A MAGNETIC SURVEY OF THE ARGENTINE ISLANDS, GRAHAM LAND

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SURVEY PROCEDURE

The magnetic survey was undertaken in 1960 by H. E. Agger and in 1961 by I. Preece, in order to provide magnetic coverage of the area surrounding the British Antarctic Survey geomagnetic observatory (Argentine Islands, A.973) on Galindez Island. A trigonometrical survey was carried out at about the same time, so that wherever possible the magnetic stations could be located relative to the triangulation points. In this way the positions of the stations could be determined to within 10 yd. (9 m.). Altogether 50 stations were occupied, at each of which readings of the vertical component of the geomagnetic field were taken with B.M.Z. No. 110. These readings were referred to an arbitrary zero at a base station situated 35–40 yd. (32–37 m.) south-east of the geomagnetic observatory. The survey was planned to have a regular station spacing of 1,094 yd. (1 km.) but practical considerations necessitated considerable departures from this ideal. The instrument was specially designed for field work and it was normally dismantled for transport between stations. Because the instrument was carefully packed, risk of damage was eliminated and there was no appreciable error in the readings. The instrument was usually transported by man-packing but it was sometimes carried on a small dog sledge constructed specially for this purpose. All the readings have been corrected for diurnal variation of the magnetic field and for instrumental drift. The accuracy of the reduced value of the field at any station is estimated to be ± 2 gammas. These values have been plotted on a map of the area (Fig. 1), on which are also drawn contour lines of equal intensity of the magnetic field. A positive value of the field indicates an increase in the vertical (upward) component of the geomagnetic field relative to that at the base station. The expected mean gradients in the vertical component are: north–south, an increase (upwards) of about 5 gammas/km. proceeding southwards; east–west, an increase of about 1·5 gammas/km. proceeding westwards.

The mean field for 1960 was: H, 23,330 γ; D, 17°06·9′ east of north; Z, 36,664 γ upward.

INTERPRETATION

Inspection of the contour map (Fig. 1) indicates a clear distinction between the variation of the field over Galindez, Skua and Winter Islands, and that over Grotto Island. It appears that the boundary is marked by a line drawn through the length of Meek Channel. To the south of this line, apart from one anomalous station near the prominent rock ridge at the western end of Skua Island, the field variation is relatively small and regular with no marked features other than a contour trend north-east to south-west. In contrast, the field over Grotto Island is complex, with large and irregular changes from one station to the next. The fluctuations are so great that a much more detailed survey of the island is needed in order to work out the pattern of the field with precision. The present data are sufficient to show two main features running across the northern and southern halves of the island. The southern feature is elongated roughly east–west, and is comparatively sharp. It is best visualized on profile B—B′ (Fig. 1) and consists of a sharp "peak" 100 yd. (91 m.) to the north of a weaker, broader "trough". Such an anomaly can be interpreted in terms of a model consisting of a uniformly magnetized horizontal cylinder, i.e. equivalent to a line of dipoles. The best fit was obtained (Fig. 1, profile B—B′) with a cylinder magnetized in a direction inclined at 72° upward and having its axis 200 ft. (61 m.) below the surface. On the basis of this fit of the model to the observed anomaly it can be inferred that the geological body producing the anomaly is centred at a depth of 200 ft. (61 m.), which provides an estimate of the maximum depth to its top. The body, although elongated roughly east–west is equidimensional in cross-section with a diameter of no more than 400 ft. (122 m.). This means geologically either an

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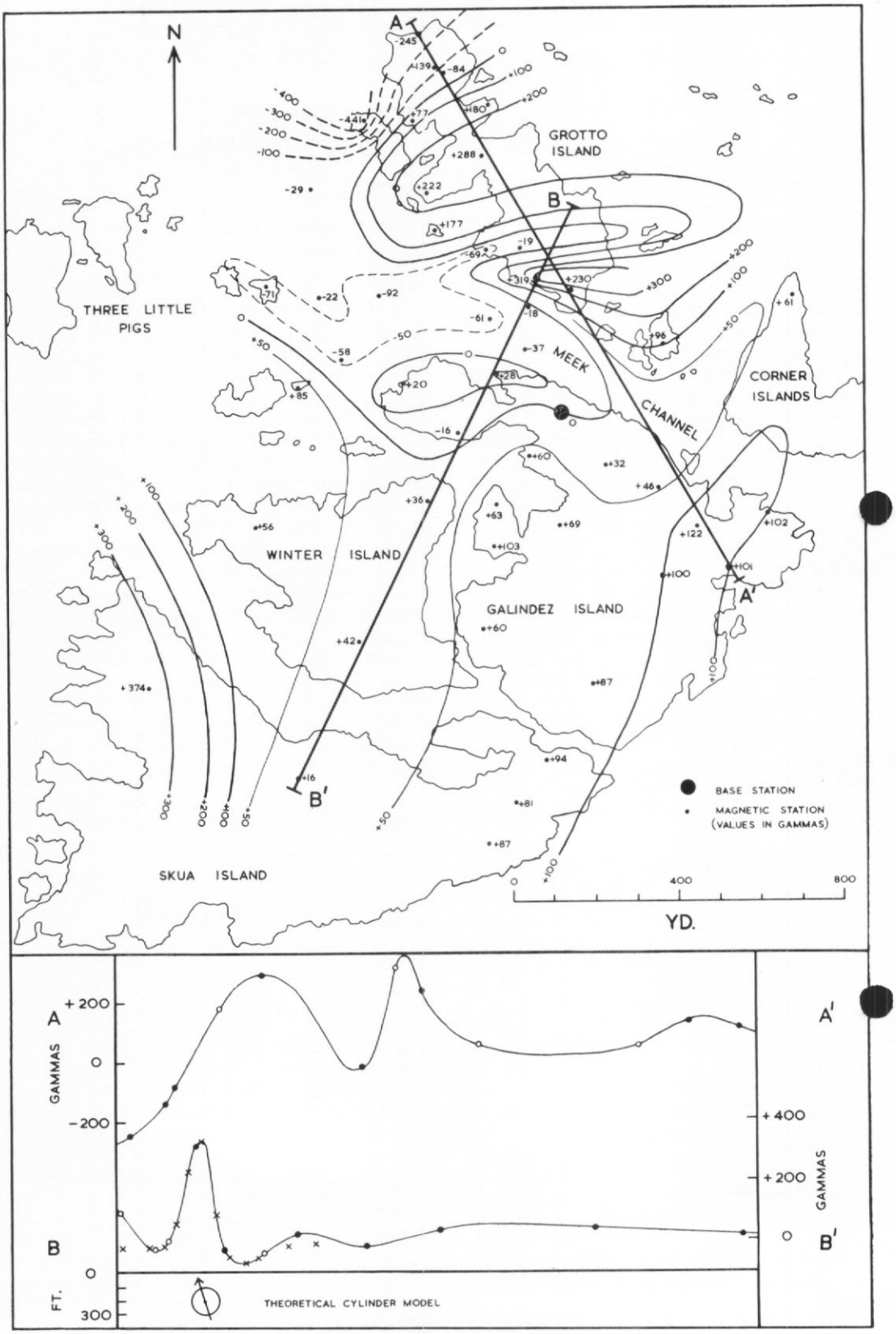

Fig. 1. Map of the Argentine Islands showing variations in the vertical component of the Earth's magnetic field. Contours are in gammas relative to the arbitrary base-station value of zero. Profiles A—A′ and B—B′.

- ● Values from stations on the line of profile.
- ○ Values from contour lines or nearby stations.
- × Theoretical values calculated for the horizontal cylinder model indicated.

isolated body or a topographic feature of these proportions rising from a much larger body with a roughly horizontal top surface. The area of cross-section of the body is inversely proportional to the intensity of magnetization, which must have a minimum value of 6×10^{-4} c.g.s. units, implying a minimum susceptibility of $1 \cdot 2 \times 10^{-3}$ c.g.s. units. The surface geology of the Argentine Islands has been studied recently in the field by G. J. Roe and in the laboratory by D. H. Elliot (in press), who have observed that Galindez, Skua, Winter *and* Grotto Islands are all composed of the Upper Jurassic Volcanic Group. The rocks on all these islands are essentially part of a single volcanic suite of interbedded andesite lavas and dacite tuffs. Tertiary dykes trending north-west to south-east cut across all these islands and though some of them are fairly basic (and therefore likely to be strongly magnetic), the majority are of intermediate composition. There are thus no surface features on Grotto Island that can explain the observed magnetic anomalies; the body producing the southern feature must be at some depth and hence have a susceptibility greater than the minimum value mentioned above. This lies within the range of values obtained from measurements of specimens of the Andean Intrusive Suite of The Barchans but it is rather high for the Upper Jurassic volcanic rocks of the area. The conclusion that the magnetic anomaly arises from the presence of an Andean intrusion at a shallow depth below Grotto Island must, however, be considered as very tentative, since it is based entirely on observations at only five stations. The inclination of the magnetization needed for the cylinder model is greater than the observed present field direction by 15° and it may be surmised that the anomaly results from remanent as well as induced magnetism in the body.

The northern anomaly on Grotto Island is elongated approximately north-east to south-west and it is also roughly perpendicular to the length of the island and parallel to linear coastal features that suggest faulting. This anomaly is considerably broader than the southern one but it is of comparable magnitude (Fig. 1, profile A—A′). Unfortunately the northern part of this feature, which must extend across the sea north-west of the island, is undetermined. It is not possible to make any quantitative interpretation of this anomaly but as it is clearly similar in form to the southern one it may be presumed to arise from a similar cause. It may also be presumed that this body is wider, in order to produce the broader anomaly, rather than deeper, because the magnitudes of the anomalies are similar.

Despite some tentative interpretation of two anomalies over Grotto Island in terms of the presence of Andean intrusive rocks, an explanation of the contrast between these and the magnetically featureless islands to the south remains outstanding. Furthermore, any explanation of the magnetic anomalies must be given in terms of the structure of the Argentine Islands as a whole and it is not known at present to what extent the anomalies are determined by the presence of Andean intrusive rocks or to what extent they are influenced by later Tertiary structure or movement. These questions could probably be resolved by further survey work. For example, a survey of the Three Little Pigs would help to establish the boundary purported to run along Meek Channel or to indicate, by the presence of strong anomalies, the proximity of Andean intrusive rocks, which crop out on The Barchans nearby. Some stations on The Barchans themselves or on the Forge Islands where Andean intrusive rocks also crop out would help to indicate the extent of the magnetic anomalies associated with these rocks. Certainly a more detailed survey of Grotto Island is essential to a more precise interpretation of the anomalies that have been observed there, and if stations can be occupied on sea ice or on some of the tiny islands to the north-west and north-east of this island the full extent of the anomalies may be determined. The present magnetic survey has already shown indications of the structure of the Argentine Islands. It has given a hint that Meek Channel marks a discontinuity, perhaps a major fault, crossing what appears to be the main north-west to south-east structural trend that is followed by the elongation of the magnetic contours and by the predominant trend of the Tertiary dykes. The survey has raised more questions than it has solved and any extension of it must surely be very fruitful.

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REFERENCE

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