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Lithostratigraphy of the Tertiary Vaigat Formation on Disko, central West Greenland

by

Asger Ken Pedersen

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Lithostratigraphy of the Tertiary Vaigat Formation on Disko, central West Greenland

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1985

Abstract

The lithostratigraphy of the early Tertiary Vaigat Formation on Disko is presented. The formation is divided into six members: Naujánguit Member, Asuk Member, Kûgánguaq Member, Qordlortorssuaq Member, Ordlingassoq Member and Manîtdlat Member. The members were formed by two major igneous events. The first event gave rise to the volcanic rocks from the Naujánguit Member and two minor volcanic systems enclosed therein: the Asuk and Kûgánguaq Members. The basalts of the Qordlortorssuaq Member constitute the waning phase of the first igneous event. The second igneous event gave rise to the volcanic rocks of the Ordlingassoq Member within which are enclosed the alkaline basalts of the Manîtdlat Member. The members are composed of the following igneous rocks: Naujánguit Member: tholeiitic picrites, minor silicic basalts and olivine-poor tholeiitic basalts; Asuk Member: silicic basalts and magnesian andesites, many rocks carry native iron; Kûgánguaq Member: silicic basalts and magnesian andesites; Qordlortorssuaq Member: olivine-poor tholeiitic basalts; Ordlingassoq Member: tholeiitic picrites, minor alkaline picrites; Manîtdlat Member: alkaline picrites and alkaline basalts.

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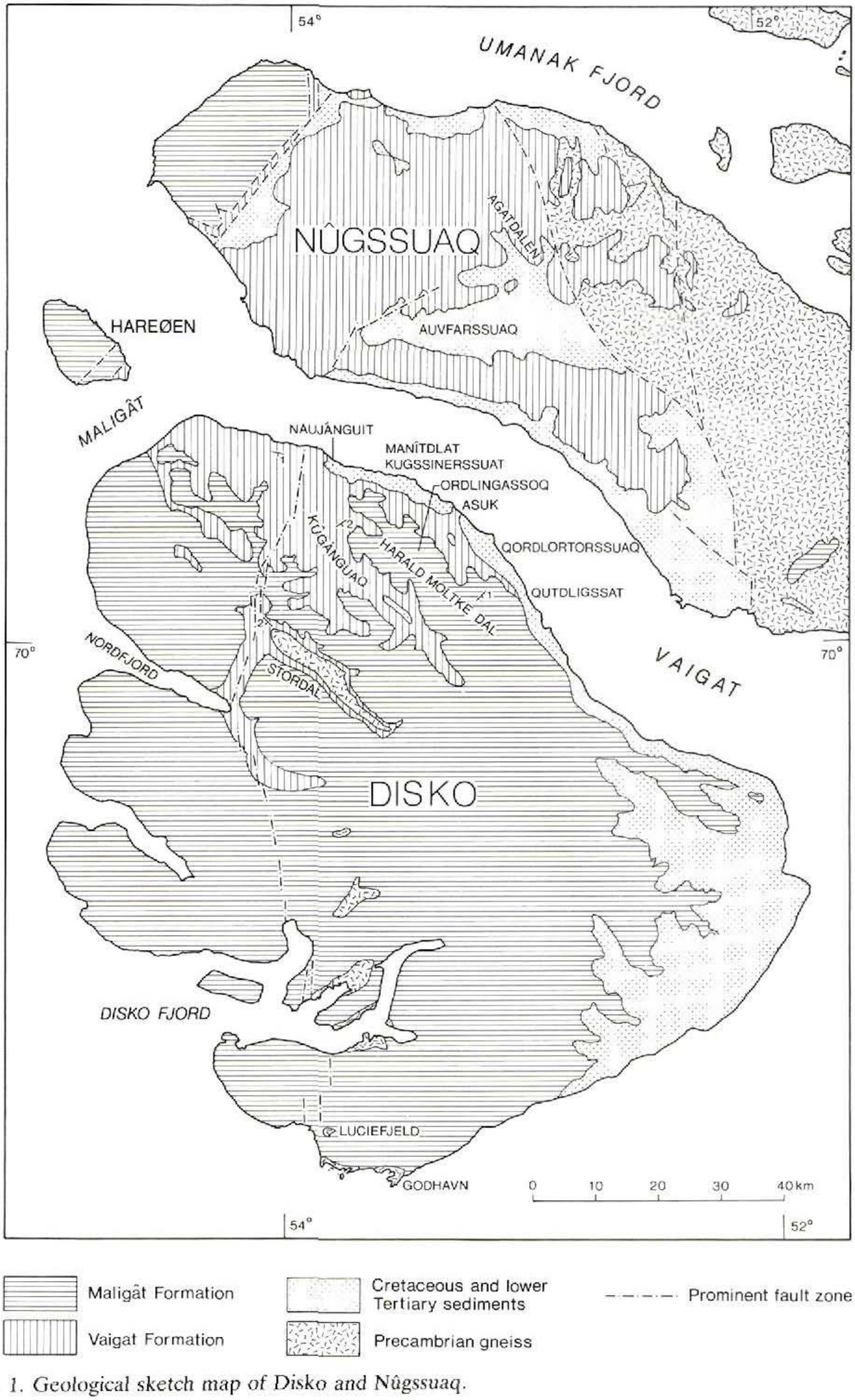

Fig. 1. Geological sketch map of Disko and Nûgssuaq.

INTRODUCTION

The early Tertiary lavas in West Greenland have been divided into three lithostratigraphical units by Hald & Pedersen (1975). They comprise from below the Vaigat Formation consisting of lavas and hyaloclastites, mostly of picritic composition, the Maligât Formation dominated by feldspar-phyric tholeiitic basalts, and the Hareøen Formation consisting mostly of olivine-porphyritic transitional basalts. The type area of the Vaigat Formation is the north-east coast of Disko (fig. 1).

A subdivision of the Vaigat Formation on Disko into six members is presented. With modifications this account formalizes the informal stratigraphy presented by Pedersen (1973). A summary of the geology in this area has been given by Rosenkrantz & Pulvertaft (1969), Henderson (1973, 1975), Münther (1973), Pedersen (1973), Athavale & Sharma (1975), Clarke & Pedersen (1976) and Henderson *et al.* (1976, 1981). A geological map (1: 100 000 Sheet Qutdligssat 70 V.1 S) covering the area was published in 1976.

LITHOSTRATIGRAPHY

Vaigat Formation

Hald & Pedersen, 1975

The formation is divided into six members: Naujánguit Member, Asuk Member, Kûgánguaq Member, Qordlortorssuaq Member, Ordlingassoq Member and Manîtdlat Member (fig. 2). The members were formed by two major igneous events.

The first event gave rise to the volcanic rocks from the Naujánguit Member and two minor volcanic systems enclosed therein: the Asuk and Kûgánguaq Members both of which are composed of volcanic rocks derived from the reaction between crust and magma. The basalts of the Qordlortorssuaq Member constitute the waning phase in the first igneous event.

The second igneous event gave rise to the volcanic rocks of the Ordlingassoq Member, within which are enclosed the alkaline basalts of the Manîtdlat Member.

Naujánguit Member

new member

General. Pedersen (1973, fig. 8 and p. 24) recognized the oldest volcanic rocks on Disko as a pillow breccia unit (unit 1), which is at least 230 m thick. The breccia is covered by picritic lavas enclosing minor sequences of contaminated lavas.

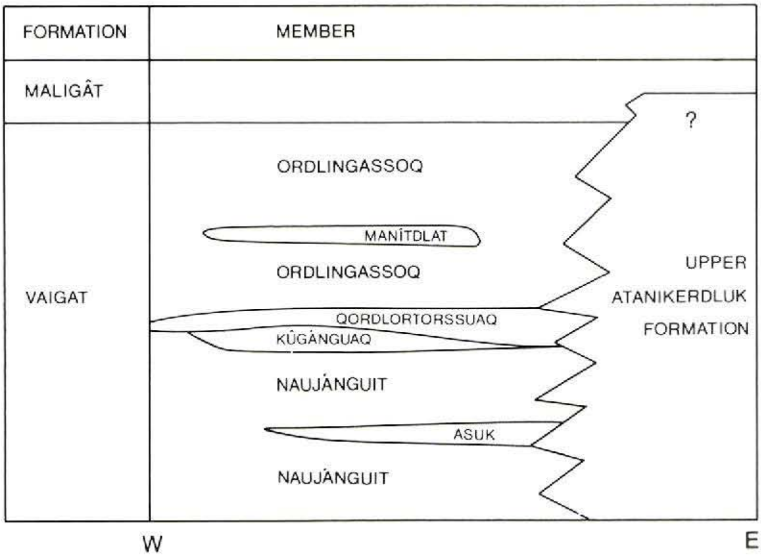

Fig. 2. Lithostratigraphic scheme of the Vaigat Formation on Disko.

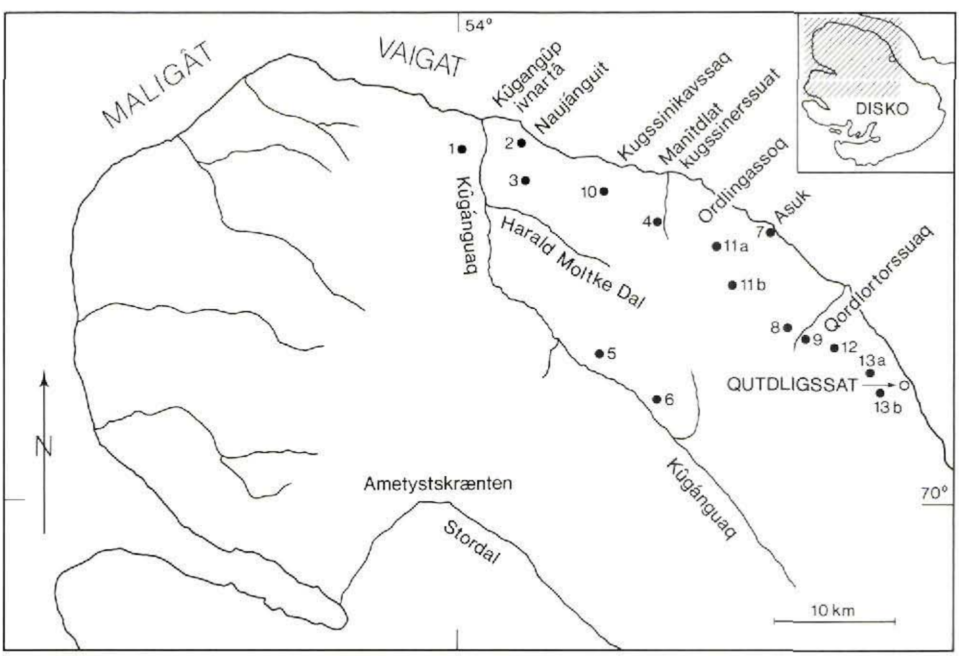

Fig. 3. Map of northern Disko showing the location of measured sections and type localities for members in the Vaigat Formation. The sections are shown in figs 4, 9, 14 and 19.

Name. After Naujánguit on the north coast of Disko, 4 km ESE of the entrance to the Kûgánguaq valley (fig. 3).

Type area. The mountain bounded by the Vaigat (from Naujánguit to Kûgangûp ivnartâ) in the north, by Kûgánguaq in the west and by Harald Moltke Dal in the south (figs 1, 3 and sections 2 and 3, fig. 4).

Thickness. The maximum exposed thickness is about 800 m and is found in the type area. The member gradually peters out towards the east.

Lithology. The member comprises both hyaloclastites and subaerial lavas, whereas air-fall tuffs are extremely scarce. The dominant rocks are picritic pahoehoe lavas ranging mostly between less than 1 and 10 m in thickness, thicker flows being less common (figs 4, 5 and 6). The picritic lava flows are mostly greyish weathering and contain abundant zeolite minerals in the vesiculated lava tops. Subordinate hyaloclastite units are only exposed east of 54°W on Disko but may occur below the present sea level further west. Subordinate, but sometimes voluminous, lava flows up to 35 m thick of olivine-poor feldspar-phyric tholeiitic basalts also occur. They form very erosion resistant dark greyish to brownish weathering marker horizons.

Olivine-microporphyritic, aphyric or orthopyroxene-microporphyritic basalts occur both as hyaloclastite and as lavas and form subordinate brownish weathering marker horizons. These basalts are derived from the reaction between picrite magma and the continental crust, either Precambrian rocks or Mesozoic sediments, by processes as described by Pedersen (1985).

A single cylindrical volcanic neck, and basaltic lavas derived from this feeder channel, are known from just east of Ametystskrænten in Stordal. These are dark grey to dark brown weathering basalts which chemically show alkaline affinities.

The picritic lavas, which constitute the bulk of the member, show a varying rock chemistry, but with a particular abundance of samples containing about 21 to 23 wt.% MgO. The rocks are characterized by very low concentrations of K_2O and P_2O_5.

A few typical rock analyses from the Naujánguit Member are shown in Table 1. Four sections presented in fig. 4 give some detail of the lithological variation in the Naujánguit Member.

Boundaries. The lower contact in most areas is obscured by landslides or is below the present level of exposure. In central Disko the pre-volcanic topography and lithology are rounded hills of Precambrian gneiss, which locally have developed kaolinitized surfaces many metres deep. In northern Disko sandstone, siltstone and shale belonging to the Lower Cretaceous Atane Formation (Nordenskiöld, 1871) form a surface showing local, steep topography of more than 300 m with local narrow erosion gullies due to active faulting shortly prior to the volcanism. The oldest Naujánguit Member rocks are cross-bedded hyaloclastite and minor pillow lavas which have filled a more than 200 m deep basin which extends below the present sea level (section 2, fig. 4). After filling the basin the basalts have spilled over an escarpment and have extended towards the east as lavas and minor hyaloclastites. Here gradually younger volcanic units from the Naujánguit Member rest directly on Atane Formation sediments (section 4, fig. 4). From Asuk towards the east the contact relations to ol-

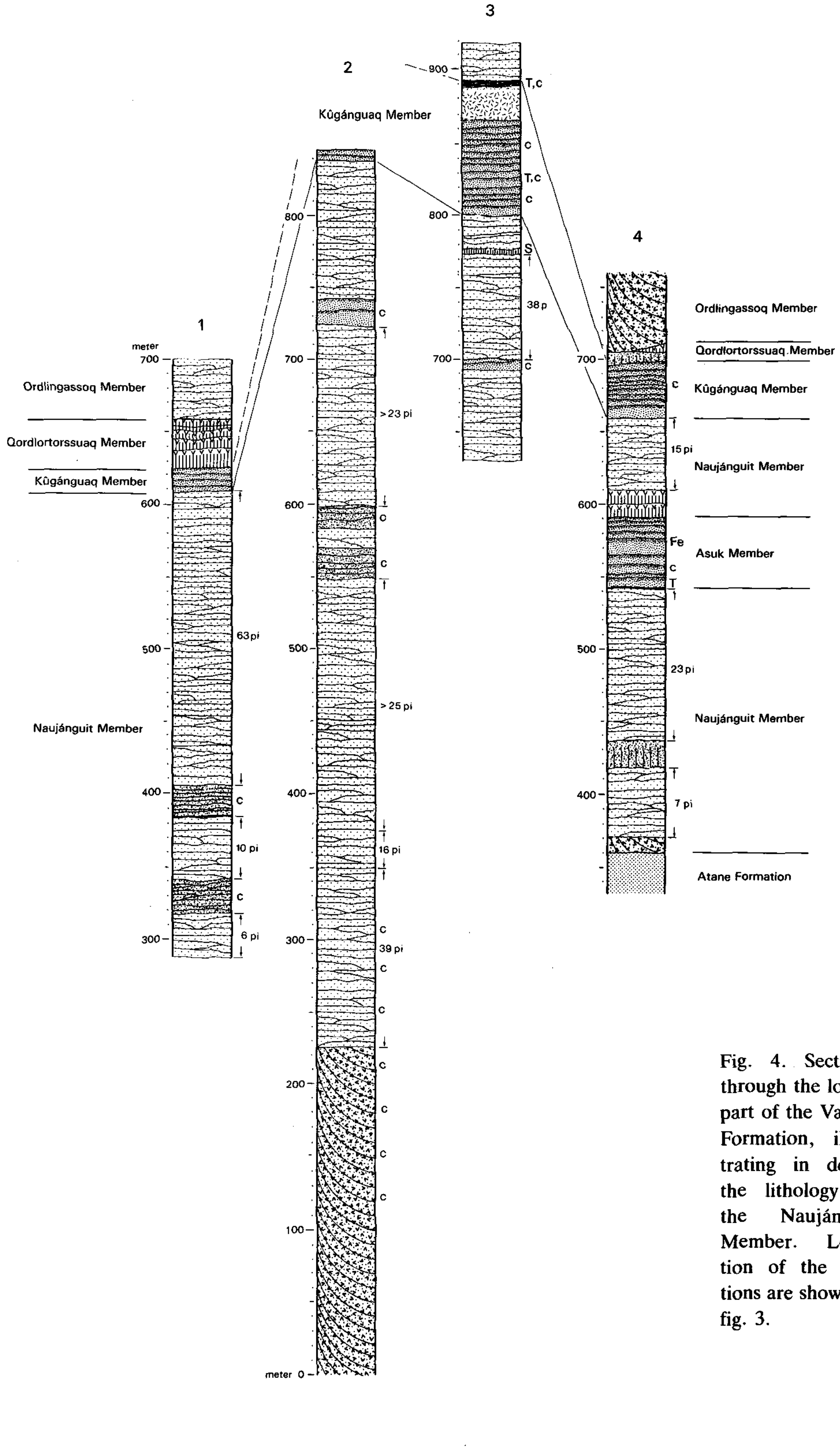

Fig. 4. Sections through the lower part of the Vaigat Formation, illustrating in detail the lithology of the Naujánguit Member. Location of the sections are shown in fig. 3.

der rocks are obscured by large-scale landslides, but older Tertiary sediments are probably present between the volcanic rocks and the Cretaceous sediments (Rosenkrantz, 1970).

A minor volcanic system containing metallic iron bearing rocks occurs within the upper part of the Naujánguit Member and is formalized as a separate member (Asuk Member) below.

The Naujánguit Member is covered by the contaminated basalt and andesite lavas from the Kûgánguaq Member (see below) in central and north-east Disko and by the Qordlortorssuaq Member basalts in the north-west (see below).

Distribution. Naujánguit Member lavas and hyaloclastites occur on north-west, north and north-east Disko, west of 53°12′W (fig.7). The Naujánguit Member also crops out along the south coast of Nûgssuaq as far east as 53°12′W, but has not been mapped in detail there.

Asuk Member

new member

General. Lavas and breccias from the Asuk Member have been described by Steenstrup (1876, 1883, 1900), Lorenzen (1883), Törnebohm (1878), Nicolau (1900), Bøggild (1953, review), Pauly (1958, 1969), Vaasjoki (1965), Melson & Switzer (1966) and Pedersen (1969, 1973, 1978, 1979). Its stratigraphic position is given as unit 3 in Pedersen (1973, fig. 8), and it has been mapped as a regional marker horizon (map sheet Qutdligssat 70 V.1 S).

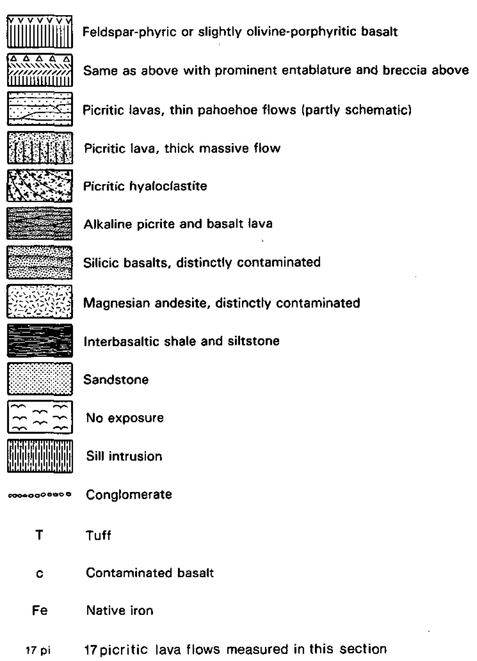

Fig.4 *cont.* The legend is common for figs 4, 9, 14 and 19.

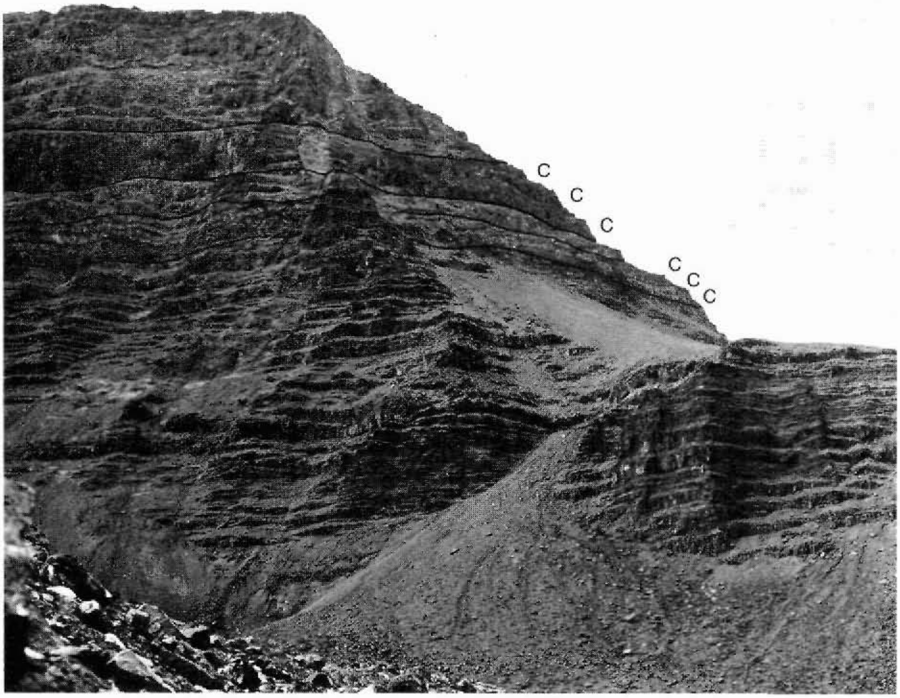

Fig. 5. Thin brownish weathering lavas from the lower part of the Naujánguit Member. In the upper part of the section is seen light grey-brown weathering lava flows of contaminated basalt (C). The east side of Kûgángûp ivnartâ, northern Disko (fig. 4, section 2).

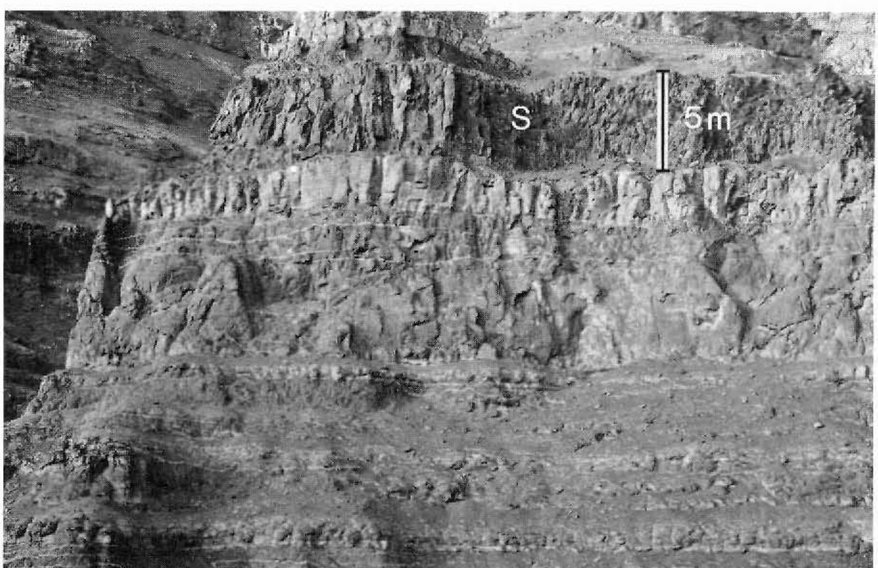

Fig. 6. Picritic lavas showing prominent development of segregation veins. From the upper part of the Naujánguit Member. A 5 m thick basaltic transgressive sill (S) is seen in the upper part of the photograph. From the east side of Kûgánguaq valley at alt. 650 m. The location is shown in fig. 4, section 3.

Table 1. Chemical analyses of lavas of the Naujánguit and Asuk Members

	Naujánguit Member			Asuk Member			
Analysis	1	2	3	4	5	6	7
GGU no.	135919	138230	113325	113220	176734	113277	113280
SiO_2	47.29	43.96	47.74	52.65	53.78	52.68	55.77
TiO_2	1.00	0.86	1.56	1.15	1.04	1.28	1.09
Al_2O_3	11.83	9.10	14.05	15.35	14.68	15.40	15.67
Cr_2O_3	0.17	0.29	0.06	0.07	0.08	0.05	0.05
Fe_2O_3	1.45	2.29	3.34	1.50		1.14	
FeO	8.25	8.94	7.95	7.30	7.90	8.02	4.94
Fe°					0.9		2.9
MnO	0.16	0.18	0.21	0.17	0.13	0.16	0.14
MgO	14.50	22.27	9.89	8.23	6.99	7.49	6.04
CaO	8.66	7.81	12.02	8.42	7.53	9.23	7.78
Na_2O	1.91	1.08	1.89	2.42	1.83	2.09	2.55
K_2O	0.22	0.04	0.11	0.74	0.89	0.57	0.94
P_2O_5	0.10	0.06	0.16	0.13	0.12	0.13	0.14
H_2O^+	1.38	1.40	1.30	1.70	1.45	1.05	0.98
H_2O^-		0.50					
CO_2		0.50		<0.02		0.07	0.03
C					1.91	0.03	0.30
S					0.91	0.10	0.48
less O / excess					-0.45	+0.05	+0.24
l.o.i.	2.44						
	99.36	99.28	100.28	99.83	99.69	99.44	99.56

1: Olivine porphyritic contaminated basalt from pillow-sausage. Kûgángûp ivnartâ at altitude 135 m. Section 2, figs 3 and 4.

2: Picritic pillow from minor pillow horizon 5 m above the contact to Cretaceous sediments at Kugssinikavsak at altitude 330 m. Section 10, fig. 3.

3: Olivine and plagioclase porphyritic basalt from 2 m above the base of a 30 m thick lava. The steep gully between the points 1440, 1869 and 1730 in the north east side of Kûgánguaq valley at altitude 450 m. Section 5, figs 3 and 9.

4: Silicic basalt. Sample from 3.5 m above the base of a 9.5 m thick lava. The lowermost lava in the Asuk Member at Manîtdlat kugssinerssuit at altitude 545 m. Section 4, figs 3 and 9.

5: Graphite-rich magnesian andesite with native iron. About 20 m below the top of the lowermost composite lava in the Asuk Member. Same locality as no. 3 at altitude 375 m. Section 5, figs 3 and 9.

6: Silicic basalt from the lowermost part of the composite native iron bearing lava in the Asuk Member at Asuk. Section 7, figs 3 and 9.

7: Magnesian andesite with native iron from the central part of the composite lava in the Asuk Member at Asuk. Section 7, figs 3 and 9.

Name. After Asuk, a small point on the north-east coast of Disko (fig. 3).

Type section. North-east Disko around Asuk where the Asuk Member forms part of a large landslipped block (fig. 8 and fig. 9 section 7).

Reference sections. The north-east side of Kûgánguaq valley at 70°06′N, 50°43′W and at 70°05′N, 53°33′W (see figs 3 and 9).

Thickness. The thickness varies from 0 to at least 140 m.

Lithology. The Asuk Member consists of sediment contaminated basalts and andesites several of which contain metallic iron. These andesites are the most strongly reduced terrestrial

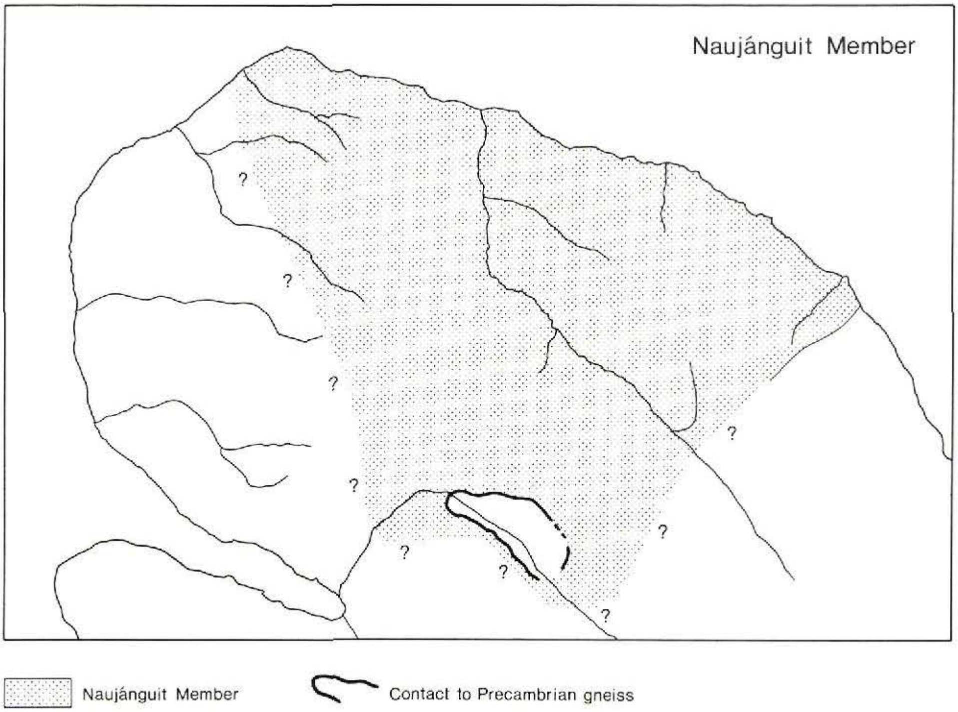

Fig. 7. The extent of the Naujánguit Member on northern Disko. Towards the west the Vaigat Formation rocks are buried by plateau basalts from the Maligât Formation and are below the present level of exposure.

volcanic rocks known. Both basalts and andesites show a red to yellow-brown weathering colour which makes them conspicuous against the greyish weathering enclosing Naujánguit Member picrites (fig. 10). Around Asuk the lowermost Asuk Member units form subaqueous breccias and pillow lavas, intercalated with minor shale horizons with tuffs. The breccias are covered by subaerial lavas (fig. 9). Further west exclusively subaerial lavas are found, except for some minor subaerial tuffs. The most voluminous units are up to 60 m thick iron bearing composite lava flows. These consist of a few metres thick lower zone of basalt and an upper zone of andesite tens of metres thick, which may contain up to several per cent graphite. The Asuk Member rocks commonly carry xenoliths of shale and sandstone, modified to a varying degree by reaction with the magma. A few representative rock analyses are given in Table 1.

Boundaries. The Asuk Member forms a minor volcanic system enclosed within Naujánguit Member lavas. The lowermost units comprise several airfall tuffs. Over large areas its lower boundary is below the present level of exposure, or is obscured by landslides; in the eastern area the member overlies Cretaceous or Lower Tertiary sediments, but no contact is exposed. In Stordal parts of the Asuk Member rest on Precambrian gneiss, but contacts are not

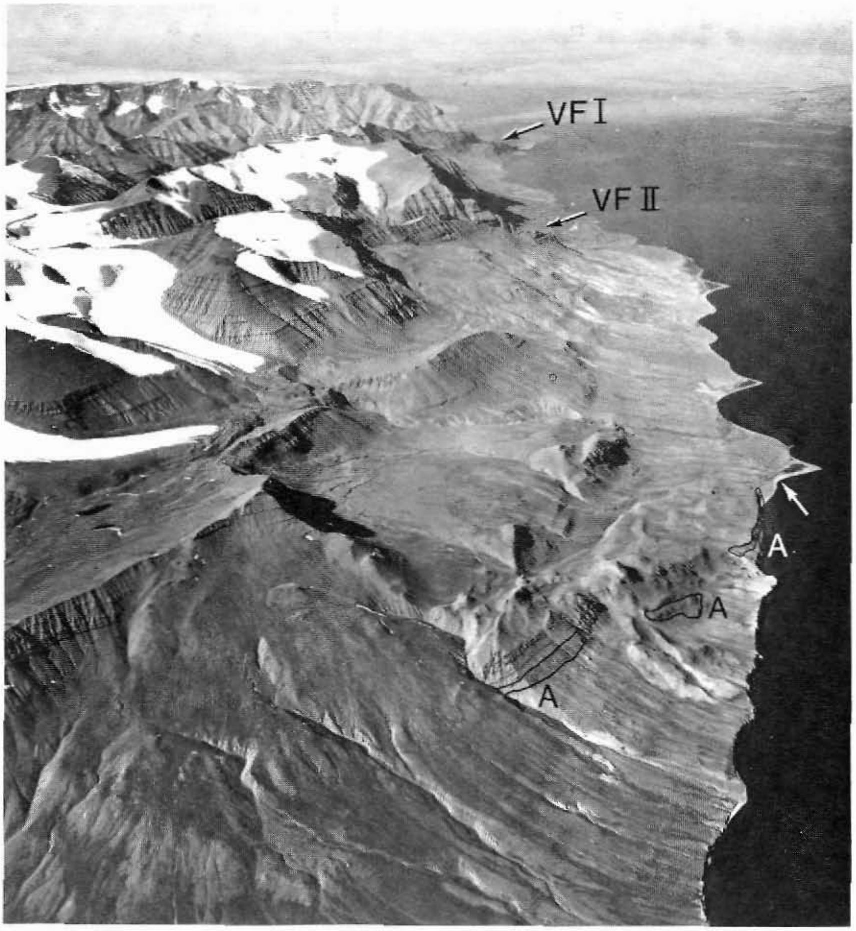

Fig. 8. Oblique aerial photograph showing the north-east coast of Disko. In the foreground the classical locality at Asuk (white arrow) (Steenstrup, 1883), type locality for the Asuk Member. The locality forms part of a series of landslides with large coherent fragments of Asuk Member lithologies (A). In the background the type sections for the Vaigat Formation at Kûgángûp ivnartâ (lower part, VF I), sections 2 and 3, fig. 3, and at Manîtdlat kugssinerssuat (upper part, VF II), section 4, fig. 3). Copyright Geodetic Institute (A.495/79), route 515, E–V, no 12199

exposed. The member is overlain by one or two olivine-poor tholeiitic basalt lavas from the Naujánguit Member.

Distribution. The Asuk Member is known in northern, north-eastern and central Disko (fig. 11). It also crops out in a limited area on the south coast of Nûgssuaq around Nûk kitdleq.

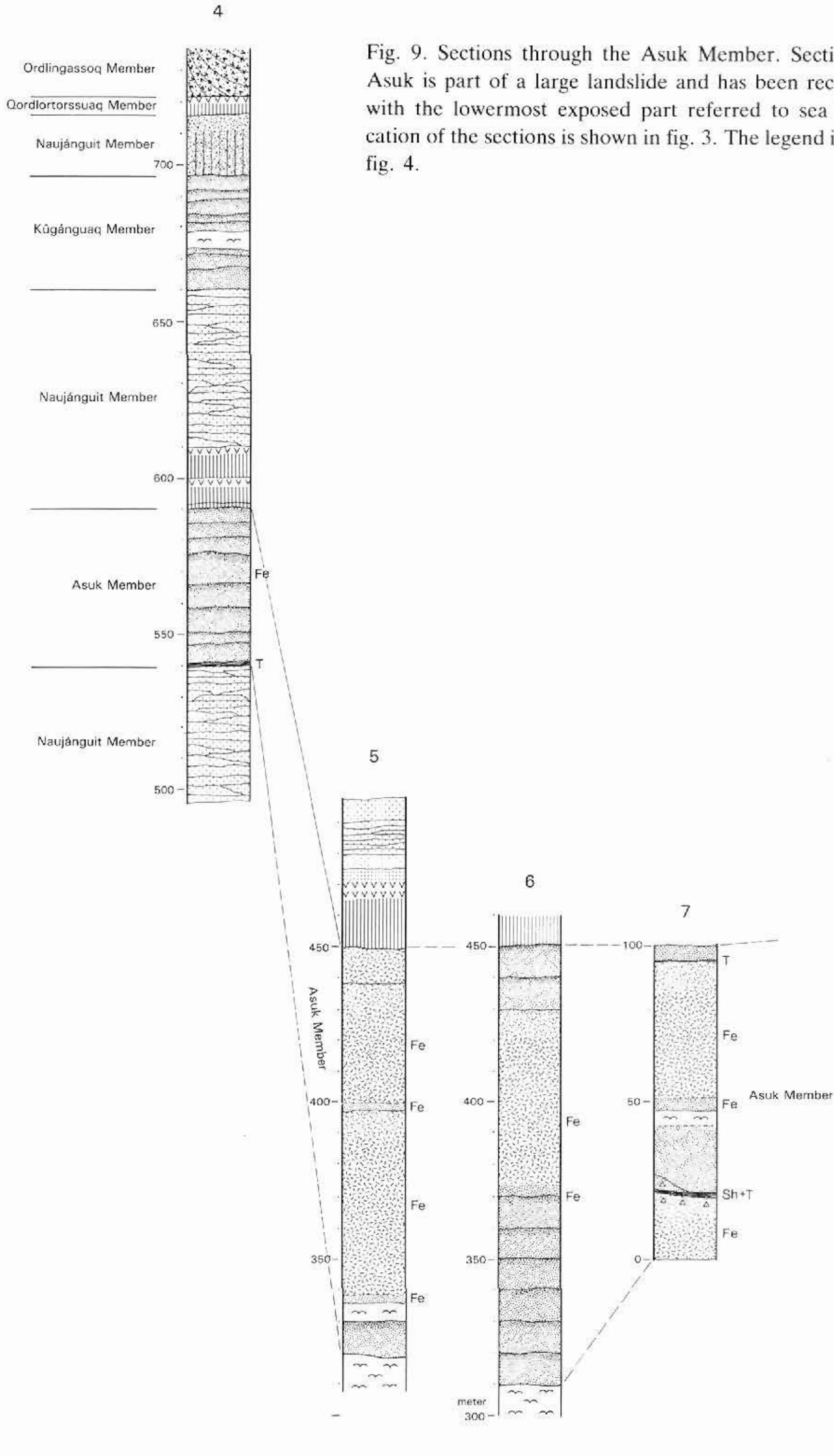

Fig. 9. Sections through the Asuk Member. Section 7 from Asuk is part of a large landslide and has been reconstructed with the lowermost exposed part referred to sea level. Location of the sections is shown in fig. 3. The legend is shown in fig. 4.

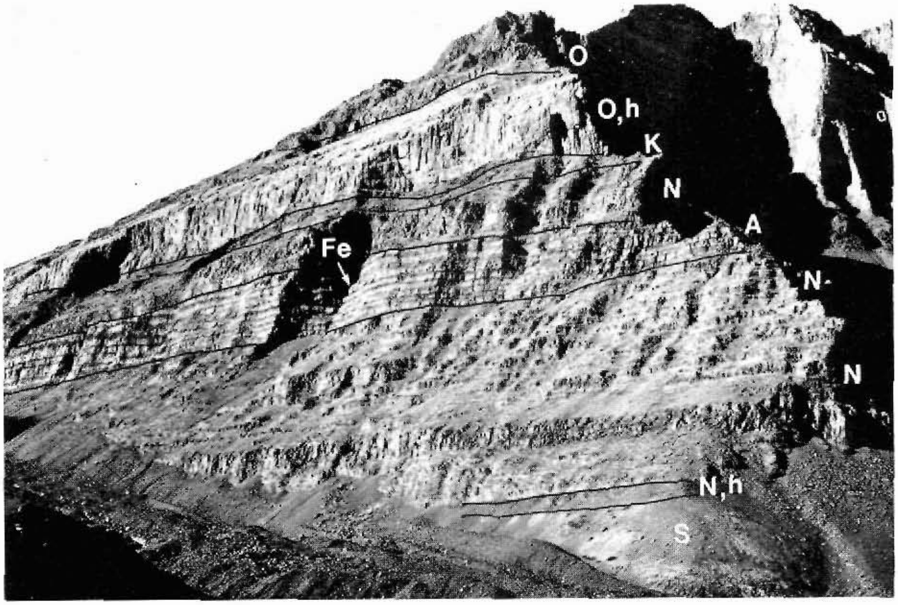

Fig. 10. The lower part of the upper type section for the Vaigat Formation at Manîtdlat kugssinerssuat at the west side (section 4, fig. 4). S: Cretaceous sandstone from the Atane Formation. N,h: picritic hyaloclastite from the Naujánguit Member. N: picritic lavas from the Naujánguit Member. A: lavas from the Asuk Member with one native iron bearing unit (Fe). K: lavas from the Kûgánguaq Member. O,h: picritic hyaloclastite from Ordlingassoq Member. O: lavas from Ordlingassoq Member.

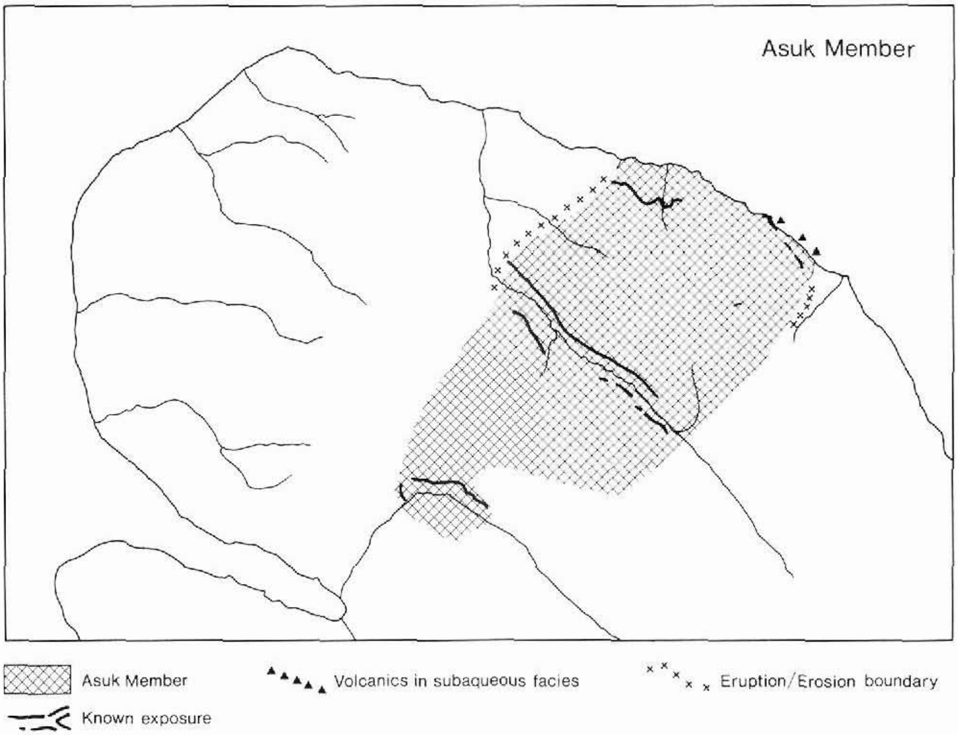

Fig. 11. The extent of the Asuk Member on northern Disko.

Kûgánguaq Member

new member

General. Olivine-microporphyritic silicic basalts and magnesian andesites erupted from a central crater area in the northern part of Kûgánguaq were reported by Pedersen (1969 and 1973, unit 4). The volcanic rocks from the Kûgánguaq Member are derived from the reaction between picrite magma and the continental crust and is described in considerable detail by Pedersen (1985).

Name. After Kûgánguaq in northern Disko. Kûgánguaq forms the largest river and valley on the island.

Type section. The section 3 (figs 3 and 4) on the northern corner of the opening from Kûgánguaq into Harald Moltke Dal. The section is illustrated in Pedersen (1985, fig. 5).

Thickness. The thickness of the Kûgánguaq Member varies from 90 m in the central eruption area to 0 m in distal areas.

Table 2. Chemical analyses of lavas of the Kûgánguaq and Qordlortorssuaq Members

	Kûgánguaq Member			Qordlortorssuaq Member	
Analysis	1	2	3	4	5
GGU no.	113321	135924	135972	113328	113330
SiO_2	51.60	56.24	51.84	47.23	47.50
TiO_2	1.16	1.00	1.48	1.47	2.29
Al_2O_3	14.18	13.30	15.25	14.48	13.90
Cr_2O_3	0.20	0.12	0.08	0.05	0.03
Fe_2O_3	1.19	3.50	2.10	4.71	4.50
FeO	8.38	4.68	7.52	6.50	8.30
MnO	0.18	0.25	0.21	0.19	0.20
MgO	10.80	8.95	6.11	9.17	7.41
CaO	8.70	6.95	10.38	12.06	12.10
Na_2O	1.55	2.30	2.03	1.85	2.31
K_2O	0.53	0.72	0.21	0.07	0.21
P_2O_5	0.14	0.17	0.19	0.17	0.24
H_2O^+	1.20	1.33	1.31	1.99	0.55
H_2O^-			0.66		
CO_2					
	99.81	99.51	99.37	99.94	99.54

1: Olivine microporphyritic silicic basalt from welded glass tuff in the Kûgánguaq Member. At the east side of Kûgánguaq valley about 1.2 km north of Harald Moltke Dal, at altitude 804 m. Section 3, fig. 3.

2: Magnesian andesite from lava in the Kûgánguaq Member. The north side of Harald Moltke Dal about 1.5 km to the east of the entrance to the valley, at altitude 840 m.

3: Feldspar-phyric silicic basalt from the uppermost lava flow in the Kûgánguaq Member. About 1 km north of Harald Moltke Dal on the east side of Kûgánguaq valley, at altitude 840 m. Section 3, fig. 3.

4: Phenocryst-poor basalt from the second lava flow in the Qordlortorssuaq Member. The steep gully between the points 1440, 1869 and 1730 on the north-east side of the Kûgánguaq valley, at altitude 532 m. Section 5, figs 3 and 5.

5: Feldspar-phyric basalt from the uppermost lava in the Qordlortorssuaq Member. Same locality as no. 4, at altitude 547 m. Section 5, figs 3 and 5.

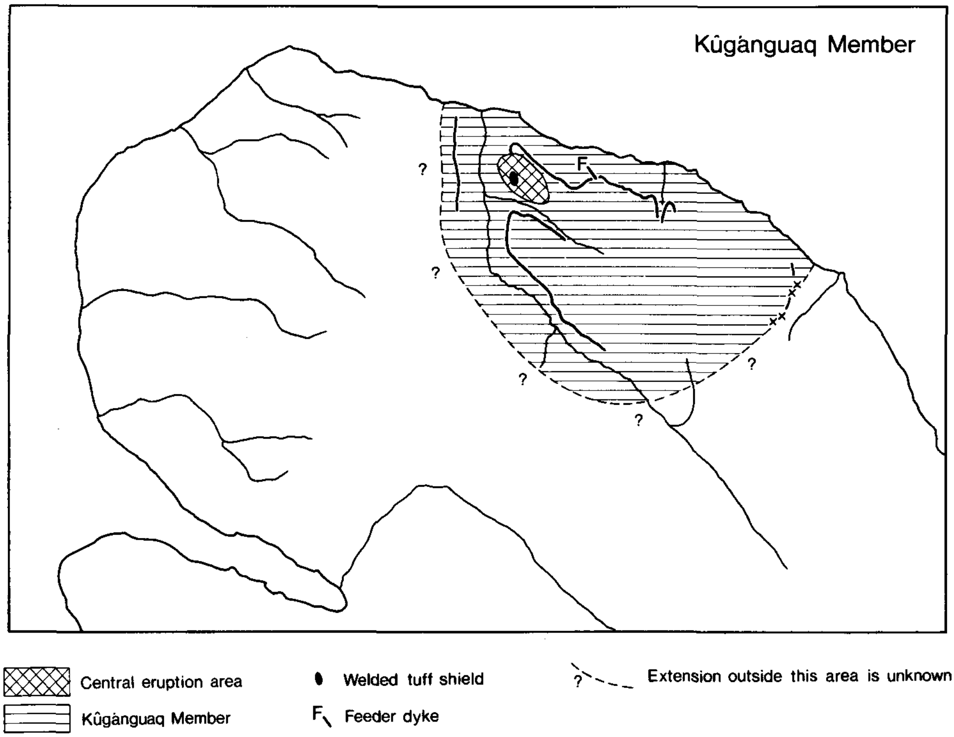

Fig. 12. The extent of the Kûgánguaq Member on northern Disko (from Pedersen, 1985).

Lithology. The Kûgánguaq Member is dominated by yellow brownish weathering olivine microporphyritic basaltic lavas typically a few metres thick. Magnesian andesites form up to 25 m thick blocky yellow brownish weathering lavas which show characteristic conchoidal fracture patterns. Airfall tuffs form only a very minor part of the Kûgánguaq Member but in a crater area two very conspicuous red coloured welded basaltic tuffs occur. The youngest units in the member are composed of feldspar-phyric silicic basalts which form a few aa lavas which are vesiculated and of light yellow-grey weathering colour. Representative chemical analyses are shown in Table 2.

Boundaries. The lower boundary is a thin horizon of red bole which rests on picritic lavas from the Naujánguit Member.

In a limited area north of 70°13′ and east of the Kûgánguaq valley the upper boundary of the Kûgánguaq Member is an eroded surface which is directly overlain by picritic lavas or hyaloclastites of the Ordingassoq Member (Pedersen, 1985, fig. 5). South of this line and west of the Kûgánguaq valley, the Kûgánguaq Member is covered by basaltic lavas of the Qordlortorssuaq Member.

Distribution. North and north-east Disko (fig. 12 and Pedersen, 1985, fig. 4b).

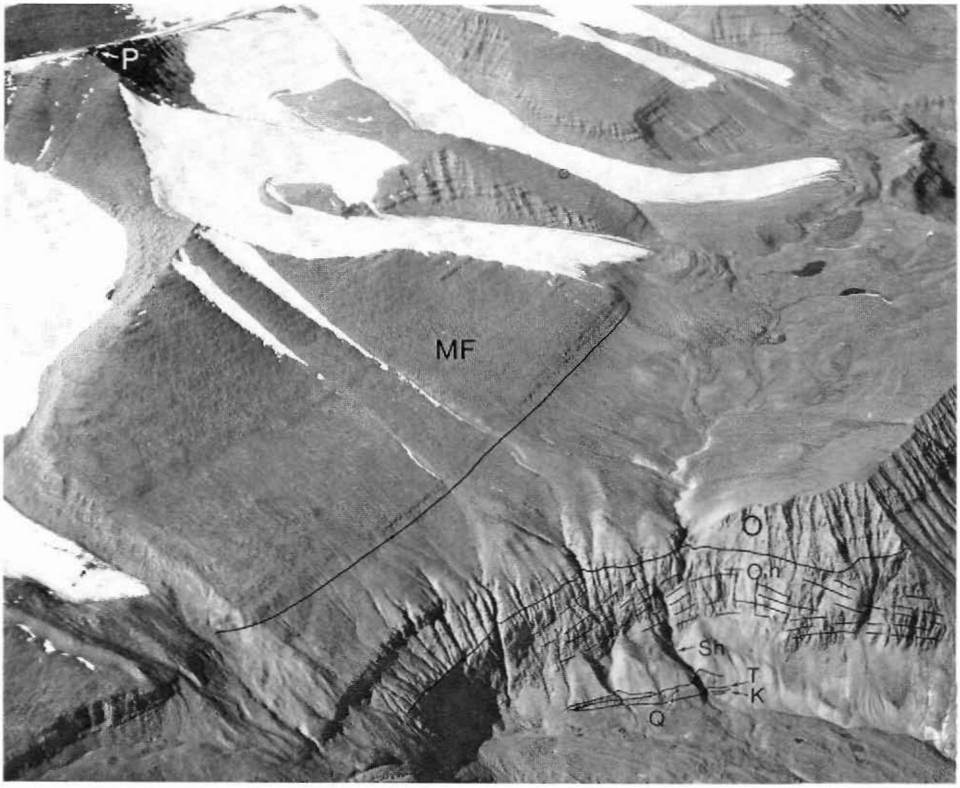

Fig. 13. The western part of Qordlortorssuaq. At the base of section 8 fig. 3 a few lavas from the Kûgánguaq Member (K) are covered by tuff (T). A large composite lava from the Qordlortorssuaq Member (Q) is covered by a smaller one. At Sh shale with petrified wood has been disturbed and engulfed by advancing cross-bedded picritic hyaloclastites (O,h) from the Ordlingassoq Member. The hyaloclastites are covered by picritic lavas from the Ordlingassoq Member and by thick feldspar-phyric basalt lavas from the Maligât Formation (MF). At point 1904 on Pyramiden (P) contaminated lavas from the Maligât Formation are seen.
Oblique aerial photograph copyright Geodetic Institute (A.495/79), route 515, E–V, no. 12201.

Qordlortorssuaq Member

new member

General. Olivine-poor erosion resistant tholeiitic basalt lavas were described and mapped as a prominent marker horizon (Pedersen, 1973, unit 5 and map sheet Qutdligssat 70 V.1 S). Further information is given by Pedersen (1985).

Name. After the waterfall, Qordlortorssuaq about 5 km east-north-east of the mountain Pyramiden (point 1904) in north-east Disko.

Type locality. Qordlortorssuaq in north-east Disko (fig. 13). The type section (no. 8 and 9,

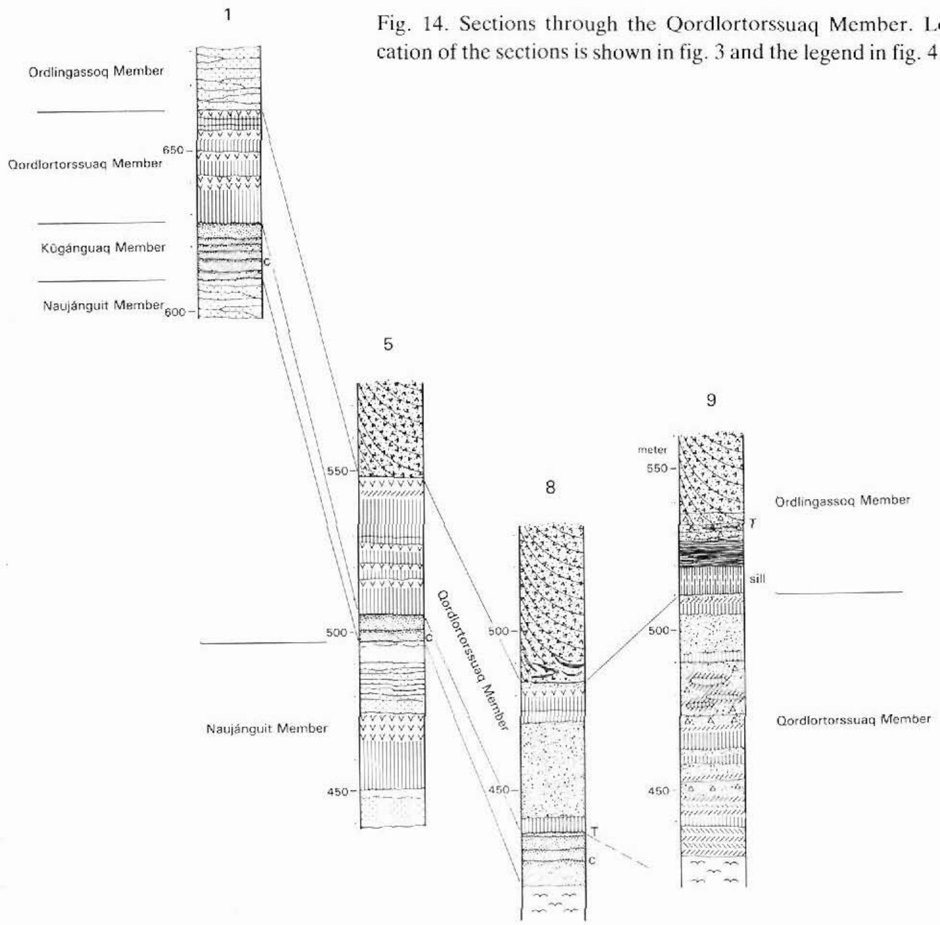

Fig. 14. Sections through the Qordlortorssuaq Member. Location of the sections is shown in fig. 3 and the legend in fig. 4.

figs 3 and 14) is illustrated by Pedersen (1973, unit 5, profile II fig. 8). The reference section (no. 5, fig. 3) is in the Kûgánguaq valley at 70°07′N 53°43′W (section 5, fig. 14).

Thickness. The thickness varies from 0 m to at least 75 m.

Lithology. The Qordlortorssuaq Member is composed of olivine-poor slightly feldsparphyric tholeiitic basalts. These form columnar jointed erosion resistant aa lavas which vary in thickness from a few to 40 metres. At the type locality there is a prominent composite lava flow consisting of a lower, nearly aphyric basalt and a thick upper picritic part (section 8 fig. 14). In the eastern part of the type locality the Qordlortorssuaq Member basalts have erupted into a shallow subaqueous environment (fig. 15). There they have developed prominent entablature zones, and parts of the flows have been transformed into hyaloclastite breccia. The same appears to be the case in the inner part of the Stordal region. A few representative rock analyses from the Qordlortorssuaq Member are given in Table 2.

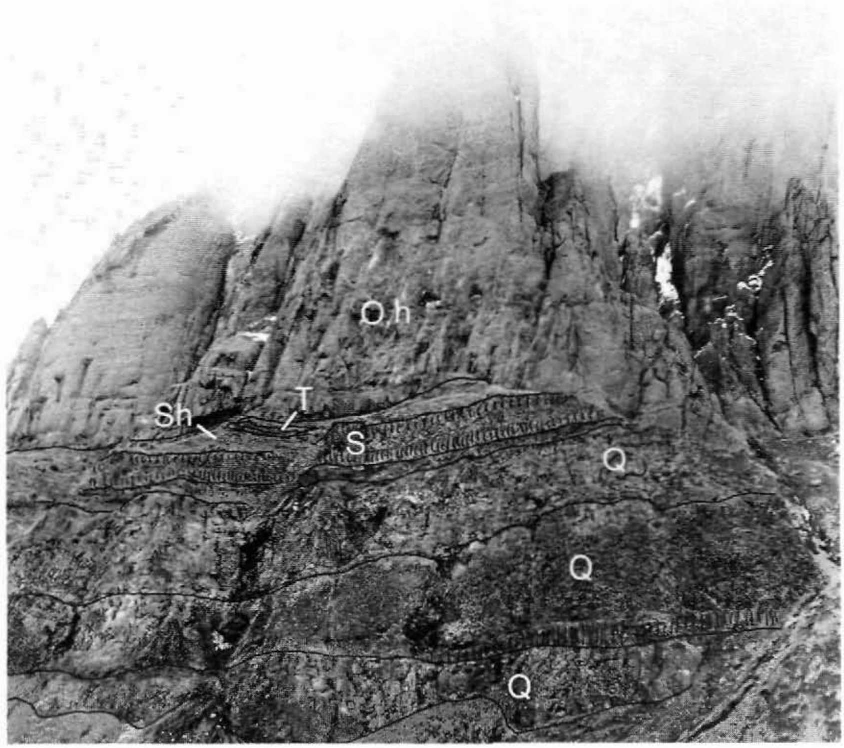

Fig. 15. Qordlortorssuaq Member lavas and breccias (Q) in transition between subaerial and subaqueous facies at the eastern locality at Qordlortorssuaq. Above the lavas is seen a basaltic sill (S) intruded into black shale and siltstone (sh) and tuff (T). The upper part of the section is composed of thick hyaloclastites of the Ordlingassoq Member (O,h). See also fig. 14, section 9.

Boundaries. The lower boundary is volcanic rocks of the Kûgánguaq Member in northern and north-eastern Disko, whereas in parts of north-western Disko the Qordlortorssuaq Member rests directly on Naujánguit Member picrites. In parts of the Stordal area the lavas rest directly on Precambrian gneiss.

The upper boundary marks a temporary termination in the volcanic activity, where regional tilting and subsidence caused large areas covered by Qordlortorssuaq Member lavas to sink below sea level. In the eastern areas the Qordlortorssuaq Member basalt lavas and hyaloclastite breccias are covered by thin shales with intercalated tuff, and by thick picritic hyaloclastites (fig. 16). The shales have been correlated by Pedersen (1973) with the early Tertiary shales of the Naujat Member (Koch, 1959). To the west the Qordlortorssuaq Member basalts are covered by thin layers of red bole and local basaltic conglomerate or minor coal sediments followed by picritic hyaloclastite. In the western areas on Disko the Qordlortorssuaq Member lavas, where present, are eroded on top and covered by picritic subaerial lava flows of the Ordlingassoq Member.

Distribution. In north-west, north-east and central Disko the Qordlortorssuaq Member has

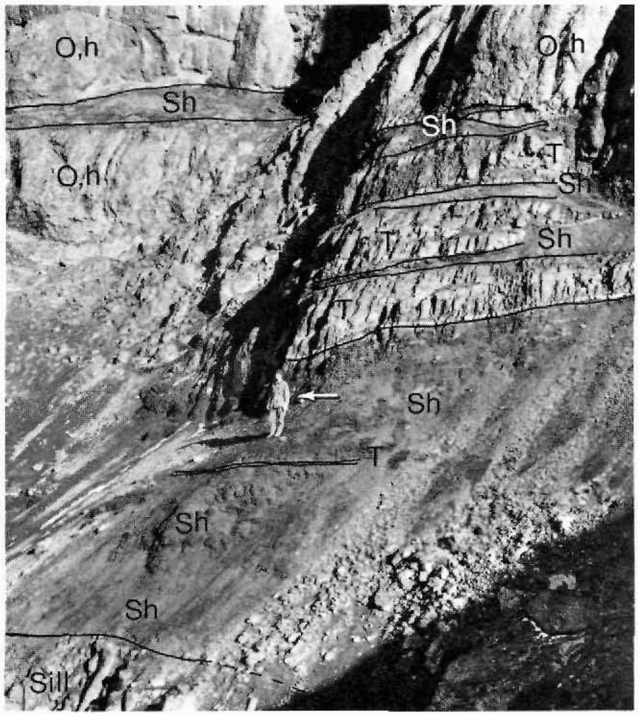

Fig. 16. The upper part of the section shown in fig. 14 no. 9 at Qordlortorssuaq. Metre thick black shale and siltstone (Sh) with plant fossils and subordinate tuff (T) are covered by a few metres thick beds of tuff or fine-grained hyaloclastite (T) with thin intercalated shale. These are covered by picritic hyaloclastites from the Ordlingassoq Member (O,h). In the foreground is seen a basaltic sill. See also fig. 14, section 9.

been mapped out as a widespread marker horizon (map Sheet Qutdligssat 70 V. 1 S and fig. 17).

In parts of central north Disko these lavas appear to be absent. Towards the south-east they terminate in hyaloclastite facies. In the Stordal area only parts of the Precambrian gneiss hills have been inundated by Qordlortorssuaq Member volcanics, whereas other gneiss hills extend above that level.

Ordlingassoq Member

new member

Name. After the mountain Ordlingassoq facing the Vaigat in north-east Disko.

Type section. Section 4 (figs 3 and 19) in the narrow, partly glaciated valley south of Manîtdlat kugssinerssuat just west of Ordlingassoq on north-east Disko. The section is also the type section for the upper half of the Vaigat Formation (Hald & Pedersen, 1975).

Thickness. The thickness on Disko varies from 0 to 800 m.

Lithology. The Ordlingassoq Member is mainly composed of tholeiitic picritic lavas and hyaloclastities. The lower part of the member also comprises minor shale horizons and minor

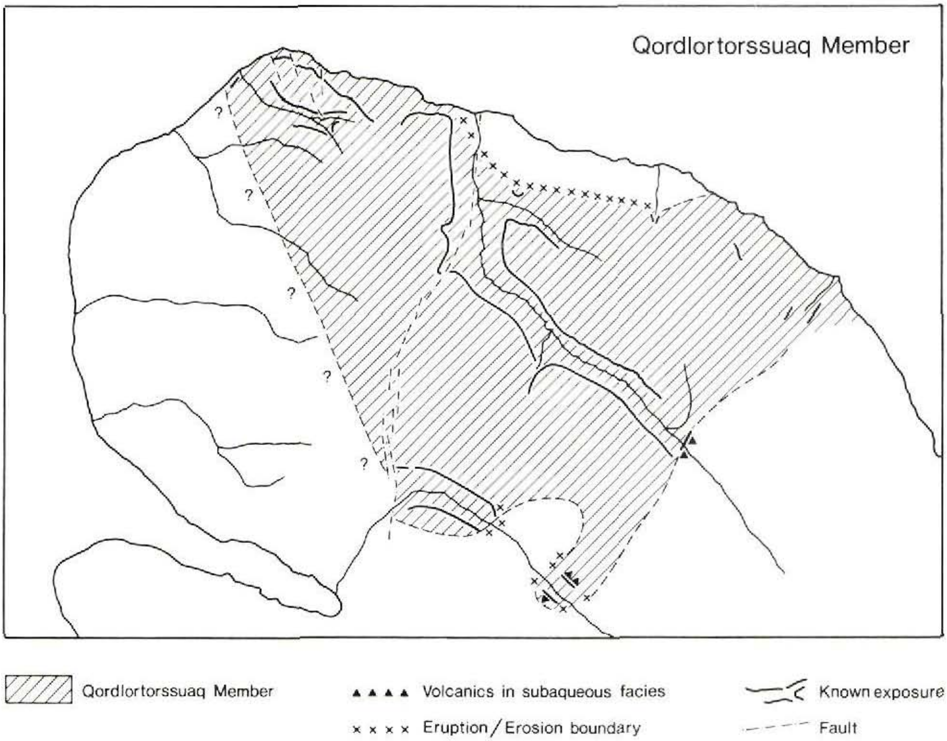

Fig. 17. The extent of the Qordlortorssuaq Member on northern Disko.

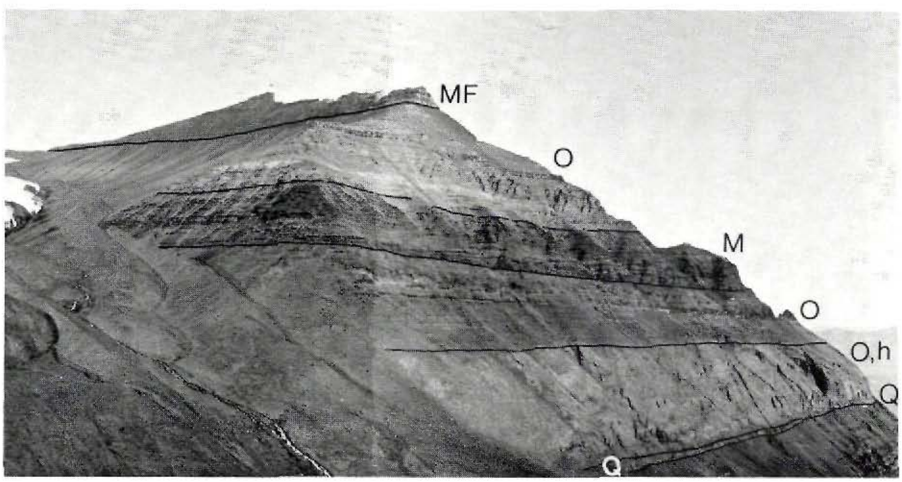

Fig. 18. The upper part of the type section of the Vaigat Formation at the west wall of the steep gully at Manîtdlat kugssinerssuat, northern Disko (section 4, figs 3 and 19). Q: a singular lava from the Qordlortorssuaq Member. O,h: the lower part of the Ordlingassoq Member in hyaloclastite facies. O: other parts of the Ordlingassoq Member. M: alkaline picrites and basalts from the Manîtdlat Member. MF: thick lavas from the lower part of the Maligât Formation.

Table 3. Chemical analyses of lavas of the Ordlingassoq and Manîtdlat Members

	Ordlingassoq Member			Manîtdlat Member		
Analysis	1	2	3	4	5	6
GGU no.	136943	156744	136981	135989	176705	264106
SiO_2	45.08	45.15	46.61	42.74	44.97	44.03
TiO_2	1.17	1.41	1.61	1.30	1.47	1.86
Al_2O_3	11.23	11.55	11.73	9.36	11.81	13.72
Cr_2O_3	0.18	0.19	0.14	0.19		
Fe_2O_3	3.63	4.06	4.14	2.33	1.04	4.93
FeO	7.62	7.81	7.77	8.76	10.06	8.00
MnO	0.17	0.21	0.19	0.19	0.21	0.23
MgO	18.48	15.93	13.84	20.25	10.47	6.66
CaO	9.59	10.33	10.94	10.29	15.73	14.44
Na_2O	1.30	1.42	1.77	0.70	1.43	1.73
K_2O	0.18	0.10	0.09	0.57	0.69	1.39
P_2O_5	0.09	0.12	0.14	0.39	0.80	0.89
H_2O^+	1.44	1.79		2.68	1.53	1.15
l.o.i.			1.21			
	100.16	100.07	100.18	99.75	100.21	99.03

1: Picritic pillow. From 1 km NW of point 860 below Ordlingassoq, at altitude 820 m.

2: Picritic pillow. From about 2 km SE of Kitdlerpât qâqarssua, at altitude 580 m. Section 13 b, figs 3 and 19.

3: Olivine porphyritic basalt from the lower part of 2 m thick lava flow. About 2 km NE of point 1680 south of Ordlingassoq, at altitude 1050 m. Section 11 b, figs 3 and 19.

4: Alkaline picrite from the lower part of an 8 m thick lava, flow no. 17 above the base of the Manîtdlat Member. About 1 km south of point 848 NNW of Ordlingassoq, at altitude 1032 m.

5: Olivine and clinopyroxene porphyritic alkaline basalt from pillow in hyaloclastite, upper part of the Manîtdlat Member. About 30 km from the entrance to Kûgânguaq valley on the north-east slope at altitude 545 m.

6: Alkaline basalt from the uppermost lava flow in the Manîtdlat Member. About 29 km from the entrance to Kûgânguaq valley on the north-east slope at altitude 935 m.

conglomerates (figs 14, 16, 18 and 19). In central Disko the member also includes light brownish weathering basalt lavas derived through the reaction between picritic magma and crustal material. A thin sequence of such lavas in Stordal contains metallic iron.

In the lower part of the Ordlingassoq Member occur subordinate alkaline picrites and alkaline basalts which can be distinguished in the field from the tholeiitic picrites by their generally more brownish weathering colours compared to the more greyish weathering colour of the picrites (fig. 18).

A prominent sequence of alkaline lavas within the Ordlingassoq Member is formalized as a separate member (Manîtdlat Member) below.

In north-west Disko, the Ordlingassoq Member consists almost exclusively of picritic pahoehoe lavas, whereas hyaloclastites dominate in eastern Disko. The transition from subaerial lavas into cross-bedded hyaloclastite has been sketched by Pedersen (1973, fig. 9).

The hyaloclastite units often contain minor black shale patches deposited on the bottom of the up to several hundred metres deep basins in the eastern areas (figs 15, 16). Minor conglomerate layers composed of basaltic beach pebbles which have rolled down the steep breccia beds are also observed occasionally.

A few subaerial and subaqueous eruption sites have been observed on Disko, but partly due to their inconspicuous appearance in the field they are only rarely seen. A few representative chemical analyses from the Ordlingassoq Member are given in Table 3.

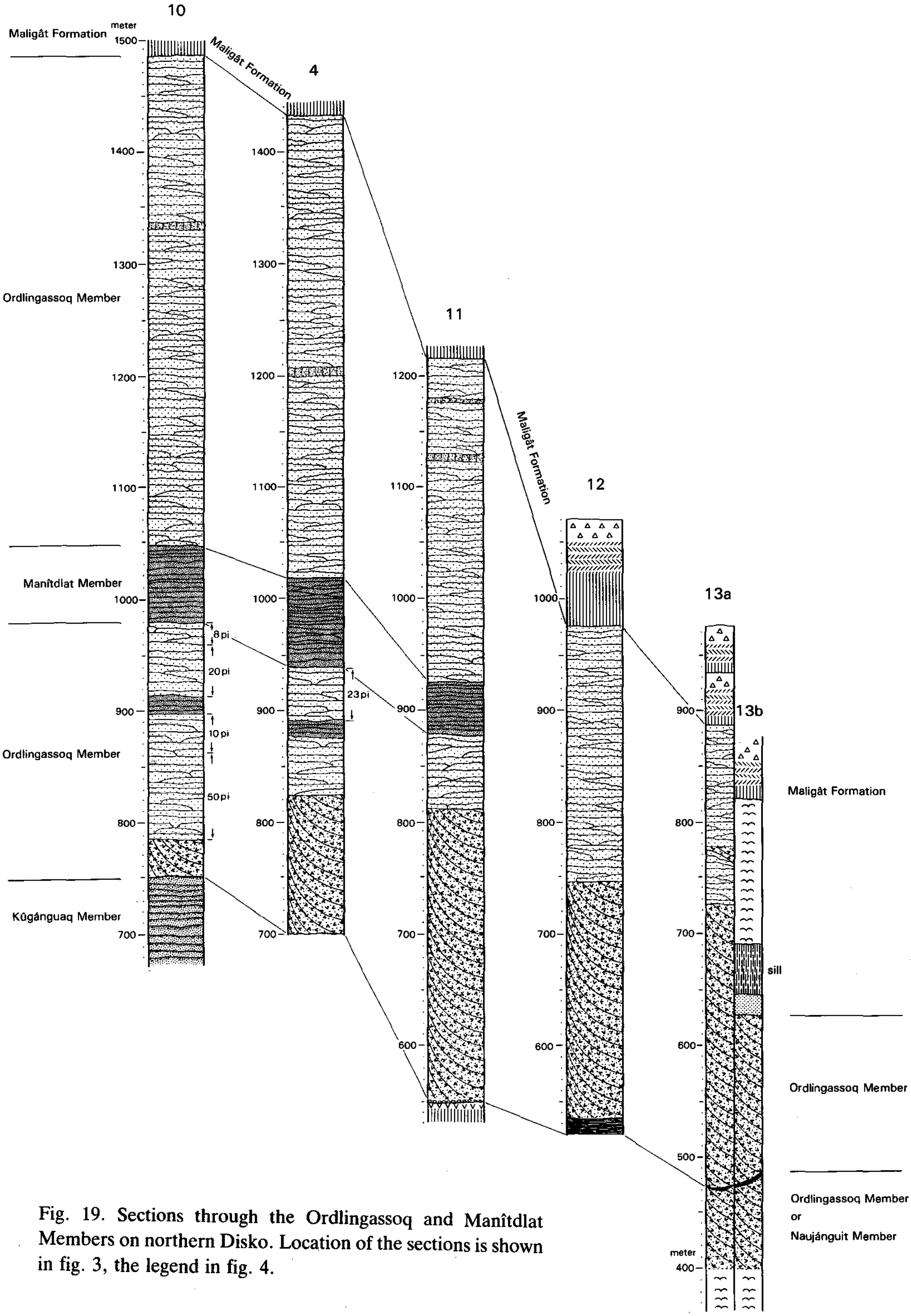

Fig. 19. Sections through the Ordlingassoq and Manîtdlat Members on northern Disko. Location of the sections is shown in fig. 3, the legend in fig. 4.

Fig. 20. The mountain slope of Kitdlerpât qáqarssua facing the abandoned town Qutdligssat (lower left). In the foreground disturbed Cretaceous coal-bearing sandstones. Picritic lavas (O,l) from the Ordlingassoq Member develop into hyaloclastite facies (O,h) towards the left. Stippled lines show large-scale cross-bedding. s: Tertiary sandstone and mudstone. Several very voluminous lavas from the Maligât Formation (MF) cover the picrites and were ponded as they flowed into humid depressions and partly developed into hyaloclastite facies. The ponded lavas are overlain by subaerial lavas from the Maligât Formation.
Oblique aerial photograph copyright Geodetic Institute (495/79), route 514, G-I-SV, no. 1785.

Boundaries. The lower boundary is marked by weathered basalts from the Qordlortorssuaq Member or, in limited areas, by Kûgánguaq Member rocks or weathered Precambrian gneiss hills.

The lower part of the Ordlingassoq Member entirely encloses the alkaline volcanic rocks of the Manîtdlat Member (see below).

The upper boundary of the Ordlingassoq Member is marked by the appearance of the thick, columnar jointed basaltic lava flows of the Maligât Formation (fig. 19) of which the lowermost are distinctly olivine-porphyritic in some areas. The uppermost few lavas of the Ordlingassoq Member are often extensively weathered. In north-east Disko the oldest basalts of the Maligât Formation are developed as extensive columnar jointed lavas with prominent entablature and an upper zone of hyaloclastite which indicate that they represent large lava flows which have accumulated in shallow water-filled basins (fig. 20).

At Qutdligssat a more than 20 m thick horizon of mudstone and sandstone is deposited on top of hyaloclastites from the Ordlingassoq Member. The sediments are covered by Maligât Formation volcanic rocks (fig. 20).

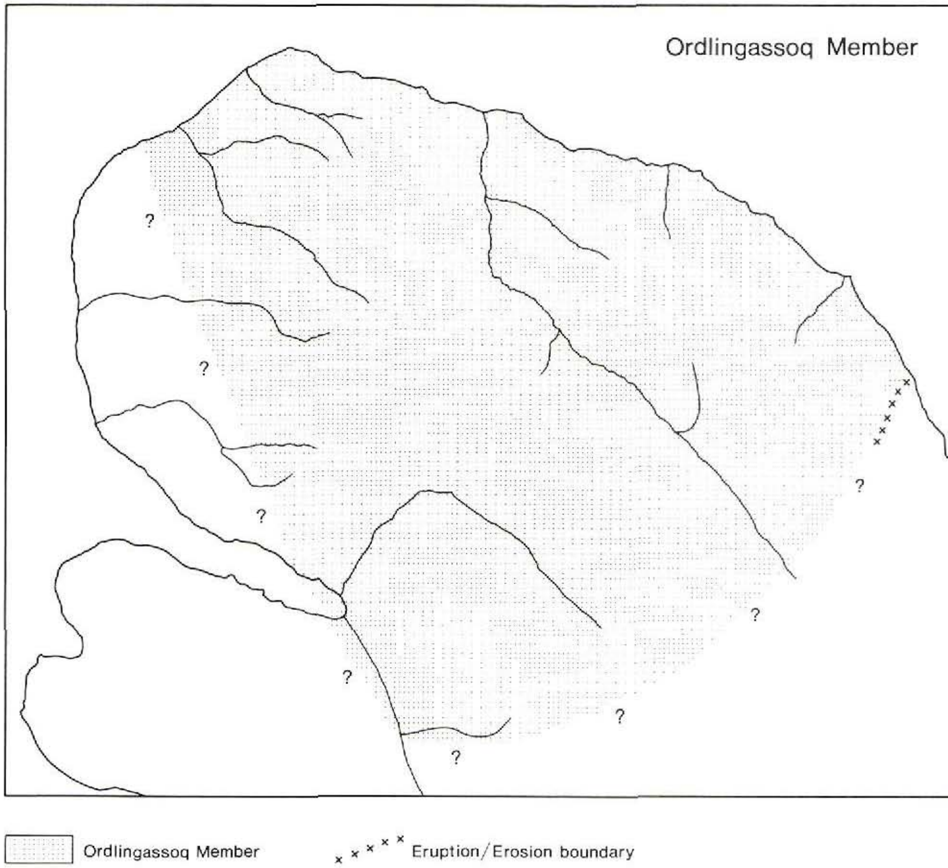

Fig. 21. The extent of the Ordlingassoq Member on northern Disko.

Distribution. The Ordlingassoq Member is found in north-west, north, north-east and central Disko (fig. 21) and is widely present on Nûgssuaq, where it has not been mapped in detail.

Manîtdlat Member

new member

General. The rocks from the Manîtdlat Member have been mapped as a marker horizon in northern Disko (map sheet Qutdligssat 70 V.1 S) and were briefly described as 'mildly alkaline basalts' and depicted in Pedersen (1973, fig. 8, unit 7). Later investigations of fresh glass rocks have indicated that most of the crystalline lava samples have lost Na_2O to circulating water and that many of them were originally nepheline normative. The rocks are therefore referred to as alkaline picrites and alkaline basalts.

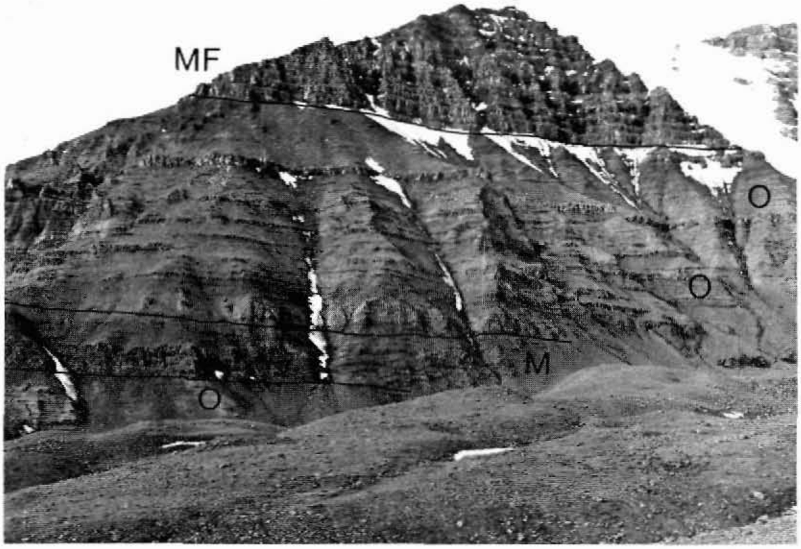

Fig. 22. Parts of the north face of the mountain Ordlingassoq in northern Disko. The upper part of the Ordlingassoq Member with thin greyish-weathering picritic lavas and a few massive erosion-resistant ones (O) covered by thick feldspar-phyric plateau basalts from the Maligât Formation (MF). In the lower part of the section are seen brownish-weathering alkaline picrites and basalts of the Manîtdlat Member (M).

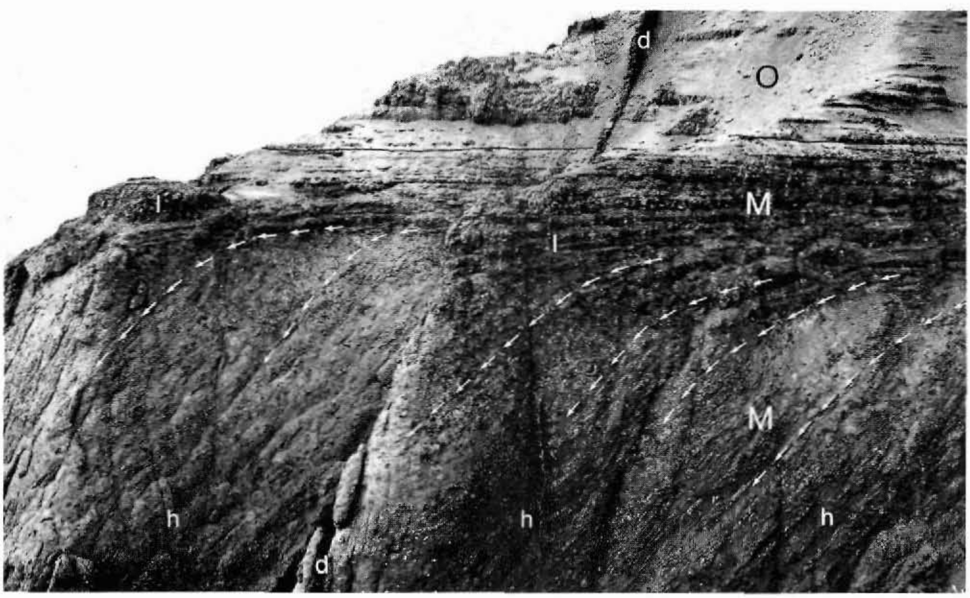

Fig. 23. Alkaline basaltic lavas (l) from the Manîtdlat Member (M) have flowed into water to form foreset-bedded hyaloclastite (h). The arrows show flow lines from subaerial to subaqueous facies. The lavas are covered by thin grey-weathering, crumbling picritic lavas from the Ordlingassaq Member (O). A dyke (d) cuts the sequence. On the north-east wall, about 28 km into the Kûgánguaq valley.

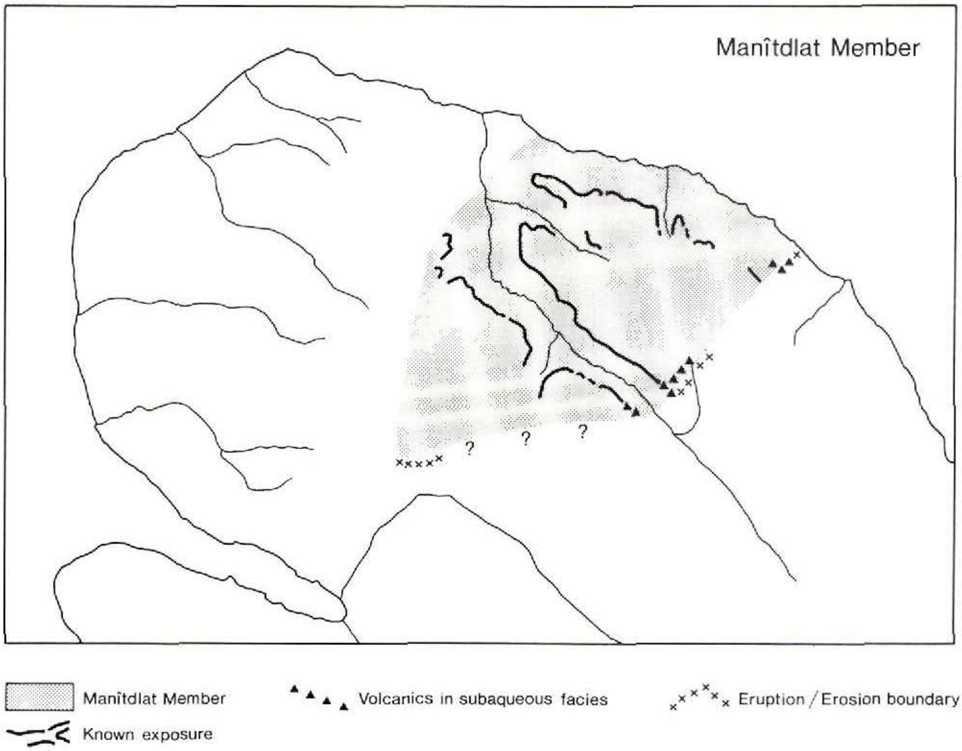

Fig. 24. The entent of the Manîtdlat Member on northern Disko.

Name. From the narrow, partly glaciated valley Manîtdlat kugssinerssuat just west of Ordlingassoq on north-east Disko.

Type section. Manîtdlat kugssinerssuat (section 4, figs 3 and 19), which is also the type section for the upper half of the Vaigat Formation (Hald & Pedersen, 1975) and for the Ordlingassoq Member (see above) (figs 3 and 18).

Thickness. The thickness of the subaerial lavas varies from 0 m to 75 m. Where the Manîtdlat Member enters hyaloclastite facies a thickness of about 200 m is reached locally.

Lithology. The Manîtdlat Member consists of brownish weathering pahoehoe lavas of alkaline picrite and alkaline basalt (figs 18 and 22). All the rocks carry phenocrystic olivine and some evolved types have glomerophyric calcic clinopyroxene and chemically resemble ankaramites. The Manîtdlat Member terminates in a broad zone of hyaloclastites where the alkaline lavas have flowed into several hundred metres deep water (fig. 23). A few representative chemical rock analyses are given in Table 3.

Boundaries. Manîtdlat Member is enclosed within the Ordlingassoq Member (fig. 19). The lower boundary is picritic pahoehoe lavas, except in the Stordal region where Manîtdlat

Member alkaline basalts flowed in from the north and were dammed up against a shield of slightly contaminated feldspar-phyric basalt lavas. The upper boundary is picritic pahoehoe lavas from the Ordlingassoq Member and their equivalent picritic hyaloclastites.

Distribution. Manîtdlat Member occurs as lavas in northern and central north Disko, while they seem to be absent in north-west Disko (fig. 24). The member enters hyaloclastite facies along a south-west trending zone from just east of Ordlingassoq to the inner part of Kûgánguaq. Similar rocks are known from central Nûgssuaq, but their distribution there is poorly known at present. The lavas of the Manîtdlat Member represents the largest known volumes of alkaline basaltic rocks in the Tertiary of West Greenland.

Acknowledgements

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