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The Tartoq Group on Nuna qaqertoq and in the Iterdlak area, South-West Greenland

by

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Continued on inside back cover.

Note:
The authorised spelling of the locality name »Nuna qaqortoq« is that used on the title page and in the maps.

THE TARTOQ GROUP ON NUNA QAQORTOQ AND IN THE ITERDLAK AREA, SOUTH-WEST GREENLAND

by

A. K. HIGGINS

With 5 figures and 2 maps

1968

Abstract

The Tartoq Group schists of Nuna qaqertoq appear to have comprised pillow lavas, sills and sediments. Those of the Iterdlak area appear to have been composed of sills and a variety of sedimentary rocks, including a conglomerate. Both areas of schists have suffered deformation and metamorphism under high greenschist facies conditions, and have in part been extensively veined by pegmatite or aplite.

Comparisons of the structures in these schists with those in the gneisses of adjacent areas supports the view that these gneisses represent the gneissified, deformed basement on which the Tartoq Group was deposited.

CONTENTS

I INTRODUCTION

In the summer of 1967 two areas of Tartoq Group supracrustal rocks were investigated. Nuna qaqortoq is situated in the Sermiligârssuk glacier north of Midternæs and was briefly visited during a helicopter reconnaissance flight in 1966. The Iterdlak area, so called after the small bay of that name at the southern edge of the area and on the north side of Sermiligârssuk fjord, was mapped by Micheelsen in 1955.

Areas of supracrustal rocks of pre-Ketilidian age occurring in the Tartoq-Sermiligârssuk-Midternæs area were collectively entitled the Tartoq Group by Higgins and Bondesen (1966). All the known outcrops of this group are shown on the map, fig. 1. Brief descriptions of all the areas, except Nuna qaqortoq and one other small area, are given by Higgins and Bondesen, and their border relations with the adjacent gneisses are discussed by Windley et al. (1966).

II STRATIGRAPHY OF NUNA QAQORTOQ

A geological map of Nuna qaqortoq appears as Map 1. Gneisses are found in the north and Tartop Group supracrustal schists in the south. The boundary between the gneisses and schists is obscured by a very complex network of granitic or pegmatitic veins and bodies occupying an extensive area in the central part of the nunatak. Mapping with the aid of very good vertical aerial photographs it proved possible to distinguish between areas of pegmatitic bodies with gneiss inclusions and areas with schist inclusions, and from these observations an approximate gneiss-Tartoq Group boundary has been reconstructed.

The gneisses of Nuna qaqortoq comprise banded and homogeneous biotite or biotite-muscovite gneisses. In all outcrops the gneisses are transected by pegmatitic or aplitic veins. A strong ribbed lineation is present in some localities.

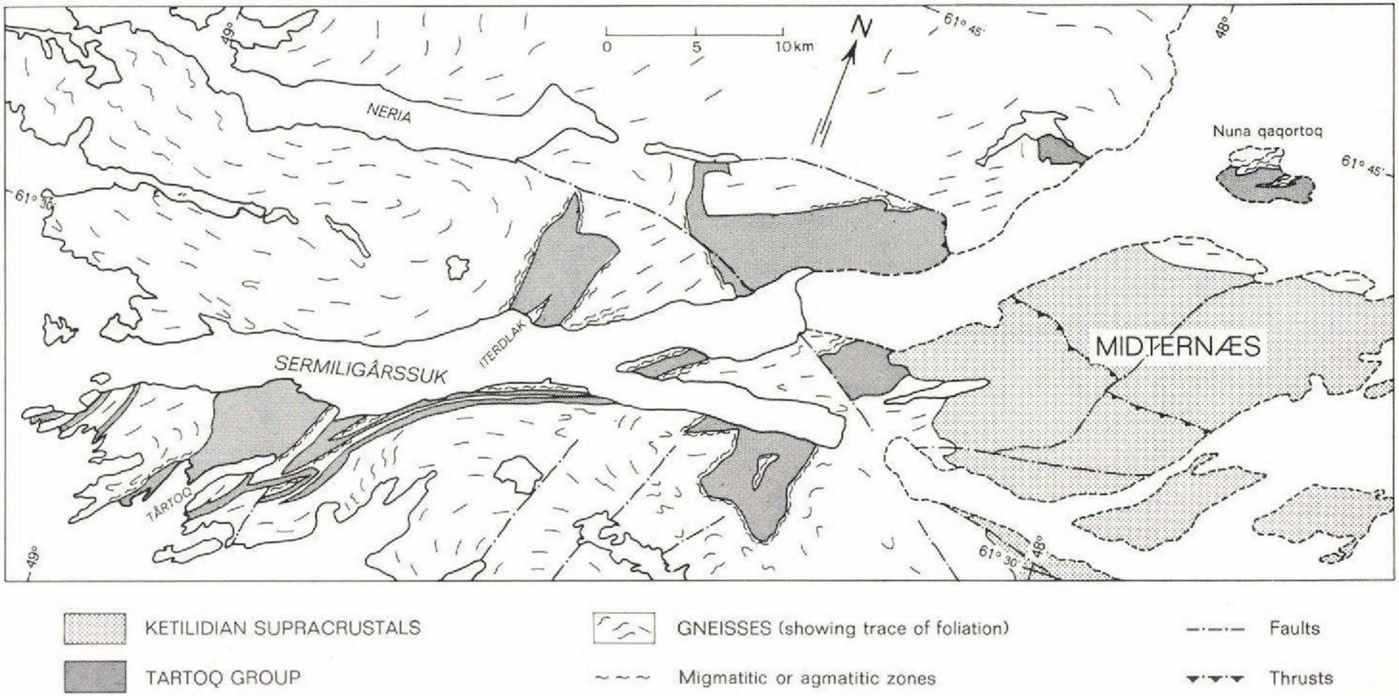

Fig. 1. The Tartoq Group areas in the Tartoq-Sermiligârssuk-Midternæs region.

The Tartoq Group of Nuna qaqortoq comprises a variety of rock types: massive dark green schists are dominant, and a few bands of grey augen schist, brown or red stained schists, and ultrabasic lenses are also found.

In the western and southern part of their outcrop the massive dark green schists preserve good, but deformed, pillow structures (fig. 2). The pillow margins are outlined by a dark band which may or may not be divided by a thin central white vein. In other outcrops these schists are rather homogeneous non-foliated rocks and preserve textures of various degrees of coarseness reminiscent of those of coarse-grained igneous rocks. In thin section the dominant component of the massive schists is amphibole in the following assemblages: amphibole, plagioclase, quartz, biotite-chlorite intergrowths and calcite; amphibole, plagioclase, quartz and sphene; amphibole, quartz, altered feldspar and a little ore. The dark rims of the relic pillows comprise coarser aggregates of amphibole than the rest of the pillow. The blastophitic appearance of some of the schists is seen in thin section to arise from aggregates of amphibole laths.

A few bands of dark shaly rocks intercalated with the massive schists consist of alternations of thin light and dark layers which probably reflect sedimentary banding.

Two main bands of grey augen schists have been mapped in the southern part of the nunatak, one of them locally several hundred metres in outcrop width. They comprise quartz, feldspar, chlorite, muscovite and epidote, the augen being quartz and feldspar, and have a somewhat sheared texture in thin section. A quartzitic schist band in the west part of the nunatak, which lacks the augen development, consists largely of quartz, with some biotite, muscovite, epidote and a little tourmaline.

Ultrabasic rocks occur in a series of lens-shaped bodies in the west part of the area, and a large isolated lens is found as an inclusion in the pegmatitic-granitic vein complex. These rocks are characterised by their distinctive orange-brown weathering and, relative to the other schists, a high specific gravity.

Two narrow zones of schists with a red or brown surface weathering have been mapped. The rusty stain appears to be derived from the weathering of a small amount of sulphide in the rocks.

Fig. 2. Deformed pillow structures on Nuna qaqortoq.

The Tartoq Group schists of Nuna qaqortoq appear to have comprised a succession of pillow lavas, sills and intercalated, mainly siliceous, sediments, which suffered moderate deformation and metamorphism under high greenschist facies conditions (Winkler, 1967). The state of preservation, however, is such that reliable stratigraphical sequences cannot be set up. The rock types are comparable to those in the other Tartoq Group areas but no correlations of successions are possible.

The distribution of the granitic, pegmatitic or aplitic veins and bodies on Nuna qaqortoq is best appreciated from the map (Map 1). Part of the central area of the nunatak comprises white, very thick and massive bodies of interconnecting granitic pegmatite. Thinner veins of various dimensions occur throughout the area in both gneisses and schists. In the schists thick veins may be parallel to the foliation, where this is developed, but most veins have a somewhat irregular disposition. Several cross-cutting sets of veins may be distinguished locally but there seems to be no systematic control of their direction. Many veins predate the folding, and thin veins in particular exhibit isoclinal and often ptygmatic folding. The larger bodies in some instances bear a weak axial plane foliation. Dark coloured reaction rims border some of the veins in the schists.

The veins vary in grain size from fine-grained to pegmatitic but most are medium- or coarse-grained. Most commonly they consist of quartz, feldspar, muscovite and biotite, and occasionally also contain tourmaline or garnet. The feldspar is microcline or plagioclase, and frequently both minerals occur in perthitic intergrowths. The micas usually occur in accessory amounts, but sometimes are conspicuous in pegmatitic developments.

III STRATIGRAPHY OF THE ITERDLAK AREA

The Iterdlak area is the western of the two large supracrustal areas on the north side of Sermiligârssuk. This area has been investigated by Micheelsen (1955) and the bordering gneisses were mapped by N. Henriksen in 1963 and 1964. A brief description of the gneiss-supracrustal border relations has been given by Windley et al. (1966). The main purpose of the short visit by the writer to this area was to investigate the significance of the complex outcrop patterns indicated on Micheelsen's field maps. Micheelsen's interpretations have been largely verified but the use of enlarged aerial photographs has permitted more detailed mapping. A slightly revised geological map is presented as Map 2.

The Tartoq Group of the Iterdlak area consists mainly of two rock types: dark green massive schists and light coloured grey to pale grey or white schists. Other rock types present locally include calcareous schists, thin ultrabasic lenses, rusty coloured schists and a conglomeratic band. Massive bodies of granitic pegmatite were encountered in the south and west of the area and thin scattered pegmatites occur in other parts of the area. A folded but apparently concordant boundary with banded quartz-muscovite gneiss was mapped in the north of the area.

The massive dark green schists are the dominant rock type. They are rather homogeneous rocks for the most part and in many localities preserve what appear to be blastophitic textures. It seems probable that the larger part of these schists were of igneous origin. In thin section these mainly fine- to medium-grained rocks comprise quartz, amphibole, plagioclase, chlorite, epidote and in some cases a little carbonate.

Some thin lenses of dense hornblendic rocks and a few bands of talc schist occur, but rocks of ultrabasic affinity are otherwise uncommon.

The outcrops indicated on the map as grey schists are a somewhat variable group of rocks. They include white highly siliceous bands in zones of pale grey schists, and in the western part of the outcrop grey-green schists which locally differ only slightly from rocks mapped as massive green schists. The siliceous bands comprise largely quartz, with quartz-K-feldspar augen developments and some muscovite. The pale grey schists contain often considerable amounts of muscovite and quartz, with tourmaline, chlorite and acicular ore minerals in accessory amounts. In some thin sections the muscovite, tourmaline and ore are deformed by microscopic folds. It is likely that most of these rocks were sedimentary, ranging from quartzitic types to semipelitic shales.

Bands of calcareous schists are most conspicuous in the west part of the area where they may exceed 50 m in thickness. They usually weather readily to form shaly screes. The carbonate content is high and small amounts of talc may also be present. A thin band of orange dolomite was noted at one locality.

Rusty red or brown stained zones of schists are fairly common. The superficial stain appears to derive from the weathering of a small amount of sulphide disseminated through the rock or in thin veins; very little fresh ore was recovered. Micheelsen (1955) describes these rocks as pyrite-quartz-chlorite schists.

A thin conglomerate was traced in the southern part of the outcrop of grey schists. At its northern end the pebbles occur in distinct beds and appear to be graded. As is discussed below, the pebbles have been strongly deformed to elongate ellipsoidal shapes. The dimensions of the pebbles vary from a few cm to about 50 cm in the longest dimension. They are of slightly variable composition but in thin section comprise for the most part aggregates of quartz, a little feldspar, chlorite and carbonate, and accessory biotite and epidote. Traced southwards the conglomeratic nature of the band becomes less pronounced and there is a transition into the grey schists.

The Iterdlak area Tartoq Group appears to have been composed originally of a succession of igneous rocks, perhaps mainly sills, and a variety of sedimentary rocks. Micheelsen (1955) and Windley et al. (1966) have previously recorded that the metamorphic state corresponds to the epidote-amphibolite facies, i.e. high greenschist facies of Winkler (1967). As in other areas of Tartoq Group rocks the intensity of deformation hinders determinations of the succession and any attempts at correlation.

Granitic pegmatite bodies occur in the west of the area near the border with gneisses. A massive body of gneissic appearance in the southern part of the area may be interpreted as gneiss or an aplitic or pegmatitic body; cross-cutting veins and several inclusions of supracrustal rocks support the latter interpretation for the northern part of this body. These bodies and the thinner pegmatite veins comprise quartz, plagioclase, microcline and muscovite, and in one example biotite-chlorite intergrowths and abundant epidote.

IV STRUCTURE OF NUNA QAQORTOQ

The axial plane schistosity of the main phase of folding in the Tartoq Group schists is the dominant planar structure in the Nuna qaqortoq area; it has a strike of 60° to 80° and dips steeply to the south-east. The only major structure visible is the synform outlined by the grey augen schist band in the east of the area, but minor folding, particularly of thin pegmatite veins, is common throughout the area. The folds are shear folds varying in degree of closure from open to isoclinal. Competence differences between the veins and the enclosing schists during deformation has led to the frequent development of ptygmatic folds. The schists in some

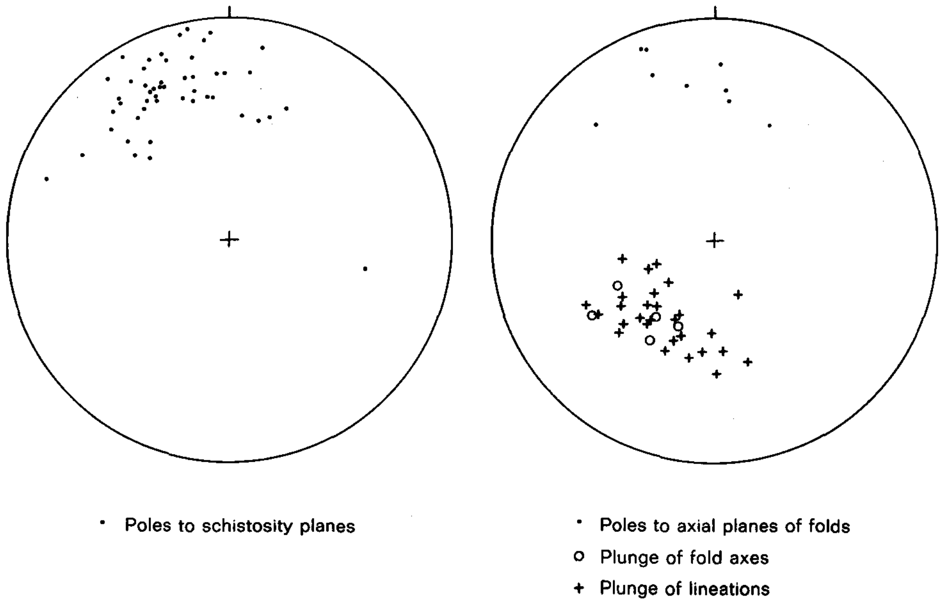

Fig. 3. Analysis of Nuna qaqortoq structures.

areas are permeated by a linear fabric and it is evident in the eastern part of the area that pillow lavas have been stretched parallel to this fabric. The lineations plunge to the south-west with the same trend and amount of plunge as fold axes of the main folding (fig. 3).

There are relic folds locally suggestive of deformation earlier than the main folding, but its significance is uncertain on the evidence available.

Although only 3 km from the nearest exposures of Ketilidian strata in Midternæs, virtually no signs of Ketilidian folding have been recognised on the nunatak. Isolated examples of kink folds may be of any age.

V STRUCTURE OF THE ITERDLAK AREA

Two main phases of folding may be recognised. An early flat-lying isoclinal folding, together with topographical variations, is responsible for the complex outcrop patterns of the grey schists; this phase corresponds to the intense isoclinal nappe folding of Micheelsen (1955). The second later phase of folding is represented by a major antiform and synform in the northern part of the area which deform the gneiss-schist boundary; these folds have axial planes trending 40^{o} to 50^{o} and south-west plunging fold axes (fig. 4); it seems likely that this phase corresponds to the main folding on Nuna qaqortoq.

The pebbles of the conglomerate have suffered an intense elongation subparallel to a linear fabric locally seen in the schists. The stretching of the pebbles probably accompanied the early isoclinal folding.

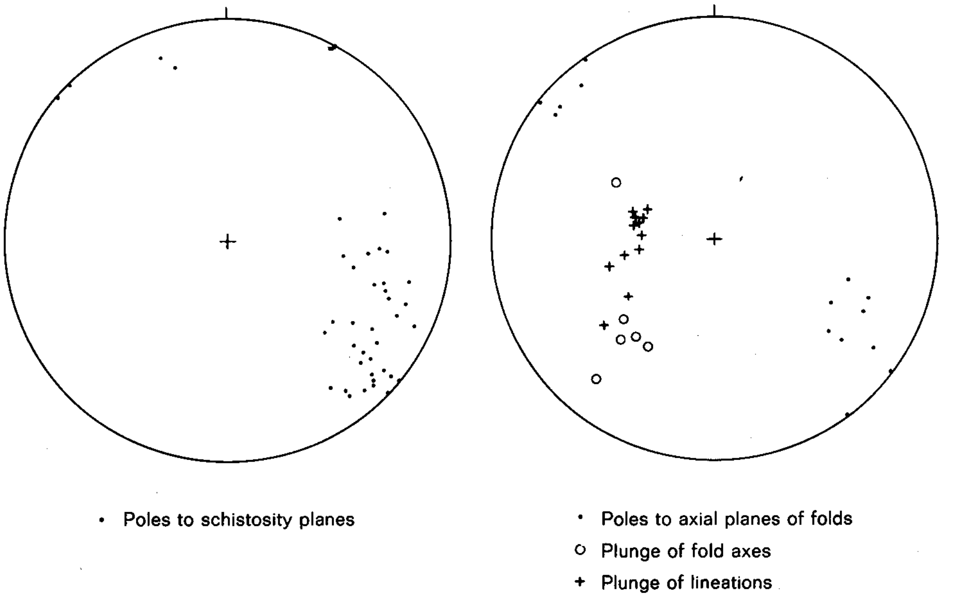

Fig. 4. Analysis of Iterdlak area structures.

Lineations, only observed in the southern part of the area, are not exactly parallel to the second phase fold axes' although they plot in the same quadrant (fig. 4). Analysis of measurements of about 200 pebbles collected from the conglomerate indicates that the majority of them have a prolate shape which suggests they have undergone an overall constrictive type of deformation (fig. 5). The rather wide range in pebble shapes indicated by the graph is probably a consequence of deformation of pebbles of a variety of non-spherical shapes (cf. Ramsay, 1967, p. 212). While it is not possible to determine precisely the amount of deformation from the measurements made, it may be surmised that the axial ratios of the strain ellipsoid corresponding to the deformation are of the order of 1 : 1.7 : 5.6.

Subsequent to the folding the entire area has been affected by a low-angle fracturing or brecciation which over a large area hinders structural interpretations. Many of the larger of the deformed pebbles are fractured and the fragments have in some cases been drawn apart from each other.

A few minor open folds and kink bands have been observed in some bands of calcareous schists. Their age is uncertain.

VI DISCUSSION

The structural history of the Tartoq Group rocks, comprising two main phases of folding, appears to be significantly less complex than that of the gneisses of the Frederikshåb region in which three, four or five fold phases have been distinguished (Kalsbeek, 1967; Andrews, 1968; Watterson, 1968). The frequent occurrence of recognisable igneous and sedimentary textures in the Tartoq Group rocks may be compared to the rare reports of such features in the areas of gneissic terrain to the north and south. Furthermore, the approximate axial ratios of the strain ellipsoid for the Iterdlak area conglomerate are 1 : 1.7 : 5.6 which contrast markedly with the figures of 1 : 3 : 100 deduced by Watterson (1968) for an area of pre-Ketilidian gneisses lying about 45 km north-west of the zone of Tartoq Group outcrops.

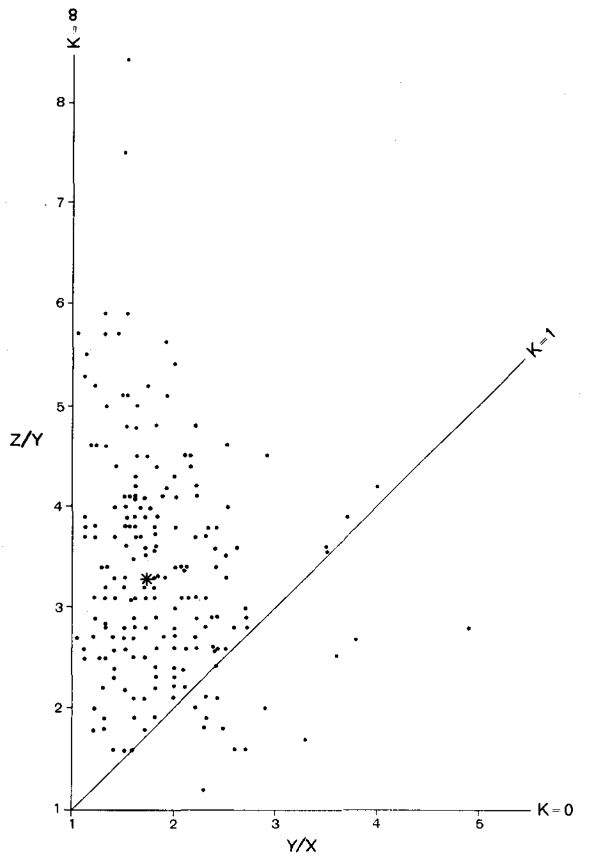

Fig. 5. Plots of axial ratios of about 200 deformed pebbles from the Iterdlak area conglomerate, where the three axes of the pebbles are Z > Y > X. ✱ indicates an ellipsoid of axial ratio 1 : 1.7 : 5.6.

The above observations tend to support the view that the Tartoq Group was laid down on an already deformed gneissic basement (see discussions in Higgins and Bondesen, 1966; Windley et al., 1966; Henriksen, in press). Both gneisses and Tartoq Group may be considered as subsequently having undergone deformation and metamorphism together, so that at the present level of exposure the Tartoq Group is preserved in a series of synclinal or fault-bounded areas in a well defined zone and any traces of an original major unconformity obliterated (Henriksen, in press).

In their descriptions of the border relations of the Tartoq Group Windley et al. (1966) note the frequent occurrence in the border zones of variously termed granitic, pegmatitic, leucocratic or gneissic bands and veins. These bands and veins may be considered indicative of reactivation of the pre-Tartoq Group gneisses during metamorphism, quartzo-feldspathic solutions invading both the gneisses and the infolded Tartoq Group supra-crustals.

Adjacent to many of the Tartoq Group areas occur zones of gneissic rocks which contain lenses and schlieren of supracrustals and have often an agmatitic or migmatitic appearance. These zones have been regarded previously as transformed or gneissified representatives of the Tartoq Group (Windley et al., 1966). However, some of these zones of mixed rocks may be viewed as extensions of the supracrustal areas which have been heavily veined by leucocratic material. The leucocratic material itself may develop a gneissic appearance by the incipient development of foliation during deformation, but the extent to which the supracrustal rocks have undergone transformation is open to question.

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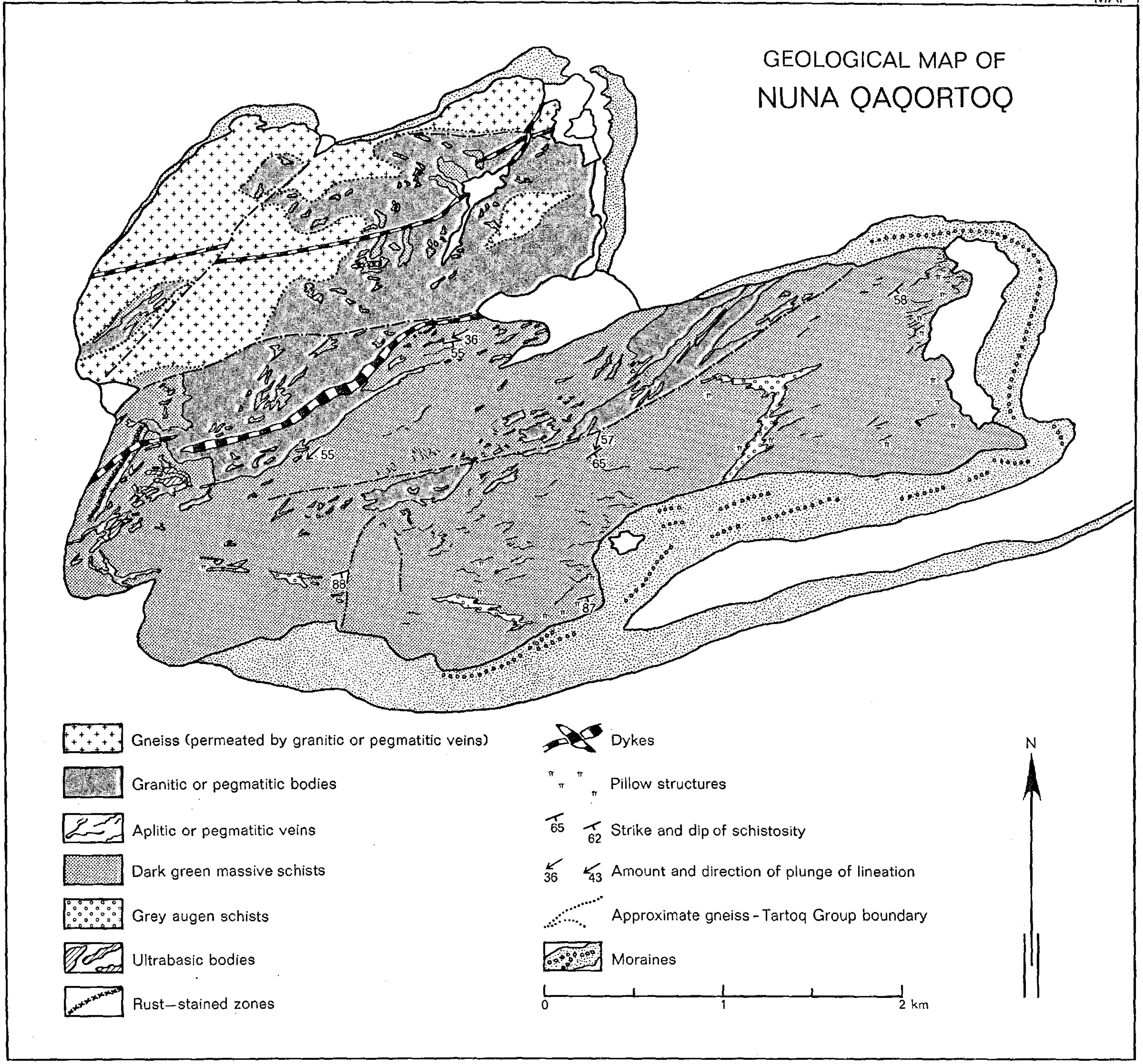
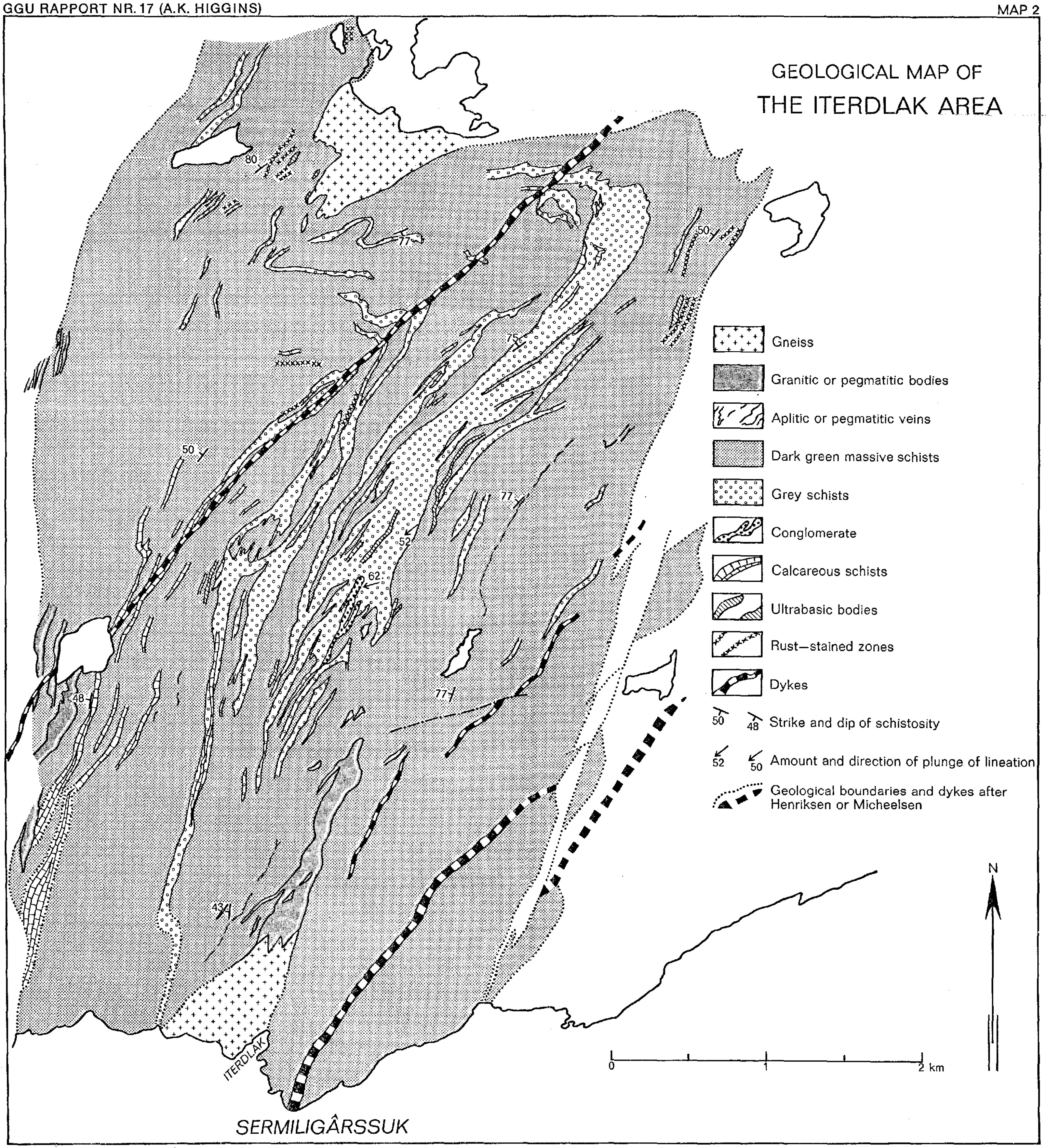

GEOLOGICAL MAP OF
NUNA QAQORTOQ
Gneiss (permeated by granitic or pegmatitic veins)
Granitic or pegmatitic bodies
Aplitic or pegmatitic veins
Dark green massive schists
Grey augen schists
Ultrabasic bodies
Rust—stained zones
Dykes
Pillow structures
Strike and dip of schistosity
Amount and direction of plunge of lineation
Approximate gneiss - Tartoq Group boundary
Moraines
0
1
2 km
N


GEOLOGICAL MAP OF
THE ITERDLAK AREA
Gneiss
Granitic or pegmatitic bodies
Aplitic or pegmatitic veins
Dark green massive schists
Grey schists
Conglomerate
Calcareous schists
Ultrabasic bodies
Rust—stained zones
Dykes
50 48 Strike and dip of schistosity
52 50 Amount and direction of plunge of lineation
Geological boundaries and dykes after Henriksen or Micheelsen
N
0 1 2 km
ITERDLAK
SERMILIGÂRSSUK

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