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STRATIGRAPHY AND CORRELATION OF LOWER PALEOZOIC FORMATIONS, SUBSURFACE OF BATHURST ISLAND AND ADJACENT SMALLER ISLANDS, CANADIAN ARCTIC ARCHIPELAGO

Ulrich Mayr

Energy, Mines and Resources Canada
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Institute of Sedimentary and Petroleum Geology, Calgary

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Author's address:
Institute of Sedimentary and Petroleum Geology
3303 - 33rd Street N.W.
Calgary, Alberta
T2A 2A7

Preface

Oil that was found in the Panarctic Tenn. et al. Bent Horn well on Cameron Island in February, 1974, was the first unequivocal indication of the petroleum potential of the lower Paleozoic rocks that underlie parts of the Canadian Arctic Archipelago.

This report deals with the subsurface stratigraphy of the Bathurst group of islands, including Cameron Island. A regional stratigraphic framework is presented, and specific attention is given to a preliminary facies interpretation of the Blue Fiord Formation in three wells of the Bent Horn oilfield. This study contributes to a better understanding of the economically important and stratigraphically complex Lower and Middle Devonian succession of the central part of the Arctic Islands. It is thus in keeping with the Geological Survey's objectives of providing information on geological features relevant to energy and mineral development.

D.J. McLaren
Director General
Geological Survey of Canada

OTTAWA, September 1978

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STRATIGRAPHY AND CORRELATION OF LOWER PALEOZOIC FORMATIONS, SUBSURFACE OF BATHURST ISLAND AND ADJACENT SMALLER ISLANDS, CANADIAN ARCTIC ARCHIPELAGO

Abstract

Seven wells on Bathurst Island and adjacent smaller islands are correlated with each other and with selected surface sections on the basis of lithology and contained micro- and macrofossils. The wells penetrate Middle Ordovician to Upper Devonian strata.

The Allison River, Caledonian River and Young Inlet wells all bottom in the Cornwallis Group. The lower part of the Ordovician Bay Fiord Formation consists of diapiric halite and dolomite, which are overlain by about 400 m (1312 ft) of dolomite and limestone. The Thumb Mountain Formation comprises dolomite in the lower part and limestone in the upper part and is 250 to 300 m (820-984 ft) thick. The Irene Bay Formation is up to 60 m (196 ft) thick and consists of limestone and shale. In contrast to the regionally persistent Cornwallis Group, the overlying formations show marked diachronism and lateral lithological changes. The Silurian Cape Phillips Formation is variable in thickness, consists of shale, and is laterally equivalent to an unnamed dolomite, part of which is present in the bottom of the Bent Horn N-72 well. In the Cameron Island area, this dolomite is overlain by Lower and Middle Devonian carbonates of the Disappointment Bay Formation and the economically important Blue Fiord Formation, whereas on Bathurst Island and Ile Vanier laterally equivalent fine clastics of the Bathurst Island, Stuart Bay and Eids Formations overlie the Cape Phillips Formation. The transition zone between carbonates and terrigenous sediments is penetrated by the Hotspur well.

The carbonates are overlain by Middle and Upper Devonian sandstone and shale, grading upward from marine to nonmarine. These sediments belong to the Cape De Bray, Bird Fiord, Hecla Bay, Beverley Inlet and Parry Islands Formations and were encountered in the Cape Fleetwood, W. Bent Horn C-44 and Bent Horn N-72 wells.

Résumé

Sur l'île Bathurst, et les îles adjacentes plus petites, on met en corrélation entre eux et avec des coupes de terrain sélectionnées, sept puits de sondage, en fonction de la lithologie, et des macrofossiles et microfossiles. Les puits pénètrent dans des couches dont l'âge se situe entre l'Ordovicien moyen et le Dévonien supérieur.

Les puits de Allison River, Caledonian River, et Young Inlet atteignent tous le groupe de Cornwallis. La tranche inférieure de la formation ordovicienne de Bay Fiord consiste en halite diapirique et dolomite, qui sont recouvertes d'environ 400 m (1312 pieds) de dolomite et de calcaire. La formation de Thumb Mountain contient de la dolomite dans sa partie inférieure, et du calcaire dans sa partie supérieure; elle a 250 à 300 m (820-984 pieds) d'épaisseur. La formation de Irene Bay atteint 60 m (196 pieds) d'épaissuer, et consiste en calcaire et schistes argileux. Contrairement au groupe de Cornwallis, uniforme à l'échelle régionale, les formations sus-jacentes présentent des diachronismes marqués et des variations lithologiques latérales. La formation silurienne de Cape Phillips a une épaissuer variable, et est composée de schistes argileux; elle est l'équivalent latéral d'une dolomite non désignée, en partie représentée à la base du puits Bent Horn N-72. Dans la région de l'île Cameron, cette dolomite est recouverte par des carbonates du Dévonien moyen et inférieur de la formation de Disappointment Bay, et de la formation de Blue Fiord, qui présente un intérêt économique, tandis que sur l'île Bathurst et l'île Vanier, des matériaux clastiques fins latéralement équivalents aux formations de Bathurst Island, de Stuart Bay et de Eids recouvrent la formation de Cape Phillips. La zone de transition entre les carbonates et les sédiments terrigènes est traversée par le puits de Hotspur.

Les carbonates sont recouverts par des grès et schistes argileux du Dévonien moyen et supérieur dont le caractère change progressivement de marin à non marin, à mesure qu'on se rapproche de la surface. Ces sédiments appartiennent aux formations de Cape De Bray, Bird Fiord, Hecla Bay, Beverley Inlet, et Parry Islands; on les a rencontrés dans les puits de Cape Fleetwood, W. Bent Horn C-44, et Bent Horn N-72.

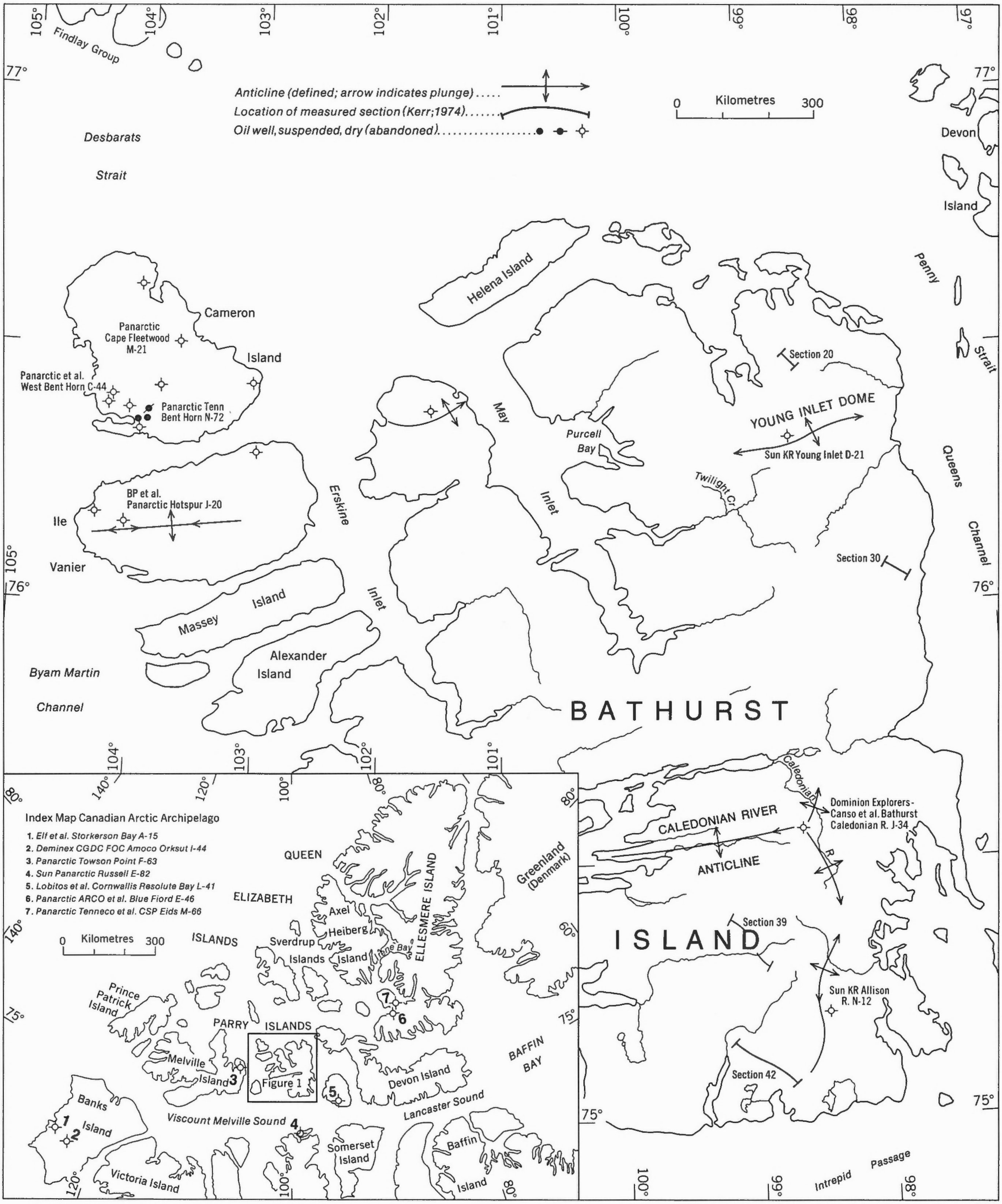

FIGURE 1. Location of wells and sections, Bathurst Island

STRATIGRAPHY AND CORRELATION OF LOWER PALEOZOIC FORMATIONS, SUBSURFACE OF BATHURST ISLAND AND ADJACENT SMALLER ISLANDS, CANADIAN ARCTIC ARCHIPELAGO

INTRODUCTION

PURPOSE AND SCOPE OF INVESTIGATION

This report deals with subsurface stratigraphy of lower Paleozoic formations of Bathurst Island and adjacent smaller islands including Cameron Island, in the central part of the Canadian Arctic Archipelago (Fig. 1). The wells under discussion are:

1. Panarctic Cape Fleetwood M-21
   (Lat. 76°30'47.8"N, Long. 103°40'37.0"W)
2. Panarctic *et al.* W. Bent Horn C-44[1]
   (Lat. 76°23'09.3"N, Long. 104°17'10"W)
3. Panarctic Tenn. *et al.* Bent Horn N-72
   (Lat. 76°21'50.7"N, Long. 103°58'11.9"W)
4. BP *et al.* Panarctic Hotspur J-20
   (Lat. 76°09'37"N, Long. 104°04'43"W)
5. Sun KR Panarctic Young Inlet D-21
   (Lat. 76°20'10"N, Long. 98°40'30"W)
6. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34
   (Lat. 75°33'31"N, Long. 98°43'00"W)
7. Sun KR Panarctic Allison R. N-12
   (Lat. 75°11'52.405"N, Long. 98°35'42.632"W)

These wells are situated on Bathurst Island, Ile Vanier, and Cameron Island (Fig. 1).

The primary aim of this report is to clarify the relationships between the lower Paleozoic sections penetrated by the seven wells and the stratigraphy exposed at the surface (Table 1). The Bent Horn N-72 well on Cameron Island is the discovery well of the Bent Horn oil occurrence and this report elucidates the regional stratigraphical relationships of that important area. Detailed, local stratigraphical interpretation and examination of the genetic history of the petroleum-bearing carbonates in the Bent Horn River area are planned for the time when more wells are released from confidential status and the apparently complex subsurface structure (Oilweek, 1977) of southern Cameron Island can be included. The wells on Cameron Island also penetrate a thin sequence of Mesozoic and upper Paleozoic formations. A description and study of these beds is not included in this report.

A second objective of this report is to offer paleogeographic interpretations for areas where information was hitherto unavailable. Only a few intervals in the wells were cored; thus most of the environmental interpretations are based on the examination of chip samples and therefore somewhat tentative. Wherever possible, published surface information has been used to supplement the interpretations from chip samples. Carbonate facies terminology is adapted from Wilson (1975).

This report is based on the study of well samples, cores and qualitative appraisal of geophysical wireline logs. Footages and thicknesses are taken directly from the logs and are not corrected for formation dip and borehole deviation. The error is estimated to be less than 2%. Selected thin sections were used to identify some lithologies. Unwashed samples, stored at the Institute of Sedimentary and Petroleum Geology in Calgary, were processed for macro- and microfossils to establish the time-stratigraphic framework for the wells. Information on lithology, age determinations and results of drill-stem tests and core analyses is summarized on well logs (Appendix I). Core descriptions are contained in Appendix II, and detailed fossil lists form Appendix III. Results of chemical analyses are listed in Appendix IV. Additional lithological information or engineering data may be obtained from the completion reports for the wells, on Open File with both the Department of Indian Affairs and Northern Development and the Geological Survey of Canada, and also commercially available.

PREVIOUS GEOLOGICAL WORK

The Bathurst group of islands was included in Operation Franklin (Fortier *et al.*, 1963) which provided the stratigraphical and structural framework for the area. Temple (1965) and Kerr (1974) later mapped the islands in detail and unravelled the complex Devonian stratigraphy. Embry and Klovan (1976) investigated the Middle and Upper Devonian formations in detail and included them in a broad regional study.

HYDROCARBON EXPLORATION

The first well on Bathurst Island was drilled on the Caledonian River Anticline during the winter of 1963-1964. It is mentioned in a study of subsurface diagenetic features by Bryant and Koch (1969). During 1971 three more wells (Allison River, Young Inlet and Hotspur) were drilled on structural prospects but all these wells were dry. Petroleum was found in 1974 in the Bent Horn N-72 well and since then drilling activity has greatly increased. At the time of writing (May, 1977), a total of seven wells had been drilled in the southwestern corner of Cameron Island. Three of these encountered oil, the origin of which is not known (Henao-Londoño, 1977).

ACKNOWLEDGMENTS

Fossils were identified by C.R. Barnes, T.T. Uyeno, D.C. McGregor and A.W. Norris. H.P. Trettin assisted with the interpretation of some thin sections. X-ray analyses were carried out at the Institute of Sedimentary and Petroleum Geology by A.G. Heinrich. The typescript was critically read by A.F. Embry and D.W. Morrow, who suggested a number of improvements and alternative interpretations.

---

[1] The original name of this well is Panarctic *et al.* Pym Point C-44

TABLE 1. Table of formations.

FORMATIONS / WELLS	Panarctic Cape Fleetwood M-21 K.B. 57.0 m (187 ft)			Panarctic *et al* W. Bent Horn C-44 K.B. 20.1 m (66 ft)			Panarctic Tenn. *et al* Bent Horn N-72 K.B. 70.5 m (231.4 ft)		
	Top metres (feet)	Thickness metres (feet)	Lithology	Top metres (feet)	Thickness metres (feet)	Lithology	Top metres (feet)	Thickness metres (feet)	Lithology
PARRY ISLANDS	291.1 (955)	728.2 (2389)	Sandstone, conglomeratic; interbedded with shale and siltstone	205.7 (675)	631.3 (2071)	Sandstone, conglomeratic; interbedded with shale and siltstone	12.2 (40)	714.8 (2345)	Sandstone, conglomeratic; interbedded with siltstone, shale and conglomerate
BEVERLEY INLET	1019.3 (3344)	600.7 (1971)	Sandstone; interbedded with shale and siltstone	837.0 (2746)	628.2 (2061)	Sandstone; interbedded with shale and siltstone	668.1 (2192)	638.6 (2095)	Sandstone; interbedded with shale and minor siltstone
HELCA BAY	1620.0 (5315)	865.6 (2840)	Sandstone; interbedded with minor siltstone	1465.2 (4807)	875.7 (2873)	Sandstone, interbedded with minor siltstone and shale	1306.7 (4287)	917.1 (3009)	Sandstone; rare interbeds of siltstone
BIRD FIORD	2485.6 (8155)	738.6 (2423)	Siltstone, calcareous; sandstone, shale	2340.9 (7680)	707.1 2340	Siltstone, calcareous; interbedded with shale and minor sandstone	2223.8 (7296)	851.3 (2793)	Siltstone, calcareous; interbedded with shale and minor sandstone
CAPE DE BRAY	3224.2 (10 578)	93.9 (308)	Siltstone, calcareous	3048.0 (10 000)	124.4 (408)	Siltstone, calcareous	3075.1 (10 089)	123.5 (405)	Siltstone, calcareous
BLUE FIORD	3318.1 (10 886)	+195.7 (+642)	Limestone; mostly grainstone	3172.4 (10 408)	+ 389.5 (+1278)	Limestone; mostly lime mudstone, dolomitic	3198.6 (10 494)	608.1 (1995)	Limestone; mostly packstone and grainstone
EIDS							1 3806.7 (12 489)	57.3 (188)	Dolomite, calcareous
DISAPPOINTMENT BAY							3864.0 (12 677)	482.5 (1583)	Limestone, mostly lime mudstone; dolomite
Unnamed dolomite							4346.5 (14 260)	+ 36.3 (+119)	Dolomite
STUART BAY									
BATHURST ISLAND									
CAPE PHILLIPS									
IRENE BAY									
THUMB MOUNTAIN									
BAY FIORD									

1. Interval included tentatively in Eids Formation

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TABLE 1. Continued

B.P. *et al* Panarctic Hotspur J-20 K.B. 211.9 m (695.1 ft)			Sun K.R. Panarctic Young Inlet D-21 K.B. 219.7 m (720.9 ft)			Dominion Explorers-Canso *et al* Bathurst Caledonian R. J-34 K.B. ± 145 m (± 475 ft)			Sun K.R. Panarctic Allison R. N-12 K.B. 229.3 m (752.3 ft)		
Top metres (feet)	Thickness metres (feet)	Lithology	Top metres (feet)	Thickness metres (feet)	Lithology	Top metres (feet)	Thickness metres (feet)	Lithology	Top metres (feet)	Thickness metres (feet)	Lithology
Surface	+137.2 (+450)	Sandstone; interbedded with shale									
137.2? (450?)	872.6? (2863?)	Sandstone									
1009.8 (3313)	1951.6 (3122)	Sandstone and calcareous siltstone; interbedded with shale									
1961.4 (6435)	670.2 (2199)	Shale; interbedded with siltstone									
2631.6 (8634)	360.3 (1182)	Limestone, mostly packstone; interbedded with shale									
2991.9 (9816)	383.2 (1257)	Shale, calcareous									
									Surface	+433.4 (+1422)	Sandstone, siltstone; limestone, shale
			Surface	+581.6 (+1908)	Siltstone, calcareous and dolomitic; interbedded with shale	Surface	+644.4 (+2114)	Siltstone, calcareous and dolomitic	433.4 (1422)	1862.4 (6110)	Sandstone, calcareous; interbedded with siltstone and minor shale
3375.1 (11 073)	+460.6 (+1511)	Shale; interbedded with limestone	581.6 (1908)	399.3 (1310)	Shale	644.4 (2114)	609.9 (2001)	Shale; interbedded with dolomite and chert	2295.8 (7532)	1010.7 (3316)	Shale; interbedded with limestone and chert
			980.9 (3218)	39.0 (128)	Shale, dolomitic; interbedded with limestone	1254.3 (4115)	50.3 (165)	Shale, interbedded with limestone	3306.5 (10 848)	61.0 (200)	Shale; interbedded with limestone
			1019.9 (3346)	254.2 (834)	Limestone, dolomitic; mostly lime mudstone	1304.5 (4280)	296.6 (973)	Limestone and dolomite	3367.4 (11 048)	+217.3 (+713)	Limestone, dolomitic; mostly lime mudstone
			1274.1 (4180)	+570.0 (+1870)	Dolomite, limestone and evaporites	1601.1 (5253)	+1446.9 (+4747)	Dolomite, limestone and evaporites			

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TABLE 2. Age and correlation of formations.

SYSTEM	SERIES	STAGES: EUROPEAN		STAGES: NORTH AMERICAN	CAMERON ISLAND	ILE VANIER	NORTHEASTERN BATHURST ISLAND	SOUTHERN BATHURST ISLAND
DEVONIAN	UPPER	FAMENNIAN		CONEWAGONIAN				
		FRASNIAN		CASSADAGIAN CHEMUNGIAN	PARRY ISLANDS 1	PARRY ISLANDS	PARRY ISLANDS	
				FINGERLAKESIAN	BEVERLEY INLET 1	BEVERLEY INLET 3	BEVERELY INLET	?
	MIDDLE	GIVETIAN		ERIAN	HECLA BAY 1	HECLA BAY 3	HECLA BAY	HECLA BAY
					BIRD FIORD 1	BIRD FIORD 3	BIRD FIORD	BIRD FIORD
		EIFELIAN	COUVINIAN		CAPE DE BRAY 1	CAPE DE BRAY 3	BLUE FIORD	BLUE FIORD
							EIDS	DISAPPOINTMENT BAY
	LOWER	EMSIAN	DALEJAN ZLICHOVIAN	SAWKILLIAN	BLUE FIORD 1	BLUE FIORD 3	STUART BAY	? ?
					EIDS ? 2	EIDS 3		STUART BAY 5
		SIEGENIAN	PRAGIAN	DEERPARKIAN	DISAPPOINTMENT BAY 2			
							BATHURST ISLAND 4	BATHURST ISLAND 5
		GEDINNIAN	LOCHKOVIAN	HELDERBERGIAN	?	?		
SILURIAN	UPPER	PRIDOLIAN		CAYUGAN	?	CAPE PHILLIPS 3	CAPE PHILLIPS 4	CAPE PHILLIPS 5
		LUDLOVIAN			Unnamed dolomite 2			
	MIDDLE	WENLOCKIAN		NIAGARAN	Not penetrated			
	LOWER	LLANDOVERIAN		ALEXANDRIAN		Not penetrated		
ORDOVICIAN (PART)	UPPER	ASHGILLIAN		RICHMONDIAN			IRENE BAY 4	IRENE BAY 5 (CORNWALLIS GROUP)
				MAYSVILLIAN				
		CARADOCIAN		EDENIAN			THUMB MOUNTAIN 4	THUMB MOUNTAIN 5 (CORNWALLIS GROUP)
				BARNEVELDIAN				
	MIDDLE			BLACKRIVERIAN			BAY FIORD 4	BAY FIORD 5 (CORNWALLIS GROUP)
		LLANDEILIAN		CHAZYAN				
		LLANVIRNIAN		WHITEROCKIAN			Not penetrated	

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FORMATIONS PENETRATED BY

1. Panarctic Cape Fleetwood M-21, Panarctic *et al* West Bent Horn C-44 Panarctic Tenn. *et al* Bent Horn N-72
2. Panarctic Ten *et al* Bent Horn N-72
3. BP *et al* Panarctic Hotspur J-20
4. Sun KR Panarctic Young Inlet D-21
5. Dominion Explorers-Canso *et al* Bathurst Caledonian R. J-34

Hiatus, nondeposition or erosion ....

STRATIGRAPHY

GENERAL STATEMENT

The wells discussed in this report penetrate a sequence of rocks from Early Ordovician to Late Devonian in age. The sediments were deposited in the Franklinian Geosyncline (Fig. 2) and, owing to the shifting of depth regimes in the geosyncline throughout the time interval of deposition, they include both shelf and basin deposits.

The three eastern wells (Young Inlet, Caledonian River and Allison River; Fig. 1) encountered at depth the shallow-water carbonates and evaporites of the Ordovician Cornwallis Group (Tables 1, 2). These rocks are overlain by the shales and siltstone of the Silurian and Lower Devonian Cape Phillips and Bathurst Islands Formations which are of deeper water origin.

Shallow-water carbonates of similar age, including unnamed dolomite as well as the Disappointment Bay and Blue Fiord Formations, are present in the wells on Cameron Island (Bent Horn N-72, W. Bent Horn C-44 and Cape Fleetwood wells; Fig. 1). The Hotspur well straddles the boundary zone between the Silurian and Lower Devonian shallow- and deep-water sediments and encountered carbonate tongues within the shales of Cape Phillips and Eids/Cape De Bray Formations.

Middle and Upper Devonian sediments were penetrated only by the wells on Ile Vanier and Cameron Island. Overlying the deep-water Cape De Bray Formation, the Bird Fiord Formation contains clastics which attest to a change from shallow-marine to strandline environments. Finally, the Beverley Inlet, Hecla Bay and Parry Islands Formations consist almost entirely of fluvial strata.

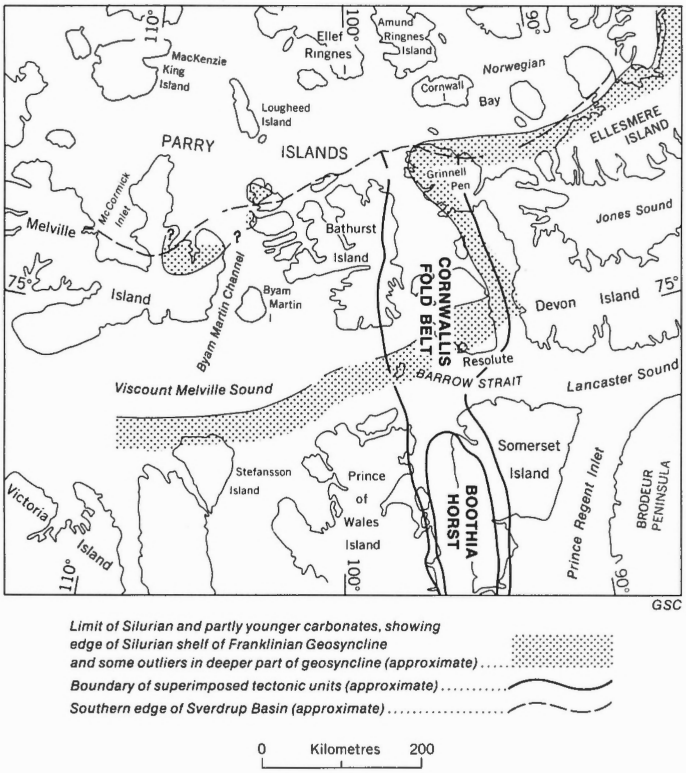

FIGURE 2. Outline of structural and stratigraphic areas, Canadian Arctic Archipelago (after Meneley, 1976, and Kerr, 1977).

ORDOVICIAN

Bay Fiord Formation

Introduction

The Bay Fiord Formation is the lowest formation of the Cornwallis Group (Kerr, 1967a). At the type section on Ellesmere Island, northeast of the head of Irene Bay, the formation consists of 502.9 m (1650 ft) of argillaceous limestone, shaly siltstone, shale, and anhydrite. It is the lowest formation exposed on Bathurst Island, with the evaporites and evaporitic shales occurring in the faulted structures in the north-central part of the island (Kerr, 1974). The lower part of the Thumb Mountain Formation, as mapped by Kerr (1974), is considered in this report to belong also to the Bay Fiord Formation. That unit is exposed in a number of anticlines in the northeastern part of the island.

The Bay Fiord Formation, the lowest unit penetrated, occurs in the Caledonian River well (Appendix If) and Young Inlet well (Appendix Ie). The formation can be subdivided into 5 units (*see* Table 3).

TABLE 3. Thickness of subdivisions of Bay Fiord Formation.

		Top		Thickness	
	Unit	metres	feet	metres	feet
Sun KR Panarctic Young Inlet D-21	5	1274.1	4180	24.4	80
	4	1298.5	4260	96.6	317
	3	1395.1	4577	67.3	221
	2	1462.4	4789	156.1	512
	1	1618.5	5310	+225.6	+740
	Total			+570.0	+1870
Dominion Explorers-Canso *et al* Bathurst Caledonian River J-34	5	1601.1	5253	20.4	67
	4	1621.5	5320	136.6	448
	3	1758.1	5768	119.5	392
	2	1877.6	6160	168.5	553
	1	2046.1	6713	+1001.9	+3287
	Total			+1446.9	+4747

GSC

Lithology

Unit 1 comprises interbedded dolomite, shale, anhydrite and salt. The dolomite is variable. The most common variety is light to dark coloured, very finely crystalline dolomite, some of it anhydritic or argillaceous. Birdseye textures were identified in some chips (Fig. 3). The second variety is finely crystalline, vuggy, light-coloured dolomite. The third variety is light yellow, aphanocrystalline dolomite. The shale is dark grey-brown and variably dolomitic. Anhydrite is white and finely crystalline. Salt is present in cores 4 (7792-7809 ft, 2375.0-2380.1 m) and 6 (8756-8780 ft, 2668.8-2676.1 m) of the Caledonian River well. X-ray diffraction analysis (Appendix IV) shows that it consists almost entirely of halite, with very small (2%) amounts of sylvite. Three samples each from cores 4 and 6 were analyzed for bromine (Appendix IV). Core 4 samples yielded an average of 0.0175%, whereas the results from core 6 were higher with an average of 0.0232%. The three cores in unit 1 (cores 4 and 6, footage listed previously; core 5, 8270-8277 ft, 2520.7-2522.8 m) give some idea about structure and relationship of the various lithologies. Bedding is always inclined and brecciation with salt cement is a common feature (Fig. 4). Anhydrite and dolomite occur often interlaminated (Fig. 5). In core 5, abundant traces of organic activity are present in laminated dolomite.

Unit 2 is composed of dolomite, dolomitic shale and anhydrite. The dolomite forms more than half of the unit. It is dark brown-grey and ranges from aphanocrystalline to finely crystalline. Indistinct structures can be recognized in the aphanocrystalline variety (Fig. 6). Argillaceous interbeds occur throughout the unit, the dolomite then being gradational to dark grey-brown, dolomitic shale. White to light grey anhydrite forms a subordinate part of the unit.

Unit 3 consists of medium grey, partly dolomitic lime mudstone with interbeds of skeletal and lump grainstone. Brachiopod and crinoidal fragments are abundant. The lower boundary of the unit appears to be sharp, while the upper boundary is gradational with the overlying dolomite.

Unit 4 consists of medium to dark brown, aphanocrystalline to finely crystalline dolomite with subordinate interbeds of argillaceous dolomite and dolomitic shale. Locally some fracturing or brecciation appears to be present.

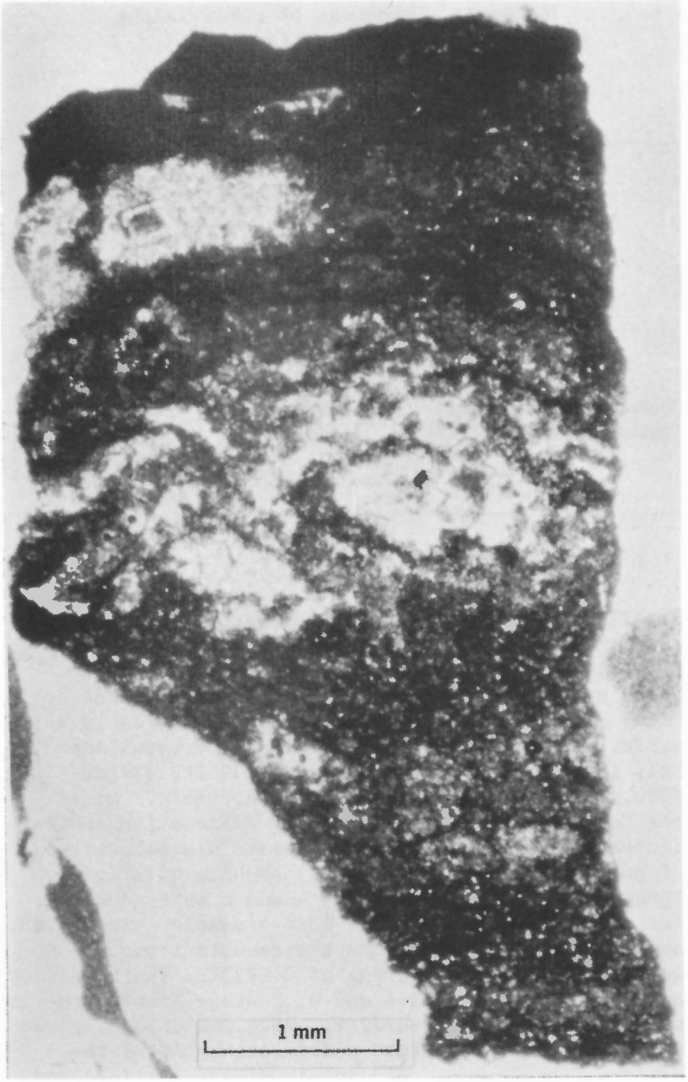

FIGURE 3. Bay Fiord Formation, cryptalgal dolomite. This thin section consists in the lower part of pelletoidal, aphanocrystalline dolomite and in the upper part of finely laminated, aphanocrystalline dolomite. The two light coloured patches are vugs with medium crystalline dolomite cement, probably indicating a laminoid fenestral or "birdseye" fabric. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34, cutting, 8550 feet (2606.0 m).

Unit 5 consists of limestone overlain by shale. The shale is dark grey and variably calcareous. The limestone is variable in texture; in the Young Inlet well a large part consists of cryptalgal limestone, whereas in the Caledonian River well lime-mudstone is dominant. Fossil fragments, mostly crinoidal, are present throughout the unit.

The upper boundary of the formation was picked above the distinct shale marker of unit 5. This is consistent with the upper boundary of the Bay Fiord Formation in the Lobitos *et al.* Cornwallis Resolute Bay L-41 well, where the boundary is drawn above the same shale marker (Thorsteinsson and Kerr, 1968; Mayr, in press).

Mode of origin

The Bay Fiord Formation is the product of a restricted and evaporitic platform which had two episodes of normal marine sedimentation. Unit 1 is dominated by evaporite (halite, anhydrite and sylvite). The organic, dark lamination and birdseye textures of the interbedded dolomite may indicate deposition on a very shallow to supratidal platform with a large expanse of pools where the evaporite formed. Bromine concentrations in halite have been used to interpret stratigraphy and origin of salt deposits (Braitsch, 1971; Schulze, 1960), but much caution must be used (Holser *et al.*, 1972; Baar, 1977). Generally an increase in salinity in the original brine is reflected by an increase in bromine in the halite, and in a natural salt sequence the bromine content is expected to increase upward. However, this is not the case with cores from the Caledonian River well, where the lower core 6 shows a higher bromine concentration than the higher core 4 (*see* Appendix IV).

Within an anticline, where some salt flowage has taken place (Meneley, 1976), it is difficult to interpret two isolated groups of X-ray analyses. If the salt in the two cores is still in its original stratigraphic sequence and has not been altered chemically by recrystallization during flowage or by leaching, then the reversal of the bromine increase could indicate that at least two major evaporitic cycles took place during the deposition of the salt.

Unit 2 is also of restricted origin but it was not dominated by evaporitic conditions. It probably also formed on a shallow subtidal to supratidal platform, as indicated by the very fine, and aphanocrystalline dolomite. Unit 3 was formed on a submerged, open platform. The general lack of clasts in the limestone and the preponderance of lime-mudstone indicate sheltered conditions, but the abundant and varied invertebrate remains imply near normal marine salinity. Conditions for unit 4 were similar to those for unit 2. Traces of breccia are interpreted as solution breccia and thus are indicative of a restricted, occasionally evaporitic platform for unit 4. During deposition of unit 5, conditions changed rapidly from shallow subtidal to open marine, as indicated by the sudden appearance of shale and invertebrates.

Age and correlation

Organic material is abundant in unit 1, but only some scolecodonts and acritarchs without biostratigraphic value were recovered from the samples (Jenkins, pers. com., 1976). Conodonts are present in unit 3 in the Young Inlet and Caledonian River wells (*see* Appendix III, GSC locs. C-58249/4660-4780 and C-5208/6120-6160) and give an age of early Chazyan (Marmorian, mid-Llanvirnian). Generally, the faunal combination from the two wells is similar to that of the middle part of the Bay Fiord Formation (Nowlan, 1976). The maximum age range of the formation in the eastern part of the Arctic Archipelago is about mid-Whiterockian to mid-Blackriverian (early Llanvirnian to early Caradocian, Table 2).

The upper boundary of the Bay Fiord Formation used in this report is not the same as that of Kerr (1974). Kerr assigned only the evaporites in the May Inlet and Purcell Bay anticlinal structures to the Bay Fiord Formation, whereas in this report part of the

FIGURE 4. Bay Fiord Formation, halite breccia. Fragments of aphanocrystalline, argillaceous dolomite, interlaminated with anhydrite are floating in a matrix of halite. Dominion Explorers-Canso *et al.* Caledonian R. J-34, core 4, 7800 feet (2377.4 m).

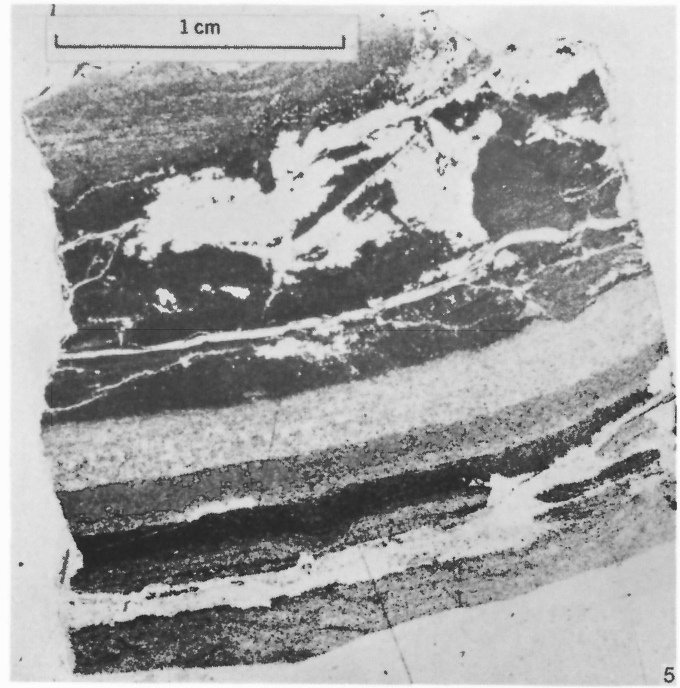

FIGURE 5. Bay Fiord Formation, interlaminated dolomite and anhydrite. This thin section is from the core piece of Figure 4. Lighter coloured lamination in lower part is formed by anhydrite with varying amounts of dolomite. Dolomite grades into anhydrite in uppermost part of thin section. Very light coloured areas are holes and cracks in the section. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34, core 4, 7800 feet (2377.4 m).

overlying carbonate sequence is also included in the formation. This is based on correlation of unit 5 with a similar shale marker in the Lobitos *et al.* Cornwallis Resolute Bay L-41 (Fig. 8). That well also contains anhydrite stringers in beds equivalent to unit 4 (Mayr, in press). Further evidence is the Llanvirnian age of unit 3. Kerr (1974, p. 17) implied that a lithological change takes place within the carbonate sequence about 300 m (900-1000 ft) below the top of the Thumb Mountain Formation. This change coincides approximately with the upper Bay Fiord Formation boundary chosen in this report.

Salt in surface exposures has not been reported, but it appears to be present extensively in subsurface on Bathurst Island and eastern Melville Island (Meneley, 1976).

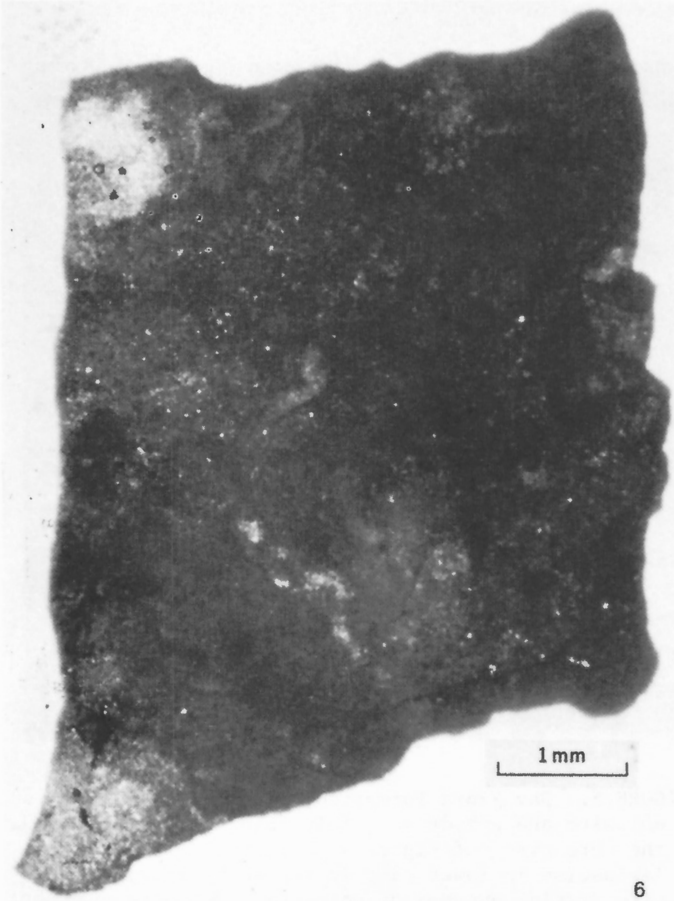

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FIGURE 6. Bay Fiord Formation, pelletoidal dolomite. This is an aphanocrystalline dolomite, consisting of poorly sorted, deformed pelletoids and showing evidence of small-scale bioturbation. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34, cutting, 6200 feet (1889.8 m).

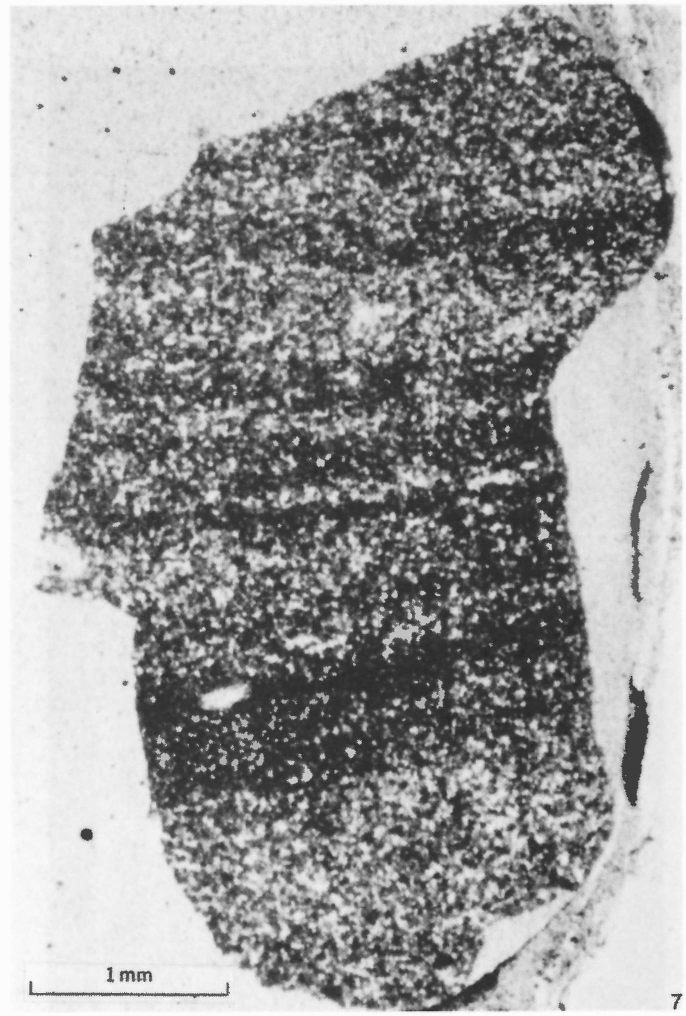

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FIGURE 7. Bay Fiord Formation, laminated dolomite. This is a very finely crystalline dolomite, which appears to be deposited, together with quartz silt and some coarser carbonate particles, as a dolosiltite. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34, cutting, 7365 feet (2244.9 m).

Thumb Mountain Formation

Introduction

The Thumb Mountain Formation (Kerr, 1967a) is the middle formation of the Cornwallis Group. At the type section at Irene Bay on central Ellesmere Island, the formation is about 450 m (1500 ft) thick and consists of argillaceous and dolomitic limestone.

On Bathurst Island, the formation is exposed in the cores of several anticlines in the northeastern part of the island and consists of limestone, dolomitic limestone and dolomite. In the subsurface, the formation is present in three wells, the Allison River, Caledonian River, and Young Inlet wells (*see* Appendices Ig, f and e, respectively). Tops and thicknesses of subdivisions are listed in Table 4.

Lithology

In the wells the Thumb Mountain Formation consists of variable carbonates and can be subdivided into two units. Unit 1 consists of interbedded dolomite, calcareous dolomite, dolomitic limestone and limestone. The proportions of the different carbonates vary; dolomite forms about 80% of the unit in the Caledonian River well, whereas in the Young Inlet well only slightly more than half of the unit is dolomite. The dolomite is variable. Both the Young Inlet and the Allison River wells contain more finely crystalline dolomite and are at best poorly fossiliferous, while unit 1 in the Caledonian River well is dominated by medium and coarsely crystalline dolomite and is relatively more fossililerous. Samples of medium crystalline dolomite from the Caledonian River well have a pelletoidal "ghost" texture (Fig. 9). Some of the dolomite is calcareous and a complete gradation to dolomitic limestone and "pure" limestone can be observed. Most of the limestone is present in the upper part of the unit. A large part of it is light brown, cryptalgal micrite and the boundary between units 2 and 1 is based on the first major occurrence of that kind of limestone. Subordinate are skeletal grainstone and dark brown lime-mudstone. Two cores are available from unit 1. Core 2 (11 750-11 761 ft; 3581.4-3584.8 m) at the base of the Allison River well is probably from the middle part of the unit.

TABLE 4. Thickness of subdivisions of Thumb Mountain Formation.

	Unit	Top metres	Top feet	Thickness metres	Thickness feet
Sun KR Panarctic Young Inlet D-21	2	1019.9	3346	71.3	234
	1	1091.2	3580	182.9	600
	Total			254.2	834
Dominion Explorers-Canso *et al* Bathurst Caledonian R. J-34	2	1304.5	4280	79.3	260
	1	1383.8	4540	217.3	713
	Total			296.6	973
Sun KR Panarctic Allison River N-12	2	3367.4	11 048	113.4	372
	1	3480.8	11 420	+103.9	+341
	Total			+217.3	+713

GSC

It consists mostly of dark grey, laminated, dolomitic lime-mudstone with faint birdseye texture, probably of cryptalgal origin. Core 3 (4687-4697.5 ft; 1428.6-1431.8 m) of the Caledonian River well represents the upper part of the unit. It comprises medium crystalline dolomite with faint skeletal structures.

Unit 2 consists of limestone with subordinate amounts of shale and dolomite. The limestone is medium to dark brown lime-mudstone that may grade into skeletal wackestone. It is locally silty or dolomitic. The shale is present in the upper part of the unit, in a zone gradational into the overlying Irene Bay Formation. Dolomite is rare and is very finely and medium crystalline. Unit 2 is relatively fossiliferous and fragments of brachiopods, ostracodes, crinoids, and bryozoans were observed.

The upper boundary of the Thumb Mountain Formation is gradational and was drawn at the base of an argillaceous-shaly interval.

Mode of origin

The two units of the Thumb Mountain Formation form the transition between the restricted platform of the Bay Fiord Formation below and the open-marine and pelagic environments of the Irene Bay and Cape Phillips Formations above. In the cores of unit 1, as indicated by the cryptalgal limestone (particularly in the Young Inlet well), there is an abundance of very finely crystalline dolomite and birdseye structures which are of restricted, probably partly supratidal, platform origin, but the occasional occurrence of shelly fauna would indicate conditions less severe than in the underlying Bay Fiord Formation. Unit 2 is of normal marine, open platform origin. It contains a small amount of winnowed skeletal lithology which, together with the predominance of "muddy" lithologies, would indicate a depositional depth of wave base and deeper.

Age and correlation

Only a single, rather nondiagnostic, conodont fauna is available from the Thumb Mountain Formation in the Young Inlet well (*see* Appendix III, GSC loc. C-58249/3580-3680). This fauna gives an age of Middle Ordovician (early Caradocian). In surface exposures on Bathurst Island and farther east, the age of the

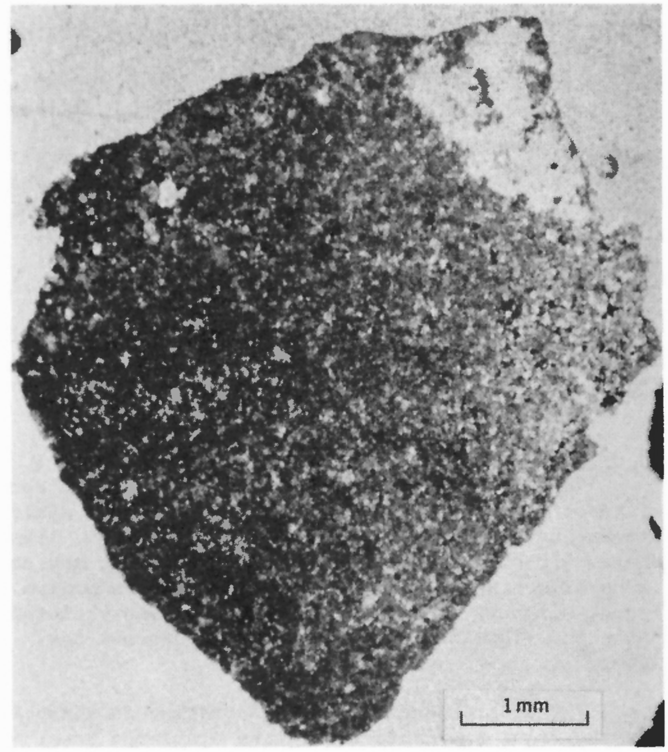


FIGURE 9. Thumb Mountain Formation, medium crystalline dolomite. This dolomite exhibits faint "ghosts" of a former pelletoidal texture. Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34, cutting, 5110 feet (1557.5 m).

formation is from late Blackriverian to early Maysvillian (early Caradocian to late Caradocian or earliest Ashgillian) (Barnes, 1974; Nowlan, 1976). A similar age range is presumed for the formation in the Young Inlet, Caledonian River and Allison River wells (Table 2.

As used in this report, the Thumb Mountain Formation is different from that of Kerr (1974), who included a large part of rocks which have in this report been assigned to the Bay Fiord Formation (*see* section on age and correlation of Bay Fiord Formation).

The two units of the Thumb Mountain Formation can be recognized throughout the eastern part of the Arctic Archipelago as far as the wells on Bjorne Peninsula (Panarctic Tenn. *et al.* CSP Eids M-66 and Panarctic ARCO *et al.* Blue Fiord E-46; Mayr *et al.*, unpubl. manuscript).

Irene Bay Formation

Introduction

The Irene Bay Formation (Kerr, 1967a) is the youngest formation of the Cornwallis Group. At the type section, at the head of Irene Bay on central Ellesmere Island, the formation is 82.3 m (270 ft) thick and consists of limestone with thin, green shale interbeds. The formation is exposed in several anticlines in the northeastern part of Bathurst Island and consists there of green shale and limestone, ranging in thickness from 10 to 60 m (30-180 ft). It is present in three of the wells under discussion (Young Inlet, Appendix Ie; Caledonian River, Appendix If; Allison River, Appendix Ig; *see* Table 5).

Lithology

In the three wells the Irene Bay Formation consists of interbedded shale and limestone, with shale accounting for more than half of the formation. The shale is medium green-grey, in part dolomitic and contains disseminated pyrite. The limestone is medium brown, slightly dolomitic lime-mudstone and skeletal packstone. Fossil fragments occur throughout the intervals.

The upper boundary of the formation is sharp and was chosen at the contact with the overlying basal carbonate unit of the Cape Phillips Formation. The lower boundary is gradational.

Mode of origin

The Irene Bay is of normal marine origin. The high content of shale implies an open, neritic shelf, probably mostly below wave base, as the most likely locus of origin for the formation.

Age and correlation

No fossils were recovered from the wells. Barnes (1973) reported on condonts from outcrops on Bathurst Island, indicating an Ashgillian (Maysvillian-Richmondian) age for the formation (Table 2).

On account of the overlying basal carbonate of the Cape Phillips Formation, the Irene Bay Formation is easily correlated by gamma ray logs with occurrences in the Lobitos *et al.* Cornwallis Resolute Bay L-41 well and elsewhere (Mayr, in press). The upper boundary of the Irene Bay Formation is presumably a time-line and was used as a datum-line in Figure 8. The lower boundary, in surface determinations, is diachronous (Barnes, 1974), and probably shaly intervals of the uppermost Thumb Mountain Formation are included in the Irene Bay Formation in some published sections. These shaly intervals are also visible on gamma ray logs, but can easily be distinguished from the much more radioactive ones of the Irene Bay Formation.

TABLE 5. Thickness of Irene Bay Formation.

	Top		Thickness	
	metres	feet	metres	feet
Sun KR Panarctic Young Inlet D-21	980.9	3218	39.0	128
Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34	1254.3	4115	50.3	165
Sun KR Panarctic Allison R. N-12	3306.5	10 848	61.0	200

GSC

ORDOVICIAN-SILURIAN-DEVONIAN

Cape Phillips Formation

Introduction

The Cape Phillips Formation (Thorsteinsson, 1958) has its type area in the northeastern part of Cornwallis Island, where it is about 3000 m (9800 ft) thick. It thins rapidly northward. The formation is subdivided into three members. The lowest member (A) consists mainly of alternating dolomite, argillaceous limestone, shale and cherty argillaceous limestone. The middle member (B) consists mainly of variably cherty argillaceous limestone, cherty, calcareous shale, cherty limestone, limestone, calcareous shale and minor shale. One of the features distinguishing member B from the underlying member A is the great increase in chert. Member B grades upward into Member C which consists of a monotonous succession of alternating calcareous shale, argillaceous limestone, limestone and shale. On Bathurst Island, the formation is exposed mostly along the eastern side and also in the cores of several anticlines farther west.

The Cape Phillips Formation occurs in four of the wells under discussion: Hotspur (Appendix Id), Young Inlet (Appendix Ie), Caledonian River (Appendix If) and Allison River (Appendix Ig) wells. Three members, which are probably the same as the ones on Cornwallis Island, can be recognized in the wells. Tops and thicknesses are listed in Table 6.

Lithology

Member A consists of shale and dolomite with shale forming more than half of the section. The shale is black, in part dolomitic or calcareous, and bituminous. Some of it is siliceous. The dolomite is very dark grey and argillaceous. Crystal size of the dolomite varies; it is finely crystalline in the Caledonian River well, whereas it is medium crystalline in the Allison River well. In the Young Inlet well, the lithology of member A is different. There it consists of calcareous shale, interbedded with light grey-brown lime-mudstone and minor skeletal wackestone. No fossils were observed in the Allison River and Caledonian River wells. Fragments of graptolites, brachiopods, and crinoids are present, however, in the Young Inlet well. In all three wells, the base of the member is formed by a distinct dolomite or limestone bed about 10 to 15 m (30-50 ft) thick.

TABLE 6. Thickness of subdivisions of Cape Phillips Formation.

	B.P. *et al* Panarctic Hotspur J-20				Sun K.R. Panarctic Young Inlet D-21				Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34				Sun KR Panarctic Allison River N-12			
	Top		Thickness		Top		Thickness		Top		Thickness		Top		Thickness	
	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet
Member C	3375.1	11 073	+460.6	+1511	581.6	1908	329.8	1082	644.4	2114	422.4	1386	2295.8	7532	778.1	2553
Member B									1066.8	3500	94.5	310	3073.9	10 085	123.5	405
Member A					911.4	2990	69.5	228	1161.3	3810	93.0	305	3197.4	10 490	109.1	358
Total			+460.6	+1511			399.3	1310			609.9	2001			1010.7	3316

GSC

Member B is present only in the Allison River and Caledonian River wells. It consists of black chert and siliceous and argillaceous dolomite. The dolomite is dark brown, finely and medium crystalline.

Member C comprises shale, interbedded in the lower part with varying proportions of limestone. The shale is very dark grey and micaceous. Locally it is calcareous or dolomitic and may contain silt. The calcareous shale is dominant in the Hotspur well. Two distinct types of limestone are present in member C. Most of it is medium to dark grey, argillaceous lime-mudstone, in part gradational to calcareous shale. Subordinate intervals of silty or dolomitic, argillaceous limestone are present. The second variety of limestone occurs only in the Hotspur well. It contains pelletoids and skeletal fragments and ranges in texture from wacke- to grainstone. The limestone in core 12 (12 523-12 535 ft, 3817.0-3820.7 m) of the Hotspur well is very uniform, very dark grey lime-mudstone with floating skeletal fragments.

The shale in the upper part of the unit is uniform, very dark grey and noncalcareous. Several cores from the upper shale interval are available (Allison River well: core 1, 9450-9471 ft, 2880.4-2886.8 m; Caledonian River well: core 2, 2554-2572 ft, 778.5-784.0 m; Hotspur well: core 10, 11 295-11 318 ft, 3442.7-3449.7 m; core 11, 11 916-11 924 ft, 3632.0-3624.4 m). The shale is generally laminated by variations in the calcareous, dolomitic or silt content. Core 10 of the Hotspur well contains skeletal material in the laminae. In the lower part of that core, distinct upward-fining beds are present. In core 11, the lamination has a dip of approximately 20°.

The lower boundary of the Cape Phillips Formation is sharp and was drawn below a continuous, distinct carbonate bed. The upper boundary is gradational. In the Allison River, Caledonian River and Young Inlet wells, the boundary was picked on the gamma ray logs at an upward decrease in radioactive material. This boundary coincides approximately with an increase of silty and sandy material above and a change from noncalcareous to calcareous shale. In the Hotspur well similar characteristics were used, but there the overlying unit 1 of the Eids Formation does not show an increase in coarser clastic material.

The member boundaries are based on the chert content and lack of radioactive material in member B. Member B is not present in the Young Inlet well and there the boundary between members A and C was drawn tentatively above a minor occurrence of chert and below a shale-limestone unit similar to one in the same stratigraphic position in the Caledonian River well.

Mode of origin

The Cape Phillips Formation is a deep-water facies deposited in the basin off the Read Bay, Cape Storm and Allen Bay carbonates and off the unnamed dolomite of the Hent Horn N-72 well. Pelagic fossils like graptolites and the fine terrigenous nature of the sediment provide ample evidence for this. Thin upward-fining cycles with skeletal material (Hotspur well, core 10) may be the distal parts of turbidites which descended from the Silurian carbonate shelf. Other interbedded limestones are dark, argillaceous and of deep-water origin. The decrease in thickness of the formation away from the carbonate shelf, as shown in the Young Inlet well which is about equidistant from Silurian carbonates on Grinnell Peninsula and Cornwallis and Vanier Islands, indicates deposition of the formation as a belt with lenticular cross-section along the edges of the carbonate platform and seaward banks. Where the formation is thick, the wells (Hotspur and Allison River) are closer to Silurian carbonate buildups. The thickening is accompanied by an increase in the amount of interbedded carbonates which were probably derived mostly from the Silurian shelf.

Age and correlation

Several faunas were collected from the Cape Phillips Formation. The oldest one consists of conodonts in the Young Inlet well (GSC loc. C-58249/2860-2960; *see* Appendix III), and has an age of late Middle or Late Ordovician. Younger faunas are present in the cores of the Hotspur well (McGregor *et al.*, 1974) and these give the penetrated part of the formation an age range from latest Llandoverian to early Pridolian. Core 1 of the Allison River well contained mid-Ludlovian (mid-Kopanian) graptolites (Norford, 1974); core 2 of the Caledonian River well contained late Pridolian graptolites (Kerr, 1974). In surface exposures, the formation has an age range from Late Ordovician (Ashgillian) to Early Devonian (Gedinnian) with the upper boundary becoming older northward. The same age range is present in the subsurface sections; in the Caledonian River well it is from Ashgillian to probably Early Devonian, while in the Hotspur well probably no Devonian strata are contained in the Cape Phillips Formation (Table 2). In the three eastern wells, member A is probably entirely Ordovician, and member C is Silurian and Devonian. The age of member B is not known.

Correlation of the lower boundary from well to well in the project area is on the basis of a basal carbonate zone, which is a distinct marker on gamma ray logs. The lower boundary of the Cape Phillips Formation is a time line and has been used as a marker on Figure 8. The correlation of members is based on the chert content and gamma ray log expression. In the Allison River and Caledonian River wells, member B is fully developed, but it pinches out farther north in the Young Inlet well. No members have been assigned to the sequence in the Hotspur well.

The upper part of the formation correlates with the unnamed dolomite in the Bent Horn N-72 well.

Unnamed dolomite

The unnamed dolomite is present only in the basal part of the Bent Horn N-72 well (Appendix Ic), below 14 260 feet (4346.5 m); 36.3 m (119 ft) of the unit were penetrated.

Lithology

The unit consists entirely of very light brown to white, medium to coarsely crystalline dolomite. Core 4 (14 349-14 379 ft, 4373.6-4382.7 m; Fig. 10) consists of variably vuggy and calcareous dolomite with vague nodular structures and traces of brecciation. Indistinct skeletal remains are present.

The upper boundary of the unnamed dolomite is very sharp and is presumably a disconformity (*see* below in section on correlation).

Mode of origin

The environmental origin of the penetrated unit is difficult to determine. The scattered fossil fragments and ?nodular structure may suggest an open platform with moderate water agitation.

Age and correlation

Core 4 yielded a poor fauna of conodonts and a fish scale (Copeland *et al.*, 1976), which indicate a probable age range from Ludlovian to Gedinnian. On Cornwallis Island that is the total age range of the Read Bay Formation (Thorsteinsson, pers. com., 1976). Thick dolomite units are not known from surface exposures of that formation. The lack of terrigenous material in the well suggests correlation with either member A or C of the Read Bay Formation. Dolomite similar to that in the Bent Horn N-72 well and in a comparable stratigraphic position forms the lower member of the Drake Bay Formation in the Sun Panarctic Russell E-82 well on Russell Island (Mayr, in press), about 295 km (183 miles) southeast of the Hotspur well.

On Cornwallis Island, the Disappointment Bay Formation overlies the Read Bay Formation with angular unconformity (Thorsteinsson and Kerr, 1968). On eastern Bathurst Island the lower contact of the Disappointment Bay Formation is also an unconformity, but there with the Stuart Bay Formation (Kerr, 1974). The sharp upper contact of the unnamed dolomite in the Bent Horn N-72 well and its correlation with the Read Bay Formation imply the possibility of a similar unconformable relationship with the overlying Disappointment Bay Formation.

Although exact time-stratigraphic correlation with other wells on Bathurst Island is not possible, the unnamed dolomite in the Bent Horn N-72 well correlates approximately with the upper part of the Cape Phillips Formation in the Hotspur, Young Inlet, Caledonian River and Allison River wells.

FIGURE 10. Unnamed dolomite. This is a medium crystalline, vuggy, slightly calcareous dolomite with irregular, nodular lamination. Panarctic Tenn. *et al.* Bent Horn N-72, core 4, 14 369.5 feet (4379.8 m).

DEVONIAN

Bathurst Island Formation

Introduction

The type-section of the Bathurst Island Formation (McLaren, 1963a) is at Twilight Creek on the northeastern part of Bathurst Island. There the formation is 1039.4 m (3410 ft) thick and comprises a monotonous sequence of very fine grained sandstone, siltstone and shale with minor interbeds of limestone and dolomite. The formation is exposed in the eastern part of Bathurst Island.

Three wells encountered the Bathurst Island Formation: Young Inlet (Appendix Ie), Caledonian River (Appendix If) and Allison River (Appendix Ig). Thicknesses and tops are listed in Table 7.

Lithology

In the Young Inlet, Caledonian River and Allison River wells, the Bathurst Island Formation consists of sandstone, interbedded with siltstone, shale and limestone. The sandstone forms about half of the sequence, while shale and siltstone make up most of the other half; limestone is subordinate. The sandstone is light grey, very fine grained, calcareous and impure. From thin sections it is estimated that only about 50% of the grains are quartz, most of the remainder are clastic carbonate. Heavy minerals, feldspars and mica are very rare or absent. Some thin sections contain up to 10% dark grains which are probably altered lithic fragments. The siltstone is similar in appearance and composition to the sandstone. The shale is dark grey, silty and calcareous or dolomitic. Skeletal fragments and carbonate intraclasts, together with quartz, form the silt-size component of the shale. Shale is most abundant in the lower 100 to 150 m (300-500 ft) of the formation, immediately above the lower boundary.

Chips from basic intrusions occur throughout the formation in the Allison River well but the dykes and sills are too thin to be distinguished in the logs.

The lower boundary of the Bathurst Island Formation is gradational. In the Young Inlet, Caledonian River and Allison River wells, it was drawn below an increase in sandy, silty and calcareous material above the relatively pure shales of the Cape Phillips Formation. The upper boundary is present only in the Allison River well. It was drawn below a limestone-shale sequence, which probably correlates with the patch reefs reported from the base of the Stuart Bay Formation (Kerr, 1974). The upper contact has a sharp expression on the gamma ray log and is probably an unconformity (Kerr, 1974).

Mode of origin

The general lack of benthonic fauna, the reworked carbonate and lithic clasts confirm Kerr's (1964) interpretation of the Bathurst Island Formation as a flysch deposit. No cores are available to indicate the presence of graded bedding, which has been reported from surface outcrops. One possible area of provenance for the Bathurst Island Formation is the Boothia Uplift to the southeast (Miall and Gibling, in press). A northerly source can be postulated for at least the lower part of the formation. The age of the lower boundary (*see* next section on age and correlation) becomes younger southward and thus indicates a southward progradation of the flysch deposits. The formation must have filled a north-south elongated trough along the west side of the Cornwallis Fold Belt, elevated during the Early Devonian (Kerr, 1974, 1977). The formation thins drastically eastward (Kerr, 1974, Sec. 30) and also westward. In the Hotspur well, it is absent and correlative strata occur in the much thinner, lower part of the Eids Formation (*see* next section on age and correlation).

TABLE 7. Thickness of Bathurst Island Formation.

	Top		Thickness	
	metres	feet	metres	feet
Sun KR Panarctic Young Inlet D-21	Surface		+581.6	+1908
Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34	Surface		+644.4	+2114
Sun KR Panarctic Allison River N-12	433.4	1422	1862.4	6110

GSC

Age and correlation

From the fossils recovered in the wells (GSC loc. C-58249/420-500; Young Inlet well, Appendix III), it can only be said that the Bathurst Island Formation is of Devonian age. In surface exposures on Bathurst Island, the formation is mostly Siegenian and Gedinnian, but may reach into Emsian in the northernmost exposures on Helena Island (Kerr, 1974). In this report, for the area covered by the cross-section in Figure 8, a Siegenian and Gedinnian age has been presumed for the Bathurst Island Formation (Table 2).

In the three wells where the formation occurs, it is very uniform and no stratigraphic markers can be seen. The datum within the Bathurst Island Formation between Kerr's (1974) Section 20 and the Young Inlet well in Figure 8 is based on surface measurements. Kerr (1974, Sec. 21) describes 760 m (2500 ft) of the formation from the northern flank of the Young Inlet anticline. This thickness is the minimum which has to overlie the sequence of the Young Inlet well which was drilled on the crest of the anticline. Westward, toward the Hotspur well, the formation disappears and is replaced by the finer grained and more calcareous Eids Formation. Thus strata of Siegenian-Gedinnian age, more than 1200 m (4000 ft) thick in the Young Inlet area, are reduced to probably less than 300 m (1000 ft) in the Hotspur well.

The lower boundary of the Bathurst Island Formation is diachronous and becomes older northwestward (Kerr, 1974). Thus the lower part of the formation correlates in part with the Cape Phillips Formation (Fig. 8).

Stuart Bay Formation

Introduction

The Stuart Bay Formation was first described by McLaren (1963a) from the Twilight Creek area (Fig. 1). There it consists of 371.9 m (1220 ft) of calcareous, argillaceous sandstone and irregular beds of bioclastic limestone. The basal 6 m (20 ft) contain several pebble beds. Farther south (Secs. 34, 35 of Kerr, 1974; *see* Fig. 1) limestone reefs form the base of the formation. In the southeastern part of Bathurst Island two members can be distinguished. The lower member consists of carbonates and siltstone, and the upper one comprises dolomite, dolomitic, sandy siltstone and sandstone. The formation is exposed extensively in the eastern part of Bathurst Island.

The Stuart Bay Formation was encountered only in the Allison River well (Appendix Ig), in the interval from surface to 433.4 m (1422 ft).

Lithology

The penetrated part of the Stuart Bay Formation can be subdivided into two units. Unit 1 consists of interbedded shale and limestone, most of the shale forming the middle part of the unit. The limestone is medium to dark grey and exhibits a variety of textures. Most abundant is mainly argillaceous, silty or dolomitic lime-mudstone. Limestones containing skeletal fragments are common and range in texture from skeletal wacke- to packstone. Subordinate are occurrences of lump-wackestone. The shale of unit 1 is very dark grey, calcareous and locally silty. Unit 1 is fossiliferous, containing abundant fragments of brachiopods, crinoids and tentaculitids.

Unit 2 is formed by sandstone and siltstone with minor interbeds of shale and dolomite. Sandstones form the upper half of the unit, the other lithologies are dominant in the lower part. The sandstone is yellow-grey and fine grained. It is impure and contains (visual estimate) up to 15% lithic fragments and carbonate grains. The siltstone is brown-grey, and mainly dolomitic and argillaceous. It is gradational in composition to very finely crystalline, silty dolomite.

The lower boundary of the Stuart Bay Formation is sharp and was drawn on the gamma ray log below the first limestone occurrence. It is reported to be an unconformity in the easternmost parts of Bathurst Island (Kerr, 1974).

Mode of origin

The Stuart Bay Formation is the first indication that the deep basin sedimentary regime of the underlying Bathurst Island Formation ceased and was replaced by sedimentation on a shelf slope or alone a shelf edge. The abundant shale, argillaceous lime-mudstone and tentaculitids in unit 1 attest to pelagic or deep neritic conditions, but the occurrence of skeletal and pelletoidal wackestone, if not redeposited and belonging to the basal conglomerate, may indicate that at least locally the sea was shallower than during the deposition of the Bathurst Island Formation.

Age and correlation

Mega- and microfossils are present in unit 1 of the Stuart Bay Formation (GSC loc. C-18157/1300-1350; Appendix III; Norris, 1977). The collections give a Pragian age (late Gedinnian to early Siegenian) for the lower part of the formation. This is approximately the same as that of the lower part of the Stuart Bay Formation in Section 20 of Kerr (1974) (McGregor and Uyeno, 1972). The upper part of the formation reaches Emsian (Kerr, *ibid.*; McGregor and Uyeno, *ibid.*) in the section (Table 2).

Kerr (1974) distinguished two members of the Stuart Bay Formation in southeastern Bathurst Island. The lower member comprises siltstone, thin-bedded dolomite with coarse boulders of chert, dolomite and limestone with coarse boulders of chert, dolomite and limestone as well as reefoid horizons; the upper member consists of dolomite and dolomitic siltstone with quartz sand. Units 1 and 2 in the Allison River well appear to have corresponding lithologies and may correlate with the two members.

The formation does not occur in any other of the wells under discussion. Time-equivalent beds in the Hotspur well are the upper part of the Eids and lower part of the Blue Fiord Formations (Fig. 8).

Eids Formation

Introduction

The Eids Formation was established for calcareous and dolomitic mudstones and siltstones on southern Bjorne Peninsula (McLaren, 1963b). The thickness in the type area is in excess of 300 m (1000 ft). On Bathurst Island the formation is between 300 and 600 m (1000 and 2000 ft) thick and comprises two distinct facies (Kerr, 1974). The western facies is typical and consists of calcareous siltstone, limy shale, grey to green calcareous, soft micaceous shale and minor shaly limestone. The transitional facies farther east is composed mainly of thin-bedded resistant carbonates. It grades westward into the typical facies of the Eids Formation and eastward into the dolomite of the Disappointment Bay Formation. The Eids Formation is exposed extensively on eastern and central Bathurst Island.

Both facies of the Eids Formation were encountered in the wells under discussion. The typical facies is present in the Hotspur well (Appendix Id). There the formation is 383.2 m (1257 m) thick and spans the interval from 9816 to 11 073 feet (2991.9-3375.1 m). The interval from 12 489 to 12 677 feet (3806.7-3864.0 m; 188 ft, 57.3 m thick) in the Bent Horn N-72 well (Appendix Ic) has been tentatively assigned to the transitional facies of the Eids Formation.

Lithology

In the Hotspur well, the Eids Formation comprises two units. Unit 1 (10 630-11 073 ft, 3240.0-3375.1 m; 135.1 m 443 ft thick) consists of very dark grey, calcareous shale. Unit 2 (9816-10 630 ft, 2991.9-3240.0 m; 248.1 m, 814 ft thick) is formed by shale interbedded with limestone and subordinate siltstone. The limestone is most abundant in the uppermost part of the interval, whereas the siltstone occurs in the middle part of the unit. The shale is dark grey, calcareous, silty and micaceous. The limestone is dark brown and has skeletal wackestone or lime-mudstone texture. The siltstone is light grey and calcareous. Core 9 (10 114-10 134 ft, 3082.8-3088.8 m) of the Hotspur well comes from the middle part of the Eids Formation. It consists of dark grey, silty shale, interlaminated with calcareous siltstone (Fig. 11). Unit 2 is fossiliferous and contains abundant tentaculitids and minor crinoid fragments.

In the Bent Horn N-72, the Eids Formation consists of white to light brown, medium crystalline dolomite, interbedded with dark brown, finely crystalline dolomite. Both varieties are variably calcareous. The dark brown dolomite is argillaceous. No shale was observed in the samples. In the upper part of the unit, white chalky limestone is present, but this may be cavings from the Blue Fiord Formation immediately above. The unit is sparsely fossiliferous.

In the Hotspur well, the lower and upper boundaries of the Eids Formation are gradational. The lower boundary was drawn at a change from non-calcareous to calcareous shale, and unit 1 may be regarded as a transition zone from the Cape Phillips to the Eids Formation. The upper boundary is based on a sharp, upward increase in limestone and is placed below a vertically continuous limestone unit. The uppermost 20 m (60 ft) of the Eids Formation thus consist of limestone and shale interbedded in equal proportions and grade downward into shale with less interbedded limestone. In the Bent Horn N-72 well the upper and lower boundaries also appear to be gradational and conformable.

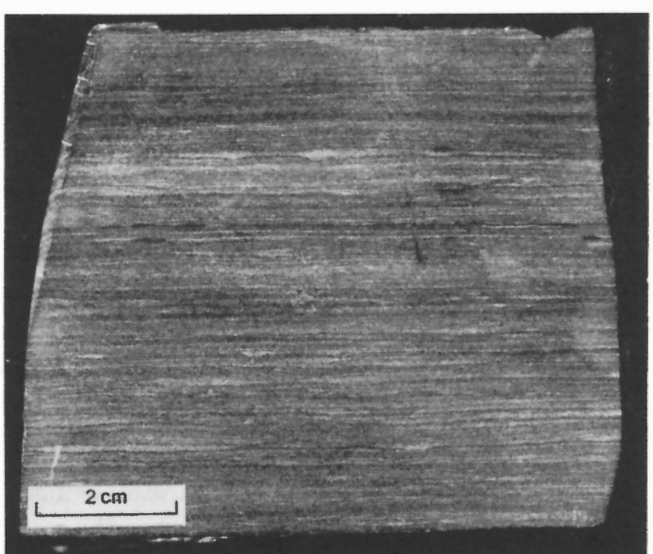


FIGURE 11. Eids Formation, laminated siltstone. This siltstone is very finely and very regularly laminated. The light laminae consist of silt-size quartz and calcite grains with lesser amount of mica flakes. The dark laminae comprise finer grained particles and an argillaceous matrix. BP *et al.* Panarctic Hotspur J-20, core 9, 10 114.3 feet (3082.8 m).

Mode of origin

The Eids Formation in the Hotspur well is interpreted as a formation intermediate between the underlying pelagic Cape Phillips and the deep reef flank deposits of the overlying Blue Fiord Formations. Tentaculitids show pelagic influences, but abundant crinoids and brachiopod fragments, presumably transported from a shallower Disappointment Bay "shelf", may make slope deposition the most likely origin for the Eids Formation. Bioturbation, characteristic of shelf sequences, was not seen in the cored interval of the formation (core 9, Hotspure well; Fig. 11).

The Eids Formation in the Bent Horn N-72 well is difficult to interpret on the basis of the available information. The relatively high argillaceous and shaly content of the unit, as expressed by the gamma ray log, may indicate an environment deeper than that of the underlying and overlying formations.

Age and correlation

Macrofossils are available from the Eids Formation in the Hotspur well. Core 9 (10 114-10 134 ft, 3082.8-3088.8 m; GSC locs. C-11481 to C-11486 *in* McGregor *et al.*, 1974) yielded early Emsian brachiopods. The total maximum age range is determined by the Silurian graptolites of the Cape Phillips Formation in core 10 about 70 m (200 ft) below the base of the Eids Formation and is thus from earliest Devonian or late Silurian to early Emsian (Table 2). No age is available for the Eids Formation in the Bent Horn N-72 well, but there a conodont fauna, about 150 m (500 ft) above the upper boundary (GSC loc. C-58284/12 000-12 100; *see* Appendix III) indicates Emsian age; thus the Eids Formation in the Bent Horn N-72 well is of Emsian or older age (Table 2). In outcrop (Fig. 8, lithological column 5) the formation is late Emsian and Eifelian in age (McGregor and Uyeno, 1972).

There is no obvious lithological correlation between the two subsurface occurrences of the Eids Formation. Northward, most of the Eids Formation in the Hotspur well is equivalent to the carbonates of the Disappointment Bay Formation in the Bent Horn N-72 well (Fig. 8). The unit in the Bent Horn N-72 well, tentatively assigned to the Eids Formation, provides a convenient separation for the carbonate succession into Disappointment and Blue Fiord Formations. At present it is not known whether the unit is regionally persistent or is only a local bank edge phenomenon. If the latter, the Disappointment Bay has to be distinguished from the Blue Fiord Formation on the basis of dolomite versus limestone as done by Kerr (1974). This would coincide with the usage of this report if the highest dolomite was used, but formation definitions based on diagenetic features are generally unsatisfactory.

In other subsurface sections the Eids Formation of the Bent Horn N-72 well may correlate with the "unnamed dolomite-shale formation" of Miall (1976) in the Deminex CGDC FOC Amoco Orksut I-44 well on Banks Island. This unit is in a comparable stratigraphic position, about 600 m (2000 ft) below the top of the Blue Fiord Formation and about 150 m (500 ft) below an Emsian fauna.

The differences between the Eids Formation and the Cape De Bray Formation are subtle. There is possibly more calcareous material in the Eids Formation, whereas the Cape De Bray Formation appears to be more sandy and silty. However, without the intervening Blue Fiord, the two formations merge and are practically indistinguishable. In this report, use of nomenclature is arbitrary (Fig. 8). Where the two formations are separated by the Blue Fiord Formation, the terms Cape De Bray and Eids Formation are used. In all other areas the total shale-siltstone sequence is called Eids Formation.

The stratigraphical nature of the lower part of the Eids Formation in the Hotspur well is problematical. The age range of the formation in this well is from earliest Devonian or latest Silurian to early Emsian and the thickness is about 400 m (1300 ft). In the Young Inlet area, the same stratigraphic interval is at least 1500 m (5000 ft) thick and comprises the Bathurst Island and probably part of the Stuart Bay Formation (Fig. 8). The boundary between the Eids and Cape Phillips Formations in the Hotspur well shows no sign of a hiatus and thus it is probable that Siegenian and Gedinnian strata are present in the lower part of the Eids Formation. Consequently, the Eids Formation and the lower part of the Blue Fiord Formation in the Hotspur well correlate with the Bathurst Island and Stuart Bay Formations in the Young Inlet area, while the Eids Formation in the Young Inlet area correlates with the upper part of the Blue Fiord Formation and the Cape De Bray Formation in the Hotspur well (Table 2).

Disappointment Bay Formation

Introduction

The Disappointment Bay Formation was defined by Thorsteinsson (1958) on Cornwallis Island where it consists of three units. The base is formed by up to 120 m (400 ft) thick conglomerates. This is overlain by a middle unit of sandy or conglomeratic dolomite, 3 to 15 m (10-50 ft) thick and an upper unit of dolomite, 120 to 150 m (400-500 ft) thick (Thorsteinsson and Kerr, 1968). The formation is extensively exposed on eastern Bathurst Island, where it is up to 600 m (2000 ft) thick and comprises dolomite with varying amounts of terrigenous material.

Two carbonate units in the Bent Horn N-72 well between 12 677 and 14 260 feet (3864.0 and 4346.5 m) have been assigned to the Disappointment Bay Formation (Appendix Ic). Total combined thickness of the units is 482.5 m (1583 ft).

Lithology

Unit 1 (13 560-14 260 ft, 4133.1-4346.5 m) is 213.4 m (700 ft) thick and consists of dolomite and subordinate limestone and shale. In the lower half of the unit, the dolomite is very light brown, interbedded with dark to very dark brown dolomite. The light-coloured dolomite is medium crystalline, calcareous and a large part of it can still be recognized as a skeletal grainstone. The dark dolomite exists as both medium and finely crystalline varieties; it is calcareous and appears to be dolomitized pack- and wackestone. In the lowest part of the unit the dolomite becomes argillaceous and grades into dark grey-brown, dolomitic and calcareous shale.

The dolomite in the upper half of the unit is very light brown, medium crystalline and calcareous. Evidence of skeletal grainstone texture is present, but rare. The unit is moderately fossiliferous in the lower part and contains crinoids, brachiopods and ostracodes.

Unit 2 (12 677-13 560 ft, 3864.0-4133.1 m) is 269.1 m (883 ft) thick. It overlies unit 1 with gradational contact. The boundary was drawn where limestone accounts for more than half of the material in the samples. Unit 2 consists of limestone, interbedded in the lower part with dolomite. The limestone is white and has a "chalky" appearance. Intraclasts are present and the texture appears to vary from lime-mudstone to pelletoid grainstone. Coated grains were also observed in thin section. Matrix consists of very finely crystalline microspar, at least in part of neomorphic origin. Very light brown micritic lime-mudstone is also present, but rare. The amount of microspar decreases downward. In the lower part of the unit are minor amounts of skeletal grainstone and crinoidal mudstone. The interbedded dolomite in the lower part of the unit is white to very light brown, medium crystalline and variably calcareous.

Fossils, mostly crinoids, are present in the lower part of the unit.

Both the upper and lower boundaries of the Disappointment Bay Formation are distinct. The upper boundary appears to be conformable, while the lower boundary, on regional grounds (*see* section on age and correlation, unnamed dolomite), is interpreted as a disconformity.

The upper boundary is based on tentative assignment of the overlying unit to the transitional facies of the Eids Formation. Kerr (1974), on eastern Bathurst Island, used the dolomite-limestone contact to distinguish the Disappointment Bay Formation from the overlying Blue Fiord Formation (*see* section on age and correlation of Eids Formation).

Mode of origin

The Disappointment Bay Formation in the Bent Horn N-72 well appears to represent a shallowing-upward carbonate sequence. The skeletal wacke- and packstone and relatively abundant fauna in the lower part of unit 1 imply sedimentation on an open shelf. Skeletal content decreases upward and the wacke- and packstones are replaced by lime-mudstone compatible with an interpretation of platform interior for unit 2. Very shallow water (i.e. above wave base) for the upper part of unit 2 is also indicated by traces of coated-grain grainstone.

Age and correlation

No fossils suitable for dating could be extracted from the Disappointment Bay Formation. Thus the age is bracketed by a fauna from core 4 (bottom of well, GSC loc. C-30172, Copeland *et al.*, 1976) of Ludlovian to Gedinnian age and fauna C-58248/12 000-12 100 (*see* Appendix III) in the lower part of the Blue Fiord Formation above. This fauna is of Emsian age and thus the maximum age range of the formation in the Bent Horn N-72 well is from Late Silurian to Emsian (Table 2). At the surface on eastern Bathurst Island the formation has an Eifelian-Emsian age (Kerr, 1974).

The Disappointment Bay Formation in the Bent Horn N-72 well is similar to the one described from outcrops on eastern Bathurst Island (Kerr, 1974), which consists of dolomite with variable texture. The basal part is formed by conglomerate or sandstone, of which there is no evidence in the well. The Disappointment Bay Formation is a time-stratigraphic equivalent of the Eids Formation in the Hotspur well. It may also correlate with the "unnamed dolomite" of Miall (1976) in the Deminex CGDC FOC Amoco Orksut I-44 well on Banks Island.

Blue Fiord Formation

Introduction

At the type-section on southern Ellesmere Island (McLaren, 1963b), the Blue Fiord Formation is about 1200 m (3800 ft) thick and consists of two members. The lower member overlies the Eids Formation with gradational contact and comprises nodular limestone with small biostromes in the lower part, and calcareous mudstone and shale. It is about 730 m (2400 ft) thick. The upper member consists of coarse-grained bioclastic limestone.

In the report area (Kerr, 1974), the Blue Fiord Formation is present in surface exposures in the eastern and southern part of the Bathurst Island and attains a maximum thickness of 460 m (1500 ft) in the northeastern part of the island. Westward the formation grades into the shale of the Cape De Bray and Eids Formations. The lower part of the Blue Fiord Formation on Bathurst Island consists of micritic and micritic-skeletal limestone; some of the limestone has birdseye texture. The upper part comprises detrital-skeletal limestone, with fragmental skeletal material making up the bulk of the deposits. As well as the main occurrence of the formation on eastern and southern Bathurst Island there are two thin, isolated limestone patches on northern Bathurst Island and on Helena Island (Kerr, 1974).

The Blue Fiord Formation is present in four of the wells under discussion: Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib), Bent Horn N-72 (Appendix Ic) and Hotspur (Appendix Id). Thicknesses and tops are listed in Table 8.

Lithology

The Bent Horn N-72 well (Appendix Ic) penetrates a complete section of the Blue Fiord Formation, in which, based on abundance of skeletal material and argillaceous content, three distinct descriptive divisions with gradational contacts are present. Unit 1 is 274.1 m (899 ft) thick and spans the interval between 11 643 and 12 489 feet (3548.8 and 3806.7 m). The unit contains three "subunits" of different dominant lithologies. The lowest subunit extends from the base of unit 1 to about 11 910 feet (3630.2 m) and consists of white, "chalky", finely to medium

TABLE 8. Thickness of Blue Fiord Formation.

	Top		Thickness	
	metres	feet	metres	feet
Panarctic Cape Fleetwood M-21	3318.1	10 886	195.7+	642+
Panarctic *et al.* West Bent Horn C-44	3172.4	10 408	389.5+	1278+
Panarctic *et al.* Bent Horn N-72	3198.6	10 494	608.1	1995
B.P. *et al.* Panarctic Hotspur J-20	2631.6	8634	306.3	1182

GSC

crystalline, neomorphic limestone. Textures of lime-mudstone, skeletal wackestone and pelletoidal grainstone are preserved in some samples. Also traces of argillaceous limestone are present. The middle subunit (11 780-11 910 ft, 3590.5-3630.2 m) comprises pelletoidal pack- and grainstone. Most of the lumps have an opaque (?organic material) internal texture or rim. Smaller, homogeneous pelletoids are also present. The upper subunit is present between 11 780 feet (3532.6 m) and the top of unit 1. It consists of light to dark brown lime-mudstone which is argillaceous and dolomitic in the upper part. It grades upward into skeletal wacke- and packstone to form a gradational contact with the overlying unit 2. Fossil fragments are rare in unit 1.

Unit 2 is 182.2 m (598 ft) thick and occurs between 10 992 and 11 643 feet (3350.4-3548.8 m). It can be subdivided into two subunits on apparent differences in faunal content and texture. The lower subunit (11 440-11 643 ft, 3486.9-3548.8 m; 61.9 m, 203 ft thick) comprises light to dark brown skeletal wackestone, packstone and lime-mudstone. The chip samples are extremely fine and textural determinations are somewhat doubtful. Core 3 (11 500-11 530 ft, 3505.2-3514.3 m) comes from the subunit and is presumably representative. It consists almost entirely of dark grey, argillaceous and dolomitic crinoidal rud- and packstone (Fig. 16).

The upper subunit (10 992-11 440 ft, 3350.4-3486.9 m; 136.5 m, 448 ft thick) comprises lime-mudstone, skeletal wacke- and packstone and pelletoidal grainstone. Again cuttings samples are very fine and the determination of carbonate texture is tentative. Neomorphic microspar is present throughout the unit. The faunal content of the upper part of unit 2 appears to be richer and more varied. In addition to abundant crinoidal fragments, traces of stromatoporoids and brachiopods are present.

Unit 3 occupies the interval between 10 494 and 11 992 feet (3198.6-3350.4 m) and is 151.8 m (498 ft) thick. The cuttings samples of the unit are dominated by stromatoporoid fragments. These fragments form more than half of the samples in the upper, returned part and decrease to 10% or less in the lower part of the unit. Dark grey, argillaceous lime-mudstone and skeletal wackestone, both here interpreted as inter-stromatoporoidal matrix, form, together with clear calcite, the remainder of the unit. Cores 1 and 2 of the Bent Horn N-72 well give a clearer picture of texture and skeletal components. Core 2 (10 720-10 739 ft, 3267.5-3273.3 m, middle part of unit 3; Fig. 20) consists of stromatoporoidal floatstone with very dark grey, dolomitic and argillaceous, skeletal wacke- and packstone matrix. Dominant fauna are stromatoporoids, both hemispherical forms and *Stachyodes* sp. Corals and brachiopods are rare. In core 1 (10 520-10 539 ft, 3206.2-3212.3 m, uppermost part of unit 3), the texture changes upward from skeletal wackestone and lime-mudstone to grain-supported lithologies. The fauna of the core is dominated by corals. In the uppermost part they are encrusting *Alveolites* sp. (Fig. 13), while in the lower parts of the core cystiphyllid corals and *Aulopora* sp. are common. Crinoid fragments, brachiopods and gastropods are rare.

Traces of mineralization are present in the uppermost part of the Blue Fiord Formation. Cuttings samples from 10 520 to 10 540 feet (3206.5-3212.6 m) contained several chips of barite and fluorite (A.G. Heinrich, pers. com., 1977) which are probably derived from the interval 10 494 to 10 520 feet (3198.6-3206.5 m). Miall (1976) reported similar occurrences of fluorite from the uppermost part of the Blue Fiord Formation in the Elf *et al.* Storkerson Bay A-15 well on Banks Island. Barite is probably also present as unconsolidated sand in cavities in the uppermost part of the Blue Fiord Formation. (The completion report mentions that "gypsum sand" plugged the tool during drill-stem test #7, 10 490-10 525 ft, 3197.4-3208.0 m).

Lost circulation intervals and geophysical wireline logs indicate the presence of caverns in the upper part of the Blue Fiord Formation (10 520-10 595 ft, 3206.5-3229.4 m).

In the Cape Fleetwood well where only the upper part of the Blue Fiord Formation was penetrated (Appendix Ia), three units can also be distinguished. Unit 1 is represented by core 4 (11 500-11 528 ft, 3505.2-3513.7 m; Fig. 21) at the bottom of the well. It consists of stromatoporoidal float- and framestone with a grainstone matrix, the dominant clasts being skeletal fragments and pelletoids with micrite coating. The fauna consists of massive, hemispherical stromatoporoids which may form up to half of the core volume. Corals, brachiopods and crinoids are rare. The upper boundary of unit 1 was drawn tentatively at 11 460 feet (3493.0 m) on account of the increase in lime-mudstone in the cuttings samples above that depth.

Two basic lithologies form the samples of unit 2 (11 260-11 460 ft, 3432.1-3493.0 m). They are, firstly, slightly clotted micrite with calcispheres and, secondly, fine-grained grainstone of pelletoids and skeletal fragments with micritized rims. Unit 2 is apparently unfossiliferous. The lower part of unit 3 (11 080-11 260 ft, 3377.2-3432.1 m) consists of dark grey lime-mudstone interbedded with skeletal pack- and wackestone and coated-grain grainstone. Recognizable fossil fragments are rare. The upper part (10 886-11 080 ft, 3318.1-3377.2 m) is represented by core 3 (10 912-10 972 ft, 3326.0-3344.3 m) of the Cape Fleetwood well. The core consists of stromatoporoidal and coral float- and boundstone with skeletal pack- and wackestone matrix (Fig. 19). Almost all of the stromatoporoids are tabular, although some irregular shapes and rare *Stachyodes* sp. are present. Stromatoporoid content may reach an estimated maximum of 38%. Corals are most abundant in the middle part of the core (core unit 3; *see* Appendix II). They are varied and comprise *Alveolites* sp. colonies of various shapes, solitary rugose (cyathophyllid and cystiphyllid), and *Thamnopora* sp. and *Aulopora* sp. fragments. Brachiopods and crinoid fragments are present throughout the core but never make up more than an estimated 2% of the rock volume. Thin sections show the presence of calcispheres. Recrystallization is evident in the core and the matrix is partially changed to coarsely crystalline limestone. Intercrystalline vugs in the crystalline limestone are filled with ?pyrobitumen and fluoride cubes (Fig. 14).

Four descriptive subdivisions can be established in the W. Bent Horn C-44 well (Appendix Ib). Unit 1 (11 549-T.D. 11 686 ft, 3520.1-3562.0 m) consists of medium brown lime-mudstone with finely crystalline dolomite ?mottling and lamination. The unit is unfossiliferous except for rare skeletal clasts in the limestone.

Unit 2 (11 320-11 549 ft, 3450.3-3520.1 m), as in the underlying unit, consists of dolomitic, medium to dark brown limestone. More than half of it is lime-mudstone, but a high amount of crinoidal wacke- and packstone is also present.

Unit 3 (10 540-11 320 ft, 3212.6-3450.3 m) consists of three parts. The lower part, below 11 140 feet (3395.3 m), is similar to unit 1 and consists of medium brown, dolomitic lime-mudstone. Also present are light coloured, textureless, uniform lime-mudstone and pelletoidal grain- and packstone. The middle part (11 020-11 140 ft, 3358.9-3395.5 m) consists almost entirely of two varieties of dolomite. One is finely to very finely crystalline; the other is aphanocrystalline, clotted to pelletoidal and has microscopic birdseye texture (Fig. 12). The upper part of unit 3 consists of lime-mudstone. It is uniform in texture and possibly light and dark brown laminated. Several argillaceous zones are present. Unit 3 is virtually unfossiliferous.

FIGURE 12. Blue Fiord Formation, pelletoidal limestone.
A. This chip consists of silt-size pelletoids with indistinct boundaries which give the rock a clotted appearance. Internal cavity is filled with medium crystalline, sparry cement and finely crystalline, euhedral cement, the latter possibly recrystallized, silt-size void sediment. Origin of void may be shrinkage in an algal-trapped sediment.
B. Pelletoids of very fine sand size and smaller form the limestone of this chip. Larger interparticle spaces are filled by sparry cement. Panarctic *et al.* W. Bent Horn C-44, cuttings, 11 060 feet (3371.1 m).

FIGURE 13. Blue Fiord Formation, coral bindstone. Tabular *Alveolites* sp. entraps carbonate mud with sponge spicules, calcispheres and other delicate, very fine sand size skeletal debris. In hand-specimen, this entrapped mud has a light grey, porcellaneous appearance. Panarctic *et al.* W. Bent Horn N-72, core 1, 10 521 feet (3206.8 m).

FIGURE 14. Blue Fiord Formation, recrystallized pelletoidal grainstone. This limestone consists of a medium crystalline calcite mosaic with intercrystalline remains of dark micrite, pelletoids and rare skeletal fragments. Cuttings of this recrystallized lithology have a "chalky" macroscopic appearance. Panarctic Cape Fleetwood M-21, core 3, 10 935.6 feet (3333.2 m).

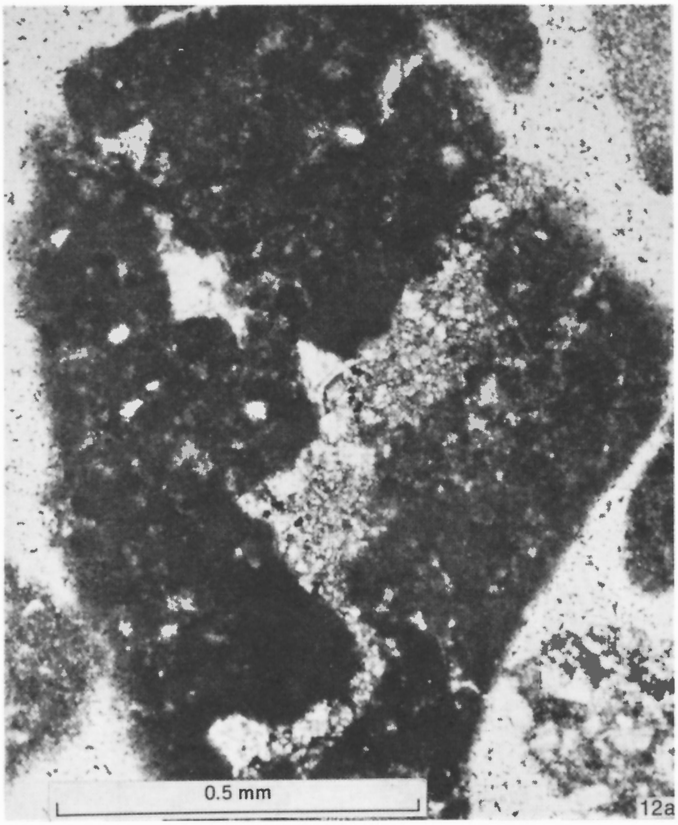


FIGURE 12a.

FIGURE 12b.

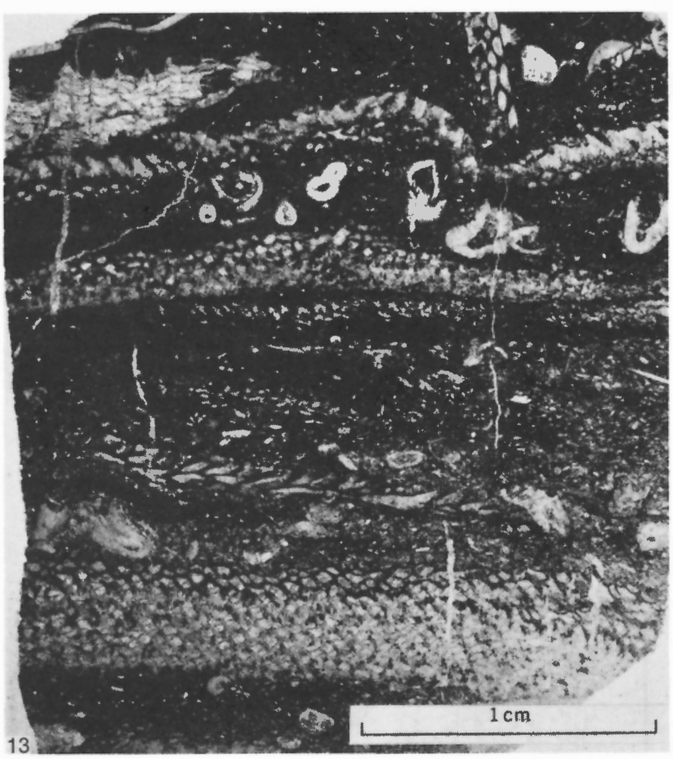


FIGURE 13.

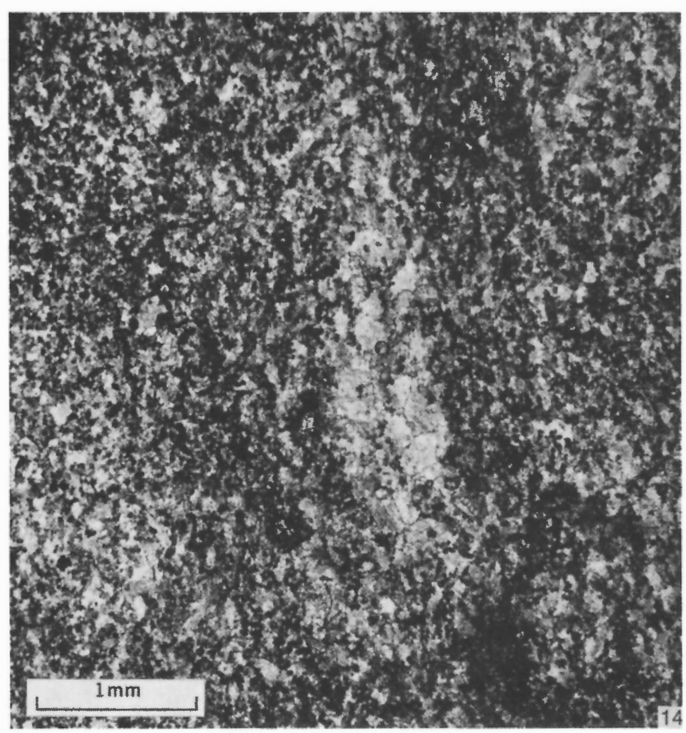


FIGURE 14.

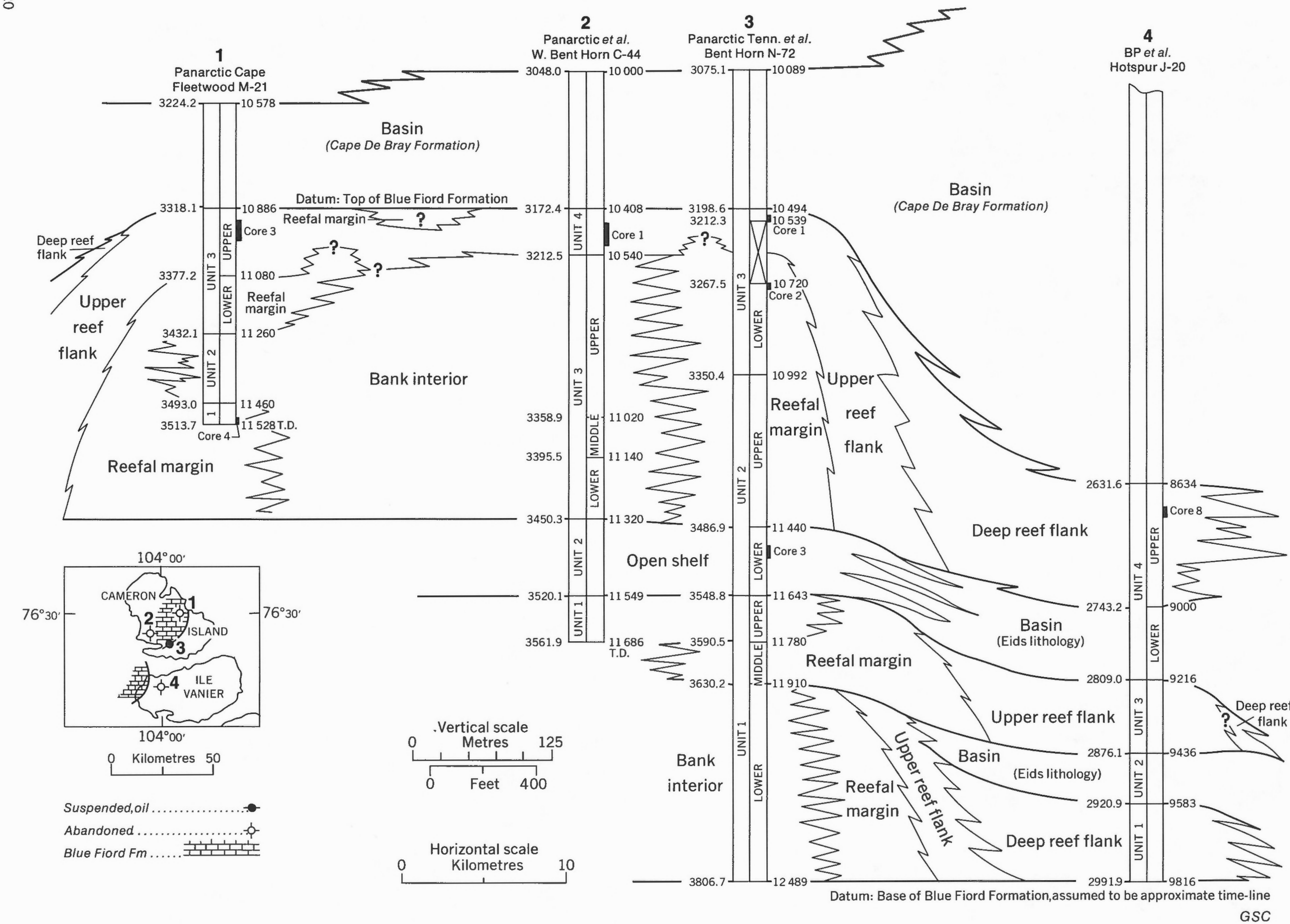


FIGURE 15. Schematic facies interpretation of the Blue Fiord Formation.

TABLE 9. Facies interpretation, Blue Fiord Formation, northwestern Bathurst Island area.

FACIES: This report	FACIES: Wilson (1975)		Panarctic Cape Fleetwood M-21: Unit	Panarctic Cape Fleetwood M-21: Main supportive evidence	Panarctic *et al.* West Bent Horn C-44: Unit	Panarctic *et al.* West Bent Horn C-44: Main supportive evidence	Panarctic Tenneco *et al.* Bent Horn N-72: Unit	Panarctic Tenneco *et al.* Bent Horn N-72: Main supportive evidence	B.P. *et al.* Hotspur J-20: Unit	B.P. *et al.* Hotspur J-20: Main supportive evidence
BASIN	I D								4 (lower part)	Shale, tentaculitids G
		metres							2743.2 - 2809.0	
		feet							9000 - 9216	
									2	Shale, tentaculitids G
		metres							2876.1 - 2920.9	
		feet							9436 - 9583	
OPEN SHELF	3D				2	Crinoidal packstone and wackestone F	2 (lower part)	Crinoidal wackestone, lime mudstone G		
		metres			3450.3 - 3520.1		3486.9 - 3548.8			
		feet			11 320 - 11 549		11 440 - 11 643			
DEEP REEF FLANK	Toe of slope, fore slope								4 (upper part)	Graded bedding G
		metres							2631.6 - 2743.2	
		feet							8634 - 9000	
									1	Stratigraphic position, crinoidal packstone P
		metres							2920.9 - 2991.9	
		feet							9583 - 9816	
UPPER REEF FLANK	5D-7D		3 (upper part)	Tabular stromatoporoids, matrix with high micrite content G	4	Coral bindstone and bafflestone, *stachgodes* sp. G	3 (Core 1)	Corals, matrix with high micrite content G	3	Rich fauna, including corals and stromatoporoids, skeletal grainstone to wackestone F
		metres	3318.1 - 3377.2		3172.4 - 3212.6		3202.2 - 3212.3		2809.0 - 2876.1	
		feet	10 886 - 11 080		10 408 - 10 540		10 506 - 10 539		9216 - 9436	
REEFAL MARGIN	8D, Sand on edge of platform		3 (lower part)	Coated grain grainstone, rare stromatoporoids P			3 (lower part)	Massive stromatoporoids, skeletal grainstone G		
		metres	3377.2 - 3432.1				3267.5 - 3350.4			
		feet	11 080 - 11 260				10 720 - 10 992			
							2 (upper part)	Coated grain and pelletoidal grainstone F		
		metres					3350.4 - 3486.9			
		feet					10 992 - 11 440			
			1	Massive stromatoporoids, coated grain grainstone G			1 (middle part)	Pelletoidal grainstone and packstone P		
		metres	3493.0 - 3513.7 T.D.				3590.5 - 3630.2			
		feet	11 460 - 11 528 T.D.				11 780 - 11 910			
BANK INTERIOR	12D, 13D		2	? Cryptalgal limestone, coated grain grainstone, calcispheres (graduational to reefal margin) P	1	Lack of fauna, pelletoidal packstone P	1 (upper part)	Lime mudstone, impoverished fauna P		
		metres	3432.1 - 3493.0		3520.1 - 3561.9 T.D.		3548.5 - 3590.5			
		feet	11 260 - 11 460		11 549 - 11 686 T.D.		11 643 - 11 780			
					3	Birdseye texture, impoverished fauna F	1 (lower part)	Lime mudstone, impoverished fauna F		
		metres			3212.6 - 3450.3		3630.2 - 3806.7			
		feet			10 540 - 11 320		11 910 - 12 489			

Level of confidence (good, fair, poor) see text for explanation ..... G, F, P

GSC

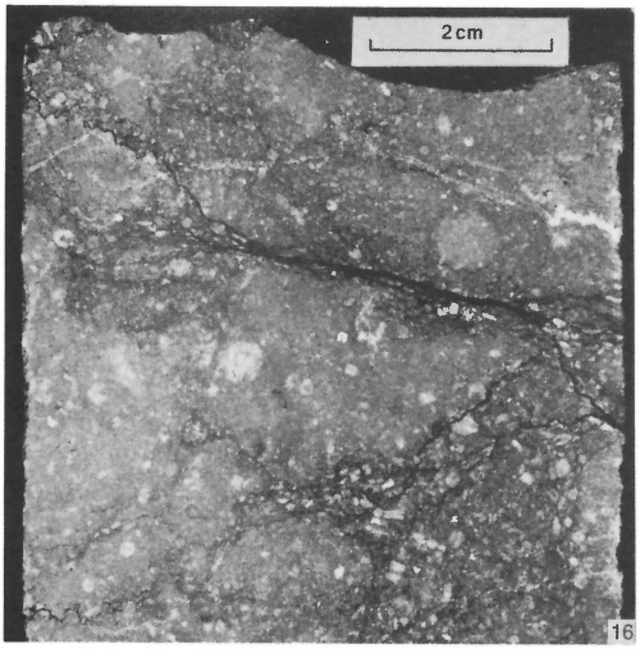


FIGURE 16. Blue Fiord Formation, open shelf facies. This skeletal packstone is composed dominantly of poorly sorted crinoidal debris with a matrix of micrite. Wilson's (1975) 3D facies is formed by this kind of lithology. Panarctic Tenn. *et al.* Bent Horn N-72, core 3, 11 501 feet (3505.5 m).

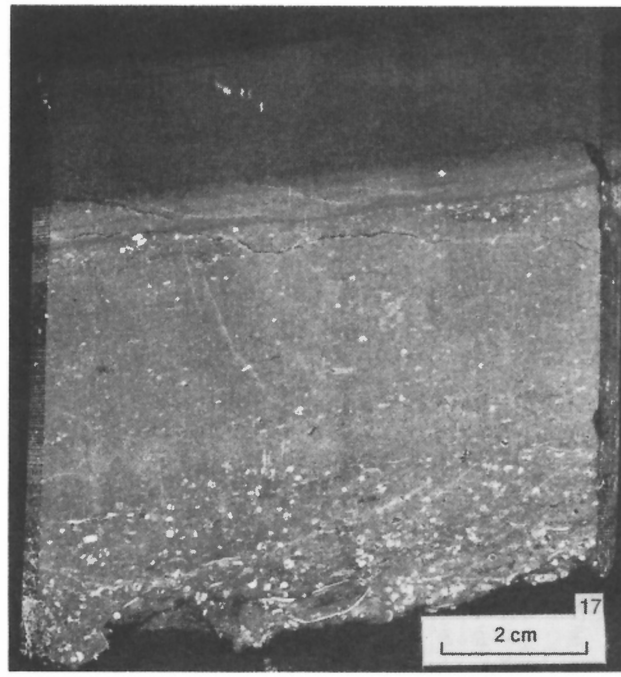


FIGURE 17. Blue Fiord Formation, deep reef flank facies. Graded bedding is the main evidence for the deep reef flank facies. In this sample, non-calcareous, black shale is very sharply overlain by skeletal pack- and wackestone which grades upward into lime-mudstone. The lime-mudstone in turn is in gradational contact with black shale. BP *et al.* Hotspur J-20, core 8, 8714.2 feet (2656.1 m).

Descriptive unit 4 forms the top of the Blue Fiord Formation and spans the interval from 10 408 to 10 540 feet (3172.4-3212.6 m). The cuttings samples consist mostly of lime-mudstone with minor skeletal wackestone and pelletoidal packstone. The lithology is best illustrated by core 1 (10 444-10 504 ft, 3183.3-3201.6 m; Fig. 18). It consists of coral float- and bafflestone with abundant *Thamnopora* sp. and encrusting *Alveolites* sp. Stromatoporoids are relatively rare. The matrix of the coralline intervals consists of dark, fine-grained, skeletal wackestone with abundant calcispheres.

A complete section of the Blue Fiord Formation is also present in the Hotspur well (Appendix Id). For descriptive and stratigraphic purposes the formation has there been subdivided into four units with gradational boundaries. The basal unit (1) is 71 m (233 ft) thick and extends from 9583 to 9816 feet (2920.9-2991.9 m). It consists mostly of dark-coloured crinoidal grain-, pack- and wackestone. Much less common lithologies are lime-mudstone, both pure and argillaceous which are present throughout the unit, and black chert in the upper part. The fauna is dominated by abundant crinoids. Tentaculitids and ostracodes are rare.

Unit 2 (9436-9583 ft, 2876.1-2920.9 m; 44.8 m, 147 ft thick) consists of shale in the lower part and limestone in the upper. The shale is very dark grey and calcareous. The limestone consists of dark grey, variably argillaceous lime-mudstone. The unit contains abundant tentaculitids; crinoids and brachiopods are rare.

Unit 3 (9436-9216 ft, 2876.1-2809.0 m; 67.1 m, 220 ft thick) is a limestone unit. It consists of medium to dark grey skeletal wackestone gradational to skeletal packstone. Also present is slightly argillaceous, dark grey lime-mudstone. The unit is very fossiliferous and contains brachiopods, corals, crinoids and tentaculitids.

Unit 4 is the uppermost unit of the Blue Fiord Formation in the Hotspur well. It is present between 9216 and 8634 feet (2809.0-2631.6 m) and is 177.4 m (582 ft) thick. It consists of limestone interbedded with shale, the shale dominant in the lower part of the unit, the limestone more common in the upper part. The limestone is dark brown and ranges in texture from argillaceous lime-mudstone to skeletal grainstone. The shale is very dark grey, calcareous, and gradational to argillaceous siltstone. Core 8 (8705-8725 ft, 2653.3-2659.4 m) displays the sedimentary relationships of the shale and various limestones. The core consists of a number of upward-fining cycles (Fig. 17), not exceeding 13 cm (0.43 ft) thick, with skeletal rud- and packstone at the base, grading upward into calcareous or noncalcareous shale. The unit is fossiliferous; brachiopods and crinoids are common in the upper part, tentaculitids are abundant in the lower, shale part. Corals are rare.

The lower boundary of the Blue Fiord Formation with the Eids Formation is gradational. The upper boundary is sharp and probably a disconformity in the Bent Horn N-72, W. Bent Horn C-44 and Cape Fleetwood M-21 wells. The abrupt change from shallow-water carbonates to deeper water shales, the cavernous (leached?) porosity of the Bent Horn N-72 well together with the barite sand recovered in the drill-stem test and the recrystallization which may indicate reaction to vadose or phreatic waters all point to a disconformity at the top of the Blue Fiord Formation.

Mode of origin

Although, with the information available at the time of writing, no single, obvious facies model can be developed yet for the Blue Fiord Formation in the northwestern part of the Bathurst group of islands, it is possible to outline a basic facies pattern from open basin to bank interior for the formation (Table 9, Fig. 15). Several assumptions were made:

1. No structural duplication or omission of sequence is present in the four wells.

2. Paleotopographical relief at the unconformity at the top of the Blue Fiord Formation can be neglected.

3. The base of the Blue Fiord Formation in the Hotspur well is approximately contemporaneous with the base of the formation in the Bent Horn N-72 well.

Six facies for the Blue Fiord Formation and equivalent shale formations are distinguished: basin, open shelf, deep reef flank, upper reef flank, reefal margin and bank interior.

"Basin" refers to deeper areas around the carbonate buildups where no or only minor detrital carbonate deposition took place. Although probably determined mostly by water depth, hydrographic as well as conditions of terrigenous supply may have been contributing factors to the developement and extent of the basinal facies. The facies is rich in pelagic fossils, in this particular case tentaculitids, and corresponds to Wilson's (1975) facies 1D. It is present in the Hotspur well as a lateral equivalent of the Blue Fiord carbonates, and in the lower part of this well is formed by tongues of Eids lithology. The Cape De Bray Formation is also a product of the basinal environment and in the Hotspur well is a lateral, argillaceous and silty equivalent to the Blue Fiord carbonates. The term "basin", as used in this context of local carbonate facies, is analogous to the term "slope" as used in the more regional discussions of the Eids and Cape De Bray Formations.

Carbonates that are interpreted to have been deposited below normal wave base and at some distance from shallow-water carbonate buildups are classed as "open shelf". They correspond to the sediments of Wilson's (1975) facies 3D. Two occurrences of this facies are present in the W. Bent Horn C-44 and Bent Horn N-72 wells. The two intervals presumably are part of the same event when water depth increased over the initial Blue Fiord carbonate bank (Fig. 16).

"Deep reef flank" is the environment for carbonates of mostly detrital origin, derived from the topographically higher reef. Wilson's (1975) "toe of slope" and "foreslope" form this facies. The facies was observed only in the Hotspur well, where it is very well represented by the graded crinoidal deposits in core 8, in the upper part of unit 4 (Fig. 17). Unit 1 in the Hotspur well with its large amount of crinoidal limestone may indicate open shelf facies, but has been placed in the deep reef flank facies because of its stratigraphical position. Deposition of this facies is visualized at the foot of the carbonate buildups. It is gradational to the carbonate basin facies and formed part of the highest portion of the Eids-Cape De Bray slope.

"Upper reef flank" refers to the higher part of the fore-reef. It includes Wilson's facies 5D to 7D. It is characterized by coral and stromatoporoidal baffle- and bindstone. Stromatoporoids are dominated by tabular forms and *Stachyodes* sp. (Figs. 18, 19). Rocks of this facies form unit 3 in the Hotspur well, the upper part of unit 3 in the Bent Horn N-72 well, unit 4 in the W. Bent Horn C-44 well and the upper part of unit 3 in the Cape Fleetwood well. Cores are present from the latter three intervals; for unit 3 in the Hotspur well upper reef flank facies was determined on the basis of a rich fauna in the cuttings samples and the stratigraphic position of the unit. The presence of an apparently continuous upper reef flank facies in the upper part of the carbonate buildup indicates sea level fluctuations and beginning tectonic instability during the last stage of Blue Fiord deposition. Water depth increased some tens of metres and deposition of reefal margin and bank interior carbonates was generally inhibited. In shallower spots, deposition of reefal margin carbonates may have persisted for some time, a possibility depicted in Figure 15. Contraction of the reefal margin into the central part of the Blue Fiord buildup is another possibility. The last episode would have been renewed lowering of sea level, still within the order of tens of metres, and subaerial exposure of the carbonates.

"Reefal margin" is the uppermost part of the seaward edge of the carbonate bank. It is above wave base and in an area of maximum turbulence. It is analogous to Wilson's (1975) facies 8D and includes also the sands of the bank margin. In the Blue Fiord carbonates, identification of this facies is based mainly on the presence of massive (hemispherical, irregular, non-flat and non-branching) stromatoporoids in cores (Figs. 20, 21) and of skeletal and other grainstone in cuttings samples. The best example of these facies is in core 4 (unit 1) of the Cape Fleetwood well which consists of a well-winnowed stromatoporoidal floatstone. The lower part of unit 3 of the same well was assigned to the reefal margin facies because of the presence of coated-grain grainstone in the cuttings samples. Similarly, pelletoidal and coated-grain grainstone is the main evidence for the uncored intervals in the Bent Horn N-72 well. In some cases the evidence is tenuous, as pelletoidal grainstone may also be found in the bank interior.

The last facies distinguished in the Blue Fiord carbonates is the "bank interior". It is the back reef facies and comprises Wilson's (1975) facies 12D and 13D. It is characterized by lime-mudstone, pelletoidal packstone, fenestral lamination, calcispheres and an impoverished fauna. In the lower part of the Blue Fiord Formation, the facies forms a large part of unit 1 in the Bent Horn N-72 well and the basal part of the Blue Fiord Formation in the W. Bent Horn C-44 well. For the upper part it is represented by unit 3 in the W. Bent Horn C-44 well.

According to seismic information (Meneley, 1976), both the Cape Fleetwood and the Bent Horn N-72 wells are at the margin of the Blue Fiord carbonate buildup, while the W. Bent Horn C-44 well is farther inward. The schematic facies cross-section in Figure 15, based on the preceding interpretation of lithologies, corroborates those well positions. The Cape Fleetwood and the upper part of the Bent Horn N-72 wells are dominated by reef flank and reef margin carbonates, whereas the W. Bent Horn C-44 well contains mostly carbonates deposited farther away from the margin.

FIGURE 18. Blue Fiord Formation, upper reef flank facies. This is a coral-stromatoporoid bafflestone with a very fine grained, skeletal wackestone matrix. In the uppermost part is an oval cross-section of a large cystiphyllid coral. The elongated, somewhat irregular shapes below that are compaction crushed, delicate solitary corals. The lower part of the core is dominated by cylindrical stromatoporoids, probably *Stachyodes* sp. Panarctic *et al.* W. Bent Horn C-44, core 1, 10 449.7 feet (3185.1 m).

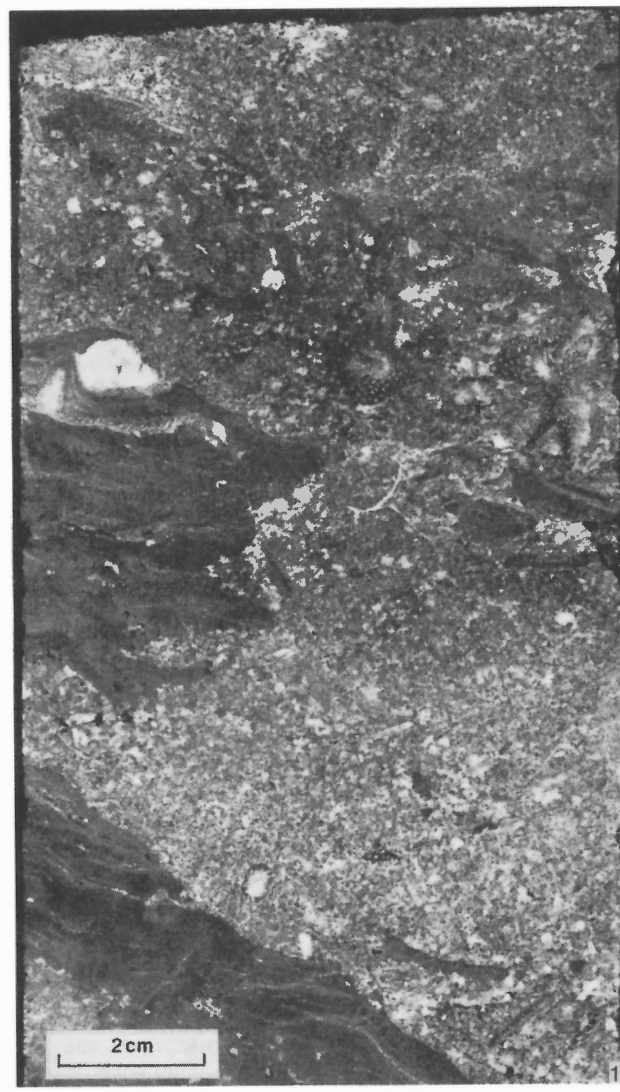
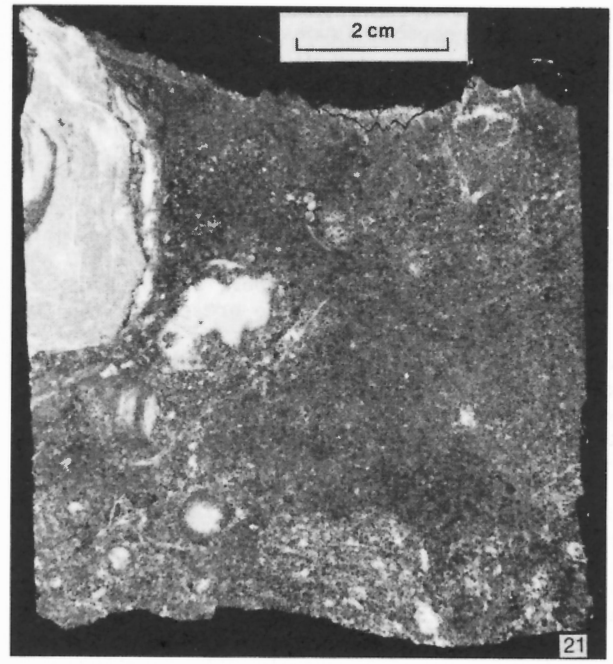


FIGURE 19. Blue Fiord Formation, upper reef flank facies. This core segment consists of tabular stromatoporoids in a partially recrystallized skeletal packstone matrix. Panarctic Cape Fleetwood M-21, core 3, 19 913.2 feet (3326.3 m).



↑ FIGURE 21. Blue Fiord Formation, reefal margin facies. Recrystallized skeletal floatstone forms the matrix that originally probably consisted of skeletal pack- or grainstone. At upper left is part of small spherical stromatoporoid, beside it an irregularly shaped *Alveolites* sp. colony. Round, dark rimmed, circular fossil in lower left is a cylindrical stromatoporoid. Panarctic Cape Fleetwood M-21, core 4, 11 519.1 feet (3511.0 m).

← FIGURE 20. Blue Fiord Formation, reefal margin facies. A massive stromatoporoid and a large *Alveolites* sp. colony are present in this core. Abundant also is *Stachyodes* sp. The matrix is slightly dolomitized and consists of skeletal packstone. Panarctic Tenn. *et al.* Bent Horn N-72, core 2, 10 720 feet (3267.5 m).

The sediments of the open shelf facies provide a natural subdivision for the carbonate complex into a lower and upper phase of reefal growth, separated by a transgression.

For reasons of completeness, the slope carbonates of the Hotspur well have been included in the cross-section of Figure 15 and correlated with the Bent Horn N-72 well to the north. It is, however, more likely that these carbonates are derived from the west, where the carbonate edge is much nearer.

In Table 9, an attempt has been made to express a level of confidence in the correctness of the facies interpretation. The grading is based on data quality and intuition. "Good" has been used only for intervals where core is available and for the basinal intervals in the Hotspur well where shale and tentaculitids make a different interpretation difficult. Intervals which are represented by cuttings only are classed as "fair" and were further downgraded to "poor" in cases where interpretations that differ from the model in Figure 15 are possible.

Age and correlation

Numerous conodont faunas were obtained from the Blue Fiord Formation. The oldest is from the Hotspur well (GSC loc. C-11488/9340-9440; *see* Appendix III), which is of late Emsian age and probably belongs to fauna 9 (Klapper *et al.*, 1971). About 200 m (700 ft) higher in the same section, another late Emsian fauna is present in core 8 of the Hotspur well (McGregor *et al.*, 1974). Late Emsian is also indicated for the lower part of the Blue Fiord Formation in the Bent Horn N-72 well (GSC locs. C-58248/11 500-11 530 and others, faunas 9 and 10 of Klapper; *see* Appendix III). The youngest conodont faunas are present in the three top cores of the formation, in the W. Bent Horn C-44 (core 1), Cape Fleetwood (core 3) and Bent Horn N-72 (core 1) wells (*see* Appendix III and Uyeno, 1977). They give an age of mid- or early Couvinian/Eifelian. Most probably it is middle Couvinian. Thus the formation has, where fully developed on Cameron Island, an age range from late Emsian to middle Eifelian. On Ile Vanier (Hotspur well), only the Emsian part is present (Table 2).

Well-to-well correlations have been discussed in some detail in the previous section (mode of origin). The upper, less argillaceous part (unit 3, Bent Horn N-72 well; unit 4 and the upper part of unit 3, W. Bent Horn C-44 well) appears to have stratigraphic significance, but it has to be found in some more wells before it can be used reliably. The open shelf facies (unit 2, W. Bent Horn C-44 well; lower part of unit 2, Bent Horn N-72 well) may also prove to be a unit than can be carried for some distance.

Elsewhere on Bathurst Island, the age of the Blue Fiord Formation is variable (Fig. 8). In Kerr's (1974) section 20 the formation appears to be younger as no Emsian is present; no physical connection exists between that occurrence and those of the Bent Horn area. There are, however, isolated, thin lenses between Young Inlet and Cameron Island (Kerr, 1974). In the southern part of Bathurst Island the formation has an Eifelian age (Kerr, *ibid.*).

Because of the variable age of the Blue Fiord carbonates, a number of facies changes are evident in Figure 8. The upper part of the Blue Fiord Formation in the Bent Horn N-72 well changes laterally into the Cape De Bray Formation, while the lower part is equivalent to the Eids Formation. Both shale formations are deeper equivalents of the shallower Blue Fiord carbonates and, in the case of the Eids Formation, it is apparent in the Hotspur well that the shale interfingers intimately with Blue Fiord Formation. For convenience, these shale tongues have been included in the Blue Fiord Formation. The interpretation adopted in this report, age equivalency between the Cape De Bray Formation and the upper part of the Blue Fiord Formation, is based on the perhaps tenuous evidence from poorly preserved spores (GSC loc. C-11488/7840-7920) in the Hotspur well. The consequence of the interpretation is simultaneous building up of carbonates and terrigenous sediments on a prograding slope. This is in contrast to Embry and Klovan's (1976) interpretation of the relationship of the same formations on Melville Island, where the Givetian Cape De Bray Formation filled deep basins between the carbonates after Blue Fiord sedimentation had stopped. The difference between the two interpretations is reconciled if the Cape De Bray Formation is considered a diachronous, westward-younging unit formed on a westward-prograding slope that during Eifelian was at Bathurst Island and by early Givetian had reached Melville Island.

TABLE 10. Thickness of Cape De Bray Formation.

	Top		Thickness	
	metres	feet	metres	feet
Panarctic Cape Fleetwood M-21	3224.2	10 578	93.9	308
Panarctic *et al.* West Bent Horn C-44	3048.0	10 000	124.4	408
Panarctic Tenn. *et al.* Bent Horn N-72	3075.1	10 089	123.5	405
B.P. *et al.* Panarctic Hotspur J-20	1961.4	6435	670.2	2199

GSC

Cape De Bray Formation

Introduction

Tozer and Thorsteinsson (1964) used the name Cape De Bray for the middle member of the Weatherall Formation which they described on Melville Island. Embry and Klovan (1976) raised Cape De Bray to formational status and selected a reference section at McCormick Inlet on northwestern Melville Island. There the formation is 915 m (3000 ft) thick and consists predominantly of medium to dark grey, non-calcareous, micaceous shale. Calcareous siltstone and very fine grained sandstone are rare.

The formation has not been recognized in surface exposures in the Bathurst Island area. Its presence in subsurface was first discovered by Embry and Klovan (1976). Four of the wells under discussion penetrated the formation: Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib), Bent Horn N-72 (Appendix Ic) and Hotspur (Appendix Id). Tops and thicknesses are listed in Table 10.

Lithology

In the four wells, the Cape De Bray Formation consists of siltstone interbedded with shale, the shale becoming more prominent in the lower part of the unit. The siltstone is medium grey, slightly calcareous and variably micaceous. In the upper part of the unit it is slightly sandy and decreases downward in grain size. The shale is medium grey to medium green-grey. Brachiopod, crinoid and undetermined fossil fragments are sparse throughout the formation. Cores 6 (6455-6475 ft, 1967.5-1973.6 m) and 7 (7518-7538 ft, 2291.5-2297.6 m) of the Hotspur well are from the Cape De Bray Formation. They consist of interlaminated siltstone and shale or argillaceous siltstone. In the middle part of core 7, a short interval of small inclined folds (Fig. 22) is present.

The lower boundary of the Cape De Bray Formation is very sharp and disconformable in the wells on Cameron Island. The upper boundary appears to be gradational. It is not immediately apparent as a lithological change in the cuttings samples but easily

TABLE 11. Thickness of subdivisions of Bird Fiord Formation.

	Panarctic Cape Fleetwood M-21				Panarctic *et al.* West Bent Horn C-44				Panarctic Tenn. *et al.* Bent Horn N-72				B.P. *et al.* Panarctic Hotspur J-20			
	Top		Thickness		Top		Thickness		Top		Thickness		Top		Thickness	
	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet
Unit 2	2485.6	8155	410.0	1345	2340.9	7680	451.1	1480	2223.8	7296	434.1	1424	1009.8	3313	951.6	3122
Unit 1	2895.6	9500	328.6	1078	2792.0	9160	256.0	840	2657.9	8720	417.2	1369				
Total			738.6	2423			707.1	2320			851.3	2793			951.6	3122

Units not distinguished in Hotspur well.
GSC

picked out by changes in gamma ray and dipmeter logs. In the Bent Horn N-72, the contact between the Bird Fiord and Cape De Bray Formations is probably a fault contact and at least one faulted interval of Cape De Bray Formation (9960-10 024 ft, 3035.8-3055.3 m) appears to be included in the lower part of the Bird Fiord Formation (interpretation from dipmeter log).

Mode of origin

The Cape De Bray Formation in the project area was deposited in an environment similar to that of the Eids Formation, that is, in relatively deep water on the slope along a terrigenous shelf (Embry and Klovan, 1976). The slope deposits interfingered along the lower part of the Blue Fiord reef flanks with carbonates and may also have abutted against escarpments of the growing Blue Fiord buildups. Changes in sea level stopped reef growth and the uppermost part of the Cape De Bray Formation covered the carbonate banks.

Age and correlation

A collection of palynomorphs (*see* Appendix III) was obtained from an interval at the upper boundary of the formation in the Cape Fleetwood well (GSC loc. C-58250/10 600-10 700); the spore assemblages give an age of early Givetian for the top of the formation. That, combined with the fact that the top of the underlying Blue Fiord Formation is of middle Couvinian/Eifelian age, gives a range from about middle Eifelian to early Givetian for the Cape De Bray Formation on Cameron Island (Table 2).

The range is greater in the Hotspur well where palynormophs from the upper part of the formation (GSC loc. C-10061; McGregor *et al.*, 1974) indicate an age of late Eifelian or early Givetian. This, together with the dates from core 8 (late Emsian; Mcgregor *et al.*, 1974), gives a maximum age range of late Emsian to early Givetian for the Cape De Bray Formation (Table 2).

The Cape De Bray Formation is diachronous (Fig. 8) and correlates in part with the Blue Fiord and Bird Fiord Formations. Farther afield, it correlates in age, stratigraphic position and lithology with most of the Orksut Formation (Miall, 1976) in the Deminex CGDC FOC Amoco Orksut I-44 well on Banks Island. It also correlates with unit 10 in Kerr's (1974) section 20 by virtue of its stratigraphic position and lithology (Fig. 8).

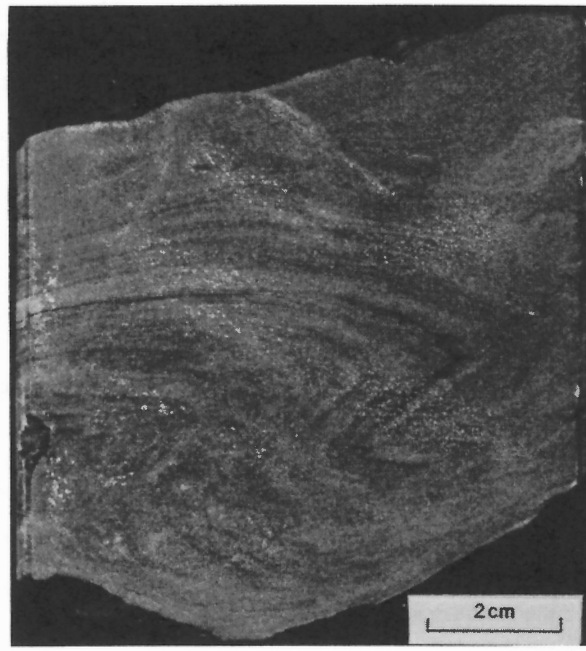


FIGURE 22. Cape De Bray Formation, folded siltstone. This is an impure, slightly calcareous, laminated siltstone. Impurities are mica flakes and white grains, probably chert. The small folds are thought to be subsidiary features in the core of a broad anticline. BP *et al.* Panarctic Hotspur J-20, core 7, 7520.3 feet (2292.2 m).

Bird Fiord Formation

Introduction

The Bird Fiord Formation was established on southern Ellesmere Island (McLaren, 1963b) for a variable succession of limestone, sandy limestone and shale, and sandstone with some gypsum, varying in thickness from 533.4 to more than 899.2 m (1750-2950 ft). Kerr (1968) mapped two members in the type area; the lower consists of sandy limestone and shale, the upper comprises calcareous and non-calcareous sandstone. On Bathurst Island (Kerr, 1974), the formation consists of calcareous, micaceous sandstone and sandy limestone, interbedded with sandy shale. It varies in thickness from less than 300 m (1000 ft) in the east to more than 700 m (2300 ft) in the central part of the island. It is generally exposed in the cores and along the flanks of synclines. The formation is present in four of the wells under discussion; Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib), Bent Horn N-72 (Appendix Ic) and Hotspur (Appendix Id), and can be subdivided into two units (Table 11).

Lithology

Unit 1 consists of siltstone interbedded with shale, with the siltstone accounting for more than half of the unit. The siltstone is light brown, calcareous, micaceous and variably argillaceous. There appears to be a tendency for a decrease in grain size from dominantly coarse-grained siltstone in the upper to fine-grained siltstone in the lower part of the unit. The shale is dark brown, micaceous and very slightly calcareous to non-calcareous. Core 2 in the Cape Fleetwood well (10 170-10 209 ft, 3099.8-3111.7 m) is from the middle part of unit 1. It consists of slightly calcareous siltstone with disrupted light and dark grey laminations. Several thin beds contain crinoidal and brachiopod debris. The siltstone laminae have a sharp lower boundary and grade upward into argillaceous, fine siltstone. Fossil fragments are abundant in unit 1 and are derived from crinoids and brachiopods.

Unit 2 overlies unit 1 with gradational contact. The boundary was drawn within a zone of gradual upward increase in the amount of very fine grained sandstone. The unit comprises sandstone, siltstone and shale, interbedded in about equal proportions. The sandstone is mostly white to light brown, very fine grained, angular and variably calcareous. In the upper part of the unit, zones with isolated skeletal grains occur in the sandstone whereas in the lower part the sandstone is persistently calcareous, including the cement. Subordinate grains in the sandstone consist of chert and mica; feldspars and heavy minerals like zircon and garnet are rare. The siltstone is medium to dark brown, micaceous and increasingly calcareous in the lower part of the unit. Grain size is variable and ranges from coarse and sandy to fine and argillaceous. The shale is medium grey to grey-brown and variably silty. Two units could not be distinguished in the Hotspur well where the complete formation consists of rocks that form unit 2 in the other three wells.

Three cores are available from the formation in the Hotspur well. Core 5 (5275-5295 ft, 1607.8-1613.9 m) is from the lower part of the formation, while cores 4 (4206-4236 ft, 1282.0-1291.1 m) and 3 (3890-3891.5 ft, 1185.7-1186.13 m) were taken from the upper half. Lithologies in all three cores are essentially the same. They consist of regularly interlaminated shale and siltstone with extensive traces of organic activity (Fig. 23). Very often the siltstone and shale laminae form couplets: the siltstone overlies the shale with sharp contact and grades upward into shale.

Fossil fragments are common in the lower part of unit 2 and have been derived from brachiopods and crinoids.

Embry and Klovan (1976) reported upward-coarsening cycles in the formation from outcrop sections on Bathurst Island. These can also be seen in some intervals on the geophysical wireline logs, for example between 9000 and 9210 feet (2743.2-2807.2 m) in the Cape Fleetwood well, at about 9800 feet (2987.0 m) in the W. Bent Horn C-44 well, between 7800 and 9375 feet (2377.4-2857.5 m) in the Bent Horn N-72 well (*see* also Embry and Klovan, 1976, Fig. 23), and around 5400 feet (1645.9 m) in the Hotspur well. The cycles in the wells are generally between 6 and 9 m (20-30 ft) thick.

The lower boundary of the Bird Fiord Formation with the Cape De Bray Formation is gradational and was drawn below the interbedded siltstone and shale of the Bird Fiord Formation and above the vertically persistent siltstone in the upper part of the Cape De Bray

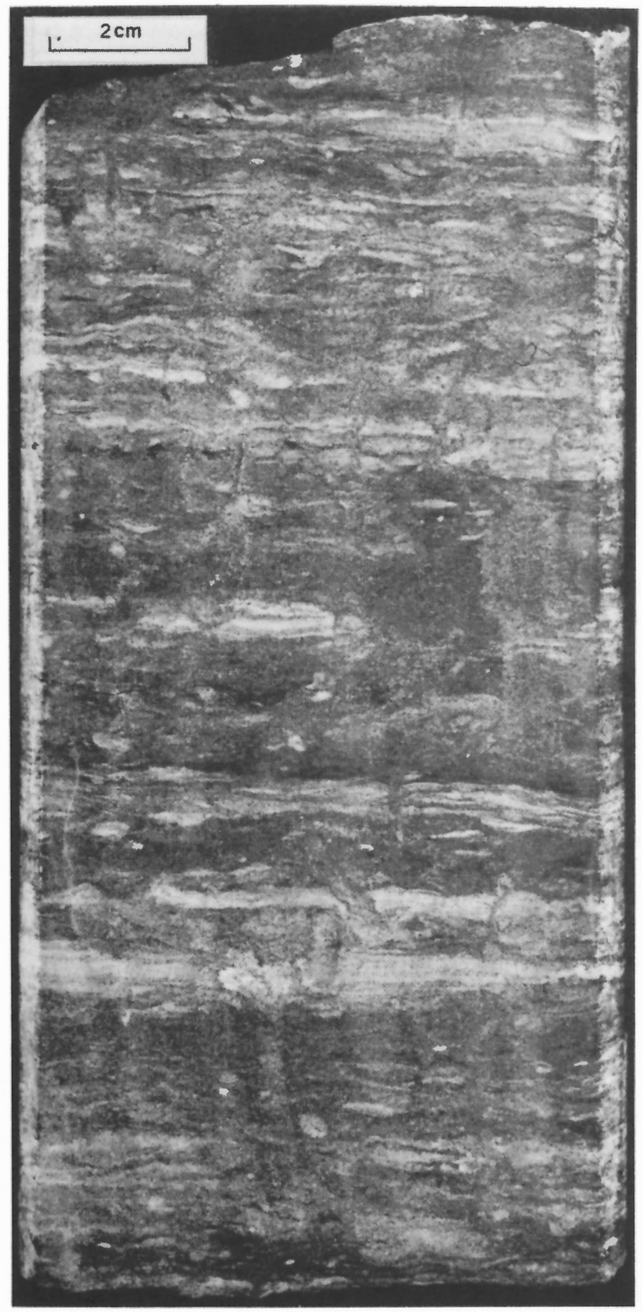


FIGURE 23. Bird Fiord Formation, burrowed siltstone. This is light coloured, calcareous siltstone with darker argillaceous lamination. The original lamination has been moderately bioturbated, particularly within the argillaceous laminae. BP *et al.* Panarctic Hotspur J-20, core 4, 4217 feet (1285.3 m).

TABLE 12. Thickness of members of Hecla Bay Formation.

	Panarctic Cape Fleetwood M-21				Panarctic *et al.* West Bent Horn C-44				Panarctic Tenneco *et al.* Bent Horn N-72				B.P. *et al.* Panarctic Hotspur J-20			
	Top		Thickness		Top		Thickness		Top		Thickness		Top		Thickness	
	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres	feet
U Member	1620.0	5315	383.2	1257	1465.2	4807	367.0	1204	1306.7	4287	398.4	1307	? 137.2	? 450	? 425.2	? 1395
L Member	2003.2	6572	482.4	1583	1832.2	6011	508.7	1669	1705.1	5594	518.7	1702	562.4	1845	447.4	1468
Total			865.6	2840			875.7	2873			917.1	3009			? 872.6	? 2863

GSC

Formation. The upper boundary of the Bird Fiord Formation is also gradational. It was drawn at a marked upward decrease in shale (<50% shale). Kerr (1974) placed the upper boundary at the first appearance of calcareous cement, but for subsurface purposes this definition is not practical. The boundary used in this report, based on shale content, does however coincide approximately in the W. Bent Horn C-44 and Bent Horn N-72 wells with the first appearance of calcareous skeletal grains. In the other wells, the boundary may be more than 200 m (600 ft) higher than the one used by Kerr (1974).

Mode of origin

Embry and Klovan (1976) interpreted the Bird Fiord Formation as a marine-deltaic assemblage mainly on the basis of upward-coarsening sedimentary cycles observed in surface exposures and in the wells. Their interpretation is followed in the present report. The Bird Fiord Formation is the product of a shallow-marine shelf, interacting with a system of shifting deltas during a period of little change in sea level.

Age and correlation

Numerous fossil samples with broad age assignments are available (Appendix III) for the Bird Fiord Formation in the four wells. The age of the upper part of the formation is early Givetian as it underlies directly core 2 (GSC loc. C-29870) in the basal part of the Hecla Bay Formation of the Hotspur well and the age of the lower part is also still early Givetian in the Cape Fleetwood, W. Bent Horn C-44 and Bent Horn N-72 wells. In the Hotspur well, the lower part of the formation is of late Eifelian age (Table 2). The lower boundary of the formation is diachronous and the Bird Fiord Formation correlates in part with the Cape De Bray Formation. The upper boundary is probably also very slightly diachronous, this assumption being based on the gradational nature of the upper boundary and the variable thickness of the lower member of the Hecla Bay Formation. The time-stratigraphic differences of the upper boundary are presumably insignificant within the study area, and the top of the Bird Fiord Formation is used as a datum (Fig. 8) to correlate the three wells on Bathurst Island with the wells on Ile Vanier and Cameron Island.

In the Bent Horn N-72 well, the lower member of the Bird Fiord Formation is about 150 m (500 ft) thicker than in the Cape Fleetwood and W. Bent Horn C-44 wells. Examination and comparison of dipmeter logs show that, below 9310 feet (2837.7 m), the beds in the Bent Horn N-72 well are faulted and the thickness increase is of a structural nature.

The Bird Fiord Formation on Bathurst Island is gradational to the Weatherall Formation farther west. For convenience (Tozer and Thorsteinsson, 1964; Embry and Klovan, 1976), Byam Channel between Byam Martin and Melville Islands is used as an arbitrary dividing line between the two formations.

Hecla Bay Formation

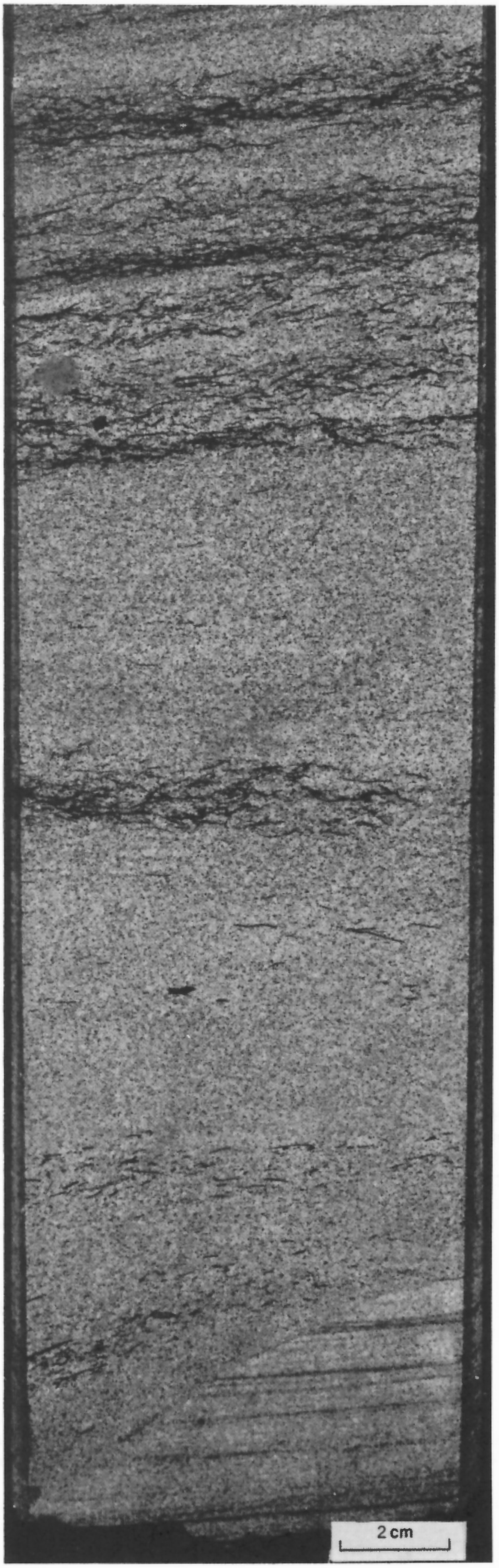
Introduction

The Hecla Bay Formation was named (Tozer and Thorsteinsson, 1964) for a relatively pure, white sandstone sequence. At the type section on southeastern Melville Island the formation is about 800 m (2600 ft) thick. In the Bathurst Island area (Kerr, 1974), the formation ranges in thickness from about 1200 m (4000 ft) in the north-central part to less than 600 m (2000 ft) in the east. It consists of two members. The lower member comprises reddish or yellow, fine- to medium-grained, hematitic quartz sandstone, interbedded in some sections with shale and siltstone. The upper member consists of poorly consolidated, white, fine-grained quartz sandstone. The formation is extensively exposed in the cores and along the flanks of synclines.

It is present in the four western wells, Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib), Bent Horn N-72 (Appendix Ic) and Hotspur (Appendix Id), where the two members can be distinguished. Tops and thicknesses are listed in Table 12.

Lithology

The lower member consists of sandstone, interbedded with minor (<10%) amounts of shale and siltstone. The sandstone is very light brown to white, very fine to fine grained and has clay or siliceous cement. Non-quartz constituents such as chert, feldspar, mica, chlorite and heavy minerals are rare. Calcareous skeletal grains are present locally in the lower part of the member. Cores 1 (1950-1980 ft, 594.4-603.5 m) and 2 (3213-3243 ft, 979.3-988.5 m) of the Hotspur well are from the lower member of the formation. Core 2 consists of fine- and very fine grained sandstone with scour surfaces (Fig. 24), parallel lamination, and minor crossbedding. Core 1 comprises very fine grained sandstone with a variety of sedimentary structures. Two erosional surfaces at 1971.04 and 1966.17 feet (600.77 and 599.29 m) imply an incomplete cyclicity, going from a thin zone of sandstone with shale clasts at the base through thick-bedded sandstone with planar crossbeds to a thin laminated unit of sandstone and shale with ripple marks. Fossil remains in the member consist of carbonized plant fragments, skeletal grains and a single bone fragment in core 1.



Embry and Klovan (1976) reported both upward-fining and upward-coarsening cycles from outcrops of the Hecla Bay Formation. The geophysical wireline logs of the wells do not show undisputable evidence, but some log configurations may be interpreted as showing sedimentary cycles in the lower member. Upward-coarsening cycles appear to be restricted to the lower part of the member:

Cape Fleetwood M-21	- at about 7600 feet (2316.5 m)
W. Bent Horn C-44	- 7220-7195 feet (2200.7-2193.0 m)
Bent Horn N-72	- immediately below 6625 feet (2019.3 m)

Upward-fining cycles may be present in the upper part of the member:

Cape Fleetwood M-21	- 6806-7140 feet (2074.5-2176.3 m)
W. Bent Horn C-44	- 6290-6417 feet (1917.2-1955.9 m)
Bent Horn N-72	- at about 6000 feet (1828.8 m)

The upper member of the Hecla Bay Formation overlies the lower member with gradational contact and consists almost entirely of white sandstone. The sandstone is fine to medium grained and has a quartzitic texture with interlocking grains. It is relatively pure and contains only rare chert fragments. Some clay cement is present.

Kerr (1974) and Embry and Klovan (1976) reported kaolin cement, but X-ray analysis from a sample in the W. Bent Horn C-44 well (4910-4930 ft, 1496.6-1502.7 m; Appendix IV) indicates that traces of illite also are present. Organic remains in the member consist of rare coal fragments and flakes of carbonized plant material.

The lower boundary of the Hecla Bay Formation is gradational. It was drawn above a substantial increase in shale. The upper boundary is sharp and was drawn above the first major sandstone zone.

Mode of origin

The lower member of the Hecla Bay Formation is interpreted as a prograding sedimentary sequence, extending from marine-deltaic in the lower part, perhaps through a nonmarine-deltaic phase, to fluviatile in the upper part. The presence of upward-coarsening cycles and of calcareous sandstone is the main evidence for the marine-deltaic interpretation of the lower part. The sandstone in core 2 of the Hotspur well (Fig. 24) may be derived from a shallow marine or intertidal sand. The possible presence of upward-fining cycles and the apparent similar cyclicity of core 1 of the Hotspur well are the bases for interpretation as fluviatile for the upper part of the member.

FIGURE 24. Hecla Bay Formation, channelled sandstone. Fine-grained sandstone is cross-laminated with bands of carbonaceous material. At the lower part of the core, the fine-grained sand cuts very fine grained sandstone with irregular impure laminae. BP *et al.* Panarctic Hotspur J-20, core 2, 3230.4 feet (984.6 m).

The upper member of the Hecla Bay Formation is interpreted as a braided stream deposit. Except for the paucity of shale, there is no direct evidence in the wells and so this interpretation is based on Embry and Klovan's (1976) field observations and interpretation.

Age and correlation

Several palynomorph collections from the wells make it possible to date the Hecla Bay Formation (Appendix III). The oldest collection is from the basal part of the formation in core 2 of the Hotspur well (GSC loc. C-29870) with a probable age of early Givetian. The upper age is bracketed by early Frasnian spores (GSC loc. C-58247/4500-4600; W. Bent Horn C-44 well; Appendix III) in the lower part of the overlying Beverley Inlet Formation, 60 m (200 ft) above the upper boundary. Thus the total age range of the Hecla Bay Formation in the wells is early Givetian to early Frasnian (Table 2). Embry and Klovan (1976) reported an early Frasnian to mid- and possibly early Givetian age for the formation. Within the project area, it appears to be essentially homologous. The lower boundary, owing to its gradational nature, may have shifted insignificantly in time (Fig. 8).

Beverley Inlet Formation

Introduction

The Beverley Inlet Formation was defined on southeastern Melville Island (Embry and Klovan, 1976) for a sequence of siltstone and shale interbedded with sandstone. At its type section the formation is 512 m (1680 ft) thick. It is exposed in synclines in the northwest part of the Bathurst group of islands.

Four of the wells discussed in this report penetrated the formation: Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib), Bent Horn N-72 (Appendix Ic) and Hotspur (Appendix Id) (*see* Table 13).

Lithology

The formation consists of siltstone and shale, interbedded with sandstone, which accounts for half or slightly less of the unit. The siltstone is medium grey with hues of green and brown and it varies from coarse grained sandy to fine grained argillaceous. Clasts consist of subangular quartz and a lesser amount of chert. The shale is varicoloured, but mostly green or brown. The silt content is variable, varieties without silt grains have a waxy surface. The sandstone is very light green to white and very fine to fine grained. Several intervals of maroon sandstone were observed in the Hotspur well. Fine- to medium-grained sandstone is rare and only in the Bent Horn N-72 well is it present in appreciable amounts. Main constituents of clasts are quartz and rock fragments, the latter together with chert were estimated visually to reach a maximum of 25%. Plagioclase is very rare, as are heavy minerals. Two zones with very rare traces of calcareous grains in the sandstone are present in the Cape Fleetwood well at 3760 and 4360 feet (1146.1 and 1328.9 m).

TABLE 13. Thickness of Beverley Inlet Formation.

	Top		Thickness	
	metres	feet	metres	feet
Panarctic Cape Fleetwood M-21	1019.3	3344	600.7	1971
Panarctic *et al.* West Bent Horn C-44	837.0	2746	628.2	2061
Panarctic Tenn. *et al.* Bent Horn N-72	668.1	2192	638.6	2095
B.P. *et al.* Panarctic Hotspur J-20	Surface		+137.2	+450

GSC

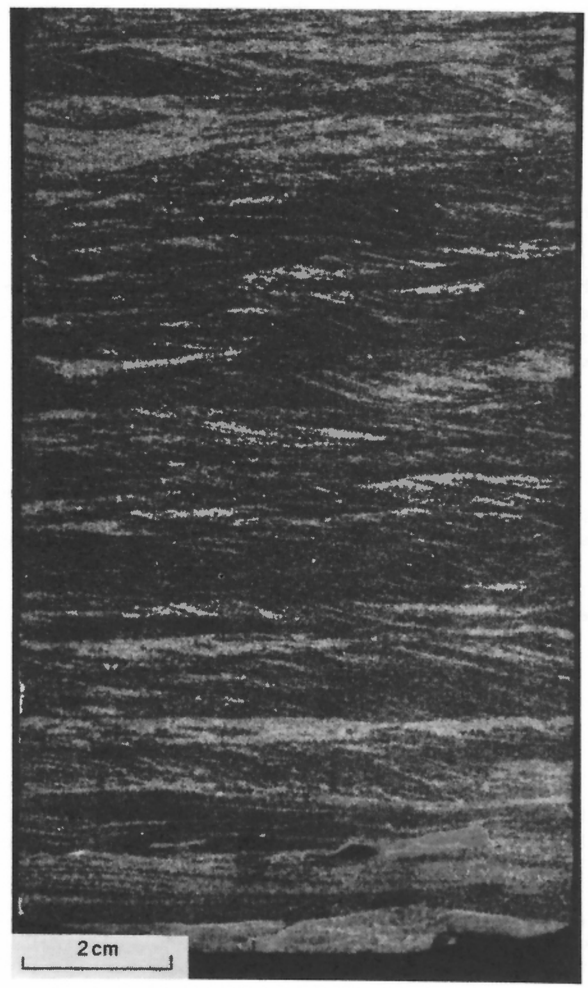


FIGURE 25. Beverley Inlet Formation, ripple-cross-laminated sandstone. Ripple-cross-lamination and climbing ripples are accentuated by the colour contrast of medium grey, very fine grained, relatively pure sandstone and darker, very fine grained sandstone containing mica, carbonaceous fragments and other impurities. Panarctic Cape Fleetwood M-21, core 1, 5115 feet (1559.1 m).

Embry and Klovan (1976) reported upward-fining cycles from outcrops of the Beverley Inlet Formation. Although they cannot be clearly distinguished in the samples, evidence from the geophysical wireline logs shows their presence throughout the formation (Appendix I; *see* also Embry and Klovan, 1976, Fig. 34).

A core is available from the basal part of the formation in the Cape Fleetwood well (core 1, 5107-5137 ft, 1556.6-1565.8 m). It consists in the upper part of interlaminated and interbedded very fine grained sandstone and siltstone and in the lower part of shale. Ripple cross-lamination, in part from climbing ripples, is a conspicuous feature (Fig. 25).

Organic remains are restricted to carbonized plant fragments and coal chips.

The lower boundary of the Beverley Inlet Formation was drawn on the gamma ray log at a marked downward decrease in silty and shaly material; similarly the upper boundary was drawn on the gamma ray log at an upward decrease in silty and shaly material.

Mode of origin

The presence of shale and upward-fining cycles, together with coal and plant fragments makes a meandering stream the most likely environment for the Beverley Inlet Formation (Embry and Klovan, 1976). Somewhat of a puzzle are the two intervals with carbonate grains in the Cape Fleetwood well. The grains may have been derived from nonmarine mollusks or could be reworked, lacustrine limestone fragments.

Age and correlation

Palynomorph collections from the lower and upper part of the Beverley Inlet Formation were obtained from several wells (Appendix III). They give an age range from early to mid-Frasnian (Table 2), similar to that reported by Embry and Klovan (1976) throughout the western Arctic Islands.

Parry Islands Formation

Introduction

The Parry Islands Formation was defined by Embry and Klovan (1976) for the uppermost sediments of the Franklinian sequence. It is heterogeneous, comprises three members, and consists of sandstone, siltstone, shale and coal. Only the lowest member, the Burnett Point, was penetrated by the wells. At the type section on northeastern Melville Island, about 270 m (900 ft) of the member are preserved and consist of variable sandstone interbedded with shale.

In the Cape Fleetwood (Appendix Ia), W. Bent Horn C-44 (Appendix Ib) and Bent Horn N-72 (Appendix Ic) wells, the Burnett Point member can be subdivided into two units (Table 14).

TABLE 14. Thickness of subdivisions of Parry Island Formation (Burnett Point member).

	Panarctic Cape Fleetwood M-21		Panarctic *et al.* West Bent Horn C-44		Panarctic Tenn. *et al.* Bent Horn N-72	
	Top metres feet	Thickness metres feet	Top metres feet	Thickness metres feet	Top metres feet	Thickness metres feet
Unit 2	291.1 955	205.7 675	205.7 675	213.4 700	12.2 40	224.0 735
Unit 1	496.8 1630	522.5 1714	419.1 1375	417.9 1371	236.2 775	431.9 1417
Total Thickness		728.2 2389		631.3 2071		714.8 2345

GSC

Lithology

Unit 1 consists of sandstone, interbedded with subordinate amounts (less than in unit 2) of shale and siltstone. The sandstone is light coloured, white to very light green or grey. The grains are subrounded to rounded and vary from fine to very coarse or even granule size. Main components are quartz, chert and rock fragments; the last two may form up to an estimated 50% of the rock. The siltstone ranges from varicoloured and coarse to green, fine and argillaceous. Most of the siltstone forms a distinct interval at the top of the unit. The shale is either green or black and carbonaceous. An additional, subordinate lithology in unit 1 is coal. Upward-fining sedimentary cycles can be recognized. They are best developed in the Bent Horn N-72 (775-1280 ft, 236.2-390.1 m) and the W. Bent Horn C-44 (1970-2203 ft, 600.5-671.5 m) wells.

Unit 2 consists 1/3 of sandstone and 2/3 of shale and siltstone. These rocks form well-developed, upward-fining sedimentary cycles. The sandstone is white to very light brown or very light grey and ranges from very coarse or coarse to very fine in distinct upward-fining cycles. In the uppermost part of the unit in the Bent Horn N-72 well, conglomeratic beds form the base of the cycles. Composition of the sandstone is similar to that in underlying unit 1 with <50% of lithic fragments and chert. Shale and siltstone form the uppermost part of the cycles. The shale is varicoloured and variably silty. The siltstone is partly gradational to shale and medium grey to green. The unit contains also some coal which appears to be associated with the shale and siltstone.

The lower boundary of the Parry Island Formation was drawn above a laterally persistent zone of dominantly shale and siltstone which probably belongs to the Beverley Inlet Formation. Above that zone, in unit 1 of the Parry Island Formation, there is a marked decrease in the amount of shale and siltstone. The Parry Island Formation is overlain unconformably by the Permian rocks of the Sverdrup Basin. The boundary was drawn mainly on the basis of the lithology, beneath those rocks containing glauconite and a rich invertebrate fauna.

Mode of origin

The Burnett Point member of Parry Island Formation is of fluviatile origin. Upward-fining sequences can be seen in the geophysical wireline logs in unit 1 (Appendix I) and are very well developed in unit 2. The dominance of sandstone implies a braided stream origin for most of the lower unit, whereas the well-developed cycles with substantial shale make a meandering stream origin more likely for the upper unit. Embry and Klovan (1976) proposed a similar origin, though with numerous alternations between the two river types, for the Burnett Point member.

Age and correlation

All three wells where the Burnett Point member occurs yielded palynomorph collections from units 1 and 2 (Appendix III). They give the member an age range from probably late Frasnian to early Famennian (Table 2). Embry and Klovan (1976) reported the same age for the member.

PALEOGEOGRAPHICAL SUMMARY

In the preceding pages the subsurface geology of Bathurst and adjacent islands has been described and correlated with better known surface sections. In this chapter an attempt will be made to present the environmental interpretations in a larger, paleogeographical context.

The Ordovician sediments encountered in the report area formed on the shelf of the Franklinian Geosyncline which extended at least as far north as the present southern edge of the Sverdrup Basin (Fig. 2). Three types of succession of Bay Fiord Formation are known: (1) on Bathurst and eastern Melville Islands and a large part of Viscount Melville Sound, the formation contains thick salt sequences (Meneley, 1976); (2) on Ellesmere, Devon and Cornwallis Islands, anhydrite forms a major part of the succession, but salt is not known; (3) south of Viscount Melville and Lancaster Sounds, evaporites are absent or form only a subordinate part and the formation consists of carbonates and terrigenous fine clastics. The formation's extension to the north, beneath the Sverdrup Basin, is not known but it is probably equivalent to the basinal sediments of the Hazen Formation (Trettin, 1971), known from northern Ellesmere Island. Unless a major carbonate barrier existed along the northern shelf edge, deposition of the evaporites must have taken place on a shallow, slowly subsiding carbonate shelf, possibly in a number of separated shallow "pools". Both the Young Inlet and Caledonian River wells bottom in the salt sequence of the Bay Fiord Formation. Carbonates included in the salt sequence appear to confirm a shallow-water origin. Deposition took place during a number of regressive and transgressive cycles, with the regressive, evaporitic phase becoming more and more subdued in the higher part of the formation until the limestone and dolomite of the overlying Thumb Mountain Formation formed on an extensive, relatively deeper carbonate shelf. The gradual subsidence of the shelf continued throughout the time of the deposition of the Thumb Mountain Formation so that the upper part of the formation contains deposits of an open subtidal platform and grades upward into the open marine sediments of the Irene Bay Formation. Studies on northern Devon Island (Morrow and Kerr, 1977) and farther south (Mayr, in press) show that the lower, inter- and supratidal part of the Thumb Mountain Formation grades northward, toward the Hazen Trough, into subtidal carbonates and thus relatively good circulation must have been present on the Thumb Mountain shelf.

Onset of deposition of the Cape Phillips Formation marked a regional differentiation of sedimentation pattern in the Canadian Arctic Archipelago (Fig. 2). In the southern and eastern part, the carbonate shelf of the Allen Bay, Cape Storm and Read Bay Formations formed while to the north and west the pelagic Cape Phillips Formation was laid down. From surface exposures on Ellesmere Island (Trettin, in press) and Melville Island (Tozer and Thorsteinsson, 1964), it is known that carbonate outliers were present in the Cape Phillips sea. Several others have been traced seismically on northwestern Melville Island (Meneley, 1976). The Towson Point well on northeastern Melville Island also penetrates a carbonate sequence underlying Lower Devonian rocks. The unnamed dolomite encountered in the Bent Horn N-72 well probably is also one of these Silurian, isolated carbonate outliers.

The passage from Silurian to Devonian coincided with another change in the regional depositional pattern. Whereas the change leading from the Thumb Mountain platform to the Cape Phillips basin was relatively gradual, the change at the Silurian-Devonian boundary is tied to pulse 2 of the Cornwallis Disturbance (Kerr, 1977), during which the Cornwallis Fold Belt (Fig. 2) was uplifted and partially eroded. The debris from the Cornwallis Fold Belt and the Boothia Horst was shed westward and northward and, together with that which may have come from the north, formed the Bathurst Island and Stuart Bay Formations, gradually filling the basin west of the uplifted zone. The farther westward sedimentary extension comprises silty calcareous shale and siltstone which form the Eids Formation (Hotspur well) around the Bent Horn carbonate buildup of the Disappointment Bay Formation. If the lower contact of the Disappointment Bay Formation in the Bent Horn area is a disconformity, then the Cornwallis Disturbance was not restricted to the Cornwallis Fold Belt, but also caused uplift in adjacent areas, at least to the west. There the disturbance was sufficiently slight not to interrupt sedimentation in the basins, but it affected shallow areas like the Bent Horn carbonate bank. After the strong second pulse of the Cornwallis Disturbance, carbonate sedimentation persisted and resulted in deposits such as the Disappointment Bay Formation in the shallower areas like the Cornwallis Fold Belt and the Bent Horn and Melville carbonate buildups, while fine terrigenous sediments of the Eids Formation were deposited in the deeper areas. This depositional pattern continued through to the early Middle Devonian while the Blue Fiord shallow-water carbonates formed and the Eids and Cape De Bray Formations were deposited on a westward-migrating slope. The extensive deltaic-marine Bird Fiord shelf had formed to the northeast of the project area (Embry and Klovan, 1976) feeding the Cape De Bray slope until the carbonates were completely surrounded and covered by fine terrigenous clastics.

During the remaining part of the history of the area, documented by the Hecla Bay, Beverley Inlet and Parry Islands Formations, nonmarine sediments encroached from the northeast and east over the entire region (Embry and Klovan, 1976).

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APPENDIX II

CORE DESCRIPTIONS

Panarctic Cape Fleetwood M-21

Lithology	Thickness[1] feet	(metres)	Top of interval[1] feet	(metres)
Core 1: 5107-5137 feet (1556.61-1565.76 m) recovered 30.0 feet (9.14 m) Beverley Inlet Formation				
Sandstone, micaceous, medium grey, very fine grained; medium to thick bedded, ripple cross-lamination, channel; well sorted, subrounded; rare shale clasts; interbedded and interlaminated with siltstone, partly argillaceous, medium grey-green; carbonized plant fragments	13.7	(4.18)	5107.0	(1556.61)
Shale, silty, medium green	16.3	(4.97)	5120.7	(1560.79)
GSC loc. C-58250/5017-5137 (Appendix IIIb)				
Core 2: 10 170-10 209 feet (3099.82-3111.70 m) recovered 39 feet (11.89 m) Bird Fiord Formation, unit 1				
Siltstone, slightly calcareous, laminated light and dark grey; disrupted lamination (bioturbation?), laminae fining upward to argillaceous, "very fine grained" siltstone ("shale"), abundant slickensides at 10 197-10 202 feet (3108.05-3109.57 m), fault; rare, very thin beds with crinoid and brachiopod debris	39.0	(11.88)	10 170.0	(3099.82)
Core 3: 10 912-10 972 feet (3325.98-3344.27 m) recovered 60 feet (18.29 m) Blue Fiord Formation, unit 3				
Limestone, very dark grey with light mottling; biosparite, skeletal float- or bafflestone with grainstone matrix; tabular stromatoporoids abundant, *Thamnopora* sp. and *Syringopora* sp. common, brachiopods, crinoids and encrusting *Alveolites* sp. rare	18.3	(5.58)	10 912.0	(3325.98)
Limestone, very dark grey; skeletal wacke- and packstone, gradational to skeletal floatstone, biomicrite; tabular stromatoporoids common, corals, brachiopods and gastropods rare, *Stachyodes* sp. very rare	8.7	(2.65)	10 930.3	(3331.56)
Limestone, very dark grey; skeletal floatstone with lime mudstone matrix, biomicrudite; corals (*Alveolites* sp. and solitary) abundant, brachiopods, crinoids, gastropods and *Thamnopora* sp. rare	8.8	(2.69)	10 939.0	(3334.21)
Limestone, dark grey; stromatoporoidal bindstone with packstone matrix, very coarse biomicrudite; tabular stromatoporoids very abundant, encrusting *Alveolites* sp. common, brachiopods, gastropods and solitary corals rare	9.2	(2.79)	10 947.8	(3336.90)
Limestone, light grey, stromatoporoidal bindstone, coarse biosparite; tabular stromatoporoids very abundant, encrusting *Alveolites* sp. common, brachiopods, gastropods and solitary corals rare	15.0	(4.58)	10 957.0	(3339.69)
GSC loc. 58250/10 912-10 972 (Appendix IIIb)				

[1] Small discrepancies in values are caused by rounding of decimals and conversion from original footages to metric equivalents.

Lithology	Thickness feet (metres)		Top of interval feet (metres)	
Core 4: 11 500-11 528 feet (3505.20-3513.73 m) recovered 28 feet (8.53 m) Blue Fiord formation, unit 1				
Limestone, dark grey with light-coloured mottling; stromatoporoidal floatstone with pelletoidal and coated grain grainstone matrix, biopelsparite; hemispherical large stromatoporoids abundant, corals, brachiopods and *Stachyodes* sp. rare	9.0	(2.74)	11 500.0	(3505.20)
Limestone, dark grey with light-coloured mottling; stromatoporoidal framestone with pelletoidal grainstone matrix, biopelsparite; very abundant large hemispherical stromatoporoids, rare corals, and brachiopods	6.8	(2.06)	11 509.0	(3507.94)
Limestone, dark grey with light-coloured mottling; stromatoporoidal floatstone with pelletoidal grainstone matrix, biopelsparite; hemispherical stromatoporoids common, rare colonial corals (including *Alveolites* sp.) and small crinoid fragments, rare oncolites	12.2	(3.73)	11 515.8	(3510.00)
Panarctic *et al.* W. Bent Horn C-44				
Core 1: 10 444-10 504 feet (3183.33-3201.62 m) recovered 60 feet (18.29 m) Blue Fiord Formation, unit 4				
Limestone, slightly dolomitic, dark brown; pelletoidal packstone, pelmicrite; argillaceous and slightly bituminous matrix; rare hemispherical stromatoporoids and corals	4.4	(1.35)	10 444.0	(3183.33)
Limestone, dark brown; coral floatstone with skeletal wackestone matrix, biomicrudite; argillaceous laminae; compacted solitary corals common, *Stachyodes* sp. and brachiopods rare, calcispheres	1.7	(0.52)	10 448.4	(3184.68)
Limestone, slightly argillaceous and bituminous; skeletal wackestone with zones of skeletal packstone, biomicrite; zone of brecciation; rare stromatoporoids and corals	2.6	(0.77)	10 450.1	(3185.20)
Limestone, medium brown; stromatoporoidal floatstone with skeletal wackestone matrix; biomicrudite; tabular stromatoporoids common, corals (various forms) rare	0.7	(0.23)	10 452.7	(3185.97)
Limestone, medium brown; coral bafflestone with skeletal packstone matrix, biomicrudite; abundant *Thamnopora*-type corals, rare tabular stromatoporoids	0.7	(0.20)	10 453.4	(3186.20)
Limestone, medium brown; coral bind- and bafflestone with skeletal grainstone matrix, biopelsparite; encrusting *Alveolites* sp. and *Thamnopora* sp. abundant, hemispherical stromatoporoids rare	0.9	(0.28)	10 454.1	(3186.40)
Limestone, medium grey-brown; coated-grain grainstone, oosparite; rare tabular stromatoporoids, brachiopods and gastropods	0.9	(0.27)	10 455.0	(3186.68)
Limestone, light grey-brown; coral bindstone, fossiliferous micrite; encrusting *Alveolites* sp. and *Thamnopora*-type corals common, very rare tabular stromatoporoids	6.0	(1.84)	10 455.9	(3186.95)
Limestone, slightly dolomitic, light grey-brown; coral bafflestone, fossiliferous micrite; brecciated?; abundant colonial corals (including *Thamnopora* type), rare brachiopods and stromatoporoids	8.9	(2.71)	10 461.9	(3188.79)

Lithology	Thickness feet	(metres)	Top of interval feet	(metres)
Limestone, light grey-brown; coral bindstone with skeletel packstone matrix, biomicrudite; trace pyrite; intracoralline vugs; very abundant encrusting *Alveolites* sp., *Thamnopora* sp. and similar corals common, rare brachiopods and tabular stromatoporoids	10.2	(3.08)	10 470.7	(3191.50)
Limestone, medium grey; ?coral bindstone, fossiliferous micrite, laminated; vuggy; stylolites; colonial corals common, rare tabular stromatoporoids, brachiopods and ostracodes	2.9	(0.89)	10 480.9	(3194.58)
Limestone, very dark brown; coral floatstone with skeletal grain- and packstone-matrix, biopelsparite; argillaceous zones; abundant tabulate coral colonies, tabular stromatoporoids common, rare *Thamnopora* sp., crinoids and brachiopods	5.9	(1.79)	10 483.8	(3195.47)
Limestone, very light grey-brown; coral baffle- and bindstone, biomicrudite; solitary and tabular colonial corals common, *Thamnopora* sp., brachiopods, ostracodes and gastropods rare	4.9	(1.49)	10 489.7	(3197.26)
Limestone, light and dark brown; coral floatstone with skeletal-pelletoidal grainstone matrix, biopelsparite; variable shaped colonial corals common, *Thamnopora* sp., tabular stromatoporoids, brachiopods, crinoids and gastropods rare, sponge spicules	9.4	(2.87)	10 494.6	(3198.75)

GSC loc. C-58247/10 444-10 504 (Appendix IIIb)

Panarctic Tenn. *et al.* Bent Horn N-72

Core 1: 10 520-10 539 feet (3206.50-3212.29 m)
recovered 16.2 feet (4.94 m)
Blue Fiord, unit 3

Lithology	Thickness feet	(metres)	Top of interval feet	(metres)
Limestone, slightly argillaceous, medium grey; coral bindstone, biomicrudite; abundant tabular and encrusting *Alveolites* sp.	1.7	(0.51)	10 520.0	(3206.50)
Limestone, slightly argillaceous and dolomitic, medium grey; skeletal packstone, biomicrite; *Aulopora* sp. and tabular *Alveolites* sp. common, brachiopods, crinoids and gastropods rare	7.3	(2.23)	10 521.7	(3207.01)
Limestone, bituminous, dark brown; coral floatstone with skeletal wackestone matrix, biomicrudite; vugs with pyrobitumen and calcite; solitary corals (cystiphyllid and cyathophyllid) abundant; tabular *Alveolites* sp. and *Aulopora* sp. rare, brachiopods rare	4.9	(1.50)	10 529.0	(3209.24)
Limestone, slightly argillaceous, dark grey; lime mudstone, fossiliferous micrite; rare solitary corals and coralline algae	2.1	(0.63)	10 533.9	(3210.74)

GSC loc. C-30172/10 521, 10 522.4, 10 534.8 (Uyeno, 1977);
C-58248/various (Appendix IIIb)

Core 2: 10 720-10 739 feet (3267.46-3273.25 m)
recovered 19 feet (5.79 m)
Blue Fiord Formation, unit 1

Lithology	Thickness feet	(metres)	Top of interval feet	(metres)
Limestone, dark brown, slightly argillaceous and with dolomitic mottling; stromatoporoidal floatstone with skeletal wackestone or lime mudstone matrix, zones of *Stachyodes* bafflestone, biomicrudite; hemispherical stromatoporoids and *Stachyodes* sp. common, corals and brachiopods rare	19.0	(5.79)	10 720.0	(3267.46)

Lithology	Thickness feet	(metres)	Top of interval feet	(metres)
Core 3: 11 500-11 530 feet (3505.20-3514.34 m) recovered 30 feet (9.14 m) Blue Fiord Formation, unit 2				
Limestone, dolomitic mottling, bituminous, very dark grey; skeletal rud- and packstone, biomicrudite; faint nodular structures; abundant crinoids, rare corals and brachiopods	30.0	(9.14)	11 500.0	(3505.20)
GSC loc. C-58248/11 500-11 530 (Appendix IIIb)				
Core 4: 14 349-14 379 feet (4373.58-4382.72 m) recovered 30 feet (9.14 m) Unnamed dolomite formation				
Dolomite, variably calcareous, very light grey, medium crystalline; zones with irregular, nodular lamination, brecciation and sparry calcite	30.0	(9.14)	14 349.0	(4373.58)
GSC loc. C-30172/14 349-14 379 (Copeland *et al.*, 1976)				
BP *et al.* Panarctic Hotspur J-20				
Core 1: 1950-1980 feet (594.36-603.50 m) recovered 27 feet (8.23 m) Hecla Bay Formation, lower member				
Sandstone, micaceous, light grey, very fine grained; thick bedded to massive; very uniform, well sorted, faint lamination through vertical variation in mica content	4.1	(1.26)	1950.0	(594.36)
Sandstone, highly micaceous, light grey, very fine grained; climbing, staggered lamination in lower part of unit, fine parallel lamination in middle part and climbing ripple cross-lamination in upper part of unit; well sorted, very uniform	0.8	(0.23)	1954.1	(595.62)
Sandstone, micaceous and carbonaceous, light grey, very fine grained; cross-lamination, in part irregular and discontinuous; coal nodule at 1956.0 feet (596.19 m)	2.4	(0.72)	1954.9	(595.85)
Sandstone, as above at 1950.0-1954.1 foot (594.36-595.62 m) interval	7.2	(2.21)	1957.3	(596.57)
Sandstone, micaceous, carbonaceous, light grey, very fine grained; crossbedded in lower part, churned? in upper part	0.5	(0.15)	1964.5	(598.78)
Sandstone, micaceous, light grey, very fine grained; ripple cross-lamination	1.1	(0.33)	1965.0	(598.93)
Shale, carbonaceous, dark grey; laminated and irregular nodular; thin carbonaceous seams; small bone fragment; unit interpreted as intraformational shale conglomerate with erosional lower surface	0.1	(0.03)	1966.1	(599.26)
Sandstone, micaceous, light grey, very fine grained; regular, low-angle cross-lamination	2.1	(0.63)	1966.2	(599.29)
Sandstone, micaceous, light grey, very fine grained; thick bedded, faint crossbedded	2.5	(0.78)	1968.3	(599.92)
Sandstone, micaceous, light grey, very fine grained; laminated; shale clasts; erosional lower contact; in uppermost 2 cm both continuous and disrupted shale laminae	0.2	(0.07)	1970.8	(600.70)

Lithology	Thickness feet (metres)		Top of interval feet (metres)	
Sandstone, micaceous, light grey, very fine grained; interbedded with shale, carbonaceous, dark grey; bedding contorted	0.5	(0.16)	1971.0	(600.77)
Sandstone and shale as above at 1971.0-1971.5 foot (600.77-600.93 m) interval; regularly interlaminated, laminae with shallow dip	0.7	(0.20)	1971.5	(600.93)
Sandstone, micaceous, light grey, very fine grained; thick bedded, crossbedded with several zones of lamination and contortion	3.5	(1.05)	1972.2	(601.13)
GSC locs. C-29869 and C-11488/1950-1980 (Appendix IIIb)				
Core 2: 3213-3243 feet (979.32-988.47 m) recovered 29 feet (8.84 m) Hecla Bay Formation, lower member				
Shale, medium grey	0.9	(0.28)	3213.0	(979.32)
Sandstone, slightly micaceous, light grey, fine grained; lower part massive, upper part with irregular, wavy crossbeds; kaolin matrix, rounded to subrounded well sorted; lower contact erosional	1.1	(0.33)	3213.9	(979.60)
Sandstone, slightly micaceous, light grey, very fine grained; regular lamination, channel-cut at 3218.5 feet (981.00 m); well sorted	15.3	(4.67)	3215.0	(979.93)
Sandstone, micaceous, light grey, fine grained; wavy cross-lamination and crossbedding; rare shale clasts; lower contact erosional	1.0	(0.31)	3230.3	(984.60)
Sandstone, micaceous, light grey, fine grained changing to very fine in uppermost 12 in (0.30 cm); massive, or faint bedding in lower part, lamination in upper; at base carbonaceous, micaceous shale and wavy irregular carbonaceous lamination	4.8	(1.46)	3231.3	(984.91)
Sandstone, slightly micaceous, light grey, very fine grained; laminated, ripple crossbedding in lowermost part	5.7	(1.72)	3236.1	(986.37)
GSC loc. C-29870 (Appendix IIIb)				
Core 3: 3890-3891.5 feet (1185.67-1186.13 m) recovered 1.5 feet (0.46 m) Bird Fiord Formation, unit 2				
Sandstone, silty, very slightly calcareous, light to medium grey, faint lamination; very uniform	1.5	(0.46)	3890.0	(1185.67)
Core 4: 4206-4236 feet (1281.99-1291.13 m) recovered 30 feet (9.14 m) Bird Fiord Formation, unit 2				
Shale, variably silty, medium grey-brown, interlaminated with siltstone, locally calcareous, medium grey; shale and siltstone form upward-fining couplets with sharp lower boundaries; extensive evidence of burrowing organisms, rare, small pelecypods, at 4232.6 feet (1290.09 m) 5 cm interval with abundant skeletal debris, pelecypods, bryozoans and crinoids	5.7	(1.72)	3236.1	(986.37)
GSC locs. C-10062 (McGregor *et al.*, 1974), and C-29871 (Appendix IIIb)				

Lithology	Thickness feet (metres)		Top of interval feet (metres)	
Core 5: 5275-5295 feet (1607.82-1613.92 m) recovered 17.5 feet (5.33 m) Bird Fiord Formation, unit 2				
Shale, variably silty, medium grey-brown; interlaminated with siltstone, medium grey; shale and siltstone form upward-fining couplets with sharp lower boundaries, siltstone predominates in lowest 1 m of core; zones of churning in siltstone, abundant vertical burrows	17.5	(5.33)	5275.0	(1607.82)
GSC loc. C-29872 (Appendix IIIb)				
Core 6: 6455-6475 feet (1967.48-1973.58 m) recovered 16 feet (4.88 m) Cape De Bray Formation				
Shale-siltstone couplets as in cores 4 and 5; bioturbation, rare brachiopods	16.0	(4.88)	6455.0	(1967.48)
GSC loc. C-10061 (McGregor *et al.*, 1974)				
Core 7: 7518-7538 feet (2291.49-2297.58 m) recovered 20 feet (6.10 m) Cape De Bray Formation				
Siltstone, light grey; laminated with argillaceous siltstone; lamination fine and parallel	0.5	(0.15)	7518.0	(2291.49)
Siltstone, argillaceous, medium grey; laminated, folded interval; dip of 45° in lower part of core	19.5	(5.94)	2518.5	(2291.64)
Core 8: 8705-8725 feet (2653.28-2659.38 m) recovered 20 feet (6.10 m) Blue Fiord Formation, unit 4				
Shale, very dark grey, interbedded with skeletal rudstone; laminated to medium bedded, beds form upward-fining cycles from skeletal limestone to shale; abundant fragments of brachiopods and crinoids; bedding angle about 10°	20.0	(6.10)	8705.0	(2653.28)
GSC locs. C-10229-10240 (McGregor *et al.*, 1974)				
Core 9: 10 114-10 134 feet (3082.75-3088.84 m) recovered 20.9 feet (6.37 m) Eids Formation, unit 2				
Shale, silty, very dark grey, interlaminated with calcareous siltstone; bedding angle about 10°; rare brachiopods	20.9	(6.37)	10 114.0	(3082.75)
GSC locs. C-11481-11486 (McGregor *et al.*, 1974)				
Core 10: 11 295-11 318 feet (3442.72-3449.73 m) recovered 23 feet (7.01 m) Cape Phillips Formation				
Shale, silty and variably calcareous, very dark grey; siliceous laminae and laminae with fine-grained skeletal material, forming thin, upward-fining beds in lower part of core; graptolites	23.0	(7.01)	11 295.0	(3449.73)
GSC loc. C-12533-12535 (McGregor *et al.*, 1974)				

Lithology	Thickness feet (metres)		Top of interval feet (metres)	
Core 11: 11 916-11 924 feet (3632.00-3634.44 m) recovered 6.5 feet (1.98 m) Cape Phillips Formation				
Shale, black; faint lamination; uniform macroscopic appearance; graptolites	6.5	(1.98)	11 916.0	(3632.00)
GSC loc. C-12536 (McGregor *et al.*, 1974)				
Core 12: 12 523-12 535 feet (3817.01-3820.67 m) recovered 5.5 feet (1.68) Cape Phillips Formation				
Limestone, argillaceous, and bituminous, very dark grey; lime mudstone with skeletal fragments, very uniform; graptolites	5.5	(1.68)	12 523.0	(3817.01)
GSC loc. C-12554 (McGregor *et al.*, 1974)				
Sun KR Panarctic Young Inlet D-21				
No cores reported				
Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34				
Core 1: 2105-2114 feet (641.60-644.35 m) recovered 3 feet (0.91 m) Bathurst Island Formation				
Shale, slightly calcareous, very dark grey; very regular lamination with silty material	3.0	(0.91)	2105.0	(641.60)
Core 2: 2554-2572 feet (778.46-783.95 m) recovered 17 feet (5.18 m) Cape Phillips Formation, member C				
Shale, very dark grey; very uniform; graptolites	17.0	(5.18)	2554.0	(778.46)
Report on graptolites in Kerr (1974)				
Core 3: 4687-4697.5 feet (1428.60-1431.80 m) recovered 10.5 feet (3.20 m) Thumb Mountain Formation, unit 1				
Dolomite, medium dark grey, medium crystalline; dolomites; patches of coarsely crystalline dolomite (fossils?, birds-eye texture?), slightly vuggy	10.5	(3.20)	4687.0	(1428.60)
Core 4: 7792-7809 feet (2375.00-2380.18 m)[1] recovered 14.5 feet (4.42 m) Bay Fiord Formation, unit 1				
Halite, translucent, extremely coarsely crystalline; floating angular fragments of dolomite, anhydritic, light grey, aphanocrystalline; laminated	1.3	(0.41)	7792.0	(2875.00)
Dolomite, anhydritic, light grey, aphanocrystalline; laminated and with argillaceous partings, brecciated; halite intrusions	2.2	(0.66)	7793.3	(2375.41)
Shale, dark grey; interlaminated with anhydrite; contorted lamination and anhydritic nodules	0.5	(0.15)	7795.5	(2376.07)
Halite, translucent, extremely coarsely crystalline; in lower part of unit fragments of interlaminated aphanocrystalline, argillaceous dolomite and anhydrite	5.0	(1.52)	7796.0	(2376.22)

[1] Core pieces appear to not be in original position.

Lithology	Thickness feet	(metres)	Top of interval feet	(metres)
Interval missing	1.0	(0.31)	7801.0	(2377.74)
Dolomite, argillaceous, medium grey, aphanocrystalline; laminae of black shale, slickensides; halite intrusions	1.3	(0.38)	7802.0	(2378.05)
Interval missing	0.5	(0.18)	7803.3	(2378.43)
Dolomite, anhydritic, light grey, very finely crystalline; laminated with shale; minor halite veins	0.7	(0.20)	7803.8	(2378.61)
As above at 7792.0-7793.3 feet (2375.00-2375.41 m)	2.0	(0.61)	7804.5	(2378.81)
<u>Core 5</u>: 8270-8277 feet (2520.70-2522.83 m) recovered 7 feet (2.13 m) Bay Fiord Formation, unit 1				
Dolomite, light grey, very finely crystalline; laminated to very thin bedded, cyclical couplets of light grey, very finely crystalline dolomite overlain by dark grey-brown, aphanocrystalline dolomite rich in organic material; vertical burrows and churned patches; rare halite veins; bedding angle 60°	7.0	(2.13)	8270.0	(2520.70)
<u>Core 6</u>: 8756-8780 feet (2668.83-2676.14 m) recovered 24 feet (7.32 m) Bay Fiord Formation, unit 1				
Dolomite, light grey-brown, very finely to finely crystalline, laminated with brown shale, intraformational breccia and minor churning	2.0	(0.86)	8756.0	(2668.83)
Breccia; fragments of dolomite, light yellow-brown, aphanocrystalline, partially laminated; halite matrix	6.7	(2.03)	8758.8	(2669.69)
Dolomite, dark grey, medium crystalline; laminated, minor intraformational breccia and convolute lamination; interbedded with breccia as above in 8758.8-8765.5 foot (2669.69-2671.72 m) interval; interbedded with dolomite, medium brown, very finely crystalline, very finely laminated	13.5	(4.12)	8765.5	(2671.72)
Shale, very dark grey; in fault contact with overlying unit; halite vein along fault plane	1.0	(0.30)	8779.0	(2675.84)

<u>Sun KR Panarctic Allison R. N-12</u>

<u>Core 1</u>: 9450-9471 feet (2880.36-2886.76 m) recovered 21 feet (6.40 m) Cape Phillips Formation, member B				
Shale, very dark grey to black; calcareous and dolomitic; medium grey, calcareous and dolomitic laminae; zones of nodular silty shale; graptolites	21.0	(6.40)	9450.0	(2880.36)
GSC loc. C-18150-18157 (Norford, 1974)				
<u>Core 2</u>: 11 750-11 761 feet (3581.40-3584.75 m) recovered 11 feet (3.35 m) Thumb Mountain Formation, unit 1				
Limestone, dolomitic, dark grey; lime mudstone with zones of skeletal wackestone; laminated, small stylolites, faint birdseye structures, zone of disturbed lamination (bioturbation?); in basal part of core fissures with calcite and sulphur; very rare brachiopods	11.0	(3.35)	11 750.0	(3581.40)
GSC loc. C-18157/11 750-11 761 (Appendix IIIb)				

APPENDIX IIIa

GSC LOCATION NUMBERS AND SOURCES OF FOSSIL IDENTIFICATIONS

Panarctic Cape Fleetwood M-21

Formation	GSC loc.	Interval feet (metres)	Age	Source: this report	Source: prev. GSC publication
Parry Islands	C-58250/ 1210-1260	1210-1260 (368.8-384.1)	late Frasnian or early Famennian	X	
	C-58250/ 2840-2940	2840-2940 (865.6-896.1)	middle or late Frasnian	X	
Beverley Inlet	C-58250/ 3460-3540	3460-3540 (1054.6-1079.0)	middle or late Frasnian	X	
	C-58250/ 5107-5137	Core 1, 5107-5137 (1556.6-1565.8)	Frasnian	X	
Hecla Bay	C-58250/ 6780-6900	6780-6900 (2066.5-2103.1)	late? Givetian	X	
Bird Fiord	C-58250/ 9300-9380	9300-9380 (2834.6-2859.0)	Givetian?	X	
Cape De Bray	C-58250/ 10 600-10 700	10 600-10 700 (3230.9-3261.4)	early? Givetian		
Blue Fiord	C-58250/ 10 912-10 972	Core 3, 10 912-10 972 (3326.0-3344.3)	early or middle Couvinian/ Eifelian	X	

Panarctic *et al.* W. Bent Horn C-44

Formation	GSC loc.	Interval feet (metres)	Age	Source: this report	Source: prev. GSC publication
Parry Islands	C-58247/ 760-840	760-840 (231.7-256.0)	early Famennian	X	
	C-58247/ 2100-2180	2100-2180 (640.1-664.5)	middle or late Frasnian	X	
Beverley Inlet	C-58247/ 2850-2950	2850-2950 (868.7-899.2)	early or middle Frasnian	X	
	C-58247/ 4500-4600	4500-4600 (1371.6-1402.1)	early Frasnian	X	
Hecla Bay	C-58247/ 6300-6400	6300-6400 (1920.2-1950.7)	late? Givetian	X	
Blue Fiord	C-58247/ 10 444-10 504	Core 1 10 444-10 504 (3183.3-3201.6)	early or middle Couvinian/ Eifelian	X	

Panarctic Tenn. *et al.* Bent Horn N-72

Formation	GSC loc.	Interval feet (metres)	Age	Source: this report	Source: prev. GSC publication
Parry Islands	C-58248/ 240-300	240-300 (73.2-91.4)	Famenian	X	
	C-58248/ 1580-1680	1580-1680 (481.6-512.1)	late? Frasnian	X	
Beverley Inlet	C-58248/ 2240-2300	2240-2300 (682.8-701.0)	middle Frasnian	X	

Formation	GSC loc.	Interval feet (metres)	Age	Source this report	Source prev. GSC publication
Beverley Inlet	C-58248/ 3850-3950	3850-3950 (1173.5-1204.0)	early or middle Frasnian	X	
Hecla Bay	C-58248/ 5920-6000	5920-6000 (1804.4-1828.8)	middle or late Givetian	X	
Blue Fiord	C-30172 /10 521 /10 522.4 /10 534.8	Core 1, 10 520-10 539 (3206.5-3212.3)	Eifelian/ Couvinian		Open file 431, p. 19
	C-58248/ various	10 520-10 539 (3206.5-3212.3)	Middle Couvinian	X	
	C-58248/ various	Core 3, 11 500-11 530 (3505.2-3514.3)	Emsian	X	
	C-58248/ 12 000-12 100	12 000-12 100 (3657.6-3688.1)	Emsian	X	
Read Bay	C-30172	Core 4, 14 349-14 379 (4373.6-4382.7)	Ludlovian to Gedinnian		Paper 75-10, p. 16

BP *et al.* Panarctic Hotspur J-20

Formation	GSC loc.	Interval feet (metres)	Age	Source this report	Source prev. GSC publication
Beverley Inlet	C-11488/ 120-220	120-220 (36.6-67.1)	early or middle Frasnian	X	
Hecla Bay	C-29869	Core 1, 1950-1980 (594.4-603.5)	late? Givetian	X	
	C-11488 1950-1980	1950-1980 (594.4-603.5)	late? Givetian	X	
	C-11488/ 2240-2300	2240-2300 (682.8-701.0)	middle? Givetian	X	
	C-29870	Core 2, 3213-3243 (979.3-988.5)	early? Givetian	X	
Bird Fiord	C-10062	Core 4, 4212 (1283.8)	late Eifelian or early Givetian		Paper 74-11, p. 22
	C-29871	Core 4, 4206-4236 (1282.0-1291.1)	late Eifelian or early Givetian	X	
	C-29872	Core 5, 5275-5295 (1607.8-1613.9)	late Eifelian	X	
Cape De Bray	C-10061	Core 6, 6468 (1971.5)	late Eifelian or early Givetian?		Paper 74-11, p. 22
	C-11488/ 7840-7920	7840-7920 (2389.6-2414.0)	Eifelian	X	
Blue Fiord	C-10229-10240	Core 8, 8705-8725 (2653.3-2659.4)	late Emsian		Paper 74-11, p. 22, 23

Formation	GSC loc.	Interval feet (metres)	Age	Source: this report	Source: prev. GSC publication
Blue Fiord	C-11488/ 9340-9440	9340-9440 (2846.8-2877.3)	Emsian	X	
Eids	C-11481-11486	Core 9, 10 119-10 134 (3084.3-3088.8)	early Emsian		Paper 74-11, p. 23
Cape Phillips	C-12533	Core 10, 11 313-11 318 (3448.2-3449.7)	Pridolian?		Paper 74-11, p. 24
	C-12536	Core 11, 11 916-11 920 (3632.0-3633.2)	latest Ludlovian		Paper 74-11, p. 24
	C-12554	Core 12, 12 523-12 535 (3817.0-3820.7)	latest Landoverian or earliest Wenlockian		Paper 74-11, p. 24
		<u>Sun KR Panarctic Young Inlet D-21</u>			
Bathurst Island	C-58249/ 420-500	420-500 (128.0-152.4)	Devonian	X	
Cape Phillips	C-58249/ 2860-2960	2860-2960 (871.7-902.2)	late Middle or Late Ordovician	X	
Thumb Mountain	C-58249/ 3580-3680	3580-3680 (1091.2-1121.7)	Middle Ordovician	X	
Bay Fiord	C-58249/ 4660-4780	4660-4780 (1420.4-1456.9)	middle Llanvirnian	X	
		<u>Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34</u>			
Cape Phillips	-	Core 2, 2554-2572 (778.5-784.0)	latest Pridolian		Mem. 378, p. 24
Bay Fiord	C-5208/ 6120-6160	6120-6160 (1865.4-1877.6)	Middle Llanvirnian	X	
		<u>Sun KR Panarctic Allison R. N-12</u>			
Stuart Bay	C-18157/ 810-900 900-1000	810-1000 (246.9-304.8)	early Pragian		Open File 431, p. 20
	C-18157/ 1300-1350	1300-1350 (396.2-411.5)	Siegenian?	X	
Cape Phillips	C-18150-18157	Core 1, 9450-9469.3 (2880.4-2886.3)	Ludlovian		Paper 74-11, p. 27
Thumb Mountain	C-18157/ 11 750-11 761	Core 2, 11 750-11 761 (3581.4-3584.8)	late Middle to late Ordovician	X	

APPENDIX IIIb

TAXONOMIC LISTS AND COMMENTS

Panarctic Cape Fleetwood M-21 (GSC loc. C-58250)

Parry Islands Formation (identifications and ages by D.C. McGregor)

1210-1260 feet
(368.8-384.1 m)

The age is late Frasnian or early Famennian. Early Famennian is favoured because of the presence of ?*Ancyrospora magnifica* Owens and *Lophozonotriletes cristifer* (Luber) Kedo, and the absence of *Archaeoperisaccus*.

2840-2940 feet
(865.6-896.1 m)

The most likely age is mid- to late Frasnian. The assemblage contains *Archaeoperisaccus oblongus* Owens, *A. opiparus* Owens, cf. *Triangulatisporites rootsii* (<200 µm diameter), and several species of *Hymenozonotriletes* sensu lato and *Hystricosporites*.

Beverley Inlet Formation (identifications and ages by D.C. McGregor)

3460-3540 feet
(1054.6-1079.9 m)

This sample contains a mid- or late Frasnian assemblage, including *Archaeoperisaccus* spp., *Geminospora* spp., *Ocksisporites maclarenii* Chaloner, *Hymenozonotriletes deliquescens* Naumova, and abundant anchor-spined spores.

Core 1
5107-5137 feet
(1556.6-1565.8 m)

The spore assemblage indicates Frasnian age. Several new species are present.

Hecla Bay Formation (identifications and age by D.C. McGregor)

6780-6900 feet
(2066.5-2103.1 m)

This sample contains the highest recorded specimens of *Dibolisporites* spp. and *Retusotriletes rotundus* in this well. Specimens of *Archaeoperisaccus*, normally taken to indicate Frasian age, may be contaminants. Based on the overall aspect of the assemblage I think late Givetian is the more likely age. The spores that are judged to be in situ are dark brown to black and broken.

Bird Fiord Formation (identifications and age by D.C. McGregor)

9300-9380 feet
(2834.6-2859.0 m)

A Middle Devonian age is indicated by the presence of *Retusotriletes rugulatus* Riegel and *Rhabdosporites langii* (Eisenack) Richardson. The spores are rather highly carbonized, but sufficiently well preserved to suggest Givetian rather than Eifelian age.

Cape De Bray Formation (identifications and age by D.C. McGregor)

10 600-10 700 feet
(3230.9-3261.4 m)

Chelinospora ligurata Allen, ?*Grandispora velata* (Eisenack) McGregor, *Retusotriletes rotundus* Streel, and *R. rugulatus* Riegel were recovered. Taken together with the overall appearance of the assemblage they indicate probably early Givetian age.

Blue Fiord Formation (identifications and age by T.T. Uyeno)

Core 3
10 912-10 972 feet
(3326.0-3344.3 m)

Polygnathus parawebbi Chatterton [2]
Icriodus expansus Branson and Mehl-*I. retrodepressus* Bultynck assemblage, of Bultynck (1972) [1]
age: Middle Devonian; early to mid-Couvinian (Cola to Co2b).

Panarctic *et al.* W. Bent Horn C-44 (GSC loc. C-58247)

Parry Islands Formation (identifications and ages by D.C. McGregor)

760-840 feet
(231.7-256.0 m)

Abundant, well-preserved spores were recovered, indicating Famennian, possibly early Famennian age.

2100-2180 feet
(640.1-664.5 m)

Spores in this sample are dark brown, indicating moderate thermal metamorphism, but are nevertheless rather well-preserved. The assemblage consists of several species of *Ancyrospora* including *A. furcula* Owens, as well as *Aneurospora greggsii* (McGregor) Street, *Archaeoperisaccus oblongus* Owens, *Ocksisporites connatispinosus* Chi and Hills, *Retusotriletes rugulatus* Riegel, and several unidentified species.

The age is middle to late Frasnian.

Beverley Inlet Formation (identifications and ages by D.C. McGregor)

2850-2950 feet
(868.7-899.2 m)

Spores are abundant, and dark brown to black. The following taxa are represented, among others:

Ancyrospora acutispinosus Chi and Hills
A. involucra Owens
Aneurospora goensis Streel
Archaeoperisaccus opiparus Owens
cf. *Cymbosporites cyathus* Allen

?Hymenozonotriletes celeber Chibrikova
Hystricosporites gravis Owens
Ocksisporites connatispinosus Chi and Hills

The age is early to middle Frasnian.

4500-4600 feet
(1371.6-1402.1 m)

The following spores have been identified:

Archaeoperisaccus oblongus Owens
?Chelinospora concinna Owens
Cymbosporites cyathus Allen
Retusotriletes rotundus Streel
Samarisporites tozeri Owens

The presence of these and several unnamed forms indicates an early Frasnian age. The spores have been subjected to relatively severe thermal metamorphism, and are dark brown to black before laboratory oxidation.

Hecla Bay Formation (identifications and age by D.C. McGregor)

6300-6400 feet
(1920.2-1950.7 m)

The presence of several Givetian forms, and the highest record of *Hymenozonotriletes archaelepidophytus* Kedo suggests a late Givetian age. The spores have been strongly carbonized.

Blue Fiord Formation (identifications and age by T.T. Uyeno)

Core 1
10 444-10 504
(3183.3-3201.6 m)

Polygnathus cf. *P. intermedius* (Bultynck) [1][1]
age: early to mid-Couvinian (Co1a to Co2b) Middle Devonian

remarks: This form is also present in the intervals 10 524-10 528 and 10 532-10 536.5 feet (3207.7-3208.9 and 3210.2-3211.5 m) of the Bent Horn N-72 well, and its age is based on these latter localities.

Panarctic Tenn. et al. Bent Horn N-72
(GSC loc. C-58248)

Parry Islands Formation (identifications and ages by D.C. McGregor)

240-300 feet
(73.2-91.4 m)

Spores in this sample include:

Lophozonotriletes cristifer (Luber) Kedo
Petrotrilites perinatus Hughes and Playford
Retusotriletes punctatus Chibrikova
Vallatisporites sp.

These and others not identified indicate Famennian age.

1580-1680
(481.6-512.1 m)

The following were recovered, among others:

Ancyrospora furcula Owens
Archaeoperisaccus ?concinnus Naumova
?Grandispora multiapicalis Chi and Hills
Hymenozonotriletes deliquescens Naumova
Retusotriletes punctatus Chibrikova

The age is Frasnian, probably late Frasnian. Conducting tissue and other plant fragments are abundant. The spores and other palynomorphs are very dark brown, indicating rather severe organic metamorphism.

Beverley Inlet Formation (identifications and ages by D.C. McGregor)

2240-2300 feet
(682.8-701.0 m)

The assemblage includes the following species, among others, and suggest a middle Frasnian age:

Apiculiretusispora porcatus Chi and Hills
Archaeoperisaccus opiparus Owens
A. ?scabratus Naumova
Archaeozonotriletes variabilis Naumova
Ocksisporites connatispinosus Chi and Hills

Megaspores (i.e. those for which the mean size exceeds 200 µm) are numerous. The spores are dark brown to black.

3850-3950 feet
(1173.5-1204.0 m)

The spore assemblage is early to middle Frasnian, and includes the following species, among others:

Ancyrospora furcula Owens
A. melvillensis Owens
Archaeoperisaccus spp.
Chelinospora concinna Allen
Cymbosporites cyathus Allen
Hystricosporites ?gravis Owens
Nikitinsporites sp.

Hecla Bay Formation (identifications and age by D.C. McGregor)

5920-6000 feet
(1804.4-1828.8 m)

Spores are abundant but broken, abraded, and highly carbonized. The following were identified:

Calyptosporites proteus (Naumova) Allen
cf. *Densosporites devonicus* Richardson
Grandispora mammillata Owens
G. velata (Eisenack) McGregor
?Hymenozonotriletes archaelepidophytus Kedo
Retusotriletes rotundus Streel
R. rugulatus Riegel
Rhabdosporites langii (Eisenack) Richardson
Verruciretusispora multituberculata Lanninger) McGregor

The age is middle to late Givetian.

[1] Figures in square brackets give number of specimens.

Blue Fiord Formation (identifications and ages by T.T. Uyeno)

Core 1
10 520-10 539 feet
(3206.5-3212.3 m)

10 520-10 524 feet
(3206.5-3207.7 m)

Polygnathus sp. (small fragmentary P element) [1]
Belodella sp. [2]
age: Devonian-Carboniferous

10 524-10 528 feet
(3207.7-3708.9 m)

Icriodus aff. *I. angustus* Stewart and Sweet, of Bultynck (1972) [5]
I. expansus Branson and Mehl-*I. retrodepressus* Bultynck assemblage, of Bultynck (1972) [2]
Polygnathus cf. *P. intermedius* (Bultynck) [4]
P. parawebbi Chatterton [4] (1 specimen transitional to *P. costatus costatus* Klapper)
Belodella sp. [2]
age: Middle Devonian; early to mid-Couvinian (Cola to Co2b)

10 528-10 532 feet
(3208.9-3210.2 m)

Polygnathus linguiformis linguiformis Hinde, morphotype β of Bultynck (1970) [1]
P. parawebbi Chatterton [4] (2 specimens transitional to *P. costatus costatus* Klapper)
Belodella sp. [5]
Coelocerodontus sp. [1]
age: Middle Devonian; about mid-Couvinian (Co2b)

10 532-10 536.5 feet
(3210.2-3211.5)

Icriodus aff. *I. angustus* Stewart and Sweet, of Bultynck (1972) [1]
Polygnathus parawebbi Chatterton [1]
P. cf. *P. intermedius* (Bultynck [1]
age: Middle Devonian; early to mid-Couvinian (Cola to Co2b)

Core 3
11 500-11 530 feet
(3505.2-3514.3 m)

Pandorinellina expansa Uyeno and Mason [1]
Polygnathus aff. *P. perbonus* (Philip) [1]
P. inversus Klapper and Johnson → *P.* aff. *P. perbonus* (Philip) [2]
P. serotinus Telford [4]
Pelekysgnathus glenisteri Klapper [2]
Belodella sp. [2]
Panderodus sp. [42]
age: Early Devonian, Emsian (a mixed fauna of Faunas 9 and 10 of Klapper *et al.*, 1971)

11 500-11 505 feet
(3505.2-3506.7 m)

Pelekysgnathus glenisteri Klapper [1]
Panderodus sp. [25]
Belodella sp. [12]
age: Early Devonian, Emsian (Faunas 9-10 of Klapper *et al.*, 1971)

11 505-11 510 feet
(3506.7-3508.3 m)

Pelekysgnathus glenisteri Klapper [1]
Pandorinellina expansa Uyeno and Mason [1]
Belodella sp. [15]
Panderodus sp. [19]
age: Early Devonian, Emsian (Faunas 9-10 of Klapper *et al.*, 1971)

11 510-11 515 feet
(3508.3-3509.8 m)

(?)*Peleskysgnathus glenisteri* Klapper [1] (broken specimen)
Belodella sp. [17]
Panderodus sp. [23]
age: probably Early Devonian

11 515-11 520 feet
(3509.8-3511.3 m)

Pelekysgnathus(?) sp. (2 S_2 elements)
Belodella sp. [12]
Panderodus sp. [6]
age: mid-Ordovician to mid-Devonian, probably Early Devonian.

11 520-11 525 feet
(3511.3-3512.8 m)

Pelekysgnathus glenisteri Klapper [2]
Polygnathus inversus Klapper and Johnson → *P.* aff. *P. perbonus* (Philip) [1]
Belodella sp. [7]
Coelocerodontus sp. [2]
Panderodus sp. [21]
age: Early Devonian, Emsian (probably Fauna 9 of Klapper *et al.*, 1971)

11 525-11 530 feet
(3512.8-3514.3 m)

Pelekysgnathus glenisteri Klapper [1]
Polygnathus aff. *perbonus* (Philip) [2 small]
Belodella sp. [3]
Panderodus sp. [13]
age: Early Devonian, Emsian (probably Fauna 9 of Klapper *et al.*, 1971)

In collections where core no. 3 was sampled at 5-foot (1.5 m) intervals, it was noted that conodonts that are probably assignable to Fauna 9 are restricted to the lower 10 feet (3.0 m). However, a mixed fauna, assignable to Faunas 9 and 10, was obtained from a sample where the core was sampled throughout its interval. This suggests that the upper part of core no. 3 is probably assignable to the younger of the two faunas, Fauna 10. Unfortunately, no diagnostic conodonts were obtained from the 5-foot (1.5 m) samples from the upper part of the core.

12 000-12 100 feet
(3657.6-3688.1 m)

Pelekysgnathus glenisteri Klapper [1]
unidentified O_1 element [1]
age: Early Devonian, Emsian (Fauna 9-10 of Klapper *et al.*, 1971)

BP *et al.* Panarctic Hotspur J-20

Beverley Inlet Formation (identifications and ages by D.C. McGregor)

120-220 feet
(36.6-67.1 m)
C-11488/120-220

This sample contains a diverse and well-preserved assemblage of spores. The age is early to mid-Frasnian. The following species are present, among others:

Ancyrospora furcula Owens
Archaeoperisaccus oblongus Owens
A. scabratus Owens
Contagisporites optivus (Chibrikova) Owens
Geminospora antaxios Owens
G. svalbardiae Allen
Hymenozonotriletes archaelepidophytus Kedo
Hystricosporites gravis Owens
Verruciretusispora magnifica (McGregor) Owens

Hecla Bay Formation (identifications and ages by D.C. McGregor)

Core 1
1950-1980 feet
(594.4-603.5 m)
C-29869
C-11488/1950-1980

This sample contains a diverse assemblage of moderately well-preserved spores of Givetian, possibly late Givetian age. The assemblage is similar to that reported by McGregor and Uyeno (1972) from the upper part of the Weatherall Formation on southeastern Melville Island. The following are present, in addition to new, undescribed species:

?Archaeozonotriletes arduus Archangelskaya
A. ?macroimplanus Archangelskaya
Biharisporites sp.
Convolutispora tegula Allen
Densosporites orcadensis Richardson
Grandispora ?macrotuberculata (Archangelskaya) McGregor
G. mammillata Owens
Hystricosporites ?furcatus Owens
H. ?gravis Owens
cf. *Perotrilites conatus* Richardson
P. bifurcatus Richardson
Raistrickia aratra Allen
Retusotriletes rugulatus Riegel
Rhabdosporites parvulus Richardson
Samarisporites concinnus Owens
Spelaeotriletes sp.

2240-2300 feet
(682.8-701.0 m)
C-11488/2240-2300

Spores are somewhat corroded, but abundant and not excessively carbonized. They indicate Givetian age, probably about mid-Givetian. The Weatherall Formation of eastern Melville Island contains a similar assemblage (McGregor and Uyeno, 1972). The following have been identified:

Auroraspora macromanifestus (Hacquebard) Richardson
Calyptosporites proteus (Naumova) Allen
?Corystisporites multispinosus Richardson
Grandispora ?diamphida Allen
G. mammillata Owens
G. velata (Eisenack) McGregor
Hymenozonotriletes archaelepidophytus Kedo
Hystricosporites gravis Owens
Retusotriletes rugulatus Riegel
Rhabdosporites langii (Eisenack) Richardson

Core 2
3213-3243 feet
(979.3-988.5 m)
C-29870

Spores are rather rare, but enough were found to indicate that the age is Givetian, probably Early Givetian. The following were identifiable:

?Acinosporites acanthomammillatus Richardson
Apiculatisporis microechinatus Owens
Apiculiretusispora sp.
cf. *Calyptosporites microspinosus* Richardson
Cristatisporites spp.
cf. *Dibolisporites echinaceus* (Eisenack) Richardson
Grandispora mammillata Owens
G. velata (Eisenack) McGregor
Lophotriletes sp.
Retusotriletes rotundus Streel
Rhabdosporites parvulus Richardson
Samarisporites inaequus (McGregor) Owens

Bird Fiord Formation (identifications and ages by D.C. McGregor.

Core 4
4206-4236 feet
(1282.0-1291.1 m)
C-29871

Spores are relatively numerous in this sample, but are corroded, pitted and broken. The following were present, in addition to some apparently new species, and indicate a late Eifelian or early Givetian age.

Anapiculatisporites petilus Richardson
?Ancyrospora ancyrea (Eisenack) Richardson
Calyptosporites proteus (Naumova) Allen
Dibolisporites echinaceus (Eisenack) Richardson
Grandispora velata (Eisenack) McGregor
Retusotriletes rugulatus Riegel
Rhabdosporites langii (Eisenack) Richardson
?Samarisporites hesperus Allen
Samarisporites sp.

Core 5
5275-5295 feet
(1607.8-1613.9 m)
C-29872

The spores in this sample are corroded, and dark brown to black. Those that were identifiable suggest a late Eifelian age, but this conclusion is only tentative. The following were identifiable:

?Ancyrospora eurypterota Riegel
Calyptosporites proteus (Naumova) Allen

Dibolisporites echinaceus (Eisenack) McGregor
Grandispora velata (Eisenack) McGregor
?*Hymenozonotriletes facetus* Archangelskaya
?*H. spinulosus* Naumova var. *antiquus*
Hystricosporites sp.
Retusotriletes rotundus (Streel) Streel
R. rugulatus Riegel
Verruciretusispora multituberculata (Lanninger) McGregor

Cape De Bray Formation (identifications and age by D.C. McGregor)

7840-7920 feet
(2389.6-2414.0 m)
C-11488/7840-7920

Spores are strongly carbonized and corroded. *Apiculatisporis microconus* Richardson, *Dibolisporites echinaceus* (Eisenack) Richardson, *D. radiatus* Tiwari and Schaarschmidt, and *Grandispora velata* (Eisenack) McGregor were identified tentatively.

The age is Eifelian.

Blue Fiord Formation (identifications and age by T.T. Uyeno)

9340-9440 feet
(2846.8-2877.3 m)
C-11488/9340-9440

Polygnathus aff. *P. perbonus* (Philip) → *P. inversus* Klapper and Johnson [1]
Pandorinellina exigua philipi (Klapper → *P. exigua exigua* (Philip) [1]
P. cf. *P. optima* (Moskalenko)
Icriodus sp. [1]
Panderodus sp. [20]
Belodella sp. [4]
age: Early Devonian, Emsian (probably Fauna 9 of Klapper *et al.*, 1971).

Sun KR Panarctic Young Inlet D-21
(GSC loc. C-58249)

Bathurst Island Formation (identifications and age by D.C. McGregor)

420-500 feet
(128.0-152.4 m)

Palynomorphs are rather rare in this sample. Based on the presence of *Hoegisphaera* sp. (chitinozoan) and a relatively large specimen of *Retusotriletes* sp., I can only say that the age is Devonian, and the environment of deposition was marine. A few fragments of scolecodonts also were recovered. All of the palynomorphs are dark brown or black, and corroded.

Cape Phillips Formation (identifications and age by C.R. Barnes)

2860-2960 feet
(871.7-902.2 m)

Three simple cones including *Acodus mutatus* (Branson and Mehl) sensu fructo [1].

The range of this species is late Middle Ordovician through the Late Ordovician.

Thumb Mountain Formation (identifications and age by C.R. Barnes)

3580-3680 feet
(1091.2-1121.7 m)

The sample contains 15 specimens belonging to:

Panderodus gracilis (Branson and Mehl) [13]
Polyplacognathus sp. [1]
Trichonodella sp. sf. [1]

The range of the genus *Polyplacognathus* is relatively restricted, occurring only in the Middle Ordovician (Chazyan to Barneveld). The single specimen is fragmentary. The genus has only been reported from the Thumb Mountain Formation in the Canadian Arctic Islands (Barnes, 1974; Nowlan, 1976).

Bay Fiord Formation (identifications and ages by C.R. Barnes)

4660-4780 feet
(1420.4-1456.9 m)

The sample includes the following taxa:

Appalachignathus n. sp. [2]
Belodina n. sp. [9]
Drepanoistodus of *D. suberectus* (Branson and Mehl) [4]
Erismodus? sp. [2]
Multioistodus subdentatus Cullison [2]
Oulodus n. sp. [1]
Panderodus cf. *P. gracilis* (Branson and Mehl) [7]
Phragmodus flexuosus Moskalenko [7]

This distinctive fauna is now relatively well known from the Canadian Arctic Islands (Barnes, 1974; Nowlan, 1976). The presence together of *Pragmodus flexuosus*, *Belodella* n. sp., *Multioistodus subdentatus*, *Oulodus* n. sp., and *Appalachignathus* n. sp. is an association typical of faunas from the middle part of the Bay Fiord Formation. In stadial terms this equates to the lower Chazyan (mid-Llanvirnian).

Dominion Explorers-Canso *et al.*
Bathurst Caledonian R. J-34
(GSC loc. C-5208)

Bay Fiord Formation (identifications and age by C.R. Barnes)

6120-6160 feet
(1865.4-1877.6 m)

This sample includes the following taxa:

Belodella n. sp. [5]
Multioistodus subdentatus Cullison [1]
Phragmodus flexuosus Moskalenko [6]
Trichonodella? memorabilis Moskalenko sensu fructo [1]
Tricladiodus n. sp. [1]

The remarks given for sample C-58249, Young Inlet D-21 well, 4660-4780 feet apply to this sample. Both samples suggest a stratigraphic position of middle Bay Fiord Formation.

Sun KR Panarctic Allison R. N-12
(GSC loc. C-18157)

Stuart Bay Formation (all identifications and ages by T.T. Uyeno)

1300-1350 feet
(396.2-411.5 m)

?*Eognathodus sulcatus* Philip (highly fragmented P_a element [1]
Panderodus sp. [1]
age: probably Early Devonian, Faunas 5 and 6 of Klapper *et al.* (1971)
remarks. Uyeno (*in* McGregor and Uyeno, 1972) reported *E. sulcatus* from possible Bathurst Island Formation and from lower part of Stuart Bay Formation.

Thumb Mountain Formation

11 750-11 761 feet
(3581.4-3584.8 m)

Phragmodus undatus Branson and Mehl (phragmodiform element) [1]
Panderodus spp. [3]
age: late mid- to Late Ordovician, Barneveld through Richmond; Faunas 8 through 12 of Sweet *et al.* (1971)
remarks: Nowlan (1976) reported *P. undatus* from the uppermost Thumb Mountain Formation.

APPENDIX IV

CHEMICAL ANALYSES (A.G. Heinrich)

Dominion Explorers-Canso *et al.* Bathurst Caledonian R. J-34

Mineralogical Analysis

X-ray diffraction analysis of six Ordovician evaporites from Dome Explorers *et al.* Bathurst Caledonian River J-34 revealed the following mineralogy with approximate percentages. (Percentages are based on peak heights, which in turn depend upon the degree of crystallinity, the size of minerals in the rock sample, amorphous material and organic matter present.)

	Quartz	Calcite	Anhydrite	Sylvite	Halite
Core 4 - 7792 feet (2375.0 m)			2	2	96
7797 feet (2376.5 m)			1	2	97
7806.5 feet (2379.4 m)		tr		2	98
Core 6 - 8760 feet (2670.1 m)			<1	2	97
8763.5 feet (2671.1 m)			4	2	94
8777 feet (2675.2 m)	1	17	8	2	72

Elemental Analyses

XRF analysis of the six Ordovician evaporites from Dome Explorers *et al.* Bathurst Caledonian River J-34 revealed the following quantitative elemental results: AGV-1 (Aug. 25, 1977) standard was used for the analysis of Fe, Ti, Sr, Ba and Cu. A standard which approximated the unknowns was made for Br. KBr was dissolved in water and added to a base of NaCl solution and then recrystallized after which it was pulverized. In all cases the standards and unknowns were treated alike.

	Lab No.	% Fe_2O_3	% TiO_2	PPM Sr	PPM Ba	PPM Cu	PPM Br
Core 4 - 7792 feet (2375.0 m)	U-41	0.29	0.005	160	109	65	152
7797 feet (2376.5 m)	U-42	0.39	0.007	38	49	69	214
7806.5 feet (2379.4 m)	U-43	0.43	0.008	23	34	62	160
Core 6 - 8760 feet (2670.1 m)	U-44	0.40	0.012	71	170	65	259
8763.5 feet (2671.1 m)	U-45	0.36	0.005	94	23	62	208
8777 feet (2675.2 m)	U-46	0.34	0.006	143	35	58	229