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Geophysical surveys at Boco Siding

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Abstract

Five reversed seismic refraction spreads, combined with gravity traverses along the same lines, showed that the depth of the glacial materials at Boco Siding varied from zero on outcrop at the western end of Spread 3 to over 100 metres. Three linked profiles were obtained. The density contrast of the glacial materials compared with the underlying materials is approximately -0.6 t/m^3, and supports the use of the gravity method, with suitable control, for determining the basement depth.

INTRODUCTION

As part of the Mt Read Volcanics Project a number of known problem areas for geophysics were surveyed using a variety of techniques. Boco Siding is one such area, where a highly variable thickness of glacial materials overlies Cambrian volcanic rocks. Thicknesses in excess of one hundred metres are known. Augustinus and Colhoun (1986) reported that the glacial deposits contain boulders of Owen Conglomerate, Granite Tor Granite, and Cambrian volcanic rocks. Their measurements of the density of the Cambrian volcanic clasts show a range from 2.22 to 2.66 t/m^3. No bulk density measurements for the glacial deposits are available.

Vegetation in the Boco Siding area is predominantly low buttongrass, although some tea-tree was encountered on Spreads 3 and 4. Levelling and positioning was caried out using a combination of electronic distance measurement and traditional optical techniques. Spreads 1 and 2 were located (fig. 1) along a traverse recommended by Dr J. R. Bishop as providing maximum drill hole control. Spread 3 ran off basement outcrop at its western end and, combined with Spread 4, provides a good profile across the valley.

The gravity data was acquired using Sodin gravity meter number 183 and fully corrected to yield a Bouguer anomaly. A Bouguer density of 2.67 t/m^3 was used. Magnetic data was acquired along Spreads 1 and 2 using a McPhar proton magnetometer, and was corrected for diurnal variation by repeat reading of a base station. The reversed refraction spreads were recorded with a 30 m gephone interval and used the reciprocal method (Hawkins, 1961). Spreads 1, 3, 4 and 5 used 24 channels, and Spread 2 used 12 channels. Total

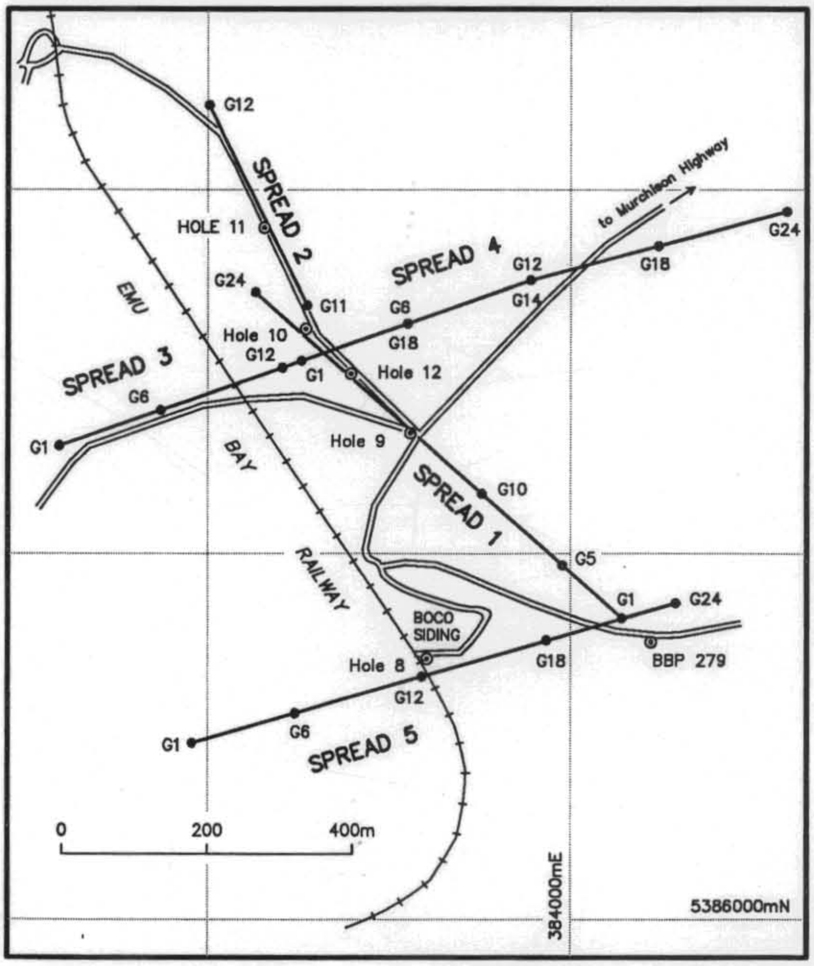


Figure 1. *Locality plan, Boco Siding.*

acquisition time was five days, including one day of heavy rain and two days of periodic showers.

SEISMIC REFRACTION RESULTS

Spread 1

- 30 m geophone spacing
- 24 channels
- End shots 30 m north of geophone 24 and 30 m south of geophone 1.
- Long shots 200 m north of geophone 24 and 200 m south of geophone 1.

V_1=1270 m/sec
V_2=1900 m/sec
V_3=4900 m/sec

Depth from south end shot	84 m
Depth from north end shot	112 m

The depth profile obtained after applying the reciprocal method to the data from the long and end shots (fig. 2) agrees in shape with the drill hole profile but the depths measured are up to 20% deeper. This may be attributed to weathering of the basement surface, the inhomogenous nature of the glacial deposits, and the known irregular basement profile.

Spread 2

- 30 m geophone spacing
- 12 channels
- End shots 30 m north of geophone 12 and 30 m south of geophone 1
- Long shots 200 m north of geophone 12 and 200 m south of geophone 1

V_1=1750 m/sec
V_2 (northern end)=5200 m/sec
V_2 (southern end)=4100 m/sec

Depth from south end shot	67 m
Depth from south long shot	103 m
Depth from north end shot	41 m

The reciprocal time was only recorded for the north end shot because of 50 Hz interference, and the depths calculated at geophones 6 and 7 using the reciprocal method (49 m and 47 m respectively) were used to obtain a theoretical reciprocal time of 282 msec for the long shots. The depth profile thus obtained (fig. 3) corresponds to the basement depth measured at Hole 11.

Spread 3

- 30 m geophone spacing
- 24 channels
- End shots located at geophones 1 and 24
- Long shots 100 m west of geophone 1 and 100 m east of geophone 24.

V_1=2000 m/sec
V_2 (west end)=2860 m/sec
V_2 (east end)=5300 m/sec

Depth from centre shot (west end)	46 m
Depth from east end shot	82 m

The depth profile obtained after applying the reciprocal method to the data from the long and end shots (fig. 4) ties well with the profile from Spread 1 near Hole 10 (Spread 1 geophone 20=101 m, Spread 3 geophone 14=99 m, Hole 10=99 m).

Spread 4

- 30 m geophone spacing
- 24 channels
- End shots 60 m west of geophone 1 and 60 m east of geophone 24
- Long shots 200 m west of geophone 1 and 200 m east of geophone 24

V_1=1800 m/sec
V_2 (west end)=4200 m/sec
V_2 (east end)=5900 m/sec

Depth from west end shot	127 m
Depth from west long shot	100 m
Depth from east end shot	64 m

The depth profile obtained after applying the reciprocal method to the data from the long and end shots (fig. 5) agrees with the data from Spread 3.

Spread 5

- 30 m geophone spacing
- 24 channels
- End shots 60 m west of geophone 1 and 60 m east of geophone 24
- Long shots 200 m west of geophone 1 and 200 m east of geophone 24

V_1=1800 m/sec
V_2=3800 m/sec
V_3=5000 m/sec

Depth from west end shot	32 m
Depth from east end shot	60 m

The depth profile obtained after applying the reciprocal method to the data from the long and end shots (fig. 6) is significantly shallower (66–74 m versus 85 m) than the depths obtained from the southern end of Spread 1 and Hole BBP279. The profile at geophone 12 (depth from long shot=94 m) agrees with the measured depth of 97 m in Hole 8.

MAGNETICS

The magnetic data were acquired at the geophone positions of Spreads 1 and 2, and in the case of Spread 1 for an additional 100 m to the north, after removal of the cables and geophones. The data are plotted on Figures 2 and 3. Surface boulders in the area are up to six metres across, and shallowly buried boulders of such dimensions could easily account for the single point anomalies. The magnetic data from both Spreads 1 and 2 show a marked increase in value north of Hole 10, corresponding to the decrease in basement depth between Holes 10 and 11.

GRAVITY

The gravity data were acquired at the geophone positions and are shown on Figures 2 to 6. Variation in basement density, which is known from drill holes and bulk sample measurements, produced some interpretation problems with the simple models used, and the gravity data for each spread is discussed individually.

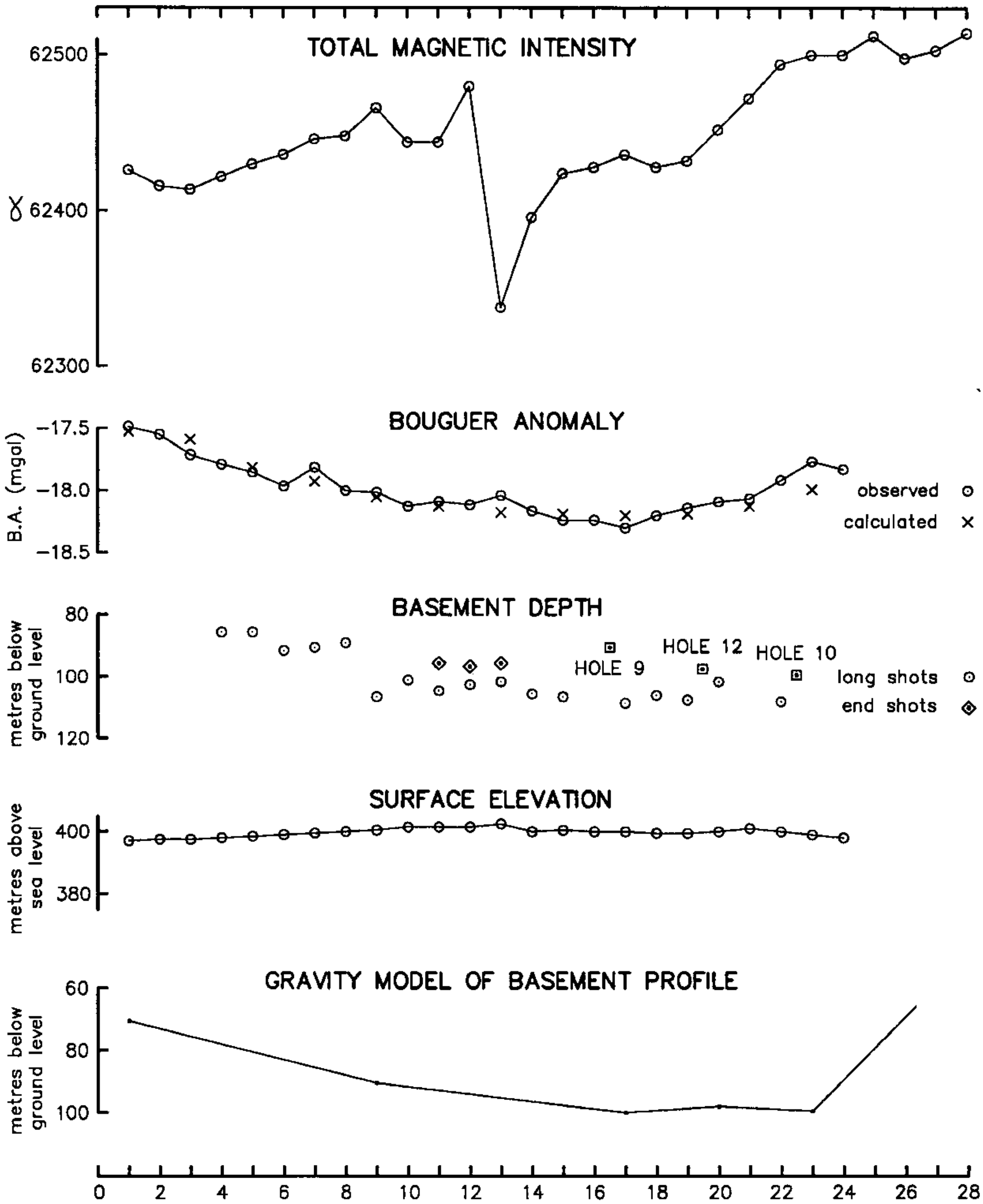
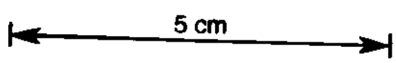


Figure 2. *Data from Spread 1.*



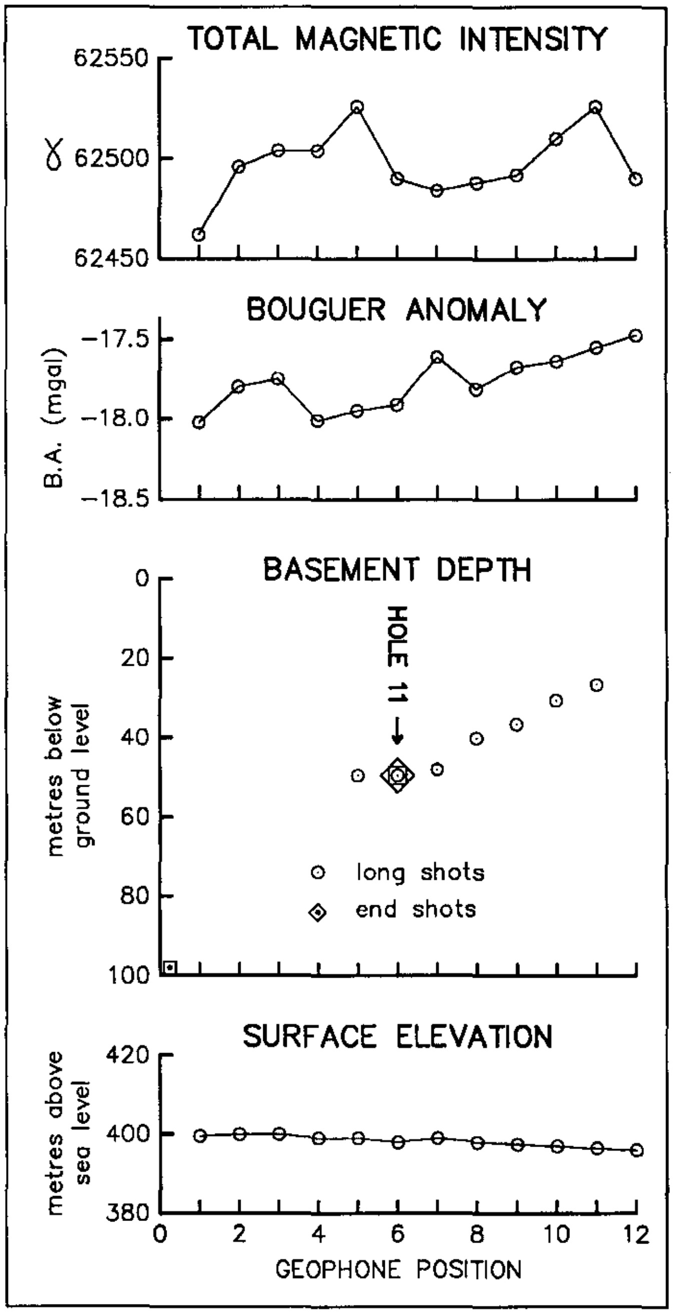


Figure 3. *Data from Spread 2.*

A simple model for Spread 1, based on the drill hole data (fig. 2) and using an average bulk density contrast of -0.7 t/m^3, shows acceptable agreement between the observed and calculated Bouguer anomalies. The exception is at Hole 9, where the gravity model indicates a depth of 100 m rather than the 90 m reported from the drill hole.

The models for Spreads 3, 4 and 5 are based on both the drill hole and seismic depth information, and use bulk density contrasts of -0.5 t/m^3, -0.5 t/m^3, and -0.6 t/m^3 respectively.

CONCLUSION

The methods applied have delineated the basement profile and show an average bulk density contrast of -0.5 to -0.7 t/m^3 between the glacial deposits and the underlying basement. Both the seismic and gravity data (fig. 7) show a basement depression open to the north.

REFERENCES

AUGUSTINUS, P. A.; COLHOUN, E. A. 1986. Glacial history of the upper Pieman and Boco valleys, western Tasmania. *Aust. J. Earth Sci.* 33:181–191

HAWKINS, L. V. 1961. The reciprocal method of routine shallow seismic refraction investigations. *Geophysics* 26:806–819

[7 June 1989]

5 cm

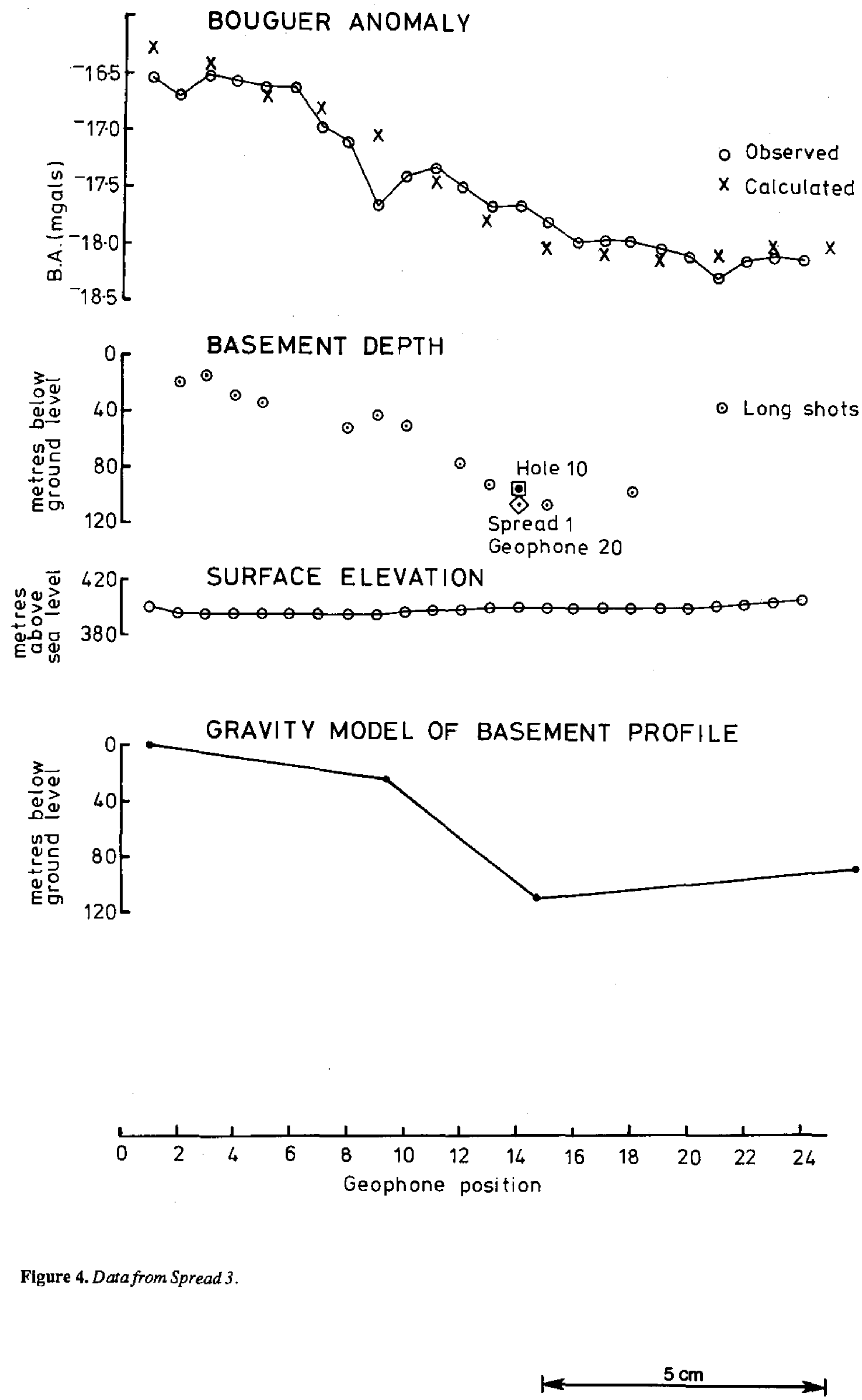
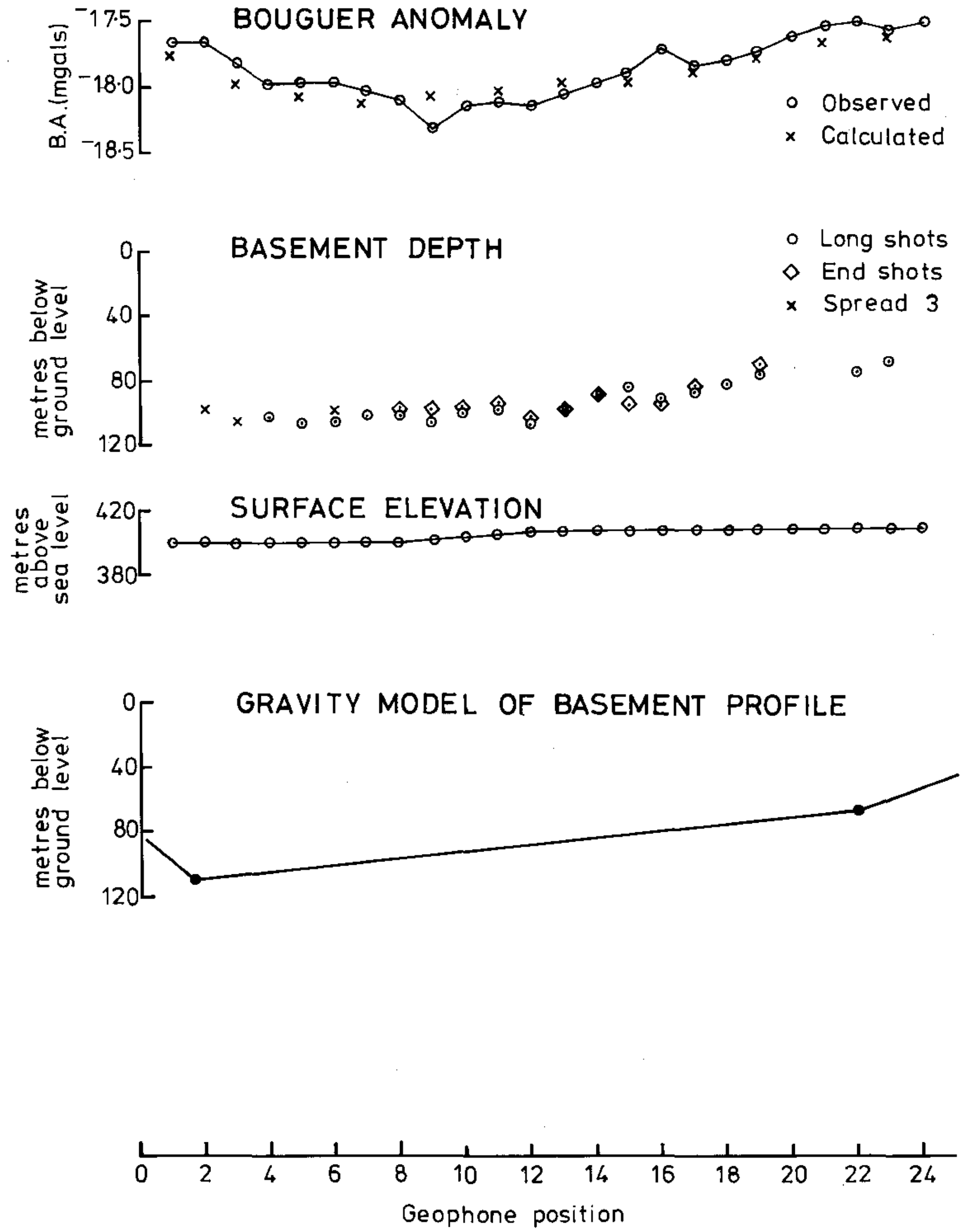


Figure 4. *Data from Spread 3.*



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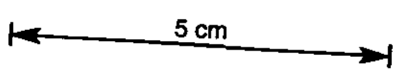

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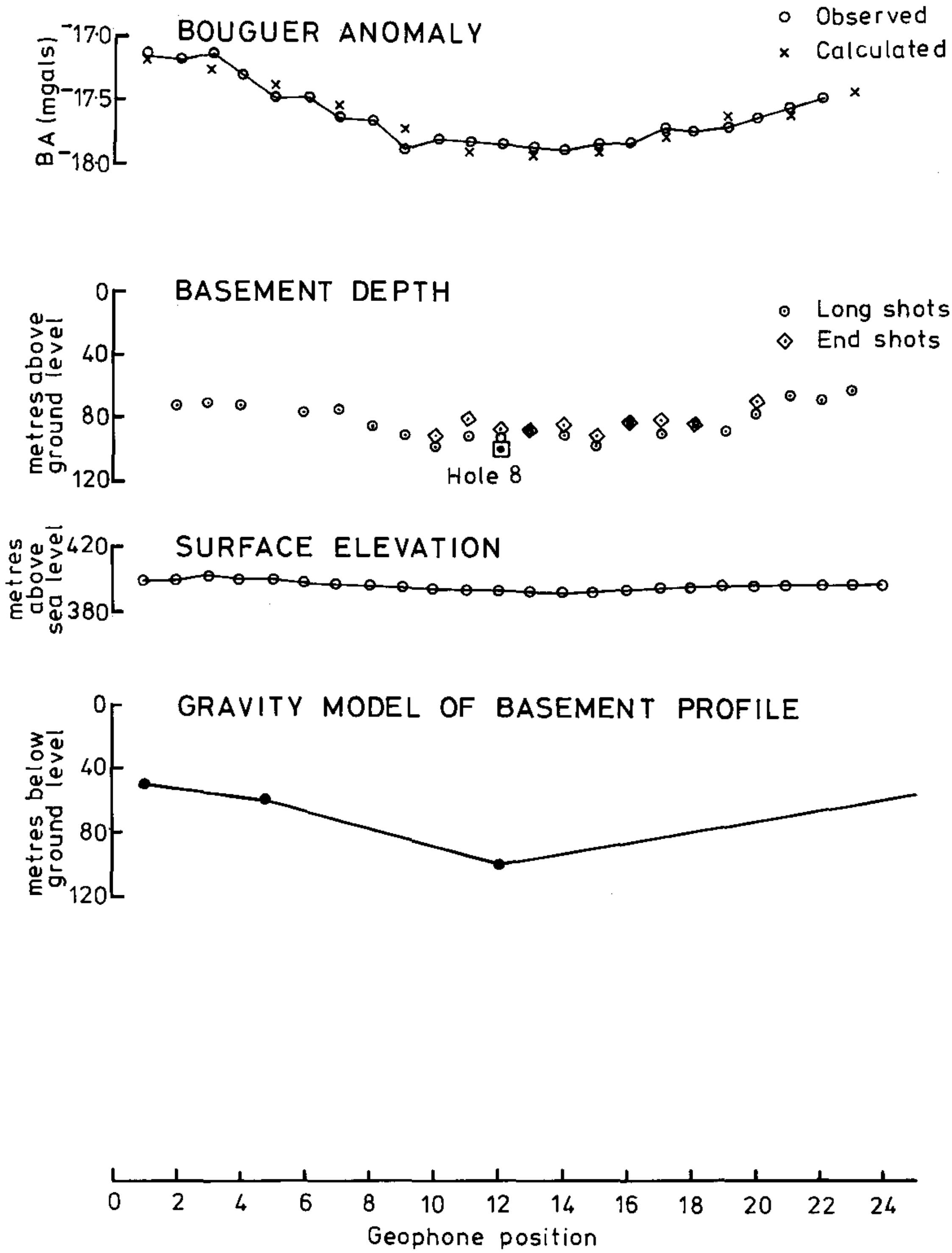

Figure 6. *Data from Spread 5.*

5 cm

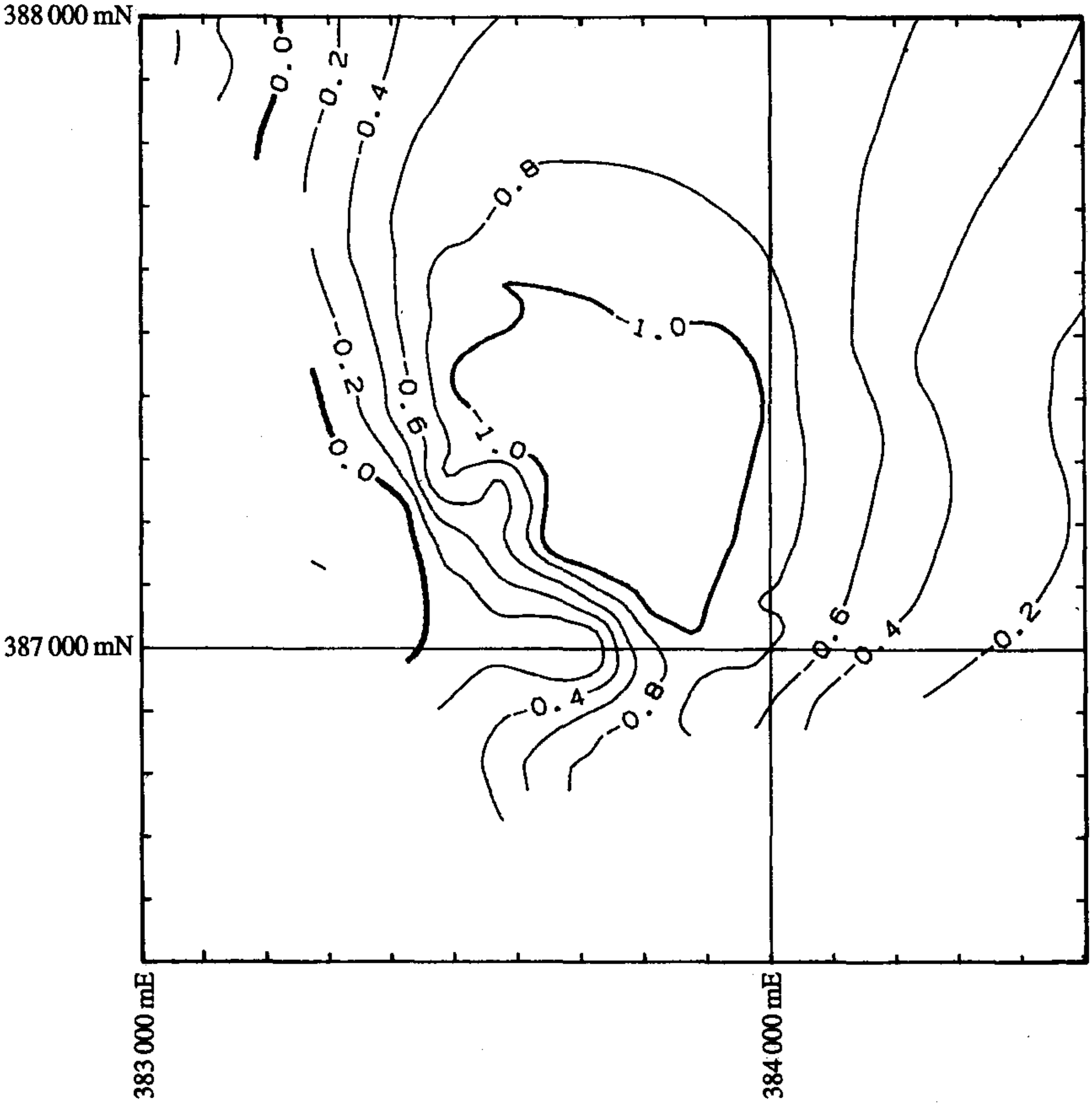

Figure 7. *Residual gravity anomaly.*

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