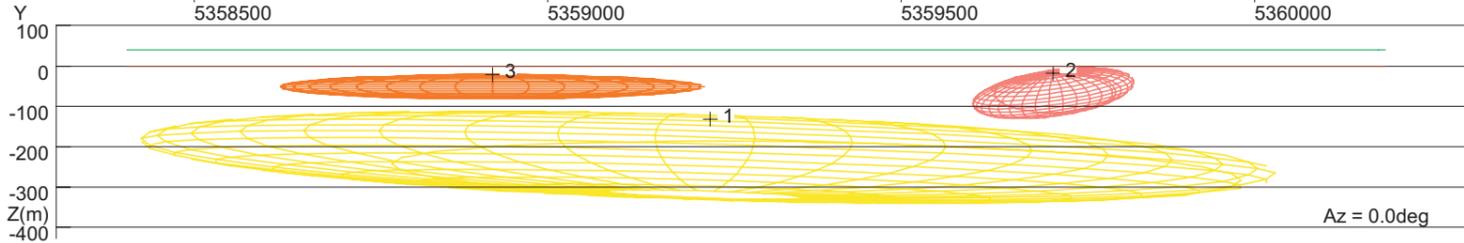
**STONEHENGE METALS LIMITED**

**STONEHENGE PROSPECT**

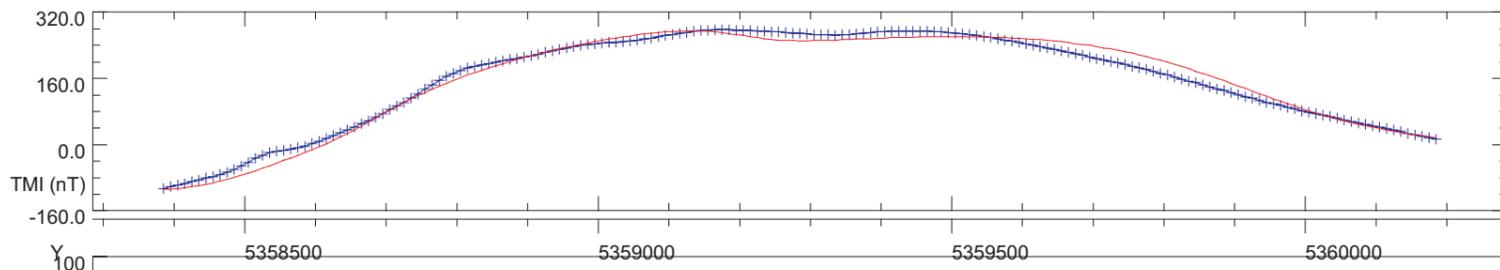
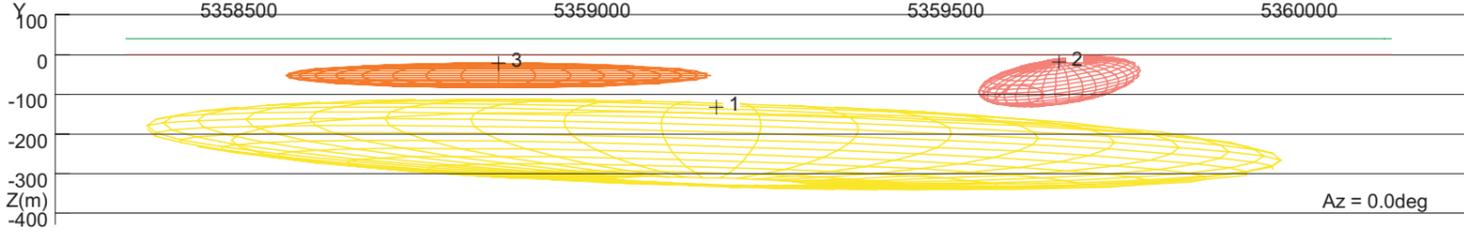
Depth Slices of  
 Inverted Magnetic Data



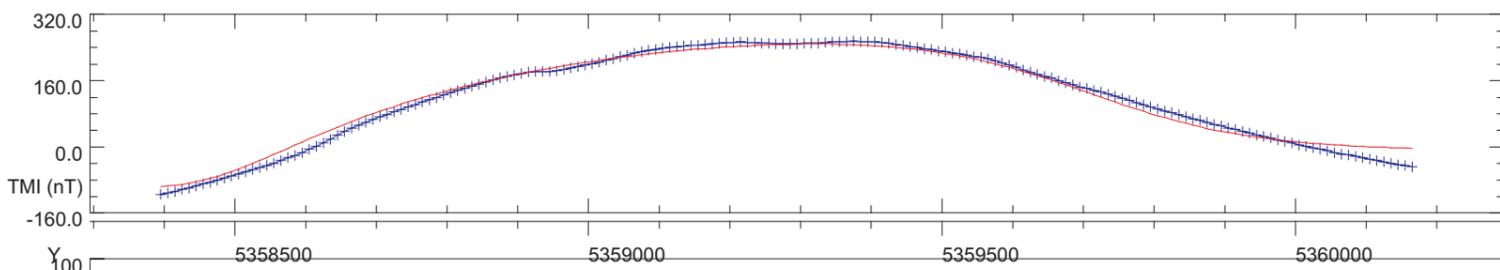
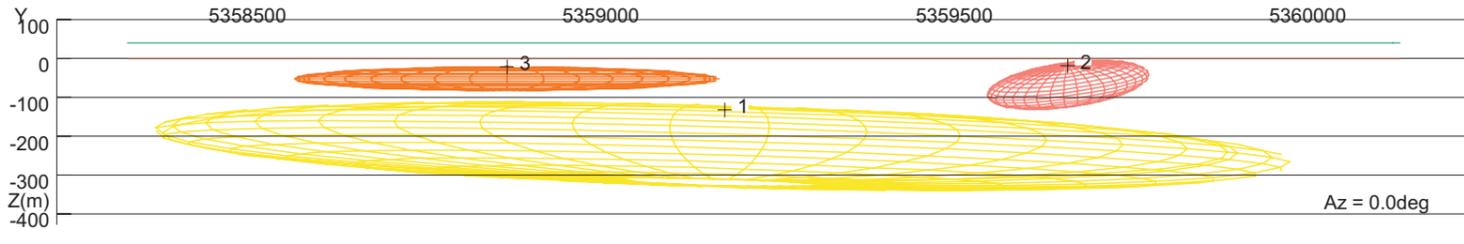
Line 358800E



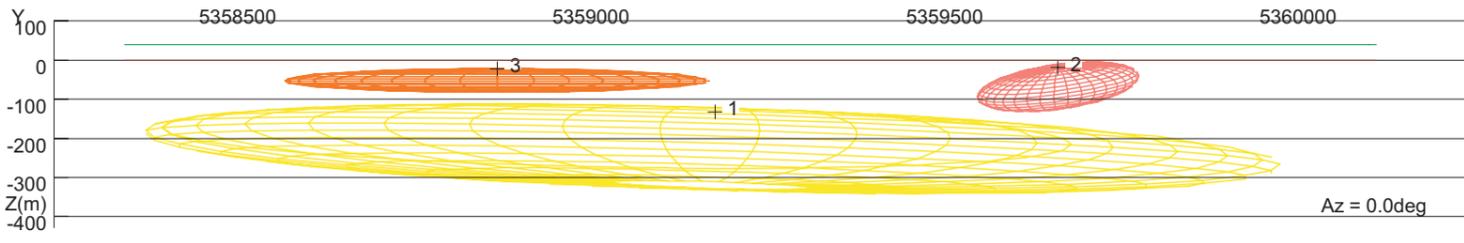
Line 359200E



Line 359600E



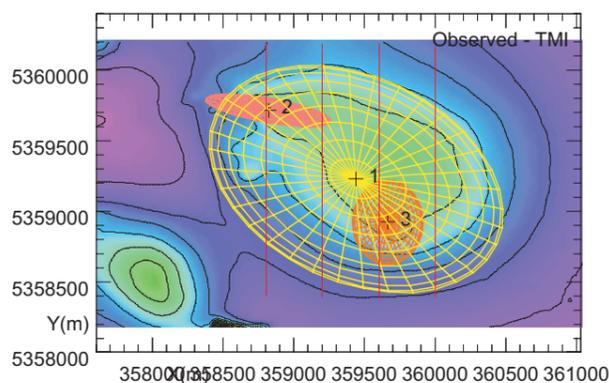
Line 360000E



**Model Summary**

IGRF : H = 61965; Az = 13.2; Inc = -72.2

Body	Type	Description	X	Y	Z	Strike	Dip	Plunge	Susc.	A	B	C
3	Ellipsoid		359663.0	5358922.1	-22.1	-90.0	0.0	0.0	0.0100	600.0	500.0	60.0
2	Ellipsoid		358822.0	5359715.0	-17.9	-80.0	0.0	-5.0	0.0190	170.0	900.0	100.0
1	Ellipsoid		359436.3	5359230.9	-132.5	-64.9	0.5	3.4	0.0405	1450.8	2199.4	188.3



Model Plan View  
1:50000

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STONEHENGE/SWEENYS PROSPECT Forward Modelled Mag Profiles		
Map Reference: GDA94/MGA Zone 55		
Author:	Original scale: 1:10000	Report No.:
Drawn by: J Carew	Date: 29 August 2007	Plan No.:3