Research Note

A new occurrence of Cenozoic(?) basalt from Manbreen, Ny Friesland, northeastern Spitsbergen

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This note describes the occurrence, petrography, and bulk rock chemistry of the basalt recently found in northeastern Ny Friesland.

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A single outcrop of unaltered basalt has been found in the northern part of the upper reaches of the Manbreen glacier, c. 7 km north of Gullfaksbreen, Ny Friesland (Fig. 1). At about 800–820 m above sea level the basalt forms a small, 10–30 m high nunatak covering an elongated area of about 500 × 100 m in a north–south direction.

The basalt lies on strongly phyllitic chlorite-sericite schists of the Mossel Series (Krasilschikov 1973), which is equivalent to the Planetfjella Group of Harland et al. (1966). The basal contact is subhorizontal, dipping only 2–5° to the north. In the southern part of the outcrop the basalt is flaggy with well developed subhorizontal joints. At the base of the observable section the rock is dense and has a light grey colour, whereas the upper part consists of a vesicular, scoriaceous variety with dark grey and black colours. This upper part, in which convex-spherulical joints are developed, does nowhere exceed 1 to 1.5 m in thickness. No sediment intercalation has been observed and the lava is not easily divisible into subunits within the outcrop. On the basis of these observations it is concluded that the basalt is a remnant of a single lava flow.

The basalt is vesicular, slightly porphyritic, with an intergranular groundmass texture. Some vesicles are filled with calcite and rarely with chlorite. The main mass of the rock is characterized by an alternation of thin layers with small-scale microdoleritic and intersertal textures. The modal composition of the rock is: olivine 5–10%, clinopyroxene 30–40%, plagioclase 50–60%, opaque minerals 5–10%, iddingsite 1%, and glass 1–3%. Olivine is the principal phenocryst phase (5–7%). Scattered plagioclase and clinopyroxene phenocrysts also occur.

Olivine occurs as 0.5–2.0 mm rounded prismatic phenocrysts and as small crystals in the groundmass. Olivine composition has been optically determined (ng = 1.740–1.741; np = 1.700) to be Fo68. Some olivine phenocrysts have opaque inclusions.

Plagioclase occurs as 0.05–2.0 mm lath shaped grains, usually without any preferred orientation, but subparallel arrangement of the laths occurs locally. Plagioclase crystals usually show polysynthetic twinning after albite law and the composition ranges from An40 to An52.

Round greenish grains (0.01–0.1 mm in size) of clinopyroxene are interpreted as ferrous augite on the basis of refractive index measurements (ng = 1.753–1.755).

When small (0.01–0.05 mm) patches of interstitial glass occur, they are always associated with plagioclase laths. In these plagioclase-glass domains no clinopyroxene has been observed. In the lowermost part of the flow the amount of glass is only 1–3%. However, in the strongly jointed part of the flow the amount of glass is as high as 15–20% in some places. There the irregularly shaped individual glass patches are up to 0.2 mm in size.

Chemical data are presented in Table 1 and Figs. 2A and B. In the AFM diagram (Fig. 2B)

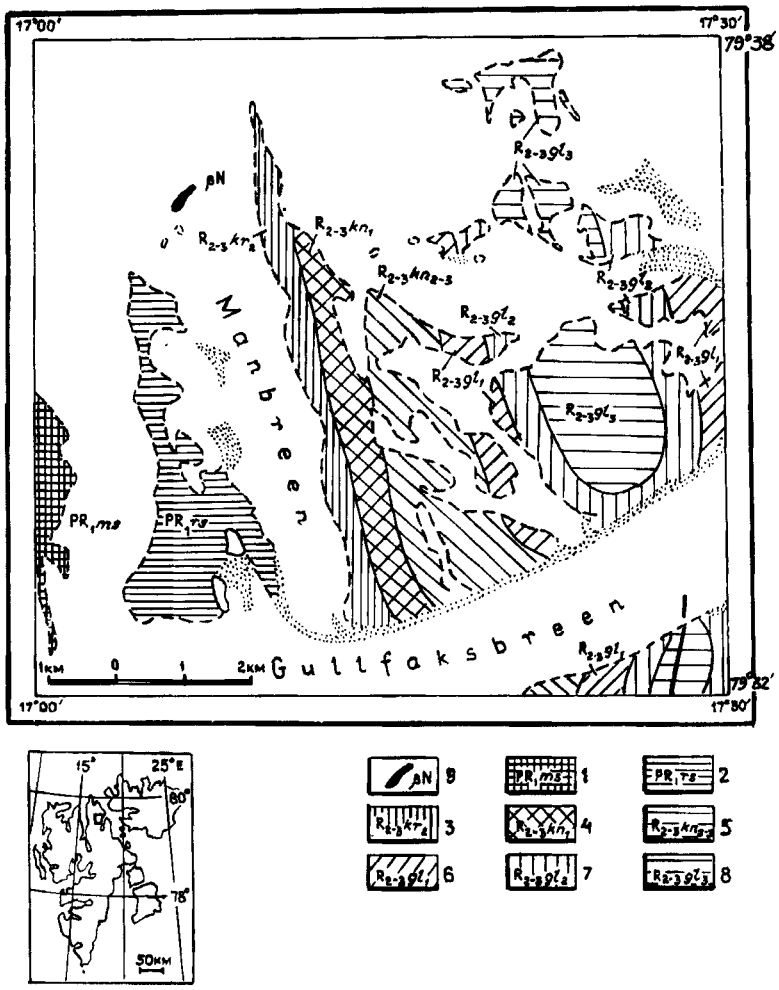

Fig. 1. Geological map of the Manbreen area.

Mossel Series: 1. Mosseldalen suite – marbles, quartzites, micaceous chlorite, and micaceous garnet schists; 2. Russefjella suite – sericite chlorite schists. Lomfjorden Series: 3. Kortbreen suite, upper subsuite – variegated quartzites; 4. Kortbreen suite, lower subsuite – siltstones, sandstones with intercalations of limestones; 5. Kingsbreen suite, Bogen-Cavendishryggen subsuite – undifferentiated green and cherry coloured argillites with intercalations of quartzites and limestones; 6. Glasgowbreen suite, first subsuite – grey and pink-grey quartzites; 7. Glasgowbreen suite, second subsuite-alternation of argillites and quartzite-sandstones; 8. Glasgowbreen suite, third subsuite – pink and dark brown quartzites; 9. Basalt of Neogene Tertiary.

the basalt plots are close to the division curve between calcalkaline and tholeiitic suites. It is obvious (Figs. 2A and B) that the composition of the basalt described here is similar to the Tertiary plateau basalts from elsewhere on Spitsbergen and different from Mesozoic dolerites and Quaternary trachybasalts from Bockfjorden (Kovaleva & Burov 1976). This infers a common magmatic source and perhaps a similar tectonic setting for the Tertiary plateau basalts of northwestern Spitsbergen and the basalt described here. TiO_2–K_2O–P_2O_5 ratios (TiO_2 = 52.6–54.5%, K_2O = 37.0–38.6%, P_2O_5 = 8.3–8.8%) indicate that the rocks are non-oceanic (Pearce et al. 1975). The trace element contents (Table 1) are similar to those of transitional basic rocks between various tectonic settings when they are plotted in diagnostic diagrams for Ni–total FeO/MgO, Cr–total FeO/MgO and V–Cr (all three Miyashiro & Shido 1975), Ti–Cr (Garcia 1978) and Ti/Cr–Ni (Beccaluva et al. 1979).

Three new analyses of the present basalt are slightly different from the average of Kovaleva & Burov (1976) (no. 4 in Table 1), especially in their larger K_2O and TiO_2 contents. However, they are rather similar to some of the rocks described by Prestvik (1978), e.g. the ne-normative samples 245 and 248. Similarity is also seen in TiO_2, K_2O, Ba, and Sr contents. Sample 587-1 of Prestvik (1978) is also ne-normative. If the iron ratio (Fe_2O_3/FeO) is normalized before norm calculation, to be for instance 0.15, sample 584-3 of Prestvik (1978) also becomes ne-normative and sample 587-2 is almost ne-normative. The present

Table 1. Chemical composition of basalts (nos. 1–3) from Manbreen, Ny Friesland, Spitsbergen. No. 4 represents mean composition of Tertiary plateau basalts from northwestern Spitsbergen (Kovaleva & Burov 1976). The analytical work was done at the chemical laboratory of the Vniiokeangeologija.

Major elements (weight per cent)				
	1	2	3	4
Sample no.	587-1	587-2	587-3	
SiO_2	49.77	49.36	49.73	49.3
TiO_2	1.80	1.80	1.80	1.3
Al_2O_3	16.62	17.32	16.83	15.7
Fe_2O_3	2.12	3.90	2.26	3.7
FeO	8.28	6.70	8.06	7.6
MnO	0.15	0.17	0.16	0.2
MgO	7.37	6.52	7.48	9.7
CaO	8.32	8.04	8.16	8.3
Na_2O	3.76	3.60	3.60	3.2
K_2O	1.32	1.30	1.22	0.7
P_2O_5	0.30	0.28	0.28	0.3
L.O.I.	0.57	1.01	0.91	
Total	100.38	100.00	100.49	

CIPW (weight) norms				
Ap	0.67	0.67	0.67	0.7
Il	3.49	3.49	3.49	2.4
Mt	3.01	5.56	3.24	5.3
Or	7.79	7.79	7.24	3.9
Ab	30.93	30.41	30.41	27.6
An	24.48	27.54	26.15	25.9
Ne	0.57	–	–	–
Di	11.98	8.51	10.16	10.7
Ol	16.79	3.44	14.74	12.0
Hy	–	9.65	3.52	11.5

Trace elements (ppm)			
Ba	450	320	350
Sr	440	430	450
Y	26	24	30
Co	45	40	47
Ni	150	130	150
Cr	280	290	220
Sc	21	22	23
V	160	160	200
Cu	44	52	46
Zn	160	130	210
Ga	16	23	20

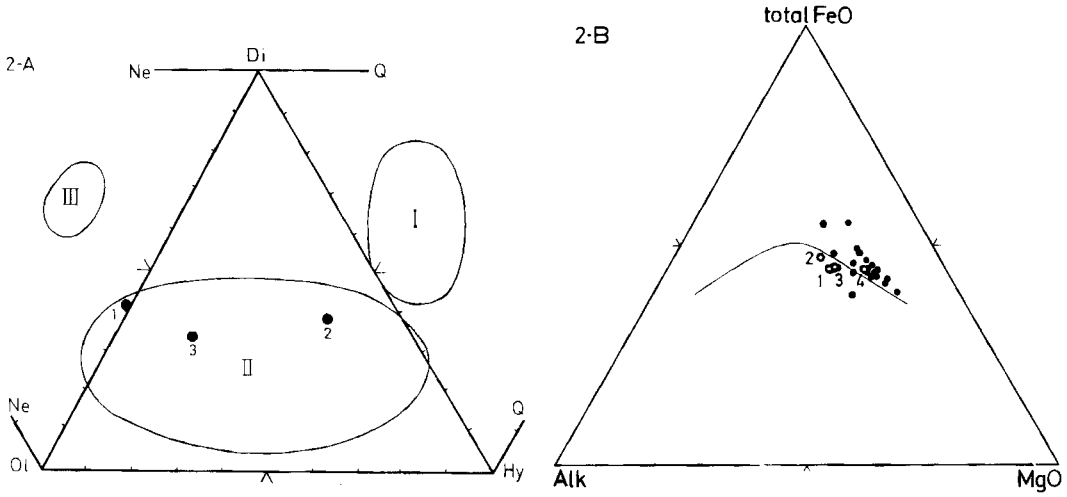

Fig. 2. A. Normative Ne–Ol–Di–Hy–Q diagram of the Mesozoic-Cenozoic basic rocks of Spitsbergen.

Dot: Neogene Tertiary basalts from Manbreen. I. Mesozoic dolerites of Spitsbergen; II. Neogene Tertiary basalts, northwestern Spitsbergen; III. Quaternary trachybasalts of Bockfjorden. I, II, and III from Kovaleva & Burov (1976).

Note that 2 and 3 will be close to Ol–Di join when the Fe_2O_3/FeO ratios are fixed to be 0.15, before the calculation of norm values.

B. A–F–M diagram of the Neogene Tertiary basalts.

Open circle with number: basalts from Manbreen and the mean composition of Tertiary basalts from Kovaleva & Burov (1976) (ref. Table 1); dot: Neogene Tertiary basalts from northwestern Spitsbergen (Kovaleva & Burov 1976).

three rocks (nos. 1, 2, and 3 in Table 1) will be plotted very close to the Ol–Di join when the iron normalization is applied.

In light of its geological position and mineralogical and chemical compositions the basalt from the Manbreen area, Ny Friesland, might be considered part of a Neogene basalt province (Burov & Zagruzina 1976; Kovaleva & Burov 1976; Prestvik 1978) on northern Spitsbergen. If such a conclusion is correct, Neogene basalt extends much further east than previously known, and enlarges the area underlain by such rocks considerably.

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