

Communications of the
Dublin Institute for Advanced Studies
Series D, Geophysical Bulletin No. 27

Magnetic Map of the Ardara Granite and Southern County Donegal

by

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DUBLIN
THE DUBLIN INSTITUTE FOR ADVANCED STUDIES
1969
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1912

MAGNETIC MAP OF THE ARDARA GRANITE AND SOUTHERN COUNTY DONEGAL

INTRODUCTION

The present work is essentially divided into two parts, a detailed survey of the Ardara granite pluton and a 'regional' survey with stations at approximately 1 mile spacing which covers the remainder of Co. Donegal south of Ardara and Glenties.

The purpose of the first part was to delineate the magnetic anomaly pattern of the Ardara granite so as to provide a comparison with an unique magnetic anomaly to the north-west of Malin Head (Riddihough, 1968). Work by King (1966) in association with magnetic fabric investigations, indicated a decreasing intensity of magnetisation of the rocks of the pluton towards its centre which suggested that an anomaly consisting of high values surrounding a 'low' might be present.

The regional survey of the area to the south was carried out to discover the general magnetic character of the Dalradian succession and to see if any correlation of magnetic anomalies with the faulting pattern (particularly the Leannan Fault, Pitcher et al., 1964) was apparent. The overlapping of the Aeromagnetic Survey of Great Britain and Northern Ireland, Sheet 7, provided an invaluable continuation of the picture in the Lough Derg area and a check on the relative levels of the two surveys.

DATA COLLECTION AND REDUCTION

Total field magnetic readings were taken with Elsec Proton Magnetometers by the author and Dr. D. G. G. Young during the summers of 1967 and 1968. Values assigned to the stations were the mean values of three readings taken approximately 10 m apart with corrections for distance from the vehicle where necessary. On the map an attempt to show the variability of these three readings has been made by the use of symbols to represent their range or 'noise'.

Diurnal variations were removed by subtracting simultaneous readings at Valentia Observatory and a regional slope was removed in accordance with the IGS, London (see Riddihough, 1969).

Consideration of the overlapping areas of the present survey and Aeromagnetic Sheet 7, from Barnesmore south to Ballyshannon, showed that a secular adjustment of -50 gamma had to be made to the present survey to bring the two surveys to the same reference level (see Section 3.5 last ref.). A possible error of ± 15 gamma can be assigned to individual stations, contours at 50 gamma intervals are therefore drawn as solid, those at 25 gamma being dotted and not everywhere significant.

FEATURES OF THE MAP

1. *Ardara Granite*

The geological outcrop of the Ardara Granite corresponds with a magnetic anomaly which is characterised by an annular 'high' surrounding a central flat area. The 'high' reaches an amplitude of 150 gamma and is most marked on the northern and western sectors of the intrusion where its peak is seen to correspond with the Outer Tonalite of

Akaad (1956). In the eastern sector it is reduced in amplitude but on the south becomes somewhat discontinuous with large negative values which may indicate a remanent magnetisation. Further susceptibility samples measured at the Institute confirm a picture of reducing intensity of magnetisation from the tonalite (susceptibilities $500-1000 \times 10^{-6}$ emu/cc) to the central granodiorite ($30-50 \times 10^{-6}$ emu/cc). Minor details such as the narrowing of the tonalite near Maas are also magnetically evident.

2. *Broad Structure of the Area excluding Ardara*

An important feature of the regional map is that the noise level of the majority of the stations is not high. This means that in general, the rocks outcropping at the surface are only weakly magnetic. The lack of any magnetic contrast at the overlap of the Carboniferous onto the Dalradian in the Bruckless-Inver area indicates that both successions are probably essentially non-magnetic.

This conclusion implies that the cause of the main magnetic pattern in the area south of Ardara must be beneath the exposed Dalradian. Thus the 'low' trough which runs from Glencolumbkille to Ardara and the broad 'high' running from Killybegs to Glenties with the south-easterly slope into the 'low' of the Donegal area, can be interpreted as either due to intrusive features at considerable depth or the topography of a magnetic substratum. An apparently preferential location of smaller 'highs' within the broad belt may be of diagnostic importance; suggesting, if they are due to bodies within a magnetic substratum, that a depth estimate might be feasible. With the present station spacing however, estimates can only indicate that sources are not at depths of greater than 2000 m. Contrarily, with regard to intrusive features, there is some evidence, for instance near Killybegs, that the smaller 'highs' coincide with areas of epidiorite intrusions in the surface geology. The 'high' at Carrick, with extremely noisy stations, is clearly related to the immediate surface geology but lies slightly north of the Killybegs-Glenties ridge.

Finally from the present readings, this system of ridges and troughs appears to terminate northwards along a line running NW-SE from Maas to Barnesmore. If real, this could represent an important structural discontinuity.

3. *Leannan Fault*

The line of the Leannan Fault as discussed by Pitcher et al. (1964), from near Lough Ea in the north of the map to its last exposure at Lough Croagh, 4 miles north of Bruckless, seems to coincide with some form of magnetic discontinuity. In particular, the section from near Tamur Lough to Lough Croagh corresponds with a small magnetic 'low' and with a parallel lineation in the magnetic contours. A continuing linearity in the 25 gamma contour south of Lough Croagh may be associated with the fault and could repay further investigation. Its course runs SSW and emerges in St. John's Peninsula.

4. *Lough Derg Complex*

The Lough Derg Complex (Anderson, 1947) situated within a broad magnetic trough, coincides with a magnetic feature of large amplitude. It is approximately circular in shape and consists of a ring of negative values (-200 gamma) surrounding a central 'high' (approx -75 gamma). The relationship of the magnetic contours to the mapped outcrop of the complex and its metamorphic zones seems to be close, the large negative values possibly resulting from a remanent magnetisation in a direction opposing the present earth's field.

5. Tertiary Dykes

The predominance of strong reversed remanent magnetisation in the Tertiary basic rocks of Ireland permits rapid magnetic determination of their presence. A number of stations showing high noise produced very strong negative values with respect to surrounding areas. In some cases a Tertiary dyke with a presumed reversed magnetisation was geologically evident. In the remainder it is inferred and a thick line at a probable orientation is drawn on the map. On a broader scale, a line of magnetic 'lows' runs NW-SE across the Killybegs-Glenties ridge through Inver and Lough Croagh and may represent some deep Tertiary feature.

Detailed work was carried out along the Blind Rock Dyke (Preston, 1967) and near Inver, the deduced position of unexposed Tertiary dykes being shown as a dash-dot line on the map.

FURTHER INVESTIGATIONS

As with all surveys, there is always room for further work, however three points seem important in this respect:

- (i) The magnetic nature of the Dalradian succession seems to be such that ground magnetic stations are not rendered useless by immediately local variations and that continuation of a regional survey over the rest of Co. Donegal would be extremely valuable.
- (ii) The indications of a magnetic expression of the Leannan Fault suggest that detailed magnetic mapping in the Bruckless area might assist in tracing its continuation beneath the Carboniferous succession.
- (iii) The magnetic anomaly over the Lough Derg Complex is unusual and not easily seen to be consistent with the geology as described. It is worthy of a much closer study with a programme of palaeomagnetic sampling.

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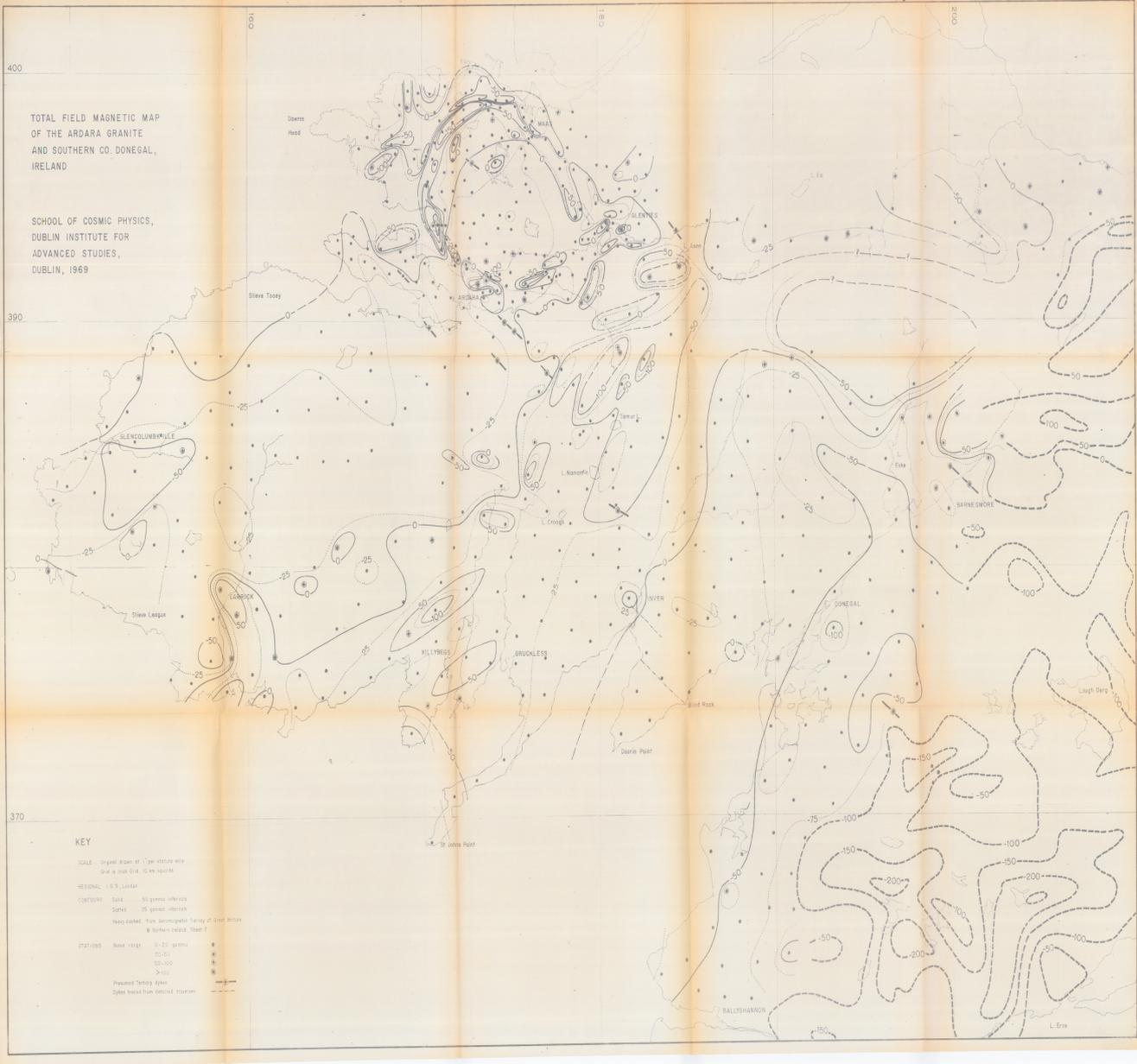
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May, 1969

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TOTAL FIELD MAGNETIC MAP
OF THE ARDARA GRANITE
AND SOUTHERN CO. DONEGAL,
IRELAND

SCHOOL OF COSMIC PHYSICS,
DUBLIN INSTITUTE FOR
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DUBLIN, 1969



KEY

SCALE: original sheet at 1" per statute mile
Grid is based 514, 10 M squares

REGIONAL: U.S.S., London

CONTOURS: 50 gauss intervals

Contours: 10 gauss intervals

Hand shaded from geomagnetic theory of great Britain

Stations: Northern Ireland, Sheet 7

STATIONS: Note range: 0-20 gauss

20-50

50-100

>100

Peaked Territory type

Open based from detailed inspection