A PALAEOMAGNETIC STUDY OF SOME PRE-CAMBRIAN ROCKS IN NORTH-WEST SCOTLAND

by

George Edward John Beckmann, M.A., M.Sc., M.Inst.P.

A thesis submitted for the Degree of Doctor of Philosophy, University of London.

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ABSTRACT

Orientated samples from dykes, gneisses and granites have been collected from the mainland Lewisian. Dykes and a gneiss with stable magnetization have been found in the south of the area studied, the mean direction of the dykes having declination 284.6^{O}, inclination + 55.4^{O}, with k = 59, α_{95} = 6.7, corresponding to an ancient pole at 37.3^{O}N, 274.8^{O}E, dp = 6.9, dm = 9.6. This magnetization was probably acquired in the Late Laxfordian metamorphism at 1800 ($\pm$ 50) Ma. In the area to the north of these stable units, unstable magnetization has been found in the dykes, gneisses and granites; these rocks generally having directions of magnetization close to the present field.

The magnetization may lie in multidomain magnetite, in the form of well-annealed grains in the unstable region, but with stress-pinned domain walls in the stable region. There is no evidence yet of stress in the magnetite itself but stress features have been noted in ilmenite in the stable region but not in the unstable region.

One isolated dyke has a different direction of magnetization, with declination 106.1^{O}, inclination + 1.0^{O}, k = 35, α_{95} = 4.4, corresponding to an ancient pole at 7.9^{O}S, 70.8^{O}E, dp = 2.2, dm = 4.4. This dyke may reflect remagnetization at 1440 Ma.

After considering polar wandering evidence from North America, it is concluded that the Atlantic Ocean was closed when these rocks were magnetized.

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CONTENTS

(Extra pages: 124A-Z and 241A)

CHAPTER 1

INTRODUCTION

Palaeomagnetism has proved to be a valuable tool for investigating crustal movement, especially for Phanerozoic times. The principle is to measure the direction of magnetization of a portion of the crust of known age; the apparent position of the ancient north pole is calculated, assuming a geocentric dipole model for the Earth's magnetic field. If this procedure is repeated in another crustal block for rocks of the same age a further pole may be obtained. If the two poles are significantly different, crustal movement has occurred since the magnetization was acquired. (If the two poles coincide, it may or may not have occurred.)

If possible a number of poles should be found for rocks of different ages from the same crustal block. When connected by an arc these are said to form a polar wander curve. If this procedure can be repeated in another crustal block, it may prove possible to fit the two polar wander curves together and so establish the ancient fit of the blocks. This technique has had particular success in the Phanerozoic for the regions bordering the Atlantic Ocean.

It is of great interest to ascertain the assembly of the continents in Precambrian times by extending their polar wander curves further back in time. Until recently little palaeomagnetic work had been done in the Precambrian but knowledge is now growing very rapidly in this field.

The Precambrian era is extremely long, stretching from the formation of the crust to 600 million years ago. Accordingly these rocks have generally experienced a complex geological history which is less well understood than for more recent rocks and may indeed be subject to differing interpretations. Rocks dating from the early Precambrian have frequently undergone reheating, erosion, reburial and consequent remagnetization. Precambrian rocks are more often unstably magnetized than later rocks. However even if stable rocks have been found and pole positions determined, their meaning is a matter for debate, particularly with regard to the radiometric age of the rocks, a problem which has two aspects:

(i) the analytical error in the age of (say) 2,000 Ma rocks is typically $\pm$ 50 Ma. Substantial polar wander may have occurred in this time,

(ii) a wide scatter of dates is found in some Precambrian terrains amounting to perhaps 1,000 Ma. This is often due to overprinting by subsequent thermal events.

Therefore, the "age" of a rock is a matter for careful interpretation. When rocks have been remagnetized the time at which this happened may be regarded as a magnetic age. Whether or not there is a connexion between radiometric age and magnetic age is again a matter for discussion.

Precambrian rocks have also had a long time in which to establish a change of attitude which of course changes the direction of magnetization.

All rocks would lose their magnetization in sufficient time due to thermal fluctuations. It might be suspected, a priori, that 2,000 million years would be sufficient. However there are now several Precambrian results of this order of age, moreover magnetization of the Moon's rocks is believed to date from 3,200 - 3,700 million years ago (Runcorn (1973)). There is therefore no need for pessimism on this point or indeed upon any of the points mentioned previously. In spite of its complexities, Precambrian palaeomagnetism presents a stimulating challenge.

In this study ancient poles have been determined from some of the early Precambrian rocks forming the Lewisian complex of north-west Scotland. The work arose from the need to know the ancient arrangement of the Precambrian regions bordering the north Atlantic, including Canada, Greenland, Scandinavia and the Ukraine. The work on Scotland is seen, therefore, as part of a larger project.

Initially, orientated samples were drilled from the dykes, which are a striking feature of the Lewisian. Dykes were sampled because they are believed to have been intruded over a limited time span (at about 2,200 Ma) and have since experienced very little relative movement; it was at first thought that palaeomagnetic poles from the dykes would relate to their intrusion. However in the course of the project the host rocks were also sampled and the results have caused this to be regarded as improbable.

Some understanding of the geology is essential to the interpretation of the results and is discussed in the next chapter and in Chapter 3 which features the dykes, some of which had already been dated. The principal geographical locations, to which reference is made in the text, are shown in Fig. 1.1.

The specimens have been collected and analysed by standard techniques which are described in Chapter 4. Other investigations, which arose largely from the need to find the cause of differences in magnetic stability, are considered in Chapter 5. Chapter 6 is a long chapter describing individual dykes; the next chapter describes the other sampling sites.

Finally, the results are presented in Chapter 8 and interpretations suggested in the final chapter.

An unexpected outcome of this study is that it seems to throw some light on the geological and thermal history of the region.

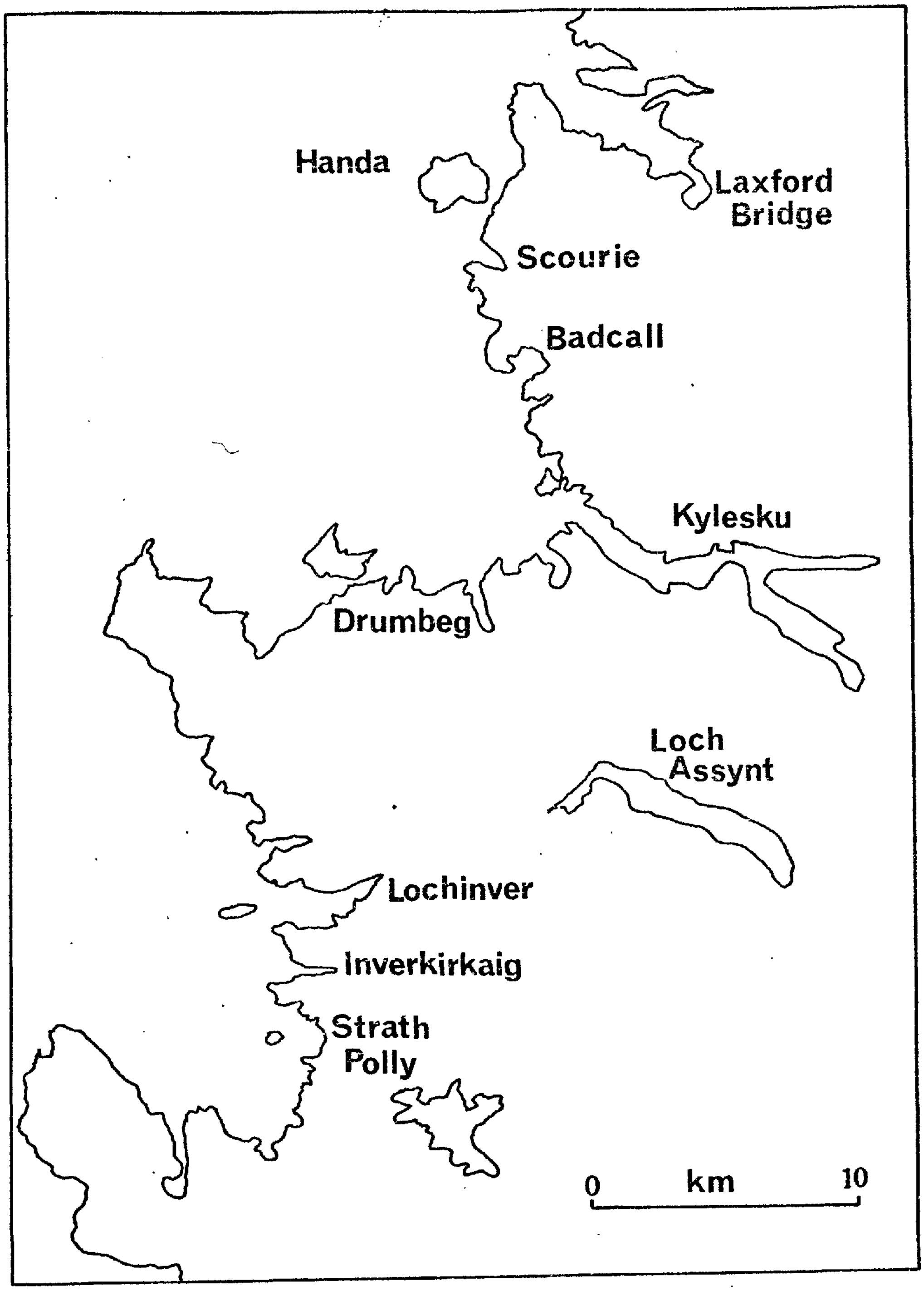


Fig 1.1 Map showing principal place-names occurring in the text.

CHAPTER 2

LEWISIAN GEOLOGY AND HISTORY

2.1 INTRODUCTION

In this chapter a geological outline will be presented, emphasizing those aspects which are relevant to the interpretation of the palaeomagnetic results.

The Lewisian is a complex of ancient rocks in the Highlands and Islands of north-west Scotland, whose extent is shown in Fig. 2.1. This thesis is almost entirely concerned with the mainland belt. The countryside consists of gently rolling peat moorland interspersed with many lochs. Extensive glaciated rock exposures can be seen from almost any point and these give the landscape a characteristic "knobbly" appearance. The Lewisian consists mainly of gneisses with dykes, pegmatites and granite sheets as minor intrusive constituents.

The geology of the mainland Lewisian was studied by Peach and others (1907) whose mapping resulted in three regions being distinguished (Fig. 2.2). The gneisses in the northern and southern zones are characterized by hornblende and biotite but in the central zone by pyroxene. The following chain of events was recognized in the Lewisian:

1. Formation of the fundamental complex of gneisses having similarities to plutonic rocks.
2. Intrusion of basic dykes.
3. A period of stress in which previously existing rocks were modified.

However Sutton and Watson (1951 A) took this work further in two ways by asserting:

1. That the original complex was not plutonic but metamorphic,

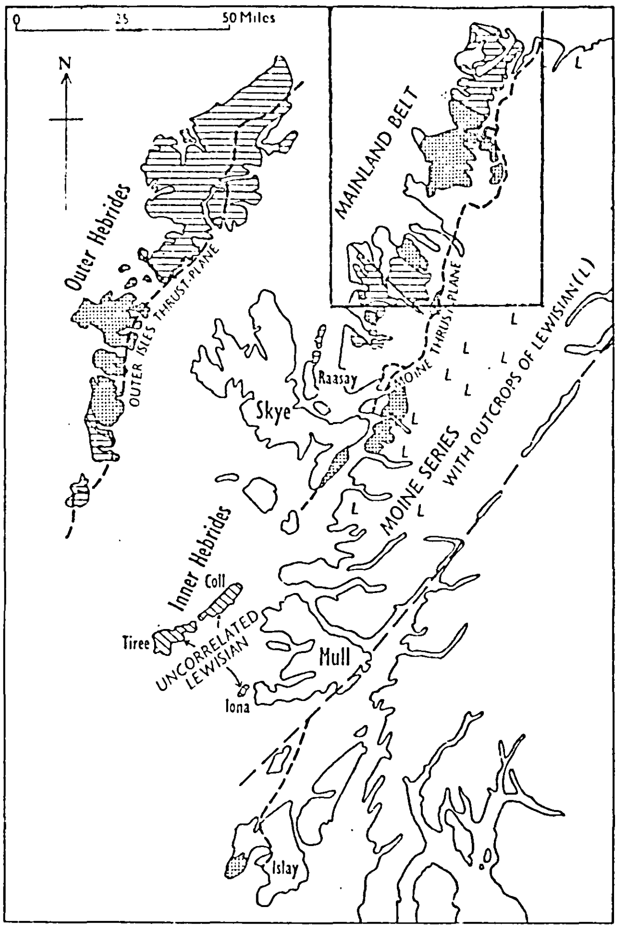


Fig 2.1
The Extent of the Lewisian (after Watson (1965)).

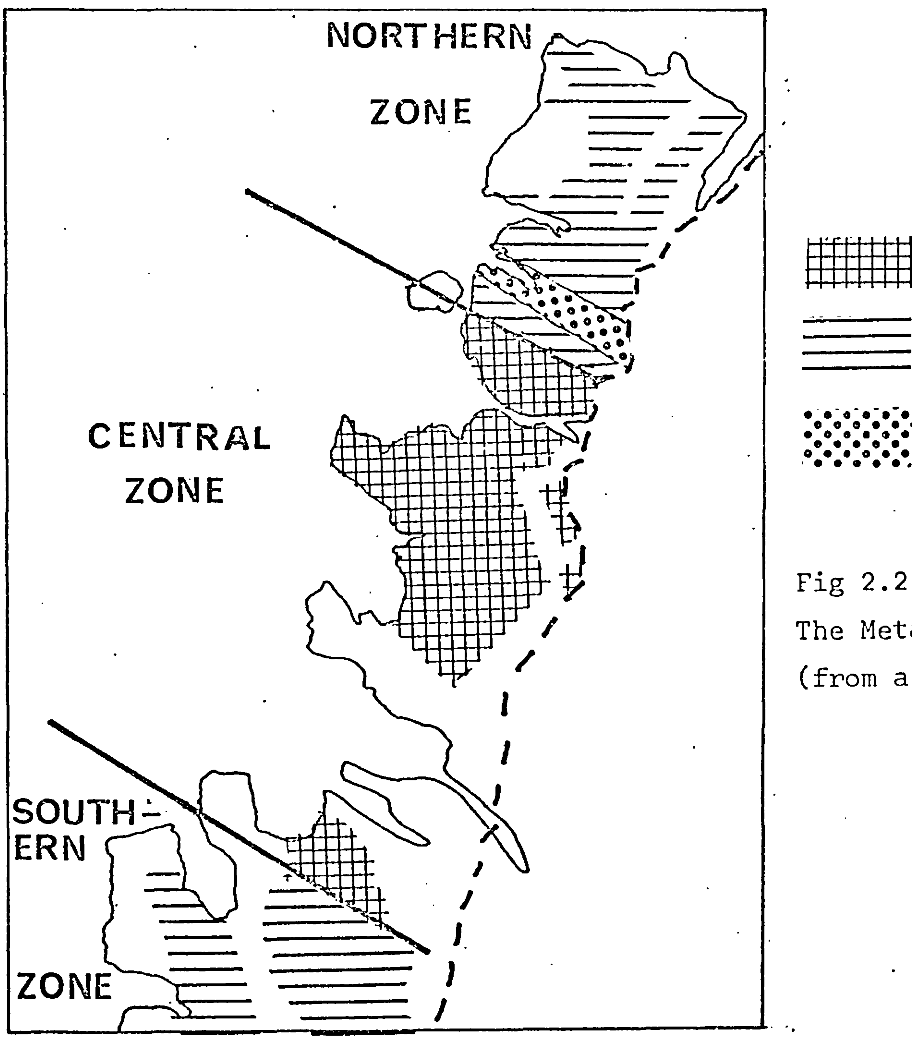


Fig 2.2
The Metamorphic Zones.
(from a slide of Professor J.G.Ramsay).

2. That the later period of stress was profound and was associated with a metamorphism which created new rocks and did not merely modify existing ones.

The terms Scourian and Laxfordian respectively were proposed for the complexes of rocks produced by the two metamorphisms. The metamorphisms and the intrusions of the dykes were regarded as major events in the history of the crust, indeed Sutton (1963) related them to rhythmic cycles in the evolution of the continents.

In the following sections of this chapter and for part of the next chapter the principal objectives will be to establish what evidence there is about:

(a) the condition of the crust when the dykes were intruded,

(b) subsequent happenings likely to affect magnetization.

2.2 KATARCHAEAN ?

The oldest rocks in the world are those formed in the Katarchaean division of the Pre-Cambrian over 2,950 Ma ago, (Sutton (1967)). Such rocks occur as patches a few km across in the Archaean of the Kola peninsula which may for the most part be re-worked Katarchaean. A few dates greater than 3,000 Ma have been determined from North American rocks. In Greenland, some gneisses approach 4,000 Ma (Black and others (1971)). Indeed a time-table of Katarchaean events in Greenland is now emerging (Bridgwater and others (1973)); it is thought (Watson (1973A)) that substantial masses of continental crust originated before 3,000 Ma.

The occurrence of such rocks in the Lewisian, preceding the Scourian, has been strongly suspected (Dearnley (1966), Sutton (1967), Sutton and Watson (1969)). In the Outer Hebrides, Dearnley and Dunning (1968) have identified deformation of pegmatites with the Scourian metamorphism and therefore considered that the rocks into which they were intruded were pre-Scourian. Again in the Outer Hebrides, gneisses have been found which were originally sediments, perhaps laid on a Katarchaean basement (Coward and others (1969)). The greater part of the Lewisian complex was probably already in existence at about 2,900 Ma (Moorbath and others (1969), Moorbath and Park (1972)).

2.3 THE SCOURIAN CYCLE

This is the name given to the orogenic activity which produced the Scourian complex of rocks. Within it three phases have been discerned, the Early Scourian metamorphism, pegmatite injection and a late and less intense metamorphism often known as the Inverian (Sutton and Watson (1969)).

2.3.1 The Early Scourian Metamorphism

This was the metamorphism which generated the Scourian gneisses and was of granulite facies (Fig. 2.3) over much of the mainland outcrop; Park (1970) preferred the term Badcallian. Its culmination occurred at 2,900 Ma and it had terminated by about 2,600 Ma (Moorbath and Park (1972)). The former is a lead isotope date whereas the latter rests upon the potassium-argon method and is supported by Evans (1964, 1965), Lambert and others (1970 A), Francis and others (1971). (Reviews of the merits of the various dating methods have been given by Moorbath (1965, 1967)).

This was the local manifestation of the high-grade metamorphism involving the whole North Atlantic craton, typically at 2,900 Ma - 2,800 Ma (Bridgwater and others (1973)).

The importance in this thesis of the Early Scourian, indeed the whole Scourian cycle, lies in providing a basis for considering the temperature

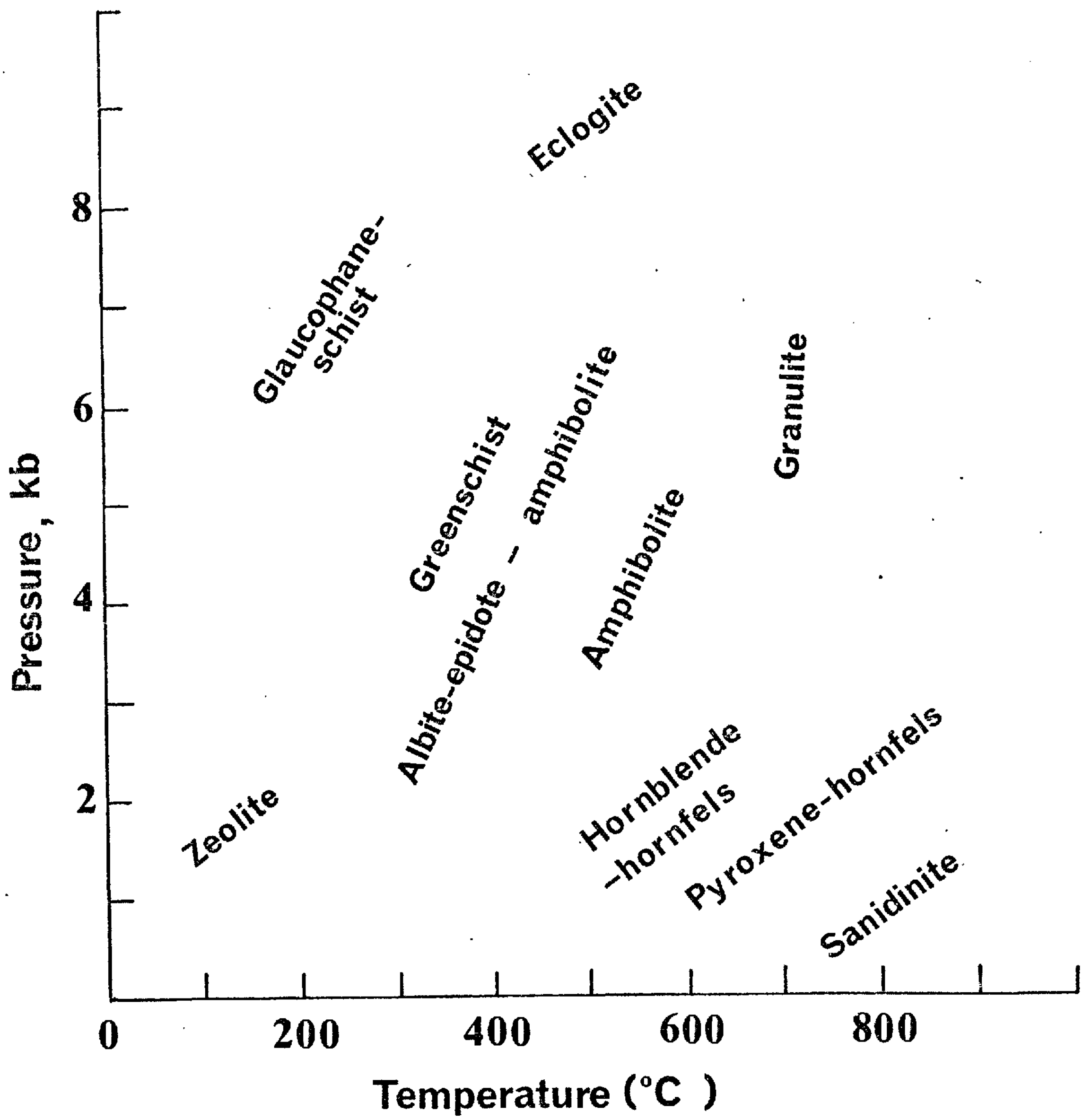


Fig 2.3 Pressure-Temperature diagram showing the possible relationships of the metamorphic facies, based on Fyfe and Turner.

of the crust when the dykes were intruded. At the peak of the Early Scourian the temperature would have been about 800°C at say 2,900 Ma. Very slow cooling followed until by 2,600 Ma isolated patches had become closed systems for radiogenic isotopes. By the time the dykes were intruded the crust had cooled further but its temperature is a matter for discussion and this will be attempted in Section 3.4.

2.3.2 The Scourian Rocks

A feature of the Lewisian gneisses is their banding (due to uneven distribution of the mafic minerals) which strikes typically NE/SW and is evident in all but a few of the basic examples.

The gneisses can be divided according to composition into acid, basic and ultrabasic types. Acid gneisses are the commonest, basic less so, whilst ultrabasic gneisses are rare. On the other hand they can be classified as granulite or amphibolite facies gneisses on the basis of metamorphic state.

TABLE 2.1

Metamorphic State	Chemical Variation		
	Acid	Basic	Ultrabasic
Granulite facies	Pyroxene - gneisses	Basic pyroxene (- garnet) gneisses	Pyroxenites, olivine - pyroxene rocks
Amphibolite facies	Hornblende or biotite gneisses	Amphibolites and garnet - amphibolites	hornblendites, serpentines etc.

The gneisses in this study are almost all basic granulites. They have the following characters:

(a) They are denser than most basic rocks. The average density of this collection is 3.16 g/cm^3, a figure which may be compared with 2.7 g/cm^3 for crustal rocks generally and 3.3 g/cm^3 for mantle rocks (Holmes (1965), 30).

(b) They contain "dry" minerals, e.g. pyroxenes $\pm$ garnet, feldspars, quartz; there are few hydroxyl-bearing minerals.

(c) Magnetite $\pm$ ilmenite are present (in contrast to amphibolite facies basic rocks).

(d) They are resistant to metamorphic change and deformation, an observation which has frequently been made in the Lewisian. (Sutton and Watson (1951 A, 1962), Coward and others (1969)).

The last two points are of course necessary requirements for palaeomagnetic work. The recognition of these rocks in the field requires experience but colour is some guide. They are often pale grey to dark red-brown, medium to coarse-grained and weathering to a brown crust on account of oxidation of the pyroxenes. Garnets are sometimes present. Hypersthene endows the rocks with a green, greasy texture (which must be distinguished from the green-black of hornblende).

2.3.3 <u>The Early Pegmatites</u>

Pegmatites are intrusive bodies consisting of quartz, alkali feldspars and mica; the large crystal size of 1 cm or more implies a slow-cooling environment rich in volatiles.

Two generations of pegmatites were recognized by Sutton and Watson (1951 A) at Badcall. The earlier ones, π 1, were cut by dykes, whereas others, π 2, cut the dykes. Their relative ages were confirmed radiometrically (Giletti and others (1961)).

One of the early ones was dated at 2,540 Ma; the same age, 2,540 (± 55) Ma was given by a pegmatite in the Isle of Barra (Francis and others (1971)) and 2,560 (± 80) Ma (Lambert and others (1970 A)) by the "gneissose pegmatite" of Dearnley and Dunning (1968). Giletti and others (1961) also found a scatter of younger dates for early pegmatites and Evans (1963), in the Lochinver district, obtained pegmatite ages of 2,320 (± 50) Ma. Summarizing, the early pegmatite dates, which are all Rb/Sr determinations, fall in the range 2,300 - 2,600 Ma.

(There is an uncertainty of 6% in the half-life of ^{87}Rb and values of 4.7×10^{10}, 4.85×10^{10} and 5.0×10^{10} years are used. In this thesis, all Rb/Sr ages are quoted or have been recalculated on the basis of the intermediate value 4.85×10^{10} years for which precedents in the Lewisian have been set by Lambert and others (1970 A) and Lambert and Holland (1972); moreover this is considered to be the most accurate value by Black and others (1971)).

2.3.4 The Inverian Episode

Evans (1965) proposed that after the early pegmatites but before the intrusion of the dykes, amphibolite facies metamorphism and deformation under a NE/SW stress took place in the vicinity of Lochinver. The name Inverian was advocated for this disturbance. Although the evidence was confined to Lochinver it was believed (Evans and Lambert (1964)) that it was an event of major significance, and affected the Scourie area as well as Lochinver. Furthermore Moorbath and Park (1972) considered that the Inverian was intense and widespread over the whole southern region and it has been claimed (Cresswell (1969)) that all the gneisses in the Torridon area were completely recrystallized in this episode. Reference has also been made to a belt of Inverian gneisses in the northern region (Holland and Lambert (1972), Lambert and Holland (1972)). The presence of pre-Laxfordian amphibolized gneisses had been noted by Sutton and Watson

(1951 A) and attributed to the later stages of the Scourian cycle.

2.3.4.1 Dating the Inverian

Evans (1965) noted that the Brackloch Farm dyke near Lochinver cut Inverian gneisses. This dyke had been dated by the Rb/Sr method by Evans and Tarney (1964). The limits imposed by this dyke and the pegmatites are given in the following table:

TABLE 2.2

Limits of the Inverian

EVENT	DATE, Ma	
	^{87}Rb, $T_{\frac{1}{2}} = 4.7 \times 10^{10}$ y.	^{87}Rb, $T_{\frac{1}{2}} = 4.85 \times 10^{10}$ y.
Intrusion of Brackloch Farm dyke	2,190 ($\pm$ 50)	2,260 ($\pm$ 50)
Intrusion of Pegmatites	2,250 ($\pm$ 50)	2,320 ($\pm$ 50)

However, the assertion that the Inverian was distinct from the period of pegmatite injection has been questioned, (Park (1970)). Moreover, the dykes may have been intruded during the waning stages of the Inverian whilst the country rocks were still hot (Moorbath and Park (1972)) and undergoing deformation (Park and Cresswell (1972)). The timing of this episode has also been questioned on the grounds that pegmatites of the age specified by Evans are not always present in localities which have been described as Inverian; it may be preferable to use the term "later Scourian". (Watson (1973 B)).

2.4 THE DYKES

Immediately after the Inverian, or perhaps in its closing stages, the dykes were intruded. A discussion of the dykes is deferred until the next chapter.

2.5 THE LAXFORDIAN CYCLE

Some time after the emplacement of the dykes there followed a further long period of intense tectonic disturbance and metamorphism in which there is some evidence for distinct episodes.

2.5.1 The Early Laxfordian Metamorphism

Clouded feldspars and garnets are valuable indicators of metamorphism in the dykes. They have been attributed (Sutton and Watson (1951 B)) to the earliest effects of the Laxfordian (with the reservation that they could have been the result of autometamorphism). The phenomena have been ascribed to incipient granulite facies metamorphism by Dearnley (1962) who regarded this as part of the Laxfordian cycle because the folding in this event had the same trend as the following retrograde metamorphism; the terms Early Laxfordian and Late Laxfordian were proposed (see also Dearnley (1963), Dearnley and Dunning (1968), Dearnley (1973)). Attempts are at present being made to date the Early Laxfordian which is considered to be of higher grade in the Outer Hebrides than on the mainland. Watson (1965) regarded it as weak on the mainland. Coward and others (1969) maintained that in the Outer Hebrides the earliest Laxfordian alteration is mostly of amphibolite but locally of granulite facies. An event affecting the dykes in the granulite facies, even if only "incipient" or "weak", would be significant for the palaeomagnetic interpretation in that the temperature would be greater than the Curie point of magnetite, 580°C.

2.5.2 The Late Laxfordian

This metamorphism, originally known simply as the Laxfordian, was in the amphibolite facies. The whole Lewisian was affected by it but differences in its intensity resulted in the formation of the three regions of the mainland belt. The metamorphism was most intense in the northern and southern regions. These are separated from the central block by transition zones which are a few km wide and within which zones marking intensities of the metamorphism have been distinguished (Sutton and Watson (1951 A)). The Late Laxfordian had two main effects:

2.5.2.1 Chemical Changes

The metamorphism involved the circulation of pore-fluids; exchange of elements (metasomatism) took place between these liquids and the crystals in the rock. Substantial increases in the potassium content of the gneisses occurred in this way (Peach and others (1907), Sutton and Watson (1951 A, 1969), Holland and Lambert (1972)). Such increases ensued in the dykes too (Burns (1966)), indeed they responded sensitively to the potassium chemistry of the host rocks, although their lithium content remained essentially constant (Holland and Lambert (1972)). (Apparently lithium metasomatism was a feature of the Inverian but not the Laxfordian). New minerals, particularly microcline and biotite, were formed in the gneisses by the introduction of potassium and these enable the progress of the metamorphism to be studied.

The effect of the water was to introduce the OH radical and so produce amphiboles and micas from anhydrous pyroxenes and garnets.

At the highest grades of Laxfordian metamorphism temperatures rose to a level at which a new clinopyroxene became stable (Sutton and Watson (1951 A)) and its occurrence is also a useful indicator of the metamorphic intensity.

2.5.2.2 Structural Effects

In contrast to the Scourian trend the stresses in the Laxfordian produced structures with a NW/SE strike (parallel to the dykes). These stresses caused plastic flow of the very hot rocks in the northern and southern regions, whilst in the central region they were rigid and responded by fracturing into blocks with dimensions of a few hundred metres. At their margins relative movement occurred, accompanied by penetration and metasomatism by the hot fluids already mentioned (Beach and Fyfe (1972)); plastic flow developed in these shear-zones and shear-belts, a few cm to 30 metres wide. These features often followed dyke margins which were zones of weakness.

Other important effects were the development of a foliation marked by alignment of minerals: also banding, folding, faulting and joint-formation. Joints sometimes developed into fissures which allowed volatiles to circulate resulting in late pegmatites.

Laxfordian stresses have been especially studied in the northern region (Sutton and Watson (1962)). The dominant factor was compression by planes dipping at 60° to the SW; this caused reduction of the angle between the banding in the gneisses and the planes of the dykes and halved the number of dykes per km (Fig. 2.4). On this model it is also clear how the banding in the gneisses developed a strike parallel to the dykes, in contrast to the strike of Scourian structures. When the pressure relaxed late in the Laxfordian the granite sheets were emplaced.

Laxfordian effects seen in the field are remarkable for their patchiness. This observation seems to be due partly to the metamorphism itself and partly to rock composition. Relics of basic Scourian gneisses have been noted deep in Laxfordian country where the acid gneisses have been entirely reconstituted. (Sutton and Watson (1951 A, 1962). In the central region

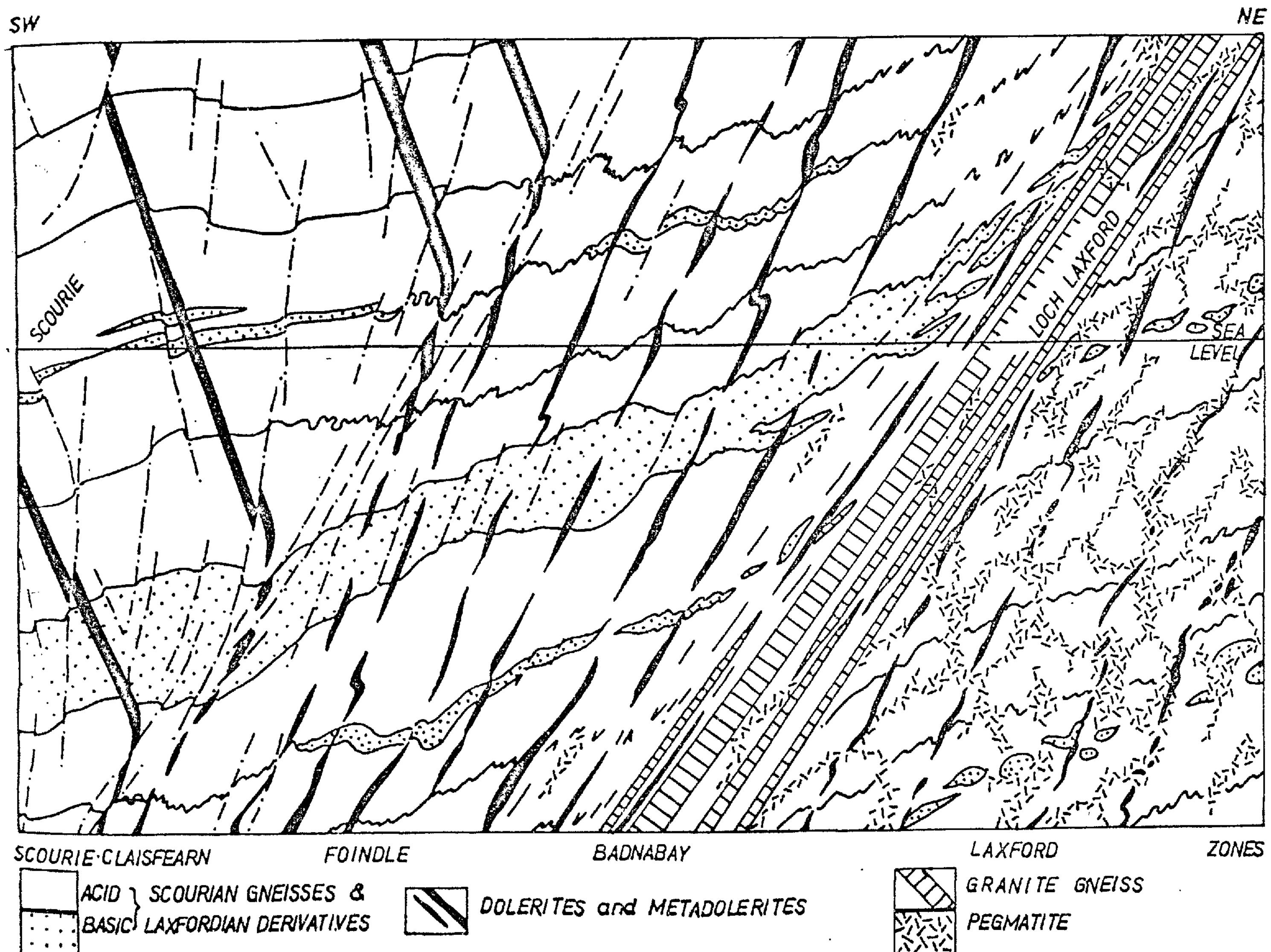


Fig 2.4
Schematic Section of the Margin of the Laxfordian Complex (after Sutton & Watson (1962)).

patches of altered rock are found within a few metres of unaltered rock particularly in the dykes (Evans and Tarney (1964)) which responded more readily to changes in their environment (Sutton and Watson (1951 B)) than the gneisses.

2.5.2.3 Temperature and Pressure in the Late Laxfordian

In the northern and southern zones the metamorphism was of high-grade in the amphibolite facies, indicating temperatures of 650 - 700^{o}C. The central block although not generally metamorphosed contains Laxfordian structures and must therefore have been heated in this disturbance (Watson (1965)). Watson and Tarney have estimated independently (in discussion) that the temperature might have been 400 - 500^{o}C.

This metamorphism occurred less deep in the crust than the Scourian. However it was not a shallow event because there are no local indications of those igneous rocks associated with granite which are known to form at high crustal levels, e.g. felsites, porphyrites and lamprophyres. Moreover the metamorphic minerals are not those characteristic of low pressure metamorphism. A fair estimate of the depth might be 10 km.

2.5.2.4 Dating the Late Laxfordian

A generation of pegmatites, including π2 at Badcall, arrived late in this metamorphism. The mean Rb/Sr age in feldspar for π 2 is 1,650 ($\pm$ 40) Ma (Giletti and others (1961)). Similarly a Laxfordian pegmatite in the Outer Hebrides has been dated at 1,679 ($\pm$ 25) Ma by the K/Ar method applied to biotite (Francis and others (1971)).

The height of the metamorphism would have occurred previously. Its minimum age has now been estimated at 1,850 ($\pm$ 50) Ma and the metamorphism is said to have ended by 1,750 Ma (Lambert and Holland (1972) using the Rb/Sr and K/Ar methods).

In the southern region the main metamorphism occurred at 1,700 Ma (minimum) according to Moorbath and Park (1972).

2.5.3 Post-Late Laxfordian Episodes

Some scattering of dates is characteristic of geochronological work in the Lewisian (Giletti and others (1961), Evans and Tarney (1964), Evans (1965), Evans and Park (1965), Lambert and others (1970 A), Moorbath and Park (1972), Lambert and Holland (1972)). This spread has often been held to reflect specific events which may sometimes overprint each other. In the Laxfordian cycle, the interpretation of Lambert and Holland (1972) is that after the peak of metamorphism there was gradual cooling of the crust over 400 Ma. However these authors concede that there may have been a distinct event at about 1,400 Ma at Gairloch (Evans and Park (1965), Park (1970 B), Moorbath and Park (1972)) and at Lochinver (Evans (1965)). The present writer believes that the evidence of Evans and Tarney (1964) may indicate a happening at Badcall at about this time (9.4).

The K/Ar dating technique of Moorbath and Park (1972) has relied upon specific minerals and has resulted in the distinction of events at the following times in the southern region:

1,700	main metamorphism
1,500	
1,400)	localized reheating
1,150)	

There is no evidence of any further metamorphism or thermal events in the parts of the Lewisian sampled in this study; in particular, there is no evidence of the Caledonian orogeny.

Shortly after 1,000 Ma the complex became covered by Torridonian sandstone Moorbath (1969) which accumulated to a depth of many thousands of metres. This in turn was covered by the Cambrian and younger formations, followed by erosion revealing the present aspect of the Lewisian.

TABLE 2.3

Summary of Lewisian History

Events	Date Ma
The Lewisian complex became covered by Torridonian sandstone.	Upper: 751 Lower: 935
Reheating episode at Torridon	1,150
Retrograde metamorphic episodes in specific localities	1,400
Slow cooling of the Laxfordian complex	1,800 - 1,400
Late Pegmatites	1,650
End of the Late Laxfordian	1,750
Height of the Late Laxfordian	≥ 1,850
Early Laxfordian, perhaps intense in the Outer Hebrides but mild on the mainland	As yet undated
Intrusion of the dykes	Say 2,260 but see Chapter 3.
Inverian	Min: 2,260 Max: 2,320 but perhaps less precise.
Early Pegmatites: within the range	2,300 - 2,600
End of the Early Scourian	2,600
Height of the Early Scourian	2,900
Katarchaean relics, probably	> 3,000

2.6 COMPARISON OF LEWISIAN EVENTS WITH GLOBAL EVENTS

Pre-Cambrian dates throughout the world are concentrated in clusters with sharp peaks (Dearnley (1965 A)). The correlation between these and Lewisian dates is striking (Fig.. 2.5) and thus bears out the global significance of Lewisian activity suspected by Sutton and Watson (1951 A). In turn these peaks may be associated with major events in the history of the mantle and core manifested by constant polarity of the ancient geomagnetic field. This line of thought receives support from the palaeomagnetic results of this thesis and will be amplified in their interpretation (9.6).

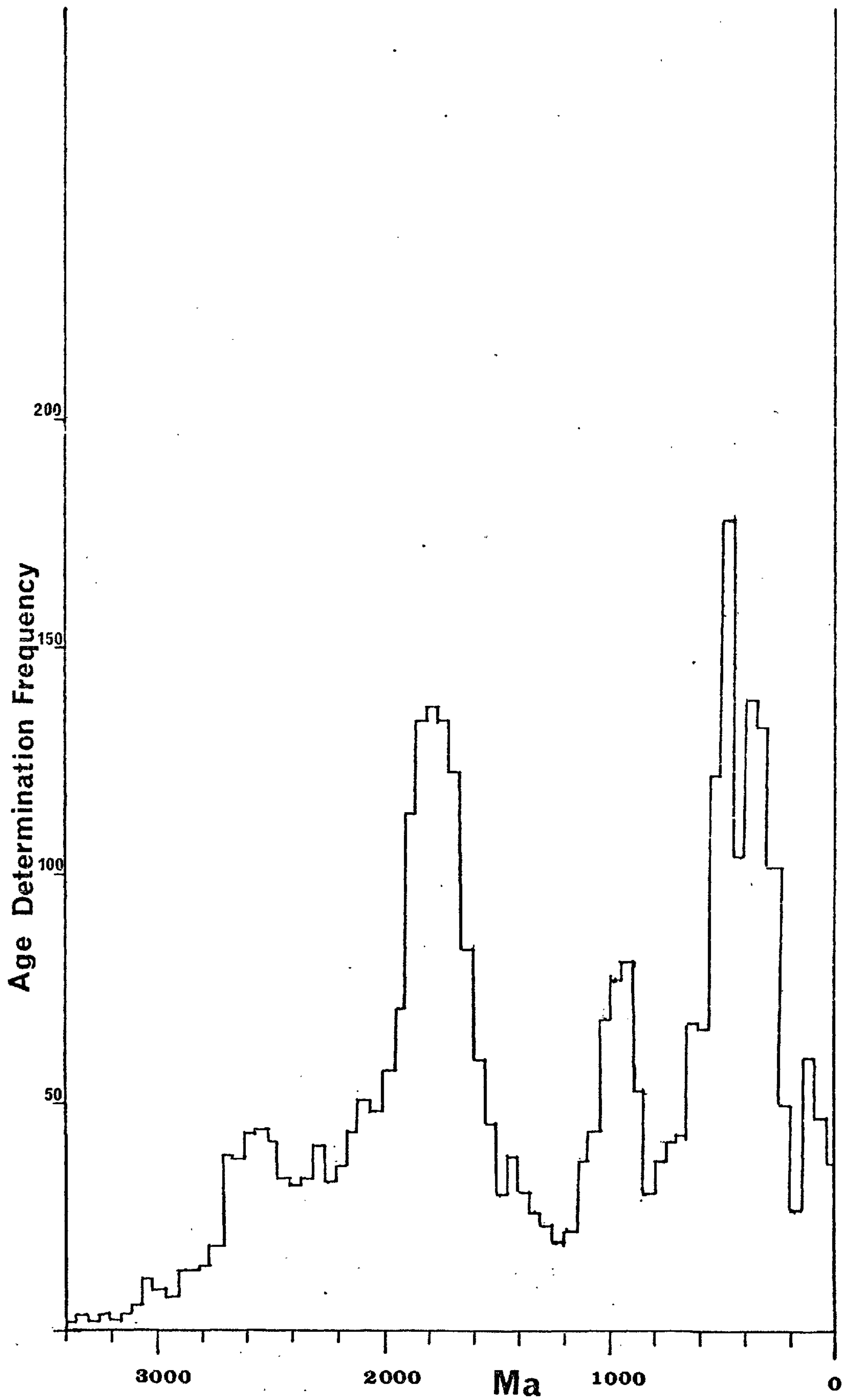


Fig 2.5 Histogram of age determinations.
(after Dearnley (1965)).

CHAPTER 3

THE DYKES

3.1 INTRODUCTION

The dykes occur as a swarm over the whole Lewisian. The widths of individual dykes range from a few cm to over 200 metres. Their strike is approximately NW/SE and their dip, at least in the central zone, averages about 70° to the NE. The dyke rocks weather slightly more readily than the gneisses and so form troughs, a feature which is useful in locating dykes.

Teall (1885) described one of the dykes immediately to the north of Scourie; consequently the dyke swarm became known as the "Scourie dykes". Subsequently two generations of dykes were distinguished, the basic and the ultrabasic; nevertheless Bailey (1951) was content to group all the dykes under the general heading.

O'Hara (1962) recognized four types of dyke in close association at Badcall and Tarney (1963) described eight types in the Assynt district. Evans and Tarney (1964) reserved the term Scourie dykes for the common variety, the dolerites, whose essential minerals are monoclinic pyroxene and labradorite (Read and Watson (1968), 385).

Of the other varieties the picrite dykes are the most important; these are ultrabasic and therefore characterized by low feldspar and a high mafic mineral content, e.g. olivine. South of Lochinver these dykes have the same strike as the other dykes but in the Assynt region they are inclined somewhat towards the E/W direction, sometimes cutting the dolerites, thus proving that the ultrabasics were a later generation.

Subsequent sections of this chapter deal with dyke attitudes, criteria of alteration, the conditions of dyke intrusion, and the ages of the dykes.

3.2 DYKE ATTITUDES

The simultaneous constancy of the strike and dip of the dykes in the central region for a distance of about 50 km is a remarkable feature. This is the best evidence for regarding the Scourian part of the Lewisian complex as having remained a rigid block since dyke intrusion.

3.2.1 Dips

The dip of about 70^{o} to the NE contrasts with vertical dyke swarms, say the Tertiary dykes. The present dip of the Scourie dykes may have been their original dip or they may have been intruded with some other dip, including the vertical possibility. However if they were initially vertical it is not clear how the present dips might have been acquired. The dips of the Torridonian sandstone are generally only a few degrees and so the present dips of the dykes were probably in existence in Torridonian times. The effect of the Laxfordian was to change a pre-existing dip in the altered regions (by rotation in the northern region and by folding in the southern region) with respect to the unaltered ones (Sutton and Watson (1962, 1969)). In addition it could perhaps have caused a general rotation of the block; however a consequence of this suggestion is that a difference of level amounting to say 18 km would have resulted. When erosion had taken place yielding the present exposures of the Lewisian, differences of petrology would be expected, unless the further assumption is made that this effect was counteracted by faulting parallel to the dykes. At present there are apparently no grounds for supposing that the original dips of the dykes differed from their present dips. (As we shall see, it will probably be sufficient in this thesis to assume that the dips have remained constant since the Late Laxfordian).

3.2.2 Rotation about an axis at right angles to the Strike of the Dykes?

This matter is more complicated in view of the unconformities between the Cambrian and the Torridonian and even within the Torridonian itself. Considering first the Cambrian and Torridonian, the apparent post-Lewisian movements are indicated in Fig. 3.1, in which the attitude of the Lewisian is thought to have been altered and then tilted back to nearly its original position. The figure illustrates the common exposures of the Torridonian which have shallow dips. However at the base of the Torridonian evidence has been found (Stewart (1966)) in 3 localities of a sandstone formation dipping at 25^{o} - 30^{o} to the West (Fig. 3.2). It may be the case that this represents the ancient horizontal or it may indicate a faulted block (like the island of Handa) or an accumulation of sediments down an ancient mountain-side or in a hollow.

The most promising approach to the whole problem of finding the ancient horizontal in dykes may lie in work now being carried out by Dearnley. It appears that plagioclase laths well away from a margin tended to settle horizontally. If this is verified in Tertiary dykes, whose attitude has changed little since intrusion, the method will be extended to Scourie dykes.

Meanwhile in this thesis, although the palaeomagnetic results may be wrong on account of the lack of tectonic correction, there are no compelling grounds for applying a particular correction to them.

3.3 DEGREE OF ALTERATION

The dykes vary greatly in degree of alteration. In the Assynt and Strathpolly regions there are many little-altered dykes; in the block from Scourie to Kylescu they tend to be less unaltered. In the transition zone north of Scourie they are distinctly altered whilst in the completely

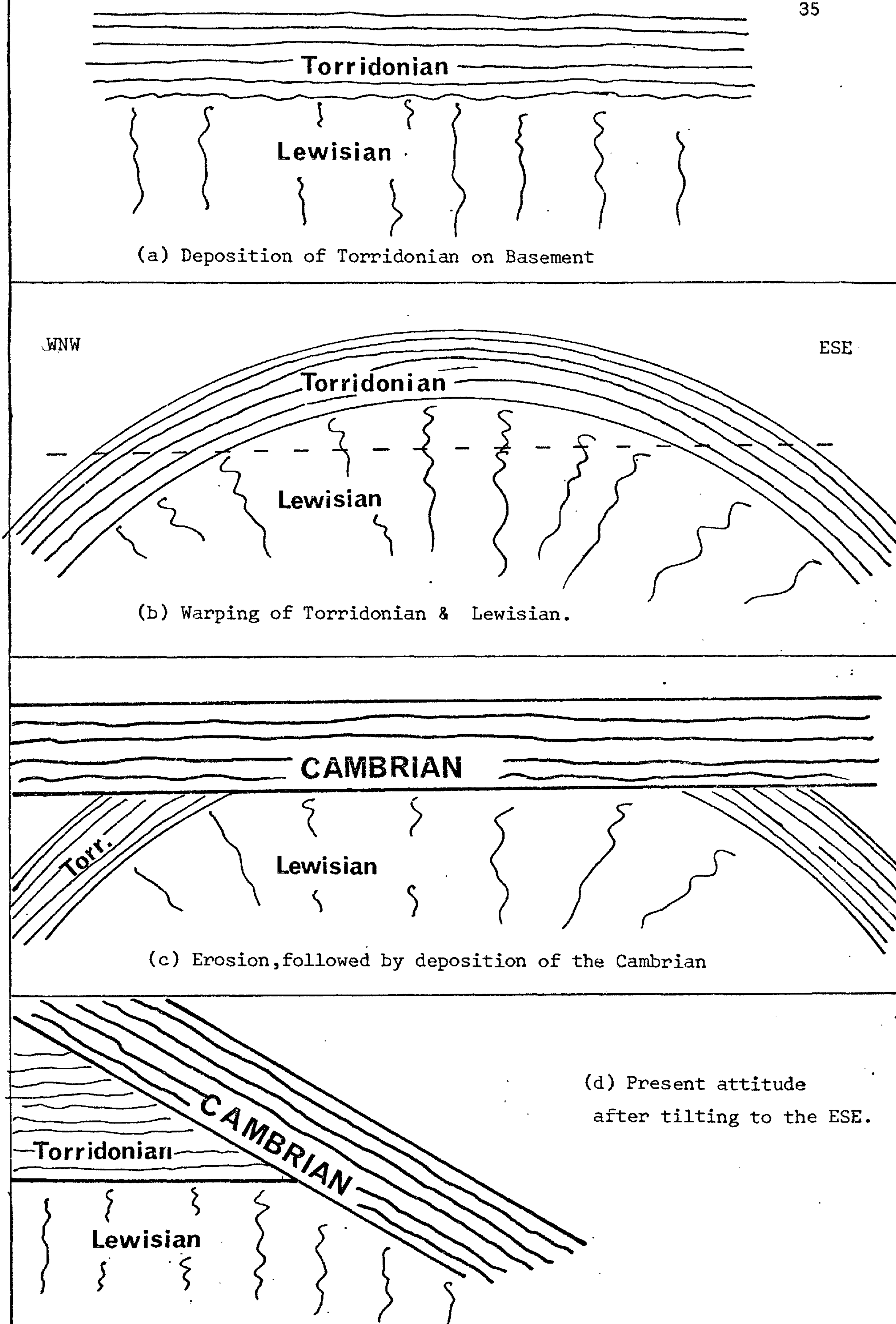


Fig 3.1 Apparent post-Lewisian movements.

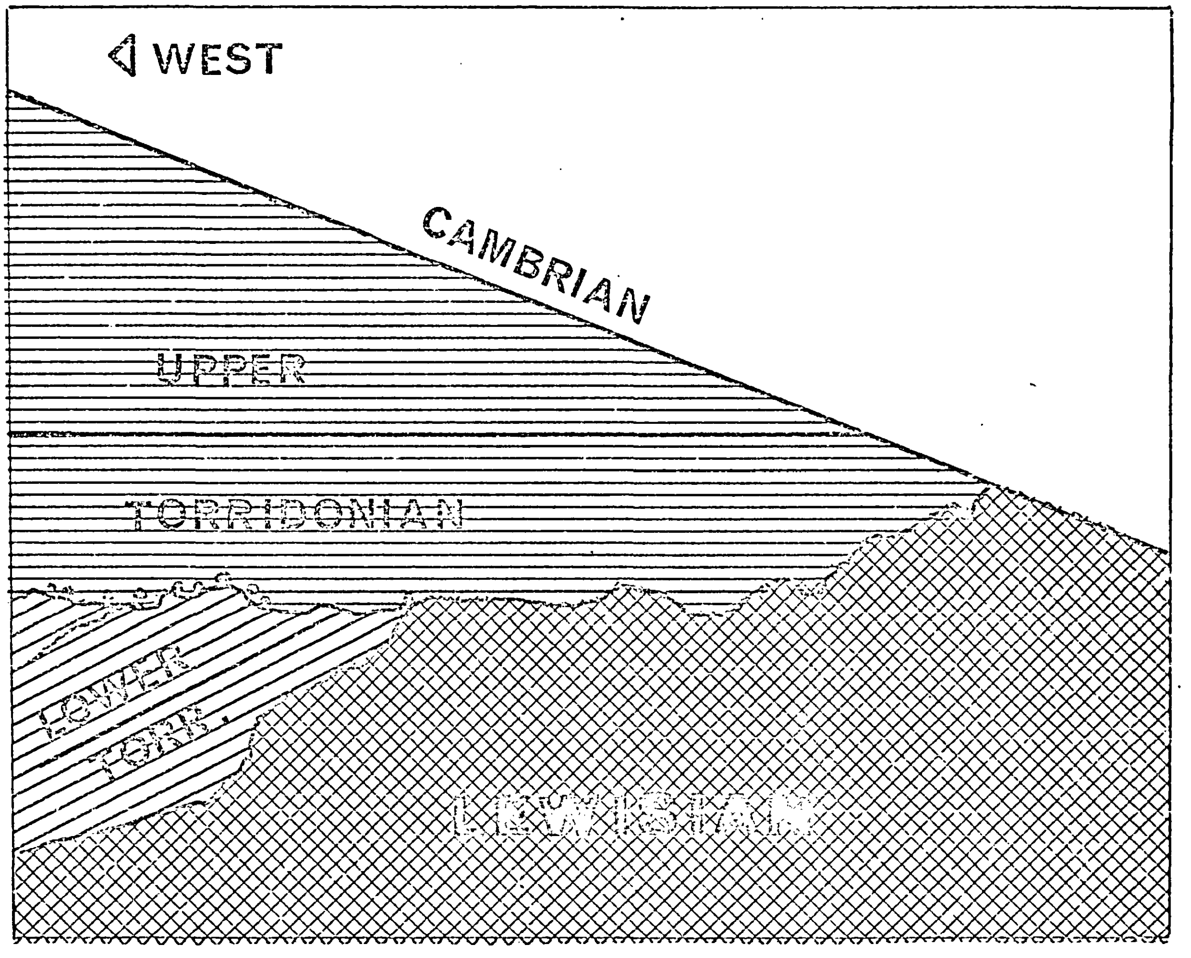


Fig 3.2 The unconformity in the Torridonian
(after Moorbath & others (1967)).

regenerated rocks north of Laxford Bridge it is often impossible to distinguish the dykes from older basic gneiss. On the basis of such differences the dykes played a vital role in discriminating between the Scourian and Laxfordian metamorphisms.

This thesis is almost invariably concerned with little-altered dykes. However even the freshest have experienced some modification. Apparently it is not possible to find a Scourie dyke which is as little-altered as say a Tertiary dyke in Skye.

Alteration occurs as a result of elevated temperature and pressure and involves recrystallization and the development of new mineral species. It is usually accompanied by physical disturbance of the dyke. Where extensive alteration has taken place its effects are clearly recognizable in the field. (Dykes showing such obvious modifications were not sampled in this survey).

3.3.1 Structural Criteria of Alteration

The significance of slight amounts of structural modification of the dykes can best be appreciated by considering the effects of the Laxfordian where it has acted intensely on the dykes. The change in dips seen in Fig. 2.4 from 70° to NE to $45 - 70^{\circ}$ to SW occur over less than 1 km (whilst the strike remained unaffected). This change was accompanied by squeezing into thicker and thinner portions and separation into lenticular fragments.

The banding in the gneisses, where least modified by Laxfordian influences, is rather flat-lying and strikes at $60 - 90^{\circ}$ with the strike of the dykes. Such dykes are said to be discordant. However the effect of Laxfordian compression was to change the dip of the dykes and to cause the banding in the gneisses to lie in parallel planes to the dykes, which are said to be concordant (Fig. 3.3).

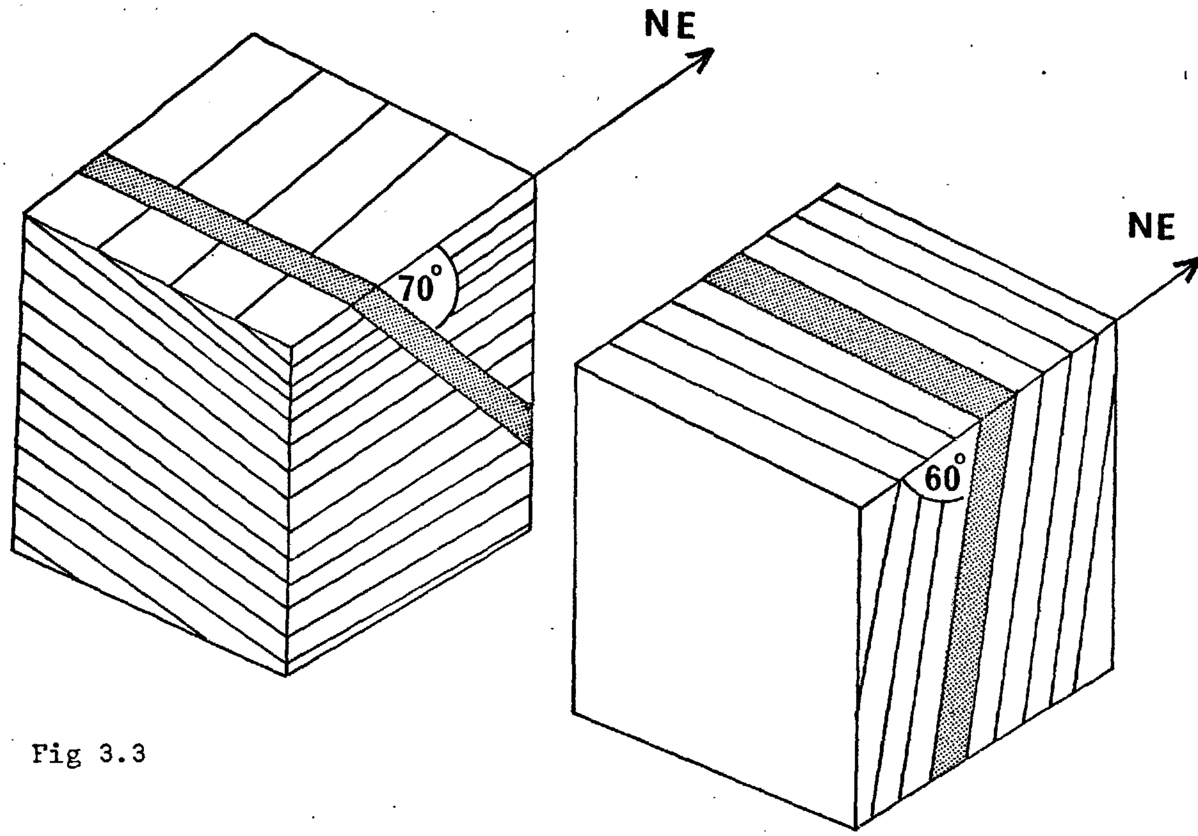


Fig 3.3

(a) A Discordant Dyke (b) A Concordant Dyke

The Attitudes shown are typical of the Scourie Dykes.

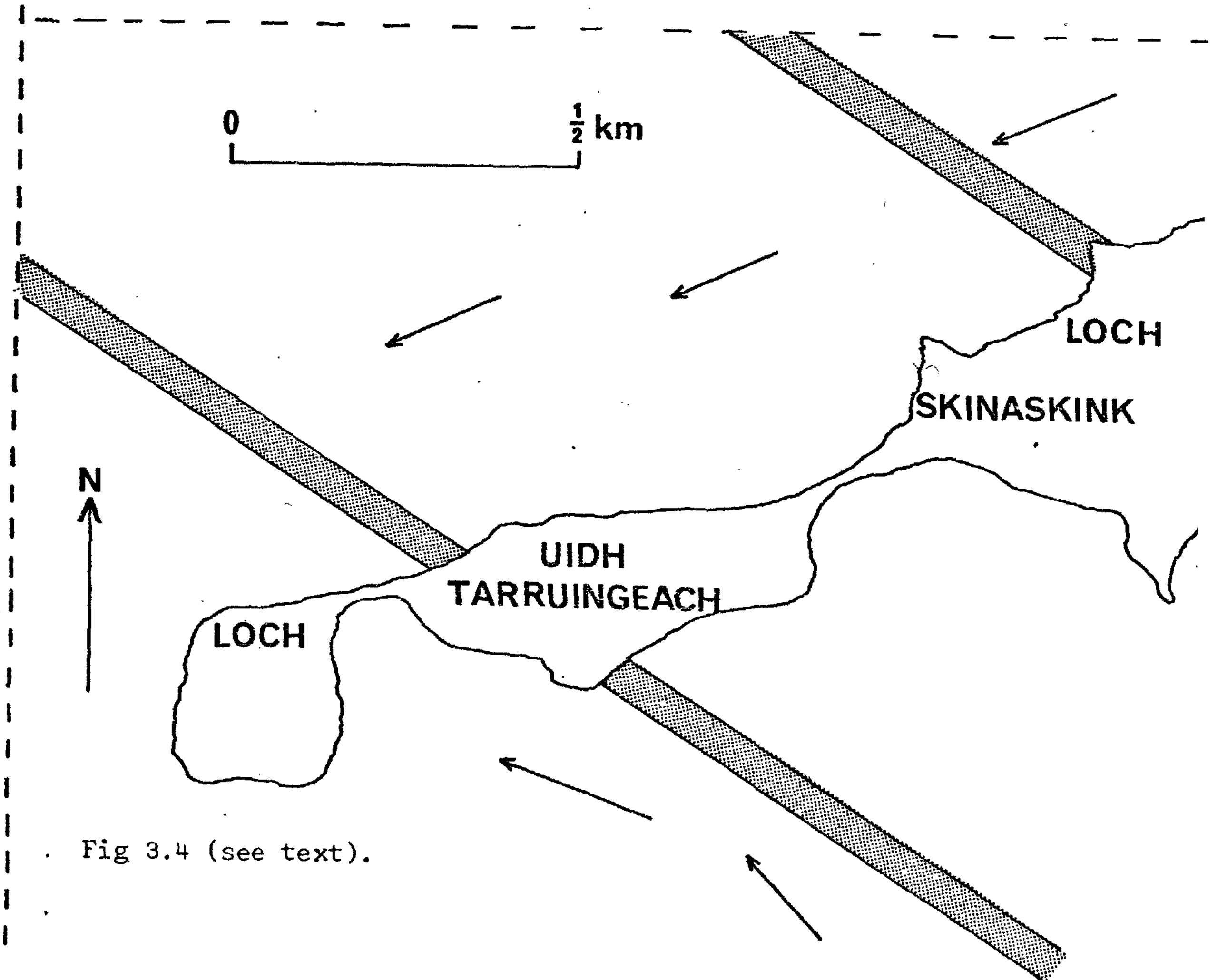


Fig 3.4 (see text).

3.3.1.1 Evidence of non-disturbance

Evidence that a dyke has not been disturbed since emplacement comes from several factors taken together. When a dyke runs straight, has constant width, and has dip near the average for the central block, we have such evidence. The presence of branching is a good sign; it appears from the lack of obvious branching in the transition zones that an effect of the Laxfordian was to eliminate branches by squeezing them out of existence.

Both the Late Scourian (Inverian) and the Laxfordian resulted in steeply dipping structures in the gneisses, in which the dykes approach concordance. Conversely shallow dips in the gneiss banding, say $< 25^{\circ}$, provide an indication that the gneisses have not been greatly disturbed since their formation and therefore that the dykes have not been disturbed either. Where the dips in the gneisses are greater, the disturbance may have taken place before or after dyke intrusion, that is either in one of the Scourian episodes or the Laxfordian. It is sometimes possible to distinguish between these alternatives using the 6" geological survey maps; where a dyke is undistorted even though it runs through two zones of gneisses with different dips, it is probable that the variation of dip in the gneiss was pre-dyke.

A similar point may be clearly seen in regard to the strike of the gneisses by looking at the 6" map of Peach and others (1888), sheet 1c. (Fig. 3.4). The two dykes in the Figure are parallel, even though they pass through gneisses having different strikes. This shows that the contortion of the gneisses took place before the intrusion of the dykes.

The condition of the dyke margin is another valuable guide. Where the contact is sharp and the marginal rocks of the dyke show no foliation we have evidence that there has been no disturbance; sometimes there is shattering at the margin, in which case it is known that there has been some movement, and sometimes the marginal part of the dyke shows a foliation, indicating movement and recrystallization.

The greater geological stability of basic gneisses compared with the acid variety has frequently been stressed (2.3.2). Basic bodies tend to resist deformation and recrystallization and so retain features which may be lost in the more acid gneisses which enclose them. For this reason dykes within basic bodies tend to be protected from gross deformation and alteration. The greater abundance of basic gneisses in the Strathpolly and Assynt regions may be one of the factors responsible for the favourable palaeomagnetic results from the dykes there (8.2.1.1).

3.3.2 Mineralogical Criteria of Alteration

In order to appreciate altered dyke mineralogy it is first necessary to note the primary mineral assemblages.

3.3.2.1 Primary Mineral Assemblages

The following table indicates the primary minerals which are usually encountered in the Scourie dykes:

TABLE 3.1

Primary Minerals in the Dykes

Dyke Type	Major Minerals	Minor Minerals
The Dolerites	Pyroxene(s): Clinopyroxene (monoclinic) and sometimes Hypersthene (orthorhombic) Feldspar: Plagioclase (zoned crystals with labradorite cores)	Magnetite Ilmenite Quartz Hornblende ± Olivine
The Ultrabasics	Olivine Pyroxenes (monoclinic and/or orthorhombic)	Magnetite Ilmenite Spinel Hornblende Plagioclase (very little)

3.3.2.2 Mineralogy of altered dykes

Teall (1885) described the metamorphism of the Scourie dyke on the north side of Scourie Bay and distinguished seven stages of alteration. The interest in this thesis lies in slight alteration of little-altered dykes. Nearly all the dykes in the present survey fall into Teall's first stage: "hornblende rims form round the pyroxene grains". For the purpose of this study the following more sensitive scale of mild alteration as seen in thin section has kindly been devised by Dr. J. Watson:

3.3.2.3 Mild Alteration in Scourie dykes

Category 1 (the least altered)

The Plagioclase laths are intact, not distorted or recrystallized. The main modification is clouding in the form of a host of minute transparent specks (due to exsolution).

The Pyroxenes have thin rims of hornblende around them. The pyroxenes have a mosaic texture.

Category 2

Plagioclase is the same as in 1.

Pyroxenes have slightly wider rims of hornblende. Under crossed Nicols the pyroxenes look patchy because pale amphibole related to hornblende has developed inside the grains; this appears as yellow fuzz and dark brown stringers.

Category 3

Plagioclase sometimes has a patchy appearance under crossed Nicols, but for the most part appears unaltered.

Hornblende is now more noticeable and constitutes about 1/3 of the ferromagnesian minerals.

Pyroxene areas are now very patchy under crossed Nicols with much hornblende inside. Sometimes there's a worm-eaten appearance too.

Category 4

Beginnings of extensive plagioclase modification; specks of hornblende inside.

Pyroxenes: very little left; replaced by pebbly clusters of hornblende. The sites of the pyroxene grains are still just visible.

Most of the dykes fall into the first three categories. Category 4 is regarded as "thoroughly altered" although it is only the second of Teall's seven stages.

Sometimes the feldspars are bent without having recrystallized; this indicates that the dyke has suffered deformation.

Garnets (2.5.1) and biotite are sometimes seen and are both indicative of metamorphism.

3.3.2.4 Field Assessment

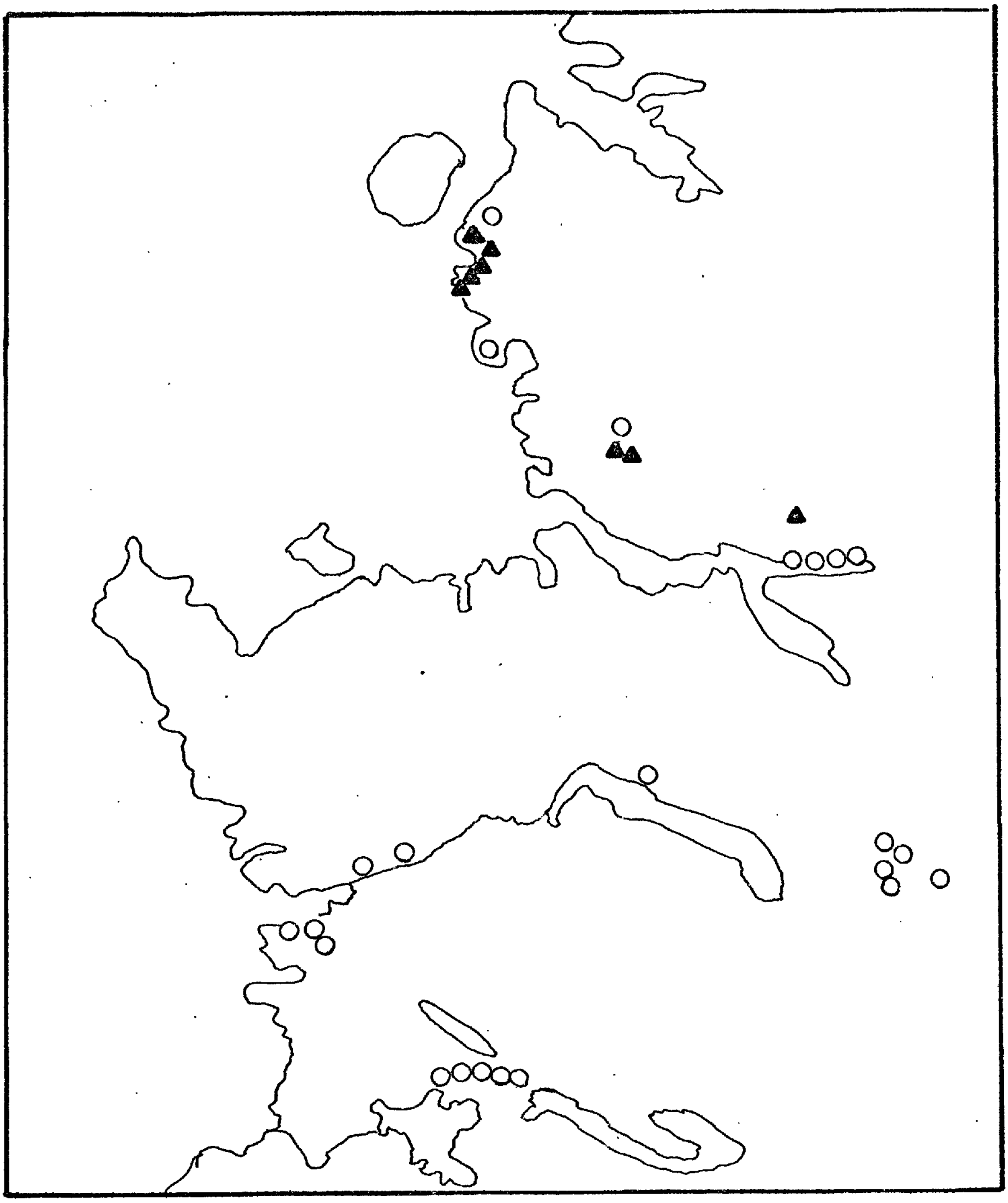
The recognition of little-altered dykes in the field requires experience. Unaltered dykes have a rather uniform grey texture and the mineral crystals interlock in a random manner. On the other hand, in altered rock, green-black crystals of hornblende are seen and the feldspars assume a chalky-white appearance due to alteration products; such rocks have a speckled aspect and may show a parallel texture (foliation). Rocks displaying foliation were usually rejected; shear zones were always avoided. The colour of the drilling mud was also noted because this is a useful diagnostic feature. An unaltered dyke yielded whitish-grey mud, whereas green mud indicated much hornblende; red mud was occasionally encountered at least initially, indicating haematite weathering.

3.4 CONDITIONS OF DYKE INTRUSION

Sutton and Watson (1951 A) envisaged the following series of events:

1. Scourian metamorphism deep in the crust.
2. A period of uplift and cooling.
3. Intrusion of the dykes at a high level in the crust when it was cool.
4. Burial of the complex and the onset of the Laxfordian metamorphism.

Later the alternative view was advanced that the dykes were intruded at great depth into hot rock (O'Hara (1961B, 1962), Tarney (1963), Evans and Tarney (1964)). O'Hara's argument was based on the garnets in some dyke margins (Fig. 3.5), which he attributed to autometamorphism in the amphibolite facies during slow cooling of the complex, whilst the granulite facies mineralogy of the country rocks, which were estimated to be at 300 - 500°C,



▲ = Garnets Present

○ = Garnets Absent

Fig 3.5 Occurrence of Garnets in Dyke Margins (after O'Hara (1961B)).

persisted metastably.

On the basis of the stability of a number of minerals, Tarney (1963) estimated that the temperature of the gneisses at the time of dyke emplacement was 500°C and that the depth was 15 - 20 km. The hot rock view is now favoured by Watson (1973 B) at least in respect of the earlier members of the dyke swarm.

On the other hand, if the country rocks were as hot as this, the dykes might be expected to have caused partial melting of the gneisses at the margins (Dearnley (1973)), especially the ultrabasic dykes which were even hotter than the dolerites. However partial melting is rarely seen. Dyke intrusion must therefore have occurred when the country rocks were cool and at a high level in the crust (Dearnley (1962, 1963, 1973)); moreover in these conditions garnets could not have been formed by autometamorphism (Dearnley (1973)). Some time after intrusion the dykes, on Dearnley's view, were deeply buried and experienced the Early Laxfordian metamorphism.

Evidence for pre-Laxfordian amphibolite facies metamorphism of the dykes has been regarded as the consequence of simultantaneous intrusion and amphibolization by two mechanisms:

(a) Autometamorphism, as already noted,

(b) In specific localities, as a result of the Inverian, both on geological grounds (Tarney (1963), Evans and Tarney (1964)) and on geochronological grounds (Moorbath and Park (1972)).

3.5 DYKE AGES

The dates for the pegmatites π 1 and π 2 at Badcall are 2,540 and 1,650 Ma respectively (Giletti and others (1961)); these placed limits on the age of the dykes. 33 dykes have since been dated, see Table 3.2 and

TABLE 3.2

Scourie Dyke Ages

Authors	Locality	Method	Mineral Used	Ages (Ma)	No. of Dykes	NOTES
Evans & Tarney (1964)	Scourie, Badcall, Assynt, Lochinver	K/Ar	Whole rock	1390 - 3860	15	Concentration at 2,200 Ma. Older dates due to excess argon. Younger dates partly due to "overprinting," partly to possible spread of ages from 2,200 - 1,950 Ma.
" " "	near Lochinver	Rb/Sr	Biotite/ whole rock	2260 (± 50)	1	This dyke is included in the 15 above.
Moorbath (1967)	Loch Duich, just north of Glenelg east of the Moine Thrust	K/Ar	Hornblende	1500 - 2200	1	Dyke age at least 2,200 Ma; this dyke is in a Lewisian inlier. Gneiss biotite age 420 Ma.
Lambert and others (1970A)	South Uist and Benbecula.	K/Ar	Whole rock	1720 1565 1500	3	post Late Laxfordian dates ?
Lambert and others (1970B)	Central Lewis	K/Ar	Whole rock	2490 2380 (± 60)	1	This dyke is in an area where regional Laxfordian regeneration is slight. The authors believe that this is not an "excess argon" age.
Moorbath and Park (1972)	Torridon, Gairloch & Gruinard Bay areas	K/Ar	Whole rock	2230	1	This dyke is believed to have been emplaced during the waning Inverian; its age is interpreted as a minimum.
		K/Ar	Hornblende	1468 - 1712	12	These dykes showed signs of alteration and the results were used to separate events in the Laxfordian.

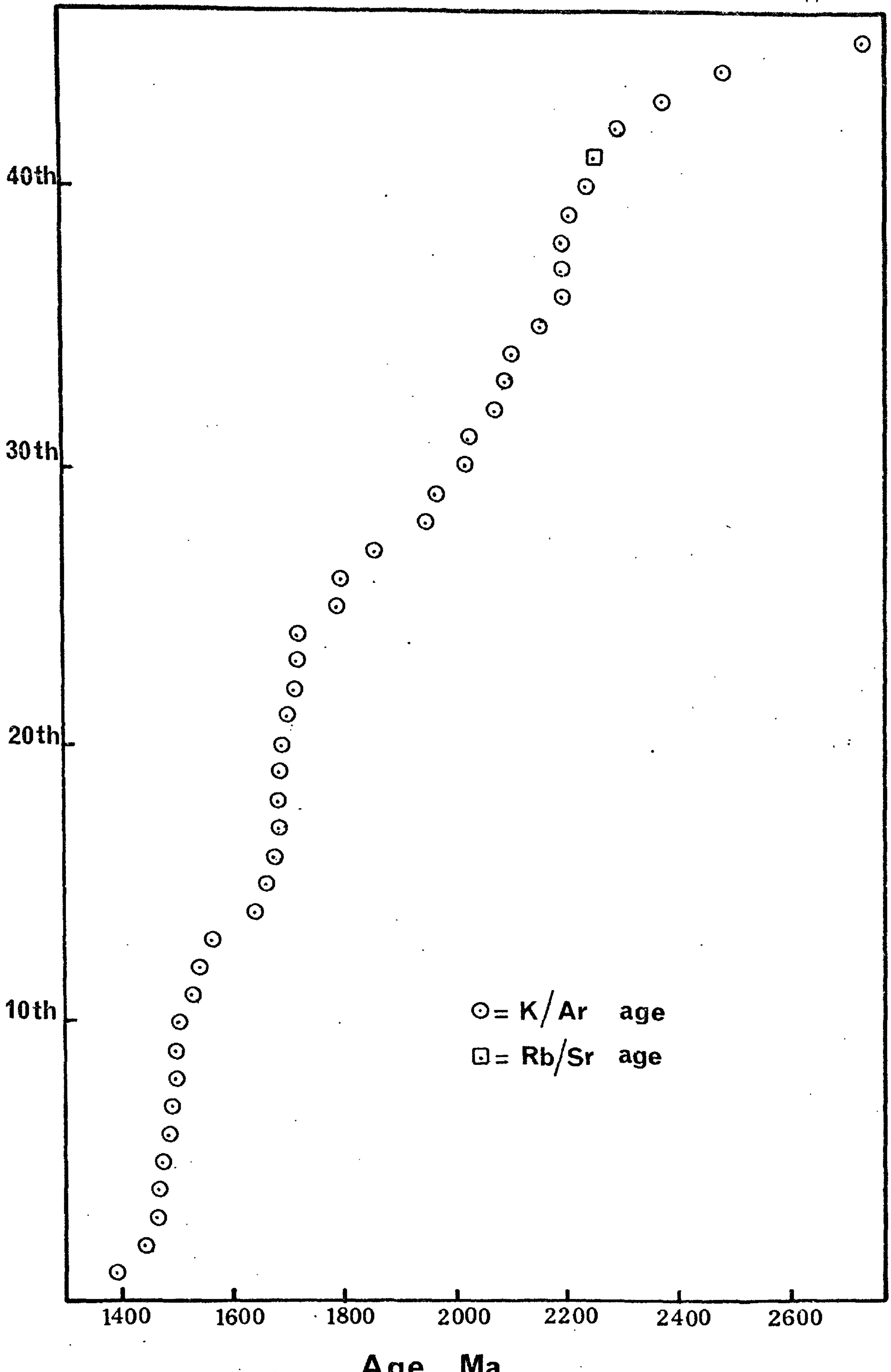


Fig 3.6 Dyke Ages. The ordinate is the number of the analysis when arranged in order of apparent age. The excess argon ages 3,800 and 3860 have been omitted.

Fig. 3.6. One determination was by the Rb/Sr method whereas the remainder were K/Ar dates.

3.5.1 Some Remarks on Dating Methods

Mineral ages are thought to represent points in the history of cooling and uplift at which radiogenic isotopes are retained. It is this stage which is dated rather than the peak of metamorphism (or dyke intrusion). For argon the temperature at this stage has been estimated at 300°C (Lambert and Holland (1972)). Conventional potassium-argon dates in orogenic belts are nearly always too low; at best they approach the true age only when there has been a completely uneventful history (Fitch and others (1969)). However it has been calculated that amphiboles (e.g. hornblende) will retain their argon for 100 Ma at 500°C and that such dates approach the time of the last crystallization. The Rb/Sr method on whole rocks also yields ages approaching the time of crystallization (Moorbath (1967)).

3.5.2 Application of Dating Methods to the Dykes

The K/Ar method using hornblende has been applied to altered dykes with a view to isolating specific events in the Laxfordian (Moorbath and Park (1972)). (See Fig. 3.6 and (2.5.3).).

The Rb/Sr method using whole rock and biotite was applied to one of the fairly unaltered dykes. The resulting age 2,260 (± 50) Ma is probably close to the age of intrusion of this dyke, which is a picrite. The dolerites preceded the picrites and so on this evidence were emplaced prior to 2,260 (± 50) Ma.

The scattering of K/Ar dates in the Lewisian has been noted (2.5.3). This may be largely due to the mineral assemblages becoming closed systems at different times but is sometimes due to the presence of "excess argon" (Evans and Tarney (1964), Evans (1965)). (This is rather rare in orogenic belts (Fitch and others (1969)) but has also been noted in other environments, e.g. by Funkhouser and others (1968).) Such a scatter in the dyke ages has however been interpreted alternatively as the result of dyke intrusion in distinct episodes over about 1,000 Ma (e.g. Bowes (1968)).

One of the objects of Evans and Tarney (1964) was to ascertain whether any of the unaltered dykes were Laxfordian. The conclusion reached was that the majority of the dolerites were intruded between about 2,200 and 1,950 Ma and so were pre-Laxfordian. Over part of the area the (Inverian) gneissses were dated at 2,200 - 1,900 Ma; this factor may in some cases have set an upper limit to the dyke dates even though they might have been intruded previously. In view of this aspect, the whole rock K/Ar date 2,230 Ma for one dyke has been interpreted as a minimum age by Moorbath and Park (1972) who stated that "the age of intrusion and primary amphibolitization of the basic dykes remains a problem". For the purposes of this thesis it will be sufficient to assume that the dykes were indeed pre-Laxfordian (Sutton and Watson (1951 A), Watson (1973 B)); the Rb/Sr date 2,260 Ma will be quoted when a representative date is needed.

CHAPTER 4

PALAEOMAGNETIC SAMPLING AND MEASUREMENT

4.1 FIELD WORK

Orientated cores, 2.45 cm diameter and about 6 cm long, were collected using the procedure of Doell and Cox (1967A) in conjunction with a Brunton compass and local 1" and 6" ordnance survey maps.

4.2 THE PALAEOMAGNETIC LABORATORY

The apparatus in the laboratory consists of an astatic magnetometer, a Spinner magnetometer and equipment for A.C. demagnetization.

4.2.1 The Astatic Magnetometer

An astatic magnetometer has been constructed which measures intensities of magnetization from 3×10^{-6} to 2×10^{-3} emu/cm^3. It was built on the site of a previous version but is much more sensitive.

These instruments are usually operated in non-magnetic huts remote from man-made disturbances. In these circumstances the principles used for maximizing the sensitivity have been described by Blackett (1952), Roy (1963), Deutsch and others (1967) and Collinson (1967). The large magnetic gradients and noise in Imperial College necessitated compromises with such principles. The magnetometer which resulted has proved capable of measuring all but a few of the rocks in this collection. The rocks which it could not measure have magnetizations so small as to be rather near the limit of measurement of any instrument.

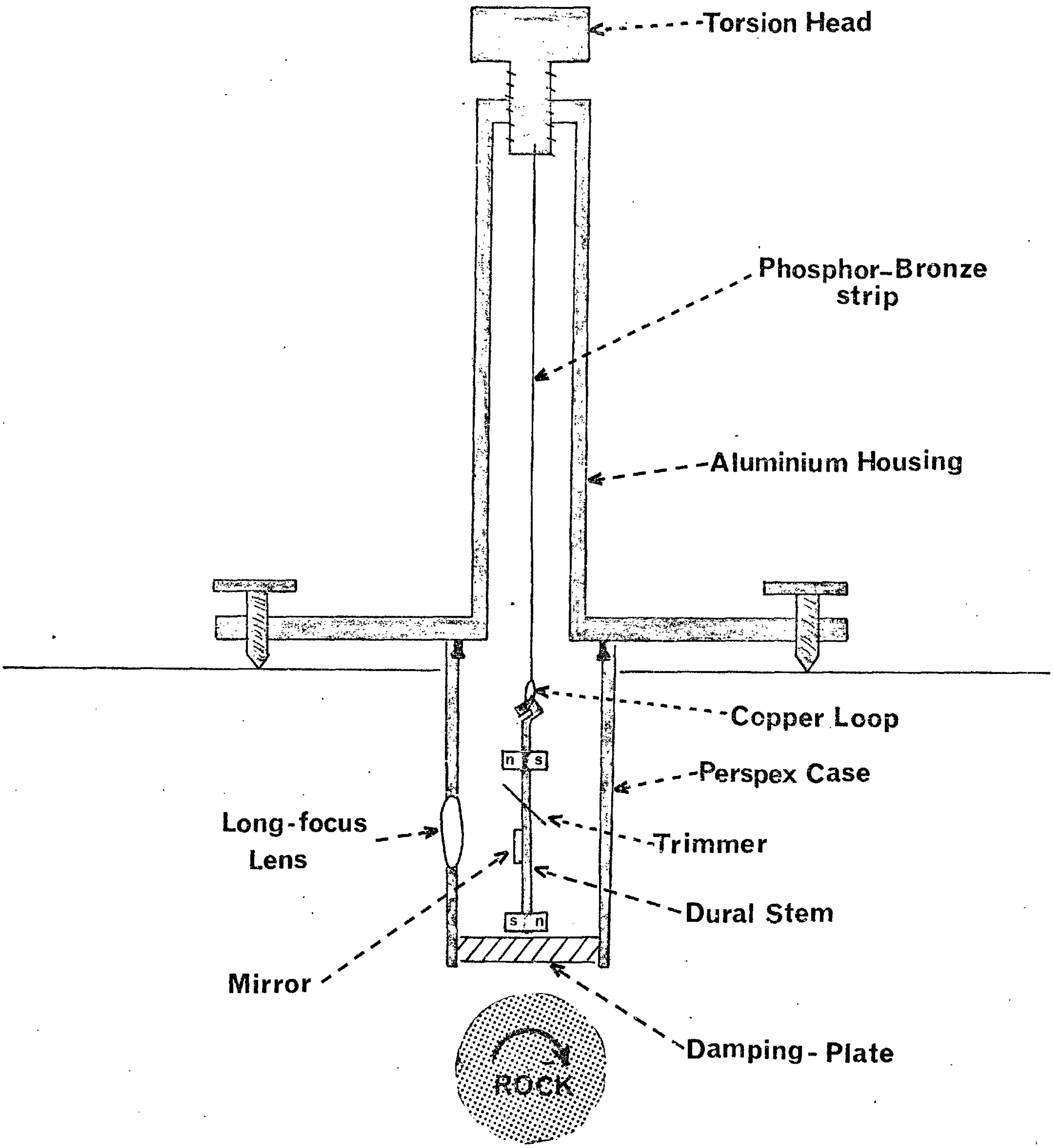


Fig 4.1 The Astatic Magnetometer.

4.2.1.1 The Astatic Pair

The essential feature of the instrument is a pair of magnets of nearly equal magnetic moment mounted in opposite directions on a stem (Fig. 4.1); this system and the rock spinning device below it are placed so as to be near the centre of three pairs of Helmholtz coils which annul the Earth's field.

The magnets are made of Alcomax III and measure approximately 6 x 2 x 2 mm; their masses differ by less than 2½%. They were magnetized longitudinally in a field of 7,500 oe and then stabilized by slight demagnetization in an alternating field of 50 oe. The magnet holder material is Dural, a light, tough alloy.

4.2.1.2 Astaticizing

The procedure described by Collinson (1967) was found very helpful and this was followed to a large extent. The early stages are best carried out using a torsionless fibre which does not break readily. Accordingly silk thread was used; although exceedingly fine it has longitudinal elasticity and this renders it much less fragile than the phosphor-bronze thread which is ultimately employed for the suspension.

It can readily be shown (e.g. Nagata (1961), 50) that the sensitivity

$$\left(\frac{d\theta}{dh}\right) = \frac{m_1}{(m_1-m_2)H + \tau}$$

where m_1 is moment of the lower magnet, m_2 of the upper magnet, H is the ambient magnetic field and τ is the torsional constant of the fibre. High sensitivity may therefore be achieved by making the magnetic moments large but their difference small, making the ambient field small and the torsional constant of the fibre small. The phosphor-bronze fibre is so fine (cross-section: 0.002" x 0.0001") that it will only just support the weight of the magnet system. The least important factor is H in that it has been found possible to astaticize in the Earth's field giving a sensitivity close to that with the field annulled.

Incidentally the expression for the sensitivity requires modification in the present case to

$$\left(\frac{d\theta}{dh}\right) = \frac{m_1}{(m_1H_1-m_2H_2) + \tau}$$

where H_1 and H_2 are the fields acting at the lower and upper magnets respectively. The astaticizing problem in this instrument is therefore to make $m_1H_1 = m_2H_2$.

The magnets were made nearly equal by demagnetizing the stronger in a small A.C. field. There came a point when, upon suspension, the magnets set east-west instead of north-south; they were then almost equal and were glued into position on the stem. The stem was then twisted slightly until the magnets again set north-south but with increased period. Trimming magnets were made (Blackett (1952), 314) by soldering 2 1 cm lengths of Platinax wire (which is already magnetized longitudinally) to short lengths of copper wire which were then mounted on the stem so as to provide small variable moments in 2 perpendicular directions. Small systematic rotations of these trimming magnets resulted in the attainment of high astaticism. Once achieved, this astaticism was maintained for 2 years. The system was well-damped by the copper base-plate, but not critically. The time of measurement is 25 seconds. Deflexions of the astatic system are measured by an optical lever with a path of 4¼ metres, terminating in a light spot on a scale of length 50 cm each side of an arbitrary zero.

4.2.1.3 Calibration

The instrument was calibrated by placing a small coil, having the same size as the rocks, in the rock-holder and passing a current sufficient to give nearly full deflexion on the scale. The current was then reversed and the total deflexion and its sense noted. The magnetic moment is proportional to the current; the constant of proportionality is worked out from the number of turns and geometry of the coil. By adjusting the height of the coil, seven positions were calibrated giving a sensitivity factor for each, enabling a wide range of rock intensities to be measured.

4.2.1.4 Measuring components of magnetization

The cylinders of rock held in a perspex cube are spun about a horizontal axis at right angles to the axes of the magnets. The period of rotation of the rocks is small compared with the period of the magnetometer so that non-axial components of the field are averaged out.

The position of the light spot is noted with the rock pointing in one direction and then with this direction reversed. The difference in position of the light spot is caused by twice the moment in the rock for a particular component. Any induced component is thus eliminated but is in any case small. This procedure is repeated at least once and the other two components measured in a similar manner. All three components are measured using the same calibration position which is selected so as to give a deflexion as near 50 cm as possible for the largest component. The total measuring time is about 5 minutes.

4.2.2 Spinner Magnetometer

This instrument, constructed in the Geophysics Department, Imperial College, is used to measure intensities greater than 2×10^{-3} emu/cm^3. It has the advantage of speed; total measuring time needed to measure each component twice is about three minutes.

4.2.3 Calculation of Results

From the three components of magnetization, the orientation of the core and the site latitude and longitude, the ancient pole may be calculated using standard formulae in spherical trigonometry. The routine calculation of pole positions and related calculations were effected by program PALS for each demagnetization stage of each specimen.

The mean results for rock units have been calculated by program PALT, using the statistics of Fisher (1953), an account of which is given with worked examples by McElhinny (1967). See also Nagata (1961), 284-286.

4.2.4 Alternating Field Demagnetization

The natural remanent magnetization (NRM) may be defined as "all the measurable residual magnetization possessed by rocks in situ" (Nagata (1961), 148). In general this may consist of stable ancient components masked by unstable ones. The object of partial A.C. demagnetization is to remove the latter and so reveal the stable components.

A rock is subjected to a certain peak alternating field, say H_p, which slowly decreases to zero. Whilst this happens the rock is tumbled about two or three axes (two in the current study) so as to present as many orientations as possible to the demagnetizing field (Doell and Cox (1967 B)). The result is that all grains whose coercivities are less than H_p will have had their magnetizations randomized. The demagnetizing coil is situated at the centre of a set of Helmholtz coils which annul the Earth's field; if this is not done a spurious component, namely anhysteric remnant magnetization, is introduced (Patton and Fitch (1962)). The current must be free of a D.C. component and harmonics (As (1967)) and must decrease smoothly.

The NRMs of specimens from a particular rock unit are usually scattered. Demagnetization in steps improves the grouping until a point is reached where the directions start to disperse due to demagnetization of the stable component as well as unstable ones. The best result is regarded as the one for which the grouping is least scattered.

4.2.4.1 Description of the Demagnetizing Apparatus

The coil is in series with a bank of high voltage paper capacitors whose value has been chosen so that at 50 Hz the coil and capacitors form a tuned circuit, thus minimizing the voltage which need be supplied. Also the high quality of the capacitors ensures that any D.C. component of current in the coil is negligible.

Voltage is supplied by a Variac pre-set to a suitable value; this is applied to a potential divider in the form of a tall glass column filled with copper sulphate solution (Fig. 4.2). Smooth variation of the voltage applied to the coil is made possible by means of a movable electrode raised by an electric motor.

Peak alternating fields up to 700 oe may be generated. At the end of a demagnetizing run the specimen is placed in a field-free box made of radiometal and then transferred to the field-free space of the magnetometer. This obviates the possibility of components being acquired whilst crossing the laboratory. The residual field in the demagnetizing apparatus is $<$ 2 moe and is checked every hour using a Newport fluxgate magnetometer.

4.2.4.2 Choice of Demagnetizing Fields

Initially the demagnetizing fields were chosen arbitrarily at 0,50, 100, 150 peak oersteds. These fields were applied to all the rocks collected in the earlier half of the sampling programme. Nearly all these units were so unstable that the choice of demagnetizing fields was immaterial. However when indications of stability were discerned in the rocks collected later, a refined procedure was adopted in the hope of maximizing the information which could be recovered from them. One in five samples was demagnetized at six fields; on the basis of the grouping of their directions all specimens in the rock unit were demagnetized at three suitable fields (or sometimes more). The selection of three fields allows for the possibility that the "best" demagnetizing field for all the specimens may

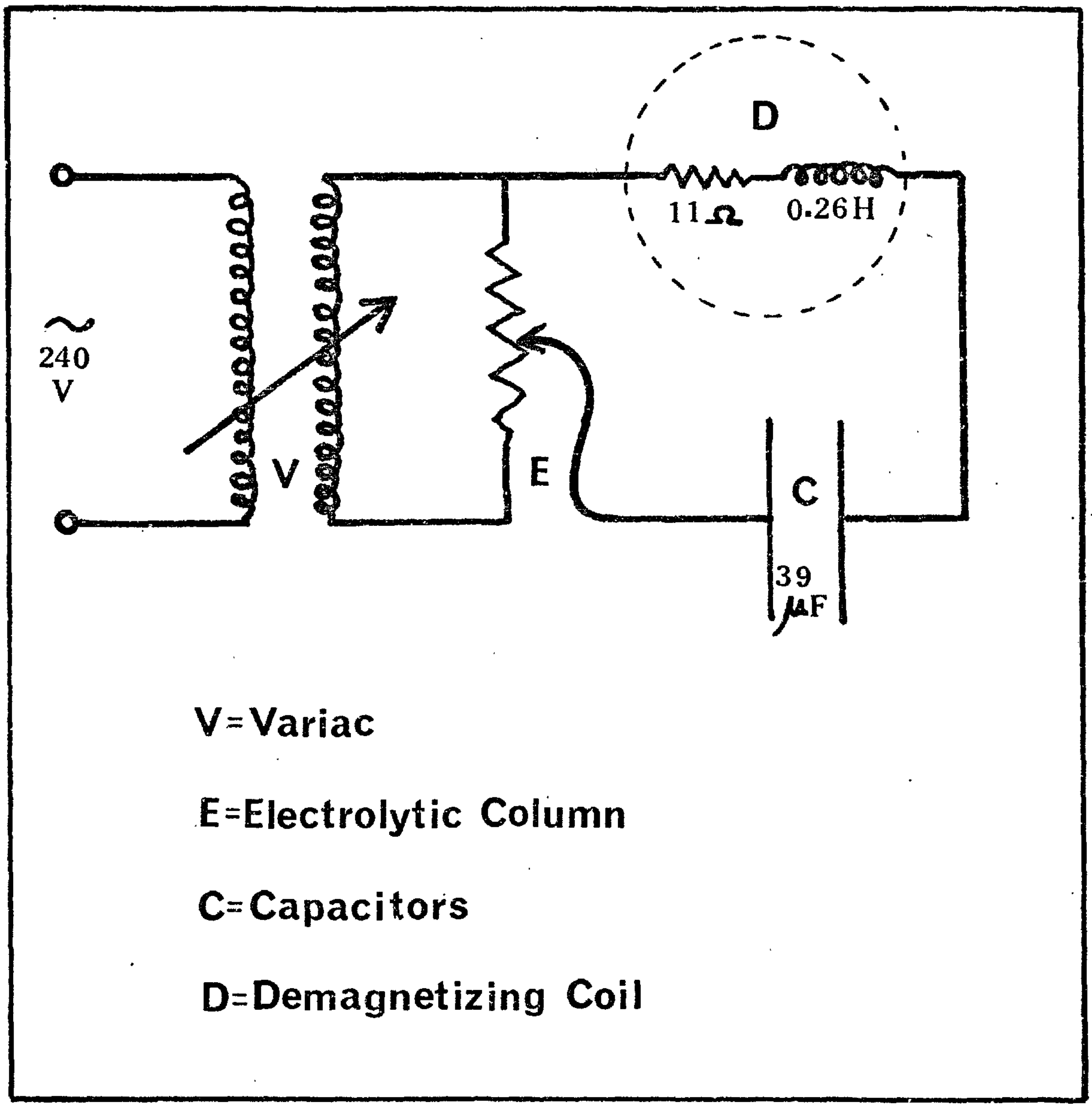


Fig 4.2 Demagnetizing Circuit.

differ by one step from the "best" field which emerged from the pilot investigation; three fields are also necessary for the application of the stability criterion which has been developed in this study (4.2.5.1).

4.2.5 Stability Criteria

Rocks are said to possess magnetic stability when they have retained a component of magnetization for long periods of geological time. On the other hand unstable rocks are readily remagnetized and so when the direction of magnetization falls close to that of the present Earth's field there are grounds for suspecting instability. Some of the rocks in the present collection reverse their direction of magnetization simply by hammering them; obviously these are unlikely to have maintained their magnetization for any length of time.

The behaviour towards A.C. demagnetization is a particularly useful indication of stability. When this procedure, applied in steps, produces progressive improvement of the grouping of directions in a rock unit, and the mean direction lies well away from that of the present geomagnetic field, the unit is probably stable. When a similar direction emerges from a number of rock units, there is strong evidence of stability.

Stability in a whole rock unit is the synthesis of stable behaviour in individual specimens. If the application of an alternating magnetic field, having a value large compared with the Earth's field, does not produce too great a reduction in the intensity of magnetization in a specimen nor too great a change in its direction, the specimen may be regarded as stable. In this study the values of these quantities are specified in a certain criterion, known as "criterion A", which has been found suitable for the dykes. The need for such a criterion was first felt when considering the results for Dyke 11. It was noted that in this dyke about 1 in every 5 specimens displayed a direction of magnetization which had already been recognized in certain other dykes; moreover these specimens seemed stable on the general grounds mentioned above. Criterion "A" arose from an attempt to objectify these impressions.

4.2.5.1 Stability Criterion "A"

A specimen is considered stable if two conditions hold:

(i) At a particular value of demagnetizing field $\geqslant$ 50 (peak) oersteds, the ratio of the intensity of magnetization to the initial intensity, $J/J_0 > 0.2$, not only at this demagnetizing step but for the next step and all previous steps.

(ii) the angle through which the magnetic vector has just turned and is about to turn in the next step are both $< 7.5^\circ$ per 25 oersted step (or 15° per 50 oersted step).

The stability of a whole dyke is defined as a percentage by the expression:

$$\left(\frac{\text{Number of specimens satisfying criterion "A"}}{\text{Total number of cores from the dyke}}\right) \times 100$$

The criterion has been applied to all the dykes and has been found useful in that the whole range of dyke stabilities is covered from 0 to 100%. The criterion gives no improvement in the results for the unstable dykes (8.2.1) but the typical effect of its application on the stable ones is to enhance k and α_{95} but to leave the pole position little changed.

As an experiment, an iterative procedure was carried out for Dyke 11. First the mean direction of magnetization was computed for the 11 stable specimens. Then for each specimen the demagnetization stage was chosen for which the direction of magnetization lay closest to this mean. Then the mean for these 11 directions was computed. This process was repeated several times until a unique set of 11 directions was found, each of which lay closer to the mean than any other choice. The result is as follows:

TABLE 4.1

Dyke 11

Whole Dyke 50 oe				Criterion "A" 50 oe				Iterative Procedure			
Dip	Dec	k	α_{95}	Dip	Dec	k	α_{95}	Dip	Dec	k	α_{95}
61.8	274.1	2	19.6	55.6	264.7	70	5.5	56.6	263.5	178	3.4

This procedure has not been applied beyond this example. It is somewhat similar to that of Watkins and Richardson (1968) who maximized k for small numbers of specimens by considering every possible combination of directions arising from all the demagnetizing stages.

Stability criteria have also been proposed by Tarling and Symons (1967), Wilson and others (1968) and Briden (1972). These are general criteria whereas criterion "A"'s value is not necessarily claimed beyond the Scourie dykes.

CHAPTER 5

SUPPORTING INVESTIGATIONS

5.1 INTRODUCTION

Much of the work described in this chapter was undertaken to try to find a reason for the variations in magnetic stability. The problem was approached on a broad front by looking for correlations between stability and various properties, for example the degree of alteration apparent in thin section, features seen in polished section, the nature of the magnetic mineral, grain size and whole rock chemistry. Emphasis will be placed upon procedures, especially polished section examination, with a minimum of reference to particular sampling sites. The details of the sampling localities, including the application of these procedures, will be given in the next two chapters.

5.2 THE NATURE OF THE MAGNETIC SPECIES

The carrier of remanent magnetization in igneous rocks is frequently titanomagnetite, which is a solid solution of magnetite, Fe_3O_4 and ulvospinel, Fe_2TiO_4. Its Curie point and hence its value for palaeomagnetism is related approximately linearly with composition (Fig. 5.1). It was at first suspected, therefore, that the variation of stability, particularly in the dykes, might be the result of variation of titanium in titanomagnetite. Now the titanium content also varies linearly with the lattice parameter (Fig. 5.2) and so this was measured for the magnetic material in a typically stable and a typically unstable dyke, using three cores from each (see acknowledgements).

First the cores were crushed and the powder passed through sieves.

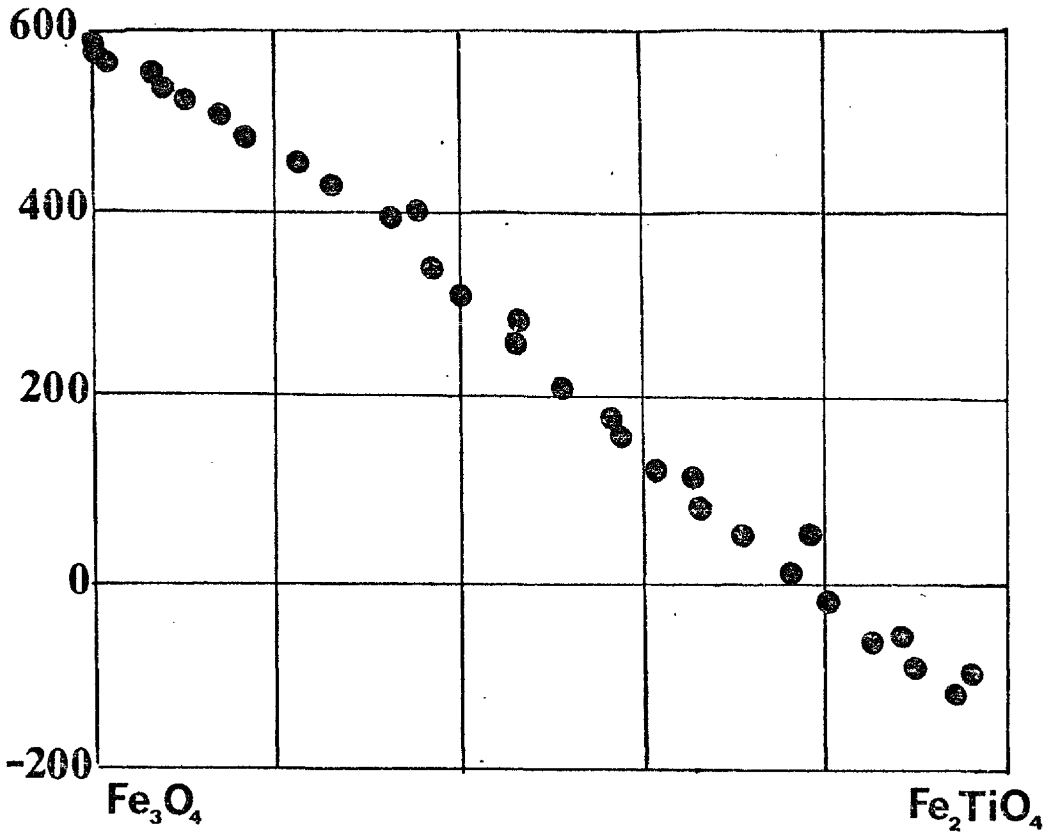


Fig 5.1 Variation of Curie Temperature with Composition

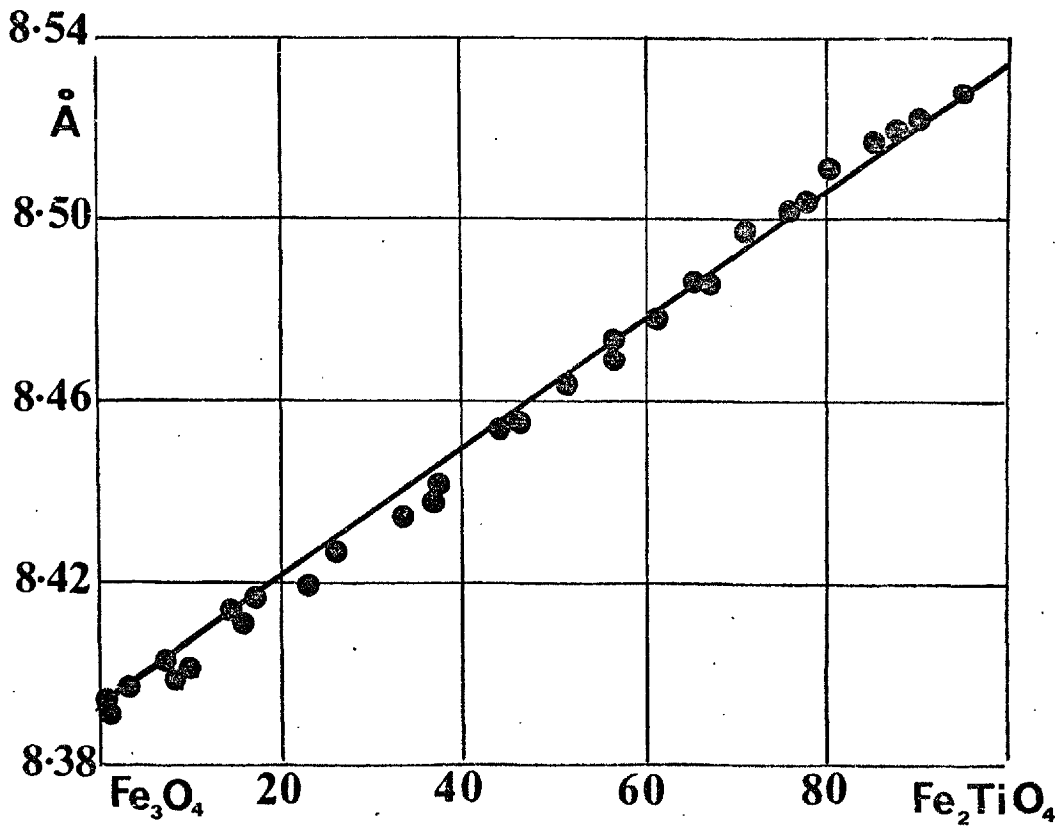


Fig 5.2 Variation of Cell-Size with Composition (after Nagata (1961)).

It was next passed through a Frantz magnetic separator. Microscopic examination then showed that separation of the magnetic material was far from complete in that the grains were attached to a great deal of pyroxene and amphibole. The material was further separated by flotation using methylene iodide. The heavy fractions still contained a high proportion of composite grains and were therefore subjected to further crushing and magnetic separation, yielding a powder containing 75% to 95% of magnetic material. The difficulty of obtaining a pure magnetic fraction was surprising but has previously been noted by Nicholls (1955).

X-ray diffraction powder films were taken of the fractions from the six cores. The results were as follows:

TABLE 5.1

	Sample No.	Unit Cell size Å
Stable dyke	18 - 2	8.393 ± 0.001
	18 - 11	8.396 ± 0.001
	18 - 26	8.394 ± 0.001
Unstable dyke	5 - 1	8.397 ± 0.001
	5 - 43	8.395 ± 0.001
	5 - 18	8.394 ± 0.001

Clearly the results show no significant differences. Moreover they are almost identical with the values determined for pure magnetite (at 18°C):

8.3963 ± 0.0005 Å (Basta (1957))

Experiments specifically seeking titanium in the magnetite, again in a stable and an unstable dyke, using electron probe techniques indicated that the titanium content was below the limit of detection (0.1%).

Adjacent grains of ilmenite and magnetite (in specimen 17-12) were analysed for iron, titanium and vanadium on the Geoscan electron microprobe and after the usual corrections for absorption, atomic number effect and fluorescence, the following compositions were found:

TABLE 5.2A

Analysis of ilmenite

	Probe analysis mean of 3 determinations
Ti-O_2	53.6 ± 0.7
V_2O_5	-
FeO	45.93 ± 0.06
Fe_2O_3	51.03 ± 0.06
	99.53

TABLE 5.2B

Analysis of magnetite

	Probe analysis Mean of 3 determinations	Recalculation of FeO and Fe_2O_3
SiO_2		
TiO_2	-	-
Al_2O_3		
V_2O_3	0.77 ± 0.05	0.77
FeO	92.2 ± 0.3	28.6
Fe_2O_3	102.5 ± 0.4	70.7
		100.07

5.3 POLISHED SECTIONS

The opaque minerals have been examined with a Reichert ore microscope by reflecting white light from thick, polished sections of rock mounted in transparent plastic blocks. The sections were viewed either in plane polarized light or with crossed Nicols; the microscope stage can be rotated so that pleochroism and anisotropy may be investigated. There is a choice of eye-pieces and objectives but those most often used had magnifications of x 6.3 and x 32 respectively, giving a field of view of 550μ. The sections were normally scrutinized in air but occasionally in oil.

Usually two polished sections were made per rock unit but eight or nine for units of particular interest.

Table exist for identifying the ores (e.g. Uytenbogaardt (1968)). The opaque of greatest interest here is of course magnetite, Fe_3O_4. Next in importance is ilmenite, $FeTiO_3$, with which magnetite is closely associated. Various sulphides are often present and sometimes a little haematite.

Magnetite crystallizes in the cubic system whereas ilmenite is rhombohedral. On account of this difference ilmenite is anisotropic and pleochroic whereas magnetite is isotropic and non-pleochroic. Anisotropy is the most useful criterion for distinguishing these two ores, although magnetite sometimes displays slight anisotropy whilst, in certain orientations, ilmenite appears isotropic. Difference in colour is often a useful feature, magnetite normally looking grey-brown against ilmenite which appears brownish-pink. Unfortunately, in the Scourie dykes there is usually no colour difference at all, both ores being the same shade of grey. In these circumstances and when differences of anisotropy are also minimal it has been necessary to rely upon the state of the surfaces. Magnetite and ilmenite both take a good polish but the surface of ilmenite is smooth in contrast to magnetite which is pitted (Plate 5.1).

The magnetite usually formspart of a composite grain consisting of magnetite, ilmenite (Plate 5.11) and sometimes sulphide grains (especially pyrite, FeS_2). Sometimes the composite grains take the form of a sandwich consisting of a magnetite grain with a thick parallel-sided lath or laths of ilmenite inside (Plate 5.6). These sandwiches have been seen mainly in the gneisses. The boundary between grains of magnetite and ilmenite is visible either as a black line, or as an extremely sharp junction with no other material between the grains; such a junction is said to be a "sealed boundary" (Vincent and Phillips (1954)).

Lamellae have been seen in the ilmenite grains in many of the sections but rarely in magnetite (Dyke 27 appears to display the only examples of ilmenite lamellae in magnetite (Plate 5.8) and may indicate a peculiar cooling history (5.3.2 and 6.27)). Owing to the similarity of the ilmenite and magnetite, it was not at first easy to decide whether the lamellae were in ilmenite or magnetite. To resolve this problem the separated magnetic grains (5.2) were mounted in black plastic and polished; hundreds of magnetite grains could then be seen under the ore microscope but none contained lamellae. This experiment proved that the lamellae had been in the ilmenite only. In the light of this experience, the point was much easier to resolve microscopically.

5.3.1 Textures in Ilmenite

Apart from the composite grains, ilmenite occurs as isolated grains known as "separate ilmenite" (Ade-Hall and Lawley (1970)) and these are commoner than isolated magnetite grains.

Ilmenite otherwise free of distinctive features is sometimes seen as remnant blebs or lobate grains intergrown with the silicates. This texture is myrmekitic (Plate 5.2).

The following features have also been noted:

(a) Fine lamellae

These lamellae are only a few microns wide and parallel-sided (Plate 5.1). They occur either singly or as several parallel lamellae sometimes with others with a different orientation. These lamellae are not abundant but are present in most of the rock units, irrespective of their geography.

(b) Irregular blades

These are blades of variable thickness, typically about 15μ, which are pleochroic and form parallel systems (Plates 5.3, 5.4, 5.5, 5.10, 5.12). Sometimes the blades fill whole grains and present a woven appearance. When present as a single set they sometimes appear as fingers (Plate 5.5). These irregular blades are a very common feature in the rocks of the Assynt and Strathpolly districts and have been seen both in the granulite G6 (Plate 5.12) and the dykes. On the other hand they have never been seen in the rocks from the Scourie and Badcall region.

Three analyses on one grain of ilmenite and on three different blades in it (in specimen 18-5) were carried out on the Geoscan microprobe. The results for the elements titanium, vanadium, manganese and iron from both the ilmenite host and the blades agree to within 1σ and so there is no difference in composition for these elements. Host and lamellae could not be distinguished on the electron image display and so no photograph could be taken. The electron image is formed by the backscattered electrons from the specimen which are a function of atomic number and so it is probable that the same elements are present to the same extent in the blades and the ilmenite host, in other words there is no difference in composition;

TABLE 5.3

Analysis of ilmenite and irregular blades in specimen 18-5

	Ilmenite	Blades
TiO_2	52.4 ± 0.2	52.5 ± 0.3
V_2O_5	0.32 ± 0.03	0.33 ± 0.03
MnO	0.67 ± 0.03	0.72 ± 0.02
FeO	46.1 ± 0.1	46.1 ± 0.1
(Fe_2O_3	51.3 ± 0.1)	(51.2 ± 0.1)
	99.49	99.65

In view of the lack of compositional difference between the blades and host grains and the observation that they are found in both dykes and on granulite, this is not a chemical effect. A physical cause is therefore suspected; it seems likely that these blades may have been caused by straining.

There is a strong correlation between the occurrence of irregular blades in ilmenite and magnetic stability; this theme will be resumed in Chapter 8.

(c) Mosaic texture

Sometimes grains are broken-up into a large number of sub-grains, of approximately equal area, not in optical continuity but joined together by sealed boundaries. This texture will be described as "mosaic" (Plate 5.9). Occasionally irregular blades are difficult to distinguish from mosaic texture and so it seems likely that they illustrate the same phenomenon but that in the mosaic texture we are seeing a recovery from the disturbance which produced the irregular blades. If this recovery process were continued a homogeneous grain of ilmenite might result. Such homogeneous grains are typical of the Scourie and Badcall regions and ilmenite grains with mosaic texture have very occasionally been seen here. Mosaic texture is rather common in Dyke 11 which lies about half way between Loch Assynt and Scourie.

(d) White blades

In two of the dykes (which are exceptionally stable) a common feature of ilmenite grains is the presence of a few (usually less than 10) white and strongly pleochroic blades, as a single parallel system. In contrast with the colour of these blades the host grain looks brown. They are typically 10 - 15μ in thickness and parallel-sided. They either traverse a grain or terminate within it with a rounded end. At the grain boundary they sometimes continue into the non-opaque minerals but with a sponge-like appearance, suggesting mutual reaction (Plate 5.7). Within the blades black pits are often seen. A unique feature of this type of blade is that the parallelism is continued from one grain to another. (It was observed for example that in traversing ¾ of the distance across one polished section, seven grains of ilmenite came into the field of view all with the same blade-orientation; thereafter there was a change to a new orientation).

In these there is a distinct compositional difference between blades and host as may be seen from the following Geoscan analyses:

TABLE 5.4

Analysis of ilmenite and white blades in specimen 26-30

	Ilmenite mean of 3 determinations	White blades mean of 3 determinations
TiO_2	52.1 ± 0.1	4.5 ± 1.4
V_2O_5	0.5 ± 0.1	5.0 ± 0.5
MnO	0.54 ± 0.01	0.06 ± 0.03
FeO	45.9 ± 0.1	85.1 ± 0.5
(Fe_2O_3	51.1 ± 0.2)	(94.6 ± 0.6)
	99.04	94.66

The strong pleochroism of the blades and the fact that red internal reflexions are sometimes seen in them suggests that they may be related to haematite; however the colour is white whereas haematite usually has a blue tinge. The substantial amounts of titanium and vanadium suggest that these blades may be a hitherto undescribed mineral phase.

Plate 5.1

Specimen G5-1. A composite grain of magnetite and ilmenite. The magnetite has a typical pitted appearance but is otherwise well preserved. The ilmenite is also typical with a good polish. A few fine lamellae are seen in the ilmenite.

Plate 5.2

Specimen 18-5. A myrmekitic grain of ilmenite. There are corroded small grains of chalcopyrite at each end.

Plates 5.3 and 5.4

Specimen 11-25. These are photographs of the same grain of ilmenite containing irregular blades with the Nicols almost crossed but in opposite senses.

Plate 5.1.

Plate 5.2

Plate 5.3

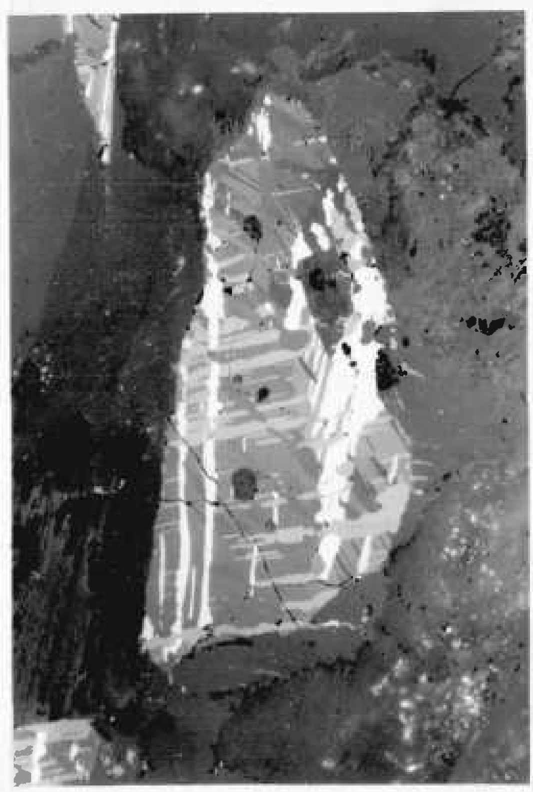


Plate 5.4.

Plate 5.5

Specimen 18-5. Irregular blades in ilmenite displaying finger-formation.

Plate 5.6

Specimen G6-23. A photograph of a grain of magnetite containing thick laths of ilmenite as a sandwich.

Plate 5.7

Specimen 26-30. White blades in ilmenite.

Plate 5.8

Specimen 27-2. A grain of magnetite containing ilmenite lamallae, (exceptional).

Plate 5.5

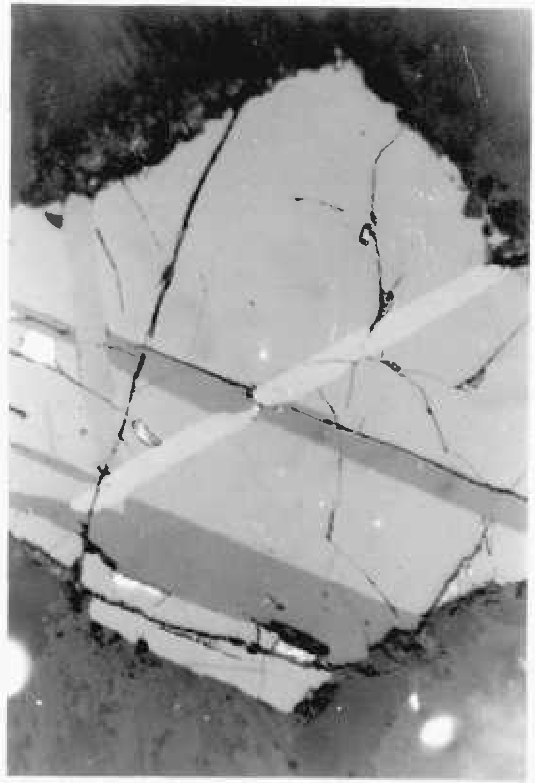


Plate 5.6

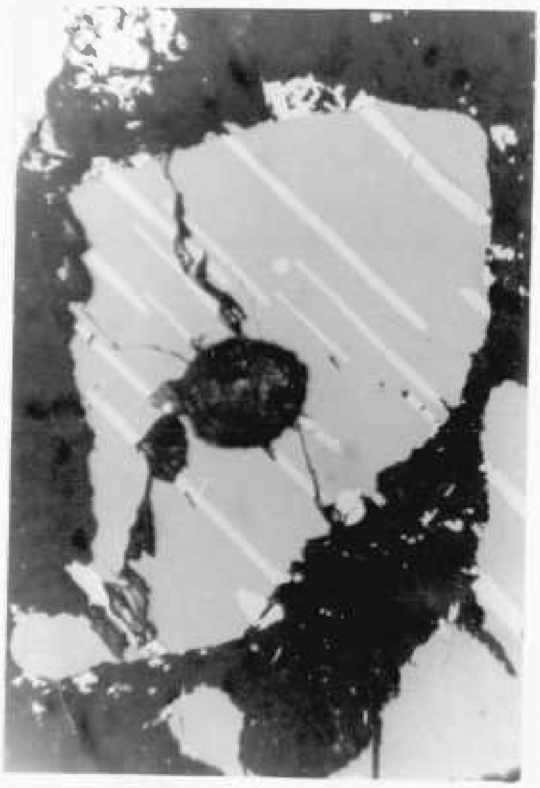


Plate 5.7

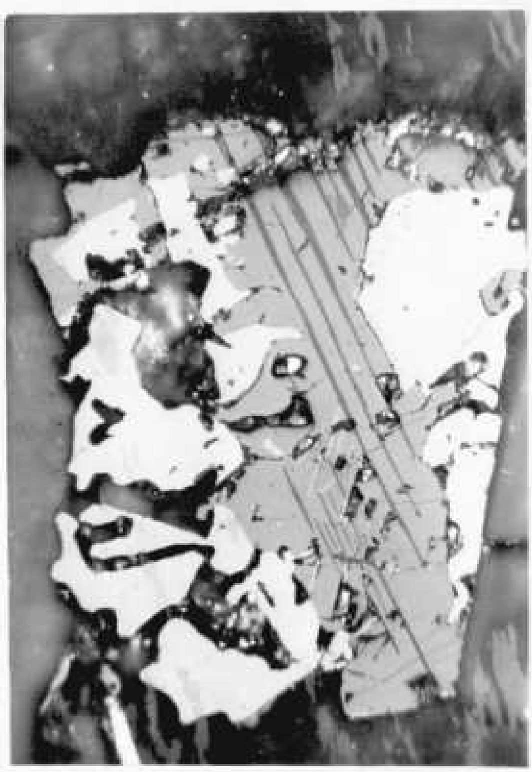


Plate 5.8

Plate 5.9

Specimen 18-4 — A grain of ilmenite demonstrating mosaic texture.

Plate 5.10

Specimen 18-1 — Composite grain of ilmenite and magnetite. The contrast between the thick irregular blades in the ilmenite, which show cross hatching, and the absence of lamellae in the magnetite is striking.

Plate 5.11

Specimen 25-2 — A composite grain of magnetite and ilmenite.

Plate 5.12

Specimen G6-23 — Ilmenite grains showing thick irregular blades. It is interesting to note the presence of these blades in a gneiss as well as dykes.

Plate 5.9

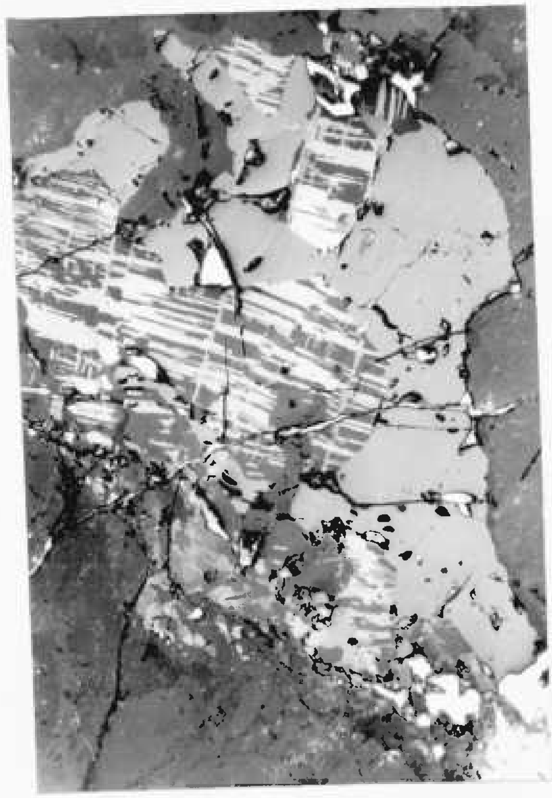


Plate 5.10

Plate 5.11

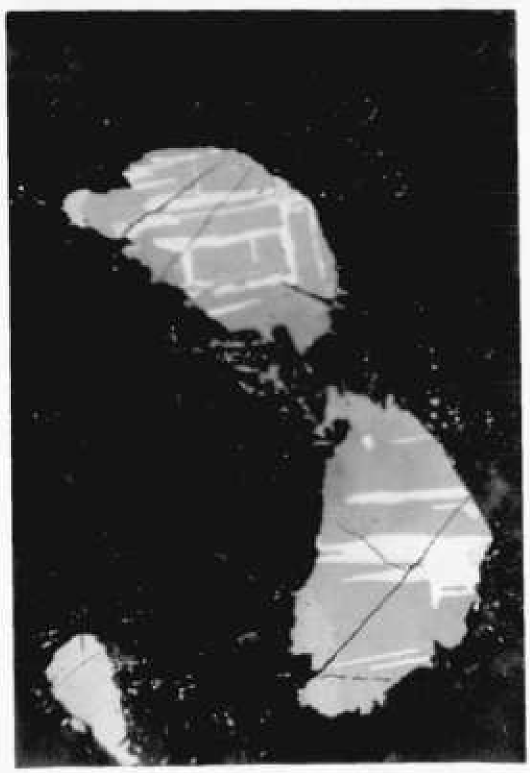


Plate 5.12

Geoscan photographs of ilmenite containing white blades in Specimen 26-30.

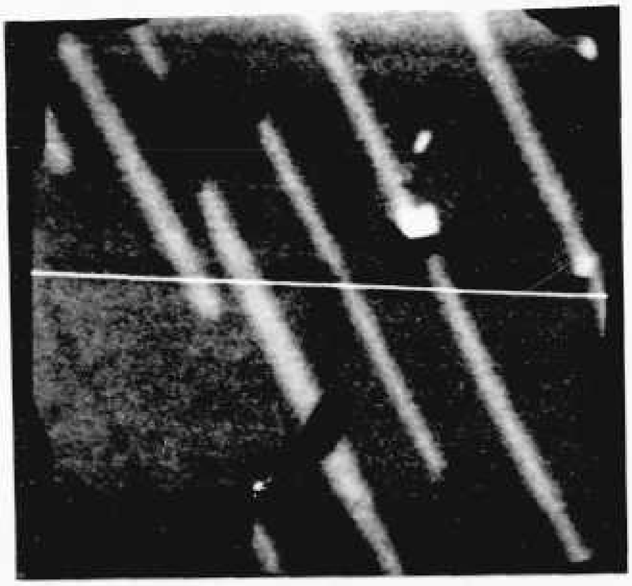
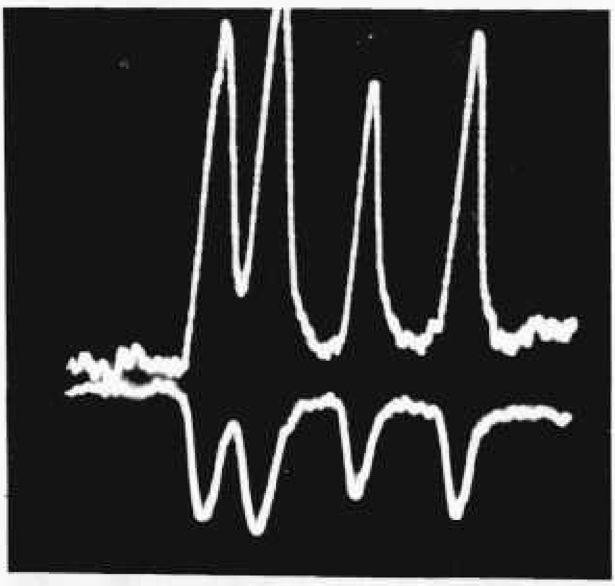


Plate 5.13.
Backscattered electron image x 350

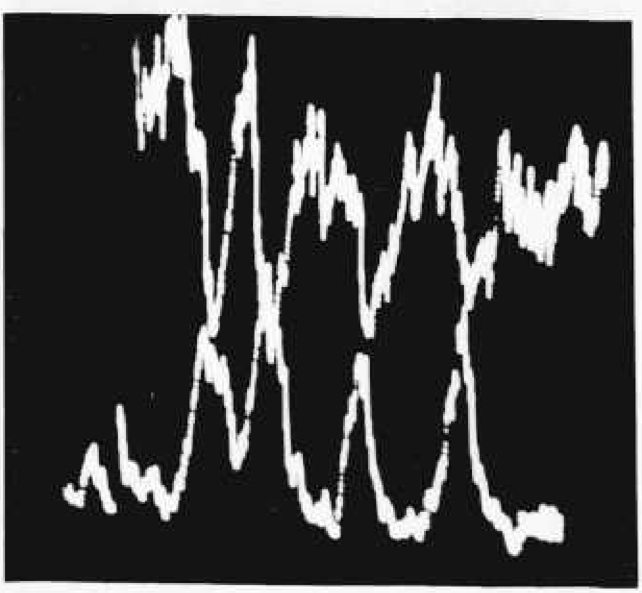
LINE OF SCAN



Fe

Plate 5.14.
Elemental variation for Fe and Ti in traverse

Ti



Mn

Plate 5.15.
Elemental variation for Mn and V in traverse

V

5.3.2 Comparison with other Work

The opaque minerals have been studied intensively in Tertiary rocks but little has been published in this field for the Pre-cambrian. In the Lewisian, textures in three dykes have been described by Stumpfl (1961) who noted the scarcity of ilmenite lamellae in magnetite. Of a basic gneiss near Scourie, O'Hara (1961 A) remarked that there are no fine lamellae of either oxide in the other. On the other hand there are numerous references to ilmenite lamellae in magnetite in Tertiary lavas and dykes.

In this section an attempt will be made to understand the origin of some of the textures in magnetite and ilmenite described in this study, in the light of published work.

The occurrence of composite grains suggests an intimate history. The grains may originally have been titanomagnetite in which the ulvospinel became oxidized to ilmenite:

$$6Fe_2TiO_4 + O_2 = 2Fe_3O_4 + 6FeTiO_3$$

The solubility of ilmenite in magnetite is negligible (Buddington and Lindsley (1964)) on account of the different crystal structure. Moreover in the solid state the ilmenite has only limited mobility. The result is that ilmenite lamellae form in the magnetite. However if a high temperature were maintained for a long time the lamellae might tend to move out of the magnetite grains and form grains outside them. Such external granule formation would be favoured by high initial temperature and slow rate of cooling; this process would probably have finished at a higher temperature than required for formation of lamellae. (Buddington and Lindsley (1964)).

On the other hand it is fair to add that an experiment which attempted to homogenize ilmenite lamellae in magnetite by heating to 1,250 - 1,300°C for five hours was not successful. (Vincent and others (1957)). However the time factor may be vital. In spite of this experiment it seems probable that the mechanism suggested, acting perhaps over millions of years, resulted in the lamellae-free magnetite grains in the great majority of the Scourie dykes. In contrast, the presence of such lamellae in Dyke 27 is interesting in that there are grounds for believing (6.27) that the country rocks were cooler when this dyke was intruded.

Temperatures at which magnetite is in equilibrium with various concentrations of ulvospinel and oxygen have been calculated (Buddington and Lindsley (1964)) but not for a concentration of titanium as low as 0.1% (5.2). At this level, equilibrium might correspond, perhaps, to a temperature below 500°C and might be attained after a few million years.

The irregular blades in the ilmenite grains adjacent to the magnetite may have occurred at the same time as their mutual separation or later. It seems likely that they were later because they are conspicuous in the Assynt region but absent near Scourie, whereas the composite grains occur equally in both. Therefore there was probably some difference in the physical conditions subsequent to composite grain formation.

A 7-point scale of high temperature alteration of ilmenite in Icelandic rocks was established by Haggerty (1968). This scale does not seem to be applicable to the present study. In particular the ferri-rutile blades which are said to be a titanium-rich form of ilmenite, or $(FeTi)O_2$ (Ade-Hall and Lawley (1970)), have not been seen in this study. This suggests that the features seen in ilmenite in the Lewision rocks are metamorphic and not igneous effects.

Another type of alteration, known as regional hydrothermal alteration, has been described (Ade-Hall and others (1971)) and operates at temperatures less than 300°C. It is accompanied by rise in Curie point (which may be regarded as an increase of magnetic stability) and affects both magnetite and ilmenite. It is believed that Dyke 7 has experienced this kind of alteration (6.7).

The sulphides occurring as members of a composite grain also suggest an intimate history. On the other hand where sulphides have filled fractures they are clearly a late feature due to hydrothermal activity (Stumpfl (1961)).

5.4 GRAIN SIZE OF OPAQUES

The average chord length of opaque grains in thin section was measured on the I.G.S. Quantimet using about two slides per rock unit. This gave precise results for individual slides but no general conclusions suggested themselves.

5.5 DYKE CHEMISTRY

Dykes covering a range of magnetic stabilities have been analysed chemically (see acknowledgements) and the results are tabulated in Chapter 8.

CHAPTER 6

SAMPLING SITES: THE DYKES

"The world is only partly made of Scourie dykes" -
Bonney.

In this chapter and the next, full descriptions will be given of the individual sampling sites. The mineral assemblages are those in (3.3.2.1) and (3.3.2.2), subject to individual variations which will be recorded. Features seen in polished section will be described in the light of (5.3). However only brief general references are made to the palaeomagnetic results which will be presented in Chapter 8.

Details of the localities, strikes and dips are given in Table 6.1. (Some of the strikes and dips could not be discerned.) Sampling sites are indicated in Fig. 6.1.

6.1 DYKE 1

This dyke is exposed below a pebbly beach by Scourie graveyard. It is best visited at low water when the whole width of the dyke, 45 metres, is revealed. The margins are marked by gneiss walls, the south-west wall standing about 4 metres above the dyke, the north-east wall about 2 metres. Some disturbance is apparent at these margins in the form of shattering, foliation and quartz veining. The banding in the gneisses strikes nearly at right angles to the strike of the dyke and dips at 30° to the north-west.

The dyke has a coarse texture showing little sign of Laxfordian deformation except near the margins. As a whole the dyke is altered but the least-altered rocks have a somewhat brownish-green colour with a subdued speckling due to clusters of feldspar laths. On the other hand there are patches where black and white speckling is pronounced due to hornblende

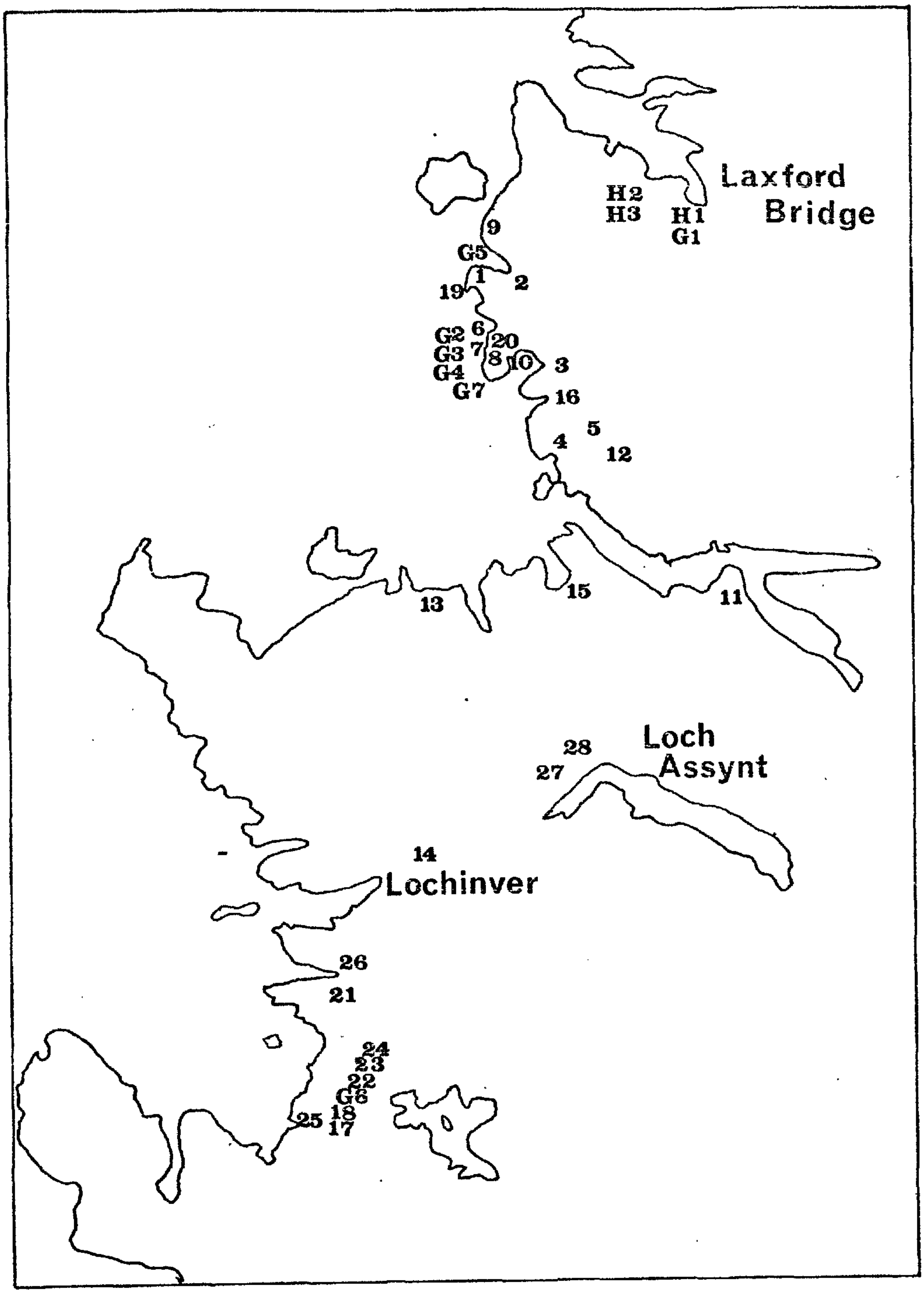


Fig 6.1 Sampling Sites.

<u>TABLE 6.1</u>

Dyke Number	Locality	Site Lat °N	Site Long °W	Grid Ref.	Strike	Dip to NE
1	Scourie Bay	58°21'	5°10'	NC 149449	300°(approx)	75°
2	South shore of Loch a' Bhadaidh Daraich	58°21'	5°08'	NC 168443		
3	Geisgeil	58°19'	5°07'	NC 174408		
4	Bend in A894 at mouth of Allt an t-Srathain	58°18'	5°07'	NC 172382		
5	100 m WNW of bridge over Allt an t-Srathain	58°18'	5°07'	NC 177386	286°	90°
6	Coast west of Badcall	58°20'	5°10'	NC 147419	325°(approx)	80°
7	Coast west of Badcall	58°19½'	5°10'	NC 146418	296°	76°
8	Coast west of Badcall	58°19'	5°10'	NC 147417		
9	Scourie Bay	58°21'	5°09'	NC 152451		
10	Coast west of Badcall	58°19'	5°10'	NC 148416	298°	
11	Unapool near Kylescu	58°14'	5°01'	NC 235329	293°	
12	Loch a Mhinidh	58°17'	5°06'	NC 186381	309°	68°
13	Drumbeg	58°14'	5°13'	NC 119330	300°	
14	Brackloch Farm, Lochinver	58°09'	5°13'	NC 118239	302°(approx)	
15	Gleann Ardbhair	58°14'	5°06'	NC 183331		
16	100 m south of Loch Duartbeg	58°18'	5°08'	NC 169387	319°	69°
17	Strathpolly	58°04'	5°14'	NC 082136	314°	75°
18	Strathpolly	58°04'	5°14'	NC 085143	300°	76°
19	Cleit Mhor, Scourie More	58°21'	5°11'	NC 141442	305°	88°(± 5°)

TABLE 6.1 (continued)

Dyke Number	Locality	Site Lat °N	Site Long °W	Grid Ref.	Strike	Dip to NE
20	Coast west of Badcall	58°20'	5°10'	NC 147417	311°	
21	Between Loch an Arbhair and Loch a Choin, near Inverkirkaig	58°07'	5°16'	NC 081187	316°	
22	Northern tip of Loch Call an Uigean	58°05'	5°13'	NC 094150	305°	85°
23	Loch Buine Moire	58°05'	5°14'	NC 095156	292°	67°
24	Loch Buine Moire	58°05'	5°14'	NC 095156		
25	450 m NW of Loch na Dail	58°04'	5°15'	NC 080140	300°	60 - 69°
26	Inverkirkaig, ⅓ km west of Loch Bad na Muirichinn	58°07'	5°14'	NC 085200	300° (approx)	
27	Lochan Mhic Leoid	58°10'	5°10'	NC 151253	320°	
28	½ km NW of Little Assynt	58°10'	5°10'	NC 152254	315°	

and altered feldspar.

Near the south-west margin there is a zone about 1 metre wide of much more altered material which may be a separate dyke.

The graveyard dyke contains 2 pyroxenes, garnets and abundant opaques which display minor alteration to biotite; it has been placed in alteration category 3. Polished section examination reveals opaques about $\frac{1}{2}$ mm across, generally in the form of composite grains of magnetite and ilmenite and sometimes pyrite. The ilmenite grains occasionally contain fine lamellae (5.3.1.1 texture (a)).

Chemical analyses of the dyke at points about 2 km inland have been carried out by Burns (1966). (Chapter 8)

The palaeomagnetic results are very poor; only 3 out of 52 specimens satisfy stability criterion "A" (4.2.5.1). The magnetization of a specimen from this dyke could be reversed at will by banging with a block of wood.

6.2 DYKE 2

This dyke is a continuation of the "Scourie dyke" (Teall (1885)). It presents itself as a prominent bluff. The width of the dyke is 50 metres and cuts the gneisses at a high angle. It has a massive but battered appearance with widespread fine quartz veining. Quartz veining suggests the vicinity of a fault. The dyke has been shifted about 50 metres north-eastwards by a shear belt.

This dyke contains no original pyroxene. It does contain much haematite which imparts a mauve-red hue to the rock and gives rise to red drilling mud. Thin sections sometimes contain a high % of opaques; these are largely ilmenite surrounded by sphene rims. The dyke has been placed in alteration category 4. Twenty cores were taken but there is so little magnetite that their magnetism could not be measured.

6.3 DYKE 3

This is a picrite dyke exposed in the bed of the stream Allt Crom Gisgil, beneath a prominent bluff; the exposure consists of only a few blocks of rock. No better exposure was found further up the stream. The rock is coarse-grained and massive, almost black; in hand specimen it seems little altered. It contains two pyroxenes and some plagioclase whereas opaques are scarce and small (30 - 60). Of the secondery minerals, serpentine is present (ex-olivine) and chlorite (ex-plagioclase). The dyke has been placed in alteration category 2.

In polished section pyrrhotite has been noted, often as composite grains with chalcopyrite, also traces of the nickel ores violarite and pentlandite.

The palaeomagnetic results are almost random and there are no stable specimens.

6.4 DYKE 4

The main road follows the SW margin of this dyke which was sampled about 50 m NW of the right-angle bend. At the bend itself there is shattering and quartz veining. At the sampling point foliation was seen in the cores and so only four were taken.

6.5 DYKE 5

This is a very wide dyke. The SW margin is vertical and is clearly seen as it runs up the hillside; however the other margin could not be discerned.

The dyke is exposed as numerous rounded rock features on the grassy slope which ascends to a lochan 300 m from the road. The rock has a light grey unaltered texture and so this dyke was extensively sampled.

This dyke contains two pyroxenes, plagioclase which is clouded and bent but not recrystallized, abundant opaques and a trace of biotite. It has been placed in alteration category 2.

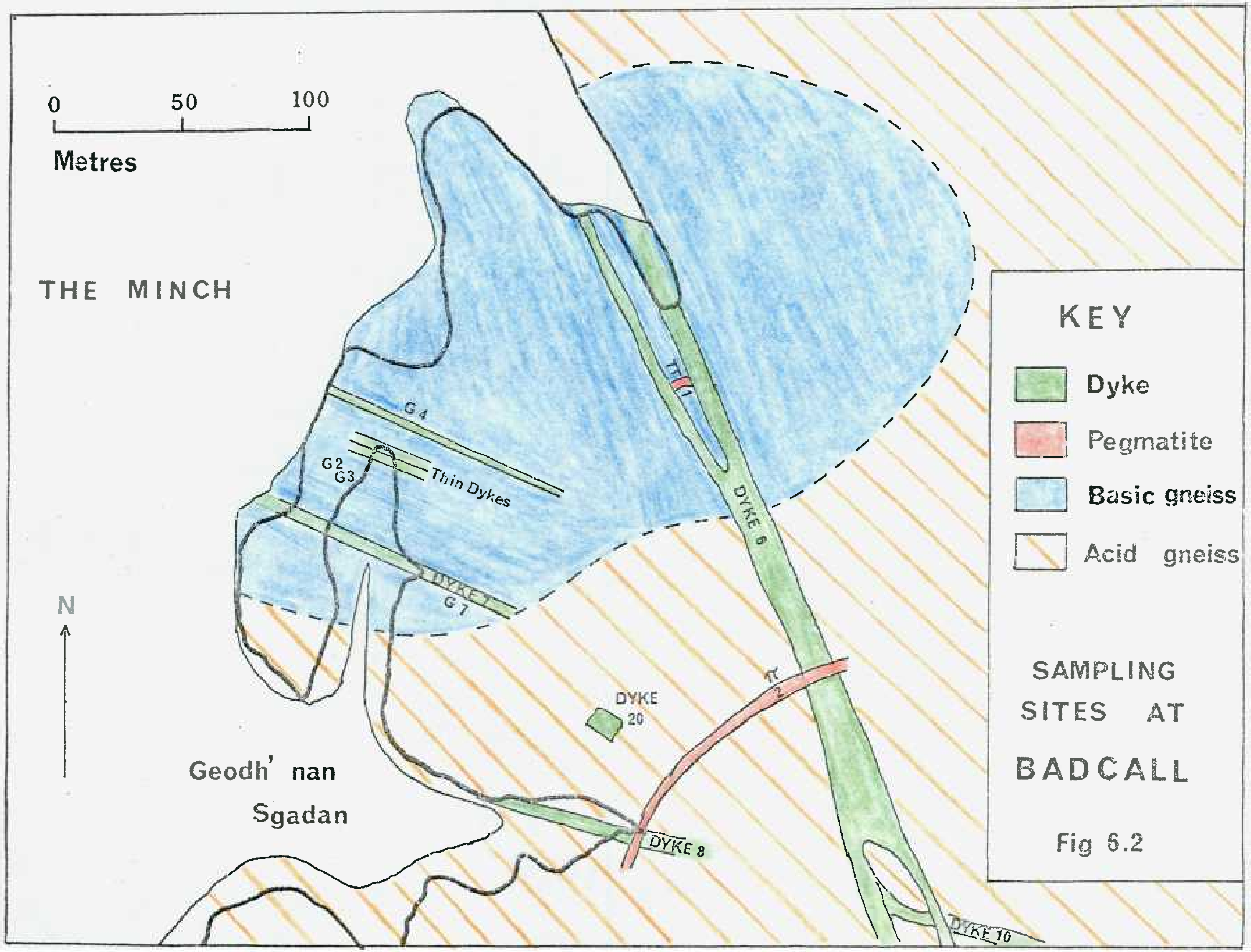
In polished section the magnetite and ilmenite are seen to occur as both separate and composite grains, typically about $\frac{1}{2}$ mm across; ilmenite, which is more abundant than magnetite, sometimes contains a few fine lamellae. Chalcopyrite and pyrite are widespread and sometimes altered to haematite.

There are seven magnetically stable specimens out of 39 but their directions are almost random. This dyke is a typical example of an unstable dyke; it will be recalled that the cell dimension of the magnetic mineral corresponds closely to pure magnetite (5.2) and that there are no ilmenite lamellae in the magnetite (5.3.1).

6.6 DYKE 6

This dyke lies due west of the hill Cnoc an Fhir Bhreige. The sea has eroded it to form a conspicuous rectangular inlet. Both margins are visible, the NE one forming a spectacular cliff which overhangs the sea. The dyke is about 30 metres wide and has a shear zone in the neighbourhood of the SW margin. The rock is very coarse-grained and shows much variation in alteration; the most altered rock has pronounced black and white speckling and is highly amphibolitized, whereas other parts retain their primary minerals and are grey-brown in colour with a more subdued mottling.

This dyke cuts the pegmatite π 1 (Sutton and Watson (1951 A)). The textures and mineralogy have been described by O'Hara (1962). The dyke



SAMPLING SITES AT BADCALL

Fig 6.2

has been dated by Evans and Tarney (1964) at 2,300 m.y. where little-altered and 1,460 m.y. where amphibolitized. Both Burns (1966) and Tarney (unpublished data) have analysed it chemically (see Chapter 8). It is interesting to note that they found little difference in the potassium content between sheared and unsheared portions and between unaltered and amphibolitized portions respectively, although, as has been seen (2.5.2.1) potassium metasomatism was a typical effect of the Laxfordian.

This dyke has been placed in alteration category 3.

Most of the magnetite has been altered to amphiboles; however, there are abundant ilmenite grains, some of which contain fine lamellae (like those in Plate 5.1). There are remnants of pyrite and chalcopyrite grains which have been extensively altered to haematite.

On account of foliation and amphibolitization this dyke was only lightly sampled. Only seven specimens had sufficient magnetization to be demagnetized at 50, 100, 150 oe; of these only two were stable. The poles lie near the geographical north pole.

Dyke 6 is but one of several dykes and gneisses sampled on the coast west of Badcall: see Fig. 6.2.

6.7 DYKE 7

This dyke appears out of the gneisses about 100 metres from the sea, an effect due to shearing; its width is 5.3 metres. Both margins are clearly defined and rise above the dyke as walls $\frac{1}{2}$ - 2 metres high (Plate 6.1 and Fig. 6.3). The gneisses are basic to ultrabasic in composition with broad banding showing regular dip to NW of about 20° - 30°. The dyke is totally discordant and there are no indications of disturbance of banding in the dyke margins. Therefore there has probably been little or no movement since intrusion. The gneisses are composed of orthopyroxene,

Plate 6.1. Dyke 7.
(Note hammer in middle distance).

Plate 6.2. Thin dykes at Badcall (O'Hara 1962 and Sutton and Watson 1951A).

Plate 6.3. A sheared dyke near Badcall (with a penknife in the middle to indicate scale).

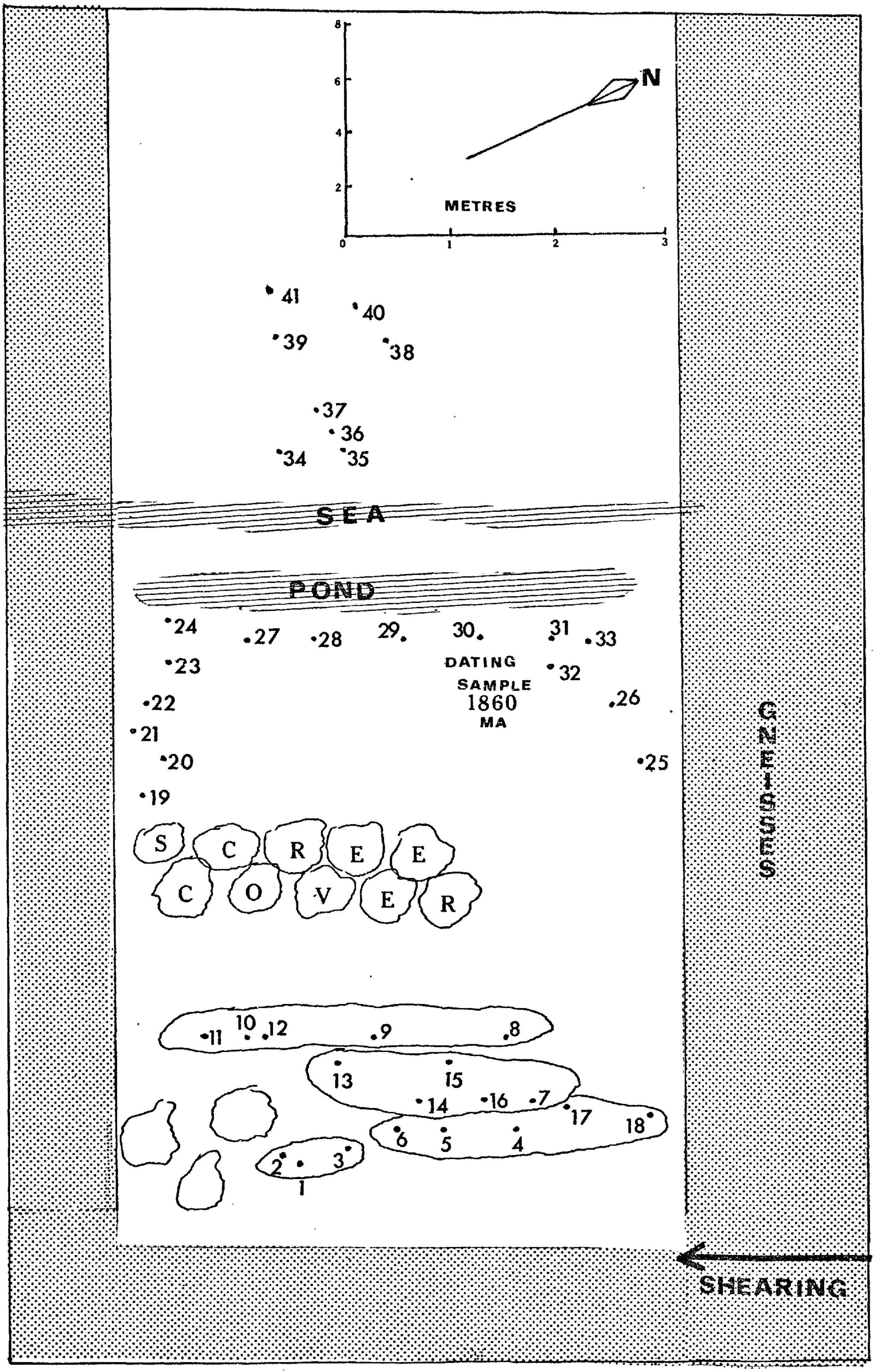


Fig 6.3 Sampling Map of Dyke 7 .

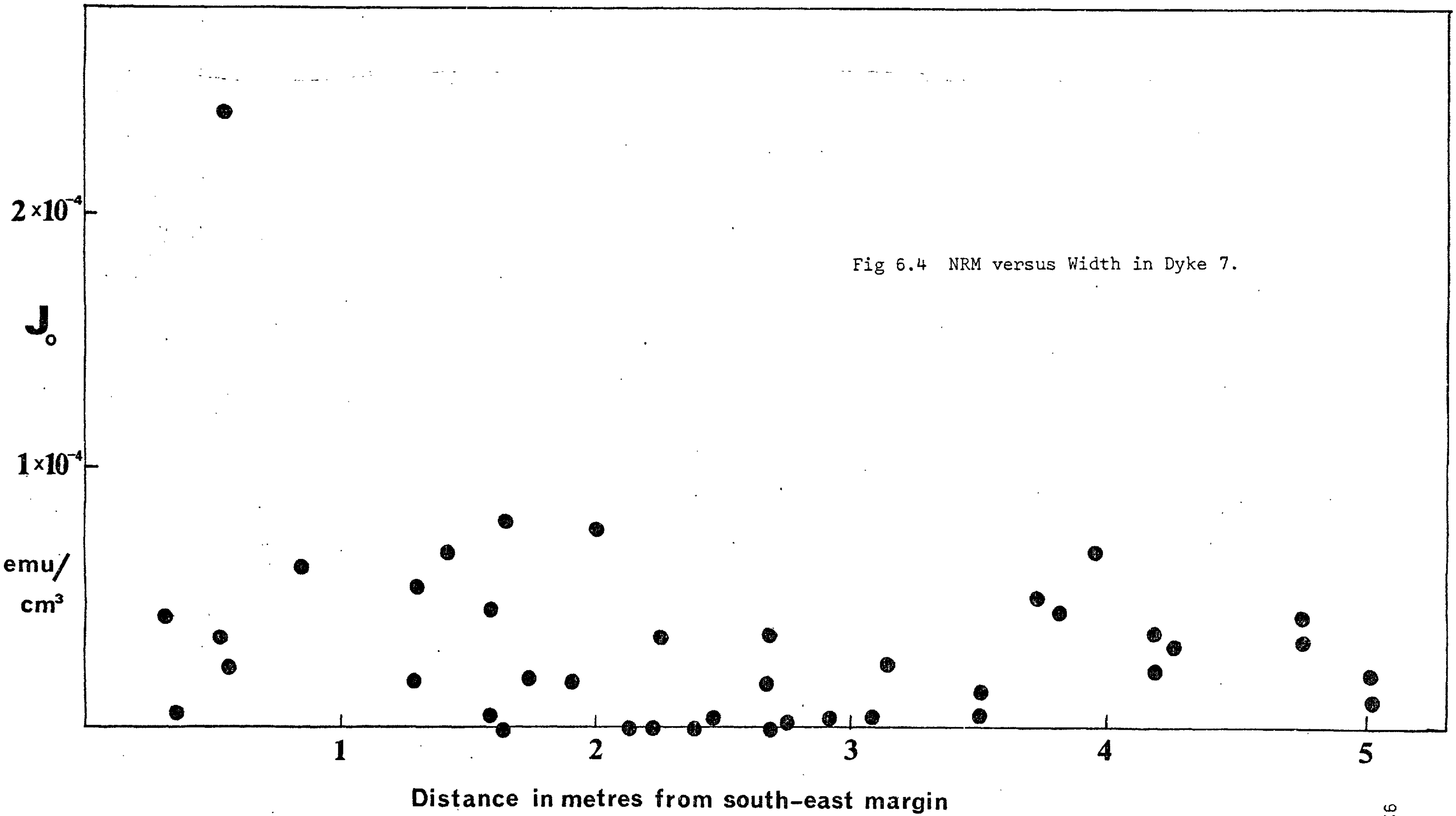


Fig 6.4 NRM versus Width in Dyke 7.

clinopyroxene, quartz, some plagioclase and hornblende.

The dyke itself is massive, rather fine-grained and has an unaltered appearance. Fresh surfaces have a blue tint.

Another section of this dyke has been found 80 metres SE of the shear (Fig. 6.3). This portion has almost the same width, 5.0 metres, but is much altered; this too was sampled and has been called "Dyke 20". A further altered section now recognized as the same dyke has been sampled and designated "Dyke 10". (See Fig. 6.2.)

Dyke 7 appears on the map of Badcall of Sutton and Watson (1951A), and was described by O'Hara (1962). It is known as a norite because it contains more hypersthene than clinopyroxene. For this reason and on account of the greater content of quartz and alkali feldspar and the appearance of hypersthene as the prominent phenocryst in the margin, O'Hara regarded this dyke as different from the typical Scourie dykes. Tarney (unpublished data) noted that the titanium content is low and that there is much more nickel and chromium than in the typical dykes (see Chapter 8).

On account of the different chemistry and mineralogy it is likely that this dyke was intruded at a different time from the other dykes. It has been noted (Sutton and Watson (1951A) and O'Hara (1962)) that the continuation of Dyke 7 is cut by Dyke 6 which was dated by Evans and Tarney (1964) at 2,300 Ma. It is therefore possible that Dyke 7 may have been one of the very first dykes. The presence of a welded contact supports this contention. Evans and Tarney obtained the date 1,860 Ma for this dyke and attributed it to up-dating associated with the local shearing (Plate 6.3 shows another example of dyke shearing in Badcall). An amphibolitized section of this norite (Dyke 20) was dated at 1,440 Ma (Evans and Tarney (1964)).

In thin section the dyke is little-altered but displays some patchy local alteration; differences of alteration can sometimes be observed even in the same core. The original texture is different from the typical dolerites; there is a very pale amphibole and rather abundant biotite sometimes associated with the opaques, sometimes not. Curved cleavages have been observed in the clinopyroxenes. The dyke has been placed in alteration category 1.

Polished sections (see acknowledgements) have been examined using high magnification (x 1350, oil immersion); the opaques are much smaller (say one tenth) than in the typical dolerites. The magnetite grains are generally not greater than 30μ although a few are as much as 100μ . Their particular shade of grey has been attributed to a cation deficient state which is associated with a rise of Curie point and may be responsible for the stability of this dyke. In turn this state may be associated with regional hydrothermal alteration occurring at 300°C over a period of the order of one million years. (Ade-Hall and others (1971), 166). The magnetites are often surrounded by reddened silicates, indicating oxidation (Watkins (1969)) which is of course consistent with cation deficiency. Areas of clothwork texture in some of the ilmenites have been recognized and these too have been attributed to regional hydrothermal alteration (Ade-Hall and others (1971) Fig. 8).

The magnetite grains are primary but the frequent indications of cation deficiency probably originated long after their formation; this may well be true of the magnetization too.

Dyke 7 is the only stably magnetized dyke which has been found north of Kylescu. It is weakly magnetized but 36 of the 41 specimens have proved measurable on the astatic magnetometer. Of these 32 satisfied the stability criterion. There is no apparent variation of intensity of magnetization in traversing the dyke (Fig. 6.4).

Dyke 7 is chemically and mineralogically similar to another norite on the south side of Loch Assynt which is completely unaltered (Tarney (1963)) and has been dated at 2,200 Ma (Evans and Tarney (1964)). Palaeomagnetic sampling of this dyke might prove significant in view of the fact that Dyke 7 has yielded a distinctly different pole (9.4) from the other stably magnitized rock units.

6.8 DYKE 8

This dyke is 1.5 metres wide and tapers as it runs into Geodh' nan Sgadan (Fig. 6.2). It lies below high water mark and is poorly exposed. It has been described (O'Hara (1962)) as a medium-grained dark green amphibolite which, like Dyke 7 contains a high chromium and nickel content, It has an ultrabasic character and may be a continuation of Dyke 3. The dyke and country rock appear welded and are difficult to distinguish from each other, a feature which O'Hara regarded as evidence of intrusion into hot rock. Dyke 8 has been dated at 2,080 Ma, an age which has again been attributed to updating by the local shearing (Evans and Tarney (1964)).

Thin section examination indicates alteration category 3. In polished section large grains of pyrite may be seen, say 400μ , but magnetite and ilmenite grains are only about 60μ across.

On account of the poor exposure the sampling was minimal; moreover none of the specimens was stably magnetized.

6.9 DYKE 9

This is a branch of the "Scourie dyke" (Teall (1885)). Unfortunately only two cores could be taken on account of mechanical failure; neither was stable palaeomagnetically.

6.10 DYKE 10

There is a good exposure of dyke about 200 metres inland from Geodh' nan Sgadan. It is apparent from thin sections that this is an outcrop of the norite, Dyke 7, and its amphibolitized portion, Dyke 20 (Fig. 6.2). The dyke appears little altered but this was deceptive on account of the unfamiliar mineralogy. In thin section much pale feebly pleochroic amphibole and biotite are seen; it has been placed in alteration category 3. In polished section opaques are extremely sparse. No magnetization could be detected in any of the 34 cores which were collected.

6.11 DYKE 11

This dyke is exposed for 120 metres as a road cutting nearly parallel to the strike. The adjacent gneisses also form the cutting and consist of amphibolitized granulite in which little pyroxene remains. This amphibolitization preceded the dyke which is little-altered and discordant. The gneisses contain thick black basic bands dipping at 15 - 20° to the north-west. There are no local signs of disturbance in spite of the proximity of the Moine thrust, an outcrop of which may be seen only 1 km away across Loch Glencoul, with Lewisian lying upon Cambrian rocks.

Small grains of pyroxene and feldspar are visible in hand specimen but hornblende is not apparent. In thin section the dyke is seen to be a two-pyroxene dolerite, fine-grained near the margins but coarse-grained elsewhere. The alteration category averages 2 but there is some individual variation.

Initially 35 cores were collected from this dyke, one in five of which showed signs of stability. Stability criterion "A" was defined on the basis of these and a further collection of 22 samples was made the following year in order to obtain further stable specimens. Altogether 11 of the 57 cores are stable and the resulting pole position is considered to be significant (8.2.1).

Polished sections were studied more extensively than for other dykes in the hope of establishing some difference between the stable and unstable specimens. To this end, nine polished sections were made from four stable and five unstable specimens. Irregular blades (5.3.1) are a common feature of the ilmenite, sometimes in finger-formation; mosaic and myrmekitic textures are also often seen (see Plates 5.2, 5.3, 5.4, 5.5, 5.9). These alteration features seemed to be slightly more apparent in the stable than in the unstable specimens but much more work would be needed before such a connexion could be claimed for individual specimens. However a general connexion will be claimed between certain alteration features in ilmenite and magnetic stability (8.5) of whole rock units.

The magnetite and ilmenite generally occur as composite grains about $\frac{1}{2}$ mm across but sometimes as complexes up to $2\frac{1}{4}$ mm across. The ilmenite is a pinky-brown or cream colour, the magnetite is usually cream but occasionally a cold grey. Also the ilmenite quite often displays minimum anisotropy. Consequently the two ores were sometimes easy to distinguish but in other instances difficult. There appears not to be any correlation between the colours and stability. Reaction rims are to be seen around the grains. Sometimes silicate and pyrite are enclosed in the ilmenite. Some of the silicates are reddened and there are traces of haematite after pyrite. Pyrite and chalcopyrite are abundant; in one of the sections there is much pyrrhotite.

6.12 DYKE 12

The road from Loch a' Mhinidh strikes NW along the dyke. A few tens of metres from the loch is a passing-place and the dyke was sampled by this. This dyke is probably a continuation of Dyke 5, but displaced by a shear-zone.

The dyke is massive, moderately exposed in a cliff about 5 metres high. There are more exposures at the top where the path of the gneiss margin may be traced, standing a few cm above the dyke. The material is mostly altered displaying very large speckles of white feldspars yielding grey-green drilling mud. However some cores were less altered, thin sections of which contain some hypersthene as well as clinopyroxene; the feldspars, although cloudy, are not recrystallized.

In polished section ilmenite and magnetite are present both as composite and separate grains, the ilmenite being more abundant and having a pinkish colour against magnetite. These grains tend to be about $\frac{1}{2}$ mm across but there are also some streaks of small grains, less than 50 μ across. The ilmenite often exists as skeletal relics with evidence of several sub-grains. Lamellae in the ilmenite are not common and confined to an occasional fine lamella (5.3.1). There is a moderate amount of pyrite and chalcopyrite.

There was not a single magnetically stable specimen out of 18 cores.

6.13 DYKE 13

100 metres NW of the hotel at Drumbeg the road cuts the dyke, exposed as rocky knolls. It is about 50 metres wide and the gneiss margins are at the same level as the dyke. The gneisses are nearly flat-lying.

The general appearance of the dyke is altered but there are some less-altered patches in which the pyroxenes are visible as large black specks with a pearly appearance; for this reason it was decided that the dyke was worth sampling. However much alteration in the form of large white speckles was seen in the dyke feldspars, the dyke contained a shear zone and there is much foliation. The colour of the drilling mud was green. The alteration observed in the field is confirmed in thin section where the average alteration category is 3.

In polished section much more ilmenite than magnetite is seen. No blades have been seen in the ilmenite but two grains have been noted with mosaic texture. The magnetite consisted largely of martitized remnants. There is abundant haematite, often after pyrite, and reddening of the silicates. Chalcopyrite is also present.

Of the 19 cores, magnetism could be measured in only 11. Three of these are stable but randomly directed.

6.14 DYKE 14

This ultrabasic dyke, termed a bronzite-picrite, was dated by Evans and Tarney (1964) as follows:

TABLE 6.2

Method	Rock	Date, Ma
Rb/Sr	biotite/whole rock	2,190 ($\pm$ 50)
K/Ar	"Fairly Fresh", whole-rock	2,160 ($\pm$ 50)
K/Ar	biotite	1,790 ($\pm$ 50)

The Rb/Sr date is based on the $\frac{1}{2}$-life of ^{87}Rb of 4.7×10^{10}y. However with the $\frac{1}{2}$-life 4.85×10^{10}y, the age becomes 2,260 ($\pm$ 50) Ma.

The dyke outcrops as a number of rocky hillocks in the field on the opposite side of the road from the Farm. It is coarse-grained with black, white and green speckles. Being ultrabasic, it has very little feldspar and the pyroxenes are partly replaced by fibrous amphiboles; the interlocking of these minerals may account for the unusual fact that none of the 20 cores broke whilst drilling them. The drilling mud was grey and the rock is less hard than the dolerites. A further 10 cores were taken from an exposure further from the road by about 50 metres. This was harder rock having chalky feldspars and yielding grey-green drilling mud. It was learnt later that this was not the same dyke but a parallel dolerite.

The gneiss margins could not be seen but it was noticed that the banding of the gneisses of the hills nearby is nearly horizontal.

Thin sections from the ultrabasic were placed in alteration category 1. There appear to be two generations of magnetite, the original grains and dusty opaque inclusions formed by alteration of olivine. A section from the parallel dolerite was thoroughly altered with no original pyroxene or plagioclase.

In polished section, much more magnetite than ilmenite is seen in the ultrabasic; the magnetite exists as grains, sometimes triangular, up to 150μ across. There are often minute (1μ) white blebs within; sometimes there are thick blades of this white material which is isotropic and m might be maghaemite. There are small grains of pyrite (10μ); also chalcopyrite and pyrrhotite.

In a section from the parallel dolerite there is no magnetite; there are very many dispersed grains of ilmenite surrounded by reaction rims, probably sphene. All the ilmenite grains are partly replaced by white, mottly material which has a brown luminescence under crossed Nicols and may be rutile.

The magnetic remanence of all 20 cores from the ultrabasic dyke are measurable but only four of the ten from the dolerite. Five of the former were stable, but none of the latter. The directions of magnetization of the stable specimens are well-scattered.

6.15 DYKE 15

At the point on the road where there is a clear view down the Gleann to Loch Ardbhair there is a parking place and in this the dyke outcrops as a small patch of rock. It is extremely fragile and so it proved possible only to drill two cores. This fragility is borne out by shatter planes in thin section; the alteration category is 4. The magnetism is unstable, the intensity dropping to less than 10% after demagnetizing at only 50 oe in one case and after 100 oe in the other.

6.16 DYKE 16

The overhanging gneiss wall forming the NE margin of the dyke has a conspicuous fold in the banding. Apart from this the banding appears to dip at about 25^{o} to the NW; its strike could not be ascertained. The samples were taken along the strike and within $4\frac{1}{2}$ metres of the foot of the wall. Some shattering of the gneisses was observed and a bent plagioclase crystal was seen in thin section (3.3.2.2).

In polished section there is about the same quantity of magnetite as ilmenite, some occurring as composite grains, others separately, and all the same colour. Some of the grains are fractured and silicate had grown in the fissures. The ilmenite is often skeletal and one grain was seen with mosaic texture. There is a moderate amount of haematite, sometimes as fracture-filling veins, sometimes after pyrite. Sulphide is rather sparse but included one grain of pyrite 600μ across and some chalcopyrite.

There are 11 stable specimens out of 27 but the best grouping (k = 20) occurs at the NRM, yielding a pole with a high latitude. This result may be connected with the proximity to the strained margin; the same phenomenon occurs in Dyke 19.

6.17 DYKE 17

This dyke is about 20 metres wide and was sampled on both sides of the road as it runs close to Loch na Dail. The gneisses are acid, particularly at the SW margin. There are patches of amphibolitization in the dyke but not a trace of foliation. This was the most southerly dyke sampled and it lies 2 km north of the point at which the Lewisian is covered by the Torridonian.

In thin section there is partial alteration and replacement of pyroxene by hornblende and biotite rims, both effects of the Late Laxfordian. There is much hypersthene; the plagioclase is cloudy but otherwise little altered. The alteration category is 3. There is no sign of deformation in thin section.

In polished section roughly equal amounts of ilmenite and magnetite may be seen both separately and as composite grains. These grains tend to be large, the largest such complex observed being $2\frac{1}{2} \times \frac{1}{2}$ mm. The magnetite is frequently much corroded with silicates occupying holes within the grains. There are a few white blades in the ilmenite and frequent examples of mosaic texture. Haematite, sometimes after pyrite, is plentiful in some sections and there is general reddening of the silicates. Chalcopyrite, pyrrhotite and marcasite were seen and a little rutile.

Fourteen of the 24 specimens proved stable. Usually picking out the stable specimens gives a substantial increase in k but in this dyke the effect is not marked, being only from 35 to 45. Demagnetization does not result in a sharp pole position, especially with regard to latitude; this may indicate the smearing-on of another component.

6.18 DYKE 18

The road passes a Lochan on its SE side and at this point the dyke, which is about 30 metres wide, is exposed on both sides of the road. Seventy metres NW of the Lochan there is a vertical fault in the form of a flat-bottomed valley 30 metres wide, at which the dyke is shifted 30 metres in a sinistral sense. In the further section some shattering is seen in the gneisses at the NE margin.

The adjacent gneisses are acid and their banding strikes nearly at right angles to the dyke with dips of about 10° to the NW.

The dyke is completely massive with no signs of either amphibolitization or chalky-white feldspars. It is fairly mafic and coarse-grained. Thin section examination confirms the unaltered appearance in the field and has resulted in the dyke being placed in category 1. A bent plagioclase lath has been noted and in polished section cracks have been seen; both these features may be due to the proximity of the fault.

This dyke is very stable magnetically, 29 of the 30 specimens proving stable. Eight polished sections were made and carefully examined. For this purpose the stable specimens were subdivided into ten grades on the basis of the angle through which the magnetic vector turned per demagnetization stage. A correlation seems to exist between these grades and the extent of the development of alteration features in ilmenite (5.3.1), especially irregular blades which are particularly abundant in this dyke (Plates 5.10). Mosaic texture (Plate 5.9) and finger-formation (Plate 5.5) are also common. There are only a few grains without such features and these have generally been reduced to myrmekitic blebs (Plate 5.2). There is considerably more ilmenite than magnetite, the two ores commonly existing as composite grains, often in close association with sulphides. There is some reddening of the silicates and a moderate amount of haematite, especially after sulphide.

It may be recalled (5.2) that the magnetic species is magnetite in which there are no ilmenite lamellae (5.3.1).

6.19 DYKE 19

This is one of the thin dykes described by O'Hara (1961 B). Its width varies in the range 15 ($\pm$ 2) cm and its 34 metre path across the headland is kinky and exposed for about $\frac{2}{3}$ of this distance; at its southern end it passes through a pegmatite, which is probably of the same generation as the nearby dated pegmatite with an Rb/Sr feldspar date 2,395 ($\pm$ 55) Ma. (Giletti and others (1961)). The dyke is visible in the rocks above the sea south of the headland but here both pegmatite and dyke are sheared.

Seven metres to the west of this dyke is another (also referred to by O'Hara) and this is 30 cm wide dipping 60° to the NE. Thirty-three metres west of Dyke 19 there is a further parallel dyke which is 3.2 metres wide having a severly jointed appearance, both margins clearly visible but not in contact with the dyke. Clearly there has been considerable movement in the vicinity of this headland. The unusual dip of Dyke 19 is consistent with this conclusion.

The strike of the banding in the gneisses and the strike of the dyke are approximately orthogonal. A few tens of metres away extensive garnet formation is visible in the gneisses of the inlet Geodh' Eanruig.

The margins are very sharp and there is no difference in level between the country rock and the dyke. The appearance of the dyke is unaltered, but it has a fabric parallel to the margins. The drilling mud was grey; there was no difficulty in drilling this dyke (in contrast to the even thinner ones (Plate 6.2) at Badcall) (O'Hara (1962)) from which it proved impossible to obtain cores owing to their fragility.

In thin section a porphyritic texture is seen; there are large undeformed separate plagioclase crystals and a few large pyroxene grains, set in a very fine-grained matrix of plagioclase, hornblende, some pyroxene and abundant garnets (3.4). The large crystals were formed deep in the crust whereas the fine-grained groundmass was the result of quick cooling at higher levels.

All the opaques are small, say 30μ, but densely distributed in the non-opaques, in which a mosaic texture can sometimes be seen. The magnetite occurs usually as separate grains but sometimes with ilmenite, containing fine lamellae, attached to them. Sulphides are sparse but pyrite and chalcopyrite were noted.

Only nine cores could be drilled for mechanical reasons and of these only two were stable. The results were odd in that (for all nine specimens) easily the best k, 25, occurred at the NRM but with high latitude. This result may be associated with the foliation and the similar result for Dyke 16 suggests that it may sometimes be a property of a dyke margin.

6.20 DYKE 20

This is an outcrop of dyke a few square metres in extent and 5.0 metres wide. It is really a continuation of Dyke 7 from which it lies 80 metres away (Fig. 6.2) but on the other side of a shear and having a lateral shift from it of a few metres. The dyke is at exactly the same level as the surrounding gneisses.

This portion of the "norite" was dated at 1440 Ma by Evans and Tarney (1964).

On the surface the rock has a green appearance and shows altered feldspars; moreover the drilling mud was green. However, beneath the surface the dyke looks unaltered with a light grey-blue colour reminiscent of Dyke 7 itself. Nevertheless in thin section the dyke is seen to be thoroughly altered. There is still feldspar present but this has recrystallized; there is no pyroxene. There is much pale amphibole which is not hornblende (which may account for the deceptive appearance in the field); there is also much biotite. (It may be recalled that both the "pale amphibole" and biotite were noted in Dyke 7.) There is abundant sphene, after ilmenite; however, there are a few opaques left. This section of dyke has been placed in category 3. In polished section rutile has been seen.

The magnetization is too small to measure on the departmental astatic magnetometer. However, the cores were measured on the PAR Spinner magnetometer at Newcastle, in the hope of recovering a 'remnant of remanence'. Unfortunately, although it proved just possible to measure these rocks, the precision parameter is only 6 and the direction of magnetization does not correspond with those recognized elsewhere in this study; in particular it seems to bear no relation to Dyke 7.

6.21 DYKE 21

The margins are not clear owing to vegetation but the width seems to be 45 - 50 metres. The feldspars and the pyroxenes appear unaltered; the texture of fresh surfaces is almost indistinguishable from a granulite. There is no evidence of shear zones or shattering. The gneisses are acidic, of the granulite facies and lie nearly horizontal.

In thin section very little alteration is seen. The plagioclase is cloudy, there is a very thin rim of hornblende round the pyroxene and opaques; these observations place the dyke in alteration category 1. The pyroxene is mostly monoclinic, there is appreciable quartz and the opaques are coarse.

In polished section ilmenite can easily be distinguished from magnetite on account of the striking colour difference, the ilmenite looking distinctly pink against the magnetite which is bright blue. Fine lamellae and irregular blades are sometimes seen in the ilmenites. Of the sulphides, pyrite, chalcopyrite, bornite and chalcocite have been observed, the pyrite and chalcopyrite being often martitized.

This dyke is highly unstable, there being only one stable specimen out of 23. The resulting pole for all the specimens lies close to the present north pole. This instability was surprising in that the dyke lies in the region in which stable dykes are found. An explanation suggested was that the striking blue colour of the magnetite was due to partial oxidation to maghaemite, $\gamma\ Fe_2O_3$, which elsewhere has been held responsible for unstable remanence (Akimoto and Kushiro (1960), Watkins and Haggerty (1965)). However, x-ray powder diffraction analysis (see acknowledgements) showed that, even if present, the maghaemite concentration in the magnetite could not exceed a few percent. Nevertheless it is possible that the blue colour indicates a degree of non-stoichiometry which is responsible for the instability.

6.22 DYKE 22

This dyke is exposed as a wall projecting from the NE margin. There is some shattering at the margin itself and for this reason samples were taken at least ½ a metre away from the contact. The shattering and untypical dip suggest that there has been some movement. A fair amount of rotten rock may be seen and much jointing. The drilling mud was grey-green. In spite of these features fresh surfaces of the dyke for the most part have a little-altered character.

The gneisses dip to the south-west at about 30° and are acid and pyroxene-bearing.

In thin section the feldspar is hardly clouded. There is however considerable hornblende; this dyke is in alteration category 2. It is a quartz-foliated dolerite. Some of the opaques are very coarse whereas others have grown in an odd way, not as compact grains but as seived grains surrounded by hornblende and minor biotite.

In polished section there are approximately equal amounts of ilmenite and magnetite but identification is not easy owing to weak anisotropy in the magnetite and the absence of any colour difference. The grain size is typically $\frac{1}{2}$ mm but may be as much as 2 mm across. There are fine needles of opaques in the silicates. The ilmenite frequently has a myrmekitic, lobate form; elsewhere it sometimes contains irregular blades. Pyrrhotite is abundant and there is moderate pyrite and sparse chalcopyrite.

Sixteen of the 25 specimens are stable. Even for the stable specimens the precision parameter is not good, gradually creeping up to the value 18 at 125 oe.

Values of the local magnetic declination as measured in the field with the Brunton compass, show undue variation, ranging over 49°.

6.23 DYKE 23

On the 6" geological map of Peach and others (1888) this is described as a "green ultrabasic dyke" and it is said to contain "large crystals of ? olivine". The dyke is exposed as a few square metres of rock adjacent to a bend in the road. On account of the dense vegetation, the nature of the gneisses could not be discerned.

There is of course virtually no feldspar in this dyke; most of its pyroxene has been replaced by amphiboles and these have a fibrous, interlocking nature which imparts strength to the rock. (This explains the field observation that the cores were difficult to break-off.) The alteration category is 4. The opaques are in two forms:

1. Big grains like those in the typical dolerites.
2. Clusters of dust clumped into sharply-definedlittle areas; these are probably resting on the site of original olivine and occupy a greater total area than the large grains.

In polished section, fine inclusions seen in the silicates may be magnetite. There are a few corroded grains of ilmenite, say 200μ across, surrounded by reaction rims and containing tiny pits displaying internal reflexion. There are some 50μ blue grains, which might be maghaemite and these contain minute white pleochroic wormy inclusions.

Sulphides are plentiful viz. pyrite, chalcopyrite, bornite, pyrrhotite, neodigenite, chalcocite. There is sparse haematite in some sections but more in others.

The specimens exhibited great variation in intensity of magnetization, some being readily measurable on the astatic magnetometer, whereas others had to be measured on the PAR Spinner at Newcastle. Eight out of 17 specimens are stable but the precision parameter is only four at best.

The alteration and the poor precision in this dyke are in sharp contrast to those of Dyke 24 which lies only about 40 metres to the north.

6.24 DYKE 24

This dyke is about 25 metres wide and exposed for part of this width as a road cutting. No evidence of alteration can be seen in the field; fresh surfaces have a uniform grey texture. The dyke seems massive but cracks, which may have been caused by blasting, made it difficult to obtain cores of adequate length.

In thin section two pyroxenes are apparent surrounded by a little hornblende; the plagioclase is clouded but otherwise unmodified. The dyke has been assigned to alteration category 1. This is a quartz-bearing dolerite. There are very coarse clusters of "sieved" opaques intergrown with the hornblende.

In polished section there is very little colour difference between magnetite and ilmenite. Ilmenite is more abundant; it is often in skeletal or mosaic texture. The ilmenite displays extensive development of irregular blades, often very thick ones; bending of these blades is sometimes seen, indicating deformation. Sulphides are abundant. Pyrrhotite and chalcopyrite each containing lamellae have been observed as a composite grain; there is also vermicular pyrite and marcasite.

Eleven out of the 17 specimens proved stable, and have yielded a precise pole position.

6.25 DYKE 25

This dyke is 28 metres wide and both margins project about 2 metres above the dyke. The NE margin dipsat 60 - 69^{o} to the north-east but the SW margin dips at only 30 - 40^{o}; this peculiar feature may indicate gross movement or may be an erosion plane. There are pegmatites in the NE margin and these are cut by the dyke. The dyke is discordant; a small island of gneiss was noted in the middle of it. No sign of alteration of the minerals was seen in the field; the drilling mud was grey. In thin section the dyke has been placed in category 1. It is a foliated dolerite having small amounts of hornblende and biotite.

In polished section slightly more ilmenite than magnetite is seen, a typical grain size being $\frac{1}{2}$ mm. A colour difference has been noted but this is not as distinct as in Dyke 21. The magnetite is often in the form of a sandwich containing a grain of ilmenite say 30 - 60μ thick. Ilmenite grains sometimes demonstrate finger-formation and skeletal textures. Of the sulphides, pyrite, pyrrhotite and marcasite have been seen. There is some haematite, partly after pyrite.

After sampling, this dyke was traversed with a portable magnetometer. A large magnetic anomaly was found ranging up to 12,500 gammas. Like Dyke 22 the magnetic declinations at each core varied greatly; they extended over a range of 66°. Two of the specimens are found to be reversely magnetized. Seven out of the 24 specimens are stable but one of these is reversely magnetized, the local value of the magnetic declination, as measured at the core with the Brunton compass, being - 49°. A calculation of an ancient pole position from these seven specimens would have been misleadingly imprecise and so the reversely magnetized specimen has been omitted from the statistics.

6.26 DYKE 26

Excess argon dates of 3,800 and 3,860 Ma were determined for this dyke by Evans and Tarney (1964). It lies in the region of basic and ultrabasic gneisses identified as Early Scourian by Evans (1965). There is a shear about 100 metres from the sampling sites but clearly this did not cause argon loss even though Laxfordian shearing caused up-dating of the olivine-gabbro, which cuts the northern branch of this dyke, to 1,720 Ma (Evans and Tarney (1964)).

The margins of Dyke 26 are very poorly exposed but seem to lie at a slightly lower level than the dyke which is probably about 50 metres wide; the palaeomagnetic samples were taken from rounded knolls near the SW margin.

No sign of alteration could be seen in the field, except in core 26-1. In this there are reddish-purple patches which looked like garnets. In polished section crystals were seen which again looked like garnets; one of these was picked-out with a pin and an x-ray diffraction pattern showed that it was plagioclase. Subsequently a thin section was made (see acknowledgements); there are no garnets in this whereas the plagioclase has a pinky-buff colour, presumably on account of haematite, staining.

In polished section the sulphides are martitized in this core which is thought to be an isolated example of weathering; nevertheless its palaeomagnetic quality is excellent.

In general, thin section examination reveals that the dyke contains equal amounts of hypersthene and clinopyroxene suggesting minimal alteration; however they have a mosaic texture. The plagioclase is cloudy and there is a good deal of hornblende; on the basis of these criteria the dyke has been placed in alteration category 3. However, Evans and Tarney (1964) considered that in excess argon dykes the substantial hornblende and the "greyish" clouding of the plagioclase are either primary features of crystallization or result from metamorphism very shortly afterwards. Clearly the extent of alteration recognized in this dyke depends on the interpretation of the mineralogy.

In polished section "white blades" in the ilmenite are conspicuous (5.3.1). See Plate 5.7.

Twenty-seven out of the 33 specimens proved stable and yielded a precise and constant pole position at 50 and 75 oe. This pole is almost the same as that of the NRM; the improvement in precision shows that demagnetization removed a small randomly directed component. The fact that even the NRM is not influenced by the Earth's present field is an excellent test of stability. As a further test of stability the six pilot specimens (4.2.4.2) were demagnetized in steps up to higher fields and found to maintain the same direction of magnetization with some precision up to 250 oe (see Appendix, PALT, Dyke 26 Pilot).

6.27 DYKE 27

This is the "thin tholeitic dyke" dated at 1,950 Ma by Evans and Tarney (1964). The late date could be due to the presence of a fault only about 30 metres away; however it has been seen in Dyke 26 that the vicinity of a fault does not necessarily cause argon to be lost. The above authors sampled this dyke in the belief, based on observations of Tarney (1963), that it was "more likely than most to be Laxfordian in age". They concluded that the date "may well be real". If this is correct it would have been intruded near the end of the 300 Ma period during which, according to Evans (1965), the country rock became progressively cooler. Now this is the only dyke in the present survey in which there are thin, ilmenite lamellae in the magnetite (Plate 5.8). These features support the view that the country rocks were cooler when this dyke appeared (5.3.2).

The dyke is 13 metres wide and was intruded into hornblende gneisses. The margins are irregular with arms of dyke penetrating the gneiss walls; an island of gneiss was seen in the middle of the dyke. In thin section the dyke has been placed in category 2.

In polished section the magnetite contains ilmenite having a great range of dimensions, varying from lamellae a few μ thick to hundreds of μ as a sandwich. It was often a moot point as to whether the ilmenite should be described as lamellae or as part of a composite grain of magnetite and ilmenite. Perhaps in this dyke we are seeing the transition from the lamellae stage to the familiar composite grains. The presence of the thin ilmenite lamellae in magnetite, which are unique in this collection, was confirmed using the electron probe. Sometimes two or three parallel sets of the blades were seen in the same grain of magnetite. Ilmenite often contains irregular blades and also occurs as skeletal relics. Some composite grains are as much as 2 mm across; sometimes pyrite, which is abundant, is seen as inclusions in the magnetite. Chalcopyrite has sometimes been observed but, haematite is sparse.

The chemical analysis of this dyke appears in Chapter 8.

6.28 DYKE 28

This is an excess argon dyke which has been dated at 2,740 and 1,800Ma (Evans and Tarney (1964)). The palaeomagnetic samples were taken from the section of dyke which had yielded the lower date; here the dyke stops just short of a shear. It is a broad dyke say 60 metres wide whose margins are not easily seen on account of grass cover. The country rock is composed of hornblende gneisses.

The rock at the sampling site, near the SW margin, is rather unaltered; large translucent white feldspar patches were sometimes seen in the cores. On the other hand only 100 metres to the north-west amphibolitization and chalky white feldspars were noted.

In thin section the coarse patches of feldspar display signs of alteration; these may have formed at the time of crystallization in a process which differentiated the acid part of the magma. Apart from these patches (compare Dyke 26) the feldspar is but little altered. The pyroxene is mostly monoclinic but there is a slight amount of orthorhombic too. There are thin rims of hornblende round the pyroxenes. These observations place the dyke in category 2. There are large grains of opaques associated with a little biotite. There are fractures across the slides and these probably resulted from the shearing. They may have allowed argon to escape and so given rise to the low date which was unexpected in view of the rather unaltered character of the dyke. Some of the other lower Scourie dyke dates have been attributed to shearing (Evans and Tarney (1964)). Moreover in Greenland local shearing in two regions has also caused sporadic loss of radiogenic argon (Bridgwater and others (1973)) yielding dates near 1,800 Ma.

It might at first be thought that the 1,800 Ma date which, in the light of Lambert and Holland (1972), is a typical Late Laxfordian date, corresponds to the time at which the shearing happened. However in the Late Laxfordian the rocks were in a somewhat plastic state whereas the shearing would have taken place in brittle conditions at a later time. This date may therefore best be interpreted as a date intermediate between dyke intrusion and the time of shearing.

There are interesting chemical differences between the two dated sites (Tarney, unpublished data):

TABLE 6.3

Chemical differences in Dyke 28

	K_2O %	Rb ppm	S ppm	$\frac{Fe_2O_3}{FeO}$
1,800 Ma site	0.48	10	348	0.254
2,740 Ma site	0.35	7	235	0.206
$\frac{\text{1,800 Ma values}}{\text{2,740 Ma values}}$	1.4	1.4	1.48	1.23

These differences may well have been established in the Late Laxfordian, before the shearing happened.

Late minerals have formed in the cracks mentioned above, namely chlorite, an amphibole, calcite and a string of quartz grains. The temperature at this time may have been less than 400°C.

In polished section much more ilmenite is seen than magnetite, these occurring both as composite grains displaying "sealed junctions" and in the case of ilmenite, as separate grains. The ilmenite has translucent reaction rims and is sometimes corroded and skeletal; mosaic texture is not uncommon, sometimes martitizing. White blades in the ilmenite have been seen and closely resemble those described in Dyke 26 (Plate 5.7); ilmenite also contains irregular blades.

Haematite is plentiful and has often been formed at the expense of iron sulphides which are present only as sparse relics; there is orange staining of the silicates. Possibly the haematite is simply the result of weathering but in any case it is worth noting the contrast in this dyke between the alteration seen in polished section and its general absence in thin section. Indeed Watkins and Haggerty (1967) have observed that the two are not necessarily related and have seen "huge differences" of this type.

This is the most stable dyke palaeomagnetically, having all 29 specimens stable. After measuring the NRM there was found to be virtually no difference in pole position between one demagnetizing field and another. That at 125 oe with k = 202 was adopted (see Appendix).

The six pilot specimens were treated to a further seven demagnetizing stages up to 700 oe; very little change in pole position was seen up to 500 oe, at which there was still about half the original remanence, and k was more than 150 for all stages up to this field. The first 22 samples collected had a particularly precisely directed magnetization indicated by an unprecedented k = 639 before demagnetization. Clearly the magnetization bears no trace of secular variation and so was not acquired by slow cooling of a great volume of rock. It was probably acquired at a precise instant due to a specific event.

CHAPTER 7

SAMPLING SITES: THE GNEISSES AND GRANITES

The positions of these rock units are given in the following table, in which G represents gneisses and H granites:

TABLE 7.1

Rock Unit	Locality	Lat °N	Long °W	Grid Ref.
G1	Laxford Bridge	58° 22'	5° 00'	NC 236467
G2) G3) G4)	Badcall	58° 19'	5° 10'	NC 146418
G5	Scourie Pier	58° 21'	5° 09'	NC 156449
G6	Loch Call an Uidhean	58° 04'	5° 14'	NC 090148
G7	Badcall	58° 19'	5° 10'	NC 146418
H1	Laxford Bridge	58° 22'	5° 00'	NC 236467
H2)	½ km north-east of Loch na Claise Fearna	58° 22'	5° 03'	NC 207474
H3)		58° 22'	5° 03'	NC 206472

The gneisses were sampled initially in the belief that if ancient pole positions could be recovered from them, they might correspond to cooling at the end of the Early Scourian metamorphism some 2,600 Ma ago. All but one of the gneisses are unstably magnetized. However one of them, G6, has given palaeomagnetic results which are considered thoroughly reliable; the pole falls in the midst of those of stable dykes (Fig. 8.1), a result which caused surprise and led to the abandonment of the idea that a pre-dyke pole might be recovered from the gneisses.

The granites were sampled in the hope of finding a Laxfordian pole but their instability rendered this impossible.

G1 is a single core drilled by accident in the gneiss margin of the Laxford granite sheet H1. (The pole after demagnetizing at 25 oe is shown by a cross in Fig. 9.1 but no general conclusions can be drawn from a single core.)

G2, G3, G4, G7 are all gneisses from the area of basic gneisses at Badcall shown in Fig. 6.2. G2 has a pink surface due to weathering; in thin section a fair amount of hornblende is seen which seems to have formed in two generations. There is much more ilmenite than magnetite, the ilmenite being often divided into a number of sub-grains. Opaques also present are pyrite and chalcopyrite, sometimes as composite grains; pyrite is also seen as wormy fracture-filling features.

G3 is a patch of green ultrabasic gneiss only 1½ square metres in area lying 10 metres from G2. The rock contains much hornblende, no feldspar and the few opaques are mainly sulphides. The magnetization is very small indeed but has been measured on the PAR Spinner magnetometer at Newcastle University. The grouping of directions is poor.

G4 is the gneiss margin of a dyke a few metres from G2 and G3. In thin section very little alteration is seen; there is a good deal of hypersthene, also monoclinic pyroxene, plagioclase and some primary hornblende. In polished section the magnetite has for the most part a well-defined appearance although there are a few corroded grains too. Ilmenite often exists as "sandwich" laths at least 30μ thick in the magnetite; the ilmenite generally is very well-preserved and individual grains are sometimes divided into several smaller ones. There is a little chalcopyrite and pyrite.

G7 is a basic to ultrabasic gneiss containing orthopyroxene, clino-pyroxene, hornblende and only a little plagioclase. The specimens were collected along the marginal walls of Dyke 7. The palaeomagnetic results are very poor ($k = 2$), a circumstance which contrasts strongly with the stability of the dyke itself.

G5 is the basic, garnet-bearing gneiss at Scourie pier, which is quite unaltered and contains very little hornblende. In polished section Plate 5.1

shows the typical appearance of magnetite and ilmenite. There is abundant pyrite and some chalcopyrite and pyrrhotite. Reddening of the silicates is common.

The basic gneiss G6 occurs as a road cutting along which 23 cores were collected over a distance of about 100 metres. This granulite contains abundant garnets and only a trace of amphibole. In polished section the magnetite and ilmenite often occur as thick sandwich grains. (Plate 5.6) In ilmenite the irregular blades may often be seen (Plate 5.12). There is no haematite but pyrite is abundant, sometimes occurring as large grains (say 350μ), otherwise as very long fracture-filling features.

The palaeomagnetic results are easily the best for the gneisses. The pole position does not change greatly with demagnetization, the precision parameter gradually increases to its optimum value of 25 at 125 oe at which the specimens retain a substantial fraction of their original magnetization. The magnetic behaviour of this granulite is similar to that of a stable dyke. Eleven of the specimens satisfied the stability criterion; however this was not applied, on the grounds that it had been developed for dykes.

Three of the granite sheets (2.5.2.2) were sampled. These granites are extremely weakly magnetized and unstable. Forty-one cores were collected; some of the less weakly magnetized ones could be measured on the Imperial College astatic magnetometer. Further samples were measured on the Newcastle PAR Spinner. It was noticed that the remanence of one of the samples was changing during measurement. It was then banged with a hammer; this caused a thirty-fold increase in intensity and the new value did not change during measurement. The specimen was then demagnetized and yielded an intensity similar to the original value. In view of this experiment further measurements on the granites were abandoned.

CHAPTER 8

THE PALAEOMAGNETIC RESULTS AND THEIR SIGNIFICANCE

8.1 INTRODUCTION.

The full palaeomagnetic results are given in the Appendices. In this chapter they will be summarised and appraised and will be considered in the light of other observations, especially with regard to magnetic stability.

8.2 PALAEOMAGNETIC RESULTS FOR THE DYKES.

The stability criterion (4.2.5.1) has been applied to each dyke and mean directions of magnetization have been determined from the stable specimens on the assumption that Fisher's statistics are obeyed. When directions are very scattered the resulting mean direction and its circle of 95% confidence may not be statistically significant. This point may be tested using the Table of Irving (1964), 63. The dykes fall into 3 classes and are listed in Table 8.1.

Class 1. This set contains 10 dykes with significant mean directions at the 95% confidence level. 9 of these dykes form a tight group of directions (Fig. 8.17(a)).

Class 2. This class contains three dykes about whose statistics there is some doubt. One of them has a strongly non-Fisherian distribution of directions.

Class 3. The remaining dykes are placed in this class for a variety of reasons as indicated in the notes in Table 8.1.

N' is the number of stable specimens and N is the total number of specimens.

TABLE 8.1

Summary of the Palaeomagnetic Results for the Dykes

Class & Rock Unit	Best Demag. Field (peak) oe	N′	Mean direction of Magnetization		k	α_{95}	N	Dyke Stability %	Alteration Category	NOTES
			Declination	Inclination						
CLASS 1										
Dyke 7	100	32	106.1	1.0	35	4.4	36	89	1	
Dyke 11	50	11	264.7	55.6	70	5.5	57	19	2	
Dyke 17	50	14	301.1	62.1	45	6.0	24	58	3	
Dyke 18	150	29	262.0	50.7	166	2.1	30	97	1	
Dyke 22	125	16	297.1	55.4	18	8.9	25	64	2	
Dyke 24	100	11	294.0	49.6	200	3.2	17	65	1	
Dyke 25	25	6	298.7	57.4	66	8.3	24	25	1	
Dyke 26	75	27	293.1	50.3	184	2.1	33	82	3	
Dyke 27	50	6	284.0	63.8	36	11.3	20	30	2	
Dyke 28	125	29	272.4	46.6	202	1.9	29	100	2	
CLASS 2										
Dyke 1	150	3					52	6	3	Too few stable specimens to test whether Fisher's statistics hold or not.
Dyke 16	0	11					27	41	3	The distribution of directions is somewhat non-Fisherian (Fig.8.13(a)), moreover the grouping is peculiar in that the tightest group occurs at the NRM.
Dyke 23	100	8					17	47	4	Strongly non-Fisherian distribution (Fig. 8.13(b)). Ultrabasic.

TABLE 8.1 (Continued)

Class & Rock Unit	Best Demag. Field (peak) oe	N′	Mean direction of Magnetization: Declination	Mean direction of Magnetization: Inclination	k	α_{95}	N	Dyke Stability %	Alteration Category	NOTES
CLASS 3										
Dyke 2							20		4	Too weak to measure
Dyke 3		0					9	0	3	No stable speciments. Ultrabasic.
Dyke 4		1					4	25		Only 1 stable specimen.
Dyke 5		7					39	18	2	Not significant at level of 95% confidence.
Dyke 6		2					7	29	3	Too few stable specimens for the significance test.
Dyke 8		0					5	0	3	No stable specimens.
Dyke 9		0					2	0		No stable specimens.
Dyke 10							34		3	Too weak to measure.
Dyke 12		0					18	0	3	No stable specimens.
Dyke 13		3					11	27	3	Not significant.
Dyke 14		5					20	25	1	Not significant. Ultrabasic.
Dyke 15		0					2	0	4	No stable specimens.
Dyke 19		1					9	11		Only 1 stable specimen.
Dyke 20							13		3	Exceedingly weak; insufficient data to apply the stability criterion.
Dyke 21		1					23	4	1	Only 1 stable specimen.

8.3 PALAEOMAGNETIC RESULTS FOR THE OTHER ROCK UNITS.

The results for the gneisses and granites, all of which are significant at the 95% confidence level, are summarized in Table 8.2. (G1-1 was an isolated core.)

TABLE 8.2

	Best Demag. Field (peak) oe	N	Mean Direction of Magnetization Dec-lination	Inc-lination	k	α_{95}
THE GNEISSES						
G2	25	12	305.5	76.5	39.0	7.0
G3	0	5	322.3	62.0	12.3	22.7
G4	0	8	36.7	64.0	7.7	21.3
G5	0	16	118.3	28.9	7.6	14.3
G6	125	22	290.8	59.5	24.9	6.3
G7	0	11	36.0	80.5	1.9	47.2
THE GRANITES						
H1	25	8	350.3	83.9	5.6	25.8
H2	0	5	270.3	65.4	10.8	24.4
H3	0	7	32.5	76.2	3.4	38.7

8.4 ASSESSMENT OF THE RESULTS.

The palaeomagnetic quality of the results may conveniently be considered by means of equal area projections of directions of magnetization and by demagnetization curves. On the projections the north pole is indicated with the usual symbol and declinations measured eastwards in a clockwise sense; values of inclination increase from zero at the circumference to 90° at the centre, north-seeking poles dipping downwards indicated by dots, and upwards by circles.

Figs. 8.1 to 8.16 illustrate the groupings of directions in particular rock units and the change in the pattern upon partial demagnetization. The behaviour of all the specimens in a typical low stability dyke is demonstrated and may be compared with that of the 10 class 1 dykes, in which only the stable specimens are shown because it is upon these that the statistics depend. For the partially stable Dyke 11 the grouping of the stable specimens is contrasted with that of the unstable ones. Figs. 8.17(a) and 8.17(b) show the mean directions and circles of 95% confidence of all the rock units which are significant.

Figs. 8.18 to 8.35 illustrate the stability of individual specimens, the projections showing changes of direction and the graphs the accompanying changes of intensity for the same specimens. These specimens have been chosen so as to be as representative as possible of the rock units in which they occur. Points on the projections have been joined by great circles on the assumption that the changes of direction take place by the shortest paths.

Symbols:

▲ = the mean direction for the whole rock unit.

◈ = the direction of the present geocentric axial dipole field.

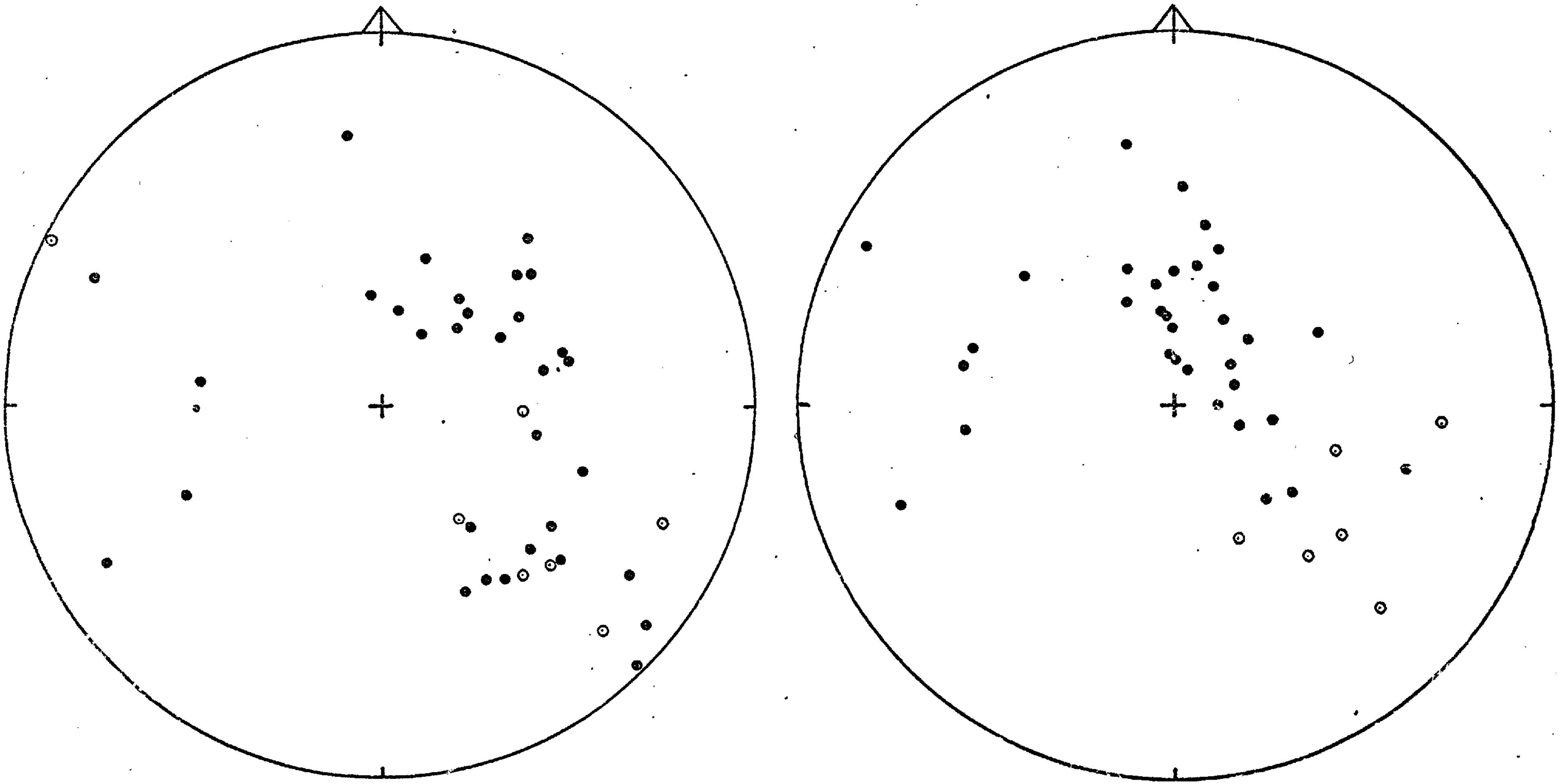


Fig. 8.1 Directions in a typical unstable dyke, Dyke 5.

(a) NRM

(b) After 50 oe.

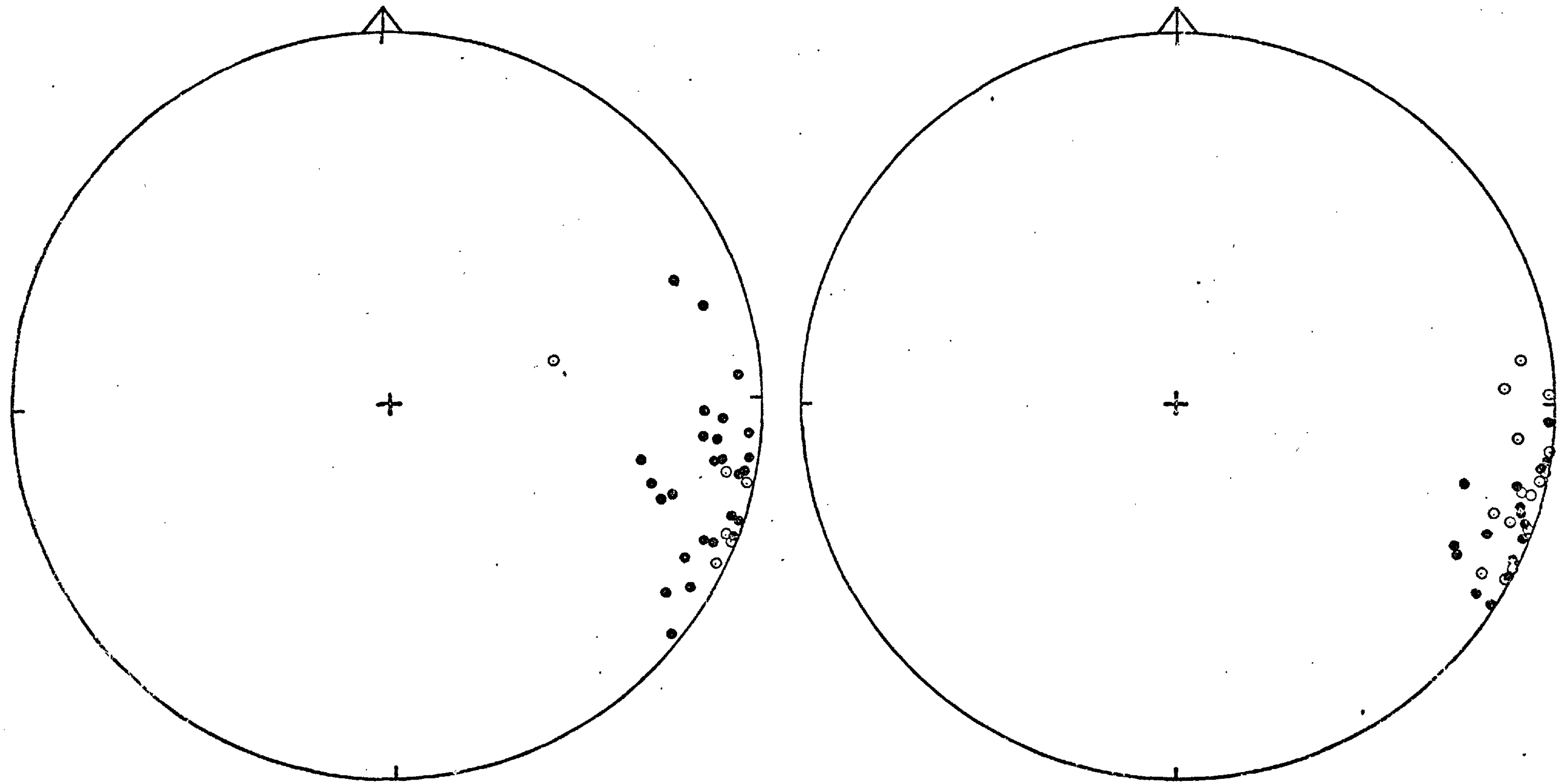


Fig. 8.2 Directions of stable specimens in Dyke 7

(a) NRM

(b) After 100 oe.

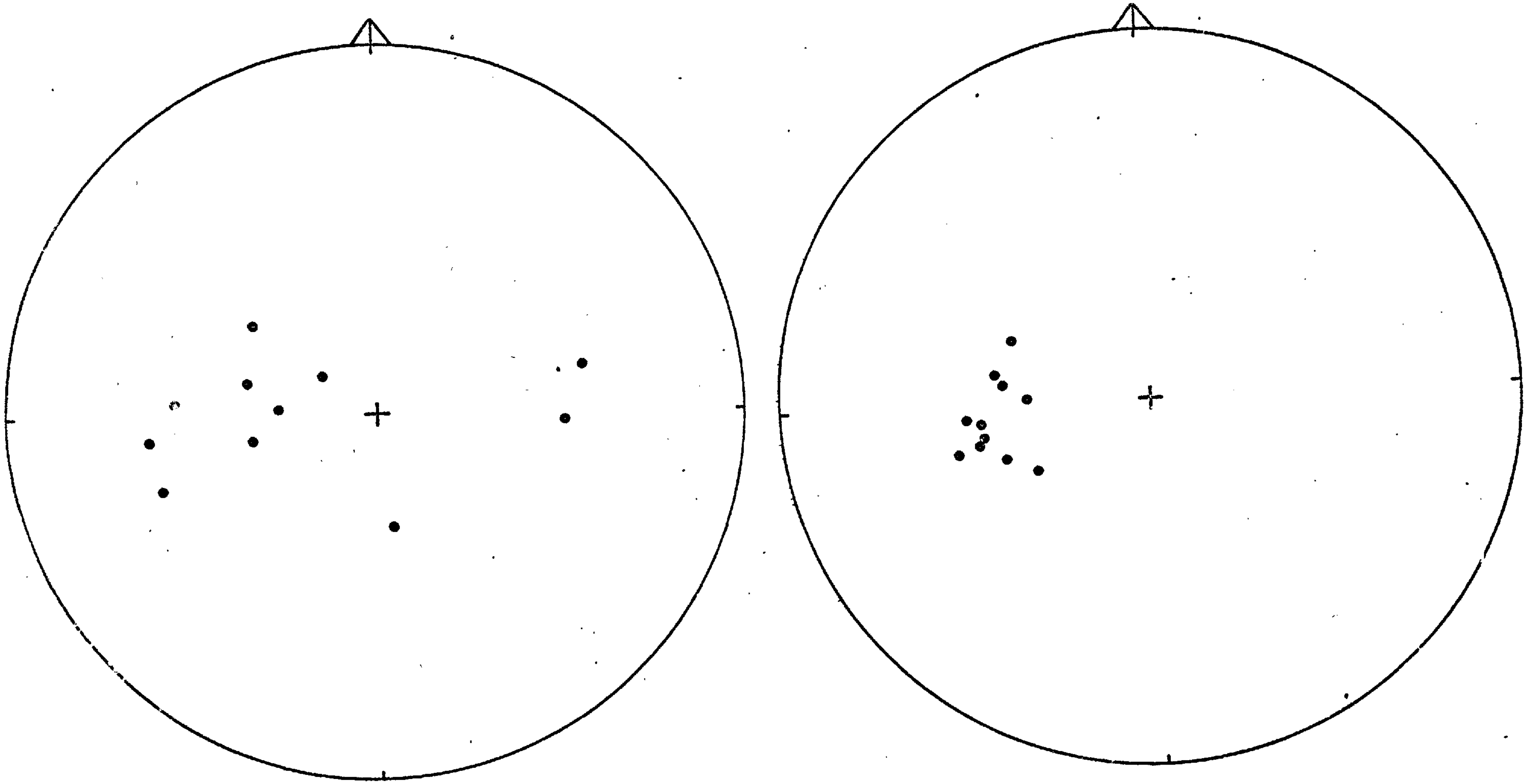


Fig. 8.3 Directions of stable specimens in the partially stable Dyke 11

(a) NRM

(b) After 50 oe.

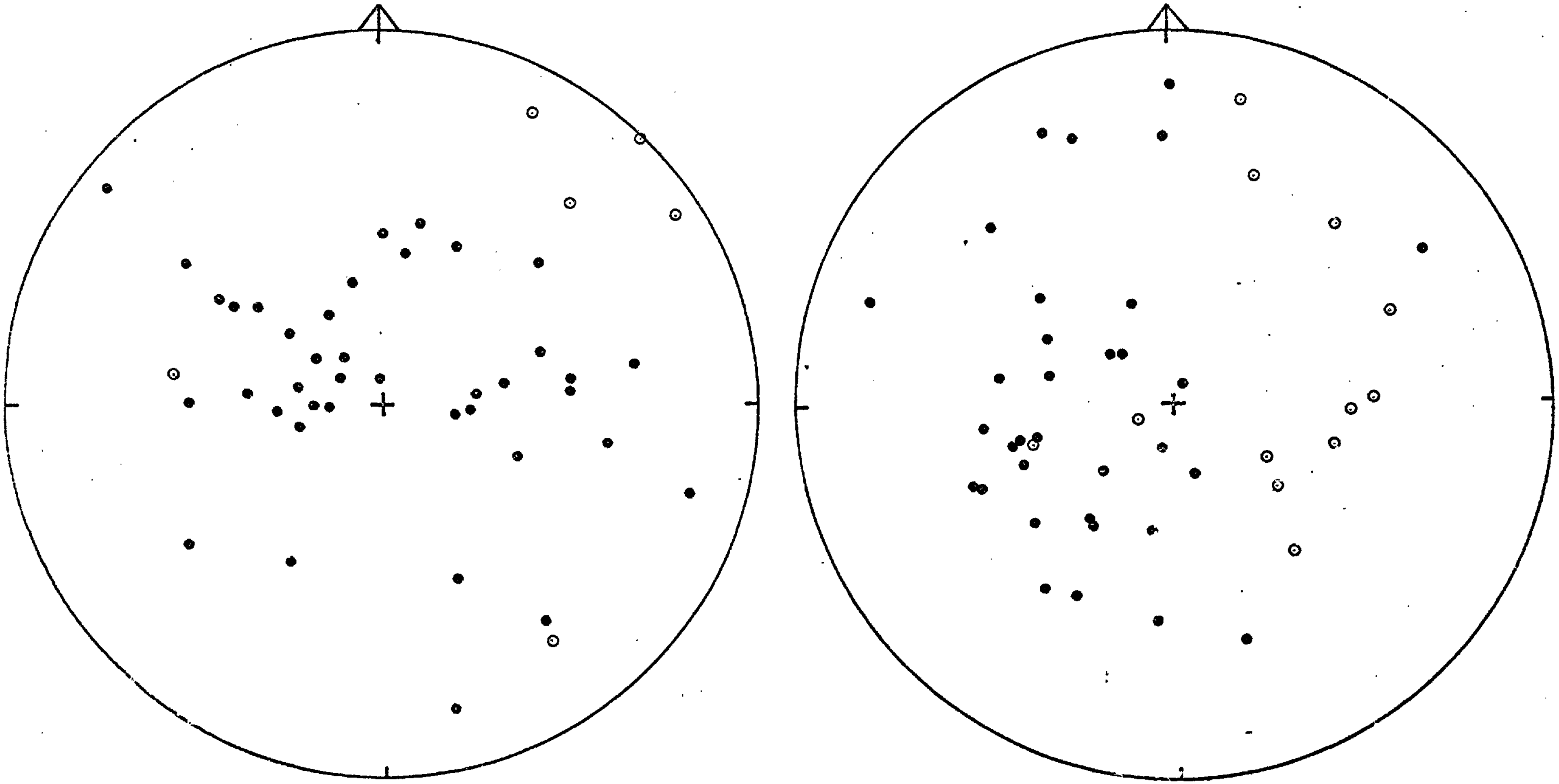


Fig. 8.4 Directions of the unstable specimens in Dyke 11

(a) NRM

(b) After 50 oe.

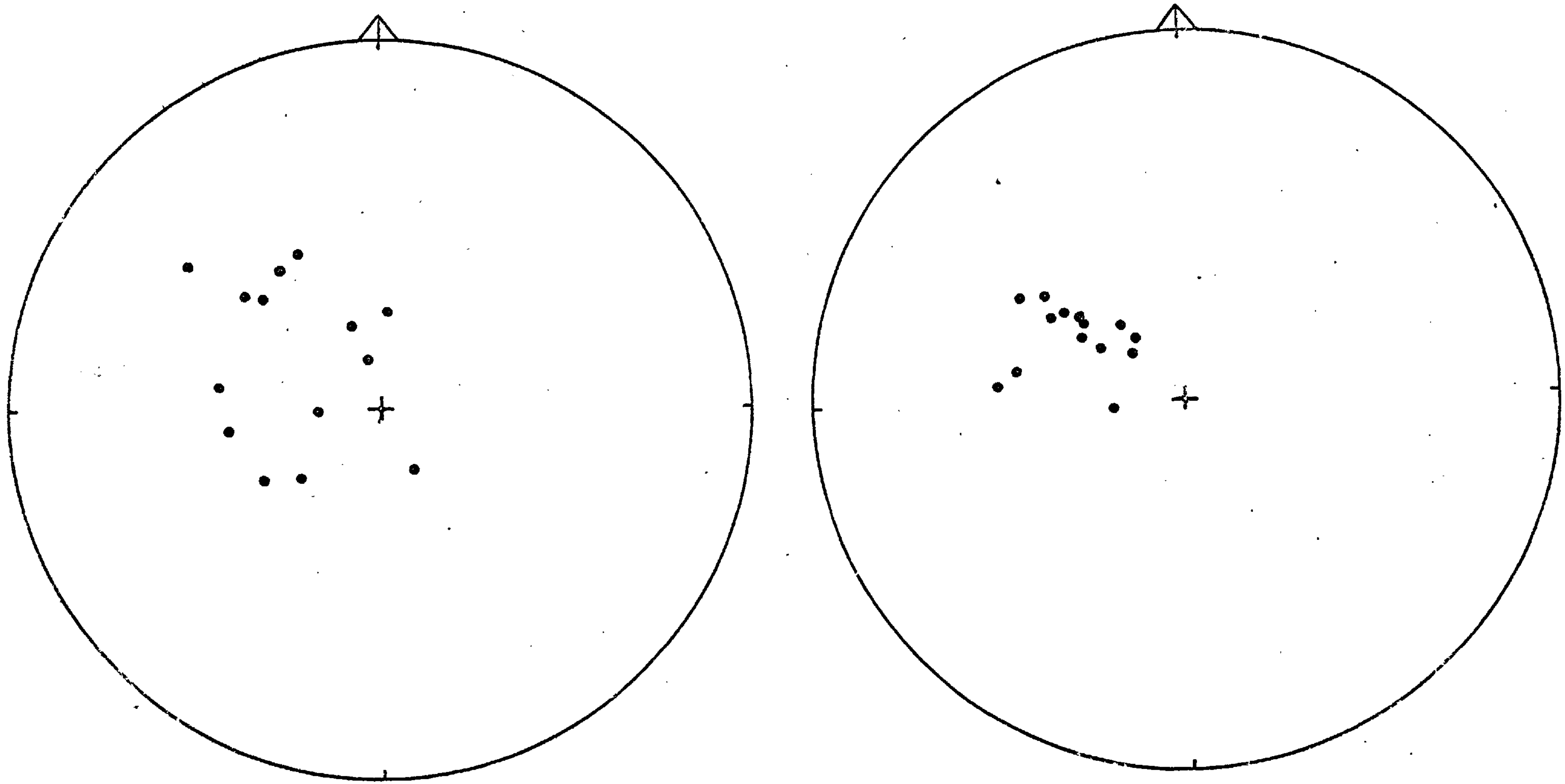


Fig. 8.5 Directions of stable specimens in Dyke 17

(a) NRM (b) After 50 oe.

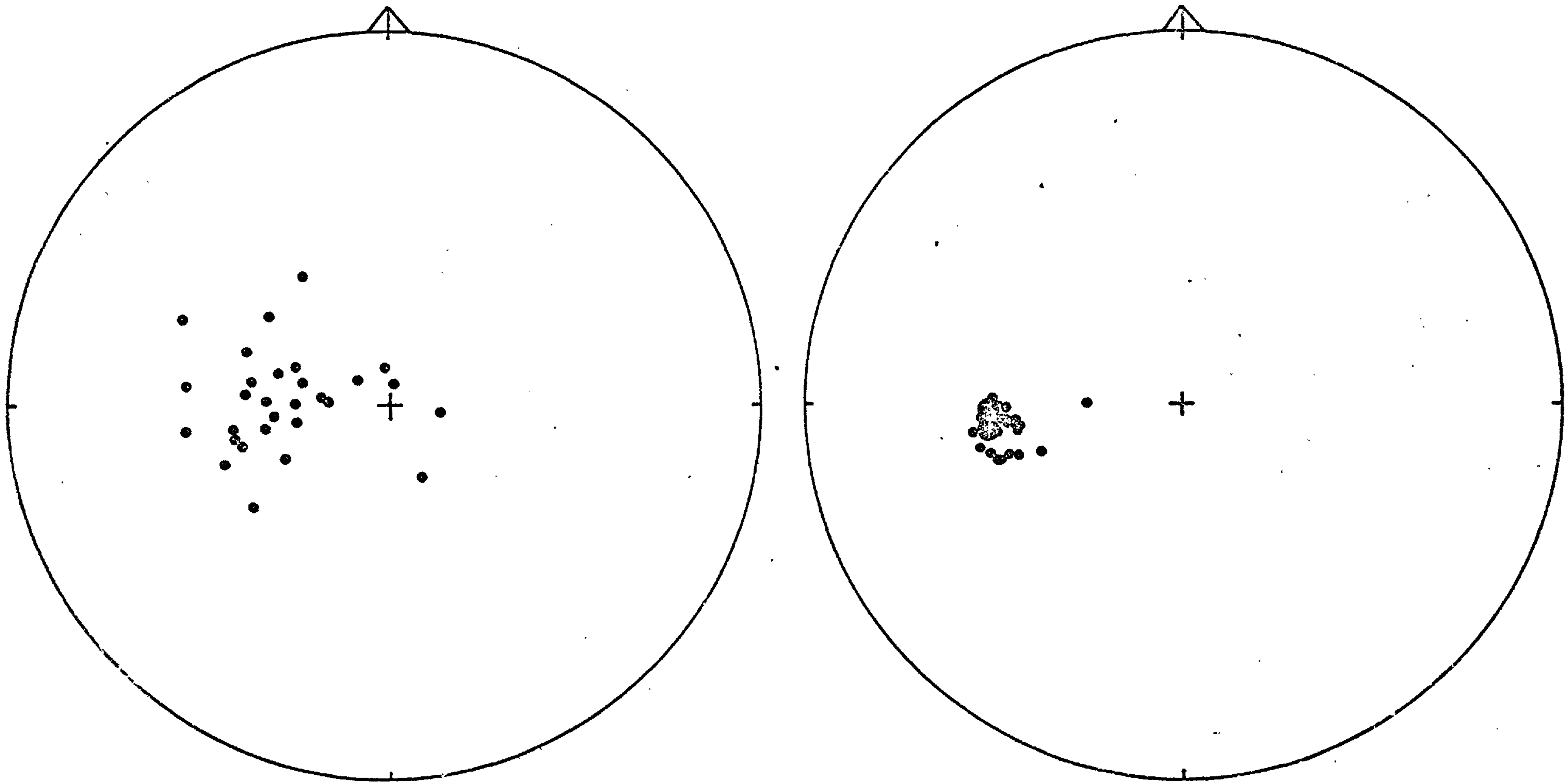


Fig. 8.6 Directions of stable specimens in the typically stable Dyke 18

(a) NRM (b) After 150 oe.

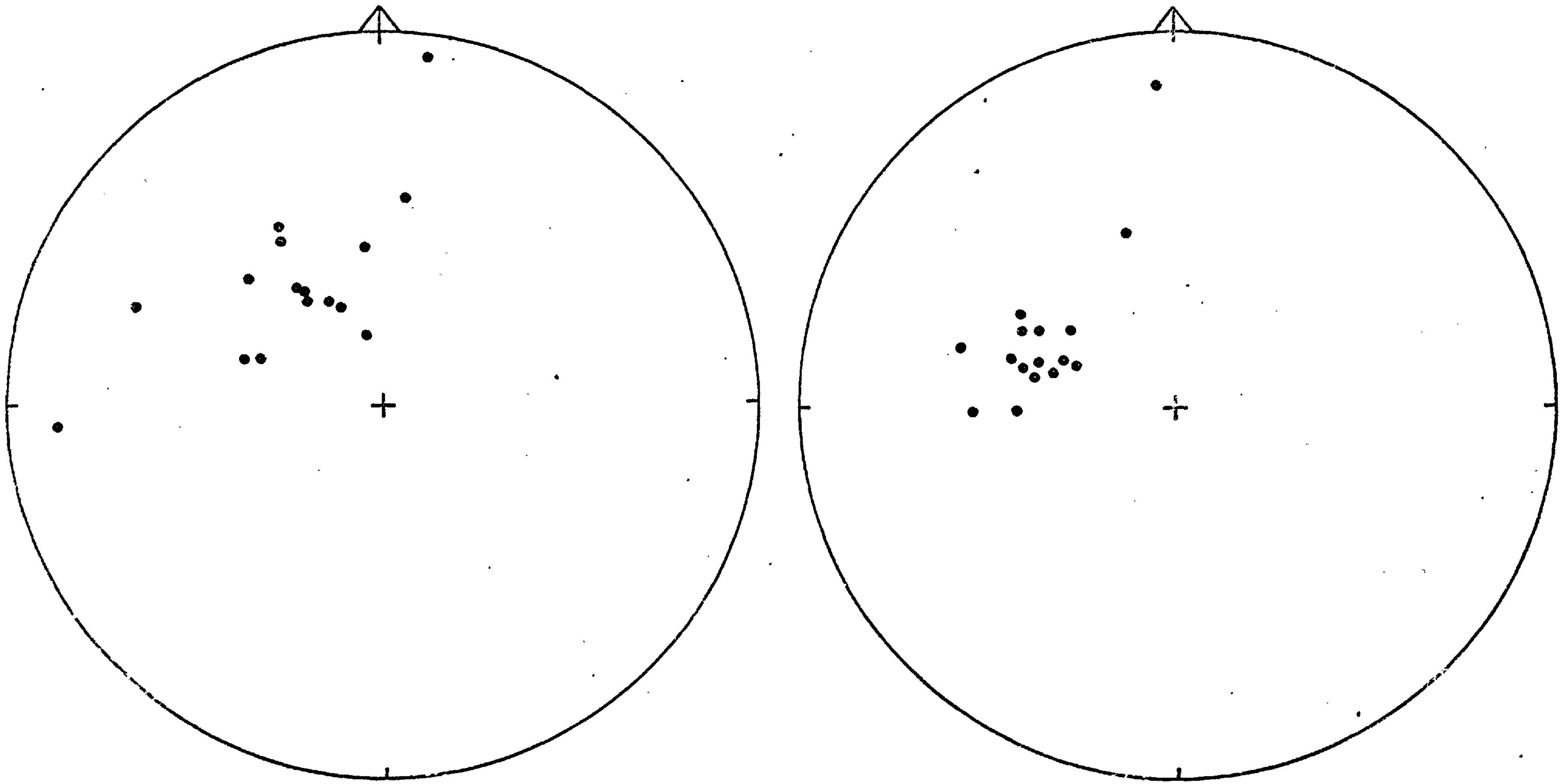


Fig. 8.7 Directions of stable specimens in Dyke 22

(a) NRM

(b) After 125 oe.

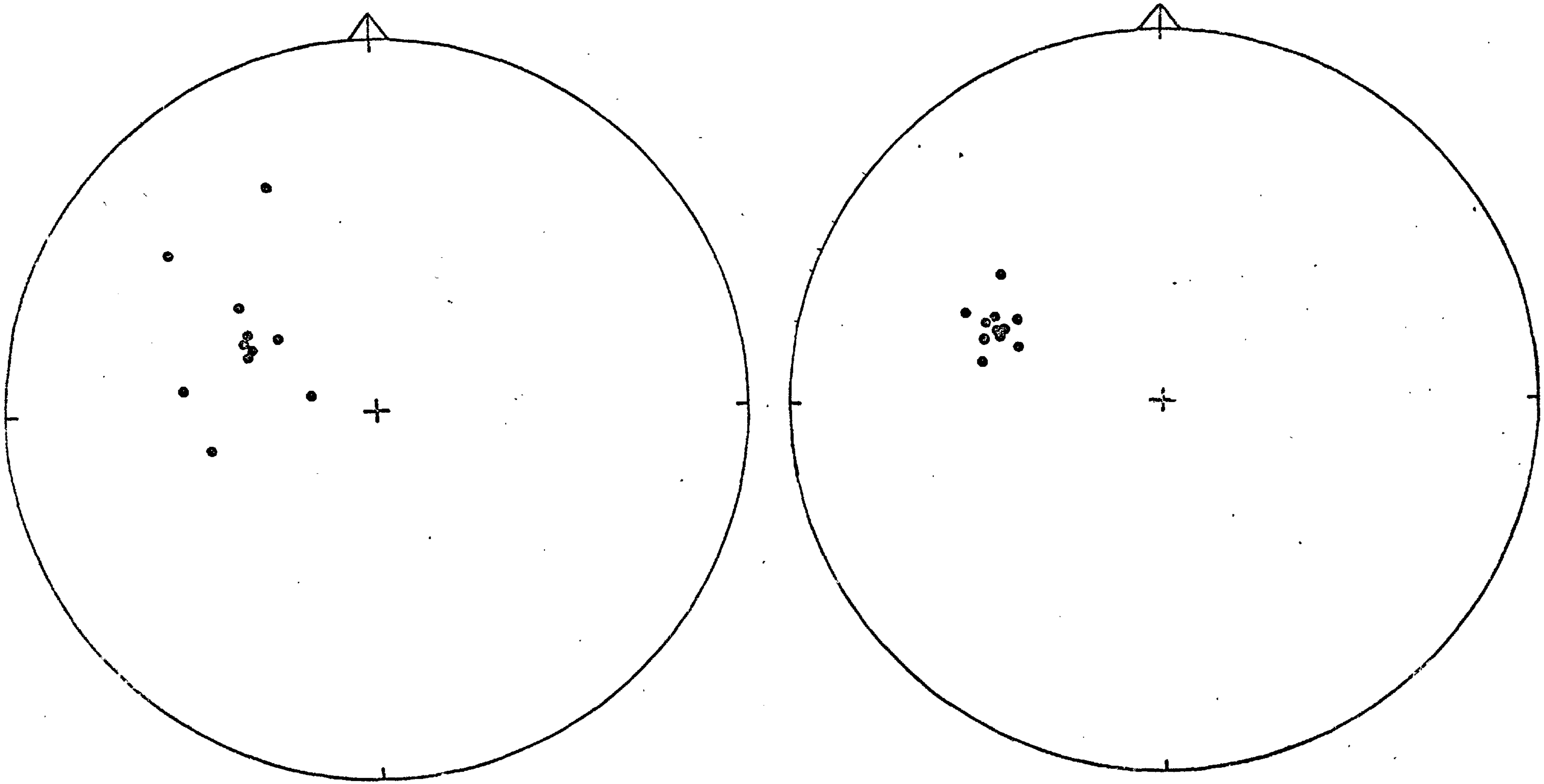


Fig. 8.8 Directions of stable specimens in Dyke 24

(a) NRM

(b) After 100 oe.

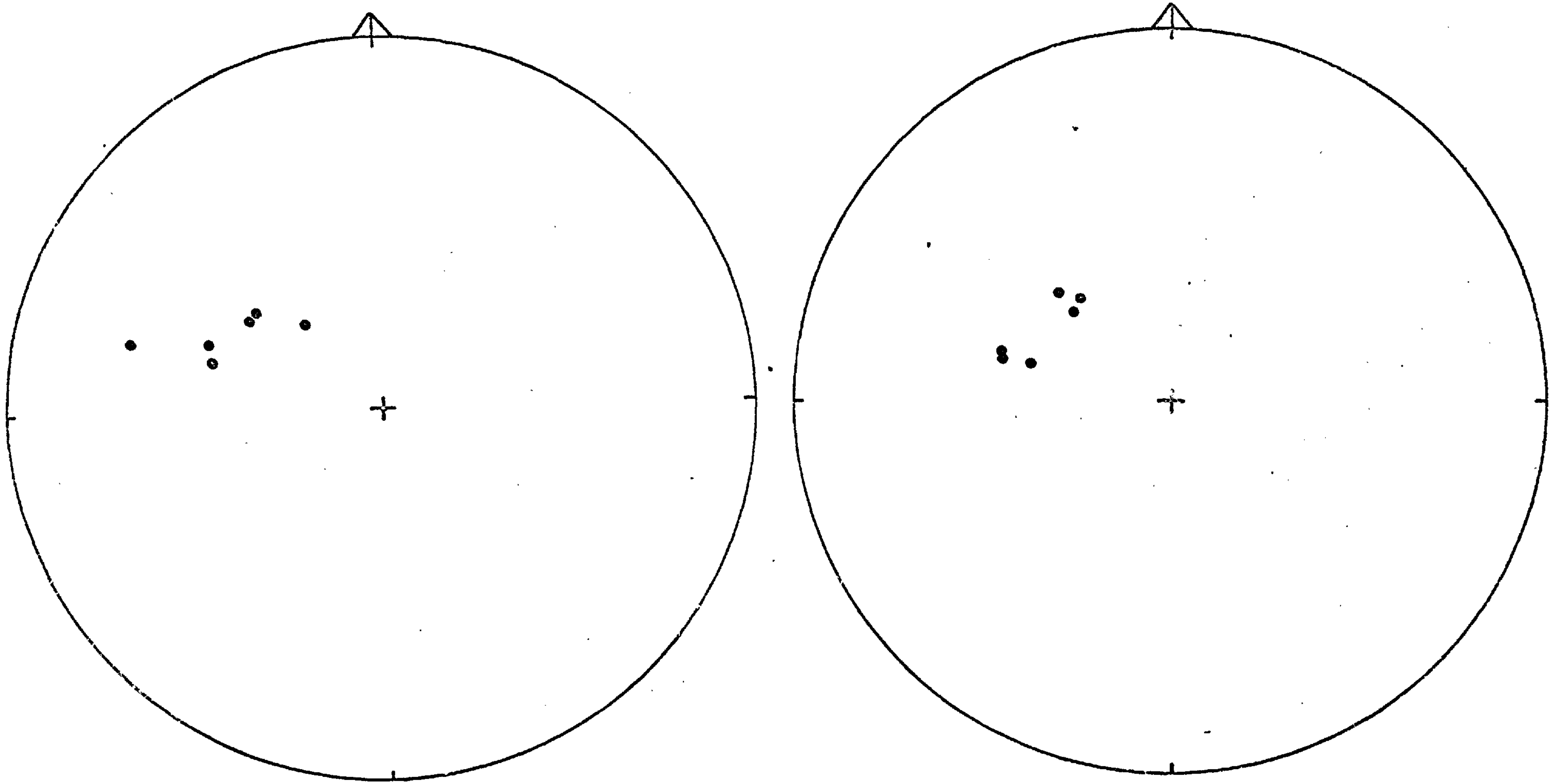


Fig. 8.9 Directions of stable specimens in Dyke 25

(a) NRM

(b) After 25 oe.

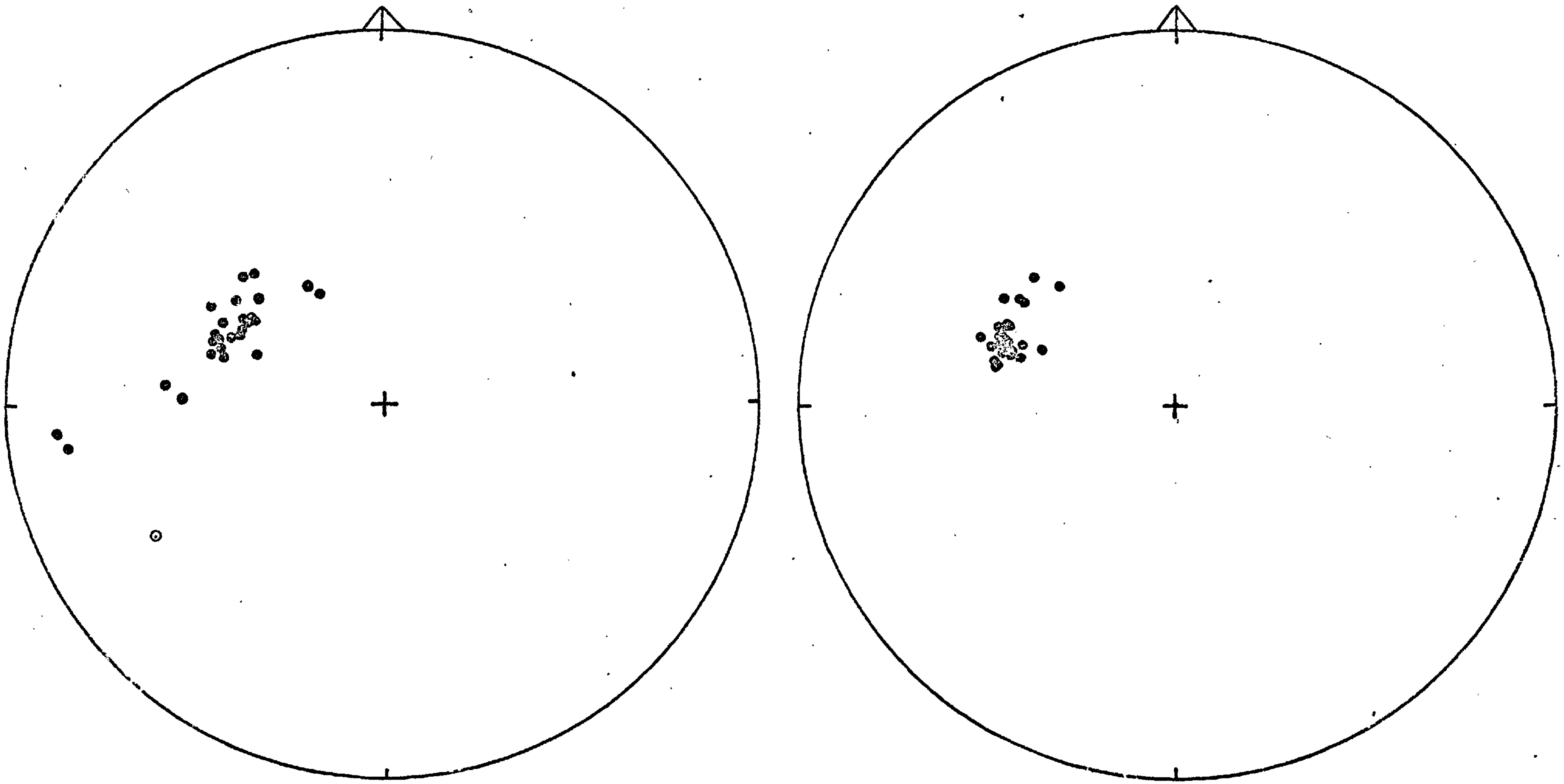


Fig. 8.10 Directions of stable specimens in Dyke 26

(a) NRM

(b) After 75 oe.

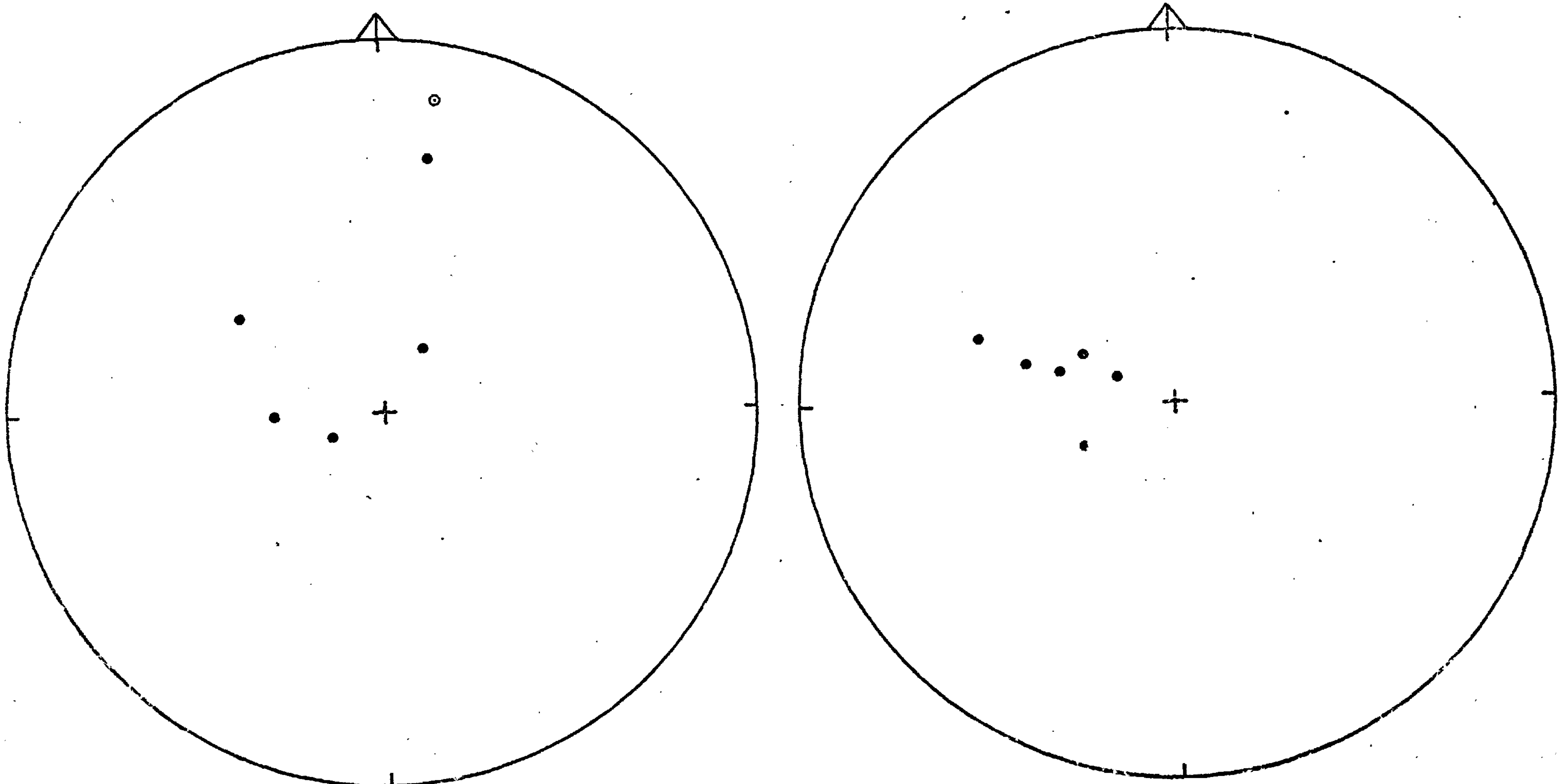


Fig. 8.11 Directions of stable specimens in Dyke 27

(a) NRM

(b) After 50 oe.

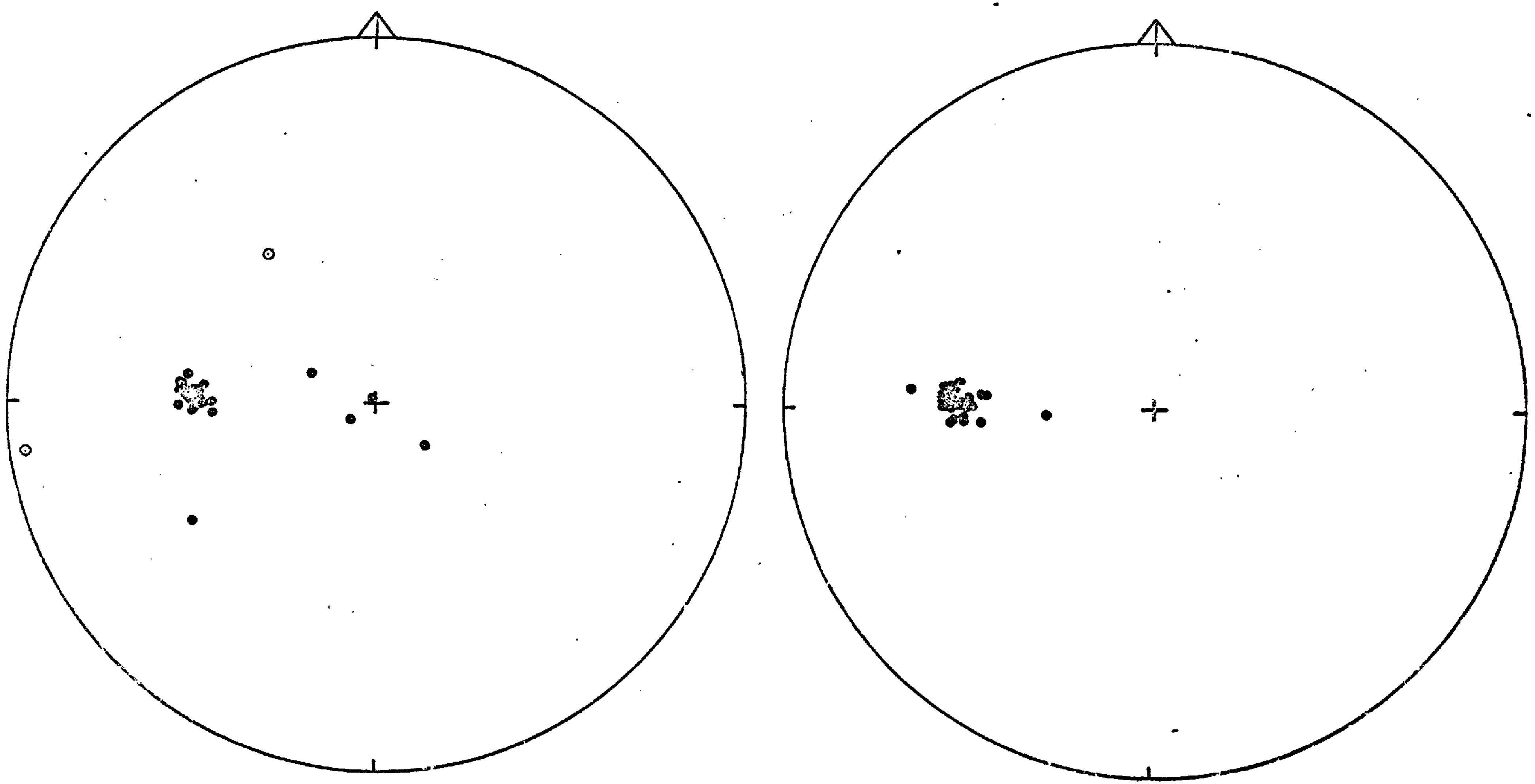


Fig. 8.12 Directions of the 29 specimens (all stable) in Dyke 28

(a) NRM

(b) After 125 oe.

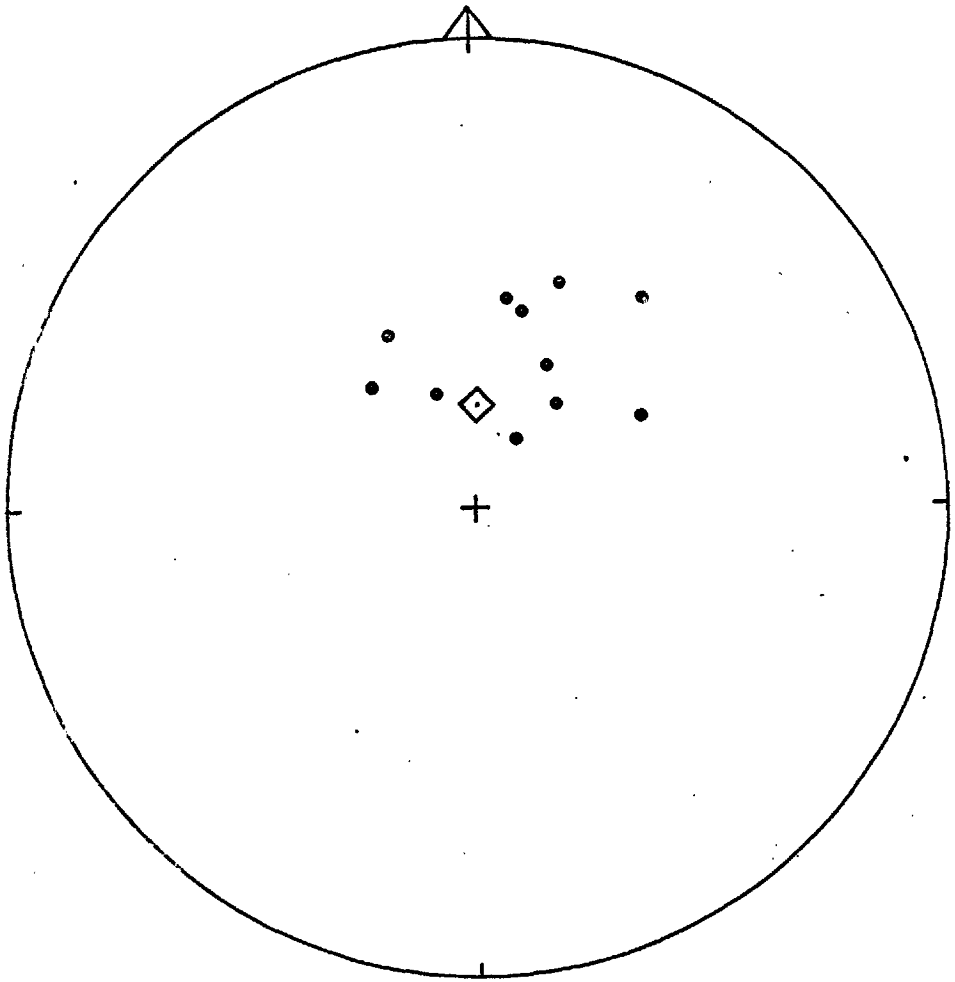


Fig. 8.13 (a) NRM directions of stable specimens in Dyke 16, showing proximity to the present dipole field direction.

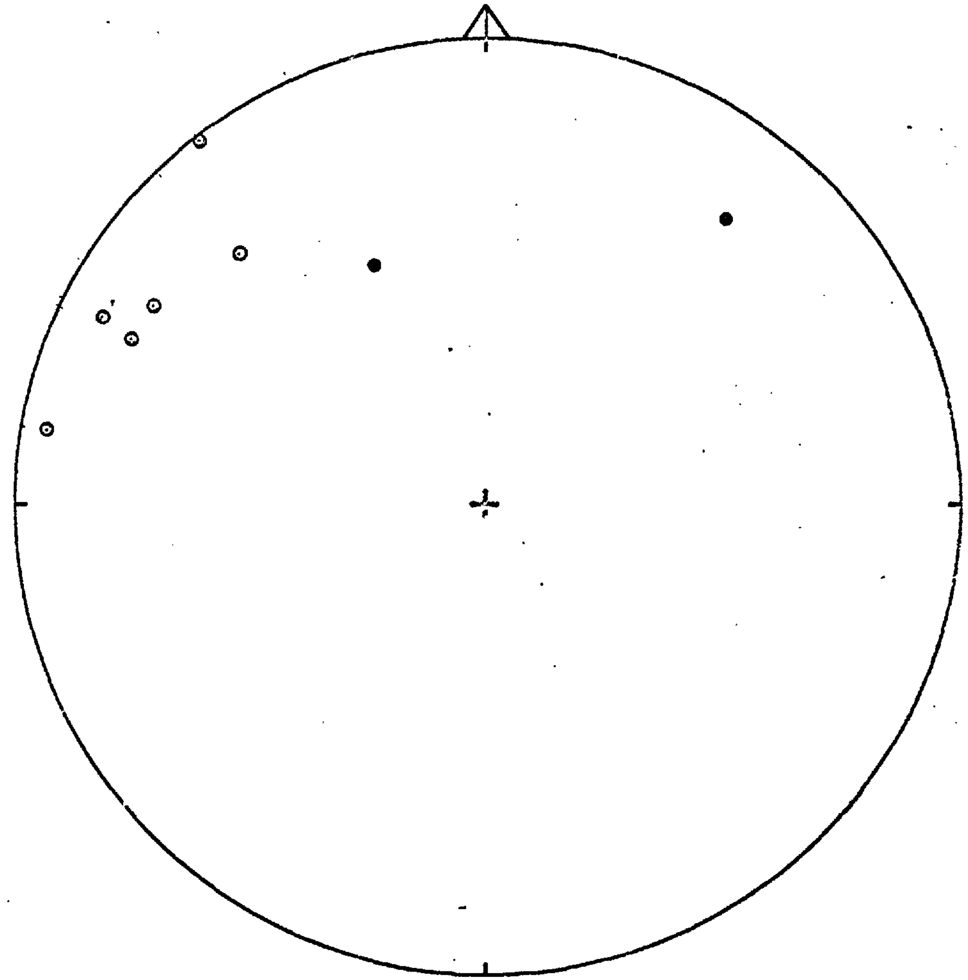


Fig. 8.13 (b) Directions of stable specimens in the ultrabasic Dyke 23 after 100 oe, displaying non-Fisherian distribution.

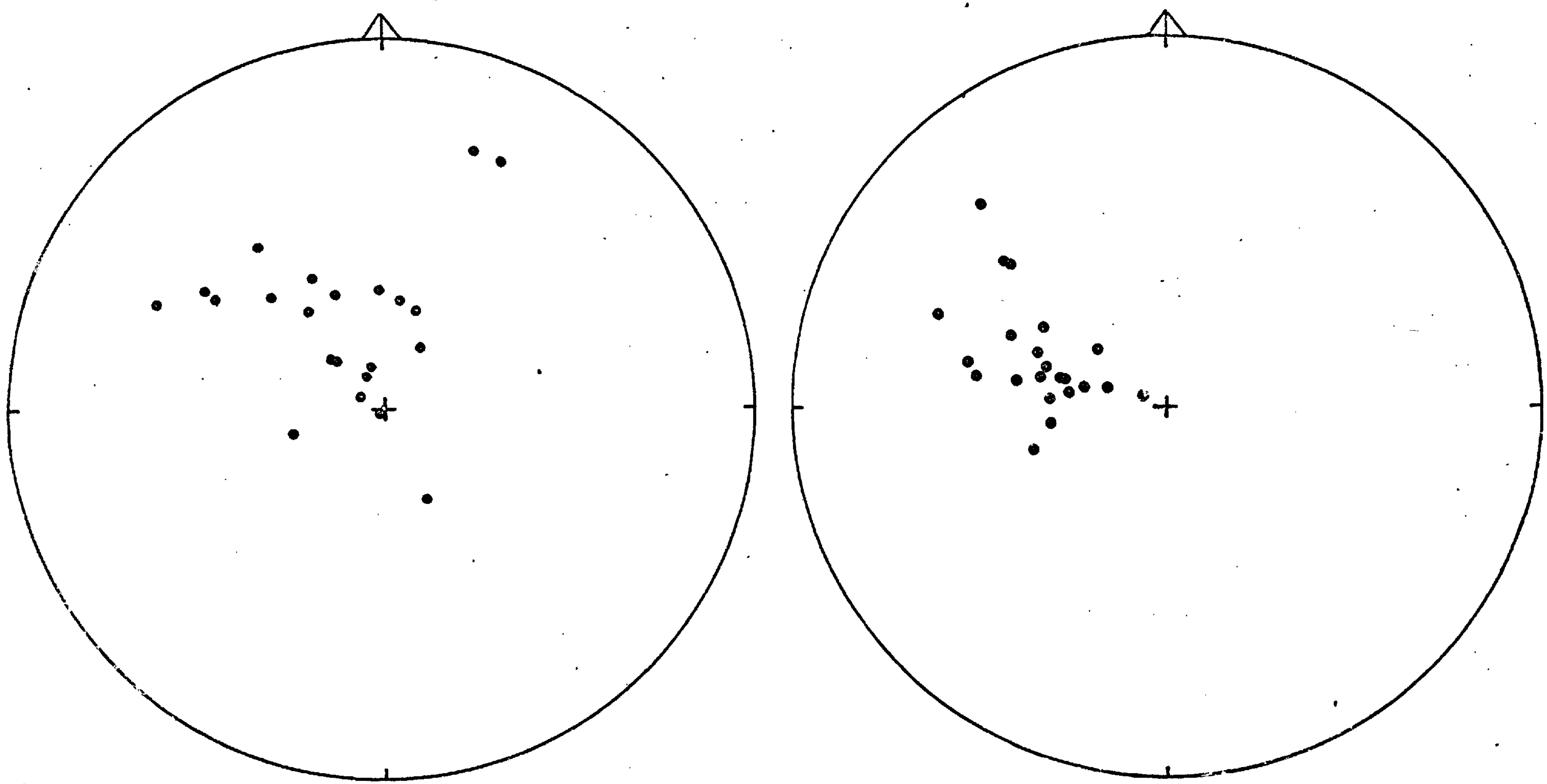


Fig. 8.14 Directions of all specimens in the stable gneiss G6

(a) NRM

(b) After 125 oe.

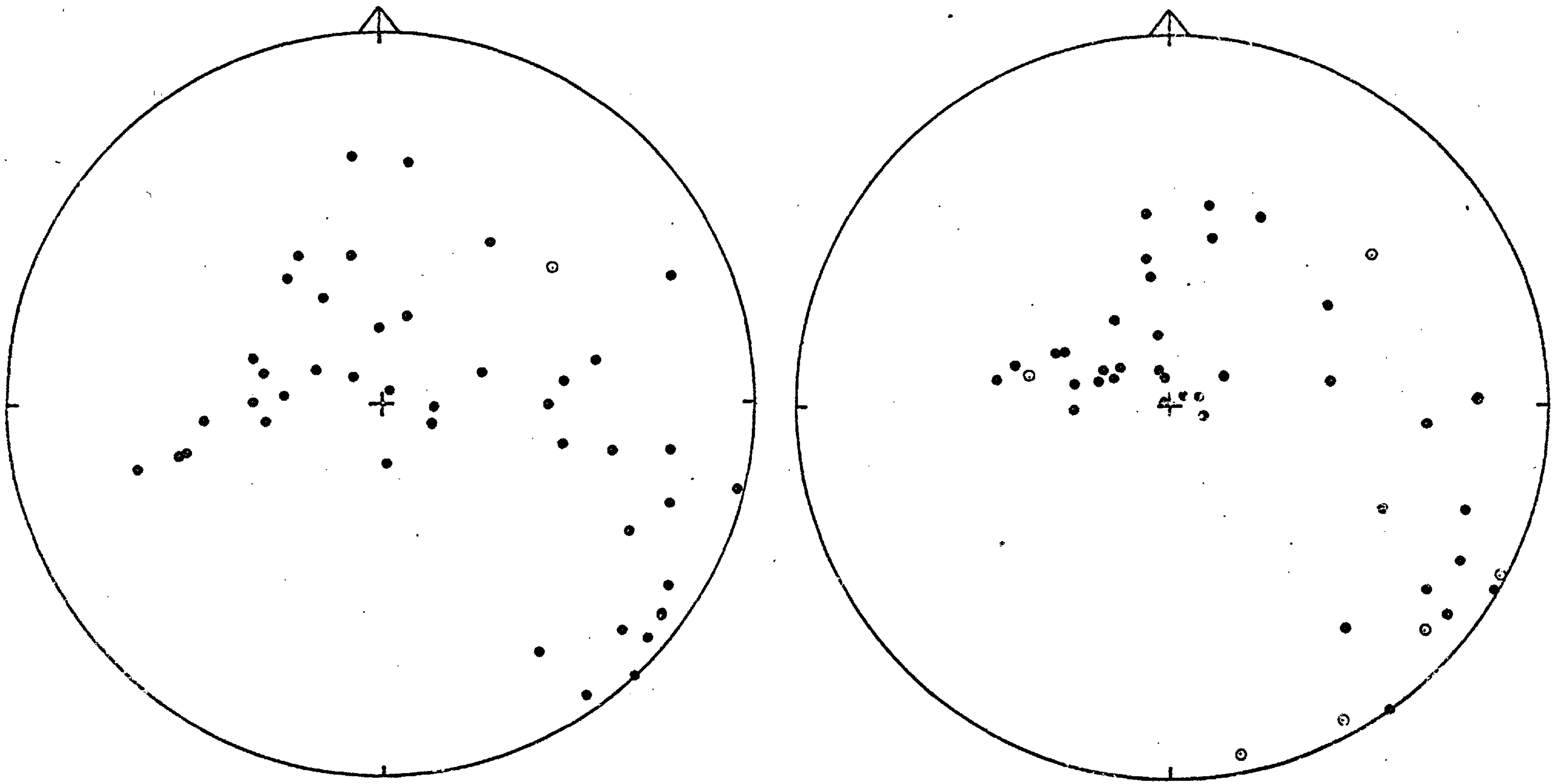


Fig. 8.15 Directions of all specimens in the unstable gneisses G2, G3, G4, G5

(a) NRM

(b) After 25 oe.

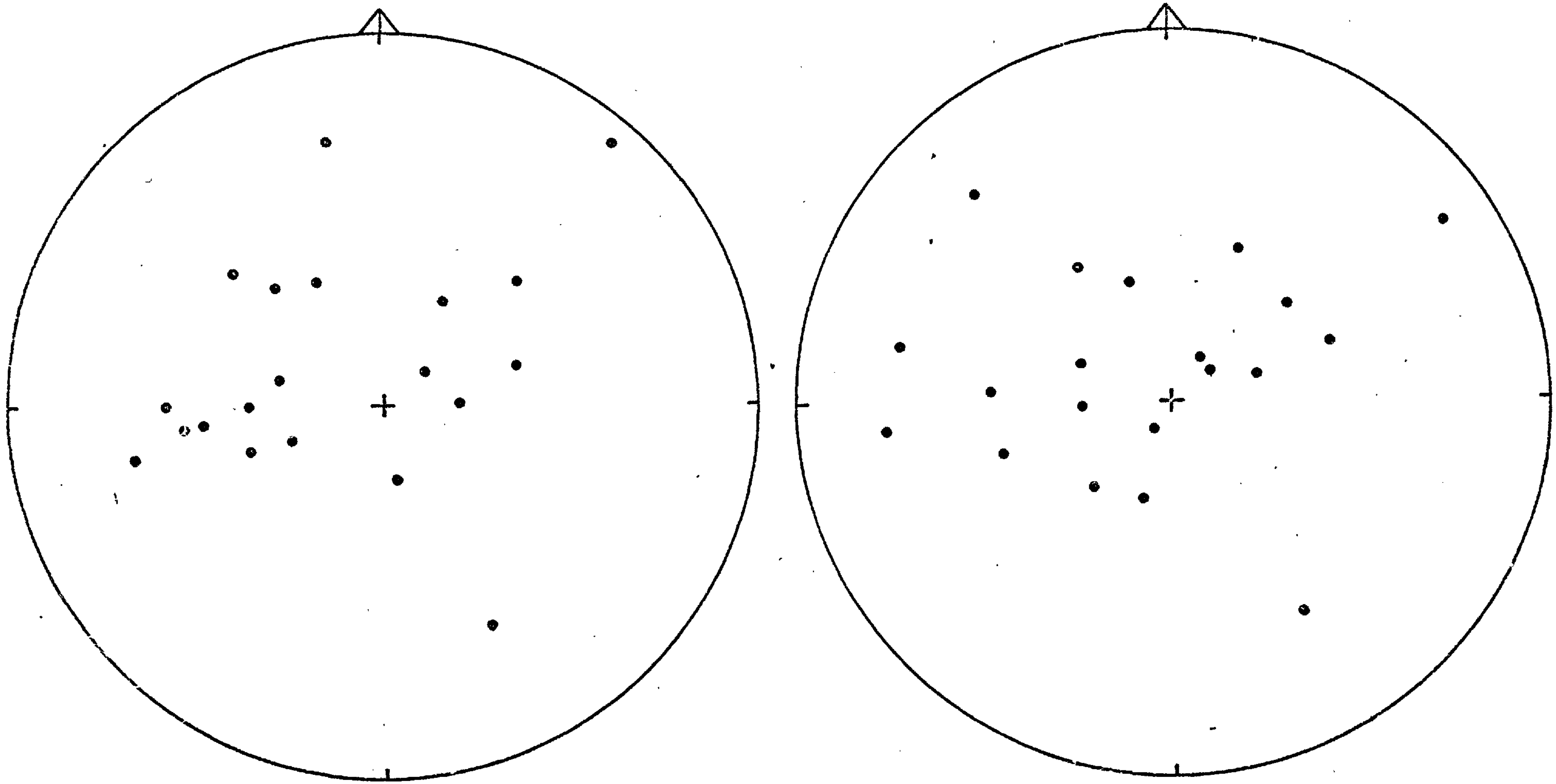


Fig. 8.16 Directions of the granite specimens

(a) NRM (b) After 25 oe.

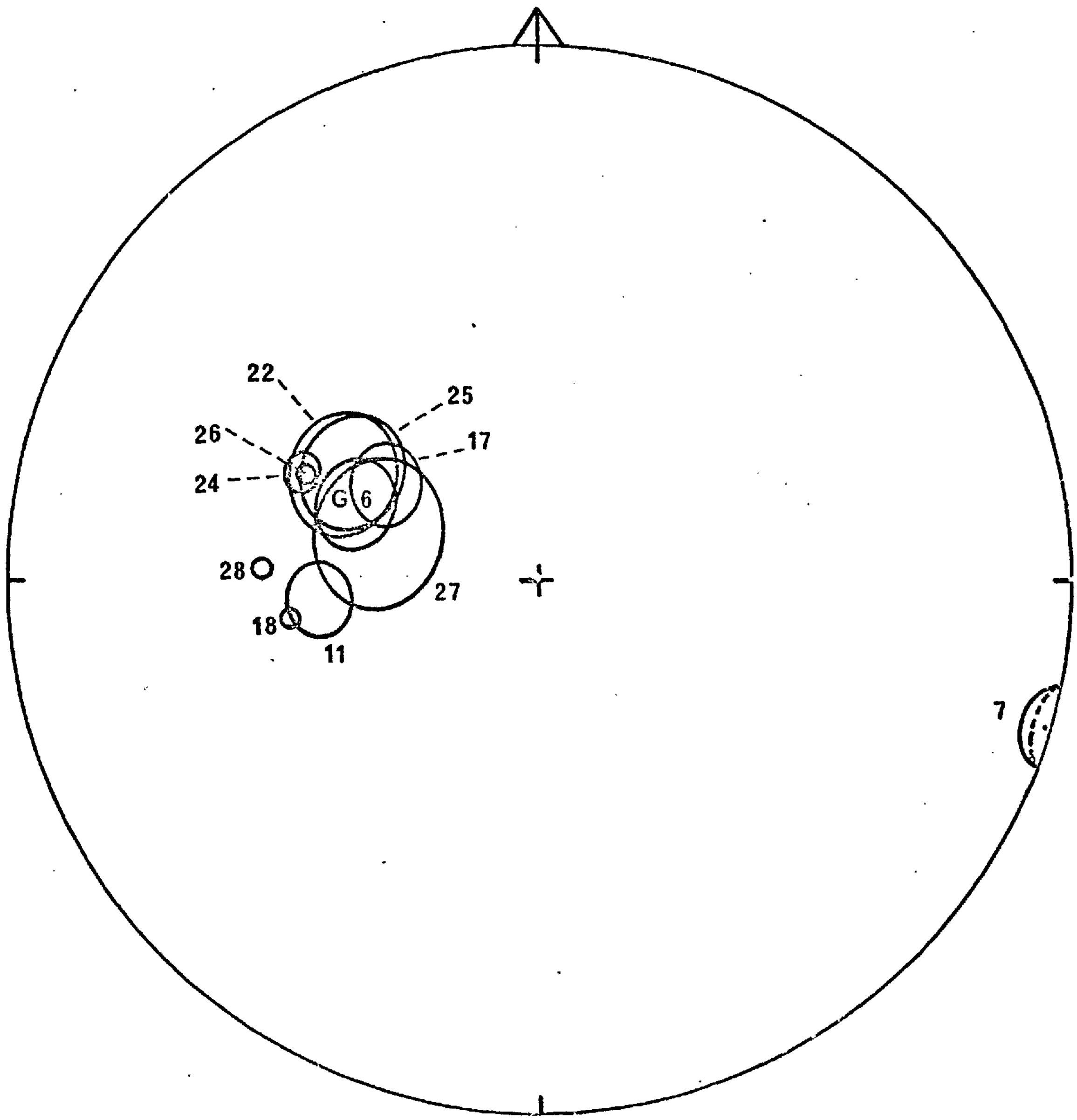


Fig. 8.17(a) Circles of 95% confidence for the directions of magnetization of the 10 class 1 dykes and the granulite G6.

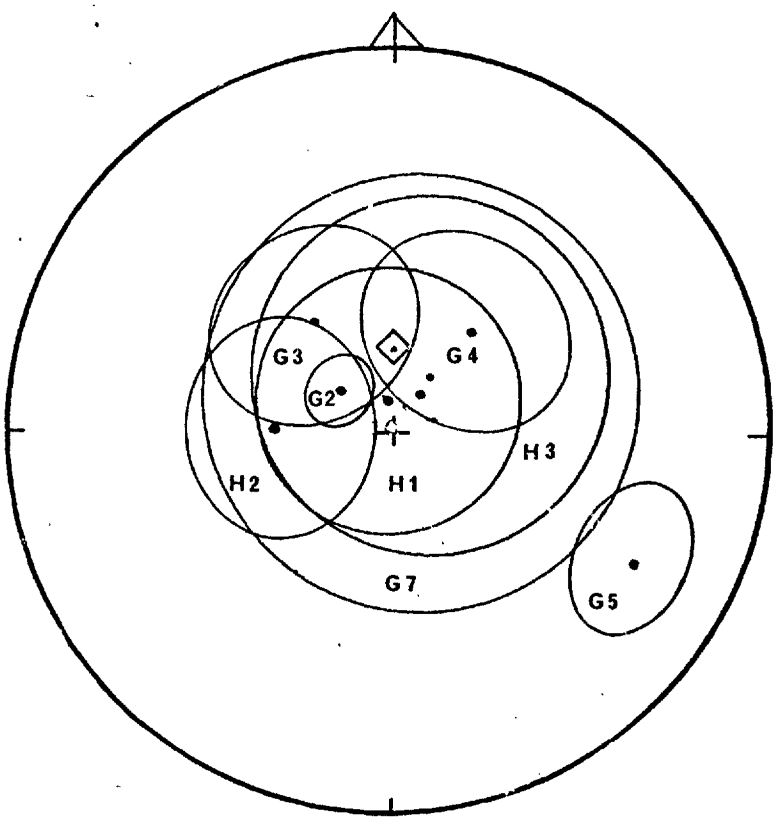


Fig. 8.17(b) Circles of 95% confidence for the directions of magnetization of the granites and gneisses (apart from G6).

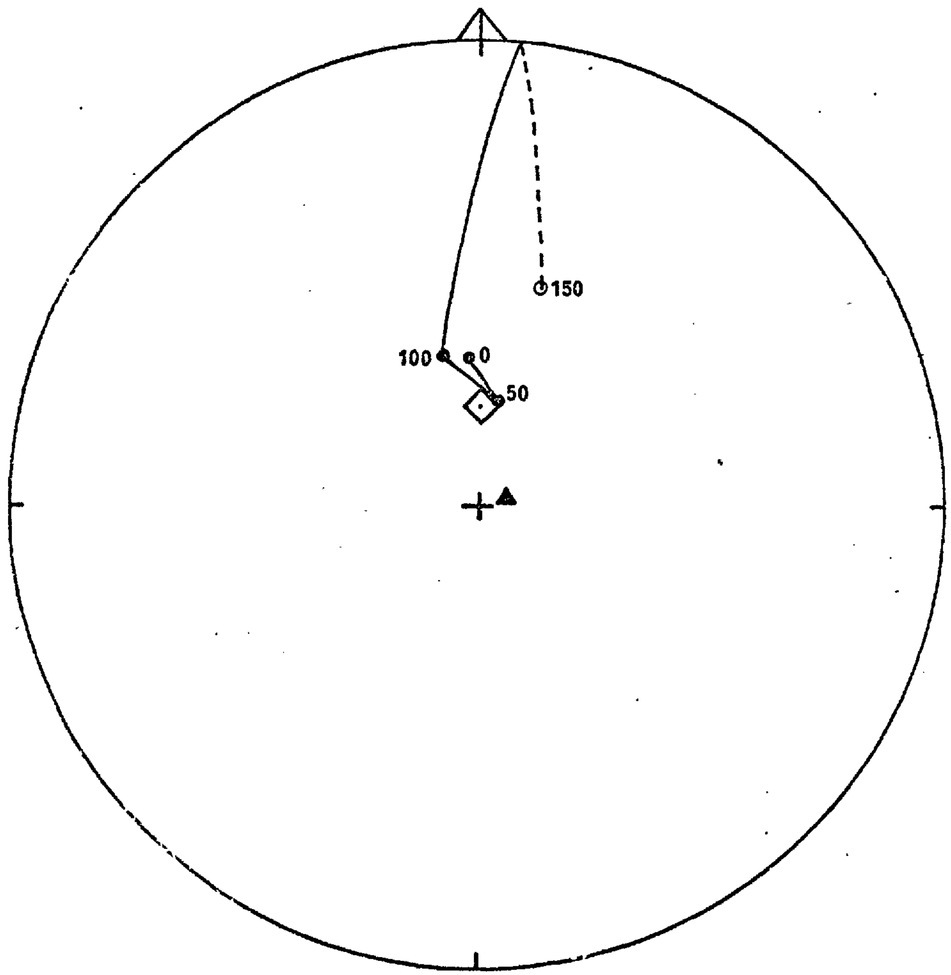


Fig 8.18 Directions in specimen 1-52 (unstable).

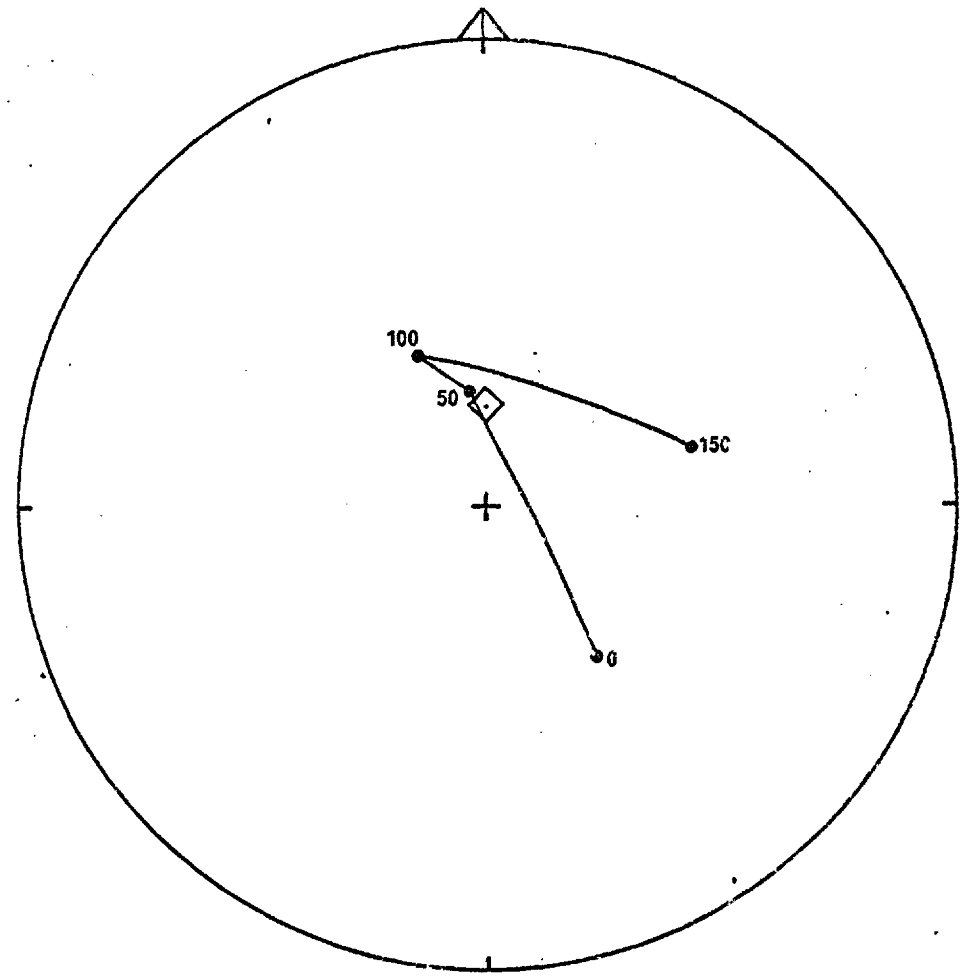


Fig. 8.19 Directions in specimen 5-10L (unstable).

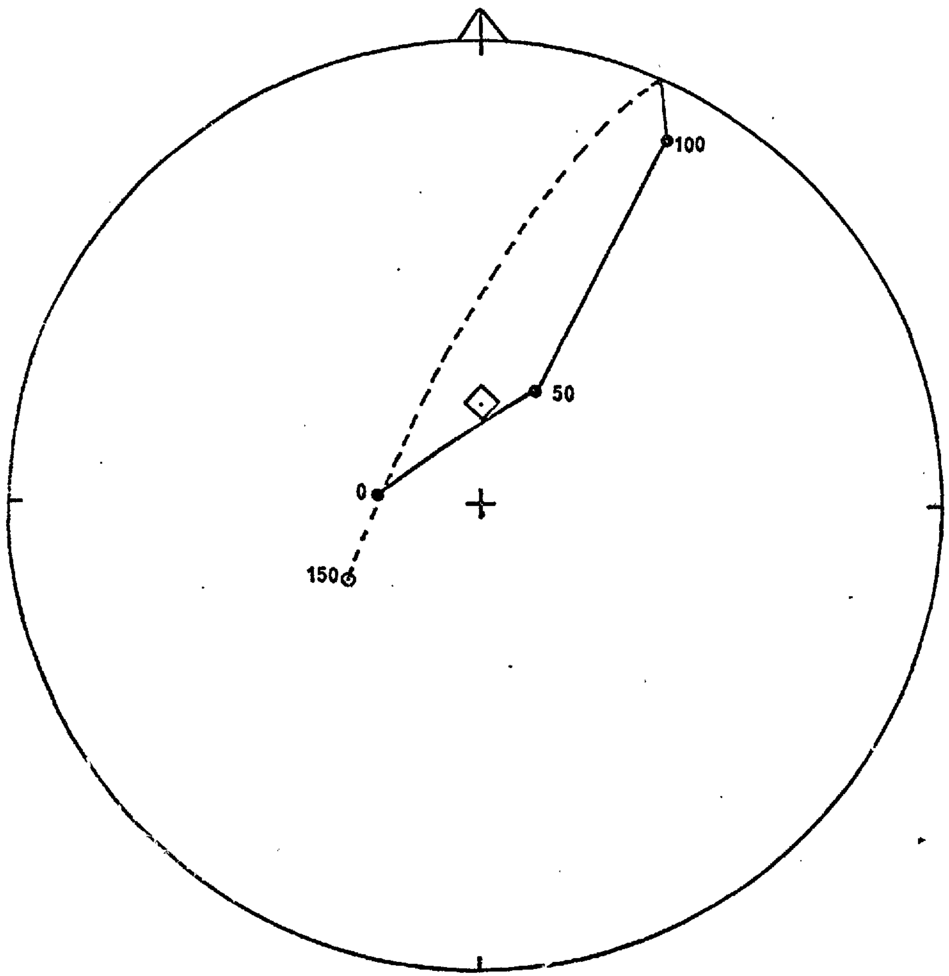


Fig. 8.20 Directions in specimen 12-12 (unstable).

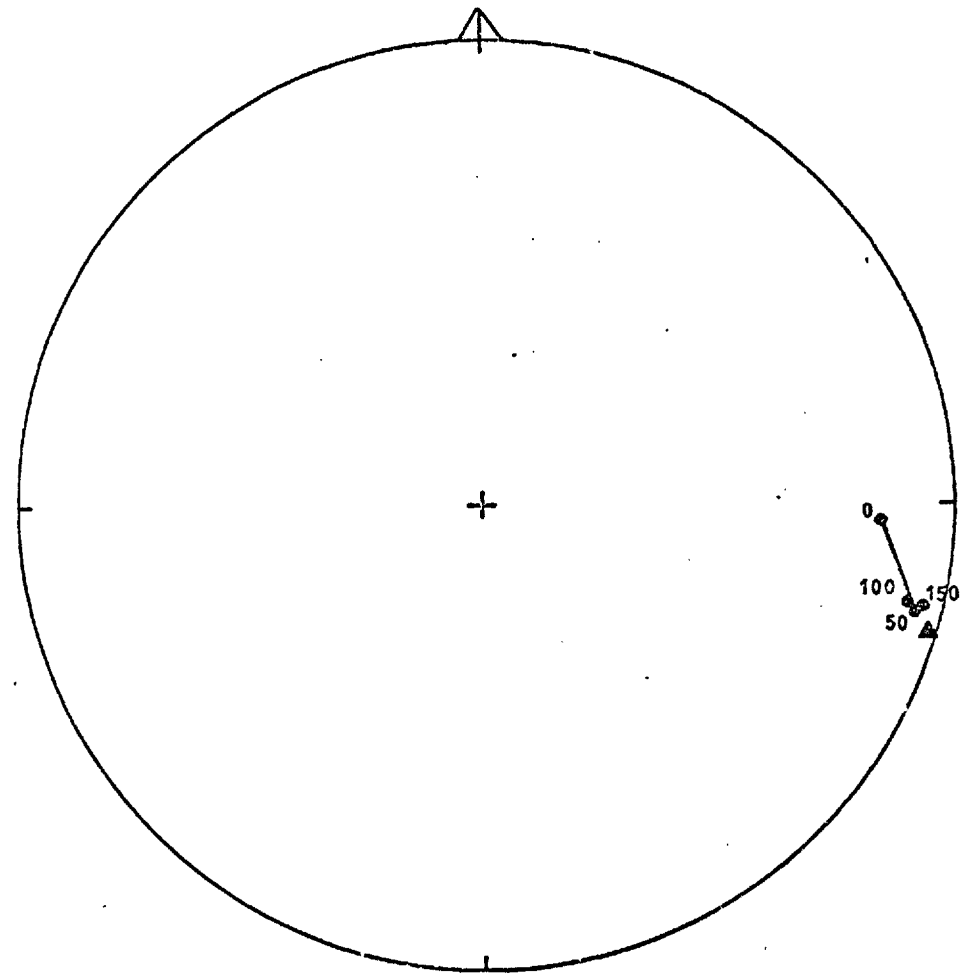


Fig. 8.21 Directions in specimen 7-7U (stable)

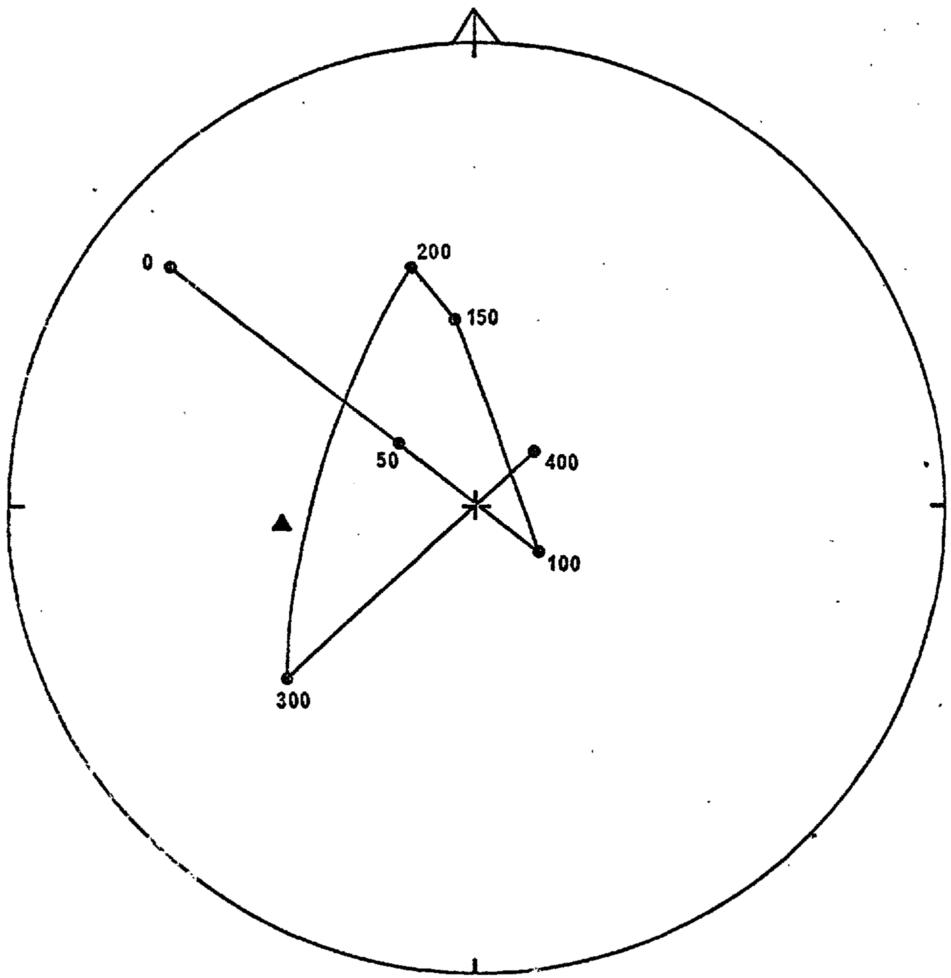


Fig. 8.22 Directions in specimen 11-6L (an unstable specimen in the partially stable Dyke 11)

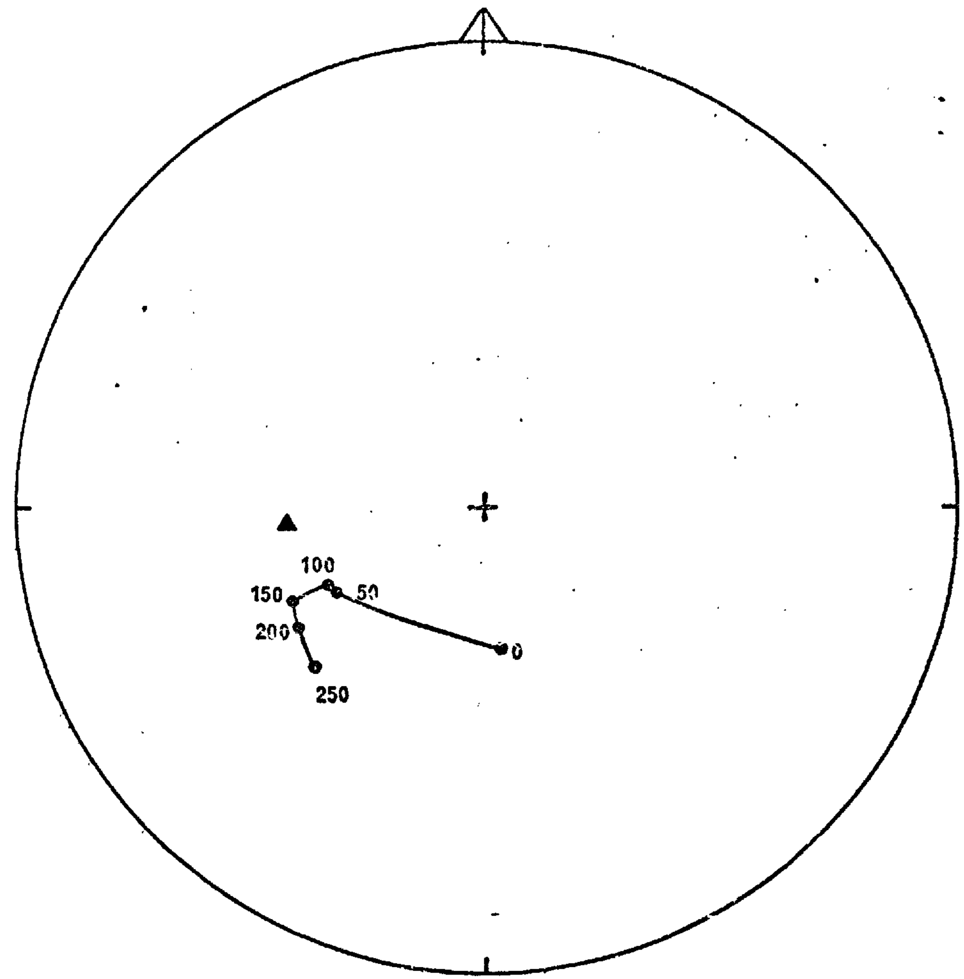


Fig. 8.23 Directions in specimen 11-16 L (a stable specimen in Dyke 11).

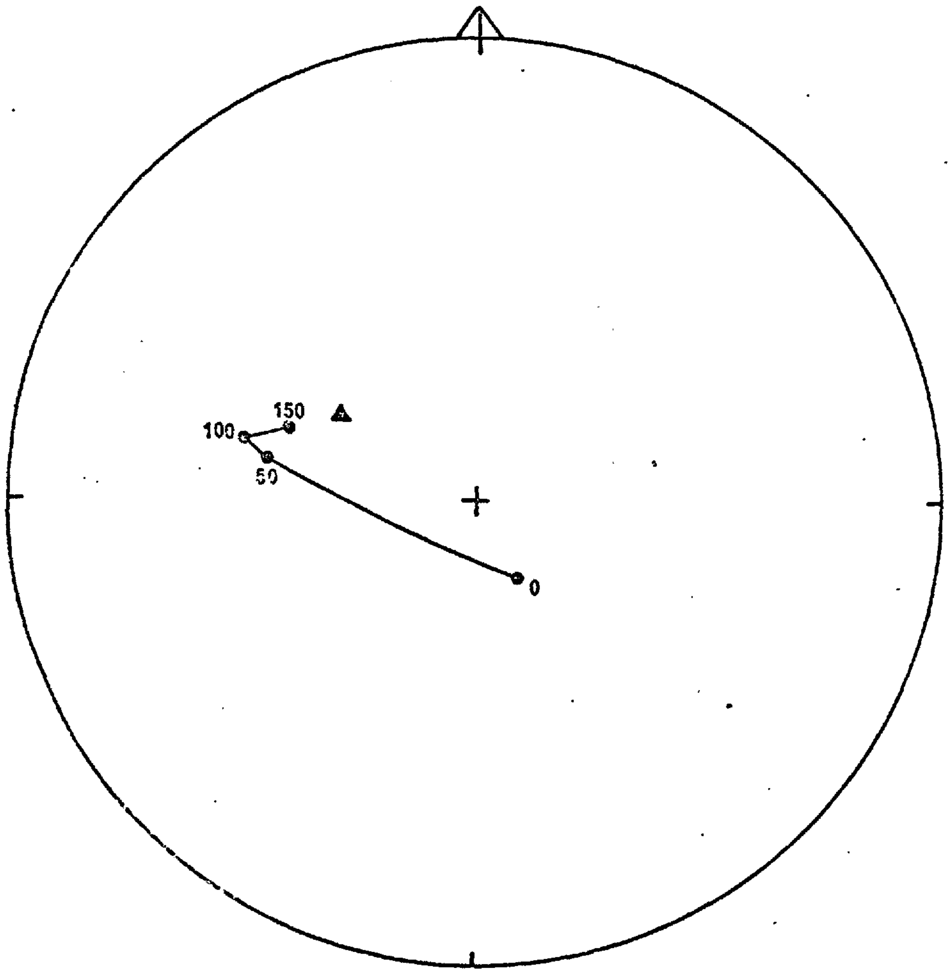


Fig. 8.24 Directions in specimen 17-11 (stable)

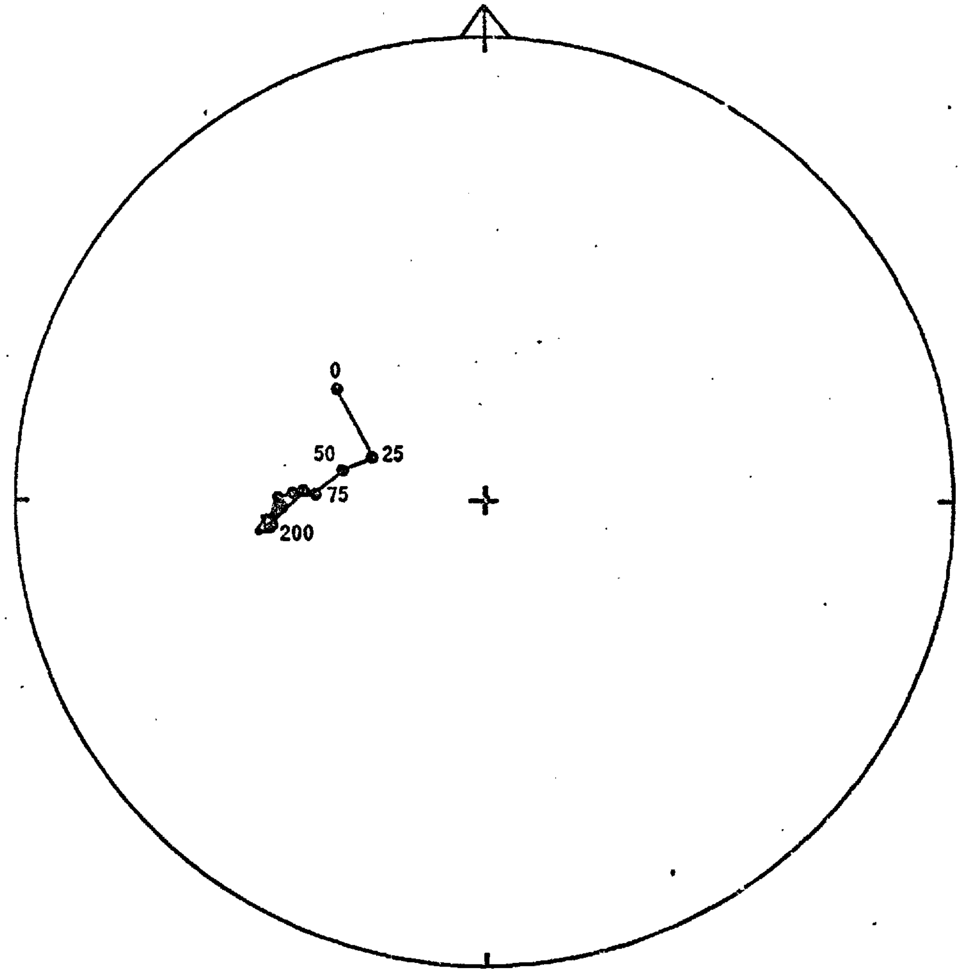


Fig. 8.25 Directions in specimen 18-21 after demagnetization at 25, 50, 75, 100, 125, 150, 175, 200, 250 oe. The direction after 200 oe almost coincides with the mean for the whole dyke.

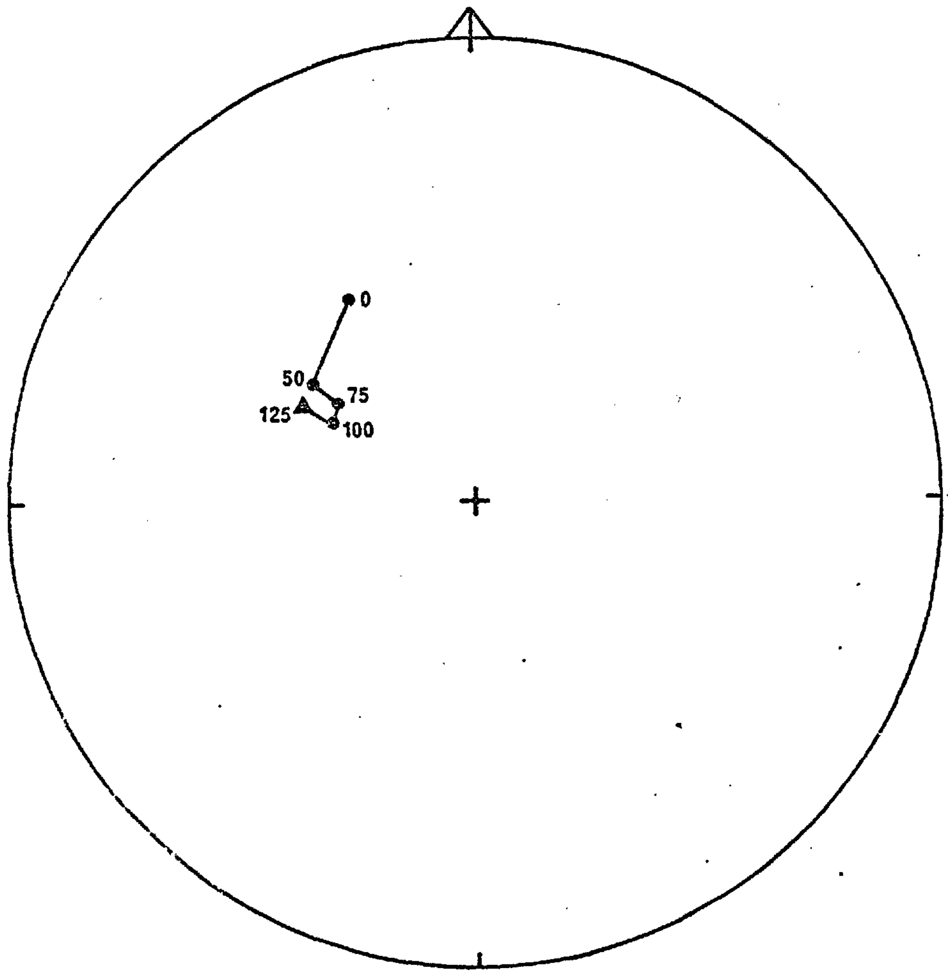


Fig. 8.26 Directions in specimen 22-14 (stable)

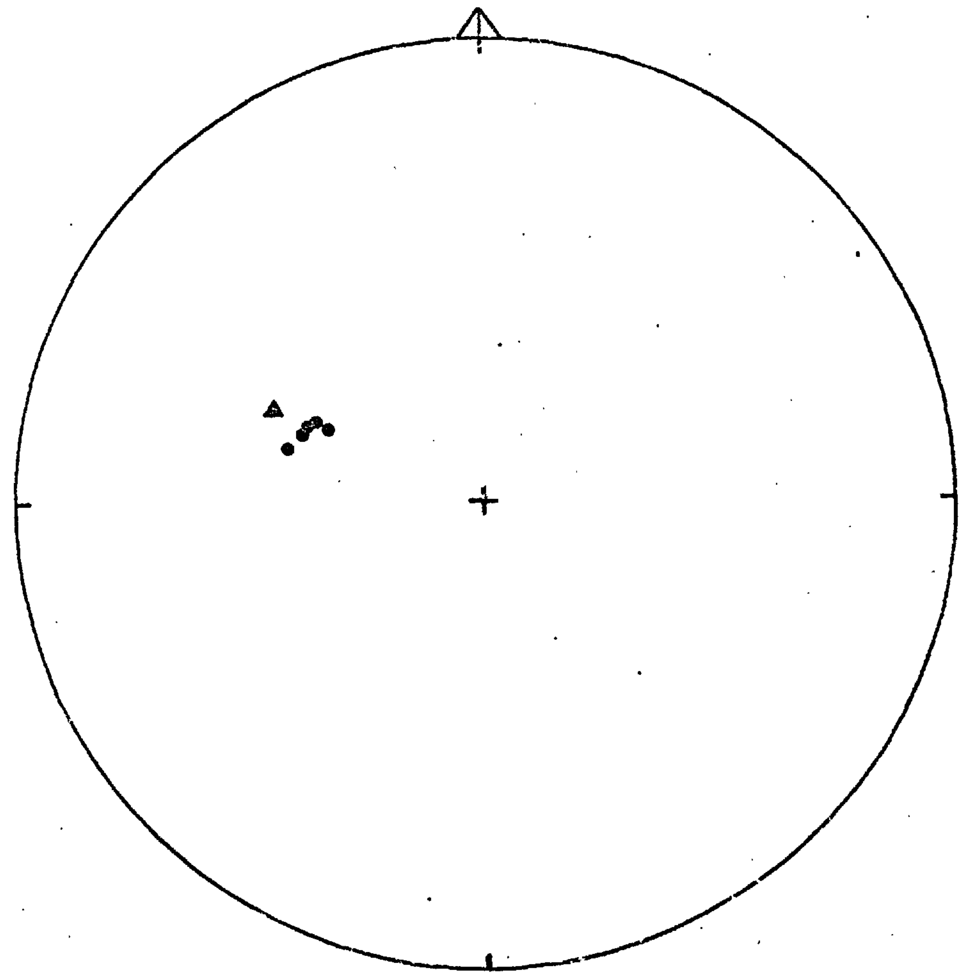


Fig. 8.27 Directions in specimen 24-16 (stable) after demagnetization at 0, 25, 50, 75, 100 oe.

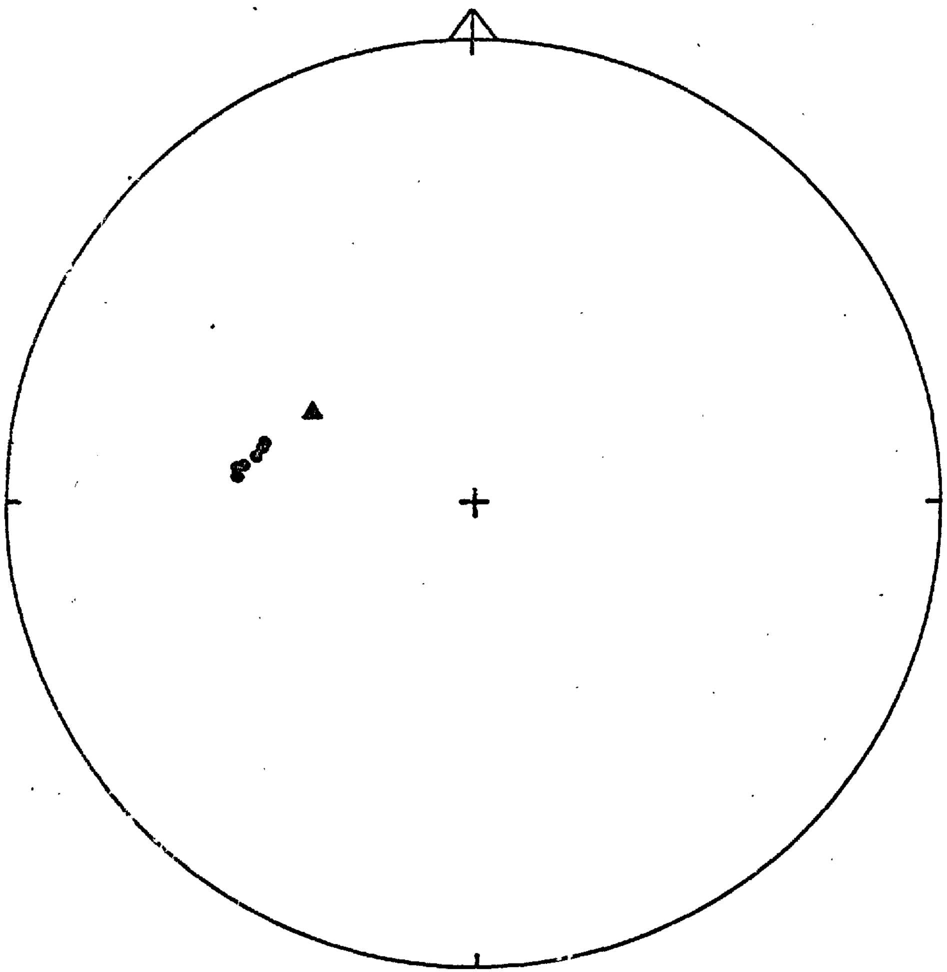


Fig. 8.28 Directions in specimen 25-6 after demagnetization at 0, 25, 50, 75, 100, 125 oe.

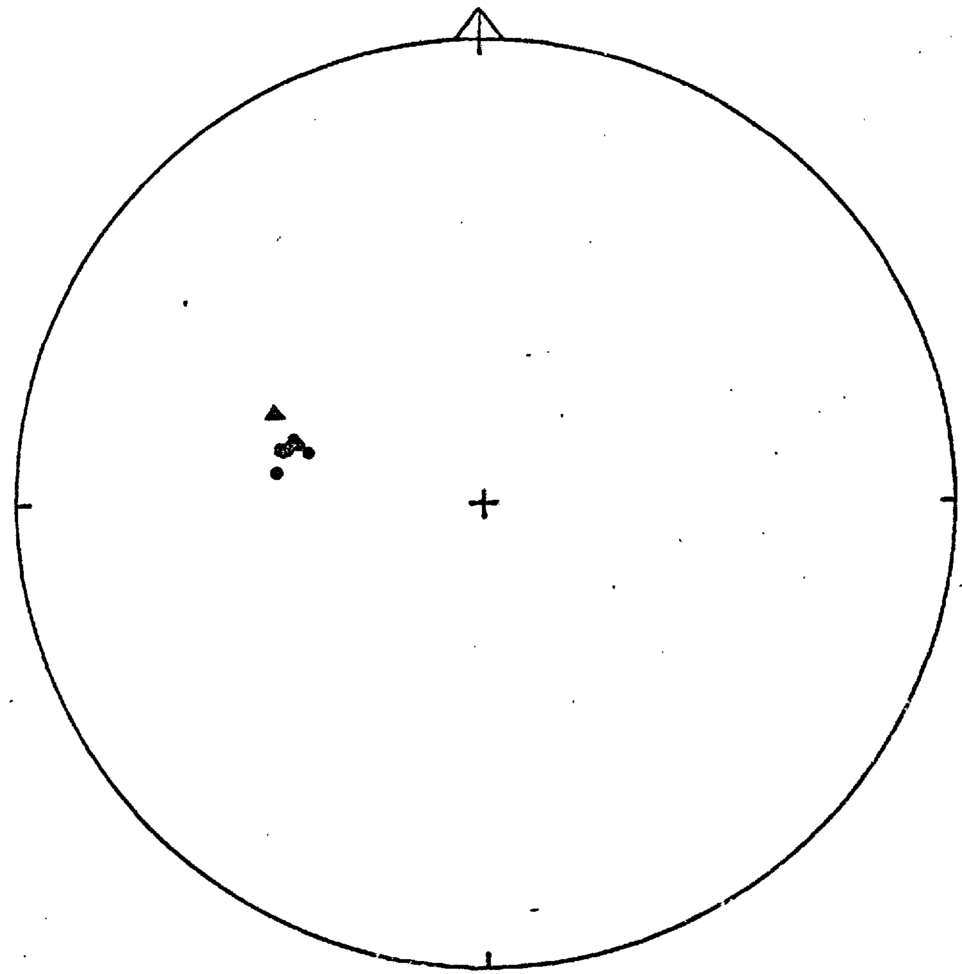


Fig. 8.29 Directions in specimen 26-26 (stable) after demagnetization at 0, 25, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500 oe.

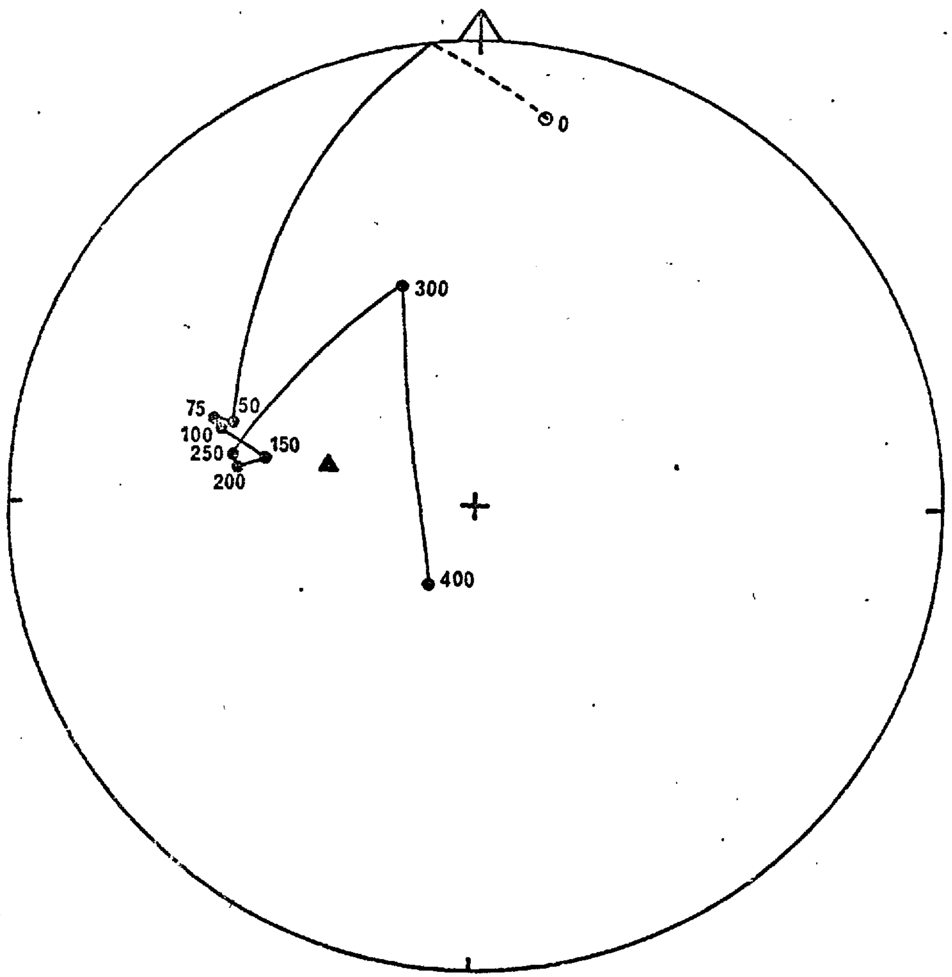


Fig. 8.30 Directions in specimen 27-3 (stable)

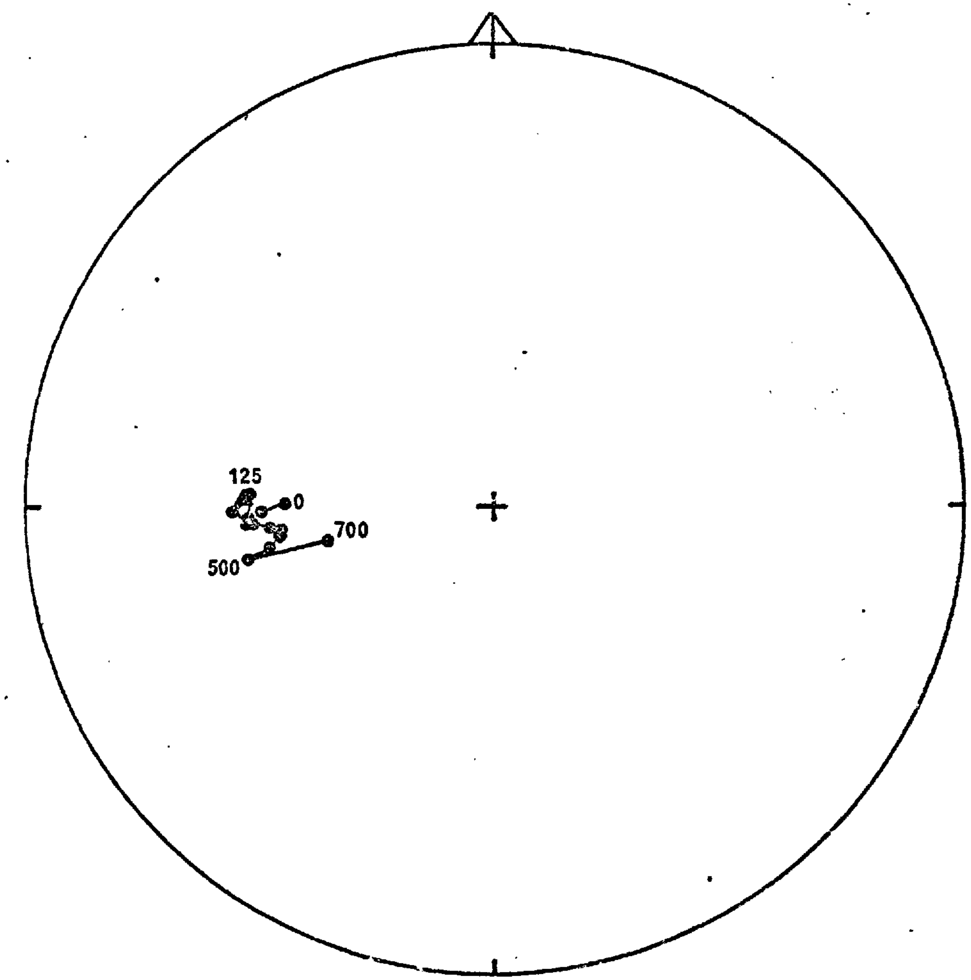


Fig. 8.31 Directions in specimen 28-6 after demagnetization at 25, 50, 75, 100, 125, 150, 200, 250, 300, 400, 500, 700 oe. The direction at 125 oe almost coincides with the mean direction for the whole dyke.

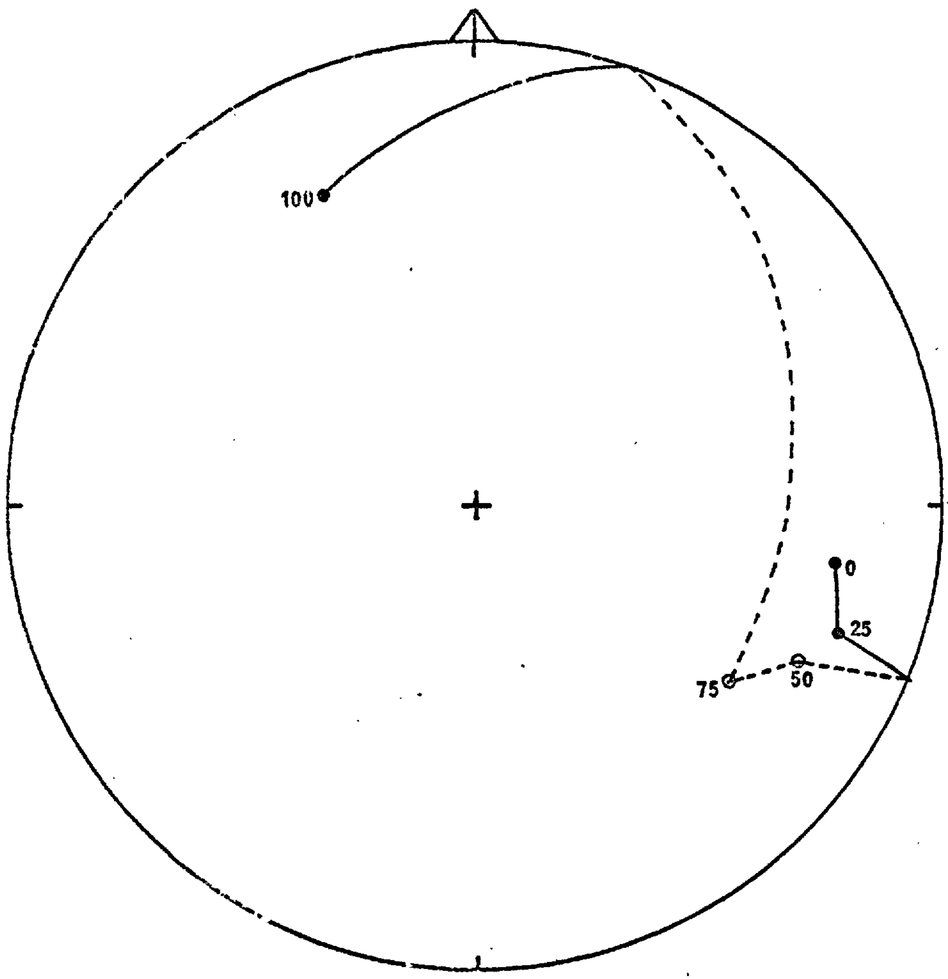


Fig. 8.32 Directions in specimen G5-6, typical of the unstable gneisses.

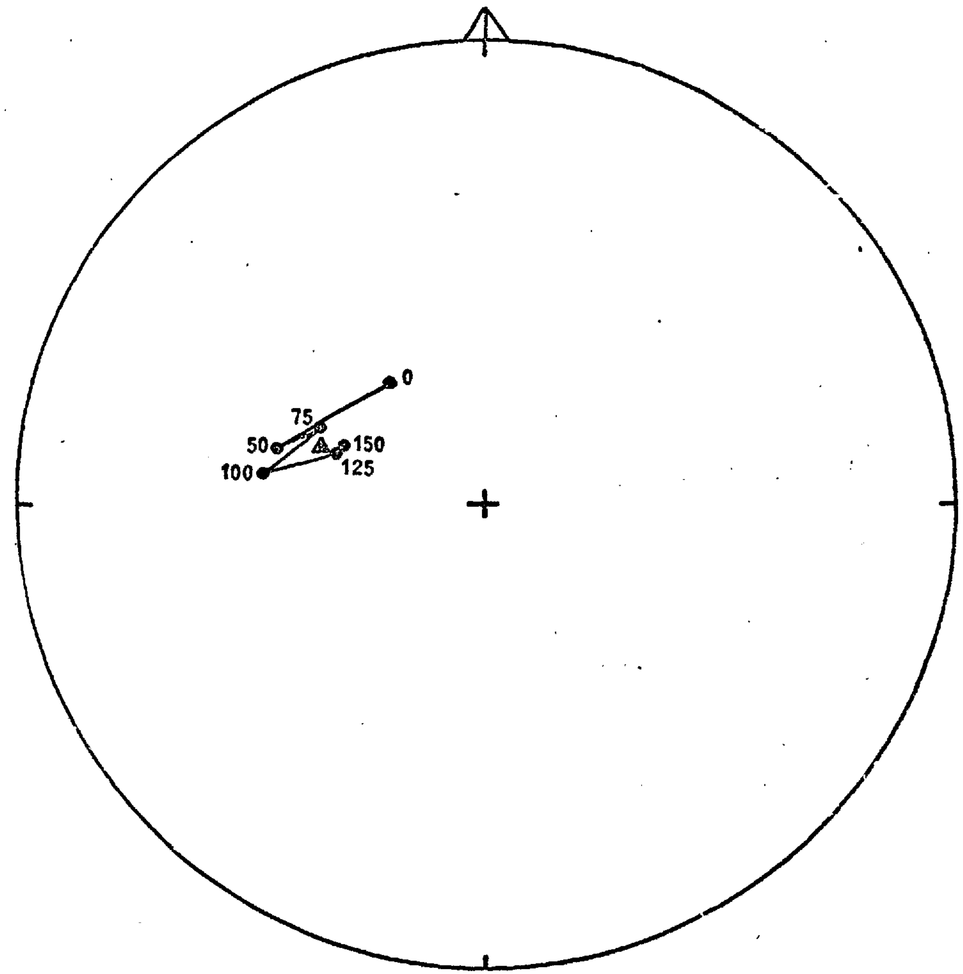


Fig. 8.33 Directions in specimen G6-7, a typical example in the stable gneisses, G6.

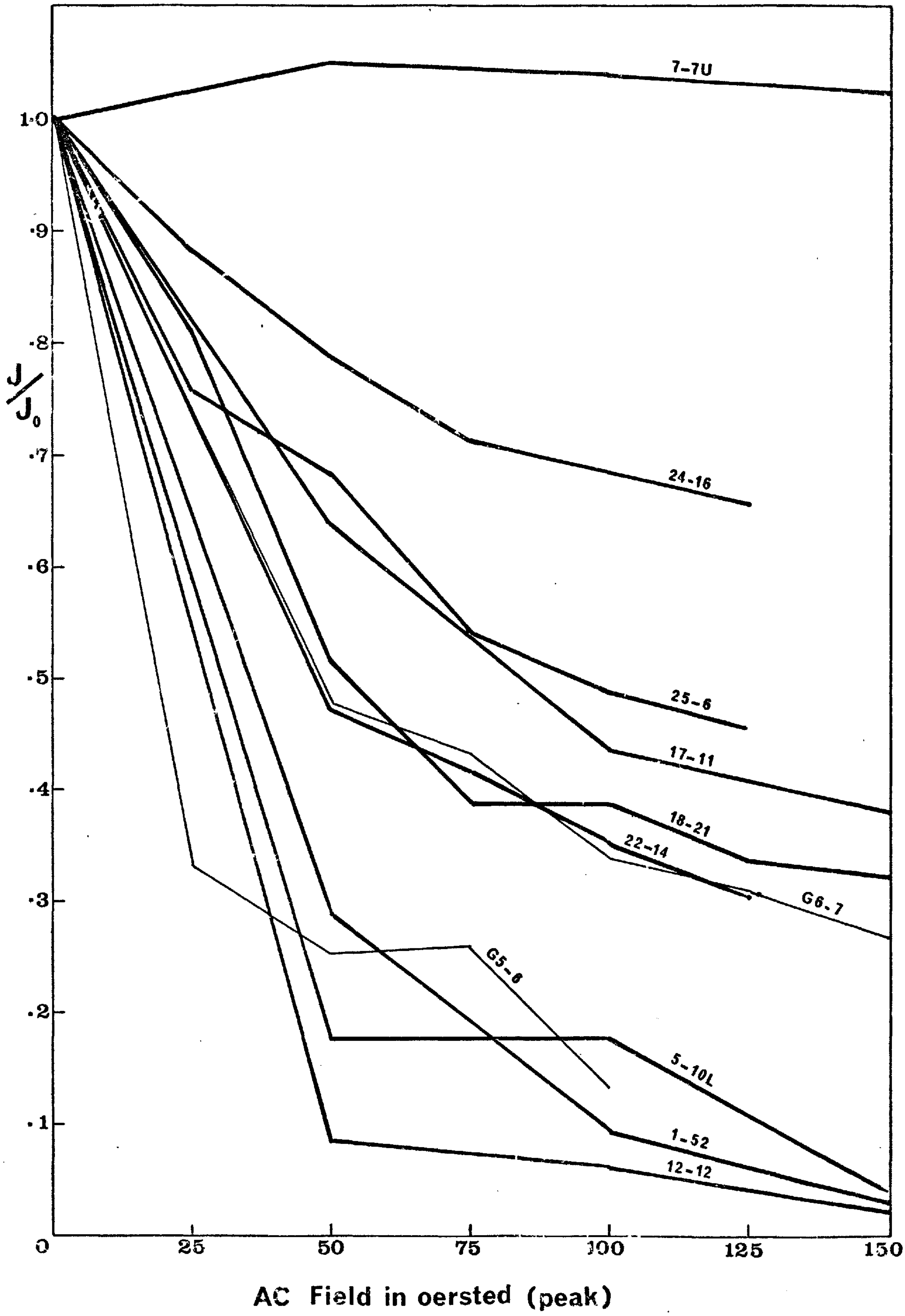


Fig. 8.34 Examples of intensity changes in individual specimens upon demagnetization at fields $\leqslant$ 150 oe.

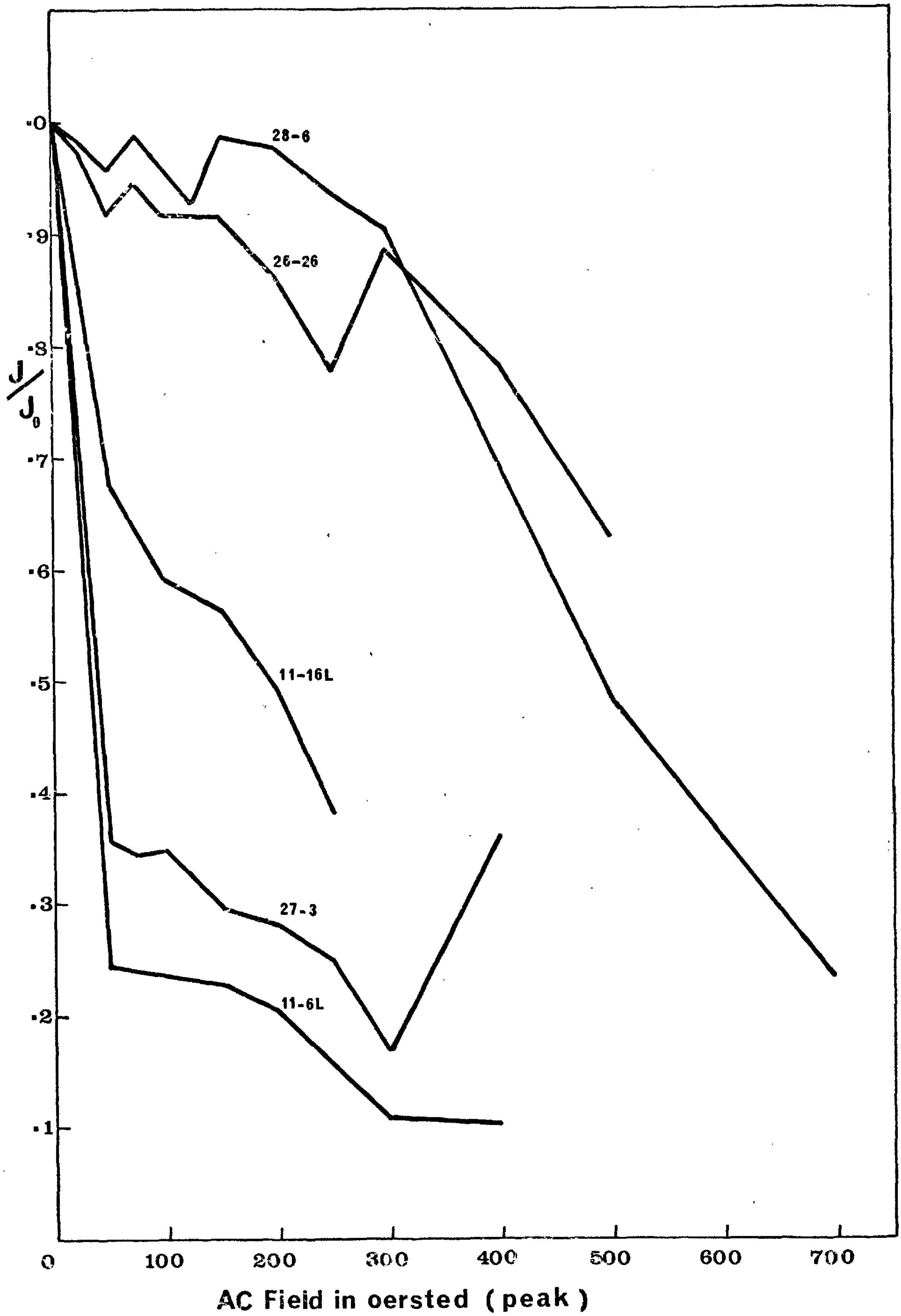


Fig. 8.35 Examples of intensity changes at higher fields.

It may be seen in Table 8.1 that the class 1 dykes tend to have higher percentages of stable specimens than the other dykes. Stability has been defined in terms of both angle changes between demagnetizing stages and values of J/J_O; for some of the specimens these criteria are strikingly illustrated, for example by 18-21 (Figs. 8.25 and 8.34). At the other extreme, for typical specimens in class 3 dykes, note the large changes in direction and sharp drop in intensity for small demagnetizing fields and the tendency for the path of the magnetic vector to pass close to the present axial geocentric dipole direction (Figs. 8.18, 8.19, 8.20, 8.34).

In the stable specimens there is a range of demagnetizing fields through which there is little movement of the magnetic vector; this indicates a range of coercivities large compared with the Earth's present field, suggesting that the magnetism was acquired in an ancient field. In the class 1 dykes individual specimens cooperate giving tighter grouping after demagnetization than at the NRM. The mean directions from 9 out of the 10 class 1 dykes form a tight cluster of directions (Fig. 8.17(a)) well away from the present field. These 9 dykes are separated geographically by as much as 24 km and so their almost identical directions of magnetization provide very strong evidence that the magnetization was indeed acquired in an ancient field. It is thought that Dyke 7 also reflects an ancient direction of magnetization but that it was acquired at a different time.

The same considerations may be applied to the gneisses and granites. For the most part these display unstable behaviour in that the magnetic vectors change greatly upon demagnetization, e.g. G5-6 (Figs. 8.32 and 8.34) behaves very similarly to an unstable dyke specimen. The best grouping of directions generally occurs at the NRM or at a small demagnetizing field; moreover the mean directions are clustered near the present geocentric axial dipole direction (Fig. 8.17(b)); these are prima facie indications of instability. (The mean direction for G5 is distinctly different from the other gneisses but the individual specimens often behave unstably; the meaning of this result is not yet clear.)

However one of the gneisses, G6, is quite different from the others. Its demagnetizing behaviour is very close to that of a class 1 dyke; the intensity curve for specimen G6-7 is almost identical to that of the stable dyke specimens 18-21 and 22-14 (Fig. 8.34) and its changes of direction have a typically stable appearance (Fig. 8.33) and lie close to the mean for the whole unit. The directions for all the specimens in this gneiss steadily improve their grouping upon demagnetization (Fig. 8.14). Finally, and perhaps most impressive, the mean direction virtually coincides with the mean of the group of 9 class 1 dykes.

8.4.1 Regional Variations

There is a regional variation in magnetic stability as indicated in Fig. 8.36. The group of 9 class 1 dykes and the granulite G6 all come from the region marked "stable". Nearly all the class 2 and 3 dykes and all the other gneisses and the granites come from the "unstable" region. No stable remanence has been recovered from the ultrabasic dykes and a reason for this will be suggested in 8.5.2. The only class 1 dyke in the stable region is Dyke 7 and this will be considered in the last chapter. The only unstable dolerite dyke to be found in the "stable" region is Dyke 21. An interesting case is presented by Dyke 11 from which it was only just possible to recover stable remanence; accordingly it is believed that this dyke lies close to the boundary of stability.

The distribution of unstable and stable rock units is reminiscent of the presence and absence respectively of garnets in dyke margins (Fig. 3.5). However the possibility of a correlation between these

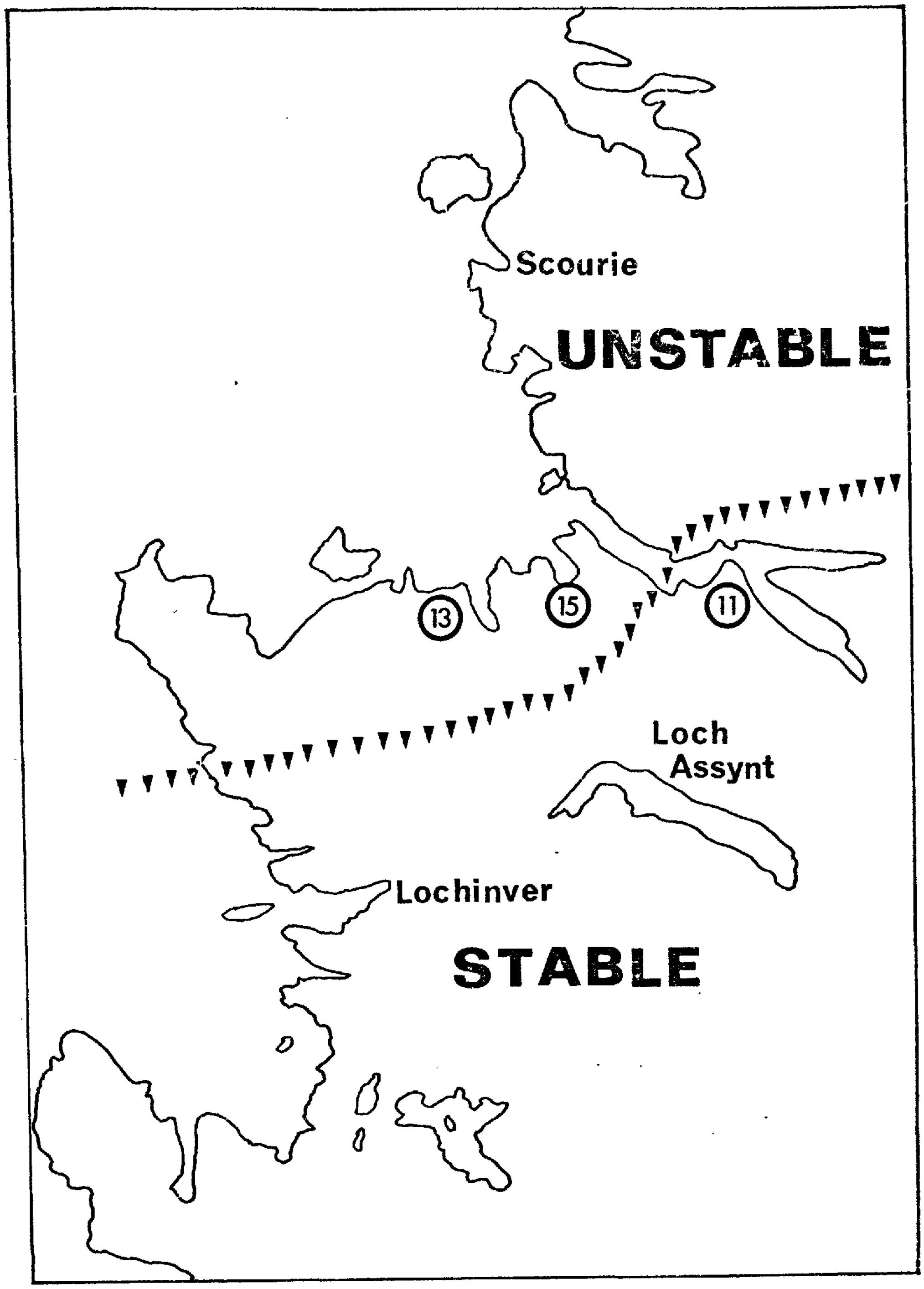


Fig 8.36 Approximate Boundary of
Magnetic Stability.

two phenomena could be more effectively approached by considering individual dykes than regions.

The degree of alteration seen in thin section does not appear to be linked either with stability or dyke class.

The irregular blades in ilmenite are a conspicuous feature of the stable region and occur in both the dolerite dykes and the granulite G6 (Plate 5.12). On the other hand these blades have never been seen in the unstable region. It is therefore possible that the reason for the differences in magnetic stability may lie in these blades; this idea will be explored further in the next section. (Admittedly the blades are also found in the unstable Dyke 21 in the stable region but the conspicuous colours of the magnetite and ilmenite in this dyke (6.21) may indicate a further event which destroyed the magnetization after these blades were formed.) The white blades in ilmenite (5.3.1) are conspicuous in the very stable Dyke 26 and have sometimes been seen in Dykes 17 and 28, all in the stable region; on the other hand they have never been seen in the unstable region.

8.5 ON THE NATURE OF THE MAGNETIZATION

The experiment described in 5.2, in which rocks were crushed and magnetic material removed with a magnetic separator, proved that magnetite was the material with the highest susceptibility. It did not in itself prove that these large grains of magnetite carry the permanent magnetization which has been measured. However two further experiments have suggested that this was in fact the case:

1. The magnetite grains were mounted in plastic (5.3). This material is initially liquid but hardens at room temperature. The mounted grains were placed in the field-free space beneath the magnet system of the astatic magnetometer and gave a strong deflexion. The orientation of the plastic mounting was then reversed, whereupon the

sense of the deflexion also reversed. This experiment indicated that the grains of magnetite were indeed permanent magnets and had aligned themselves under the influence of the Earth's field whilst the plastic was setting; thus they carried at least part of the remanence in the rock. There is the reservation that the separating magnet could have imparted an IRM, but even if this had happened the experiment proved that the magnetite grains were capable of remanence. This reservation could be rendered unnecessary in future experiments if the separation were done entirely with heavy liquids.

2. A low temperature experiment. The main minerals which are known to carry remanence in rocks are magnetite and haematite, magnetite being usually responsible in igneous rocks and haematite in sedimentary rocks. Now the weak but hard parasitic ferromagnetism in haematite vanishes at the Morin transition temperature which is $-15^{\circ}C$ for pure haematite but may be nearly as low as $-60^{\circ}C$ for haematite containing titanium (Haigh (1957)). Accordingly if remanence is greatly reduced in a rock when cooled below this range of temperatures in field-free space, it is likely that the remanence is held by haematite.

In the present rocks haematite has sometimes been seen, apparently as a result of weathering. However the "white blades" which have been proved to be essentially haematite (5.3.1(d)) are conspicuous in Dyke 26 and look as if they had a metamorphic origin. If any remanence is carried by haematite it would be most likely in this dyke. These blades in specimen 26-30 may be seen in Plate 5.7; accordingly this specimen was cooled in dry ice ($-78.5^{\circ}C$) which would take haematite below the Morin transition. The intensity and direction of magnetization were then quickly measured and compared with the room temperature values. There was apparently no change, suggesting that haematite was not responsible for an appreciable fraction of the remanence.

Experiments at yet lower temperatures could prove that the remanence is carried by magnetite. Magnetite changes from a cubic to an orthorhombic structure at about −153°C (Bickford (1949)) and the remanence decreases sharply on cooling through this temperature using say liquid nitrogen (−196°C) (Ozima and others (1964)).

Further experiments could be carried out with the magnetic grains. For example take two similar stably magnetized rocks and demagnetize one of them. Then crush both and separate the large grains of magnetite and mount them in the Earth's field. If the demagnetized grains displayed much less remanence than the untreated grains, we would have evidence that most of the remanence had indeed resided in large grains of magnetite. Experiments using densely packed grains suffer the disadvantage that their magnetism interferes. This was avoided by Parry (1965) by mixing magnetite in plaster at concentrations encountered in rocks. Parry caused such dispersed magnetite to acquire a TRM and he then carried out AF demagnetization. It would be interesting to do such experiments upon the magnetite grains of the present work to see how closely the J/J_o curves followed those for the original rocks.

Another valuable series of experiments on the whole rocks would be to determine Curie points in that remanence carried by haematite and magnetite can readily be distinguished, the Curie point of titanium-free magnetite being 578°C whereas that of haematite is approximately 695°C. It is known that our large grains of magnetite are titanium-free (5.2) and so a Curie point approaching 578°C might be considered conclusive evidence that the remanence is carried in these grains.

Nevertheless the possibility exists that the remanence could be carried by very small magnetite grains dispersed in the transparent minerals. Indeed needle-like opaques, about 1 μ wide, have been seen in the pyroxenes in some of the dykes. Now long thin magnetite grains would be expected to have high coercive force, the theoretical limit being 2800 oe (Strangway (1970), 27). To test the hypothesis that the remanence is carried by such needles the rock dust from which the large grains of magnetite had been removed could be compacted and then given an IRM or if possible a TRM. Then investigate whether the intensity and demagnetization behaviour are close to that of the original rock.

The form of the demagnetizing curves which have been found in this study (Figs. 8.34 and 8.35) are an invaluable indication of the remanence-carrier. TRM of ilmeno-haematite acquired in the geomagnetic field is demagnetized only a little even by 1,000 oe whereas magnetite can usually be demagnetized to less than half by the application of only a few hundred oe (Nagata (1967)). On this basis (with the possible exception of Dyke 7) the species responsible for the remanence in the present rocks is invariably magnetite. However the variations in slope of the demagnetization curves suggest that it is in a variety of states.

8.5.1 Single or multidomain magnetite

Assuming that the remanence is carried by magnetite it would be interesting to know whether it is present as single or multidomain grains. Multidomain grains can change their magnetization by movement of domain walls whereas single domains, having no such walls, can be reversed but not demagnetized below the Curie point. This property makes them of particular importance for palaeomagnetism. However calculations of the grain size of spherical single domain grains of magnetite indicate a diameter of 0.03μ (Morrish & Yu (1955)) which implied superparamagnetic behaviour in which the domains are (Néel (1955)) characterized by relaxation times less than 100 seconds. It was at first thought therefore that single domains in magnetite were not important in palaeomagnetism. (In view of this difficulty Stacey (1963) proposed the idea of pseudo single domain grains in which the critical size would be say 17μ.)

However if the grains are elongated the lengths can be much greater than the diameters permitted for spherical grains and yet still be single domain; particles of axial ratio 10:1 can be single domain up to 3μ long (Morrish & Yu (1955)). In elongated grains the transition from superparamagnetic to single domain behaviour with relaxation times much greater than 10^{11} years takes place over a very restricted length and has been plotted for a range of axial ratios by Evans & McElhinny (1969) who concluded that magnetite needles several μ in length could be single domain. These authors have also shown that multidomain grains of magnetite cannot have coercivities greater than 900 oe; moreover Evans and others (1968) demonstrated that coercivities greater than 1000 oe must arise from the shape anisotropy of single domains.

8.5.2 Possible mechanisms in the Lewisian rocks.

Let us now consider the types of remanence found in the present collection of rocks in the light of these ideas. In Dyke 28 specimens demagnetized at 700 oe still retain about 0.3 of their NRM. It seems probable that some of this would survive 1000 oe of demagnetizing field and so would reflect single domain remanence. The remanence of Dyke 23 with the non-Fisherian distribution of directions may be associated with the 2 types of opaque noted in this dyke (6.23), particularly as the directions seem to be intensity-dependent, the two stable and normally magnetized specimens being an order of magnitude less intense than the others. This observation makes it possible that at least some of the remanence may rest within the "clusters of dusty opaques". In the stable Dyke 7 stringers of opaques have been noted in thin section in the clinopyroxene and a multitude of fine opaque needles seen in polished section. The specimens demagnetized up to 250 oe show no fall in intensity and so it is possible that some of the stable remanence may lie in single domains in the form of these needles. // n.p. At the other extreme, the observation of very short relaxation time in the granites (p.119) (which was proved to be a magnetic effect and not simply due to electrostatic charge) suggests superparamagnetism. The components of magnetization changed to the extent of 5 or 10% in 10 seconds during measurement. However banging the rock with a hammer caused a thirty-fold increase in components; moreover the new values were constant (to 5 significant figures over a measuring time of say 50 seconds). This proved that banging with a hammer caused the unstable behaviour to vanish. Now superparamagnetism is thought to be held in minute separate magnetite particles; in that case there is no reason why banging with a hammer should destroy the superparamagnetism. A possible explanation is as follows. The visible magnetite is in the form of rare grains about 50μ across; possibly these contain very many small domains separated from each other by walls which can move with the greatest of ease and for which one configuration is as unstable as another. However perhaps the banging introduces imperfections into the crystal and so pins the domain walls into specific positions determined by minimum energy considerations. The fact that the steady magnetization can be destroyed by demagnetization is not surprising in view of Chebotkevich & others (1966) who showed that dislocations can be moved by magnetic fields. In the Rockall granite (Beckmann and others (in press)) stability in individual specimens has been found but no grouping of directions for the unit as a whole; one possible explanation of this is that the violent pounding of Rockall by waves may have introduced stability, but in scattered directions, by the mechanism described above.

In Dyke 1 the direction of magnetization may be reversed at will by banging; it is possible that all the gneisses and dykes in the "unstable" region owe their instability either to superparamagnetism or, perhaps more likely, to very easy domain wall movement in multidomain magnetite.

8.5.2.1 Hypothesis to account for magnetization in the stable region.

Stable magnetization in magnetite-bearing rocks has often been linked with the presence of ilmenite lamellae in the magnetite or titanomagnetite (Graham (1953), Powell (1963), Watkins & Haggerty (1965), Haggerty (1968), Strangway & others (1968), Ade-Hall (1969), Watkins (1969), Spall (1971B), Irving & others (1972B)). Strangway & others (1968) argued that the function of the ilmenite lamellae was to break up the magnetite grains into long thin needles which would be single domain and thus have high coercivity. McElhinny (1973) regards this proposal as superfluous because he and his co-workers have experimental evidence for separate single-domain particles of magnetite. Where ilmenite lamellae in magnetite are absent it has been claimed that large grains of magnetite (10μ) are always unstable (Larson & others (1969)). In this study such lamellae have been seen only in Dyke 27. Consequently the reason for the stability of our stable units must be sought elsewhere.

Irregular blades in ilmenite have been observed in each of the group of 9 dykes and the granulite (except Dyke 26 in which white blades in ilmenite are conspicuous) and it was suggested (5.3.1) that they may have formed as the result of straining. Dearnley has made the point that if this is so it is surprising that similar effects are not observable in the other minerals. These rocks generally show no evidence of deformation in hand specimen; however it may be the case that the features in ilmenite are a particularly sensitive indicator of deformation. If this is so, the strains would have been experienced by the magnetite as well. White (1973) has noted similar lamellae in naturally deformed quartz; he has kindly agreed to use the electron microscope to test the hypothesis that there are strains in the ilmenite and magnetite in the "stable" region but not in the "unstable" region.

Grinding of magnetite increases its coercive force due to internal stress but subsequent annealing causes the coercive force to decrease (van Oosterhout & Klomp (1962)). The magnetic properties of nickel are very similar to those of magnetite (Fuller (1970)); nickel is more easily studied because it is easy to machine and is not brittle. A strongly-stressed nickel bar acquires stable thermo-remanent magnetization whereas an annealed nickel bar hardly acquires it at all (Uyeda (1958)). However in stressed nickel the thermo-remanent magnetization is much larger than the induced component whereas the reverse is true for annealed nickel (Fuller (1970)). In magnetite itself the stability and intensity of remanence depend critically on the state of internal stress which is thought to impede domain wall movement by creating barriers to wall motion (Lowrie (1967), Lowrie & Fuller (1969), Fuller (1970)). Verhoogen (1959) had put forward a theory to account for high coercivity of TRM in multidomain grains by supposing that there are local stress regions around dislocations and that these behave as single domains. In its original form Verhoogen's theory has been strongly criticized by a number of authors, whereas others have sought to maintain it by making modifications, for example Kobayashi & Fuller (1968) showed that pile-ups of dislocations could result in stress-pinned single domain-like regions.

If our group of ten stable rock units experienced stresses which were not annealed subsequently, their magnetic stability could be accounted for in this way. The experiment on the granite has shown that a more stable remanence can be imparted by shock. This work could be taken further by performing shock experiments in magnetic fields on the unstable rocks through a range of elevated temperatures.

The high temperature and stresses experienced during the history of the Lewisian might well have been even more effective in producing stable magnetization. The time at which this might have happened will be considered in the last chapter.

8.6 DYKE CHEMISTRY.

The analyses available for some of the dykes are presented in Table 8.3. They have been carefully considered to see if there is any connexion between dyke chemistry and magnetic stability but apparently there is none. For example, one possibility is that there might be a correlation with the oxidation state of the iron; the ratios of the iron oxides are placed at the end of the table but evidently bear no relation to stability. This negative result supports the view that the source of magnetic stability is physical rather than chemical.

TABLE 8.3

Chemical Analyses

Dyke Number	1	5	6 Fresh	6 Amph	7	8	11	17	18	21	26	27	28
Reference	B	I	T	T	T	O'H	I	I	I	I	I	T	T
			1630	1631	1629							1604	1613
SiO_2	46.0	51.9	49.5	49.2	53.4	46.88	49.9	49.0	51.1	48.9	50.3	50.3	51.5
TiO_2	2.6	1.6	1.93	1.22	0.50	1.19	1.5	1.9	1.5	1.8	1.4	1.45	0.80
Al_2O_3	11.2	13.6	14.10	14.20	9.18	8.61	12.8	13.3	13.4	14.0	14.0	13.31	13.78
Fe_2O_3	5.6	2.9	5.34	4.56	2.16	3.85	2.0	3.1	2.1	2.3	1.8	3.13	2.44
FeO	12.8	11.7	11.70	10.43	6.90	8.13	12.9	12.7	11.9	12.0	9.7	9.17	9.63
MnO	0.26	0.22	0.22	0.21	0.15	0.20	0.23	0.26	0.22	0.21	0.19	0.17	0.17
MgO	6.5	5.6	6.29	7.09	16.60	15.95	5.9	5.9	5.8	5.1	6.3	6.84	6.31
CaO	10.4	9.6	11.50	11.75	7.70	11.23	10.1	9.7	10.0	9.7	10.6	11.55	11.32
Na_2O	2.4	2.5	2.45	2.45	1.78	1.22	2.4	2.5	2.5	2.5	2.4	2.18	2.39
K_2O	0.53	0.77	0.31	0.31	0.72	0.01	0.57	0.52	0.57	0.65	0.38	0.64	0.48
P_2O_5	0.19	0.18	0.07	0.054	0.055	0.06	0.15	0.25	0.14	0.18	0.12	0.092	0.066
H_2O^+	0.6					2.10							
H_2O^-						0.32							

B = Burns (1966), I = Institute of Geological Sciences (unpublished data), O'H = O'Hara (1962), T = Tarney (unpublished data),

in which the codes refer to Evans and Tarney (1964).

TABLE 8.3 (Continued)

Trace Elements (p.p.m.)

Dyke Number	1	5	6 Fresh T	6 Amph T	7 T	8 O'H	11	17	18	21	26 T	27 T	28 T
S			2870	350	220						207	942	348
Cr			181	139	2049	2000					191	257	155
Ni			107	64	598	1000					110	89	99
Rb			5	3	17						10	11	10
Sr			114	56	179	25					155	206	170
Y			15	13	9						17	15	14
Zr			49	43	80	65					82	82	71
Nb			11	7	10						17	19	7
Pb			10	3	14						8	5	10
Th			2	<2	3						<2	<2	5
Ba			183	114	346	10					218	261	225
Ce			18	8	6						18	25	18
Co						55							
V						270							
Li						16							
Ga						10							
Sc						30							

TABLE 8.3 (continued)

Dyke Number	1	5	6	7	8	11	17	18	21	26	27	28
Fe_2O_3 / FeO	0.44	0.25	0.46	0.31	0.47	0.155	0.24	0.18	0.19	0.19	0.34	0.25
Magnetic Stability %	6	18	29	89	0	19	58	97	4	82	30	100

CHAPTER 9

INTERPRETATION OF THE RESULTS

9.1 INTRODUCTION

The mean direction and corresponding pole position for the group of nine class 1 dykes have been calculated. Table 9.1 and Fig. 9.1 show these results; they also give those for the granulite G6 and the remaining class 1 dyke, Dyke 7:

TABLE 9.1

Rock Units	Direction of Magnetization		k	α_{95}	Ancient Pole		dp	dm
	Dip.	Decl.			Lat.	Long.		
Mean of 9 dykes	55.4	284.6	59	6.7	37.3	274.8	6.9	9.6
G6	59.5	290.8	25	6.3	43.8	273.8	7.2	9.5
Dyke 7	1.0	106.1	35	4.4	−7.9	70.8	2.2	4.4

Comparison with polar wander curves will be made easier if Dyke 7 is reversed. Moreover comparison with North American polar wander curves can conveniently be considered after closing the Atlantic Ocean following Bullard & others (1965) in which a rotation of 38.1° is made about a pole of rotation at 88.4°N, 27.7°E:

TABLE 9.2

Rock Units	Poles after closing the Atlantic	
	Lat°N	Long°E
9 dykes (mean)	38.1	236.3
Dyke 7 (reversed)	8.3	212.6

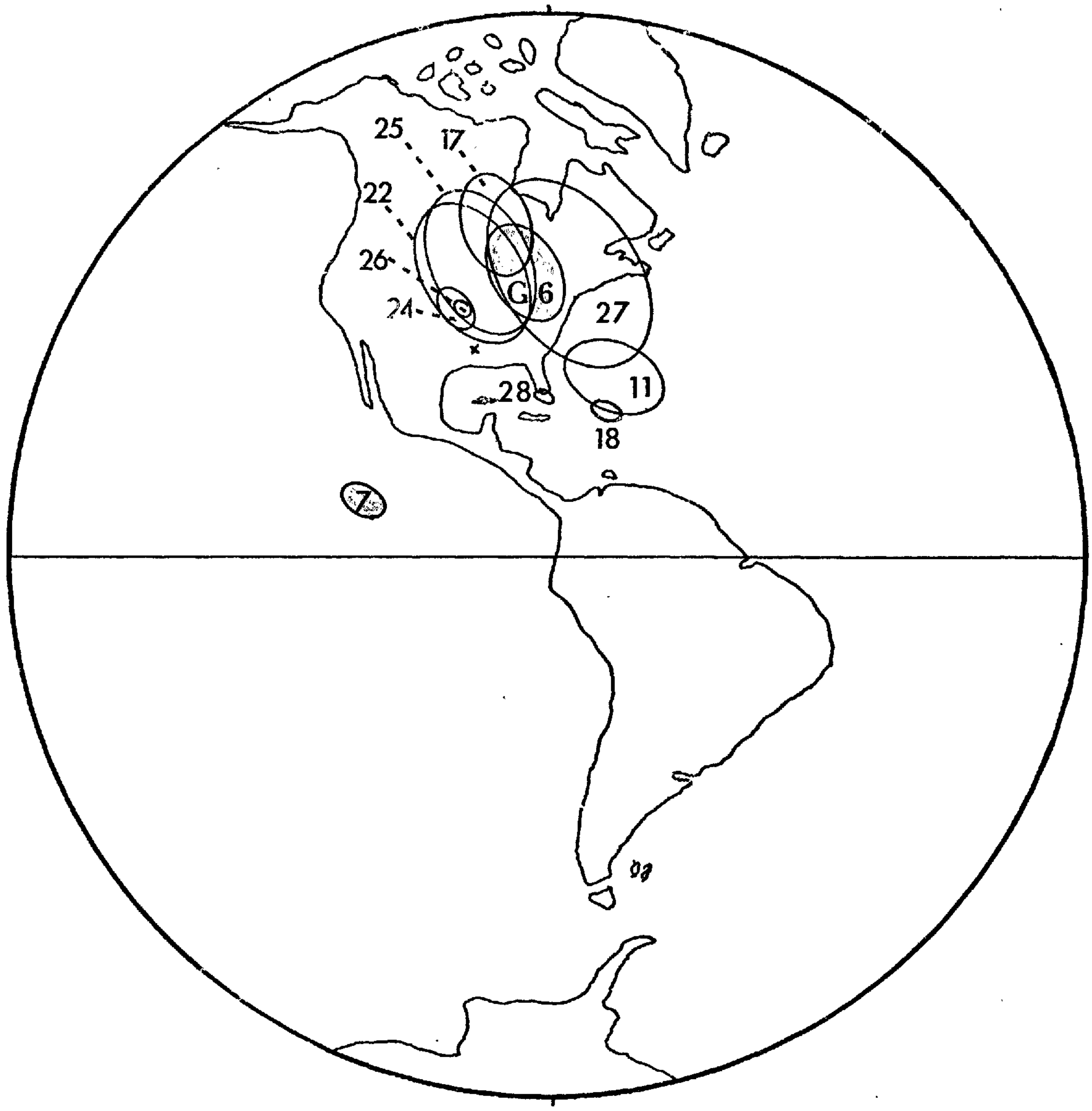


Fig. 9.1 Poles from the 10 Class 1 dykes and the granulite G6.
(x represents the pole from the single core G1-1)

9.2 THE TIME OF MAGNETIZATION OF THE "NINE DYKES" AND THE GRANULITE, G6

The closeness of these dyke poles and their common polarity suggest that they acquired their magnetization over a short time-span. The great precision of 3 of the poles raises the possibility of specific events within that time. There may therefore have been relatively small individual variations in time of magnetization. The pole for G6, falling close to the mean pole of the nine dykes, suggests that the country rocks may have been magnetized at the same time as the dykes. Admittedly this is a strong conclusion to draw from a single granulite. However it is enhanced by the additional palaeomagnetic evidence that the demagnetizing behaviour of G6 displays a strong affinity with that of stable dykes (Figs. 8.14, 8.33, 8.34). This suggests the remanence-carrier is again magnetite and that it is in the same condition as that in the dykes, implying that the magnetization was established during an experience common to both dykes and granulite. There is little reason to suppose that such an experience coincided with intrusion of the dykes, but a metamorphic episode at some later time could provide such a common experience. It seems most likely that the observed magnetization originated in the Late Laxfordian. The grounds for this view will now be considered.

9.2.1 The case for magnetization in the Late Laxfordian

9.2.1.1 Geochronology

Three of the nine dykes have been dated as follows by the K/Ar method (Evans & Tarney (1964)):

TABLE 9.3

Dyke Number	Age Ma
26	3,830
27	1,950
28	1,800

If the assumption of simultaneous magnetization is correct, which of these dates, if any, reflects the time of magnetization? It is often assumed that the time of magnetization corresponds to the isotopic date. Spall (1973) has remarked that we do not know the extent to which this is true; in the Pre-Cambrian, evidence on the problem is scanty. Most palaeomagnetic workers are inclined to the view that revision of K/Ar dates took place more readily than remagnetization (e.g. Ade-Hall & others (1971)). However remagnetization without change of K/Ar date has sometimes been suggested (Mulder (1971), Spall (1971B), Spall (1971C)).

In the Lewisian there are certain grounds for thinking that remagnetization happened more readily than revision of K/Ar dates. The following lines of thought are offered. It is tempting to say that argon is readily driven off from rocks when they are heated and so the survival of ancient dates is evidence that the rocks have not been re-heated. However there are very many instances of rocks undergoing events of great intensity without the argon being expelled. For example the Early Scourian K/Ar dates for the gneisses (2.3.1) survived the Inverian, the Early Laxfordian and the Late Laxfordian and its reverberations. This point is particularly striking in the Outer Hebrides. An estimate of the temperature there in the proposed Early Laxfordian is 700 - 750°C. Moreover the Late Laxfordian in these islands was more profound than on the mainland. In spite of these events Early Scourian K/Ar ages of 2,580 Ma have been obtained (Francis and others (1971)).

Indeed Watson (1973A) has remarked that the occurrence of remnants in which the isotopic clocks have not been re-set is "almost a hall-mark of polycyclic gneiss complexes".

A similar point may be made about the dykes. The least altered dyke in the Outer Hebrides is as altered as the most altered dyke on the mainland. Nevertheless for one of the dykes in the Outer Hebrides Lambert and others (1970B) have obtained the K/Ar date of 2,440 Ma.

There is no reason to suppose that magnetization is equally resilient; on the contrary, it could not have been retained above 580°C, which is the Curie point of pure magnetite (Nagata (1961), 89). Indeed a temperature of only 300°C maintained for a few million years is probably sufficient to cause remagnetization in the prevailing magnetic field (Tarling (1971), 37).

Minerals containing radiogenic argon may sometimes retain it in spite of high temperatures when the local partial pressure of argon does not permit its escape. On the other hand remagnetization takes place simply by readjustments within the magnetite grains and is not dependent upon chemical exchanges.

This point of view certainly holds good for Dyke 26 with its excess argon age; in such cases the view has a logical advantage in that a K/Ar age can precede the existence of a rock unit whereas its time of magnetization cannot.

Dyke 27 has an age of 1,950 Ma and this is probably the date of its intrusion as discussed in 6.27.

The date 1,800 Ma of Dyke 28 arose on account of the vicinity of a fault which allowed escape of argon and so dated events which would otherwise have passed isotopically unnoticed as they did further along the dyke where the date 2,740 Ma occurs. Even if this other portion of the dyke had been sampled it seems likely that the palaeomagnetic results would have been similar (as they were for the excess argon Dyke 26).

Finally, applying the hypothesis of almost simultaneous remagnetization it seems possible that these three dykes and, a fortiori, the nine dykes and the granulite were remagnetized at 1,800 Ma, or possibly afterwards. However in view of Lambert & Holland (1972) 1,800 Ma is a typical Late Laxfordian date and so it is possible that the magnetization was in fact at this time, since the palaeomagnetic results have also implied that the magnetization could have been imposed during a metamorphism. The Late Laxfordian was the last important metamorphic event in the Lewisian (page 29). Evidence from polished sections (9.2.1.3) tends to support this conclusion.

9.2.1.2 Temperature

The Late Laxfordian was less intense in the central than in the northern and southern zones (2.5.2.3) and this variation caused only patchy alteration of minerals in the central portion. This factor, together with the occurrence of higher isotopic ages in the central zone formed the bases for Watson's & Tarney's estimates of a temperature of 400°C - 500°C in this zone. The Lewisian was at a depth of say 10 km in this metamorphism and so such temperatures were probably held for some millions of years.

Rocks existing for great spans of time at elevated temperatures below the Curie point may acquire hard viscous remanent magnetization simulating TRM. Irving (1964), 34, quotes several examples in which this may have happened. In the present case it is felt that the high temperature was a factor but that the magnetization happened at particular times due to shocks.

The stably magnetized rocks occur in the middle of the central zone, whereas the unstable rocks are found nearer the boundary of the northern zone (Figs. 2.2 and 8.36), where the temperatures would have been higher. Thus the fact that the quality of the magnetization can be linked with variations in the intensity of the Late Laxfordian is an argument for attributing the stable magnetization to this metamorphism.

9.2.1.3 Opaque mineralogy

Evidence from polished sections supports this interpretation. It has been noted (8.4.1) that irregular blades in ilmenite occur only in the stably magnetized region. Moreover they are to be seen in the granulite G6 (Plate 5.12) as well as in the dykes. Once again we have compelling evidence that G6 and the stable dykes underwent a common experience. On the other hand these blades are absent in both the gneisses and the dykes in the unstable region. It seems probable that the irregular blades are twinning lamellae introduced by deformation whilst the rocks were in a somewhat plastic state. Now deformation was a typical characteristic of the Late Laxfordian (2.5.2.2). On the other hand to the north of the stable region the temperature was higher (2.5.2.3 and 9.2.1.2) and these features in ilmenite were either unable to form or did form but recrystallized (perhaps via the mosaic stage, Plate 5.9) giving, once again, homogeneous grains of ilmenite. The finding that these blades in ilmenite, an opaque very closely allied to magnetite, can also be related to the intensity of the Late Laxfordian lends further support to the hypothesis of magnetization at that time. The significance of the irregular blades in ilmenite may be that they indicate local stress which simultaneously affected the magnetite by strong pinning of domain walls in the stable region, whereas in the unstable region both features vanished by annealing.

9.2.2 <u>A note on polarity</u>

The area over which the stably-magnetized rocks were collected is some 500 km^2. It seems unlikely that local stresses which may have magnetized a particular rock unit would have occurred at exactly the same time for other units. One might speculate that there were differences amounting perhaps to 50 million years. The common polarity of all ten rocks units is remarkable in any case but, if the last suggestion is correct, may indicate a period of absence of reversals of the Earth's field at about 1,800 Ma. It is of course possible that there could have been reversals between the magnetization of individual dykes. If more units were collected from this region, the chance of such intervening polarities would be reduced. One of the reasons for raising the possibility of constant polarity is that if it is true it would be a global phenomenon. Irving (1971) has suggested that it may be feasible to construct a Precambrian reversal stratigraphy consisting of a time-table of intervals in which the field was constant for about 50 million years at a time. As the picture of this emerges it may eventually prove possible to use this approach as a dating tool against which the suggestion of magnetization in the Late Laxfordian can be further tested. (For example the 4 closely-grouped Wind River dykes, $\geqslant$1880 Ma,(Spall (1971B)) have the same polarity as each other and as the Scourie dykes.) In general reversals occur in the Precambrian with a frequency similar to that in the Phanerozoic (McElhinny (1973), 133).

Notice that it is unlikely that the magnetizations in the Lewisian originated during very slow cooling of a great volume of rock, if reversals were occurring as frequently as at present, because the temperature might have fallen only say 1^{o} or 2^{o}C between reversals so that the rocks would be effectively demagnetized, whereas these rocks are strongly magnetized. Larochelle (1969) has also noted constancy of direction of magnetization over many km, in spite of change of rock-type, in the Sudbury nickel irruptive. He presumed that the geomagnetic field must have been particularly steady over the lengthy period during which these rocks were magnetized. Polarity will be mentioned again briefly in connexion with the polar wander curves.

9.2.3 Magnetization at other times?

It is possible that the nine dykes and the granulite gained a common magnetization after intrusion into hot rock (at 500°C)(Tarney (1963)). However the regional variations in the magnetization cannot be accounted for in this way, nor is there any reason why the features in ilmenite would have formed at this time. If any dykes still retain magnetization from intrusion, it would be expected in the least-altered. However an examination of the pattern of poles (Fig. 8.17(a)) in the light of Watson's categories of mild alteration, reveals no systematic variation. Magnetization of the whole region could have come about in the Early Laxfordian in which the temperature on the mainland would have been greater than 600°C; in this case the rocks could have been magnetized simply by TRM. Stresses in this metamorphism might have produced the irregular blades but the stable and unstable regions cannot easily be explained because the metamorphism decreased in grade towards the East (Dearnley (1962)). The Lewisian rocks were probably magnetized both at the time of dyke intrusion and in the Early Laxfordian but remagnetized in the Late Laxfordian. One mechanism which is unlikely is that the dykes were intruded into cold rock and never reheated sufficiently to remagnetize them, unless there were no net polar wander between the magnetization of the country rocks and the intrusion of the dykes.

9.3 DYKE 7

This is the only stably magnetized dyke which has been found in the "unstable" region. It has just been suggested that the instability in this region was due to the Late Laxfordian. If this is correct any stable rocks found here owe their stability to a subsequent event.

The palaeomagnetic samples were taken from the little-altered section of the dyke near the point from which the dating sample (Fig.6.3) gave the date 1,860 Ma (Evans & Tarney (1964). However amphibolitized rock from this dyke yielded the date 1,440 Ma which is close to the 1,460 Ma for altered material from the adjacent Dyke 6, suggesting a late event at Badcall at about this time as has been suggested for other localities (2.5.3). This possibility is supported by the evidence (6.7) of regional hydrothermal alteration seen in polished section, which may have imparted magnetic stability. It is thought therefore that the magnetization was acquired, not at 1,860 Ma but 1,440 Ma.

However, adjacent dykes at Badcall did not gain stable magnetization. The stability of Dyke 7 may also be linked either with the grain size of the magnetites which is much smaller than in the dolerites, typically about 30μ but with a multitude of exceedingly small grains, or with its unusual chemistry.

9.4 FURTHER WORK

Further sampling might be undertaken to test the ideas of this chapter:

1. The most important requirement is to drill further granulites in the stable region; this could readily be done because several other high grade basic granulites were noted.

2. Sampling of the dyke (6.7) in the stable region identical with Dyke 7 might prove whether Dyke 7 does owe its pole to a late event as proposed, or whether it is a property of its unusual mineralogy.

3. Sampling of π 1 and π 2 pegmatites, representing pre-dyke and waning Late Laxfordian intrusives, in the stable and unstable regions might prove significant.

4. Some of the dykes in the Lewisian inliers in the Torridonian, about 12 km to the south of our most southerly sampling point, are said to be exceptionally unaltered (A.E.Wright, personal communication). If a pre-Late Laxfordian pole can be recovered from any dykes, it would be most likely in these.

5. The Institute of Geological Sciences in collaboration with the author has just made a collection from the three members of the South Harris igneous complex and the associated paragneisses. The Outer Hebrides experienced both phases of the Laxfordian more intensely than the mainland and so it will be interesting to determine the direction of magnetization in these rocks.

9.5 SUMMARY

It is proposed that the two directions of magnetization recognized in this study should be dated as follows:

TABLE 9.4

Rock Units	Ancient Pole		Pole after closing the Atlantic		Date Ma
	Lat°N	Long°E	Lat°N	Long°E	
9 Dykes	37.3	274.8	38.1	236.3	1800 (± 50)
Dyke 7	−7.9	70.8	−8.3	32.6	1440 (± 50)
Dyke 7 (reversed)	7.9	250.8	8.3	212.6	

9.6 CORRELATION WITH NORTH AMERICAN POLAR WANDER CURVES

The poles in this thesis (after closure of the Atlantic) may be compared with the two polar wander curves recently proposed (Spall (1971A), Irving & others (1972B))for North American rocks. The curves coincide in the vicinity of 1400 Ma which is a well-documented region; Dyke 7 of this study falls in this group of poles. However the main group of poles emerging from the present study fits Spall's curve but not Irving's. Let us consider the evidence upon which the two curves depend in the neighbourhood of 1800 Ma.

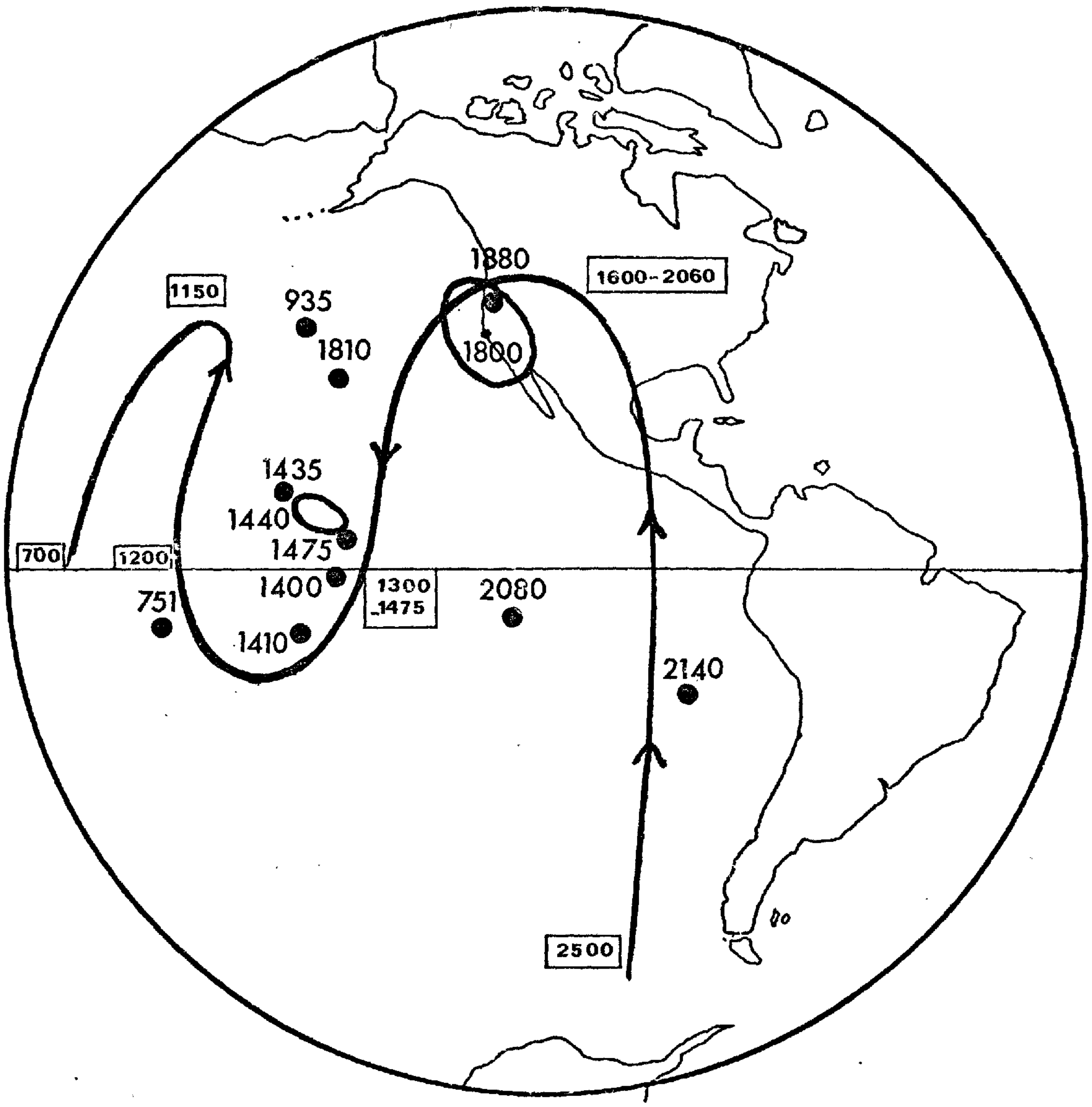


Fig 9.2 The North American Polar Wander Curve of Spall (1971A).

Ovals of confidence are shown for the "nine dykes" and Dyke 7 (reversed) upon closure of the Atlantic Ocean after Bullard & others (1965).

9.6.1 Spall's curve

The intention of Spall (1971A) was to devise a curve which demonstrated the general trends of polar wander in the Precambrian without insisting that points on the curve must follow each other in strict chronological sequence. The portion of interest here is the Animikie-Sudbury trend, assigned the span 1600-2060 Ma. Within this time Spall concluded that the pole was in the vicinity of 240-270°E, 30-45°N. This conclusion was based mainly on three sets of dated igneous rocks, the Marathon dykes, the Wind River dykes, and the Sudbury nickel irruptive, whose poles are given in Table 9.5.

9.6.1.1 The Marathon dykes

This is one of three sets of dykes in the Canadian Shield investigated by Fahrig & others (1965). Spall's curve passes close to the pole for the Marathon dykes, dated at 1810 Ma. The other two sets, the Molson and Abitibi dykes have poles nearly falling on Spall's curve but have younger K/Ar ages at 1445 and 1230 Ma respectively. Spall considers that these dykes are really older. Fahrig & others (1965) refer to the "usual assumption that unaltered basic igneous rocks acquire and generally retain a stable magnetization.... at the time of the dyke intrusion". This seems an over-simplification in view of the fact noted in the Lewisian that igneous rocks can have had a metamorphic history without extensive mineralogical alteration; moreover these authors concede that there is evidence of alteration in some of their dykes.

9.6.1.2 The Wind River Range dykes, Wyoming (Spall 1971B)

Four of these dykes form a group; three of them have been dated by the K/Ar method applied to the pyroxenes; the ages thus obtained were 200-400 Ma greater than previous K/Ar whole-rock ages. The greatest pyroxene age has been interpreted as the minimum age of the group.

9.6.1.3 The Sudbury nickel irruptive.

This is an intrusive body in Canada some 50 x 20 km in extent and consisting of a norite and a micropegmatite. It has been studied palaeomagnetically by Hood (1961), Sopher (1963) and Larochelle (1969). The tectonic history of the area is a matter of controversy. Hood and Sopher have attempted to make tectonic corrections to pole positions whereas Larochelle preferred to publish only directions because, in view of the unknown amounts of mutual rotation within the irruptive, misleading kinks in the polar wander curve might otherwise occur. The Rb/Sr age of the complex (Fairbairn & others (1968)) is 1700 Ma.

9.6.1.4 The Gunflint iron formation

This is an ore body in the Lake Superior district whose direction of magnetization was determined by Symons (1966). It was dated at 1635 Ma (Faure & Kovach (1969)) using the Rb/Sr method. These authors consider that the body may be older if somewhat metamorphosed; a previous estimate of the age had been 1900 Ma. The interpretation of Spall (1971B) is 1600-1850 Ma whereas that of Irving & others (1972B) is 1700-2300 Ma.

9.6.1.5 Cobalt group sediments

The pole from these rocks (Symons (1967)) shows closer affinity with the 1600-2060 Ma trend than with the earlier Matachewan-Stillwater trend although strictly the dating, 2180-2650 Ma (McElhinny (1973)), places it in the latter group.

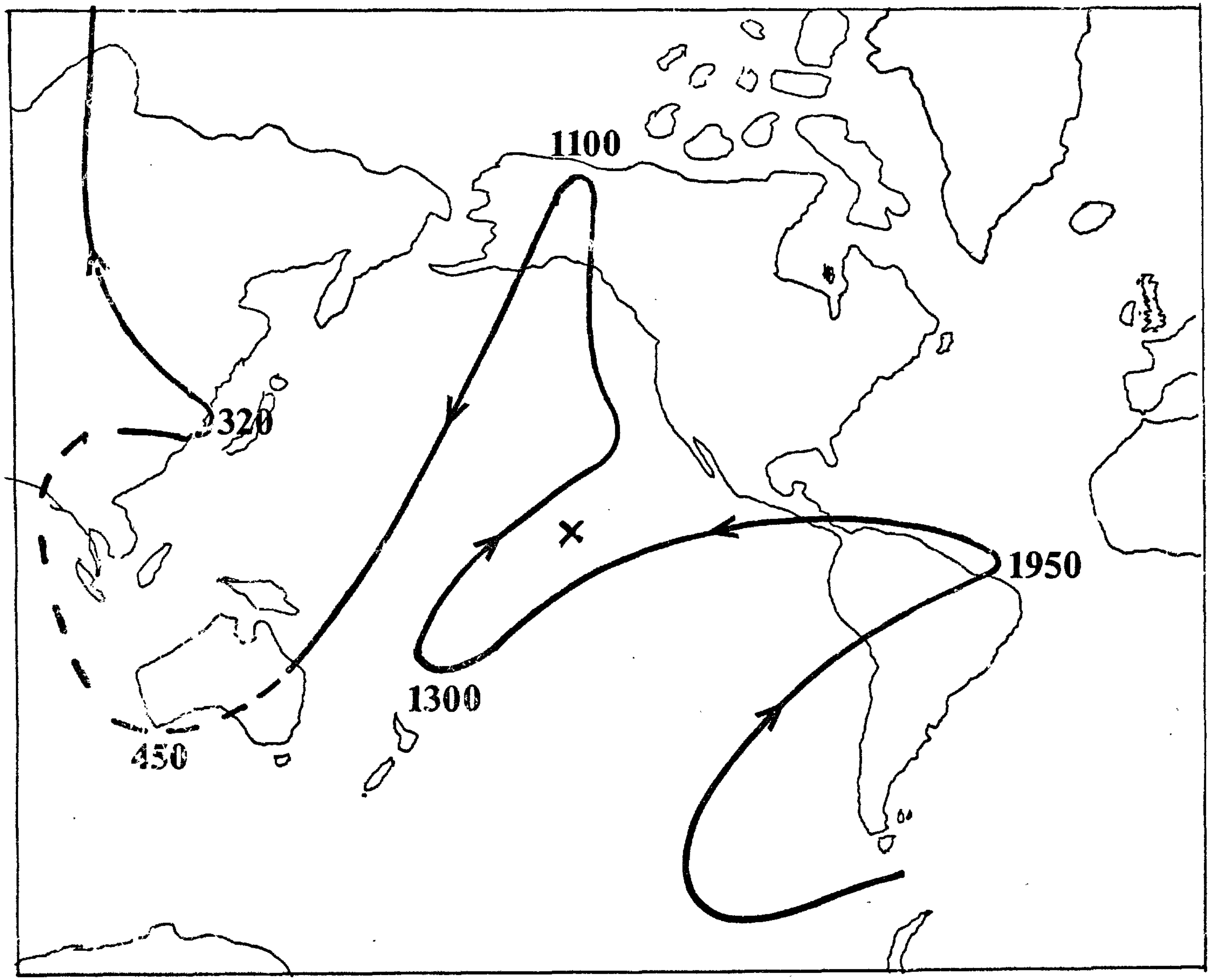


Fig 9.3
The North American Polar
Wander Path of Irving & Park (1972).

X=Dyke 7 (reversed).

TABLE 9.5

Table of Relevant Poles

Rock Units	Ancient Pole Lat°N	Ancient Pole Long°E	Age (Ma)	Palaeomagnetic References
POLES NEAR 1800 Ma UPON WHICH SPALL'S CURVE DEPENDS				
Marathon Dykes	29.0	213.2	1810	Fahrig & others (1965)
Wind River Dykes	43	239	$\geq$1880	Spall (1971B)
Sudbury irruptive:				
either	53.4	244.1		Hood (1961)
or	38.4	260.6	1700	Hood (1961)
North Range	47	253		Sopher (1963)
South Range	2.5	274		Sopher (1963)
Gunflint Iron Formation	28	266	1635 or 1600-1850 or 1700-2300	Symons (1966)
Cobalt group sediments	22	263	2180-2650	Symons (1967)
POLES NEAR 1800 Ma UPON WHICH IRVING'S CURVE DEPENDS				
Et-Then sediments	- 1	312	1250-1845	Irving & others (1972A)
Western Channel diabase	9	245	1325-1785	Irving & others (1972B)
Port Radium Sill	21	276	Older than Western Channel	Irving & others (1972B)
Hornby Bay Sediments	22	265	Older than Western Channel	Irving & others (1972B)
Cameron Bay Volcanics	1	256	1770 (Rb/Sr)	Irving & others (1972B)
Dubawnt group	7	277	1725	Park & others (1973)
POINTS ON FIG.9.2 (after closure of Atlantic for Scotland and Greenland)				
Nipissing Diabase	19.4	91.9	2140	Symons (1970)
Indian Harbour dykes	- 6	243	2080	Murthy & Deutsch (1972)
Wind River dykes	43	239	$\geq$1880	Spall (1971B)
Marathon dykes	29.0	213.2	1810	Fahrig & others (1965)
The 9 Scourie dykes	38.1	236.3	1800	This thesis
Croker Island samples	5.5	217	1475	Palmer (1969)
Dyke 7 (reversed) (NW Scotland)	8.3	212.6	1440	This thesis

TABLE 9.5 (continued)

Rock Units	Ancient Pole Lat°N	Ancient Pole Long°E	Age (Ma)	Palaeomagnetic References
Gardar (Greenland)	12	206	1435	Bullock (1967)
Sherman granites	- 8	209	1410	Eggler & Larson (1968)
Michikiman anorthosite	- 0.5	215.3	1400	Murthy & others (1968)
Lower Torridonian	36	203	935	) Iriving & Runcorn (1957)
Upper Torridonian	- 6	185	751	)

9.6.2 Irving's curve

This polar wander curve was published by Irving & Park (1972) and again in Donaldson & others (1973); the greater part of it appeared previously in Irving & others (1972B). Spall's curve is not discussed by these authors. In the vicinity of 1800 Ma the curve depends upon 6 poles. There are great uncertainties in some of the dates, 460 Ma in one case and 595 Ma in another. However the points on the curve follow each other best if the maximum ages are assumed for each.

9.6.3 Resumé of Spall's and Irving's curves

At first sight the two curves appear to be in conflict. However this is probably not so because they describe different parts of the Canadian Shield. Spall's curve depends upon the terrain including Lake Superior and Wyoming, whereas Irving's represents material entirely from the North-West Territories, in the neighbourhood of 1800 Ma. The difference between the two curves could be explained by relative movement between these regions. Indeed Donaldson & others (1973) regard the Wind River dykes result as of much potential interest, representing a divergence from the "main" curve; they explain it by a very large displacement during the Hudsonian orogeny.

Both curves will be known in greater detail when the uncertainties in the isotopic ages can be reduced and when there is more knowledge about the correspondence between isotopic and magnetic ages.

9.6.4 The Lewisian Results

The poles of this thesis, after closure of the Atlantic, fit Spall's curve very well, implying that the Atlantic was closed in accordance with the Bullard fit and that this fragment of NW Scotland was joined to the terrain upon which Spall's curve depends, when the Lewisian rocks were magnetized.

The good fit implies that there has been no net change of attitude and no rotation of this fragment, apart from that about the Bullard pole. Independent evidence of non-rotation comes from the strike of the dykes. It has been pointed out (Payne & others (1965)) that when the Atlantic is closed without otherwise rotating Scotland, the Scourie dykes fall on an arc of a great circle 4000 km long stretching from Yellowknife in Canada, through Greenland to Scotland.

On the other hand it had been tentatively suggested (McElhinny (1973), 209) on the basis of the Late Precambrian poles (Irving & Runcorn (1957)) that Scotland could be associated with the Baltic Shield polar wander path (Fig. 9.4). This proposal seems to overlook the unconformity in the Torridonian. Moreover the Caledonian orogenic belt comes between the Lewisian and the Baltic implying closure of an ocean and an unknown amount of displacement. Also the rock types are different, the Baltic Shield consisting mainly of volcanic and sedimentary rocks. Brock (1973) has **stressed** the need for caution when making reassemblies using polar wander paths and considers that the palaeomagnetic method is best used to check and refine an assembly for which there are already geological or geometrical grounds. The relationship of the Lewisian with the Baltic Shield is of great interest and is one of the broader aims of this project. However it seems preferable to establish first the less complicated fit with North America and especially with Greenland.

9.6.5 Geological justification for closing the Atlantic

The superposition of the Lewisian poles and a North American polar wander curve is justified on geological grounds in that the Lewisian, Southern Greenland and Labrador formed an Archaean craton (Bridgwater, Watson & Windley (1973). Geological comparisons between the Lewisian and Greenland are striking. The rocks are similar in appearance and

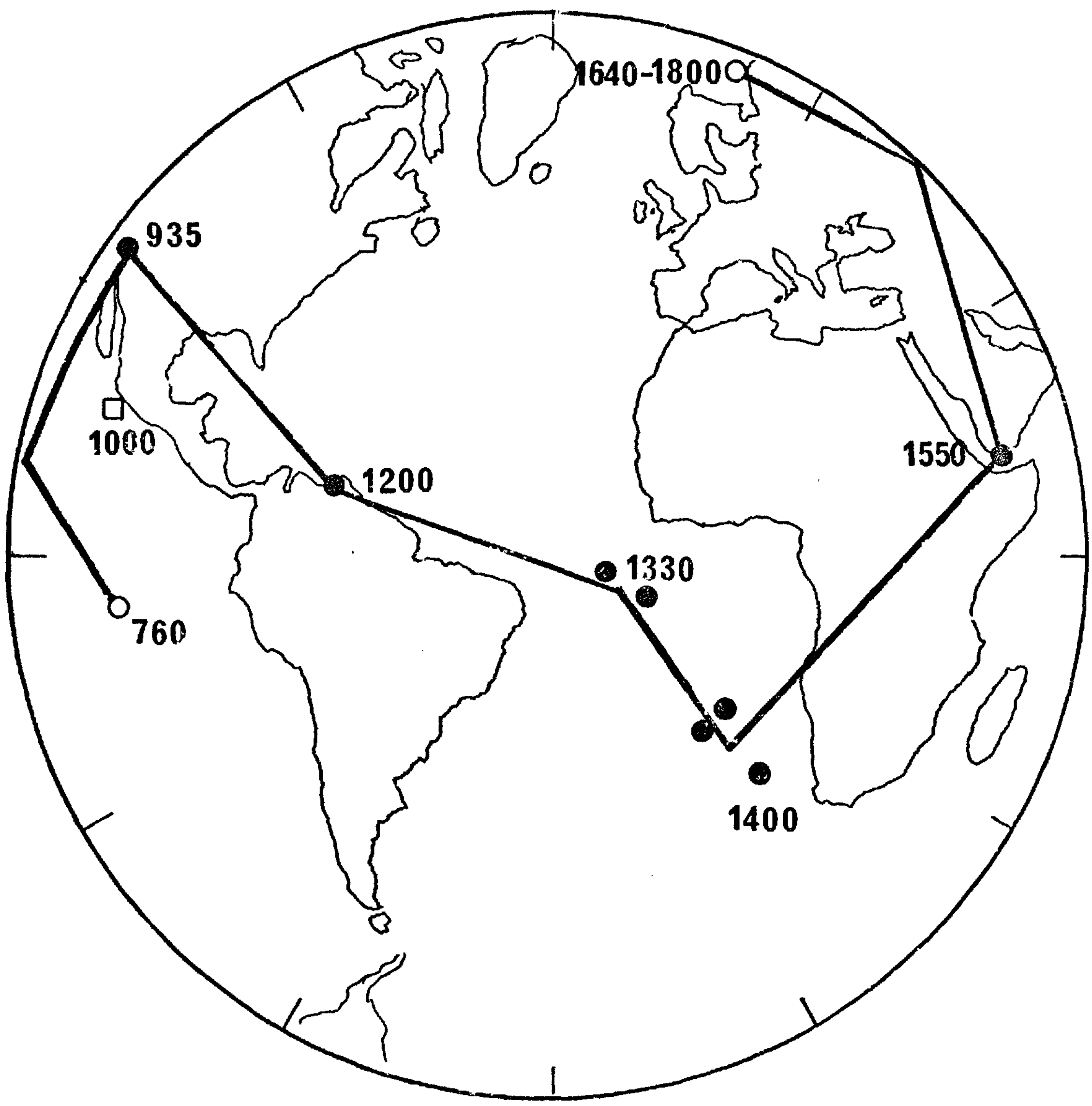


Fig 9.4 The Polar Wander Path of the Baltic Shield and Scotland proposed by McElhinny (1973).

have experienced a parallel metamorphic history (as demonstrated by, for example, Bridgwater, Escher & Watterson (1973) and Wright & others (1973)) and simultaneous injection by basic dykes and, earlier, by anorthosites and other igneous rocks.

It is upon noting unusual features that the affinity of the Lewisian with Greenland becomes especially convincing. The high-grade gneisses in the Lewisian and East Greenland have exceptionally low concentrations of potassium, rubidium, thorium and uranium compared with similar Precambrian rocks in other parts of the world (Tarney & others (1972)). The geographical arrangement of zones, Laxfordian, Scourian, Laxfordian, is an example of an augen structure which Watterson (in discussion) has seen many times in Greenland; he has also noted in the Itivdleq shear zone remarkable pinch-and-swell dykes, and again in the Loch Torridon region of NW Scotland **and in N. Uist.**

There is no evidence of any orogenic belt between Greenland and NW Scotland; apparently they parted due to the simple opening of an ocean. Palaeomagnetic measurements on rocks from West Greenland are now being made by G.E. Morgan and the author and it is hoped that these will throw further light upon the ancient fit of Greenland, Scotland and North America and upon some of the other possibilities put forward in the present work, for which there is, as yet, insufficient evidence for firm conclusions.

9.6.6 Hairpins in the polar wander curves.

Irving & Park (1972) drew attention to hairpins in their polar wander curve. The two most recent hairpins are at 90 Ma and 320 Ma and are marked by an interval of stable polarity of the Earth's field. (It is fair to add that an interval of absence of reversals remote from a hairpin has been noted by Fahrig & others (1972) at 1200 Ma). Now the hairpin marked "1950" on Fig. 9.3 depends on the Et-Then group

(Irving & others (1972A)) with a maximum age of 1845 Ma.

The supposed 1800 Ma pole of this study falls close to what might be regarded as a hairpin in Spall's curve. Perhaps both points are characterized by constant polarity, as has been suspected from the Lewisian poles.

Moreover the world-wide peak of K/Ar dates at 1800 Ma (Dearnley (1965A)) have been linked with a change in the number of convection cells within the mantle (Dearnley (1965B), Runcorn (1965)). Such a disturbance would make itself felt in the crust by sudden horizontal changes in the relative motion of continental blocks, in other words as hairpins in the polar wander paths. Simultaneous uplift and cooling would have caused the peak of age dates. The turmoil in the mantle would have stirred the core. Now generation of the Earth's magnetic field depends upon assymmetrical motions in the core (Runcorn (1965), Hide (1967), Lilley (1970)). It is therefore most stable when these motions are assymmetrical, whereas when they approach symmetry the field is unstable so that reversals occur.

One might speculate that the common polarity of the group of nine Scourie dykes and the granulite G6 might be explained by such a mechanism.

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APPENDIX A

Palaeomagnetic Results for Individual Specimens
(Program PALS Outputs)

The Symbol A indicates a specimen satisfying stability criterion A .

ANG indicates the angle in degrees turned by the magnetic vector in each demagnetizing step.

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
1 1							
0	70.5	12.2	0.535E-03	82.3	108.4	0.0	1.000
50	68.6	0.6	0.294E-03	83.6	171.5	4.5	0.550
100	75.9	2.5	0.236E-03	84.8	7.2	A 7.4	0.442
150	76.9	75.3	0.117E-03	55.9	41.5	16.0	0.218
1 2							
0	62.7	158.0	0.432E-03	14.1	11.0	0.0	1.000
25	75.6	151.9	0.293E-03	33.1	9.7	13.0	0.678
50	78.1	200.2	0.170E-03	36.3	345.3	10.9	0.392
100	70.7	216.2	0.107E-03	27.1	332.6	8.4	0.249
150	-6.1	88.3	0.151E-04	-1.7	87.9	107.6	0.035
1 3							
0	67.5	152.7	0.360E-03	21.0	13.1	0.0	1.000
50	77.4	191.2	0.127E-03	34.5	349.3	14.7	0.352
100	77.3	212.4	0.816E-04	36.5	339.0	A 4.6	0.227
150	76.8	229.8	0.706E-04	38.8	330.3	3.9	0.196
1 5							
0	6.9	123.9	0.906E-02	-13.9	53.5	0.0	1.000
50	-10.0	116.3	0.154E-02	-17.8	64.6	18.5	0.170
100	-37.6	113.3	0.395E-03	-30.0	76.5	27.8	0.044
150	-53.1	120.3	0.317E-03	-43.8	79.6	16.2	0.035
1 6							
0	63.6	94.9	0.108E-02	34.9	53.8	0.0	1.000
50	59.1	134.5	0.324E-03	15.3	29.4	19.1	0.301
100	-77.3	5.2	0.225E-03	-34.2	172.3	155.3	0.209
150	-53.6	342.0	0.166E-03	-3.7	189.7	25.1	0.154
1 7							
0	37.5	15.8	0.102E-02	50.9	151.1	0.0	1.000
50	71.1	340.3	0.148E-03	79.0	258.9	38.3	0.145
100	85.8	11.1	0.117E-03	66.5	358.9	15.4	0.115
150	35.8	9.6	0.526E-04	50.9	160.5	50.0	0.052
1 8							
0	60.5	45.6	0.895E-03	57.0	95.3	0.0	1.000
50	77.5	21.4	0.115E-03	77.5	38.0	18.8	0.129
100	42.4	104.0	0.492E-04	13.8	60.2	47.3	0.055
150	70.8	91.6	0.416E-04	43.7	47.0	29.1	0.047
1 9							
0	72.9	17.8	0.185E-02	80.7	76.6	0.0	1.000
50	71.0	86.2	0.329E-03	46.2	49.5	20.1	0.178
100	62.8	85.1	0.136E-03	38.7	61.1	8.2	0.074
150	-4.1	39.4	0.623E-04	22.0	131.6	75.2	0.034
1 11							
0	59.7	353.3	0.206E-02	71.7	191.4	0.0	1.000
50	56.0	52.7	0.317E-03	49.7	93.9	30.8	0.154
1 13U							
0	55.5	338.3	0.257E-02	63.5	217.0	0.0	1.000
50	63.8	309.6	0.853E-03	57.3	264.2	16.5	0.331
100	58.1	160.0	0.106E-03	8.6	10.5	55.9	0.041
1 14							

1 14							
0	77.5	324.2	0.161E-02	71.9	305.1	0.0	1.000
50	75.9	102.6	0.191E-03	45.1	33.3	24.9	0.118
100	51.6	71.9	0.869E-04	36.4	80.9	27.1	0.054
150	59.0	71.9	0.759E-04	42.1	74.6	7.4	0.047
1 15							
0	73.0	45.1	0.221E-02	66.8	65.0	0.0	1.000
50	70.1	105.9	0.307E-03	37.2	40.0	18.6	0.139
100	78.8	36.9	0.176E-03	71.1	37.9	18.9	0.079
150	-25.6	342.3	0.128E-03	16.7	192.8	108.8	0.058
1 16							
0	82.3	53.0	0.119E-02	64.7	23.9	0.0	1.000
50	78.5	28.2	0.116E-03	74.3	36.0	5.6	0.098
100	-22.5	4.6	0.107E-03	19.9	170.1	101.9	0.090
150	-28.1	8.1	0.104E-03	16.4	166.7	6.4	0.088
1 17							
0	49.8	235.1	0.197E-02	10.1	309.1	0.0	1.000
50	81.5	65.1	0.583E-03	61.5	27.8	48.5	0.296
100	-13.6	293.6	0.160E-03	6.1	241.1	109.1	0.081
1 19							
0	70.1	87.8	0.198E-02	44.6	50.1	0.0	1.000
50	52.7	94.4	0.540E-03	25.6	62.5	17.7	0.272
100	73.9	15.1	0.123E-03	82.1	66.6	37.4	0.062
150	0.2	278.6	0.116E-03	4.6	257.6	91.6	0.058
1 20							
0	79.3	143.0	0.168E-02	40.4	11.1	0.0	1.000
50	77.5	17.3	0.298E-03	78.9	33.6	20.7	0.177
100	-49.2	76.2	0.299E-04	-18.5	112.4	131.7	0.018
150	78.4	338.8	0.265E-03	76.7	318.3	139.3	0.157
1 21							
0	82.3	0.5	0.232E-02	73.5	355.3	0.0	1.000
50	74.5	165.1	0.676E-03	29.9	3.1	23.0	0.292
100	50.7	19.9	0.135E-03	59.9	139.5	52.6	0.058
150	0.9	16.2	0.134E-03	30.7	155.9	49.9	0.058
1 22							
0	52.8	64.2	0.836E-03	41.3	86.4	0.0	1.000
50	64.2	65.1	0.348E-03	49.9	73.4	11.3	0.416
100	30.0	16.7	0.112E-03	46.0	151.5	45.5	0.134
150	49.1	71.6	0.147E-03	34.7	82.7	45.3	0.176
1 23							
0	48.4	16.5	0.152E-02	58.9	146.3	0.0	1.000
50	44.4	25.3	0.452E-03	53.2	135.1	7.2	0.297
100	46.6	39.5	0.261E-03	49.1	115.7	10.2	0.172
150	-27.4	234.0	0.705E-04	-30.8	289.1	157.7	0.046
1 24							
0	66.7	20.6	0.809E-03	74.9	112.9	0.0	1.000
50	63.6	357.8	0.353E-03	76.8	181.7	10.0	0.436
100	71.3	323.7	0.155E-03	70.3	273.3	14.9	0.191
150	47.9	234.5	0.844E-04	8.4	308.9	45.1	0.104
1 25							
0	44.3	43.6	0.321E-02	45.7	112.5	0.0	1.000
50	56.3	6.0	0.109E-02	68.2	161.8	26.3	0.340
100	32.5	270.0	0.122E-03	15.0	274.4	66.5	0.038
1 26							

0	50.9	37.1	0.222E-02	53.4	115.4	0.0	1.000
50	48.0	32.8	0.570E-03	53.0	122.9	4.0	0.256
100	43.5	33.5	0.977E-04	49.5	124.7	4.5	0.044
150	44.9	46.4	0.233E-03	44.7	109.1	9.3	0.105
1 31							
0	74.0	53.0	0.212E-02	63.6	58.1	0.0	1.000
50	78.4	42.1	0.832E-03	69.3	40.9	5.1	0.392
100	72.4	36.9	0.487E-03	70.6	71.1	6.1	0.230
150	75.3	47.3	0.352E-03	66.8	55.0	4.1	0.166
1 32							
0	35.7	54.7	0.465E-03	35.0	105.2	0.0	1.000
50	88.6	116.7	0.140E-03	57.0	359.6	53.6	0.302
100	-36.5	250.7	0.720E-04	-27.3	270.1	127.5	0.155
150	-48.1	250.6	0.929E-04	-34.5	264.3	11.5	0.200
1 33							
0	5.0	294.5	0.407E-03	14.7	245.0	0.0	1.000
50	45.7	306.5	0.101E-03	41.7	248.5	42.1	0.247
100	72.3	321.3	0.111E-03	69.7	279.1	27.5	0.273
150	-48.7	261.8	0.116E-03	-29.1	254.7	127.9	0.285
1 34L							
0	51.9	23.4	0.261E-03	59.7	133.1	0.0	1.000
50	70.4	285.3	0.731E-04	50.6	292.8	44.7	0.280
100	68.9	275.0	0.715E-04	44.6	296.3	3.8	0.274
150	-19.8	277.6	0.400E-04	-4.7	253.1	88.7	0.153
1 35							
0	65.7	166.0	0.134E-02	16.8	4.6	0.0	1.000
50	68.8	245.9	0.458E-03	32.7	313.1	28.9	0.343
100	65.8	232.6	0.302E-03	24.8	319.1	5.9	0.226
150	66.5	237.5	0.220E-03	27.2	316.4	2.1	0.165
1 36							
0	73.1	9.6	0.216E-02	85.0	77.4	0.0	1.000
50	68.9	23.7	0.434E-03	75.4	98.6	6.2	0.201
100	-32.6	285.4	0.144E-03	-7.2	242.7	123.1	0.067
150	72.5	16.7	0.162E-03	81.2	81.1	121.3	0.075
1 37							
0	81.3	23.1	0.184E-02	72.8	17.8	0.0	1.000
50	80.5	336.0	0.461E-03	73.6	327.5	7.3	0.251
100	-69.7	349.5	0.205E-03	-22.1	181.6	150.4	0.112
150	77.5	318.5	0.126E-03	69.6	304.2	148.3	0.069
1 38							
0	54.4	100.8	0.130E-02	24.0	56.6	0.0	1.000
50	59.9	66.5	0.244E-03	45.6	77.9	19.2	0.188
100	27.1	8.7	0.763E-04	45.5	162.8	50.8	0.059
150	47.1	21.9	0.145E-03	56.4	138.5	22.5	0.111
1 39							
0	76.2	349.2	0.111E-02	82.5	315.4	0.0	1.000
50	74.6	32.1	0.259E-03	73.8	61.4	10.7	0.233
100	7.0	147.3	0.264E-04	-22.9	30.7	89.7	0.024
150	-36.6	166.3	0.127E-03	-50.8	15.4	47.2	0.114
1 40L							
0	70.7	24.1	0.198E-02	76.4	88.9	0.0	1.000
50	84.1	1.1	0.300E-03	70.1	355.5	14.0	0.151
100	69.7	292.5	0.239E-03	53.5	287.4	18.9	0.121
150	70.2	285.2	0.186E-03	50.4	292.4	2.5	0.094

1 41							
0	47.7	62.0	0.109E-02	38.7	92.0	0.0	1.000
50	69.5	49.4	0.198E-03	62.4	73.8	22.7	0.182
100	73.3	31.2	0.156E-03	73.9	69.3	6.9	0.143
150	-63.5	199.4	0.109E-03	-72.3	304.7	169.4	0.100
1 42							
0	71.8	157.6	0.229E-02	26.4	8.4	0.0	1.000
50	71.4	91.6	0.286E-03	44.3	46.1	19.8	0.125
100	-53.3	309.5	0.140E-03	-11.4	215.7	155.6	0.061
150	-68.8	331.2	0.252E-03	-23.0	193.6	18.5	0.110
1 43							
0	49.2	122.5	0.161E-02	10.6	42.8	0.0	1.000
50	81.7	127.7	0.301E-03	46.6	13.7	32.5	0.187
100	64.0	65.3	0.230E-03	49.7	73.5	23.2	0.143
150	-63.3	327.0	0.206E-03	-16.7	198.7	146.2	0.128
1 44							
0	60.2	345.8	0.239E-02	70.6	208.7	0.0	1.000
50	67.6	3.2	0.701E-03	81.9	160.1	10.5	0.293
100	72.7	305.6	0.392E-03	62.1	288.1	19.4	0.164
1 45L							
0	66.3	139.7	0.221E-02	22.1	22.2	0.0	1.000
50	59.4	114.4	0.342E-03	22.6	43.7	13.3	0.155
100	-57.7	317.1	0.835E-04	-13.1	208.1	168.1	0.038
150	-52.8	316.8	0.174E-03	-8.6	210.2	4.9	0.079
1 46							
0	58.3	122.2	0.101E-02	18.6	38.8	0.0	1.000
50	53.6	114.1	0.961E-04	17.5	47.2	6.5	0.095
100	-12.3	342.7	0.132E-03	23.9	193.7	123.7	0.131
150	23.1	124.7	0.151E-03	-6.6	48.9	142.4	0.150
1 47							
0	81.7	143.6	0.285E-02	44.4	8.3	0.0	1.000
50	61.5	69.4	0.277E-03	45.4	73.7	27.3	0.097
100	-15.1	334.3	0.155E-03	20.8	202.3	105.7	0.055
150	-20.9	322.6	0.317E-03	14.5	212.9	12.5	0.111
1 48L							
0	66.1	286.9	0.157E-02	47.6	284.6	0.0	1.000
50	50.9	288.5	0.499E-03	36.0	268.1	15.2	0.318
100	39.4	292.8	0.224E-03	30.8	257.8	11.8	0.143
1 49L							
0	19.2	262.1	0.706E-03	4.3	276.8	0.0	1.000
50	50.5	248.8	0.770E-03	16.2	298.8	33.0	1.091
100	53.4	250.5	0.206E-03	19.3	298.9	3.1	0.291
150	-50.1	58.0	0.273E-03	-11.4	126.9	171.6	0.387
1 50							
0	34.7	211.5	0.114E-02	-8.3	325.0	0.0	1.000
50	41.6	253.9	0.922E-04	12.3	290.9	33.7	0.081
100	-54.6	36.8	0.679E-04	-8.4	145.2	152.5	0.059
150	-70.0	358.1	0.346E-04	-22.4	176.1	23.0	0.030
1 51							
0	9.3	143.4	0.373E-03	-20.5	34.3	0.0	1.000
50	-37.0	173.6	0.129E-03	-52.0	4.6	54.2	0.345
100	-18.9	190.7	0.933E-04	-40.7	340.9	23.5	0.250
150	-23.8	313.5	0.129E-03	9.8	220.9	109.7	0.346

1 52							
0	63.5	356.3	0.210E-02	76.6	186.3	0.0	1.000
50	71.3	9.6	0.604E-03	84.2	106.1	9.2	0.288
100	62.7	346.4	0.197E-03	73.5	211.4	12.3	0.094
150	-49.8	15.4	0.632E-04	0.1	161.6	114.9	0.030
1 53							
0	78.5	91.0	0.207E-02	51.7	32.4	0.0	1.000
50	69.5	352.8	0.894E-03	83.5	216.2	24.8	0.431
1 54							
0	18.4	208.3	0.288E-02	-18.5	325.4	0.0	1.000
50	73.1	198.7	0.277E-03	27.9	344.0	54.9	0.096
100	76.2	149.6	0.237E-03	34.3	10.5	13.0	0.083
150	-75.2	271.2	0.340E-03	-48.4	219.5	166.1	0.118
1 55							
0	68.8	290.5	0.487E-03	51.8	286.9	0.0	1.000
50	-2.6	187.2	0.519E-04	-32.7	346.3	97.2	0.107
1 56							
0	37.3	68.5	0.141E-02	28.9	91.7	0.0	1.000
50	80.1	93.8	0.123E-03	52.3	27.6	43.8	0.087
100	74.6	165.7	0.751E-04	30.0	2.8	15.4	0.053
150	31.7	220.2	0.121E-04	-7.6	316.4	50.4	0.009
1 57							
0	41.8	87.0	0.126E-02	21.8	74.1	0.0	1.000
50	53.2	215.7	0.617E-04	6.8	325.7	75.2	0.049
100	62.8	114.0	0.174E-03	26.1	41.7	48.9	0.138
1 58							
0	29.1	154.5	0.697E-04	-13.2	20.1	0.0	1.000
50	79.6	330.6	0.697E-04	73.1	319.5	71.3	0.999
100	72.9	339.8	0.734E-04	79.5	274.0	7.0	1.053
150	-75.1	6.6	0.220E-04	-30.5	171.3	149.0	0.315
1 59							
0	27.7	358.3	0.382E-03	46.3	177.2	0.0	1.000
50	69.5	15.3	0.129E-03	80.0	109.3	43.0	0.336
100	28.2	53.5	0.257E-04	31.5	109.3	46.7	0.067
1 60							
0	22.0	58.5	0.198E-02	25.9	106.6	0.0	1.000
50	65.7	64.8	0.537E-03	51.4	71.2	44.0	0.271

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
3 3L							
0	-62.0	150.9	0.397E-03	-66.5	57.9	0.0	1.000
25	-66.2	114.6	0.362E-03	-51.5	99.9	16.1	0.912
50	-58.6	76.7	0.416E-03	-26.4	117.7	18.8	1.051
75	-48.9	207.8	0.247E-03	-55.8	309.0	65.3	0.621
100	-1.6	240.8	0.302E-03	-15.6	289.9	55.1	0.760
150	-49.6	61.6	0.622E-03	-12.5	124.0	128.7	1.566
3 4							
0	34.3	113.5	0.273E-03	4.4	55.5	0.0	1.000
50	48.8	113.2	0.225E-03	14.0	50.2	14.5	0.826
75	-17.9	115.9	0.304E-03	-21.2	67.3	66.8	1.113
3 5							
0	29.1	256.6	0.290E-03	6.3	284.4	0.0	1.000
50	33.4	228.2	0.312E-03	-3.8	309.8	24.6	1.077
75	53.2	237.2	0.327E-03	13.6	309.0	20.8	1.128
3 8L							
0	22.2	347.4	0.659E-03	42.3	191.8	0.0	1.000
25	11.8	352.7	0.504E-03	37.4	184.1	11.5	0.764
50	-1.3	354.7	0.409E-03	30.9	181.1	13.3	0.620
75	10.7	330.3	0.438E-03	32.3	210.6	27.1	0.664
3 9L							
0	-16.8	179.5	0.575E-04	-40.3	355.6	0.0	1.000
25	-49.8	165.3	0.870E-04	-60.6	21.4	35.0	1.513
50	-52.7	194.9	0.985E-04	-63.1	326.7	18.6	1.713
75	-75.7	187.2	0.112E-03	-84.1	208.3	23.2	1.947
3 10L							
0	-25.0	138.0	0.310E-03	-35.0	47.6	0.0	1.000
25	-25.4	139.2	0.286E-03	-35.7	46.4	1.2	0.922
50	-45.1	135.9	0.299E-03	-46.0	58.5	19.9	0.965
75	-21.2	159.5	0.156E-03	-40.2	21.7	30.8	0.503
3 13L							
0	13.2	71.5	0.649E-04	15.3	97.3	0.0	1.000
25	-22.2	108.3	0.858E-04	-19.4	75.3	50.6	1.321
50	1.3	135.4	0.786E-04	-21.4	43.8	35.4	1.211
75	41.7	151.1	0.467E-04	-4.3	21.2	42.7	0.720
100	58.9	147.1	0.867E-04	11.7	20.2	17.4	1.335
150	-60.3	45.1	0.249E-03	-16.4	141.2	142.9	3.829
3 14L							
0	5.4	110.2	0.133E-03	-8.1	66.2	0.0	1.000
25	-30.4	101.7	0.145E-03	-20.0	83.9	36.8	1.092
50	-41.1	103.0	0.124E-03	-26.7	87.2	10.8	0.934
75	-61.0	67.6	0.300E-03	-24.9	125.7	29.2	2.259
3 15L							
0	30.4	130.3	0.459E-03	-5.0	42.1	0.0	1.000
25	21.8	142.5	0.339E-03	-14.0	32.9	13.9	0.738
50	27.6	181.9	0.298E-03	-17.1	353.0	36.1	0.650
75	34.2	222.5	0.368E-03	-5.4	314.9	35.2	0.802

DYKE 4

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
4 1							
0	82.8	322.4	0 522E-04	68.0	331.4	0.0	1.000
50	39 6	36.2	0.795E-04	45 8	123.3	48 7	1.523
100	66 2	78.0	0.304E-04	45 3	61.7	35 4	0.583
150	57.6	23.3	0.196E-04	64.9	127.7	26.2	0.375
4 2							
0	31 7	46.1	0 221E-03	36 8	115.6	0 0	1.000
50	42 0	34 2	0 119E-03	48.2	124.7	14 0	0.536
100	44.5	30.2	0.739E-04	51.5	128.4	3 8	0.334
150	52 5	26.4	0.199E-04	59 2	128.2	8 5	0.090
4 3							
0	76 7	33.0	0 311E-03	73 3	48 6	0 0	1.000
50	66.8	46.1	0.139E-03	62.0	83.0	10.7	0.447
100	56.7	300.0	0.533E-04	46 4	263.4	44 9	0.171
150	57.4	70.1	0.694E-04	41.7	77.6	59 1	0.223
4 4							
0	23.1	28.3	0.276E-03	39 1	138.3	0 0	1.000
50	46.3	28.3	0.101E-03	53 6	129.9	23 2	0.366
100	40.3	21.9	0.176E-03	51 4	141.5	7 6	0.638
150	9.8	205.0	0.173E-04	-23 7	327.5	129 8	0.063

	**** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0	
5 1								
0	42.3	245.5	0.119E-02	8.8	298.0	0.0	1.000	
50	43.6	263.2	0.520E-03	18.1	284.4	13.0	0.439	
100	43.0	266.6	0.231E-03	19.3	281.4	2.5	0.195	
150	45.3	266.6	0.141E-03	20.8	282.5	2.3	0.119	
5 2								
0	-2.3	297.0	0.470E-02	12.8	241.0	0.0	1.000	
50	9.1	297.5	0.245E-02	18.0	243.3	11.3	0.521	A
100	11.0	293.7	0.109E-02	17.0	247.3	4.2	0.231	
150	6.5	296.8	0.535E-03	16.5	243.4	5.4	0.114	
5 3L								
0	49.5	277.5	0.159E-02	29.3	276.1	0.0	1.000	
50	44.2	286.0	0.431E-03	30.2	266.2	7.8	0.272	
100	43.2	283.7	0.131E-03	28.3	267.6	2.0	0.082	
150	46.7	283.5	0.456E-04	30.5	269.6	3.6	0.029	
5 4U								
0	-59.6	145.4	0.143E-01	-61.7	60.9	0.0	1.000	
50	-57.5	154.4	0.788E-02	-63.9	45.6	5.1	0.551	A
100	-49.2	161.1	0.358E-02	-59.0	27.9	9.2	0.250	
150	-52.0	159.0	0.204E-02	-60.7	33.0	3.0	0.143	
5 5U								
0	-59.2	92.8	0.694E-02	-34.5	106.7	0.0	1.000	
50	-53.7	106.4	0.202E-02	-37.0	91.9	9.3	0.291	
100	-51.0	105.5	0.641E-03	-34.5	90.7	2.8	0.092	
150	-46.7	116.4	0.343E-03	-37.2	78.6	8.3	0.049	
5 7U								
0	-38.4	133.2	0.223E-02	-40.3	57.8	0.0	1.000	
50	-43.1	128.1	0.862E-03	-40.9	65.4	6.1	0.386	
100	-46.4	129.3	0.473E-03	-43.6	66.2	3.4	0.212	A
150	-45.4	125.9	0.305E-03	-41.2	68.9	2.6	0.137	
5 9L								
0	44.6	133.8	0.593E-03	2.8	35.3	0.0	1.000	
50	58.9	341.7	0.711E-04	68.0	215.2	74.0	0.120	
100	-40.9	106.3	0.635E-04	-28.2	84.2	141.5	0.107	
150	-26.7	99.6	0.707E-04	-17.0	84.3	15.2	0.119	
5 10L								
0	57.2	144.1	0.413E-03	10.7	23.0	0.0	1.000	
50	69.5	352.7	0.726E-04	83.5	216.8	51.6	0.176	
100	60.8	336.4	0.735E-04	67.9	227.2	11.0	0.178	
150	52.4	73.9	0.164E-04	35.9	78.7	49.2	0.040	
5 11								
0	28.6	352.8	0.101E-01	46.6	185.1	0.0	1.000	
50	30.7	349.9	0.605E-02	47.6	189.3	3.3	0.597	
100	35.2	343.1	0.327E-02	49.2	199.7	7.3	0.323	A
150	34.8	343.8	0.202E-02	49.1	198.7	0.7	0.199	
5 13U								
0	-41.1	140.4	0.155E-01	-45.4	51.2	0.0	1.000	
50	-45.4	138.7	0.657E-02	-47.5	55.4	4.5	0.425	
100	-44.9	140.1	0.248E-02	-47.7	53.6	1.1	0.160	
150	-44.9	134.3	0.117E-02	-45.1	60.1	4.1	0.076	

5 14U							
0	-20.4	112.8	0.393E-03	-20.8	70.8	0.0	1.000
50	-30.0	93.8	0.110E-03	-15.7	90.3	19.6	0.281
100	-9.4	136.0	0.105E-03	-26.5	45.6	44.4	0.268
150	-46.1	123.0	0.972E-04	-40.3	72.1	38.4	0.247
5 15							
0	45.4	149.3	0.826E-03	-1.0	22.0	0.0	1.000
50	61.5	135.9	0.141E-03	17.4	27.3	17.9	0.171
100	82.0	298.6	0.155E-03	62.5	323.8	36.2	0.187
150	72.9	305.8	0.164E-03	62.3	288.5	9.2	0.198
5 17L							
0	3.9	135.5	0.138E-02	-20.2	43.2	0.0	1.000
50	58.0	126.6	0.952E-04	16.7	35.8	54.5	0.069
100	51.4	230.0	0.403E-04	9.5	313.8	54.2	0.029
150	-65.1	63.1	0.710E-04	-27.5	131.7	164.7	0.051
5 18U							
0	9.3	129.9	0.779E-03	-15.4	47.4	0.0	1.000
50	36.8	106.1	0.734E-04	9.3	60.7	34.9	0.094
100	-29.6	120.9	0.525E-04	-29.5	66.4	67.8	0.067
150	73.2	329.8	0.692E-04	74.4	280.2	133.8	0.089
5 19							
0	55.8	100.4	0.367E-03	25.4	56.1	0.0	1.000
50	58.8	9.5	0.700E-04	70.2	152.7	45.3	0.191
100	51.7	314.3	0.729E-04	49.9	244.9	31.3	0.199
150	41.6	320.8	0.465E-04	45.8	231.0	11.0	0.127
5 20L							
0	37.5	130.5	0.845E-03	-0.8	40.1	0.0	1.000
50	75.0	106.9	0.980E-04	42.7	32.8	39.1	0.116
100	82.8	100.6	0.104E-03	53.2	18.7	7.8	0.123
150	74.0	90.9	0.777E-04	47.2	42.0	9.0	0.092
5 21L							
0	44.8	156.1	0.690E-03	-3.0	16.3	0.0	1.000
50	78.9	355.3	0.988E-04	79.5	345.4	55.8	0.143
100	-19.9	129.7	0.583E-04	-28.8	54.7	117.5	0.084
150	-31.9	136.6	0.813E-04	-38.1	51.4	13.4	0.118
5 22L							
0	43.0	144.7	0.293E-03	-1.7	26.5	0.0	1.000
50	63.0	351.1	0.416E-04	75.2	200.6	71.9	0.142
100	70.6	307.5	0.645E-04	61.6	281.0	18.2	0.220
150	-39.8	120.2	0.664E-04	-34.8	71.4	149.0	0.227
5 23L							
0	17.4	294.1	0.452E-03	20.0	248.8	0.0	1.000
50	42.6	280.9	0.882E-04	26.4	269.7	27.7	0.195
100	55.0	257.9	0.778E-04	23.9	294.5	19.4	0.172
150	-69.2	135.8	0.889E-04	-64.9	91.6	151.0	0.197
5 24L							
0	44.1	125.6	0.362E-03	5.5	42.2	0.0	1.000
50	80.7	89.4	0.109E-03	54.1	26.9	38.7	0.301
100	-31.5	89.4	0.450E-04	-14.1	94.6	112.2	0.124
150	-51.3	92.4	0.586E-04	-27.9	101.2	19.9	0.162
5 25L							
0	43.6	107.5	0.257E-03	12.9	56.9	0.0	1.000
50	68.5	29.8	0.580E-04	71.9	92.9	45.7	0.226

100	-25.4	84.7	0.340E-04	-8.6	96.5	102.0	0.132
150	87.9	125.9	0.645E-04	55.6	1.1	113.8	0.251
5 26L							
0	21.4	124.7	0.442E-03	-7.4	49.4	0.0	1.000
50	82.0	21.5	0.802E-04	72.1	13.7	70.6	0.181
100	-40.3	94.1	0.408E-04	-21.5	94.1	127.5	0.092
150	82.5	281.4	0.780E-04	58.1	326.6	137.7	0.176
5 27L							
0	-17.5	135.5	0.511E-02	-30.2	48.1	0.0	1.000
50	-24.5	134.8	0.156E-02	-33.4	50.9	7.1	0.305
100	-24.5	134.8	0.679E-03	-33.4	50.8	0.1	0.133
150	-27.2	136.5	0.512E-03	-35.5	49.9	3.1	0.100
5 28U							
0	48.4	45.7	0.625E-03	47.5	107.5	0.0	1.000
50	73.1	359.5	0.861E-04	89.5	323.5	31.9	0.138
100	85.5	244.0	0.835E-04	53.5	341.3	19.3	0.134
150	-55.1	71.1	0.170E-03	-20.9	119.5	149.6	0.272
5 29L							
0	53.8	77.3	0.519E-03	35.1	74.9	0.0	1.000
50	68.4	98.6	0.594E-04	38.1	46.3	17.6	0.115
100	-61.3	34.3	0.882E-04	-14.7	149.4	137.6	0.170
150	-55.2	22.0	0.151E-03	-5.8	157.1	8.9	0.291
5 30U							
0	40.9	40.4	0.431E-03	44.8	117.8	0.0	1.000
50	49.5	9.0	0.110E-03	61.4	158.5	23.5	0.254
100	-7.5	98.5	0.498E-04	-7.7	79.6	95.4	0.115
150	46.9	330.9	0.133E-03	53.7	221.3	120.6	0.308
5 31L							
0	62.2	42.5	0.531E-03	60.1	95.7	0.0	1.000
50	60.6	360.0	0.107E-03	73.3	175.0	20.0	A 0.202
100	60.5	345.4	0.113E-03	70.8	210.2	7.2	0.213
150	62.6	324.0	0.147E-03	63.8	247.9	10.3	0.276
5 32L							
0	46.2	47.9	0.370E-03	44.9	106.7	0.0	1.000
50	41.3	2.2	0.351E-04	55.4	171.4	32.9	0.095
100	53.1	355.4	0.483E-04	65.2	184.2	12.7	0.130
150	-46.8	123.2	0.786E-04	-40.8	72.4	146.6	0.212
5 33U							
0	16.6	240.2	0.108E-01	-7.7	295.0	0.0	1.000
50	23.8	249.6	0.236E-02	0.3	288.7	11.5	0.219
100	23.1	249.2	0.448E-03	-0.3	288.8	0.9	0.042
150	34.4	258.4	0.268E-03	10.1	284.7	13.9	0.025
5 34L							
0	66.7	43.6	0.643E-03	63.3	85.4	0.0	1.000
50	65.2	335.9	0.120E-03	71.8	237.9	26.3	0.187
100	67.6	337.2	0.101E-03	74.7	244.0	2.5	0.157
150	63.2	330.6	0.788E-04	67.5	240.8	5.2	0.123
5 35L							
0	54.1	56.3	0.633E-03	46.3	92.4	0.0	1.000
50	54.4	15.6	0.123E-03	64.4	144.3	23.5	0.194
100	-46.8	158.6	0.380E-04	-56.3	30.5	155.7	0.060
150	57.4	24.9	0.727E-04	64.1	125.5	150.3	0.115
5 36L							

5 36L							
0	48.8	73.0	0.807E-03	33.7	81.9	0.0	1.000
50	76.6	72.0	0.889E-04	56.9	43.5	27.8	0.110
100	84.5	333.2	0.912E-04	67.6	341.9	15.3	0.113
150	83.2	235.5	0.742E-04	49.3	337.8	9.4	0.092
5 37L							
0	60.3	59.5	0.497E-03	49.5	83.0	0.0	1.000
50	75.2	53.0	0.838E-04	64.2	53.6	15.1	0.169
100	81.8	52.2	0.667E-04	65.1	26.1	6.6	0.134
150	71.4	14.6	0.533E-04	81.8	94.3	13.0	0.107
5 38U							
0	56.6	16.5	0.377E-03	66.3	140.6	0.0	1.000
50	80.5	1.6	0.885E-04	76.9	357.2	24.3	0.235
100	78.4	31.0	0.825E-04	73.4	37.8	5.7	0.219
150	81.0	32.3	0.706E-04	71.0	24.5	2.6	0.187
5 39L							
0	47.4	76.1	0.279E-03	31.2	80.1	0.0	1.000
50	55.0	63.2	0.569E-04	43.4	85.4	11.0	0.204
100	-77.1	231.4	0.433E-04	-65.5	226.5	157.5	0.155
150	-72.3	231.1	0.599E-04	-63.5	244.6	4.9	0.215
5 40L							
0	61.4	36.1	0.347E-03	62.6	104.2	0.0	1.000
50	62.9	18.2	0.792E-04	72.2	128.2	8.5	A 0.228
100	49.0	16.7	0.741E-04	59.4	145.6	14.0	0.213
150	60.4	19.9	0.758E-04	68.9	129.7	11.6	0.218
5 41L							
0	66.0	354.7	0.374E-03	79.5	195.0	0.0	1.000
50	46.3	311.4	0.575E-04	44.6	244.0	30.1	0.154
100	-46.7	72.7	0.707E-04	-15.1	114.0	140.6	0.189
150	-37.8	77.3	0.114E-03	-11.6	106.7	9.5	0.305
5 42L							
0	72.2	28.1	0.339E-03	75.1	76.8	0.0	1.000
50	68.7	48.0	0.724E-04	62.5	76.9	7.5	A 0.214
100	58.9	42.1	0.853E-04	57.4	101.2	10.2	0.252
150	-57.3	54.7	0.998E-04	-16.5	132.7	115.6	0.294
5 43L							
0	69.0	9.2	0.554E-03	82.2	129.2	0.0	1.000
50	70.8	354.8	0.124E-03	85.8	220.1	5.3	0.223
100	-83.7	341.8	0.579E-04	-46.3	180.5	154.7	0.105
150	86.9	199.3	0.129E-03	52.4	351.6	175.7	0.233

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
6 2							
0	55.2	327.9	0.831E-05	59.1	232.0	0.0	1.000
6 3							
0	73.0	236.9	0.209E-03	35.1	322.4	0.0	1.000
50	69.3	23.1	0.267E-04	76.0	97.4	35.1	0.128
100	-27.8	1.8	0.238E-04	16.9	173.0	98.4	0.114
150	-35.7	358.7	0.210E-04	11.9	176.1	8.3	0.101
6 4							
0	72.6	286.3	0.416E-05	53.0	296.9	0.0	1.000
6 5							
0	77.3	37.2	0.292E-05	71.4	45.7	0.0	1.000
6 6							
0	65.7	308.8	0.164E-04	58.5	268.4	0.0	1.000
50	70.1	311.9	0.146E-04	63.5	276.9	4.6	A 0.888
100	75.4	316.0	0.131E-04	68.3	294.6	15.4	0.795
150	66.9	55.2	0.101E-04	57.4	75.8	29.0	0.613
6 7							
0	50.4	294.0	0.651E-05	38.5	263.1	0.0	1.000
6 8L							
0	70.0	51.3	0.598E-03	61.8	71.1	0.0	1.000
50	77.6	21.2	0.149E-03	77.4	36.9	11.1	A 0.249
100	76.1	24.0	0.135E-03	77.3	49.5	1.6	0.225
150	26.8	307.9	0.248E-04	31.4	238.5	60.8	0.041
6 9							
0	75.1	315.2	0.392E-03	67.8	293.4	0.0	1.000
100	45.9	275.4	0.447E-04	25.7	275.7	33.8	0.114
150	4.2	268.9	0.308E-04	1.2	266.8	42.1	0.079
6 11L							
0	69.8	65.7	0.796E-03	54.4	63.1	0.0	1.000
50	59.7	66.9	0.174E-03	45.2	77.7	10.1	0.219
100	49.6	76.4	0.155E-03	32.5	78.4	11.4	0.194
150	35.9	315.8	0.669E-04	40.0	233.8	79.7	0.084
6 12L							
0	51.4	40.2	0.258E-03	52.4	111.3	0.0	1.000
50	68.5	3.9	0.113E-03	83.1	154.3	24.3	0.437
100	58.3	35.3	0.130E-03	60.3	109.8	17.1	0.502
150	14.3	288.8	0.694E-04	16.0	252.5	86.3	0.269
6 13							
0	66.3	263.8	0.417E-03	36.9	299.6	0.0	1.000
50	79.4	219.7	0.645E-04	40.9	337.6	17.6	0.155
100	-7.6	338.7	0.698E-04	25.6	198.5	102.7	0.168
150	-15.6	334.6	0.521E-04	20.6	201.8	8.9	0.125
6 15							
0	-10.2	53.5	0.300E-04	13.6	119.4	0.0	1.000
50	38.1	26.0	0.709E-05	48.7	136.7	54.7	0.236

	**** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
7 1U								
0	31.8	103.2	0.198E-04	7.9	64.7	0.0		1.000
50	8.0	101.1	0.166E-04	-2.4	73.2	23.8	A	0.840
100	-2.0	109.5	0.145E-04	-11.0	68.6	13.0		0.735
150	0.4	107.9	0.167E-04	-9.1	69.3	2.9		0.842
7 2U								
0	3.5	99.1	0.462E-04	-3.3	76.1	0.0		1.000
50	-1.9	101.6	0.480E-04	-6.9	75.4	5.9	A	1.038
100	-2.6	102.1	0.486E-04	-7.4	75.1	0.9		1.052
150	-9.8	105.9	0.541E-04	-12.5	73.8	8.2		1.170
7 4U								
0	4.7	95.8	0.461E-04	-1.0	78.7	0.0		1.000
50	-0.3	98.6	0.476E-04	-4.6	77.6	5.8		1.033
100	-1.7	100.4	0.472E-04	-6.2	76.4	2.3	A	1.025
150	-2.3	101.0	0.461E-04	-6.7	76.0	0.8		1.000
7 5U								
0	13.1	73.6	0.506E-05	14.2	95.4	0.0		1.000
50	2.1	87.3	0.661E-05	2.3	86.6	17.4		1.307
100	2.8	92.9	0.563E-05	-0.3	81.6	5.7	A	1.114
150	-8.9	91.1	0.448E-05	-4.4	86.2	11.9		0.886
7 7U								
0	17.3	92.1	0.678E-04	6.4	78.4	0.0		1.000
50	6.9	104.3	0.712E-04	-4.5	70.8	15.8	A	1.050
100	8.7	103.8	0.706E-04	-3.5	70.7	1.8		1.040
150	5.0	103.8	0.694E-04	-5.0	71.7	3.6		1.023
7 8U								
0	18.0	67.6	0.503E-04	19.5	99.3	0.0		1.000
50	2.3	81.7	0.495E-04	5.3	91.3	21.0		0.984
100	-9.4	82.6	0.490E-04	-0.2	93.6	11.7	A	0.975
150	-11.5	81.5	0.482E-04	-0.5	95.1	2.4		0.959
7 9U								
0	22.8	108.2	0.406E-05	0.9	63.2	0.0		1.000
50	1.9	103.1	0.410E-05	-6.1	73.1	21.5		1.012
100	0.5	98.7	0.417E-05	-4.3	77.2	4.6	A	1.028
150	-3.3	97.9	0.431E-05	-5.6	78.9	3.9		1.063
7 10U								
0	1.9	112.3	0.552E-04	-10.7	65.1	0.0		1.000
50	-3.4	111.6	0.539E-04	-12.6	67.1	5.3		0.976
100	-7.4	109.8	0.546E-04	-13.5	69.7	4.4	A	0.988
150	-5.6	112.1	0.541E-04	-13.8	67.2	2.9		0.979
7 11L								
0	-3.9	117.0	0.624E-04	-15.5	62.4	0.0		1.000
50	-10.6	118.5	0.626E-04	-19.2	62.7	6.9		1.003
100	-8.3	119.1	0.630E-04	-18.5	61.6	2.3	A	1.008
150	-1.7	114.1	0.652E-04	-13.1	64.4	8.3		1.045
200	-7.4	127.2	0.703E-04	-21.9	53.7	14.3		1.126
250	-14.2	94.4	0.610E-04	-8.5	84.9	32.9		0.977
7 12								
0	-2.6	103.7	0.681E-04	-8.3	73.7	0.0		1.000
50	-8.4	106.6	0.823E-04	-12.3	72.8	6.6		1.208

100	-7.1	104.6	0.819E-04	-10.7	74.2	2.4		1.202
150	-7.2	107.4	0.804E-04	-12.2	71.7	2.8	A	1.180
7 14								
0	-4.2	111.8	0.380E-05	-13.1	67.1	0.0		1.000
50	10.1	105.0	0.633E-05	-3.5	69.3	15.8	A	1.663
100	-1.0	97.0	0.531E-05	-4.1	79.1	13.7		1.395
150	-3.4	103.9	0.688E-05	-8.7	73.8	7.2		1.810
7 15								
0	-52.7	76.3	0.252E-04	-21.3	114.2	0.0		1.000
50	-19.3	92.4	0.118E-04	-9.7	88.0	35.7	A	0.470
100	-14.2	87.4	0.112E-04	-4.8	90.8	7.1		0.446
150	-8.8	91.5	0.100E-04	-4.5	85.9	5.7		0.397
7 16L								
0	-9.7	102.9	0.150E-04	-10.9	76.3	0.0		1.000
50	-8.8	98.5	0.203E-04	-8.2	79.9	4.5		1.350
100	-12.2	109.2	0.185E-04	-15.2	71.5	11.1	A	1.228
150	-12.6	111.2	0.163E-04	-16.4	69.9	2.0		1.084
200	-4.7	100.8	0.131E-04	-7.7	76.8	12.8		0.868
250	-3.1	141.5	0.172E-04	-25.7	38.5	40.6		1.141
7 17								
0	12.9	97.1	0.319E-04	1.9	75.4	0.0		1.000
50	3.9	100.7	0.330E-04	-3.9	74.6	9.7		1.036
100	2.3	100.1	0.349E-04	-4.3	75.6	1.8	A	1.094
150	-1.8	99.8	0.350E-04	-5.9	76.9	4.0		1.097
7 18								
0	7.7	86.2	0.107E-04	5.3	86.0	0.0		1.000
50	-2.2	86.3	0.120E-04	1.0	88.5	9.9		1.117
100	-10.4	96.1	0.147E-04	-7.6	82.4	12.7	A	1.365
150	-12.6	95.3	0.144E-04	-8.2	83.7	2.4		1.339
7 19								
0	4.1	101.5	0.425E-04	-4.3	73.9	0.0		1.000
50	-0.5	102.2	0.466E-04	-6.6	74.5	4.7		1.096
100	-4.3	104.3	0.450E-04	-9.3	73.7	4.3	A	1.057
150	-6.3	102.3	0.445E-04	-9.1	76.0	2.9		1.045
7 20								
0	3.3	130.5	0.348E-04	-18.5	48.1	0.0		1.000
50	-1.9	122.1	0.352E-04	-17.0	57.2	9.9		1.012
100	1.7	122.6	0.386E-04	-15.7	55.8	3.7	A	1.108
150	-0.4	122.4	0.411E-04	-16.5	56.6	2.2		1.180
7 21								
0	50.1	307.6	0.461E-03	45.4	250.4	0.0		1.000
50	66.9	311.9	0.287E-03	61.0	268.4	16.9		0.621
100	65.4	319.4	0.401E-03	63.8	258.7	3.3		0.869
150	-57.9	141.6	0.333E-03	-58.4	63.1	172.4		0.723
7 22								
0	54.0	3.1	0.586E-05	66.2	168.4	0.0		1.000
50	52.3	343.7	0.579E-05	62.3	205.4	11.8		0.989
100	72.2	50.9	0.479E-05	63.5	64.7	34.3		0.818
150	71.6	106.4	0.325E-05	38.8	37.8	16.6		0.555
7 23								
0	6.5	122.3	0.245E-04	-13.4	55.0	0.0		1.000
50	10.2	122.3	0.264E-04	-11.7	54.1	3.7		1.074
100	7.2	122.6	0.263E-04	-13.2	54.6	3.0	A	1.073
150	12.1	126.8	0.287E-04	-12.9	49.5	6.4		1.167

200	12.7	125.5	0.300E-04	-12.0	50.6	1 4		1.224
250	-8 7	131.6	0.292E-04	-24.4	49.8	22 2		1.189
7 24								
0	23.9	109.8	0.240E-03	0.6	61.5	0.0		1.000
50	22.0	121.1	0.525E-04	-5.6	52.3	10 6	A	0.219
100	18 5	117.0	0.574E-04	-5 4	56.8	5 3		0.239
150	16.3	119.3	0.577E-04	-7.5	55.3	3 1		0.240
7 25								
0	10 6	100.3	0.199E-04	-0.8	73.3	0 0		1.000
50	0 8	102.2	0.222E-04	-6 0	74.1	10 0		1.115
100	5.7	106.9	0.233E-04	-6.3	68.8	6 8	A	1.170
150	-3.4	106.4	0.241E-04	-10.0	71.6	9.1		1.212
7 26								
0	11 9	93.7	0.339E-04	3 2	78.5	0 0		1.000
50	4.2	92.8	0.360E-04	0 3	81.3	7 8		1.064
100	-1 1	88 8	0.336E-04	0.2	86.1	6.6	A	0.992
150	-1.7	84.9	0.345E-04	2.0	89.6	4 0		1.020
200	-1 1	82.0	0.364E-04	3.7	91.9	2 9		1.076
250	-9 1	107.6	0.389E-04	-13.1	72.1	26 8		1.147
7 27								
0	5.4	112.4	0.192E-04	-9.2	64.1	0 0		1.000
50	7 2	111.5	0.202E-04	-8.0	64.5	2 0		1.054
100	5.5	107.4	0.208E-04	-6.7	68.5	4 4	A	1.082
150	-4.5	106.0	0.209E-04	-10.3	72.3	10 1		1.091
7 28								
0	-1 1	112.9	0.180E-04	-12 3	65.4	0 0		1.000
50	3.8	112.9	0.182E-04	-10.1	64.1	4 9		1.009
100	2 4	111 4	0 207E-04	-10 0	65.8	2 0	A	1.147
150	6.0	118.0	0.220E-04	-11.6	59.0	7 5		1.217
7 29L								
0	17.3	97.0	0.342E-05	3.9	74.3	0 0		1.000
50	21 6	133 0	0 362E-05	-10.8	41.7	34 2	A	1.058
100	17.5	118.5	0.482E-05	-6.6	55.7	14 3		1.410
150	13.3	118.0	0.479E-05	-8.3	57.2	4 2		1.400
7 30								
0	27 4	77.4	0.579E-05	18.9	87.7	0.0		1.000
50	32.4	91.8	0.559E-05	14.0	73.8	13 5		0.966
100	18 5	74.7	0.578E-05	16 1	92.9	20 7		0.998
150	32.3	79.2	0.759E-05	20.5	84.4	14 3		1.311
200	8 4	43.0	0 293E-05	26 5	125.4	41 1		0.506
7 31								
0	28.1	107.7	0.226E-04	3 7	62.1	0 0		1.000
50	20.4	111.2	0.241E-04	-1.8	61.3	8 3		1.067
100	22 8	105.3	0 232E-04	2 2	65.6	6 0	A	1.030
150	27.4	104.5	0.235E-04	5.0	65.0	4 7		1.042
200	-13 6	117.6	0 227E-04	-20 1	64.4	43 0		1.004
250	49.2	92.5	0.259E-04	24 0	65.9	66 6		1.149
7 32								
0	12.7	118.7	0.369E-04	-8 9	56.7	0 0		1.000
50	4.1	113.0	0.325E-04	-10.1	63.9	10 4		0.881
100	2.3	115.0	0.365E-04	-11.8	62.6	2 7	A	0.991
150	2.5	117.0	0 347E-04	-12 7	60.8	2 0		0.941
7 33								
0	13.1	101.0	0.432E-04	-0.1	72.0	0 0		1.000

50	3.3	95.2	0.404E-04	-1.3	79.5	11.4		0.936
100	2.3	86.6	0.477E-04	2.8	87.1	8.5	A	1.103
150	1.3	91.1	0.462E-04	-0.0	83.5	4.6		1.069
7 35								
0	9.7	114.4	0.356E-04	-8.3	61.3	0.0		1.000
50	29.3	110.9	0.512E-04	2.8	59.0	19.8	A	1.437
100	2.6	109.3	0.427E-04	-8.9	67.5	26.7		1.198
150	3.4	111.6	0.427E-04	-9.6	65.4	2.4		1.197
200	-6.4	115.5	0.445E-04	-15.9	64.3	10.6		1.249
7 36L								
0	7.1	114.2	0.361E-04	-9.3	62.2	0.0		1.000
50	3.6	116.9	0.422E-04	-12.2	60.6	4.4		1.168
100	-1.5	116.1	0.399E-04	-14.0	62.5	5.2	A	1.105
150	-3.3	112.7	0.413E-04	-13.1	66.1	3.9		1.142
200	-12.1	115.8	0.405E-04	-18.6	65.6	9.4		1.121
250	-5.8	115.5	0.405E-04	-15.7	64.2	6.3		1.122
7 37								
0	4.7	119.3	0.771E-04	-12.8	58.1	0.0		1.000
50	2.5	120.8	0.745E-04	-14.5	57.3	2.7		0.966
100	1.8	117.6	0.828E-04	-13.3	60.4	3.3	A	1.074
150	4.0	116.9	0.814E-04	-12.0	60.5	2.3		1.056
7 38								
0	11.5	125.1	0.177E-04	-12.4	51.3	0.0		1.000
50	11.7	118.3	0.188E-04	-9.2	57.4	6.7		1.059
100	12.3	112.5	0.204E-04	-6.2	62.3	5.7	A	1.149
150	2.4	115.3	0.201E-04	-11.9	62.3	10.3		1.136
7 39								
0	2.0	109.8	0.796E-04	-9.4	67.3	0.0		1.000
50	1.8	119.4	0.824E-04	-14.2	58.8	9.6		1.036
100	-1.8	117.9	0.835E-04	-15.1	61.0	3.9	A	1.050
150	-3.4	117.8	0.827E-04	-15.7	61.5	1.5		1.040
7 41								
0	22.9	123.1	0.544E-05	-6.0	50.3	0.0		1.000
50	7.4	92.4	0.472E-05	1.9	80.8	33.3		0.868
100	45.8	121.0	0.669E-05	8.5	45.2	45.6		1.229
150	54.2	173.7	0.827E-05	3.2	360.0	34.0		1.519
200	-39.2	32.6	0.171E-04	5.1	144.7	149.9		3.136
250	46.3	200.9	0.321E-04	-2.3	336.4	168.8		5.899

DYKE 8

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
8 1L							
0	52.5	299.5	0.162E-03	42.9	259.8	0.0	1.000
50	3.3	301.2	0.229E-03	17.3	238.4	49.2	1.414
100	79.4	305.9	0.147E-03	64.8	313.1	76.1	0.910
150	-9.7	300.1	0.199E-03	11.0	236.2	89.1	1.230
8 2							
0	29.3	266.1	0.159E-03	11.2	276.5	0.0	1.000
50	-9.7	311.4	0.156E-03	15.9	225.9	58.5	0.980
100	42.0	257.8	0.211E-03	14.3	287.9	71.2	1.328
150	-14.7	356.3	0.125E-03	24.2	178.9	106.1	0.787
8 3							
0	33.5	290.1	0.195E-03	26.0	257.7	0.0	1.000
50	8.0	297.1	0.205E-03	17.4	243.3	26.4	1.053
100	54.8	334.4	0.118E-03	61.5	222.4	55.4	0.607
150	-0.9	294.8	0.227E-03	12.3	243.1	64.5	1.164
8 6							
0	73.5	9.0	0.331E-03	85.2	67.7	0.0	1.000
50	43.2	308.2	0.129E-03	40.9	245.2	40.8	0.389
100	47.3	302.8	0.108E-03	40.9	253.0	5.6	0.325
150	-31.8	301.0	0.150E-03	0.4	229.8	79.1	0.452
8 7L							
0	-22.6	249.2	0.139E-03	-20.9	276.5	0.0	1.000
50	-78.2	328.8	0.872E-04	-37.6	189.5	65.7	0.628
100	19.7	179.0	0.690E-04	-21.5	355.9	119.8	0.497
150	-40.2	4.0	0.173E-03	8.7	171.1	159.0	1.249

DYKE 9

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
9 1							
0	86.8	70.4	0.233E-02	60.0	7.1	0.0	1.000
50	10.5	53.7	0.349E-03	22.8	114.3	76.4	0.150
100	32.4	13.5	0.237E-03	48.0	155.3	42.9	0.102
150	-49.2	124.8	0.659E-03	-43.3	72.3	127.3	0.283
9 2							
0	50.2	48.1	0.675E-03	47.6	103.7	0.0	1.000
50	0.3	93.7	0.259E-03	-1.8	81.6	63.1	0.383
100	15.5	105.7	0.345E-03	-1.3	67.3	19.3	0.511
150	5.2	105.1	0.259E-03	-5.6	70.6	10.3	0.384

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
11 1							
0	-24.1	144.9	0.198E-03	-37.3	39.9	0.0	1.000
5	-34.6	146.3	0.159E-03	-43.7	41.8	10.5	0.805
10	-24.6	137.5	0.112E-03	-34.6	48.2	12.5	0.565
50	-61.7	129.4	0.862E-04	-55.4	81.3	37.5	0.435
100	-72.9	135.1	0.102E-03	-66.8	104.6	11.3	0.514
150	-59.6	108.3	0.550E-04	-42.6	95.9	16.8	0.278
200	-23.5	159.2	0.471E-04	-41.4	22.5	50.5	0.238
300	-35.3	150.0	0.326E-04	-45.5	37.3	14.3	0.164
400	-39.2	169.8	0.284E-04	-53.2	10.9	16.2	0.144
11 2L							
0	48.9	86.1	0.136E-03	27.0	71.2	0.0	1.000
50	-35.5	42.2	0.211E-04	4.7	135.8	93.0	0.156
100	-37.4	344.8	0.461E-04	9.8	189.4	45.5	0.340
150	-36.8	321.7	0.545E-04	5.1	210.7	18.4	0.402
11 3							
0	56.2	9.2	0.153E-03	67.7	155.3	0.0	1.000
50	52.7	309.6	0.130E-04	48.3	250.8	33.8	0.085
100	67.6	95.3	0.316E-04	33.7	49.2	57.0	0.206
150	66.1	97.9	0.477E-04	36.0	49.4	1.9	0.312
11 4L							
0	64.6	307.9	0.428E-03	57.1	267.4	0.0	1.000
50	39.9	215.7	0.984E-04	-3.8	322.4	55.4	0.230
100	21.3	180.5	0.334E-04	-20.7	354.5	35.2	0.078
150	-10.0	167.8	0.208E-04	-36.0	10.1	33.7	0.049
11 5							
0	18.1	167.4	0.288E-03	-21.7	8.4	0.0	1.000
50	49.8	230.3	0.473E-04	8.2	313.0	58.9	0.164
100	23.6	224.6	0.317E-04	-10.7	310.7	26.6	0.110
150	23.3	227.1	0.281E-04	-9.9	308.4	2.3	0.097
11 6L							
0	8.0	308.4	0.195E-03	22.7	233.0	0.0	1.000
50	72.3	309.9	0.481E-04	64.0	285.1	64.4	0.246
100	76.2	126.6	0.461E-04	38.7	21.9	31.4	0.236
150	56.9	353.9	0.444E-04	68.9	188.8	43.5	0.228
200	45.9	345.2	0.398E-04	57.4	200.0	12.2	0.204
300	44.1	227.7	0.210E-04	3.0	313.2	74.3	0.108
400	64.0	215.8	0.319E-04	18.1	329.6	21.0	0.164
400	76.2	45.5	0.202E-04	67.8	51.5	39.7	0.103
400	30.4	14.5	0.187E-04	46.8	154.5	48.0	0.096
11 7							
0	52.3	1.2	0.354E-04	64.6	172.8	0.0	1.000
25	77.0	6.6	0.157E-04	82.4	16.2	24.8	0.445
50	85.0	22.0	0.108E-04	67.2	4.5	8.3	0.306
75	81.9	14.0	0.801E-05	73.3	8.3	3.2	0.226
11 8L							
0	36.1	234.6	0.525E-03	3.3	305.0	0.0	1.000
25	69.4	237.5	0.202E-03	30.6	319.2	33.3	0.385
50	59.4	257.0	0.110E-03	27.3	298.2	12.9	0.210
75	49.9	244.6	0.839E-04	13.8	301.9	11.9	0.160
75	57.2	237.2	0.961E-04	17.3	311.0	8.6	0.183
75	48.2	252.9	0.789E-04	16.3	294.7	13.0	0.150

75	54.2	249.0	0.839E-04	19.2	300.7	6.4		0.160
11 9								
0	38.2	250.8	0.462E-03	8.6	292.3	0.0		1.000
25	44.6	265.8	0.245E-03	20.0	282.9	13.0	A	0.530
50	48.6	265.3	0.276E-03	22.5	285.3	4.0		0.597
75	51.2	259.3	0.286E-03	21.5	291.3	4.6		0.618
11 10								
0	48.2	157.5	0.506E-03	-0.6	14.5	0.0		1.000
25	53.1	206.2	0.284E-03	4.5	333.4	30.7		0.560
50	39.6	248.6	0.126E-03	8.6	294.7	31.5		0.248
75	30.4	224.7	0.151E-03	-6.9	312.2	21.6		0.297
11 11								
0	42.2	77.8	0.586E-04	26.9	81.5	0.0		1.000
25	66.5	270.8	0.369E-04	40.3	295.7	70.9		0.630
50	54.6	280.8	0.382E-04	34.8	277.2	12.8		0.652
75	54.5	274.0	0.398E-04	31.2	282.3	4.0		0.679
100	59.5	276.4	0.443E-04	36.5	284.8	5.2		0.756
150	55.4	301.9	0.342E-04	46.4	260.4	14.2	A	0.584
200	57.4	282.9	0.292E-04	38.0	277.9	10.7		0.498
250	63.3	305.0	0.222E-04	54.4	267.5	12.3		0.379
300	56.9	240.0	0.290E-04	18.0	308.8	31.6		0.496
350	53.4	230.7	0.234E-04	11.4	314.2	6.4		0.399
11 12								
0	-37.4	263.3	0.346E-04	-21.2	259.1	0.0		1.000
25	65.4	276.1	0.120E-04	41.7	291.0	103.3		0.347
50	62.8	272.2	0.116E-04	37.4	290.7	3.1	A	0.337
75	64.2	287.0	0.889E-05	45.9	282.2	6.7		0.257
11 13								
0	36.6	306.0	0.827E-03	35.9	244.4	0.0		1.000
25	62.0	271.3	0.324E-03	36.2	290.5	33.3		0.392
50	53.4	256.0	0.146E-03	21.7	295.0	11.8		0.177
75	46.8	250.4	0.113E-03	14.1	296.0	7.5		0.136
11 14								
0	29.3	144.1	0.131E-03	-10.4	30.1	0.0		1.000
25	-66.0	120.4	0.360E-04	-54.3	95.6	97.0		0.274
50	-67.4	120.7	0.306E-04	-55.6	98.0	1.4		0.233
75	-68.5	89.1	0.313E-04	-41.5	119.3	11.8		0.238
11 15								
0	47.9	93.2	0.397E-04	22.7	66.3	0.0		1.000
25	56.5	283.5	0.369E-04	37.6	276.8	75.3	A	0.930
50	56.7	278.0	0.330E-04	34.9	280.9	3.1		0.830
75	54.8	270.6	0.329E-04	29.7	285.0	4.5		0.829
11 16L								
0	64.6	172.4	0.631E-03	14.9	0.4	0.0		1.000
50	59.9	239.5	0.428E-03	20.7	310.8	30.1		0.679
100	59.6	241.9	0.373E-03	21.2	308.9	1.3	A	0.592
150	52.4	243.5	0.354E-03	15.4	303.9	7.2		0.562
200	51.0	236.6	0.310E-03	11.5	308.5	4.5		0.492
250	48.6	226.2	0.242E-03	5.9	315.9	7.1		0.384
11 17								
0	72.7	305.0	0.222E-03	61.8	288.8	0.0		1.000
25	89.1	284.5	0.658E-04	58.7	351.6	16.4		0.297
50	48.0	263.5	0.175E-04	21.1	286.4	41.2		0.079
75	-33.4	210.9	0.387E-05	-44.1	312.4	94.0		0.017

11 18L							
0	32.8	81.0	0.645E-04	19.8	82.9	0.0	1.000
25	-26.3	98.5	0.905E-04	-16.2	85.3	61.4	1.404
50	-54.1	104.3	0.116E-03	-36.2	94.0	28.1	1.795
75	-53.1	111.8	0.115E-03	-39.3	87.1	4.6	1.777
100	-73.0	78.3	0.130E-03	-42.0	131.5	24.3	2.009
11 19							
0	61.9	258.0	0.571E-03	30.1	299.5	0.0	1.000
25	54.0	258.3	0.426E-03	23.2	293.7	7.9 A	0.747
50	51.7	258.8	0.392E-03	21.6	291.9	2.3	0.686
75	49.4	255.2	0.377E-03	18.2	293.5	3.3	0.660
11 20L							
0	53.2	71.4	0.356E-03	37.8	80.2	0.0	1.000
25	83.6	88.3	0.745E-04	56.4	18.5	30.7	0.209
50	62.2	190.9	0.161E-04	12.1	347.0	29.8	0.045
75	-68.6	92.6	0.385E-04	-43.1	117.3	148.0	0.108
11 21L							
0	39.6	100.0	0.520E-03	13.9	64.7	0.0	1.000
50	-51.8	92.3	0.444E-04	-28.2	101.7	91.6	0.085
100	-82.6	52.2	0.566E-04	-47.9	157.8	32.9	0.109
150	-74.9	81.2	0.772E-04	-45.2	133.2	9.4	0.149
200	-79.7	107.9	0.600E-04	-58.7	136.3	7.5	0.116
250	-72.7	74.3	0.562E-04	-40.3	133.2	10.3	0.108
11 22L							
0	47.4	303.4	0.270E-03	41.3	252.7	0.0	1.000
25	73.2	339.4	0.156E-03	79.3	276.9	30.4	0.577
50	33.1	315.1	0.255E-04	38.2	233.7	41.9	0.094
75	25.6	349.9	0.230E-04	44.6	189.0	31.0	0.085
11 23L							
0	16.9	106.2	0.159E-03	-1.0	66.7	0.0	1.000
25	70.4	188.6	0.255E-04	22.9	349.8	71.5	0.161
50	-81.8	248.9	0.373E-04	-60.4	206.5	155.3	0.235
75	-74.8	153.8	0.400E-04	-76.6	109.9	17.9	0.252
11 24							
0	51.1	304.6	0.526E-03	44.6	254.3	0.0	1.000
25	-7.0	240.3	0.412E-03	-18.2	289.2	79.9	0.782
50	43.7	246.7	0.273E-03	10.3	297.6	51.0	0.519
75	38.2	270.1	0.121E-03	18.2	276.7	18.4	0.230
11 25							
0	-43.5	279.0	0.112E-03	-16.9	243.9	0.0	1.000
25	32.1	337.1	0.162E-04	45.8	207.3	92.3	0.144
50	-58.4	254.4	0.151E-04	-40.2	253.4	113.3	0.135
75	-64.7	276.1	0.172E-04	-35.4	231.9	12.1	0.153
11 26							
0	56.7	306.4	0.330E-03	49.7	257.6	0.0	1.000
50	56.6	294.8	0.107E-03	43.6	267.7	6.4	0.324
100	57.0	288.7	0.866E-04	40.7	273.0	3.3 A	0.263
150	58.5	269.4	0.846E-04	32.2	288.7	10.4	0.257
200	56.5	277.9	0.621E-04	34.7	280.9	5.0	0.188
250	58.1	260.3	0.494E-04	27.6	294.9	9.6	0.150
11 27L							
0	76.8	321.6	0.304E-03	70.9	301.2	0.0	1.000
25	67.6	341.5	0.125E-03	76.8	237.2	10.9	0.411
50	62.3	284.0	0.824E-04	42.7	282.0	24.0	0.271
75	5.7	306.7	0.194E-04	20.9	234.0	59.0	0.064

11 28							
0	-8.2	57.2	0.281E-02	12.9	115.6	0.0	1.000
25	0.5	31.1	0.139E-02	27.0	139.5	27.5	0.495
50	28.9	358.4	0.227E-03	47.2	177.3	42.2	0.081
75	22.8	333.7	0.151E-03	39.5	209.3	23.0	0.054
11 29							
0	-27.5	43.0	0.143E-02	9.1	133.1	0.0	1.000
25	2.2	9.3	0.278E-03	32.4	164.0	43.9	0.194
50	25.4	340.3	0.141E-03	42.7	201.5	36.3	0.098
75	22.7	329.5	0.112E-03	38.2	214.2	10.2	0.079
11 30L							
0	-0.3	43.9	0.228E-02	22.2	126.6	0.0	1.000
25	48.8	336.1	0.107E-02	57.1	215.5	75.8	0.471
50	59.1	298.2	0.126E-02	47.3	267.5	24.1	0.552
75	60.7	285.3	0.140E-02	42.0	279.3	6.7	0.614
100	60.1	269.0	0.137E-02	33.4	290.3	8.1	0.601
11 31							
0	51.5	25.3	0.215E-03	58.8	130.7	0.0	1.000
50	74.2	315.2	0.715E-04	67.5	289.9	35.8	0.332
100	76.7	276.0	0.472E-04	52.4	310.8	9.9	0.219
150	71.3	246.6	0.297E-04	35.9	315.6	9.6	0.138
200	76.5	259.0	0.219E-04	46.3	317.0	6.2	0.102
250	86.2	284.7	0.167E-04	59.4	340.4	10.2	0.078
11 32							
0	84.3	359.4	0.150E-03	69.6	354.7	0.0	1.000
25	76.4	156.9	0.746E-04	33.6	6.9	19.0	0.498
50	74.1	163.8	0.347E-04	29.2	4.1	2.9	0.232
75	69.4	79.0	0.145E-04	47.7	56.3	24.7	0.097
11 33							
0	48.5	82.2	0.227E-02	28.7	74.6	0.0	1.000
25	28.7	58.8	0.323E-02	29.2	104.1	26.7	1.422
50	22.9	58.5	0.342E-02	26.4	106.3	5.9	1.507
75	14.2	51.6	0.379E-02	25.5	115.5	10.9	1.669
11 34							
0	-13.5	27.4	0.116E-02	21.3	145.6	0.0	1.000
25	-4.3	31.9	0.360E-03	24.5	139.6	10.2	0.311
50	15.5	0.5	0.128E-03	39.7	174.3	36.8	0.110
75	24.3	346.7	0.992E-04	43.4	193.0	15.7	0.086
11 35L							
0	62.7	347.0	0.338E-03	73.7	210.1	0.0	1.000
25	76.2	232.4	0.956E-04	38.5	328.6	35.2	0.283
50	69.1	226.8	0.391E-04	27.2	325.2	7.3	0.116
75	71.9	75.0	0.213E-04	51.8	53.9	37.8	0.063
11 36							
0	67.2	265.4	0.377E-03	38.6	299.9	0.0	1.000
25	58.0	213.7	0.580E-04	10.9	328.9	24.6	0.154
11 37							
0	49.8	210.7	0.361E-03	2.5	329.0	0.0	1.000
25	74.8	213.4	0.106E-03	32.4	336.9	25.0	0.295
50	79.8	196.1	0.736E-04	39.0	348.1	6.3	0.204
75	-52.3	52.5	0.128E-03	-11.1	132.2	150.0	0.354
11 38							
0	75.2	268.7	0.995E-03	48.3	310.5	0.0	1.000

25	69.8	275.7	0.330E-03	45.7	297.4	5.8		0.332
50	65.9	339.6	0.569E-04	74.3	234.3	23.2		0.057
75	-36.9	48.5	0.752E-04	1.6	130.5	115.5		0.076
11 39								
0	79.0	303.1	0.673E-03	63.7	311.8	0.0		1.000
25	80.5	269.6	0.247E-03	53.6	322.6	6.1		0.367
50	59.3	215.4	0.186E-03	12.7	328.0	26.2		0.276
75	41.8	207.9	0.173E-03	-4.4	329.7	18.1		0.257
11 40								
0	47.3	270.3	0.287E-03	24.0	280.7	0.0		1.000
25	32.1	283.4	0.451E-04	21.8	263.2	18.1		0.157
50	-46.1	88.4	0.457E-04	-22.3	101.5	162.0		0.159
75	-42.0	88.8	0.929E-04	-19.8	99.3	4.1		0.324
11 41								
0	43.1	48.0	0.996E-04	42.8	108.4	0.0		1.000
25	55.7	161.1	0.106E-04	5.8	10.2	66.2		0.106
11 42								
0	71.0	92.9	0.287E-03	43.2	46.1	0.0		1.000
25	58.4	126.5	0.100E-03	17.1	35.7	18.6		0.348
50	41.8	185.3	0.217E-04	-7.5	350.2	39.6		0.075
75	-49.9	231.6	0.477E-04	-45.7	280.5	100.3		0.166
11 43								
0	60.4	283.7	0.518E-03	40.9	280.1	0.0		1.000
25	58.0	261.8	0.355E-03	28.2	293.8	11.4	A	0.686
50	54.7	255.8	0.286E-03	22.6	295.9	4.7		0.552
75	60.3	250.0	0.239E-03	25.2	303.7	6.5		0.462
11 44								
0	74.6	98.1	0.883E-04	45.1	37.7	0.0		1.000
25	72.6	161.9	0.368E-04	27.0	5.7	17.3		0.417
50	42.4	208.1	0.406E-04	-4.0	329.6	37.2		0.460
75	-44.9	3.4	0.349E-04	5.2	171.9	162.0		0.395
11 45								
0	63.4	80.2	0.550E-04	41.6	63.9	0.0		1.000
25	-37.8	66.6	0.192E-04	-6.5	115.5	101.7		0.349
75	-9.2	144.1	0.396E-04	-29.6	37.2	74.5		0.719
100	1.2	162.4	0.444E-04	-29.5	15.3	21.0		0.807
11 46								
0	60.5	274.0	0.538E-03	36.2	287.1	0.0		1.000
25	57.4	267.3	0.421E-03	30.3	289.4	4.6		0.783
50	51.4	279.4	0.354E-03	31.6	276.0	9.2		0.658
75	49.1	267.8	0.345E-03	24.0	283.7	7.8		0.641
11 47								
0	68.2	273.3	0.586E-03	43.0	296.3	0.0		1.000
25	53.2	270.5	0.348E-03	28.4	284.0	15.1	A	0.594
50	51.3	263.2	0.307E-03	23.4	288.5	4.8		0.524
75	46.1	258.7	0.304E-03	17.5	289.2	6.0		0.520
11 48								
0	78.0	267.9	0.566E-03	50.7	316.7	0.0		1.000
25	73.4	247.8	0.168E-03	38.9	317.5	6.7		0.296
50	-17.7	13.6	0.287E-04	21.8	160.6	116.8		0.051
11 49								
0	71.7	255.0	0.277E-03	39.3	311.5	0.0		1.000
25	61.6	275.5	0.165E-03	37.8	287.2	12.9		0.594

50	55.1	256.1	0.139E-03	23.1	295.9	12.0		0.501
75	45.2	285.8	0.102E-03	30.7	267.0	21.2		0.368
11 50								
0	58.7	111.8	0.235E-03	22.9	46.1	0.0		1.000
25	22.2	25.4	0.442E-04	39.5	142.1	69.4		0.189
50	34.8	164.1	0.372E-04	-11.5	10.3	110.9		0.158
75	-23.9	27.7	0.538E-04	15.8	146.9	140.8		0.229
11 51								
0	67.1	329.7	0.384E-03	70.6	252.7	0.0		1.000
25	64.0	6.3	0.692E-04	76.9	155.3	15.2		0.180
50	-35.1	19.8	0.528E-04	10.7	156.0	99.7		0.137
75	-46.3	30.0	0.673E-04	0.5	148.7	13.6		0.175
11 52								
0	69.7	83.7	0.957E-04	45.9	53.2	0.0		1.000
25	76.5	301.5	0.515E-04	62.3	302.8	32.0		0.538
50	20.9	335.4	0.304E-04	39.0	206.9	58.1		0.318
75	17.0	244.3	0.287E-04	-5.6	291.5	84.9		0.300
11 53								
0	44.0	273.2	0.237E-03	23.4	276.7	0.0		1.000
25	55.8	257.8	0.129E-03	24.5	295.2	15.3	A	0.547
50	54.9	248.8	0.111E-03	19.7	301.2	5.2		0.471
75	55.7	242.4	0.102E-03	17.8	306.4	3.7		0.431
11 54								
0	55.6	308.1	0.232E-03	49.8	254.9	0.0		1.000
25	41.6	275.0	0.104E-03	22.8	274.2	25.6		0.448
50	16.0	289.3	0.698E-04	17.0	252.7	28.5		0.301
75	6.6	309.3	0.551E-04	22.5	231.7	21.7		0.238
11 55								
0	75.3	305.9	0.339E-03	63.6	296.8	0.0		1.000
25	57.5	270.8	0.169E-03	32.1	286.9	21.9		0.499
50	50.0	256.8	0.163E-03	19.4	292.6	11.1	A	0.481
75	47.9	249.9	0.142E-03	14.7	296.9	5.0		0.419
100	43.3	253.2	0.113E-03	13.0	292.3	5.2		0.334
11 56								
0	71.7	282.6	0.372E-03	50.6	297.0	0.0		1.000
25	48.4	254.2	0.266E-03	17.0	293.8	26.7		0.716
50	43.9	247.5	0.260E-03	10.8	297.1	6.5		0.698
75	31.5	258.1	0.175E-03	8.3	284.0	15.0		0.471
11 57								
0	49.1	12.1	0.253E-03	60.5	153.4	0.0		1.000
25	47.6	0.4	0.708E-04	60.5	174.4	7.9		0.280
50	-48.7	141.3	0.644E-04	-51.1	54.9	154.2		0.255
75	17.7	9.2	0.242E-04	40.3	163.0	130.5		0.096

DYKE 12

DMAG	**** MAGNETIZATION ****			POLE POSITION			
	DIP	DEC	J	LAT	LONG	ANG	J/J0
12 1							
0	83.7	111.7	0.171E-03	52.1	14.0	0.0	1.000
50	73.2	340.9	0.951E-04	80.1	276.8	21.4	0.557
100	45.0	29.6	0.305E-04	52.1	129.0	35.8	0.179
150	60.0	354.9	0.741E-04	72.4	187.7	25.5	0.434
12 2							
0	-66.9	322.8	0.170E-01	-22.1	200.0	0.0	1.000
50	73.2	303.6	0.110E-02	61.5	290.8	140.7	0.065
100	71.2	349.1	0.184E-03	83.5	246.2	13.7	0.011
150	71.3	294.2	0.567E-03	55.6	290.0	17.1	0.033
12 3							
0	47.9	332.1	0.182E-02	54.9	220.3	0.0	1.000
50	47.0	227.4	0.231E-03	5.1	314.3	64.7	0.127
100	-13.4	350.7	0.787E-04	24.5	185.1	122.2	0.043
150	29.6	228.3	0.205E-03	-5.9	308.7	124.5	0.113
12 4							
0	38.7	291.3	0.161E-02	29.5	258.9	0.0	1.000
50	69.4	298.9	0.381E-03	56.4	283.2	31.0	0.237
100	76.3	323.8	0.208E-03	71.9	298.5	9.9	0.129
150	58.5	301.9	0.218E-03	48.8	263.8	19.4	0.136
12 5							
0	13.5	270.1	0.692E-03	5.9	268.5	0.0	1.000
50	34.2	110.4	0.598E-04	5.8	58.0	128.5	0.087
100	23.6	204.0	0.979E-04	-16.7	330.5	79.8	0.142
150	-43.9	20.2	0.142E-03	4.3	156.8	159.4	0.205
12 6							
0	84.2	344.5	0.750E-03	69.2	346.2	0.0	1.000
50	71.7	301.5	0.161E-03	59.4	287.4	14.5	0.215
100	62.6	262.0	0.160E-03	32.5	297.2	17.4	0.213
150	-35.2	72.9	0.464E-04	-7.8	109.4	152.0	0.062
12 7							
0	70.8	166.2	0.334E-03	24.0	3.5	0.0	1.000
50	86.4	199.5	0.129E-03	51.4	351.1	16.3	0.386
100	21.4	38.8	0.926E-04	34.5	126.7	72.0	0.277
150	32.8	221.2	0.170E-03	-6.6	315.8	125.7	0.509
12 8							
0	61.2	297.6	0.487E-03	48.9	270.4	0.0	1.000
50	75.8	261.3	0.672E-04	46.3	314.7	19.1	0.138
100	-31.4	61.3	0.618E-04	-0.4	117.9	134.6	0.127
150	46.2	255.0	0.131E-03	15.9	292.0	161.8	0.270
12 9							
0	52.2	197.3	0.538E-03	2.3	340.4	0.0	1.000
50	65.9	295.3	0.113E-03	51.6	278.9	46.6	0.209
100	43.4	283.7	0.119E-03	28.4	267.8	23.4	0.222
150	-27.4	83.9	0.170E-03	-9.2	97.7	157.4	0.316
12 10							
0	49.4	61.9	0.364E-03	40.0	91.0	0.0	1.000
50	44.7	95.3	0.105E-03	19.5	66.1	23.1	0.287
100	-6.6	12.6	0.509E-04	27.6	160.7	89.5	0.140
150	47.7	148.4	0.107E-03	1.0	22.3	124.3	0.293

12 11							
0	81.5	288.5	0.233E-03	59.6	322.4	0.0	1.000
50	73.6	325.4	0.679E-04	72.3	283.5	10.9	0.291
100	79.8	121.4	0.323E-04	45.0	19.1	26.1	0.139
150	25.6	352.2	0.181E-04	44.8	185.7	71.1	0.078
12 12							
0	72.3	274.1	0.696E-03	47.5	302.4	0.0	1.000
50	68.1	27.9	0.589E-04	72.6	96.9	33.1	0.085
100	13.7	27.1	0.433E-04	34.6	141.6	54.4	0.062
150	-62.2	239.5	0.145E-04	-51.2	260.5	126.3	0.021
12 13							
0	64.1	2.5	0.940E-03	77.5	167.0	0.0	1.000
50	32.7	317.8	0.464E-04	39.1	230.4	41.7	0.049
100	-12.6	258.7	0.374E-04	-11.4	271.2	72.3	0.040
150	-21.0	269.3	0.315E-04	-9.6	259.7	13.2	0.034
12 14L							
0	-32.7	66.5	0.205E-02	-3.5	113.9	0.0	1.000
50	-50.9	65.7	0.284E-03	-15.2	121.4	18.2	0.139
100	-18.2	84.5	0.487E-04	-5.1	94.5	35.9	0.024
150	-29.3	59.8	0.650E-04	1.4	118.6	25.1	0.032
12 15							
0	82.2	264.0	0.218E-04	53.7	328.6	0.0	1.000
50	46.9	32.0	0.459E-05	52.6	124.7	48.2	0.211
100	-11.0	74.3	0.979E-05	3.4	101.2	69.1	0.450
12 16L							
0	31.2	242.9	0.375E-03	1.0	296.5	0.0	1.000
50	64.6	298.5	0.863E-04	52.2	274.5	47.5	0.230
100	55.2	289.3	0.347E-04	39.6	270.8	10.5	0.093
150	-25.9	72.9	0.424E-04	-2.9	106.5	140.6	0.113
12 17L							
0	50.9	296.2	0.514E-03	40.0	261.6	0.0	1.000
50	62.3	21.1	0.493E-04	70.3	124.1	44.5	0.096
100	35.5	48.4	0.313E-04	37.9	111.6	31.7	0.061
150	-8.3	51.9	0.344E-04	15.2	120.5	43.9	0.067
12 18							
0	50.8	114.5	0.185E-03	15.0	48.4	0.0	1.000
50	85.3	67.8	0.386E-04	60.7	12.7	36.1	0.209
100	48.0	347.9	0.116E-04	59.6	196.1	41.4	0.063

DYKE 13

DMAG	**** MAGNETIZATION ****			POLE POSITION				
	DIP	DEC	J	LAT	LONG	ANG		J/J0
13 1								
0	77.7	275.9	0.518E-02	53.2	313.1	0.0		1.000
50	69.7	299.7	0.237E-02	57.0	283.3	10.3		0.457
100	66.6	302.7	0.974E-03	56.0	274.9	3.3		0.188
150	66.7	306.0	0.477E-03	57.8	272.6	1.3		0.092
13 8								
0	39.5	7.5	0.101E-03	53.7	163.0	0.0		1.000
50	45.7	55.8	0.323E-04	40.6	99.0	35.5		0.318
100	37.5	57.3	0.220E-04	34.8	101.9	8.3		0.217
150	53.4	60.3	0.165E-04	43.7	89.2	16.0		0.162
13 9								
0	49.2	208.2	0.681E-03	1.4	330.7	0.0		1.000
50	71.4	182.1	0.181E-03	24.3	353.5	25.3		0.267
100	65.5	230.6	0.847E-04	23.8	320.2	18.2		0.124
150	38.2	228.1	0.327E-04	-0.9	311.0	27.4		0.048
13 10								
0	19.2	34.6	0.434E-03	34.9	131.8	0.0		1.000
50	60.7	252.7	0.570E-04	26.7	301.9	94.5		0.131
100	47.7	277.1	0.453E-04	27.8	275.4	19.1		0.104
150	49.7	238.4	0.564E-04	11.2	306.4	25.3		0.130
13 11								
0	67.7	4.0	0.249E-03	82.1	156.0	0.0		1.000
50	79.4	195.0	0.683E-04	38.2	348.2	32.7		0.274
100	63.8	233.5	0.274E-04	22.8	317.1	19.0		0.110
150	80.5	226.9	0.292E-04	43.8	336.1	16.7		0.117
13 12								
0	61.8	333.9	0.291E-02	67.7	233.0	0.0		1.000
50	72.0	359.0	0.716E-03	88.6	199.1	14.0		0.246
100	73.1	7.3	0.239E-03	86.1	73.8	2.7		0.082
150	72.9	18.3	0.146E-03	80.4	75.7	3.2		0.050
13 13								
0	-67.2	153.4	0.274E-03	-72.5	68.1	0.0		1.000
50	-70.8	158.6	0.286E-03	-77.9	79.3	4.1		1.046
100	-71.3	148.4	0.202E-03	-72.8	90.6	3.3	A	0.737
150	-71.3	157.0	0.143E-03	-77.3	84.3	2.7		0.521
13 14								
0	81.2	144.8	0.972E-03	43.3	8.3	0.0		1.000
50	84.0	108.9	0.797E-03	52.8	13.7	5.2		0.820
100	83.6	71.6	0.478E-03	60.0	19.3	4.0	A	0.492
150	84.4	50.3	0.303E-03	64.1	14.8	2.3		0.312
13 15								
0	-76.4	86.7	0.216E-04	-48.8	133.6	0.0		1.000
50	-80.0	100.2	0.210E-04	-56.4	138.4	4.5		0.972
100	-65.4	113.2	0.867E-05	-50.1	99.4	15.0		0.402
13 17								
0	28.3	291.0	0.156E-03	23.8	254.9	0.0		1.000
50	27.7	289.4	0.136E-03	22.6	256.1	1.5	A	0.874
100	27.2	292.3	0.619E-04	23.9	253.4	2.6		0.398
150	28.9	294.3	0.287E-04	25.8	252.2	2.5		0.184

13 18							
0	-39.5	35.9	0.138E-03	4.0	141.9	0.0	1.000
50	-39.7	35.9	0.448E-04	3.9	141.9	0.2	0.325
100	-25.9	29.8	0.168E-04	14.1	144.9	14.7	0.122
150	-14.6	24.6	0.979E-05	21.4	148.5	12.4	0.071

DYKE 14

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
14 1L							
0	17.3	75.2	0.945E-03	15.1	92.8	0.0	1.000
50	30.1	24.6	0.522E-03	44.2	141.0	47.8	0.552
100	-11.4	316.6	0.481E-03	17.2	220.5	77.3	0.509
150	55.1	36.3	0.593E-03	57.2	112.2	93.5	0.628
14 2L							
0	9.2	36.8	0.133E-02	29.3	131.8	0.0	1.000
50	15.8	46.3	0.108E-02	28.7	120.2	11.4	0.869
100	-49.4	329.6	0.411E-03	-2.0	230.8	93.6	0.308
150	-29.4	292.6	0.566E-03	-2.0	237.6	34.3	0.425
14 3L							
0	8.8	54.0	0.776E-03	22.0	114.4	0.0	1.000
50	10.5	50.8	0.494E-03	24.2	117.0	3.6	0.637
100	5.8	76.3	0.482E-03	9.6	95.0	25.7	0.621
150	35.4	93.2	0.483E-03	14.8	71.8	33.4	0.623
14 4L							
0	68.6	122.0	0.357E-02	29.8	31.9	0.0	1.000
50	42.8	82.5	0.102E-02	24.8	77.2	33.0	0.286
100	16.7	321.8	0.422E-03	32.4	221.2	99.4	0.118
150	41.2	88.4	0.451E-03	20.7	73.1	103.9	0.126
14 5							
0	48.2	313.9	0.424E-03	47.2	242.8	0.0	1.000
50	82.7	63.3	0.216E-03	61.9	22.9	44.7	0.509
100	75.9	349.4	0.333E-03	82.7	314.1	13.9	0.784
150	67.7	215.0	0.263E-03	22.5	331.6	33.7	0.620
14 6L							
0	53.3	52.3	0.444E-03	47.9	96.8	0.0	1.000
50	-6.0	26.2	0.413E-03	25.3	145.6	63.3	0.929
100	-18.2	313.0	0.898E-03	12.5	222.5	72.2	2.023
150	51.0	130.6	0.442E-03	21.3	58.7	138.4	0.996
14 7L							
0	57.6	24.0	0.165E-02	64.7	126.4	0.0	1.000
50	62.4	32.7	0.123E-02	65.3	106.1	6.5	0.746
100	83.9	20.5	0.951E-03	69.2	6.8	21.6	0.577
150	-38.1	259.9	0.564E-03	-23.4	261.5	131.1	0.342
14 8L							
0	71.4	13.7	0.154E-02	82.3	94.9	0.0	1.000
50	64.1	11.6	0.130E-02	75.8	140.0	7.3	0.843
100	77.4	141.4	0.369E-03	37.5	13.5	35.2	0.239
150	59.4	18.5	0.891E-03	68.5	133.5	38.8	0.577
14 9L							
0	68.1	52.9	0.150E-02	59.5	74.7	0.0	1.000
50	72.4	46.1	0.127E-02	66.0	66.4	4.9	0.847
100	40.6	25.1	0.296E-03	50.7	136.9	33.4	0.197
150	-48.5	316.2	0.802E-03	-5.0	212.0	107.8	0.534
14 10							
0	65.2	330.1	0.647E-03	69.1	246.5	0.0	1.000
50	55.9	329.4	0.450E-03	60.4	231.0	9.4	0.695
100	75.8	316.1	0.512E-03	68.4	296.7	20.5	0.792
150	61.2	359.4	0.607E-03	74.1	176.8	20.7	0.939

14 11L							
0	64.6	89.2	0.181E-02	38.4	56.3	0.0	1.000
50	72.3	77.5	0.175E-02	51.0	51.8	8.8	A 0.966
100	70.8	52.7	0.159E-02	61.6	67.9	7.9	0.882
150	80.7	40.0	0.913E-03	69.0	28.9	10.3	0.506
14 12L							
0	58.0	2.9	0.263E-02	70.4	168.0	0.0	1.000
50	62.5	359.2	0.219E-02	75.7	177.3	4.9	0.832
100	56.0	356.8	0.193E-02	68.3	131.8	6.6	A 0.736
150	54.8	341.5	0.752E-03	64.1	211.1	8.7	0.286
14 13							
0	31.5	357.4	0.538E-03	48.8	178.8	0.0	1.000
50	20.1	341.5	0.415E-03	43.2	198.9	18.2	0.772
100	-0.4	299.0	0.264E-03	14.6	239.5	46.4	0.490
150	5.0	315.2	0.224E-03	24.3	225.4	17.0	0.416
14 14							
0	12.6	310.3	0.391E-03	25.7	232.1	0.0	1.000
50	6.1	321.7	0.306E-03	27.3	219.0	13.0	0.783
100	-29.1	328.1	0.236E-03	11.7	206.2	35.8	0.604
150	-4.9	312.5	0.206E-03	18.6	225.9	28.4	0.526
14 15L							
0	26.7	2.7	0.527E-03	45.9	171.1	0.0	1.000
50	34.1	354.5	0.412E-03	50.3	183.1	10.2	0.783
100	33.9	303.6	0.158E-03	33.1	245.5	41.8	0.300
150	33.7	332.2	0.170E-03	45.3	213.9	23.7	0.323
14 16							
0	19.6	333.9	0.727E-03	38.0	258.2	0.0	1.000
50	25.4	336.6	0.486E-03	41.8	236.1	6.3	0.669
100	20.7	342.5	0.382E-03	40.7	197.8	7.2	A 0.525
150	2.9	319.9	0.252E-03	25.1	220.1	28.2	0.347
14 17L							
0	42.6	331.7	0.385E-03	50.9	218.0	0.0	1.000
50	31.3	310.6	0.284E-03	35.1	237.5	20.2	0.739
100	34.5	307.8	0.329E-03	35.5	241.6	3.9	A 0.855
150	32.1	303.9	0.271E-03	32.3	244.4	4.0	0.704
14 18L							
0	-60.0	223.3	0.413E-01	-57.9	278.1	0.0	1.000
50	-0.6	205.4	0.994E-01	-28.7	325.8	61.1	2.404
100	4.7	206.0	0.537E-01	-26.0	325.6	5.3	A 1.299
150	8.7	205.4	0.251E-01	-24.2	326.9	4.1	0.608
14 19							
0	-70.0	279.5	0.251E-01	-39.5	223.8	0.0	1.000
50	-49.2	280.7	0.108E-01	-20.0	239.8	20.8	0.431
100	-31.9	274.8	0.300E-02	-12.2	251.5	17.8	0.119
150	-21.7	284.4	0.155E-02	-2.2	246.7	13.3	0.062
14 20							
0	-65.0	290.3	0.889E-02	-29.7	222.3	0.0	1.000
50	-43.7	277.7	0.280E-02	-17.6	244.5	22.4	0.315
100	-29.4	284.5	0.890E-03	-5.9	244.3	15.3	0.100
150	-20.9	279.4	0.447E-03	-4.3	251.2	9.7	0.050
14 21							
0	-2.9	285.8	0.148E-02	7.0	250.8	0.0	1.000
50	44.4	290.3	0.775E-04	32.6	262.8	47.5	0.052

100	63.5	279.0	0.284E-04	41.3	286.6	20.1	0.019
150	66.8	242.6	0.236E-04	29.1	313.4	15.4	0.016
14 22							
0	-68.3	325.5	0.334E-02	-23.2	197.4	0.0	1.000
50	-66.5	349.2	0.343E-03	-17.5	182.2	9.3	0.103
100	-62.3	354.1	0.892E-04	-11.9	179.2	4.7	0.027
150	-48.8	6.1	0.429E-04	1.9	169.5	15.0	0.013
14 23							
0	49.2	21.2	0.190E-04	58.3	138.1	0.0	1.000
50	67.4	332.0	0.577E-05	72.0	251.0	30.4	0.303
14 30							
0	-45.1	277.0	0.159E-04	-13.9	244.5	0.0	1.000
50	-49.8	279.7	0.128E-04	-20.8	240.0	5.1	0.803

DYKE 15

DMAG	**** MAGNETIZATION **** DIP	DEC	J ****	POLE POSITION LAT	LONG	ANG	J/J0
15 1							
0	-34.5	150.1	0.329E-02	-45.1	36.8	0.0	1.000
50	-42.8	139.6	0.278E-03	-46.1	52.9	11.6	0.085
100	-62.2	130.3	0.141E-03	-56.3	81.1	20.2	0.043
150	-16.7	19.8	0.565E-04	21.3	153.8	84.4	0.017
15 2							
0	21.1	248.6	0.605E-03	-1.6	288.8	0.0	1.000
50	47.8	322.2	0.181E-03	50.7	233.0	63.6	0.299
100	-30.8	315.3	0.456E-04	6.6	217.7	78.8	0.075
150	-65.8	141.6	0.103E-03	-65.2	77.4	83.3	0.170

DYKE 16

DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
	**** MAGNETIZATION ****			POLE POSITION			
16 1							
0	-34.4	304.1	0.434E-03	0.2	226.5	0.0	1.000
50	39.3	305.1	0.188E-03	37.0	246.4	73.7	0.434
100	27.7	320.3	0.109E-03	37.4	226.0	17.1	0.252
150	14.9	316.2	0.627E-04	29.2	226.8	13.3	0.145
16 2							
0	83.0	300.4	0.868E-03	62.8	328.1	0.0	1.000
50	59.9	95.6	0.216E-03	31.1	56.8	36.6	0.249
100	-55.5	278.1	0.211E-04	-26.2	238.0	175.5	0.024
150	-9.6	201.6	0.158E-04	-34.0	328.7	74.5	0.018
16 3							
0	33.5	103.4	0.671E-03	8.7	64.0	0.0	1.000
50	57.7	58.8	0.797E-04	47.9	86.6	38.4	0.119
100	58.6	54.8	0.165E-03	50.6	89.1	2.3	0.246
150	35.3	49.2	0.751E-04	37.4	111.0	23.6	0.112
16 4							
0	83.0	27.6	0.734E-03	69.6	13.2	0.0	1.000
50	61.9	9.3	0.198E-03	73.8	150.0	21.6	0.270
100	57.4	14.3	0.132E-03	67.7	144.2	5.2	0.180
150	31.4	4.6	0.440E-04	48.5	168.3	26.8	0.060
16 5							
0	75.2	225.5	0.766E-03	35.4	336.7	0.0	1.000
50	71.9	39.1	0.193E-03	69.3	72.1	32.9	0.251
100	52.4	21.1	0.937E-04	61.0	136.4	21.1	0.122
150	58.8	352.0	0.340E-04	70.6	193.8	17.5	0.044
16 6							
0	74.0	349.7	0.587E-03	84.4	289.5	0.0	1.000
50	48.0	29.2	0.141E-03	54.5	127.7	31.1	0.241
100	42.7	50.0	0.220E-04	41.6	106.6	15.4	0.037
150	28.3	40.7	0.546E-04	37.3	122.5	16.2	0.093
16 7							
0	67.2	330.8	0.159E-04	71.1	251.2	0.0	1.000
50	79.9	32.6	0.168E-04	71.8	30.2	20.1	1.058
100	82.0	353.0	0.132E-04	73.8	348.1	6.4	0.829
150	57.6	307.2	0.915E-05	50.9	257.7	27.4	0.575
16 8							
0	56.9	62.3	0.873E-04	45.4	84.5	0.0	1.000
50	45.4	103.2	0.720E-04	16.1	59.6	27.6	0.825
100	39.3	99.1	0.451E-04	14.2	65.4	6.8	A 0.516
150	39.0	95.7	0.348E-04	15.7	68.3	2.7	0.398
16 9							
0	68.5	12.9	0.913E-03	80.2	120.6	0.0	1.000
50	40.4	47.7	0.215E-03	41.2	110.1	33.7	0.235
100	26.7	50.4	0.146E-03	32.2	112.9	13.9	0.160
150	-2.2	40.0	0.516E-04	22.7	130.7	30.6	0.057
16 10							
0	45.1	28.9	0.111E-02	52.5	129.8	0.0	1.000
50	50.1	7.9	0.332E-03	62.1	160.3	15.0	0.298
100	38.6	0.7	0.242E-03	53.5	173.8	12.6	0.218
150	35.8	2.0	0.150E-03	51.5	171.9	3.0	0.134

16 11								
0	41.9	38.9	0.277E-04	46.2	119.0	0.0		1.000
50	44.1	60.5	0.237E-04	37.2	95.8	15.8	A	0.857
100	36.4	49.8	0.161E-04	37.8	109.9	11.2		0.583
150	32.3	56.3	0.134E-04	32.3	105.1	6.8		0.483
16 12								
0	69.2	342.4	0.107E-03	78.7	243.7	0.0		1.000
50	75.5	10.9	0.892E-04	83.1	40.9	10.5		0.834
100	70.0	339.4	0.539E-04	77.8	253.0	10.7	A	0.504
150	63.5	349.0	0.383E-04	75.2	206.8	7.5		0.358
16 13L								
0	62.3	27.2	0.547E-03	67.7	114.3	0.0		1.000
50	51.8	46.9	0.438E-03	49.4	103.7	14.9		0.801
100	53.6	45.7	0.218E-03	51.4	103.3	2.0	A	0.398
150	52.6	53.0	0.213E-03	46.9	96.8	4.5		0.388
16 14								
0	41.4	116.4	0.538E-03	7.5	50.7	0.0		1.000
50	64.5	60.0	0.145E-03	52.8	76.7	39.1		0.269
100	43.4	354.7	0.397E-04	56.8	183.8	41.4		0.074
150	57.8	65.3	0.643E-04	44.5	81.1	44.8		0.120
16 15								
0	47.3	21.2	0.518E-04	56.7	139.5	0.0		1.000
50	58.6	32.1	0.292E-04	62.1	113.5	13.1		0.564
100	47.7	31.5	0.179E-04	53.4	124.8	11.0	A	0.345
150	49.1	39.2	0.182E-04	51.1	114.2	5.3		0.352
16 16								
0	24.1	327.6	0.513E-03	38.2	216.7	0.0		1.000
50	70.0	319.0	0.900E-04	67.1	272.0	46.2		0.175
100	2.2	354.6	0.202E-04	32.7	181.3	71.7		0.039
150	49.8	330.7	0.200E-04	55.9	223.7	51.8		0.039
16 17L								
0	62.6	320.0	0.521E-03	61.7	252.3	0.0		1.000
50	64.9	325.6	0.381E-03	66.5	251.1	3.4		0.732
100	69.9	323.0	0.221E-03	69.1	268.5	5.1	A	0.424
150	64.3	348.6	0.134E-03	76.0	209.4	11.3		0.258
16 18								
0	52.3	9.8	0.372E-04	63.8	156.1	0.0		1.000
50	41.4	26.4	0.389E-04	50.7	134.9	15.7	A	1.045
100	36.4	23.5	0.244E-04	48.3	140.7	5.5		0.657
150	30.9	20.0	0.169E-04	45.8	146.8	6.2		0.454
16 19								
0	60.2	76.3	0.739E-03	40.8	70.1	0.0		1.000
50	68.0	338.9	0.798E-04	75.9	243.0	38.8		0.108
100	58.1	318.6	0.305E-04	57.1	246.8	13.4		0.041
150	-19.6	7.1	0.148E-04	21.4	167.4	87.4		0.020
16 20								
0	71.2	6.4	0.832E-03	85.7	117.8	0.0		1.000
50	56.6	62.6	0.221E-03	45.0	84.5	27.3		0.266
100	49.9	92.7	0.113E-03	24.4	65.5	19.0		0.135
150	0.4	93.8	0.538E-04	-1.8	81.8	49.5		0.065
16 21L								
0	68.8	57.1	0.845E-03	58.0	70.4	0.0		1.000
50	30.0	23.9	0.142E-03	44.2	142.0	43.3		0.168

100	8.7	22.9	0.955E-04	33.2	147.3	21.3		0.113
150	-76.1	47.0	0.521E-04	-37.0	150.9	86.0		0.062
16 22								
0	58.9	38.7	0.300E-03	59.1	105.0	0.0		1.000
50	58.6	8.3	0.182E-03	70.3	155.6	15.7		0.339
100	42.6	0.9	0.799E-04	56.4	173.5	16.7		0.267
150	55.5	17.0	0.364E-04	65.1	140.7	16.7		0.121
16 23								
0	54.3	14.0	0.590E-03	64.8	147.2	0.0		1.000
50	49.4	352.2	0.343E-03	61.5	189.1	14.2		0.581
100	47.8	350.2	0.144E-03	59.8	192.2	2.1	A	0.245
150	47.0	358.6	0.104E-03	59.9	177.4	5.7		0.176
16 24								
0	76.4	31.0	0.950E-03	74.2	50.2	0.0		1.000
50	66.2	21.3	0.428E-03	74.1	113.5	10.7		0.451
100	54.5	21.1	0.256E-03	62.8	134.6	11.7	A	0.269
150	54.0	20.8	0.192E-03	62.5	135.6	0.5		0.262
16 25								
0	67.1	38.2	0.929E-03	66.4	89.1	0.0		1.000
50	58.4	25.2	0.561E-03	64.9	123.9	10.6	A	0.604
100	56.1	18.0	0.302E-03	65.4	138.4	4.5		0.325
150	49.4	21.3	0.291E-03	58.4	138.1	7.0		0.313
16 26								
0	55.9	333.6	0.660E-03	62.1	224.8	0.0		1.000
50	59.6	352.6	0.353E-03	71.5	192.9	10.8		0.534
100	53.1	351.9	0.250E-03	64.8	190.8	6.5	A	0.378
150	48.9	352.5	0.780E-04	61.0	188.5	4.2		0.118
16 27								
0	51.3	53.4	0.522E-03	45.7	97.5	0.0		1.000
50	53.8	29.2	0.214E-03	59.2	123.1	14.9		0.409
100	50.9	30.2	0.576E-04	56.3	124.2	3.0		0.110
150	-75.7	296.2	0.477E-04	-40.8	207.4	139.7		0.391

DYKE 17

DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
	**** MAGNETIZATION	****		POLE POSITION				
17 1								
0	53.8	278.1	0.143E-02	32.7	278.5	0.0		1.000
50	55.7	303.3	0.106E-02	47.4	259.4	14.6		0.742
100	55.3	296.0	0.536E-03	43.2	265.5	4.2	A	0.374
150	53.5	300.5	0.456E-03	44.2	260.0	3.2		0.319
17 2								
0	59.6	239.1	0.140E-02	20.1	310.8	0.0		1.000
50	48.6	275.4	0.940E-03	27.5	277.3	23.6		0.672
100	45.9	274.3	0.763E-03	25.1	276.7	2.8	A	0.546
150	44.2	273.1	0.660E-03	23.4	276.7	1.8		0.471
17 3								
0	44.2	330.4	0.232E-02	51.7	220.6	0.0		1.000
50	55.0	301.2	0.927E-03	45.7	260.6	21.6		0.400
100	57.7	298.3	0.615E-03	46.3	265.6	3.2		0.265
150	51.4	278.7	0.300E-03	31.2	276.4	13.0		0.129
17 4L								
0	76.3	268.2	0.162E-02	49.1	312.9	0.0		1.000
50	68.3	303.2	0.793E-03	57.6	278.3	13.0		0.490
100	67.0	279.4	0.492E-03	44.7	291.0	9.0	A	0.304
150	71.9	297.8	0.399E-03	57.7	289.9	8.0		0.246
17 5								
0	68.6	3.6	0.198E-02	83.5	154.8	0.0		1.000
50	68.3	321.0	0.110E-02	66.9	265.3	15.3		0.557
100	68.4	313.3	0.738E-03	62.9	271.6	2.9	A	0.373
150	69.0	313.0	0.569E-03	63.2	273.3	0.5		0.287
17 6								
0	50.2	310.8	0.115E-02	47.2	247.4	0.0		1.000
50	62.4	309.1	0.745E-03	55.9	262.6	12.2	A	0.650
100	63.5	303.2	0.443E-03	53.7	269.3	2.9		0.387
150	62.9	309.9	0.339E-03	56.7	262.8	3.0		0.296
17 7								
0	54.1	313.8	0.158E-02	51.6	247.7	0.0		1.000
50	57.4	307.8	0.682E-03	51.1	257.2	4.7		0.433
100	55.3	316.2	0.469E-03	53.7	246.4	5.1	A	0.298
150	59.6	303.2	0.256E-03	50.4	263.8	8.2		0.162
17 8L								
0	41.8	6.7	0.148E-02	55.7	164.0	0.0		1.000
50	52.2	309.6	0.750E-03	48.0	250.3	39.2		0.507
100	53.1	304.8	0.445E-03	46.1	255.7	3.1		0.301
150	59.5	307.6	0.280E-03	52.6	259.8	6.6		0.189
17 9								
0	41.6	33.3	0.231E-02	48.4	125.7	0.0		1.000
50	53.4	299.1	0.637E-03	43.4	261.1	60.0		0.276
100	51.3	292.6	0.365E-03	38.5	265.1	4.5		0.158
150	51.3	284.5	0.236E-03	34.2	271.7	5.0		0.102
17 10L								
0	56.0	261.7	0.220E-02	26.4	292.3	0.0		1.000
50	51.5	308.3	0.107E-02	46.8	250.9	27.4	A	0.488
100	52.5	314.6	0.794E-03	50.8	245.4	4.0		0.361
150	55.5	313.1	0.689E-03	52.3	249.8	3.1		0.314

17 11								
0	74.7	152.5	0.148E-02	31.4	9.8	0.0		1.000
50	52.1	281.0	0.947E-03	33.0	275.1	48.6		0.640
100	47.1	284.2	0.648E-03	31.1	269.3	5.4	A	0.438
150	54.5	290.5	0.565E-03	39.7	269.3	8.4		0.382
17 12								
0	35.7	307.1	0.172E-02	35.9	242.8	0.0		1.000
50	47.1	303.7	0.151E-02	41.3	252.2	11.8		0.878
100	47.1	308.1	0.111E-02	43.6	248.0	3.0	A	0.648
150	40.6	279.1	0.385E-03	24.3	270.2	21.7		0.224
17 13								
0	78.4	345.5	0.151E-02	78.4	326.7	0.0		1.000
50	72.8	323.0	0.793E-03	70.7	281.1	7.9		0.525
100	79.9	319.8	0.646E-03	69.3	316.9	7.1	A	0.427
150	89.6	118.5	0.548E-03	57.7	356.2	10.5		0.363
17 14								
0	51.9	324.9	0.778E-03	55.2	233.0	0.0		1.000
50	63.5	302.9	0.574E-03	53.5	269.8	16.4		0.738
100	60.9	291.0	0.388E-03	45.1	275.2	6.1	A	0.499
150	51.1	282.4	0.269E-03	32.9	273.3	10.9		0.346
17 15								
0	51.2	331.8	0.151E-02	57.5	223.2	0.0		1.000
50	60.4	310.5	0.597E-03	55.0	258.4	15.0		0.395
100	54.7	328.1	0.678E-03	58.9	231.8	10.9	A	0.449
150	48.9	328.2	0.678E-03	54.2	226.4	5.8		0.448
17 16								
0	67.4	316.5	0.201E-02	63.9	266.5	0.0		1.000
50	54.9	314.9	0.955E-03	52.7	247.3	12.6		0.474
100	44.7	220.0	0.251E-03	0.8	319.7	57.3		0.125
17 17								
0	-14.0	1.2	0.249E-02	24.8	173.5	0.0		1.000
50	53.9	323.9	0.118E-02	56.3	236.1	75.0		0.473
100	12.3	199.2	0.364E-03	-23.9	333.9	99.0		0.146
17 18								
0	54.1	280.9	0.184E-02	34.3	276.6	0.0		1.000
50	53.1	247.7	0.380E-03	17.7	300.9	19.5		0.206
100	46.1	337.3	0.927E-03	55.5	212.0	54.6		0.503
17 19								
0	62.7	307.8	0.197E-02	55.4	264.2	0.0		1.000
50	44.1	310.8	0.158E-02	42.9	243.3	18.7		0.805
100	43.6	318.4	0.162E-02	46.2	234.8	5.5		0.824
150	-24.2	167.2	0.669E-03	-43.6	12.2	149.6		0.340
17 20								
0	47.5	5.9	0.181E-02	63.2	164.4	0.0		1.000
50	43.5	273.0	0.437E-03	22.9	276.5	61.1		0.241
100	70.4	336.2	0.140E-02	76.4	259.9	40.7		0.772
150	64.5	330.4	0.127E-02	68.6	244.4	6.3		0.698
200	-44.2	176.7	0.167E-03	-57.8	0.3	155.0		0.092
17 21								
0	68.8	251.5	0.129E-02	34.6	309.8	0.0		1.000
50	72.6	292.3	0.561E-03	55.6	294.1	13.7		0.435
100	-1.8	300.1	0.114E-03	14.6	238.2	74.5		0.089

17 22							
0	51.3	259.7	0.113E-02	21.7	290.9	0.0	1.000
50	65.5	314.7	0.391E-03	61.4	263.3	30.8	0.348
100	39.5	80.2	0.359E-03	24.0	80.5	66.9	0.319
150	-64.6	48.1	0.227E-03	-21.9	141.3	107.1	0.202
17 23							
0	70.7	341.6	0.178E-02	79.4	255.9	0.0	1.000
50	74.6	313.7	0.870E-03	66.9	231.9	9.0	0.489
100	65.1	299.4	0.415E-03	53.0	274.9	10.6	A 0.233
150	52.3	294.9	0.259E-03	40.4	263.8	13.1	0.146
17 24							
0	66.8	228.8	0.923E-03	24.7	322.2	0.0	1.000
50	74.4	264.2	0.722E-03	45.6	310.8	13.6	A 0.783
100	65.7	292.5	0.348E-03	50.0	280.6	12.7	0.377
150	50.2	321.2	0.253E-03	52.2	236.0	21.4	0.274

DYKE 18

DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
	**** MAGNETIZATION ****			POLE POSITION				
18 1								
0	67.9	291.2	0.178E-02	51.2	285.1	0.0		1.000
25	63.7	296.2	0.146E-02	50.1	274.9	4.7		0.822
50	62.3	289.8	0.951E-03	45.6	277.7	3.2	A	0.534
75	54.6	278.4	0.657E-03	33.5	278.5	9.7		0.369
100	53.5	274.7	0.608E-03	30.8	280.9	2.4		0.342
125	51.7	271.7	0.579E-03	27.9	282.1	2.6		0.325
150	49.1	268.3	0.461E-03	24.2	283.1	3.4		0.259
175	49.5	276.0	0.484E-03	28.5	277.3	5.1		0.272
200	49.9	266.6	0.392E-03	24.0	284.9	6.1		0.220
250	50.1	279.2	0.459E-03	30.6	275.2	8.1		0.258
18 2								
0	77.0	272.1	0.264E-02	51.2	312.9	0.0		1.000
50	58.4	262.2	0.148E-02	28.7	293.7	18.9		0.560
100	51.7	270.2	0.120E-02	27.1	283.1	8.2	A	0.453
150	50.3	265.4	0.107E-02	23.7	286.0	3.3		0.406
200	49.8	265.0	0.101E-02	23.1	286.0	0.6		0.383
18 3L								
0	81.2	310.9	0.136E-02	66.0	321.4	0.0		1.000
50	60.0	269.8	0.694E-03	33.7	289.6	24.0		0.512
100	52.9	267.7	0.503E-03	26.7	285.8	7.3		0.371
150	54.1	263.8	0.482E-03	25.8	289.5	2.6	A	0.355
200	49.3	263.5	0.386E-03	22.0	286.9	4.8		0.285
18 4								
0	40.0	292.3	0.136E-02	30.8	258.7	0.0		1.000
50	52.3	264.6	0.718E-03	24.8	287.8	22.6		0.529
100	52.1	263.4	0.500E-03	24.1	288.6	0.8	A	0.368
150	51.5	263.8	0.432E-03	23.8	287.9	0.7		0.318
200	51.7	267.9	0.357E-03	25.9	284.9	2.5		0.263
18 5								
0	56.0	326.5	0.225E-02	59.3	235.0	0.0		1.000
50	58.3	263.4	0.115E-02	29.1	292.7	33.1		0.510
100	57.8	262.4	0.825E-03	28.2	293.1	0.8	A	0.367
150	57.5	250.9	0.660E-03	22.8	301.1	6.1		0.294
200	57.6	246.2	0.540E-03	21.0	304.5	2.5		0.240
18 6L								
0	59.6	279.6	0.139E-02	38.2	282.2	0.0		1.000
50	53.0	256.9	0.613E-03	21.7	294.0	14.2		0.440
100	47.7	254.3	0.479E-03	16.4	293.2	5.6	A	0.344
150	50.6	253.2	0.538E-03	18.1	295.5	3.0		0.386
200	44.5	256.8	0.367E-03	15.4	289.8	6.5		0.263
250	50.2	255.2	0.354E-03	18.7	293.7	5.8		0.254
18 7								
0	85.0	8.2	0.941E-03	67.8	358.5	0.0		1.000
50	57.6	267.7	0.393E-03	30.5	289.1	33.6		0.417
100	47.8	269.2	0.302E-03	23.7	281.7	9.9		0.321
150	47.3	269.7	0.285E-03	23.7	281.0	0.6	A	0.303
200	45.1	271.6	0.236E-03	23.2	278.4	2.6		0.251
18 8L								
0	88.8	99.6	0.208E-02	57.6	359.2	0.0		1.000
50	50.0	263.7	0.101E-02	22.6	287.2	41.1		0.485
100	47.7	263.0	0.103E-02	20.7	286.5	2.3	A	0.492

150	48.2	266.5	0.902E-03	22.7	284.0	2.4		0.433
200	46.8	259.6	0.873E-03	18.3	288.7	4.9		0.419
18 9L								
0	62.2	258.6	0.131E-02	30.5	299.1	0.0		1.000
50	47.6	262.7	0.939E-03	20.4	286.7	14.8		0.718
100	44.8	261.7	0.795E-03	18.0	286.1	2.9	A	0.608
150	44.7	257.4	0.830E-03	15.8	289.5	3.1		0.635
200	44.1	253.4	0.815E-03	13.5	292.4	2.9		0.623
18 10L								
0	56.4	290.4	0.228E-02	41.1	271.0	0.0		1.000
50	46.1	263.0	0.132E-02	19.5	285.7	19.8		0.582
100	42.6	257.0	0.129E-02	14.3	288.8	5.5	A	0.566
150	43.1	262.2	0.121E-02	17.1	285.0	3.8		0.531
200	43.4	257.4	0.118E-02	15.0	288.8	3.4		0.518
18 11								
0	44.3	262.6	0.112E-02	18.1	285.2	0.0		1.000
50	52.6	258.0	0.820E-03	21.9	292.9	8.8		0.731
100	48.6	256.4	0.749E-03	18.1	292.0	4.1		0.667
150	47.4	253.3	0.688E-03	15.8	293.8	2.4	A	0.614
200	45.7	255.9	0.658E-03	15.8	291.1	2.4		0.586
250	48.5	255.5	0.573E-03	17.6	292.7	2.8		0.511
18 12								
0	64.0	242.4	0.201E-02	25.8	311.3	0.0		1.000
50	52.3	263.9	0.159E-02	24.4	288.3	16.1		0.794
100	50.6	263.4	0.145E-02	22.9	287.7	1.7		0.722
150	48.7	261.8	0.136E-02	20.8	287.9	2.2	A	0.679
200	47.8	260.8	0.134E-02	19.6	288.2	1.2		0.667
18 13L								
0	55.4	257.1	0.147E-02	23.7	295.3	0.0		1.000
50	51.5	267.4	0.111E-02	25.5	285.2	7.3		0.757
100	47.8	266.8	0.103E-02	22.6	283.5	3.7	A	0.703
150	46.4	263.4	0.872E-03	19.9	285.5	2.7		0.593
200	48.2	264.7	0.791E-03	21.8	285.4	2.0		0.538
18 14								
0	51.5	249.9	0.194E-02	17.3	298.5	0.0		1.000
150	46.2	262.3	0.143E-02	19.2	286.3	9.7		0.738
200	43.9	264.6	0.131E-02	18.9	283.4	2.8	A	0.675
18 15								
0	64.6	264.6	0.252E-02	35.6	297.5	0.0		1.000
50	51.4	254.8	0.205E-02	19.5	294.7	14.2	A	0.815
100	48.9	255.3	0.189E-02	17.8	293.0	2.6		0.752
150	48.1	252.5	0.198E-02	15.9	294.8	2.0		0.786
200	48.7	254.2	0.195E-02	17.1	293.8	1.3		0.776
18 16								
0	56.3	254.1	0.174E-02	23.1	298.0	0.0		1.000
50	49.7	257.8	0.149E-02	19.5	291.5	7.0		0.858
100	47.5	257.3	0.149E-02	17.7	290.8	2.2	A	0.854
150	46.8	255.4	0.138E-02	16.3	291.9	1.4		0.793
200	44.9	254.8	0.132E-02	14.7	291.8	2.0		0.757
250	44.6	251.4	0.129E-02	13.0	294.1	2.4		0.741
18 17								
0	70.2	283.4	0.157E-02	49.5	293.6	0.0		1.000
50	62.3	281.7	0.777E-03	41.6	283.6	7.8		0.495
100	58.6	287.5	0.627E-03	41.3	275.4	4.7	A	0.400
150	58.3	271.8	0.609E-03	33.2	286.7	8.2		0.388

200	55.3	276.6	0.558E-03	33.1	280.8	4.0		0.355
18 18								
0	52.4	232.9	0.165E-02	11.2	311.8	0.0		1.000
50	60.8	276.4	0.752E-03	37.6	285.7	24.8		0.455
100	51.0	261.3	0.652E-03	22.2	289.8	12.9	A	0.394
150	47.5	263.5	0.585E-03	20.7	286.0	3.8		0.354
200	46.7	258.1	0.580E-03	17.5	289.8	3.8		0.351
18 19								
0	72.8	156.9	0.131E-02	27.8	8.3	0.0		1.000
50	66.1	246.9	0.525E-03	32.1	312.0	27.6		0.401
100	56.5	260.7	0.354E-03	26.3	293.4	13.2		0.270
150	47.6	262.3	0.274E-03	20.2	287.0	8.9	A	0.210
200	53.4	256.3	0.265E-03	21.7	294.8	6.9		0.203
18 20								
0	63.1	271.7	0.188E-02	37.4	291.2	0.0		1.000
50	57.4	262.6	0.106E-02	28.0	292.8	7.2		0.562
100	55.0	262.7	0.871E-03	26.0	290.9	2.4		0.463
150	53.6	260.7	0.820E-03	23.9	291.5	1.8	A	0.436
200	48.4	260.8	0.627E-03	20.0	288.5	5.2		0.334
18 21								
0	57.3	306.9	0.164E-02	50.5	257.8	0.0		1.000
25	69.2	289.9	0.133E-02	51.7	288.2	14.1		0.811
50	64.8	281.5	0.848E-03	43.6	286.7	5.5	A	0.518
75	60.3	272.3	0.638E-03	35.1	288.0	6.2		0.389
100	56.2	271.2	0.637E-03	31.1	285.5	4.1		0.389
125	53.9	270.5	0.553E-03	28.9	284.3	2.4		0.337
150	51.8	264.1	0.531E-03	24.2	287.9	4.4		0.324
175	54.5	267.0	0.499E-03	27.7	287.4	3.2		0.305
200	51.3	262.8	0.491E-03	23.1	288.6	4.1		0.300
250	58.5	272.6	0.530E-03	33.8	286.3	9.2		0.324
18 22								
0	44.4	275.3	0.209E-02	24.7	275.1	0.0		1.000
50	57.4	264.7	0.137E-02	29.0	291.1	14.6		0.654
100	55.0	267.5	0.106E-02	28.4	287.4	2.9	A	0.507
150	53.6	263.1	0.998E-03	25.1	289.8	3.0		0.478
200	49.1	260.0	0.827E-03	20.1	289.5	4.9		0.396
18 23								
0	75.5	276.7	0.122E-02	51.4	307.7	0.0		1.000
50	60.3	262.2	0.854E-03	30.4	295.1	16.0		0.699
100	45.5	262.2	0.697E-03	18.8	286.0	14.8	A	0.570
150	46.3	260.8	0.702E-03	18.6	287.5	1.3		0.574
200	48.0	257.1	0.404E-03	18.0	291.2	3.1		0.331
18 24								
0	69.5	270.6	0.178E-02	43.1	299.8	0.0		1.000
50	60.8	262.1	0.137E-02	30.8	295.8	9.4		0.771
100	53.6	262.9	0.122E-02	25.0	289.9	7.2	A	0.684
150	54.3	262.1	0.123E-02	25.1	290.9	0.8		0.692
200	53.4	261.4	0.124E-02	24.1	290.9	1.0		0.695
18 25								
0	82.0	351.7	0.136E-02	73.4	346.9	0.0		1.000
50	77.9	276.7	0.726E-03	53.6	313.7	12.6		0.534
100	63.4	268.9	0.429E-03	36.3	293.4	14.7		0.315
150	69.5	270.5	0.441E-03	43.0	299.8	6.1	A	0.325
200	69.1	267.5	0.343E-03	41.3	301.0	1.1		0.252
18 26								

18 26								
0	58.3	274.1	0.187E-02	34.3	285.0	0.0		1.000
50	52.2	273.2	0.133E-02	29.0	281.3	6.1		0.715
100	53.0	268.3	0.116E-02	27.1	285.5	3.1	A	0.622
150	53.0	264.5	0.999E-03	25.3	288.3	2.3		0.535
200	52.6	263.3	0.918E-03	24.4	289.0	0.8		0.492
250	55.3	263.1	0.102E-02	26.4	290.8	2.7		0.545
18 27								
0	84.1	333.5	0.181E-02	67.9	341.0	0.0		1.000
50	63.4	271.8	0.643E-03	37.6	291.4	24.4		0.355
100	59.3	268.8	0.423E-03	32.6	289.7	4.3		0.234
150	51.8	270.0	0.320E-03	27.1	283.4	7.5		0.177
200	51.9	267.9	0.291E-03	26.1	285.1	1.3		0.161
18 28								
0	55.5	260.7	0.146E-02	25.4	292.7	0.0		1.000
50	55.3	272.2	0.811E-03	30.9	284.1	6.5		0.557
100	48.3	267.4	0.596E-03	23.2	283.4	7.6	A	0.409
150	46.8	269.3	0.526E-03	23.1	281.1	2.1		0.361
200	47.7	264.4	0.450E-03	21.3	285.4	3.5		0.309
18 29								
0	69.6	258.9	0.139E-02	38.4	306.5	0.0		1.000
50	57.2	259.5	0.961E-03	26.3	294.7	12.5		0.689
100	53.3	270.8	0.844E-03	28.6	283.7	7.5	A	0.605
150	52.7	252.4	0.760E-03	19.4	297.2	11.0		0.546
200	53.0	252.6	0.724E-03	19.7	297.1	0.3		0.519
18 30								
0	65.0	286.4	0.182E-02	46.2	283.6	0.0		1.000
50	59.0	271.9	0.109E-02	33.8	287.3	9.0		0.602
100	51.4	271.9	0.896E-03	27.7	281.7	7.7	A	0.493
150	51.2	268.5	0.800E-03	25.9	284.2	2.1		0.440
200	52.4	271.8	0.725E-03	28.4	282.4	2.4		0.399

DYKE 19

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
19 1L							
0	72.7	353.6	0.233E-02	86.6	264.0	0.0	1.000
50	76.2	24.1	0.739E-03	77.2	48.8	8.8	0.317
100	-20.4	113.4	0.420E-03	-21.2	70.1	109.7	0.180
150	76.8	78.6	0.380E-03	54.5	40.7	99.4	0.163
19 2L							
0	80.0	48.6	0.210E-02	66.6	33.9	0.0	1.000
50	66.6	107.7	0.519E-03	32.6	42.5	20.0	0.247
100	-51.3	102.0	0.189E-03	-32.9	93.8	118.0	0.090
150	-60.5	127.3	0.355E-03	-53.3	81.1	16.7	0.169
19 3L							
0	71.6	61.9	0.208E-02	57.7	60.9	0.0	1.000
50	65.8	84.2	0.692E-03	41.9	58.1	9.9	0.333
100	-31.9	151.7	0.234E-03	-44.0	33.8	110.4	0.113
150	56.4	87.1	0.701E-03	32.2	65.4	103.8	0.338
19 4L							
0	72.2	130.0	0.173E-02	32.2	24.1	0.0	1.000
50	49.9	122.9	0.684E-03	10.9	42.2	22.6	0.394
100	-57.7	52.7	0.314E-03	-16.1	134.3	121.9	0.181
150	41.0	112.0	0.621E-03	9.1	54.3	110.4	0.358
19 5L							
0	57.7	79.7	0.200E-02	37.0	69.9	0.0	1.000
50	48.3	91.5	0.821E-03	23.8	67.2	11.7	0.410
100	38.6	108.0	0.574E-03	9.5	58.3	15.3	0.286
150	36.4	109.1	0.496E-03	7.7	58.3	2.3	0.248
19 6							
0	65.2	79.8	0.142E-02	43.5	61.7	0.0	1.000
50	20.5	101.8	0.258E-03	2.9	69.3	47.0	0.181
100	36.2	119.6	0.516E-03	2.8	49.7	22.1	0.363
150	-76.9	301.5	0.440E-03	-41.0	203.2	139.2	0.309
19 7L							
0	72.6	359.0	0.225E-02	89.3	230.8	0.0	1.000
50	71.6	3.1	0.854E-03	87.5	131.7	1.6	0.380
100	-55.0	140.5	0.164E-03	-55.6	61.0	155.6	0.073
150	-63.1	174.1	0.433E-03	-75.9	12.1	18.8	0.193
19 8U							
0	71.4	14.6	0.279E-02	81.8	94.1	0.0	1.000
50	77.5	37.3	0.672E-03	71.3	44.8	8.5	0.241
100	-33.5	106.6	0.214E-03	-24.2	80.7	118.4	0.077
150	-73.0	134.2	0.547E-03	-66.5	105.4	41.9	0.196
19 9							
0	58.7	7.4	0.231E-02	70.6	157.4	0.0	1.000
50	63.7	58.0	0.886E-03	53.2	79.5	24.2	0.383
100	56.9	65.3	0.612E-03	43.8	81.8	7.6	0.265
150	56.5	79.3	0.548E-03	36.2	71.1	7.7	0.237

DYKE 20

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
20 1							
0	47.7	112.2	0.127E-05	13.7	51.4	0.0	1.000
100	59.0	93.3	0.773E-06	31.4	58.9	15.8	0.608
20 2							
0	81.6	110.6	0.327E-06	49.8	19.0	0.0	1.000
100	76.4	174.1	0.181E-06	32.6	357.9	12.3	0.552
20 3L							
0	65.9	68.6	0.413E-06	49.6	68.3	0.0	1.000
100	65.0	21.6	0.385E-06	72.9	116.4	19.1	0.934
20 4L							
0	67.9	62.0	0.430E-06	54.7	69.2	0.0	1.000
100	67.6	17.7	0.363E-06	77.2	114.3	16.4	0.842
20 5L							
0	74.9	32.3	0.272E-06	73.7	59.4	0.0	1.000
100	54.5	28.9	0.161E-06	59.9	122.7	20.4	0.591
20 6L							
0	44.4	74.1	0.197E-06	30.2	83.3	0.0	1.000
100	14.8	84.9	0.122E-06	9.1	85.2	31.0	0.619
20 7L							
0	35.2	13.4	0.274E-06	49.9	154.9	0.0	1.000
100	9.2	7.1	0.252E-06	36.1	166.1	26.7	0.921
20 8L							
0	67.3	333.5	0.491E-06	72.6	248.5	0.0	1.000
100	70.8	335.7	0.315E-06	76.4	262.2	3.6	0.643
20 9L							
0	62.1	13.1	0.266E-06	73.0	140.4	0.0	1.000
100	57.4	8.5	0.253E-06	69.0	155.8	5.3	0.951
20 10L							
0	20.3	93.4	0.217E-06	7.1	76.4	0.0	1.000
100	16.8	72.1	0.220E-06	16.7	95.7	20.5	1.011
20 11							
0	26.4	75.3	0.179E-06	19.5	89.9	0.0	1.000
100	16.9	74.1	0.922E-07	15.7	93.9	9.6	0.515
20 12L							
0	68.9	24.4	0.192E-06	75.0	97.5	0.0	1.000
100	60.9	51.5	0.176E-06	54.3	89.0	13.8	0.915
20 13L							
0	47.8	155.2	0.235E-05	-0.4	16.4	0.0	1.000
50	76.2	323.2	0.131E-05	71.6	298.0	55.7	0.556
100	71.6	330.0	0.961E-06	73.8	270.8	5.0	0.408

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
21 1							
0	72.1	66.4	0.549E-03	55.9	57.2	0.0	1.000
25	69.1	25.9	0.244E-03	74.4	94.2	13.5	0.444
50	79.7	325.8	0.102E-03	71.3	318.0	18.1	0.186
21 2L							
0	63.6	268.3	0.817E-03	36.3	293.9	0.0	1.000
25	60.0	260.7	0.377E-03	29.4	295.9	5.1	0.461
50	53.9	247.3	0.125E-03	18.1	301.8	9.5	0.153
21 3							
0	68.7	186.9	0.498E-03	20.2	350.3	0.0	1.000
25	43.4	160.8	0.229E-03	-5.1	12.2	28.7	0.460
50	-66.8	98.3	0.151E-03	-44.0	111.3	120.0	0.302
21 4							
0	70.9	303.7	0.343E-03	59.8	284.1	0.0	1.000
25	76.0	255.0	0.184E-03	44.3	317.7	14.3	0.538
50	73.5	210.1	0.118E-03	29.8	337.7	11.8	0.345
21 5							
0	48.1	52.3	0.364E-03	44.1	100.5	0.0	1.000
25	8.7	96.7	0.188E-03	0.2	76.7	54.3	0.517
50	-53.6	109.9	0.329E-03	-38.7	88.9	63.3	0.903
21 6							
0	63.3	242.0	0.509E-03	25.0	311.1	0.0	1.000
25	79.3	211.5	0.211E-03	39.3	340.9	18.2	0.415
50	61.7	139.8	0.798E-04	16.3	24.3	26.8	0.157
21 7							
0	64.5	351.9	0.460E-03	77.2	201.1	0.0	1.000
25	63.3	46.6	0.195E-03	58.9	89.3	23.4	0.425
50	54.1	37.7	0.136E-03	55.8	111.4	10.3	0.295
21 8							
0	50.8	64.0	0.399E-03	39.9	87.8	0.0	1.000
25	-33.3	103.5	0.275E-03	-22.4	83.3	91.0	0.688
50	-15.1	99.9	0.283E-03	-11.7	86.4	18.5	0.710
21 9L							
0	29.7	328.4	0.802E-03	41.7	217.3	0.0	1.000
25	82.8	337.1	0.533E-04	70.5	338.0	53.1	0.066
50	47.7	85.1	0.326E-03	26.7	72.4	45.0	0.407
21 10							
0	49.4	70.2	0.233E-02	35.7	83.5	0.0	1.000
25	33.7	78.5	0.595E-03	21.6	84.3	16.9	0.255
50	27.5	76.6	0.400E-03	19.4	88.3	6.5	0.172
21 11							
0	54.9	300.6	0.339E-03	45.3	261.0	0.0	1.000
25	30.8	16.5	0.124E-03	46.7	151.3	57.4	0.366
50	-48.2	280.7	0.339E-04	-19.2	240.1	116.1	0.100
21 12L							
0	44.8	324.2	0.515E-03	49.6	228.8	0.0	1.000
25	62.6	350.2	0.114E-03	74.6	202.4	23.2	0.222
50	-31.1	223.6	0.141E-03	-37.7	298.2	133.9	0.274

21 13L							
0	42.0	214.6	0.462E-03	-2.8	323.6	0.0	1.000
25	66.3	248.0	0.677E-04	30.5	309.5	30.5	0.147
50	-40.6	292.7	0.156E-03	-8.5	233.8	112.3	0.338
21 14							
0	45.1	42.5	0.440E-03	46.8	112.9	0.0	1.000
25	8.2	75.5	0.132E-03	11.1	95.0	46.6	0.301
50	-29.4	91.8	0.144E-03	-14.2	91.7	40.7	0.327
21 15							
0	7.3	324.1	0.652E-02	28.8	216.6	0.0	1.000
25	10.2	334.5	0.265E-02	33.4	205.8	10.6	0.406
50	13.7	347.8	0.783E-03	38.0	190.3	13.5	0.120
21 16							
0	-33.0	286.8	0.161E-03	-6.7	241.3	0.0	1.000
25	-39.3	273.1	0.714E-04	-17.2	250.1	12.8	0.444
50	-22.1	270.0	0.198E-04	-9.7	258.6	17.4	0.123
21 17							
0	42.9	35.8	0.195E-03	48.3	121.8	0.0	1.000
25	10.9	58.2	0.125E-03	21.0	109.8	37.4	0.639
50	-40.8	126.8	0.521E-04	-38.9	65.4	81.6	0.267
21 18							
0	23.6	115.9	0.122E-03	-2.5	56.3	0.0	1.000
25	50.4	91.5	0.416E-04	25.3	65.9	32.7	0.341
50	-15.8	160.4	0.117E-04	-37.7	19.6	89.4	0.096
21 19							
0	60.1	278.8	0.108E-02	38.1	283.2	0.0	1.000
25	58.9	249.1	0.538E-03	23.4	303.2	15.0	0.498
50	49.1	242.9	0.437E-03	12.5	302.7	10.4	0.405
21 20							
0	66.2	230.0	0.146E-02	24.3	321.0	0.0	1.000
25	60.9	244.0	0.110E-02	23.2	308.1	8.2	0.752
50	58.3	246.7	0.106E-02	21.8	304.6	2.9	0.725
75	48.4	257.5	0.685E-03	18.4	291.0	11.8	0.469
21 21							
0	78.1	359.7	0.116E-02	80.9	354.0	0.0	1.000
25	85.5	358.2	0.873E-03	67.0	354.0	7.4	0.752
50	86.5	299.6	0.435E-03	61.0	342.2	4.0 A	0.374
75	85.5	313.0	0.353E-03	63.4	340.1	1.3	0.304
21 22							
0	82.9	224.9	0.149E-02	47.2	340.2	0.0	1.000
25	77.5	243.4	0.993E-03	42.8	325.1	6.2	0.668
50	72.5	243.6	0.755E-03	36.4	318.4	5.0	0.508
75	62.3	220.9	0.286E-03	17.2	325.1	13.3	0.193
21 23L							
0	78.0	259.1	0.121E-02	47.9	319.8	0.0	1.000
25	71.8	241.2	0.928E-03	34.6	318.9	7.7	0.766
50	60.0	234.5	0.435E-03	18.9	314.2	12.1	0.360

DYKE 22

	**** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
22 1								
0	74.3	347.0	0.186E-02	82.9	291.2	0.0		1.000
25	68.4	295.3	0.203E-02	53.7	283.4	16.9	A	1.088
50	64.6	284.3	0.191E-02	44.9	284.6	5.8		1.024
75	60.8	281.7	0.161E-02	40.2	281.9	4.0		0.862
100	60.3	276.2	0.144E-02	37.1	285.3	2.7		0.770
125	62.6	284.8	0.137E-02	43.3	281.7	4.7		0.734
22 2								
0	67.0	337.4	0.206E-02	74.3	241.9	0.0		1.000
50	66.0	305.3	0.212E-02	56.8	272.1	12.7		1.027
75	60.8	296.3	0.182E-02	47.8	271.0	6.6	A	0.884
100	64.3	301.4	0.182E-02	53.4	272.0	4.2		0.881
125	66.3	292.3	0.158E-02	50.4	281.7	4.3		0.764
22 3								
0	61.5	290.3	0.542E-02	45.2	276.5	0.0		1.000
50	59.7	268.9	0.421E-02	33.0	290.0	10.6		0.778
75	49.6	270.5	0.380E-02	25.7	281.7	10.2	A	0.701
100	49.4	266.3	0.334E-02	23.4	284.8	2.8		0.616
125	44.9	268.3	0.278E-02	21.4	281.0	4.7		0.514
22 4								
0	60.7	358.1	0.110E-02	73.6	179.8	0.0		1.000
50	50.2	273.5	0.126E-02	27.7	279.7	45.6		1.146
75	59.2	289.5	0.117E-02	42.9	274.5	12.8		1.067
100	49.2	266.3	0.104E-02	23.3	284.7	16.7		0.951
22 5								
0	64.5	332.8	0.194E-02	69.8	241.0	0.0		1.000
50	58.2	294.0	0.154E-02	44.4	269.8	19.3		0.795
75	60.4	306.7	0.131E-02	52.9	261.9	6.8	A	0.678
100	58.8	301.2	0.117E-02	48.7	264.7	3.2		0.605
125	63.5	292.4	0.102E-02	48.0	277.5	6.3		0.524
22 6								
0	60.7	325.6	0.284E-02	62.9	242.7	0.0		1.000
25	56.6	296.8	0.205E-02	44.6	266.0	15.4		0.722
50	54.4	290.8	0.198E-02	39.7	268.9	4.1	A	0.697
75	54.6	287.4	0.176E-02	38.2	271.9	2.0		0.619
100	53.7	277.6	0.162E-02	32.4	278.8	5.8		0.569
125	52.7	286.2	0.169E-02	36.1	271.4	5.2		0.593
22 7								
0	14.3	266.2	0.287E-02	4.1	271.9	0.0		1.000
50	36.2	268.9	0.143E-02	16.4	276.7	22.1		0.498
75	41.6	265.9	0.122E-02	18.0	281.3	5.8	A	0.426
100	43.8	265.6	0.115E-02	19.3	282.6	2.3		0.402
125	54.9	268.4	0.115E-02	28.7	286.7	11.2		0.402
22 8								
0	43.9	5.5	0.554E-02	57.4	165.5	0.0		1.000
50	48.2	351.7	0.257E-02	60.6	189.7	10.5		0.464
75	47.9	347.3	0.202E-02	59.6	197.1	2.9	A	0.364
100	45.5	285.0	0.120E-02	30.4	267.8	41.7		0.217
125	61.5	306.4	0.114E-02	53.7	263.7	20.3		0.205
22 9								
0	58.4	324.6	0.270E-02	60.4	240.4	0.0		1.000

50	57.1	305.8	0.177E-02	49.8	258.7	10.1		0.653
75	54.9	302.6	0.156E-02	46.4	259.3	2.8	A	0.579
100	54.9	291.2	0.124E-02	40.4	269.1	6.6		0.458
125	52.5	296.5	0.114E-02	41.4	262.8	4.0		0.423
							202	
22 10								
0	7.5	7.6	0.526E-01	35.4	165.5	0.0		1.000
50	11.7	357.0	0.236E-01	37.8	178.7	11.3		0.449
75	13.7	354.7	0.148E-01	38.7	181.8	2.9	A	0.281
100	14.6	353.4	0.963E-02	39.1	183.3	1.6		0.183
125	15.3	351.8	0.715E-02	39.3	185.4	1.7		0.136
22 11								
0	46.2	8.9	0.516E-02	58.9	159.4	0.0		1.000
25	58.6	351.4	0.271E-02	70.4	195.2	16.3		0.525
50	58.9	332.7	0.131E-02	64.6	230.2	9.6		0.254
75	60.1	326.8	0.119E-02	63.0	240.3	3.2		0.230
100	53.6	312.4	0.748E-03	50.5	248.7	10.2		0.145
125	55.3	310.3	0.642E-03	50.7	252.5	2.1		0.124
22 12								
0	62.6	324.6	0.374E-02	64.1	247.5	0.0		1.000
50	61.5	288.9	0.235E-02	44.5	277.5	16.5		0.629
75	58.8	285.8	0.230E-02	40.7	276.9	3.1	A	0.633
100	58.3	282.4	0.208E-02	38.5	279.0	1.8		0.557
125	58.1	288.1	0.201E-02	41.3	274.5	3.0		0.539
22 13								
0	30.4	292.2	0.279E-02	25.5	254.6	0.0		1.000
50	47.7	287.3	0.221E-02	33.1	267.1	17.7		0.793
75	48.4	286.9	0.205E-02	33.4	267.9	0.8	A	0.733
100	50.4	287.0	0.189E-02	34.9	269.1	2.1		0.677
125	55.6	284.9	0.181E-02	37.6	274.7	5.4		0.647
22 14								
0	47.6	328.6	0.448E-02	53.5	224.9	0.0		1.000
50	54.6	306.2	0.211E-02	48.0	255.8	15.7		0.471
75	60.6	305.9	0.186E-02	52.7	262.9	6.0		0.416
100	61.3	299.1	0.158E-02	49.7	269.5	3.4	A	0.352
125	55.9	298.9	0.136E-02	45.2	263.5	5.4		0.303
22 15								
0	55.6	353.9	0.286E-01	67.7	188.0	0.0		1.000
50	50.0	355.1	0.134E-01	62.5	184.0	5.6		0.466
75	49.9	350.4	0.897E-02	61.8	192.5	3.0	A	0.313
100	50.2	345.1	0.590E-02	61.0	201.9	3.4		0.206
125	50.2	344.3	0.487E-02	60.8	203.4	0.5		0.170
22 16								
0	44.6	330.2	0.414E-02	51.9	221.1	0.0		1.000
25	47.5	323.4	0.217E-02	51.1	231.5	5.5		0.523
50	53.2	306.3	0.134E-02	47.0	254.3	12.2	A	0.323
75	52.8	296.0	0.108E-02	41.4	263.3	6.2		0.261
100	50.2	302.9	0.111E-02	43.0	255.1	5.0		0.269
125	50.3	301.0	0.109E-02	42.2	257.0	1.2		0.264
22 17								
0	58.1	288.4	0.244E-02	41.4	274.2	0.0		1.000
50	53.1	293.7	0.134E-02	40.3	265.5	5.8		0.549
75	52.4	292.8	0.114E-02	39.4	265.8	0.8	A	0.469
100	58.1	276.5	0.706E-03	35.4	283.1	10.8		0.290
125	58.1	281.8	0.719E-03	38.0	279.3	2.8		0.295
22 18								

0	-13.9	238.2	0.734E-02	-22.4	289.1	0.0	1.000
50	1.0	231.0	0.167E-02	-19.0	299.6	16.6	0.227
75	11.6	236.4	0.109E-02	-11.8	297.0	11.8	0.149
150	39.9	252.5	0.937E-03	10.4	291.4	31.7	0.128
22 19							
0	41.6	285.3	0.249E-02	28.1	265.5	0.0	1.000
50	54.0	266.4	0.127E-02	26.9	287.5	17.6	0.509
75	49.4	258.3	0.111E-02	19.6	291.0	6.8	0.445
100	60.4	274.7	0.102E-02	36.4	286.5	14.4	0.409
22 20							
0	-64.8	205.5	0.222E-01	-71.0	290.3	0.0	1.000
50	-43.2	235.3	0.433E-02	-39.3	280.8	27.3	0.195
75	-28.8	242.5	0.207E-02	-27.4	280.4	15.5	0.093
100	-12.9	247.4	0.131E-02	-17.4	280.9	16.5	0.059
22 21							
0	36.3	275.4	0.307E-02	19.8	271.3	0.0	1.000
50	64.1	263.9	0.132E-02	34.7	297.4	28.7	0.429
75	73.3	263.8	0.126E-02	44.3	309.2	9.2	0.410
100	24.6	277.5	0.103E-02	14.9	265.4	49.3	0.334
22 22							
0	-13.8	274.7	0.128E-01	-3.5	257.1	0.0	1.000
50	-8.7	273.1	0.242E-02	-2.1	259.9	5.4	0.189
75	12.8	269.8	0.115E-02	5.4	268.4	21.7	0.090
100	-1.9	265.9	0.150E-02	-3.0	267.8	15.2	0.118
22 23							
0	49.4	313.3	0.353E-02	47.8	244.3	0.0	1.000
50	48.5	271.7	0.228E-02	25.6	280.1	26.9	0.645
75	41.9	293.0	0.231E-02	32.4	259.0	16.3	0.653
100	40.4	294.1	0.210E-02	32.1	257.2	1.8	0.594
125	40.6	285.9	0.171E-02	27.9	264.4	6.3	0.483
22 24							
0	2.0	178.8	0.541E-02	-30.9	356.2	0.0	1.000
50	49.7	248.1	0.193E-02	15.1	299.0	75.2	0.356
75	63.2	250.8	0.209E-02	28.3	305.2	13.6	0.386
100	43.8	263.5	0.190E-02	18.2	284.2	20.8	0.351
22 25							
0	67.0	314.8	0.314E-02	62.7	266.9	0.0	1.000
50	51.6	287.2	0.289E-02	35.8	269.8	20.5	0.922
75	62.0	287.6	0.213E-02	44.2	279.0	10.4	0.680
100	44.3	283.2	0.266E-02	28.7	268.6	17.9	0.848

DYKE 23

	**** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
23 1								
0	12.7	344.6	0.919E-06	37.0	194.1	0.0		1.000
50	25.1	8.7	0.173E-05	44.6	162.9	25.8		1.884
100	16.4	1.5	0.204E-05	37.2	172.9	16.2		2.217
23 3								
0	78.5	125.3	0.601E-06	42.1	19.3	0.0		1.000
50	48.6	45.3	0.811E-06	47.9	107.6	40.8		1.351
100	55.6	35.4	0.578E-06	58.0	112.7	9.2		0.963
23 4								
0	58.1	355.8	0.170E-05	70.5	184.6	0.0		1.000
50	51.5	347.6	0.147E-05	62.7	198.2	8.2	A	0.866
100	42.5	335.3	0.942E-06	52.2	213.2	12.3		0.554
23 5								
0	27.9	340.3	0.211E-05	44.3	201.9	0.0		1.000
50	12.2	348.4	0.194E-05	37.3	189.4	17.4		0.918
100	-6.9	350.0	0.153E-05	27.9	186.1	19.2		0.723
23 6								
0	-0.1	61.6	0.324E-05	14.5	109.5	0.0		1.000
50	-31.9	64.0	0.201E-05	-1.8	115.7	31.9		0.620
100	-29.2	105.0	0.405E-05	-21.1	80.5	35.3		1.249
150	-51.6	162.1	0.306E-05	-61.4	27.7	47.4		0.943
23 7								
0	17.8	348.1	0.762E-05	40.2	190.3	0.0		1.000
50	-0.7	337.9	0.716E-05	29.0	200.3	21.1		0.939
100	-5.6	318.5	0.691E-05	20.7	219.8	19.9		0.907
150	15.7	4.6	0.881E-05	39.8	168.9	50.3		1.156
23 8								
0	-22.6	326.4	0.133E-04	15.0	209.0	0.0		1.000
50	-25.0	319.5	0.153E-04	11.4	215.1	6.8		1.147
100	-22.5	315.7	0.136E-04	11.4	219.1	4.3	A	1.019
150	-19.5	322.4	0.114E-04	15.3	213.4	7.0		0.855
23 9								
0	3.6	301.3	0.592E-04	17.5	238.4	0.0		1.000
50	-2.1	300.4	0.591E-04	14.6	237.8	5.8		0.999
100	-9.5	296.5	0.540E-04	9.4	239.6	8.3	A	0.913
150	-9.7	296.7	0.492E-04	9.4	239.3	0.3		0.831
23 10								
0	-11.1	304.5	0.369E-03	12.4	232.0	0.0		1.000
50	-15.2	302.6	0.380E-03	9.7	232.7	4.5		1.029
100	-18.5	301.6	0.381E-03	7.6	232.8	3.4	A	1.031
150	-26.6	297.9	0.351E-03	1.9	233.9	8.8		0.951
23 11								
0	13.3	294.7	0.271E-03	18.6	247.0	0.0		1.000
50	3.6	288.8	0.221E-03	11.4	249.7	11.3		0.816
100	-5.8	279.8	0.195E-03	2.7	255.0	13.0	A	0.719
150	-4.9	283.6	0.187E-03	5.0	252.0	3.9		0.692
23 12								
0	31.6	326.0	0.368E-03	41.9	220.8	0.0	A	1.000
50	10.6	320.2	0.292E-03	28.9	221.6	21.7		0.793

100	-0.8	322.2	0.253E-03	24.3	217.2	11.5		0.688
150	8.7	322.4	0.269E-03	28.8	218.9	9.5		0.731
23 13								
0	49.7	350.9	0.123E-04	61.7	191.7	0.0		1.000
50	47.1	350.4	0.877E-05	59.4	191.7	2.7		0.715
100	28.6	349.0	0.698E-05	46.4	190.4	18.5		0.569
150	10.2	301.9	0.437E-05	20.7	239.6	47.7		0.356
23 14								
0	-2.1	294.4	0.811E-04	11.7	243.2	0.0		1.000
50	-12.1	297.1	0.853E-04	8.5	238.4	10.4		1.052
100	-17.6	295.2	0.845E-04	5.1	238.6	5.8	A	1.041
150	-7.5	304.9	0.796E-04	14.3	232.4	13.9		0.981
23 15								
0	30.1	31.1	0.263E-05	42.1	132.8	0.0		1.003
50	-8.7	53.0	0.279E-05	14.6	119.4	44.1		1.059
100	-21.6	51.5	0.246E-05	9.1	123.8	12.9		0.933
23 17								
0	26.5	43.4	0.172E-05	35.3	120.0	0.0		1.000
50	28.9	41.5	0.192E-05	37.4	121.3	2.9		1.117
100	21.3	39.4	0.130E-05	34.3	125.9	7.8	A	0.757
23 18								
0	65.8	351.5	0.555E-05	78.7	205.3	0.0		1.000
50	65.0	351.5	0.365E-05	77.8	203.3	0.8		0.657
23 19								
0	59.1	53.0	0.409E-05	52.0	89.7	0.0		1.000
50	54.1	30.7	0.390E-05	58.9	120.3	13.2		0.952
100	13.5	38.1	0.305E-05	30.9	129.2	41.0		0.745

DYKE 24

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG		J/J0
24 1								
0	75.7	283.4	0.297E-02	54.3	305.5	0.0		1.000
25	55.5	304.4	0.236E-02	47.8	258.2	21.7		0.793
50	51.8	306.0	0.237E-02	45.8	253.4	3.8	A	0.798
75	51.5	305.4	0.204E-02	45.3	253.6	0.4		0.686
100	48.7	289.3	0.187E-02	34.9	266.1	10.7		0.629
125	48.9	304.4	0.180E-02	43.0	252.6	9.9		0.604
24 2								
0	44.0	355.7	0.164E-02	57.5	182.0	0.0		1.000
75	45.0	295.9	0.145E-02	35.9	258.1	41.7		0.884
100	44.9	296.5	0.131E-02	36.1	257.5	0.4		0.801
125	53.4	276.6	0.106E-02	31.7	279.4	15.5		0.644
24 3								
0	57.2	297.6	0.238E-02	45.5	265.9	0.0		1.000
75	49.3	294.3	0.123E-02	37.9	262.2	8.1	A	0.518
100	48.6	296.7	0.116E-02	38.8	259.6	1.8		0.488
24 4								
0	57.1	301.0	0.281E-02	47.3	262.9	0.0		1.000
75	51.0	292.5	0.226E-02	38.2	264.9	7.8	A	0.803
100	52.0	291.5	0.193E-02	38.3	266.5	1.2		0.685
24 5								
0	59.0	293.7	0.241E-02	44.9	271.0	0.0		1.000
75	52.9	293.9	0.170E-02	40.3	265.2	6.1	A	0.706
100	50.4	293.0	0.143E-02	38.0	264.1	2.6		0.594
24 6								
0	52.5	257.0	0.168E-02	21.3	293.6	0.0		1.000
25	48.9	284.4	0.136E-02	32.4	270.3	17.6	A	0.808
50	45.2	293.3	0.118E-02	34.6	260.5	7.1		0.701
75	43.1	284.5	0.941E-03	28.7	266.9	6.6		0.561
100	47.2	294.0	0.879E-03	36.3	261.1	7.8		0.524
125	43.0	282.9	0.661E-03	27.7	268.2	8.9		0.394
24 7								
0	31.2	307.8	0.232E-02	33.8	240.3	0.0		1.000
75	46.9	301.6	0.148E-02	40.1	254.1	16.4	A	0.639
100	42.1	294.2	0.142E-02	33.1	258.1	7.1		0.612
24 8								
0	63.1	307.7	0.289E-02	55.7	264.9	0.0		1.000
75	51.8	298.7	0.167E-02	42.1	260.2	12.2	A	0.577
100	51.6	294.3	0.143E-02	39.6	263.8	2.7		0.496
24 9								
0	52.0	308.1	0.247E-02	47.1	251.6	0.0		1.000
75	48.0	309.1	0.181E-02	44.7	247.5	4.1	A	0.733
100	44.6	308.0	0.168E-02	41.8	246.5	3.5		0.679
24 10								
0	47.0	277.0	0.332E-02	27.3	275.2	0.0		1.000
75	50.3	282.3	0.273E-02	32.3	272.8	4.8	A	0.820
100	49.1	282.7	0.241E-02	31.7	271.8	1.2		0.725
24 11								
0	33.1	334.9	0.119E-02	45.9	210.2	0.0		1.000

25	57.1	312.3	0.159E-02	53.2	252.4	28.5		1.336
50	54.8	301.2	0.148E-02	45.6	260.5	6.6		1.246
75	52.9	299.6	0.139E-02	43.3	260.2	2.2	A	1.167
100	53.6	298.8	0.119E-02	43.4	261.5	0.9		0.999
125	54.3	297.3	0.108E-02	43.1	263.5	1.2		0.911
24 12								
0	40.6	283.8	0.303E-02	26.7	266.2	0.0		1.000
75	39.0	289.5	0.277E-02	28.8	260.6	4.7		0.912
100	39.6	279.8	0.225E-02	24.0	269.1	7.5		0.740
24 13								
0	56.1	313.2	0.183E-02	52.8	250.4	0.0		1.000
75	52.2	280.0	0.120E-02	32.4	275.9	19.6		0.660
100	47.1	299.2	0.151E-02	39.0	256.4	13.4		0.829
24 14								
0	30.8	282.1	0.337E-02	20.4	263.7	0.0		1.000
75	26.1	272.7	0.142E-02	13.1	269.9	9.4		0.422
100	44.2	289.4	0.192E-02	32.0	263.4	22.6		0.571
24 15								
0	49.3	283.4	0.145E-02	32.1	271.3	0.0		1.000
75	44.3	268.7	0.490E-03	21.2	280.3	11.2		0.337
100	42.2	286.5	0.127E-02	29.2	264.7	13.1		0.871
24 16								
0	59.6	295.8	0.195E-02	46.5	270.0	0.0		1.000
25	57.5	295.7	0.172E-02	44.8	267.9	2.1	A	0.883
50	56.5	293.2	0.153E-02	42.7	268.9	1.7		0.787
75	54.1	285.5	0.139E-02	36.7	273.0	5.0		0.713
100	56.2	290.6	0.134E-02	41.1	270.7	3.6		0.685
125	56.4	292.0	0.128E-02	41.9	269.7	0.8		0.655
24 17								
0	59.9	338.6	0.154E-02	68.0	222.4	0.0		1.000
75	50.6	299.1	0.408E-03	41.3	258.9	23.9		0.265
100	54.8	282.4	0.215E-03	35.7	276.0	10.9		0.139

DYKE 25

DMAG	**** MAGNETIZATION **** DIP	DEC	J ****	POLE POSITION LAT	LONG	ANG		J/J0
25 1								
0	-5.9	285.8	0.332E-02	5.8	249.7	0.0		1.000
25	53.0	287.1	0.126E-02	36.8	270.7	58.8		0.378
50	60.2	279.6	0.121E-02	38.6	282.7	8.3		0.363
75	54.1	275.4	0.791E-03	31.6	280.7	6.4		0.238
100	49.6	274.2	0.620E-03	27.6	278.8	4.6		0.187
125	48.8	278.6	0.514E-03	29.3	274.8	3.0		0.155
25 2								
0	1.2	283.8	0.470E-02	7.7	253.3	0.0		1.000
25	50.1	296.0	0.189E-02	39.4	261.1	50.0		0.402
50	46.6	275.5	0.986E-03	26.2	276.0	14.0		0.210
75	41.8	271.3	0.847E-03	20.9	277.0	5.7		0.180
100	-0.6	238.6	0.376E-03	-16.2	292.0	51.6		0.080
25 3								
0	11.8	280.6	0.382E-02	10.6	258.9	0.0		1.000
25	47.2	302.1	0.150E-02	40.6	253.6	39.8		0.394
50	48.2	291.0	0.834E-03	35.4	264.2	7.6		0.219
75	51.9	290.3	0.811E-03	37.7	267.4	3.8		0.213
100	39.9	280.4	0.343E-03	24.5	268.7	13.9		0.090
25 4								
0	31.8	285.5	0.424E-02	22.7	261.0	0.0		1.000
25	51.7	285.2	0.278E-02	34.8	271.4	19.9	A	0.657
50	50.7	279.6	0.210E-02	31.2	275.1	3.6		0.496
75	48.4	276.0	0.173E-02	27.7	276.6	3.3		0.408
100	37.1	271.5	0.122E-02	18.2	274.8	11.8		0.288
25 5								
0	43.2	280.1	0.263E-02	26.4	270.5	0.0		1.000
25	64.3	288.2	0.144E-02	46.6	281.3	21.6		0.546
50	60.0	288.1	0.104E-02	42.8	276.2	4.3		0.396
75	51.7	276.2	0.738E-03	30.2	278.4	10.6		0.281
100	26.8	262.7	0.477E-03	8.2	278.4	26.9		0.181
25 6								
0	51.2	286.1	0.412E-02	34.9	270.3	0.0		1.000
25	51.3	284.5	0.311E-02	34.1	271.6	1.0		0.756
50	50.3	281.6	0.282E-02	31.9	273.3	2.1	A	0.684
75	48.1	278.8	0.223E-02	28.9	274.2	2.8		0.540
100	47.4	276.2	0.201E-02	27.1	275.9	1.9		0.488
125	48.1	277.4	0.188E-02	28.2	275.3	1.1		0.456
25 7								
0	39.8	60.8	0.151E-01	34.4	97.3	0.0		1.000
25	43.9	59.5	0.137E-01	37.6	96.3	4.3		0.904
50	55.6	54.0	0.967E-02	48.7	92.7	12.1		0.639
75	65.4	45.5	0.686E-02	61.2	86.1	10.7		0.453
100	73.7	28.9	0.478E-02	75.1	66.6	10.0		0.316
25 8								
0	52.1	10.2	0.237E-01	63.7	155.0	0.0		1.000
25	60.5	1.0	0.172E-01	73.4	172.1	9.8		0.724
50	69.3	335.9	0.108E-01	75.4	254.1	13.6		0.455
75	69.7	313.1	0.793E-02	63.8	275.3	8.0		0.335
100	63.3	288.5	0.559E-02	45.8	279.9	11.6		0.236

25 9

25 9								
0	-48.6	81.3	0.118E+00	-20.4	108.1	0.0		1.000
25	-53.1	79.8	0.826E-01	-23.1	111.8	4.6		0.700
50	-55.2	90.5	0.491E-01	-33.0	105.1	6.6		0.416
75	-56.1	102.7	0.345E-01	-36.9	96.7	6.9		0.292
100	-60.0	115.2	0.210E-01	-46.5	90.8	7.7		0.178
125	-58.5	117.7	0.107E-01	-46.6	87.1	2.0	A	0.090
150	-68.7	154.4	0.812E-02	-74.3	73.3	18.8		0.069
200	-64.3	199.1	0.386E-02	-73.3	302.5	17.9		0.033
250	71.3	57.6	0.306E-02	59.5	63.7	164.2		0.026
300	-49.7	242.4	0.311E-02	-39.9	270.0	158.3		0.026
							209	
25 10								
0	55.7	304.6	0.159E-01	48.1	258.2	0.0		1.000
25	60.2	318.6	0.885E-02	58.9	249.9	8.6	A	0.558
50	61.3	307.5	0.526E-02	54.1	262.4	5.5		0.332
75	59.0	294.8	0.389E-02	45.5	270.0	6.7		0.245
100	58.8	309.0	0.385E-02	52.9	257.6	7.3		0.243
25 11								
0	9.3	106.7	0.448E-01	-4.7	68.0	0.0		1.000
25	10.6	100.3	0.302E-01	-0.9	73.1	6.5		0.676
50	23.5	92.2	0.104E-01	9.3	76.3	15.1		0.232
75	40.9	82.0	0.425E-02	23.9	78.4	19.4		0.095
100	54.8	62.6	0.278E-02	43.6	85.8	19.0		0.062
25 12								
0	49.3	291.8	0.769E-02	36.6	264.2	0.0		1.000
25	55.9	313.4	0.367E-02	52.8	249.9	14.6	A	0.478
50	57.2	317.7	0.222E-02	56.0	246.7	2.7		0.289
75	58.2	313.0	0.170E-02	54.5	252.9	2.7		0.221
100	67.2	338.9	0.208E-02	75.3	240.6	14.7		0.271
25 13								
0	53.2	298.9	0.148E-01	43.2	261.0	0.0		1.000
25	60.9	302.4	0.691E-02	51.1	266.1	7.9		0.467
50	63.7	297.3	0.438E-02	50.7	274.0	3.6		0.296
75	55.8	290.3	0.299E-02	40.6	270.4	8.7		0.202
100	48.5	283.0	0.245E-02	31.4	271.1	8.6		0.165
25 14								
0	55.8	308.8	0.941E-02	50.3	254.4	0.0		1.000
25	61.3	312.5	0.562E-02	56.7	257.8	5.8		0.597
50	63.2	308.3	0.314E-02	56.1	264.5	2.7	A	0.334
75	61.5	307.0	0.226E-02	54.0	263.0	1.8		0.240
100	56.1	288.1	0.125E-02	39.6	272.5	11.2		0.133
25 15								
0	54.4	257.8	0.305E-02	23.2	294.1	0.0		1.000
25	59.7	238.4	0.194E-02	42.7	275.7	17.3		0.634
50	55.4	290.1	0.159E-02	40.2	270.3	4.3		0.519
75	47.9	276.3	0.973E-03	27.5	276.1	11.4		0.319
100	46.7	275.1	0.681E-03	26.0	276.4	1.5		0.223
25 16								
0	56.7	309.0	0.500E-03	51.2	255.2	0.0		1.000
25	65.6	313.4	0.359E-03	60.8	264.8	9.1		0.718
50	34.7	295.2	0.215E-03	29.4	253.8	32.7		0.429
75	77.3	285.9	0.265E-03	56.4	309.0	42.7		0.529
100	-28.3	288.6	0.185E-03	-3.3	241.2	105.6		0.370
125	88.0	348.9	0.274E-03	62.0	353.1	117.3		0.548
25 17								
0	59.6	49.3	0.751E-03	54.4	92.5	0.0		1.000
25	74.5	302.2	0.889E-03	61.5	295.4	37.7		1.183

50	76.4	286.2	0.791E-03	55.9	306.4	4.4	1.054
75	39.6	279.9	0.394E-03	24.1	269.0	36.9	0.524
100	4.2	272.3	0.289E-03	3.0	263.9	36.1	0.384
25 18							
0	49.6	322.2	0.210E-03	52.2	234.3	0.0	1.000
25	60.9	286.0	0.222E-03	42.5	278.8	23.1	1.056
50	68.0	252.9	0.229E-03	34.2	308.2	15.7	1.090
75	70.8	244.7	0.273E-03	34.6	315.9	4.0	1.297
100	15.0	275.1	0.100E-03	9.2	264.4	58.8	0.476
25 19							
0	48.2	281.6	0.804E-03	30.5	272.0	0.0	1.000
25	45.5	261.2	0.909E-03	18.2	286.7	14.2	1.130
50	47.4	254.2	0.913E-03	16.2	293.1	5.2	1.135
75	37.1	266.3	0.693E-03	15.5	279.1	13.6	0.862
100	28.9	276.6	0.497E-03	16.5	267.5	11.9	0.618
25 20							
0	48.2	327.1	0.115E-02	53.3	227.2	0.0	1.000
25	49.2	299.0	0.918E-03	40.3	257.8	18.5	0.801
50	50.2	292.7	0.748E-03	37.7	264.1	4.2	0.653
75	40.4	275.0	0.494E-03	22.0	273.3	15.8	0.432
100	4.0	237.7	0.313E-03	-14.6	293.9	49.5	0.274
25 21							
0	62.8	311.5	0.764E-03	57.4	261.0	0.0	1.000
25	63.4	286.7	0.626E-03	45.0	281.3	11.2	0.819
50	58.0	277.0	0.492E-03	35.5	282.6	7.2	0.644
75	50.6	271.6	0.415E-03	27.0	281.3	8.0	0.543
100	65.6	272.4	0.501E-03	40.1	293.5	15.0	0.655
125	35.1	265.8	0.253E-03	14.2	278.7	30.7	0.331
25 22							
0	65.3	318.6	0.318E-03	63.3	259.2	0.0	1.000
25	58.5	284.7	0.280E-03	39.9	277.3	17.1	0.881
50	53.7	276.9	0.215E-03	32.0	279.3	6.5	0.675
75	47.5	273.1	0.170E-03	25.6	278.4	6.6	0.534
100	71.9	274.8	0.243E-03	47.3	301.2	24.4	0.765
25 23							
0	34.1	323.9	0.454E-03	42.6	224.1	0.0	1.000
25	50.4	305.4	0.377E-03	44.5	252.8	21.2	0.830
50	57.2	290.9	0.354E-03	42.0	271.3	10.9	0.779
75	48.9	285.3	0.254E-03	32.9	269.4	8.9	0.559
100	24.8	278.6	0.182E-03	15.6	264.4	24.7	0.400
25 24							
0	-25.2	136.0	0.761E-02	-34.4	49.7	0.0	1.000
25	-26.1	139.5	0.457E-02	-36.3	46.3	3.2	0.600
50	-22.9	152.8	0.145E-02	-39.4	30.1	12.5	0.190
75	0.7	176.7	0.598E-03	-31.5	358.7	33.1	0.079
100	-18.5	205.9	0.345E-03	-37.5	321.9	34.5	0.045

	*** MAGNETIZATION ***			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
26 1								
0	50.7	291.5	0.219E-02	36.9	266.4	0.0		1.000
25	51.6	289.5	0.206E-02	37.0	267.8	1.0		0.941
50	51.1	286.2	0.205E-02	34.9	270.2	2.1		0.936
75	50.7	283.9	0.201E-02	33.5	271.6	1.5		0.917
100	50.4	284.2	0.197E-02	33.4	271.4	0.3	A	0.898
125	50.4	283.1	0.193E-02	32.8	272.2	0.7		0.879
150	50.2	287.1	0.187E-02	34.8	268.9	2.6		0.852
200	50.0	283.4	0.257E-02	32.6	271.8	2.4		1.172
250	50.1	287.0	0.240E-02	34.6	268.9	2.3		1.096
300	50.3	295.9	0.246E-02	39.4	261.5	5.7		1.123
400	40.0	284.2	0.136E-02	26.6	265.7	13.1		0.622
500	57.1	335.7	0.201E-02	64.2	223.3	37.0		0.917
26 2								
0	51.0	291.5	0.259E-02	37.7	265.8	0.0		1.000
50	50.2	291.3	0.250E-02	37.0	265.4	0.8		0.965
75	49.3	289.2	0.225E-02	35.2	266.5	1.6	A	0.870
26 3								
0	50.9	296.8	0.176E-02	40.4	261.1	0.0		1.000
50	46.3	294.4	0.165E-02	36.0	260.2	4.8	A	0.934
75	47.5	293.7	0.151E-02	36.4	261.5	1.3		0.856
26 4								
0	52.7	288.7	0.220E-02	37.4	269.3	0.0		1.000
50	50.5	289.2	0.204E-02	36.0	267.4	2.2		0.927
75	47.7	287.8	0.184E-02	33.4	266.7	2.9	A	0.837
26 5								
0	51.3	292.2	0.125E-02	38.2	265.5	0.0		1.000
50	50.6	291.3	0.115E-02	37.2	265.7	0.9		0.923
75	50.2	286.5	0.107E-02	34.4	269.4	3.1	A	0.858
26 6								
0	46.4	299.6	0.121E-02	38.7	255.6	0.0		1.000
25	47.4	290.8	0.112E-02	34.8	264.0	6.1	A	0.929
50	48.9	291.3	0.116E-02	36.0	264.5	1.5		0.962
75	44.8	289.3	0.108E-02	32.3	263.7	4.3		0.896
100	44.1	286.9	0.100E-02	30.6	265.4	1.8		0.832
125	49.1	293.4	0.106E-02	37.3	262.8	6.7		0.878
150	53.3	289.5	0.164E-02	38.2	269.2	4.9		1.365
200	48.6	285.5	0.137E-02	32.8	269.2	5.3		1.139
250	43.4	288.0	0.114E-02	30.7	264.1	5.5		0.948
300	54.6	298.7	0.137E-02	44.1	262.5	13.2		1.133
400	24.1	265.6	0.986E-03	8.4	275.3	39.1		0.818
500	56.3	332.5	0.152E-02	62.1	227.2	57.4		1.257
26 7								
0	53.8	293.7	0.102E-02	40.8	266.1	0.0		1.000
50	50.3	291.0	0.947E-03	36.9	265.6	3.9	A	0.924
75	48.9	292.8	0.878E-03	36.8	263.2	1.8		0.857
26 8								
0	48.1	339.8	0.234E-02	57.8	209.4	0.0		1.000
50	57.7	305.4	0.148E-02	50.0	259.6	22.5		0.633
75	57.9	308.8	0.135E-02	52.0	256.7	1.9		0.576
100	52.6	278.8	0.957E-03	32.2	277.2	17.8		0.409

26 9								
0	50.8	286.1	0.241E-02	34.6	270.1	0.0		1.000
50	50.6	287.3	0.201E-02	35.1	269.0	0.8	A	0.996
75	50.0	282.4	0.162E-02	32.1	272.6	3.2		0.806
26 10								
0	55.6	300.9	0.252E-02	46.0	261.4	0.0		1.000
50	51.8	289.3	0.245E-02	37.0	268.2	7.9	A	0.974
75	52.8	289.0	0.221E-02	37.6	269.2	1.0		0.877
26 11								
0	48.3	312.4	0.131E-02	46.5	244.3	0.0		1.000
25	47.5	305.6	0.119E-02	42.6	250.7	4.6	A	0.909
50	43.9	302.3	0.101E-02	38.5	251.6	4.2		0.774
75	45.4	302.1	0.110E-02	39.4	252.7	1.5		0.842
100	45.8	303.4	0.107E-02	40.3	251.6	1.0		0.821
125	47.2	304.9	0.107E-02	42.0	251.1	1.7		0.818
150	43.3	300.7	0.180E-02	37.3	252.7	4.9		1.376
200	40.8	299.2	0.748E-03	35.0	252.6	2.7		0.573
250	51.8	306.6	0.977E-03	46.2	252.8	12.1		0.748
300	48.9	308.0	0.100E-02	44.8	249.2	3.1		0.767
400	56.9	319.1	0.918E-03	56.5	245.0	10.4		0.703
500	37.7	317.3	0.450E-03	42.0	233.1	19.2		0.345
26 12								
0	59.7	327.1	0.149E-02	62.8	239.2	0.0		1.000
50	51.1	317.1	0.931E-03	50.9	241.5	10.3	A	0.625
75	53.5	315.9	0.830E-03	52.1	244.8	2.5		0.558
26 13								
0	56.3	341.0	0.169E-02	65.4	213.6	0.0		1.000
50	52.7	326.1	0.117E-02	56.4	232.3	9.4		0.691
75	41.3	312.4	0.797E-03	41.9	240.2	14.7		0.471
26 14								
0	54.8	339.2	0.172E-02	63.4	215.2	0.0		1.000
50	44.2	318.6	0.811E-03	46.7	234.9	17.0		0.472
75	37.2	312.2	0.583E-03	39.3	238.3	8.5		0.339
100	38.3	316.6	0.679E-03	42.0	234.1	3.7		0.395
26 15								
0	49.8	315.8	0.162E-02	49.3	241.8	0.0		1.000
50	45.9	309.6	0.127E-02	43.5	245.7	5.7	A	0.787
75	48.1	312.3	0.131E-02	46.4	244.3	2.9		0.810
26 16								
0	62.1	330.6	0.126E-02	66.6	238.9	0.0		1.000
25	55.6	311.9	0.104E-02	51.8	251.2	11.6		0.825
50	52.1	305.6	0.865E-03	45.8	254.0	5.1		0.689
75	48.7	304.6	0.658E-03	42.9	252.4	3.5		0.524
100	45.9	302.6	0.559E-03	39.9	252.5	3.1	A	0.445
125	43.4	304.9	0.409E-03	39.5	248.8	3.0		0.326
150	53.2	306.3	0.464E-03	47.1	254.4	9.9		0.369
200	51.6	272.6	0.239E-03	28.2	281.3	20.5		0.190
250	67.0	306.8	0.369E-03	58.4	273.0	22.8		0.294
300	24.2	351.8	0.336E-03	44.1	186.0	51.0		0.267
400	-15.5	342.9	0.107E-03	22.5	193.3	40.7		0.086
500	67.0	319.3	0.194E-03	65.0	262.9	84.3		0.155
26 17								
0	68.6	318.5	0.182E-02	65.8	268.1	0.0		1.000
50	48.2	316.7	0.103E-02	48.6	239.7	20.4		0.565
75	36.1	314.3	0.675E-03	39.6	235.6	12.2		0.371
100	24.4	318.5	0.512E-03	35.0	227.0	12.3		0.281

26 18								
0	54.2	310.6	0.230E-02	50.0	251.1	0.0		1.000
50	45.5	301.5	0.169E-02	39.1	253.3	10.4	A	0.735
75	49.2	304.1	0.157E-02	43.0	253.3	4.1		0.682
26 19								
0	55.2	297.7	0.349E-02	44.1	263.9	0.0		1.000
50	51.6	293.6	0.324E-02	39.2	264.5	4.4	A	0.926
75	53.9	291.5	0.320E-02	39.8	257.9	2.6		0.917
26 20								
0	-30.5	239.7	0.258E-02	-29.8	282.4	0.0		1.000
50	41.0	294.3	0.155E-02	32.5	257.4	87.5	A	0.598
75	46.2	294.5	0.174E-02	37.2	261.3	7.1		0.674
100	46.3	294.9	0.155E-02	36.2	259.7	1.9		0.601
26 21								
0	41.2	275.0	0.123E-01	22.5	273.8	0.0		1.000
25	49.3	282.0	0.719E-02	31.4	272.5	9.4		0.579
50	54.6	287.1	0.409E-02	38.0	272.1	6.2		0.334
75	58.1	292.9	0.281E-02	43.8	270.6	4.7		0.230
100	55.3	291.5	0.267E-02	40.9	269.2	2.8		0.218
125	55.9	293.6	0.245E-02	42.4	268.0	1.3		0.200
150	52.7	285.1	0.191E-02	35.5	272.3	5.9	A	0.156
200	54.7	285.6	0.194E-02	37.3	273.4	2.0		0.159
250	54.3	283.7	0.191E-02	36.0	274.8	1.2		0.156
300	54.2	289.3	0.118E-02	38.8	270.1	3.3		0.096
400	35.7	295.6	0.875E-03	30.1	253.7	19.0		0.071
500	64.7	284.0	0.174E-02	44.8	284.9	29.8		0.142
26 22								
0	-41.4	181.5	0.925E-02	-55.7	352.5	0.0		1.000
50	-29.3	187.2	0.234E-02	-47.2	344.6	13.0		0.253
75	5.9	219.9	0.923E-03	-21.2	311.5	47.2		0.100
26 23								
0	50.8	305.2	0.245E-02	44.7	253.4	0.0		1.000
50	50.3	293.1	0.256E-02	38.0	263.9	7.7	A	1.046
75	48.9	291.2	0.226E-02	36.0	264.8	1.8		0.923
26 24								
0	55.4	295.6	0.353E-02	43.1	265.9	0.0		1.000
50	54.0	289.5	0.338E-02	38.8	269.7	3.8	A	0.956
75	50.6	288.1	0.345E-02	35.6	268.4	3.5		0.976
26 25								
0	14.2	264.8	0.731E-02	3.4	273.0	0.0		1.000
50	45.5	279.5	0.406E-02	27.5	272.3	33.6	A	0.555
75	48.8	284.1	0.400E-02	32.2	270.5	4.6		0.547
100	49.4	285.3	0.375E-02	33.2	269.8	1.0		0.513
26 26								
0	53.5	286.5	0.327E-02	36.8	271.7	0.0		1.000
25	54.8	286.5	0.317E-02	37.8	272.8	1.3		0.971
50	56.1	286.5	0.299E-02	38.8	273.8	1.3		0.917
75	54.7	286.5	0.309E-02	37.7	272.8	1.4		0.945
100	54.5	286.5	0.300E-02	37.6	272.5	0.2		0.919
125	56.1	286.5	0.299E-02	38.8	273.8	1.6		0.917
150	53.4	283.5	0.299E-02	35.2	274.1	3.2	A	0.915
200	53.6	285.3	0.282E-02	36.3	272.7	1.1		0.863
250	53.1	277.8	0.254E-02	32.1	278.3	4.5		0.778
300	55.5	288.6	0.289E-02	39.4	271.7	6.7		0.885
400	53.2	283.8	0.256E-02	35.2	273.7	3.6		0.784

500	58.5	286.1	0.205E-02	40.5	276.4	5.4		0.628
26 27								
0	55.7	302.6	0.218E-02	47.0	260.1	0.0		1.000
50	49.3	296.9	0.182E-02	39.2	259.9	7.3	A	0.834
75	48.8	295.5	0.156E-02	38.2	260.8	1.0		0.722
26 28								
0	55.9	301.3	0.426E-02	46.5	261.5	0.0		1.000
50	49.0	287.4	0.350E-02	34.1	267.8	10.9	A	0.821
75	50.6	291.0	0.367E-02	37.1	265.9	2.8		0.862
26 29								
0	60.3	290.8	0.300E-02	44.5	274.7	0.0		1.000
50	54.1	283.7	0.293E-02	35.8	274.5	7.3	A	0.975
75	52.8	286.8	0.285E-02	36.4	270.9	2.3		0.951
26 30								
0	16.7	262.1	0.703E-02	3.1	276.1	0.0		1.000
50	47.4	287.2	0.308E-02	32.9	267.0	37.0	A	0.439
75	48.5	291.9	0.310E-02	36.0	253.7	3.3		0.440
100	48.7	291.5	0.296E-02	36.0	264.2	0.3		0.421
26 31								
0	56.2	303.2	0.311E-02	47.7	260.1	0.0		1.000
50	50.1	296.0	0.215E-02	39.4	261.3	7.4	A	0.659
75	49.3	296.0	0.173E-02	38.8	260.7	0.8		0.556
26 32								
0	45.4	271.9	0.401E-02	23.5	278.3	0.0		1.000
50	52.8	285.0	0.323E-02	35.5	272.4	11.3	A	0.804
75	51.5	290.3	0.328E-02	37.3	267.1	3.5		0.818
26 33								
0	-23.2	117.6	0.476E-02	-24.7	67.3	0.0		1.000
50	-18.6	112.8	0.848E-03	-20.0	70.2	6.4		0.178

DYKE 27

	*** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
27 1								
0	18.7	7.0	0.207E-02	41.1	165.7	0.0		1.000
50	55.2	322.8	0.752E-03	56.9	238.7	49.4		0.363
75	44.8	317.6	0.594E-03	46.6	236.5	10.9		0.287
27 2								
0	6.7	359.3	0.275E-02	35.2	175.8	0.0		1.000
25	43.9	334.6	0.910E-03	52.9	214.5	43.1		0.330
50	59.7	292.5	0.869E-03	44.9	272.7	29.7		0.315
75	51.5	293.5	0.750E-03	39.1	264.5	8.2		0.272
100	40.2	296.1	0.685E-03	33.0	255.3	11.5		0.249
125	42.8	292.5	0.707E-03	32.7	259.9	3.8		0.257
150	66.5	261.6	0.624E-03	36.2	301.4	29.1		0.227
200	51.6	278.7	0.487E-03	31.4	276.6	17.2		0.177
250	27.3	286.8	0.369E-03	21.1	258.4	25.1		0.134
300	31.2	287.0	0.355E-02	23.2	259.6	3.9		1.288
400	62.6	220.4	0.559E-03	17.6	325.7	52.0		0.203
27 3								
0	-16.9	9.8	0.201E-02	22.7	164.4	0.0		1.000
50	44.6	288.9	0.723E-03	31.9	264.0	95.6		0.359
75	40.9	287.9	0.695E-03	29.1	262.9	3.7		0.345
100	42.9	286.3	0.703E-03	29.5	265.3	2.3		0.349
150	52.1	281.9	0.595E-03	33.4	274.4	9.7	A	0.296
200	47.4	278.4	0.567E-03	28.2	274.5	5.3		0.282
250	46.2	280.5	0.501E-03	28.6	271.9	1.9		0.249
300	48.7	341.4	0.340E-03	58.7	207.2	40.1		0.169
400	73.7	210.2	0.729E-03	30.2	337.8	53.3		0.362
27 4								
0	8.7	2.9	0.326E-02	36.1	171.3	0.0		1.000
50	66.6	302.1	0.556E-03	55.6	275.4	70.8		0.171
75	30.9	290.9	0.383E-03	25.1	256.1	36.3		0.118
27 5								
0	44.8	357.0	0.120E-02	58.1	180.0	0.0		1.000
50	53.0	292.1	0.913E-03	39.4	266.8	42.0		0.763
75	60.5	277.0	0.111E-02	37.7	285.0	11.1		0.928
27 6								
0	31.5	317.5	0.105E-02	38.4	230.3	0.0		1.000
50	67.9	263.0	0.547E-03	38.3	302.1	47.9		0.519
75	53.5	286.8	0.423E-03	37.0	271.5	18.3		0.402
27 7								
0	19.8	4.8	0.207E-02	41.9	168.6	0.0		1.000
25	70.5	317.0	0.134E-02	66.4	275.0	57.9		0.645
50	59.9	294.2	0.834E-03	46.0	271.6	14.0		0.402
75	57.1	290.2	0.755E-03	41.6	271.8	3.5		0.364
100	44.9	283.6	0.575E-03	29.3	268.6	12.9		0.277
125	66.9	293.7	0.838E-03	51.6	281.6	22.6		0.404
27 8								
0	34.5	349.7	0.198E-02	50.1	190.2	0.0		1.000
50	67.2	281.1	0.108E-02	45.6	290.2	50.3		0.545
75	52.5	291.8	0.807E-03	38.9	266.6	15.6		0.408
27 9								
0	27.8	337.5	0.157E-02	43.4	205.5	0.0		1.000

50	60.6	280.6	0.834E-03	39.6	282.5	50.0		0.530
75	51.1	286.6	0.715E-03	35.1	270.0	10.1		0.448
27 10								
0	32.2	10.5	0.160E-02	48.6	159.6	0.0		1.000
50	56.6	285.9	0.897E-03	39.0	274.8	60.8		0.559
75	56.4	278.8	0.907E-03	35.1	280.1	3.9		0.565
100	52.9	282.7	0.790E-03	34.4	274.3	4.2	A	0.493
150	64.6	275.4	0.801E-03	40.5	290.4	12.3		0.499
200	24.7	247.5	0.540E-03	-0.4	290.7	43.8		0.337
300	84.1	233.7	0.894E-03	50.2	340.1	59.6		0.558
400	-19.7	281.4	0.464E-03	-2.7	250.0	105.7		0.289
27 11								
0	44.9	327.0	0.147E-02	50.8	225.4	0.0		1.000
50	65.5	295.9	0.850E-03	51.5	277.9	26.6		0.578
75	43.8	280.0	0.585E-03	26.7	271.0	23.4		0.398
27 12								
0	71.2	26.9	0.106E-02	75.3	82.7	0.0		1.000
25	73.2	264.8	0.923E-03	44.7	308.8	31.0		0.874
50	53.7	281.5	0.611E-03	34.4	275.8	20.8		0.579
75	29.1	285.0	0.518E-03	21.1	260.8	24.7		0.491
100	14.8	283.6	0.455E-03	13.5	257.3	14.3		0.431
125	-3.2	284.2	0.492E-03	6.1	252.0	18.0		0.466
150	57.8	281.6	0.535E-03	37.7	279.1	60.9		0.506
200	1.0	294.2	0.404E-03	12.9	244.3	57.6		0.383
300	72.4	300.4	0.489E-03	59.4	289.9	71.5		0.463
400	-29.4	305.5	0.424E-03	3.7	226.7	101.9		0.402
27 13								
0	59.1	11.7	0.169E-02	70.3	147.4	0.0		1.000
50	74.5	289.0	0.123E-02	55.7	300.5	32.4		0.727
75	60.8	289.0	0.783E-03	44.0	276.8	13.7		0.463
27 14								
0	66.0	268.0	0.197E-02	38.5	296.8	0.0		1.000
50	68.1	244.5	0.983E-03	31.3	313.5	9.3		0.500
75	68.0	239.8	0.687E-03	29.6	316.2	1.7	A	0.350
100	65.3	241.3	0.473E-03	27.0	313.1	2.8		0.241
125	65.2	252.0	0.425E-03	30.9	306.1	4.5		0.216
27 15								
0	73.7	31.5	0.247E-02	73.8	66.0	0.0		1.000
50	67.4	298.7	0.132E-02	54.6	279.2	28.3		0.534
75	62.5	291.1	0.923E-03	46.5	277.1	5.8	A	0.373
100	60.5	287.9	0.915E-03	43.2	277.1	2.5		0.373
125	62.2	291.4	0.940E-03	46.4	276.5	2.4		0.380
27 16								
0	52.3	304.0	0.576E-03	45.1	255.8	0.0		1.000
50	63.8	286.0	0.395E-03	45.0	282.3	14.8		0.686
75	67.3	279.7	0.426E-03	45.1	291.2	4.4	A	0.739
100	64.8	278.2	0.348E-03	42.1	288.8	2.6		0.605
125	63.0	275.3	0.321E-03	39.1	288.7	2.2		0.558
27 17								
0	77.3	246.1	0.761E-02	43.4	323.9	0.0		1.000
25	79.1	278.9	0.521E-02	55.3	316.3	6.8		0.685
50	76.4	294.5	0.279E-02	59.3	303.9	4.3	A	0.367
75	74.0	301.0	0.197E-02	60.7	294.3	2.9		0.259
100	72.6	301.0	0.157E-02	59.8	290.2	1.4		0.207
125	68.2	290.2	0.859E-03	51.0	286.2	5.7		0.113

27 18							
0	38.1	342.0	0.257E-02	51.0	202.2	0.0	1.000
50	61.1	313.2	0.141E-02	56.9	256.8	29.1	0.549
75	53.0	304.2	0.947E-03	45.8	256.1	9.5	0.369
27 19							
0	48.5	4.7	0.197E-02	61.1	166.4	0.0	1.000
50	69.5	309.8	0.806E-03	61.9	276.8	33.4	0.408
75	58.0	299.5	0.616E-03	47.2	265.1	12.4	0.312
27 20							
0	63.6	328.7	0.144E-02	67.0	244.4	0.0	1.000
50	73.0	293.5	0.102E-02	56.6	294.5	15.6	0.711
75	54.2	301.7	0.615E-03	45.4	259.5	19.0	0.428

DYKE 28

	*** MAGNETIZATION ****			POLE POSITION				
DMAG	DIP	DEC	J	LAT	LONG	ANG		J/J0
28 1								
0	45.4	270.4	0.468E-02	22.8	279.5	0.0		1.000
25	45.9	271.8	0.473E-02	23.8	278.6	1.1		1.011
50	44.5	269.6	0.457E-02	21.8	279.7	2.1		0.977
75	45.1	270.2	0.459E-02	22.5	279.5	0.7		0.981
100	45.4	270.8	0.466E-02	23.0	279.1	0.5		0.995
125	45.4	271.3	0.457E-02	23.3	278.6	0.4	A	0.977
150	43.4	271.6	0.447E-02	22.2	277.5	2.0		0.955
200	41.7	267.6	0.425E-02	19.0	279.9	3.5		0.908
250	40.6	270.5	0.396E-02	19.8	277.1	2.5		0.847
300	36.6	278.8	0.417E-02	22.9	269.5	6.6		0.891
400	46.2	269.9	0.334E-02	23.1	280.3	10.0		0.713
500	48.8	271.2	0.242E-02	25.5	280.7	2.7		0.516
700	71.3	312.3	0.154E-02	64.5	280.3	29.3		0.330
28 2								
0	45.9	273.9	0.439E-02	24.9	277.0	0.0		1.000
100	43.6	272.9	0.423E-02	22.9	276.6	2.4	A	0.964
125	43.8	273.1	0.426E-02	23.1	276.6	0.3		0.971
28 3								
0	50.5	271.9	0.318E-02	27.1	281.1	0.0		1.000
100	49.5	270.5	0.292E-02	25.7	281.6	1.3	A	0.918
125	49.6	270.7	0.292E-02	25.8	281.4	0.1		0.920
28 4								
0	49.5	268.1	0.470E-02	24.5	283.4	0.0		1.000
100	45.7	266.8	0.464E-02	21.2	282.5	3.9	A	0.988
125	44.6	266.6	0.455E-02	20.4	282.1	1.1		0.973
28 5								
0	50.0	268.4	0.437E-02	25.0	283.5	0.0		1.000
100	47.2	266.4	0.412E-02	22.0	283.5	3.1	A	0.942
125	47.5	266.6	0.416E-02	22.3	283.6	0.3		0.953
28 6								
0	53.2	270.8	0.329E-02	28.5	283.6	0.0		1.000
25	49.2	268.6	0.323E-02	24.5	282.9	4.2	A	0.982
50	46.8	267.3	0.315E-02	22.2	282.6	2.5		0.958
75	47.6	265.2	0.325E-02	21.7	284.7	1.6		0.987
100	46.0	265.7	0.315E-02	20.9	283.5	1.6		0.957
125	47.1	272.8	0.305E-02	25.2	278.4	5.0		0.927
150	43.9	268.4	0.325E-02	20.8	280.3	4.5		0.988
200	50.8	264.1	0.321E-02	23.5	287.2	7.5		0.976
250	52.5	263.1	0.308E-02	24.2	289.0	1.8		0.937
300	52.6	262.3	0.297E-02	[illegible]	289.6	0.5		0.902
400	50.2	259.1	0.229E-02	20.6	290.8	3.1		0.695
500	45.9	257.5	0.160E-02	16.7	289.9	4.5		0.484
700	60.7	257.4	0.763E-03	28.6	298.7	14.8		0.232
28 7								
0	48.3	266.5	0.433E-02	22.8	284.0	0.0		1.000
100	45.8	266.9	0.420E-02	21.3	282.4	2.5	A	0.969
125	45.5	267.0	0.418E-02	21.1	282.2	0.3		0.965
28 8								
0	53.4	266.2	0.412E-02	26.4	287.2	0.0		1.000
100	51.0	265.7	0.404E-02	24.4	286.1	2.4		0.982
125	51.3	265.7	0.400E-02	24.6	286.3	0.3	A	0.970

28 9								
0	51.9	270.5	0.457E-02	27.4	283.0	0.0		1.000
100	48.4	271.5	0.449E-02	25.4	280.1	3.6	A	0.982
125	47.9	270.6	0.446E-02	24.6	280.8	0.8		0.976
28 10								
0	50.5	273.0	0.403E-02	27.6	280.3	0.0		1.000
100	47.9	271.6	0.383E-02	25.1	279.8	2.7	A	0.950
125	47.6	271.9	0.384E-02	25.0	279.4	0.4		0.953
28 11								
0	48.1	273.3	0.416E-02	26.1	278.8	0.0		1.000
25	44.0	273.2	0.407E-02	23.3	276.8	4.0		0.979
50	43.3	272.4	0.402E-02	22.4	276.8	1.0		0.966
75	41.4	271.7	0.392E-02	20.9	276.6	1.9		0.944
100	43.6	272.6	0.407E-02	22.7	276.8	2.3	A	0.978
125	42.9	272.6	0.403E-02	22.3	276.5	0.7		0.970
150	43.3	268.1	0.390E-02	20.2	280.3	3.3		0.937
200	46.1	274.8	0.403E-02	25.5	276.3	5.6		0.969
250	42.4	272.5	0.358E-02	21.9	276.4	4.0		0.861
300	46.8	267.0	0.366E-02	22.0	282.9	5.8		0.880
400	51.0	266.4	0.304E-02	24.7	285.7	4.3		0.730
500	51.0	267.1	0.225E-02	25.0	285.0	0.5		0.540
700	61.5	279.9	0.120E-02	40.0	283.9	12.7		0.289
28 12								
0	49.7	275.2	0.330E-02	28.2	278.1	0.0		1.000
100	43.4	274.8	0.318E-02	23.8	274.9	6.3	A	0.965
125	43.6	274.7	0.316E-02	23.8	275.1	0.2		0.959
28 13								
0	45.9	276.4	0.363E-02	26.2	274.9	0.0		1.000
100	42.3	273.3	0.343E-02	22.3	275.8	4.3	A	0.945
125	42.4	273.6	0.345E-02	22.5	275.4	0.2		0.951
28 14								
0	48.8	271.7	0.511E-02	25.8	280.2	0.0		1.000
100	44.7	272.2	0.498E-02	23.2	277.7	4.1	A	0.976
125	44.7	272.1	0.499E-02	23.2	277.8	0.1		0.977
28 15								
0	47.4	278.7	0.379E-02	28.4	273.9	0.0		1.000
100	43.5	276.3	0.374E-02	24.6	273.8	4.2	A	0.987
125	43.1	276.4	0.373E-02	24.4	273.5	0.5		0.984
28 16								
0	51.2	276.5	0.302E-02	29.9	278.0	0.0		1.000
25	47.6	275.7	0.304E-02	27.0	276.4	3.6	A	1.006
50	46.7	276.0	0.300E-02	26.5	275.7	0.9		0.993
75	46.5	275.7	0.301E-02	26.2	275.8	0.3		0.998
100	46.5	275.6	0.299E-02	26.2	275.9	0.0		0.991
125	45.6	277.4	0.295E-02	26.5	274.0	1.5		0.976
150	46.3	272.5	0.294E-02	24.5	278.3	3.5		0.973
200	46.0	274.2	0.281E-02	25.1	276.8	1.2		0.930
250	45.8	274.8	0.271E-02	25.3	276.1	0.5		0.897
300	44.4	273.5	0.254E-02	23.7	276.5	1.7		0.840
400	48.6	273.1	0.201E-02	26.4	279.0	4.2		0.666
500	54.1	277.6	0.163E-02	32.7	279.1	6.2		0.539
700	61.3	297.1	0.850E-03	48.6	270.8	12.5		0.282
28 17								
0	46.2	276.0	0.474E-02	26.2	275.4	0.0		1.000
100	43.0	276.3	0.454E-02	24.3	273.8	3.1	A	0.958

125	43.4	275.9	0.454E-02	24.3	274.1	0.5		0.957
28 18								
0	46.5	274.4	0.342E-02	25.0	276.9	0.0		1.000
100	40.8	272.8	0.340E-02	21.1	275.4	5.9	A	0.993
125	42.8	270.8	0.341E-02	21.3	277.9	2.5		0.997
28 19								
0	49.2	274.2	0.316E-02	27.3	278.5	0.0		1.000
100	43.2	272.7	0.309E-02	22.5	276.5	6.1	A	0.978
125	44.0	273.4	0.310E-02	23.4	276.4	0.9		0.980
28 20								
0	48.4	272.7	0.375E-02	26.0	279.2	0.0		1.000
100	45.1	276.6	0.363E-02	25.8	274.4	4.2	A	0.967
125	45.8	276.4	0.363E-02	26.2	274.8	0.7		0.969
28 21								
0	50.5	274.5	0.483E-02	28.5	279.1	0.0		1.000
25	46.3	273.8	0.468E-02	25.1	277.2	4.3	A	0.968
50	45.6	273.6	0.467E-02	24.5	277.0	0.7		0.966
75	46.0	273.7	0.475E-02	24.9	277.1	0.4		0.983
100	45.0	273.7	0.467E-02	24.2	276.8	1.0		0.967
125	45.3	271.3	0.462E-02	23.2	278.7	1.7		0.957
150	45.5	264.9	0.441E-02	20.1	283.9	4.5		0.912
200	44.8	262.8	0.432E-02	18.6	285.2	1.7		0.894
250	47.4	264.3	0.443E-02	21.1	285.3	2.8		0.917
300	47.1	265.0	0.414E-02	21.3	284.6	0.6		0.857
400	51.3	264.7	0.354E-02	24.2	287.1	4.2		0.732
500	48.9	262.2	0.290E-02	21.2	287.7	2.9		0.599
700	57.4	263.2	0.160E-02	23.3	292.2	8.5		0.331
28 22								
0	52.0	269.8	0.357E-02	27.2	283.8	0.0		1.000
100	48.8	272.2	0.341E-02	26.0	279.8	3.6	A	0.955
125	48.2	272.8	0.342E-02	25.9	279.1	0.6		0.958
28 23								
0	74.4	296.0	0.382E-02	58.7	297.2	0.0		1.000
100	52.9	275.3	0.256E-02	30.6	280.0	23.1	A	0.670
125	52.2	275.2	0.251E-02	30.0	279.7	0.7		0.656
28 24								
0	83.7	236.4	0.504E-02	50.0	338.5	0.0		1.000
100	50.2	273.6	0.204E-02	27.8	279.8	34.9	A	0.405
125	49.0	273.4	0.197E-02	26.8	279.1	1.2		0.390
150	48.5	274.9	0.193E-02	27.2	277.6	1.2		0.383
28 25								
0	76.1	130.0	0.749E-02	37.7	20.2	0.0		1.000
100	71.6	263.0	0.197E-02	42.2	306.9	29.6	A	0.263
125	66.9	267.6	0.190E-02	39.3	298.0	4.9		0.254
28 26								
0	88.4	349.5	0.746E-02	61.3	353.8	0.0		1.000
25	80.1	293.7	0.493E-02	60.7	316.8	9.1		0.661
50	65.5	277.6	0.336E-02	42.5	290.0	15.2		0.451
75	59.0	272.6	0.299E-02	34.2	286.7	6.9	A	0.401
100	53.2	269.9	0.274E-02	28.1	284.3	6.0		0.368
125	51.4	274.7	0.268E-02	29.2	279.5	3.4		0.359
150	48.9	266.5	0.244E-02	23.2	284.4	5.9		0.327
200	48.6	268.5	0.238E-02	24.0	282.8	1.4		0.320
250	46.9	267.8	0.225E-02	22.5	282.3	1.7		0.301
300	46.6	265.7	0.208E-02	21.2	283.8	1.5		0.279

400	36.7	261.3	0.150E-02	12.8	283.1	10.4		0.201
500	49.9	265.2	0.127E-02	23.3	285.3	13.5		0.170
700	72.2	288.6	0.790E-03	53.7	[illegible]	24.7		0.106
							221	
28 27								
0	-48.3	324.7	0.367E-02	-2.4	205.1	0.0		1.000
100	29.2	277.8	0.178E-02	17.3	266.7	88.2	A	0.485
125	34.4	274.5	0.208E-02	18.3	271.4	5.9		0.566
150	30.5	271.8	0.180E-02	18.1	274.4	3.0		0.489
28 28								
0	-5.6	262.0	0.190E-02	-6.0	270.2	0.0		1.000
100	45.4	267.1	0.217E-02	21.1	282.1	51.2	A	1.089
125	47.5	268.0	0.207E-02	23.0	282.5	2.2		1.089
150	44.8	271.2	0.176E-02	22.8	278.5	3.6		0.925
28 29								
0	41.0	237.5	0.197E-02	4.5	303.9	0.0		1.000
100	46.3	279.8	0.263E-02	28.3	272.4	30.7	A	1.337
125	46.6	278.4	0.253E-02	27.7	273.5	1.0		1.288
150	46.5	279.1	0.229E-02	[illegible]	273.1	0.6		1.164

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
G1 1							
0	37.8	283.1	1.816E-04	24.7	265.7	0.0	1.000
25	46.1	285.8	1.352E-04	31.3	267.4	8.6	0.431
50	40.2	295.1	1.156E-04	32.4	256.2	9.0	0.191

DMAG	*** MAGNETIZATION *** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
G2 1							
0	76.9	176.0	0.239E-02	33.4	356.3	0.0	1.000
25	87.9	285.8	0.150E-02	59.2	346.7	14.0	0.630
50	85.2	350.2	0.933E-03	67.6	350.8	4.3	0.391
G2 2							
0	35.3	6.6	0.101E-02	50.9	165.0	0.0	1.000
25	57.1	351.0	0.262E-03	68.5	194.5	24.2	0.260
50	69.1	308.1	0.160E-03	60.8	276.5	22.2	0.158
G2 3							
0	61.9	270.5	0.489E-02	35.7	290.7	0.0	1.000
25	68.9	282.1	0.264E-02	47.8	292.0	8.5	0.541
50	74.8	278.6	0.207E-02	51.7	305.3	6.1	0.423
G2 4							
0	60.7	289.5	0.753E-03	44.2	275.3	0.0	1.000
25	73.3	288.7	0.333E-03	54.7	297.2	12.6	0.441
50	82.7	275.2	0.200E-03	56.7	327.9	9.8	0.265
75	-22.3	119.8	0.930E-04	-25.2	64.5	118.9	0.123
G2 5							
0	45.2	255.5	0.130E-02	15.3	291.1	0.0	1.000
25	72.0	295.0	0.347E-03	57.0	292.7	33.0	0.266
50	23.3	174.5	0.115E-03	-19.4	0.5	76.3	0.088
G2 6							
0	50.2	264.0	0.237E-02	22.9	287.0	0.0	1.000
25	64.2	296.5	0.881E-03	50.7	275.2	22.1	0.372
50	27.7	308.6	0.759E-03	32.2	238.1	37.3	0.321
G2 7							
0	32.6	254.7	0.299E-02	7.3	286.9	0.0	1.000
25	69.0	266.8	0.742E-03	41.1	331.1	37.1	0.248
50	52.5	138.8	0.147E-03	7.6	28.8	52.7	0.049
G2 8							
0	68.0	274.8	0.870E-04	43.6	295.0	0.0	1.000
25	83.9	349.7	0.496E-04	70.2	348.5	21.2	0.570
50	88.0	22.6	0.363E-04	61.9	358.0	4.6	0.417
75	78.0	62.3	0.325E-04	61.4	41.4	10.6	0.373
G2 9							
0	74.0	297.4	0.412E-03	59.1	295.5	0.0	1.000
25	76.9	306.1	0.163E-03	64.4	302.8	3.6	0.396
50	20.7	288.3	0.918E-04	18.7	254.8	56.9	0.223
G2 10							
0	42.8	255.7	0.398E-02	13.9	289.9	0.0	1.000
25	76.5	294.5	0.896E-03	59.4	303.9	37.4	0.225
50	82.6	221.2	0.512E-03	46.4	341.0	13.4	0.128
G2 11							
0	63.6	284.9	0.531E-03	44.3	282.8	0.0	1.000
25	73.8	298.1	0.206E-03	59.3	294.5	11.2	0.389
50	78.5	299.1	0.128E-03	62.2	309.9	4.7	0.242
G2 12							
0	53.9	90.7	0.724E-03	28.4	64.4	0.0	1.000
25	77.2	61.3	0.523E-03	61.5	44.3	25.7	0.723
50	62.6	16.2	0.166E-03	72.6	132.9	20.3	0.229

G3

DMAG	*** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
G3 3							
0	81.2	311.4	0.767E-05	66.3	321.2	0.0	1.000
25	82.1	342.8	0.718E-05	72.6	339.5	4.6	0.923
50	81.0	339.9	0.597E-05	73.7	333.2	1.1	0.778
100	80.9	356.9	0.378E-05	76.0	353.4	3.0	0.493
G3 4							
0	46.1	305.0	0.440E-05	41.2	250.1	0.0	1.000
50	45.1	303.2	0.348E-05	39.7	251.2	1.6	0.790
100	39.3	303.1	0.262E-05	36.0	248.2	5.8	0.595
G3 5							
0	51.7	342.7	0.119E-05	61.5	206.7	0.0	1.000
50	56.1	9.8	0.753E-06	67.5	154.1	16.5	0.633
100	47.3	11.3	0.474E-06	59.2	155.2	8.9	0.399
G3 6							
0	60.4	17.2	0.576E-06	69.9	134.8	0.0	1.000
50	57.1	29.7	0.483E-06	61.8	118.7	7.3	0.839
100	46.6	18.5	0.369E-06	57.0	143.8	12.5	0.641
G3 7							
0	49.0	285.6	0.378E-05	33.8	269.8	0.0	1.000
50	44.0	280.8	0.276E-05	27.3	270.4	6.8	0.731
100	31.2	276.4	0.184E-05	18.7	266.8	12.9	0.488

G4

	**** MAGNETIZATION ****			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
G4 2							
0	49.5	83.4	0.254E-03	28.9	72.3	0.0	1.000
25	17.6	126.3	0.619E-04	-10.0	48.5	46.9	0.240
50	-25.5	172.9	0.455E-04	-44.8	4.6	62.5	0.179
G4 4							
0	77.9	110.3	0.835E-04	45.2	26.5	0.0	1.000
25	82.3	168.6	0.446E-04	51.1	17.3	4.5	0.534
50	78.6	198.5	0.250E-04	37.0	346.3	13.7	0.299
G4 5							
0	16.3	66.6	0.601E-03	19.3	100.7	0.0	1.000
25	43.7	24.6	0.134E-03	52.9	136.2	44.8	0.224
50	-20.8	201.1	0.836E-04	-39.8	327.4	156.9	0.139
G4 6							
0	70.5	16.0	0.272E-03	80.5	100.0	0.0	1.000
25	51.5	14.5	0.102E-03	62.0	147.9	19.1	0.376
50	46.7	351.1	0.705E-04	59.0	190.3	16.0	0.259
G4 7							
0	73.1	357.0	0.376E-03	88.3	283.1	0.0	1.000
25	74.4	350.2	0.137E-03	84.4	296.0	2.3	0.365
50	70.4	320.8	0.108E-03	68.3	271.9	9.6	0.287
G4 8							
0	63.3	332.0	0.627E-04	68.3	238.9	0.0	1.000
25	55.0	284.7	0.230E-04	37.1	274.2	25.0	0.366
50	-38.2	231.7	0.150E-04	-37.9	287.1	103.6	0.239
G4 9							
0	46.7	33.9	0.100E-03	51.6	122.3	0.0	1.000
25	-58.8	281.1	0.723E-04	-27.6	233.5	139.4	0.721
50	-68.6	266.1	0.145E-03	-43.8	233.2	11.8	1.451
G4 10							
0	56.7	348.2	0.366E-03	67.7	200.2	0.0	1.000
25	44.8	10.7	0.144E-03	57.2	156.9	18.5	0.395
50	27.3	10.0	0.131E-03	45.6	160.9	17.4	0.358
75	-24.8	196.0	0.758E-04	-43.1	333.3	174.1	0.207

G5

DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
	**** MAGNETIZATION ****			POLE POSITION			
G5 1							
0	41.5	78.5	0.720E-02	26.2	81.3	0.0	1.000
25	46.9	56.8	0.149E-02	42.3	96.1	16.8	0.206
50	47.5	52.5	0.229E-03	43.5	101.3	3.2	0.032
G5 2							
0	20.2	109.2	0.661E-03	-0.9	63.2	0.0	1.000
25	20.3	88.6	0.216E-03	9.6	80.8	19.3	0.327
50	1.9	85.6	0.746E-04	3.1	88.2	18.6	0.113
G5 3							
0	67.5	72.6	0.485E-02	49.1	63.2	0.0	1.000
25	54.7	81.7	0.316E-02	33.6	70.9	13.6	0.650
50	52.3	87.7	0.157E-02	28.7	68.[illegible]	4.3	0.324
G5 4							
0	37.9	111.4	0.240E-03	7.5	56.0	0.0	1.000
25	26.1	142.1	0.820E-04	-11.5	32.4	28.4	0.341
50	4.6	164.0	0.412E-04	-28.0	13.1	30.0	0.172
G5 5							
0	78.9	93.1	0.105E-03	51.5	30.7	0.0	1.000
25	83.7	71.7	0.569E-04	60.1	19.1	5.7	0.543
50	79.9	97.3	0.176E-04	51.2	27.[illegible]	5.2	0.168
G5 6							
0	23.7	99.4	0.124E-02	5.7	70.5	0.0	1.000
25	19.1	109.5	0.414E-03	-1.6	63.2	10.5	0.334
50	-24.2	115.8	0.315E-03	-24.2	69.2	43.7	0.254
75	-34.6	125.0	0.323E-03	-34.2	64.4	13.1	0.261
100	26.5	334.3	0.166E-03	41.6	209.3	153.6	0.134
G5 7							
0	49.6	102.7	0.837E-03	19.4	58.0	0.0	1.000
25	32.6	94.4	0.275E-03	12.8	71.8	18.1	0.329
50	-0.7	118.3	0.126E-03	-14.7	60.5	40.1	0.150
G5 8							
0	59.8	136.3	0.548E-04	15.5	27.9	0.0	1.000
G5 9							
0	7.2	127.3	0.250E-02	-15.3	50.3	0.0	1.000
25	1.3	119.9	0.822E-03	-14.6	58.5	9.4	0.329
50	16.8	129.3	0.184E-03	-11.6	46.3	18.0	0.073
G5 10							
0	2.6	113.5	0.261E-03	-10.9	63.9	0.0	1.000
25	-1.9	117.7	0.849E-04	-14.9	61.3	6.2	0.326
50	-15.8	102.6	0.303E-04	-13.4	78.4	20.3	0.116
G5 11							
0	-0.0	137.5	0.204E-03	-22.7	42.1	0.0	1.000
25	0.3	144.4	0.102E-03	-25.1	34.9	6.9	0.502
50	50.4	124.2	0.423E-04	10.9	41.0	53.0	0.207
75	31.3	105.2	0.350E-04	6.7	63.3	23.8	0.172
100	5.6	134.3	0.579E-04	-18.9	44.[illegible]	37.5	0.284
G5 12							
0	5.7	145.2	0.332E-03	-22.8	33.1	0.0	1.000

25	-5.7	168.2	0.522E-04	-33.7	9.1	25.6	0.157
50	20.5	152.4	0.172E-04	-17.4	23.5	30.5	0.052
G5 13							
0	26.4	117.3	0.243E-02	-1.7	54.5	0.0	1.000
25	37.5	116.0	0.686E-03	5.2	52.3	11.2	0.283
50	52.3	132.1	0.222E-03	9.6	34.1	18.6	0.091
G5 14							
0	5.8	131.8	0.199E-03	-17.8	46.4	0.0	1.000
25	-10.8	131.5	0.790E-04	-25.2	50.4	16.5	0.398
50	-27.7	125.6	0.377E-04	-30.8	61.1	17.8	0.189
G5 15							
0	10.5	122.9	0.182E-03	-11.8	53.6	0.0	1.000
25	14.0	118.5	0.503E-04	-8.2	56.7	5.5	0.276
50	-5.9	84.7	0.123E-04	0.3	91.0	39.0	0.068
G5 16							
0	12.9	133.6	0.403E-03	-15.2	43.1	0.0	1.000
25	8.9	127.4	0.146E-03	-14.5	49.8	7.3	0.361
50	8.3	120.0	0.847E-04	-11.5	56.7	7.3	0.210

DMAG	DIP (MAGNETIZATION)	DEC (MAGNETIZATION)	J (MAGNETIZATION)	LAT (POLE POSITION)	LONG (POLE POSITION)	ANG	J/J0
G6 1							
0	42.6	303.9	0.645E-03	38.5	249.4	0.0	1.000
50	42.9	301.6	0.653E-03	37.5	251.6	1.6	1.012
75	42.2	299.9	0.582E-03	36.2	252.9	1.4	0.902
100	40.5	302.5	0.506E-03	36.5	249.6	2.6	0.784
125	43.1	312.6	0.526E-03	43.2	246.8	8.0	0.816
150	42.6	317.1	0.464E-03	44.9	235.7	3.3	0.719
G6 2							
0	33.5	294.7	0.131E-03	28.5	253.6	0.0	1.000
50	34.3	287.0	0.997E-04	24.9	260.8	6.4	0.759
75	30.1	286.9	0.853E-04	22.6	259.2	4.2	0.650
100	28.6	286.9	0.718E-04	18.5	263.6	5.4	0.547
125	27.5	317.7	0.726E-04	36.3	228.7	32.4	0.553
150	19.2	338.9	0.940E-04	39.1	202.1	21.1	0.716
G6 3							
0	45.5	303.2	0.644E-03	40.0	251.7	0.0	1.000
50	39.7	299.4	0.595E-03	34.4	252.1	6.4	0.924
75	40.3	298.4	0.543E-03	34.3	253.3	1.0	0.843
100	42.5	297.3	0.467E-03	35.0	255.4	2.3	0.724
125	34.7	292.2	0.394E-03	27.8	256.4	8.7	0.612
150	36.2	291.9	0.356E-03	28.4	257.3	1.5	0.553
G6 4							
0	68.4	275.3	0.222E-02	44.1	295.5	0.0	1.000
50	54.9	284.9	0.189E-02	37.1	274.2	14.2	0.852
75	54.8	286.9	0.179E-02	38.1	272.4	1.2	0.805
100	50.9	281.8	0.162E-02	32.5	273.6	5.0	0.727
G6 5							
0	55.2	315.1	0.230E-02	53.1	247.4	0.0	1.000
25	58.5	310.3	0.188E-02	48.9	255.0	8.7	0.819
50	52.9	295.7	0.146E-02	41.2	263.6	6.2	0.634
75	46.2	286.9	0.117E-02	31.9	266.6	8.8	0.507
100	50.5	292.3	0.107E-02	37.7	264.7	5.6	0.463
125	52.4	294.7	0.958E-03	40.3	264.1	2.4	0.417
150	39.9	287.0	0.671E-03	28.0	263.3	13.5	0.292
G6 6							
0	75.8	315.2	0.177E-02	67.9	297.0	0.0	1.000
50	65.9	309.2	0.209E-02	58.8	268.9	10.1	1.183
75	59.9	295.4	0.177E-02	46.5	270.7	8.7	0.999
100	62.4	296.7	0.162E-02	49.3	272.7	2.5	0.916
125	70.6	310.0	0.156E-02	62.8	279.8	9.8	0.883
150	69.1	311.0	0.127E-02	62.3	274.9	1.6	0.720
G6 7							
0	63.2	322.2	0.111E-02	63.4	251.2	0.0	1.000
50	52.3	284.5	0.530E-03	34.8	272.5	22.5	0.476
75	58.3	294.3	0.483E-03	44.7	269.8	8.3	0.434
100	50.8	277.8	0.376E-03	30.3	276.8	12.2	0.338
125	62.6	289.0	0.343E-03	45.5	278.6	13.2	0.309
150	63.5	292.3	0.299E-03	47.9	277.5	1.8	0.269
G6 8							
0	88.4	233.8	0.815E-03	56.1	350.2	0.0	1.000
50	56.8	257.6	0.536E-03	25.2	295.6	31.7	0.658
75	48.7	258.8	0.488E-03	19.3	290.2	8.2	0.599

100	43.6	259.6	0.481E-03	16.2	237.2	5.1	0.590
125	59.6	252.2	0.318E-03	25.3	301.6	16.7	0.390
150	39.3	266.9	0.335E-03	17.1	279.6	22.4	0.411
G6 9							
0	68.2	154.8	0.412E-03	21.3	11.4	0.0	1.000
50	53.0	263.3	0.184E-03	24.7	239.2	47.9	0.446
75	38.0	280.6	0.166E-03	23.5	267.6	19.2	0.403
100	36.2	285.9	0.152E-03	26.4	263.4	4.1	0.368
125	67.2	285.5	0.176E-03	47.8	237.4	29.1	0.427
150	79.4	288.8	0.116E-03	53.7	315.1	12.3	0.281
G6 10							
0	44.0	322.4	0.132E-02	49.2	230.5	0.0	1.000
25	53.9	280.7	0.806E-03	34.1	276.6	28.6	0.657
50	53.8	279.8	0.802E-03	33.6	277.3	0.5	0.609
75	52.9	280.9	0.673E-03	33.4	275.7	1.2	0.511
100	50.5	279.5	0.548E-03	31.0	275.2	2.5	0.416
125	47.6	279.0	0.455E-03	28.7	273.8	2.9	0.345
150	61.5	283.1	0.461E-03	41.5	231.7	14.1	0.350
G6 11							
0	80.9	343.3	0.845E-03	74.4	335.7	0.0	1.000
50	62.8	289.6	0.525E-03	45.9	278.5	22.9	0.653
75	58.3	285.1	0.456E-03	39.9	276.9	5.6	0.567
100	55.3	281.9	0.402E-03	35.8	276.8	3.5	0.500
125	68.3	278.3	0.359E-03	45.6	293.2	13.0	0.446
150	65.6	277.9	0.293E-03	42.6	239.9	2.7	0.364
G6 12							
0	62.9	337.3	0.620E-03	70.4	230.3	0.0	1.000
50	59.7	299.0	0.359E-03	48.3	267.5	18.4	0.580
75	47.6	284.3	0.269E-03	31.5	269.6	14.8	0.434
100	43.2	280.5	0.212E-03	26.6	270.3	5.1	0.341
125	59.2	292.6	0.183E-03	44.6	272.1	17.7	0.295
150	62.9	296.0	0.127E-03	49.4	273.9	4.0	0.206
G6 13							
0	67.3	18.7	0.159E-02	76.5	113.1	0.0	1.000
50	81.1	7.2	0.728E-03	75.2	3.3	14.1	0.458
75	62.5	285.8	0.488E-03	43.8	280.9	27.5	0.307
100	80.4	303.3	0.427E-03	63.8	317.6	18.5	0.268
125	84.2	296.8	0.407E-03	61.6	333.0	3.9	0.256
150	59.6	279.7	0.268E-03	38.2	282.1	24.9	0.168
G6 14							
0	63.6	358.1	0.232E-02	77.1	130.9	0.0	1.000
50	66.5	305.9	0.158E-02	57.6	272.7	21.5	0.679
75	63.5	301.9	0.140E-02	53.0	270.6	3.4	0.605
100	50.5	284.7	0.103E-02	33.7	271.1	16.0	0.444
125	61.8	283.8	0.936E-03	42.1	281.6	11.3	0.403
150	64.5	296.0	0.793E-03	50.7	276.3	6.1	0.342
G6 15							
0	84.1	297.1	0.153E-02	61.6	332.6	0.0	1.000
25	72.5	290.9	0.119E-02	54.9	294.5	11.7	0.778
50	66.7	285.6	0.968E-03	47.4	286.6	6.0	0.634
75	67.2	281.4	0.826E-03	45.7	290.0	1.7	0.541
100	68.1	282.4	0.712E-03	47.1	290.8	1.1	0.466
125	66.8	285.3	0.647E-03	47.3	286.9	1.7	0.423
150	68.7	274.1	0.577E-03	43.8	296.5	4.6	0.378
G6 16							
0	74.2	312.9	0.102E-02	66.3	290.9	0.0	1.000

50	51.4	270.9	0.731E-03	27.2	232.5	28.6	0.715
75	52.6	268.6	0.635E-03	27.0	235.0	1.9	0.629
100	40.0	270.1	0.448E-03	19.2	277.3	12.6	0.438
125	56.6	28[illegible]	0.395E-03	35.9	279.2	17.7	0.387
150	55.2	265.9	0.350E-03	27.8	288.7	8.0	0.342
G6 17							
0	69.2	254.1	0.157E-02	35.0	318.8	0.0	1.000
50	66.[illegible]	265.9	0.147E-02	37.5	298.1	5.5	0.940
75	66.5	260.0	0.135E-02	35.4	312.3	2.4	0.863
100	68.3	252.3	0.120E-02	34.4	318.9	3.5	0.763
125	64.5	261.9	0.814E-03	34.2	299.1	5.4	0.519
150	70.2	243.2	0.839E-03	33.3	316.2	9.1	0.535
G6 18							
0	55.9	8.9	0.594E-03	78.7	143.0	0.0	1.000
50	59.7	298.6	0.373E-03	48.1	267.9	30.9	0.628
75	64.5	287.6	0.329E-03	46.4	282.2	7.0	0.554
100	61.2	277.8	0.289E-03	38.6	285.1	5.6	0.486
125	71.4	283.2	0.225E-03	50.5	296.1	10.4	0.379
150	44.1	270.6	0.192E-03	22.0	278.7	28.0	0.323
G6 19							
0	74.7	31.7	0.146E-02	73.8	60.2	0.0	1.000
50	67.9	282.7	0.504E-03	47.1	290.2	30.6	0.345
75	54.2	273.6	0.401E-03	30.7	282.3	14.3	0.275
100	71.3	283.1	0.460E-03	50.3	296.5	17.6	0.316
125	76.8	289.0	0.350E-03	57.3	306.8	5.7	0.240
150	66.4	254.2	0.195E-03	33.0	305.8	14.7	0.134
G6 20							
0	27.3	25.1	0.802E-03	42.5	141.0	0.0	1.000
25	65.6	308.3	0.448E-03	58.1	269.0	59.9	0.558
50	50.7	284.3	0.351E-03	41.4	279.9	11.8	0.438
75	52.3	278.7	0.293E-03	31.9	277.1	8.9	0.365
100	47.3	278.2	0.259E-03	28.0	274.3	5.0	0.323
125	44.9	283.0	0.219E-03	29.0	269.1	4.1	0.273
150	45.6	275.0	0.166E-03	25.3	276.0	5.7	0.207
G6 21							
0	82.0	333.3	0.116E-02	70.9	333.0	0.0	1.000
50	57.4	269.3	0.953E-03	31.2	287.8	29.9	0.822
75	50.0	273.8	0.760E-03	27.6	279.4	7.9	0.656
100	48.6	270.2	0.655E-03	24.8	281.2	2.7	0.565
125	64.6	274.4	0.619E-03	40.0	291.0	16.2	0.534
150	60.0	287.1	0.463E-03	42.3	277.1	7.5	0.399
G6 22							
0	-27.5	19.2	0.425E-02	15.6	155.5	0.0	1.000
50	-16.3	6.8	0.750E-03	23.4	167.5	16.0	0.176
75	7.4	356.8	0.376E-03	35.6	178.8	25.7	0.088
100	32.1	345.2	0.230E-03	47.9	196.1	27.0	0.054
125	41.7	311.9	0.201E-03	41.9	240.8	28.1	0.047
150	30.9	302.2	0.141E-03	30.9	245.7	13.3	0.033
G6 23							
0	57.1	331.6	0.160E-02	62.5	229.5	0.0	1.000
50	55.3	289.8	0.132E-02	39.9	270.5	23.0	0.821
75	49.5	281.4	0.111E-02	31.2	273.1	7.7	0.691
100	47.7	280.8	0.940E-03	29.7	272.5	1.8	0.587
125	57.9	303.0	0.822E-03	48.9	262.0	16.7	0.513
150	57.4	292.3	0.589E-03	42.9	270.5	5.7	0.368

DMAG	**** MAGNETIZATION **** DIP	DEC	J	POLE POSITION LAT	LONG	ANG	J/J0
G7 1							
0	16.4	184.6	0.597E-03	-23.2	349.8	0.0	1.000
G7 2							
0	-41.2	51.7	0.546E-03	-2.4	128.8	0.0	1.000
25	-33.8	52.5	0.304E-03	1.9	126.0	7.4	0.563
50	-32.3	46.7	0.169E-03	4.3	128.9	3.5	0.313
G7 3							
0	86.9	21.2	0.247E-03	64.0	360.0	0.0	1.000
25	86.6	57.3	0.164E-03	61.5	6.9	2.0	0.664
50	73.0	57.7	0.664E-04	60.7	59.3	13.6	0.270
G7 4							
0	64.1	261.2	0.106E-03	33.7	299.1	0.0	1.000
25	51.6	279.0	0.388E-04	31.6	276.2	15.6	0.364
50	68.8	215.7	0.424E-04	24.3	331.8	33.8	0.399
G7 5							
0	52.7	330.8	0.681E-03	58.2	225.7	0.0	1.000
25	67.9	327.2	0.271E-03	69.9	257.8	15.4	0.398
50	70.2	226.8	0.148E-03	28.7	325.8	31.9	0.217
G7 6							
0	70.6	263.4	0.340E-03	41.3	305.1	0.0	1.000
G7 7							
0	55.4	323.1	0.574E-03	57.1	238.4	0.0	1.000
25	61.3	352.0	0.361E-03	73.3	196.0	16.1	0.629
50	58.6	8.6	0.253E-03	70.3	154.9	8.7	0.440
G7 8							
0	34.0	353.3	0.262E-03	50.1	184.8	0.0	1.000
25	47.2	352.8	0.105E-03	59.7	187.5	13.2	0.400
50	55.4	352.5	0.107E-03	67.1	190.8	8.1	0.407
G7 9							
0	22.7	148.0	0.146E-03	-15.2	27.4	0.0	1.000
25	-5.0	151.8	0.426E-04	-30.0	27.9	28.0	0.291
50	-50.8	210.8	0.501E-04	-56.0	303.4	66.9	0.342
G7 10							
0	-20.8	67.9	0.593E-04	2.0	109.2	0.0	1.000
G7 14							
0	79.8	110.3	0.457E-04	47.7	22.9	0.0	1.000

	*** MAGNETIZATION ***			POLE POSITION			
DMAG	DIP	DEC	J	LAT	LONG	ANG	J/J0
H1 1							
0	45.5	263.0	0.264E-04	19.2	285.4	0.0	1.000
25	64.9	223.4	0.165E-04	21.1	324.7	29.0	0.623
50	72.0	168.1	0.139E-04	25.7	2.1	20.7	0.527
H1 2							
0	8.0	41.1	0.165E-04	27.0	127.8	0.0	1.000
25	14.8	56.7	0.152E-04	23.4	110.4	16.7	0.924
50	6.2	56.0	0.179E-04	19.8	113.2	8.7	1.088
H1 3							
0	45.6	311.8	0.129E-04	44.3	243.1	0.0	1.000
25	79.1	50.4	0.776E-05	66.2	38.4	47.0	0.603
50	61.7	162.5	0.993E-05	12.3	8.0	33.8	0.771
H1 4							
0	68.6	249.9	0.223E-04	34.0	310.8	0.0	1.000
25	68.1	197.5	0.160E-04	20.6	343.4	18.7	0.716
50	58.1	155.5	0.116E-04	9.3	14.0	20.9	0.521
H1 6							
0	54.9	318.3	0.111E-04	54.3	243.4	0.0	1.000
25	54.0	326.3	0.740E-05	57.4	232.8	4.8	0.667
50	46.1	311.4	0.571E-05	44.5	243.8	12.4	0.514
H1 7							
0	73.9	87.3	0.101E-04	48.6	43.9	0.0	1.000
25	70.8	72.2	0.464E-05	52.2	57.7	5.5	0.458
H1 8							
0	49.9	263.8	0.227E-04	22.7	287.0	0.0	1.000
25	68.8	294.1	0.116E-04	53.5	284.7	23.9	0.509
50	71.9	302.5	0.784E-05	60.1	287.1	4.2	0.345
H1 9							
0	66.3	283.6	0.100E-04	46.2	287.2	0.0	1.000
25	70.8	267.8	0.574E-05	43.4	303.0	7.2	0.573
H2 5							
0	41.7	270.1	0.416E-04	20.3	278.0	0.0	1.000
25	27.2	282.3	0.364E-04	18.7	262.2	17.6	0.874
H2 6							
0	60.5	269.2	0.183E-04	33.9	290.3	0.0	1.000
25	51.4	253.3	0.127E-04	18.9	295.8	12.7	0.692
H2 9							
0	73.8	171.4	0.764E-04	28.3	359.3	0.0	1.000
25	82.8	211.1	0.425E-04	45.7	344.5	11.6	0.556
H2 10							
0	59.0	332.5	0.122E-03	64.4	230.4	0.0	1.000
25	62.3	342.1	0.784E-04	71.6	219.8	5.8	0.642
H2 11							
0	58.9	251.6	0.218E-04	24.6	301.5	0.0	1.000
25	50.1	273.9	0.181E-04	27.9	279.3	15.6	0.830
H3 4							

H3 4							
0	63.3	29.6	0.233E-04	67.4	108.9	0.0	1.000
25	53.7	24.0	0.183E-04	61.0	130.9	10.0	0.786
H3 10							
0	28.4	348.1	0.143E-04	45.8	191.8	0.0	1.000
25	25.0	317.4	0.146E-04	34.7	228.2	27.5	1.019
H3 12							
0	34.8	154.6	0.370E-04	-9.6	19.2	0.0	1.000
25	34.6	148.8	0.282E-04	-8.4	24.2	4.8	0.761
H3 13							
0	49.7	46.9	0.339E-04	47.8	105.4	0.0	1.000
25	56.4	49.7	0.254E-04	51.5	96.5	6.9	0.750
H3 14							
0	59.9	72.8	0.156E-04	42.3	73.1	0.0	1.000
25	53.2	69.4	0.125E-04	33.8	81.9	7.0	0.799
H3 15							
0	78.5	50.3	0.999E-05	66.2	40.9	0.0	1.000
25	78.4	33.4	0.665E-05	72.5	38.9	3.4	0.666
H3 17							
0	32.4	258.0	0.189E-04	8.8	284.3	0.0	1.000
25	24.8	264.6	0.197E-04	8.3	276.3	9.5	1.039

APPENDIX B

Palaeomagnetic Statistics for Each Rock Unit
(Program PALT Outputs)

	LAT	LONG	N
9 WELL-GROUPED DYKES	58.1	-5.2	9

SPECIMEN	NO OF DEMAG STAGES
11	1
17	1
18	1
22	1
24	1
25	1
26	1
27	1
28	1

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
1	9	55.4	284.6	59.2	6.7	37.3	274.8	6.9	9.6

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	LAT	LONG	N
DYKE 1	58.3	-5.2	3

SPECIMEN	NO OF DEMAG STAGES
1 1	4
1 3	4
1 31	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	3	86.2	71.7	15.4	32.5	59.1	32.1	59.8	62.4
50	3	83.8	17.8	20.8	27.7	69.7	5.6	53.6	54.5
100	3	83.9	14.6	23.6	25.0	69.8	3.2	50.2	51.1
150	3	85.2	70.4	26.8	24.3	69.3	13.1	47.6	48.1

	LAT	LONG	N
DYKE 5	58.3	354.9	7

SPECIMEN	NO OF DEMAG STAGES
5 2	4
5 4U	4
5 7U	4
5 11	4
5 31L	4
5 40L	4
5 42L	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	7	48.2	23.7	1.3	111.3	56.7	135.1	95.9	146.5
50	7	49.9	7.2	1.3	104.0	62.0	161.7	92.7	138.9
100	7	47.7	0.8	1.3	104.3	60.5	173.4	88.4	135.8
150	7	4.2	0.5	1.1	180.0	33.8	174.3	90.4	180.4

	LAT	LONG	N
DYKE 6	58.3	-5.2	2

SPECIMEN	NO OF DEMAG STAGES
6 6	4
6 8L	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	2	75.6	353.5	11.3	83.1	84.4	322.3	140.3	152.7
50	2	76.5	337.6	35.5	43.3	77.8	303.5	74.3	80.2
100	2	73.1	348.9	52.5	35.2	79.8	329.8	62.4	66.3
150	2	57.8	333.7	2.6	183.0	63.9	226.8	194.2	264.4

	LAT	LONG	N
DYKE 7	58.3	-5.2	32

SPECIMEN	NO OF DEMAG STAGES
7 1U	4
7 2U	4
7 4U	4
7 5U	4
7 7U	4
7 8U	4
7 9U	4
7 10U	4
7 11L	6
7 12	4
7 14	4
7 15	4
7 16L	6
7 17	4
7 18	4
7 19	4
7 20	4
7 23	6
7 24	4
7 25	4
7 26	6
7 27	4
7 28	4
7 29L	4
7 31	6
7 32	4
7 33	4
7 35	5
7 36L	6
7 37	4
7 38	4
7 39	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	32	7.7	104.8	16.9	6.4	-4.4	70.1	3.2	6.4
50	32	4.0	106.9	27.7	4.9	-7.1	69.3	2.5	4.9
100	32	1.0	106.1	34.9	4.4	-7.9	70.8	2.2	4.4
150	32	-0.6	106.8	33.6	4.4	-9.0	70.6	2.2	4.4

	LAT	LONG	N
DYKE 11	58.2	-5.0	11

SPECIMEN	NO OF DEMAG STAGES
11 9	4
11 11	9
11 12	4
11 15	4
11 16L	6
11 19	4
11 26	6
11 43	4
11 47	4
11 53	4
11 55	5

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	11	69.8	267.9	3.3	29.7	42.3	301.8	43.7	50.9
25	9	57.1	267.9	103.3	5.1	30.3	288.7	5.4	7.4
50	11	55.6	264.7	70.0	5.5	27.5	290.0	5.6	7.9
75	9	54.4	259.9	75.5	6.2	24.3	292.7	6.1	8.7
100	4	56.2	264.2	32.9	16.3	27.8	290.7	16.9	23.4

	LAT	LONG	N
DYKE 13	58.2	-5.2	3

SPECIMEN	NO OF DEMAG STAGES
13 13	4
13 14	4
13 17	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	3	42.9	254.5	0.9	180.0	13.3	291.0	138.0	222.9
50	3	39.7	265.7	0.9	180.0	16.8	280.7	129.7	216.1
100	3	42.0	280.2	0.9	180.0	25.8	269.9	135.6	221.0
150	3	41.1	282.0	0.9	180.0	26.1	267.9	133.2	219.0

	LAT	LONG	N
DYKE 14	58.2	-5.2	5

SPECIMEN	NO OF DEMAG STAGES
14 11L	4
14 12L	4
14 16	4
14 17L	4
14 18L	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	5	46.7	338.7	1.7	91.4	56.3	21[illegible].2	75.8	117.7
50	5	61.2	311.4	2.2	69.1	56.1	253.6	81.5	1[illegible]6.1
100	5	53.5	317.9	2.3	66.3	57.1	248.2	72.9	98.4
150	5	5[illegible].3	298.9	2.4	64.9	41.[illegible]	253.8	58.3	87.0

	LAT	LONG	N
DYKE 16	58.3	-5.1	11

SPECIMEN	NO OF DEMAG STAGES
16 8	4
16 11	4
16 12	4
16 13L	4
16 15	4
16 17L	4
16 18	4
16 23	4
16 24	4
16 25	4
16 26	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	11	62.[illegible]	16.[illegible]	2[illegible].3	1[illegible].4	71.9	134.6	12.5	16.1
50	11	61.2	29.[illegible]	13.2	13.1	65.8	113.8	15.4	2[illegible].[illegible]
100	11	56.6	24.8	11.1	14.4	63.4	126.7	15.[illegible]	2[illegible].8
150	11	52.9	27.6	11.6	14.[illegible]	59.[illegible]	126.1	13.4	19.4

	LAT	LONG	N
DYKE 17	58.1	-5.2	14

SPECIMEN	NO OF DEMAG STAGES
17 1	4
17 2	4
17 4L	4
17 5	4
17 6	4
17 7	4
17 10L	4
17 11	4
17 12	4
17 13	4
17 14	4
17 15	4
17 23	4
17 24	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	14	67.3	299.9	12.2	11.8	55.2	278.4	16.4	19.7
50	14	62.1	311.1	45.5	6.[illegible]	51.4	268.8	7.2	9.3
100	14	60.2	300.4	40.3	6.3	49.4	266.9	7.3	9.6
150	14	58.5	299.3	26.5	7.9	47.5	265.9	8.7	11.7

		LAT	LONG	N
DYKE 18		58.1	-5.2	29

SPECIMEN	NO OF DEMAG STAGES
18 1	9
18 2	5
18 3L	5
18 4	5
18 5	5
18 6L	6
18 7	5
18 8L	5
18 9L	5
18 10L	5
18 11	6
18 12	5
18 13L	5
18 14	3
18 15	5
18 16	6
18 17	5
18 18	5
18 19	5
18 20	5
18 21	9
18 22	5
18 23	5
18 24	5
18 25	5
18 26	6
18 28	5
18 29	5
18 30	5

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	29	66.4	272.3	22.1	5.8	40.6	294.6	7.9	9.6
50	28	57.3	265.7	99.9	2.7	29.4	290.3	2.9	4.0
100	28	51.7	264.9	169.0	2.1	24.5	287.3	2.0	2.9
150	29	50.7	262.0	165.6	2.1	22.3	288.8	1.9	2.8
200	29	49.9	261.1	150.5	2.2	21.2	289.1	1.9	2.9
250	6	51.7	262.2	90.6	7.1	23.2	289.2	6.6	9.6

241A

		LAT	LONG	N
DYKE 20	Very weakly magnetized dyke; insufficient data for stability criterion.	58 3	-5.2	13

SPECIMEN	NO OF DEMAG STAGES
20 1	2
20 2	2
20 3L	2
20 4L	2
20 5L	2
20 6L	2
20 7L	2
20 8L	2
20 9L	2
20 10L	2
20 11	2
20 12L	2
20 13L	3

		****** MAGNETIZATION	****	***		***** POLE	********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	13	63.4	57.6	6.9	17.0	48.0	72.5	21.2	26.8
100	13	57.4	46.3	5.4	19.7	54 3	98.8	21.1	28 8

	LAT	LONG	N
DYKE 22	58.1	-5.2	16

SPECIMEN	NO OF DEMAG STAGES
22 1	6
22 2	5
22 3	5
22 5	5
22 6	6
22 7	5
22 8	5
22 9	5
22 10	5
22 12	5
22 13	5
22 14	5
22 15	5
22 16	6
22 17	5
22 23	5

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	16	54.5	323.3	9.4	12.7	56.5	237.4	12.6	17.9
50	16	55.7	303.6	13.2	10.5	47.5	259.1	10.8	15.1
75	16	54.1	302.5	14.9	9.9	45.7	258.7	9.8	13.9
100	16	53.9	295.0	16.4	9.4	41.6	265.1	9.2	13.1
125	16	55.4	297.1	18.2	8.9	43.9	264.6	9.0	12.7

	LAT	LONG	N
DYKE 23	58.1	-5.2	8

SPECIMEN	NO OF DEMAG STAGES
23 4	3
23 8	4
23 9	4
23 10	4
23 11	4
23 12	4
23 14	4
23 17	3

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	8	14.1	319.6	3.8	32.9	30.3	223.0	17.2	33.7
50	8	5.3	316.6	3.9	32.0	25.0	224.1	16.1	32.1
100	8	-2.2	314.0	4.0	31.5	20.5	225.0	15.8	31.5
150	6	-10.2	304.6	17.6	16.4	12.9	232.1	8.4	16.6

	LAT	LONG	N
DYKE 24	58.1	-5.2	11

SPECIMEN	NO OF DEMAG STAGES
24 1	6
24 3	3
24 4	3
24 5	3
24 6	6
24 7	3
24 8	3
24 9	3
24 10	3
24 11	6
24 16	6

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	11	55.2	298.9	26.8	10.3	44.6	262.9	10.4	14.6
25	4	55.2	298.6	100.3	9.2	44.5	263.1	9.3	13.1
50	4	52.2	298.3	164.0	7.2	42.1	260.8	6.8	9.9
75	11	50.5	295.2	157.8	3.6	39.3	262.2	3.3	4.9
100	11	49.6	294.0	199.8	3.2	38.0	262.6	2.9	4.3
125	4	50.9	293.8	92.2	9.6	38.8	263.8	8.6	13.[illegible]

	LAT	LONG	N
DYKE 25	58.1	-5.3	6

SPECIMEN	NO OF DEMAG STAGES
25 4	5
25 6	6
25 10	5
25 12	5
25 14	5
25 22	5

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	6	52.1	296.9	35.4	11.4	41.3	261.9	10.7	15.7
25	6	57.4	298.7	65.6	8.3	46.3	265.1	8.9	12.2
50	6	57.2	293.5	52.1	9.4	43.4	269.1	10.0	13.7
75	6	54.6	288.3	47.7	9.8	38.8	271.2	9.8	13.9
100	6	58.4	289.0	20.1	15.3	41.9	274.0	15.8	22.6

		LAT	LONG	N
DYKE 26		58.1	-5.2	27

SPECIMEN	NO OF DEMAG STAGES
26 1	12
26 2	3
26 3	3
26 4	3
26 5	3
26 6	12
26 7	3
26 9	3
26 10	3
26 11	12
26 12	3
26 15	3
26 16	12
26 18	3
26 19	3
26 20	4
26 21	12
26 23	3
26 24	3
26 25	4
26 26	12
26 27	3
26 28	3
26 29	3
26 30	4
26 31	3
26 32	3

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	27	49.6	291.3	13.3	7.9	36.6	265.0	7.0	10.6
25	6	51.5	294.2	101.2	6.7	39.4	263.9	6.2	9.1
50	27	50.1	293.0	161.0	2.2	37.8	263.9	2.0	2.9
75	27	50.3	293.1	183.6	2.1	38.0	263.9	1.8	2.8
100	9	49.1	292.1	171.6	3.9	36.6	264.0	3.5	5.2
125	6	50.6	294.9	111.0	6.4	39.2	262.6	5.8	8.6

	LAT	LONG	N
DYKE 26 PILOT ONLY	58.1	-5.2	6

SPECIMEN	NO OF DEMAG STAGES
26 1	12
26 6	12
26 11	12
26 16	12
26 21	12
26 26	12

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	6	51.7	297.1	34.2	11.6	41.1	261.5	10.8	15.8
25	6	51.5	294.2	101.2	6.7	39.4	263.9	6.2	9.1
50	6	51.4	293.6	136.5	5.8	39.0	264.3	5.3	7.8
75	6	50.7	293.5	115.5	6.3	38.4	263.9	5.7	8.4
100	6	49.6	292.8	120.9	6.1	37.4	263.7	5.4	8.1
125	6	50.6	294.9	111.0	6.4	39.2	262.6	5.8	8.6
150	6	51.4	292.3	133.6	5.8	38.3	265.4	5.4	7.9
200	6	50.2	285.7	115.1	6.3	34.0	270.0	5.6	8.4
250	6	53.7	290.6	61.5	8.6	39.2	258.6	8.4	12.0
300	6	50.5	308.4	15.2	17.7	46.2	250.1	16.0	23.9
400	6	36.3	298.3	5.5	31.6	31.8	251.5	21.4	36.8
500	6	58.5	314.0	27.6	13.0	55.2	252.4	14.3	19.3

	LAT	LONG	N
DYKE 27	58.2	-5.1	6

SPECIMEN	NO OF DEMAG STAGES
27 3	9
27 10	8
27 14	5
27 15	5
27 16	5
27 17	6

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	6	58.9	344.0	3.4	42.7	68.8	211.0	47.4	63.6
50	6	63.8	284.0	36.1	11.3	44.0	283.7	14.2	17.9
75	6	62.6	280.8	31.2	12.2	41.4	284.6	14.9	19.1
100	6	60.9	280.2	34.8	11.5	39.6	283.1	13.5	17.6

	LAT	LONG	N
DYKE 28	58.2	-5.2	29

SPECIMEN	NO OF DEMAG STAGES
28 1	13
28 2	3
28 3	3
28 4	3
28 5	3
28 6	13
28 7	3
28 8	3
28 9	3
28 10	3
28 11	13
28 12	3
28 13	3
28 14	3
28 15	3
28 16	13
28 17	3
28 18	3
28 19	3
28 20	3
28 21	13
28 22	3
28 23	3
28 24	4
28 25	3
28 26	13
28 27	4
28 28	4
28 29	4

		****** MAGNETIZATION ******				*********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	29	51.0	271.9	10.1	8.9	27.5	281.4	8.1	12.0
25	6	52.1	273.6	33.1	11.0	29.1	283.8	11.1	16.2
50	6	48.7	272.4	87.5	7.2	26.1	279.7	6.3	9.5
75	6	47.6	271.5	158.4	5.3	24.8	279.8	4.5	6.9
100	29	46.6	272.2	133.3	2.3	24.5	278.7	1.9	3.0
125	29	46.6	272.4	261.7	1.9	24.6	278.5	1.6	2.4
150	10	44.8	270.9	309.7	2.7	22.7	278.8	2.2	3.5
200	6	46.4	268.7	304.6	3.3	22.6	281.3	3.2	4.9
250	6	46.1	269.0	237.8	4.4	22.5	280.9	3.6	5.6
300	6	46.2	269.1	165.8	5.2	22.6	280.9	4.3	6.7
400	6	47.4	265.7	151.5	5.5	21.8	284.2	4.6	7.1
500	6	50.0	266.5	240.8	4.3	24.0	285.0	3.9	5.8
700	6	65.2	280.3	58.0	8.9	43.5	287.9	11.6	14.4

	LAT	LONG	N
DYKE 28.FIRST 22 SPECS ONLY	58.2	-5.2	22

SPECIMEN	NO OF DEMAG STAGES
28 1	13
28 2	3
28 3	3
28 4	3
28 5	3
28 6	13
28 7	3
28 8	3
28 9	3
28 10	3
28 11	13
28 12	3
28 13	3
28 14	3
28 15	3
28 16	13
28 17	3
28 18	3
28 19	3
28 20	3
28 21	13
28 22	3

		****** MAGNETIZATION			******	********* POLE		**********	
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	22	49.2	272.5	638.7	1.2	26.5	279.9	1.1	1.6
25	5	46.6	272.6	971.1	2.5	24.7	278.3	2.0	3.2
50	5	45.4	271.8	835.2	2.6	23.5	278.4	2.1	3.4
75	5	45.3	271.3	496.2	3.4	23.2	278.7	2.8	4.4
100	22	45.5	271.8	536.7	1.3	23.6	278.4	1.1	1.7
125	22	45.6	272.0	607.2	1.3	23.8	278.3	1.0	1.6
150	5	44.5	269.1	1017.6	2.4	21.5	280.0	1.9	3.0
200	5	46.0	268.7	257.0	4.8	22.3	281.1	3.9	6.1
250	5	45.9	269.3	192.8	5.5	22.5	280.6	4.5	7.1
300	5	46.0	269.8	137.4	6.6	22.9	280.3	5.4	8.4
400	5	49.6	266.8	401.9	3.8	23.8	284.5	3.4	5.1
500	5	50.0	266.6	193.8	5.5	24.2	284.8	4.9	7.4
700	5	63.0	279.2	52.8	10.6	41.6	286.9	13.4	16.9

	LAT	LONG	N
G2	58.3	-5.2	12

SPECIMEN	NO OF DEMAG STAGES
G2 1	3
G2 2	3
G2 3	3
G2 4	4
G2 5	3
G2 6	3
G2 7	3
G2 8	4
G2 9	3
G2 10	3
G2 11	3
G2 12	3

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	12	66.6	275.1	7.1	17.5	42.4	293.0	23.8	28.9
25	12	76.5	305.5	39.0	7.0	64.0	301.1	12.1	13.1
50	12	78.9	279.1	5.3	20.8	55.3	315.5	37.4	39.4

	LAT	LONG	N
G3	58.3	-5.2	5

SPECIMEN	NO OF DEMAG STAGES
G3 3	4
G3 4	3
G3 5	3
G3 6	3
G3 7	3

		****** MAGNETIZATION	******			********** POLE	**********		
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	5	62.0	322.3	12.3	22.7	62.3	248.5	27.3	35.2
50	5	64.3	329.7	8.1	28.6	68.0	244.3	36.5	45.7
100	5	57.2	330.5	5.6	35.5	61.9	230.8	37.7	51.7

	LAT	LONG	N
G4	58.3	-5.2	8

SPECIMEN	NO OF DEMAG STAGES
G4 2	3
G4 4	3
G4 5	3
G4 6	3
G4 7	3
G4 8	3
G4 9	3
G4 10	4

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	8	64.0	30.7	7.7	21.3	64.6	93.4	27.0	33.9
25	8	66.7	11.3	2.2	50.1	78.8	133.9	63.1	82.6
50	8	26.2	245.4	1.1	154.0	-0.5	292.8	90.2	166.6

	LAT	LONG	N
G5	58.4	-5.1	16

SPECIMEN	NO OF DEMAG STAGES
G5 1	3
G5 2	3
G5 3	3
G5 4	3
G5 5	3
G5 6	5
G5 7	3
G5 8	1
G5 9	3
G5 10	3
G5 11	5
G5 12	3
G5 13	3
G5 14	3
G5 15	3
G5 16	3

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	16	23.9	118.3	7.6	14.3	-0.8	53.0	8.7	15.7
25	15	23.3	118.2	5.5	18.0	-3.6	54.0	10.2	19.2
50	15	18.6	115.1	4.1	21.5	-4.5	53.5	11.6	22.4

	LAT	LONG	N
G6 (GRANULITE)	58.1	-5.2	23

SPECIMEN	NO OF DEMAG STAGES
G6 1	6
G6 2	6
G6 3	6
G6 4	4
G6 5	7
G6 6	6
G6 7	6
G6 8	6
G6 9	6
G6 10	7
G6 11	6
G6 12	6
G6 13	6
G6 14	6
G6 15	7
G6 16	6
G6 17	6
G6 18	6
G6 19	6
G6 20	7
G6 21	6
G6 22	6
G6 23	6

		****** MAGNETIZATION ******				************* POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	23	67.5	331.3	7.3	12.0	71.7	252.3	16.7	20.0
25	4	63.0	294.3	66.8	11.3	48.6	275.4	14.0	17.8
50	23	57.5	291.5	12.9	8.8	42.6	271.2	9.4	12.9
75	23	52.8	287.6	19.2	7.1	36.9	270.3	6.5	9.8
100	23	52.3	284.7	22.5	6.5	35.0	272.3	6.2	9.0
125	22	59.5	290.8	24.9	6.3	43.8	273.8	7.2	9.5
150	22	56.6	288.4	17.5	7.6	40.2	272.8	8.0	11.0

	LAT	LONG	N
G7	58.3	-5.2	11

SPECIMEN	NO OF DEMAG STAGES
G7 1	1
G7 2	3
G7 3	3
G7 4	3
G7 5	3
G7 6	1
G7 7	3
G7 8	3
G7 9	3
G7 10	1
G7 14	1

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	11	80.5	36.0	1.9	47.2	70.4	23.7	87.2	90.7
25	7	71.3	9.8	1.9	61.4	84.2	104.2	93.9	107.4
50	7	77.1	8.2	1.6	74.6	81.9	13.8	129.8	139.2

	LAT	LONG	N
H1 GRANITE	58.4	-5.0	8

SPECIMEN	NO OF DEMAG STAGES
H1 1	3
H1 2	3
H1 3	3
H1 4	3
H1 6	3
H1 7	2
H1 8	3
H1 9	2

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	8	67.1	305.7	4.6	29.1	58.0	273.7	40.0	48.3
25	8	83.9	350.3	5.6	25.8	70.3	348.9	49.9	50.8
50	6	84.0	96.8	3.3	43.7	55.1	16.1	84.6	86.0

	LAT	LONG	N
H2 GRANITE	58.4	-5.1	5

SPECIMEN	NO OF DEMAG STAGES
H2 5	2
H2 6	2
H2 9	2
H2 10	2
H2 11	2

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	5	65.4	270.3	10.8	24.4	39.1	294.5	32.1	39.6
25	5	58.9	279.6	8.7	27.6	37.6	281.4	30.6	41.1

	LAT	LONG	N
H3 GRANITE	58.4	-5.1	7

SPECIMEN	NO OF DEMAG STAGES
H3 4	2
H3 10	2
H3 12	2
H3 13	2
H3 14	2
H3 15	2
H3 17	2

		****** MAGNETIZATION ******				********** POLE **********			
DMG	N	DIP	DECLN	K	A95	LAT	LONG	DP	DM
0	7	76.2	32.5	3.4	38.7	73.6	52.0	66.1	71.5
25	7	76.2	11.9	3.0	42.6	82.1	36.0	72.9	78.8