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STRATIGRAPHY OF THE INDEPENDENCE FJORD GROUP (PROTEROZOIC) OF EASTERN NORTH GREENLAND

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Introduction

Completion of fieldwork in the Proterozoic sediments of eastern North Greenland allows a lithostratigraphic scheme to be erected. This scheme (Table 1) modifies and formalises the informal scheme proposed earlier (Collinson, 1979).

Mapping between Sydpasset and the southern part of Mylius-Erichsen Land (fig. 2) has demonstrated the need to describe the sequence in terms of two areas between which correlation must remain speculative. The intense development of large intrusive sheets of dolerite and granophyre in Vildtland, western J. C. Christensen Land and Heilprin Land makes it necessary to draw a somewhat arbitrary boundary along Independence Fjord and Academy Gletscher (fig. 2).

The lack of certain correlation between the two areas does, however, allow the retention

Table 1. Scheme of stratigraphical subdivision proposed for the Independence Fjord Group

Independence Fjord Group			
N & W of Academy Gletscher and Independence Fjord		S & E of Academy Gletscher and Independence Fjord	
Inuiteq Sø Formation >1000 m	Himmerlanddal Member (45 m) red siltstone Baggården Member (>36 m) red siltstone (No stratigraphical order implied between siltstone layers) base not seen	Norsemandal Formation >1800 m	Fiil Fjord Member (465-600 m) sandstone Kap Stadil Member (65-90 m) red siltstone Astrup Fjord Member (290 m) sandstone Hagen Bræ Member (4->70 m) red siltstone - - - - unconformity? - - - - Academy Gletscher Member (>900 m) sandstone base not seen

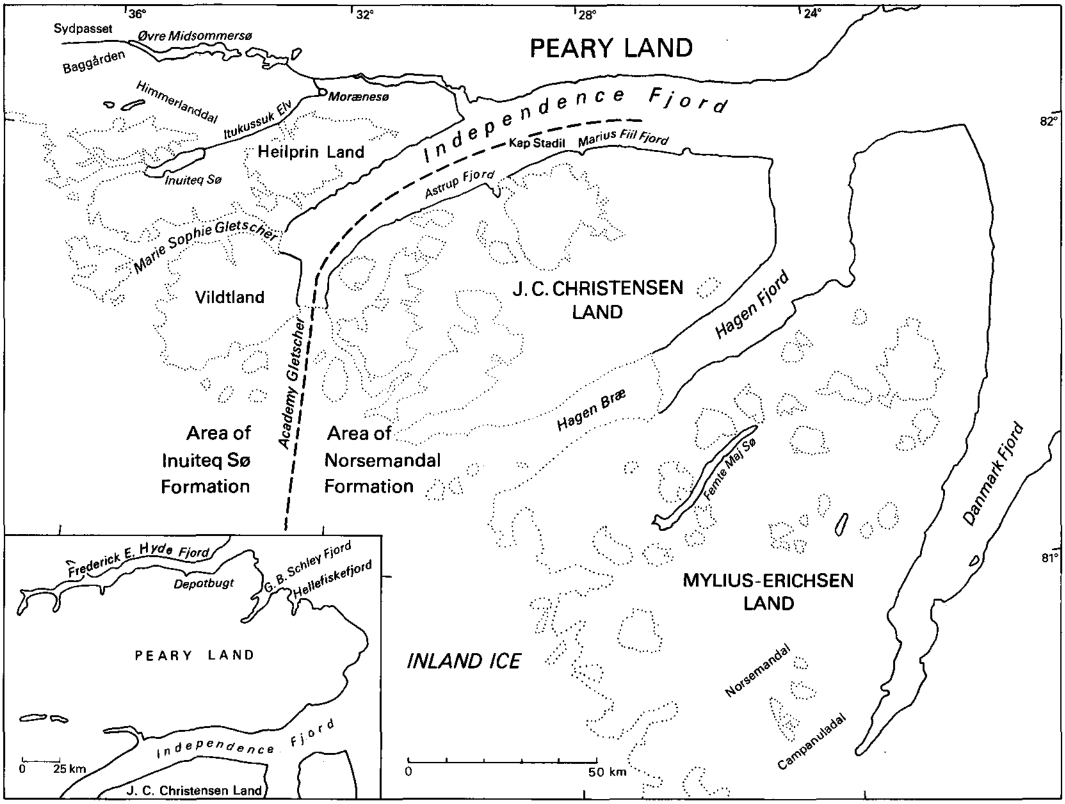

Fig. 2. Location map of the main outcrop area of the Independence Fjord Group, showing the arbitrarily chosen boundary between the outcrop areas of the Inuiteq Sø and Norsemandal Formations. Inset map shows the location of the exposures in eastern Peary Land.

of some of the established stratigraphical names. The rocks north and west of the boundary are still referred to as the Inuiteq Sø Formation (Jepsen, 1971) whilst the re-defined term Norsemandal Formation is used for the rocks to the south and east (cf. Norsemandal Sandstone of Adams & Cowie, 1953; Norsemandal Formation of Cowie, 1971), and the rocks of the two areas together are defined as the Independence Fjord Group.

Further subdivision of these formations into mappable members is possible, with more success being achieved in the Norsemandal Formation than the Inuiteq Sø Formation.

Independence Fjord Group

General. The group is identical with the informally defined 'Proterozoic sandstones' (Collinson, 1979) and forms the lower part of what had, at one time, been referred to as 'Thule Formation' (Koch, 1929) and 'Thule Group' (Troelsen, 1949; Haller, 1971). The abandonment of these terms has already been advocated by Dawes (1976).

Name. After the major fjord of the region which also demarcates most of the boundary between the constituent formations.

Type area. Western J. C. Christensen Land and Heilprin Land between Sydpasset and Hagen Bræ.

Thickness. At least 1750m and more likely in excess of 2500m.

Lithology. A sequence of thick homogeneous sandstones with thin, but laterally persistent units of red siltstone or interbedded sandstone and red siltstone. These lithologies alternate, with no overall trend of lithological change.

Boundaries. The base is not seen anywhere, but it is inferred to be a non-conformity upon the crystalline basement. The nearest outcrop of these basement rocks is at the head of Victoria Fjord, 100km west of the north-western limit of the group's outcrop. Here the crystalline basement is overlain by Lower Cambrian(?) rocks (Hurst & Peel, 1979).

The top is variable. South of Independence Fjord the group is overlain conformably by the Zig-Zag Dal Basalt Formation (Jepsen, this report), the top being taken at the base of the first basalt flow. North of Independence Fjord, the group is overlain unconformably by sediments of the Moræneso (Proterozoic) and Portfjeld (Lower Cambrian; Peel, 1980) Formations. There is seldom any detectable angular discordance, though the base of the Morænesø Formation commonly shows considerable relief.

Distribution. The group occupies most of Heilprin Land, Vildtland, western J. C. Christensen Land and Mylius-Erichsen Land though intrusions may locally occupy up to 50 per cent of the outcrop area (fig. 2).

Geological age. The group is clearly Proterozoic in age. Radiometric ages on the clays of the Hagen Bræ Member suggest an age of *c.* 1350 m.y. (Larsen & Graff-Pedersen, this report). An intrusive granophyre has yielded a whole-rock Rb-Sr isochron age of 1230 ± 25 m.y. (Jepsen & Kalsbeek, 1979). The overlying basalts have yet to yield a satisfactory age. A middle or early Upper Proterozoic age is, therefore, likely for the group.

Subdivisions. Because of problems of correlation, the group is divided into two formations, based on geographical distribution, the Inuiteq Sø and Norsemandal Formations (Table 1; fig. 2).

Inuiteq Sø Formation

General. The Formation was originally defined by Jepsen (1971) and is retained here and applied to all rocks of the Independence Fjord Group lying to the north and west of Independence Fjord and Academy Gletscher.

Name. After the lake, Inuiteq Sø in central Heilprin Land (fig. 2).

Type section. The northern corner of Inuiteq Sø. This section is the same as that used by

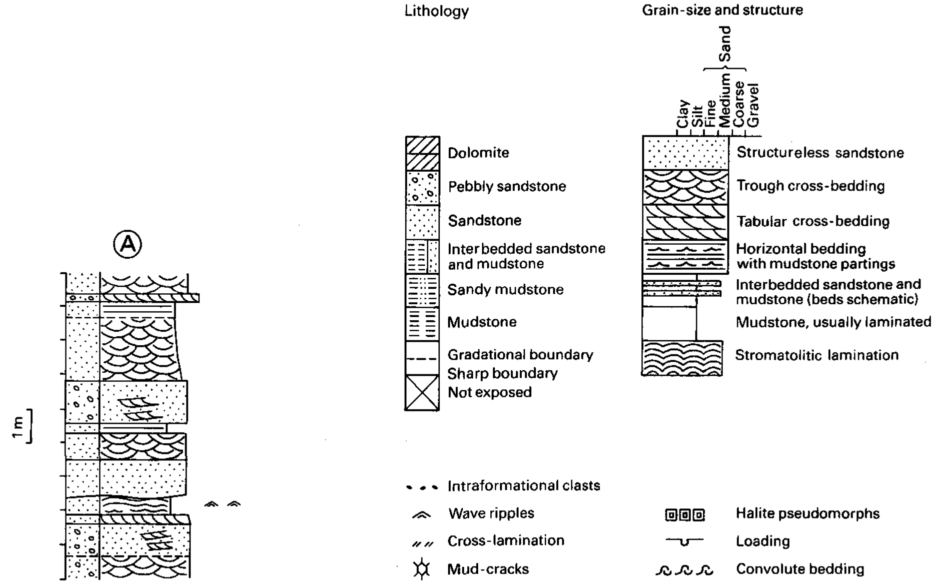

Fig. 3. Standard legend covering all the figured sections. (A) Short section in Inuiteq Sø Formation sandstones at the south-western end of Inuiteq Sø. This is fairly typical of the sedimentation which characterizes many hundreds of metres of these sandstones. Legend applies to all measured sections.

Jepsen (1971) and involves sandstones, a siltstone-bearing unit and a 2 m dolomite bed, the latter two of which probably equate with the Himmerlanddal Member, defined below.

Thickness. A minimum thickness of *c.* 800 m on the south side of Inuiteq Sø but the true total thickness is probably well in excess of 1 km. The intense development of intrusions makes comprehensive estimates of thickness impossible.

Lithology. Dominantly medium- to coarse-grained sandstones of variable composition from feldspathic to quartzitic, commonly with well rounded grains (fig. 3A). Sandstones are usually pale brown to yellow weathering but are commonly white. There are some conglomerate horizons. The sandstones are usually cross-bedded but interbedded units of cross-lamination occur and ripples are quite common on upper bedding surfaces. There is no obvious pattern or ordering to the lithologies within the sandstones (fig. 3A).

Interbedded with the sandstones there are at least two units in which red siltstone is a conspicuous lithology. These units are sufficiently distinctive to be mappable over restricted areas and are accorded 'member' status.

Boundaries. As for the group as a whole, the base of the Inuiteq Sø Formation is not seen, being beneath the inland ice. The top is an unconformity with either the Moræneso or Portfjeld Formation. Only at Inuiteq Sø is an angular divergence seen where intrusions have locally tilted the bedding in the Inuiteq Sø Formation (Jepsen, 1971, fig. 21). Elsewhere, however, the younger formations probably rest on different levels in the Inuiteq Sø Formation as a result of the variable displacements caused by the intrusions, but it is not possible to demonstrate this directly.

Distribution. Heilprin Land and Vildtland (fig. 2).

Subdivisions. Two siltstone-bearing members are recognized, the Himmerlanddal and the Baggården Members (Table 1). They constitute only a small proportion of the sequence and their stratigraphical relationships are unknown. In consequence, the sandstones which form the bulk of the formation are left undivided.

Himmerlanddal Member

Name. After Himmerlanddal (fig. 2 & 5) along both sides of which the member is exposed.

Type section. South side of Øvre Midsommersø (fig. 5, Locality A).

Thickness. 45 m (maximum) at the type section (fig. 4A). This thickness could be up to 10 m less as the top is poorly exposed. The thickness in Himmerlanddal is between 30 and 35 m, whilst at Inuiteq Sø, a maximum thickness of 50 m seems likely (L. B. Clemmensen, personal communication).

Lithology. The member is dominated by red siltstone, commonly poorly sorted with scattered, sand-sized grains and with thin beds of feldspathic sandstone up to 10 cm thick (fig. 4A). These sandstones are parallel-sided and commonly have wave ripples on their top surfaces. Some show grading and contain scattered mudflakes and the bases of some beds show well-developed halite pseudomorphs. In the lowest 2 m of the member, sandstones are coarser, sometimes conglomeratic, and may be up to 20 cm thick. Siltstones, where interbedded with sandstones, commonly show mudcracks with sand infills.

In addition to the thin sandstone beds, thicker beds of sandstone up to 3.5 m thick are present, usually showing thin, sub-parallel bedding defined by mudflakes or thin silty partings. Other thick sandstones show small-scale cross-bedding. A conspicuous feature of the member is a thin bed of dolomite about 11 m above the base at the type locality where the bed is 1 m thick. 4 m above this is a 60 cm thick, white, carbonate-cemented sandstone bed. In Himmerlanddal, there are two dolomite beds, a lower one which is 1.25 m thick and an upper one, about 4 m higher, which is about 40 cm thick. Both are brown, of sand-grain size and with a fine lamination, sometimes cross-laminated. A 2 m dolomite, probably at a similar level, occurs at Inuiteq Sø (Jepsen, 1971).

Boundaries. The lower boundary at the type locality is a sharp contact with the underlying sandstones (fig. 4A). A clastic dyke, 75 cm deep and 20 cm wide, which cuts into the sandstone, is filled with green, sandy conglomerate like that in the lowest 2 m of the member. The flat base and vertical walls of the dyke suggest lithification of the older sandstone before fissure development and deposition of the overlying member. At the type locality, the upper part of the member is poorly exposed and is overlain unconformably by

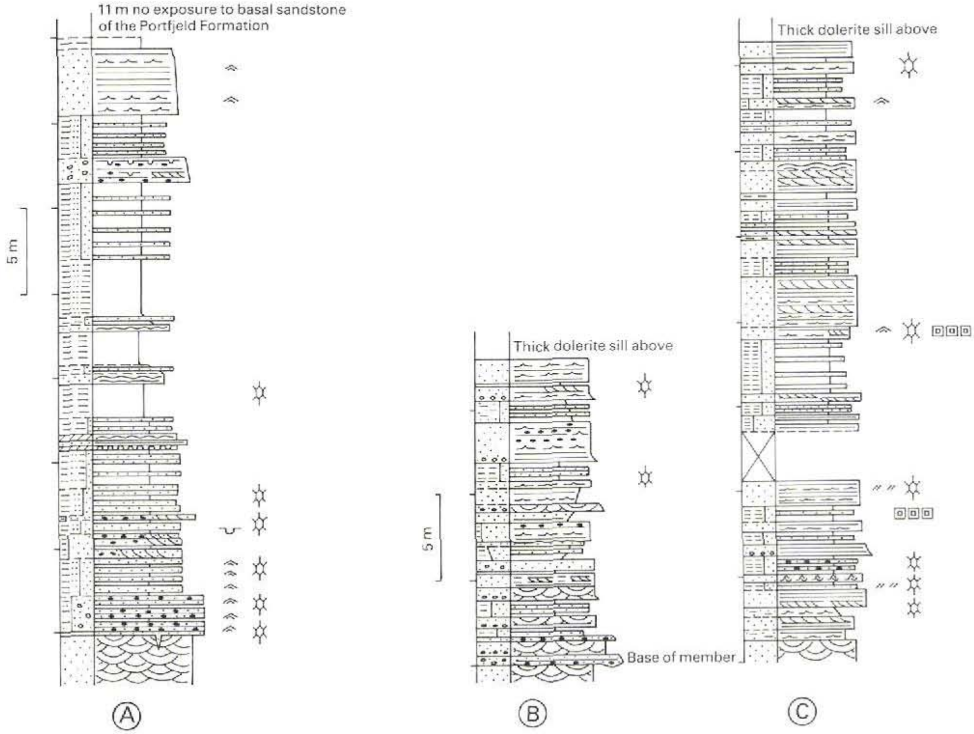

Fig. 4. (A) Type section of the Himmerlanddal Member of the Inuiteq Sø Formation on the southern side of Øvre Midsommersø (locality A, fig. 5). The basal contact with sandstones of the Inuiteq Sø Formation is seen but the upper boundary is not visible. (B, C) Sections in the Baggården Member of the Inuiteq Sø Formation in the type area (locality B, fig. 5). B is a section from the base of the member, exposed on the south side of the valley at Sydpasset; C is a section, whose relation to the top and bottom of the member is unknown, measured on the north side of the valley, 1 km W of Øvre Midsommersø.

the basal sandstone unit of the Portfjeld Formation. In Himmerlanddal and at Inuiteq Sø, the member is sharply overlain by cross-bedded sandstone.

Distribution. The member crops out in the cliffs south of the western part of Øvre Midsommersø and along both sides of Himmerlanddal (fig. 5). It is traceable from the south side of Himmerlanddal to the eastern end of Inuiteq Sø where it is cut out, under the locally angular unconformity, by the overlying Moræneso Formation (Jepsen, 1971, fig. 21). Fragmentary exposure links the outcrops south of Øvre Midsommersø with those at the eastern end of the north side of Himmerlanddal.

Baggården Member

General. The member is not so extensively mappable as the Himmerlanddal Member. Isolated and rather widely scattered outcrops are correlated on the basis of lithological similarity and it is possible that more than one unit may be involved.

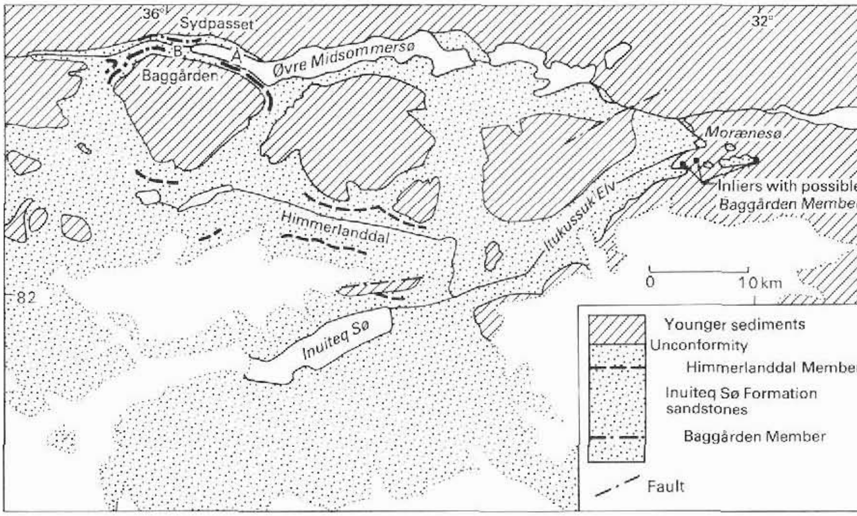

Fig. 5. Geological map of the northern part of the area of outcrop of the Inuiteq Sø Formation, showing the outcrops of the Himmerlanddal and Baggården Members. The type section of the Himmerlanddal (A) and the type area of the Baggården (B) Members are also indicated.

Name. After the area at the western end of Øvre Midsommersø.

Type area. Baggården and Sydpasset, at the western end of Øvre Midsommersø (fig. 5, locality B) where the member occurs on both the north and south sides of the valley. At all localities, the member is intruded by large dolerite sills which prevent definition of a complete type section.

Thickness. North of the river, 1 km west of the western end of Øvre Midsommersø, 36 m of silt-bearing sediment occur. The base is not seen and the top is truncated by a dolerite sill (fig. 4C). South of the river, up to 20 m are exposed with the base visible but the top again truncated by a sill (fig. 4B).

In the inliers at Itukussuk Elv (fig. 2), only relatively small fragments of the member are exposed, the maximum demonstrable thickness being 19 m.

Lithology. Interbedded, dark red, sandy siltstones and sandstones. The sandstone/siltstone ratio differs between the two main outcrop areas. At Itukussuk Elv, siltstones are dominant with most sandstones less than 7 cm thick, while at Sydpasset, sandstones are more abundant and thicker sandstone units are up to 3 m thick (fig. 4 B, C). Thin sandstones are commonly sharp-based, laterally extensive and with rippled tops, desiccation mud cracks and halite pseudomorphs all common. Thicker sandstones usually show irregular, sub-horizontal thin bedding defined by thin silty partings and mud flakes. Cross-bedding in sets up to 10 cm is quite common with rare thicker sets.

Boundaries. The base, where seen, shows a sudden incoming of siltstone above a purely sandstone sequence. It is additionally characterized by the intense development of spherical concretions up to 20 cm in diameter in the top of the underlying sandstone. These occur at both Sydpasset and Itukussuk Elv and constitute the main reason for correlating the two areas. However, as less well developed concretionary horizons occur also at, or near, the base of other red siltstone-bearing members, it is possible that even the intense development is non-unique and the correlation therefore spurious.

The top of the member is not seen anywhere, because of truncation either by an unconformity or by a dolerite sill which in turn lies beneath an unconformity.

Distribution. Along the south side of the valley at Sydpasset for a distance of 8 km and on the north side of the valley for *c.* 1 km west of the western end of Øvre Midsommersø (fig. 5). On the valley side, south of Itukussuk Elv, for 3 km west of Moræneso, occurring in inliers beneath the Moræneso Formation.

Norsemandal Formation

General. The 'Norsemandal Sandstone' was originally defined by Adams & Cowie (1953) from Campanuladal (fig. 2). It referred to rocks below the Campanuladal sandstones and limestones. Whilst Adams & Cowie mistook the Zig-Zag Dal Basalt for intrusives, it is clear that the sandstones to which they refer are equivalent to the top of the Norsemandal Formation (i.e. to the Fiil Fjord Member) as re-defined here.The Norsemandal Formation is the sequence of sediments below the Zig-Zag Dal Basalt, in the area to the south and east of Independence Fjord and Academy Gletscher.

Name. After the valley in the south-eastern part of Mylius-Erichsen Land (fig. 7).

Type area. The eastern side of the valley, about 18 km south of the head of Astrup Fjord, shows representatives of all five constituent members, although the type sections of the members themselves are widely scattered.

Thickness. The upper four members of the formation have a total thickness of the order of 900 m. The lowest member (Academy Gletscher Member) has a minimum thickness of 900 m. With no observed base to the formation, and with uncertainty about the relationship of this member with higher members due to extensive intrusive sheets, 1800 m is a conservative estimate of minimum thickness. A figure in excess of 2000 m is likely.

Lithology. Mainly medium to coarse sandstones varying in composition from quite feldspathic to fairly pure quartzite. Colours range from dark red-brown to yellow and white. Most sandstones are cross-bedded though some are more thinly bedded with ripple marked top surfaces. In addition, two relatively thin units, containing significant proportions of red siltstone, are valuable mapping units and are accorded 'member' status.

Boundaries. The base of the formation is not seen anywhere and lies beneath the Inland Ice. The top is an apparently conformable contact with the Zig-Zag Dal Basalt.

Distribution. To the south-east of Academy Gletscher and Independence Fjord in J. C. Christensen Land and Mylius-Erichsen Land (fig. 7).

Subdivisions. The Formation is divided into five members, three of which are sandstones and two of which are characterized by red siltstones (Table1). No members of either type are recognizable purely on internal characteristics and mapping is crucial to identification. The mapping relies entirely on the tracing of the two relatively thin members with red siltstone.

Academy Gletscher Member

General. The Member constitutes the oldest rocks of J. C. Christensen Land and includes part of the informally defined 'lower sandstone formation' of Collinson (1979). In that earlier scheme, the member was grouped with rocks now assigned to the Inuiteq Sø Formation.

Name. After the major glacier which forms the western boundary to arbitrarily defined geographical limits of the formation.

Type area. Cliffs on the south side of Independence Fjord between Academy Gletscher and Astrup Fjord (Fig. 2; locality A, fig. 7).

Thickness. Estimates of a reliable minimum thickness for the member are hampered by the intensity of dolerite intrusion along the south side of Independence Fjord and in the area 10–30 km to the south-east. Local, relatively intrusion-free sections in cliffs, about 5 km north of the end of Academy Gletscher, show 800 m of sandstones occupying the full height of the cliff, but it is impossible to estimate reliably how far the rocks in the top of the cliff lie beneath the base of the overlying Hagen Bræ Member.

Lithology. The member is dominated by medium- and coarse-grained sandstones, varying in composition from feldspathic to quartzitic. The sandstones are cross-bedded, commonly in sets up to 1 m, and more rarely up to 2.5 m, thick (fig. 6 A). Most sets are in the 30-50 cm range. The sandstones form monotonous successions with no obvious breaks or minor sequences though relatively rare pebble horizons may be lag deposits. Sand grains are commonly well rounded suggesting aeolian abrasion, though the greater part of the sequence seems water lain. In addition there are less important units of thinly bedded sandstone with thin silty partings and with rippled tops and desiccation cracks. The sandstones range from white through yellowish-brown to irregular, patchy, dark red and orange-brown. Colour banding follows primary structures in some cases but in others it cross-cuts them.

Little overall vertical change can be detected through the member, though there is a slight tendency for feldspar content to decrease and for thinner, rippled beds to increase upwards.

Boundaries. The base is not seen anywhere. The top varies in character across the area. On the north side of Hagen Bræ it is an unconformity with a topographic relief of at least 70 m but with no visible angular discordance. Both to the north in J. C. Christensen Land and in the area to the south of Hagen Bræ, the boundary appears conformable though it is possible that the horizontal contact may represent a long time interval.

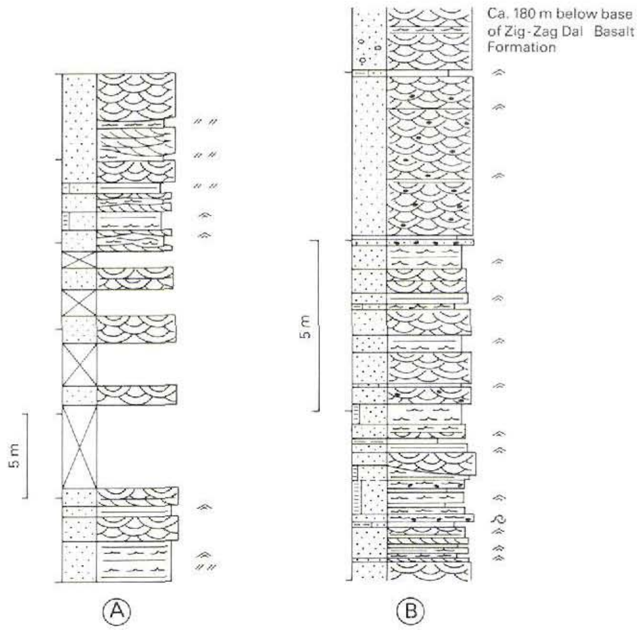

Fig. 6. (A) Fragmentary section in the upper part of the Academy Gletscher Member of the Norsemandal Formation on the eastern side of the valley south of Astrup Fjord (fig. 7). The interbedding of cross-bedded and more thinly bedded sandstone is fairly typical of the member. (B) Representative section in about the middle of the Fiil Fjord Member, west of the ice-dammed lake on the north side of Hagen Bræ.

Distribution. J. C. Christensen Land, west of the valley south of Astrup Fjord and the north-western corner of Mylius-Erichsen Land (fig. 7). Along the northern side of Hagen Bræ, the uppermost 70 m of the member are exposed in 'hills' beneath the unconformity, over a distance of 20 km (cf. Collinson, 1979).

Hagen Bræ Member

General. This is equivalent to the informal 'lower red siltstone member' of Collinson (1979) and is one of the key mapping horizons in the area.

Name. After the major glacier along both sides of which the member is well exposed (fig. 7).

Type area. North side of Hagen Bræ (locality B, fig. 7). Details of the vertical sequence vary with the position relative to the underlying palaeotopography.

Thickness. Highly variable. Along the north side of Hagen Bræ above the unconformity with its palaeotopography, thickness changes from over 70 m in 'palaeo-valleys' to less than 10 m over 'palaeo-hills'. South of Hagen Bræ, the member is 30 m thick.

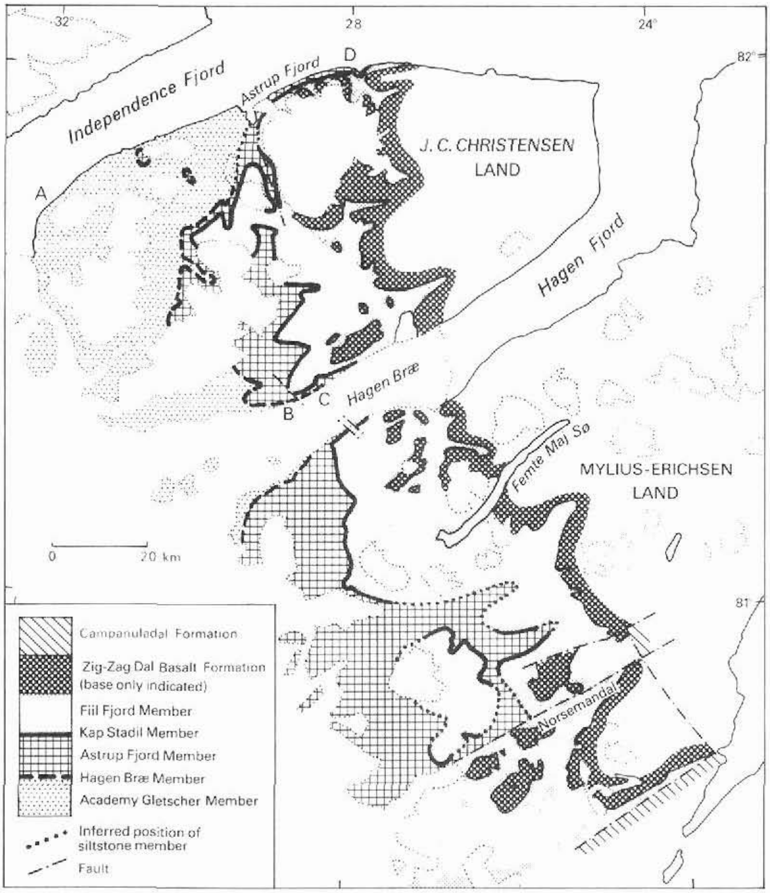

Fig. 7. Geological map showing the distribution of the constituent members of the Norsemandal Formation. The map also shows the location of the type area of the Academy Gletscher Member (A), the type area of the Hagen Bræ Member (B), the type section of the Astrup Fjord Member (C) and the type sections of the Kap Stadil and Fiil Fjord Members (D).

Along the east side of the valley south of Astrup Fjord, only 4 m of the member are seen and it may be absent locally (fig. 8C).

Lithology. Dominantly dark red, poorly-sorted, rather sandy siltstones with thin sandstone beds which become thicker and more common upwards (fig. 8). Siltstones are homogeneous or weakly laminated. Thin sandstones, up to 5 cm thick, are usually sharp-based, laterally extensive and possess wave-rippled tops. Desiccation mud cracks and halite pseudomorphs are quite common. Thicker sandstones have irregular, sub-horizontal bedding with thin silty partings (fig. 8).

On the north side of Hagen Bræ, wedges of breccia are banked against the sides of palaeo-hills, on the unconformity. The breccias have clasts of the underlying Academy

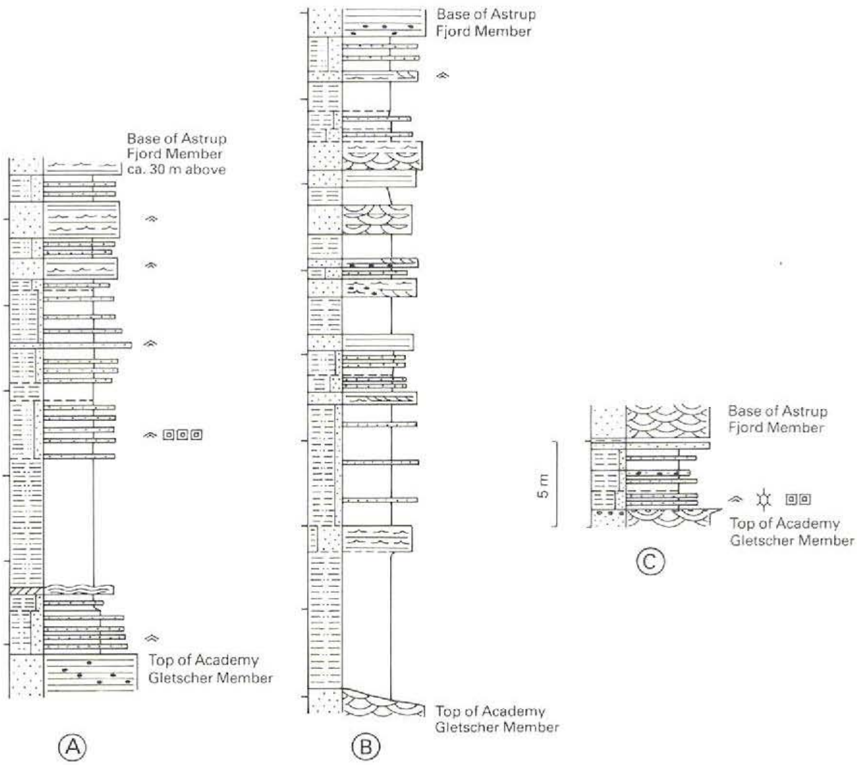

Fig. 8. (A, B, C) Sections in the Hagen Bræ Member. A, on the south side of Hagen Bræ; B, the north side of Hagen Bræ and C in the valley south of Astrup Fjord.

Gletscher Member sandstones set in a sandy matrix suggesting an interval of time sufficient for these sandstones to have become lithified. Thin units of dolomite occur just above the unconformity on the north side of Hagen Bræ and at a level about 3 m above the base of the member on the south side of Hagen Bræ. No carbonate unit is seen in the valley south of Astrup Fjord.

Boundaries. On the north side of Hagen Bræ, the base is an unconformity with the underlying Academy Gletscher Member but elsewhere the topography which allows recognition of the unconformity is absent. The top is a conformable contact with the sandstones of the Astrup Fjord Member. Feldspathic sandstones, interbedded with the siltstones, become more abundant towards the top of the Hagen Bræ Member but the top of the member is taken at the base of the sandstone above which no further red siltstones are seen.

Distribution. J. C. Christensen Land from the valley south of Astrup Fjord to Hagen Bræ and the north-western corner of Mylius-Erichsen Land (fig. 7).

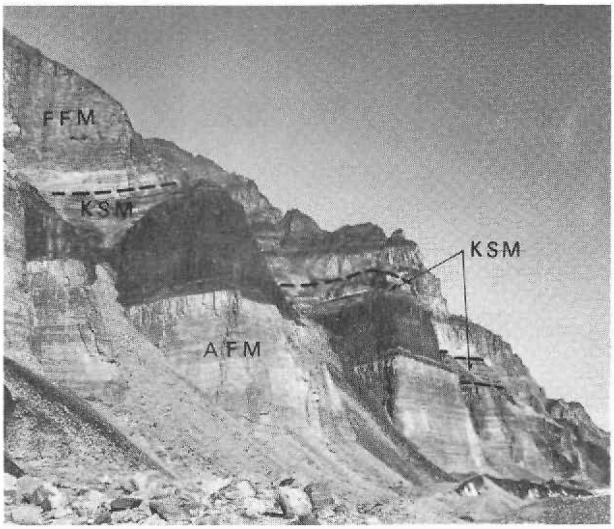

Fig. 9. Type section of the Astrup Fjord Member on the north side of Hagen Bræ (locality C, fig. 7). The base of the member is just below the level of the moraine terrace in the left-hand foreground. The thick dolerite sill is intruded along the boundary of the Astrup Fjord and Kap Stadil Members. AFM: Astrup Fjord. Member; KSM: Kap Stadil Member; FFM: Fiil Fjord Member.

Astrup Fjord Member

General. This is equivalent to the informal 'feldspathic sandstone member' of Collinson (1979).

Name. After the fjord in north-western J. C. Christensen Land where the member crops out extensively along the eastern side of the valley south of the fjord (fig. 7).

Type section. Cliffs on the north side of Hagen Bræ where the full thickness of the member is exposed (locality C, fig. 7).

Thickness. At the type section the member is 290 m thick (fig. 9). This is the only thickness measured with confidence. Elsewhere, incomplete exposure or extensive intrusions complicate matters. The thickness is, however, fairly representative as no very dramatic thickness changes are apparent in the area.

Lithology. Medium to coarse sandstone, feldspathic in the base but becoming less so upwards. Cross-bedding, in sets up to 90 cm thick, is the dominant sedimentary structure. On the north side of Hagen Bræ cross-bedding is present from the base of the member. Further north, in central J. C. Christensen Land, the lowest sandstone is rather thinly and irregularly bedded before it passes up into cross-bedded sandstone. Red and white coloration is irregularly developed throughout the member.

Boundaries. The base is conformable upon the Hagen Bræ Member (fig. 9). On the north side of Hagen Bræ the base is a planar erosion surface whereas to the north and south it is non-erosional and marked by the incoming of coarser feldspathic sands. The top is a sharp, but apparently conformable, contact with siltstones of the Kap Stadil Member.

Distribution. A north–south trending strip across J. C. Christensen Land from Astrup Fjord and widening to the south (fig. 7). Much of the outcrop is ice-covered and boundaries inland are only recognized by mapping the sub- and superjacent red siltstone-bearing members. The member also occupies a wide area of western Mylius-Erichsen Land but little is exposed here, most of the area being a plateau covered by solifluxion debris. In the south, the member is invaded by abundant dolerite and granophyre sheets.

Kap Stadil Member

General. The member is equivalent to the informal 'upper red siltstone member' of Collinson (1979) and is the more extensive of the two key mapping units.

Name. After the headland on the south side of Independence Fjord (fig. 2).

Type section. The western side of Marius Fiil Fjord (figs. 2 & 8; locality D, fig. 7).

Thickness. Thickness varies slightly over the area, from 90 m at the type section to 65 m at Hagen Bræ, and at least 45 m in the south-east of Mylius-Erichsen Land. A section in central Mylius-Erichsen Land, however, seems to have only about 10 m of silty sediments, though exposure is poor.

Lithology. The member is dominated by dark red and, less commonly, green sandy siltstones. Thin sandstone interbeds, commonly a few centimetres thick, but with some thicker beds up to about 3 m, occur, particularly towards the top of the member which may be sand-dominated (fig. 10). Thin sandstones have sharp bases and current- or wave-rippled tops. Halite pseudomorphs and desiccation mudcracks also occur. Thicker sandstones have sub-horizontal, thin, irregular bedding with thin silty partings and mudflakes. Some are cross-bedded in sets up to 10 cm thick.

At Marius Fiil Fjord, a brown-weathering, grey dolomite bed, some 2 m thick and with stromatolitic lamination, occurs at about 13 m from the top of the member (fig. 10 A). Dolomites are not recorded elsewhere in this member.

Boundaries. Both top and bottom boundaries are sharp and apparently conformable. Red siltstones sharply overlie the sandstones of the top of the Astrup Fjord Member. Quartzites of the Fiil Fjord Member sharply overlie siltstones at the top of the member (fig. 10).

Distribution. The outcrop of this key mapping unit extends from Marius Fiil Fjord to the south central part of Mylius-Erichsen Land where faults displace its outcrop beneath the inland ice (fig. 7). It also probably occurs in north-east Peary Land at Hellefiskefjord (fig. 2).

Fiil Fjord Member

General. This is equivalent to the informal 'quartzite member' of Collinson (1979) and its upper part corresponds with that originally defined as the Norsemandal sandstone (Adams & Cowie, 1953).

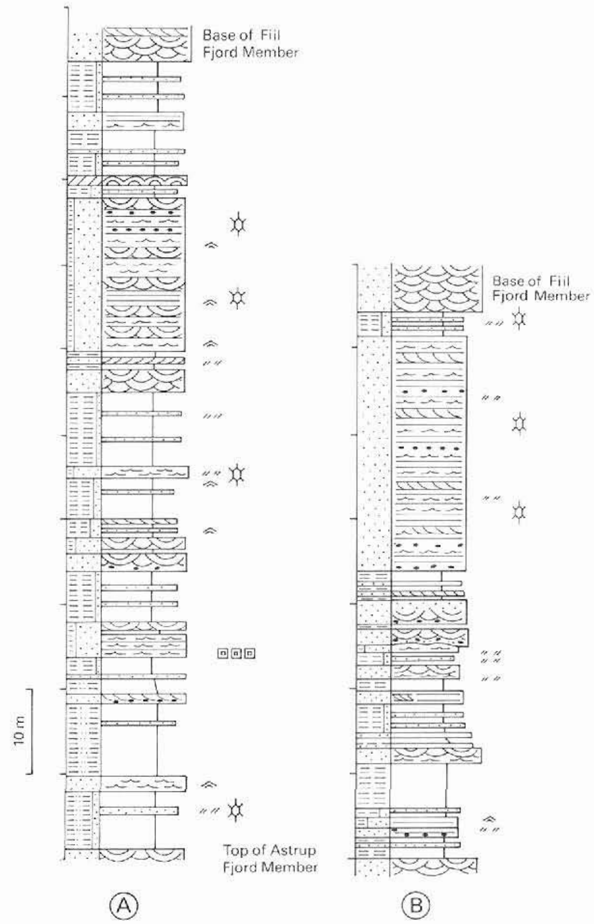

Fig. 10. (A, B) Sections through the Kap Stadil Member. A, at the type locality at Fiil Fjord (locality D, fig. 7) and, B, on the north side of Hagen Bræ.

Name. After the small inlet Marius Fiil Fjord, on the south side of Independence Fjord (fig. 2).

Type section. The eastern side of Marius Fiil Fjord (figs 2 & 8; locality D, fig. 7).

Thickness. At the type section, the member is 465 m thick. At Hagen Bræ, the thickness is estimated at around 570 m whilst in the southern part of Mylius-Erichsen Land a minimum thickness of 600 m seems a reasonable estimate.

Lithology. A monotonous sequence of medium- to coarse-grained quartzites, cross-bedded in sets commonly 20-30 cm thick but up to 1 m (fig. 6 B). Some units of thinner bedding with wave-ripples on bedding planes also occur. Rare mud cracks occur in association with thin silty partings and mud flakes are also present in places. The colour may be red-white, orange-brown or a dull grey. Colour variation forms the basis of a limited mappable subdivision of the member.

Boundaries. The base is a sharp, apparently conformable contact with the red siltstones of the Kap Stadil Member, the boundary being at the top of the highest red siltstone bed (fig. 10). The top is an apparently conformable contact with the Zig-Zag Dal Basalt.

Distribution. The member occupies a wide tract from Independence Fjord to the south of Mylius-Erichsen Land around Campanuladal (fig. 7). In central Mylius-Erichsen Land, the member is heavily intruded by dolerite and granophyre sheets. A probable lateral equivalent of this member occurs in north-eastern Peary Land between Depot Bugt and Hellefiskefjord (fig. 2).

Subdivision. From Independence Fjord to the area between Hagen Bræ and Femte Maj Sø (fig. 7) a mappable subdivision, based on colour, appears tenable, although further south this appears to break down. Two subdivisions are mappable. A lower unit, up to about 270 m thick, is characterized by red and brown coloration and an upper unit is dominantly dull grey.

Relationships between the Inuiteq Sø and Norsemandal Formations

The two constituent formations of the Independence Fjord Group are separated on arbitrarily chosen geographical grounds. It is clear that near Academy Gletscher at least, there must be some equivalence between a part of the Academy Gletscher Member of the Norsemandal Formation and the sandstones of the Inuiteq Sø Formation. The extent of any correlation between the two formations however presents a difficult problem. As correlation is based on the red siltstone members, there are several possibilities for correlation of which three types seem worthy of further consideration.

(1) The two red siltstone members of the Inuiteq Sø Formation correlate with the two red siltstone members of the Norsemandal Formation, even though it is not possible to say which pairs equate owing to the unknown stratigraphical relationship of the Himmerlanddal and Baggården Members.

(2) One of the red siltstone members in the Inuiteq Sø Formation correlates with the Hagen Bræ Member of the Norsemandal Formation but the Kap Stadil Member has no equivalent in the Inuiteq Sø Formation. The other red siltstone and much of the sandstone of the Inuiteq Sø Formation would then lie below the Academy Gletscher Member.

(3) None of the red siltstone members correlate and the two siltstone members of the Inuiteq Sø Formation lie at a level below the lowest beds in the Academy Gletscher Member of the Norsemandal Formation. Correlation would then be limited to an equivalence of the uppermost sandstones of the Inuiteq Sø Formation and the lower part of the Academy Gletscher Member.

The lithological similarity of all the red siltstone members means that it is impossible to identify them unambiguously out of their field context. Correlation by direct comparison of the various siltstone members is therefore impractical and one must rely on the mapped distributions. Of these possibilities, it seems that (1) is highly unlikely, (2) is possible, but (3) is most likely. The only hope for resolving the problem, other than on these intuitive grounds, seems to lie with the acquisition of palaeomagnetic data.

If correlation is confined to the equivalence of the uppermost Inuiteq Sø Formation and the lower part of the Academy Gletscher Member, and if the unconformity associated with the base of the Hagen Bræ Member is of regional significance, the Hagen Bræ Member and younger sediments may reflect deposition in a somewhat different basin configuration to that which prevailed during deposition of the Inuiteq Sø Formation and the Academy Gletscher Member. There could, indeed, be a regional erosional episode represented by the base of the Hagen Bræ Member with this member overstepping different levels of the Academy Gletscher Member. However, this cannot be demonstrated in the absence of a more refined stratigraphy.

Correlations with north-eastern Peary Land

In the area between Depotbugt on the south side of Frederick E. Hyde Fjord and Hellefiskefjord (fig. 2), quartzites with dolerite intrusions and basalts were recognized by Christie & Ineson (1979). The sediments here also include a 40 m unit of red siltstones and thin sandstones with halite pseudomorphs exposed near the south-eastern end of Hellefiskefjord. The basalts rest directly on the quartzites, and comparison with the sequence seen in J. C. Christensen Land suggests that the quartzites are equivalent to the Fiil Fjord Member, with the siltstones equating with the Kap Stadil Member. Poorly exposed quartzites below the red siltstone equate with the top of the Astrup Fjord Member.

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