

1985/26. Geophysical surveys over the Ocean Beach magnetic anomaly,
western Tasmania

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Abstract

Magnetic, seismic and gravity surveys over the Ocean Beach magnetic anomaly show the anomaly source to lie at the foot of, or part way up, the north-eastern margin of the Macquarie Harbour graben. The depth to the anomaly source is 500+ m. A line of outcrops of Siluro-Devonian sediments marks the top of a large basement ridge.

INTRODUCTION

The Department of Mines West Tasmania aeromagnetic survey, flown in 1981, showed a strong positive anomaly in the Ocean Beach area centred on 358 km E, 335 km N (fig. 1). The anomaly has an amplitude of 450 nT and lies in an area of Cainozoic cover, with Siluro-Devonian sediments cropping out two kilometres to the north-east (Corbett *et al.*, 1982). Possible sources for the anomaly include volcanic rocks, ultramafic rocks or dolerite. A preliminary interpretation of the anomaly using half-width methods suggests a source depth of approximately 800-1000 m.

At the request of Dr K.D. Corbett, magnetic, gravity and seismic refraction surveys were performed to cover the anomaly position on the ground and to determine the target type and depth more accurately. The area is covered by sand dunes up to 60 m high with swamps in the lower areas. Prior to the magnetic survey, three access lines (the base line, eastern line and western line on Figure 2) were cut. After ground recovery of the anomaly a nominally north-west/south-east line was cut along the anomaly maximum for access for the seismic survey.

MAGNETIC SURVEY

The magnetic field was measured at 50 m intervals along the cut line using a proton magnetometer. The profiles (fig. 3) reflect the general shape of the aeromagnetic anomaly and show that the seismic line (the southern-most line) runs along the top of the anomaly.

SEISMIC SURVEYS

Two seismic refraction spreads were recorded along the seismic line (the southern-most line) using 30 m geophone spacing and 24 channel recording. The first spread used the reciprocal method with end shots ten metres from the end geophones and long shots 105 m from the end geophones. The velocities recorded were 300 m/sec, corresponding to dry sand to a depth of approximately 12 m and 1550 m/sec, corresponding to water-saturated sand to a depth of approximately 70 m. The velocity below this depth was approximately 1950 m/sec, indicating poorly consolidated material. An additional shot with an offset of approximately 250 m showed no higher velocity material.

The second spread used radio timebreak transmission to allow much greater offsets. Some problems with the radio units prevented use of reciprocal interpretation. Shots were fired 1045 m and 1610 m west of the western-most geophone and 1010 m and 2010 m east of the eastern-most geophone. Critical distance depth estimates show a depth to a refractor with a velocity of 3000 m/sec of 500-700 m.

A third spread, along a bearing of 204 degrees (true) from 358.62 km E 335.67 km N and using a 30 m geophone spacing, showed a refractor with a velocity of 3000 m/sec at a depth of 160-250 m. A second shot with a minimum offset of 1800 m showed the same velocity. It should be noted that the depth mentioned here is at a point north of the northern end of the spread.

A spread recorded on outcropping Siluro-Devonian sediments using a five metre geophone spacing showed a velocity of 3000 m/sec.

GRAVITY SURVEY

Two gravity meters, a Worden 913 and a Sodin 183, were used to provide a general gravity coverage around the anomaly and a detailed coverage of the anomaly (fig. 4). The data have been corrected for drift, latitude, elevation and terrain effects to a radius of 19 km. A density of 2.67 t/m³ was used for all corrections. The datum for the survey was station 6491.9136 at the Strahan airport.

The Bouguer anomaly map (fig. 5) shows a positive anomaly of 17 mgal with a steep negative gradient to the south. The magnetic anomaly lies over this gradient. A regional anomaly calculated by averaging values in a one kilometre radius circle about each gravity station (fig. 6) shows little difference from the Bouguer anomaly plot, suggesting that the negative gradient is the side of a much larger structure. An examination of the State 1:500 000 gravity map shows that this area lies on the northern margin of the Macquarie Harbour graben. A seismic reflection survey along Macquarie Harbour (Womer, 1983) showed a depth to basement of between 490 m and 760 m. Greater depths are possible near the north-eastern margin of the graben.

A south-north profile along 358.2 km E (fig. 7) shows a positive anomaly suggesting a basement ridge. The positive anomaly coincides with the outcrop of the Siluro-Devonian sediments. Measurements of samples from the first 342 m of a drill hole located at 358.28 km E, 335.11 km N show an average wet density of 2.1 t/m³. Two-dimensional models of this profile (fig. 8 and 9) using basement densities of 2.5 t/m³ and 2.7 t/m³ show maximum depths to basement of 1000 m and 600 m respectively. The corresponding depths to basement at the drill site are 370 m and 230 m.

CONCLUSIONS

The combined geophysical surveys have shown that the Ocean Beach magnetic anomaly lies at the foot of, or part way up, the slope of the north-eastern margin of the Macquarie Harbour graben. The depth to basement at the drill hole is a minimum of 500 m from the seismic refraction data, and 230 m to 370 m from the gravity data. In view of the sensitivity of the gravity interpretation to changes in density, the depth of 500+ m from the seismic data is preferred until additional density control becomes available. The presence of a significant mass of magnetic intrusives or extrusives will increase the depth estimates.

REFERENCES

- CORBETT, K.D.; RICHARDSON, R.G.; COLLINS, P.L.F.; GREEN, G.R.; BROWN, A.V. 1982. The 1981 West Coast aeromagnetic survey : summary of information and results. *Unpubl.Rep.Dep.Mines Tasm.* 1982/39.

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WOMER, M.B. 1983. Final report, E.L. 5/75 - Tasmania. *Unpubl.Rep.Amoco Aust.Petroleum Co.* [open file TCR 83-1981].

[23 May 1985]

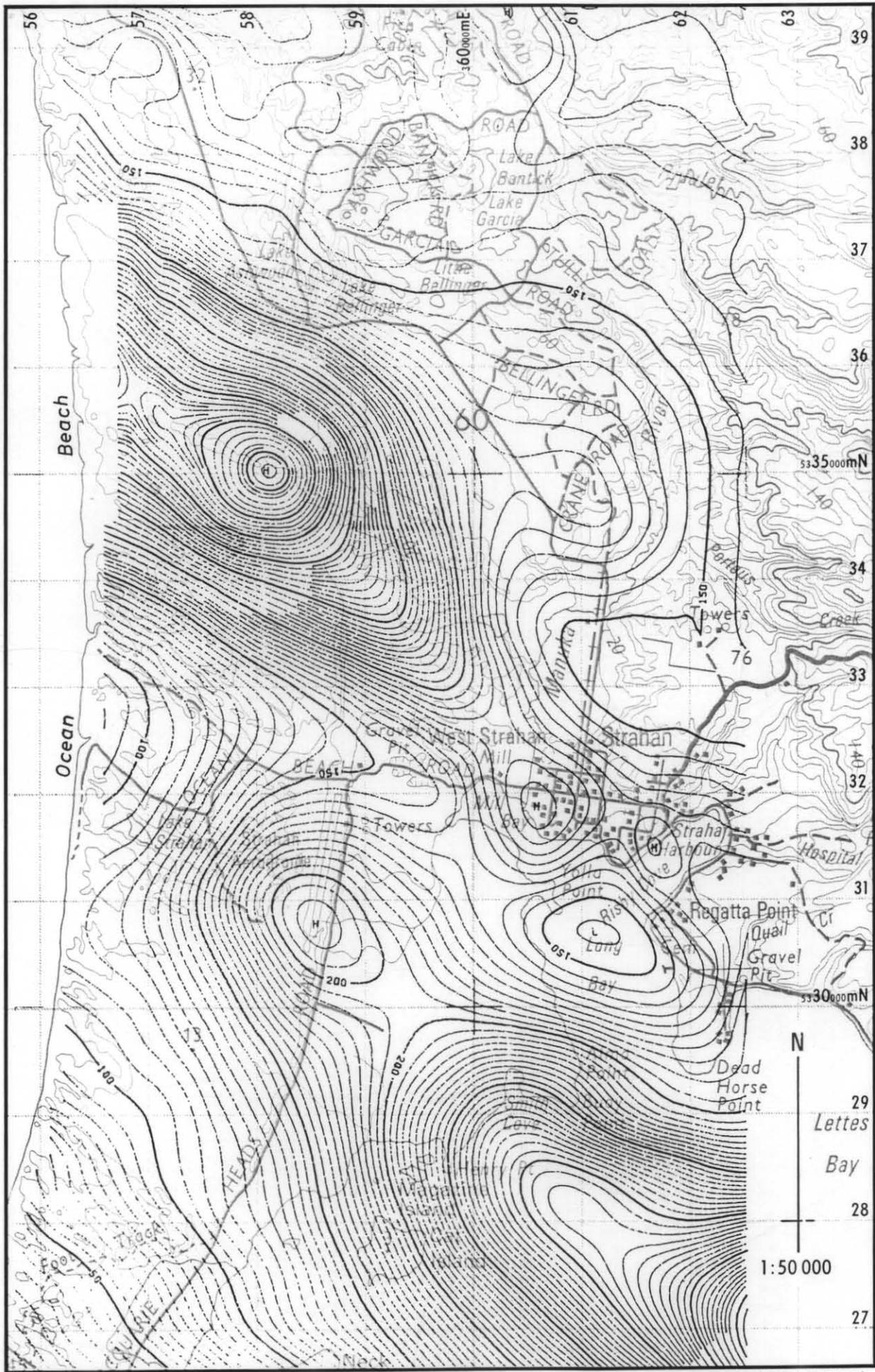


Figure 1. Topography and aeromagnetic contours

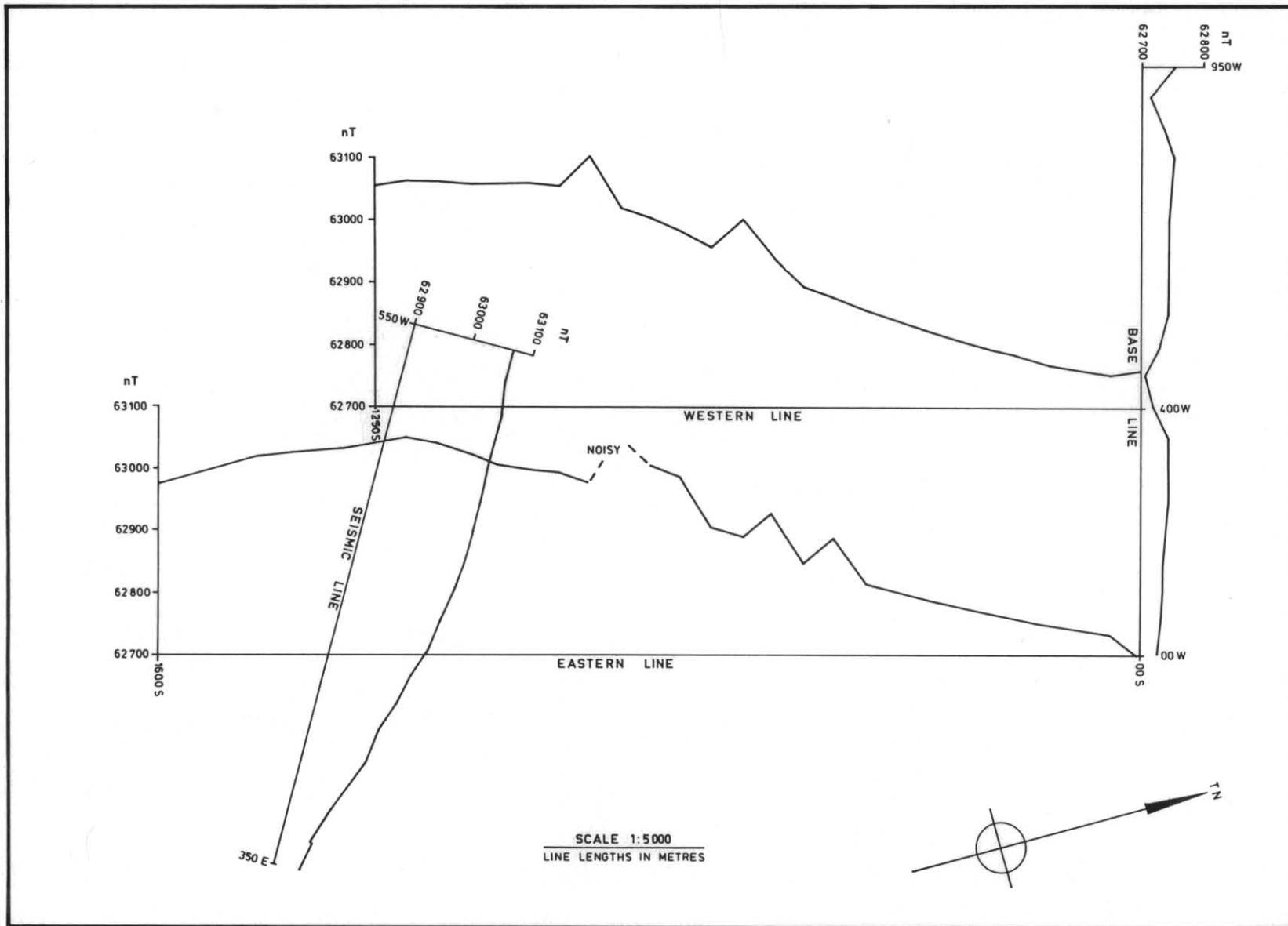
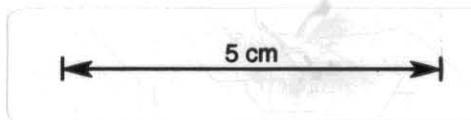


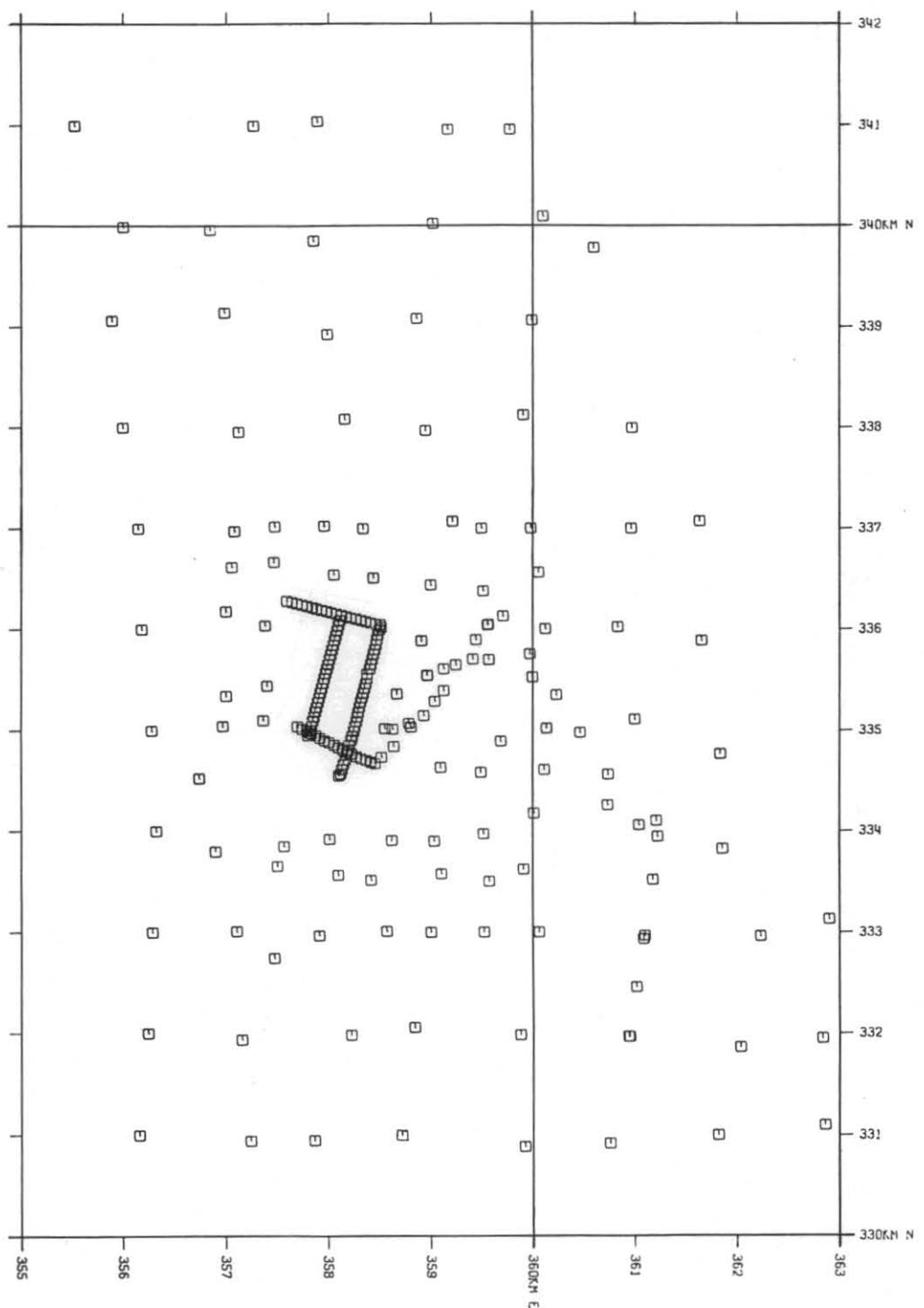
Figure 3. Magnetic profiles along cut lines.

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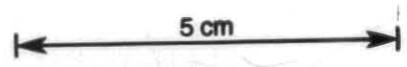


Figure 4. *Position of gravity stations*

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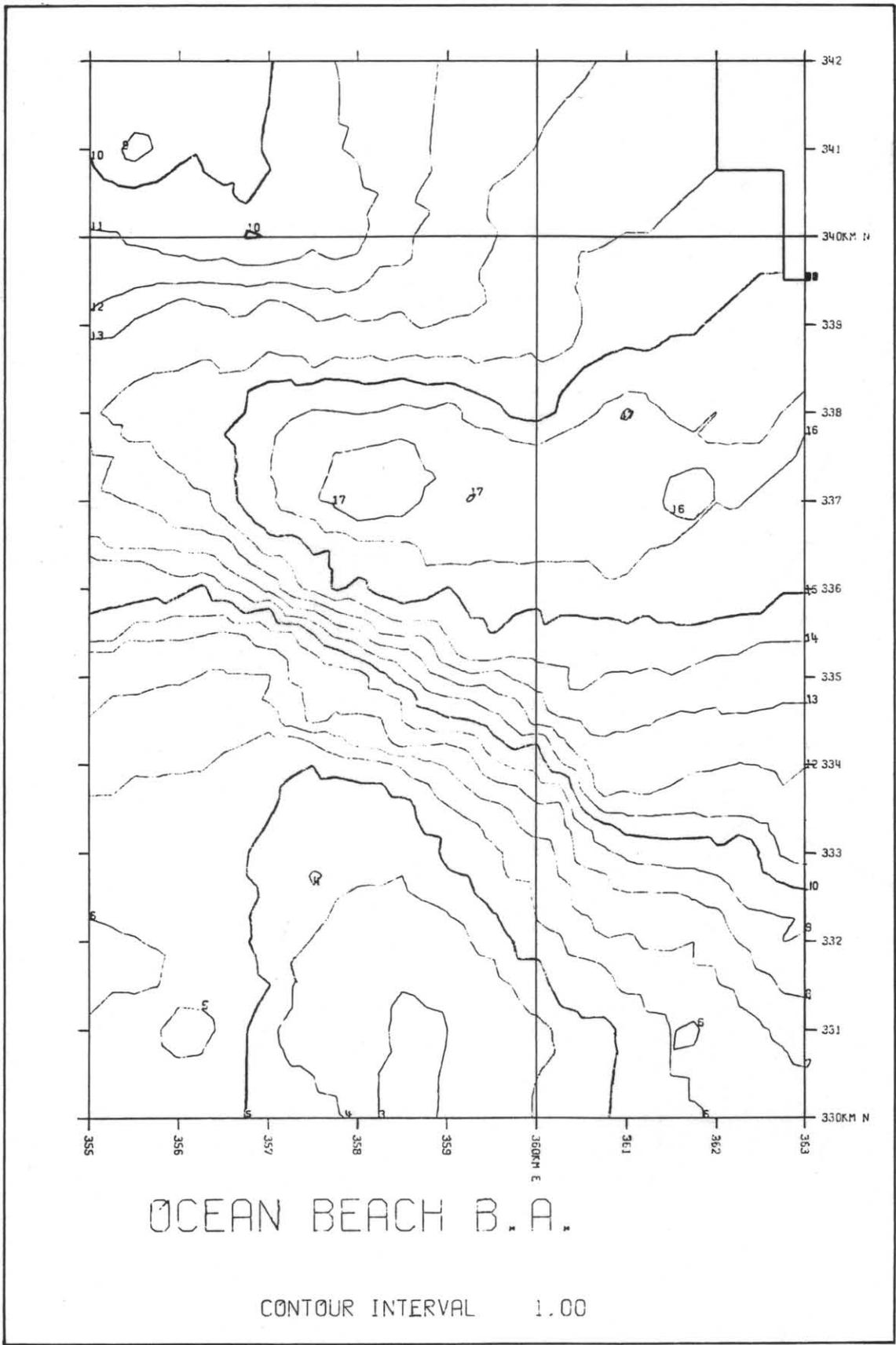


Figure 5. Bouguer anomaly, Ocean Beach. Contours in mgal.

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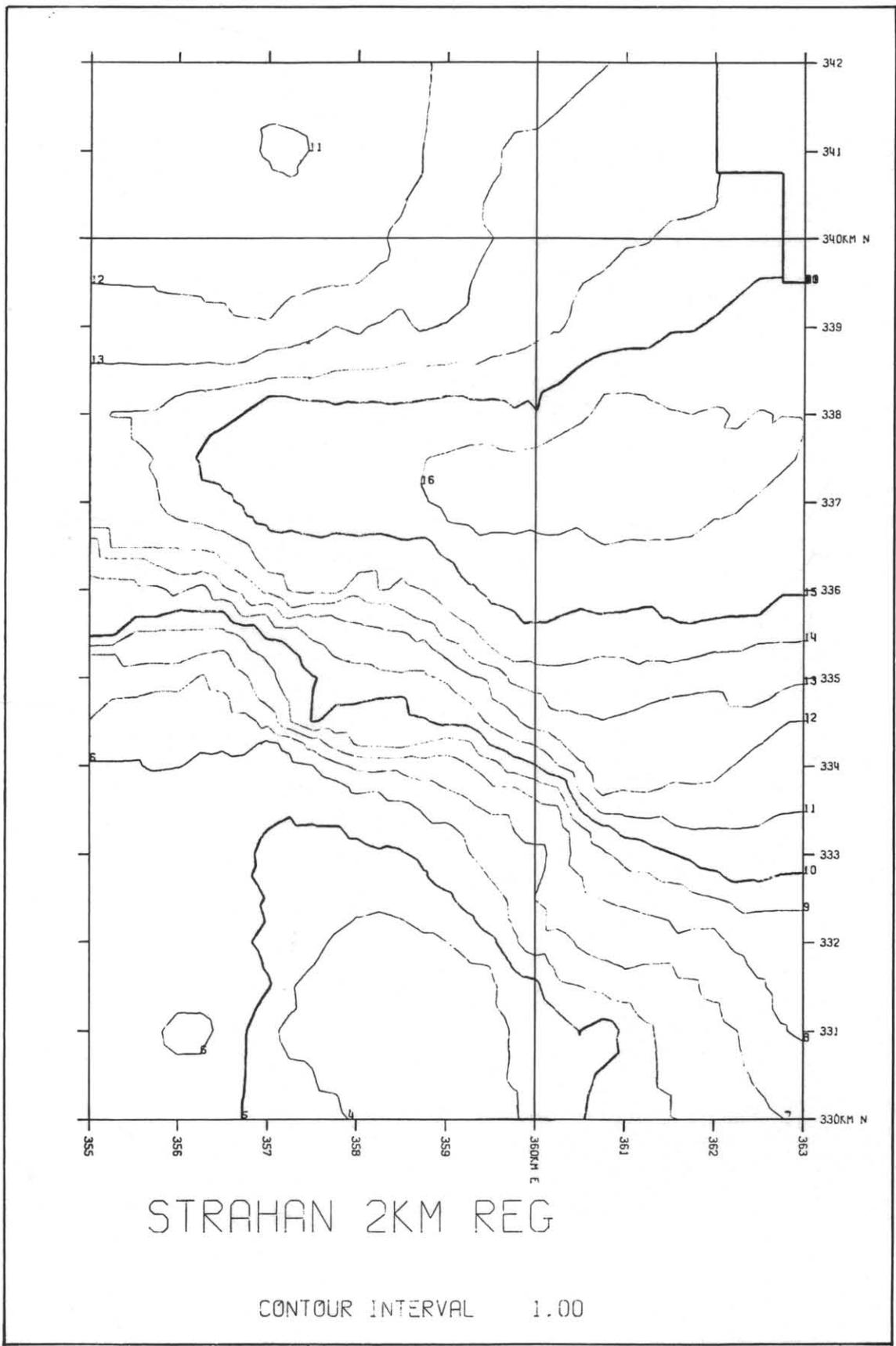


Figure 6. Two kilometre regional anomaly. Contours in mgal.

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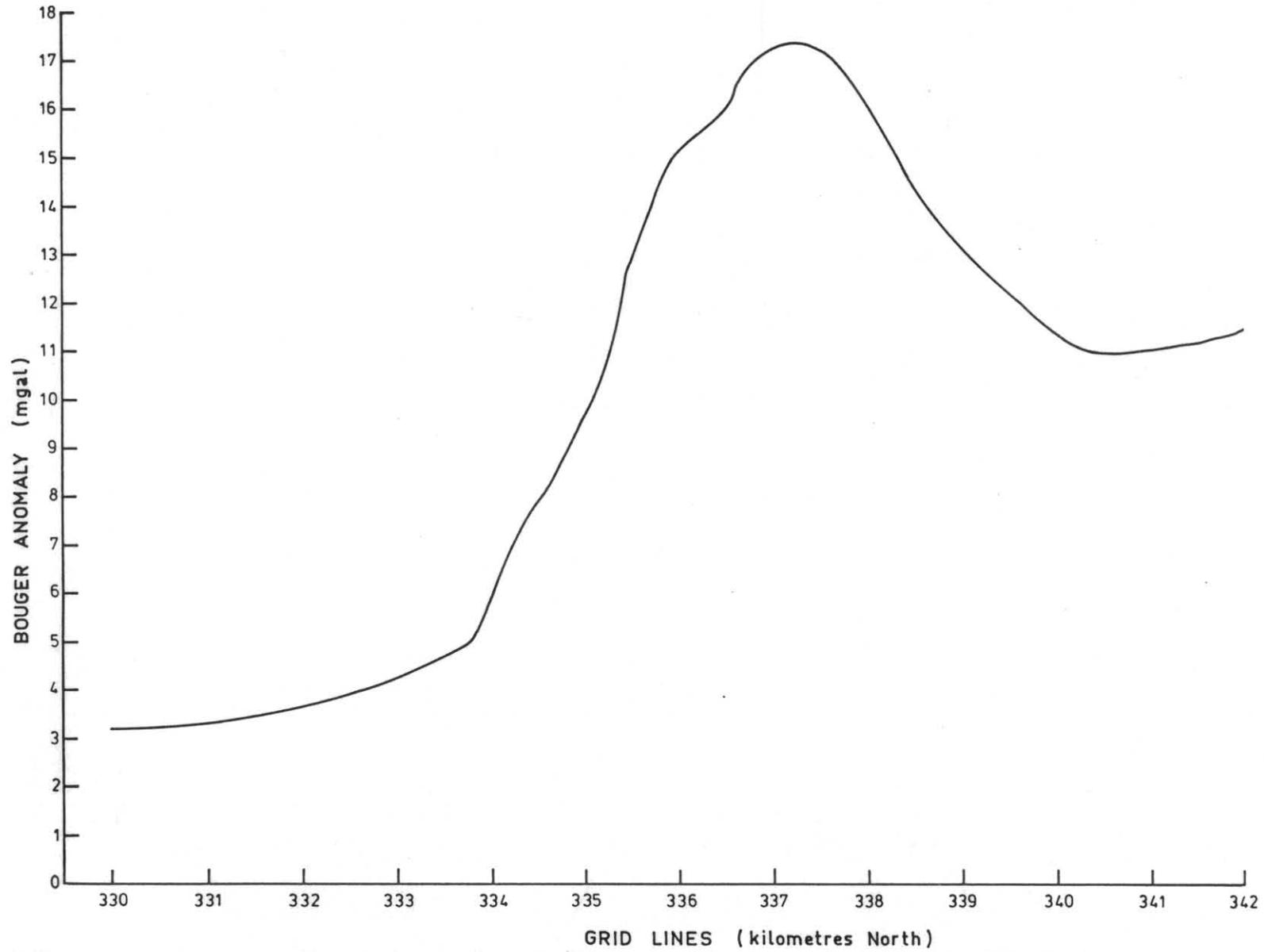


Figure 7. Bouguer anomaly profile along line 358.2 kmE.

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358.2 km E

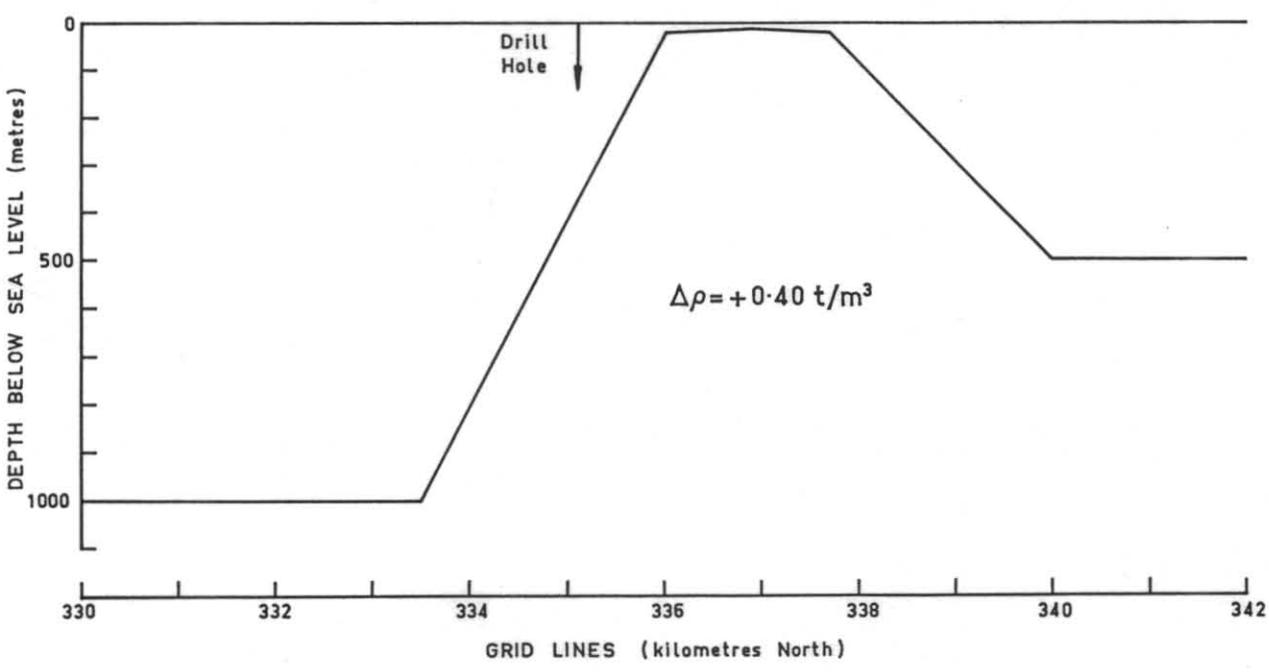
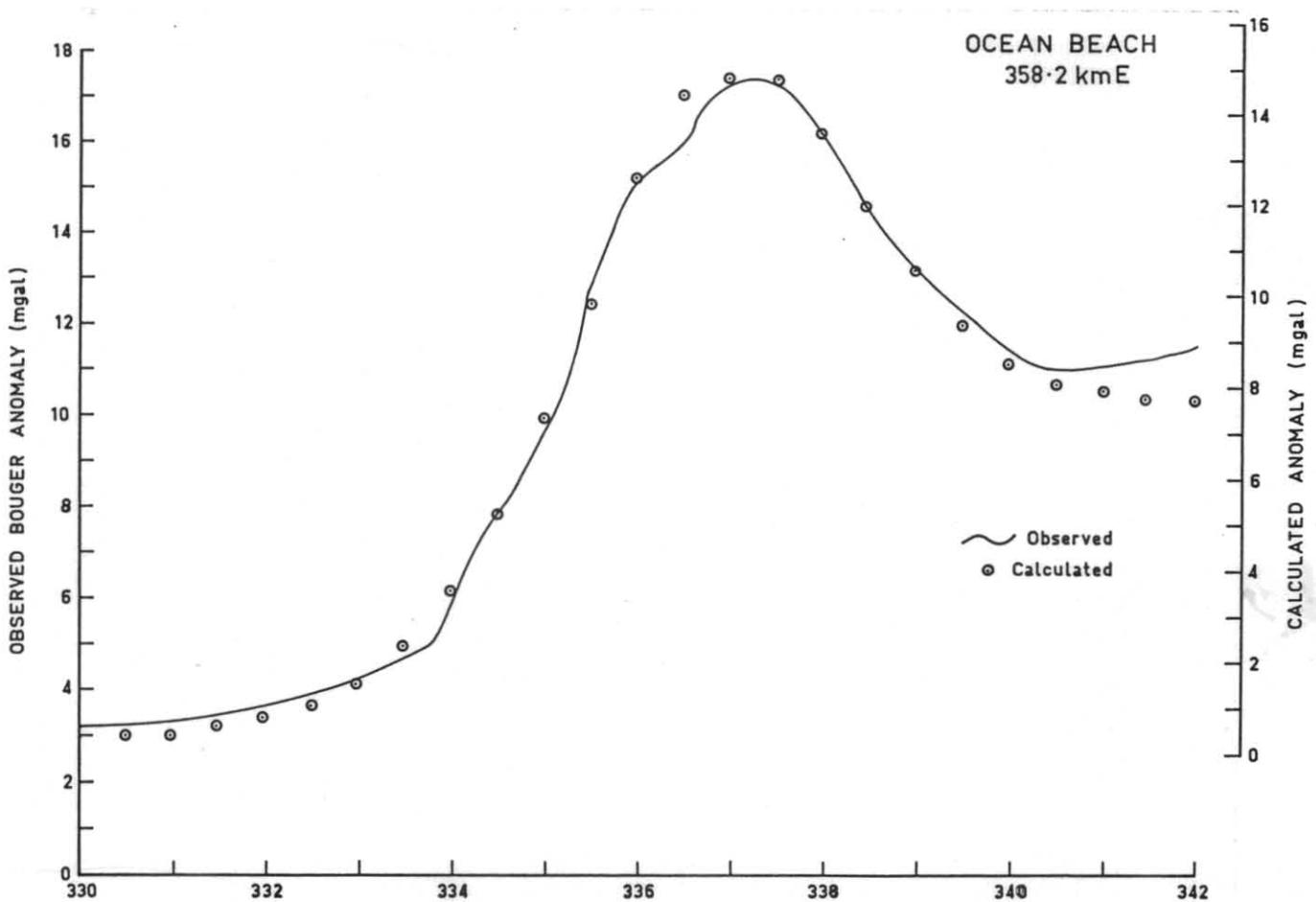


Figure 8. Calculated and observed anomaly profiles and model for $\Delta\rho = 0.40 \text{ t/m}^3$.

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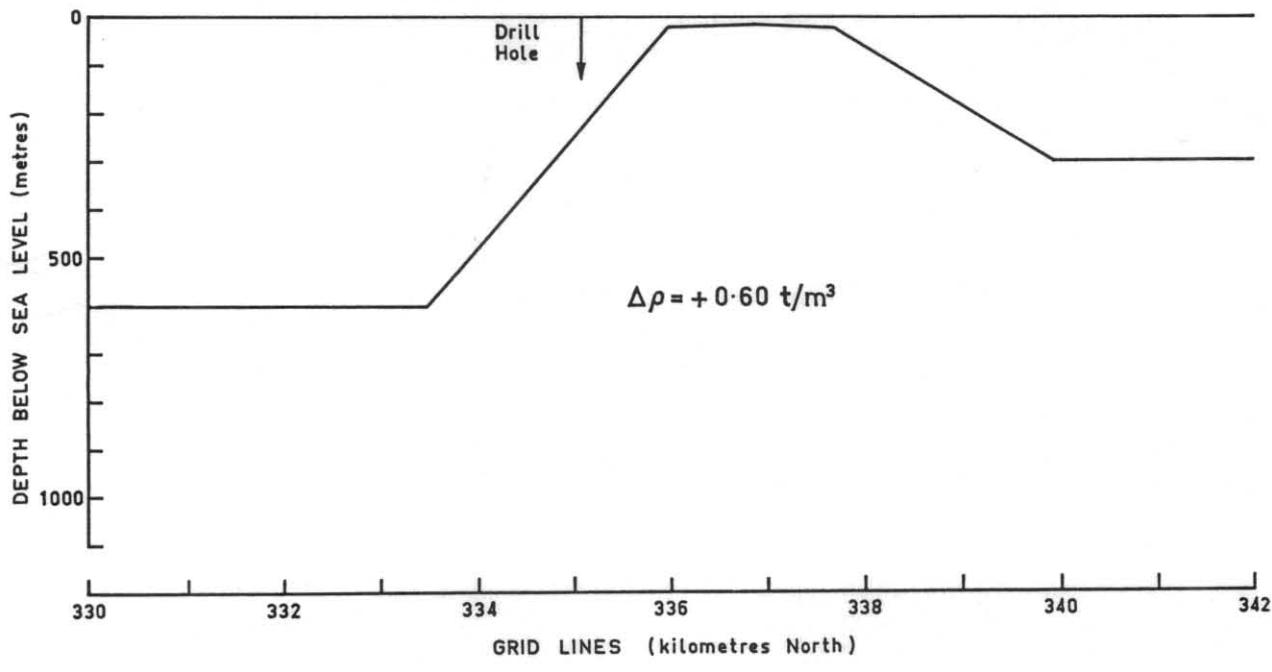
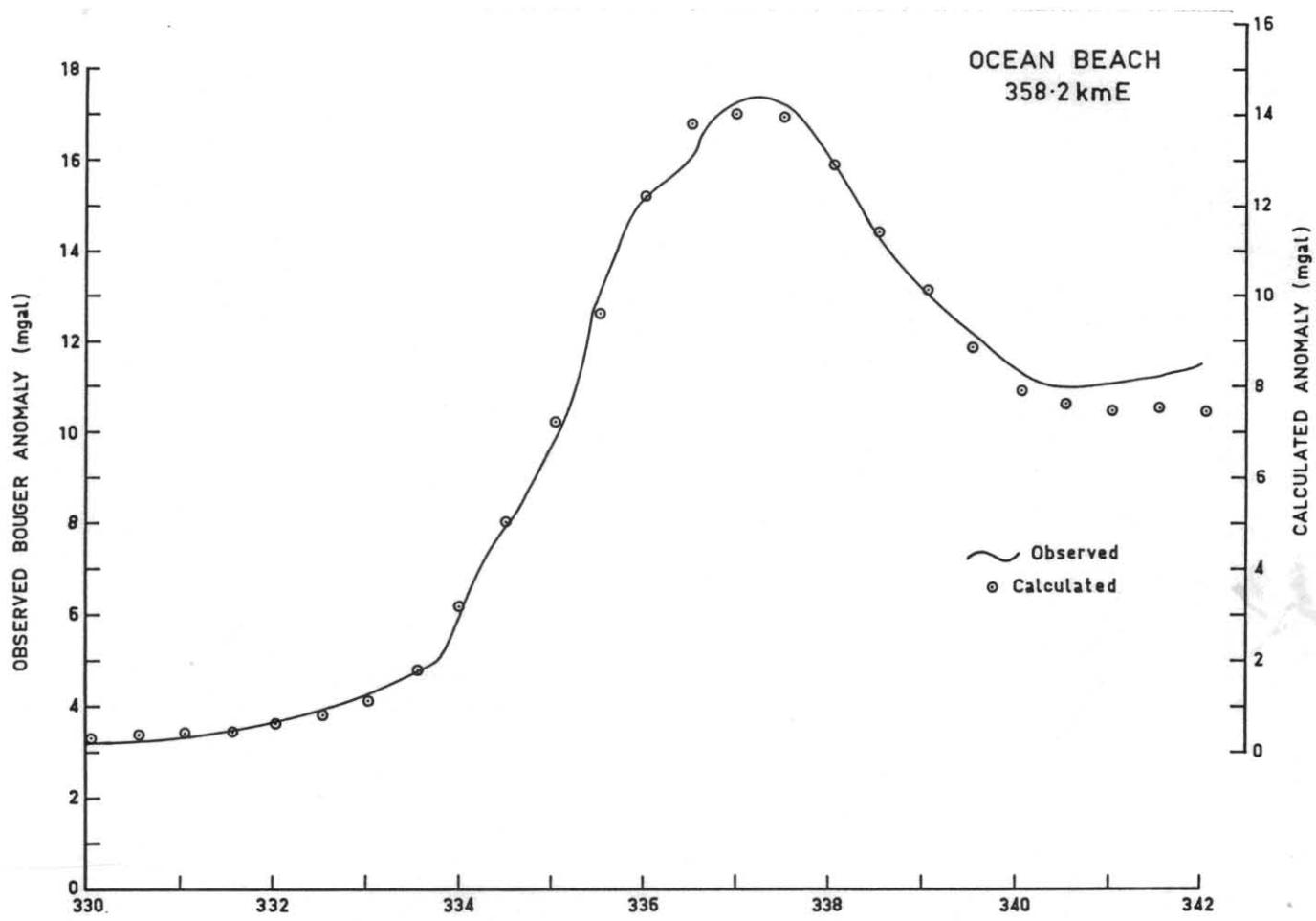


Figure 9. Calculated and observed anomaly profiles and model for $\Delta\rho = 0.60 \text{ t/m}^3$.