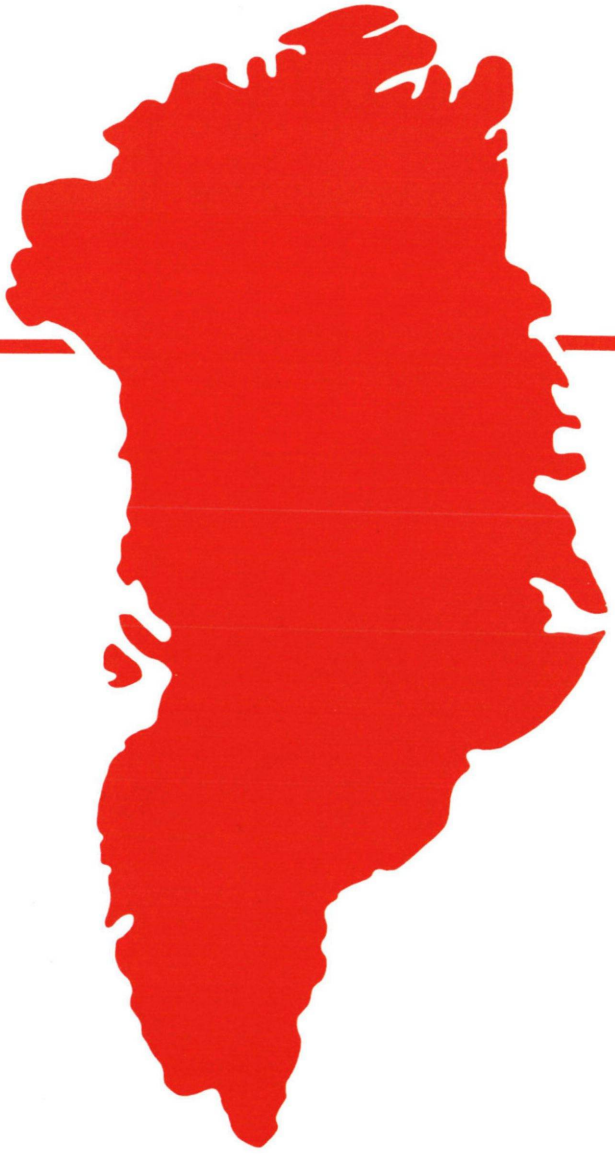
Photogeological interpretation of Inglefield Land, North-West Greenland

Hans-Jørgen Bengaard



Open File Series 95/4

March 1995

GRØNLANDS GEOLOGISKE UNDERSØGELSE
Ujarassiortut Kalaallit Nunaanni Misissuisoqarfiat
GEOLOGICAL SURVEY OF GREENLAND

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ABSTRACT

Inglefield Land consists of a Middle Proterozoic crystalline basement with outliers of Upper Proterozoic and Lower Palaeozoic platform cover. Vertical aerial photographs at 1:150 000 with limited ground control have been used to distinguish gneisses, marble-rich metasediments, and basic and granitoid rocks in the basement. In the sedimentary cover a lower clastic unit and three succeeding carbonate units are recognised and can be correlated with previously known stratigraphy.

In the basement two gneiss complexes are separated by a belt of granitoid rocks and are deformed by three sets of major folds. A basement flexure causes a local angular unconformity in central Inglefield Land near the boundary between the Early and Middle Cambrian strata.

Many circular 20-250 m wide structures of post-Cambrian age, which may be volcanic pipes or surficial structures, occur along a WNW-ESE trending lineament cutting crystalline basement rocks in central Inglefield Land.

CONTENTS

PREFACE

The photogeological interpretation presented in this report was commissioned and funded as a part of project AEM Greenland 1994-1998, a 5-year project initiated and financed by the Greenland Home Rule Government and managed by the Geological Survey of Greenland (GGU). The main purpose of the project is to acquire new and detailed airborne geophysical data (electromagnetics and magnetics) over selected regions in Greenland, thereby stimulating the mining exploration activity in Greenland. The geophysical results from the first year's survey over Inglefield Land have been reported in Stemp & Thorning (1995).

Existing topographical maps from Inglefield Land were inadequate as the basis for the airborne survey operations and the subsequent compilation of the new data. Therefore, GGU's photogeological laboratory was commissioned to produce new topographic base maps at scale 1:100 000. These were made by Hans F. Jepsen and Jørgen Neve, GGU, and completed in June 1994.

It was also decided to carry out a photointerpretation of the geology as a supplement to the geophysical data. For practical reasons this was carried out by Hans-Jørgen Bengaard in November 1994. The information gained through the photogeological study is clearly an important addition to the geoscience data base produced by project AEM Greenland 1994-1998.

Leif Thorning, GGU

1. INTRODUCTION

Inglefield Land is a land area *c.* 200 × 60 km in size, situated in North-West Greenland on the southern shore of the Kane Basin. The area is close to the settlement of Qaanaq, but has no permanent habitation. It is composed of a high grade crystalline complex of Early Proterozoic age, overlain in places by relatively thin sedimentary sequences referred to the Middle to Late Proterozoic Thule Basin and the Lower Palaeozoic Franklinian Basin successions (Dawes, 1988, in press). Major Quaternary cover is restricted to the south-eastern parts of the area near the Inland Ice.

The work reported here was carried out as a part of project AEM Greenland 1994-1998.

2. SUMMARY OF KNOWN GEOLOGY

The first systematic study of the geology of Inglefield Land was that of Lauge Koch, who visited the area several times in the years 1917 to 1923. Koch (1933) described three major rock complexes: a crystalline basement composed of hypersthene-bearing meta-igneous rocks and high grade metasediments (the 'Etah Formation'); sandstone, dolomites and basic intrusions of supposed late Precambrian age (the 'Thule Formation'); and Cambrian carbonates. Troelsen (1950) revised Koch's stratigraphy of the sedimentary rocks. In the period 1970-1980 geologists of the Geological Survey of Greenland (GGU) studied the crystalline rocks of western Inglefield Land (Dawes, 1972, 1979, 1988) and revised the stratigraphy of the Thule Basin sequence (Dawes, in press). Data on the position of the boundary between the Thule Basin and the Franklinian Basin successions have only been summarily published (Peel *et al.*, 1982; Peel & Christie, 1982).

Crystalline rocks of Early Proterozoic age occupy most of eastern and northern Inglefield Land, while in western Inglefield Land they are overlain by a sedimentary cover. In the south and south-east, large areas are hidden beneath Quaternary deposits, and where these are absent, a prominent regolith obscures most exposures. In the north-east exposures are excellent.

Most field observations on the crystalline basement rocks are from western Inglefield Land, where they have been described by Koch (1933) and Dawes (1972, 1979, 1988), who studied coastal exposures between Foulke Fjord and Rensselaer Bugt. From the rest

of the area, only scattered observations and sample collections have been made by passing geologists (Dawes, 1988). A small area in southernmost Inglefield Land (around 78°15′N, 68°30′W) was mapped by A. Clebsch (undated report). Greenarctic Consortium apparently did very little work in Inglefield Land, although their photogeological work identified the large refolded fold named the 'Wulff structure' in the north-east (Stuart Smith & Campbell 1971). The report of a prospecting party from IMAS (Gray, 1975) gave little new information, while a prospecting party from RTZ provided short descriptions from a number of localities (Sharp, 1991), mainly in northern Inglefield Land. A summary of the knowledge of the basement rocks of Inglefield Land was given by Dawes (1988).

Gneisses from an area at Sunrise Pynt near Etah have yielded a Lower Proterozoic Rb/Sr whole rock 'errorchron' age of *c.* 1850 Ma. (Dawes *et al.*, 1988). The initial $^{87}Sr/^{86}Sr$ ratio of *c.* 0.703 shows that the samples do not include reworked Archaean material. K/Ar mineral ages from south-western Inglefield Land, interpreted as cooling ages, range from 1756 to 1795 Ma (Larsen & Dawes, 1974).

The sedimentary rocks of Inglefield Land can be subdivided into a succession of clastic sediments followed by a succession of carbonates. Koch (1933) realized that two major units were present in the area and referred the clastic sediments and the lowermost, unfossiliferous carbonates to the Precambrian, while the upper, fossiliferous carbonates were shown to be Cambrian. A major hiatus was believed to separate the two successions. Later investigations (Peel *et al.*, 1982, Higgins *et al.*, 1991) have shown that sediments of two different basins, the Middle to late Proterozoic Thule Basin and the Palaeozoic Franklinian Basin, occur in Inglefield Land.

3. PRESENT STUDY

A photointerpretation of the geology of Inglefield Land was made by the author in November 1994. The interpretation was undertaken using diapositives of super-wide angle vertical aerial photographs at a scale of *c.* 1:150 000, supplied by Kort- og Matrikelstyrelsen (KMS). The photographs are of excellent quality, with no clouds and only minor snow cover in a few areas. The photointerpretation was made using the PG2 photogrammetric instrument of the photogeological laboratory of the Geological Survey of Greenland, connected to a HP 1000 minicomputer programmed for data collection and

calculation of geological parameters such as strike and dip (Jepsen & Dueholm, 1978). Thirty-six stereographic models were studied; two of the models in southernmost Inglefield Land were studied by H. F. Jepsen (GGU). The study resulted in two geological map sheets at 1:100 000 (deposited in GGU's map archive), and an overview map sheet at scale 1:250 000, enclosed with this report. The results of the photogeological study are described below in two sections on stratigraphy and lithology (4) and structures (5), respectively.

4. STRATIGRAPHY AND LITHOLOGY

4.1. The basement rocks

The photogeological study indicates that the basement terrain can be subdivided into a northern and a southern crystalline complex, separated by a discontinuous belt of granitoid rocks (Fig. 1).

Four rock types can be distinguished, most of them occurring in both complexes:

- Marble-rich metasediments of the Etah Group (es);
- Basic rocks (b);
- Granitoids (gr);
- Undifferentiated gneisses (gn).

The southern complex is characterized by the widespread occurrence of light-coloured bands of metasedimentary rocks (es), and by the dark colour and recessive nature of the gneisses (gn). The metasedimentary rocks are light-coloured and more recessive than the surrounding gneisses. They are frequently colour banded on a 100 m scale. They occur in kilometre-wide strips, that on the south-western coast link up with exposures of metasediments described by P. R. Dawes (unpubl. field diary 1971) as marbles with subordinate calc-silicate rocks, quartzites and metabasics. Dawes also included siliceous garnet gneisses in the metasediments, but these are photogeologically indistinguishable from the non-metasedimentary gneisses.

The gneisses appear dark on the photographs, and tend to form rather featureless, regolith-covered plateaus, where only low ridges mark the structural trend. The non-metasedimentary gneisses are described by Dawes (unpubl. field diary 1971, 1988) as

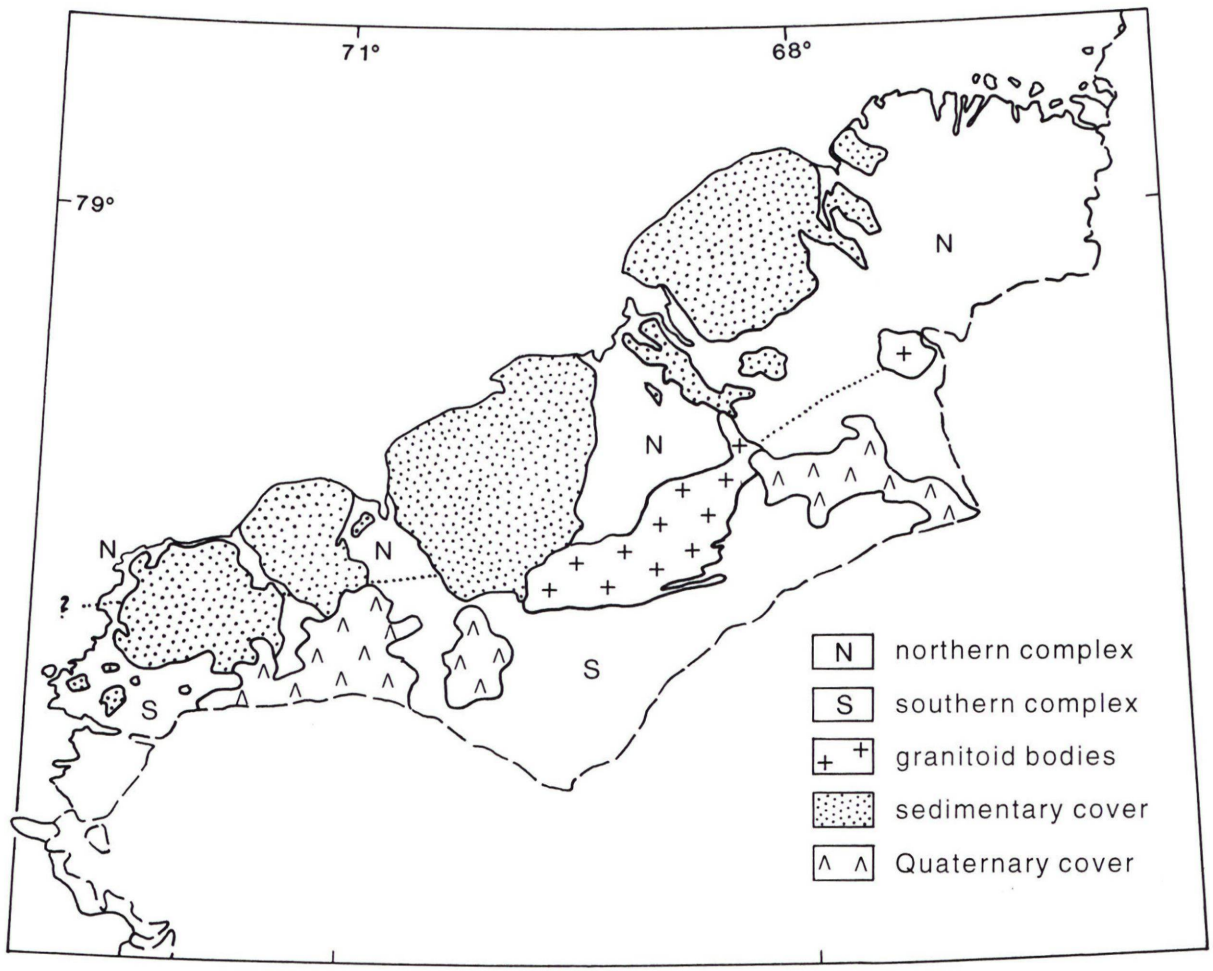

Fig. 1. Distribution of the two gneiss complexes in Inglefield Land.

hypersthene-bearing meta-igneous rocks, massive or foliated, that intrude the metasedimentary rocks and are deformed together with them. A melanocratic quartz diorite is common, while granodioritic to granitic types frequently appear to be somewhat younger. Aplitic and pegmatitic bands and veins are frequent. Dawes (1988) groups the metasediments and the meta-igneous rocks together under the name 'Etah meta-igneous complex', while the metasedimentary rocks are called the 'Etah Group'. A third, rather ill-defined rock complex in the area is called the 'variable gneiss group'. It could not be distinguished photogeologically, and judging from the descriptions of Dawes (unpubl. field diary 1971) it does not occupy large areas.

A small area of the southern complex near the southern angle of the Inland Ice has also been investigated by A. Clebsch (undated report). The gneisses here are described as dark grey, banded, garnet gneisses with rusty brown weathering colour, and with closely spaced jointing that make them very susceptible to frost shattering. Massive granitic and pegmatitic rocks are subordinate to the banded gneisses.

The central and eastern parts of the southern complex contain frequent occurrences of basic rocks (b), distinguished by their very dark colour. The light-coloured metasediments contain some 100 m wide bands several kilometre in length, that appear to be concordant to the banding in the metasediments. Other bands up to 500 m width near the area examined by Clebsch and in the easternmost exposures of the complex appear to be discordant to the main structural trend, although at least the eastern occurrences are folded and appear to be cut by an east–west trending foliation or jointing. Clebsch describes the basic rocks in this area as amphibolites grading into hornblendites. A large (at least 5 × 15 km) occurrence of dark, probably basic rocks in the eastern part of the complex appears to be an undeformed or only weakly deformed intrusion.

Near the area Clebsch examined is an occurrence *c.* 2 × 1 km in size of light-coloured, rather resistant rocks (gr), that is probably a felsic intrusion. It appears to be undeformed or only weakly deformed.

The northern boundary of the complex is well defined in central Inglefield Land, where it frequently has a sharp boundary to light-coloured, resistant, rather homogeneous granitoid rocks. The gneisses immediately south of Rensselaer Bugt appear to belong to the northern complex, and the boundary in this area should probably be drawn just north of the northernmost metasedimentary band at 78°30′N. Further to the west, the gneiss

complexes cannot be distinguished in the narrow coast or valley exposures. East of central Inglefield Land, the boundary probably runs between the east end of the large granitoid body and the smaller granitoid body near Hiawatha Gletscher. The area is, however, poorly exposed.

The northern complex is distinguished by its resistant, fairly light-coloured gneisses (gn) with frequent banding on a scale of several hundred metres between resistant and less resistant types. Metasedimentary rocks (es) similar to those of the southern complex are restricted to a small dome near Kap Agassiz, and possibly a few thin bands along the river draining September Søerne. Apart from these and a number of what appear to be felsic intrusions (gr), the complex is generally very homogeneous. The main inhomogenities stem from the distribution of the banding; some areas are strongly banded while other areas are rather structureless. The cause of the banding is not known. Descriptions (Dawes, 1988) of samples from the Wulff structure, where the banding is very prominent, are not related to differences in weathering resistance. Where the banding is weak or absent, a much finer banding can sometimes be distinguished, that appears to be an axial planar foliation to the main east–west folds in the complex.

Systematic field studies of the complex have never been undertaken, but Koch (1933) and Dawes (1979, 1988) describe samples of meta-igneous rocks similar to those of the Etah meta-igneous complex. Sharp (1991) describes garnet-biotite-(sillimanite) quartzo-feldspathic gneisses from all the basement localities visited by the RTZ prospecting party, with subordinate more felsic rocks. Sharp describes the whole complex as comprising garnet granulites and refers it to the 'variable gneiss complex' of Dawes (1988). No certain metasediments were found by the party.

Areas of very light-coloured and resistant rocks (gr), interpreted as felsic intrusions, are frequent around Minturn Elv south of Marshall Bugt. Most of the occurrences are irregular in shape, but are clearly deformed along with the surrounding gneisses. A minor occurrence at the head of Marshall Bugt is very irregular in shape and may be undeformed. Small occurrences of light-coloured rocks are scattered throughout the northern complex.

A very large and a smaller granitoid body (gr) separate the northern and the southern complexes in central Inglefield Land. The granitoids appear as light-coloured, homogeneous, resistant rocks. Their boundary to the southern complex is well-defined and

often sharp, and seems in places to be discordant to the gneiss-metasediment boundaries. The boundary to the northern complex is less well-defined, and the granitoids are mainly distinguished from the northern gneisses by their lack of coarse banding. They are probably best described as homogeneous varieties of the northern gneisses. The smaller, eastern granitoid in particular is poorly defined. The granitoids have a fine banding or foliation that in places is folded.

4.2. The sedimentary cover

The sedimentary cover of Inglefield Land could photogeologically be subdivided into four units. The lowest unit comprises a succession of clastic rocks, while the upper three units form a carbonate succession.

The clastic sediments can be referred to the Middle Proterozoic Smith Sound Group of the Thule Supergroup (Dawes, in press) and to the Early Cambrian Dallas Bugt Formation (Peel *et al.*, 1982).

The boundary between the two parts of the succession is an unconformity in the upper part of the clastic sediments. This unconformity is hardly visible in the field and could not be seen on the aerial photographs. The basic intrusions which characterize the Thule Supergroup were only visible in steep cliff exposures. The clastic sediments of the two basins are consequently described together here.

The clastic sediments are recessive and often poorly exposed. They are generally somewhat lighter in colour than the underlying gneisses. The boundary to the gneisses shows a considerable palaeorelief in central and eastern Inglefield Land, but since the boundary is often obscured by scree, its exact position is often difficult to see. East and south of Marshall Bugt, some of the areas shown as sediment on the map may be gneiss with a discontinuous cover of sediment preserved in hollows. Clastic sediments and Quaternary cover are also difficult to distinguish in this area. Koch (1933) records small patches of clastic sediments all along the coast between Kap Scott and Kap Agassiz.

The Smith Sound Group in Inglefield Land is subdivided into three formations by Dawes (in press): the Sonntag Bugt Formation (highest), the Rensselaer Bugt Formation and the Cape Camperdown Formation (lowest). The lower boundary of the Sonntag Bugt Formation follows a thick sill in the area between Foulke Fjord and Force Bugt, and was

thus easy to trace in the steep cliff exposures along the coast. Inland exposures are very poor, and the boundary shown here is very uncertain. The other formational boundaries could not be traced.

On the map, the clastic sediments are given four different acronyms:

- T is the Thule Supergroup below the thick sill in the sediment areas west of Force Bugt. It is probably mainly made up of the Rensselaer Bugt Formation, perhaps with a little Cape Camperdown Formation at the base of the easternmost occurrences.
- SD is the clastic sediment above the thick sill in the sedimentary areas west of Force Bugt. It consists of the Sonntag Bugt Formation of the Thule Supergroup and the Early Cambrian Dallas Bugt Formation undivided.
- TD is the Thule Supergroup and the Dallas Bugt Formation undivided in the sediment areas between Force Bugt and Marshall Bugt.
- DB is the Dallas Bugt Formation east of Marshall Bugt. Here the Thule Supergroup is believed to have wedged out (Peel *et al.*, 1982; Dawes, in press).

The present study shows that clastic sediments are much less extensive east of Rensselaer Bugt than earlier thought (see e.g. Peel *et al.*, 1982). In a small area south–east of Rensselaer Bugt, the carbonates even seem to directly overlie the gneisses. Since the northernmost basic intrusion known in the clastic sediments occurs as near Rensselaer Bugt as Kap Leiper (Koch, 1933; Dawes *et al.*, 1982), it is possible that the Thule Supergroup wedges out more rapidly east and south of Rensselaer Bugt than previously thought.

The carbonate succession of Inglefield Land has been subdivided into three units in the present study. The units correspond to the following formations of Troelsen (1950):

- LI: Cape Leiper and Cape Ingersoll Formations (both Early Cambrian) undivided.
- WKW: Wulff River (Early Cambrian), Cape Kent (Early Cambrian) and Cape Wood (Middle Cambrian) Formations undivided.
- CF: Cass Fjord Formation (mainly Late Cambrian).

The LI unit is distinguished by its resistant nature, and its lower boundary is taken at the change from recessive to resistant sediments. A light-coloured band is frequently present at the base of the unit. Judging from Fig. 6 of Peel *et al.* (1982), the upper part of the Dallas Bugt Formation may be included in the unit. The thickness is everywhere close to 50 m. It correlates with the Kastrup Elv Formation in Washington Land.

The WKW unit is recessive at its base, where the recessive Wulff River Formation overlies the resistant Cape Ingersoll Formation. The Wulff River Formation is followed by

the thin, resistant Cape Kent Formation; this sequence gives rise to a characteristic terrace at the base of the WKW unit, which is further enhanced by the relatively dark colour of the Wulff River Formation, and can be followed through poorly exposed terrain. The base of the WKW is drawn along this terrace. Though the terrace is a good marker, the exact position of the boundary within the terrace is often difficult to pinpoint; it was probably often placed somewhat too high in the interpretation, so that the lowest part of the Wulff River Formation is included in the LI unit. The resistant Cape Kent Formation is followed by the recessive lower part of the Cape Wood Formation, giving rise to another terrace; the upper part of the Cape Wood Formation is resistant. The thickness of the WKW unit is fairly constant at 110 m. This is somewhat less than the 150 m given in Higgins *et al.* (1991).

The WKW unit correlates with the Telt Bugt Formation in Washington Land. A prominent angular unconformity occurs between the Cape Kent and the Cape Wood Formations along the eastern boundary of the sediment area between Rensselaer Bugt and Marshall Bugt. It is described in more detail below.

The CF unit, which only comprises the Cass Fjord Formation, is characterized by an alternation of thin recessive and resistant units, giving rise to a terraced landscape. The lower boundary of the formation is drawn at the base of the first prominent terrace above the resistant upper part of the WKW unit. A light-coloured band is often present a little above this terrace. The Cass Fjord Formation forms the top of the sedimentary succession in Inglefield Land; approximately 100 m of the formation is preserved. In Washington Land, where the whole formation is preserved, the complete thickness is up to 470 m (Peel & Christie, 1982).

4.3. Basic dykes and sills

Dykes and sills are common in the sediments of the Thule Supergroup. Several sills could be traced in the steep north-facing cliff exposures of the sedimentary area west of Force Bugt, and on top of the smaller sediment patches in this area. The highest of these sills has a thickness of up to 60 m. Dolerite dykes are described as frequent both in the Thule Supergroup (Dawes, in press) and in the crystalline basement (Dawes, 1988), but only a few dykes could be identified photogeologically. This is probably because the dykes are easily eroded; several lineaments could in places be seen to contain dykes. A dyke in the area mapped by Clebsch (undated report) is described as deeply weathered.

K/Ar whole rock ages of 1073 to 1107 Ma have been obtained on the sills of Inglefield Land, while a dyke at Kap Leiper has given a K/Ar whole rock age of 627 ± 25 Ma (Dawes *et al.*, 1973, Dawes *et al.*, 1982).

4.4. Circular structures

During the photointerpretation a swarm of small circular structures was identified in central Inglefield Land (see Fig. 2).

The circular structures were seen on a variety of surfaces, including Cambrian carbonates; widespread, well-exposed gneiss and granitoid terrains; flat, regolith-covered gneiss plateaus; and the bottom of V-shaped, erosional valleys. No circular structures have been seen in areas indicated on the map as undifferentiated Quaternary.

The structures appear as dark, circular areas or dark rings, most of them with a diameter between 20 and 70 m; a few have diameters of up to 250 m. They could be interpreted as a volcanic pipe swarm, but may also be surficial phenomena. The structures (foliation and banding) of the surrounding rocks sometimes continue through the ring-formed structure. One of the circular structures, occurring on the boundary between the gneisses and the Proterozoic-Cambrian sediments, is cut through by a small river canyon, suggesting that it is not a superficial feature. Topographically most of the circular structures are level with the surface of the surrounding rocks; a few seem to form small hills.

More than a hundred such circular structures have been identified, most of them situated on both sides of a WNW–ESE directed, 25 km long linear zone (lineament) between 78°40′N, 69°30′W and 78°32′N, 68°30′W. Scattered occurrences can be seen up to 8 km from the lineament. The lineament continues to the ESE as a broad valley for a further 15 km towards the Inland Ice, though no circular structures have been identified here. There is a concentration of circular structures near the prominent NW–SE directed lineament which crosses the WNW-ESE lineament just east of Minturn Elv, and groups of 3-4 circular structures may be arranged in linear clusters parallel to this direction. The WNW-ESE linear zone of circular structures forms a direct continuation of the northern flank of the early Devonian Inglefield Uplift, formerly known as the Bache Peninsula Arch (Smith & Okulitch, 1991). Their tectonic setting is thus comparable to that of the kimberlite occurrences on the flank of the late Silurian to early Devonian Boothia Uplift (Okulitch *et al.*, 1991).

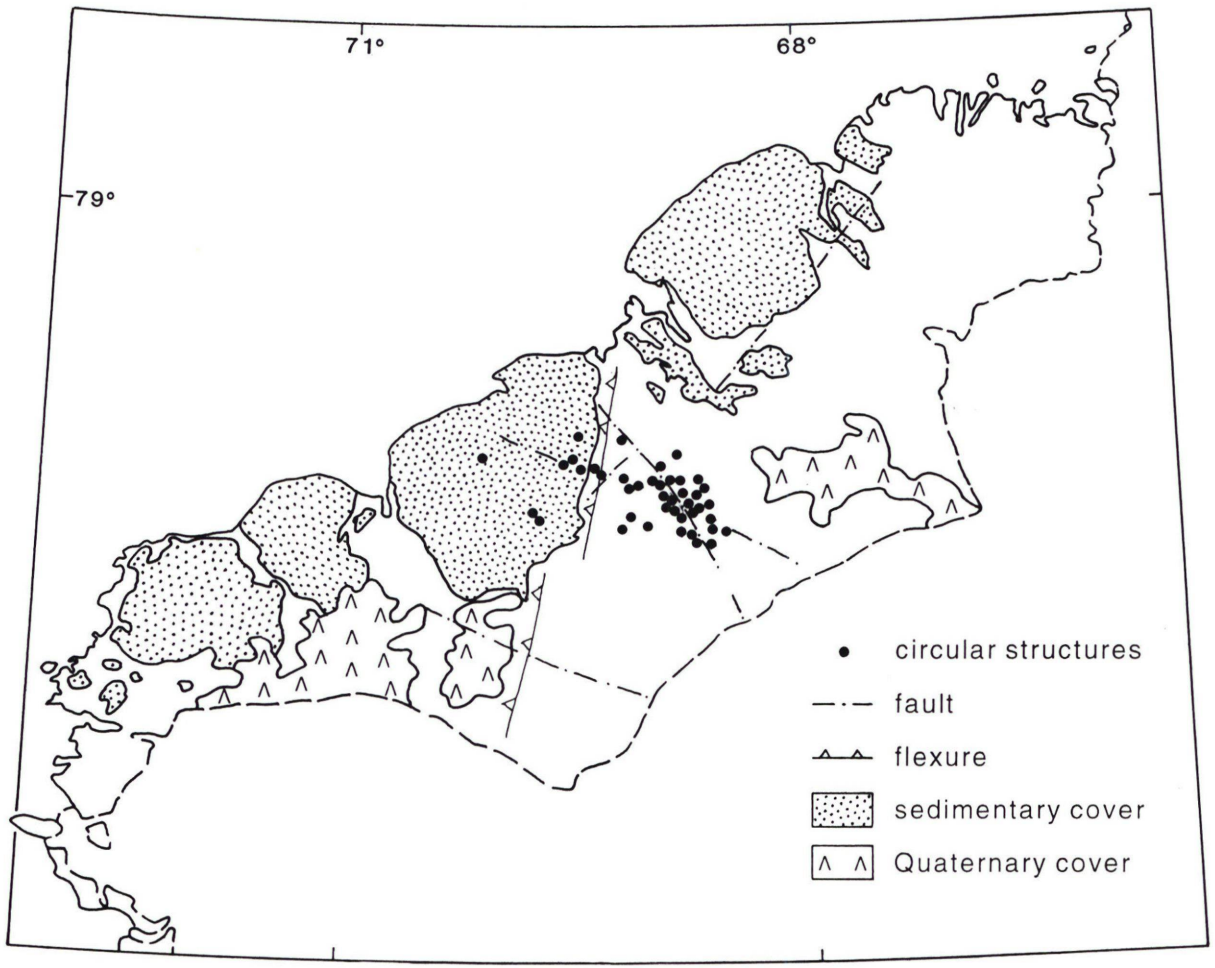

Fig. 2. Distribution (simplified) of the circular structures in relation to major lineaments and basement flexures in the area.

Circular structures have also be seen on surfaces of the Cambrian carbonate succession, including the Cass Fjord Formation, and are thus of post-Cambrian age. The gneisses appear to be more recessive where the circular structures are abundant in the WNW-ESE linear zone, possibly a result of deeper weathering than in corresponding gneisses where the circular structures are not present.

The circular structures are too small to be adequately studied using the 1:150 000 aerial photographs. If further photointerpretation of them is contemplated, it should be carried out using the older 1:50 000 aerial photographs, which also exist from the area. Complete coverage of Inglefield Land by aerial photographs at 1:50 000 can be obtained from Kort- og Matrikelstyrelsen.

5. STRUCTURES

5.1. Folding in the crystalline rocks

The photogeological study showed the existence of many trend lines in the crystalline rocks, but the flat nature of the terrain permitted only a few strike and dips to be measured. The strong relief exaggeration that is a feature of the super-wide angle aerial photographs makes estimation of direction of dip difficult for even moderately steep orientations. Consequently, while there is much information on the strike of planar surfaces, little is known about their dips.

The southern complex has been described as an E–W directed 'straight belt' by Dawes (1988). The present study confirms this description for the central part of the complex, which is dominated by long, straight bands of metasediment, in which tight, internal folding with axial planes parallel to the bands can sometimes be discerned. The northern and southern parts of the complex seem to display more open folding; exposures here are, however, poor. Dawes (1988) describes refolded small-scale structures from the western part of the complex, but fold interface patterns are not readily apparent in the outcrop pattern drawn out during the photogeological study. Multiple deformation is demonstrated by the deformed, discordant basic bands in the eastern part of the complex (see above), and perhaps by the large, deformed granitoid body that seems to be discordant to structures in the metasediments.

In the northern complex, multiple folding is evident, as exemplified by the spectacular Wulff structure east of Kap Scott. The Wulff structure appears to be a classic fold interference pattern, but the axes in both the tight, 'early' closures and the open, 'late' closure appear to plunge south–west, so an element of doming is probably important in the structure. Closed domes and basins are outlined by the trend lines in most of the northern complex; the lack of dip data precludes any detailed analysis, but the structural pattern is perhaps best explained by the following model (Fig. 3).

- An early phase of recumbent folding, seen in the scattered tight folds with refolded axial planes.
- Two later phases of upright folding with axial planes striking E–W and NNE–SSW, producing the dome and basin pattern through their interference.

The NNE–SSW striking folds are best seen in north-eastern Inglefield Land, and the impression is that the E–W folding increases in strength towards the south, obscuring the NNE–SSW folds. The E–W folding can in places be seen to parallel a fine colour banding in the gneisses that is interpreted as a foliation, and which also seems to be axial planar to the late deformation of the basic bands in the easternmost parts of the southern complex.

5.2. Lineaments

The crystalline rocks are cut by innumerable lineaments. Most of them seem to be joints, as they do not offset structures in the gneisses. Three directions are prominent:

- NNW–SSE, approximately perpendicular to the coast line. Lineaments with this direction are often prominent structures, that can be traced for long distances. A spectacular example is the lineament which traverses almost all of Inglefield Land just east of Minturn Elv. Around Rensselaer Bugt, the sediments are offset by faults with this direction.
- N–S. Lineaments with this direction are widespread, but are generally minor structures.
- NNE–SSW to NE–SW. Lineaments with this direction are most common in north–eastern Inglefield Land. An important, but not very spectacular lineament with this direction can be traced as discontinuous segments from south of Kap Scott (70°02′N, 67°25′W) to south of Marshall Bugt (78°45′N, 68°35′W).

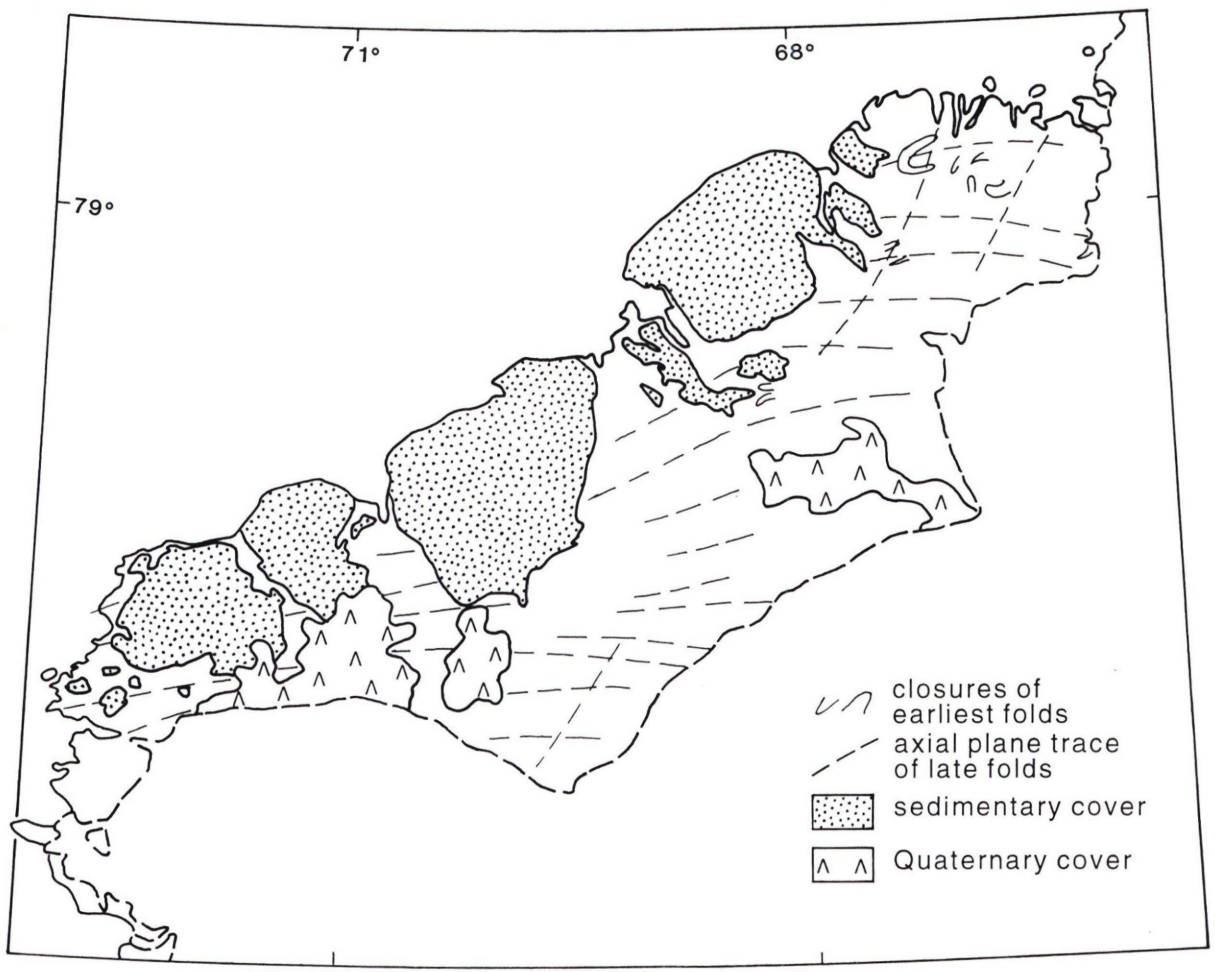

Fig. 3. Supposed closures of the earliest folds and axial plan traces of the two sets of later folds.

The lineaments generally stop at the boundary of the Proterozoic-Cambrian sediments, showing that they are mainly older than the *c.* 1250 Ma age of the Smith Sound Group. All three directions do, however, occur in the sediments, pointing to later (post-Cambrian) rejuvenation.

An important, WNW-ESE trending linear feature is formed by the circular structures described above.

Several areas of gneiss in north-eastern Inglefield Land display a pervasive ?jointing that obscures most other structures in the rocks. The direction of this jointing is generally NW–SE, perpendicular to the coastline. The distribution is patchy and may be related to the nature of the gneisses it occurs in; they appear very resistant in spite of the ?jointing. In other areas the direction of the jointing is WNW–ESE. These areas are often in valleys near major lineaments, and may represent shear zones.

5.3. Faulting and flexuring in the sedimentary cover

The Proterozoic-Cambrian sedimentary cover is largely undeformed and dips generally uniformly towards the NNW at *c.* 1°. In western Inglefield Land, the sediments are cut by a number of coast-parallel normal faults with downthrow towards the south, and at Rensselaer Bugt two coast-perpendicular faults cut the sediments.

The sediments between Rensselaer Bugt and Marshall Bugt are deformed by an important flexure that in part can be shown to be synsedimentary. Along the eastern boundary of this sediment area, from at least 78°44′N to 78°35′N, the crystalline rocks west of the boundary are raised, in places outcropping more than 100 m above the sediments; the sediments along the boundary are tilted by up to 20° towards the west. The tilting dies out 1-2 km west of the boundary. At 78°40′N, it is clearly seen on the aerial photographs that the tilting affects the succession up to and including the Early Cambrian Cape Kent Formation, while the Middle Cambrian Cape Wood Formation onlaps the tilted surface of the Cape Kent Formation with a spectacular angular unconformity. The basement flexure can consequently be dated to around the Early–Middle Cambrian boundary. A minor amount of flexuring has, however, occurred later, as shallow westward dips also occur in the Cass Fjord Formation in this area.

The flexure seems to be displaced *en echelon* some 5 km towards the west at around

78°33′N, and from there to continue to the Inland Ice. The change occurs where a continuation of the important NE–SW lineament would cut the flexure.

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Geological map of Inglefield Land 1:250 000

Legend

Photointerpretation by H.-J. Bengaard 1994

Undifferentiated Quaternary

Post-Cambrian

+ Circular structure

Area with many circular structures

Cambrian

CF Cass Fjord Formation

WKW Wulff River, Cape Kent & Cape Wood Formations

LI Cape Leiper & Cape Ingersoll Formations

Middle Proterozoic to Cambrian

Basic intrusions

DB Dallas Bugt Formation

SD Dallas Bugt and Sonntag Bugt Formations undifferentiated

T Thule Supergroup undifferentiated

TD Thule Supergroup & Dallas Bugt Formation undifferentiated

Lower Proterozoic

es Marble-rich metasediments of the Etah Group

b Basic rocks

gr Granotoid rocks

gn Undifferentiated gneisses

Kane Basin

Kap Agassiz

Kap Scott

Kap Kent

Dallas Bugt

Kap Wood

Wulff River

Marshall Bugt

September Søerne

Hiawatha Gletscher

Kap Leiper

Kap Ingersoll

Rensselaer Bugt

Force Bugt

Minturn Elv

Sunrise Pynt

Foulke Fjord

Etah

Sonntag Bugt

Inland Ice

0 25 km

79° 14'

79° 00'

78° 40'

78° 20'

78° 00'

73° W

72°

71°

70°

69°

68°

67°

66°

65° 30'

1 : 250 000 UTM-ZONE 20 (NAD83-NAD83).

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