GROUND-BASED MAGNETIC PATTERNS ACROSS SELECTED IRISH ROCKS AND STRUCTURES

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Abstract

Magnetic data acquired over a range of lithologies show the following: the Deer Park Complex of Clew Bay exhibits different magnetic characteristics east and west of Croagh Patrick. Very large magnetic signatures (4000–8000nT) occur in the west but the anomalies are significantly lower in the east. In addition, the peak anomaly bounds the northern edge of the Deer Park Complex in the west but the southern edge to the east Lower Palaeozoic volcanics flanking the Leinster Granite yield anomalies of 300nT with a variance of 5–30nT, whereas those in the Kildare Inlier have a variance of 20–100nT and anomalies of 700nT. The background variation in magnetism for the Northern, Upper Liffey Valley and Lugnaquillia Units of the Leinster Granite is 2–5nT (similar to the Lower Palaeozoic sediments into which the granite is intruded) and structures are associated with anomalies of 30nT. The magnetic variance within the Dalradian in County Tyrone is about 5nT and peak anomalies of around 30nT have been obtained. Structures within Tertiary basalts and gabbros produce anomalies of a similar magnitude (1000–2000nT), but the variance for the basalts (300nT) is an order of magnitude greater than the variance of the gabbros. Structures in a range of lithologies (including Carboniferous limestone) exhibit similar magnetic patterns, though the amplitude of the peak anomaly can vary.

Introduction

The application of magnetometry as an aid for deducing geological structure is well known (e.g. Bailey 1974, Hildenbrand 1985; Lee 1987; Morris 1982). In general, this often takes the form of aeromagnetic surveys, where data are typically collected at a flying height of about 300m along 2km-spaced flightlines. A disadvantage of aeromagnetic surveys is that, while the gross structure of a region can be deduced, small-scale features can be completely missed. This disadvantage can be negated by taking ground magnetometer traverses with closely spaced stations. However, the results of these traverses are often poorly understood. A magnetic anomaly can take a number of forms—a gradual rise, a step across which background values change, or a narrow zone of anomalous readings. The significance or otherwise of an anomaly of 100nT, for example, depends on the lithologies over which the data are obtained. Over Tertiary basalts and many serpentinites such an anomaly would not be significant, whereas it would be significant over Dalradian metasediments and the Leinster Granite. Such an anomaly is much greater than any observed over Lower Palaeozoic volcanics in Tyrone but this is not true for the Lower Palaeozoic volcanics in Kildare and Wicklow.

The magnetic characteristics obtained for different rocks in Ireland are discussed in this paper in order to:

(a) illustrate the geological information that can be acquired from magnetometer profiling;
(b) demonstrate that similar magnetic patterns can be observed in a range of lithologies;
(c) provide an inventory of magnetic signatures against which other ground-based magnetic surveys can be compared.

Data were collected using a G856 GeoMetrics proton precession magnetometer along a number of traverses in three geographically separate regions in order to sample a range of different rock types. The station spacing is typically 10–20m, though this is often reduced in the vicinity of magnetic anomalies in order to obtain better definition.

Clew Bay region

The Fair Head–Clew Bay lineament, which is partly aligned along the southern shore of Clew Bay, is one of the most fundamental discontinuities in Ireland. It has been correlated with the Highland Boundary fault in Scotland (e.g. Hutton 1987; Max and Riddihough 1975), though recent work proposes that it is a splay of the Highland Boundary fault (Ryan *et al* 1995) The lineament is delineated by a strong regional magnetic signature (Max and Inamdar 1983) and an upper crustal conductivity zone (Brown and Whelan 1995); offshore seismics show that it is a north-dipping structure that becomes almost horizontal in the mid-crust (Klemperer *et al.* 1991). It separates the Dalradian of north Mayo from the Ordovician of south Mayo and has been interpreted as an important terrane boundary (Murphy *et al.* 1991). The major lithologies within the study area are the Killadangan Formation, the Deer Park Complex and the Cregganbaun Formation (Fig. 1). The Deer Park Complex has been interpreted as a north-dipping ophiolitic *mélange* composed of serpentinite, metagabbro, carbonate-talc schists, amphibolite and serpentinite breccia (Ryan *et al.* 1983). The Killadangan Formation, consisting of sandstones, conglomerate, chert and volcanics, has been interpreted as a Silurian *mélange* (Williams *et al.* 1994). The Silurian Cregganbaun Formation is over 1000m thick at Croagh Patrick, and cross-bedding indicates a derivation from east and north (Kelly and Max 1979).

The results of six magnetic traverses across the Deer Park Complex are shown in Fig. 2. In general the Deer Park Complex is associated with very high magnetic values. The highest were found on the most western traverse (Fig. 2a), where values over 58,000nT were recorded, 9000nT above the background. These very high values are due to the strong magnetic character of the serpentinite. McManus (1972) reported that the high magnetism was due to chromite grains being superseded by extensive magnetite overgrowth. Other serpentinite bodies which occur discontinuously along the Fair Head–Clew Bay lineament (Long 1989) are also highly magnetic (Lemon 1966, Seeds and Poole 1946). A magnetite content of over 14% has been recorded for part of the Slishwood serpentinite (Hardman and Hull 1883).

Magnetic readings for the Cregganbaun Formation are 300–600nT higher than for the Killadangan Formation on all the traverses, averaging 49,100nT for traverses (a) and (b), 49,200nT for traverses (d) and (f), and 49,300nT for traverses (c) and (e). Variations within the Killadangan Formation were also observed: magnetic readings for the central traverses (c) and (d) are about 150nT lower (48,650nT) than to the east and west (48,800nT).

A number of differences are evident in the ophiolitic *mélange* as one moves in an east–west direction. The ophiolite zone is much narrower in the west (200m) than in the east

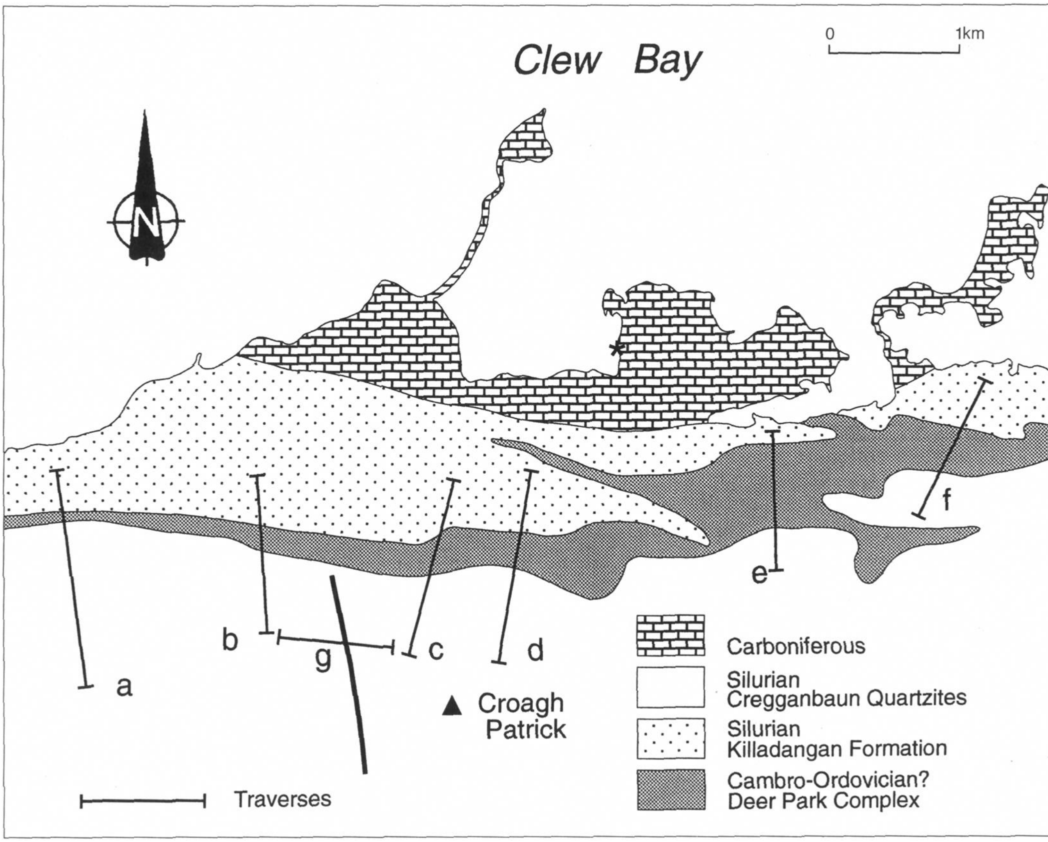

Fig. 1—Simplified geological map of the area around Croagh Patrick, Clew Bay, modified after Aherne *et al.* 1992. Letters refer to the location of traverses. **a**: Fig. 2a; **b**: Fig. 2b; **c**: Fig. 2c; **d**: Fig. 2d; **e**: Fig. 2e; **f**: Fig. 2f; **g**: Fig. 3a. Asterisk shows the location of Fig. 3b.

(>800m). Magnetic readings for the ophiolite for the western traverses (a–d) average around 52,000nT, whereas for the easternmost traverses (e and f) the readings are considerably lower (around 49,500nT for traverse (f) and about 48,500nT for traverse (e)). This change most likely reflects a marked decrease in the magnetite content of the ophiolite in the eastern part, possibly reflecting a greater degree of replacement of serpentinite by talc. Although the readings for the ophiolite in traverse (e) are similar to those obtained over the Killadangan Formation, the former show a much greater variance.

Traverses (e) and (f) are both associated with a distinctive positive magnetic anomaly, delineating the southern edge of the Deer Park Complex, which is absent in the other traverses. Traverses (a), (c) and (d) have a positive anomaly delineating the northern edge of the Deer Park Complex. Magnetic gradients are extremely high and changes of 8000nT in 50m have been recorded.

A disadvantage of the traverses shown in Fig. 2 is that, because the Deer Park Complex is associated with such a large magnetic signature, significant magnetic anomalies in other lithologies might be overlooked. It was reported above that magnetic readings over the Cregganbaun Formation averaged 49,100nT for traverse (b) and 49,300nT for traverse (c). A short east–west magnetic traverse (g, Fig. 1) was made between these lines in order to investigate this change. This traverse also crossed a north–south fault marked by a narrow, steep-sided valley in the vicinity of the Leckanvy gold deposits. The results of this traverse (Fig. 3a) show that magnetic readings

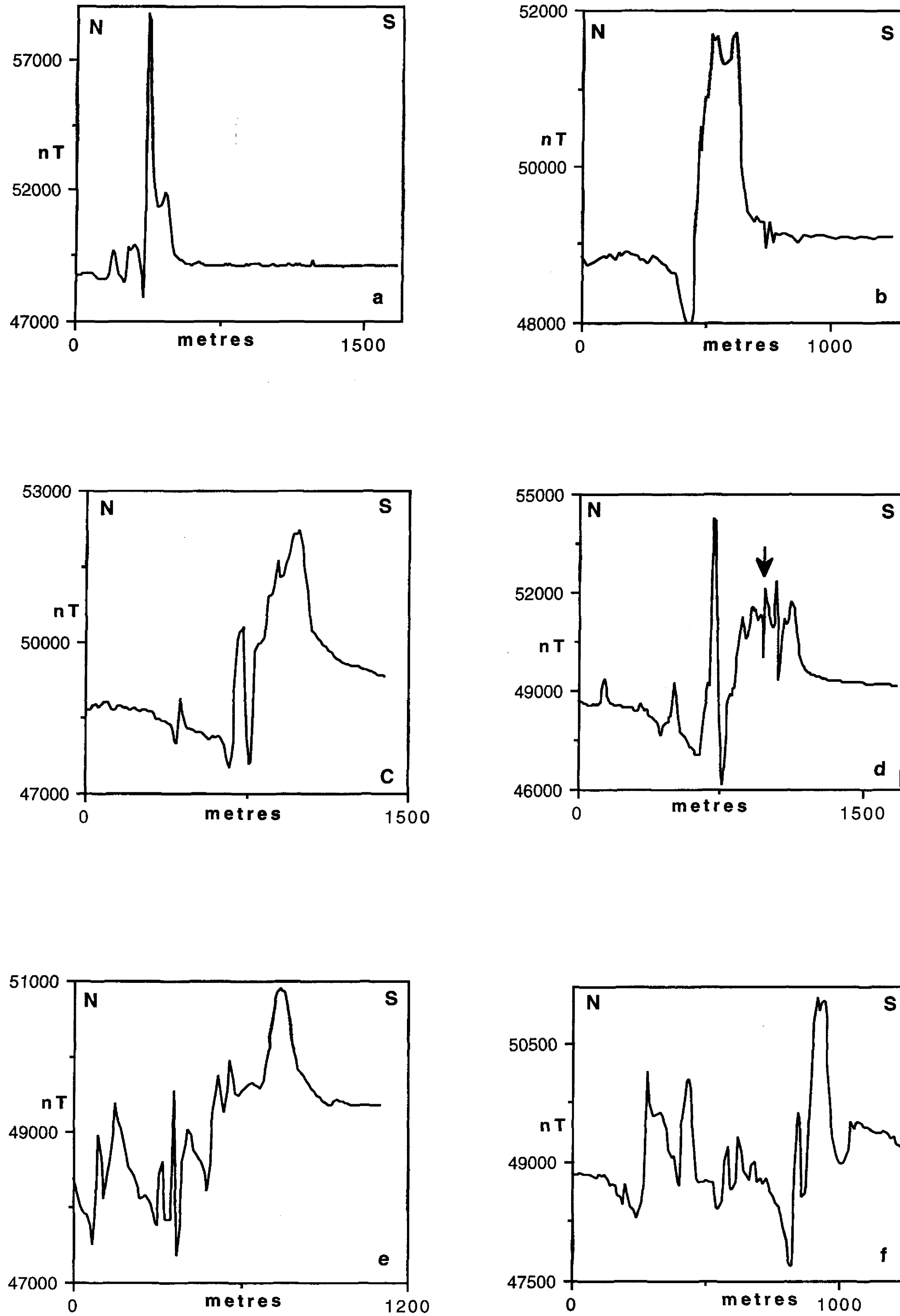

Fig. 2—Magnetic traverses in the Croagh Patrick region of Clew Bay. See Fig. 1 for location.

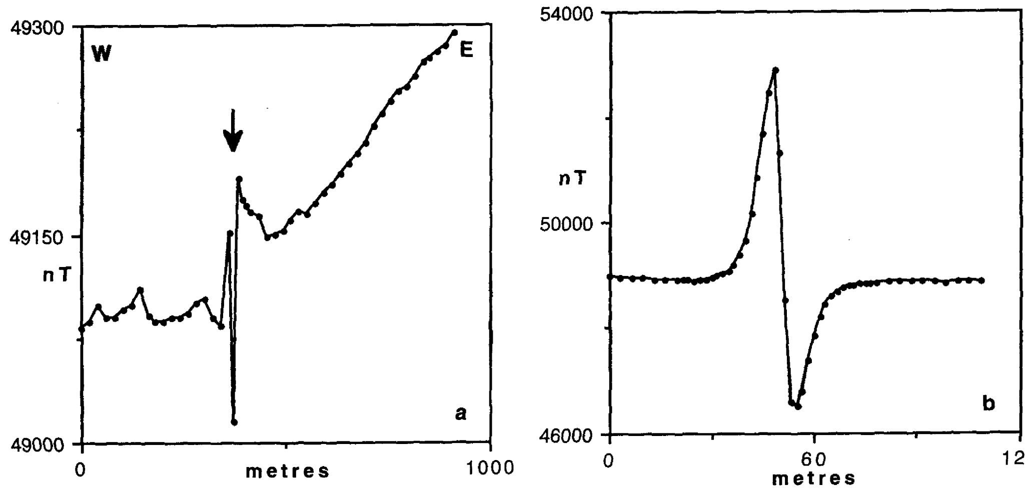

Fig. 3—Magnetic traverses near Leckanvy (a) and Murrisk (b). See Fig. 1 for location.

for the Cregganbaun Formation remain constant at about 49,100nT west of the fault. The fault is delineated by a prominent anomaly of 160nT (arrowed, Fig. 3a) and marks a change in the character of the magnetic signature. To the east, magnetic values increase away from the fault at a constant gradient. The variance of the signature is also less east of the fault. Movement on the fault has possibly brought a more magnetic lithology closer to the surface on the east side. A possible explanation for this pattern of changing magnetism associated with a fault is presented later.

Approximately 100 spot magnetic readings were taken within the Carboniferous rocks in the northern part of the study area (Fig. 1). Magnetic values tended to remain fairly constant at around 48,800nT, as would be expected for rocks which contain virtually no magnetic minerals. However, at one location on Murrisk Strand (shown by an asterisk on Fig. 1) an anomaly of over 6000nT was found (Fig. 3b). Magnetic values change from 52,887nT to 46,500nT within a distance of 7m. Such readings could only be caused by the serpentinites of the Deer Park Complex, and thus a narrow (<20m), possibly fault-bounded serpentinite lies quite close to the surface. Max (1989) also reported the existence of unexposed serpentinite near this locality.

East Kildare/Wicklow region

The Kildare Inlier (K, Fig. 4) is a 9km-long north-east/south-west-trending structure located 50km west-south-west of Dublin. It forms a prominent topographic feature which rises 100–150m above the surrounding Carboniferous limestone plain. The inlier is composed of Old Red Sandstone and Ordovician and Silurian rocks. The most important rocks magnetically are the andesitic lavas (Common Andesite Member). These are underlain by the Grange Cottage Member (shallow-water clastics) of the Grange Allen Formation and overlain by the calcareous shales and siltstones of the Grange Hill Member (Parkes and Palmer 1994). The Ordovician andesites formed in an island-arc tectonic setting along with other volcanic rocks in eastern Ireland—Lambay, Portrane and Balbriggan (Stillman and Williams 1978).

Two north-west/south-east-trending magnetic traverses were taken across the Common Andesite Member in the Grange Hill region of the Kildare Inlier (Fig. 5a, b). The Ordovician volcanics produce very distinctive high-frequency, high-amplitude signatures (200–700nT) that contrast well with the surrounding less-magnetic Carboniferous sediments, which have a relatively uniform signature. However,

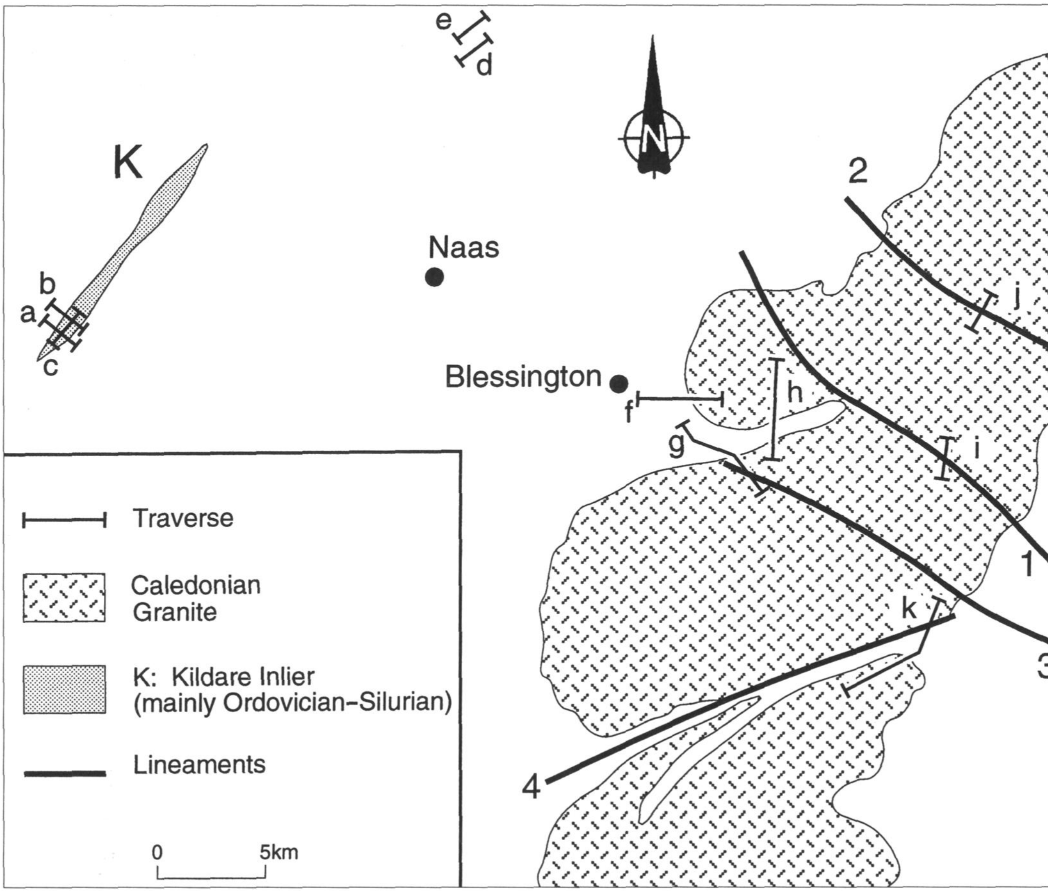

Fig. 4—Geographical location of magnetic traverses obtained in the east Kildare/Wicklow region. **a**: Fig. 5a; **b**: Fig. 5b and 5c; **c**: Fig. 5d; **d**: Fig. 6a; **e**: Fig. 6b; **f**: Fig. 7a; **g**: Fig. 7b; **h**: Fig. 7c; **i**: Fig. 7d; **j**: Fig. 7e; **k**: Fig. 7f. K: Kildare Inlier; 1: Sally Gap lineament; 2: Glencree lineament; 3: Lough Dan lineament; 4: Glen of Imail lineament.

magnetic readings over the Carboniferous limestone are approximately 70–100nT higher south-east of the inlier, where calcareous sandstones, shales and carbonates of the Navan Group occur, compared to the north-west, where argillaceous bioclastic limestones are present. The area north-west of the inlier is shown at a greater scale in Fig. 5c. A reduction in magnetic reading over the Carboniferous of 60nT in 500m is evident with a pronounced increased gradient south-east of a prominent anomaly (arrowed, Fig. 5c). This anomaly correlates with a fault, and rocks of the Ordovician Conlanstown Formation occur at subcrop to the east of it (Parkes and Palmer 1994). A north-east/south-west traverse (Fig. 5d) yields a magnetic signature consisting of two high-amplitude zones separated by a 250m-wide zone where magnetic readings are much lower than to the east or west. The magnetic pattern suggests the possibility of two volcanic centres, with the higher magnetic signatures being obtained where the lavas are thickest. This view is supported by the existence of another outcrop of andesites 3km along strike of Grange Hill, centred on the Hill of Allen.

The results of two magnetic traverses across faults in Carboniferous strata 5km south of Maynooth are shown in Fig. 6. Owing to the low magnetic content of the limestones the range of values is low. However, similar patterns to those observed on other lithologies can be seen. Fault 1 (1, Fig. 6a), within argillaceous bioclastic limestone, is characterised by a 6nT anomaly with a step in

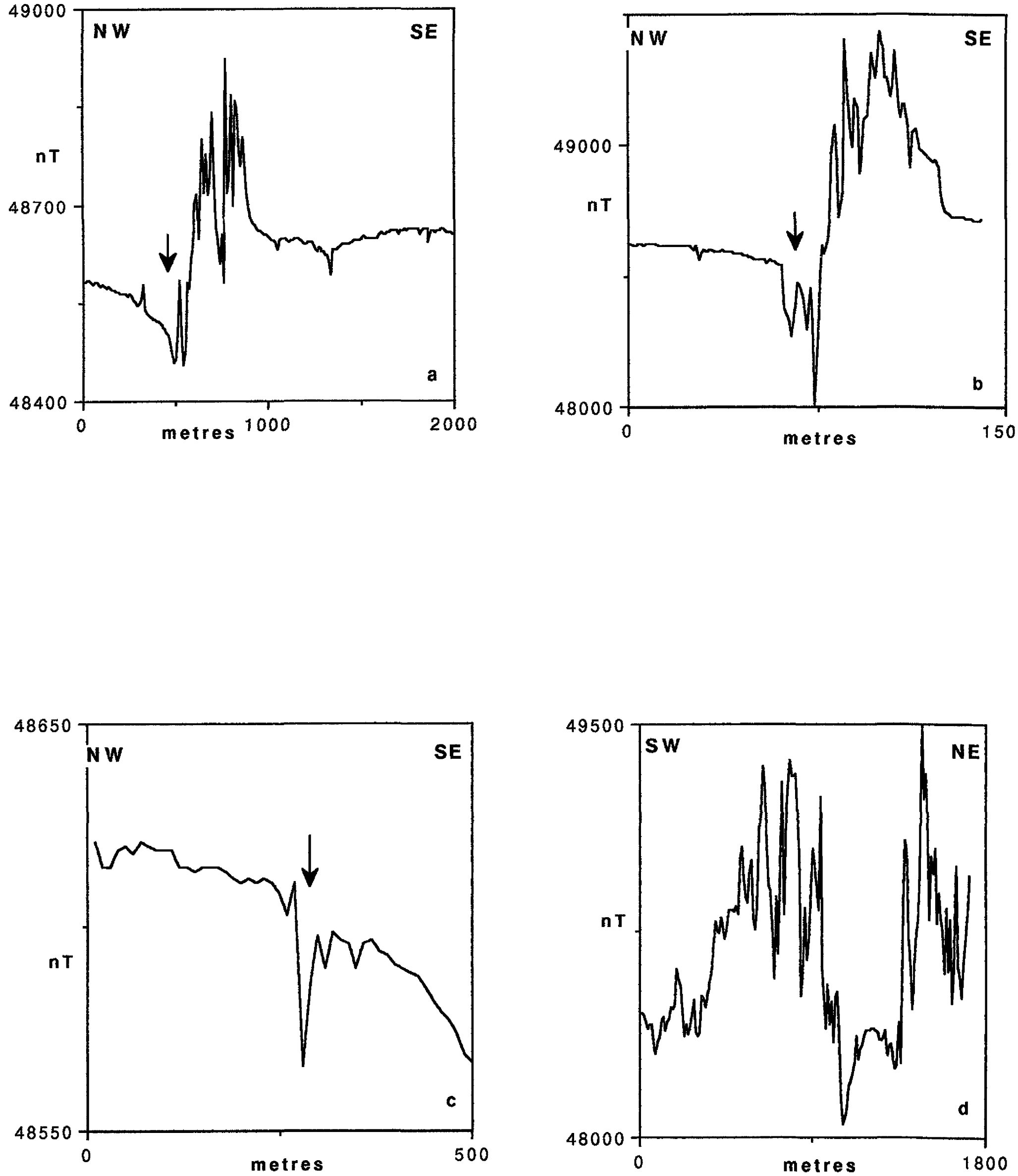

Fig 5—Magnetic traverses within the Kildare Inlier in the east Kildare/Wicklow region See Fig 4 for location

the magnetic profile across it. Fault 2 (2, Fig. 6a) is also marked by a magnetic anomaly (10nT), south-west of which the magnetic readings decrease by 17nT. Fault 1 was also investigated on another traverse and again it is delineated by a magnetic anomaly (6nT) and a change in the magnetic signature across it (arrowed, Fig. 6b). Magnetic readings decrease in a north-easterly and south-westerly direction as distance from the fault increases.

The Caledonian Leinster Granite is formed of five plutons, three of which (Northern Unit, Upper Liffey Valley Unit and the Lugnaquillia Unit) are considered here. Five granite types have been distinguished, generally ranging in composition from quartz-diorite to adamellite

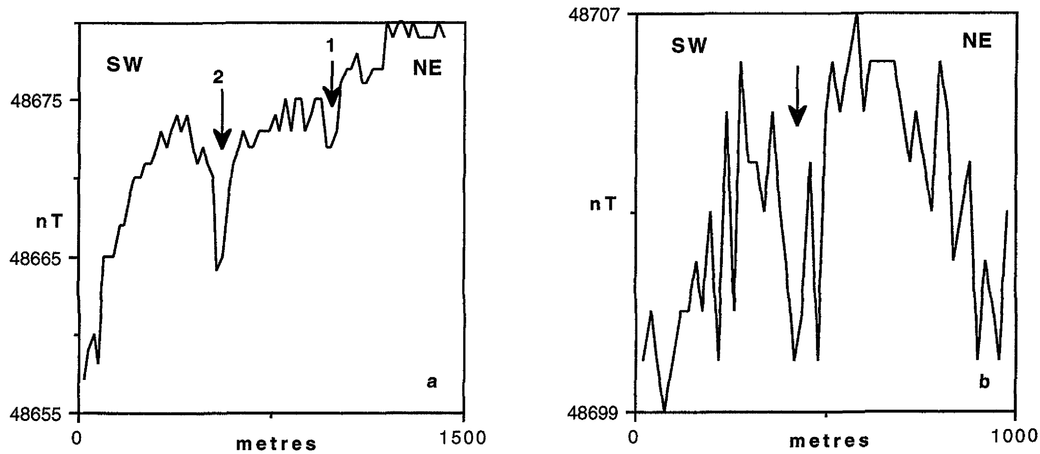

Fig 6—Magnetic traverses in Carboniferous limestone in the east Kildare/Wicklow region See Fig 4 for location

(Bruck and O'Connor 1977; Bruck and Reeves 1983). The Leinster Granite is intruded into Lower Palaeozoic greywackes, slates and siltstones (Bruck 1970) Andesitic and doleritic sheets are intruded into these sediments along the western edge of the granite (Bruck 1976).

An east–west traverse south-east of Blessington (f, Fig. 4) is shown in Fig. 7a The relatively horizontal magnetic signature for the Lower Palaeozoic sediments (A, Fig. 7a) is separated from the flat signature for the Upper Liffey Valley Unit of the Leinster Granite (C, Fig. 7a) by a 1km-wide zone (B, Fig. 7a) of elevated magnetic readings due to the presence of andesites and dolerites. Isolated peaks in this zone with amplitudes of 300nT probably indicate the location of individual igneous sheets. The traverses shown in Fig. 7b and c, which were taken in the same area, also show similar elevated readings for the andesites and dolerites The decrease in magnetic values of 70nT (1, Fig. 7b), which also marks the termination of the high-amplitude zone, represents the contact with the Northern Unit of the Leinster Granite. The profile in Fig. 7c is taken from the Upper Liffey Valley Unit in the north, across the dolerites and andesites to the Northern Unit in the south. Magnetic values decrease towards the margin of the Upper Liffey Valley Unit from 48,546nT to 48,515nT over a distance of 2km.

Bruck and O'Connor (1980) mapped a number of lineaments within the Leinster Granite using aerial photography and satellite imagery. The lineaments are associated with a range of geological features, such as alteration zones, explosion breccias and base metal mineralisation. Magnetic traverses (Fig. 7d, e and f) were taken across three of the lineaments to ascertain whether they are also associated with magnetic anomalies. The Sally Gap lineament is marked by a pronounced step of 34nT (arrowed, Fig. 7d). North of the lineament readings average about 48,500nT, though south of the lineament magnetic values decrease with increasing distance. The Glencree lineament is characterised by a magnetic anomaly of 34nT (arrowed, Fig. 7e) and a change in the background readings. The profile shown in Fig 7b crossed the Lough Dan lineament where it is associated with a 30nT signature (2, Fig. 7b) The Glen of Imail lineament was crossed by a north-east/south-west profile (Fig. 7f) from the Northern Unit to the Lugnaquillia Unit east of Lough Ouler. Magnetic values decrease by 23nT over a distance of 2km as the granite margin is approached, though they increase by 25nT at the margin. In the south-east, magnetic values for the Lugnaquillia Unit show little variation, though a step of 10nT suggests that a fault or internal contact has been crossed. The Glen of

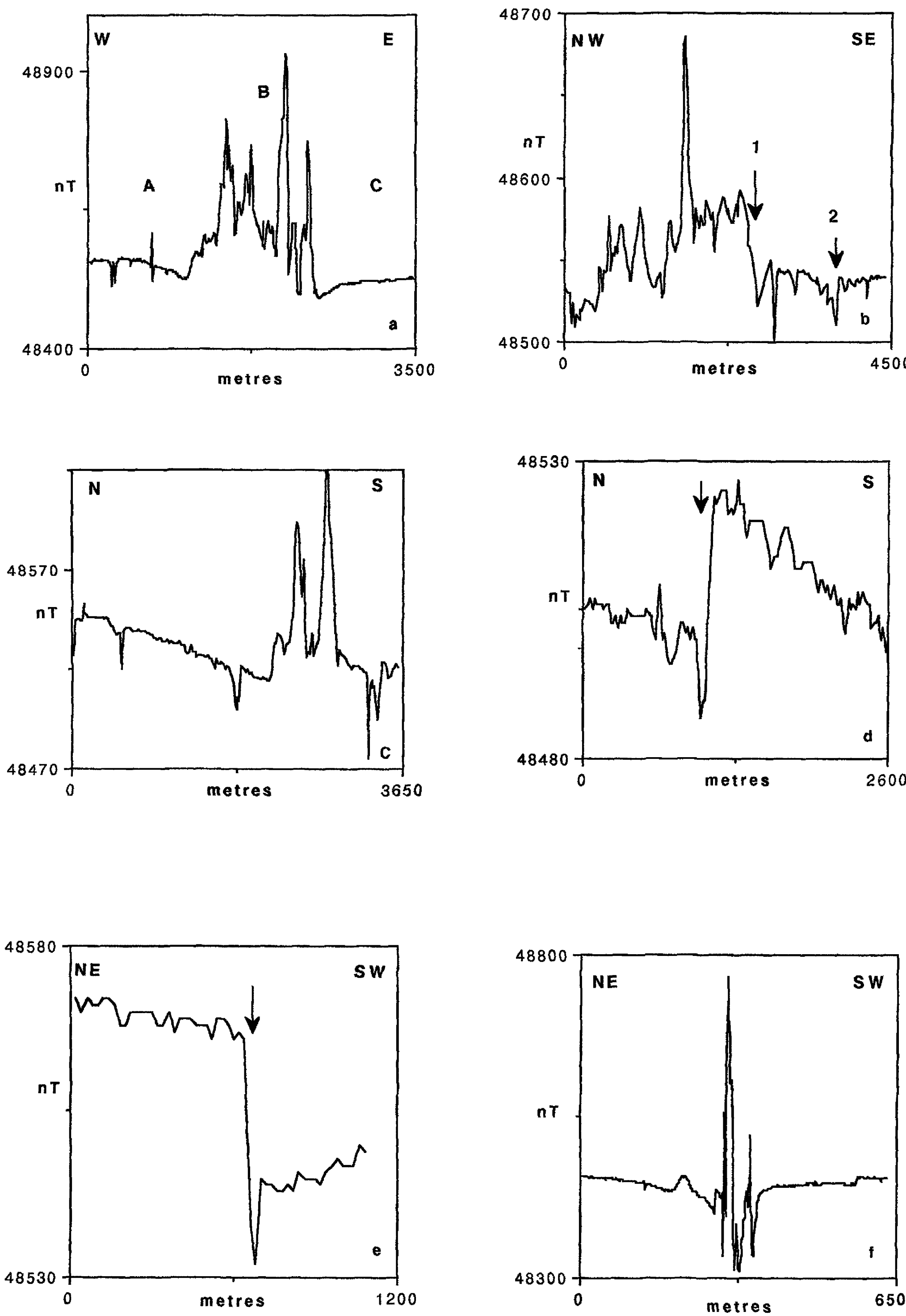

Fig 7—Magnetic traverses in granite and Lower Palaeozoic sediments and volcanics in the east Kildare/Wicklow region See Fig 4 for location

Imail lineament is located between the Northern Unit and the Lugnaquillia Unit and is associated with a 400nT anomaly. This anomaly is an order of magnitude greater than that recorded for other lineaments but similar to that recorded for the andesites and dolerites shown in earlier traverses (Fig. 7a, b and c), indicating the probable existence of these lithologies in this region.

North-east Ireland

Magnetic profiles were acquired across a range of lithologies, from Dalradian to Tertiary, in north-east Ireland. Two traverses across a north–south fault are shown in Fig. 9a and b (see Fig. 8 for location). The Carboniferous sandstones to the west of the fault (arrowed, Fig. 9a) have a higher magnetic signature (49,145nT) than the Dalradian metasediments to the east (49,115nT). The same fault is associated with a magnetic anomaly of 55nT 1.5km to the north (arrowed, Fig. 9b). Dalradian rocks again occur east of the fault and have an approximately horizontal profile, whereas west of the fault magnetic readings for Triassic mudstones increase from 49,185nT to 49,493nT as the distance from the fault increases.

A traverse was taken across the Omagh Fault (c, Fig. 8), which is recognised as one of the major structures in north-east Ireland. The Omagh Fault, shown by the Geological Survey of Northern Ireland (1977) as forming the southern margin to the Dalradian Succession in the Sperrin Mountains, is a shallow north-dipping thrust (Hartley 1938; Hutton 1987) along which the Dalradian has been moved southwards over the Tyrone Igneous Complex, which has been interpreted as an ophiolite (Hutton *et al.* 1985). A magnetic traverse was made across the Omagh Fault from the Dalradian Mullaghcarn Schists to the Ordovician volcanics of the Tyrone Igneous Complex (Fig. 9c). The Omagh Fault is shown by the 100nT anomaly (arrowed, Fig. 9c), across which there is a difference in average background readings of about 50nT. The signature for the schists to the north is greater than that of the volcanics to the south,

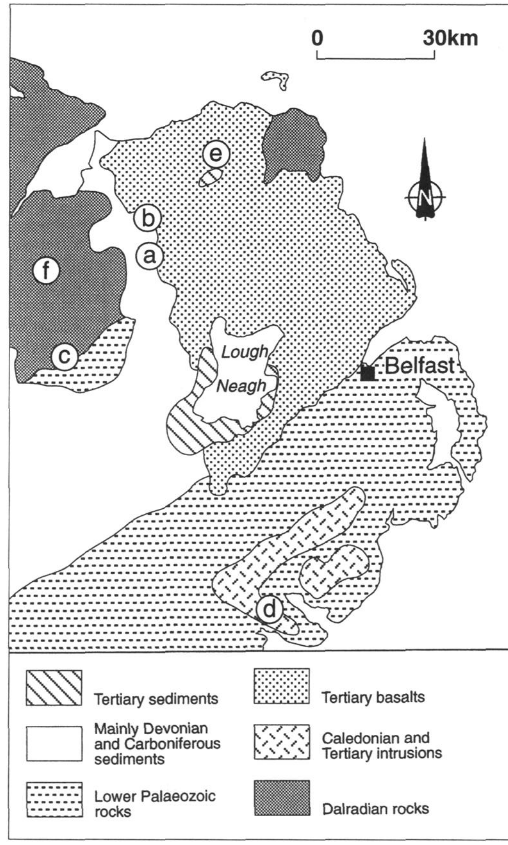

Fig. 8—Simplified geological map of north-east Ireland, showing the geographical location of magnetic traverses obtained in this region. **a**: Fig. 9a; **b**: Fig. 9b; **c**: Fig. 9c; **d**: Fig. 9d; **e**: Fig. 11a; **f**: Fig. 11b.

suggesting that, like the Tertiary basalts, the Ordovician andesitic lavas could be reversely magnetised. This is supported by the aeromagnetic map of Northern Ireland, which shows that the outcrop of volcanic rocks is associated with a negative anomaly (Geological Survey of Northern Ireland 1971).

Tertiary igneous activity in the Carlingford region (d, Fig. 8) commenced with the extrusion of tholeiitic and alkali basalts and was followed by the intrusion of gabbroic plugs and a lopolith (Le Bas 1960; H. Wilson 1972). The gabbros are over 365m thick, and four layers are recognised based on basal olivine segregation and systematic plagioclase feldspar variation (Institute of Geological Sciences 1978). The results of a traverse eastward from the top of Carlingford Mountain are shown in

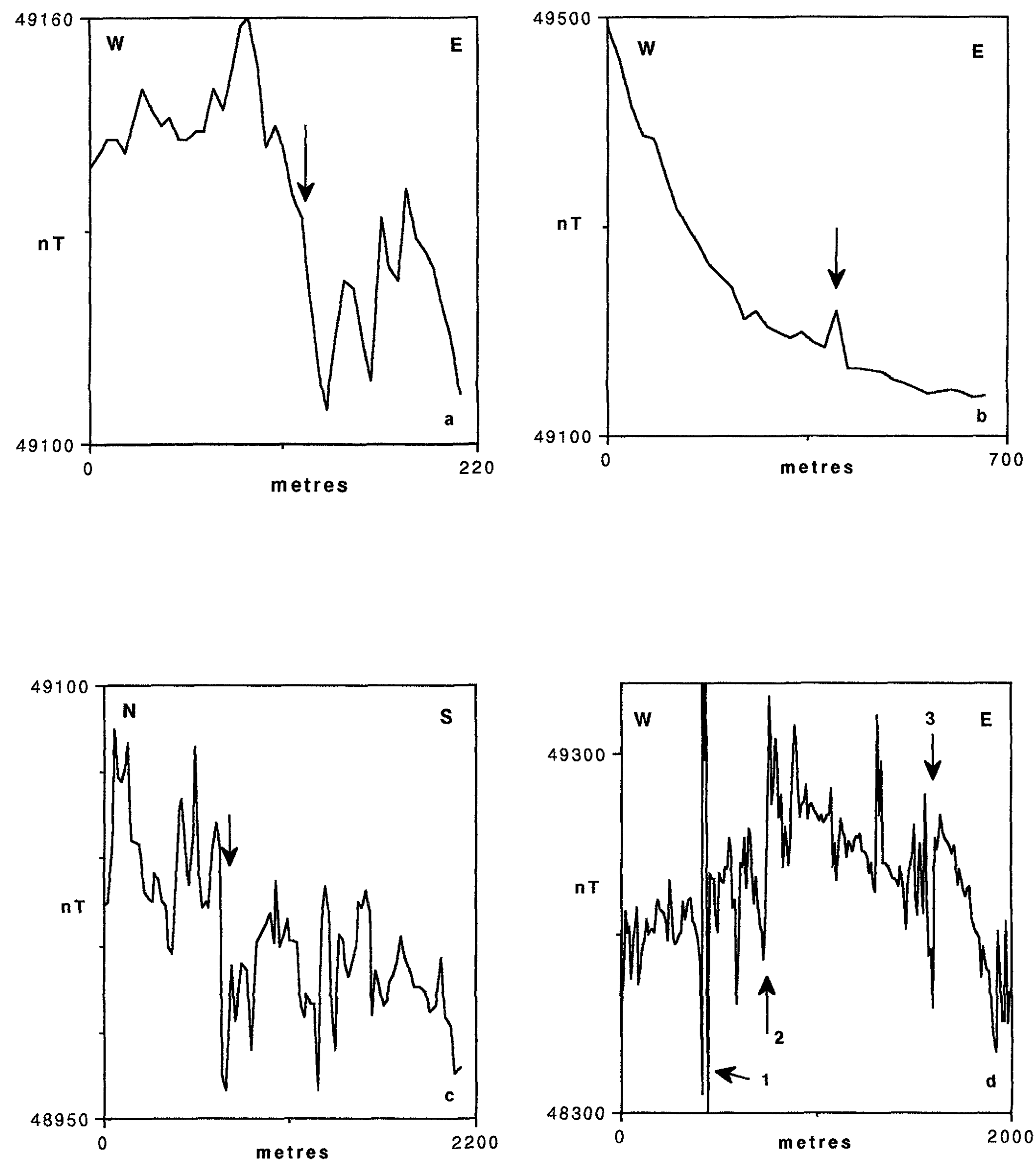

Fig 9—Magnetic traverses in north-east Ireland See Fig 8 for location

Fig. 9d. The profile is domed, though the peak does not coincide with the topographic high, being approximately 1km to the east of it The magnetic variance over the gabbro is about 30–50nT, an order of magnitude lower than the Tertiary basalts (Gibson and Lyle 1993). Two distinct magnetic zones can be observed on the traverse. Initially magnetic values increase from 48,700nT to 49,100nT A very large anomaly of 1500nT in this region (1, Fig 9d) represents a fault. A smaller anomaly of 800nT (2, Fig. 9d) possibly represents a fault between two of the gabbroic layers because east of the anomaly the magnetic gradient reverses and values decrease eastward. Anomaly 3 (Fig. 9d) is the contact between the gabbro and Silurian greywackes. The signature over the greywackes tends to be much smoother, though in the extreme east of the traverse the variable signature is caused by dolerite dykes

Discussion

Fifty kilometres of magnetic data were obtained at closely spaced intervals on 26 traverses over a range of lithologies. Dalradian metasediments (Dart and Mullaghcarn Schists); Carboniferous sandstone; Carboniferous limestone; Tertiary basalt; Tertiary gabbro; Tertiary sediments; Ordovician andesites and dolerites; Silurian greywackes; Silurian quartzites, Caledonian granite, Triassic mudstones, serpentinite and ophiolitic *mélange*. Structures within the serpentinites are associated with anomalies greater than 4000nT, the largest anomalies of any of the lithologies investigated. Structures within Tertiary basalts—see Fig 11a and also Gibson and Lyle 1993—and gabbros tend to produce anomalies of the same magnitude, approximately 1000–2000nT, but their background variance differs by an order of magnitude, approximately 30–50nT for the gabbro and 300nT for the basalts. Igneous rocks of the Kildare Inlier yield larger anomalies (700nT) than those flanking the Leinster Granite (300nT), while within the Leinster Granite itself anomalies of about 30nT amplitude are recorded. Conway (1993) reported the existence of long-wavelength magnetic anomalies within the Northern Unit of the granite The background variance for the granite is low (2–5nT), similar to that of the Lower Palaeozoic sediments. Readings obtained over Dalradian rocks exhibit a variance of around 5nT. The Ordovician volcanics in north-east Ireland vary by 5–10nT—much lower than the volcanics in Kildare (20–100nT) and Wicklow (5–30nT).

Structures such as faults display a range of signatures; similar magnetic patterns are observed in different lithologies but the amplitude of the anomaly varies. A common characteristic probably indicating a fault or fracture is a sharp drop in magnetic values below the background readings followed closely by an abrupt rise above the background, after which the profile settles back to the background values. A fault with such a signature (2000nT) is shown by the arrow in Fig 2d. This pattern is often seen to encompass both the lowest and the highest magnetic readings obtained on a traverse (Figs 2d, 3b, 7f and 9d)

Faults also produce a 'step-like' signature caused by the juxtaposition of lithologies with different magnetic properties (e.g. Figs 7e, 9a and 9c). Often the magnetic signature rises or falls slightly in close proximity to the fault (e.g. Figs 7e and 9a). Thus, although the difference in background magnetic values across the fault shown in Fig. 9a is 30nT, the fault between them has an anomaly of 55nT This effect is in part due to the orientation of the fault-plane. Modelling was performed for the fault shown in Fig 9a assuming a small magnetic contrast of 0.05A/m between the sandstone and the Dalradian. Three models were tested: normal fault (45° dipping), vertical fault and reverse fault (Fig. 10) All three models produce the correct anomaly difference between the sandstone and the Dalradian (A and B, Fig. 10), but the reverse fault produces a peak anomaly which is much too high while the 45° dipping model yields too low an anomaly for the fault. The vertical fault-plane model accords best with the observed readings, producing the correct difference in the background readings and the size of the anomaly produced for the fault.

When comparing faults taken across different lithologies the size of the associated magnetic anomaly cannot be correlated with the importance of the fault. Minor faults in basalts could produce much higher anomalies than, for example, the Omagh Fault (Fig. 9c),

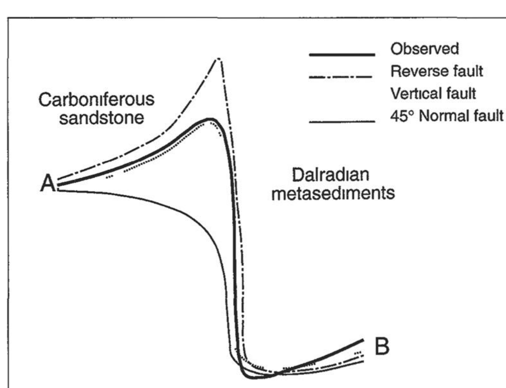

Fig 10—Models for magnetic traverse shown in Fig 9a using different fault-plane orientations The vertical fault fits the observed data best

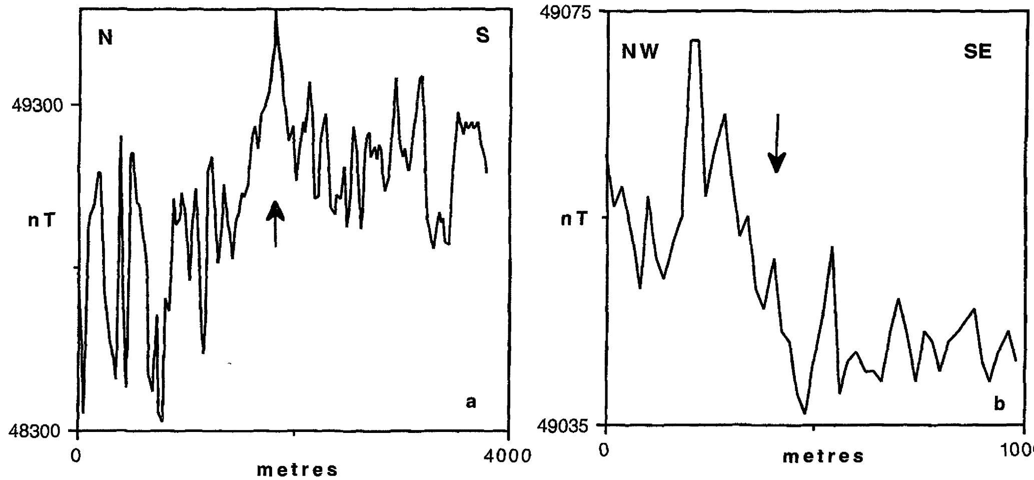

Fig 11—Magnetic traverses in north-east Ireland where no known geological structures exist Comparison with known signatures suggests that they represent faults See Fig 8 for location

which is a major structure. However, on some traverses, magnetic values show an increasing or decreasing pattern which is confined to one side of the major anomaly and which terminates at the structure (Figs 3a, 9b and 7d). Changes in magnetism in the vicinity of faults and fractures are quite common (see Gibson 1991 for examples). In general, the magnetic changes tend to be restricted to the close proximity of faults (50–100m), but in some instances (Figs 3a and 7d) the background magnetism which changed at the structure is still being affected at distances of up to 500–1000m, suggesting that they are major structures. A possible explanation for this signature is that fracturing associated with the fault would tend to be more extensive in the vicinity of the fault and decrease farther away. Thus if alteration or leaching of magnetic minerals occurs within these fractures the magnetic signature would decrease as the fault is approached (Fig. 3a). However, migrating fluids within the fracture might introduce magnetic minerals, and in this situation an increase in magnetic values as the fault is approached would be expected (Fig. 7d). In view of the existence of auriferous quartz veins near the fault shown in Fig 3a (Aherne *et al.* 1992), similar veins might exist at depth immediately to the east of this fault.

Significantly, the traverses over faults in Carboniferous limestone show similar magnetic characteristics to those obtained for other lithologies. Fault 1 in Fig. 6a has a step-like profile similar to Fig. 9a. Magnetic values decrease with distance on the south-western side of fault 2 in Fig. 6a, similar to Fig. 7d, and magnetic readings decrease with distance from the fault in Fig. 6b, similar to the change east and west of anomaly 2 in the Carlingford gabbro (Fig. 9d). Thus magnetic investigations of Carboniferous limestone are capable of providing useful geological information.

The traverses presented here and elsewhere (see Gibson and Lyle 1993) allow comparisons to be made with magnetic data acquired where no known structures exist. A north–south magnetic traverse from the Tertiary basalts into the Ballymoney sedimentary basin is shown in Fig. 11a. The basin contains 200m of the Lough Neagh Group, formed predominantly of clays with subordinate sandy horizons underlain by basalt. The southern edge of the basin is bounded by the Fair Head–Clew Bay lineament, though its northern edge, where the traverse was taken, is not thought to be faulted (Griffith *et al.* 1987). However, a lineament could be observed on LANDSAT imagery at this location (Gibson 1991). The magnetic readings to the north of the lineament are characterised by a variance of 500nT, with an average of 48,800nT (Fig. 11a). This increases to

49,600nT, the highest on the traverse (arrowed, Fig. 11a), and decreases to 49,200nT in the south, with a reduced variance of 300nT. The step-like nature of the profile strongly supports the hypothesis that it is a fault. In addition, magnetic readings to the north are lower than to the south, which is what would be expected because the basalts are reversely magnetised (R. Wilson 1970). Also, the variance is lower to the south, which again is what would be expected as this is consistent with the variable magnetic signature for the basalts being 'smoothed' by overlying thick clay deposits.

A profile across a lineament observed on SEASAT radar imagery (6, Fig. 8) is shown in Fig. 11b. The lineament is aligned along the trend of the Fair Head–Clew Bay lineament within the Dart Schists of the Sperrin Mountains. The total change in magnetism is 35nT and the observed pattern of a step-like change in magnetism (arrowed, Fig. 11b), including the increase in the close proximity of the lineament, is virtually identical to the fault shown in Fig. 9a.

Conclusions

A large amount of geological information can be obtained by magnetometry profiling even when outcrops are minimal, as was the case for the majority of the traverses in this study. Because the magnetic characteristics of different lithologies vary, in some circumstances the presence of rocks in subcrop can be determined, for example the serpentinites in Clew Bay and the andesites and dolerites in Wicklow. Similar magnetic patterns are observed for structures in a range of lithologies, including Carboniferous limestone, although the amplitudes of the anomaly will vary. Changes in magnetism related to structures can often be detected up to 1km from the structure. The inventory of magnetic signatures presented here can form a basis for the analysis of other magnetic data obtained on other traverses.

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