# DETAILED MAGNETIC AND GRAVITY SURVEYS OF PART OF THE NORTH FALLIÈRES COAST OF GRAHAM LAND

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ABSTRACT. Detailed magnetic and gravity surveys are described for the area of McClary, Todd and McMorrin Glaciers, north Fallières Coast of Graham Land. Contoured magnetic field and Bouguer anomaly values are given.

GRAVITY surveys have been carried out intermittently along the fjord coastline of northern Marguerite Bay since the initial reconnaissance in 1963 (Kennett, 1965*b*; Smith, 1973). The present paper discusses a more detailed total magnetic field and gravity survey carried out by the author in 1972–73 for an area of the hinterland to the south of Square Bay (Fig. 1.) The area is dominated by three west-flowing glaciers, McClary, Todd and McMorrin Glaciers, which flow from below the Graham Land plateau between steep, sub-parallel ridge systems.

## GRAVITY SURVEY

A Worden Master gravimeter (No. 743) was used for the survey and values were measured relative to the base station at Stonington Island, for which the accepted value of 982·5094 cm. sec.$^{-2}$ was adopted (Kennett, 1965*a*). A gravity tie-flight linked the Stonington Island values to a base on Todd Glacier, thereby minimizing instrumental drift. From this, secondary base stations were established and their frequent re-occupation enabled further drift control.

The problems associated with Antarctic gravity surveys using dog-sledge transport have been previously discussed (Butler, 1975). However, the present work did not suffer from all of the shortcomings usually encountered. An accurate 1:50,000 contoured map was available for the surveyed area, together with a relatively close distribution of permanent traverse stations with heights determined to an accuracy of $\pm 1$ m. The elevations of three focal points in the gravity network were obtained by theodolite resection on to known traverse station heights, and the occupation of selected traverse stations themselves enabled correction to be made for misclosures. Other station heights were determined using two Baromec precision aneroid barometers in conjunction with a field barograph, the latter operating within the area to provide a continuous pressure reference. The estimated error in the gravity station elevations is $\pm 4$ m. with a standard deviation of $\pm 2{\cdot}2$ m. Assuming an average crustal density of 2·67 g. cm.$^{-3}$, this corresponds to a maximum error in the elevation correction of $\pm 1{\cdot}2$ mgal.

All gravity readings were taken on rock, which in this area incurred the unavoidable penalty of large terrain effects. Where possible, station localities were selected to minimize these effects and terrain corrections were applied for the above-ice topography up to a range of 5 km. Terrain correction values averaged 3·5 mgal and it is estimated that they are accurate to within 10·5 mgal. Topographic effects beyond 5 km. have been ignored as it is estimated that they contribute less than 1 mgal. More important, however, is the effect of local sub-ice topography and, as ice thicknesses are generally unknown in the area, there may be additional errors of up to an estimated 2 mgal. For the majority of stations, the error in the Bouguer anomaly values is considered to be less than $\pm 2{\cdot}6$ mgal.

## MAGNETIC SURVEY

Total-field measurements were made with an Elsec proton-precession magnetometer using a station spacing of 0·5 km. unless an emerging feature prompted smaller intervals. The magnetometer was warmed overnight and during the survey it was transported in a thick thermal insulation. This maintained the internal temperature above $-10$°C, below which the accuracy of the crystal oscillator could not be guaranteed. The magnetic traverses were planned to cross

obliquely the geological strike where known. Wherever possible, readings were tied to a temporary base at the beginning and end of each day thus giving some diurnal control. The standard deviation in the field readings due to diurnal variation is estimated to be less than $\pm 8$ gammas.

## Discussion

Reconnaissance geological investigations in this area (personal communication from A. C. Skinner) have indicated that an *ortho*gneissic basement predominates both to the south, along Butson Ridge and Boulding Ridge, and to the east, forming the mountaings immediately west of Swithinbank Glacier. This basement is intruded by granites which crop out extensively at Cape Calmette and around the head of McMorrin Glacier. There is a single outcrop of diorite at the western end of Boulding Ridge.

The Bouguer gravity values have been contoured at an interval of 5 mgal (Fig. 1) and they show little variation over the area apart from an apparent south-easterly decrease across Butson Ridge. This feature may partially reflect an inadequate compensation for sub-ice topography but estimates for the depths of ice in McClary and North-east Glaciers (Smith, 1973) suggest that the contribution is unlikely to affect the anomaly pattern. More detailed geophysical evidence on the anomaly is required before any interpretation is attempted.

The magnetic field contours indicate no obvious reflection of the regional trend, which the International Geomagnetic Reference Field over the area shows to increase at approximately 8·4 gammas/km. to the south-west. The considerable 4,500 gammas anomaly (Fig. 1) around the western end of Boulding Ridge correlates with an outcrop of diorite exposed higher on the ridge. Its steep gradient over 0·5 km. implies that the structural contact of the dioritic rock with the country rock is near vertical. The other notable anomalies are all located over ice. They are characterized by similar parameters having 1,000–1,500 gammas amplitudes, some 2–3 km. in extent and with a lenticular shape.

## Acknowledgements

I should like to thank R. Bostelmann and S. Wormald for their invaluable assistance in the field, and Professor D. H. Griffiths, Department of Geological Sciences, University of Birmingham, for his criticism of the manuscript.

*MS. received 21 January 1977*

## REFERENCES

Butler, P. F. 1975. A linear Bouguer anomaly in central Alexander Island. *British Antarctic Survey Bulletin*, Nos. 41 and 42, 147–50.

Kennett, P. 1965*a*. Revision of gravity links between South America and the Antarctic. *British Antarctic Survey Bulletin*, No. 7, 25–28.

———. 1965*b*. Reconnaissance gravity survey of the Fallières and Loubet Coasts, Antarctic Peninsula. *British Antarctic Survey Bulletin*, No. 7, 43–46.

Smith, I. F. 1973. Gravity survey in northern Marguerite Bay, Graham Land. *British Antarctic Survey Bulletin*, No. 36, 115–21.