NEOHELIKIAN BYLOT SUPERGROUP OF BORDEN RIFT BASIN, NORTHWESTERN BAFFIN ISLAND, DISTRICT OF FRANKLIN

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G.D. Jackson, T.R. Iannelli[1], R.D. Knight[2], and D. Lebel[3]
Precambrian Geology Division

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Abstract

About 6100 m of sandstones, shales, conglomerates and stromatolitic carbonates were deposited during a 1200-1250 Ma Mackenzie rifting episode and are separated into three groups: a lower and an upper sequence, each of which grades from predominantly alluvial up into basinal and/or subtidal strata, and a middle shelf carbonate sequence. Thick coastal sabkha evaporites occur in the middle carbonates, and tholeiitic subaerial basalts occur near the base of the lower group.

Episodic syndepositional faulting in northern Borden Basin was coincidental with, but less intense than that in southern Borden Basin. An uplifted western source area existed during lower Elwin and a northern source area during upper Elwin sedimentation. Some separation of Greenland from North America probably occurred during Bylot Supergroup sedimentation.

Postdepositional faulting increases in intensity northward and may be related largely to formation of Lancaster Aulacogen in the Cretaceous.

Résumé

Environ 6 100 m de grès, schistes argileux, conglomérats et carbonates stromatolitiques ont été mis en place pendant un épisode de formation d'un fossé tectonique dans le bassin du Mackenzie il y a 1200 à 1250 Ma. On subdivise ces dépôts en trois groupes: une séquence inférieure et une séquence supérieure, dont chacune passe progressivement de strates principalement alluviales à des strates de type sédimentaire profond ou subtidal, ou aux deux à la fois, et une séquence carbonatée de plate-forme médiane. Dans les carbonates de la séquence médiane, on rencontre d'épaisses couches d'évaporites de sebkha littorales, et des basaltes tholéiitiques d'origine subaérienne, près de la base du groupe inférieur.

Les épisodes de formation de failles synsédimentaires dans le nord du bassin de Borden, ont coincidé avec un épisode du même type dans le sud de ce bassin, toutefois moins intense. Il existait dans la partie ouest une région source soulevée pendant la sédimentation ancienne d'Elwin, et une région source au nord pendant la sédimentation récente d'Elwin. Durant la sédimentation du supergroupe de Bylot, a probablement eu lieu un mouvement de séparation entre le Groenland et l'Amérique du Nord.

L'intensité des épisodes de formation de failles postsédimentaires augmente vers le nord, phénomène peut-être dû largement à la formation de l'aulacogène de Lancaster survenue au cours du Crétacé.

[1] Department of Geology, University of Western Ontario, London, Ontario N6A 5B7
[2] Department of Geology, Carleton University, Ottawa, Ontario K1S 5B6
[3] Université de Montréal, Montréal, Québec H3C 3J7

Introduction

The 1984 field season was oriented toward filling gaps in the field coverage remaining from previous field seasons, and in investigating some aspects of the Bylot Supergroup in more detail (Fig. 75.1).

This preliminary report deals chiefly with the data gathered during the 1984 field season, and the reader is referred to previous publications for additional data on the Bylot Supergroup and Nanisivik mine (Blackadar, 1970; Clayton and Thorpe, 1982; Geldsetzer, 1973a, b; Iannelli, 1979; Jackson and Davidson, 1975; Jackson and Iannelli, 1981; Jackson et al., 1975, 1978, 1980; Olson, 1977, 1984). All previous data for the Elwin Formation, and selected data for the other map units within the 1984 field area, have been incorporated into the figures of this paper. Iannelli is completing a Ph.D thesis on the Arctic Bay and Fabricius Fiord Formations; the Elwin Formation is the subject of a master's thesis by Knight. Lebel provided a résumé and an interpretation of his observations during the summer for this paper.

The regional distribution of formations is essentially as shown by Blackadar (1968a, b), Jackson and Davidson (1975), and by Jackson and Iannelli (1981, Fig. 16.2).

The Bylot Supergroup (up to 6100 m, Table 75.1) is spectacularly exposed throughout much of the map area (Fig. 75.2), unconformably overlies an Archean-Aphebian gneiss complex and is intruded by northerly to northwesterly trending 750 Ma Hadrynian Franklin diabase dykes. Christie and Fahrig (1983) have concluded that an older swarm – the 950 Ma Borden dykes – and a few Mackenzie dykes are also present.

Bylot Supergroup is overlain unconformably by Cambro-Silurian strata (Blackadar, 1968a,b) in northern Borden Peninsula, and rests directly on the gneiss complex of the Navy Board High.

Bylot Supergroup strata are overlain unconformably by Cretaceous-Eocene Eclipse Group strata on northern Bylot Island (Jackson and Davidson, 1975).

The Eqalulik and Uluksan groups (Table 75.1) occur in a narrow belt along the north side of Navy Board High from Elwin Inlet eastward to about 20 km west of Navy Board Inlet (Fig. 75.1, 75.2). On Bylot Island the strata floor North Bylot Trough, and Eclipse Trough north and east of Canada Point. Eqalulik strata also outcrop around the northwest nose of Byam Martin High. Nunatsiaq Group strata underlie most of northern Borden Peninsula north of the Hartz-Mounlain Fault Zone. Strathcona Sound strata also occur north of Canada Point on Bylot Island.

Basement complex

A cursory examination of the basement complex of Navy Board High indicated that the gneisses are highly sheared. Remnants of supracrustal strata and mafic rocks are common, and late granitic intrusions, although abundant, are rarely more than 500 m in diameter.

An east-west trending belt of partially migmatized high-grade supracrustals extends southward for at least 20 km across the Navy Board High just west of Navy Board Inlet and may be the western extension of a similar belt southwest of Pond Inlet (Jackson et al., 1975). Amphibolite is the predominant lithology. Greywacke-type paragneiss, intermediate metavolcanics and quartzose metasandstones occur chiefly on the southern side of the belt. A coarse grained to pegmatitic, differentiated metamorphosed basic-ultrabasic intrusion, some 600 m in diameter, occurs about 5 km west of the coast. Anorthositic gabbro and gabbro occur in layers up to 100 m thick and bronzite-bearing ultrabasics in layers up to 25 m. Some metagabbro layers up to 2 m thick are internally thinly banded.

A preliminary Rb-Sr age of 2330 ± 49 Ma (M.S.W.D. = 2.0) has been determined by the Survey's Geochronological Laboratory for a migmatite on the east coast of Admiralty Inlet a few kilometres south of Arctic Bay (Fig. 75.1). In comparison granite gneiss from southern Devon Island has yielded a U-Pb age of 2426 Ma (Frisch, 1983). K-Ar ages for basement gneisses about Borden Basin range from 1525-2011 Ma.

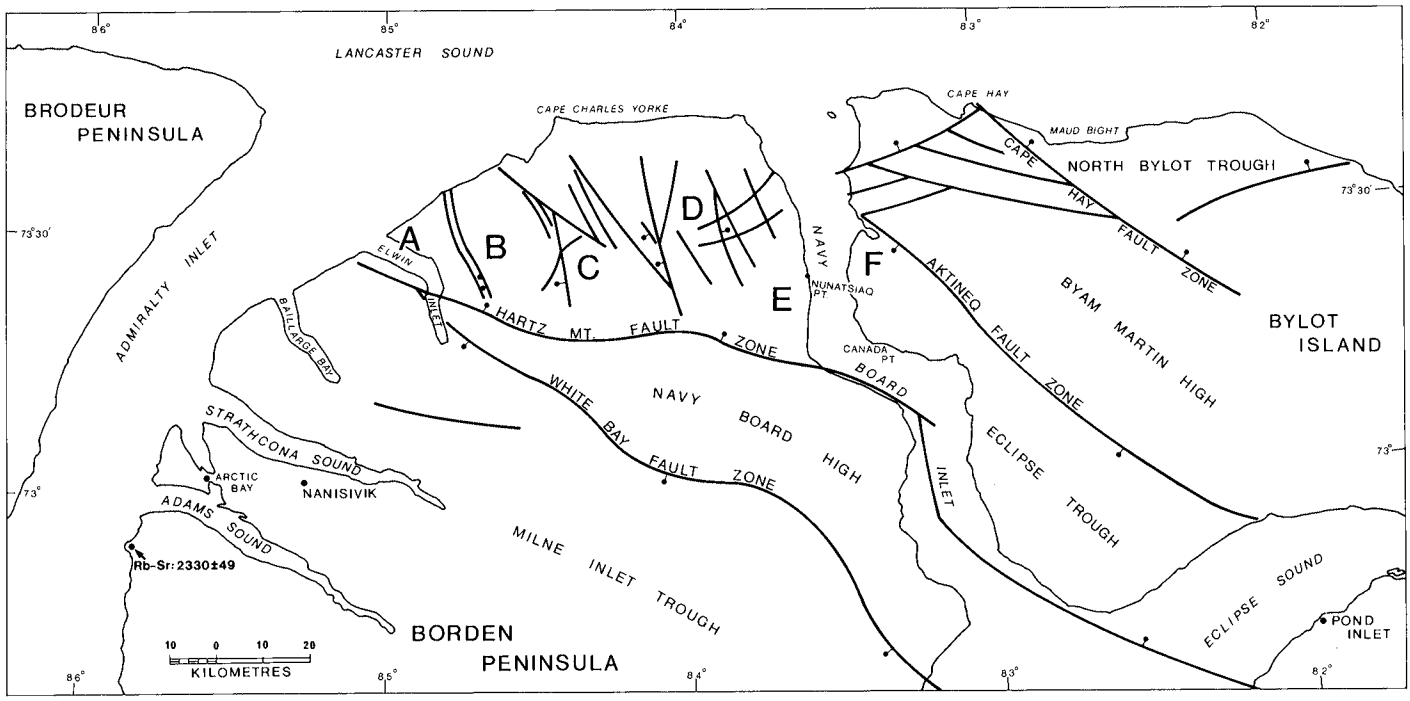

Figure 75.1. *Location map and distribution of major structural elements. Thick lines indicate faults and dots the downthrown side.*

Table 75.1. Table of formations

HADRYNIAN			Franklin Intrusions: Diabase	
		GP	Intrusive Contact	
NEOHELIKIAN	BYLOT SUPERGROUP	NUNATSIAQ	Elwin Fm. (470-1220 m):	EL_1: Quartzarenite, siltstone EL_2: Sandstone, siltstone, dolostone
			Gradational	
			Strathcona Sound Fm: (430-910 m+)	SS_6: SS_{1-5} lithologies interbedded SS_5: Polymictic conglomerate SS_4: Siltstone, greywacke SS_3: Arkose-greywacke, shale SS_2: Dolostone, dolostone conglomerate SS_1: Shale, siltstone
			Gradational	
			Athole Point Fm: (0-585 m) Limestone, sandstone, shale	
			Gradational	Gradational to Unconformable
		ULUKSAN	Victor Bay Fm: (156-735 m)	VB_2: Limestone, dolostone, flat pebble conglomerate VB_1: Shale, siltstone, sandstone, limestone
			Conformable, Abrupt to Gradational	
			Society Cliffs Fm: (263-856 m)	SC_2: Stromatolitic & massive dolostones
			Chiefly Unconformable?	
		EQALULLIK	Fabricius Fiord Fm: (400-2000 m+)	SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
			FF_4: Arkose, conglomerate, dolostone	Gradational to Unconformable
			FF_3: Subarkose, conglomerate	Arctic Bay Fm: (180-770 m) AB_4: Shale, dolostone AB_3: Shale, siltstone AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
			FF_2: Shale, quartzarenite	
			FF_1: Quartzarenite, shale	
			Conformable, Abrupt to Gradational	
			Adams Sound Fm: (0-610 m)	
			AS_3: Quartzarenite, conglomerate, shale	AS_U: Quartzarenite
			AS_2: Quartzarenite	AS_L: Quartzarenite, conglomerate
			AS_1: Quartzarenite, conglomerate	
			Conformable	
			Nauyat Fm: (0-430 m)	NA_2: Plateau basalt NA_1: Quartzarenite, subarkose, basalt
			Nonconformity	
ARCHEAN-APHEBIAN			Granitic gneiss basement complex: Migmatite, foliated granitic rocks, granite, charnockite, supracrustal relics	

Nauyat Formation

The Nauyat Formation is the basal formation of the Bylot Supergroup. It consists of two conformable members: a lower NA_1 member composed chiefly of quartzarenite, and an upper NA_2 member of basalt flows. The formation is about 100 m thick east of Elwin Inlet (Fig. 75.2).

NA_1 member

The lower (NA_1) member (40-45 m) consists of very thin- to medium-bedded buff to reddish brown and pink quartzarenite, with thin quartz-pebble conglomerate layers in the basal part. Crossbeds indicate unimodal northwesterly directed paleocurrents east of Elwin Ice Cap.

NA_2 member

The NA_2 member consists of at least 4 massive columnar jointed tholeiitic basalt flows conformably overlying the NA_1 member. Amygdules are abundant in most of the flow tops and are commonly filled with agate, quartz, carbonate minerals, and chlorite. Thin units of quartzarenite, chert, and varicoloured siltstone occur between the flows. The NA_2 member is about 60 m thick east of Elwin Inlet.

Interpretation

The Nauyat flows (NA_2) were probably extruded along the major fault zones into a subaerial environment on a fluvial braidplain (NA_1), and were burried by quartzarenite before significant erosion could take place (Jackson and Iannelli, 1981). Absence of Nauyat flows below the Adams Sound Formation on eastern Borden Peninsula and northwestern Bylot Island probably reflects an absence of an eruption centre. No evidence has been found anywhere for significant erosion of flows during the filling of Borden Basin. Absence of the lower Adams Sound member in most of these localities suggests a local topographic control.

Adams Sound Formation

The Adams Sound east of Elwin Inlet (Fig. 75.2) and at several places on Bylot Island consists of thin- to thick-bedded quartzarenites. Sedimentary structures are varied and abundant throughout the unit (eg. Jackson and Iannelli, 1981).

The formation is more than 300 m thick east of Elwin Inlet. On Bylot Island it is about 210 m thick along the northeast side of Eclipse Trough (Fig. 75.1) but may be as much as 490 m thick to the north where partial sections of 367-414 m are exposed. More than 160 m of Adams Sound strata are exposed in North Bylot Trough. The Adams Sound Formation is conformable with the underlying Nauyat Formation, and also overlies basement gneisses nonconformably. At one locality on Bylot Island, adjacent to the Aktineq Fault Zone, 10 cm-1 m of grey greywacke regolith in the basement grades upward into 1 m of grey impure sandstone which in turn to grades into quartzarenite of the upper member of the Adams Sound. The contact with the overlying Arctic Bay Formation is gradational. Adams Sound strata have been divided into two intergradational members (AS_L, AS_U), as detailed below.

AS_L member

The AS_L member consists of pink, to light brown and purple-red quartzarenite with some siltstone and shale in the upper part. Thin quartz-pebble- to cobble-conglomerate beds occur at the base of fining upward cycles. The AS_L member is up to 130 m thick east of Elwin Inlet, 171-262 m thick in northern Byam Martin Mountains, 100 m at Cape Hay and 20-100 m in North Bylot Trough, but is absent in most of northern Borden Peninsula area, and along much of the north edge of Eclipse Trough on Bylot Island.

AS_U member

White to grey, buff and pink quartzarenite dominate this member. Thin interlayers of quartz-pebble conglomerate occur locally, and minor green siltstone and shale beds in the upper part increase in abundance adjacent to the contact

with the Arctic Bay Formation. Fining- and thinning-upward cycles are present. Needle shaped cavities, common east of Elwin Inlet, may represent gypsum molds. The member is more than 170 m thick east of Elwin Inlet, about 210 m on Bylot Island in Eclipse Trough, 146-270 m in northern Byam Martin Mountains and 160 m in North Bylot Trough (Fig. 75.1).

Interpretation

Adams Sound strata in the field area have been interpreted to have been deposited in mixed fluvial marine environments (Jackson and Davidson, 1975; Jackson et al., 1978; Jackson and Iannelli, 1981).

Paleocurrent patterns for individual units range from unimodal to bimodal, bimodal-bipolar, and polymodal (Jackson et al., 1980; Jackson and Iannelli, 1981). Cumulative roses (Fig. 75.3) indicate similar features, and show that westerly to northeasterly trends predominante, except at the extreme west where a south-southwest direction is indicated for one unit and at the extreme east where a northeast direction is indicated for another unit.

Arctic Bay Formation

The Arctic Bay Formation was examined at one locality a few kilometres east of Elwin Inlet (Fig. 75.1, 75.2) and at several localities on Bylot Island. It consists of dark grey to black, commonly micaceous, locally pyritiferous shale,

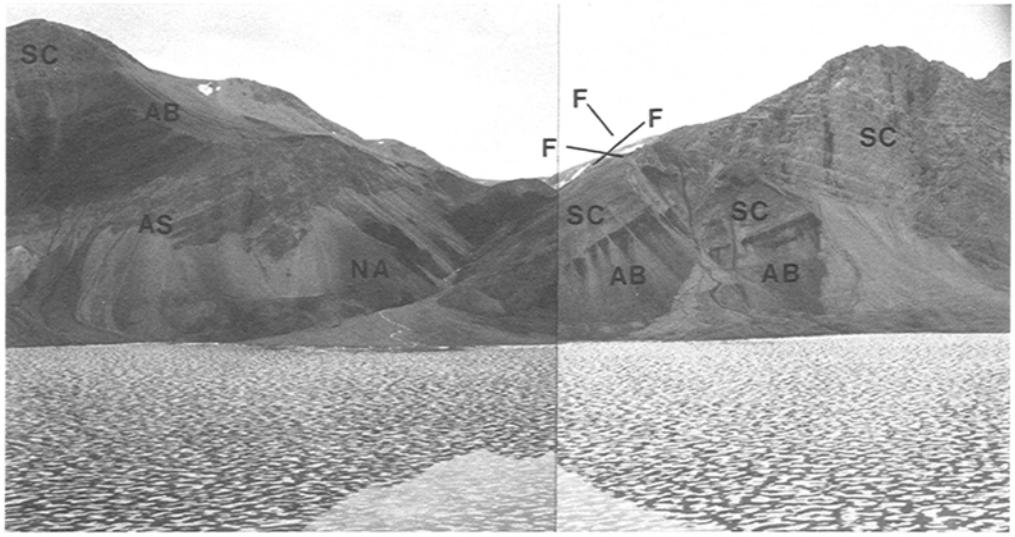

Figure 75.2. Looking east at Elwin Inlet toward splay from Hartz Mountain Fault Zone. NA = Nauyat Fm., AS = Adams Sound Formation, AB = Arctic Bay Formation, SC = Uluksan Group, F = faults. The highest elevations are about 620 m. Photo by G.D. Jackson.

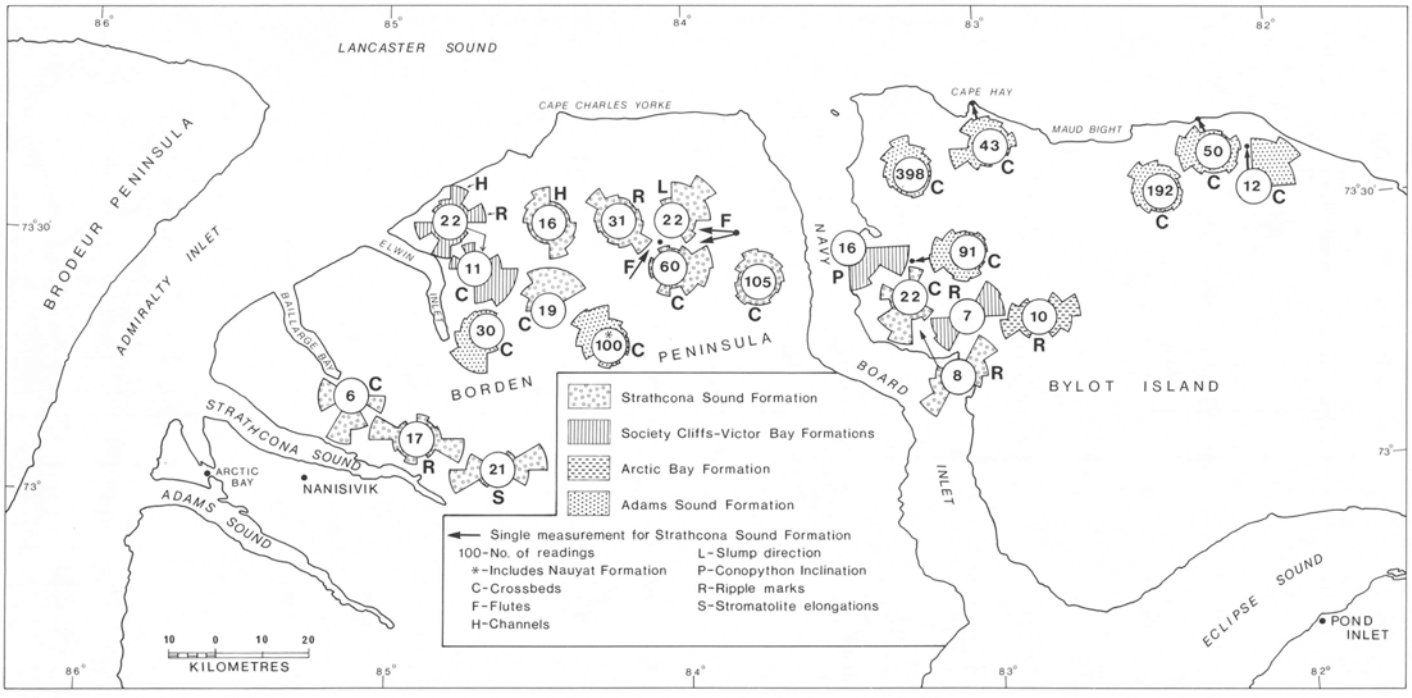

Figure 75.3. Paleocurrent data for some of Bylot Supergroup strata. Radius of circle in centre of rose is 20 per cent. Readings start on the circumference.

similar to the Arctic Bay of Milne Inlet Trough. Siltstone, quartzarenite and subarkose are interbedded with shale throughout the Formation and dolostones form interbeds in the upper part. Thickness of 520 to more than 600 m occur east of Elwin Inlet and 604 m were measured in Eclipse Trough on Bylot Island. Comparable thicknesses appear to be present west of Cape Hay and in North Bylot Trough. Sedimentary structures are common (Jackson and Iannelli, 1981; Jackson et al., 1978, 1980). The same four intergradational members distinguished farther south (Table 75.1; Iannelli, 1979) are also present throughout the area.

AB_1 member

Greyish green to grey white and brownish thinly interbedded fine grained quartzarenite, siltstone and minor shale make up this member. Black shale increases upward. Some beds contain shale intraclasts similar to Fabricius Fiord strata. The member is 10-44 m east of Elwin Inlet and up to 24 m in Eclipse Trough.

AB_2 member

This member is composed of shale dominated shale-siltstone-sandstone coarsening-upward cycles. The shale is grey to black and the coarser lithologies grey-green to grey and brown. The sandstones are predominantly quartzarenite but some are subarkose and resemble Fabricius Fiord strata. The AB_2 member is 120-146 m thick east of Elwin Inlet where about twenty 5-15 m thick cycles are present. However, the total AB_2 may be no more than 25 m thick in Eclipse Trough.

AB_3 member

The AB_3 member consists predominantly of planar to lenticular bedded grey to black shale with up to 25% siltstone and quartzarenite. A few coarsening up sequences occur in Eclipse Trough where a 20 m unit in the upper part of the member consists of alternating red and green shale dominated units with some thin concretion-rich layers and conglomerate composed of concretions. AB_3 strata range from 142-400 m east of Elwin Inlet, and are 195 m in Eclipse Trough.

AB_4 member

Grey or black shale is typically the chief lithology of this member which is 372 m thick in the Eclipse Trough, and more than 30 m thick east of Elwin Inlet, where the member consists of coarsening up shale-siltstone cycles. Sandstones are generally lacking in this member in North Bylot Trough and carbonates are relatively abundant. In Eclipse Trough on Bylot Island the shale is interbedded with several other lithologies. There, grey to greenish grey subarkose is the major lithology in the basal 135 m, whereas grey quartzarenite is prominent in the middle 50 m. Grey, buff to orange-brown weathering dolostones increase in abundance in the upper part of the sequence which is capped by 23 m of the carbonates. The carbonates include dolosiltite, dololutite, stromotalitic to biohermal dolostone and dolostone conglomerate. Grey siltstones are common throughout the section.

Most of the strata in Eclipse Trough are arranged in shale-subarkose, or shale-quartzarenite coarsening up cycles and much of the strata are reminiscent of Fabricius Fiord strata. Interbedded shale-dolostone sequences are common in the middle and upper parts of the section.

Interpretation

AB_1 member has been interpreted to have been deposited in a mixed intertidal-shallow subtidal environment (Jackson and Iannelli, 1981). Clastic shoreline and muddy shelf regimes persisted during deposition of the AB_2 member, and shallow to deep subtidal or basinal during AB_3 sedimentation. The AB_4 member east of Elwin Inlet and on western Bylot Island were probably deposited in marine-influenced delta complexes while shallow shelf carbonate environments persisted farther out in the basin and on northern Bylot Island.

Uluksan Group

The Uluksan Group was examined in one area east of Elwin Inlet and in several localities on Bylot Island (Fig. 75.1, 75.2). Although these strata have been examined at several other localities previously in this region, a satisfactory way of dividing these strata on a regional basis north of Navy Board High has not yet been determined (see also Blackadar, 1968a). The lower Victor Bay shaly member (VB_1) is absent on northern Borden Peninsula and there has been a "telescoping" of facies, so that Victor Bay lithologies and structures are identical to those in the Society Cliffs. Subdivisions can be made adjacent to Byam Martin High on Bylot Island, but the relation of these boundaries to the Society Cliffs-Victor Bay boundary in Milne Inlet Trough is not known. The Uluksan Group is probably about 900 m thick east of Elwin Inlet and at least 1000 m thick on Bylot Island.

The contact with the underlying Arctic Bay Formation is either drift covered or faulted. The contact with the overlying Strathcona Sound Formation is disconformable east of Elwin Inlet, but gradational on Bylot Island where varicoloured shale, siltstone quartzarenite and arkose increase upward in abundance adjacent to the Strathcona Sound Formation.

Victor Bay strata were examined north of eastern Strathcona Sound in Milne Inlet Trough. The thickness and composition of the formation is similar to that at Nanisivik but there is considerably more limestone and the VB_2 member is at least 50 m thicker than at Nanisivik.

On Borden Peninsula and on much of Bylot Island, the Uluksan Group is composed almost entirely of grey to buff and light brown dolostones similar in composition and contained structures to those of the Society Cliffs Formation in Milne Inlet Trough (Jackson and Iannelli, 1981). Uluksan Group strata emit a petroliferous odour and locally contain flecks of bitumen and may be classified as: thick bedded to massive dolostone, laminated to thin bedded dolostone, nodular to ellipsoidal dolostone, and dolostone conglomerate and breccia. Each of these categories is locally predominant in units up to 25 m thick. Cyclic deposition is similar to that in Milne Inlet Trough, but is less obvious. Several types of stromatolites are common and include conophyton. Biohermal mounds seem less common than in Milne Inlet Trough and are less than 15 m in diameter. Local chert replacement of dolostone is common. Shale and sandstone beds are relatively rare except adjacent to Byam Martin High (Fig. 75.1). East of Elwin Inlet 15-25 m of basal brown-weathering dolostones closely resemble the Society Cliffs in western Milne Inlet Trough.

Evaporitic sequences in the Uluksan Group are abundant adjacent to Byam Martin High on Bylot Island but may die out completely within 20 km from the High. These sequences consist of grey, brown, green, and pink dolostones interbedded with grey to black green and red shales and gypsum in units up to 66 m thick. Abundant salt casts occur at several positions in the sequence, and oncolites and oolites occur locally. Depositional sequences include those

previously described, but also include numerous thinning-upward cycles and intergradational dolostone to shale up to gypsum units to 6 m thick with abrupt contacts at the tops. Adjacent to Byam Martin High shale bearing zones alternate with shale-free zones 50-140 m thick. Zones containing red shale units range from 100 to 190 m thick and occur primarily in the middle and upper parts of the Group.

At one locality the lower 610 m of the Uluksan Group is gypsiferous, contains at least 60 gypsum beds that range from 10 cm to 3 m, innumerable beds and lenses less than 10 cm thick, and a large amount of nodular gypsum and gypsum interlaminated with shale and dolostone (Fig. 75.4). Most of the gypsum is white and ranges from impure to pure, and granular to dense and massive.

Interpretation

Uluksan Group strata on Borden Peninsula were deposited in shallow subtidal to intertidal environments. Adjacent to Byam Martin High the strata, which include coastal gypsiferous sabkha sequences, were deposited in a variety of environments ranging from alluvial plain to supratidal and intertidal including lagoons and ephemeral ponds. While Byam Martin High must have been uplifted somewhat, the north side of Navy Board High seems to have been stable.

Strathcona Sound Formation

The formation, as noted previously (Jackson and Iannelli, 1981), comprises a wide variety of complexly interfingering laminated to thin-bedded shales and siltstones, thin- to very thick-bedded sandstones, dolostones and dolostone breccia-conglomerates which occur interbedded in units up to 75 m. The shales-sandstones commonly contain white mica.

This formation occurs throughout an irregular narrow belt that broadens eastward from Elwin Inlet to a width of 20 km west of Navy Board Inlet. It also underlies a few small areas north of Canada Point (Fig. 75.1). The Strathcona Sound Formation is 493 m thick east of Elwin Inlet in a complete section, and sections of 400-520 m have been measured to the east (Fig. 75.2). It is, however, much thinner north of Navy Board High than to the south. The contact between the Strathcona Sound and underlying Uluksan Group

Figure 75.4. *Deformed gypsum bed in Uluksan Group, northwest Bylot Island. The lens cap is about 5 cm. Photo by G.D. Jackson. (GSC 204194)*

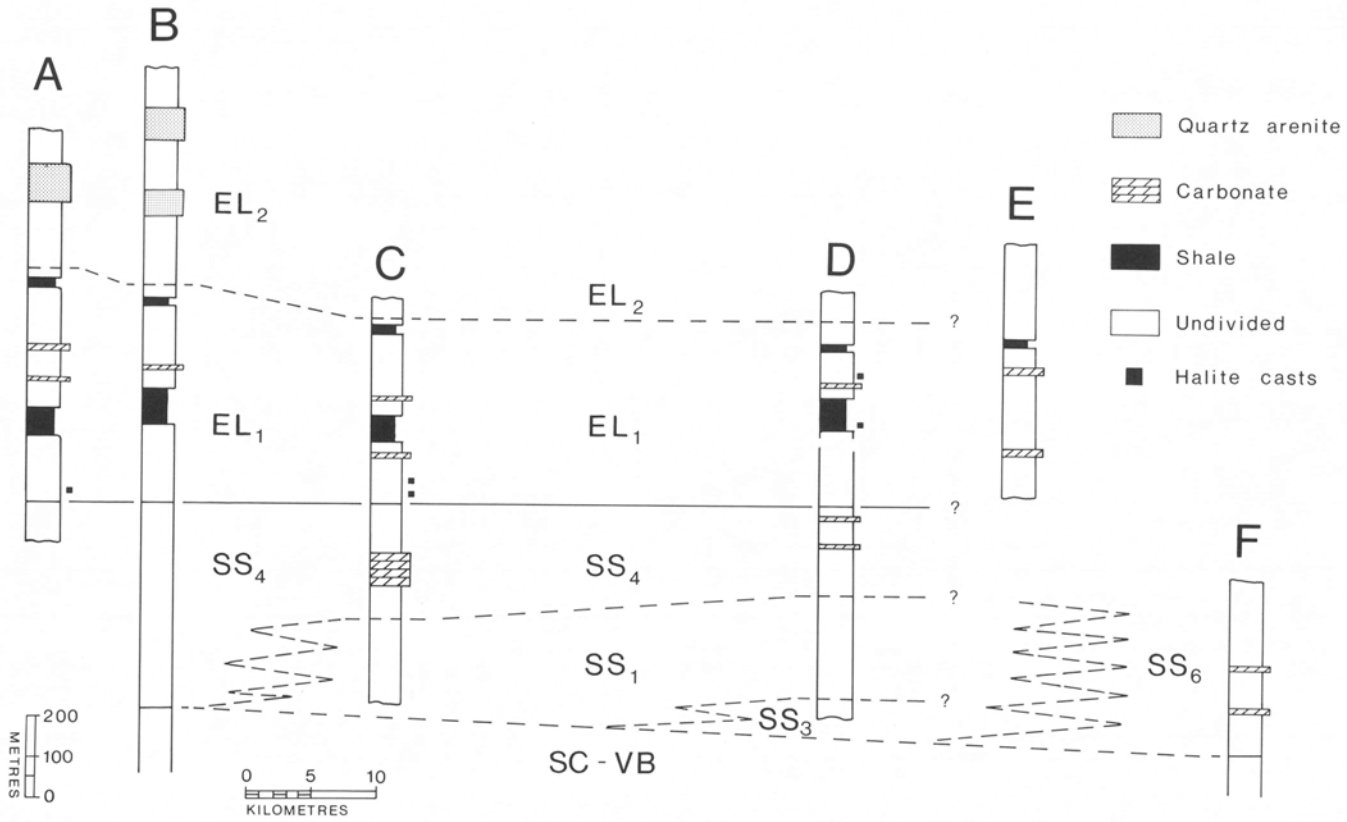

Figure 75.5. *Generalized stratigraphy of Strathcona Sound Formation ($SS_{1,3,4,6}$) and Elwin Formation ($EL_{1,2}$), northern Borden Basin.*

on northern Borden Peninsula is disconformable, but gradational on Bylot Island. The contact with the overlying Elwin Formation is everywhere conformable, and in places gradational.

The Strathcona Sound Formation has been divided into 6 members by Jackson and Iannelli (1981). These members grade into one another vertically and laterally, but locally are disconformable with one another. Five of the six (SS_1-$_4$, SS_6) members were examined during the past season and four of these (SS_1, SS_3, SS_4, SS_6), occur in Eclipse Trough (Fig. 75.5). Fining- and thinning-upward cycles predominate in these four members, but coarsening- and thickening-upward cycles also occur. Dolostone breccia-conglomerate lenses up to a few metres thick are common in the basal parts of SS_3 and SS_4 members with as many as 6 lenses locally. Some are probably debris flows. Structures were noted previously (Jackson and Iannelli, 1981) although crossbeds, ripple marks, and dissication cracks are rare in SS_1 and SS_4 members, in which the most common structures are slumps, channels, load structures, flutes, and graded bedding. The Strathcona Sound Formation comprises chiefly the SS_1 and SS_4 members on northern Borden Peninsula (Fig. 75.5).

Red Arkose member (SS_3)

This member is composed chiefly of red arkose and subarkose with minor siltstone, shale, dolostone, stromatolitic dolostone, and dolostone breccia-conglomerate. Crossbeds are common and some sandstone-to-dolostone cycles are present. The SS_3 member has been recognized only in eastern Borden Peninsula immediately north of Navy Board High where at least 100 m is present, and it is overlain by SS_1 member (Fig. 75.5).

Red Shale-Siltstone member (SS_1)

Red shales and calcareous siltstones predominate in this member and are interbedded with green to grey and red arkose, subarkose, and quartzarenite. Some 115 m of dark grey sandstone occurs locally near the top of SS_1 member, and slump features up to several metres across are common (Fig. 75.6).

The SS_1 member is at least 300 m thick in east-central Borden Peninsula. It probably interfingers laterally eastward with the SS_6 member on Bylot Island. It dies out to the west where it interfingers laterally with the SS_4 member (Fig. 75.6).

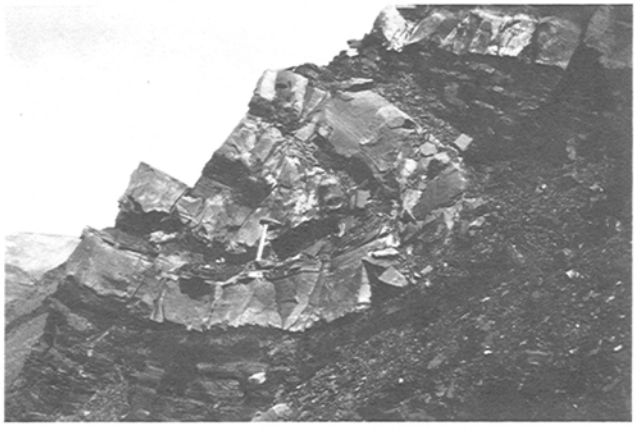

Figure 75.6. *View looking west at slumps in red shale and subarkose beds of SS_1 member of Strathcona Sound Formation. Slump moved from left to right. Base of an overriding slump occurs in the top of the picture. The hammer is 30 cm long. Photo by G.D. Jackson. (GSC 201952-S)*

Green-Grey Siltstone member (SS_4)

Most of this member is a monotonous sequence of shales and calcareous siltstones interbedded with minor arkose and subarkose. Fine grained quartzarenite is abundant in the upper part adjacent to the Elwin contact and dolostone and limestone units to 15 m thick are common in Central Borden Peninsula. Dolostone breccia-conglomerate lenses occur in the basal part. Slump structures are abundant. The SS_4 member constitutes the entire Strathcona Formation in the Elwin Inlet area where it is 492 m thick. About 220 m of SS_4 strata overlie SS_1 strata in east-central Borden Peninsula (Fig. 75.5).

Interbedded member (SS_6)

This member contains a variety of thinly interbedded lithologies including dolostone, and has been described previously. Only the strata on Bylot Island (400-450 m) are now considered to belong to this member (see Jackson and Iannelli, 1981).

Dolostone member (SS_2)

The SS_2 member, about 250 m thick, extends from the head of Strathcona Sound northward to White Bay Fault Zone (Jackson and Iannelli, 1981). It is a biohermal platform complex composed chiefly of grey stromatolitic dolostone bioherms and dolostone conglomerates and breccias that have

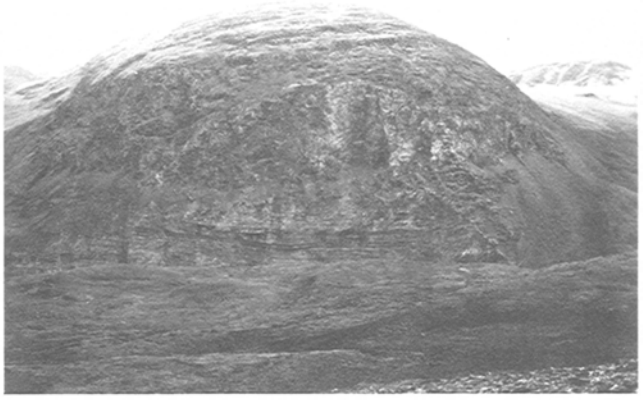

Figure 75.7. *Strathcona Sound (SS_2) bioherm overlying horizontal Victor Bay strata. Smaller domal structures are faintly visible. Height of the dome is about 150 m above Victor Bay beds. Photo by G.D. Jackson. (GSC 201952-V)*

Figure 75.8. *Strathcona Sound (SS_2) conglomerate. Dolostone clasts in red calcareous siltstone matrix. Hammer is 30 cm long. Photo by G.D. Jackson. (GSC 201952-Y)*

Figure 75.9. *Conophyton in SS_2 dolostone, grading into a hemispheroidal stromatolite at the top. Small stromatolites also present. The lens cap is about 4 cm in diameter. Photo by G.D. Jackson.*

in part slumped off the bioherms to form aprons which interfinger with the interbiohermal SS_1, SS_3, and SS_4 strata (Fig. 75.7, 75.8, 75.9). Locally, SS_1 red shale and siltstone interfinger with, underlie and overlie the Strathcona Sound bioherms. Some bioherms began growing during deposition of the Victor Bay and continued growing throughout Strathcona Sound accumulation. Elsewhere in the same area, a disconformity separates Victor Bay strata from the overlying Strathcona Sound bioherms. The present topography is in part exhumed.

Interpretation

Most of the paleocurrent data for Strathcona Sound strata north of Navy Board High indicate northerly to easterly transport (Fig. 75.3). Slumps and channels, abundant throughout the formation, are especially common in central and eastern Borden Peninsula. These data, the relative abundance of carbonates adjacent to Navy Board High, and the general absence of alluvial fan conglomerates (SS_5) adjacent to the eastern part of the High indicate that Navy Board High was uplifted to the east and south relative to the west and north. The southern and eastern sides of the Eclipse Block west of Navy Board Inlet probably dropped down slightly and Byam Martin High rose. Principal depositional environments for the various members were probably as follows:

- SS_3 - mixed alluvial, intertidal (northeast Borden P.)
- SS_1 - alluvial plain (north central Borden P.)?
- SS_4 - intertidal-shallow subtidal (northwest Borden P.)
- SS_6 - mixed alluvial plain, supratidal to intertidal (west Bylot I.)
- SS_2 - shallow subtidal to intertidal carbonate platform. Bioherms "drowned" by encroaching SS_1 strata (south central Borden P.).

Elwin Formation

The Elwin, the uppermost formation of the Bylot Supergroup, outcrops solely on northern Borden Peninsula where the type section is on Elwin Inlet (Lemon and Blackadar, 1963). It consists of laminated to thick bedded, and massive varicoloured micaceous (white) sandstones and siltstones with minor shales and rare dolostones. The latter commonly contain planar to low domal and laterally linked hemispheroidal stromatolites and serve as key (traceable) beds. The strata are variously interbedded in units up to 50 m thick, but most are 10 m or less.

The Elwin Formation is conformable and locally gradational with the underlying Strathcona Sound Formation. The base of the Elwin is taken at the base of a thick (± 15 m) distinctive white quartzarenite, below which the drab shales and siltstones of the Strathcona Sound SS_4 member contain minor thin quartzarenite beds. Above it are chiefly grey, green to red or white subarkose-quartzarenite. The basal quartzarenite contains crossbeds and, except in the Elwin Inlet area, also contains slumps, basal loads, and rip-up clasts. Elwin strata are 1070 m thick in the Elwin Inlet region, which is probably close to the maximum thickness present. The strata have been truncated by lower Paleozoic strata and by the present erosion surface. The formation has been divided into two intergradational members, lower (EL_1) and upper (EL_2).

Figure 75.10. *Buff and red fluvial subarkoses of lower Elwin (EL_1) member. Cross beds are unimodal and indicate eastward transport. The rod is 1.5 m. Photo by R.D. Knight. (GSC 201952-T)*

Planar and trough crossbeds, symmetrical and assymetrical ripples, synaeresis and dessication cracks, slumps, and small scour channels are common throughout the formation. Rip-up clasts and mud chips are common and rare quartz and dolostone clasts occur locally.

Lower member (EL_1)

EL_1 strata outcrop throughout northern Borden Peninsula. The lithofacies are similar throughout and consist of interbedded quartzarenite, lithic arenite, subarkose, siltstone, and dolostone (dolosiltite, intraformational dolorudite; minor dololutile, stromatolitic dolostone). However, whereas colours in northwest Borden Peninsula are red, grey-green, white, and buff, northeastern Broden strata are chiefly buff brown to brown. Basal strata in the latter area also commonly contain large (2 m diameter) ball and pillow structures and numerous slumps.

Several submembers are present in the western two thirds of Borden Peninsula. The lower 150 m of the EL_1 member is a distinctive unit of fining- and shallowing-upward cycles, the lower parts of which are crossbedded, and ripple-marked medium- to coarse-grained thin- to medium-bedded buff-pink subarkose. Upper parts are fine grained laminated to very thin-bedded subarkose to quartz arenite with ripples, dessication cracks and halite casts. Some cycles are overlain by dolostone with red shale below and/or above. Several 2-20 m thick green to minor red siltstone-shale units also occur within the lower submember.

The basal submember is overlain by 60-90 m of strata that consist of two shale-siltstone units separated by 5-15 m of thin- to medium-bedded grey subarkose. The lower thicker shale unit itself contains a lower red and an upper green unit in the west but is entirely green in the east. The upper shale unit is predominantly green.

The remainder of the EL_1 member is commonly cyclical, and is chiefly subarkoses and quartzarenites with the minor vari-coloured lithologies (Fig. 75.10). A few 50-100 m thick sand dominated units contain few minor lithologies and are relatively resistant.

The contact between the EL_1 and EL_2 members is gradational and taken at the top of a 10 m thick unit of thin-bedded red subarkose containing minor interbedded shale. EL_1 member is 525-536 m in the Elwin Inlet region and thins to about 450 m in eastern Borden Peninsula.

Several structures and cycles have been documented previously (Jackson and Iannelli, 1981). Halite casts are common in the lower part of the member, a few gypsum casts may occur locally, and "rain-drop" imprints were noted in several places.

Upper member (EL_2)

Elwin strata undergo an abrupt colour change at the EL_1-EL_2 contact, as the EL_2 strata are predominantly white to light grey, and buff to orange brown quartzarenites. Minor interbedded siltstones and shales are green to grey and black, occur in beds up to 3 m thick, and locally are as much as 60 per cent of a few thicker units. Subarkose and sublitharenite occur rarely in the lower part of the member and red beds are rare or absent (Fig. 75.11).

EL_2 strata occur only in northwestern Borden Peninsula where 534 m are present. Upper member strata are thicker bedded, and more mature than lower member strata. Coarsening-up cycles are common in the EL_2 member and are defined by an upward decrease of shale interbedded in quartzarenite, which grades upward into thick "clean" units up to 70 m thick.

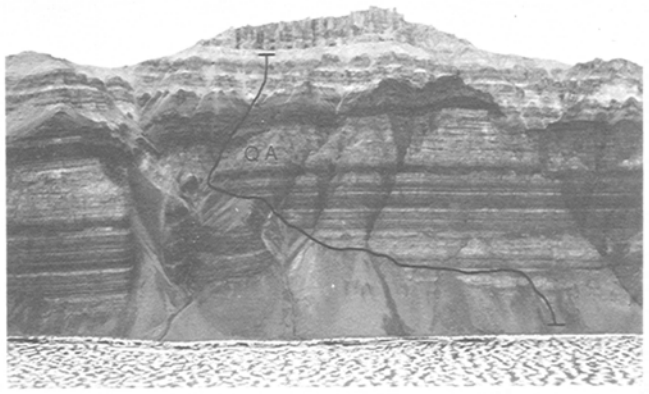

Figure 75.11. *Upper Elwin (EL_2) strata on the north side of Elwin Inlet, capped by vertically jointed lower Paleozoics. QA = thick quartzarenite unit in section A of Fig. 5. The measured section is indicated by the black line. The peak is 582 m high. Photo by G.D. Jackson. (GSC 201952-N)*

Fewer and lesser varieties of sedimentary structures occur in EL_2 strata as compared with EL_1. Synaeresis and dessication cracks are abundant locally. Channels (both shale and sandstone infilled), slumps and current lineations are present.

Interpretation

The various lithologies, depositional cycles, sedimentary structures, and presence of halite casts and gypsum molds indicate the EL_1 member accumulated in an intertidal to predominantly supratidal and alluvial braidplain environments. Evaporitic strata probably accumulated in ephemeral tidal flat pools or in lagoons. The basal (150 m) submember was probably deposited in a relatively low-energy subaerial, semi arid to arid environment. The shaly submember is probably intratidal for the most part, whereas the overlying thick quartzarenite units are probably braidplain deposits (Jackson and Iannelli, 1981). El_2 strata accumulated chiefly in an intertidal to subtidal shelf environment.

An abatement of tectonic activity in the immediate area is suggested for deposition of most El_1 strata (Jackson and Iannelli, 1981). Cumulative roses for crossbeds (Fig. 75.12) indicate predominance of easterly directed currents on western Borden Peninsula, northerly-directed on central Borden and easterly directed on eastern Borden. The paleocurrent data, the easterly thinning of El_1 member, and the slump features and increased dolostone content and facies changes in eastern Borden, indicate a western source area such as Brodeur Peninsula may have been uplifted about this time. Byam Martin High also probably rose slightly while the floor of Eclipse Trough on Borden Peninsula was down tilted eastward toward Navy Board Inlet.

A period of relative stability prevailed during El_2 sedimentation and northwesterly-directed paleocurrents (dominant in Borden Basin) again prevailed. Southerly-directed paleocurrents in north-central Borden Peninsula may be related to the Devon High (Fig. 16.35, Jackson and Iannelli, 1981).

Economic geology

Little of economic interest was seen in the field area. Gypsum is abundant on northern Bylot Island, traces of malachite staining and pyrite, marcasite, chalcopyrite and galena occur locally, and a few manganiferous goethite pods occur in uppermost Uluksan Group strata east of Elwin Inlet.

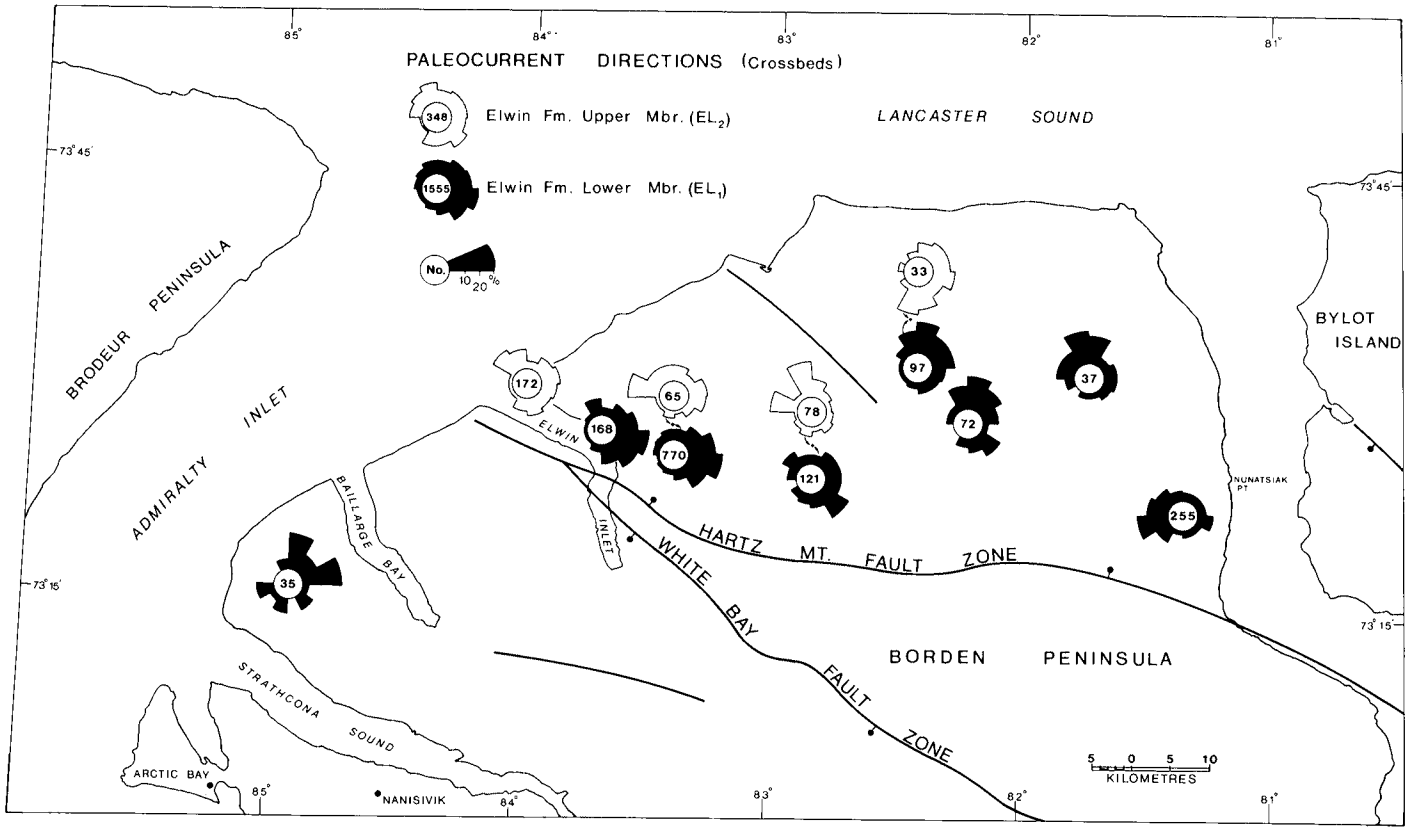

Figure 75.12. *Crossbed measurements in the Elwin Formation.*

Lower Victor Bay (VB_1) shales are thickest in the Nanisivik mine area, and may have acted as a cap rock to ore solutions percolating upward. If northwest trending faults have played any part in emplacement of zinc-lead orebodies on Little Cornwallis Island and at Nanisivik, then the intervening Brodeur Peninsula and Somerset Island carbonates should be considered as possible exploration areas.

Regional tectonics

The lower Eqalulik and upper Nanatsiaq groups grade upward from predominantly alluvial into subtidal strata. They are separated by the Ulukson Group shelf carbonates.

Syndepositional faulting was episodic throughout Borden Basin with culminations during lower Arctic Bay and Strathcona Sound sedimentation. Tilting of adjacent grabens was toward the Navy Board High on both sides of the High and faulting was less intense to the north of it.

Formation of Borden Basin and deposition of Bylot Supergroup has been related by Jackson and Iannelli (1981) to rifting during the Mackenzie Igneous events, and the opening of the Poseidon Ocean to the northwest at 1200-1250 Ma. Bylot Supergroup strata formerly extended much farther to the east and southeast than their present distribution. Thus it seems likely that Borden and Thule basins were either connected during contemporaneous sedimentation or part of a single larger sedimentary basin. This is even more likely if Greenland is brought closer to Baffin Island by using any one of several available reconstructions (e.g. Le Pichon et al., 1977).

Lithofacies distributions indicate north-south faulting was active along Milne Inlet-Navy Board Inlet during Bylot Supergroup sedimentation. Also paleomagnetic results of Marcussen and Abrahamsen (1983) indicate Greenland probably has moved away from North America during the Neohelikian. Significant movement in the Phanerozoic is debatable (Dawes and Kerr, 1982), and it seems likely that some separation of Greenland from North America was a result of Navy Board Inlet-Nares Strait fault movement during the Neohelikian rifting.

Phanerozoic block faulting is most abundant in northern Borden Basin adjacent to Lancaster Sound (Fig. 75.1), and is probably related to the Cretaceous Lancaster Aulacogen (Kerr, 1980). Although most faults are northerly, movement has also occurred along and parallel to the major southeast-trending faults (Fig. 75.2).

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