JURASSIC DOLERITES FROM THE FALKLAND ISLANDS AND DRONNING MAUD LAND

By JANET W. BROWN

A DOLERITE from Fox Bay, West Falkland, is compared petrographically with two similar dolerite specimens from Vestfjella, Dronning Maud Land. The Vestfjella specimens are of known Jurassic age (Rex, 1967) and they are closely comparable to the well-known Tasmanian and Karroo dolerites. Further comparisons of petrography and age are drawn between these three specimens and dolerites from other parts of Antarctica.

DOLERITE FROM THE FALKLAND ISLANDS

On 2 December 1963, Professor D. H. Griffiths and W. Ashcroft (Department of Geology, University of Birmingham) had the opportunity of visiting a prominent dolerite dyke which crops out 11 miles (17·6 km.) north-east of Fox Bay (lat. 51°50′S., long. 59°52′W.), West Falkland. They were able to collect a set of ten large representative samples (Nos. 1–10) from the dyke over a distance of 0·25 miles (0·4 km.). Palaeomagnetic investigations on the samples are now in progress but no age determinations have yet been made.

Field relations

The dyke trends north-north-east and it is either vertical or has a steep dip (~80°) to the west; its width varies from 60 to 100 ft. (18·3 to 30·5 m.) which is indicative of its apparent non-vertical attitude. The country rock into which the dolerite was intruded is a current-bedded red sandstone. Although no sharp contacts were observed in the field, a certain amount of bleaching could be seen in the sandstone adjacent to the contact with the dyke.

Petrography

In thin section, specimen No. 4 is an essentially homogeneous, coarse-grained dolerite with an intergranular to subophitic texture (Fig. 1). Of the three photomicrographs included in Baker's (1922) report, specimen No. 4 is most like the dolerite shown in his fig. 2, a specimen from Port Sussex, East Falkland; the other two specimens illustrated by Baker have a different grain-size and contain a considerable quantity of olivine. The labradorite (An_{61}) in this specimen occurs both as laths and larger subhedral prisms which vary in length from 0·5 to 1·0 mm. or sometimes to almost 2·0 mm. Oscillatory zoning, from a lime-rich core through several sodic zones to a calcic margin, is poorly defined. Both multiple and simple twins are invariably present in the laths, whereas the larger crystals are usually untwinned; a few are completely saussuritized.

Fig. 1. Intergranular to subophitic texture of a coarse-grained dolerite; 11 miles (17·6 km.) north-east of Fox Bay, West Falkland (specimen No. 4; X-nicols; ×14).

Idiomorphic pyroxene crystals are absent from the thin section and their general form is that of elongated irregular anhedra arranged in glomeroporphyritic aggregates. The dominant pyroxene is a magnesian pigeonite ($2V\gamma = 10–20°$, $\gamma:c = 31°$) but several crystals of an augitic pyroxene ($2V\gamma = 20–30°$) are also present and form an irregular and quite wide rim around a core of pigeonite. Cores of augite in pigeonite have also been observed. Both of the clinopyroxenes have a neutral or very pale brown colour and they commonly show simple twinning; lamellar twins are more rare. Extensive peripheral alteration and replacement along fractures readily distinguishes anhedra of colourless hypersthene from those of clinopyroxene (the orthopyroxene is invariably enclosed by pigeonite). Hypersthene is replaced by a mixture of scales and fibres of green-brown hornblende ($\gamma:c = 16°$) and occasional small flakes of brown-green biotite. Large irregular aggregates of octahedra (0·1–0·3 mm.) and skeletal growths of magnetite (with a small amount of iron pyrites) are commonly associated with pyroxene, occupying the interstices between plagioclase and pyroxene crystals. Small grains of sphene which occur at the margins of a few ore crystals suggest that the magnetite is titaniferous.

The mesostasis is abundant and forms large interstitial patches in the rock. It is composed of a micrographic intergrowth of quartz and alkali-feldspar, often in minute vermicules radiating outwards from the corners or edges of plagioclase crystals, or less commonly in large plumose intergrowths. Small crystals of quartz and turbid plagioclase are extremely rare but wisps and fibres of chlorite, accompanied by minute flakes of reddish brown biotite, are common.

Dolerite from Dronning Maud Land

Two orientated dolerite specimens (A and B) were collected on 6 December 1962 from Vestfjella (lat. 73°50′S., long. 15°W.), Dronning Maud Land, by G. Blundell and M. J. Winterton. The palaeomagnetism of specimen A has been measured by Blundell (1964), whilst K/Ar age determinations on both specimens A and B have yielded dates of 168 and 172 m. yr. (Rex, 1967).

Petrography

Specimen A is a fine-grained rock with an abundance of iron ore and an intergranular texture (Fig. 2). Laths of labradorite (An_{52}), varying in length from 0·1 to 0·6 mm., are invariably twinned on either the Carlsbad or the albite law. Large plagioclase phenocrysts are rare (Fig. 2) and partially saussuritized, whereas the laths are quite fresh.

The pyroxene is a slightly pleochroic magnesian pigeonite ($2V\gamma = 5–10°$; $\gamma:c = 44°$) which varies from colourless to pale brown. Because of the intergranular texture, idiomorphic crystals are absent and the pigeonite occurs as subhedra or anhedra separating laths of labradorite from one another; a few crystals are simply twinned but zoned ones are extremely rare. Pigeonite is replaced along fractures by a fibrous green-brown hornblende or small flakes of chloritized biotite.

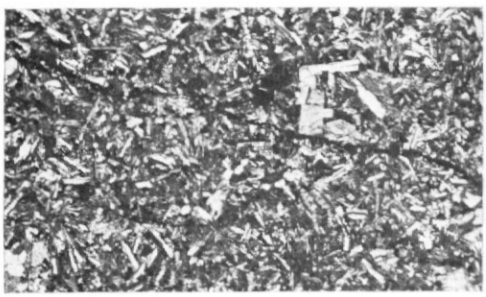

Fig. 2. Fine-grained dolerite with an intergranular texture and abundant magnetite. Plagioclase phenocrysts are rarely present; Vestfjella, Dronning Maud Land (specimen A; X-nicols; ×14).

Fig. 3. Typical intergranular texture of a coarse-grained dolerite; Vestfjella, Dronning Maud Land (specimen B; X-nicols; ×14).

The thin section of the dolerite is crowded with numerous small suboctahedra of magnetite accompanied by less regularly shaped masses, skeletal crystals, lamellae and specks of ore. Much of it is clustered around the periphery of pyroxene crystals and, in particular, occurs as small specks enclosed in chlorite/biotite. The mesostasis forms small, poorly defined patches in the dolerite and it is composed of quartz, alkali-feldspar (?) and minute needles of chlorite; no micrographic intergrowth of quartz and alkali-feldspar was observed. Small irregular pseudomorphs of olivine scattered sporadically through the rock are formed by a bright green amorphous serpentine and they are occasionally bordered by small grains of sphene.

Specimen B (Fig. 3) is remarkably similar to specimen No. 4 from West Falkland, although its texture has no subophitic tendencies. The laths of labradorite are less calcic (An_{52}) than in the Fox Bay dolerite, whilst a few of the larger plagioclase crystals display more clearly defined oscillatory zoning. Further differences between the two specimens are of a compositional nature; the pigeonite in specimen B has $2V\gamma = 0–15°$ and $\gamma:c = 22°$.

Discussion

Apart from minor mineralogical and textural differences, the three dolerites described here are notably similar; Table I shows the similarity between their modal analyses and it also gives two contrasting analyses from the Ferrar Dolerites of southern Victoria Land. The major differences between specimens A, B and No. 4 are:

i. The unusually high content of iron ore and the presence of only one clinopyroxene in specimen A.
ii. The presence of an orthopyroxene in specimens B and No. 4.
iii. The increased anorthite content of the plagioclase and the relatively high percentage of mesostasis in specimen No. 4.
iv. The only textural difference, besides grain-size, occurs in specimen No. 4, where a slightly subophitic texture is present.

Table I. Modal analyses of Jurassic dolerites from the Falkland Islands and Antarctica

	1	2	3	4	5
Plagioclase	46·9	50·1	55·4	37·3	36·6
Orthopyroxene	—	10·6	2·6	—	—
Clinopyroxene	32·1	30·1	27·4	46·0	30·2
Magnetite	12·8	1·1	2·3	2·2	3·8
Hornblende	3·0	2·8	2·8	—	0·5
Biotite				3·3	2·9
Sphene	*	*	*	—	—
Mesostasis	5·2	5·3	9·5	11·2	26·0

* Present.

1. Specimen A; fine-grained dolerite from Vestfjella, Dronning Maud Land.
2. Specimen B; coarse-grained dolerite from Vestfjella, Dronning Maud Land.
3. Specimen No. 4; coarse-grained dolerite from 11 miles (17·6 km.) north-east of Fox Bay, West Falkland, Falkland Islands.
4. Ferrar Dolerite specimen from the top of Detour Nunatak dyke, south Victoria Land (Gunn, 1962, p. 845).
5. Ferrar Dolerite specimen from 1,430 ft. (436 m.) below the top of Detour Nunatak dyke, south Victoria Land (Gunn, 1962, p. 845).

Numerous comparisons have already been made in the literature concerning the remarkable petrographic and petrogenetic similarities between the Jurassic dolerites of the Southern Hemisphere, one of the most recent being that of Stephenson (1966). He has described a number of dolerites from the Theron Mountains, Shackleton Range and Whichaway Nunataks

which closely resemble those from Vestfjella and the Falkland Islands. However, they are distinguished from the dolerites described here by the presence of minor amounts of fayalitic olivine, zircon and apatite. Olivine also occurs in other dolerites from the Falkland Islands (Baker, 1922) but it is absent from the dolerite sill in the Horlick Mountains described by Treves (1964).

The Ferrar Dolerites (Gunn, 1962; Hamilton, 1964, p. 447, figs. 6 and 7) of eastern Antarctica are mainly thick sills which show the effects of differentiation processes not observed in the dolerites described here, but they are petrographically similar to them, e.g. zoned crystals of plagioclase, the types of pyroxenes present and the presence of plumose micrographic intergrowths. However, they usually contain a higher percentage of mesostasis (Table I), have a lower, more basic feldspar content (An_{60-70}) and include apatite in their mineral assemblage. Roots (1953) and von Brunn (1964, p. 417) have also noted petrographical similarities between the dolerites of western Dronning Maud Land and the Ferrar Dolerites, and von Brunn has mentioned the comparable ages of the dolerites from both areas.

Age determinations on other dolerites in the Southern Hemisphere have given ages similar to those of the Vestfjella dolerites. The Ferrar Dolerites have been dated at 162 and 170 m. yr. (Gunn, 1962, p. 859) and 147–163 m. yr. (McDougall, 1963), whilst the Tasmanian and Karroo dolerites are of a similar Mesozoic age (Gunn, 1962).

In conclusion, it should be noted that specimens A, B and No. 4 are petrographically the same as the tholeiitic basalts discussed by Turner and Verhoogen (1960, p. 205–14).

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