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1986/77. Geophysical surveys at Boco Siding - Stage 1

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Abstract

Two reversed seismic refraction spreads, combined with gravity and magnetic traverses along the same lines, showed that the depth of the glacial materials at Boco Siding varies from approximately 40 m to 100 m along the line of the traverse. The density contrast of the glacial materials compared with the underlying materials is approximately -0.7 t/m³ 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 are being 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, High 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/m³. No bulk density measurements for the glacial deposits are available.
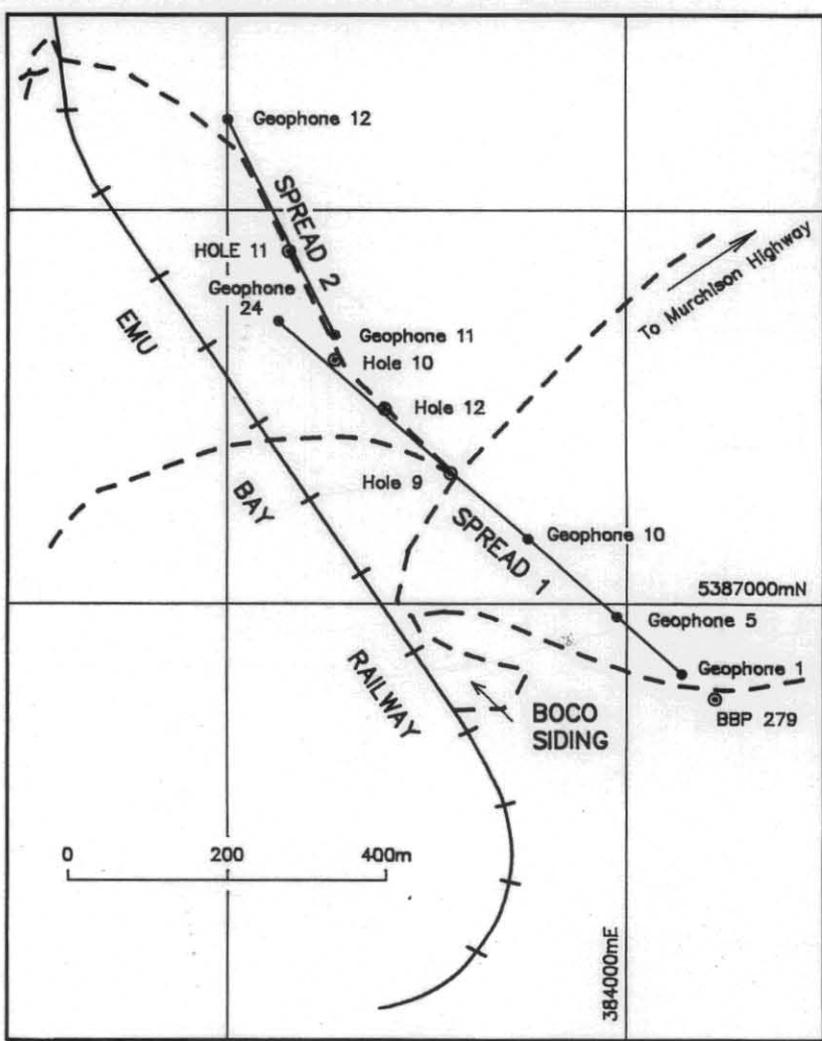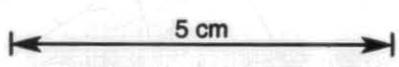

Figure 1. *Locality plan, Boco Siding*

The traverse position (fig. 1) was recommended by Dr J. R. Bishop as providing maximum drill-hole control. The vegetation was low buttongrass and access to the southern and northern ends of the traverse was by foot. Levelling and positioning was carried out by using a combination of electronic distance measurement and optical levelling.

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. The magnetic data was acquired using a McPhar proton magnetometer and corrected for diurnal variation by repeat reading of a base station. The reversed refraction spreads were recorded with a 30 m geophone interval and used the reciprocal method (Hawkins, 1961). Spread 1 used 24 channels and Spread 2 used 12 channels.

The field data was acquired over two days. Heavy rain on the first day and periodic showers on the second day slowed operations and associated leakage on the reciprocal phone lines produced 50 Hz interference that obliterated the signal on the last shots of Spread 2. In fine conditions the duration of the field survey would be reduced by approximately 30 percent.

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
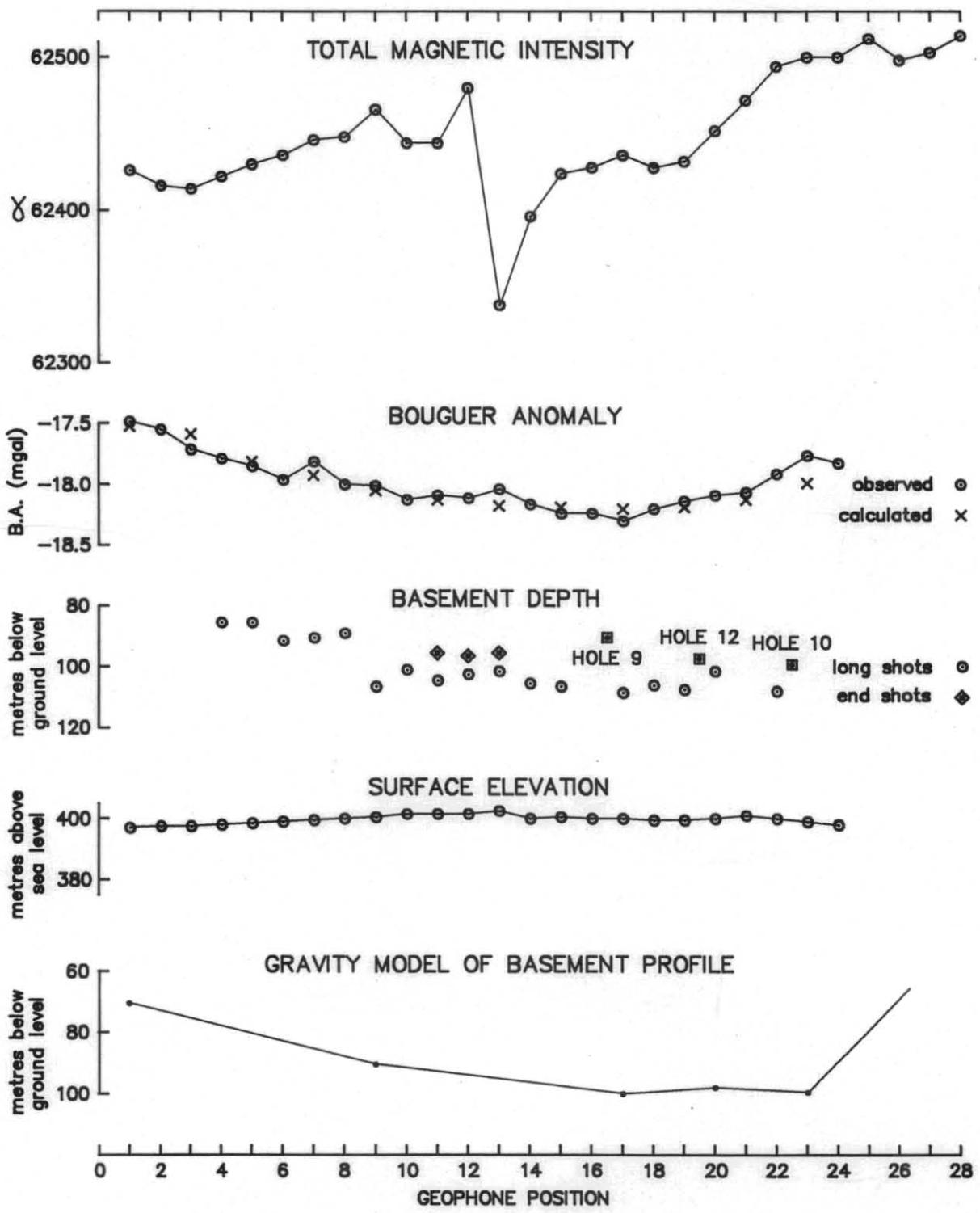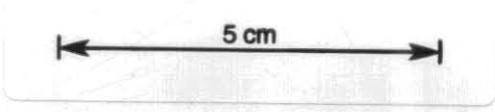Depth from north end shot   41 m

Figure 2. Data from Spread 1

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 m/sec for the long shots. The depth profile thus obtained (fig. 3) corresponds to the basement depth measured at Hole 11.

Magnetics

The magnetic data were acquired at the geophone positions, and in the case of Spread 1 for an additional 120 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 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 and 3. A simple model based on the drill-hole data (fig. 2) and using an average bulk density contrast of -0.7 t/m³ show 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. This greater depth is in agreement with the depth profile from the seismic refraction data.

Figure 3. *Data from Spread 2*

CONCLUSION

The methods applied have delineated the basement profile and show an average bulk density contrast of -0.7 t/m³ between the glacial deposits and the underlying basement. A further set of surveys running approximately east-west across the glacial deposits between basement outcrops is planned. A smaller sampling interval will be used for the magnetic measurements to provide possible information on near-surface boulders within the glacial deposits.
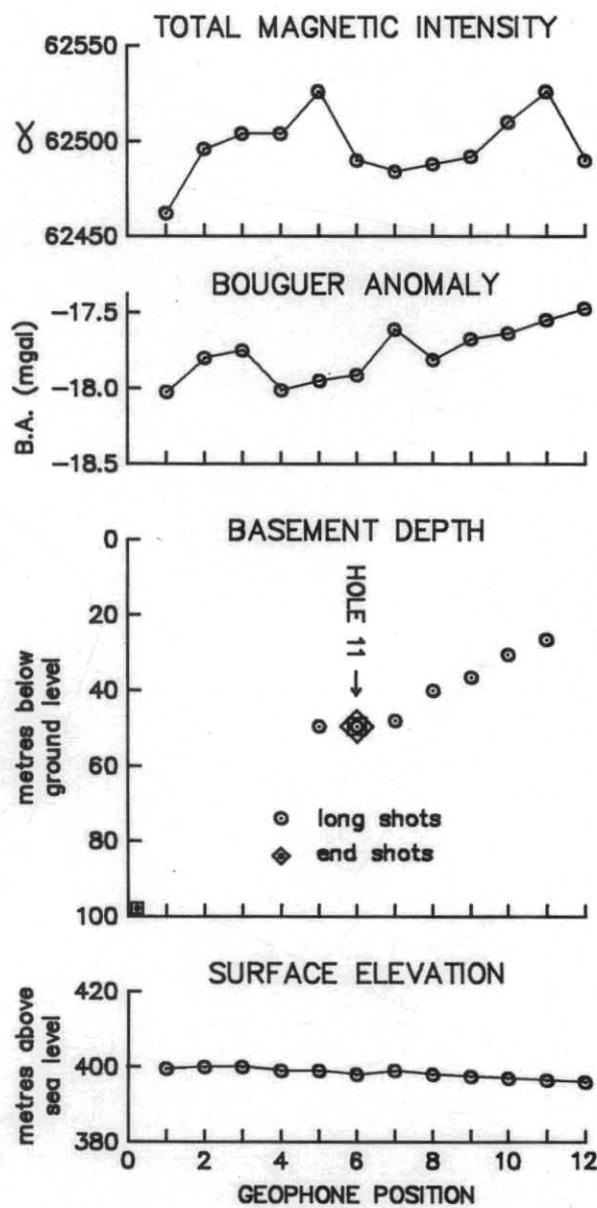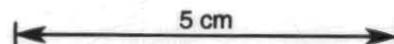
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