UR1989_37

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Tasmania Department of Mines—Report 1989/37

The vertical continuation of aeromagnetic data

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Abstract

During aeromagnetic surveys in areas of rugged topography the actual terrain clearance deviates markedly from the nominal terrain clearance, and vertical continuation may be used to more closely approximate the data which would be acquired with a specified terrain clearance. Application of this technique to a small portion of the 1989 Department of Mines Mangana–Alberton survey showed that continuation below a terrain clearance of 200 m produced large amplitude anomalies due to instability in the continuation process. Following these tests the entire survey has been vertically continued to 250 m terrain clearance and 1500 m barometric altitude.

INTRODUCTION

The Mangana–Alberton area was flown with a nominal terrain clearance of 150 m but the actual clearance varied from 38 m to 858 m with an average value of 243 m. This problem may arise in any area with rugged topography, and interpretation of data from such areas must consider the actual terrain clearance.

There are a number of software packages available for performing the vertical continuation of magnetic data. The package used for this work was GPC from Exploration Computer Services (modules GPCFLT, GRDEXT). Gridded data were continued to a number of heights above and below the observation level using two-dimensional Fourier techniques. Linear interpolation was then used to calculate the values at a specified terrain clearance or altitude.

THE CONTINUATIONS

The gridded terrain clearance (fig. 1) varied from 55 m to 876 m, with the increase in range resulting from overshoot in the gridding program. As a maximum of 8 grids, including the elevation grid, can be accommodated in GRDEXT the terrain clearance range was divided into five intervals of 170 m each for determining continuation levels. Table 1 shows the levels used in calculating each terrain clearance.

All continuations are presented as residuals and those below 650 m were filtered with a 900 m radius Gaussian filter before contouring.

Figure 2 shows the raw magnetic data and Figure 3 the raw magnetic data filtered with a 900 m radius Gaussian filter. The positive ridges near 567000 mE, 5424500 mN and 568500 mE, 5416000 mN are in areas of large terrain clearance, and become more significant on the continuation.

Figures 4 to 10 show continuations to between 1200 m terrain clearance and 150 m terrain clearance. The high terrain clearance continuations (fig. 4 and 5) are dominated by strong anomalies in the northeast and southwest, with the remainder of the map showing only small amplitude variations. As the terrain clearance decreases the dipole nature of the anomalies becomes increasingly apparent (e.g. 573500 mE, 5416000 mN on fig. 7 to 10), and the positive ridges on Figures 4 and 5 become major anomalies. At continuation to terrain clearances of 200 m and 150 m (fig. 9 and 10) some anomalies become very high amplitude because of instability introduced by the amount of downward continuation required.

DISCUSSION

Figures 11 to 15 show the effect of varying terrain clearances on simple anomalies. The examples using a single rectangular prism show clearly the apparent loss of dipole character with increasing height, and the rapid reduction in amplitude compared to normal contour intervals with increasing heights. Figure 15 shows the loss of resolution with height, with detection of a two-body situation being most unlikely from a contour map with a contour interval of 2 nT, even at a terrain clearance of 150 metres.

In areas of rugged terrain, interpretation of aeromagnetic data must take variations in terrain clearance into consideration. By vertically continuing the data to a uniform terrain clearance interpretation is made more straightforward but care must be taken to avoid creating anomalies from computational instability.

[28 September 1989]

Table 1.

Terrain clearance	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
150 m	+120 m	0 m	-50 m	-220 m	-390 m	-560 m	-730 m
200 m	+170 m	0 m	-170 m	-340 m	-510 m	-680 m	-
300 m	+270 m	+100 m	0 m	-70 m	-240 m	-410 m	-580 m
450 m	+420 m	+250 m	+80 m	0 m	-90 m	-260 m	-430 m
650 m	+620 m	+450 m	+280 m	+110 m	0 m	-60 m	-230 m
900 m	+850 m	+710 m	+540 m	+370 m	+200 m	+30 m	0 m
1200 m	+1150 m	+1010 m	+840 m	+670 m	+500 m	+330 m	-

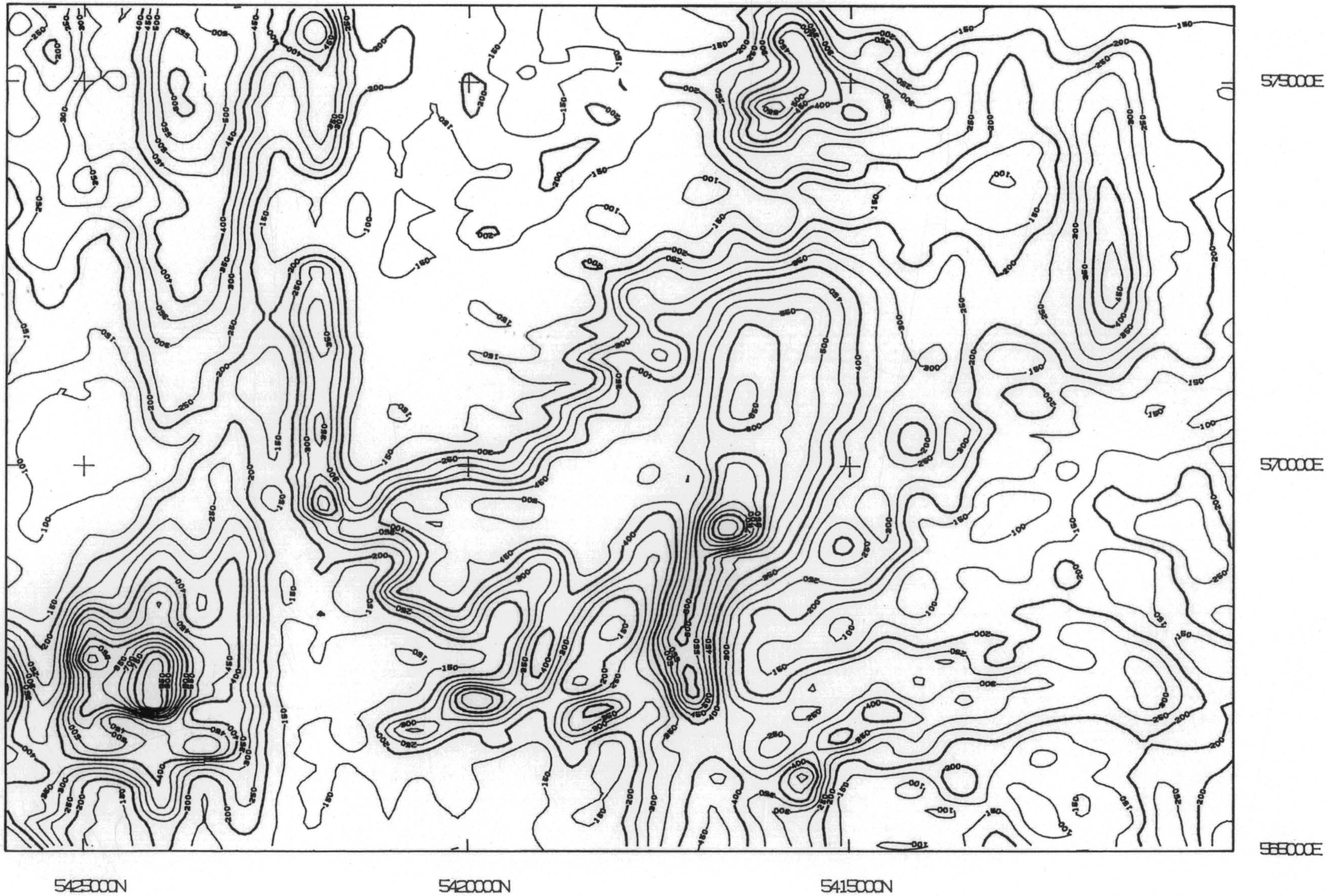
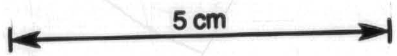


Figure 1. Terrain clearance (m)



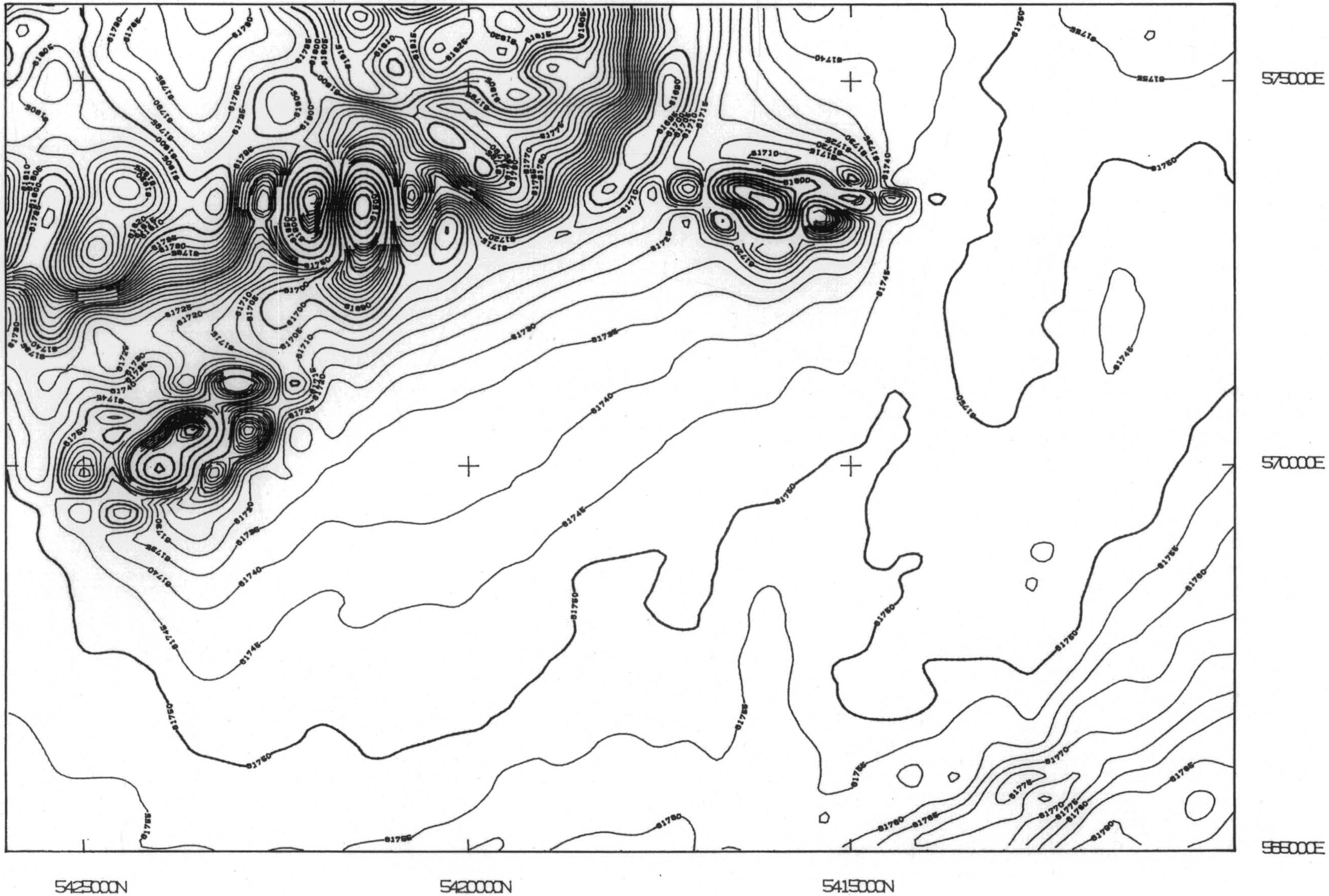


Figure 2. Raw magnetic data.

5 cm

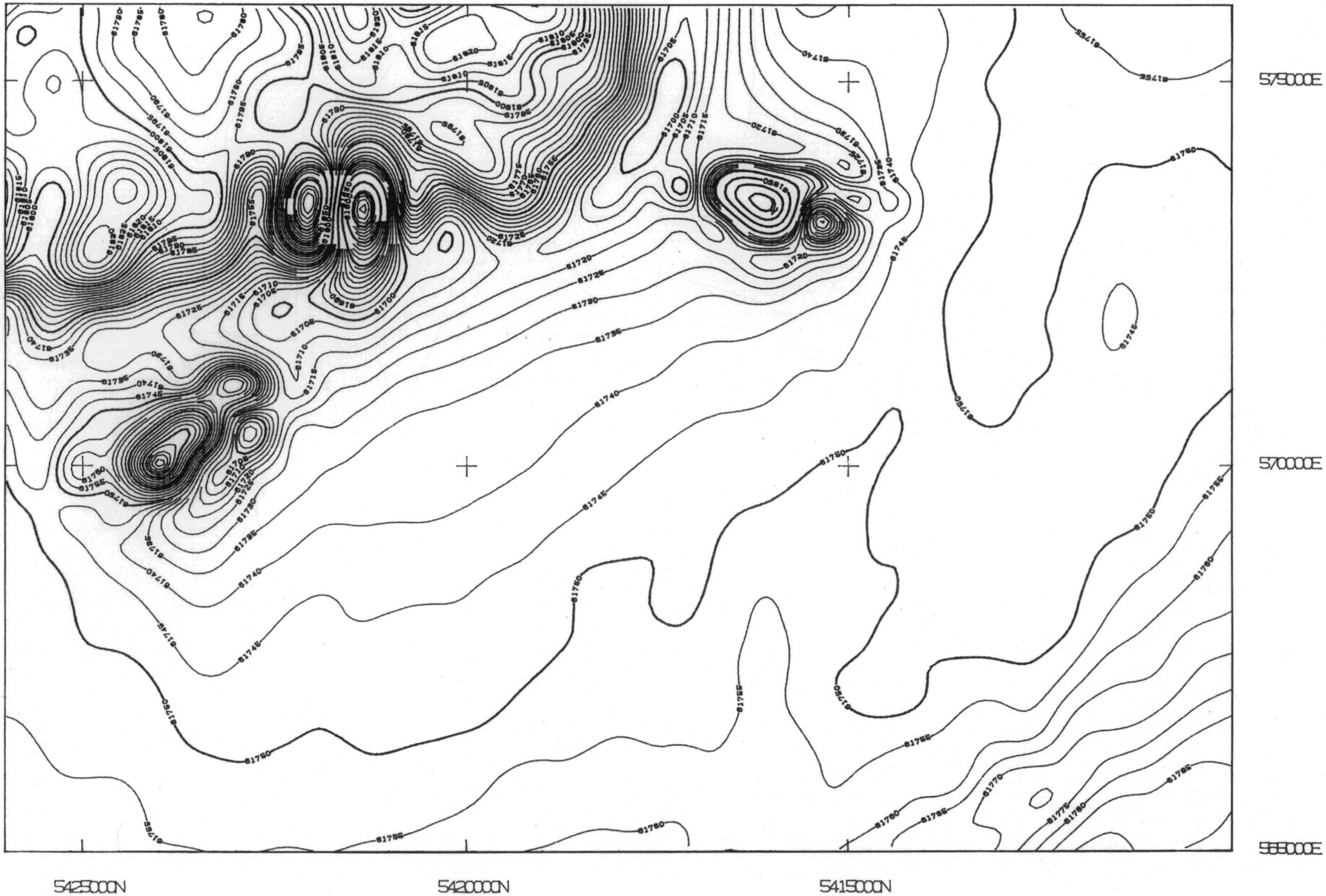
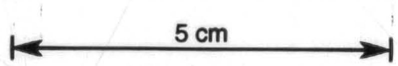


Figure 3. Raw magnetic data (900 m filter).



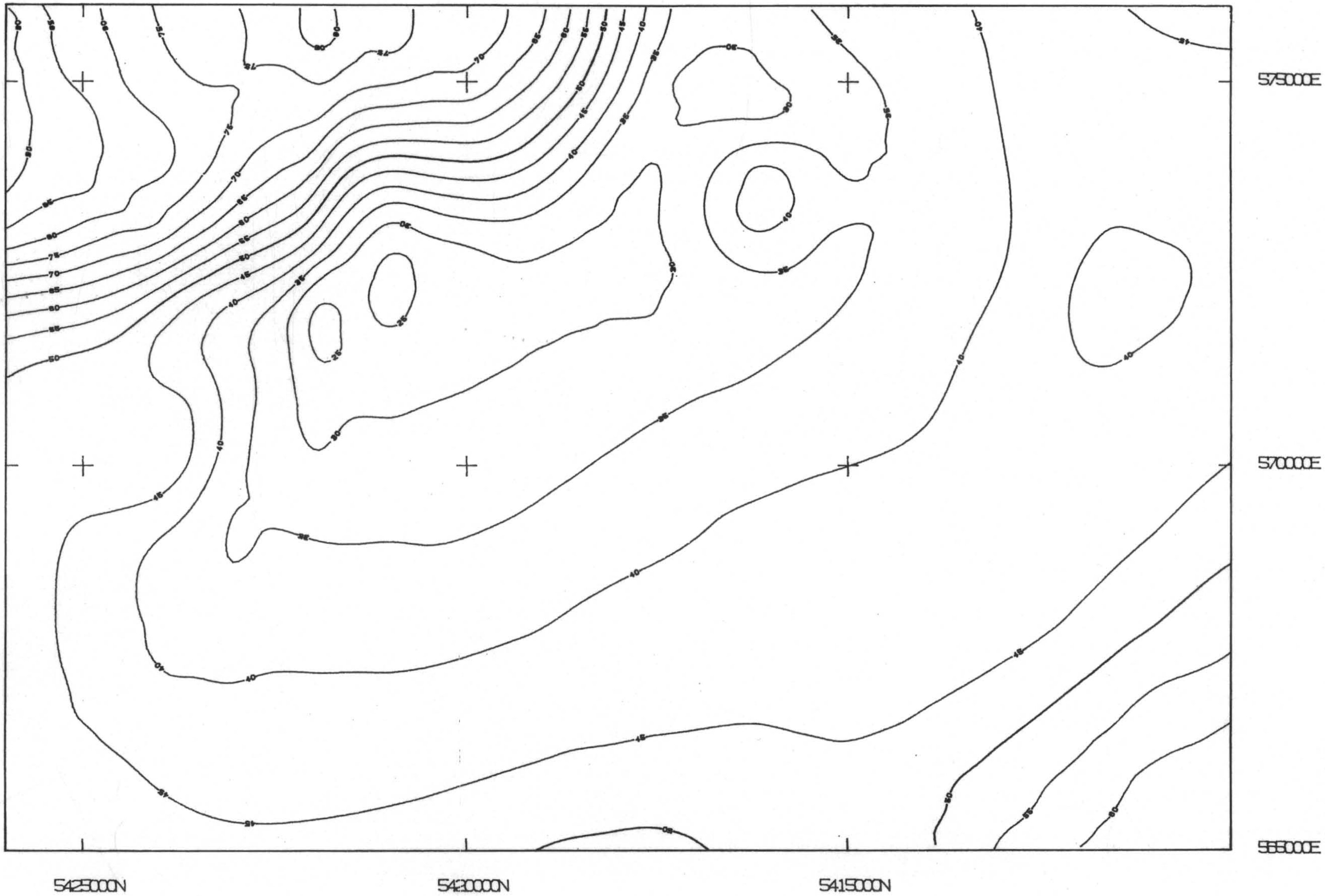


Figure 4. Magnetic data—1200 m terrain clearance (no filtering).

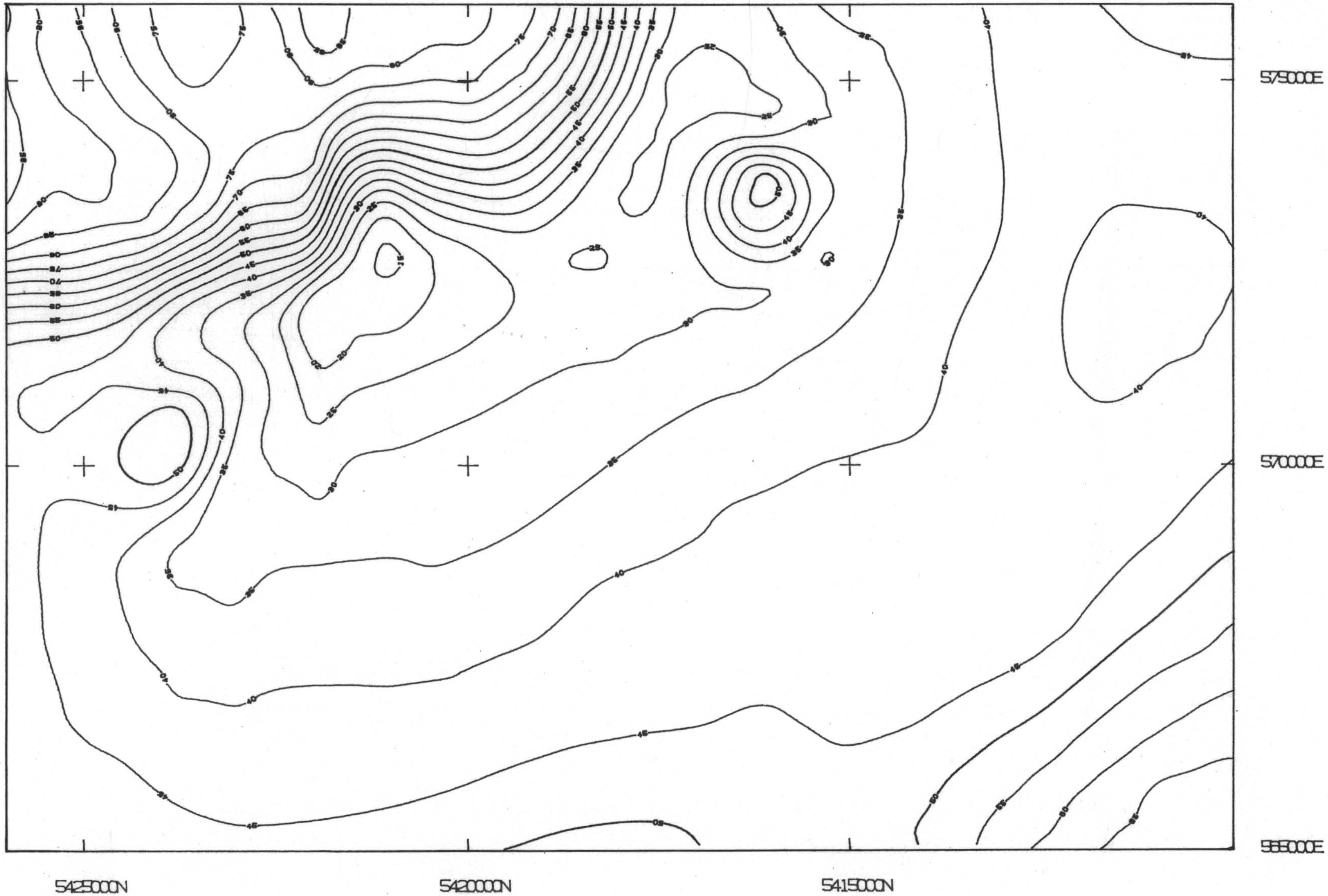


Figure 5. Magnetic data—900 m terrain clearance (no filtering).

5 cm

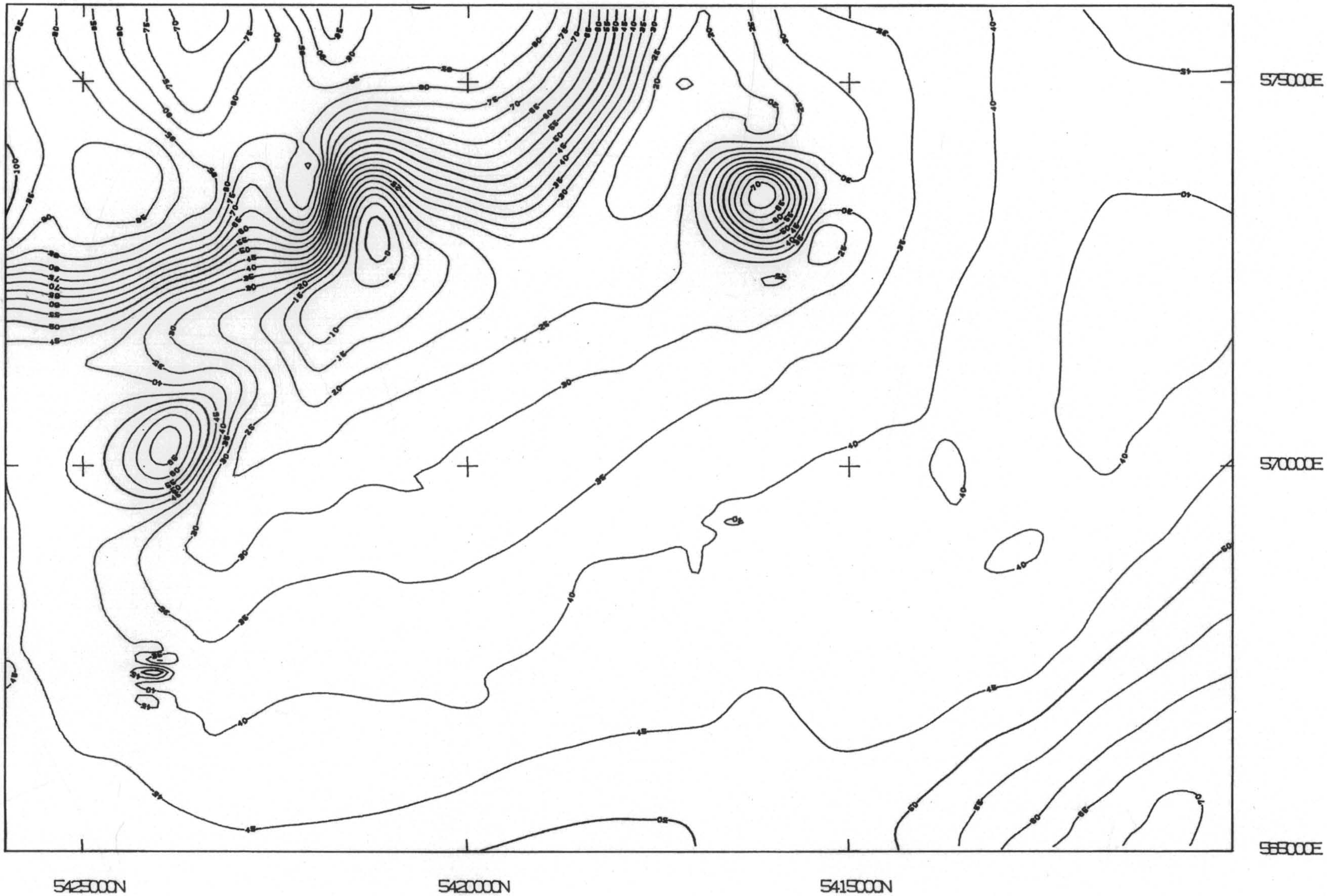


Figure 6. Magnetic data—650 m terrain clearance (no filtering).

5 cm

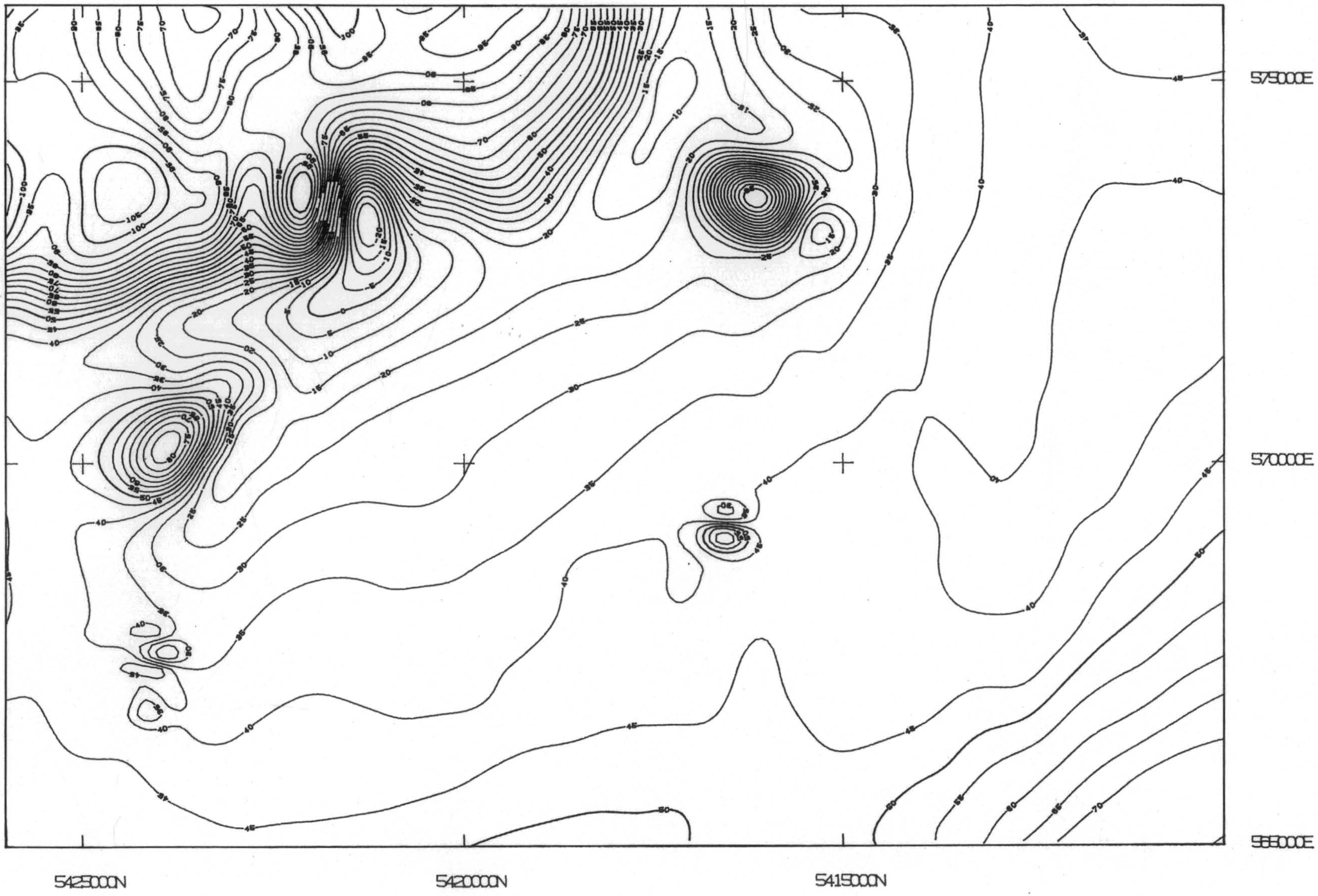


Figure 7. Magnetic data—450 m terrain clearance (900 m filter).

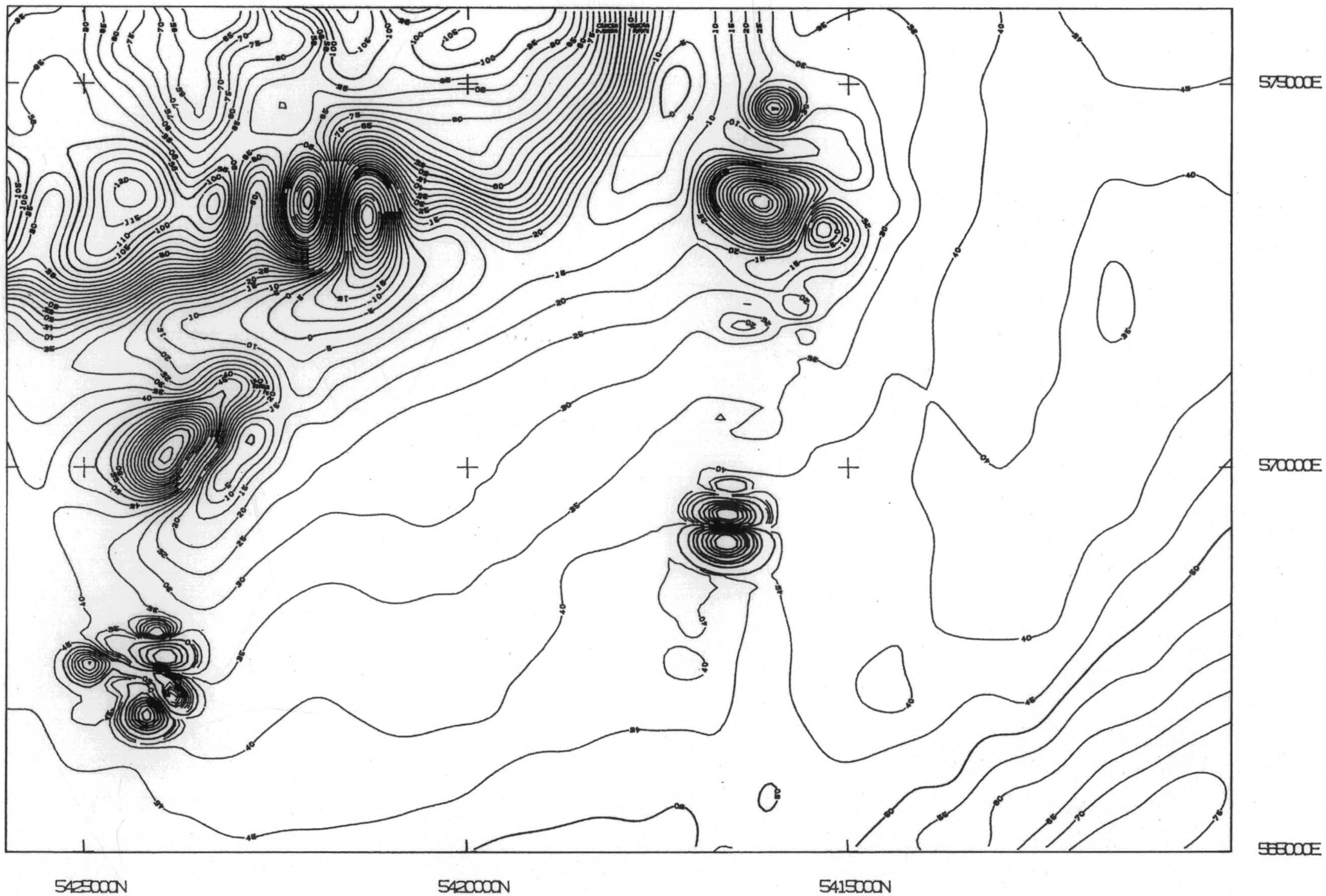
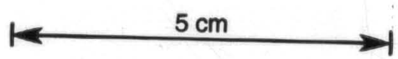


Figure 8. Magnetic data—300 m terrain clearance (900 m filter).



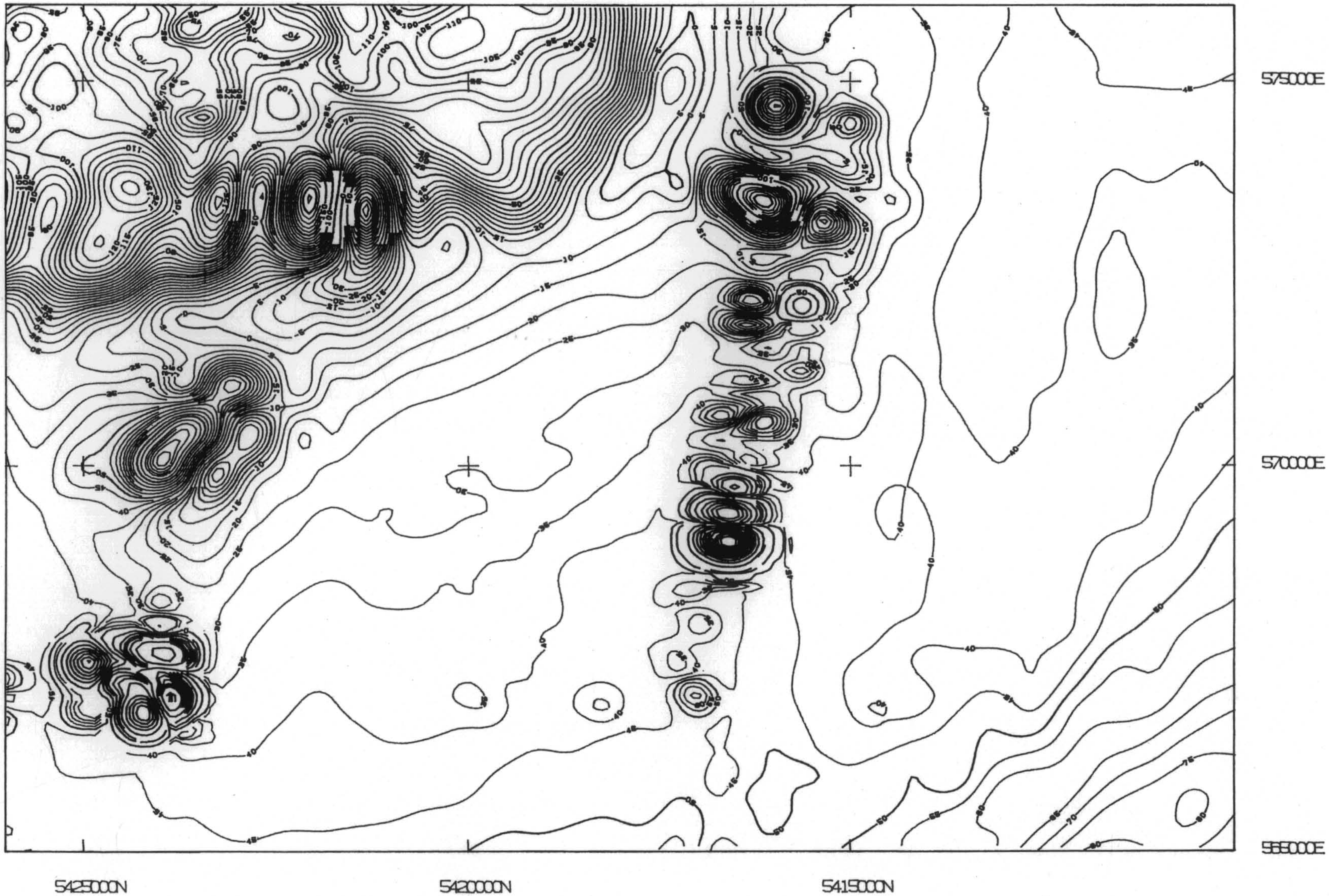


Figure 9. Magnetic data—200 m terrain clearance (900 m filter).

5 cm

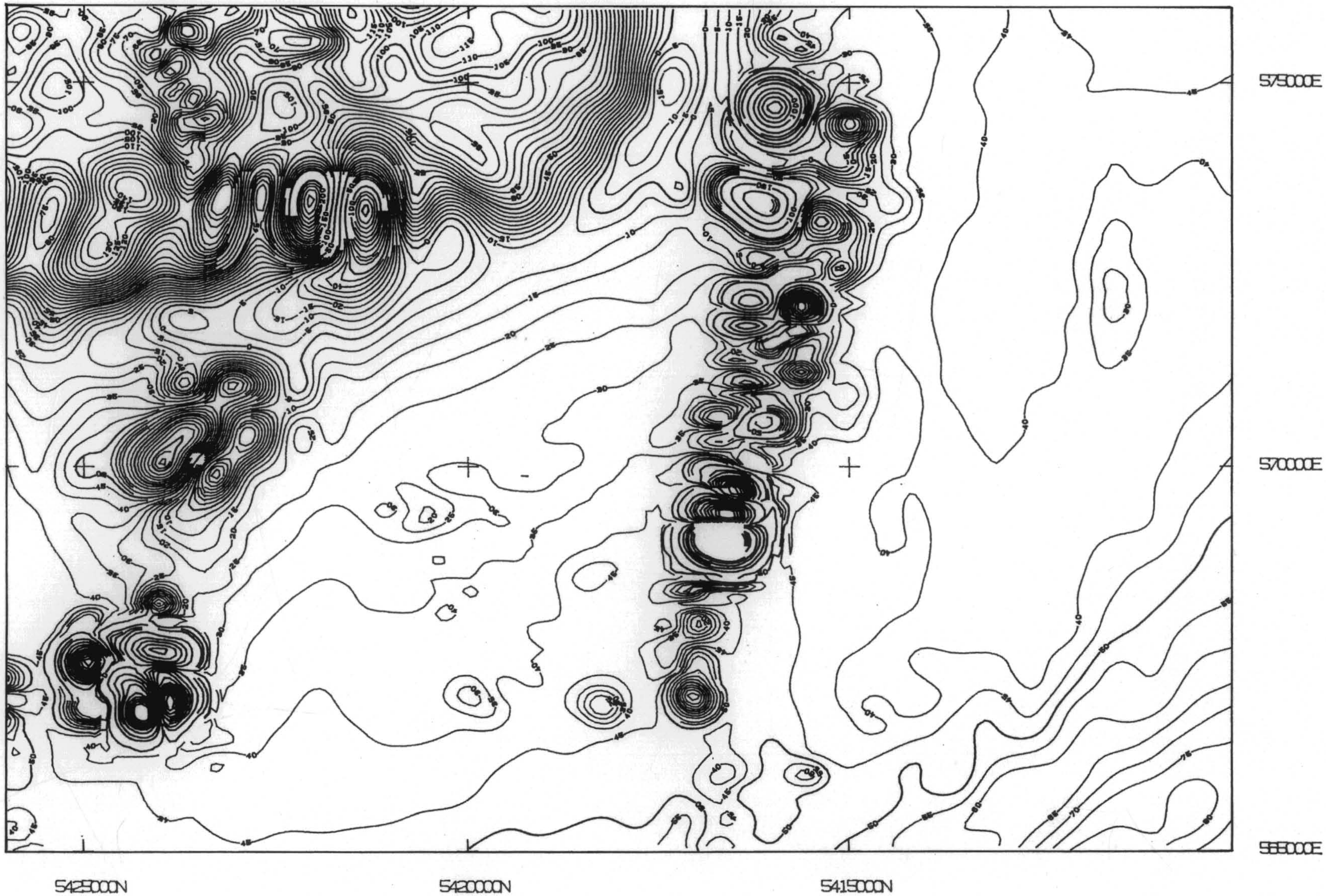


Figure 10. Magnetic data—150 m terrain clearance (900 m filter).

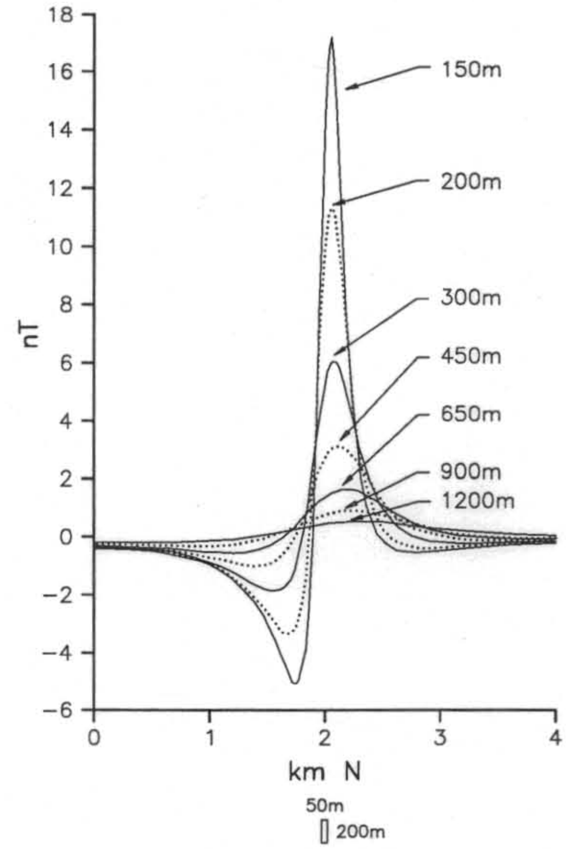


Figure 11. Theoretical anomaly over a thin body of 200 m extent at various heights (0.0008 cgs).

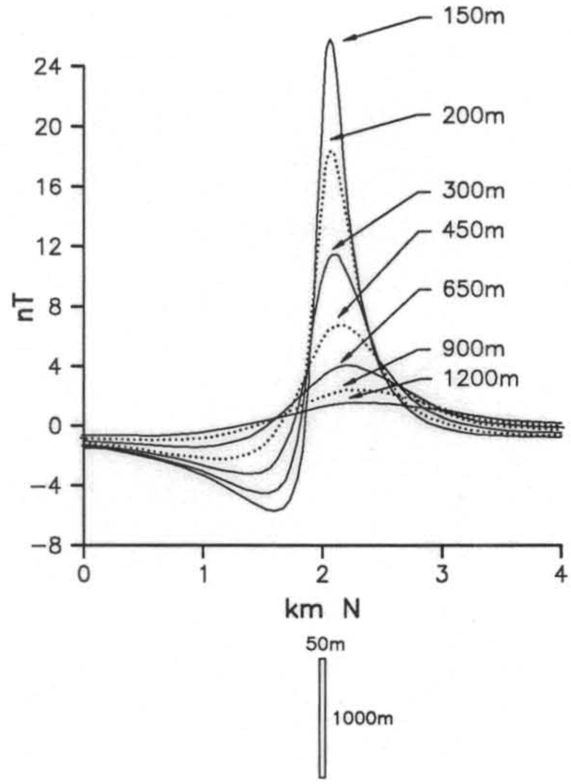
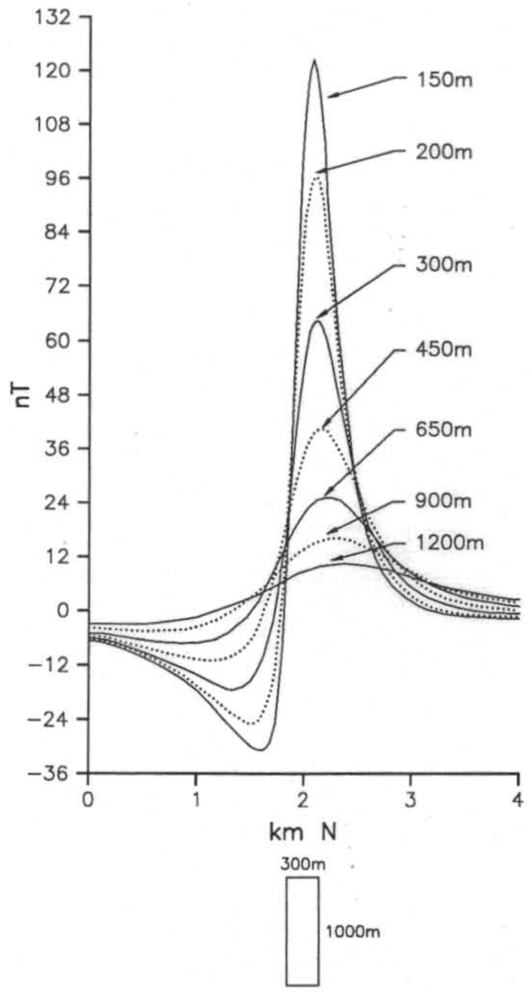


Figure 12. Theoretical anomaly over a thin body of 1000 m extent at various heights (0.0008 cgs).



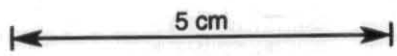


Figure 13. Theoretical anomaly over a 300 m wide body of 1000 m extent at various heights (0.0008 cgs).

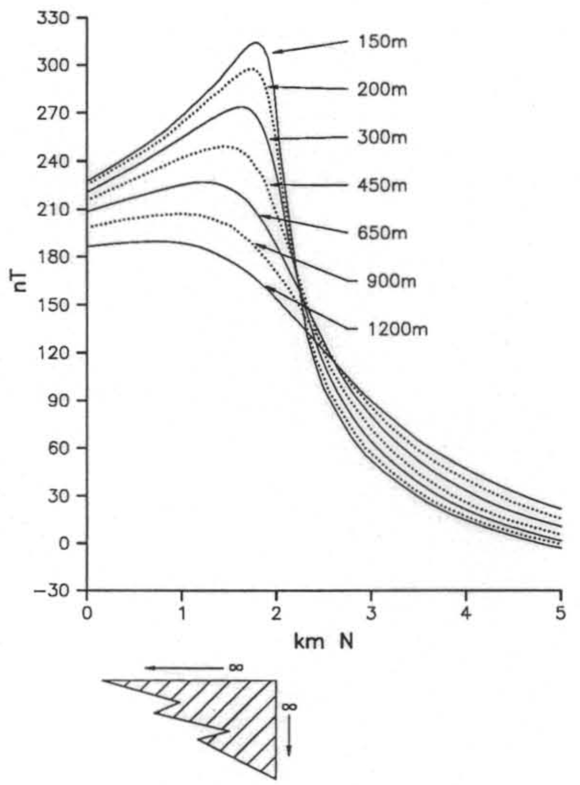


Figure 14. Theoretical anomaly over a fault at various heights (0.0008 cgs).

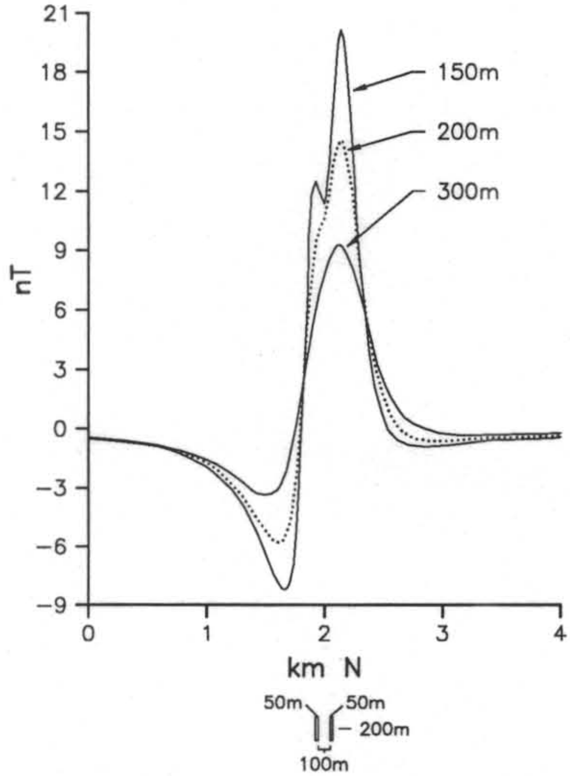


Figure 15. Theoretical anomaly over two thin bodies separated horizontally by 100 m (0.0008 cgs).