Significance of Mineral Grains in Clothing and Skins from the Mummy Graves

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A description of the geology and topography around the burial site is given. Mineral grains washed out from the mummies' clothing and other skins were studied under the microscope and compared with the mineralogical composition of the local rocks and the beach sands below the graves.

The significance of 'foreign' minerals lodged in the skins as indicators of the ancient people's wanderings in the Uummannaq area is discussed.

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During the anatomical studies of the mummies from Qilakitsoq a large number of highly reflective fragments were revealed in their clothing by X-ray investigations. In March 1979 the author was asked to study the composition of these fragments and if possible to identify their provenance. This was only possible on the basis of a detailed knowledge of the topography and geology around the graves at Qilakitsoq as well as of the grave and covering stones. Accordingly, the author visited the empty graves at Qilakitsoq and their surroundings for three days in August 1979, drew a sketch map of the site (scale 1:1000), and collected rock samples and sands from the beaches near the graves. A detailed report of the field work is given by Ghisler (1979).

The author received samples of stones, rock fragments and sands collected or washed out from different skins during the conservation process from the Conservation Department of the National Museum in Copenhagen in 1981.

Purpose of investigation

The geological and mineralogical investigations aim if possible to help to elucidate the wanderings of the people from Qilakitsoq and the circumstances of their death.

1. What is the provenance of the mineral grains occurring in the clothing and skins? Are they fragments of the rocks and gravels covering the graves, or weathered particles from the surrounding and overhanging cliffs, or do some of these grains represent material from the areas where the people lived and camped? In other words, is it possible to distinguish between mineral grains of 'local' and 'foreign' origin? Are any such 'foreign' minerals related to certain areas or localities, thus indicating where the people lived and travelled?

2. It has been proposed that the six women and two children capsized and drowned, and all were accordingly buried at the same time (Rosing 1979). If this theory is correct the bodies would have washed ashore. It may be expected that the salvaging of the bodies and the equipment probably took place at one of the beaches below the grave site. Do any of the skins contain mineral grains that are diagnostic for the beach sands?

Geology and topography around the burial site

Qilakitsoq is situated on the north coast of Nuussuaq near the boundary between the Precambrian basement to the east and the Tertiary basalts and the Cretaceous-Tertiary sediments to the west. The bedrock at Qilakitsoq consists mainly of different types of flat-lying grey gneisses, occasionally with minor lenses of black amphibolite. Numerous fissures cut the rock in two directions, one running NW-SE, the other N-S. The area is partly covered by talus with boulders, all of local origin, some up to a hundred tons. A sketch map of the area is given in Fig. 1.

The graves are situated at 20 m above sea level about 50 m from the coast at the northeast side of a steep, 200 m high slope, which continues more gently upwards to a

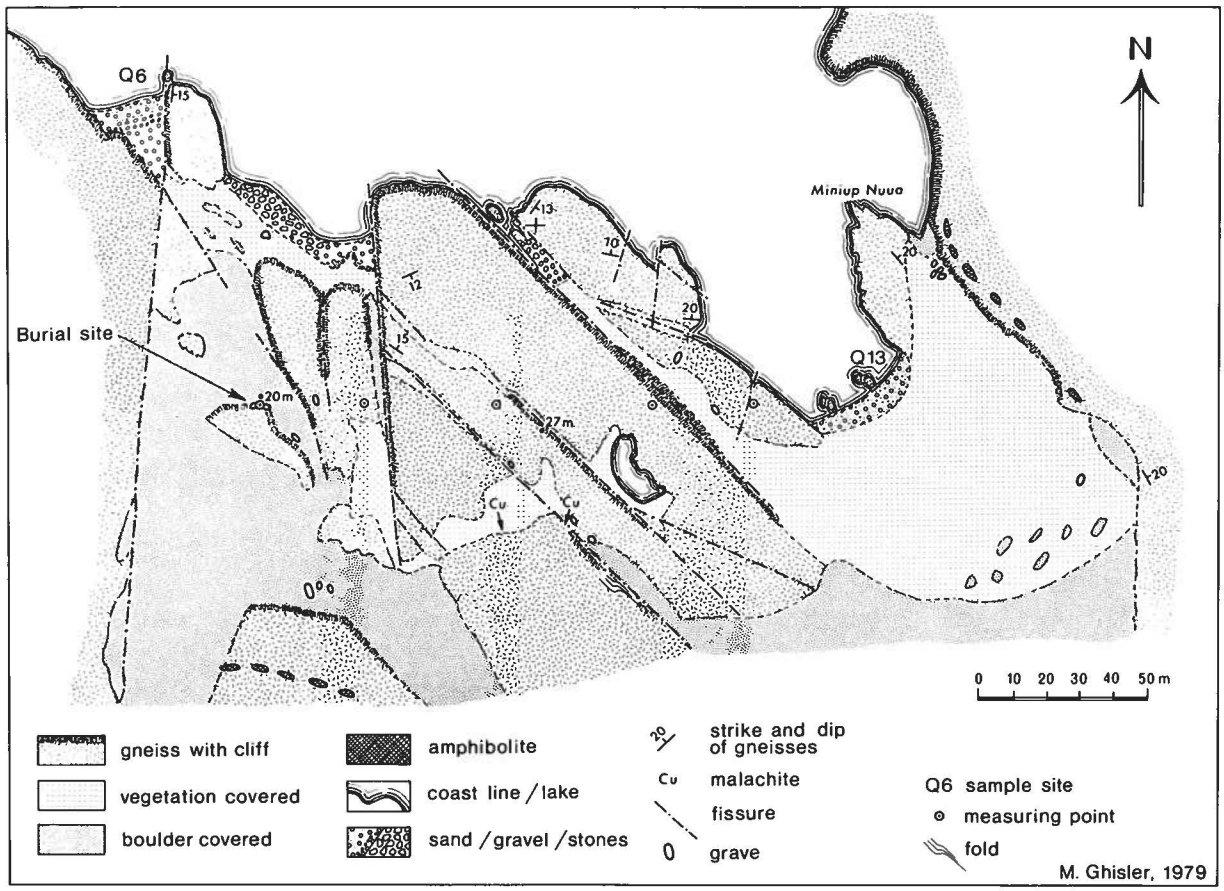

Fig. 1. Sketch map of the geology around the burial site of Qilakitsoq.

plateau at an altitude of 900–1000 m. The burial site is almost always in shadow. Even during the summer the sun does not reach the place until late in the evening (August 12th at 8.45 p.m.).

The graves are sheltered by an overhanging cliff. A rock 2 × 2 × 1.70 m in size is split from the cliff along two zones of weakness: in the roof, a curved layer in the gneiss rich in biotite; to the southwest, one of the regional northwest-southeast fissures. The disrupted block is rotated some thirty degrees leaving a wedge-shaped excavation, at the bottom of which grave I (Fig. 2) is situated. Grave II is situated immediately to the southeast of grave I. A fissure belonging to the north-south oriented system forms the west side of grave II, which is sheltered by a less marked overhang on the east side of the cliff (Fig. 3).

The stones used for building the graves are all of local origin. The largest of them, the covering stones, are up to 75 × 60 cm in size and 10 cm thick. Such rocks are exposed at the nearby coast: they are strongly weathered, banded gneisses (Fig. 4). When the graves were found they were covered with a layer of small stones of both angular and round shape (J. Grønvold, personal communication). The unusual nature of this top layer was the reason the trained eyes of the two Greenlandic hunters discovered the graves. A rounded gneiss pebble from this top layer was found by the author at the grave site. Similar pebbles occur at the triangular beach northwest of the graves (at Q6, Fig. 1).

Mineralogical composition of the covering stones and the bedrock around the graves

The mineralogical composition of the rocks was studied under the microscope, thin sections under transmitted light and polished sections under reflected light. The rock-forming minerals of the gneisses are quartz, plagioclase, green hornblende and brown biotite (Fig. 5), whereas the amphibolites mainly consist of plagioclase and green hornblende. Of special interest for this study is, however, the content of minor components which

Fig. 2. Grave I seen looking east. The grave is placed in the wedge-shaped excavation between the cliff and the main block at which the person is standing.

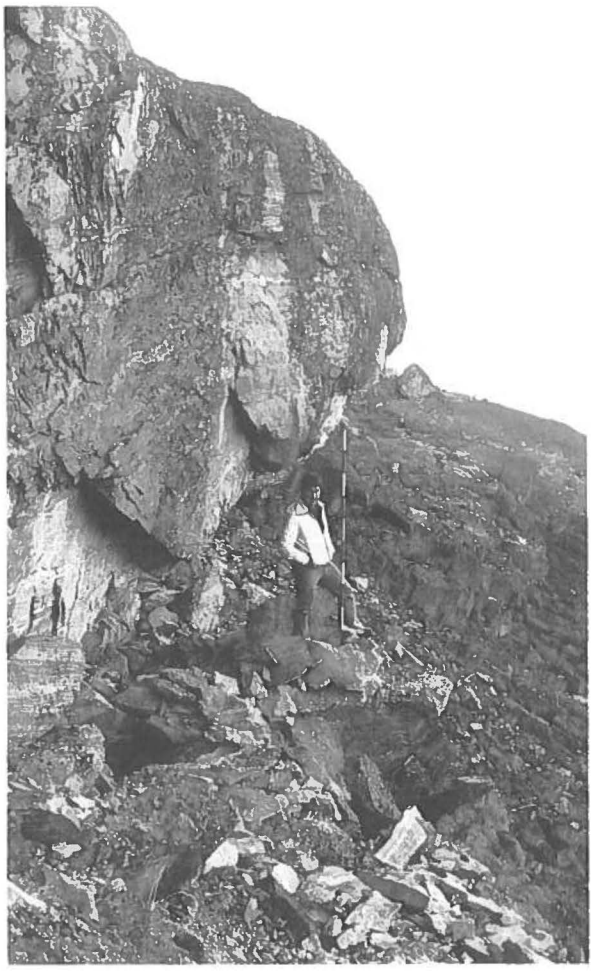

Fig. 3. Grave II at the left side seen looking west. The person is standing at the same place as in Fig. 2

may be of diagnostic importance. The following minerals were identified, listed in alphabetic order: apatite, chalcopyrite, goethite, hematite, ilmenite, magnetite, molybdenite, pyrite, pyrrhotite, rutile, sphene and zircon.

Mineralogical composition of the beach sands

Samples of sand were collected from the main bay (Q13, fig. 1), the beach immediately below the grave site (Q6, Fig. 1), and from two localities 150 m (Q7) and 300 m (Q8) to the northwest, respectively. The samples consist mainly of quartz and feldspar. The heavy minerals (specific gravity above 2.9) were separated out by heavy liquids and studied under the microscope. The heavy minerals form on average 8% of the sands, of which the main portion is green hornblende.

The individual sand grains have a relatively angular shape (Fig. 6). This indicates they have not travelled far – they have only been poorly rounded.

The following minerals were identified in the heavy fractions of the beach sands: andalusite, apatite, chalcopyrite, chromite, diopside, epidote, garnet, goethite, hematite, hypersthene, ilmenite, magnetite, olivine, pyrite, rutile, sphene, titanomagnetite, tremolite and zircon.

The beach sands mainly consist of eroded components from the local rocks. In addition, however, they contain characteristic minerals originating from the basalts occurring in the inner parts of Nuussuaq and along its coast to the northwest. These grains have been transported by means of rivers, glaciers and wind to their present place, after travelling only a few kilometres.

Fig. 4. Schistose gneiss used as covering stones for the graves. At the coast below the burial site.

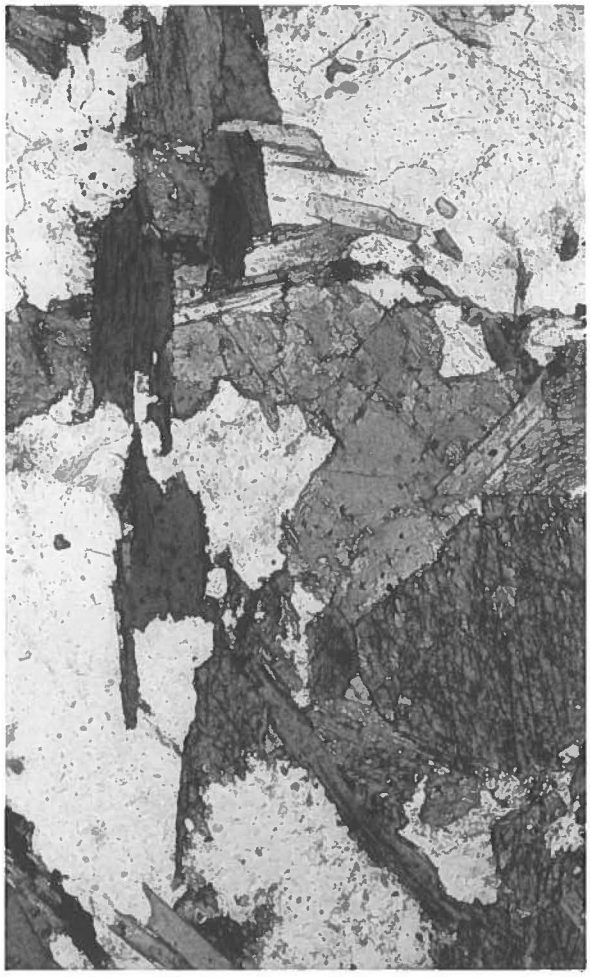

Fig. 5. Microphotograph of gneiss. Transmitted light. Quartz and feldspar (white) are intergrown with hornblende (grey) and biotite (dark grey). Long side of picture 2 mm.

Rock fragments and mineral grains from clothing and skins

A large number of rock fragments (186) ranging in size from 0.5 to 2 cm, enclosed or lodged within skin and clothing from the two graves, were investigated with a hand lens. They all proved to be of local origin. In addition seven samples of sand washed out of the skins were investigated under the microscope, with special emphasis on the study of the heavy mineral components. The content of heavy minerals in the sands washed out from the skins averages 15%.

The most common minerals are quartz, feldspar, hornblende and biotite. The following accessories were identified: apatite, augite, chalcopyrite, chlorite, chromite, diopside, epidote, goethite, hematite, ilmenite, magnetite, pyrite, pyrrhotite, rutile, sphene, white spinel, titanomagnetite, tremolite and zircon. In several cases individual grains from the skins consisted of rock fragments composed of minerals intergrown with typical basaltic structures.

Special attention is drawn to the occurrence of some characteristic structures in the mineral grains found:

1) Exsolution structures of hematite in ilmenite (Fig. 7).

2) Chromite grains, sometimes with a corona of different chemical composition (Fig. 8).

3) Incomplete, skeletal magnetite crystals sometimes altered to hematite (Fig. 9).

4) Magnetite grains surrounded by worm-like intergrowths between magnetite and silicates (Fig. 10).

5) Intense intergrowths between the sulphide minerals pyrite, chalcopyrite and pyrrhotite.

Discussion of results

The mineralogical investigations have shown that most of the mineral grains and rock fragments found in the skins are of local origin. They represent local decomposed rocks and gravel used for the burial. The skins, however, also contained minerals and fragments which belong to geological formations not present near the burial site.

Some of the mineral components found in the beach sands beneath the graves are 'foreign minerals'. Glaciers, rivers and the wind have transported them from the mountains and along the coast. A similar transport of 'foreign' minerals to the graves in the sheltered site under an overhanging cliff is excluded. The possibility of introduction by humans of foreign minerals from the beach is supported by the presence of a rounded pebble from the beach at the burial site.

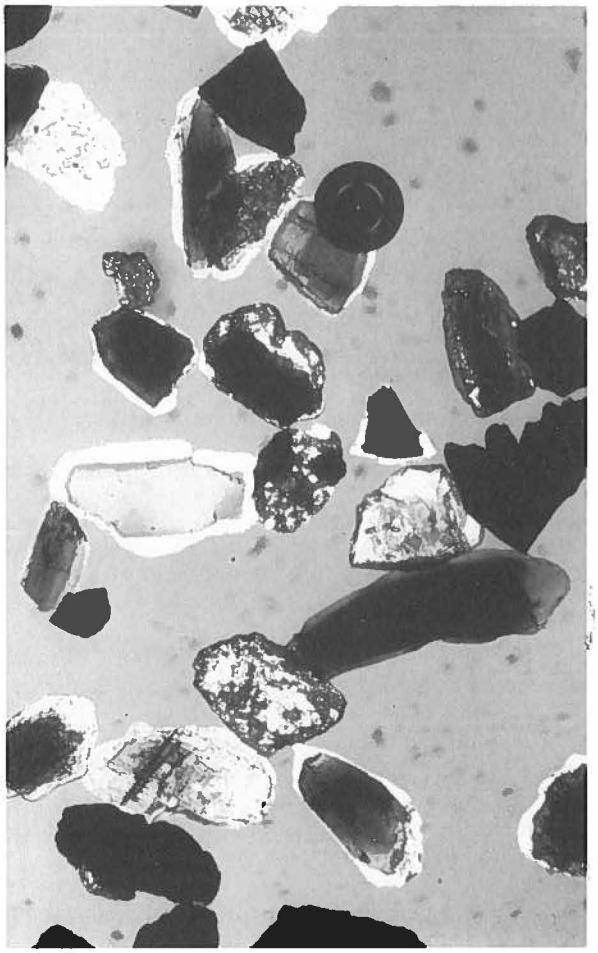

Fig. 6. Microphotograph of beach sand from site Q6. Transmitted light. Hornblende (black) dominates the sample. Note the angularity of the grains. Long side of picture 2 mm.

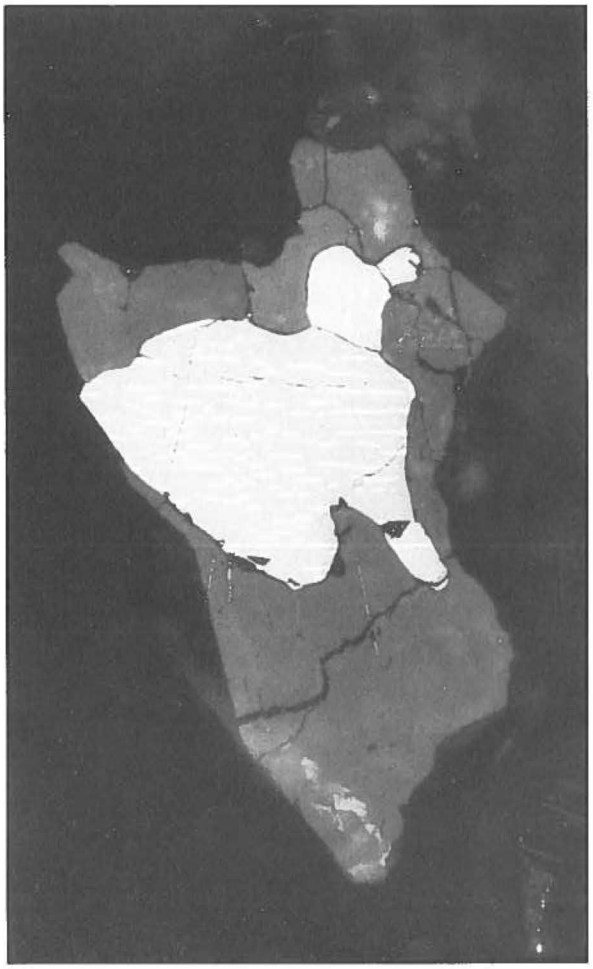

Fig. 7. Microphotograph of ilmenite with regularily arranged inclusions of hematite, surrounded by silicate grains. Reflected light. Longest dimension of picture 0.5 mm. Sand from skin No. 37 between body 7 and 8, grave II.

A comparison between the various foreign minerals occurring in the beach sands and the samples from the graves show that many of the characteristic minerals from the beach are not found in the graves. Thus it is unlikely that sand from the beach has 'polluted' the graves.

A number of selected minerals of importance in the evaluation of the provenance of the mineral components in the skins are listed in Table 1. The minerals occurring in the local rock are also present in the beach sands and the skins. Of those minerals not present in the local bedrock, some are common in the beach sands but

Table 1. Table of the presence of selected minerals in sands from skins, in beach sands and rock samples around the burial site.

Minerals	Sand from skins	'Local' rocks	Beach sands
Hornblende	+	+	+
Sphene	+	+	+
Magnetite	+	+	+
Garnet			+
Olivine			+
Augite			+
Ilmenite	+		+
Skeletal magnetite	+		+
Chromite with corona	+		(+)
Chromite without corona	+		
Skeletal hematite	+		
White spinel	+		
Chalcopyrite with pyrrothite	+		

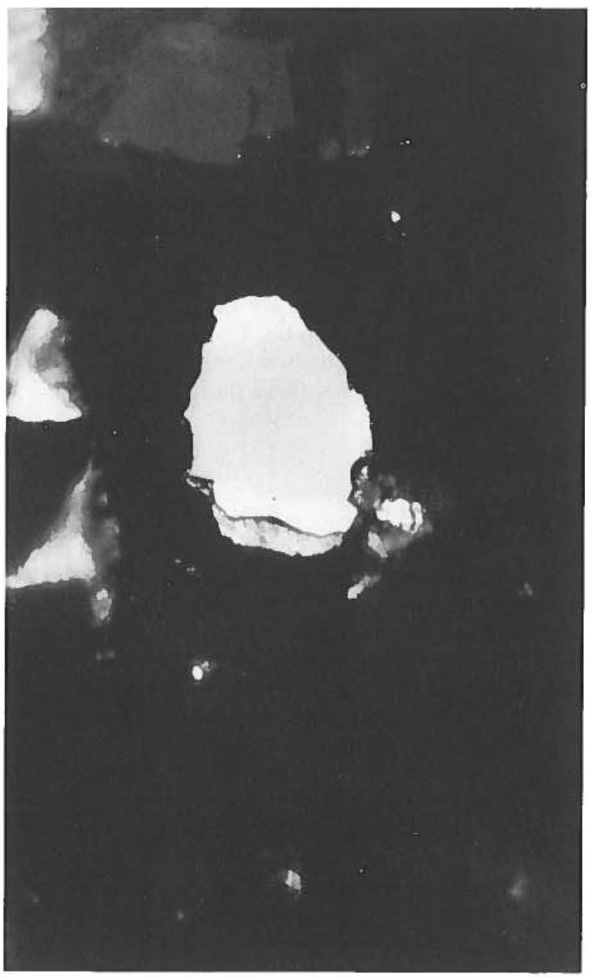

Fig. 8. Microphotograph of chromite grains with a brighter, more iron-rich rim. Reflected light. Longest dimension of picture 0.2 mm. Same sample as Fig. 7.

Fig. 9. Microphotograph of incomplete skeletal magnetite. The crystals cooled so fast in the basaltic lava that the grains were never completed. Reflected light. Longest dimension of picture 0.4 mm. Sand mainly from skin No. 28 above body 8, grave II.

are entirely absent from any of the samples from the skins; others are present in both beach sands and in the skins. A few characteristic minerals are only found in samples from the skins.

Heavy minerals are twice as frequent in the samples from the graves as in the beach sands. This suggests that some mineral components in the skins come from areas relatively rich in heavy minerals (e.g. basalt terrains).

Some of the minerals (chromite, skeletal hematite etc.) found in the skins can be clearly related to special basalt types, known to occur to the northwest along the north coast of Nuussuaq (A. K. Pedersen, personal communication). The identification of white spinel in one sample suggests an origin in Uummannaq Storø, some 25 km ENE of Qilakitsoq. This peculiar mineral is only known to occur in connection with amphibolite

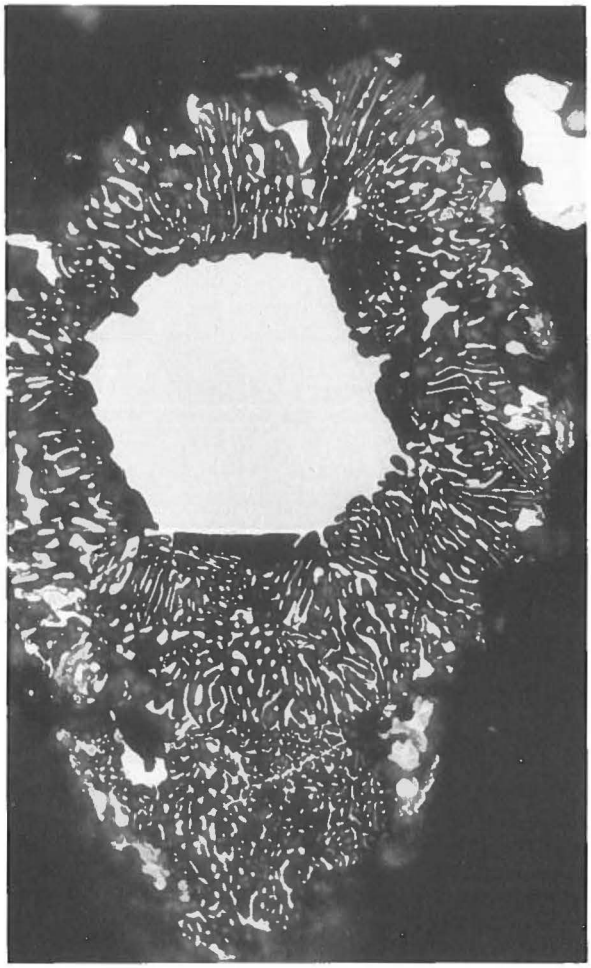

Fig. 10. Microphotograph of a central magnetite grain surrounded by minute silicate-magnetite intergrowths. Typical of basaltic lavas from Nuussuaq. Longest dimension of picture 0.2 mm. Same sample as fig. 7.

layers at two localities in the Uummannaq district (B. Thomsen, personal communication) of which one is a steep mountain slope.

Conclusions

1. Some of the mineral grains lodged in the hairs of clothing and skins found in the graves of Qilakitsoq are definitely of 'foreign' origin.
2. The people of Qilakitsoq obviously travelled and camped on gneissic as well as basaltic terrain in the Uummannaq area. This statement is supported by occurrence of minerals typical of the basalts of western Nuussuaq found in skins and clothing.The presence of white spinel points to the settlement Tupersuatsiaat at Ummannaq Storø as source area.
3. The absence of certain minerals in the skins that are common in the beach sand below the burial site, such as garnet, does not support the theory of capsizing accident. During salvaging of the bodies at the beach some of the most common heavy mineral grains would probably have lodged in the hairs of clothing or skins. The absence of these minerals diagnostic for the beach sand does not however entirely exclude such a theory.

Acknowledgements

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