

FAULTING IN THE WESTERN PART OF LIVERPOOL LAND, EAST GREENLAND

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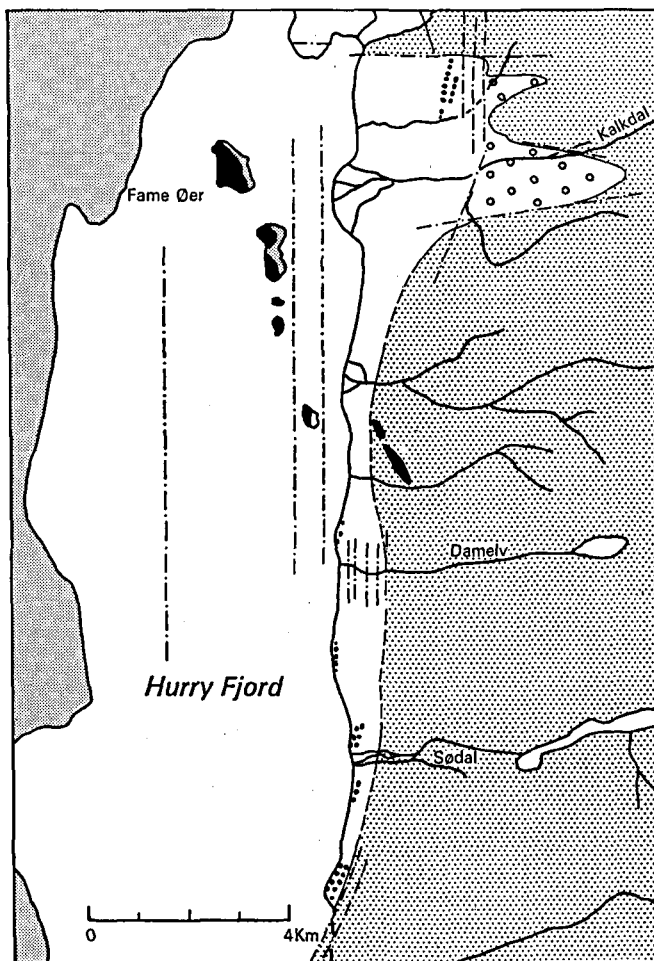
A non-metamorphosed sedimentary sequence (?Upper Palaeozoic or Lower Mesozoic) on the Fame Øer and in Liverpool Land north-east of Hurry Fjord is penetrated by a Tertiary dolerite sill. Normal faults with a north-south trend are shown to have been active before and after the emplacement of the sill. The faults constitute the boundary to the Mesozoic sedimentary basin to the west.

The geology of the coastal strip east of Hurry Fjord is largely concealed by thick spreads of glacial and fluvio-glacial debris. However, from the patchy exposure, it is possible to demonstrate the existence of a series of faults and to show that faulting took place over a protracted period.

Hurry Fjord is a 46 km long, parallel-sided fjord with an unusual orientation, flanked on the west by the almost horizontal Mesozoic rocks of Jameson Land and on the east mainly by the Liverpool Land gneisses. In the north-eastern part the "Hurry Inlet granite", reasonably presumed by Kranck (1935) to be a high level Caledonian intrusion, meets the coast and is in part overlain by a non-metamorphosed sedimentary formation. These strata together with some Mesozoic sediments and a sill of Tertiary age form a group of five islands, the Fame Øer. The present contribution is about the relationships between these rock groups.

The sediments were first recorded by Nathorst (1901). In a very brief account he assigned some of them to the Keuper but with little justification. Sedimentary rocks from this area were also referred to by Nordenskjöld (1907) who attempted a lithological correlation with strata from Kap Brown and Kap Fletcher, concluding that they were of Lower Permian age. For reasons given below it is considered that correlation of these lithologies over such distances is hazardous. Nordenskjöld was aware of important faulting in Liverpool Land and referred to deformation of the Hurry Inlet granite. Kranck's description of the area (1935) remains the most detailed but is considered to be erroneous in certain important aspects. He assigned a pre-Hurry Inlet granite age to limestones and phyllites alleged to outcrop on the coastal plain and considered these to be overlain unconformably by first

Fig. 1. The geology around Hurry Fjord, East Greenland. Coarse stipple: Hurry Inlet granite. Unshaded: Older sedimentary sequence Upper Palaeozoic). The lower and upper conglomerate horizons are shown (dots and circles). Fine stipple: Mesozoic rocks of Jameson Land and the northern Fame Øer. Solid black: Tertiary intrusions.



a polymict conglomerate and later (on the Fame Øer) by a second conglomerate. These were assigned to the Devonian and the Eotriassic. Kranck's interpretations were largely refuted by Bütler (1957) who recognised the granite-bearing conglomerate as the base of a sedimentary succession which continued with sandy or marly shales, in turn overlain by beds of arkose and conglomerate. The whole succession was assigned to the Eotriassic but with no palaeontological evidence. Bütler also saw the significance of faulting in the area and linked the boundary fault between the granite and the conglomerate to the north-south system known to the north where there is evidence for its very long period of activity.

The contact between the Hurry Inlet granite and its western envelope is not exposed, but in the east it is clear that in places the margins are faulted.

Shearing in the granite near its eastern margin suggests that whilst some of the faulting post-dates the granite the emplacement may in the final stages have been sheet movement of largely crystalline material. This is a feature of high level emplacement of small granite plutons.

The period of unroofing of the granite is not represented in the local stratigraphy as the oldest of the non-metamorphosed rocks lie unconformably on the granite and appear to be composed entirely of granite debris of local derivation. These rocks, conglomerates and very coarse grained arkosic grits are presumably those referred by Kranck (1935) to the Devonian. The principal exposures are two patches north and south of Kalkdal and one further north, but almost identical material forms the easternmost part of the section in Damelv. The conglomerates are usually massive so that bedding surfaces are not discernible, but local large-scale erosion channels occur and in other places lenses of red or chocolate flagstones and marls are to be found. The constituent material is entirely granitic in origin. Granite blocks, usually angular, occur together with clasts of aplite and less commonly quartz porphyry. The matrix is feldspar rich, unsorted and overall coarse-grained. Clearly the material suffered little chemical change during transportation and the minimal amount of sorting suggests rapid deposition under arid or semi-arid conditions. The distribution of the outcrop is in part controlled by post-depositional faults but the material has the characteristics of trough deposition in an area of high relief. There is, however, no evidence of banking of material against fault-bounded topography, nor of steep depositional dips. In Damelv the conglomerate outcrop is only 5 m broad and bounded by faults against both the granite and younger strata.

In the Kalkdal sections the conglomerates are succeeded by red beds consisting of banded sandstones, arkoses (which in places are extremely coarse-grained) and bedded conglomerates. Finer lithologies – silts and marls – are less well developed and seem to be confined to rapidly thinning lenses. The striking feature of the conglomerates is that thin beds (0.3 m) containing an abundance of large granite blocks in a sandstone matrix may be interbedded with more uniform arkoses and sandstones. Occasional isolated blocks 0.15 m in diameter occur in sandstone bands. As with the lower conglomerates, all the material can be identified with the Hurry Inlet granite. Beds of very similar character outcrop on the coast in a strip from south of Sødal to north of Damelv, but between the two series there are outcrops of beds of a darker colour. These are feldspathic sandstones but some are argillaceous and some slightly calcareous. Sedimentary structures observed in the sandstones and siltstones include cross-bedding, ripple drift cross-lamination and small-scale slumps, and in some horizons there are polygonal dessication cracks. Plant debris occurs locally and in a few siltstone bands it is quite abundant.

The petrographic features of the sediments, particularly the range in grain size, rapid lateral and vertical variations of grain size and the freshness of the material, all of local granite origin, suggest rapid erosion and transport in an area of high relief, with deposition near an eroding upland. As the sequence post-dates the granite which is a late-stage intrusion, it seems likely that the high relief was maintained during deposition by fault activity. Deposition in an area of irregular topography in which faulting was active results in difficulties in correlation, even over short distances. This follows since the material deposited is always of local origin and the environment of deposition rapidly changing. The fossil-bearing samples thus become of paramount importance.

Evidence for post-depositional faulting is strong. North of Kalkdal the lower conglomerates, which are nearly horizontal, are faulted against westerly dipping younger strata. The latter succession is broken in several places by faults and whilst the strata consistently dip westwards, the angle varies between faults. Similar features obtain in the Damelv section. The mean dip for these strata is to the north-west of 43° (031/43); that for the lower conglomerate almost due west at 6° (170/6), a relation which shows that the area has not been subjected to a regional tilt. It must therefore be concluded that dips were induced by movement on a series of north-south trending faults.

The two biggest of the Fame Øer lie north and west of the rest. On the southernmost (Ingmikêrteralik kiterpaq) a 'sill' of strongly feldsparphyric dolerite has a horizontal lower contact against quartzites and arkoses lithologically identical to those on the adjacent mainland. These sediments dip westwards at about 45° . On the more northerly islands what is clearly the same intrusion has an almost concordant lower contact with very gently dipping deep-red sandstones and marls of a type not seen on the east side of Hurry Fjord, but almost certainly like the lower horizons of the Mesozoic strata on the northwest side (the Eotriassic of Kranck). Hence a (more or less) north-south fault must lie west of the southernmost island and throw down to the west. This clearly pre-dates the emplacement of the sill. On the other hand, failure of the sill to outcrop on the mainland indicates the existence of another north-south fracture east of the southernmost island. This also downthrows to the west but continued movement after the emplacement of the sill.

There seems no reason to doubt that all these faults are related. They define the eastern limit of the Jameson Land Mesozoic strata; they seem to have been a controlling factor in the formation of the Hurry Fjord and are almost certainly related to important north-south breaks that occur further west and that bring the same Mesozoic strata against older crystalline rocks.

The full investigation of the Jameson Land strata will solve the problem of their provenance. It appears however that the Mesozoic strata were deposited in a trough with a north-south elongation. The present limits of outcrop are fault controlled but there is no evidence that the higher horizons were deposited on Liverpool Land. It follows that the depositional trough was also fault bounded, a view which is consistent with the indications of a long history of steep faulting on north-south lines.

The observations recorded here were made during the 1969 GGU expedition to Scoresby Sund. I would like to thank the director of GGU K. Ellitsgaard-Rasmussen for permission to publish the results.

Dansk sammendrag

I området nordøst for Hurry Fjord findes en sen-kaledonisk granit (Hurry Inlet granite, Kranck (1935)), der mod vest begrænses af en ikke-metamorfoseret sedimentserie af sandsynlig øvre palæozoisk eller nedre mesozoisk alder. På Fame Øerne i fjordens bund gennemsættes sedimenterne af tertiære sills. Nord-sydlig normale forkastninger med relativ sænkning af den vestlige side, kan vises at have været virksomme gennem en længere periode med delbevægelser både før og efter sill intrusionerne. Forkastningerne danner begrænsningen til det mesozoiske sedimentationsbassin mod vest.

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