1992

Revised Stratigraphy Of The Late Proterozoic Bylot Supergroup, Northern Baffin Island, Arctic Canada: Implications For The Evolution Of Borden Basin

Thomas R. Iannelli

Recommended Citation

Iannelli, Thomas R., "Revised Stratigraphy Of The Late Proterozoic Bylot Supergroup, Northern Baffin Island, Arctic Canada: Implications For The Evolution Of Borden Basin" (1992). *Digitized Theses*. 2089.
https://ir.lib.uwo.ca/digitizedtheses/2089

REVISED STRATIGRAPHY OF THE LATE PROTEROZOIC BYLOT SUPERGROUP, NORTHERN BAFFIN ISLAND, ARCTIC CANADA: IMPLICATIONS FOR THE EVOLUTION OF BORDEN BASIN

VOLUME I

by

Thomas R. Iannelli

Department of Geology

Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
January, 1992

National Library of Canada
Canadian Theses Service

Bibliothèque nationale du Canada
Service des thèses canadiennes

Ottawa, Canada
K1A 0N4

ISBN 0-315-71980-X

ABSTRACT

The Bylot Supergroup comprises 4200 m of Late Proterozoic strata that unconformably overlie Archean-Aphebian gneisses within the North Baffin Rift Zone and infill the component troughs of the Borden Basin. The succession includes three groups separated by intrabasin unconformities. The lower siliciclastic-dominated Eqalulik Group, 600 m to >2000 m thick, consists mainly of shale, siltstone, sandstone, conglomerate and basalt of the Nauyat, Adams Sound and Arctic Bay Formations. The middle carbonate-dominated Uluksan Group, 440 m to 1550 m thick, contains stromatolitic to calciclastic dolostone and limestone and subordinate subarkose, conglomerate, siltstone and shale of the Society Cliffs, Fabricius Fiord and Victor Bay Formations. The upper siliciclastic-dominated Nunatsiaq Group, 600 m to >1500 m thick, comprises shale, siltstone, sandstone, pebbly sandstone, conglomerate and minor stromatolitic to calciclastic limestone and dolostone of the Strathcona Sound, Athole Point, Canada Point, Lower Elwin and Upper Elwin Formation. The strata accumulated in shallow marine shelf to deep subtidal basin settings.

Abrupt marginal to basinal facies changes occur in most formations. Major depocentres for the Lower Eqalulik Group were oriented to the northwest, while depocentres for the remaining formations occur in southeastern parts of the basin and marginwards towards major fault zones. Sedimentation patterns were strongly influenced by syndepositional tectonism associated with the fault zones. Strata accumulated in multiple-block fault troughs; major successions are separated by intrabasinal unconformities that mark the transition from periods of regional tectonism to those of general stability. Major intrabasinal boundaries have been termed critical event horizons; at least five occur in the Borden Basin.

Deposition of the Bylot Supergroup is explained by related stages of rift-associated extension and sedimentation. An initial Rift-I Stage (Eqalulik Group) was characterized by faulting and deposition of quartzarenites, siltstones, shales, conglomerates and extrusion of basalt flows. Regional extension was succeeded by a semi-stable Downwarp-I Stage (Uluksan Group) during which carbonates infilled the basin and spread beyond the margins of the component troughs. Active tectonism resumed during the Rift-II Stage (Lower Nunatsiaq Group). The basin was infilled with siltstones, sandstones and conglomerates, with only minor carbonates. The second rift stage was succeeded by another period of regional subsidence and stability, the Downwarp-II Stage (Middle and Upper Nunatsiaq Group). The final infill succession was dominated by sandstones, siltstones and shales.

ACKNOWLEDGEMENTS

The author is indebted to Dr. G. M. Young for his supervision and guidance throughout the various stages and problems associated with the thesis. He served as a source for new ideas and as an aid in interpreting and understanding a wide variety of geological phenomena. Dr. Young also edited several versions of the thesis; his enduring patience is greatly appreciated.

The author is equally indebted to Dr. G. D. Jackson whose constant support and example in the field provided a source of inspiration during all stages of the work. He provided numerous suggestions and ideas for solving geological problems associated with the thesis.

The author expresses heartfelt thanks to parents and in-laws for their understanding and support over the years.

Finally, the author is grateful for the continued patience and understanding shown by his wife Martie. She never lost faith in him. Without her help the thesis would never have been finished. Martie provided the technical expertise and time for the thankless task of inputting text and, in the final stages, kept the project on track to completion. I give you my solemn oath that I will never put you through such pain and frustration again.

Geological Discussion:

Additional discussions on geological problems, directly and indirectly concerned with the thesis, were provided by a number of people. The most notable include: Dr. F.H.A. Campbell, Dr. F. Chandler, Dr. T. Frisch, Dr. C.W. Jefferson, Dr. G. Yeo and Mr. Ross Knight. Their contributions are gratefully acknowledged.

Financial and Technical Support:

Financial support, during the winter and spring terms of 1977 to 1980 at the University of Western Ontario, were provided by teaching assistantships funded in part by the Department of Geology and by N.S.E.R.C. grants to Dr. Young. The author was employed by the Geological Survey of Canada, on Operation Borden, during the 1977, 1979, and 1984 field seasons. Financial support was also provided by an N.S.E.R.C. post-graduate scholarship for 1979 to 1981. Finally, Petro-Canada (Minerals Division) and Strathcona Mineral Services allowed the author to gather additional field information during the 1981 and 1989 field seasons.

The Geological Survey of Canada provided thin sections, relevant publications and various other forms of technical support. The latter included reproduction of field photographs, slides and diagrams.

The author is grateful for the logistical support provided by the Polar Continental Shelf Project (especially for the 1978 field season) and, in particular, for help and advice from Mr. Fred Ault and Mr. Fred Hunt. Lodging and additional logistical assistance were provided by a number of residents in the north Baffin Island communities of Nanisivik and Arctic Bay.

Field assistants:

The field portion of the project was made considerably easier through the help of the following assistants:

(a). 1977 field season: A. Galley, P. Jarvie and G. Morin

(b). 1978 field season: R. Myles

(c). 1979 field season: L. MacLaren

(d). 1981 field season: R. Knight

(e). 1984 field season: R. Knight

TABLE OF CONTENTS

VOLUME II

LIST OF PHOTOGRAPHIC PLATES

LIST OF TABLES

LIST OF FIGURES

Figure Description Page

LIST OF APPENDICES

LIST OF REPRINTS

CHAPTER 1 - INTRODUCTION

1.1 General Introduction and Purpose of Study

The rugged highlands and spectacular coastal scenery of northern Baffin Island provide an inspiring setting for the study of the geology of this remote area. The scenic topography is largely the result of erosion of uplifted, tilted fault blocks comprised mainly of Late Proterozoic sedimentary and volcanic rocks that nonconformably overlie Archean - Aphebian granite and gneiss. A maximum preserved thickness of about 4.2 km of such strata fills several fault-bounded troughs, defined originally by Christie et. al., (1972) as the Borden Basin. The Late Proterozoic rocks of the Borden Basin are exposed in northwest-southeast oriented outcrop belts in which beds dip generally to the northeast. Strata outcrop in castellated coastal cliffs and along inlets, bays and river valleys of the Borden Peninsula, the Milne Inlet to Paquet Bay area and the northern part of Bylot Island (Figs. 1.1 and 1.2).

The Borden Basin contains a relatively undisturbed succession of Late Proterozoic volcanic and sedimentary rocks. The strata occupy graben of the North Baffin Rift Zone (Jackson and Davidson, 1975; Jackson et. al., 1975; Jackson and Iannelli, 1981). They are classified within the Bylot Supergroup in the following units: the lower, clastic-dominated Eqalulik Group; the middle, carbonate-dominated Uluksan Group; and an upper clastic-dominated Nunatsiaq Group (Jackson and Iannelli, 1981, 1989; Table 1.1). The sedimentary strata comprise a diverse array of rock types characterised by striking latero-vertical thickness and compositional

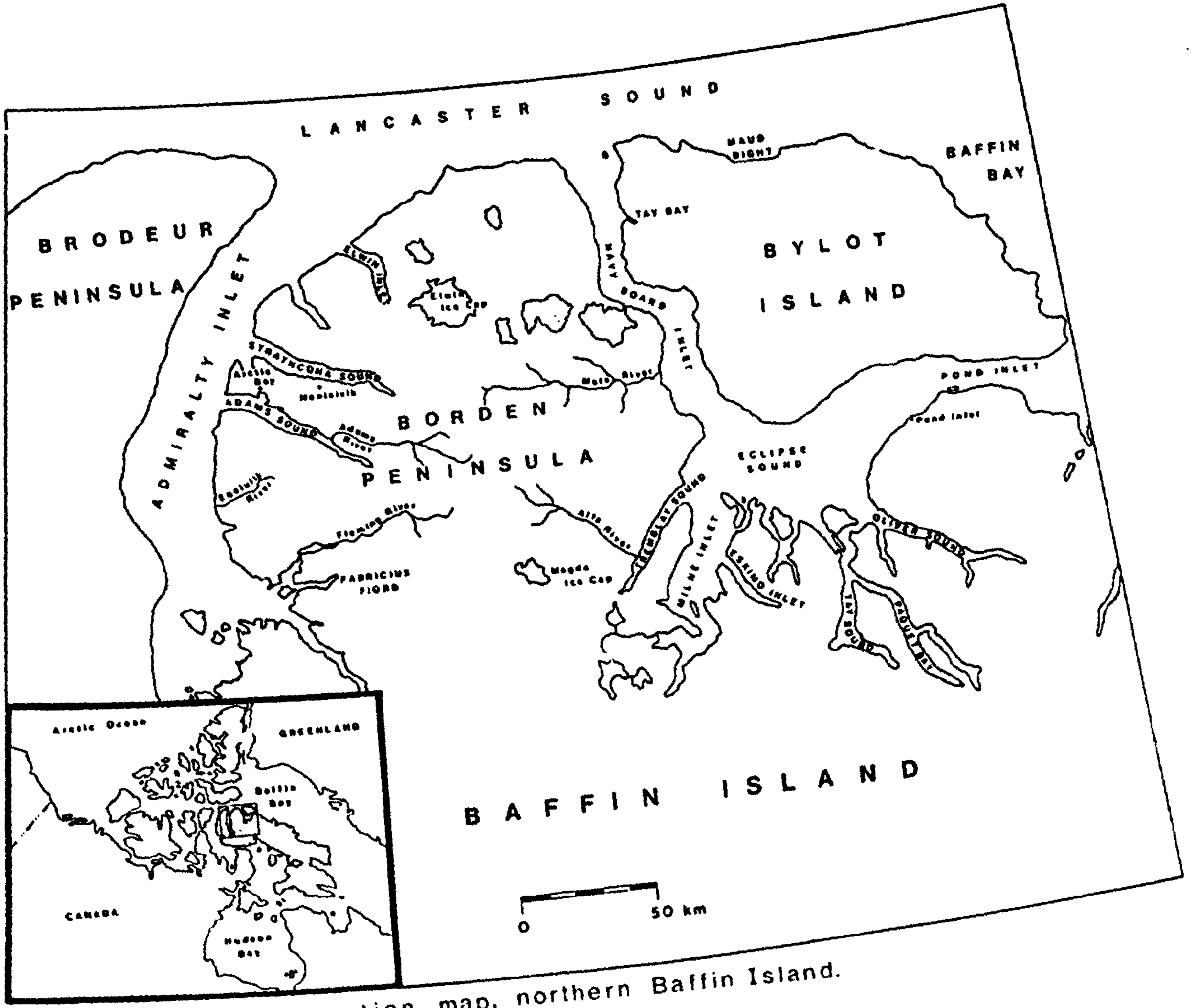


Fig. 1.1: Location map, northern Baffin Island.

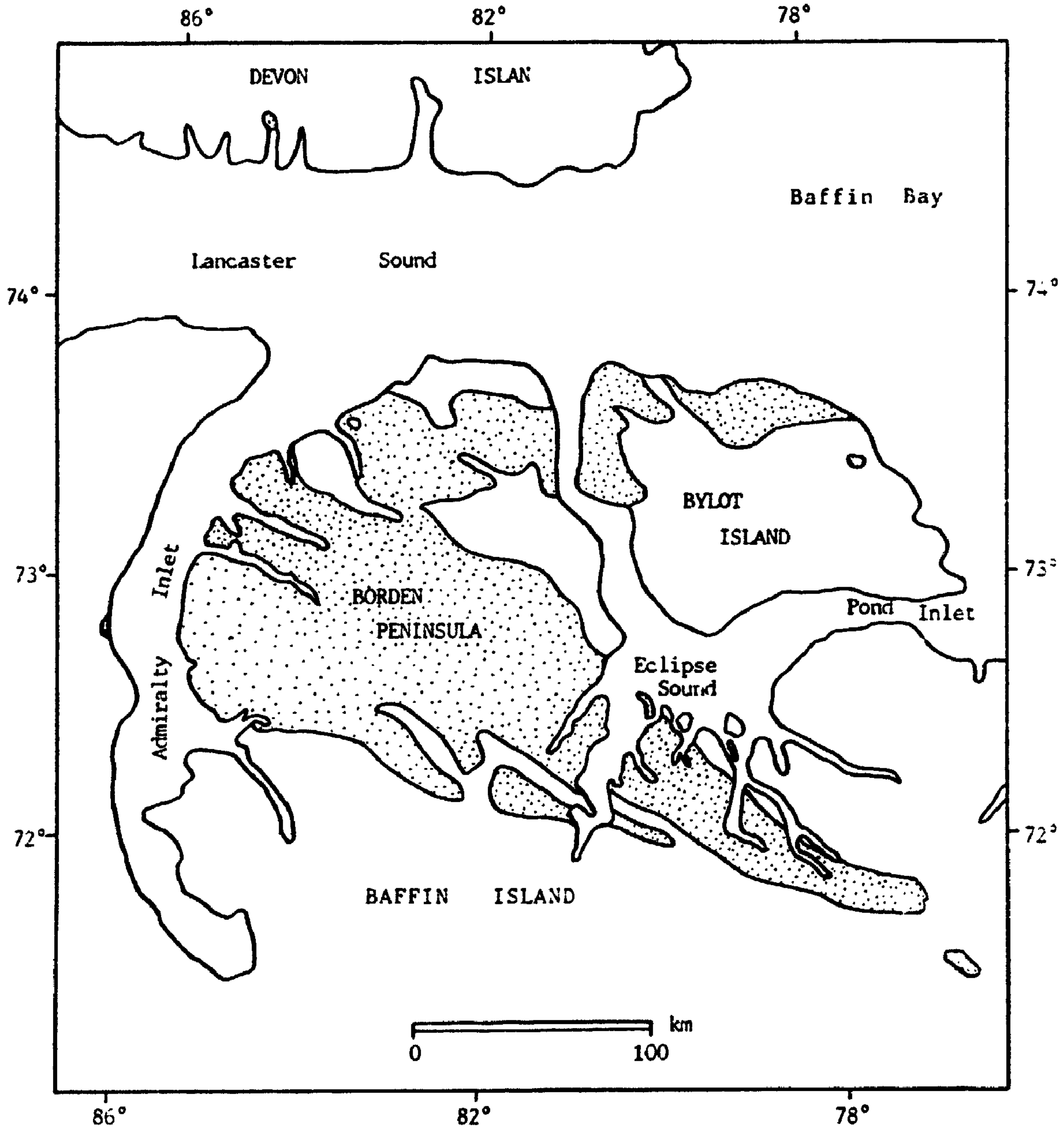


Fig. 1.2: Known outcrop area (stippled) of late Proterozoic rocks of the Borden Basin.

changes (Jackson et. al., 1978a, 1980, 1985; Jackson and Iannelli 1981, 1989; Iannelli 1979, 1982; Tables 2.1 to 2.4; Figs. 2.2 to 2.5).

In this study, preliminary results of analysis of the Late Proterozoic geology of the Borden Basin are presented. The main objectives are as follows:

(1). Analysis and revision of the lithostratigraphy of the Bylot Supergroup and the establishment of a stratigraphic framework that incorporates observed facies variations in the Borden Basin,

(2). Reconstruction of the depositional history of the Bylot Supergroup,

(3). An outline of the structural framework of the Borden Basin and the delineation of the major components,

(4). Construction of a model outlining the evolution of the Borden Basin during the depositional history of the Bylot Supergroup based on the implications of 1, 2 and 3 above.

1.2 Definition of the Borden Basin

Christie et. al., (1972) originally defined the Borden Basin as "an assemblage of gently deformed and unmetamorphosed quartzites, dolomites and shaly beds widely exposed on northern Baffin Island...". In addition to these rocks the basin contains a considerable variety of other types including limestones, arkoses, lithic-arenites, conglomerates, calciclastics and minor evaporites. As outlined in Christie's Fig. 11 (Christie et. al., 1972, facing p.46), the major outcrops occur on northern Baffin Island. Excluded from this figure are outcrops of quartzarenite from the Adams Sound

Formation located on the eastern coast of the Brodeur Peninsula (Blackadar et. al., 1968b; Blackadar, 1970), the sequence of rocks of the Eqalulik and Uluksan Groups that outcrop on northern Bylot Island (Jackson and Davidson, 1975), and an outcrop of red siltstone and sandstone, probably equivalent to the SS_{RS} member of the Strathcona Sound Formation, exposed at the head of Powell Inlet on southern Devon Island (Thorsteinsson and Mayr, 1987). Incorporation of these considerably expands the known outcrop area of the Borden Basin (Fig. 1.2; see also Jackson and Iannelli, 1981, Fig. 16.1). It is also likely that drowned fault troughs in Lancaster Sound and Baffin Bay were once part of the Borden Basin (McWhae, 1981).

The maximum preserved length of the basin is 400 km; it has a maximum width of about 250 km in the Admiralty Inlet - Lancaster Sound area. Late Proterozoic sedimentary and volcanic rocks are preserved over an area of about 30,000 km^2 (Figs. 1.2 and 5.1; see also Jackson and Iannelli, 1981, Fig. 16.1: Jackson and Iannelli, 1989, Fig. 1).

1.3 Previous Geological Work

The early history of geological investigation on northern Baffin Island was outlined by Blackadar (1970). The first modern studies, performed by R.G. Blackadar and R.R.H. Lemon in 1954, consisted of reconnaissance mapping and stratigraphic studies in the area of Admiralty Inlet and western Borden Peninsula (Blackadar, 1956; Lemon and Blackadar, 1963). In this work, which produced the first accurate geological map in the project area, the Proterozoic sequence was subdivided into the

Eqalulik Group (Nauyat and Adams Sound Formations only) and the overlying Uluksan Group. Mapping and stratigraphic work continued in 1963 with the helicopter-supported project named Operation Admiralty (Blackadar, 1965, 1970). The entire Borden Peninsula was mapped during the course of the project. A series of four reconnaissance-scale geological base maps was produced (Blackadar et. al., 1968a, b, c and d), and the previously identified stratigraphic units were mapped and correlated over the entire peninsula. Additionally defined were the Fabricius Fiord and Athole Point Formations of the Uluksan Group, and the Nauyat and Adams Sound Formations of the Eqalulik Group. Although facies changes were proposed to explain some lateral variations in lithology, the idea was not incorporated into regional stratigraphic interpretation (Lemon and Blackadar, 1963, p.15; Blackadar, 1970).

The final phase of reconnaissance mapping was completed in 1968 during Operation Bylot, a regional project that included geological investigation of Bylot Island and southeastern Borden Basin (Jackson and Davidson, 1975; Jackson et. al., 1975, 1978b). Geological base maps for the entire area were produced, and the Late Proterozoic strata were correlated with those defined previously from the Borden Peninsula. Members were identified and mapped within the Adams Sound and Arctic Bay Formations. Significant facies changes were implied, especially for the lithological variations observed in the Arctic Bay and Society Cliffs Formations in the Tay Sound to Paquet Bay area (Jackson et. al., 1975, 1978b).

These projects delineated the basic geology and stratigraphy of the entire

Borden Basin and were the basis for the first major detailed investigation of the basin, performed during the Geological Survey of Canada project named Operation Borden. Field work for this project was completed during the summers of 1977 to 1979 and 1984. The project was designed to provide detailed geologic base maps, a definitive stratigraphic and structural framework and a comprehensive analysis of the depositional history and evolution of the Late Proterozoic rocks of the basin. Preliminary results have been presented in several publications (Galley, 1978; Iannelli, 1979; Jackson and Iannelli, 1981, 1989; Jackson et. al., 1978a, 1980, 1983, 1985; Knight, 1988). The regional geology has been outlined in Map 1-1987 (Jackson and Sangster, 1987).

In addition to the operations of the Geological Survey, several private companies have also worked in the Borden Basin. The most important include investigations by Texas Gulf, King Resources, Global Arctic Islands, Nanisivik Mines and Strathcona Mineral Services, all of which were involved in lead-zinc exploration in dolostone of the Society Cliffs Formation. Most of this work was confined to Nanisivik and the immediately surrounding areas (Olson, 1977, 1984). Notable contributions to the geology of the basin were made by Geldsetzer (1973a,b) and Olson (1977, 1984). Geldsetzer (1973a) introduced the concept of a megacycle and suggested that strong tectonic control affected the depositional history of the sedimentary rocks, although the style and mechanism of tectonism were not indicated. He presented a basic paleo-environmental model for the basin, recognised some of the major facies relationships between units (especially in the Society Cliffs Formation) and hinted at the presence of facies changes and paleocurrent reversals in the upper part of the succession. Olson (1977, 1984) analysed the economic geology of the Society Cliffs Formation. He outlined the major karsting episodes recorded in the succession, and suggested a possible explanation for the origin of the sulphide mineralization in the Society Cliffs Formation at Nanisivik and vicinity. Olson (ibid) also suggested that Borden Basin may have originated as an aulacogen related to the development of the Franklinian Geosyncline. Other studies of the economic geology of the Arctic Bay and Society Cliff Formations have been made by Graf (1974) and Sangster (1981).

The author led a Petro-Canada mineral exploration party that spent the latter part of the 1981 field season searching for lead-zinc mineralization on northern Baffin Island. Exploration work was concentrated in the area extending northwest from Paquet Bay to Adams Sound (Fig.1.1). In the course of this work, several important contributions were made to the stratigraphy and sedimentology of the Nauyat, Adams Sound and Arctic Bay Formations (Iannelli, 1982). In addition, a mineralization model involving the Arctic Bay Formation was proposed (Iannelli, 1982, 1984).

1.4 Sources of Data

The information for this thesis was gathered mainly while the author was employed by the Geological Survey of Canada on Operation Borden. During the 1977 field season, data were collected primarily from the eastern half of Borden Peninsula (Jackson et. al., 1978a). In 1978, field work was concentrated in areas along

Tremblay Sound, in south central Borden Peninsula and in the Milne Inlet to Paquet Bay region (Iannelli, 1979). In the following season geologic investigations were carried out on northern and northeastern Borden Peninsula and Bylot Island (Jackson et. al., 1980). In the 1981 field season, when the author was employed by Petro-Canada, section work and mapping were concentrated in the area stretching northwest from Paquet Bay to Adams Sound (Iannelli, 1982). In 1984 field work was concentrated on northern Borden Peninsula and northwestern Bylot Island (Jackson et. al., 1985).

1.5 Analytical Methods

1.5.1 Field Methods

The bulk of the information upon which this thesis is based was collected in the field during the course of geologic examination of the Borden Basin on northern Baffin and Bylot Islands. Mapping was performed at several scales. The information gathered from ground - and helicopter-based mapping was initially plotted on 1:50,000 scale (1 cm = 500 m) airphotos and then transferred to base maps. The base maps included 1:50,000 scale photomosaics and topographic sheets and 1:250,000 scale topographic sheets. Foot traverses were performed to delineate complex lithofacies and structural relationships in well exposed areas. The information for the present study was gathered, in large part, from observations made at over 1500 field stations (Appendix I).

Ground-based geologic investigation was supplemented by observations compiled from stratigraphic sections. Information from more than 100 stratigraphic sections, measured at sites across the entire basin, was used in the thesis (Appendix II). A major portion of the information required for lithostratigraphic analysis was provided by these sections. A wooden staff, 1.5 m in height and graduated in 10 cm units, was used to measure the sections. The staff was equipped with a clinometer for use on inclined sequences.

Paleocurrent measurements were taken on crossbeds, wave and current ripple-marks, flute marks and elongate stromatolite mounds. These measurements were corrected for tectonic effects when necessary or were plotted directly, in the case of azimuth measurements from axes of trough crossbeds in horizontal or sub-horizontal strata.

1.5.2 Laboratory Methods

Laboratory work included the analysis of hand specimens from field stations and sections, and the analysis of thin sections. The work was performed largely to confirm field observations and to delineate major lithotypes in the fundamental stratigraphic units. Since most of the study was based on field information, much of the laboratory work consisted of the analysis and interpretation of large amounts of basic geological observations from airphotos, base maps, field stations and section notes.The lithologic units in each section and station have been classified into a system of basic lithofacies units. The latero-vertical distribution of these basic lithofacies units provides the framework for the detailed analysis and classification of

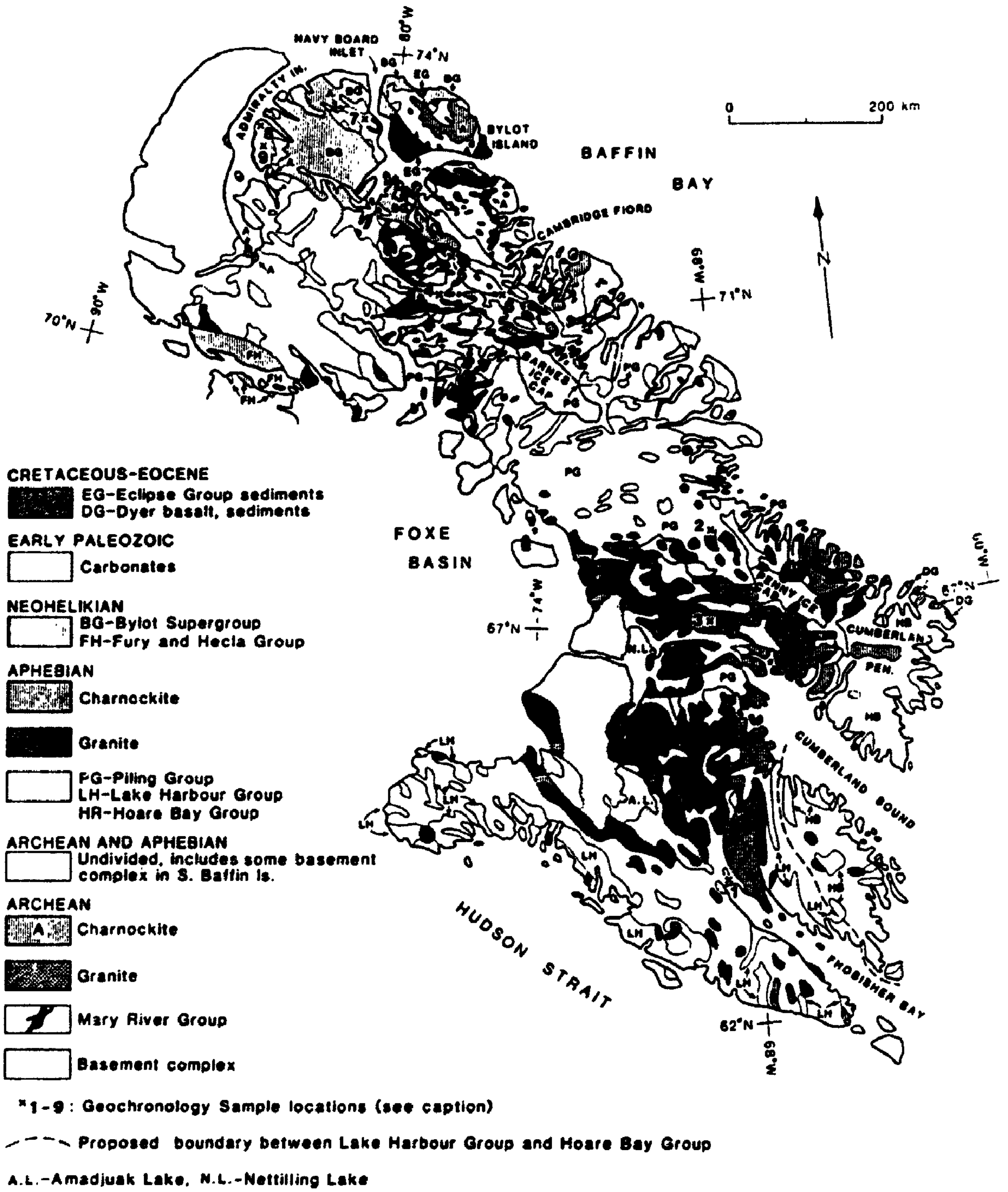


Fig.1.3: Geology of Baffin Island: 1- Iqaluit, 2- West of Nudlung Fiord, 3- north-central Cumberland Batholithic Complex, 4- Mary River Group dacite, and basement tonalite, 5- late Archean quartz monzodiorite in Mary River region, 6- nebulitic migmatite at head of Cambridge Fiord, 7- monzogranite west of Navy Board Inlet, 8- crystalline complex east of Admiralty Inlet, 9- Nauyat plateau basalt (from Jackson et. al., 1990, Fig. 1, p 125; Geological Survey of Canada, Department of Energy, Mines and Resources; Reproduced with the permission of the Minister of Supply and Services Canada, 1992).

Table 1.1: Precambrian regional geology, northern Baffin Island - table of of formations, depositional / intrusive and tectonic events (modified after Jackson and Morgan, 1978; Jackson and Iannelli, 1981).

TABLE 1.1

EON	ERA	AGE (Ma)	DEPOSITIONAL/INTRUSIVE EVENT	TECTONIC EVENT	ACTIVE ELEMENTS
PALEOZOIC	CAMBRIAN		*erosion*	Epeirogenic uplift, slight warping, erosion, and diagenesis.	Borden Basin: erosion of basement highs and infill sequence.
PROTEROZOIC	HADRYNIAN	780 950 ?	Northwest-Southeast, and minor North- South trending diabase dykes: Franklin igneous event Borden igneous event ? ? ? ? ? ?	Northwest-Southeast trending tension faults, diagenesis; subgreenschist metamorphism. ? ? ? ?	Main intrusive and tensional activity along axis of Borden Basin. ? ? ?
	HELIKIAN		**BORDEN BASIN:** **Nunatsiaq: Group** Upper Elwin Fm (467+ - 511+ meters) Lower Elwin Fm (450-540 + meters) Strathcona Sound Formation / Athole Point Formation (430-910 + meters) Canada Point Fm (550 + meters)	↑	BORDEN RIFT BASIN: Downwarp Stage: basin-wide stability. Rifting Stage: Major fault zones active.
			Uluksan : Group Victor Bay Formation (160-730 meters) Society Cliffs Formation (265- 856 meters) Fabricius Fiord Fm (1100 + meters)	BORDEN RIFT EPISODE	Downwarp Stage: minor tectonism in basin; marginal activity along Central Borden Fault Zone, Aktineq Fault Zone, White Bay Fault Zone.
			Eqalulik : Group Arctic Bay Formation (208-1380 meters)	↓	Rifting Stage: major fault zones active.
		1270	Adams Sound Formation (2 -580 meters) Nauyat Formation (0-292 meters)	Mackenzie Event: Northwest-Southeast trending tension faults.	
			erosion	Uplift and erosion; ≃ 30? km. (granulites brought to surface) NW-SE oriented tension faults and cataclased zones.	Proto Central Borden, White Bay, Hartz Mountain, Aktineq, and Cape Hay Fault Zones.
	APHEBIAN	1600 1800		HUDSONIAN OROGENY (subgreenschist to granulite facies metamorphism)	
		1900 2300	Anorogenic to synorogenic massive and porphyritic granitic intrusions.	Local deformation and mild metamorphism.	
			Piling Lake Harbour and Hoare Bay Groups; shelf, miogeosyncline and eugeosyncline sediments and basic to ultrabasic intrusions; acidic volcanics in Hoare Bay Group.		
			erosion	Uplift and erosion: ≃ 20? km. (upper amphibolite rocks brought to surface)	
ARCHEAN		2550 2600	Synorogenic? Granitic Intrusions	KENORAN OROGENY Not developed everywhere; chiefly lower to upper amphibolite metamorphism.	
		2750	Basic Dykes Mary River Group: chiefly eugeosyncline sediments; acidic and basic volcanics, basic and ultrabasic intrusions; ultrabasic volcanics?		
			erosion	Uplift and Erosion	
			Chiefly Northeast-Southwest trending basic dykes		
		ca 2800+	Synorogenic? granitic intrusions in chiefly granitic terrain; acidic volcanics.		

Table 1.2: Phanerozoic regional geology, northern Baffin Island - table of formations, depositional / intrusive and tectonic events (modified after Kerr, 1980 and Miall *et*. *al*., 1980).

TABLE 1.2

ERA	PERIOD	SERIES	DEPOSITIONAL/INTRUSIVE EVENT	TECTONIC EVENT		ACTIVE ELEMENTS
CENOZOIC	QUATERNARY	RECENT		Baffin Bay/ Davis Strait Rift		
		PLEISTOCENE	Glacial Deposits			
	TERTIARY	PLIOCENE				
		MIOCENE			Eurekan Deformation (Eurekan Rift Episode)	Eclipse and Milne Inlet(?) Troughs; 1. Fault Zones:White Bay, Central Borden, Hartz Mountain, Aktineq. 2. Highs:Krag Montain, Navy Board, Byam Martin. 3.Volcanism in related areas.
		OLIGOCENE				
		EOCENE	Eureka Sound Formation: sandstone shale			
		PALEOCENE				
MESOZOIC	CRETACEOUS	UPPER	Kanguk Formation:shale,(sandstone)			
		LOWER	Hassel Formation:fluvial sandstone			
	JUR.					
	TRI.					
	PERM					
	PENNS			Uplift and erosion (0.5— 1 Kilometer uplift from erosion	Melvillian Disturbance	Melville Arch Bredeur [illegible]
	MISS					

TABLE 1.2

ERA	PERIOD	SERIES	DEPOSITIONAL/INTRUSIVE EVENT		TECTONIC EVENT		ACTIVE ELEMENTS
CENOZOIC	QUATERNARY	RECENT			Baffin Bay/ Davis Strait Rift		
		PLEISTOCENE	Glacial Deposits				
	TERTIARY	PLIOCENE					
		MIOCENE				Eurekan Deformation (Eurekan Rift Episode)	Eclipse and Milne Inlet(?) Troughs; 1. Fault Zones:White Bay, Central Borden, Hartz Mountain, Aktineq. 2. Highs:Krag Montain, Navy Board, Byam Martin. 3.Volcanism in related areas.
		OLIGOCENE					
		EOCENE	Eureka Sound Formation: sandstone shale				
		PALEOCENE					
MESOZOIC	CRETACEOUS	UPPER	Kanguk Formation:shale,(sandstone)				
		LOWER	Hassel Formation:fluvial sandstone				
	JUR.						
	TRI.						
PALEOZOIC	PERM					Melvillian Disturbance	
	PENNS				Uplift and erosion (0.5— 1 kilometer uplift from erosion of Paleozoic sequence)		Melville Arch Brodeur Homocline
	MISS.						
	DEV.					Cornwallis Disturbance	
	SILURIAN	UPPER	Cape Crauford Formation (408 meters)	Member C (110+ meters)	Admiralty Sedimentary Basin Episode		
		MIDDLE		Member B (110 meters)			
		LOWER		Member A (170 meters)			Admiralty and(Foxe) Basins: 1.Northwest-Sotheast Faulting(Central Borden Fault Zone active?) 2.Major Uplifts: (Melville Arch, Steensby High)
	ORDOVICIAN	UPPER	Baillarge Formation (500 meters)				
		MIDDLE	Ship Piont Formation (45-275 meters)				
		LOWER	Admiralty Group	Turner Cliffs Formation (0-305 meters)			
	CAMBRIAN	UPPER		Gallery Formation (0-340 meters)			
		MIDDLE					
		LOWER			Epeirogenic uplift, erosion, warping, diagenesis? (2— 4 kilometers uplift from erosion of Late Proterozoic sequence)		Borden Basin:Erosion of Horsts and Arches.
LATE PROTEROZOIC			Northwest-Southeast trending dykes		Franklin Event:Dykes, Southeast tentional faults; Metamorphism		

the strata of the Bylot Supergroup.

1.6 Regional Precambrian Geology of the Borden Basin

The regional Precambrian geology of the Borden Basin has been outlined in several publications. Reprints of the relevant papers are included in the map pocket (Jackson et. al., 1978a, 1980, 1985; Jackson and Iannelli, 1981, 1989; Iannelli, 1979). In general, the basin contains a succession of Late Proterozoic sedimentary and volcanic rocks, with a maximum preserved thickness of 4.2 km (Fig. 2.4), unconformably overlying a complex basement that comprises Archean and Aphebian gneiss, granite, metavolcanics and metasediments (Table 1.1, Fig. 1.3). The Late Proterozoic rocks are unconformably overlain by flat-lying Phanerozoic sedimentary rocks (Table 1.2). They are preserved in the northwest-southeast oriented graben of the North Baffin Rift Zone.

1.7 Regional Archean - Aphebian Geology of Northern Baffin Island

1.7.1 Archean - Aphebian Rock Units

The strata of the Bylot Supergroup were deposited on a basement of Archean - Aphebian gneisses, metasediments, metavolcanics, and intrusive rocks (Jackson et. al., 1978a; Jackson et. al., 1975). These rocks are well exposed in several major highs that strike northwestwards across the basin (Figs. 1.3 and 5.1). The basement complex comprises the northern portion of the Churchill Province of the Canadian Shield. It was partially metamorphosed during the Kenoran orogeny and more extensively metamorphosed during the Hudsonian orogeny (Jackson and Morgan, 1978: Table 1.1). Migmatitic gneisses predominate and include mainly banded types, although porphyroblastic, nebulitic and flaser varieties are also common (Jackson and Sangster, 1987). The gneisses are intruded by at least two generations of granite - a younger group 1900 Ma to 2300 Ma, and an older group about 2600 Ma to 2800 Ma. They are also intruded by a set of northwest-trending basic dykes, that are thought to be in excess of 2700 Ma (Table 1.1). Rare calc-silicate gneisses also occur.

Foliated granites and pegmatites, a few of which are amethyst bearing, are common. In a few areas sill-like foliated to massive quartz monzonite and monzocharnockite masses occur, the largest being the Bylot Batholith on southeastern Bylot Island with an area of about 2600 km^2 (Jackson and Davidson, 1975; Jackson and Sangster, 1987). Scattered throughout the basement are also remnant lenses and layers of felsic, mafic, and ultramafic volcanic rocks, and metasiltstone, quartzarenite and rare iron formation. These rocks are part of the Aphebian Piling, Lake Harbour, and Hoare Bay Groups and the Archean Mary River Group (Fig. 1.3). They represent thick sedimentary and volcanic sequences deposited in "miogeosynclinal" and "eugeosynclinal" settings marginal to the northern part of the Canadian Shield (Jackson and Taylor, 1972; Jackson and Morgan, 1978; Table 1.1).

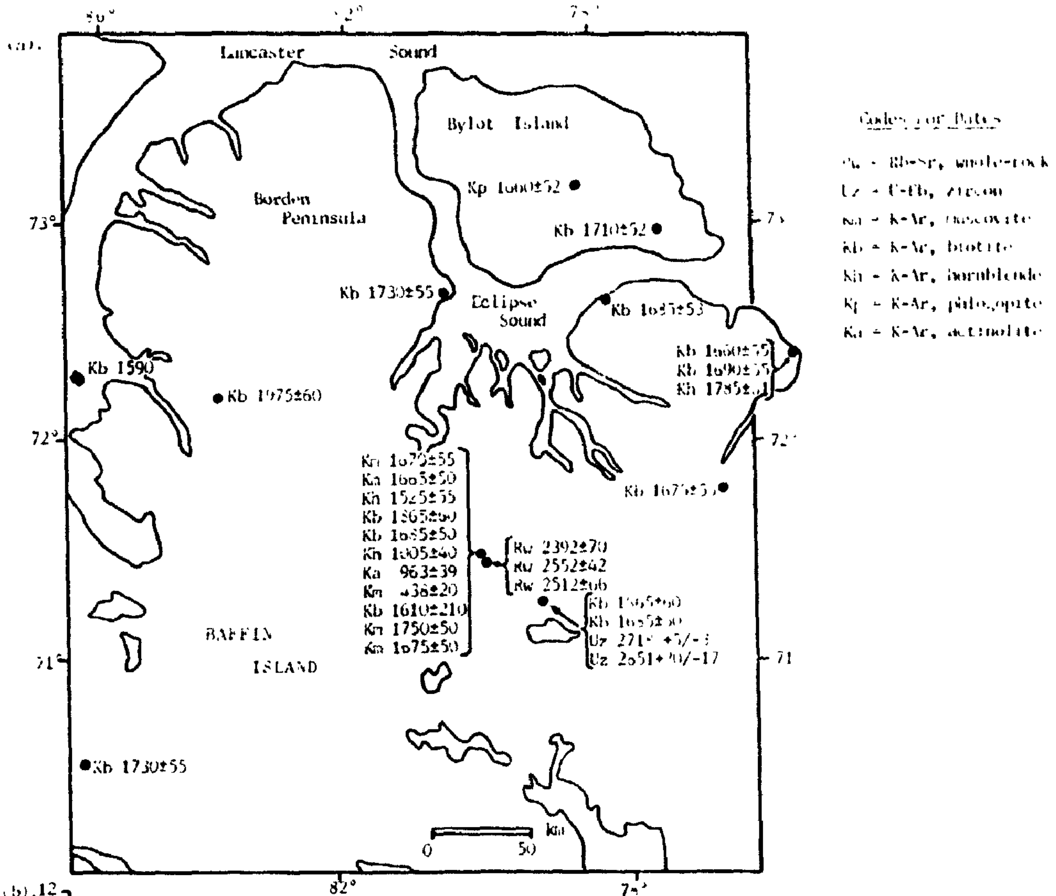
The rocks of the basement complex have undergone several phases of Archean and Aphebian metamorphism. Upper amphibolite regional metamorphism prevails throughout the complex, whereas granulite facies rocks are common on northern Bylot Island and in the area south of the Central Borden Fault Zone (Jackson and

Davidson, 1975; Jackson et. al., 1975). As illustrated in Fig. 1.4, the available age dates indicate extensive metamorphism coincident with Hudsonian deformation and, to a lesser degree, with Kenoran deformation. Anomalous younger ages may be related to a later period of mild metamorphism, possibly associated with deformation during the Late Proterozoic (Jackson et. al., 1990; Table 1.1).

1.7.2 Regolith

A thin regolith occurs on top of the basement rocks in several localities. In some areas the gneisses are hematite-stained for several metres below the Proterozoic nonconformity. Elsewhere, a true regolith is present at this contact. Localities where a regolith is well exposed include the Paquet Bay area, where 1 m- to 3 m-thick regoliths are developed, and the Magda Icecap to Tremblay Sound region, where the unit is 2 m to 6m thick (Fig. 1.1). In such places unaltered gneiss passes gradationally upward through purple-pink-brown to yellow-brown, lightly weathered and altered units, to light yellow-green to green-white, extensively altered and weathered quartz-dominated units. The colour changes, and corresponding upward increase in friability are probably a result of alteration and removal of feldspars from the gneiss.

Regolithic units consist essentially of moderately to poorly consolidated, massive to crudely bedded layers of granular to crystalline quartz and interlocking, variably weathered feldspar grains. Quartz grains are angular to subrounded, typically polycrystalline and less than 5 mm across, with smooth to ragged margins. Quartz makes up 30% to more than 50% of the rock. The relative percentage of quartz



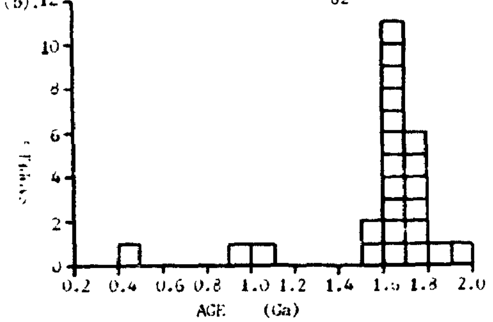


Fig. 1.4a: K-Ar, Rb-Sr and U-Pb age dates for basement rocks in the North Baffin Rift Zone. Age dates derived from the following sources: Blackadar ([illegible]a, [illegible]), Jackson and Davidson (1975) and Jackson et al. (1977, 1978a, [illegible]).

Fig. 1.4b: Plot of K-Ar age dates.

increases upward in the unit. Quartz masses are intermixed with moderately to extensively altered (sericitized) feldspar. Feldspar grains are partially to totally altered. Minor components include remnant biotite flakes, altered hornblende and rare pyrite grains, which together comprise less than 5% of the unit. Variable amounts of clay material occur as a matrix component.

Pebbles in some basal conglomerates of the Adams Sound Formation comprise quartzarenite with a significant green-yellow clay component in the matrix. The pebbles are unlike any quartzarenites present in the Nauyat or Adams Sound Formations. This may indicate that pre-Bylot Supergroup siliciclastic deposits accumulated over parts of northern Baffin Island.

1.7.3 Structural Geology

The major portion of the following section is based on the geological maps and papers of Jackson and Davidson (1975) and Jackson et. al. (1975, 1978b), (Fig. 1.5). Although trends vary considerably across the basement complex, there is a tendency for gneissossity to parallel adjacent northwest-southeast fault zones. This suggests contemporaneous formation of these structures, and indicates that the major fault zones are ancient and very long lived structures. They do not appear to influence the structure and orientation of the Archean Mary River Group metavolcanic-metasedimentary belts. Many of the major fault zones may have originated during the waning stages of the latest period of regional gneissification, that is, during the Hudsonian deformational event (Table 1.1). The structural regime initiated during the

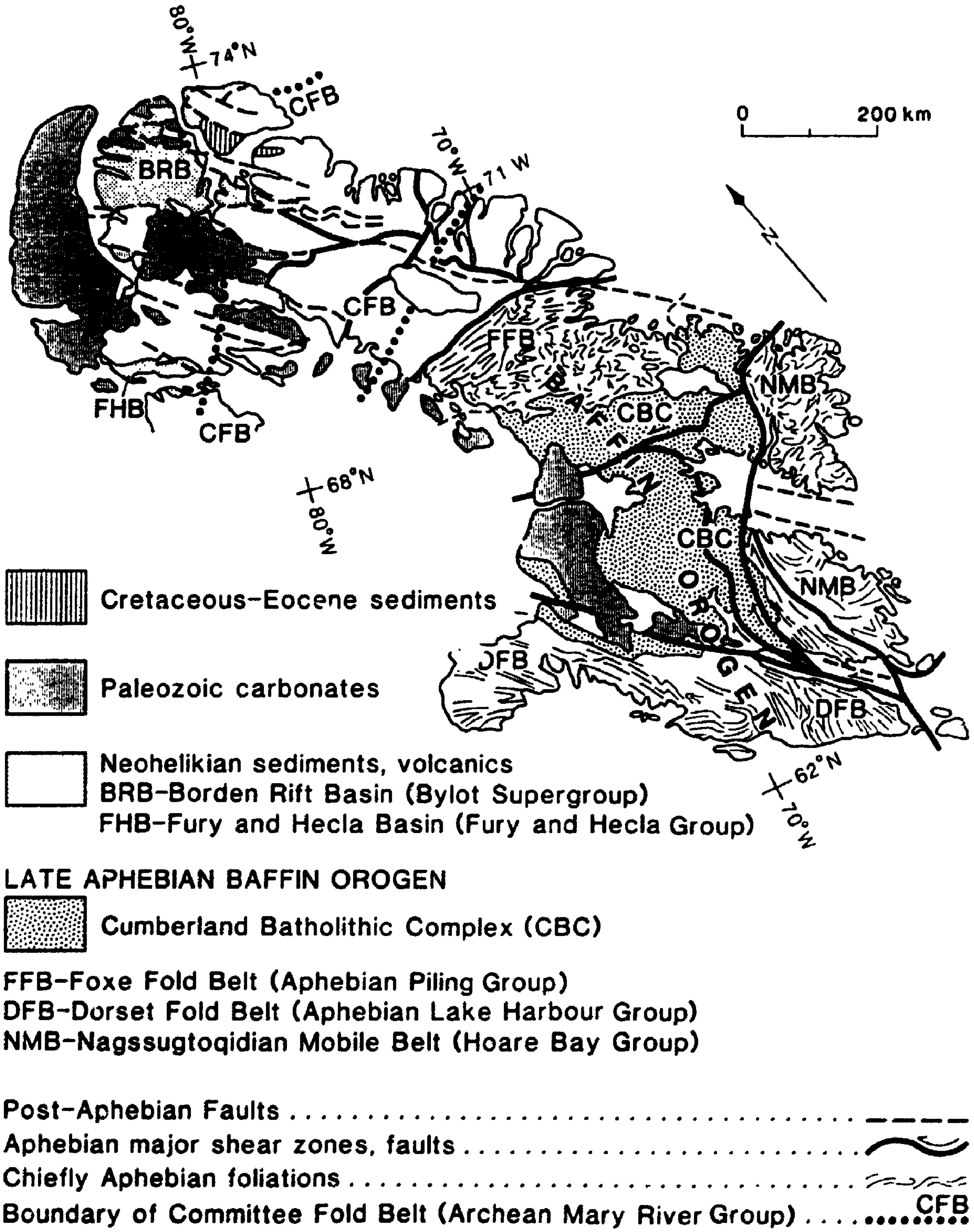


Fig. 1.5: Regional structural geology of Baffin Island (from Jackson et. al., 1990, Fig. 1.2, p. 126; Geological Survey of Canada, Department of Energy, Mines and Resources; Reproduced with the permission of the Minister of Supply and Services Canada, 1992).

Hudsonian Orogeny had a major influence on the subsequent sedimentary and structural history of northern Baffin Island during the Late Proterozoic.

A broad arcuate pattern within the basement complex on northern Baffin Island is a continuation of a similar structure on Bylot Island. The structure is outlined by foliations, the distribution of rock types and the granulite facies isograds. The structure becomes poorly defined in the area of Pond Inlet (Jackson and Davidson, 1975).

Small-scale (<1 m across) to very large-scale (>1 km across) domal to overturned and recumbent isoclinal folds are common in the gneisses. Recumbent folds are characterized by west-northwest-trending axial planes and north-northeast dips; they typically plunge northerly at a high angle to the gneissosity trends. Subhorizontal or westerly-plunging open antiformal and synformal flexures are also common (Jackson et.al., 1975, 1978).

CHAPTER 2 - BYLOT SUPERGROUP: Stratigraphic Revisions and New Formation Tables

2.1 Revised Stratigraphic System: New Formation Tables and Regional Cross-sections for the Bylot Supergroup in the Borden Basin

The Late Proterozoic succession of the Borden Basin contains a great variety of sedimentary rocks that range in composition from quartzarenites to polymictic boulder conglomerates and from stromatolitic dolostone and limestone to a diverse assortment of calciclastics (Jackson and Iannelli, 1981, 1989; Tables 2.5a to 2.5d). Subordinate basalt flows, of variable thickness and number, occur near the base of the succession. The original formation nomenclature as defined for the Borden Basin by Lemon and Blackadar (1963), and Blackadar (1965, 1970) has proven to be too simple to accommodate observed regional and local lithofacies changes. Subsequent workers suggested various modifications (Geldsetzer, 1973a; Iannelli, 1979; Jackson et. al., 1978a, 1980). Jackson and Iannelli (1981, 1989) further revised the basic structure of the nomenclature system. This revision resulted in assignment of the Arctic Bay and "Lower Fabricius Fiord" Formations to the Eqalulik Group, the organization of the strata into three groups each separated (in part) by intrabasinal unconformities, assignment of the entire sequence to the Bylot Supergroup, and subdivision of the formations into regionally defined members.

The basic classification system defined by Jackson and Iannelli (1981, 1989) is retained in the present study. The Bylot Supergroup includes the following subdivisions (Tables 2.5a to 2.5d):

Eqalulik Group: A siliciclastic-dominated group, 700 m to more than 2000 m thick and consisting mainly of sandstone, siltstone, shale, conglomerate and basalt of the Nauyat, Adams Sound and Arctic Bay Formations. The Eqalulik Group has been subdivided into lower and upper subgroups.

Uluksan Group: A carbonate-dominated group, 1000 m to more than 2000 m thick, composed of stromatolitic to massive dolostone and limestone, argillaceous to sandy carbonate, and subordinate pebbly sandstone, immature sandstone, conglomerate, siltstone and shale of the Society Cliffs, Fabricius Fiord and Victor Bay Formations. The Uluksan Group has been subdivided into lower and upper subgroups.

Nunatsiaq Group: A siliciclastic-dominated group, 1055 m to over 2130 m in thickness, composed of shale, siltstone,sandstone, pebbly sandstone, conglomerate and minor stromatolitic to massive limestone and dolostone of the Athole Point, Canada Point, Strathcona Sound, Lower Elwin and Upper Elwin Formations. The Nunatsiaq Group has been subdivided into lower, middle and upper subgroups.

These subdivisions are a gross simplification of the observed lithofacies assemblages in the basin. Tables 2.1 to 2.4 and Figs. 2.2 to 2.5 more realistically outline the complex stratigraphy. These tables and cross-sections represent a concise classification of the regional latero-vertical distribution of lithofacies types and thickness trends observed in the Borden Basin.

The table of formations used by Blackadar (1970), Jackson et. al. (1978a, 1980, 1985) and Jackson and Iannelli (1981, 1989) has been replaced by four tables summarising the regional latero-vertical lithologic distribution along and across the axes of the major component troughs (Tables 2.1 to 2.4). The formation tables have been constructed through the use of regional stratigraphic cross-sections (Figs. 2.2 to 2.5). Each section represents a composite from various parts of the Borden Basin. The regional cross-sections are in turn based on the formation cross-sections comprised of both general and detailed sequences from across the basin (Figs. 3.2, 3.7, 3.10, 3.13, 3.16, 3.19 and 3.21; Appendix II).

The revised stratigraphic system more accurately portrays the lithologic diversity present in the Borden Basin. The regional and formational cross-sections clearly outline thickness variations and member distribution.

A simplified comprehensive table of lithologies (Table 2.5, parts a, b, c, and d) is also presented for use with both the regional and formation cross-sections. The table comprises generalized lithofacies and lithofacies associations for the major member subdivisions of each formation. The table of lithologies has been constructed from observations of lithofacies at numerous field stations and stratigraphic sections (Appendices I and II).

The proposed system of stratigraphy and outline of the regional lithostratigraphy and depositional history of the Bylot Supergroup provide:

(a). The first comprehensive attempt to portray the distribution of formations and members across the entire Borden Basin.

(b). A base for the eventual detailed revision of stratigraphy when all the information from Operation Borden is processed.

(c). The most detailed information currently available on the regional stratigraphy of the Borden Basin. This information is relevant to mineral exploration in the basin.

(d). Previously unavailable insight into the evolution of the Borden Basin.

(e). New type and reference sections for all of the established formations and for newly defined or redefined formations.

(f). Information concerning distinctive or rare lithological units (such as reef-bearing carbonates or sulphide-bearing shales).

2.2 Outline of Major Stratigraphic Revisions for the Eqalulik Group

This study has resulted in major revisions in the stratigraphy and nomenclature of the Adams Sound and Arctic Bay Formations as previously defined and used in Jackson et. al. (1978a, 1980, 1985), Iannelli (1979) and Jackson and Iannelli (1981, 1989). Member definitions and distribution, for all formations of the Eqalulik Group, were refined on a regional scale. Regional cross-sections and isopach maps have been made for each formation. The formation cross-sections summarise the regional thickness trends, major contacts and latero-vertical distribution of lithofacies associations (Figs. 3.2, 3.7 and 3.10). The isopach maps show regional thickness trends and delineate the major depocentres (Figs. 3.3, 3.8 and 3.11).

2.2.1 Nauyat Formation (Figs. 2.2 to 2.5 and 3.2; Tables 2.1 to 2.4 and 2.5a)

The regional stratigraphy and nomenclature of the Nauyat Formation, in general, resemble those previously defined and used by Jackson et. al. (1978a, 1980, 1985), Galley (1978) and Jackson and Iannelli (1981). The Nauyat outcrops in southwest and south central Borden Peninsula, the Elwin Icecap and north Bylot Island. but is absent southeast of the Milne Inlet - Koluktoo Bay area (Fig. 1.1).

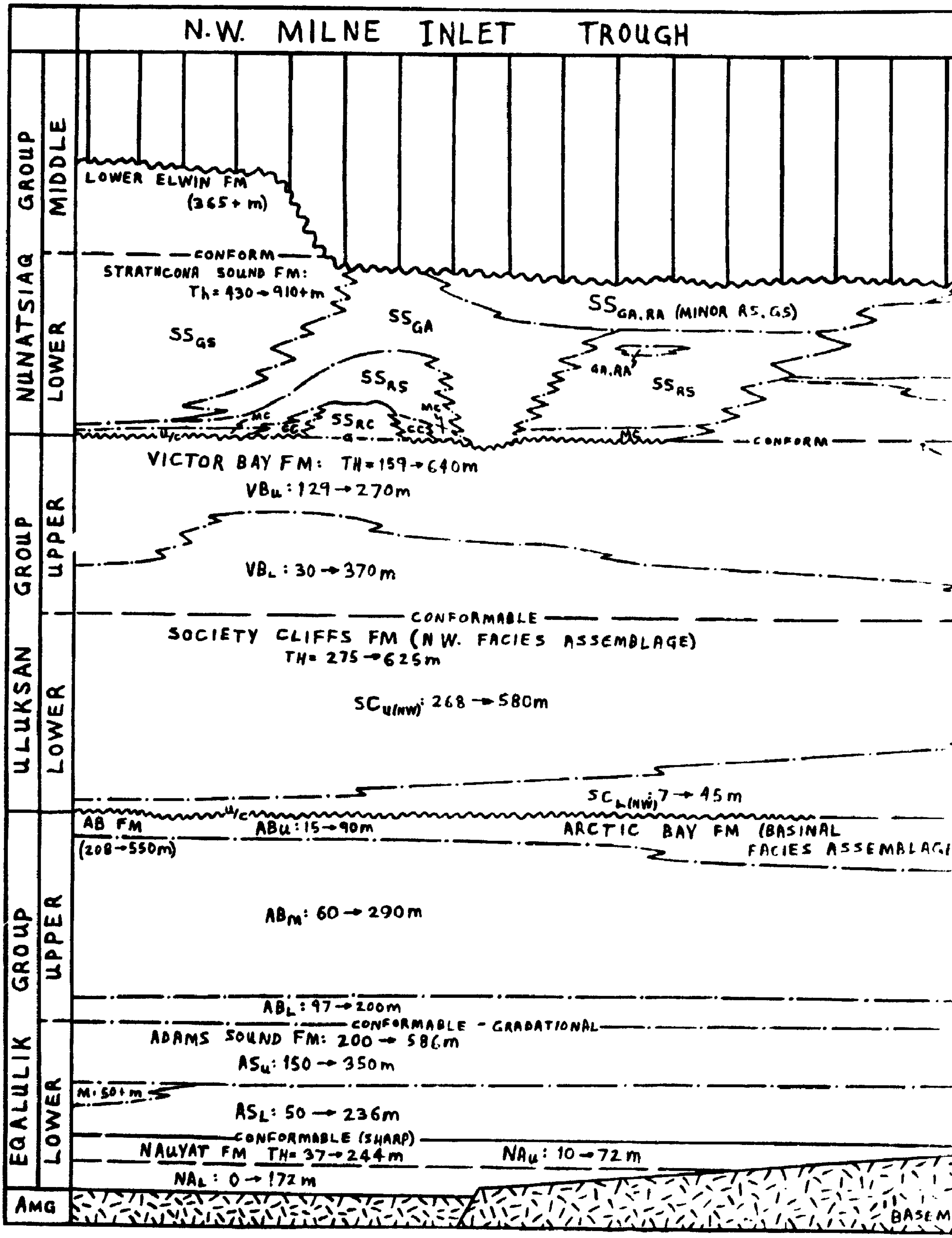


Table 2.1: Bylot Supergroup - Formation and member nomenclatur
thickness; axial (NW-SE) cross-section, Milne Inlet

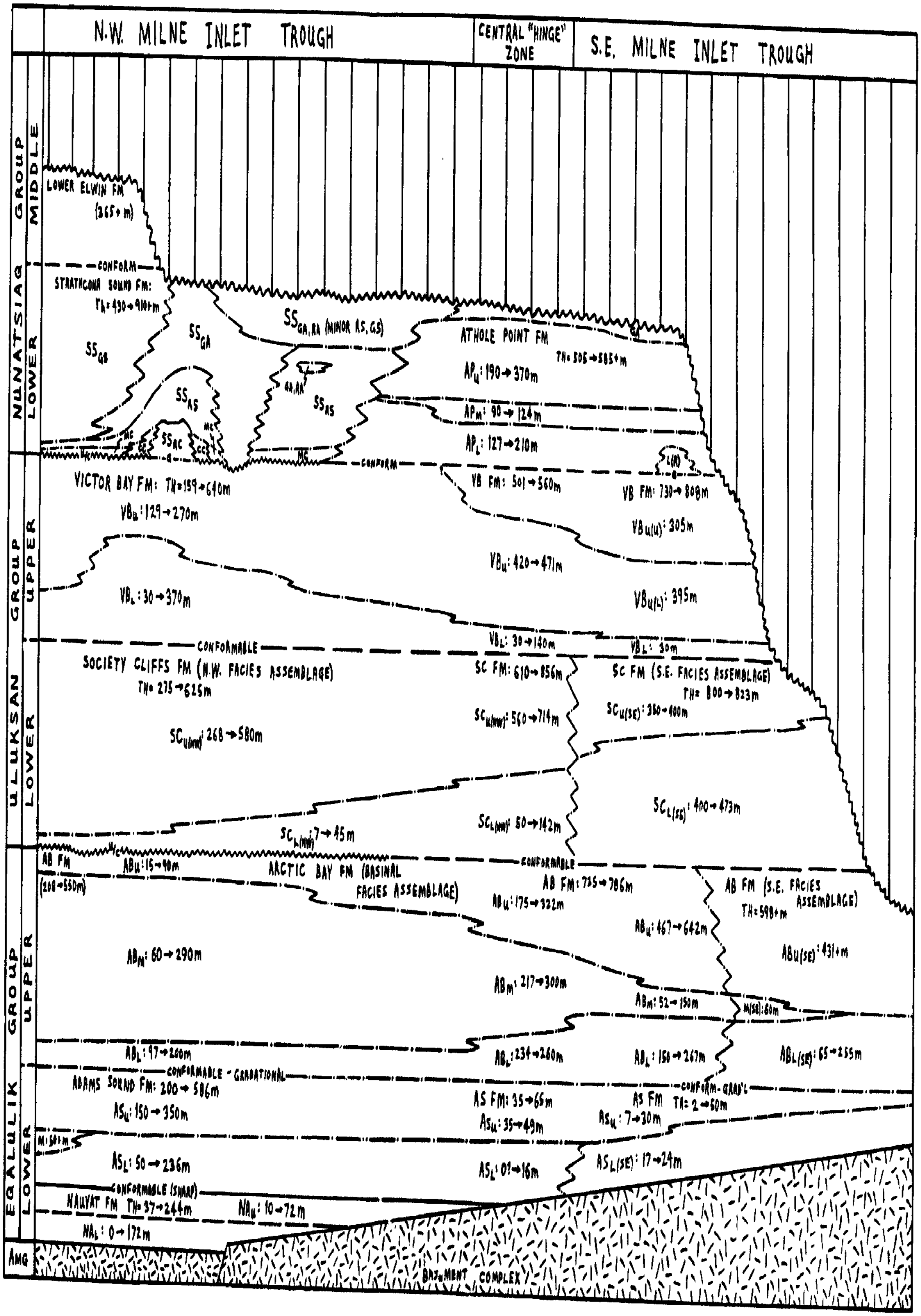


Table 2.1: Bylot Supergroup - Formation and member nomenclature and thickness; axial (NW-SE) cross-section, Milne Inlet Trough.

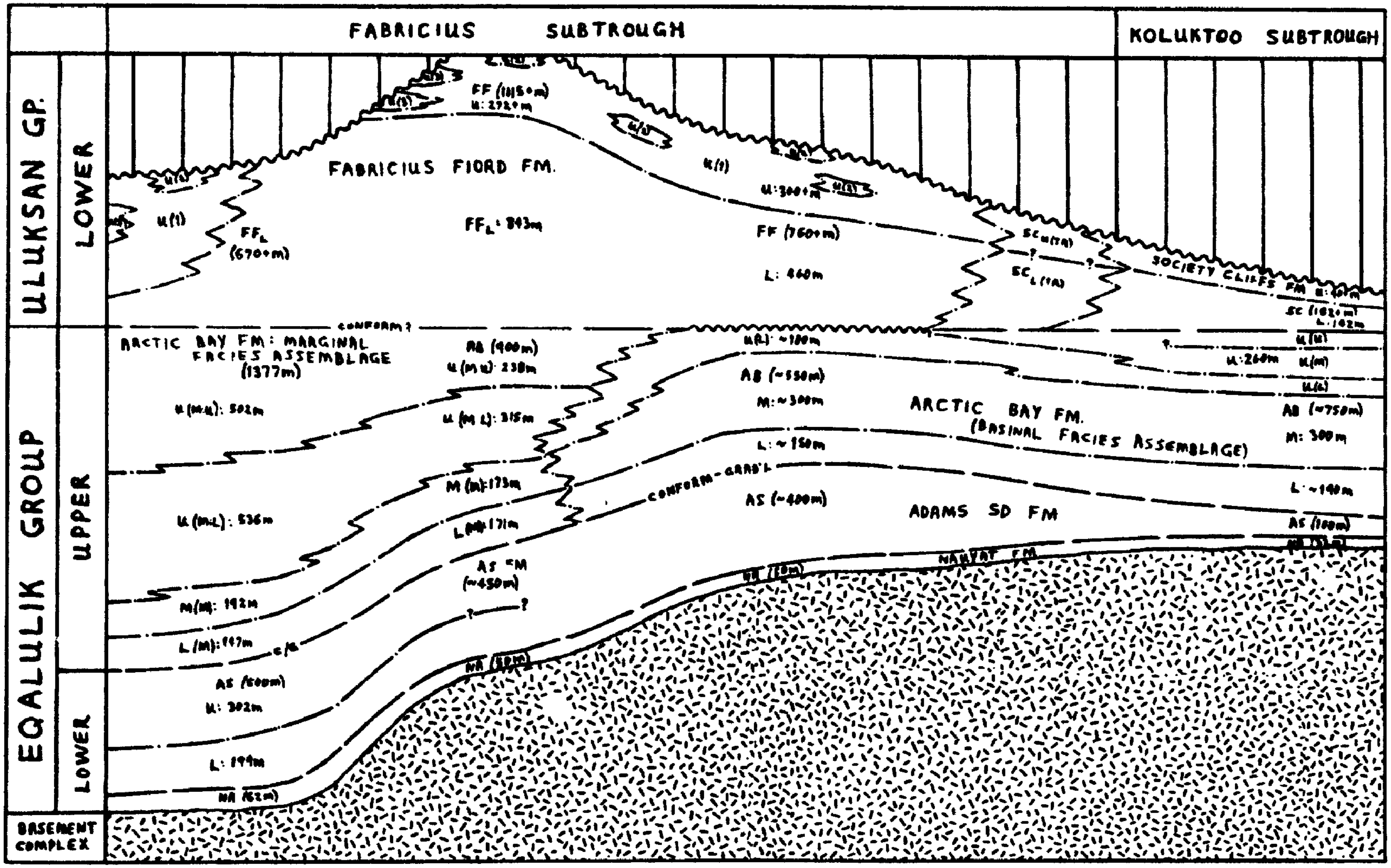


Table 2.2: Bylot Supergroup - Formation and member nomenclature and thickness; marginal cross-section (adjacent to the Central Borden Fault Zone), Milne Inlet Trough.

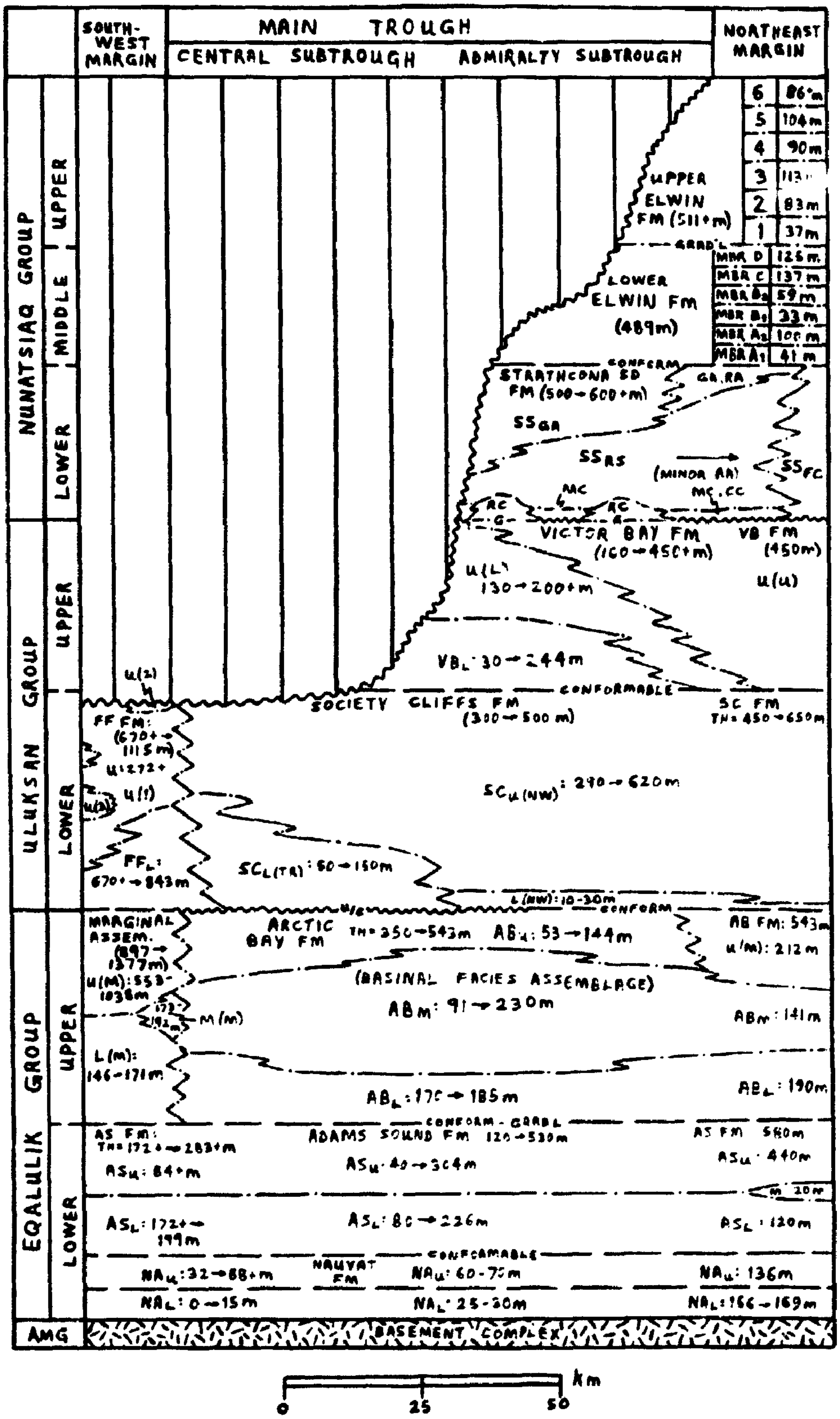


Table 2.3: Bylot Supergroup - Formation and member nomenclature and thickness; transverse (SW - NE) cross-section, northwest Milne Inlet Trough.

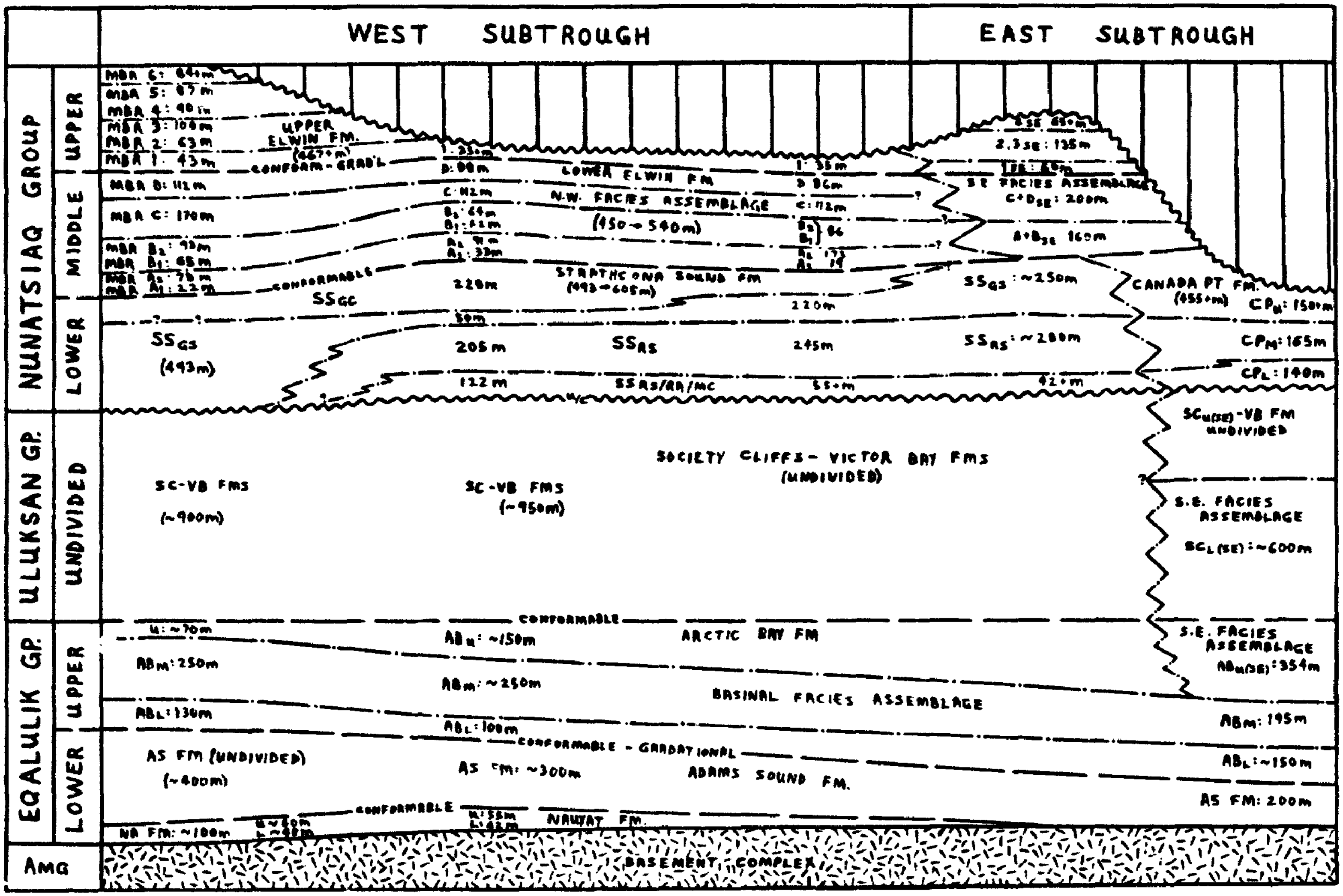


Table 2.4: Bylot Supergroup - Formation and member nomenclature and thickness; axial (W-E) cross-section, Eclipse Trough.

The formation has been subdivided into lower (NA_L) and upper (NA_U) members. The NA_L member consists mainly of red, purple-brown, buff to grey-brown quartzarenite and subarkose with minor interlayers of quartz-pebble conglomerate. The NA_U member comprises amygdaloidal to massive tholeiitic basalt flows. The strata were previously denoted as the NA_1 and NA_2 members in Jackson et. al. (1978a, 1980, 1985), Galley (1978) and Jackson and Iannelli (1981).

2.2.2 Adams Sound Formation (Figs. 2.2 to 2.5 and 3.7; Tables 2.1 to 2.4 and 2.5a)

The stratigraphic subdivision of the Adams Sound Formation, outlined in previous papers (Jackson et. al., 1978a, 1980, 1985; Iannelli, 1979; Jackson and Iannelli, 1981) has been largely retained in this study. In an attempt to simplify the nomenclature, some members were redefined and restructured (Fig. 3.7; Table 2.5a).

The strata of the Adams Sound Formation outcrop mainly on southern and southeastern Borden Peninsula, in the Elwin Inlet area and on northwest Bylot Island; thin sequences also occur in southeastern Milne Inlet Trough (Figs. 1.1 and 5.1). In this study the formation comprises lower (AS_L), middle (AS_M), upper (AS_U) and lower, southeast ($AS_{L(SE)}$) members (Fig. 3.7). The formation consists of two to three members on mainland Borden Peninsula (AS_L, AS_M and AS_U members; the AS_M member is only locally present in northwestern Milne Inlet and Eclipse Troughs). The Adams Sound Formation includes two members in southeastern Milne Inlet Trough ($AS_{L(SE)}$ and AS_U members) and two members (or locally, one) in southeastern Eclipse and North Bylot Troughs (AS_L and AS_U members).

The AS_L member consists of red, purple-red, orange- to pink-buff and pink-grey thick laminated to medium bedded quartzarenite and minor interlayers of siltstone and quartz-pebble conglomerate. The member includes all strata previously defined as the AS_1 and AS_2 members of Jackson et. al. (1978a, 1980), Iannelli (1979), and Jackson and Iannelli (1981), and as the AS_L member of Jackson et. al. (1980, 1985) and Jackson and Iannelli (1981).

The $AS_{L(SE)}$ member comprises variably intermixed massive to poorly bedded quartz-pebble to quartz-cobble conglomerate, thin to medium bedded quartzarenite and minor interlayered subarkose and pebbly subarkose. It includes all strata previously defined as those of the AS_4 member of Iannelli (1979) and as those of the AS_L member, southeast of Milne Inlet, of Jackson and Iannelli (1981).

The AS_M member is newly defined in this study. It consists of thin sequences of thick laminated to thin bedded purple, red-pink to green-grey quartzarenite, interbedded with siltstone and shale. The member is only locally present in northwestern Milne Inlet and Eclipse Troughs (Fig. 3.7).

Strata of the AS_U member consist of planar thick laminated to medium bedded, grey-white, buff-grey to buff-yellow quartzarenite with minor interlayers of pebbly quartzarenite, quartz-pebble conglomerate and siltstone. The member includes all strata previously defined as the AS_3 member of Jackson et. al. (1978a, 1980), Iannelli (1979) and Jackson and Iannelli (1981), as the AS_U member of Jackson et. al. (1980, 1985) and Jackson and Iannelli (1981), and as the AS_5 member of Iannelli (1979).

2.2.3 Arctic Bay Formation (Figs. 2.2 to 2.5 and 3.10; Tables 2.1 to 2.4 and 2.5a)

The Arctic Bay Formation is here defined as a shale-bearing to shale-dominated sequence comprised of three lithofacies assemblages. These include basinal (Tremblay Sound), marginal (Fabricius River) and southeast (Paquet Bay) lithofacies assemblages (Table 2.5a). The formation is characterised by the occurrence of planar thin to thick laminated black to black-grey shale with variable amounts of siltstone, sandstone, dolostone, limestone, calciclastic carbonate, pebbly sandstone, flat carbonate clast conglomerate and quartz-clast and feldspar-clast conglomerate. The non-shale components of the formation vary considerably in composition and amount across the basin (Fig. 3.10).

2.2.3a Tremblay Sound Lithofacies Assemblage: Basinal Lithofacies Assemblage of the Arctic Bay Formation

The Tremblay Sound Assemblage is what was formerly defined as the Arctic Bay Formation in the northwestern portions of Milne Inlet, Eclipse and North Bylot Troughs and denoted as the AB_1, AB_2, AB_3 and AB_4 members in Jackson et. al. (1978a, 1980, 1985), Iannelli (1979) and Jackson and Iannelli (1981, 1989). The strata are widely distributed on Borden Peninsula, and north and northwestern Bylot Island (Fig. 1.1). The assemblage has been subdivided into lower (AB_L), middle (AB_M) and upper (AB_U) members.

The AB_L member consists of cyclically alternating units of planar thin laminated black-grey shale, grey to buff planar to lensed or wavy bedded intermixed shale-siltstone-sandstone and buff-grey thick laminated to thin or medium bedded quartzarenite. The AB_M member is mainly planar thin laminated black to black-grey shale with minor beds and lenses of buff-grey to grey siltstone, quartzarenite, dolomitic shale, and calciclastic carbonate. The AB_U member is a diverse association of planar thin laminated black-grey shale, dolomitic shale and grey, buff-grey to orange-brown thin laminated to thin bedded dolostone, limestone, stromatolitic limestone, stromatolitic dolostone and dololutite.

2.2.3b Fabricius River Lithofacies Assemblage: Marginal Lithofacies Assemblage of the Arctic Bay Formation

The Fabricius River Assemblage includes all of the strata formerly defined as the FF_1 and FF_2 members of the Fabricius Fiord Formation (Jackson et. al., 1978a, 1980; Iannelli, 1979; Jackson and Iannelli, 1981). Strata of the Fabricius River Assemblage are most widely exposed on southern Borden Peninsula, adjacent to the Central Borden Fault Zone. Scattered outcrops also occur along the White Bay Fault Zone in the area of the Elwin Icecap and northwest of the end of Tremblay Sound (Fig. 1.1). The Fabricius River Assemblage has been subdivided into lower ($AB_{L(M)}$), middle ($AB_{M(M)}$) and upper ($AB_{U(M)}$) members.

The $AB_{L(M)}$ member consists of alternating units of planar thin laminated black-grey to grey shale cyclically interlayered with planar to wavy bedded intermixed shale-siltstone-quartzarenite and thick laminated to thin bedded quartzarenite, pebbly quartzarenite and minor arkose, litharenite and quartz- and feldspar-pebble conglomerate. The shale content increases upwards in the member. Strata of the middle member are essentially similar to those of the AB_M member of the basinal assemblage except that siltstone and quartzarenite beds are more common and carbonates are less abundant. The $AB_{U(M)}$ member comprises cyclically alternating units of shale, intermixed shale-siltstone-sandstone, and sandstone, pebbly sandstone, quartz to quartz-pebble and feldspar-pebble conglomerate and rare interlayered buff to dark-grey dolostone, dolosiltite and carbonate flat clast conglomerate. Shale content decreases upwards and marginwards in the member.

2.2.3c Paquet Bay Lithofacies Assemblage: Southeast Lithofacies Assemblage of the Arctic Bay Formation

The Paquet Bay Lithofacies Assemblage comprises strata of the Upper Eqalulik Group that were deposited in the southeastern portions of the Milne Inlet and Eclipse Troughs. The assemblage comprises all strata previously included in the Arctic Bay Formation southeast of Milne Inlet (Iannelli, 1979; Jackson et. al., 1980, 1985; Jackson and Iannelli, 1981, 1989). Strata of the Paquet Bay Assemblage outcrop in the area southeast of Eskimo Inlet and in the vicinity of Tay Sound and east and west Paquet Bay and on northwestern Bylot Island (Fig. 1.1). The succession has been subdivided into lower ($AB_{L(SE)}$), middle ($AB_{M(SE)}$) and upper ($AB_{U(SE)}$) members (Figs. 3.10a and 3.10f).

The $AB_{L(SE)}$ member comprises cyclically interlayered units of grey, black-grey to black thin laminated shale, planar to wavy bedded intermixed shale-siltstone-quartzarenite, quartzarenite and minor pebbly quartzarenite and subarkose. Shale content increases upward at the expense of siltstone and sandstone. The $AB_{M(SE)}$ member is chiefly planar thin laminated black-grey to black shale and closely resembles the middle member of the basinal assemblage in composition. The $AB_{U(SE)}$ member consists of cyclically interlayered facies units made up of grey, green-grey to black shale and thick laminated to thin bedded intermixed shale-siltstone-sandstone-calcarenite, and thick laminated to thin bedded quartzarenite, subarkose, pebbly sandstone, carbonate flat clast conglomerate, quartz-pebble and feldspar-pebble conglomerate and dolostone to stromatolitic dolostone. Shale content decreases upwards in the member and also near the fault margins. Sandstones and conglomerates increase upwards and towards the faulted basin margins.

2.3 Outline of Major Stratigraphic Revisions for the Uluksan Group

Regional stratigraphic analysis of the Uluksan Group resulted in major revisions in the stratigraphy and nomenclature of the Fabricius Fiord and Society Cliffs Formations as previously defined and used in Jackson et. al. (1978a, 1980, 1985), Iannelli (1979) and Jackson and Iannelli (1981). Related results include the construction of regional cross-sections and isopach maps for each formation and the definition and distribution of members within the Fabricius Fiord, Society Cliffs and Victor Bay Formations. The formation cross-sections summarise regional thickness trends, contacts and the latero-vertical distribution of lithofacies associations (Figs. 3.13 and 3.16). The isopach maps illustrate regional thickness variations within the Milne Inlet Trough (Figs. 3.14 and 3.17).

TABLE 2.5A: EQALULIK GROUP - LITHOLOGY LEGEND

ARCTIC BAY FORMATION

(A). Marginal Facies Association (Fabricius River Assemblage)

(i). Central Borden Fault Zone margin

▤	AB$_{U(M:U)}$ MBR	Alternating units of intermixed shale-siltstone-sandstone and thin to thick bedded subarkose, conglomerate; sand-cglm capped coarsening-up cycles
▤	AB$_{U(M:L)}$ MBR	Alternating facies units as in AB$_{L(M)}$ MBR but with shale greatly reduced and sandstone increasing up in amount; minor pebbly sandstone, conglomerate
▤	AB$_{M(SE)}$ MBR	Shale dominated member (see description for AB$_M$ below) : increased siltstone and sandstone
▤	AB$_{L(M)}$ MBR	Alternating units of shale, intermixed shale-siltstone-sandstone and sandstone (quartzarenite; minor arkose, litharenite, conglomerate); facies arranged into sandstone capped, coarsening-up cycles; shale increases up in amount in the member

(ii). White Bay Fault Zone margin

▤	AB [illegible] MBR	Planar laminated, black to grey shale variably intermixed with units of dolostone, stromatolitic dolostone, interlayered shale-siltstone-sandstone; rare beds of carbonate breccia-conglomerate, concretionary carbonate and pisolites; carbonate layers dominate the upper 2 m of the member locally

(B). SE Facies Association (Paquet Bay Assemblage)

(i). SE Milne Inlet Trough

▤	AB$_{U(SE:M)}$ MBR	Arkose, subarkose dominated and minor sandstone-carbonate bearing, coarsening- and thickening-up cycles
▤	AB$_{U(SE:T)}$ MBR	Carbonate (calcarenite, dolosiltite, dolorudite etc.) and sandstone bearing to dominated coarsening- and thickening-up cycles
▤	AB$_{M(SE)}$ MBR	Shale dominated member (see description for AB$_M$ below); increased calciclastic carbonate
▤	AB$_{L(SE)}$ MBR	Intermixed shale-siltstone-sandstone and sandstone bearing to dominated coarsening-upward cycles: shale increases up in amount in the member

(ii). SE Eclipse Trough

▤	AB$_{U(SE)}$ MBR	Variably interlayered units of grey, green-grey to black shale, intermixed shale-siltstone-sandstone, quartzarenite, subarkose, pebbly sandstone, polymictic conglomerate, dolostone and stromatolitic dolostone; minor stromatolitic mounds

(C). Basinal Facies Association: Central and NW Milne Inlet Trough ([illegible] Assemblage)

▤	AB [illegible] MBR
▤	[illegible]

TABLE 2.5A: EQALULIK GROUP - LITHOLOGY LEGEND

ARCTIC BAY FORMATION

(A). Marginal Facies Association (Fabricius River Assemblage)

(i). Central Borden Fault Zone margin

▨	$AB_{U(M:U)}$ MBR	Alternating units of intermixed shale-siltstone-sandstone and thin to thick bedded subarkose, conglomerate; sand-cglm capped coarsening-up cycles
▨	$AB_{U(M:L)}$ MBR	Alternating facies units as in $AB_{L(M)}$ MBR but with shale greatly reduced and sandstone increasing up in amount; minor pebbly sandstone, conglomerate
▨	$AB_{M(SE)}$ MBR	Shale dominated member (see description for AB_M below) ; increased siltstone and sandstone
▨	$AB_{L(M)}$ MBR	Alternating units of shale, intermixed shale-siltstone-sandstone and sandstone (quartzarenite; minor arkose, litharenite, conglomerate); facies arranged into sandstone capped, coarsening-up cycles; shale increases up in amount in the member

(ii). White Bay Fault Zone margin

▨	$AB_{U(M:L)}$ MBR	Planar laminated, black to grey shale variably intermixed with units of dolostone, stromatolitic dolostone, interlayered shale-siltstone-sandstone; rare beds of carbonate breccia-conglomerate, concretionary carbonate and pisolites; carbonate layers dominate the upper 20 m of the member locally

(B). SE Facies Association (Paquet Bay Assemblage)

(i). SE Milne Inlet Trough

▨	$AB_{U(SE:M)}$ MBR	Arkose, subarkose dominated and minor sandstone-carbonate bearing, coarsening- and thickening-up cycles
▨	$AB_{U(SE:T)}$ MBR	Carbonate (calcarenite, dolosiltite, dolorudite etc.) and sandstone bearing to dominated coarsening- and thickening-up cycles
▨	$AB_{M(SE)}$ MBR	Shale dominated member (see description for AB_M below); increased calciclastic carbonate
▨	$AB_{L(SE)}$ MBR	Intermixed shale-siltstone-sandstone and sandstone bearing to dominated coarsening-upward cycles; shale increases up in amount in the member

(ii). SE Eclipse Trough

▨	$AB_{U(SE)}$ MBR	Variably interlayered units of grey, green-grey to black shale, intermixed shale-siltstone-sandstone, quartzarenite, subarkose, pebbly sandstone, polymictic conglomerate, dolostone and stromatolitic dolostone; minor stromatolitic mounds

(C). Basinal Facies Association: Central and NW Milne Inlet Trough (Tremblay Sound Assemblage)

▨	$AB_{U(U)}$ S.MBR	Variably intermixed planar thin laminated black-grey shale, dolomitic shale and grey, buff-grey to orange-brown laminated to bedded dolostone, limestone, stromatolitic dolostone, stromatolitic limestone, dololulite; minor siltstone, subarkose, flat carbonate clast conglomerate; locally with stromatolitic bioherms; facies units arranged into thickening-upward (shallowing-upward), shale into carbonate megacycles
▨	$AB_{U(M)}$ S.MBR	
▨	$AB_{U(L)}$ S.MBR	
▨	$AB_{U(LL)}$ S.MBR	
▨	AB_M MBR	Planar thin laminated black to grey shale; with minor interlayers and lenses of buff-grey to grey siltstone, quartzarenite, dolomitic shale, calcilutite, dololutite and dolosiltite; rare concretionary carbonate and flat clast conglomerate beds; shale locally pyritiferous
▨	AB_L MBR	Alternating units of planar thin laminated black-grey shale, grey to buff planar to lensed bedded intermixed shale-siltstone-sandstone and buff-grey thick laminated to thin bedded quartzarenite; facies units arranged into sandstone capped, coarsening-upward cycles that range from less than 5 m to more than 20 m in thickness; siltstone and sandstone decrease upward in amount within the member

ADAMS SOUND FORMATION

▨	AS_U MBR	Planar to crossbedded, thick laminated to medium bedded, grey, buff-grey to white quartzarenite with minor intermixed layers and lenses of pebbly quartzarenite and quartz-pebble conglomerate
▨	AS_M MBR	Planar to lensed, laminated to thin bedded intermixed quartzarenite, siltstone and minor shale; buff- to green-grey to pink-grey
▨	AS_L MBR	Planar to crossbedded, thick laminated to medium bedded pink-grey, orange, purple, red and grey quartzarenite; minor lenses and beds of pebbly quartzarenite, subarkose; rare shale and quartz-pebble conglomerate
▨	$AS_{L(SE)}$ MBR	[SE Milne Inlet Trough] Massive to poorly stratified, quartz-pebble to cobble conglomerate with variably intermixed beds of subarkose, pebbly subarkose, quartzarenite

NAUYAT FORMATION

∨∨∨∨	NA_U MBR	Amygdaloidal to massive, green, green-grey to red-brown basalt; one to seven flows present; rare interflow sediments occur locally and include quartzarenite, siltstone and thin laminated stromatolitic limestone
▨	NA_L MBR	Planar to crossbedded, thick laminated to medium bedded buff, grey to pink quartzarenite intermixed with minor subarkose, quartz-pebble conglomerate, pebbly subarkose and rare shale and siltstone; one to two basalt flows are locally present in the middle part of the member

▨	ANK	Archean - Aphebian basement complex: migmatitic gneiss, granitic gneiss, granite, amphibolite

▤	$AB_{U(M)}$ S.MBR	Variably intermixed planar thin laminated black-grey shale, dolomitic shale and grey, buff-grey to orange-brown laminated to bedded dolostone, limestone, stromatolitic dolostone, stromatolitic limestone, dololulite; minor siltstone, subarkose, flat carbonate clast conglomerate; locally with stromatolitic bioherms; facies units arranged into thickening-upward (shallowing-upward), shale into carbonate megacycles
▦	$AB_{U(L)}$ S.MBR	
▩	$AB_{U(LL)}$ S.MBR	
▒	AB_{M} MBR	Planar thin laminated black to grey shale; with minor interlayers and lenses of buff-grey to grey siltstone, quartzarenite, dolomitic shale, calcilutite, dololutite and dolosiltite; rare concretionary carbonate and flat clast conglomerate beds; shale locally pyritiferous
☰	AB_{L} MBR	Alternating units of planar thin laminated black-grey shale, grey to buff planar to lensed bedded intermixed shale-siltstone-sandstone and buff-grey thick laminated to thin bedded quartzarenite; facies units arranged into sandstone capped, coarsening-upward cycles that range from less than 5 m to more than 20 m in thickness; siltstone and sandstone decrease upward in amount within the member

---

ADAMS SOUND FORMATION

░	AS_{U} MBR	Planar to crossbedded, thick laminated to medium bedded, grey, buff-grey to white quartzarenite with minor intermixed layers and lenses of pebbly quartzarenite and quartz-pebble conglomerate
▩	AS_{M} MBR	Planar to lensed, laminated to thin bedded intermixed quartzarenite, siltstone and minor shale; buff- to green-grey to pink-grey
░	AS_{L} MBR	Planar to crossbedded, thick laminated to medium bedded pink-grey, orange, purple, red and grey quartzarenite; minor lenses and beds of pebbly quartzarenite, subarkose; rare shale and quartz-pebble conglomerate
⁘	$AS_{L(SE)}$ MBR	[SE Milne Inlet Trough] Massive to poorly stratified, quartz-pebble to cobble conglomerate with variably intermixed beds of subarkose, pebbly subarkose, quartzarenite

NAUYAT FORMATION

∨	NA_{U} MBR	Amygdaloidal to massive, green, green-grey to red-brown basalt; one to seven flows present; rare interflow sediments occur locally and include quartzarenite, siltstone and thin laminated stromatolitic limestone
░	NA_{L} MBR	Planar to crossbedded, thick laminated to medium bedded buff, grey to pink quartzarenite intermixed with minor subarkose, quartz-pebble conglomerate, pebbly subarkose and rare shale and siltstone; one to two basalt flows are locally present in the middle part of the member

---

⁚	AMC	Archean - Aphebian basement complex: migmatitic gneiss, granitic gneiss, granite, amphibolite

TABLE 2.5B: ULUKSAN GROUP - LITHOLOGY LEGEND

UPPER

VICTOR BAY FORMATION

Central and NW Milne Inlet Trough

▨	$VB_{U(U)}$ MBR	Biohermal, stromatolitic dolostone intermixed with laminated to thick bedded calcisiltite, dolosiltite, dolostone and minor flat clast conglomerate, light- to dark-grey, buff-grey
▨	$VB_{U(L)}$ MBR	Variably intermixed planar to undulose, thin laminated to medium bedded shale, calcilutite, dololutite, dolostone, dolosiltite and round to flat carbonate clast, pebble to boulder conglomerate
▨	VB_L MBR	Planar laminated, dark grey to black shale, dolomitic shale and interlayered minor dololutite, calcilutite, calcisiltite, dolosiltite and thin flat carbonate clast conglomerate beds; shale locally pyritiferous

NW Milne Inlet and Eclipse Troughs

▨	SC-VB	Undivided Grey to buff-grey, intermixed planar to undulose dolostone, stromatolitic dolostone, dolosiltite; minor flat clast conglomerate and breccia

SE Eclipse Trough

▨	SC_U -	VB Undivided Planar to undulose, grey, buff- to pink-grey, pink-red sandy dolostone, dolosiltite, dolarenite and dolorudite; minor flat carbonate clast conglomerate and calcareous quartzarenite

LOWER

FABRICIUS FIORD FORMATION (Marginal Facies Assemblage)

▨	$FF_{U(3)}$ MBR	Massive, pebble to boulder, pink to brown-grey weathered breccia-conglomerate comprised of subrounded to angular quartz, feldspar and gneiss clasts set in a sandy dolostone matrix
▨	$FF_{U(2)}$ MBR	Thick laminated to medium bedded dolostone, sandy to pebbly dolosiltite and stromatolitic dolostone; minor intermixed flat pebble conglomerate and pebbly, calcareous subarkose; orange- to chocolate-brown weathered surfaces
▨	$FF_{U(1)}$ MBR	Brown, orange- to chocolate-brown weathered fine-grained to pebbly arkose and subarkose; minor siltstone, fine-grained to pebbly litharenite and polymictic conglomerate
▨	FF_L MBR	Thick laminated to thick bedded, locally massive, brown- to buff-grey subarkose, pebbly subarkose to sublitharenite; minor lenses and layers of quartz- and quartz-feldspar-pebble conglomerate

SOCIETY CLIFFS FORMATION

(i). NW Facies Assemblage (NW Milne Inlet and Eclipse Troughs)

▨	$SC_{U(NW)}$ MBR	Planar to domal, laminated to bedded buff-grey to grey dolostone, dolosiltite, stromatolitic dolostone, carbonate flat clast conglomerate; locally extensive, karst-related breccia
▨	$SC_{L(NW)}$ MBR	Variably intermixed, light- to dark-grey, thin-laminated to thin bedded dololutite to dolarenite, and stromatolitic dolostone; minor shale, quartzarenite, flat carbonate clast conglomerate
▨	$SC_{L(TR)}$ MBR	Transitional member; buff- to grey-brown weathered, massive to bedded sandy dolostone and stromatolitic dolostone

(ii). SE Facies Assemblage

(a). Southeast Eclipse Trough

▨	SC_{SE} MBR	Alternating facies units comprised of grey, buff to white dolostone, dolosiltite, stromatolitic dolostone and gypsum; minor dololutite and flat carbonate clast conglomerate

(b). Southeast Milne Inlet Trough

▨	$SC_{U(SE)}$ MBR	Grey, brown- to buff-grey, planar to undulose, laminated to medium bedded dolostone, dolosiltite, biohermal stromatolitic dolostone; minor shale and red calciclastics
▨	$SC_{L(SE)}$ MBR	Intermixed grey to buff stromatolitic limestone, stromatolitic dolostone and pink-grey to red shale, siltstone, subarkose, dolosiltite, dolarenite; minor gypsum

TABLE 2.5C: LOWER NUNATSIAQ GROUP - LITHOLOGY LEGEND

(A). Southeast Facies Assemblages

(i). ATHOLE POINT FORMATION

(Central and Southeast Milne Inlet Trough)

▨	AP_U MBR	Intermixed units of planar to undulose, laminated to thick bedded, grey, brown to black calcilutite, calcisiltite, stromatolitic limestone and calcareous sandstone; minor flat carbonate clast conglomerate
▨	AP_M MBR	Grey to black intermixed stromatolitic limestone and laminated to thin bedded calcilutite, calcisiltite
▨	AP_L MBR	Dark-grey to black, thin laminated to medium bedded calcilutite and calcisiltite; beds and lenses of calcarenite, flat pebble conglomerate, calcareous sandstone, dolostone
▨	$AP_{L(R)}$ MBR	Reefal carbonate member: laminated to massive limestone, dolostone, stromatolitic limestone, stromatolitic dolostone: light- to dark-grey

(ii). CANADA POINT FORMATION

(Southeast Eclipse Trough)

▨	CP_U MBR	Intermixed laminated to thin bedded, red to grey-green siltstone, shale, subarkose and quartzarenite; minor lenses and beds of polymictic conglomerate and dolostone
▨	CP_M MBR	Planar to lensed, laminated to thin bedded red, grey-green siltstone, subarkose; minor shale and silty to argillaceous dolostone
▨	CP_L MBR	Interlayered, thin to medium bedded siltstone, arkose and sandy dolostone; minor silty to argillaceous dolostone, stromatolitic dolostone and carbonate pebble conglomerate

(B). Northwest Facies Assemblage

STRATHCONA SOUND FORMATION - Northwest Milne Inlet and Eclipse Troughs

▨	SS_{FC} MBR	Massive to poorly stratified, grey-green, green-pink to red-brown, pebble to block, polymictic conglomerate; gneiss, carbonate and sandstone clasts
▨	SS_{GC} MBR	Green-grey, grey, white-grey to yellow-brown intermixed dolostone, dolosiltite, quartzarenite, siltstone; minor units of subarkose and calcisiltite
▨	SS_{GS} MBR	Thin planar laminated to thin bedded, green to green-grey siltstone with minor interlayers of shale, subarkose and conglomerate
▨	SS_{GA} MBR	Thick laminated to thick bedded, grey- to pink-green to green, fine-grained to pebbly arkose, arkosic wacke and litharenite; minor interlayers and lenses of siltstone and polymictic conglomerate
▨	SS_{RA} MBR	Intermixed red, red- to pink-brown arkosic siltstone, fine-grained to pebbly arkose, litharenite and polymictic paraconglomerate and orthoconglomerate
▨	SS_{RS} MBR	Planar layered, thick laminated to thin bedded, red to purple-red siltstone; minor intermixed lenses and beds of subarkose, arkose and carbonate pebble to boulder conglomerate
▨	SS_{RC} MBR	Reefal carbonate member; comprised of massive, bedded to stromatolitic dolostone and associated carbonate round to flat clast conglomerate to conglomero-breccia and variably intermixed lenses and beds of dolosiltite, dolarenite, calcareous subarkose, litharenite
▨	SS_{CC} MBR	Carbonate conglomerate member; comprised of carbonate pebble to block-sized, rounded to angular fragments in a matrix of coarse-grained calcareous litharenite
▨	SS_{MC} MBR	Buff-grey, pink-grey to yellow, poorly stratified to massive carbonate pebble to boulder orthoconglomerate with variably intermixed lenses and layers of siltstone, dolostone and subarkose
▨	$SS_{RS/RA/MC}$ MBR	Thin- to thick bedded, variably intermixed red to purple-red siltstone, arkose, litharenite and siltstone to carbonate clast, pebble to boulder conglomerate

TABLE 2.5D: MIDDLE AND UPPER NUNATSIAQ GROUP - LITHOLOGY LEGEND

UPPER ELWIN FORMATION (UPPER NUNATSIAQ GROUP)

NW Milne Inlet and Eclipse Troughs

▤	MBR 6	Alternating units of shale, intermixed shale-siltstone-quartzarenite and quartzarenite (as in member 2)
░	MBR 5	Quartzarenite, minor unit of intermixed shale-siltstone-quartzarenite (as in member 3)
▤	MBR 4	Alternating units of shale, intermixed shale-siltstone-quartzarenite and quartzarenite (as in member 2)
░	MBR 3	Planar to crossbedded, buff, grey to orange-brown, thin to thick bedded quartzarenite with minor units of intermixed planar to lensed shale-siltstone-quartzarenite
▤	MBR 2	Alternating units of black-grey shale, buff-grey planar to lensed shale-siltstone-quartzarenite and laminated to thin bedded subarkose to quartzarenite
⁘	MBR 1	Buff, grey- to green-buff, planar to cross-bedded, fine- to coarse-grained subarkose

SE Eclipse Trough

░	MBR 4_{SE}	Intermixed units of thin to thick bedded quartzarenite to arkose and minor laminated black-grey shale
≋	MBR $2,3_{SE}$	Intermixed units of planar to cross-bedded quartzarenite to arkose, buff to grey dolostone, stromatolitic dolostone; minor laminated shale and dolarenite
▧	MBR 1_{SE}	Planar to crossbedded, thick laminated to medium bedded quartzarenite, subarkose and arkose; minor intermixed units of dolostone and stromatolitic dolostone

---

LOWER ELWIN FORMATION (MIDDLE NUNATSIAQ GROUP)

NW Milne Inlet and Eclipse Troughs

□	MBR D	Intermixed planar to crossbedded subarkose and quartzarenite; minor units of shale and interlayered shale-siltstone-sandstone
▤	MBR C	Planar to crossbedded, laminated to medium bedded subarkose; minor units of dolostone to dolarenite and intermixed shale-siltstone-sandstone
▒	MBR B_2	Planar laminated black-grey to green-grey shale with minor subarkose and siltstone interbeds
▤	MBR B_1	Intermixed planar to crossbedded subarkose and units of thin bedded dolostone, dolarenite and interlayered shale-siltstone-sandstone
▤	MBR A_2	Buff, pink to red, planar to crossbedded subarkose with minor interlayered units of shale, quartzarenite and intermixed shale-siltstone-sandstone
░	MBR A_1	Buff-white to white, planar to crossbedded subarkose to quartzarenite

SE Eclipse Trough

≋	MBR $C+D_{SE}$	Intermixed planar to crossbedded arkose and stromatolitic dolostone, minor lenses and beds of siltstone and dolarenite
≋	MBR $A+B_{SE}$	Planar to lensed and crossbedded siltstone, quartzarenite and stromatolitic dolostone; minor sandy to argillaceous dolostone

Table 2.6: Lithology and mineral symbols, and formation codes, used in the regional and formation cross-sections.

(A). Lithology and Mineral Symbols

□	Breccia
■	Carbonate flat and round clast conglomerate
z	Sphalerite-galena-hematite
p	Pyrite
O	Chert
x	Gypsum
oo	Conglomerate
b	Bitumen / Anthraxolite

(B). Formation Codes

U.EL = Upper Elwin Formation

L.EL = Lower Elwin Formation

CP = Canada Point Formation

AP = Athole Point Formation

SS = Strathcona Sound Formation

VB = Victor Bay Formation

SC = Society Cliffs Formation

FF = Fabricius Fiord Formation

AB = Arctic Bay Formation

AS = Adams Sound Formation

NA = Nauyat Formation

AMG = Basement Complex (Migmatitic gneiss)

Table 2.7: Regional cross-sections: legend for sedimentary structures and cycles.

(A). Sedimentary Structures

⌒ Large scale Bioherms / Reefs

≈ Cryptalgal Laminites

Ω Hemispherical Stromatolites

⋒ Columnar Stromatolites

● Microfossils

○ Oolites; Pisolites

⋓ Crossbedding

∿ Ripple Marks

⌄ Shrinkage Cracks

s Slumps / Soft Sediment Folds

▶ Flutes

x Halite Casts

c Large Scale Channels

▷ Concretions

(B). Cycles

◇ Turbidites

△ Fining - upward

▲ Thinning - upward

▽ Coarsening - upward (Siliciclastic)

▼ Shallowing - upward (Carbonate + Calciclastic)

2.3.1 Fabricius Fiord Formation (Figs. 2.3, 2.4 and 3.13b; Tables 2.2, 2.3 and 2.5b)

The Fabricius Fiord Formation comprises the basin-marginal lithofacies assemblage of the Lower Uluksan Group. This formation includes strata previously described as the FF_3 and FF_4 members of the Fabricius Fiord Formation of Jackson et. al. (1978a, 1980), Iannelli (1979), and Jackson and Iannelli (1981). It is only this portion of the Fabricius Fiord Formation (former usage) that is, in fact, part of the Uluksan Group and comprises the marginal, coarse siliciclastic-dominated facies equivalent of the Society Cliffs Formation. The former FF_1 and FF_2 members, as previously noted, form the marginal (Fabricius River) lithofacies assemblage of the Arctic Bay Formation.

Sandstone, pebbly sandstone and conglomerate beds of the Fabricius Fiord Formation outcrop in south central Borden Peninsula, adjacent to the Central Borden Fault Zone. Minor outcrops occur in the area northwest of the end of Tremblay Sound, adjacent to the White Bay Fault Zone, and in northwestern Eclipse Trough, along the Hartz Mountain Fault Zone (Figs. 1.1 and 5.1). The formation has been subdivided into two members. The lower (FF_L) member consists of planar thick laminated to thick bedded subarkose, pebbly subarkose and pebbly sublitharenite with minor interlayers of quartz and quartz-pebble and feldspar-pebble conglomerate; it represents the FF_3 member of former usage (Jackson et. al. 1978a; Iannelli, 1979; Jackson and Iannelli, 1981). The FF_U (or upper) member comprises medium bedded to massive, fine-grained to pebbly calcareous subarkose, arkose, polymictic conglomerate and litharenite with intermixed lenses and layers of gritty dolostone and stromatolitic dolostone, and fault-associated lenses or wedges of polymictic pebble to boulder conglomero-breccia. The member has been subdivided into three submembers (Figs. 3.13b; Table 2.5b); it comprises strata of the FF_4 member as previously used in Iannelli (1979) and Jackson and Iannelli (1981).

2.3.2 Society Cliffs Formation (Figs. 2.2 to 2.5 and 3.13; Tables 2.1 to 2.4 and 2.5b)

The Society Cliffs Formation represents the basinal lithofacies of the Lower Uluksan Group. Strata of the formation can be separated into two major regionally defined successions: the Northwestern and Southeastern Facies Assemblages. Previous researchers have subdivided the formation in a similar manner (Geldsetzer, 1973b; Jackson et. al., 1980, 1985; Iannelli, 1979; Jackson and Iannelli, 1981). Carbonates of the Society Cliffs Formation outcrop in a central, northwest-southeast-trending axial belt across Borden Peninsula; outcrops also occur on northern Borden Peninsula, north and northwest Bylot Island and in the area southeast of Milne Inlet (Figs. 1 1 and 5.1).

The Northwestern Facies Assemblage comprises all of the strata of the Society Cliffs Formation present in the northwestern parts of Milne Inlet and Eclipse Troughs. The assemblage can be subdivided into lower ($SC_{L(NW)}$) and upper ($SC_{U(NW)}$) members. The $SC_{L(NW)}$ member consists of variably intermixed, light- to dark-grey, thin laminated to thin bedded dololutite, dolarenite and stromatolitic dolostone. These strata were formerly included in the SC_1 member of Jackson et. al. (1980), Iannelli (1979) and Jackson and Iannelli (1981). The $SC_{U(NW)}$ member includes planar to domal, thin laminated to thin bedded, grey to buff-grey dolostone, dolosiltite, stromatolitic dolostone and carbonate flat clast conglomerate. This member includes strata previously defined as the SC_2 member of Jackson et. al. (1980), Iannelli (1979) and Jackson and Iannelli (1981). The Northwestern assemblage locally contains a transitional member ($SC_{L(TR)}$ member) that is buff to grey-brown, massive to bedded sandy dolostone and stromatolitic dolostone. The sequence is transitional between the basin-marginal deposits of the Fabricius Fiord Formation and those of the basinal Society Cliffs sequences and is best preserved in south-central Borden Peninsula (Fig. 2.3; Table 2.5b).

The Southeastern Assemblage includes strata of the Society Cliffs Formation preserved in southeastern Milne Inlet Trough (southeast of Milne Inlet), Eclipse Trough (Society Cliffs strata on northwestern Bylot Island) and North Bylot Trough. The assemblage can be subdivided into lower ($SC_{L(SE)}$) and upper ($SC_{U(SE)}$) members. Strata of the $SC_{L(SE)}$ member comprise intermixed grey to buff calciclastic to stromatolitic carbonate, pink-grey to red shale, siltstone, sandstone and dolarenite, and pink, grey to white gypsum and chert. The succession includes strata formerly defined as part of the SC_1 member of Jackson and Iannelli (1981) and Iannelli (1979). The $SC_{U(SE)}$ member consists of variably intermixed buff-grey dolostone, dolosiltite, stromatolitic dolostone, flat carbonate clast conglomerate and gypsiferous dolostone and grey to red shale, dololutite and dolarenite.

2.3.3 Victor Bay Formation (Figs. 2.2, 2.4 and 3.16; Tables 2.3, 2.4 and 2.5b)

The regional stratigraphy and nomenclature of the Victor Bay Formation, in general, resemble those used by Jackson et. al. (1978a, 1980) and Jackson and Iannelli (1981). The major subdivision into lower and upper sequences, in Milne Inlet Trough, is retained. In addition, member definition and distribution across the basin have been refined and a new member has been defined in the upper sequence (Table 2.5b).

The strata of the Victor Bay Formation outcrop in a belt that extends from the vicinity of Arctic Bay southeastwards to Tay Sound; additional outcrops occur in the area of Elwin Inlet, the Mala River valley and on north and northwestern Bylot Island (Fig. 1.1). The Victor Bay Formation, in Milne Inlet Trough, can be subdivided into three members. The VB_L member consists of interlayered planar thin laminated to thin bedded, dark-grey to black shale, dolomitic shale, dolosiltite and minor carbonate flat clast conglomerate. It is the VB_1 member of Jackson and Iannelli (1981) and Jackson et. al. (1978a, 1980).

The upper succession of the Victor Bay Formation in the Milne Inlet Trough is, in this study, subdivided into the $VB_{U(L)}$ and $VB_{U(U)}$ members (Fig. 3.16). The $VB_{U(L)}$ member comprises variably intermixed light- to dark-grey shale, calciclastic to stromatolitic carbonate and carbonate pebble to boulder conglomerate. The $VB_{U(U)}$ member outcrops southeast of Eskimo Inlet and consists of light- to buff-grey, bioherm-bearing stromatolitic dolostone together with light- to dark-grey calcisiltite, dolosilitite, dolostone and flat carbonate clast conglomerate. The $VB_{U(L)}$ and $VB_{U(U)}$ members comprise the VB_2 member of previous usage (Jackson and Iannelli,

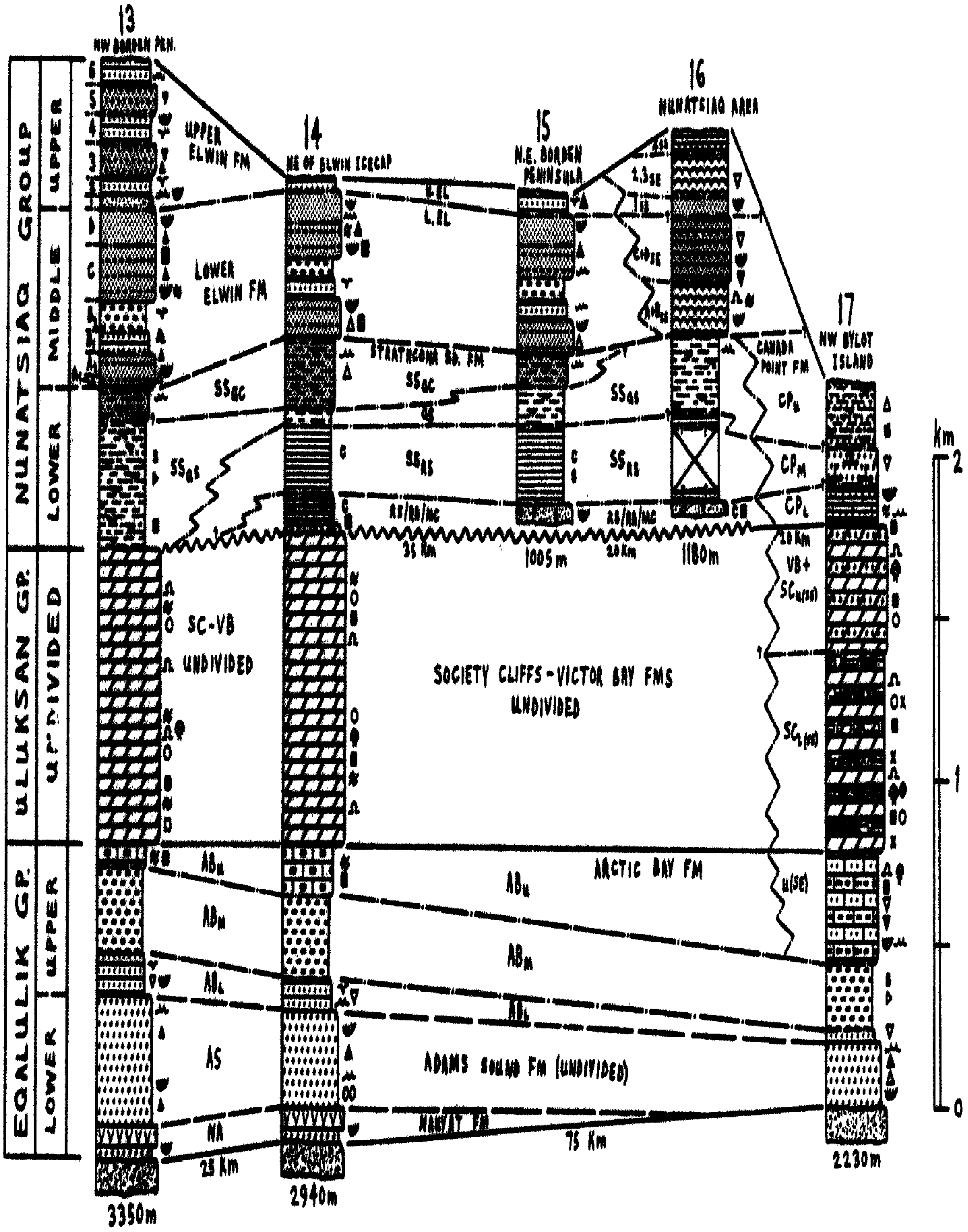


Fig. 2.5: Axial (W - E) cross-section, Eclipse Trough.

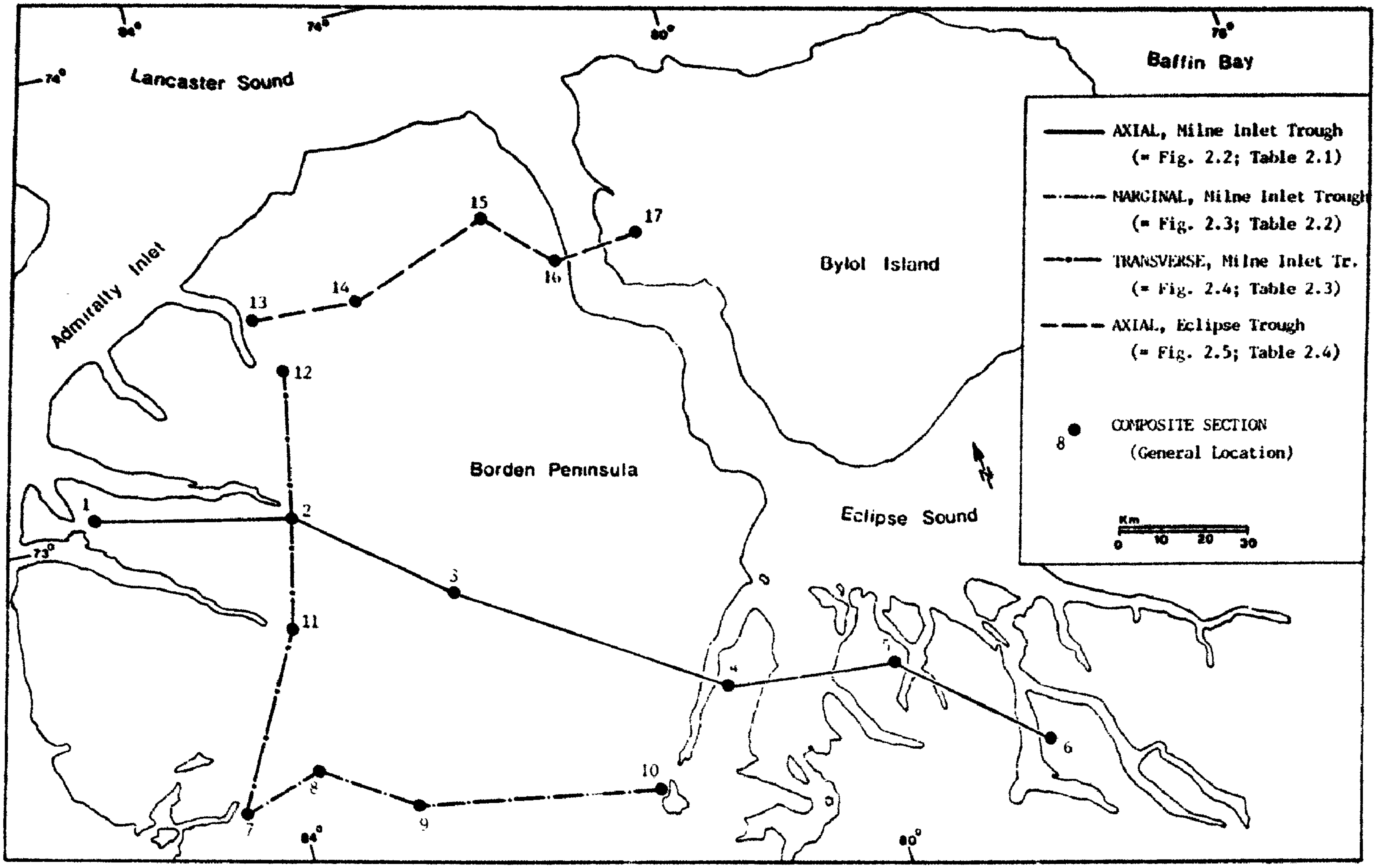


Fig. 2.1: Location map for regional stratigraphic tables and lithologic cross-sections of the Bylot Supergroup.

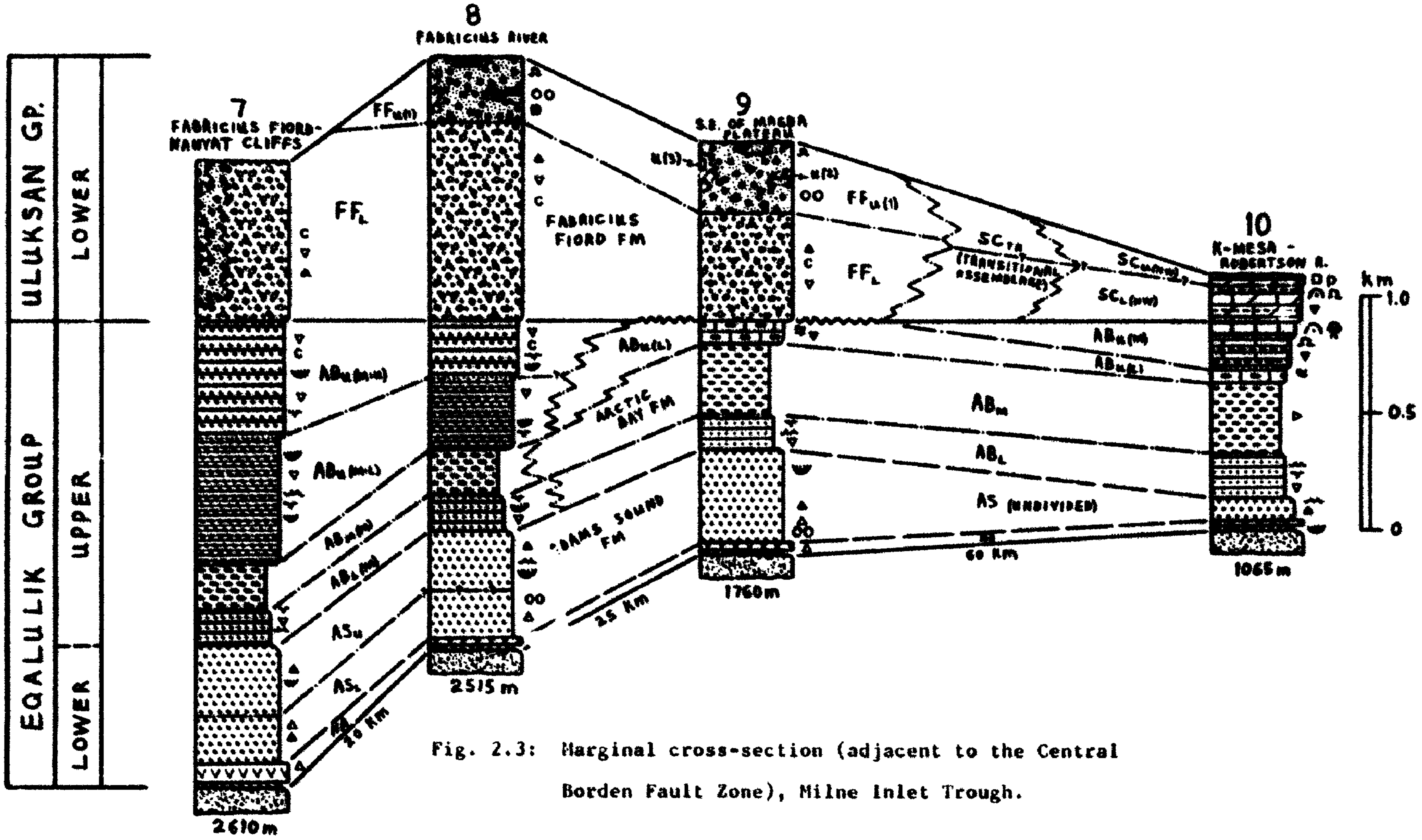


Fig. 2.3: Marginal cross-section (adjacent to the Central Borden Fault Zone), Milne Inlet Trough.

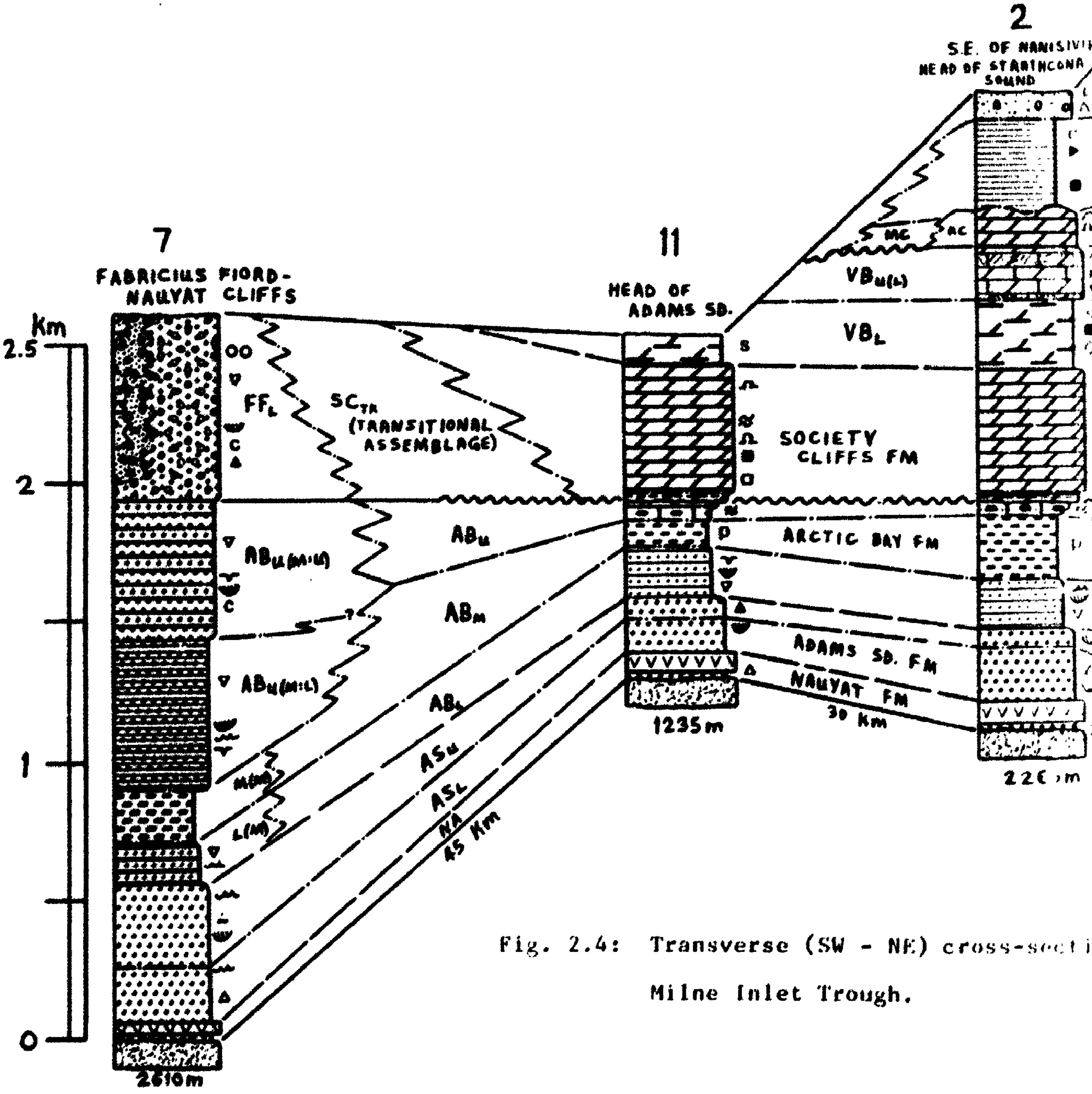


Fig. 2.4: Transverse (SW - NE) cross-secti

Milne Inlet Trough.

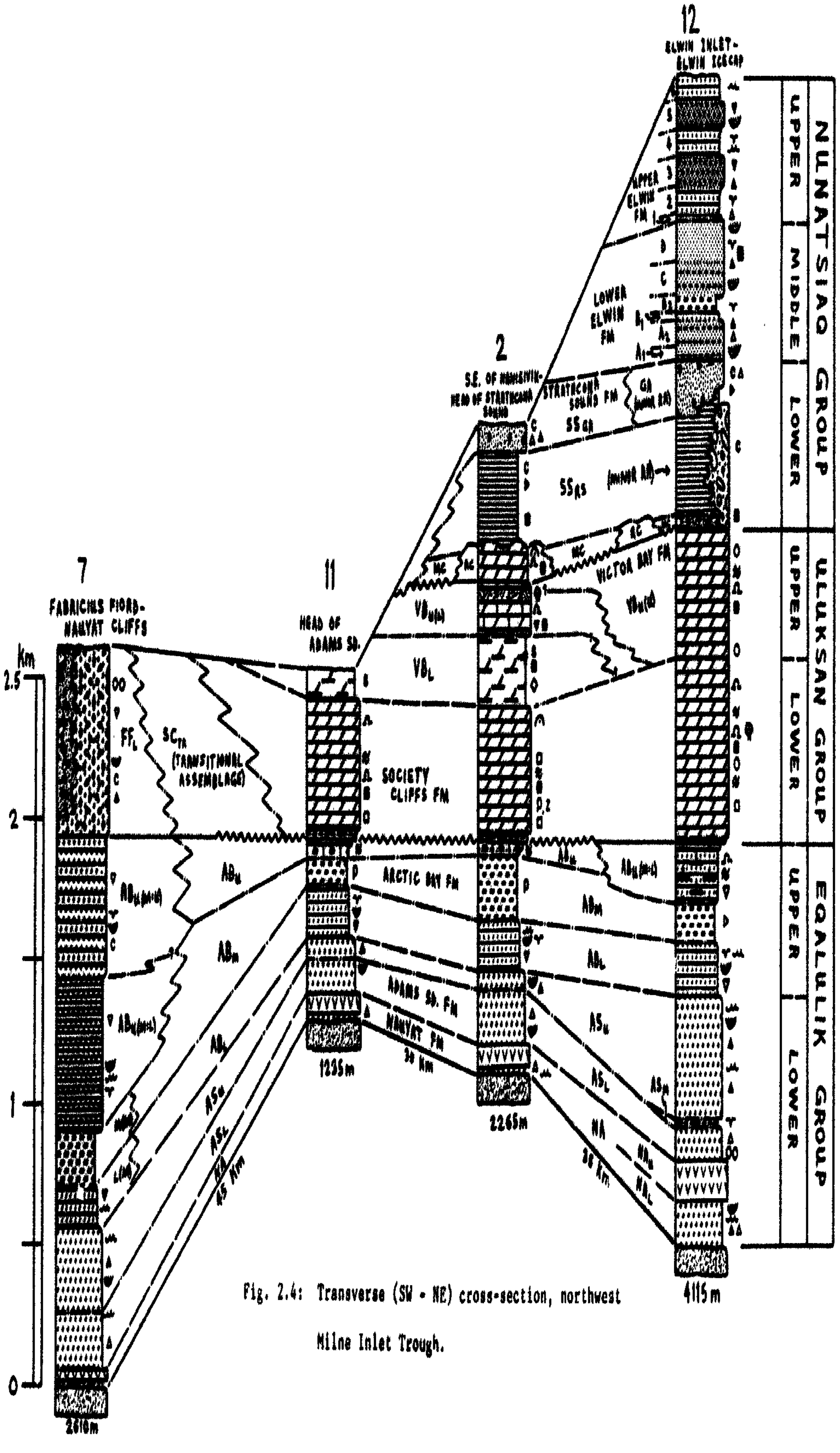


Fig. 2.4: Transverse (SW - NE) cross-section, northwest Milne Inlet Trough.

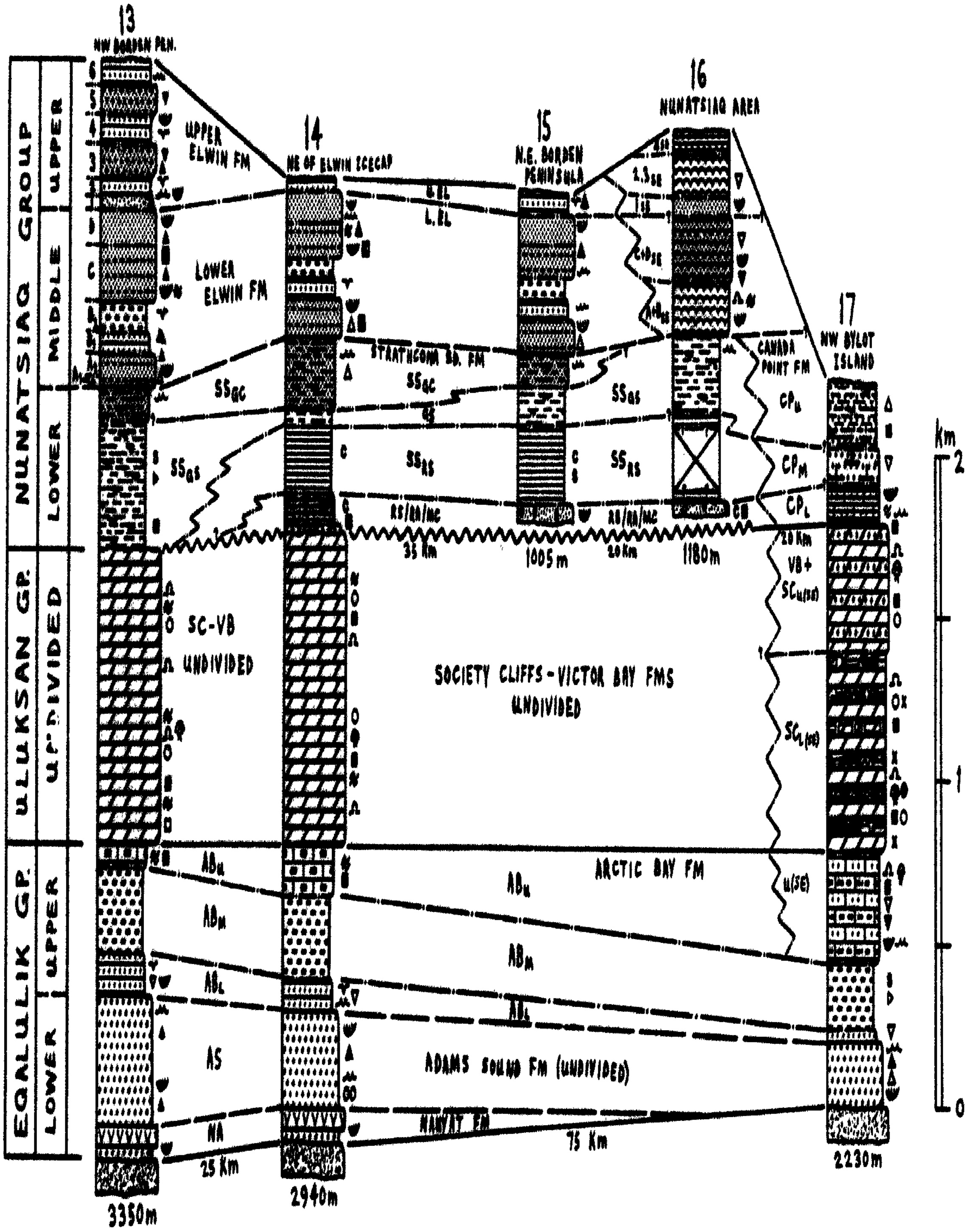


Fig. 2.5: Axial (W - E) cross-section, Eclipse Trough.

stromatolitic carbonates (Fig. 3.19; Table 2.5c).

The SS_{RC} (Reefal Carbonate) member occurs in the basal part of the formation in northwest Milne Inlet Trough. It consists of lithologies previously defined as part of the SS_2 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and as part of the Carbonate Facies of Jackson et. al. (1978a). The member includes reef-bearing dolostones and related calciclastic and siliciclastic subfacies. The SS_{CC} (Carbonate Conglomerate) member outcrops in northwestern Milne Inlet Trough and comprises reef-fringing massive carbonate pebble to boulder conglomerate to conglomero-breccia. The member includes strata formerly defined as part of the SS_2 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and as part of the Carbonate Facies of Jackson et. al. (1978a).

The SS_{RS} (Red Siltstone) member outcrops across central and northwestern Milne Inlet and Eclipse Troughs. The member represents strata formerly defined as the SS_1 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and as the Red Siltstone Facies of Jackson et. al. (1978a). It includes planar thick laminated to thin bedded red, red-brown to purple-brown siltstone with minor interbeds of shale, sandstone and carbonate clast conglomerate. The SS_{RA} (Red Arkose) member outcrops in central and northwestern Milne Inlet Trough; it represents strata previously included in the former SS_3 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and the former Arkose Facies of Jackson et. al. (1978a). The SS_{RA} member includes red to pink-brown intermixed arkose, litharenite and polymictic conglomerate.

Strata of the SS_{GS} (Green-grey Siltstone) member outcrop across northwestern

Milne Inlet Trough and central and northwestern Eclipse Trough. They comprise the SS_4 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and the Grey Siltstone Facies of Jackson et. al. (1978a). This member is mainly green-grey to green siltstone with minor interlayered shale, subarkose and carbonate clast conglomerate. The SS_{GC} (Grey-green Siltstone and Carbonate) member (new) outcrops in central and northwestern Eclipse Trough where it grades upward from the SS_{GS} member. It is mostly thick laminated to thin bedded green-grey to buff-brown intermixed siltstone, dolostone, dolosiltite and fine-grained quartzarenite. The SS_{GA} (Grey-green Arkose) member outcrops across central and northwestern Milne Inlet Trough and was previously included in the SS_3 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and the Greywacke Facies of Jackson et. al. (1978a). SS_{GA} member beds comprise mainly interlayered grey-green to green arkose, arkosic wacke, litharenite and polymictic conglomerate.

The SS_{FC} (Fault-margin Conglomerate) member outcrops adjacent to the White Bay Fault Zone in Milne Inlet Trough and along the Hartz Mountain Fault Zone in Eclipse Trough (Fig. 5.1). These rocks were previously described as the SS_5 member of Jackson and Iannelli (1981). They comprise massive to poorly stratified gneiss-carbonate-sandstone clast, pebble to boulder conglomerate. Strata of the SS_{MC} (Massive Conglomerate) member outcrop across northwestern Milne Inlet Trough. The member was previously included as part of the SS_2 member of Jackson and Iannelli (1981) and Jackson et. al. (1985) and as part of the Carbonate Facies of Jackson et. al. (1978a). Strata of the SS_{MC} member are mainly carbonate pebble to boulder conglomerates with some beds of siltstone, dolostone and subarkose. The

$SS_{RA/RS/MC}$ (Siltstone-Sandstone-Conglomerate) member is a newly defined lithofacies association that includes the diverse strata of the basal part of the Strathcona Sound Formation, preserved in central Eclipse Trough. It includes thin to thick bedded, purple to brown-red siltstone, arkose, litharenite and polymictic conglomerate.

2.4.2 Athole Point Formation (Figs. 2.2 and 3.19; Tables 2.1 and 2.5c)

The Athole Point Formation represents the lithofacies assemblage of the Lower Nunatsiaq Group in the southeastern and central Milne Inlet Trough . Strata of the Athole Point Formation outcrop in the area between central Borden Peninsula and the sea cliffs of southern Ragged Island and the adjacent northeast shore of Milne Inlet (Fig. 1.1). The Athole Point Formation has been subdivided into regionally extensive lower (AP_L), middle (AP_M) and upper (AP_U) members in the same manner as outlined for the AP_1, AP_2 and AP_3 members in Jackson and Iannelli (1981). The AP_L and AP_U members consist of planar thin laminated to medium bedded, dark-grey, grey-brown to black calcilutite and calcisiltite with interbeds layers of calciclastic to stromatolitic limestone and calcareous sandstone. A reef-bearing unit, defined in the present study as the $AP_{L(R)}$ submember, occurs in the basal part of the AP_L member in the area of White Bay in southeastern Milne Inlet Trough. The AP_M member comprises thin bedded to massive, grey to black intermixed stromatolitic limestone and thin laminated to thin bedded calcilutite and calcisiltite.

2.4.3 Canada Point Formation (Figs. 2.5 and 3.19d; Tables 2.4 and 2.5c)

The Canada Point Formation is a newly defined formation that replaces the SS_6 member of former usage (Jackson and Iannelli, 1981; Jackson et. al. 1985). The SS_6 member includes an entire lithofacies assemblage that has been subdivided into several members. In addition, the association of multicoloured sandstone, siltstone, shale and carbonate beds clearly distinguish this unit from facies-equivalent rocks in central and northwestern Eclipse Trough. The lithofacies assemblage was therefore given formational status. The name is derived from northwestern Bylot Island near the type section.

The Canada Point Formation comprises the southeastern Eclipse Trough lithofacies assemblage of the Lower Nunatsiaq Group. Strata outcrop on northwest Bylot Island where the succession can be subdivided into lower (CP_L), middle (CP_M) and upper (CP_U) members (Fig. 3.19d; Table 2.5c).

2.4.4 Lower Elwin Formation (Figs. 2.4, 2.5 and 3.21; Tables 2.3, 2.4 and 2.5d)

The Lower Elwin Formation is newly defined; it replaces the EL_1 member of former usage (Jackson and Iannelli, 1981; Jackson et. al., 1985). The former EL_1 member, has been subdivided into several members. In addition, the sandstone-dominated nature and the distinct varicoloured appearance of the succession clearly distinguish it from the overlying EL_2 member. The name is informal.

The Lower Elwin Formation represents the sandstone-dominated succession of, what, in this study, is termed the Middle Nunatsiaq Group. The formation outcrops on northern Borden Peninsula, in the Elwin Inlet to Navy Board Inlet area (Fig. 1.1). The Lower Elwin Formation consists of two regionally defined lithofacies assemblages (Fig. 3.21; Table 2.5d):

(i). Northwestern Lithofacies Assemblage, comprised almost entirely of sandstone and occupying the northwestern parts of Milne Inlet and Eclipse Troughs. The Northwest Assemblage has been subdivided into six regionally defined members.

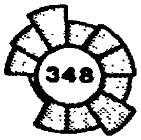
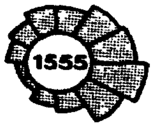
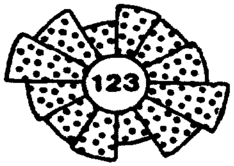
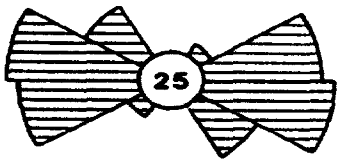
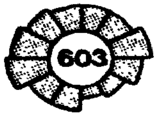
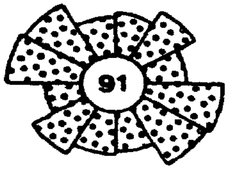
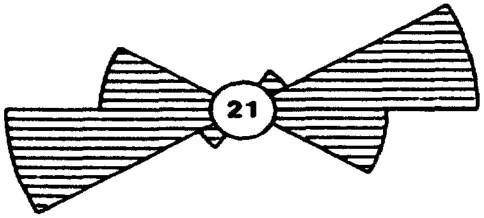
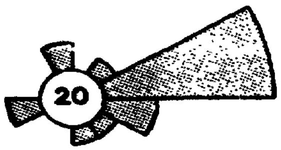
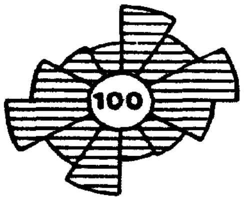
(ii). Southeastern Lithofacies Assemblage, comprised of sandstone and some carbonate, occupies the central (and southeastern?) part of Eclipse Trough. The Southeast Assemblage has been subdivided into two members.

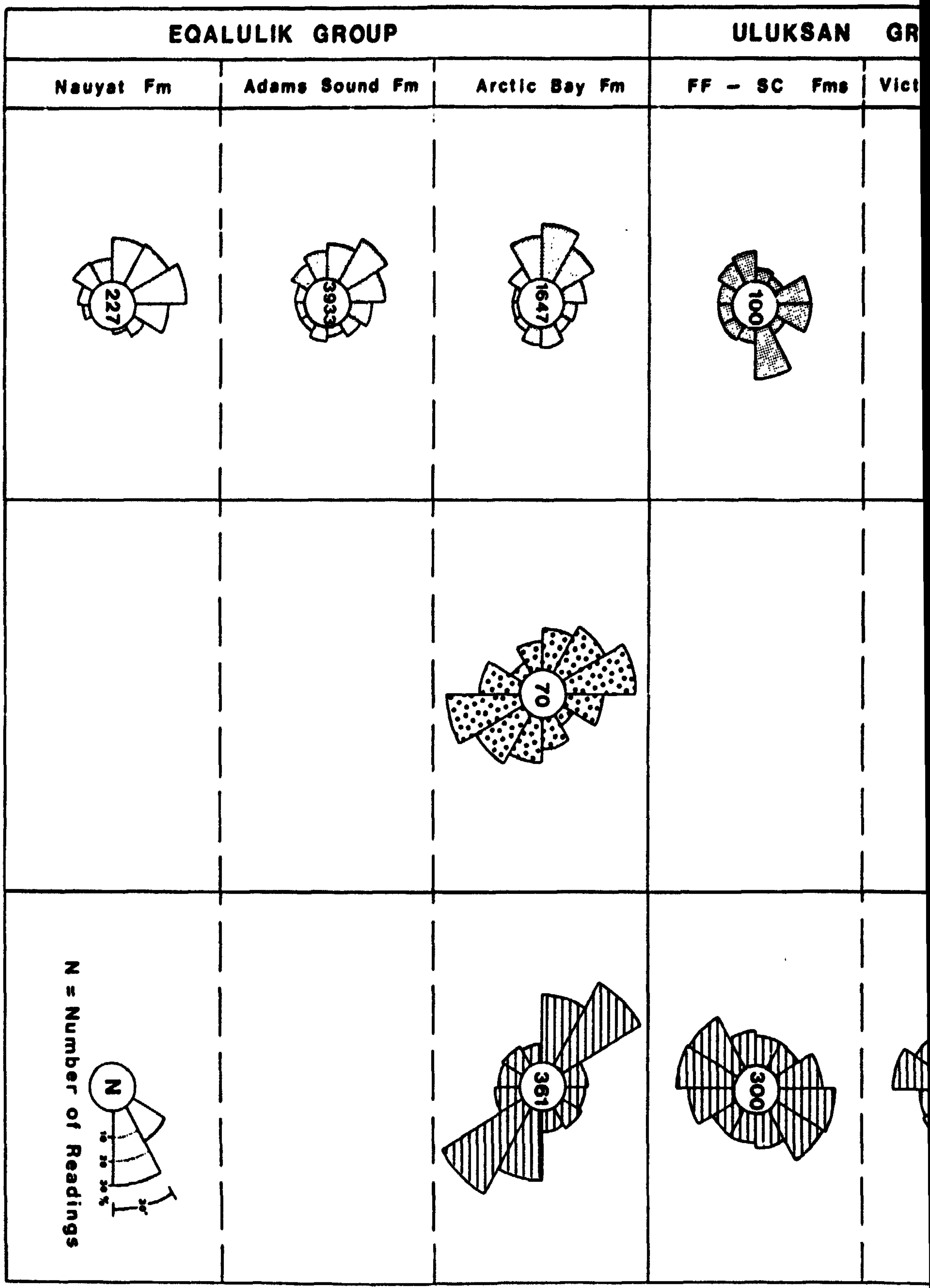
2.4.5 Upper Elwin Formation (Figs. 2.4, 2.5 and 3.21; Tables 2.3, 2.4 and 2.5d)

The Upper Elwin Formation is also newly defined. In the present study it replaces the EL_2 member of former usage (Jackson and Iannelli, 1981; Jackson et. al., 1985). The former EL_2 member was subdivided into several major units each of member status. The member lithofacies units alternate in a distinct cyclic manner and the sequence, as a whole, includes large amounts of black to black-grey planar thin laminated shale. The sequence is a distinct, mappable unit. The name Upper Elwin Formation is informal.

The beds of the Upper Elwin Formation represent the intermixed shale-siltstone-sandstone and quartzarenite-dominated sequence of the Upper Nunatsiaq Group. These rocks outcrop on northwestern and northeastern Borden Peninsula (Fig. 1.1). There are two regionally-defined lithofacies assemblages (Fig.

TABLE 2.8: REGIONAL PALEOCURRENT TRENDS.

		Crossbeds, Current Ripple Marks (Channels, Flutes)	Wave Ripple Marks	Stromatolite Elongations
NUNATSIAQ GROUP	Upper Elwin Fm			
	Lower Elwin Fm			
	SS-AP Fms			
GROUP	Victor Bay Fm			


EQALULIK GROUP
ULUKSAN GR
Nauyat Fm
Adams Sound Fm
Arctic Bay Fm
FF – SC Fms
Vict
227
3933
1647
100
70
361
300
N
10 20 30 %
30°
N = Number of Readings

3.21; Table 2.5d):

(i). Northwestern Facies Assemblage, comprised of alternating intermixed shale-siltstone-sandstone - and quartzarenite-dominated members arranged into at least three thickening upward megacycles and occupying the northwest portions of Milne Inlet and Eclipse Troughs. The Northwest Assemblage has been subdivided into six regionally-defined members.

(ii). Southeastern Facies Assemblage, comprised of sandstone and variably intermixed amounts of carbonate and shale and occupying the southeastern part of Eclipse Trough. The Southeast Assemblage has been subdivided into three general members.

2.5 Age of the Bylot Supergroup

The age of the Bylot Supergroup is poorly constrained. Relevant data have been outlined by Jackson et. al.. (1990), Jackson and Iannelli (1981), Fahrig et. al. (1981) and Christie and Fahrig (1983). Radiometric age determinations and paleomagnetic analyses have been obtained from samples of basalts from the Nauyat Formation and from diabase dykes that intrude the succession. Paleomagnetic analyses were also performed on sandstone samples from the Adams Sound and Strathcona Sound Formations (Fahrig et. al., 1981). The ages determined from these samples provide an estimate of the time of deposition of the Bylot Supergroup. A qualitative age range can be determined by comparison with what have been interpreted to be equivalent Late Proterozoic successions from the Canadian Arctic and Greenland (Jackson and Iannelli, 1981, Fig. 16.33, p. 295). Using this method the basal volcanic-bearing portion of the Bylot Supergroup has been estimated to be between 1.3 Ga and 1.0 Ga.

Seventeen whole rock K-Ar ages were determined for basalt samples from the Nauyat Formation. Ages ranged from 762 Ma to 1221 Ma, with a mean age of 946 Ma (Jackson and Iannelli, 1981, Fig. 16.3, p. 273). Fourteen basalt samples were analyzed by the Rb-Sr method and yielded dates between 819 Ma and 982 Ma (Jackson et. al., 1990, Fig. 19, p. 142). The results of the K-Ar and Rb-Sr analyses are not interpreted as indicating the true age of basalt extrusion. They are generally attributed to Late Proterozoic regional metamorphism (Jackson et. al., 1990).

Fahrig et. al. (1981, Fig. 17.15, p. 309) obtained paleomagnetic poles for samples from the Nauyat, Adams Sound and Strathcona Sound Formations. The Nauyat - Adams Sound pole was interpreted to represent an age of 1220 Ma, and the Strathcona Sound pole an age of about 1203.5 Ma. Fahrig et. al. (1981) concluded that volcanism in the Borden Basin was related to the MacKenzie Igneous Event (Table 1.1). Chemical data for the basalt flows of the Nauyat Formation (Galley et. al., 1983; Jackson and Iannelli, 1981, 1984) are similar to those for other MacKenzie igneous rocks. The most accurate age for this event comes from the recent work of LeCheminant and Heaman (1989). They determined a U-Pb age of 1269 ± 2 Ma for MacKenzie dykes and a U-Pb age of 1270 ± 4 Ma for the Muskox intrusion which is cut by these dykes.

On the basis of the chemical similarities noted above, and if the paleomagnetic correlation of Fahrig et. al. (1981) is valid (i.e. that the Nauyat volcanics are related to the MacKenzie Igneous Event), then the age of the basal part of the Bylot

Supergroup is about 1.27 Ga. The total infill history, as estimated by Fahrig et. al. (1981, Fig. 17.15, p. 309), may have occupied about 20 Ma. The time for infill history is comparable to that required for sediment deposition in a recent rift basin such as the Gulf of Suez (Evans, 1988, 1990).

Basalts of the Nauyat Formation have undergone subgreenschist facies metamorphism (Fig. 5.6). Late Proterozoic diabase dykes, in Borden Basin (Table 1.1), appear to be unaltered (Jackson and Morgan, 1978; Christie and Fahrig, 1983). The metamorphism is hence older than the dykes and, as previously indicated, may have caused the scattering of K-Ar and Rb-Sr age determinations for the basalt samples. The metamorphism may be related to deformation associated with the postulated closing of the Poseidon Ocean at about 1.0 Ga (Galley et. al., 1983; Jackson and Iannelli, 1981, 1984).

CHAPTER 3: Stratigraphy of the Bylot Supergroup

3.1 Eqalulik Group

The Eqalulik Group was originally defined by Blackadar (1956, 1965 and 1970) and Lemon and Blackadar (1963) to include the Proterozoic volcanic and sedimentary rocks that tower above the shores of Adams Sound. The group originally consisted only of rocks of the Nauyat and Adams Sound Formations. They were thought to be separated from rocks of the Arctic Bay Formation (formerly part of the Uluksan Group) by an unconformity (Lemon and Blackadar, 1963) or by a conformable to unconformable contact (Blackadar, 1970). In more recent studies (Jackson and Davidson, 1975; Jackson et. al., 1975, 1978a, 1980) it became evident that the Adams Sound Formation grade up into strata of the Arctic Bay Formation over most of the Borden Basin. In turn, the Arctic Bay Formation is unconformably to (locally) gradationally overlain by carbonate and clastic rocks of the facies equivalent Fabricius Fiord and Society Cliffs Formations (Tables 2.1 to 2.3; Figs. 2.2 to 2.4).

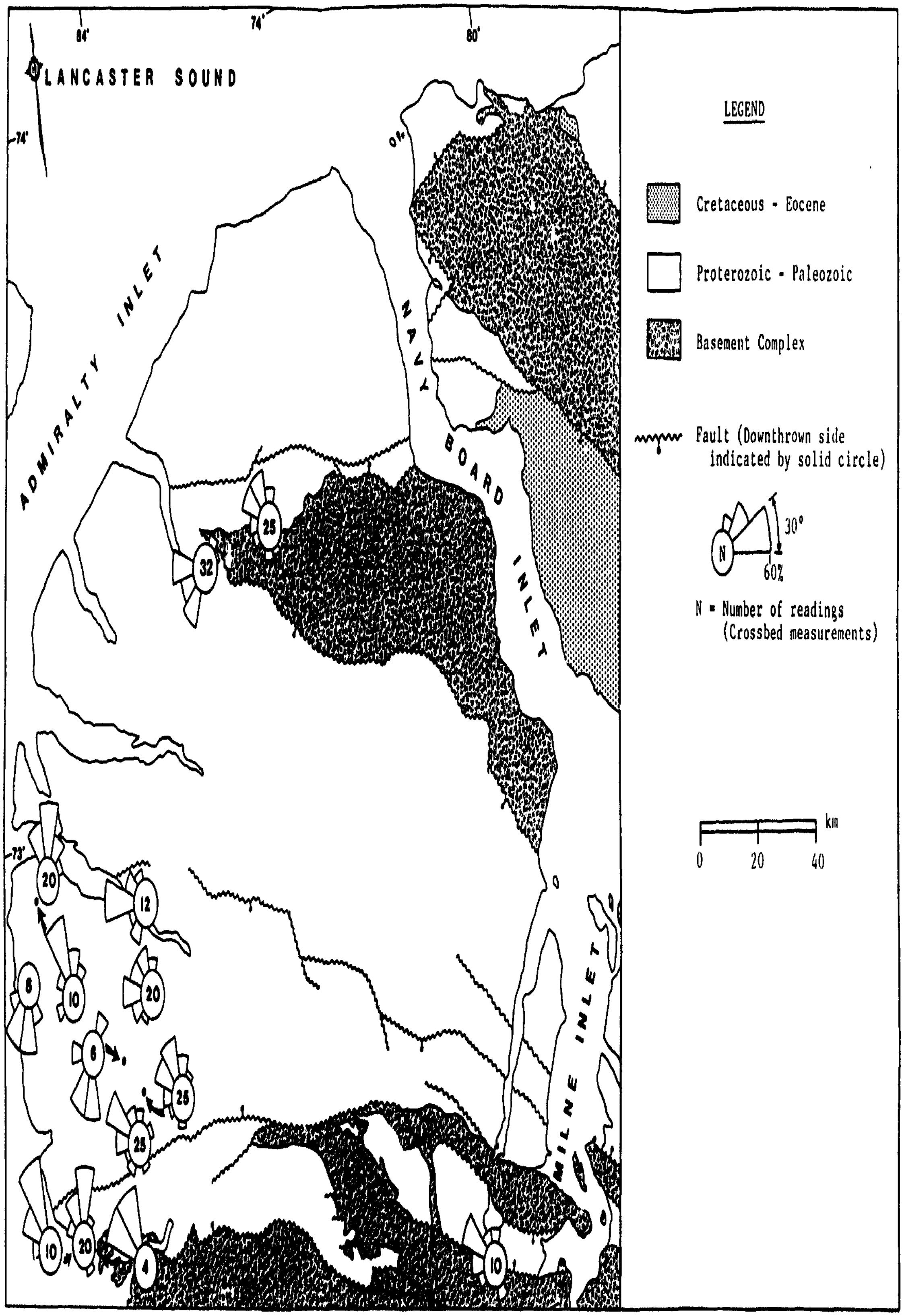
In the revised system outlined by Jackson and Iannelli (1981), and further refined in this study, the Eqalulik Group is composed of the sandstone-dominated Nauyat and Adams Sound Formations (Lower Eqalulik Group) and the shale, siltstone, sandstone, calciclastic and carbonate bearing Arctic Bay Formation (Upper Eqalulik Group). The latter formation can be readily subdivided into three regionall, defined facies assemblages (Tables 2.1 to 2.5a).

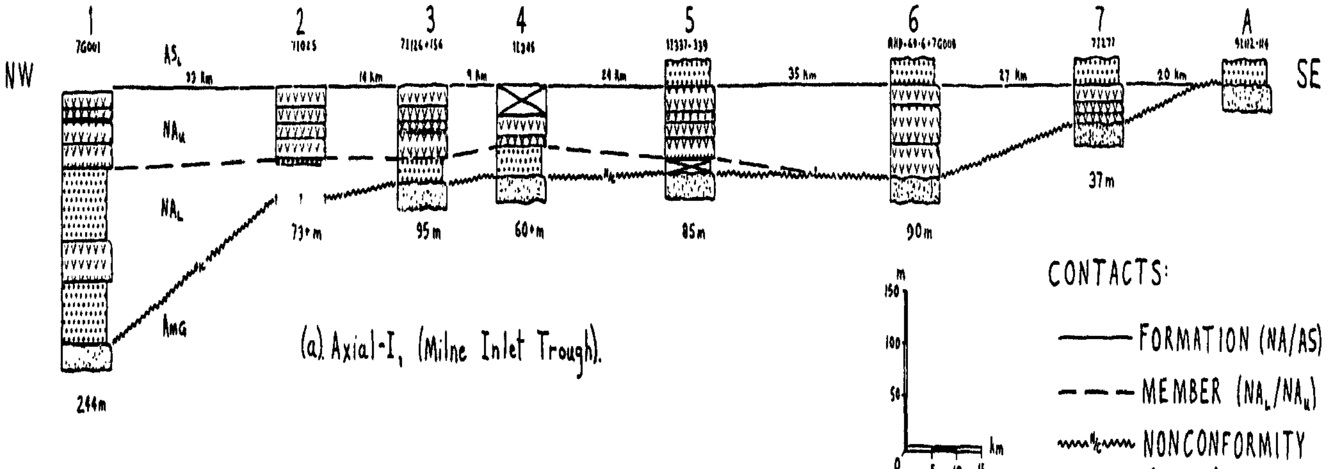
3.2 Nauyat Formation

The Nauyat Formation outcrops mainly in the area south of Adams Sound, across much of southwestern Borden Peninsula. Nauyat strata also outcrop along the coasts of Adams Sound, in the vicinity of Elwin and Magda Icecaps and in a few localities on northern Bylot Island (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The formation is absent in the area east and southeast of Milne Inlet and Koluktoo Bay and occurs as a thin veneer, only 10 m to 30 m thick, over the basement gneiss in the area of the Magda Icecap and on northern Bylot Island. Nauyat Formation sequences thicken greatly to the northwest and west; they are 13 m to 32 m thick in the Magda Icecap - Koluktoo Bay area and thicken to over 240 m in the area north of the Eqalulik River and to 292 m in the vicinity of the Elwin Icecap (Figs. 3.2 and 3.3). The latter section comprises the thickest and most complete Nauyat section measured and is suggested as the type section for the formation (section 18 in Fig. 3.2d; reference station 71236 in Appendices I and II). Sandstones and basalts, of the Nauyat Formation, nonconformably rest upon basement gneiss over a surface that undulates considerably on a local scale. Contact relationships with overlying quartzarenite beds of the Adams Sound Formation are generally conformable and sharp, although locally the contact appears erosional (Jackson and Iannelli, 1981; Galley, 1978).

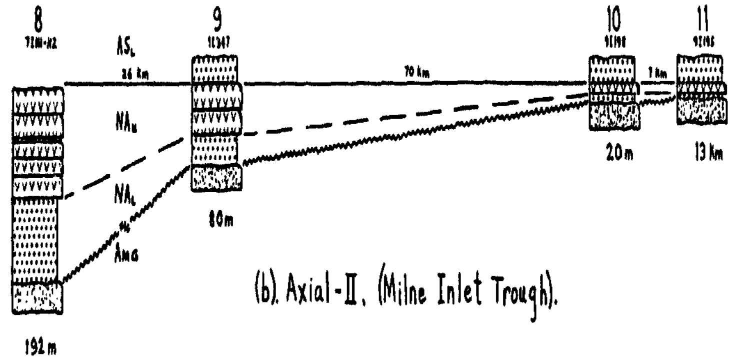
The Nauyat Formation can be subdivided into two members: a lower member (NA_L) comprised largely of thick laminated to thin bedded quartzarenite, and an upper member (NA_U) that is mainly basalt flows. The sandstone beds of the NA_L member are similar, in composition and sedimentary style, to those of the overlying

Fig. 3.5: Nauyat Formation - distribution of paleocurrent measurements.

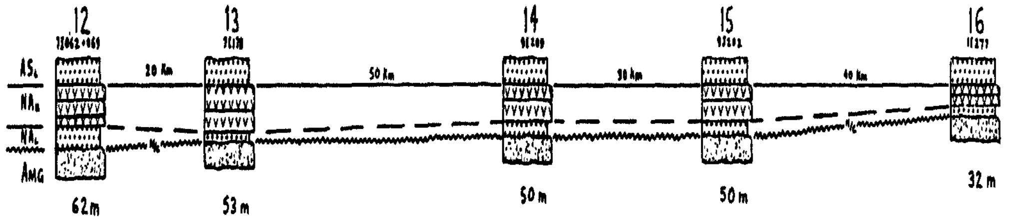




(a). Axial-I, (Milne Inlet Trough).

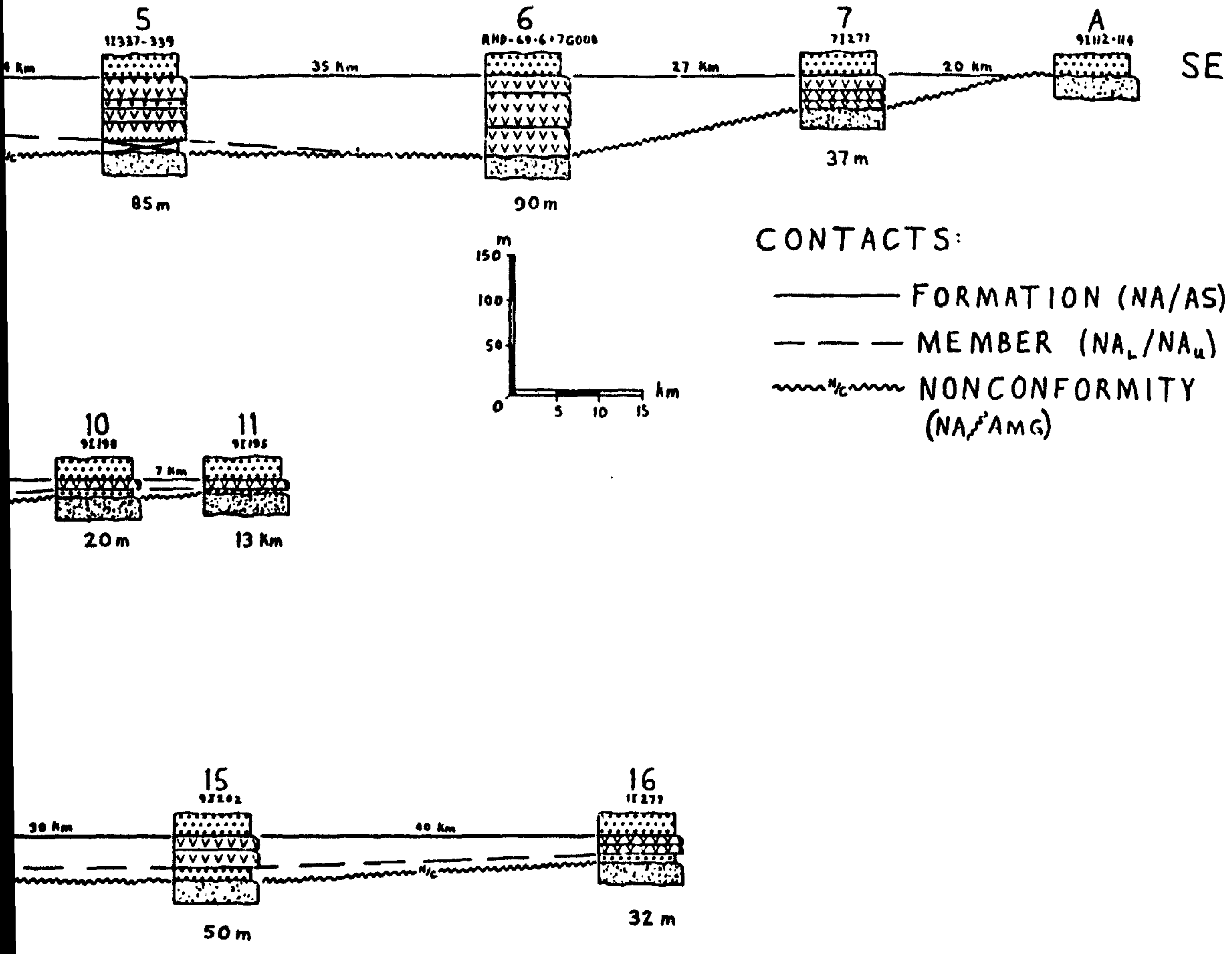


(b). Axial-II, (Milne Inlet Trough).

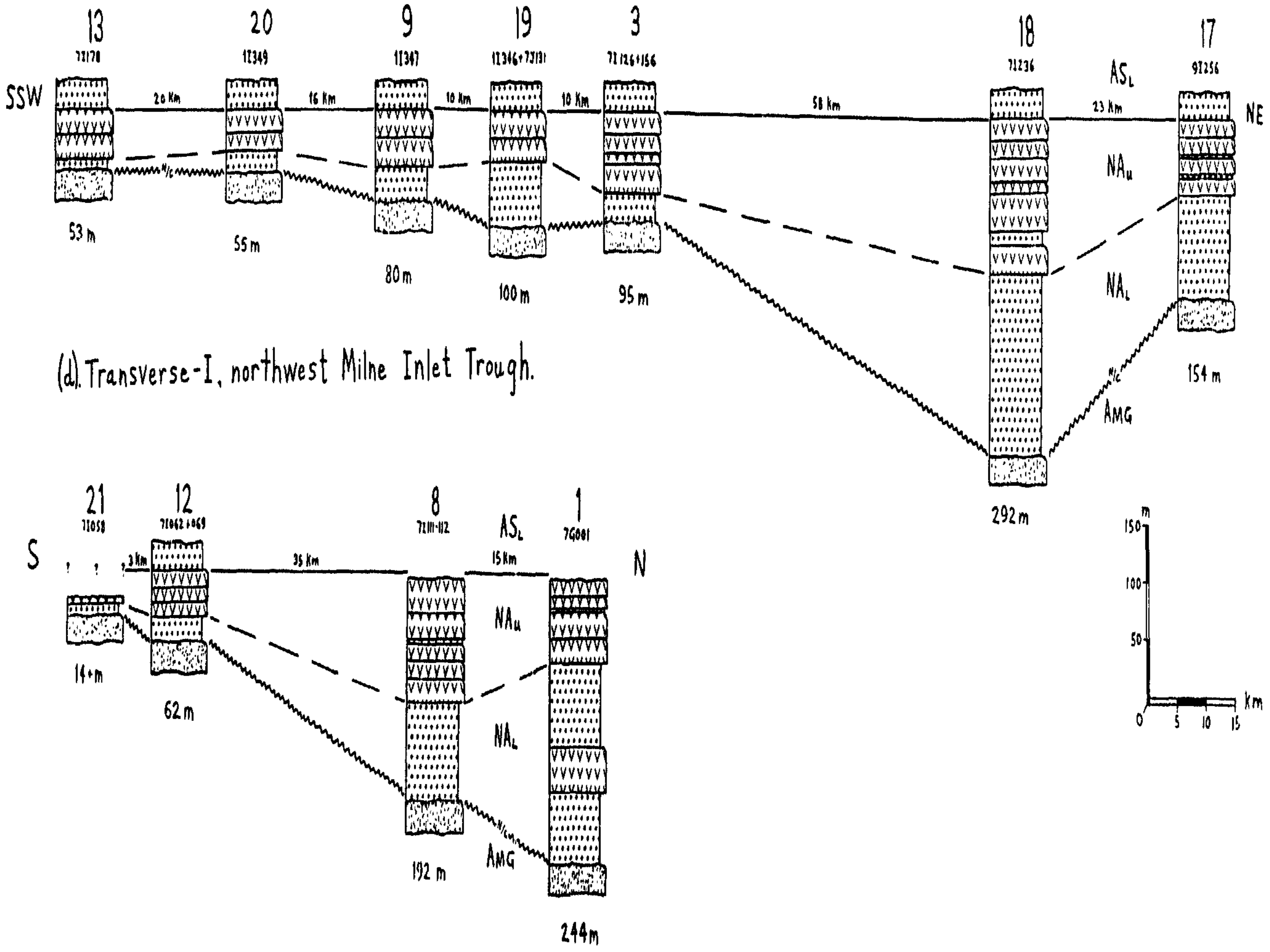


(c). Axial-III, (Milne Inlet Trough).

FIG. 3.2a,b,c: NAUYAT FM— AXIAL (NW-SE) CROSS-SECTIONS, MILNE INLET TROUGH.



S. MILNE INLET TROUGH.



(d). Transverse-I, northwest Milne Inlet Trough.

(e). Transverse-II, central Milne Inlet Trough.

FIG. 3.2d.e: NAUYAT FORMATION: TRANSVERSE CROSS-SECTIONS, MILNE INLET TROUGH.

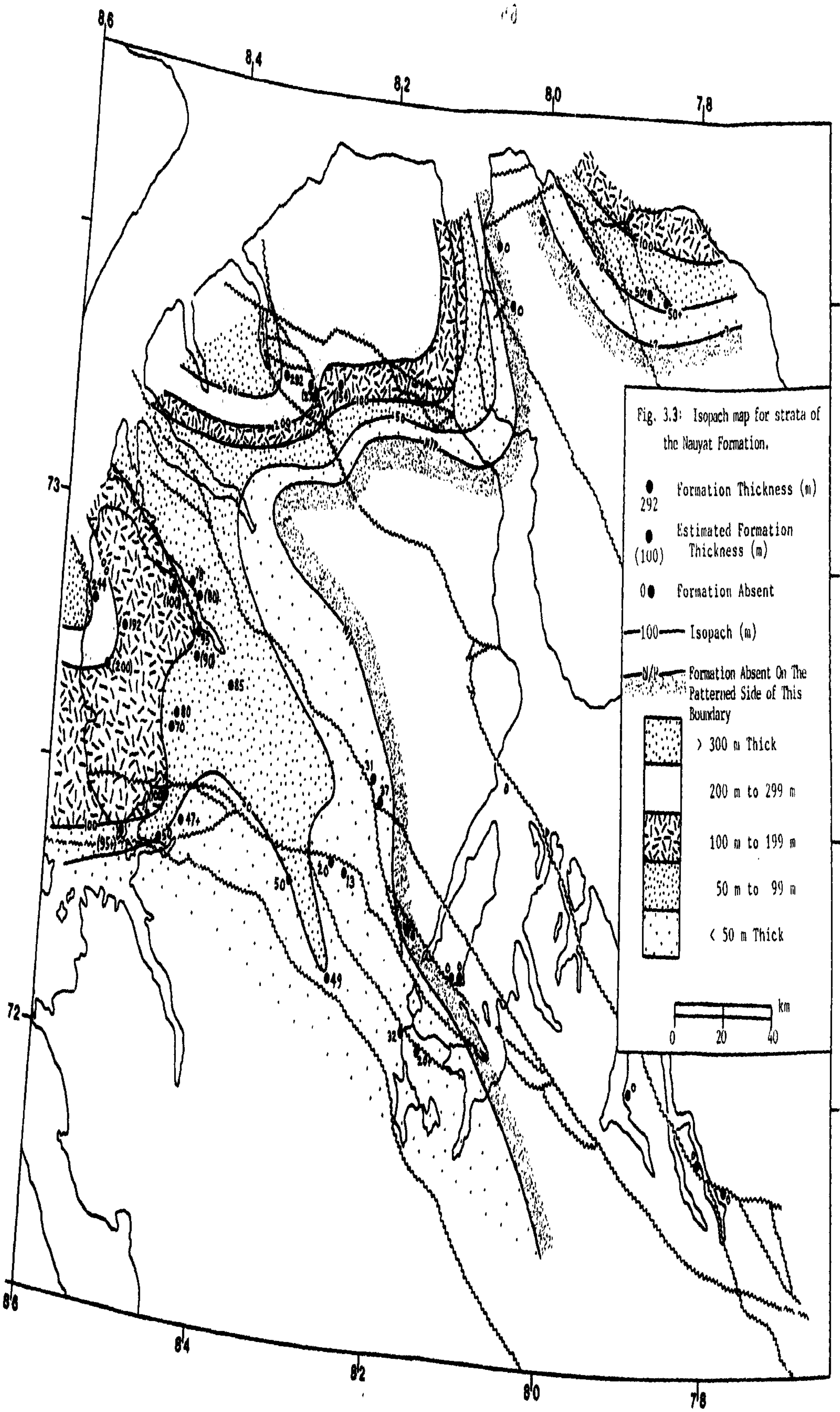


Fig. 3.3: Isopach map for strata of the Nauyat Formation.

Adams Sound Formation and are almost certainly part of the same depositional complex (Tables 4.1a and 6.6).

3.2.1 NA_L Member

The NA_L member comprises mainly planar to crossbedded, thick laminated to thin bedded quartzarenite and minor interbedded subarkose, siltstone, quartz-granule to quartz-pebble conglomerate and rare lenses and layers of thin laminated shale (Plate 3.1A, Figs. 1 to 4). The strata are red to purple-red, pink, brown-grey to (less commonly) buff-brown. The sandstone beds are fine to coarse grained, and (less commonly) pebbly. Conglomerate layers are typically less than 1 m thick and confined to the basal part of the member; a thin (<1 m thick) pebbly sandstone to quartz-pebble conglomerate layer commonly occurs on the basement surface. The quartzarenite-dominated NA_L succession locally contains a conformable volcanic submember comprised of one or two, massive to amygdaloidal basalt flows. The flows are similar in composition to those in the NA_U member and are up to 40 m in thickness (section 1 in Fig. 3.2a). The contacts with overlying and underlying sandstone beds are sharp. Sandstones beneath the flows are baked. Rare basalt fragments in overlying sandstone beds (Galley, 1978) indicate local erosion.

Strata of the NA_L member thicken considerably to the west and northwest and are absent east and southeast of the Koluktoo Bay - Milne Inlet area. The northwest-thickening wedge ranges from about 10 m thick, in the vicinity of Koluktoo Bay and the Magda Icecap, to a maximum of 172 m thick on southwest Borden Peninsula (Figs. 3.2a and 3.2b). Thickness trends outline major depocentres in the northwestern portions of the Milne Inlet, Eclipse and North Bylot Troughs (Figs. 3.2 and 3.3).

The sandstone-dominated NA_L member consists of both planar bedded and cyclic units. The latter contain a variety of small- to medium- scale thinning- and fining-upward cycles. South of Adams Sound, the member contains conglomerate - based, pebbly sandstone- to quartz-pebble conglomerate - dominated fining-upward cycles less than 2 m to 10 m thick (Fig. 3.4a). The cycles contain a basal conglomerate or pebbly sandstone unit overlain by bedded to crossbedded sandstone; they are capped by thick laminated sandstone and, less commonly, siltstone and rare shale. In this area, and throughout the rest of the basin, NA_L sequences also contain sandstone-dominated fining- and thinning-upward cycles similar to those noted above. A variety of styles occurs, based on the concentration of the sandstone facies present; they are outlined in Figs. 3.4b and 3.4c.

Sedimentary structures are mainly small to medium scale trough and planar crossbeds (10 cm to 1 m high; see Figs. 3.4b,c and Plate 3.1A, Fig. 3). Minor structures include small to medium scale asymmetric current ripple marks (2 cm to 5 cm high), scour channels and small load casts. Paleocurrent trends, mainly from crossbeds, are northerly- and northwesterly-directed (Table 2.8; Fig. 3.5).

The sandstone beds of the NA_L member are sharply and conformably overlain by basalt of the NA_U member. The contact is generally planar and adjacent sandstones are baked and highly indurated.

PLATE 3.1A

Nauyat Formation - NA_L Member

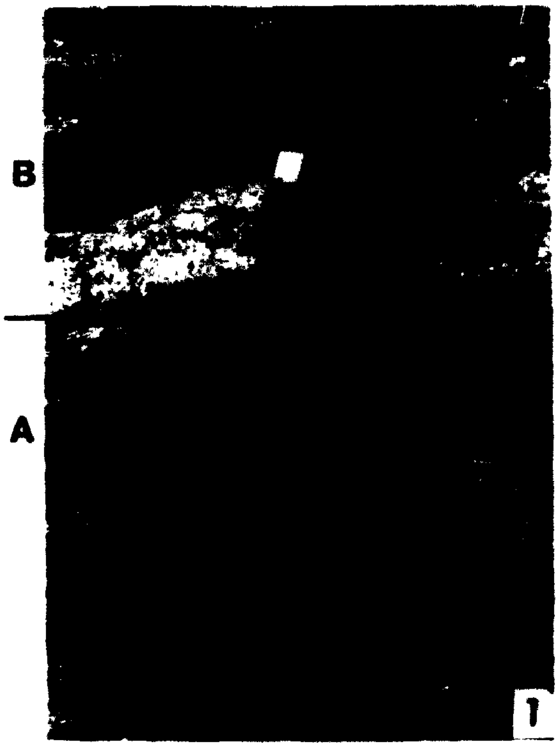
Fig. 1: Portions of two fining- and thinning-upward cycles in the vicinity of Nauyat Cliffs, southwestern Borden Peninsula. The upper part of one cycle 'A', is dominated by trough crossbedded subarkose and the lower part of 'B' is dominated by crudely bedded, quartz-pebble conglomerate. The tape measure at top centre is 5 cm in height.

Fig. 2: Cycle 'B' displays a base of crudely bedded quartz-pebble conglomerate that passes into intermixed conglomerate and subarkose which is in turn overlain by interlayered planar- to crossbedded subarkose.

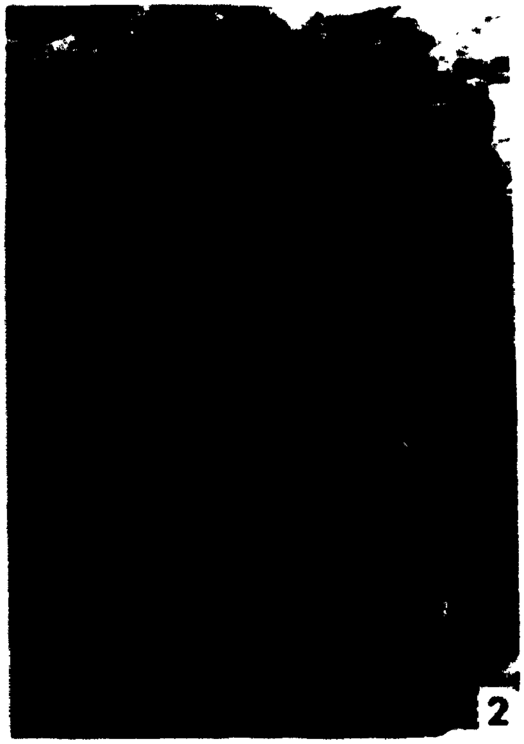
Fig. 3: Detail of medium- to coarse-grained, trough-crossbedded subarkose exposed immediately above the strata illustrated in Fig. 3. The beds comprise the basal portion of a thinning-upward cycle. Notebook, bottom left corner, for scale.

Fig. 4: Thinning-upward cycles comprised of trough crossbedded overlain by planar- to ripple-bedded subarkose to quartzarenite: upper part of the NA_L member in the vicinity of Nauyat Cliffs.

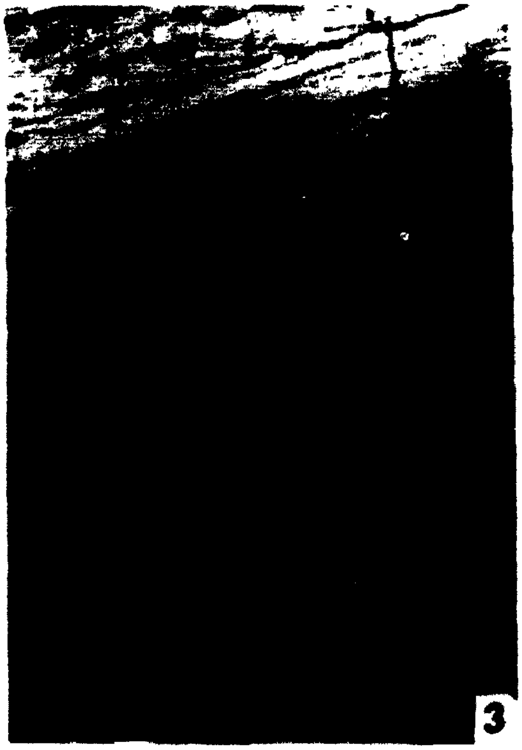
PLATE 3.1A



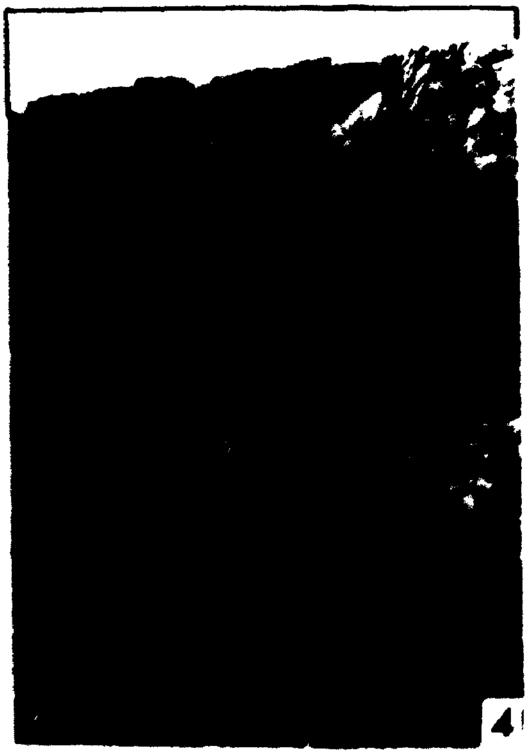
1



2



3



4

Fig. 3.4: Cycle types in the NA_L member.

LEGEND

■	Planar thin laminated Shale
▒	Planar to ripple bedded, fine-grained Subarkose, Quartzarenite to Siltstone
▨	Trough cross-laminated Subarkose to Quartzarenite
▤	Planar crossbedded Subarkose to Quartzarenite
▧	Trough crossbedded Subarkose to Quartzarenite
▩	Trough crossbedded pebbly Subarkose to Quartzarenite
░	Thin to medium bedded Pebbly Subarkose to Quartzarenite
▓	Poorly stratified Quartz-pebble Conglomerate
〰	Cycle boundaries
2. 71047-D	Field station reference

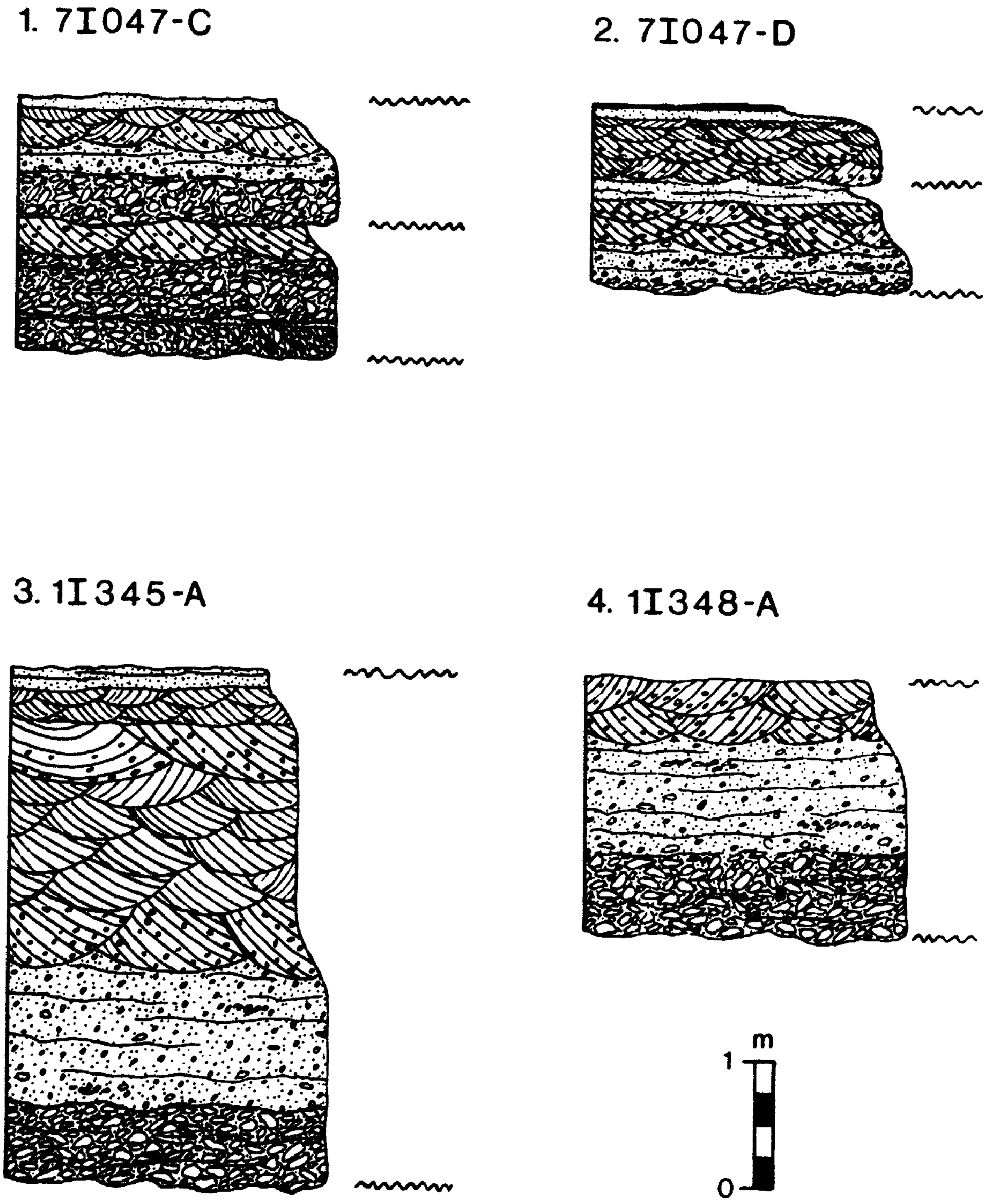
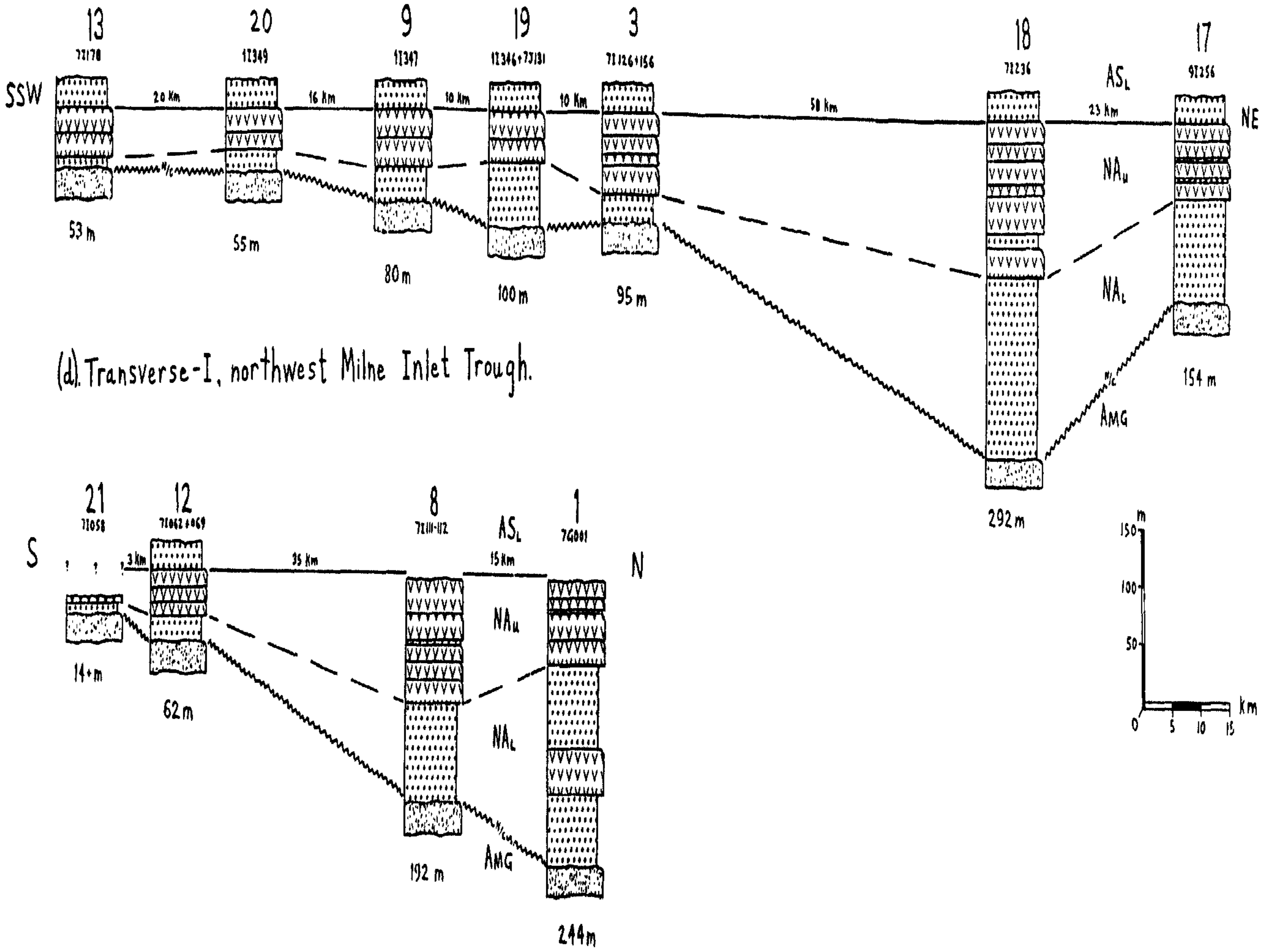


Fig. 3.4a: Representative conglomerate-dominated to conglomerate-bearing fining-upward cycles of the NA_L member.



(d). Transverse-I, northwest Milne Inlet Trough.

(e). Transverse-II, central Milne Inlet Trough.

FIG. 3.2d.e: NAUYAT FORMATION: TRANSVERSE CROSS-SECTIONS, MILNE INLET TROUGH.

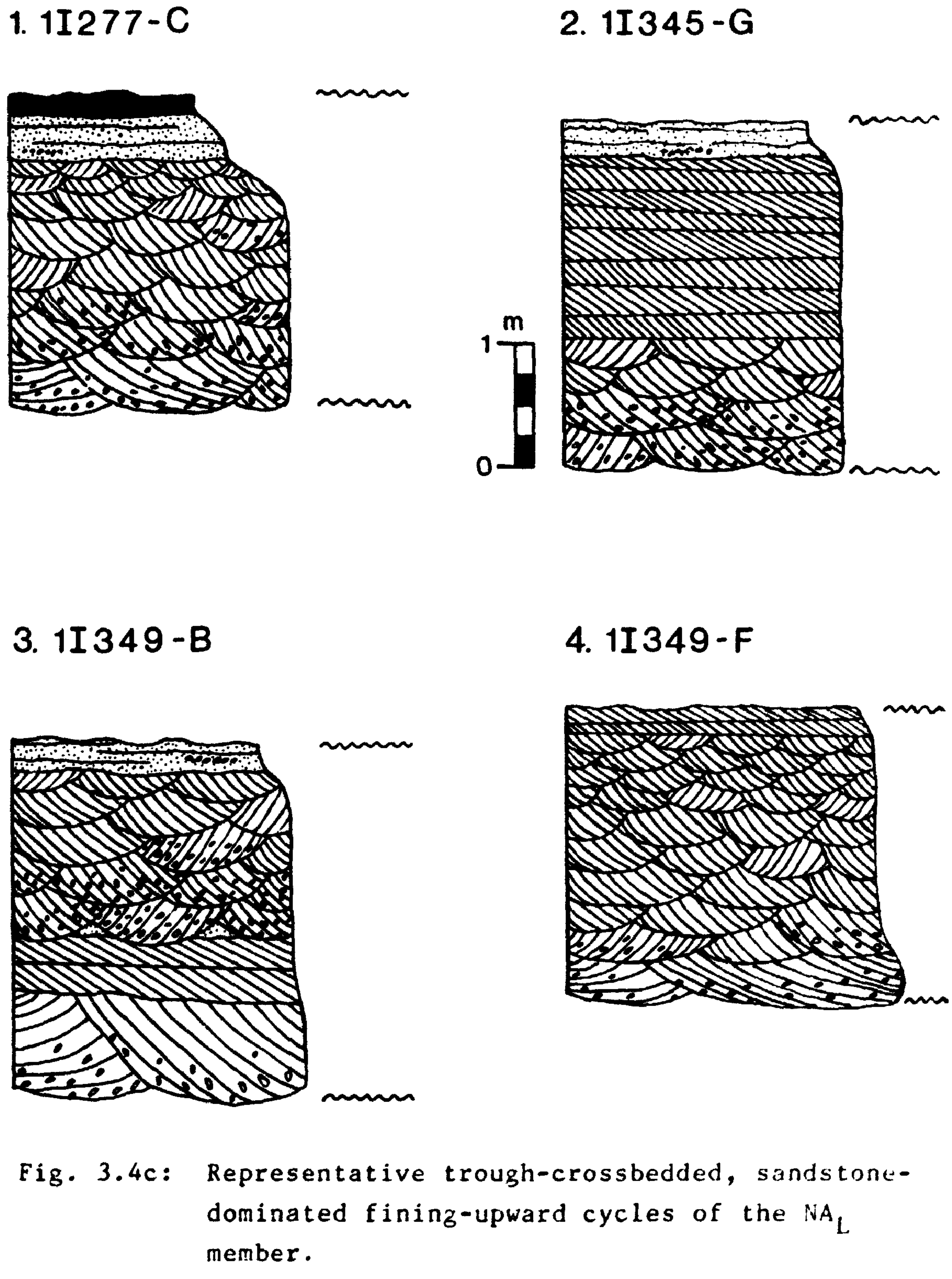


Fig. 3.4c: Representative trough-crossbedded, sandstone-dominated fining-upward cycles of the NA_L member.

3.2.2 NA_U Member

The upper member, of the Nauyat Formation, comprises a volcanic sequence that includes up to six basalt flows, and minor interflow layers and lenses of siltstone, sandstone, limestone and rare volcanic breccia (Fig. 3.2; Plate 3.1B, Figs. 1 and 2; Plate 3.2, Fig. 1). The basalts rest sharply on sandstone of the underlying NA_L member, and directly on basement gneiss in some areas of central Borden Peninsula (Fig. 3.2a). The upper contact, with overlying AS_L member beds, is sharp and generally conformable; some sharp to subrounded basalt clasts in the basal quartzarenite beds indicate some erosion of the underlying basalt flow.

The volcanic sequences follow the same thickness trends noted for the NA_L member (Figs. 3.2 and 3.3). The volcanic pile thickens, and basalt flows increase in number, to the northwest.

NA_U member sequences range from less than 10 m in thickness, in the vicinity of the Magda Icecap, to more than 107 m thick in west Borden Peninsula and attain a maximum thickness of 134 m near the Elwin Icecap at the type section; the number of flows increases from 1 northwesterly to 6 over the same area (Fig. 3.2). Over most of northwestern Milne Inlet Trough,the member contains 3 to 5 flows.

Flows in the NA_U member are massive to amygdaloidal basalts that are typically fine-grained, less commonly medium-grained. Flows generally fine upwards from the base to the middle. Some are massive; others have massive bases and amygdaloidal tops or are amygdaloidal throughout. Individual flows vary in colour, type and amount of jointing and concentration of amygdules. The uppermost flow is generally finer grained, more resistant and more massive than the underlying flow

3.2.2 NA_U Member

The upper member, of the Nauyat Formation, comprises a volcanic sequence that includes up to six basalt flows, and minor interflow layers and lenses of siltstone, sandstone, limestone and rare volcanic breccia (Fig. 3.2; Plate 3.1B, Figs. 1 and 2; Plate 3.2, Fig. 1). The basalts rest sharply on sandstone of the underlying NA_L member, and directly on basement gneiss in some areas of central Borden Peninsula (Fig. 3.2a). The upper contact, with overlying AS_L member beds, is sharp and generally conformable; some sharp to subrounded basalt clasts in the basal quartzarenite beds indicate some erosion of the underlying basalt flow.

The volcanic sequences follow the same thickness trends noted for the NA_L member (Figs. 3.2 and 3.3). The volcanic pile thickens, and basalt flows increase in number, to the northwest.

NA_U member sequences range from less than 10 m in thickness, in the vicinity of the Magda Icecap, to more than 107 m thick in west Borden Peninsula and attain a maximum thickness of 134 m near the Elwin Icecap at the type section; the number of flows increases from 1 northwesterly to 6 over the same area (Fig. 3.2). Over most of northwestern Milne Inlet Trough,the member contains 3 to 5 flows.

Flows in the NA_U member are massive to amygdaloidal basalts that are typically fine-grained, less commonly medium-grained. Flows generally fine upwards from the base to the middle. Some are massive; others have massive bases and amygdaloidal tops or are amygdaloidal throughout. Individual flows vary in colour, type and amount of jointing and concentration of amygdules. The uppermost flow is generally finer grained, more resistant and more massive than the underlying flow

(Galley, 1978; Jackson et. al., 1978a). Most flows are 10 m to 25 m thick but range up to almost 40 m thick in central Milne Inlet Trough (Fig. 3.2a).

The basalts are dark- to grey-green and red- to green-brown. The flows are typically fractured and display columnar jointing (Plate 3.1B, Fig. 2). Bent columns in flow 1 of section 1 (Fig. 3.2a) suggest that they have flowed in an easterly direction (Galley, 1978). Rare indistinct pillow structures, (< 0.5 m in diameter) occur south of Adams Sound (Jackson et. al., 1978a) and south-southwest of Koluktoo Bay (Jackson and Iannelli, 1981). Blackadar (1970) also mentioned the occurrence of rare pillow structures in basalt from the east side of Admiralty Inlet, south of Adams Sound. Flow banding occurs locally and a lens or layer of basalt clast breccia occurs between flows 3 and 4 in sequences in the Eqalulik River valley. The upper parts of some flows contain partially resorbed quartz grains, quartzarenite pebbles and cobbles, and quartzarenite-filled cracks. These features may indicate that flow surfaces were semi-molten when sediments were deposited upon them (Galley, 1978).

Sedimentary sequences, 1 to 13 m thick, occur as interflow units at several horizons in the NA_U member (sections 1, 3, 8, 17 and 18, Fig. 3.2; Plate 3.1B, Fig. 2). These strata are well indurated and partially baked. They include planar to crossbedded, fine- to coarse-grained, thick laminated to thin bedded quartzarenite, thin planar to wavy laminated stromatolitic to siliceous limestone and thin bedded siltstone and calcisiltite. The strata are pink, purple-red, buff-grey to pink-grey and green-grey. Quartzarenite beds, in these sequences, resemble those of the NA_L member.

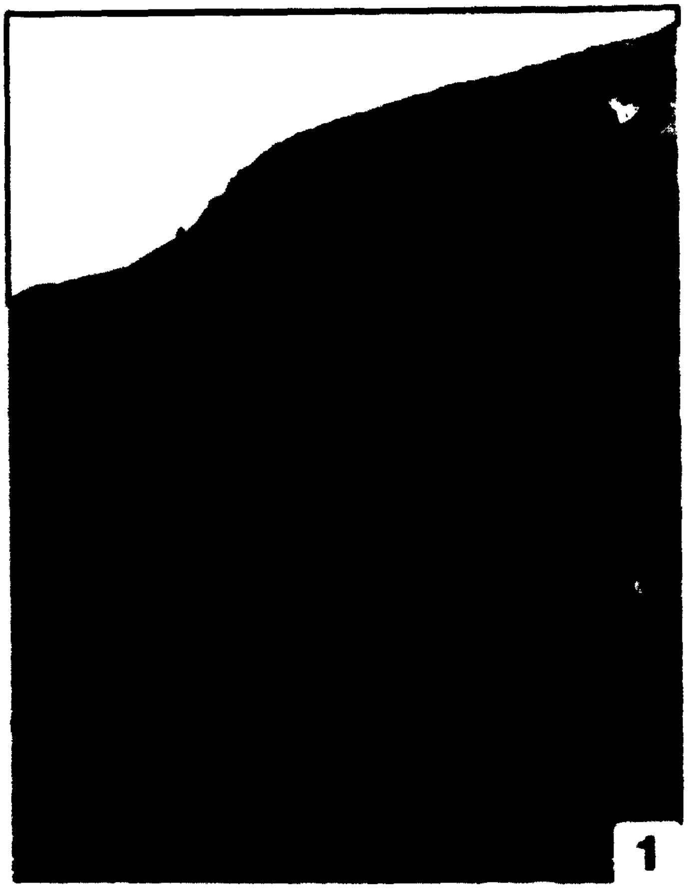
PLATE 3.1B

Nauyat Formation - NA_U Member

Fig. 1: Basalt flows conformably overlain by buff-pink quartzarenite beds of the AS_L member: 8 km southeast of the head of Adams Sound. The NA_U member is about 90 m thick.

Fig. 2: Basalt flows of the NA_U member exposed at the type section at the head of Elwin Inlet (section 18 in Fig. 3.2d). Note the quartzarenite beds between the first and second flows and sandstones of the NA_L member beneath the first flow. The NA_U member is 134 m thick.

PLATE 3.1B



1

2

Chemical analyses (Galley, 1978) indicate that both the NA_L and NA_U member flows are tholeiitic plateau basalts which become more alkalic towards the top of the sequence (Jackson and Iannelli, 1981, Fig. 16.9, p. 275 and Fig. 16.10, p. 276). Galley et. al. (1983) and Dostal et. al. (1989) showed that the basalts are continental tholeiites with the characteristics of mid-ocean ridge-basalts.

3.3 Adams Sound Formation

The multi-coloured sandstones of the Adams Sound Formation outcrop over a large part of southwestern Borden Peninsula stretching from the coast cliffs of Adams Sound, south to the shores of Fabricius Fiord. Adams Sound sandstones are also exposed in the vicinity of the Elwin and Magda Icecaps, along the Alfa River valley, on northern Bylot Island and east of Milne Inlet to southeast of Paquet Bay (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). Strata thicken greatly to the west and northwest (Fig. 3.7), outlining a major depocentre in northwestern Milne Inlet Trough (Fig. 3.8). Adams Sound sequences are 586 m thick on western Borden Peninsula, 580 m thick in the vicinity of the Elwin Icecap, and are estimated to be more than 415 m thick on northern Bylot Island (Jackson and Davidson, 1975). A composite of sections 1 and 2 (Fig. 3.7a) indicates a maximum thickness of over 650 m. To the southeast, in central Borden Peninsula, the Adams Sound Formation is only 200 m to 300 m thick. It decreases to 10 m to 60 m thick east of Milne Inlet and to only 2 m in the area 50 km southeast of the head of Paquet Bay (Figs. 3.7 and 3.8). The suggested type section is in northwestern Milne Inlet Trough, due southeast of the Elwin Icecap. This composite but complete section is 580 m thick (section 15, Fig.

3.7b; Plate 3.2, Fig. 1; reference station 91238, Appendices I and II).

Sandstone beds of the Adams Sound Formation conformably overlie basalts of the NA_U member west and northwest of Milne Inlet, and nonconformably overlie basement gneiss or regolith east and southeast of the Tremblay Sound to Koluktoo Bay area. At these localities the contact is planar to undulatory, with local relief of up to 2 m (Fig. 3.7; Plate 3.2, Figs. 1 and 2). The sandstone beds grade up into strata of the Arctic Bay Formation. The contact is placed at the first occurrence of dark-grey to black, thin laminated shale and siltstone.

The formation can be subdivided into lower (AS_L) and upper (AS_U) members throughout most of the Borden Basin. Locally, in northwest Milne Inlet and North Bylot Troughs, a thin sequence of quartzarenite, siltstone and shale occurs in the middle portion of the formation. This sequence is defined as the AS_M (or middle) member (Fig. 3.7; Plate 3.2, Figs. 1 and 4). In southeastern Milne Inlet Trough the lower part of the formation consists mainly of massive conglomerate to intermixed conglomerate and coarse-grained sandstone; it is defined as a separate southeastern member (the $AS_{L(SE)}$ member; Fig. 3.7a). In a few areas, such as southeast Eclipse Trough, the formation remains undivided. Member contacts are gradational.

The Adams Sound Formation is composed largely of fine- to coarse-grained, planar to crossbedded quartzarenite; minor beds of subarkose, quartz-pebble conglomerate, siltstone and shale also occur. The sandstones contain abundant small to medium scale planar and trough crossbeds, and current and wave ripple marks. Channels, scours, load casts, microfaults and soft sediment deformed beds are less common. Fining- and thinning-upward cycles, of the style and scale previously noted

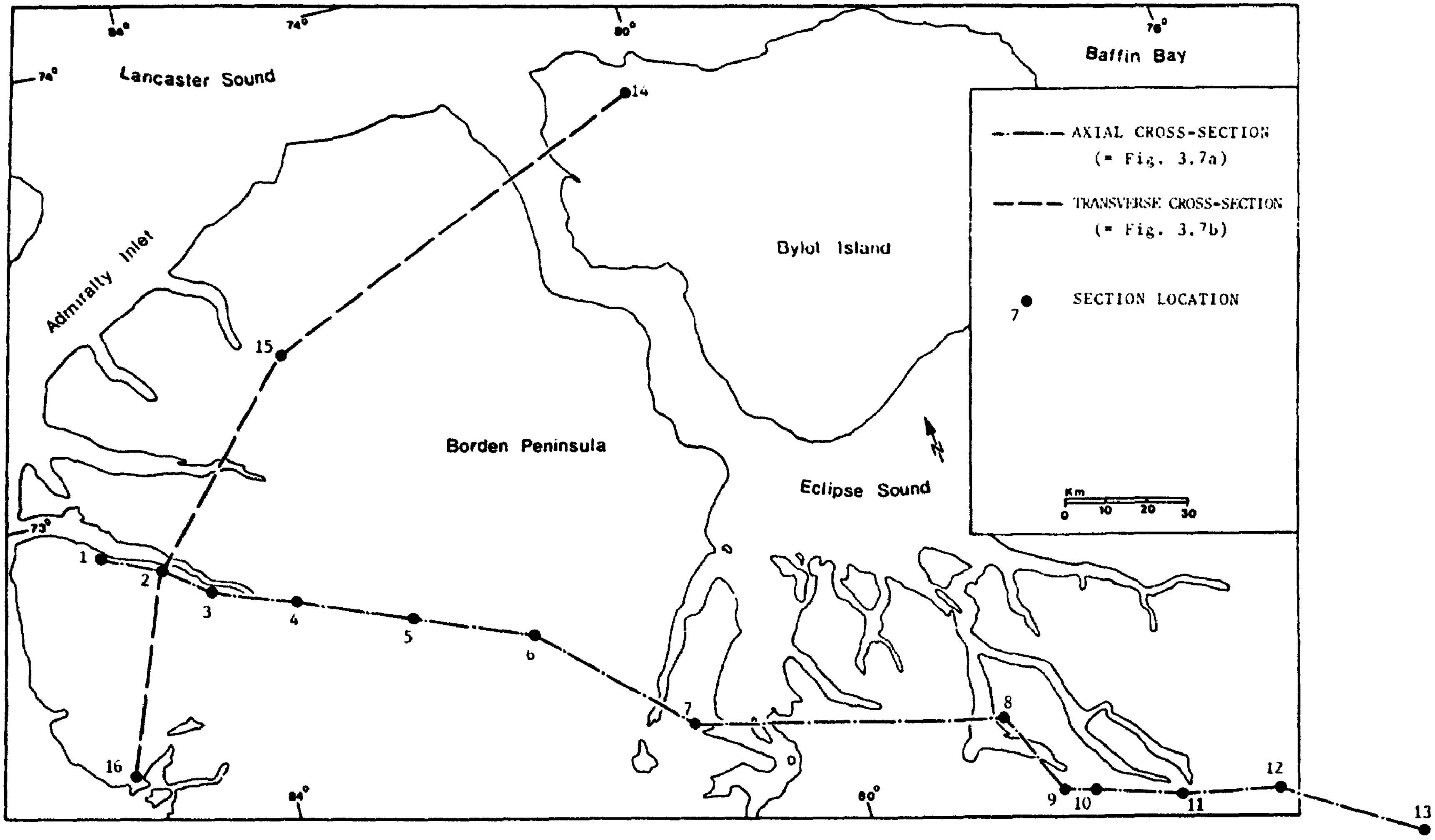
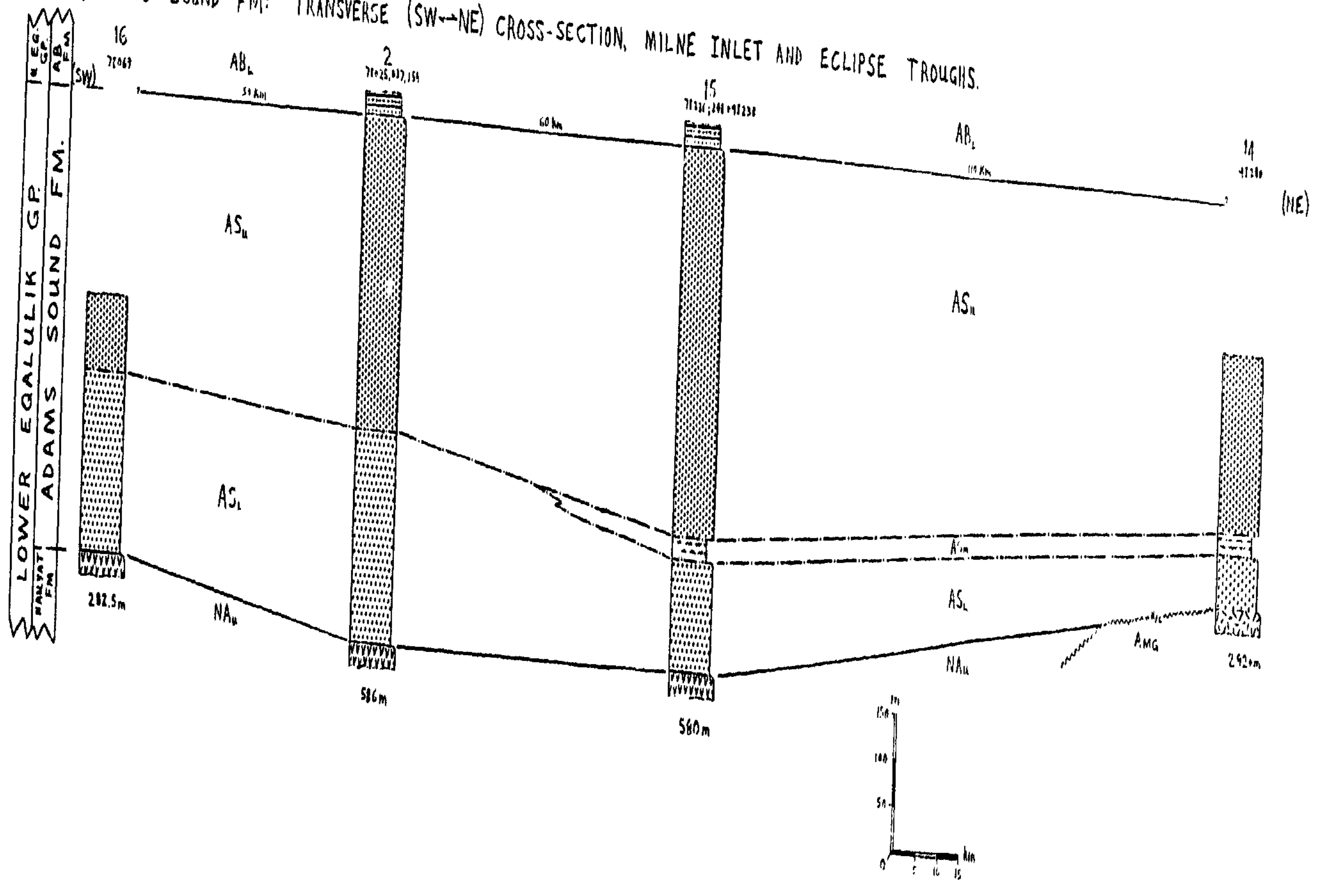


Fig. 3.6: Location map for regional cross-sections of the Adams Sound Formation.

FIG. 3.7b: ADAMS SOUND FM: TRANSVERSE (SW↔NE) CROSS-SECTION, MILNE INLET AND ECLIPSE TROUGHS.



in the NA_L member (Fig. 3.4), are also common in the formation. Paleocurrent trends, derived largely from crossbeds, are northwest-directed for the entire formation (Table 2.8). In the AS_L member paleocurrents trend to the northwest and north-to-northeast, and in the AS_U member, to the northwest, northeast and (less commonly) southeast (Iannelli, 1979, Fig. 11.3, p. 48, Fig. 11.4, p. 49, Fig. 11.5, p. 50; Jackson et. al., 1980, Fig. 46.1, p. 320; Jackson et. al., 1985, Fig. 75.3, p. 642).

3.3.1 AS_L Member

The brightly coloured strata of the AS_L member consist mainly of thick laminated to medium bedded, fine- to coarse-grained quartzarenite with minor beds and lenses of pebbly quartzarenite, quartz-pebble to (less commonly) quartz-cobble conglomerate, fine- to coarse-grained subarkose and rare siltstone and thin laminated shale. The sandstone-dominated sequences are variably coloured in shades of red, purple-red, orange-pink to buff-pink and pink-grey (Plate 3.2, Figs. 1 to 3; Plate 3.3, Figs. 3 and 4). Mottled and colour banded beds are typical. Some colour banding is due to disseminated hematite and pyrite grains. Lenses and layers of conglomerate occur primarily in the basal part of the member. In addition to quartz clasts, some conglomerates contain quartzarenite, chert and gneiss pebbles and cobbles.

The AS_L member thickens greatly to the northwest. It is 16 m thick southeast of the head of Tremblay Sound and 235 m thick along the shores of Adams Sound (Fig. 3.7). It is 58 m thick on northwestern Bylot Island and 125 m thick in the vicinity of the Elwin Icecap. The member grades southeastwards, in Milne Inlet Trough, into the conglomerate-dominated $AS_{L(SE)}$ member and upwards into the in the NA_L member (Fig. 3.4), are also common in the formation. Paleocurrent trends, derived largely from crossbeds, are northwest-directed for the entire formation (Table 2.8). In the AS_L member paleocurrents trend to the northwest and north-to-northeast, and in the AS_U member, to the northwest, northeast and (less commonly) southeast (Iannelli, 1979, Fig. 11.3, p. 48, Fig. 11.4, p. 49, Fig. 11.5, p. 50; Jackson et. al., 1980, Fig. 46.1, p. 320; Jackson et. al., 1985, Fig. 75.3, p. 642).

3.3.1 AS_L Member

The brightly coloured strata of the AS_L member consist mainly of thick laminated to medium bedded, fine- to coarse-grained quartzarenite with minor beds and lenses of pebbly quartzarenite, quartz-pebble to (less commonly) quartz-cobble conglomerate, fine- to coarse-grained subarkose and rare siltstone and thin laminated shale. The sandstone-dominated sequences are variably coloured in shades of red, purple-red, orange-pink to buff-pink and pink-grey (Plate 3.2, Figs. 1 to 3; Plate 3.3, Figs. 3 and 4). Mottled and colour banded beds are typical. Some colour banding is due to disseminated hematite and pyrite grains. Lenses and layers of conglomerate occur primarily in the basal part of the member. In addition to quartz clasts, some conglomerates contain quartzarenite, chert and gneiss pebbles and cobbles.

The AS_L member thickens greatly to the northwest. It is 16 m thick southeast of the head of Tremblay Sound and 235 m thick along the shores of Adams Sound (Fig. 3.7). It is 58 m thick on northwestern Bylot Island and 125 m thick in the vicinity of the Elwin Icecap. The member grades southeastwards, in Milne Inlet Trough, into the conglomerate-dominated $AS_{L(SE)}$ member and upwards into the

AS_U member; locally strata of the AS_U member grade up into the AS_M member (Fig. 3.7).

The AS_L member consists largely of alternating facies units, about 5 m to 10 m thick, of planar bedded sandstone and crossbedded sandstone displaying small to medium scale, fining- and thinning-upward cycles. Some conglomerate-based to pebbly quartzarenite based fining-upward cycles, 1 m to about 5 m thick, were noted. They are generally capped by thick laminated quartzarenite or (less commonly) by siltstone or siltstone-shale sequences similar to cycles observed in the lower part of the NA_L member (Figs. 3.4a and 3.4b). Many cycles are crossbedded quartzarenite-dominated, thinning- and fining-upward sequences, 2 m to 10 m thick (Plate 3.3, Fig.3). They are similar to those observed in the NA_L member (Figs. 3.4b and 3.4c). Some cycles display a lower unit of medium- to coarse-grained trough crossbedded quartzarenite with basal scours, that grades up into fine-grained, thin bedded to thick laminated, planar to ripple-bedded quartzarenite. Another type is made up of quartzarenite with large scale planar crossbeds that passes up into medium to thin bedded, fine- to medium-grained quartzarenite (Plate 3.3, Fig. 3).

Sedimentary structures include small to medium scale planar and trough crossbeds and wave and current ripple marks. Load casts, lensed beds and rare synaeresis and desiccation cracks also occur. Foresets of some trough and planar crossbeds are graded.

PLATE 3.2


1


2


3


4

3.3.2 $AS_{L(SE)}$

The $AS_{L(SE)}$ member occurs in southeastern Milne Inlet Trough, and outcrops sporadically along the shores of Tay Sound and Paquet Bay and inland. It includes mainly thick bedded to massive quartz-pebble to (less commonly) quartz-cobble conglomerate with interbeds and lenses of thin to medium bedded, fine- to very coarse-grained subarkose to quartzarenite and pebbly subarkose. The sandstone and pebbly sandstone beds increase upwards and to the northwest; these constitute up to 30% of the member. The strata are purple-orange, to purple-grey to grey and resistant. Clasts in the conglomerates include, in addition to quartz, subrounded to subangular quartzarenite, feldspar and gneiss, all of which are set in a coarse-grained to granular quartzarenitic to subarkosic matrix. Gneiss clasts are more common near the basal contact.

The $AS_{L(SE)}$ member is only 2 m thick, 50 km southeast of the head of Paquet Bay, but has an average thickness of 15 m to 20 m over much of southeastern Milne Inlet Trough (Fig. 3.7a). The basal contact is undulating, with local relief of up to 2 m. Conglomerate beds are draped over this surface, resulting in small-scale pinch outs of beds against the gneiss.

Sedimentary structures are not common. They include large-scale planar crossbeds, up to 2.5 m high. The crossbeds commonly display current-aligned quartz pebbles along the foreset and bottomset beds. In some sequences, small to medium scale, conglomerate-dominated fining-upward cycles that range from about 2 m to 5 m in thickness are similar in style to those in the basal part of the NA_L member (Fig. 3.4a).

PLATE 3.3

Adams Sound Formation

Fig. 1: Trough-crossbedded and planar bedded buff-yellow to buff-grey quartzarenite beds of the AS_U member exposed in section 15 on northwestern Bylot Island.

Fig. 2: Detail of the upper portion of a thinning-upward cycle in the AS_U member on northwestern Bylot Island. The succession consists of medium to coarse-grained, trough-crossbedded quartzarenite passing up into thick laminated to very thin, wavy bedded siltstone and quartzarenite.

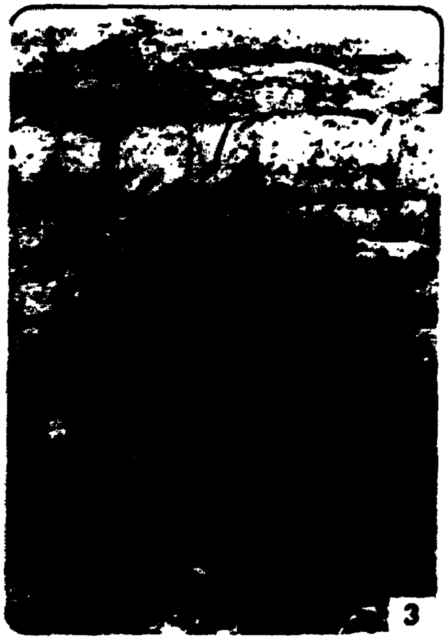
Fig. 3: A thinning-upward cycle in the AS_L member in the area due south of the head of Adams Sound. A basal unit comprised of planar crossbedded, medium- to coarse-grained quartzarenite is overlain by planar, thin to medium bedded fine- to medium-grained quartzarenite.

Fig. 4: Detailed view of pink to pink-brown, trough crossbedded fine- to medium-grained quartzarenite beds present in the AS_L member. Location as for Fig. 3.

PLATE 3.3


1


2


3


4

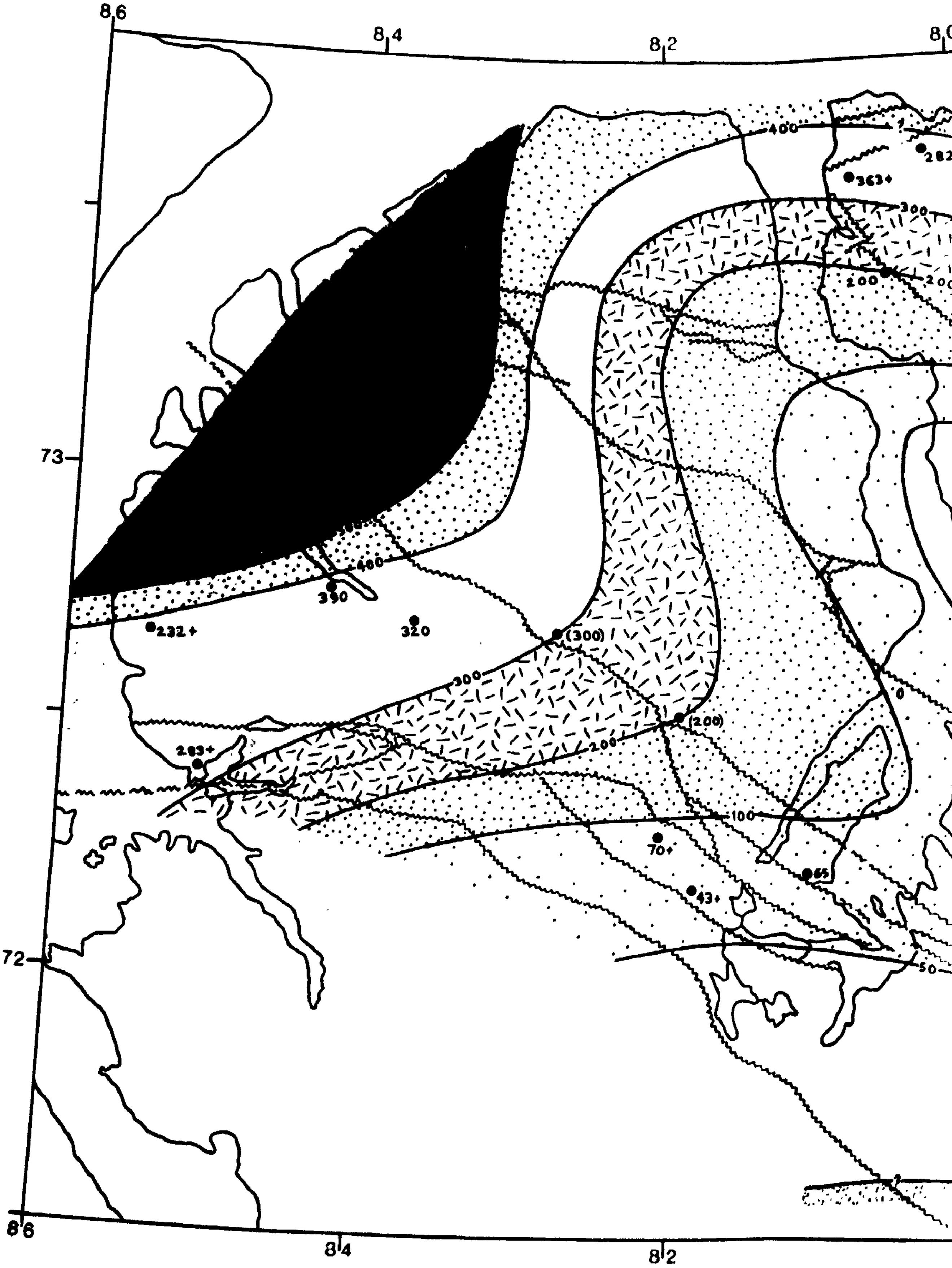
3.3.3 AS_M Member

The AS_M member occurs locally in the middle portion of the formation. It has a gradational contact with the underlying AS_L member and overlying AS_U member. The AS_M member is only locally preserved in northwestern Milne Inlet and North Bylot Troughs (Fig. 3.7; Plate 3.2, Figs. 1 and 2). In northwest Milne Inlet Trough it ranges from 25 m thick, southeast of the Elwin Icecap, to more than 49 m thick on west Borden Peninsula; it is 28 m thick on northern Bylot Island.

The AS_M member is made up of interlayered purple-red, purple-pink, green-grey to buff, planar to lenticular bedded and thick laminated to thin bedded quartzarenite and siltstone and planar thin laminated shale. Shale generally comprises less than 25% of the member. The strata are extensively hematite-stained on northern Bylot Island (Plate 3.2, Figs. 2 and 4). Sedimentary structures include small to (less commonly) medium scale trough and planar crossbeds, small current ripple marks and microfaults.

3.3.4 AS_U Member

The blandly coloured upper member of the formation consists mainly of fine- to coarse-grained, planar bedded to crossbedded, thick laminated to medium bedded quartzarenite. There are minor beds and lenses of pebbly quartzarenite, quartz-pebble conglomerate and rare thick to thin laminated siltstone and shale. A higher proportion (25%) of conglomerate was noted in southeastern Milne Inlet Trough, but these beds decrease upwards in abundance and thickness. Rare channel infills of sedimentary breccia with quartzarenite clasts occur near the Alfa River delta. The AS_U member is

86
84
82
80
73
72
86
84
82
400
300
200
200
100
50
0
400
300
200
363+
200
390
320
232+
(300)
(200)
283+
70+
65
43+

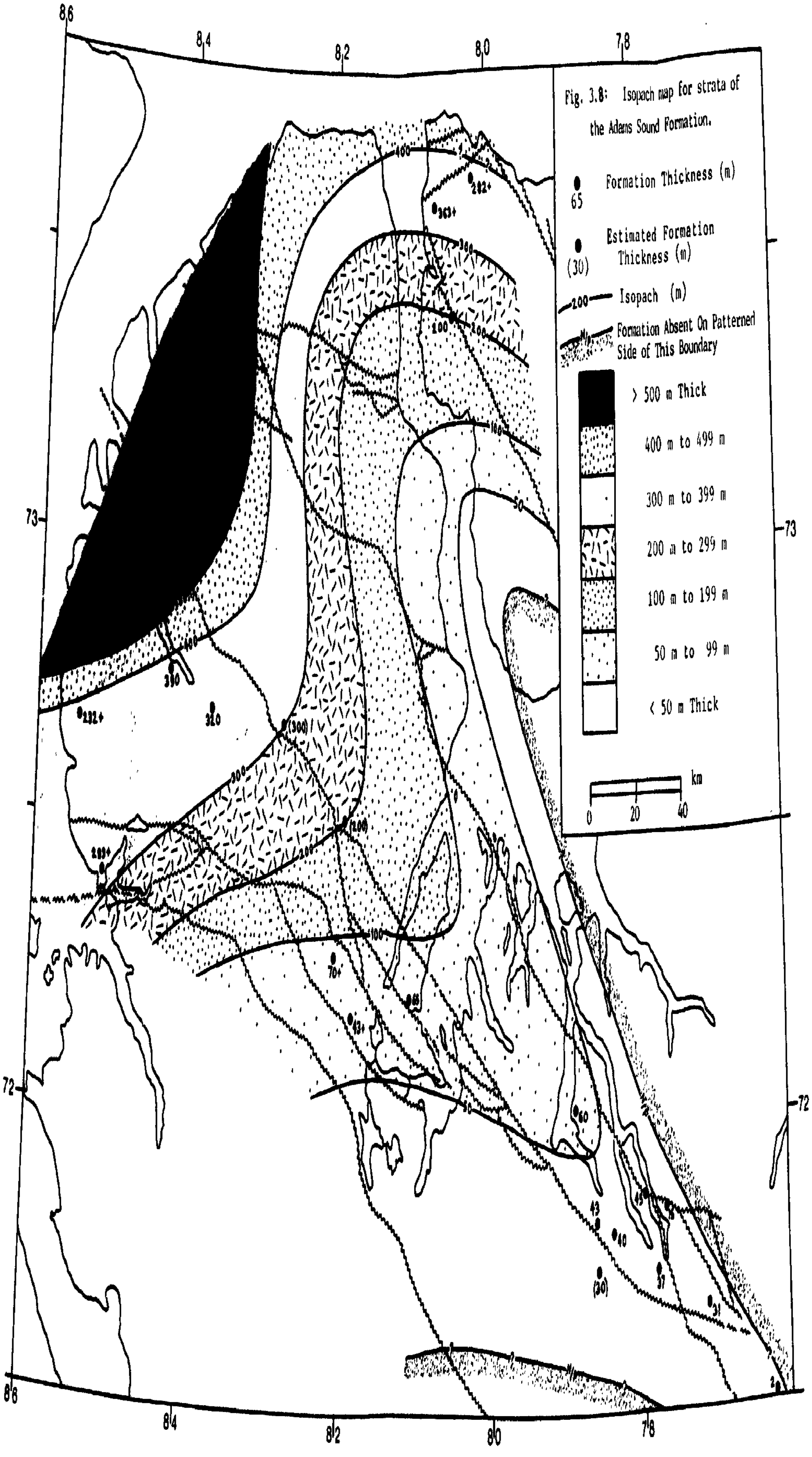


Fig. 3.8: Isopach map for strata of the Adams Sound Formation.

typically white, buff, light-brown, light- to dark-grey and, less commonly, pink. Southeast of Milne Inlet the beds are brown-grey to white (Plate 3.2, Figs. 1 and 2; Plate 3.3, Figs. 1 and 2). The strata commonly contain minor disseminated pyrite resulting in yellow- to rust-brown-weathered outcrops. Locally, malachite-azurite occurs as coatings on joint and fracture surfaces.

The AS_U member is absent in the southeasternmost part of the Milne Inlet Trough but strata thicken to the northwest, averaging 14 m to 45 m southeast of Milne Inlet and 200 m in central Borden Peninsula. The beds are 350 m thick in west Borden Peninsula and reach a maximum thickness of 430 m at the type section near the Elwin Icecap (Fig. 3.7b). In these areas, the AS_U member grades up into the lower member of the Arctic Bay Formation.

Strata in the AS_U member are arranged into alternating planar bedded and cyclic units. Fining- and thinning-upward cycles occur and are mainly sandstone-dominated, as in the NA_L and AS_L members (Figs. 3.4b and 3.4c; Plate 3.3, Fig. 2). Fining-upward cycles, in the area of Adams and Fabricius Fiord, are 1 m to 5 m thick and consist of trough-crossbedded quartzarenite to pebbly quartzarenite, passing up into planar to ripple-bedded, thin layered quartzarenite. Similar cycles on northern Bylot Island are 1 m to 4 m in thickness and at Tremblay Sound are 4 m to 8 m thick. Southeast of Milne Inlet some sequences contain conglomerate-based fining-upward cycles similar to those in the basal part of the NA_L member (Fig. 3.4a).

Abundant sedimentary structures include small to large scale planar and trough crossbeds, small to medium scale wave and current marks, graded beds, channels, and soft-sediment deformed beds. Mega-ripples with wavelengths of up to 2 m were noted. In southeastern Milne Inlet Trough, large scale planar crossbeds and current ripple marks (with wavelengths of 30 cm to over 1 m) are common.

3.4 Arctic Bay Formation

The Arctic Bay Formation is the shale-bearing to shale-dominated lithofacies complex of the Upper Eqalulik Group (Figs. 2.2 to 2.5 and 3.10; Table 2.5a). The formation outcrops in a broad northwest - southeast-oriented belt that extends southeast from Arctic Bay to Paquet Bay; across southern and northern Borden Peninsula and in north and northwestern Bylot Island (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The formation is characterised by the presence of planar thin laminated black to grey-black shale, which is locally pyritiferous (Plate 3.4, Fig. 3; Plate 3.8, Fig. 3). Interbedded siltstone and quartzarenite are present in the lower part of the formation; siltstone, quartzarenite, subarkose, arkose, conglomerate and calciclastic to stromatolitic carbonate make up the upper part of the formation (Plates 3.4 to 3.6). The non-shale components vary in type and amount across the basin. In general, shale content decreases gradually marginwards and southeastwards (Fig. 3.10). In contrast, sandstone, pebbly sandstone and conglomerate increase towards the major fault margins, and sandstone, conglomerate and calciclastic carbonate increase to the southeast in the Milne Inlet and Eclipse Troughs (Table 2.5a). On the basis of the regional distribution of the non-shale components, the Arctic Bay Formation has been subdivided into three regional lithofacies assemblages. These are: basinal (Tremblay Sound), marginal (Fabricius River) and southeast (Paquet Bay) lithofacies assemblages (Table 2.5a). Lithologic diversity is greatest between the upper members of each assemblage (Figs. 3.10a to 3.10f).

Significant thickness variations occur across the basin (Figs. 3.10a to 3.10f), and the regional depocentres are different from those in the Nauyat and Adams Sound Formations (Figs. 3.3, 3.8 and 3.11). The succession thickens southeastwards from 208 m near Arctic Bay to about 800 m east of Milne Inlet, and marginwards to about 1300 m along the White Bay Fault Zone and 1377 m along the Central Borden Fault Zone. Depocentres shift from being northwesterly-located during deposition of the Lower Eqalulik Group, to southeasterly- and marginally located for the Upper Eqalulik Group (Figs. 3.10 and 3.11). The magnitude of these changes suggests that a fundamental change in basin evolution occurred after deposition of the Adams Sound Formation (Table 6.6).

Paleocurrent directions are similar to those observed for the Nauyat and Adams Sound Formations, and include northwesterly- and westerly-directed trends (Table 2.8).

For each assemblage a type section has been suggested.

3.4.1 Tremblay Sound Assemblage (Basinal Facies Assemblage)

The Tremblay Sound Assemblage comprises strata of the Arctic Bay Formation in the northwestern portion of Milne Inlet, Eclipse and North Bylot Troughs (Plate 3.4). The sequences are widely distributed on Borden Peninsula, and northern and northwestern Bylot Island (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). They thicken to the southeast, from 208 m at Arctic Bay to 786 m

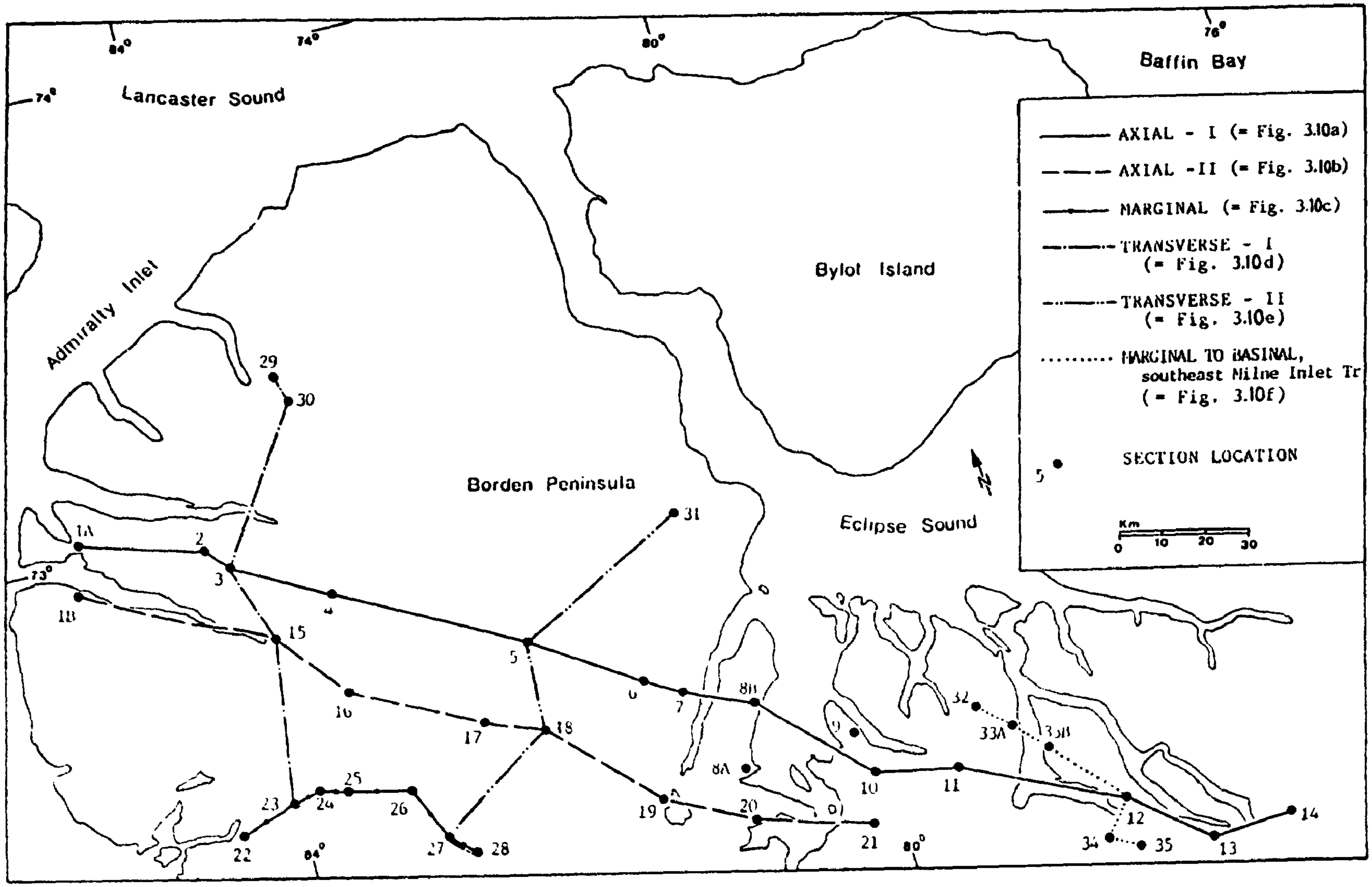


Fig. 3.9: Location map for regional cross-sections of the Arctic Bay Formation in the Milne Inlet Trough.

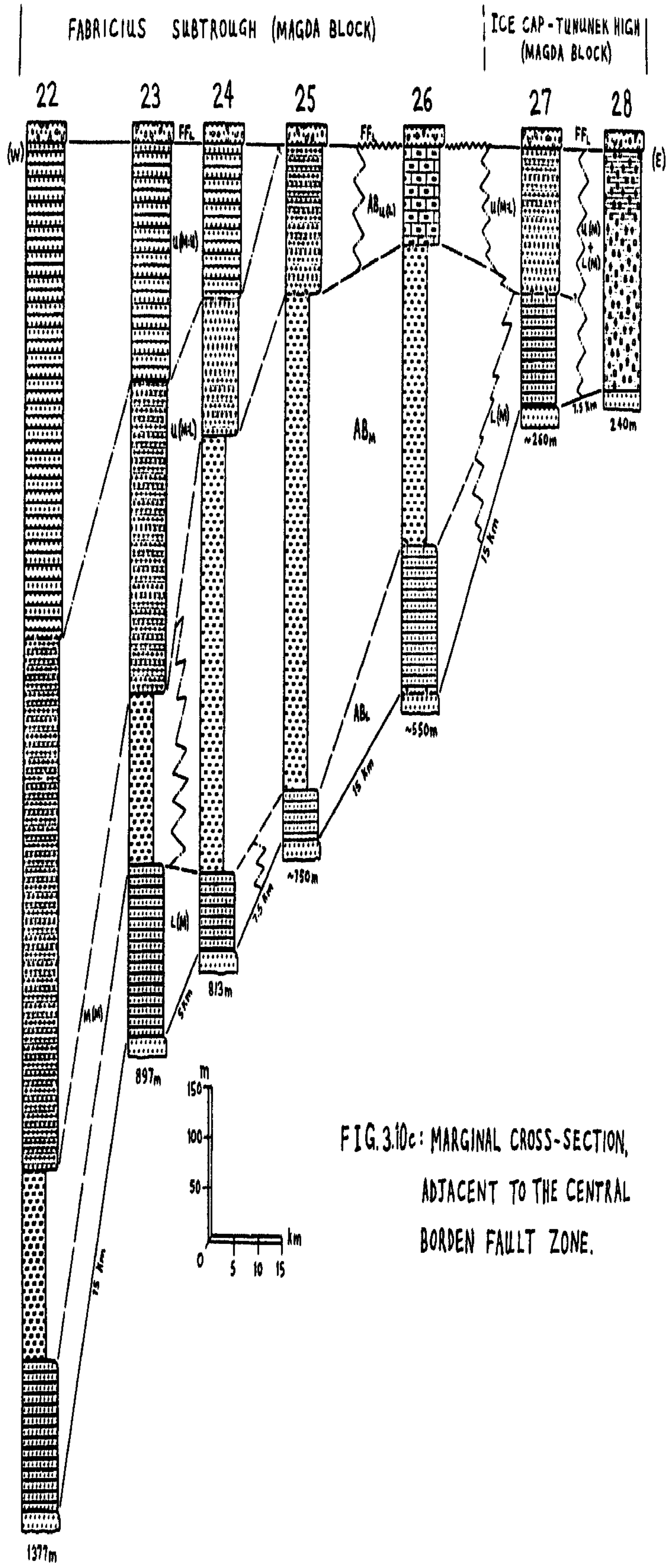


FIG. 3.10c: MARGINAL CROSS-SECTION, ADJACENT TO THE CENTRAL BORDEN FAULT ZONE.

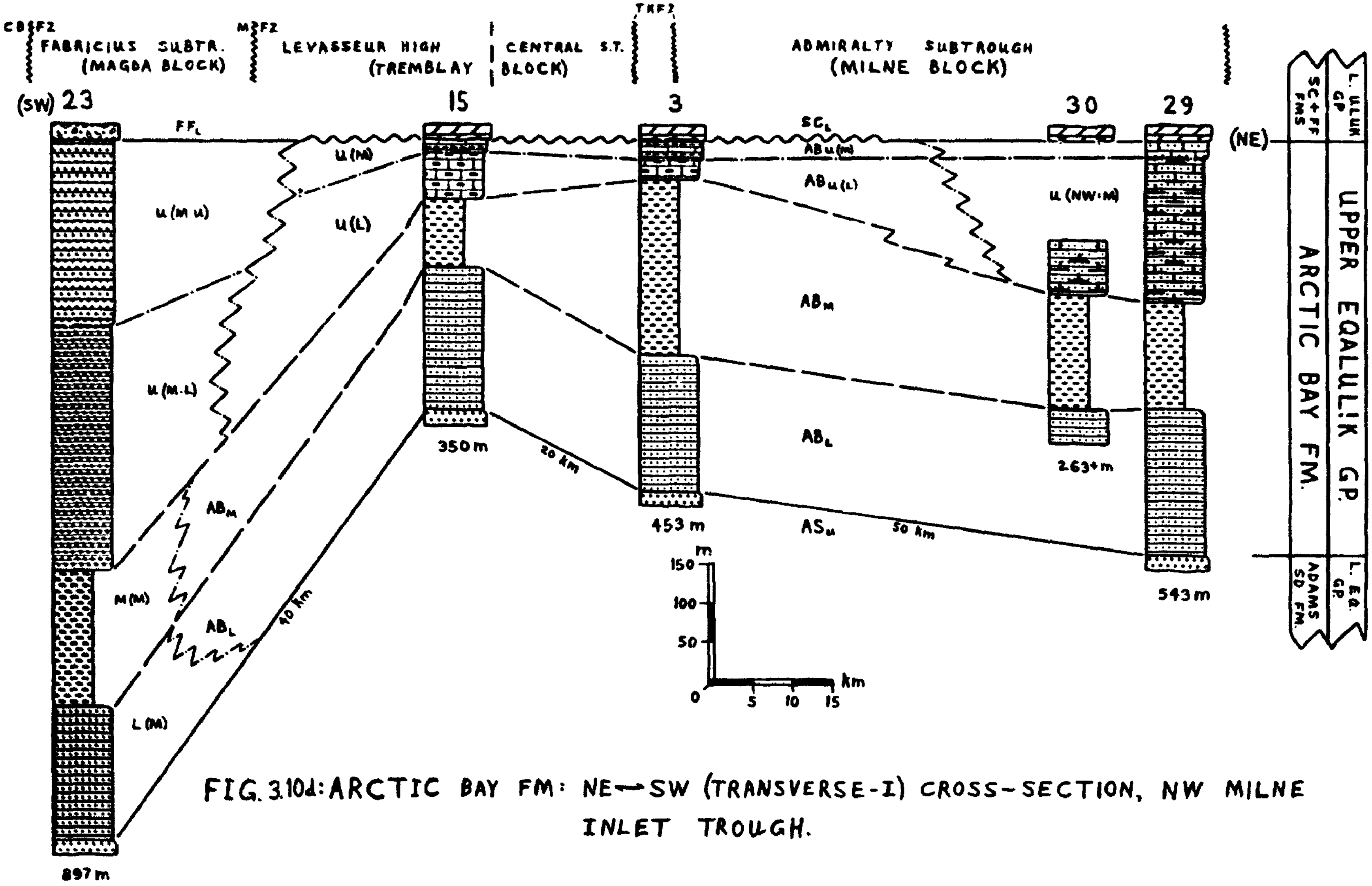


FIG. 3.10d: ARCTIC BAY FM: NE→SW (TRANSVERSE-I) CROSS-SECTION, NW MILNE INLET TROUGH.

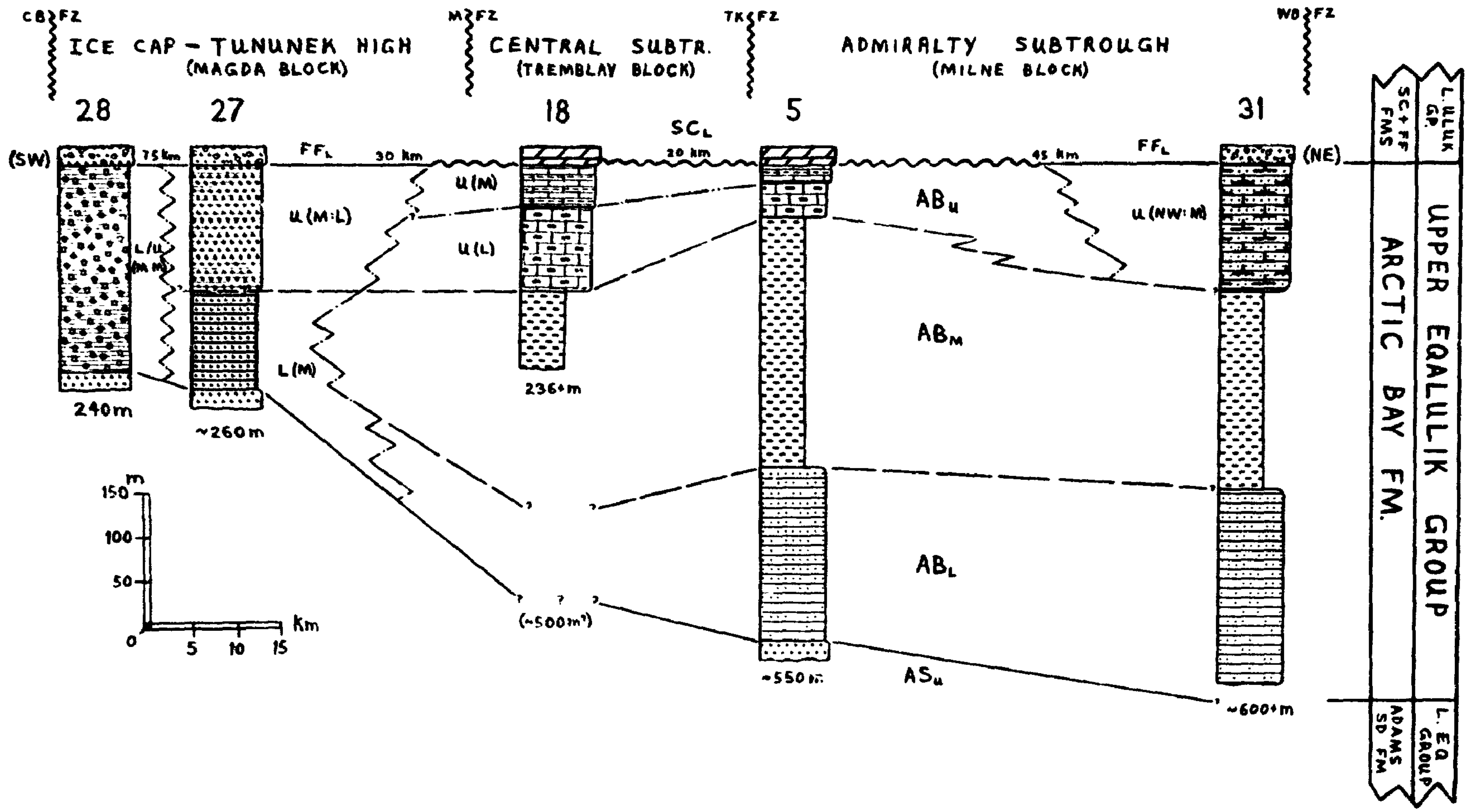


FIG. 3.10e: ARCTIC BAY FM: NE-SW (TRANSVERSE-II) CROSS-SECTION. CENTRAL MILNE INLET TROUGH.

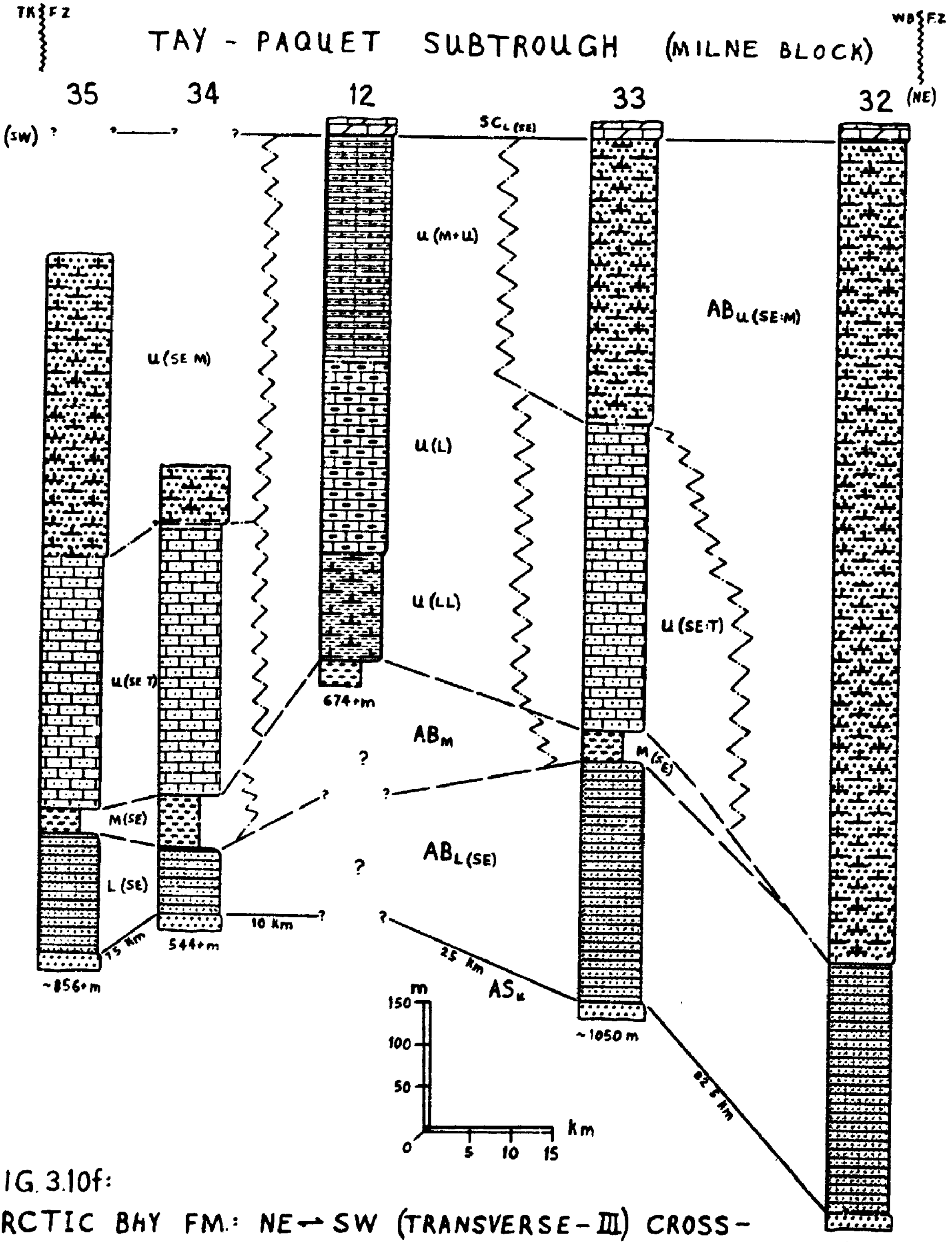


FIG. 3.10f:
ARCTIC BAY FM: NE→SW (TRANSVERSE-III) CROSS-SECTION, S.E. MILNE INLET TROUGH.

southeast of Milne Inlet (Fig. 3.10a). The suggested type section is due north of the Alfa River delta, along the west central coast of Tremblay Sound (section 7 in Fig. 3.10a; reference stations 81008 to 81012 in Appendices I and II).

Strata of the Tremblay Sound Assemblage conformably overlie quartzarenite beds of the AS_L member. Contact relationships with overlying dolostones and calciclastic carbonates of the Society Cliffs Formation range from unconformable, in the northwestern part of Milne Inlet and Eclipse Troughs, to conformable and gradational in the southeastern portions of these troughs (Figs. 3.10a to 3.10d). Locally the unconformity is angular, with removal of up to 15 m of the Arctic Bay Formation (Plate 3.8, Fig. 3) prior to deposition of the Society Cliffs dolostones. The basinal assemblage is unconformably overlain by calcareous sandstone and conglomerate of the Fabricius Fiord Formation and grades marginwards into facies equivalent beds of the Fabricius River Assemblage and, to the southeast, into beds of the Paquet Bay Assemblage (Figs. 3.10a to 3.10f).

The Tremblay Sound Assemblage has been subdivided into lower (AB_L), middle (AB_M) and upper (AB_U) members. It consists largely of shale over much of northwestern Milne Inlet, Eclipse and North Bylot Troughs. Siltstone and quartzarenite are more common near the base, and calciclastic to stromatolitic carbonate increases upwards (Figs. 3.10a to 3.10e). Sedimentary structures are most common in the siltstones, quartzarenites and carbonates. Structures include small to medium scale planar crossbeds, wave and current ripple marks, synaeresis and desiccation cracks, load casts, scours, teepee structures, dewatering structures, soft sediment folds, microfaults and growth faults. Carbonate strata contain small vugs and emit a petroliferous odour. The shale beds contain small scale convolute bedding, concretions and cone-in-cone structure. They are typically coated with a calcareous and gypsiferous efflorescence.

Paleocurrent trends from crossbed measurements are northwesterly- and westerly-directed; those from stromatolite mound elongations have a preferred northwest - southeast orientation (Table 2.8; Iannelli, 1979, Fig. 11.4, p. 49; Jackson et. al., 1985, Fig. 75.3, p. 642).

3.4.1a AB_L Member

The AB_L member ($AB_{L(L)}$ and $AB_{L(U)}$ submembers) consists of alternating facies units of planar thin laminated black-grey shale, grey to buff planar to lenticular or wavy bedded intermixed shale-siltstone-quartzarenite and buff-grey thick laminated to thin bedded quartzarenite. Facies units are arranged into (<5 - >20 m-thick) quartzarenite-capped, coarsening- and thickening-upward cycles (Plate 3.4, Figs. 1 and 2; Plate 5.1, Fig. 6; Jackson and Iannelli, 1981, Fig. 16.13a, p. 278).

The cycles begin with planar thin laminated black shale with minor lenses and laminae of siltstone and quartzarenite, in units 2 m to 10 m thick. Shale beds grade up into mid-cycle units (1 - 5 m) of planar to wavy layered intermixed shale-siltstone-quartzarenite. The upper unit of the cycles comprises buff-grey, grey-brown to white, thick laminated to thin bedded, fine- to coarse-grained quartzarenite with abundant crossbeds and ripple marks. These sandy beds are 0.5 m to 5 m thick and are less common in the upper part of the AB_L member (Plate 3.4, Figs. 1 and 2). Siltstone and quartzarenite content decreases upward as the percentage of shale increases.

PLATE 3.4

Arctic Bay Formation - Tremblay Sound Assemblage

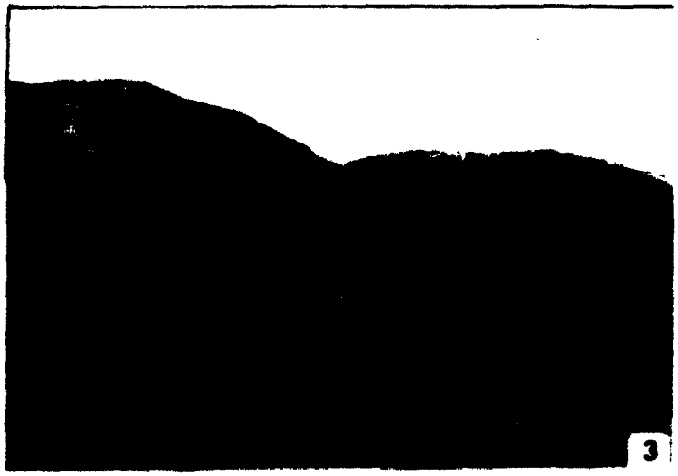
Fig. 1: Small to medium scale cycles in the mid to upper AB_L member. The cycles consist of alternating facies units of black shale and intermixed black-grey shale-siltstone-sandstone; they average 10 m to 15 m in thickness: 13 km northwest of the Alfa River Delta.

Fig. 2: Cyclically alternating facies units of black shale and grey intermixed shale-siltstone-sandstone beds forming the mid to upper portion of the AB_L member. The section is about 75 m thick and outcrops due northeast of the Elwin Icecap, adjacent to the Hartz Mountain Fault Zone.

Fig. 3: Prominent gossan, due to the presence of laminated and disseminated pyrite, in a black shale-dominated sequence that includes portions of the AB_L and AB_M members. The mineralized sequence, which is about 50 m thick, is disrupted by a large northwest-trending diabase dyke and is associated with the fault system that forms the boundary between the Fleming and Tremblay Blocks in Milne Inlet Trough (Figs. 5.2 and 5.4a): 3 km southeast of the head of Adams Sound.

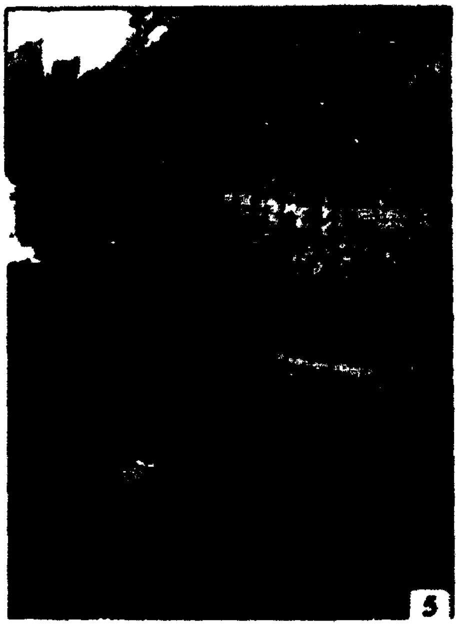
PLATE 3.4

1



3

4



5

6

PLATE 3.4

Arctic Bay Formation - Tremblay Sound Assemblage

Fig. 4: Carbonate-rich thickening upward cycles. The cycles consist of alternating facies units of black-grey shale that pass up into mixed shale and calciclastic carbonate overlain by interlayered calciclastic to stromatolitic carbonate. They average 10 m to 20 m in thickness. The section is the mid portion of the AB_U member and is about 150 m thick: 8 km south-southeast of the end of Eskimo Inlet.

Fig. 5: Detail of two carbonate-dominated, thickening-upward cycles of the type shown in Fig. 4. Lower part of the AB_U member: 3 km due north of the Alfa River delta. Illustrated section is about 25 m thick.

Fig. 6: Orange-brown-weathering stromatolitic dolostone from the lowermost AB_U member. The bed contains bun-shaped and columnar upward-expanding stromatolites that form small elongate mounds. The dolostone bed occurs in thin laminated black-grey shale: southeast part of Tremblay Peninsula.

Locally, in the vicinity of Tremblay Sound, the member can be subdivided into lower ($AB_{L(L)}$) and upper ($AB_{L(U)}$) submembers (Fig. 3.10a). The lower submember comprises buff-grey, grey-white to green-grey, thick laminated to thin bedded quartzarenite and siltstone with thin partings and laminae of black-grey shale. Shale content increases upwards. The submember is 15 m to 50 m thick. The upper submember consists of cyclic strata similar to those described for the AB_L member.

The AB_L member thickens to the southeast, from 97 m at Arctic Bay to 267 m due east of Milne Inlet (Figs. 3.10a to 3.10e).

3.4.1b AB_M Member

The AB_M member comprises thin laminated black to black-grey shale, minor laminae and thin lenses of buff-grey to grey siltstone, quartzarenite, dolomitic shale, calcilutite, dololutite and dolosiltite (Plate 3.8, Fig. 3; Plate 5.1, Figs 3 and 5). Rare facies include concretionary carbonate, flat carbonate clast conglomerate and pyritiferous shale. The latter exhibits thin pyrite laminae interlayered with thin laminated black shale; locally pyrite makes up 15% of the rock (Plate 3.4, Fig. 3). Rare sedimentary structures include small load casts, microfaults, small current ripple marks and graded bedding.

The AB_M member is an important component of the Tremblay Sound Assemblage over much of northwestern Milne Inlet, Eclipse and north Bylot Troughs. It is about 60 m thick at Arctic Bay and 300 m thick in central Borden Peninsula. Southeast of the head of Paquet Bay and towards the Central Borden Fault Zone the member is thinner (Figs. 3.10a to 3.10d).

3.4.1c AB_U Member

The AB_U member includes a diverse association of planar thin laminated black-grey shale, buff-grey to orange-brown laminated to bedded dolostone, limestone, stromatolitic limestone and dololutite (Plate 3.4, Figs. 4 to 6; Plate 3.8, Fig. 2; Plate 5.1, Fig. 5). Minor rock types include thin to medium bedded siltstone, subarkose, pebbly sandstone and flat carbonate clast conglomerate. The lithofacies units are commonly arranged into thickening-upward shale-into-carbonate cycles, 5 m to 50 m thick (Plate 3.4, Figs. 4 and 5).

In the vicinity of the head of Adams Sound, thickening-upward cycles are up to 40 m thick. They comprise lower units of planar thin laminated black shale, middle units of thick laminated to thin bedded intermixed shale-calcisiltite and limestone (Jackson and Iannelli, 1981). In the area of Tremblay Sound and Milne Inlet the cycles (10 m to 20 m thick) consist of alternating units of black-grey thin laminated shale overlain by mixed shale and thick laminated to thin bedded calcisiltite to dolosiltite, capped by calciclastic to stromatolitic dolostone to limestone (Plate 3.4, Figs. 4 and 5).

Distinctive orange-brown-weathering stromatolitic carbonate beds, up to 5 m thick, are present in up to 25% of the AB_U member. They include tabular to lensoid units, some of which contain bioherms. The latter include both dolostones and limestones and consist of elongate mounds that average 1 m to 2 m in width,1 m to 3 m in length,and are up to 1 m high. Low domal cones are succeeded by upward-expanding columns (Plate 3.4, Fig. 6) that give way to branching columnar stromatolite types (Baicaila types; Jackson and Iannelli, 1981, 1989). The mounds are

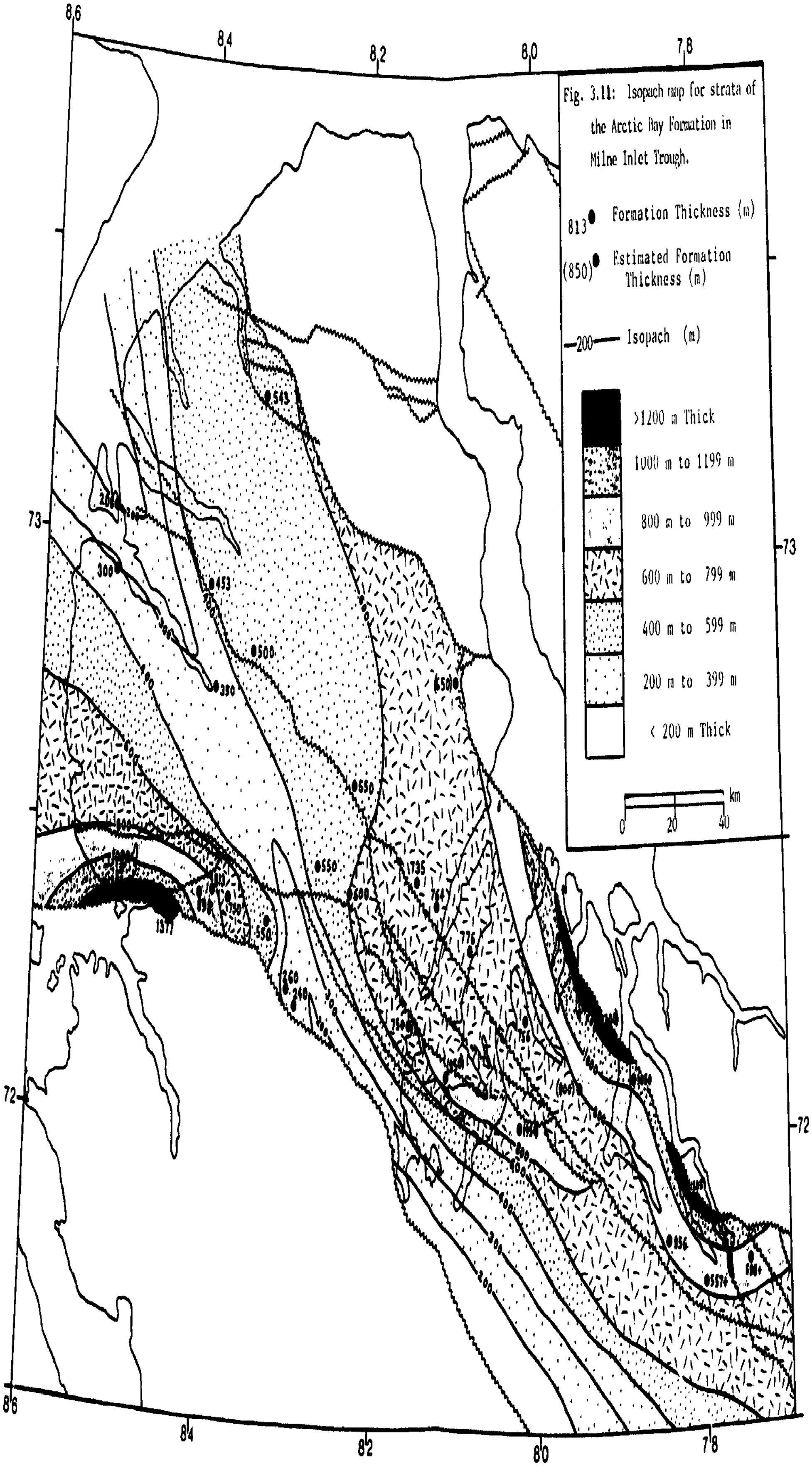


Fig. 3.11: Isopach map for strata of the Arctic Bay Formation in Milne Inlet Trough.

associated with stromatolite-clast, flat pebble conglomerate lenses and layers.

The member has been subdivided into $AB_{U(LL)}$, $AB_{U(L)}$, $AB_{U(M)}$ and $AB_{U(U)}$ submembers on the basis of the gradual increase upwards and southeastwards in the amount of calciclastic and stromatolitic carbonate beds (Figs. 3.10a and 3.10b). The upper submembers are not present in the northwest part of the Milne Inlet and Eclipse Troughs.

The member thickens markedly to the southeast, from 58 m at Arctic Bay to 230 m at the type section. It reaches a maximum of 642 m due north of the head of Tay Sound (Figs. 3.10a and 3.10b).

3.4.2 Fabricius River Assemblage (Marginal Facies Assemblage)

The Fabricius River Assemblage includes all of the strata formerly defined as the FF_1 and FF_2 members of the Fabricius Fiord Formation and of the marginal Arctic Bay Formation in northwestern Milne Inlet Trough (Jackson et. al., 1978a, 1980; Iannelli, 1979; Jackson and Iannelli, 1981). It is most widely exposed on southern Borden Peninsula, adjacent to the Central Borden Fault Zone but also outcrops along the White Bay Fault Zone near the Elwin Icecap and northwest of the end of Tremblay Sound (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The marginal assemblage thickens greatly towards the fault zones; sequences range in thickness from 240 m, 60 km east-southeast of the head of Fabricius Fiord, to 1377 m at the fiord, adjacent to the Central Borden Fault Zone (Figs. 3.10c to 3.10e). The suggested type section is 15 km east-southeast of the head of Fabricius Fiord (section 23 in Fig. 3.10c; reference stations 81099 and 81105 in Appendices I and II).

Lower contact relationships are similar to those of the Tremblay Sound Assemblage. The marginal assemblage appears to be conformably overlain by sandstone and pebbly sandstone beds of the FF_L member of the Fabricius Fiord Formation. It grades laterally into facies-equivalent beds of the Tremblay Sound Assemblage (Figs. 3.10c to 3.10e).

The Fabricius River Assemblage has been subdivided into lower ($AB_{L(M)}$), middle ($AB_{M(M)}$) and upper ($AB_{U(M)}$) members.

3.4.2a $AB_{L(M)}$ Member

The $AB_{L(M)}$ member comprises alternating facies units of thin planar laminated black-grey shale, intermixed planar to wavy bedded shale-siltstone-sandstone and thick laminated to thin bedded sandstone (Plate 3.5, Figs. 1 to 3). The sandstone beds include fine- to coarse-grained quartzarenite and subarkose, and (less commonly) arkose to litharenite (Plate 3.5, Fig. 4). Minor pebbly sandstone and quartz-pebble to feldspar-pebble conglomerate beds also occur. The facies units comprise 10 to 19 coarsening-upward cycles, 5 m to 15 m thick, that are similar to those of the AB_L member (Jackson and Iannelli, 1981, Fig. 16.16, p. 281). The cycles are typically sandstone-rich and, in the lower part of the member, may be capped by a layer of pebbly sandstone or conglomerate. Sedimentary structures are similar to those in sandstone beds of the Tremblay Sound Assemblage, but also include herringbone crossbeds, megaripples and channels (Plate 3.5, Fig. 4). Paleocurrents are predominately directed to the northwest and west (Iannelli, 1979, Fig. 11.3, p. 48).

PLATE 3.5

Arctic Bay Formation - Fabricius River Assemblage

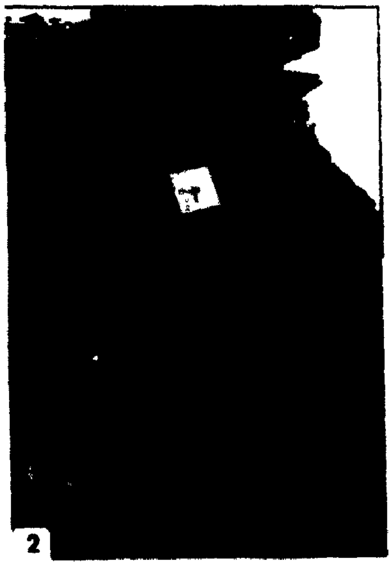
Fig. 1: Mixed shale-siltstone-sandstone member of a coarsening-upward cycle. The sequence consists of alternating sheet-like, massive quartzarenite beds (storm beds?) and wavy-bedded quartzarenites interlayered with thin to thick laminated, planar to wavy bedded shale-siltstone-sandstone. The quartzarenite beds comprise 30% to 40% of the sequence: $AB_{L(M)}$ member, 3 km southeast of the head of Fabricius Fiord.

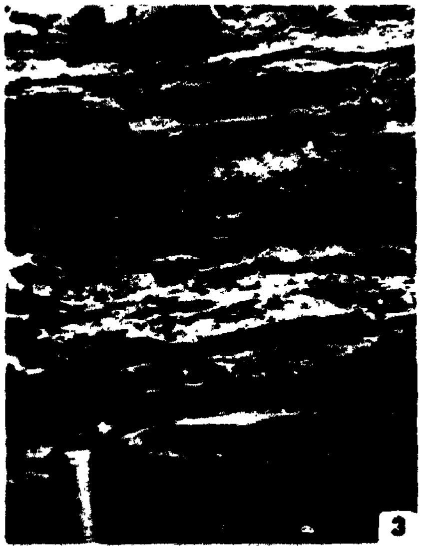
Fig. 2: Intermixed shale-siltstone-sandstone facies unit from a coarsening-upward cycle in the $AB_{L(M)}$ member. The unit consists of planar laminated black shale with planar, lenticular to wavy bedded siltstone and quartzarenite interlayers and, near the top of the photo, two massive quartzarenite beds which probably represent storm deposits: 15 km east-southeast of the head of Fabricius Fiord. The staff is 1.5 m long.

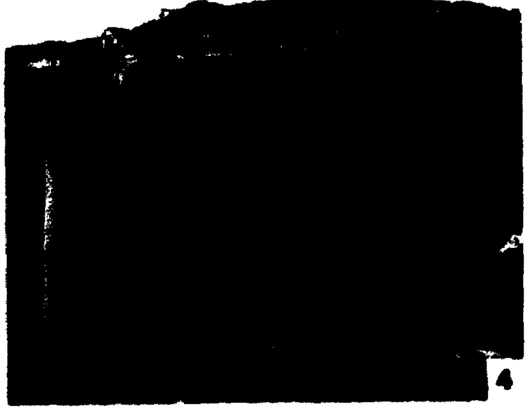
Fig. 3: Detail of thick laminated to thin bedded, wavy to lenticular siltstone and quartzarenite beds, with minor shale partings, together with a probable storm sandstone layer. The latter is graded, contains a basal pebbly layer and a loaded base. The sequence is part of a shale-siltstone-sandstone facies unit, in a coarsening-upward cycle in the $AB_{L(M)}$ member. Location as for Fig. 2.

PLATE 3.5


1


2


3


4


5

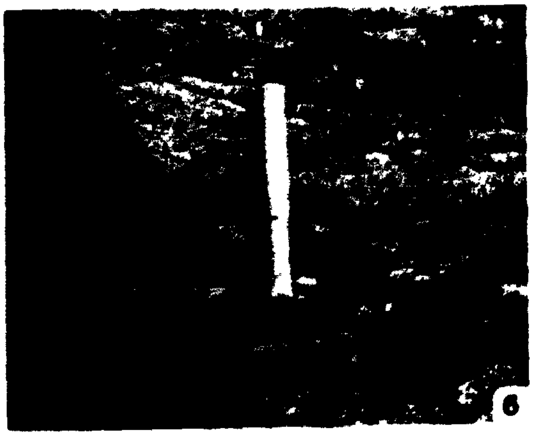

6

PLATE 3.5

Arctic Bay Formation - Fabricius River Assemblage

Fig. 4: Detailed view of medium- to coarse-grained quartzarenite with planar bedding, passing up into herringbone crossbedding. The view shows the upper member of a coarsening-upward cycle in the lower part of the $AB_{L(M)}$ member: 15 km east-southeast of the head of Fabricius Fiord.

Fig. 5: Detail of planar to crossbedded, medium- to coarse-grained subarkose. The sequence is part of the upper member of a siltstone-sandstone - dominated coarsening-upward cycle in the $AB_{U(M:L)}$ member. The beds contain reactivation surfaces and scours, trough crossbeds and megaripple marks: 55 km east-southeast of the head of Fabricius Fiord.

Fig. 6: Subarkose beds forming the upper part of a sandstone-dominated coarsening-upward cycle in the $AB_{U(M:L)}$ member. The rock is planar to wavy layered, thick laminated to thin bedded coarse-grained to granular subarkose. Location as for Fig. 5.

The $AB_{L(M)}$ member is 147 m thick, due south of the head of Fabricius Fiord, and 171 m thick at the type section; 55 km east-southeast of the head of the fiord it is only 113 m thick (Fig. 3.10c).

3.4.2b $AB_{M(M)}$ Member

The middle member is similar to the AB_M member of the basinal assemblage, but planar to wavy bedded siltstone and quartzarenite beds are more common and there are fewer carbonate strata (dolosiltite, dololutite). Adjacent to the Central Borden Fault Zone, the member comprises medium to large scale shale-dominated, coarsening-upward cycles similar to those observed in the upper AB_L member in the vicinity of Tremblay Sound (Plate 3.4, Figs. 1 and 2). They number up to 13 and average 10 m to 30 m in thickness.

The member is 192 m thick, due south of Fabricius Fiord, and 173 m thick at the type section; it pinches out adjacent to the Central Borden Fault Zone (Figs. 3.10c to 3.10e).

3.4.2c $AB_{U(M)}$ Member

The $AB_{U(M)}$ member ($AB_{U(M:L)}$ and $AP_{(M:M)}$ submembers) consists entirely of coarsening-upward cycles similar to those observed in the $AB_{L(M)}$ member. Sedimentary structures and paleocurrent trends are also similar. The $AB_{U(M:L)}$ submember comprises alternating facies units of shale, intermixed shale-siltstone-sandstone, and sandstone. The sandstones are thin to medium bedded, fine- to very coarse-grained and include quartzarenite, subarkose, arkose and litharenite.

Minor layers and lenses of pebbly sandstone and quartz- and feldspar-pebble conglomerate also occur (Plate 3.5, Figs. 5 and 6). The shale content decreases upwards and is much less than was seen in the AB_L member. The numerous (up to 25) coarsening-upward cycles, which are sandstone-rich, are between 8 m and 20 m thick. In some areas adjacent to the White Bay Fault Zone, upper cycle members contain minor amounts of buff-grey to dark-grey dolostone, dolosiltite, stromatolitic dolostone and carbonate flat-clast conglomerate.

The $AB_{U(M:U)}$ submember consists of cyclically-arranged facies units of planar to wavy bedded intermixed shale-siltstone-sandstone and thin to thick-bedded, fine- to very coarse-grained subarkose, pebbly subarkose and quartz- to quartz- and feldspar-pebble conglomerate. The coarsening-upward cycles are sandstone-dominated and typically capped by a layer of conglomerate. The cycles total 7 in number and range from 21 m to more than 58 m thick. Pebbly sandstone and conglomerate increase upwards in amount.

The succession thickens greatly adjacent to the Central Borden Fault Zone. The member ranges in thickness from 150 m, 55 km east-southeast of the head of Fabricius Fiord, to 544 m at the type section and is 1038 m due south of the head of Fabricius Fiord (Figs. 3.10c and 3.10d).

3.4.3 Paquet Bay Assemblage (Southeast Facies Assemblage)

The Paquet Bay Assemblage comprises strata of the Upper Eqalulik Group preserved in the southeastern portions of the Milne Inlet and Eclipse Troughs. It includes the former Arctic Bay Formation southeast of Milne Inlet (Iannelli, 1979;

Jackson et. al., 1980, 1985; Jackson and Iannelli, 1981, 1989). The Paquet Bay Assemblage outcrops southeast of Eskimo Inlet and in the vicinity of Tay Sound and east and west Paquet Bay (in southeastern Milne Inlet Trough) and on northwestern Bylot Island (in southeastern Eclipse Trough; Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). It thickens to the southeast and near major fault zones. It ranges in thickness from about 544 m to 1300 m, adjacent to the White Bay Fault Zone (Figs. 3.10a and 3.10f). The suggested type section outcrops 6 km southwest of the head of west Paquet Bay (section13 in Fig. 3.10a; reference stations 81330 and 81344 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.12b, p. 278).

These rocks conformably overlie quartzarenites of the Adams Sound Formation and locally rest unconformably on basement gneiss. They grade laterally northwestwards into facies equivalent rocks of the Tremblay Sound Assemblage and grade upwards into stromatolitic and calciclastic carbonates of the $SC_{L(SE)}$ member of the Society Cliffs Formation (Figs. 3.10a and 3.10f).

The Paquet Bay Assemblage has been subdivided into lower ($AB_{L(SE)}$), middle ($AB_{M(SE)}$) and upper ($AB_{U(SE)}$) members.

3.4.3a $AB_{L(SE)}$ Member

The $AB_{L(SE)}$ member comprises alternating facies units of grey to black-grey, planar thin laminated shale, intermixed planar to wavy bedded shale-siltstone-quartzarenite, thin planar bedded to crossbedded buff-grey to white-grey quartzarenite and minor pebbly quartzarenite and subarkose. The units are arranged into small to

PLATE 3.6

Arctic Bay Formation - Paquet Bay Assemblage

Fig. 1: Mixed carbonate and siliciclastic, thickening-upward cycle from the middle part of the $AB_{U(SE)}$ member. Planar thick laminated calcilutite and calcisiltite pass upward into planar thin to medium bedded calcarenite, medium -grained to granular calcareous subarkose to sublitharenite and minor flat carbonate pebble conglomerate: northeast coast of Tay Sound about 6 km south of the White Bay Fault Zone.

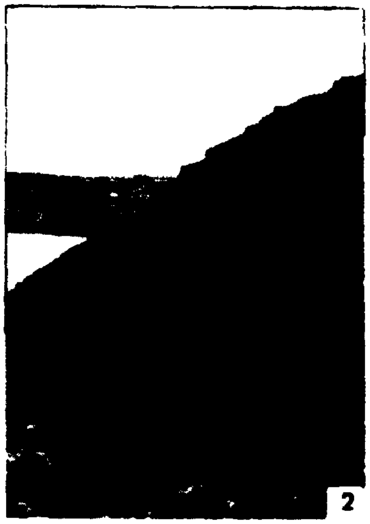
Fig. 2: Medium scale, sandstone-dominated coarsening-upward cycles in the lowermost part of the $AB_{U(SE:M)}$ member. The cycles consist of alternating facies units of thick laminated shale and interlayered thin bedded siltstone and quartzarenite, overlain by thin to medium bedded, planar layered to crossbedded quartzarenite and subarkose. The succession shown is about 7 m thick: 10 km north of the head of Paquet Bay, adjacent to the White Bay Fault Zone.

Fig. 3: Large scale teepee structure in thick laminated to thin bedded calcareous quartzarenite and dolarenite of the $AB_{U(SE:T)}$ member. Note disrupted layers in the core of the structure. The teepee is about 1 m in height: 8 km northwest of the head of west Paquet Bay.

Fig. 4: Poorly stratified coarse-grained to pebbly arkose comprising the upper member of an arkose-dominated coarsening-upward cycle in the $AB_{U(SE:M)}$ member, 11 km southeast of the end of Tay Sound, adjacent to the White Bay Fault Zone.

PLATE 3.6


1


2


3


4


5


6

PLATE 3.6

Arctic Bay Formation - Paquet Bay Assemblage

Fig. 5: Detail of planar thin laminated buff-grey dolosiltite, with well developed small scale teepee structures, underlain by fine- to medium-grained red-brown subarkose to sublitharenite with thin laminae, lenses and isolated flat clasts of buff dolosiltite. The strata are part of the $AB_{U(SE:T)}$ member, 20 km southeast of the end of Tay Sound, 4 km southwest of the White Bay Fault Zone.

Fig. 6: Bedding plane view of shrinkage cracks in blister mat stromatolitic dolostone. Shrinkage cracks are infilled with sand-bearing dolarenite. The orange-brown-weathering dolostone bed is interlayered with thin bedded sand-bearing dolarenite and calcareous sublitharenite. The beds occur in the mid portion of the $AB_{U(SE:T)}$ member, 5 km south of the White Bay Fault Zone, on the northwest coast of Tay Sound.

medium scale coarsening- and thickening-upward cycles, that are mainly sandstone-rich like those in the AB_L and $AB_{L(M)}$ members (Jackson and Iannelli, 1981, Fig. 16.13b, p. 278). Shale content increases upwards in the member. Sedimentary structures and paleocurrent trends are similar to those noted in the AB_L and $AB_{L(M)}$ members (Iannelli, 1979, Fig. 11.5, p. 50; Jackson et. al., 1980, Fig. 46.1, p.320, Fig. 46.3, p. 322).

The member thickens marginwards and to the southeast, increasing from 65 m at the type section, to an estimated maximum of 300 m adjacent to the White Bay Fault Zone (Figs. 3.10a and 3.10f).

3.4.3b $AB_{M(SE)}$ Member

The $AB_{M(SE)}$ member consists largely of planar thin laminated black to black-grey shale and closely resembles the middle member of the basinal assemblage. Carbonate content is generally higher and the member is much thinner than the AB_M member. The middle member is absent southeast of Tay Sound, in the southeastern part of the Milne Inlet Trough (Figs. 3.10a and 3.10f).

3.4.3c $AB_{U(SE)}$ Member

The $AB_{U(SE)}$ member ($AB_{U(SE:T)}$ and $AB_{U(SE:M)}$ submembers) consists of grey, grey-green to black planar thin laminated shale, green- to buff-grey planar to wavy layered, thick laminated to thin bedded intermixed shale, siltstone, sandstone, and calcarenite, and thin to medium bedded, grey, buff-brown to orange-brown quartzarenite, subarkose, pebbly sandstone, carbonate flat clast conglomerate, quartz-pebble conglomerate and calciclastic to stromatolitic carbonate (Plate 3.6). The strata are arranged into numerous small to medium scale, thickening- and coarsening-upward cycles. Shale content decreases upwards and towards the fault zones. Sandstone and conglomerate are more abundant in the upper part of the member, towards fault zones and in the southeastern part of Milne Inlet and Eclipse Troughs.

The $AB_{U(SE:T)}$ submember consists of small to medium thickening- and coarsening-upward cycles comprised of shale, overlain by interlayered calciclastic to stromatolitic carbonate and sandstone (Plate 3.6, Figs, 1, 3, 5 and 6). The cycles, which average 5 m to 25 m in thickness, contain a lower member of planar laminated shale, with minor thin lenses and laminae of siltstone, dolosiltite and dololutite. Middle cycle members consist of planar, lenticular to wavy bedded siltstone, sandstone dolarenite to dolosiltite, calcarenite to calcisiltite and minor layers of shale to dololutite. Upper cycle members are mainly stromatolitic to sandy dolostone, dolarenite, fine- to coarse-grained calcareous quartzarenite to subarkose and lenses and layers of carbonate flat pebble conglomerate (Jackson and Iannelli, 1981, Fig. 16.14b, p. 279; Plate 3.6, Fig. 1). Sedimentary structures include trough and planar crossbeds, wave and current ripple marks, teepee structures, load casts and soft-sediment folds. Elongate stromatolite mounds and bioherms are locally common; they comprise low domal, and simple to complex columnar stromatolites similar to those in the AB_U member.

The $AB_{U(SE:M)}$ submember consists of small to medium coarsening- and thickening-upward cycles comprised mainly of arkose, subarkose, pebbly sandstone and lesser amounts of calciclastic carbonate (Plate 3.6, Figs. 2 and 4). They are similar in thickness and style to those of the $AB_{U(SE:T)}$ submember, but contain more immature sandstone and shale and stromatolitic carbonate. The submember occurs adjacent to the White Bay Fault Zone and interfingers basinwards with the $AB_{U(SE:T)}$ submember and AB_{U} member (Figs. 3.10a and 3.10f).

3.5 Uluksan Group

The carbonate-dominated sequences, of the Uluksan Group, are exposed across a northeast-dipping outcrop belt, oriented along and north of the axis of the Milne Inlet Trough and stretching southeast from Arctic Bay to Tay Sound. They also occur on north Borden Peninsula and on north and northwest Bylot Island (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). In these areas, the Uluksan Group ranges from more than 760 m to 2650 m in thickness. The Society Cliffs and Victor Bay Formations thicken to the southeast; the Fabricius Fiord Formation thickens to the southwest and the south, towards fault margins (Figs. 2.2 to 2.5). Strata of the Uluksan Group are characterised by calciclastic and massive to stromatolitic carbonates in basinal settings (Society Cliffs and Victor Bay Formations) and by sandstone, pebbly sandstone, sandy dolostone and conglomerate beds in marginal and southeast trough settings (Fabricius Fiord Formation and the southeasterly facies assemblage of the Society Cliffs Formation).

Revisions similar to those outlined for the Upper Eqalulik Group can also be applied to the strata of the Lower Uluksan Group. The Lower Uluksan Group can be considered as consisting of three regional lithofacies assemblages (Table 2.5b; Figs. 2.2, 2.3 and 3.13):

(i). A northwestern facies assemblage in the northwest portions of the Milne Inlet, Eclipse and North Bylot Troughs and defined in this study as the northwest facies of the Society Cliffs Formation.

(ii). A southeastern facies assemblage in the southeastern portions of the Milne Inlet, Eclipse and North Bylot Troughs and defined as the southeast facies of the Society Cliffs Formation.

(iii). A marginal facies assemblage developed adjacent to major fault zones (the redefined Fabricius Fiord Formation).

The southeast facies assemblage of the Society Cliffs Formation consists of a complex association of siliciclastic, evaporitic and calciclastic to stromatolitic carbonate rocks that comprise a semi-restricted, proximal to distal shallow marine depositional complex (Tables 2.5b and 4.2).

The Fabricius Fiord Formation was originally defined by Blackadar (1965, 1970), who considered it to be equivalent to the Arctic Bay Formation. The former Fabricius Fiord Formation is here considered as two major lithofacies assemblages, each of formation rank. The lower portion is now defined as the marginal (Fabricius River) facies assemblage of the Arctic Bay Formation (Table 2.5a). The upper portion is a marginal facies equivalent of the Society Cliffs Formation (Table 2.5b). It is proposed that the term "Fabricius Fiord Formation" be restricted to that part of the original Fabricius Fiord sequence equivalent to the Society Cliffs Formation and composed of the FF_3 and FF_4 members of Iannelli (1979) and Jackson and Iannelli (1981).

3.6 Fabricius Fiord Formation

The Fabricius Fiord Formation comprises the marginal lithofacies assemblage of the Lower Uluksan Group. The succession, which is dominated by coarse sandstone and pebbly sandstone, is a marginal facies equivalent of the Society Cliffs Formation (Figs. 2.3, 2.4 and 3.13b). Sandstone, pebbly sandstone and conglomerate beds of the formation outcrop in south central Borden Peninsula, adjacent to the Central Borden Fault Zone, in the area stretching east-southeast from Fabricius Fiord to south of the Magda Icecap. Small outcrops also occur in the area northwest of the end of Tremblay Sound, adjacent to the White Bay Fault Zone, and in northwestern Eclipse Trough, along the Hartz Mountain Fault Zone (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The formation is more than 670 m thick at Fabricius Fiord. It increases to 1115 m, in the section exposed 15 km east-southeast of the head of Fabricius Fiord, and is over 760 m thick, about 30 km southwest of the Magda Icecap (Figs. 2.3 and 3.13b). Thickness trends outline a major fault margin-associated depocentre located in the area due east of Fabricius Fiord (Fig. 3.14). The suggested type section for the Fabricius Fiord Formation is 15 km east-southeast of the head of Fabricius Fiord. In this area the formation is well exposed and the section contains the thickest succession in the basin (section 11 in Fig.3.14b; Plate 3.7, Fig. 1; reference station 8I105 in Appendices I and II).

Massive to bedded sandstones, pebbly sandstones and conglomerates of the Fabricius Fiord Formation grade laterally basinwards into facies equivalent strata of the northwest facies assemblage of the Society Cliffs Formation. Strata of the Fabricius Fiord Formation appear to be overlain, locally, by massive dolostones thought to belong to the $SC_{U(NW)}$ member (Figs. 2.3 and 3.13b). Lenses and thin beds of similar dolostone also occur within the upper part of the formation in south-central Borden Peninsula, and may be transitional with the $SC_{U(NW)}$ member. The Fabricius Fiord Formation is generally downfaulted against basement gneiss. The strata unconformably overlie shale, carbonate and minor siltstone and sandstone beds of the basinal facies assemblage (Tremblay Sound Assemblage) of the Arctic Bay Formation, but appear to conformably overlie strata of the marginal facies assemblage (Fabricius River Assemblage) of the same formation (Figs. 3.10c and 3.lOd). Upper contact relationships were not observed.

The Fabricius Fiord Formation consists of two major members. The lower (FF_L) member comprises bedded to massive sandstone and pebbly sandstone intermixed with lesser amounts of conglomerate. Medium to large scale coarsening and fining-upward cycles are locally common. The strata grade upward into the FF_U (or upper) member. The upper member includes beds and lenses of calcareous sandstone, pebbly sandstone, sandy dolostone, stromatolitic dolostone and fault-associated conglomero-breccia (Fig. 3.13b; Table 2.5b).

3.6.1 FF_L Member

The resistant strata of the FF_L member consist of thick laminated to medium bedded and (less commonly) massive, brown-grey, buff-grey and light-grey to buff, fine- to very coarse-grained subarkose, pebbly subarkose, pebbly sublitharenite and minor layers and lenses of thin bedded to massive quartz-pebble and quartz- to feldspar - pebble conglomerate (Plate 3.7, Figs. 1 and 2). This unit is more than 670

PLATE 3.7

Fabricius Fiord Formation

Fig. 1: Planar to undulatory, medium to thick bedded buff-brown, very coarse-grained to granular subarkose of the FF_L member, 15 km southeast of the head of Fabricius Fiord. They form the basal portion of the Fabricius Fiord Formation type section (section 11 in Fig. 3.14b).

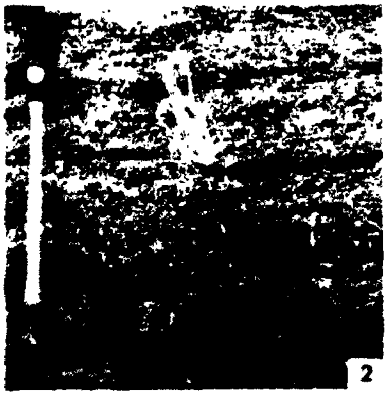
Fig. 2: Poorly bedded, planar to undulose layered, coarse-grained to pebbly, grey-green subarkose of the FF_L member exposed at station 81034. The strata outcrop about 50 km east-southeast of the head of Fabricius Fiord.

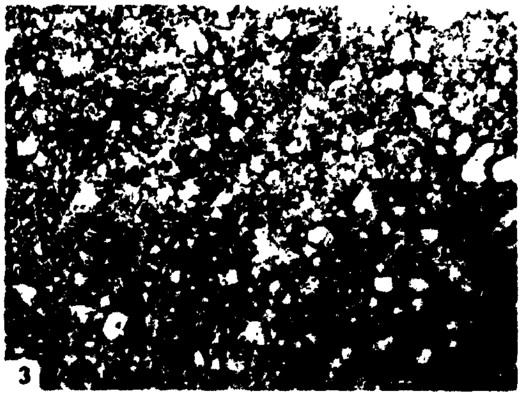
Fig. 3: Quartz-feldspar-gneiss pebble conglomero-breccia of the $FF_{U(l)}$ member in the upper part of the type section. These massive beds occur adjacent to the Central Borden Fault Zone. Location as for Fig. 1.

Fig. 4: Massive chocolate- to dark-brown-weathered, granular to pebbly calcareous arkose to litharenite, with isolated clasts of gritty to stromatolitic dolostone. The strata belong to the $FF_{U(l)}$ member and outcrop in the upper part of the type section.

PLATE 3.7


1


2


3


4


5


6

PLATE 3.7

Fabricius Fiord Formation

Fig. 5: Chocolate-brown weathered, coarse- to very coarse-grained arkose and arkosic conglomerate with lenses and thin beds of brown-weathered stromatolitic to gritty dolostone. The strata, which comprise part of the $FF_{U(2)}$ member, outcrop 16 km east-southeast of the head of Fabricius Fiord.

Fig. 6: Detailed view of chocolate-brown-weathered, coarse-grained to granular calcareous arkose intermixed with thrombolitic to gritty dolostone. The strata are part of the $FF_{U(2)}$ member and outcrop 40 km east-southeast of the head of Fabricius Fiord.

m thick at Fabricius Fiord. It thickens to 843 m at the type section and thins southeastwards to 460 m in the area 30 km southwest of the Magda Icecap (Figs. 2.3 and 3.13b).

In some areas the FF_L member consists solely of alternating units of planar bedded to massive sandstones and conglomerate. Elsewhere it comprises alternating planar bedded units, several tens of metres thick, and medium to large scale (5 - 30 m thick) coarsening- and fining-upward cycles. Fining-upward cycles are similar to, but thicker than, those observed in basal NA_L member beds (Fig. 3.4a). Coarsening-upward cycles comprise a lower unit of medium to thick-bedded, coarse-grained to pebbly subarkose that grades up into massive, pebbly subarkose and quartz-pebble conglomerate.

Rare sedimentary structures include medium to large scale trough and planar crossbeds (up to 1.5 m high) and some small to large scale wave and current ripple marks with wavelengths from 5 cm to more than 1 m. In the larger scale crossbeds, current-aligned quartz pebbles are present along some foreset and bottomset beds. Paleocurrents flowed to the north and west (Iannelli, 1979, Fig. 11.3, p. 48; Jackson et. al., 1980, Fig. 46.1, p. 320).

3.6.2 FF_U Member

The striking colours of the subarkose, arkose, stromatolitic to sand-bearing dolostone, pebbly sandstone beds and conglomero-breccia lenses of the FF_U member contrast sharply with the drab strata of the underlying FF_L member. Brown-weathering strata of the upper member outcrop adjacent to major fault zones in marginward-thickening wedges that are over 272 m thick at the type section and more than 300 m thick in the area 30 km southeast of the Magda Icecap (Figs. 2.3 and 3.13b). The FF_U member consists of at least three laterally and vertically intergradational lithofacies associations (Iannelli, 1979; Jackson and Iannelli, 1981) defined, in this study, as the $FF_{U(1)}$, $FF_{U(2)}$ and $FF_{U(3)}$ submembers. The $FF_{U(1)}$ submember comprises at least 65% of the upper member and consists largely of calcareous sandstone and pebbly sandstone. The $FF_{U(2)}$ and $FF_{U(3)}$ submembers are distributed randomly within the $FF_{U(1)}$ submember. The $FF_{U(2)}$ submember includes mainly stromatolitic and sand-rich dolostone beds and lenses. The massive $FF_{U(3)}$ submember consists of fault-marginal conglomero-breccia.

3.6.2a $FF_{U(1)}$ Submember

The $FF_{U(1)}$ submember consists mainly of brown-weathering thin to thick bedded, planar layered to massive, medium-grained to granular calcareous subarkose, arkose, litharenite and pebbly subarkose, with minor beds and lenses of polymictic conglomerate (Plate 3.7, Figs. 3 and 4). The conglomerates contain subrounded to angular clasts of quartz, feldspar, granite and gneiss. They increase in thickness and amount towards the fault margins (Iannelli, 1979). Dark steel-grey coatings, related to hematite and disseminated to massive galena gossans occur in several localities. Few sedimentary structures are present in the $FF_{U(1)}$ submember. They include some medium to large scale planar crossbeds, scours and channel-like structures. Rare, poorly defined coarsening-upward cycles occur in some parts of the $FF_{U(1)}$ sequence. They range from 20 m to more than 35 m in thickness and comprise basal units of thin bedded, medium- to coarse-grained sandstone that grade upward into thin to medium bedded coarse-grained to pebbly sandstone capped by intermixed pebbly sandstone and layers and lenses of massive conglomerate.

3.6.2b $FF_{U(2)}$ Submember

The $FF_{U(2)}$ submember consists of chocolate- to orange-brown-weathering, thick laminated to medium bedded dolostone, sandy dolosiltite, massive dolostone and stromatolitic dolostone with rare thrombolitic dolostone (Plate 3.7, Figs. 5 and 6). Minor layers and lenses of flat carbonate clast conglomerate and coarse-grained to pebbly subarkose and sublitharenite are also present. The carbonate layers and lenses are generally between 0.5 m and 5 m in thickness. The dolostones include quartz and feldspar grains ranging from coarse sand to pebble size. They comprise less than 5% to about 25% of the rock. The sandy dolostones resemble those in the $SC_{L(TR)}$ member (Table 2.5b).

Lenses and layers of flat carbonate pebble conglomerate are typically associated with stromatolite mounds and small bioherms. The mounds, some of which are elongate, consist of domal to columnar stromatolites that range in height from 5 cm to 20 cm. They resemble mounds in the $SC_{U(NW)}$ member. The domes and columnar stromatolites are found in situ and also overturned and incorporated as clasts in the conglomerate layers (Plate 3.7, figs. 4 and 5).

A few measurements from the axes of elongate stromatolite mounds suggest northwest - southeast-directed paleocurrents (Jackson et. al., 1980, Fig. 46.2, p. 322).

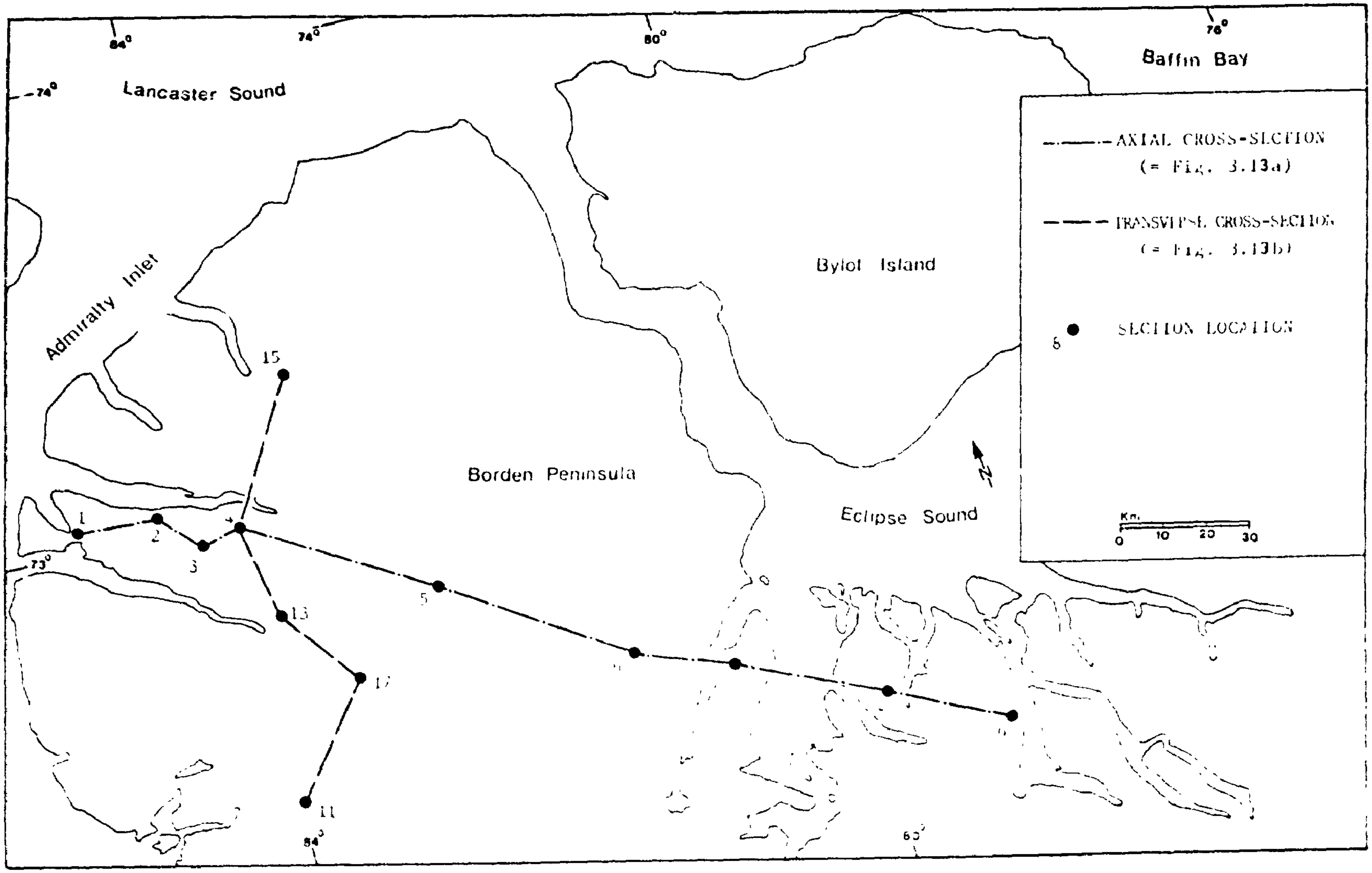
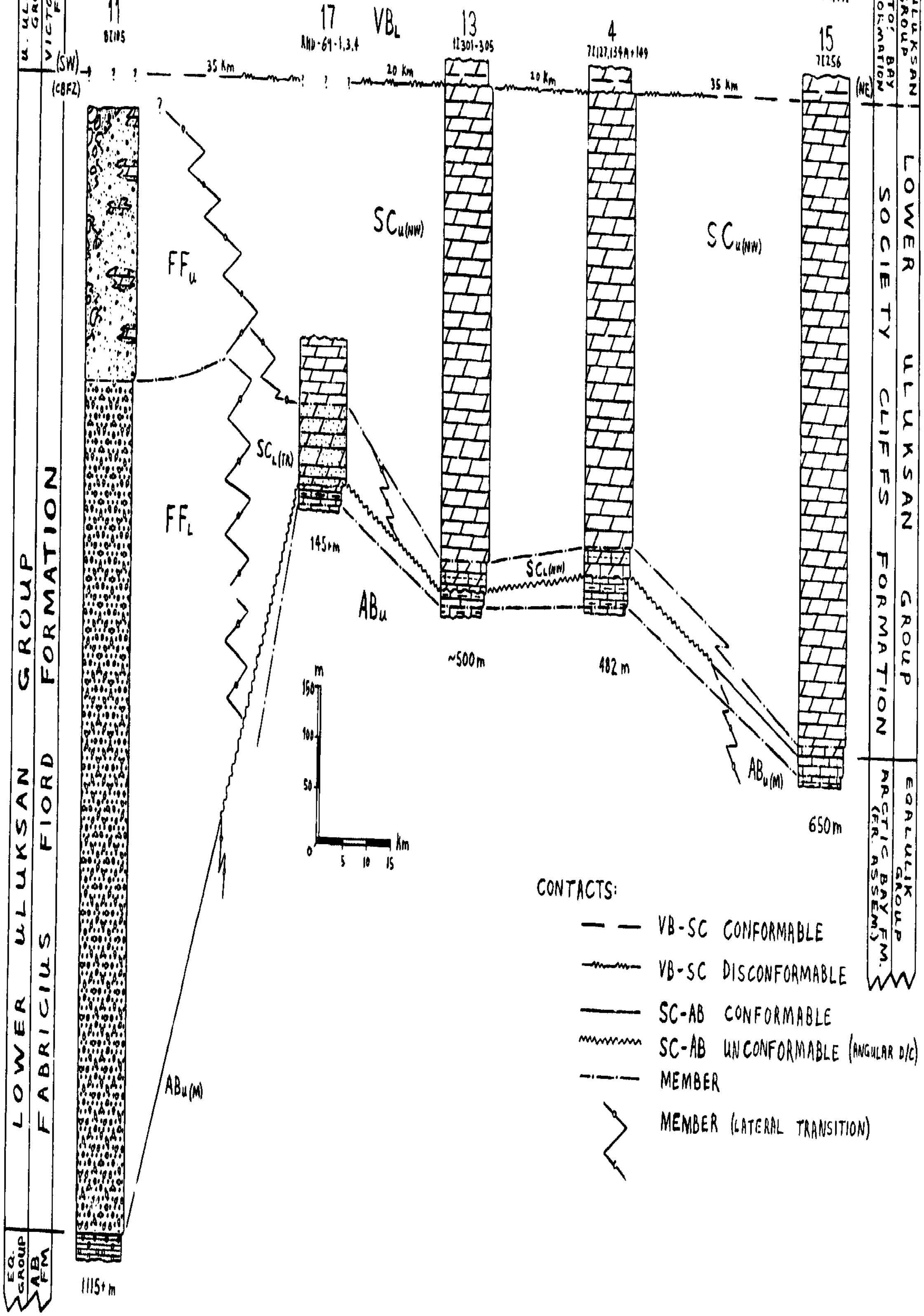


Fig. 3.12: Location map for regional cross-sections of the Fabricius Fiord and Society Cliffs for all Fms.

FIG. 3.13b:

LOWER ULUKSAN GROUP: TRANSVERSE (NE↔SW), CROSS-SECTION, MILNE INLET TROUGH.



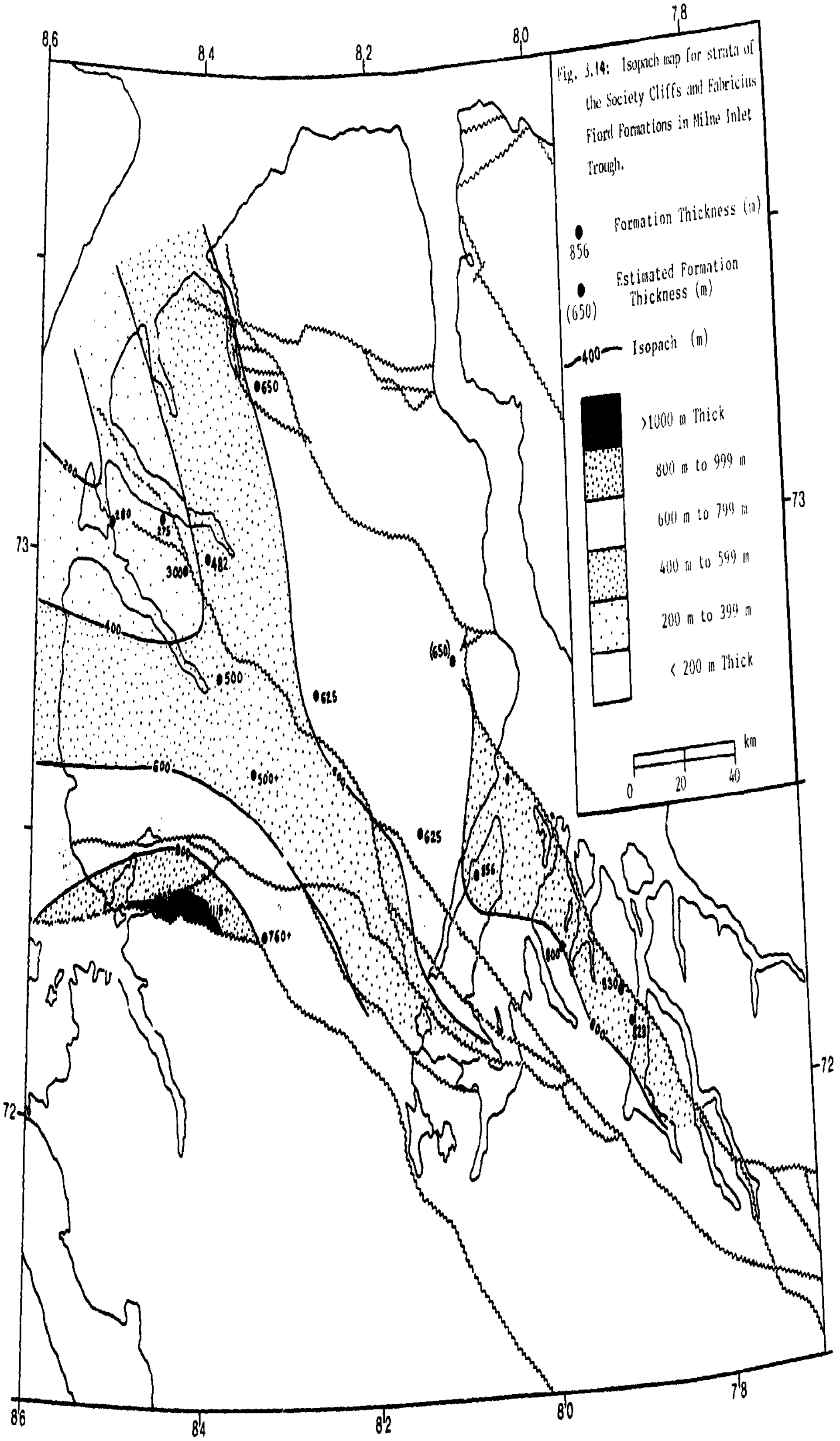


Fig. 3.14: Isopach map for strata of the Society Cliffs and Fabricius Fiord Formations in Milne Inlet Trough.

3.6.2c $FF_{U(3)}$ Submember

The massive, structureless rocks of the $FF_{U(3)}$ submember comprise fault-associated, marginwards-thickening wedges or aprons of chocolate-brown- to pink-brown-weathering conglomero-breccia. This distinctive rock type consists of subangular to angular pebbles to boulders of quartz, granite and gneiss set in a dolostone to dolosiltite matrix. The dolomitic matrix comprises up to 40% of the conglomero-breccia and contains coarse sand-sized grains of quartz and feldspar, and scattered flakes of biotite (Iannelli, 1979). Gneiss and granite clasts are bigger and more abundant in the vicinity of the faults.

Individual conglomero-breccia bodies are at least 5 m thick. They thin rapidly away from the fault margins and are absent from successions more than 0.5 km away from the Central Borden Fault Zone (Iannelli, 1979; Jackson and Iannelli, 1981).

3.7 Society Cliffs Formation

The Society Cliffs Formation represents the basinal lithofacies of the Lower Uluksan Group. The dolostone-dominated formation can be regionally divided into northwestern and southeastern facies assemblages based on the southeastwards increase in the amount of siltstone, sandstone and evaporite beds (Figs. 2.2 to 2.5 and 3.13a; Table 2.5b). Carbonates of the Society Cliffs Formation outcrop in a northwest-southeast - trending axial belt across Borden Peninsula, on north Borden Peninsula, north and northwest Bylot Island, and in the area of White Bay, Tay Sound and Paquet Bay in southeastern Milne Inlet Trough (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). In Milne Trough the formation thickens to the southeast, from 280 m, in the vicinity of Arctic Bay, to 856 m on Tremblay Sound and 823 m southeast of Milne Inlet (Fig. 3.13a). In Eclipse Trough it is about 500 m thick, in the northwest, and 600 m thick, in the southeast (Fig. 2.5). Thickness variations in Milne Inlet Trough indicate the occurrence of major depocentres to the southeast and near major fault zones (Fig. 3.14).

The Society Cliffs Formation unconformably to gradationally overlies shale, carbonate and siliciclastic beds of the AB_U and $AB_{U(SE)}$ members of the Arctic Bay Formation (Plate 3.8, Fig.2 and 3). Contact relationships with the overlying Victor Bay Formation are sharply conformable, gradational or disconformable (karsted). As noted in the previous section, the Society Cliffs Formation grades laterally (marginwards in northwestern Milne Inlet and Eclipse Troughs) into calcareous sandstones and conglomerates of the Fabricius Fiord Formation (Fig. 3.13b).

Stromatolites are common. The most abundant types include laterally-linked hemispheroids, low domal and bun-shaped forms, and simple non-branching columns that pass upwards into expanding-upward and complex columnar branching forms. Some columnar types resemble Conophyton and Baicaila (Jackson and Iannelli, 1981). The stromatolites commonly comprise small, elongate mounds with dimensions similar to those in the AB_U member. Large scale bioherms occur in several areas from Tremblay Sound northwest to Nanisivik. Over these areas, bioherms 30 m 60 m in diameter and 8 m to 20 m high are present, mainly in the middle to upper part of the formation (Jackson and Iannelli, 1981, 1989). A diverse assemblage of coccoid and filamentous microfossils are preserved in the Society Cliffs carbonates (Hofmann and Jackson, 1991). The microfossils occur at several stratigraphic horizons, in 14 localities across the basin, preserved in black chert nodules and layers, replacing stromatolitic dolostone.

Sedimentary structures, in the carbonate beds, include synaeresis and desiccation cracks, teepee and molar tooth structures, soft-sediment folds and microfaults. Sandstone beds include small scale trough crossbeds, current and wave ripple marks and small flute casts. Paleocurrent trends, from stromatolite mound elongations, are northeast - southwest directed (Table 2.8; Jackson *et*. *al*., 1980, Fig. 46.2, p. 322).

Mineral occurrences in the Borden Basin have been discussed by Blackadar (1970), Geldsetzer (1973a) and examined in detail by Olson (1977, 1984). The only known major mineralization occurs in the Society Cliffs Formation and, to a lesser extent, in the Victor Bay Formation. Mississippi Valley type lead-zinc, and associated massive pyrite deposits, occupy a paleocave system (karst developed) in dolostones of the Society Cliffs Formation in the area of Nanisivik (Olson, 1977, 1984; Jackson and Sangster, 1987; Clayton and Thorpe, 1982). Lead-zinc and related pyrite showings occur sporadically throughout the entire Society Cliffs outcrop belt from Nanisivik southeast to the area of Magda Icecap, but nowhere is mineralization as extensive as at Nanisivik (Jackson and Sangster, 1987). Pods of hematite also occur in the carbonates of the Society Cliffs Formation, in the Nanisivik - Strathcona Sound area. Olson (1977, 1984) suggested that these deposits are spatially related to the sphalerite-galena-pyrite ores. Jackson and Iannelli (1981) considered ore emplacement to have occurred during the karsting and erosional interval post-dating deposition of the Upper Elwin Formation and preceding intrusion of the Franklin dyke swarm.

3.7.1 Northwest Facies Assemblage

The Northwest Facies Assemblage comprises all strata of the Society Cliffs Formation present in the northwestern portions of Milne Inlet and Eclipse Troughs (Figs. 2.5 and 3.13a). The assemblage has been subdivided into lower ($SC_{L(NW)}$) and upper ($SC_{U(NW)}$) members. The suggested type section is on the east coast of Tremblay Sound, 12 km northeast of the Alfa River delta (section 7 in Fig. 3.13a; reference stations 9J016 to 9J029 in Appendices I and II; Plate 3.8, Fig. 1).

3.7.1a $SC_{L(NW)}$ Member

The $SC_{L(NW)}$ member consists of interlayers of light- to dark-grey, thin laminated to thin bedded dololutite, dolosiltite, dolarenite and stromatolitic dolostone (Plate 3.8, Figs. 1 and 2). Minor layers and lenses of shale, quartzarenite and flat carbonate pebble conglomerate also occur. In the area of Tremblay Sound, small to large scale stromatolitic mounds and bioherms and small to medium scale shallowing - upward cycles are present. The cycles are up to 30 m thick and consist of a lower member of interlayered dololutite, dolosiltite, minor shale and sandstone, overlain by a unit of stromatolitic dolostone and flat carbonate pebble conglomerate, and minor dolosiltite to dolarenite (Jackson and Iannelli, 1981, Fig. 16.18a, p. 283).

The $SC_{L(NW)}$ member is locally absent in northwestern Milne Inlet Trough, and absent across all of northwestern Eclipse Trough (Figs. 2.5 and 3.13a). It is 10 m thick at Arctic Bay, and increases southeastwards to a maximum of 150 m at the type section (Fig. 3.13a).

PLATE 3.8

Society Cliffs Formation - Northwest Assemblage

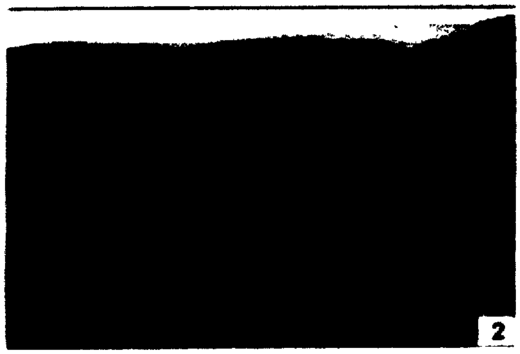
Fig. 1: Cyclic carbonate succession exposed along the west coast of Milne Inlet. The 600 m- high cliffs consist of dolostone of the $SC_{U(NW)}$ member. The sequence is underlain, in the foreground, by about 100 m of $SC_{L(NW)}$ member strata (largely covered by talus.

Fig. 2: The $AB_{U(M)}$ member, overlain by calciclastic to stromatolitic dolostones of the $SC_{L(NW)}$ member near the Tikerakdjuak Fault Zone, 15 km northwest of the Alfa River delta. The illustrated succession is about 120 m thick.

Fig. 3: Light grey brecciated (karsted), hematite-stained massive to stromatolitic dolostone of the $SC_{U(NW)}$ member overlying the black shale dominated AB_M and $AB_{U(L)}$ members of the Arctic Bay Formation. The contact is an angular disconformity with relief of up to 15 m. The strata are disrupted by numerous small scale faults. These outcrops are 25 km southeast of Nanisivik.

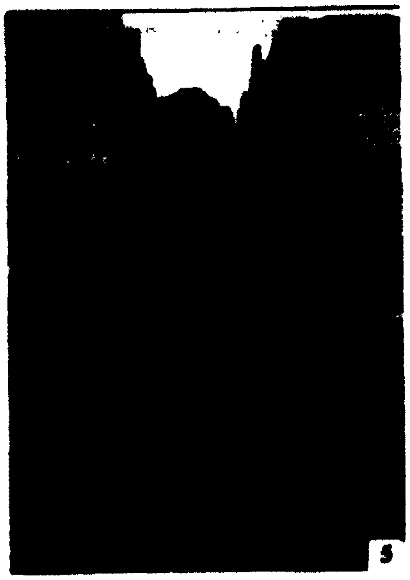
PLATE 3.8


1


2


3


4


5

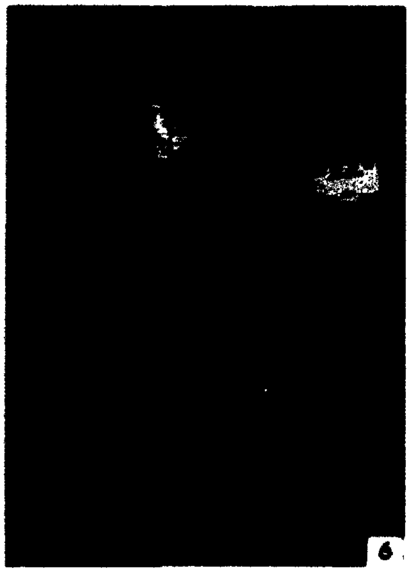

6

PLATE 3.8

Society Cliffs Formation - Northwest Assemblage

Fig. 4: Thin to thick laminated dolostone in the lowermost part of the $SC_{U(NW)}$ member, 45 km northwest of the Alfa River delta.

Fig. 5: Detail of cycles as shown in Fig. 1. The cliffs consist of dark-grey to grey-brown dololutite and dolosiltite and units of buff-grey to light-grey stromatolitic dolostone, dolosiltite and carbonate flat pebble conglomerate. Goethite-bearing horizons, in the dolostone beds, are the source of the prominent surface stains on the cliff face. The cycles are 10 m to 20 m thick.

Fig. 6: Thin to thick laminated dolostone (cryptalgal laminite) in the lowermost part of the $SC_{U(NW)}$ member at Arctic Bay.

3.7.1b $SC_{U(NW)}$ Member

The $SC_{U(NW)}$ member consists mainly of light-grey to buff-grey dolostone and minor layers and lenses of carbonate clast conglomerate and breccia (Plate 3.8, Figs. 1 and 3 to 6). The strata locally contain significant concentrations of sulphide mineralization (Nanisivik area).

The dolostones include thick bedded to massive units that typically have internal, indistinct thin lamination to thin beds. Most of the carbonates comprise planar to undulose, thin to thick laminated dolostone (cryptagal laminite), dololutite and dolosiltite (Plate 3.8, Figs. 5 and 6). The dolostones commonly contain small stromatolitic mounds and, locally, medium to large scale bioherms. In central Milne Inlet Trough the strata are arranged into 10 m to 20 m thick shallowing-upward cycles (Plate 3.8, Figs. 1 and 5). The dolostone beds typically contain small vugs and emit a petroliferous odour.

Carbonate conglomerates consist of flat to round dolostone pebbles set in a matrix of dolosiltite. Clasts include stromatolitic dolostone, dolosiltite and dololutite. Conglomerates occur throughout the member, locally in beds up to 10 m thick.

Dolostone clast breccias are abundant in western Borden Peninsula and, in the area of Nanisivik, comprise a large portion of the formation. The breccias decrease in amount southeastwards in Milne Inlet and Eclipse Troughs. They comprise angular stromatolitic dolostone and dolosiltite clasts set in a dolosiltite to calcite - dolomite matrix, and are related to karstification and solution collapse. The breccias occur as lenses, wedges and channel and paleocave infill (Jackson et. al., 1978a, Fig. 5, p. 7).

The $SC_{U(NW)}$ member thickens to the southeast, in Milne Inlet Trough, increasing from 273 m at Arctic Bay to 706 m at the type section (Fig. 3.13a). It makes up the entire formation in northwestern Eclipse Trough, where it is about 500 m thick (Fig. 2.4).

The Northwest Facies Assemblage locally contains a transitional ($SC_{L(TR)}$) member that comprises buff- to grey-brown, massive to thin bedded sandy dolostone and stromatolitic dolostone. The sequence is transitional between the marginal deposits of the Fabricius Fiord Formation and basinal deposits of the Society Cliffs Formation. It is best preserved in south-central Borden Peninsula (Figs. 2.4 and 3.13b).

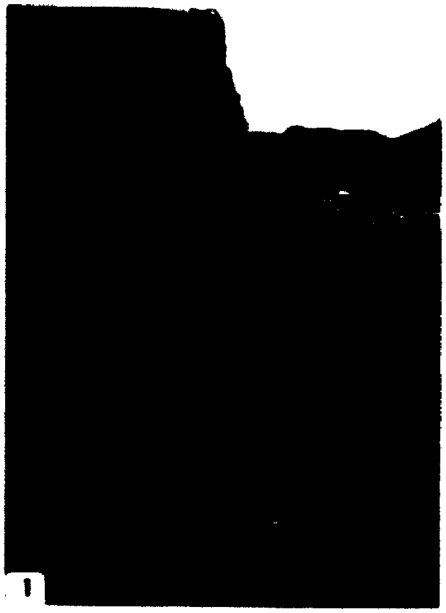
3.7.2 Southeast Facies Assemblage

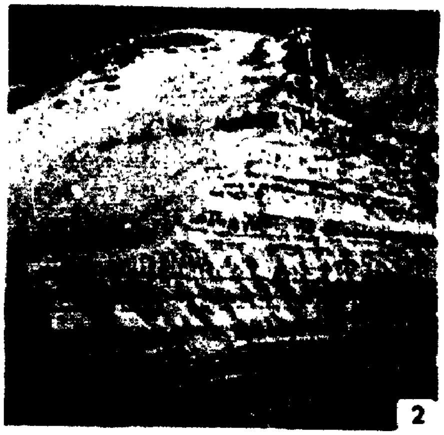
The Southeast Facies Assemblage includes strata of the Society Cliffs Formation in southeastern Milne Inlet Troughs (southeast of Milne Inlet), Eclipse Trough (Society Cliffs strata on northwestern Bylot Island) and North Bylot Trough (Figs. 2.5 and 3.13a). The assemblage has been subdivided into lower ($SC_{L(SE)}$) and upper ($SC_{U(SE)}$) members. The suggested type section outcrops at Rainbow Cliffs along the west coast of Tay Sound, 3 km south of the White Bay Fault Zone (section 9 in Fig. 3.13a; reference station 81256 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.17b, p. 282).

3.7.2a $SC_{L(SE)}$ Member

Strata of the $SC_{L(SE)}$ member consist of intermixed grey- to buff-grey to buff stromatolitic dolostone, stromatolitic limestone; pink-grey to red shale, siltstone,

PLATE 3.9


1


2


3


4


5


6

PLATE 3.9

Society Cliffs Formation - Southeast Assemblage

Fig. 4: Detail of light-grey, thick laminated to thin bedded dolosiltite with minor layers of pink-red to dark-grey dolosiltite and lenses of red chert. The sequence is about 2 m thick and occurs in the mid portion of the $SC_{U(SE)}$ member 15 km northeast of Canada Point on northwestern Bylot Island.

Fig. 5: Detail of alternating planar laminated to folded white gypsum and grey to black, thin laminated to thin bedded dolosiltite and dololutite. The beds occur in the lower part of the $SC_{L(SE)}$ member, 16 km northeast of Canada Point.

Fig. 6: Thick unit of columnar stromatolitic dolostone (middle of photo), underlain and overlain by intermixed planar, wavy to folded layers of white to grey-white gypsum and grey to black, thin laminated to thin bedded dololutite and dolosiltite. The beds occur in the lower part of the $SC_{L(SE)}$ member, location as in Fig. 5.

PLATE 3.9

Society Cliffs Formation - Southeast Assemblage

Fig. 4: Detail of light-grey, thick laminated to thin bedded dolosiltite with minor layers of pink-red to dark-grey dolosiltite and lenses of red chert. The sequence is about 2 m thick and occurs in the mid portion of the $SC_{U(SE)}$ member 15 km northeast of Canada Point on northwestern Bylot Island.

Fig. 5: Detail of alternating planar laminated to folded white gypsum and grey to black, thin laminated to thin bedded dolosiltite and dololutite. The beds occur in the lower part of the $SC_{L(SE)}$ member, 16 km northeast of Canada Point.

Fig. 6: Thick unit of columnar stromatolitic dolostone (middle of photo), underlain and overlain by intermixed planar, wavy to folded layers of white to grey-white gypsum and grey to black, thin laminated to thin bedded dololutite and dolosiltite. The beds occur in the lower part of the $SC_{L(SE)}$ member, location as in Fig. 5.

subarkose, dolosiltite, dolarenite, and pink, grey to white gypsum (Plate 3.9, Figs. 1,2,5 and 6). Minor lithologies include flat carbonate pebble conglomerate, grey, black and red chert, and sublitharenite. Adjacent to the White Bay Fault Zone, $SC_{L(SE)}$ member sequences also contain minor interlayers of calcareous arkose and polymictic conglomerate. Gypsum makes up as much as 25% of the member in southeastern Eclipse and North Bylot Troughs, where beds up to 3 m thick occur (Jackson and Iannelli, 1981).

Sedimentary structures include small trough crossbeds and current ripple marks, soft-sediment folds and slumps and teepee structures. Small elongate stromatolite mounds are locally common, as are small medium scale mixed redbed and carbonate, thickening-upward cycles (Plate 3.9, Fig. 1; Jackson and Iannelli, 1981, Fig. 16.18b, p. 283).

The member thickens to the southeast, in Milne Inlet Trough, reaching a maximum of 475 m at the type section (Fig. 3.13a).

3.7.2b $SC_{U(SE)}$ Member

The $SC_{U(SE)}$ member, in southeast Milne Inlet Trough, consists of grey, brown- to buff-grey, planar to undulose layered, thin laminated to thin bedded dolostone, dolosiltite, stromatolitic dolostone and minor intermixed grey to red shale, dolosiltite and dolarenite to calcareous litharenite. The $SC_{U(SE)}$ member, in southeast Eclipse Trough, comprises interlayered grey, buff to grey-white dolostone, dolosiltite, stromatolitic to gypsiferous dolostone, grey to white thin laminated to thin bedded gypsum and red dolosiltite (Plate 3.9, Figs. 2 and 4). Minor beds and lenses of dololutite, grey to red chert (Plate 3.9, Fig.4) and carbonate flat pebble conglomerate also occur.

The member is 343 m thick in southeast Milne Inlet Trough at the type section (Fig. 3.13a).

3.8 Victor Bay Formation

The carbonate-dominated successions of the Victor Bay Formation occur in an outcrop belt that extends southeastwards from Arctic Bay to the west coast of Tay Sound. These strata are also present in the vicinity of Elwin Inlet and the Elwin Icecap, along the Mala River valley and on north and northwestern Bylot Island (Fig. 1.1, Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The formation thickens greatly to the southeast in the Milne Inlet Trough. Thickness trends outline a major depocentre to the southeast, in the vicinity of White Bay (Fig. 3.17). The succession thickens rapidly southeastwards from 160 m at Arctic Bay, to about 600 m in central Borden Peninsula and 730 m in the vicinity of White Bay, southeast of Milne Inlet (Fig. 3.16a). The section at White Bay is the suggested type section; it is complete and well exposed and is the only section to contain all three Victor Bay members in one sequence (section 8 in Fig. 3.16a; reference stations 9J11O to 130 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.19b, p. 284). The strata of the Victor Bay Formation cannot be differentiated from those of the Society Cliffs Formation throughout much of northwestern Milne Inlet and Eclipse Troughs. In these areas the Victor Bay succession makes up at least half of the Uluksan sequence and is 500 m thick (Figs. 2.5 and 3.16b).

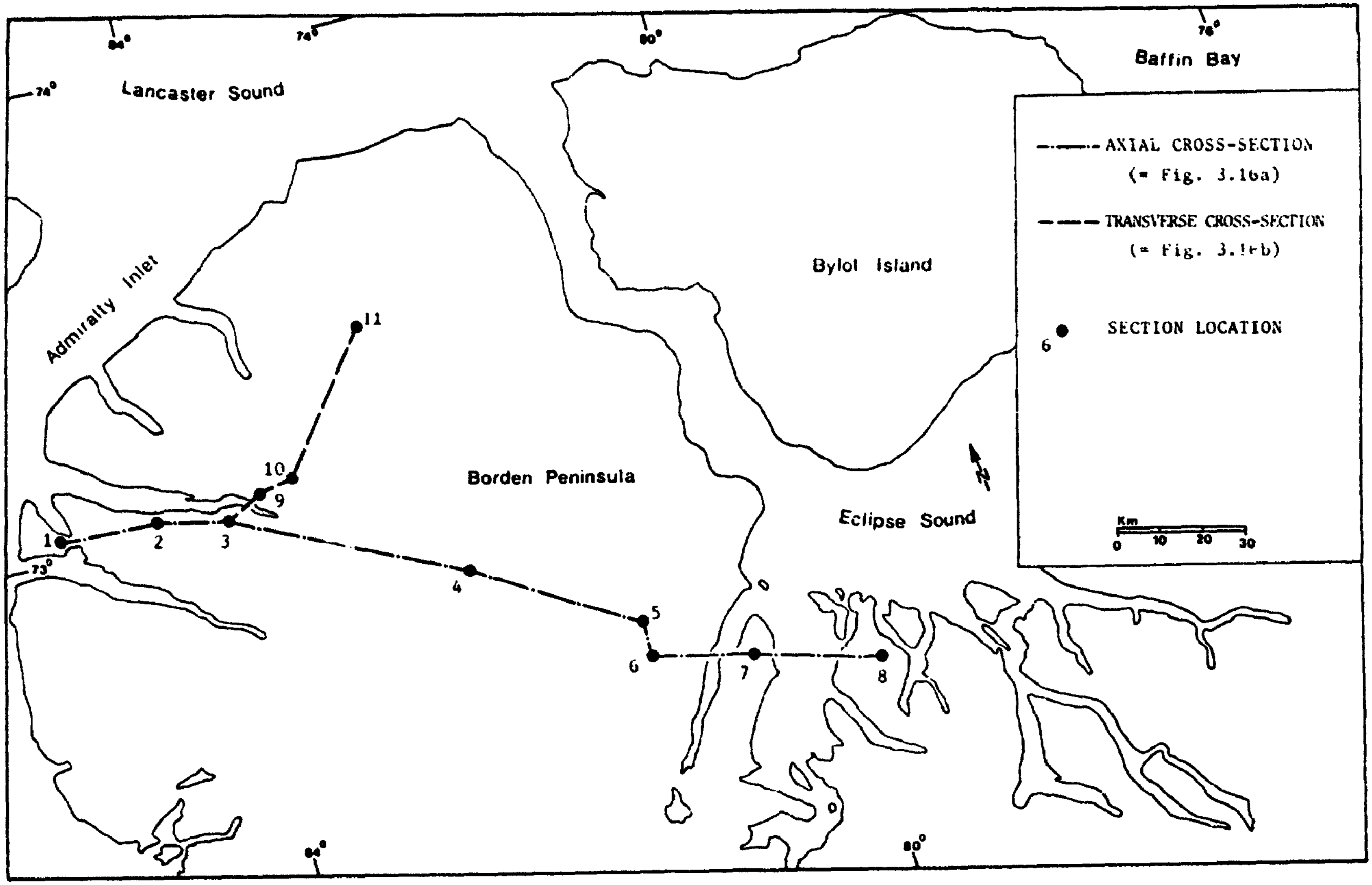


Fig. 3.15: Location map for regional cross-sections of the Victor Bay Formation.

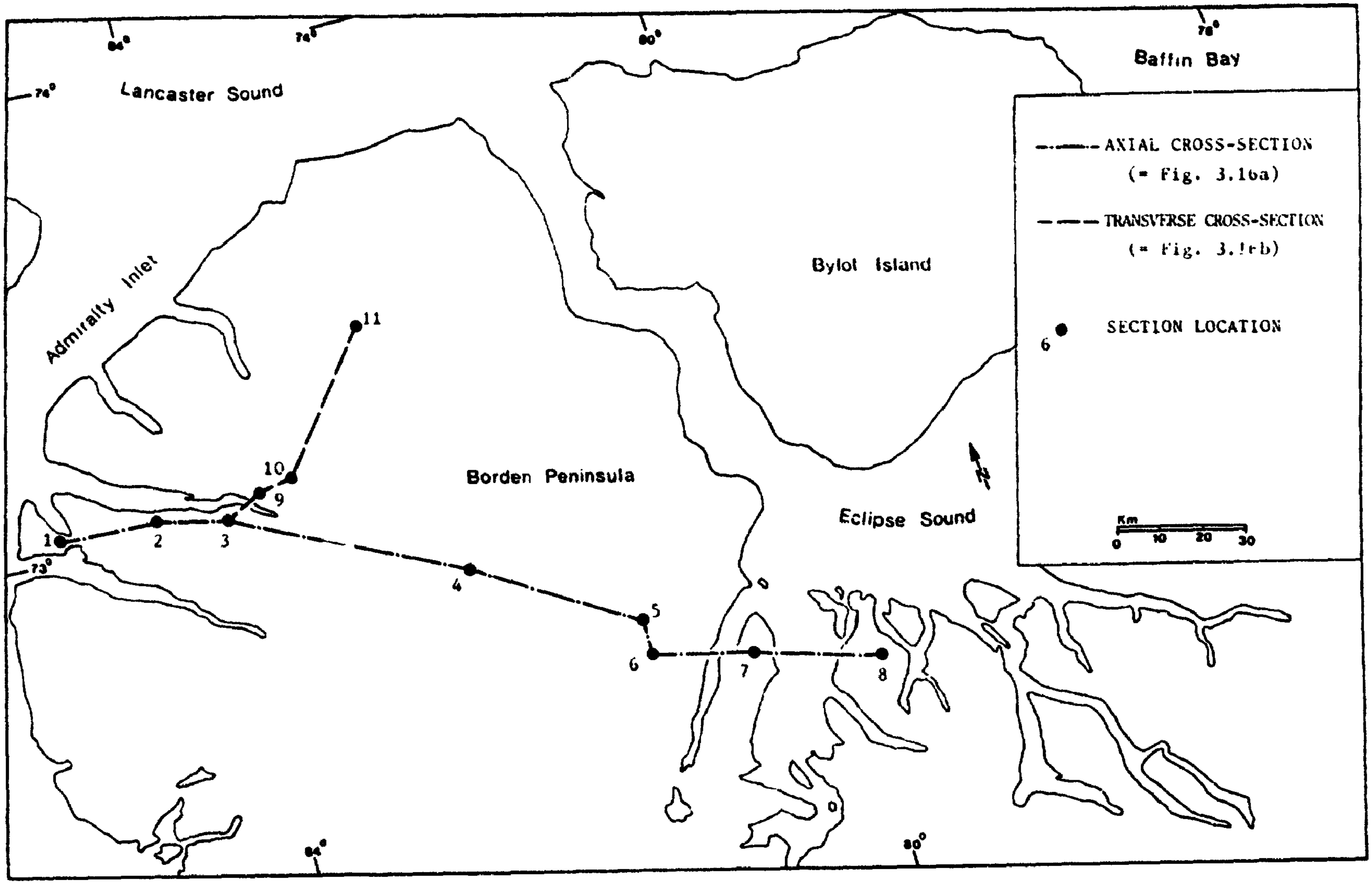


Fig. 3.15: Location map for regional cross-sections of the Victor Bay Formation.

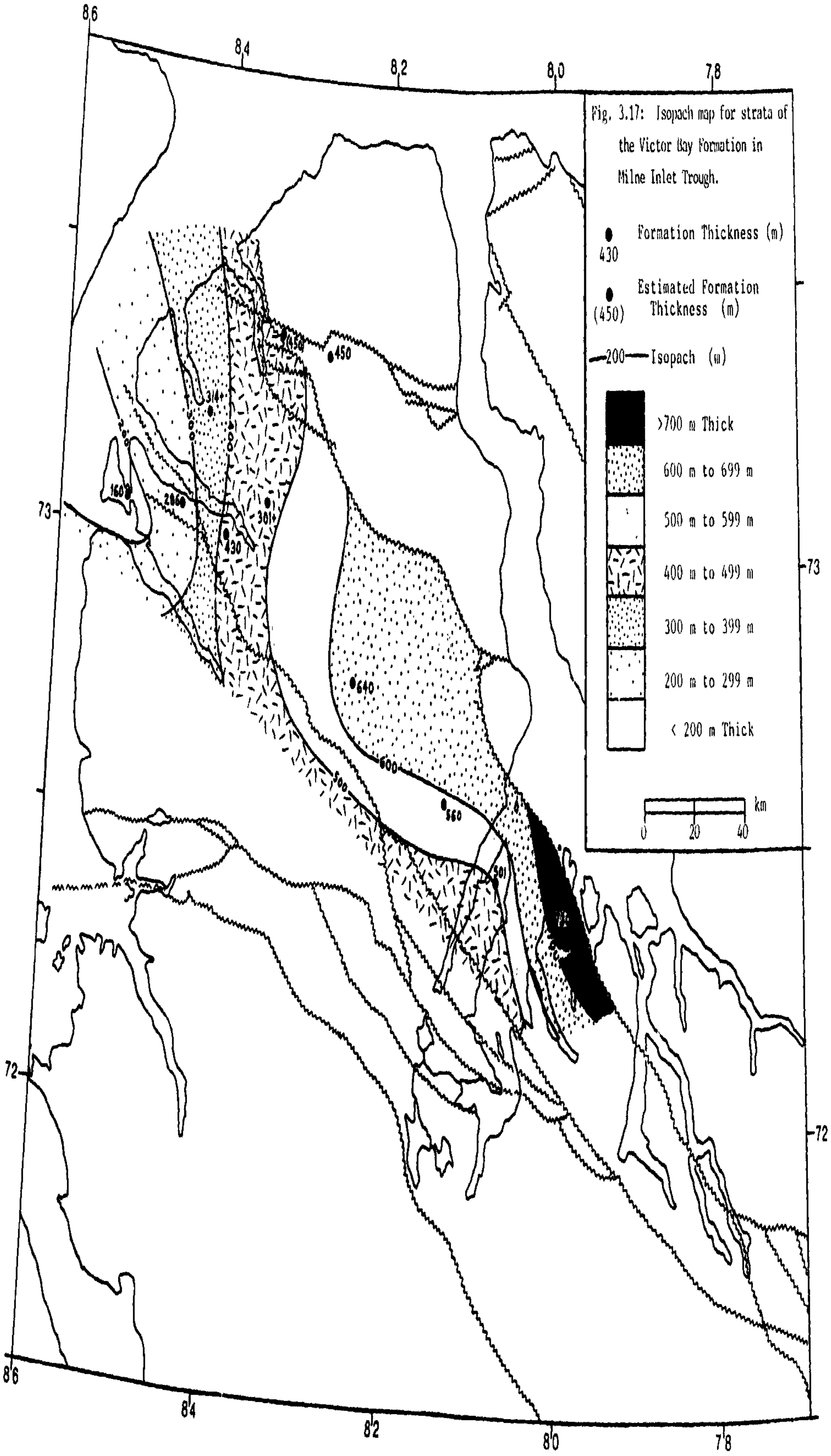


Fig. 3.17: Isopach map for strata of the Victor Bay Formation in Milne Inlet Trough.

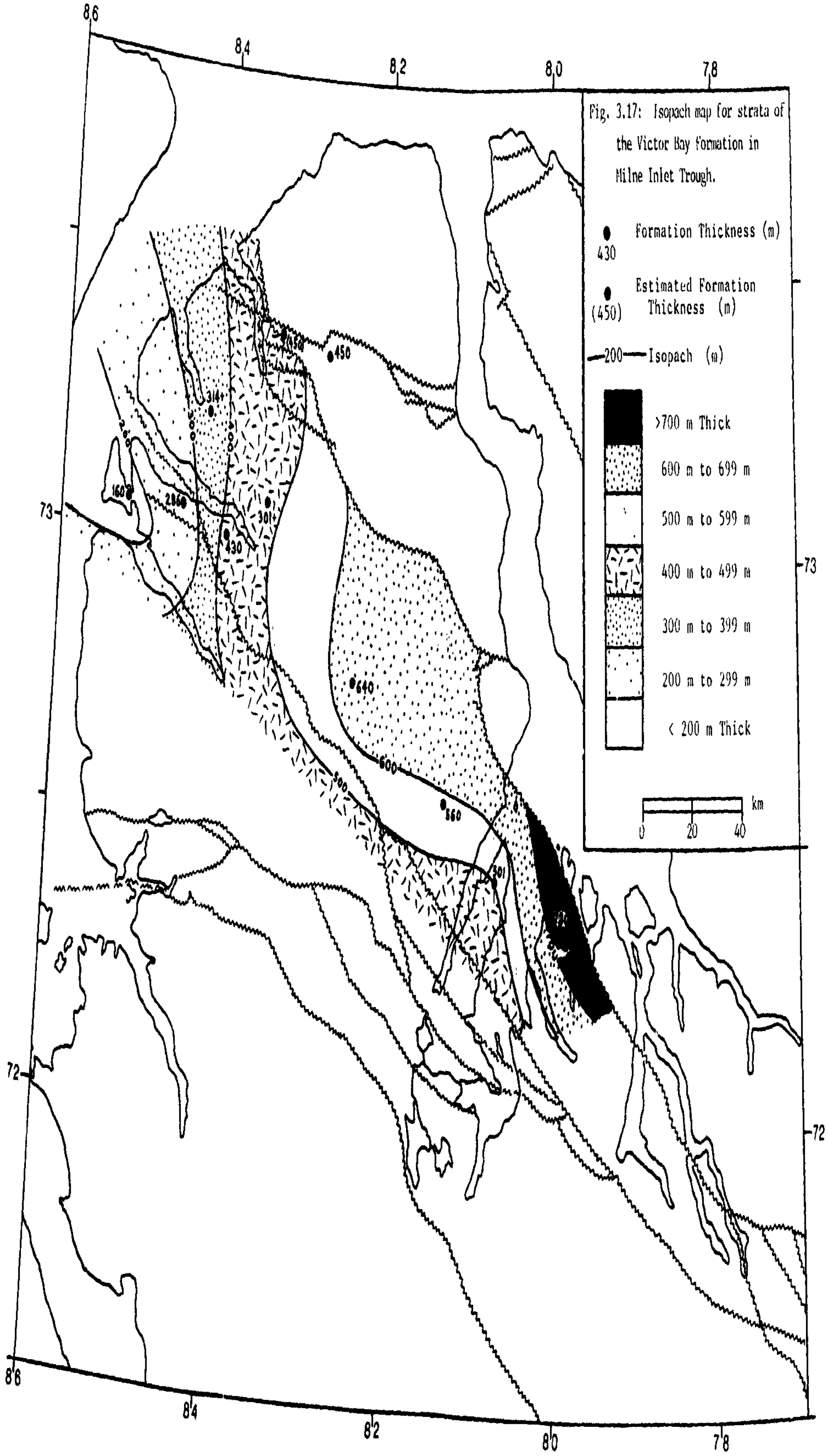


Fig. 3.17: Isopach map for strata of the Victor Bay Formation in Milne Inlet Trough.

CP_L member is a regional unconformity (Fig. 3.19d), and is generally marked by the occurrence of a distinctive carbonate-clast, pink-buff weathering conglomero-breccia (Plate 3.16, Fig. 3).

The Victor Bay Formation, south of the White Bay Fault Zone in Milne Inlet Trough, can be subdivided into three intergradational members. The lower (VB_L) member consists of interbedded shale, carbonate and minor flat carbonate clast conglomerate. The gradationally overlying strata of the upper part of the formation can be divided into the $VB_{U(L)}$ and $VB_{U(U)}$ members. They comprise calciclastic to stromatolitic carbonate, massive dolostone and limestone, carbonate flat and round clast conglomerate and minor dark-grey to black shale. The shale and argillaceous carbonate content of the formation decrease to the north and northwest, and the VB_L member is absent north of the White Bay Fault Zone on north Borden Peninsula and on Bylot Island (Figs. 2.5 and 3.16). In these areas, the carbonates of the VB_U member constitute the entire formation and cannot be readily separated from similar carbonate strata of the Society Cliffs Formation.

3.8.1 VB_L Member

The shale-dominated VB_L member forms a thick lens in the Milne Inlet Trough. The strata thicken southwestwards away from the White Bay Fault Zone into the central part of the trough (Fig. 3.16). These strata are only 30 m thick at Arctic Bay but thicken to about 370 m in central Borden Peninsula, and then thin to only 30 m in the vicinity of White Bay (Fig. 3.16a). The VB_L member thins out and is absent in northwestern Milne Inlet Trough and across all of Eclipse Trough (Figs. 2.5 and

3.16).

The member consists mainly of dark-grey to black, planar thin to thick laminated shale, dolomitic shale, argillaceous dololutite and planar thick laminated to thin bedded dolosiltite and fine-grained dololutite. Minor interlayers of nodular dolosiltite, thick laminated to thin bedded calcarenite, dolorudite and carbonate flat pebble conglomerate also occur (Plate 3.10, Figs. 1 to 4). The non-shale beds are 5 cm to 50 cm thick, comprising 30% to 60% of the unit. Rare beds and lenses of fine- to coarse-grained arkose and litharenite occur adjacent to the White Bay Fault Zone.

Planar laminated black shale occurs in units which range from less than 0.5 m to 5 m thick. The shales are locally graphitic and pyritiferous. The latter rocks comprise thin, very fine-grained laminae of pyrite intermixed with the black shale laminae. Black shale units alternate with mixed shale and carbonate units up to 40 m thick (Plate 3.10, Fig. 1; Plate 3.11, Fig. 1). The units generally alternate in a random fashion, but locally may be arranged into poorly defined thickening upward cycles. The cyclic sequences consist of basal units of black shale overlain by intermixed shale and carbonate beds capped by conglomeratic units or dolosiltites (Jackson et. al., 1978a, 1980; Jackson and Iannelli, 1981). The cyclic sequences are carbonate-poor versions of the cycles present in the $VB_{U(L)}$ member (Plate 3.11, Fig. 2). The shale content is greatest in the thickest sections of the VB_L member.

Sedimentary structures include a variety of load and soft sediment structures. The structures include small to large scale channels, cross lamination, small current ripple marks, flute marks, small to large scale flame, ball and pillow and slump structures, soft sediment folds and growth faults (Plate 3.10, Figs. 1 and 2).

PLATE 3.10

Victor Bay Formation

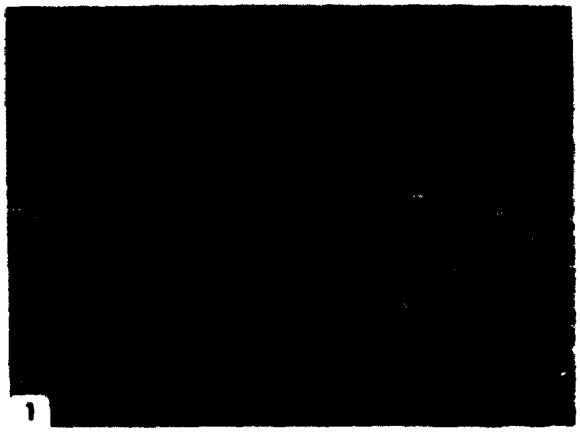
Fig. 1: Alternating planar thin laminated black shale and light- to dark-grey dololutite and dolosiltite of the VB_L member. The illustrated beds, which are disrupted by small faults, are 20 m thick. The outcrop is located due west of the Nanisivik minesite.

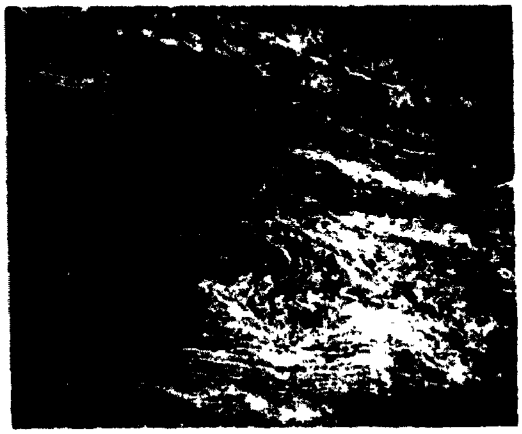
Fig. 2: Detail of soft sediment folds in thin to thick laminated shale, dololutite and dolosiltite of the VB_L member. This outcrop is 8 km due north of the head of Strathcona Sound.

Fig. 3: Flat carbonate pebble conglomerate bed in strata of the VB_L member due west of the Nanisivik minesite. The conglomerate bed is interlayered with nodular bedded dolosiltite, fine-grained dolarenite and thin laminated dolomitic shale.

Fig. 4: Carbonate turbidite in the VB_L member from the same sequence as Figs. 1 and 3. Graded dolorudite passes up into thick laminated to thin bedded dolosiltite and is intermixed with thin planar laminated black shale and dark-grey shale .

PLATE 3.10





Carbonate turbidites are common (Plate 3.10, Fig. 4) and typically have a basal graded dolorudite overlain by planar, thick laminated to thin bedded fine-grained dolarenite to dolosiltite.

3.8.2 $VB_{U(L)}$ Member

The $VB_{U(L)}$ member consists of 2 m- to 30 m-thick alternating massive carbonate flat to round pebble conglomerate and stromatolitic dolostone and limestone, interbedded with thick laminated to medium bedded dolosiltite and calcisiltite. Minor lithologies include thin laminated to thin bedded dololutite, calcilutite to dolomitic shale and vuggy dolostone with lenses of chert (Plate 3.11, Figs. 2 to 4). Rare sandy dolostone and arkoses occur adjacent to the White Bay Fault Zone. These strata are light- to dark-grey, buff-grey to (less commonly) black. The base of the member is delineated by a thick massive dolostone bed or massive carbonate flat to round pebble to boulder conglomerate (Plate 3.11, Fig. 3).

The conglomerate units consist of massive beds to lenses of flat to round carbonate pebble to boulder paraconglomerate to orthoconglomerate. The clasts are subrounded to subangular dolostone, stromatolitic dolostone to limestone, dolosiltite and calcisiltite that make up 20% to over 50% of the rocks. They are set in a matrix of fine- to coarse-grained calcarenite to dolarenite or calcisiltite to dolosiltite (Plate 3.11, Figs. 3 and 4). The clasts average 2 cm to 15 cm in length, but larger blocks occur in some thicker beds. These megaclasts are up to 5 m x 3 m; they have disrupted to soft sediment deformed contacts and have distorted the surrounding beds. Thick conglomerates also occur as channel fills. The channels are downcut as much as

5 m and have sharply defined erosional margins.

The carbonate units consist of thin laminated to thin bedded, planar to wavy layered stromatolitic limestone to dolostone with some layers of calcisiltite, calcilutite dolosiltite, dololutite and minor dolomitic shale and vuggy dolostone. They comprise about 40% to 60% of the member. The stromatolitic carbonates typically contain small mounds and bioherms containing low domal and simple, non-branching stromatolites.

Some sections contain 10 m to 30 m thickening-upward sequences. The cycles begin with thin laminated to thin bedded calcisiltite and intermixed shale that grade up into massive to bedded carbonate and stromatolitic carbonate, or bedded carbonate and carbonate flat to round clast conglomerate (Plate 3.11, Fig. 2). Alternating units of carbonate flat clast conglomerate and massive to vuggy dolostone pass into intermixed shale, dolosiltite, and calcisiltite, possibly representing another style of cyclic succession (Jackson and Iannelli, 1981). Carbonate turbidites, similar to those noted in the VB_L member, also occur in the $VB_{U(L)}$ member.

The $VB_{U(L)}$ member outcrops across Milne Inlet Trough and is preserved in a southeasterly-thickening wedge. Sequences measure 76 m to 130 m in thickness in the Arctic Bay - Nanisivik area and increase to 270 m in central Borden Peninsula and to 395 m in southeast Milne Inlet Trough at the type section (Fig. 3.16a). The $VB_{U(L)}$ member is the upper part of the formation in the area northwest of Milne Inlet and grades laterally and vertically into carbonates of the $VB_{U(U)}$ member in southeastern Milne Inlet Trough.

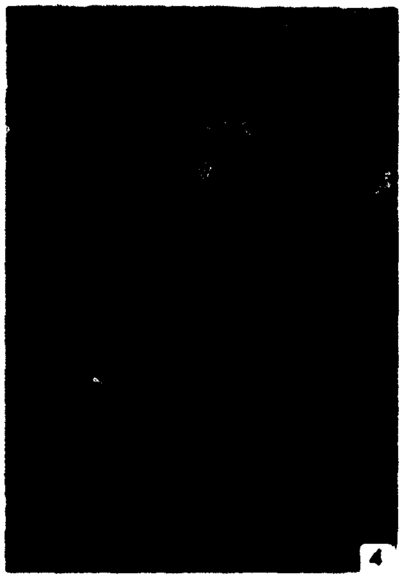
Sedimentary structures associated with the conglomerates include convoluted

PLATE 3.11

1

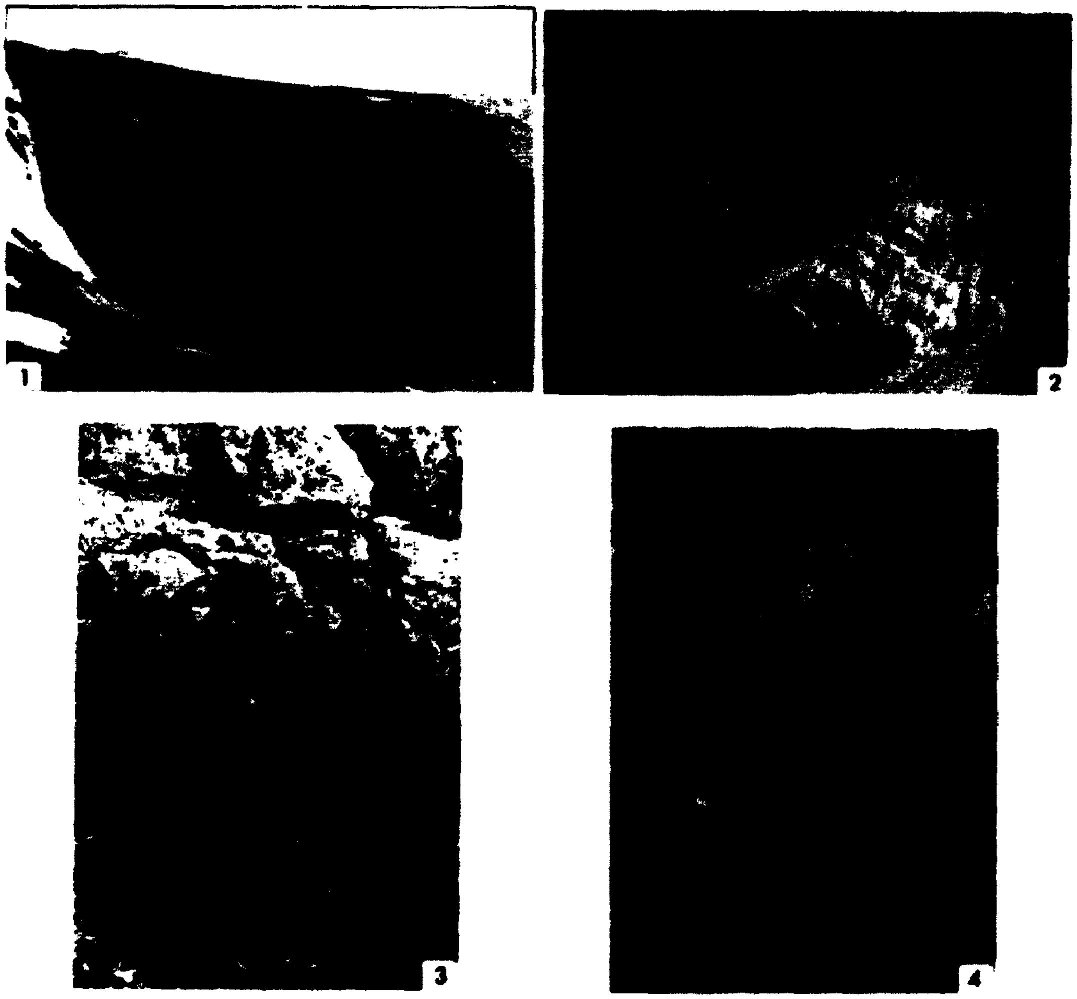
2

3



4

PLATE 3.11



beds, load casts, soft sediment folds, dewatering structures, slumps, channels, scours and graded bedding. The carbonate beds contain rare trough crossbeds, microfaults, tepee structures, synaeresis cracks, molar tooth structure and calcite- and dolomite-lined vugs. The strata emit a petroliferous odour and typically have pitted and rough-weathered surfaces. Limited data from crossbeds indicate east-northeast-directed paleocurrents (Table 2.8; Jackson et. al., 1980, Fig. 46.2, p. 322).

3.8.3 $VB_{U(U)}$ Member

The $VB_{U(U)}$ member consists of grey massive to stromatolitic dolostone and dolosiltite with minor thin laminated to medium bedded calcisiltite, dolarenite and carbonate flat to round clast conglomerate. Rare sandy to argillaceous dolostone and minor grey to black chert lenses also occur. Conglomerate beds are less common than in the $VB_{U(L)}$ member.

The member is characterised by the occurrence of stromatolite mounds, bioherms and reef-like structures. Stromatolites are mainly simple domal types that range from 0.1 m to 1 m in height; others include laterally linked hemispheroids, simple columns and branching upward columns up to 0.7 m high. The stromatolites comprise small mounds, and domes from 1 m to 15 m high. Bioherms in the area of Tremblay Sound and Ragged Island are comprised of low domal stromatolites from 5 m to 40 m high and from 100 m to over 1 km long. The bioherms have synoptic relief from 3 m to more than 10 m. Large domes have onlapping and intermound layers and lenses of planar laminated dolostone and flat carbonate pebble conglomerate. A spectacular reef-like structure is preserved in the uppermost beds of the member in southeastern Milne Inlet Trough at White Bay. The structure has an estimated length of 1500 m and a height of 270 m (Jackson and Iannelli, 1989, Fig. 5, p. 59).

The $VB_{U(U)}$ member, in Milne Inlet Trough, occurs mainly southeast of Tremblay Sound where it is 305 m thick (Fig. 3.16a). It grades laterally to the northwest into the $VB_{U(L)}$ member. $VB_{U(U)}$ member makes up most of the formation in the northernmost part of Milne Inlet Trough, measuring an estimated 450 m in the vicinity of the Elwin Icecap. It probably passes gradationally southwards into beds of the $VB_{U(L)}$ member (Fig. 3.16b). In the Eclipse Trough, where the Society Cliffs and Victor Bay Formations remain largely undivided, the strata of the Upper Uluksan Group comprise grey to buff-grey, thin laminated to thin bedded, planar to wavy layered dolostone, stromatolitic dolostone and dolosiltite with minor beds of carbonate flat clast conglomerate. Stromatolite mounds are common and the succession closely resembles that of the $VB_{U(U)}$ member in southeastern Milne Inlet Trough.

Sedimentary structures are similar to those noted in the carbonate beds of the $VB_{U(L)}$ member. Elongate stromatolite mounds display east-northeast - west-southwest and north-northeast - south-southwest trends (Table 2.8; Jackson et. al., 1980, Fig. 46.2, p. 322; Jackson et. al., 1985, Fig. 75.3, p. 642).

3.9 Nunatsiaq Group

The Nunatsiaq Group is a varied assemblage of multi-coloured sandstones, siltstones, shales, conglomerates and calciclastic to stromatolitic carbonates (Tables

2.5c and 2.5d; Figs. 2.2 to 2.5). The Nunatsiaq Group was established by Jackson and Iannelli (1981) to recognize the fact that the upper sequences, formerly Uluksan Group (the Strathcona Sound, Athole Point and Elwin Formations) of Lemon and Blackadar (1963) and Blackadar (1970), are lithologically distinct from the carbonate-dominated Society Cliffs and Victor Bay Formations and are separated from them by a regional unconformity, over much of Borden Basin (Figs. 3.16 and 3.19).
In the present study the group has been further subdivided into three major sequences: a lower sequence that includes the facies-equivalent lithological assemblages of the Strathcona Sound, Athole Point and Canada Point Formations; a middle sequence comprised of the varicoloured sandstones and siltstones of the Lower Elwin Formation, and an upper sequence that consists of cyclical strata of the Upper Elwin Formation (Tables 2.5c and 2.5d; Figs. 3.19 and 3.21). These formations outcrop in northwest-southeast-oriented belts on central Borden Peninsula and east-west oriented belts on northern Borden Peninsula (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). A few outcrops also occur on northwest Bylot Island (Canada Point Formation) and in the area north of Eskimo Inlet in south-eastern Milne Inlet Trough (Athole Point Formation).

The group is about 600 m thick in northwest Milne Inlet Trough and over 1500 m thick in northwest Eclipse Trough (Figs. 2.2 to 2.5). The Lower Nunatsiaq Group thickens to the northeast, southeast and marginwards in the Milne Inlet and Eclipse Troughs. The Lower and Upper Elwin Formations appear to have a regionally consistent thickness (Figs. 3.19 and 3.21).

3.10 Strathcona Sound Formation

The Strathcona Sound Formation represents the northwestern lithofacies assemblage of the Lower Nunatsiaq Group in Milne Inlet and Eclipse Troughs (Figs. 2.2, 2.4 and 2.5; Table 2.5c). It outcrops across central and northern Borden Peninsula and is best exposed along the shores of Strathcona Sound and Elwin Inlet and along the Mala River valley (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The formation thickens to the southeast and near the White Bay Fault Zone in Milne Inlet Trough. It is about 400 m thick in the Arctic Bay-Baillarge Bay area and more than 900 m in central Borden Peninsula (Figs. 3.19a and 3.19b). In Eclipse Trough, it ranges from about 500 m in the northwest to more than 580 m in the southeast (Fig. 3.19d). Regional type sections are suggested due to the strong facies variations. Section 1 in Fig. 3.19a is suggested as the type section for the northwest facies association in Milne Inlet Trough (reference station 7N100 in Appendices I and II). Section 3 in Fig. 3.19a is suggested as the type section for the basinal facies association in Milne Inlet Trough (reference station 4I147 in Appendices I and II). Section 12 in Fig. 3.19d is suggested as the type section for the basinal facies association in Eclipse Trough (reference stations 4K010 and 4I021 in Appendices I and II). Section 10 in Fig. 3.19b is suggested as the type section for the marginal facies association (reference stations 9I230 to 231 in Appendices I and II).

The lower contact, with the $VB_{U(L)}$ member, is unconformable and in northwest Milne Inlet Trough is an angular discordance. In central Milne Inlet Trough, there is a gradational contact between stromatolitic dolostone of the $VB_{U(U)}$ member and similar strata of the SS_{RC} member (Figs. 3.19a and 3.19b). The upper contact, with sandstones of the Lower Elwin Formation, is conformable and locally gradational (Fig. 3.19d). Strata of the Strathcona Sound Formation, in Milne Inlet Trough, interfinger gradationally to the east and southeast into facies-equivalent calciclastic and stromatolitic carbonate beds of the Athole Point Formation. Sandstone and conglomerate beds of the SS_{RA} and SS_{GA} members conformably overlie the AP_{U} member in the area from mid Borden Peninsula southeast to White Bay (Figs. 3.19a and 3.19c). In Eclipse Trough the Strathcona Sound Formation grades laterally to the east and southeast into shale, siltstone, sandstone and dolostone of the Canada Point Formation (Fig. 3.19d).

The Strathcona Sound Formation has been subdivided into ten members. Shale, siltstone, sandstone and conglomerate are the predominant lithologies. The lower part of the formation, over most of the Borden Peninsula, consists of a basal succession of carbonates and conglomerates of the SS_{RC}, SS_{CC} and SS_{MC} members which are overlain by red siltstones of the SS_{RS} member (Plate 3.12, Fig. 1); to the southeast these strata grade into the Athole Point Formation (Fig. 3.19a). The upper part of the formation, in Milne Inlet Trough, consists of siltstones, sandstones and conglomerates of the SS_{GS}, SS_{GA} and SS_{RA} members. These strata overlie, with an erosional contact, the lower part of the formation in northwest Milne Inlet Trough. They overlie the Athole Point Formation in central and southeastern Milne Inlet Trough (Figs. 3.19a to 3.19c). In Eclipse Trough the formation is largely made up of strata of the SS_{GS}, SS_{GS} and SS_{RS} members with the $SS_{RS/RS/MC}$ member comprising a southeast-thickening basal unit (Fig. 3.19d). The SS_{FC} member outcrops adjacent to the White Bay Fault Zone, in northwest Milne Inlet Trough, and along the Hartz

Mountain Fault Zone, in Eclipse Trough (Figs. 3.19b and 3.19c).

Sedimentary structures are not common but include channels, flute marks, flame and load structures and rare small to medium scale trough crossbeds, current ripple marks and hummocky cross-stratification (Plate 3.13, Fig. 2). Small to medium scale fining- and thinning-upward cycles, composed of conglomerate overlain by sandstone, are common in the SS_{RA} and SS_{GA} members (Jackson and Iannelli, 1981, Fig. 16.23a, p. 288; Jackson et. al., 1978a, Fig. 13, p.12). Regional paleocurrent plots are generally polymodal with weakly defined east-west and northwest-southeast modes (Table 2.8; Jackson et. al., 1980, Fig. 46.1, p. 320, Fig. 46.2, p. 322; Jackson et. al., 1985, Fig. 75.3, p. 642).

3.10.1 SS_{RC} (Reefal Carbonate) Member

The SS_{RC} member is restricted to northwest Milne Inlet Trough (Fig. 3.19a). It consists of grey to buff-grey stromatolitic dolostone and related calciclastic carbonates that comprise a small carbonate platform developed on similar strata of the $VB_{U(U)}$ member. The platform contains well developed stromatolite mounds and a striking dendritic channel pattern incised into the surface of the carbonates, possibly representing spur and groove structure (Plate 3.12, Figs. 1 and 2; Jackson et. al., 1978a, Frontispiece, facing p. 1; Jackson and Iannelli, 1989, Plate 1, figs. b, c and d, p. 60). The platform is at least 24 km in width and extends north from Strathcona Sound to the Elwin Icecap, a distance of about 50 km (Jackson and Iannelli, 1981, 1989).

The most striking feature of the carbonate platform is the presence of stromatolitic mound structures, which are exposed north and northeast of the head of Strathcona Sound. They comprise a core of stromatolitic dolostone mantled by carbonate pebble to boulder conglomero-breccia. Mounds are circular to elongate in plan, and range up to 1 km in length and 150 m in thickness (Plate 3.12, Figs. 1 and 2; Jackson et. al., 1985, Fig. 75.7, p. 645). They are composed of laterally-linked hemispheroids, and low domes to megadomes, that range from about 1 m to more than 10 m in height. Columnar mounds are also common and consist of distinctive Conophyton stromatolites and other related branching types (Jackson and Iannelli, 1989, Fig. 3, p. 58, Plate 1, Figs. g and h, p. 60). The stromatolitic mounds are onlapped and overlain by red siltstones of the SS_{RS} member (Plate 3.12, Fig. 1).

Related lithofacies, associated with the platformal carbonates, include several types of calciclastic carbonate strata. Intra-mound carbonate pebble to boulder conglomerate and conglomero-breccia occur draped over the mounds and as channel infills (Jackson and Iannelli, 1989, Plate 1, Figs. e and f, p. 60). The buff- to pink-grey rocks occur as lenses, layers and wedge- and channel-shaped bodies. Other strata between and beneath the mounds include buff-grey, grey to red thick laminated to thin bedded interlayered limestone, calcisiltite, calcareous siltstone and carbonate flat to round pebble conglomerate and units of intermixed grey, buff-pink to pink-red thin bedded dolosiltite, dolostone, subarkose to sublitharenite and carbonate flat pebble conglomerate. Rare lenses and layers of planar thin bedded, fine-grained brown quartzarenite to subarkose occur in some successions.

The SS_{RC} member ranges from 160 m to 200 m in thickness. The carbonates interfinger to the northwest and southeast with conglomerates and conglomero-breccia

PLATE 3.12

Strathcona Sound Formation

Fig. 1: Exhumed stromatolitic carbonate mounds of the SS_{RC} member. The mounds are overlain by a monotonous sequence of red siltstones of the SS_{RS} member. The lake, at left, is about 1 km long: about 10 km north of the head of Strathcona Sound.

Fig. 2: Possible spur and groove structure on the slopes of a semi-isolated reefal mound in the SS_{RC} member. The mound is about 450 m in length and is composed of a core of stromatolitic dolostone and carbonate clast conglomero-breccia; it is surrounded by an apron of carbonate boulder conglomerate (SS_{CC} member). The structure is enveloped by red siltstones of the SS_{RS} member and is located about 10 km north-northeast of the head of Strathcona Sound.

Fig. 3: Fore-reef slope-derived, carbonate pebble to boulder conglomerate. The massive, structureless rocks occur adjacent to the main reef complex of the SS_{RC} member. Note the large block of columnar stromatolitic dolostone at the bottom of the photo (hammer at upper contact of the block; height = 3 m, length = 4 m). This block was derived from the reefal mounds of the SS_{RC} member: 9 km north-northeast of the head of Strathcona Sound.

Fig. 4: Detail of carbonate pebble to boulder conglomerate of the SS_{CC} member. The massive, inversely graded bed contains at least six distinct carbonate clast types derived from the SS_{RC} and $VB_{U(U)}$ members. Location as for Fig. 3.

PLATE 3.12


1


2


3


4


5


6

PLATE 3.12

Strathcona Sound Formation

Fig. 5: Carbonate pebble to boulder conglomero-breccia at the base of the Strathcona Sound Formation. The massive beds consist of subrounded to angular dolostone clasts set in a matrix of red dolomitic siltstone. The rocks, which belong to the SS_{MC} member, outcrop about 20 km northwest of the head of Strathcona Sound.

Fig. 6: Poorly stratified carbonate pebble to cobble conglomerate with thin lenses of red dolomitic siltstone. The conglomerates comprise flat to round carbonate clasts set in a matrix of dolosiltite and dolomitic siltstone. Note imbrication of clasts in the conglomerate layers. The strata occur in the SS_{MC} member and outcrop 25 km northwest of the head of Strathcona Sound.

of the SS_{CC} and SS_{MC} members (Figs. 3.19a and 3.19b).

3.10.2 SS_{CC} (Carbonate Conglomerate) Member

The SS_{CC} member outcrops in northwest Milne Inlet Trough where it is associated with stromatolitic dolostones of the SS_{RC} member (Figs. 3.19a and 3.19b). The member consists of massive to poorly bedded, grey, buff-grey to buff-yellow carbonate pebble to boulder conglomerate and conglomero-breccia (Plate 3.12, Figs. 3 and 4). The conglomerate occurs at the base of the formation as an apron or marginal fringe on the outer edges of the SS_{RC} carbonate platform complex. The massive beds are more than 60 m thick adjacent to the platform complex and thin rapidly away from it to the west, northwest and southeast (Figs. 3.19a and 3.19b).

The conglomerate is clast supported and poorly sorted. Clasts range from granules to boulders or blocks more than 4 m in length; they comprise between 50% and more than 90% of the rock. The subrounded to angular clasts include at least six carbonate lithologies, derived from the $VB_{U(U)}$ and SS_{RC} members. The main clast types consist of calcarenite, flat carbonate pebble conglomerate, dolosiltite, dolorudite and pebbles to blocks of stromatolitic dolostone (Plate 3.12, Figs. 3 and 4). They are set in a matrix of dolarenite to calcareous subarkose, which is resistant and weathers in relief. The conglomerates contain normal and inverse grading, rip-up intraclasts, channels and scoured surfaces and soft-sediment folds where conglomerate beds overlie calcareous sandstone of the SS_{MC} member.

3.10.3 SS_{MC} (Massive Conglomerate) Member

The SS_{MC} member is present in northwestern Milne Inlet Trough and comprises successions of buff-yellow, pink-brown to pink-grey, massive carbonate pebble to boulder conglomerate and units of interlayered, poorly stratified carbonate pebble to boulder conglomerate to conglomero-breccia and red to grey-green thick laminated siltstone, buff-grey to pink, thick laminated to thin bedded dolostone and fine- to coarse-grained buff-grey subarkose (Plate 3.12, Figs. 5 and 6; Jackson et. al., 1978a, Figs. 10 and 11, p. 11). The conglomerate beds consist of flat to spheroidal, subrounded to angular dolostone and stromatolitic dolostone clasts set in a matrix of red to buff-grey dolosiltite to dolomitic siltstone. Clasts are commonly imbricated (Plate 3.12, Fig. 6). The carbonate clasts resemble rocks of the $VB_{U(L)}$, $VB_{U(U)}$ and SS_{RC} members. Rare gneiss clasts occur in sequences near the White Bay Fault Zone. Clasts are up to 2.5 m in length. In some areas, dolostone slump blocks (olistoliths) up to 1 km in length occur (Jackson et. al., 1978a, Jackson and Iannelli, 1981).

The massive conglomerate member occurs at the base of the formation. It is highly variable in thickness, ranging from less than 5 m to more than 130 m thick across northwest Milne Inlet Trough (Figs. 3.19a and 3.19b). The conglomerates, in northwest Borden Peninsula, are draped over an irregular erosion surface between the $VB_{U(L)}$ member and the Strathcona Sound Formation (Fig. 3.19a).

3.10.4 SS$_{RS}$ (Red Siltstone) Member

The SS$_{RS}$ member outcrops across central and northwestern Milne Inlet and Eclipse Troughs (Figs. 3.19a and 3.19d). It consists mainly of thick monotonous sequences of planar thin to thick laminated red (less commonly grey-green), red-brown to purple-red siltstone with minor layers of thin laminated shale, thin bedded subarkose to arkose, and layers and lenses of carbonate pebble to boulder conglomerate (Plate 3.13, Figs. 1 to 3). Randomly distributed isolated carbonate pebbles to boulders also occur. The strata are commonly calcareous to dolomitic. Siltstones of the SS$_{RS}$ member onlap carbonate and conglomerate beds of the SS$_{RC}$ and SS$_{CC}$ members (Plate 3.12, Figs. 1 and 2).

The sandstone interbeds are generally less than 1 m thick. Some are structureless, others contain small current ripple marks and hummocky cross-stratification and have scoured bases. The conglomerate layers contain flat to spheroidal, rounded to subangular pebbles to boulders of dolostone, dolosiltite and stromatolitic dolostone set in a matrix of red dolomitic siltstone. Many are lenticular; most are less than 3 m thick. The conglomerate beds decrease upwards in thickness and number. Rare sedimentary structures include, in addition to those already mentioned, flute marks, small load casts and slumps (Jackson *et*. *al*., 1985, Fig. 75.6, p. 645). Turbidites and small scale fining-upward cycles (< 2 m thick) are present.

The maximum estimated thickness of 500 m occurs in central Milne Inlet Trough. To the northwest the member thins to 90 m; to the southeast it grades into the Athole Point Formation (Fig. 3.19a). It is 245 m thick in central Eclipse Trough.

PLATE 3.13

Strathcona Sound Formation

Fig. 1: Red siltstones of the SS_{RS} member (200 m thick) overlain by grey siltstones of the SS_{GS} member (50 m thick) which, in turn, grade up into buff to grey-green siltstone, dolostone and quartzarenite of the SS_{GC} member (> 220 m thick): 12 km north of the Elwin Icecap.

Fig. 2: Alternating red and brown-red, thick laminated siltstone and massive to planar bedded and hummocky cross-stratified subarkose. Minor interbeds of dolosiltite clast, conglomero-breccia occur at the base of the photo. Note the loaded or channelled bases of the subarkose layers. These strata are part of the SS_{RS} member, 7 km north-northeast of the head of Strathcona Sound.

Fig. 3: Detail of carbonate pebble to boulder conglomero-breccia in planar thick laminated red siltstone of the SS_{RS} member. The conglomero-breccia layer pinches and swells: 25 km northwest of the head of Strathcona Sound.

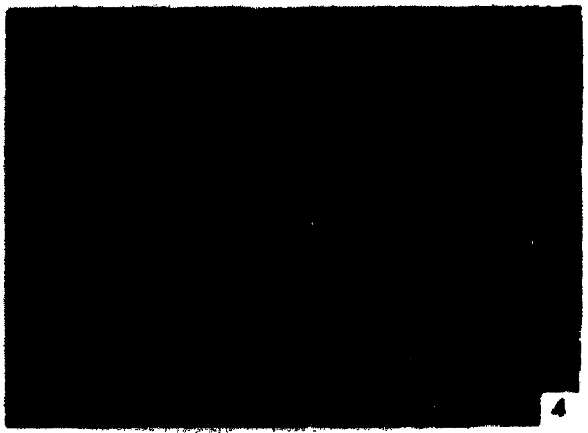
Fig. 4: General view of strata of the SS_{RA} member in a section 25 km west of the mouth of the Mala River. The strata consist of red coarse-grained massive arkose with isolated boulders and cobble boulder lenses of gneiss, and thin beds and lenses of arkosic siltstone and fine-grained arkose.

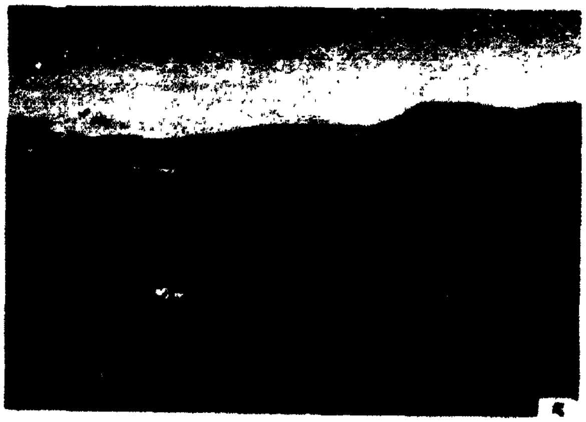
PLATE 3.13


1


2


3


4


5

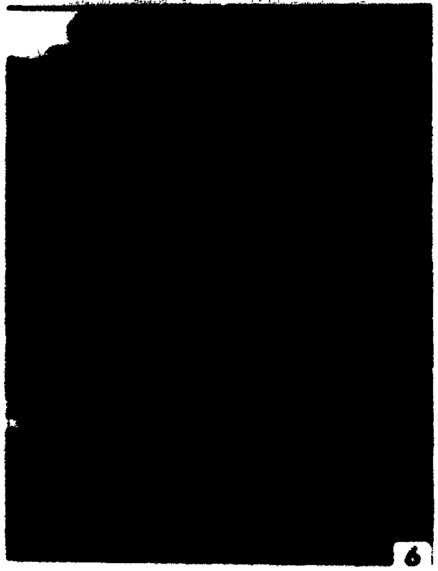

6

PLATE 3.13

Strathcona Sound Formation

Fig. 5: Red siltstones of the SS_{RS} member (foreground, in stream valley) grading up into a monotonous sequence of green-grey siltstones and shales of the SS_{GS} member (in mid-portion of photo; thickness about 120 m), and overlain by the SS_{GC} member (background). The Strathcona Sound beds are gradationally overlain by pink to buff weathered strata of the Lower Elwin Formation (far background): north central Borden Peninsula, 10 km northeast of the Elwin Icecap.

Fig. 6: Detail of small-scale fining-upward cycles comprised of granule to pebble polymictic conglomerate overlain by coarse-grained to medium-grained arkose. Conglomerate beds have scoured bases. Basal part of the SS_{GA} member, 7 km northeast of the head of Strathcona Sound.

In a northwesterly direction, it grades into the SS_{GS} member and to the southeast, into the CP_U member (Fig. 3.19d).

3.10.5 SS_{RA} (Red Arkose) Member

The SS_{RA} member outcrops in central and northwestern Milne Inlet Trough where it comprises thick laminated to medium bedded, red, red- to pink-brown interlayered arkosic siltstone, fine-grained to pebbly arkose, fine-grained to pebbly litharenite and polymictic conglomerate. The conglomerates are bedded to massive, and contain subrounded to angular quartz, feldspar, granite and gneiss pebbles in a coarse-grained arkosic to litharenitic matrix. Isolated pebbles to boulders of gneiss occur in sequences adjacent to the fault zones (Plate 3.13; Fig. 4).

The strata are commonly arranged into small to medium scale fining- and thinning-upward cycles. The conglomerate-dominated to sandstone-dominated cycles contain scoured or channelled bases and range from 1 m to more than 10 m thick (Jackson and Iannelli, 1981, Fig. 16.23a, p. 288). Conglomerate-filled channels up to 15 m deep occur in some sequences (Jackson et. al., 1978a). Rare trough crossbeds and small current ripple marks are also present.

These rocks overlie red siltstone of the SS_{RS} member in central Milne Inlet Trough where the SS_{RA} member has a maximum thickness of about 300 m (Fig. 3.19a).

3.10.6 SS_{GS} (Green-grey Siltstone) Member

The SS_{GS} member outcrop across northwestern Milne Inlet Trough and central and northwestern Eclipse Trough (Figs. 3.19a and 3.19d). It consists of monotonous sequences of planar thin laminated to thin bedded green to green-grey siltstone with minor interlayered thin laminated shale, fine-grained buff-grey to buff-green subarkose and thin lenses and layers of carbonate pebble to boulder conglomerate to conglomero-breccia (Plate 3.13 Fig. 5). Rare, randomly distributed dolostone pebbles to boulders also occur. Few sedimentary structures are present.

The sandstones are structureless to thin bedded, with scoured or channelled bases. Conglomerate and conglomero-breccia beds contain subrounded to angular, buff-grey to buff-yellow clasts of dolostone, dolosiltite and stromatolitic dolostone in a matrix of grey-green to green dolomitic siltstone. The conglomerates resemble those in the SS_{RS} member.

The SS_{GS} member, in Milne Inlet Trough, reaches a maximum thickness of 300 m south of Baillarge Bay and thins to the southeast where it grades into the SS_{GA} member (Fig. 3.19a). In Eclipse Trough, the member reaches a maximum thickness of 400 m on northwestern Borden Peninsula, thinning to 50 m in the central part of the trough and thickening to about 250 m on northeast Borden Peninsula (Fig. 3.19d). The member, in this area, grades up into the SS_{GC} member and into the southeast facies assemblage of the Lower Elwin Formation.

3.10.7 SS_{GA} (Grey-green Arkose) Member

The SS_{GA} member outcrops across central and northwestern Milne Inlet Trough. It overlies carbonates of the Athole Point Formation in central and southeast Milne Inlet Trough,and it interfingers northwestwards and marginwards with siltstones of the SS_{GS} member and conglomerates of the SS_{FC} member. Locally these strata occupy a megachannel (canyon?) cut through beds of the lower Strathcona Sound Formation, and rest disconformably on strata of the $VB_{U(L)}$ member (Figs. 3.19a to 3.19c). Sandstones and conglomerates of the SS_{GA} member also cut down as much as 15 m into the underlying siltstone and shale beds of the SS_{RS} member in northwest Borden Peninsula (Jackson et. al., 1978a, Fig. 15, p. 13).

The SS_{GA} member consists of planar thick laminated to medium bedded intermixed grey-green, green to (less commonly) pink to red-green, fine-grained to pebbly arkose, arkosic wacke and litharenite with minor layers of thick laminated siltstone and bedded to massive layers and lenses of pebble to boulder polymictic conglomerate (Plate 3.13, Fig. 6; Jackson et. al., 1978a, Figs. 12 and 13, p. 12). The strata are commonly arranged into small to medium scale fining- and thinning-upward cycles that alternate with more massive units. Cycles are commonly 2 m to 10 m thick, conglomerate based, and sandstone-dominated (Jackson and Iannelli, 1981, Fig. 16.23a, p. 288; Jackson et. al., 1978a, Fig. 13, p. 12, Fig. 14, p. 13). The cycles have scoured and channelized bases. Rare small to medium scale trough crossbeds and current ripple marks are present.

The conglomerates contain subrounded to angular clasts of granite, gneiss, quartz and feldspar; less common are quartzarenite, arkose and dolostone pebbles.

Pebbles predominate, but larger clasts (up to boulder size) occur in some successions.

The member is more than 380 m thick in northwestern Milne Inlet Trough,and may be more than 800 m thick in central Borden Peninsula, where it constitutes the entire formation (Fig. 3.19a).

3.10.8 SS_{GC} (Grey-green Siltstone and Carbonate) Member

The SS_{GC} member outcrops in central and northwestern Eclipse Trough where it has a gradational contact with the underlying SS_{GS} member (Fig. 3.19d). It consists of grey-green planar thin to thick laminated siltstone, buff-grey, white-grey to brown thick laminated to thin bedded fine-grained quartzarenite and buff-grey to black thick laminated dolosiltite and dolostone (Plate 3.14, Figs. 1 and 2). Minor interlayers of thin bedded subarkose and calcisiltite also occur. Few sedimentary structures are present; they include small clastic dykes, synaeresis cracks and microfaults. Differentially weathered beds are common in dolostone and sandstone layers.

The member is preserved as a lens-shaped body. It has a maximum thickness of 228 m northeast of the Elwin Icecap and thins to the northwest and southeast (Fig. 3.19d).

3.10.9 SS_{FC} (Fault-margin Conglomerate Member)

The SS_{FC} member consists of massive to poorly stratified, polymictic pebble to boulder conglomerate with minor thin layers and lenses of coarse-grained to pebbly arkose to litharenite (Plate 3.14, Figs. 3 and 4). The strata are red-brown, grey- to brown-green and pink-green. The conglomerates consist of subrounded to angular

PLATE 3.14

Strathcona Sound Formation

Fig. 1: Detail of small ptygmatically folded clastic dykes (deformed synaeresis cracks?) in alternating thin bedded brown quartzarenite and black dolosiltite. Note the differentially weathered outcrop surface. The strata belong to the SS_{GC} member and outcrop 10 km north of the Elwin Icecap on northwestern Borden Peninsula.

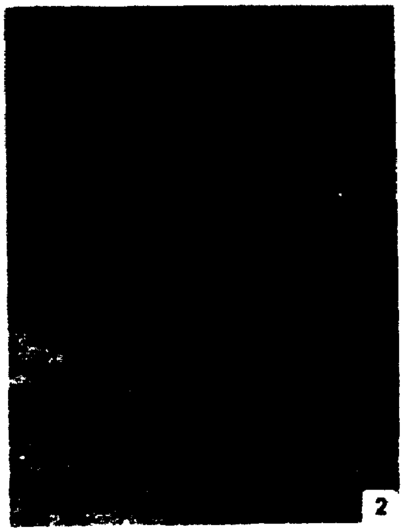
Fig. 2: Thin laminated black calcilutite alternating with planar thin laminated to thin bedded brown calcisiltite. The strata occur in the SS_{GC} member and outcrop in the same area as Fig. 1.

Fig. 3: General view of massive gneiss pebble to boulder conglomerate with minor lenses and poorly stratified layers of pebbly arkose and litharenite. The strata are part of the SS_{FC} member and outcrop 25 km west of the mouth of the Mala River.

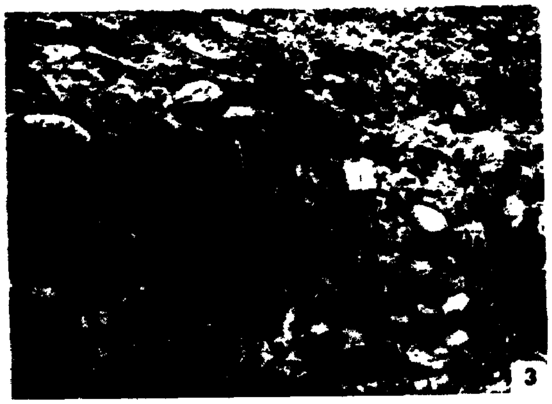
Fig. 4: Detailed view of poorly stratified, green-brown polymictic conglomerate with thin lenses of pebbly litharenite. The granule to cobble size clasts include gneiss, granite, basalt, quartzarenite and dolostone. These SS_{FC} member rocks outcrop 30 km southeast of the Elwin Icecap. The dolostone clast at top, centre measures 60 cm in length.

PLATE 3.14

1



2



3

4

gneiss and granite clasts (less commonly dolostone, quartzarenite and basalt) set in a matrix of coarse-grained arkose to litharenite (Plate 3.14, Fig. 4). Rare slump blocks of massive to stromatolitic dolostone of the $VB_{U(U)}$ and SS_{RC} members occur in the massive beds. Megaclasts range from dolostone blocks 10 m to 15 m in length and 1 m to 3 m in height, to olistoliths(?) up to 70 m thick and 2 km long (Jackson and Iannelli, 1981).

The member is best developed along major fault zones and interfingers basinwards with sandstones and conglomerates of the SS_{GA} and SS_{RA} members. It represents the marginal facies of these members (Figs. 2.5, 3.19b and 3.19c). The SS_{FC} member is estimated to be more than 500 m thick (Fig. 3.19b; Jackson and Iannelli, 1989, Fig. 2, p. 56).

3.10.10 $SS_{RA/RS/MC}$ (Siltstone-Sandstone-Conglomerate) Member

The strata of the $SS_{RA/RS/MC}$ member comprise the basal part of the Strathcona Sound Formation in central Eclipse Trough. It consists of alternating units, 2 m to 20 m thick, of poorly stratified, pink to pink-brown siltstone clast and dolostone clast, sharp to round pebble conglomerate, red to red-brown thick laminated to thin bedded siltstone (with minor shale and subarkose interlayers), and red to pink, thick laminated to thin bedded arkose to pebbly arkose. The siltstone and arkose beds contain rare channels, and small to medium scale trough and planar crossbeds. The arkose beds are locally arranged into small scale thinning-upward cycles, 1 m to 3 m thick.

The conglomerate beds are massive to poorly stratified and contain subrounded

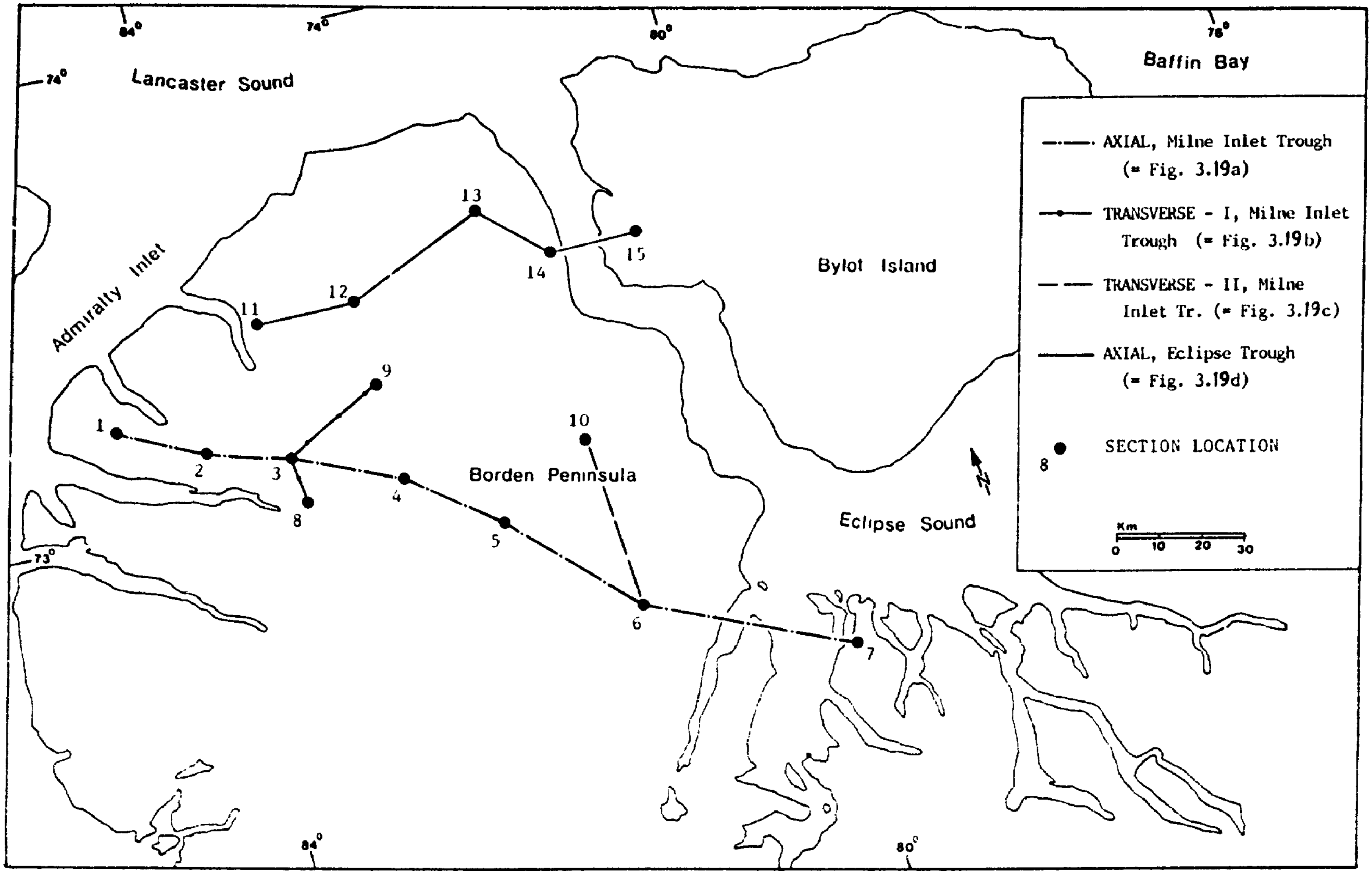


Fig. 3.18: Location map for regional cross-sections of the Strathcona Sound, Athole Point and Canada Point Formations.

FIG. 3.19b: STRATHCONA SOUND FM - TRANSVERSE I (NE-SW) CROSS-SECTION. MILNE INLET TROUGH.

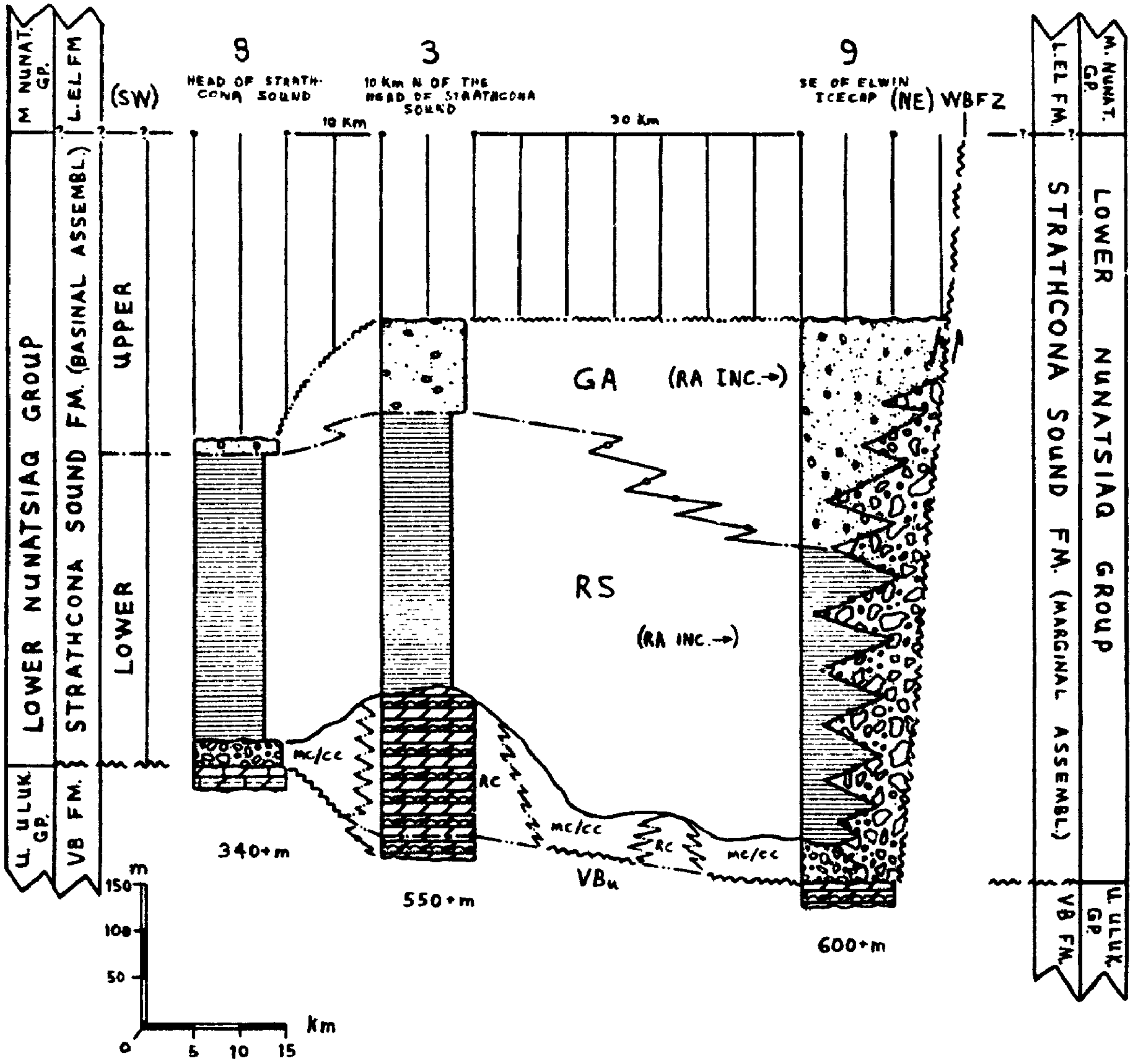


FIG. 3.19c:
LOWER NUNATSIAQ GROUP: TRANSVERSE (NNW-SSE) CROSS-SECTION, MILNE INLET TROUGH.

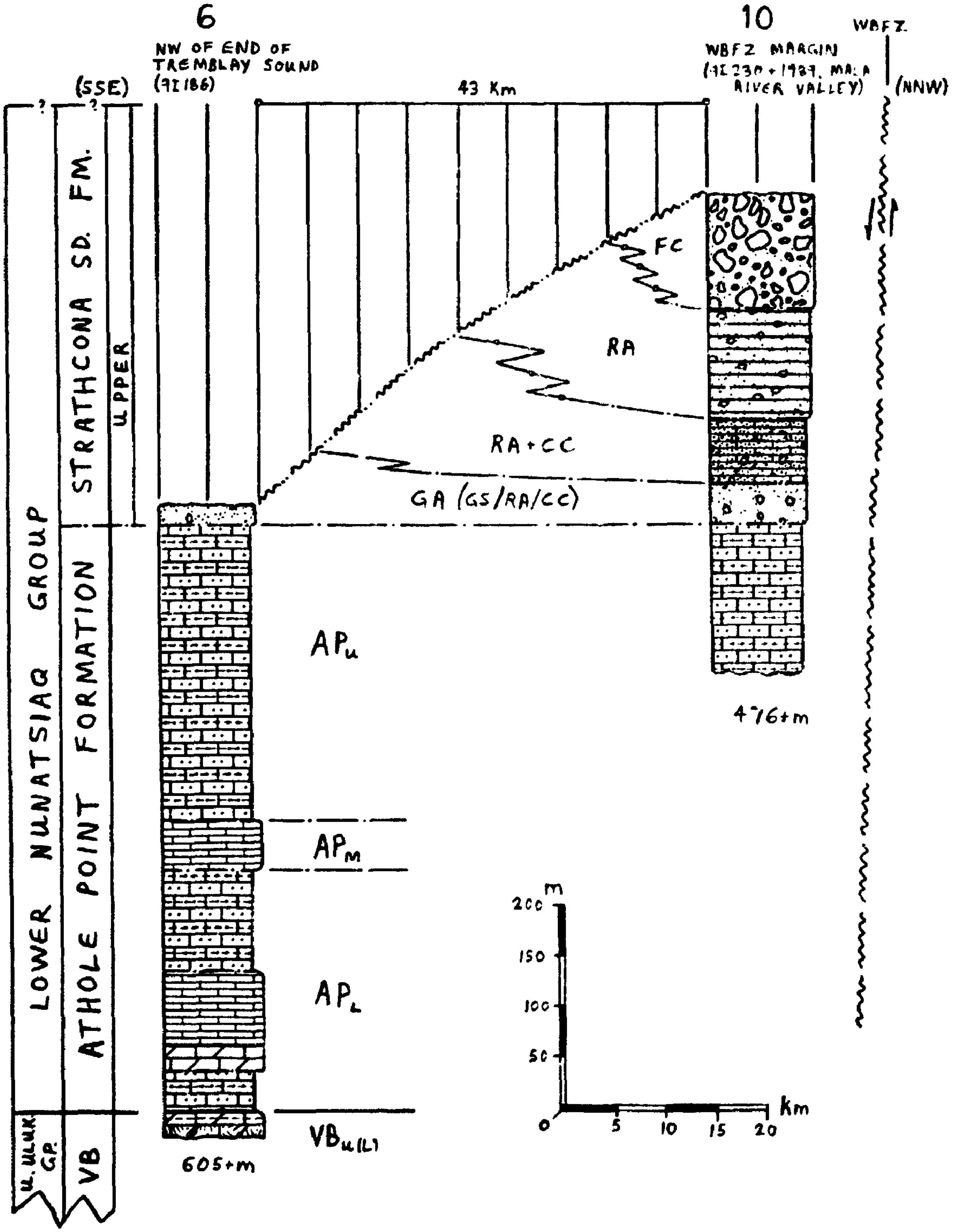
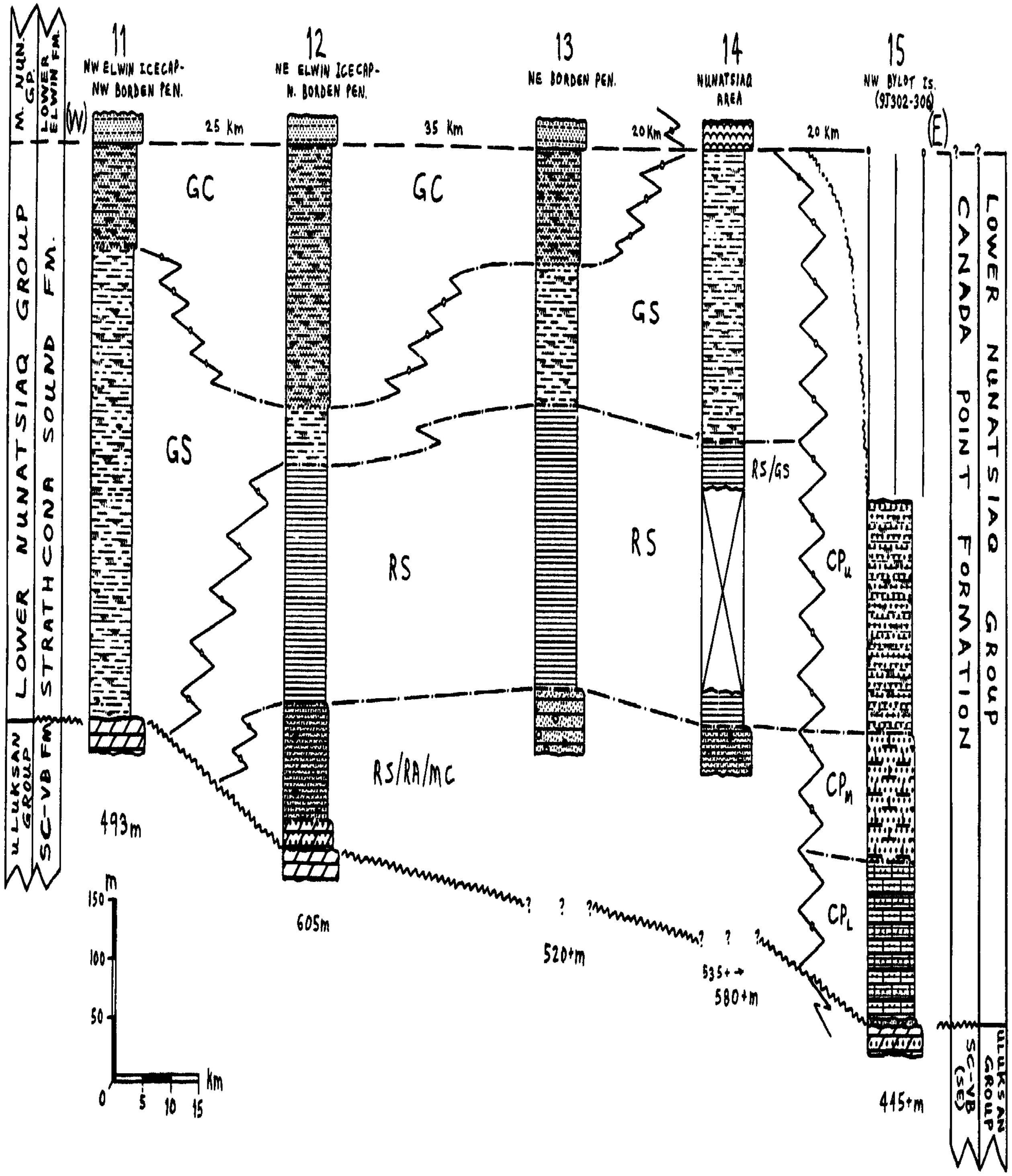


FIG. 3.19d: LOWER NUNATSIAQ GP. - AXIAL (W-E) CROSS-SECTION, ECLIPSE TROUGH.



to angular pink, buff to grey siltstone, dolostone and dolosiltite clasts in a matrix of red to pink dolosiltite. Siltstone beds comprise 50% to 60% of the member and increase upwards in the member. Conglomerate beds decrease upwards in amount and thickness; locally they form a 25 m-thick basal unit, unconformably overlying dolostone of the $VB_{U(U)}$ member.

The member is 122 m thick northeast of the Elwin Icecap. It appears to thicken to the southeast where it is tentatively correlated with the CP_L and CP_M members (Fig. 3.19d).

3.11 Athole Point Formation

The Athole Point Formation is the carbonate-dominated lithofacies assemblage of the Lower Nunatsiaq Group preserved in central and southeast Milne Inlet Trough (Table 2.5c). It outcrops in the area from central Borden Peninsula to the southern part of Ragged Island and the southeast shore of Milne Inlet (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). Sequences range in thickness from 585 m west of Tremblay Sound, to at least 525 m east of Milne Inlet (Fig. 3.19a). The suggested type section outcrops 7 km southwest of the south end of Ragged Island in southeast Milne Inlet Trough (section 7 in Fig. 3.19a; reference stations 9J131 to 135 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.20, p. 286). Strata of the Athole Point Formation conformably and gradationally overlie carbonate beds of the Victor Bay Formation (Fig. 3.19a). The formation is equivalent to the lower part of the Strathcona Sound Formation. Carbonate beds wedge out laterally to the west and northwest and, in central Borden Peninsula, are replaced by siltstone, sandstone and conglomerate beds of the SS_{RS} and SS_{MC} members. The Athole Point Formation is gradationally overlain by subarkose and conglomerate beds of the SS_{GA} member in central and southeast Milne Inlet Trough (Figs. 3.19a and 3.19c).

The Athole Point Formation consists of planar to wavy layered, thin laminated to medium bedded, grey, grey-brown to black calcilutite, calcisiltite and interlayered calciclastic to stromatolitic limestone and minor calcareous sandstone and carbonate pebble conglomerate. The rocks emit a petroliferous odour. The formation has been subdivided into lower (AP_L), middle (AP_M) and upper (AP_U) members (Tables 2.5c and 3.19a). Sedimentary structures are most common in the AP_L and AP_U members and are dominated by load and soft sediment deformation features (Plate 3.15, Figs. 2 and 5). They include graded beds (associated with turbidites), flute and load casts, soft sediment folds and deformed beds, flame structures, scours, slumps and slumped blocks, cross lamination, small current ripple marks and microfaults. Stromatolites, in the limestone beds, are mainly low domal, hemispheroidal and simple columnar forms. Small stromatolite mounds, 10 cm to 50 cm in height, are locally common in the AP_M member. Turbidites form a significant portion of the AP_L and AP_U member. There are three main types that range in thickness from 10 cm to 50 cm (Plate 3.16, Fig. 1). Type 1 comprises graded, very coarse- to medium-grained calcarenite. Type 2 consists of graded calcarenites that pass upward into planar thin bedded to thick laminated fine-grained calcarenite and calcisiltite. Type 3 includes graded calcarenite overlain by cross laminated to planar bedded fine-grained calcarenite and calcisiltite. The turbidites contain scoured and loaded bases and alternate with thin laminated calcilutite.

Limited directional data, from crossbed measurements, indicate west-northwest paleocurrent trends (Jackson et. al., 1980, Fig. 46.1, p. 320; Jackson and Iannelli, 1981, Fig. 16.8, p. 275).

3.11.1 AP_L Member

The AP_L member consists largely of planar to wavy layered, light-grey to black, thick laminated to medium bedded calcisiltite, calcarenite and thin laminated calcilutite (Plate 3.15; Plate 3.16, Fig. 1). Minor interlayered lithologies include thick laminated to thin bedded limestone, nodular limestone, cryptalgal laminite, calcareous quartzarenite, sand-bearing limestone and carbonate flat to round pebble conglomerate. The lithologies occur as 1 m- to 10 m-thick units. Turbidite- dominated successions alternate with units of intermixed massive carbonate pebble conglomerate, soft-sediment deformed calcisiltite and calcarenite beds and thin to thick laminated calcilutite - calcisiltite-dominated units (Plate 3.15, Figs. 2, 5 and 6). Low angle intraformational unconformities, or internal truncation surfaces, disrupt the strata. Scoured surfaces and soft sediment- deformed units are common.

A reef-bearing unit, the $AP_{L(R)}$ submember, occurs in the area of White Bay in southeastern Milne Inlet Trough (Fig. 3.19a; Table 2.5c). Strata of the $AP_{L(R)}$ submember grade up from similar beds in the $VB_{U(U)}$ member (Jackson and Iannelli, 1989, Fig. 5, p. 59). They comprise light- to dark-grey, thin laminated to massive limestone, dolostone, stromatolitic limestone and stromatolitic dolostone forming a 130 m- to 150 m-thick reef structure. The outer margins of the reef interfinger with off-reef calcilutite and calcarenite beds of the AP_L member.

PLATE 3.15

Athole Point Formation

Fig. 1: Low angle unconformity in strata of the lower part of the AP_L member. These intraformational truncation surfaces occur in alternating thick laminated to thin bedded, planar to wavy stromatolitic limestone, calcisiltite and flat pebble conglomerate. The strata outcrop 25 km west of the head of Tremblay Sound.

Fig. 2: Detail of intermixed massive to poorly stratified calcirudite (flat carbonate clast conglomerate) and tabular to lensed calcisiltite and calcarenite beds (carbonate turbidites or storm layers) of the AP_L member. Location as for previous photo.

Fig. 3: Section view of carbonate units showing thrust faults or intraformational truncation surfaces. The sequence comprises alternating planar to wavy dolostone, stromatolitic dolostone and planar to wavy, thin laminated to thin bedded limestone, calcisiltite, calcilutite and flat clast conglomerate beds. These strata form part of the AP_L member and outcrop in the same area as the previous photo.

Fig. 4: Close-up view of carbonate units shown in the previous photo, with a possible thrust or intraformational truncation plane (immediately above the measuring staff).

PLATE 3.15

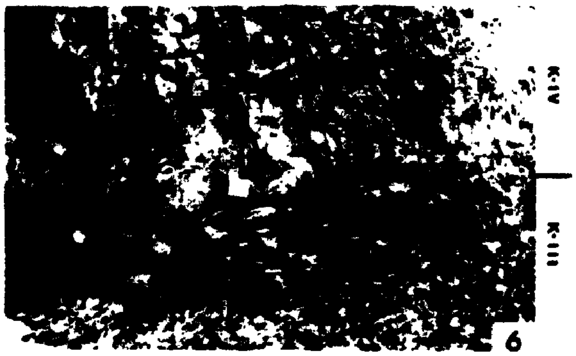

1


2


3


4

5



6

PLATE 3.15

Athole Point Formation

Fig. 5: Soft sediment folds and microfaults in flat carbonate clast conglomerates, overlain by an undeformed sequence of alternating thick laminated to very thin bedded dololutite, calcilutite and planar to lensed, very thin to thin bedded calcisiltite and calcarenite. The strata are part of the AP_L member and outcrop 25 km west of the head of Tremblay Sound.

Fig. 6: K.III beds, truncated and unconformably overlain by K.IV beds.The contact is undulatory and erosional. Location as in Fig. 5.

(i). K.III unit is 0.5 m to 2 m thick and comprised of thick laminated, planar to undulose dololutite overlain by planar to wavy, thick laminated to very thin bedded calcisiltite and calcarenite.

(ii). K.IV unit is 4.5 m to 5.5 m thick and comprised of bedded to massive, buff-grey dolostone; brecciated, truncated and convoluted layers occur near the lower contact; remaining portion contains undulatory bedding surfaces though to be soft sediment deformation structures, possibly related to syndepositional faulting.

The AP_L member is 200 m thick in the area northwest of Tremblay Sound and 210 m thick in the vicinity of the type section (Fig. 3.19a).

3.11.2 AP_M Member

The light- to dark-grey carbonates of the AP_M member comprise thin laminated to thin bedded, planar to wavy layered limestone, massive limestone, cryptalgal laminite and minor thin laminated to thin bedded calcilutite and calcisiltite (Plate 3.16, Fig. 2). Rare sandy, orange-brown-weathering limestone beds also occur in the succession. Disseminated and nodular pyrite are present in some beds, and calcite-lined vugs occur in the massive limestone beds. The laminated limestone beds commonly contain small stromatolite mounds made up of low domal to simple columnar forms.

The member varies in thickness from 125 m at the type section to about 50 m northwest of Tremblay Sound (Fig. 3.19a).

3.11.3 AP_U Member

The upper member is planar to wavy layered, thick laminated to thin bedded, grey, brown and black calcilutite, calcisiltite, calcarenite, stromatolitic limestone and calcareous sandstone to sand-bearing limestone (Plate 3.16, Fig. 2). Minor layers and lenses of calcirudite, nodular limestone and carbonate flat to round pebble conglomerate also occur. This sequence coarsens upward to the northwest due to an increase in concentration of sandy carbonate and siliciclastic beds, including thin bedded calcareous quartzarenite to subarkose, arkose and litharenite. Abundant turbidites are present in the AP_U member. Turbidite-dominated units alternate with units of intermixed calcilutite and calcisiltite to sand-bearing limestone. Bedded limestone and conglomerate layers occur throughout the succession.

AP_U member strata have a gradational contact with the underlying AP_M member (Plate 3.16, Fig. 2). The member thickens to the west and northwest from 190 m at the type section to 285 m in the area northwest of Tremblay Sound (Fig. 3.19a).

3.12 Canada Point Formation

The varicoloured strata of the Canada Point Formation represent the southeastern lithofacies assemblage of the Lower Nunatsiaq Group preserved in Eclipse Trough. On northwest Bylot Island thicknesses range from about 450 m to over 550 m (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). The suggested type section is 15 km due north of Canada Point (section 15 in Fig. 3.19d; reference stations 9J302 to 306 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.21c, p. 287). The Canada Point Formation unconformably overlies dolostones of the Victor Bay Formation and is unconformably overlain by Cretaceous sandstone beds. The lower contact is generally delineated by the presence of a pink-buff weathered, carbonate pebble conglomerate bed (Plate 3.16, Fig. 3). The Canada Point Formation grades laterally to the northwest and west into the Strathcona Sound Formation (Fig. 3.19d).

The Canada Point Formation comprises mainly interbedded red, green-grey, red-grey, buff to (less commonly) white arkose, subarkose, quartzarenite, siltstone, shale and minor dolostone, stromatolitic to sand-bearing dolostone, and carbonate pebble conglomerate. It has been subdivided into lower (CP_L), middle (CP_M) and upper (CP_U) members (Fig. 3.19d; Table 2.5c). Sedimentary structures, present in the sandstone beds, include small to medium scale trough and planar crossbeds, and wave and current ripple marks. The carbonate beds contain tepees, dewatering structures,molar tooth structure and microfaults. Dolostone beds commonly contain low domal and laterally linked hemispheroidal stromatolites. Sandstone-dominated fining- and thinning-upward cycles occur locally in the subarkose and quartzarenite units and resemble cycles in the NA_L member (Figs. 3.4b and 3.4c). Thinning- and thickening-upward cycles and cyclic sequences, 2 m to 40 m thick, and made up of intermixed sandstone, siltstone, dolostone and shale also occur (Jackson and Iannelli, 1981, Fig. 16.23b, p. 288). Crossbed measurements and stromatolite mound elongations, indicate west-southwest paleocurrent trends (Jackson and Iannelli, 1981).

3.12.1 CP_L Member

The CP_L member consists of thick laminated to medium bedded, planar to wavy layered, fine- to coarse-grained subarkose (about 50%) and planar thick laminated to thin bedded siltstone (about 30%) (Plate 3.16, Fig. 4). Minor lithologies include sandy to argillaceous dolostone, stromatolitic dolostone and carbonate flat to round pebble conglomerate (Plate 3.16, Fig. 5). Rare oolitic and pisolitic dolostone beds also occur. The strata are mainly red to grey- or brown-red, less commonly pink-buff and brown- to pink-grey. The sandstones and siltstones make up units 5 m to 30 m thick. Conglomerate occurs locally as a basal layer. The member is 130 m

PLATE 3.16

Athole Point and Canada Point Formations

Fig. 1: Loaded contact between calcisiltite-calcilutite layer (lower part of the photo) and a graded calcarenite layer (turbidite) typical of the AP_L member. The strata outcrop on the northeast coast of Tremblay Sound.

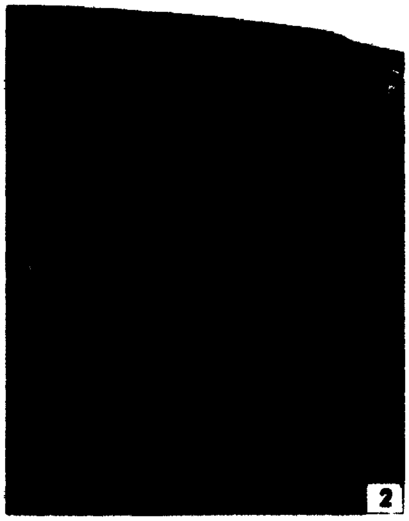
Fig. 2: Transition from buff- to light-grey limestone beds of the AP_M member up into intermixed dark-grey calciclastic limestones and buff-grey stromatolitic limestones of the AP_U member. The section illustrated is about 110 m thick and outcrops 50 km northwest of the end of Tremblay Sound.

Fig. 3: Bedding plane view of carbonate clast conglomerate at the base of the Canada Point Formation. This subrounded to angular calciclastic to stromatolitic dolostone clasts are set in a matrix of dolomitic arkose to litharenite. The conglomerate outcrops 15 km northeast of Canada Point on northwestern Bylot Island.

Fig. 4: Large scale trough crossbeds in red, banded pink, fine- to very coarse-grained subarkose. The strata occur in the lower part of the CP_L member in the same location as Fig. 3.

PLATE 3.16


1


2


3


4

thick at the type section.

3.12.2 CP_M Member

The gradationally-overlying CP_M member consist largely of grey-green to red thick laminated to thin bedded, planar to lensed siltstone, fine to coarse-grained quartzarenite to subarkose and planar thin laminated shale. Minor layers of buff- to dark-grey sandy dolostone also occur. These lithologies alternate in units 5 m to 10 m thick. The CP_M member is 165 m thick at the type section. Strata of the lower and middle members grade laterally, to the northwest and west, into sandstone, siltstone and conglomerate beds of the $SS_{RS/RA/MC}$ member.

3.12.3 CP_U Member

The CP_U member includes interlayered thick laminated to thin bedded, red to grey-green siltstone, thin planar laminated shale and fine- to coarse-grained subarkose and quartzarenite. Minor lithologies include layers and lenses of brown to grey, thin laminated to thin bedded dolostone and dolostone flat to round pebble conglomerate. The CP_U member is over 150 m thick at the type section. It gradationally overlies beds of the CP_M member and grades laterally to the west and northwest into the SS_{RS} member (Fig. 3.19d).

3.13 Lower Elwin Formation

The Lower Elwin Formation comprises the sandstone-dominated facies assemblage of the Middle Nunatsiaq Group (Figs. 2.4 and 2.5; Table 2.5d). It outcrops on north and northwestern Borden Peninsula, in the Elwin Inlet to Navy Board area (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). Complete sections range in thickness from 450 m on northern Borden Peninsula to 495 m at Elwin Inlet and reach a maximum of 540 m on northwestern Borden Peninsula (Fig. 3.21). The formation has a regionally consistent thickness distribution but there are local variations in member thicknesses. The suggested type section outcrops on the north coast of Elwin Inlet on northwestern Borden Peninsula (lower part of section 1 in Fig. 3.21; reference station 7N200 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.24a, p. 289).

The formation conformably and gradationally overlies siltstone, shale, subarkose and conglomerate beds of the SS_{GS}, SS_{GC} and SS_{GA} members. It passes gradationally upwards into crossbedded subarkose of the lowermost member of the Upper Elwin Formation (Fig. 3.21).

The Lower Elwin Formation comprises two regionally-defined lithofacies assemblages delineated on the basis of a gradual increase, to the east and southeast, in the amount of carbonate and arkose beds in the sequences (Fig. 3.21 and Table 2.5d):

(i). Northwest Lithofacies Assemblage: This assemblage is preserved in the northwest portion of Milne Inlet Trough and the central and northwest portions of Eclipse Troughs. It is mainly planar bedded to crossbedded subarkose and quartzarenite with lesser amounts of siltstone and shale. The Northwest

Assemblage has been subdivided into six members.

(ii). Southeast Lithofacies Assemblage: The Southeast Lithofacies Assemblage is preserved in southeast Eclipse Trough and consists of planar bedded to crossbedded quartzarenite to subarkose together with siltstone, stromatolitic dolostone and minor dolarenite and carbonate flat pebble conglomerate. The assemblage has been subdivided into two members.

3.13.1 Northwest Lithofacies Assemblage

Strata of the Northwest Lithofacies Assemblage have been subdivided into six members all but one of which are sandstone-dominated. Sedimentary structures include mainly small to medium scale wave and current marks, trough and planar crossbeds, load casts, convolute bedding, halite casts and hummocky cross-stratification. Synaeresis cracks, desiccation cracks and wavy to lenticular bedding occur in shale-bearing and intermixed shale-siltstone-sandstone units. There are rare rain-prints and gypsum casts. Small to medium scale, planar to crossbedded, sandstone-dominated thinning-upward cycles, similar to those in the NA_L member (Figs. 3.4b and 3.4c), occur in all members except member B_2 (Plate 3.17, Fig. 3). Small to medium scale fining- and thinning-upward, sandstone-siltstone-shale cycles also occur and are most abundant in members B_2, C and D. Paleocurrents, obtained mainly from crossbed measurements, are easterly- and southeasterly-directed (Table 2.8; Jackson et. al., 1985, Fig. 75.12, p. 648).

The lowermost member, A_1, consists of thin to medium bedded, buff to white quartzarenite and subarkose. The sandstone beds are planar to crossbedded and

PLATE 3.17

Lower Elwin Formation - Northwest Assemblage

Fig. 1: Members A_1 into C of the Lower Elwin Formation conformably overlying grey beds of the SS_{GC} member. The white sandstone band represents member A_1 at the base of the Lower Elwin Formation. Subarkose beds of member D are exposed in the foreground: 10 km north of the Elwin Icecap.

Fig. 2: Members C into D of the Lower Elwin Formation (foreground) and members 1 through 3 of the Upper Elwin Formation (background). Northwest Borden Peninsula, about 21 km east-southeast of Elwin Inlet.

Fig. 3: Alternating crossbedded, fine- to very coarse-grained pink subarkose and thick laminated to thin bedded red-brown siltstone and fine-grained subarkose of member A_2. Location as for Fig. 1.

Fig. 4: Member B_2, comprised of thin laminated red-brown shale and minor lenses and layers of thin bedded green-grey to grey-brown siltstone and subarkose. Location as for Fig. 2.

PLATE 3.17


1


2


3


4


5

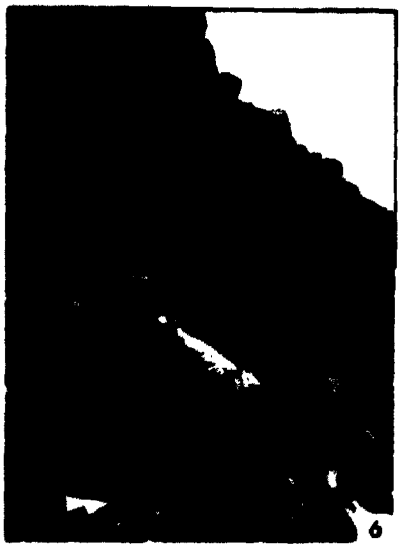

6

PLATE 3.17

Lower Elwin Formation - Northwest Assemblage

Fig. 5: Curvilinear shrinkage cracks on ripple marked surface of a coarse-grained subarkose bed from member C: 15 km northwest of the Elwin Icecap on northwest Borden Peninsula.

Fig. 6: Planar thin laminated to thin bedded, interlayered shale, siltstone and medium- to coarse-grained subarkose. The subarkose beds comprise 60% of the succession which occurs in the lower part of member D. Same general area as Fig. 5.

typically fine- to coarse-grained. Small to medium scale, sandstone-dominated thinning-upward cycles (e.g. Figs. 3.4b and 3.4c) alternate with units of planar bedded sandstone, in 1 m- to 5 m-thick sequences. Member A_1 ranges from 19 m thick, on northeast Borden Peninsula, to 33 m thick on northwest Borden Peninsula and is 41 m thick at the type section at Elwin Inlet. The strata define a westward-thickening wedge (Fig. 3.21).

The overlying A_2 member is thin to medium bedded buff, pink to red, planar bedded to crossbedded, fine- to coarse-grained subarkose interlayered with pink- to red-brown units of thick laminated shale, thin bedded quartzarenite and intermixed shale-siltstone-sandstone (Plate 3.17, Figs. 1 and 3). It consists entirely of small to medium scale, thinning- and fining-upward cycles. The cycles contain a lower part comprised of crossbedded and ripple marked, thin bedded buff-pink subarkose which passes up into thick laminated to thin planar bedded subarkose, siltstone and shale that commonly contain ripple marks, halite casts and desiccation cracks. In Eclipse Trough the member ranges from 173 m on northeast Borden Peninsula to 78 m on northwest Borden Peninsula; it is 100 m thick at the type section (Fig. 3.21).

The A_2 beds are gradationally overlain by member B_1. They consist of pink- to grey-buff and purple-red, planar bedded to crossbedded subarkose interlayered with 1 m- to 3 m-thick units of orange-brown, buff-brown to green-grey thin bedded dolostone, stromatolitic dolostone, dolarenite, dolomitic subarkose and interlyered thick laminated to thin bedded shale-siltstone-sandstone. The subarkose beds are typically medium- to coarse-grained. Stromatolitic dolostone beds locally contain small, low domal mounds. The member thins slightly to the west and is 62 m thick on northwestern Borden Peninsula. It decreases to 33 m at Elwin Inlet (Fig. 3.21).

The strata of member B_2 consist mainly of planar thin laminated green, green-grey to (less commonly) red shale and minor interlayered very thin to medium bedded, green-grey to grey-brown siltstone and fine- to coarse-grained subarkose and arkose (Plate 3.17, Fig. 4). The siltstone and sandstone beds comprise less than 10% of the member and commonly have scoured and loaded bases. In northwestern Borden Peninsula the shale beds are separated by a 10 m- to 30 m-thick, thin-bedded grey subarkose submember. In this area the lower shale succession contains lower red and upper green sub- divisions; the upper shale succession is green to grey-green. The member is 70 m thick on northern Borden Peninsula, thickens to 93 m on northwestern Borden Peninsula and thins to 59 m at the type section along the north coast of Elwin Inlet (Fig. 3.21).

Varicoloured beds of member C comprise purple- to pink-red and purple- to green-grey, planar bedded to crossbedded, thick laminated to medium bedded subarkose with minor interlayers of thin laminated to thin bedded dolostone and dolarenite and intermixed shale-siltstone-sandstone (Plate 3.17, Fig. 5). The subarkose beds are fine- to coarse-grained. Small to medium scale fining- and thinning-upward cycles, similar to those in members A_1 and A_2, are common throughout the member (Jackson et. al., 1985, Fig. 75.10, p. 646). It thickens towards northwestern Borden Peninsula. It is 112 m on northeast Borden Peninsula, thickens to 170 m on northwest Borden Peninsula and thins westwards to 137 m at the type section (Fig. 3.21).

The uppermost member, D, includes purple- to pink-red, purple-red, mottled or banded buff-grey alternating layers of planar to crossbedded, fine- to coarse-grained subarkose and quartzarenite with minor layers and lenses of thin to thick laminated shale and intermixed shale-siltstone-sandstone (Plate 3.17, Fig. 6). Small to medium scale, planar to crossbedded, sandstone-dominated fining- and thinning-upward cycles, similar to those observed in the NA_L member, are common throughout member D. Strata thicken gradually to the west and range from 86 m on north Borden Peninsula, to 112 m northwest of the Elwin Icecap and to 125 m at the type section (Fig. 3.21). These strata are gradationally overlain by sandstone beds of the Upper Elwin Formation.

3.13.2 Southeast Lithofacies Assemblage

Strata of the Southeast Lithofacies Assemblage have been subdivided into two members: a lower member ($A+B_{SE}$) tentatively correlated with members A_1 through B_2 of the Northwest Assemblage, and an upper member ($C+D_{SE}$) tentatively equated with members C and D of the Northwest Assemblage.

Sedimentary structures include small to medium scale trough and planar crossbeds, small to medium scale wave and current ripple marks, synaeresis and desiccation cracks and small load casts. Small to medium scale fining- and thinning-upward cycles include sandstone-dominated types (e.g. Figs. 3.4b and 3.4c) and mixed sandstone and carbonate, thinning- and coarsening-upward cycles (Jackson and Iannelli, 1981, Fig. 16.23, p. 288). Small stromatolite mounds, 10 cm to 30 cm in height, occur locally in the dolostone beds; they are comprised of simple, low domal and laterally-linked hemispheroidal forms. Directional information, derived from stromatolite mounds, indicates east-west paleocurrent trends (Jackson et. al., 1980,

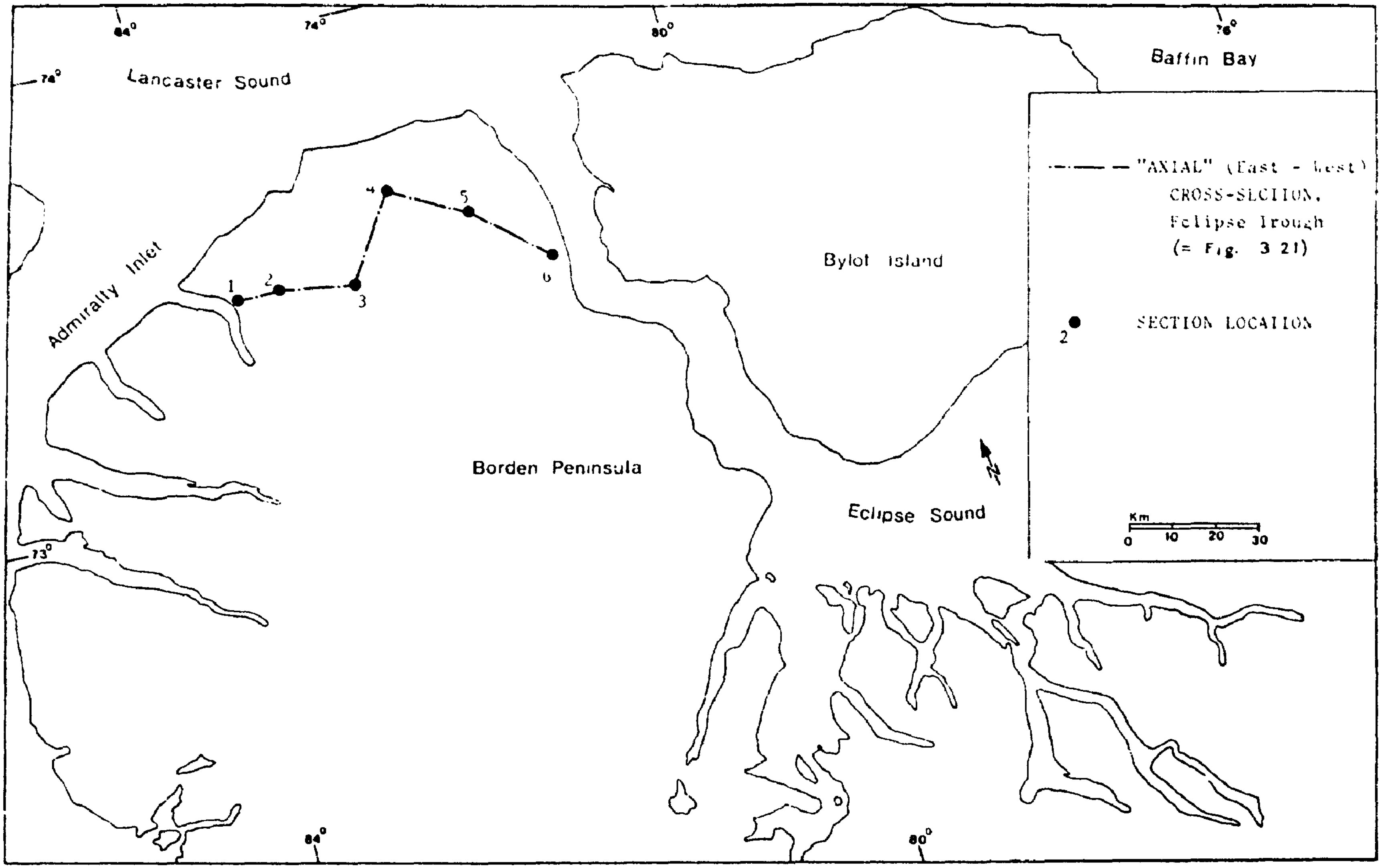


Fig. 3.20: Location map for regional cross-sections of the Lower Elwin and Upper Elwin Formations.

FIG. 3.21: LOWER ELWIN AND UPPER
FORMATIONS- AXIAL (W—

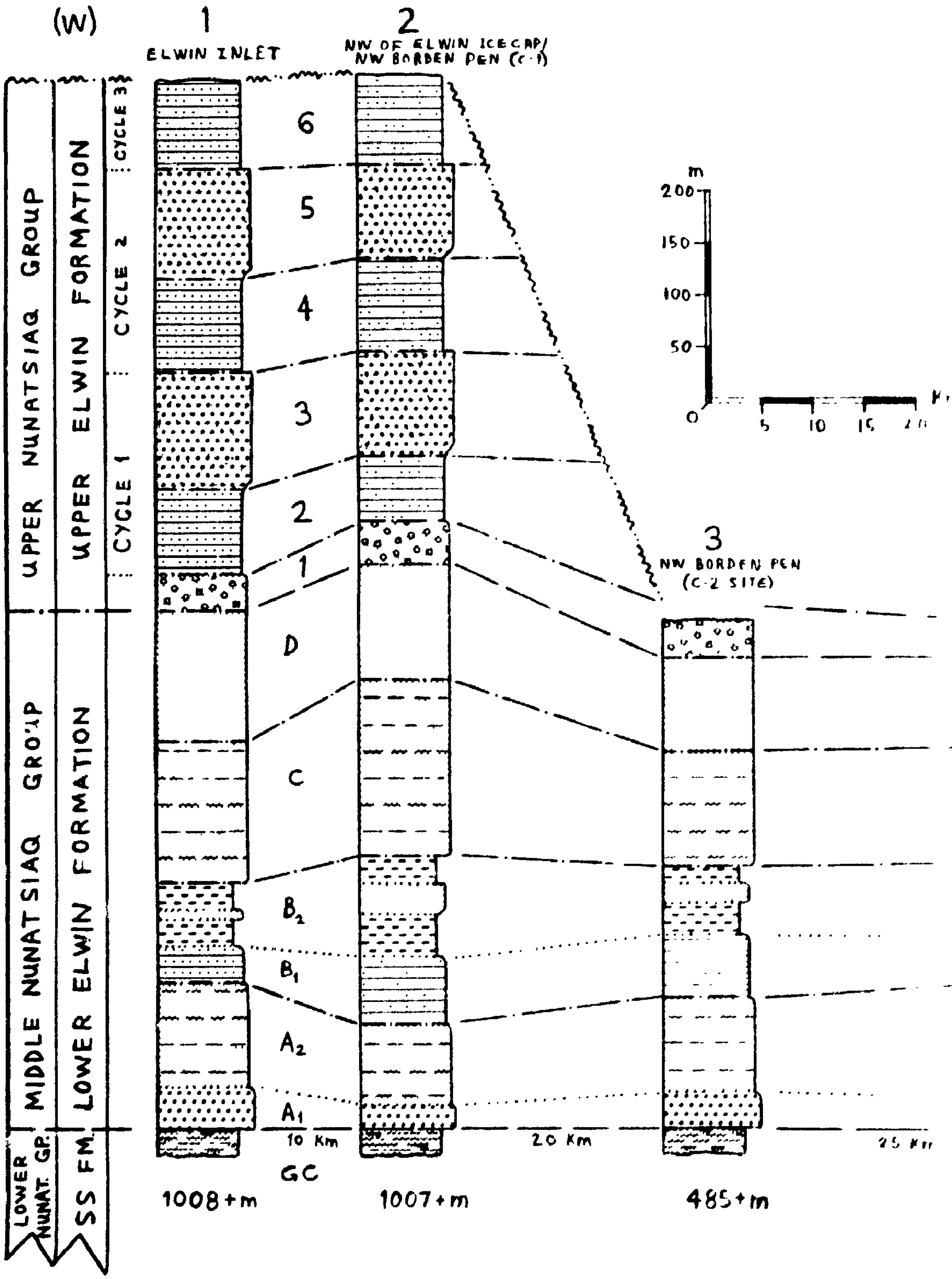


FIG. 3.21: LOWER ELWIN AND UPPER ELWIN FORMATIONS- AXIAL (W-E) CROSS-SECTION, ECLIPSE TROUGH.

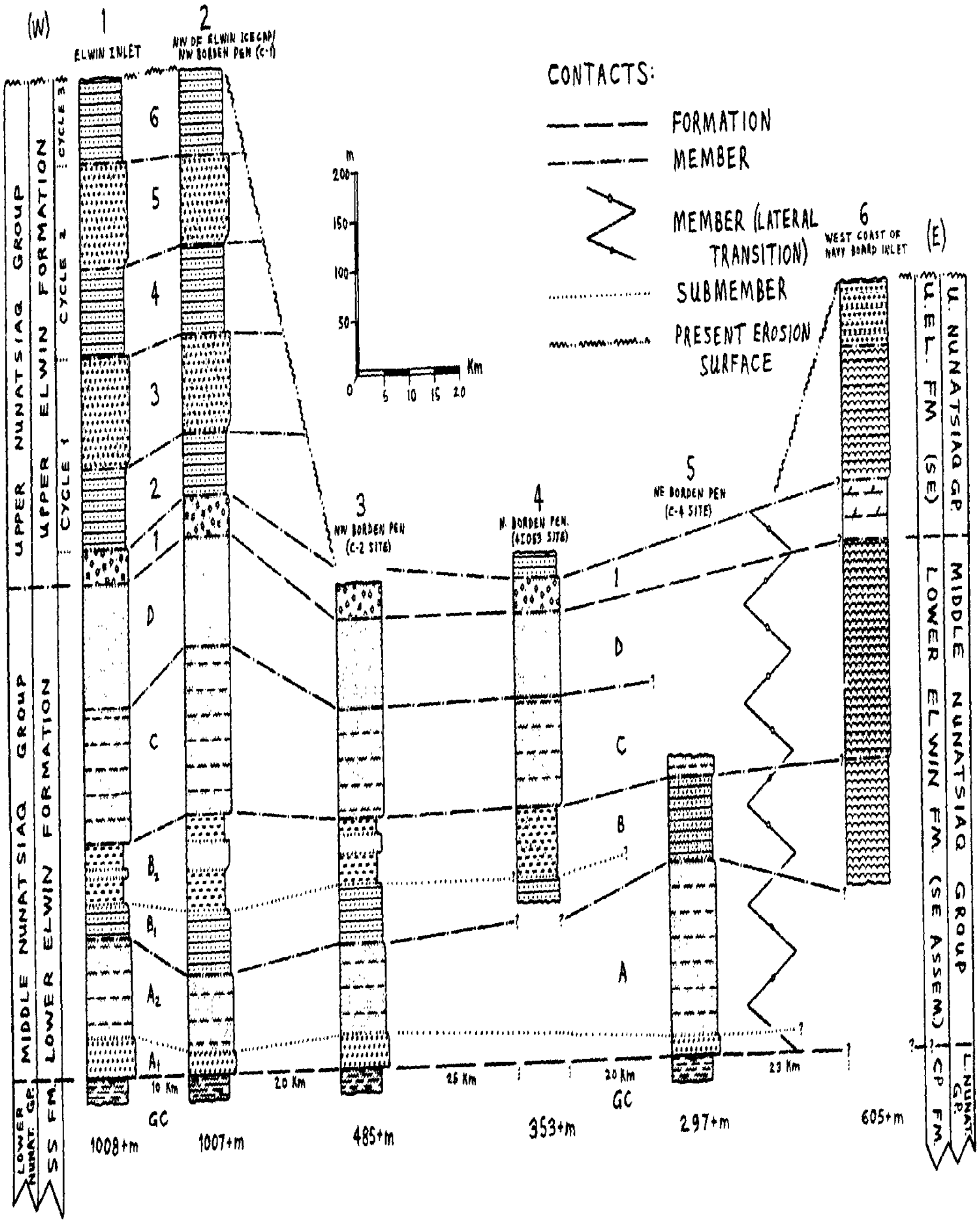


Fig. 46.2, p. 322).

The lower member, $A+B_{SE}$, comprises buff-grey to pink-grey, thin to medium bedded, planar to crossbedded siltstone and fine- to coarse-grained quartzarenite mixed with buff-to orange-brown stromatolitic dolostone. Minor lithologies include thick laminated to thin bedded sand-bearing dolostone, dolarenite and rare dolorudite, dolosiltite and flat carbonate pebble conglomerate. Small domal stromatolitic mounds are present in the dolostone beds and typically occur interlayered with dolosiltite, dolarenite and associated flat carbonate clast conglomerate. The unit is at least 125 m thick along the west coast of Navy Board Inlet (Fig. 3.21).

The gradationally-overlying beds of member $C+D_{SE}$ consist of purple-red, red-pink to buff-grey thick laminated to medium bedded, planar to crossbedded arkose and stromatolitic dolostone to sandy dolostone. Minor layers of thick laminated siltstone and dolarenite also occur. The sandstone beds are medium to very coarse-grained and contain scattered trough and planar crossbeds. The member is 220 m thick (Fig. 3.21).

3.14 Upper Elwin Formation

The strata of the Upper Elwin Formation represent the intermixed shale-siltstone-sandstone - dominated facies assemblage of the Upper Nunatsiaq Group (Figs. 2.4 and 2.5; Table 2.5d). Sequences outcrop on northwestern and northeastern Borden Peninsula (Fig. 1.1; Jackson and Iannelli, 1981, Fig. 16.2, p. 272). Partial sections range from about 260 m thick on northeastern Borden Peninsula, to 467 m thick northwest of the Elwin Icecap, to over 511 m on northwestern Borden Peninsula

(Fig. 3.21). The suggested type section outcrops on the north coast of Elwin Inlet (upper part of section 1 in Fig. 3.21; reference station 4K017 in Appendices I and II; illustrated in Jackson and Iannelli, 1981, Fig. 16.24a, p. 289). The Upper Elwin Formation conformably and gradationally overlies crossbedded subarkose and quartzarenite beds of member D of the Lower Elwin Formation. The beds are overlain by Lower Paleozoic strata at an angular unconformity.

The Upper Elwin Formation, as with the previous formation, can be separated into two regionally-distinct lithofacies assemblages. The Northwest and Southeast assemblages are defined on the basis of a gradual increase, to the east and southeast, in the concentration of interlayered subarkose, arkose and carbonate beds (Fig. 3.21 and Table 2.5d):

(i). Northwest Lithofacies Assemblage: This assemblage fills the northwestern parts of Milne Inlet and Eclipse Troughs. It is comprised of alternating units of shale, intermixed shale-siltstone-sandstone and quartzarenite arranged into at least three upward-thickening megacycles. The Northwest Assemblage has been subdivided into six members.

(ii). Southeast Lithofacies Assemblage: Sequences of the Southeast Lithofacies Assemblage outcrop in the southeastern part of Eclipse Trough; they consist of interlayered quartzarenite to arkose and minor beds of carbonate and shale.The assemblage has been subdivided into three members.

3.14.1 Northwest Lithofacies Assemblage

The Northwest Lithofacies Assemblage consists of alternating units of planar to crossbedded sandstone, shale and intermixed shale-siltstone-sandstone that have been grouped into six members. Sedimentary structures abound and include small to large scale trough and planar crossbeds (with heights of 5 cm to over 1 m), small to medium scale wave and current ripple marks, synaeresis cracks, hummocky cross-stratification, microfaults and load casts. Small to medium scale fining- and thinning-upward cycles, similar to those in several underlying formations (e.g. Figs. 3.4b and 3.4c) occur in the sandstone-dominated members. Medium to very large scale, thickening- and coarsening-upward cycles occur throughout the assemblage. They resemble cycles in the $AB_{U(M:U)}$ member of the Arctic Bay Formation. Small mounds, made up of low domal stromatolites, occur locally in the dolostone beds. Paleocurrent trends, from crossbed measurements, are highly variable (Table 2.8; Jackson et. al., 1985, Fig. 75.12, p. 648).

The lowermost member (member l) comprises thin to medium bedded, buff, grey- to green-buff, planar bedded to crossbedded fine- to coarse-grained subarkose. Trough and planar crossbeds are common; hummocky cross-stratification is locally present. Sandstone-dominated thinning-upward cycles alternate with planar bedded sequences as in member A_1 . Sequences are 37 m-thick in the vicinity of the type section and 43 m-thick northwest of Milne Inlet (Fig. 3.21).

The strata of members 2, 4 and 6 are similar and include alternating facies units of planar thin laminated dark-grey to black shale, grey to buff-grey planar to wavy layered, thick laminated to thin bedded intermixed shale-siltstone-sandstone, and buff-grey thick laminated to thin bedded subarkose and quartzarenite. The beds contain small to medium scale thinning- and thickening-upward cycles. Member 2 is 37 m to 43 m thick, member 4 is about 90 m thick and member 6 is over 86 m thick, in northwestern Borden Peninsula (Fig. 3.21).

The beds of members 2, 4 and 6 alternate with quartzarenites of members 3 and 5. The latter two members consist of thin to thick bedded buff, grey to (less commonly) orange-brown planar bedded to crossbedded quartzarenite interlayered with minor units of light- to dark-grey, planar to wavy bedded intermixed shale-siltstone-quartzarenite. Member 3 contains a 28 m-thick middle submember separating the quartzarenite beds. It is mainly quartzarenite with minor layers of shale-siltstone-sandstone. Member 3 ranges in thickness from 100 m to 113 m and member 5 from 104 m to 87 m in northwestern Borden Peninsula (Fig. 3.21).

Strata of members 2, 4 and 6 alternate with those of members 3 and 5 to define at least three thickening-upward megacycles. Complete megacycles range in thickness from 196 m to 194 m (Fig. 3.21).

3.14.2 Southeast Lithofacies Assemblage

The Southeast Lithofacies Assemblage comprises three members: a lower member (1_{SE}) tentatively correlated with member 1 of the Northwest Assemblage, a middle member ($2+3_{SE}$) tentatively equated with members 2 and 3 of the Northwest Assemblage and an upper member (4_{SE}) tentatively correlated with member 4 of the Northwest Assemblage (Fig. 3.21). Sedimentary structures and cycles are similar to those of the Southeast Assemblage of the Lower Elwin Formation.

Member 1_{SE} consists of buff- to pink-grey, thick laminated to medium bedded quartzarenite, subarkose and arkose. The sandstone beds are fine- to coarse-grained and alternate with minor buff-grey, thin laminated to thin bedded, planar to wavy layered dolostone and stromatolitic dolostone. It is 60 m-thick along the west coast of Navy Board Inlet and grades up into member $2+3_{SE}$.

Member $2+3_{SE}$ comprises pink- to red-grey and buff-grey planar bedded to crossbedded quartzarenite to arkose and interlayered buff to grey thin to thick laminated dolostone, stromatolitic dolostone and minor planar thick laminated shale, dolarenite and pebbly sandstone. It is 135 m-thick on northeastern Borden Peninsula (Fig. 3.21).

Strata of member 4_{SE} include thin to thick bedded, fine to coarse-grained quartzarenite to arkose with minor layers of thin planar laminated black-grey shale. Sedimentary structures include small to medium scale trough and planar crossbeds, and wave and current ripple marks. It is about 65 m-thick along the west coast of Navy Board Inlet.

CHAPTER 4: Depositional History of the Bylot Supergroup

The depositional history of the Bylot Supergroup is complex (Tables 4.1 to 4.1 to 4.4; Figs. 4.1 to 4.4). Lithofacies and paleocurrent analyses indicate that major, early-formed, structural features influenced the depositional history and tectonics influenced sedimentation throughout much of the history of the basin. Repeated uplift of crustal blocks along major fault zones is interpreted in terms of the evolutionary stages of a rift complex (Figs. 6.1. and 6.2). The Late Proterozoic disturbance, during which the basin evolved, is here termed the Borden Rift Episode (Tables 1.1 and 6.6).

Regional paleocurrent trends were directed to the west and northwest throughout most of the depositional history of the Eqalulik and Uluksan Groups (Table 2.8; Figs. 3.5). Paleocurrents flowed to the northeast, east and south (Table 2.8; Jackson et. al., 1985, Figs. 75.3 and 75.12) during deposition of the Nunatsiaq Group, reflecting the influence of new source areas during later stages of basin evolution (Figs. 6.1 and 6.2; Table 6.6).

Sedimentation patterns of the Upper Eqalulik, Lower Uluksan and Lower Nunatsiaq Groups (Figs. 4.1 to 4.4) reflect the influence of contemporaneous tectonism. Facies assemblages, in these units, are arranged into well-defined fault-marginal (proximal) and basinal (distal) complexes (Figs. 4.2, 4.3, 4.5 and 4.6).

TABLE 4.1: EQALULIK GROUP - DEPOSITIONAL ENVIRONMENTS

ARCTIC BAY FORMATION

(I). Upper Arctic Bay Formation (Regional Facies Assemblages)

(i). Central Borden Fault Zone Assemblage:

⁘	$AB_{U(M:U)}$ Member:	Mixed delta fan, coarse shoreline - marginal siliciclastic shelf deposits; dominated by cyclically arranged units of intermixed mud-silt-sand into mixed quartz- and feldspar-bearing sands and gravels; mud content decreases upwards and marginwards
▤	$AB_{U(M:L)}$ Member:	Marginal siliciclastic shelf complex (= coarse shoreline to shallow subtidal environments) characterised by prograding shoreface sequences; comprised of cyclically arranged units of mud, intermixed mud-silt-sand into quartz- and feldspar-bearing sand; mud content decreases upwards and marginwards; U(M:U) and U(M:L) members comprise a coarsening up megacycle

(ii). White Bay Fault Zone Assemblage:

┴	$AB_{U(M:WBFZ)}$ Mbr:	Mixed carbonate and siliciclastic shelf complex comprised of cyclically arranged units of mud, intermixed mud-silt-sand and bedded to stromatolitic carbonate; deposited in shoreface to shallow subtidal environments; rare carbonate clast storm deposits

(iii). Southeast Milne Inlet and Eclipse Troughs Assemblage:

≋	$AB_{U(SE:M)}$ Member:	Marginal deposits comprised of cyclically arranged, intermixed quartz- and feldspar-bearing sand and gravel, bedded carbonate and minor mud; sediments deposited in mixed braidplain, shoreface to intertidal shelf environments
▦	$AB_{U(SE:T)}$ Member:	Transitional shelf complex comprised of cyclically arranged mud, carbonate and sand deposited in supratidal to intertidal settings; marginal and transitional members comprise a coarsening- and thickening-up megacycle

(iv). Northwest (Axial) Milne Inlet and Eclipse Troughs Assemblage:

┴	$AB_{U(NW)}$ Member:	Incipient carbonate shelf with variably intermixed slope and basin deposits; intertidal to deep subtidal setting; deposits include mainly bedded to stromatolitic carbonate and laminated mud; minor calciclastics, quartz-bearing sands and gravels

(II). Lower and Middle Arctic Bay Formation:

░	Ab_M Member:	Shallow to deep subtidal deposits in shelf, slope to deep basin settings; dominated by thin laminated mud with minor thin silt and quartz-bearing sand beds (= distal turbidites or storm deposits); rare carbonate clast debris flows
▤	AB_L Member:	Siliciclastic shelf complex (= "retreating shoreface" complex) comprised of cyclically arranged units of mud, into intermixed mud-silt-sand and quartz-bearing sand; shoreface to shallow subtidal deposits; mud increases upwards in amount; sand increases marginwards in amount

ADAMS SOUND FORMATION

⁘	AS_U Member:	Siliciclastic shelf: shoreface to shallow subtidal settings; dominated by deposits of clean quartz sand
⁘	AS_M Member:	Siliciclastic shelf: intertidal to shallow subtidal settings; intermixed deposits of mud, silt and fine to medium sand
⁘	AS_L Member:	Siliciclastic shelf: shoreface to shallow subtidal settings; dominated by deposits of clean quartz sand

Southeast Milne Inlet Trough

⁘	$AS_{U(SE)}$ Member:	Siliciclastic shelf; shoreface to shallow subtidal settings; dominated by deposits of clean sand
▩	$AS_{L(SE)}$ Member:	Braidplain (marginal setting) and intermixed braidplain and shoreface deposits (basinal setting); dominated by quartz-bearing sands and gravels

NAUYAT FORMATION

VVVV	NA_U Member:	Basalt flows (= continental tholeiites) of variable thickness and extent; with a chemical composition transitional between continental tholeiites and mid-ocean ridge basalts; minor shallow marine interflow deposits; flows emplaced in a shallow marine basin
⁚	NA_L Member:	Siliciclastic shelf (setting as for AS_L and AS_U members); marginal braidplain deposits; locally with a single tholeiitic basalt flow emplaced in a shallow marine basin setting

L O W E R

TABLE 4.2 - ULUKSAN GROUP - DEPOSITIONAL ENVIRONMENTS

UPPER

VICTOR BAY FORMATION

▦	$VB_{U(U)}$ Member:	Carbonate platform comprised of intertidal to shallow subtidal, bedded to stromatolitic carbonates and minor mid to upper slope deposits; small to large scale stromatolitic mounds
▦	$VB_{U(L)}$ Member:	Mixed carbonate plaform, margin and slope deposits; shoreface, intertidal to basinal settings; includes slumps, debris flows and conglomerate filled channels
▦	VB_L Member:	Carbonate- and mud-bearing, mid to lower slope and basin deposits; shallow to deep subtidal settings; deposits include debris flows and turbidites

Northwest Milne Inlet and Eclipse Troughs

▦	SC - VB Undivided:	Uluksan Carbonate Platform Complex; comprised mainly of bedded to stromatolitic carbonates deposited in intertidal to shallow subtidal settings; small to large scale stromatolitic mounds

Southeast Eclipse Trough

▦	$SC_{U(SE)}$ - VB_{SE} Undivided:	Uluksan Carbonate Platform Complex (main features as above); minor calciclastic (including red carbonates) and siliciclastic deposits

LOWER

FABRICIUS FIORD FORMATION

▦	$FF_{U(3)}$ Member:	Fault-associated alluvial fan and delta fan deposits; sediments comprise a debris apron adjacent to fault margins
▦	$FF_{U(2)}$ Member:	Interfan or interdistributary carbonate bank deposits with associated stromatolitic mounds or small bioherms
▦	$FF_{U(1)}$ Member:	Upper delta fan complex with intermixed shoreline deposits; dominated by feldspar-bearing, fine to pebbly sand
▦	FF_L Member:	Lower delta fan complex with intermixed shoreline to shallow subtidal deposits; dominated by quartz- and feldspar-bearing sand

SOCIETY CLIFFS FORMATION

▦	$SC_{U(TR)}$ Member:	Upper, siliciclastic-bearing carbonate shelf deposits, transitional between those of the FF assemblage and the basinal SC_{NW} assemblage
▦	$SC_{L(TR)}$ Member:	Lower, siliciclastic-bearing carbonate shelf deposits
▦	SC_{TR} Undivided:	Siliciclastic-bearing, intertidal to shallow subtidal carbonate shelf; dominated by bedded, stromatolitic to sand-bearing carbonate
▦	$SC_{U(NW)}$ Member:	Carbonate platform deposits; shoreface to subtidal; bedded to stromatolitic carbonates; with small to large scale stromatolitic mounds
▦	$SC_{L(SE\ ECT)}$ Mbr:	Supratidal to intertidal, bedded to stromatolitic to gypsiferous carbonates, variably intermixed with bedded evaporites; deposited in a restricted carbonate basin
▦	$SC_{L(SE\ MIT)}$ Mbr:	Intermixed supratidal to intertidal carbonates (as above) and minor evaporites and shoreface to intertidal calciclastics and siliciclastics
▦	$SC_{L(NW\ MIT)}$ Mbr:	Intertidal to shallow subtidal deposits; comprised of variably intermixed laminated mud and bedded to conglomeratic carbonate

TABLE 4.3: LOWER NUNATSIAQ GROUP - DEPOSITIONAL ENVIRONMENTS

(A). Southeast Facies Assemblage:

(i). ATHOLE POINT FORMATION (Central and Southeast Milne Inlet Trough)

▦	AP_U Member:	Carbonate margin, slope and basin deposits; includes carbonate submarine fan sediments and carbonate turbidites; structures include channels and slumps
▦	AP_M Member:	Semi-restricted carbonate platform and related margin deposits; minor slope deposits; dominated by bedded to stromatolitic carbonate
▦	AP_L Member:	Carbonate margin, slope and basin deposits; includes carbonate turbidites and debris flows
▦	$AP_{L(R)}$ Mbr:	Carbonate reef complex comprised mainly of bedded and stromatolitic carbonate(= White Bay Reef complex); related off-reef carbonates interfinger with basinal deposits of the AP_L member

(ii). CANADA POINT FORMATION (Southeast Eclipse Trough)

▦	CP_U Member:	Calciclastic and siliciclastic shelf (intertidal - shallow subtidal setting) up into slope deposits
▦	CP_M Member:	Siliciclastic shelf, shoreface to shallow subtidal settings; dominated by quartz- and feldspar-bearing silts and sands; minor mud and carbonate
▦	CP_L Member:	Slope up into intermixed calciclastic - siliciclastic - carbonate shelf deposits; basinal to intertidal settings

(B). Northwest Facies Assemblage:

STRATHCONA SOUND FORMATION (Northwest Milne Inlet and Eclipse Troughs)

▦	SS_{FC} Member:	Marginal, alluvial to delta fan complex; sediments consist largely of continental to shallow marine fanglomerates that comprise a fault fringing talus apron
▦	SS_{GC} Member:	Intertidal to shallow subtidal deposits forming a shelf to shallow marine basin complex dominated by mixed calciclastic and siliciclastic sediments
▦	SS_{CS} Member:	Mud and silt dominated slope and basin deposits with scattered sand filled channels; sediments include distal submarine fan deposits and distal turbidites
▦	SS_{RA} Member:	Submarine fan complex comprised of fan and related slope and basin deposits; sediments comprise mainly inner to mid fan, minor outer fan deposits; fining upward cycles and sequences
▦	SS_{CA} Member:	Submarine fan complex comprised of fan and related slope and basin deposits; inner to mid-fan sediments; includes channel and canyon deposits, fining-up cycles and sequences
▦	SS_{RS} Member:	Silt and mud dominated slope and basin deposits with sand filled channels; sediments include distal submarine fan deposits and distal turbidites
▦	SS_{RC} Member:	Carbonate reef complex comprised of bedded to stromatolitic carbonate, carbonate breccia and conglomerate; characterised by small to large scale stromatolitic mounds, dilation breccia, spur and groove structure, steep ocean-facing margin
▦	$SS_{RS/RA/MC}$ Mbr:	Mid to lower slope deposits in marginal setting; comprised largely of intermixed mud, silt, sand and pebble to boulder conglomerate; with slumps and channel deposits
▦	SS_{CC} Member:	Carbonate-clast breccia-conglomerate aprons deposited adjacent to reef margins and carbonate platform margins
▦	SS_{MC} Member:	Large scale debris flow deposits in mid to upper slope and basin setting; comprised largely of carbonate-clast conglomerates

TABLE 4.4: MIDDLE AND UPPER NUNATSIAQ GROUP - DEPOSITIONAL ENVIRONMENTS

U P P E R

UPPER ELWIN FORMATION

(i). Northwest Milne Inlet and Eclipse Troughs

⛶	Members 3 & 5:	Upper siliciclastic shelf; shoreface to intertidal settings; includes beach, sandwave and offshore sand bar deposits; sediments dominated by clean quartz sand
□	Members 2,4 & 6:	Lower siliciclastic shelf; intertidal to shallow subtidal settings; dominated by variably intermixed mud, mud-silt-sand and quartz sand deposits
▨	Member 1:	Lower siliciclastic shelf; shoreface to shallow subtidal marine settings; dominated by deposits of intermixed quartz- and feldspar-bearing sand

(ii). Southeast Eclipse Trough

□	Member 4_{SE}:	Marginal shelf setting; nearshore feldspar- and quartz-bearing sand; minor gravel deposits
▨	Member $2\&3_{SE}$:	Shoreface to shallow subtidal settings; characterised by quartz- and feldspar-bearing sand and carbonate deposits; minor intermixed mud
□	Member 1_{SE}:	Shoreface to shallow subtidal settings with marginal mixed braid-plain and shoreface deposits; sediments dominated by feldspar- and quartz-bearing sand; minor bedded to stromatolitic carbonate

M I D D L E

LOWER ELWIN FORMATION

(ii). Northwest Milne Inlet and Eclipse Troughs

□	Members C & D:	Shoreface to shallow subtidal settings; includes beach and offshore sandbar and sandwave deposits; sediments dominated by feldspar- and quartz-bearing sand; minor carbonate and mud deposits
▤	Members B_1 & B_2:	Intertidal to shallow subtidal settings; includes intertidal shelf sand, mud and minor carbonate deposits (= member B_1) and mud dominated shelf, slope and basin deposits (= member B_2)
□	Members A_1 & A_2:	Intertidal to shallow subtidal deposits; dominated by clean, quartz- and feldspar-bearing sand (= member A_1); up into alluvial braid-plain sediments dominated by deposits of feldspar-bearing sand (= member A_2)

(ii). Southeast Eclipse Trough

▦	Member $C\&D_{SE}$:	Intermixed carbonate and siliciclastic shelf into mixed braidplain - shoreface deposits
▦	Member B_{SE}:	Intermixed carbonate and siliciclastic shelf deposits; local small scale stromatolitic mounds; shoreface to intertidal setting.
▦	Member A_{SE}:	Intermixed carbonate and siliciclastic shelf deposits; dominated by quartz-bearing silts and sands and by bedded to stromatolitic carbonate

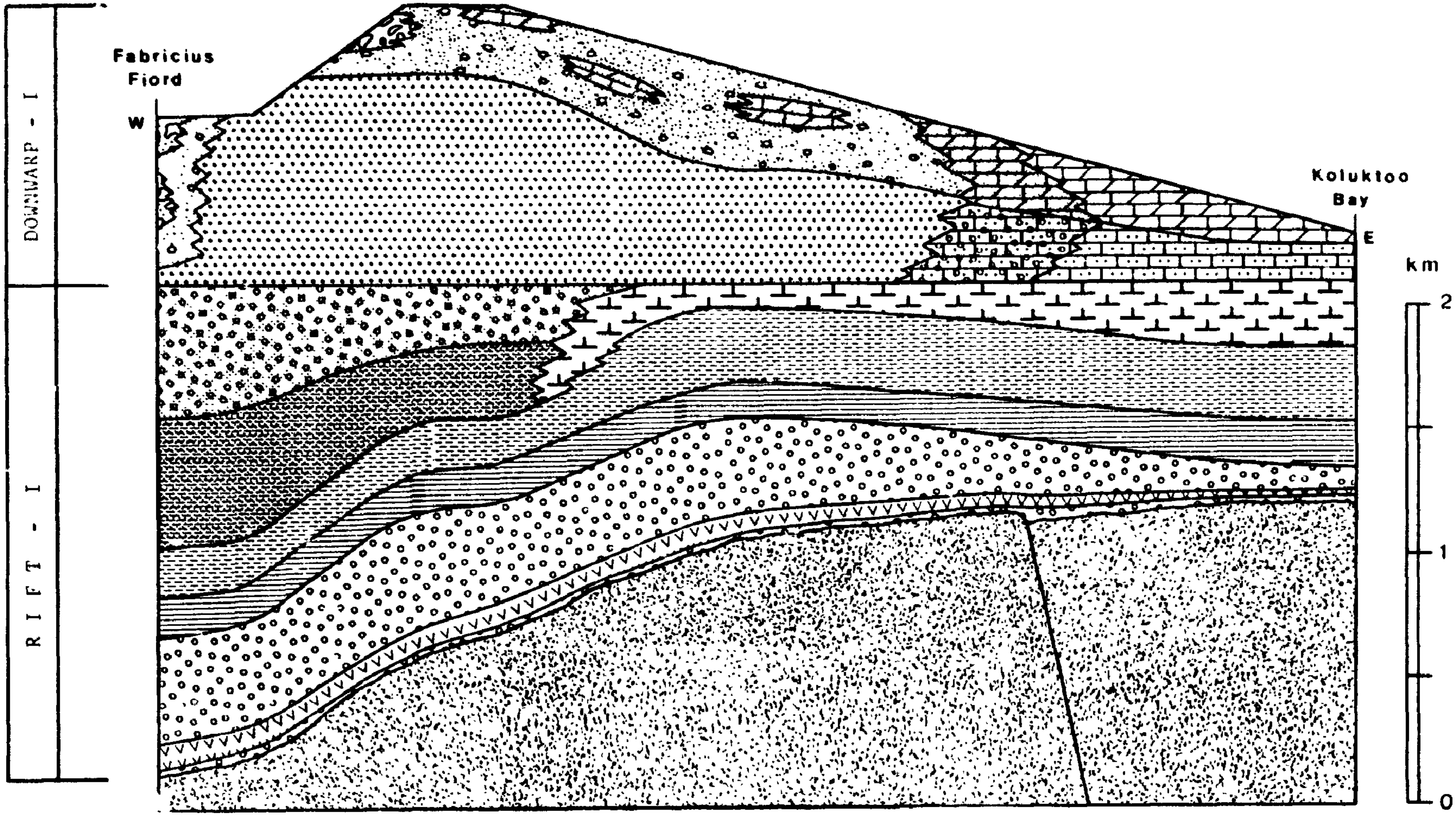


Fig. 4.2: Summary of depositional environments for strata adjacent to the Central Borden Fault Zone, west Milne Inlet Trough.

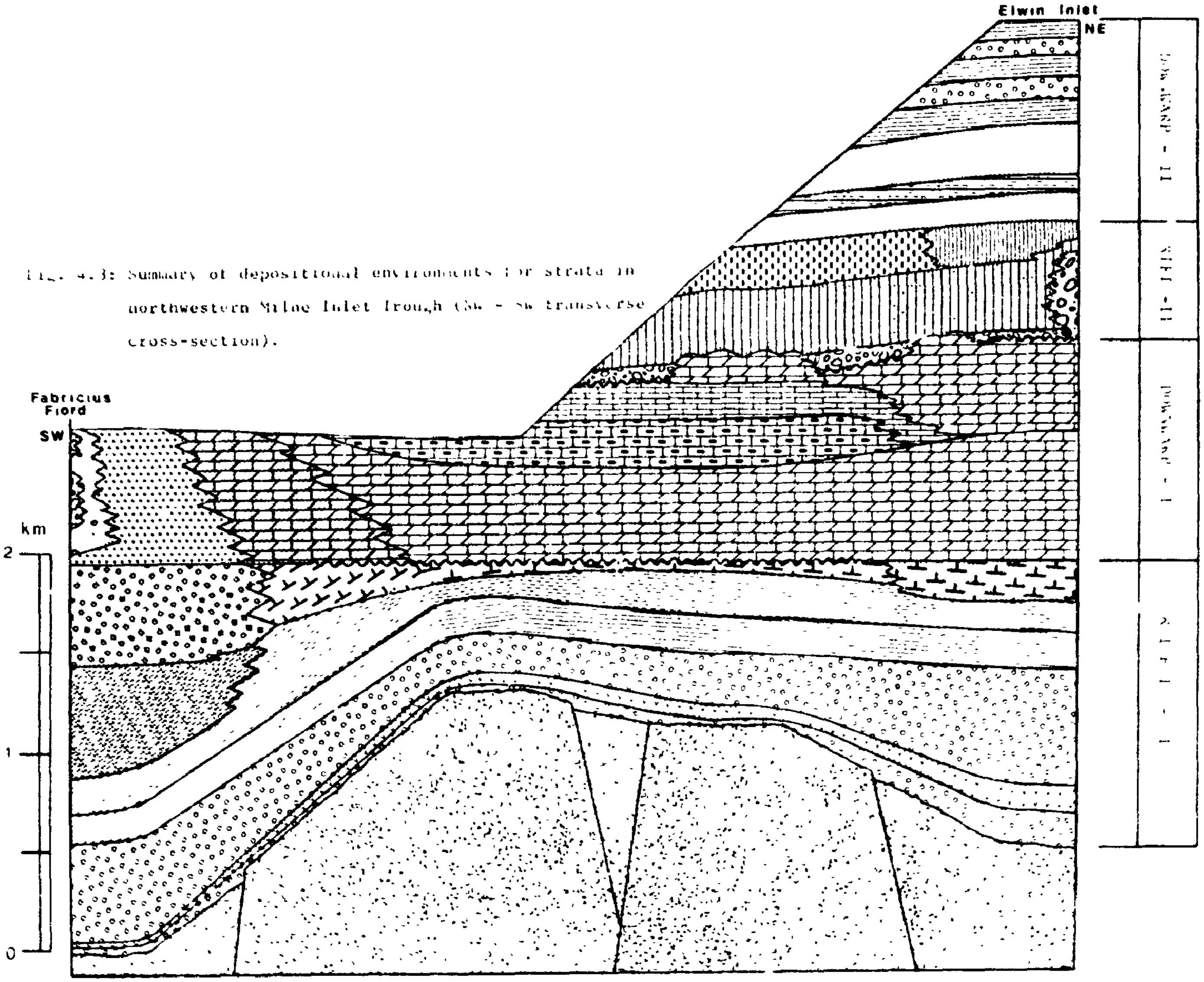


Fig. 4.3: Summary of depositional environments for strata in northwestern Milne Inlet Trough (NE - SW transverse cross-section).

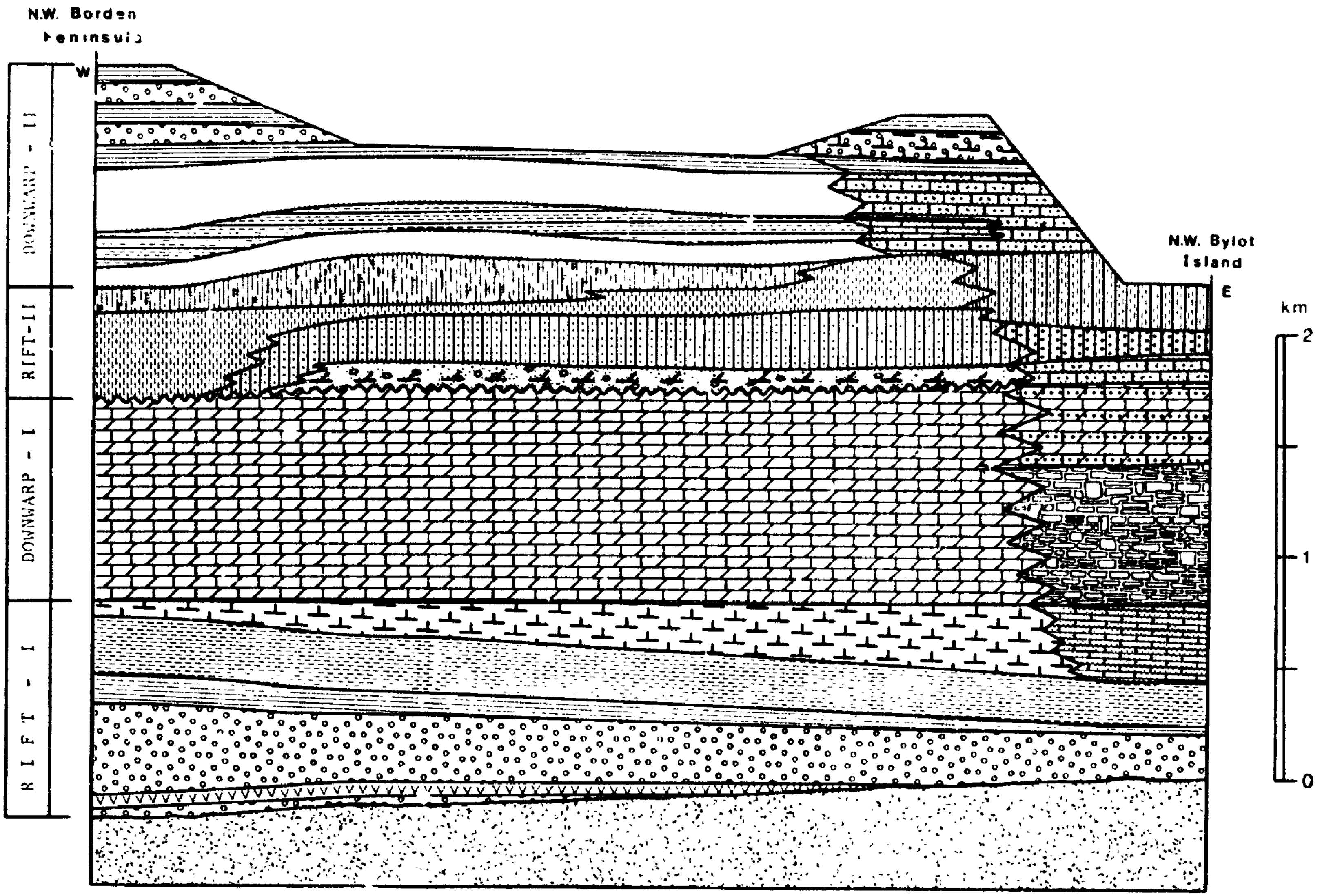


Fig. 4.4: Summary of depositional environments along the axis of the Eclipse Trough.

4.1 Eqalulik Group

4.1.1 Lower Eqalulik Group

Strata of the NA_L member are thought to represent a pre-rifting period with proximal braidplain sediments which interfingered, to the northwest, with shoreface to shallow subtidal sediments. The marine sediments eventually spread across the entire basin (Figs. 4.1 to 4.4). Sedimentation of the NA_L member was interrupted by a phase of rift-related regional basalt volcanism. Basalt flows, of the NA_U member, were extruded from major northwest-southeast - oriented fissures along and parallel to the axis of the basin (Fig. 6.1a and 6.2a). Such flows eventually covered most of the northwest portion of the Borden Basin (Figs. 4.1 to 4.4).

Shallow marine sedimentation continued throughout the deposition of the Adams Sound Formation. Sediments accumulated in beach to shallow marine shelf settings across most of the basin (Table 4.1; Figs. 4.1 to 4.4). In southeastern parts of the proto-troughs a thin fringe of marginally-situated, proximal to distal braidplain sediments were deposited (Fig. 4.1). Sediments, of the Adams Sound Formation, show little evidence of major tectonic influences, having accumulated during the passive stage of rift evolution (Figs. 6.1a and 6.2a; Table 6.6).

4.1.2 Upper Eqalulik Group

The Arctic Bay Formation has been subdivided into three lithofacies assemblages (Figs. 3.10 and 4.5; Tables 2.1 to 2.4) which constitute a conformable transgressive shallow-to-deep marine sequence with superimposed fault-influenced progradational terrigenous clastic complexes. These complexes were deposited in environments that included prograding beach ridges, tidal flats, tidal bars, delta fans, and mixed braidplain to alluvial fan siliciclastic wedges (Figs. 4.1 to 4.3; Table 4.1).

Lithofacies, paleocurrent trends and cycle distribution indicate roughly contemporaneous deposition of the following sediment assemblages (Figs. 4.1 to 4.4; Figs. 6.1a and 6.2a):

(1). Open marine siliciclastics, predominantly mud, silt and sand, deposited in the shelf to basin transition zone in the axial portions of the troughs and sub-basins (= AB_L member).

(2). Beach to shallow siliciclastic shelf sediments deposited along the margins of the northwestern portions of first-order troughs (= $AB_{L(M)}$ and $AB_{L(SE)}$ members).

(3). Shallow to deep subtidal deposition, primarily from suspension, in the basinal (i.e. central and northwestern) portions of the first-order troughs (= AB_M member).

(4). Intermixed terrigenous, calciclastic and carbonate sediments deposited around the margins of the southeastern portions of the first-order troughs; these deposits are associated with the semi-restricted, southeastern sub-basins of the Milne Inlet and Eclipse Troughs (= $AB_{U(SE:T)}$ member).

(5). Open to semi-restricted, shallow to deep marine carbonates and fine siliciclastics and calciclastics deposited in the transitional regime in central and southeastern sub-basins; these deposits include incipient carbonate shelf and carbonate slope and basin sediments (= AB_U member and related submembers).

(6). Polymictic orthoconglomerates and related immature sandstones deposited in fault-influenced alluvial fan and proximal braidplain environments in the southeastern portion of first-order troughs (= $AB_{U(SE:M)}$ member).

(7). Sandstones, pebbly sandstones and conglomerates forming medium to very large scale coarsening upward cycles deposited in marine-influenced delta fans and beach-to-shallow shelf complexes situated adjacent to fault margins (= $AB_{U(M:L)}$ and $AB_{U(M:U}$ members).

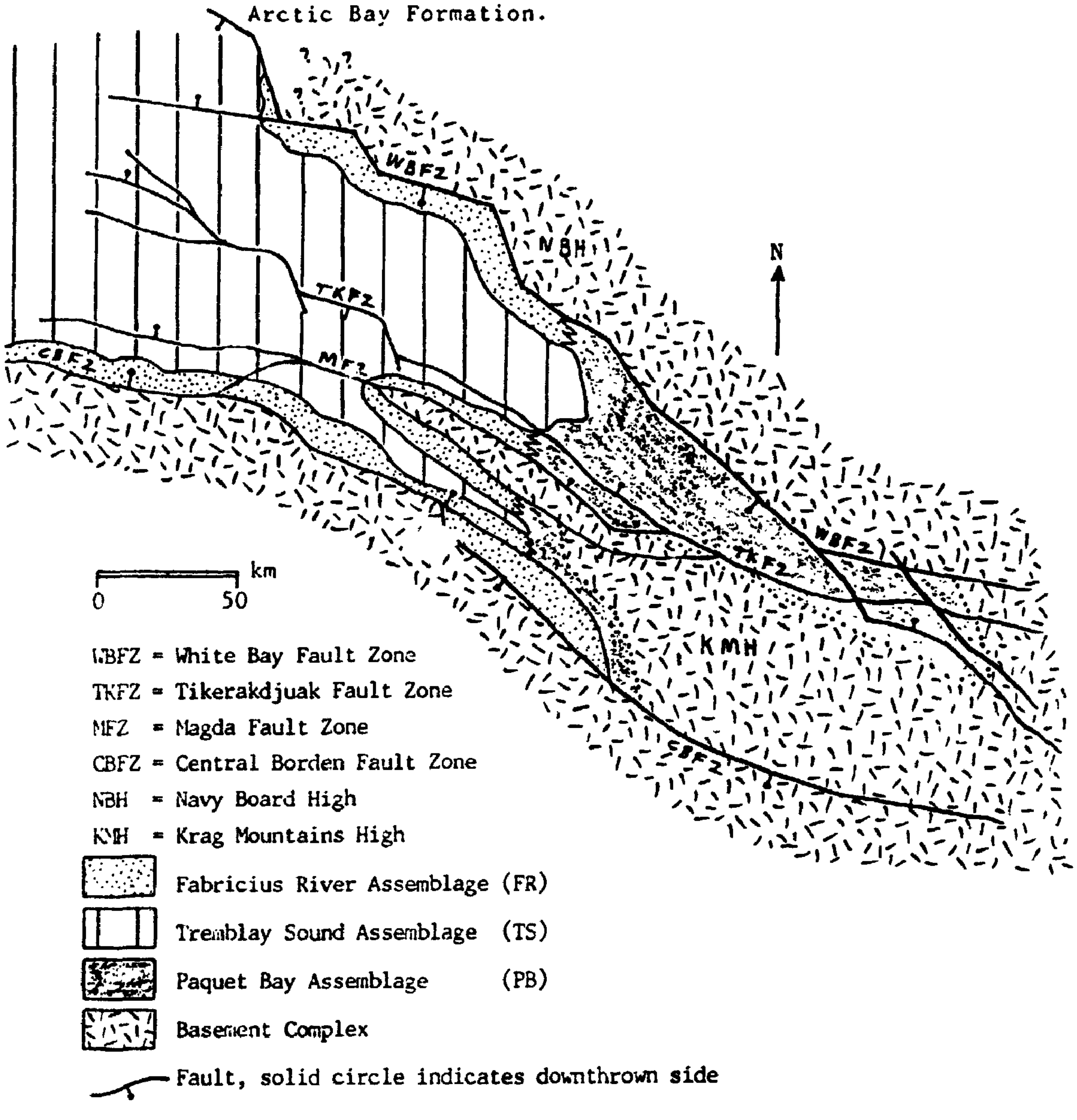
(8). Stromatolitic to evaporitic carbonates deposited in supratidal salt pans (coastal sabhkas) in the semi-restricted southeastern portions of first-order troughs (= $AB_{U(SE:M)}$ and $AB_{U(SE:T)}$ members).

4.1.3 Origin of Cycles in the Upper Eqalulik Group

During periods of regional faulting, tectonically-induced pulses of terrigenous clastic sediments spread across the basin. As fault activity diminished and the basin subsided, fine clastic and carbonate deposition resumed and gradually predominated as a result of basinwide transgression. This interplay between fault-induced clastic progradation and carbonate-clastic transgressive deposits caused the formation of numerous and varied cycles and repetitive lithofacies associations. Fault activity during deposition of the Upper Eqalulik Group caused the component troughs of Borden Basin to be filled by a largely cyclic succession of alternating shallow to deep marine sediments fringed by coarser intermixed siliciclastics and calciclastics (Plates 3.4 to 3.6). Cycles range from less than 5 m to more than 50 m in thickness and include clastic, mixed clastic-carbonate and carbonate facies, commonly comprising thickening- or coarsening-upward sequences (Figs. 2.2 to 2.5).

These cycles are interpreted as true erosion-sedimentation cycles in the sense of Illies and Baumann (1982). Repeated faulting in an active rift trough establishes a

Fig. 4.5: Distribution of facies assemblages in Milne Inlet Trough during the depositional history of the Arctic Bay Formation.



self-sustaining "conveyor belt" system of subsidence, uplift of source areas, sedimentation and subsequent cycle formation related to the attainment of isostatic equilibrium by the fault blocks. The balance is continually upset due to sediment input which results in periodic subsidence. Cyclic systems of this kind are typical of active rift troughs (Illies and Baumann, 1982; Steel and Gloppen, 1980).

4.2 Uluksan Group

The depositional history of the Uluksan Group was dominated by the establishment and construction of a regionally-extensive carbonate platform complex (Figs. 4.1 to 4.4; Figs. 6.1b and 6.2b). Marginal lithofacies assemblages, characterized by coarse siliciclastic deposits, are typical of the Lower Uluksan Group and constitute the Fabricius Fiord Formation (Table 4.2). Delta fan construction and growth dominated the depositional history of the Fabricius Fiord Formation. Growth and distribution of the fans took place during the transition from the active rift stage to the early downwarp stage (Table 6.6). Basinward of the fan complexes, platformal and restricted siliciclastic-influenced carbonate deposits accumulated (Figs. 4.1 to 4.3; Table 4.2).

The FF_L member includes deposits of prograding fan lobes, which coalesced to form regionally-extensive fan complexes. Five or six fan complexes accumulated along the Central Borden Fault Zone during the depositional history of the Lower Uluksan Group. These sediments comprised extensive fan platforms, upon which strata of the $FF_{U(1)}$ member were deposited. Depositional environments on the platform also included interlobe carbonate banks or bioherms ($FF_{U(2)}$ member), and conglomero-breccia talus wedges adjacent to fault margins (marginal alluvial fan deposits of the $FF_{U(3)}$ member; Figs. 4.2 and 4.3). These wedges of immature sediment were shed during periods of intense fault activity. As tectonism diminished and source areas were worn down, fan growth ceased and the fan complexes were gradually overwhelmed by transgressive platformal carbonates of the Society Cliffs and Victor Bay Formations (Figs. 4.2, 4.3, 6.1b and 6.2b).

Basinwards and southeastwards of the deposits of the Fabricius Fiord Formation, carbonates and minor siliciclastic sediments of the Society Cliffs Formation accumulated in a variety of continental to marine environments. Strata of the SC_L member, in the semi-restricted southeastern portions of Milne Inlet, Eclipse and North Bylot Troughs, accumulated in marginal alluvial fan, mixed braidplain - coastal, and supratidal to intertidal environments (Figs. 4.1, 4.3, 4.4 and 6.2b). Carbonates of the SC_U member represent the gradual buildup and expansion of a stromatolitic platform that developed during the relatively stable phase of the depositional history of the Lower Uluksan Group (Figs. 4.1 to 4.4; Table 6.6). Platformal carbonates eventually spread beyond the margins of the Borden Basin and may have been continuous with similar deposits of adjacent basins, such as the Fury and Hecla, and Thule Basins (Jackson and Iannelli, 1981; Fig. 16.33, p. 295).

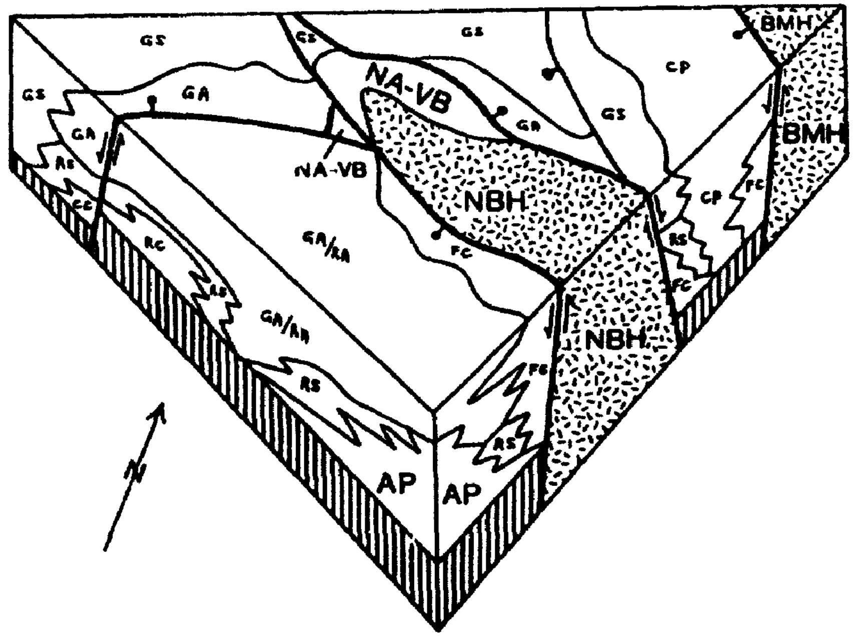
A carbonate platform was present throughout most of the Borden Basin during the deposition of the VB_U member. Strata of the VB_L member, however, appear to have accumulated in mid to lower slope and deep marine basin settings in a northwesterly-situated, mud-bearing sub-basin in Milne Inlet Trough (Table 4.2; Figs. 4.1 and 6.2b). Formation of the sub-basin was probably related to mild tectonic carbonates of the AP$_{M}$ member (Table 4.3; Fig. 4.1). The Athole Point Formation accumulated in the same sub-basin as the Arctic Bay (AB$_{U}$ submembers in central Milne Inlet Trough; AB$_{U(SE)}$ member in southeast Milne Inlet Trough) and Victor Bay (VB$_{L}$ member) Formations (Table 6.6). Eventually the sediments of the Athole Point Formation were overwhelmed by prograding siliciclastic deposits of the SS$_{RA}$ member of the Strathcona Sound Formation (Figs. 3.19 and 4.1).

Reactivation of fault systems in Eclipse and North Bylot Troughs (Fig. 6.2c) also took place. In Eclipse Trough, strata of the Canada Point Formation accumulated in a semi-restricted southeasterly-situated sub-basin; they represent the southeastern facies assemblage of the Lower Nunatsiaq Group in Eclipse Trough (Fig. 3.19d). Strata of the Canada Point Formation comprise intermixed marginal braidplain and beach-to-shallow marine shelf- to (less commonly) deep marine deposits. Marine environments ranged from intertidal to shallow tidal (Fig. 4.4; Table 4.3).

Depositional patterns in the Strathcona Sound Formation were strongly influenced by renewed tectonism during the second phase of rifting (the Rift II Stage; Table 6.6; Fig. 3.19). Strata of the Strathcona Sound Formation accumulated as part of a highly varied depositional regime (Table 4.3; Figs. 4.1, 4.3 and 4.4).

The SS$_{RC}$ and SS$_{CC}$ members represent a restricted carbonate platform, the last surviving remnants of the Upper Uluksan Carbonate Platform (Figs. 4.1 and 4.3).Carbonates and conglomerates accumulated in fore-reef, reef, back-reef and slope environments. Dilation breccia, related to rifting of the carbonate platform, was also produced. The surface of the platform was extensively reworked by tidal currents resulting in the formation of an impressive channel network (Jackson et. al., 1978a,

Fig. 4.6: Schematic diagram looking north-northwest, illustrating depositional relationships among formations of the Lower Nunatsiaq Group. The south-facing section trends along the axis of Milne Inlet Trough; whereas the east-facing sections extends from Milne Inlet Trough northward across Eclipse Trough to western Bylot Island (modified after Jackson and Iannelli, 1981). See Table 4.3 for an outline of the depositional environments.



LEGEND

Strathcona Sound Formation:

RC = SS_{RC} member
CC = SS_{CC} member
RS = SS_{RS} member
GS = SS_{GS} member
RA = SS_{RA} member
GA = SS_{GA} member
FC = SS_{FC} member

Athole Point Formation = AP

Canada Point Formation = CP

Nauyat to Victor Bay Formations = NA-VB

▥ Victor Bay Formation

▨ Basement Complex

BMH = Byam Martin High

NBH = Navy Board High

—•— Fault, solid circle indicates downthrown side

// Fault (cross-section view)

↓ Downthrown Block

↑ Upthrown Block

Fig. 4.6: Schematic diagram looking north-northwest, illustrating depositional relationships among formations of the Lower Nunatsiaq Group. The south-facing section trends along the axis of Milne Inlet Trough; whereas the east-facing sections extends from Milne Inlet Trough northward across Eclipse Trough to western Bylot Island (modified after Jackson and Iannelli, 1981). See Table 4.3 for an outline of the depositional environments.

LEGEND

Strathcona Sound Formation:

RC = SS_{RC} member   RA = SS_{RA} member
CC = SS_{CC} member   GA = SS_{GA} member
RS = SS_{RS} member   FC = SS_{FC} member
GS = SS_{GS} member

Athole Point Formation = AP

Canada Point Formation = CP

Nauyat to Victor Bay Formations = NA-VB

▥ Victor Bay Formation

▨ Basement Complex

BMH = Byam Martin High

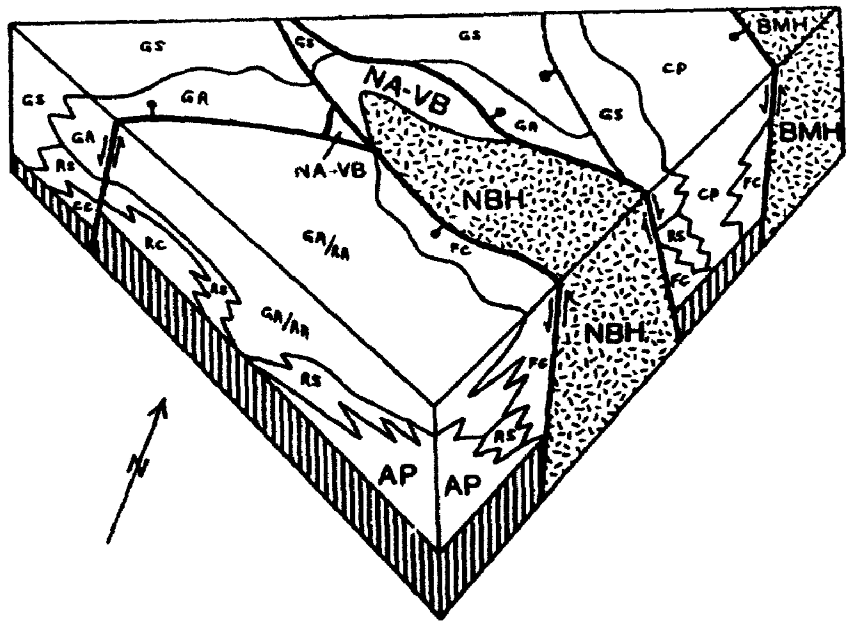
NBH = Navy Board High

Fault, solid circle indicates downthrown side

Fault (cross-section view)

Downthrown Block

Upthrown Block



siliciclastic shelf (Siliciclastic Shelf III; Table 6.6). This is mainly shallow subtidal to intertidal deposits formed in clastic shoreline and shallow marine shelf environments (Figs. 4.3, 4.4, 6.1d and 6.2d). In southeastern Eclipse Trough, shelf sediments interfingered with minor marginally situated continental sediments and with deposits of sand and carbonate that accumulated in a semi-restricted shallow marine shelf.

The construction of regionally-extensive siliciclastic shelves dominated the deposition of the Middle and Upper Nunatsiaq Group. Shelf deposits of the Lower Elwin and Upper Elwin Formations accumulated under an increasingly stable tectonic regime associated with basinwide subsidence and the continued evolution of a passive divergent margin (the Downwarp II Stage of basin evolution; Table 6.6 and Fig. 6.2d).

siliciclastic shelf (Siliciclastic Shelf III; Table 6.6). This is mainly shallow subtidal to intertidal deposits formed in clastic shoreline and shallow marine shelf environments (Figs. 4.3, 4.4, 6.1d and 6.2d). In southeastern Eclipse Trough, shelf sediments interfingered with minor marginally situated continental sediments and with deposits of sand and carbonate that accumulated in a semi-restricted shallow marine shelf.

The construction of regionally-extensive siliciclastic shelves dominated the deposition of the Middle and Upper Nunatsiaq Group. Shelf deposits of the Lower Elwin and Upper Elwin Formations accumulated under an increasingly stable tectonic regime associated with basinwide subsidence and the continued evolution of a passive divergent margin (the Downwarp II Stage of basin evolution; Table 6.6 and Fig. 6.2d).

CHAPTER 5: Structural Geology, Metamorphism and Diabase Dykes of the Borden Basin

5.1 Structural Geology

The Bylot Supergroup is preserved in a northwest - southeast trending graben called the North Baffin Rift Zone (Jackson and Davidson, 1975; Jackson and Iannelli, 1981, Fig. 16.26, p. 292). The large scale graben include (from northeast to southwest) the North Bylot, Eclipse and Milne Inlet Troughs (Fig. 5.4A). Geophysical evidence, from Lancaster Sound and Baffin Bay, indicates that the North Bylot Trough may be considerably larger than the portion that has been preserved on northern Bylot Island (McWhae, 1981). A fourth trough may also have been an integral part of the Borden Basin (McWhae, 1981). The major troughs are delineated by large scale, primary or first-order faults (Fig. 5.3) that dip steeply towards the graben (Figs. 5.4B to 5.4E and Fig. 5.5).

The Milne Inlet Trough is the largest trough of the North Baffin Rift Zone (Figs. 5.2 and 5.4A). It has a preserved length of about 400 km and widens from about 80 km at its southeastern end, in the area southeast of Paquet Bay, to over 125 km at its northwestern end, which is located in the vicinity of Admiralty Inlet (Figs. 5.2 and 5.4B to 5.4E). The northeastern limit, of the trough, is delineated by the White Bay Fault Zone, whereas the southwestern boundary is the Central Borden Fault Zone. The Tikerakdjuak Fault Zone bisects the trough. The northeastern part of the trough is down-dropped against the Navy Board and Tunuiaqtalik (new term) Highs, whereas the southwestern part abuts against Moffet High (new term) and

Inuktorfik High (new term) and, in part, forms the northeastern boundary of Phillips Creek Trough (Figs. 5.2 and 5.4B to 5.4E). Rocks of the Bylot Supergroup are distributed in northwest-southeast - oriented belts (Jackson and Iannelli, 1981, fig. 16.2, p. 272). The strata dip at low to moderate angles generally to the northeast, although in several areas strata dip to the south and southwest (Blackadar et. al., 1968a; Jackson et. al., 1975; Jackson et. al., 1978b; Fig. 5.1). In the vicinity of major fault zones, dips are moderate to steep and some units are strongly folded.

The Eclipse Trough, of northern Borden Peninsula and southwestern Bylot Island, has a preserved length of 250 km. The trough is about 50 km wide at its southeastern end and narrows to only 25 km at the mid point in western Bylot Island. It widens to over 75 km on northern Borden Peninsula (Figs. 5.2 and 5.4A). Strata of the Bylot Supergroup are preserved in east-west and northwest-southeast oriented belts in the northwestern portion of the trough (Jackson and Iannelli, 1981, Fig. 16.2, p. 272). It is also probable that Late Proterozoic strata are preserved beneath the more than 3.5 km of Cretaceous - Tertiary sedimentary rocks that infill the southeastern portion (Kerr, 1980; McWhae, 1981). The northeast margin of the trough is delineated by the Aktineq Fault Zone and the southwest margin by the Hartz Mountain Fault Zone. The northwestern end of the Hartz Mountain Fault Zone curves to the north; this trend is repeated by the two other major faults in the northwestern part of the trough (Figs. 5.2 and 5.4A).

The North Bylot Trough is a small preserved remnant on northern Bylot Island (Figs. 5.2 and 5.4A). Structural evidence, outlined in McWhae (1981, Fig. 2, p. 301), indicates that North Bylot Trough may have had an original length of about 200

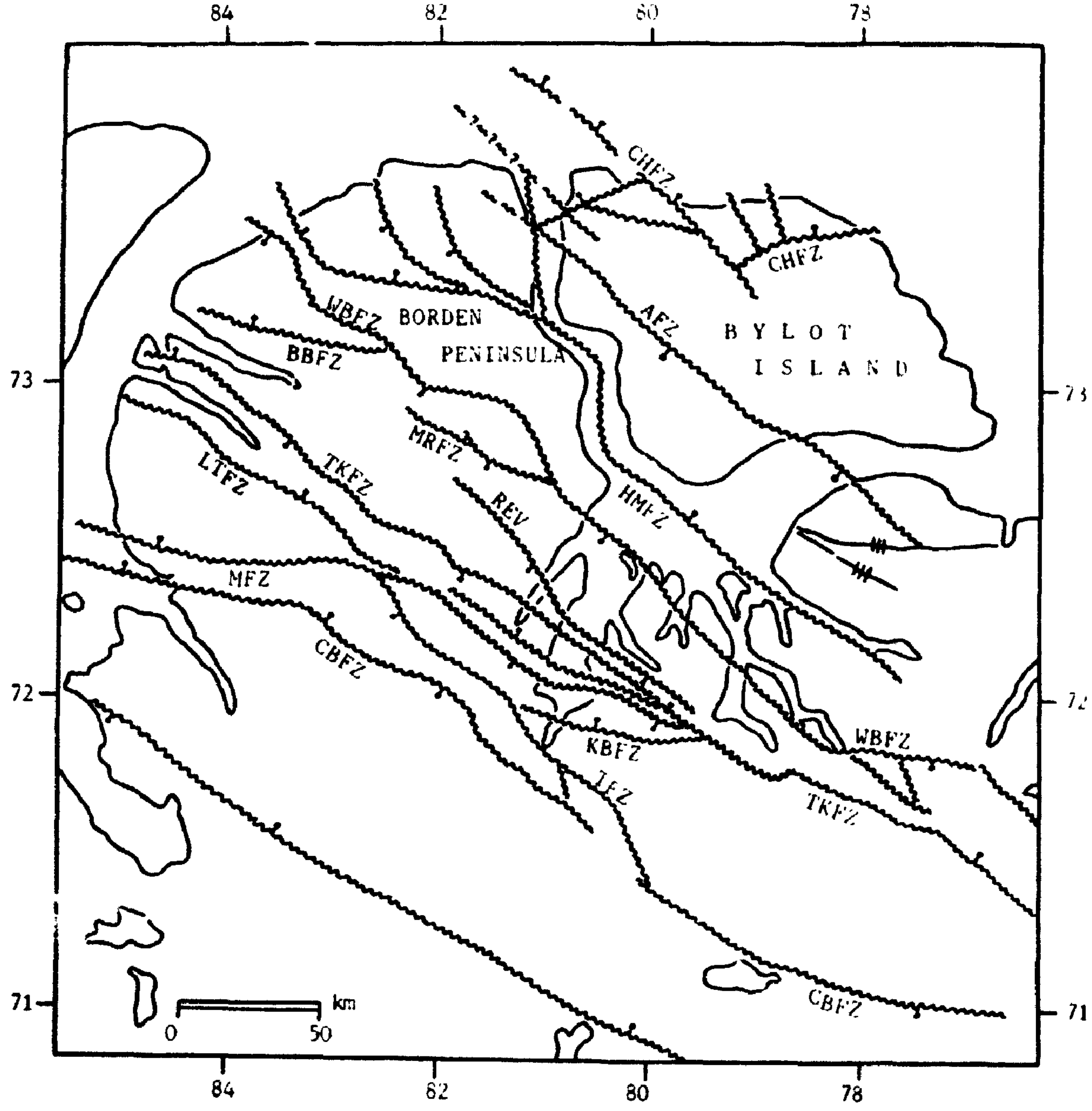


Fig. 5.3: An outline of the major (i.e. first-order) fault zones of the Borden Basin. Faults are indicated by wavy lines; downthrown blocks by the solid circles. See Table 5.2 and Fig. 5.1 for fault zone codes.

km and an average width of about 60 km. Part of the trough is buried beneath the waters of Lancaster Sound as part of the Lancaster Aulacogen (Kerr, 1979, 1980). The southern margin of the preserved portion of the trough is delineated by the Cape Hay Fault Zone (Figs. 5.1 and 5.3). The Eclipse and North Bylot Troughs are separated by Byam Martin High. They share a common inter-trough arch which is the northwestern extension of the Byam Martin High (Fig. 5.4A).

Late Proterozoic sedimentary rocks may also have been deposited in, and subsequently eroded from the Phillips Creek Trough (Figs. 5.2 and 5.4A). This trough is bounded by the Central Borden Fault Zone to the north and the Nina Bang Fault Zone to the south; it has been downdropped between the Krag Mountains and Inuktofik Highs to the north and the Steensby High to the south. It is also probable that the trough received sediments only during the Paleozoic (Trettin, 1969, 1975), and that a composite horst, the Moffet - Inuktorfik High, existed here during the Proterozoic.

The troughs are separated by horsts comprised of Archean - Aphebian gneiss and granite. The horsts and bounding faults, most of which have been previously named (Trettin, 1969; Jackson and Davidson, 1975; Jackson et. al., 1975) include the following from north to south (Figs. 5.2 and 5.4A):

(a). Philpots Ridge, in Baffin Bay, located northeast of the drowned portion of the North Bylot Trough in Lancaster Sound (McWhae, 1981, Fig. 2, p. 301).

(b). Byam Martin High, bounded by the Cape Hay Fault Zone to the north and the Aktineq Fault Zone to the south, and separating the North Bylot and Eclipse Troughs.

south-central part of the Milne Inlet Trough is tilted to the south and southwest (Figs. 5.4C to 5.4E). The first-order faults represent deep-seated, very long-lived structures (Table 1.1). The Tikerakdjuak Fault Zone, in particular, appears to have greatly affected the regional evolution of Borden Basin. The fault zone strongly influenced the depositional patterns of the Bylot Supergroup, acted as the major conduit for mineralized fluids both during and after deposition of the Bylot Supergroup (most of the major mineralization in Borden Basin occurs at or near this fault system) and as the major locus for dyke intrusion.

Second-order faults are smaller and splay off from and occur between the major fault zones (Fig. 5.1). They typically range from about 1 km to 100 km in length and generally have displacements of less than 100 m. These faults are more common in the northwest parts of the Milne Inlet and Eclipse Troughs (Fig. 5.1; Jackson and Iannelli, 1981, Fig. 16.25, p. 291). They formed both during and after deposition of the Bylot Supergroup and include normal and large scale growth faults (Plate 5.1, Fig. 2).

Third-order faults include structures ranging from those at the small end of the spectrum of second-order structures to faults with displacements of less than 1 m, which are apparent only at outcrop scale. They include both normal faults, growth faults and rare thrust faults. Thrust faults typically have eastward displacements of less than 1 m to several metres. They are most common in strata of the Upper Uluksan and Nunatsiaq Groups.

The first-order and larger second-order faults of the Borden Basin comprise mostly listric normal faults; reverse faults are less common, but are locally south-central part of the Milne Inlet Trough is tilted to the south and southwest (Figs. 5.4C to 5.4E). The first-order faults represent deep-seated, very long-lived structures (Table 1.1). The Tikerakdjuak Fault Zone, in particular, appears to have greatly affected the regional evolution of Borden Basin. The fault zone strongly influenced the depositional patterns of the Bylot Supergroup, acted as the major conduit for mineralized fluids both during and after deposition of the Bylot Supergroup (most of the major mineralization in Borden Basin occurs at or near this fault system) and as the major locus for dyke intrusion.

Second-order faults are smaller and splay off from and occur between the major fault zones (Fig. 5.1). They typically range from about 1 km to 100 km in length and generally have displacements of less than 100 m. These faults are more common in the northwest parts of the Milne Inlet and Eclipse Troughs (Fig. 5.1; Jackson and Iannelli, 1981, Fig. 16.25, p. 291). They formed both during and after deposition of the Bylot Supergroup and include normal and large scale growth faults (Plate 5.1, Fig. 2).

Third-order faults include structures ranging from those at the small end of the spectrum of second-order structures to faults with displacements of less than 1 m, which are apparent only at outcrop scale. They include both normal faults, growth faults and rare thrust faults. Thrust faults typically have eastward displacements of less than 1 m to several metres. They are most common in strata of the Upper Uluksan and Nunatsiaq Groups.

The first-order and larger second-order faults of the Borden Basin comprise mostly listric normal faults; reverse faults are less common, but are locally structurally significant (Plate 5.1, Fig. 5; Figs. 5.4B to 5.4E and Fig.5.5). Large scale reverse faults in the Milne Inlet and Eclipse Troughs were active both during and following the depositional history of the Borden Basin (Table 1.1).

The fault system of the Borden Basin has been active from at least the Aphebian to the Recent (Jackson and Morgan, 1978; Jackson et. al., 1975, 1978b; Jackson and Iannelli, 1981, 1989; Iannelli, 1979; McWhae, 1981). Syndepositional faulting, during deposition of the Bylot Supergroup, is suggested by numerous aspects of the sedimentology; these are summarised in Table 6.4. Major features include regional and local facies and thickness changes and variations in paleocurrent trends adjacent to and across the major fault zones (Figs. 3.10, 3.11, 3.13, 3.14, 3.16, 3.17, and 3.19). This evidence suggests that the troughs were depositional centres throughout most of the history of the Borden Basin (Fig. 6.2). The major fault zones of northern Baffin Island may have originated during the Hudsonian Orogeny as zones of crustal weakness (i.e. shear or suture zones) which later became major fault systems in the Late Proterozoic (Table 1.1; Fig. 1.7; Jackson et. al., 1990; G.D. Jackson, pers. comm., 1990).

Stratigraphic and sedimentologic data from the Bylot Supergroup (Table 6.4), have been used to subdivide the Milne Inlet and Eclipse Troughs into several sub-blocks and sub-troughs (Figs. 5.2 and 5.4A to 5.4E, and Fig. 5.5). The Milne Inlet Trough has been subdivided into five major blocks; these, in turn, have been subdivided into sub-blocks and sub-troughs (Figs. 5.2, 5.4A to 5.4E). In a similar manner, the Eclipse Trough has been subdivided into two major blocks, both of which have been further separated into sub-blocks and sub-troughs (Figs. 5.2, 5.4A and

Fig. 5.4: Structural cross-sections, Borden Basin.

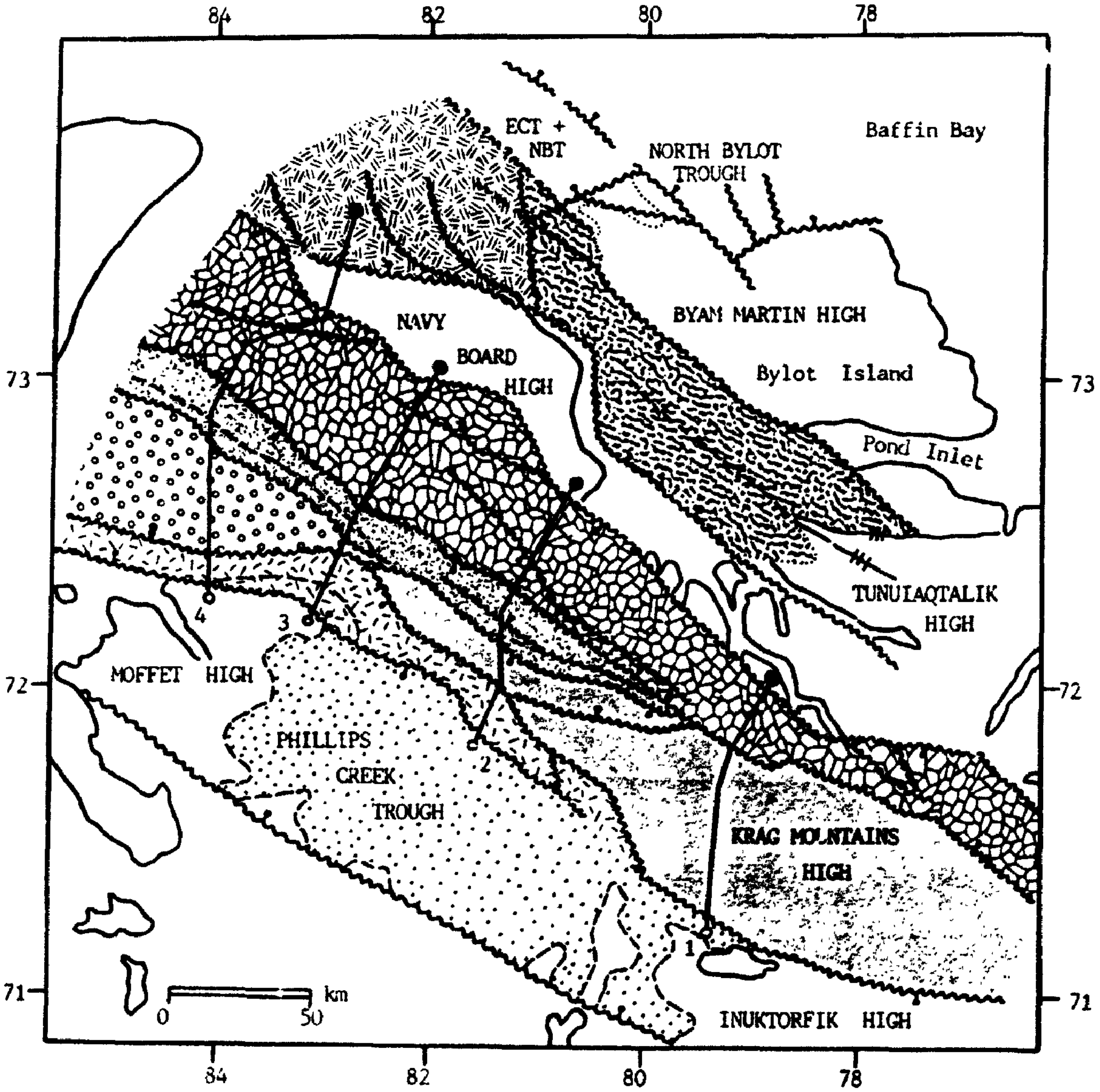
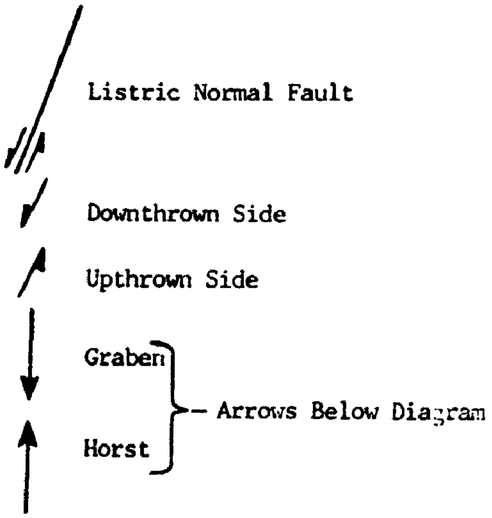


Fig. 5.4A: Location map for structural cross-sections.

TABLE 5.2: Legend for structural cross-sections, Figs. 5.4B to 5.4E.

(a). Fault Zones:

CBFZ = Central Borden Fault Zone
TKFZ = Tikerakdjuak Fault Zone
LTFZ = Little Tikerakdjuak Fault Zone
MFZ = Magda Fault Zone
MFZ (N),(S) = Magda Fault Zone; north and south splays (SE Milne Inlet Tr.)
WBFZ = White Bay Fault Zone
EFZ = Elwin Fault Zone
HMFZ = Hartz Mountain Fault Zone
SSFZ = Strathcona Sound Fault Zone
KBFZ = Koluktoo Bay Fault Zone
BBFZ = Baillarge Bay Fault Zone
REV = Reverse fault
FZ = Unnamed fault zone
MRFZ = Mala River Fault Zone



(b). Formation Symbols:

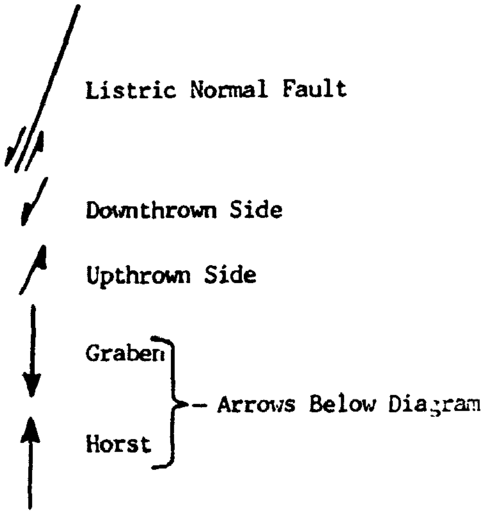
U.EL = Upper Elwin Formation
L.EL = Lower Elwin Formation
SS = Strathcona Sound Formation
AP = Athole Point Formation
VB = Victor Bay Formation
SC = Society Cliffs Formation
FF = Fabricius Fiord Formation
AB = Arctic Bay Formation
AS = Adams Sound Formation
NA = Nauyat Formation

▨ Adams Sound Formation
▨ Nauyat Formation
▨ Archean - Aphebian Basement Complex

TABLE 5.2: Legend for structural cross-sections, Figs. 5.4B to 5.4E.

(a). Fault Zones:

CBFZ = Central Borden Fault Zone
TKFZ = Tikerakdjuak Fault Zone
LTFZ = Little Tikerakdjuak Fault Zone
MFZ = Magda Fault Zone
MFZ (N),(S) = Magda Fault Zone; north and south splays (SE Milne Inlet Tr.)
WBFZ = White Bay Fault Zone
EFZ = Elwin Fault Zone
HMFZ = Hartz Mountain Fault Zone
SSFZ = Strathcona Sound Fault Zone
KBFZ = Koluktoo Bay Fault Zone
BBFZ = Baillarge Bay Fault Zone
REV = Reverse fault
FZ = Unnamed fault zone
MRFZ = Mala River Fault Zone



(b). Formation Symbols:

U.EL = Upper Elwin Formation
L.EL = Lower Elwin Formation
SS = Strathcona Sound Formation
AP = Athole Point Formation
VB = Victor Bay Formation
SC = Society Cliffs Formation
FF = Fabricius Fiord Formation
AB = Arctic Bay Formation
AS = Adams Sound Formation
NA = Nauyat Formation

░ Adams Sound Formation
▤ Nauyat Formation
▨ Archean - Aphebian Basement Complex

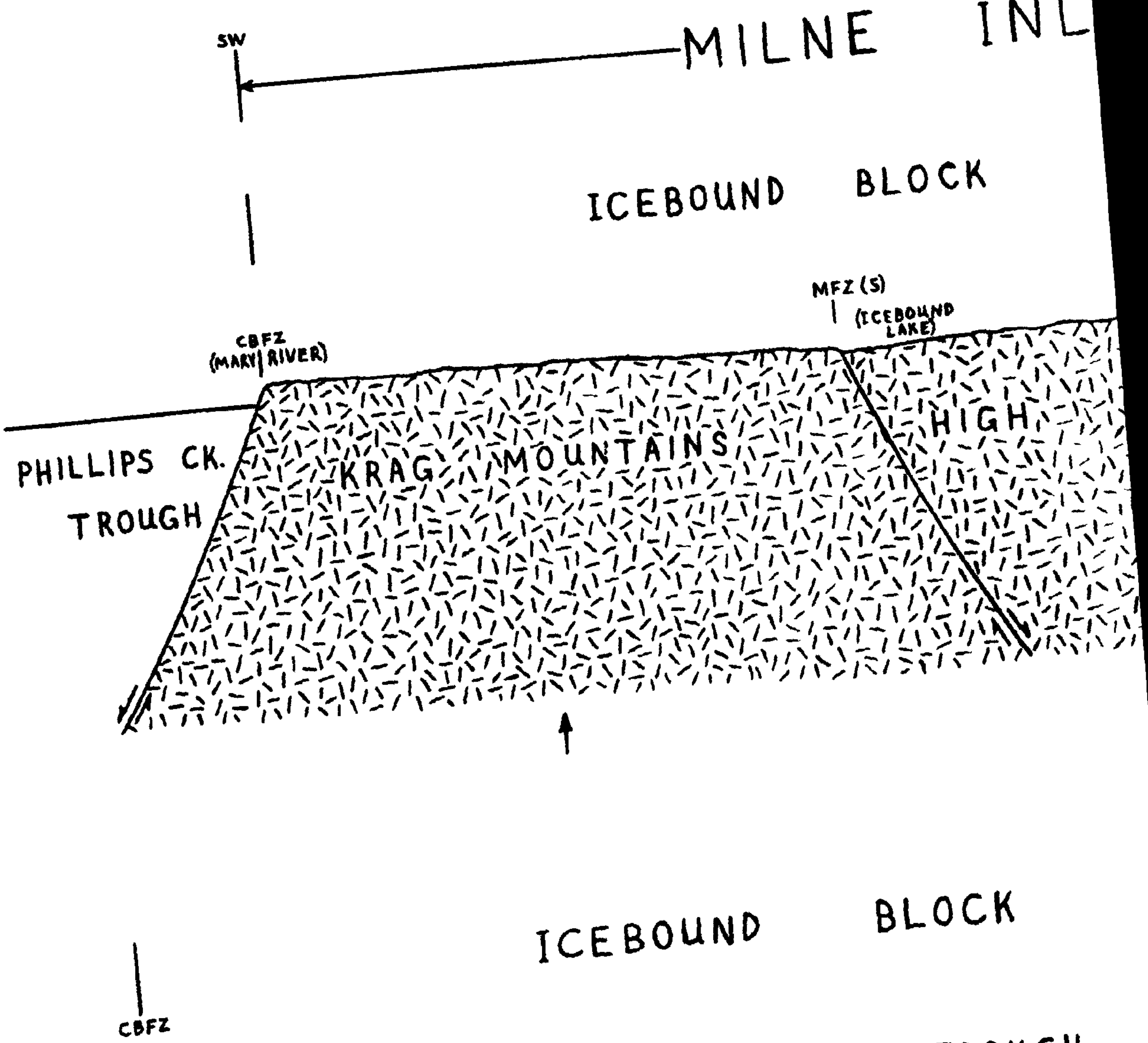


FIG. 5.4B: SECTION 1 - S.E. MILNE INLET TROUGH.

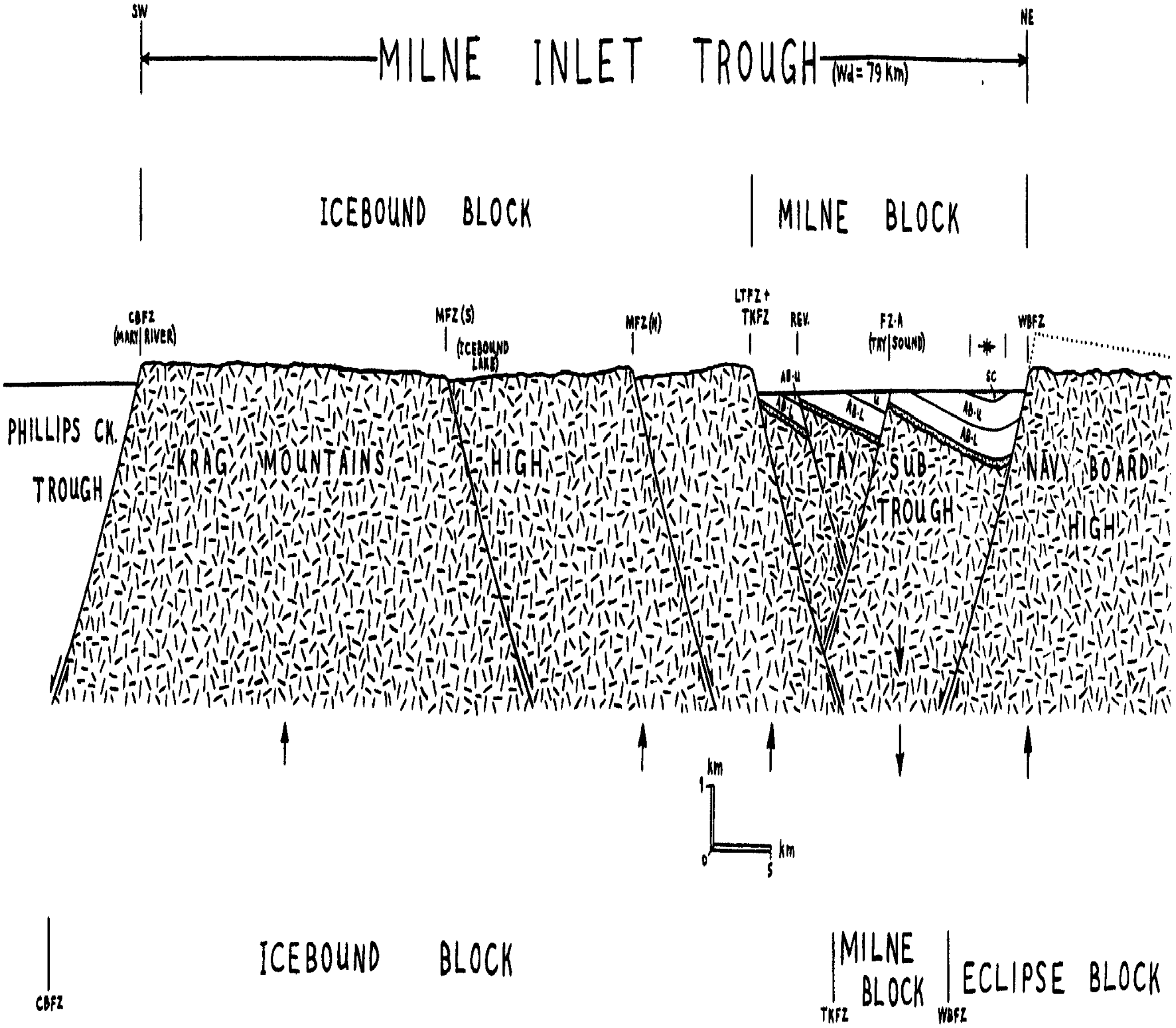


FIG. 5.4B: SECTION 1 - S.E. MILNE INLET TROUGH.

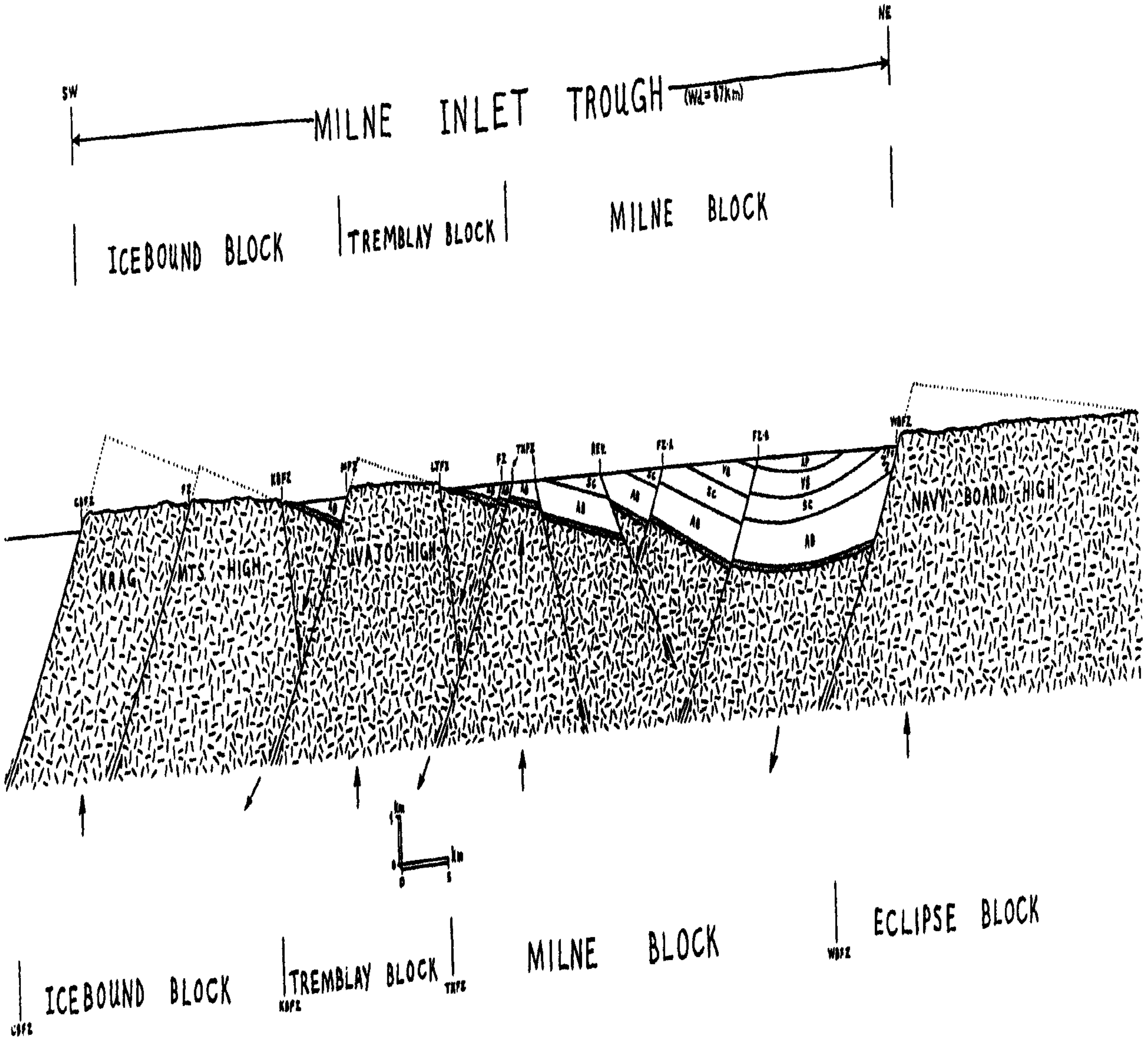


FIG. 5.4C: SECTION 2- CENTRAL MILNE INLET TROUGH.

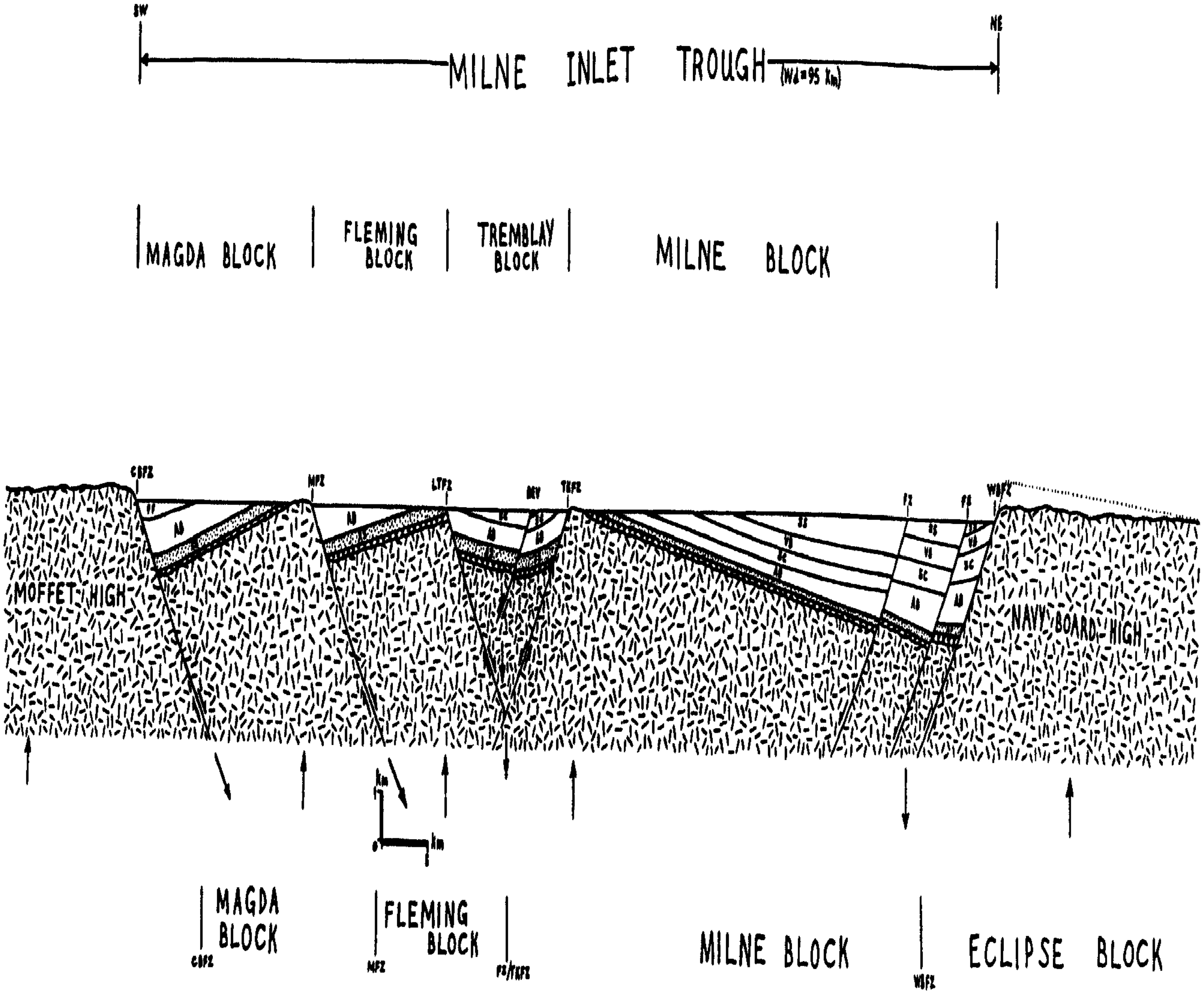


FIG. 5.4D: SECTION 3 - N.W. MILNE INLET TROUGH.

PLATE 5.1

Fault Zones of the Borden Basin

Fig. 1: View, looking southeast of the Tikerakdjuak Fault Zone. The fault zone is located due south of the Nanisivik townsite and is delineated by the ridge of snow covered quartzarenite of the Adams Sound Formation. See Fig. 5.5 for reference.

Fig. 2: View, looking east, of Keystone Graben (right; forming stream valley) and the Mine Horst (left) at the Nanisivik minesite. See Fig. 5.5 for reference.

Fig. 3: General view of strata of the Uluksan Group (buff-grey dolostones) downthrown against the black shale dominated succession of the Arctic Bay Formation along the Hartz Mountain Fault Zone. the strata outcrop in the area due northwest of the Elwin Icecap. See Fig. 5.4E for reference.

PLATE 5.1

Fault Zones of the Borden Basin

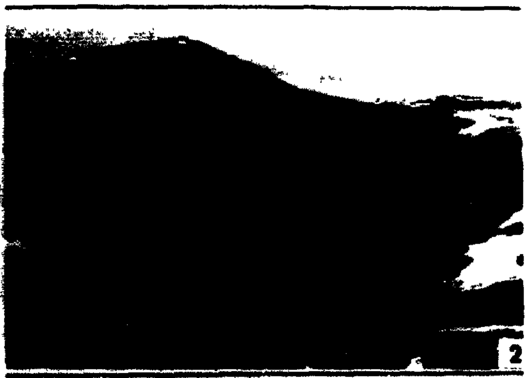
Fig. 1: View, looking southeast of the Tikerakdjuak Fault Zone. The fault zone is located due south of the Nanisivik townsite and is delineated by the ridge of snow covered quartzarenite of the Adams Sound Formation. See Fig. 5.5 for reference.

Fig. 2: View, looking east, of Keystone Graben (right; forming stream valley) and the Mine Horst (left) at the Nanisivik minesite. See Fig. 5.5 for reference.

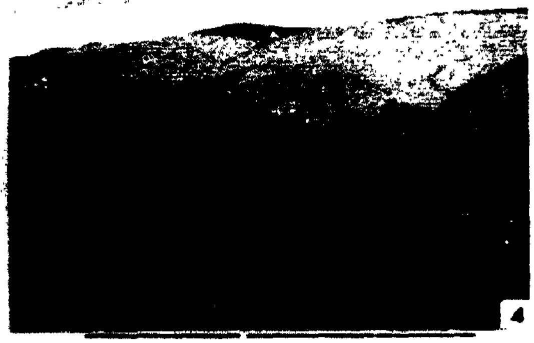
Fig. 3: General view of strata of the Uluksan Group (buff-grey dolostones) downthrown against the black shale dominated succession of the Arctic Bay Formation along the Hartz Mountain Fault Zone. the strata outcrop in the area due northwest of the Elwin Icecap. See Fig. 5.4E for reference.

PLATE 5.1


1


2


3


4


5

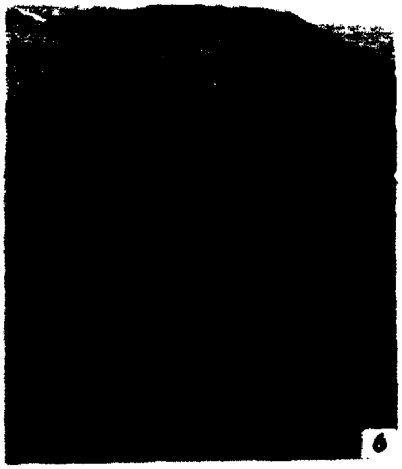

6

PLATE 5.1

Fault Zones of the Borden Basin

Fig. 4: General view of strata of the Arctic Bay Formation (black shales, siltstones in foreground) downthrown against buff quartzarenite of the Adams Sound Formation along the Elwin Fault Zone. The dolostone cliffs, in the background, mark the trace of the Hartz Mountain Fault Zone. The strata outcrop about 5 km northwest of the Elwin Icecap. See Fig. 5.4E for reference.

Fig. 5: Reverse Fault about 10 km northeast of the Alfa River delta along the west coast of Tremblay Peninsula. The black shale-dominated sequence of the upper Arctic Bay Formation (on left) has been faulted over the carbonate-dominated sequence of the AB_U member and $SC_{L(NW)}$ member (on right). See Fig. 5.4C for reference.

Fig. 6: View, looking southeast towards Tremblay Sound, of a fault that disrupts shale-dominated strata of the lower Arctic Bay Formation. Note the small en-echolon faults in the foreground, located due northeast of the major fault plane. The major fault is a splay of the Tikerakdjuak Fault Zone. The strata outcrop about 10 km northwest of the Alfa River delta.

For example, in the Tay Sound Paquet Bay area, the Adams Sound and Arctic Bay Formations have dips of 20° to 30° along the Tikerakdjuak Fault Zone and dips of 40° to 60° along the White Bay Fault Zone; dips within the Tay - Paquet Sub-Trough are generally less than 10° (Iannelli, 1979; Jackson et. al., 1975). A steeply-plunging tight syncline occurs in the vicinity of the White Bay Fault Zone in the same area (Fig.5.1). There is extensive folding of strata of the Arctic Bay and Fabricius Fiord Formations along the southwest margin of Milne Inlet Trough, adjacent to the Central Borden Fault Zone (Figs. 5.1, 5.4 D and 5.4E).

5.2 Metamorphism

The strata of the Bylot Supergroup have been subjected to generally weak regional metamorphism. The most accurate information concerning the degree of alteration has come from petrographic studies of the basalts of the NA_U member (Dostal et. al., 1983; Galley et. al., 1983; Jackson and Morgan, 1978). Basalt petrography indicates regional metamorphic conditions ranging from prennite - pumpellyite to greenschist facies. Jackson and Sangster (1987) concluded that the Nauyat volcanics and most of the remaining strata of the Bylot Supergroup have undergone subgreenschist facies metamorphism (Fig. 5.6).

The precise age of the metamorphism is as yet undetermined. The most likely period is 900 Ma to 1100 Ma; i.e. in the period extending from post-Bylot Supergroup deposition to the time of the Borden Igneous episode (Jackson and Sangster, 1987; Table 1.1).

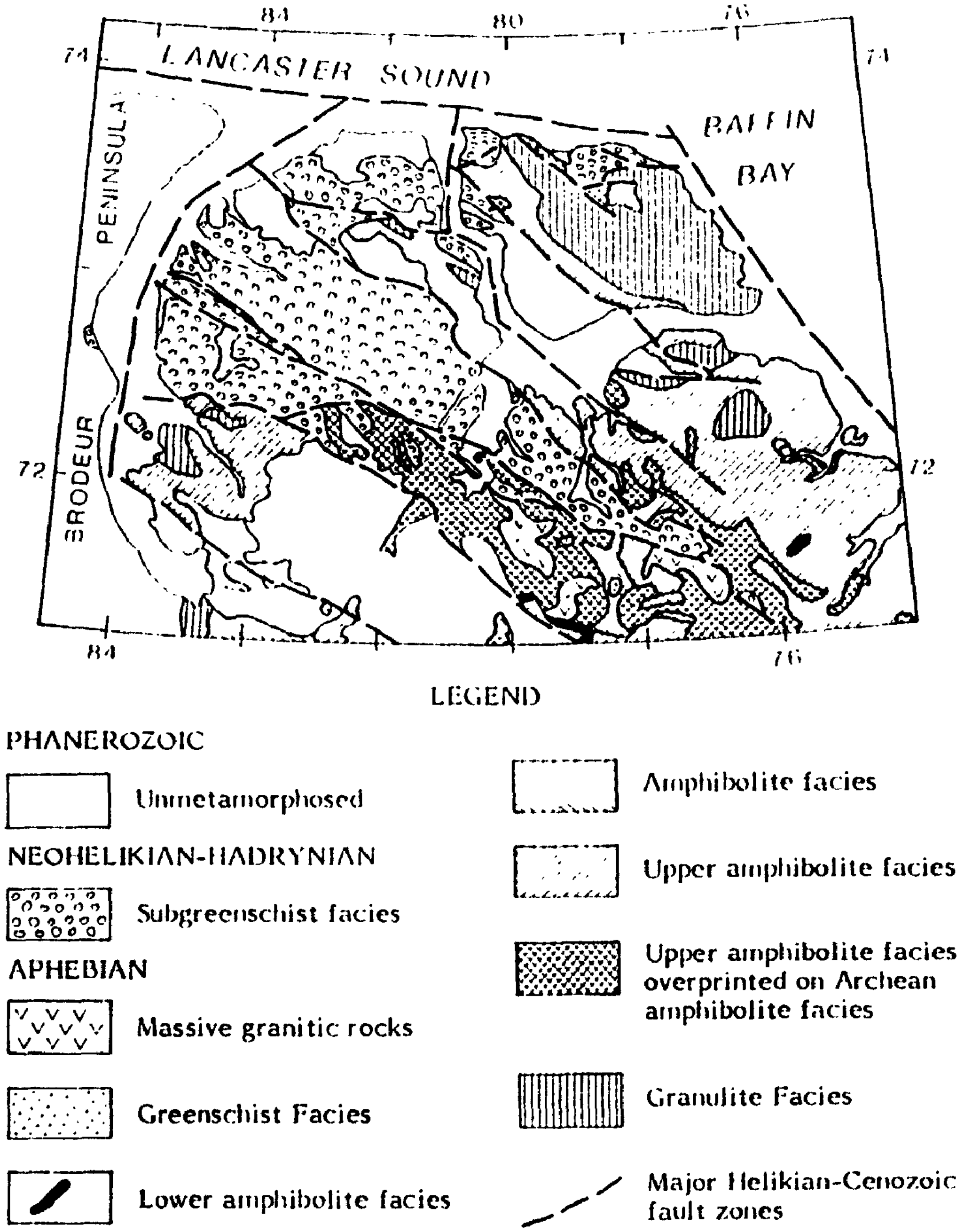


Fig. 5.6: Regional metamorphism of northern Baffin Island (from Jackson and Sangster, 1987, Fig. 2, p. 6 ; Geological Survey of Canada, Department of Energy, Mines and Resources; Reproduced with the permission of the Minister of Supply and Services Canada, 1992).

5.3 Late Proterozoic Dykes

Tholeiitic diabase dykes intrude rocks of the basement complex and the Bylot Supergroup. They have not been observed intruding the Lower Paleozoic succession on northern Baffin Island. Two distinct sets of dykes are present; a regionally-extensive northwesterly-trending set, and a more restricted northerly-trending set (Jackson and Iannelli, 1981, Fig. 16.4, p. 273; Christie and Fahrig, 1983, Fig. 1, p. 276). Widths range from less than 5 m to over 200 m, and lengths from less than 10 km to more than 50 km. Diabase dykes are common across all of northern Baffin Island, exclusive of Brodeur Peninsula. They also occur, to a much lesser extent, on Bylot Island (Jackson and Davidson, 1975). They are particularly prominent along the axis of Milne Inlet Trough where they trend parallel to the Tikerakdjuak Fault Zone (Blackadar et. al., 1968a; Jackson et. al., 1975; Jackson et. al., 1978b). These axial dykes, in Milne Inlet Trough, continue in the basement rocks to the southeast. Their emplacement was largely controlled by major fault zones and the regional structural setting of the Borden Basin (Figs. 5.1 and 5.2). They are part of a huge swarm of dykes that extends in an arc from Great Bear Lake to Baffin Island and northern Quebec (Fahrig et. al., 1971).

Field evidence indicates that the dykes were emplaced after deposition of the Bylot Supergroup and before deposition of the Lower Paleozoic succession. K-Ar age determinations range from 463 Ma to 819 Ma (Jackson and Iannelli, 1981, Fig. 16.3, p. 273; Jackson and Sangster, 1987). K-Ar analyses do not give an accurate date of intrusion or indicate whether more than one intrusive episode occurred. The most reliable age dates are from paleomagnetic analysis of dyke samples (Christie and

Fahrig, 1983). The analyzed dyke samples were dated, differentiated and assigned to the Borden (950 Ma) and Franklin (750 Ma) Igneous events (Table 1.1). Additional paleomagnetic work by Fahrig et. al., (1971) suggests that dyke emplacement occurred at low paleolatitudes.

The north-trending dykes are thinner and less resistant than the northwest-trending ones and are typically poorly exposed. The larger northwesterly-trending dykes form resistant ridges that extend for many kilometres across the basin. Many dykes have a sinuous outcrop pattern. A few of the larger dykes have small offshoots that branch and, in some cases, rejoin the main stock (Jackson et. al., 1978b). Some of the north-trending dykes cut northwest-oriented dykes, but others appear to be co-intrusive and occur as splays from the main northwest set (Jackson and Iannelli, 1981, Fig. 16.4, p. 273).

In areas of extensive dyke intrusion, strata of the Bylot Supergroup have been folded, faulted and baked adjacent to the contacts. Most of the dykes are medium grained, but have fine grained chilled contacts. Alteration effects are usually limited to the contact zone in areas where the intruded strata are sandstones or carbonates. Where dykes intrude predominantly shaly sequences, however, baking and deformation effects extend several metres from the contact zone. In some cases xenoliths of country rock have been incorporated into the contact zone.

The fresh dyke rocks are dark green to grey-green and green-brown on weathered surfaces. A rust-brown-coloured, friable weathering rind 1 cm to over 2 cm thick is common. Representative modal and chemical data are outlined in Blackadar (1970). The dykes are usually fractured and jointed. They are, in general, less altered than rocks of the Bylot Supergroup; i.e. they appear to have escaped subgreenschist facies metamorphism (Jackson and Sangster, 1987). The wider dykes locally contain evidence of differentiation (Blackadar, 1970).

A few thin sills, similar in composition to the dykes, occur at three levels within black-grey shales of the AB_M member in sequences exposed at the southeast end of Milne Inlet (Figs. 1.1 and 3.10a). They are discordant, 1 m- to 3 m-thick, and are probably offshoots of a large northwest-trending dyke located immediately to the south.

CHAPTER 6: Evolution of the Borden Basin

6.1 Introduction

The sedimentary and structural evolution of the Borden Basin, during the depositional history of the Bylot Supergroup, resembles most closely that of rifts associated with ocean basin formation and the development of divergent, passive (i.e. "Atlantic type") continental margins (Figs. 6.1 and 6.2). A rift origin for the Borden Basin had been proposed in earlier works. Olson (1977) suggested that the basin was an aulacogen associated with the development of the Franklinian Geosyncline (Olson, 1977, p. 268). Jackson and Iannelli (1981) interpreted the basin as a failed arm or aulacogen (Tables 6.1 and 6.2) that was related to the 1.2 Ga opening, to the northwest, of the Poseidon Ocean (Jackson and Iannelli, 1981, Fig. 16.35, p. 297).

The current interpretation of the Borden Basin is based on a detailed analysis of sedimentary and structural features of the basin (Tables 6.4 and 6.5; Figs. 5.4A to 5.4E) and comparison with features of other rifts and rift models from numerous sources including: Hoffman (1973, 1980), Hoffman et. al. (1974), Burke (1977, 1980), Bott (1976, 1981, 1982), Bott and Mithen (1983), Bott and Kusznir (1984), Illies (1981, 1982), Turcotte (1983), Turcotte and Emermann (1983), Le Pichon and Sibuet (1982), Neugebauer (1976, 1983), Ziegler and Louwrens (1979), Ziegler (1978) and McKenzie (1978). These models outline the basic stages of mantle convection, crustal thinning, updoming, extension and crustal downwarp involved in rift formation and evolution. The major features are summarised in Figs. 6.1 and 6.2. Other relevant information concerning rift trough origin and structural development is presented by Bally (1981, 1982), Bally and Snelson (1980), Rosendahl et. al. and Rosendahl (1987).

The models provide a mechanism to explain such features as initiation of rifting or extension, the nature of lithofacies distribution, thickness trends, paleocurrent changes, the shape and fault-bounded nature of the component troughs and preservation of the basin highs (Tables 6.4 and 6.5; Figs. 6.1 and 6.2). The Borden Basin appears to have evolved in a manner similar to the "North Sea type" failed rift basin of Burke (1977), Ziegler and Louwrens (1979) and Ziegler (1978); the "proto-aulacogen" of Hoffman (1973, 1977, 1980); the modern East African - Red Sea rift system (Burke, 1977, 1980; Baker et. al., 1972; Rosendahl et. al., 1986; Rosendahl, 1987; Morley et. al., 1990; Moore and Davidson, 1978; Mohr, 1987) and the Gulf of Suez rift (Evans, 1988, 1990; El Haddad et. al., 1984; Gawthorpe et. al., 1990). Other Late Proterozoic basins in the eastern Arctic Islands and northwestern Greenland contain similar sedimentary and structural features (Jackson and Iannelli, 1981) and may have evolved in a similar manner. These basins include the Late Proterozoic Thule Basin of southeastern Ellesmere Island and northwestern Greenland (Dawes, 1976, 1979; Dawes and Kerr, 1982; Frisch, 1983; Frisch and Christie, 1982; Jackson, 1986) and the Fury and Hecla Basin of northwestern Baffin Island (Chandler et. al., 1980; Chandler and Stevens, 1981; Jackson and Iannelli, 1981).

TABLE 6.1: Relevant Definitions

(A). Aulacogen

Hoffman (1973):	Long-lived, deeply subsiding fault troughs that extend at high angles from a geosyncline, far into the interior of a platform.
Hoffman *et. al.* (1974):	Transverse linear troughs that extend from geosynclines far into the interiors of foreland platforms.
Burke (1977, 1980):	Long troughs with thick sedimentary sequences that extend into continental cratons from fold belts (restricted definition).

(B). Rifts, Failed Rifts

Rift (Burke, 1980):	Elongate depressions overlying places where the entire lithosphere has ruptured in extension. Rifts occur at all stages of the Wilson Cycle since extensional tectonism can develop at all stages.
Failed Rift = Failed Arm (Burke, 1977, 1980):	Rifts that fail to develop into a new ocean; formed at plume generated triple junctions (i.e. RRR junction). Rifts or rift complexes striking into continents at a variety of angles from Atlantic type (i.e. passive) ocean margins.

Table 6.2: Comparison of major geological features of aulacogens and the Borden Basin. Features of aulacogens taken from Hoffman (1973), and Hoffman *et*. *al*. (1974).

	AULACOGEN	BORDEN BASIN
THICK SEDIMENDTARY AND VOLCANIC SEQUENCE	X	X
LONG LIVED	X	X
LINEAR TROUGHS; FAULT BOUNDED	X	X
PRESENCE OF EVAPORITES UPWARD IN SUCCESSION	X	X
ALKALINE TO THOLEIITIC LAVAS	X	THOLEIITIC ONLY
VERTICAL TECTONISM	X	X
HORSTS THAT INFLUENCED SEDIMENTATION PATTERNS	X	X
REACTIVATION - FAULTING AND UPLIFT	X	X
MILD COMPRESSION	X	?[1]
LACK OF METAMORPHISM	X	X
EXTEND AT HIGH ANGLE FROM GEOSYNCLINE	X	X
LOCATED AT RE-ENTRANT	X	?
ASSOCIATED WITH RRR TRIPLE JUNCTION	X	?

1 = Reverse faults have been observed in several areas (Figs. 5.4B to 5.4E). These faults may be associated with the Rift-II Stage or with Cretaceous - Tertiary rift events.

6.2 Basis of a Rift Model for Borden Basin

6.2.1 Model for Regional Evolution

The Borden Basin was initiated when a mantle plume developed beneath a portion of the North American - Greenlandian craton. This event caused initial updoming, followed by thinning, fracturing and extension of the stretched continental crust (Figs. 6.1 and 6.2). Basaltic volcanism resulted from upward migration of magma along fractures and into the proto-troughs. This volcanism was a result of tapping of the magma chamber associated with the mantle plume or embryonic midoceanic ridge magma reservoir. The tapping process occurred along deep seated fractures which, in the Borden Basin, included the ancestral first-order fault zones (Figs. 5.1 and 5.3). A mantle plume in this area may have been associated with an RRR-triple junction (Burke and Dewey, 1973; Jackson and Iannelli, 1981). Rifting of this nature, in Borden, Thule, and Fury and Hecla Basins may have been related to incipient ocean opening associated with the McKenzie Igneous Event (ca 1267 Ma; i.e. the opening of the Poseidon Ocean of Jackson and Iannelli, 1981). Ocean opening may have occurred along a rift axis parallel to the Late Proterozoic cratonic margin (Burke, 1980; Sawkins, 1980; Young, 1979). The evolution of these basins would have occurred along the trailing edge of the rifted Late Proterozoic North American craton.

The Borden Basin evolved as a failed rift on a passive continental margin through several major stages typical of rifts on divergent margins (Bally, 1981; Watts, 1981; Grow, 1981). It did not develop into an aulacogen (sensu-stricto) since there is no evidence for a major orogenic event later in the history of the basin. Partial

Table 6.3: Comparison of active and passive rifts. Information modified after Turcotte (1983) and Turcotte and Emermann (1983).

ACTIVE RIFTS	PASSIVE RIFTS
(1). Early updoming	(1). Late updoming
(2). Post-doming extension	(2). Pre-doming extension
(3). Updoming event followed by Downwarp Stage	(3). Downwarp Stage may still be influenced by updoming
(4). Typical infill sequence: ↑ Clastic succession = Reactivation Carbonate succession = Downwarp Clastic succession = Updoming Base	(4). Typical infill sequence: ↑ Clastic succession = Downwarp - II Clastic + Carbonate succession = Rift - II Carbonate succession = Downwarp - I Clastic succession = Updoming Volcanic + Clastic succession = Extension Base
(5). Narrow troughs → broad shelf → narrow troughs	(5). Broad shelf → narrow troughs → broad platform → narrow troughs → broad shelf
(6). Evaporites early in basin history	(6). Evaporites later in basin history (middle and late phases)
(7). Bimodal volcanism; mainly in early phase	(7). Basalt into alkaline volcanism in early and late phases

closure of the ocean may have occurred approximately 1.0 Ga ago (Jackson and Iannelli, 1981; 1984).

The evolution of the Borden Basin can be outlined in four major stages: the Rift-I Stage, Downwarp-I Stage, Rift-II Stage and Downwarp-II Stage (Figs. 6.1 and 6.2; Table 6.6). The basin evolved from a series of narrow, fault-bounded troughs, during the Rift-I Stage, to a regionally-extensive carbonate-dominated basin, in the Downwarp-I Stage. It was the site of renewed extension in the Rift-II Stage which was followed by a final period of regional sagging during the Downwarp-II Stage. Associated with these four stages are ten depositional phases (Table 6.6) which summarise the tectono - sedimentary development of the Bylot Supergroup.

A number of sedimentary and structural features suggest that the Borden Basin underwent both "passive" and "active" rifting (Tables 6.3 to 6.6). The basin appears to have undergone passive rifting during deposition of the Lower Eqalulik Group. The extensional regime gradually shifted to one of active rifting during deposition of the Upper Eqalulik Group. A second phase of active rifting occurred during deposition of the Nunatsiaq Group (Figs. 6.1 and 6.2). The major features of passive and active rifting can be outlined in the following:

(I). Passive Rifting (Table 6.3):

(i). Passive rifting is characterised by episodic thinning of the crust followed by heating and possibly doming due to the formation of a mantle diapir (i.e. passive rift model of Turcotte, 1983; Turcotte and Emerman, 1983; Mckenzie, 1978).

(ii). Rifting in which the asthenosphere is passive; i.e. where rifting results from tensional stresses transmitted through the lithosphere (LePichon and Cochran, 1988).

(iii). In passive rifting the rate of extension and subsidence should be equally distributed across the basin. The troughs should be symmetrically fractured with fault blocks tilted in a random fashion and there should be near symmetrical distribution of restricted lithofacies associations (Mckenzie, 1978; Turcotte, 1983).

(iv). Passive rifting is characterised by gradual stretching of the continental crust as it undergoes regional extension. The initial extension is accomplished by plastic failure or deformation of the upper continental crust.

(II). Active Rifting (Table 6.3):

(i). Active rifting is characterised by formation of a mantle plume associated with RRR-triple junction development and evolution of an ocean basin. The mantle plume causes updoming and extension of the continental crust, which is later followed by regional crustal sagging or downwarp (i.e. active rift models of Turcotte, 1980, 1983; Turcotte and Emerman, 1983; Burke, 1976, 1977, 1980; Hoffman, 1973; Burke and Dewey, 1973).

(ii). Rifting in which the asthenosphere is active; i.e. where rifting results from the upwelling of an anomalously hot asthenosphere, causing doming and thinning of the overlying lithosphere (LePichon and Cochran, 1988).

(iii). In active rifting the intensity of syndepositional tectonism and rift-related regional fracturing should increase towards the ocean basin (i.e. in the direction of the mantle plume and new ocean basin). The major, first-order troughs should be more extensively fractured in this direction.

(iv). Active rifting is further characterised by rapid stretching of the continental crust. This is accomplished by brittle deformation of the upper continental crust .

6.2.2 Model for Intrabasin Evolution

In this section a composite multiple-block rift model, that outlines the possible origin of the internal structure of the Borden Basin, will be presented. The intrabasin structural evolution can best be explained through the use of two complimentary models for development of multiple-block rifts (Figs. 6.4 and 6.5).

(i). Type I Model

The internal structure of the basin developed, in part, as a series of offset, opposing or alternating half graben in the manner proposed for the origin of East African rifts by Rosendahl et. al. (1986), Rosendahl (1987) and Scott and Rosendahl (1989). In this model multiple-block rifts develop through the alternation of half graben along a sinusoidal interconnection of border faults and interbasinal ridges (Fig. 6.4). The model can explain the sedimentary history and structure of the northwest portion of Milne Block and of the Magda, Tremblay, Fleming and Icebound Blocks of Milne Inlet Trough and the Southeast Sub-trough of Eclipse Trough (Figs. 5.2 and 5.4). The occurrence of simple and complex marginal faults, in combination with synthetic or antithetic intrabasin faults, results in the possibility of numerous structural scenarios for rift trough settings (Figs. 5.4 and 6.4).

(ii).Type II Model

The second model comprises a composite of similar models used to explain the structure of rift basins associated with the origin of the rifted North American and Australian continental margins (Bally, 1980, 1981, 1982; Bally and Snelson, 1980; Harding, 1984; Enachescu, 1987; Etheridge et. al. 1987). In this model rifts developed as variably-tilted multiple-block troughs, comprised of stepped second- and third-order graben, separated and offset by intrabasin transform faults (Fig. 6.5). The transform faults, which are also termed transfer faults by Enachescu (1987) and Etheridge et. al. (1987), have limited lateral movement and apparently accommodate lateral strain developed across the basin during extension. This model can explain the sedimentary history and structure of the central and southeast portions of the Milne Block of Milne Inlet Trough and the Northwest Sub-trough of Eclipse Trough (Figs. 5.2 and 5.4).

These models can shed light on the nature of some of the major sedimentary and structural features of the basin:

(1). The nature of the fracture system indicates that the basin developed under the influence of three stress regimes. The major regime, reflected in the northwest-southeast trend of the first-order faults, outlines the stress field of the failed arm of the RRR-triple rift system.

The minor trends, north-northwest - south-southeast and northeast - southwest, reflect the stress field of the original spreading arms of the new ocean basin (Fig. 6.2a). The minor trends affected the development of the transform (or transfer) fault system during evolution of the multiple-block system (Fig. 6.5).

(2). The models can explain the nature of the complex fracture system and the origin of offsets along the major fault zones. The major faults are comprised of short along-strike segments or variably offset and overlapped segments, features common through development of a multiple-block rift system in the manner of Type I and II models (Figs. 5.1, 6.4 and 6.5).

(3). The development of multiple depocentres and associated complex thickness and facies changes. In the type I model depocentres occur in several settings on deeply subsiding portions of half graben (Fig. 6.4). In the type II model the sub-basins (in the case of Borden Basin) deepen progressively to the southeast, in a series of steps, with local depocentres generally situated in the northwestern parts of second and third order graben.

(4). Movement along the transform faults could provide a mechanism for repeated restriction in the southeastern parts of the first-order troughs.

(5). The multiple-block structural regime could provide a setting for scissor-type fault movement along marginal and internal fault zones between sub-blocks.

(6). The models provide a mechanism to explain apparent changes in direction of throw along the length of major fault zones. The apparent change in direction of throw is a result of the juxtaposition of adjacent bounding fault zones between sub-blocks (Figs. 5.4B to 5.4E, 6.4 and 6.5).

(7). The models can explain the occurrence of numerous splays and the presence of intra-trough highs as a result of the various ways in which bounding fault segments can overlap (Figs. 6.4 and 6.5).

6.2.3 Critical Events

The strata of the Bylot Supergroup display contact zones that range from nonconformable (basal contact with gneisses of the basement complex), conformable, gradational, unconformable (Eqalulik - Uluksan Groups; Upper Uluksan - Lower Nunatsiaq Groups) to angular unconformities (locally between strata of the Upper Eqalulik and Lower Uluksan Groups and Upper Ulksan and Lower Nunatsiaq Groups). Contacts between groups and subgroups within the basin represent times when major changes have occurred in the sedimentary and structural evolution. These contact zones or boundaries are here termed critical event boundaries (Table 6.6); five have been defined in the Borden Basin.

The lowermost boundary (Critical Event I) is the basal nonconformity where the strata of the Nauyat and Adams Sound Formation rest unconformably on gneisses and granites of the basement complex. The boundary represents the initiation of extension in the region, the deposits signalling the onset of rifting associated with incipient ocean basin formation.

Critical Event II is between the Adams Sound and Arctic Bay Formations. This boundary appears to mark the transition from passive to active rifting in basin evolution, reflecting a transition from ductile to brittle failure in the stretched continental crust (Figs. 6.1a and 6.2a; Table 6.6).

The contact between the Upper Eqalulik Group and the Lower Uluksan Group, which ranges from unconformable in the northwest to gradational in the southeastern parts of troughs, represents the Critical Event III boundary. The contact marks the transition from the Rift-I to Downwarp-I Stage (Figs. 3.13, 6.1b and 6.2b; Table

6.6). Critical Event III represents the break-up or post-rift unconformity that is associated with the rift to drift transition in rift systems (Bally, 1981; Bally and Snelson, 1981; Grow, 1981; Grantz and May, 1982).

The fourth critical event is at the transition from the Upper Uluksan to Lower Nunatsiaq Groups; it ranges from unconformable in the northwest to gradational in central and southeast parts of the first-order troughs (Figs. 3.16 and 3.19). Critical Event IV represents the reactivation unconformity and a transition from regional downwarp back to regional extension (i.e. Downwarp-II to Rift-II transition; Figs. 6.1c and 6.2c; Table 6.6).

The fifth critical event is associated with the gradational and conformable contact between strata of the Lower Nunatsiaq Group and those of the Lower Elwin Formation (Figs. 3.26 and 3.28). This boundary represents the transition from a stage of regional extension back into one of regional stability and downwarp (Figs. 6.1d and 6.2d; Table 6.6). It apparently coincides with the transition from a second major phase of active rifting to a second phase of regional crustal cooling, thickening and sagging.

6.2.4 Rift-I Stage (Eqalulik Group)

The structural and sedimentary history of the Eqalulik Group conforms to a model of basin evolution involving an early passive- into active-extensional period here termed the Rift-I Stage (Table 6.6). The sedimentary and structural features of the the Eqalulik Group were developed during an initial phase of extension related to rapid thinning of the continental crust followed by brittle deformation of the stretched crust caused by updoming near an active mantle plume (i.e. passive and active rift substages, Table 6.6; see also Table 6.3; Turcotte, 1983; Turcotte and Emerman, 1983; LePichon and Cochran, 1988).

The gradual development of an active mantle plume, situated to the northwest of the Borden Basin, could have caused regional extension and reactivation of ancient zones of structural weakness (Figs. 6.1a and 6.2a). Mantle plume activity associated with the proposed ocean basin formation event would have involved doming, thinning and fracturing of the continental crust of the craton. Eventual brittle deformation of the stretched continental crust could account in Borden Basin for reactivation and expansion of the fault system, early basaltic volcanism, delineation of a series of fault troughs comprised of sub-blocks and sub-troughs (Figs. 5.2 and 5.4), a variation in the regional subsidence regime and related thickness trend of the infill successions and a major change in the nature of lithofacies trends from Lower into Upper Eqalulik depositional time (Figs. 3.2, 3.3, 3.7, 3.8, 3.10, 3.11, 4.1 to 4.4, 5.2 and 5.4A to 5.4E).

Although earliest rifting began during Lower Eqalulik Group time, as evidenced by basaltic volcanism and deep subsidence to the northwest in proto-troughs, the main phase of crustal extension occurred during deposition of the Upper Eqalulik Group. The Lower Eqalulik Group records a sub-stage of passive rifting with minor or limited crustal extension, whereas the Upper Eqalulik Group records a substage of major crustal extension (Figs. 6.1a and 5.2a; Table 6.6).

6.2.5 Downwarp-I Stage (Uluksan Group)

Following regional extension and thinning of the continental crust, the mantle plume is inferred to have been reduced or removed due to drift and separation of the cratonic plates as ocean basin formation progressed. The crustal bulge or arch associated with the plume would have been removed, so that the basin lost regional support for the major fault blocks of the first-order troughs. Removal of the heat source and reduction or cessation of crustal extension would have allowed the continental crust beneath Borden Basin to gradually cool, thicken and ultimately sag on a regional scale (Figs. 6.lb and 6.2b). The basin could then have developed as a mature failed rift along a subsiding passive, divergent continental margin (i.e. the Downwarp-I Stage of basin evolution; Hoffman, 1973; Hoffman et. al., 1974; Bally, 1981; Turcotte, 1983). The Downwarp-I Stage was characterized by reduced syndepositional tectonism, extensive regional subsidence and development of the carbonate platform complex of the Society Cliffs and Victor Bay Formations (Figs. 4.1 to 4.4). The carbonate platform was associated with regional marine transgression undisturbed by major influxes of terrigenous material (Figs. 6.1b and 6.2b). Coarse, immature siliciclastic fans and coastal deposits did however accumulate along major fault zones during deposition of the Lower Uluksan Group (Fig. 3.13b). Mixed siliciclastic carbonate - evaporite deposition occurred at the same time in the semi-restricted southeastern portions of the first-order troughs (Figs. 4.1 and 4.4). The thickness of the sedimentary pile enhanced subsidence in the basin and further weakened the fractured crust, resulting in continued minor tectonism throughout the entire stage.

6.2.6 Rift-II Stage (Lower Nunatsiaq Group)

Basin reactivation occurred across the entire Borden Basin. Major effects included renewed regional tectonic activity, deep subsidence of the central and southeastern parts of at least the Milne Inlet Trough and development of a highly varied infill succession (Figs. 3.19a to 3.19d). There was reactivation of major first-order fault zones and major horsts including the Navy Board, Byam Martin, Tunuiaqtalik and Krag Mountains Highs (Figs. 5.1, 5.2, 6.1c and 6.2c). A thick siliciclastic-dominated sequence began to accumulate in the first-order troughs.

The Rift-II Stage represents the second major period of regional extension that affected the Borden Basin (Table 6.6). This second period of rifting may have been related to the formation of new crust in the recently formed ocean basin. Formation of the North Atlantic ocean involved two major rift episodes (Enacnescu, 1987; Lambeck et. al., 1987). Multiple extensional events appear to be a typical feature in the evolution of major rift systems (Falvey, 1974; Sinclair, 1988; Tankard and Welsink, 1987; Masson and Miles, 1986a,b; Scott and Rosendahl, 1989; Boote and Kirk, 1989; Hubbard et. al., 1987; Hiscott et. al., 1990).

6.2.7 Downwarp-II Stage (Middle and Upper Nunatsiaq Groups)

Regional stability returned to the Borden Basin during the Downwarp-II Stage (Table 6.6). This was related to gradual cooling and thickening of the stretched continental crust (Figs. 6.1d and 6.2d). Regional sagging resulted in widespread shallow marine transgression, and the basin was ultimately filled with siliciclastic deposits of shallow-marine shelf facies (Figs. 3.21 and 4.4) during the Terminal

Table 6.4: Sedimentary features of the Borden Basin considered relevant for interpretation of the basin as an active, multi-block rift trough.

1. Component troughs of the Borden Basin contain variable thicknesses of sedimentary and minor volcanic rocks; the sedimentary succession displays considerable facies variability on a local and regional scale

2. Regional paleocurrent trends parallel the axes of the major component troughs; major changes in the regional paleocurrent trends occur in the Terminal Sandstone Phase during deposition of the Lower Elwin and Upper Elwin Formations

3. Local variations in paleocurrent trends, coupled with associated local thickness and facies changes, indicate the presence of shoals or internal highs; this supports the concept of tilted, variably subsiding fault blocks (Figs. 5.4 and 6.5)

4. Striking regional and local thickness changes occur across the basin and within formations and component troughs; significant thickness changes also occur within formations in relatively short time-space intervals; this implies deposition on tilted fault blocks in a continuously subsiding basin (Figs. 5.2 to 5.4 and 6.3 to 6.5); the change in orientation of thickness trends from the Adams Sound into the Arctic Bay Formations reflects a major change in the structural regime of the Borden Basin (i.e. transition from passive into active rifting; Table 6.6)

5. The occurrence of a great number and variety of cycle types and of cycles of several orders of magnitude; they represent primary tectonic cycles

6. Abrupt, complex latero-vertical facies changes; facies variations include both proximal to distal across major fault zones and proximal to distal from the southeastern end to the northwestern corner of first order troughs (i.e. in the direction of the new ocean basin); the best examples include facies relationships of the Lower Nunatsiaq (Fig. 3.19) and Lower Uluksan (Fig. 3.13) Groups

7. Evaporites and red beds have been deposited in restricted portions of the second and third order troughs; evaporites formed mainly during the Downwarp-I Stage (Society Cliffs Formation; Southeast Facies Assemblage); minor evaporites accumulated during the Downwarp-II Stage (Lower Elwin Formation)

Table 6.4 (Cont'd)

8. Local, within-trough proximal-to-distal facies changes; these occur as "anomalous" facies changes or facies reversals in portions of troughs thought to be axially or basinally situated; these facies changes indicate the presence of local lows and highs (i.e. local depocentres and upturned edges of tilted fault blocks; Figs. 5.4 and 6.5). Examples include the following:
    - (i). Reversal of facies from basinal to marginal in the southeastern end of the Koluktoo Sub-trough (Icebound Block; Fig. 5.2)
    - (ii). Onlap of strata of the Arctic Bay Formation (Paquet Bay Facies Assemblage) on a basement high in the southeastern part of Milne Inlet Trough, adjacent to the Tikerakdjuak Fault zone along the upturned edge of Milne Block
    - (iii). Occurrence of stromatolitic bioherms and reefs in a basinal setting at K-Mesa (Icebound Block, Koluktoo Subtrough; Fig. 5.2) in the Arctic Bay (Tremblay Sound Facies Assemblage) and Society Cliffs (Northwest Facies Assemblage) Formations
    - (iv). Occurrence of strata of the Arctic Bay Formation (Fabricius River Facies Assemblage) along a splay of the Magda Fault zone in the area 20 km to 30 km west of the Magda Icecap (Magda Block, Fabricius Sub-trough; Fig. 5.2)
    - (v). The distribution of the SS_{RC} and $AP_{L(R)}$ members of the Strathcona Sound and Athole Point Formations

9. Elongate nature of troughs would strongly influence the tidal regime; resulting effects are most obvious in the paleocurrent trends of the Arctic Bay Formation

10. Regional lithofacies trends are especially definitive:
    - (i). Sandstone content increases towards the fault margins and in a southeasterly direction in the first order troughs
    - (ii). Sandstone lithofacies units become increasingly immature towards the marginal fault zones

11. Micro- to megascale growth faults occur and are best developed in the Arctic Bay, Victor Bay and Athole Point Formations

12. If sub-trough terminations are oriented perpendicular to the NW-SE trend of Milne Inlet Trough then these features may account for the development of carbonate reefs or carbonate platform margin settings in the mid part of the Milne Inlet Trough and for carbonate platform-to-slope basin transitions in the middle and central parts of Milne Inlet Trough (Tremblay Sound - K-Mesa area for the Society Cliffs Formation; central Milne Inlet Trough for the Athole Point Formation; northwest Milne Inlet Trough for the Strathcona Sound Formation)

Table 6.5: Structural features of the Borden Basin considered relevant for interpretation of the basin as an active, multi-block rift trough.

1. Borden Basin was initiated as a narrow fault bounded trough, or series of troughs (Rift-I Stage); it later became the site of a broad downwarp (Downwarp-I Stage) and next became the site of rejuvenated extension (Rift-II Stage) and a second period of regional subsidence (Downwarp-II Stage)

2. Borden Basin extends far into the interior of the craton where it gradually dies out (i.e. the basin is "hinged" to the craton to the southeast); the major bounding fault zones (e.g. Central Borden and White Bay Fault Zones) extend a considerable distance southeastwards into the craton

3. Borden Basin is a linear fault-bounded basin composed of several major component fault troughs; fault zones and troughs are northwest-southeast oriented; second and third order faults reflect both NW-SE and subordinate N-S and NNW-SSE stress patterns; faulting was largely vertical along listric normal faults

4. Component troughs are deeply subsiding; they are characterised by variable rates and degrees of subsidence due to the presence of tilted fault blocks in multiple half-graben settings (Figs. 5.2 and 5.4); they comprise "nested" troughs of several orders (e.g. Milne Inlet Trough comprises five major blocks each of which consist of sub-blocks and sub-troughs; Figs. 5.2 and 5.4)

5. Presence of tholeiitic basalt flows (in part subaerially extruded); fissures oriented northwest-southeast parallel to the major bounding fault zones (both marginal and internal) of the first order troughs

Table 6.5 (Continued)

6. Borden Basin has been subjected to mild compression only and lacks significant metamorphism, due to its original formation as a failed arm of an RRR rift system and subsequent escape from later collision effects as a result of its setting far into the craton

7. Borden Basin is a long-lived structure which has influenced sedimentation patterns from at least the late Proterozoic to the Recent

8. Borden Basin contains a stratigraphic succession divided by major intrabasin boundaries and unconformitites which are the physical manifestations of five critical events that have influenced the evolution of the basin (Table 6.6)

9. Borden Basin contains several orders of magnitude of horsts; these structures have influenced sedimentation patterns throughout the history of the basin; they occur within and between first-order troughs; edges of tilted fault blocks are the sites of local onlap, facies reversals and paleocurrent deviations; first-order troughs could contain several tilted sub-blocks with variable margin styles (e.g. low and high angle margins; see Figs. 5.4 and 6.3)

10. Major fault zones are complex and comprise variably-oriented segments that result in a "zig-zag" pattern across the basin; such patterns are characteristic of active rifts comprised of multiple half-graben (Figs. 6.4 and 6.5)

Sandstone and Prograding Megacycle phases of the Middle and Upper Nunatsiaq Groups. The sedimentary succession has a regionally consistent thickness distribution and displays gradual marginal to basinal facies transitions (Figs. 3.21 and 4.4.).

6.3 Tectono - Sedimentary History of the Eqalulik Group

6.3.1 Major sedimentary and Structural Features

The Eqalulik Group contains several sedimentary and structural features that are best explained by a rift model. These include the following (Tables 6.3 and 6.4; Figs. 3.2, 3.7, 3.10, 4.1 to 4.4 and 5.4B to 5.4E):

(a). The occurrence of basalt flows at the base of the succession and their increase in thickness and concentration to the northwest (Figs. 3.2a to 3.2e).

(b). The upward change in chemical composition in the basalt flows. The flows are tholeiitic basalts that become more alkalic towards the top of the volcanic pile (Jackson and Iannelli, 1981, Fig. 16.9, p. 275).

(c). The predominance of continental to shallow and deep marine siliciclastic sediments and associated plateau basalts in the early stages of the history of the Borden Basin (Figs. 4.1 to 4.4).

(d). The distribution of lithofacies, in particular the striking marginal-to-basinal transitions in the Arctic Bay Formation (Figs. 3.10a to 3.10f).

(e). The nature of the fault system in the Borden Basin and reactivation of these faults during the deposition of the Upper Eqalulik Group. The faults, as described in chapter 5, represent three orders of magnitude (Figs. 5.1 and 5.4A to 5.4E).

(f). The hierarchy of component troughs (Figs. 5.2 and 5.4A to 5.4E).

(g). The occurrence of numerous cycles of various types and magnitudes; they include mainly coarsening- and shallowing-upward, shallow marine cycles that range in scale from about 5 m to 25 m that are best developed in the AB_L and AB_U members.

(h). The nature of the contact between the Adams Sound and Arctic Bay Formations; i.e. the transition from the Lower to Upper Eqalulik Group. In addition, the nature of the associated change in regional thickness trend from northwesterly thickening, during Adams Sound depositional time, to southeasterly thickening in Arctic Bay time (Figs. 3.7a, 3.7b and 3.10a to 3.10f).

(i). The relationship between trough architecture and the thickness and compositional variations of the Nauyat, Adams Sound and Arctic Bay Formations.

6.3.2 Explanations for the Major Tectono - Sedimentary Features of the Eqalulik Group

The major sedimentary and structural features of the Eqalulik Group can be explained in the context of an initial rift stage in the evolution of the Borden Basin (i.e. Rift-I Stage; Table 6.6; Figs. 6.la and 6.2a). The aspects of this stage relevant to an explanation of the features in section 6.3.1 include the following:

(a,b). The position and distribution of volcanic flows, in the Borden Basin, are related to the probable tapping of a mantle magma source early in the evolution of the basin. The tapping of this mantle plume was accomplished through the deep seated ancient fracture system as represented by the first-order fault zones, in particular the Tikerakdjuak Fault Zone. Tapping of the magma source resulted in the extrusion of basaltic lavas into the proto-troughs (Figs. 6.1a and 6.2a). The increase in flow number and overall thickness of the volcanic succession to the northwest (Figs. 3.2a to 3.2e) may be related to:

(i). Increased or continuous subsidence and extension in the vicinity of the mantle plume (i.e. in the direction of ocean basin formation and plate separation).

(ii). The southeastern portions of the proto-troughs were local highs during the history of the Lower Eqalulik Group, producing a northwesterly-inclined paleoslope.

The mantle magma source was exhausted relatively quickly, resulting in only partial magma differentiation. A bimodal volcanic pile was not produced, but partial differentiation did result in an upward increase in alkalinity of the lava flows (Galley, 1978; Jackson and Iannelli, 1981).

(c). The occurrence of a siliciclastic-dominated succession, associated with volcanics early in basin evolution, is an indication of rapid crustal thinning or updoming and extension in an active rift (Tables 6.3 and 6.6). This rock assemblage is diagnostic of Borden-type rifts with intense primary structural control of sedimentary infill successions. Mixed continental, marine and subaqueous to subaerial basalts are a distinct feature of the early history of rifts formed at RRR-triple junctions (Burke and Dewey, 1973; Burke and Whiteman, 1973; Hoffman, 1973). Continental and semi-restricted marine sedimentary successions are common at this time, because complete separation of the triple rift system had not yet occurred, and the newly formed ocean did not yet have direct access to the failed rift portion of the system.

(d). The sequence of events leading to rifting and formation of rift troughs strongly influenced the nature of the infill succession. The component troughs were elongate in a northwest - southeast direction and semi-restricted due to the occurrence of tilted sub-blocks and increased subsidence to the northwest (Figs. 5.4A to 5.4E). They were fractured by major faults, separated by major horsts and characterised by upraised margins throughout at least the depositional history of the Upper Eqalulik and Lower Nunatsiaq Groups (Figs. 5.2, 5.4A to 5.4E and 6.3). Delta fan, alluvial fan, prograding coastal complexes and intermixed siliciclastic calciclastic shoreline sediments of the Adams Sound and Arctic Bay Formations were deposited near the active horsts and fault systems (Figs. 6.1a and 6.2a). These lithofacies assemblages were widespread parallel to the trough margins, but restricted in a basinwards direction. Basinwards they graded into finer, more mature distal siliciclastic lithofacies associations of the shallow to deep marine shelf and basin regime (Figs. 4.1 to 4.4). In summary, during deposition of the Eqalulik Group, the latero-vertical distribution of sediment patterns in the Borden Basin was controlled by the development of a major rift system (Figs. 6.1a and 6.2a; Table 6.6).

(e). The fracture system, which was active from the earliest stages of rifting, may in part have rejuvenated an older system (Fig. 1.7). The major, first-order fault zones consist of many smaller component faults that display a "zig-zag" pattern typical of many rifts in extensional settings (Jackson and Iannelli, 1981; Freund and Merzer, 1976; Moore and Davidson, 1978). The system and pattern arose because the upper layer of the crust was brought under deviatoric stress by an active rifting regime as outlined by Bott (1976, 1981, 1982a,b), Turcotte (1983), Turcotte and Emerman (1983) and Bally (1981) (Figs. 6.1a and 6.2a).

If the Borden Basin is related to active rifting at an RRR-triple junction, then the position of the three arms, of the rift, may have been influenced by areas of former structural weakness. Development of a major rift basin on northern Baffin Island was probably related to the Hudsonian orogeny (Jackson and Morgan, 1978). Development of northwest-southeast-oriented troughs and faults paralleled older gneissic trends and apparent suture zones (Fig. 1.7; Table 1.1). The major fault zones were periodically active throughout the entire history of the Borden Basin (Tables 1.1 and 6.6).

(f). The formation of multiple troughs, of several orders of magnitude, is a common feature of major rift systems. The component troughs are composed of tilted sub-blocks and subtroughs (Figs. 5.2 and 5.4A to 5.4E). The trough architecture is directly related to the character of the major fault zones, the subsidence regime in the basin and the original structural trends in the basement crust (Figs. 5.4, and 6.3 to 6.5) (Bally, 1981; Rosendahl *et*. *al*., 1986; Rosendahl, 1987; Surlyk, 1978; Hoffman, 1973; Gjelberg and Steel, 1981; Dalland, 1981; Surlyk *et*. *al*., 1981; Steel *et*. *al*., 1981).

If the basin originated as an active rift, evidence of rifting and regional subsidence should increase to the northwest (i.e. in the direction of the mantle plume and new ocean basin). The major troughs should thus be more extensively fractured to the northwest, and possibly more restricted to the southeast. McKenzie (1978) and Turcotte (1983) suggested that, in a passive rift setting, the rate of extension and subsidence should be equally distributed across the basin. The troughs should be symmetrically fractured, with fault blocks tilted in a random fashion, and there should be a symmetrical distribution of restricted lithofacies associations. In the Borden Basin, however, there are sedimentary and structural features that appear compatible with both modes of rift origin (Table 6.3). These features include the following:

(1). The occurrence of semi-restricted lithofacies assemblages only in the southeastern portions of first-order troughs (Figs. 3.10a to 3.10f).

(2). The great increase in thickness to the northwest, observed in the Nauyat and Adams Sound Formation. There is also an increase in thickness and number of volcanic flows in the same direction (Figs. 3.2 and 3.7).

(3). The sediments of the Lower Eqalulik Group were deposited in largely shallow marine environments in proto-troughs in the initial phase of the Rift-I Stage (Figs. 6.1a and 6.2a; Table 6.6). The proto-troughs and associated incipient fracture system represented the pervasive but subdued effects of incipient tectonism that would occur in a basin undergoing passive rifting.

(4). The depositional history of the Upper Eqalulik Group, in contrast to that of the Lower Eqalulik Group, appear to represent sedimentation in an active rift basin (Table 6.6). The major troughs were fully active and fractured into sub-blocks and sub-troughs, the depositional regime was entirely different from the previous phase and a major change in thickness trend and depocentres was occurring (Figs. 3.10, 3.11, 4.1 to 4.4, 5.2 and 5.4A to 5.4E). Fracturing, of the first-order troughs, apparently increased to the northwest and the troughs appear to widen slightly in that direction (Figs. 5.1, 5.2 and 5.4).

In summary, after an initial phase of passive rifting, represented by the depositional history of the Lower Eqalulik Group, the Borden Basin evolved as an active rift along a divergent passive margin (Figs. 6.1 and 6.2; Table 6.6).

(g). The hierarchy of cycles is a result of tectonic control of sedimentation superimposed on continuous subsidence in a setting of tilted sub-blocks. The cycles resemble those in other rifts (Illies, 1982; Steel, 1976; Larsen and Steel, 1978; Steel et. al., 1977; Gjelberg and Steel, 1981; Dalland, 1981; Surlyk et. al., 1981; Steel et. al., 1981; see also section 4.1.3). The combination of episodic faulting and continuous subsidence caused progradation of siliciclastic and calciclastic wedges out into a rift basin undergoing continuous transgression (Figs. 6.la and 6.2a). This resulted in the accumulation of thick, cyclic successions, particularly during deposition of the AB_L and AB_U members (Figs. 3.l0a to 3.l0f). For example, repeated fault-margin uplift caused periodic progradation of mixed calciclastic siliciclastic shoreface sand bars and tidal sand flat complexes out over muddy, subtidal shelf sediments, resulting in accumulation of a thick, shallowing upward cyclic succession in the southeastern part of Milne Inlet and Eclipse Troughs during deposition of the upper Arctic Bay Formation (Figs. 4.1 to 4.4).

(h). The boundary between the Adams Sound and Arctic Bay Formations represents the transition from passive to active rifting, signifying a major change from plastic (passive rifting) to brittle (active rifting) deformation of the upper part of the stretched continental crust (Figs. 6.la and 6.2a). It marks the second critical event in basin evolution (Table 6.6). During deposition of the Lower Eqalulik Group, regional subsidence was related to gradual stretching of the continental crust as it underwent regional extension (Figs. 6.1a and 6.2a). This initial phase of extension was accomplished by plastic failure or deformation of the upper continental crust. The crust must have reached a critical point where extension could no longer occur by plastic deformation and a transition to brittle deformation was initiated. This transition was reflected, in Borden Basin, by the change from incipient rift trough formation, with associated minor faulting and increasing basin subsidence to the northwest (deposition of the Nauyat and Adams Sound Formations; Figs. 3.2, 3.3, 3.7 and 3.8), to active rift trough formation with major basin-wide faulting and major changes in the subsidence regime (deposition of the Arctic Bay Formation). The latter phase involved formation of multiple-block rift troughs comprised of tilted sub-blocks, migration and increased number of depocentres, thickness changes and a complex subsidence regime highlighted by increased subsidence in southeastern parts of first-order troughs (Figs. 3.10, 3.11, 5.2, and 5.4; Table 6.6). These events resemble those described for rift basins and rifted continental margins by LePichon et. al. (1982a,b) and Chenet et. al. (1982) where active rifting is associated with brittle fracture in the upper continental crust following thinning in the underlying ductile lower continental crust and with the change from low to high rates of tension.

Depositional and structural styles, characteristic of the Critical Event II transition period, strongly suggest that the transition from plastic to brittle deformation was ultimately associated with some form of regional updoming of the area to the northwest of the basin. This could be accounted for by the expansion of the mantle plume associated with the formation of the ocean basin or by the development of another plume adjacent to the failed rift. Proximity to this plume may have been the regional driving force that caused the basin to develop beyond the passive rift phase.

The apparent absence of a major unconformity between the Adams Sound and Arctic Bay Formations, at the Critical Event II boundary, might be explained by the following:

(1). A very subtle, low-angle unconformity may be present, but is indistinguishable from normal bedding undulations because the tilt on the fault blocks required to accommodate the observed thickness variations in the Arctic Bay Formation, is small, ranging from 1/2° to 2°.

(2). The transition into full-scale active rifting may not have occurred until deposition of the AB_L member and may be represented in the form of one or more low-angle intraformational unconformities.

(i). Important aspects of the relationship between trough architecture and composition and thickness of lithofacies assemblages can be outlined by analysis of major depositional settings of the basin. The sediments infilling a multiple-block rift trough can accumulate in three major settings (Figs. 6.3, 6.4 and 6.5; examples from the deposition of the Upper Eqalulik Group):

(1). High-Angle Margin:

The high-angle margin is characterised by the accumulation of coarse clastic-dominated, proximal sequences and cycles such as those of the upper members of the Fabricius River and Paquet Bay lithofacies assemblages of the Arctic Bay Formation (Figs. 3.10a to 3.10f), which were deposited along a trough margin with extreme changes in paleoslope. The proximal association predominates along the deeply subsiding downdropped side of the tilted blocks. Here, thick wedges or fans of coarse and immature siliciclastic and mixed siliciclastic - calciclastic sediments have accumulated along the entire lengths of active fault block margins. As a result, the high angle margin setting is characterised by thick infill successions that, in general, are typified by a gradational transition into strata of the Lower Uluksan Group (Figs. 3.13a and 3.13b).

(2). Low-Angle Margin:

Sediments accumulating along low-angle margins would be dominated by finer grained clastic assemblages and characterised by proximal facies assemblages containing a lower proportion of coarse clastic material than those of high-angle margins. Sediments would accumulate on a surface characterised by a shallow-dipping paleoslope (Fig. 6.3), reflected in the stratigraphic record by a gradual transition from proximal to distal facies associations. Such a gradual slope can only accommodate thin successions. These would be more likely to have unconformable contacts with overlying strata of the Lower Uluksan Group (Figs. 3.10 and 3.13). Because the low-angle parts of the tilted sub-blocks were generally high standing during Upper Eqalulik deposition, they were more likely to be eroded during periods of regional tectonism.

(3). Transcurrent Margin:

Transcurrent margins are the fault trough margins that occur transversely between sub-blocks (Fig. 5.2). Sedimentation patterns along such margins display aspects of both the high-angle and low-angle type settings. Proximal to distal transitions and thickness trends, in these assemblages, are commonly slightly laterally offset.

6.3.3 Deposition of the Eqalulik Group

The sedimentary and structural evolution of the Eqalulik Group can be outlined in the Rift-I Stage of the evolution of the Borden Basin (Table 6.6). This stage consists of the Pre-Quartzarenite, Quartzarenite and Transitional-I Depositional Phases (Figs. 6.la and 6.2a).

Mantle plume activity to the northwest of northern Baffin Island caused initial thinning, extension and fracturing of the crust. The formation of a rift complex is related to development of a RRR-triple junction along an area situated between the Late Proterozoic North American-Greenlandian supercontinent and an unknown continent to the northwest. A failed rift formed in the vicinity of northern Baffin Island. Its location was probably related in part, to the presence of older zones of structural weakness. Rift activity initiated the vertical tectonic regime that persisted throughout most of the evolution of the basin. It also brought about an interval of basalt volcanism and associated continental to shallow marine siliciclastic deposition. During this stage the Borden Basin developed from a series of small incipient or proto-troughs (i.e. passive rifting; Lower Eqalulik Group) into a multiple trough rift system in excess of 500 km in length and 125 km to over 200 km in width (i.e. active rifting; Upper Eqalulik Group)(Table 6.6; Figs. 6.la and 6.2a).

6.3.3a Pre-Quartzarenite Phase

The depositional history of the strata of the Pre-Quartzarenite Phase was strongly influenced by the tectonic regime that developed during the initial stages of RRR-triple junction formation. Early rifting occurred by rapid stretching of the lower, ductile part of the continental crust, allowing significant extension in the area of the Borden Basin with limited associated syndepositional tectonism.

In an initial pre-volcanic phase, fluvial to shallow marine sandstone, with minor intermixed conglomerate, accumulated in small proto-troughs that formed on the rifted margins of the basin (Figs. 6.la to 6.2a). Proximal to distal redbeds and conglomerate-based, sandstone-dominated cyclic sequences pass to the northwest into shallow marine sediments deposited in shoreface to subtidal environments. Sandstone deposition was interrupted by a series of tholeiitic basalt flows. The basalts were related to the initial extension and deep fracturing of the Borden Basin. The feeder fissures were probably aligned in a northwest-southeast direction along the axes of the first-order troughs (Fig. 5.1). At the time of basalt extrusion the proto-troughs were preferentially subsiding to the northwest, allowing thicker accumulations of flows in these areas (Figs. 3.2a to 3.2e).

6.3.3b Quartzarenite Phase

The Quartzarenite Phase was dominated by deposition of shallow marine sandstone in shoreface to tidal shelf settings. Minor distal braidplain deposition occurred in marginal settings in the basin. The sandstone covered the basalt flows of the previous phase and onlapped onto the basement in the northeast, southeast and southwest, covering the Navy Board, Krag Mountains, Byam Martin and Tunuiaqtalik Highs (Figs. 6.1a and 6.2a). These deposits gradually infilled the proto-troughs until a thick northwesterly-thickening sandstone blanket occupied the basin (Siliciclastic Shelf I, Table 6.6; Figs. 3.7 and 3.8). The maturity of the sandstones on a regional scale, the lack of extensive coarse, immature marginal deposits and absence of rapid marginal to basinal facies transitions, in contrast to those of the Arctic Bay Formation (Figs. 3.10a to 3.10f) support the interpretation of limited tectonism (Table 6.6).

The Precambrian Shield to the south and southeast was the major clastic source (Table 2.8). Basin subsidence was a major factor in controlling sediment accumulation. Subsidence of proto-troughs to the northwest may have initiated basin-wide transgression. The increased northwesterly subsidence may have been related to the presence of the thick sedimentary and volcanic pile or to increased stretching of the continental crust as ocean basin formation progressed (Figs. 6.1a and 6.2a; Figs. 3.7 and 3.8). As the Quartzarenite Phase drew to a close, sedimentation in the basin was dominated by shallow marine sandstone deposits accumulating in coastal, tidal shelf and shallow siliciclastic shelf environments (Figs. 4.1 to 4.4).

6.3.3c Transitional-I Phase

The relative stability of the Quartzarenite Phase ended with activation of the fault system of the Borden Basin (the Active Rift period) (Table 6.6). Active regional tectonism marked the beginning of the Transitional-I Phase. This phase is characterized by highly varied sediments, by a major change in regional thickness trends and by changes in paleocurrent trends (Figs. 3.10a to 3.10f, and 3.11).

Proximal braidplain deposits formed along the margins of the southeast part of Milne Inlet Trough ($AB_{U(SE:M)}$ member). Alluvial to delta fan cycles of the upper members of the Paquet Bay and Fabricius River Facies Assemblages were fault influenced. Siliciclastic- and calciclastic-dominated coarsening-up and carbonate-clastic shallowing-up cycles in the semi-restricted southeastern portions of the Milne Inlet and Eclipse Troughs comprise the $AB_{L(SE)}$ and $AB_{U(SE)}$ members. Incipient carbonate platform deposits accumulated basinwards of the clastic assemblages (AB_U and $AB_{U(SE)}$ members) and a shale-dominated, subtidal marine basin developed northwest of Milne Inlet (AB_M and AB_U members; Figs. 3.10a to 3.10f and 4.1 to 4.4). Tectonic influence on the sedimentation patterns is most evident in the development of fault-fringing delta fan, coarse shoreface and proximal braidplain deposits along the margins of the first-order troughs and in striking proximal to distal facies transitions (Figs. 4.1 to 4.4). The marginal and southeastern facies assemblages interfingered basinwards with shales, carbonates and siliciclastic and calciclatic deposits of the Basin Facies Assemblage (Figs. 3.10a to 3.10f; Table 2.5). The basinal assemblage infilled much of the central and northwestern potions of the first-order troughs during deposition of the Upper Eqalulik Group in the Transitional-I Phase (Figs. 6.1a and 6.2a).

Regional thickness trends changed dramatically from those of the previous phase. First-order troughs were deeply subsiding, preferentially to the southeast, during the Transitional-I Phase. Thick sediment piles accumulated adjacent to some major faults (Figs. 3.10a to 3.10f) and there were multiple depocentres (Fig. 3.11). These featuress indicate active rifting (Table 6.6).

Table 6.6: Summary of the tectono-sedimentary history of the Borden Basin.

LEGEND

(A). Major Event symbols:

□ = Shelf or platform construction

○ = Basin collapse; shelf or platform destruction

V = Critical Event V; Active to passive transition (i.e. rift to drift transition)

IV = Critical Event IV; Reactivation unconformity or drift to rift transition (locally = angular disconformity)

III = Critical Event III; Active to passive transition or rift to drift transition (i.e. "Break-up" or Post-rift unconformity; locally = angular disconformity)

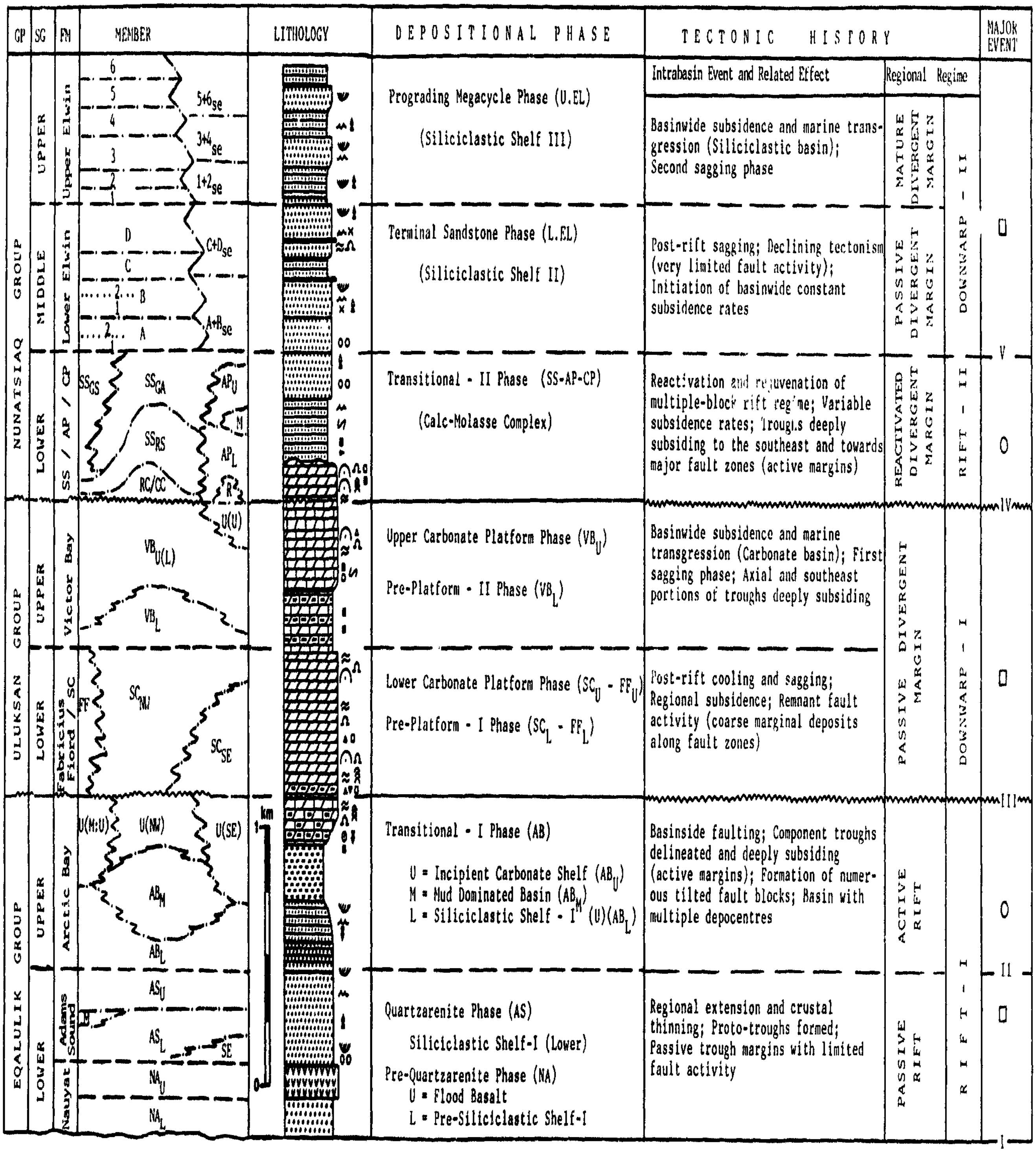
II = Critical Event II; Passive rift to active rift transition

I = Critical Event I; Initiation of regional extension

(B). Symbol codes for stratigraphic column: See Table 2.7.

(C). Lithology codes for stratigraphic column: See Table 2.5.

TABLE 6.6: SUMMARY OF THE TECTONO - SEDIMENTARY HISTORY OF THE BORDEN BASIN.



GP	SG	FM	MEMBER	DEPOSITIONAL PHASE	TECTONIC HISTORY: Intrabasin Event and Related Effect	Regional Regime		MAJOR EVENT
NUNATSIAQ GROUP	UPPER	Upper Elwin	6 5 4 3 2 1 5+6$_{se}$ 3+4$_{se}$ 1+2$_{se}$	Prograding Megacycle Phase (U.EL) (Siliciclastic Shelf III)	Basinwide subsidence and marine transgression (Siliciclastic basin); Second sagging phase	MATURE DIVERGENT MARGIN	DOWNWARP - II	□
	MIDDLE	Lower Elwin	D C 2 B 1 2 A 1 C+D$_{se}$ A+B$_{se}$	Terminal Sandstone Phase (L.EL) (Siliciclastic Shelf II)	Post-rift sagging; Declining tectonism (very limited fault activity); Initiation of basinwide constant subsidence rates	PASSIVE DIVERGENT MARGIN		
								V
	LOWER	SS / AP / CP	SS$_{GS}$ SS$_{GA}$ SS$_{RS}$ RC/CC AP$_U$ M AP$_L$ R	Transitional - II Phase (SS-AP-CP) (Calc-Molasse Complex)	Reactivation and rejuvenation of multiple-block rift regime; Variable subsidence rates; Troughs deeply subsiding to the southeast and towards major fault zones (active margins)	REACTIVATED DIVERGENT MARGIN	RIFT - II	O
								IV
ULUKSAN GROUP	UPPER	Victor Bay	U(U) VB$_{U(L)}$ VB$_L$	Upper Carbonate Platform Phase (VB$_U$) Pre-Platform - II Phase (VB$_L$)	Basinwide subsidence and marine transgression (Carbonate basin); First sagging phase; Axial and southeast portions of troughs deeply subsiding	PASSIVE DIVERGENT MARGIN	DOWNWARP - I	□
	LOWER	Fabricius Fiord / SC	FF SC$_{NW}$ SC$_{SE}$	Lower Carbonate Platform Phase (SC$_U$ - FF$_U$) Pre-Platform - I Phase (SC$_L$ - FF$_L$)	Post-rift cooling and sagging; Regional subsidence; Remnant fault activity (coarse marginal deposits along fault zones)			
								III
EQALULIK GROUP	UPPER	Arctic Bay	U(M:U) U(NW) U(SE) AB$_M$ AB$_L$	Transitional - I Phase (AB) U = Incipient Carbonate Shelf (AB$_U$) M = Mud Dominated Basin (AB$_M$) L = Siliciclastic Shelf - I (U)(AB$_L$)	Basinside faulting; Component troughs delineated and deeply subsiding (active margins); Formation of numerous tilted fault blocks; Basin with multiple depocentres	ACTIVE RIFT	RIFT - I	O
								II
	LOWER	Adams Sound	AS$_U$ M AS$_L$ SE	Quartzarenite Phase (AS) Siliciclastic Shelf-I (Lower)	Regional extension and crustal thinning; Proto-troughs formed; Passive trough margins with limited fault activity	PASSIVE RIFT		□
		Nauyat	NA$_U$ NA$_L$	Pre-Quartzarenite Phase (NA) U = Flood Basalt L = Pre-Siliciclastic Shelf-I				
								I

6.4 Tectono - Sedimentary History of the Uluksan Group

6.4.1 Major Sedimentary and Structural Features

The Uluksan Group contains a variety of important sedimentary and structural features that are best explained by a rift model. These tectono - sedimentary features include (Tables 6.4 and 6.5):

(a). An initial phase of regional tectonism with eventual regional stability and local, intermittent tectonic activity (Figs. 6.lb and 6.2b).

(b). An early phase of cyclic sedimentation with associated fault-marginal, coarse siliciclastic sequences and fan complexes.

(c). Buildup and expansion of a southeasterly- and northeasterly-thickening, regionally extensive carbonate platform; with a maximum thickness in central and southeastern Milne Inlet Trough.

(d). The occurrence of redbed and evaporite deposits and associated carbonate - clastic shallowing upward cycles and the semi-restricted nature of the southeastern portions of the major troughs. Carbonate, calciclastic and evaporite deposits occur in the southeastern parts of the Milne Inlet and Eclipse Troughs (Figs. 2.5 and 3.15a), indicating restricted circulation associated with tectonically-introduced, coarse siliclastic sediments.

(e). The numerous and abrupt lithologic and thickness changes and the regional distribution of lithofacies assemblages (Figs. 3.13a, 3.13b, 3.16a and 3.16b).

(f). The nature of the contact between the Eqalulik and Uluksan Groups ranges from an erosional (and, locally, slightly angular) unconformity in the northwestern part of the troughs, to an apparently gradational contact in the central-southeastern part of

Milne Inlet, and Eclipse Troughs (Figs. 3.10a to 3.10f).

(g). The nature of the contact between strata of the Uluksan and Nunatsiaq Groups. The contact ranges from unconformable in the northwestern part of the troughs to apparently gradational in the southeastern part of Milne Inlet and Eclipse Troughs (Figs. 3.16a, 3.16b, 3.19a to 3.19d).

6.4.2 Explanations for the Major Tectono - Sedimentary Features of the Uluksan Group

The major sedimentary and structural features of the Uluksan Group, outlined in the previous section, can be explained as a Downwarp Stage in rift basin evolution (Figs. 6.1b and 6.2b; Table 6.6) as follows:

(a). Significant syndepositional tectonism continued into the early Downwarp Stage of basin evolution. This tectonic activity was related to continued extension associated with the gradual relaxation of the stretched and thinned continental crust. As the component sub-blocks of the multi-part troughs subsided back into their pre-rift positions, renewed movement occurred along the major fault zones, resulting in the accumulation of coarse, immature siliciclastic deposits along the perimeters of the sub-blocks. When the extended continental crust beneath the troughs attained the pre-rift equilibrium position, major regional tectonism ceased. Minor intra-basin tectonism, along troughs margins and in southeastern parts of troughs, continued throughout the depositional history of the Uluksan Group (Figs. 6.1b and 6.2b).

(b). The number and regional distribution of cycles and cyclic sequences were a result of controls previously outlined for the Eqalulik Group. Continuous, or intermittent subsidence, combined with periodic faulting, led to the accumulation of thick successions of intermixed redbed, carbonate, evaporite-carbonate and carbonate- to calciclastic-dominated shallowing upward cycles. The redbed-carbonate and evaporite-carbonate cycles accumulated in the restricted southeastern portions of the Milne Inlet, Eclipse and North Bylot Troughs. These are interpreted as primary tectonic-erosion cycles similar to those described from other rifts (Illies, 1981, 1982; Illies and Bauman, 1982; Gjelberg and Steel, 1981; Steel et. al., 1981; Dalland, 1981; Surlyk et. al., 1981).

(c). The effects of continuous regional subsidence, in combination with gradual tectonic stability (Table 6.6), allowed regional marine transgression and the gradual buildup of extensive carbonate platform deposits (Figs. 4.1 to 4.4). These platformal carbonates were diluted by marginally-deposited tectonically-introduced siliciclastic influxes. A continuous carbonate buildup occurred until destruction and burial by siliciclastic deposits of the Lower Nunatsiaq Group in the early phase of the Reactivation Stage (Figs. 6.1c and 6.2c). Variations in thickness of the carbonate platform were related to variable subsidence of the sub-blocks.

(d,e). The occurrence of redbeds, evaporites, and marginal, immature siliciclastic sequences with associated abrupt lithologic and thickness changes can be related to syndepositional tectonic activity and continued restriction of the southeastern portions of the first-order fault troughs (Figs. 6.1b and 6.2b). Such a setting resulted in development of a large variety of cycles. The restricted portions of the Milne Inlet and Eclipse Troughs were tectonically active to some extent throughout most of the depositional history of the Borden Basin, and have been periodically reactivated throughout subsequent geologic history up until recent times (McWhae; 1981; Miall et. al., Trettin, 1969, 1975; Jackson and Iannelli, 1981).

(f). The boundary between the Eqalulik and Uluksan Groups represents the third critical event in the evolution of the Borden Basin, marking the transition from the Rift-I to Downwarp-I Stage, that is, the rift-to-drift transition (Table 6.6; Figs. 6.1a and 6.2a). The Critical Event III boundary has also been termed the "post-rift" or "breakup" unconformity of rift development on passive divergent margins (Grow, 1981; Grantz and May, 1982; Hutchinson et. al., 1982; Pigram and Panggabean, 1984; Bally, 1981). Formation of oceanic crust began in the main rift, and ocean opening, on a regional scale, was initiated (Figs. 6.1a and 6.2a). With the separation of stretched continental crust, subsiding passive margins were formed along the edges of the diverging plates. This subsident regime led to formation of fringing carbonate platforms (Bally, 1981; Watts, 1981; Grow, 1981). In Borden Basin this phase is represented by the Society Cliffs carbonate platform (Table 6.6; Figs. 6.1b and 6.2b). Both carbonate and siliciclastic sedimentation occurred in a complex basin comprised of several tilted and subsiding blocks and troughs (Figs. 5.4A to 5.4E). The boundary between the Eqalulik and Uluksan Groups is an erosional surface in the northwestern part of Milne Inlet and Eclipse Troughs. It is gradational in the central and southeastern parts of the troughs (Figs. 2.2 to 2.5). These features indicate that active updoming of stretched continental crust occurred to the northwest of Borden Basin during the deposition of the Arctic Bay Formation. It appears to have influenced sedimentation well into the depositional history of the Uluksan Group (Figs. 6.1a,b and 6.2a,b). The updoming event was superimposed on regional subsidence particularly in central and southeastern portions of first-order troughs where sedimentation was uninterrupted across the Rift-I to Downwarp-I boundary (Figs. 3.10a to 3.10f).

(g). The boundary between the Uluksan and Lower Nunatsiaq Groups represents the transition from an immature passive continental margin to a second period of rifting (Figs. 6.1c and 6.2c; Table 6.6). The contact marks the fourth critical event in basin evolution; it is also termed the reactivation unconformity or the drift to rift unconformity since it represents the passage from the Downwarp-I to Rift-II Stage (Table 6.6). The boundary is highlighted by a variety of contact relationships among the strata of the Victor Bay, Strathcona Sound, Athole Point and Canada Point Formations. At the Uluksan - Lower Nunatsiaq boundary, the tectono-sedimentary regime changed from one of regional stability and expansion of the Victor Bay carbonate platform to one of regional instability. There was associated destruction of the carbonate platform by basin-wide progradation of siliciclastic and calciclastic sediments (Figs. 6.1c, 6.2c and 3.19a to 3.19d). The nature of the contact and southeasterly thickening indicate that active updoming of stretched continental crust again occurred to the northwest of Borden Basin during the deposition of the Victor Bay Formation and the Lower Nunatsiaq Group. The central and southeastern portions of first-order troughs subsided and sedimentation was uninterrupted across the Drift to Rift transition. Tectonic activity associated with the Rift-II Stage, was greater than that during deposition of the Upper Eqalulik Group. Tectonic activity, is inferred from the abruptness and variety of lithologic changes present in the strata of the Lower Nunatsiaq Group (Figs. 3.19a to 3.19d).

6.4.3 Deposition of the Uluksan Group

The sedimentary and structural evolution of the Uluksan Group can be outlined in the Downwarp-I Stage of basin evolution. It consists of the Pre-Platform I, Platform 1, Pre-Platform II, and Platform II depositional phases (Table 6.6). As the mantle plume was removed, by continental separation or reduced by cessation of convection activity, tectonism gradually decreased and ultimately ceased. In the Borden Basin this was reflected in a gradual sagging of the stretched and fractured continental crust supporting the troughs and by gradual establishment of stable conditions (Figs. 6.lb and 6.2b). Downwarp of the crust allowed gradual marine transgression to occur. Regional transgression combined with general stability and near-complete cessation of significant clastic influxes allowed the gradual buildup of an extensive carbonate platform complex. This carbonate platform ultimately expanded across the margins of the Borden Basin.

6.4.3a Pre-Platform I and Platform I Phases (Lower Uluksan Group)

Although regional tectonism was in general decline, across Borden Basin, tectonic activity continued to affect the margins and southeastern portions of first-order troughs throughout much of the depositional history of the Lower Eqalulik Group (Figs. 4.1 to 4.4). Delta fan and coarse shoreface and coastal deposits accumulated along the margins of northwestern parts of first-order troughs well into the depositional history of the upper Society Cliffs Formation while fault-related, intermixed alluvial fan, coarse braidplain and beach to shallow shelf deposits accumulated in the southeastern parts of the troughs (Figs. 6.lb and 6.2b). These deposits interfingered basinwards, in the restricted portions of the troughs, with carbonate-siliciclastic-calciclastic lithofacies in the form of coarsening and shallowing upward cycles, that accumulated in subtidal to intertidal settings, and evaporite calciclastic deposits formed in supratidal sabkha environments. These are all components of the Pre-Platform I depositional Phase. They interfinger with, and are overlain by the Society Cliffs carbonate platform complex, in the northwest and central portions of the first-order troughs (Figs. 4.1 to 4.4; Table 6.6). The main parts of the troughs received both calciclastics and carbonates, typically arranged in shallowing upward cycles, together with carbonate-dominated sequences ($SC_{U(NW)}$ member). The depositional history of the $SC_{U(NW)}$ member records the initial stages in the construction of the Uluksan Carbonate Platform complex and represents the Platform I depositional phase. Carbonate platform deposits were continuous across the northern portion of Milne Inlet Trough, on Borden Peninsula, and across the northwestern portions of Eclipse and North Bylot Troughs (Figs. 4.1 to 4.4).

6.4.3b Pre-Platform II and Platform II Phases (Upper Uluksan Group)

As the Borden Basin continued to subside and regional tectonism diminished, an extensive carbonate platform was built up on the base developed in the Platform I phase. Carbonate platform deposits, of the Lower Uluksan Group, accumulated in the central and northwest parts of the first-order troughs but eventually they expanded across the entire basin during the Platform II phase (Figs. 6.lb and 6.2b). A semi-restricted carbonate-calciclastic-shale basin developed along the northwestern and central portion of Milne Inlet Trough during deposition of the VB_L member (Figs.

3.16a and 3.16b). Carbonate platform deposits, of the VB_U member, did not completely cover the basin until uppermost Uluksan depositional time (Figs. 4.1 to 4.3). The deposits of the VB_L member may be related to the formation of sub-basins in response to differential subsidence along north-northeast - trending second and third order faults. Deposits of the carbonate platform complex ultimately overwhelmed those of the VB_L sub-basin and blanketed the entire Borden Basin (Figs. 6.1b and 6.2b). Some horsts persisted locally into the earliest parts of the Upper Transitional phase of the Rift-II Stage (Table 6.6). Intertidal to shallow subtidal planar bedded to domal and columnar stromatolitic carbonates dominated the entire Borden Basin as the Downwarp 1 Stage drew to a close (Figs. 4.1 to 4.4).

6.5 Tectono - Sedimentary History of the Nunatsiaq Group

6.5.1 Major Sedimentary and Structural Features

The strata of the Nunatsiaq Group contain a diverse assemblage of sedimentary and structural features, that must be accounted for by a comprehensive rift model of basin evolution and includes as follows (Figs. 3.19, 3.21, 4.1 to 4.4, 6.1c,d and 6.2c,d; Tables 6.4 to 6.6): -

(a). Renewed regional tectonism, reactivated major fault zones and the first-order troughs (Figs. 5.1, 6.1c and 6.2c).

(b). Deposition of an assemblage of shallow to deep marine siliciclastic, calciclastic and carbonate sediments (Lower Nunatsiaq Group) (Fig. 3.19). These include fault-fringing alluvial to submarine fan complexes (SS_{FC} and $SS_{KA,GA}$ members), a remnant carbonate platform complex (SS_{CC}, SS_{RC} and $AP_{L(R)}$ members) and mixed continental shallow marine associations of the Canada Point Formation in southeastern Eclipse Trough (Figs. 4.1 to 4.4).

(c). The nature of the transition from the Lower Nunatsiaq Group into the Middle Nunatsiaq Group (Table 6.6; Figs. 3.19 and 3.21).

(d). Paleocurrent changes in the Nunatsiaq Group (Table 2.8).

(e). The reason for the regional preservation of the basin high on the craton (Fig. 6.2d). There is little evidence of extensive folding, thrust faulting or significant metamorphism.

6.5.2 Explanations for the Major Tectono - Sedimentary Features of the Nunatsiaq Group

The nature of the sedimentary and structural features of the Nunatsiaq Group, outlined in the previous section, can be accommodated by renewed extension (Rift-II Stage) followed by a second period of regional sagging (Downwarp-II Stage; Table 6.6; Figs. 6.1c, 6.ld, 6.2c and 6.2d). The explanations for these features are outlined below:

(a). A second period of extension may have been caused by renewed mid-oceanic ridge rifting in the new ocean basin or proximity of the failed rift arm to another mantle plume (Figs. 6.1c and 6.2c). Reactivation of the fracture system across the basin radically changed the composition and distribution of the sediments (Figs. 3.16 and 3.19).

(b). As noted above, renewed extension caused a change from regional stability to tectonic instability (Table 6.6; Figs. 6.1c and 6.2c). Depositional patterns were again strongly influenced by syndepositional faulting, resulting in a diverse assemblage of lithologies (Figs. 3.19a to 3.19d). Coarse, immature alluvial to submarine fans accumulated adjacent to the faulted trough margins while reefal to deep water carbonates were deposited in central and southeastern portions of the Milne Inlet Trough. The strong tectonic control on the sedimentation patterns was also evident in the striking marginal to basinal facies changes over short distances (Figs. 3.19 and 4.1 to 4.4).

(c). The contact between strata of the Lower Nunatsiaq Group and the Lower Elwin Formation represents the transition from regional extension and active tectonism to a period of regional stability and crustal downwarp (Figs. 6.ld and 6.2d). The boundary has been designated as the fifth critical event in basin evolution (Table 6.6). It is gradational and represents the gradual infilling of the tectonically-deepened rift troughs and development of a shallow siliciclastic shelf complex (Siliciclastic Shelf II of the Lower Elwin Formation; Fig. 3.21).

(d). Major changes in regional paleocurrent trends reflect the influences of new source areas related to the effects of renewed extension (Figs. 6.1c, 6.1d, 6.2c and 6.2d; Table 2.8). New source areas may have included the Melville Arch or the Brodeur Peninsula.

(e). The Borden Basin has survived relatively intact; the basin lacks significant deformation and metamorphism. This preservation is due to the evolution of the basin as a failed arm of an ancient RRR-triple junction (Fig. 6.2). The failed arm originally extended far into the craton. In this position, the failed arm escaped destruction in later ocean-closing collisional events.

Fig. 6.1: Transverse cross-sections illustrating the sequence of events in the evolution of the Borden Basin.

LEGEND

▨ Brittle (Upper) Continental Crust

▨ Ductile (Lower) Continental Crust

▨ Thermal uplift of Moho beneath thinned continental crust ("Rift Cushion")

·····S···· Shear Zone: Boundary between Lower (Ductile) and Upper (Brittle) Continental Crust

——M—— Moho: Boundary between Upper Mantle and Lower Continental Crust

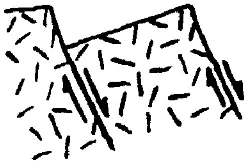
—SL— Sea level

⟸ ⟹ Regional Extension

⟹ ⟸ Regional Sagging

↰↱ / ↰↑↱ Active Mantle Plume (Convection)

↓↓↓ Mantle Plume Absent or Inactive (Regional Downwarp)



Tilted Fault Block:

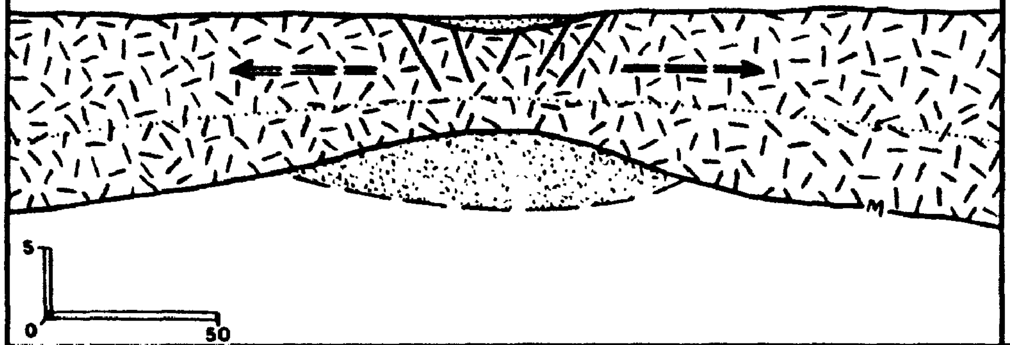
╲ Downthrown Side

╲ Upthrown Side

Figure 6.1a: Rift-I Stage

(I). Passive Rift Sub-stage

(i). Incipient Rift (Nauyat Formation)



COMMENTS

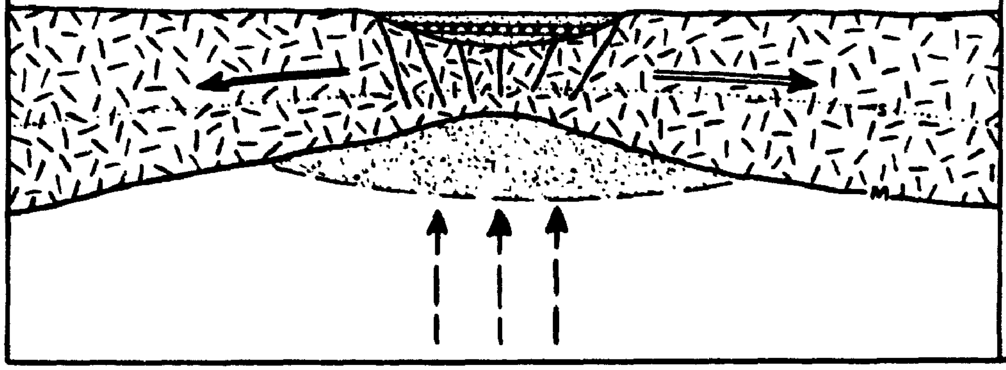
(1). Deviatoric stress related to subduction of the Helikian North American craton

(2). Tension causes later development of a series of hotspots

(3). Incipient RRR-triple junction

(4). Rapid (early) thinning of the continental crust

(ii). Early Rift (Adams Sound Formation)



COMMENTS

(1). Continued extension (thinning) of the continental crust

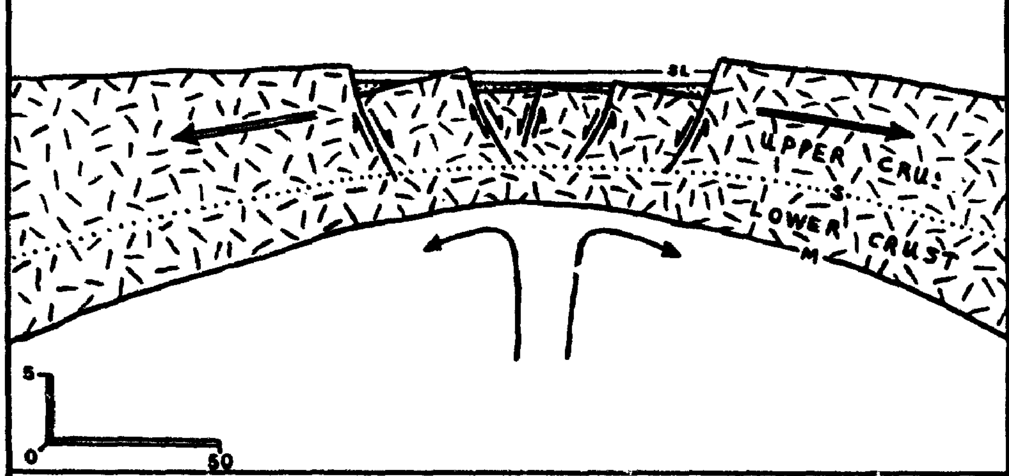
(2). Initiation of upper mantle melting; formation of "rift cushion" (= thermal uplift of Moho beneath thinned continental crust)

(3). Production of oceanic crust not yet established in area of RRR-triple junction

Figure 6.1a: Rift-I Stage

(II). Active Rift Sub-stage (Arctic Bay Formation)

(i). Active (incipient) Plume (AB_L Member)



COMMENTS

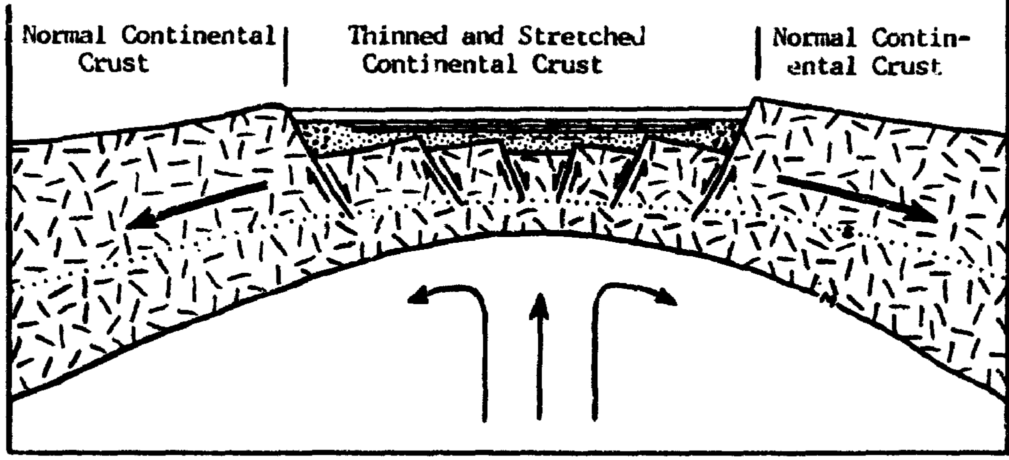
(1). Initial thinning phase followed by updoming related to mantle plume formation

(2). Ocean crust formation in new ocean basin

(3). Active RRR-triple junction associated with formation of emerging divergent margin

(4). Two distinct types of continental crust (horizontal subdivisions): Brittle (upper) and ductile (lower); References: Grow (1981), Watts (1981), Hutchinson et. al. (1982)

(ii). Active (mature) Plume (AB_M, AB_U Members)



COMMENTS

(1). Collapsing (foundering) mud, sand and carbonate-dominated basin

(2). Two distinct types of continental crust (vertical subdivisions): Stretched and normal; References: Chenet et. al. (1981)

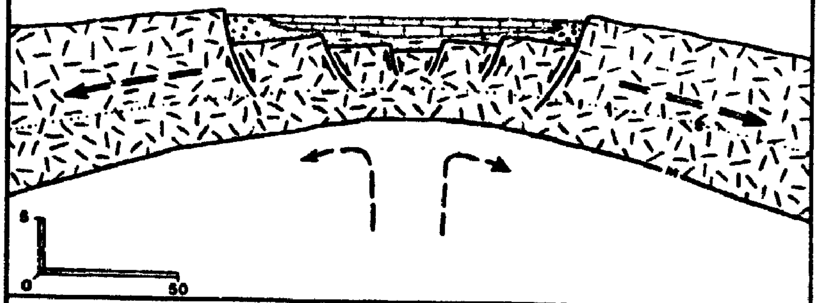
(3). Development of proto-carbonate shelf in central and southeast Milne Inlet and Eclipse Troughs

(4). Occurrence of striking thickness and facies variations

Figure 6.1b: Downwarp-I Stage

(III). Passive Divergent Margin (Uluksan Group)

(i). Waning Plume (FF_L, SC_L Members)



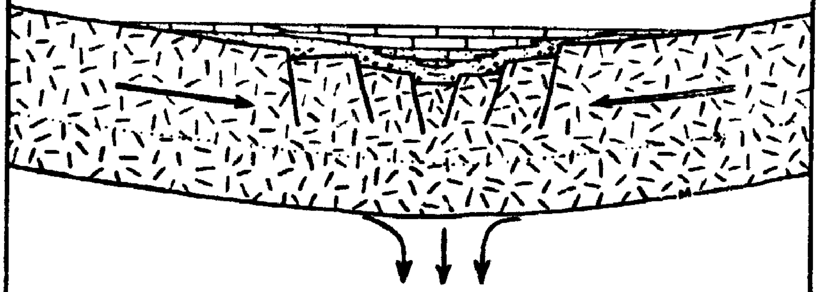
COMMENTS

(1). Cooling and thickening crust

(2). Waning plume; decreasing regional tectonism

(3). Plume eventually becomes inactive

(ii). Plume Removed (FF_U, SC_U Members)



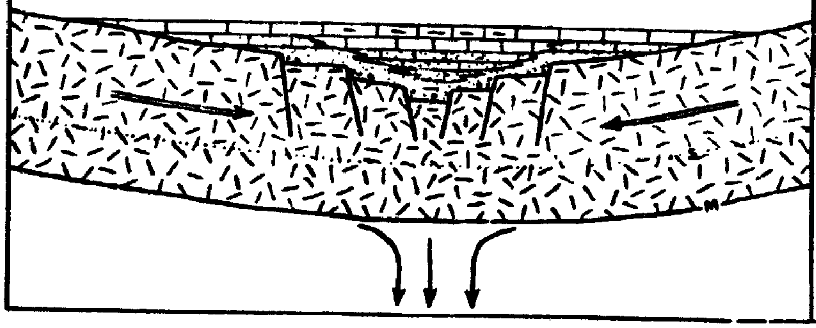
COMMENTS

(1) Tension released; crust continues to cool and thicken

(2). Cooling, sagging; post-rift subsidence

(3). Development of extensive carbonate platform

(iii). Passive Subsidence (Victor Bay Formation)



COMMENTS

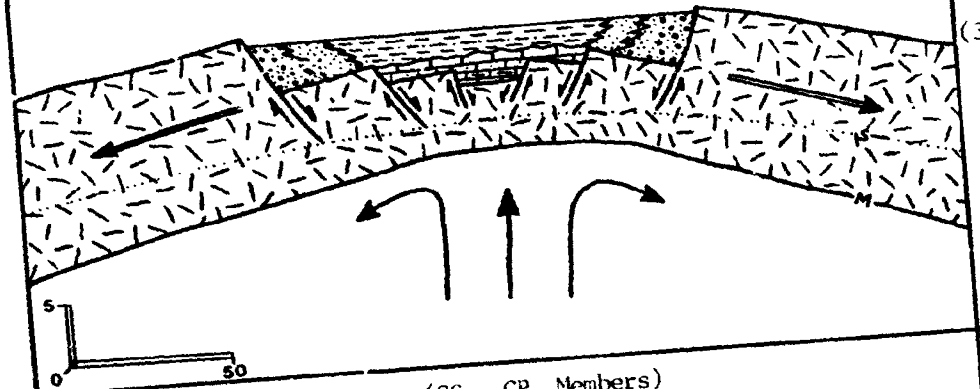
(1). Regional downwarp; general regional stability

(2). Continued construction of regional carbonate platform

Figure 6.1c: Rift-II Stage

(IV). Reactivated Divergent Margin (Lower Nunatsiaq Group)

(i). Active (incipient) Plume (CP_L, SS_L, $AP_{L,H}$ Mbrs)



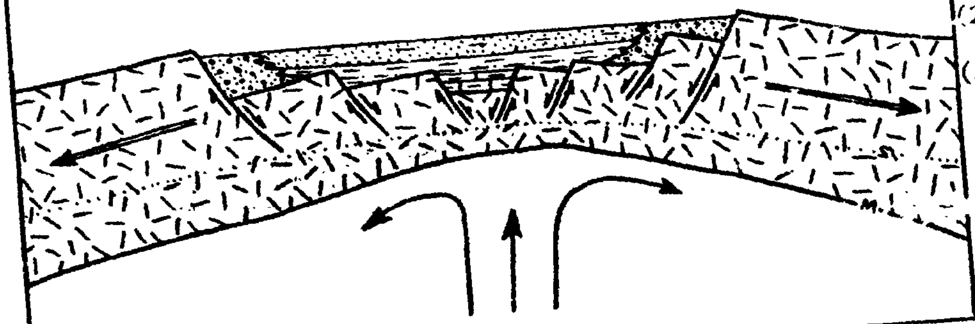
COMMENTS

(1). Tension due to renewed rifting

(2). Plume reactivation; renewed crustal thinning

(3). Regional faulting and deep subsidence

(ii). Active (mature) Plume (SS_U, CP_U Members)



COMMENTS

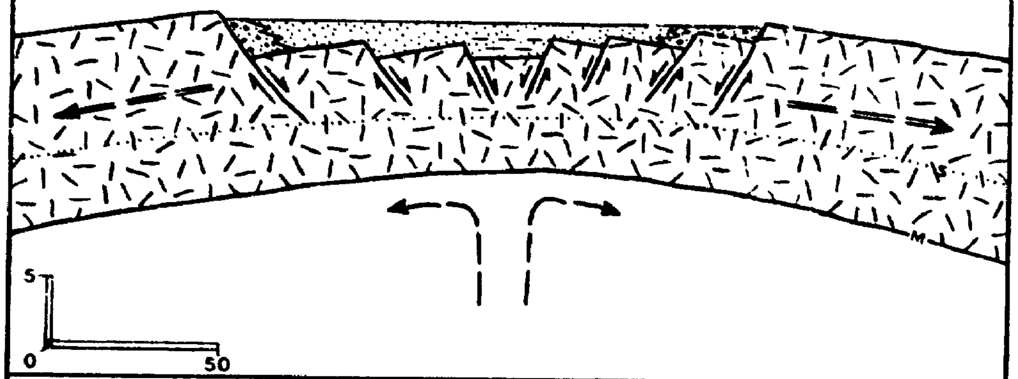
(1). Active extension; extreme facies changes; very coarse marginal (continental) facies; extensive faulting

(2). Regional uplift; reactivation of horsts

(3). Transitional siliciclastic and minor calciclastic sediments; continental (marginal) and marine

Figure 6.1d: Downwarp-II Stage

(V). Passive Divergent Margin (Lower Elwin Formation)



COMMENTS

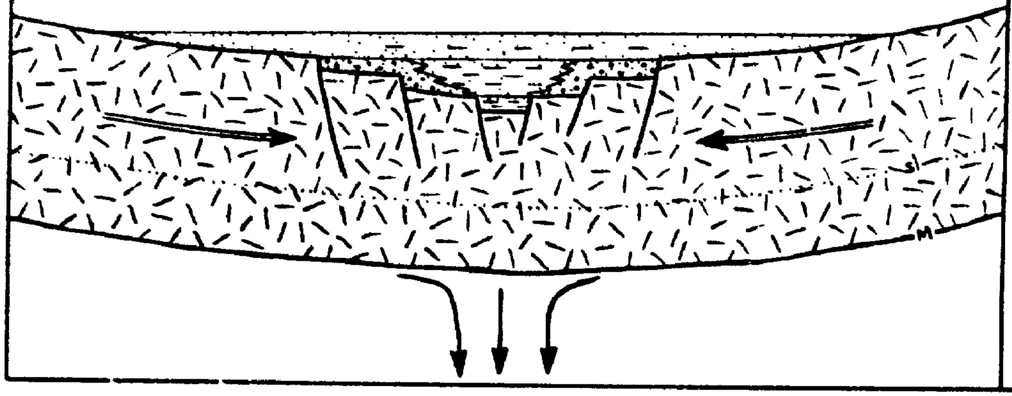
(1). Waning mantle plume; cessation of crustal thinning process

(2). Waning syndepositional tectonism

(3). Marine sediments: siliciclastic shelf (shallow marine) and minor continental

(4). Post-rift cooling and and regional subsidence (second generation)

(VI). Mature Divergent Margin (Upper Elwin Formation)



COMMENTS

(1). Plume removed; plume inactive or basin has drifted away from region of ocean crust formation

(2). Regional siliciclastic shelf; shallow marine megacycles (at least 3) dominate shelf sedimentation

(3). Stable marine basin; major facies and paleocurrent modifications (i.e. when compared with trends from the Eqalulik and Uluksan Groups)

6.5.3 Deposition of the Lower Nunatsiaq Group

The sedimentary and structural evolution of the Lower Nunatsiaq Group can be outlined as the Rift-II Stage of basin evolution or Transitional-II depositional phase (Figs. 6.1c and 6.2c).

The Rift-II Stage represents the resumption of regional extension initiated by renewed rifting along the mid-oceanic ridge in the new ocean basin and related mantle plume activity. Renewed extension caused extensive reactivation of the fault system and first-order troughs in the Borden Basin (Fig. 6.2c; Table 6.6).

The resumption of regional syndepositional faulting and uplift of major highs led to fragmentation and destruction of the Society Cliffs - Victor Bay Carbonate Platform complex (Figs. 6.1c and 6.2c). The Transitional-II phase was characterised by a return to siliciclastic-dominated deposition with extensive shallow to deep marine lithofacies assemblages (SS_{RS}, SS_{GS}, SS_{GA} and SS_{RA} members; Figs. 4.1 to 4.4). Subsidiary carbonate platforms were constructed in semi-restricted portions of the first-order troughs such as the central and southeastern parts of the Milne Inlet Trough ($AP_{L(R)}$, SS_{CC} and SS_{RC} members; Figs. 3.19a to 3.19d). This early-constructed, tectonically-influenced carbonate platform complex was eventually overwhelmed by shallow to deep marine silts and sands of the lower part of the Strathcona Sound Formation (SS_{RS}, SS_{GS} and SS_{GA} members; Figs. 3.19a to 3.19c). A semi-isolated, mud- and carbonate-dominated, deep subtidal marine basin existed in central and southeastern Milne Inlet Trough during deposition of the lower part of the Strathcona Sound Formation (Athole Point Formation; Figs. 3.19a, 3.19c and 6.2c). The Athole Point basin was related to deep subsidence of the sub-blocks of the central and southeastern parts of Milne Inlet Trough (Figs. 5.4B to 5.4D). Deposits of the Athole Point Formation were eventually overwhelmed by coarse siliciclastic sands and gravels of the upper part of the Strathcona Sound Formation (SS_{RA}, SS_{GA} and SS_{FC} members; Figs. 3.19c and 4.1). Marginal alluvial to submarine fan deposits of the SS_{FC} member interfingered basinwards with shallow to deep marine deposits of the SS_{RS}, SS_{GS}, SS_{RA} and SS_{GA} members (Figs. 3.19 and 4.1 to 4.4; Table 2.5).

6.5.4 Deposition of the Middle and Upper Nunatsiaq Groups

The sedimentary and structural evolution of the Middle and Upper Nunatsiaq Groups are ascribed to the Downwarp-II Stage of basin evolution. The Downwarp-II Stage comprises the Terminal Sandstone depositional phase (Lower Elwin Formation) and the Prograding Megacycle depositional phase (Upper Elwin Formation; Figs. 6.1d and 6.2d).

6.5.4a Terminal Sandstone Phase

The Terminal Sandstone Phase was characterised by a progressive reduction in tectonism related to the regional change in stress regime from one of extension to one of crustal relaxation (i.e. the second rift to drift transition; Figs. 6.1d and 6.2d). The active tectonic regime, dominant in the Rift-II Stage, was gradually replaced by regional stability and crustal cooling during the Downwarp-II Stage (Table 6.6).

Sedimentation patterns, during the Terminal Sandstone phase, were dominated by the development of a regionally-extensive sheet of shallow marine sandstones

(Siliciclastic Shelf-II; Figs. 4.4 and 6.2d; Table 6.6). Subordinate deposits of carbonates, redbeds and rare evaporitic sediments accumulated in the main parts of troughs and across much of southeastern Eclipse Trough (Figs. 3.21 and 4.4).

The Terminal Sandstone phase also witnessed the development of new source areas as implied by regional changes in paleocurrent trends (Table 2.8; Jackson et. al., 1978, 1980, 1985). The source changes may have been related to renewed regional updoming during the second rift episode. Paleocurrent studies (Jackson and Iannelli, 1981; Jackson et. al., 1980, 1985; Table 2.8) indicate that major new source areas, such as the Melville Arch and the Brodeur High, became active (Fig. 6.2d).

6.5.4b Prograding Megacycle Phase

The sediments of the Prograding Megacycle Phase are the product of regional stability associated with basin-wide subsidence and continued marine transgression. The basin was dominated by shallow marine shelf deposits (Siliciclastic Shelf III). The final phase of basin evolution involved the continued development of a passive divergent margin, characterised by at least three shallow shelf megacycles (Figs. 3.21, 4.4, 6.1d and 6.2d; Table 6.6). Paleocurrent trends were similar to those of the preceding phase.

Sedimentation was followed by regional uplift and mild compression. The entire succession was then intruded by diabase dykes of the Borden Igneous Event at about 950 Ma and dykes of the Franklin Igneous Event at about 750 Ma (Table 1.1). These events suggest renewed regional tension.

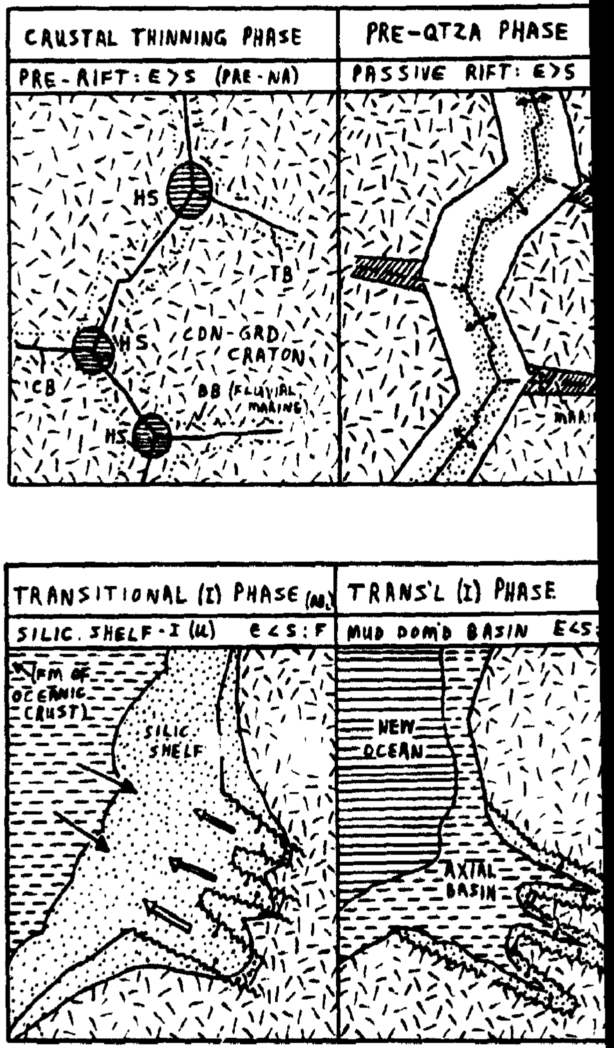
Fig. 6.2: Plan views illustrating the sequence of events in the evolution of Borden Basin.

LEGEND

BB = Borden Basin
TB = Thule Basin
CB = Coppermine Basin
HS = Hot Spot
CDN = Canadian
GRD = Greenlandian
Qtza = Quartzarenite
Trans'l = Transitional
Cont'l = Continental
Silic = Siliciclastic
Carb = Carbonate
Trans'n = Transgression
Tect'n = Tectonism
Subsid = Subsidence
Sdst = Sandstone
Dom'd = Dominated
Incip = Incipient
Volcs = Volcanics
Fm = Formation

FIG. 6.2: PLAN VIEWS ILLUSTRATING
EVENTS IN THE EVOLUTION O

(A). EQALULIK GROUP
RIFT-I STAGE



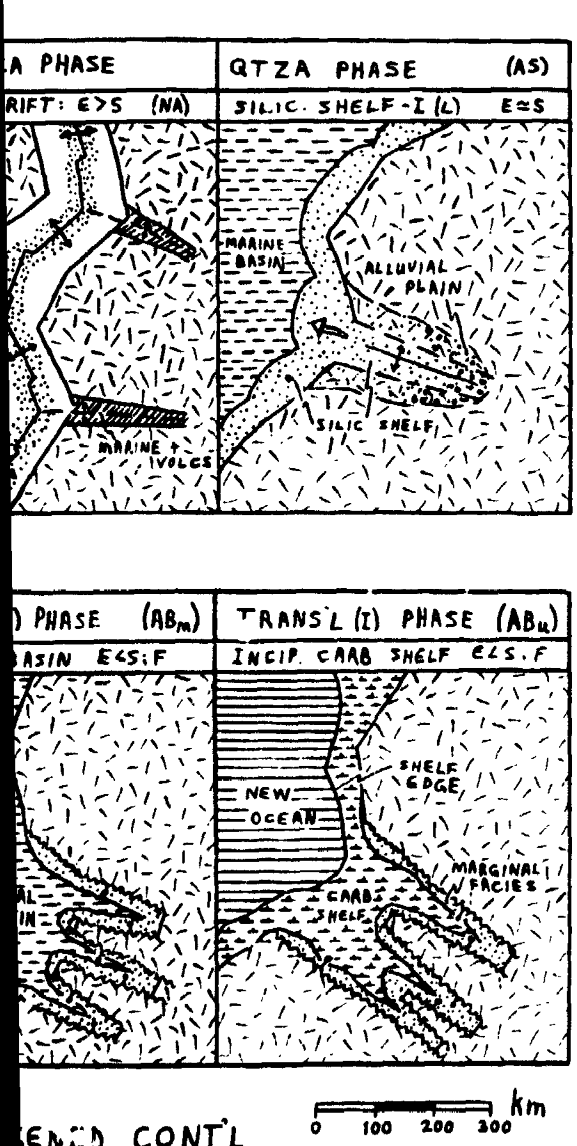
▨ PRE-RIFT WEAKENED C
CRUST

E = EXTENSION
C = COMPRESSION
F = FAULTING
S = SUBSIDENCE

THINNED CONT'L CRUST
☐ RIFTED CONTINENTAL MAR
▨ INTRACONTINENTAL FAILE

▨ CONTINENTAL CRUST
░ OCEANIC CRUST

NG THE SEQUENCE OF
ON OF BORDEN BASIN.



ENDED CONT'L

NTAL MARGIN

L FAILED RIFT

CRUST

ST

HS = HOT SPOT

SPREADING AXIS

DIRECTION OF SEDIMENT TRANSPORT

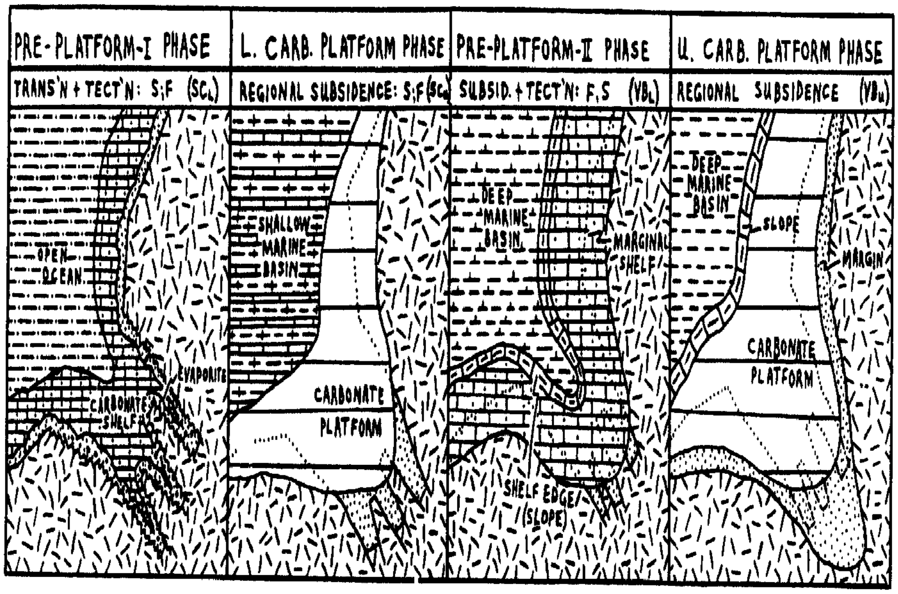
FAULT MARGIN; DOWNTHROWN BLOCK INDICATED BY SOLID CIRCLE

TRANSGRESSION TREND

FIG. 6.2 (CONT'D)

(B). ULUKSAN GROUP

DOWNWARP-I STAGE

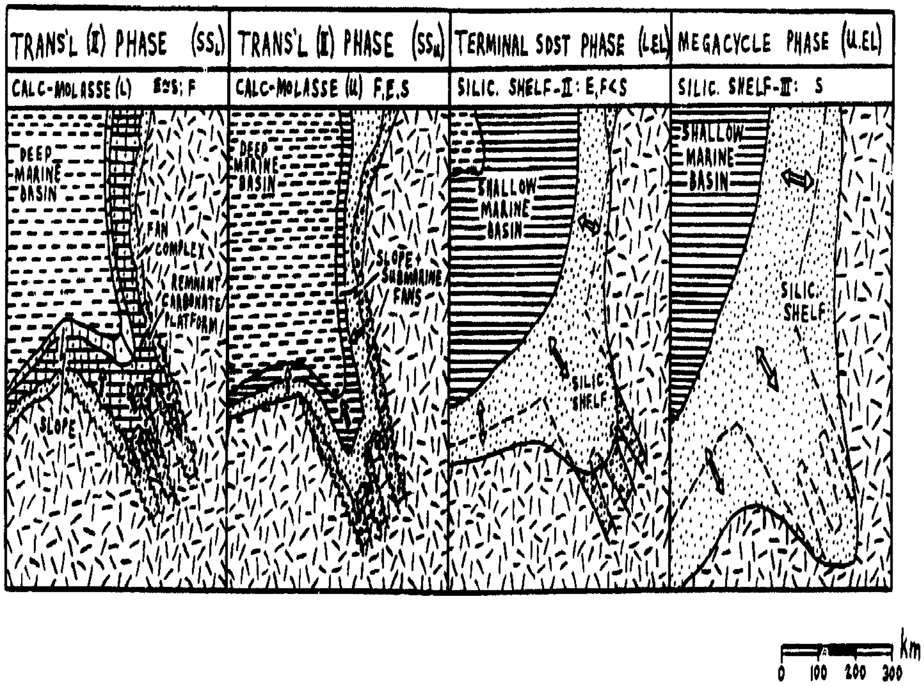


(C). NUNATSIAQ GROUP (LOWER)

RIFT-II STAGE

(D). MIDDLE + UPPER NUNATSIAQ GP.

DOWNWARP-II STAGE



6.6 Tectono - Sedimentary History of the Borden Basin

6.6.1 Sedimentary and Structural Features

Sedimentary and structural features of the Late Proterozoic successions of the eastern Arctic Islands can best be explained by crustal rifting and incipient ocean opening, as proposed by Dewey and Burke (1974) and Burke (1976, 1977, 1980). Rift basins such as those on northern Baffin Island and northwestern Greenland were probably related to partial ocean opening but evidence for closure is limited. Features supporting such a model include the following:

(a). Development of rift troughs including the Thule, Fury and Hecla, Borden, Bathurst Inlet (?), and Coppermine River basins.

(b). Contemporaneous basalts in widely separate basins, related to the MacKenzie Igneous Episode.

(c). Thick successions consisting of lower clastic, middle carbonate and (in northern Baffin Island) upper clastic sequences (Jackson and Iannelli, 1981, Fig. 16.33, p. 295).

(d). Possible carbonate shelf-equivalent strata to the northwest and north, especially for sequences in north and northwest Greenland.

(e). Extensive metamorphism and deformation of Late Proterozoic rocks on northwest Ellesmere Island.

(f). Tilted fault blocks in major troughs.

6.6.2 Mechanism for the Origin of Late Proterozoic Basins in the Eastern Arctic Islands

The suggested mechanism is regional rifting related to one or more hot spots, resulting in the formation of RRR-triple junctions (Fig. 6.2a). Rifting, updoming, continental fracture, separation and ocean formation may have occurred along a suture in the Melville Sound - Lancaster Sound to Baffin Bay and Nares Strait area. This is thought to be related to the MacKenzie Igneous event at about 1267 Ma. Regional volcanism and dyke intrusion were associated with ocean opening and formation of rift basins along an irregular, Late Proterozoic craton margin (Fig. 6.2a) (Dewey and Burke, 1974; Rankin, 1976). Rifting occurred on several scales as follows:

(i). Mid-oceanic ridge suture: this feature encompassed the entire continental rift system and may have extended from northern Greenland to Alaska and thence along the west coast of North America (scale = 1000's of kilometres).

(ii). Marginal rift basins: these comprise failed rifts (Table 6.1) situated on divergent, passive Atlantic type margins associated with hot spot activity and the formation of RRR-triple junctions (scale = 100's of kilometres).

(iii). Tectonism within rift troughs: encompasses the smaller scale features of the rift basins such as the first, second and third order sub-troughs (Figs. 5.4B to 5.4E, 6.1 and 6.2; scale = 10's of kilometres to 100's of kilometres).

Thick miogeoclinal sequences developed along divergent passive margins that may have been continuous from northern Greenland and northwestern Ellesmere Island, to northern Baffin Island, along the northern margin of the Late Proterozoic North American craton to the Alaska region (Young, 1979; Burke, 1980;

Muehlberger, 1980). The ocean may have closed at about 1.0 Ga, but supporting evidence is limited (Jackson and Iannelli, 1981, 1984).

6.6.3 Evolution of the Late Proterozoic Basins of the Eastern Arctic

The regional tectono - sedimentary features outlined earlier can best be explained by ocean opening and related regional extension as summarised below:

(a). Development of rift basins is tentatively associated with the opening of the Poseidon Ocean (Jackson and Iannelli, 1981), initiated about 1267 Ma, during the MacKenzie Igneous Episode (Jackson et. al., 1990). Individual rift basins were associated with hot spot activity and formation of RRR-triple junctions (Figs. 6.la and 6.2a). Mantle plumes may have occurred to the north and northwest of the rift basins in the vicinity of the Coronation Gulf, Melville Sound and northern Baffin Bay.

(b). Extensive volcanism, at about 1267 Ma (MacKenzie Igneous Event) occurred during the early phase. Mantle magma sources were tapped by deep seated fractures such as the Tikerakdjuak Fault system in both oceanic and failed rift settings. These events were associated with widespread diabase dyke swarms (Fahrig et. al., 1971).

(c). The thick succession in the Borden Basin was deposited in an active rift setting. Rifts associated with the evolution of the Poseidon Ocean evolved through four stages (Figs. 6.1 and 6.2; Table 6.6):

(i). A lower, tectonically-influenced, semi-restricted stage, in which thick, siliciclastic-dominated successions accumulated (= Rift - I Stage).

(ii). An overlying, tectonically more stable stage associated with extensive platform deposits, marginal coarse siliciclastic fan deposits and carbonate -

evaporite deposits in restricted portions of the troughs (= Downwarp-I Stage).

(iii). An upper, tectonically-influenced, semi-restricted stage, dominated by marine siliciclastic deposits and associated carbonate - siliciclastic deposits in the southeastern parts of first-order troughs (= Rift-II Stage).

(iv). An overlying, tectonically more stable stage characterised by extensive siliciclastic shelf deposits (= Downwarp-II Stage).

(d). Shelf sequences of the northwestern Ellesmere Island and north Greenland carbonate platform may be parts of a miogeoclinal succession marginal to or northwest of, the rift troughs. The shelf postdated the initial rifting stage (Fig. 6.2b). A thick "geosynclinal" assemblage is lacking but a relatively thin shelf succession developed on the margin of the craton.

(e). Deformation and metamorphism of the Late Proterozoic succession on northwestern Ellesmere may be related to closure of the Poseidon Ocean at about 1.0 Ga and possibly the early history of the Pearya Geanticline (Jackson and Iannelli, 1981; Trettin, 1987).

(f). The size, shape, and evolutionary history of component troughs of individual rift basins are probably related to crustal thickness, composition and structure, and proximity of the basin to an active mantle plume. The occurrence of such features, in the Thule, and Fury and Hecla Basins lends further support to the existence of several hot spots during the initial phases of the MacKenzie Igneous event.

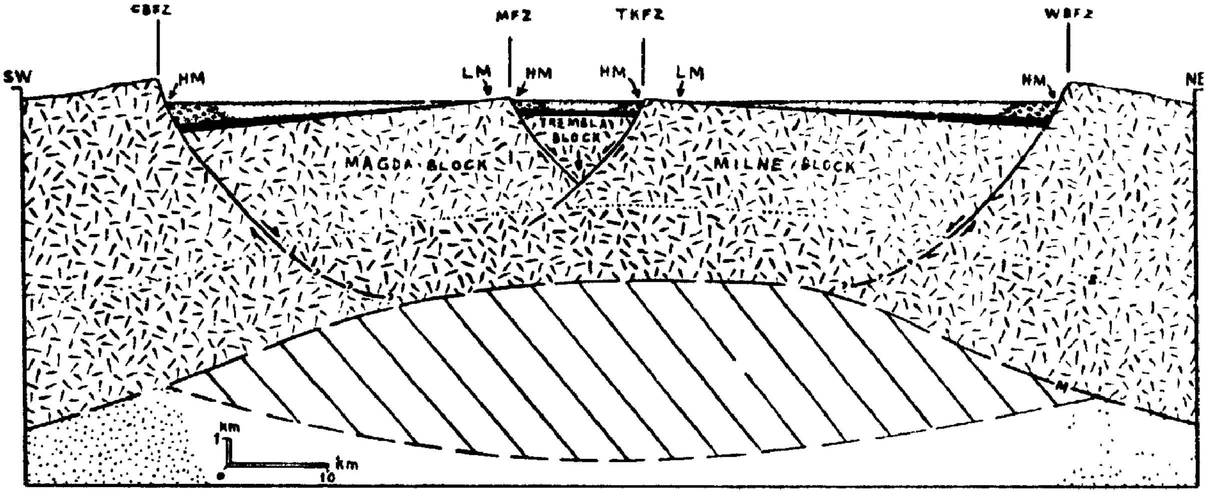


Fig. 6.3: General view of a simplified northeast - southwest cross-section, in central Milne Inlet Trough, during deposition of the Arctic Bay Formation. The diagram illustrates the concept of low and high angle fault-block margins.

LEGEND

Arctic Bay Formation:

- ▨ Marginal Facies Assemblage
- ☐ Basinal Facies Assemblage

■ Adams Sound Formation

Continental Crust:

- ▨ Brittle (upper) Crust
- ▨ Ductile (lower) Crust

▨ Upper Mantle

▧ Thermal Uplift of Moho Under Thinned Continental Crust ("Rift Cushion")

CBFZ = Central Borden Fault Zone

WBFZ - White Bay Fault Zone

MFZ = Magda Fault Zone

TKFZ = Tikerakdjuak Fault Zone

LM = Low-angle Margin

HM = High-angle Margin

--S-- = shear zone delineating the boundary between the Lower (ductile) and Upper (brittle) continental crust

—M— = Moho: boundary between the upper mantle and lower continental crust

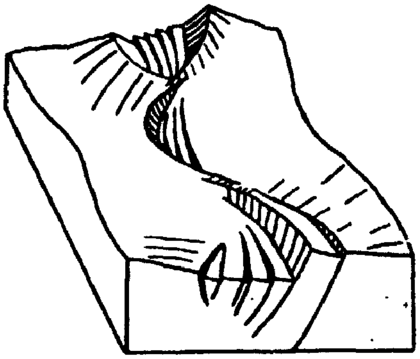


Fig. 6.4A: Block diagram showing alternation of half graben along a sinusoidal interconnection of border faults and interbasinal ridges (Type-I Model; modified after Rosendahl et.al., 1986). The portion of rift illustrated is about 100 km long.

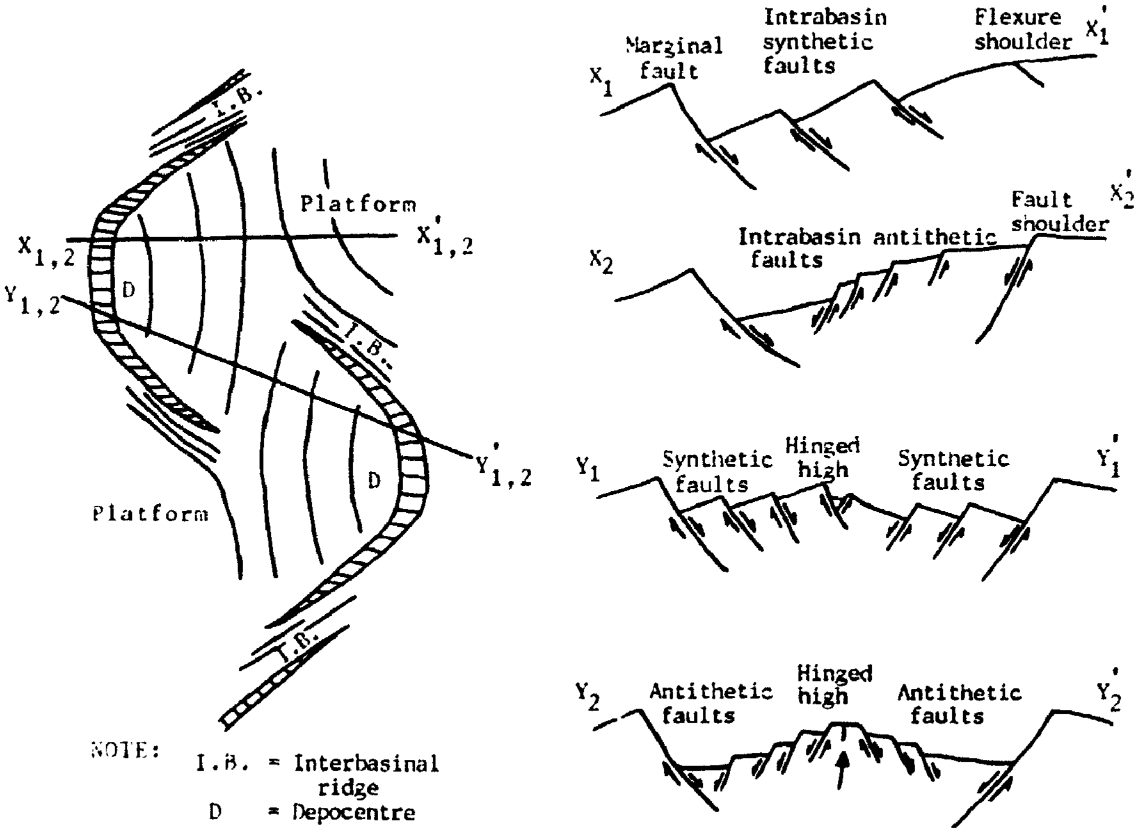
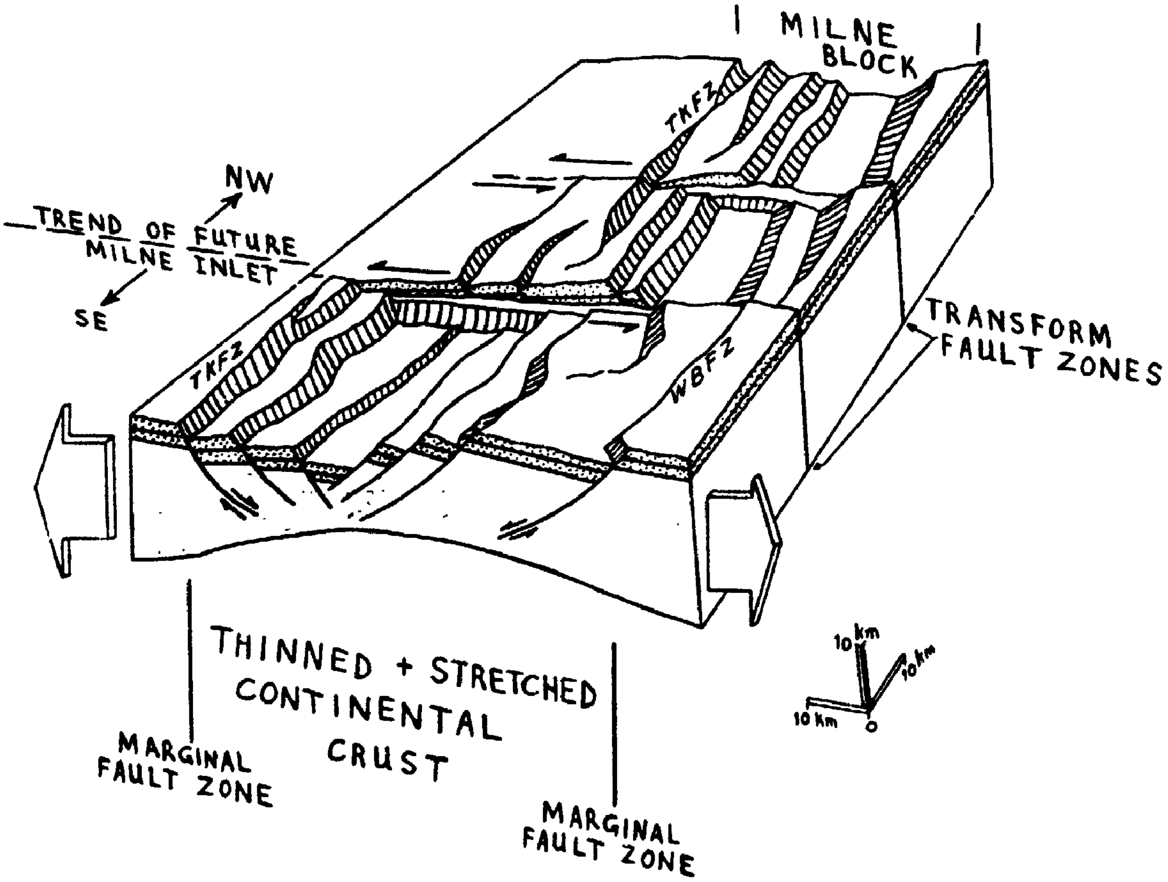


Fig. 6.4B: Illustrations of possible cross-sections across alternating half graben. Series 1 cross-sections with intrabasin synthetic faults; series 2 cross-sections with antithetic faults (modified after Rosendahl et. al., 1986).

Fig. 6.5: Block diagram illustrating crustal thinning, listric normal faulting and transform faulting in a multiple-block rift model of the central part of Milne Inlet Trough (i.e. central Milne Block; Type II Model). Diagram modified after Bally (1981, 1982) and Bally and Snelson (1980). The transform faults, used in the model, are equivalent to the transfer faults in rift models from Enachescu (1987) and Etheridge *et*. *al*. (1987).



REVISED STRATIGRAPHY OF THE LATE PROTEROZOIC BYLOT SUPERGROUP, NORTHERN BAFFIN ISLAND, ARCTIC CANADA: IMPLICATIONS FOR THE EVOLUTION OF BORDEN BASIN

VOLUME II

by

Thomas R. Iannelli

Department of Geology

Submitted in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Graduate Studies
The University of Western Ontario
London, Ontario
January, 1992

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF REPRINTS

Appendix I

Field Station Locations

The locations of field stations, used in the analysis of the stratigraphy of the Bylot Supergroup and geology of the Borden Basin, are listed in this appendix. The field stations originate largely from the mapping and exploration projects of the Geological Survey of Canada (i.e. Operation Borden, Sections 1, 2, 3 and 5) and Petro-Canada (1981 field season, Section 4). The few stations from the 1989 field season with Strathcona Minerals are listed in section 6. Also listed in this section are field stations, from earlier Geological Survey of Canada and mineral exploration projects on northern Baffin Island, from which stratigraphic information was derived.

Field station co-ordinates have been calculated using the Universal Transverse Mercator (UMT) grid on 1:250,000 scale topographic maps. The relevant sheets, for northern Baffin Island, are outlined in Fig. I-1. Rock unit codes for individual field stations are listed in Table I-1.

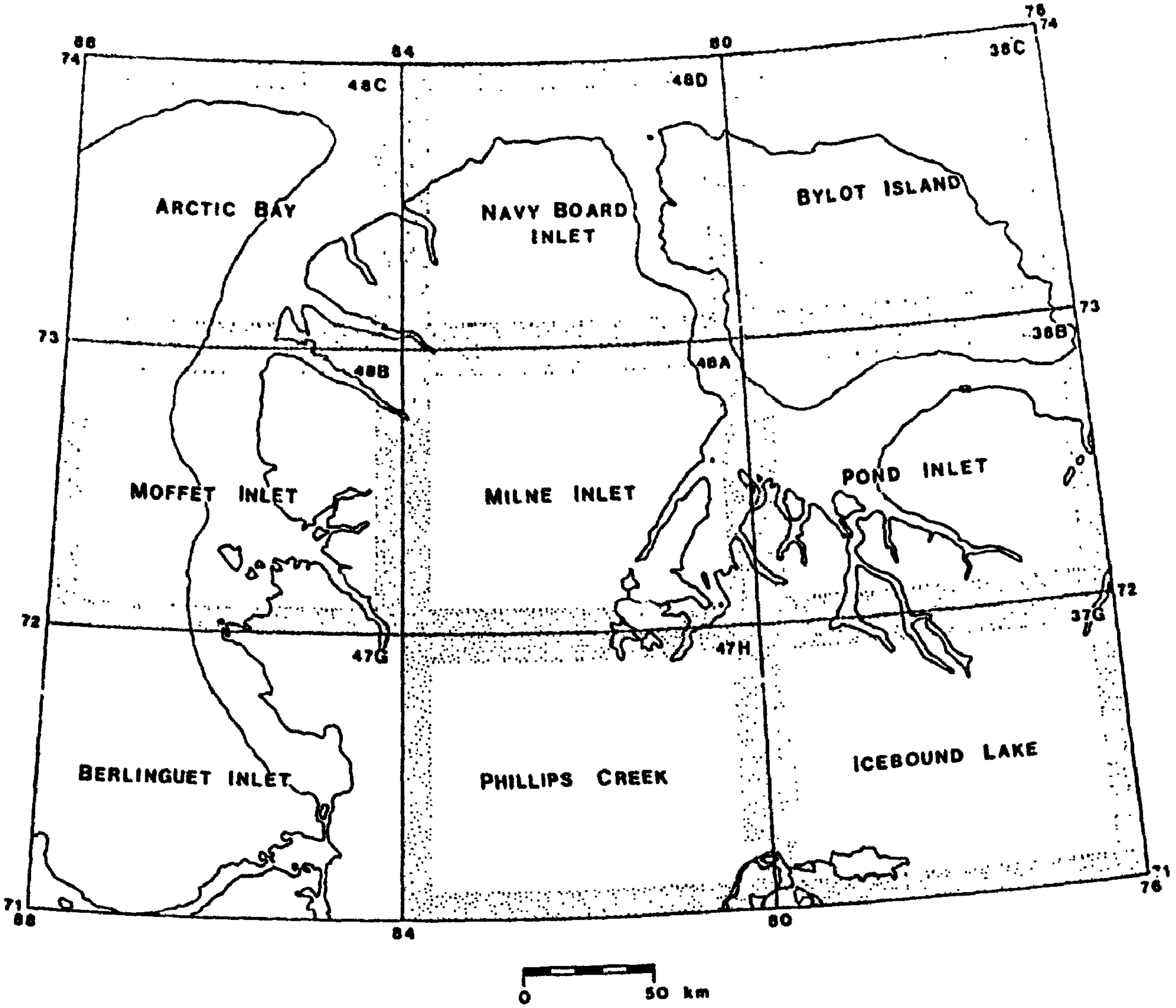


Fig. 1.1: Location of topographic base maps (1:250,000 scale) that are included in the thesis area and in which the field stations are located (stippled margins).

TABLE I-1: ROCK UNIT CODES FOR APPENDIX I

PAL = Paleozoic
DYKE = Late Proterozoic diabase dyke
U.EL = Upper Elwin Formation
L.EL = Lower Elwin Formation
CP = Canada Point Formation
AP = Athole Point Formation
SS_{RC} = Strathcona Sound Formation; Clastic Carbonate Member
SS_{RS} = Strathcona Sound Formation; Red Shale-Siltstone Member
SS_{RA} = Strathcona Sound Formation; Red Arkose Member
SS_{GS} = Strathcona Sound Formation; Green-grey Siltstone Member
SS_{GA} = Strathcona Sound Formation; Grey-green Arkose Member
SS_{GC} = Strathcona Sound Formation; Grey-green Siltstone - Carbonate Member
SS_{FC} = Strathcona Sound Formation; Fault-margin Conglomerate Member
SS_{MC} = Strathcona Sound Formation; Mixed Clastics and Conglomerate Member
VB = Victor Bay Formation
SC = Society Cliffs Formation
FF = Fabricius Fiord Formation
AB_{PB} = Arctic Bay Formation; Southeast (Paquet Bay) Facies Assemblage
AB_{TS} = Arctic Bay Formation; Basinal (Tremblay Sound) Facies Assemblage
AB_{FR} = Arctic Bay Formation: Marginal (Fabricius River) Facies Assemblage
AS = Adams Sound Formation
NA = Nauyat Formation
REG = Regolith
AMG = Basement Complex

(1). 1977 Field Stations

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
7I001	559900	8103600	48C 02	16	AS
7I002	559700	8103600	48C 02	16	AS
7I003	559500	8103600	48C 02	16	AS,AB_{TS}
7I004	559300	8103610	48C 02	16	AB_{TS}
7I005	559200	8103600	48C 02	16	DYKE
7I006	559100	8105050	48C 02	16	SC
7I007	558100	8105800	48C 02	16	VB
7I008	557600	8105000	48C 02	16	VB
7I009	557610	8105050	48C 02	16	VB,SS_{RS}
7I010	557900	8105650	48C 02	16	VB
7I011	560780	8105950	48C 02	16	AB_{TS}
7I012	561000	8105950	48C 02	16	SC
7I013	559700	8103790	48C 02	16	AS
7I014	559600	8103850	48C 02	16	AB_{TS},SC
7I015	551200	8090450	48B 15	16	AMG
7I016	551470	8090460	48B 15	16	AMG
7I017	552540	8080830	48B 15	16	AMG
7I018	553220	8091820	48B 15	16	NA
7I019	554000	8092420	48B 15	16	NA
7I020	553980	8093170	48B 15	16	NA,AS
7I021	553160	8095380	48B 15	16	AS
7I022	553690	8097560	48B 15	16	AS
7I023	558800	8096450	48B 15	16	AB_{TS}
7I024	557950	8095900	48B 15	16	AB_{TS}
7I025	577200	8087080	48B 16	16	AS
7I026	576750	8086780	48B 16	16	NA,AS
7I027	562400	8088500	48B 15	16	AS
7I028	557800	8088850	48B 15	16	NA

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
7I029	549950	8109200	48C 02	16	SS_{GS}
7I030	550000	8111500	48C 02	16	PAL
7I031	551600	8117650	48C 02	16	SS_{GS}
7I032	550420	8116030	48C 02	16	AS
7I033	578400	8102100	48C 12	16	AS
7I034	576800	8102400	48C 12	16	AS
7I035	575000	8102700	48C 13	16	AS
7I036	573700	8101540	48B 16	16	AS
7I037	573120	8101740	48C 1	16	AS
7I038	572430	8101380	48B 16	16	AB_{TS}
7I038.A	572200	8101400	48B 16	16	DYKE,AB_{TS}
7I039.B	5 1980	8101300	48B 16	16	DYKE,AB_{TS}
7I038.C	571520	8101050	48B 16	16	DYKE
7I038.D	571400	8101050	48B 16	16	DYKE
7I039	571000	8100720	48B 16	16	AB_{TS}
7I039.A	571120	8100380	48B 16	16	AB_{TS}
7I039.B	571740	8099840	48B 16	16	AB_{TS}
7I040	570550	8099460	48B 16	16	AS
7I041	569540	8098410	48B 16	16	AS
7I042	582600	816500	48C 01	16	SC
7I043	558550	8035900	48B 07	16	AS
7I044	558740	8035800	48B 07	16	AS
7I045	558820	8035130	48B 07	16	AS
7I045.A	559200	8034830	48B 07	16	AS
7I045.B	560000	8034940	48B 07	16	AS
7I045.C	560390	8035100	48B 07	16	AS
7I046	561000	8035170	48B 07	16	AS
7I047	560600	8034600	48B 07	16	NA
7I048	561380	8034600	48B 07	16	NA

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71049	564550	8035120	48B 07	16	AMG,NA
71049.A	564510	8035150	48B 07	16	AMG
71050	564800	8034780	48B 07	16	AMG
71051	565200	8034030	48B 07	16	AMG
71052	565350	8033540	48B 07	16	AMG
71052.A	565320	8033550	48B 07	16	AMG,NA
71053	565400	8033150	48B 07	16	DYKE,AMG
71053.A	565420	8032780	48B 07	16	AMG
71053.B	565400	8032710	48B 07	16	AMG
71054	565760	8032580	48B 07	16	AMG
71055	565200	8032140	48B 07	16	AMG
71056	564380	8032220	48B 07	16	AMG
71057	563640	8032800	48B 07	16	AMG
71058	563520	8033380	48B 07	16	AMG,NA
71059	563370	8034000	48B 07	16	AMG,NA
71060	563860	8034230	48B 07	16	AMG
71061	565220	8035700	48B 07	16	AMG
71062	566190	8036220	48B 07	16	AMG,NA
71063	566800	8035330	48B 07	16	AS
71063.A	566850	8035350	48B 07	16	AS
71064	567140	8035130	48B 07	16	AS
71064.A	567150	8035110	48B 07	16	AS
71065	567880	8035990	48B 08	16	AS
71066	569380	8037420	48B 08	16	AS
71067	570740	8038600	48B 08	16	AS
71068	564640	8035630	48B 07	16	AMG
71069	564050	8035800	48B 07	16	NA,AS
71070	565200	8035870	48B 07	16	AS
71071	565420	8035920	48B 07	16	NA

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71072	550340	8063500	48B 10	16	REC
71073	550420	8063200	48B 10	16	NA
71074	550950	8063000	48B 10	16	NA
71075	551440	8064120	48B 10	16	NA
71076	551140	8063250	48B 10	16	NA
71077	550250	8062540	48B 10	16	AS
71078	550150	8062650	48B 10	16	AS
71079	550100	8062700	48B 10	16	AS
71080	548200	8063060	48B 10	16	AS
71081	548260	8063550	48B 10	16	AS
71082	548200	8062880	48B 10	16	AS
71083	543800	8093250	48B 15	16	NA
71084	544520	8089860	48B 15	16	AMG
71085	544280	8085320	48B 15	16	NA
71086	544350	8081840	48B 15	16	NA
71087	543790	8087420	48B 15	16	AMG
71088	544430	8072770	48B 10	16	AMG
71089	544490	8068760	48B 10	16	AMG
71090	543840	8066600	48B 10	16	AMG
71090.A	544000	8066360	48B 10	16	NA
71091	548350	8047600	48B 10	16	AMG
71092	548190	8057420	48B 10	16	AS
71093	547140	8068830	48B 10	16	AMG
71094	547760	8081150	48B 15	16	NA
71095	548240	8086960	48B 15	16	NA,AS
71096	548050	8090890	48B 15	16	AMG
71097	547980	8097670	48B 15	16	AS
71098	551970	8094610	48B 15	16	AS
71099	551830	8087700	48B 15	16	NA

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
7I100	551150	8086390	48B 15	16	AMG
7I101	551510	8080120	48B 15	16	NA
7I102	551660	8071390	48B 15	16	AS
7I103	551660	8071390	48B 10	16	NA
7I104	552180	8063000	48B 10	16	AS
7I105	550730	8051600	48B 10	16	AS
7I106	551200	8040500	48B 07	16	AS
7I107	555330	8040100	48B 07	16	AS
7I108	555100	8044610	48B 07	16	AS
7I109	555680	8051330	48B 10	16	AS
7I110	544400	8055930	48B 10	16	AS
7I111	554280	8066180	48B 10	16	AMG
7I112	554830	8066880	48B 10	16	NA
7I113	554960	8078080	48B 15	16	AS
7I114	555610	8086980	48B 15	16	NA
7I115	556180	8093930	48B 15	16	AS
7I116	566380	8090200	48B 15	16	AS
7I117	566600	8089850	48B 16	16	AS
7I118	595620	8092490	48B 16	16	SC
7I118.A	595290	8091903	48B 16	16	DYKE
7I118.B	594290	8091620	48B 16	16	AB
7I119	594000	8091090	48B 16	16	AB_{TS}
7I119.A	593400	8090200	48B 16	16	AB_{TS}
7I119.B	593280	8090000	48B 16	16	DYKE
7I120	593040	8089740	48B 16	16	AB_{TS}
7I120.A	591820	8089600	48B 16	16	AB_{TS}
7I121	591280	8089400	48B 16	16	AS,AB_{TS}
7I122	590800	8089220	48B 16	16	AS
7I123	590580	8089000	48B 16	16	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71123.A	590330	8088650	48B 16	16	AS
71124	589220	8088620	48B 16	16	AS
71124.A	588800	8088560	48B 16	16	AS
71124.B	588260	8088550	48B 16	16	AS
71125	587500	8088300	48B 16	16	DYKE
71125.A	587340	8087000	48B 16	16	AS
71126	586800	8086370	48B 16	16	AMG,NA
71127	402150	8094100	48A 13	17	AB_{TS},SC
71128	401900	8095100	48A 13	17	SC
71129	597540	8097970	48B 16	16	SC
71130	403400	8098250	48A 13	17	SC
71131	402000	8099400	48A 13	17	SC
71132	596570	8100790	48B 16	16	SC
71133	595840	8101270	48B 16	16	SC
71134	595180	8102020	48B 16	16	SC
71135	594200	8102800	48C 01	16	VB
71136	594600	8103550	48C 01	16	VB
71137	596400	8103300	48C 11	16	SC_{RS}
71138	596430	8102660	48B 16	16	VB
71139	402150	8099500	48A 13	16	SC
71140	402150	8099500	48A 13	17	VB
71141	404400	8100500	48A 13	17	SS_{RA}
71142	404850	8101900	48A 13	17	SS_{RA}
71143	405000	8102780	48D 04	17	SS_{RA}
71144	405800	8105800	48D 04	17	SS_{GA}
71145	406400	8104300	48D 04	17	SS_{RS},SS_{GA}
71146	407570	8105000	48D 04	17	SS_{GA},VB
71147	597230	8099200	48B 16	16	SC,VB
71148	597230	8097100	48B 16	16	VB

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71149	597450	8101100	48B 16	16	SC
71150	597500	8100450	48B 16	16	SC
71151	402700	8099500	48A 13	17	SC,VB
71152	403100	8101000	48A 13	17	SC,VB
71153	403300	8101250	48A 13	17	SC
71154	403050	8101300	48A 13	17	SC
71155	588750	8078970	48B 16	16	AS
71156	589080	8079160	48B 16	16	NA,AS
71157	589450	8079600	48B 16	16	NA
71158	5575290	8092440	48B 16	16	AS
71159	579430	8092630	48B 16	16	AS
71160	587800	8039450	48B 08	16	AS
71161	587780	8039780	48B 08	16	AS
71162	587820	8038500	48B 08	16	AS
71163	586600	8040130	48B 08	16	AS
71164	585930	8041680	48B 08	16	NA
71165	585000	8042790	48B 08	16	AMG,DYKE
71166	584000	8044320	48B 08	16	AMG
71167	583080	8043700	48B 08	16	NA
71168	582480	8043100	48B 08	16	NA,AS
71169	587800	8037670	48B 08	16	AS
71170	587820	8037090	48B 08	16	AS
71171	589200	8036540	48B 08	16	AS
71172	586820	8035920	48B 08	16	AS
71173	585920	8034440	48B 08	16	AS
71174	586000	8034010	48B 08	16	AS
71175	585000	8033000	48B 08	16	AS
71176	584200	8031470	48B 08	16	AS
71177	584140	8031200	48B 08	16	AS,DYKE

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71178	582920	80312309	48B 08	16	NA,AS
71179	583800	8031150	48B 08	16	AS
71180	585400	8034000	48B 08	16	AS
71181	585720	8034930	48B 08	16	AS
71182	588000	8036430	48B 08	16	AS
71183	588420	8035000	48B 08	16	REC
71184	587000	8034430	48B 08	16	REC
71185	586320	8036980	48B 08	16	AS
71186	589800	8039580	48B 08	16	AS
71187	592000	8041430	48B 08	16	AS
71188	592270	8043030	48B 08	16	AS
71189	594200	8045180	48B 08	16	AMG,NA
71190	593780	8045900	48B 08	16	AB$_{TS}$
71191	592840	8046220	48B 08	16	AS
71192	592550	8043340	48B 08	16	AS
71192.A	592360	8042900	48B 08	16	AS
71193	591420	8041930	48B 08	16	AS
71193.A	591400	8041500	48B 08	16	AS
71194	591030	8041160	48B 08	16	AS
71195	590050	8040400	48B 08	16	AS
71196	588510	8033720	48B 08	16	AS,AB$_{FR}$
71197	588650	8033180	48B 08	16	AB$_{FR}$
71198	587630	8032520	48B 08	16	AB$_{FR}$
71199	58660	8029450	48B 08	16	AB$_{FR}$,FF
71200	589810	8032240	48B 08	16	AB$_{FR}$
71201	590720	8030810	48B 08	16	AB$_{FR}$,FF
71202	588010	8028150	48B 08	16	FF
71203	409200	8036550	48A 05	17	AB$_{TS}$
71204	409650	8036200	48A 05	17	AB$_{TS}$

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
71205	411000	8035780	48A 05	17	AB_{TS}
71206	410900	8034600	48A 05	17	AB_{TS}
71207	411600	8034100	48A 05	17	AB_{TS}
71208	413000	8033620	48A 05	17	AB_{TS}
71209	414210	8033200	48A 05	17	AB_{TS},SC

(2). 1978 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I001	494850	8029770	48A 07	17	AB_{TS}
8I002	494590	8029630	48A 07	17	AB_{TS}
8I002.B	494400	8029780	48A 07	17	AB_{TS}
8I002.C	494080	8029800	48A 07	17	AB_{TS}
8I003	493200	8029860	48A 07	17	AS
8I003.A	493600	8029800	48A 07	17	AB_{TS}
8I004	492410	8030620	48A 07	17	AS
8I005	492590	8030640	48A 07	17	AS
8I006	492590	8030450	48A 07	17	AS
8I007	493170	8030380	48A 07	17	AS
8I008	493440	8030010	48A 07	17	AB_{TS}
8I009	493710	8030790	48A 07	17	AB_{TS}
8I010	494820	8031240	48A 07	17	AB_{TS}
8I011	496050	8031890	48A 07	17	AB_{TS}
8I012	496780	8031290	48A 07	17	AB_{TS}
8I013	497230	8033000	48A 07	17	SC
8I014	496830	8030610	48A 07	17	AB_{TS}
8I015	493610	8028090	48A 07	17	AS,DYKE
8I016	493640	8027200	48A 07	17	AB_{TS},SC
8I017	493460	8027000	48A 07	17	SC
8I018	493390	8026000	48A 07	17	AB_{TS},SC
8I019	42990	8024160	48A 07	17	AB_{TS}
8I020	492810	8024610	48A 07	17	SC
8I021	492590	8024200	48A 07	17	AB_{TS}
8I022	492250	8024230	48A 07	17	AB_{TS}
8I023	492620	8029420	48A 07	17	AB_{TS}
8I024	492200	8029000	48A 07	17	SC
8I025	491050	8031420	48A 07	17	AB_{TS}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81026	493200	8028800	48A 07	17	AB_{TS}
81027	496690	8025360	48A 07	17	AB_{TS}
81028	497070	8026090	48A 07	17	DYKE
81029	497920	8027040	48A 07	17	AB_{TS}
81030	499220	8028300	48A 07	17	AB_{TS}
81031	499840	8028600	48A 07	17	AB_{TS}
81032	501800	8029360	48A 08	17	SC
81033	432040	8016230	48A 03	17	FF
81034	431800	8016480	48A 04	17	FF
81035	431210	8017420	48A 04	17	FF
81036	431180	8017850	48A 05	17	AB_{FR},FF
81037	430790	8018220	48A 05	17	AB_{FR}
81038	429580	8019310	48A 05	17	AB_{FR}
81039	429470	8018960	48A 05	17	AB_{FR}
81040	428800	8018850	48A 05	17	AB_{FR}
81041	429180	8018720	48A 05	17	PAL,AB_{FR}
81042	429830	8018390	48A 05	17	AB_{FR}
81043	430580	8017110	48A 04	17	AB_{FR},FF
81044	431640	8016250	48A 04	17	FF
81045	432030	8016020	48A 03	17	FF
81046	432870	8015780	48A 03	17	FF
81047	433400	8015970	48A 03	17	AB_{FR},FF
81048	433480	80116800	48A 03	17	AB_{FR}
81048.A	433600	8016920	48A 03	17	AS
81049	433780	8017600	48A 03	17	AS
81050	432650	8018890	48A 06	17	AS
81051	431940	8020000	48A 06	17	AS
81051.A	432780	8021120	48A 06	17	AS
81052	431490	8021140	48A 05	17	AS,AB_{FR}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I053	431780	8017770	48A 04	17	AB_{FR}
8I054	431670	801690	48A 04	17	AB_{FR},FF
8I055	433960	8014180	48A 03	17	FF
8I056	434250	801930	48A 03	17	FF
8I057	434780	8013420	48A 03	17	AS,AB_{FR}
8I058	435940	8014160	48A 03	17	FF
8I059	436420	8013660	48A 03	17	AB_{FR}
8I059.A	436670	8013410	48A 03	17	AB_{FR}
8I060	436750	8014000	48A 03	17	AS
8I061	437810	8013620	48A 03	17	AS
8I062	439100	8012530	48A 03	17	AS
8I063	435620	8013040	48A 03	17	AB_{FR}
8I064	435110	8013000	48A 03	17	AB_{FR},FF
8I065	428130	8018470	48A 05	17	AB_{FR},FF
8I066	428120	8020610	48A 05	17	AB_{FR},DYKE
8I067	427020	8022090	48A 05	17	AB_{FR}
8I068	426630	8022490	48A 05	17	AB_{FR}
8I069	426000	8022730	48A 05	17	FF
8I070	424050	8023660	48A 05	17	FF
8I071	423790	8023810	48A 05	17	FF
8I072	422760	8023680	48A 05	17	FF,AMG
8I073	421990	8024370	48A 05	17	AMG
8I074	421370	8024580	48A 05	17	AMG
8I076	422020	8025560	48A 05	17	FF
8I077	422230	8025800	48A 05	17	FF
8I078	422580	8026140	48A 05	17	FF
8I079	423200	8026800	48A 05	17	FF
8I080	423150	8028060	48A 05	17	FF
8I081	423400	8029670	48A 05	17	FF

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81082	422760	803850	48A 05	17	FF
81083	422590	8031430	48A 05	17	AB_{TS},FF
81084	421660	8029850	48A 05	17	FF
81085	421430	8028750	48A 05	17	FF
81086	421260	8028540	48A 05	17	FF
81087	420860	8028550	48A 05	17	FF
81088	420270	8027880	48A 05	17	FF
81088.A	419980	8026670	48A 05	17	FF
81089	420900	8025710	48A 05	17	FF
81089.A	421480	8025710	48A 05	17	FF,SC
81090	420970	8025320	48A 05	17	FF
81091	421360	8025140	48A 05	17	FF
81092	421020	8024820	48A 05	17	FF
81093	421800	8024470	48A 05	17	FF
81094	423660	8022860	48A 05	17	AMG
81095	425270	8021110	48A 05	17	PAL
81096	426290	8020650	48A 05	17	PAL
81097	428580	8018600	48A 05	17	AB_{FR},PAL
81098	424180	8032250	48A 05	17	AB_{FR},AB_{TS}
81098.A	415180	8029920	48A 05	17	AB_{TS}
81099	399640	8037730	48A 05	17	AB_{FR}
81100	401700	8034520	48A 05	17	AB_{FR},FF
81101	399050	8037570	48A 05	17	AB_{FR}
81102	398850	8037460	48A 05	17	AB_{FR}
81103	601410	8036880	48B 08	16	AB_{FR}
81104	601300	8035440	48B 08	16	AB_{FR}
81105	599080	8035170	48B 08	16	AB_{FR},FF
81106	402620	8029590	48A 05	17	FF
81107	399980	8038410	48A 05	17	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I108	400550	8040180	48A 05	17	AS
8I109	399160	8039080	48A 05	17	AS
8I110	400120	8038000	48A 05	17	AS
8I111	401220	8038240	48A 05	17	AS
8I112	402290	8038620	48A 05	17	AS
8I113	402990	8038670	48A 05	17	AS
8I114	402380	8038560	48A 05	17	AS
8I115	402230	8038390	48A 05	17	AB_{FR}
8I116	404610	8034330	48A 05	17	FF
8I117	600790	8037420	48A 08	16	AS
8I118	600210	8037230	48B 08	16	AS
8I119	599360	8037060	48B 08	16	AS,AB_{FR}
8I120	599750	8036280	48B 08	16	AB_{FR}
8I121	601200	8037240	48B 08	16	AB_{FR}
8I122	600510	8036670	48B 08	16	AB_{FR}
8I123	599960	8035690	48B 08	16	AB_{FR}
8I124	598070	8033780	48B 08	16	AB_{FR}
8I124.A	597900	8034430	48B 08	16	AB_{FR}
8I124.B	596630	8031910	48B 08	16	AB_{FR}
8I125	599380	8036600	48B 08	16	AB_{FR}
8I126	400580	8038400	48A 05	17	AS
8I127	400950	8038470	48A 05	17	AS
8I128	401540	8038840	48A 05	17	AS
8I129	402010	8039000	48A 05	17	AS
8I130	403120	8039010	48A 05	17	AS,DYKE
8I131	403410	8038900	48A 05	17	AS,AB_{FR}
8I132	403410	8038900	48A 05	17	AS
8I133	404160	8039870	48A 05	17	AS
8I134	405400	8041330	48A 05	17	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81135	405170	8041640	48A 05	17	AS
81136	405610	8044360	48A 05	17	AS
81137	402890	8040020	48A 05	17	AS
81138	401790	8039390	48A 05	17	AS
81139	505060	8043000	48A 08	17	SC
81140	534200	8007420	38B 04	17	AB_{PB}
81141	534970	8007330	38B 04	17	AB_{PB}
81142	535720	8007210	38B 04	17	AB_{PB}
81143	536000	8007060	38B 04	17	AB_{PB}
81144	535840	8006670	38B 04	17	AB_{PB}
81145	536650	8006200	38B 04	17	AB_{PB}
81146	536660	8005780	38B 04	17	AB_{PB},DYKE
81147	538120	8004710	38B 04	17	AB_{PB}
81148	536480	8005270	38B 04	17	AB_{PB}
81149	563130	8004280	38B 04	17	AB_{PB}
81150	534190	8006410	48A 01	17	AB_{PB}
81151	535060	8004420	38B 04	17	AB_{PB}
81152.A	533370	8004280	48A 01	17	AB_{PB}
81152.B	533000	8005250	48A 01	17	AB_{PB}
81153	535020	8001830	38B 04	17	AB_{PB}
81154	535480	8001070	38B 04	17	AB_{PB}
81155	535310	8000190	38B 04	17	AB_{PB}
81156	534200	799040	48A 01	17	AMG,AB_{PB}
81157	537200	8000680	38B 04	17	AB_{PB}
81158	536200	8001510	38B 04	17	AB_{PB},DYKE
81159	536200	8003680	38B 04	17	AB_{PB}
81160	530180	8007360	48A 01	17	AB_{PB}
81161	529480	8007890	48A 01	17	AB_{PB}
81162	529460	8007780	48A 01	17	AB_{PB},DYKE

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I163	528530	8006650	48A 01	17	AB_{PB}
8I164	527540	8009390	48A 01	17	AB_{PB}
8I164.A	526670	8008720	48A 01	17	AB_{PB}
8I165	528540	8006000	48A 01	17	AB_{PB}
8I166	528520	8004600	48A 01	17	AMG,AB_{PB}
8I166.A	527860	8004160	48A 01	17	AB_{PB}
8I167	529750	8005170	48A 01	17	AB_{PB}
8I168	531440	8005820	48A 01	17	AB_{PB}
8I169	532390	8005560	48A 01	17	AB_{PB}
8I170	53320	8005290	48A 01	17	AB_{PB},DYKE
8I171	532100	8006590	48A 01	17	AB_{PB},DYKE
8I172	532190	8008820	48A 01	17	AB_{PB}
8I173	532960	8010530	48A 01	17	AB_{PB}
8I173.J	530390	8015200	48A 01	17	AB_{PB}
8I173.X	529600	8017170	48A 08	17	SC
8I174	528730	8015600	48A 01	17	AB_{PB}
8I175	528950	8013910	48A 01	17	AB_{PB}
8I176	529610	8012060	48A 01	17	AB_{PB}
8I177	530660	8009390	48A 01	17	AB_{PB}
8I178	416170	7959650	37G 10	18	AB_{PB}
8I179	416460	7959540	37G 10	18	AB_{PB}
8I180	417880	7959090	37G 10	18	AB_{PB}
8I181	418870	7959200	37G 10	18	AB_{PB}
8I182	420120	7959860	37G 10	18	AB_{PB}
8I183	422210	7960740	37G 10	18	AB_{PB}
8I184	424620	7960930	37G 10	18	AS,AB_{PB}
8I185	422600	7961780	37G 10	18	AS
8I185.A	421130	7962040	17G 10	18	AS,AB_{PB}
8I186	419600	7962260	37G 10	18	AB_{PB}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81187	418320	7961950	37G 10	18	AB_{PB}
81188	416640	7962180	37G 10	18	AB_{PB}
81189	415860	7960150	37G 10	18	AB_{PB}
81190	416200	7959390	37G 10	18	AB_{PB}
81191	416980	7958400	37G 10	18	AB_{PB}
81192	417630	7957510	37G 10	18	AS,AB_{PB}
81193	418530	7956500	37G 10	18	AB_{PB}
81194	419060	7955240	37G 10	18	AS
81195	419770	7954150	37G 10	18	AB_{PB}
81196	420120	7953080	37G 10	18	AS
81196.A	420560	7952170	37G 10	18	AS,AB_{PB}
81197	419940	7952020	37G 10	18	AMG,AS
81198	418220	7952190	37G 10	18	AS,
81199	418530	7953600	37G 10	18	AS,AB_{PB}
81200	418000	7954690	37G 10	18	AS,AB_{PB}
81201	417190	7956260	37G 10	18	AB_{PB}
81202	415710	7958250	37G 10	18	AB_{PB}
81203	415490	7960400	37G 10	18	AB_{PB}
81204	414960	7961340	37G 10	18	AB_{PB}
81205	414540	7962190	37G 10	18	AB_{PB}
81206	414380	7962900	37G 15	18	AB_{PB}
81207	413060	7962190	37G 10	18	AB_{PB}
81208	412400	7960890	37G 10	18	AB_{PB}
81209	411320	7960430	37G 10	18	AB_{PB}
81210	410600	7960010	37G 10	18	AB_{PB}
81211	409480	7959120	37G 10	18	AB_{PB}
81212	412610	7959450	37G 10	18	AB_{PB}
81213	414230	7959760	37G 10	18	AB_{PB}
81214	415200	7960140	37G 10	18	AB_{PB}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I215	415200	7960140	37G 10	18	AB_{PB}
8I216	414230	7963550	37G 15	18	AB_{PB}
8I217	414180	7963870	37G 15	18	AB_{PB}
8I218	413590	7964200	37G 15	18	AB_{PB}
8I220	412320	7965690	37G 15	18	AB_{PB}
8I221	412140	7966110	37G 15	18	AB_{PB}
8I222	411650	7968070	37G 15	18	AB_{PB}
8I223	411110	7968250	37G 15	18	AB_{PB}
8I224	410290	7968630	37G 15	18	AB_{PB}
8I225	409580	7969200	37G 15	18	AB_{PB}
8I226	408290	7971460	37G 15	18	REC
8I227	406730	7971510	37G 15	18	AB_{PB}
8I228	405860	7972030	37G 15	18	AB_{PB}
8I229	404720	7972490	37G 15	18	AB_{PB}
8I230	403580	7972890	37G 15	18	AB_{PB}
8I231	402900	7972770	37G 15	18	AB DPB U
8I232	403660	7974000	37G 15	18	AMG,AS
8I233	404120	7974000	37G 15	18	AMG,AB_{PB}
8I234	405190	7973770	37G 15	18	AB_{PB}
8I236	408030	7972810	37G 15	18	AMG,AB_{PB}
8I237	411390	7971070	37G 15	18	AB_{PB}
8I238	408020	7968730	37G 15	18	AB_{PB}
8I139	407940	7968200	37G 15	18	AB_{PB}
8I240	406610	7967080	37G 15	18	AB_{PB}
8I241	406170	7966000	37G 15	18	AB_{PB}
8I242	406360	7965190	37G 15	18	AB_{PB}
8I243	406490	7964260	37G 15	18	AB_{PB}
8I244	408480	7963800	37G 15	18	AB_{PB}
8I245	409810	7963000	37G 15	18	AB_{PB}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81246	410930	7962360	37G 10	18	AB_{PB}
81247	411910	7961900	37G 10	18	AB_{PB}
81248	425000	7953960	37G 10	18	AS,AB_{PB}
81249	422810	7955360	37G 10	18	AB_{PB}
81250	422940	7957200	37G 10	18	AB_{PB}
81251	424600	7962230	37G 15	18	AS,AB_{PB}
81252	421000	7962680	37G 15	18	AS,AB_{PB}
81253	418010	7964980	37G 15	18	AB_{PB}
81254	421800	7966210	37G 15	18	AB_{PB}
81255	567860	8003020	38B 04	17	AB_{PB}
81256	568090	8005410	38B 04	17	SC
81257	567570	8007420	38B 04	17	SC
81258	567750	8008560	38B 04	17	AMG,VB
81259	567380	8008650	38B 04	17	AB_{PB}
81260	566980	7998820	38B 04	17	AB_{PB}
81261	566060	7997200	38B 04	17	AB_{PB}
81262	564350	7993080	38B 04	17	AB_{PB}
81263	568320	7985890	37G 13	17	AB_{PB}
81264	568000	7982200	37G 13	17	AB_{PB}
81265	567460	7977110	37G 13	17	AB_{PB}
81266	570050	7975780	37G 14	17	AMG,AB_{PB}
81267	572970	7978010	37G 14	17	AB_{PB}
81268	573720	7980000	37G 14	17	AB_{PB}
81269	574000	7983280	37G 14	17	AB_{PB}
81269.A	579650	7979460	37G 14	17	AB_{PB}
81270	579670	7985490	37G 14	17	AB_{PB}
81271	576060	7987760	37G 14	17	AB_{PB}
81272	573200	8005410	38B 03	17	AB_{PB},SC
81273	573550	8003800	38B 03	17	AB_{PB},SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81274	53340	8002030	38B 03	17	AB_{PB},SC
81275	573610	7999160	38B 03	17	AB_{PB}
81276	572590	7996380	38B 03	17	AB_{PB}
81277	585120	7974270	37G 14	17	AB_{PB}
81278	584790	7973850	37G 14	17	AB_{PB}
81280	581570	7976670	37G 14	17	AB_{PB}
81281	5823320	7973520	37G 14	17	AB_{PB}
81282	582790	7972260	37G 14	17	AB_{PB}
81283	582500	7971330	37G 14	17	AB_{PB}
81284	582060	7970790	37G 14	17	AB_{PB}
81285	582600	7969910	37G 14	17	AS,AB_{PB}
81286	583100	7969560	37G 14	17	AMG,AS
81287	584400	7969310	37G 14	17	AMG
81288	584500	7969570	37G 14	17	AMG,AS
81289	584310	797092	37G 14	17	AMG,AS
81290	584590	7971820	37G 14	17	AB_{PB}
81291	586260	7973040	37G 14	17	AB_{PB}
81293	585670	7978490	37G 14	17	AB_{PB}
81294	588610	7980920	37G 14	17	AB_{PB}
81295	589040	7981370	37G 14	17	AB_{PB}
81296	585380	7984460	37G 14	17	AB_{PB}
81297	588770	7979200	37G 14	17	AB_{PB}
81298	588040	7977610	37G 14	17	AB_{PB}
81299	589050	7977260	37G 14	17	AB_{PB}
81300	589630	7978880	37G 14	17	AB_{PB}
81301	590300	7979600	37G 14	17	AB_{PB}
81302	590890	7980250	37G 14	17	AB_{PB}
81303	591800	7981020	37G 14	17	SC
81303.A	589470	7985660	37G 14	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81303.B	593980	7983200	37G 14	17	SC
81304	591900	7979670	37G 14	17	SC
81305	592600	7977330	37G 14	17	AB_{PB}
81306	592380	7975600	37G 14	17	AB_{PB}
81307	590580	7975250	37G 14	17	AB_{PB}
81308	587390	7973670	37G 14	17	AB_{PB}
81309	587390	7971190	37G 14	17	AS,AB_{PB}
81311	587260	7968730	37G 14	17	AS,AB_{PB}
81312	588470	7969510	37G 14	17	AB_{PB}
81313	587920	7967460	37G 14	17	AS,AB_{PB}
81314	588220	7966800	37G 14	17	AMG,AS
81315	589120	7966000	37G 14	17	AMG,AS
81315.A	589790	7965200	37G 14	17	AMG,AS
81316	589050	7970800	37G 14	17	AB_{PB}
81317	591270	7971860	37G 14	17	AB_{PB}
81318	589410	7973580	37G 14	17	REC
81319	398440	796440	37G 15	18	AB_{PB}
81320	398780	7963480	37G 15	18	AB_{PB}
81321	398910	7962180	37G 10	18	AB_{PB}
81321.A	398140	7961850	37G 10	18	AB_{PB}
81322	397910	7961650	37G 10	18	AMG,AS
81322.A	397780	7961540	37G 10	18	AMG,AS
81323	397100	7961210	37G 10	18	AMG,AS
81324	396690	7961130	37G 10	18	AS,AB_{PB}
81325	396660	7961010	37G 10	18	AMG,AS
81325.A	396260	7960910	37G 10	18	AS
81326	395980	7960990	37G 10	18	AMG,AS
81327	395530	7960910	37G 10	18	AS,AB_{PB}
81327.A	604570	7960950	37G 11	17	AS,AB_{PB}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
8I328	603800	7960990	37G 11	17	AMG,AS
8I329	603390	7962400	37G 11	17	AMG,AS
8I329.A	602410	7961860	37G 11	17	AS
8I330	603420	7962810	37G 11	17	AB_{PB}
8I331	604350	7964000	37G 14	17	AB_{PB}
8I332	605220	7964690	37G 15	18	AB_{PB}
8I333	398000	7965280	37G 15	18	AB_{PB}
8I334	401090	7964610	37G 15	18	REC
8I335	402430	7963740	37G 15	18	AB_{PB}
8I336	402570	796850	37G 10	18	AB_{PB}
8I337	401210	7962350	37G 10	18	AB_{PB}
8I337.A	401140	7962140	37G 10	18	AB_{PB}
8I338	400820	7961530	37G 10	18	AB_{PB}
8I338.A	401760	7959420	37G 10	18	AMG,AS
8I339	400030	796700	37G 10	18	AB_{PB}
8I340	399990	7963850	37G 15	18	REC
8I341	400120	7966330	37G 15	18	AB_{PB}
8I342	399450	7967070	37G 15	18	AB_{PB}
8I343	399890	7968200	37G 15	18	AB_{PB}
8I344	398120	7967610	37G 15	18	AB_{PB}
8I345	397820	7969060	37G 15	18	AB_{PB}
8I346	398790	797400	37G 15	18	AB_{PB}
8I347	396310	7969740	37G 15	18	AB_{PB}
8I348	396210	7970610	37G 15	18	AB_{PB}
8I349	396740	7971600	37G 15	18	AB_{PB}
8I350	397920	7966090	37G 14	18	AB_{PB}
8I351	602900	7971410	37G 14	17	AB_{PB}
8I352	603640	7971860	37G 14	17	AB_{PB}
8I353	604130	7972879	37G 14	17	AB_{PB}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
81354	396350	7974410	37G 15	18	AB$_{PB}$
81355	397190	7975290	37G 15	18	AB$_{PB}$
81356	397360	7975610	37G 15	18	AMG,AS
81357	396840	7976370	37G 15	18	AMG,AS
81358	396250	7976400	37G 15	18	AS,AB$_{PB}$
81359	602060	7977710	37G 14	17	AS,AB$_{PB}$
81360	603760	7974780	37G 14	17	AB$_{PB}$
81361	603230	7973800	37G 14	17	AB$_{PB}$
81362	602410	7972710	37G 14	17	AB$_{PB}$
81363	599890	7974070	37G 14	17	AB$_{PB}$
81364	598820	7975570	37G 14	17	AB$_{PB}$
81365	597750	7977220	37G 14	17	AB$_{PB}$
81366	598970	7977610	37G 14	17	AB$_{PB}$
81367	597000	7978840	37G 14	17	AB$_{PB}$
81368	596410	7979920	37G 14	17	AB$_{PB}$,SC
81369	595320	7981600	37G 14	17	SC
81370	594380	7982520	37G 14	17	SC
81371	595880	7975710	37G 14	17	AB$_{PB}$
81372	596940	7974370	37G 14	17	AB$_{PB}$
81373	597410	7973160	37G 14	17	AB$_{PB}$
81374	601230	7973160	37G 14	17	AB$_{PB}$
81375	600380	796060	37G 14	17	AB$_{PB}$
81376	603220	7968670	37G 14	17	AB$_{PB}$
81377	601820	7965600	37G 14	17	AB$_{PB}$
81378	397010	7966870	37G 15	18	AB$_{PB}$

(3). 1979 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91001	560600	8105390	48C 02	16	AB_{TS}
91002	560720	8105620	48C 02	16	AB_{TS}
91003	560720	8105770	48C 02	16	AB_{TS},SC
91004	561050	8104800	48C 02	16	SC
91005	561050	8106040	48C 02	16	SC
91006	558800	8104800	48C 02	16	SC
91007	557650	8105280	48C 02	16	SC,DYKE
91008	557000	8105750	48C 02	16	SC
91009	556650	8106140	48C 02	16	SC,VB
91010	556300	8106550	48C 02	16	VB
91011	556220	8107000	48C 02	16	$SS_{RS,CC}$
91011.A	555340	8107520	48C 02	16	VB
91012	580690	8106470	48C 01	16	SC
91013	580210	8104080	48C 01	16	SC,VB
91014	580000	8104730	48C 01	16	SC,VB
91015	512780	8042920	48A 08	17	AP
91016	512130	8042190	48A 08	17	AP
91017	511540	8042210	48A 02	17	AP
91018	493380	8014610	48A 02	17	AS
91019	496810	8012210	48A 02	17	AS
91020	499060	8011720	48A 02	17	AMG
91021.A	498610	8011990	48A 02	17	AS,AB_{TS}
91021.X	499560	8013760	48A 02	17	AB_{TS}
91022	502440	8015860	48A 01	17	SC
91023	485620	8019100	48A 07	17	AMG
91024	488210	8025800	48A 07	17	AB_{TS},SC
91025	488190	8026200	48A 07	17	SC
91026	483060	8039080	48A 07	17	AB_{TS}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91027	483760	8038650	48A 07	17	AS
91028	484590	8037810	48A 07	17	AS
91029	485610	8036590	48A 07	17	AB_{TS}
91030	485990	8037630	48A 07	17	AB_{TS}
91031	484740	8010600	48A 02	17	AB_{TS}
91032	484180	8011020	48A 02	17	SC
91033	504000	8014060	48A 01	17	AB_{TS}
91034	502440	8015860	48A 01	17	SC
91035	578660	8002280	38B 03	17	AMG
91036	578790	8001380	38B 03	17	AMG
91037	578860	8000780	38B 03	17	AB_{PB}
91037.A	579000	8000020	38B 03	17	AB_{PB}
91038	579390	7999420	38B 03	17	AB_{PB}
91039	580310	7998890	38B 03	17	AB_{PB}
91040	580740	7997800	38B 03	17	AB_{PB}
91041	581000	7996390	38B 03	17	AB_{PB}
91042	580990	7995900	38B 03	17	AB_{PB}
91042.A	580800	7995370	38B 03	17	AB_{PB}
91043	580600	7994410	38B 03	17	AB_{PB}
91044	580210	7992860	38B 03	17	AB_{PB}
91045	580400	7991620	38B 03	17	AB_{PB}
91046	580410	7991620	38B 03	17	AB_{PB}
91046.D	582190	7992620	38B 03	17	AB_{PB},SC
91047	582510	7992729	38B 03	17	SC
91048	584810	7992990	38B 03	17	SC
91049	581820	7989720	37G 14	17	SC
91050	582240	7988040	37G 14	17	SC
91051	584440	7987990	37G 14	17	SC
91052	586520	7988020	37G 14	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91053	583740	7989600	37G 14	17	SC
91054	582030	7990590	38B 03	17	SC
91055	579200	7992180	38B 03	17	AB_{PB}
91056	578060	7992800	38B 03	17	AB_{PB}
91057	576080	7993790	38B 03	17	AB_{PB}
91058	574410	7995080	38B 03	17	AB_{PB}
91058.A	574200	7994990	38B 03	17	AB_{PB}
91059	573260	7995890	38B 03	17	AB_{PB}
91060	573210	7995280	38B 03	17	AB_{PB}
91061	572320	7995780	38B 03	17	AS
91062	572690	7994210	38B 03	17	AS,AB_{PB}
91063	573600	7993220	38B 03	17	AB_{PB}
91064	574940	7993220	38B 03	17	AB_{PB}
91065	576740	7992640	38B 03	17	AB_{PB}
91066	485620	8041880	48A 07	17	SC
91067	486180	8042120	48A 07	17	SC
91068	488180	8043010	48A 07	17	SC
91069	489200	8044990	48A 10	17	SC
91070	489880	8046220	48A 10	17	SC
91071	490610	8046110	48A 10	17	VB
91072	493180	8047420	48A 10	17	VB
91073	494010	8049440	48A 10	17	VB
91074	494380	8051180	48A 10	17	VB
91075	494620	8053190	48A 10	17	AB,AP
91076	494220	8053630	48A 10	17	VB
91077	519280	8009650	48A 01	17	AMG
91078	526990	8004420	48A 01	17	AB_{PB}
91079	533320	8000050	48A 01	17	AMG,AB_{PB}
91080	544590	7990410	38B 04	17	AMG

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91081	5566190	7988780	37G 13	17	AB_{PB}
91082	550410	7991640	38B 04	17	AB_{PB}
91083	547990	7993390	38B 04	17	AB_{PB}
91084	543190	7996190	38B 04	17	AB_{PB}
91085	537780	7999180	38B 04	17	AB_{PB}
91086	527920	8007180	48A 01	17	AB_{PB}
91087	525800	8009040	48A 01	17	AB_{PB}
91088	526990	8018710	48A 08	17	SC
91089	526680	8022340	48A 08	17	SC
91090	528210	8017790	48A 08	17	SC
91091	539800	8002280	38B 04	17	AB_{PB}
91092	546000	8000020	38B 04	17	AB_{PB}
91093	553760	7996200	38B 04	17	AB_{PB}
91094	558210	7995260	38B 04	17	AB_{PB}
91095	562720	7996000	38B 04	17	AB_{PB}
91096	556590	8001490	38B 04	17	SC
91097	551580	8003920	38B 04	17	AB_{PB},SC
91098	483740	8007680	48A 02	17	AB_{TS}
91099	478200	8001990	48A 02	17	AMG
91100	473790	8006600	48A 02	17	NA,AS
91101	469590	8008700	48A 02	17	REG,AS
91102	466800	8005760	48A 02	17	AMG
91103	468180	8010610	48A 02	17	AS
91104	571040	8015370	48A 02	17	AS
91105	566610	8020810	48A 07	17	AS
91106	570210	8025280	48A 07	17	AS
91107	576780	8021500	48A 07	17	AMG
91108	574080	8014460	48A 02	17	AS
91109	574460	8010990	48A 02	17	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91110	481880	8009980	48A 02	17	AB$_{TS}$
91111	578390	8026170	48A 07	17	AMG,REG
91112	578410	8026640	48A 07	17	AS
91113	579020	8026610	48A 07	17	AS
91114	580000	8025820	48A 07	17	AS
91115	580210	8024810	48A 07	17	AS,AB$_{TS}$
91116	581120	8024080	48A 07	17	AS
91117	499140	8035090	48A 07	17	SC
91118	498620	8034370	48A 07	17	SC
91119	497650	8034370	48A 07	17	SC
91120	496630	8033780	48A 07	17	AB$_{TS}$
91121	497620	8033140	48A 07	17	AB$_{TS}$,SC
91122	446540	8031220	37G 08	18	AS,AB$_{PB}$
91123	445320	8031400	37G 08	18	AB$_{PB}$
91124	444640	8029520	37G 08	18	AB$_{PB}$
91125	447320	8027320	37G 08	18	AB$_{PB}$
91126	442160	8031790	37G 08	18	AB$_{PB}$
91127	428700	7957770	37G 11	18	AS
91128	425450	7960690	37G 11	18	AMG
91129	423840	7966630	37G 15	18	AS
91130	421390	7966250	37G 15	18	AS
91131	598160	7963280	37G 14	17	AS,AB$_{PB}$
91132	596010	7965140	37G 14	17	AS,AB$_{PB}$
91133	596600	795610	37G 14	17	AB$_{PB}$
91134	597370	7967830	37G 14	17	AB$_{PB}$
91135	549040	7989260	37G 14	17	SC
91136	583340	7995370	38B 03	17	AB$_{PB}$
91137	573700	8002480	38B 03	17	AB$_{PB}$
91138	573860	7996730	38B 03	17	AB$_{PB}$

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91139	559400	8012030	38B 04	17	AB_{PB}
91140	555580	8004090	38B 04	17	SC
91141	544820	8016020	38B 04	17	SC
91142	549170	8017980	38B 05	17	SC,VB
91143	550580	8007920	38B 04	17	SC,VB
91144	547430	8005810	38B 04	17	SC
91145	541210	8010240	38B 04	17	SC
91146	532200	8021720	48A 08	17	SC
91147	531150	8027910	48A 08	17	SC,VB
91148	534910	8033120	38B 05	17	VB
91149	540720	8037970	38B 05	17	VB
91150	546520	8026200	38B 05	17	VB
91151	471940	8028650	48A 07	17	AS
91152	473210	8031690	48A 07	17	AS
91153	473830	8033680	48A 07	17	SC
91154	475710	8036280	48A 07	17	SC
91155	477600	8039390	48A 07	17	SC
91156	477260	8041200	48A 07	17	AS
91157	473190	8043760	48A 07	17	AB_{TS}
91158	470000	8038740	48A 07	17	AB_{TS},SC
91159	509810	8070540	48A 09	17	AMG
91160	509620	8069800	48A 09	17	AMG,VB
91161	509390	8068790	48A 09	17	AMG
91162	508960	8067420	48A 09	17	AMG
91163	509620	8025580	48A 09	17	AMG
91164	510050	8064800	48A 09	17	AMG,SC
91165	507560	8065180	48A 09	17	SC
91166	507210	8064800	48A 09	17	SC,VB
91167	506480	8064180	48A 09	17	VB

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91168	505810	8063380	48A 09	17	VB
91169	505210	8062740	48A 09	17	VB,AP
91170	504590	8061790	48A 09	17	AP
91171	489300	8049160	48A 10	17	SC,VB
91172	492750	8052190	48A 10	17	VB,AP
91173	478640	8053630	48A 10	17	VB
91174	477990	8051920	48A 10	17	SC,VB
91175	477770	8049810	48A 10	17	SC
91176	476990	8049320	48A 10	17	SC
91177	477230	804200	48A 10	17	AB_{TS},SC
91178	477190	8046600	48A 10	17	AB_{TS}
91179	474230	8044620	48A 10	17	AB_{TS}
91180	473340	8043620	48A 10	17	AB_{TS}
91181	509120	8065930	48B 11	16	AS
91182	509370	8065000	48B 11	16	AS
91183	581190	8053520	48B 09	16	AS
91184	597820	8066800	48B 09	16	NA
91185	597400	8066800	48B 09	16	AS
91186	493080	8056070	48A 10	17	VB,AP
91187	490600	8058060	48A 10	17	AP
91188	483610	8014620	48A 02	17	AMG,SC
91189	480520	8012490	48A 02	17	AB_{TS},SC
91190	478170	8016240	48A 02	17	AB_{TS},SC
91191	468020	8028910	48A 07	17	AMG
91192	470350	8031660	48A 07	17	AS
91193	460560	8029600	48A 06	17	AMG
91194	457680	8032860	48A 06	17	AB_{TS},SC
91195	452930	8033970	48A 06	17	NA,AS
91196	446380	8036340	48A 06	17	AB_{TS}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91197	439590	8034600	48A 06	17	AMG
91198	444420	8032800	48A 06	17	NA,AS
91199	450670	8027650	48A 06	17	AS
91200	452240	8024600	48A 06	17	AMG
91201	457780	8023290	48A 06	17	AS
91202	457810	8016480	48A 03	17	AS
91203	464300	8021880	48A 06	17	AS
91204	466270	8017060	48A 07	17	AS
91205	456470	8054260	48A 11	17	AS
91206	452260	8040060	48A 06	17	SC
91207	440610	8044420	48A 06	17	AB_{TS}
91208	431630	8037090	48A 05	17	AMG
91209	428500	8035600	48A 05	17	NA,AS
91210	431200	8040340	48A 05	17	AB_{TS},FF
91211	422500	8048620	48A 12	17	AB_{TS},FF
91212	419420	8037000	48A 05	17	NA
91213	412420	8042720	48A 05	17	AS
91214	416200	8047660	48A 12	17	AB_{TS}
91215	422580	8057400	48A 12	17	AS
91216	434740	8058180	48A 11	17	AB_{TS},SC
91217	439880	8059080	48A 11	17	VB
91218	446420	8056000	48A 11	17	SC
91219	451420	8059620	48A 11	17	AS
91220	452040	8054100	48A 11	17	DYKE
91221	460200	8068800	48A 11	17	SC,VB
91222	466080	8073380	48A 14	17	VB
91223	461640	8080600	48A 14	17	VB,SS_{RS}
91224	463740	8091060	48A 14	17	SS_{RS}
91225	463180	8093780	48A 14	17	SS_{RA}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91226	456580	8097000	48A 14	17	SS_{RS}
91227	448220	8094800	48A 14	17	SS_{RA}
91228	449460	8087180	48A 14	17	SS_{RS}
91229	458300	8087540	48A 14	17	SS_{RS}
91230	486870	8100220	48A 15	17	$SS_{FC,MC}$
91231	485860	8096940	48A 15	17	AP,SS_{GA}
91232	455370	8108180	48D 03	17	SS_{FC}
91233	449600	8113460	48D 03	17	$SS_{RS,RA}$
91234	445790	8119050	48D 03	17	AS
91235	443340	8121500	48D 03	17	VB,SS_{RS}
91236	435080	8125580	48D 04	17	SC
91237	431410	8124550	48D 04	17	AS,AB_{TS}
91238	428200	8129910	48D 05	17	NA,AS
91239	423200	8133460	48D 05	17	AS
91240	418010	8136930	48D 05	17	SC
91241	421000	8127920	48D 04	17	SC
91242	428950	8123420	48D 04	17	SC
91243	438870	8112900	48D 03	17	SS_{RS}
91244	439430	8107600	48D 03	17	SS_{GA}
91245	444010	8104050	48D 03	17	SS_{RS}
91246	447860	8100110	48A 14	17	$SS_{RS,RA}$
91247	455000	8101550	48D 03	17	SS_{RA}
91248	461320	8101230	48D 03	17	SS_{RA}
91249	466430	8103050	48D 03	17	SS_{FC}
91250	477740	8101900	48D 02	17	SS_{FC}
91251	494760	8144820	48D 07	17	L.EL
91252	493440	8144310	48D 07	17	L.EL
91253	505800	8168730	48D 09	17	AMG,AS
91254	505810	8168770	48D 09	17	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
91255	545390	8131850	48D 06	17	AMG
91256	545620	8132710	48D 06	17	NA
91257	545200	8132980	48D 06	17	NA
91258	545680	8134080	48D 06	17	NA,AS
91259	545580	8134480	48D 06	17	NA,AS
91260	545000	8135820	48D 06	17	AB$_{FR}$,SC
91261	544450	8136670	48D 06	17	SC
91262	544440	8137810	48D 06	17	SC
91263	544220	8139000	48D 06	17	SC,VB
91264	544140	8140000	48D 06	17	VB
91265	540820	8140900	48D 06	17	VB,SS$_{CC,RS}$
91266	543800	8141750	48D 06	17	SS$_{MC,RS}$
91267	545630	8143280	48D 06	17	SS$_{RS}$
91268	547920	8144010	48D 06	17	SS$_{RS,GS}$
91269	548920	8145580	48D 06	17	SS$_{RS}$
91270	573180	8154030	38C 06	17	AS
91271	573400	8154490	38C 06	17	AS
91272	572720	8155770	38C 06	17	AS
91273	572810	8156920	38C 06	17	AS
91274	572940	8157450	38C 06	17	AS
91275	573230	8157900	38C 11	17	NA,AS
91276	573620	815650	38C 11	17	AB$_{TS}$
91277	574210	8159830	38C 11	17	AB$_{TS}$
91278	575400	8159830	38C 11	17	AS
91279	575930	8161050	38C 11	17	AS
91280	525200	8171840	48D 09	17	AS
91281	525800	8171730	48D 09	17	AS
91282	517620	8151280	48D 08	17	AS
91283	506130	8151350	48D 08	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
9I284	506890	8151500	48D 08	17	SC
9I285	507860	8151850	48D 08	17	SC
9I286	508270	8153000	48D 08	17	AB_{PB},SC
9I287	509400	8156800	48D 09	17	AMG
9I288	510030	8156570	48D 09	17	AS
9I289	479060	8148820	48D 07	17	SC
9I290	479730	8148470	48D 07	17	SS_{GS},L.EL
9I291	479710	8146190	48D 07	17	SS_{GC}
9I292	479540	8145350	48D 07	17	SS_{GC}
9I293	478720	8144600	48D 07	17	SS_{MC}
9I294	478120	8143950	48D 07	17	$SS_{MC,RS}$
9I295	477310	8144530	48D 07	17	SS_{RS}
9J016	503100	8033400	48A 08	17	AB_{TS},SC
9J025	506500	8036350	48A 08	17	SC
9J029	509000	8039350	48A 08	17	SC,VB
9J047	581600	7995250	38B 03	17	AB_{PB}
9J048	563560	799830	38B 03	17	AB_{PB}
9J049	563210	7993440	38B 03	17	AB_{PB}
9J050	573580	7988410	37G 14	17	AB_{PB}
9J051	579320	7985800	37G 14	17	AB_{PB}
9J053	585060	7979360	37G 14	17	AB_{PB}
9J054	581800	7976880	37G 14	17	AB_{PB}
9J055	576790	7981560	37G 14	17	AB_{PB}
9J056	573990	7983380	37G 14	17	AB_{PB}
9J058	566610	7981410	37G 13	17	AB_{PB}
9J059	572060	7981520	37G 14	17	AB_{PB}
9J061	581940	7976000	37G 14	17	AB_{PB}
9J062	575780	7976320	37G 14	17	AB_{PB}
9J070	553800	7982440	37G 13	17	AMG,AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
9J076	556790	7988200	37G 13	17	AB_{PB}
9J077	569030	7985820	37G 14	17	AB_{PB}
9J078	562820	7989010	37G 13	17	AB_{PB}
9J090	529810	7991260	48A 01	17	AB_{PB}
9J098	535200	8014250	38B 04	17	AB_{PB}
9J099	535650	8014620	38B 04	17	SC
9J100	536700	8015550	38B 04	17	SC
9J101	537800	8016050	38B 04	17	SC
9J102	538950	8016450	38B 04	17	SC
9J103	539800	8017700	38B 05	17	SC
9J104	539700	8018950	38B 05	17	SC
9J105	540100	8020200	38B 05	17	SC
9J106	540050	8021950	38B 05	17	SC
9J107	540150	8024050	38B 05	17	SC
9J110	541620	8025200	38B 05	17	VB
9J125	538700	8027350	38B 05	17	VB
9J129	538820	8029200	38B 05	17	VB
9J130	539900	802900	38B 05	17	VB
9J131	540500	8029600	38B 05	17	VB
9J132	540050	8030100	38B 05	17	AP
9J133	539580	8030200	38B 05	17	AP
9J135	538850	8031900	38B 05	17	AP,SS_{GA}
9J164	489980	8002780	48A 02	17	AB_{PB}
9J165	492500	7999800	48A 02	17	AB_{PB}
9J166	483620	7998000	48A 02	17	REG,NA
9J173	504100	7993980	48A 01	17	AB_{PB}
9J175	497220	7999380	48A 02	17	AB_{PB}
9J176	502760	8000000	48A 01	17	AB_{PB}
9J202	446210	8011250	48A 03	17	AMG,NA

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
9J205	446990	8009640	48A 03	17	FF
9J206	441010	8009400	48A 03	17	FF
9J207	435200	8023620	48A 06	17	AMG
9J208	430810	8018360	48A 05	17	FF
9J209	420400	8023990	48A 05	17	AMG
9J210	421010	8026030	48A 05	17	FF
9J211	428600	8030020	48A 05	17	AB_{FR}
9J214	433790	8038000	48A 06	17	FF
9J234	507330	8071190	48A 09	17	AS
9J252	476640	8131040	48D 07	17	AB_{FR}
9J257	490400	8145400	48D 07	17	U.EL
9J258	490250	8144700	48D 07	17	U.EL
9J259	489700	8144100	48D 07	17	U.EL
9J260	510250	8165420	48D 09	17	AS
9J278	565660	8155210	38C 06	17	AS
9J279	565390	8156000	38C 06	17	NA
9J280	565820	8155620	38C 06	17	AB_{TS}
9J286	566800	8163430	38C 11	17	AB_{TS}
9J289	527220	8166370	48D 09	17	AS
9J290	519590	8170600	48D 09	17	AB_{TS}
9J291	560540	8162070	38C 12	17	AB_{TS}
9J302	507000	8145000	48D 08	17	CP
9J303	507800	8145050	48D 08	17	CP
9J304	508300	8145700	48D 08	17	CP
9J305	508850	8146300	48D 08	17	CP
9J306	509400	8146800	48D 08	17	CP,VB
9M010	476700	8028500	48A 07	17	AS
9M012	477750	8029300	48A 07	17	AB_{TS},SC
9M013	476700	8030100	48A 07	17	SC,DYKE

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
9M014	475950	8029750	48A 07	17	AB_{TS},SC
9M015	526100	7991660	48A 01	17	AMG
9M016	527000	7992800	48A 01	17	AB_{PB}
9M017	527400	7992880	48A 01	17	AB_{PB}
9M018	527420	7003200	48A 01	17	AB_{PB}
9M019	529200	7992400	48A 01	17	AB_{PB}
9M020	553220	7995480	38B 04	17	AB_{PB}
9M021	553360	7996400	38B 04	17	AB_{PB}
9M022	552580	7997000	38B 04	17	AB_{PB}
9M023	552400	7997300	38B 04	17	AB_{PB}
9M024	554000	7998000	38B 04	17	AB_{PB}
9M025	553580	7998200	38B 04	17	AB_{PB}
9M026	553260	7998210	38B 04	17	AB_{PB}
9M027	553260	7998210	38B 04	17	AB_{PB}
9M028	552700	7998500	38B 04	17	AB_{PB}
9M029	552300	7999800	38B 04	17	AB_{PB}
9M030	552000	8000000	38B 04	17	AB_{PB}
9M032	551400	8000240	38B 04	17	AB_{PB}
9M033	551320	8000000	38B 04	17	AB_{PB}
9M041	536260	7991900	38B 04	17	AB_{PB}
9T042	557100	8014190	38B 04	17	AB_{PB},SC
9T044	510390	8024820	48A 08	17	AB_{TS},SC
9T093	503000	8077600	48A 16	17	AB_{TS}
9T139.A	456750	8035430	48A 06	17	AB_{TS}
9T139.I	456920	8035400	48A 06	17	AB_{TS}
9T140	456760	8035700	48A 06	17	AB_{TS},SC
9T141	456620	8036300	48A 06	17	SC
9T142	456380	8036460	48A 06	17	SC

(4). 1981 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
1I221	502100	7999500	48A 01	17	AB_{PB}
1I222	501700	8000050	48A 01	17	AB_{PB}
1I223	502100	8000400	48A 01	17	AB_{PB}
1I224	502400	8000900	48A 01	17	AMG
1I225	499600	8011650	48A 02	17	REG,AS
1I226	492590	8030450	48A 07	17	AS
1I228	503030	8029450	48A 08	17	AB_{TS},SC
1I229	488700	8018400	48A 07	17	AB_{TS},DYKE
1I230	479200	8016200	48A 02	17	AB_{TS},SC
1I231	507700	8026000	48A 08	17	AB_{TS}
1I232	511500	8028400	48A 08	17	SC
1I233	516600	8035950	48A 08	17	VB
1I138	542000	8035400	38B 05	17	VB
1I239	543250	8033300	38B 05	17	VB
1I240	544800	8032050	38B 05	17	VB
1I242	480400	8015950	48A 02	17	$AB_{TS,SC}$
1I245	485850	8041460	48A 07	17	SC
1I246	476150	8046900	48A 10	17	SC
1I247	471350	8050950	48A 10	17	SC
1I248	461600	8054100	48A 11	17	AB_{TS},SC
1I249	456200	8059500	48A 11	17	AB_{TS},SC
1I250	434900	8071050	48A 11	17	SC
1I250.A	434800	8074550	48A 11	17	SC
1I261	559800	8011500	38B 04	17	AB_{PB}
1I262	596150	7964650	37G 14	17	AS,AB_{PB}
1I263	397550	7961020	37G 10	18	AS
1I264	397200	7960900	37G 10	18	AS
1I265	396920	7974870	37G 15	18	AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
11268	445650	7929800	37G 08	18	AMG
11269	563500	7914500	37G 05	17	AMG
11270	564700	7910750	37G 05	17	AMG
11271	586900	7933100	37G 06	17	AMG
11272	603850	7901500	37G 03	17	AMG
11273	572800	7905400	37G 03	17	AMG
11274	504200	7993500	48A 01	17	AB_{TS}
11277	481700	7997100	48A 02	17	REG,NA,AS
11278	454200	8035500	48A 06	17	AB_{TS},SC
11279	463000	8045100	48A 11	17	SC
11280	447620	8043950	48A 06	17	SC
11281	449600	8041650	48A 06	17	SC
11282	449650	8039800	48A 06	17	SC,AB_{TS}
11284	451750	8037800	48A 06	17	AB_{TS}
11285	574350	8003200	38B 03	17	SC
11286	573950	8002650	38B 03	17	AB_{TS}
11287	573850	8000600	38B 03	17	AB_{PB}
11288	574050	7999100	38B 03	17	AB_{PB}
11289	573850	7998600	38B 03	17	AB_{PB}
11290	573800	7998300	38B 03	17	AB_{PB}
11291	573150	7997100	38B 03	17	AS
11292	572550	7995900	38B 03	17	AMG
11293	572000	7994300	38B 03	17	AS
11294	571850	7993200	38B 03	17	AB_{PB}
11295.A	496300	8032800	48A 07	17	AB_{TS}
11295.B	497400	8030600	48A 07	17	AB_{TS},SC
11296.A	491020	8035500	48A 07	17	AS,AB_{TS}
11296.B	490700	8032550	48A 07	17	AB_{TS}
11297	417450	8088950	48A 13	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
1I298	437500	8068450	48A 11	17	AS
1I300	408050	8082900	48A 13	17	AB$_{TS}$
1I301	411650	8073300	48A 12	17	AB$_{TS}$,SC
1I302	413500	8074200	48A 12	17	SC
1I303	415950	8077100	48A 13	17	SC
1I304	415100	8078700	48A 13	17	SC
1I305	415450	8079700	48A 13	17	SC
1I306	418900	8080250	48A 13	17	AB$_{TS}$,DYKE
1I307	421150	8079350	48A 13	17	AB$_{TS}$
1I308	422150	8077000	48A 13	17	AB$_{TS}$
1I309	422100	8076950	48A 13	17	SC
1I310	427620	8076150	48A 13	17	SC
1I311	426800	8077600	48A 13	17	AB$_{TS}$
1I312	456800	8035600	48A 06	17	AB$_{TS}$,SC
1I315	457900	8032000	48A 06	17	AMG,AS
1I316	591100	8100900	48B 16	16	SC
1I317	592200	8099750	48B 16	16	SC
1I319.A	594950	8096700	48B 16	16	AB$_{TS}$
1I319.B	595950	8097200	48B 16	16	SC
1I320	597300	8095200	48B 16	16	SC
1I321	403200	8095100	48A 13	17	SC
1I322	451100	8079900	48A 14	17	VB,AP/SS$_{MC}$
1I323	451250	8078000	48A 14	17	VB
1I324	454400	8076300	48A 14	17	VB
1I325	455820	8076000	48A 14	17	VB
1I326	457000	8075050	48A 14	17	VB
1I327	457300	8073800	48A 14	17	VB
1I328	456650	8061850	48A 11	17	SC
1I329	457300	8059950	48A 11	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
11330.A	458150	8058300	48A 11	17	AB_{TS}
11330.B	458950	8059300	48A 11	17	SC
11331.A	460050	8057550	48A 11	17	AB_{TS}
11331.B	461600	8058200	48A 11	17	SC
11332	461420	8055700	48A 11	17	AB_{TS}
11333	462300	8054000	48A 11	17	AS,AB_{TS}
11334	464080	8052860	48A 11	17	AB_{TS}
11335	415900	8065920	48A 12	17	AS
11336	416350	8066300	48A 12	17	AS
11337	416670	8066680	48A 12	17	NA,AS
11338	410650	8067600	48A 12	17	NA
11339	409950	8068400	48A 12	17	NA,AS
11340	407600	8070850	48A 12	17	AMG,NA
11341	403100	8072800	48A 12	17	AB_{TS}
11342	400950	8072700	48A 12	17	NA,AS
11343	400600	8069700	48A 12	17	NA,AS
11345	586400	8071450	48B 09	16	NA,AMG
11346	582750	8068500	48B 09	16	NA,AMG
11347	584100	8060200	48B 09	16	NA,AMG
11348	582400	8055550	48B 09	16	NA,AMG
11349	579400	8049200	48B 09	16	NA,AMG
11351	415500	8092050	48A 13	17	VB
11352	411700	8094700	48A 13	17	VB
11353	409550	8097550	48A 13	17	VB
11354	422050	8036300	48A 05	17	NA,AS
11355	421420	8026380	48A 05	17	FF
11356	422100	8025050	48A 05	17	AMG,FF
11357	419380	8025850	48A 05	17	FF
11358	408200	8037200	48A 05	17	AB_{FR}

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
11359	399800	8037950	48A 05	17	AB_{FR}
11360	402000	8034900	48A 05	17	AB_{FR},FF

(5). 1984 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
41001	423100	8153250	48D 05	17	L.EL
41002	423600	8152600	48D 05	17	L.EL
41003	421580	8154250	48D 05	17	L.EL
41004	421350	8155100	48D 05	17	L.EL,U.EL
41005	420100	8154000	48D 05	17	L.EL
41006	420650	8153000	48D 05	17	L.EL
41007	429800	8152450	48D 05	17	L.EL
41008	423600	8152600	48D 05	17	L.EL
41009	423620	8153000	48D 05	17	L.EL
41010	423050	8151400	48D 05	17	L.EL
41011	441850	8151680	48D 05	17	L.EL,U.EL
41012	441800	8149720	48D 05	17	L.EL,SS_{GS}
41013	440400	8149600	48D 06	17	L.EL,SS_{GS}
41014	439750	8149300	48D 06	17	L.EL,SS_{GS}
41015	439950	8149000	48D 06	17	L.EL,SS_{GS}
41016	440050	8148350	48D 06	17	L.EL
41017	440350	8146000	48D 06	17	SS_{GS}
41018	442450	8147550	48D 06	17	SS_{GS}
41019	442950	8148050	48D 06	17	SS_{GS}
41020	442450	8149100	48D 06	17	SS_{GS},L.EL.
41021	441350	8150200	48D 06	17	SS_{GS},L.EL
41022	441350	8150200	48D 06	17	$SS_{GS,GC}$
41023	426250	8136850	48D 05	17	AMG,NA
41024	425600	8137850	48D 05	17	NA,AS
41025	424420	8139580	48D 05	17	AB_{TS}
41026	424050	8140200	48D 05	17	AS
41027	424500	8140000	48D 05	17	AS
41028	424600	8140420	48D 05	17	NA,AS

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
41029	424250	8141500	48D 05	17	AS
41030	424200	8141850	48D 05	17	$\mathrm{AB_{TS}}$,SC
41031	428250	8146250	48D 05	17	$\mathrm{SS_{GS}}$,L.EL
41032	433850	8145150	48D 05	17	$\mathrm{SS_{GS}}$
41033	437780	8147400	48D 06	17	$\mathrm{SS_{GS}}$
41034	443180	8145550	48D 06	17	$\mathrm{SS_{GS}}$
41035	454500	8142650	48D 06	17	$\mathrm{SS_{GS}}$
41036	456500	8142200	48D 06	17	$\mathrm{SS_{RS}}$
41037	464000	8147900	48D 06	17	$\mathrm{SS_{GS}}$,L.EL
41038	463800	8152000	48D 06	17	$\mathrm{SS_{GS}}$,L.EL
41039	466400	8155800	48D 06	17	$\mathrm{SS_{GS}}$
41040	475300	8151000	48D 06	17	$\mathrm{SS_{GS}}$,L.EL
41041	481000	8155720	48D 10	17	L.EL
41042	477900	8158000	48D 10	17	L.EL
41043	474450	8158250	48D 10	17	$\mathrm{SS_{GS}}$,L.EL
41044	440150	8157600	48D 11	17	L.EL
41045	440050	8158800	48D 11	17	L.EL
41046	439150	8161500	48D 11	17	L.EL
41047	438250	8163000	48D 11	17	U.EL
41048	437800	8163820	48D 11	17	U.EL
41049	437350	8164350	48D 11	17	L.EL
41050	436500	8164700	48D 12	17	L.EL
41051	435600	8166550	48D 12	17	L.EL
41052	434820	8166600	48D 12	17	L.EL
41053	458200	8167450	48D 11	17	L.EL,U.EL
41054	458550	8167820	48D 11	17	U.EL
41055	459400	8140800	48D 06	17	$\mathrm{SS_{MC}}$
41056	458700	8140900	48D 06	17	$\mathrm{SS_{MC}}$
41057	457950	8140150	48D 06	17	VB,$\mathrm{SS_{MC}}$

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
41058	458300	8138500	48D 06	17	SC,VB
41059	458650	8137100	48D 06	17	SC
41060	476950	8159750	48D 10	17	L.EL
41061	477900	8160400	48D 10	17	L.EL
41062	478200	8160150	48D 10	17	L.EL
41063	478800	8160750	48D 10	17	L.EL
41064	478400	8160800	48D 10	17	L.EL,DYKE
41065	479600	8161650	48D 10	17	L.EL
41066	481400	8162300	48D 10	17	L.EL
41067	482000	8162500	48D 10	17	L.EL
41068	483000	8162180	48D 10	17	L.EL
41069	484800	8163350	48D 10	17	L.EL,PAL
41070	485420	8164550	48D 10	17	L.EL
41071	485900	8163450	48D 10	17	L.EL
41072	485600	8161650	48D 10	17	L.EL
41073	483950	8160220	48D 10	17	L.EL
41074	481200	8160500	48D 10	17	L.EL
41075	480100	8160870	48D 10	17	PAK
41076	477400	8158600	48D 10	17	SS_{GC},L.EL
41077	477800	8158800	48D 10	17	L.EL
41078	475250	8160950	48D 10	17	L.EL
41079	474580	8161300	48D 10	17	L.EL,DYKE
41080	474050	8161800	48D 10	17	L.EL,DYKE
41081	472400	8164320	48D 10	17	SS_{GS},L.EL
41082	471500	8163950	48D 10	17	SS_{GS},L.EL
41083	471800	8161420	48D 10	17	L.EL,DYKE
41084	472200	8161150	48D 10	17	L.EL
41085	473250	8159950	48D 10	17	L.EL
41086	474300	8160000	48D 10	17	L.EL

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
41087	477800	8158800	48D 10	17	L.EL
41088	477900	8158000	48D 10	17	L.EL
41089	478200	8158800	48D 10	17	L.EL
41090	477050	8159550	48D 10	17	SS_{GS},L.EL
41091	476600	8159500	48D 07	17	SS_{GS}
41092	477300	8155420	48D 07	17	SS_{GS}
41093	478000	8155350	48D 07	17	SS_{GS},L.EL
41094	477600	8154700	48D 07	17	$SS_{RS,GS}$, L.EL
41095	476200	8154350	48D 07	17	SS_{GS},L.EL
41096	476000	8154600	48D 07	17	L.EL
41098	519100	8141700	48D 08	17	SC
41099	519350	8142350	48D 08	17	SC
41100	519400	8142700	48D 08	17	SC
41101	520050	8143050	48D 08	17	AP_{PB}
41102	520180	8143400	48D 08	17	AP_{PB}
41103	520750	8143600	48D 08	17	AB_{PB}
41104	522050	8144100	48D 08	17	AS
41105	522250	8144800	48D 08	17	AS
41106	520020	8144800	48D 08	17	AS,AB_{PB}
41107	519800	8142600	48D 08	17	AB_{PB}
41108	519250	8142850	48D 08	17	SC
41109	518750	8141250	48D 08	17	SC
41110	578820	8176250	38C 11	17	AS
41111	580600	8175250	38C 11	17	AS
41112	581300	8174550	38C 11	17	AB_{TS}
41114	581600	8172100	38C 11	17	AB_{TS}
41115	583800	8171450	38C 11	17	AB_{TS}
41116	510600	8184400	48D 16	17	SC

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
41117	511350	8182450	48D 09	17	SC
41118	507850	8132950	48D 08	17	SC
41119	507800	8133800	48D 08	17	SC
41120	417420	8109150	48D 04	17	SS_{CC}
41121	417900	8109180	48D 04	17	SS_{RC}
41122	418000	8108900	48D 04	17	SS_{RC}
4123	418420	8108720	48D 04	17	$SS_{CC,RC}$
41124	418000	8108600	48D 04	17	SS_{RC}
41125	418750	818200	48D 04	17	VB,SS_{RC}
41126	419550	8108200	48D 04	17	VB,SS_{RC}
41127	419550	8108550	48D 04	17	VB,SS_{RC}
41128	418600	8108950	48D 04	17	SS_{RC}
41129	419000	8108450	48D 04	17	VB,SS_{RC}
41130	419700	8108450	48D 04	17	VB,SS_{RC}
41131	419900	8108550	48D 04	17	$SS_{CC,RC}$
41132	420300	8108400	48D 04	17	$SS_{CC,RC}$
41133	420700	8108450	48D 04	17	SS_{RC}
41134	420100	8109300	48D 04	17	SS_{RC}
41135	418850	8109300	48D 04	17	SS_{RC}
41136	418300	8109200	48D 04	17	SS_{RC}
41137	419180	8107800	48D 04	17	SS_{RC}
41138	418700	8107350	48D 04	17	SS_{RC}
41139	418200	8106800	48D 04	17	$SS_{RC,CC}$
41140	417250	8107000	48D 04	17	$SS_{RC,CC}$
41141	416600	8107000	48D 04	17	$SS_{RC,CC}$
41142	416350	8106950	48D 04	17	SS_{RC}
41143	415850	8106850	48D 04	17	$SS_{CC,RC}$
41144	420600	8107520	48D 04	17	SS_{RC}
41145	420350	8107000	48D 04	17	$SS_{RC,RS}$

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
4I146	420320	8106620	48D 04	17	$SS_{RC,RS}$
4I147	420800	8105850	48D 04	17	$SS_{RS,GA}$
4I148	420900	8105300	48D 04	17	SS_{GA}
4I149	422900	8112380	48D 04	17	SS_{RC}
4I150	423400	8112150	48D 04	17	SS_{RC}
4I151	423500	8111700	48D 04	17	SS_{RC}
4I152	423600	8110500	48D 04	17	SS_{RC}
4I153	423250	8110600	48D 04	17	SS_{RC}
4I154	423000	8110800	48D 04	17	SS_{RC}
4I155	422450	8111200	48D 04	17	SS_{RC}
4I156	422600	8112600	48D 04	17	VB,SS_{RC}
4I157	422950	8113030	48D 04	17	$SS_{RC,CC}$
4I158	423200	8113220	48D 04	17	$SS_{RC,CC}$
4I159	423400	8114250	48D 04	17	VB,SS_{RC}
4I160	422700	8113800	48D 04	17	SS_{RC}
4I161	421980	8113550	48D 04	17	SS_{RC}
4I162.A	423220	8114200	48D 04	17	SS_{RC}
4I162.B	423050	8114150	48D 04	17	SS_{RC}
4I162.C	423000	8114250	48D 04	17	SS_{RC}
4I163	423200	8114500	48D 04	17	SS_{RC}
4I164	421820	8113900	48D 04	17	SS_{RC}
4I165	421800	8112380	48D 04	17	$SS_{CC,RC}$
4I166	420180	8112500	48D 04	17	VB,SS_{CC}
4I167	419000	8111780	48D 04	17	VB,SS_{RC}
4I168	418820	8112200	48D 04	17	$SS_{RC,RS}$
4I169	419300	8112400	48D 04	17	$SS_{RC,RS}$
4I170	421230	8113200	48D 04	17	$SS_{RC,RS}$
4J200	416200	8108600	48D 04	17	VB
4K010	441150	8151100	48D 06	17	SS_{GC},L.EL

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
4K017	410650	8155200	48D 05	17	L.EL,U.EL
4K084	404250	8117850	48D 04	17	$SS_{MC,RS}$
4K097	591900	8120500	48C 01	16	$SS_{GA,RS}$
C1-84	423200	8152750	48D 05	17	L.EL,U.EL
C7-84	417550	8109050	48D 04	17	$SS_{RC,RS}$

(6). Miscellaneous Stations

(A) Lemon and Blackadar (1963) - Arctic Bay Area

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
Site 1 LB-63-1(SC)	559600	8105100	48C 02	16	SC
Site 1 LB-63-1(VB)	558600	8105700	48C 02	16	VB

(B) Operation Bylot - 1968 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
JD-68D	568090	8005410	38B 04	17	AB_{PB},SC
JD-68C	559650	8013800	38B 04	17	AB_{PB}

(C) Huntec - 1969 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
RHD-69-1	432500	8053450	48A 12	17	AB_{TS},SC
RHD-69-3	428000	8057200	48A 12	17	AB_{TS}
RHD-69-4	418000	8059650	48A 12	17	AB_{TS}
RHD-69-6	444150	8063450	48A 11	17	NA,AS
RHD-69-9	490700	8044900	48A 10	17	VB
RHD-69-10	486400	8044600	48A 10	17	SC
RHD-69-11	457750	8035950	48A 06	17	AB_{TS},SC
RHD-69-12	458500	8060200	48A 11	17	AB_{TS},SC

(D) Blackadar (1970)

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
Site 2 B-70-2	511200	8036000	48A 08	17	SC,VB

(E) King Resources - 1970 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
K-5(Base)	533800	8035150	38B 05	17	AP
K-5(Top)	535050	8037600	38B 05	17	AP
K-6	540700	8037950	38B 05	17	VB,AP

(F) Olson (1977) - Nanisivik Minesite

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
OLSON-77	581100	8106450	48C 01	17	SC

(G) Strathcona Minerals - 1989 Field Season

STATION	EASTING	NORTHING	MAP	ZONE	ROCK UNIT
S9-89	503200	8078550	48A 16	17	AB_{PB}
S11-89	488150	8091100	48A 15	17	AP,SS_{RA}
S15-89	579800	8106900	48C 01	16	VB

Appendix II

Stratigraphic Sections

The stratigraphic sections, used in the analysis of the stratigraphy of the Bylot Supergroup, are listed in the same chronological order as outlined for the field station locations in Appendix I. Formation and member codes used in the lists are defined in Tables 2.5A to 2.5D and in Appendix I.

The type sections indicated for each formation reflect the much broader stratigraphic information base than was previously accessible to Lemon and Blackadar (1963) and Blackadar (1970). The sections are those that best reflect the stratigraphy of the Bylot Supergroup in the Borden Basin. The sections are all reasonably accessible, stratigraphically complete (i.e. with well defined bases, tops and vertical continuity) and well exposed. The definition of formal type sections for all of the formations and related facies assemblages is a primary requirement for a truly comprehensive revision of the stratigraphy of the Bylot Supergroup.

(1). 1977 Stratigraphic Sections

STATION(S)	SEQUENCE	THK (m)	COMMENTS
7I011	AB_M to $SC_{U(NW)}$	191	Original type section for the Arctic Bay Formation (Lemon and Blackadar, 1963). 7I003-005 + 7I011 = Section 1A in Fig. 3.10a.
7I013	AS_U	101	
7I018	NA_L	26	
7I019	NA_U to AS_L	67	
7I023	AB_L to AB_M	136	Section 1B in Fig. 3.10b.
7I025	NA_L to AS_U	363	Section 2 in Fig. 3.2a.
7I027-028	AS_L	260	
7I037-039	AS_U to AB_L	84	
7I047	AS_L	25	
7I058	AMG/NA_L to NA_U	14	Section 21 in Fig. 3.2e.
7I059	AMG/NA_L to NA_U	27	
7I062	AMG/NA_L to NA_U	31	7062+069 = Section 12 in Fig. 3.2c and Section 16 in Fig. 3.7b.
7I069	NA_U to AS_U	314	
7I071	NA_U to AS_L	42	
7I073	NA_U	45	
7I075	NA_U	97	
7I077	NA_L to NA_U	104	
7I080	AS_L to AS_U	232	
7I090	AMG/NA_L to NA_U	35	
7I101-103	NA_U to AS_L	191	
7I111-112	AMG/NA_L to NA_U	204	Section 8 in Fig. 3.2b.

STATION(S)	SEQUENCE	THK (m)	COMMENTS
71116	AS_M	49	71116 + 71027-028 = Section 1 in Fig. 3.7a.
71120-124	AS_L to AB_L	381	
71126	AMG/NA_L to NA_U	78	71126+156 = Section 3 in Fig. 3.2a.
71127	AB_L to $SC_{U(NW)}$	451	Section 3 in Fig. 3.10a.
71135	VB_L to SS_{RS}	444	Section 3 in Fig. 3.16a.
71145-146	VB_U to SS_{GA}	387	
71149	$SC_{U(NW)}$	405	71149 + 71127+134a = Section 4 in Fig. 3.13a.
71155	AS_L to AS_U	190	71155 + 71120-124 = Section 3 in Fig. 3.7a.
71156	NA_U	59	
71158	AS_L to AS_U	212	71025+037 + 71158 = Section 2 in Fig. 3.7a.
71160	NA_U to AS_U	180	
71167	NA_U to AS_L	179	
71178	NA_L to AS_U	222	Section 13 in Fig. 3.2c.
71189	AMG/NA_L to NA_U	52	
71196-201	AS_U to FF_L	1760	Original type section of the "Fabricius Fiord Formation" of Blackadar (1970). Section 22 in Fig. 3.10c.
71204-211	AB_L to FF_L	700	71204-211 + 71222-224 = Section 25 in Fig. 3.10c.
71222	$AB_{L(M)}$ to AB_M	130	
71224	$AB_{L(M)}$ to AB_M	147	
71228	AS_U to AB_M	76	
71236	AMG/NA_L to AS_L	768	Section 18 in Fig. 3.2d. Suggested type section for the Nauyat Formation.
71238	$AB_{L(M)}$ to $AB_{U(M:L)}$	263	Section 30 in Fig. 3.10d.

STATION(S)	SEQUENCE	THK (m)	COMMENTS
7I248	AS_U to $AB_{L(M)}$	129	
7I252	AS_U to $SC_{U(NW)}$	620	Section 29 in Fig. 3.10d.
7I256	$SC_{L(NW)}$ to $VB_{U(U)}$	611	7I256 + 4I030 = Section 15 in Fig. 3.13b.
7I258	AB_L to $SC_{L(NW)}$	311	7I258 + 1I301 = Section 15 in Fig. 3.10b.
7I264-268	AS_U to AB_L	100	
7I277	AMG/NA_U to AS_L	213	NA_L absent southeast of this station. Section 7 in Fig. 3.2a.
7G001	AMG/NA_L to NA_U	244	Section 1 in Fig. 3.2a.
7G008	AMG/NA_L to AS_L	166	7G008 + RHD-69-6 = Section 6 in Fig. 3.2a.
7G019	AB_M to $SC_{U(NW)}$	347	
7G021	AB_L to AB_M	146	7G019-021 +1I306 = Section 4 in Fig. 3.10a.
7G025	AS_L to AS_U	168	
7J131	AMG/NA_L to NA_U	53	
7N100	$VB_{U(L)}$ to SS_{GS}	320	Section 1 in Fig. 3.19a. Suggested type section for the northwest facies assemblage of the Strathcona Sound Formation.
7N200	SS_{GS} to L.EL	595	Section 1 in Fig. 3.21. Suggested type section for the Lower Elwin Formation.

(2). 1978 Stratigraphic Sections

STATION(S)	SEQUENCE	THK (m)	COMMENTS
8I001-004	AS_U to AB_L	90	
8I006	AS_U	24	
8I008	AS_U to AB_L	168	
8I010	AB_M to $AB_{U(M)}$	394	8I008-012 + 1I295 = Section 7 in Fig.3.10a. Suggested type section for the basinal (TS) facies assemblage of the Arctic Bay Formation
8I016	$AB_{U(M)}$ to $SC_{L(NW)}$	99	
8I019-021	AB_M to $SC_{L(NW)}$	260	
8I023	AB_M to $SC_{L(NW)}$	294	
8I031	AB_M to $AB_{U(M)}$	282	
8I034	FF_L	42	
8I036	$AB_{U(M:U)}$ to FF_L	56	
8I036-048a	AS_U to FF_L	260	Section 27 in Fig. 3.10c.
8I057	$AB_{U(M)}$ to FF_L	470	Section 28 in Fig. 3.10c.
8I083	$AB_{U(M)}$ to FF_L	50	8I083+099 + 8I209, 9J211 = Section 26 in Fig. 3.10c.
8I084	FF_L to FF_U	149	
8I089	$FF_{U(1)}$ to $SS_{U(NW)}$	20	
8I098	AB_M to $AB_{U(L)}$	15	
8I099-105	AS_U to FF_U	2059	Suggested type section for the marginal (FR) facies assemblage of the Arctic Bay Formation (= Section 23 in Fig. 3.10c). Suggested type section for the Fabricius Fiord Formation (= Section 11 in Fig. 3.13b).
8I107	AS_U to $AB_{L(M)}$	50	

STATION(S)	SEQUENCE	THK (m)	COMMENTS
81115	AS$_U$ to AB$_{U(M:U)}$	812	Section 24 in Fig. 3.10c.
81119	AS$_U$ to AB$_{L(M)}$	126	
81131	AS$_U$ to AB$_{L(M)}$	55	
81148	AB$_{U(SE)}$	20	
81156	AMG/AS to AB$_{U(L)}$	471	Section 10 in Fig. 3.10a.
81162	AB$_M$ to AB$_{U(L)}$	65	
81164	AB$_M$ to AB$_{U(L)}$	72	
81169	AB$_M$ to AB$_{U(SE:T)}$	93	
81172	AB$_M$ to AB$_{U(M)}$	286	
81173	AB$_L$ to SC$_{U(NW)}$	721	Section 9 in Fig. 3.10a.
81188	AB$_{L(SE)}$ to AB$_{U(SE)}$	184	
81190	AB$_{L(SE)}$	37	
81198	AMG/AS to AB$_{L(SE)}$	108	Section 12 in Fig. 3.7a.
81203-206	AB$_{L(SE)}$ to AB$_{U(SE)}$	247	
81209	AB$_{U(SE)}$	13	
81218-224	AB$_{U(SE)}$	360	81188 + 81218-224 = Section 14 in Fig. 3.10a.
81231	AMG/AS$_{L(SE)}$ to AS$_{U(SE)}$	189	
81242	AB$_{U(SE)}$	56	
81243	AB$_{L(SE)}$	123	
81255	AB$_{U(SE)}$	241	Section 33A in Fig. 3.10f.
81256	SC$_{L(SE)}$	364	81256 + JD-68b = Section 9 in Fig. 3.13a. Suggested type section for the southeast facies assemblage of the Society Cliffs Formation.
81278-285	AMG/AS to AB$_{U(SE)}$	590	Section 34 in Fig. 3.10f. Section 9 in Fig. 3.7a.

STATION(S)	SEQUENCE	THK (m)	COMMENTS
81293	$AB_{U(L)}$ to $AB_{U(U)}$	598	81293 +302 = Section 12 in Fig. 3.10a.
81302-303	$AB_{U(U)}$ to $SC_{L(SE)}$	215	
81311	AMG/ASdL(SE) to $AB_{U(SE)}$	275	Section 10 in Fig. 3.7a.
81319	$AB_{U(SE)}$	36	
81322-324	AMG/AS to $AB_{U(SE)}$	201	Section 11 in Fig. 3.7a.
81330	$AB_{U(SE)}$	291	
81337A	$AB_{L(SE)}$	41	
81342	$AB_{U(SE)}$	30	
81344	$AB_{U(SE)}$	228	81322-324 + 81330+344 = Section 13 in Fig. 3.10a. Suggested type section for the southeast (PB) facies assemblage of the Arctic Bay Formation.
81355-356	AMG/AS to $AB_{L(SE)}$	90	Reference section for $AS_{L(SE)}$ member.
81357-358	AMG/AS to $AB_{L(SE)}$	92	
81361	$AB_{U(SE)}$	46	
81368	$SC_{L(SE)}$	74	

(3). 1979 Stratigraphic Sections

STATION(S)	SEQUENCE	THK(m)	COMMENTS
91010	VB_U	32	
91019	AMG/AS_L	20	
91021	AMG/AS_L to $AB_{U(M)}$	635	Section 7 in Fig. 3.7a.
91026-027	AS_U to AB_L	48	
91029	AS_L to AB_M	328	91029 + 11296 + 81023 = Section 6 in Fig. 3.10a.
91031	AB_M to $SC_{U(NW)}$	481	Section 19 in Fig. 3.10b.
91033	AB_M to $SC_{L(NW)}$	322	91021 + 91033 = Section 8A in Fig. 3.10a.
91037A-038	$AB_{U(SE)}$	57	
91041-042	$AB_{U(SE)}$	225	
91046	$AB_{U(SE)}$ to $SC_{L(SE)}$	200	
91100	NA_U to AS_U	43	
91111-114	REG/AS_L to AB_L	38	Section A in Fig. 3.2a.
91117	$SC_{U(NW)}$	32	
91122+124	AMG/$AS_{L(SE)}$ to AB_M	192	Section 13 in Fig. 3.7a.
91132-133	AMG/AS to $AB_{L(SE)}$	62	
91171	$SC_{U(NW)}$ to AP_L	609	Section 5 in Fig. 3.16a.
91175-177	$AB_{U(L)}$ to $SC_{U(NW)}$	155	
91186	VB_U to AP_M	317	Section 6 in Fig. 3.19a.
91195	AMG/NA_L to AS_L	63	Section 11 in Fig. 3.2b.
91198	AMG/NA_L to AS_L	75	Section 10 in Fig. 3.2b.
91207	$AB_{U(M)}$	25	
91209	AMG/NA_L to AS_L	75	Section 14 in Fig. 3.2c.

STATION(S)	SEQUENCE	THK(m)	COMMENTS
91210	AB_M to FF_L	65	
91215	AS_U	60	91215 + RHD-69-3,4 = Section 16 in Fig. 3.10b.
91223-229	$VB_{U(L)}$ to SS_{RA}	500	91221-229 + 11322 = Section 5 in Fig. 3.19a.
91230-231	AP_U to SS_{FC}	361	Section 10 in Fig. 3.19b. Suggested type section for the marginal facies assemblage of the Strathcona Sound Formation in Milne Inlet Trough.
91232-233	$VB_{U(U)}$ to SS_{RS}	260	Section 9 in Fig. 3.19b.
91238	AMG/NA_L to AS_U	478	91238 + 71236+248 = Section 15 in Fig. 3.7b. Suggested type section for the Adams Sound Formation.
91251	$L.EL_{SE}$	335	91251 + 91257 = Section 6 in Fig. 3.21.
91253	AMG/AS_L to AS_U	374	
91256	AMG/NA_L to AS_L	154	Section 17 in Fig. 3.2d.
91265-269	VB_U to SS_{GA}	382	
91264	$SC_{U(NW)}$ to SS_{MC}	500	Section 11 in Fig. 3.16b.
91275	NA_L to AS_L	53	
91280	AMG/AS_L to AS_U	282	Section 14 in Fig. 3.7b.
91289-294	SS_{MC} to L.EL	620	Section 14 in Fig. 3.19d.
9J016-029	$AB_{U(U)}$ to VB_L	856	Section 7 in Fig. 3.13a. Suggested type section for the northwestern facies assemblage of the Society Cliffs Formation.
9J099-107	$AB_{U(U)}$ to VB_L	800	91099-107 + 81088-089 = Section 8 in Fig. 3.13a.

STATION(S)	SEQUENCE	THK(m)	COMMENTS
9J110-130	$SC_{U(SE)}$ to AP_L	730	Section 8 in Fig. 3.16a. Suggested type section for Victor Bay Formation.
9J131-135	$VB_{U(U)}$ to SS_{GA}	615	Section 7 in Fig. 3.19a. Suggested type section for the Athole Point Formation.
9J202	AMG/NA_L to NA_U	49	Section 15 in Fig. 3.2c.
9J257	L.EL_{SE} to U.EL_{SE}	300	
9J302-306	VB_U to CP_U	475	Section 15 in Fig. 3.19d. Suggested type section for the Canada Point Formation.
9M019	$AB_{U(SE)}$	183	9M016-019 = Section 21 in Fig. 3.10b.
9M040	$AB_{U(SE)}$	30	
9M041	$AB_{U(SE)}$	12	
9TO42	$AB_{U(SE)}$ to $SC_{L(SE)}$	758	
9TO44	AB_M to $AB_{U(M)}$	398	
9TO93	AB_L	20	
9T139	$AB_{U(L)}$ to $SC_{U(NW)}$	159	

(4). 1981 Stratigraphic Sections

STATION(S)	SEQUENCE	THK(m)	COMMENTS
11221-223	AB_M to $AB_{U(SE)}$	480	Section 20 in Fig. 3.10b.
11232	AB_M to $SC_{U(NW)}$	284	Section 8B in Fig. 3.10a.
11250-250A	$AB_{U(M)}$ to VB_L	625	Section 5 in Fig. 3.13a.
11261	$AB_{U(SE)}$	100	
11262	AMG/AS to $AB_{U(SE)}$	800	81311 + 91132-133 + 11262 = Section 35 in Fig. 3.10f.
11277	AMG/NA_L to NA_U	32	Section 16 in Fig. 3.2c.
11283-284	$AB_{U(L)}$ to $SC_{U(NW)}$	100	11283-284 + 91207 = Section 17 in Fig. 3.10b.
11286	$AB_{U(SE)}$	294	91057-060 + 11286 = Section 33B in Fig. 3.10f.
11291-293	AMG/AS to $AB_{L(SE)}$	65	11291-293 + 91061 = Section 8 in Fig. 3.7a.
11295	AB_M to $SC_{L(NW)}$	500	
11296	AS_U to AB_M	510	
11301	AB_M to $SC_{L(NW)}$	150	
11301-305	$AB_{U(M)}$ to $SC_{U(NW)}$	500	Section 13 in Fig. 3.10b.
11306	AB_L to AB_M	250	11306 + 7G019-021 = Section 4 in Fig. 3.10a.
11316	$AB_{U(L)}$ to VB_L	300	Section 3 in Fig. 3.13a.
11317-319	AB_M to $SC_{U(NW)}$	175	Section 2 in Fig. 3.2a.
11322-327	VB_L to SS_{MC}	650	Section 4 in Fig. 3.16a.
11330-333	ASZ_U to $SC_{L(NW)}$	550	11330-333 + RHD-69-12 = Section 5 in Fig. 3.10a.
11335-337 + 11341	NA_U to AB_L	320	Section 4 in Fig. 3.7a.
11337-339	NA_U to AS_L	85	Section 5 in Fig. 3.2a.

STATION(S)	SEQUENCE	THK(m)	COMMENTS
1I345	AMG/NA$_L$ to NA$_U$	60	Section 4 in Fig. 3.2a.
1I346	AMG/NA$_L$ to AS$_L$	100	1I346 + 7J131 = Section 19 in Fig. 3.2d.
1I347	AMG/NA$_L$ to AS$_L$	80	Section 9 in Fig. 3.2b.
1I349	AMG/NA$_L$ to AS$_U$	55	Section 20 in Fig. 3.2d.

(5). 1984 Stratigraphic Sections

STATION(S)	SEQUENCE	THK(m)	COMMENTS
4I008	L.EL	36	
4I009	L.EL	76	
4I010	L.EL	29	
4I011	L.EL to U.EL	432	4I011, 021 + 4K010 = Section 3 in Fig. 3.21.
4I021	SS_{GC} to L.EL	301	
4I053	L.EL to U.EL	353	Section 4 in Fig. 3.21.
4I076	SS_{GC} to L.EL	381	Section 13 in Fig. 3.19d. Section 5 in Fig.3.21.
4I106	AMG/AS to $AB_{U(SE)}$	786	
4I108	$SC_{L(SE)}$ to SC-VB undiv.	786	
4I116	$SC_{U(NW)}$	570	
4I118	$SC_{L(SE)}$ to $SC_{U(SE)}$	253	
4I147	SS_{RS} to SS_{GA}	202	
4J200	VB_{L} to $VB_{U(L)}$	201	C7-84+ 4J200 = Section 10 in Fig. 3.16b.
4K010	SS_{GC} to L.EL	442	4K010 + 4I021 + 9I265-269 = Section 12 in Fig. 3.19d. Suggested type section for the basinal facies assemblage of the Strathcona Formation in Eclipse Trough.
4K017	E.EL TO PAL	478	Section 1 in Fig. 3.21. Suggested type section for the Upper Elwin Formation.
4K084	SS_{MC} to SS_{GS}	471	4k084 + 097 = Section 2 in Fig. 3.19a.
4K097	SS_{GA} to SS_{RS}	219	
C1-84	SS_{GS} to U.EL	1500	Section 11 in Fig. 3.19d. Section 2 in Fig. 3.21.

STATION(S)	SEQUENCE	THK(m)	COMMENTS
C7-84	$VB_{U(L)}$ to SS_{RS}	500	C7-84 + 7I147 = Section 3 in Fig. 3.19a. Suggested type section for the basinal facies assemblage of the Strathcona Sound Formation in the Milne Inlet Trough.

(6). Miscellaneous Stratigraphic Sections

STATION(S)	SEQUENCE	THK(m)	COMMENTS
LB-63-1SC	SC	280	Original type section of the Society Cliffs Formation. Section 1 in Fig. 3.13a.
LB-63-1VB	VB	160	Original type section of the Victor Bay Formation. Section 1 in Fig. 3.16a.
JD-68b	$AB_{U(SE)}$ to $VB_{U(L)}$	1234	
JD-68c	$AB_{U(SE)}$ to $AB_{U(SE)}$	1280	JD-68c + 1I261 = Section 32 in Fig. 3.10f.
RHD-69-1	$AB_{U(M)}$ to $SC_{U(NW)}$	135	
RHD-69-3	$AB_{U(M)}$ to $SC_{U(NW)}$	183	RHD-69-1,3+4 = Section 17 in Fig. 3.13b.
RHD-69-4	AB_{M} to $SC_{L(TR)}$	145	
RHD-69-5	AB_{M} to $SC_{U(NW)}$	110	
RHD-69-6	NA_{U} to AS_{U}	335	RHD-69-6 + 7G008 = Section 5 in Fig. 3.7a.
RHD-69-7	AB_{M} to $SC_{U(NW)}$	432	
RHD-69-9	SC_{U} to $VB_{U(L)}$	410	Section 6 in Fig. 3.16a.
RHD-69-10	$SC_{U(NW)}$	122	RHD-69-10 + 7I075-077 = Section 6 in Fig. 3.13a.
RHD-69-11	AB_{M} to $SC_{U(NW)}$	305	Section 18 in Fig. 3.10b.
RHD-69-12	AB_{L} to $SC_{U(NW)}$	382	
B-70-2	$SC_{U(NW)}$ to $VB_{U(L)}$	501	Section 7 in Fig. 3.16a.
K-5	AP_{L} to AP_{U}	512	

STATION(S)	SEQUENCE	THK(m)	COMMENTS
OLSON-77	SC	275	Nanisivik minesite. Section 2 in Fig. 3.13a.
S9-89	AB_L to $SC_{U(NW)}$	600	S9-89 + 9T093 = Section 31 in Fig. 3.10e.
S15-89	VB_L to SS_{MC}	325	Section 2 in Fig. 3.16a.

REFERENCES

Austin, J.A. Jr., Uchupi, E., Shaughnessy, D.R. III, and Ballard, R.D. 1980. Geology of New England passive margin. AAPG Bulletin, 64: 501-526.

Baker, B.H., Mohr, P.A., and Williams, L.A.J. 1972. Geology of the Eastern Rift system of Africa. The Geological Society of America, Special Paper 136.

Bally, A.W. 1980. Basins and subsidence - a summary. In Dynamics of Plate Interiors. Geodynamic Series, vol 1. Edited by A.W. Bally, P.L. Bender, T.R. McGetchin and J. Walcott. American Geophysical Union, Washington, D.C., pp. 5-20.

Bally, A.W. 1981. Atlantic-type margins. In Geology of Passive Continental Margins. American Association of Petroleum Geologists, Continuing Education Course Note Series 19, pp.1-1 - 1-48.

Bally, A.W. 1982. Musings over sedimentary basin evolution. In The Evolution of Sedimentary Basins. Edited by P. Kent, M.H.P. Bott, D.P. McKenzie, and G.A. Williams. Philosophical Transactions of the Royal Society of London, A305, pp. 319-324.

Bally, A.W. and Snelson, S. 1980. Realms of subsidence. Canadian Society of Petroleum Geology, Memoir 6, pp.1-94.

Baragar, W.R.A. 1972. Coppermine River basalts - District of MacKenzie. In Rubidium-Strontium Isochron Age Studies: Report 1. Edited by R.K Wanless and W.D. Loveridge. Geological Survey of Canada, Paper 72-23, pp. 21-24.

Baragar, W.R.A. and Robertson, W.A. 1973. Fault rotation of paleomagnetic directions in Coppermine River lavas and their revised pole. Canadian Journal of Earth Sciences, 10: 1519-1532.

Blackadar, R.G. 1956. Geological reconnaissance of Admiralty Inlet, Baffin Island, Arctic Archipelago, Northwest Territories. Geological Survey of Canada, Paper 55-6.

__________1958. Fury and Hecla, District of Franklin, Northwest Territories. Geological Survey of Canada, Map 3-1958 (with marginal notes).

__________1963. Additional notes to accompany Map 3-1958 (Fury and Hecla Strait map-area) and Map 4-1958 (Foxe Basin north map-area). Geological Survey of Canada, Paper 62-35.

__________1965. Geological reconnaissance of the Precambrian of northwestern Baffin Island, Northwest Territories. Geological Survey of Canada, Paper 64-42.

__________1967. Precambrian geology of Boothia Peninsula, Somerset Island and Prince of Wales Island, District of Franklin. Geological Survey of Canada, Bulletin, 151, maps.

__________1970. Precambrian geology northwestern Baffin Island, District of Franklin. Geological Survey of Canada, Bulletin, 91.

Blackadar, R.G. and Fraser J.A. 1960. Precambrian geology of Arctic Canada, a summary account. Geological Survey of Canada, Paper 60-8.

Blackadar, R.G., Davison, W.L., and Trettin, H.P. 1968a. Milne Inlet, District of Franklin. Geological Survey of Canada, Map 1235A. (map with marginal notes).

______________________________1968b. Navy Board Inlet, District of Franklin. Geological Survey of Canada, Map 1236A. (map with marginal notes).

______________________________1968c. Arctic Bay-Cape Clarence, District of Franklin. Geological Survey of Canada, Map 1237A. (map with marginal notes).

______________________________1968d. Moffet Inlet-Fitzgerald Bay, District of Franklin. Geological Survey of Canada, Map 1238A. (map with marginal notes).

______________________________1968e. Berlinguet Inlet-Bourassa Bay, District of Franklin. Geological Survey of Canada, Map 1241A. (map with marginal notes).

______________________________1968f. Phillips Creek, District of Franklin. Geological Survey of Canada, Map 1239. (map with marginal notes).

Boote, D.R.D. and Kirk, R.B. 1989. Depositional wedge cycles on evolving plate margin, western and northwestern Australia. AAPG Bulletin 73: 216-243.

Bott, M.H.P. 1976. Formation of sedimentary basins of graben type by extension of the continental crust. Tectonophysics 36: 77-86.

_______ 1981. Crustal domal and the mechanism of continental rifting. Tectonophysics, 73: 1-8.

________ 1982. The mechanism of continental splitting. Tectonophysics, 81: 301-309.

Bott, M.H.P. and Kusznir, N.J. 1984. The origin of tectonic stress in the lithosphere. Tectonophysics, 103: 1-13.

Bott, M.H.P. and Mithen, D.P. 1983. Mechanism of graben formation - the wedge subsidence hypothesis. Tectonophysics, 94: 11-22.

Brown, R.L., Dalziel, I.W.F., and Rust, B.R. 1969. The structure, metamorphism and development of the Boothia Arch, Arctic Canada. Canadian Journal of Earth Sciences, 6: 252-543.

Burke, K. 1976. Development of graben associated with the initial ruptures of the Atlantic Ocean. Tectonophysics, 36: 93-112.

_______1977. Aulocagens and continental breakup. Annual Review of Earth and Planetary Science, 5: 371-396.

_______1980. Intracontinental rifts and aulacogens. In Dynamics of Plate Interiors. Geodynamics Series, vol. 1. Edited by A.W. Bally, P.L. Bender, T.R. McGetchin and I. Walcott. American Geophysical Union, Washington, D.C., pp. 42-49.

Burke, K. and Dewey, J.F. 1973. Plume-generated triple junctions: key indicators in applying plate tectonics to old rocks. Journal of Geology, 81: 406-433.

Chandler, F.W. and Stevens, R.D. 1981. Potassium-argon age of the Proterozoic Fury and Hecla Formation, Northwest Baffin Island, district of Franklin. In Current Research, part A. Geological Survey of Canada, Paper 81-1A, pp. 37-40.

Chandler, F.W., Charbonneau, B.W., Ciesielski, A., Maurice, Y.T., and White, S. 1980. Geological studies of the Late Precambrian supracrustal rocks and underlying granitic basement, Fury and Hecla Strait area, Baffin Island, District of Franklin. In Current Research, part A. Geological Survey of Canada, Paper 80-1A, pp. 125-132.

Chenet, P., Montadert, L., Gairaud, H. and Roberts, D. 1982. Extension ratio measurements on the Galicia, Portugal, and Northern Biscay continental margins: implications for evolutionary models of passive continental margins. In Studies in Continental Margin Geology. Edited by: J.S. Watkins and C.L. Drake. American Association of Petroleum Geologists, Memoir 34, pp. 703-715.

Christie, K.W. and Fahrig, W.F. 1983. Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop. Canadian Journal of Earth Sciences, 20: 275-289.

Christie, R.L., Cook, D.G., Nassichuk, W.W., Trettin, H.P., and Yorath, C.J. 1972. The Canadian Arctic Islands and the MacKenzie region. 24th International Geological Congress, Guidebook Excursion A-66.

Clayton, R.H. and Thorpe, L. 1982. Geology of the Nanisivik zinc-lead deposit. In Precambrian Sulphide Deposits. Edited by: R.W. Hutchinson, C.D. Spence and J.M. Franklin. Geological Association of Canada, Special Paper 25, pp. 739-758.

Dalland, A. 1981. Mesozoic sedimentary succession at Andoly, northern Norway, and relation to structural development of the North Atlantic area. In Geology of the North Atlantic Borderlands. Edited by: J.Wm. Kerr and A.J. Fergusson. Canadian Society of Petroleum Geologists, Memoir 7, pp. 543-561.

Davies, W.E., Krinsley, D.B., and Nichol, A.H. 1963. Geology of the North Star Bugt area, northwest Greenland. Meddeleser om Gronland, Copenhagen, 162, n.12.

Dawes, P.R. 1976. Precambrian to Tertiary of northern Greenland. In Geology of Greenland. Edited by A.E. Escher, and W.S. Watt. Geological Survey of Greenland, pp. 248-303.

________1979. Field investigations in the Precambrian terrain of the Thule district, northwest Greenland. Report of Activities (1978). Gronlands Geologiske Undersogelse, rap. no. 95, pp. 14-22.

Dawes, P.R., and Kerr, J.W. ed. 1982. Nares Strait and drift of Greenland; a conflict in plate tectonics. Meddelelser Om Gronland, Copenhagen, Geoscience 8,.

Dawes, P.R., Rex, D.C., and Jepsen, H.F. 1973. K-Ar whole rock ages of dolerites from the Thule district, western North Greenland. Report of Activities, (1972). Gronlands Geologiske Undersogelse, rap. no. 55, p. 61-66.

Dewey, J.F. and Burke, K. 1974. Hot spots and continental break-up: implications for collisional orogeny. Geology, 2: 57-60.

Dixon, J. 1974. Revised stratigraphy of the Hunting Formation (Proterozoic), Somerset Island, Northwest Territories. Canadian Journal of Earth Sciences, 1: 635-642.

Dixon, O.A., Williams, S.K., and Dixon, J. 1971. The Aston Formation (?Proterozoic) on Prince of Wales Island, Arctic Canada. Canadian Journal of

Earth Sciences, 8: 732-742.

Dostal, J. Jackson, G.D. and Galley, A. 1989. Geochemistry of Neohelikian Nauyat plateau basalts, Borden Rift Basin, northwestern Baffin Island, Canada. Canadian Journal of Earth Sciences, 26: 2214-2223.

El Haddad, A., Aissaoui, D.M., and Soliman, M.A. 1984. Mixed carbonate-siliciclastic sedimentation on a Miocene fault-block, Gulf of Suez, Egypt. Sedimentary Geology, 37: 185-202.

Enachescu, M.E. 1987. Tectonic and structural framework of the northeast Newfoundland continental margin. In Sedimentary Basins and Basin-Forming Mechanisms. Edited by: C. Beaumont and A.J. Tankard. Canadian Society of Petroleum Geologists, Memoir 12, pp. 117-146.

Etheridge, M.A., Branson, J.C., and Stuart-Smith, P.G. 1987. The Bass, Gippsland and Otway Basins, southeast Australia: a branched rift system formed by continental extension. In Sedimentary Basins and Basin-Forming Mechanisms. Edited by: C. Beaumont and A.J. Tankard. Canadian Society of Petroleum Geologists, Memoir 12, pp. 147-162.

Evans, A.L. 1988. Neogene tectonic and stratigraphic events in the Gulf of Suez rift area, Egypt. Techonophysics, 153: 235-247.

________1990. Miocene sandstone provenance relations in the Gulf of Suez: insights into synrift unroofing and uplift history. AAPG Bulletin, 174: 1386-1400.

Fahrig, W.F. and Jones, D.L. 1969. Paleomagnetic evidence for the extent of the MacKenzie igneous events. Canadian Journal of Earth Sciences, 6: 679-688.

Fahrig, W.F. and Schwarz, E.J. 1973. Additional paleomagnetic data on the Baffin diabase dykes and a revised Franklin pole. Canadian Journal of Earth Sciences, 10: 576-581.

Fahrig, F.W., Christie, K.W., and Jones, D.L. 1981. Paleomagnetism of the Bylot Basins: Evidence for MacKenzie continental tensional tectonics. In Proterozoic Basins of Canada. Edited by F.H.A, Campbell. Geological Survey of Canada, Paper 81-10. Report 17.

Fahrig, F.W., Irving, E., and Jackson, G.D. 1971. Paleomagnetism of the Franklin Diabases. Canadian Journal of Earth Sciences, 8: 455-467.

Falvey, D.A. 1974. The development of continental margins in plate tectonic theory. Australian Petroleum Exploration Association Ltd. Journal, 14: 95-106.

Freund, R. and Merzer, A.M. 1976. The formation of rift valleys and their zigzag fault patterns. Geological Magazine, 113: 561-568.

Frisch, T.O. 1983. Reconnaissance geology of the Precambrian Shield of Ellesmere, Devon and Coburg Islands, Arctic Archipelago; a preliminary account. Geological Survey of Canada, Paper 82-10.

Frisch, T.O. and Christie, R.L. 1982. Stratigraphy of the Proterozoic Thule Group, southeastern Ellesmere Island, Arctic Archipelago. Geological Survey of Canada, Paper 81-19.

Frisch, T.O., Morgan, W.C., and Dunning, G.R. 1978. Reconnaissance geology of the Precambrian Shield on Ellesmere and Coburg Islands, Canadian Arctic Archipelago. In Current Research, part A. Geological Survey of Canada, Paper 78-1A, pp. 135-138.

Fuchtbauer, H. and Richter, D.K. 1983. Carbonate internal breccias: a source of mass flows at early geosynclinal platform margins in Greece. In The Shelf Break. Edited by D.J. Stanley and G.T. Moore. Society of Economic Paleontologists and Mineralogists, Special Publication 33, pp. 207-215.

Galley, A. 1978. The petrology and chemistry of the Nauyat Formation volcanics, Borden Peninsular, Northwestern Baffin Island. Unpublished B.Sc. Thesis, Carleton University, Ottawa.

Galley, A.G., Jackson, G.D., and Iannelli, T.R. 1983. Neohelikian subaerial basalts with ocean-floor type chemistry, northwestern Baffin Island [abst]. Geological Association of Canada, Programs and Abstracts, 8, p. 25.

Gawthorpe, R.L., Hurst, J.M. and Sladen, C.P. 1990. Evolution of Miocene Footwall-derived course-grained deltas, Gulf of Suez, Egypt: Implications for exploration. AAPG Bulletin 74: 1077-1086.

Geldsetzer, H. 1973a. Syngenetic dolomitization and sulfide mineralization. In Ores in Sediments. Edited by G.G. Amstutz and A.J. Bernard. Springer-Verlag, New York, pp. 115-127.

__________1973b. The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T. In Proceedings of the Symposium on the Geology of the Canadian Arctic. Edited by J.D. Aitken and D.J. Glass. Geological Association of Canada - Canadian Society of Petroleum Geologists, pp. 99-126.

Gjelberg, J.G. and Steel, R.J. 1981. An outline of Lower-Middle Carboniferous sedimentation on Svalbard: effects of tectonic, climatic and sea level changes in rift basin sequences. In Geology of the North Atlantic Borderlands. Edited by: J.Wm. Kerr and A.J. Fergusson. Canadian Society of Petroleum Geologists, Memoir 7, pp. 543-561.

Graf, C.W. 1974. A trace metal analysis across the Arctic Bay-Society Cliffs Formations contact, Borden Peninsula, Baffin Island, Northwest Territories. Unpublished B.Sc. Thesis, University of British Columbia, Vancouver.

Grantz, A. and May, S.D. 1982. Rifting history and structural development of the continental margin north of Alaska. In Studies in Continental Margin Geology. Edited by: J.S. Watkins and C.L. Drake. American Association of Petroleum Geologists, Memoir 34, pp. 77-100.

Grow, J.A. 1981. Structure of the atlantic margin of the United States. In Geology of Passive Continental Margins. American Association of Petroleum Geologists, Continuing Education Course Note Series 19, pp. 3-1 - 3-41.

Harding, T.P. 1984. Graben hydrocarbon occurrences and structural style. AAPG Bulletin, **68**: 333-362.

Harland, W.B. and Gayer, R.A. 1972. The Arctic Caledonides and earlier oceans. Geological Magazine, **109**: 289-314.

Haworth, R.T. and Keen, C.E. 1979. The Canadian Atlantic margin: a passive continental margin encompassing an active past. Tectonophysics, **59**: 83-126.

Henriksen, N. and Jepsen, H.F. 1970. K-Ar age determinations on dolomites from southern Peary Land. Report of Activities (1969). Gronlands Geologiske Undersogelse, rap. no. 28, pp. 55-58.

Hiscott, R.N., Wilson, R.C.L. Gradstein, F.M., Pujalte, V., Garcia-Mondejar, J., Boudreau, R.R, and Wishart, H.A. 1990. Comparative stratigraphy and subsidence history of Mesozoic rift basins of North Atlantic. AAPG Bulletin **74**: 60-76.

Hoffman, P.F. 1973. Evolution of an early Proterozoic continental margin: the Coronation geosyncline and associated aulocogens of the northwestern Canadian Shield. In Philosophical Transactions of the Royal Society of London, A, pp. 547-581.

__________1980. Wopmay Orogen: A Wilson Cycle of early Proterozoic age in the northwest of the Canadian Shield. In The Continental Crust and its Mineral Deposits. Edited by D.W.Strangway. Geological Association of Canada, Special Paper 20, pp. 523-549.

Hoffman, P., Dewey, J.F., and Burke, K. 1974. Aulacogens and their genetic relation to geosynclines, with a Proterozoic example from Great Slave Lake, Canada. In Modern and ancient geosynclinal sedimentation. Edited by R.H. Dott Jr. and R.H. Shaver. Society of Economic Paleontologists and Mineralogists, Special Publication no. 19, pp. 38-55.

Hofmann, H.J. and Jackson, G.D. 1991. Shelf-facies microfossils from the Uluksan Group (Proterozoic Bylot Supergroup), Baffin Island, Canada. Journal of Paleontology, **65**: 361-382.

Hubbard, R.J., Edrich, S.P. and Rattey, R.P. 1987. Geologic evolution and hydrocarbon habitat of the 'Arctic Alaska Microplate'. Marine and Petroleum Geologists, **4**: 2-34.

Hutchinson, D.R., Grow, J.A., Klitgord, K.D. and Swift, B.A. 1982. Deep structure and evolution of the Carolina trough. In Studies in Continental Margin Geology. Edited by: J.S. Watkin and C.L. Drake. American Association of Petroleum Geologists, Memoir 34, pp. 129-152.

Iannelli, T.R. 1979. Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin. In Current Research, part A. Geological Survey of Canada, Paper 79-1A, pp. 45-56.

__________1982. Regional and economic geology of the Late Proterozoic Borden Basin, northern Baffin Island. Confidential Report, Petro-Canada Minerals Division.

__________1984. Preliminary outline for a regional exploration program in the Borden Basin, northern Baffin Island, Arctic Canada. Confidential Report, Strathcona Minerals Services Ltd.

Illies, J.H. 1981. Mechanism of Graben formation. Tectonophysics, **73**: 249-266.

Illies, J.H. and Baumann, H. 1982. Crustal dynamics and morphodynamics of the Western European Rift System. Z. Geomorph, N.F., Suppl., **42**: 135-165.

Jackson, G.D. 1969. Reconnaissance of north-central Baffin Island (27-C, 37C-H, 38A-C, parts of 48A). Geological Survey of Canada, Paper 69-1, part A, pp. 171-176.

__________1974. Interpretation of whole-rock K-Ar ages for some related samples from west Arctic Bay. In Age determinations and geological studies, K-Ar isotopic ages: Report 12. Edited by R.K. Wanless, R.D. Stevens, G.R. Lachance, and R.N.D. Delabio. Geological Survey of Canada, Paper 74-2, pp. 24-25.

__________1986. Notes on the Proterozoic Thule Group, northern Baffin Bay. In Current research, part A. Geological Survey of Canada, Paper 86-1A, pp. 541-552.

Jackson, G.D. and Cumming, L.M. 1981. Evaporites and folding in the Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin. In Current Research. Geological Survey of Canada, Paper 81-C, pp. 35-44.

Jackson, G.D. and Davidson, A. 1975. Bylot Island map-area, District of Franklin. Geological Survey of Canada, Paper 74-29.

Jackson, G.D. and Iannelli, T.R. 1981. Rift-related cyclic sedimentation in the Neohelikian Borden Basin, Northern Baffin Island. In Proterozoic Basins of Canada. Edited by F.H.A. Campbell. Geological Survey of Canada, Paper 81-10, pp. 269-302.

Jackson, G.D., and Iannelli, T.R. 1984. Borden Basin, N.W. Baffin Island: Mid-Proterozoic rifting and possible ocean opening. Geological Association of Canada, Programs with Abstracts, 9, p.76.

__________________________1989. Neohelikian reef complexes, Borden Rift Basin, northwestern Baffin Island. In Reefs, Canada and Adjacent Area. Edited by H.H.J.Geldsetzer, N.P. James, and G.E. Tebbutt. Canadian Society Petroleum Geologists, Memoir 13, pp. 55-63.

Jackson, G.D. and Morgan, W.C. 1978. Precambrian metamorphism on Baffin and Bylot Islands. In Metamorphism in the Canadian Shield. Edited by J.A. Fraser and W.W. Heywood. Geological Survey of Canada, Paper 78-10, pp. 249-267.

Jackson, G.D. and Sangster, D.F. 1987. Geology and resource potential of a proposed national park, Bylot Island and northwest Baffin Island, Northwest Territories. Geological Survey of Canada, Paper 87-17. (Map 1-1987 included).

Jackson, G.D. and Taylor, F.C. 1972. Correlation of major Aphebian rock units in the northeastern Canadian Shield. Canadian Journal of Earth Sciences, 9: 1650-1669.

Jackson, G.D., Davidson, A., and Morgan, W.C. 1975. Geology of the Pond Inlet map-area, Baffin Island, District of Franklin. Geological Survey of Canada, Paper 74-25.

Jackson, G.D., Morgan, W.C. and Davidson, A. 1978. Geology Buchan Gulf-Scott Inlet, District of Franklin. Geological Survey of Canada, Map 1449A, coloured, scale 1 : 250 000.

Jackson, G.D., Hunt, P.A., Loveridge, W.D., and Parrish, R.R. 1990. Reconnaissance geochronology of Baffin Island, N.W.T. In Radiogenic Age and Isotopic Studies: Report 3. Geological Survey of Canada, Paper 89-2, pp. 123-148.

Jackson, G.D., Iannelli, T.R., Knight, R.D., and Lebel, D. 1985. Neohelikian Bylot Supergroup of the Borden Rift Basin, northwestern Baffin Island, District of Franklin. In Current Research. Geological Survey of Canada, Paper 85-1A, pp. 639-649.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J. 1978a. Upper Proterozoic sedimentary and volcanic rocks of northeastern Baffin Island. Geological Survey of Canada. Paper 78-14.

Jackson, G.D., Iannelli, T.R., and Tilley, B.J. 1980. Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin. In Current Research, part A. Geological Survey of Canada, Paper 80-1A, pp. 319-328.

Jackson, G.D., Morgan, W.C., and Davidson, A. 1978b. Geology Icebound Lake, District of Franklin. Geological Survey of Canada, Map 1451A, coloured, scale 1 : 250 000.

Jansa, L.F. and Wade, J.A. 1975. Geology of the continental margin off Nova Scotia and Newfoundland. Edited by W.J.M. Van Der Linden and J.A.Wade. Geological Survey of Canada, Paper 74-30, vol. 2, pp. 51-105.

Jepsen, H.F. and Kalsbeek, F. 1979. Igneous rocks in the Proterozoic platform of eastern north Greenland. In Report on the 1978 geological expedition to the Peary Land region, north Greenland. Gronlands Geologiske Undersogelse, rap. no. 88, pp. 11-14.

Jones, B. and Dixon, O.A. 1977. Stratigraphy and sedimentology of Upper Silurian rocks, northern Somerset Island, Arctic Canada. Canadian Journal of Earth Sciences, 14: 1427-1452.

Jones, D.L. and Fahrig, W.F. 1978. Paleomagnetism and age of the Aston dykes and Savage point sills of the Boothia Uplift, Canada. Canadian Journal of Earth Sciences, 15: 1605-1612.

Kerr, J.W. 1977a. Cornwallis Fold Belt and the mechanism of basement uplift. Canadian Journal of Earth Sciences, 14: 1374-1401.

Kerr, J.W. 1977b. Cornwallis Lead-Zinc District; Mississippi Valley-type deposits controlled by stratigraphy and tectonics. Canadian Journal of Earth Sciences, 14: 1402-1426.

_______1979. Evolution of the Canadian Arctic islands - a transition between the Atlantic and Arctic Oceans. Geological Survey of Canada, Open File Report 618.

_______1980. Structural framework of Lancaster Aulacogen, Arctic Canada. Geological Survey of Canada Bulletin, **319**.

Kerr, J.W. and deVries, C.D.S. 1976. Structural geology of Somerset Island, District of Franklin. In Report of Activities, part A. Geological Survey of Canada, Paper 76-1A, pp. 493-495.

_________________1977. Structural geology of Somerset Island and Boothia Peninsula. In Report of Activities, part A, Geological Survey of Canada, Paper 77-1A, pp. 107-111.

Kinsman, D.J.J. 1975. Rift Valley basins and sedimentary history of trailing continental margins. In Petroleum and Global Tectonics. Edited by A.G. Fischer and S. Judson. Princeton University Press, Princeton, N.J., pp. 83-126.

Knight, R.D. 1988. Sedimentology and stratigraphy of part of the Neolhelikian Elwin Formation, uppermost Bylot supergroup, Borden Rift Basin, northern Baffin Island. Unpublished MSc. thesis. Carleton University, Ottawa.

Lambeck, K. Cloteting, S. and McQueen, H. 1987. Intraplate stresses and apparent changes in sea level: the basins of northwestern Europe. In Sedimentary Basins and Basin-Forming Mechanisms. Edited by: C. Beaumont and A.J. Tankard. Canadian Society of Petroleum Geologists, Memoir 12, pp. 259-268.

Larsen, V. and Steel, R.J. 1978. The sedimentary history of a debris-flow dominated, Devonian alluvial fan - a study of textual inversion. Sedimentology, **25**: 37-59.

LeCheminant, A.N. and Heaman, L.M. 1989. Mackenzie Igneous events, Canada: Middle Proterozoic hotspot magnetism associated with ocean opening. Earth and Planetary Science Letters, **96**: 38-48.

Lemon, R.R.H. and Blackadar, R.B. 1963. Admiralty Inlet area, Baffin Island, District of Franklin. Geological Survey of Canada, Memoir 328.

LePichon, X., Angelier, J. and Sibuet, J.C. 1982. Plate boundaries and extensional tectonics. Tectonophysics, **81**: 239-256.

LePichon, X., and Cochran, J.R. 1988. Conclusions of the International Workshop on the Gulf of Suez and Red Sea Rifting, Hurghada, Egypt, 1986. In The Gulf of Suez and Red Sea Rifting. Tectonophysics, **153**: ix-xi.

LePichon, X., Angelier, J. and Sibuet, J.C. 1982b. Subsidence and stretching. In Studies in Continental Margin Geology. American Association of Petroleum Geologists, Memoir 34, pp. 731-741.

LePichon, X., Sibuet, J.C., and Francheteau, J. 1977. The fit of the continents around the North Atlantic Ocean. Tectonophysics, 38: 169-209.

McKenzie, D. 1978. Some remarks on the development of sedimentary basins. Earth and Planetary Science Letters, 40: 25-32.

McWhae, J.R.H. 1981. Structure and spreading history of the northwestern Atlantic Region from the Scotian Shelf to Baffin Bay. In Geology of the North Atlantic Borderlands. Edited by J.Wm. Kerr and A.J. Fergusson. Canadian Society of Petroleum Geologists, Memoir 7, pp. 299-332.

Marcussen, C. and Abrahamsen, N. 1983. Paleomagnetism of the Proterozoic Zig-Zig Dal basalt and the Midsommers dolerites, eastern north Greenland. Geophysical Journal of the Royal Astronomical Society, 73: 367-387.

Masson, D.G., and Miles, P.R. 1986a. Development and hydrocarbon potential of Mesozoic sedimentary basins around margins of the North Atlantic. AAPG Bulletin, 70: 721-729.

Masson, D.G., and Miles, P.R. 1986b. Structure and development of Porcupine Seabright Sedimentary Basin, offshore southwest Ireland. AAPG Bulletin, 70: 536-548.

Miall, A.D. and Kerr, J.W. 1977. Phanerozoic stratigraphy and sedimentology of Somerset Island and northeastern Boothia Peninsula. In Report of Activities, part A. Geological Survey of Canada, Paper 77-1A, pp. 99-106.

Miall, A.D., Balkwill, H.R., and Hopkins Jr., W.S. 1980. Cretaceous and Tertiary sediments of the Eclipse Trough, Bylot Island area, Arctic Canada, and their regional setting. Geological Survey of Canada, Paper 79-23.

Mohr, O. 1987. Patterns of faulting in the Ethiopian rift valley. In Continental Rifts - Principle and Regional Characteristics. Edited by: I.B. Ramberg, E.E. Milanovsky, and G. Quale. Tectonophysics, 143: 169-179.

Moore Jr., J.M., and Davidson, A. 1978. Rift structure in southern Ethiopia. Tectonophysics, 46: 159-173.

Morley, C.K., Nelson, R.A., Patton, T.L., Munn, S.G. 1990. Transfer zones in the East African Rift system and their relevance to hydrocarbon exploration in rifts. AAPG Bulletin, 78: 1234-1253.

Muehlberger, W.R. 1980. The shape of North America during the Pre-Cambrian. In Studies in Geophysics: Continental Tectonics. National Research Council, Geophysics Study Committee, no. 15, pp. 175-183.

Neugebauer, H.J. 1976. Crustal doming and the mechanism of rifting. Part 1: Rift formation. Tectonophysics, **45**: 159-186.

__________1983. Mechanical aspects of continental rifting. Tectonophysics, **94**: 91-108.

Neugebauer, H.J. and Temme, P. 1981. Crustal uplift and the propagation of failure zones. Tectonophysics, **45**: 33-51.

Olson, R.A. 1977. Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T. Unpublished PhD. thesis, University of British Columbia, Vancouver.

________1984. Genesis of paleokarst and strata-bound zinc-lead sulfide deposits in a Proterozoic dolostone, northern Baffin island, Canada. Economic Geology, **9**: 1059-1103.

Pigram, C.J. and Panggabean, H. 1984. Rifting of the northern margin of the Australian continent and the origin of some microcontinents in Eastern Indonesia. Tectonophysics, **107**: 331-353.

Rankin, D.W. 1976. Appalachian salients and recesses: Late Precambrian continental breakup and the opening of the Iapetus Ocean. Journal of Geophysical Research, **81**: 5605-5619.

Reinson, G.E., Kerr, J.W., and Stewart, W.D. 1976. Stratigraphic field studies, Somerset Island, District of Franklin (58B to F). In Report of Activities, part A. Geological Survey of Canada, Paper 76-1A, pp. 497-499.

Robertson, W.A. 1969. Magnetization directions in the Muskox intrusions and associated dykes and lavas. Geological Survey of Canada, Bulletin, 167.

Robertson, W.A. and Baragar, W.R.A. 1972. The petrology and paleomagnetism of the Coronation sills. Canadian Journal of Earth Sciences, **9**: 123-140.

Rosendahl, B.R. 1987. Architecture of continental rifts with special reference to East Africa. Annual Review of Earth and Planetary Sciences, **15**: 445-503.

Rosendahl, B.R.,Reynolds, D.J., Lorber, P.M., Burgess, C.F. McGill, J., Scott, D., Lambiase, J.J. and Derksen, S.J. 1986. Structural expressions of rifting lessons from Lake Tanganyika, Africa. In Sedimentation in the African Rifts. Edited by L.E. Frostick, R.W.Renault, I. Reid and J.J. Tiercelin. Geological

Society, Special Publication, no. 25, pp. 29-43.

Sanders, J.E. 1963. Late Triassic tectonic history of northeastern United States. American Journal of Science, **261**: 501-524.

Sangster, D.F. 1981. Three potential sites for the occurrence of stratiform shale-hosted lead-zinc deposits in the Canadian Arctic. In Current Research, part A. Geological Survey of Canada, Paper 81-1A, pp. 1-8.

Schopf, J.W., Zhu, W-Q., Zu, Z.L. and Hsu, J. 1984. Proterozoic stromatolitic microbiotas of the 1400-1500 Ma-old Gaoyuzhuang Formation near Jixian, northern China. Precambrian Research, **24**: 335-349.

Scott, D.L. and Rosendahl, B.R. 1989. North Viking graben: an East African perspective. AAPG Bulletin, **73**: 155-165.

Sengor, A.M.C., Burke, K., and Dewey, J. 1978. Rifts at high angles to orogenic belts: tests for their origin and the upper Rhine Graben as an example. American Journal of Science, **278**: 24-40.

Sinclair, I.K. 1988. Evolution of Mesozoic-Cenozoic sedimentary basins in the Grand Banks area of Newfoundland and comparison with Falvey's (1974) rift model. Bulletin of Canadian Petroleum Geology, **36**: 255-273.

Steel, R.J. 1976. Devonian basins of western Norway - sedimentary response to tectonism and to varying tectonic context. In Sedimentary Basins of Continental Margins and Cratons. Tectonophysics, **36**: 207-224.

Steel, R.J., Dalland, A., Kalgraff, K., and Larsen, V. 1981. The Central tertiary Basin of Spitsbergen: sedimentary development of a sheared-margin basin. In Geology of the North Atlantic Borderlands. Edited by: J.Wm. Kerr and A.J. Fergusson. Canadian Society of Petroleum Geologists, Memoir 7, pp.647-664.

Steel, R.J., Maehle, S., Nilsen, H., Roe, S.L. and Spinnanger, A. 1977. Coarsening-upward cycles in the alluvium of Hornelen Basin (Devonian) Norway: sedimentary response to tectonic events. Geological Society of America Bulletin, **88**: 124-1134.

Surlyk, Finn 1978. Submarine fan sedimentation along fault scarps on titled fault blocks (Jurassic-Cretaceous boundary, East Greenland). Gronlands Geologiske Undersolgelse Bulletin, **128**.

Surlyk, F., Clemmensen, L.B. and Larsen, H.C. 1981. Post-Paleozoic evolution of the East Greenland continental margin. In Geology of the North Atlantic borderlands. Edited by: J.Wm. Kerr and A.J. Fergusson. Canadian Society of Petroleum Geologists, Memoir 7, pp. 611-645.

Tankard, A.J. and Welsink, H.J. 1987. Extensional tectonics and stratigraphy of the Hibernia Oil Field, Grand Banks, Newfoundland. AAPG Bulletin, 71: 1210-1232.

Thorsteinsson, R. and Mayr, U. 1987. The sedimentary rocks of Devon Island, Canadian Arctic Archipelago. Geological Survey of Canada, Memoir 411.

Thorsteinsson, R. and Tozer, E.T. 1962. Banks, Victoria, and Stefansson Islands, Arctic Archipelago. Geological Survey of Canada. Memoir 330.

Trettin, H.P. 1969. Lower Paleozoic sediments of northwestern Baffin Island, District of Franklin. Geological Survey of Canada, Bulletin, 157.

_________.1975. Investigation of lower Paleozoic geology, Foxe Basin, northeastern Melville Peninsula, and parts of northwestern and central Baffin Island. Geological Survey of Canada, Bulletin, 251.

_________.1987. Pearya: a composite terrane with Caledonian affinities in northern Ellesmere Island. Canadian Journal of Earth Sciences, 24: 224-245.

Trettin, H.P. and Balkwill, H.R. 1979. Contributions to the tectonic history of the Innuitian Province, Arctic Canada. Canadian Journal Earth Sciences, 16: 748-769.

Trettin, H.P., Frisch, T.O., Sobczak, L.W., Weber, J.R., Niblett, E.R., Law, L.K., DeLaurier, I., and Whitham, K. 1972. The Innuitian Province. In Variations in Tectonic Styles in Canada. Edited by R.A. Price and R.J.W. Douglas. Geological Association of Canada, Special Paper no. 11, pp. 83-181.

Tuke, M.F., Dineley, D.L., Rust, B.R. 1966. The basal sedimentary rocks in Somerset Island, N.W.T. Canadian Journal of Earth Science, 3: 697-711.

Turcotte, D.L. 1980. Models for the evolution of sedimentary basins. In Dynamics of Plate Interiors. Geodynamics Series, vol. 1. Edited by A.W. Bally,P.L. Bender, T.R. McGetchin and I. Walcott. American Geophysical Union and the Geological Society of America, pp. 21-26.

__________1983. Mechanisms of crustal deformation. Journal of the Geological Society of London, 140: 701-724.

Turcotte, D.L. and Angevine, C.L. 1982. Thermal mechanisms of basin formation. In The Evolution of Sedimentary Basins. Edited by P. Kent, M.H.P. Bott, D.P. MacKenzie and C.A. Williams. Philosophical Transactions of the Royal Society of London, A305, pp. 283-294.

Turcotte, D.L. and Emermann, S.H. 1983. Mechanisms of active and passive rifting. Tectonophysics, 94: 39-50.

Veevers, J.J. 1981. Morphotectonics of rifted continental margins in embryo (East Africa), youth (Africa-Arabia), and maturity (Australia). Journal of Geology, 89: 57-82.

Vidal, G. and Dawes, P.R. 1980. Acritarchs from the Proterozoic Thule Group, northwest Greenland. Report of Activities (1979). Gronlands Geologiske Undersogelse, rap. no. 100, pp. 24-29.

Wanless, R.K. 1970. Isotopic age map of Canada. Geological Survey of Canada, Map 1256A, scale 1 : 5 000 000.

Watts, A.B. 1981. The U.S. Atlantic continental margin: subsidence history, crustal structure and thermal evolution. In Geology of Passive Continental Margins. American Association of Petroleum Geologists, Continuing Education Course Note Series 19, pp. 2-1 - 2-75.

Young, G.M. 1974. Stratigraphy, paleocurrents, and stromalolites of Hadrynian (Upper Precambrian) rocks of Victoria Island, Arctic Archipelago, Canada. Precambrian Research, 1: 13-41.

________1979. Correlation of middle and upper Proterozoic strata of the northern rim of the North Atlantic craton. Transactions of the Royal Society of Edinburgh, 76: 323-336.

Zeigler, P.A. and Louwrens, C.J. 1979. Tectonics of the North Sea. In The Quaternary History of the North Sea. Edited by E. Oele, R.T.E. Schuttenhelm and A.J. Wiggers. Acta Universitatis Upsala Symposia, Upsala Annum Quingentesium Celebrantis. v. 2, pp. 7-22.

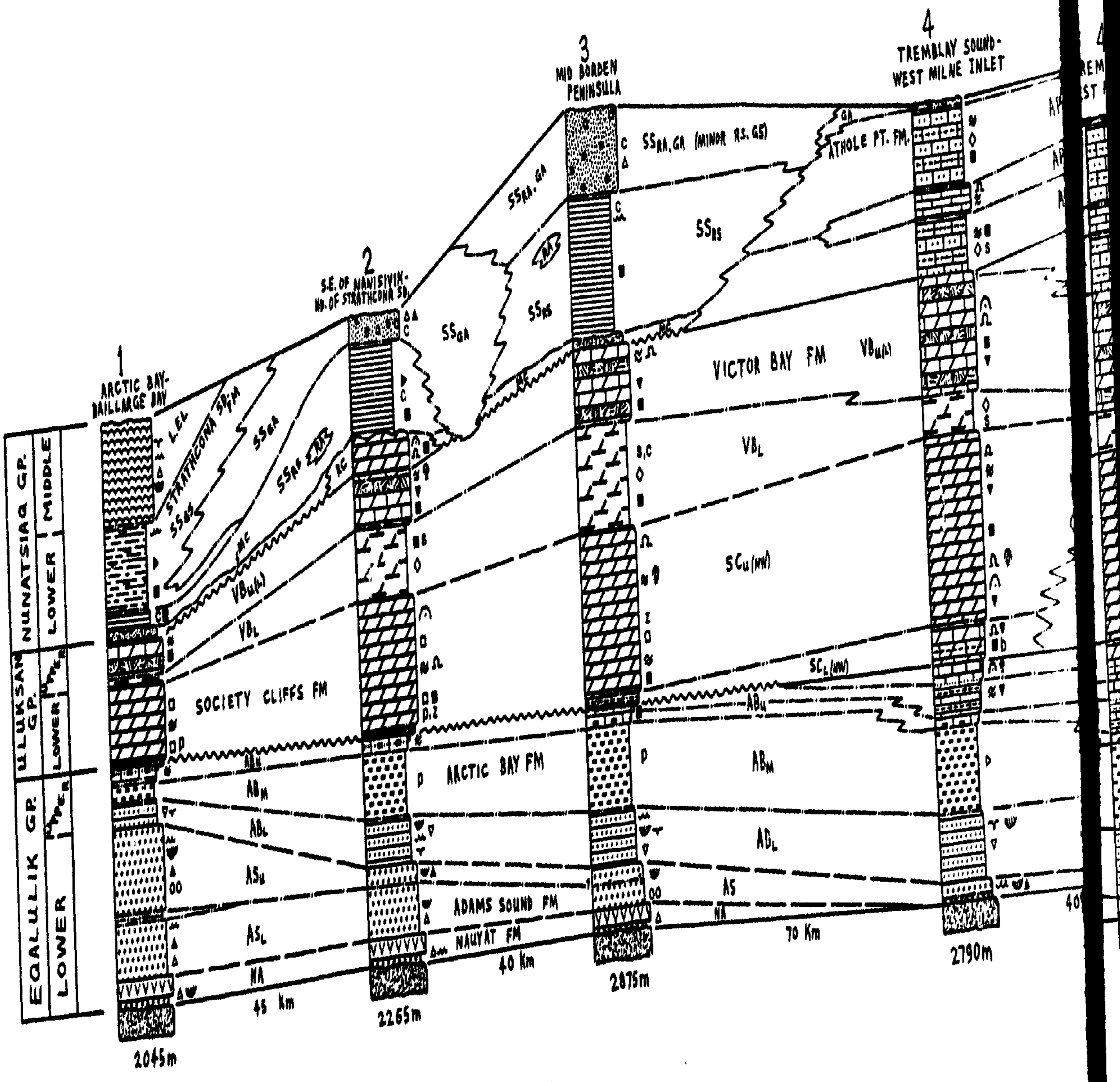
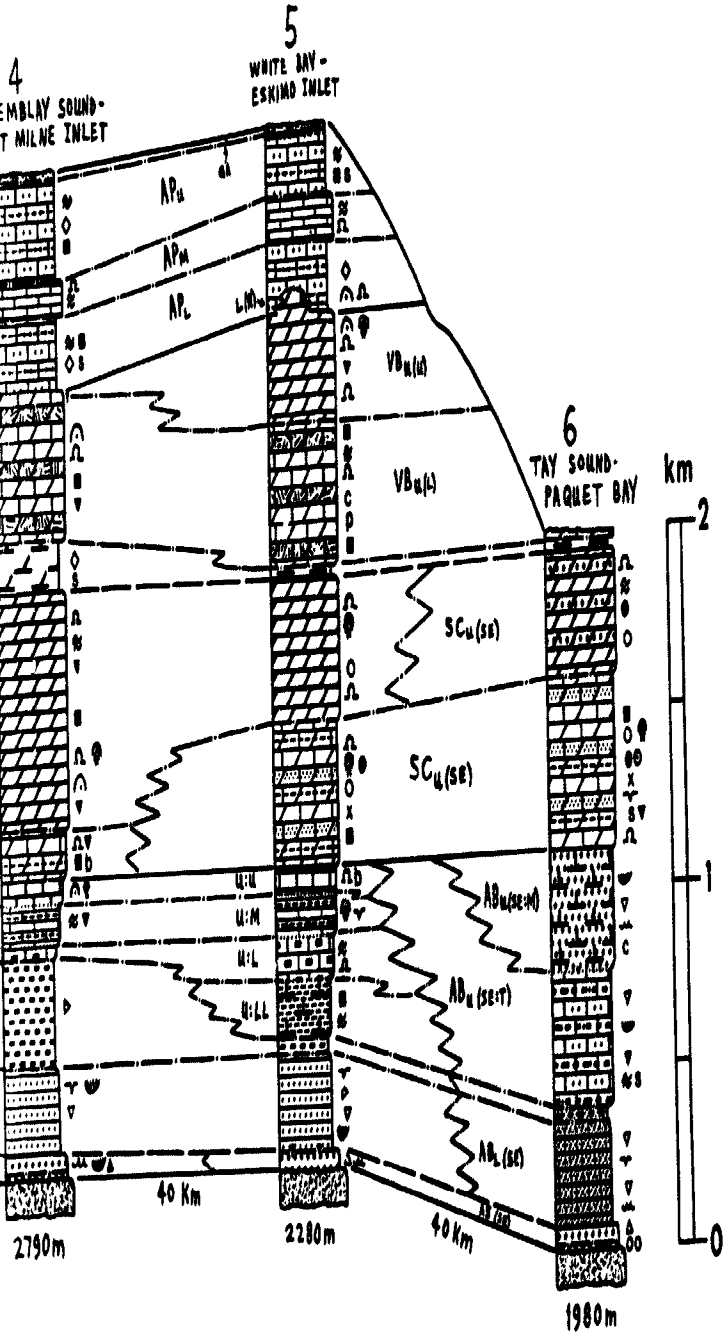


Fig. 2.2: Axial (NW - SE) cross-section, Milne Inlet Trough.


4
EMBLAY SOUND-
T MILNE INLET
5
WHITE BAY-
ESKIMO INLET
6
TAY SOUND-
PAQUET BAY
km
2
1
0
APu
APM
APL
L(M)
VBu(u)
VBu(L)
SCu(SE)
SCu(SE)
U:U
U:M
U:L
U:LL
ABu(SE:M)
ABu(SE:T)
ABL(SE)
40 Km
40 Km
2790m
2280m
1980m

2045m

Fig. 2.2: Axial (NW - SE) cross-section, Milne Inlet Trough.

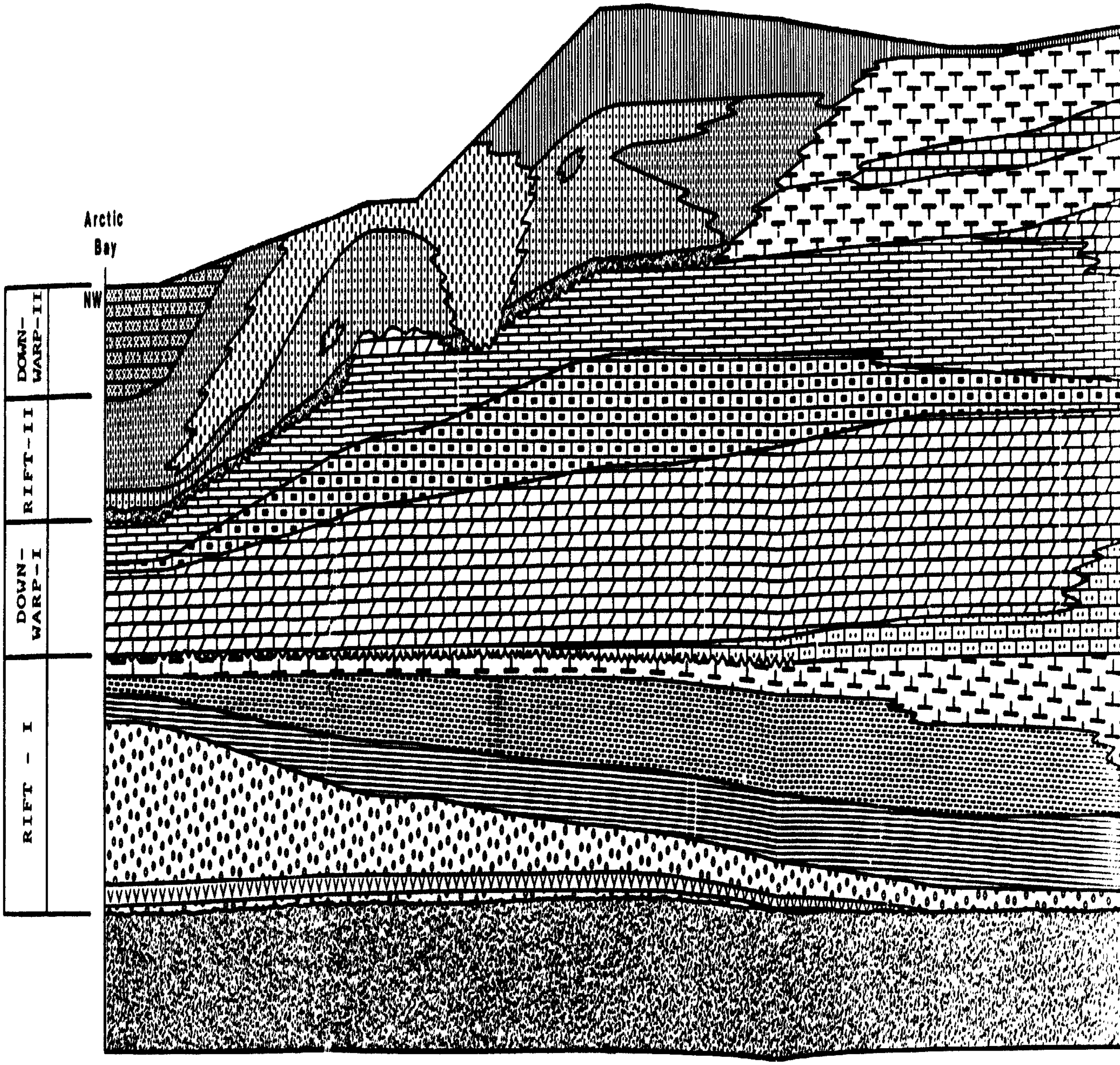
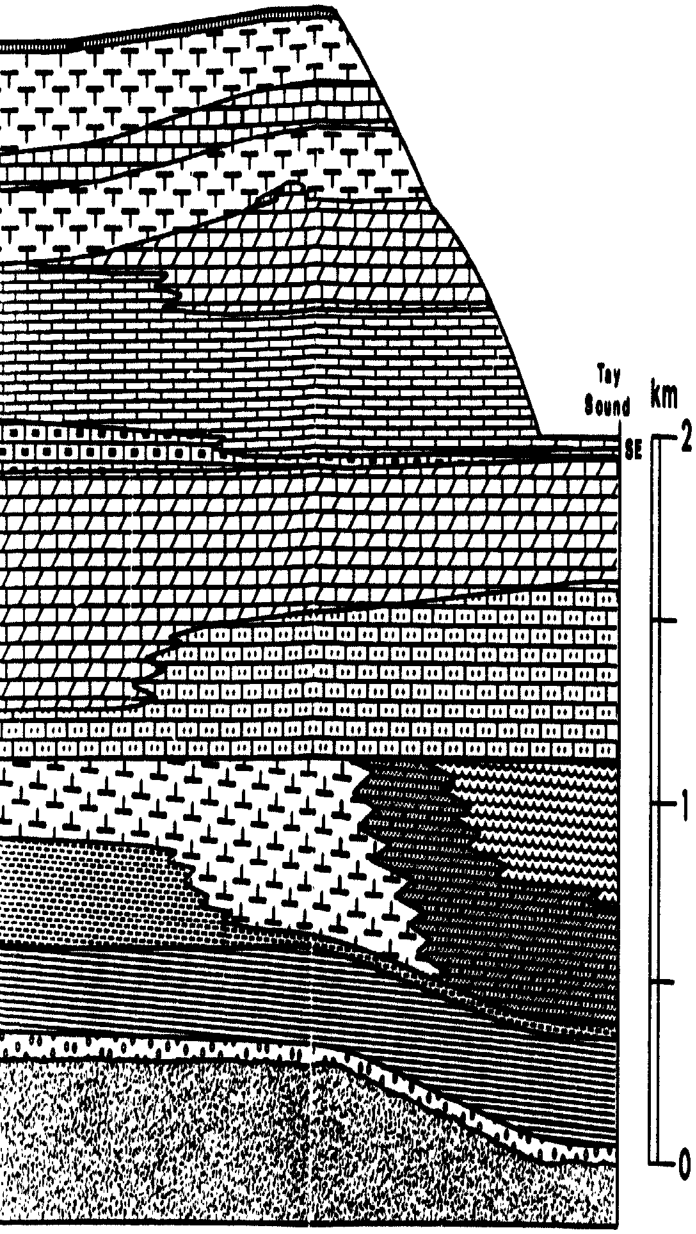


Fig. 4.1: Summary of depositional environments along the axis of Milne Inlet Trough.



FIGS. 2.2 AND 4.1

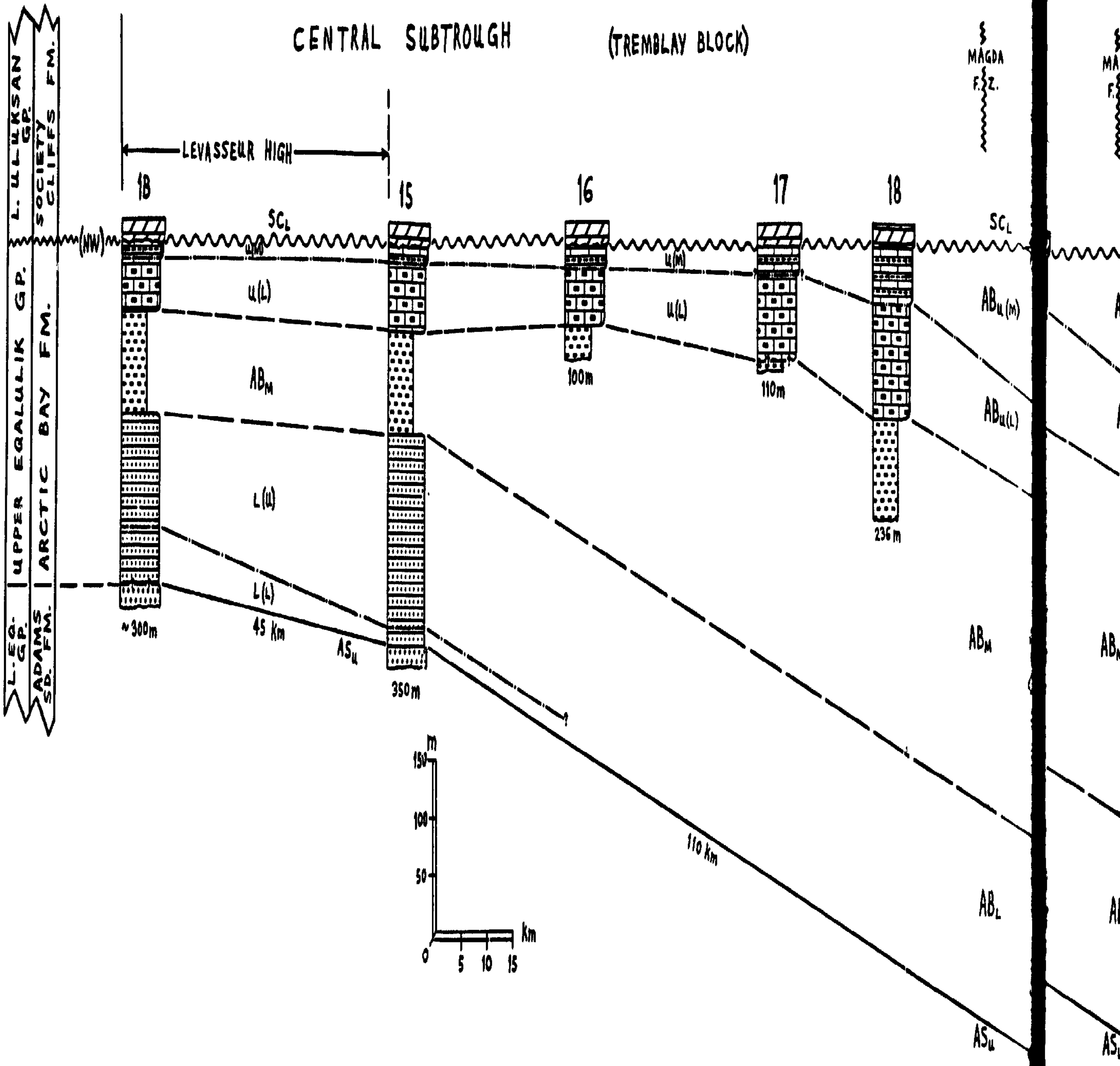
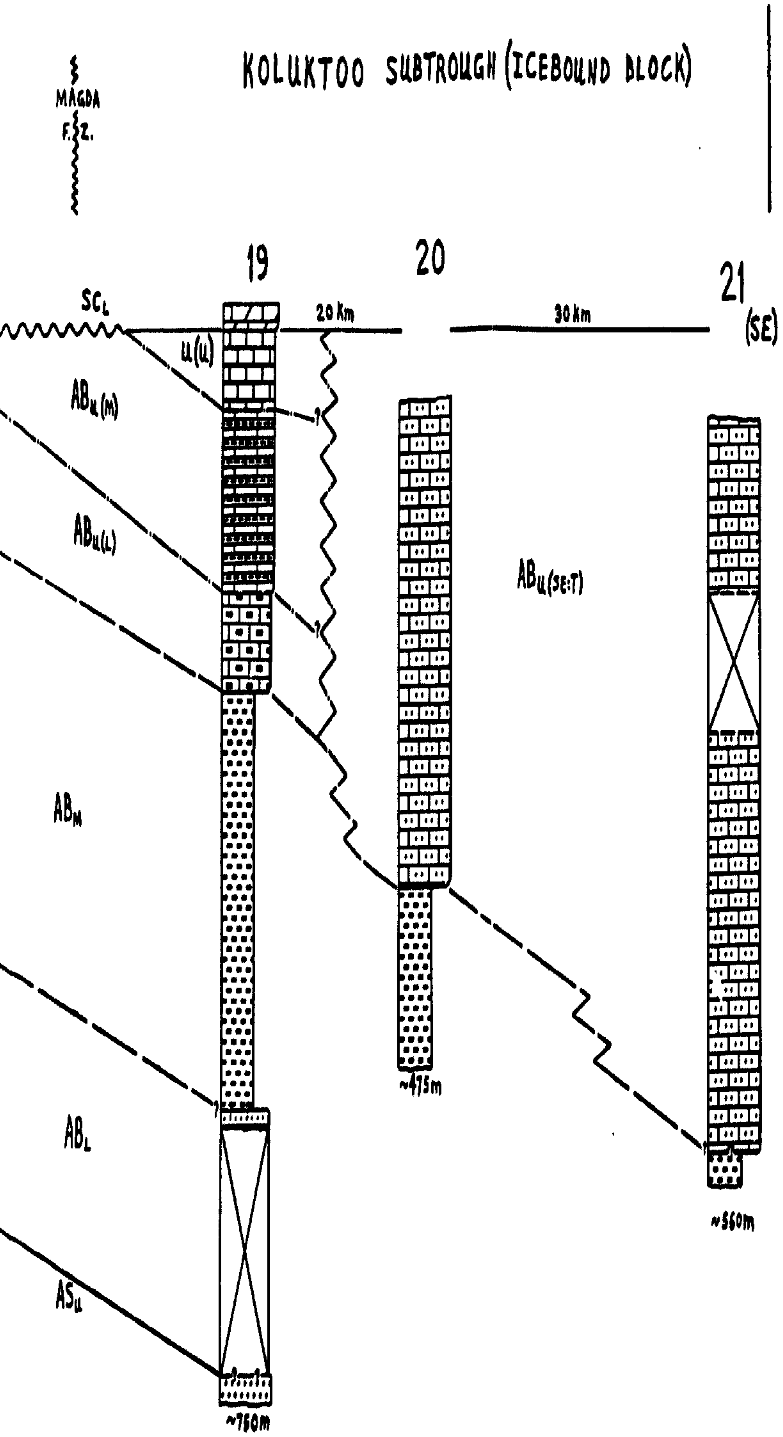


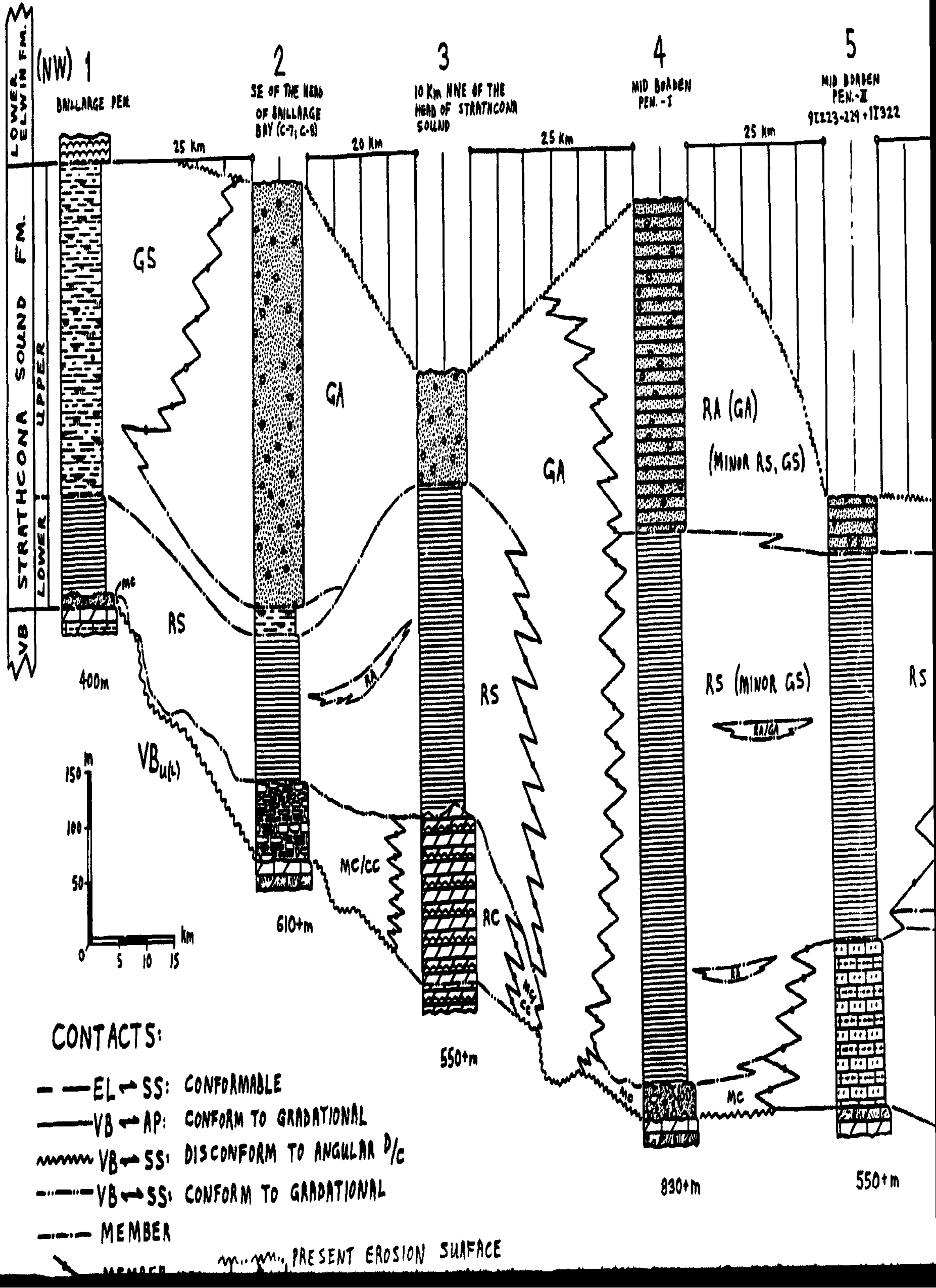
FIG. 3.10b: NW-SE (AXIAL-II) CROSS-SECTION, MILNE INLET TROUGH (ADAMS SD. SE TO THE TUGA O THE T



THE TUGAAT R. VALLEY).

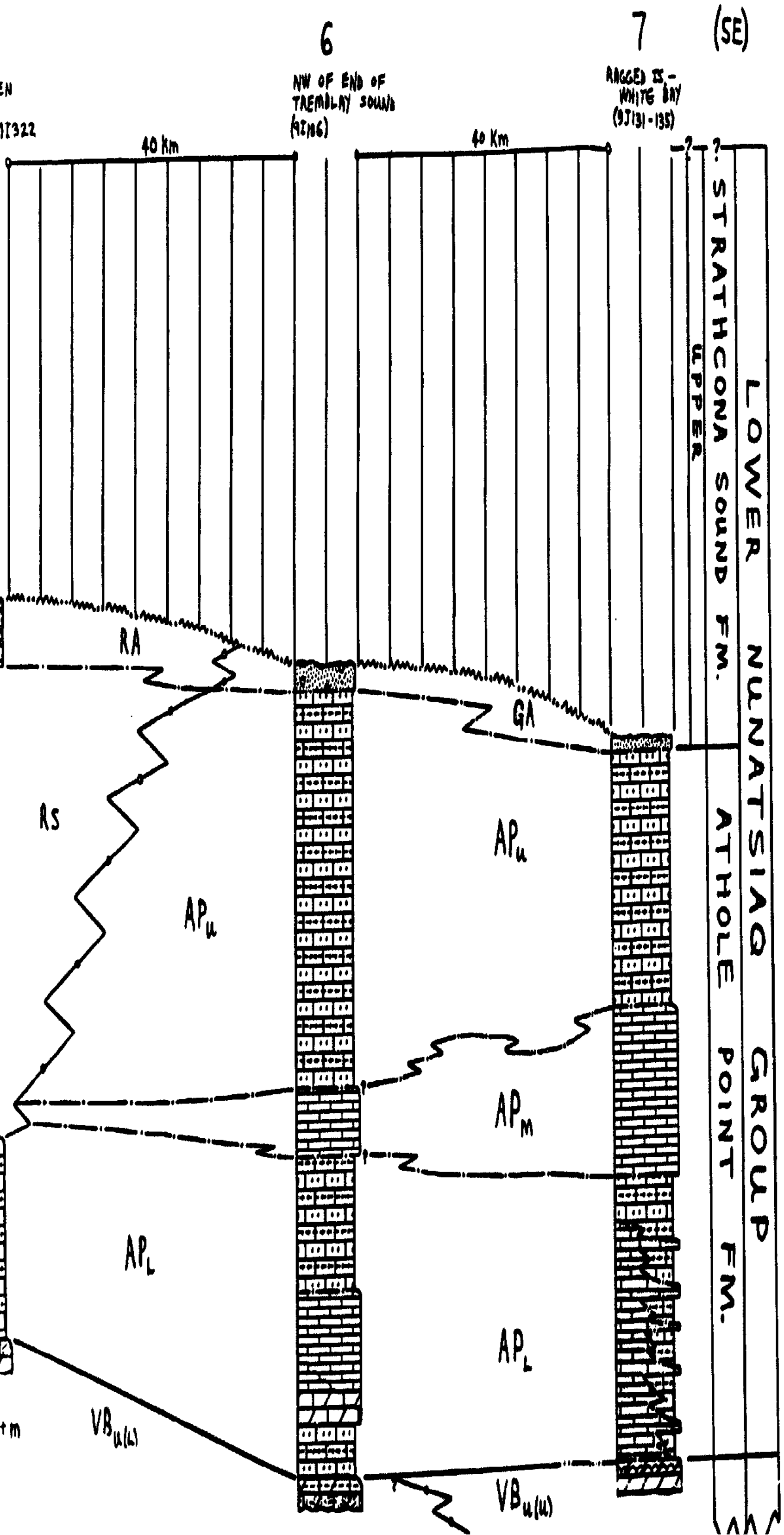
TAY - RAQUET SUBTROUGH (MILNE BLO MILNE

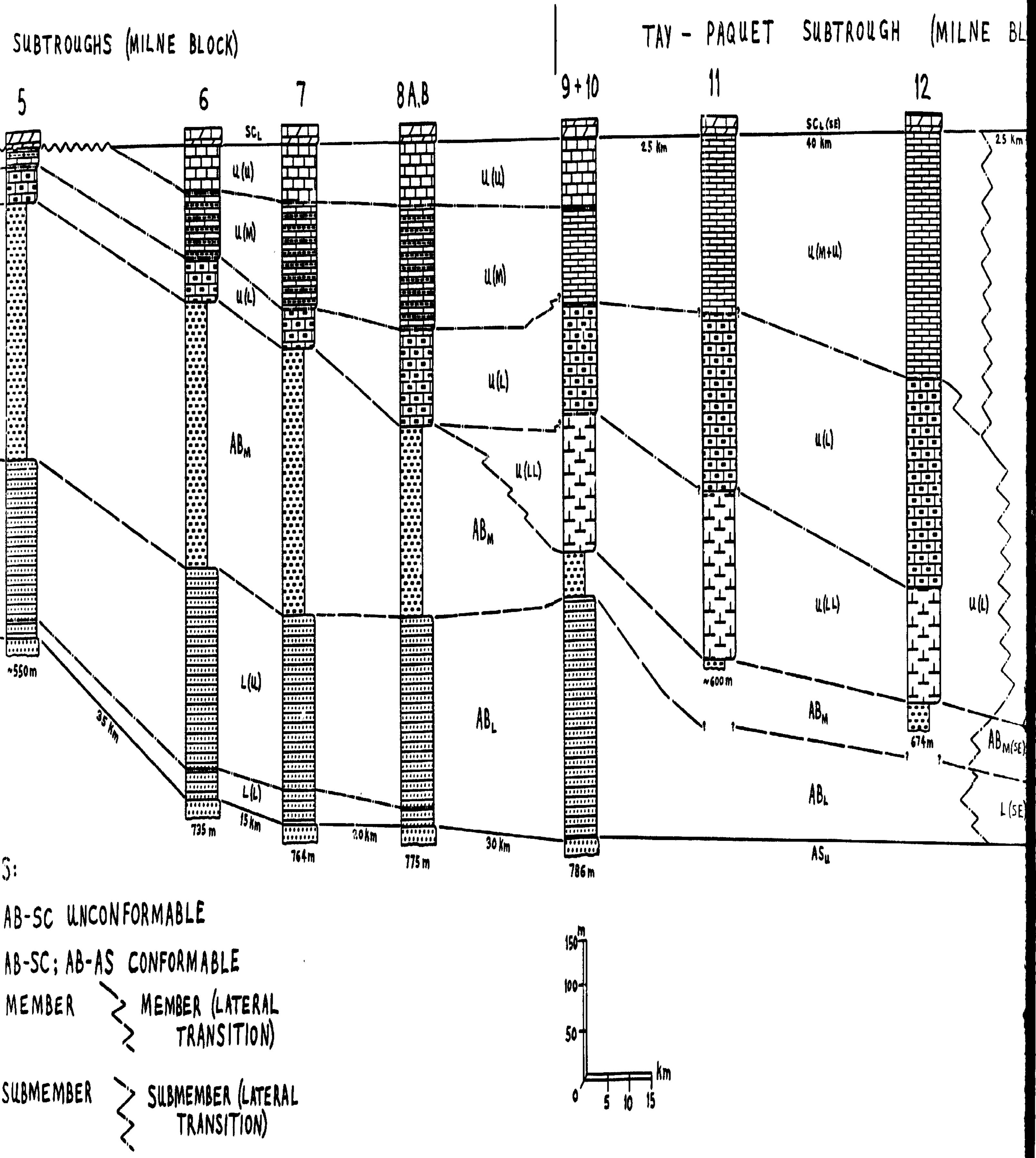
FIG. 3.19a:
LOWER NUNATSIAQ GROUP: AXIAL (NW→SE) CROSS-SECTION, MILNE INLET



LET TROUGH.

FIGS. 3.13a, 3.16a AND 3.19a




SUBTROUGHS (MILNE BLOCK)
TAY - PAQUET SUBTROUGH (MILNE BL
5
6
7
8A,B
9+10
11
12
SCL
SCL(SE)
2.5 Km
40 Km
2.5 Km
u(u)
u(M)
u(L)
u(LL)
u(M+u)
ABM
ABL
L(u)
L(L)
ABM(SE)
L(SE)
ASu
~550m
735 m
764m
775m
786m
~600m
674m
35 Km
15 Km
20 Km
30 Km
S:
AB-SC UNCONFORMABLE
AB-SC; AB-AS CONFORMABLE
MEMBER
MEMBER (LATERAL TRANSITION)
SUBMEMBER
SUBMEMBER (LATERAL TRANSITION)
m
150
100
50
0
5
10
15
km

ILNE BLOCK)

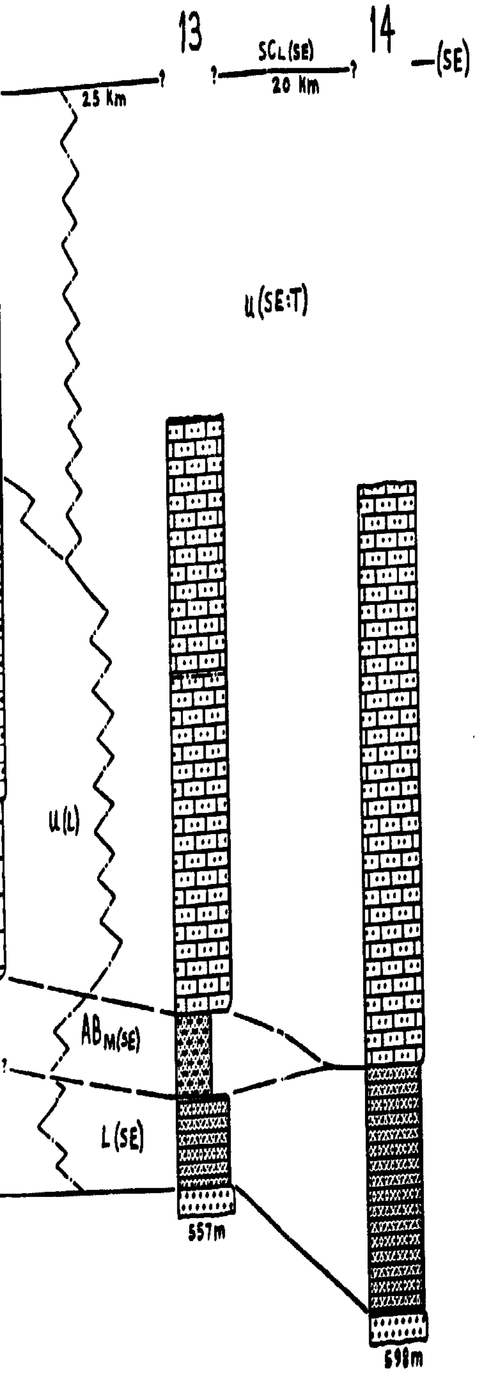
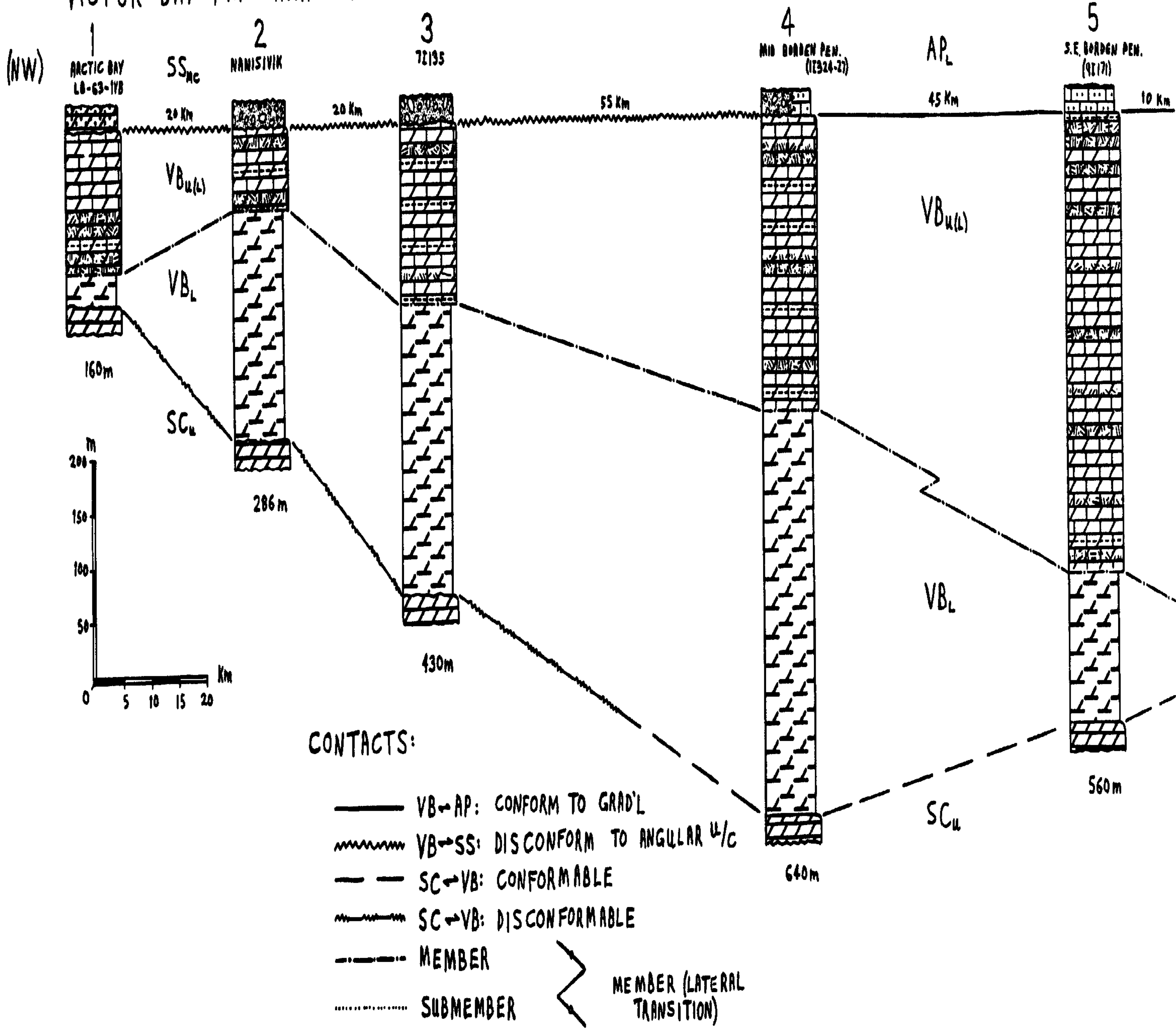
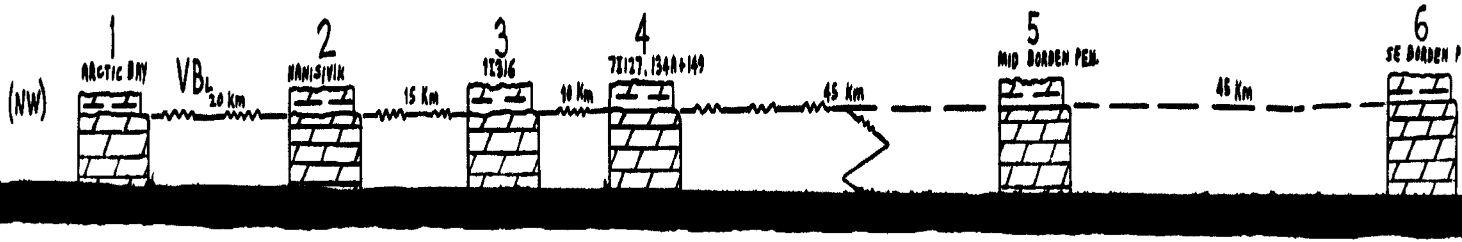
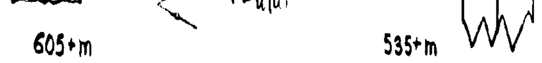
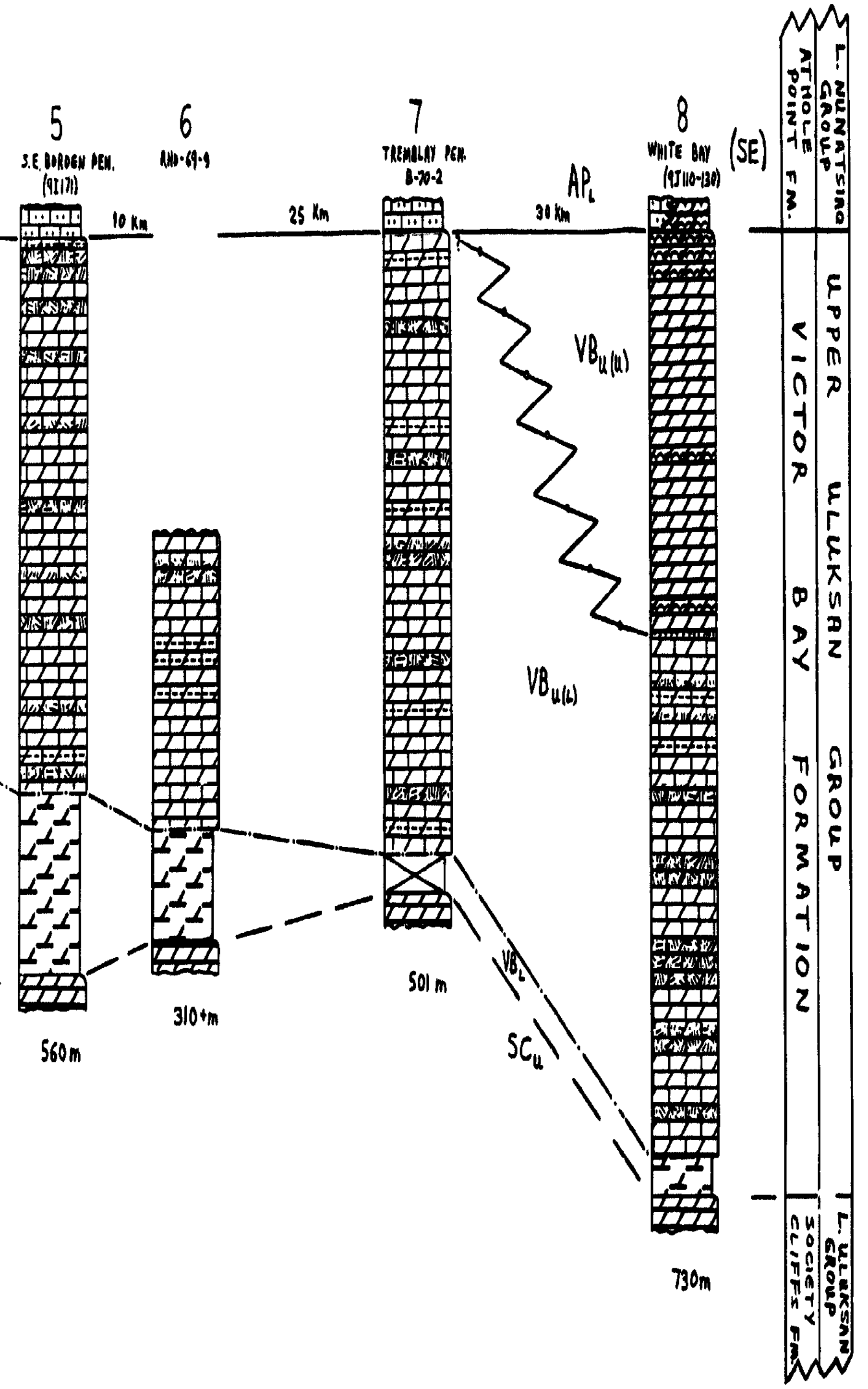


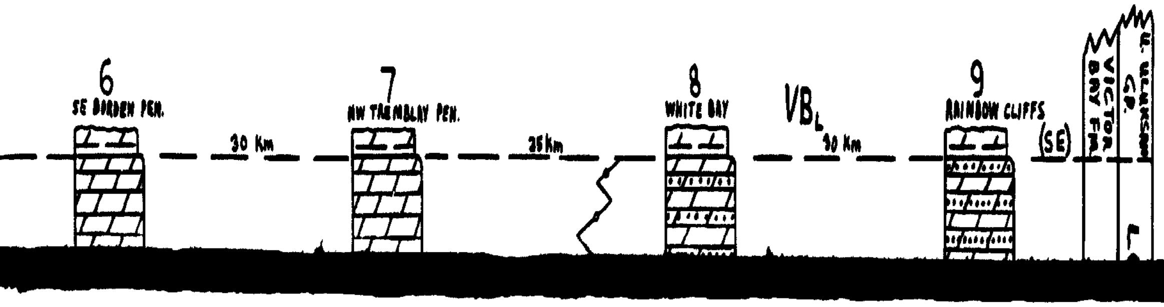
FIG. 3.16a:
VICTOR BAY FM: AXIAL (NW↔SE) CROSS-SECTION, MILNE INLET TROUGH.






605+m
535+m


5
S.E. BORDEN PEN.
(9I171)
6
RAD-69-9
7
TREMBLAY PEN.
B-70-2
8
WHITE BAY
(9J110-130)
(SE)
10 Km
25 Km
30 Km
AP_L
VB_u(u)
VB_u(L)
VB_L
SC_u
560m
310+m
501 m
730m
L. NUNATSIAQ GROUP
ATHOLE POINT FM.
UPPER ULUKSAN GROUP
VICTOR BAY FORMATION
L. ULUKSAN GROUP
SOCIETY CLIFFS FM.


6
SE BORDEN PEN.
7
NW TREMBLAY PEN.
8
WHITE BAY
9
RAINBOW CLIFFS
30 Km
25 Km
30 Km
VB_L
(SE)
VICTOR BAY FM.
U. ULUKSAN GR.
L.

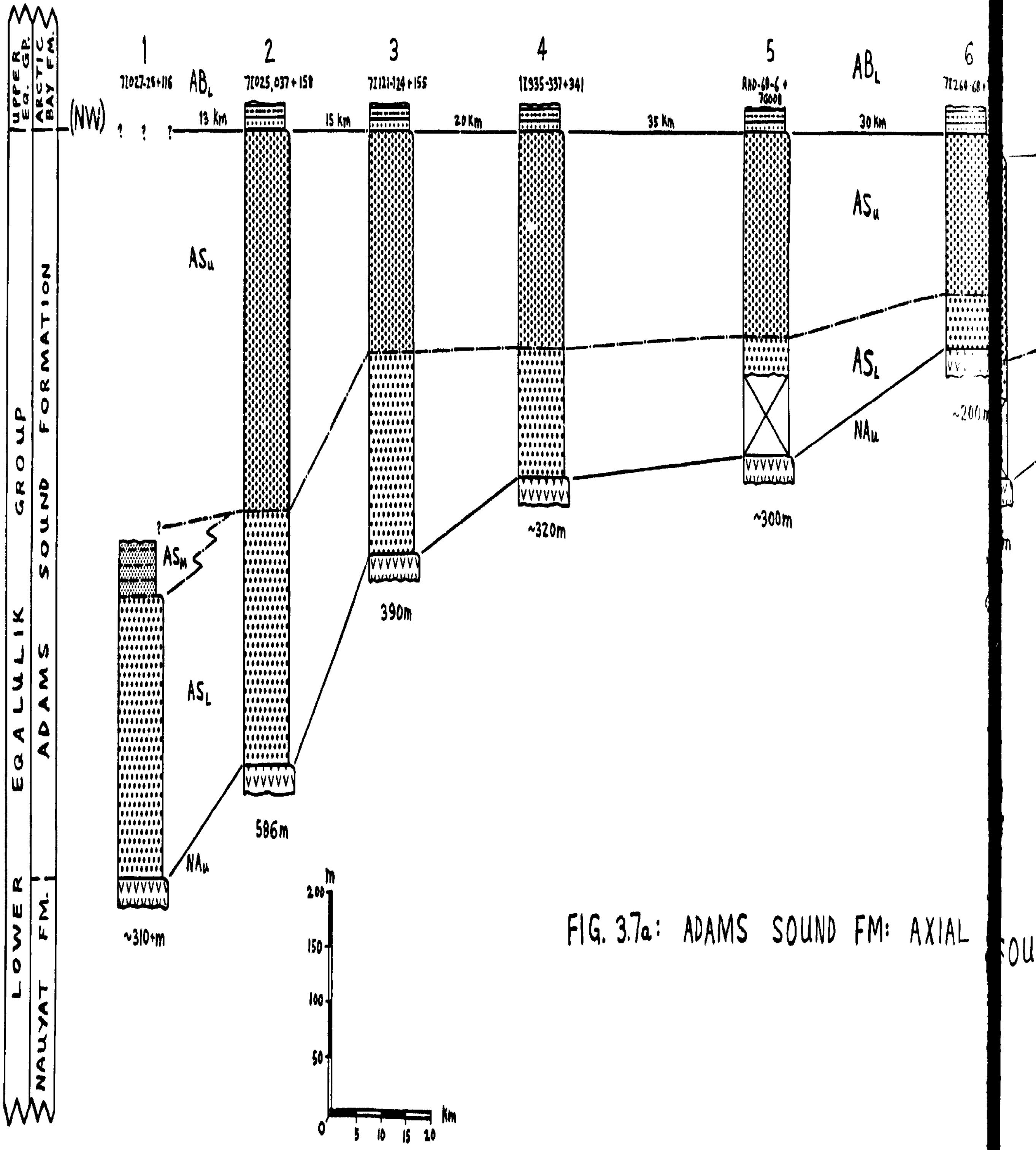
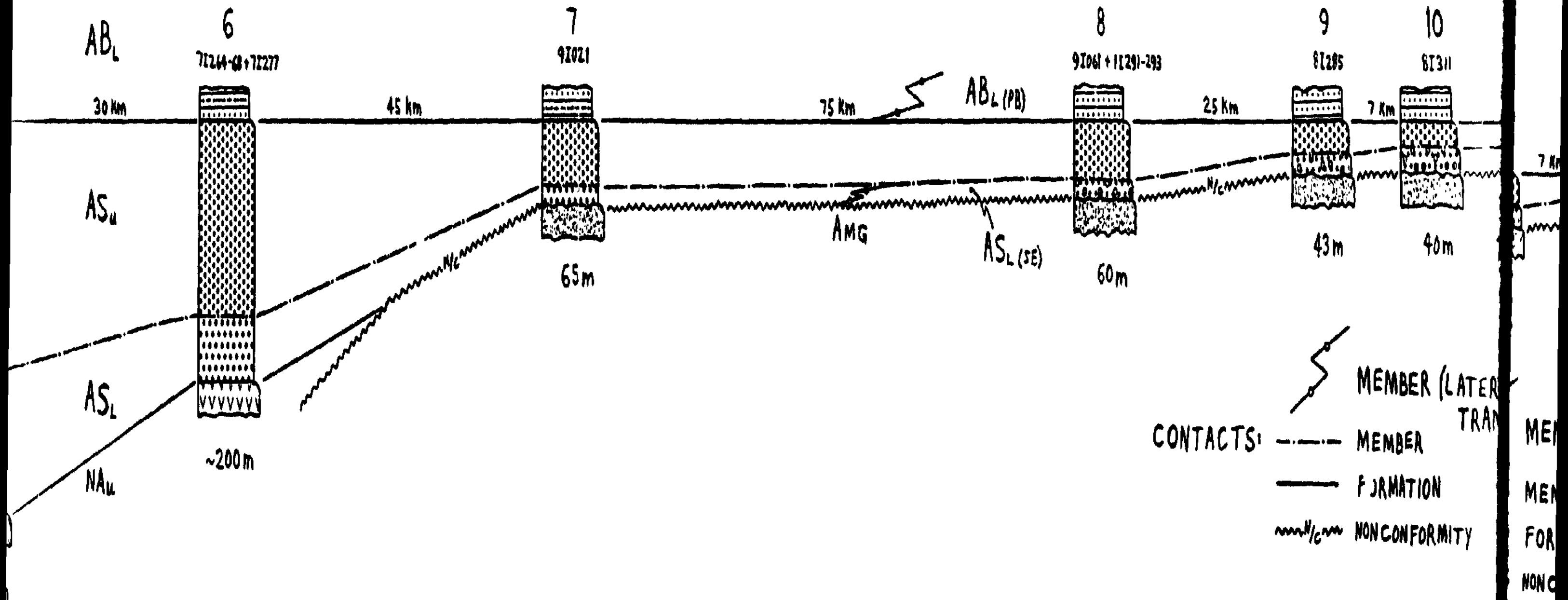
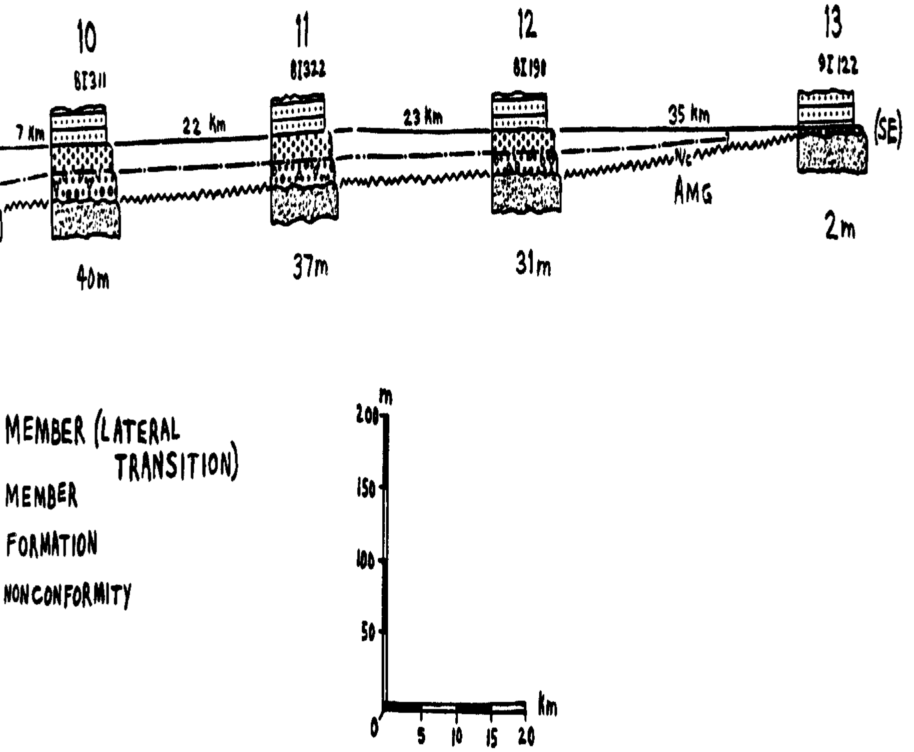


FIG. 3.7a: ADAMS SOUND FM: AXIAL SOU



OUND FM: AXIAL (NW←SE) CROSS-SECTION, MILNE INLET TROUGH.



FIGS. 3.7a, 3.10a AND 3.10b

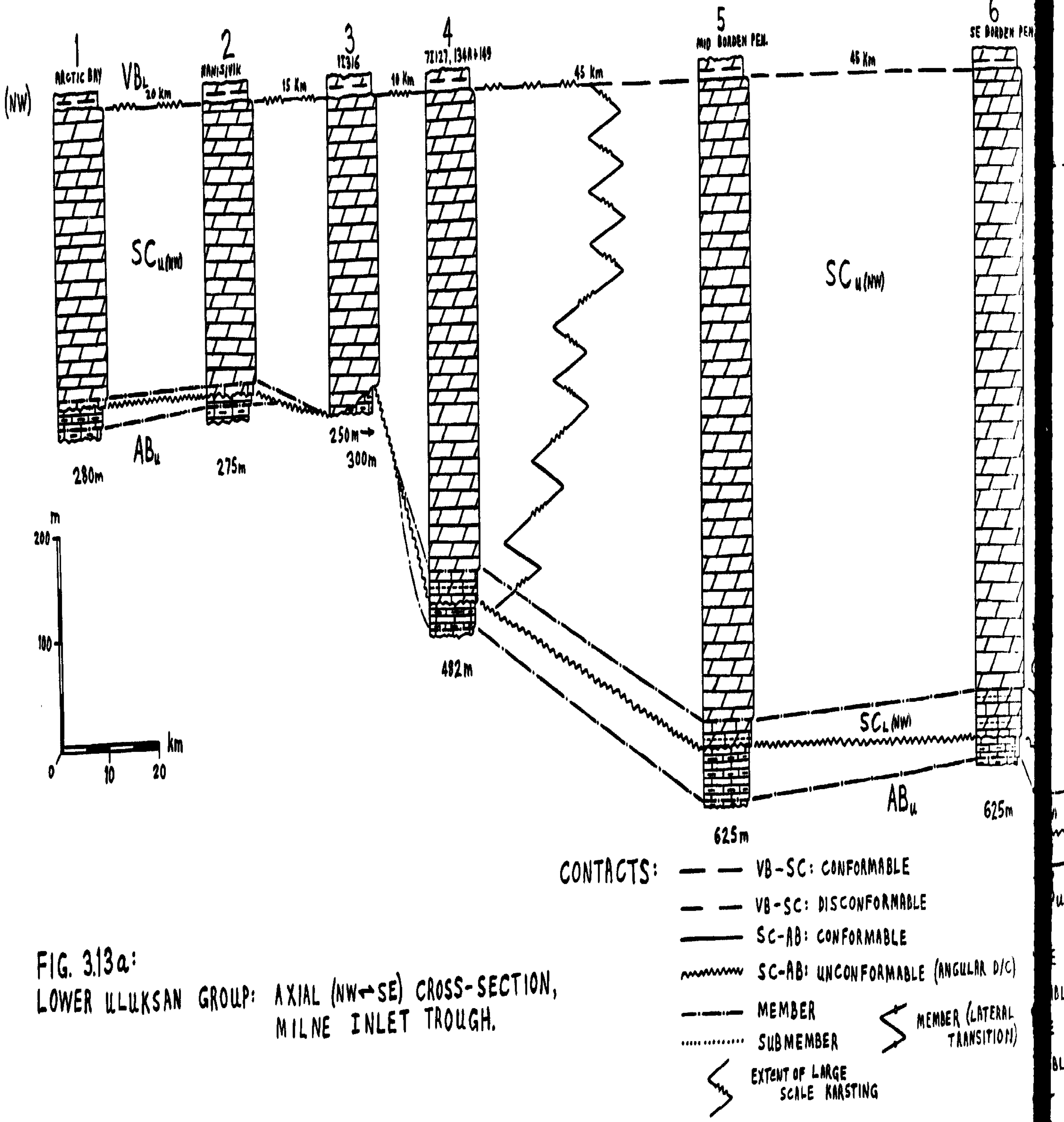
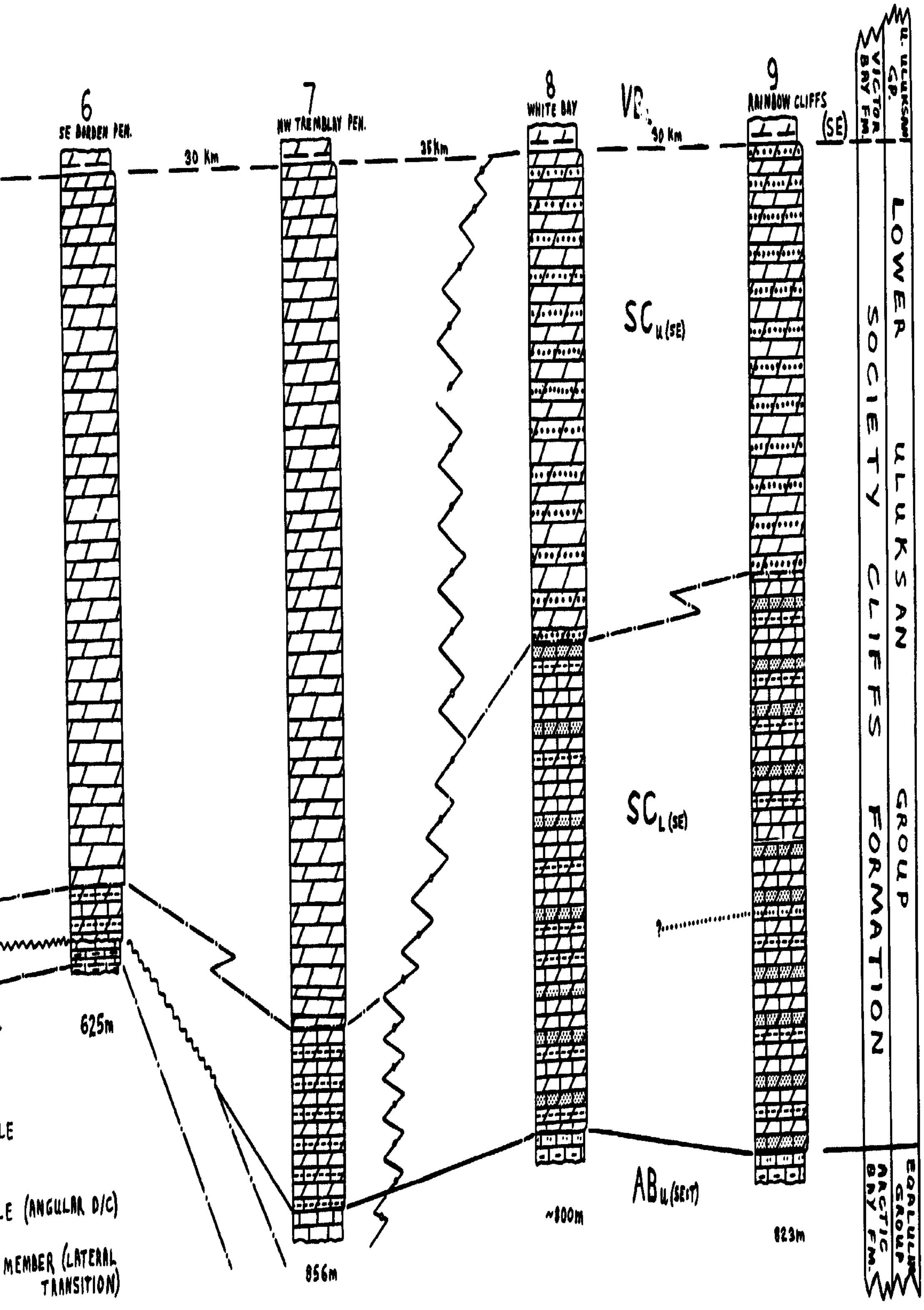
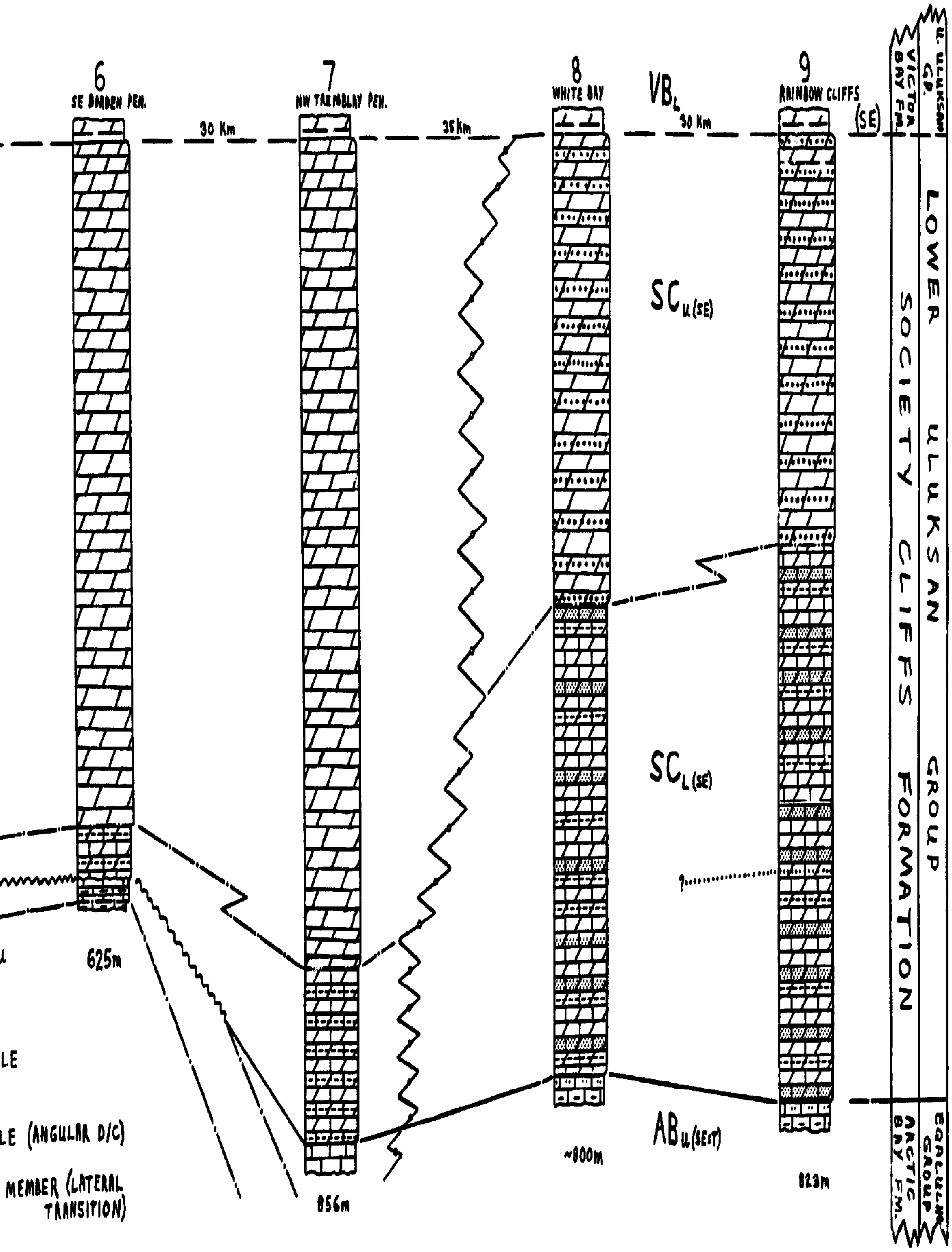
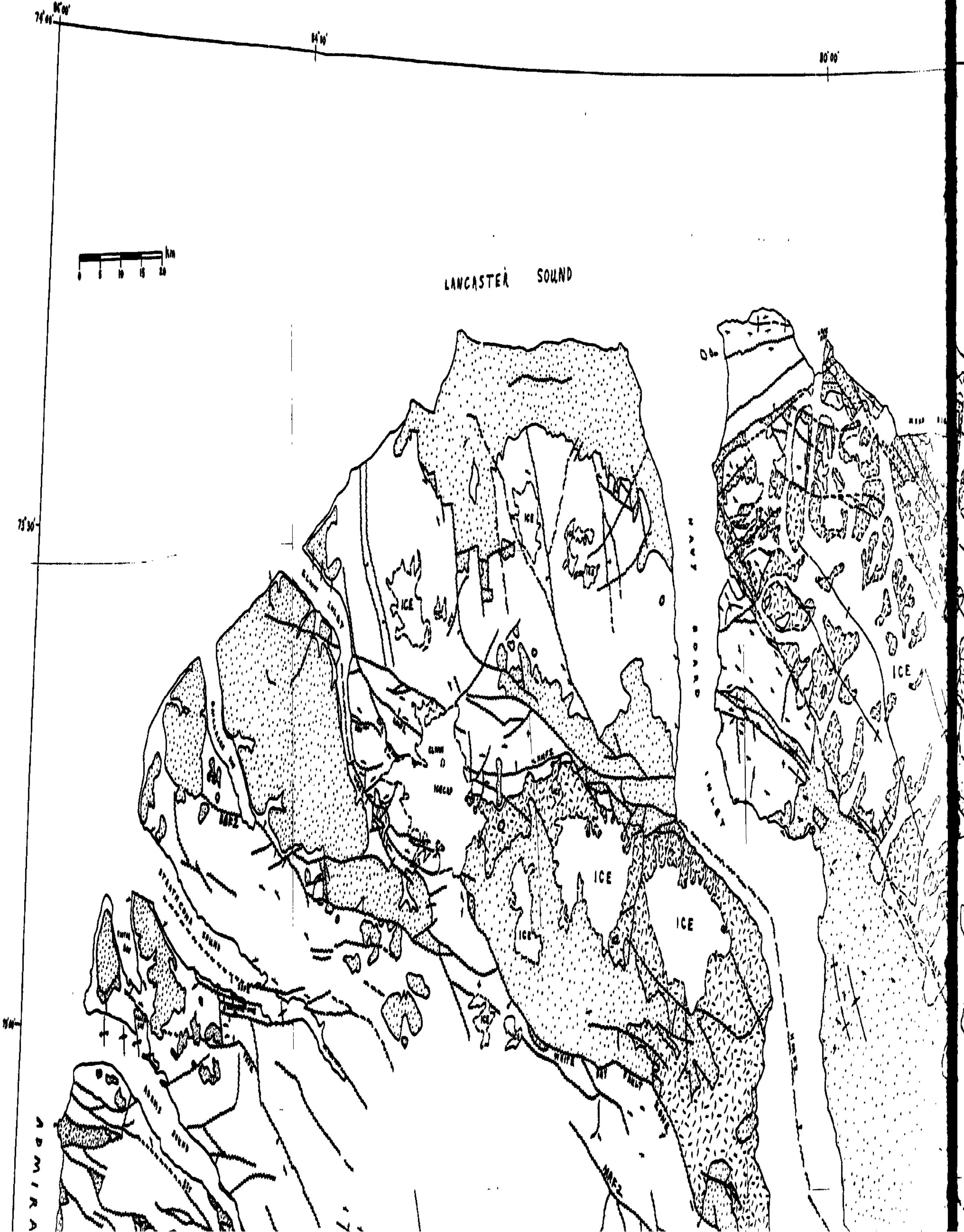


FIG. 3.13a:
LOWER ULUKSAN GROUP: AXIAL (NW↔SE) CROSS-SECTION, MILNE INLET TROUGH.


6
SE BORDEN PEN.
30 Km
7
NW TREMBLAY PEN.
35Km
8
WHITE BAY
VB
30 Km
9
RAINBOW CLIFFS
(SE)
VICTOR BAY FM.
U. ULUKSAN GP.
LOWER ULUKSAN GROUP
SOCIETY CLIFFS FORMATION
SC_U(SE)
SC_L(SE)
?
AB_U(SE?)
ARCTIC BAY FM.
EQALULIK GROUP
625m
856m
~800m
823m
LE
LE (ANGULAR D/C)
MEMBER (LATERAL TRANSITION)


6
SE BORDEN PEN.
30 Km
7
NW TREMBLAY PEN.
35 Km
8
WHITE BAY
VB_L
30 Km
9
RAINBOW CLIFFS
(SE)
U. ULUKSAN GP.
VICTOR BAY FM.
LOWER ULUKSAN GROUP
SOCIETY CLIFFS FORMATION
SC_U(SE)
SC_L(SE)
?
625m
856m
~800m
AB_U(SE)T
823m
ARCTIC BAY FM.
EQALULIK GROUP
LE
LE (ANGULAR D/C)
MEMBER (LATERAL TRANSITION)


74°00'
86°00'
84°00'
80°00'
73°30'
73°00'
km
0
5
10
15
20
LANCASTER SOUND
NAVY BOARD INLET
ICE
ICE
ICE
ICE
ICE
ICE
GLENN IS
ICECAP
WHITE BAY FAULT
ADMIRA

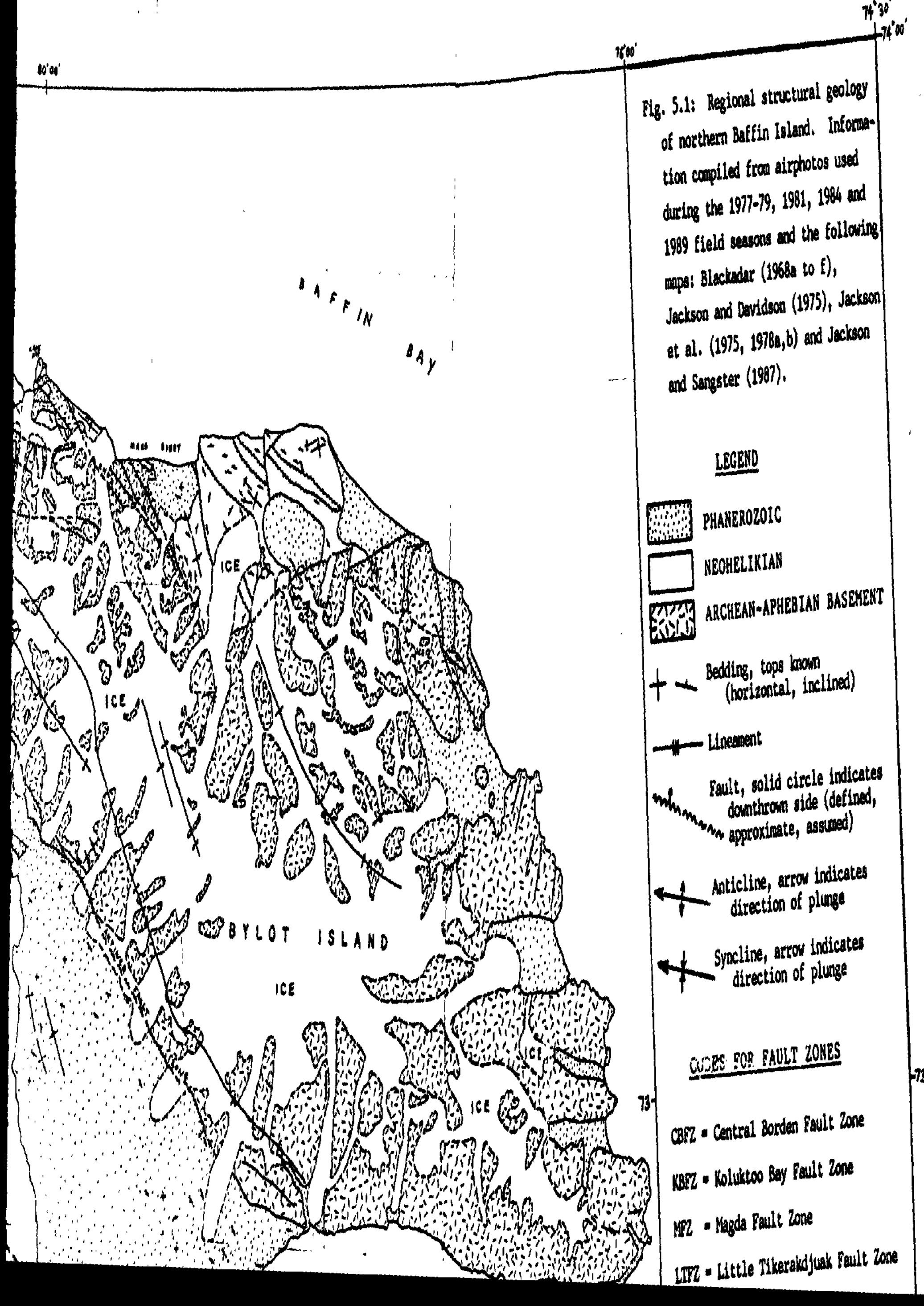
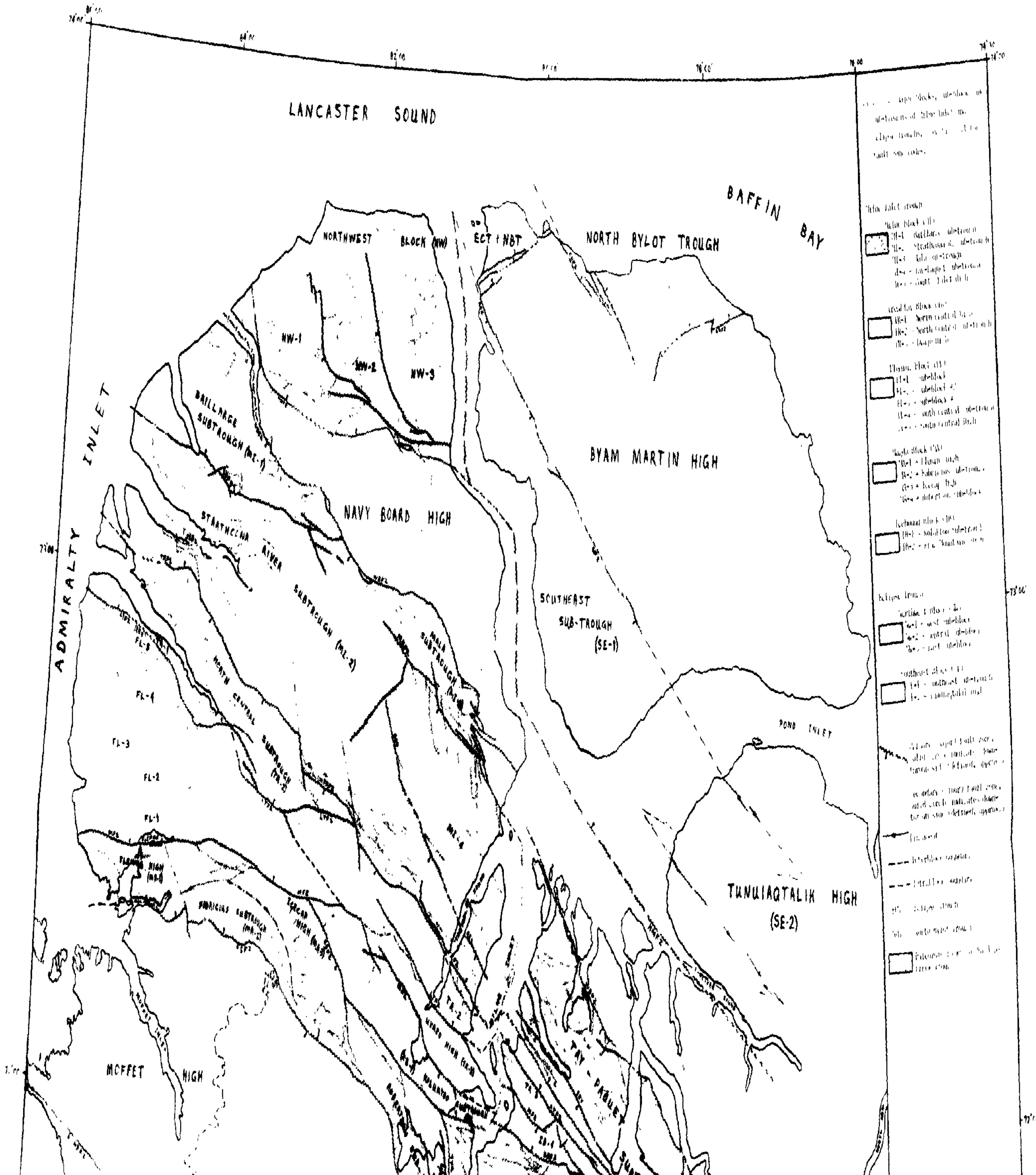
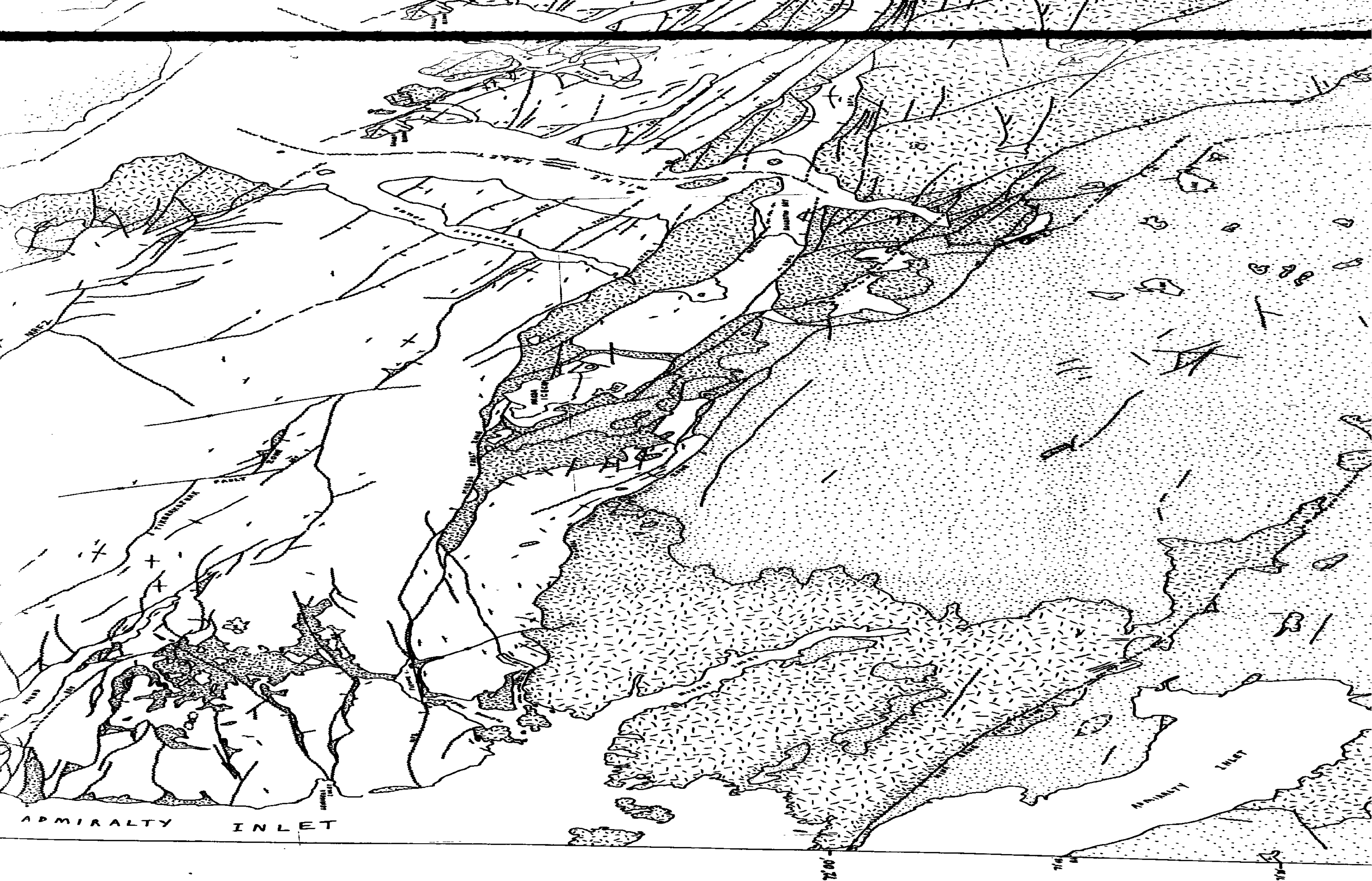
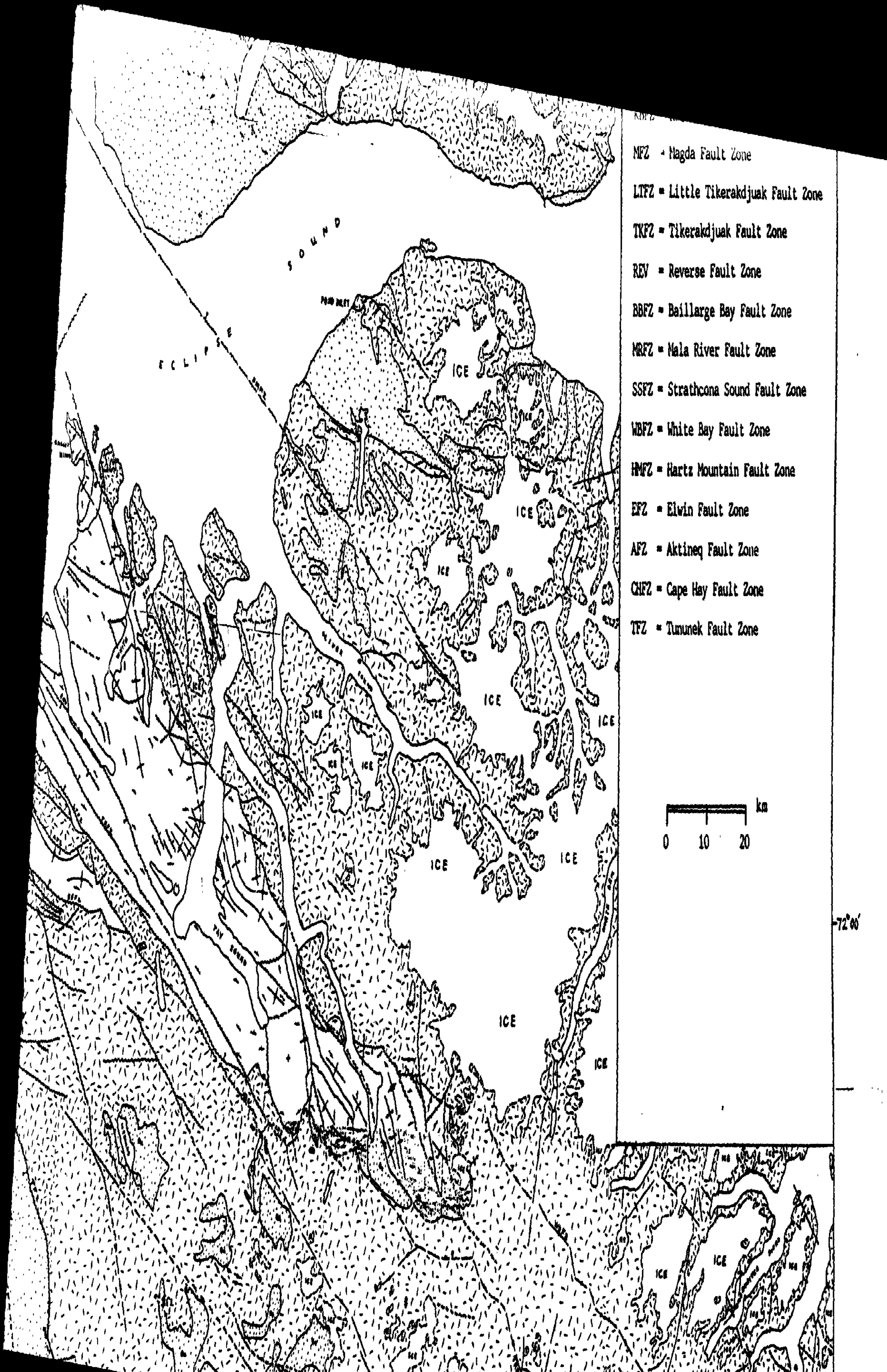
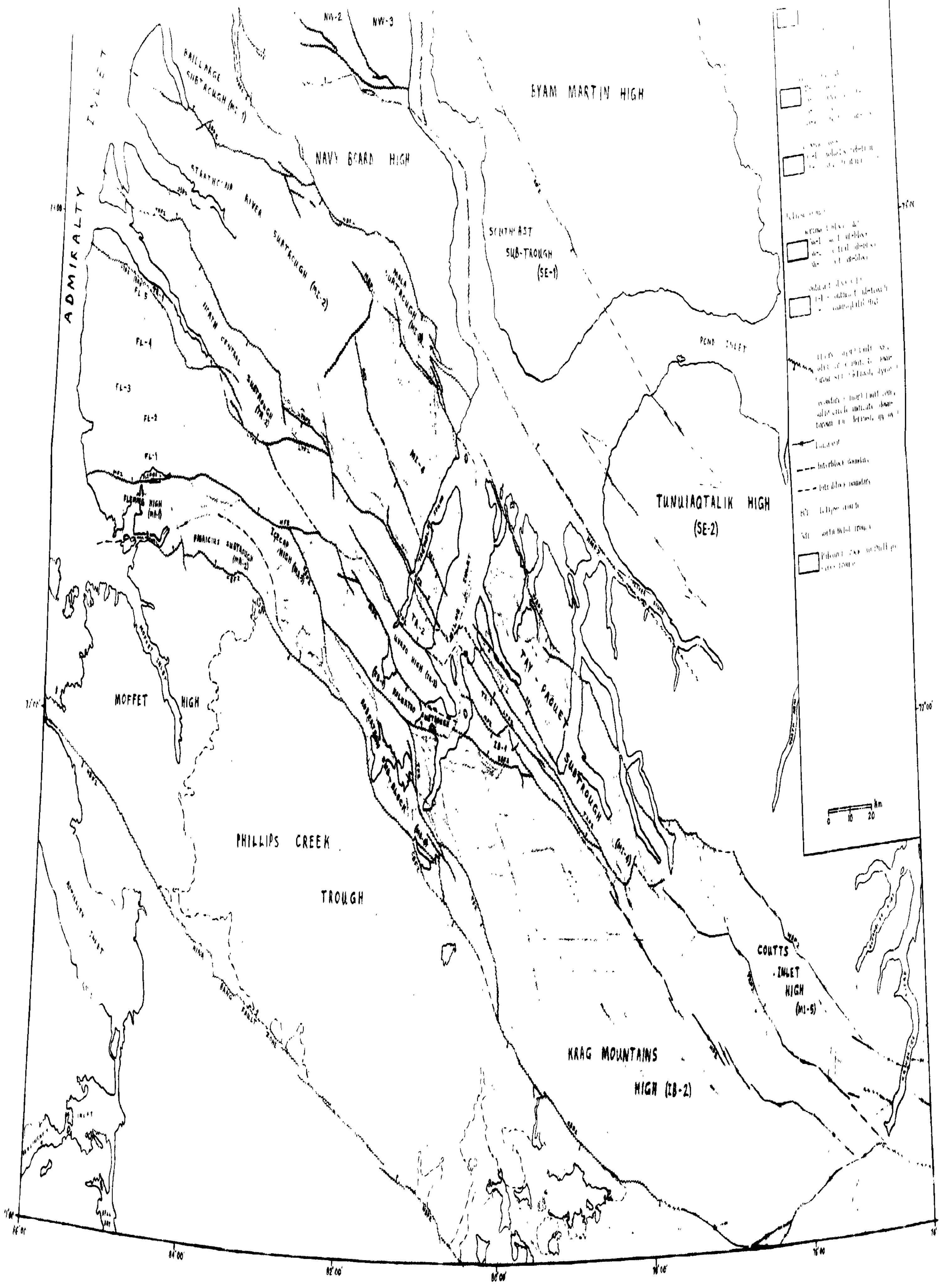


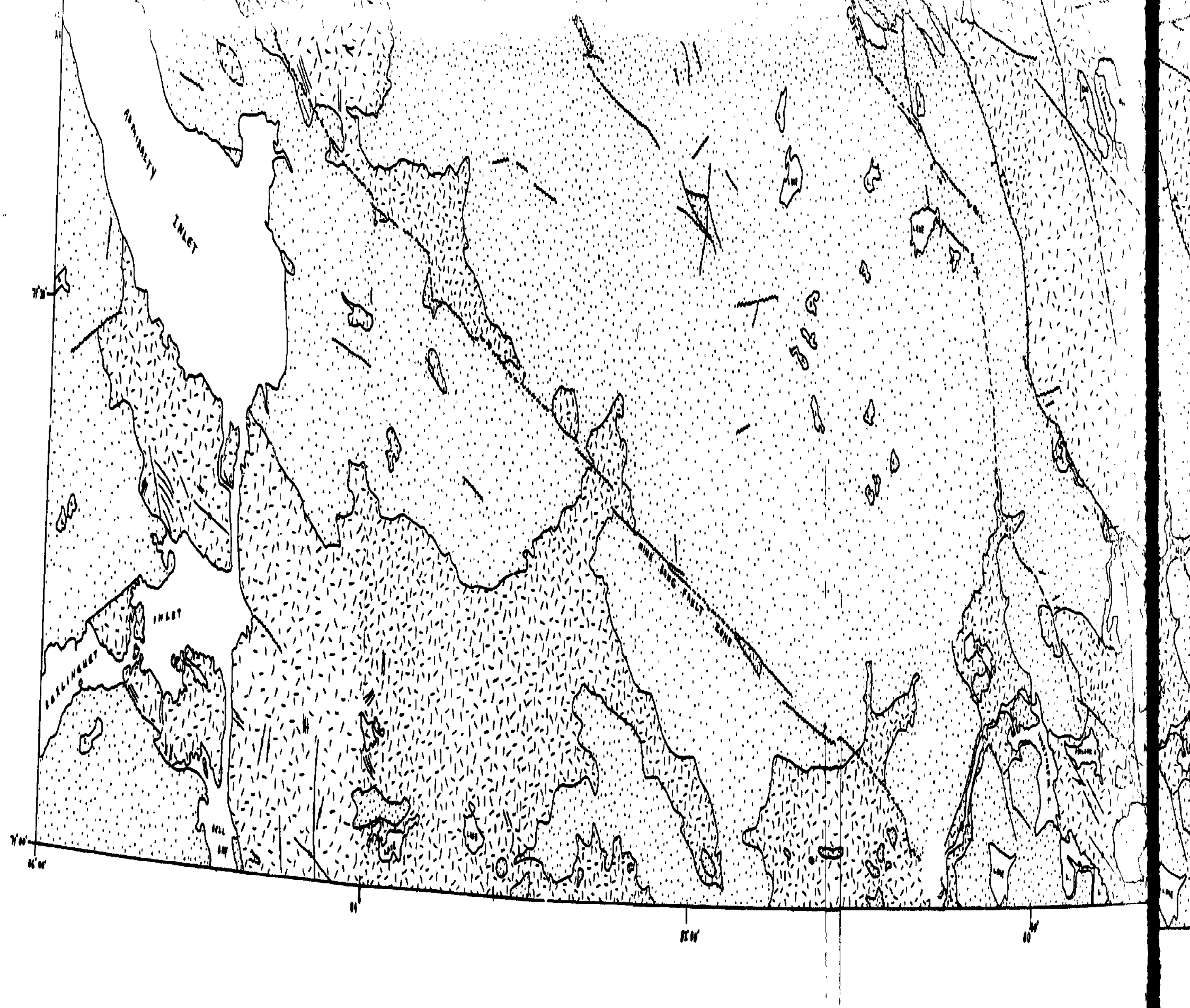
Fig. 5.1: Regional structural geology of northern Baffin Island. Information compiled from airphotos used during the 1977-79, 1981, 1984 and 1989 field seasons and the following maps: Blackadar (1968a to f), Jackson and Davidson (1975), Jackson et al. (1975, 1978a,b) and Jackson and Sangster (1987).


LANCASTER SOUND
BAFFIN BAY
ADMIRALTY INLET
NORTHWEST BLOCK (NW)
ECT + NBT
NORTH BYLOT TROUGH
NW-1
NW-2
NW-3
BAILLARGE SUBTROUGH (MI-1)
NAVY BOARD HIGH
BYAM MARTIN HIGH
STRATHCONA RIVER SUBTROUGH (MI-2)
MALA SUBTROUGH (MI-3)
SOUTHEAST SUB-TROUGH (SE-1)
NORTH CENTRAL SUBTROUGH (MI-2)
FL-5
FL-4
FL-3
FL-2
FL-1
MI-4
POND INLET
TUNUIAQTALIK HIGH (SE-2)
PAQUETTE HIGH (MB-1)
FABRICIUS SUBTROUGH (MB-2)
ISACAR HIGH (MB-3)
TX-2
TAY-PAQUET SUBTROUGH
MOFFET HIGH
CD-1
74°00'
73°00'
72°00'


ADMIRALTY INLET
MILNE INLET
ADMIRALTY INLET
72°00'


MFZ = Nagda Fault Zone
LTFZ = Little Tikerakdjuak Fault Zone
TKFZ = Tikerakdjuak Fault Zone
REV = Reverse Fault Zone
BBFZ = Baillarge Bay Fault Zone
MRFZ = Mala River Fault Zone
SSFZ = Strathcona Sound Fault Zone
WBFZ = White Bay Fault Zone
HMFZ = Hartz Mountain Fault Zone
EFZ = Elwin Fault Zone
AFZ = Aktineq Fault Zone
CHFZ = Cape Hay Fault Zone
TFZ = Tununek Fault Zone
km
0
10
20
ECLIPSE SOUND
ICE
72°00'


NW-2
NW-3
BAILLARGE SUBTROUGH (MI-1)
BYAM MARTIN HIGH
NAVY BOARD HIGH
STRATHCONA RIVER SUBTROUGH (MI-2)
SOUTHEAST SUB-TROUGH (SE-1)
MALA SUBTROUGH (MI-3)
ADMIRALTY INLET
FL-5
FL-4
FL-3
FL-2
FL-1
NORTH CENTRAL SUBTROUGH (TA-2)
MI-4
POND INLET
TUNUIAQTALIK HIGH (SE-2)
FLEMING HIGH (MA-1)
PHARICIUS SUBTROUGH (MA-2)
ICEPAD HIGH (MA-3)
TA-2
TA-1
TAY - PAQUET SUBTROUGH (MI-6)
MOFFET HIGH
MOFFET INLET
PHILLIPS CREEK TROUGH
ZB-1
COUTTS INLET HIGH (MI-5)
KRAG MOUNTAINS HIGH (ZB-2)
Interblock boundary
Intrablock boundary
km
0
10
20
73°00'
72°00'
71°00'
86°00'
84°00'
82°00'
80°00'
78°00'
76°00'


ADMIRALTY INLET
INLET
FAULT ZONE


ICE
ICE
ICE
ICE
ANGAJURJUALUK LAKE
80°00'
78°00'
76°00'
74°30'
71°00'

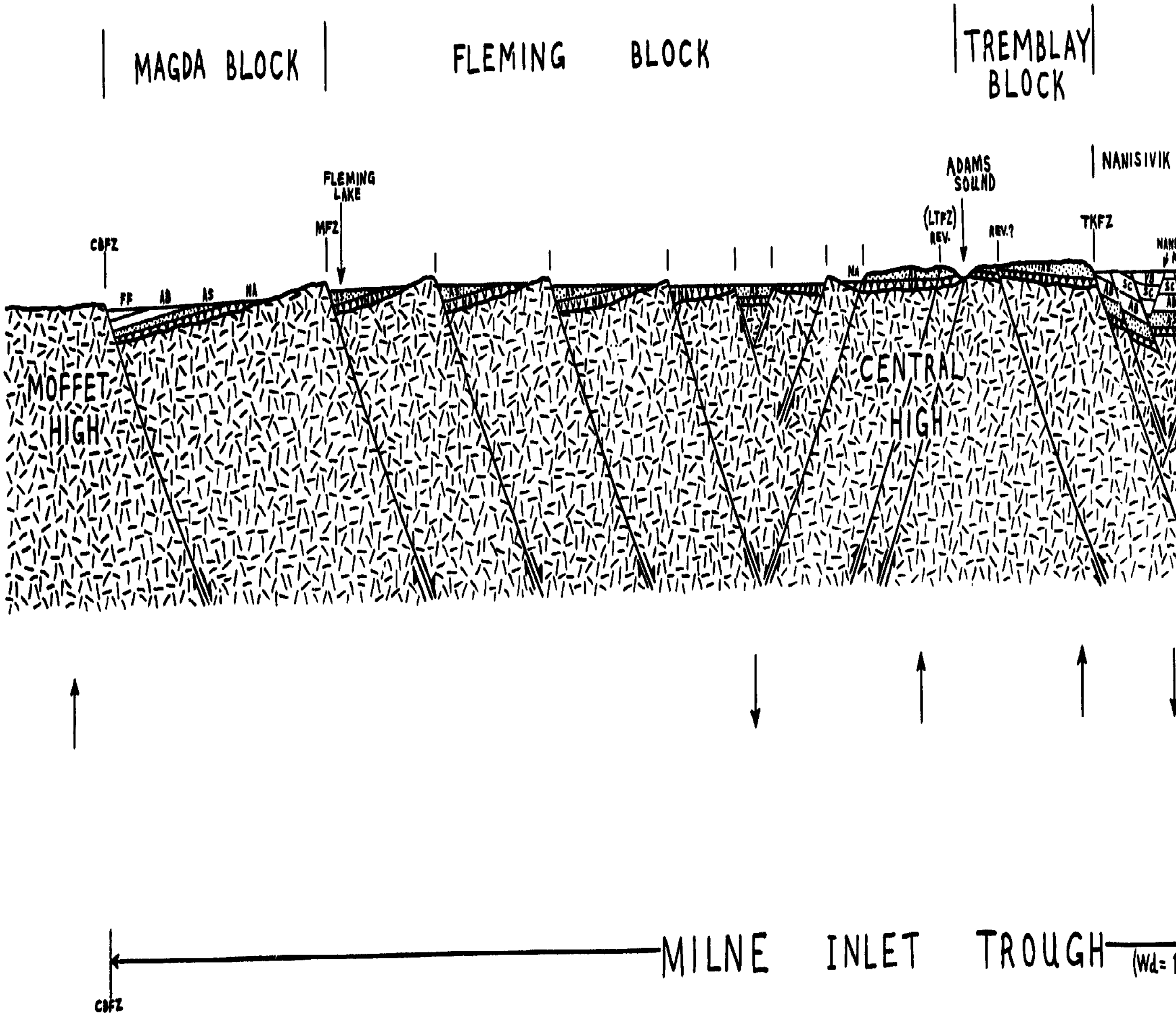
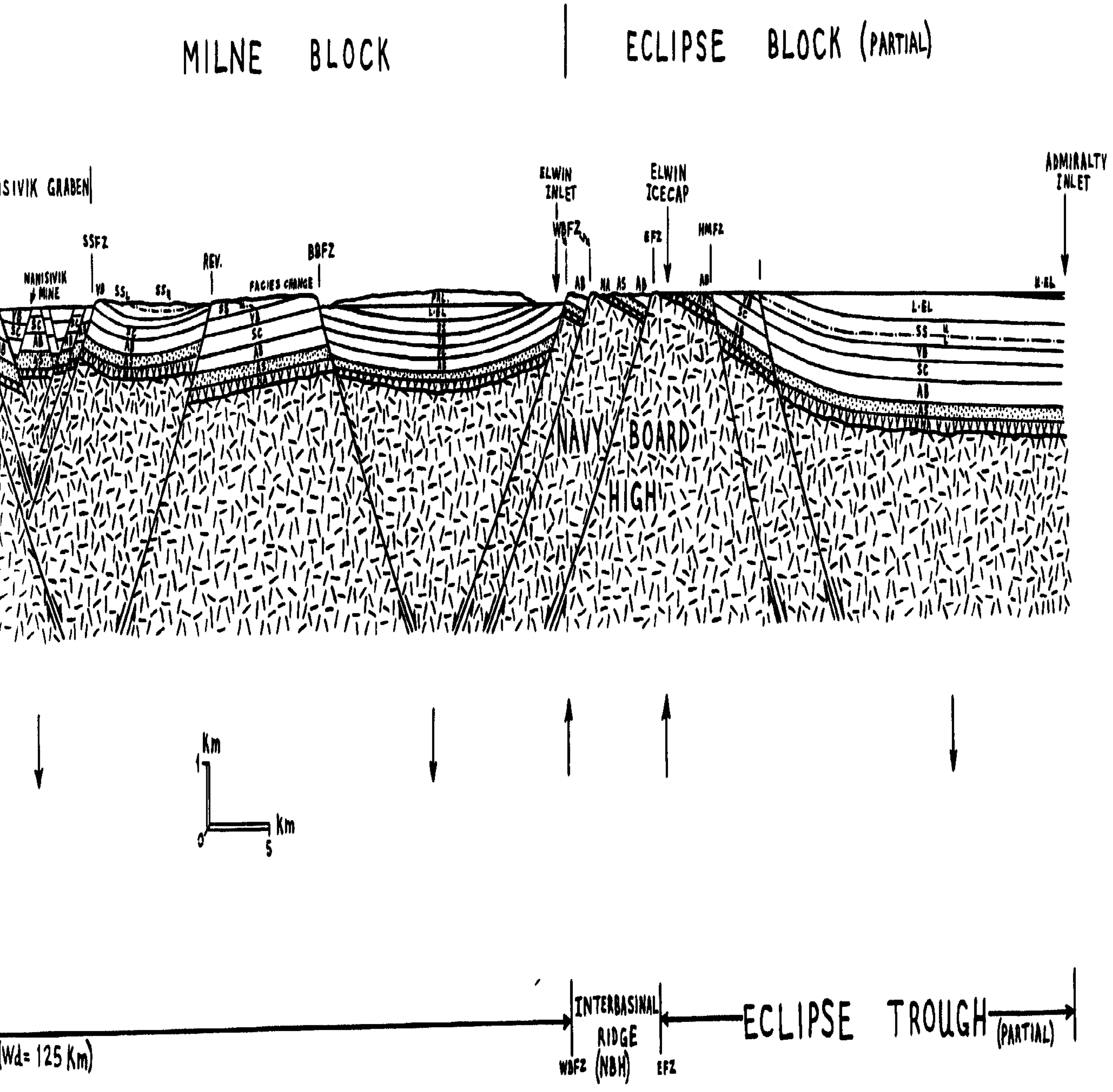


FIG. 5.4E: SECTION 4- N.W. MILNE INLET AND ECLIPSE


MILNE BLOCK
ECLIPSE BLOCK (PARTIAL)
SIVIK GRABEN
NANISIVIK MINE
SSFZ
VB
SS
REV.
BDFZ
FACIES CHANGE
ELWIN INLET
WBFZ
ELWIN ICECAP
EFZ
HMFZ
AB
NA
AS
ADMIRALTY INLET
L-EL
SS
VB
SC
AB
NAVY BOARD HIGH
Km
1
0
5
Km
(Wd= 125 Km)
INTERBASINAL RIDGE
WBFZ
(NBH)
EFZ
ECLIPSE TROUGH
(PARTIAL)

E TROUGHS.

FIG. 5.4E: SECTION 4- N.W. MILNE INLET AND ECLIPSE TROUG

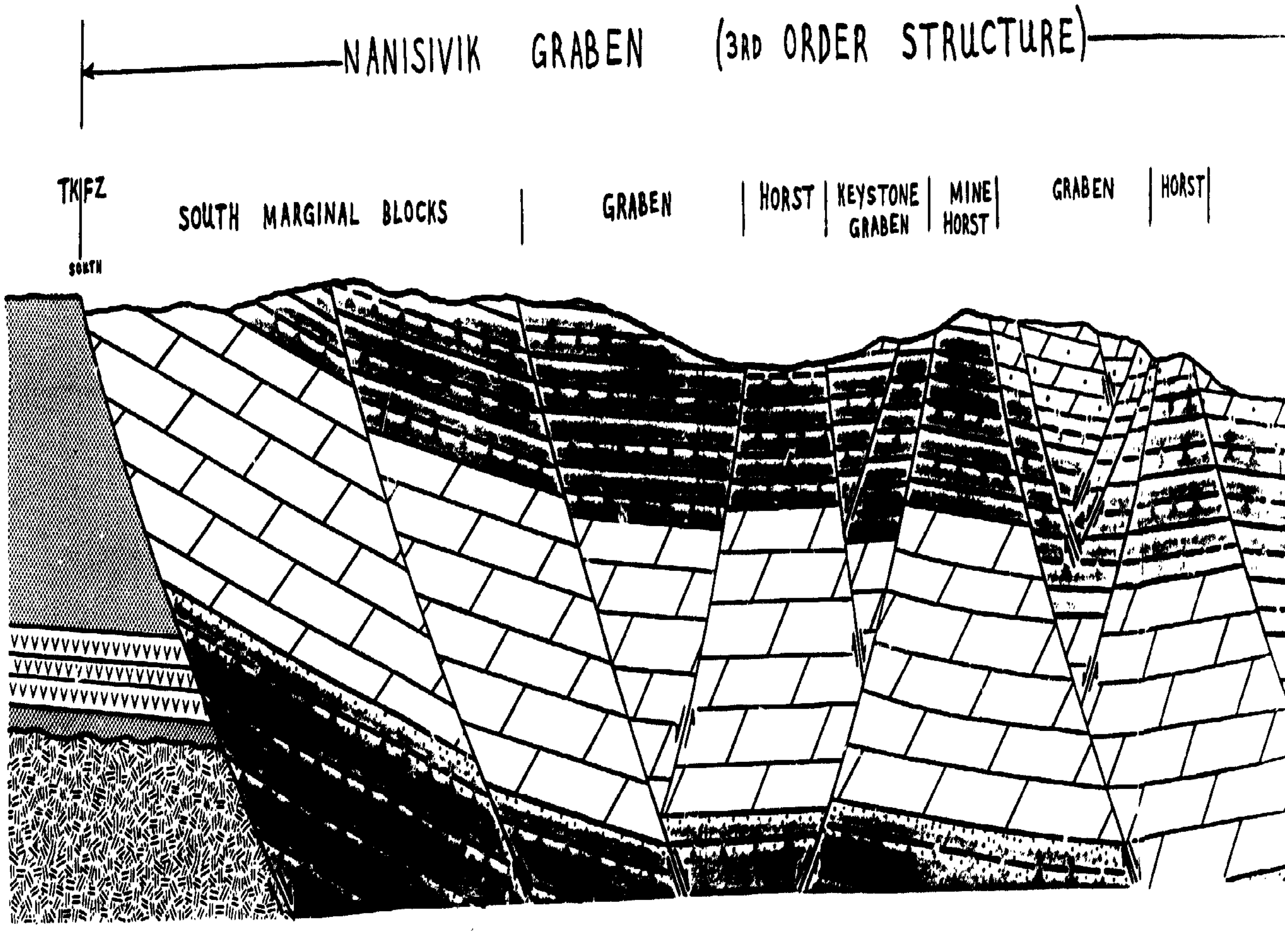


FIG. 5.5: Nanisivik Graben: North-south cross-section in the area due west of the West Boundary Fault Zone. Note the following:

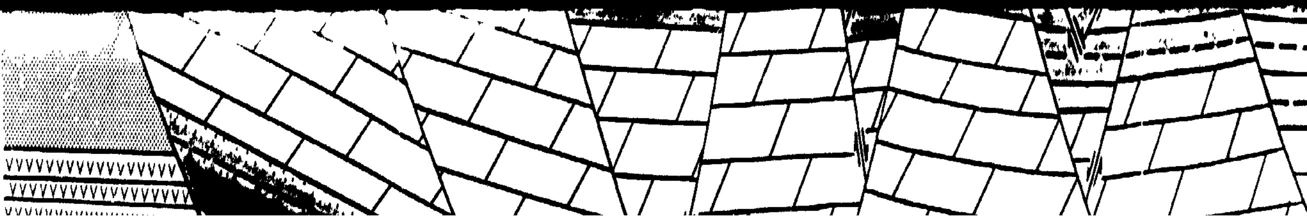
TKFZ = Tikerakdjuak Fault Zone

SSFZ = Strathcona Sound Fault Zone

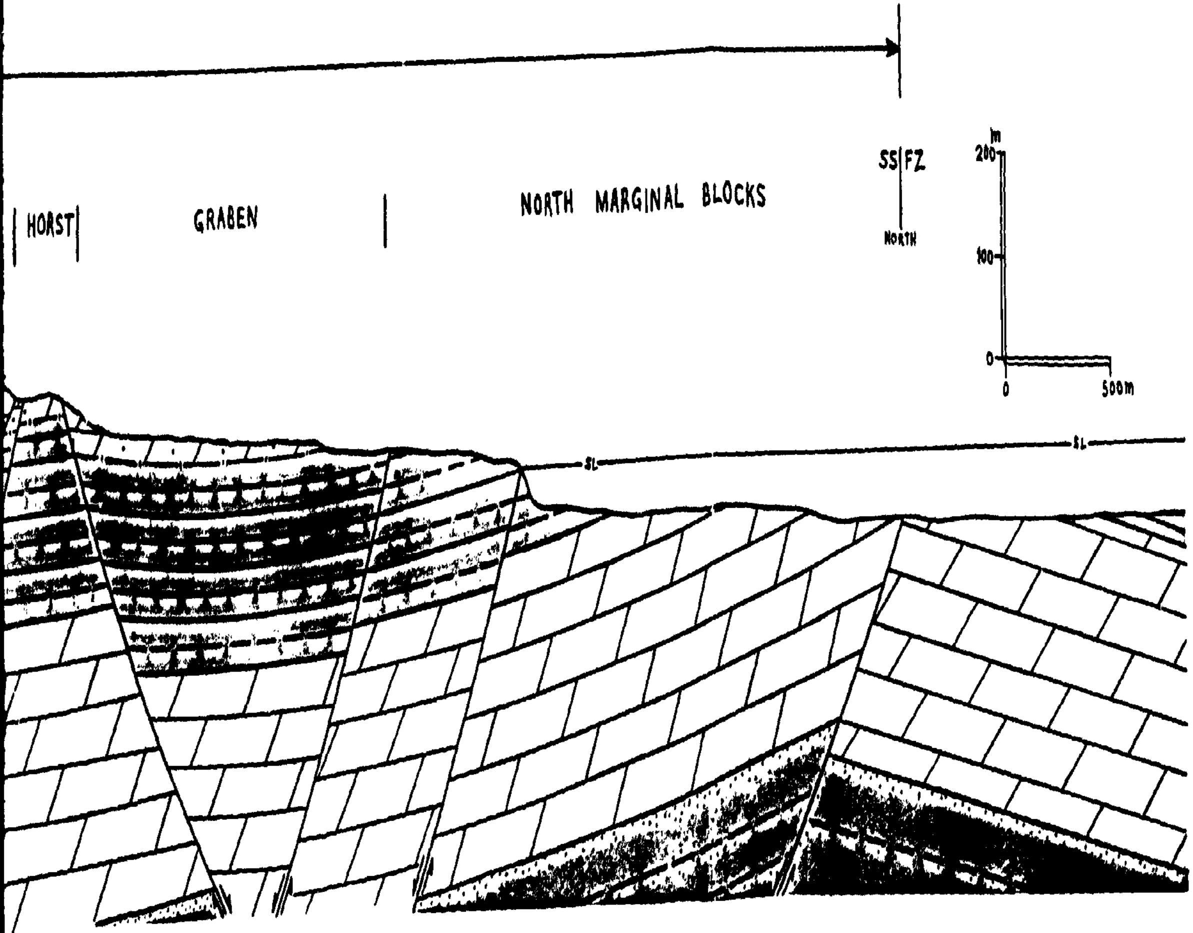
▨ VICTOR BAY FM (UPPER MEMBER: VB_U)

▨ VICTOR BAY FM (LOWER MEMBER: VB_L)

▨ SOCIETY CLIFFS FORMATION



E TROUGHS.



Note: The structural cross-section, of the Nanisivik Graben, is based on field stations, field photographs and air- [illegible] from mineral exploration and mapping projects,

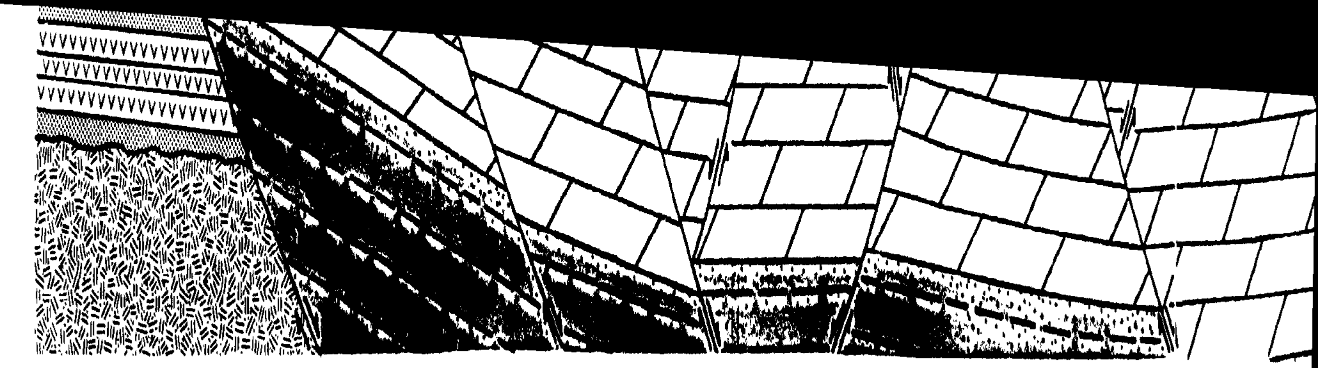


FIG. 5.5: Nanisivik Graben: North-south cross-section in the area due west of the West Boundary Fault Zone. Note the following:

TKFZ = Tikerakdjuak Fault Zone
SSFZ = Strathcona Sound Fault Zone
SL = Sea Level
↑ = Upthrown side of fault zone
↓ = Downthrown side of fault zone

(Note: See Fig. 5.4E for location of the Nanisivik Graben.)

▨ VICTOR BAY FM (UPPER MEMBER: VB_U)
▨ VICTOR BAY FM (LOWER MEMBER: VB_L)
▨ SOCIETY CLIFFS FORMATION
▨ ARCTIC BAY FORMATION
▨ ADAMS SOUND FORMATION
▨ NAUYAT FORMATION
▨ BASEMENT COMPLEX

Note: The structural cross-section, of the Nanisivik Graben, is based on field stations, field photographs and air-photos from mineral exploration and mapping projects, and on interpretations from geology maps of the Nanisivik area from the work of Strathcona Minerals (courtesy of Dr. R. von Guttenberg), Clayton and Thorpe (1982) and Olson (1977).

FIGS. 5.4E AND 5.5

NEOHELIKIAN REEF COMPLEXES, BORDEN RIFT BASIN, NORTHWESTERN BAFFIN ISLAND[3]

G.D. Jackson,[1] and T.R. Iannelli[2]

General Location	- northwestern Baffin Island
Age	- Neohelikian (ca 1200 Ma)
Reef Type	- isolated bioherms and pinnacle reefs to bioherm and reef complexes
Dimensions	- individual bioherms up to 1500 m long and 270 m + high - the Strathcona Sound reef complex is about 200 m high, and 15 km long on each side
Depositional Setting	- carbonate shelf
Tectonic Region	- Borden Rift Basin (aulacogen? failed rift arm)
Crustal Position	- cratonic shelf/intracratonic basin (i.e. failed rift on passive "Atlantic-type" margin)
Foundation below buildups	- partly restricted shale-calciclastic basin to stromatolitic carbonate shelf
Reef-forming Process	- periodic growth of stromatolitic bioherms related to syndepositional tectonism
Dominant Organism(s)	- planar to domal hemispheroidal and conical algal stromatolites
Diagnostic Aspect(s)	- faint stratification due to stacking of stromatolitic bioherms. - breccia-conglomerate aprons - internal dilation breccias - dendritic spur and groove structure

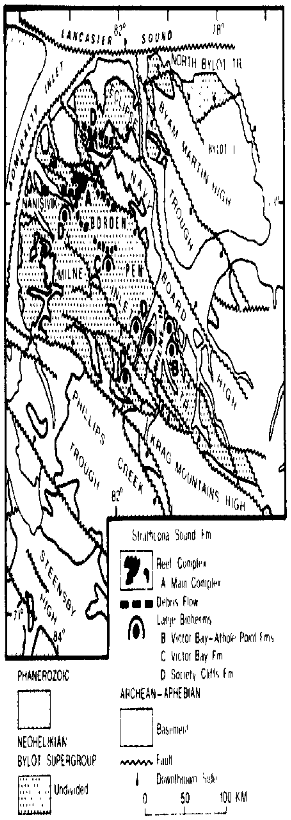


Fig. 1. Geology and basic reef data.

INTRODUCTION

LOCATION

Reefal buildups occur chiefly in Milne Inlet Trough in the upper parts of the Arctic Bay, Society Cliffs and Victor Bay Formations, and in the lower parts of the Strathcona Sound and laterally equivalent Athole Point Formations (Figs. 1, 2; Table 1).

The major development of reefs in Borden Rift Basin is in the southwestern Navy Board Inlet map sheet (NTS 48D). The lower Strathcona Sound main reef complex, the largest buildup in Borden Basin, lies east of Nanisivik. Bioherms and small reefs occur adjacent to the main buildup. A less spectacular development lies to the southeast in the Milne Inlet area and Arctic Bay bioherms are restricted to this area. Locations are best reached by helicopter from Resolute, although locations near the coast are accessible by boat or skidoo. The Milne Inlet area lies within a proposed park (Jackson and Sangster, 1987).

DIMENSIONS

Upper Arctic Bay, Society Cliffs and Victor Bay reefs range from individual bioherms to patch reefs and small platformal reefs. Upper Arctic Bay Reefs are up to several metres thick and a kilometre or more in length. They occur in shelf carbonates in a zone 80 km long (NW-SE, 10 km wide and 50-320 m + thick.

---

[1] Geological Survey Canada, 601 Booth St., Ottawa, Ontario K1A 0E8

[2] University of Western Ontario, Dept. of Geology, London, Ontario N6A 5B7

[3] Geological Survey of Canada Contribution No. 10587

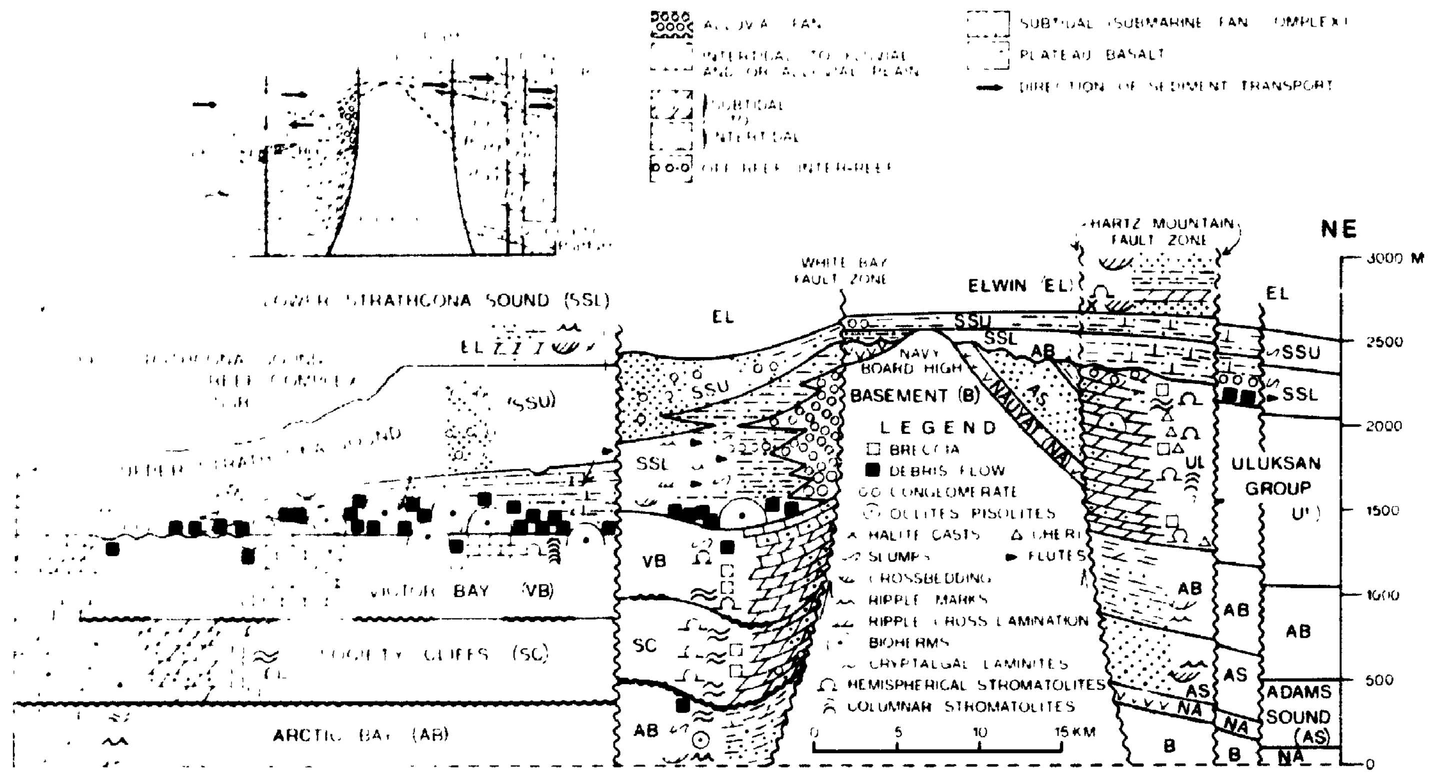


Fig. 2 Transverse (SW-NE) cross-section and depositional environments.

Upper Society Cliffs and Victor Bay reefal zones are commonly up to 15 km long along strike and 30 m thick. They are developed in a carbonate platform (Fig. 2) that is about 1000 m thick near Nanisivik, and in Eclipse and North Bylot Troughs (Fig. 1). The platform thins west of [illegible]k but thickens to 1600 m in the Milne Inlet area, [illegible] to the southeast, and underlies about 13,000 [illegible] in Borden Basin.

The lower Strathcona Sound main reef complex is about 15 km by 15 km, although irregular in shape, and has a maximum thickness about 200 m. The complex probably extends several kilometres northward under Paleozoic strata. Short extensions of the reef facies to the east and west probably underlie siliciclastic Strathcona Sound strata, although most reef exposures in those regions seem to be discrete bodies. The main reef complex and several small reef buildups, including individual bioherms, pinnacle and patch reefs occur within an area about 25 km wide and 60 km long (E-W) (Figs. 1, 2). Carbonate clast debris flow breccias in lower Strathcona Sound strata extend another 60 km easterly, but may be related to local, presently buried reefs.

A reef complex in the upper Victor Bay and extending into overlying lower Athole Point (laterally equivalent to lower Strathcona Sound, Table 1) strata may continue along strike for about 20 km southeast from Milne Inlet, and is about 140 m thick. This complex contains the largest individual bioherm (1500 m? x 270 m? high) in Borden Basin (Figs. 1, 5). Large bioherms are commonly elongated parallel to Milne Inlet Trough. A few small bioherms occur locally in upper Society Cliffs strata on the south side of western Eclipse Trough (Fig. 1).

History

The Neohelikian Bylot Supergroup (Table 1), of which these carbonate reefs are a part, was studied first by Lemon and Blackadar (1963), Blackadar *et al.* (1968a-d) and Blackadar (1970), who named the formations and assigned them to two groups. Trettin (1969) concluded that some of the major faults in Borden Basin originated during Neohelikian sedimentation.

Geldsetzer (1973a, 1973b), concentrating on the Uluksan Group, provided the first regional study of facies distributions and depositional environments. He concluded that the Bylot Supergroup was deposited as a megacycle on a stable shelf during regional subsidence interrupted by four regional upwarps. Geldsetzer considered the formation of horsts and grabens to have occurred later, probably in the Hadrynian. Olson (1977, 1984) identified 4 karst episodes, concluded that the Nanisivik lead zinc orebody was deposited in a previously formed cave system in Society Cliffs dolostone and considered the Milne Inlet Trough (Fig. 1) to be an aulacogen.

Jackson and Davidson (1975) and Jackson *et al.* (1975) concluded that sedimentation had occurred in an active rift zone, and that faulting has continued to Recent time. Jackson *et al.* (1978, 1980, 1985), Iannelli (1979), Jackson and Iannelli (1981), and Jackson and Cumming (1981) refined the stratigraphy, concluded that two active rift episodes

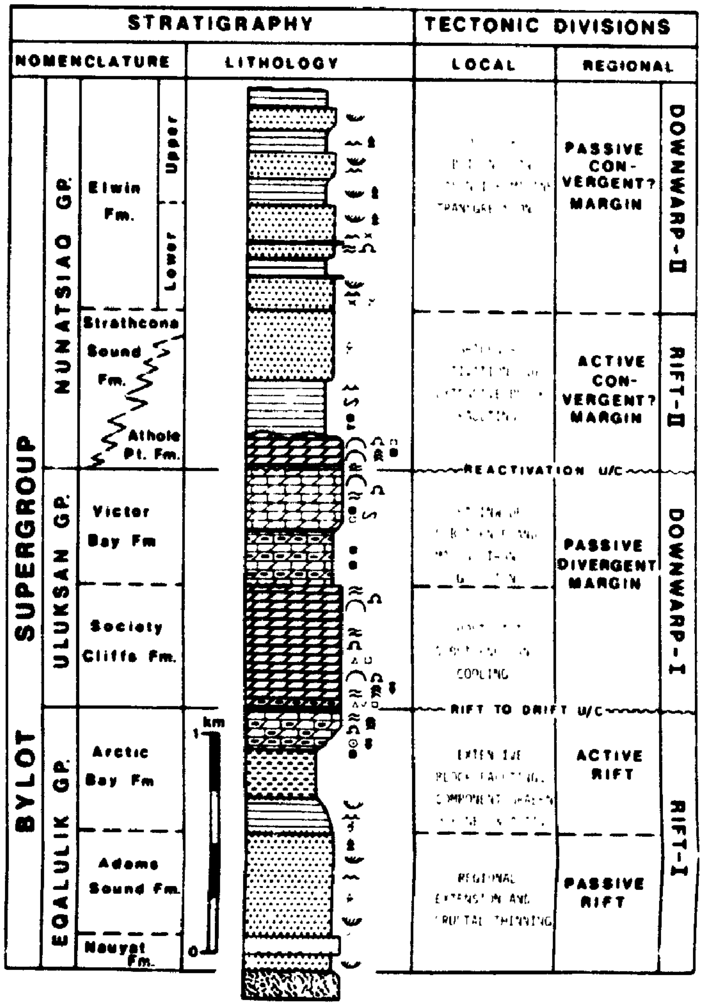


Table 1. Table of formations and tectonic subdivisions. Most of the symbols are illustrated in Figure 2. The double solid triangles pointing up indicate thinning upward cycles, and pointing down indicate shallowing upward cycles. The double open triangles pointing up indicate fining upward cycles, and pointing down indicate coarsening upward cycles.

had interrupted shelf sedimentation and related the rifting and subgreenschist metamorphism to the opening, and possibly the closing of the Neohelikian Poseidon Ocean.

GEOLOGICAL SETTING, STRATIGRAPHIC RELATIONS

Most of the Bylot Supergroup was deposited in cycles of various types (Jackson and Iannelli, 1981). Paleomagnetic data (Fahrig *et al*., 1981) suggest that the Bylot Supergroup probably developed in tropical latitudes in the northern hemisphere.

Deposition of basal shelf quartzarenite, containing thin subaerial basalt flows, during a southeastward marine transgression was interrupted by rifting (Table 1) and the formation of a semi-restricted shale basin in which Arctic Bay shale onlaps basement gneisses in eastern Milne Inlet Trough. Along the southwestern edge of the western trough both Arctic Bay and overlying lower Society Cliffs strata grade laterally into a thick marine siliciclastic complex. Stromatolitic shelf carbonate was deposited with siliciclastics in the upper Arctic Bay Formation in the Milne Inlet area.

Brief uplift and erosion produced a disconformity at the top of the Arctic Bay Formation regionally west of Milne Inlet, and locally east of the inlet. As stable conditions returned deposition of stromatolitic marine shelf carbonate expanded rapidly throughout Borden Basin, forming the lower Uluksan carbonate (Society Cliffs) and upper Uluksan carbonate (Victor Bay) platforms (Figs. 1, 2, Table 1). In Milne Inlet Trough a second period of brief uplift and erosion was followed by foundering and the deposition of a wedge of southwesterly-derived basinal shale (lower Victor Bay), disconformably to conformably on Society Cliffs carbonate. The distribution of facies in the Uluksan and upper Eqalulik Groups suggests that a peninsula or island (Navy Board High) separated Milne Inlet and Eclipse Troughs during the development of the carbonate platform and that the Byam Martin High and large landmasses both north and south of Borden Basin were present. The Uluksan cratonic carbonate platform onlapped the basin margins (Table 1) and probably [illegible] to Somerset Island and northwestern Greenland ([illegible] and Iannelli, 1981).

Resumption of major rifting throughout Bor[illegible] (vs. epeirogenic uplift — Geldsetzer, 1973b) [illegible] tion of the Uluksan Platform (Fig. 1, Ta[illegible]). Local variations along the Victor Bay-Strathcona Sound contact and within the Strathcona Sound interval in western Milne Inlet Trough suggest that relatively small fault blocks moved relative to one another during sedimentation ([illegible] 2). The unconformity, commonly marked by a conglom[illegible] dolostone clasts (debris flow?; Jackson *et al*., 1978, Fig. 10) is widespread across western Borden Peninsula (Figs. 2, 4). Near the White Bay Fault Zone a small reef complex (SSR) unconformably overlies Arctic Bay strata. Elsewhere in western Milne Inlet Trough, the contact is abruptly to gradationally conformable (Pl. 1, a, d).

Shelf carbonate sedimentation persisted above the Uluksan carbonate platform only in a rapidly subsiding area east and north of Nanisivik (Fig. 1, 3, 4, Plate 1, b h). There lower Strathcona Sound reefs (SSR) are conformable to locally unconformable above Victor Bay strata, and are laterally equivalent to, and overlain by lower Strathcona Sound (SSL) red, fine grained calcareous turbiditic siliciclastics that thicken and coarsen north eastward, where they grade laterally into 1000 m of coarse conglomerate along the White Bay Fault Zone (Fig. 2). Clasts of gneiss, carbonate and, locally, Nauyat basalt and Adams Sound quartzarenite are present. Erosion of the reef complex during redbed sedimentation provided debris flow breccias, present in lower Strathcona Sound siliciclastics (SSL) up to more than 100 m above the base of the formation.

Grey-green, calcareous, turbiditic, locally channel[illegible] coarse proximal submarine fan strata of the upper Strathcona Sound Formation (SSU proximal) were deposited [illegible] contemporaneously with the redbeds, but probably came from the southwest (Fig. 2). They interfingered with [illegible]

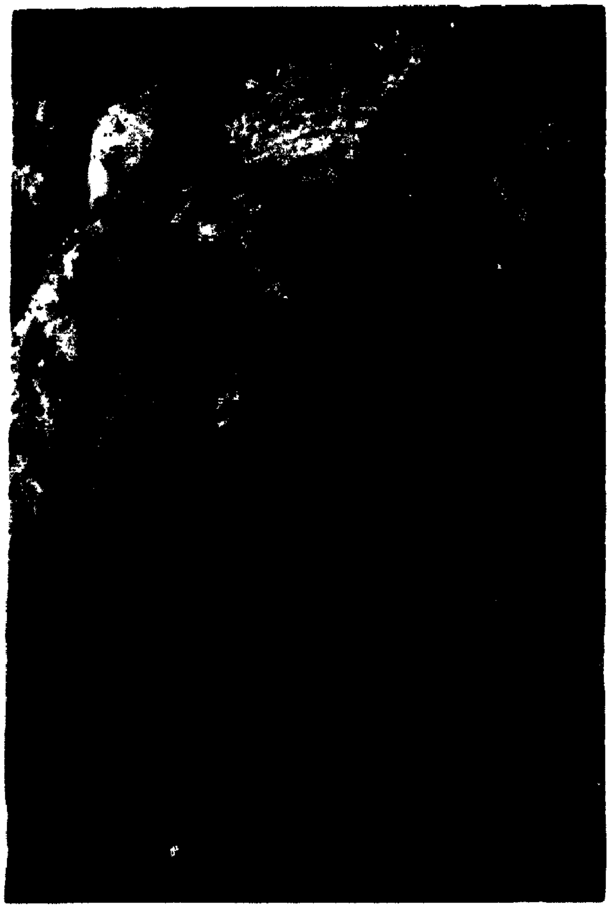


Fig. 3. *Conophyton* capped by a hemispheroidal stromatolite in reef complex.

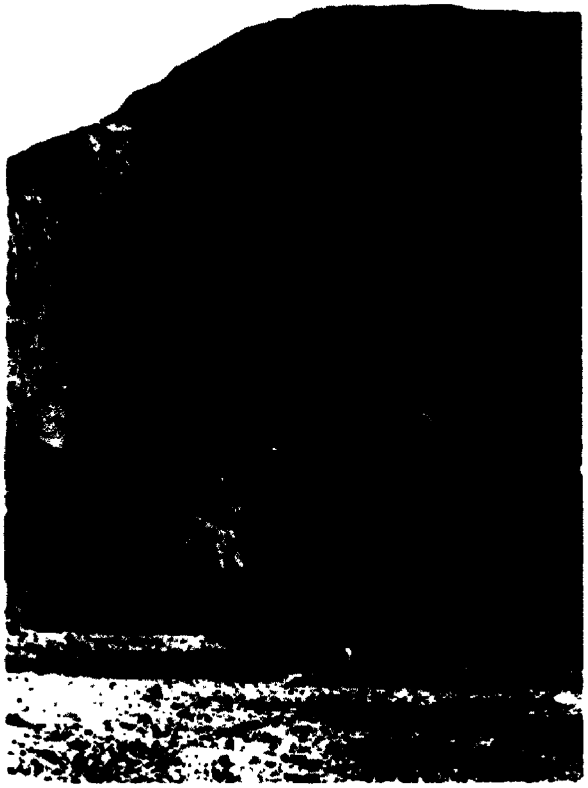


Fig. 4. Upper Victor Bay, with small domes, upturned to north and unconformably overlain by lower Strathcona Sound carbonate: a bioherm rimmed by carbonate-clast conglomerate. Hill est. 50 m high.

overrode the redbeds and the Athole Point carbonate basin, and grade laterally and northerly into grey-green, fine grained calcareous siliciclastic turbidite strata (SSU distal) that make up the entire Strathcona Sound Formation adjacent to Admiralty Inlet. SSU distal strata overrode most of Navy Board High and were deposited on the redbeds north of the high (Fig. 2).

The Athole Point Formation overlies the Victor Bay Formation conformably and, locally, unconformably in the Milne Inlet area. East of Milne Inlet the Athole Point Formation contains a basal round-clast carbonate-boulder conglomerate and consists mostly of basinal stromatolitic dark limestone, black cryptalgal laminite and turbiditic siltstone and sandstone. The siliciclastics increase in abundance westward and upward as the formation grades into Strathcona Sound strata.

As faulting abated lower Elwin intertidal to alluvial shale, sandstone and minor stromatolitic carbonate were deposited conformably on Strathcona Sound strata.

ANATOMY

MAJOR SUBDIVISIONS

Medium bedded to massive, micritic, light-weathering stromatolitic, locally reefal (upper Society Cliffs) dolostone, and brown dolostone composed of cryptalgal laminite are the major lithologies of the lower Uluksan carbonate platform (Society Cliffs). Round- and flat-clast dolostone conglomerate, angular-clast solution (karst) breccia, nodular gypsiferous dolostone, stromatolitic gypsiferous sabkha deposits and sandstone and shale are locally abundant. The lower Victor Bay shale member thins northward (Fig. 2) and is absent in Eclipse and North Bylot Troughs (Fig. 1). Upper Victor Bay strata are chiefly platformal, thin bedded to massive, stromatolitic, locally reefal dolostones interbedded with minor limestone, dark shale and sandstone. Carbonate flat-clast conglomerate is abundant only in Milne Inlet Trough.

The lower Strathcona Sound reef complexes (Fig. 2, Pl. 1) are made up of limestone and dolostone that comprise carbonate-clast orthoconglomerate, breccia and stromatolitic, structurally complex biohermal carbonate. The stromatolitic carbonate beds are variously intermixed with the conglomerate and breccia, including debris flows derived from the reefs, and minor shale and sandstone (Pl. 1, f, Fig. 4). Reefs are rare in the laterally equivalent Athole Point Formation.

LITHO- AND BIOFACIES

As in other Precambrian reefs, the builders are restricted to algal stromatolites. Several stromatolite types are abundant in most carbonate-rich units. These include: cryptalgal and coarser planar laminites; individual to laterally linked undulose, tabular or rectangular, low domal to hemispheroidal conical to columnar (*Conophyton*) types up to 1 m high (Pl. 1, g, h; Fig. 3); branching (digitate, dendroid) columnar (*Baicaila*) types; expanding upward columnar types; and spheroidal to ellipsoidal types.

Upper Arctic Bay Shale-Bearing Carbonate Shelf

Upper Arctic Bay strata thicken southeastward to over 320 m at Milne Inlet, where stromatolitic, locally siliciclastic grey limestone and dolostone become increasingly abundant toward the top of the formation. Carbonate beds are interbedded with shale and sandstone in as many as 50 shallowing upward cycles. Stromatolitic biohermal mounds occur individually and in small clusters in the carbonate beds and have relatively low relief. Individual bioherms range up to 10 m long and 3 m high and are brecciated locally.

Uluksan Carbonate Platform — Lower Part (Society Cliffs)

Society Cliffs strata thicken to 856 m at Milne Inlet (Fig. 2). In addition to the stromatolites commonly present tubular stromatolites (5 cm in diameter) and low domes with radially attached small columnar types occur in the Milne Inlet area. Bioherms are especially common in the middle to upper parts of the Society Cliffs Formation at Milne Inlet and southeast of Nanisivik. They are concentrated along a few stratigraphic horizons and most are less than 20 m in diameter. Dolostone breccia is common in the intervening depressions. Bioherms 30-60 m in diameter and 8-20 m high are locally common at Milne Inlet, and biohermal masses southeast of Nanisivik have a maximum length of about 900 m, and may exceed 100 m in height. Stromatolites are absent from an area in central Milne Inlet Trough, which may have been a high-energy shoal area (Geldsetzer, 1973b).

Uluksan Carbonate Platform — Upper Part (Victor Bay)

The Victor Bay Formation thickens to 730 m just east of Milne Inlet (Fig. 2). Stromatolites are most abundant in the eastern part of the basin and are uncommon in lower Victor Bay strata. A spectacular bioherm east of Milne Inlet (Fig. 5) is about 1500 m long, 270 m high, and extends up to 130 m into the Athole Point Formation. Carbonate-boulder conglomerates in uppermost Victor Bay, and basal Athole Point strata a few kilometres to the south are probably foreslope debris flows derived from the Victor Bay-Athole Point buildup.

Low domal bioherms from one to a few hundred metres across are common in uppermost Victor Bay strata in the vicinity of the lower Strathcona Sound main reef complex. Slump features and breccias are common in and just below the base of some of the bioherms, some of which extend up into Strathcona Sound strata. An isolated bioherm about 400 m across occurs just above the middle of the Victor Bay Formation in central Borden Peninsula and does not seem to be associated with breccia or conglomerate.

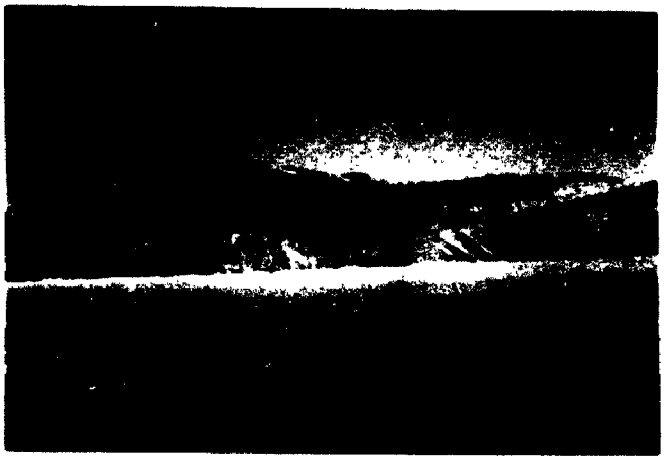


Fig. 5. Looking west across White Bay. Victor Bay (VB) and Athole Point (AP) strata containing large bioherm (B). Local relief is ca. 460 m.

Lower Strathcona Sound Main Reef Complex (SSR; Figure 2, Plate 1)

The main reef complex has a maximum thickness of 160-200 m and is characterized by the growth [illegible]ated to interconnected bioherms and bioherm complexes from less than 1 m to 200 m thick and 1 m to more than 800 m in length (Pl. 1, d). *Elongate bioherms tend to be oriented in northerly to northeasterly directions.*

Most of the larger bioherm cores comprise smaller coalescing, simple to complex domes (i.e. algal megadomes compare with similar structures in El Haddad *et al.*, 1984). These growth centres may be up to 60 m long and 25 m high, but most are up to 15 m across and 2-5 m high. Most basal bioherm strata are planar and gradational with underlying strata (Pl. 1, d). However, within a few metres upward layering in the cores becomes irregular to chaotic and contains a large variety of simple and complexly intergrown stromatolite assemblages. These include large distinctive conical *Conophyton* in colonies forming mounds up to 5 m high (cf. *Conophyton cylindricum*, *C. garganicum*, Schopf *et al.*, 1984) capped by 3 m of non-branching columnar stromatolites, spiked domal types and upward coalescent types (Pl. 1, g, h; Fig. 3). The tops of bioherms commonly contain shrinkage cracks and crevasses filled with red calcareous silt, and variously scattered angular to rounded carbonate clasts. These features suggest that the present domed and hummocky surface is in part an exhumed karsted erosion surface (Pl. 1, b-d).

Extensive erosion of the complex has produced a striking dendritic channel pattern (Pl. 1, c) that is in part controlled by the shapes of bioherms which commonly form the cores of intervening ridges. The channels may be spur and groove structures formed by tidal currents during reefal growth. Channels in the conglomerates commonly range up to 1 km in length and 100 m wide. Some contain shale, sandstone or fine carbonate conglomerate deriv

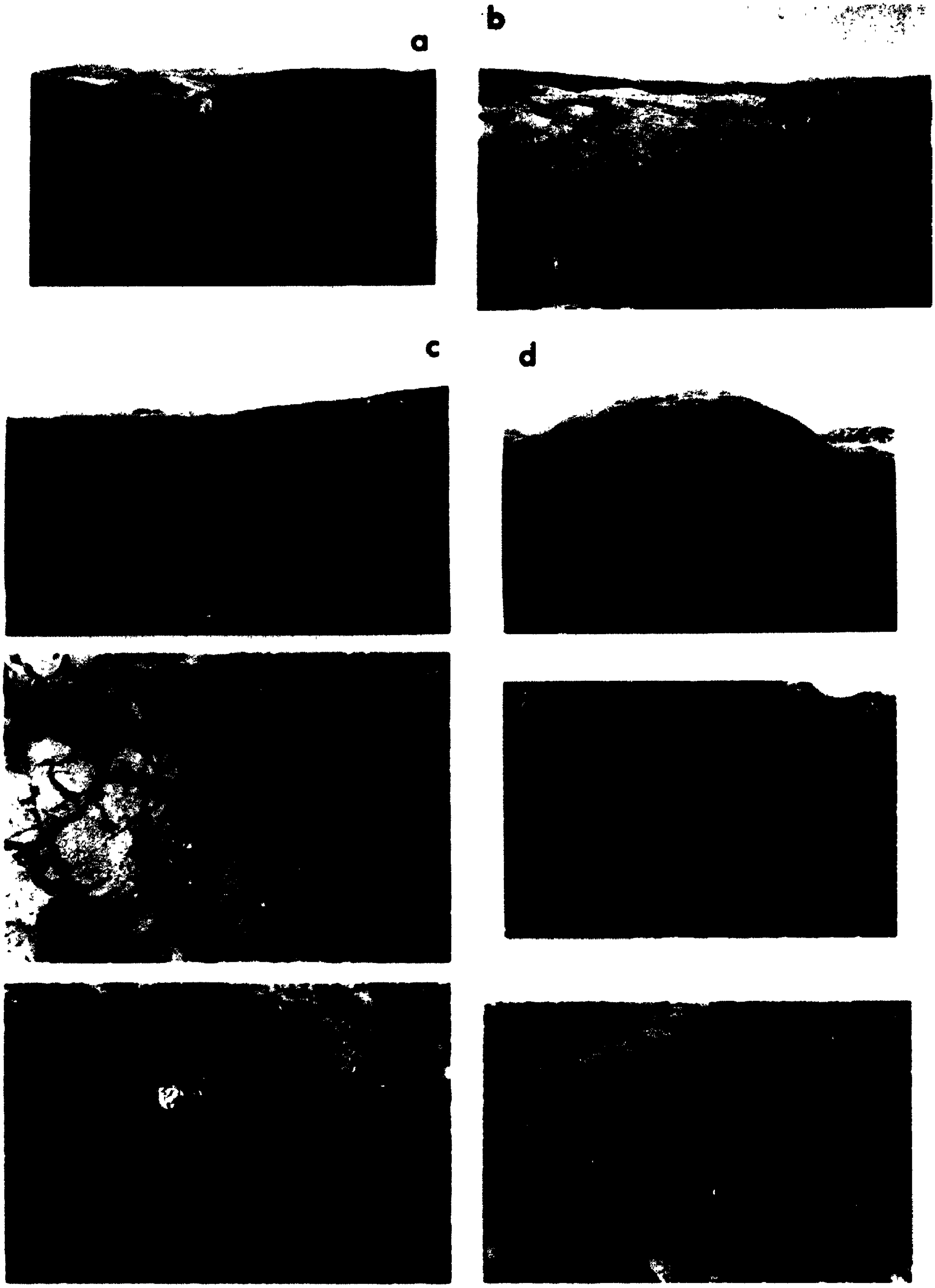


Plate 1

Plate 1. Lithofacies and biofacies of the lower Strathcona Sound reef complex. (a) Looking west, south side of Strathcona Sound, southwest of main reef complex. Cliff view in foreground est. 200 m. Lower part is Victor Bay Formation (VB) overlain conformably, and possibly interbedded with lower Strathcona Sound (SSL) interbedded redbeds and carbonates of lower off-reef facies. Carbonate beds (a) and (b) lie on unconformities and are overlain by upper off-reef red, brown and green siliciclastics. Carbonate bed (a) cuts down-section to south (left), and carbonate bed (b) cuts down-section to northwest. Upper turbiditic grey-green siliciclastics (SSU) overlie these strata up-section to left of photo. (b) Looking north across the eastern lower Strathcona Sound reef complex. Note broad domes marked by cliffs. Pond in foreground is about 0.2 km long. (c) Neohelikian dendritic erosional pattern developed on side of reef complex bioherm, about 450 m long. (d) Reef complex bioherm nearly 1000 m long and 150 m + high overlying planar Victor Bay (and SSL?) strata. Smaller domal structures are faintly visible. (e) Internal "dilation" breccia in reef complex. (f) Coarse dolostone-clast conglomerate in reef complex. (g) *Conophyton* in reef complex. Vertical section. (h) Horizontal sections through *Conophyton* in algal-mat dolostone of reef complex.

from the SSL member.

As a result of this partial reworking individual bioherms and the complex as a whole are aproned and in part mantled by debris flows consisting of carbonate clast breccia-conglomerate that is locally at least 60 m thick. Clasts range up to 10 m in diameter. A buildup north of Nanisivik is flanked by conglomeratic carbonate that contains olistoliths up to 1 km long.

Some coarse conglomerate (clasts to 1 m) on the east side of the complex contains closely packed, well rounded carbonate clasts. The clasts may have been derived from partially cemented carbonate or detached bulbous stromatolites which were slightly deformed after deposition. Some internal carbonate breccias formed in place (Pl. 1, e), have a matrix of dark red to brown fine calcareous shale or silt, and may be dilation breccias (Füchtbauer and Richter, 1983). The largest clasts occur in the western part of the complex, suggesting that the fore reef was to the west and back reef to the east.

Geldsetzer (1973b) considered these reefs to be part of the upper Victor Bay Formation. The authors recognize that some bioherms began in the upper Victor Bay and that some of these continued growing during deposition of Strathcona Sound strata. The bulk of the reefs discussed here, however, are considered to occur in the Strathcona Sound Formation, and much of the carbonate-clast conglomerate is considered to be coeval for the following reasons:

1. For several kilometres along strike a sharp conformable contact separates planar Victor Bay strata below from overlying strata that change upward from planar to undulose and biohermal within a few metres (Pl. 1, d).
2. Some Victor Bay carbonate is overlain conformably by, and locally interbedded with green and red Strathcona Sound siliciclastics. Interbedded carbonate beds thicken toward the main reef complex and mark disconformities within the Strathcona Sound Formation (Pl. 1, a).
3. Victor Bay and biohermal Strathcona Sound carbonates in the main reef complex are separated by 0.5-10 m of red shale and calcareous siltstone discontinuously for more than 10 km along a disconformable to conformable contact.
4. Locally, upturned Victor Bay carbonate is overlain unconformably by Strathcona Sound bioherms and carbonate-clast conglomerate (Fig. 4).
5. Stromatolites have grown between the clasts of coarse carbonate-clast conglomerate and bioherms have grown out over adjacent carbonate-clast conglomerate
6. Lower Strathcona Sound redbeds (SSL) intertongue with carbonates along the sides of several bioherms and underlie carbonate clast conglomerate capped by stromatolitic carbonate.
7. Stromatolitic carbonate and carbonate-clast conglomerate are variously intermixed within most bioherms
8. Locally disconformities in lower Strathcona Sound strata transgress downward into upper Victor Bay strata (e.g. just south of Pl. 1, a). Possibly the main erosional episode that truncated Victor Bay strata may have occurred after some Strathcona Sound strata had been deposited.

Offreef and Related Facies — Lower Strathcona Sound (SSL)

The lower Strathcona Sound redbed (SSL) member is about 300 m thick in the vicinity of the reef complex. The initial beds, directly above the Uluksan platform, and locally under the reef complex, are red to grey and green, thinly interbedded shale, limestone and calcareous siltstone and sandstone. These strata form a subunit about 1-100 m thick which at several localities contains one or more beds of carbonate-clast debris flow conglomerate that are up to 10 m thick adjacent to the reef complex but thin away from the complex (Pl. 1, a; Jackson *et al.*, 1978, fig. 11).

Athole Point Semi-Restricted Carbonate Basin

The Athole Point Formation is about 585 m thick in the Milne Inlet area. It thins westward, and in central Borden Peninsula intertongues with or is replaced by Strathcona Sound reefal carbonates and siliciclastics. Stromatolites are chiefly planar to undulose lamellar and unbranched or columnar types, and bioherms are rare. However, a spectacular bioherm east of Milne Inlet that straddles the Victor Bay-Athole Point contact is probably the upward extension of a Victor Bay reef buildup that extends west of Milne Inlet (Figs. 1, 5). The bioherm seems to interfinger with Athole Point strata (Fig. 5) so they are considered here to be coeval. However, the karsted upper surface of the bioherm suggests to Geldsetzer (1973b) that the buildup predates Athole Point deposition.

DIAGENESIS

Karsting and dolomitization have destroyed many of the features in the Society Cliffs Formation in Milne Inlet Trough of western Borden Peninsula. Dolomitization has also obliterated or masked many of the features of the Uluksan carbonate platform in Eclipse and North Bylot Troughs and, locally, many of the primary features in the bioherms of the lower Strathcona Sound reef complex. In the latter area a pseudo-breccia is common in the tops of many of the bioherm complexes. It consists of variously-shaped carbonate fragments up to more than a metre in diameter, in a matrix of completely recrystallized dolostone.

Chert replacement of stromatolites is sparse in the Uluksan platform on Borden Peninsula; it is more common in Society Cliffs than in Victor Bay strata, and more common in Eclipse Trough than in Milne Inlet Trough. Varicolored chert is locally abundant on Bylot Island and east of Milne Inlet. Upper Arctic Bay strata contain little chert; chert is rare or absent in the Athole Point Formation and sparse in the lower Strathcona Sound reef complex.

DEPOSITIONAL ENVIRONMENT, HISTORY

Periodic influxes of terrigenous material into the Milne Inlet area interrupted deposition of upper Arctic Bay platform carbonates. Deposition occurred in shallowing upward cycles that include marine-influenced delta to alluvial fan deposits in mixed clastic shoreline and shallow shelf environments.

Society Cliffs strata were deposited on a shallow subtidal to intertidal shelf. Eastern basin-margin coastal gypsiferous sabkha sediments were deposited in alluvial plain to intertidal environments. Society Cliffs karsting occurred both before and after Victor Bay deposition.

Lower Victor Bay strata were probably deposited in a starved subtidal environment. The upper Victor Bay carbonates were deposited on a shallow subtidal to intertidal shelf. Many of the flat-clast conglomerate beds are probably debris flows.

Strathcona Sound carbonate shelf sedimentation occurred in shallow subtidal to intertidal environments and persisted only in the rapidly subsiding area of the reef complex. The rapid subsidence allowed bioherms to build rapidly upward to offset the encroachment of siliciclastics. Similarly, contemporaneous carbonate sedimentation in subtidal to supratidal environments persisted in the Athole Point semi-restricted basin at Milne Inlet because of local downfaulting.

AGE

The age of the Bylot Supergroup is considered to be about 1220 Ma. A Rb-Sr isochron age of 1129 Ma and 17 whole-rock K-Ar ages ranging from 762-1221 Ma have been obtained from the Nauyat basalts (Jackson and Iannelli, 1981). The 1221 Ma age agrees well with an estimate by Fahrig *et al.* (1981), who suggested on the basis of paleomagnetic data that deposition of the Bylot Supergroup began about 1220 million years ago and continued over a period of 18 Ma.

ECONOMIC POTENTIAL

Mineral deposits in Borden Basin have been studied by Geldsetzer (1973a), Olson (1977, 1984), Sangster (1981), and Jackson and Sangster (1987). Nanisivik Mines' lead-zinc ore body lies in the Society Cliffs Formation and there may well be other, similar deposits. It has been suggested that the Nanisivik ore was derived from the underlying Arctic Bay Formation (Olson, 1977, 1984). However, Society Cliffs strata, especially biohermal buildups, may have been the main source. Traces of sphalerite are common throughout much of the Society Cliffs Formation. Zinc, deposited with the carbonates, may have been concentrated during karsting. Lower Victor Bay basinal shales may have acted as a cap-rock to the ore-bearing solutions.

Large gypsum deposits and small hematite bodies occur chiefly in the Society Cliffs formation. Bitumen traces are common in the Uluksan Group and most abundant in Athole Point strata. Chances of hydrocarbon accumulations on land are slim, although favorable structures exist offshore. Negligible amounts of petroleum and/or natural gas might be trapped in larger, buried bioherms.

ACKNOWLEDGMENTS

We acknowledge the ideas contributed by Guy Narbonne during early discussions on the Strathcona Sound Formation (*in* Jackson *et al.*, 1978). We are also grateful to Helmut Geldsetzer, John Henderson, Noel James, and Guy Narbonne for critically reading the manuscript, noting several errors and suggesting many improvements.

REFERENCES

Blackadar, R.G., 1970. Precambrian geology, northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 91.

Blackadar, R.G., Davison, W.L. and Trettin, H.P., 1968a. Milne Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1235A.

———, 1968b. Navy Board Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1236A.

———, 1968c. Arctic Bay-Cape Clarence, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1237A.

———, 1968d. Moffet Inlet-Fitzgerald Bay, District of Franklin (map with marginal notes); Geological Survey of Canada, May 1238A.

El Haddad, A., Aissaoui, D.M. and Soliman, M.A., 1984. Mixed carbonate-siliciclastic sedimentation on a Miocene fault-block, Gulf of Suez, Egypt: Sedimentary Geology, v. 37, p. 185-202.

Fahrig, W.F., Christie, K.W. and Jones D.L., 1981. Paleomagnetism of the Bylot Basins: Evidence for Mackenzie continental tensional tectonics; *In:* Proterozoic Basins of Canada, F.H.A. Campbell (Ed.), Geological Survey of Canada, Paper 81-10, p. 303-312.

Füchtbauer, H. and Richter, D.K., 1983. Carbonate internal breccias: a source of mass flows at early geosynclinal platform margins in Greece, *In:* The Shelf Break, D.J. Stanley and G.T. Moore (Eds.), Society of Economic Paleontologists and Mineralogists, Special Publication 33, p. 207-215.

Geldsetzer, H., 1973a. Syngenetic dolomitization and sulfide mineralization; *In:* Ores in Sediments, G.G. Amstutz and A.J. Bernard, (Eds.), Springer-Verlag, p. 115-127.

______, 1973b. The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T.; *In:* Geology of the Canadian Arctic, J.D. Aitken and D.J. Glass, (Eds.), Geological Association of Canada - Canadian Society of Petroleum Geologists, Symposium Proceedings, p. 99-126.

Iannelli, T.R., 1979. Stratigraphy and depositional history of some Upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin: *In:*Current Research, Geol. Surv. Can., Paper 79-1A, p. 45-56.

Jackson, G.D. and Cumming, L.M., 1981. Evaporites and folding in the Neohelikian Society Cliffs Formation, northeastern Bylot Island, Arctic Canada; *In:* Current Research, Geological Survey of Canada, Paper 81-1C, p. 35-44.

______ and Davidson, A., 1975. Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29.

______, Davidson, A. and Morgan, W.C., 1975. Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-25.

______ and Iannelli, T.R., 1981. Rift-related cyclic sedimentation in the Neohelikian Borden Basin, northern Baffin Island; *In:* Proterozoic basins of Canada, F.H.A. Campbell, (Ed.), Geological Survey of Canada, Paper 81-10, p. 269-302.

______, Iannelli, T.R., Narbonne, G.M. and Wallace, P.J., 1978. Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14.

______, Iannelli, T.R. and Tilley, B.J., 1980. Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; *In:* Current Research, Geological Survey of Canada, Paper 80-1A, p. 319-328.

______, Iannelli, T.R., Knight, R.D. and Lebel, D., 1985. Neohelikian Bylot Supergroup of Borden Rift Basin, northwestern Baffin Island, District of Franklin; *In* Current Research, Geological Survey of Canada, Paper 85-1A, p. 639-649.

______ and Sangster, D.F., 1987. Resource geology and potential of a proposed national park, Bylot and N.W. Baffin Island area, Geological Survey of Canada, Paper 87-17.

Lemon, R.R.H. and Blackadar, R.B., 1963. Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328.

Olson, R.A., 1977. Geology and genesis of zinc lead deposits within a late Precambrian dolomite, northern Baffin Inland N.W.T., unpublished Ph.D. Thesis, University of British Columbia

______, 1984. Genesis of paleokarst and strata-bound zinc-lead sulfide deposits in a Proterozoic dolostone, northern Baffin Island, Canada, Economic Geology, v. 79, p. 1059-1103.

Sangster, D.F., 1981. Three potential sites for the occurrence of stratiform shale-hosted lead-zinc deposits in the Canadian Arctic, *In* Current Research, Geological Survey of Canada, Paper 81-1A, p. 1-8

Schopf, J.W., Zhu, W-Q., Zu, Z.L. and Hsu, J., 1984. Proterozoic stromatolitic microbiotas of the 1400-1500 Ma-old Gaoyuzhuang Formation near Jixian, northern China: Precambrian Research, v. 24, p. 335-349.

Trettin, H.P., 1969. Lower Paleozoic sediments of northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 157.

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

Project 770013

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

Jackson, G.D., Iannelli, T.R., Knight, R.D., and Lebel, D., Neohelikian Bylot Supergroup of Borden Rift Basin, northwestern Baffin Island, District of Franklin; in *Current Research, Part A, Geological Survey of Canada, Paper 85-1A, p. 639-649, 1985.*

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

Table 75.1. [illegible] formations

Era	Supergroup	Group	Formation	Members
HADRYNIAN			Franklin Intrusi[illegible]abase	
		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 SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
			Chiefly Unconformable?	Gradational to Unconformable
		EQALULIK	Fabricius Fiord Fm: (400-2000 m+) FF_4: Arkose, conglomerate, dolostone FF_3: Subarkose, conglomerate FF_2: Shale, quartzarenite FF_1: Quartzarenite, shale	Arctic Bay Fm: (180-770 m) AB_4: Shale, dolostone AB_3: Shale, siltstone AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
			Conformable, Abrupt to Gradational	
			Adams Sound Fm: (0-610 m) AS_3: Quartzarenite, conglomerate, shale AS_2: Quartzarenite AS_1: Quartzarenite, conglomerate	AS_U: Quartzarenite AS_L: 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

Table 75.1. [illegible] formations

HADRYNIAN			Franklin Intrusive 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?	SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
		EQALULIK	Fabricius Fiord Fm: (400-2000 m+) FF_4: Arkose, conglomerate, dolostone FF_3: Subarkose, conglomerate FF_2: Shale, quartzarenite FF_1: Quartzarenite, shale	Gradational to Unconformable Arctic Bay Fm: (180-770 m) AB_4: Shale, dolostone AB_3: Shale, siltstone AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
			Conformable, Abrupt to Gradational	
			Adams Sound Fm: (0-610 m) AS_3: Quartzarenite, conglomerate, shale AS_2: Quartzarenite AS_1: Quartzarenite, conglomerate	AS_U: Quartzarenite AS_L: 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,

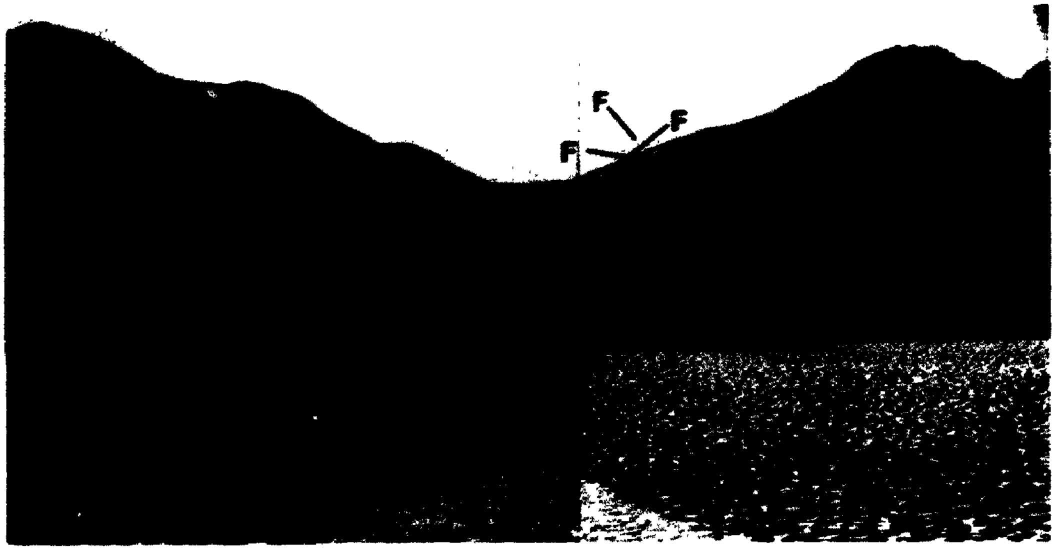


Figure 75.2. *Looking east at Elwin Inlet toward splay from Hartz Mountain Fault Zone. NA = Nauyat Fm., AS = Adams Sound Formation, AB = Arctic Bay Formation, SC = Uluksan Group, F = faults. The highest elevations are about 620 m. Photo by G.D. Jackson.*

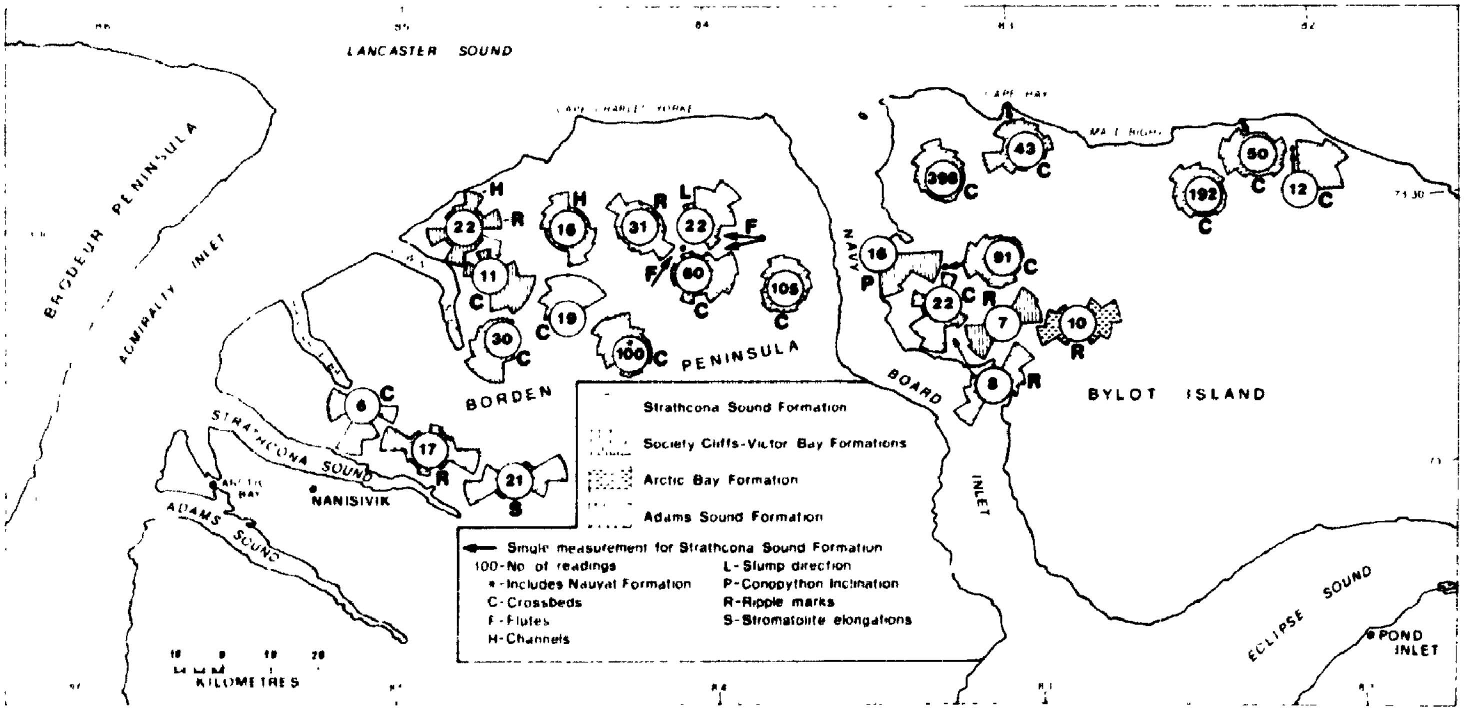


Figure 75.3. *Paleocurrent data for some of Bylot Supergroup strata. Radius of circle in centre of rose is 20 per cent. Readings start on the circumference.*

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

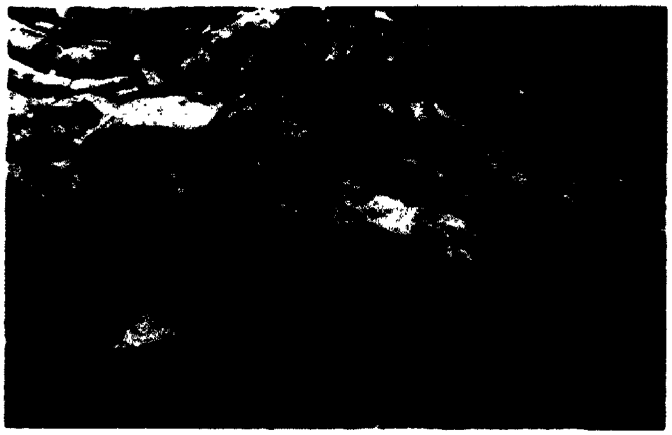


Figure 75.4. Deformed gypsum bed in Uluksan Group, northwest Bylot Island. The lens cap is about 5 cm. Photo by G.D. Jackson. (GSC 204194)

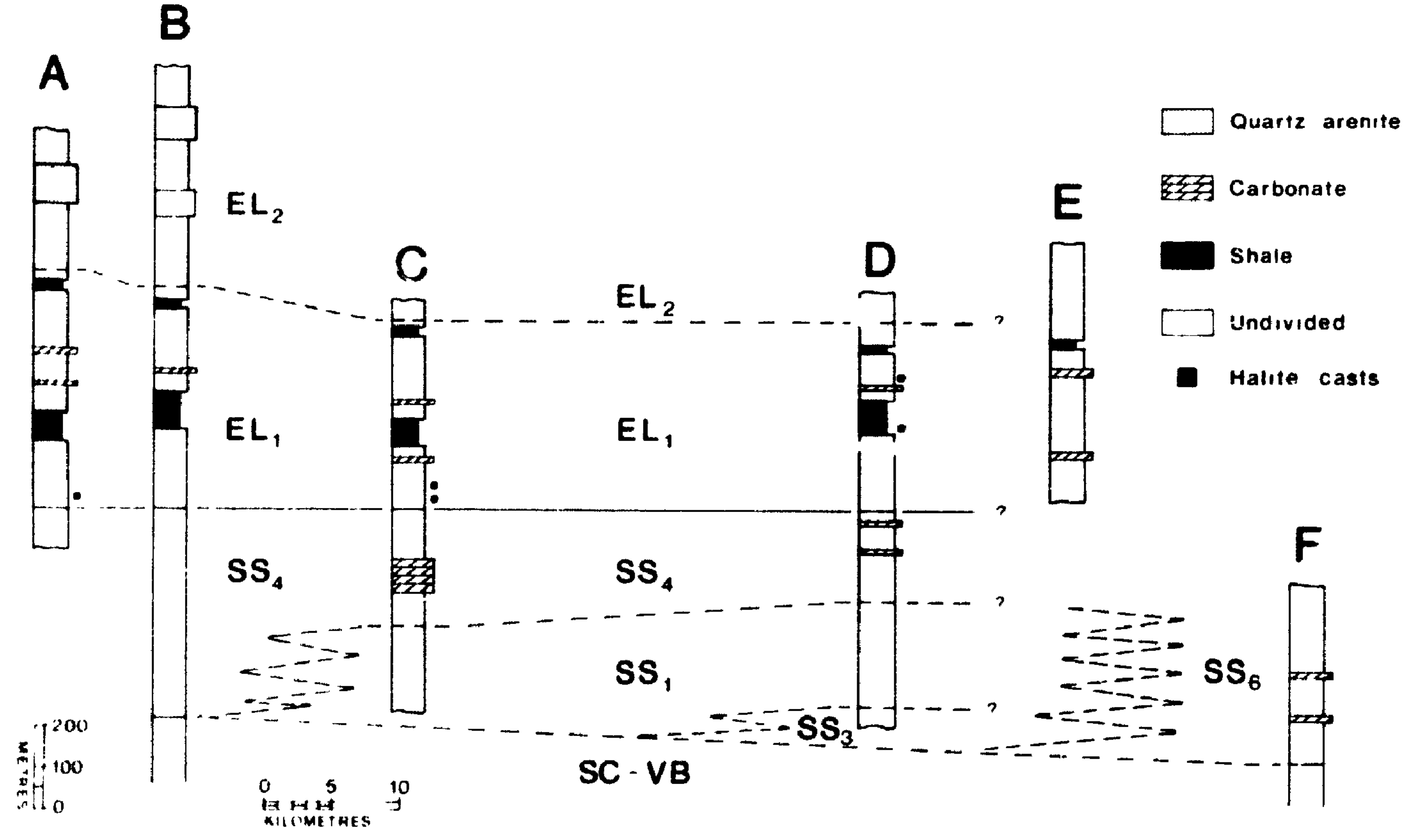


Figure 75.5. Generalized stratigraphy of Strathcona Sound Formation ($SS_{1,3,4,6}$) and Elwin Formation ($EL_{1,2}$), northern Borden Basin.

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

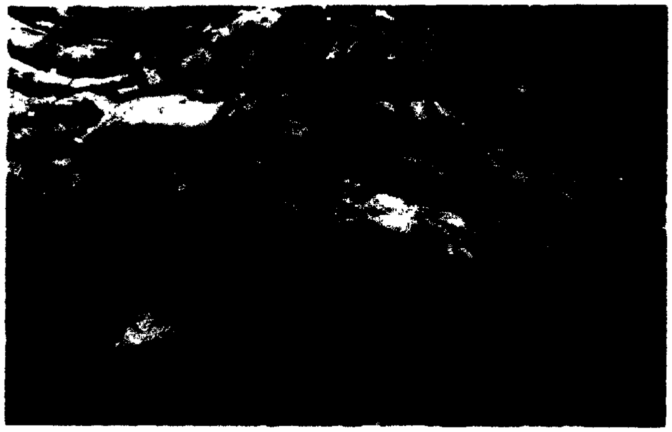


Figure 75.4. *Deformed gypsum bed in Uluksan Group, northwest Bylot Island. The lens cap is about 5 cm. Photo by G.D. Jackson. (GSC 204194)*

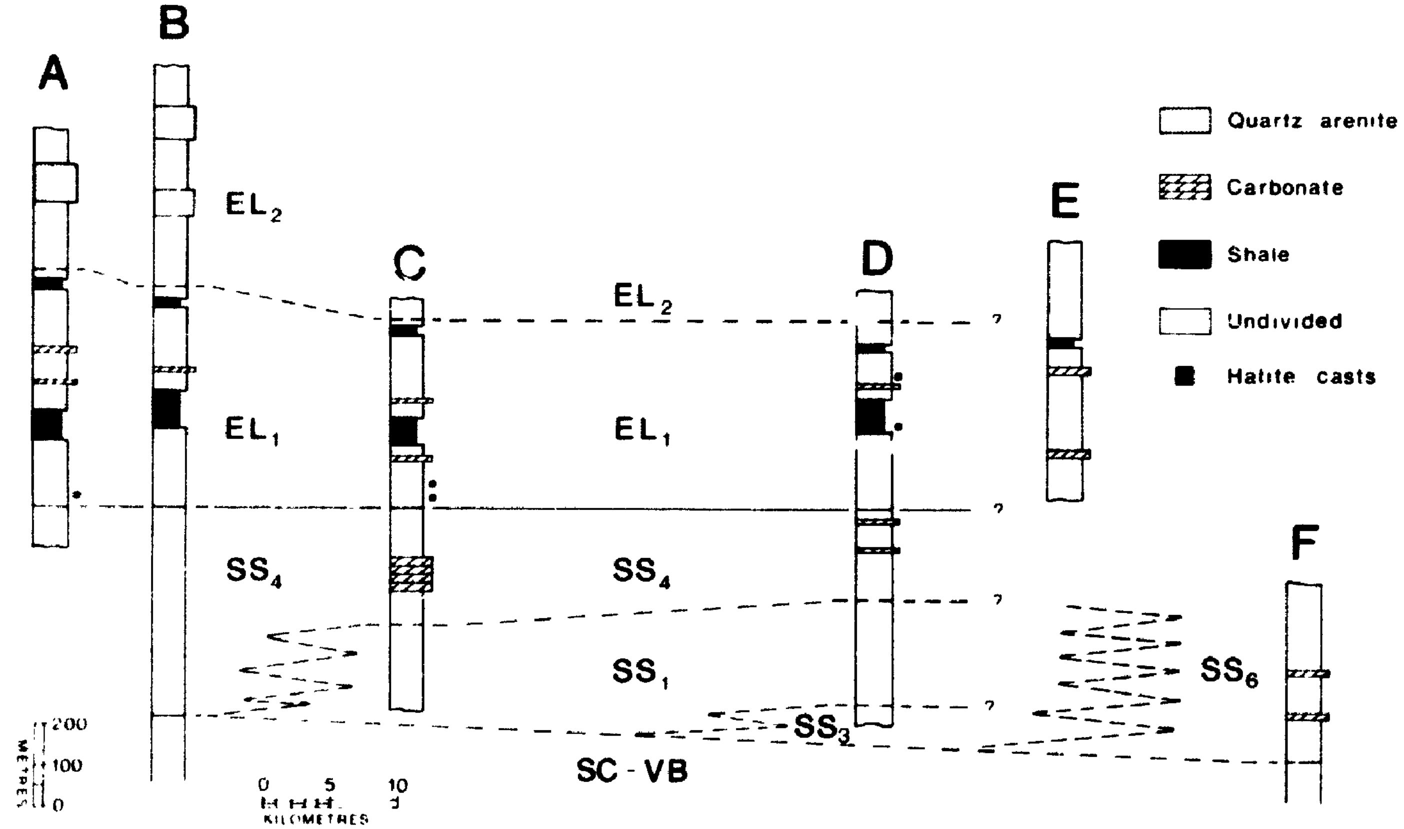


Figure 75.5. *Generalized stratigraphy of Strathcona Sound Formation ($SS_{1,3,4,6}$) and Elwin Formation ($EL_{1,2}$), northern Borden Basin.*

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_5 - 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.

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.

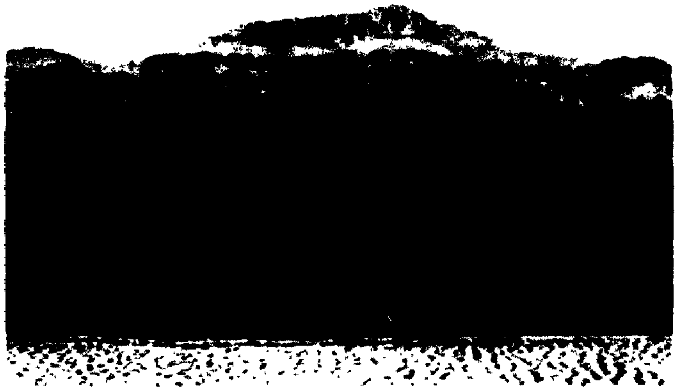


Figure 75.11. *Upper Elwin (EL_2) strata on the north side of Elwin Inlet, capped by vertically jointed lower Paleozoics. QA = thick quartzarenite unit in section A of Fig. 5. The measured section is indicated by the black line. The peak is 582 m high. Photo by G.D. Jackson. (GSC 201952-N)*

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.

Blackadar, R.G. (cont.)
1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 91, 89 p.

Christie, K.W. and Fahrig, W.F.
1983: Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop; Canadian Journal of Earth Sciences, v. 20, p. 275-289.

Clayton, R.H. and Thorpe, L.
1982: Geology of the Navisivik Zinc-lead deposit; in Precambrian sulphide deposits, ed. R.W. Hutchinson, C.D. Spence and J.M. Franklin; Geological Association of Canada, Special Paper 25, p. 739-758.

Dawes, P.R. and Kerr, J.W. (editors)
1982: Nares Strait and the drift of Greenland: a conflict in plate tectonics; Meddelelser Om Grønland, Geoscience 8, Copenhagen, 392 p.

Frisch, T.
1983: Reconnaissance geology of the Precambrian Shield of Ellesmere, Devon and Coburg Islands, Arctic Archipelago: a preliminary account; Geological Survey of Canada, Paper 82-10, 11 p.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in Ores in Sediments, ed. G.G. Amstutz and A.J. Bernard; Springer-Verlag, p. 115-127.

1973b: The tectono-sedimentary development of an algal-dominated Helikian succession on norther Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, p. 99-126.

Iannelli, T.R.
1979: Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 45-56.

Jackson, G.D. and Davidson, A.
1975: Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29, 12 p.

Jackson, G.D. and Iannelli, T.R.
1981: Rift-related cyclic sedimentation in the Neohelikian Borden Basin, norther Baffin Island; in Proterozoic Basins of Canada, ed. F.H.A. Campbell; Geological Survey of Canada, Paper 81-10, p. 269-302.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-25, 33 p.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J.
1978: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Jackson, G.D., Iannelli, T.R., and Tilley, B.J.
1980: Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 319-328.

Kerr, J.W.
1980: Structural framework of Lancaster Aulacogen, Arctic Canada; Geological Survey of Canada, Bulletin 319, 24 p.

Lemon, R.R.H. and Blackadar, R.B.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Le Pichon, X., Sibnet, J.C., and Francheteau, J.
1977: The fit of the continents around the North Atlantic Ocean; Tectonophysics, v. 38, p. 169-209.

Marcussen, C. and Abrahamsen, N.
1983: Palaeomagnetism of the Proterozoic Zig-Zag Dal basalt and the Midsommers dolerites, eastern north Greenland; Geophysical Journal of Royal Astronomical Society, v. 73, p. 367-387.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; unpublished Ph.D. thesis, University of British Columbia, 371 p.

1984: Genesis of paleokarst and strata-bound zinc-lead sulfide deposits in a Proterozoic dolostone, northern Baffin Island, Canada; Economic Geology, v. 79, p. 1059-1103.

Blackadar, R.G. (cont.)
1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 91, 89 p.

Christie, K.W. and Fahrig, W.F.
1983: Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop; Canadian Journal of Earth Sciences, v. 20, p. 275-289.

Clayton, R.H. and Thorpe, L.
1982: Geology of the Navisivik Zinc-lead deposit; in Precambrian sulphide deposits, ed. R.W. Hutchinson, C.D. Spence and J.M. Franklin; Geological Association of Canada, Special Paper 25, p. 739-758.

Dawes, P.R. and Kerr, J.W. (editors)
1982: Nares Strait and the drift of Greenland: a conflict in plate tectonics; Meddelelser Om Grønland, Geoscience 8, Copenhagen, 392 p.

Frisch, T.
1983: Reconnaissance geology of the Precambrian Shield of Ellesmere, Devon and Coburg Islands, Arctic Archipelago: a preliminary account; Geological Survey of Canada, Paper 82-10, 11 p.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in Ores in Sediments, ed. G.G. Amstutz and A.J. Bernard; Springer-Verlag, p. 115-127.

1973b: The tectono-sedimentary development of an algal-dominated Helikian succession on norther Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, p. 99-126.

Iannelli, T.R.
1979: Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 45-56.

Jackson, G.D. and Davidson, A.
1975: Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29, 12 p.

Jackson, G.D. and Iannelli, T.R.
1981: Rift-related cyclic sedimentation in the Neohelikian Borden Basin, norther Baffin Island; in Proterozoic Basins of Canada, ed. F.H.A. Campbell; Geological Survey of Canada, Paper 81-10, p. 269-302.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-25, 33 p.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J.
1978: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Jackson, G.D., Iannelli, T.R., and Tilley, B.J.
1980: Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 319-328.

Kerr, J.W.
1980: Structural framework of Lancaster Aulacogen, Arctic Canada; Geological Survey of Canada, Bulletin 319, 24 p.

Lemon, R.R.H. and Blackadar, R.B.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Le Pichon, X., Sibnet, J.C., and Francheteau, J.
1977: The fit of the continents around the North Atlantic Ocean; Tectonophysics, v. 38, p. 169-209.

Marcussen, C. and Abrahamsen, N.
1983: Palaeomagnetism of the Proterozoic Zig-Zag Dal basalt and the Midsommers dolerites, eastern north Greenland; Geophysical Journal of Royal Astronomical Society, v. 73, p. 367-387.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; unpublished Ph.D. thesis, University of British Columbia, 371 p.

1984: Genesis of paleokarst and strata-bound zinc-lead sulfide deposits in a Proterozoic dolostone, northern Baffin Island, Canada; Economic Geology, v. 79, p. 1059-1103.

16.

RIFT-RELATED CYCLIC SEDIMENTATION IN THE NEOHELIKIAN BORDEN BASIN, NORTHERN BAFFIN ISLAND

G.D. Jackson[1] and T.R. Iannelli[2]

Jackson, G.D. and Iannelli, T.R., Rift-related cyclic sedimentation in the Neohelikian Borden Basin, northern Baffin Island; in Proterozoic Basins of Canada, F.H.A. Campbell, editor; Geological Survey of Canada, Paper 81-10, p. 269-302, 1981.

Abstract

Mid-Proterozoic sedimentation in the Borden Basin began as 1000 m of braided fluvial to marginal marine quartz arenites and plateau basalts accumulated over a local regolith developed on a peneplaned gneiss complex. Deposition was initially restricted to a narrow fault-controlled channel that merged northwestward into an alluvial braidplain. The overlying 1100 m of strata were deposited during major faulting in large sandstone-shale, marine-influenced delta fan complexes that grade laterally northward into subtidal shales.

Subordinate faulting continued during deposition of the succeeding 1700 m of supratidal to shallow subtidal stromatolitic shelf carbonates that include a subtidal shale zone, and contain economic lead-zinc deposits and many gypsiferous coastal sabkha cycles.

Major faulting accompanied by local erosion and karsting occurred as about 1000 m of interbedded sandstones, shales, carbonates and boulder conglomerates accumulated in alluvial fan to subtidal environments. The uppermost 1200 m of strata were deposited during a relatively stable tectonic interval. Fluvial to intertidal sandstones grade upward into shallow subtidal shelf quartz arenites, and are overlain disconformably by lower Paleozoic strata.

Borden Basin was initiated as a Neohelikian aulacogen in the North Baffin Rift Zone. The Borden is one of several similar, penecontemporaneous, temporarily interconnected, basins which developed by rifting along the northwest edge of the Canadian-Greenlandic Shield. The basins are probably related to the 1200-1250 Ma old opening of the Proto-Arctic Ocean – the Poseidon Ocean.

Résumé

Dans le bassin de Borden, la sédimentation du Protérozoïque moyen a débuté par l'accumulation d'arénites quartzeuses d'origine fluviatile (cours d'eau anastomosés) à marine (milieu marginal) et l'accumulation de basaltes de plateaux, au-dessus d'un régolite local formé sur un complexe gneissique pénéplané. La sédimentation était initialement restreinte à un étroit chenal limité par des failles, qui fusionnait au nord-ouest avec une plaine alluviale réticulée. Les 1100 m de couches sus-jacentes se sont déposés pendant la formation de grandes failles dans les vastes complexes deltaïques qui montrent des influences marines, sont constitués de grès et de schistes argileux, et passent latéralement à des schistes argileux de type subtidal vers le nord.

Ensuite s'est manifestée une phase moins forte de fracturation pendant le dépôt de 1700 m de sédiments stromatolitiques carbonatés sur une plate-forme supratidale à subtidale peu profonde, contenant un niveau subtidal de schistes argileux et des gîtes minéraux exploitables de plomb et zinc, ainsi que de nombreux cycles de sebkha littorale à couches gypsifères.

Une phase de forte fracturation, suivie de processus locaux d'érosion et karstification a accompagné l'accumulation d'environ 1000 m de couches interstratifiées de grès, schistes argileux, carbonates et conglomérats de blocs, dans des milieux de cône alluvial ou de type subtidal.

Les 1200 m supérieurs de strates se sont formés pendant un intervalle de stabilité tectonique relative. Les grès fluviatiles à intertidaux passent progressivement vers le haut à des arénites quartzeuses de plate-forme subtidale peu profonde, et sont recouverts en discordance d'érosion par des strates datant de la fin du Paléozoïque.

Le bassin de Borden a tout d'abord été au Néohélikien un aulacogène dans la zone de rift du nord de l'île Baffin. Le bassin de Borden est l'un de plusieurs bassins similaires, presque contemporains, temporairement reliés entre eux, qui résultent de la fracturation du rebord nord-ouest du bouclier canadien – Groenlandais. La formation de ces bassins résulte probablement de l'ouverture, il y a 1200 à 1250 Ma, de l'océan Proto-arctique – ou océan de Poséidon.

---

[1] Geological Survey of Canada, 601 Booth Street, Ottawa K1A 0E8.
[2] Department of Geology, University of Western Ontario, London N6A 5B7.

16.

RIFT-RELATED CYCLIC SEDIMENTATION IN THE NEOHELIKIAN BORDEN BASIN, NORTHERN BAFFIN ISLAND

G.D. Jackson[1] and T.R. Iannelli[2]

Jackson, G.D. and Iannelli, T.R., Rift-related cyclic sedimentation in the Neohelikian Borden Basin, northern Baffin Island; in Proterozoic Basins of Canada, F.H.A. Campbell, editor; Geological Survey of Canada, Paper 81-10, p. 269-302, 1981.

Abstract

Mid-Proterozoic sedimentation in the Borden Basin began as 1000 m of braided fluvial to marginal marine quartz arenites and plateau basalts accumulated over a local regolith developed on a peneplaned gneiss complex. Deposition was initially restricted to a narrow fault-controlled channel that merged northwestward into an alluvial braidplain. The overlying 1100 m of strata were deposited during major faulting in large sandstone-shale, marine-influenced delta fan complexes that grade laterally northward into subtidal shales.

Subordinate faulting continued during deposition of the succeeding 1700 m of supratidal to shallow subtidal stromatolitic shelf carbonates that include a subtidal shale zone, and contain economic lead-zinc deposits and many gypsiferous coastal sabkha cycles.

Major faulting accompanied by local erosion and karsting occurred as about 1000 m of interbedded sandstones, shales, carbonates and boulder conglomerates accumulated in alluvial fan to subtidal environments. The uppermost 1200 m of strata were deposited during a relatively stable tectonic interval. Fluvial to intertidal sandstones grade upward into shallow subtidal shelf quartz arenites, and are overlain disconformably by lower Paleozoic strata.

Borden Basin was initiated as a Neohelikian aulacogen in the North Baffin Rift Zone. The Borden is one of several similar, penecontemporaneous, temporarily interconnected, basins which developed by rifting along the northwest edge of the Canadian-Greenlandic Shield. The basins are probably related to the 1200-1250 Ma old opening of the Proto-Arctic Ocean – the Poseidon Ocean.

Résumé

Dans le bassin de Borden, la sédimentation du Protérozoïque moyen a débuté par l'accumulation d'arénites quartzeuses d'origine fluviatile (cours d'eau anastomosés) à marine (milieu marginal) et l'accumulation de basaltes de plateaux, au-dessus d'un régolite local formé sur un complexe gneissique pénéplané. La sédimentation était initialement restreinte à un étroit chenal limité par des failles, qui fusionnait au nord-ouest avec une plaine alluviale réticulée. Les 1100 m de couches sus-jacentes se sont déposés pendant la formation de grandes failles dans les vastes complexes deltaiques qui montrent des influences marines, sont constitués de grès et de schistes argileux, et passent latéralement à des schistes argileux de type subtidal vers le nord.

Ensuite s'est manifestée une phase moins forte de fracturation pendant le dépôt de 1700 m de sédiments stromatolitiques carbonatés sur une plate-forme supratidale à subtidale peu profonde, contenant un niveau subtidal de schistes argileux et des gîtes minéraux exploitables de plomb et zinc, ainsi que de nombreux cycles de sebkha littorale à couches gypsifères.

Une phase de forte fracturation, suivie de processus locaux d'érosion et karstification a accompagné l'accumulation d'environ 1000 m de couches interstratifiées de grès, schistes argileux, carbonates et conglomérats de blocs, dans des milieux de cône alluvial ou de type subtidal.

Les 1200 m supérieurs de strates se sont formés pendant un intervalle de stabilité tectonique relative. Les grès fluviatiles à intertidaux passent progressivement vers le haut à des arénites quartzeuses de plate-forme subtidale peu profonde, et sont recouverts en discordance d'érosion par des strates datant de la fin du Paléozoïque.

Le bassin de Borden a tout d'abord été au Néohélikien un aulacogène dans la zone de rift du nord de l'île Baffin. Le bassin de Borden est l'un de plusieurs bassins similaires, presque contemporains, temporairement reliés entre eux, qui résultent de la fracturation du rebord nord-ouest du bouclier canadien – Groenlandais. La formation de ces bassins résulte probablement de l'ouverture, il y a 1200 à 1250 Ma, de l'océan Proto-arctique – ou océan de Poséidon.

---

[1] Geological Survey of Canada, 601 Booth Street, Ottawa K1A 0E8.
[2] Department of Geology, University of Western Ontario, London N6A 5B7.

INTRODUCTION

As much as 6100 m of late Proterozoic (Neohelikian) strata are spectacularly exposed in towering castellated cliffs along inlets and fiord-like sounds of rugged, mountainous northern Baffin and Bylot islands (Fig. 16.1). These strata nonconformably overlie an Archean-Aphebian gneiss complex, are intruded by Hadrynian Franklin diabase dykes, and are overlain unconformably by Paleozoic and Cretaceous-Eocene strata. Lemon and Blackadar (1963) and Blackadar (1970) documented early exploratory work, established the stratigraphic succession, and defined the formations. Other recent studies include those by Blackadar (1968a-d), Galley (1978), Geldsetzer (1973a,b), Graf (1974), Iannelli (1979), Jackson and Davidson (1975), Jackson et al. (1975, 1978a,b, 1980), Olson (1977), and Sangster (1981).

This paper presents primarily results obtained during Operation Borden (1977, 1978 and 1979 field seasons) and results from some previous studies. All Rb-Sr ages quoted have been calculated, or recalculated, using $\lambda^{87}\text{Rb} = 1.42 \times 10^{-11}\text{a}^{-1}$.

The basic formational nomenclature erected by Lemon and Blackadar (1963) and by Blackadar (1970) for the Neohelikian strata has been retained in this paper, although individual formations have been divided into members (e.g. see Iannelli, 1979; Jackson and Davidson, 1975; Jackson et al., 1975, 1978a,b, 1980). Some formations need to be better defined and reference sections selected to augment the type sections. It is also considered more logical to classify the formations into 3 groups rather than the 2 groups of Lemon and Blackadar (1963).

The three groups – lower clastic (Eqalulik), middle carbonate platform (Uluksan), and upper clastic (Nunatsiaq[1]) are commonly separated by intra-basinal disconformities, and are here referred to collectively as the Bylot Supergroup (Table 16.1, Fig. 16.2).

The Neohelikian strata of the Bylot Supergroup were assigned to the Borden Basin by Christie et al (1972). Deposition in the eastern part of the basin occurred predominantly in three grabens of the North Baffin Rift Zone (Jackson et al., 1975) separated by basement horsts that both plunge and die out toward the northwest (Fig. 16.2, 16.26).

The Bylot Supergroup has been considered to be of Helikian and/or Hadrynian age by recent workers (Blackadar, 1970; Geldsetzer, 1973b; Jackson, 1969; Jackson et al., 1975, 1978a,b, 1980; Olson, 1977). Ages noted immediately below have been determined by the Geochronological Laboratories of the Geological Survey of Canada.

Seventeen whole rock K-Ar ages determined for Nauyat volcanics range from 762 ± 26 to 1221 ± 31 Ma and have a mean age of 946 Ma (Fig. 16.3, 16.34). In addition, 6 of 14 sample analyses yield a 1129 Ma, 6-point Rb-Sr age with an initial intercept of 0.7120 and a MSWD of 5.5.

Fahrig et al. (1981) obtained paleomagnetic poles for the Bylot Supergroup which they interpreted as Mackenzie. They also interpreted the Nauyat-Adams Sound pole to be about 1220 Ma, and the Strathcona Sound pole to be about 16.5 Ma younger. Both Fahrig et al. (1981) and Chandler and Stevens (1981) considered the mid-late Proterozoic volcanism to be a Mackenzie igneous event, with which we concur.

Sphalerite-galena deposits lie chiefly within Society Cliffs dolostone in the Nanisivik region of Milne Inlet Trough (Fig. 16.26) and are associated with pyrite and hematite-goethite deposits. The sulphide bodies are secondary cavity fillings and replacement bodies emplaced some time after Victor Bay sedimentation and prior to Franklin dyke intrusion (see also: Geldsetzer, 1973a,b; Graf, 1974; Olson, 1977; Sangster, 1981).

Northwest-trending tholeiitic Franklin (Fahrig et al., 1971; Fahrig and Schwarz, 1973) diabase dykes up to 200 m thick cut all Precambrian rocks of the map area (Fig. 16.4), postdate some folding and faulting of the Bylot Supergroup, and are overlain nonconformably by lower Paleozoic strata. Franklin dykes appear less altered than Nauyat Formation volcanics, which have probably undergone subgreenschist facies metamorphism (Jackson and Morgan, 1978). Chemically, the Franklin diabases are more highly differentiated than the Nauyat volcanics. A similar relationship between Neohelikian volcanics and Hadrynian dykes has been observed in the Thule Basin (Fig. 16.34; Frisch and Christie, in press).

Many of the Franklin dykes were emplaced along fault zones and dominant northwest-trending dykes are concentrated along the Tikerakdjuak Fault Zone (Fig. 16.4, 16.25, 16.26). Some subordinate, thinner, northerly trending dykes cut northwest-trending dykes, while others seem to be co-intrusive and to simply be splays off the main northwest-trending dykes. The two trends probably developed penecontemporaneously in response to brittle fracturing of a block related to tension and torsion caused by movement along bounding fault zones. Dykes of both orientations yield similar whole rock K-Ar ages (Fig. 16.3, 16.34; Blackadar, 1970; Jackson, 1974). To date, all paleomagnetic measurements indicate a single paleomagnetic pole for Franklin dykes and Fahrig (personal communication, 1981) estimates that the Franklin Igneous Event is probably 700-750 Ma old.

BASEMENT COMPLEX

The Archean-Aphebian basement is a variable complex of high-grade gneisses and igneous rocks. The gneisses are chiefly irregularly banded intermediate to acidic migmatites, in part fluidal, that are commonly intruded by at least two

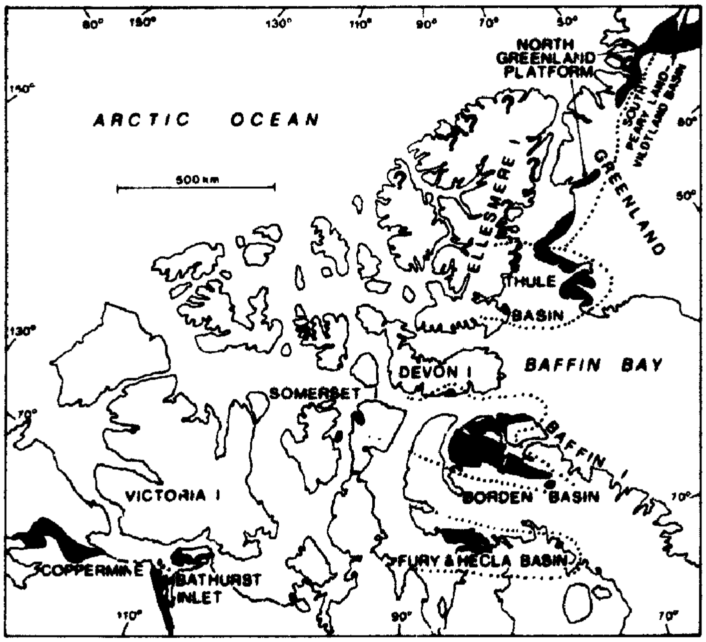


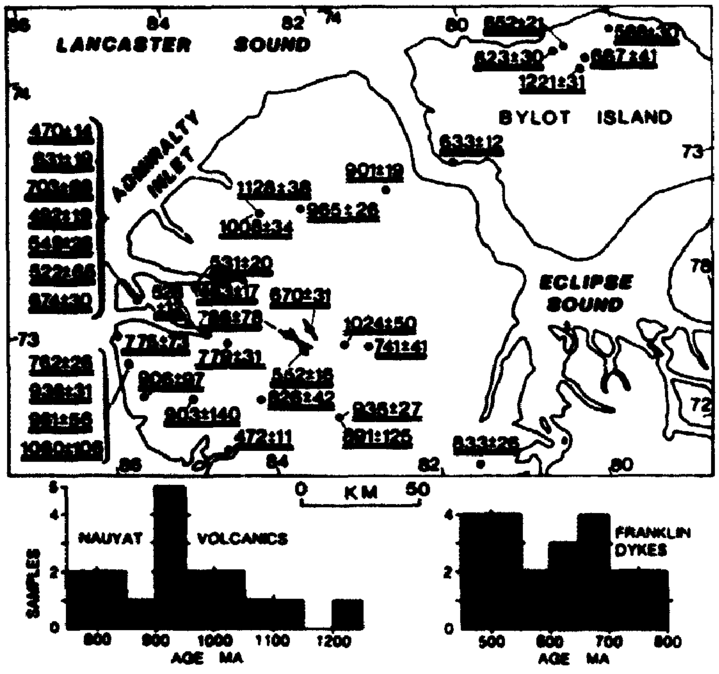
Figure 16.1. *Location of strata within Borden Basin and in other Neohelikian basins, northwest edge of Canadian-Greenlandic Shield.*

---

[1] Nunatsiaq (from Nunatsiaq Point, 81°09'W Long., 73°25'N Lat.) is Inuit for "good land".

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?	SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
		EQALULIK	Fabricius Fiord Fm: (400-2000 m+) FF_4: Arkose, conglomerate, dolostone FF_3: Subarkose, conglomerate FF_2: Shale, quartzarenite FF_1: Quartzarenite, shale	Gradational to Unconformable
				Arctic Bay Fm: (180-770 m) AB_4: Shale, dolostone AB_3: Shale, siltstone AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
			Conformable, Abrupt to Gradational	
			Adams Sound Fm: (0-610 m) AS_3: Quartzarenite, conglomerate, shale AS_2: Quartzarenite AS_1: Quartzarenite, conglomerate	AS_U: Quartzarenite AS_L: 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	



Double underline = Nauyat volcanics
Solid underline = Franklin diabases

Figure 16.3. *Whole rock K-Ar ages in Borden Basin.*

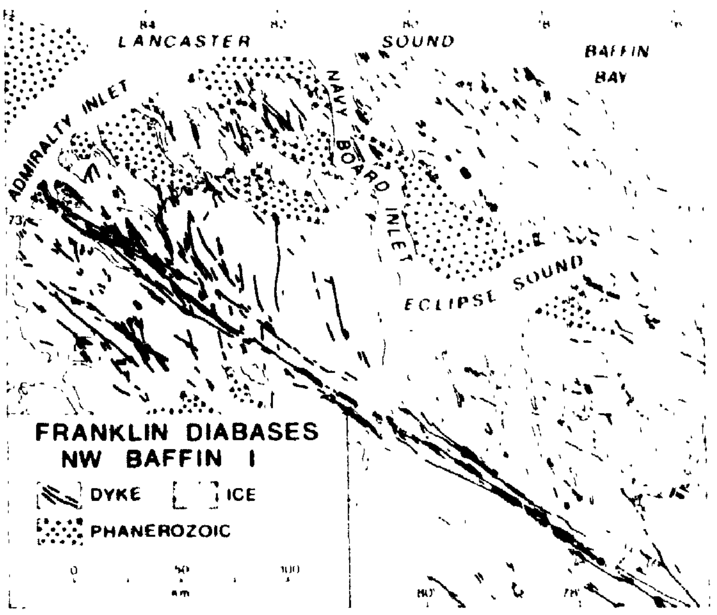


Figure 16.4. *Distribution of Franklin diabase dykes on northern Baffin and Bylot islands. Note main concentration along Tikerakdjuak Fault Zone (see Fig. 16.26).*

generations of granites. Upper amphibolite regional metamorphism predominates in the complex except on Bylot Island where granulite grade predominates. On northwestern Baffin Island granulite facies rocks are most abundant adjacent to the Borden Basin and occur in Navy Board and Byam Martin highs (Jackson and Morgan, 1978).

A thin regolith is locally present at the contact between Bylot Supergroup rocks and the gneissic basement. The gneisses are commonly stained red for several metres below the unconformity. Up to 6 m of regolithic material is preserved south and east of the head of Tremblay Sound, in the Paquet Bay area and on Bylot Island (Fig. 16.2). In these areas basement gneisses pass gradually upward into friable, varicoloured, massive to poorly stratified rocks that consist essentially of recessive masses of kaolinized feldspar and more resistant granular layers and lenses of quartz, all in a finely crystalline chloritic matrix. The contact between the regolith and basal Bylot Supergroup strata is unconformable and planar to slightly undulatory. Where the regolith is absent, the contact between the gneisses and overlying Neohelikian strata is also planar to undulatory, with a maximum observed relief of 2 m. Local draping and pinching-out of sedimentary beds occurs over the small basement topographic highs.

EQALULIK GROUP

In the revised nomenclature presented here, the Fabricius Fiord and Arctic Bay formations have been reassigned to the Eqalulik Group along with the Nauyat and Adams Sound formations (Fig. 16.2).

Nauyat Formation

The Nauyat, lowermost formation of the Eqalulik Group (Table 16.1), outcrops primarily south of Adams Sound and extends to south of Tremblay Sound (Fig. 16.2). Nauyat strata average almost 240 m in thickness in the western part of the area, and may be 430 m thick south of Adams Sound.

The Nauyat Formation is divided into two members: a lower NA_1 member composed chiefly of quartz arenite, and an upper NA_2 member consisting almost entirely of basalt flows. Nauyat quartz arenites are similar to those of the overlying Adams Sound Formation, and are included in the latter formation where NA_2 basalt flows and sills are absent. Nauyat volcanics are thickest along a line trending north-northeast through Elwin Icecap, thin southeastward, and do not occur east of Tremblay Sound (Fig. 16.2, 16.5, 16.6).

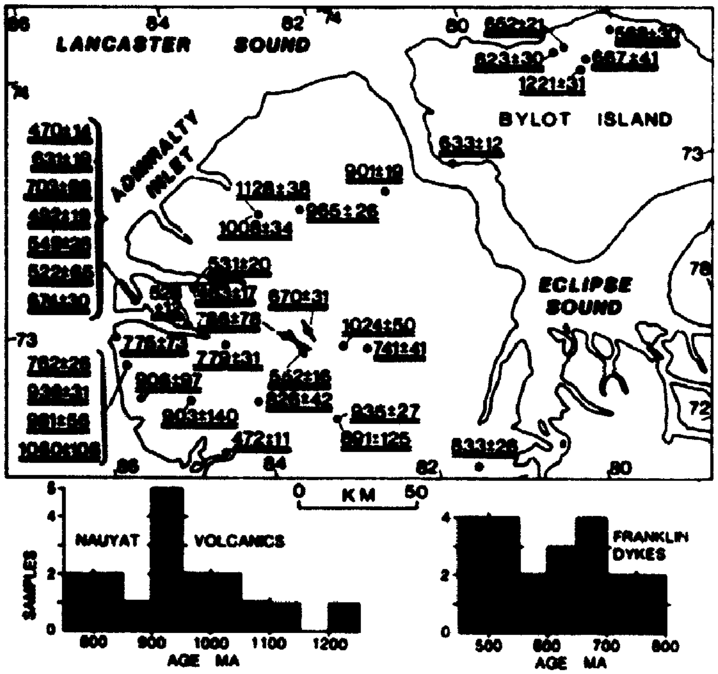
NA_1 Member

The NA_1 member consists predominantly of multicoloured (chiefly buff to pink) quartz arenite interbedded with minor subarkose, lesser amounts of quartz granule-pebble conglomerate and siltstone, and rare shale. The subarkose and conglomerate beds occur mainly in the basal part of the member; a thin conglomeratic unit commonly rests on basement gneisses (Fig. 16.5, 16.6).

The NA_1 member is entirely quartz arenite south of Tremblay Sound and on northern Bylot Island. Elsewhere, a conformable volcanic subunit containing one or two amygdaloidal plateau basalt flows, similar to those in the NA_2 member, occurs sporadically in the middle part of the member. The lower contact is sharp and the underlying sediments are baked, while the upper contact is sharp, but possibly erosional. Locally, rare volcanic fragments occur in the overlying strata.

This member varies in thickness from 0 to more than 160 m in the western part of the area and increases in thickness to the northwest. The intra-member volcanics, from 27 m thick southeast of Elwin Inlet to 60 m north of Levasseur Inlet, are under- and overlain by quartz arenites.

South of Adams Sound, the member is characterized by conglomerate-based fining-upward cycles 2-8 m thick (Fig. 16.7). These cycles consist of a thin basal conglomerate overlain by a thick, graded quartz arenite, and capped by thin



Double underline = Nauyat volcanics
Solid underline = Franklin diabases

Figure 16.3. *Whole rock K-Ar ages in Borden Basin.*

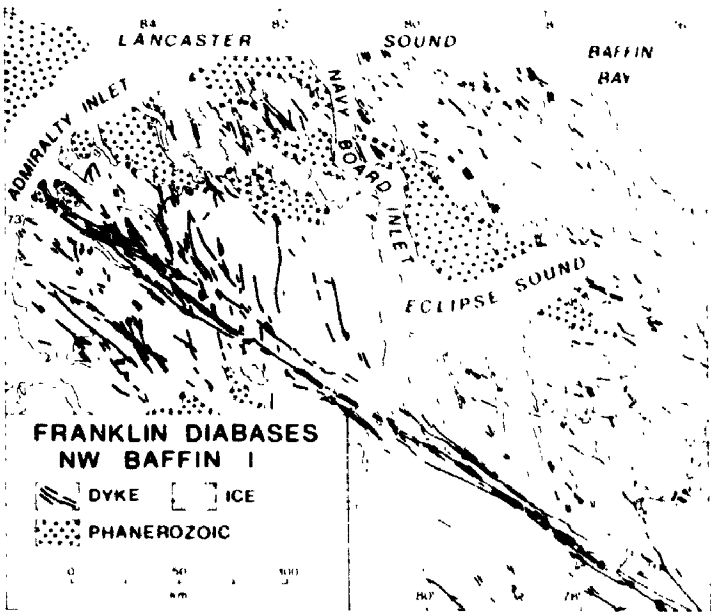


Figure 16.4. *Distribution of Franklin diabase dykes on northern Baffin and Bylot islands. Note main concentration along Tikerakdjuak Fault Zone (see Fig. 16.26).*

generations of granites. Upper amphibolite regional metamorphism predominates in the complex except on Bylot Island where granulite grade predominates. On northwestern Baffin Island granulite facies rocks are most abundant adjacent to the Borden Basin and occur in Navy Board and Byam Martin highs (Jackson and Morgan, 1978).

A thin regolith is locally present at the contact between Bylot Supergroup rocks and the gneissic basement. The gneisses are commonly stained red for several metres below the unconformity. Up to 6 m of regolithic material is preserved south and east of the head of Tremblay Sound, in the Paquet Bay area and on Bylot Island (Fig. 16.2). In these areas basement gneisses pass gradually upward into friable, varicoloured, massive to poorly stratified rocks that consist essentially of recessive masses of kaolinized feldspar and more resistant granular layers and lenses of quartz, all in a finely crystalline chloritic matrix. The contact between the regolith and basal Bylot Supergroup strata is unconformable and planar to slightly undulatory. Where the regolith is absent, the contact between the gneisses and overlying Neohelikian strata is also planar to undulatory, with a maximum observed relief of 2 m. Local draping and pinching-out of sedimentary beds occurs over the small basement topographic highs.

EQALULIK GROUP

In the revised nomenclature presented here, the Fabricius Fiord and Arctic Bay formations have been reassigned to the Eqalulik Group along with the Nauyat and Adams Sound formations (Fig. 16.2).

Nauyat Formation

The Nauyat, lowermost formation of the Eqalulik Group (Table 16.1), outcrops primarily south of Adams Sound and extends to south of Tremblay Sound (Fig. 16.2). Nauyat strata average almost 240 m in thickness in the western part of the area, and may be 430 m thick south of Adams Sound.

The Nauyat Formation is divided into two members: a lower NA_1 member composed chiefly of quartz arenite, and an upper NA_2 member consisting almost entirely of basalt flows. Nauyat quartz arenites are similar to those of the overlying Adams Sound Formation, and are included in the latter formation where NA_2 basalt flows and sills are absent. Nauyat volcanics are thickest along a line trending north-northeast through Elwin Icecap, thin southeastward, and do not occur east of Tremblay Sound (Fig. 16.2, 16.5, 16.6).

NA_1 Member

The NA_1 member consists predominantly of multi-coloured (chiefly buff to pink) quartz arenite interbedded with minor subarkose, lesser amounts of quartz granule-pebble conglomerate and siltstone, and rare shale. The subarkose and conglomerate beds occur mainly in the basal part of the member; a thin conglomeratic unit commonly rests on basement gneisses (Fig. 16.5, 16.6).

The NA_1 member is entirely quartz arenite south of Tremblay Sound and on northern Bylot Island. Elsewhere, a conformable volcanic subunit containing one or two amygdaloidal plateau basalt flows, similar to those in the NA_2 member, occurs sporadically in the middle part of the member. The lower contact is sharp and the underlying sediments are baked, while the upper contact is sharp, but possibly erosional. Locally, rare volcanic fragments occur in the overlying strata.

This member varies in thickness from 0 to more than 160 m in the western part of the area and increases in thickness to the northwest. The intra-member volcanics, from 27 m thick southeast of Elwin Inlet to 60 m north of Levasseur Inlet, are under- and overlain by quartz arenites.

South of Adams Sound, the member is characterized by conglomerate-based fining-upward cycles 2-8 m thick (Fig. 16.7). These cycles consist of a thin basal conglomerate overlain by a thick, graded quartz arenite, and capped by thin

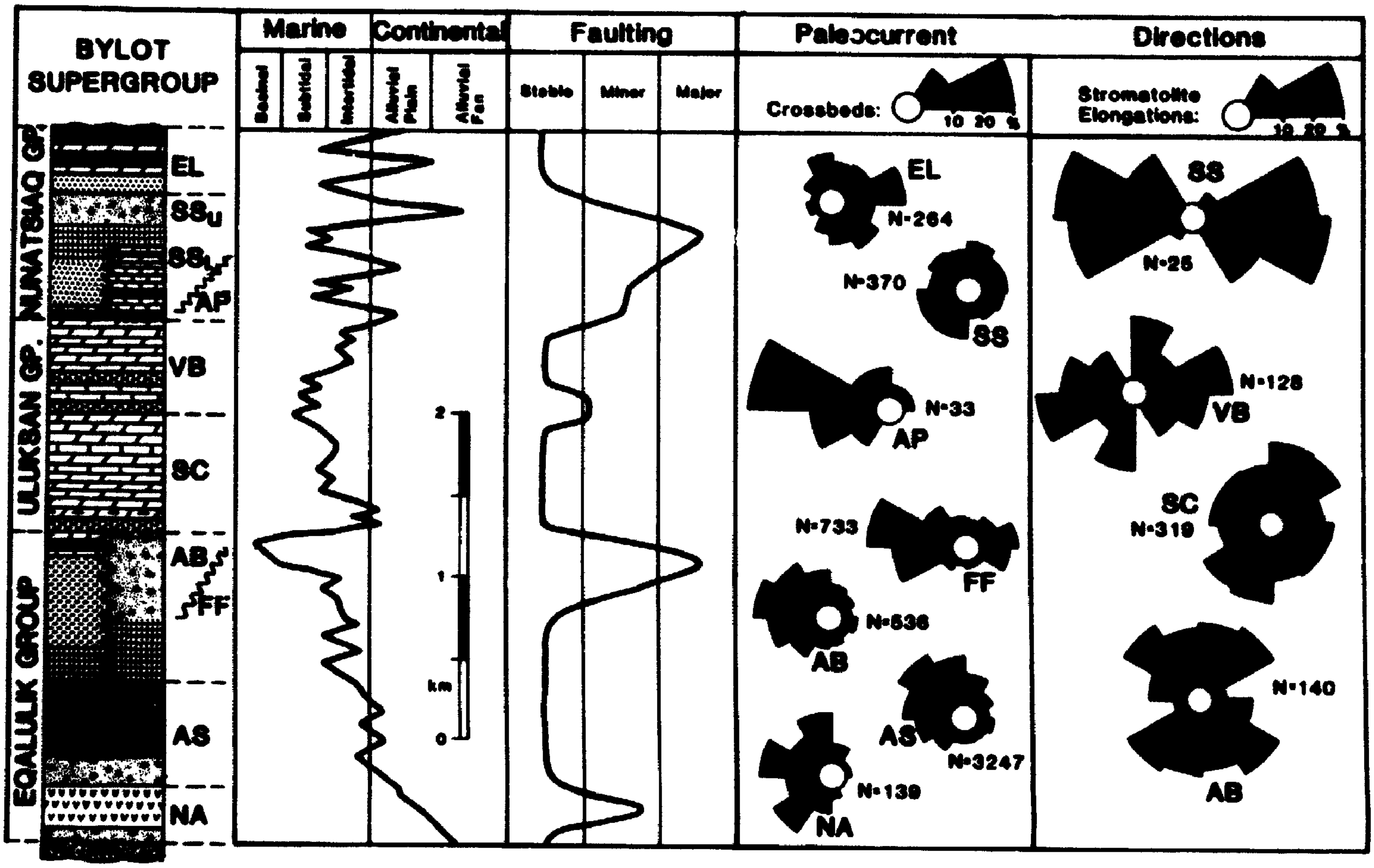


Figure 16.8. Generalized section of Bylot Supergroup as well as depositional environments, relative intensity of faulting, and cumulative crossbed and stromatolite elongations for each formation. Formation abbreviations as in text and for formation sections.

The contact with the overlying Adams Sound Formation is sharp and apparently conformable, but local volcanic clasts in the suprajacent quartz arenites suggest minor local erosion.

Individual flows are commonly 2 to 20 m thick but may be as much as 60 m. All flows are fine grained and dark green to green-grey. Most flows are increasingly amygdaloidal upward but the uppermost flow is massive, resistant and amygdule-free. Chemical analyses indicate that both NA_1 and NA_2 flows are tholeiitic basalts which become more alkalic toward the top of the sequence (Galley, 1978; Fig. 16.9, 16.10).

Columnar joints are commonly well-developed. Rare pillows, chiefly 25 cm or less in diameter with indistinct rims, occur south of Adams and Tremblay sounds. Flow-banding occurs locally and volcanic breccia lenses occur north of Levasseur Inlet. Upper parts of some flows contain partially resorbed quartz grains, quartz arenite clasts up to cobble size, and quartz arenite-filled cracks. This suggests that some flow surfaces were probably semi-fluid when the clastics were deposited on them (Galley, 1978).

Thin, baked, interflow sediments up to several metres thick occur locally in NA_2. These include vuggy quartz arenite, thinly laminated stromatolitic(?) limestone, iron-rich carbonate, minor chert and siltstone, and rare volcanic breccia lenses. Small-scale quartz arenite-dominated fining-upward cycles occur within some of these sequences.

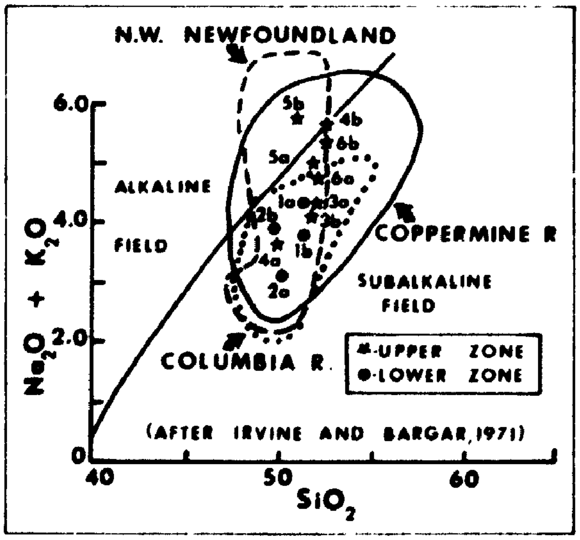


Figure 16.9. Alkali-silica diagram for Nauyat basalts. From Galley (1978).

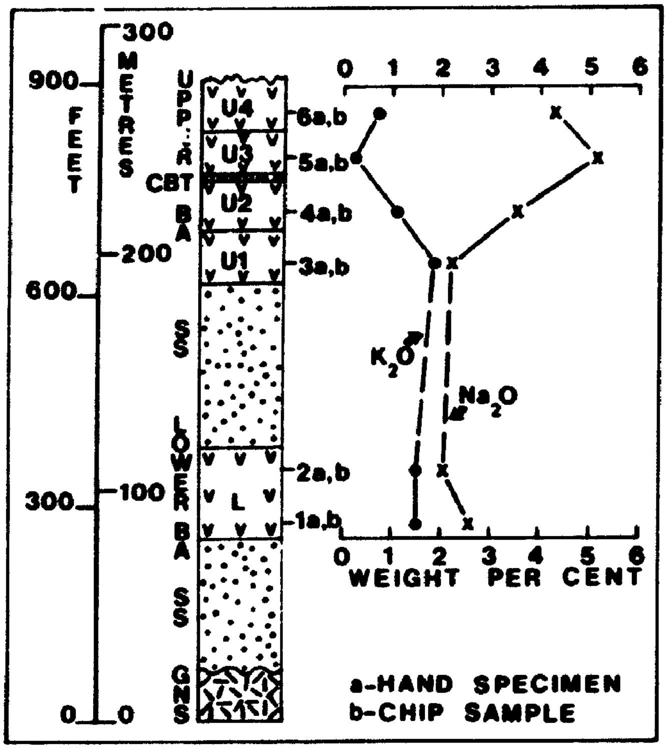


Figure 16.10. Stratigraphic positions of chemically analyzed Nauyat basalt samples and variations in K_2O and Na_2O. From Galley (1978).

The volcanic pile is spatially related to the present Central Borden, Tikerakdjuak, White Bay, Hartz Mountain and Cape Hay fault zones (Fig. 16.2, 16.26).

Interpretation

Unimodal paleocurrent trends (crossbeds are unimodal locally but cumulative rose is trimodal – Fig. 16.8) and conglomerate-based to quartz arenite-dominated fining-upward cycles indicate a fluvial depositional environment for most of the Nauyat sediments.

The composition (Fig. 16.9, 16.10) and physical properties of the Nauyat volcanics indicate that they are predominantly subaerial tholeiitic plateau basalts that were extruded quietly along fissures or linearly-controlled eruptive centres (Galley, 1978). They were covered by sediments before significant erosion could occur.

Adams Sound Formation

The Adams Sound Formation is the middle formation of the Eqalulik Group, and outcrops extensively in southern Borden Peninsula (Fig. 16.2). The Adams Sound conformably overlies NA_2 volcanics wherever the latter are present, although a thin (8 cm) layer of volcanic arenite locally overlies the volcanics (Geldsetzer, 1973b). Elsewhere the Adams Sound rests upon basement gneisses. The formation ranges from 610 m thick on western Borden Peninsula, to 45 to 65 m east of Tremblay Sound, and at least 415 m on northwestern Bylot Island.

The Adams Sound Formation consists predominantly of thin- to thick-bedded, rarely massive, quartz arenites, with minor interbedded subarkose, quartz-pebble conglomerate and rare siltstone and shale (Fig. 16.11). Sedimentary structures are common and include current ripples, trough and planar crossbeds (Fig. 16.8), channels, scours, load casts, soft sediment deformation structures, clastic dykes and microfaults.

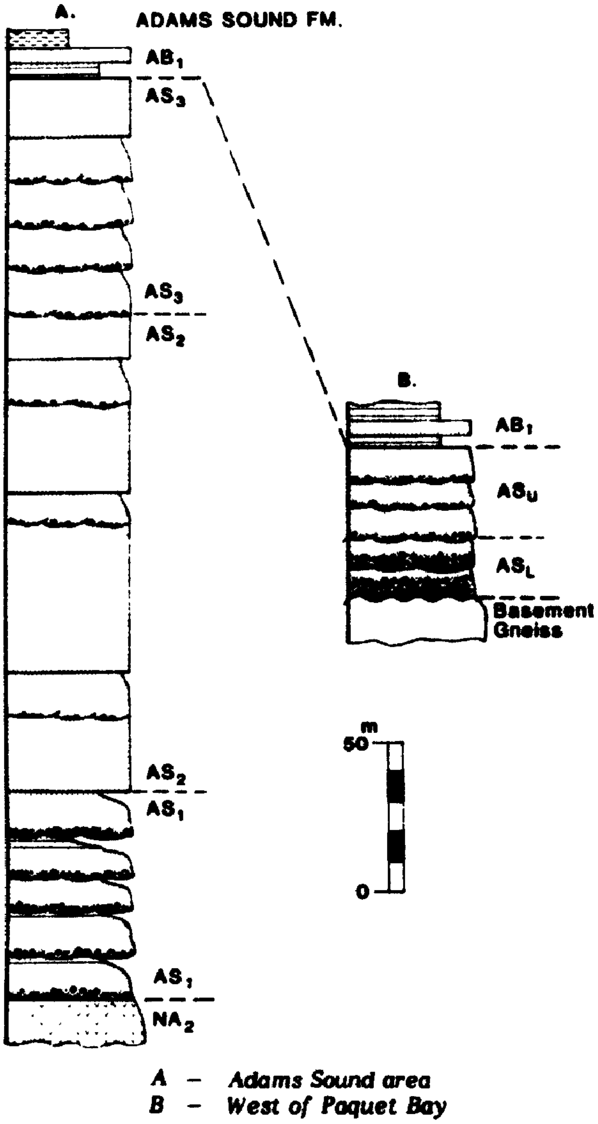


Figure 16.11. Representative stratigraphic sections of Adams Sound Formation (AS).

Two broad regions of Adams Sound strata have been delineated on the basis of subtle changes in lithology, the nature of depositional cycles, and contained sedimentary structures. These regions are: Borden Peninsula, and the Eastern Region (southeast of Milne Inlet, and Bylot Island, Fig. 16.2).

Borden Peninsula

The Adams Sound in this region has been divided into three intergradational members.

AS_1 Member: Most of this member is composed of buff to red, planar to crossbedded quartz arenite that contains minor interbedded and interlensed granular to pebbly quartz

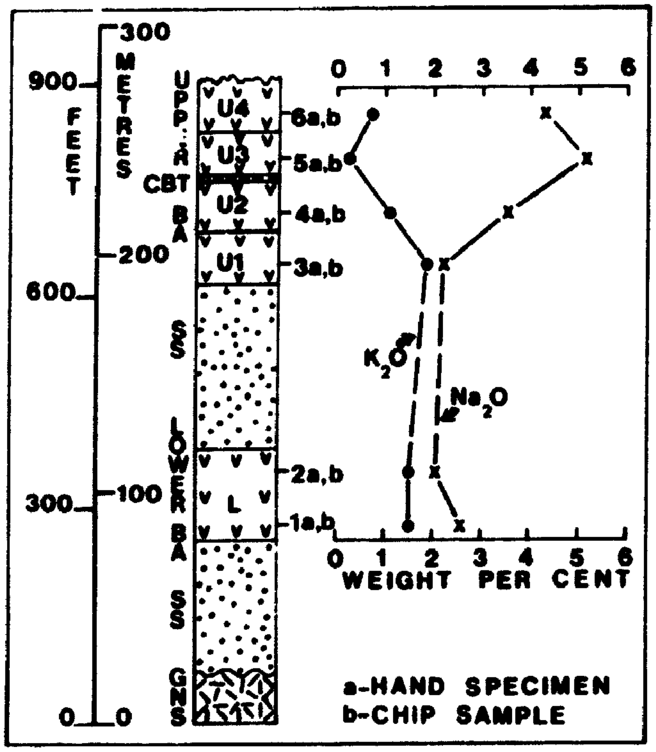


Figure 16.10. Stratigraphic positions of chemically analyzed Nauyat basalt samples and variations in K_2O and Na_2O. From Galley (1978).

The volcanic pile is spatially related to the present Central Borden, Tikerakdjuak, White Bay, Hartz Mountain and Cape Hay fault zones (Fig. 16.2, 16.26).

Interpretation

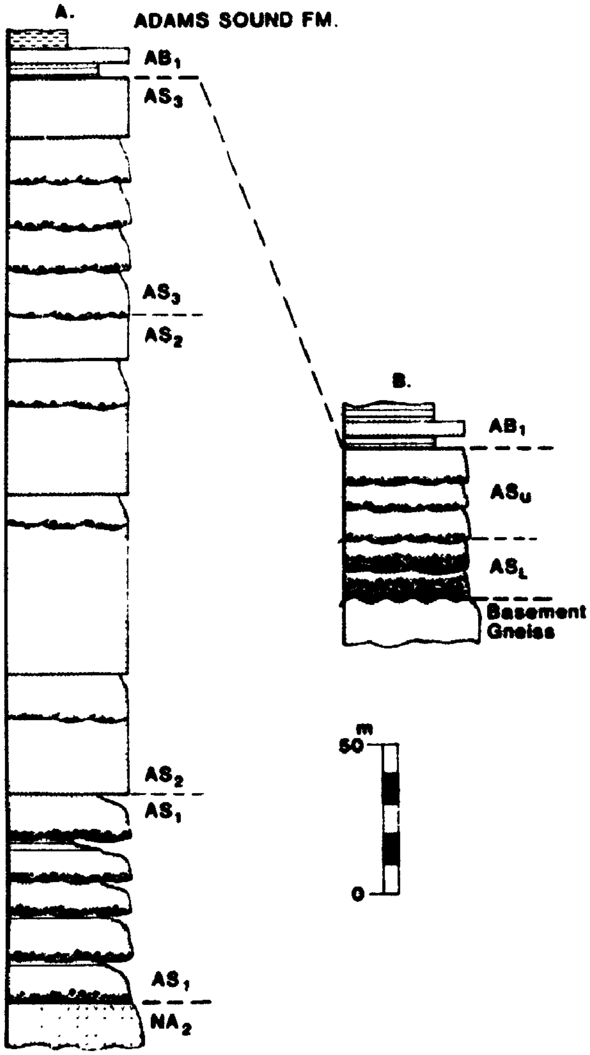
Unimodal paleocurrent trends (crossbeds are unimodal locally but cumulative rose is trimodal – Fig. 16.8) and conglomerate-based to quartz arenite-dominated fining-upward cycles indicate a fluvial depositional environment for most of the Nauyat sediments.

The composition (Fig. 16.9, 16.10) and physical properties of the Nauyat volcanics indicate that they are predominantly subaerial tholeiitic plateau basalts that were extruded quietly along fissures or linearly-controlled eruptive centres (Galley, 1978). They were covered by sediments before significant erosion could occur.

Adams Sound Formation

The Adams Sound Formation is the middle formation of the Eqalulik Group, and outcrops extensively in southern Borden Peninsula (Fig. 16.2). The Adams Sound conformably overlies NA_2 volcanics wherever the latter are present, although a thin (8 cm) layer of volcanic arenite locally overlies the volcanics (Geldsetzer, 1973b). Elsewhere the Adams Sound rests upon basement gneisses. The formation ranges from 610 m thick on western Borden Peninsula, to 45 to 65 m east of Tremblay Sound, and at least 415 m on northwestern Bylot Island.

The Adams Sound Formation consists predominantly of thin- to thick-bedded, rarely massive, quartz arenites, with minor interbedded subarkose, quartz-pebble conglomerate and rare siltstone and shale (Fig. 16.11). Sedimentary structures are common and include current ripples, trough and planar crossbeds (Fig. 16.8), channels, scours, load casts, soft sediment deformation structures, clastic dykes and microfaults.



A – Adams Sound area
B – West of Paquet Bay

Figure 16.11. Representative stratigraphic sections of Adams Sound Formation (AS).

Two broad regions of Adams Sound strata have been delineated on the basis of subtle changes in lithology, the nature of depositional cycles, and contained sedimentary structures. These regions are: Borden Peninsula, and the Eastern Region (southeast of Milne Inlet, and Bylot Island, Fig. 16.2).

Borden Peninsula

The Adams Sound in this region has been divided into three intergradational members.

AS_1 Member: Most of this member is composed of buff to red, planar to crossbedded quartz arenite that contains minor interbedded and interlensed granular to pebbly quartz

arenite, oligomictic to polymictic pebble to cobble orthoconglomerate, subarkose, siltstone and shale. Conglomeratic rocks occur mostly in the basal part of the member; clasts are predominantly quartz, but locally include quartz arenite, chert and gneiss. Some sequences contain well-developed conglomerate- to pebbly quartz arenite-based, quartz arenite dominated, fining-upward cycles (1 to 3 m) rarely capped by thin units of siltstone or siltstone-shale (Fig. 16.7). AS_1 thicknesses range from 130 m at Elwin Inlet to 8-16 m near Tremblay Sound.

Sedimentary structures, especially planar and trough crossbeds are ubiquitous. Paleocurrents are primarily unimodal northwest to northeast, with subsidiary southwest to southeast trends.

***AS_2 Member*:** The entire member is dominated by buff to light pink quartz arenite. Poorly defined 3-5 m thinning- and fining-upward cycles occur locally. These consist of lower units of medium- to coarse-grained, medium-bedded quartz arenite, with large trough crossbeds and scours, grading upward into fine grained, thin bedded to laminated, quartz arenite. This member has a maximum thickness of 128 m at Adams Sound but thins to 33 m at Tremblay Sound.

The relatively few sedimentary structures present include crossbeds, current ripple marks, load casts, and synaeresis or desiccation cracks. Paleocurrent patterns show high dispersion, unimodal northwest to northeast transport with subsidiary east and southeast trends.

***AS_3 Member*:** This member is chiefly white, light to dark grey and pink quartz arenite with interbeds and lenses of granular to pebbly quartz arenite, and quartz-pebble conglomerate. Thin shale and siltstone interbeds occur in the uppermost part of the member. Rare channels filled by quartz arenite-clast breccia occur in the Tremblay Sound area, where some sections also contain 4-8 m thick fining- and thinning-upward cycles. Fining-upward cycles in the Adams Sound area are 1.5-4.5 m thick and have large basal scour channels filled with quartz granule to quartz-pebble conglomerate. AS_3 strata are commonly 68-100+ m and are somewhat thicker locally at Tremblay Sound.

Megaripple marks with wavelengths up to 2 m, wave ripple marks and graded and overturned crossbeds also occur. Paleocurrent trends are polymodal, northwest-southeast bimodal, and northwest and northeast to southeast unimodal.

Eastern Region

Adams Sound strata on Bylot Island and southeast of Milne Inlet are similar to those on Borden Peninsula, but are here informally divided into only a lower (AS_L) and upper (AS_U) member that are approximately equivalent to the Borden Region strata. Measured thicknesses are in excess of 374 m on Bylot Island where one partial section was estimated to be 415 m (Jackson and Davidson, 1975). The Adams Sound Formation southeast of Milne Inlet has a much higher proportion of conglomerate than elsewhere, but is much thinner (45-65 m).

***AS_L Member*:** Buff to pink, orange and purple strata dominate this member. On Bylot Island quartz arenite predominates and contains some interbeds of granular to pebbly quartz arenite and quartz-pebble conglomerate. The upper part of this member contains a distinctive dark purplish-red hematite-stained quartz arenite sequence with abundant siltstone and shale partings.

Southeast of Milne Inlet most of the AS_L is thick-bedded to massive, oligomictic to polymictic, quartz-pebble to quartz-cobble orthoconglomerate in which quartz arenite, feldspar, and gneiss clasts are locally abundant. The gneiss clasts decrease in abundance upward in the member. Subarkose, pebbly subarkose and quartz arenite are interbedded with the conglomerate.

Fining-upward cycles occur locally throughout the member. On Bylot Island the beds in the cycles also thin upward, and cycles are 2-5 m thick. These cycles consist of a lower unit of medium-bedded, medium-grained to granular quartz arenite with large trough crossbeds, channels and load casts. This unit grades upward into medium-bedded to thick-laminated fine grained quartz arenite with smaller trough crossbeds, current ripple marks and synaeresis cracks. Fining-upward cycles southeast of Milne Inlet are conglomerate based and conglomerate dominated (Fig. 16.7). The member is typically 110-196 m thick on Bylot Island and 1-15 m southeast of Milne Inlet.

Few sedimentary structures are present southeast of Milne Inlet, but include large scattered planar crossbeds up to 2.5 m thick that contain current aligned quartz pebbles along foreset and bottomset beds. Paleocurrent patterns show north-northwest, north, and southeast unimodal transport. Paleocurrent patterns on Bylot Island vary from northwest-southeast bimodal-bipolar to unimodal northwest to southwest.

***AS_U Member*:** White to buff and brown-grey quartz arenite predominates in this member. Minor interbeds of granular to pebbly quartz arenite and quartz-pebble conglomerate thin and decrease in abundance upward. Siltstone partings are rare. Some 1-4 m fining-upward cycles are present, and are similar to those present in AS_L member from the respective areas (Fig. 16.7). These cycles also thin-upward on Bylot Island. The member ranges from 140-200 m thick on Bylot Island to 18-35 m southeast of Milne Inlet.

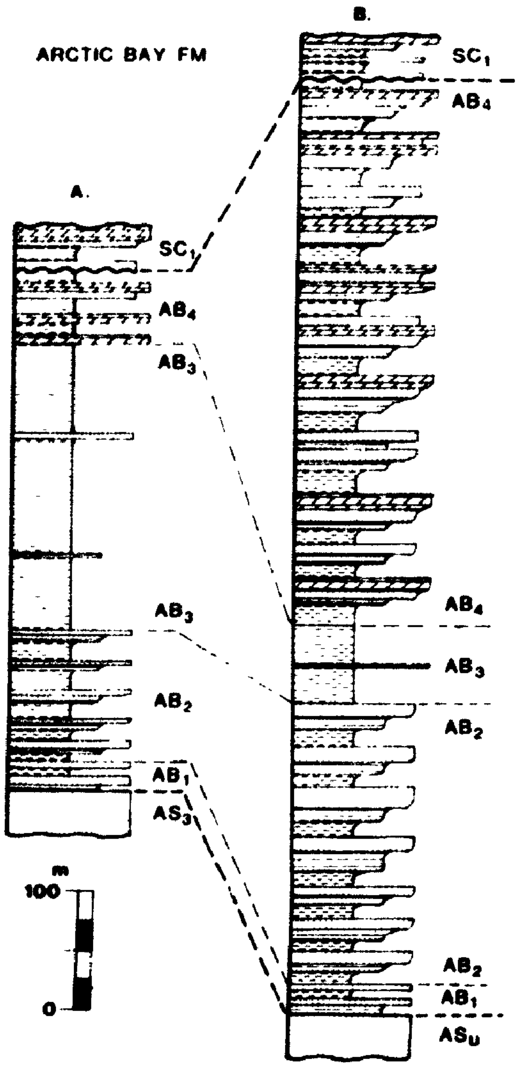
Large-scale planar crossbeds with graded foresets megaripples, and scour channels are common locally southeast of Milne Inlet. The crossbeds show unimodal northwest to north transport, whereas transport in the Bylot Island succession was southwest to northwest unimodal and bimodal.

***Interpretation*:** The conglomerate-dominated, conglomerate-based and quartz arenite-dominated fining-upward cycles, predominance of strongly unimodal paleocurrents (Fig. 16.8), and the abundance of festoon crossbeds and other structures, indicate that AS_1 member of the Borden Peninsula region and the AS_L and AS_U members southeast of Milne Inlet were deposited under proximal to distal braided fluvial environments.

The AS_2 and AS_3 members on Borden Peninsula and AS_L and AS_U on Bylot Island were deposited in mixed fluvial-marine environments, as suggested by thinning-upward clastic shoreline cycles, large tidal or fluvial bar-like structures, and strong unimodal to bimodal-bipolar paleocurrent trends.

Arctic Bay Formation

The Arctic Bay Formation outcrops in a broad belt across most of the southern basin (Fig. 16.2). Locally, pyritiferous shale is the predominant lithology, with siltstone and quartz arenite interbedded with shale in the lower part of the formation, and siltstone, dolostone and quartz arenite interbedded with shale in the upper part.



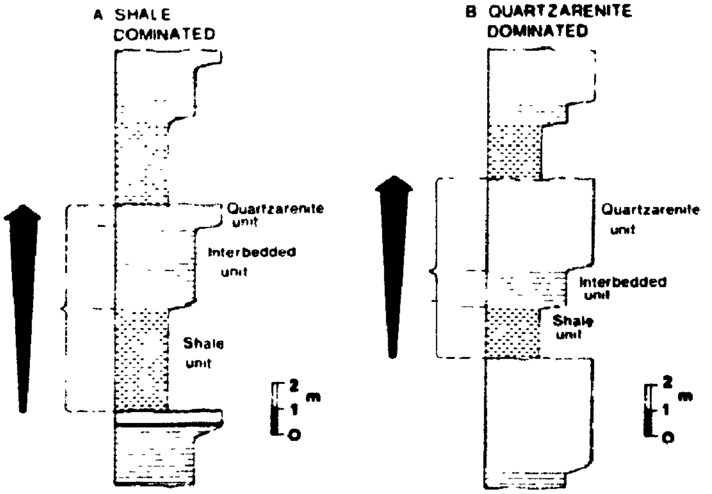
A - Upper Tremblay Sound area
B - Tay Sound-Paquet Bay area

Figure 16.12. *Representative stratigraphic sections of Arctic Bay Formation (AB).*

The formation is 180 m thick at Arctic Bay, and ranges from 500 to 770 m throughout most of the rest of the area. The lower contact with the Adams Sound Formation is conformable and gradational.

Sedimentary structures are most common in the siltstone, quartz arenite, and stromatolitic dolostone beds. They include wave and current ripples, planar and trough crossbeds, synaeresis and desiccation cracks, molar tooth and tepee structures, load casts, rip-ups, scours, rill marks, convolute or soft sediment-folded beds, and dewatering structures. Some dolostones contain small vugs lined with calcite, dolomite, quartz, and rarely celestite, siderite, and black bituminous material. Some shale beds contain concretions and cone-in-cone structures. White gypsum efflorescence and calcareous coatings are common on the shales and some strata emit a strong petroliferous odour.

Four intergradational members are distinguished in the formation throughout the area (Table 16.1, Fig. 16.12). However, the entire formation is distinctly different southeast of Milne Inlet.



A - West of Milne Inlet
B - East of Milne Inlet

Figure 16.13. *Generalized coarsening-upward cycles of the AB_2 member.*

AB_1 Member

This member comprises grey-green to white interbedded siltstone and quartz arenite and minor thin interlayers and partings of black shale that increase upward. Buff-white to grey quartz arenite with minor thin grey siltstone and shale interlayers and partings predominate east of Milne Inlet. Thicknesses range from 12-48 m in the Milne Inlet Trough and are similar elsewhere.

Characteristic sedimentary structures include herringbone crossbeds, megaripples, small clastic dykes, and lensoid bedding. Paleocurrents everywhere are bimodal-bipolar northwest-southeast, with polymodal transport trends also present in the Borden-Bylot area.

AB_2 Member

The entire AB_2 member is composed of 12 to 15 coarsening-upward shale-dominated cycles that consist of three intergradational units (Fig. 16.13). Individual cycles are 4.5-21 m thick in the Borden-Bylot region. However, there are only 4 to 6 cycles in the east Milne Inlet area, and these are quartz arenite-dominated, and 6.5-17 m thick. The member is typically 48-115 m thick, but is 150-260 m around Tremblay Sound.

The lowermost unit of the cycles, is chiefly black shale with minor lensoid to thin-bedded silty shale and quartz arenite. It is typically 2-5 m thick east of Milne Inlet and 3-9 m thick elsewhere. The middle unit of the cycles consists of lenticular- to planar-interbedded grey-white siltstone-quartz arenite and shale. The shale component decreases upward from more than 85 per cent at the base to less than 50 per cent at the top. The middle unit is 1.5-4.5 m thick east of Milne Inlet and 1.5-6 m thick elsewhere.

The upper unit of the cycles is composed of grey-brown to grey and white thin- to thick-bedded quartz arenite. The unit contains some interlayers and partings of grey-black siltstone and shale and decreases upward in thickness throughout the member. Thickness ranges from 3-7.5 m east of Milne Inlet, and 0.3-1.5 west of the inlet.

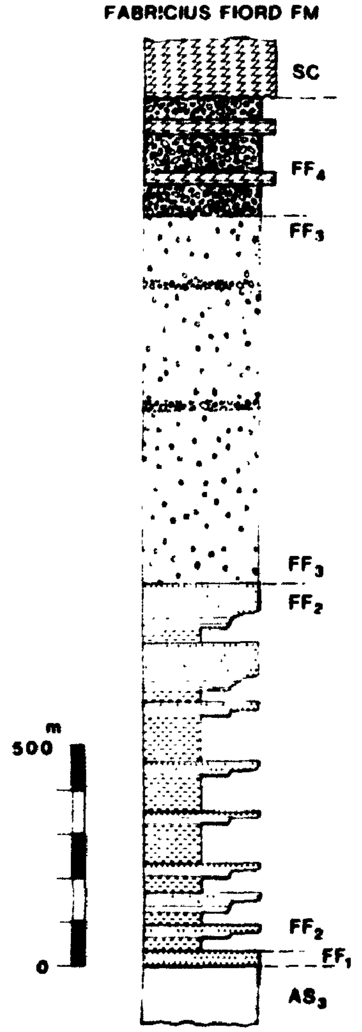


Figure 16.15. *Generalized stratigraphic section of Fabricius Fiord Formation (FF) east of Fabricius Fiord.*

Fabricius Fiord Formation

The Fabricius Fiord Formation outcrops from Fabricius Fiord eastward to south of the Magda Icecap (Fig. 16.2). A few small isolated areas of Fabricius Fiord-like strata, which will not be discussed further, occur adjacent to major fault zones at several localities throughout the basin (Fig. 16.2).

In general, the Fabricius Fiord Formation contains a lower sequence composed chiefly of black shale, grey to grey-white siltstone, and brown-grey to white quartz arenite in which the alternation of recessive and resistant beds gives a distinctive ribbed appearance to the outcrop. The remainder of the formation is predominantly subarkose and conglomerate, and several minor lithologies (Fig. 16.15). Locally the strata outcrop in large fan-shaped structures. Sedimentary structures are most abundant in the lower quartz arenites and siltstones and include: current and wave ripples, trough, planar and herringbone-crossbeds, channels, small-scale load casts, convolute beds, clastic dykes, rills and synaeresis cracks. The crossbeds yield well-defined unimodal to bimodal-bipolar paleocurrent patterns that indicate major distributing currents flowed west and northwest (Fig. 16.8).

The Fabricius Fiord Formation ranges from 400 to more than 2000 m thick. Four intergradational members have been defined within the formation. In addition, three interlensing lithologic associations have been differentiated in the uppermost FF_4 member.

The contact with the underlying Adams Sound Formation is conformable and sharp to gradational. Fabricius Fiord strata are invariably downfaulted along, and/or marginal to major fault zones as along the Central Borden Fault Zone. The lower FF_1 and FF_2 members grade laterally northward (basinward) into facies-equivalent Arctic Bay strata. The FF_3 and FF_4 members are overlain disconformably by massive dolostone that closely resembles the Society Cliffs Formation in both lithology and contained stromatolites. Lenses (possibly biohermal) and thin beds of similar dolostone also occur within the FF_4 member. Therefore, although contact relations between upper Fabricius Fiord strata and lower Society Cliffs (SC_1) strata have not been seen, the two are considered tentatively to be facies equivalents.

FF_1 Member

In the Fabricius Fiord area the lower part of this member is mostly white to rust-brown, hematite-stained quartz arenite which grades upward into shale, and interbedded siltstone and quartz arenite. Eastward, in south-central Borden Peninsula, the FF_1 member contains a lower sequence consisting largely of grey-green quartz arenite and subarkose interbedded with lesser amounts of pebbly subarkose, quartz- and feldspar-pebble conglomerate, siltstone and shale. Upper beds in this area are massive quartz arenite containing graded planar- and trough-crossbeds and load casts. The FF_1 member is an average 18 m thick in the west and ranges from 15-23 m thick in the east.

FF_2 Member

The thick, distinctive, FF_2 member consists entirely of coarsening-upward cycles that range from 9 to 40 +m and up to 55 in number. The member ranges from 370 to 892 m in thickness.

Each coarsening-upward cycle contains three distinct intergradational units (Fig. 16.16). The lower unit, 3-15 m thick, contains shale, silty shale, and minor siltstone, and grades upward into the middle unit (1.5-6 m thick), which consists of interbedded quartz arenite, siltstone and shale. The quartz arenites and siltstones grade upward from lensoid and undulatory-bedded into planar-bedded as their proportion increases from less than 10 to more than 60 per cent of the unit. The upper unit (0.5-15 m) is quartz arenite with thin siltstone or shale partings, and with conglomerate in the upper part of the member. These quartz arenites contain nearly all the herringbone-crossbeds, ripple marks and channels in the formation. Lower FF_2 member cycles contain the three units in equal proportions. Cycles in the middle of the member are dominated by shale (70 per cent), and those in the upper part of the member are sandstone dominated.

FF_3 Member

The massive, resistant FF_3 member is mostly medium bedded to massive light grey to buff subarkose and pebbly subarkose interbedded with thin- to thick-bedded quartz- and quartz-feldspar-pebble conglomerate. Quartz arenite is abundant locally. The FF_3 member is 736 m thick at Fabricius Fiord and 840 m thick in south-central Borden Peninsula.

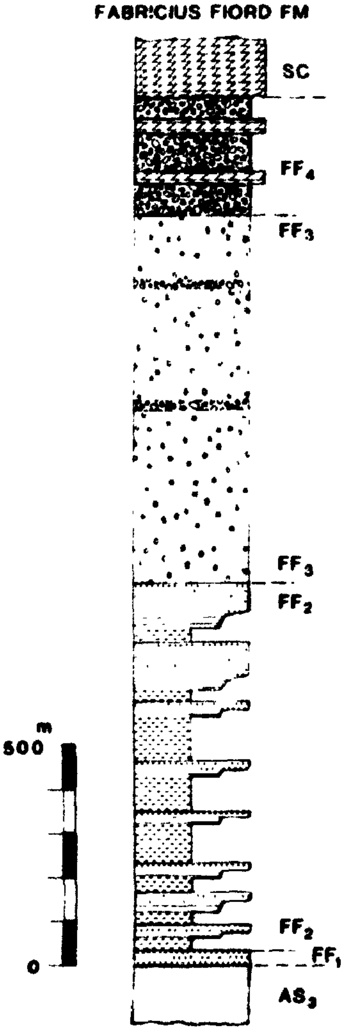


Figure 16.15. *Generalized stratigraphic section of Fabricius Fiord Formation (FF) east of Fabricius Fiord.*

Fabricius Fiord Formation

The Fabricius Fiord Formation outcrops from Fabricius Fiord eastward to south of the Magda Icecap (Fig. 16.2). A few small isolated areas of Fabricius Fiord-like strata, which will not be discussed further, occur adjacent to major fault zones at several localities throughout the basin (Fig. 16.2).

In general, the Fabricius Fiord Formation contains a lower sequence composed chiefly of black shale, grey to grey-white siltstone, and brown-grey to white quartz arenite in which the alternation of recessive and resistant beds gives a distinctive ribbed appearance to the outcrop. The remainder of the formation is predominantly subarkose and conglomerate, and several minor lithologies (Fig. 16.15). Locally the strata outcrop in large fan-shaped structures. Sedimentary structures are most abundant in the lower quartz arenites and siltstones and include: current and wave ripples, trough, planar and herringbone-crossbeds, channels, small-scale load casts, convolute beds, clastic dykes, rills and synaeresis cracks. The crossbeds yield well-defined unimodal to bimodal-bipolar paleocurrent patterns that indicate major distributing currents flowed west and northwest (Fig. 16.8).

The Fabricius Fiord Formation ranges from 400 to more than 2000 m thick. Four intergradational members have been defined within the formation. In addition, three interlensing lithologic associations have been differentiated in the uppermost FF$_4$ member.

The contact with the underlying Adams Sound Formation is conformable and sharp to gradational. Fabricius Fiord strata are invariably downfaulted along, and/or marginal to major fault zones as along the Central Borden Fault Zone. The lower FF$_1$ and FF$_2$ members grade laterally northward (basinward) into facies-equivalent Arctic Bay strata. The FF$_3$ and FF$_4$ members are overlain disconformably by massive dolostone that closely resembles the Society Cliffs Formation in both lithology and contained stromatolites. Lenses (possibly biohermal) and thin beds of similar dolostone also occur within the FF$_4$ member. Therefore, although contact relations between upper Fabricius Fiord strata and lower Society Cliffs (SC$_1$) strata have not been seen, the two are considered tentatively to be facies equivalents.

FF$_1$ Member

In the Fabricius Fiord area the lower part of this member is mostly white to rust-brown, hematite-stained quartz arenite which grades upward into shale, and interbedded siltstone and quartz arenite. Eastward, in south-central Borden Peninsula, the FF$_1$ member contains a lower sequence consisting largely of grey-green quartz arenite and subarkose interbedded with lesser amounts of pebbly subarkose, quartz- and feldspar-pebble conglomerate, siltstone and shale. Upper beds in this area are massive quartz arenite containing graded planar- and trough-crossbeds and load casts. The FF$_1$ member is an average 18 m thick in the west and ranges from 15-23 m thick in the east.

FF$_2$ Member

The thick, distinctive, FF$_2$ member consists entirely of coarsening-upward cycles that range from 9 to 40 +m and up to 55 in number. The member ranges from 370 to 892 m in thickness.

Each coarsening-upward cycle contains three distinct intergradational units (Fig. 16.16). The lower unit, 3-15 m thick, contains shale, silty shale, and minor siltstone, and grades upward into the middle unit (1.5-6 m thick), which consists of interbedded quartz arenite, siltstone and shale. The quartz arenites and siltstones grade upward from lensoid and undulatory-bedded into planar-bedded as their proportion increases from less than 10 to more than 60 per cent of the unit. The upper unit (0.5-15 m) is quartz arenite with thin siltstone or shale partings, and with conglomerate in the upper part of the member. These quartz arenites contain nearly all the herringbone-crossbeds, ripple marks and channels in the formation. Lower FF$_4$ member cycles contain the three units in equal proportions. Cycles in the middle of the member are dominated by shale (70 per cent), and those in the upper part of the member are sandstone dominated.

FF$_3$ Member

The massive, resistant FF$_3$ member is mostly medium bedded to massive light grey to buff subarkose and pebbly subarkose interbedded with thin- to thick-bedded quartz- and quartz-feldspar-pebble conglomerate. Quartz arenite is abundant locally. The FF$_3$ member is 736 m thick at Fabricius Fiord and 840 m thick in south-central Borden Peninsula.

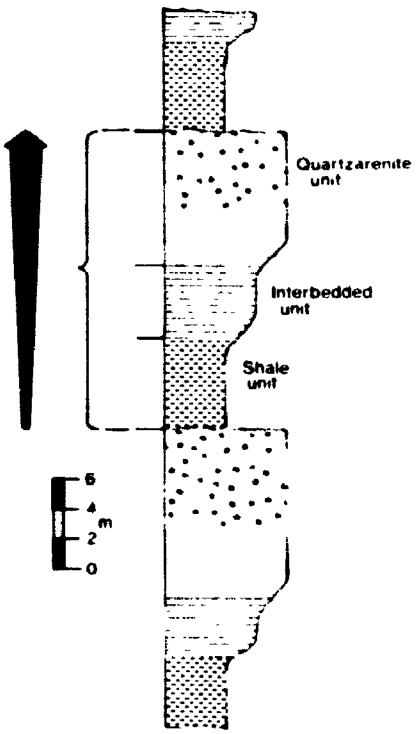


Figure 16.16. ***Representative coarsening-upward cycles in FF_2 member east of Fabricius Fiord (same location as for Fig. 16.15).***

Poorly defined 4-30 m thick coarsening-upward cycles are best developed southwest of Magda Icecap. These consist of a lower unit of medium- to thick-bedded, coarse grained to pebbly subarkose that grades upward into massive pebbly subarkose and conglomerate. Sedimentary structures are rare, but a few large planar crossbeds occur locally. They have a maximum thickness of 1.5 m and current-aligned quartz pebbles occur along foreset and bottomset beds.

FF_4 Member

Thick alternating beds and lenses of grey to yellow-brown and red-orange subarkose and arkose, light to medium-grey gritty to stromatolitic dolostone, and pink to brown-grey breccia-conglomerate constitute the FF_4 member. This member occurs adjacent to the Central Borden Fault Zone, and individual beds locally increase in thickness towards the fault zone. The member is 150-245 m thick and has been divided into three laterally and vertically intergradational lithological associations. The FF_4 member comprises more than 65 per cent of the FF_{4A} association, the rest consisting of scattered lenticular zones of FF_{4B} association and unstratified FF_{4C} wedges adjacent to the Central Borden Fault Zone. FF_{4B} and FF_{4C} associations occur at various stratigraphic positions within FF_{4A}. Both the FF_{4A} and FF_{4B} associations weather a diagnostic chocolate brown colour due to breakdown of contained iron-rich carbonate.

FF_{4A} Association. **This association is mostly chocolate-brown subarkose and pebbly subarkose with minor interbeds of arkose and pebbly arkose. The strata commonly have a calcareous matrix and the arkoses typically occur as thin wedges which increase in thickness toward the fault zone. Sedimentary structures are rare and consist of a few scattered medium- to large-scale planar crossbeds, poorly-developed scours, and shallow channels.**

FF_{4B} Association. Carbonate-rich strata predominate in the FF_{4B} and consist of stromatolitic dolostone and relatively massive gritty dolostone. The latter forms one of the two lithologic end members, the other being calcareous subarkose. The grit in the dolostone is chiefly subrounded to subangular sand to pebble-sized clasts of quartz and feldspar which make up 5 to more than 25 per cent of the rock. The stromatolitic dolostone is commonly interlensed with flat pebble conglomerate and calcareous, pebbly subarkose.

Stromatolites of the FF_{4B} association occur in isolated lenses, in small biohermal mounds in the arkosic rocks, and as clasts in the flat pebble and boulder conglomerate. They include planar, or low domal forms 5-10 cm high, and unbranching expanding-upward columnar forms up to 20 cm high. The stromatolites commonly occur in a gritty or arkosic matrix and some are overturned and partially eroded.

FF_{4C} Association. The entire association comprises structureless massive breccia-conglomerate wedges up to 5 m thick adjacent to the Central Borden Fault Zone, but nearly all wedge out within 0.5 km north of the fault zone. Granule to cobble-size quartz and feldspar clasts and pebble to boulder granite and gneiss clasts predominate. In addition, cobble- to boulder-sized clasts are common adjacent to the fault zone but clast size decreases northward until pebble-sized clasts predominate 0.5 km away. The clasts are supported in a dolostone matrix that constitutes 10-40 per cent of the rock and contains scattered biotite flakes and quartz and feldspar sand grains.

Interpretation

The large scale coarsening-upward trend within the formation, cyclic deposition, and contained sedimentary structures, suggest the Fabricius Fiord strata were deposited in large marine-influenced delta fan complexes. These complexes extend more than 10 km basinward (north), are 1-2 km thick, and dominated the southern margin of the Borden Basin and Milne Inlet Trough throughout Fabricius Fiord deposition.

FF_1 beds are thin coastal to shallow marine shelf blanket sandstones and siltstones that were buried by prograding FF_2 coarsening-upward cycles of the lower and mid-fan complexes. These cycles in turn grade upward and toward the fault zone into thick FF_3 and FF_{4A} sheet sandstones and conglomerates of the upper fan platform. The FF_{4B} rocks originated within interdistributary basins on the emergent platform while FF_{4C} breccia-conglomerates were sporadically deposited as wedges along the fault zones during periodic tectonic activity. With cessation of major faulting along the basin margins, and subsequent expansion of the Society Cliffs carbonate platform Fabricius Fiord deposition ended.

ULUKSAN GROUP

The term Uluksan Group is restricted here to strata of the Society Cliffs and Victor Bay formations. These distinctive strata, together with the Nauyat, are the strata within the Bylot Supergroup that can probably best be correlated with strata in other regions.

Society Cliffs Formation

The Society Cliffs Formation outcrops chiefly in a broad lenticular belt that extends from Arctic Bay east-southeast to Paquet Bay (Fig. 16.2).

mottled buff and light brown. Disseminated quartz and feldspar grains occur in some beds and silty and clayey terrigenous material in others. Regularly laminated dolostones (cryptalgal laminites) are mostly planar laminated and are in general most abundant in the upper part of the formation. Minor wavy laminated varieties occur chiefly in the lower part of the formation (SC$_1$ and lower SC$_2$). Cryptalgal laminites are composed of thick, light-coloured laminae (2-5 mm) that alternate with thinner, darker-coloured to black laminae, mostly less than 2 mm thick. Very thin- to thin-bedded dolostones are commonly interbedded with the cryptalgal laminites.

Category 3. Nodular, irregularly-laminated dolostones make up much of the lower part (SC$_1$ and lower SC$_2$) of the formation in the Arctic Bay area, but are only a minor constituent elsewhere. The nodular dolostone contains nodules and lenticular beds of massive vuggy dolostone in, or separated by, irregularly-laminated dolostone that contains relatively abundant closely-spaced black carbonaceous laminae. Nodules are commonly outlined by a gypsiferous coating and some nodule cores contain gypsum crystal casts (Geldsetzer, 1973b; Olson, 1977).

Category 4. Several types of dolostone conglomerates and breccias occur in the Society Cliffs Formation. In most, both the clast and matrix are dolomite. Flat pebble conglomerate beds are a common, although minor, lithology throughout the formation east of Milne Inlet, and in the lower half to the west.

Round clast conglomerates occur locally throughout the Borden Basin, are less abundant than flat pebble conglomerates, and occur chiefly at the base or near the top of the formation.

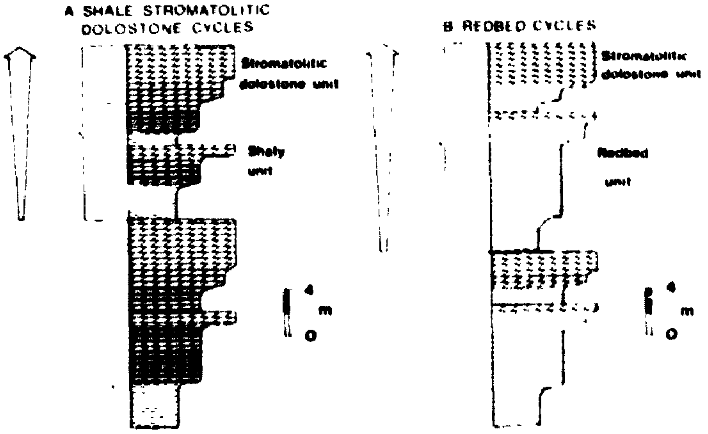
Dolostone breccias are abundant in the Strathcona-Adams Sound region and locally make up almost the entire formation. They decrease in abundance eastward from this area, and are rare elsewhere. Most breccias are related to karstification and/or solution collapse. They and associated dolostones are commonly hematite stained. Some upper breccia contacts are marked by reworked breccia redeposited as sediments. Chutes, channels and lenses of breccia, and carbonate and quartz veins are common in adjacent unbrecciated dolostone.

SC$_1$ Member

Most of this member comprises various combinations of dolostones described above in variously interbedded units. Terrigenous clastics, interbedded with the dolostones, contain gypsum beds in the eastern part of the basin.

Throughout most of the Borden Basin the terrigenous clastics are chiefly white to light grey quartz arenite, sublitharenite, arkose, and dolomitic quartz-feldspar granule conglomerate, with minor local grey to black shale. Locally, adjacent to the White Bay Fault Zone in the eastern part of the basin, the terrigenous clastics are varicoloured, and polymictic conglomerate clasts include granitic and dolomite granules and cobbles.

Evaporitic redbed sequences in the SC$_1$ consist of green, red, and black shale with interbedded grey-green and pink dolostone and white gypsum. Salt casts occur sporadically. Individual gypsum beds, commonly less than 1.5 m thick, range up to 3 m thick on northern Bylot Island. Elsewhere, gypsiferous coatings, gypsum casts, and crystal aggregates ("desert roses") occur locally in the dolostones.



A – *shale-stromatolitic dolostone cycles near Tremblay Sound*
B – *redbed cycles on west side of Tay Sound*

Figure 16.18. *Generalized shallowing-upward cycles of the SC$_1$ member east of Tremblay Sound.*

The SC$_1$ and SC$_2$ members are intergradational and the contact is arbitrarily defined as the horizon above which terrigenous clastics abruptly cease to be abundant. Thus the SC$_1$ member is 10-15 m thick in the westernmost part of Borden Basin, thickens gradually eastward to about 45 m on eastern Borden Peninsula, then thickens abruptly to 460 m near Tay Sound, and comprises the whole formation (480 m) locally on western Bylot Island.

Most of the SC$_1$ member consists of shallowing-upward cycles (Fig. 16.18) composed of two intergradational units. The lower, thicker, unit is composed of variously arranged terrigenous and/or dolostone clastics. The upper unit is composed chiefly of stromatolitic dolostone with minor clastic dolostone and, locally, shale. Gypsum occurs in the upper unit of redbed evaporitic cycles (Fig. 16.18B).

Only a few simple 2-3 m cycles occur in the western part of the Borden Basin. Cycles are commonly up to 30 m thick in the eastern part of the basin and locally are stacked in large complex shallowing-upward cycles as much as 135 m thick.

SC$_2$ Member

The SC$_2$ member consists predominantly of the four major buff to brownish grey dolostone lithologies already described. Rare terrigenous clastics are almost entirely shale. Poorly defined fining-, coarsening-, shallowing-, thickening-, and thinning-upward cycles up to 15 m thick are locally common. The SC$_2$ member ranges in thickness from 30 m to more than 600 m.

Interpretation

The widespread shale-dolostone shallowing-upward cycles, dewatering structures, variation in stromatolite types, and internal unconformities, suggest that the SC$_1$ member was deposited in shallow subtidal to intertidal environments west of Milne Inlet (Fig. 16.30). Redbed cycles and coastal gypsiferous sabkha sequences, in addition to features listed above, are interpreted as a variety of environments ranging from alluvial plain to supratidal and intertidal east of Milne Inlet and on Bylot Island.

mottled buff and light brown. Disseminated quartz and feldspar grains occur in some beds and silty and clayey terrigenous material in others. Regularly laminated dolostones (cryptalgal laminites) are mostly planar laminated and are in general most abundant in the upper part of the formation. Minor wavy laminated varieties occur chiefly in the lower part of the formation (SC_1 and lower SC_2). Cryptalgal laminites are composed of thick, light-coloured laminae (2-5 mm) that alternate with thinner, darker-coloured to black laminae, mostly less than 2 mm thick. Very thin- to thin-bedded dolostones are commonly interbedded with the cryptalgal laminites.

Category 3. Nodular, irregularly-laminated dolostones make up much of the lower part (SC_1 and lower SC_2) of the formation in the Arctic Bay area, but are only a minor constituent elsewhere. The nodular dolostone contains nodules and lenticular beds of massive vuggy dolostone in, or separated by, irregularly-laminated dolostone that contains relatively abundant closely-spaced black carbonaceous laminae. Nodules are commonly outlined by a gypsiferous coating and some nodule cores contain gypsum crystal casts (Geldsetzer, 1973b; Olson, 1977).

Category 4. Several types of dolostone conglomerates and breccias occur in the Society Cliffs Formation. In most, both the clast and matrix are dolomite. Flat pebble conglomerate beds are a common, although minor, lithology throughout the formation east of Milne Inlet, and in the lower half to the west.

Round clast conglomerates occur locally throughout the Borden Basin, are less abundant than flat pebble conglomerates, and occur chiefly at the base or near the top of the formation.

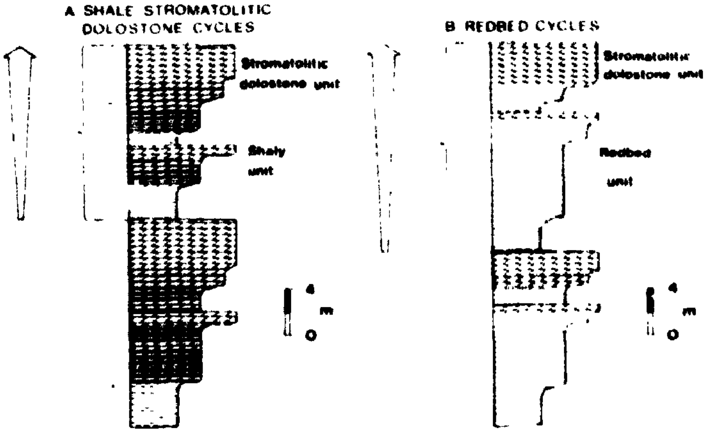
Dolostone breccias are abundant in the Strathcona-Adams Sound region and locally make up almost the entire formation. They decrease in abundance eastward from this area, and are rare elsewhere. Most breccias are related to karstification and/or solution collapse. They and associated dolostones are commonly hematite stained. Some upper breccia contacts are marked by reworked breccia redeposited as sediments. Chutes, channels and lenses of breccia, and carbonate and quartz veins are common in adjacent unbrecciated dolostone.

SC_1 Member

Most of this member comprises various combinations of dolostones described above in variously interbedded units. Terrigenous clastics, interbedded with the dolostones, contain gypsum beds in the eastern part of the basin.

Throughout most of the Borden Basin the terrigenous clastics are chiefly white to light grey quartz arenite, sublitharenite, arkose, and dolomitic quartz-feldspar granule conglomerate, with minor local grey to black shale. Locally, adjacent to the White Bay Fault Zone in the eastern part of the basin, the terrigenous clastics are varicoloured, and polymictic conglomerate clasts include granitic and dolomite granules and cobbles.

Evaporitic redbed sequences in the SC_1 consist of green, red, and black shale with interbedded grey-green and pink dolostone and white gypsum. Salt casts occur sporadically. Individual gypsum beds, commonly less than 1.5 m thick, range up to 3 m thick on northern Bylot Island. Elsewhere, gypsiferous coatings, gypsum casts, and crystal aggregates ("desert roses") occur locally in the dolostones.



A – shale-stromatolitic dolostone cycles near Tremblay Sound
B – redbed cycles on west side of Tay Sound

Figure 16.18. *Generalized shallowing-upward cycles of the SC_1 member east of Tremblay Sound.*

The SC_1 and SC_2 members are intergradational and the contact is arbitrarily defined as the horizon above which terrigenous clastics abruptly cease to be abundant. Thus the SC_1 member is 10-15 m thick in the westernmost part of Borden Basin, thickens gradually eastward to about 45 m on eastern Borden Peninsula, then thickens abruptly to 460 m near Tay Sound, and comprises the whole formation (480 m) locally on western Bylot Island.

Most of the SC_1 member consists of shallowing-upward cycles (Fig. 16.18) composed of two intergradational units. The lower, thicker, unit is composed of variously arranged terrigenous and/or dolostone clastics. The upper unit is composed chiefly of stromatolitic dolostone with minor clastic dolostone and, locally, shale. Gypsum occurs in the upper unit of redbed evaporitic cycles (Fig. 16.18B).

Only a few simple 2-3 m cycles occur in the western part of the Borden Basin. Cycles are commonly up to 30 m thick in the eastern part of the basin and locally are stacked in large complex shallowing-upward cycles as much as 135 m thick.

SC_2 Member

The SC_2 member consists predominantly of the four major buff to brownish grey dolostone lithologies already described. Rare terrigenous clastics are almost entirely shale. Poorly defined fining-, coarsening-, shallowing-, thickening-, and thinning-upward cycles up to 15 m thick are locally common. The SC_2 member ranges in thickness from 30 m to more than 600 m.

Interpretation

The widespread shale-dolostone shallowing-upward cycles, dewatering structures, variation in stromatolite types, and internal unconformities, suggest that the SC_1 member was deposited in shallow subtidal to intertidal environments west of Milne Inlet (Fig. 16.30). Redbed cycles and coastal gypsiferous sabkha sequences, in addition to features listed above, are interpreted as a variety of environments ranging from alluvial plain to supratidal and intertidal east of Milne Inlet and on Bylot Island.

VB_2 Member

The VB_2 member is present everywhere in the formation and constitutes the entire formation north of the Milne Inlet Trough. It is composed of several major carbonate lithologies, several minor terrigenous clastics and shaly, silty and quartzitic to arkosic carbonates (Fig. 16.19), and locally abundant varicoloured chert. The VB_2 member ranges from 130 m thick at Arctic Bay to 702 m east of Milne Inlet. The contact with the underlying VB_1 member varies from gradational to locally disconformable. Where disconformable, carbonate, conglomeratic calcareous shale, or siliciclastic limestone beds lie on the VB_1.

Grey, brownish grey to black and white clastic carbonates constitute most of the VB_2 member. All are similar to those of the Society Cliffs Formation, but commonly contain more disseminated terrigenous clay, silt and sand. Laminated to thin bedded carbonates are the dominant lithologies, but medium- to thick-bedded, very thick-bedded, and lumpy-bedded (nodular) carbonates, as well as cryptalgal laminites, are also common. Carbonate flat pebble-boulder conglomerates are abundant in the south, and rare in the northwest. Round clast conglomerate and chaotic breccia occur locally, while edgewise conglomerate and angular-rectangular clast breccias are rare. Conglomerate clasts are predominantly intraformational, but a few may have been derived from the Society Cliffs Formation. Most clasts are less than 20 cm but range up to 70 cm; rare, deformed slump blocks up to 5 m across occur in the west.

Carbonates within the Milne Inlet Trough are chiefly limestone in the lower part of the member and dolostone in the upper part. Dolostone predominates throughout the member to the north.

Grey to black, locally pyritiferous, shales are the dominant terrigenous clastics, and occur as lamellar partings or thin interbeds, and in interbedded units up to 5 m thick. Shale is most abundant in the lower part of the VB_2 where the underlying VB_1 member is thickest. Minor siltstone, siliciclastic dolostone, locally conglomeratic arkose, quartz arenite, and quartz-pebble quartz arenite occur near the upper contact or adjacent to the White Bay Fault Zone.

Shallowing-up sequences (to 30 m) in the VB_2 consist of a lower unit of laminated to medium bedded carbonates, shale, or interbedded shale and carbonate, and an upper unit of massive carbonate or carbonate flat-clast conglomerate. Minor deepening-up cycles begin with carbonate flat-clast conglomerate which grades upward into massive vuggy carbonate, or into interbedded conglomerate and shale which in turn is overlain by interbedded carbonate and shale.

Stromatolites are most abundant in the VB_2 member in the eastern part of Milne Inlet Trough, and are uncommon in the Arctic Bay-Nanisivik area. Stromatolites occur as planar, and isolated to laterally-linked undulose, low domal (to 30 cm diameter), hemispheroidal (to 70 cm diameter), and columnar to digitate columnar (2-70 cm high) types. Together, these types occur in bioherms, which are 20-1500 m long and occur mainly in the upper part of the member.

Common sedimentary structures in the VB_2 include: molar tooth, tepee and other dewatering structures, synaeresis, desiccation cracks, scour channels, load casts, rip-ups, convolute bedding, soft-sediment folds, slump structures, graded bedding, boudinaged beds, birds eye structure, planar crossbeds, ripples, and microfaults. Rare structures include ball and pillow, stylolites, rain prints and quartz arenite dykes.

Elongated domal stromatolites in the eastern part of the Milne Inlet Trough indicate chiefly east-northeast or west-southwest currents with subordinate secondary trends (Fig. 16.8). A few crossbed measurements from two locations show southeast and east transport.

Interpretation

The abundant grey and interbedded black pyritiferous shale suggests that the lensoid VB_1 was deposited in a euxinic starved subtidal environment. The distribution of the VB_1, the absence of a basal unconformity, and the abrupt lithologic change from the underlying Society Cliffs Formation, indicates that the depositional area rapidly subsided and was tilted southward, possibly by movement along the Central Borden Fault Zone. This down-drop was accompanied by regional basinal sagging initially centred in east-central Borden Peninsula and later in the Milne Inlet area. The relative abundance of sandstone and the presence of quartz pebble-cobble conglomerate adjacent to the White Bay Fault Zone east of Milne Inlet suggests that there may have been some syndepositional movement along this zone as well. Carbonate-capped shallowing-up cycles, together with an upward-increasing carbonate content, suggest gradual shoaling punctuated by sudden syndepositional, fault-related deepening.

The regional abundance of carbonate flat clast conglomerate, the interbedded lithologies, and extensive variety of sedimentary structures indicate that most of the VB_2 member was deposited in intertidal to supratidal environments. Round clast conglomerates in the lower and uppermost VB_2 member are therefore probably beach deposits. Isolated large bioherms in the upper part of the member, however, indicate shallow subtidal environments were continuously maintained in some areas. The siltstone and arkose at the top of the VB_2 herald uplift of the Byam Martin High and Navy Board High source areas.

NUNATSIAQ GROUP

Strata overlying the Victor Bay Formation are assigned to the newly named Nunatsiaq Group, which includes the Athole Point, Strathcona Sound and Elwin formations (Table 16.1). Except for the Athole Point Formation, the group is dominated by terrigenous clastics.

Athole Point Formation

The Athole Point Formation outcrops southeastward from central Borden Peninsula in the eastern part of the Milne Inlet Trough (Fig. 16.2).

The Athole Point is composed chiefly of various dark-coloured limestones interbedded with subordinate siliciclastic limestones, calcareous siltstones, and sandstones. As in the Victor Bay Formation, these lithologies occur in variously interbedded sequences commonly 2-40 m thick. The limestones typically have a petroliferous odour. The Athole Point ranges from 525-585 m in thickness. It consists of three intergradational members east of Milne Inlet (Fig. 16.20): the lower, AP_1 member is predominantly limestone; the middle, AP_2 member is composed of limestone cryptalgal laminite; and the upper, AP_3 member is composed of interbedded limestones, cryptalgal laminites, and siliciclastic limestones and sandstones. The AP_2 member thins abruptly west of Tremblay Sound where only the AP_1 and AP_3 are presently differentiated.

VB_2 Member

The VB_2 member is present everywhere in the formation and constitutes the entire formation north of the Milne Inlet Trough. It is composed of several major carbonate lithologies, several minor terrigenous clastics and shaly, silty and quartzitic to arkosic carbonates (Fig. 16.19), and locally abundant varicoloured chert. The VB_2 member ranges from 130 m thick at Arctic Bay to 702 m east of Milne Inlet. The contact with the underlying VB_1 member varies from gradational to locally disconformable. Where disconformable, carbonate, conglomeratic calcareous shale, or siliciclastic limestone beds lie on the VB_1.

Grey, brownish grey to black and white clastic carbonates constitute most of the VB_2 member. All are similar to those of the Society Cliffs Formation, but commonly contain more disseminated terrigenous clay, silt and sand. Laminated to thin bedded carbonates are the dominant lithologies, but medium- to thick-bedded, very thick-bedded, and lumpy-bedded (nodular) carbonates, as well as cryptalgal laminites, are also common. Carbonate flat pebble-boulder conglomerates are abundant in the south, and rare in the northwest. Round clast conglomerate and chaotic breccia occur locally, while edgewise conglomerate and angular-rectangular clast breccias are rare. Conglomerate clasts are predominantly intraformational, but a few may have been derived from the Society Cliffs Formation. Most clasts are less than 20 cm but range up to 70 cm; rare, deformed slump blocks up to 5 m across occur in the west.

Carbonates within the Milne Inlet Trough are chiefly limestone in the lower part of the member and dolostone in the upper part. Dolostone predominates throughout the member to the north.

Grey to black, locally pyritiferous, shales are the dominant terrigenous clastics, and occur as lamellar partings or thin interbeds, and in interbedded units up to 5 m thick. Shale is most abundant in the lower part of the VB_2 where the underlying VB_1 member is thickest. Minor siltstone, siliciclastic dolostone, locally conglomeratic arkose, quartz arenite, and quartz-pebble quartz arenite occur near the upper contact or adjacent to the White Bay Fault Zone.

Shallowing-up sequences (to 30 m) in the VB_2 consist of a lower unit of laminated to medium bedded carbonates, shale, or interbedded shale and carbonate, and an upper unit of massive carbonate or carbonate flat-clast conglomerate. Minor deepening-up cycles begin with carbonate flat-clast conglomerate which grades upward into massive vuggy carbonate, or into interbedded conglomerate and shale which in turn is overlain by interbedded carbonate and shale.

Stromatolites are most abundant in the VB_2 member in the eastern part of Milne Inlet Trough, and are uncommon in the Arctic Bay-Nanisivik area. Stromatolites occur as planar, and isolated to laterally-linked undulose, low domal (to 30 cm diameter), hemispheroidal (to 70 cm diameter), and columnar to digitate columnar (2-70 cm high) types. Together, these types occur in bioherms, which are 20-1500 m long and occur mainly in the upper part of the member.

Common sedimentary structures in the VB_2 include: molar tooth, tepee and other dewatering structures, synaeresis, desiccation cracks, scour channels, load casts, rip-ups, convolute bedding, soft-sediment folds, slump structures, graded bedding, boudinaged beds, birds eye structure, planar crossbeds, ripples, and microfaults. Rare structures include ball and pillow, stylolites, rain prints and quartz arenite dykes.

Elongated domal stromatolites in the eastern part of the Milne Inlet Trough indicate chiefly east-northeast or west-southwest currents with subordinate secondary trends (Fig. 16.8). A few crossbed measurements from two locations show southeast and east transport.

Interpretation

The abundant grey and interbedded black pyritiferous shale suggests that the lensoid VB_1 was deposited in a euxinic starved subtidal environment. The distribution of the VB_1, the absence of a basal unconformity, and the abrupt lithologic change from the underlying Society Cliffs Formation, indicates that the depositional area rapidly subsided and was tilted southward, possibly by movement along the Central Borden Fault Zone. This down-drop was accompanied by regional basinal sagging initially centred in east-central Borden Peninsula and later in the Milne Inlet area. The relative abundance of sandstone and the presence of quartz pebble-cobble conglomerate adjacent to the White Bay Fault Zone east of Milne Inlet suggests that there may have been some syndepositional movement along this zone as well. Carbonate-capped shallowing-up cycles, together with an upward-increasing carbonate content, suggest gradual shoaling punctuated by sudden syndepositional, fault-related deepening.

The regional abundance of carbonate flat clast conglomerate, the interbedded lithologies, and extensive variety of sedimentary structures indicate that most of the VB_2 member was deposited in intertidal to supratidal environments. Round clast conglomerates in the lower and uppermost VB_2 member are therefore probably beach deposits. Isolated large bioherms in the upper part of the member, however, indicate shallow subtidal environments were continuously maintained in some areas. The siltstone and arkose at the top of the VB_2 herald uplift of the Byam Martin High and Navy Board High source areas.

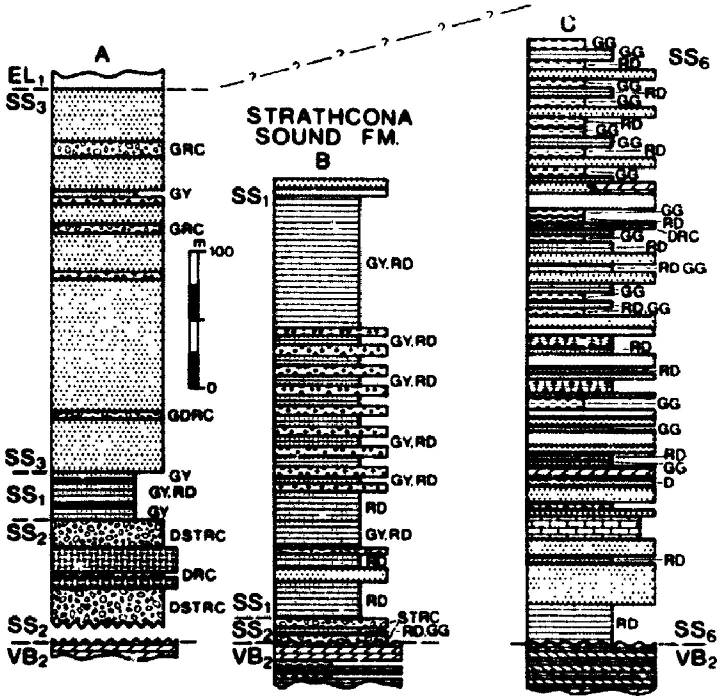
NUNATSIAQ GROUP

Strata overlying the Victor Bay Formation are assigned to the newly named Nunatsiaq Group, which includes the Athole Point, Strathcona Sound and Elwin formations (Table 16.1). Except for the Athole Point Formation, the group is dominated by terrigenous clastics.

Athole Point Formation

The Athole Point Formation outcrops southeastward from central Borden Peninsula in the eastern part of the Milne Inlet Trough (Fig. 16.2).

The Athole Point is composed chiefly of various dark-coloured limestones interbedded with subordinate siliciclastic limestones, calcareous siltstones, and sandstones. As in the Victor Bay Formation, these lithologies occur in variously interbedded sequences commonly 2-40 m thick. The limestones typically have a petroliferous odour. The Athole Point ranges from 525-585 m in thickness. It consists of three intergradational members east of Milne Inlet (Fig. 16.20): the lower, AP_1 member is predominantly limestone; the middle, AP_2 member is composed of limestone cryptalgal laminite; and the upper, AP_3 member is composed of interbedded limestones, cryptalgal laminites, and siliciclastic limestones and sandstones. The AP_2 member thins abruptly west of Tremblay Sound where only the AP_1 and AP_3 are presently differentiated.



A – east of head of Baillarge Bay
B – north of head of Strathcona Sound
C – western Bylot Island

Figure 16.21. *Generalized stratigraphic sections of the Strathcona Sound Formation (SS).*

sequences and an upward increase in both grain size and amount of terrigenous clastic material suggests a progressive shallowing and infilling of the basin.

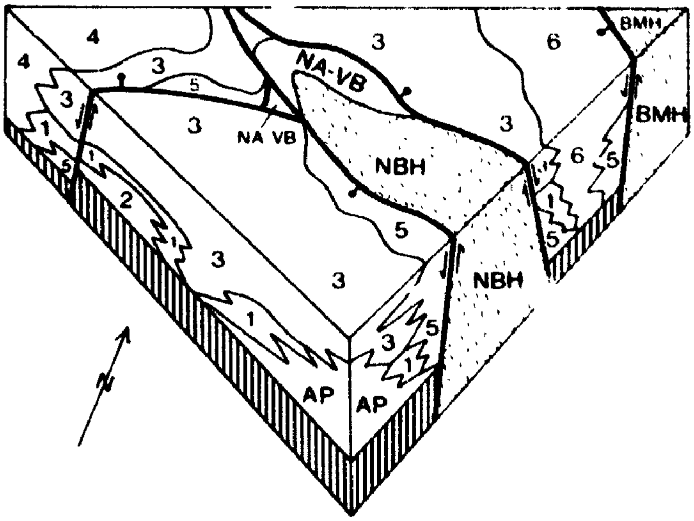
Strathcona Sound Formation

The Strathcona Sound Formation is most abundant in the axial portion of a major syncline from Baillarge Bay to Tremblay Sound (Fig. 16.2). In this paper, the formation includes most of the strata mapped previously as undivided Victor Bay-Society Cliffs on western Bylot Island (Jackson and Davidson, 1975).

The formation comprises a wide variety of complexly interfingering lithologies. These are mainly laminated to thin-bedded shales and siltstones, thin- to very thick-bedded sandstones, stromatolitic dolostones, dolostone conglomerates, and polymictic conglomerates (Fig. 16.21). These various lithologies occur singly, or interbedded with others in units to 30 m, and rarely, 110 m.

Faults, and the varied nature of the formation, make thickness determinations difficult. Partial sections up to 813 m are present and the formation is estimated to exceed 910 m. The contact between the Strathcona Sound and Victor Bay formations varies from conformable (abrupt to gradational) to disconformable. Contacts of the Strathcona Sound with the laterally equivalent Athole Point and the overlying Elwin Formations are conformable and gradational.

The Strathcona Sound Formation has been subdivided into six intergradational members (Table 16.1; Fig. 16.22). Only two, however, are typically present: a lower shale-siltstone member (SS_1), and an upper arkose-greywacke member (SS_3).



NBH = Navy Board High
BMH = Byam Martin High (see Fig. 16.26)

Figure 16.22. *Schematic diagram, looking north-northwest, showing relationships of Strathcona Sound members (1 = SS_1, 3 = SS_3, etc.). Left section is along Milne Inlet Trough. Right section extends from the Trough northward to western Bylot Island.*

The greatest variety of sedimentary structures occurs in SS_1 and SS_3 members, and include: ripples (symmetrical, asymmetrical, interference, climbing), planar trough and herringbone crossbeds, flutes, flames, load casts, ball and pillow, graded beds (normal and reverse), rip-ups, convolute bedding and slumps, microfaults, scour channels, tool marks, desiccation cracks (SS_1), and clastic dykes. Relatively few of these structures are common in SS_5 member and they are rare in both the SS_2 and SS_4.

Crossbeds from the SS_1 and SS_3 members indicate predominantly southwest to west transport south of the White Bay Fault Zone (Fig. 16.8, 16.25, 16.36), and westerly and northerly to easterly transport north of the Hartz Mountain Fault Zone.

Lower Shale-Siltstone Member (SS_1)

Red to red-brown or locally grey to green interbedded calcareous shales and siltstones predominate in this member (Fig. 16.21B). Both commonly contain disseminated quartz and feldspar sand grains. Very fine grained arkose and subordinate litharenite are locally abundant. Carbonate and medium to coarse grained arkose, litharenite, greywacke and rare quartz arenite beds and lenses occur sporadically throughout the member. The carbonate is in part stromatolitic, commonly contains terrigenous material, is chiefly dolostone in central Borden Peninsula and limestone to the northwest and southeast.

Fining- and thinning-upward cycles (to 2 m) occur at several localities. Fining-upward cycles consist chiefly of arkose, litharenite or siltstone grading upward into siltstone, shale, or calcisiltite.

Carbonate-clast orthoconglomerates commonly occur in the lower part of the member, particularly at or a short distance above the base of the member. Most conglomerate beds are less than 5 m thick and contain clasts of: grey to reddish massive or laminated or stromatolitic carbonate to

30 cm (rarely 100 cm); minor shale or siltstone; and rarely, gneisses. Clast rounding increases westerly and easterly away from the centre of Borden Peninsula. In general, degree of rounding and proportion of shale, silt and gneiss clasts increase upward, and gneiss clasts commonly predominate in conglomerates in the upper part of the member.

The SS_1 member is best developed in south- and north-central Borden Peninsula and constitutes most of the formation in the latter. It is laterally intergradational with the SS_2, SS_4, SS_5, SS_6 members, and with the Athole Point Formation (Fig. 16.22). SS_1 red siltstone overlies karsted Victor Bay dolostone south of Elwin Ice Cap. Relationships with the overlying SS_3 member vary from interfingering and intergradational to unconformable. Measured partial sections indicate a maximum thickness of more than 348 m.

Dolostone Member (SS_2)

This member is composed almost entirely of dolostones. Light grey, stromatolitic dolostone predominates. Locally, stromatolites are rare and interbeds of breccia, round-clast and flat-pebble conglomerate, and shaly dolostone with local synaeresis cracks are present.

The SS_2 member extends from the head of Strathcona Sound to just north of Elwin Ice Cap (Fig. 16.2). The biohermal part of the member is conformable and gradational with the underlying Victor Bay Formation. SS_2 strata laterally interfinger with, and are locally overlain by, SS_1 red shale and siltstone. Maximum thickness may be at least 300 m.

Laterally the central part of the member is composed mostly of elliptical, narrow, elongate bioherms up to 1 km long and 120 m thick. Bioherms have a variety of orientations, but easterly and northeasterly elongations predominate. They are composed largely of vertically stacked and laterally-linked hemispheroids with some undulose planar or branching columnar stromatolites, and rare, more complex types. Each bioherm is developed from a number of coalescing growth centres 2-5 m high.

The marginal areas of the SS_2 member are predominantly oligomictic to polymictic boulder orthoconglomerates and breccias which occur in irregular lenses (2-140 m thick) interbedded with dolosiltite, dolarenite, siltstone and shale (Fig. 16.21A). Most clasts are dolostones derived from the Victor Bay, Society Cliffs, and from upper Victor Bay-lower Strathcona Sound biohermal carbonates, but granitic gneiss boulders occur locally. Most clasts are 30 cm or less across, but south of Baillarge Bay (Fig. 16.2) they range up to 2.5 m. In this same area olistoliths up to 1 km long, and underlain by olistostromes, were probably derived from the Society Cliffs Formation to the south.

Arkose-Greywacke Member (SS_3)

This member is composed mostly of grey to green, locally red-brown, sandstones interbedded with conglomerates, siltstones, shales, and locally with minor dolostones and limestones. The sandstones are fine to very coarse grained and are commonly conglomeratic, with scattered granules and pebbles of granitic rocks, quartz and feldspar, and locally of shale, siltstone, and carbonate. The sandstones are invariably calcite cemented. Lithic arenites and arkoses predominate, although greywackes, sublitharenites and subarkoses are abundant; quartz arenite and quartz wacke are minor.

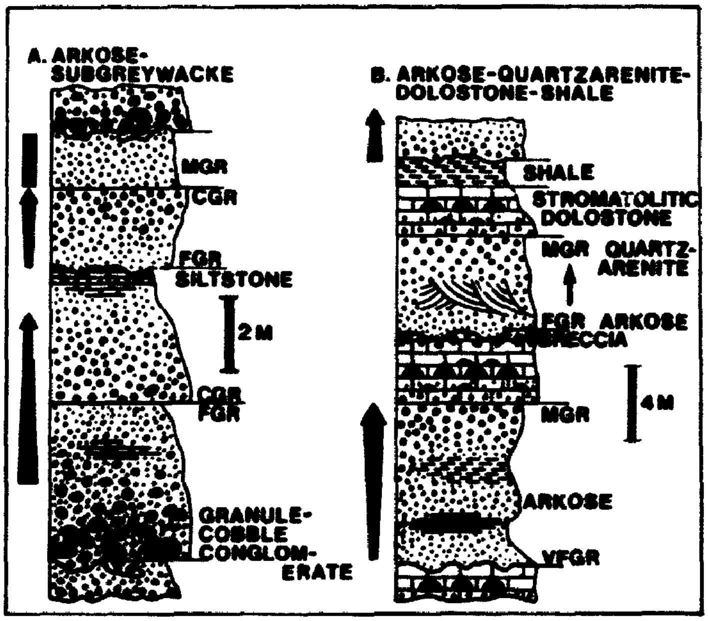


Figure 16.23. ***Representative cycles in Strathcona Sound and Elwin members. A – fining- and coarsening-upward cycles in SS_3 and SS_5 members in central Borden Peninsula; B – coarsening- and shallowing-upward cycles in SS_6 and EL_1 members along northern Navy Board Inlet. VFGR = very fine grained, etc.***

The SS_3 member conglomerates are polymictic orthoconglomerates with moderately to highly rounded and spherical clasts. Most are pebble-granule size, but a few range to more than a metre across. Granitic gneiss, quartz, and feldspar are the predominant clasts but sandstone, siltstone, shale and carbonate clasts are common. Carbonate clasts are predominant locally in the basal part of the member, and conglomerate or chert clasts occur locally.

SS_3 strata are interbedded cyclic packets of fining-upward units 1-90 m thick. In addition to the individual fining-upward beds and cycles, the packets also typically fine upward. Basal beds commonly rest on scoured surfaces and local conglomerates fill channels up to 15 m deep. A large variety of fining-up cycles are present (Fig. 16.23A). In addition, thinning-up cycles are common, and some coarsen upward. Locally, a disconformity within the SS_3 may divide lower fine grained varied lithologies and upper coarse calcareous feldspathic wacke.

The SS_3 member lies disconformably on Victor Bay strata in the vicinity of Strathcona Sound, grades laterally into and interfingers with SS_4, SS_5 and SS_6 members, and interfingers laterally with and conformably overlies Athole Point Formation (Fig. 16.2, 16.22). The contact with the overlying Elwin Formation is gradational. Partial sections indicate the member is more than 410 m thick. Locally, it may constitute the entire formation, as in the vicinity of Strathcona Sound (Fig. 16.22). The member is generally much thinner on northern Borden Peninsula.

Siltstone-Greywacke Member (SS$_4$)

This member consists predominantly of a monotonous sequence of laminated grey siltstone interbedded with minor very thin to medium-bedded grey subarkose and feldspathic wacke. It occurs between Strathcona Sound and Baillarge Bay. The strata are commonly calcareous and a few thin beds of limestone and dolostone are present. Sedimentary structures are rare, but increase in abundance immediately below the Elwin Formation, and include ripple marks, cross-lamination, small low angle planar crossbeds, load structures, flutes, and scoured bases.

About 270 m of SS$_4$ strata were measured in a partial section but the member may be nearly 600 m. It is transitional eastward into the SS$_1$ and SS$_3$ members, and is gradational into the overlying Elwin Formation.

Polymictic Conglomerate Member (SS$_5$)

This member is most abundant along the White Bay Fault Zone (Fig. 16.22, 16.30, 16.31), and lenses-out abruptly a short distance away from it. The SS$_5$ member consists chiefly of red to pink and grey-green, fine- to coarse-grained arkoses, polymictic pebble-boulder orthoconglomerates interbedded with subordinate lithic arenites, siltstones, shales and calcisiltites, and minor quartz arenites. Most strata are calcareous; calcisiltites and stromatolitic limestones (to 20 m) occur locally in the lower part of the member. Slumped fault blocks of massive, bedded (VB$_2$?) and stromatolitic dolostones up to 70 m thick and 2 km long occur southeast of Elwin Ice Cap.

The member contains ortho-, para-, oligomictic, and polymictic conglomerates which range from a few centimetres to a lens more than 186 m thick containing rounded carbonate clasts up to 10 m. Most clasts are less than 1 m across.

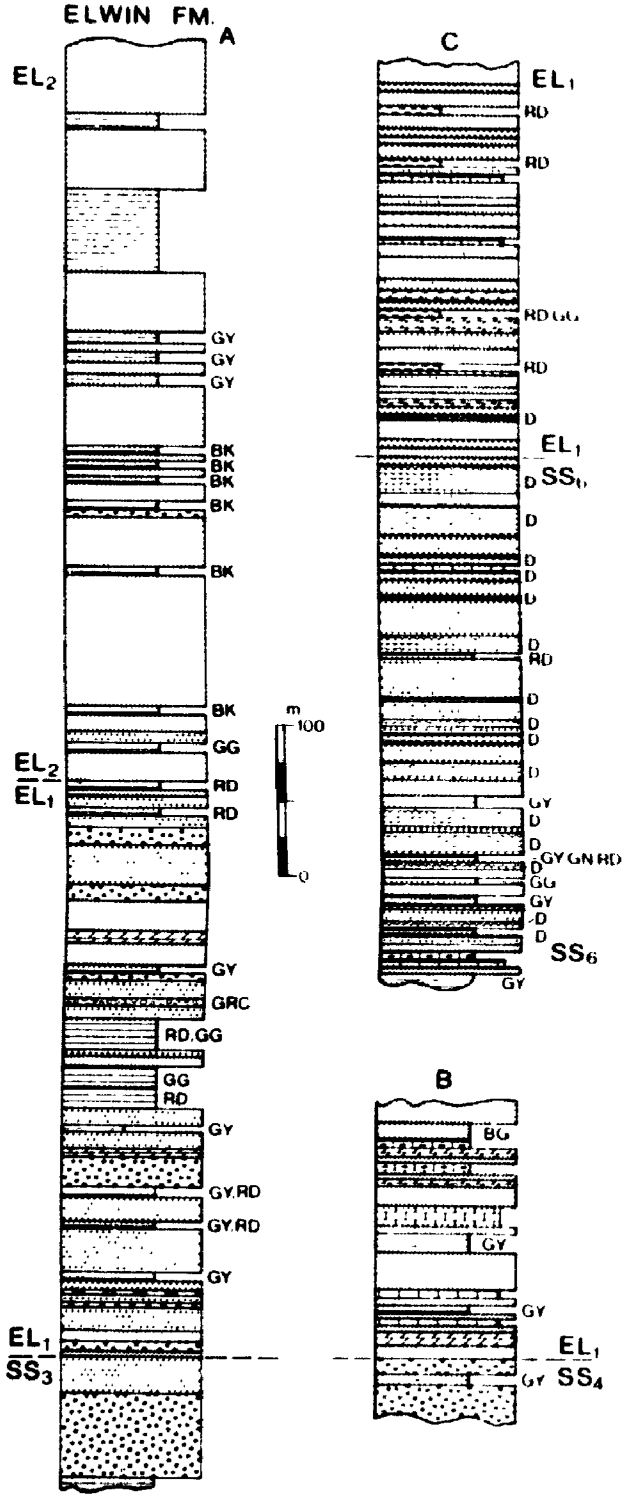
The polymictic conglomerates contain clasts mostly of carbonate and basement gneisses, minor siltstone, shale, and sandstone, as well as local conglomerates and quartz arenite. The conglomerates are concentrated in fans which grade along and away from the White Bay Fault Zone into typical SS$_1$, SS$_3$ and Athole Point strata.

SS$_5$ strata units, up to 50 m thick in the fans, are commonly less than 5 m elsewhere. Sedimentation in the SS$_5$ is dominated by fining-upward cycles (Fig. 16.23) but a few shoaling-upward and coarsening-upward cycles are also present. At least 812 m of SS$_5$ strata occur along the White Bay Fault Zone.

Sedimentary structures in the member include: ripple marks, trough crossbeds, convolute beds, load casts, rip-up clasts, microfaults, and stromatolites. Crossbeds and imbricate clasts indicate dominantly southerly to westerly transport.

Interbedded Member (SS$_6$)

Whereas only a few lithologies predominate in the other Strathcona Sound members described above, several lithologies are thinly interbedded throughout all but the lowermost 60 m of Strathcona Sound strata on western Bylot Island and along the west side of Navy Board Inlet (Fig. 16.21C, 16.24C). This thinly interbedded nature is characteristic of the lower EL$_1$ member of the Elwin Formation, which, however, commonly has more quartz arenite and less carbonate strata than does the Strathcona Sound Formation (Fig. 16.21, 16.22). Therefore strata bordering northern Navy Board Inlet (Fig. 16.2) are assigned to the Interbedded member (SS$_6$).



A – composite section, Elwin Inlet
B – south side of Baillarge Bay
C – west side of northern Navy Board Inlet

Figure 16.24. *Generalized stratigraphic sections of the Elwin (EL) and Strathcona (SS) formations.*

Siltstone-Greywacke Member (SS_4)

This member consists predominantly of a monotonous sequence of laminated grey siltstone interbedded with minor very thin to medium-bedded grey subarkose and feldspathic wacke. It occurs between Strathcona Sound and Baillarge Bay. The strata are commonly calcareous and a few thin beds of limestone and dolostone are present. Sedimentary structures are rare, but increase in abundance immediately below the Elwin Formation, and include ripple marks, cross-lamination, small low angle planar crossbeds, load structures, flutes, and scoured bases.

About 270 m of SS_4 strata were measured in a partial section but the member may be nearly 600 m. It is transitional eastward into the SS_1 and SS_3 members, and is gradational into the overlying Elwin Formation.

Polymictic Conglomerate Member (SS_5)

This member is most abundant along the White Bay Fault Zone (Fig. 16.22, 16.30, 16.31), and lenses-out abruptly a short distance away from it. The SS_5 member consists chiefly of red to pink and grey-green, fine- to coarse-grained arkoses, polymictic pebble-boulder orthoconglomerates interbedded with subordinate lithic arenites, siltstones, shales and calcisiltites, and minor quartz arenites. Most strata are calcareous; calcisiltites and stromatolitic limestones (to 20 m) occur locally in the lower part of the member. Slumped fault blocks of massive, bedded (VB_2?) and stromatolitic dolostones up to 70 m thick and 2 km long occur southeast of Elwin Ice Cap.

The member contains ortho-, para-, oligomictic, and polymictic conglomerates which range from a few centimetres to a lens more than 186 m thick containing rounded carbonate clasts up to 10 m. Most clasts are less than 1 m across.

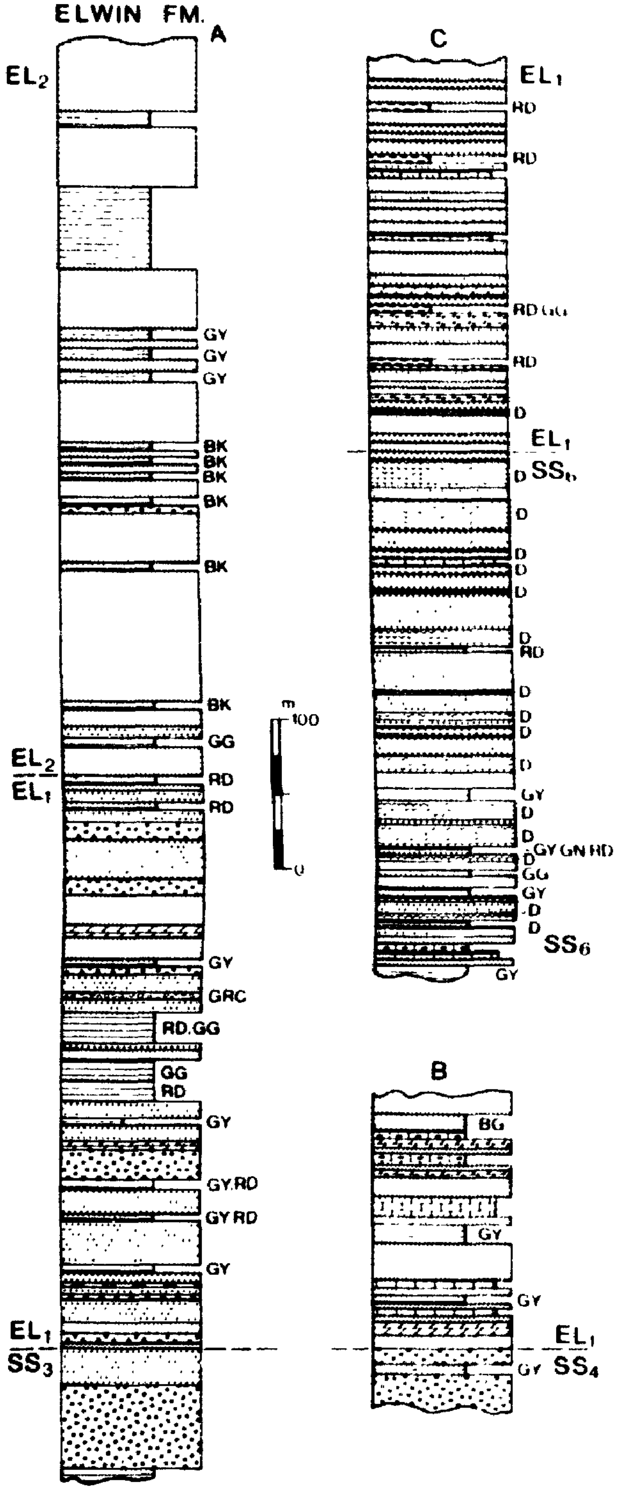
The polymictic conglomerates contain clasts mostly of carbonate and basement gneisses, minor siltstone, shale, and sandstone, as well as local conglomerates and quartz arenite. The conglomerates are concentrated in fans which grade along and away from the White Bay Fault Zone into typical SS_1, SS_3 and Athole Point strata.

SS_5 strata units, up to 50 m thick in the fans, are commonly less than 5 m elsewhere. Sedimentation in the SS_5 is dominated by fining-upward cycles (Fig. 16.23) but a few shoaling-upward and coarsening-upward cycles are also present. At least 812 m of SS_5 strata occur along the White Bay Fault Zone.

Sedimentary structures in the member include: ripple marks, trough crossbeds, convolute beds, load casts, rip-up clasts, microfaults, and stromatolites. Crossbeds and imbricate clasts indicate dominantly southerly to westerly transport.

Interbedded Member (SS_6)

Whereas only a few lithologies predominate in the other Strathcona Sound members described above, several lithologies are thinly interbedded throughout all but the lowermost 60 m of Strathcona Sound strata on western Bylot Island and along the west side of Navy Board Inlet (Fig. 16.21C, 16.24C). This thinly interbedded nature is characteristic of the lower EL_1 member of the Elwin Formation, which, however, commonly has more quartz arenite and less carbonate strata than does the Strathcona Sound Formation (Fig. 16.21, 16.22). Therefore strata bordering northern Navy Board Inlet (Fig. 16.2) are assigned to the Interbedded member (SS_6).



A – composite section, Elwin Inlet
B – south side of Baillarge Bay
C – west side of northern Navy Board Inlet

Figure 16.24. *Generalized stratigraphic sections of the Elwin (EL) and Strathcona (SS) formations.*

This member is composed of interbedded arkoses, lithic arenites, quartz arenites, siltstones, shales, dolostones, and siliciclastic and stromatolitic dolostones that are red, green, grey, buff, white, laminated to medium bedded, planar to wavy bedded, and locally lumpy bedded. Oolites, pisolites and frosted sand grains are common in the upper part, and some beds contain disseminated pyrite.

Although each lithology predominates in units commonly 10 m or less thick, much if not most of the member consists of red-coloured lithologies in 5-130 m sequences separated by grey-green lithologies in 8-50 m sequences. Fining-, shallowing-, and thinning-upward cycles 2-40 m thick are characteristic (Fig. 16.23B), and include sandstone-siltstone-dolostone or shale cycles. Coarsening- and thickening-upward cycles are less common.

The SS$_6$ member may be divided into a lower sequence characterized by relatively thick lithological units, a middle sequence containing abundant interbedded quartz arenite, and an upper sequence of arkose interbedded with either siltstone and shale or stromatolitic dolostone (Fig. 16.21C, 16.24C). The contact with the underlying Victor Bay and overlying Elwin formations is conformable and gradational. Tentative correlation between partial sections of 450 m and 350 m (Fig. 16.21C, 16.24C) indicates the SS$_6$ member is at least 550 m thick and probably constitutes the entire formation in the Navy Board Inlet area.

Sedimentary structures typical of the SS$_1$ and SS$_3$ members are common throughout the SS$_6$ (excluding flutes and tool marks). Synaeresis, birds eye, tepee and other dewatering structures, and molar tooth occur in the carbonates, which also contain planar, low domal and laterally-linked hemispheroidal stromatolites. Crossbeds, locally to 2 m, and stromatolite elongations indicate west-northwest transport was dominant.

Interpretation

Lithologies, cycles and contained structures of the Strathcona Sound Formation, as well as facies relations between members, indicate that the SS$_5$ member is composed of partially coalescing alluvial fan complexes that accumulated rapidly along the active White Bay Fault Zone adjacent to the rising Navy Board High (Fig. 16.22) that was stripped of a cover of previously-deposited Bylot Supergroup strata. The few shoaling-up sequences suggest that local parts of the fan complexes may be lacustrine or shallow marine.

The SS$_5$ member interfingers laterally southward with the lower shale-siltstone (SS$_1$) and upper arkose-greywacke (SS$_3$) members (Fig. 16.22). The lower SS$_1$ member probably accumulated in overbank alluvial and intertidal environments throughout the Borden Basin. The carbonate clast conglomerates immediately above the Victor Bay Formation in the Milne Inlet Trough are interpreted as debris flows, although some may be breccias related to the solution of interbedded evaporites. Channel deposits, conglomerate-based fining-upward cycles, and terrigenous clastic-carbonate cycles, indicate the SS$_3$ was deposited in mixed alluvial and intertidal environments.

Carbonate beds in the Milne Inlet Trough are best developed near the White Bay Fault Zone, which suggests that as the Trough subsided, it was also tilted downward toward the north, and carbonate deposition occurred in a tongue of the sea or in shallow ephemeral lakes. The few northeasterly to easterly directed crossbeds in SS$_3$ lithic arenites that disconformably overlie Victor Bay and SS$_1$ strata southeast Strathcona Sound (Fig. 16.2) suggest that some SS$_3$ strata may have been derived from a southerly or westerly source related to renewed activity along the Central Borden Fault Zone or a fault along Admiralty Inlet.

The SS$_2$ member accumulated as a small biohermal carbonate platform in a shallow subtidal to intertidal environment. Westward- and southward-prograding SS$_1$ clastics buried the locally-emergent carbonate platform. West of this platform, the monotonous grey siltstone-greywacke turbidites of the SS$_4$ member accumulated in a downfaulted wedge-shaped basin between Strathcona Sound and Elwin Inlet (Fig. 16.22).

The large scale lateral variations, rapid lateral changes within individual beds, the oolites, pisolites and frosted quartz and feldspar grains, and the abundance of fining- and shallowing-upward cycles, all indicate that the SS$_6$ member was deposited in closely-spaced alluvial plain to supratidal and intertidal environments.

The distribution of SS$_2$, SS$_4$ and SS$_6$ members suggests that north- to northeast- as well as northwest-trending faults continuously influenced sedimentation. The vertically and laterally variable nature of the Strathcona Sound and Athole Point formations, the presence of large olistoliths underlain by olistostromes along the western side of the SS$_2$ member, and large slumped carbonate fault blocks in the SS$_5$ member attest to continuous tectonic instability during Strathcona Sound deposition.

Elwin Formation

The Elwin Formation is the uppermost formation of the Nunatsiaq Group, and outcrops only on northern Borden Peninsula (Fig. 16.2). It is composed of varicoloured quartz-rich sandstones, with minor siltstones, dolostones and shales (Fig. 16.24). The strata are very thin- to thick-bedded, and the sandstones are equigranular and generally contain even less matrix than those of the Strathcona Sound.

The Elwin Formation is conformable and gradational with the underlying Strathcona Sound Formation. This contact is difficult to define, but is commonly marked by the abrupt appearance of quartz arenite, and a slight but distinct diminution in sandstone grain size. The Elwin is overlain unconformably by lower Paleozoic strata, ranges from 870 to 1220 m thick, and is divided into two intergradational members.

Planar crossbeds, small scour channels, synaeresis, symmetrical and asymmetrical ripples, and frosted sand grains are common throughout the formation. Larger clasts of rounded quartz, feldspar, and dolostone, and angular rip-up clasts of siltstone, sandstone and shale, are locally present. Desiccation cracks are sparse.

Lower Member (EL$_1$)

The EL$_1$ member is composed of interbedded red, grey-green, white and buff subarkoses, quartz arenites, lithic arenites, siltstones, and dolostones (dololutite, dolosiltite, intraformational dolorudite). Commonly, the sandstones contain kaolinized feldspar and are very fine to medium grained, although coarse grained sandstones are locally common (Fig. 16.24). Rare stromatolitic dolostone contains planar and wavy laminated, low domal, and laterally-linked hemispheroids.

The contact between the lower and upper Elwin members is gradational, and is marked by an abrupt increase in the amount of quartz arenite and a corresponding decrease in the number of other lithologies. The EL$_1$ member ranges from more than 265 m to 375 m in thickness.

Strata occur variously interbedded in units up to 30 m thick but most are 10 m or less. Depositional cycles are common but are not as apparent as in the underlying Strathcona Sound. Cycles range from simple to complex and some include two of the following types in compound cycles: thinning-up (bedding), thickening-up, coarsening-up (grain), fining-up, and shallowing-up (Fig. 16.23B). Fining- and shallowing-up cycles include: arkose to quartz arenite to dolostone, with red shale below and/or above the dolostone; arkose to shale to locally brecciated dolostone; coarsening-up (and deepening?) cycles include dololutite to shale to arkose.

Trough crossbeds, climbing ripples, concretions, slump structures, microfaults, load casts, and sole marks are common in the member in addition to structures already noted for the formation as a whole. Tepee structures occur in some dolostones and oolites and pisolites are common locally, as are halite casts 80-100 m above the base of the member.

Paleocurrent patterns are polymodal and have high dispersion (Fig. 16.8).

Upper Member (EL_2)

The EL_2 member is predominantly very fine to medium grained, white to light grey, buff to orange, red and light-green quartz arenites interbedded with minor siltstones (Fig. 16.24A). Although well to poorly sorted, they are finer grained, better sorted and more mature than sandstones in the lower member. Rare subarkose and sublitharenite occur in the lower part of the member. Most siltstones are black in the lower part of the member and grey in the upper part. The EL_2 member is at least 495 m thick at Elwin Inlet and may be as much as 850 m thick elsewhere on Borden Peninsula.

Strata of the upper member are thicker bedded than those in the lower member and occur interbedded in units up to at least 90 m thick, although most are less than 17 m. Typically the member comprises alternating quartz arenite units (65 per cent), and quartz arenite-shale units (35 per cent) that are 70 per cent quartz arenite. Where present, cyclic deposition is vague, ill-defined, and constitutes a few graded beds and coarsening-up cycles.

In addition to the sedimentary structures characteristic of the whole formation, rare current lineations occur in the middle of the member. Paleocurrent patterns from crossbeds show high dispersion, and indicate polymodal, east-northeast transport (Fig. 16.8). Directions most commonly indicated in both members are: north-northwest, northeast, and southeast (Fig. 16.8).

Interpretation

The large variety of lithologies, depositional cycles and sedimentary structures, indicates the EL_1 member accumulated in intratidal to supratidal and alluvial braidplain environments. The local evaporitic strata probably accumulated in ephemeral pools on tidal flats or in lagoonal areas.

The abundant trough and planar crossbeds, asymmetrical and symmetrical and climbing ripples, small channels, desiccation cracks, and coarse subarkose lenses suggest a braided fluvial environment for the upper 100 m of the EL_1 at Elwin Inlet. East-northeast to southeast trends predominate in the paleocurrent pattern for this unit, as well as for the rest of the EL_1 member of western Borden Peninsula, and suggest that some detritus may have been supplied from sources in the northern Brodeur Pininsula and/or Devon Island areas.

Predominant west-southwest paleocurrent trends adjacent to Navy Board Inlet suggest the Byam Martin High may have been the major EL_1 source area near Navy Board. However, northerly paleocurrent trends on north-central Borden Peninsula indicate that here the Navy Board High may have been the major source area. In these regions, as in the others, subsidiary northeast and east-southeast paleocurrents suggest that tidal currents were active.

The kaolinized feldspar, abundant quartz arenite, and better sorted nature of the lower Elwin as compared with Strathcona Sound strata, suggest an abatement of tectonic activity and EL_1 strata are more reworked, possibly during prolonged transport. The thin nature of the EL_1 member, and relative paucity of contained carbonate strata on central Borden Peninusla compared with areas to the west and east, suggest that environments more typical of EL_2 deposition prevailed slightly earlier in central Borden Peninsula, or that this area was farther from source areas during EL_1 deposition compared with areas to the west and east.

The lithologies, structures, and polymodal paleocurrent patterns indicate the EL_2 accumulated chiefly in a subtidal sandstone shelf environment. The major north-northwest and south-southeast paleocurrent trends are interpreted as a result of tidal activity and the east-northeast trends as being related to longshore currents (Fig. 16.8). The predominance of equigranular quartz arenites suggests that previously-deposited sands were reworked and redeposited during a period of prolonged relative stability.

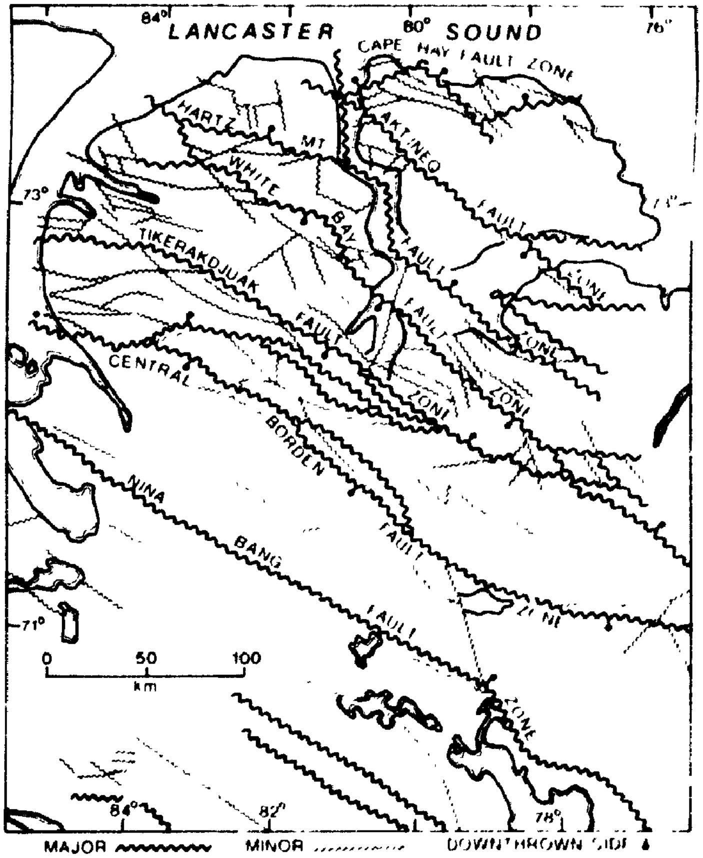


Figure 16.25. *Major fault zones and associated minor faults in northwestern Baffin Island east of Admiralty Inlet.*

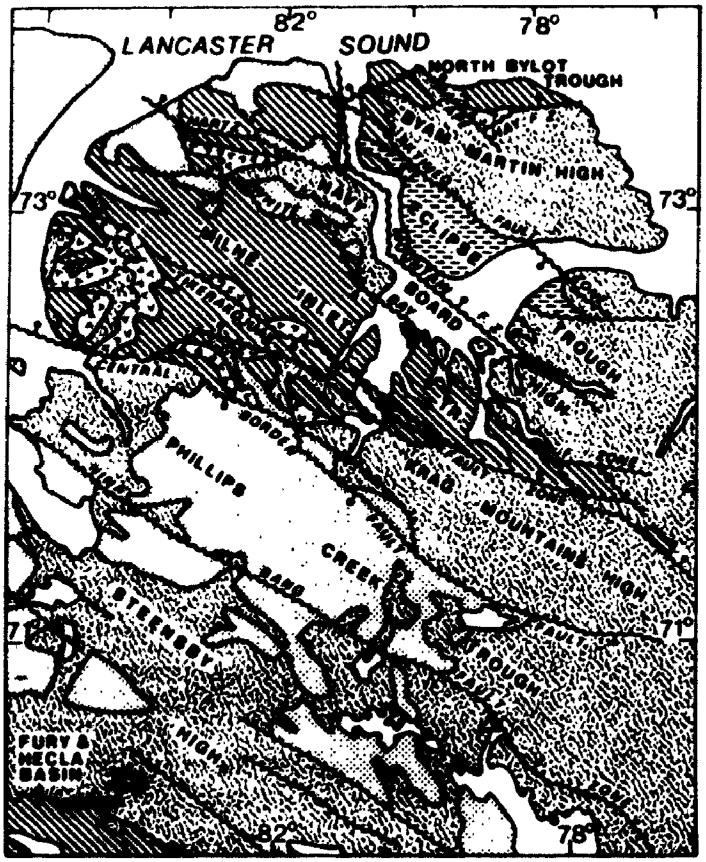


Figure 16.26

Horsts and grabens of the North Baffin Rift Zone, northwestern Baffin Island.

The cumulative paleocurrent diagram indicates predominantly easterly transport for the Elwin Formation compared with predominantly westerly transport for all of the other formations (Fig. 16.8). This change in direction may signify increased tectonic activity to the west, perhaps in the vicinity of the Boothia Arch or farther out in the basin.

FAULTING

Faulting, predominantly along northwest-trending faults (Fig. 16.25, 16.26) has taken place in northwest Baffin Island from the end of Aphebian to Recent time (Jackson et al., 1975, 1978a; Jackson and Morgan, 1978). The gentle folds and local vertical dips in Bylot Supergroup strata were caused by this faulting. Several small northwest-dipping, low-angle thrusts may be mainly syndepositional but may also be related to postdepositional compression from the northwest.

Most of the faulting during deposition of the Bylot Supergroup occurred as vertical movements along steep northwest-trending faults. Movements were episodic and culminated during deposition of the Arctic Bay-Fabricius Fiord formations and later during Strathcona Sound-Athole Point Formation deposition.

Northerly to northeasterly trending faults were much less widespread and of relatively local extent during sedimentation. Parts of the Milne-Navy Board Inlets zone acted as a hinge zone throughout sedimentation, whereas faulting occurred along other parts. Alignment of this zone with the east margins of Devon and Ellesmere islands and Nares Strait (Fig. 16.1) suggests (vertical) movement may have occurred along this linear in Neohelikian time. Penecontemporaneous basic volcanics in basal strata of the aligned Fury and Hecla, Borden and Thule basins, apparently absent at Somerset Island to the west, suggest most volcanism probably occurred along northerly to northeasterly trending fissures.

Although much faulting postdates Bylot Supergroup deposition, the present fault distribution and nature of the North Baffin Rift Zone (Fig. 16.25, 16.26) probably approximates the nature of horst and graben development at the close of Elwin deposition. A low negative Bouguer anomaly over southwest Bylot Island suggests that although components of the Eclipse Trough (Fig. 16.26) were in existence in the Neohelikian, they were modified subsequently. Lancaster Sound may have been a graben area within the North Baffin Rift Zone, although the present graben (Kerr, 1980) may have a more easterly trend than the Neohelikian one.

EVOLUTION OF BORDEN BASIN

In this section the deposition of the Neohelikian Bylot Supergroup is summarized, brief comparisons and correlations are made with Neohelikian strata in adjacent basins, and the origin of Borden Basin is discussed.

Filling of the Basin

Deposition of Bylot Supergroup commenced with faulting, terrigenous clastic sedimentation and basic volcanism (Eqalulik Group) during initial marine transgression of a northwesterly dipping peneplaned Archean-Aphebian grani-toid basement complex. Later broad downwarping resulted in regional shallow marine carbonate sedimentation (Uluksan Group). Continued downwarping resulted in renewed

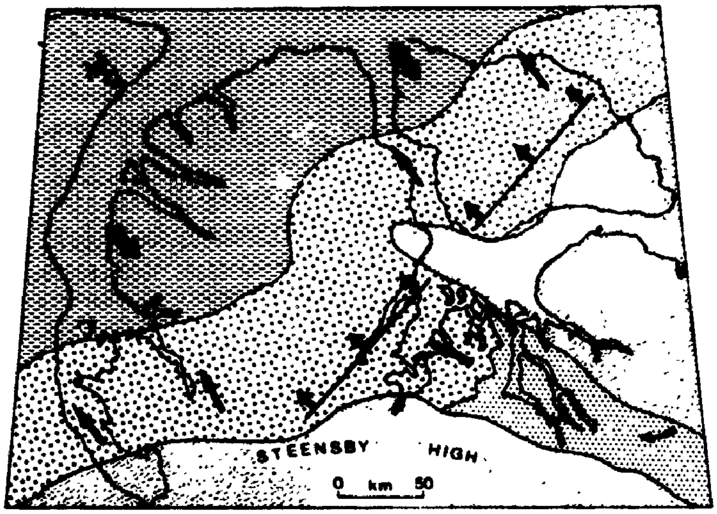


Figure 16.27. *Paleoenvironmental reconstruction for Nauyat and lower to middle Adams Sound deposition.*

faulting, collapse, and mild compression, and finally, basin stability (Nunatsiaq Group). Presence of a marine basin to the northwest is indicated during most of Bylot Supergroup deposition.

The dominantly braided fluvial sandstones of the lower Nauyat and Adams Sound accumulated in a narrow channel southeast of Milne Inlet that may have originated by faulting. This channel is transitional into an alluvial plain delineated by an anastomosing network of upward-coalescing braided stream deposits (Fig. 16.27, 16.28). Lower Nauyat strata in the northern part of the basin were deposited in mixed fluvial to marginal-marine environments.

Regionally, sedimentation was interrupted by quiescent extrusion of southeast-thinning Nauyat terrestrial tholeiitic plateau basalts. These volcanics were probably not deposited in the southeastern part of the basin. The present distribution of the flows is determined by major northwesterly trending faults. However, northwestward thickening of the volcanics suggests the erupting fissures were probably northeasterly trending. Renewed sedimentation rapidly buried the volcanics beneath prograding braided fluvial clastics before appreciable erosion or incision.

Throughout deposition of the Adams Sound, fluvial environments predominated in the southeast part of the basin, whereas mixed fluvial and marginal marine environments predominated in the northeast. In the western (north and south) part of the basin fluvial sedimentation occurred throughout AS_1 deposition and mixed fluvial and marginal marine sedimentation during AS_{2-3} deposition.

Periodic regional subsidence was accompanied by marine transgression until marine sedimentation prevailed during deposition of the interfingering and intergradational Fabricius Fiord and Arctic Bay formations. Lower Fabricius Fiord (FF_1) coastal and shallow shelf sediments accumulated along the southern margin of the basin. Coeval lower Arctic Bay (AB_1) intertidal sediments were deposited in the southeast and mixed intertidal to shallow subtidal clastics in the rest of the basin.

Major intrabasinal faulting and extrabasinal uplift began late during lower Arctic Bay-Fabricius Fiord deposition, and continued sporadically throughout deposition of both formations. The most pronounced effect of this faulting and uplift was in the southern part of the basin, where large coalescing marine-influenced delta fan complexes (FF_{2-4}) were deposited along the Central Borden Fault Zone (Fig. 16.26, 16.28, 16.29) and extend upward to interfinger with lower Society Cliffs strata.

While these Fabricius Fiord delta-fan complexes formed, the coeval Arctic Bay member (AB_2) was deposited in marine-influenced deltas and on clastic shorelines in the southeast, and in a shelf environment elsewhere. The AB_3 member accumulated in a subtidal, locally starved, basin environment. AB_4 strata, including deltaic-alluvial fan complexes, were deposited in shallower mixed clastic shoreline and shelf environments.

The upward-increasing carbonates in the Arctic Bay are precursors of the thick platformal carbonates of the Society Cliffs and Victor Bay formations. However, the disconformity common at the base of the Society Cliffs suggests that faulting or regional warping again may have played a major role in changing the nature of sedimentation.

Carbonate shelf environments were maintained throughout most of the basin during deposition of the Society Cliffs, with subtidal to intertidal sedimentation predominating. Syndepositional faulting produced local karst topography and elevated the proto-Navy Board and Byam Martin highs. Terrigenous clastics shed from these highs accumulated in alluvial plain and intertidal to supratidal or sabkha environments throughout most of the eastern Society Cliffs (Fig. 16.28, 16.30).

Downfaulting of the Milne Inlet Trough, accompanied by a sagging of the south-central part of the basin at the beginning of Victor Bay sedimentation, resulted in deposition of a northward-thinning tongue of subtidal shale (Fig. 16.28, 16.31). Elsewhere, intertidal to supratidal, with rare subtidal, carbonate deposition predominated.

Major syndepositional faulting during accumulation of the Strathcona Sound and Athole Point formations produced a large variety of local and regional depositional environments and interfingering lithologies (Fig. 16.22, 16.28, 16.32). With uplift of the Navy Board and Byam Martin highs, previously deposited sandstones and carbonates were stripped off the

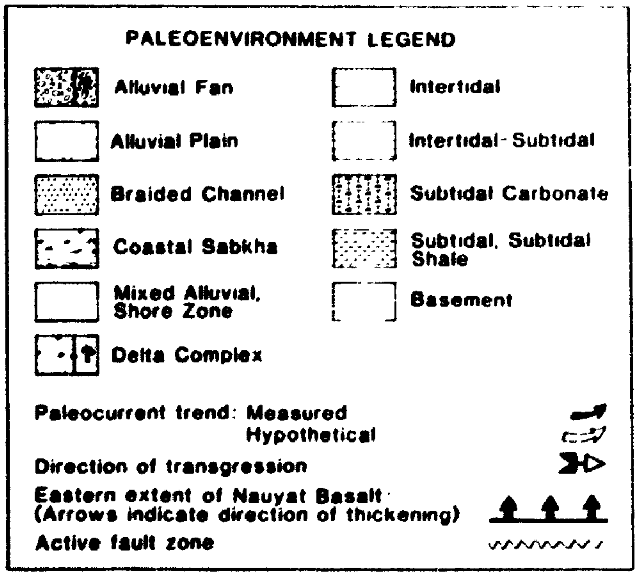


Figure 16.28. *Legend for paleoenvironmental reconstructions in Figures 16.27 and 16.29-16.32.*

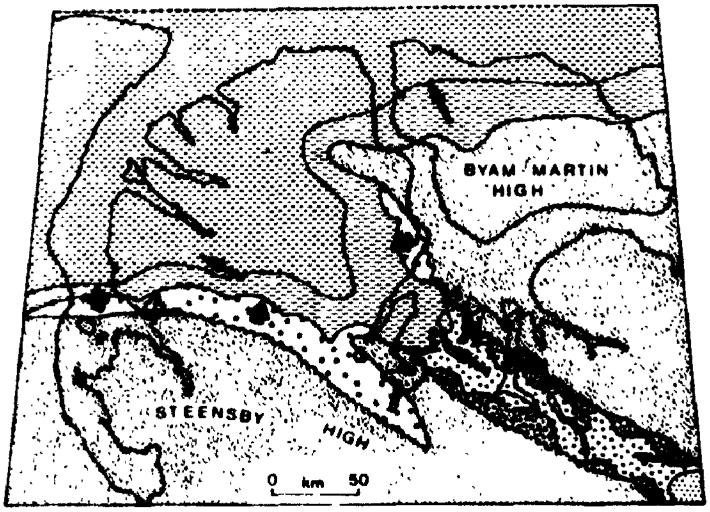


Figure 16.29. *Paleoenvironmental reconstruction for Arctic Bay and laterally equivalent Fabricius Fiord deposition.*

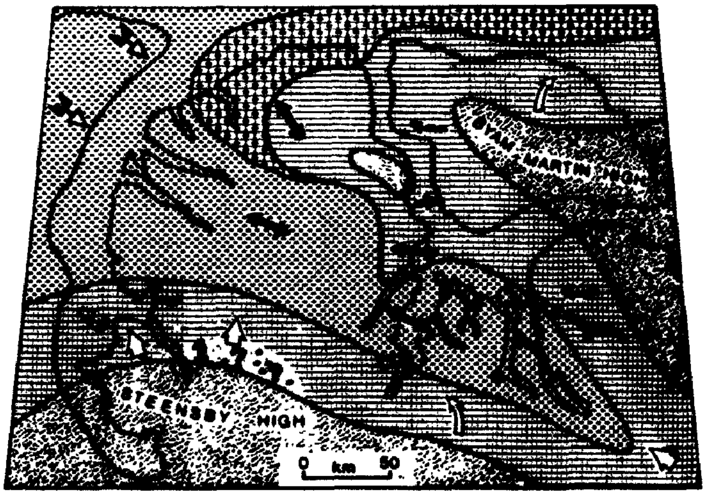


Figure 16.31. *Paleoenvironmental reconstruction for lower Victor Bay deposition.*

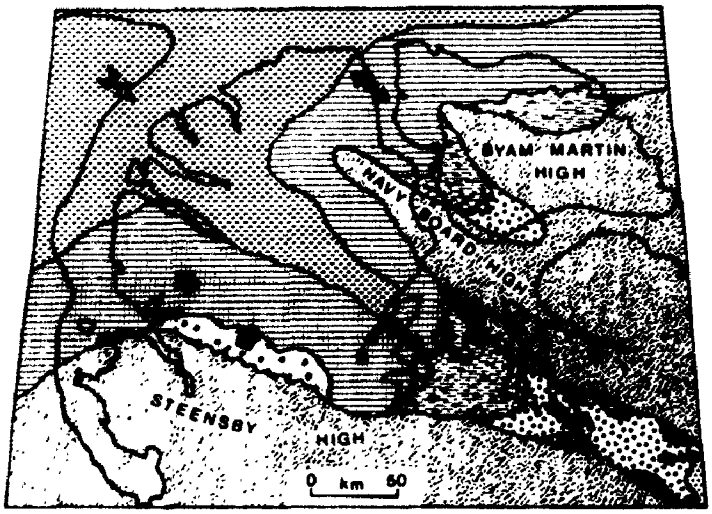


Figure 16.30. *Paleoenvironmental reconstruction for Society Cliffs and uppermost Fabricius Fiord deposition.*

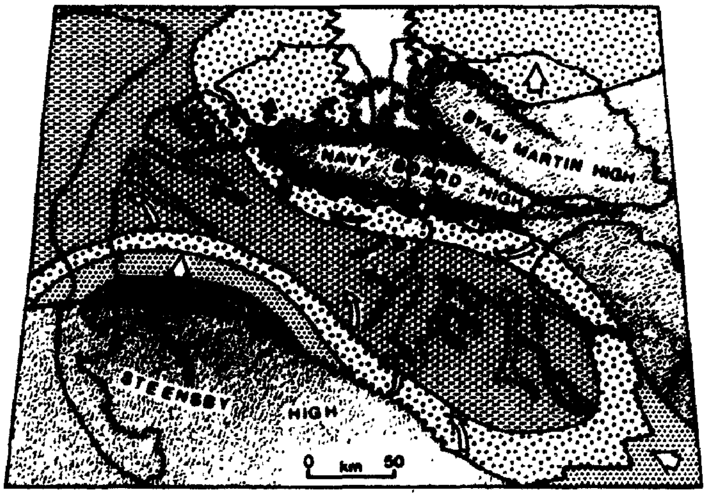


Figure 16.32. *Paleoenvironmental reconstruction for Athole Point and lower Strathcona Sound deposition.*

Navy Board High and a thick sequence of coarsely conglomeratic coalescing alluvial fan complexes (SS_5) were deposited south of the White Bay Fault Zone (Fig. 16.26, 16.28, 16.32) during virtually the entire Strathcona Sound depositional period. At the same time, finer grained, varied sediments (SS_6) were deposited in the north-central part of the basin, and a monotonous sequence of turbidite clastics (SS_4) accumulated in a down-dropped area in the central western part of the basin.

Faulting during lower Strathcona Sound deposition involved northward down-tilting of the Milne Inlet Trough and scissor-type movement between the Trough and Navy Board High. This resulted in deposition of lacustrine or shallow marine limestones in the lower SS_5 member adjacent to the Navy Board High. It also resulted in deposition of the predominantly intertidal-subtidal Athole Point limestones with turbidites and minor interbedded debris flow conglomerates in the southeastern part of the basin. When the deepened portion of the Milne Inlet Trough was eventually filled, the Athole Point strata were buried by prograding upper Strathcona (SS_3) fluvial and shallow marine sands.

In the northern and south-central parts of the Borden Basin, lower Strathcona Sound (SS_1) intertidal and overbank alluvial strata include scattered channel deposits and debris flow breccia and conglomerate lenses. An isolated small subtidal-intertidal biohermal carbonate platform (SS_2) developed rapidly in the west-central part of the basin, east of the SS_4 member, during deposition of lower Strathcona Sound sediments. Syndepositional faulting shed prograding alluvial SS_1 clastics westward, terminating carbonate platform development.

SS_1, SS_2 and Athole Point strata are overlain by upper Strathcona Sound (SS_3) mixed channel and overbank deposits. The coarseness of SS_3 compared with SS_1 strata suggests rejuvenation of the source areas. Uplift of the area south of

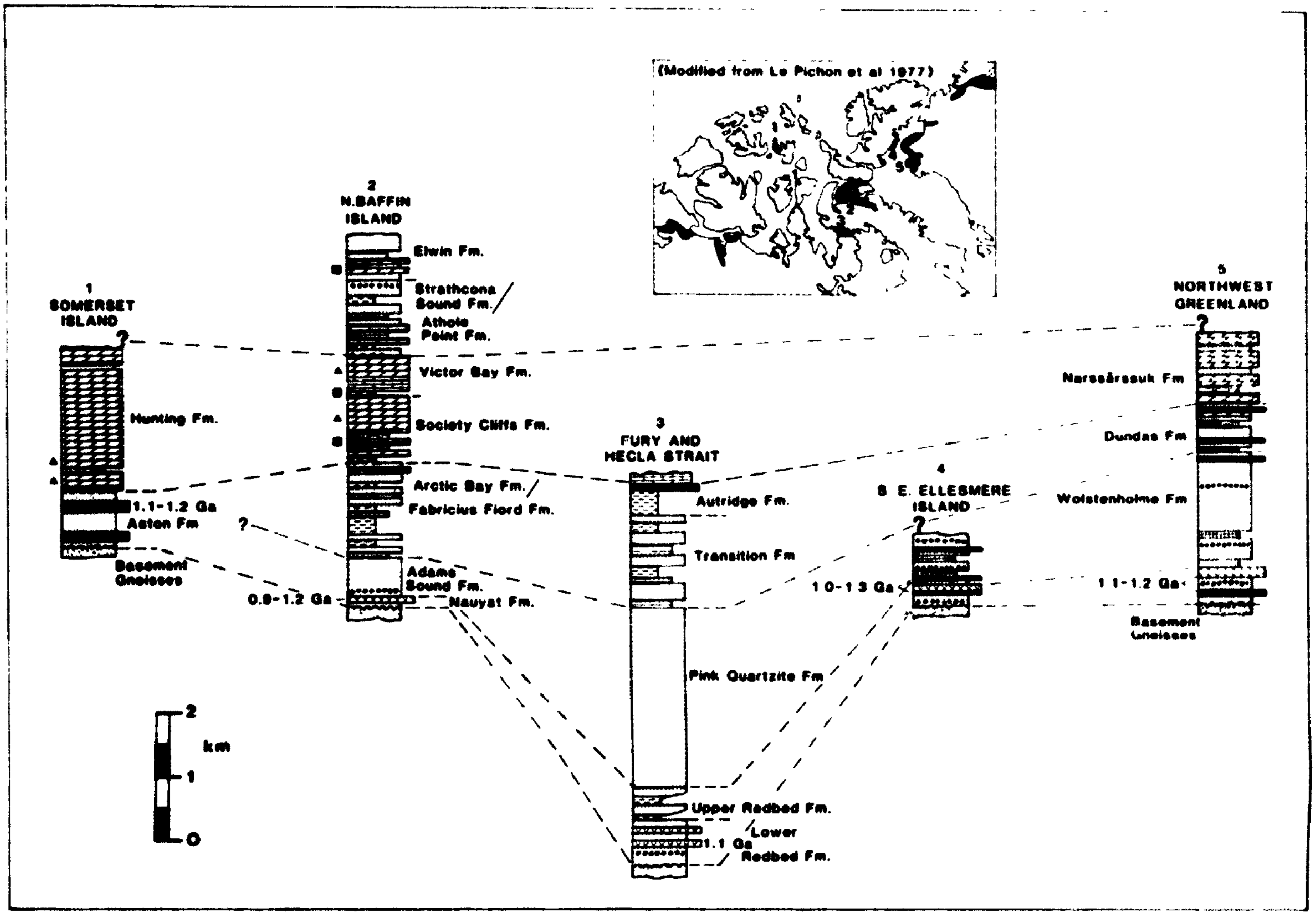


Figure 16.33. Correlation of Neohelikian strata in Somerset Island-Prince of Wales Island area (1), Borden Basin (2), Fury and Hecla Basin (3), and Thule Basin (4,5).

the Central Borden Fault Zone (Steensby High) may have shed fluvial and shallow marine sands north and northeastward across the Milne Inlet Trough. While the eastern Milne Inlet Trough was probably connected to a westerly sea during most of Strathcona Sound deposition, this connection may have been temporarily severed during deposition of upper SS_3.

Strathcona Sound strata on southeastern Devon Island (Fig. 16.1) rest unconformably on basement gneisses (G.M. Narbonne, personal communication, 1979). This suggests that this area may have been a source area during deposition of much of the Bylot Supergroup although fault-initiated uplift along Lancaster Sound may also have stripped earlier Bylot strata and redeposited them elsewhere.

Waning source area uplift and minimal subsidence during lower Elwin Formation deposition in intertidal to supratidal environments was superseded by deposition of relatively clean and well-sorted deeper water sands of the upper Elwin.

Correlations

Neohelikian sedimentary sequences are preserved in several basins and areas along the northwest edge of the Canadian-Greenland Shield (Fig. 16.1, 16.33-16.35). Sequences in the Thule (Canada and Greenland) and Fury and Hecla basins and in the vicinity of Somerset Island most closely resemble the Bylot Supergroup (Fig. 16.33).

These sequences lie nonconformably on gneissic basement, contain tholeiitic basalts and/or basic sills about 1.2 Ga in age, yield Mackenzie paleomagnetic poles, and contain similar lithologies arranged in similar stratigraphic sequences and deposited in similar environments; some syndepositional faulting is common (Fig. 16.1, 16.33-16.35). Regional correlations involving these Neohelikian strata along the northwest edge of the Canadian-Greenlandian Shield have been made by Blackadar (1970), Blackadar and Fraser (1960), Christie et al. (1972), Lemon and Blackadar (1963), Dawes (1976), Fahrig et al. (1981), Kerr (1979), and Young (1979).

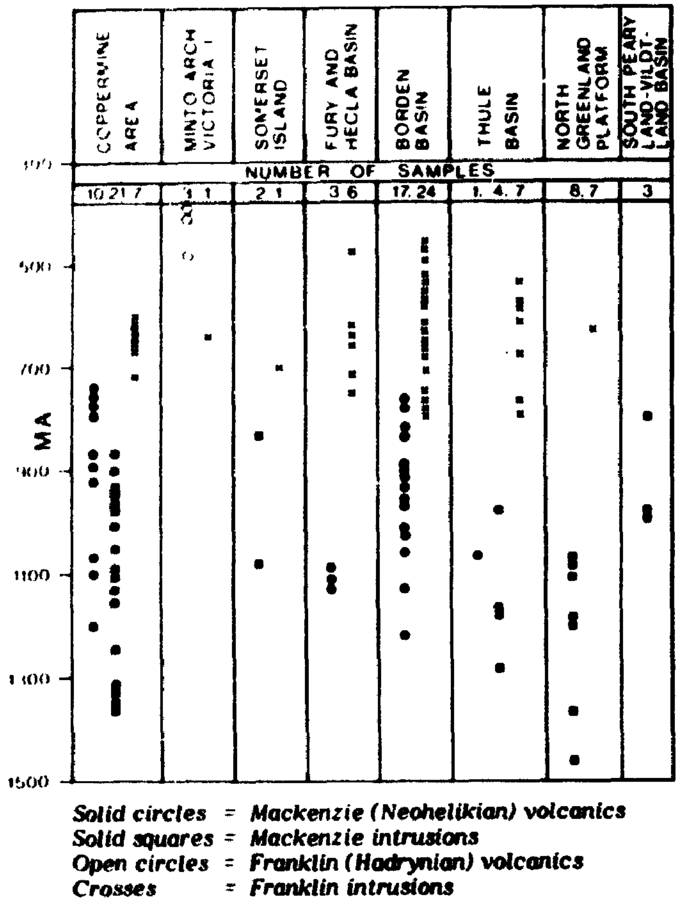


Figure 16.34. *K-Ar ages for some basic igneous rocks along northwest edge of Canadian-Greenlandian Shield. References in text, except for Minto Arch, from Wanless (1970).*

Thule Basin

As much as 4.5 km of Thule Group strata are preserved in the fault-bounded Thule Basin 300 km northeast of the Borden Basin (Davies et al., 1963; Dawes, 1976, 1979; Dawes et al., 1973; Frisch et al., 1978; Frisch and Christie, in press; Vidal and Dawes, 1980). The basal Wolstenholme Formation comprises two to four members, the lowermost of which consists of varicoloured sandstone, basic tholeiitic plateau basalt and basic sills. The igneous rocks yield whole rock K-Ar ages (Fig. 16.34) similar to those obtained for the Mackenzie Nauyat volcanics, and the lowermost Wolstenholme member is correlated with the Nauyat Formation (Fig. 16.33). The overlying Wolstenholme members are composed of locally conglomeratic sandstones and are similar to Adams Sound members. The Wolstenholme Formation thins to the north, south, and east, where the lowermost member may be absent.

Shales and fine sandstones predominate in the Dundas Formation which is gradational with the underlying Wolstenholme Formation. Coarsening-upward cycles occur in the lower part. Gypsum beds are present and dolostones in the upper Dundas thin northward (marginward?). Hadrynian Franklin sills and dykes intrude Dundas strata (Fig. 16.34) and the Dundas is correlated with the Arctic Bay-Fabricius Fiord formations (Fig. 16.33).

The Narssârssuk Formation contains three members, of which the lower two contain gypsum. The contact with the underlying Dundas Formation is not exposed. Lower and upper red members are composed of varicoloured carbonates, shales, siltstones and sandstones that are arranged in cycles (Davies et al., 1963), similar to those in the Society Cliffs Formation. The middle Aorfêrneq dolomite member contains oolites, minor limestone, and breccia. The Narssârssuk is considered to be equivalent to the Society Cliffs and possibly to the Victor Bay formations.

Thule Group strata were deposited in environments, in part semi-restricted, similar to those in which the equivalent Eqalulik and Uluksan Group strata were deposited. Crossbed measurements indicate westward transport (Frisch and Christie, in press), and thinning of strata indicates a northern to eastern and southern shoreline.

Fury and Hecla Basin

About 6 km of sedimentary strata occur in the vicinity of Fury and Hecla Strait 200 km south of Borden Basin. Blackadar (1958, 1963, 1970) differentiated a thick lower Fury and Hecla Formation and an upper Autridge Formation. Chandler (in Chandler et al., 1980) divided the Fury and Hecla Formation into four informal formations: lower redbed formation, upper redbed formation, pink quartzite formation, and transition formation. These Neohelikian strata are intruded by Hadrynian Franklin dykes (Fig. 16.34; Blackadar, 1970; Chandler and Stevens, 1981), although Chandler and Stevens (1981) noted that a slightly older Hadrynian event might also be represented.

The two redbed formations are chiefly red sandstone, siltstone and shale, with minor light-coloured sandstone and stromatolitic dolostone. An orthoconglomerate in the lower redbed formation thins and fines westward. Whole rock K-Ar ages of about 1100 Ma have been obtained for two thin plateau basalt flows in the upper part of the same member (Fig. 16.34; Chandler and Stevens, 1981). Coarsening-upward cycles occur in the upper redbed formation. The two redbed formations are correlated with the Nauyat Formation, and laterally equivalent sandstones in Borden Basin.

The pink quartzite formation thins westward and is correlated with the Adams Sound Formation. The transition formation, composed of varicoloured shales, siltstones and sandstones, and the overlying Autridge Formation, chiefly black shale, are correlated with the Arctic Bay-Fabricius Fiord formations. About 80 m of grey limestone locally overlies Autridge shale (Blackadar, 1958, 1963, 1970; Heywood, personal communication, 1980) and is correlated with the Society Cliffs Formation.

Fury and Hecla Basin strata, like the Thule Group, were deposited in environments similar to those in which correlative Bylot Supergroup strata were deposited. Crossbed measurements indicate northwest transport for the lower redbed formation, western transport for the upper redbed formation, and southerly transport for the pink quartzite and transition formations (Chandler et al., 1980). The strata are displaced by east-west and northwest-southeast faults. However, it is not yet known whether or not syndepositional faulting was important or whether the present distribution of strata reflects the site of a depositional basin (Chandler, personal communication, 1980). It is inferred here from the presence of basal polymictic, possibly fault-related breccia at two localities (Chandler et al., 1980), the great thickness of the succession and the similarity of its setting and depositional history as compared with the fault-controlled Bylot Supergroup, that syndepositional faulting was prominent.

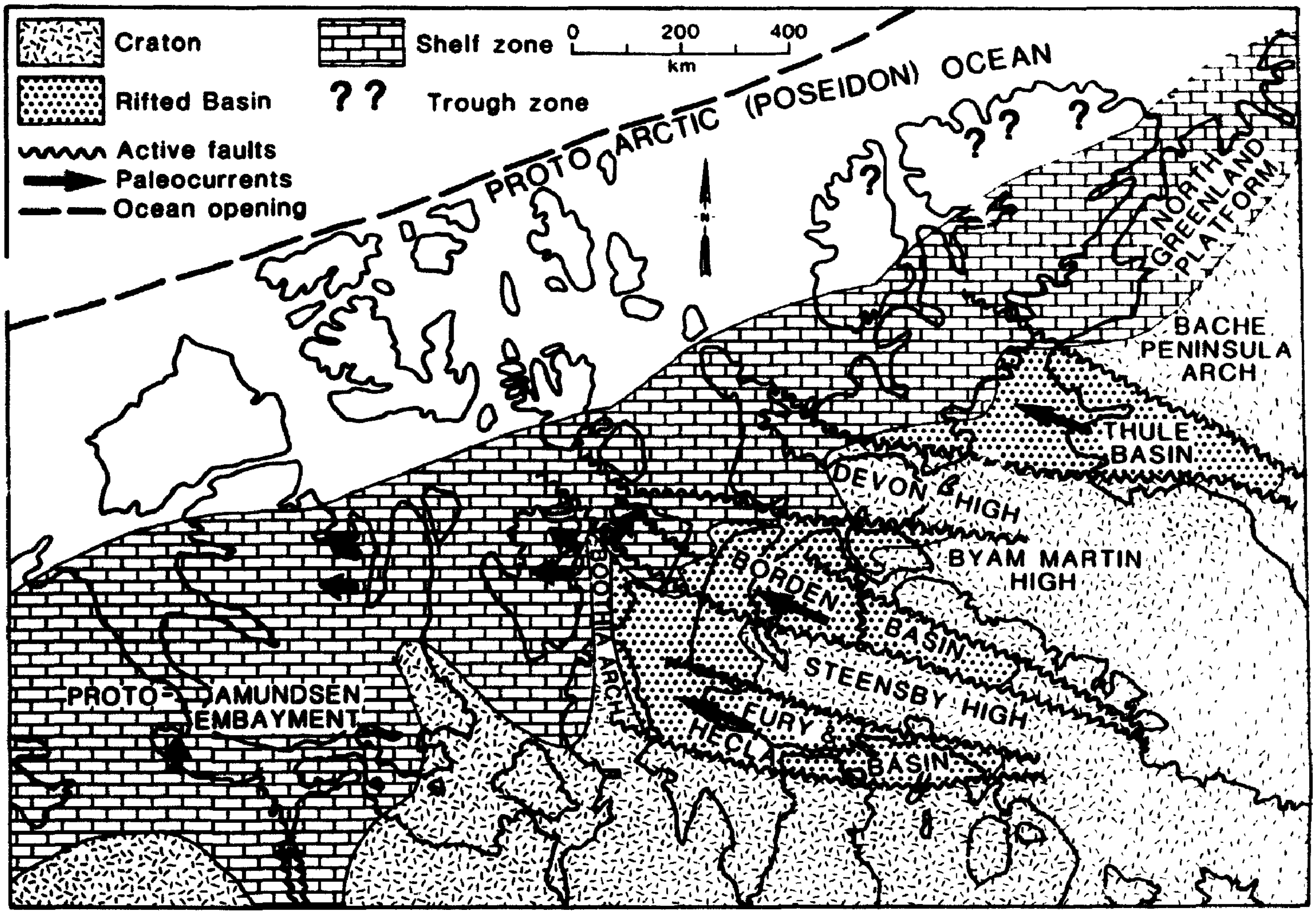


Figure 16.35. Schematic reconstruction for 1200-1250 Ma old opening of the early Proto-Arctic (Poseidon) Ocean.

Somerset Island Area

At least 3 km of Neohelikian strata outcrop in the vicinity of western Somerset and eastern Prince of Wales islands (Fig. 16.1, 16.33; Blackadar, 1967; Brown et al., 1969; Dixon et al., 1971; Dixon, 1974; Kerr, 1977a; Kerr and deVries, 1976; Miall, 1969; Reinson et al., 1976; Tuke et al., 1966). The lower Aston Formation is composed of sandstones and minor siltstones and stromatolitic dolo stones. Locally, an angular gneiss-clast cobble-boulder breccia lies directly on basement gneisses. Immature sandstones, with minor shale layers, reappear locally in the upper part of the formation. The Aston Formation both thickens and dips away from the Boothia Arch (Horst) of basement gneisses, and is thickest to the west in the vicinity of eastern Prince of Wales Island.

The Hunting Formation overlies the Aston on Somerset Island and is composed chiefly of several commonly stromatolitic, dolostone lithologies. At some localities a basal conglomerate grades upward through finer clastics into sandy dolostone. Quartz sand content increases upward in the upper part of the formation and interbeds of red sandstone and siltstone occur near the base and top of the formation, while chert occurs chiefly in the middle.

The contact between the Hunting and Aston formations apparently ranges from conformable and transitional to unconformable (Dixon, 1974; Kerr, 1977a; Kerr and deVries, 1976; Tuke et al., 1966). Kerr and Kerr and deVries (op. cit.) concluded that the Aston was eroded from westernmost Somerset Island prior to westward encroachment of the Hunting across the Aston, and its contained intrusions, onto basement gneisses. Aston and Hunting formations were deformed into north-trending folds prior to intrusion of northeast-trending dykes.

Neohelikian Mackenzie paleomagnetic poles have been interpreted for the Aston Formation and for a truncated basic sill in the Aston (Jones and Fahrig, 1978; Fahrig et al., 1981). Hadrynian Franklin paleomagnetic poles have been interpreted for several northeast-trending dykes that intrude both formations and a possible Tertiary pole was obtained for one dyke. K-Ar ages (Fig. 16.34; Dixon, 1974; Jones and Fahrig, 1978) also indicate at least two ages of basic intrusions.

Crossbeds consistently indicate northeast transport on Somerset Island (Tuke et al., 1966) and westward transport in the vicinity of Prince of Wales Island to the west. Some Aston lithologies in the latter area may reflect changes in position of the Boothia Arch (Horst) source area and a shoreward east and southeast transition toward the Arch (Dixon et al., 1971). Emergence of the Boothia Arch during Aston deposition probably involved some faulting.

The Aston and Hunting formations are very similar to, and are correlated with, the Nauyat-Adams Sound Formation and with the Society Cliffs Formation respectively. Strata equivalent to the Arctic Bay and Fabricius Fiord formations, and possibly the upper Adams Sound Formation, were either not deposited or were eroded prior to Hunting deposition. Descriptions of the Aston-Hunting contact suggest the unconformity is locally well developed, but may die out away from the Boothia Horst and so represents a small time interval. Therefore, we presently consider the Hunting to be older than the lithologically similar strata of the Shaler Group on Victoria Island that is commonly considered to be Hadrynian (Thorsteinsson and Tozer, 1962; Young, 1974, 1979). Upper Hunting strata may in part be equivalent to lower Victor Bay strata, although Dixon (1974) has identified an unconformity between the Hunting and overlying lower Paleozoic strata. Dixon (1974) considered black shales that Tuke et al. (1966) placed in the uppermost Hunting to be lower Paleozoic.

The Aston and Hunting formations were deposited in a tectonically active semi-restricted basin in which the Boothia Arch (Horst) was probably a source for Aston sediments. Depositional environments were very similar to those of the correlative formations in Borden Basin.

Origin, Regional Relations

Borden Basin evolved within the North Baffin Rift Zone, in which movement along dominantly vertical northwest-trending faults, probably from the close of Aphebian to Recent time, resulted in formation of several horsts and grabens (Fig. 16.26). Post-Aphebian northwest-trending faults extend throughout Baffin Island (Jackson and Morgan, 1978), and the structures shown in Figure 16.26 probably extend much farther than shown. Alignment of faults, graben structures, Franklin dykes, mineral deposits and topographic features (Blackadar, 1967; Jackson and Morgan, 1978; Jones and Dixon, 1977; Kerr, 1977a, b; Kerr and deVries, 1977; Miall and Kerr, 1977; Reinson et al., 1976) indicates that the Milne Inlet Trough structure probably extends 1200 km from Somerset-Cornwallis islands southeast to the northwest corner of Home Bay on the east coast of Baffin Island (Fig. 16.35). Information presently available, however, indicates that significant Phanerozoic faulting has not affected the Brodeur Homocline west of Admiralty Inlet (Blackadar, 1968c, d; Trettin, 1969).

Borden Basin probably developed along a failed arm or aulacogen, as first suggested by Olson (1977), during a 1.2 Ga ocean opening to the northwest (Fig. 16.35). Doming and crustal extension accompanied by early faulting initiated the aulacogen and basin. Some of the features within the Borden Basin also found in aulacogens (e.g. Hoffman et al., 1974; Freund and Merzer, 1976), but not necessarily restricted to them, include:

1) Faults have developed a zig-zag pattern (Fig. 16.25); individual faults are irregular, steep, and most of the movement has been dip-slip.
2) Faults locally follow pre-existing structures, but grabens, such as the Milne Inlet Trough, do not seem to follow a specific structure, although it is subparallel to the regional Archean-Aphebian gneissosity.
3) Once developed, fault movement has occurred over a long period of time.
4) Central horsts such as Navy Board High, have been elevated but not as high as marginal horsts (Byam Martin) or bordering areas.
5) Relative abundance of granulite facies rocks adjacent to Borden Basin (Jackson and Morgan, 1978) may be a result of early updoming.
6) Paleocurrents are chiefly longitudinal. Northwest transport directions predominated except during Elwin deposition when a reversal resulted in easterly transport predominating.
7) Metamorphism is weak to absent.

Figure 16.35 shows schematically what the relationships may have been between several of the Neohelikian basins along the northwest edge of the Canadian-Greenland Shield during early sedimentation in these basins. The positions of Greenland and Ellesmere Island are from Le Pichon et al. (1977). Similarities in lithology, stratigraphy, inferred ages and depositional environments, and the general indications of a marine basin to the northwest suggest that sedimentation in Fury and Hecla and Thule basins and the Somerset Island area was penecontemporaneous with sedimentation in Borden Basin, and that the other three basins were interconnected with the Borden Basin at least temporarily (Fig. 16.35). The most likely period for interconnection was relatively late in the sedimentary history, during deposition of the platform carbonates (Uluksan Group, Hunting Formation, Narssârssuk Formation, etc.). At this time the basins may have been modified to merely broad embayments along the southeastern edge of an ocean.

Its on-strike nature with the Bylot Supergroup suggests that the Aston-Hunting succession was probably deposited in the western part of the Borden Basin, while the Bylot Supergroup was deposited in the eastern part of the same basin. The southeastern edge of a major ocean may have been only a short distance northwest of Somerset Island area at this time, and Borden Basin may have been at least partially divided by development of a north-south horst or upwarp in the area of Brodeur Peninsula (west of Admiralty Inlet, Fig. 16.2) near the close of Borden Basin sedimentation.

As suggested in Figure 16.35, Fury and Hecla Basin may have been connected with the Borden Basin to the west. During early development of these basins, however, the Steensby High may have extended westward to the west side of Somerset Island, at least temporarily, thus including part of the Boothia Arch. During these times the Fury and Hecla Basin may have been landlocked or connected to an ocean across the southern part of the Boothia Arch. During deposition of the platform carbonates the western part of the Devon High may have been an island to the east of which the Borden and Thule basins were interconnected.

A Rb-Sr isochron age of 1257 ± 45 Ma (Baragar, 1972) has been obtained for plateau basalts of the Copper Creek Formation in the Coppermine region (Fig. 16.1). Mackenzie paleomagnetic poles have been obtained for these volcanics and for coeval intrusions (Fahrig and Jones, 1969; Robertson, 1969). In northeastern Greenland a Rb-Sr isochron age of 1230 ± 25 Ma has been obtained for red granophyric sheets and dykes in mid-Proterozoic sandstones. The granophyres have been interpreted as being genetically related to dolerite sills and basaltic to rhyolitic flows (Jepsen and Kalsbeek, 1979). K-Ar ages (Fig. 16.34) from the Coppermine region (Fahrig and Jones, 1969; Baragar and Robertson, 1973; Robertson and Baragar, 1972), and from eastern Ellesmere Island and northwestern Greenland (Dawes, 1976; Dawes et al., 1973; Frisch and Christie, in press; Frisch, personal communication, 1981; Henrikson and Jepsen, 1970) support the Rb-Sr and paleomagnetic data, and a mid-Proterozoic (Neohelikian) age for some of the sedimentary and volcanic rocks in these regions.

We conclude that several basins developed about 1200-1250 Ma ago and extended for about 3200 km, between the Cordilleran Geosyncline in western North America, and the Carolinidian Geosyncline in eastern Greenland, along what is now the northwest edge of the Canadian-Greenlandic

Shield (Fig. 16.35). Most of these basins were initiated and/or evolved as grabens. The evolution of these basins is consistent with the interpretation that they are related to a 1250 Ma ocean opening to the northwest that formed the Proto-Arctic Ocean of Trettin et al. (1972).

Harland and Gayer (1972) proposed the term Pelagus (Greek god who ruled over part of the ancient ocean) for an ocean that was probably present north of Greenland and Ellesmere Island, at least in early Paleozoic time, in order to differentiate it from the present Arctic Ocean. Trettin and Balkwill (1979) interpreted the eastern Arctic Ocean as being closed between 1000 Ma old and earliest Cambrian. If so, the 1250 Ma ocean is distinctly older. Rather than call it the Proto-Pelagus Ocean, which would be confused with the initial Pelagus opening, the name Poseidon Ocean is proposed here for the Neohelikian ocean which was ancestral to the early paleozoic Arctic ocean called Pelagus. Poseidon, in Greek mythology, was the brother of Zeus, and was the god of water and the father of Pelagus.

This Neohelikian ocean opening and the related strata and structures may be analogous to the early Mesozoic opening of the Atlantic Ocean and the related strata and structures along the Northern American Atlantic coast (Austin et al., 1980; Burke, 1976; Falvey, 1974; Jansa and Wade, 1975; Haworth and Keen, 1979). Structures related to the early Arctic, Poseidon, ocean opening (e.g. Milne Inlet Trough, Boothia Arch) are commonly subperpendicular to one another and oriented at 40-70 degrees to the opening axis, whereas they are chiefly subparallel or subvertical to the axis of the Atlantic opening. This apparent difference may be an indication that a different reconstruction than that of Le Pichon et al. (1977) is required for the Neohelikian, which is not surprising. The Boothia Arch (Horst) and Milne Inlet Trough are known to have been active over a much longer period of time and may be larger than the Mesozoic Atlantic structures, although the late Triassic graben extending from Delaware to Vermont (Sanders, 1963) is about the same size as the Boothia Arch.

ACKNOWLEDGMENTS

We are grateful to W.R.A. Baragar, W.F. Fahrig, T. Frisch and J.B. Henderson, for discussions and suggestions concerning various aspects of the paper, and to G.M. Young, who read an early version of the paper and made several constructive comments. J.H. Maley did an excellent job of computer processing data from Operation Borden. W.D. Loveridge was most helpful in discussing Rb-Sr age determinations and lead isotope work, and R.D. Stevens discussed at length various ways of treating K-Ar data. Most of the diagrams were drawn by K. Bencik. We wish especially to thank F.H.A. Campbell for excellent editing, and especially for his enthusiastic support and innumerable helpful, purgative, suggestions.

REFERENCES

Austin, J.A. Jr., Uchupi, E., Shaughnessy, D.R. III, and Ballard, R.D.
1980: Geology of New England passive margin; American Association of Petroleum Geologists Bulletin, v. 64, no. 4, p. 501-526.

Baragar, W.R.A.
1972: Coppermine River basalts - District of Mackenzie; in Wanless, R.K. and Loveridge, W.D., Rubidium-Strontium Isochron Age Studies, Report 1; Geological Survey of Canada, Paper 72-23, p. 21-24.

Baragar, W.R.A. and Robertson, W.A.
1973: Fault rotation of paleomagnetic directions in Coppermine River lavas and their revised pole; Canadian Journal of Earth Sciences, v. 10, p. 1519-1532.

Blackadar, R.G.
1958: Fury and Hecla Strait, District of Franklin, Northwest Territories; Geological Survey of Canada, Map 3-1958 (with marginal notes).

1963: Additional notes to accompany Map 3-1958 (Fury and Hecla Strait map-area) and Map 4-1958 (Foxe Basin north map-area); Geological Survey of Canada, Paper 62-35, 24 p.

1967: Precambrian geology of Boothia Peninsula, Somerset Island and Prince of Wales Island, District of Franklin; Geological Survey of Canada, Bulletin 151, 62 p., maps.

1968a: Milne Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1235A.

1968b: Navy Board Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1236A.

1968c: Arctic Bay-Cape Clarence, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1237A.

1968d: Moffet Inlet-Fitzgerald Bay, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1238A.

1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 91, 89 p.

Blackadar, R.G. and Fraser, J.A.
1960: Precambrian geology of Arctic Canada, a summary account; Geological Survey of Canada, Paper 60-8, 24 p.

Brown, R.L., Dalziel, I.W.D., and Rust, B.R.
1969: The structure, metamorphism and development of the Boothia Arch, Arctic Canada; Canadian Journal of Earth Sciences, v. 6, no. 4, pt. 1, p. 525-543.

Burke, K.
1976: Development of graben associated with the initial ruptures of the Atlantic Ocean; Tectonophysics, v. 36, p. 93-112.

Chandler, F.W. and Stevens, R.D.
1981: Potassium-argon age of the late Proterozoic Fury and Hecla Formation, Northwest Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 37-40.

Chandler, F.W., Charbonneau, B.W., Ciesielski, A., Maurice, Y.T., and White, S.
1980: Geological studies of the Late Precambrian supracrustal rocks and underlying granitic basement, Fury and Hecla Strait area, Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 125-132.

Christie, R.L., Cook, D.G., Nassichuk, W.W., Trettin, H.P., and Yorath, C.J.
1972: The Canadian Arctic Islands and the Mackenzie region; 24th International Geological Congress, Guidebook Excursion A-66, 146 p.

Davies, W.E., Krinsley, D.B., and Nicol, A.H.
1963: Geology of the North Star Bugt area, northwest Greenland; Meddeleser om Grønland, bd. 162, n. 12, 68 p.

Dawes, P.R.
1976: Precambrian to Tertiary of northern Greenland; in Geology of Greenland, Escher, A.E. and Watt, W.S., ed.; Geological Survey of Greenland, p. 248-303.

1979: Field investigations in the Precambrian terrain of the Thule district, northwest Greenland; Grønlands Geologiske Undersøgelse, Report of Activities, 1978, rap. no. 95, p. 14-22.

Dawes, P.R., Rex, D.C., and Jepsen, H.F.
1973: K/Ar whole rock ages of dolerites from the Thule district, western North Greenland; Grønlands Geologiske Undersøgelse, Report of Activities, 1972, rap. no. 55, p. 61-66.

Dixon, J.
1974: Revised stratigrapny of the Hunting Formation (Proterozoic), Somerset Island, Northwest Territories; Canadian Journal of Earth Sciences, v. 11, p. 635-642.

Dixon, O.A., Williams, S.R., and Dixon, J.
1971: The Aston Formation (?Proterozoic) on Prince of Wales Island, Arctic Canada; Canadian Journal of Earth Sciences, v. 8, no. 7, p. 732-742.

Fahrig, W.F. and Jones, D.L.
1969: Paleomagnetic evidence for the extent of the Mackenzie igneous events; Canadian Journal of Earth Sciences, v. 6, p. 679-688.

Fahrig, W.F. and Schwarz, E.J.
1973: Additional paleomagnetic data on the Baffin diabase dikes and a revised Franklin pole; Canadian Journal of Earth Sciences, v. 10, no. 4, p. 576-581.

Fahrig, W.F., Christie, K.W., and Jones, D.L.
1981: Paleomagnetism of the Bylot Basins: Evidence for Mackenzie continental tensional tectonics; in Proterozoic Basins of Canada, F.H.A. Campbell, ed., Geological Survey of Canada, Paper 81-10, report 17.

Fahrig, W.F., Irving, E., and Jackson, G.D.
1971: Paleomagnetism of the Franklin Diabases; Canadian Journal of Earth Sciences, v. 8, no. 4, p. 455-467.

Falvey, D.A.
1974: The development of continental margins in plate tectonic theory; Australian Petroleum Exploration Assoc. Ltd., Journal, v. 14, pt. 1, p. 95-106.

Freund, R. and Merzer, A.M.
1976: The formation of rift valleys and their zigzag fault patterns; Geological Magazine, v. 113, p. 561-568.

Frisch, T.O. and Christie, R.L.
Stratigraphy of Proterozoic Thule Group, southeastern Ellesmere Island, Arctic Archipelago; Geological Survey of Canada, Paper with stratigraphic sections. (in press)

Frisch, T.O., Morgan, W.C., and Dunning, G.R.
1978: Reconnaissance geology of the Precambrian Shield on Ellesmere and Coburg Islands, Canadian Arctic Archipelago; in Current Research, Part A, Geological Survey of Canada, Paper 78-1A, p. 135-138.

Galley, A.
1978: The petrology and chemistry of the Nauyat Formation volcanics, Borden Peninsula, Northwestern Baffin Island; unpublished B.Sc. Thesis, Carleton University, 53 p.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in Ores in Sediments, G.G. Amstutz and A.J. Bernard, ed., Springer-Verlag, p. 115-127.

1973b: The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, p. 99-126.

Graf, C.W.
1974: A trace metal analysis across the Arctic Bay-Society Cliffs Formations contact, Borden Peninsula, Baffin Island, Northwest Territories; unpublished B.Sc. Thesis, University of British Columbia, 63 p.

Harland, W.B. and Gayer, R.A.
1972: The Arctic Caledonides and earlier oceans; Geological Magazine, v. 109, no. 4, p. 289-314.

Haworth, R.T. and Keen, C.E.
1979: The Canadian Atlantic margin: a passive continental margin encompassing an active past; Tectonophysics, v. 59, p. 83-126.

Henriksen, N. and Jepsen, H.F.
1970: K-Ar age determinations on dolerites from southern Peary Land; Grønlands Geologiske Undersøgelse, Report of Activities, 1969, rap. no. 28, p. 55-58.

Hoffman, P., Dewey, J.F., and Burke, K.
1974: Aulacogens and their genetic relation to geosynclines, with a Proterozoic example from Great Slave Lake, Canada; in R.H. Dott Jr. and R.H. Shaver, ed., Modern and ancient geosynclinal sedimentation; Society of Economic Paleontologists and Mineralogists, Special Publication no. 19, p. 38-55.

Iannelli, T.R.
1979: Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 45-56.

Irvine, T.N. and Baragar, W.R.A.
1971: A guide to the Chemical Classification of the Common Volcanic Rocks; Canadian Journal of Earth Sciences, v. 8, p. 523-548.

Jackson, G.D.
1969: Reconnaissance of north-central Baffin Island (27C-G, 37C-H, 38A-C, parts of 48A); Geological Survey of Canada, Paper 69-1, Part A, p. 171-176.

1974: Interpretation of whole-rock K-Ar ages for some related samples from west of Arctic Bay; in Wanless, R.K., Stevens, R.D., Lachance, G.R., and Delabio, R.N.D., "Age determinations and geological studies, K-Ar isotopic ages, report 12", Geological Survey of Canada, Paper 74-2, p. 24-25.

Jackson, G.D. and Davidson, A.
1978: Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29, 12 p.

Jackson, G.D. and Morgan, W.C.
1978: Precambrian metamorphism on Baffin and Bylot Islands; in Metamorphism in the Canadian Shield, J.A. Fraser and W.W. Heywood, ed., Geological Survey of Canada, Paper 78-10, p. 249-267.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-25, 33 p.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J.
1978a: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Jackson, G.D., Iannelli, T.R., and Tilley, B.J.
1980: Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 319-328.

Jackson, G.D., Morgan, W.C., and Davidson, A.
1978b: Geology Icebound Lake, District of Franklin; Geological Survey of Canada, Map 1451A, coloured, 1:250 000.

Jansa, L.F. and Wade, J.A.
1975: Geology of the continental margin off Nova Scotia and Newfoundland; Geological Survey of Canada, Paper 74-30, v. 2, W.J.M. Van Der Linden and J.A. Wade, ed., p. 51-105.

Jepson, H.F. and Kalsbeek, F.
1979: Igneous rocks in the Proterozoic platform of eastern north Greenland; in Report on the 1978 geological expedition to the Peary Land region, north Greenland, Grønlands Geologiske Undersøgelse, rap. no. 88, p. 11-14.

Jones, B. and Dixon, O.A.
1977: Stratigraphy and sedimentology of Upper Silurian rocks, northern Somerset Island, Arctic Canada; Canadian Journal of Earth Sciences, v. 14, no. 6, p. 1427-1452.

Jones, D.L. and Fahrig, W.F.
1978: Paleomagnetism and age of the Aston dykes and Savage Point sills of the Boothia Uplift, Canada; Canadian Journal of Earth Sciences, v. 15, p. 1605-1612.

Kerr, J.W.
1977a: Cornwallis Fold Belt and the mechanism of basement uplift; Canadian Journal of Earth Sciences, v. 14, no. 6, p. 1374-1401.

Kerr, J.W.
1977b: Cornwallis Lead-Zinc District; Mississippi Valley-type deposits controlled by stratigraphy and tectonics; Canadian Journal of Earth Sciences, v. 14, no. 6, p. 1402-1426.

1979: Evolution of the Canadian Arctic Islands – a transition between the Atlantic and Arctic Oceans; Geological Survey of Canada, Open File Report 618, 107 p.

1980: Structural framework of Lancaster Aulacogen, Arctic Canada; Geological Survey of Canada, Bulletin 319, 24 p.

Kerr, J.W. and deVries, C.D.S.
1976: Structural geology of Somerset Island, District of Franklin; in Report of Activities, Part A, Geological Survey of Canada, Paper 76-1A, p. 493-495.

1977: Structural geology of Somerset Island and Boothia Peninsula; in Report of Activities, Part A, Geological Survey of Canada, Paper 77-1A, p. 107-111.

Lemon, R.R.H. and Blackadar, R.B.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Le Pichon, X., Sibnet, J.C., and Francheteau, J.
1977: The fit of the continents around the North Atlantic Ocean; Tectonophysics, v. 38, p. 169-209.

Miall, A.D.
1969: The sedimentary history of the Peel Sound Formation, Prince of Wales Island, Northwest Territories, Ph.D. thesis, University of Ottawa, Appendix IV, p. 260-261.

Miall, A.D. and Kerr, J.W.
1977: Phanerozoic stratigraphy and sedimentology of Somerset Island and northeastern Boothia Peninsula; in Report of Activities, Part A, Geological Survey of Canada, Paper 77-1A, p. 99-106.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; unpublished Ph.D. thesis, University of British Columbia, 371 p.

Reinson, G.E., Kerr, J.W., and Stewart, W.D.
1976: Stratigraphic field studies, Somerset Island, District of Franklin (58B to F); in Report of Activities, Part A, Geological Survey of Canada, Paper 76-1A, p. 497-499.

Robertson, W.A.
1969: Magnetization directions in the Muskox intrusions and associated dykes and lavas; Geological Survey of Canada, Bulletin 167, 51 p.

Robertson, W.A. and Baragar, W.R.A.
1972: The petrology and paleomagnetism of the Coronation sills; Canadian Journal of Earth Sciences, v. 9, no. 2, p. 123-140.

Sanders, J.E.
1963: Late Triassic tectonic history of northeastern United States; American Journal of Science, v. 261, p. 501-524.

Sangster, D.F.
1981: Three potential sites for the occurrence of stratiform shale-hosted lead-zinc deposits in the Canadian Arctic; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 1-8.

Thorsteinsson, R. and Tozer, E.T.
1962: Banks, Victoria, and Stefansson Islands, Arctic Archipelago; Geological Survey of Canada, Memoir 330, 85 p.

Trettin, H.P.
1969: Lower Paleozoic sediments of northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 157, 70 p.

Trettin, H.P. and Balkwill, H.R.
1979: Contributions to the tectonic history of the Innuitian Province, Arctic Canada; Canadian Journal of Earth Sciences, v. 16, no. 3, p. 748-769.

Trettin, H.P., Frisch, T.O., Sobczak, L.W., Weber, J.R., Niblett, E.R., Law, L.K., de Laurier, I., and Whitham, K.
1972: The Innuitian Province; in Variations in Tectonic Styles in Canada, R.A. Price and R.J.W. Douglas, ed., Geological Association of Canada, Special Paper no. 11, p. 83-181.

Tuke, M.F., Dineley, D.L., and Rust, B.R.
1966: The basal sedimentary rocks in Somerset Island, N.W.T.; Canadian Journal of Earth Sciences, v. 3, no. 5, p. 697-711.

Vidal, G. and Dawes, P.R.
1980: Acritarchs from the Proterozoic Thule Group, northwest Greenland; Grønlands Geologiske Undersøgelse, Report of Activities, 1979, rap. no. 100, p. 24-29.

Wanless, R.K.
1970: Isotopic age map of Canada; Geological Survey of Canada, Map 1256A, 1:5 000 000.

Young, G.M.
1974: Stratigraphy, paleocurrents, and stromatolites of Hadrynian (Upper Precambrian) rocks of Victoria Island, Arctic Archipelago, Canada; Precambrian Research, v. 1, p. 13-41.

1979: Correlation of middle and upper Proterozoic strata of the northern rim of the North Atlantic craton; Royal Society of Edinburgh, Transactions, v. 76, p. 323-336.

GEOLOGICAL SURVEY
PAPER 78-14

UPPER PROTEROZOIC SEDIMENTARY AND VOLCANIC ROCKS OF NORTHWESTERN BAFFIN ISLAND

G.D. JACKSON
T.R. IANNELLI
G.M. NARBONNE
P.J. WALLACE

1978

available by mail from

Printing and Publishing
Supply and Services Canada,
Hull, Québec, Canada K1A 0S9,

and

The Geological Survey of Canada
601 Booth St., Ottawa, K1A 0E8

or

Through your bookseller.

Catalogue No. M44-78/14
ISBN - 0-660-01531-5

Price: Canada: $3.00
Other Countries: $3.60

Price subject to change without notice

CONTENTS

Page

Illustrations

VB = Victor Bay Formation
SS = Strathcona Sound Formation
B = Bioherm in Strathcona Sound Formation
P = Paleozoic strata
E = Elwin Icecap

Frontispiece: Looking east toward Bylot Island (BI) and Eclipse Sound (ES). NAPL T249R-118.

UPPER PROTEROZOIC SEDIMENTARY AND VOLCANIC ROCKS OF NORTHWESTERN BAFFIN ISLAND

Abstract

About 15 000-20 000 feet (4600-6100 m) of Neohelikian strata consisting of quartzarenites, shales, carbonate strata commonly containing stromatolites and/or bioherms, greywackes, arkoses and conglomerates outcrop east of Admiralty Inlet, Baffin Island. These strata were deposited in environments that ranged from fluvial to subtidal and may include a submarine channel-fan complex in the upper part. Paleocurrent trends for all but the uppermost formation indicate westerly transport, whereas easterly transport is indicated for the uppermost formation. About 300-500 feet (90-150 m) of tholeiitic plateau basalts occur near the base of the sequence.

Faulting was active during deposition that took place in a rift zone which (according to Olson) may be an aulacogen related to early development of the Franklinian Geosyncline.

Résumé

A l'est de l'inlet de l'Amirauté, dans l'île Baffin, affleurent environ 15 000 à 20 000 pieds (4600-6100 m) de strates néohélikiennes composées d'arénites quartziques, de schistes argileux et de couches carbonatées contenant généralement des stromatolites, ou des biohermes, grauwackes, arkoses et conglomérats, ou tous ces éléments à la fois. Ces couches se sont déposées dans des milieux fluviatiles à subtidaux, et dans leur tranche supérieure, peuvent inclure le complexe chenal sous-marin – cône alluvial. Dans toutes les formations, excepté celles situées au sommet de la succession, l'orientation des paléocourants indique un transport vers l'ouest; pour les autres, le transport a eu lieu vers l'est. On rencontre environ 300 à 500 pieds (90-150 m) de basaltes tholéiitiques de plateaux à proximité de la base de la succession.

Les phénomènes de faillage ont été actifs pendant la période de sédimentation, qui a eu lieu dans une aire de fracturation (zone de rifts) qui, d'aprés Olson, est peut-être un aulacogène, dont l'existence aurait été liée aux premières phases de l'évolution du géosynclinal Franklinien.

INTRODUCTION

Rarely are late Precambrian strata as well exposed as they are in the towering cliffs of the inlets and fiord-like sounds found from Admiralty Inlet to east of Milne Inlet in northwestern Baffin Island. These multicoloured rocks were first reported early in this century, and were mapped in 1954, 1963 and 1968, as part of the Geological Survey's reconnaissance mapping program. Two groups were recognized, the Eqalulik Group – mainly quartzarenites and basic volcanics, and the Uluksan Group – a succession whose diverse lithologies and structures reflect a varied sedimentary history. Remapping of these rocks began in 1977 as part of a study designed to clarify stratigraphic problems, to understand the sedimentary history and provide data for a basin analysis of the area, and to evaluate the economic potential of northern Baffin and Bylot islands. Numerous lead-zinc occurrences are known and the Nanisivik Mine,which lies east of Arctic Bay and began production in 1976, is the most northerly mine in the world other than coal operations in Spitzbergen. This study will also provide data with which to better determine the relationship of these rocks to those of similar age elsewhere in northern Canada, and in western Greenland.

More than one-third of the area underlain by the Eqalulik and Uluksan groups was remapped in 1977 during a field season of two and a half months. Also, detailed stratigraphic and sedimentological data were collected from the eastern halves of topographic sheets 48B and 48C, from the western third of 48A and from much of the southwest part of 48D. Stratigraphic sections were measured in feet but metric equivalents are quoted throughout the text. A Bell 47G4A helicopter was attached to the 10-man party, which was headed by G.D. Jackson, and Twin Otter support was periodically received from Polar Continental Shelf Project.

Comments concerning the geology of the region are contained in early reports by Bernier (1911), Tremblay (1921), Matthiassen (1933, 1945), Teichert (1937) and Weeks (1926). Geological reconnaissances by Lemon and Blackadar (1963) and by Blackadar (1970) resulted in geological reports and maps and an established stratigraphic succession that has provided an excellent basis not only for subsequent economic explorations by Texas Gulf Sulphur, King Resources (1970), and other companies, but also for subsequent geological studies such as those by Geldsetzer (1973a, 1973b), Olson (1977) and the present study.

This is a preliminary report, and summarizes chiefly data gathered during the 1977 field season, although some conclusions are based in part on previous work. Iannelli worked chiefly on the Adams Sound, Nauyat, Arctic Bay and Fabricius Fiord formations for which he submitted a draft report. Narbonne spent most of his time on the Strathcona Sound and Elwin formations and prepared a draft report on them. Jackson and Wallace distributed field time among all the map units, and Wallace provided a résumé of her summer's work. Carbonate rocks were classified according to Grabau (1904) whereas sandstones were classified according to Pettijohn (1975).

Critical readers

K.E. Eade
F.H.A. Campbell

Authors' Addresses

G.D. Jackson, Geological Survey of Canada, Ottawa, Ontario
T.R. Iannelli, University of Western Ontario, London, Ontario
G.M. Narbonne, University of Ottawa, Ottawa, Ontario
P.J. Wallace, P.O. Box 215, Manotick, Ontario

Original manuscript submitted: 1977 - 11 - 4
Approved for publication: 1978 - 2 - 10

TABLE OF FORMATIONS

FORMATION		LITHOLOGY
Franklin Intrusions		Diabase
Intrusive Contact		
Elwin about 4000 ft (1220 m)		Subarkose, quartz arenite, siltstone
Gradational		
[illegible] Sound [illegible] ft (910 m)		Arkose facies, greywacke facies, grey siltstone facies, red siltstone facies, carbonate facies
Gradational to Unconformable		
[illegible]		VB₂ Flat pebble conglomerate, shale VB₁ Shale, siltstone, dolostone
Gradational? to Unconformable		
		Stromatolitic dolostones
Gradational to Unconformable		
[illegible] 1700 ft (520 m	Fabricius Fiord 5400 ft (1650 m)	AB₅ Stromatolitic dolostone, shale AB₄ Shale, siltstone, dolosiltite AB₃ Shale, siltstone AB₂ Shale, siltstone, dolostone AB₁ Siltstone, shale, quartz arenite FF₃ Siltstone, quartz arenite, quartz-pebble conglomerate FF₂ Shale, siltstone, quartz arenite FF₁ Quartz arenite, shale
Gradational		
[illegible]		AS₃ Quartz arenite, minor conglomerate AS₂ Quartz arenite AS₁ Quartz arenite, minor conglomerate, shale
Conformable		
[illegible]		N₂ Basalt flows N₁ Subarkose, quartz arenite, minor basalt
Nonconformity		
[illegible]matitic gneiss basement		

The final description and definition of the Adams Sound and Nauyat formations by Blackadar (1970) causes some difficulty in that the sandstones underlying and interbedded with the Nauyat flows, although previously recognized and described (Lemon and Blackadar, 1963), were not clearly distinguished when the Nauyat Formation was set up. Rather than introduce new names at this time the sandstones below and between the flows are considered to be part of the Nauyat Formation. Also, a future revision of group nomenclature may prove advantageous.

Pending the completion of age determinations in progress, these Upper Proterozoic strata are tentatively considered to be Neohelikian (Jackson et al., 1975).

BASEMENT COMPLEX

A complex assemblage of gneisses is separated from the overlying Neohelikian strata by a nonconformity. A thin regolith may be present in a few places on the gneisses, which are commonly stained red for several feet (a few metres) below the nonconformity. Most exposures of basement gneisses lie south of Adams Sound and are commonly associated with block faulting along the Central Borden and White Bay Fault Zones which bound the Milne Inlet Trough to the south and north respectively (Jackson et al., 1975).

The gneisses are chiefly irregularly banded migmatites commonly cut by more than one generation of granites. The paleosome is chiefly granodiorite to amphibolite of uncertain origin. Biotite-hornblende (± garnet, ± pyroxene) paragneiss paleosome is common; minor feldspathic quartzite and local calc-silicate gneisses were also seen. The neosome is chiefly granite to granodiorite and includes varying amounts of pegmatitic material. Nebulitic and foliated granitic rocks are abundant and white porphyroblastic migmatites and flaser gneisses are common. A few concordant, sill-like, foliated and massive, granite-quartz monzonite and, equivalent, hypersthene-bearing charnockite-monzocharnockite bodies up to a few thousand feet (c. 1000 m) wide occur locally. Rare relict pods of metamorphosed basic and ultrabasic rocks range up to a few hundred feet (c 100 m) in diameter.

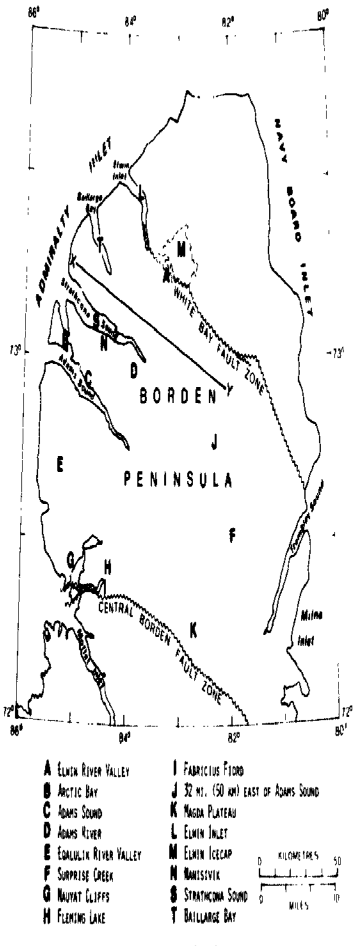


Figure 1. Map of Borden Peninsula showing locations of field sites.

The complex is chiefly of upper amphibolite facies but locally contains scattered areas of granulite facies rocks that seem to be more abundant south of the Central Borden Fault Zone than north of it. In addition, although gneissosity trends are highly variable, there is a distinct tendency for gneissosity to parallel adjacent east-west faults. These gneisses are similar to, and lie within the same complex as the gneisses east of the map area (Jackson et al., 1975; Jackson, 1978). They have all probably undergone more than one period of deformation and metamorphism and may include rocks of both Archean and Aphebian ages.

NAUYAT FORMATION

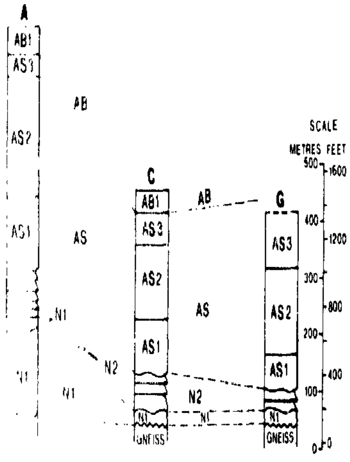
This formation occurs chiefly from the vicinity of Adams Sound south to Fabricius Fiord, but outcrops as far north as the Elwin River Valley, and as far east as the Surprise Creek area (Fig. 1). Best-exposed sections occur along the edges of extensively uplifted fault blocks where basement gneisses, Nauyat volcanics, and Adams Sound quartzarenites commonly form towering, locally castellated cliffs.

The Nauyat Formation has been divided informally into a lower (N_1) member composed predominantly of sandstones, and an upper (N_2) member composed of basic volcanics (Fig. 2). Total thicknesses for the formation are commonly about 800 feet (240 m) or less, but locally may be as much as 1400 feet (430 m). It is difficult to separate the N_1 member from the overlying Adams Sound Formation where the N_2 volcanic member is missing.

N_1 member

Subarkoses and quartzarenites are commonly associated with quartz-pebble conglomerate, siltstone and shale in the southern part of the area; but at Elwin River Valley this member is composed of quartzarenite. The strata are thin- to medium-bedded, planar- to wavy-bedded, and range from grey to white, yellow, orange and brown. Purple tints are common in the vicinity of Nauyat Cliffs. At some localities the strata are arranged in crude fining-upward cycles 10 to 25 feet (3 to 8 m) thick, with basal scour channels filled with conglomerate. Trough crossbeds are relatively abundant in Elwin River Valley where current ripple marks are also present.

This member ranges from 0 to 500 feet (150 m) thick from Adams Sound southward, and is 500 feet (150 m) thick in Elwin River Valley. A conformable volcanic sequence, commonly containing one or two flows, similar to those in the upper (N_2) member, forms part of the N_1 member north of Eqalulik River (200 feet (60 m)) and in Elwin River Valley (87 feet (27 m)) (Fig. 1). This lower sequence of flows is overlain by 50 to 340 feet (15 to 100 m) of quartzarenite and is underlain in most places by 10 to 500 feet (3 to 150 m) of quartzarenite. A nonconformity separates the N_1 member from underlying basement gneisses, but N_1 is conformably overlain by the volcanics of N_2 member. Both the N_1 and N_2 volcanics are underlain by baked and indurated sedimentary strata.



AB = Arctic Bay Formation

Figure 2. Representative sections of Adams Sound (AS) and Nauyat (N) formations. Locations as on Figure 1.

N₁ member

Nauyat volcanics occur in one sequence containing between two and five flows throughout most of the area examined during the past summer. The flows are fine grained, commonly slightly amygdaloidal at their base, and are increasingly amygdaloidal upward. Poor columnar jointing and amygdules and vugs containing calcite, dolomite, quartz, agate, zeolites and minor sulphides, are also common throughout. Chlorite is abundant and most olivine has been altered. Some flows contain partially resorbed clastic quartz grains. Pillows have been reported previously from one locality on the east side of Admiralty Inlet south of Adams Sound (Blackadar, 1970; pers. comm.). Vague pillows and pillow-like structures were seen at only two localities during the past summer, also south of Adams Sound. Brecciated volcanic rock was seen at one locality in the Eqalulik River valley. The top flow of the sequence is massive, finer grained, more resistant, and contains better formed columnar joints than the lower flows. Twelve chemical anlayses indicate that the flows are tholeiitic plateau basalts with alkalic affinities. Thin, baked quartzarenite beds, thinly laminated limestone, ... carbonate and chert, and rare breccia lenses ... between flows. Individual flows range from a ... about 200 feet in thickness (1 to 60 m) while the ... whole ranges from 100 feet (30 m) to 330 feet ... Eqalulik and Elwin River valleys respectively, but ... considerably thicker northwest of Surprise Creek and ... Adams Sound (Fig. 2). N₂ member rests directly on ... gneisses in several places, and in some of these the ... surface has considerable local relief.

Interpretation

The Nauyat volcanics are interpreted as a series of dominantly subaerial flows that were extruded rapidly and quietly during a period of fluvial sedimentation. Renewed sedimentation buried the flows before they could be eroded.

ADAMS SOUND FORMATION

Adams Sound strata underlie about half of the area south of Strathcona Sound and occupy relatively small areas at "Surprise Creek" and Elwin River valleys (Fig. 1).

The strata are predominantly varicoloured quartzarenites, most being reddish brown to orange, buff, yellow, pink or grey to white. Minor subarkose, quartz-pebble orthoconglomerate, shale, and siltstone are present. Measured thicknesses range from 550 (170 m) to 960 (290 m) feet. Estimates indicate that 2000 feet (610 m) may be present, but may include the N₁ member of the Nauyat Formation. The basal beds seem sharply conformable with the upper Nauyat volcanic sequence, and do not appear to be baked. However the presence of rare volcaniclasts in basal beds suggests that a disconformity may be present locally. The upper contact with the overlying Arctic Bay Formation is conformable and gradational.

The rocks are thin- to thick-bedded, planar- to wavy-bedded, and display a wide variety of internal sedimentary structures. These include straight and undulatory to lunate ripple marks, planar- and trough-crossbeds, scour and tool marks, load casts, convoluted bedding, channels, clastic dykes, and microfaults. Division into intergradational members (Fig. 2) is based on differences in colour, lithology and dominant contained structures.

AS₁ member

Orange-red to purple quartzarenite predominates, and is associated with minor quartz-granule and quartz-pebble conglomerate, siltstone and shale. The quartzarenite contains abundant trough crossbeds, scour channels and a variety of other sedimentary structures. Well developed, fining-upward cycles 5 to 50 feet (1 to 15 m) thick occur locally. This member is 135 feet (40 m) thick at Surprise Creek, and over 200 feet (60 m) at Adams Sound.

AS₂ member

The AS₁ member grades upward into orange-pink to brown, massive quartzarenites of the AS₂ member, which is 240 feet (73 m) thick at Fabricius Fiord and 340 to 420 feet (103 to 128 m) thick at and south of Adams Sound. The relatively few sedimentary structures present include oscillation and current ripple marks, rill-like marks and mud cracks.

AS₃ member

Grey to white quartzarenites are gradational with the underlying AS₂ member, and are 225 feet (68 m) thick at Fabricius Fiord and 330 feet (100 m) thick at Arctic Bay. Fining-upward cycles 5 to 15 feet (1.5 to 4.5 m) thick with large basal scour channels filled with quartz-pebble and granule conglomerate are common. Coarse grained, graded trough crossbeds and soft-sediment deformation structures overlain by fine grained planar-stratified beds are abundant.

Interpretation

The Adams Sound Formation was deposited in a dominantly fluvial environment. Many of the fluvial sediments were probably deposited by braided streams. Paleocurrent data (Fig. 3) suggest sediment source regions lay to the southeast and east. The massive AS₂ member may have been deposited in a shallow, nearshore environment during a period of marine encroachment.

ARCTIC BAY FORMATION

The Arctic Bay Formation outcrops along Adams Sound southeast to Surprise Creek, from the head of Adams Sound south and southeast to Magda Plateau, and in the Elwin River Valley to the north. The formation is composed chiefly of fissile, micaceous, graphitic black to grey shale and minor interbedded siltstone, dolosiltite and quartzarenite. Thickness of the formation varies from about 590 feet (180 m) at Arctic Bay to about 1700 feet (520 m) in Elwin River Valley. A similar thickness has been estimated for north of the head of Adams Sound, and about 2000 feet (610 m) for northwest of Surprise Creek. The contact with the overlying Society Cliffs Formation is conformable in some places. Elsewhere it is marked by an indistinct to pronounced angular discordance of the upper Arctic Bay beds, possibly due in part to the undulatory nature of the stromatolitic beds.

The formation is recessive and poorly exposed, but has been subdivided informally into five intergradational members (Fig. 4). Sedimentary structures are abundant in the lower three members which contain planar to wavy bedding, undulatory to lunate current ripples, planar- and trough crossbeds, load casts, convoluted beds, synaeresis cracks, molar tooth structure, and rill-like markings.

AB₁ member

This member consists of interbedded grey-green to red siltstone and shale, and similarly coloured, as well as white, quartzarenite.The quartzarenite decreases in abundance upward. Thicknesses of the member range from 45 to 160 feet (14 to 48 m) in the vicinity of Adams Sound. Structures include those noted above and herringbone crossbeds, clastic dykes, and flaser bedding.

AB₂ member

This member consists of coarsening-upward cycles, most of which range from 15 to 70 feet (4.5 to 21 m) in thickness. The lower part of each cycle is composed of a thick shale unit that grades upward into interbedded shale, siltstone, dolosiltite, and fine grained quartzarenite. Either medium grained quartzarenite or finely crystalline dolostone occurs in the upper parts of some cycles. The AB₂ member is 160 to 380 feet (48 to 115 m) thick in the vicinity of Adams Sound and 480 feet in Elwin River Valley.

AB₃ member

The member consists of laminated shale with minor interbeds of dolosiltite, siltstone, and quartzarenite. Near Arctic Bay 290 feet (88 m) are present, whereas 465 feet (142 m) occur in Elwin River Valley. Sedimentary structures are not as abundant as in AB₂ member but include numerous finely crystalline dolostone lenses that disrupt the shale beds, and contain cone-in-cone structures and vugs lined with quartz, calcite, siderite and celestite. Some gypsiferous laminae are interbedded with shale, which may also have a gypsiferous coating on weathered surfaces. Hematite stains are common on the weathered surfaces of the various rock types.

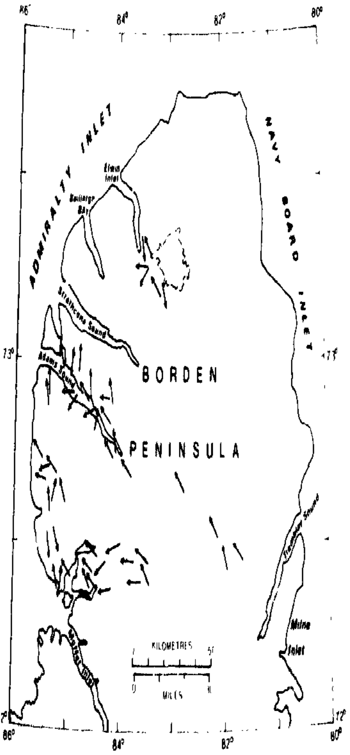


Figure 3. Average paleocurrent trends from crossbeds in the Adams Sound Formation. Total readings – 1120.

AB₄ member

Like the AB₂ member, this member consists of cycles, the nature of which, however, varies from one locality to another. At the head of Adams Sound individual cycles consist of fissile shale overlain by a relatively thin unit of interbedded shale and dolosiltite, or by dolosiltite alone. Individual cycles range in thickness from 20 to 130 feet (6 to 39 m).

In the Elwin River Valley this member has been subdivided informally into three units. The lower unit is composed of cycles similar to those at Adams Sound and shale is overlain by interlayered shale, siltstone and quartzarenite. The middle unit is composed of a lower calcareous bed containing pisolite-like structures, a middle bed of rusty to grey bulbous concretions in a finely crystalline calcareous matrix, and an upper, breccia bed of shale and siltstone ... in a finely crystalline limestone matrix. The upper unit is composed of shale grading upward into siltstone in cycles 40 to 50 feet (12 to 15 m) thick. The member is 617 feet (188 m) thick at the head of Adams Sound and 635 feet (194 m) thick in the Elwin River Valley.

AB₅ member

This member is composed of thinly laminated, grey, stromatolitic dolostone interbedded with grey-black, finely crystalline argillaceous limestone and calcareous shale. Stromatolites are planar to low domal forms that are locally brecciated. Some of these beds emit a petroliferous odour. Thicknesses range from 48 feet (14.5 m) at Arctic Bay to 60 feet (18 m) in Elwin River Valley and 160 feet (49 m) north of the head of Adams Sound.

Interpretation

The Arctic Bay Formation may represent a basin-wide transgression followed by minor regression. Shallow tidal to subtidal marine conditions (AB₁ member) were followed by progressively deeper subtidal environment (AB₂ and AB₃ members). A reversal of the trend brought on gradually shallower water environments which were accompanied by a gradual increase in the proportion of carbonate strata deposited and a decrease in siltstone and quartzarenite deposition in AB₄ and AB₅ members. Presumably, therefore, at this stage source areas had been worn down, were providing relatively little coarse clastic material, and were in part transgressed by the sea and covered by sediment.

FABRICIUS FIORD FORMATION

The Fabricius Fiord Formation outcrops from Fabricius Fiord eastward at least as far as Magda Plateau (Fig. 1). It is composed of grey to black shale, grey siltstone, sandstone and conglomerate. The sandstone ranges from quartzarenite to arkose, most is grey to white, but some is yellow, orange or mauve. The formation has a total thickness in the west of about 5400 feet (1645 m) which may be its thickest development, and where it has been subdivided into three intergradational members (Fig. 4). The contact with the underlying Adams Sound Formation is both conformable and gradational. The upper part of the Fabricius Fiord Formation is downfaulted against high grade gneisses to the south along the Central Borden Fault Zone. The lower two members grade eastward along strike into more typical Arctic Bay strata. Strata in the lower two members contain abundant sedimentary structures, including load structures, trough- and herringbone-crossbeds, straight, undulatory, lunate, and lingoid ripple marks, convolute bedding, synaeresis cracks, clastic dykes, and rill-like markings.

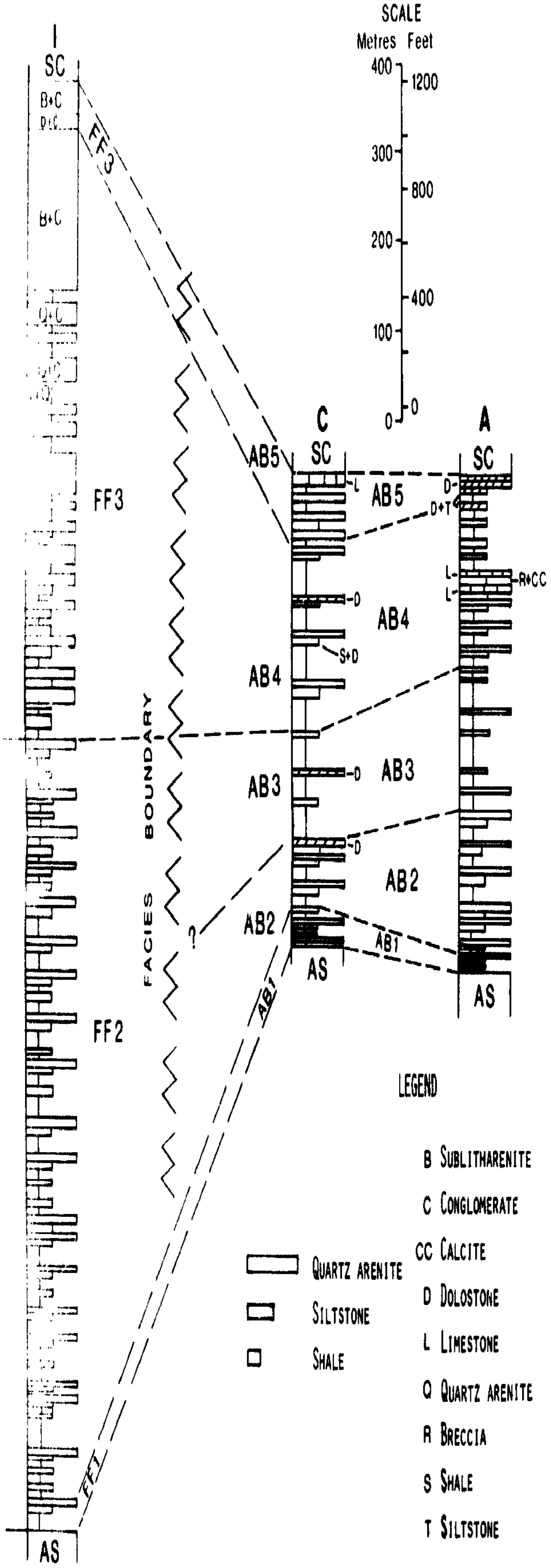


Figure 4. Facies relationships between the Arctic Bay (AB) and Fabricius Fiord (FF) formations.

FF_1 member

This member averages 60 feet (18 m) in thickness. White to hematite-stained quartzarenite beds in the lower part grade upward into interbedded black shale, siltstone and quartzarenite.

FF_2 member

Most strata within this member were deposited in cycles that in the lower part of the unit are composed of brown to black micaceous fissile shale which grades upward into interbedded shale, siltstone, and minor quartzarenite. Some cycles are capped by a thin unit of quartzarenite. Shale makes up over 70 per cent of the lower cycles and decreases in abundance upward to make up 50 per cent or less of the cycles in the upper part of the member. This change is accompanied by an increase in number and thickness of quartzarenite beds upward in the member. Individual cycles range from 30 to 140 feet (9 to 42 m) in thickness, and the member is 2925 feet (892 m) thick.

FF_3 member

Shale-siltstone-quartzarenite cycles in the lower part of this member are similar to those in the upper part of FF_2. However, the shale component decreases upward in the member until the cycles are predominantly interbedded siltstone and quartzarenite. The upper half of this member is predominantly coarse grained quartzarenite, and very coarse grained immature, thick bedded to massive subarkosic arenite. Quartz-granule and quartz-pebble conglomerate is abundant throughout the upper half of the member and is present in the lower half as well. At one locality a 10-foot (3 m) bed near the top of the member contains brown-weathering stromatolitic dolomite interbedded with quartz-pebble conglomerate. West of Magda Plateau, carbonate beds, carbonate bioherm-like mounds, and conglomerate beds containing dolostone boulders also occur in the upper part of this member. All these carbonates resemble Arctic Bay carbonates rather than Society Cliffs carbonates, although Geldsetzer (1973b) considers that the upper part of the Fabricius Fiord Formation can be traced laterally into the Society Cliffs Formation. The FF_3 member is 2415 feet (736 m) thick near Fabricius Fiord.

Interpretation

The Fabricius Fiord Formation is the lateral nearshore marginal facies equivalent of the Arctic Bay Formation. The lower members (FF_1, FF_2) grade eastward along strike into more typical Arctic Bay strata. The FF_1 member was deposited under shallow, nearshore, marine conditions. The FF_2 member may be largely composed of reworked deltaic deposits that were deposited in an intertidal environment. The FF_3 member is considered to be composed largely of sediments deposited at the periphery of a shallow marine basin; the lower, deltaic, deposits grade upward into braided stream deposits. Carbonate deposition probably occurred in protected embayments.

Movement along the Central Borden Fault Zone triggered the influx of clastic material into the basin, possibly from the south (Fig. 7). It has yet to be determined whether or not the upper strata (FF_3) are lateral equivalents of part of the Society Cliffs Formation.

Paleocurrent data indicate westward to northwestward transport of material and east-west trending tidal currents.

SOCIETY CLIFFS FORMATION

The Society Cliffs Formation extends from the mouth of Adams Sound to Nanisivik and southeast to Surprise Creek area, and is characterized by thick bedded to massive, internally regularly laminated, brownish grey to grey stromatolitic dololutite and dolosiltite in crudely cyclic units. Some of the lamination is irregular and beds are highly contorted locally. Planar stromatolites are ubiquitous and low domal varieties up to 3 feet (1 m) in diameter are common and rarely are as large as 10 feet (3 m) across. Cabbage-head types are less common and columnar forms are rare. Large elongate biohermal masses, composed chiefly of stromatolitic dolomite rarely 5000 feet (about 1500 m) long, occur southeast of Nanisivik. Some mounds and bioherms are elongated in a northwest-southeast direction. A strong petroliferous odour is almost always present and trace amounts of bitumen-like material are common.

Dolomite breccias are abundant throughout the formation (Fig. 5) and most are unstained and seem to have been formed during sedimentation. The clasts are very angular. Some interstices seem not to have been filled, and some associated strata contain dessication cracks. Some of these breccias occur between stromatolite mounds and bioherms.

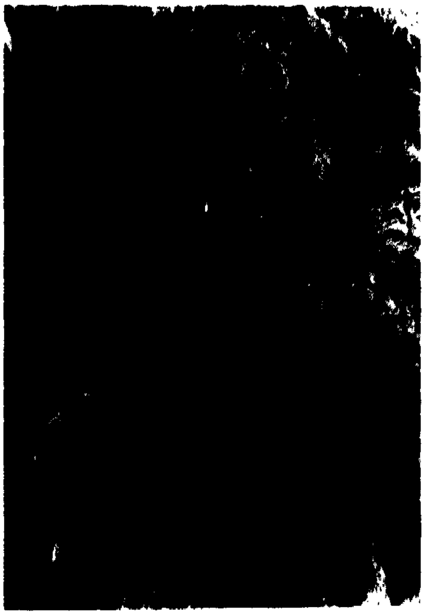


Figure 5.

Society Cliffs breccia east of Nanisivik; clasts of thinly laminated stromatolitic dolostone in a finely crystalline dolomite matrix. Note the 3-inch (8 cm) knife in the vug. Photo by T.R. Iannelli. GSC 172617.

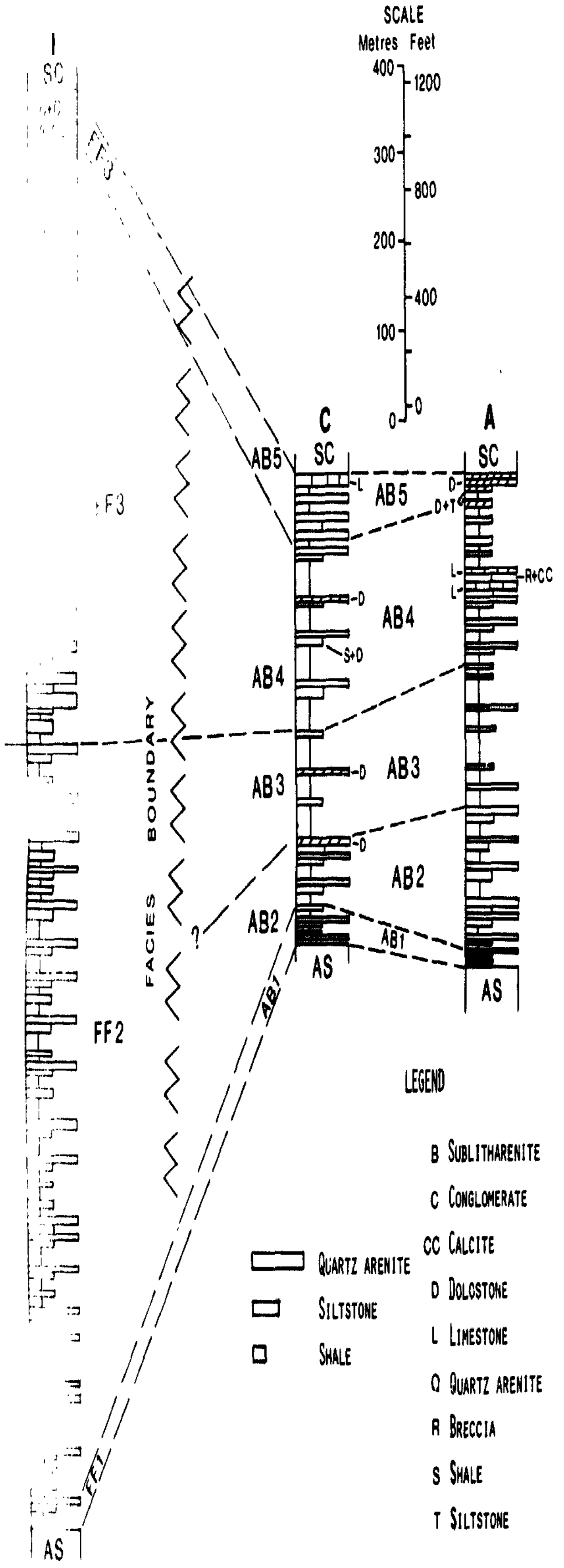


Figure 4. Facies relationships between the Arctic Bay (AB) and Fabricius Fiord (FF) formations.

FF_1 member

This member averages 60 feet (18 m) in thickness. White to hematite-stained quartzarenite beds in the lower part grade upward into interbedded black shale, siltstone and quartzarenite.

FF_2 member

Most strata within this member were deposited in cycles that in the lower part of the unit are composed of brown to black micaceous fissile shale which grades upward into interbedded shale, siltstone, and minor quartzarenite. Some cycles are capped by a thin unit of quartzarenite. Shale makes up over 70 per cent of the lower cycles and decreases in abundance upward to make up 50 per cent or less of the cycles in the upper part of the member. This change is accompanied by an increase in number and thickness of quartzarenite beds upward in the member. Individual cycles range from 30 to 140 feet (9 to 42 m) in thickness, and the member is 2925 feet (892 m) thick.

FF_3 member

Shale-siltstone-quartzarenite cycles in the lower part of this member are similar to those in the upper part of FF_2. However, the shale component decreases upward in the member until the cycles are predominantly interbedded siltstone and quartzarenite. The upper half of this member is predominantly coarse grained quartzarenite, and very coarse grained immature, thick bedded to massive subarkosic arenite. Quartz-granule and quartz-pebble conglomerate is abundant throughout the upper half of the member and is present in the lower half as well. At one locality a 10-foot (3 m) bed near the top of the member contains brown-weathering stromatolitic dolomite interbedded with quartz-pebble conglomerate. West of Magda Plateau, carbonate beds, carbonate bioherm-like mounds, and conglomerate beds containing dolostone boulders also occur in the upper part of this member. All these carbonates resemble Arctic Bay carbonates rather than Society Cliffs carbonates, although Geldsetzer (1973b) considers that the upper part of the Fabricius Fiord Formation can be traced laterally into the Society Cliffs Formation. The FF_3 member is 2415 feet (736 m) thick near Fabricius Fiord.

Interpretation

The Fabricius Fiord Formation is the lateral nearshore marginal facies equivalent of the Arctic Bay Formation. The lower members (FF_1, FF_2) grade eastward along strike into more typical Arctic Bay strata. The FF_1 member was deposited under shallow, nearshore, marine conditions. The FF_2 member may be largely composed of reworked deltaic deposits that were deposited in an intertidal environment. The FF_3 member is considered to be composed largely of sediments deposited at the periphery of a shallow marine basin; the lower, deltaic, deposits grade upward into braided stream deposits. Carbonate deposition probably occurred in protected embayments.

Movement along the Central Borden Fault Zone triggered the influx of clastic material into the basin, possibly from the south (Fig. 7). It has yet to be determined whether or not the upper strata (FF_3) are lateral equivalents of part of the Society Cliffs Formation.

Paleocurrent data indicate westward to northwestward transport of material and east-west trending tidal currents.

SOCIETY CLIFFS FORMATION

The Society Cliffs Formation extends from the mouth of Adams Sound to Nanisivik and southeast to Surprise Creek area, and is characterized by thick bedded to massive, internally regularly laminated, brownish grey to grey stromatolitic dololutite and dolosiltite in crudely cyclic units. Some of the lamination is irregular and beds are highly contorted locally. Planar stromatolites are ubiquitous and low domal varieties up to 3 feet (1 m) in diameter are common and rarely are as large as 10 feet (3 m) across. Cabbage-head types are less common and columnar forms are rare. Large elongate biohermal masses, composed chiefly of stromatolitic dolomite rarely 5000 feet (about 1500 m) long, occur southeast of Nanisivik. Some mounds and bioherms are elongated in a northwest-southeast direction. A strong petroliferous odour is almost always present and trace amounts of bitumen-like material are common.

Dolomite breccias are abundant throughout the formation (Fig. 5) and most are unstained and seem to have been formed during sedimentation. The clasts are very angular. Some interstices seem not to have been filled, and some associated strata contain dessication cracks. Some of these breccias occur between stromatolite mounds and bioherms.

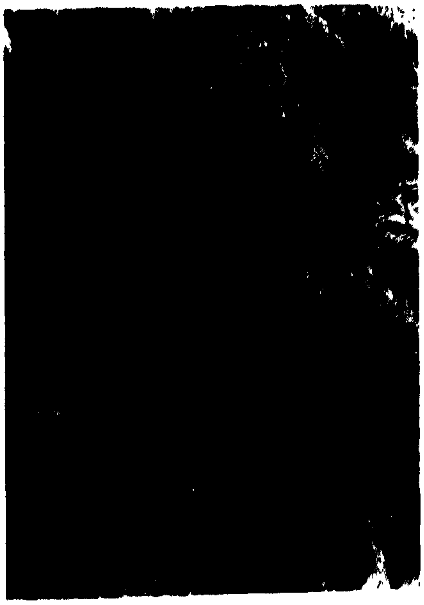


Figure 5.

Society Cliffs breccia east of Nanisivik; clasts of thinly laminated stromatolitic dolostone in a finely crystalline dolomite matrix. Note the 3-inch (8 cm) knife in the vug. Photo by T.R. Iannelli. GSC 172817.

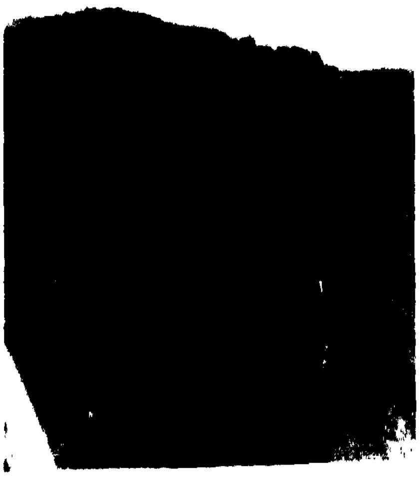


Figure 6.

Society Cliffs dolomite disconformably above Arctic Bay shale southeast of Nanisivik. Photo by G.D. Jackson. GSC 173216.

Much of the brecciation may be related to karstification, particularly in the Arctic Bay-Nanisivik area, south of Baillarge Bay and in the Elwin Inlet-Elwin Icecap region. These breccias are relatively coarse, are stained red, and locally are cavernous. Secondary pods of specular hematite up to about 140 feet (40 m) in diameter occur southeast from Nanisivik for several miles, where some breccias seem to occupy pipes or chutes in unbrecciated dolomite. Minor breccia, chiefly of this type, has been formed along faults.

Other lithologies of widespread but minor occurrence include flat pebble conglomerate, round-clast conglomerate, and grey to black chert lenses and nodules. Nodular, gypsiferous dolomite occurs near Arctic Bay (Gelsetzer, 1973b).

Many of the dolomitic rocks have been recrystallized and are vuggy. Most vugs are less than 2 inches (5 cm) and are commonly lined with calcite, dolomite, a gypsiferous coating, hematite, sulphide minerals, chert, quartz, and possibly barite or celestite.

Quartzarenite, arkose and minor quartz-feldspar dolomitic conglomerate occur in units up to 20 feet (6 m) thick in a north-south-trending belt east of the head of Adams Sound (Fig. 7). Red shale and siltstone are thinly interbedded with what is considered to be Society Cliffs dolomite south and southeast of Elwin Icecap. Vertical fractures 6 feet (2 m) long extend down from the top of the dolomite in the same area and are filled with red siltstone. The correlation of this carbonate with the Society Cliffs Formation is as yet uncertain.

The Society Cliffs Formation is 862-1000 feet (263-305 m) thick near Arctic Bay, up to 1800 feet (550 m) between there and Surprise Creek, and is over 2000 feet (610 m) thick in the Elwin River Valley. The contact with the underlying Arctic Bay Formation is conformable in some places, but disconformable in others (Fig. 6), and is marked by a basal dolomite conglomerate east of the head of Adams Sound where a round pebble and cobble conglomerate occurs at the base. The contact with the overlying Victor Bay Formation is obscured or poorly exposed in most places, but locally seems conformable and in some places somewhat gradational. At one locality near Nanisivik, the shale and silt content increases upward in the top 3 feet (1 m) of thinly-laminated Society Cliffs dolosiltite. Scattered cabbage-head stromatolites and small black chert lenses occur at the top of the formation and are overlain conformably by thinly laminated silty dolomite and shale of the Victor Bay Formation.

Interpretation

Society Cliffs strata were deposited under shallow, subtidal to intertidal conditions. Geldsetzer (1973b) considered the northerly-trending belt containing quartzarenites and arkoses described above to be parallel to a western shoreline and to separate an intertidal zone to the west from a subtidal zone to the east. However, the thinly laminated stromatolitic dolostone, which Geldsetzer considers to be subtidal and could equally well be intertidal, also occurs west of this northerly trending belt. Possibly the terrigeneous material in the northerly-trending belt (Fig. 7) was transported by a stream flowing northward across a tidal flat from the uplifted area to the south that provided the coarse detritus in the Fabricius Fiord Formation. The relative sparseness of breccias east of Milne Inlet (Geldsetzer, 1973b; Olson, 1977; Jackson, et al., 1975) suggests that deposition in that region may have been in a protected lagoonal environment. Abundance of breccias, some of which are associated with bioherms, suggests that deposition in the area to the west took place in a higher-energy, possibly barrier reef, environment, and that Geldsetzer's western shoreline may have been an offshore barrier with associated reefs.

Geldsetzer (1973b) and Olson (1977) argued convincingly that an interval of erosion, karstification, mineralization and dolomitization occurred before the Victor Bay Formation was deposited. Olson also concluded that there were three later karstification episodes. The region in which the Society Cliffs Formation is considered to be extensively brecciated and karsted is shown in Figure 7 (modified from Geldsetzer, 1973b). Within the same region brecciation and karstification occurs to a minor extent in lower Strathcona Sound carbonate strata, and to a limited extent in Victor Bay carbonate.

VICTOR BAY FORMATION

Victor Bay strata outcrop for the most part in the same general area as the underlying Society Cliffs Formation, and consist of thinly bedded shale, siltstone, argillaceous dolostone and limestone, and thinly bedded to massive flat pebble conglomerate and round-clast conglomerate. The strata are commonly dark grey and the presence of a petroliferous odour is rare, compared with the Society Cliffs Formation. The Victor Bay Formation is about 514 feet (160 m) thick near Arctic Bay, from 1000 to 1500 feet (300 to 460 m) both at and southeast and east of Nanisivik, and is about 2130 feet (640 m) 32 miles (50 km) east of the head of Adams Sound.

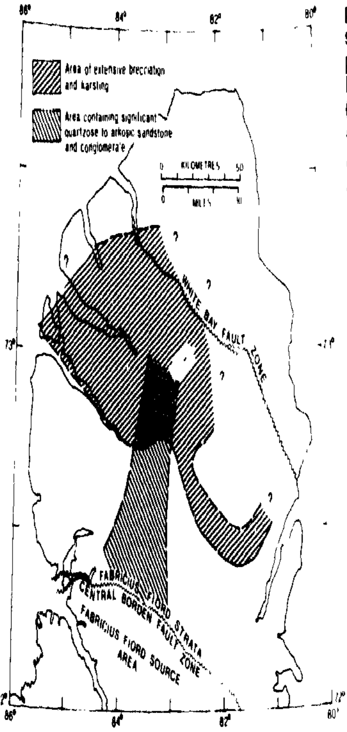


Figure 7. Relationship of quartzose and arkosic sandstones and conglomerates in Society Cliffs Formation to Fabricius Fiord strata and Central Borden Fault Zone. Region of extensive brecciation and karst development, chiefly within Society Cliffs strata, is also shown (modified from Geldsetzer, 1973b).

The contact relationships between the Victor Bay and the overlying Strathcona Sound Formation are laterally variable. South of the head of Baillarge Bay (Fig. 1) the contact is a low-angle unconformity, marked by a carbonate boulder conglomerate. The Victor Bay Formation seems to have been faulted and folded prior to deposition of Strathcona Sound strata east of Baillarge Bay. The contact is marked by a disconformity overlain by a carbonate boulder conglomerate containing gneiss clasts between the head of Strathcona Sound and a point 10 miles (16 km) to the southeast. For another 25 miles (40 km) to the southeast, as well as in the area north of the head of Strathcona Sound, the contact [illegible] conformable and gradational, and interbedded [illegible], shale, siltstone and thinly laminated stromatolitic [illegible] of the Victor Bay Formation grade upward [illegible] green, red and green, and red shale and [illegible] Strathcona Sound Formation.

Most of the Victor Bay Formation [illegible] intergradational members: a lower shale [illegible] carbonate member. At a few localities [illegible] subdivided, whereas in others, several [illegible] made.

VB$_1$ member

Dark grey shale, siltstone and argillaceous dolostone are the predominant lithologies in the lower member. They are commonly thinly interbedded in units up to [illegible] (40 m) thick that are separated by fissile, black graphitic shale in units up to 6 feet (2 m) thick, and rarely 20 feet (6 m). Limestone and dolostone beds [illegible] 100 feet (30 m) but increase [illegible] ness and number toward [illegible] member. A crude cyclicity [illegible] some units by a gradual upward [illegible] of individual beds and in other units by limestone interbeds in the lower part giving way to dolostone interbeds in the upper part.

The lower member (VB$_1$) ranges from 90 feet (27 m) thick near Arctic Bay to an average of 700 feet (about 210 m) in the area around and southeast and east of Nanisivik, and about 1200 feet (370 m) 32 miles (50 km) east of the head of Strathcona Sound.

Carbonate-clast breccia and flat-pebble, and round-pebble conglomerate beds occur in the upper part of the member. Concretions, small lenses and masses of black chert, pebble-sized pyrite-marcasite masses, and gypsiferous coatings on weathered surfaces were noted in several places. Slump structures, ripple marks, load structures, possible groove casts, flame structures, ball and pillow structures and cross-beds were noted at various localities.

VB$_2$ member

The upper Victor Bay member is characterized by units of flat pebble-boulder dolostone and limestone conglomerates (Fig. 8) that alternate with units of variously interbedded dark grey shale, siltstone, dolostone

Figure 8. Victor Bay flat pebble limestone conglomerate southeast of head of Strathcona Sound. Limestone clasts in a dolostone matrix. Photo by P.J. Wallace. GSC 173078.

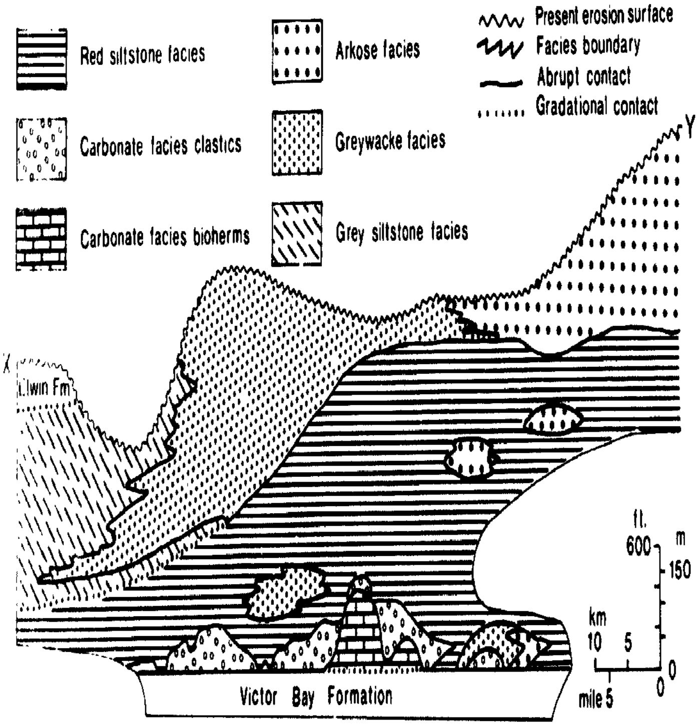


Figure 9. Facies relationships within the Strathcona Sound Formation along a line from north of the mouth of Strathcona Sound east-southeasterly to north of "Y" on Figure 1.

and limestone. Some of the latter units are composed of very evenly and thinly interbedded (1 to 6 in) (2 to 15 cm) shale, and either dolostone or limestone. These alternating units range up to 60 feet (18 m) thick. Clasts within the conglomerate units are commonly up to one foot (30 cm) long; one measured 10 feet by 6 feet (3 m by 2 m). Most of the clasts in the flat-pebble conglomerate beds seem to be composed of the same rock types that are interbedded with the conglomerates, and stromatolitic clasts are minor. Some conglomerate beds grade upward into thinly bedded argillaceous carbonate. Minor round cobble-boulder conglomerate is also present.

The upper, VB_2, member ranges from 424 feet (129 m) thick near Arctic Bay to an average of about 250 feet in the area around and southeast and east of Nanisivik and to 940 feet (287 m) 32 miles (50 km) east of Strathcona Sound.

Regularly laminated stromatolitic limestone and dolostone occur in the upper part of this member, east of Strathcona Sound. One bioherm, possibly a reef, about 1200 feet (370 m) long, was identified 32 miles (50 km) east of the head of Adams Sound. Scour channels, chert lenses and clasts, and disseminated pyrite occur at various localities in the member. Load structures and ball and pillow structures are rare. Mud cracks and graded bedding have been reported from the uppermost beds at one locality.

Interpretation

The Victor Bay Formation was probably deposited under subtidal to intertidal conditions. Geldsetzer (1973b) and Olson (1977) have speculated on possible reasons why algal growth did not reach the peak it did during development of the Society Cliffs carbonate. They considered Victor Bay deposition to have taken place during a period of maximum stability. Considering the overlying Strathcona Sound Formation as well as the Victor Bay Formation, it seems likely that the area may not have been as stable as pictured by Geldsetzer (1973b). Some instability and an abundance of fine terrigenous clastic material may have helped to prevent algal growth.

STRATHCONA SOUND FORMATION

The Strathcona Sound Formation outcrops in the vicinity of Strathcona Sound and eastward and northward. The formation is composed of a wide variety of complexly interfingering rock types, which include clastic and stromatolitic dolostone, shale, siltstone, arkose, greywacke, carbonate conglomerate, and granitic gneiss conglomerate. The nature of the strata and presence of faults makes it difficult to determine thicknesses. Individual well exposed sections in excess of 1600 feet (430 m) occur locally and the formation may exceed 3000 feet (910 m). Five major and distinct facies were recognized (Fig. 9). Their variable stratigraphic positions, and the presence of an unconformity locally between the Strathcona Sound Formation and underlying Victor Bay Formation enables representatives of any of the five facies to lie directly on the Victor Bay Formation. The Strathcona Sound Formation is gradational with the overlying Elwin Formation.

Carbonate facies

Detrital dolostones make up most of this facies throughout most of the formation and are predominantly oligomictic to polymictic, boulder orthoconglomerates and breccias (Figs. 10, 11) which occur in irregular lenses and zones, most of which are less than 30 feet (9 m) thick, but are as much as 450 feet (137 m). Most of the clasts are composed of dolostone and are derived from the Victor Bay Formation, although clasts derived from the Society Cliffs Formation and from the upper Victor Bay-lower Strathcona Sound biohermal platform predominate locally. Some Victor Bay dolostone clasts show soft-sediment deformation. Most clasts are one foot (30 cm) or less in diameter, but south of Baillarge Bay range up to 8 feet (2.5 m) in diameter. In the same area there are slump blocks up to 0.6 miles (1 km) long probably derived from Society Cliffs Formation a few miles to the south. Granitic gneiss boulders are abundant locally.

A small algal-dominated carbonate platform was developed initially either directly on or in the uppermost part of the Victor Bay Formation. Most of the contained strata, however, seem to lie within the lower Strathcona Sound Formation. Basal platform strata rest conformably on, and in some places interfinger with, Victor Bay strata. However, the platform strata also interfinger with the red shale and siltstone of the lower Strathcona Sound Formation. It is not yet known how much of the red shale now occurring between bioherms originally may have been draped over the bioherms.

Figure 10. Dolomite breccia-conglomerate in lower Strathcona Sound strata north of head of Strathcona Sound. Photo by G. Narbonne. GSC 173011.

The platform is at least 15 miles (24 km) wide and extends for about 30 miles (48 km) in a northeasterly direction, from north of Strathcona Sound to south of the Elwin Icecap. Elliptical, narrow, elongated bioherms are up to 0.6 miles (1 km) long and 400 feet (120 m) thick (Frontispiece). Bioherms have a variety of orientations, but easterly and northeasterly elongations seem to predominate. They are composed largely of vertically stacked and laterally linked hemispheroids with some undulose planar stromatolites, branching columnar stromatolites, and more complex types. Each bioherm is composed of a large [illegible] of coalescing growth centres or subbioherms. [illegible] structures and convex-upward sedimentary [illegible] primary topographic relief of several feet.

Stromatolitic dolostone predominates but in some areas stromatolitic [illegible] breccia, round-clast and flat-pebble conglomeratic dolostone are present. Synaeresis cracks [illegible] carbonate platform contains strata [illegible] Society Cliffs Formation, which make [illegible] bedrock and clasts difficult.

Red siltstone facies

These strata occur chiefly in the [illegible] formation and are composed of uniform [illegible] and sandy siltstone. The facies thickens, possibly [illegible] than 1000 feet (305 m) and becomes coarser grained to the east and northeast. Rare asymmetric ripple marks, [illegible] planar crosslamination, and flute casts were the [illegible] sedimentary structures observed.

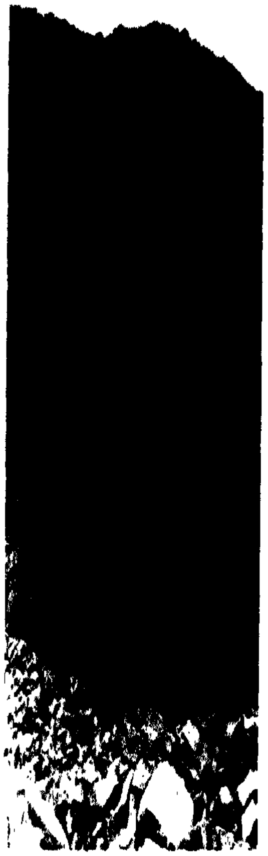
Figure 11. Dolomite oligomictic orthoconglomerate in lower Strathcona Sound strata west of Arctic Bay. Photo by G.D. Jackson. GSC 173110.

Grey siltstone facies

This facies grades [illegible] into the Greywacke facies [illegible] thick sequence of monotonous [illegible], at least a few of which [illegible] and have a white efflorescence on the weathered surface. Ripple marks, [illegible] symmetrical, and low-angle planar crosslamination are very rare.

Greywacke facies

This facies is composed predominantly of grey-green arkosic wacke, granule conglomerate, and siltstone with lenses of cobble and boulder conglomerate. It exhibits good cyclicity (Fig. 12), and many cycles begin with a scoured base, some of which exhibit tool marks and flute casts, and grade upward from a granule- or pebble-conglomerate, or coarse arkosic wacke, to a fine- to medium-grained arkosic wacke (Figs. 13, 14). Conglomerate clasts characteristically are composed of granitic gneiss. The cycles are 6 to 30 feet (2 to 10 m) thick and the conglomerate lenses are up to 25 feet (7 m) thick. Some units contain planar-laminated, fine grained greywacke, [illegible] laminated and massive siltstone. Crosslamination is very rare. In a few places trough and planar crossbeds are [illegible] discernible and the basal coarse bed of a [illegible] undercuts into, is draped over, [illegible]



[illegible] 12. Turbidite-like greywacke and siltstone strata in Strathcona Sound Formation east-southeast from the head of Baillarge Bay. Photo by G. Narbonne. GSC 172992.

crevasses in the underlying unit. The fabric of these rocks makes identification of trough crossbeds difficult. Coarsening-upward cycles were rarely seen. At one locality strata of this facies truncate at least 50 feet (15 m) of underlying Red siltstone facies (Fig. 15).

Arkose facies

[illegible] red and buff-grey arkose, arkosic wacke and [illegible] conglomerate predominate in this facies, which [illegible] in the eastern part of the area examined. [illegible] 50 feet (15 m) deep and infilled with granitic [illegible] -boulder conglomerate are common. Flute [illegible] current lineation and asymmetric ripple marks [illegible] although excellent graded bedding and erosion-[illegible] similar to those in the greywacke facies are [illegible] crossbed determinations suggest southerly to [illegible] transport. The maximum observed thickness is [illegible]

Interpretation

The small biohermal platform within the uppermost [illegible] Bay and lower Strathcona Sound formations was formed in a shallow subtidal to intertidal environment. A sudden influx of sediment, probably related to faulting, seems to have put an end to algal growth. The platform originally was probably more continuous than at present and may have contributed much of the material present in the closely associated carbonate conglomerates. These conglomerates occur in the lower part of the formation. Their universal chaotic nature, and apparently wide lateral extent, suggests a debris-flow mechanism for deposition, possibly on a submarine fan.

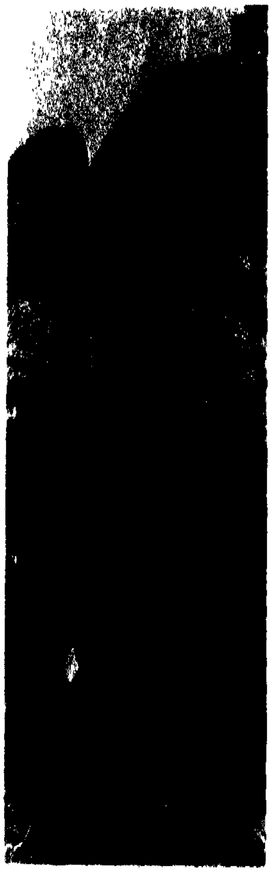


Figure 13. Fining-upward beds of granitic-pebble conglomerate and arkosic wacke in Greywacke facies of Strathcona Sound Formation southeast of head of Strathcona Sound. Photo by G.D. Jackson. GSC 173239.

Geldsetzer (1973b) and Olson (1977) have correlated the Athole Point Formation in the vicinity of Milne Inlet with the entire Strathcona Sound and Elwin formations to the west. It seems equally possible that the Athole Point represents a small eastern carbonate platform developed in the Milne Inlet area that is temporally and stratigraphically related to the basal Strathcona Sound carbonate platform described above. Geldsetzer (1973b) considered the Strathcona and Elwin formations to be a molasse facies, and possibly fluvial-deltaic.

Deposition of the red siltstone facies may have occurred either in a subtidal environment below storm wave-base, or in an alluvial environment. Interfingering with the biohermal carbonates described above favour the former, although more data concerning this point are needed.

The arkosic wacke cycles within the Greywacke facies are tentatively interpreted as turbidites, and the continued repetition of Zone A of the "Bouma sequence" is characteristic of relatively proximal turbidites (Walker, 1967). The planar-laminated, fine grained greywacke may represent Zone B and the laminated and massive siltstone Zones D-E. Crosslamination characteristic of Zone C is very rare.

The erosionally-based lenses of conglomerate are interpreted as submarine channel deposits. The orientation of channels, rare flute casts and most of the very rare planar crossbeds are consistent and indicate transport from the east or southeast.

Figure 14. Scour channel in medium grained Strathcona Sound arkosic wacke filled by pebbly granule arkosic wacke southeast of head of Strathcona Sound. Photo by G.D. Jackson. GSC 173242.

Figure 15. Arkosic wackes of Greywacke facies, Strathcona Sound Formation, shown in Figures 12 and 13, truncating underlying red shale and siltstone of the Red siltstone facies southeast of Strathcona Sound. Same locality as for figures 12, 13. Photo by G.D. Jackson. GSC 173303.

The Grey siltstone facies was probably deposited in a subtidal environment below storm wave-base, and is considered to be a lateral equivalent of the more proximal Greywacke facies. Rare current indicators suggest westerly transport. The Arkose facies may be a proximal equivalent of the Red siltstone and perhaps the Greywacke facies. Both the Greywacke and Arkose facies may include coarse braided stream deposits in the east.

The rare current indicators and distribution of facies suggest chiefly westerly transport. The occurrence of large granitic gneiss clasts within the various conglomerates, and the immature nature of the Greywacke and Arkose facies strata, strongly suggest that uplift and erosion of source areas such as the Navy Board High, east of the [illegible] (Jackson et al., 1978), was caused by faulting.

ELWIN FORMATION

The Elwin Formation [illegible] Strathcona Sound Formation [illegible] sedimentary unit on Borden [illegible] investigated [illegible] Baillarge Bay, and north of [illegible] is a varicoloured [illegible] with minor shale and [illegible] sandstones of the Strathcona [illegible] and quartzarenites of the [illegible]

Over 2300 feet [illegible] of Elwin Icecap, ba[illegible] (1220 m) thick in the [illegible] were differentiated.

The basal [illegible] subarkose in which [illegible] and planar crossbeds are [illegible] dessication cracks [illegible] formational dolorudite, and [illegible] siltstone and shale beds [illegible]

The lower unit [illegible] abundant trough and [illegible] symmetric ripple marks [illegible] small-scale channels. [illegible] abundant, discrete [illegible] of the unit, which is [illegible] feet [illegible]

[illegible] sequence of [illegible] siltstone. [illegible] and syneresis cracks are [illegible] locally. Herringbone crossbeds are [illegible]

Interpretation

The basal 1190 feet were probably deposited in very shallow subtidal to intertidal conditions. Halite cast-bearing strata probably accumulated in ephemeral pools on tidal flats. The middle unit probably is of braided fluvial origin. Crossbeds, including trough crossbeds, suggest easterly to southeasterly transport for both units. Deposition of the upper unit probably occurred under chiefly subtidal conditions.

The source area for the Elwin Formation was a predominantly granitic terrain. Although there is much lateral and vertical variability within the Elwin, in general the sediments become increasingly [illegible] grained and less feldspathic upwards.

Figure 16.

Halite casts in Elwin Foramtion east of Elwin Inlet. Photo by G.M. Narbonne. GSC 201952-J.

FRANKLIN INTRUSIONS

West-northwest and north-northwest to north-trending diabase dykes intrude the Neohelikian strata, but are not known to intrude Paleozoic strata. North-northeast trending dykes are minor. Of the two major trends, the north-northwesterly trend seems the younger in the majority of cases. Elsewhere, what appears to be the same dyke changes from a westerly to a northerly trend, or two sub-parallel dykes seem to have extended out from a common focal point. The most reliable K-Ar ages determined indicate an age of 650-700 Ma. for these dykes.

ECONOMIC GEOLOGY

Several lead-zinc occurrences are present within the [illegible] including the producing mine in the Society Cliffs Formation at Nanisivik. During the past summer, only traces of sulphide minerals were seen, and most of these had been previously prospected.

Trace amounts of sphalerite and galena were seen at several localities in carbonate strata, chiefly within the Society Cliffs Formation. Copper minerals are relatively rare. Pods of pure hematite up to 140 feet (42 m) in diameter [illegible] near Nanisivik in Society Cliffs strata. They are [illegible] similar in grain size, texture, and in overall [illegible] to much of the ore in the No. 1 deposit at Mary [illegible] 1966; Jackson, 1966). Possibly they, and part of [illegible] River ore, were formed by the same event.

Small amounts of chalcopyrite, bornite, chalcocite and [illegible] occur locally in the Nauyat volcanics. Trace [illegible] were also seen in adjacent Adams Sound strata, [illegible] those immediately overlying the volcanics.

The ubiquitous strong petroliferous odour within the Society Cliffs Foramtion suggests that this might be a satisfactory reservoir rock.

SYNOPSIS AND STRUCTURAL NOTES

About 15 000-20 000 feet (4600-6100 m) of presumably Neohelikian strata outcrop within the area examined. These strata rest nonconformably on an Aphebian-Archean granitic gneiss basement and have been block faulted and gently folded. The block faulting resulted in a series of alternating northwest-trending grabens and horsts (Jackson, et al., 1975), and northwest-trending fold structures. Many minor structures trend northerly and attitudes are steep to vertical adjacent to some of the larger faults. A few small thrust faults occur locally.

Possible Society Cliffs strata overlie Strathcona Sound, and Arctic Bay-like strata overlie Society Cliffs strata south of Elwin Icecap. However, the units must be identified with greater certainty before this can be ascribed to thrusting.

Franklin diabase dykes were emplaced along many of these faults and have been subsequently faulted. Fluvial subarkose and quartzarenite marked the beginning of Neohelikian deposition. Quiescent extrusion of plateau basalt flows occurred soon after, with little or no accompanying explosive activity, and the extruded flows were covered by sediments before erosion could take place. The Nauyat volcanics seem to be thickest along a line that trends from Fleming Lake in the south, north-northeast to Elwin River Valley; they thin eastward, and perhaps die out near Surprise Creek. The Arctic Bay, Society Cliffs and Victor Bay formations all thicken eastward, but the thickness patterns of the Adams Sound, Fabricius Fiord, Strathcona Sound, and Elwin formations are undetermined, although the Adams Sound thickens slightly to the north.

Abrupt vertical and lateral changes in lithologies and depositional environments, the cyclic nature of many of the formations, changes in transportation directions, and the presence of interformational unconformities, all indicate that syndepositional faulting played an important role in the sedimentation patterns within the basin. Some major faults may have originated in late Aphebian time and then been reactivated in the Neohelikian or later. However, most of the faulting identified within the map area seems to have occurred after deposition of the Eqalulik and Uluksan groups, both before and after deposition of lower Paleozoic strata in the area.

Jackson, et al. (1975) considered the Milne Inlet Trough to be part of the North Baffin Rift Zone. Olson (1977) has suggested that, more specifically, it represents an aulacogen related to the early development of the Franklinian Geosyncline.

ACKNOWLEDGMENTS

Excellent assistance in the field was provided by Alan Galley of Carleton University, Philip Jarvie and Margaret Robinson of University of Western Ontario, Gilles Morin of McGill University, and John Reeve of the University of Toronto. Field notes have been generously provided by Helmut Geldsetzer, and some company compilations were provided several years ago by King Resources Ltd.

The authors wish to thank M.R. Gibling and W.C. Morgan for reviewing parts of the manuscript, and K.E. Eade and F.H.A. Campbell for reviewing the entire manuscript. Geological discussions with W.R.A. Baragar and H. Geldsetzer are also acknowledged.

REFERENCES

Bernier, J.E.
1911: Report on the Dominion Government Expedition to the Northern Waters and Arctic Archipelago; 161 p.

Blackadar, R.G.
1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geol. Surv. Can., Bull. 191, 89 p.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in: Ores in Sediments, Springer-Verlag, ed. by G.C. Amstutz and A.J. Bernard, p. 115-127.

1973b: The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T.; in: Symposium on Arctic Geology, p. 99-126, Geol. Assoc. Can., Mem. 19.

Grabau, A.W.
1904: On the classification of sedimentary rocks; Am. Geol. J., v. 33, p. 228-247.

Gross, G.A.
1966: The origin of high grade iron deposits on Baffin Island, Northwest Territories; Can. Min. J., v. 87, p. 111-114.

Jackson, G.D.
1966: Geology and mineral possibilities of the Mary River region, northern Baffin Island; Can. Min. J., v. 87, p. 57-61.

1978: Basement gneisses and the Mary River Group of No. 4 deposit area, northern Baffin Island; Part b – Geological setting and interpretation; in: Geol. Surv. Can., Paper 77-14, Rubidium Strontium Isotopic Age Studies, Rept. 2.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geol. Surv. Can., Paper 74-75, 33 p.

King Resources Limited
1970: King Resources Company exploration – 1970, Strathcona project, Baffin Island, N.W.T.; company report for King Resources Ltd., by Trigg, Woollett and Associates Ltd., and by Geowest Services Ltd.

Lemon, R.R.H. and Blackadar, R.G.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geol. Surv. Can., Mem. 328, 84 p.

Mathiassen, T.
1933: Report of the Fifth Thule Expedition, 1921-1924, v. 1, no. 3; Copenhagen.

1945: Report of the Fifth Thule Expedition, 1921-1924, v. 1, no. 1; Copenhagen.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; Univ. British Columbia, unpubl. Ph.D. thesis, 371 p.

Pettijohn, F.J.
1975: Sedimentary rocks, 3rd edition; Harper & Row Publishers, 628 p.

Teichert, C.
1937: Report of the Fifth Thule Expedition [illegible], v. 1, no. 5, Copehagen.

Tremblay, A.
1921: Cruise of the Minnie Maud [illegible] Publishing Ltd., 583 p.

Walker, R.G.
1967: Turbidite sedimentary [illegible] relationship to proximal [illegible] environments; J. Sed. [illegible]

Weeks, L.J.
1926: The geology of parts of eastern Arctic [illegible] Geol. Surv. Can., Summ. Rept. [illegible]

11.

STRATIGRAPHY AND DEPOSITIONAL HISTORY OF SOME UPPER PROTEROZOIC SEDIMENTARY ROCKS ON NORTHWESTERN BAFFIN ISLAND, DISTRICT OF FRANKLIN

Contract 94843

Thomas R. Iannelli[1]
Regional and Economic Geology Division

Iannelli, Thomas. R., Stratigraphy and depositional history of some Upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geol. Surv. Can., Paper 79-1A, p. 45-56, 1979.

Abstract

Neohelikian strata outcropping on southwest Borden Peninsula and southeast into the Paquet Bay area (northwestern Baffin Island) include about 1500 m of shales, quartzarenites, subarkoses, stromatolitic dolostones and conglomerates. These beds were deposited in environments that ranged from fluvial braided stream, delta fan complex, to marine basin supratidal, intertidal and subtidal. Paleocurrent dispersal patterns indicate that the dominant depositional trends were from the east and southeast.

The pattern of sediment deposition was influenced by faulting, which occurred within northwest trending zones

Introduction

Upper Proterozoic sedimentary rocks are well preserved in a fault bounded graben that extends across Borden Peninsula, southeast to the Paquet Bay area. During the 1978 field season nearly three months were spent studying preselected areas within NTS sheets 48A, 38B and 37G (Fig. 11.1) that contain strata of the Adams Sound, Fabricius Fiord, Arctic Bay and Society Cliffs formations. Foot and boat traverses were augmented by helicopter reconnaissance. Mapping was carried out at a scale of 1:50 000 and about 40 stratigraphic sections were measured.

The data collected will be incorporated into a doctoral thesis, at the University of Western Ontario. The work, which is sponsored by the Geological Survey of Canada under the supervision of G.D. Jackson, is part of a continuing study of the Neohelikian strata of the North Baffin Rift Zone that was begun in 1977 (Jackson et al., 1978). Carbonate rocks were classified according to Grabau (1904) whereas sandstones were classified according to Pettijohn (1975).

Regional Geology

A crystalline, Archean to Aphebian basement complex underlies most of the region. These rocks are chiefly irregularly banded, complexly folded, migmatites intruded by massive granite to granodiorite. Nebulitic to porphyroblastic gneiss and paragneiss are also present. Minor pegmatite veins are common.

Several thousand metres of Neohelikian sediment overlie the gneisses unconformably. The rock types include shale, siltstone, quartzarenite, subarkose, conglomerate and stromatolitic dolostone. The rocks are generally flat lying to gently dipping with highly folded beds common near major faults which separate them from the basement complex. The Neohelikian beds are overlain by Paleozoic strata in adjacent areas.

The Neohelikian rocks of Borden Peninsula were first defined and subdivided by Lemon and Blackadar (1963) and originally examined in the present study area by Blackadar (1970). Subsequent investigations include those by Geldsetzer (1973), Jackson et al. (1975, 1978) and Olson (1977).

Adams Sound Formation

The Adams Sound Formation outcrops extensively southwest of Magda Plateau. It is also found in Alfa River valley and along Tay Sound and Paquet Bay. It is characterized by thin- to thick-bedded and massive quartzarenite, with thin interbeds of subarkose and quartz pebble orthoconglomerate. These rocks are greyish purple, and locally have poorly defined, conglomerate-based, fining upward cycles.

This formation has a thickness of nearly 300 m west of Milne Inlet (Jackson et al., 1978) but is only 50 m thick east of the inlet (Fig. 11.2 – locality 6). The Adams Sound rests directly upon basement gneiss in the vicinity of, and east of

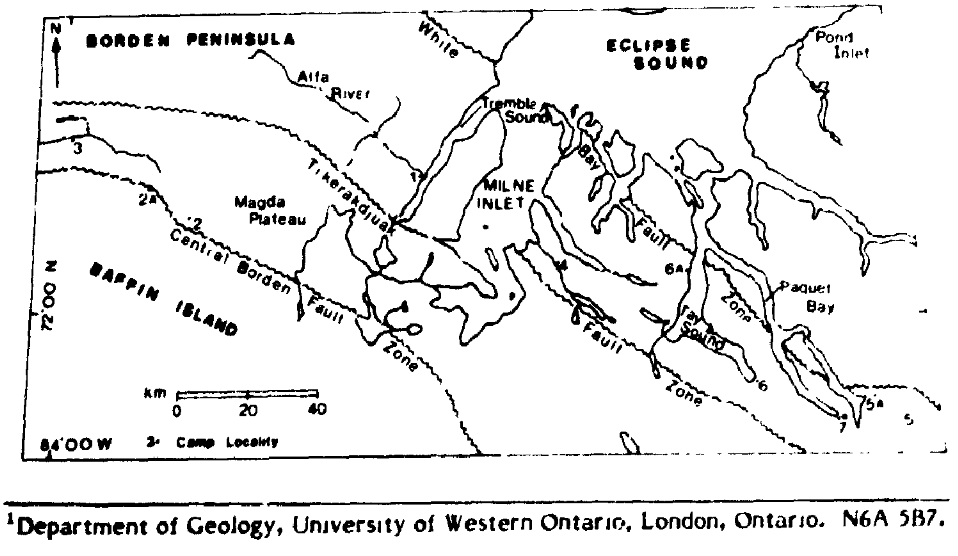


Figure 11.1 *Location map*

---

[1] Department of Geology, University of Western Ontario, London, Ontario. N6A 5B7.

Table 11.1

Table of Formations

	West of Milne Inlet							East of Milne Inlet	
NEOHELIKIAN	Victor Bay Fm. (610 m)	VB:		Shale, siltstone, dolostone					
	Conformable?								
	Society Cliffs Fm. (580 m)	SC_2:		Stromatolitic and massive dolostone				SC_2:	Stromatolitic dolostone, minor siltstone, quartzarenite
	Unconformable								
	Fabricius Fiord Fm. (1500-2000 m)	FF_4:	FF_{4c}:	Breccia-conglomerate		SC_1:	Stromatolitic dolostone, minor quartzarenite, subarkose, shale	SC_1:	Redbed sequences, stromatolitic dolostone, minor quartzarenite
			FF_{4b}:	Gritty, stromatolitic dolostone					
			FF_{4a}:	Subarkose, arkose					
		FF_3:		Subarkose, conglomerate		Gradational to		Unconformable	
		FF_2:	U-	Quartzarenite dominated, large coarsening up cycles	Arctic Bay Fm. (610-770 m)	AB_4:	Shale, minor stromatolitic dolostone	AB_4:	Quartzarenite, dolarenite, shale, stromatolitic dolostone
			M-	Shale dominated, large coarsening up cycles		AB_3:	Shale	AB_3:	Shale, minor siltstone
			L-	Coarsening up cycles of shale, siltstone, quartzarenite		AB_2:	Shale dominated, small coarsening up cycles	AB_2:	Quartzarenite dominated, small coarsening up cycles
		FF_1:		Subarkose, quartzarenite, minor shale, conglomerate		AB_1:	Quartzarenite, siltstone, minor shale	AB_1:	Quartzarenite, siltstone, minor shale
	Gradational								
	Adams Sound Fm. (50-300 m)	AS_3:		Quartzarenite, minor conglomerate					
		AS_2:		Quartzarenite				AS_5:	Quartzarenite, conglomerate
		AS_1:		Quartzarenite				AS_4:	Conglomerate
	Nonconformity								
ARCHEAN-APHEBIAN	Amg	—		Granitic gneiss basement					

Milne Inlet. Adams Sound quartzarenite grades upward into both the Arctic Bay and Fabricius Fiord formations (Table 11.1).

The strata commonly contain medium sized, undulatory- to lunate-current ripple marks, planar- and trough-crossbeds and a few megaripples and bulbous load casts. Hematite staining and pyrite bedding plane coatings were seen in a few places.

The Adams Sound Formation is divisible into the AS$_1$, AS$_2$ and AS$_3$ members west of Milne Inlet (Jackson et al., 1978) and into the AS$_4$ and AS$_5$ members east of Milne Inlet.

AS$_1$ and AS$_2$ members

These members are present at locality 3 where they are poorly exposed. The AS$_1$ member grades upward into the overlying AS$_2$ member, and thin- to medium-bedded, greyish purple quartzarenite is characteristic of both units.

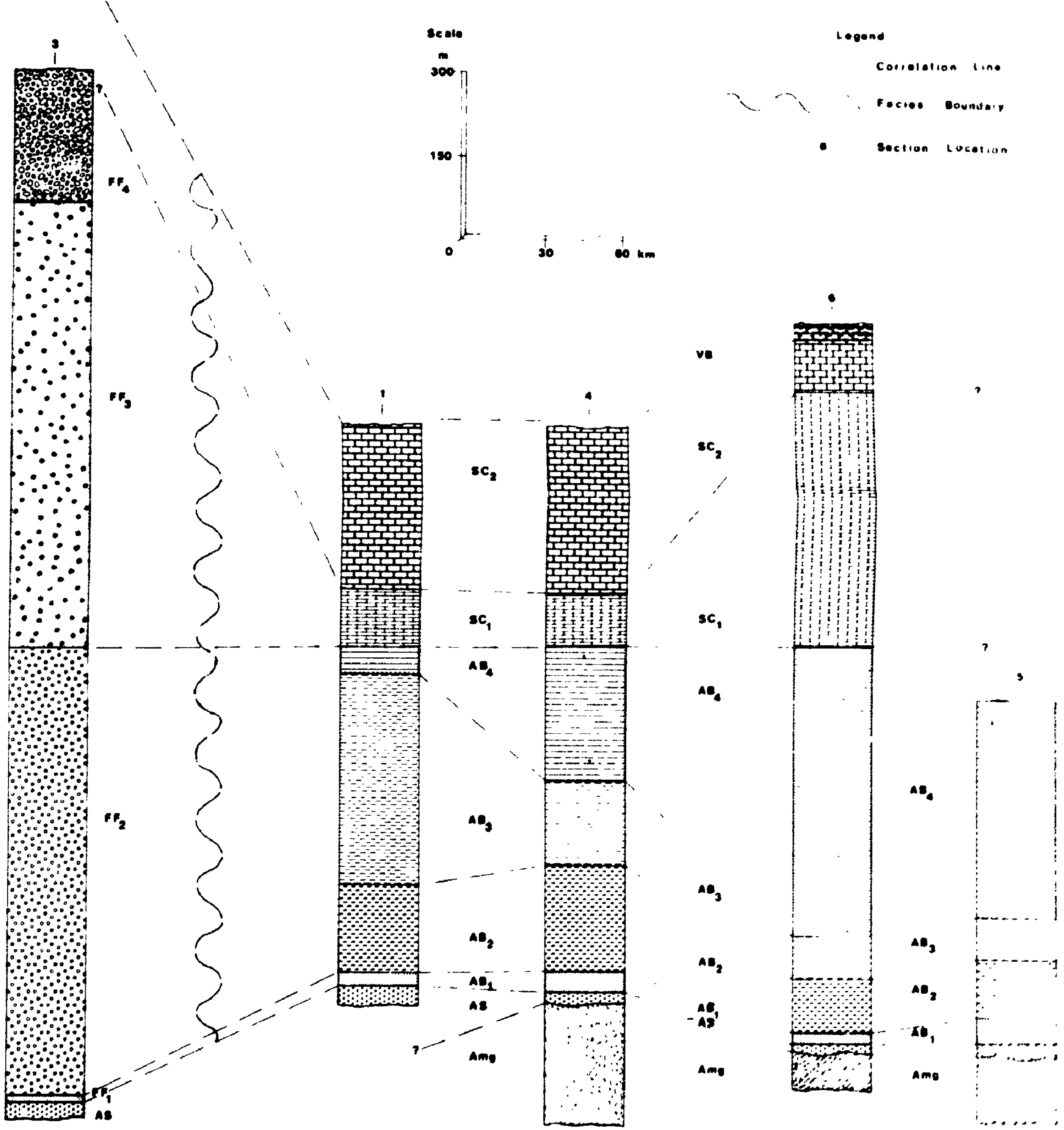


Figure 11.2. Representative stratigraphic sections from the study area. The formation abbreviations are listed in Table 11.1.

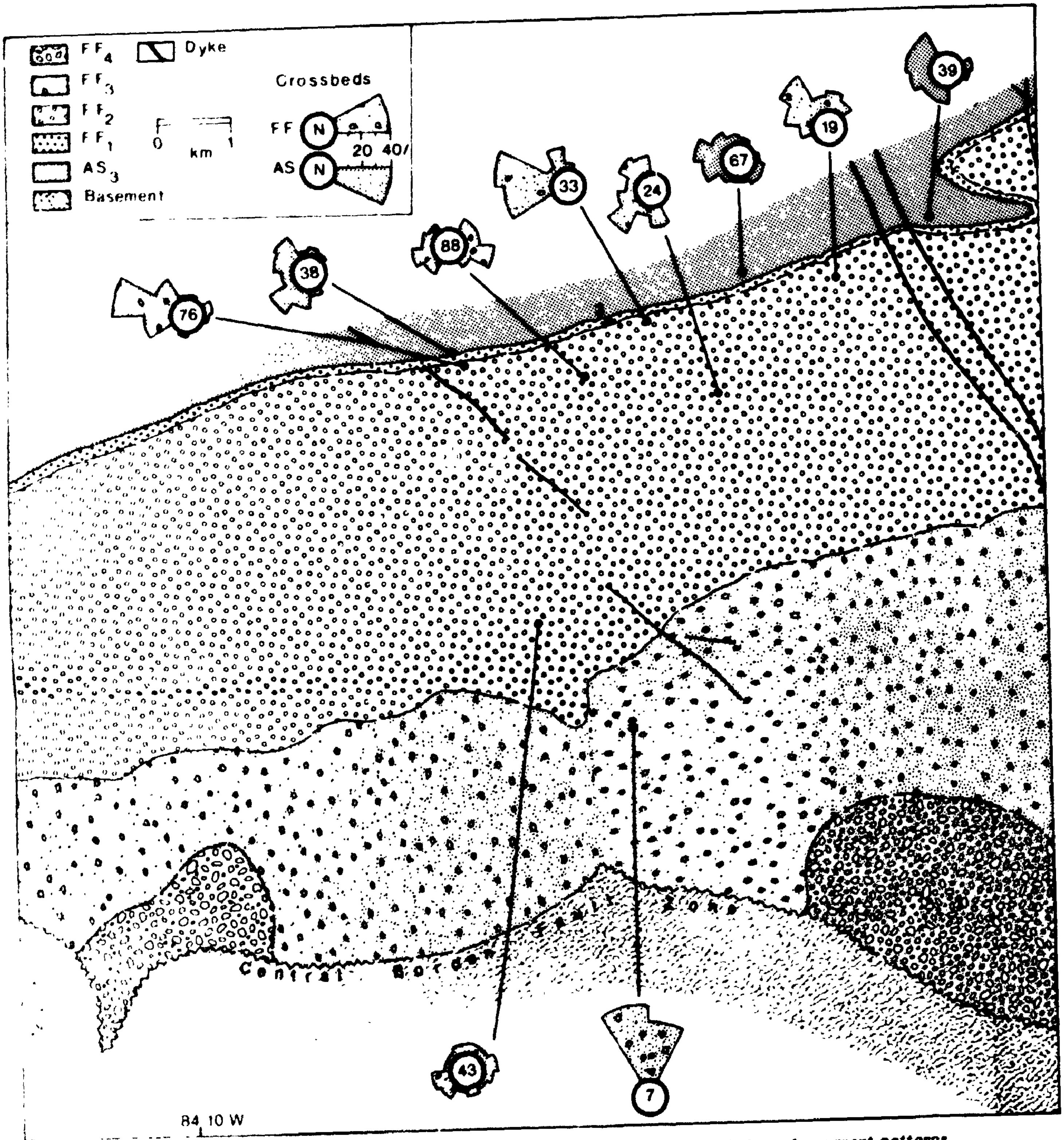


Figure 11.3 *General geology in the vicinity of locality 3. The map includes paleocurrent patterns of trough and planar-crossbeds from the Fabricius Fiord and Adams Sound formations. The number of readings from each station is shown in the centre of the rose diagram.*

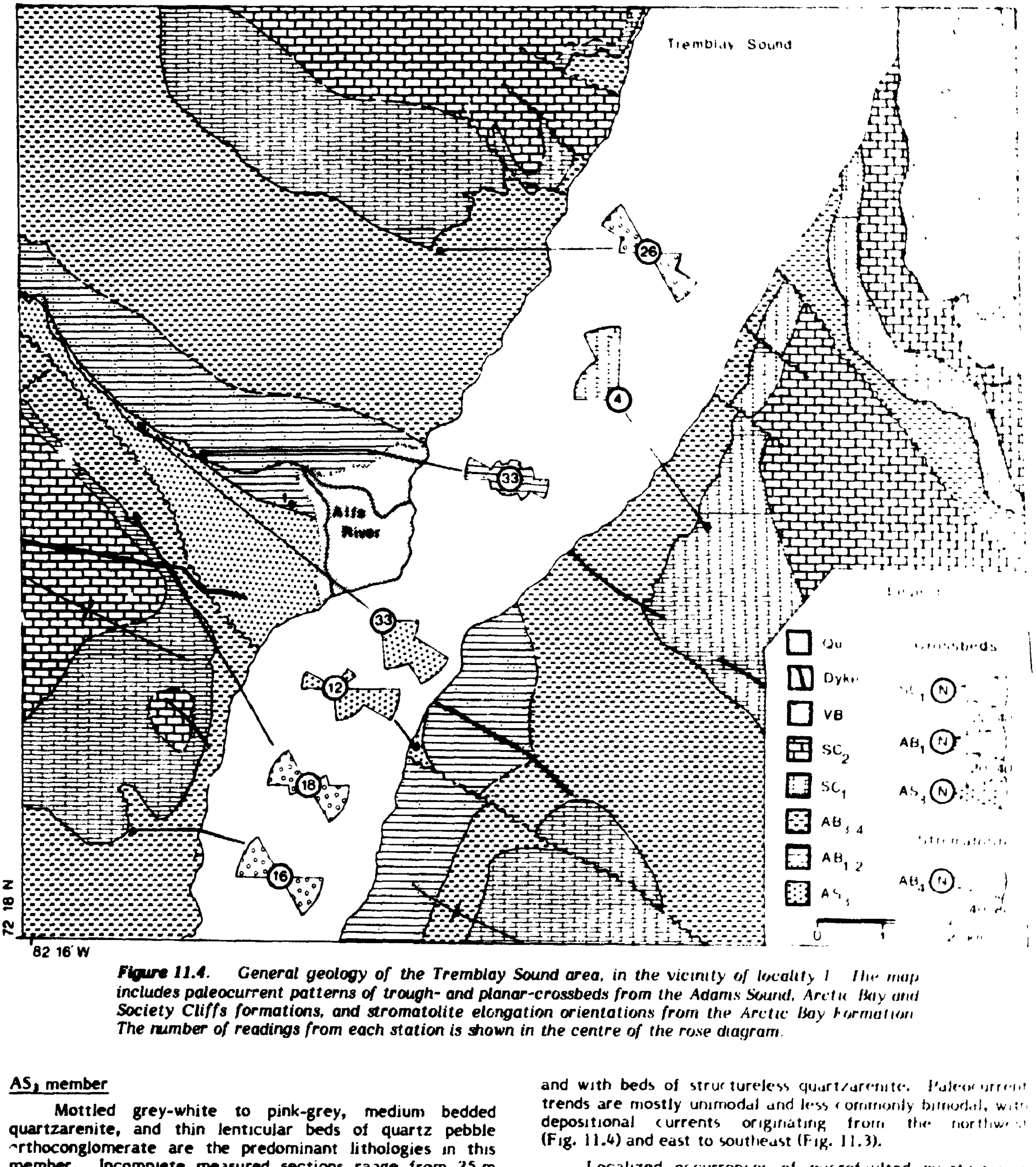


Figure 11.4. *General geology of the Tremblay Sound area, in the vicinity of locality 1. The map includes paleocurrent patterns of trough- and planar-crossbeds from the Adams Sound, Arctic Bay and Society Cliffs formations, and stromatolite elongation orientations from the Arctic Bay Formation. The number of readings from each station is shown in the centre of the rose diagram.*

AS_3 member

Mottled grey-white to pink-grey, medium bedded quartzarenite, and thin lenticular beds of quartz pebble orthoconglomerate are the predominant lithologies in this member. Incomplete measured sections range from 25 m thick at locality 1, to 64 m thick at locality 3.

Megaripples, with wavelengths of 1 to 2 m, heights of 0.3 to 0.6 m and consisting of large planar crossbeds occur in most sections. These have smaller undulatory current ripple marks superimposed on their upper surfaces. Ripple marked beds alternate with those having overturned planar crossbeds and with beds of structureless quartzarenite. Paleocurrent trends are mostly unimodal and less commonly bimodal, with depositional currents originating from the northwest (Fig. 11.4) and east to southeast (Fig. 11.3).

Localized occurrences of microfaulted quartzarenite and of wedge shaped clastic dykes indicate postdepositional disturbance. This is also implied at locality 1 where a sedimentary breccia channel 3 m wide, 2 m high and over [illegible] long contains partially detached quartzarenite wall rock, angular, ripple marked quartzarenite clasts set in a coarse grained quartzarenite matrix.

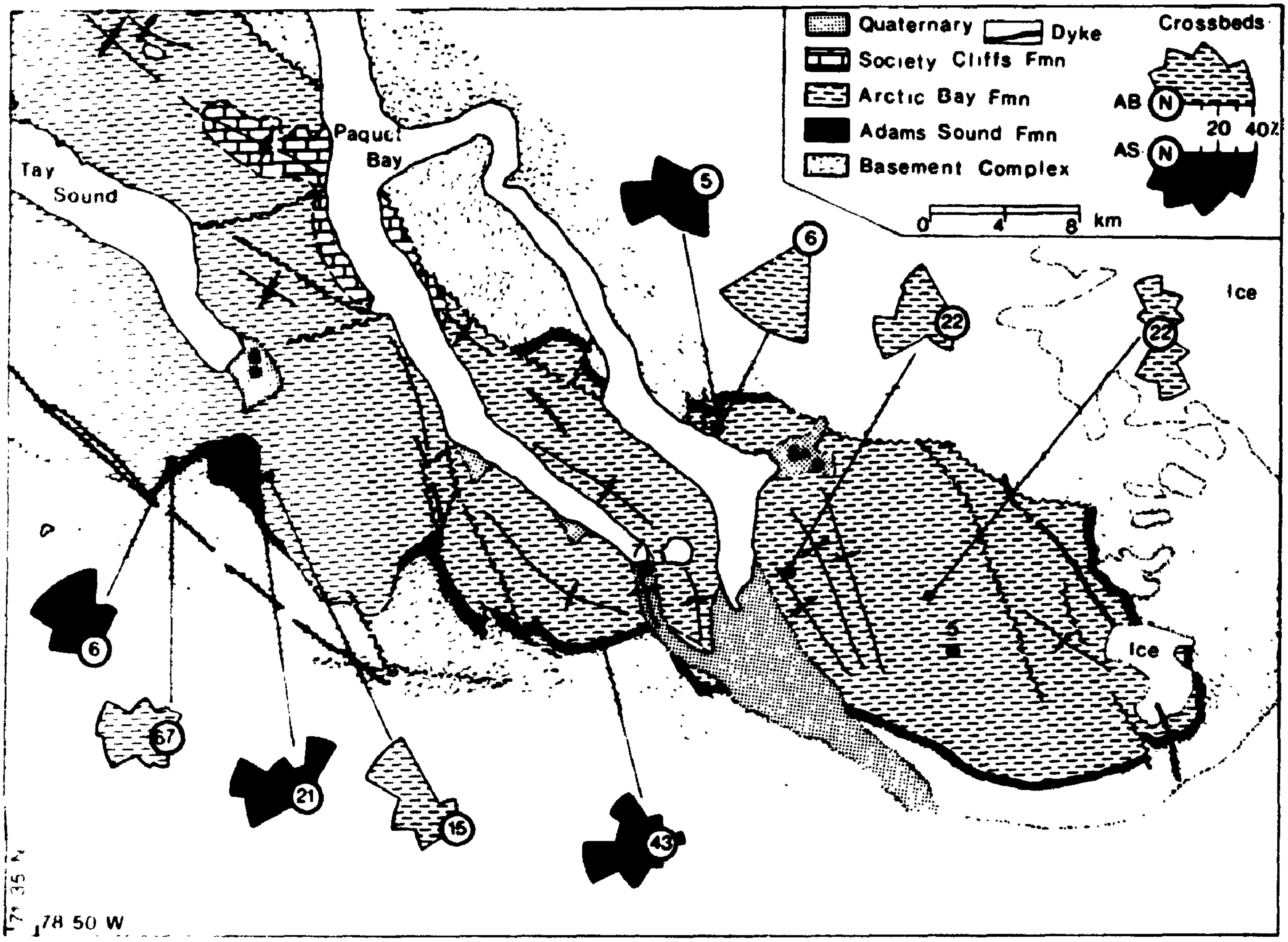


Figure 11.5. General geology of the eastern map area, in the vicinity of localities 5 to 7. The map includes paleocurrent patterns of trough- and planar-crossbeds from the Adams Sound and Arctic Bay formations. The number of readings from each station is shown in the centre of the rose diagram.

AS_4 member

Most of the AS_4 member is thick bedded to poorly bedded to massive, polymictic orthoconglomerate. Minor interbeds of purple-orange to grey subarkose, pebbly subarkose and quartzarenite also occur. Clasts within the conglomerate are chiefly quartz pebbles and cobbles, although quartzarenite, feldspar and gneiss clasts are found locally. The gneiss clasts increase in abundance downward toward the basal contact. AS_4 beds are found only east of Milne Inlet where the member ranges from 1 to 10 m thick.

The conglomerates unconformably overlie the basement complex at an undulatory contact whose relief is estimated to be 1 to 2 m. The beds are draped over the irregular basement surface, giving this member a pinch and swell character. Lower beds within the member appear to pinch out against the underlying gneisses. A regolith 3 m thick occurs at locality 5, immediately below the AS_4 contact.

Planar crossbeds in the conglomerates range up to 2.5 m thick, and contain current-aligned quartz pebbles along foreset and bottomset beds. Paleocurrent dispersal patterns from these crossbeds indicate sediment transport from the north and southeast (Fig. 11.5).

AS_5 member

This member includes medium bedded to massive quartzarenite which alternates with thin to thick beds of quartz pebble orthoconglomerate. At locality 7 these brown-grey to white rocks occur in conglomerate-based fining upward cycles. The member is present east of Milne Inlet where it is 18 to 28 m thick and is gradational with both the underlying AS_4 member and the overlying lower Arctic Bay strata.

Large scale planar crossbeds with graded foreset beds, crescent shaped current ripple marks with wavelengths of 0.3 to 1 m, and surface channels occasionally occur in these beds. The planar crossbeds have unimodal paleocurrent trends that indicate depositional currents from the southeast and south (Fig. 11.5).

Interpretation

On Borden Peninsula, west of the present day Milne Inlet, an extensive accumulation of fluvial quartzarenite (AS_1) gradually blanketed the basement terrane, in early Adams Sound time. Sedimentation progressed with little influence from fault related tectonism. Deposition of mixed fluvial-intertidal sand bodies (AS_2, AS_3) followed as subsidence caused marine waters to encroach upon the earlier river systems.

Adams Sound sedimentation patterns east of the present day Milne Inlet, were probably influenced by periodic faulting and restriction within the narrow southeast arm of the Milne Inlet Trough of Jackson et al. (1975). Early Adams Sound deposition here was characterized by episodic shedding of clastic material, resulting in the formation of conglomerate-dominated proximal braided stream deposits (AS_4) and quartzarenite-dominated distal braided stream cycles (lower AS_5). As tectonic activity subsided, or as source areas were worn down, these fluvial deposits were overlain by intertidal to subtidal sand bodies (upper AS_5; lower Arctic Bay strata) when transgressive marine water overwhelmed the trough.

Fabricius Fiord Formation

The Fabricius Fiord Formation outcrops in a belt 54 km long and 10 km wide, extending west from Magda Plateau (Fig. 11.1). It contains a thick lower unit of shale-siltstone-quartzarenite cycles and a thick upper unit of pebbly subarkose and conglomerate beds. Minor lithologies include stromatolitic dolostone, gritty dolostone, and granite clast breccia conglomerate. The formation ranges in thickness from 1500 m at locality 2A to 2000 m at locality 3 (Fig. 11.2).

The Fabricius Fiord was previously subdivided into three members (Jackson et al., 1978). Detailed examination in 1978 allowed subdivision into four intergradational members (Table 11.1). In addition, the FF_2 member has been expanded to include the lower two thirds of the FF_3 member of Jackson et al. (1978). The upper one third of the same FF_3 member is equivalent to the lower FF_3 member of the present study.

The contact with the underlying Adams Sound Formation is both conformable and gradational. The lower two members grade laterally northeast along strike into the Arctic Bay Formation (Fig. 11.6). Upper members are overlain at locality 2A by massive Society Cliffs dolostone and are laterally correlated with the lower member of the Society Cliffs Formation. The Fabricius Fiord strata are downfaulted against basement gneiss along the Central Borden Fault Zone (Fig. 11.3).

Siltstone and quartzarenite of the lower two members commonly contain small- to medium-sized, straight and undulatory- to lunate-current ripple marks, trough and planar-crossbeds, tubular to bulbous load structures and synaeresis cracks. The paleocurrent patterns, for the lower three members, indicate unimodal to bimodal trends with dominant clastic sources from the southeast and east (Fig. 11.3).

FF_1 member

This member contains a lower sequence predominantly of thin bedded quartzarenite and subarkose. Thin interbeds of pebbly subarkose, quartz- and feldspar-pebble orthoconglomerate, siltstone and shale are also present. The rocks are greyish green and 15 to 23 m thick.

The upper beds are more massive, brown to grey quartzarenite and contain graded crossbeds and structureless to load casted interbeds.

FF_2 member

The FF_2 member consists of clastic strata that were deposited in coarsening upward cycles which range from [illegible] over 30 m thick and contain three subunits. The member ranges from 370 m thick, at locality 2, to [illegible] m at locality 3.

The lower subunit of each cycle contains [illegible] thick-laminated, black to grey, shale and silty shale, with minor thinly bedded siltstone. This subunit is 3 to 15 m thick. It grades up into middle subunits of interlayered, thin- to medium-bedded, brownish grey quartzarenite, siltstone and shale. The quartzarenite and siltstone beds are undulatory to

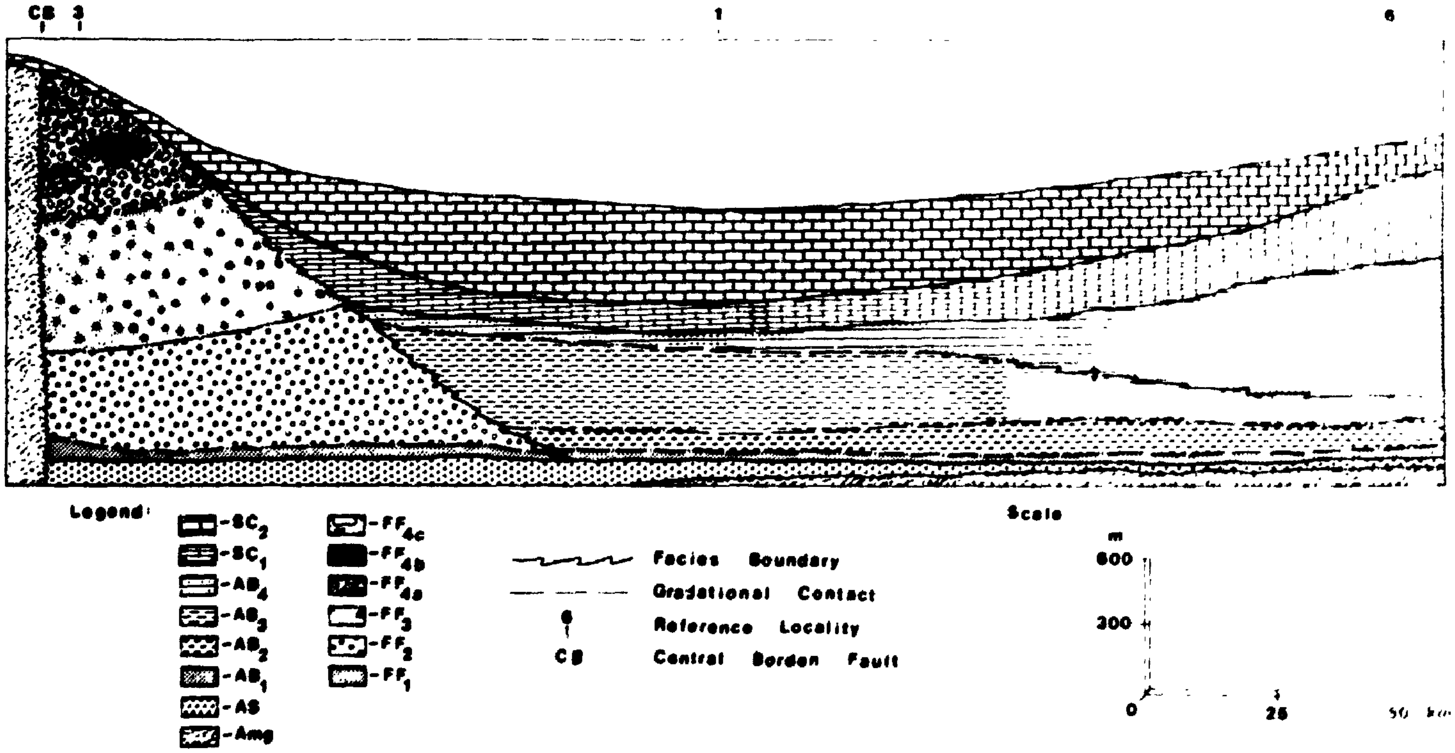


Figure 11.6. Facies relationships between the Fabricius Fiord, Arctic Bay and Society Cliffs formations

lenticular and increase upwards in amount from 10 to 60 per cent. The interlayered subunit commonly is 1.5 to 6 m thick.

The upper subunits, of FF_2 cycles, consist of thin- to medium-bedded quartzarenite, with thin siltstone or shale partings. These rocks are brownish white to grev and vary considerably in thickness ranging from 0.5 to 1.5 m. In addition to the sedimentary structures noted above, the beds contain planar- and herringbone-crossbeds which are up to 0.3 m thick, straight-crested wave ripple marks with wavelengths of 0.3 to 1 m, and surface channels.

The FF_2 cycles change from lower member cycles that contain equal amounts of shale, siltstone and quartzarenite, through middle member shale-dominated cycles, into upper member quartzarenite dominated cycles. The FF_2 member may lend itself to further subdivision, based upon the proportion of shale, siltstone and quartzarenite, within the cycles.

FF_3 member

Medium- to thick-bedded and massive subarkose and pebbly subarkose alternating with thin beds of quartz-feldspar pebble conglomerate are the predominant lithologies of this member. The rocks range in colour from yellowish grey to brown and locally occur as conglomerate capped, vaguely defined coarsening upward cycles ranging in thickness from 15 to over 30 m.

The FF_3 member attains a maximum thickness of 840 m, at locality 3. The beds are generally devoid of sedimentary structures and contain only scattered large planar crossbeds. These structures are up to 1.5 m thick and show current aligned quartz pebbles along foreset and bottomset beds.

FF_4 member

Thick beds of subarkose, arkose, stromatolitic dolostone and breccia conglomerate constitute the uppermost FF_4 member of the Fabricius Fiord Formation. These beds are situated adjacent to the Central Borden Fault Zone and are 150 m thick at locality 2A and 245 m thick at locality 3. Three major laterally and vertically intergradational lithological associations can be defined from data collected at these localities.

FF_{4a} Association. This lithological association is predominantly medium- to thick-bedded subarkose and pebbly subarkose, with minor interlayers of arkose and pebbly arkose. These arkoses are present as wedges, which increase in thickness towards the fault zone. At a distance of about 1 km they average 5 to 10 cm thick and increase to upwards of 0.6 m at the fault contact. Fresh surfaces are mostly yellowish brown, grey, and reddish orange, whereas weathered surfaces are brownish grey to dark chocolate brown. The latter colour is probably due to the weathering of iron-rich carbonates in the matrix, and helps to distinguish FF_{4a} subarkoses from FF_3 subarkoses which are lighter coloured. Dark steel-grey coatings of hematite are found on some beds.

The only sedimentary structure observed in these beds, are scattered medium- to large-scale planar crossbeds. More than 65 per cent of FF_4 exposure area consists of FF_{4a} subarkose and arkose. The remainder of the member consists of scattered, lenticular zones of FF_{4b} lithological associations, and unstratified wedges of FF_{4c} lithological associations marginal to the fault zone (see Fig. 11.6). Both associations occur at various stratigraphic positions within FF_{4a} strata.

FF_{4b} Association. This carbonate-rich lithological association contains medium- to thick-bedded stromatolitic dolostone and more massive gritty dolostone. The grit component is chiefly quartz and feldspar sand- to pebble-sized clasts in amounts of 5 to 25 per cent. Fresh surfaces are light to medium grey; weathered surfaces are typically chocolate brown to light brown. The beds are sometimes coated by steel-grey hematite.

The stromatolites include planar, laterally linked low domal, and unbranching columnar forms. The low domal forms are 5 to 10 cm high; the columnar forms are up to 20 cm high and are found in situ and overturned. Breccia wedges and 'pipes' of angular, pebble size stromatolitic dolostone, and thin beds of dolostone-clast flat pebble conglomerate, occur locally as part of the association. These breccias and conglomerates contain a granular subarkose matrix.

The stromatolites found in these strata are distinct from those present within the upper Arctic Bay beds (AB_4 member), but similar to some of the forms that occur within the Society Cliffs dolostone. Further study may allow a more specific intrabasin correlation between the upper Fabricius Fiord and Society Cliffs formations.

FF_{4c} Association. Structureless, massive breccia conglomerate constitutes the third lithological association. It occurs as wedges, as much as 5 m thick, adjacent to the Central Borden Fault Zone usually no more than 0.5 km north of this contact. The breccia-conglomerate contains granule- to cobble-size, subrounded to subangular quartz and feldspar clasts, and pebble- to boulder-size subangular to angular granite and gneiss clasts. The clasts are supported in a dolostone matrix that makes up 10 to 40 per cent of the rock, and contains scattered small biotite flakes and sand-size quartz and feldspar grains. These rocks weather chocolate- to pink-brown and have pink-grey to brownish grey fresh surfaces.

A gradual increase in clast size occurs towards the fault contact. At locality 3, pebble size clasts dominate 0.5 km north from the contact. Adjacent to the contact the average has increased into the cobble- to boulder-size range.

Interpretation

To date the Fabricius Fiord Formation has been found only in restricted areas due north of the Central Borden Fault Zone. That periodic syndepositional faulting influenced the deposition of the Fabricius Fiord sediments is suggested by the paleocurrent dispersal patterns, the large amount of immature sediments and the increased abundance of arkose and breccia conglomerate wedges towards the fault margin. Most of the movement probably occurred along the Central Borden Fault Zone although movement along fault zones farther to the south cannot yet be ruled out as a major influence.

The lithologies and sedimentary structures, the overall coarsening upward trend, the cyclic nature of the beds, and their outcrop pattern suggest deposition within large delta fan complexes. They may be marine equivalents of alluvial fans, such as the Devonian Karlskaret fan in Norway (Larsen and Steel, 1978) and ancient analogs of recent continental margin submarine fans (Normark, 1978). The sequence of beds observed are similar to those produced by prograding delta fans (Pettijohn, 1975). If this interpretation is correct, then it appears that Neohelikian delta fan complexes in excess of 10 km in basinward extent and 2 to 3 km in height, dominated the southern margins of the Milne Inlet Trough throughout Fabricius Fiord depositional time (Fig. 11.3 and 11.7).

Faulting, beginning in FF_1 time, initiated delta fan deposition in the southern part of the trough. Early intertidal to subtidal deposited sands (FF_1) spread northeast over the basin gradually covering the largely fluvial Adams Sound quartzarenites. Deposition of the FF_2 member occurred as the prograding delta migrated over the basin tidal flats. Nearer to the fault zone, large amounts of coarse clastics accumulated as proximal and distal delta sheet sands (FF_3, FF_{4a}; Fig. 11.7). These were actively reworked by distributary channels. As the upper fan platform built up and extended seaward, shallow restricted interdistributary basins and embayments formed over its surface. These were the centres for carbonate deposition and formation of stromatolitic beds (FF_{4b}). Migration of distributary channels through these small basins brought carbonate deposition on the fan to a close. At the fault margin, tectonic pulses caused rapid shedding of breccia wedges onto the upper fan platform.

Arctic Bay Formation

The Arctic Bay Formation outcrops across the entire study area, being especially well exposed in sections along Alfa River, Tremblay Sound and at the mouth of Paquet Bay. West of Milne Inlet it is composed of micaceous black to grey shale and minor, greyish brown, interbedded siltstone, quartzarenite, dolosiltite and stromatolitic dolostone. East of Milne Inlet the shale content is significantly reduced, being replaced by increased amounts of white to greyish green quartzarenite-siltstone and orange- to rust-brown dolosiltite, dolarenite and stromatolitic dolostone. Thicknesses vary from 610 m at locality 1 to about 770 m at localities 6 [illegible] (Fig. 11.2).

The contact with the overlying Society Cliffs Formation is conformable at locality 4. At localities 1 and 6 [illegible] unconformable, being undulatory and erosional in nature. [illegible] Arctic Bay is normally underlain by the Adams Sound Formation. However, at localities 4 and 6 it nonconformably overlies the basement in areas where the Adams Sound [illegible] wedged out against the gneisses.

Sedimentary structures are common in the siltstone, quartzarenite and dolostone beds. These rocks contain [illegible] to medium sized, undulatory bifurcating- to lunate [illegible] ripple marks, trough- and planar-crossbeds, cylindrical [illegible] subspherical load casts, synaeresis cracks and tool marks. The shale beds sometimes include cone-in-cone concretions, thin lenses and beds of pyrite and gypsum efflorescence.

The formation has been subdivided into four intergradational members (Table 11.1). In reference to the previous subdivision in Jackson et al. (1978), the AB[illegible] member was not identified in the study area. It is tentatively assumed [illegible] the AB_4 and AB_5 members of Jackson et al. (1978) [illegible] equivalent to the AB_4 member of this report. Also, the AB[illegible] equivalent to Jackson's et al. (1975) AB-[illegible] member. [illegible] detailed mapping carried out in the Paquet Bay region [illegible] has shown that the AB_4 member covers a larger area [illegible] been previously realized.

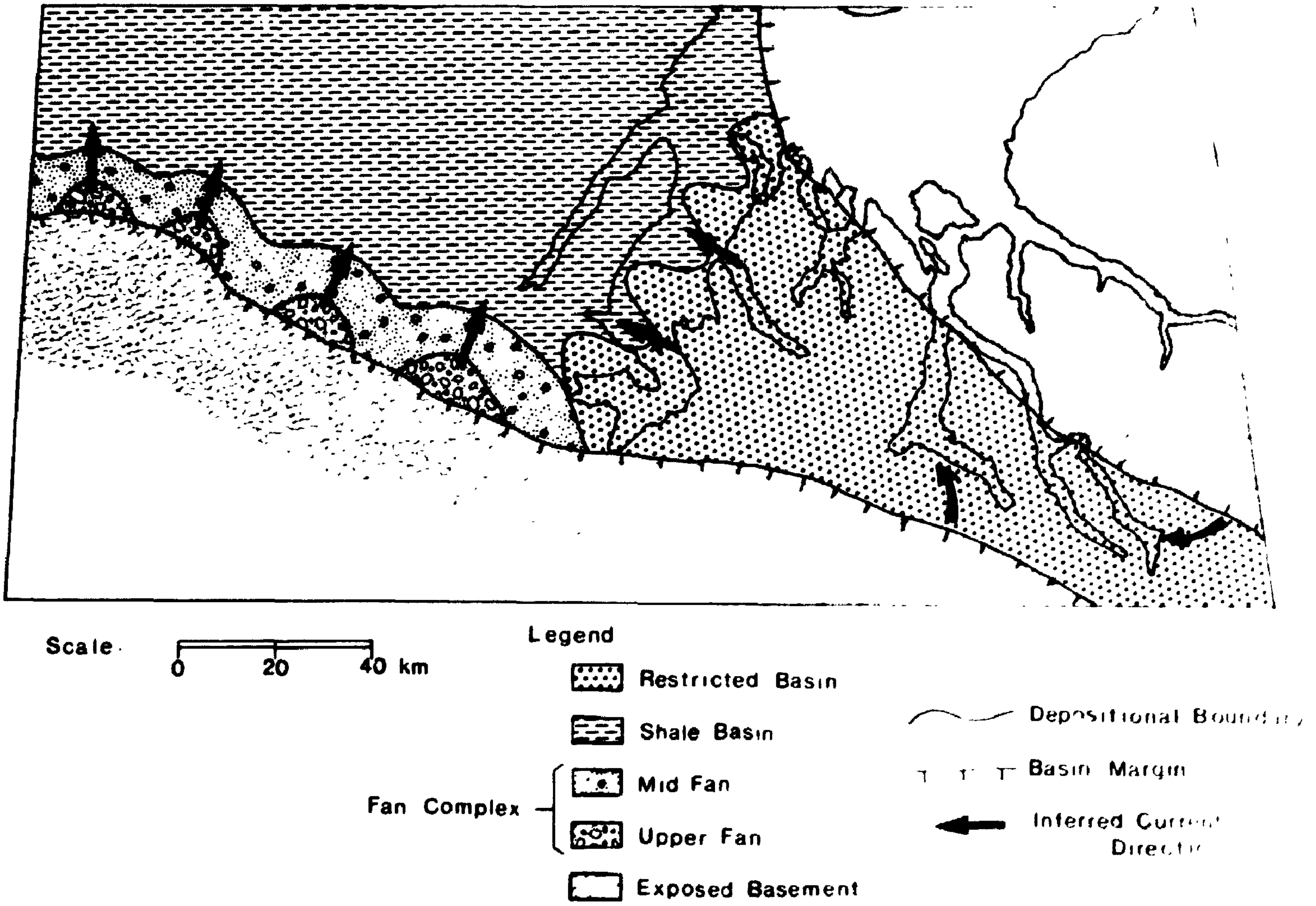


Figure 11.7. Hypothetical reconstruction of depositional environments during the early history of the Milne Inlet Trough. The area is the same as that shown in Figure 11.1.

AB$_1$ member

Thin- to medium-bedded quartzarenite and siltstone dominate the member. These beds also contain some thin shale interlayers and partings. The weathered surfaces range from rust-brown to greenish brown whereas the fresh surfaces are greyish green to white. This member is 17 m thick at locality 1, 45 m thick at locality 5 and 13 m thick at locality 7. In some sections, as at locality 1, the beds contain abundant planar- and trough-crossbeds and scattered megaripples. Paleocurrent patterns from the crossbeds show 180° opposed bimodal trends and indicate depositional currents from both the northwest and southeast (Fig. 11.4).

AB$_2$ member

This member consists of coarsening upward cycles which contain three subunits ranging in thickness from 9 to 15 m. These cycles are smaller and include larger proportions of shale than the similar FF$_2$ types.

The lowest subunit of these AB$_2$ cycles is chiefly thin- to thick-laminated, planar shale and scattered thin beds of silty shale and quartzarenite. These rocks have rust-brown to grey weathered surfaces and black to dark grey fresh surfaces. The beds are micaceous, range from 3 to 9 m thick, and are generally devoid of sedimentary structures.

The shale grades up into an interlayered middle subunit of thin- to medium-bedded shale, siltstone and quartzarenite. The siltstone-quartzarenite beds are undulatory to lenticular and increase in amount upwards from 15 to 50 per cent. These rocks have brownish grey weathered surfaces and grey to white fresh surfaces. This subunit is 1.5 to 6 m thick west of Milne Inlet and 1.5 to 4.5 m thick east of the inlet.

AB$_2$ cycles to the west of Milne Inlet are capped by thin bedded quartzarenite which contains shale and siltstone partings. The rocks are greyish brown to greyish white and range in thickness from 0.3 to 1.5 m thick at locality 1. East of Milne Inlet this upper subunit consists of thick bedded quartzarenite. Weathered rock surfaces are yellowish white to brownish green, whereas fresh surfaces are light grey to white. Beds range from 3 to 7.5 m thick and include medium- to large-sized trough-, planar- and herringbone-crossbeds, megaripples with wavelengths of 1 to 2 m, and surface channels. Paleocurrent patterns include unimodal to 180° opposed bimodal trends with the dominant depositional currents coming from the east and southeast (Fig. 11.5).

Cycles of the AB$_2$ member, west of Milne Inlet, pass upward into shale dominated forms. Those east of the inlet pass up into quartzarenite dominated forms. The member changes in thickness from 155 m at locality 1 to 60 m at localities 5 and 7.

AB$_3$ member

AB$_3$ beds consist chiefly of very thin- to thick-laminated, planar black shale and scattered thin silty shale, siltstone and dololutite interlayers. These interlayers are rare west of Milne Inlet, but increase in amount to the east. At locality 4, a 1 m thick bed of concretionary limestone occurs in the middle of the member. The beds have few sedimentary structures. This member averages 380 m thick at locality 1 but thins considerably east of Milne Inlet to a thickness of 92 m at locality 4 and 64 m at locality 7.

AB$_4$ member

West of Milne Inlet. In this area, the AB$_4$ member consists largely of thick laminated, planar black shale with carbonate interbeds ranging from 20 to 30 per cent by volume. These are chiefly thin bedded limestone, dolostone and stromatolitic dolostone and occur as beds 0.6 to 3.3 m thick, with orange-brown weathered surfaces and grey fresh surfaces. Small vugs lined by dolomite and smoky quartz occur in some beds. The entire member is 46 m thick.

The stromatolitic dolostone occurs as lenticular beds consisting of small mounds. The stromatolites change from planar forms near the mound base, through low domal, into diverse columnar forms. These columns divide, branch and expand upwards. They average 0.5 to 0.8 m high and are found both upright in the mounds and inclined in one direction. The mounds have ripple marked surfaces and wedges of stromatolite-clast breccia. Stromatolite mound elongation orientations show southeast to northwest trends (Fig. 11.4).

East of Milne Inlet. The AB$_4$ member constitutes the majority of the Arctic Bay Formation east of Milne Inlet. The beds occur in cyclic sequences that contain three subunits. The lower is black, thick laminated planar shale and silty shale and is 1.5 to 7.7 m thick. These shales grade up into interlayered thin bedded shale, siltstone, quartzarenite and doloarenite The beds are undulatory and have orange-brown to greenish grey weathered surfaces, and greenish white to grey fresh surfaces. The middle subunit is 0.6 to 6 m thick. The upper beds of AB$_4$ cycles include calcareous siltstone to quartzarenite, dolosiltite, doloarenite, dololutite, dolostone, limestone and planar to columnar stromatolitic dolostone. These rocks have medium, undulatory to lenticular bedding, orange-brown to greenish brown weathered surfaces and brown-grey to greenish grey fresh surfaces. The subunit ranges from 3 to 15 m thick. In addition to the sedimentary structures noted before, these beds also contain molar tooth structures, scoured bases, scattered large, southeast-trending planar crossbeds and megaripples. Small pyrite and dolomite filled vugs are common in some beds.

Thicknesses for the entire member range from 370 m at locality 7 to about 615 m at locality 6.

Interpretation

Most of the Arctic Bay Formation accumulated in an extensive basin situated west of Milne Inlet where Arctic Bay sediments were deposited as the basinward, fine clastic equivalent of the outer portions of the Fabricius Fiord fan complexes (Fig. 11.6 and 11.7). The prograding fans deposited shallow subtidal proximal basin fringes of sand-silt mud (AB$_1$, AB$_2$ members) and deep subtidal, thick distal basin, blanket deposits of fine silt and mud (AB$_3$ member). Progressive filling of this basin resulted in a shallowing trend and eventually in carbonate deposition in thin stromatolitic mounds (AB$_4$ west). This shallowing trend continued into Society Cliffs depositional time.

In the Tay Sound-Paquet Bay region, the Milne Inlet Trough appears to have been more restricted and tectonically active. Northwest-southeast trending faulted margins may have confined deposition to a narrow basin (Fig. 11.7). The abundance of thick, coarse sand bodies hints at rapid deposition rates perhaps influenced by tectonic activity along the White Bay and Tikerakdjuak Fault Zones. The smaller eastern basin remained shallow throughout most of Arctic Bay time, with sediments accumulating in deltaic-intertidal (AB$_1$, AB$_2$ east), to intertidal-shallow subtidal (AB$_3$, AB$_4$ east) environments. This clastic- and carbonate-dominated small basin retained its relatively restricted and shallowing character into Society Cliffs depositional time.

Society Cliffs Formation

The carbonate-rich Society Cliffs Formation extends from Alfa River valley, eastwards into Pacquet Bay area. It is divisible, in the study area, into a lower SC$_1$ member of brownish grey alternating subarkose, quartzarenite, shale and stromatolitic dolostone, and an upper SC_2 member of grey stromatolitic to massive dolostone. Interbedded red, green and grey shale, siltstone and quartzarenite appear cyclically throughout the SC_1 member east of Tay Sound. Minor lithologies include dolostone-clast flat pebble conglomerate and breccia, and black to grey, thinly bedded to nodular chert. To the west, in the Arctic Bay – Nanisivik region, the Society Cliffs has not yet been subdivided (Jackson et al., 1978), and is equivalent to both members of the present study.

The thickness of this formation averages 580 m at localities 1 and 6A. The overlying contact with the Victor Bay Formation is typically poorly exposed, but appears conformable. The beds commonly contain synaeresis and desiccation cracks, molar tooth and small teepee structures, medium to large symmetrical wave ripple marks, small load casts and scoured beds. Small vugs lined by calcite, dolomite and quartz crystals are found in the more massive dolostones. Some of the carbonate rocks emit a strong petroliferous odour.

SC_1 member

West of Tay Sound. This member contains cyclically arranged beds. Cycles in the lower part of the member have a lower subunit composed of pebbly subarkose, subarkose and quartzarenite beds, 1 to 2 m thick, as well as thinly bedded dolostone, dololutite and shale. These grade upward into upper subunits of medium- to thick-bedded, planar stromatolitic dolostone with flat pebble conglomerate and breccia. The rocks have brownish grey weathered surfaces, and light grey fresh surfaces. Lower subunits range in thickness from 3 to 12 m; upper subunits are 4.5 to 6 m thick. The subarkose and quartzarenite contain graded beds and medium to very large scale planar-crossbeds which are up to 1.2 m thick. Dispersal patterns from these crossbeds indicate current deposition from the south and southeast.

The upper part of this member consists of vague cycles of interlayered, thinly bedded dolostone and shale, which grade up into thick bedded stromatolitic dolostone. The stromatolites include both planar and laterally linked low domal forms, and are disrupted by beds of flat pebble conglomerate and breccia.

The member averages 105 m thick, and passes gradationally into the overlying SC_2 beds.

East of Tay Sound. The SC_1 member thickens eastwards, where it contains much more clastic material, including at least eight redbed sequences. These consist of alternating, thinly bedded, planar shale, argillaceous to sandy siltstone, minor argillaceous quartzarenite and dolostone. The rocks range from dark reddish purple and pink to dark green. The redbeds range in thickness from 10 to 30 m. Interspersed are sequences of thin bedded interlayered grey shale, dololutite and stromatolitic dolostone 2 to 18 m thick. There are also several 3 to 5 m-thick massive beds of yellowish brown, coarse grained to pebbly quartzarenite and sublitharenite and scattered thinly bedded, granite-bearing grit bands. The planar to domal stromatolitic dolostone includes some thin beds of chert and lenses of gypsum. The member averages 460 m in thickness.

SC_2 member

This member consists mainly of medium- to thick-bedded, stromatolitic dolostone and more massive, vuggy dolostone. The beds have light grey to medium grey weathered and fresh surfaces. To the west of Tay Sound the member is more than 305 m thick at locality 1 (Fig. 11.2). However, east of Tay Sound it thins to less than 185 m at locality 6A where thin interlayers of red siltstone and quartzarenite occur in the lower parts of the member. Stromatolites in the dolostone are of several forms including hemispherical to chevron-laminated domes ranging from 0.2 to over 1 m in height, planar and low domal forms, and short unbranching columnar forms 5 to 15 cm high.

Interpretation

The basin shallowing trend initiated during late Victor Bay time continued into the early depositional history of the Society Cliffs Formation. West of present day Tremblay Sound, carbonate shelf deposition commenced with the formation of extensive algal mats within a shallow subtidal to intertidal environment. East of Tremblay Sound, the clastic deposition that had periodically disrupted earlier VB sediments continued into Society Cliffs depositional time. These clastic influxes may have been tectonically induced, perhaps by faulting along the White Bay and Tikerakdjuak fault zones. Clastic deposition for most of the eastern Society Cliffs took place within supratidal and intertidal environments and to a lesser extent within fluvial influenced environments. These were replaced later on by carbonate deposition in shallow subtidal environments as the major basin water spread into this semirestricted eastern arm.

Structural Notes

Major faults, such as the Central Borden Fault Zone, may have originated in late Aphebian time and been reactivated in the Neohelikian (Jackson et al., 1978). Faulting along or near the Central Borden Fault Zone during deposition of the Fabricius Fiord Formation influenced the nature of the sediments and the sites of maximum sediment accumulation. This in turn affected the sedimentation patterns of the Arctic Bay Formation to the north. Syndepositional faulting appears to be responsible for the increased clastic content of the Arctic Bay and Society Cliffs formations east of Milne Inlet. Most faults in the study area, however, appear to have formed after Neohelikian sedimentation and both before and after deposition of Paleozoic strata.

The formations are subhorizontal to gently dipping over most of the map area. Dips increase substantially toward the margins of the fault zones. In the Fabricius Fiord Formation dips of 20° to 30° are found in the downfaulted portions along the Central Borden Fault. In the Tay Sound – Paquet Bay region, steeply dipping beds were found at localities 5, 6A and 7. Here, along the Tikerakdjuak Fault zones, beds in the Adams Sound and Arctic Bay formations have dips of 20° to 30°. Northwards, at the margin of the White Bay Fault Zone, beds of the Adams Sound, Arctic Bay and Society Cliffs formations are more steeply dipping, in the range of 40° to 60°. In these areas some of the beds are tightly folded into moderately plunging anticlines and synclines. Elsewhere, between the major fault zones, the beds are gently folded into broad anticlines and synclines. Within the SC_1 member, at locality 7, a single 5 m unit of shale, siltstone and dolostone displays tight, plastically deformed recumbent folds. The overlying and underlying beds, however, are planar and not deformed.

Hadrynian, Franklin diabase dykes intrude the Neohelikian strata. Widths in excess of 60 m and lengths of over 40 km are common. These dykes trend northwest; emplacement was, at least in part, controlled by the pre-existing fault planes. In areas of intensive intrusion, the Neohelikian strata have been upwarped and folded [illegible] dyke margins. The dykes are near vertical and form resistant ridges which commonly protect fringes of less resistant beds from erosion.

Acknowledgments

Excellent assistance in the field was provided by Reid Myles of the University of Western Ontario. The author is also indebted to the Polar Continental Shelf Project which supplied logistical support. G.D. Jackson, G.M. Young and K.E. Eade critically read the manuscript and contributed valuable geological discussions.

References

Blackadar, R.G.
1970: Precambrian geology, northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 191, 89 p.

Geldsetzer, H.
1973: The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, p. 99-126.

Grabeau, A.W.
1904: On the classification of sedimentary rocks; American Geological Journal, v. 33, p. 228-247.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 7[illegible]-75, 33 p.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J.
1978: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Larsen, V. and Steel, R.J.
1978: The sedimentary history of a debris-flow dominated, Devonian alluvial fan – a study of textural inversion; Sedimentology, v. 25, p. 37-60.

Lemon, R.R.H. and Blackadar, R.G.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Normark, W.R.
1978: Fan valleys, channels, and depositional lobes on modern submarine fans: characters for recognition of sandy turbidite environments; American Association of Petroleum Geology Bulletin, v. 62, p. 911-931.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; University of British Columbia, unpublished Ph.D. thesis, 371 p.

Pettijohn, F.J.
1975: Sedimentary rocks, 3rd edition; Harper & Row Publishers, 628 p.

46.

RIFT-RELATED LATE PROTEROZOIC SEDIMENTATION AND VOLCANISM ON NORTHERN BAFFIN AND BYLOT ISLANDS, DISTRICT OF FRANKLIN

Project 770013

G.D. Jackson, T.R. Iannelli[1] and B.J. Tilley[2]
Precambrian Geology Division

Jackson, G.D., Iannelli, T.R., and Tilley, B.J., Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin, in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 319-328, 1980.

Abstract

More than 5600 m of late Proterozoic quartzarenites, shales, stromatolitic and biohermal carbonates, arkoses, greywackes and conglomerates, were deposited in environments ranging from fluvial to subtidal on northern Baffin and Bylot islands. A delta-fan complex occurs in the lower part of the succession, coastal sabkha-type evaporites in the middle part, and an alluvial fan complex in the upper part. As much as 80 m of tholeiitic plateau basalts occur near the base of the succession.

Syndepositional faulting had a significant effect on the sedimentation pattern. Paleocurrent trends are varied, but most indicate northwesterly transport in central graben areas and in some horst areas. Transport away from fault zones active during sedimentation and toward central graben areas, is indicated in marginal trough areas. Rifting was probably related to a late Proterozoic ocean opening event to the northwest; perhaps an early phase of the Franklinian Geosyncline.

Introduction

The 1979 field season was the third on the project and the second in which a full-sized party was active. The major goals of the project continue to be the study of the several thousand metres of strata present in the Eqalulik and Uluksan groups. Early work is well documented by Lemon and Blackadar (1963) and by Blackadar (1970). More recent studies include those by Galley (1978), Geldsetzer (1973a, b), Iannelli (1979), Jackson and Davidson (1975), Jackson et al. (1975, 1978), and Olson 1977).

About 19 400 km^2 (7500 sq. miles) remained to be examined in 1979 during a 2 1/2 month field season (48 D, eastern two-thirds of 48 A, northern 37 G, western 38 B, northern 38 C). Because of poor weather relatively little work was carried out on the basement gneisses, and several large patches of late Proterozoic strata on northern Borden Peninsula and Bylot Island remain to be studied (Fig. 46.1, 46.2).

A Bell 206 B helicopter from Aerotrades Ltd. was used by the 9-man party headed by G.D. Jackson, and also provided support for W.F. Fahrig and K. Christie in their paleomagnetic studies. Excellent Twin Otter support was provided periodically by Polar Continental Shelf Project.

This preliminary report for the most part summarizes data gathered during the 1979 field season. Most of the work in the Eqalulik Group and the overlying Arctic Bay Formation was carried out by Iannelli (Contract No. 95704) who is responsible for those rocks in this report (Table of Formations). Jackson and Tilley worked chiefly in the Uluksan Group. Tilley provided a résumé of her work and a preliminary draft of the paleocurrent diagrams (Fig. 46.1, 46.2).

Basement Complex

A variable complex assemblage of Archean-Aphebian gneisses and igneous rocks is separated from the overlying late Proterozoic strata by a nonconformity. Most of the gneisses are irregularly banded migmatites which are commonly intruded by two or more generations of granitic rocks. Upper amphibolite metamorphic grade predominates but granulite grade occurs in several places and seems to have superseded late granitic emplacement.

Regolithic material up to 6 m thick is preserved beneath the Proterozoic strata at several localities. Basement rocks grade upward into poorly consolidated varicoloured rocks containing kaolinized feldspar, granular quartz and fine chlorite-sericite matrix and partings. The contact with overlying Nauyat and Adams Sound strata is undulatory and disconformable.

Nauyat Formation

The Nauyat Formation outcrops chiefly from south of Adams Sound southeast to south of Tremblay Sound (Fig. 46.1), east of Elwin Inlet and on northern Bylot Island. It is the basal formation of the late Proterozoic succession, nonconformably overlies the basement complex, ranges from 16 to over 95 m thick, and has been divided informally into two conformable members, N_1 and N_2 (Jackson et al., 1978).

Rb-Sr and K-Ar ages recently completed by the Geochronology Section of the Geological Survey of Canada range from 762 to 1966 Ma. Preliminary considerations of the results suggest that an age of 917 ± 32 Ma is most likely for the formation.

N_1 Member

The lower (N_1) member consists chiefly of thin- to medium-bedded, grey-white to pink, dark red, buff and brown quartzarenite. Thin layers of quartz-granule to quartz-pebble conglomerate occur as basal units of fining upward cycles in the lower part of the member. Sedimentary structures include trough- and planar-crossbeds, wave and current ripple marks, load casts, and synaeresis cracks. Crossbeds indicate unimodal northwesterly paleocurrent trends. The member ranges from 8 to 20 m in thickness.

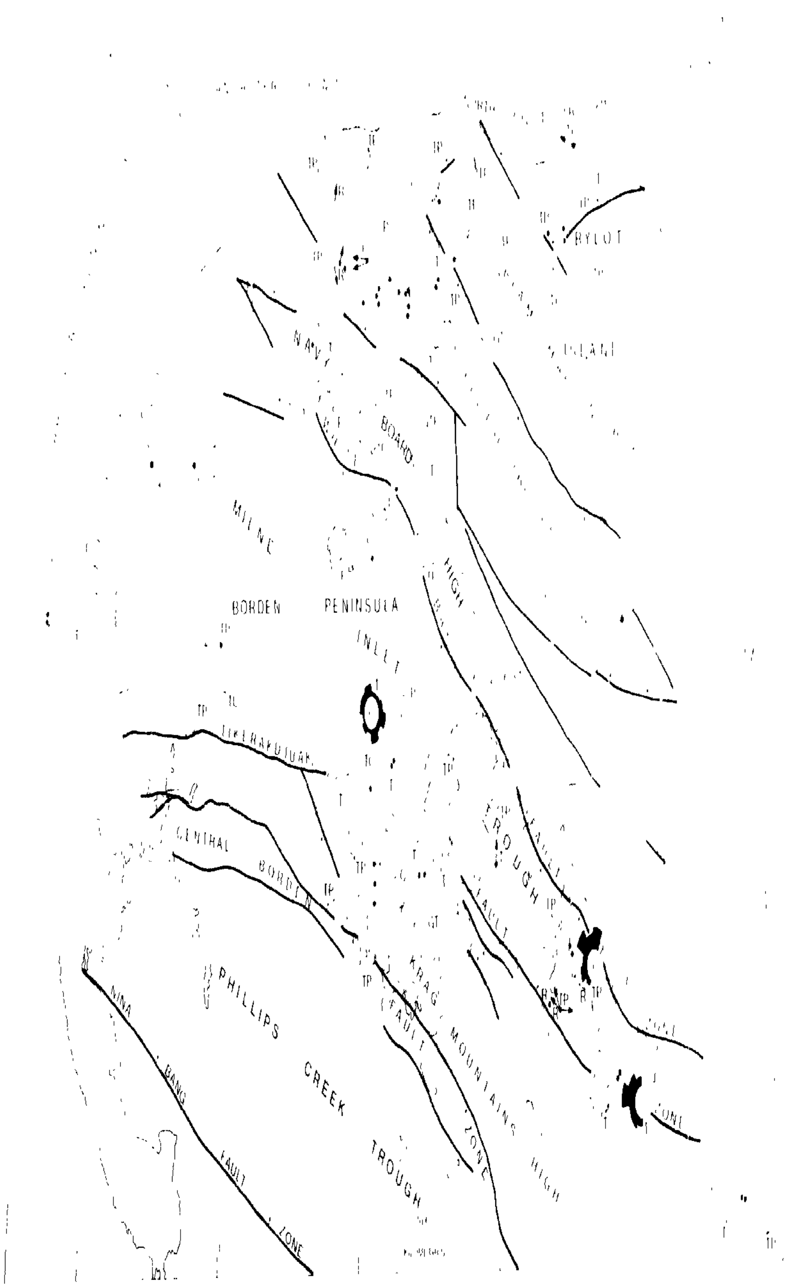
N_2 Member

Nauyat volcanics overlie basement gneisses nonconformably where the N_1 member is absent. The flows occur in a single sequence containing 1 to 5 flows of fine grained, massive, amygdaloidal tholeiitic plateau basalt with alkalic affinities (Galley, 1978; Jackson et al., 1978). Some layers on northern Bylot Island are fine- to medium-grained, olive green, ultramafic, and may be ultrabasic sills. Thin, baked quartzarenite, siltstone, dolosiltite and chert beds are interbedded with the flows locally.

---

[1] Department of Geology, University of Western Ontario, London, Ontario, N6A 5B7

[2] Alberta Research Council, 11315 - 87th Avenue, Edmonton, Alberta, T6G 2C2


BYLOT
ISLAND
NAVY
BOARD
MILNE
BORDEN
PENINSULA
INLET
HIGH
TIKERAKDJUAK
CENTRAL
BORDER
TROUGH
FAULT
NINA
BANG
FAULT
ZONE
PHILLIPS
CREEK
TROUGH
KRAG
FAULT
MOUNTAINS
ZONE
HIGH
ZONE
TP
T

The flows contain amygdules filled with quartz, agate, calcite, and dolomite. Columnar joints and flow banding occur locally. Small pillows occur south and southwest of Tremblay Sound. Individual flows range from 2.5 to 20 m thick. The sequence thickens to the northwest, ranging from 8 to 16 m thick near the Central Borden Fault zone to over 85 m thick east of Elwin Inlet.

Interpretation

Deposition of N$_1$ quartzarenite in a braided fluvial environment was interrupted by extrusion of chiefly subaerial basalt. Continued sedimentation buried the flows before they could be eroded. The flows are spatially related to major fault zones and were probably extruded along them.

Adams Sound Formation

Adams Sound strata are exposed along the southern edge of the study area, east of Elwin Inlet, and on northwestern Bylot Island. The formation consists chiefly of thin- to thick-bedded quartzarenite with minor shale and siltstone. Quartz-pebble conglomerate occurs mostly in the lower and upper parts of the formation. Sedimentary structures include trough- and planar-crossbeds (Fig. 46.1), current ripple marks, scours, channels, load casts, graded beds, synaeresis and dessication cracks, microfaults and small vugs. Pyrite and marcasite occur locally.

The formation is about 65 m thick from Tremblay Sound east to Paquet Bay and 340 m thick on northwest Bylot Island. It thickens toward the north and northwest. Adams Sound Formation is conformable with the Nauyat Formation and rests conformably on basement gneisses where the Nauyat is absent. The contact with the overlying Arctic Bay Formation is gradational. The Adams Sound Formation has been divided into three intergradational members on Borden Peninsula (AS$_1$, AS$_2$, AS$_3$), two members in the Paquet Bay area (AS$_4$, AS$_5$) and into a lower and upper member (AS$_L$, AS$_U$) on Bylot Island (Jackson and Davidson, 1975).

AS$_1$ Member

This member is mostly pink, purple-red to cream-brown quartzarenite with pebble- to cobble-polymictic conglomerate interbeds at the base of fining upward cycles. Paleocurrent trends are unimodal and northwest to northeast (Fig. 46.1). Thicknesses range from 8 to 16 m near Tremblay Sound to over 30 m east of Elwin Inlet.

AS$_2$ Member

AS$_2$ strata are chiefly buff-white, pink-white to purple-grey quartzarenites that contain fining upward cycles. Unimodal northwest to northeast paleocurrent trends predominate. Southeast trends are less common. The member is 33 m thick at Tremblay Sound and over 100 m thick east of Elwin Inlet.

Figure 46.1. *Location map and rose diagrams showing crossbed measurements. The radius of the centre circle is 20 per cent. Single determinations are indicated by a straight line or arrow.*

- *Adams Sound Formation*
- *Arctic Bay Formation*
- *Fabricius Fiord Formation*
- *Society Cliffs Formation*
- *Victor Bay Formation*
- *Athole Point Formation*
- *Strathcona Sound Formation*
- *Elwin Formation*

C - channels
F - flutes
G - giant trough crossbeds
I - imbricate clasts
P - planar crossbeds
R - ripple marks
S - stromatolite elongations
T - trough crossbeds

AS$_3$ Member

White and grey to grey-brown quartzarenite with interbeds and lenses of pebbly quartzarenite and quartz-pebble conglomerate dominate the AS$_3$ member. Minor shale and siltstone interbeds occur in the uppermost part. Fining upward cycles occur in some sections. Most paleocurrent trends are polymodal to bimodal, although some are unimodal northwest to northeast. The member is 16 m thick near Tremblay Sound and over 75 m thick east of Elwin Inlet.

AS$_4$, AS$_5$ Members (see Iannelli, 1979)

These strata are grey-white to buff-grey quartzarenite. Minor quartz-pebble conglomerate occurs chiefly at the base. Paleocurrents are unimodal and trend north-northwest. These strata are 45-65 m thick in the Paquet Bay area.

AS$_L$ Member

The AS$_L$ member is chiefly pink, buff-orange to purple-red quartzarenite with interbeds of pebbly quartzarenite and pebble conglomerate. Siltstone and shale beds occur in the upper part. Poorly defined fining upward cycles are present. Bipolar-bimodal northwest and southeast trending paleocurrents predominate. Polymodal trends and northwest to southwest unimodal trends occur locally. Thicknesses of 88 to over 200 m occur on northern Bylot Island, but the member is absent locally on central western Bylot Island.

AS$_U$ Member

This member is composed of buff-grey, white to pink-grey quartzarenite with thin interlayers of siltstone, and quartz-pebble conglomerate. Fining upward cycles are seen in some sections. Paleocurrent trends are unimodal to the northwest and bimodal southwest to west. Thicknesses range from over 79 m on central west Bylot Island to 140 m on northeast and 196 m on northwest Bylot Island.

Interpretation

During early Adams Sound time braided fluvial sediments were deposited in the southern and southeastern parts of the map area, whereas mixed fluvial and intertidal sediments were deposited in the northern part. Regional basin transgression ended this fluvial deposition, which was followed by intertidal to shallow subtidal deposition.

Arctic Bay Formation

The Arctic Bay Formation outcrops in the same general areas as does the Society Cliffs Formation. The strata are chiefly laminated shale and thin- to medium-bedded siltstone, quartzarenite, dolosiltite, doloarenite and stromatolitic dolostone. Structures include cone-in-cone, concretions, soft sediment folds, load casts, microfaults, convoluted beds, wave and current ripples, trough- and planar-crossbeds, scours, rip-up clasts, synaeresis and dessication cracks, dewatering structures, and vugs filled with carbonate, quartz, and bituminous material. White gypsum efflorescence is common on the shales. Some beds emit a strong petroliferous odour and others contain disseminated pyrite and marcasite.

The Arctic Bay Formation exceeds 260 m in thickness west of Tremblay Sound, and 600 m east of Elwin Inlet. It is 466 m thick at the head of Tremblay Sound and is more than 414 m thick west of Tay Sound. The formation rests nonconformably on basement gneisses at several places. The contact with the overlying Society Cliffs Formation ranges from conformable to erosional. Four intergradational and regionally variable members have been identified (Iannelli, 1979).

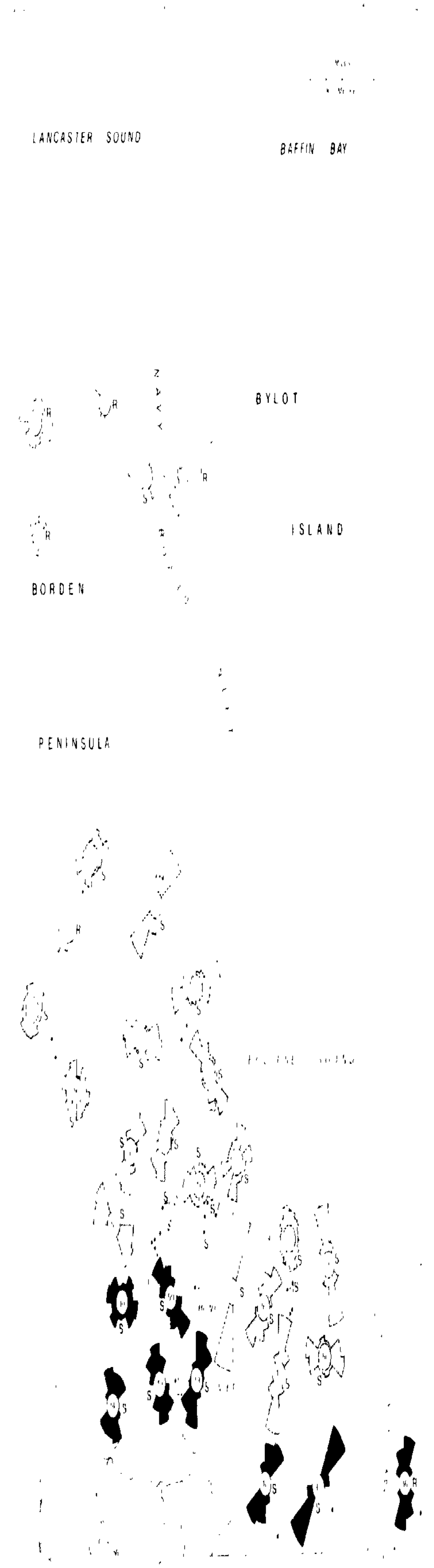


Figure 46.2. Rose diagrams showing measurements for ripplemarks and stromatolites. See Figure 46.1 for legend.

TABLE OF FORMATIONS

HADRYNIAN		Franklin Intrusions: Diabase	
		Intrusive Contact	
	ULUKSAN GROUP	Elwin Fm. (700 m+): Siltstone, quartzarenite, siltstone	
		Gradational	
		Strathcona Sound Fm. (870 m+): Arkose, conglomerate, shale, greywacke	
		Gradational	
		Athole Point Fm. (585 m): Limestone, sandstone, shale	
		Gradational	Gradational to unconformable
		Victor Bay Fm. (724 m):	VB_2: Limestone, dolostone, flat pebble conglomerate Vb_1: Shale, siltstone, sandstone
		Gradational?	
		Society Cliffs Fm. (825 m+):	SC_2: Stromatolitic and massive dolostone
		Unconformable	
		Fabricius Fiord Fm. (1500 m+) FF_4: Conglomerate, dolostone	SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
			Gradational to unconformable
		FF_3: Subarkose FF_2: Shale, quartzarenite FF_1: Sandstone, shale	Arctic Bay Fm. (600 m) AB_4: Shale, dolostone AB_3: Shale AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
NEOHELIKIAN?		Gradational	
	EQALULIK GROUP	Adams Sound Fm. (340 m): AS_3: Quartzarenite, conglomerate AS_2: Quartzarenite AS_1: Quartzarenite	$AS_{4,5}$: Quartzarenite, conglomerate AS_U: Quartzarenite AS_L: Quartzarenite, conglomerate
		Conformable	
		Nauyat Fm. (90 m+)	N_1: Basalt N_2: Quartzarenite
		Nonconformity	
ARCHEAN-APHEBIAN		Granitic gneiss basement complex	

AB₁ Member

Throughout most of the area this member consists of interlayered green-grey siltstone and quartzarenite and pink-red or grey to white quartzarenite. At the southeast corner of the map area the member is composed of a basal quartz cobble conglomerate which grades up into interbedded purple-orange to brown-grey quartzarenite, subarkose, quartz feldspar pebble conglomerate and siltstone. Bimodal-bipolar northwest to southeast paleocurrent trends predominate. Polymodal trends also occur. Thicknesses range from 12 m southeast of Paquet Bay to 36 m west of Tremblay Sound and 15 m east of Elwin Inlet.

AB₂ Member

This member is composed of 5 to 15 coarsening upward cycles, up to 25 m thick each, which are shale dominated west of Milne Inlet and quartzarenite dominated east of Milne Inlet. The lower parts of the cycles are chiefly grey-black shale. The upper parts are green-grey, buff-white, and pink interlayered quartzarenite, subarkose, siltstone, dolostone, and quartz pebble-cobble conglomerate. Paleocurrents include unimodal southwest to northwest trends and polymodal patterns. Thicknesses west of Milne Inlet range from 150 to 261 m and to the east from 65 to more than 150 m.

AB₃ Member

This member comprises black to grey shale. Minor interlayers of dolosiltite, siltstone, and quartzarenite increase in amount of the south and southeast. However, the member increases in thickness from 200 m west of Tremblay Sound to 285 m on the west side of Milne Inlet and more than 400 m east of Elwin Inlet.

AB₄ Member

West of Milne Inlet this member consists chiefly of black grey shale with thin interbeds of buff-grey to orange-brown siltstone, dolosiltite, stromatolitic dolostone and limestone. Locally, the top 10 m is stromatolitic dolostone. The stromatolites include planar, small mounds, and branching columnar types. Mound and stromatolite elongations indicate paleocurrent trends ranging from northwest southeast to north, northeast to south and southwest. The member contains more that 112 m on the west side of Milne Inlet. It is 152 m thick at the head of Tremblay Sound, 25 m thick just west of it, and 132 m about 50 km northwest of the head of the Sound. More than 30 m occur east of Elwin Inlet.

East of Milne Inlet the AB₄ member constitutes most of the Arctic Bay Formation. It consists chiefly of over 30, 3-15 m thick, coarsening up cycles whose lower parts are composed of black-grey shale which grades into the upper part composed of interbedded green-grey and orange-buff to brown siltstone, quartzarenite, dolosiltite, stromatolitic dolostone and flat pebble conglomerate. Coarsening-upward arkose-rich wedges or fans occur along the White Bay Fault Zone. Elongate stromatolites indicate northeast to southwest paleocurrent trends. The AB₄ member is over 130 m thick in the Tay Sound area and may be 414 m thick between Tay Sound and Milne Inlet.

Interpretation

Basin transgression initiated in late Adams Sound time continued throughout most of Arctic Bay time. Deposition west of Milne Inlet was under mixed intertidal and subtidal environments. East of Milne Inlet alluvial and delta fans accumulated adjacent to active fault zones and interfingered basinward with alluvial plain and intertidal sediments.

Fabricius Fiord Formation

Fabricius Fiord strata outcrop locally north of the Central Borden Fault Zone. Similar strata outcrop locally south of the White Bay Fault Zone west of Eclipse Sound. Only two of the four subdivisions were examined in 1979.

FF₂ strata consist of about 12 coarsening up cycles in which black-grey shale grades up into interlayered siltstone, and quartzarenite. The FF₂ member grades up into FF₃ interbedded quartzarenite, subarkose and conglomerate which contain trough-crossbeds, current ripples, and synaeresis cracks. Three-metre high crossbeds southwest of Milne Inlet indicate southwest transport. Incomplete sections range from 30 to more than 100 m thick.

Interpretation

The FF₂ and FF₃ strata were deposited in marine influenced delta fan complexes that prograded northward. These strata pass laterally northward into AB₂ to AB₄ basinward facies equivalents.

Society Cliffs Formation

Society Cliffs strata outcrop in a belt from Adams and Strathcona sounds southeast to Tremblay Sound and Paquet Bay. They also outcrop west of southern Navy Board Inlet, east and southeast of Elwin Inlet, and on western and northern Bylot Island. In all of these areas, except for the first-mentioned belt, it is difficult to differentiate Society Cliffs from Victor Bay strata because of the general absence of the lower Victor Bay member (VB₁). Therefore, total thicknesses at these localities are for strata between the Arctic Bay and Strathcona Sound formations.

Laminated to thin bedded, commonly stromatolitic and thick bedded to massive (faintly internally bedded) dolostones predominate in units up to 40 m thick. Thin, flat pebble conglomerate beds are common. Most stromatolites are individual to laterally linked low domal and hemispheroidal types, and columnar types are also present. Cryptalgal laminites are abundant. Bioherms of various sizes are common and varieties 30 to 60 m across are locally abundant. Most elongations of stromatolites and bioherms indicate northeast to southwest paleocurrent trends. Chert has commonly replaced the carbonate rocks and is particularly abundant on Bylot Island where red varieties are common, and east of Milne Inlet where brown and black varieties are common. Dolomitization and brecciation has obscured primary structures in much of the rock. Petroliferous odours and specks of black bituminous material are common. Disseminated pyrite occurs locally. Sedimentary structures include tepees, molar tooth, wave ripple marks, synaeresis and dessication cracks, convoluted to disrupted beds, dewatering structures, load casts, scours, local unconformities, soft sediment deformation, vugs, and microfaults.

The Society Cliffs Formation is about 665 m thick at the head of Tremblay Sound. Partial sections indicate thicknesses of 825 m near the mouth of Tremblay Sound, 345 m east of Milne Inlet, 450 m thick east of Elwin Inlet, and about 750 m on western Bylot Island. The formation is conformable with the overlying Victor Bay Formation. Two members have been differentiated.

SC₁ Member

West of Milne Inlet a 10 to 15 m thick lower unit contains pebbly calcareous quartzarenite to sublitharenite interlayered with stromatolitic dolostone, limestone, and flat pebble conglomerate. This unit is overlain by two 120 m thick internally cyclic shallowing upward sequences containing shale, brown-grey stromatolitic dolostone and flat pebble conglomerate or breccia. This member thins abruptly northwestward and ranges from 165 to more than 315 m in the vicinity of Tremblay Sound, to 45 m west of Tremblay Sound, and 15 m east of Elwin Inlet.

East of Milne Inlet and on Bylot Island the SC_1 member is relatively thick due to the presence of black shale and redbed sequences interbedded with grey to brown-grey, black-grey, green-grey and pale pink dolostones. The shaly units contain interbedded purple to red, green, black, brown and grey shale, dolostone, calcareous quartzarenite and subarkose. A few white gypsum beds occur east of Milne Inlet and are extensively developed on Bylot Island. The gypsum rarely occurs in beds more than 1 m thick. At one locality on western Bylot Island gypsum is abundant throughout the lower 240 m of the formation and occurs interbedded with shales and dolostones in units up to 40 m thick. Salt casts occur locally. East of Milne Inlet measured thicknesses, most incomplete, range from 75 to 155 m. On western Bylot Island the gypsiferous zone, which may contain as much as 20 per cent gypsum, is over 240 m thick and the SC_1 member may be at least 380 feet thick.

SC_2 Member

This member consists chiefly of grey to brown-grey dolostones as already described for the formation. Beds of red and green shale, siltstone and arkose, occur throughout the member on Bylot Island and in the Tay Sound area, and are accompanied by hematite staining of the associated strata. About 250 m are present in the Tay Sound area. Elsewhere, incomplete sections indicate thicknesses of 665 m west of Milne Inlet, 370 m on western Bylot Island and west of Tremblay Sound, and 450 m east of Elwin Inlet.

Interpretation

West of Milne Inlet the formation was deposited in shallow subtidal to intertidal environments, whereas to the east of the inlet and on Bylot Island it originated in an environment that varied from alluvial plain to shallow subtidal. The gypsiferous units probably represent coastal sabkha evaporites.

Victor Bay Formation

The Victor Bay Formation outcrops in the same general areas as the Society Cliffs Formation. It is about 460 to 640 m thick 50 m northwest of Tremblay Sound, 724 m east of Milne Inlet, and 423 m west of southern Navy Board Inlet. It is divisible into two members in the southern part of the area. The lower member (VB_1) is absent west of Eclipse Sound and in most of the northern part of the area. In these localities it is very difficult to separate the SC_2 from the VB_2 member.

VB_1 Member

Grey to black and brownish grey laminated to very thin bedded shale, calcareous to dolomitic shale, siltstone, dololutite and dolosiltite predominate in this member. Minor graphitic shale, quartzwacke, quartzarenite and subarkose, flat pebble carbonate conglomerate and pyrite laminae, occur locally. Scour channels, soft sediment deformation, crossbeds, ripple marks, synaeresis cracks; and molar tooth, load, and ball and pillow structures are rare.

The VB_1 member is 170 to 370 m thick 50 km northwest of Tremblay Sound, 100 to 140 m 15 km west of Tremblay Sound, 15 m along northern Tremblay Sound, 120 m west of Eclipse Sound and 44 m east of Milne Inlet.

VB_2 Member

This member is composed of various light to dark grey and black limestone and dolostone lithologies that occur in 1 to 20 m thick units (rarely as thick as [illegible] m). East of Milne Inlet, for example, the lower [illegible] m are chiefly limestones, the upper 260 m are chiefly dolomites, and the middle [illegible] m contain both. Petroliferous odours are most common in the limestone. Major lithologies are flat pebble breccia conglomerate, laminated to very thick bedded carbonate, stromatolitic carbonate, cryptalgal laminites, lumpy bedded carbonate, evenly nodular carbonate, and vuggy carbonate. Minor round clast conglomerate, "turbidite" units, oolite and replacement chert, are common. Lenses of quartzarenite, quartzwacke and subarkose occur locally.

Stromatolites occur individually and in bioherms up to 1.5 km in length. Individual and laterally linked hemispheroidal and columnar and digitate columnar types are the most common. Hemispheroidal stromatolites are elongated in predominantly east-west to northeast-southwest directions at several localities (Fig. [illegible]). Other common structures are molar tooth, tepees, tipups, [illegible], scour channels, synaeresis and desiccation cracks, load casts, convoluted beds, soft sediment folds, dewatering structures, birds eye structures, ripple marks, crossbeds, and microfaults.

Thickness for the VB_2 member are: about [illegible] m [illegible] west of Tremblay Sound, [illegible] m 15 km west of Tremblay Sound, 680 m east of Milne Inlet, [illegible] m west of Eclipse Sound and [illegible] m east of Elwin Inlet. VB_1 and VB_2 members are conformable and interfinger at most localities. However, a local disconformity may occur at the contact [illegible] of Tremblay Sound where 15 m of round clast [illegible] conglomerate occurs at the base of VB_2.

Interpretation

Most of the VB_1 member was probably deposited under subtidal conditions. Influx of fine terrigenous clastic material probably prevented algal growth. The upper (VB_2) member was probably deposited under shallow subtidal to intertidal conditions.

Athole Point Formation

Athole Point Formation outcrops from east of Milne Inlet to about 50 km northeast of Tremblay Sound. Medium to dark grey and black laminated to medium bedded limestones, cryptalgal laminite and stromatolitic limestone predominate in units [illegible] to 50 m thick. Minor lithologies include lumpy bedded carbonates and flat pebble and round clast conglomerates. At least one "debris flow" carbonate breccia bed occurs near the base of the formation east of Milne Inlet. Orange-weathered 1 to 15 [illegible] carbonate beds occur sporadically throughout the formation. Stromatolites other than planar types are relatively uncommon, but include low domed hemispheroidal and small columnar types as well as bioherms. Carbonate cemented sandstone, quartzarenite, sublitharenite, subarkose, shale, siltstone, and flat-pebble conglomerate occur chiefly in the upper part of the formation in fining upward turbidite sequences, and become increasingly abundant northeastward. Observed structures include graded beds, flute casts, load casts, flame structures, small scale crossbeds, synaeresis and dessication cracks, soft sediment deformation, channels, scours, birds eye structures, convoluted beds, molar tooth, tepees, concretionary structures, and microfaults. [illegible] crossbeds indicate west-northwesterly transport.

Athole Point Formation may be divided into a lower member containing abundant cryptalgal laminites and an upper member in which turbidite sequences are common. The formation is probably about 560-585 m thick in the vicinity of Milne Inlet and thins westward and abruptly northward. It is conformable with both the underlying Victor Bay and overlying Strathcona Sound Formation.

Interpretation

Most of the strata were probably deposited in intertidal to subtidal environments with relatively deep water lying to the south. The formation is considered to be the seaward equivalent of the lower and possible middle parts of the Strathcona Sound Formation with which it interfingers laterally.

Strathcona Sound Formation

This formation outcrops chiefly in a broad belt south of the White Bay Fault Zone west of Eclipse Sound. It also underlies small areas between Elwin Inlet and northern Navy Board Inlet and on western Bylot Island.

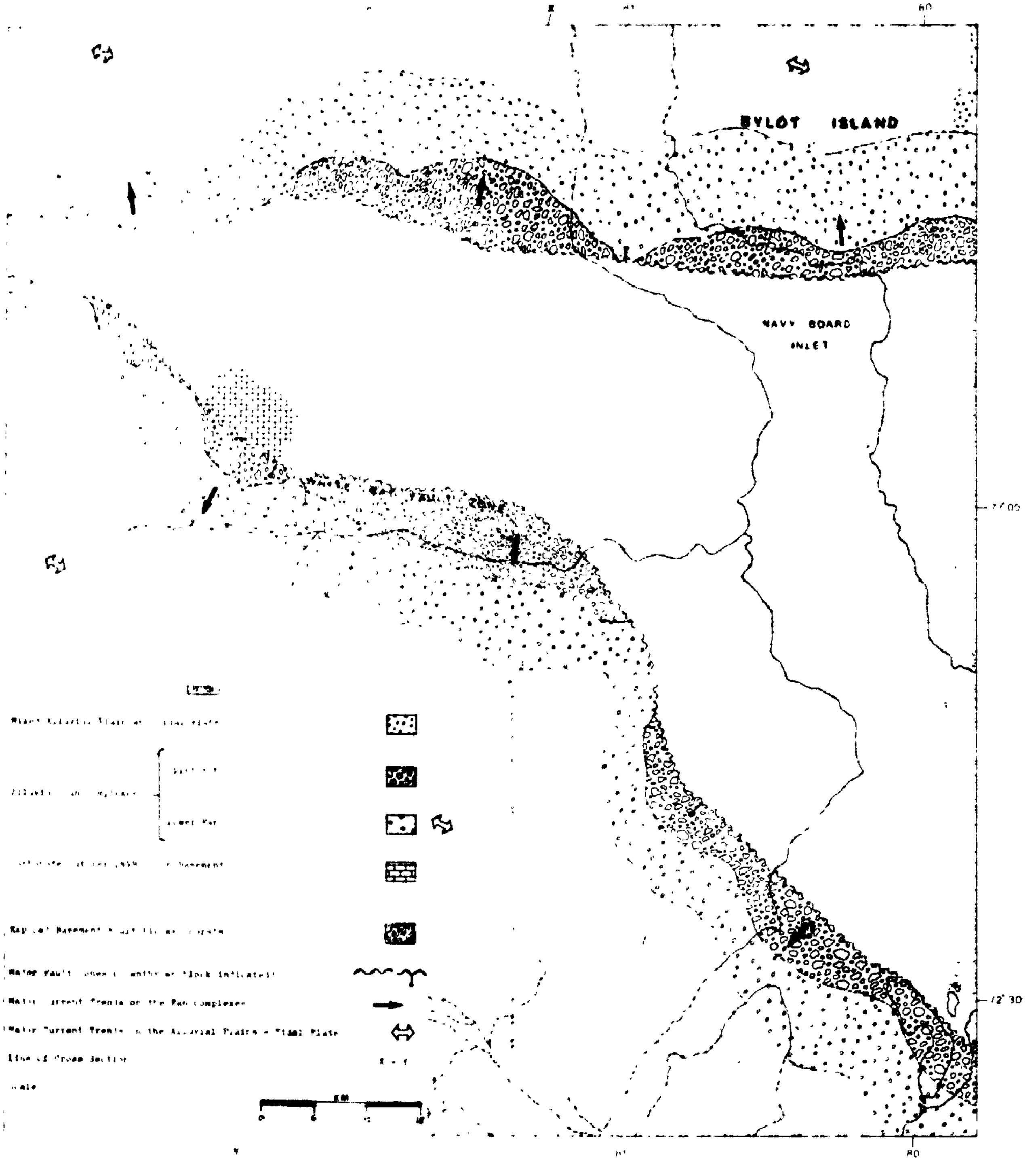


Figure 46.3. *Tentative reconstruction of facies distribution around basement fault blocks during the early depositonal history of the Strathcona Sound Formation.*

Most of the strata are laminated to thin bedded, although many are medium to very thick bedded. The various lithologies occur chiefly in alternating units from 1 to 20 m thick, but which range to more than 100 m thick. These units may contain a single lithology or may contain several interbedded lithologies. Fining upward sequences predominate. Sedimentary structures include graded bedding, trough, planar and herringbone crossbeds, ripple marks, imbricated clasts, soft sediment folds, slump features, convoluted and disrupted beds, scours, channels, flutes, synaeresis cracks, and microfaults.

Paleocurrent trends adjacent to and south of the White Bay Fault Zone are moderately unimodal and indicate chiefly southerly to westerly transport. North of the fault they range from unimodal to bimodal and polymodal, and indicate chiefly northerly to easterly transport west of Navy Board Inlet and southwesterly transport on western Bylot Island.

More than 110 m of grey interlayered siltstone, sandstone, fine calcareous clastics, and limestone form the basal member of the Strathcona Sound Formation about 50 km west of Eclipse Sound. This unit thins northward to about 40 m locally near the White Bay Fault Zone. It seems to be absent north of the fault zone. It represents a transition zone between the Victor Bay, Athole Point and Strathcona Sound sediments.

In the same region west of Eclipse Sound these strata are overlain by more than 400 m of grey, brown, green and chiefly red shale, siltstone, feldspathic wacke, and arkose. The sandstones commonly have a calcareous matrix. One or more beds or lenses of oligomictic angular clast carbonate breccia in the lower part of this member probably are debris flow breccias. These strata are overlain by grey-green, coarse calcareous feldspathic wacke and minor polymictic conglomerate.

Northward, adjacent to the White Bay Fault Zone, more than 870 m of Strathcona Sound strata are composed chiefly of red arkoses and polymictic conglomerates that contain carbonate clasts and clasts from the basement complex in varying proportions. Flat pebble conglomerate and oligomictic carbonate conglomerate clasts occur locally (Fig. 46.3, 46.4). The conglomerates are absent from the lower 170 m in some places but in others are interbedded throughout the formation. At one locality more than 186 m of chiefly oligomictic carbonate conglomerate rests directly on the Society Cliffs-Victor Bay Formation and contains clasts up to 10 m across. The upper part of the formation is chiefly conglomerate as described above.

Strathcona Sound strata west of northern Navy Board Inlet are similar to the strata west of Eclipse Sound above the basal grey siltstone member and includes a debris flow breccia in the lower part of the section. Bylot Island strata are also similar, but red arkose predominates in the basal part, and contains crossbeds more than 3 m high. Orange weathering, locally stromatolitic carbonate beds range up to 10 m thick and occur sparsely throughout the Bylot Island strata which are more than 365 m thick.

Interpretation

The boulder conglomerates and arkoses adjacent to the White Bay Fault Zone probably represent alluvial fan complexes that were deposited rapidly along an active fault (Fig. 46.3, 46.4). These deposits interfinger with the shales, siltstones and sandstones to the south, which represent alluvial plain and mixed alluvial and intertidal to shallow subtidal deposition. The alluvial deposits may include minor channel deposits.

Elwin Formation

These strata outcrop from northern Navy Board Inlet west to Elwin Inlet. In the east they consist chiefly of red to minor green arkose, siltstone and shale interbedded with buff sandstone, white quartzarenite and grey to buff and light red sandy to stromatolitic dolostone. Stromatolites include planar, low domal and hemispheroidal types. Some dolostone beds are brecciated at the top. The strata are laminated to medium bedded and occur in lithological units 1 to 20 m thick. Most of the redbed strata occur in sequences 5-130 m thick separated by 8-50 m thick sequences of grey to green strata. Both sequences are cyclic. Carbonate strata seem to decrease in abundance upward as well as toward the west, whereas the proportion of white quartzarenite and buff sandstone seems to increase westward. Frosted sand grains are common in the sandstones and dolostones.

Cycles within the redbed sequences are 2-40 m thick and commonly consist of lower arkose-shale that grades upward into dolostone. A less common cycle contains basal arkose that grades upward into quartzarenite which grades into dolostone. Shale may occur above or below the latter dolostone as part of the cycle. Cycles in the grey to green sequences include arkose or quartzarenite grading upward into siltstone or dolostone.

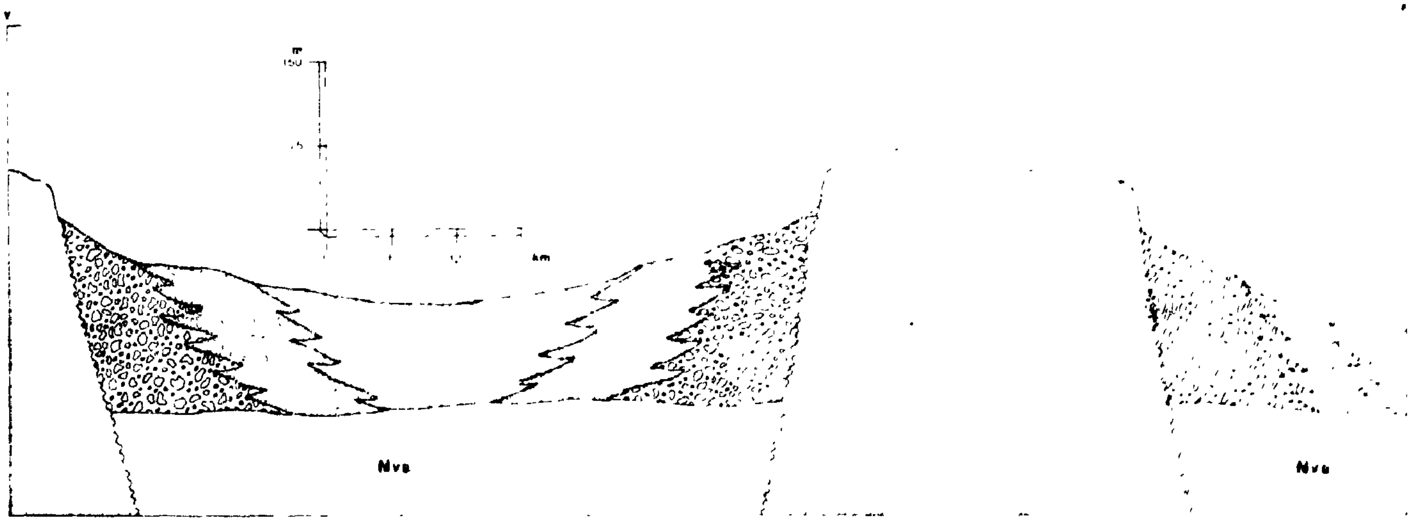


Figure 46.4. Cross-section along the line X-Y in Figure 46.3. Legend as in Figure 46.3.

Sedimentary structures include trough crossbeds (some 2 m), planar crossbeds, ripple marks, synaeresis and dessication cracks, local unconformities, microfaults, tepees, dewatering structures, birds eye structure, channels, stylolites, oolites and pisolites, shale chips and rip-up clasts, ball and pillows, flutes, soft sediment folds and convoluted beds. Crossbed measurements indicate unimodal to bimodal and weakly bipolar patterns which indicate chiefly westerly and northerly transport. Stromatolite and ripple measurement indicate chiefly east-west paleocurrents.

The Elwin Formation is at least 470 m thick on the west side of Navy Board Inlet. The lower contact with the Strathcona Sound Formatin is conformable and possibly gradational. A low-angle unconformity separates the Elwin from overlying Lower Paleozoic strata.

Interpretation

Most of the strata were probably deposited in locales that ranged from alluvial plain to intertidal. Some channel deposits are present and some aeolian deposits may be present in both the Elwin and Strathcona formations.

Notes

There is little evidence that Adams Sound deposition was significantly affected by contemporaneous faulting, although the association of Nauyat basalt with major fault zones suggests that some rifting had already occurred in early Adams Sound time. The onlap of Arctic Bay strata onto basement gneisses in the Tay Sound region supports this. Faulting was active during Arctic Bay sedimentation, at which time the effects of movement along the Central Borden Fault Zone were greater than for the White Bay Fault Zone. The reverse seems to have been true in Strathcona Sound time. Also, the Byam Martin Mountain High does not seem to have been significantly uplifted until late or post Society Cliffs time.

Paleocurrent measurements crudely outline portions of the Milne Inlet and Eclipse troughs. The facies changes in the Milne Inlet area, and the fact that the known westerly extent of Society Cliffs gypsiferous redbeds is a north-northwesterly trending line, suggest that some syndepositional faulting may have occurred in a north-south direction and that the Borden Peninsula component of the Navy Board High may have been an island. This is supported by a few paleocurrent measurements.

Acknowledgments

Excellent assistance in the field was provided by L.M. Cumming of the Geological Survey of Canada, Valerie Gislason of Toronto University, Leslie MacLaren of Queen's University, John McEwen of Atomic Energy of Canada Limited, and Beverlee McLean of Georgian College.

The authors are grateful to Polar Continental Shelf for their excellent logistical support. We are also grateful to John Rogers, Project Manager for Nanisivik Mines Ltd., and Lionel Thorpe, the company's geologist, for making maps and drill core available and for supporting a brief examination of mine geology.

References

Blackadar, R.G.
1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 191, 89 p.

Galley, A.
1973: The petrology and chemistry of the Nauyat Formation volcanics, Borden Peninsula, Northwestern Baffin Island; unpublished B.Sc. Thesis, Carleton University, 53 p.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in Ores in Sediments, G.C. Amstutz and A.J. Bernard, ed., Springer-Verlag, p. 115-127.

1973b: The tectono-sedimentary development of an algal dominated Helikian succession on northern Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, p. 99-126.

Iannelli, T.R.
1979: Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 45-56.

Jackson, G.D. and Davidson, A.
1975: Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29 12 p.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-75, 33 p.

Jackson, G.D., Iannelli, T.R., Narbonne, G.M. and Wallace, P.J.
1978: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Lemon, R.R.H. and Blackadar, R.G.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Olson, R.A.
1977: Geology and genesis of zinc lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; unpublished Ph.D. Thesis, University of British Columbia, 371 p.

NOTE TO CONTRIBUTORS

Submissions to the *Discussion* section of *Current Research* are welcome from both the staff of the Geological Survey and from the public. Discussions are limited to 6 double-spaced typewritten pages (about 1500 words) and are subject to review by the Chief Scientific Editor. Discussions are restricted to the scientific content of Geological Survey reports. General discussions concerning branch or government policy will not be accepted. Illustrations will be accepted only if, in the opinion of the editor, they are considered essential. In any case no redrafting will be undertaken and reproducible copy must accompany the original submissions. Discussion is limited to recent reports (not more than 2 years old) and may be in either English or French. Every effort is made to include both *Discussion* and *Reply* in the same issue. *Current Research* is published in January, June and November. Submissions for these issues should be received not later than November 1, April 1, and September 1 respectively. Submissions should be sent to the Chief Scientific Editor, Geological Survey of Canada, 601 Booth Street, Ottawa, Canada, K1A 0E8.

Avis aux auteurs d'articles

Nous encourageons tant le personnel de la Commission géologique que le grand public à nous faire parvenir des articles destinés à la section discussion *de la publication* Recherches en cours. *Le texte doit comprendre au plus six pages dactylographiées à double interligne (environ 1500 mots), texte qui peut faire l'objet d'un réexamen par le rédacteur en chef scientifique. Les discussions doivent se limiter au contenu scientifique des rapports de la Commission géologique. Les discussions générales sur la Direction ou les politiques gouvernementales ne seront pas acceptées. Les illustrations ne seront acceptées que dans la mesure où , selon l'opinion du rédacteur, elles seront considérées comme essentielles. Aucune retouche ne sera faite aux textes et dans tous les cas, une copie qui puisse être reproduite doit accompagner les textes originaux. Les discussions en français ou en anglais doivent se limiter aux rapports récents (au plus de 2 ans). On s'efforcera de faire coincider les articles destinés aux rubriques* discussions *et* réponses *dans le même numéro. La publication* Recherches en cours *paraît en janvier, en juin et en novembre. Les articles pour ces numéros doivent être reçus au plus tard le 1er novembre, le 1er avril et le 1er septembre respectivement. Les articles doivent être renvoyés au rédacteur en chef scientifique: Commission géologique du Canada, 601, rue Booth, Ottawa, Canada, K1A 0E8.*

ERRATUM

The legend for Figures 46.1 and 46.2 in Current Research, Part A, Paper80-1A (p. 320-322) was incomplete.

The complete legend and figures follow.

Figure 46.1.

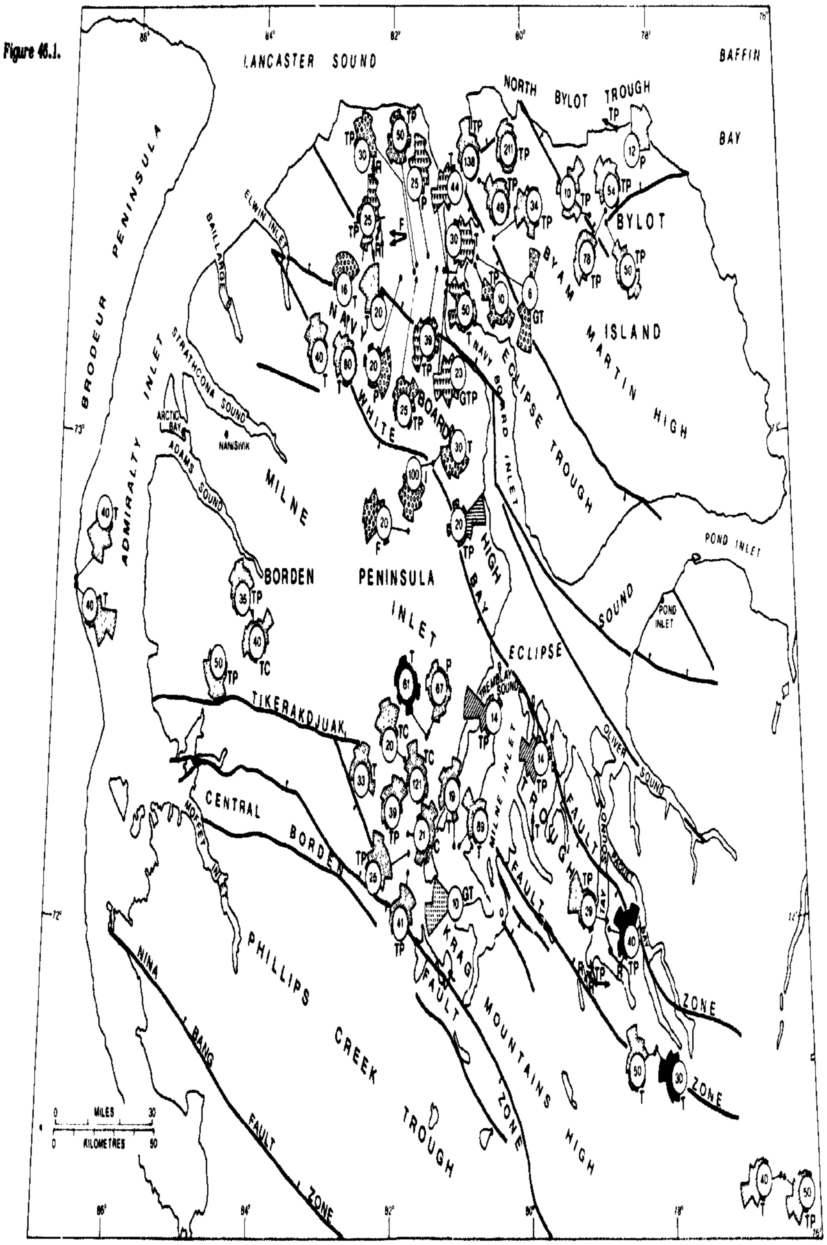
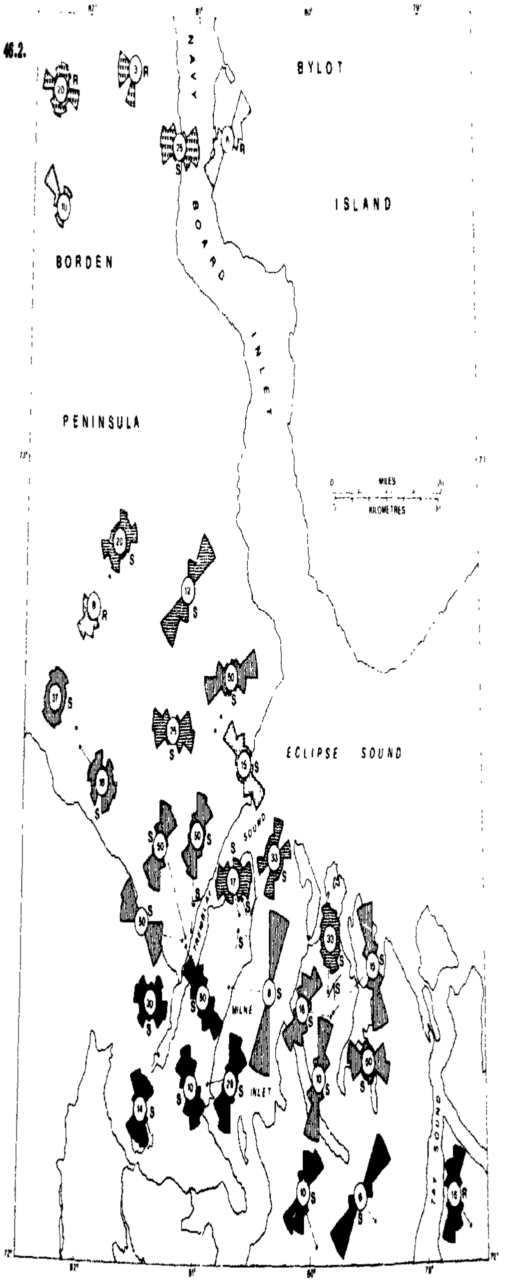


Figure 46.2.



Legend for Figures 46.1 and 46.2

As a scale reference the radius of center circle in each row is 20 per cent, readings start on the circumference.
Numbers in circle indicate the number of readings.
Single determinations are indicated by a straight line or arrow.

- ☐ *Adams Sound Formation*
- ■ *Arctic Bay Formation*
- ▦ *Fabricius Fiord Formation*
- ▥ *Society Cliffs Formation*
- ▤ *Victor Bay Formation*
- ▨ *Athole Point Formation*
- ░ *Strathcona Sound Formation*
- ▤ *Elwin Formation*

C - channels
F - flutes
G - giant trough crossbeds
I - imbricate clasts
P - planar crossbeds
R - ripple marks
S - stromatolite elongations
T - trough crossbeds

AUTHOR INDEX