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DETAILS AND SIGNIFICANCE OF PRE-KETILIDIAN DOLERITE DYKES IN AN AREA NORTH–EAST OF BJØRNESUND, NEAR FISKENÆSSET, WEST GREENLAND

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Introduction

Three sets of dolerite dykes cut all pre-Ketilidian structures in an area north-east of Bjørnesund, where they are intimately associated with transcurrent faults. The earliest dykes trend approximately north–south, are followed by an east–north–east trending set, which in turn are cut by the youngest and most abundant set, trending east–south–east. The east–north–east set may be subdivided into subordinate north–east, and dominant east–north–east trending swarms. Similar field relations have been recorded by Chadwick (1969), Dawes (1970), Jensen (1966), Rivalenti & Sighinolfi (1971), and by many others in unpublished GGU reports. Recent mineralogical and geochemical work by Rivalenti & Sighinolfi concerns similar dykes in the Frederikshåb area to the south. Within the area south and east of Fiskenæsset, the field relations and petrological characteristics of the dykes are relatively uniform, according to information furnished by colleagues working in adjacent areas.

Field occurrence

Field data are presented in Table 16. All dykes exhibit chilled margins, some contain internal chills and other multiple intrusion phenomena. The earlier two sets are not numerous, rendering an analysis of their trends and occurrence unreliable. The youngest, east–south–east swarm, contains twenty dykes. Most are concentrated in areas dominated by structures parallelling their trend, produced in the preceding, pre-Ketelidian, tectonothermal event. All dykes are vertical and straight except where they cross-cut faults. Some faults appear to have locally reoriented the regional stress pattern, such that a dyke may assume a different trend, and sometimes occupies the fault for some distance.

Internal textural phenomena

The east–south–east and east–north–east dolerites both contain structures indicating the process of multiple intrusion. The most common of these is the presence of internal chills. Movement of magma from the central, unconsolidated portion of a dyke often occurs, breaking through the initial chilled zone into the surrounding host rock. Perhaps the most striking feature is the vertical banding present in many of the east–south–east dykes with widths of more than 5 m. Bands of feldspathic and normal dolerite are longitudinally impersistent, and can only be traced for 30 m. Bands are normally restricted to the doleritic portions of each intrusion, the gabbroic central parts are homogeneous. A process involving either multiple injection of magma, or variation in physical conditions, such

Table 16. Field and petrological data for Bjørnesund dolerites

Dyke set	North-south	East-north-east	East-south-east
Width	0.8 to 25 m	Up to 50 m	Up to 50 m
Fault association	Close to or within faults of similar trend		Parallel with, but not associated with ESE faults
Chilled margins	Always present, large dykes have gabbroic centres, rare pegmatites		
Trend	150 to 180, vertical	065 to 090, vertical 038 to 045, vertical	090 to 140, vertical mean trend 120
Number of dykes	6	8	20
Characteristics	Generally thin, but very persistent. Large dykes contain many poikocrysts	Some evidence of multiple intrusion. Margins often fault bounded, epidosites	Commonly show en echelon and en bayonet structures. Large dykes induce melting of contact rocks
Olivine	Euhedral & skeletal phenocrysts, poikocrysts, interstitial grains	Phenocrysts in large dykes only	Very rare phenocrysts completely altered
Hypersthene	Phenocrysts and interstitial grains	Phenocrysts in large dykes only	Not present
Augite	Phenocrysts and mantles around hypersthene, interstitial	Phenocrysts, glomeroporphyritic and interstitial grains	Zoned glomeroporphyritic and interstitial grains
Plagioclase	Resorbed phenocrysts, zoned poikocrysts, variolitic and normal laths, An 45-65	Zoned poikocrysts, phenocrysts and laths, An 45-65	Zoned, resorbed phenocrysts and laths, An 45-55
Magnetite Ilmenite	Interstitial grains	Interstitial grains	Interstitial grains. Large, altered, subhedral plates
Alteration	Plagioclase stained brown, chlorite and white mica	Small dykes often wholly altered to chlorite and white mica, epidosites	Uralitic hornblende, biotite and chlorite leucoxene from ilmenite

as water vapour pressure, during precipitation of the silicate phases from the magma, is considered to be the most likely cause of these banded rocks (Williams, 1973).

Petrography

Brief mineralogical data are presented in Table 16. Most of the dykes are medium-grained, sometimes porphyritic dolerites, the larger ones containing gabbroic centres. The older two sets contain phenocrysts of all the normal silicate phases found in dolerites, while the east–south–east set contains only zoned plagioclase phenocrysts and glomeroporphyritic clots of clinopyroxene. Plagioclase phenocrysts show frequent signs of partial resorption, while the olivine and orthopyroxene phenocrysts are often mantled by clinopyroxene.

Up to 5% interstitial alkali feldspar – quartz intergrowth is found in the latest set of dykes, being absent in the first two.

Dykes associated with, or sampled near to faults are frequently altered. East–south–east dykes are more altered than others, perhaps due to mild autometamorphism. They contain abundant uralitic hornblende developed from clinopyroxene, minor biotite, chlorite, leucoxene plates and white mica. A more hydrous assemblage is characteristic of these east–south–east dolerites.

Chemistry

The AFM diagram (fig. 43) indicates that most of the dolerites have compositions that plot along an iron-enrichment trend. No significant variation in major-element chemistry can be recognised with respect to dyke size or trend, excepting some dykes in the north–south swarm. Of the six dykes analysed from this set, three are poor in iron and titanium, but rich in magnesium. These magnesian rocks are extremely coarse-grained, rich in euhedral phenocrysts and poikocrysts of olivine and hypersthene, and poor in magnetite. They may represent a relatively primitive magma, a differentiated portion of which was responsible for the remaining intrusions.

Average K_2O wt.% composition for the three swarms taken together is 0.6, a value found in many continental tholeiites and dolerites.

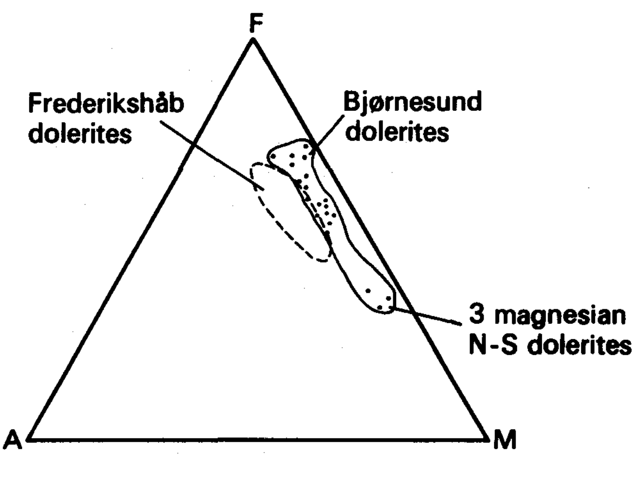

Fig. 43. AFM diagram plotted as weight per cent oxides of dolerites from southern West Greenland.

Table 17. Correlation of dyke trends

Bjørnesund	Frederikshåb**	Godthåb* Sukkertoppen	Canadian† Shield	North-west† Scotland
N-S	MD_1 (160)	010,160		
ENE	MD_2 (040-060)	065-105		
ESE	MD_3 (090-120)	130	Yellowknife & Ungava	Scourie dyke swarm

* from Berthelsen & Bridgwater (1960), Jensen (1962)
** from Jensen (1966)
† from Payne et al. (1965), Bridgwater et al. (1973)
Figures indicate the trend range, or average trend in each swarm

Figure 43 also shows the position of the dolerites analysed by Rivalenti & Sighinolfi, from the Frederikshåb area. The variation in composition of the Bjørnesund dolerites is slightly greater than that in the Frederikshåb rocks; total alkalies are significantly different but the variation may be analytical in origin. The average compositions of the two groups are very similar. Comparison with other analysed continental basaltic rocks suggests that there are few significant major-element differences between many of these and the pre-Ketilidian dolerites of West Greenland.

Correlations and their significance

Although incomplete, mapping has provided the data upon which the following correlations have been made (Table 17).

In West Greenland there is a close correlation between dyke trend and relative age. Mineralogical data support these field correlations.

The Canadian and Scottish dyke swarms of late Archaean age have been correlated with those in West Greenland by Payne *et al.* (1965), and Bridgwater *et al.* (1973). After allowance is made for the effects of continental break-up and drift, the Archaean dykes describe a great circle across the North Atlantic Craton. The dykes were intruded at the end of a long period of thermal and tectonic activity, at a time when the crust was first able to fracture on a large scale. Previously, dyke swarms were of a relatively local extent, reflecting the distribution and size of crustal material competent enough to support fractures. The dyke intrusion event is a world-wide one, examples of late Archaean dolerites occur also in Australia (McCall & Peers, 1971) and Rhodesia (Wilson, 1973), suggesting that a global change in crustal conditions was responsible for the cooling and fracturing of the continental crust.

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