



Mineral Resources Tasmania

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Geophysical anomalies at Anio Creek

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Abstract

The two magnetic anomalies delineated in the Anio Creek area are produced by bodies at a depth of less than 100 metres. The anomalies are sourced by rock types not yet found outcropping in the area and their association with granite, alteration and electrical conductivity suggests that they may be small examples of a new mineral exploration target.

INTRODUCTION

The Anio Creek area lies inside the Cradle Mountain–Lake St Clair National Park about 800 m south and southeast of Mt Remus. During an airborne DIGHEM survey of Exploration Licence 2/70, which abutted the northern boundary of the national park, a coincident electromagnetic and magnetic anomaly was recorded in the turn-around area above the national park. This anomaly has come to be known as Anomaly 13 (Large and Duffin, 1981) and was unique within the area flown.

No further geophysical data acquisition was carried out until late in 1993 when Mineral Resources Tasmania had a helicopter-borne aeromagnetic system working nearby. Mineral Resources Tasmania obtained permission from the Department of Environment and Land Management to collect data over the Anio Creek area.

AVAILABLE DATA SETS

The geophysical data sets covering the Anio Creek area are as follows:–

(i) DIGHEM

This survey was flown along northwest-southeast lines spaced about 100 m apart (Large and Duffin, 1981). Anio Creek lies inside the turn-around area where the helicopter is being lined up visually for the next line and the large towed sensor is being stabilised. The data are not of optimum quality.

(ii) Gravity

There are gravity data points at a nominal density of one point per square kilometre over much of the area from Elliott Bay to Penguin. Anio Creek falls within this area and the gravity data provide an insight into the regional setting of the Mt Remus area.

(iii) Aeromagnetic

The Anio Creek area has been covered by two aeromagnetic surveys. The first, flown by the Australian Geological Survey Organisation in 1985, has data collected along east-west lines 1500 m apart as part of a coverage of Tasmania and assists only in examining the regional setting of the area. The second, flown in 1993 by Mineral Resources Tasmania, acquired both magnetic and natural radiometric data along northwest-southeast lines spaced 100 m apart using modern navigation techniques, and constitutes a high-quality data set.

REGIONAL SETTING

(i) Aeromagnetic

The regional aeromagnetic data were gridded with a 250 m mesh after filtering the line data with 15 unit 41 term Gaussian filter. They were then downward continued by 50 m to approximately the same height as the detailed Anio Creek survey to allow direct comparison and use for the production of a residual anomaly.

The magnetic data (fig. 1) show an area of predominantly low values in the southeast separated from an area of more positive values, associated in part with volcanic rocks, by a northeast-trending positive anomaly. This anomaly extends under the Owen Conglomerate, and correlates with the edge of a southeast-dipping thrust surface and associated ultramafic rocks proposed by Leaman *et al.* (1984). Further work in the Que River area supports this proposal (D. E. Leaman, pers. comm.) The Anio Creek area lies on the strong negative gradient on the southeastern flank of this anomaly.

(ii) Gravity

The Bouguer gravity data were converted to residual form using the MANTLE91 model (Leaman and Richardson, 1989a) and gridded with a 100 m mesh (fig. 2). The major negative anomalies are the Granite Tor Granite and the Dolcoath Granite, which are linked by a ridge of granite (Leaman and Richardson, 1989b). Separating the two granites are the thicker Precambrian rocks of the Waldheim area. A small spine from the Dolcoath Granite extends south under the Anio Creek area but it is not well defined by the extant gravity data.

(iii) DIGHEM

The DIGHEM survey covered the 58 square kilometres of the Mackintosh East Exploration Licence (EL 2/70) with northwest-southeast lines spaced 100 m apart (Herrmann, 1984). There were no tie-lines to assist data levelling and both navigation and flight path recovery were by aerial photography. The survey was predominantly over the Cambrian Bond Range Porphyry and Back Peak Beds but also covered an area of Precambrian rocks northwest of Pencil Pine.

As expected, high amplitude magnetic anomalies were recorded over the Tertiary basalts, with only gentle gradients and few contour closures over the remainder of the exploration licence. In the Anio Creek area there were two isolated anomalies of about 150 nT amplitude. The first was fully closed and is Anomaly 13, the second was open to the southwest and is over the old Mt Remus prospect. No other similar anomalies were found in the survey.

The electromagnetic data were used to produce a map of ground resistivity. Sheets 1 and 2 of this data are presented in Herrmann (1984) and sheet 3 is presented in Large and Duffin (1981). Sheet 1 has no low resistivity areas whilst sheet 2 has low resistivity in the areas of Tertiary basalt and also in a valley running north from Pencil Pine Creek. The anomalies in the latter area have been interpreted as near surface, and almost certainly correspond to clay and black shale or carbonaceous schist. Ground resistivities are less than one ohm-metre in several areas and there are no associated magnetic responses. On sheet 3 there is only one area of low ground resistivity (50 Ω m) and this is coincident with the magnetic anomaly of Anomaly 13. There is no resistivity anomaly over the Mt Remus prospect.

THE ANIO CREEK AREA

(i) Qualitative Interpretation

The total magnetic field over the Anio Creek area (fig. 3) shows a strong negative gradient from northwest to southeast, reflecting the regional effects of the ultramafic bodies associated with the southeasterly-dipping thrust surface. Superimposed upon this are two positive anomalies, one over the Mt Remus prospect and the other corresponding to the previously recorded Anomaly 13. There are no other high-amplitude near-surface features and the field is, in general, smooth. An automatic gain control plot, normally used to enhance linear features in the magnetic data, shows no pronounced features (fig. 4) emphasising the smoothness of the field.

The radiometric data reflect the character of the surficial materials. The total count image (fig. 5) shows zones of low total counts over Mt Remus (401 000 mE, 5 390 000 mN) and in the south. A zone of high counts over the Back Peak Beds terminates on the west at a north-south feature and also has distinct southeastern and northeastern margins. The small parallel northwest-southeast anomalies are flight line effects. The three-colour composite (fig. 6) allows further discrimination based on elemental composition. There are areas of higher potassium and uranium content at both Anomaly 13 and the Mt Remus

prospect, and zones of low counts in all elements show as dark regions. Some linear features are also apparent.

The radiometric three-colour ratio plot (fig. 7) shows element proportions and minimises the effects of terrain clearance and total count variations. Both the Mt Remus prospect and Anomaly 13 are marked by zones of higher uranium values and, to a lesser extent, potassium values suggesting local alteration. The northwest corner of the survey area, near Mt Remus, shows as a region that is relatively high in potassium. Other regions are also discriminated.

The residual gravity data (fig. 8) have a low under Anomaly 13 and another low immediately north of the Mt Remus prospect. These negative anomalies are over granite spines but it must be remembered that the data are widely spaced and that the availability of additional high quality data will almost certainly change both the anomaly shapes and positions.

(ii) Quantitative Interpretation

The residual magnetic intensity was calculated by subtracting the regional data (fig. 1) from the Anio Creek area total magnetic intensity data (fig. 3). The resulting data set (fig. 9) shows the isolated natures of both the Anomaly 13 and Mt Remus prospect anomalies. There is a small positive anomaly corresponding to the Bond Range Porphyry on the northwestern edge of the survey. Approximately west-east and north-south sections, shown on Figure 9, were selected for two-dimensional modelling. Models were produced using three different susceptibilities, a data shift of 0, and a requirement of consistency between the north-south and west-east sections.

(a) Section W-E

The first model (fig. 10) assumed that the anomaly was sourced by outcropping bodies and requires a susceptibility of 17.6×10^{-3} SI, a value approximately three times that measured to date from any rock sample from the area. The anomaly over the Mt Remus prospect results from a source with a slightly higher susceptibility.

Both the medium (fig. 11) and high susceptibility models (fig. 12) show that the source of the anomaly over the Mt Remus prospect is shallower than that of Anomaly 13. The maximum possible depth for the Anomaly 13 source is approximately 100 m, as below this depth the anomaly width produced from the model is too great regardless of susceptibility.

(b) Section N-S

As for the W-E section the minimum susceptibility outcropping model (fig. 13) provides the best fit to the observed data. For both the medium (fig. 14) and high susceptibility models (fig. 15) the maximum possible anomaly depth is approximately 100 metres.

Both the magnetic anomalies in the Anio Creek area are three dimensional (fig. 9), whilst the modelling carried out assumes the modelled bodies are infinite in the strike direction. The effect of restricting strike length is to reduce the size of the calculated anomaly requiring either an increase in source susceptibility or a decrease in source

depth. Even without this change no materials have yet been found at surface that could account for the magnetic anomalies.

CONCLUSIONS

The two magnetic anomalies delineated in the Anio Creek area are unlike any others in the surrounding area. They are isolated closed anomalies in an area of gently changing magnetic field, lie over a spine from the Dolcoath Granite, and have coincident radiometric anomalies suggestive of alteration. Anomaly 13, the easternmost of the two anomalies, has also been found to be conductive. Two-dimensional modelling shows that the anomaly sources have a maximum depth of 100 m to the top and that the minimum required magnetic susceptibilities are at least three times any yet measured from surface samples.

The anomalies at Anio Creek are sourced by rock types not yet found in this area. Their location in association with granite, alteration and electrical conductivity suggests that they may constitute a small example of a new mineral exploration target for Tasmania. Surveys to date have been of no or little environmental impact and the following investigations should be performed with similar care to further understand the anomaly sources:—

- acquire helicopter electromagnetic coverage of the detailed survey area;

- acquire a line of close-spaced (1–2 m) ground magnetic data over each anomaly to provide information on the fine structure;
- carry out magnetic susceptibility measurements in the area;
- acquire high-precision close-spaced gravity data using both helicopter and ground access.

REFERENCES

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[24 June 1994]

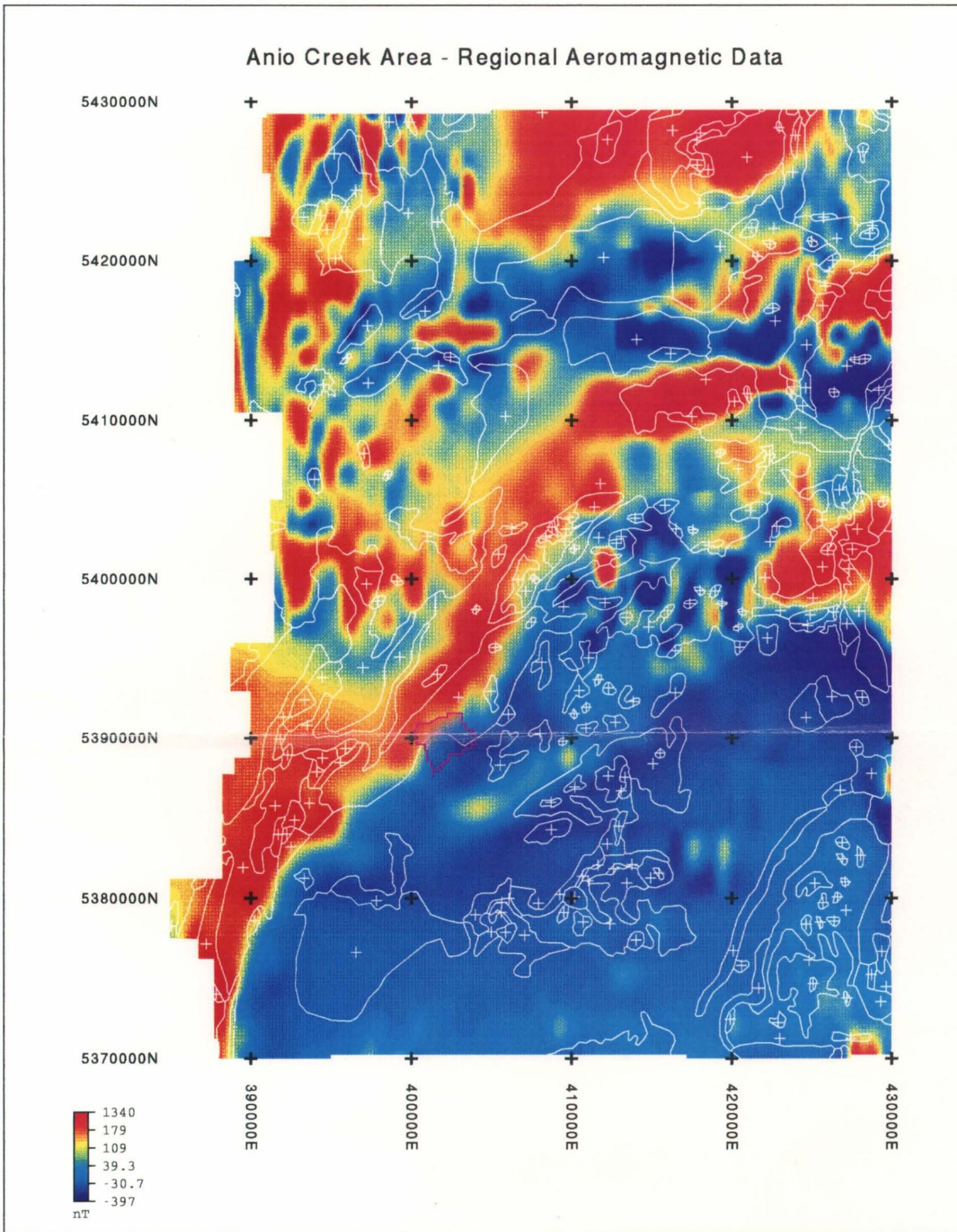


Figure 1

Regional aeromagnetic data. Boundaries of 1:500 000 scale geological polygons shown in white. Anio Creek detailed survey area shown in magenta (near 400 000 mE, 5 390 000 mN).



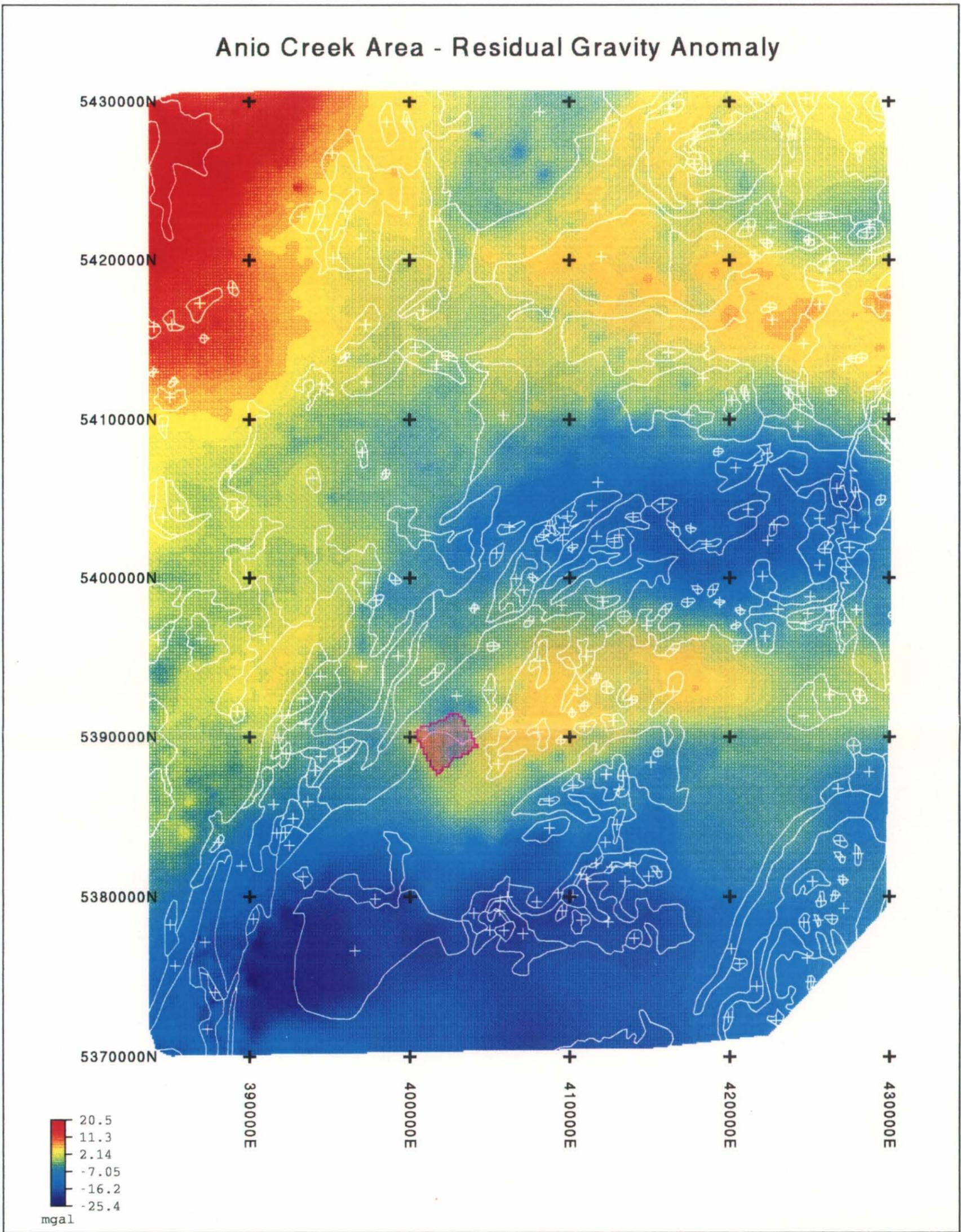


Figure 2

Regional residual gravity anomaly. Boundaries of 1:500 000 scale geological polygons shown in white. Anio Creek area shown in magenta (near 400 000 mE, 5 390 000 mN).



Anio Creek Total Magnetic Intensity

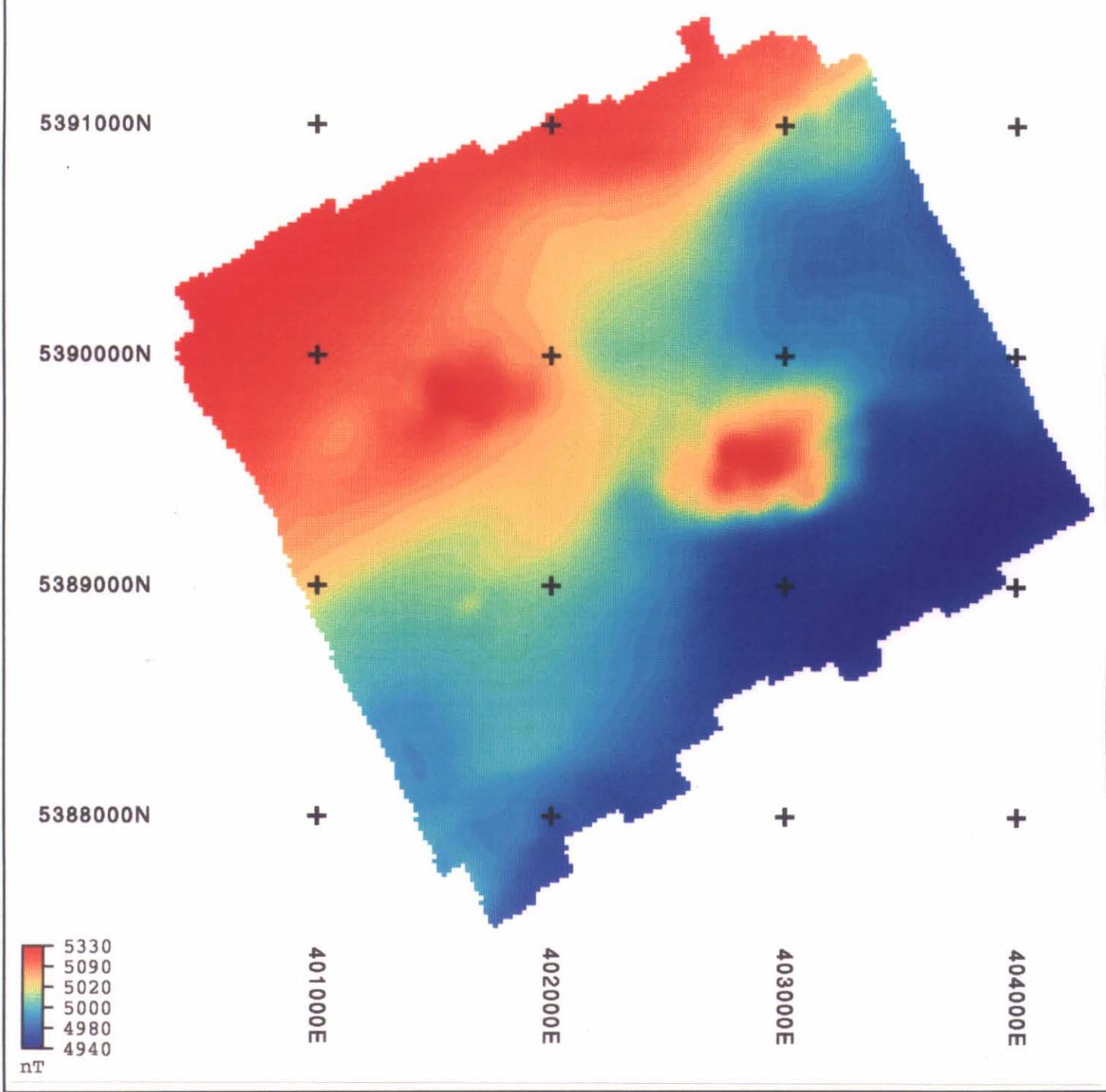


Figure 3

Anio Creek — total magnetic intensity



Anio Creek AGC Magnetics

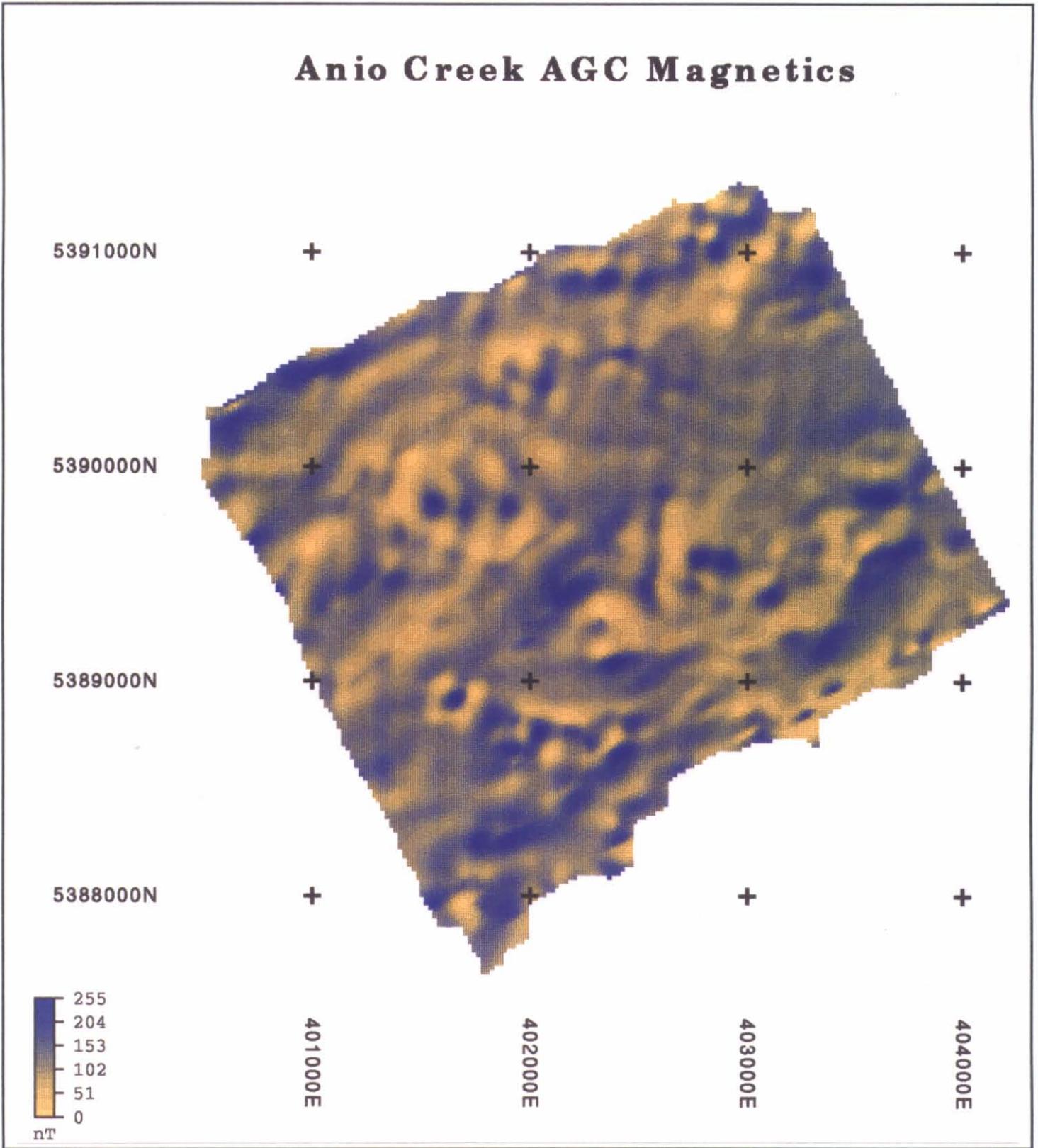


Figure 4

Anio Creek — AGC magnetics

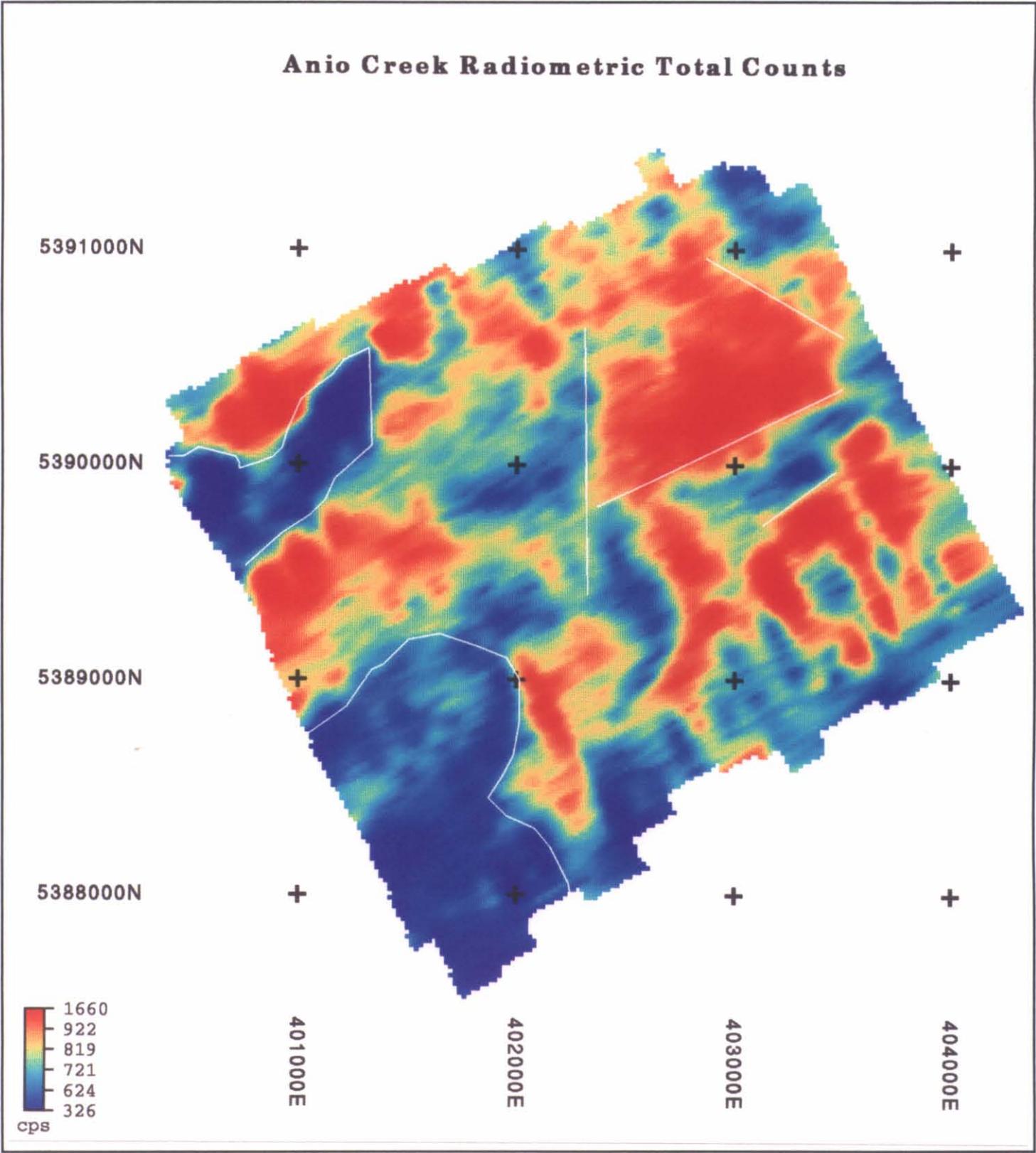


Figure 5
Anio Creek radiometric total counts
(Lines and boundaries shown in white)

5 cm

Anio Creek Radiometric 3 Colour Composite

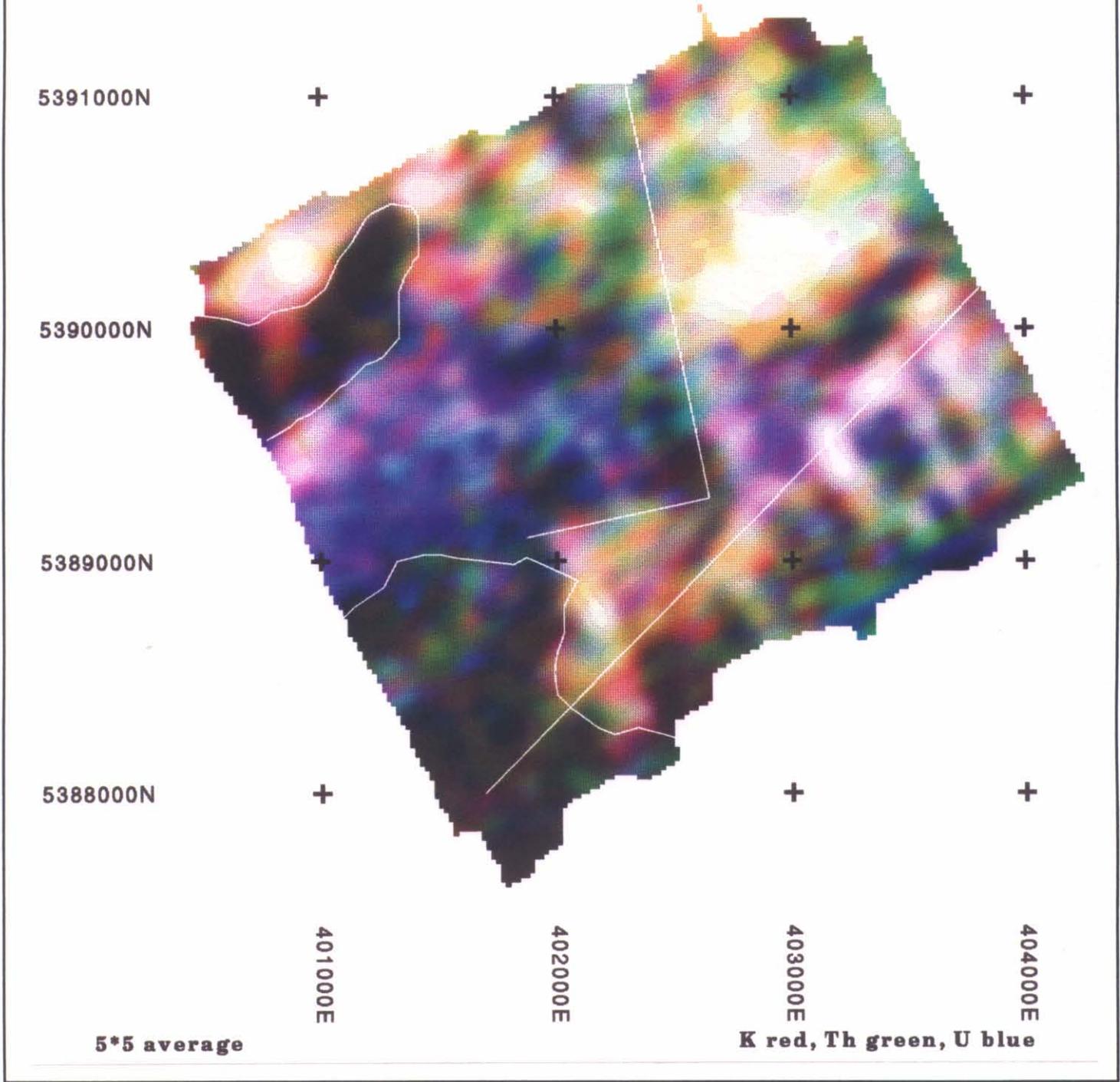
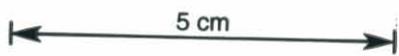


Figure 6

Anio Creek radiometric 3 colour composite
(Lines and boundaries shown in white)



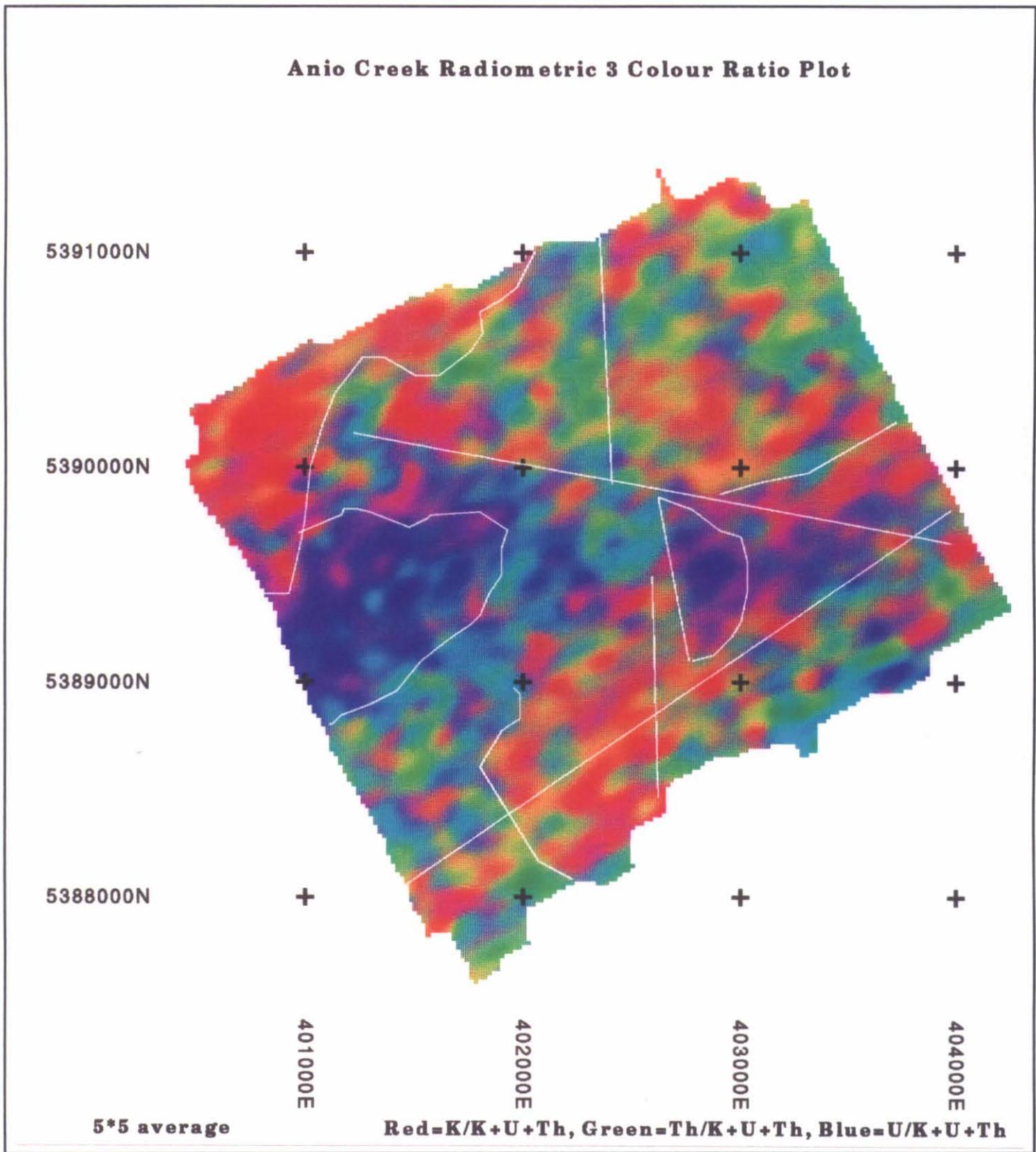
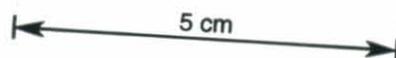


Figure 7

Anio Creek radiometric 3 colour ratio plot
(Linears and boundaries shown in white)



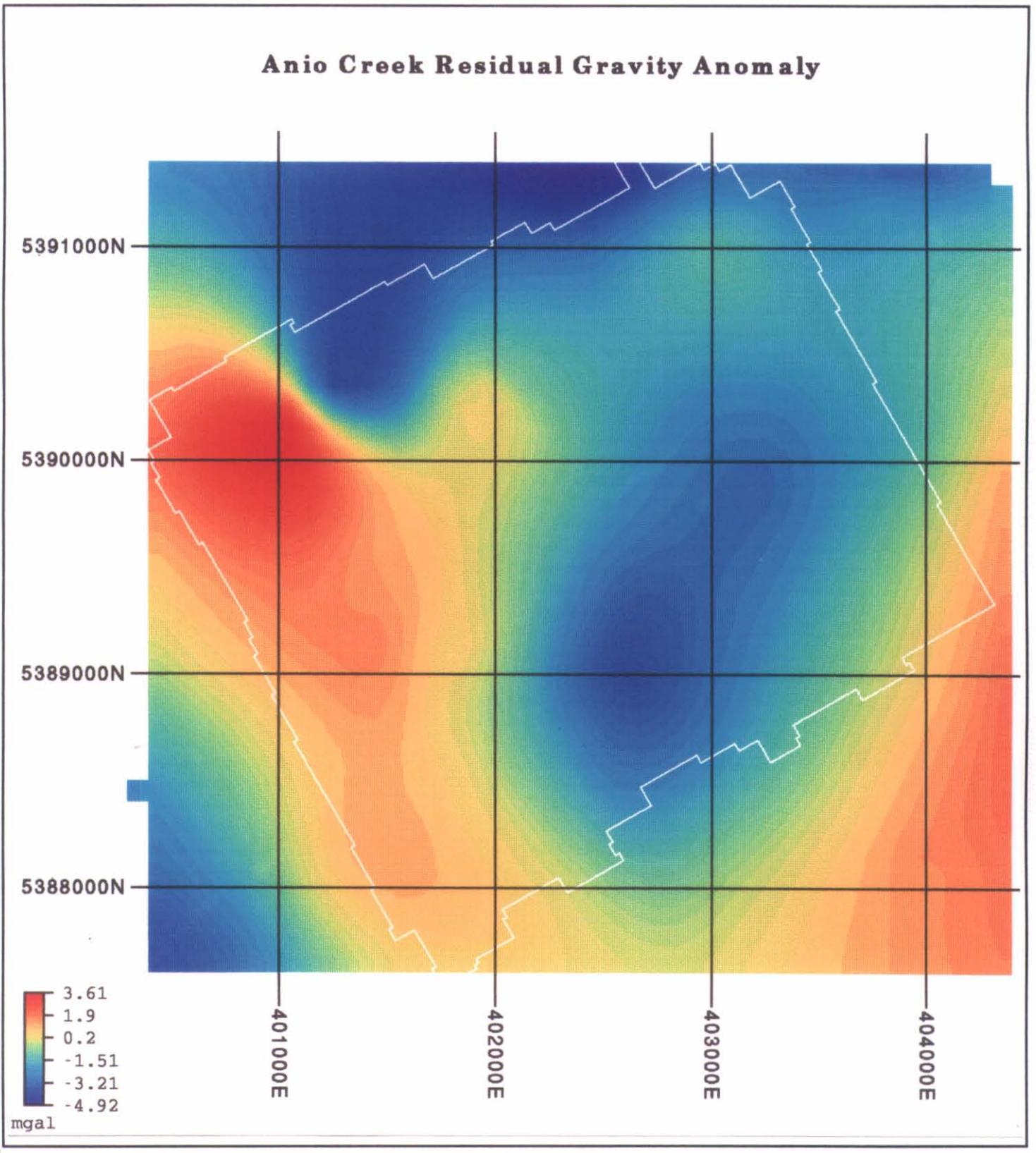
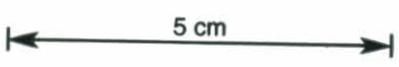


Figure 8
Anio Creek residual gravity anomaly
(Boundary of aeromagnetic survey shown in white)



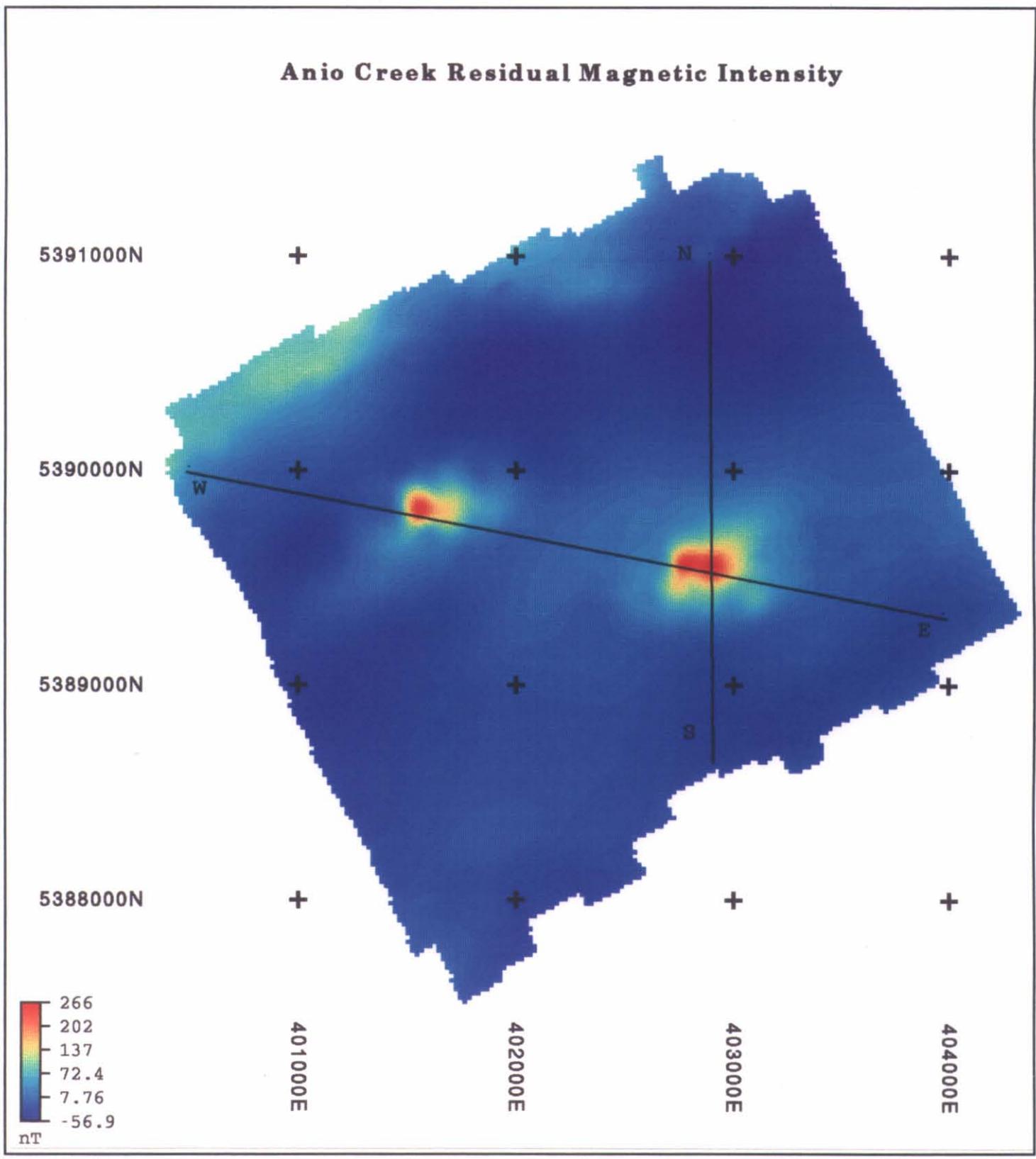
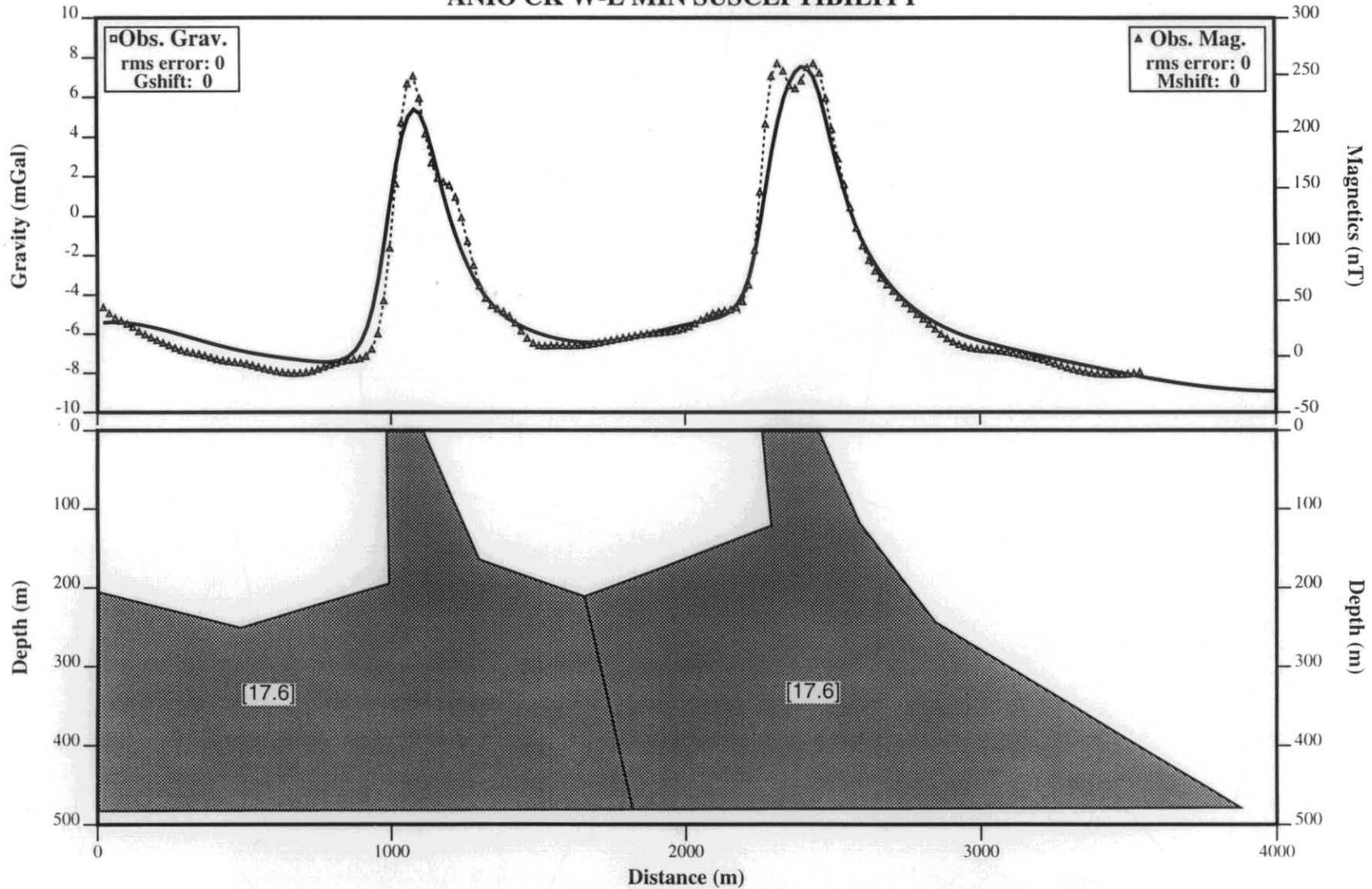


Figure 9
Anio Creek residual magnetic intensity
(Section lines shown in black)

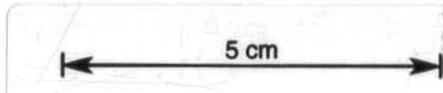
← 5 cm →

2D GRAVITY AND MAGNETICS MODEL ANIO CK W-E MIN SUSCEPTIBILITY

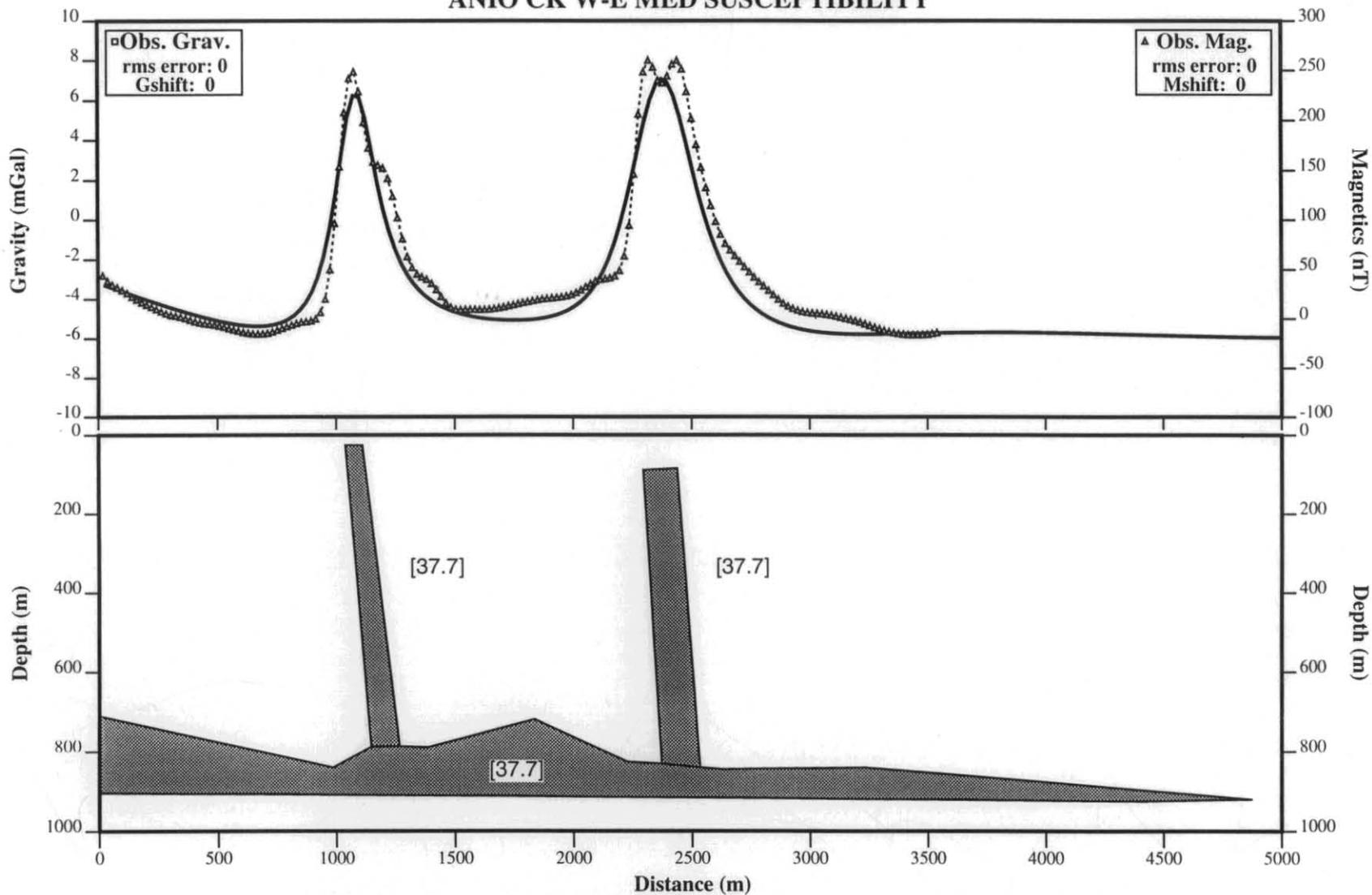


Model File:ANWE1.MOD Obs. Magnetic:ANWEMAG.OBS Date:06-20-1994 Time:08:21:44

Figure 10. Anio Creek Section W-E. Minimum Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]

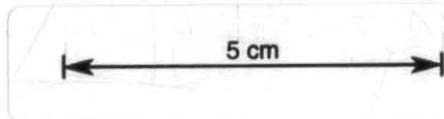


2D GRAVITY AND MAGNETICS MODEL ANIO CK W-E MED SUSCEPTIBILITY

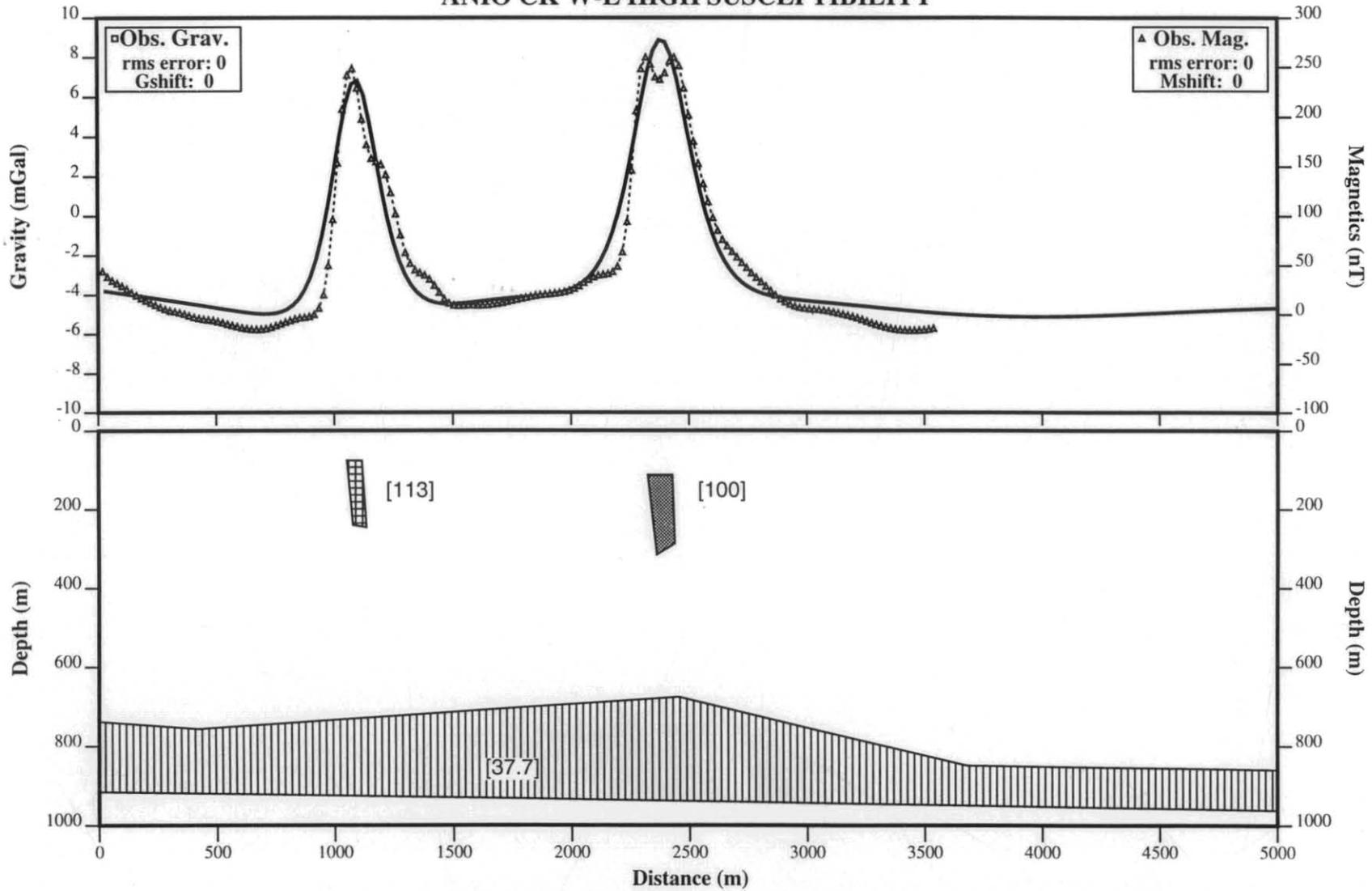


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Figure 11. Anio Creek Section W-E. Medium Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]

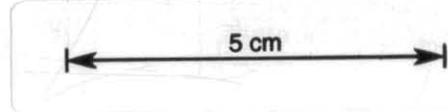


2D GRAVITY AND MAGNETICS MODEL ANIO CK W-E HIGH SUSCEPTIBILITY

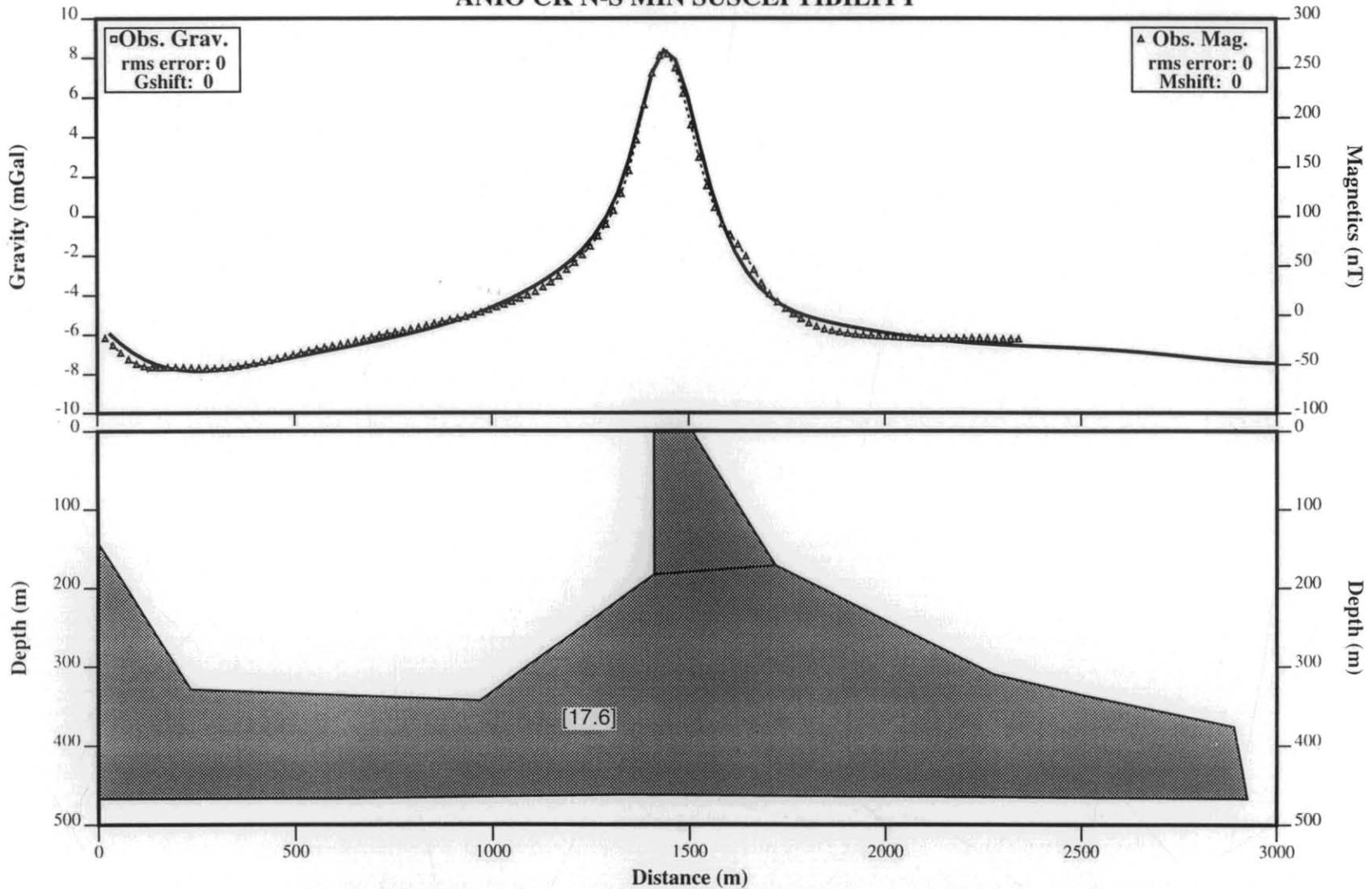


Model File:ANWE3.MOD Obs. Magnetic:ANWEMAG.OBS Date:06-20-1994 Time:08:29:09

Figure 12. Anio Creek Section W-E. High Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]

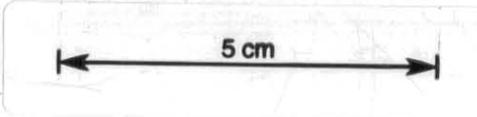


2D GRAVITY AND MAGNETICS MODEL ANIO CK N-S MIN SUSCEPTIBILITY

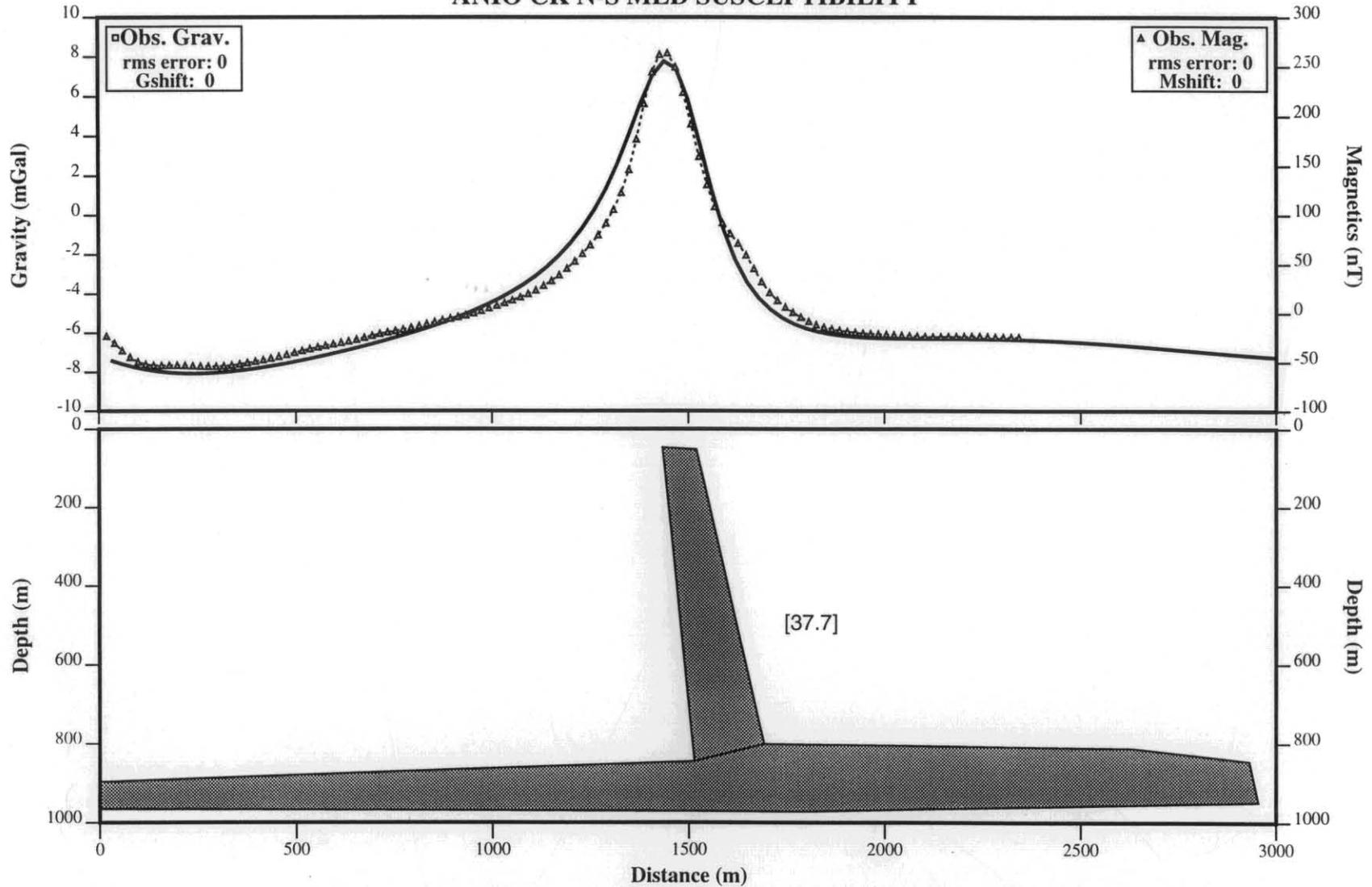


Model File:ANNS1.MOD Obs. Magnetic:ANNSMAG.OBS Date:06-20-1994 Time:08:30:39

Figure 13. Anio Creek Section N-S. Minimum Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]

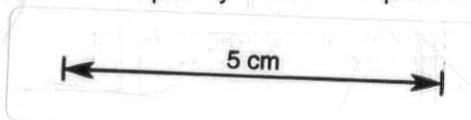


2D GRAVITY AND MAGNETICS MODEL ANIO CK N-S MED SUSCEPTIBILITY

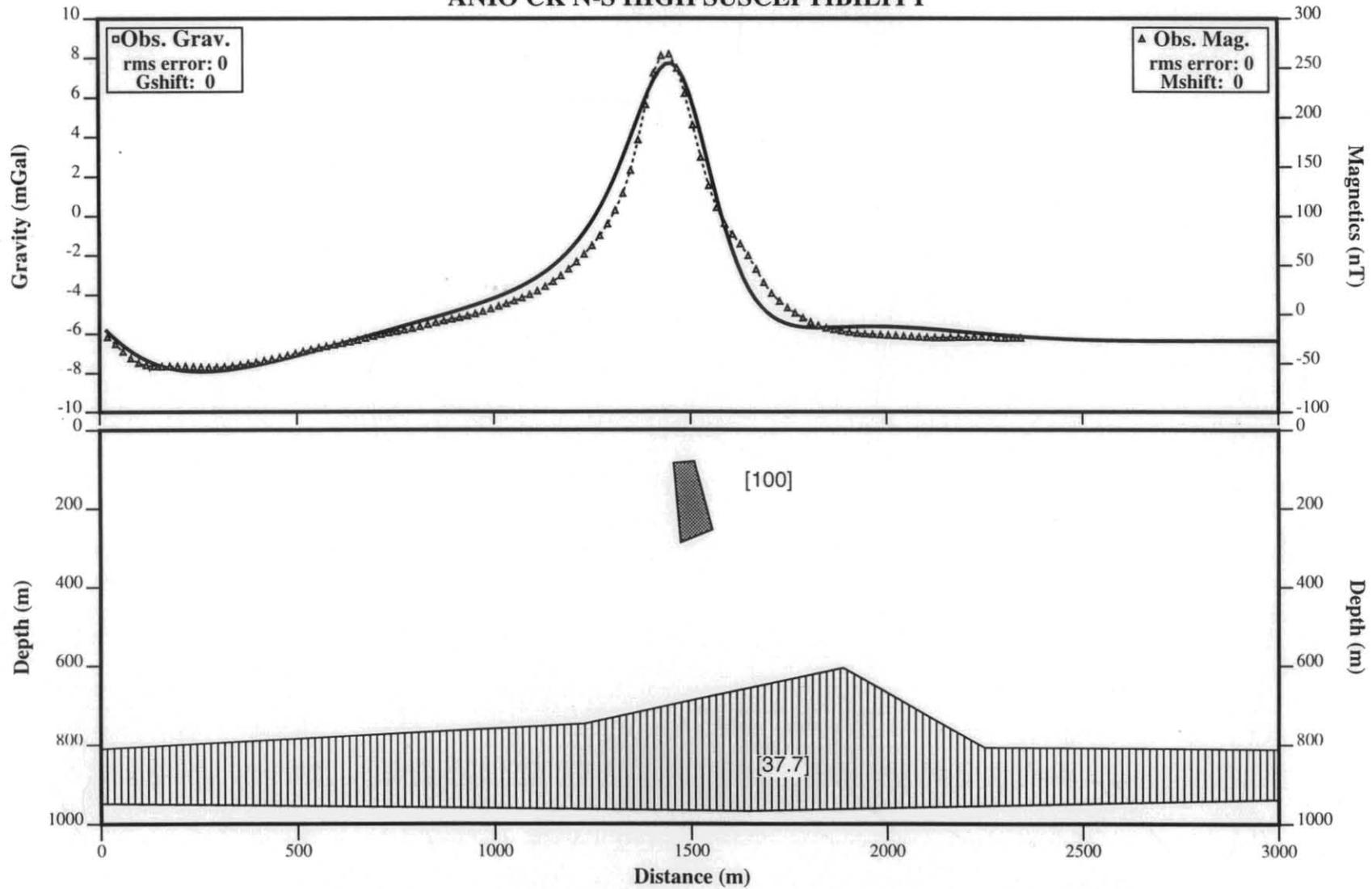


Model File:ANNS2.MOD Obs. Magnetic:ANNSMAG.OBS Date:06-20-1994 Time:08:31:40

Figure 14. Anio Creek Section N-S. Medium Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]



2D GRAVITY AND MAGNETICS MODEL ANIO CK N-S HIGH SUSCEPTIBILITY



Model File:ANNS3.MOD Obs. Magnetic:ANNSMAG.OBS Date:06-20-1994 Time:08:33:16

Figure 15. Anio Creek Section N-S. High Susceptibility. Values in square brackets are magnetic susceptibilities [$\times 10^{-3}$ SI]

5 cm