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GEOLOGICAL MAP OF ATANIKERDLUK AND ENVIRONS 1:10000

BY

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WITH 11 FIGURES IN THE TEXT
AND 1 MAP

KØBENHAVN
C. A. REITZELS FORLAG
BIANCO LUNOS BOGTRYKKERI A/S
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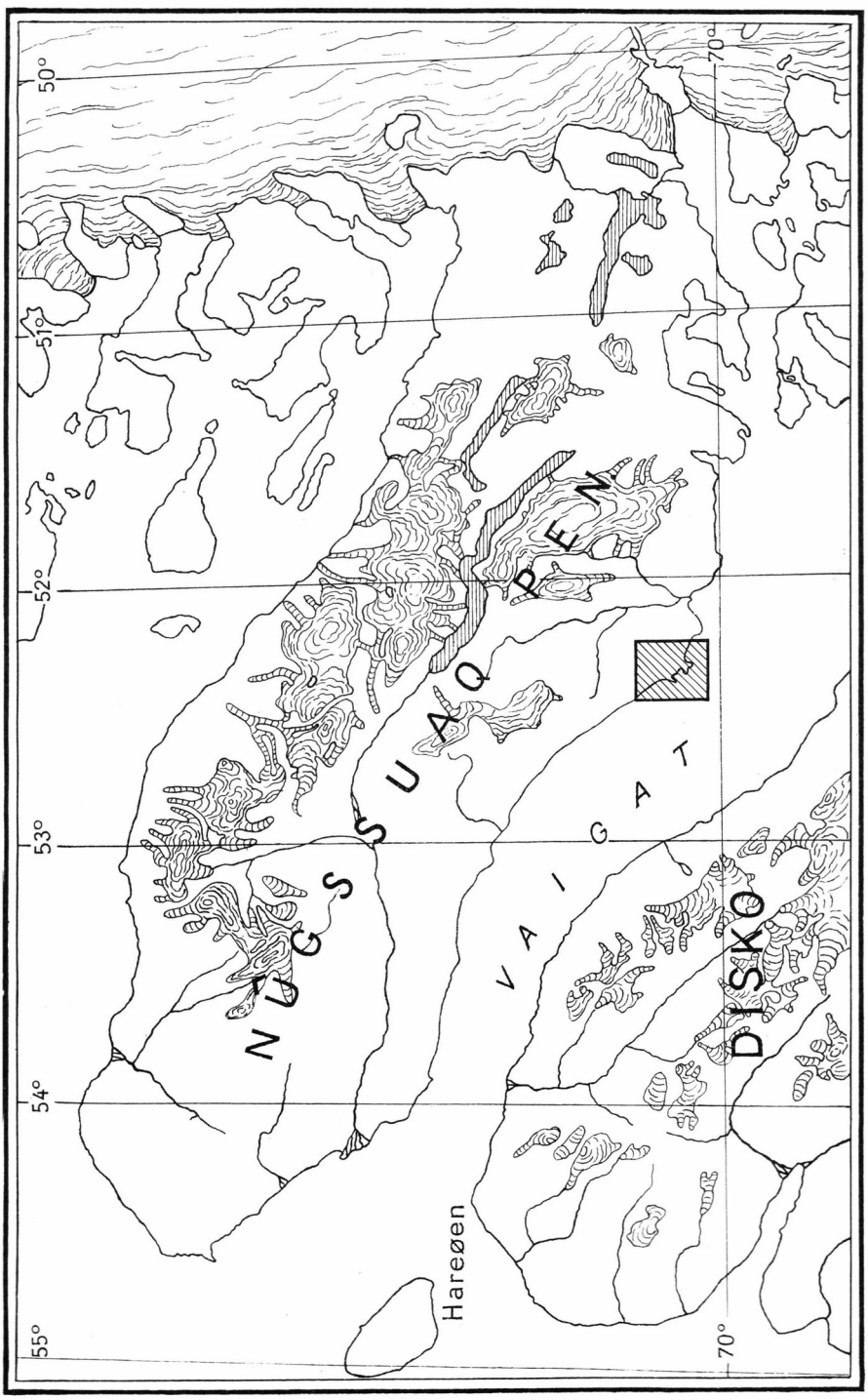

Fig. 1. Map of the Nûgssuaq peninsula showing the position of the geological map of this paper.

PREFACE

The unravelling of the geology of the Atanikerdluk area is one product of the geological investigations which since 1951 have been carried out along the south coast of the Nûgssuaq peninsula under the GEOLOGICAL SURVEY of GREENLAND.

The complex of investigations which under the leadership of professor A. ROSENKRANTZ were concentrated on the geological map NÛGSSUAQ, and which necessitated the unravelling of the geological conditions of the whole West Greenland sedimentary area in outline, led the senior author of this paper to the Tertiary occurrences of the territory round Atanikerdluk in 1951. Since, there has been worked in this field in the summers of 1952, 1954, and 1956 (B. ESKE KOCH 1955 and 1959). In 1956 the junior author commenced an investigation of the Cretaceous sequence along the south coast of the Nûgssuaq peninsula to obtain a micropaleontological-stratigraphical cronology.

The basic topographic map (70 V2, 1:10 000, Atanikerdluk) was made by the Geodetic Institute in 1951 for the Greenland Department under the Ministry of State in connection with the technical investigations as to the possibilities of utilizing the Cretaceous coal seams at Atanikerdluk. The appurtenant aerial photographs (at a height of 1500 m) have been used for the preparation of the geological map.

On account of a very extensive cover of lose soil and vegetation of a strongly varying character: from patch-wise occurrences through thin and faintly covering layers to greater thicknesses, and seeing that the necessary material of observation has not yet been collected the Quaternary, apart from the landslides, is not included. Two shades of the same colour have been used for each sign. The pure colours indicate occurrences observed, and a fainter shade indicates the extension below the Quaternary constructed on the basis of the observations made. Where the limit between the individual members is observed, it is drawn up with an unbroken line while the limits constructed are indicated by a hatched line. As, on account of erosion and Quaternary cover, the landslides do not all appear distinctly, and as the landslide areas on the whole are rather chaotic, it may not be expected that they will all be included on the map.

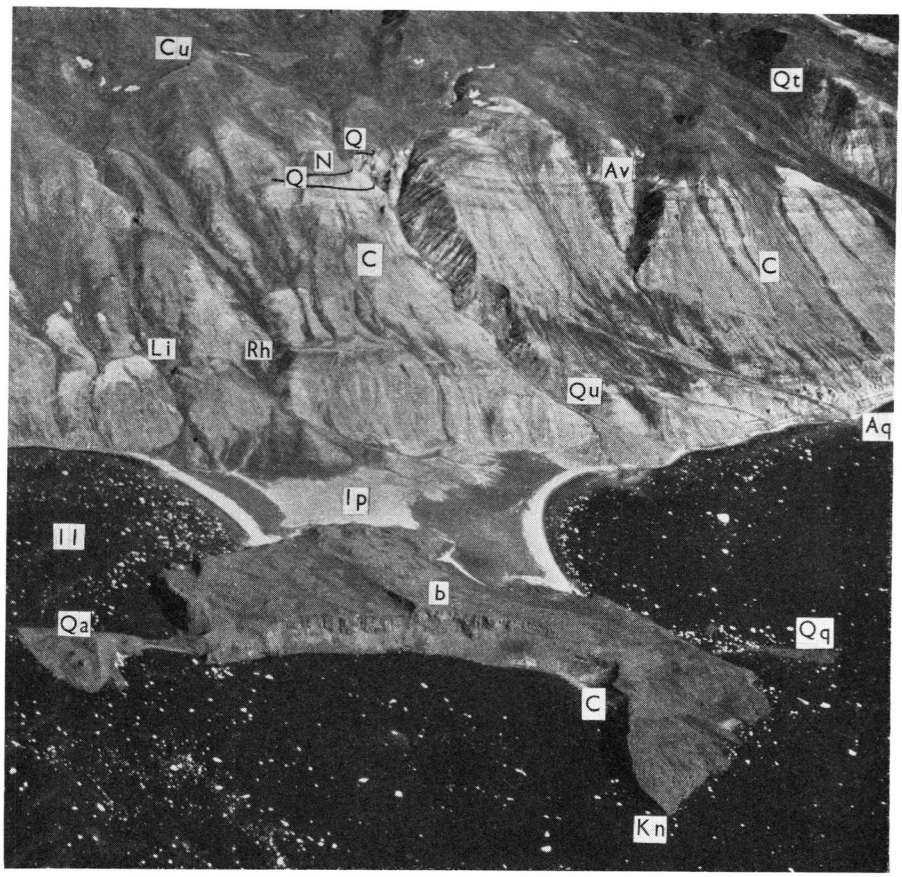

Fig. 2. Aerial view of Atanikerdluk and the coastal slope immediately to the north of the peninsula.

b: Basalt, C: Cretaceous Atane formation, Q: Tertiary Quikavsak member, N: Tertiary Naujât member, Cu: landslide coulisse.

Aq: Avqutdlugiaq, Av: Avqutdlugíssap-kûa, Il: Iluarâ, Ip: Ipiutaq, Kn: Kangerupnûa, Li: Liriodendronkløft, Qa: Qagssutit, Qq: Qeqertánguaq, Qt: Qernertuarssûpkûa, Qu: Quikavsaup-kûa, Rh: Rhododendronkløft. The black lines show the limits between Cretaceous, Quikavsak member and Naujât member.

The most outstanding ones have been marked according to a tolerant judgment.

Cartography: H. F. RØHLING
Translation: ESTHER JACOBSEN
Photography: CHR. HALKIER.

Older geological investigations of the area were made by K. L. GIESECKE (1811), H. RINK (1851), R. BROWN (1868), A. E. NORDEN-

SKIÖLD (1870), K. I. V. STEENSTRUP (1871) and (1872), A. G. NATHORST (1883), E. VANHÖFFEN (1893), D. WHITE & C. SCHUCHERT (1897), and A. C. SEWARD (1921). In recent time investigations have been made under the Danish Nûgssuaq expedition 1939 when S. MUNCK investigated the basalt intrusion at the Atanikerdluk peninsula (S. MUNCK 1945), and H. GRY, PH. D. made investigations of the sediments. Further historical information of the geological investigations at Atanikerdluk may be found in the senior author's paper from 1955 (B. ESKE KOCH 1955 pp. 8—16).

TOPOGRAPHY

The position 52°20′ W, 70°05′ N is near to the central point of the map which comprises an area of 6.5 ×8 km (ref. fig. 1).

The area is located at the coast of the southeastern part of the Nûgssuaq peninsula and belongs to the district of Jakobshavn in West Greenland (fig. 1). It is bounded on the southwest by the coastline (facing the Vaigat), and comprises part of the coastal slope of a mountain ridge which follows the coast from the Sarqaqdalen valley to Kingigtoq (ref. B. Eske Koch 1959 pl. 5). The crest of this ridge forms the northeastern limit. On the east as well as the west it is bounded by lines running north to south through the coast at Qernertuarssûp-kûa and at the lagoon at Qagdloq.

The map has derived its name from the peninsula of Atanikerdluk, one of the few projections on the otherwise even coast of the Vaigat strait. Atanikerdluk (fig. 2) consists of an outer basalt rock the longitudinal axis of which follows the trend of the coast, and a low combined alluvial and marine sand and gravel plain called Ipiutaq which connects the basalt rock with the hinterland.

This SE—NW striking basalt rock reaches in the middle at the coastal cliff the height of 99 m (Ivnaq), is in the coastal direction 1.3 km long, and at Ivnaq 0.4 km wide. Towards NW the 50 m high rock Qagssutit forms a projection from the main part of the peninsula, only connected with this by a narrow ridge which shelters the small creek, Terqíssap-atâ, located on the inside. On the south side of the peninsula a part of the basalt rock, abt. 50 m high, projects towards the west ending in the point Kangerup-nûa and giving Atanikerdluk the shape of a hook. On this part stand the remains of the former village Tupersuánguit. It is described by Rink in 1857 as being inhabited (Rink 1857). The ruins are also mentioned by Giesecke 1811, who describes the place as uninhabited (Giesecke †1910). A number of grave mounds in the peninsula above the village remains gives evidence that here was once a built-up area before the Danish colonization was commenced. To the east of Tupersuánguit are the islets of Arqatigssat and Qeqertánguaq which besides give shelter to the anchorage east of Atanikerdluk.

The plain named Ipiutaq has no doubt its origin in alluvial and marine silting up under protection of the original island of Atanikerdluk. Both on the southeastern and the northwestern side there is a large lagoon bounded by beach ridges with but few outlets. The part of Ipiutaq lying between the lagoons appears as a naked gravel plain. Towards SW, along the basalt mountain of Atanikerdluk, there is in the plain a zone with lengthy sand dunes, 1—2 m high, with direction SE—NW.

On the western side of Ipiutaq, sheltered by Atanikerdluk, there is an excellent anchorage. The basin here is called Iluarâ, and it is moreover sheltered on the northwest by the small peninsula Nûnguaq. This peninsula is located $1^1/_2$ km NW of Atanikerdluk from where it stretches off shore abt. $^1/_2$ km in a southerly direction. It consists of a low, almost circular basalt rock hardly 100 m in diameter, and is connected with the hinterland by an isthmus similar to that of Atanikerdluk.

To the SE and NW of Atanikerdluk-Nûnguaq the coastline has an even course.

Behind the coastline the country rises steeply with gradient 1:3—2:3 up to an altitude of abt. 400 m above Iluarâ, and to the east and west of this basin up to altitudes of 500—600 m. Above Iluarâ, between the brook of the Liriodendronkløften gully and the gash of Siorqat-kûat, there is a shelf-like incision in the mountain the bottom of which has a smaller gradient between altitudes of abt. 400 and abt. 600 m with undulating topography of basalt hills, and between them winding brooks through marshy hollows. The configuration is rounded off as after weathering and erosion of long duration and with a good cover of vegetation, showing that the features of this topography may be traced back into early postglacial time. Behind this plain the slope of the mountain again rises steeply to an altitude of more than 900 m up to the crest separating the coastal slope from the cirque of Puiagtugssuaq. A similar topography is observed to the east at an altitude of more than abt. 500 m below the mountains of Iviangernat.

Between Siorqat-kûat and the easternmost of the gashes at Qagdlúnguaq (B. Eske Koch 1958: Qagdlúnguaq SE) the gradient is steep (abt. 1:2) up to alt. abt. 600 m when it becomes less steep up to Keglen (Qagdlorssuaq). West of this mountain there is, above the altitudes of abt. 500 m to abt. 750 m, an area with a highly uneven topography with numerous big hills consisting of loose, rather fresh basalts, and without vegetation. Between the hills there are many funnel-shaped hollows; in this case a young terrain.

NW of Nûnguaq are clear-cut gashes with steep slopes stretching up to abt. 500 m above sea-level: Siorqat-kûat, Qagdlorssûp-kûa, two gashes at Qagdlúnguaq (B. Eske Koch 1959: Qagdlúnguaq SE and Qagdlúnguaq NW).

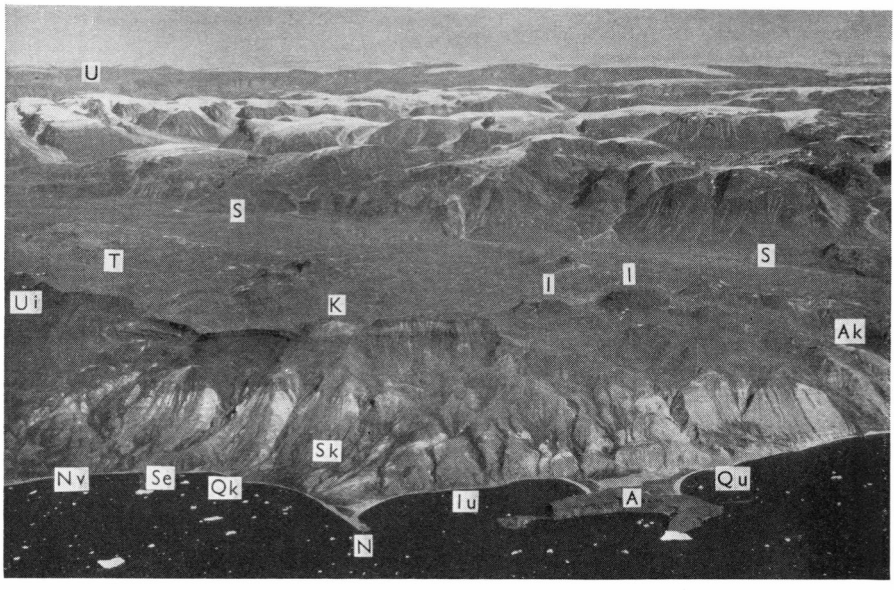

Fig. 3. Aerial view of Atanikerdluk and surroundings with localities referred to in the text. A: Atanikerdluk, Ak: Aussiviup-kûa, I-I: Iviangernat, Iu: Iluarâ, K: Keglen (Qagdlorssuaq), N: Nûnguaq, Nv: The ravine of Qagdlúnguaq NW, Qk: Qagdlorssûp kûa, Qu: Quikavsaup-kûa, S: Sarqaqdalen, Se: The ravine of Qagdlúnguaq SE, Sk: Siorqat–kûat, T: Tarajornitsoq, U: Umanak fjord, Ui: Umiussat.

Beyond Iluarâ and Ipiutaq there are only smaller gashes and gullies, but immediately east of Ipiutaq and Atanikerdluk lies the big gash Quikavsaup-kûa which is bifurcated at an altitude of abt. 300 m. Within the map area there is further to the east another big bifurcated gash Avqutdlugíssap-kûa which debouches at an altitude of abt. 200 m into a probably marine terrace abt. $^1/_2$ km across, covered with vegetation and with a lower gradient which is here facing the coast from an altitude of abt. 50 m, i.e. from the coastal cliff and upwards to abt. 150 m above sea-level.

The highest point of the map area is in the eastern part where two isolated mountains of 1033 and 992 m above sea-level are situated side by side and together bear the name Iviangernat. West of this and along the mountain ridge follows a number of peaks (the points 938, 976, 933 etc.) of which one in the western part is called Keglen (point 942) (Qagdlorssuaq), which in itself is the best description of the mountain: a cone with a circular basal area.

B. ESKE KOCH

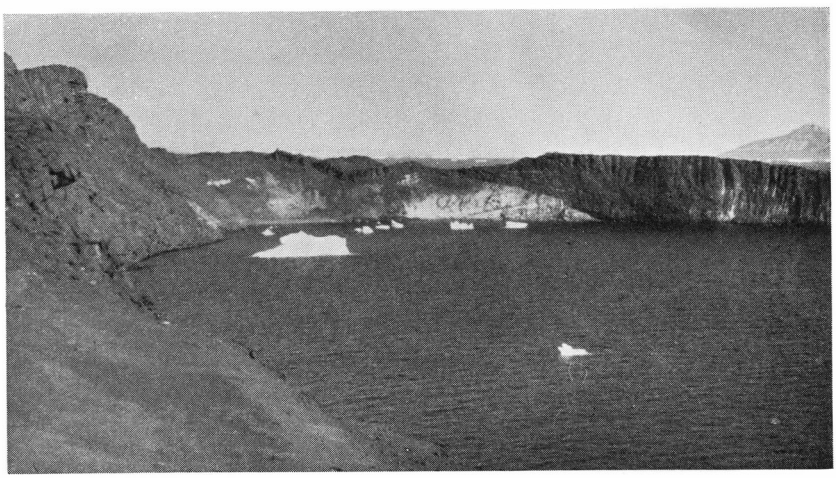

Fig. 4. The Cretaceous sediments N. of Kangerup-nûa, Atanikerdluk. K.R.P. fot.

GEOLOGY

Within the map area occurrences have been observed belonging to the periods Cretaceous, Tertiary, and Quaternary.

Cretaceous.

Atanikerdluk.

The Peninsula of Atanikerdluk (fig. 2) consists mainly of a Tertiary dolomitic sill (SOLE MUNCK 1945), but in the cliff to the south, facing the Vaigat, it shows minor outcrops of the underlying Atane formation (ref. TROELSEN 1956). The biggest is located in a section of the north-western side of the hook with Kangerup-nûa (fig. 4) (SOLE MUNCK 1945 fig. 10). Here, along the creek, there is a cliff of quartz sandstone with beds of shale one of which is abt. 10 m thick and located between 10 and 20 m above sea-level. This layer is rich in impressions of fern leaves and must be what Steenstrup designates „Bregnelaget" [the "fernbed"] (STEENSTRUP 1883). The sediments are here exposed from sea-level and up to an altitude of abt. 30 m at the head of the creek, but the occurrence wedges out strongly towards SW, and the overlying basalts reach sea-level already abt. 300 m NE of Kangerup-nûa. The occurrence is also traced in a northwesterly direction along the coast as far as or passing Ivnaq, but how far and of what thickness cannot be ascertained on account of talus of blocks of the overlying basalt. A similar section is located on the south side of Qagssutit facing the Vaigat. Sandstone is

exposed on a stretch of 100—150 m in the cliff along the coast where it forms some small points and reach an altitude of abt. 25 m before it is overlayn by the basalts (ref. SOLE MUNCK 1945 fig. 9). The sandstone continues into the bottom of the sea in the creek.

Along the northeastern side of Qagssutit sandstones are observed in the bottom of Terqíssap-atâ, rising above sea-level as small outcrops in the beach. These softer rocks are also revealed by a ravine leading down to the shore where otherwise only the steep cliff of basalts is seen.

On the northern side of the peninsula, above the western lagoon, a few hummocks of sandstone occur representing the hanging of the intrusive.

The hinterland (fig. 2,3).

The area behind Atanikerdluk comprised by this map is the slope of the coastwise mountain ridge (fig. 3). It shows the sequence of the Atane formation (Cretaceous) consisting of alternating sandstones and shales from sea-level. The lower limit of the formation cannot be observed. The upper limit is visible in the northwestern part of the area from Siorqat-kûat to Qagdlúnguaq where it is overlain by Naujât member of the Tertiary Upper Atanikerdluk formation at an altitude of 500 ± 10 m (ref. the measurings for the lower limit of Naujât member page 20).

On the stretch between the Liriodendronkløften gully and the Quikavsaup-kûa gash it is overlain by Quikavsak member of the Upper Atanikerdluk formation, a fluviatile member (fig. 8 ref. pag. 18). It fills in a fossil river-valley, which is here more than 100 m deep and is carved into the Atane formation in a period with negative epeirogeny preceding the Paleocene transgression, and this again is a consequence of the same positive epeirogeny as the deposits of Quikavsak member. For this reason the upper limit of the Atane formation is somewhat lower as, from abt. 480 m above sea-level in the Liriodendronkløften gully, it reaches its minimum SE of point 445 at altitudes of 345—350 m. In the eastern slope of Quikavsaup-kûa above the big water-fall it again rises to 389 m above sea-level, and already abt. 600 m east of this place outcrops which are assumed to be part of the Atane formation are exposed up to an altitude of 495 m without the Tertiary being visible.

Between Siorqat-kûat and the Liriodendronkløften gully and east of Quikavsaup-kûa, within the area of this map, the upper limit of the Atane formation is not visible. The limit shown on the map is estimated on the basis of scattered observations of the limit (NW and SE of the map these observations may be consulted in B. ESKE KOCH 1959) and the known average dip of abt. 7 m per km horizontal distance in a SE direction along the coast. This is an approximate figure justified by the experience of the even course of the limit outside the zone of influence of Quikavsak member revealed by the scattered observations from Kingigtoq to Sarqaqdalen.

Fig. 5. Section of the western slope of Quikavsaup-kûa with the Cretaceous Atane formation. Obs. the small fault. K.R.P. fot.

The limit may therefore be encumbered by mistakes appearing as the difference in height between the ideal plain represented by the average and the plain represented by the real surface of the Atane formation.

As the lenticular structure dominates the deposit, it is difficult to present an exact measuring for the dip of the Cretaceous sequence but is assumed to be 10—15° NE with strike abt. N 140° (B. Eske Koch 1955).

Along the coast clean sections are exposed in the cliff east of Atanikerdluk from Quikavsaup-kûa to Qernertuarssuk. The strata are here, according to the known eastern component of the dip, a recurrence of the sequence in the lower part of Quikavsaup-kûa.

The biggest section through the sequence east of Atanikerdluk is found in the gash Quikavsaup-kûa which crosses the sequence from 20—25 m above sea-level up to an altitude of abt. 400 m (fig. 5, 6). A

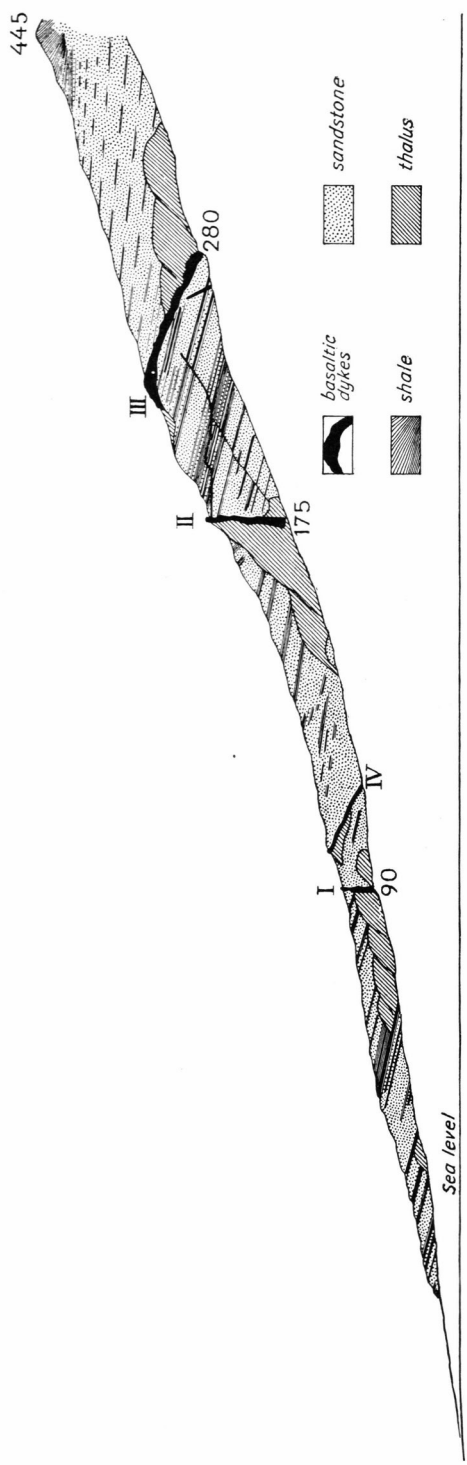

Fig. 6. The section of Quikavsaup-kûa drawn from Steenstrup's original sketch. 445: The hill with point 445 west of Quikavsaup-kûa.

description of this sequence was published by BROWN 1875 who records a detailed measuring. This gives a clear insight into the types of the sediments. STEENSTRUP 1883 renders a raw sketch of the section. A similar section, possibly the original of the above-mentioned, which was found among the effects he left behind, is shown in fig. 6. It is an extremely exact picture of the structure of the western slope of the gash though it suffers from lack of information of the dimensions (fig. 6);[1]) some heights, however, have been added to the present fig. 6.

Quikavsaup-kûa exposes a continuous alternation of sandstones and shales in varying, but most often considerable thicknesses (10—20 m). The shale is often silty with mica, but also cleaner, bituminous shale occurs in minor thicknesses. Some thin coal seams occur in connection with the shales as demonstrated in the following table:

Coal seams in Quikavsaup-kûa.

In the eastern slope; the big ravine along dyke III:

Alt. 372 m	10 cm coal. The same layer as at alt. 314 m in the section along dyke II and alt. 270 m below the waterfall.

Below the hill with point 445; the funnel-shaped ravine:

Alt. abt. 360 m	Abt. 30 cm coal.

The ravine above the waterfall:

Alt. abt. 340 m	Alternating coal and shale; the same stratum as mentioned above at alt. 360 m.

In the western slope:

Alt. 314 m	Abt. 25 cm coal (assumed to be the same seam as the one mentioned in B. ESKE KOCH 1955 pag. 10 to be found in the gash below the waterfall at an altitude of abt. 270 m).
— 276 m	10—20 cm coal (above small sill).
— 142 m	Coal in shale abt. 1 m in total.

The succession of the deposits is illustrated in fig. 4 showing part of the western slope of the gash above dyke II.

The succession is without any considerable anomalies, but minor flexures and a single minor fault are seen to cross the gash. The fault appears from STEENSTRUP's sketch (fig. 6) and can also be recognized on fig. 5. Its age appears from the fact that the basalt has been intruded into

[1]) Above dyke III it is incorrect, e. g. fails to show the unconformity between the Atane formation and the Tertiary Quikavsaq member.

the fault from a sill (ref. fig. 6) and has been guided upwards by the fault. It is therefore older than, or simultaneous with the basalt volcanism. Thus, it is not a young fault related to creep phenomena and sliding of the coastal slope, but must rather be looked upon as one of several minor faults observed along and parallel to the coast as part of a fault zone connected with the formation of the Vaigat strait. However, the tectonic origin of this has not been proved so far. The sequence is crossed by several big dykes mentioned in the following.

On the stretch between Siorqat-kûat and Quikavsaup-kûa minor outcrops of the Atane formation are found in the Liriodendronkløften gully and other minor gullies and ravines (fig. 2, 3). In the outlet of the Liriodendronkløften gully there is a shale bed abt. 60 m above sea-level, which by HEER was designated „Liriodendronlaget" (the Liriodendron bed) (HEER 1883), discovered by A. E. Nordenskiöld as fossiliferous with, among others, *Liriodendron Meekii* Hr.[1]) Some of the sandstone beds are strongly consolidated and appear in the coastal slopes as weathered hills or scarps, for example immediately W and SW of the hill with point 445 below the Tertiary strata. In other places it is the durable basalt dykes and sills which have resisted the erosion and protect part of the Cretaceous sediments which therefore stand out as exposures.

Between Siorqat kûat and Qagdloq there are 4 big gashes (fig. 3), which appear as big cuts through the Atane formation from abt. 100 m above sea-level and to its upper limit to the Tertiary shale designated Naujât member. The sequence is here as in Quikavsaup-kûa an alternation of sandstones and shales and is best demonstrated in fig. 7 by the east side of the eastern one of the gashes at Qagdlúnguaq. Coal seams are here found as follows:

Coal seams in Qagdlúnguaq.

Alt. 468—470 m	Tertiary shale.
— 441 m	30 cm coal.
— 415 m	Thin coal seam of magnitude 20 cm.
— 312—313 m	30 cm coal. 40 cm shale. 40 cm coal
— 308 m	30 cm coal.
— 264 m	30 cm coal in shale beds only separated from the preceding shale bed by a thin sandstone bed.
— 260 m	20 cm coal in shale beds of 3—4 m.

Of these coal seams the one exposed in Qagdlorssûp-kûa abt. 320 m

[1]) rev. by Seward (1924): *Dalbergites simplex* (Newb).

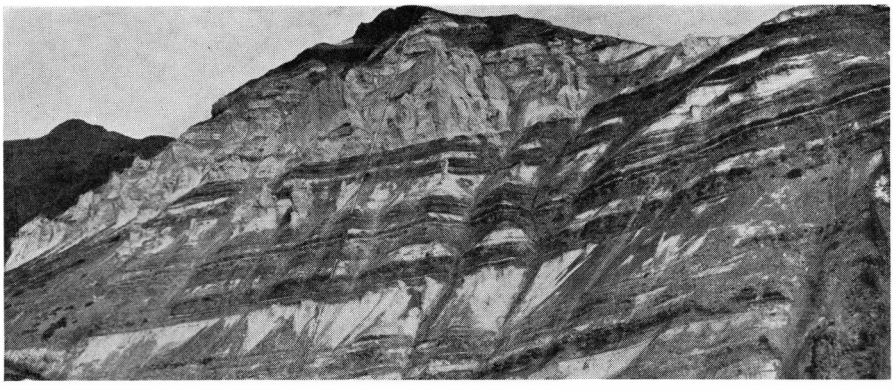

Fig. 7. The eastern slope of Qagdlúnguaq NW showing the Cretaceous Atane formation in a section of abt. 300 m. K.R.P. fot.

above sea–level previously attracted attention, first in 1920 under professor BRETTING's investigations of which remains of the experimental "stolls" can still be seen. In 1951 experimental mining was commenced for the Greenland Department. Several "stolls" were in activity and are marked on the map. Above this seam Dr. J. R. DINSDALE in the service of the Greenland Department reports two other workable seams in Qagdlorssûp–kûa at heights of abt. 350 m (48 cm) and abt. 370 m (58 cm).

Fossils: In his description of the fossils of the Atane formation (HEER 1882, 1883b) Heer also treats the species and their distribution in the localities: Bregnelaget (the "Fern bed") in the Peninsula of Atanikerdluk (see page 11), Liriodendronlaget (the "Liriodendron bed") (see page 16), the cliff east of the gash (HEER writes S of the gash. By "the gash" is meant Quikavsaup-kûa) and Qagdloq (HEER: Kardlok) (HEER 1882, 1883b). Few of these species have later been revised. Some of them are treated by SEWARD 1925, SEWARD 1926, and SEWARD & CONWAY 1935 in a description of the plant fossils from Atanikerdluk, Qagdlúnguaq, and Kingigtoq.

According to Heer the fossil flora is typical of Upper Cretaceous and probably Cenomanian. This determination is essentially based on the knowledge of European fossil floras which is also the case with the wrong age-determination of the Tertiary strata, so one should hardly use them uncritically. Heer's material originates from the lower parts of the sequence at Atanikerdluk only, but NATHORST (ref. NORDENSKIÖLD 1885) found the flora at several levels in the formation and as far as the top of Quikavsaup-kûa, which means that HEER's age determination must comprise the whole Cretaceous sequence at Atanikerdluk, with the above reservation.

B. ESKE KOCH and K. RAUNSGAARD-PEDERSEN

Tertiary.

The Tertiary sequence of the area rests unconformably upon the Atane formation (B. ESKE KOCH 1955, 1959) (fig. 8), and according to (HEER 1882) the whole sedimentary Tertiary sequence, adapted to the existing international nomenclature, is designated: *Upper Atanikerdluk Formation* (TROELSEN 1956). It is by the senior author divided into 5 members (B. ESKE KOCH 1959) as mentioned below, the youngest member at the head of the list:

Points 976 member
Aussivik member
Umiussat member
Naujât member
Quikavsak member

A brief description of these members beginning with the oldest, is given in the following.

Quikavsak member (B. ESKE KOCH 1959).

This member is not continuous within its area of distribution on the south coast of the Nûgssuaq peninsula, but appears as isolated occurrences owing to its deposition as an infilling of a "fossil" river-bed with a winding course (B. ESKE KOCH 1959) which in places crosses the south coast of the Nûgssuaq peninsula. One of these sections is part of the map area and reaches from Quikavsaup-kûa, where the most distinct outcrops occur round the hill with point 445 (fig. 8), to the Liriodendronkløft gully in the west (B. ESKE KOCH 1955 fig. 12).

The course of the Tertiary/Cretaceous limit is described in B. ESKE KOCH 1955 and treated in detail in B. ESKE KOCH 1959 with reference to the present geological map. From its easternmost occurrence in the east slope of Quikavsaup-kûa where the lower limit lies at an altitude of 395 m, it declines westwards attaining an altitude of 365 m in the west slope of Quikavsaup-kûa. The minimum is reached between altitudes of 345 and 350 m in a small gully southwest of point 445. From this place there is a constant increase westwards to an altitude of abt. 390 m in the most westerly occurrence observed in the west slope of the Liriodendronkløft. This section, the direction of which is rather east-west, thus traverses a depression in the surface of the Cretaceous. In the section, very nearly north-south, seen in the west slope of Quikavsaup-kûa, the limit keeps a constant altitude of 365—370 m. A groove in the surface of the Cretaceous traversing the coastal slope here is no doubt manifested (for further information ref. B. ESKE KOCH 1959 pp. 16—25).

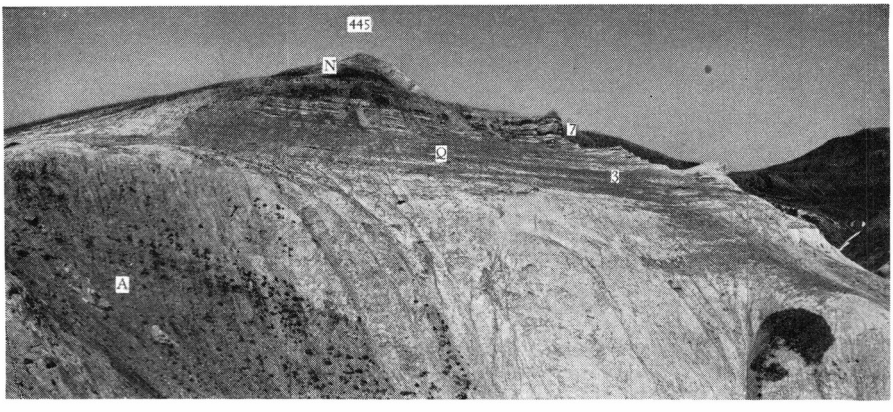

Fig. 8. The south slope of the hill with point 445 immediately west of Quikavsaup-kûa. A: The Cretaceous Atane formation, Q: Quikavsak member, (beds nos. 3 and 7 marked), N: Naujât member. B.E.K. fot.

That it is a subaeric erosion-carved surface, a former land surface, appears from the observation of the "fossil" weathering of the surface along the limit Tertiary/Cretaceous in the east slope of Quikavsaup-kûa (B. Eske Koch 1955 and 1959) with traces of podsolation.

The sediment consists of loosely consolidated sandstones and subordinate conglomerates of small pebbles alternating with thin silt to clay beds cemented by siderite to clay ironstone. Upon the Cretaceous beds follows abt. 1 m of sands and clays without distinct bedding. This is succeeded by abt. 25 m of coarse cross-laminated beds of sandstones abt. 1 m thick constantly alternating with max. 25 cm of sideritic shale-clay ironstone containing plant fossils (Heer: Upper Atanikerdluk A-flora, ref. Heer 1882, 1883b); the bedding here is distinct and of rhythmical character. Next follows a 2 m thick percurrent bed in which the lenticular structure is dominating: ochreous, cross-laminated lenticular sandstones entwined with lamina of shale. This sandstone bearing witness of considerable iron precipitation may be a brackish deposit (see B. Eske Koch 1959 page 60,83).

The upper limit of this sequence was ascertained to be at an altitude of abt. 400 m wherever it was observed in the area round point 445. As a whole it must be regarded a fluviatile member: coarse, cross-laminated sands and gravels with many plants and scattered insect fossils and with no traces of marine fossils. A detailed description of the profile as well as historical information is found in (B. Eske Koch 1955 and 1959).

This occurrence round point 445 at Quikavsaup-kûa is the type of *Quikavsak member*. The occurrence is by the senior author shown to be of the same age as the marine Tertiary in the Agatdalen (Angmartusut) in the interior of the Nûgssuaq peninsula which on the basis of the fossil fauna

is referred to Lower Paleocene (ROSENKRANTZ 1952). Quikavsak member can be followed along the south coast of the Nûgssuaq peninsula from this fluviatile occurrence to occurrences with ingression of marine mollusc types which are common in the Lower Paleocene of the Agatdalen valley (B. ESKE KOCH 1959). Further, alle these occurrences contain the same fossil flora "association" and occupy the same stratigraphical position in the Tertiary succession of the Nûgssuaq peninsula.

A small occurrence of coarse sandstone weathered into brown colours is found uppermost in the east slope of Qagdlorssûp-kûa. It is unconformably deposited upon the Atane formation and is overlain by the succeeding Naujât member. The thickness is abt. 2 m, and no fossils were found. Due to its position in the succession and its facies, the occurrence is referred to Quikavsak member (ref. B. ESKE KOCH 1959).

Naujât member (B. ESKE KOCH 1959).

This member is found partly in situ in the northwestern part of the map area (fig. 9) and partly in dislocated occurrences. The occurrences in situ, from Siorqat-kûat to Qagdlúnguaq, are situated upon the Atane formation. The shale is unconformably deposited on the Cretaceous formation at altitudes as follows (ref. B. ESKE KOCH 1959 pp. 31—34):

In the west slope of Siorqat-kûat	490 m
Between Siorqat-kûat and Qagdlorssûp-kûa	504 -
In the east slope and at the head of Qagdlorssûp-kûa	514 -
The west slope of Qagdlorssûp-kûa	490—500 -
The eastern gash at Qagdlúnguaq (Q. SE)	490 -

Only minor thicknesses are seen as stationary:

At Siorqat–kûat below the hill with points 587/592	60 -
At the head of Qagdlorssûp-kûa	80 -
In the eastern gash at Qagdlúnguaq (Q. SE) abt.	20 -

The other exposures are smaller. Everywhere the shale is upwards concealed by Quaternary deposits. It cannot be the total thickness that is exposed in the map areas as Naujât member has a total thickness of more than 200 m both to the east and to the west of this map and the stationary occurrences within the map area are overlain by landslides and other forms of Quaternary deposits which is most distinctly exposed in the eastern gash at Qagdlúnguaq (Qagdlúnguaq SE) (B. ESKE KOCH 1959 fig. 7).

Naujât member consists of black, bituminous shale. The basal layers contain thin lamina of a few cm consisting of a brown claystone which, apart from a considerable content of iron compounds, is characterized by

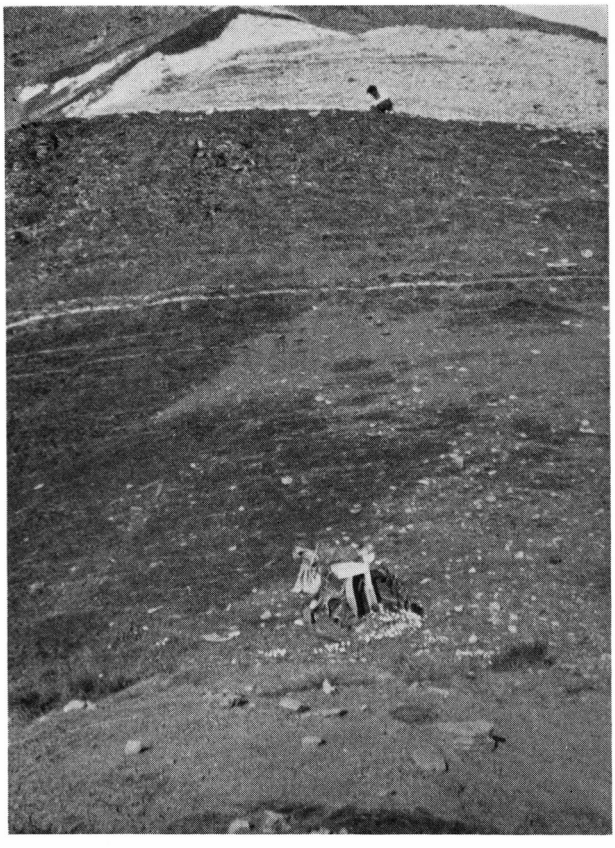

Fig. 9. Section of shale of the Naujât member immediately east of Qagdlúnguaq NW. K.R.P. fot.

a content of palagonite grains, consequently a tuff (B. Eske Koch 1959 pag. 25—26).

In the area between Siorqat-kûat and Quikavsaup-kûa there are several dislocated occurrences. Thus, on the area with an undulating topography which like a shelf lies in the mountains between Siorqat-kûat and the Liriodendronkløften gully, several of the hills nearest to the Vaigat appear to consist of black bituminous shale. This, for instance, is the case with the hill with point 493. The shale is here most often crushed, and thin clay ironstones may often be found with the character of being continuous, though broken. A similar occurrence is seen in the Liriodendronkløften gully abt. 400 m above sea-level immediately above the big dyke (II) which crosses the gully.

Of these occurrences the one in the hill with point 445 at the western margin of Quikavsaup-kûa is, however, the easiest accessible for observations in the section of the west slope of Quikavsaup-kûa. The shale is

strongly jointed and dislocated, though the original bedding is visible and shows a strong northerly dip (up to abt. 60°). Further, some small faults may be observed.

In the occurrence of Naujât member in the hill with point 445 (fig. 8), on the coastwise side, plant fossils were found (HEER 1883: "Upper Atanikerdluk B" flora) at an altitude of abt. 410 m in the brown tuff which is well-known from the basal layers of Naujât member on the south coast of the Nûgssuaq peninsula.

Uppermost in the hill with point 445 the shale is, by a faultlimit with tectonic breccia, separated from an abt. 10 m thick occurrence consisting mainly of sandstones with subordinate shales. In the southernmost part of the section in the west slope of Quikavsaup-kûa this deposit shows a considerable dip (abt. 60°); the dip decreases evenly the more northerly one advances in the section of the gash, so that each bed describes an even bow from a steep northerly dip southernmost in the occurrence to an almost horizontal position northernmost (B. ESKE KOCH 1955 fig. 4). Whether this arenaceous deposit represents the transition strata between Naujât member and Umiussat member which can be observed at Aussiviup-kûa by Tartunaq (east of the map area described in this paper) (ref. B. ESKE KOCH 1959 pl. 5), or whether it is part of Umiussat member itself cannot be determined definitely, but it is probable that it is one or the other of these possibilities.

In the northwestern part of the map area the lower limit of Naujât member can be observed. The limit for the remaining part, of which no observations were obtainable, is constructed theoretically by the heights of the limit observed at Siorqat-kûat, the section by the Sarqaqdalen valley (west of the map area), and the faint easterly coastwise component of the dip known for the south coast of the Nûgssuaq peninsula between the Sarqaqdalen valley and Ipeqarfiúnge (west of the map area), with an easterly coastwise component of a decline of 7—8 m per 1000 m horizontal distance as basis.

The limit between Umiussat member and Naujât member was observed at Umiussat (west of the map area) and Naujât (Sarqaqdalen) (B. ESKE KOCH 1959), and it shows in average the same component of the dip in an easterly direction. On this basis the assumed limit for the map area described in this paper was constructed.

According to (B. ESKE KOCH 1959) the lowermost 10 m of Naujât member is referred to Lower Paleocene, the limit being but tentatively defined. Whether more of the overlying shale of Naujât member belongs to Lower Paleocene cannot yet be determined. Regionally the initial deposition of Naujât member can be correlated with the beginning of the "continuously eruptive" period of the basalt volcanism the first part of which is petrographically characterized as basalt breccia (SOLE MUNCK in ROSENKRANTZ et. al. 1940).

Umiussat member (B. Eske Koch 1959).

This member is not visible in its entire thickness within the map area, and its lower limit can only be assumed as mentioned in the preceding chapter of Naujât member. Exposures of Umiussat member are found in the steep slope which, between altitudes of 650 and abt. 950 m, towers above Nûnguaq and forms the northwesterly limit of the landslide area which appears like a shelf in the mountains between Siorqat-kûat and the Liriodendronkløften gully (fig. 10). Minor exposures of the member are visible in the lower part of the slope which for the greater part is covered with basalt talus. The sequence consists mainly of quartz sandstones with subordinate siltstones and shales. Exposures are seen from alt. 748 m to the upper limit of the member, bordering the Aussivik member 773 m above sea-level (B. Eske Koch 1959 p. 34).

West of the torrent of the Liriodendronkløften gully, in the wide landslide area, several landslides are found with yellow sand below basalts, and at Siorqat–kûat even one where the sand lies on black shale. They are probably dislocated occurrences of Umiussat member seeing that the basalt of the landslides in all essentials originates from the basalt level of Aussivik member as mentioned below.

Further descriptions are found in (B. Eske Koch 1955 (Upper Fluviatile Series) and 1959 (Umiussat member)).

Aussivik member (B. Eske Koch 1959).

Aussivik member is found in the same steep slope as the above-mentioned exposures of Umiussat member which it overlies in the eastern part of the slope at an altitude of 773 m (fig. 10). The member consists of black, bituminous shale containing a huge zone of basalts. The basal layer consists of shales, though this part is only of inconsiderable thickness (773—780 m above sea-level in the eastern part of the steep slope). It is overlain by basalt in three beds the uppermost of which appears to be separated from the underlying one at maximum 10 m black, bituminous shale. This basalt horizon is of considerable thickness. In the eastern part of the scarp its lower limit lies at an altitude of 780 m, and the upper limit of the third bed on the same place at an altitude of abt. 850 m, consequently a total thickness of 70 m. The thickness of the basalt complex varies somewhat, thus it is only abt. 55 m in the western part of the scarp (ref. B. Eske Koch 1959). These basalts are by the author considered to be the oldest lava flows of the area. They are overlain by black, bituminous shale which can be followed as far as the interval at alt. 905—925 m. Less than one metre above the basalt a bed of brown tuff clay, several centimetres thick, is found here similar to the one known from Naujât

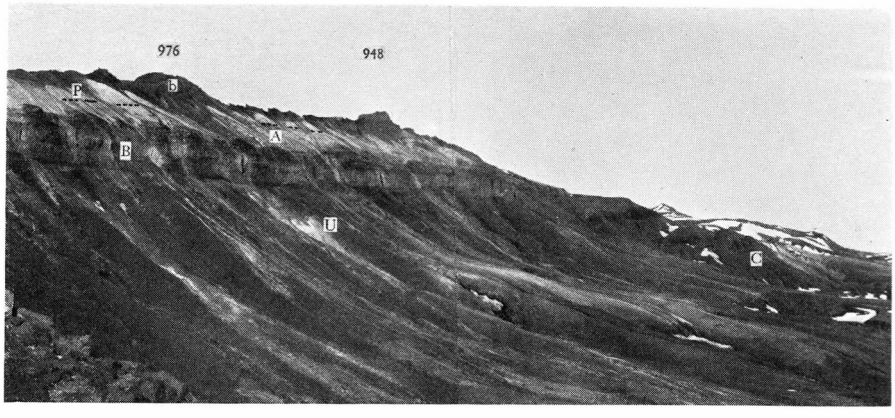

Fig. 10. The scarp with Tertiary outcrops above Iluarâ. U: Umiussat member, B: Basalt level of Aussivik member, A: Upper shale of Aussivik member, P: Point 976 member, b: Plateau basalts, C: Landslide consisting of (B). B.E.K. fot.

member. It has not yielded fossils within the map area. The top layers of this upper shale of Aussivik member consist of light, greyish brown shale.

The basalt level of Aussivik member can be followed westwards leaving the map at Qagdlorssûp-kûa and, though somewhat veiled by talus, distinguished eastwards as far as the pass between the two mountains called Iviangernat (points 992 and 1033) (fig. 3). The lower shale is only seen well-exposed in the eastern part of the scarp below point 948 and is visible in some places west of Keglen (Qagdlorssuaq). The upper shale of Aussivik member can be followed from ridge to ridge all through the scarp against Nûnguaq forming the basal part of the cone-shaped mountain Keglen (Qagdlorssuaq), up to an altitude of abt. 900 m. Further, on the aerial views of the Geodetic Institute from alt. 1500 m, on which the topographical mapping is based, a few minor exposures can be observed above the basalt level in the pass between the two mountains of Iviangernat. Even if the locality has not been visited, it is most probable exposures of this shale.

Point 976 member (B. ESKE KOCH 1959).

This member is a sequence consisting of coarser and finer sands which often show cross-laminations. It succeeds the shale of Aussivik member in the steep slope above Nûnguaq already mentioned (fig. 10). Here it appears at varying altitudes from 915 to 935—940 m determined by the lower limit of the Plateau Basalts with incline towards southwest. The upper part of Keglen (Qagdlorssuaq) consists of the sediments of Point 976 member, apart from a heap of basalt boulders on the top reminding of the former presence of the Plateau Basalts. In the scarp above the large

shelf-like landslide area above Nūnguaq it is visible from spur to spur all through the section. It may also be found in the pass between the two mountains of Iviangernat.

The Plateau Basalts.

The two large mountains of Iviangernat (points 970 and 1033) in the eastern part of the map consist of Plateau Basalts, which may be observed from an altitude of abt. 950 m; as the whole base of these mountains is covered with talus of basalts the lower limit is inaccessible.

Along the crest of the mountain ridge separating the coastal slope from the cirque-valley Puiagtugssuaq, and in whose steep, coastwise slope the above-mentioned sedimentary exposures are seen, there are a few minor basalt remnants, e.g. points 940, 940/948, 976, and 945. Behind this ridge there are other basalt mountains, e.g. points 938 and the bigger basalt mountain that forms the east side of the pass with the small lake at alt. 843 m. Finally, the summit west of Keglen, point 925, consists of basalt. This is located at a somewhat lower level than that of the Plateau Basalts ordinarily observed in the map area. Father to the northwest, outside the map, there are moreover indications that this place is not far from the northwestern limit of the "intrabasaltic" sedimentary occurrence, and that towards west at Umiussat it is replaced by basalt flows.

In the author's opinion the basalt level of the Aussivik member belongs to the Plateau Basalts genetically, and so the upper shale of Aussivik member and Point 976 member are intrabasaltic, not only stratigraphically but also genetically. But as the senior author has only been able to make probable, not to prove finally, that the basalt level of the Aussivik member consists of beds of surface lava, he has decided to describe them as belonging to Aussivik member to which it is stratigraphically bound.

Intrusions (Basalts.)

The peninsula of Atanikerdluk consists of an enormous sill and the country behind the peninsula is rich in sills and dykes of which several can be traced over considerable stretches.

Sills.

The biggest intrusion exposed within the map area is that of the peninsula of Atanikerdluk (fig. 2), which is part of a system that can be followed as far as the Sarqaqdalen valley and from the outlet of this valley far into the country (full description in Sole Munck 1945). The sediments underlying this sill appear on the outer coasts of the peninsula representing the sandstones and shales of the Atane formation, while the overlying part of this formation only appears as inconsiderable remnants

exposed on the northwestern slopes of the peninsula. About these sediments ref. page 11-12, and about the basalts ref. SOLE MUNCK 1945.

In the western slope of the Rhododendronkløften there is a sill abt. 5 m thick with its lower limit abt. 120 m above sea-level. It can be traced towards Quikavsaup-kûa where it assumably continues as basalt intrusion IV. In Quikavsaup-kûa it crosses dyke I and can be observed in both slopes. Basalt intrusion IV has the distinct characteristics of a sill. It crosses dyke I in the eastern slope abt. 120 m above sea-level and is only a few metres thick.

At the head of Qagdlúnguaq SE a sill, of a thickness of 3 m, was observed (basalt intrusion VIII) in the eastern slope. It is visible above the exposures of Naujât member abt. 515 m above sea-level.

Dykes.

Quikavsaup-kûa is crossed by several big, almost vertical dykes (fig. 6). Dyke I crosses the brook-bed at an altitude of abt. 90 m (thickness 1—3 m), and its strike is 142°; it is, as mentioned above, crossed by sill IV (B. ESKE KOCH 1955). About 175 m above sea-level the brook-bed is crossed by a dyke abt. 5 m thick eroded into the shape of a giant-staircase against both gash slopes (II). It can be observed towards SE as a low wall through the terrain till it reaches the coastal cliff 700 m east of the delta of Quikavsaup kûa (fig. 2, 3). Towards northwest it appears as erosional remnants, e.g. point 384, as far as the Liriodendronkløften gully which it crosses like a dam abt. 390 m above sea-level (dyke II). Its strike is N 160°.

In the western slope of Quikavsaup-kûa above dyke II there is a big dyke forming a vertical wall through which the gash has been cut. The dyke has retarded erosion in the gash in such a way that the brook-bed shows a difference in altitude of more than 10 m between one side of the dyke and the other over which wall the torrent forms a fall down to 280 m. This dyke is visible over a distance down the coastal slope as erosional remnants and traces in the topography as far as immediately east of the outlet of the Rhododendronkløften with strike abt. N 77°. The thickness where Quikavsaup-kûa crosses the dyke is abt. 10 m. On the map it is designated as dyke III (fig. 6; III).

As the crest of the spur forming the southeastern limit of Avqutdlugíssap-kûa, a vertical dyke stands as a wall against the mountain slope (fig. 2). It is indicated on the map as dyke V, and as dyke II and III it appears directly from the contours on the map.

In the eastern slope of Siorqat-kûat a remnant is seen of an almost vertical dyke of a thickness of 1 m with strike N 24°, at an altitude of abt. 400—450 m, and in the western slope of the same gash immediately

at the entrance of an experimental stoll there is a small dyke (VII) with strike N 128° and dip 72° SW.

Between the two gashes at Qagdlúnguaq a considerable piece of a dyke (alt. 300—400 m) is exposed with strike N 128^0 (dyke IX).

All these big, steep dykes, many of which are vertical, are characteristic of the geology of this area as no similar dyke swarm has been found on the southcoast of the Nûgssuaq peninsula.

B. Eske Koch

Landslides.

(B. Eske Koch 1955 fig. 14), fig. 3.

It is a matter of taste whether this problem should be treated under the title Quaternary or under those members of the Tertiary to which the landslide "coulisses" belong.

The landslides consist of the various parts of the upper sequence of the area, especially basalts which for the greater part can be referred to the basalt level of Aussivik member (ref. this member), as dislocated blocks of this strongly columnar basalt can be traced stepwise down the slope; further, the shales of Naujât member, and sandstones underneath basalt or on top of shale, most likely belonging to Umiussat member.

The landslide "coulisses" occur over an interval of the coastwise mountain slope the ultimate upper limit of which is the basalt horizon of Aussivik member. Downwards there is no distinct lower level, but approximately the occurrence shows a noteworthy trend. Thus, in the southeastern part of the map area east of Quikavsaup-kûa, the lower limit is at an altitude of abt. 500 m; between Quikavsaup-kûa and Siorqat-kûat, the stretch facing the big shelf-like incision above Nûnguaq the topography of which is conditioned by landslides, such can be traced downwards to an altitude of abt. 240 m; some of the landslides lie, however, as low as at the foot of the mountain slope near the shore as, for instance, at Siorqat-kûat, and west of Siorqat-kûat above the big gashes at alt. abt. 500 m, and even higher.

The phenomenon of landslide "coulisses" is described in B. Eske Koch 1955. All the landslides which consist of sufficiently undisturbed rock mass show considerable dip towards the mountain slope away from the coast, the characteristic feature of landslides. In some places where shale of Naujât member is part of landslides there is sign of burning. As the phenomenon of ignition in landslides with bituminous shales is well-known from recent landslide action e.g. Pujortoq at Niaqornat, the explanation of the red shales is given (see further B. Eske Koch 1955 page 31—32). The greater part of the landslide "coulisses" are not yet overgrown with vegetation, and may be considered a relatively young phenomenon which from the present time through historical times can be

traced back to the last maximum glaciation. The landslides close to sea-level, of which there are but few (Siorqat-kûat: one, Qagdloq: a few) must be younger than the culmination of the last advance when a glacier has forced its way through the Vaigat and passed the Atanikerdluk peninsula, which is a distinct roché moutonnée attacked from east. This glacier would have removed these unconsolidated heaps. When it has withdrawn is not exactly known, nor is it possible exactly to determine the oldest possible date for these movements represented by the low-lying landslide "coulisses". But the great landslide action which has left the shelf-like incision above Iluarâ, has taken place after the glacier's withdrawal on account of the existence of low-lying landslides. The lack of landslide "coulisses" on the mountain slope east and west of Iluarâ, on the whole up to altitudes of 4—500 m (fig. 3), may also be ascribed to the action of this glacier. The clear mountain slope of a somewhat equal profile all the way along the even coastwise course must attempt one to assume this view (niviation) unless irregularities of a lower rank due to later erosions: frost, running water, wind etc. blurs the representation. On these stretches landslide action has ceased before the glacier regression.

About the very cause of the landslide movements can only be guessed. The basal part of the "mobile" sequence is black shales of Naujât member which may assumably have acted as a lubricant. The movement may have started by too big a gradient arisen by niviation leaving parts of the mountain unsupported by the melting of the supporting glacier. But there may also be deeper causes as for instance earth quakes in connection with the fault systems which are so amply represented on the peninsula of Nûgssuaq.

B. ESKE KOCH

Quaternary.

No marine Quaternary deposits are exposed, and neither has it been possible to show any terminal or lateral moraines. Moraine material is no doubt present in a considerable amount as accumulation of gneiss boulders were observed on the shore where marine erosion is active along the coast. Occurrences of the crystalline basement are only found east of this area and have not been observed until the Sarqaqdalen (S. valley). No gneiss boulders, however, were observed by the author in the mountains at higher levels.

Ice scratches are distinctly visible in the Atanikerdluk peninsula which may be considered as a "roché moutonnée" attacked from the east (fig. 11). Especially on the eastern landward slopes, the rounded rock is well-preserved. Its sides are here almost polished and show distinct ice scratches from SE to NW.

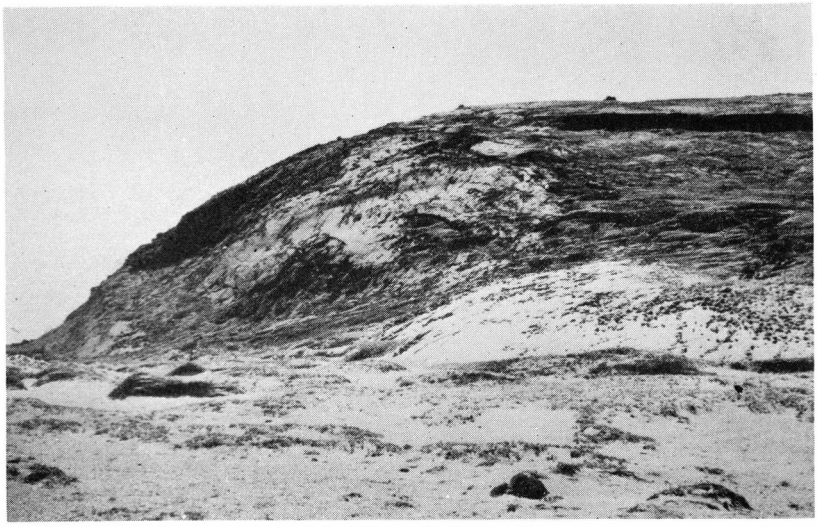

Fig. 11. View from the stoss side of the Atanikerdluk peninsula with rounded and polished surfaces. B.E.K. fot.

Even if marine Quaternary deposits cannot be shown, it must be assumed that an essential part of the isthmus Ipiutaq which connects the Atanikerdluk peninsula with the hinterland, consists of marine and/or littoral deposits and beach ridges. The torrent from the Liriodendronkløften gully, whose alluvial cone is spreading behind Ipiutaq, has no doubt also participated in the conveyance of material. The strong winds that characterize the place, have through deflation smoothed the isthmus, which now appears as a flat gravel plain, and effaced all vestiges of the structure of the isthmus. The isthmus is limited to the hinterland by a low slope which may be interpreted as an overgrown cliff. On both sides Ipiutaq is bordered by typical beach ridges which protect a mud-filled lagoon, a characteristic feature which suggests a relatively rapidly developed upheaval which can be registered on the map area as the last epirogenic event. The mud is deposited by the water from the torrents of the Liriodendronkløften and the Rhododendronkløften which with their alluvial cones pointing to the isthmus no doubt contribute to the formation of this.

Solifluction is plainly active and on account of the considerable gradient it often appears as stripes of mobile matter with narrow skirts of vegetation on the sides. Actual polygones only occur in the high mountains and only in few places. Stone circles frequently occur in the high mountains and, at a lower level, in the plains between the strongly worn landslide coulisses in the eastern part of the map.

B. Eske Koch

LITERATURE

Brown, R. 1875: On Noursoak Peninsula, Disco Island and the country in the vicinity of Disco Bay, North Greenland. Trans. Geol. Soc. Glasgow, vol. 5, pt. 1.

Giesecke, K. L. † 1910: Mineralogisches Reisejournal über Grönland 1806—1813. Meddelelser om Grønland bd. 35.

Heer, O. 1868: Flora Fossilis Arctica, vol. 1: Die fossile Flora der Polarländer. Zürich 1868.

— 1869: Flora Fossilis Arctica, vol. 2 no. 4: Contributions to the fossil flora of North Greenland. Phil. Trans. Roy. Soc. London vol. 159.

— 1874: Flora Fossilis Arctica, vol. 3, pt. 1: Die Kreideflora der Arctischen Zone. K. Svensk. Vetenskapsakad. Handl. vol. 12 no. 6. Stockholm.

— 1874: Flora Fossilis Arctica vol. 3 no. 3: Nachträge zur Miocenen Flora Grönlands. K. Svensk. Vetenskapsakad. Handl. vol. 13 no. 2. Stockholm.

— 1880: Flora Fossilis Arctica, vol. 6 no. 1: Nachträge zur fossilen Flora Grönlands. K. Svensk. Vetenskapsakad. Handl. vol. 18 no. 2. Stockholm.

— 1882: Flora Fossilis Arctica vol. 6: Flora Fossilis Groenlandica 1. Zürich 1882.

— 1883a: Flora Fossilis Arctica vol. 7: Flora Fossilis Groenlandica 2. Zürich 1883.

— 1883b: Oversigt over Grønlands fossile Flora. Meddelelser om Grønland vol. 5 no. 3.

Koch, B. E. 1951: Meddelelse om en ny Macclintockia Kanei-flora fra Agatdalen, NW-Grønland, og dens equivalenter. Proc. 5th. Conv. Scand. Geologists, Denmark 1951. Medd. Dansk Geol. Foren. vol. 12 pt. 1 p. 158. København.

— 1955: Geological observations on the Tertiary sequence of the area around Atanikerdluk, West Greenland. Meddelelser om Grønland vol. 135 no. 5.

— 1959: Contribution to the Stratigraphy of the Non-Marine Tertiary deposits on the South Coast of the Nûgssuaq Peninsula, Northwest Greenland. Meddelelser om Grønland vol. 162 no. 1.

— 1955: Lidt om de grønlandske tertiærfloraer. Naturens Verden vol. 39. København.

— 1955: Et skovklædt Grønland i fortiden. Grønland 1955 no. 1. Odense.

Koch, L. 1929: Stratigraphy of Greenland. Meddelelser om Grønland vol. 73 no. 2.

Kreuger, H. K. E. 1928: Zur Geologie von Westgrönland, besonders der Umgebung der Disko-Bucht und des Umanak-fjordes. Meddelelser om Grønland vol. 74 no. 8.

Munck, S. 1945: On the Geology and Petrography of the West Greenland basalt province, pt. V. Meddelelser om Grønland vol. 137 no. 5.

Nathorst, A. G. 1884: De växtförande lagren vid Atanikerdluk på Nûgssuaqhalfön, Grönland. Geol. Fören. Stockholm Förhandl., vol. VII, häft 1. Stockholm.

— 1885: Ref. Nordenskiöld, A. E. 1885, kap. 6.

— 1907: Pseudocycas, eine neue Cycadophytengattung aus den cenomanen Kreideablagerungen Grönlands. K. Svensk. Vetenskapsakad. Handl. vol. 42 no. 5. Stockholm.

NORDENSKIÖLD, A. E. 1871: Redogörelse för en expedition till Grönland år 1870.
— 1884: Grönlandsexpeditionen 1884. Rept. till Dr. Oscar Dickson, Göteborg 1884.
— 1885: Den andra dicksonska expeditionen till Grönland ... 1885. Stockholm.
RINK, H. 1857: De danske Handelsdistrikter i Nordgrønland. København.
— 1852: En Udsigt over Nordgrønlands Geognosi. København.
ROSENKRANTZ, A. et al. 1940: Den danske Nûgssuaqekspedition 1939. Medd. Dansk Geol. Foren. vol. 9 (653—663). København.
ROSENKRANTZ, A. 1951: Oversigt over Kridt- og Tertiærformationens stratigrafiske Forhold i Vestgrønland. Proc. 5th. Conv. Scand. Geologists, Denmark 1951. Medd. Dansk Geol. Foren. vol. 12. København.
SEWARD, A. C. 1924: Notes sur la flora cretacique du Groenland. Soc. Geol. du Belgique. 5eme anniversaire Livre Jubilaire, tome I fasc. 1. Liège.
— 1926: The Cretaceous Plant-bearing Rocks of West Greenland. Phil. Trans. Roy. Soc. London,..Ser. B, vol. 215 (57—175).
SEWARD, A. C. & V. M. CONWAY 1935: Additional Cretaceous Plants from Western Greenland. K. Svensk. Vetenskapsakad. Handl., 3 ser. vol. 15 no. 3. Stockholm.
— — 1939: Fossil Plants from Kingigtoq and Kagdlunguak, West Greenland.
STEENSTRUP, K. J. V. 1874: Om de kulförende Dannelser på Öen Disko, Hareöen og Syd-Siden af Nûgssuaq's Halvöen i Nord-Grönland. Köbenhavn.
— 1883: Om Forekomsten af Forsteninger i de kulførende Dannelser i Nordgrønland. Meddelelser om Grønland vol. 5 no. 1 (translation to danish of the paper following just below).
— 1883: Über die Lagerungsverhältnisse der Kohlen und Versteinerungen führende Bildungen auf der Westkuste von Grönland zwischen 69°15′ und 72°15′ n. Br. HEER: Flora Fossilis Groenlandica 1883.
TROELSEN, J. 1956: Lexique Stratigraphique International vol. I fasc. la: Groenland (Greenland). Congres Géologique International. — Comm. Stratigr. Paris.
VANHÖFFEN, E. & H. ENGELHARDT 1897: Die Fauna und Flora Grönlands. Pt. 1 of: E. von Drygalski: Grönland-Expedition der Gesellschaft für Erdkunde zu Berlin 1891—1893. Berlin.
WHITE, D. & CH. SCHUCHERT 1898: Cretaceous series of the West Coast of Greenland. Bull. Geol. Soc. Amer. vol. 9. New York.

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GEOLOGICAL MAP OF
ATANIKERDLUK AND ENVIRONS, NÛGSSUAQ PENINSULA WEST GREENLAND

Scale 1:10000

By Eske Koch and K. Raunsgaard Pedersen.

Topographical map by the Geodetic Institute, Copenhagen.

25' 52°20' 15'

06

70° 04'

Qagdlup kûa
Qagdlunguaq
Keglen
Qagdlorssuaq
Qagdlorssûp kûa
Siorqat kûat
Qingartut
Qingartût kûat
Qâqait
Lagoon
Nûnguaq
Ilua
Liriodendronklöft
Rhododendronklöft
Terqissap aûa
Qagssutit
Ipiutaq
Lagoon
Lagoon
Ivnaq
Atanikerdluk
Kangerup nûa
Ivnârguaq
Arqatigssat
Qeqertânguaq
Tupertssuarguit
Ivviangernat
Qvikavsaup kûa
Avqutdlugissap kûa
Avqutdlugiaq
GATAT

Legend

Exposed / Assumed (covered by Quaternary deposits) / Landslides

Tertiary — Upper Atanikerdluk Formation
- Basalt
- Point 976 Member Sediments
- Aussivik Member ,,
- Umiussat Member ,,
- Naujât Member ,,
- Quikavsak Member ,,

Cretaceous
- Atane Formation ,,

Mine

Fault

Basalt dykes and sills

1:10 000

100 0 500 1000m

Heights in metres. Contour interval 10 m locally supplemented by intermediate broken 5 m contours.

25' 52°20' W. of Greenwich 15'

Grønlands Geologiske Undersögelse
The Geological Survey of Greenland