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F.H.A. CAMPBELL

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STRATIGRAPHY AND SEDIMENTATION IN THE HELIKIAN ELU BASIN AND HIUKITAK PLATFORM, BATHURST INLET-MELVILLE SOUND, NORTHWEST TERRITORIES

Abstract

Helikian sedimentation in the Melville Sound area commenced with deposition of the Tinney Cove Formation fanglomerate on remnant outliers of the Aphebian fluviatile Burnside River Formation and underlying Archean basement. With uplift and erosion, a hematitic, anomalously radioactive regolith formed on the Tinney Cove and Archean rocks.

Sedimentation in the Elu Basin and adjacent Hiukitak Platform commenced with the deposition of fluvial trough crossbedded quartzite, grit, and conglomerate between and eventually across the pre-Ellice hills of Archean and Aphebian rocks. Distal braided fluvial sediments are transitional into a quartz-sand dominated deltaic complex. Thin stromatolitic units, locally interstratified with oolites and aeolian-transported quartz grains, were deposited in ephemeral lagoons and embayments on the northwestern part of the deltaic complex. Seaward of the coarse clastics, red mudstone, shale, and dolomite accumulated in the more distal parts of intermittently-exposed deltaic complex.

Beyond the limits of significant terrigenous clastic sedimentation, clastic and biogenic carbonate rocks accumulated on a shallow shelf. Gypsum interbedded with the carbonate formed in significant quantities in quiescent parts of the carbonate shelf facies. The evaporites later dissolved and formed a chaotic solution breccia in the Parry Bay Formation. With transgression and decreasing supply of terrigenous clastics, clastic carbonate, accompanied by thin sheets of low-amplitude, elongate, laterally-linked domal stromatolites, was deposited over the evaporite-bearing facies. With stability in the basin, extensive tabular bioherms of this same type of stromatolite accumulated at the platform-basin margin on the same low-angle paleoslope established during deposition of the Ellice Formation. Coarse grained doloarenite and intraformational carbonate-pebble conglomerate were deposited following formation of the tabular bioherm complex. A thin continuous unit of conical stromatolites formed during a lull in coarse clastic sedimentation, and the southern limit of this unit delineates the northern margin of the Hiukitak Platform south of Daniel Moore Bay.

Reefoid stromatolite bioherms, with inter-reef distributary channels spread southwestward across the basin during renewed subsidence. These were in turn buried beneath algal-bound fine grained carbonate in the east and coarser grained carbonate in the west, terminating deposition in the Elu Basin.

Résumé

Dans la région du détroit de Melville, la sédimentation hélikienne a commencé par la mise en place de la formation de Tinney Cove constituée d'un cône alluvial cimenté et localisé sur des vestiges de buttes témoins de la formation fluviatile de Burnside River de l'Aphébien et sur le socle archéen sous-jacent. Un régolithe riche en hématite et caractérisé par des anomalies radioactives s'est formé à la suite d'un soulèvement suivi d'érosion sur la formation de Tinney Cove et les roches archéennes.

La sédimentation dans la bassin d'Elu et sur la plate-forme adjacente de Hiukitak a commencé par le dépôt fluviatil constitué de quartzites à stratification entrecroisé de type gouttière, de grits et de conglomérats qui en premier lieu, a recouvert les parties basses de la région à collines de la formation de pré-Ellice, constitué de roches archéennes et aphébiennes; ultérieurement, cette région a été recouverte en son entier par ce type de dépôt. Les sédiments les plus élocgnés, déposés par des cours d'eau anastamosés constituent un dépôt transitoire à l'intérieur d'un complexe deltaïque composé surtout de sable quartzeux. Des units minces de stromatolites, localement interstratifiés avec des oolites et des grains de quartz éoliens, se sont déposées dans des lagunes et rentrants éphémères, dans la partie nord-ouest du complexe deltaïque.

Au-delà des limites des principaux secteurs de sédimentation clastique terrigène, des carbonates clastiques et biogéniques se sont accumulés sur une plate-forme peu profonde. Dans les parties peu agitées du faciès carbonaté de cette plate-forme, se sont formées d'importantes intercalations de gypse avec les carbonates. Plus tard, les évaporites se sont dissoutes, et ont formé dans la formation de Parry Bay une brèche par mise en solution des matériaux. Par suite d'une transgression marine et d'une diminution de l'apport de roches clastiques terrigènes, des carbonates clastiques accompagnés de minces couches à structures stromatolitiques en dôme, de faible amplitude, allongées et latéralement reliées, se sont déposés sur le faciès à évaporites. Grâce aux conditions de stabilité qui ont régné dans le bassin, de vastes biohermes tabulaires, constitués par le même type de stromatolites, se sont accumulés sur la marge entre la plate-forme et le bassin, sur la même pente ancienne, de faible inclinaison, qui s'était formée pendant la sédimentation d'Ellice River. Une doloarénite à grain grossier et un conglomérat intraformationnel à galets de carbonates se sont déposés après la formation du complexe tabulaire à biohermes. Il s'est constitué une mince unité continue formée de structures stromatolitiques coniques pendant une interruption de la sédimentation clastique grossière; la limite sud de cette unité délimite la marge nord de la plate-forme de Hiukitak, au sud de la baie Daniel Moore.

Des biohermes à stromatolites de type récifal, comportant un grand nombre de chenaux secondaires entre les récifs, se sont étendus vers le sud-ouest dans le bassin pendant une reprise de subsidence. A leur tour, ceux-ci se sont trouvés enfouis à l'est sous des carbonates à grain fin cimentés par des algues, et des carbonates à grain plus grossier à l'ouest, ce qui a mis un terme à la sédimentation hélikienne dans le bassin d'Elu.

INTRODUCTION

Reconnaissance stratigraphic and sedimentologic work on the Helikian rocks of the Bathurst Inlet area commenced during studies of the Aphebian Goulburn Group (Campbell and Cecile, 1976a). In 1977 detailed examination of the Helikian succession was initiated, and completed in 1978. The area studied includes all the Helikian rocks at the south end of Bathurst Inlet to the Wellington high on Victoria Island in the north (Fig. 1).

The purpose of this study was to delineate the tectono-depositional relationships of the various Helikian formations in the Bathurst Inlet-Coronation Gulf area, and to relate their deposition to correlative units in the Dismal Lakes – Great Bear Lake area.

This report presents the results of the 1978 field work, integrated with the 1977 work in the southern part of Bathurst Inlet. The Ellice and Parry Bay formations were deposited on a southern stable zone – the Hiukitak Platform, and in a correlative depression in the north – the Elu Basin (Fig. 1). These two formations are equivalent to the Hornby Bay Group in the Dismal Lakes area to the west (Campbell, 1978). In this paper, the basinal and platformal successions are described in ascending stratigraphic order. The detailed stratigraphic column is shown in the Table of Formations.

Acknowledgments

Able field assistance was provided by B.J. Tilley and G. McIsaac, both of Dalhousie University. T.M. Gordon of the GSC Data Systems Group spent considerable time developing and perfecting the computer programs which produced the projections utilized for Figures 5a and 5b. W.A. Gibbins of the Department of Indian and Northern Affairs, Yellowknife, graciously provided helicopter support for the northern Kent Peninsula and Victoria Island segments of the study. H.P. Wilton of Cominco Limited provided helicopter support in the Warrender Bay and eastern Elu Inlet areas. Helen Mary Oliver of the Department of Indian and Northern Affairs, Yellowknife, unstintingly provided excellent expediting services. G.B. Warner of Bathurst Inlet Lodge provided transportation and communication assistance; John Naneroak and William Koaha of Bathurst Inlet and Baychimo provided many of the local names.

TINNEY COVE FORMATION

The Tinney Cove in the Melville Sound area outcrops at only one locality on the eastern side of Kongoyuar Point (Fig. 2). There it consists of a thin succession of breccia of Burnside River quartzite and quartz-pebble conglomerate adjacent to or on deeply-weathered Archean granitoid rocks. The fragments in the breccia are up to 1.5 m in exposed dimension, set in a matrix of smaller fragments to sand size. All the fragments are angular, disoriented, and show no lateral or vertical sorting. The basal contact of the Tinney Cove is not exposed and the adjacent Archean granitoid rocks may have been weathered during pre-Ellice uplift.

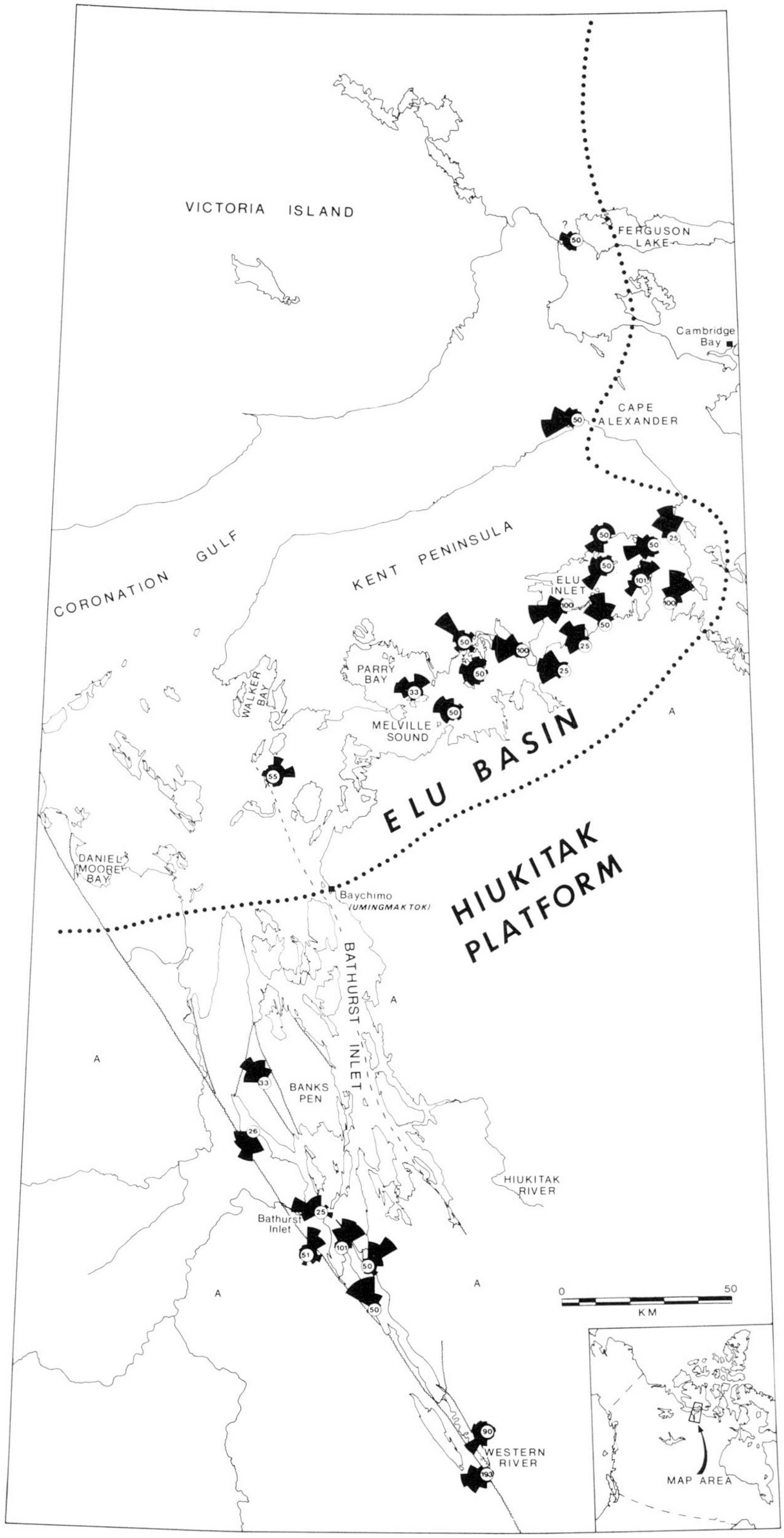

Figure 1. Distribution of the Helikian Elu Basin and the Hiukitak Platform in the Bathurst Inlet-Melville Sound area. The paleocurrent roses are from trough and planar crossbeds from the Ellice Formation, and include data for the southern part of Bathurst Inlet (Campbell, 1978). The diameter of the centre circle is 20 per cent, and the number of readings is as shown. The questionable rose at the west end of Ferguson Lake on Victoria Island may be derived from an outlier of the Hadrynian(?) Glenelg Formation. The A designation is for undifferentiated Archean and Aphebian rocks.

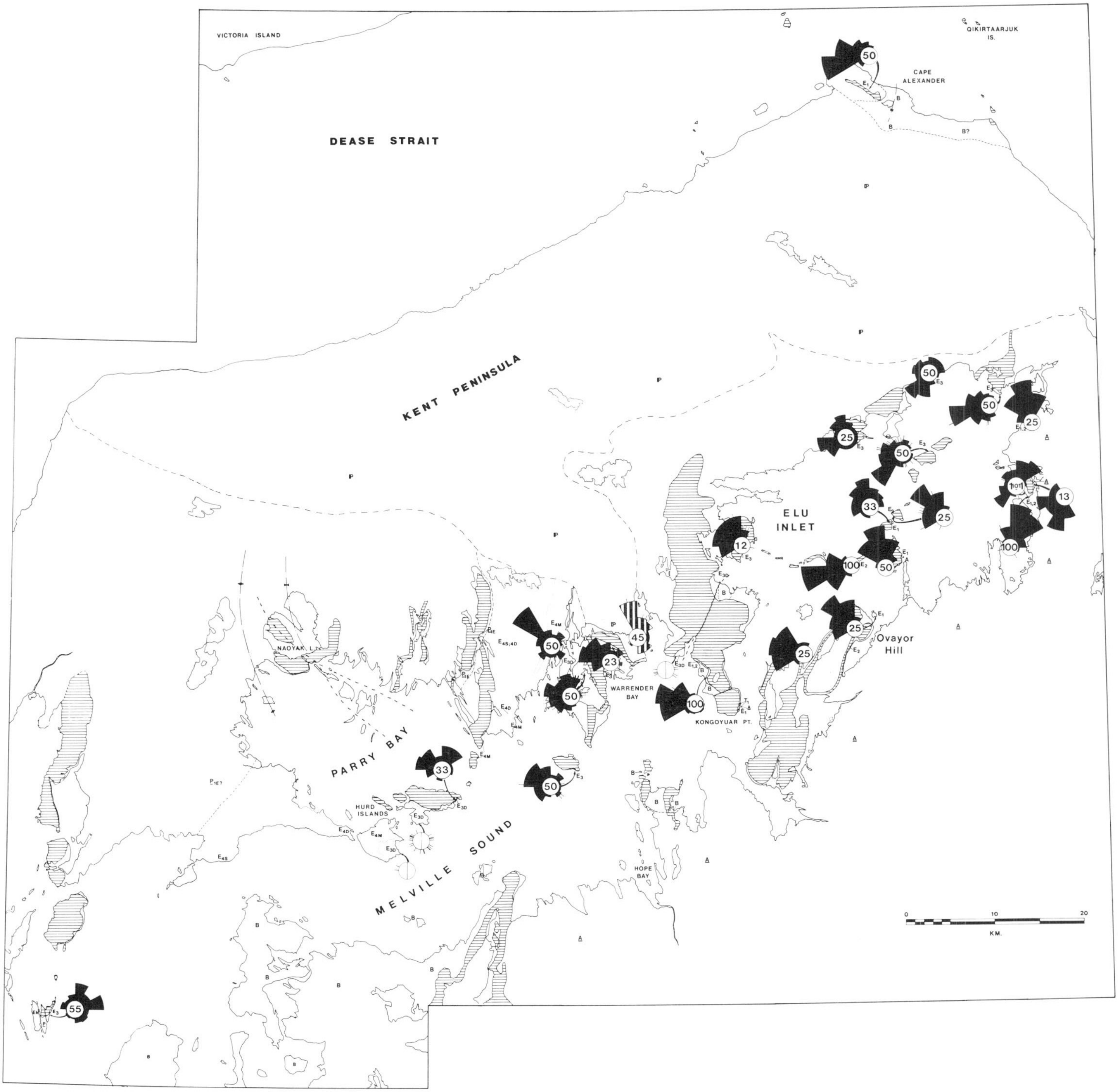

Figure 2. *Rose diagrams of trough and planar crossbeds from the various members of the Ellice Formation. The short lines at the extremities of the rose segments are current ripple directions. The location of the readings is at the centre of the rose, unless otherwise indicated. The diameter of the central circle is 20 per cent, and the number of readings per location is as shown in this circle. The vertical striped rose is from the overlying Paleozoic or Hadrynian sediments.* T_1 *is the designation for the underlying Tinney Cove Formation fanglomerate of Helikian age. B is the Aphebian Burnside River Formation, and* A̲ *is the undivided Archean basement rocks. The horizontal striping indicates the younger diabase dykes and sills.*

Table of Formations

Era	Formation	Member	Symbol	Description
HADRYNIAN				Diabase sills and dykes
				Intrusive Contact
HADRYNIAN	Jameson Island sediments			Quartzite, quartz-pebble conglomerate, minor siltstone (35 m)
				Contact relationships uncertain
HELIKIAN	Algak Fm.		Al	Reddish to purple arkose and siltstone; minor mudstone and shale (35 m)
HELIKIAN	Ekalulia Fm.		Ek	Massive olive-green basalt; minor pillowed basalt; rare doloarenite (300-500 m)
HELIKIAN	Kanuyak Fm.		Kk	Dolomite block megabreccia; chert-pebble conglomerate; minor quartzite; coarse grained doloarenite; oolitic and pisolitic dolomite; stromatolitic dolomite; red arkose, siltstone and mudstone (0-60 m)
				UNCONFORMITY
HELIKIAN	PARRY BAY FORMATION	NAOYAK REEF COMPLEX	$\underline{P}_{5U}$	Medium- to fine-grained doloarenite, dolosiltite; stromatolitic dolomite
			$\underline{P}_{5S}$	Algal laminated sheets of fine grained doloarenite, <u>on</u> $\underline{P}_{5C}$
			$\underline{P}_{5C}$	Bioherms of sheets of laterally-linked low domal stromatolites of fine grained doloarenite, <u>on</u> $\underline{P}_{5B}$
			$\underline{P}_{5B}$	Reddish bioherms of subvertical laterally-linked poorly-branching columnar stromatolites of fine grained doloarenite; inter-bioherm channels filled with planar crossbedded medium- to coarse-grained doloarenite; on top of $\underline{P}_{5E}$
			$\underline{P}_{5E}$	Tabular bioherms of narrow, continuous elongate columnar stromatolites of fine grained doloarenite; minor grey shale
			$\underline{P}_{4C}$	Fine- to medium-grained doloarenite; mudstone; red and purple shale and siltstone
			$\underline{P}_{4B}$	Reddish bioherms of subvertical laterally-linked columnar stromatolites, in sheeted, steep-sided domes; <u>on</u> top of $\underline{P}_{4E}$
			$\underline{P}_{4E}$	Tabular bioherms of narrow, continuous elongate columnar stromatolites of fine grained doloarenite; rare isolated stromatolite biscuits near the contact with $\underline{P}_{4R}$
			$\underline{P}_{4R}$	Red siltstone, mudstone, shale; intraclast-bearing medium grained and coarse grained doloarenite; minor domal stromatolites of fine grained doloarenite
			$\underline{P}_{3C}$	Coarse grained intraclast-bearing doloarenite with rare quartz pebbles; intraformational carbonate-pebble conglomerate; minor stromatolitic dolomite
			$\underline{P}_{3B}$	Low relief bioherms of laterally-linked columnar stromatolites; laterally-linked, large scale conical stromatolites; black shale and mudstone
			$\underline{P}_{3}$	Intraclast-bearing coarse grained doloarenite; carbonate-pebble conglomerate; minor low domal stromatolites
			$\underline{P}_{2}$	Tabular bioherms of elongate, laterally-linked, low amplitude domal stromatolites of fine- to medium-grained doloarenite; minor intraclast-bearing doloarenite
			$\underline{P}_{1H}$	(Hiukitak Platform facies) Fine- to coarse-grained doloarenite; dolosiltite; rare dololutite; minor grey-black shale and mudstone; stromatolitic doloarenite; oolitic, pisolitic dolomite; intraclast-bearing dolomite; rare chert-pebble conglomerate and concretionary dolomite
			$\underline{P}_{1C}$	Medium- to fine-grained doloarenite; low amplitude domal stromatolite of fine grained doloarenite; minor grey and black shale and mudstone
			$\underline{P}_{1B}$	Chaotic megabreccia of angular blocks of $\underline{P}_{1E}$ and $\underline{P}_{1C}$ rocks in a matrix of smaller angular fragments
			$\underline{P}_{1E}$	Fine- to medium-grained doloarenite; intraclast-bearing doloarenite; isolated small biscuit-type stromatolites; gypsum laminae; salt casts

HELIKIAN	ELLICE FORMATION	E_{4D}	Red, maroon, muddy coarse grained doloarenite; minor red shale and mudstone
		E_{4M}	Red and grey shale and mudstone, abundant salt casts; minor quartzite-filled channels and buff fine grained doloarenite
		E_{3C}	Medium- to coarse-grained quartzite, planar crossbedded; coarse grained crossbedded doloarenite; minor stromatolitic dolomite; rare oolitic and pisolitic dolomite; rare mud cracks in red shale
		E_3	Planar and rarely trough crossbedded coarse grained white and buff-grey quartzite; minor quartz-pebble conglomerate
		E_2	Coarse grained, large scale trough crossbedded quartzite, grit and quartz-pebble conglomerate; minor siltstone and rare shale; conglomerate in basal parts of fining-upward cycles
		E_{1B}	Reddish, vesicular, massive basalt (southern Bathurst Inlet area only)
		E_1	Very coarse grained, trough crossbedded and massive quartz grit, conglomerate and quartzite; quartzite boulder conglomerate where this unit overlies the Aphebian Burnside River Formation
		E_{1R}	Locally-developed, strongly hematitic, saprolitic-weathered regolith; primarily of granitoid Archean rocks (Melville Sound-Elu Inlet area)
			UNCONFORMITY
	TINNEY COVE FORMATION	T_2	Reddish, pink and locally mottled, poorly-sorted arkose and arkosic grit; minor quartz-pebble-bearing arkose and grit and siltstone
		T_1	Red, very coarse grained fanglomerate and quartzite-block megabreccia; coarse grained polymictic conglomerate
			UNCONFORMITY
APHEBIAN	GOULBURN GROUP	Amagok Formation	
		Brown Sound Formation	
		Kuuvik Formation	
		Peacock Hills Formation	
		Quadyuk Formation	
		Burnside River Formation	Red, pink, grey and purple quartzite, quartz grit and conglomerate; ubiquitously trough crossbedded; quartz-boulder conglomerate
		Western River Formation	
			UNCONFORMITY
ARCHEAN			Undifferentiated gneissic, granitic, metasedimentary and metavolcanic rocks

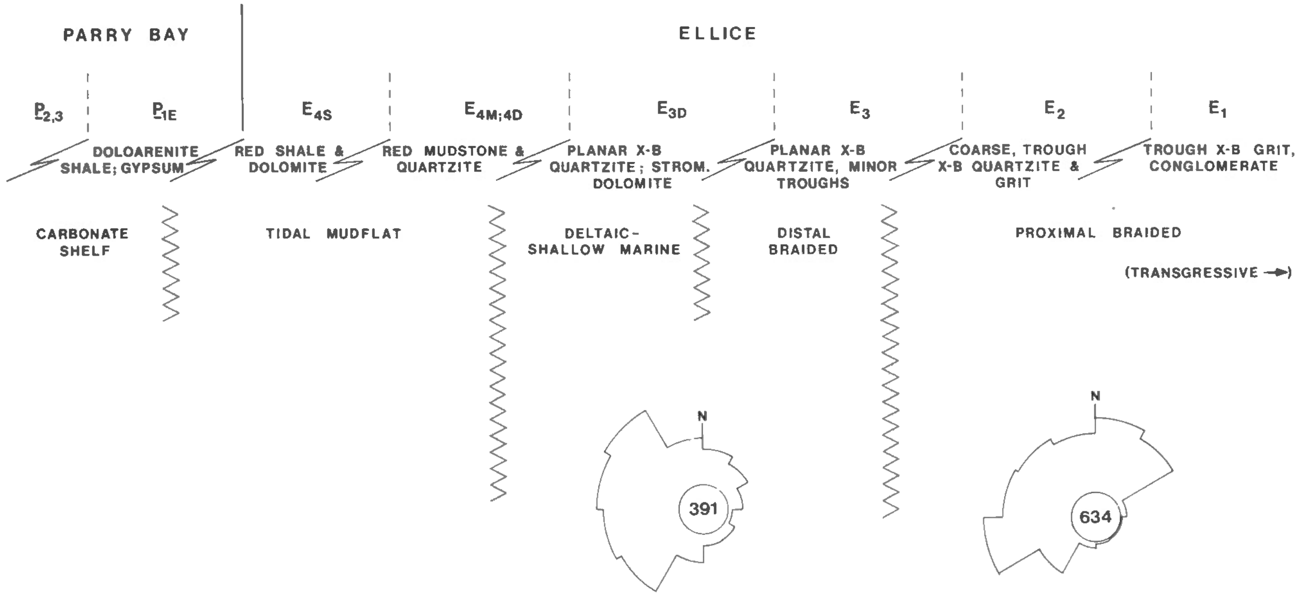

Figure 3. Interpretation of the depositional facies of the Ellice Formation. The total trough and planar crossbeds from the relevant facies are as shown. The diameter of the centre circle is 20 per cent, and the number of readings is as shown.

While the fragments of Burnside River Formation in the Tinney Cove Formation are fresh and relatively unweathered, the matrix is stained a deep hematite-red colour similar to the colour of the Archean beneath the Ellice Formation to the east. This hematitization in the Tinney Cove Formation is interpreted as a pre-Ellice weathering effect, unrelated to Tinney Cove deposition, as it is absent in the south. The top of the Tinney Cove Formation is an erosional surface covered by basal conglomerate of the Ellice Formation.

The origin of the Tinney Cove Formation in this area is consistent with the fault-derived fanglomerate and conglomerobreccia in the southern part of Bathurst Inlet (Campbell, 1978). The absence of significant exposure, however, precludes any interpretation of the orientation and displacement on the syn-depositional faults.

Anomalously high radioactivity recorded in the Tinney Cove Formation at this location is described and discussed in the Economic Geology section of this report.

ELLICE FORMATION

The Ellice Formation in the Melville Sound-Elu Inlet area is considerably more complicated than the previously-mapped Ellice Formation in the southern part of Bathurst Inlet (Campbell, 1978; Campbell and Cecile, 1975, 1976a, b). To the south, only two members of a braided fluvial succession are present, whereas to the north there is a complete facies transition from braided fluvial sediments through tidal mudflat to shallow carbonate. Facies changes in the various parts of the area are not well exposed, but overall the members exhibit characteristic primary textural and structural elements that form a laterally uninterrupted sequence.

The contact with the overlying Parry Bay Formation is not exposed in the area, but the two formations are extremely close east of Parry Bay (Fig. 2). The interpreted facies relationships and the relevant members of the Ellice Formation are shown in Figure 3, and their distribution shown in Figure 4. The various members of the Ellice Formation are described in ascending stratigraphic order below.

E_1 member

The sediments of this member rest unconformably on Archean granitic rocks, Aphebian Burnside River quartzite, and Helikian Tinney Cove fanglomerate. Relief on the contact between the Ellice Formation and the underlying rocks varies with the degree of weathering, but is nowhere greater than 3 m. In the extreme eastern part of Elu Inlet, the Ellice Formation rests directly on deeply weathered, red, hematitic, foliated Archean metasediments. The basal unit consists of cobble and boulder conglomerate on the Archean rocks. Although the Burnside River Formation is not exposed in this area, approximately 75 per cent of the cobbles and boulders are derived from the Burnside River quartzite and quartz-pebble conglomerate; the remainder are quartz and minor Archean granitoid rocks. The conglomerate, interbedded grit, and minor quartzite are characterized by poorly-exposed, large-scale trough crossbeds which show a variety of orientations, but appear directed predominantly to the southwest (Fig. 2).

On the south side of Elu Inlet, the basal part of the E_1 is characterized by very large scale (4 m wide) trough crossbedded quartz-pebble conglomerate and grit. Although these rocks are not exposed in contact with the Archean basement, they are exposed within 150 m of deeply weathered Archean rocks. The basement in this area also weathers a characteristic deep red hematitic colour. Glaciation appears to have exhumed the pre-Ellice topography south of Ovayor Hill, where low, undulating terrain with scattered "hills" of Archean basement is exposed through a thin veneer of till.

On the largest of the islands east of Ovayor Hill, the contact between the Archean and the Ellice Formation is exposed in a low cliff on the eastern shore. There, boulder conglomerate of the Ellice Formation rests directly on saprolitic-weathered greenish and red Archean granitoid rocks. The weathered zone extends at least 3 m below the base of the Ellice Formation, but the colour remains relatively constant throughout. Nearby, on a small island to the south, the granitoid rocks are a deep red colour, but there is no basal conglomerate exposed.

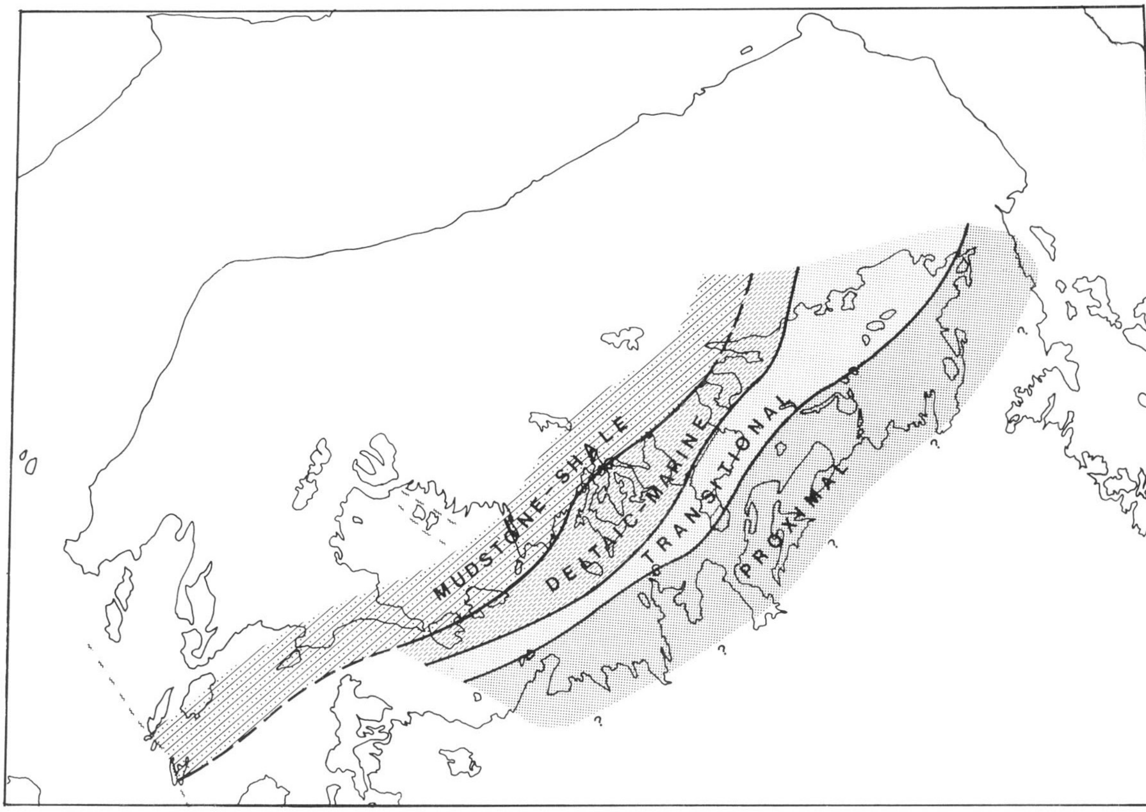

Figure 4. Distribution of the depositional facies of the Ellice Formation in the Melville Sound-Elu Inlet area, at the Hiukitak Platform-Elu Basin boundary. The facies interpretation is as shown in Figure 3.

On the east side of Kongoyuar Point (Fig. 2), basal conglomerate of Ellice Formation rests on a regolith of Tinney Cove fanglomerate and foliated Archean granitoid rocks. The conglomerate is approximately 2.5 m thick, but the overlying section is obscured by talus. The pre-Ellice relief appears to have been high in this area, as the Tinney Cove fanglomerate outcrops some 20 m higher 300 m to the west in a cliff section, where the Ellice Formation is not exposed.

The basal conglomerate in the Elu Inlet area is considered equivalent to that in the southern part of Bathurst Inlet, where it was exposed in only two places (Campbell, 1978). The basal conglomerate to the south, also mapped as a part of the E_1 member, probably should be restricted to only the basal unit(s), and the remainder of the formation should be subdivided according to the succession mapped in the Melville Sound-Elu Inlet area. This would restrict the usage of the E_1 to only the lower part of the formation, and the remainder would be classified as E_2 in the southern part of the inlet. The E_{1B} basalt member would retain its present position.

E_2 member

Overlying, and transitional into the basal E_1 member is a pebble conglomerate, quartz grit, and coarse grained quartzite, that forms the E_2 member. These strata typically show large-scale (1-3 m) trough crossbeds, sometimes in erosional-based fining-upwards cycles, and may contain minor planar crossbeds and rare current-rippled top surfaces. Their local paleocurrent pattern is more consistent than that in the basal E_1 member (Fig. 2).

In the eastern part of Elu Inlet, near the base of the member, there is a succession of fining-upwards cycles to 10 m thick, with conglomerate bases and coarse grained quartzite and grit tops. Both the upper and lower parts are strongly trough crossbedded, with troughs in the lower parts up to 0.75 m wide, 3.0 m long, and those in the upper part generally less than 0.5 m wide and 1.5 m long. The troughs show a bimodal, near-bipolar distribution (Fig. 2), with the coarsest detritus being derived from the northeast, and the finer grained material from the southwest.

The E_2 member is also well exposed on the west side of Kongoyuar Point, where it rests unconformably on quartz-pebble conglomerate of the Burnside River Formation. There, trough crossbeds are well grouped in a typical braided river distribution. Thin, randomly-distributed units of planar crossbedded quartzite to 0.5 m thick are present in this section as well, but no E_1 basal conglomerate is present at the base of the member.

E_3 member

Overlying and transitional into the E_2 member is a sequence of planar crossbedded medium- to coarse-grained quartzite, with minor fine grained quartzite with locally abundant ripple marks. The member is best exposed in the northeastern part of Elu Inlet, beneath the diabase sills which outcrop on the islands and mainland. The quartzite is characteristically white, with very few heavy mineral concentrations or other colour variations. The planar crossbeds are less than 40 cm thick, and most are less than 30 cm. In some cases they form a "herringbone" pattern in vertical section. The distribution pattern is not so consistent as that indicated by the troughs of the underlying member (Fig. 2). They appear to have been distributed predominantly in one quadrant, with other subordinate directions.

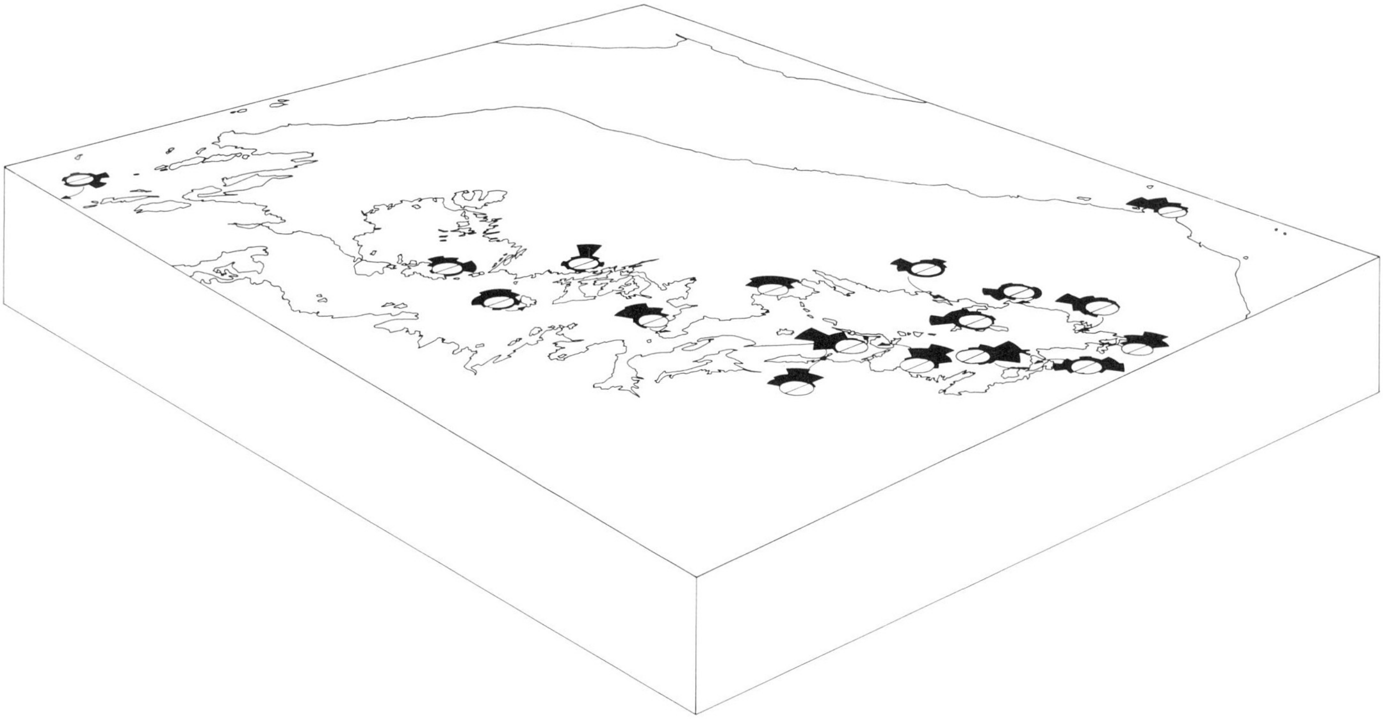

Figure 5a. Two-point perspective view of the Kent Peninsula area, showing the distribution of the main paleocurrent roses from Figure 2. Some have been omitted for the sake of clarity. The diameter of the centre circle is 20 per cent. The computer programs which were utilized to produce the topography and the rose ellipses were developed by T.M. Gordon of the Geological Survey.

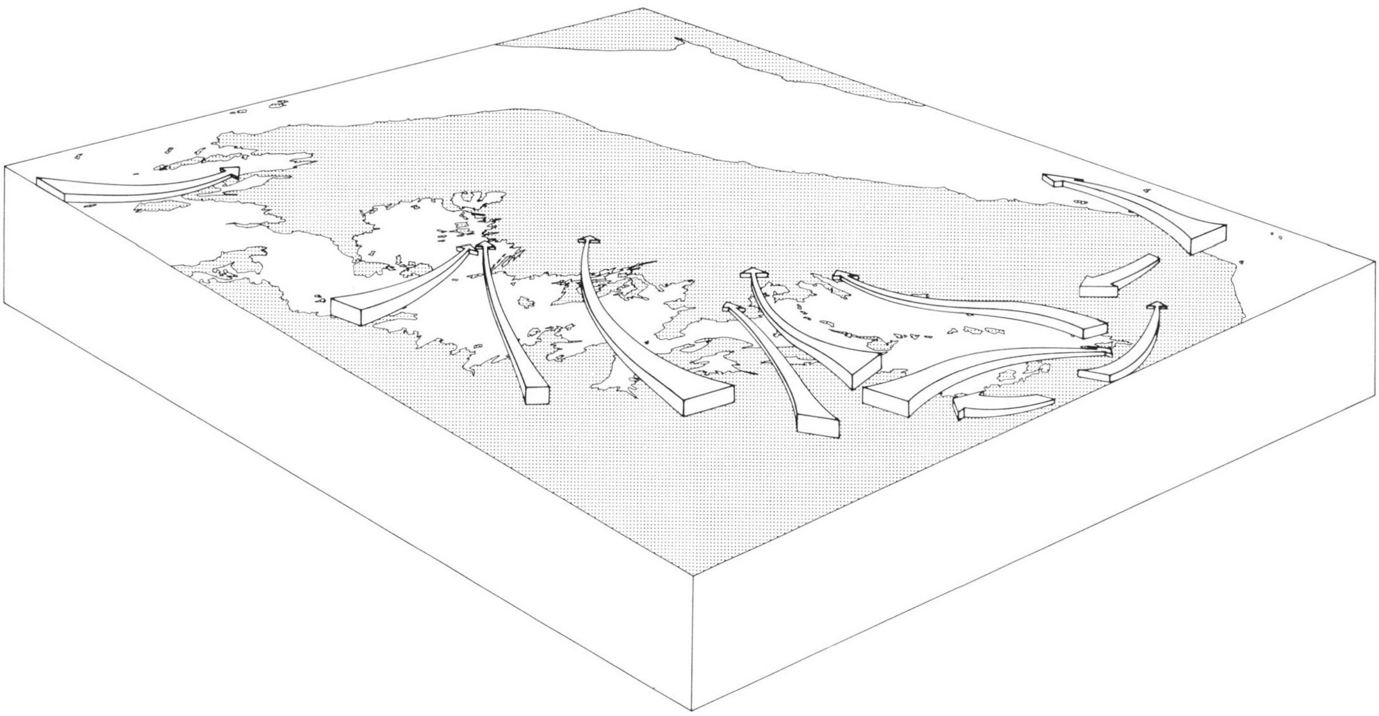

Figure 5b. Two-point perspective view of the Kent Peninsula area, showing the interpreted paleoflow patterns for the Ellice Formation. The data from Figures 2 and 5a were utilized to produce this interpretation. The computer programs which were utilized to produce the topography were developed by T.M. Gordon of the Geological Survey.

On the north shore of Elu Inlet a succession of pebbly arkose conformably(?) overlies the curviplanar crossbedded quartzite of the E_3 member in a stream-cut gorge. The arkose weathers a reddish brown, and is reddish on fresh surface. The lower part contains small pebbles (up to 2 cm in diameter) of quartzite, possibly Ellice Formation. The overall appearance of the arkose is completely different than normal Ellice strata and this, together with the pebbles, suggests that the arkose may be either basal Paleozoic or an outlier of the lowermost Hadrynian Rae Group (see Table of Formations). As the Ellice Formation is essentially flat in this area, there is no apparent angular unconformity, and down-cutting relationships could not be observed because of poor exposure. Thus, the precise relationship between the arkose unit and the Ellice is unknown.

E_{3D} member

This member is transitional into and overlies the E_3 member, although the boundary is difficult to place precisely, due to the nature of the two units. The E_{3D} member consists of interbedded doloarenite, quartzite, quartzose doloarenite, dolomitic quartzite, stromatolitic dolomite, siltstone, and oolitic dolomite.

The lower part of the member consists predominantly of quartzite and dolomitic quartzite, with dolomite increasing upwards at the expense of quartzite. The quartzite is thin- to medium-bedded, planar crossbedded and commonly rippled. At most locations it is interbedded on a large and small scale with the doloarenite. Thin laminae of shale and mudstone also occur in the stromatolitic parts of the member. Sand cracks, mud cracks, and shale flake and chip conglomerate are common in parts of this member and oolites are present on the Hurd Islands (Fig. 2). Stromatolitic, fine-grained doloarenite occurs in all parts of the member.

The stromatolites occur as continuous undulose sheets with low relief (3-10 cm) up to 1.5 m thick, and show no preferred elongation direction. Commonly they start directly on dolomitic quartzite and are overlain by tabular bioclast-bearing quartzose doloarenite.

A section composed predominantly of coarse grained quartzite west of Warrender Bay (Fig. 2) appears to lie within the member. It consists of mega-planar crossbeds (sand waves?) and also small scale troughs. The crossbeds and sand waves(?) show distribution patterns consistent with paleocurrents in the remainder of the member. This same unit may outcrop on the eastern end of the Hurd Islands, where massive, laminated coarse grained quartzite is intimately associated with the dolomitic part of the member. These may represent primary, through-delta distributary channels which fed sediments to the more distal parts of the shelf and basin.

Some of the laminated fine grained doloarenite beds in the western part of the area have laminations composed of single grains of quartz. These are interpreted to have been wind-blown, as there is no other apparent means of transporting and depositing a single-grain lamination of quartz in a dolomite.

E_{4M} member

This member is transitional into and overlies the E_{3D} member at all locations. The base of the member is defined as the first appearance of red mudstone and shale on the underlying interbedded quartzite and dolomite.

The basal mudstone is typically massive, and contains thin laminations of red shale. There is a slight increase in pigmentation in the quartzite and dolomite near the contact, but this is attributed to the introduction of small amounts of red clays in the interstices between the grains in the coarser clastics.

Salt casts and mud cracks occur in the lowermost part of the member. In addition, small channels filled with dolomitic quartzite are also present, as well as rare, thin beds of quartzite up to 4 m above the contact. This member is very poorly exposed in all parts of the area, as it is extremely friable, and there are no nearby diabase sills which would have acted as a protective cover during glaciation.

The lower part of the member contains a thin unit of ferruginous fine grained doloarenite, which is exposed as frost-disrupted blocks to the east, and as one small series of outcrops to the west of the Hurd Islands (E_{4D} member). The unit is massive, structureless, and contains no other lithologies.

E_{4S} member

This is the uppermost member in the Ellice Formation, and is almost everywhere completely disrupted, or buried beneath glacial overburden. It is exposed in the area west of the Hurd Islands on the coast, where it consists of rippled, mud cracked red shale and siltstone with abundant salt casts, and rare thin interbeds of fine grained arkose. In the east, its presence is indicated by extensive areas of frost-broken shards of red shale and mudstone. As in the west, salt casts and possible mud cracks are abundant.

The top of this member is exposed only on Imnaktuut Island to the southwest (Campbell, 1978) where salt-casted shale and mudstone are conformably overlain by the lowermost part of the Parry Bay Formation.

FACIES INTERPRETATION OF THE ELLICE FORMATION

The relationships of the members of the Ellice Formation to their interpreted facies within the basin are shown in Figure 3, and their plan view shown in Figure 4. This interpretation is simplified and generalized because of the paucity of outcrop. A general summary of the depositional environment and facies relations is given below.

Following uplift and erosion of fanglomerate of the Tinney Cove Formation, a major Helikian transgression took place, presumably from the north to the south. In the Bathurst Inlet area, reactivated Aphebian and Paleohelikian (Tinney Cove) faults controlled the distribution of the earliest Ellice fluvial sediments. In the Melville Sound-Elu Inlet area, their distribution was controlled by local paleotopographic highs. As the paleogeography was buried beneath a thin veneer of conglomerate and other coarse fluvial detritus of the E_1 member, the regional paleoslope became well established during deposition of the remaining members of the Ellice Formation (E_{2-4}), (Fig. 5a,b).

In the southeast and south, braided rivers and streams carried quartz sand and quartz pebbles from both the Archean and Aphebian Burnside River, depositing them in a low-gradient, proximal fluvial environment (E_2 member). Downslope, the southern flank of the deltaic facies was established, with deposition of the highly variable planar crossbedded quartzite and fine sand of the E_3 member. At the northern termination of the deltaic complex, fringing the marine facies, shallow embayments and lagoons were the sites of dolomite accumulation and periodic stromatolite growth (E_{3D} member). Exposed quartz sand bodies continuously supplied wind-borne sand particles to the submerged areas. Narrow, shallow, distributary channels spread the sediments from the south through the deltaic facies and into the tidal mudflat facies to the northwest.

Red, structureless, mud and mud cracked, salt-casted clays accumulated on the intermittently-exposed mudflats. Thin beds of quartz sands and dolomitic quartz sands locally

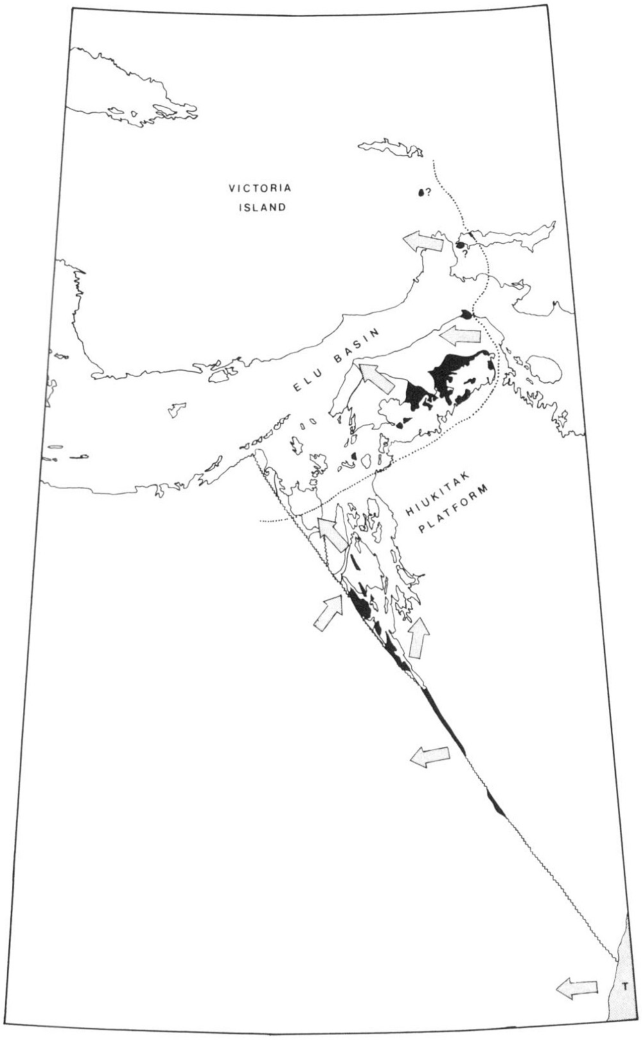

Figure 6. Distribution of the Ellice Formation (solid black) within the Helikian Elu Basin and Hiukitak Platform. The regional paleocurrent trends are shown by the arrows. The shaded unit in the southeast is the Thelon Formation, and the paleocurrent data for that formation is from Fraser et al. (1970). The questionable Ellice Formation on Victoria Island may be outliers of the Glenelg Formation.

prograded onto the mudflats at the southern termination of the mudflat facies, and small distributary channels carried some of the fine sands seaward. These channels were filled later with quartz sands and buried beneath successive mudstone units (E_{4M}).

During a minor transgressive episode, fine grained doloarenite spread across the mudflat facies, but was soon buried beneath tidal muds and clays as the pre-existing environments were re-established (E_{4D}). Seaward of the mudflat facies, red clays, silts, and fine grained dolomite accumulated on the extremity of the tidal flat. Desiccation of ephemeral ponds on the mudflat facies produced abundant salt casts and mud cracks. Clay chips and flakes produced during erosion of desiccated surfaces were incorporated into the overlying units to form intraformational chip conglomerate (E_{4S} member).

Beyond the limit of significant terrigenous clastic sedimentation, carbonate sedimentation predominated, producing a succession of fine grained doloarenite, grey dolomitic shale and mudstone, intraclasts, carbonaceous shales, and thin laminae of gypsum. High-relief domal stromatolites formed together with the gypsum and may have contributed significantly to the formation of the intraclast-bearing doloarenite. This evaporite-bearing sequence is the basal unit of the Parry Bay ($\underline{P}_{1E}$), and appears to form a part of the continuum with the various clastic facies of the Ellice Formation to the south. The southern boundary (projected) is taken as the southern limit of the Elu Basin in this area, and the remainder to the south and east is considered to be a part of the Hiukitak Platform.

On a regional scale, the Elu Basin apparently never extended into the southern part of Bathurst Inlet. The distribution of the fluvial clastics, together with the carbonate lithologies, stromatolite morphologies and thickness of the Parry Bay, indicate that Bathurst Inlet south of a line between Imnaktuut Island and just south of Daniel Moore Bay was always part of the Hiukitak Platform (Fig. 6).

PARRY BAY FORMATION

The Parry Bay Formation underlies the southern flank of the west end of Kent Peninsula, and forms prominent scarps north and west of Parry Bay (Fig. 1). The formation had been subdivided previously into a series of unnamed depositional units (Campbell, 1978), based primarily on work in the southern and central parts of Bathurst Inlet. These units were limited in scope in that no marker units could be recognized. In most cases, correlation could not be accomplished from one measured section to another, commonly less than 5 km.

During the 1978 season, several mappable units which may be utilized as continuous marker horizons were located. The most distinctive of these is a unit of conical stromatolites which caps a thin succession of tabular stromatolite bioherms ($\underline{P}_{3C}$) or black shale and mudstone. This unit can be mapped from south of Daniel Moore Bay to the eastern side of Parry Bay, and it maintains a constant thickness and stratigraphic position within the formation (see Fig. 7).

While the majority of the Parry Bay in the southern part of Bathurst Inlet remains relatively uniform throughout its exposed extent, in the northern part of the area well-developed lateral and vertical facies changes are present. The various subdivisions of the Parry Bay Formation are shown in Table 1, and they are discussed in ascending stratigraphic order below.

Transitional member ($\underline{P}_1$)

This member embraces all the rocks in the lower part of the formation. The lower part, exposed only on Imnaktuut Island, consists of laminated dolomitic siltstone and shale and minor doloarenite. The characteristic stromatolite type consists of thin units (50 cm) of laterally-linked, weakly-elongate stratified domes with relief up to 15 cm. The laminations are continuous from one dome to another, and the inter-dome material is similar to that of the domes.

Deepening-upward cycles occur in the upper parts of the member and are well exposed on the western side of Parry Bay. These cycles consist of a lower segment of intraclast-bearing medium- to coarse-grained doloarenite interstratified with laminated dolosiltite and thin beds of dololutite. Minor, thin beds of domal-type stratified stromatolites also occur in these cycles. In contrast to the stromatolites in the upper parts of the formation, these show

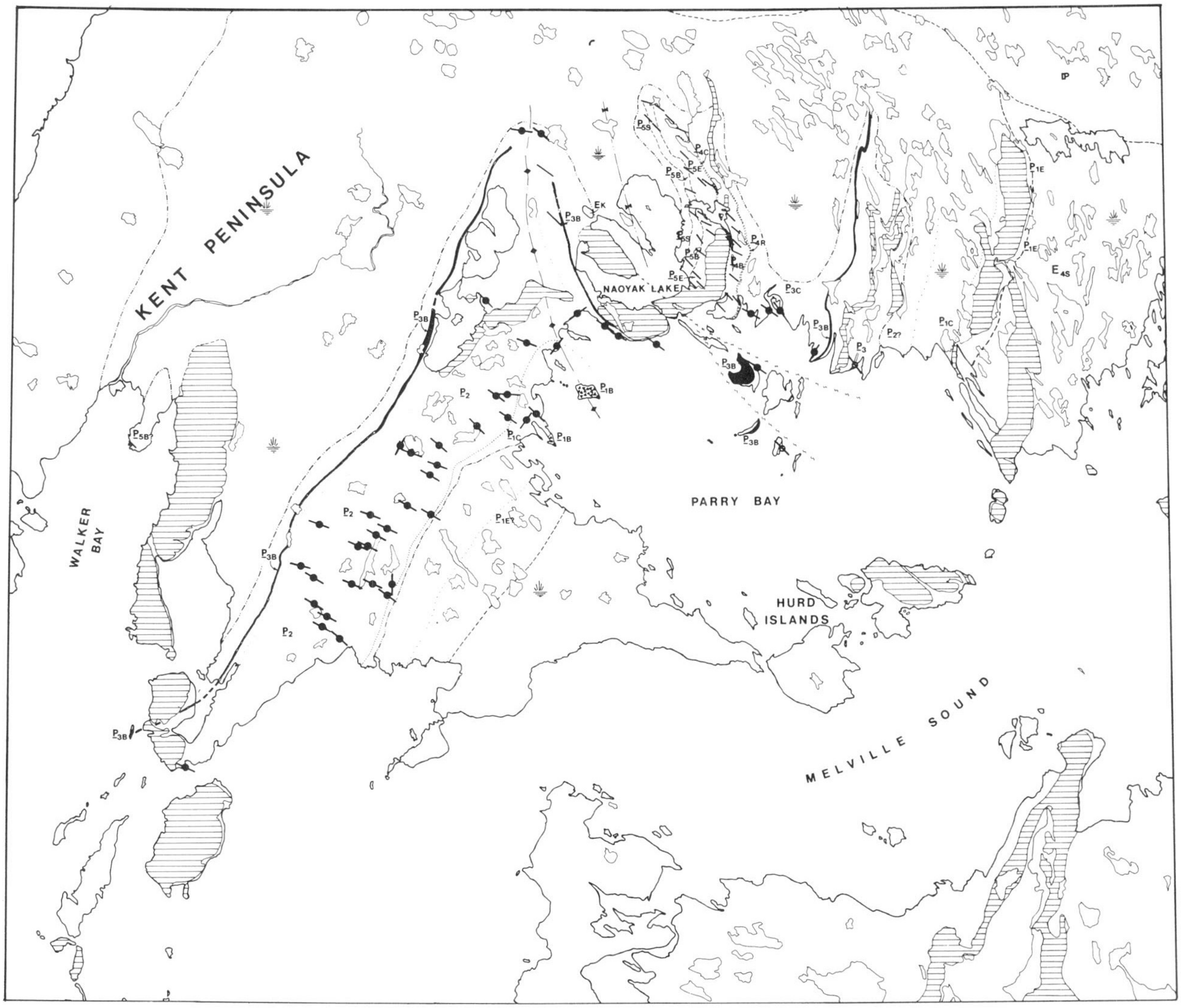

Figure 7. Distribution of the various members of the Parry Bay Formation in the Melville Sound area. The solid black pattern is the Conical stromatolite member ($\underline{P}_{3B}$). The horizontally-striped areas are diabase sills. The dashed and dotted line represents the approximate limits of outcrop. The dashed line is the southern limit of the Paleozoic cover. The short lines represent elongate stromatolite individuals and bioherms within the members.

little preferred elongation orientation. Their elongation, where present, is perpendicular to that of stromatolites in the upper parts of the cycles. Typically, in the lower parts of the cycles, walls of the individual stromatolites are steep to overhanging, and the inter-stromatolite channels are filled with intraclast debris. Rarely, the stromatolite laminae commence on upright, grouped, lath-shaped, possible radiating gypsum crystals similar to the intraclasts. The domes in the lower parts of the cycles are commonly larger than those in the upper parts, but they always occur in thinner units.

The upper parts of the deepening-upwards cycles contain well bedded and laminated fine grained doloarenite and dolosiltite, with appreciably more dololutite. In addition, there are few units of intraclast-bearing doloarenite. The stromatolites, by contrast, occur in thicker units, commonly several metres thick and consisting of strongly elongate (L:W=5:1) high-relief domal-type stromatolites, with a high degree of vertical inheritance. The stromatolites are closely spaced, with the separating distance invariably less than the width of the individuals. The inter-stromatolite clastic carbonate detritus appears to be slightly coarser grained than the material within the stromatolites themselves. Rarely, the tops of the stromatolites show ripples oriented perpendicular to the long axes of the domes and show a northwesterly transport direction. These possibly tabular units of strongly-linked and elongate stromatolites form the tops of the deepening-upwards cycles, and are usually overlain by a succession which closely resembles the high-energy clastics of the previous cycle. Although these are exposed in only the basal parts of the formation, they may represent a transitional environment from one dominated by terrigenous clastics to one dominated by algal-bound carbonate clastics, which characterizes the overlying member.

The transitional member does not outcrop west of Parry Bay. It appears to be a very easily disrupted unit, which may account for its disintegration under glacial action. In this respect, it closely resembles the uppermost sediments of the Ellice Formation.

Evaporitic member ($\underline{P}_{1E}$)

This member is best exposed east of Parry Bay, where it outcrops beneath a continuous diabase sill, and apparently conformably overlies the upper member of the Ellice Formation. Although the two formations are not in contact, there is no indication that there is any structural discordance or erosional interval.

The lower part of the member consists of thin- to medium-bedded fine- to coarse-grained doloarenite, locally with intraclast-filled scour channels and interbedded with fine grained dolosiltite and black mudstone and shale. Rare, isolated domal-type stromatolites with steep to overhanging or incised walls, are indicative of high current activity in the facies. Evaporites occur in thin beds (commonly less than 2 cm thick) interspersed with fine grained clastic carbonate and black shale. The individual beds are continuous for over 8 m, and do not appear to have been incised by the channels in the succession. Approximately 2 per cent of the sequence is composed of these thin gypsum beds and nowhere are they more than 2 cm thick. They are continuous throughout the exposed part of the succession.

Thicker evaporite sequences may have been deposited in the basin to the west, beneath the solution collapse breccia in the Parry Bay Formation ($\underline{P}_{1B}$ member). However, if only thin sequences were deposited there, the evaporites may have migrated into the core of the anticline during deformation, and were dissolved later to form the solution collapse breccia.

Postdepositional solution-collapse breccia ($\underline{P}_{1B}$)

In the western part of Parry Bay, in the projected core of the anticline, unstratified, chaotic megabreccias are exposed at two locations. These are composed of huge blocks of Parry Bay Formation, up to 10 m long and 1.5 m thick, set in a matrix of smaller blocks (Fig. 8a,b). The base of the breccia is not exposed but the top of the breccia is very close (approximately 20 m) to a continuous laminated dololutite and dolosiltite succession. This succession is cut by breccia-filled "dykes" containing locally-derived blocks. This sequence is in turn overlain by a continuous unit of laminated and thin bedded stromatolitic doloarenite. The attitude of the strata in both locations is consistent with the regional attitudes, and the breccia thus lies within the Parry Bay Formation and is conformable with it.

The breccia exhibits a crude stratigraphy in that the blocks of the same lithology occur within zones. About 60-75 per cent of the blocks within a particular section are of the same lithology, whereas the remainder are exposed in the breccia nearby. The largest of the blocks observed was coarse grained massive doloarenite and it measured approximately 12 m long by 1.6 m thick. The third dimension was not exposed. The majority of the blocks are less than 1.0 m in long dimension. None are rounded.

The angularity of the blocks, both as clasts and in the matrix, the absence of continuous beds which have been deformed, and the lack of consistent continuity within the breccia, all indicate that it is not a sedimentary slump breccia. None of the textural criteria outlined in Cecile and Campbell (1977) for the formation of sedimentary intrusive breccias is present in the Parry Bay Breccias.

The breccia is interpreted as a solution collapse breccia, as an evaporite source was present in the $\underline{P}_{1E}$ member and also in the uppermost Ellice Formation which contains abundant salt casts in the upper mudstone member (E_{4M}). The location of the breccia in the core of the major anticline suggests that the evaporites may have migrated into the crestal area during deformation, producing an over-thickened section which was dissolved later.

Tabular Bioherm member ($\underline{P}_2$)

This member, which forms the extensive cliffs at the western end of Kent Peninsula, conformably caps the Transitional member ($\underline{P}_1$) and appears to be a continuation of the last of the deepening-upwards cycles. The member is characterized by a succession of strongly elongate, laterally-linked domal-type stromatolites with a weak columnar aspect, and a high degree of vertical inheritance. The initial relief of the individual domes is estimated to have been less than 10 cm. The characteristic aspect of this member is the consistent orientation of the elongate stromatolites within the individual sheets (Fig. 7). They are invariably elongate at 305 to 315°, and this varies little with either their lateral or vertical position within the member. Some parts of the member appear to be cyclic in that the stromatolites become more elongate progressively upward in the succession, and this is accompanied by a marked decrease in the individual domes of the bioherm. Near the top of the member in the western part of Kent Peninsula, crude branching columns are present in the sequence. These, however, could not be mapped as a consistent unit across the biohermal succession. However, they are elongate in the same direction as the underlying laterally-linked sheets of tabular bioherms.

The member is remarkably uniform from the western to the eastern part of Kent Peninsula, but it was not identified in the southern part of Bathurst Inlet. East of Parry Bay, where the member is not well exposed, the lateral equivalent of the stromatolites appears to be coarse grained clastics deposited in a high energy environment. These clastics underlie a unit dominated by coarse grained carbonate clastics and both contain only thin units of laterally-linked stromatolites in tabular bioherms.

In contrast to the vast sheets of uniformly-elongate individuals with little clastic material in the west, the member in the east is dominated by clastic dolomite, carbonate-pebble conglomerate, and doloarenite with tabular bioclasts. A thin unit of distinctive bioherms occurs within this facies, but they have no equivalent in the western part of Kent Peninsula. They consist of laterally-linked continuous sheets, consisting of high relief (0.75-1.0 m), sinuous, crudely-elongate domes, many of which contain well-developed molar tooth structure. These are developed on top of a succession which has coarse grained intraclast-bearing doloarenite at the base, and which becomes progressively finer grained upwards, passing directly into dolosiltite and laminated dololutite, with none of the characteristic textures of high energy environments. Within the lower part of this succession, thin units (0.3-0.5 m) of laterally-linked domal stromatolites are present, and these weakly-elongate forms show a northeast orientation, normal to the steep-flanked bioherms at the top of the succession.

As this eastern part of the Parry Bay Formation does not contain the characteristic tabular bioherms of the western zone, its position in the formation relative to the marker units indicates that it is the lateral equivalent of the tabular bioherms in the west. Infrequent current ripples in the succession show transport to the northwest into the presumably deeper water facies of the member.

Lower clastic member ($\underline{P}_3$)

This member conformably overlies the Tabular Bioherm member at all locations, but it thins and becomes markedly finer grained to the west. Fine- to coarse-grained doloarenite interbedded with laterally-linked domal stromatolites is the predominant lithology, except east of Parry Bay, where carbonate-pebble conglomerate is predominant. The conglomerate forms beds up to 40 cm thick, which consist almost exclusively of intraformational carbonate pebbles. They are usually less than 1 cm in diameter, but pebbles to 3 cm are present. Rare, well rounded quartz pebbles up to 0.5 cm are also present in these units, but they never form more than 3 per cent of the total population. Granules and grains (1-4 mm) of jasper and chert also occur within the carbonate-pebble conglomerate, but form less than 1 per cent of the clast population. The source of these, as well as the quartz pebbles in the same unit, is unknown. Quartz pebbles are not present elsewhere in the member to the west, except perhaps as a part of the upper part of the member beneath the conical stromatolites.

In the eastern facies of the member the tops of some of the doloarenite beds have well-developed current ripples which show a consistent northwest transport. They are usually less than 4 cm in amplitude and less than 15 cm wavelength. Oscillation ripples are rare in the doloarenite but occur in the finer grained parts of the member, usually within the dolosiltite. There is no apparent consistency to the orientation of these ripples, but the general trend may be to the northwest, similar to the current ripples within doloarenite. Within this coarse succession there are thin beds of domal stromatolites which locally have been incised on their flanks by the currents carrying the coarse debris. These domal stromatolites may be the source of the intraclasts as well as the pebbles within the conglomerate. The cementation of the stromatolites must have occurred very shortly after deposition, as the pebbles in the conglomerates have been considerably abraded, yet retain their consistent flat shape.

Carbonate and other pebble types do not occur in the western part of Kent Peninsula, where the conical stromatolite unit caps the clastic unit. The total thickness of the clastic member decreases markedly from the eastern to the western part of the area. In the west, although the member is not well exposed, it is dominated by fine grained doloarenite and dolosiltite, and the conical stromatolites are directly underlain by a black chert or dark grey mudstone.

Figure 8a. Chaotic solution collapse breccia of the $\underline{P}_{1B}$ member. Note the similarity of lithologies shown by the blocks. GSC Photo 203061.

Conical stromatolite member ($\underline{P}_{3B}$)

This member, which outcrops from east of Parry Bay to south of Daniel Moore Bay, is an excellent marker horizon (Fig. 7). While the member is characterized by conical stromatolites, it is not composed solely of these types. In the Parry Bay area, the base of the member consists of tabular bioherms up to 6 m thick, formed of upward-expanding columnar stromatolites. The interstices between these laterally-linked columns are filled with fine- to medium-grained doloarenite and intraclastic doloarenite. Individual laminae in both columns and interstices are typically alternating reddish and cream-coloured.

The stromatolite columns begin as discrete, widely-spaced individuals 3-5 cm in diameter, which are slightly elongate (L:W=3:1). These expand upwards into laterally-linked, larger columns up to 15 cm in diameter, and also slightly elongate. These columns pass upwards into the conical variety. The transition occurs within less than 1 m, with the cones remaining strongly linked, yet circular in plan view. The relief of the individual columns, shown by the continuous laminae, is up to 0.75 m and is commonly 0.5 m.

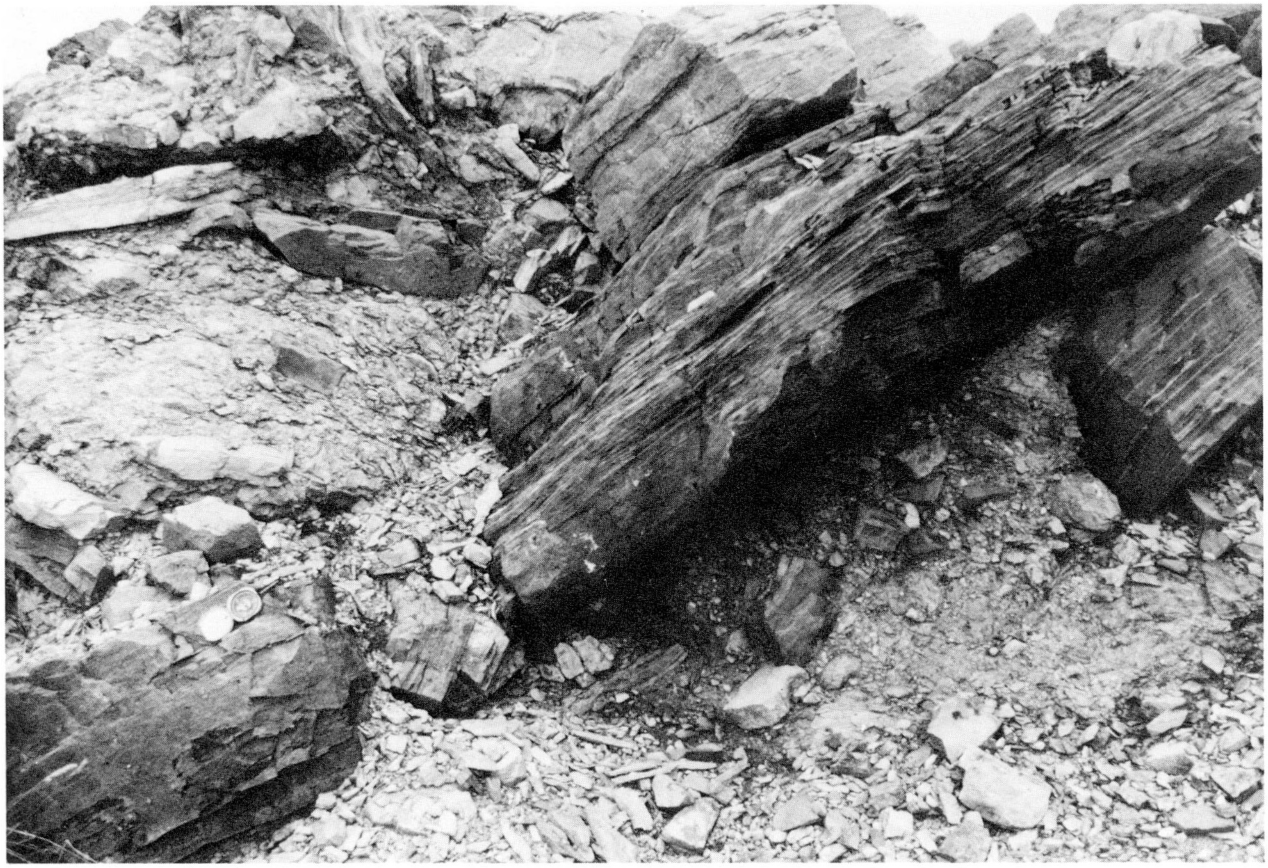

Figure 8b. Chaotic solution collapse breccia of the $\underline{P}_{1B}$ member. Note the sizes of the large blocks, and the identical lithology, producing a crude overall internal stratigraphy. GSC Photo 203060-W.

None of the columns has been incised, although the member is locally overlain by coarse grained debris. There is no apparent environmental reason which caused the change to a conical form, as internal textures and structures are identical within the columnar and conical units.

The tabular bioherms which form the lower part of the member do not occur west of Parry Bay. There is a facies transition on the west side of Naoyak Lake (Fig. 7), and the bioherms do not occur on the western limb of the major anticline. Rather, the conical stromatolites commence directly on fine grained doloarenite and dolosiltite of the Lower clastic member. The conical part thickens to form the entire member, apparently at the expense of the underlying tabular bioherms.

While the conical stromatolites are typically isolated, in some cases (generally less than 20 per cent) individuals have amalgamated to form larger columns. These are usually elongate, due to the nature of the amalgamation of two individuals. No more than three individuals were seen to amalgamate. Some of the individual columns are also slightly elongate, although the length:width ratio never exceeds 1.25:1.0. The amalgamated and slightly elongated columns never form more than 40 per cent of the total columns in any exposure. There appears to be no relationship between the diameter and height of the columns and their position within the member. The maximum diameter is less than 0.5 m and the maximum column height is approximately 2.2 m.

East of Parry Bay, the base of the member is defined as the first appearance of the tabular bioherms of columnar stromatolites; to the west, it is defined as the first appearance of the conical stromatolites. The top of the member is defined as the first appearance of clastic dolomite overlying the conical individuals.

Elongate stromatolites in the other members of the formation indicate paleoflow directions, but the slightly elongate stromatolites in the Conical member cannot be used for this. This is partly because of their subcircular shape, but primarily because of the amalgamation of individuals and their exposure.

Upper clastic member ($\underline{P}_{3C}$)

To the east the sediments of this member are characterized by a basal section of coarse grained tabular bioclast-bearing doloarenite, intraformational carbonate and jasper-pebble conglomerate, and minor dolosiltite with laterally-linked domal stromatolites. To the west, the member consists almost exclusively of medium- to coarse-grained doloarenite with minor thin intraclast-bearing beds. The conglomerate characteristic of the eastern part of the member is absent in the west.

In most respects, the member closely resembles the $\underline{P}_3$ member in both areas, except that it becomes finer grained upwards. Conglomerate, which characterizes the eastern part of the unit is not present in the upper 50 per cent of the member and is replaced by a fining-upward sequence of doloarenite.

At the top of the member to the east, medium bedded doloarenite is interbedded with grey dolosiltite. Within the uppermost 10 m of the member, red lensoid dolomitic siltstone, mudstone, and shale are present in units up to 0.75 m thick. The lenses are upwards of 10 m long in section, but their orientation could not be determined. They commence abruptly and contain no primary structures other than parallel lamination. The top of this transition zone and the appearance of crudely conical, columnar, laterally-linked stromatolites defines the top of the $\underline{P}_{3C}$ member.

The $\underline{P}_{3C}$ member is conformably overlain by a thick complex succession of tabular and mounded bioherms of columnar and sheeted stromatolites, which is collectively referred to as the Naoyak Reef Complex.

Naoyak Reef Complex ($\underline{P}_4$, $\underline{P}_5$)

This complex is one of the uppermost units in the Parry Bay Formation, and may be the top unit in the east. It outcrops in its entirety(?) east and north of Naoyak Lake (Fig. 7), and also in part at the north end of Walker Bay (Fig. 7). The Naoyak Reef Complex has no equivalent in the southern part of Bathurst Inlet. The subunits are described below in ascending stratigraphic order, although the stromatolite successions are probably synchronously deposited lateral equivalents.

$\underline{P}_{4R}$ member

This member defines the base of the Naoyak complex in the Parry Bay Formation. It is dominated by intraclast-bearing, coarse grained doloarenite with minor red siltstone, mudstone, and shale. The base of the member is defined as the first appearance of fine grained mudstone or siltstone on top of the underlying coarse grained doloarenite. The top of the member is difficult to delineate, due to the inter-bioherm channels which characterize the base of the overlying unit. However, in most localities, the top of the member can be defined as the first appearance of elongate to subcircular columnar stromatolites in tabular bioherms.

The red siltstone and mudstone occurs in a thin unit up to 2 m thick, with an undulose base. It is, however, continuous over at least 4 km, and the lateral equivalent of the same unit occurs at the north end of Walker Bay. The top of the unit in the Parry Bay area has large, subconical isolated stromatolite bioherms with incised flanks composed of upright, poorly-developed columns. In addition, the top of the unit is incised by debris-filled channels which are flanked locally by crudely conical, laterally-linked stromatolite columns which are transitional downwards into pink/reddish elongate columnar types.

The channeled top of the subunit is conformably overlain by the basal stromatolites of the $\underline{P}_{4E}$ member at almost all localities. This member is the subject of an Honours B.Sc. thesis by B.J. Tilley of Dalhousie University.

$\underline{P}_{4E}$ member

The base of this division is characterized by approximately 2.5 m of upward-expanding columnar stromatolites with a reddish or pink colour. The stromatolite complex is initiated as isolated bioherms within the uppermost units of the $\underline{P}_{4R}$ member (Fig. 9). These are composed of discrete nonbranching, laterally-linked columns, which are weakly elongate in a northwest direction. These in turn are overlain by continuous tabular bioherms of upward expanding columns, which in turn become slightly conical upwards. Both are pinkish or reddish. The top of the conical section has been incised by or developed together with, doloarenite-filled distributary(?) channels upwards of 2 m deep. They appear to have incised the flanks of the conical stromatolite succession in some places, but contain no stromatolite debris. This may have been swept through the channels downslope to deeper parts of the basin.

$\underline{P}_{4B}$ member

Directly overlying the conical stromatolite sequence is the basal section of the mounds composed of narrow columns, which also have a pronounced reddish tint. Individual columns are approximately 5 cm wide, and are decidedly elongate (L:W=7:1). The columns themselves grow vertically, but the bedding on the flanks of the bioherms is inclined up to 35° to the vertical axes of the columns. The mounds appear to be elongate in the same direction as the individual columns, but their appearance through the raised beaches is deceptive, because the cross-sections exposed are invariably oblique to the elongation direction of the columns. The bioherms maintain a relatively constant orientation throughout their exposed extent, from south to north.

Along one particular zone, the stromatolite columns are approximately 50 per cent of their normal diameter, and have been deformed from their original upright form (see Fig. 10). The columns are separated by dark grey shale and mudstone, in contrast to the more normal fine grained doloarenite. Both the deformation and the concentration of noncarbonate detritus in the intercolumn spaces is interpreted to be a result of postdepositional solution collapse of the sequence.

There is no apparent change in the form or the orientation of the individual columns within the bioherms upward in the succession, and the bioherms maintain a constant size, shape, and orientation.

At the north end of Walker Bay, in the western part of the area, reddish columnar stromatolites rest on red shale, siltstone, and reddish doloarenite, identical to the $\underline{P}_{4R}$ member. The overlying succession is identical to the Naoyak Reef Complex to the east, even to the collapsed columnar stromatolites in the $\underline{P}_{4B}$ member. This sequence represents the westernmost limit of the reef complex, as it does not occur to the south.

Although the succession in Walker Bay is separated from the remainder of the formation by a thick diabase sill, when it is graphically removed, the members are correlative on a structural basis – approximately the same distance above the Conical stromatolite member ($\underline{P}_{3B}$).

$\underline{P}_{4C}$ member

This unit conformably overlies the top of the $\underline{P}_{4B}$ member but is not exposed in direct contact with it. It outcrops beneath a diabase sill on the east side of Naoyak Lake, where it consists of interbedded fine- to medium-grained doloarenite and dololutite, with minor shale. To the north, the same unit is slightly coarser grained, but it also contains a thin (5 m) section of purple mudstone and a 1 m thick lens of red dolomitic siltstone approximately 5 m long.

The top of this subunit is not exposed in the section beneath the diabase cliff and is debris covered to the north and west. However, the overlying basal part of the topmost subunit appears to be conformable with the clastics, with no transition zone.

$\underline{P}_5$ unit

This is the most complex unit of the Parry Bay Formation, with pronounced vertical and lateral facies changes, primarily in the character of the stromatolites forming mounds, that change from discrete vertical columns at the base to laminated sheets at the top. The various parts of the unit are described in detail below.

Figure 9. Isolated bioherm at the transition zone between members $\underline{P}_{4R}$ and $\underline{P}_{4B}$ of the Parry Bay Formation. Note that the flanks of the bioherm are slightly incised. Brunton compass for scale. GSC Photo 203060-J.

Figure 10. Stromatolite columns in the $\underline{P}_{4B}$ member deformed by solution of inter-column evaporites. The amount of evaporitic material removed is estimated at approximately 35 per cent, deduced by the degree of deformation. Brunton compass for scale. GSC Photo 203062.

$\underline{P}_{5E}$ member

The tabular bioherms at the base of the subunit are composed of light grey upright, narrow, uniform, strongly elongate (L:W=10:1) columns, with white to cream inter-column detritus. The columns show very little lateral linkage, and individual columns, although only about 3 cm wide, continue vertically for at least 1 m. The thickness of this tabular bioherm zone is unknown, due to the diabase sill which underlies the unit and the glacial debris which covers the western contact with the overlying mounds of expanding columns.

As in the underlying bioherms, some columns in the tabular bioherms also show the same vertical distortion and lateral shrinkage. This is also attributed to solution of syndepositional evaporites, and subsequent collapse of the columns.

$\underline{P}_{5B}$ member

The mounds of columnar stromatolites which overlie the tabular zone appear to be the same type as those in the basal subunit. They are slightly expanding upwards and grow vertically whereas the flanks of the mounds are inclined up to 36° (measured dips varied from 24 to 36°). The length of these mounds is not known, due to removal of parts by glaciation and burial by debris; however, they appear to have been at least 80 m long and 20 m high.

The inter-mound distributary channels are filled with clastic dolomite debris which laps up onto the flanks of the bioherms. The floors of the channels appear to be flat and individual beds can be traced onto the steeply-dipping flanks of the adjacent bioherm. For the most part, the material is buff-coloured, thin bedded, medium grained doloarenite, with minor intercalations of reddish mudstone and shale. Due to the nature of the exposure, the orientations of these channels could not be determined. The spacing inferred from the positioning of the exposed mounds is approximately 30-50 m. Presumably this space was once occupied completely by thin bedded clastic dolomite of the channel facies.

$\underline{P}_{5C}$ member

The columnar parts of the mounds are vertically transitional into the laterally-linked domal stromatolites which form a continuous cover across the previously established mounds. They maintain the same elongations as the underlying individual columns and are even well-established on the steeply-dipping flanks of the mounds. Where the intermound channels are exposed, the laterally-linked stromatolites are transitional into the debris in the channels and maintain the same orientation there. The thickness of this mound facies is unknown, but it appears to be thinner than the sequence which initially established the mounds. It is surprising that the debris-filled intermound channels contain no intraclasts, which should have been sloughed off the flanks of the high relief structures.

$\underline{P}_{5S}$ member

The laterally-linked domal stromatolites are transitional upwards into the overlying continuous-sheet laminated zone, composed of algal-bound, fine grained doloarenite and dolosiltite. Initially these mounds maintained the same elongate form as the previous "core" structures but the preferred orientation decreases upwards in the section until the sheet mounds show little if any undulatory pattern.

The continuous sheets are the uppermost subunit exposed in the $\underline{P}_5$ unit and do not appear to have any equivalents in the western area. The lack of outcrop to the north precludes the extrapolation of the facies into the western parts of the basin.

$\underline{P}_{5U}$ member

The top unit in the Parry Bay Formation is exposed only in the western part of the area, at the north end of Walker Bay. It is chiefly fine- to medium-grained doloarenite, minor dolosiltite and intraclasts, with subordinate thin (0.5 m) beds of laterally-linked domal stromatolites. The latter stromatolites show little of the preferred orientations of the same stromatolites in the lower part of the succession (Campbell, 1978, Fig. 23.5B).

FACIES INTERPRETATION OF THE PARRY BAY FORMATION

With tectonic stability in the source areas, terrigenous sedimentation decreased, and carbonate accumulated seaward of the distal Ellice tidal mudflats. Evaporation, together with restricted circulation during earliest carbonate deposition, produced significant accumulations of evaporites in the lowermost part of the Parry Bay Formation. With transgression, carbonate spread across the fluvio-deltaic sediments of the Ellice Formation, extending into the southern part of Bathurst Inlet, and possibly much farther. The paleoslope and northeast-trending hingeline first established during late Ellice sedimentation was maintained throughout the deposition of the Parry Bay Formation. Stability of the southern part of the area, together with little terrigenous sedimentation, produced the thin stromatolitic and clastic carbonate succession on the Hiukitak Platform. North of the hingeline, markedly different stromatolitic and clastic carbonate accumulated in a thicker succession within the Elu Basin. The platform-basin boundary is delineated by conical, laterally-linked stromatolites which pinch out against the platform margin.

Shallowing and deepening-upward cycles, intraclast-bearing doloarenite, isolated and thin discontinuous units of stromatolites, and oolite shoals characterize the Hiukitak Platform. Vast, thick uniformly elongate stromatolite sequences are characteristic of the equivalent Elu Basin. Laterally-linked conical stromatolites overlying shale and mudstone were deposited at the basin margin in the southwest, while similar stromatolites developed on tabular bioherms of crudely-branching columns in the northeast. Seaward, a possible barrier reef formed of high relief mounds separated by inter-mound distributary channels marked the northern basin margin. This reef complex spread southward across the basin during Parry Bay deposition, but never extended onto the Hiukitak Platform.

STRUCTURAL GEOLOGY

The Parry Bay Formation and presumably the conformably underlying Ellice Formation have been folded into a series of broad, upright, open anticlines and synclines in the Kent Peninsula area (Fig. 2). The core of the anticline lies to the west of Naoyak Lake and the main syncline passes directly through the lake. The eastern limb of the syncline has been cut by two west-side-down normal faults with a calculated displacement of approximately 220 m. The calculated displacement is based on the lateral juxtaposition of equivalent members and distinctive individual units within other members in the lower part of the Parry Bay.

The rocks west of Naoyak Lake form the western limb of the major anticline and form a west-dipping homoclinal succession from Parry Bay to the faulted succession on Imnaktuut Island in the northern part of Bathurst Inlet (Campbell, 1978).

In the southern and central parts of Bathurst Inlet, the various Helikian formations have been repeatedly block-faulted, and the stratigraphic succession is repeated several times on the various islands. The main faults are the bounding faults on each side of the inlet, which created a

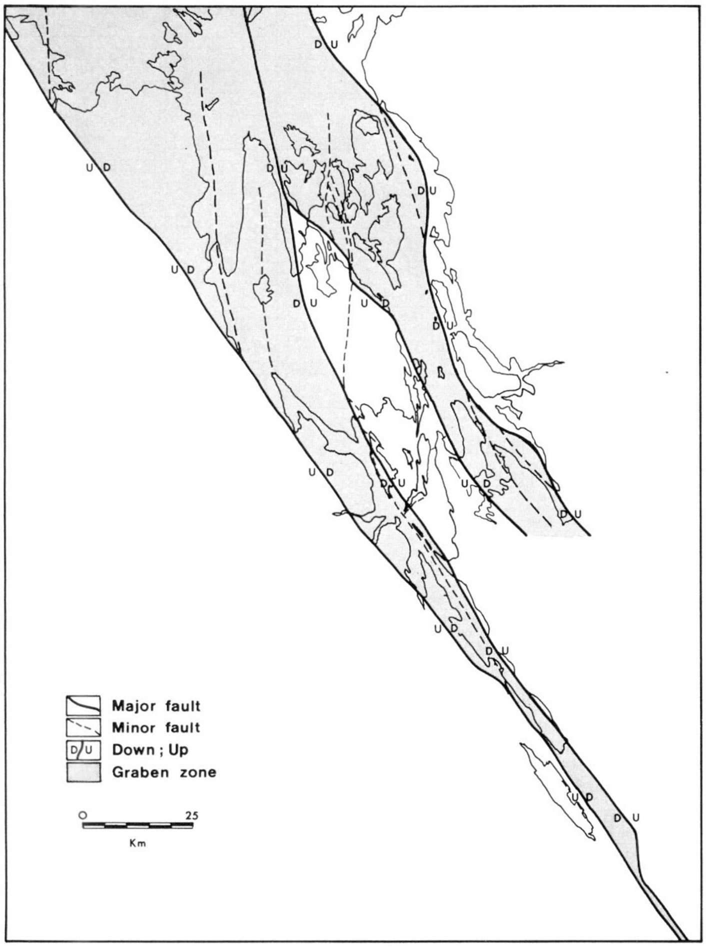

Figure 11. Major and minor dip-slip faults that affect the Helikian succession in the Bathurst Inlet area. The flanking faults on the east and west sides of the major graben zone (stippled) may have been reactivated post-Aphebian-pre-Helikian structures. The central horst in the Banks Peninsula area is composed solely of Aphebian rocks.

broad north-northwest trending graben. A central horst of Aphebian rocks on Banks Peninsula is in fault contact with flanking Helikian sediments and volcanics. In addition to the grabens which flank the central horst, subsidiary grabens, all with the east side down, have produced the repetition of the westerly-dipping succession (Fig. 11). The displacement on each of these faults is relatively minor and probably all developed at the same time. The major faults, as well as some of the subsidiary block faults within the central graben, may have been produced as a result of reactivation on older Aphebian faults.

While the post-Aphebian faults were active during the deposition of the basal rocks of the Helikian in the southern part of the inlet (Campbell, 1978) there is little indication that this was the case in the north.

ECONOMIC GEOLOGY

Little of economic interest was noted during the field season. The Burnside River Formation contains no significant mineralization. At the base of the Ellice Formation, however, in the Kongoyuar Point area, the contact between the Ellice Formation and the older rocks is defined by a well-exposed regolith. The Ellice Formation in this area rests on older Helikian Tinney Cove fanglomerate of Burnside River quartzite and also on deeply weathered Archean gneissic rocks. Slightly anomalous radioactivity was noted in this area. On the largest of the islands to the east of Ovayor Hill, the base of the Ellice Formation also rests directly on deeply-weathered Archean rocks, and patches within the basement cause readings 5-8 times the regional background on the total count and also on the U + Th count. There is only a doubling of the Th count alone.

While the contact between the Ellice and the Archean is exposed very poorly within the area, the Archean in the vicinity of the contact has a very characteristic red weathering colour, caused by the precipitation of hematite in the regolith on the individual grains of the deeply weathered basement. Exploration in the area should concentrate on the southern margin of the Elu Basin where the few contacts are exposed. To the north and west, the base of the Ellice is buried beneath younger rocks.

Scattered radiometric readings taken on Victoria Island yielded no higher readings, either within the Aphebian or the Helikian(?) rocks.

No mineralization was noted within the Parry Bay Formation, other than scattered chalcopyrite within the units in the vicinity of diabase dykes and sills. The solution collapse breccia displayed no mineralization at any of the localities observed.

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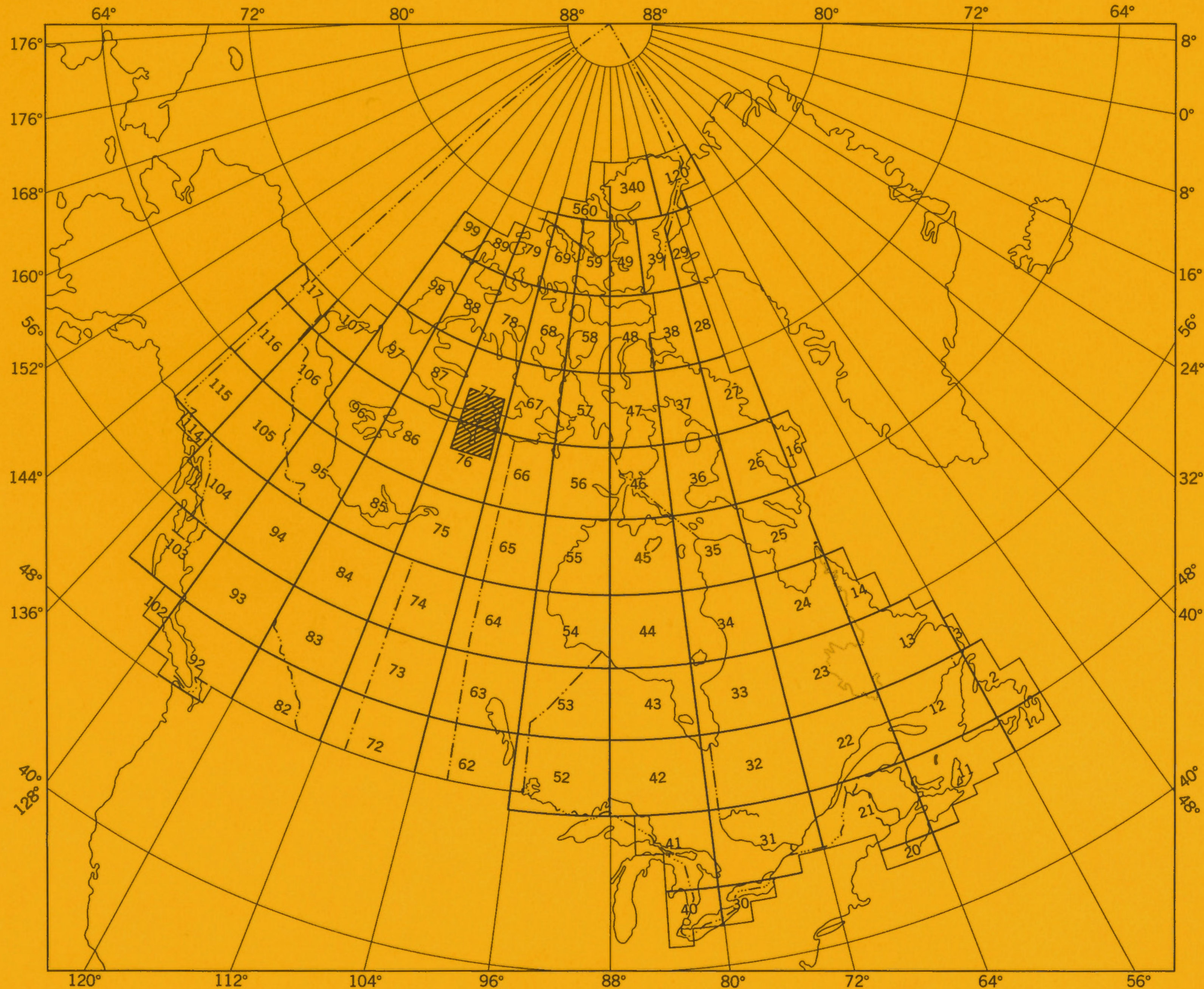

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