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NEW MAPPING IN NORTH-WESTERN DISKO 1972

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Introduction

During the summer of 1972 the areas around Hammers Dal and Rinks Dal, north-west Disko were mapped.

Special emphasis was laid on the investigation of the contaminated volcanic rocks and related intrusives occurring within the area, and on establishing the structural pattern, fundamental for the interpretation of the offshore geology.

The area investigated was previously only poorly known. Short accounts have been published by Münther (1951) and Pedersen (1969). Some general remarks were made by Münther (1973). A structural interpretation based on a photogeological study has been given by Henderson (1973) and a geological map based on earlier work by GGU before 1968 has been compiled by V. Münther (unpublished map sheet).

The western part of the area, facing the Davis Strait, is a poorly exposed lowland. Further east the land surface forms a gradually rising plateau dissected by valleys and the area becomes better exposed.

Regional geology

Within the area investigated, the only pre-Quaternary formations above sea level belong to the West Greenland Basalt Group (Hald & Pedersen, this report). In the eastern part of the area, the top of the Vaigat Formation crops out; the rest is covered by volcanic rocks and few interbasaltic sediments from the Maligât Formation. A preliminary map is presented in Plate 1. Cross-sections are given in Plate 2.

Vaigat Formation

In the inner part of Hammers Dal a few hundred metres of the Vaigat Formation volcanic rocks crop out. The lower flows form a sequence of brownish weathering basalts, slightly feldspar- and olivine-porphyritic, and are covered by about 100 m of picritic lavas. The picrite flows are generally a few metres thick, weather greyish and crumble readily. Subordinate erosion-resistant olivine-porphyritic flows occur. No unconformity separates the picrites from the overlying basalts.

Maligât Formation

About 1.5–1.8 km of these volcanic rocks are exposed. The stratigraphy of this formation is summarized in Table 1. Pending adequate definition, the subdivision of this formation into members will be regarded as informal usage.

Rinks Dal member

This is a sequence about 1.2–1.5 km thick, composed of a very monotonous pile of feldsparphyric tholeiitic plateau basalts. The flows vary in thickness from less than 5 to 50 m, most flows being 15–30 m thick.

The lavas show a brownish-weathering colour and form aa flows. Only subordinate tuff and laterite occur. No eruption centres for these basalts have been observed.

Petrographically the lavas contain phenocrysts of plagioclase, subordinate olivine

Table 1. Summary of basalt stratigraphy in north-western Disko

Formation	Member	Dominant lithology	Thickness
Maligât Formation	Niaqussat member	Contaminated volcanic rocks	200 – 400 m
	Nordfjord member	and conglomerate	
	Rinks Dal member	Feldsparphyric plateau basalts	1200 – 1500 m
Vaigat Formation		Picrite basalts	200 m
		Olivine and feldsparphyric basalts	exposed

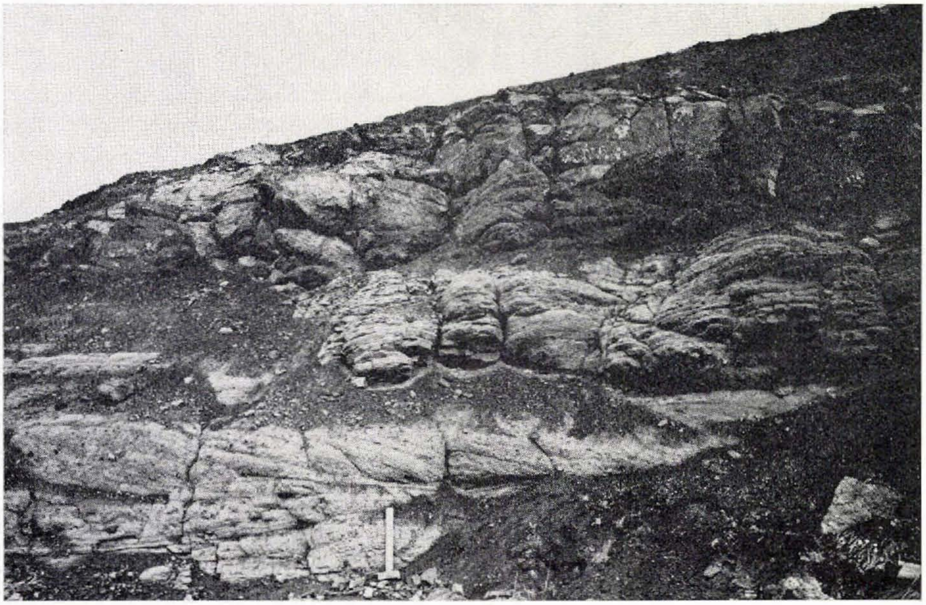

Fig. 7. Cross-bedded conglomerates and sandstone rich in plant fossils from the Nordfjord member. South of Avatarpait qáqât.

(generally pseudomorphed) and augite. The amount of phenocrysts varies from nearly none to considerable amounts.

The Rinks Dal member is so monotonous that no marker horizons have been established within the sequence.

Nordfjord member and Niaqussat member

These volcanic members are together several hundred metres thick and display a great variety of rock types and eruption forms (Table 2). The Niaqussat member rests on the Nordfjord member. They represent a change in volcanic activity from largely effusive eruptions giving rise to voluminous plateau basalts in a landscape showing only minor topography, to eruptions characterized by much more explosive activity, scattered craters and a considerable small-scale topography. A pronounced horizontal variation within the volcanic members can be seen, but will not be described in detail. No large central volcanoes with cauldrons have been found.

Within the members several conglomerates and sandstone beds were formed, derived exclusively by erosion of volcanic material. The sedimentary units can be up to 10 m thick and may show cross-bedding (fig. 7). At one locality south of Avatarpait qáqât numerous well preserved plant fossils occur in sandstone.

Table 2. Lithology of the Nordfjord and Niaqussat members

Niaqussat member	Basalt with few feldspar phenocrysts, possibly contaminated Flow-folded, inhomogeneous contaminated basalts Olivine-porphyritic, possibly contaminated basalts Contaminated basalts and tuffs Iron bearing contaminated basalts Iron bearing highly contaminated intermediate lava
Nordfjord member	Feldspar-porphyritic basaltic lavas Feldspar-porphyritic basalt, slightly contaminated Conglomerates and sandstones, sometimes with plant remains Acid redeposited tuff conglomerate with pitchstone blocks Quartz crystal tuff, redeposited, with almandine bearing dacitic blocks Contaminated basalts Iron bearing contaminated basalt Basaltic hawaiite
Rinks Dal member	Feldspar-porphyritic plateau basalts

The cause of the change in type of activity was a large-scale reaction between magma upwelling from a considerable depth and sandstone and bituminous shales. The magma which reacted with the sediments in the Niaqussat member was an olivine tholeiite, clearly more magnesian-rich than the feldsparphyric plateau basalts.

A number of eruption centres have been located. They show that these major contamination reactions occurred scattered over an area of more than 600 km^2 in north-west Disko.

During the final stages in both members the landscape was partly covered by slightly contaminated or uncontaminated basalts with a varying content of feldspar phenocrysts and again took the shape of a plateau basalt landscape.

The reaction with the sediments enriched the magmas in volatiles. The resulting rocks, formed by contamination and crystal fractionation, were slightly contaminated basalts, telluric iron and pyrrhotite bearing basalts and intermediate rocks, intermediate tuffs and in addition dacitic almandine bearing rocks and rhyolitic pitchstones and tuffs. Several of the more acid rocks are only known as blocks, up to 60 cm in size, from redeposited acid tuffs and conglomerates.

The Nordfjord and Niaqussat members contain much more telluric iron than

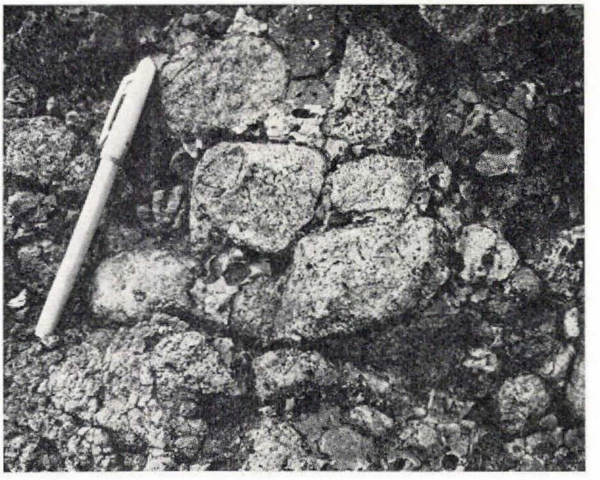

Fig. 8. Pile of rounded spinel–graphite–plagioclase xenoliths from the base of the contaminated basalt of the Niaqussat member near Igdluluarssuit qáqât.

any other parts of the lava sequence on Disko. The rocks occurring in the two members are shown in Table 2.

Included in the volcanic rocks are a variety of sedimentary xenoliths showing varying degrees of pyrometamorphism and partial magma equilibration, containing the pyrometamorphic minerals already reported by Pedersen (1969). The most characteristic xenoliths are spinel–graphite–plagioclase rocks formed during reaction between magma and bituminous aluminous sediments as large amounts of magmatic calcium diffused into the xenoliths (fig. 8).

The uppermost part of the Niaqussat member is the youngest part of the volcanic pile exposed in north-west Disko.

Alkaline basalt on Avatarpait

Still younger is the alkali basalt found on Avatarpait, a few small skerries about 2 km west of Disko. The skerries are built up of a columnar jointed alkaline olivine basalt rich in olivine phenocrysts and, rising up from a water depth of more than 25 m, they are interpreted as a volcanic neck.

Contaminated, telluric iron bearing intrusives

A number of intrusions comprising contaminated basalt with telluric iron have been found. These probably acted as feeders for the Niaqussat member. A few will be mentioned here.

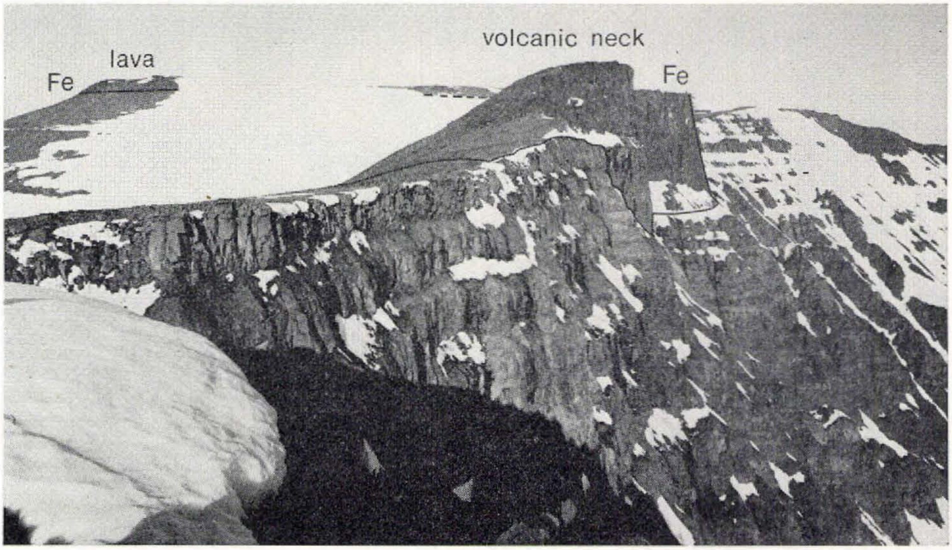

Fig. 9. The Hanekammen complex. Volcanic neck of contaminated iron-bearing rock cutting feldsparphyric plateau basalts of the Rinks Dal member. In the background iron-bearing contaminated lava of the Niaqussat member, 2.5 km north-west of Hanekammen.

Hanekammen complex

About 2.5 km north-west of the mountain Hanekammen an impressive volcanic neck composed of telluric iron bearing intermediate rock stands up through the feldsparphyric plateau basalts of the Rinks Dal member. The neck is about 200 m in diameter. It seems to have been a feeder for a voluminous telluric iron bearing lava exposed at a slightly higher level (fig. 9). From the neck a contaminated dyke extends several kilometres towards the south-east.

Point 882 neck

A circular volcanic neck of telluric iron bearing intermediate rock stands up at point 882 south of Gieseckes Dal. It was earlier reported by Pedersen (1969) and Henderson (1973).

Hammers Dal complex

A few kilometres south of the point 882 neck another body of contaminated, iron bearing rock is exposed. It may also be part of a volcanic neck. From this body a dyke up to 45 m thick, composed of telluric iron bearing rock, can be followed 2 km towards the south-east.

At a lower level in the north slopes of Hammers Dal the dyke forms irregular composite intrusives of telluric iron bearing sediment-contaminated rocks. High temperature nickeliferous pyrrhotite mineralization occurs in association with a sill, which displays impressive sediment xenolith flotation and telluric iron and pyrrhotite gravitative cumulation.

Structure

During the eruption of the exposed part of the volcanic pile, the north-western part of Disko was in a state of tension. A regular system of NW–SE striking fractures and dykes occurs. No regular basin movements comparable with those described from north-east Disko by Pedersen (1973) have been recorded.

Later a catastrophic down-sagging affected north-west Disko in connection with a major geodynamic event. The area was split into blocks. In the east a stable plateau remained, only fractured by a few predominantly N–S faults.

In the west a zone of down-sagging runs N–S parallel to the west coast of Disko. This zone is charaterized by N–S striking blocks dipping west and was partly recognized during photogeological studies by Henderson (1973).

Another prominent zone of sinking runs NE–SW parallel to the Maligât and affects the south-east corner of Hareøen and the north-west coast of Disko as far south as 5 km north of Hammers Dal. On Disko this zone is characterized by subhorizontal blocks and blocks dipping south-east and south. A complex interference pattern is found where the two zones meet.

The area investigated represents a section from the stable eastern plateau into the N–S zone of down-sagging. Although complex in detail, the general structure is very simple, and is illustrated in Plate 2.

The lavas in the eastern plateau strike NW–SE and dip typically from less than 2° to 4° SW. Further west the plateau is fractured by numerous N–S striking joints and faults and the lavas attain a N–S strike. The dip steepens from block to block from 3–4°W in the east up to 35–40°W at the west coast. The down-sagging is more than 1 km in magnitude.

A strong repetitive faulting occurs causing a great apparent thickness. This is illustrated in three E–W sections in Plate 2. Thus 6–7 repetitions of the Niaqussat and Nordfjord members shown in section B, north of Avatarpait qáqât, cause an apparent thickness of 3 km along a 5 km section.

Economic geology

The Nordfjord and Niaqussat members have a volume of at least 30 km^3 and possibly much more of magma showing a strong reaction with bituminous shales and sandstones. Much more contaminated magma may have cooled as subvolcanic intrusions. The telluric iron bearing volcanic rocks with their exposed related intrusives often contain about 1 % by volume of sulphides. A conservative estimate shows that 0.3 km^3 of sulphides have been mobilized during the volcanism.

Pedersen (1970) presented evidence to show that most of the sulphur component present in these rocks is mobilized sedimentary sulphur converted to high-temperature sulphides. During reaction with the magma, the sedimentary sulphur was first converted into pyrrhotite and Cu, Co and Ni from the sediments were extracted into the sulphide phase. As some of the sulphide entered the magmas as melts, further extraction of magmatic Cu, Co and Ni into the sulphide melt followed.

The high temperature sulphide mineralization connected with the Hammers Dal complex demontrates that these sulphides could be effectively segregated.

Prospecting for occurrences of Cu and Ni bearing high-temperature sulphide mineralization in connection with contaminated intrusives in western Disko might well be economically rewarding.

Acknowledgements

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