STRATIGRAPHY AND PALYNOLOGY OF CRETACEOUS AND TERTIARY ROCKS, NORTH BYLOT TROUGH, BYLOT ISLAND, NORTHWEST TERRITORIES, CANADA.

by

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ABSTRACT

Cretaceous and Tertiary strata of North Bylot Trough at Maud Bight on Lancaster Sound are divided into five formations representing three tectonic phases based on lithology and palynology. In detail, late Albian Hassel Formation fluvial quartz arenites were deposited at Maud Bight prior to rifting in Baffin Bay and Lancaster Sound (Phase 1). Late Campanian-mid Maastrichtian shelf mudstones (Bylot Island Formation) and mid to late Maastrichtian (Sermilik Formation) nearshore and beach deposited quartz arenites reflect uplift of the Byam Martin Mountains and separation from Eclipse Trough (Phase 2). Lower to middle Paleocene shale and thinly bedded sandstone (Navy Board Formation), lithic greywacke and over 200 metres of conglomerate (Aktineq Formation including the newly defined Maud Bight Member) are equivalent to strata in Eclipse Trough. The Navy Board Formation consists of braided stream, flood plain and lacustrine deposits. These strata are overlain by meandering stream deposits (Aktineq sandstone) and alluvial fan strata (Maud Bight Member). This tectonically deformed coarsening up sequence indicates renewed activity corresponding with the opening of Baffin Bay to the east and the Lancaster Aulacogen to the north (Phase

3).

Based on spores, pollen and fungal remains three terrestrial palynomorph assemblage zones and one subzone containing components of both the *Aquilapollenites* and Normapolles Provinces are defined for the North Bylot Trough strata: *Azonia cribrata*-*Aquilapollenites trialatus* (AA) Zone, *Porosipollenites porosus*-*Wodehouseia spinata* (PW) Zone and the *Paraalnipollenites alterniporus*-*Pesavis parva* (PP) Zone. Subzone R lies within the AA Zone and consists of >85% recycled palynomorphs typical of mid to late Albian assemblages such as *Cicatricosisporites*, *Tappanispora* and *Klukisporites*. The AA Zone is late Campanian to mid Maastrichtian and is characterized by *Azonia*, *Aquilapollenites*, *Trudopollis*, *Ceratiopsis* and *Lejeunia*. Characteristic genera of the mid to late Maastrichtian PW Zone include *Porosipollenites*, *Aquilapollenites*, *Beaupreaidites*, *Singularia* and *Wodehouseia*. The PP Zone is early to mid Paleocene and is characterized by *Paraalnipollenites*, *Trivestibulopollenites*, *Momipites*, *Triporopollenites*, *Caryapollenites* and *Pesavis*.

Organic matter recovered from strata at Maud Bight is thermally immature but with sufficient burial in offshore Lancaster Aulacogen would generate liquid and gas hydrocarbons. Stratigraphic relationships in North Bylot Trough, when applied with geophysical data in Lancaster Sound should allow for delineation of a series of stratigraphic and structural traps.

KEY WORDS: Sedimentology, Palynology, Lancaster Sound, Bylot Island, Hydrocarbons, Cretaceous, Tertiary, Rifting.

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DEDICATION

This thesis is dedicated

to the memory of

Peter Edward Benham,

my dad;

who inspired me with a wonder

for nature

from tales of his adventures

as a young adult.

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CHAPTER 1 INTRODUCTION

1.1 PURPOSE AND OBJECTIVES

Cretaceous and Tertiary outcrops are rare in the Eastern Arctic, especially along the margins of Lancaster Sound. Despite this, there is abundant geophysical evidence to show that thick sedimentary wedges occur in the offshore. Extensional faulting in Lancaster Sound, due to Cretaceous and early Tertiary rifting in Baffin Bay, created the Lancaster Aulacogen which filled with at least 6 kilometres of sediment (Kerr, 1980). Much of Kerr's (1980) interpretation of the sedimentary fill of Lancaster Aulacogen is based on geophysical studies and extrapolation from nearby but not adjacent sedimentary basins.

The study area, in North Bylot Trough, along the Maud Bight Coast, is one of the few areas where Cretaceous and Tertiary strata in the offshore are also preserved onshore. The only other outcrops occur in narrow grabens near Croker and Maxwell Bays, Devon Island, and on Somerset Island. This area is the best preserved onshore link to the submarine geology of Lancaster Aulacogen. The adjacent Eclipse Trough has a similar tectonic history and comparable sedimentation patterns but is a separate basin. A portion of North Bylot Trough with an area of 120 sq. km contains up to 500 meters of Cretaceous and Tertiary clastic sediments lying on a downfaulted block of Proterozoic strata. It is bounded by the Byam Martin High in the southwest, Helikian sediments to the east and the Maud Bight shoreline in the north. The sediments probably extend at least 10 km. further offshore to the North Baffin Fault (Kerr, 1980) on the southern margin of Lancaster Aulacogen. About 6 kilometres east of Cape Hay there is a small outlier of Cretaceous strata which is related to the main body of sediment at Maud Bight.

The aim of this study is to map strata in detail and use sedimentology and palynology to determine the age, depositional styles, provenance, tectonic and climatic conditions for the strata in the Maud Bight region. This will allow for a more accurate interpretation of geophysical studies of Lancaster Sound and tie down loosely constrained dates on the formation of Lancaster Sound and Baffin Bay. It will also permit comparison with nearby Eclipse Trough which has different but tectonically related strata.

1.2 LOCATION AND ACCESS

Bylot Island is located in the Eastern Arctic at the northeastern tip of Baffin Island (Figure 1.1). The island measures approximately 15,000 sq. km. in area and is bounded by Baffin Bay, Eclipse Sound, Navy Board Inlet and Lancaster

Sound. The study area lies on the north coast of Bylot Island along the shores of Maud Bight, in Lancaster Sound.

Access was slightly different for each of the two field seasons of late June and early July of 1988 and 1989. Air

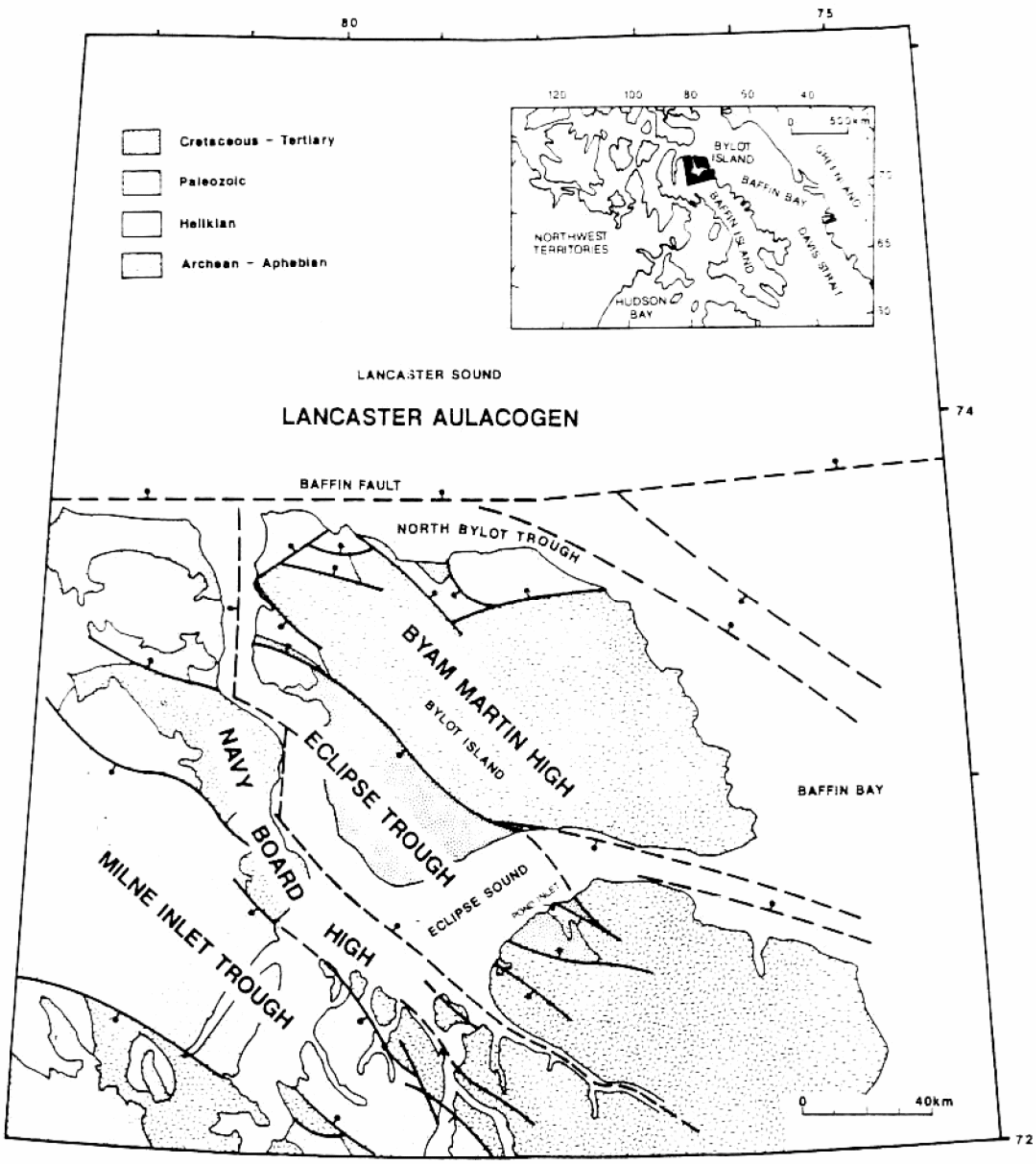

Figure 1.1 Regional and structural setting of North Bylot Trough (after G.D. Jackson and Davidson, 1975; Kerr, 1980; Waterfield, 1989).

Canada provided transportation north from Ottawa to Pond Inlet the first field season. The field crew stayed at the Arctic Research Establishment, run by Mr. H. Steltner, until expedition supplies were bought and plans were finalized. Using a helicopter provided by the Polar Continental Shelf Project we established base camp on southwestern Bylot Island. This procedure was necessary because Bylot Island has no permanent human population and is a designated bird sanctuary. The second summer, Canadian Airlines provided transportation from Montreal to Resolute Bay, Cornwallis Island. The crew stayed at the Polar Continental Shelf Project base while plans were finalized and a flight by Twin Otter aircraft was arranged. Base camp was once again set up on southwest Bylot Island due to an ongoing project. A helicopter at Maud Bight was necessary to cross glacial streams and access isolated outcrops. Both field seasons helicopter access to the Maud Bight region was severely limited by weather.

1.3 WEATHER CONDITIONS

Temperatures while at Maud Bight ranged from -2 to 7 C and it was invariably windy. Fog was the worst problem, resulting in one unpleasant three day stranding and several hasty retreats. The weather was otherwise sunny at Maud Bight because only the best days were picked (with the help of Polar Shelf satellite weather reports) to fly up from base camp.

1.4 FIELD METHODS

The Cretaceous and Tertiary strata of Maud Bight are found on a low lying coastal plain. These sediments are best exposed along coastal cliffs and the banks of glacial streams sourced from the Byam Martin Mountains. The strata, including shale, sandstone and conglomerate, varied from consolidated and poorly cemented to moderately cemented rocks. A thin veneer of glacial debris covers much of the region and it was important to distinguish between the glacial drift and similar appearing Cretaceous and Tertiary sediments. They could be distinguished by fossil content, cementation, sedimentary structures and weathering.

Before arriving in the field, air photos were examined and outcrop sites were selected for study. In the field, 32 stations were made, ranging from cursory examinations to detailed stratigraphic sections. Stratigraphic sections were measured when there was good lateral and vertical exposure of strata and the outcrops were relatively unfaulted and free of slumping. Nineteen sections varying between 12 and 345 meters in thickness were recorded. Weathering, frost heave and soil gelifluction obscured some of the structures but was unavoidable. Additional information was gained from helicopter flyovers.

Field description of the measured stratigraphy included lithology, grain size, colour, bedding thickness, contacts, cyclicity, macrofossils, sedimentary and biogenic structures. The stratigraphic sections were well distributed about the study area and allow for interpretation of lithofacies variations. Of the 87 sediment samples collected for petrology and clay mineral analysis 35 were eventually thin sectioned and 20 were analyzed for clay minerals. Cemented sediments were chosen for thin section work and shales for x-ray diffraction.

Over 100 samples were collected for palynology of which 74 were processed and 41 studied. Fine organic rich shales and siltstones were preferentially collected. The samples were collected at approximately 10 meter intervals but where the clastics were coarse, samples were obtained from the nearest available shale bed.

Plant macrofossils, including fossil logs and leaf fragments, were common. Well preserved leaves were collected for later identification.

1.5 PREVIOUS STUDIES

The northern and eastern coasts of Bylot Island were first described by A.P. Low (1906) as being composed entirely of crystalline rocks. The coast of Bylot Island was explored in more detail during an expedition led by Captain J.E. Bernier (1910) of the *D.G.S. Arctic*. R.S. Janes, Bernier's second officer, noted sedimentary rock formations containing coal deposits at Salmon River near the settlement of Pond Inlet and near Canada Point on Bylot Island. Further exploration turned up well preserved fossil trees and buds (Bernier, 1910). From the voyages of the *Minnie Maud*, Tremblay (1921) reported finding thin beds of coal south of Cape Hay.

There was no geological work done in the Maud Bight area until the 1960's. Aerial magnetic and radiometric profiles led Gregory et al. (1961) to conclude that Lancaster Sound, adjacent to the North Bylot Trough, was downfaulted. Several other geophysical studies were conducted in Lancaster Sound: Keen et al. (1972); Keen and Barrett (1973); Daae and Rutgers (1975); and H.R. Jackson et al. (1977). They added to the geophysical data on the region and confirmed the theory that Lancaster Sound was downfaulted.

The first modern onland study of the North Bylot Trough was Operation Bylot. In 1968 this helicopter supported reconnaissance mapping project was launched by the Geological Survey of Canada (G.D. Jackson, 1969). The end result was a pair of 1:250,000 maps for northern and southern Bylot Island and portions of northern Baffin Island (G.D. Jackson and Davidson, 1975 and G.D. Jackson et al., 1975). The study covered rocks ranging in age from an Archean crystalline complex to Tertiary clastic sediments and Quaternary glacial cover. G.D. Jackson et al. (1975) defined the Eclipse Group as a 1200 metre thick sequence of Cretaceous and Tertiary clastic sediments bordering the Eclipse Sound. They then divided the strata into the units detailed in Table 1.1. G.D. Jackson and Davidson (1975) divided the Cretaceous and Tertiary rocks of the Maud Bight area into Cretaceous orthoquartzites and undifferentiated, unconsolidated Cretaceous to Tertiary sandstone and shale of variable colour, texture and bedding thickness (unit KT3 on G.S.C. Map 1397A). Samples of greywacke having an oily appearance and slight petroliferous odour were collected from the Maud Bight area by G.D. Jackson. They were reported as having moderate organic content but an immature grade for generation of liquid hydrocarbons (Artru et al., 1971 in G.D. Jackson and Davidson, 1975).

1.6 REGIONAL GEOLOGICAL SETTING

North Bylot Trough is part of the North Baffin Rift Zone (Miall et al., 1980), which is composed of a series of parallel fault controlled extensional basins. G.D. Jackson et al. (1975) describe the North Baffin Rift Zone as sets of northwest trending horst and graben blocks with horsts of Archean crystalline rocks separating grabens of Paleozoic to Cenozoic sediments.

The regional tectonic and stratigraphic syntheses by G.D. Jackson et al. (1975), Kerr (1980), G.D. Jackson and Ianelli (1981) and G.D. Jackson and Sangster (1987) show these extensional structures to be truncated by the North Baffin Fault; an east-north east striking fault on the southern margin of Lancaster Aulacogen. H.R. Jackson et al. (1977), based on the previous geophysical studies, proposed that Lancaster Sound was an aulacogen: the failed third arm of a

Table 1.1
Map units of North Bylot Trough
(units mapped by Jackson et al., 1975)

GROUP	MAP UNIT	LITHOLOGY
ECLIPSE GROUP	KT_3	Undifferentiated greywacke, siltstone and shale, variable bedding thickness
	K	Orthoquartzite, arkosic sandstone, coal

triple plate junction. The Lancaster Aulacogen formed from a triple junction just northeast of Bylot Island during the rifting of Baffin Bay. Three plates were involved during rifting; the North American plate and the Greenland and Queen Elizabeth Island microplates. Kerr (1980), J.C. Jackson and Halls (1988), De Paor et al. (1989) and Okulitch et al. (1990) all suggest a rotational pivot is located off the southeastern end of Ellesmere Island, north of which a compressional regime existed and south of which (including North Bylot Trough) the region existed under an extensional regime.

Kerr's 1980 regional synthesis divided strata in Lancaster Sound into a series of 8 unconformity bounded "sequences." There is sparse exposure of Cretaceous and Tertiary sediments along the borders of Lancaster Aulacogen so Kerr drew his inferences from strata in nearby Eclipse Trough and through geophysical studies in Lancaster Sound. He used a seismic profile from Daae and Rutgers (1975) to create a north-south cross-section of Lancaster Aulacogen (figure 1.2). The sediments in North Bylot Trough provide direct correlation with the strata in Lancaster Sound.

A review of Pre-Cretaceous stratigraphy at this stage is vital in understanding that Precambrian structural features control the distribution of faulting and sedimentation throughout the history of the area. The basement of North Baffin and Bylot Island consists of a crystalline complex belonging to the Rae Province of the Precambrian Shield (Hoffman, 1989). The complex is dominantly composed of Archean and Aphebian banded migmatite, foliated granite, and monzocharnockite (G.D. Jackson and Davidson, 1975). K-Ar dates suggest that the rocks were metamorphosed during the Paleo-Helikian Hudsonian Orogeny (Wanless, 1970). The deformation and metamorphism during the Hudsonian Orogeny created a northwesterly trending structural grain defined by rock foliations and lineations. Deposition of the overlying strata and later tectonism in the Lancaster Sound region are subject to control by these Hudsonian structural trends (G.D. Jackson et al., 1975; and Kerr, 1980). In Kerr's (1980) terminology, these crystalline rocks are sequence 1.

After a period of uplift and erosion the Helikian Equalulik and Uluksan Groups were deposited. These strata, along with the Archean migmatites provide the source rocks for the Cretaceous and Tertiary strata at Maud Bight. The Equalulik Group, in stratigraphic order, consists of; the Nauyat, Adams Sound, Fabricius Fjord and Arctic Bay formations (G.D. Jackson and Ianelli, 1981). The Nauyat Formation, composed of interbedded plateau basalt flows and reddish terrestrial quartz arenites, is exposed on the southern borders of the study area. The basalts were extruded along the major fault zones as a result of periodic tectonic activity during Helikian time (G.D. Jackson and Davidson, 1975). Conformably overlying the Nauyat are the quartz arenites of the Adams Sound Formation. The sediment was deposited in a braided stream and marginal marine environments (G.D. Jackson and Ianelli, 1981). The Fabricius Fjord Formation was not deposited near the study area. The Arctic Bay Formation, just south and west of Maud Bight, consists of intertidal to subtidal grey shale and minor stromatolitic carbonate (G.D. Jackson and Ianelli, 1981).

Lying unconformably upon the Equalulik Group are the Society Cliffs and Victor Bay formations of the Uluksan Group. Society Cliffs stromatolitic dolomites, gypsiferous dolomites, shales and cherts were deposited in intertidal to sabkha conditions (G.D. Jackson and Ianelli, 1981). Conformably overlying this the Victor Bay Formation is composed of sandy dolomite, dolomite and chert breccias, black pyritiferous shale and arkosic to quartzose sandstones (G.D. Jackson and Ianelli, 1981). This was deposited in euxinic subtidal and beach environments. G.D. Jackson and Ianelli (1981) suggest that increasing clastic material and coarse dolomite breccias are a result of Precambrian uplift of the Byam Martin High. The block faulting that occurred was along northwest trends created during the Hudsonian Orogeny. G.D. Jackson and Davidson (1975) state that the Hadrynian Franklin Dikes were emplaced during this event.

Although Paleozoic sediments are postulated to be preserved in the structural low within Lancaster Sound, none have been found on Bylot Island. Brodeur Peninsula on northern Baffin and also Devon Island contain abundant lower Paleozoic carbonate and clastic sequences (Kerr, 1980).

During the late Cretaceous and Tertiary, deposition of sediment and deformation of existing strata were a result of the rifting between Greenland and North America. Areas affected by the event variously underwent extensional or compressional tectonism. Rifting began in the Labrador Sea in the lower Cretaceous and propagated northwest through Baffin Bay (Kerr, 1980; Burden and Langille, 1990). S.P. Srivastava (1978) estimated active sea floor spreading began in the southern portions of the Labrador Sea during the Campanian, the northern Labrador Sea by the Maastrichtian and Baffin Bay and Davis Strait actively spread between the Paleocene and Late Eocene. More recently Okulitch et al. (1990) describe Labrador Bay and Baffin Bay as a failed rift arm with new crust being generated only in Labrador Sea.

A period of rifting and sagging would have occurred before actual sea floor spreading began in the south, allowing a pre-rift seaway to form (Henderson et al., 1980). The region from Labrador through to Baffin and Bylot Island existed under an extensional regime. Okulitch et al. (1990) state that the estimated 10% extension in the Baffin Island region is taken up within structural features in Jones, Lancaster and Cumberland Sounds. In response to the extension in Baffin Bay, the Queen Elizabeth Islands, containing Sverdrup Basin, underwent compressional deformation. The deformation can be divided into two events: first the Sverdrup Basin was broken into smaller, isolated basins by intrabasinal upwarps then the individual basins were variably affected by folding and reverse and normal faulting (Balkwill, 1978). The isolation of basins within the Sverdrup occurred between the Campanian and Eocene, while the second phase occurred between the mid Eocene and early Oligocene (Miall, 1986). While uplift within a compressional regime such as the Sverdrup Basin is expected, there also is uplift of Precambrian basement on Baffin and Bylot Islands. It is possible that the raised craton is a result of magmatic underplating which occurred around 60 Ma in the early stages of the Iceland mantle plume (Hoffman, pers. comm. to Burden, 1991). The upwarping and rejuvenated cratons provided a source for clastic sediments of the Sverdrup, Eclipse and North Bylot Troughs. Much of the faulting occurred along existing faults from pre-Helikian time, and were otherwise controlled by the gneissicity of the basement rocks.

The faulting and extensional deformation during this time is known as the Eurekan Rifting Episode (Kerr, 1980). Northwards, on Ellesmere Island, where compressional regimes existed, the deformation was labelled the Eurekan Orogeny (Thornsteinsson and Tozer, 1970). Okulitch et al. (1990) state that 100 km. of compression was accommodated in a series of thrust faults on Axel Heiberg, Ellesmere and Greenland during that stage. The entire event is collectively known as the Eurekan Deformation (Kerr, 1980). The existence of these adjacent regimes suggests the presence of a transform pivot

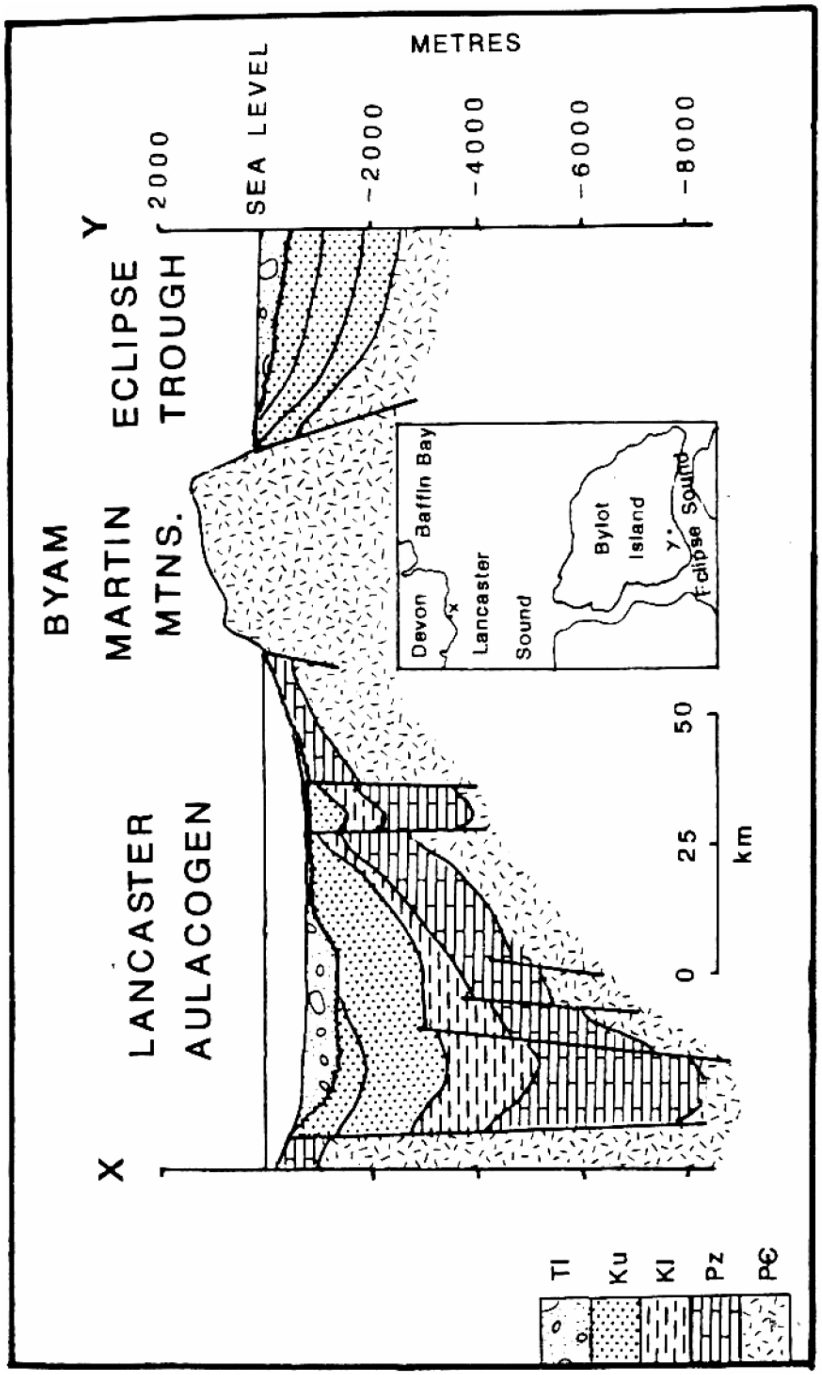

Figure1.2 North-South structural cross-section from Devon Island to Eclipse Trough on Bylot Island (after Hea _et_ _al._, 1980).

about which deformation can occur. It is likely located near southern Ellesmere Island (Kerr, 1980 and De Paor et al., 1989).

Lancaster Aulacogen formed during the Eurekan Rifting Episode. The rotation of microplates away from each other and subsidence within Baffin Bay allowed the formation of an aulacogen in Lancaster Sound during the latest Cretaceous (Kerr, 1980). Kerr (1980) suggests the existence of earlier widespread Cretaceous strata in a shallow sea in Lancaster Sound. Faulting propagated south into Eclipse Trough, resulting in equivalent tectonostratigraphic packages in both basins, although those in Lancaster Sound would probably be much thicker (Kerr, 1980). According to Kerr (1980), main faulting in Lancaster Sound probably occurred in the Paleocene to Eocene. There was likely minor activity right up to Miocene or Pliocene time with sediment continuing to fill the basin to present day. Geophysical studies note little deformation in the upper two kilometres of the strata in Lancaster Sound, suggesting relative tectonic inactivity at least since the Neogene (Keen and Barrett, 1973), although Baffin Bay still experiences moderate earthquake activity. Lancaster Sound, then, was an active aulacogen in the

Tertiary and the strata at Maud Bight are the only direct linkage to the sediments beneath the sound.

CHAPTER 2 STRATIGRAPHY AND SEDIMENTOLOGY

2.1 INTRODUCTION

Lithology, lithofacies and lithofacies associations that are defined for well exposed strata at Maud Bight and near Cape Hay allow for environmental analysis and distinction of the formations. Criteria for definition of facies are based on Reading (1986). Miall (1978) defined a series of lithofacies for fluviatile sequences only. Additional lithofacies defined or used by Rust (1978 and 1981), Eyles *et al.* (1983), Smith (1987), Eyles (1987) and DeCelles (1988) are incorporated in this study.

The lithofacies are defined in Table 2.1 and detailed in the lithology sections of the formations. In addition to lithology and paleontology each formation has a specific assemblage of lithofacies that make it distinct; the lithofacies assemblages for the formations are summarized in Table 2.2 and expanded upon in the formation descriptions. Outcropping strata are mapped in Figure 2.16.

The formation diagnostics consist of the following fundamentally required features: formation definition, distribution, thickness, synonyms, contacts, lithology, depositional environment, petrology and age. Composite sections of the strata and complete descriptions of all the measured sections at Maud Bight and Cape Hay are in

Appendices A and B. Complete petrographic point counts are available

Table 2.1 Definition of Lithofacies

FACIES CODE	LITHOFACIES	SEDIMENTARY STRUCTURES	INTERPRETATION
Gb	Clast-supported, poorly sorted, angular pebble to boulder size clasts	Structureless	Talus breccia
Gcm	Massive, clast-supported, polymodal, poorly sorted, pebble-boulder conglomerate, often channelized	Structureless	Hyperconcentrated flows; longitudinal gravel bars
Gch	Clast-supported, moderately sorted, pebble-cobble congomerate	Horizontally stratified	Longitudinal gravel bars sheet flood deposits
Gcp	Clast-supported, moderately sorted, pebble-cobble conglomerate; erosional or non-erosional base	Large-scale planar cross-stratified	Gravel ripples; transverse gravel bars
SM	Massive, poorly sorted sandy to pebbly mudstone with logs	Structureless	Muddy, cohesive debris flow
Sd	Fine to coarse sandstone, siltstone, shale	Contorted beds, intraclasts	Soft sediment deformation; flooding events
St	Sandstone, medium to v. coarse or pebbly	Solitary or grouped trough cross-beds	dunes (lower flow regime)
Sp	Sandstone, medium to v. coarse or pebbly	Solitary or grouped planar cross-beds	linguoid, transverse bars; sand waves (lower flow regime)
Sr	Sandstone, very fine to very coarse	ripple marks	ripples (lower flow regime)
Sh	Sandstone, very fine to very coarse or pebbly	Horizontal lamination, parting lineation	planar bed flow (lower and upper flow regime)
Sl	Sandstone, fine	low-angle cross-beds	scour fills, crevasse splays, antidunes
Se	Erosional scours with intraclasts	crude cross-bedding	scour fills
Ss	Sandstone, fine to coarse or with pebbly lag	broad shallow scours	scour fills
Fl	Sandstone, siltstone, mudstone ± plant debris	fine lamination very small ripples	overbank, waning flood deposits
Fm	mudstone, siltstone	massive, dessication cracks	overbank or drape deposits
Fb	mudstone, siltstone	bioturbated	shelf, tidal flat or rarely flood plain deposits
C	coal, logs, carbonaceous mudstone	plants, mud films	swamp deposits

Facies St, Sp, Sr, Sh, Sl, Se, Ss, Fl, Fm, Fr and C are adapted from Miall (1978), facies Gcm, Gch, Gcp and SM are adapted from Decelles(1988) and Sd from Eyles (1987).

Table 2.2 Summary of Facies Assemblages

FORMATION	FACIES ASSEMBLAGE	ENVIRONMENT
Bylot Island	Fb	Marine shelf below storm wave base
Bylot Island	Fb, Se, Sr	Marine shelf above storm wave base
Sermilik	Ss, St, SM, Sd	Inner shelf
Sermilik	Ss, Sp, Sh, St, Sl, Gcp	Upper shoreface, beach
Bylot Island	Fb, Fl, Ss, Sr, Sh, Sl, C	Tidal flat dissected by channels
Navy Board	Fl, Fm, C, Sr, Se	Flood plain, distal crevasse splay
Navy Board	Sh, Sr, Se, Sd, Sl, Fl, Fm, C rare Gcm	Crevasse splay, sheet flood deposits
Aktineq sst	Ss, St ,Sr, Sh, Se, C	Meandering channel
Aktineq	Gch, Se, Sh	Meandering channel with boulder lag
Sermilik & Hassel?	Ss, Sr, Sh, Se	Braided Stream
Maud Bight Member	Gcm, Sl, Fr, C	Medial alluvial fan
Maud Bight Member	Gcm, Gch, Sh, rare C	Proximal alluvial fan
Sermilik & M.B.M.	Gb, Sh	Talus slope

in Appendix C.

2.2 FORMATION DESCRIPTION AND DISTRIBUTION

2.2.1 **Hassel Formation**

Definition, Distribution and Thickness

The Hassel Formation (Heywood, 1957) is named for a quartzose sandstone dominated package near Isachsen Dome on Ellef Ringnes Island where is it sandwiched between the marine shales of the Christopher and Kanguk Formations. It is widely distributed in the Arctic and extends east from Eglington Island to Ellesmere, Bylot and North Baffin Islands (Miall et al., 1980). Hassel Formation varies from 15 to 120 metres thick in Eclipse Trough (Miall et al., 1980). Hassel is present as one small outcrop (<8 m.) of quartzo-feldspathic sandstone at Maud Bight.

Samples from the unconformably overlying Bylot Island Formation yield a recycled palynoflora equivalent to Hassel elsewhere in the Arctic. This suggests the previous existence of a widespread sheet of Hassel strata in North Bylot Trough. Kerr (1980) postulates Hassel is extensively preserved within Lancaster Aulacogen. The present distribution of the Hassel at Maud Bight consists of isolated pods of sandstone preserved in lows within the basin (composite section C).

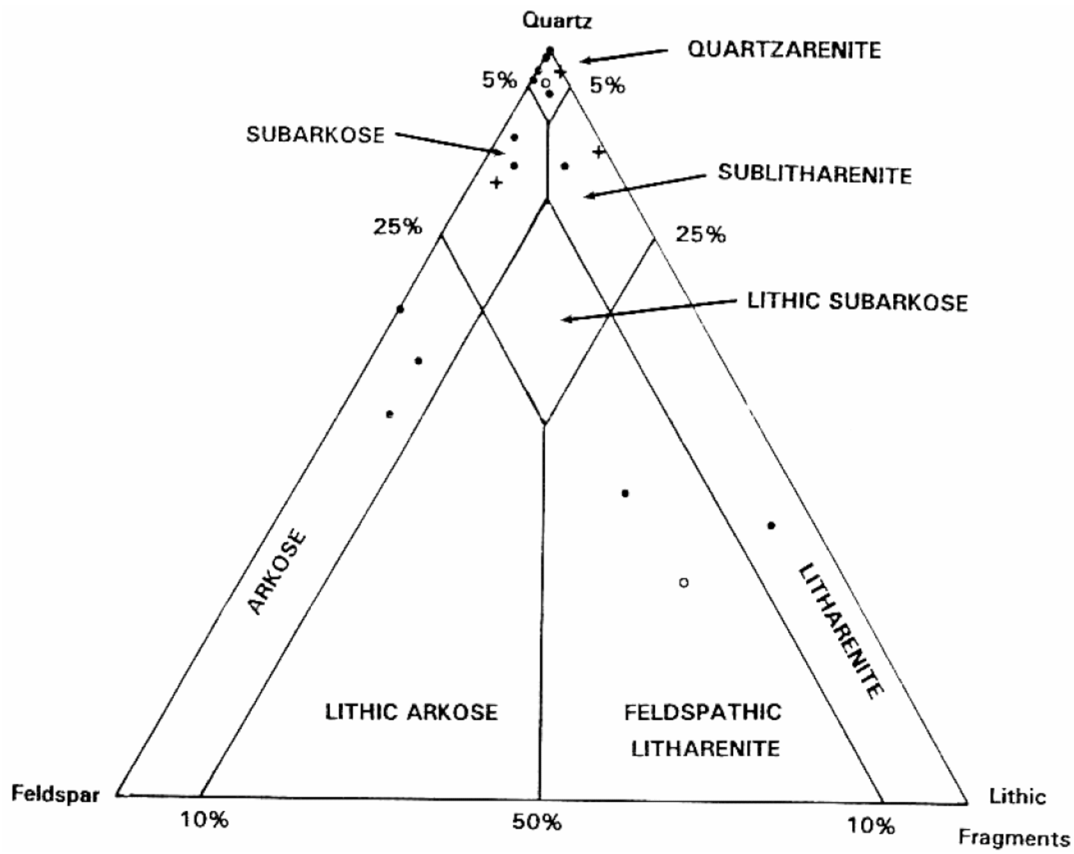

Figure 2.1 Detrital plots for sandstones with low clay content; open circles, pluses and filled circles represent Hassel, Bylot Island and Sermilik Formations respectively. See Appendix C for Quartz-Feldspar-Lithic percentages.

Synonyms

Unit K, in the regional survey of Bylot Island by Jackson and Davidson (1975) and Jackson *et al.* (1975), included all Cretaceous quartzose sandstones in Eclipse Trough and the North Bylot Trough. Miall *et al.* (1980) divided the Cretaceous Eclipse Trough sandstones into Kh (Hassel) and Kk2 (Kanguk Formation). North Bylot Trough quartzose sandstones remained as undivided unit K. Benham and Burden (1990) mapped the Hassel at Maud Bight as unit 1 in the northeast part of the map area (see Figure 2.16). Poorly exposed outcrops in the northwestern corner of Maud Bight are lithologically similar to the Hassel (Benham and Burden, 1990), but, based on palynology more likely belong to the Sermilik Formation.

Contacts

The Hassel was observed to lie with great unconformity upon dolomite breccias of Helikian age Victor Bay Formation. It is overlain unconformably by the Bylot Island Formation mudstones.

Lithology

The Hassel at Maud Bight consists of a quartzo-feldspathic sandstone overlying 3 metres of regolith. The regolith includes fragments of the underlying basement, clays and quartzo-feldspathic sandstone. This grades into white, coarse grained sandstone with an indistinct banding that may be may be bedding (lithofacies Ss). Small, greenish concretions containing pyrite are common within this sandstone.

Petrology

Hassel sandstones are compositionally variable; the two samples recovered plot as a mature quartz arenite and an immature feldspathic litharenite (see Figure 2.1). The feldspathic litharenite was taken from sand filled fractures in the Helikian Victor Bay Formation that are overlain by the Hassel sand. It may be present due to a different depositional event or just from a different source rock. Feldspars rarely have a myrmiketic texture which is known to occur in plutonic rocks. Orthoclase is dominant over plagioclase and exhibits little alteration. Quartz displayed mainly straight and rarely undulose extinction. Lithic fragments include granitic, schistose and sedimentary clasts. The samples contain rare opaques (including magnetite), mica and garnets. The maturity of the quartz arenite is a result of its derivation from the quartz arenites of the Helikian Adams Sound Formation. Clasts are rounded to sub-rounded in form and moderately to well sorted.

Environmental Interpretation

The depositional environment of the Hassel in North Bylot Trough is questionably fluviatile due to poor outcrop and lack of sedimentary structures. The quartz arenites did not possess any features of marine deposition such as glauconite or marine trace fossils. The single outcrop was barren of palynomorphs but recycled assemblages in the overlying Bylot Island Formation suggest a rich terrestrial assemblage may be found elsewhere.

Hassel strata in Eclipse Trough are interpreted by Miall *et al.* (1980) to be braided stream deposits. There may also be a marine component because more recent field studies yielded marine trace fossils in Hassel shales and quartz arenites (Burden 1989, personal communication). Future study of the depositional environment of Hassel strata in Eclipse Trough has important implications when reservoir quality and distribution of equivalent strata in Lancaster Aulacogen is being determined.

Age

Hassel Formation elsewhere in the Arctic (Miall *et al.*, 1980) is Albian to Cenomanian. Based on recycled palynomorphs in the overlying Bylot Island Formation the Hassel Formation at Maud Bight is inferred to be mid to late Albian in age. Characteristic genera include *Cicatricosisporites*, *Tappanispora*, and *Klukisporites*.

Palynomorph samples from the actual Hassel outcrop were barren.

2.2.2 **Bylot Island Formation**

Definition, Distribution and Thickness

Strata of the Bylot Island Formation were originally mapped as part of the Kanguk Formation. Kanguk Formation was first named by Souther (1963) after an exposure of marine silty shale and sandstone on the Kanguk Peninsula of Axel Heiberg Island. As with the Hassel it is widespread across the Arctic Islands. Equivalent strata are found on the Arctic mainland near the Mackenzie River Delta (Miall, 1979). Jackson et al. (1975) and Jackson and Davidson (1975) mapped similar rocks in Eclipse Trough and named them map unit KT1. Miall et al. (1980) renamed much of this map unit as the Kanguk Formation. He recognized two divisions: the lower mudstone member Kk1 and upper member Kk2 composed of immature sandstone, siltstone and mudstone. Sparkes (1989) and Waterfield (1989) remapped the Eclipse Trough strata and have split the Kanguk on Bylot Island into new formations due to lithological variation, isolation within separate basins and different tectonic regimes. Sparkes (1989) defined the lower mudstone as the Bylot Island Formation and the upper sandstone as the Sermilik Formation. Jackson and

Davidson (1975) did not distinguish many rock units at Maud Bight during their reconnaissance of the area and classified it as map unit KT3.

The Bylot Island Formation is of variable thickness at Maud Bight due to variable original accommodation space within

Figure 2.2 Approximately 30 m thick section of grey and black massive mudstones of the Bylot Island Formation (composite section C). The staff is 2 m long.

the basin and subsequent erosion prior to deposition of the overlying Tertiary strata. The Bylot Island Formation in Eclipse Trough reaches a maximum of 420 metres (Sparkes, 1989) while equivalent strata at Maud Bight range up to 80 metres. At the foot of the Byam Martin Range all formations down to the Archean migmatite were removed prior to the deposition of the conglomerate of the Maud Bight Member of the Aktineq Formation. Thus the thickest continuous section of the Bylot Island Formation strata at Maud Bight is along the sea cliffs (composite section C). The mudstone in this area reaches 80 metres in thickness. Closer to the foothills, where it is overlain by the Sermilik Formation, it thins to 24 metres (composite section D). Where the Maud Bight Member overlies the mudstones, the package ranges from a maximum of 17 metres down to zero at the erosional edge. Approximately 45 metres of Bylot Island Formation is also preserved in a fault bounded outlier near Cape Hay (composite section A).

Synonyms

The Bylot Island Formation was mapped as unit KT3 at Maud Bight and unit K near Cape Hay by Jackson and Davidson (1975). Benham and Burden (1990) originally mapped the Maud

Bight outcrop as unit 2. It is now named Bylot Island Formation after Sparkes (1989).

Contacts

Kanguk Formation rests unconformably to conformably on Hassel Formation throughout most of the Western Arctic (Miall, 1979). In Eclipse Trough the Bylot Island Formation disconformably overlies Hassel. In North Bylot Trough the Bylot Island Formation unconformably overlies Hassel, Helikian Victor Bay and Society Cliffs Formations as well as Archean banded migmatites.

In Eclipse Trough the Bylot Island Formation is, in part, overlain by the Sermilik and Pond Inlet Formations (Sparkes, 1989; Waterfield, 1989). At Maud Bight the Bylot Island Formation is conformably overlain by the Sermilik Formation sandstones. The contact is a sharp interbedded gradation from mudstone to medium grained sandstone. It is also overlain unconformably by the Aktineq sandstone and the Maud Bight Member conglomerates.

Lithology

At Maud Bight the lower strata of the Bylot Island Formation consist of lithofacies Fb while the upper strata consist of Fb, Se and Sr (see definition of lithofacies in Table 2.1 and lithofacies assemblages in Table 2.2). The lower strata are composed of grey to black mudstone, grey and brown siltstone and occasional thin yellowish bands of jarositic clays. Fresh surfaces are dark grey to black. The sediment gives off a sulfurous odour. The bedding is poor to nonexistent in most places. Fresh surfaces often are mottled; this is suggestive of extensive bioturbation. Some surfaces exhibit recognizable Chondrites traces. Where the basal beds of Bylot Island Formation overlie Victor Bay Formation the rock consists of several decimetres of dolomitic breccia in a shaley matrix. The bed shows an orange discolouration from iron staining. Nearby, where it overlies the Hassel sandstone it lacks a basal breccia (composite section C). Above the Society Cliffs Formation the basal bed is a 20 cm thick conglomerate with angular to subrounded pebbles (1-3 cm long) of black chert, quartz sandstone and minor dolomite. Granitic and gneissic rocks are absent. The bed here is also a rusty orange colour.

The main component in upper strata of the Bylot Island Formation is the intensely bioturbated grey and brown mudstones (lithofacies Fb) but it also contains a minor siltstone and fine grained lithic sandstone component (Se, Sr). The 5-20 cm thick medium grey silty beds within the mudstones are usually bioturbated beyond the point of recognition as individual beds. Those not too churned contain rare small rip-up-clasts. At one site some of the unburrowed coarser beds show ripple cross-laminae. The upper strata are further distinguished by the presence of spherical calcitic concretions reaching 75 to 150 cm in diameter (see Figure 2.2). The weathered surfaces of these concretions reveal a highly bioturbated sediment with Chondrites as the only recognizable trace fossil. Excepting the concretions, the unit is uncemented and poorly consolidated. Logs and small wood fragments are present at one site but elsewhere no plant debris is apparent.

The Cape Hay outlier of Bylot Island Formation (composite section A) consists of shale interbedded with minor lithic sandstone (lithofacies Fb, Fl, Ss, Sr, Sh, Sl and C). The black shale has thin green silty laminae and is interbedded with rare very thin fine grained yellowish grey occasionally rippled sandstone beds. The shale varied from unbioturbated to poorly bioturbated. The sandstones are flat-topped, lenticular bodies scoured into the black shales. They fine upwards, are approximately 10 metres wide and range from 1.5 to 3 metres thick. The channel sediment fines from very coarse or pebbly sandstone to siltstone. Pebbles found in the scour fill are mainly under 1 cm and are derived from Precambrian migmatites. Coaly debris is common throughout the sandstone beds especially near the top. The channel sandstones are unbioturbated and massive except for occasional planar flow laminae. The sandstone is lithic and weathers grey-green, but fresh surfaces tend to be light grey with green grains visible in the coarser parts of the bed. The sandstone beds are moderately cemented and some contain small pyritic concretions. The base of the

Bylot Island Formation at Cape Hay consists of several metres of regolith including greenish and rusty discoloured shales and blocks of Precambrian carbonates.

At Maud Bight the contact of Bylot Island Formation and the overlying quartz arenites of the Sermilik Formation is typically sharp but gradational and conformable. The coarsening of the upper Bylot Island Formation strata is a precursor to the transition to the Sermilik sandstones. Although the contact between the two formations is often obscured, the gradation from mudstone to sandstone can be observed at several sites. The contact can be characterized at Maud Bight and Cape Hay as several metres of grey siltstone and mudstone interbedded with fine to medium grained quartz rich sandstone. The sandstone becomes more common and the division between the formations is arbitrarily placed at 50% sandstone. The transition beds occasionally show soft sediment deformation (flame structures). In one outcrop at Maud Bight it is marked by two coarse grained fining up beds. The first is a very coarse grained white quartz arenite containing small quartz arenite pebbles and wood with Teredolites in its lower portions. It fines over 5 metres back into a grey siltstone and mudstone. This is overlain by a 1 metre thick conglomerate bed and coarse grained quartz-rich sandstone. The conglomerate consists entirely of buff rounded Helikian Adams Sound quartz arenite cobbles 2-15 cm long. They are poorly sorted and rest in a silty matrix which has a rusty reddish colouring (presumably from iron oxides). This too fines back into the mudstones. The exact point of transition is covered but several metres above there is only the massive quartz arenites of the Sermilik Formation.

Petrology

Two samples recovered from Bylot Island Formation at Cape Hay plot as quartz arenite and sublitharenite (Figure 2.1). Quartz grains often have secondary overgrowths and rarely exhibit undulose extinction. Lithic clasts consist of indurated and intraclastic mudstone, dolomite and chalcedonized dolomite. One sample contains rare fossil coralline algae fragments. Accessory minerals are rare but include opaques and zircon. Clay content varies from 4-10% and calcite cement averages 5% of the rock volume. Grains are moderately sorted and are rounded to subrounded.

A single sample from Maud Bight was coarse enough for detailed optical petrology; it plots as an arkose on Figure 2.1. Unaltered orthoclase is more common than plagioclase. Accessory minerals include biotite, glauconite and opaques. The glauconite component suggests deposition in a marine environment. Grains are angular to subangular and are moderately well sorted. Clay is a minor matrix component whereas calcite cement composes 10% of the rock volume.

Environmental Interpretation

The mudstones of the Bylot Island Formation were deposited in a shallow shelf setting at Maud Bight and estuarine conditions near Cape Hay.

Characteristics of shelves vary widely depending on the affect of physical processes such as tides, waves and currents. Most sedimentary structures formed by these processes at Maud Bight have been destroyed by intensive bioturbation. <u>Chondrites</u>, the only recognizable trace fossil, is found in a wide range of marine depositional environments. Intense bioturbation and increasing mud content reflect deposition in deeper and quieter waters (Davis, 1983). Larger scale features such as sand ridges are completely absent. Rare, unbioturbated siltstone/sandstone beds with ripple cross-laminae and occasional small rip-up-clasts may represent storm beds. Palynological samples contain little terrestrial organic debris and an abundant marine microflora, suggesting a shelf environment.

The Bylot Island Formation strata in Eclipse Trough are interpreted to be basin plain mudstones intercalated with occasional distal turbidites (Sparkes, 1989). Flame structures and clastic dikes "typical of turbiditic deposition" in Eclipse Trough (Sparkes, 1989) were absent in North Bylot Trough, except where the Bylot Island Formation gradationally coarsens up into the Sermilik Formation. Flame structures are present at one contact and a cobble rich debris flow with a muddy matrix at another. The typical transition beds at Maud Bight consisted of thinly bedded fine grained sandstone and mudstone over several metres. Progradational vertical sequences with transitions from shelf to shoreface environments typically contain a small transitional zone where the shelf muds begin interlayering with thin unbioturbated laminated sandstone beds such as in the Upper Cretaceous Mesaverde Group of Utah and Colorado (Reineck and Singh, 1980). Contorted storm beds (resembling the flame structures in the sandy beds of the Bylot Island Formation at Maud Bight) due to dewatering are common in transitional strata of the Middle Tertiary San Emigdio Formation of California (DeCelles, 1987).

At the Cape Hay outlier the formation is estuarine based on sedimentological characteristics and abundant marine palynomorphs. Components of estuaries include tidal flats, tidal channels and marshes. Tidal flats are low relief regions which are alternately exposed to flooding and dessication by tidal rise and fall. They may consist of marshy areas, mud and/or sand flats. The plains are dissected by a series of tidal channels which first fill with the rising tide, flood the tidal flat and then drain the region as the tide falls (Boggs, 1987). Sand typically occurs in the tidal channels and the lower portions of the flats while muds accumulate in the supratidal and upper intertidal zones of the flats (Boggs, 1987). The strata at

Cape Hay consists of mudstones dissected by several channels. Samples examined microscopically show a high concentration of marine palynomorphs, suggesting at least a marginal marine depositional system. Flaser bedding and rippled lenticular thin sand bodies were present in the mudstones and according to Davis (1983) are more likely to occur in tidally deposited strata than tidal bedding (bidirectional or herringbone cross-stratification), especially where sand supply is limited. Bioturbation varies from slight (such as Jade Bay, Germany) in sandy tidal flats to intense in mud rich flats (Reineck and Singh, 1980).

Organic debris can be common in tidal flat strata and is especially abundant in marshy areas (Boggs, 1987). Coal was reported from the vicinity of Cape Hay by Tremblay (1921) and abundant plant debris was noted in the mudstones and at the tops of tidal channels in this study. The high proportion of recycled terrestrial palynomorphs of approximately late Albian age suggests that the coal may be recycled from the Hassel Formation. The Hassel has produced coal from several outcrops near Pond Inlet on Baffin Island (G.D. Jackson et al, 1975).

The typical tidal channel on a mud flat is meandering due to the low relief of the drainage surface. Because of this tidal channels are reported to have typical characteristics of terrestrial meandering streams in addition to tidally influenced sedimentary structures and more intense bioturbation. Channels in this study, however, were not bioturbated, showed planar flow laminae, pebbly scour fill and considerably more plant debris than the surrounding mudstones. This suggests a moderate terrestrial input and possible choking of the channel by a land sourced flooding event. Pyritic nodules are present in the channel fill sediments; Boggs (1987) reports such nodules are common under reducing conditions in stagnant ocean basins, bogs and tidal flats.

Age

The Bylot Island Formation is upper Campanian to mid Maastrichtian in age. Characteristic palynomorphs include Azonia, Aquilapollenites, Trudopollis, Ceriatopsis and Lejeunia.

2.2.3 **Sermilik Formation**

Definition, Distribution and Thickness

The Sermilik Formation in Eclipse Trough was initially mapped by Jackson et al (1975) as unit K and later named by Miall et al. (1980) the Kanguk Formation sandstone member Kk2. Sparkes (1989) recently defined it as the Sermilik Formation. The formation is named after the Sermilik Glacier, near the type section in Eclipse Trough (Sparkes, 1989). In North Bylot Trough Jackson and Davidson (1975) mapped Sermilik Formation as unit K.

The Sermilik reaches 472 metres in Eclipse Trough (Sparkes, 1989) and up to 210 metres in North Bylot Trough where Tertiary erosion is minimal. Like the underlying Bylot Island Formation the Sermilik is entirely removed at the foot of the Byam Martin Mountains. It outcrops along the eastern margin of Maud Bight, in the centre of the basin where it is uplifted and folded and near Cape Hay where a down-faulted section is preserved (composite sections C, B and A respectively).

Synonyms

At Maud Bight and Cape Hay the Sermilik Formation was mapped as unit K by Jackson and Davidson (1975) and described as fine grained to pebbly quartzose sandstone with a rare shaley component. Portions of it were also included in map unit KT3 consisting of undifferentiated sandstones siltstones and shales of variable bedding thickness. Benham and Burden (1990) identified the same quartz arenites as unit 3. These strata are equivalent to the Sermilik Formation in Eclipse Trough. Some strata originally identified as Hassel (Benham and Burden, 1990) are transferred to Sermilik here, based on palynology.

Contacts

The base of the Sermilik Formation at Maud Bight and Cape Hay is conformable and gradational with the Bylot Island Formation. It is unconformably overlain by Tertiary shales, sandstones and conglomerates of the Aktineq Formation.

In Eclipse Trough the Sermilik Formation was defined as a wedge-like sand body within the Bylot Island Formation (Sparkes, 1989). Bylot Island Formation was not observed overlying Sermilik Formation at Maud Bight; it either was never deposited or was removed prior or during the deposition of the Aktineq Formation.

Lithology

The Sermilik Formation can be divided into two main components; "massive" glauconitic quartz arenite (lithofacies Ss, St, SM, Sd) and planar and crossbedded sandstone and conglomerate with minor shales (lithofacies Ss, Sp, Sh, St, Sl, Gcp).

The majority of this formation consists of the "massive" white to greenish tinged glauconitic quartz arenite. Much of it is truly massive but scattered sites reveal bedding and sedimentary structures. The sandstone typically is medium to coarse-grained but ranges from fine to very coarse-grained and pebbly. Curving, subhorizontal, moderately cemented sideritic bands run through the sandstone and may represent scour surfaces. Skolithos tubes were noted at one locality (plate 1, Figure 5); they are 3-10 cm long, up to 1 cm wide. The tubes are filled with white sand but the actual structure consists of greenish sands much richer in glauconite than the surrounding beds. It is possible that the glauconite grew preferentially here in response to the secretions the organism used to stabilize its living structure in shifting sands. Elsewhere scattered centimetre thick, horizontal to subhorizontal burrows occur.

The thickest sections of Sermilik occur in the centre of the basin area. The lower portions of the sequence contain occasional shaley bands. The scours hinted by the presence of siderite bands are further distinguished by isolated pebbly lag deposits. The pebbles are 3-20 mm long red and consist of Adams Sound sandstone, granite and occasionally gneiss. The beds, when distinguishable, are 2-6 metres thick and fine upwards. The top of some beds show soft sediment deformation and/or ripples. Planar flow laminae are clearly visible in some beds.

Further up the section the scoured bases, fining up cycles and sedimentary structures become more evident. Planar laminae and ripples occur more frequently. Green, red and grey shale rip-up-clasts are common in the fine-grained beds. Overall, the beds become coarser towards the end of the sequence, with pebble lags (1-3 cm) and rip-up-clasts being common. Siderite cement binds the coarse beds but on the whole they remain uncemented.

One debris flow punctuates the upper strata of the Sermilik Formation. It consists of Adams Sound pebbles and green/red shale rip-up-clasts in a black muddy matrix. There are numerous coaly fragments in this 3 metre thick bed.

The planar and cross-bedded sandstone component of the Sermilik Formation is located only on the eastern edge of the Maud Bight shoreline (composite section C). The conglomerate and crossbedded sandstone lithology grades up from the massive

Figure 2.3 Approximately 20 m of coarse grained sandstone and conglomerate beds in the upper Sermilik Formation

Figure 2.4 Pebble stringers, herringbone cross-stratified and heavy mineral concentrated sandstones in upper strata of the Sermilik Formation. The pen is 15 cm long.

glauconitic quartz arenites (Figure 2.3). There is a transition over 5 metres from the massive beds to several decimetre thick beds of low angle planar and herringbone cross-stratified medium to coarse grained sandstone (Figure 2.4). The beds are often scoured and filled with a lag of 5-30 mm. long Adams Sound quartz sandstone clasts. Stringers of concentrated heavy minerals are common in the sands. These are overlain by a series of scour based fining upwards sequences and a gravel bar. The sequences fine from a pebble conglomerate to a siltstone or shale and are 2-4 metres thick. The well rounded conglomerate clasts are dominantly Adams Sound sandstones but Pre-Cambrian granites and gneisses become a more important component up through the section. Following this trend the sandstones contain more lithic clasts and also have a muddier matrix upsection. The finer sediments show lamination, ripples and occasional bioturbation. Wood with Teredolites is a rare component of the sequence (Plate 1, Figure 4). The gravel bar has a scoured base, is planar cross-bedded, lenticular, 1-4 metres thick and has an undulating megarippled upper surface. Clasts in the bed are 3-15 centimetres long and are all Adams Sound sandstones. They are moderately sorted but show no imbrication.

At Cape Hay the Sermilik Formation consists of white medium to coarse grained quartz arenite (composite section

A). The tabular beds are 2-4 metres thick, fine up and have scoured bases. The finer sediments contain abundant plant debris, such as needles and leaf fragments. Plant fragments line bedding planes and define sedimentary structures such as laminar flow and ripples near the top of the beds. The base of some beds contain small shale rip-up-clasts and rounded Helikian Adams Sound clasts. Yellowish discolourations mark bedding parallel concretions along the base and near the top of the beds. Here, as in Maud Bight, the rock is uncon-solidated to poorly cemented.

Near the foot of the mountains the Sermilik Formation is composed of blocks of Adams Sound Formation interbedded with quartz arenite (Lithofacies Gb and Sh). The unit fines up from a breccia/conglomerate to a pebbly sandstone with siltstone interbeds. The single outcrop is not well exposed and inaccessible within glacial stream canyons.

Petrology

The average Sermilik sandstone plots as a subarkose but the sandstone can be divided into two compositional populations. The "massive" Sermilik sandstones consist of mature quartz arenite and subarkose while the cross-stratified Sermilik (composite cross-section C) consists of arkose, feldspathic litharenite and litharenite. Composition seems to vary due to different depositional environments with shelf sands being most compositionally mature.

Quartz is the dominant component of this sandstone; it is usually over 85% of total volume. Polycrystalline grains of quartz exhibit irregular to sinuous sutures suggestive of recycled quartzose sandstones. The quartz showed mainly straight but not uncommonly undulose extinction. The grains often contain vacuoles or inclusions of plagioclase or biotite. Rarely the vacuoles were arranged linearly suggesting stress. Secondary overgrowths were present on some grains: distinguished by thin clay coatings. Other polycrystalline grains show metamorphic style sutures. A few samples contained over 35% orthoclase feldspar grains but most sandstones contained under 10% feldspars. Lithic grains (granites, metamorphic and sedimentary rock fragments) usually are absent but range up to 10% of the rocks. Minor components include mica, hornblende, tourmaline, garnet, magnetite and other opaques. Glauconite grains are not uncommon and suggest shallow marine deposition. The majority of the sediments are poorly cemented to unconsolidated. Where cementation has occurred it is due to siderite cement or clays. The siderite is often visible as curving bands in outcrop, possibly representing scour surfaces.

Grains are subangular to subrounded and typically well sorted. Texturally and compositionally more mature sandstones in this member also showed much higher proportions of monocrystalline to polycrystalline quartz grains due to the instability of the polycrystalline grains.

The Sermilik at Maud Bight is locally derived from the quartz arenites of the Adams Sound Formation and at least partially from the Precambrian migmatites. This differs from the Eclipse Trough where the Sparkes (1989) suggests the dominant source of the Sermilik is Archean plutonic rocks.

Environmental Interpretation

The Sermilik Formation consists of shoreface, foreshore and backshore deposits along a high energy shoreline.

The majority of the Sermilik Formation was deposited in the middle to upper shoreface. Sermilik strata appears mostly massive but distinctive features become apparent with closer observation. Scour based quartz arenite beds with pebbly lag, wave ripples and planar bedding are all typical of middle to upper shoreface deposits. Skolithos burrows are also common in this environment. Green mudchips in a coal and pebble rich debris flow and the upper strata of one section may be transported from a Sermilik flood plain or coastal marsh.

Exposures of Sermilik strata on the eastern Maud Bight sea cliffs contain features typical of the foreshore; low angle planar cross-beds herringbone cross-stratification, pebble lags and stringers of concentrated heavy minerals. Herringbone cross-stratification in subtidal and intertidal zones is a component of such tide dominated shorelines such as in the (Lower Jurassic) Lower Coal Series, Bornholm, Denmark (Sellwood, 1972) and the Precambrian Wood Canyon Formation, Nevada (Davis, 1983). This suggests at least a moderate tidal influence in addition to wave dominant processes. Notably a gravel bar (likely cobbles on a storm beach) with a megarippled upper surface caps the strata containing those elements. Above the gravel bar are interbedded fine, bioturbated sediments rich in plant debris and metre thick conglomerate beds. Wood with Teredolites boring suggests proximity to a marine environment. Palynological slides yield abundant terrestrial plant debris as well as dinoflagellates. These finer grained strata were deposited in a backshore environment.

Modern examples of high energy shorelines in California and Oregon resemble Sermilik strata. Howard and Reineck (1981) describe the modern offshore of California as having intensely bioturbated fine silts with rarely preserved storm generated beds; these strata are equivalent to the Bylot Island Formation. The transition to the lower shoreface is marked by alternating HCS and bioturbated beds. McCubbin (1982) describes storm beds with a basal lag of shells or mud clasts, capped by wave ripples which may be obliterated by bioturbation. Bioturbation decreases and grain size increases towards the shoreline. Middle shoreface deposits consist of various sedimentary structures including seaward dipping low angle planar bedding, ripple cross-lamination, trough cross-beds and vertical burrows including *Skolithos* and *Ophiomorpha* (Boggs, 1987). Upper shoreface sediments vary from sand to gravel size depending on wave energy and clastic source; they contain trough and herringbone cross-bedding structures as well as rare *Skolithos* burrows (Boggs, 1987). Oregon Coast upper shoreface sediments are dominated by gently seaward dipping planar beds (Clifton *et al.*, 1971). The shoreface and foreshore transition contains numerous pebble lags concentrated by breakers. Pebble lags in Miocene shoreline deposits of California are thin but laterally continuous and may show seaward-dipping imbrication produced by breakers in the surf zone (Clifton, 1981). In addition, gravel ripples or bars, such as those occurring in Sermilik strata, may be formed by rip currents. Upward-convex, planar cross-bedded gravel megaripples with foresets dipping shorewards in middle Tertiary shoreline deposits from California are ascribed to rip currents forming in storms (DeCelles, 1987). Parallel laminated sands and concentrated heavy minerals (similar to those observed from upper Sermilik strata) from swash are the main features of foreshore (beach) facies (Howard and Reineck, 1981; Clifton, 1981). Backshore strata include structures such as aeolian trough cross-beds, plant root disturbances terrestrial burrows and intermittent storm wave modification (Boggs, 1987). Upper Sermilik strata contain red and green mudstone chips similar to those which occur in lagoonal, coastal marsh and flood plain deposits from Miocene progradational shoreline sequences in California (Clifton, 1981).

Sermilik at Cape Hay consists of a regressive sequence where fluvial strata gradationally overlie tidal flat strata of the Bylot Island Formation. Sermilik strata at Cape Hay are erosive based, fine up, contain rip-up clasts and fine plant debris. The tabular form of the sand bodies and lack of flood plain strata suggest braided rather than meandering stream deposition. Outcrop quality limits further interpretation of depositional environment.

Sermilik strata in Eclipse Trough is equivalent in age but interpreted by Sparkes (1989) to be a braid delta with submarine components. North Bylot Trough is a smaller and shallower basin and may not have accommodated such a depositional system. It is conceivable that Sermilik strata in offshore Lancaster Sound were deposited in a submarine environment.

Age

The Sermilik Formation is mid to late Maastrichtian in age. Characteristic genera include _Porosipollenites_, _Beaupreaidites_, _Aquilapollenites_, _Singularia_ and _Wodehouseia_.

2.2.4 **Navy Board Formnation**

Definition, Distribution and Thickness

A series of black structureless to laminated shales and minor muddy sandstones in Eclipse Trough was named the Navy Board Formation by Waterfield (1989). He interpreted the strata to be basinal and pro-deltaic deposits. Black shales and thinly bedded sandstones of equivalent age in North Bylot Trough belong to the Navy Board Formation.

The Navy Board Formation at Maud Bight is tabular and approximately 50 metres thick throughout the basin.

Synonyms

At Maud Bight Jackson and Davidson (1975) mapped unit KT3; consisting of poorly consolidated sandstone, siltstone and shale of variable bedding thickness and colour. Benham and Burden (1990) mapped the same strata as units 4, 5 and 6. Unit 4, composed of shale and thin siltstone/sandstone interbeds is herein named the Navy Board Formation after Waterfield (1989).

Contacts

The Navy Board Formation at Maud Bight lies unconformably upon the Bylot Island Formation, Sermilik Formation and Precambrian migmatites. It is gradationally, erosively or unconformably overlain by the Aktineq Formation depending on proximity to the Byam Martin Mountains.

Lithology

The Navy Board Formation consists of two interfingering lithologies; black shale, with or without minor lenticular sandstone beds (lithofacies Fl, Fm, Fb, C, Sr and Se) and thin bedded sandstone and siltstone (lithofacies Sh, Sr, Se, Sd, Sl, Fl, Fm, C and rare Gcm).

The Navy Board strata in the northern half of North Bylot Trough at Maud Bight is dominantly composed of fissile black shale (Figure 2.5 and composite sections B and C). It occasionally has a mottled appearance from bioturbation. Lenticular siltstone/fine grained sandstone bodies 1-3 cm thick and 5-20 cm long are occasionally present; they typically have a rippled base and fine up. Fine plant debris is visible in the coarser sediment; some fragments are recognizable conifer needles and leaves. The shales contain occasional logs reaching 20 cm in diameter but usually under 10 cm. None of the logs show borings like those found in the Sermilik Formation.

Southwards, near the foot of the Byam Martin Range (composite section D), the Navy Board Formation coarsens to thinly interbedded shale, siltstone, sandstone and rare pebbly conglomerate. The sandstone beds are tabular and 5-40 cm thick (Figures 2.7 and 2.8). The weathered sediment is light grey to green in colour while fresh faces are light green. The sandstone is medium to coarse grained with isolated well rounded pebbles. The beds are often scour based and fine up into siltstone or shale. Ripples are sometimes present on the base of the bed. Rip-up-clasts of shale are common in the sandstone beds. They are typically small and angular (usually 2-6 cm long but may reach a maximum of 100 cm in length). The rip-up-clasts are located in the middle or on top of the

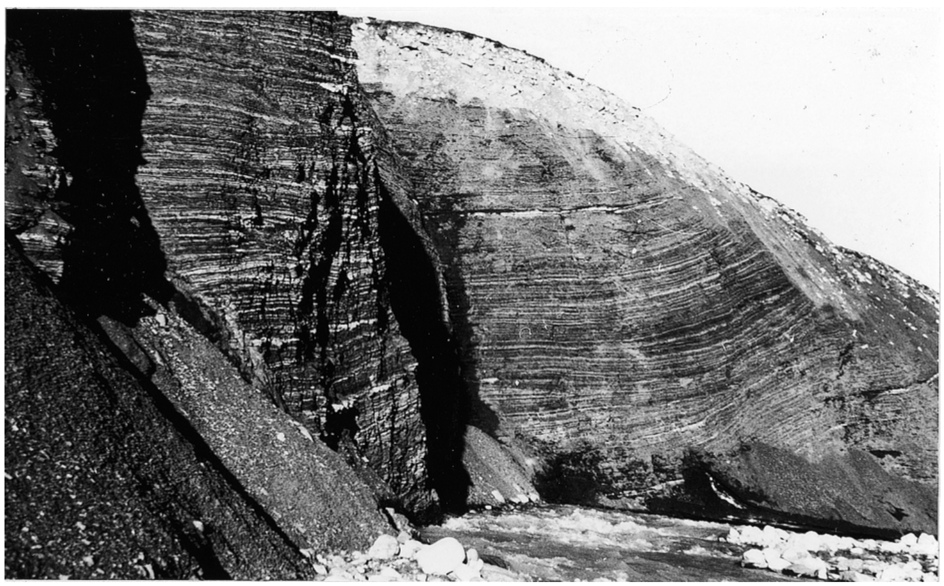

Figure 2.5 Approximately 10 m thick section of shale dominated Navy Board Formation near the Maud Bight shoreline.

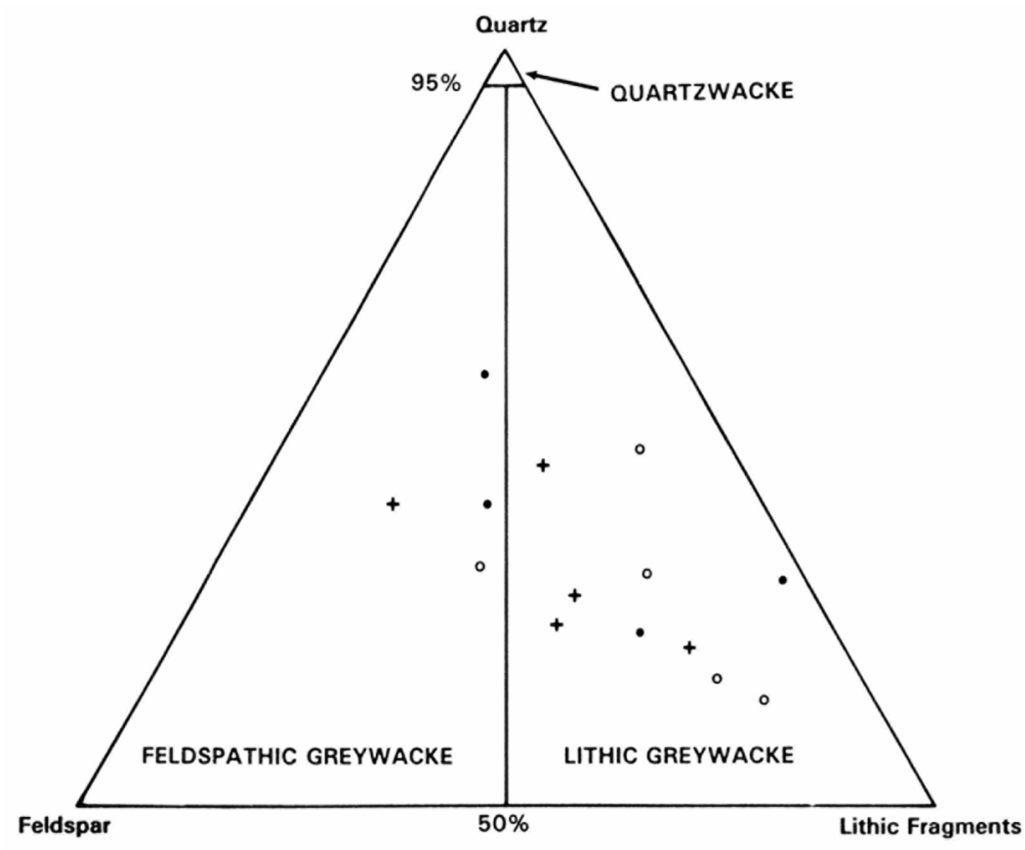

Figure 2.6 Detrital plots for sandstones with high clay content; filled circle, plus and open circle symbols represent Navy Board Formation, Aktineq sandstone and Maud Bight Member respectively. See Appendix C for Quartz-Feldspar-Lithic percentages.

sandstone beds. The dominance of the sandstone beds varies locally due to switching of depositional energy regimes. The sandstones are interbedded with 2-20 cm thick siltstones and shales. These are dark grey to black on fresh and weathered surfaces. The beds may be laminated, mottled (from burrowing) or featureless. The fine sediments also contain fine plant debris. Less common are contorted zones which incorporate a series of sandstone and shale interbeds. The incorporated strata are deformed into tight folds, overturned, discontinuous or broken into twisted clasts. These zones vary from 50 to 150 cm in thickness. Boulder beds may also appear as isolated flat topped lenticular beds within the Navy Board Formation. These channelized beds occasionally exhibit epsilon cross-bedding. They are restricted to the foot of the Byam Martin Mountains and are the only channel features within the Navy Board Formation.

Petrology

Much of the Navy Board Formation is fine grained so samples available for thin section were limited to strata near the Byam Martin Mountains. Compositional values vary widely for the samples but the sediments all show textural and compositional immaturity. Sandstones of the Navy Board Formation have a clay component of at least 15% and so were plotted on Figure 2.6. The Navy Board sandstones are lithic greywackes with higher quartz and feldspar contents than strata of the Aktineq Formation. Quartz composed 23-57%, Feldspar 3-59% and lithics 0-67% of the rock. Lithic clasts include schist, granite and minor sedimentary rock fragments. Other components include biotite, hornblende, opaques, tourmaline, garnet, pyroxene and plant debris. Hornblende grains often are highly altered, with clay filled fractures.

Clays commonly fill pore spaces and compose up to 20% of the rock volume. Grains are angular to subangular and moderately to poorly sorted.

Sediments are mainly sourced from migmatites, granites, granodiorites and charnockites of an Archean crystalline complex from the Byam Martin Mountains. Subsidiary sources likely include the Helikian sedimentary strata as well as recycled Cretaceous and Tertiary strata.

Environmental Interpretation

The Navy Board consists mainly of thinly bedded sandstones with abundant rip-up-clasts at the foot of the Byam Martin Mountains, black shales along the shore of Maud Bight, and gradation of the two between. The depositional system is composed of a braided apron debouching from the foot of the Byam Martin Mountains into a flood plain or lacustrine environment.

The interbedded thin sandstones, siltstones and occasional conglomerates of the Navy Board resemble, in part, deposits from a Malbaie type fluviatile system (Rust, 1981).

Figure 2.7 Detail of Navy Board strata near the foot of the Byam Martin Mountains. Thinly bedded sandstone and siltstone with rip-up-clasts, ripples and abundant plant debris now dominant over shale. Small divisions on staff are 10 cm.

Figure 2.8 Folding and faulting becomes more prominant in Navy Board strata on the southeastern corner of North Bylot Trough near the faults defiing the basin margin. Note the figure at the foot of the strata.

Abundant rip-up-clasts and laterally discontinuous beds at Maud Bight are similar to Malbaie strata. In addition, deformed and broken strata are evidence of flash flooding at Maud Bight. There is a lack of channelling in these deposits except near the Byam Martin Mountains where several boulder filled channels slice through thinly bedded strata.

Strata of the Malbaie Formation (Rust, 1981) are variable laterally and vertically over several metres and consist of three major facies (Se, Sh/Sl, St). Facies Se consists of erosional scours filled with sand and mudstone intraclasts ranging from rounded pebble sized clasts to angular 40 cm long clasts (Rust, 1981). Rust (1981) concluded the rip-up-clasts formed when stagnant mud-rich flood plain pools evaporated and then the dessicated muds were ripped up during floods. Flood plain muds tend to have low potential for preservation as discrete beds (Rust, 1981). Facies Sh consists of sandstone with primary current lineation and some intraclasts scattered along the lineations. The planar laminae often grade into low angle stratification (Sl). Trough cross-bedded sandstone (St) is the third major component of the Malbaie alluvial depositional system. The sandstones are interbedded with conglomerates; together they were interpreted by Rust (1981) as being deposited on a proximal braided alluvial plain. The fluvial system for the sandstone is characterized as containing elements of both the South Saskatchewan and Bijou

Creek types (Cant and Walker, 1978; McKee et al., 1967); these are equivalent to architectural models 10 and 12 of Miall (1985a).

The Navy Board strata gradationally fine northwards to thin lenticular beds of fine rippled sandstone in black shale and finally to rocks consisting entirely of black shale. The shale dominated sediments of the Navy Board represent a transition to an alluvial flood plain from the Malbaie type alluvial system. Flood plain strata consist almost entirely of fine grained sediment which may or may not exhibit horizontal bedding, dessication cracks, organic debris, mottled bedding, mollusc shells, siderite or pyrite nodules and caliche (Reineck and Singh, 1980). Miall's (1985a) architectural element equivalent OF (Overbank Fines) is typified by finely laminated muds and silts with thin lenses of silt to fine sandstone showing ripple cross-lamination. Other components include coals and crevasse splay sand sheets. Fossil logs and fine plant debris were common in the Navy Board shales. In addition, thin ripple cross-laminated sand lenses become common southwards and grade into interbedded thin shales and sandstones. Absence of marine palynomorphs in the Navy Board except for some recycled Cretaceous dinoflagellates, suggests non-marine deposition for formation. The general lack of paleosols, dessication cracks or rooted horizons may indicate the presence of a lake or series of lakes on the flood plain.

Age

The Navy Board Formation is lower Paleocene in age based on palynomorphs. Characteristic genera include _Paraalnipollenites_, _Trivestibulopollenites_, _Triporopollenites_ and _Pesavis_.

2.2.5 **Aktineq Formation**

Definition, Distribution and Thickness

The Aktineq Formation was defined by Waterfield (1989) for Tertiary fluvio-deltaic deposits of reddish brown channel sandstones and black muddy siltstones found in Eclipse Trough. The Aktineq Formation at Maud Bight consists of similar strata as well as a new recognized laterally equivalent conglomerate package.

The Aktineq is a wedge of conglomerate, sandstone and shale varying from 5 to over 200 metres in thickness at Maud Bight. In general, thickness of the formation decreases away from the foot of the Byam Martin Mountains.

The Aktineq Formation boulder beds at Maud Bight are a distinct entity and were not noted in Waterfield's (1989) definition of the formation. The Maud Bight Member (new name) containing those strata is defined and detailed in this chapter. Section 6 (Appendix B) is the type section for the Maud Bight Member of the Aktineq Formation and includes over 200 metres of conglomerate, minor sandstone and rare siltstone. The lower part of the Aktineq Formation remains undefined as a member and is informally called the Aktineq sandstone.

Synonyms

At Maud Bight the Aktineq Formation was first mapped by Jackson and Davidson (1975) as part of unit KT3 poorly consolidated sandstone, siltstone and shale of variable bedding thickness and colour. Benham and Burden (1990) mapped the same rocks as units 5 and 6, herein named the Aktineq Formation after Waterfield (1989).

Contacts

The Aktineq Formation at Maud Bight was deposited during active tectonism and lies unconformably upon the Navy Board Formation near the foot of the Byam Martin Mountains and conformably away from them (Figure 2.13). Aktineq also unconformably overlies the Sermilik Formation and Precambrian migmatites. It is covered by thin glacial deposits.

Lithology

The Aktineq Formation consists of interfingering lithologies; channelized lithic greywacke with minor conglomerate lag (lithofacies Ss, St, Sr, Sh, Se, C and rarely Gch) and black shale, with or without minor lenticular sandstone beds (similar to those described in the lithology

Figure 2.9 Over 80 m of stacked channels and flood plain strata of the Aktineq Formation sandstone (Figures 2.10 and 2.12 are from this section).

section of the Navy Board Formation) which laterally grade into thick bedded conglomerate and sandstone (lithofacies Gcm, Gch, Sh, Sl, Fr and C).

Aktineq Sandstone

The Aktineq consists of sandstone beds 1-5 metres in thickness and subordinate shale beds (Figure 2.9). The sandstone beds are lenticular, flat topped and can reach 15 metres in width (Figure 2.10). They have scoured bases and fine up from medium grained sandstone to shale. The lithic sandstone is green on both fresh and weathered surfaces. The base of the bed often contains angular black shale and buff siltstone rip-up-clasts. The clasts may reach 50 cm in length but usually are under 10 cm. The sediment above the rip-up-clasts may show planar flow laminae but usually is featureless. Near the top of the bed, as the sandstone fines upwards, ripples are common. Fine plant debris is also common and may accumulate in the ripple troughs. The black shales and grey to buff siltstones often compose up to half of the bed thickness. They are sometimes laminated or have thin lenses of fine grained sand. The laminae are occasionally disturbed by bioturbation but the majority of primary sedimentary structures are completely intact. Occasional channel plugs consist of cut bank slump debris or rip-up-clasts (Figure 2.11).

Towards the foot of the Byam Martin Mountains the Aktinrq

Figure 2.10 Interbedded channels and overbank fines within the Aktineq sandstone.

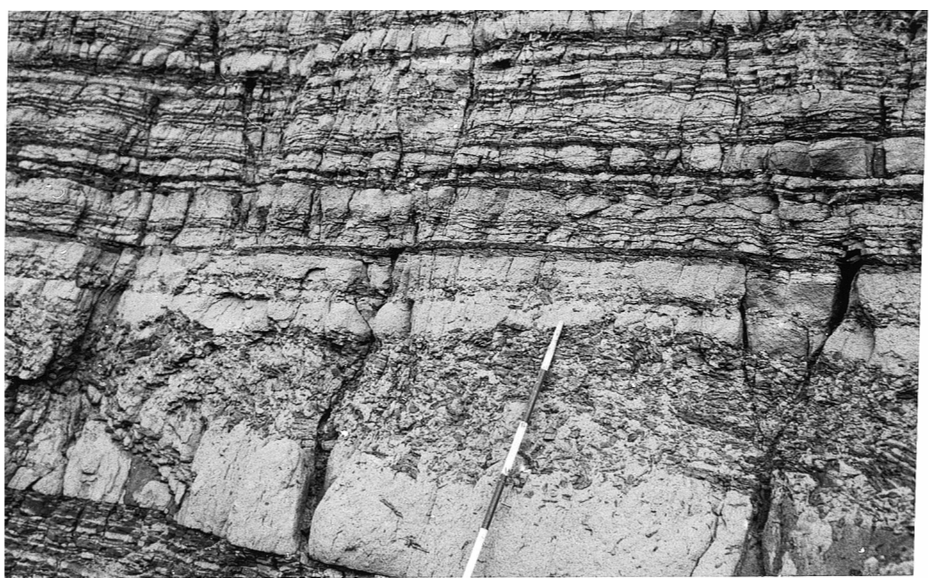

Figure 2.11 Channel filled with rip-up-clasts or cut bank slump debris in the Aktineq sandstone.

is dominantly composed of medium to very coarse scour based sandstone which invariably contains rip-up-clasts and may have a boulder lag. Siltstone is a minor component of these fining
up beds and shale is rarely present except as rip-up-clasts. The beds range from 2-8 metres in thickness, reach 20 metres in length and are lenticular, scour based and flat topped. Rip-up-clasts are common at the scoured base but they can appear along multiple horizons in a single bed suggesting a pulsing or periodic deposition. They average 15-30 cm in length but can reach 150 cm. When present pebbles, boulders and logs occur at the base of the bed with the rip-up-clasts separate and lying directly above them. The subangular to subrounded polymictic conglomerate clasts range from 5 to 110 cm with an average of 40 cm. Sedimentary structures are uncommon but include minor trough crossbedding, planar flow laminae and rare wavy laminae at the top of the bed.

Specific horizons near the top of the sandstone beds commonly are moderately cemented while the rest of the rock is poorly cemented.

Shales interbedded with the sandstones contain ripples, minor load casting and small patches of centimetre size rip-up-clasts. Mudcrack casts are common with up to 6 cm of vertical penetration. Wood fragments less the 20 cm long and 2 cm wide are abundant along with fine plant debris. Shales and interbedded sandstones occasionally showed thickening and coarsening upwards cycles (Figure 2.12).

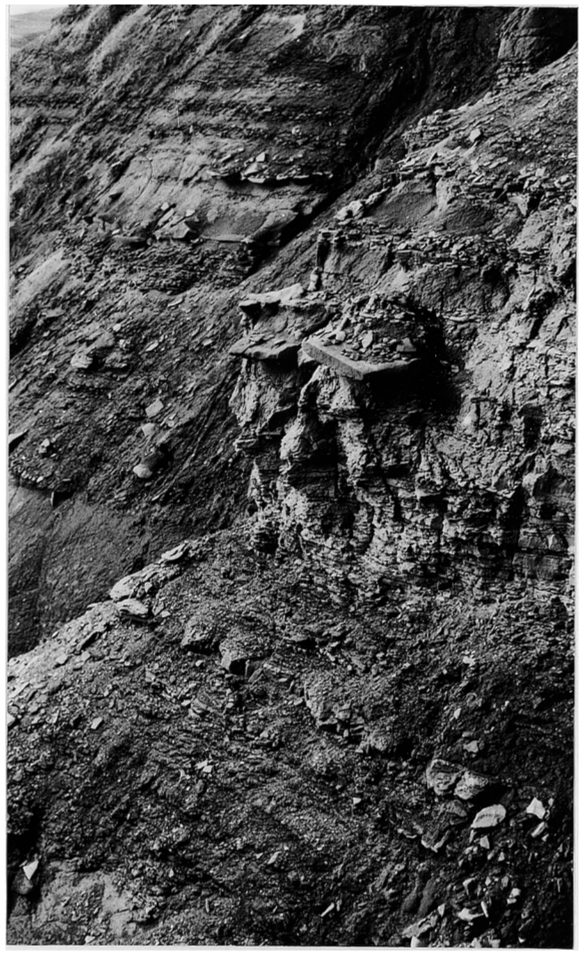

Figure 2.12 Crevasse splay strata in the Aktineq sandstone.

Maud Bight Member

The Maud Bight Member consists of thick bedded conglomerate with minor interbeds of lithic greywacke and rare siltstone. The majority of this facies is massive to poorly bedded conglomerate (lithofacies Gcm, Gch, rare Sh and C), but also includes conglomerate interbedded with sandstone (lithofacies Gcm, Sl, Fr and C) and talus breccia (lithofacies Gb and Sh). The boulders in the conglomerate average 20-60 cm (Figure 2.14) but isolated angular blocks of Pre-Cambrian migmatite are over 4 metres long. Boulder size decreases rapidly away from the Byam Martin Mountains; from a maximum 3 or 4 metres to 40 cm in diameter where the conglomerate interlobes with the Aktineq sandstones. The clasts are subangular to subrounded with roundness increasing away from the foot of the Byam Martin Mountains. Clast composition is dominantly granitic, gneissic and Adams Sound sandstone as well as rare basaltic and gabbroic boulders (Nauyat Formation and Helikian dikes respectively). The matrix of the conglomerate is a coarse to very coarse green lithic sandstone which is visually indistinguishable from the rest of the Aktineq and the Navy Board Formation. The clasts show no imbrication or sorting in the massive conglomerates. Fossil logs are present.

Where the conglomerate is interbedded with sandstone (lithofacies Gcm, Sl, Fr and C) more information can be gleaned from the rocks. Beds range from 1 to 4 metres in

Figure 2.13 Approximately 100 m thick section showing the pronounced truncation of Navy Board strata by the Maud Bight Member boulder beds

thickness. They may be scour based and channelized but often are nonerosive and sheet-like (Figure 2.15). The larger clasts may sink into the underlying sands.

The sandstone typically comprises under 10% of the facies but may make up 50% of the rock. It forms 50-100 cm thick lensoid bodies under 6 metres wide and also extensive metre thick sand sheets. The sheets show drape over the boulders (seen in laminae). Conglomerate clast size normally ranges from 15-50 cm with scattered boulders reaching a maximum of 100 cm. The clasts are rounded to subangular and show no imbrication. Some of the beds fine up. The sand bodies may show undisturbed planar laminae and occasional rip-up-clasts. The conglomerate often contains logs and the finer sediment is rich in plant fragments. In one thin siltstone bed a rich layer of well preserved leaves and occasional rootlets was found.

The conglomerate strata are polymictic except in proximal alluvial deposits where clasts are angular, poorly sorted and are the same composition as the strata they overlie.

Some beds within the sequence appear to be highly weathered and show iron staining as if the bed was exposed for a long period before being covered. Overall the conglomerate beds are poorly cemented with calcite.

Petrology

Visually the sandstones in the Aktineq sandstone and Maud Bight conglomerate are indistinguishable but they will be dealt with separately on the basis of moderate variations apparent in thin section.

The sandstone dominated northern exposures of the Aktineq Formation are compositionally and texturally immature. Point counts of the sandstones plot on Figure 2.6 as lithic greywacke. Quartz grains range from 21-45%, feldspar 18-43% and lithic fragments 17-61% of the rock. The lithic grains are mostly metamorphic but also include granites, quartz arenite and indurated shale clasts (respectively from Adams Sound and Arctic Bay Formations). Minor components include mica, garnet, hornblende and opaques. Logs were observed in outcrops but organic matter was rarely visible in thin section.

The grains are angular to subangular (often feldspar grains have retained their crystal form) and moderately sorted. Clay content was usually 15% and calcite cement was rare and never composed more than 5% of the rock.

Samples from conglomerate matrix and sandstone beds of the Maud Bight Member were composed of 14-48% quartz, 11-37% feldspar and 31-73% lithic fragments. The mean composition of these sandstones plot as a lithic greywacke on Figure 2.6 and have a higher lithic content than the rest of the Aktineq strata. Lithic clasts consist of gneissic, granitic and sedimentary fragments including shale intraclasts and well

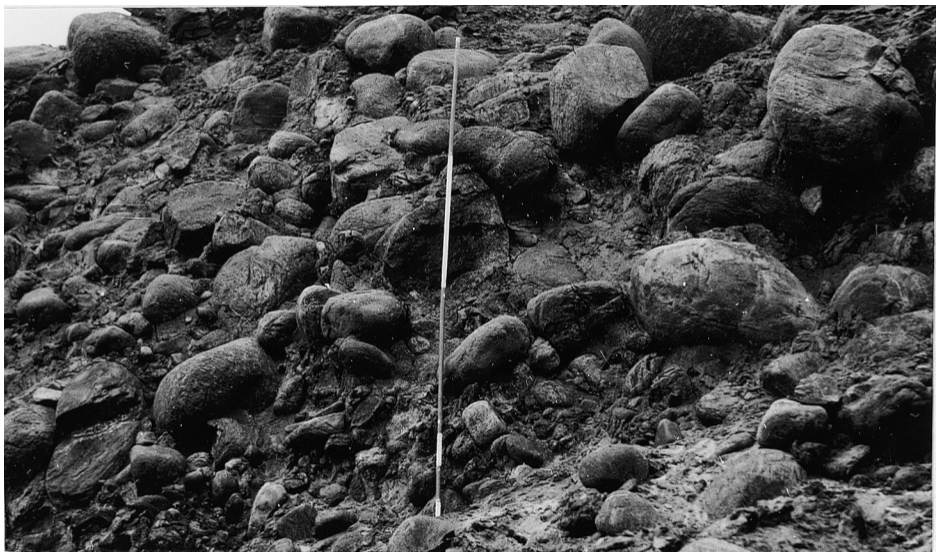

Figure 2.14 Typical massive to poorly bedded Maud Bight Member boulder beds.

Figure 2.15 Epsilon cross-sets in boulder filled channels where the Maud Bight Member interfingers with the Aktineq sandstone. There is approximately 5 m of section.

indurated shale clasts from the Helikian Arctic Bay Formation. Minor constituents include mica, hornblende, pyroxenes, garnets, sphene and opaques. Organics are present in some of the samples.

Clays are common, usually making up 8% of the rock. The conglomerates are poorly cemented but can contain up to 12% calcite cement. Grains are often ringed with a thin calcite layer and some quartz grains show calcite growths in their fractures. Occasionally quartz grains have quartz overgrowths but whether this is from recycled Adams Sound or Cretaceous sediments is unclear.

The Maud Bight Member sediments are even less mature than the Aktineq sandstones due to minimal alluvial transport and breccias in the Maud Bight Member were the least mature due to almost zero effective transport. The clastic source is mainly the Archean crystalline complex but also includes Helikian sedimentary strata.

Environmental Interpretation

Humid alluvial fans deposited the conglomeratic Maud Bight Member at the foot of the Byam Martin Mountains and meandering streams flowing north from the fans deposited the Aktineq sandstones.

Maud Bight Member

Alluvial fans occur where streams on steep slopes emerge from their confining valleys and distribute their bedload sediments in a radial fashion on the slope and basin floor. Streams emerging from the Byam Martin Mountains and facing a rapid drop to the floor of the North Bylot Trough provide the source for very coarse clastic material. The steep drop is a result of a northwest trending fault scarp which defines the margin of the North Bylot Trough. Alluvial fan/braided stream conglomerates are often associated with uplift along a fault zone; examples include the Cadomin Formation in Alberta (McLean, 1977) and the Kishenehn, Bonnet Plume, Ross River, Dawson and Hat Creek sequences of Yukon and B.C. (Long, 1981).

The alluvial strata at Maud Bight; composed of massive and poorly bedded conglomerate interbedded with sandstone compare well with typical features of the Scott type braided stream model (Miall 1978 and 1985a) although lacking trough or planar cross-bedding in the conglomerate due to larger clast size. Individual conglomerate beds are often hard to distinguish due to homogeneity of the strata although some channels were noted where sand was a moderate component. Rare sandy beds contain planar laminae and rare rip-up-clasts. The boulders likely have been transported only a few kilometres but are moderately rounded by stream transport. Sand-rich strata exhibit fining up cycles over 10 metres of section; these are a product of gradual abandonment of the proximal depositional lobe (Galloway and Hobday, 1983).

Fan size is controlled by climate, drainage basin area, discharge, relief and source rock lithology (Galloway and Hobday, 1983). Alluvial fans are characterized as either humid (dominated by streams) or semi-arid (mass-flow deposits are dominant). Semi-arid fans consist of poorly sorted mud supported debris flows containing clasts up to boulder size, well sorted sheet flood sands, stream channel deposits and gravelly sieve deposits (Collinson, 1986). Debris flow clasts exhibit no rounding from transport although they may have previously been rounded by streams. Debris flows and other features of semi-arid fans were absent from Maud Bight Member strata. Humid alluvial fans form from deposition by braided streams such as model 2 (Scott type) of Miall (1985a). This model is typical of proximal alluvial fans and outwash braidplains; containing a tabular gravel sheets and longitudinal bars which divide numbers of broad, shallow channels which branch and join continuously downstream (Miall, 1985a). The channels are not entrenched and continuously change due to bar progradation and bank erosion, especially during peak seasonal discharge. The architecture of the deposit consists of thin indistinguishable tabular intersecting gravel sheets and occasional sandy bedforms containing ripples, planar laminae or cross-bedding (Miall, 1985a). Dessicated fine muds and silts are rare in this depositional system. Where perennial streams are present and the sediment is very coarse, transport may be restricted to seasonal events such as a sheet flood after heavy rainfall or due to melting snows (Galloway and Hobday, 1983). Also, channels which are well defined in the proximal fan, may lose water from percolation through porous strata, and become poorly defined in the distal fan (Galloway and Hobday, 1983). This can lead to sheet flooding being the dominant depositional process on the lower slopes. In humid climates stream dominated fans often have considerable vegetation cover (Galloway and Hobday, 1983).

The fans at Maud Bight may have had regions that were inactive long enough for vegetation to establish itself on the slope; well preserved leaves were found in one siltstone bed and fossil logs were common throughout the sequence. Rootlets penetrate the leaf bed and some of the other siltstone beds. In addition, some boulder beds exhibited weathering and iron-staining from long exposure prior to burial.

Conglomerates resembling those at Maud Bight were recently found along the margins of Eclipse Trough at the foot of the Byam Martin Mountains (Burden, 1990 personal communication). Thick conglomerate wedges at Lake Hazen, the Judge Daly Basin and Mokka Fjord on Axel Heiberg Island were deposited by a Scott type braided stream and are very similar to alluvial deposits in Maud Bight (Miall, 1981). It is further noted these fans lie directly against major reversed faults (Miall, 1981).

Aktineq Sandstone

Alluvial fans have condensed downslope fining trends due to rapid change of slope. The Maud Bight Member boulder beds extend no further than 5 kilometres from the foot of the Byam Martin Mountains before fining into sand dominated beds. Northern exposures of the Aktineq Formation at Maud Bight consist of interbedded channel sandstones and overbank fines. This reflects a transition from braided stream deposition to that of a sandy meandering stream (model 6 of Miall, 1985a) as the coarser sediment can no longer be transported on the basin floor. The plain at the foot of the alluvial fan consisted of a series of meandering streams flowing northwards from the fans, bordered by levees and surrounded by lakes.

Reineck and Singh (1980) divided fluvial deposits into three major groups; channel (channel lag, point bar, channel bar and channel fill), bank (levee and crevasse splay) and flood basin deposits (including flood plain and marsh). At Maud Bight channel bottoms often contain mud clasts, boulders and occasionally logs. The mud clasts may be derived from flooding or slump blocks from the cut side of the channel (Reineck and Singh, 1980). The mud clasts are angular showing little transport after deposition in the channel. Lateral accretion features were rarely observed but this may be a function of the outcrop orientation, uniform grain size or post depositional in-situ internal liquefaction of sediments. Observed minor trough and planar cross-bedding might be a

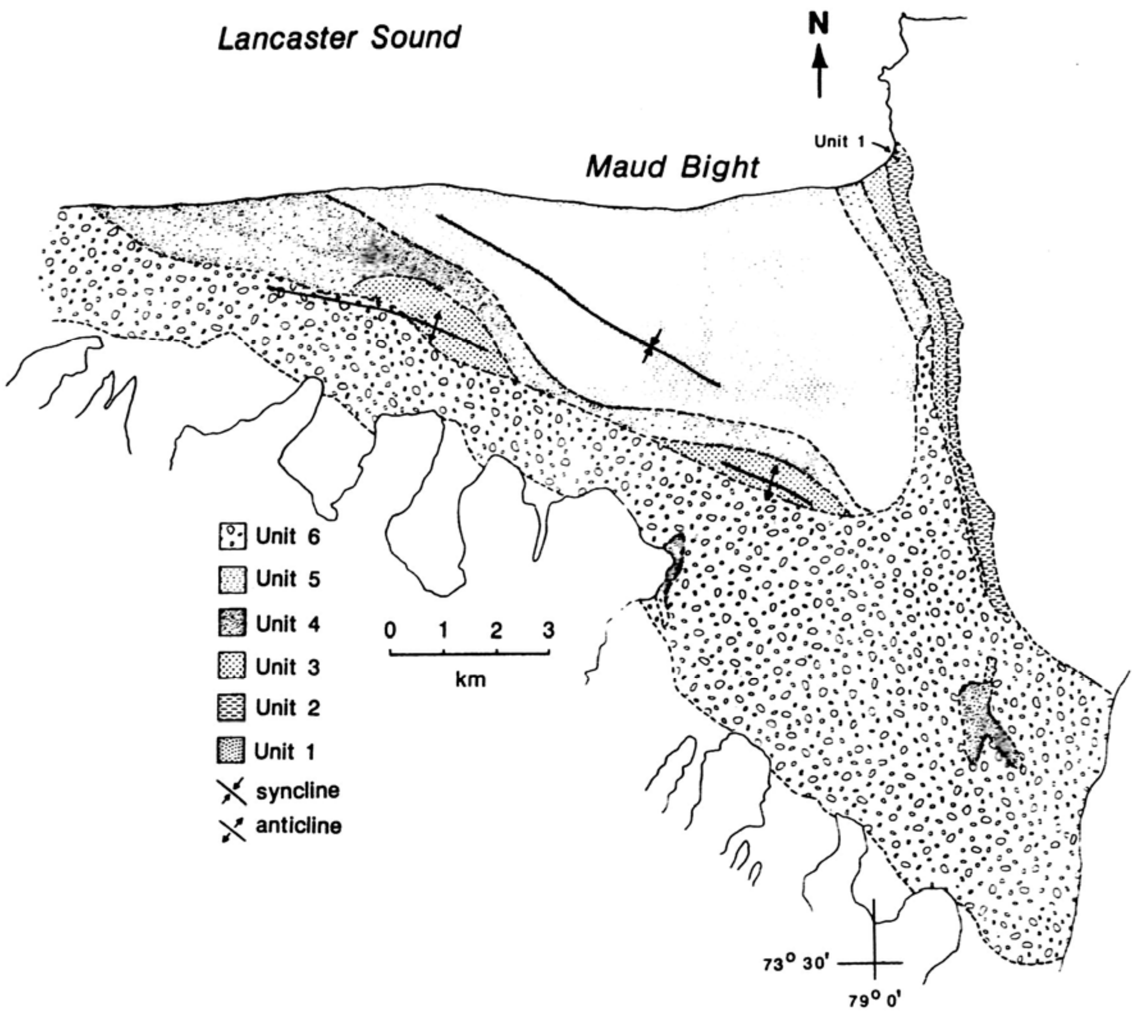

Figure 2.16 Outcrop map of Cretaceous and Tertiary strata in North Bylot Trough. The map is based on outcrop descriptions from field stations detailed in Appendix B. Units 1 to 6 represent Hassel, Bylot Island, Sermilik, Navy Board, Aktineq sandstone and Maud Bight respectively.

part of poorly preserved lateral accretion surfaces. Two styles of channel fill occur; planar flow laminated sandstone fining up to rippled and parallel laminated siltstone and shale and occasionally shale filled channels with moderate shale slump block components. The latter represents typical oxbow lakes where a meander loop gets cut off at the neck, is isolated from the rest of the stream, and gradually fills with laminated fine sediments, organics and occasional cross-bedded sands (Reineck and Singh, 1980).

Probable levee and crevasse-splay deposits occur between channel sands at Maud Bight. Sandy beds containing ripples, load casting and rip-up-clasts fine up into dessication cracked muds rich in plant debris including small branches. Flood plain deposits (see description of fine grained strata in Navy Board Formation) are also a common component. The general absence of mudcracks or root casts in these fine grained sediments suggests some may have been deposited in standing water.

Age

The Aktineq Formation is lower to mid Paleocene in age based on plant macrofossils and palynology. One bed of siltstone from lower strata in the Maud Bight Member produced many well preserved plant macrofossils from a low diversity assemblage. These include _Equisetum_ sp., _Metasequoia_ _occidentalis_ (Newberry) Chaney 1951 and _Trochodendroides_ _arctica_ (Heer) Berry 1926 and are probably early to middle Paleocene in age (Basinger, personal communication, 1988).

Characteristic palynomorphs include _Paraalnipollenites_, _Trivestibulopollenites_, _Caryapollenites_, _Pesavis_ and _Microthallites_.

2.3 TECTONISM

The strata at Maud Bight are divided into tectonostratigraphic packages representing episodes of sedimentation and deformation (Benham and Burden, 1990). In phase 1 a broad sheet of Hassel sandstone was deposited across Bylot and North Baffin Islands prior to rifting. This package is preserved as isolated pods in North Bylot Trough and more extensively in Eclipse Trough. Phase 2 consists of Bylot Island and Sermilik Formation deposits in grabens formed during the early rifting of Baffin Bay. In this stage the extensional regime was along a NW-SE axis parallal to the axes of Baffin Bay, Eclipse Trough and Milne Inlet Trough. Bylot Island and Sermilik strata along the faulted margins of North Bylot Trough dip as much as 20 degrees towards the centre of the basin.

Navy Board and Aktineq strata were deposited in phase 3 and correspond with a change in tectonic regimes. At this time extension in Lancaster and Jones Sounds occurred on an east-west axis. In the early to mid Paleocene North Bylot Trough continued to be downdropped; Tertiary strata on the edge of the basin are faulted and compressed into tight folds (Figure 2.8). Northwards, into the basin and away from the faulted margin Navy Board and Aktineq sandstones are deformed into broad, shallow northwest trending anticlines and synclines.

The thick boulder beds of the Maud Bight Member are restricted to the mountain front on the southern margin of the basin. Rapid downdrop in conjunction with uplift of the Byam Martin Mountains allowed thick deposits of conglomerate to form within a short distance of the source. This is reflected by highly angular contacts between Maud Bight Member and Navy Board Formation near the foot of the mountains and mildly erosional to conformable relationships between Aktineq sandstone and Navy Board further into the basin.

CHAPTER 3 PALEOBOTANY AND PALYNOLOGY

3.1 MACROFLORA

Plant leaf fragments and logs are common in the Aktineq Formation. Typically the leaves are fragmentary with scattered complete specimens recovered from siltstones and fine sandstones. One siltstone bed in the Maud Bight Member conglomerates yielded abundant well preserved leaves in a low diversity assemblage. Identifiable specimens are listed in Table 3.1. Specimens from sample PB-74 were identified by J. Basinger (University of Saskatchewan). This low diversity assemblage is likely early to middle Paleocene in age (Basinger, personal communication, 1988).

Fossil logs found were permineralized or lignitic. Several of the logs recovered from the Sermilik Formation contained Teredolites borings.

3.2 PREVIOUS PALYNOLOGICAL STUDIES

Terrestrial palynology is used to develop the biostratigraphy of previously undated Cretaceous and Tertiary rocks of North Bylot Trough. The biostratigraphic framework developed will also be compared and contrasted with assemblages of similar age in nearby Eclipse Trough (Sparkes, 1989; Waterfield, 1989). Previous biostratigraphic reconnaissance studies (Jackson and Davidson, 1975, Miall et al, 1980 and Ioannides, 1986) encountered serious problems in Eclipse Trough such as poor preservation, low diversity, poorly studied Arctic endemic taxa and lack of distinctive short ranging species. More intensive studies by Sparkes (1989) and Waterfield (1989) strengthened the biostratigraphic framework for Eclipse Trough; however their mainly marine strata still yielded sparse terrestrial assemblages. Other areas of the Arctic now have moderate biostratigraphic control; Felix and Burbridge (1973), McIntyre (1974), Doerenkamp et al., (1976) and Sweet et al. (1989), and well preserved assemblages at Maud Bight should help to extend correlations into the eastern Arctic.

3.3 PALYNOLOGICAL METHODS

3.3.1 Collection and Processing

Over 100 samples for palynological studies were collected from strata at Maud Bight and near Cape Hay. Much of the sediment was poorly consolidated and to limit contamination fresh undisturbed strata were exposed and sampled. Samples were never taken from slumped portions of the outcrop.

In the laboratory 72 samples were processed and 41 selected for study. They were examined for terrestrial and marine palynomorphs, fungal remains, plant debris and foraminifera test linings (Appendix D). The samples chosen for study are representative of the formations and allow for analysis of vertical sequences and lateral correlation within North Bylot Trough.

All processed samples were given a 5 digit laboratory number referring to the year processed and the sample identifying number. If damp, the samples were air dried for one day. Consolidated samples were wrapped in aluminum foil and crushed to millimetre size to help in the dissolution of the sediment. The samples were then weighed and placed in a plastic 250 ml beaker. Lithology dictated the sample weight required for processing; only 15-20 grams were necessary for siltstones and shales while up to 40 grams were needed for sandstones. Four Lycopodium tablets (totalling 48,400 ± 1600 grains) were placed in each beaker with the samples. These helped provide an estimate of the palynomorph concentrations and were a good check to see if the sample had been properly processed (Stockmarr, 1971).

The next steps involving HCl, HF and Schulz's Solution were performed in a fume hood for safety. First, 150 ml. of 20% hydrochloric acid (HCl) was added to each plastic 250 ml. beaker to dissolve carbonates. A methanol or acetone squirt bottle was useful to control excessive effervescence. The samples were immersed in HCl for approximately 12 hours and occasionally stirred. After this, samples were centrifuged and the acid was decanted. Distilled water was then added, centrifuged and decanted three times in order to remove any remaining hydrochloric acid. HCl free samples were important

Table 3.1 Paleobotanical Summary

-Sample Number	Name	Photograph (if any)
-PB-74	*Equisetum* sp.	Pl. 1, Fig. 1.
PB-74	*Metasequoia occidentalis* (Newberry) Chaney leaf	Pl. 1, Fig. 1.
PB-74	*Trochodendroides arctica* (Heer) Berry	Pl. 1, Fig. 2.
PB-74	Rhizome	
PB-145	*Alnus* sp.	Pl. 1, Fig. 3.

-

in order to avoid the formation of obscuring crystals in the sample due to a reaction with the hydrofluoric acid.

Hydrofluoric acid (HF) was used to remove silicates. It was added until all of the sample in the beaker was submerged. Acetone was used to control excessive effervesence. The samples were occasionally stirred over a 12 hour period after which it was transferred to a plastic test tube, centrifuged and decanted. Any traces of HF were removed by multiple washing, centrifuging and decanting the test tube contents. A neutral sample was important for safety during the next step.

Some samples were not sufficiently washed after the HCl stage: remaining Ca^{2+} combined with F^- from the HF acid to form fluorite crystals which obscured the palynomorphs on the prepared slides. Where necessary, the remaining sample was reprocessed with heated HCl to remove these crystals.

Prior to sieving, the first of a series of 5 slides is prepared from a portion of the unoxidized unsieved sample. A set of slides containing unsieved, sieved and oxidized samples allows control during the final stages of preparation. After the unsieved slide is prepared the remaining sample is then sieved through 10 μm mesh screen using the technique described by Cwynar et al (1979). The acid in the previous steps dissolved the carbonate and silicate minerals but did not affect the organic matter. The next step, involving oxidation, alters the organic matter so 2 slides were prepared from the sieved sample. In addition, approximately 15 ml of the residue is placed in a labelled vial for storage. Preservation of slides and residues at certain steps is important for it allows one to see where mistakes were made during processing. They can also be corrected without completely starting over.

The next step called for 20 ml of Schultz's solution to be added to the sample to oxidize the organic debris. Samples were stirred to allow equal oxidation within the vial and then left for 4-5 minutes. The sample was then washed and centrifuged three times and sieved with the 10 µm mesh for the final time.

Each sample was placed in a test tube and stained with three drops of Saffranin O. After 5 minutes each sample was washed, centrifuged and decanted until clear. Slide numbers 4 and 5 were prepared from the oxidized sieved and stained residue. The remaining sample was put in a labelled vial and stored.

To mount the slides two drops of polyvinyl alcohol and one or two drops of the sample were placed on a cover slip. A toothpick was used to spread the mixture evenly on the glass. The samples were left to dry under a box cover to limit exposure to possible contaminants. After drying, two drops of Elvacite (Dupont) were placed on the cover slip with the residue. The coverslip was mounted on a labelled glass slide and left to dry for 8-12 hours.

3.3.2 Identification

Palynomorph taxonomy, counts and photography were completed with a Zeiss Photomicroscope III, serial number 047633. Kodak T-Max 100 E.I. film was used for photography with the optics set on interference contrast.

The slides were scanned for palynomorphs at 0.5 mm intervals at 400x magnification. A total of 200 terrestrial palynomorphs, not including the Lycopodium spike, was counted. A record of the number of Lycopodium spike grains encountered, as well as a tally on dinoflagellates and fungal remains, was kept. Palynomorphs indistinguishable due to corrosion, folding or debris cover were tabulated either in bisaccate or indeterminate categories for later analysis (Appendix E). One or two slides per sample were needed to complete the count.

3.4 SYSTEMATICS

Phyletic affinity becomes increasingly difficult to determine for palynomorphs from older strata as the numbers of extinct taxa (which cannot be compared with extant taxa) increase. Because of this, most morphological classification systems suffer from an artificial and arbitrary division of taxa. There are a number of classification systems but two of the more common ones are the "Turma" system (Potonié and Kremp, 1954; Potonié, 1956; 1958; and 1960); and the "Natural" classification system (Couper, 1958; Filatoff, 1975; Singh 1964, 1971). Some authors use the "Natural" system for Tertiary spores and pollen and the "Turma" system for older palynomorphs (Couper, 1953 and 1958).

The "Turma" classification system is commonly used in pre-Tertiary assemblages because it is morphological and no phyletic relationships are implied. It is based on grouping of palynomorphs by similarities in aperture type, wall thickening or extension (saccae) and wall stratification (Dettmann, 1963). Singh's (1964) "Natural" system classified to family or genus based on similarity to modern forms. Burden (1982) and Burden and Hills (1989) generated an illustrated key based in part on both of these systems, yet avoiding implying natural relationships between genera. Classification of palynomorphs in this study is based on the key of Burden and Hills (1989) and similar keys of angiosperm pollen by McAndrews _et al._ (1973) and fungal remains by Elsik (1981) and Norris (1986).

Palynomorphs were divided into the following groups and subgroups:

TERRESTRIAL PALYNOMORPHS

Trilete Spores

Monolete Spores

Hilate Spores

Inaperturate Pollen

Monosaccate Pollen

Bisaccate Pollen

Monosulcate Pollen

Tricolpate Pollen

Tricolporate Pollen

Triporate Pollen

Stephanoporate Pollen

Binigeminate Pollen

Triprojectate Pollen

Syncolpate Pollen

FUNGAL REMAINS

Monocellate Fungal Spores

Dicellate Fungal Spores

Multicellate Fungal Spores

Mycelial Hyphae

Fungal Fruiting Bodies

MARINE MICROPLANKTON

Proximate Dinoflagellates

Each taxon's entry contains a photograph, synonymy, age and distribution and remarks or description (where relevant). The number of specimens per sample is an average unless otherwise specified. The descriptive terms for relative abundance of palynomorphs are based on Appendix D. Palynomorph abundances range from very rare (1 specimen); rare (2-4); infrequent (5-9); common 10-14 and abundant (15 or greater) out of a count of 200 palynomorphs. Specimens/sample usually stay within the number given with each relative abundance.

Specimens identifiable to a genus are listed in the range chart as, for example, Aquilapollenites sp.; specimens detailed further but unassignable to a particular species were listed, for instance, as Tricolporites sp. 1, Tricolporites sp. 2 etc.

It should be noted that the informal subzone R within the Bylot Island Formation is defined where approximately 85% or more of the assemblage is recycled. Recycled palynomorphs generally had higher thermal alteration index colours, different fluorescence colours and more wear and tear than first cycle palynomorphs.

TERRESTRIAL PALYNOMORPHS

Trilete Spores

Genus *Cingutriletes* Pierce emend. Dettmann, 1963

Type Species: *Cingutriletes* *congruens* Pierce, 1961.

Cingutriletes *pockockii* (Burger) Burden and Hills, 1989

Figure 6.

Synonymy:

1980 *Stereisporites* *pockockii* Burger, p. 58, pl. 12, figs. 14-17.

1989 *Cingutriletes* *pockockii* (Burger) Burden and Hills, p. 17, pl. 1, figs. 30,31.

1989 *Cingutriletes* *pockockii* (Burger) Burden and Hills; Sparkes, p. 47, pl. 2, fig. 2.

Age and Distribution: Burden (1982) notes a Jurassic to Tertiary range and a cosmopolitan distribution for this taxa.

Remarks: This species is rare in the Bylot Island and Sermilik Formations; a single specimen was found in the Navy Board Formation.

Cingutriletes sp. 1

Figure 7

Synonymy:

in press Cingutriletes sp. Burden and Langille, pl. 3, fig. 2.

Age and Distribution: Specimens resembling Cingutriletes sp. 1 are reported from Neocomian? to late Albian or Cenomanian strata of the Quqaluit Formation, S.E. Baffin Island (Burden and Langille, in press). This taxon may be endemic to the Eastern Arctic.

Remarks: Cingutriletes sp. is described by Burden and Langille (in press) as a trilete triangular spore with straight to convex sides and rounded apices. The cingulum thins to 2-3 µm. at the apices and widens to 4-6 µm. in the interradial regions. The laesurae extend on the cingulum and are noted to have raised lips. Specimens in their study varied from 30-35 µm in diameter; Maud Bight specimens are the same size range.

This taxon is very rare and restricted to the Bylot Island Formation.

Genus Densoisporites Weyland and Kreiger,
emend. Dettmann, 1963

Type Species: Densoisporites velatus Weyland and Kreiger, emend. Krasnova, 1961.

Densoisporites velatus Weyland and Kreiger, emend. Krasnova, 1961

Figure 8.

Synonymy:

1963 *Densoisporites velatus* Weyland and Kreiger, emend. Krasnova; Dettmann, p. 84, pl. 19, fig. 4-8.

1971 *Densoisporites velatus* Weyland and Kreiger emend. Krasnova; Singh, p. 46, pl. 3, figs. 9,10.

1980 *Densoisporites velatus* Weyland and Kreiger emend. Krasnova; Wingate, p. 12, pl. 2, fig. 10.

1981 *Densoisporites velatus* Weyland and Kreiger; Herngreen and Chlonova, p. 447, pl. 1, fig. 6.

1986 *Densoisporites velatus* Weyland and Kreiger; Ricketts and Sweet, p. 19, pl. 1, fig. 14.

1989 *Densoisporites velatus* Weyland and Kreiger; Burden and Hills, pl. 15, figs. 1-5.

Age and Distribution: *D. velatus* is distributed in Valanginian to Danian strata worldwide (Dettmann, 1963).

Remarks: This species is very rare and restricted to the Bylot Island and Sermilik Formations.

Genus *Antulsporites* Archangelsky and Gamerro, 1966

Type Species: *Antulsporites baculatus* (Archangelsky and Gamerro) Archangelsky and Gamerro, 1966.

Antulsporites distaverrucosus (Brenner)

Archangelsky and Gamerro, 1966

Figure 9.

Synonymy:

1963 *Cingulatisporites distaverrucosus* Brenner; p 58, pl. 13, figs 6,7; pl. 14, fig. 1.

1971 *Antulsporites distaverrucosus* (Brenner) Archangelsky and Gamerro; Singh, p 109, pl. 15 figs. 6,7.

1980 *Antulsporites distaverrucosus* (Brenner) Archangelsky and Gamerro; Wingate, p. 23, pl. 9, figs. 7,8.

1989 *Antulsporites distaverrucosus* (Brenner) Archangelsky and Gamerro; Sparkes, p. 49, pl. 2, fig. 4.

Age and Range: *A. distaverrucosus* is reported from the Albian Peace River Formation (Singh, 1971), Barremian to Albian strata in Maryland, U.S.A. (Brenner, 1963) and the Albian Bokchito Formation, Oklahoma (Wingate, 1980).

Remarks: This species is thought to be a recycled component in the Bylot Island Formation of Eclipse Trough (Sparkes, 1989). It is very rare in the Bylot Island and Sermilik Formations at Maud Bight.

Genus Appendicisporites Weyland and Kreiger, 1953 emend Burden and Hills, 1989

Type Species: Appendicisporites tricuspidatus Weyland and Greifeld, 1953.

Appendicisporites bifurcatus Singh, 1964.

Figure 10.

Synonymy:

1971 Appendicisporites bifurcatus Singh; Singh, p.56, pl. 4, figs. 3-5.

1971 Appendicisporites bifurcatus Singh; Playford, p. 544, pl. 104, fig. 10.

1975 Appendicisporites bifurcatus Singh; Brideaux and McIntyre, p. 15, pl., fig. 10.

1987 Appendicisporites bifurcatus Singh; Langille, p. 60-61, pl.2, fig. 5.

1989 Appendicisporites bifurcatus Singh; Sparkes, p. 50-51, pl. 2, fig. 6.

Age and Distribution: The known range of this species is Barremian to Cenomanian (Zippi and Bajc, 1990). It occurs in mid and upper Albian Peace River area strata, Alberta (Singh, 1971), mid to upper Albian Swan River Group of Saskatchewan and Manitoba (Playford, 1971) and Aptian to upper Albian of southeast Baffin Island (Langille, 1987).

Remarks: One specimen was recovered from subzone R of the Bylot Island Formation at Cape Hay.

Appendicisporites sp. cf. *Anemia* *macrorhyza*

(Maljavkina) Bolkhovitina, 1953.

Figure 11.

Synonymy:

1971 *Appendicisporites* sp. cf. *Anemia* *macrorhyza*? (Maljavkina) Bolkhovitina; Singh, p. 60-61, pl. 5, figs. 5-8.

Age and Distribution: Species described by Singh (1971) occurred in mid and upper Albian strata of the Peace River area, Alberta.

Remarks: A single specimen was found in the R subzone of the

Bylot Island Formation at Cape Hay.

Appendicisporites matesovae (Bolkhovitina) Norris, 1967

Figure 12.

Synonymy:

1967 Appendicisporites matesovae (Bolkhovitina) Norris, p. 94, pl. 12, figs. 11, 13-14.

1971 Appendicisporites matesovae (Bolkhovitina) Norris; Singh, p. 62, pl. 5, fig. 9.

1971 Appendicisporites matesovae Singh; Playford, p. 544, pl. 104, fig. 11.

1972 Appendicisporites matesovae Singh; Rouse and Srivastava, p. 1164, figs. 7-9.

Age and Range: A. matesovae is reported from upper Albian strata of the lower Shaftesbury Formation, Peace River, Alberta (Singh, 1971), upper Albian lower Colorado Group, Alberta (Norris, 1967), and mid to upper Albian Swan River Group Manitoba and Saskatchewan (Playford, 1971). Rouse and Srivastava (1972) report it from Zone 1 (Albian) in the Bonnet Plume Formation, N.E. Yukon Territory.

Remarks: *A. matesovae* is very rare; two specimens were recovered from subzone R in the Bylot Island Formation.

Appendicisporites problematicus (Burger) Singh, 1971.

Figure 13.

Synonymy;

1966 *Plicatella problemata* Burger; p. 245, pl. 10, fig. 3.

1971 *Appendicisporites problematicus* (Burger) Singh; Singh, p. 6-64, pl. 6, figs.1-6.

1971 *Appendicisporites problematicus* (Burger) Singh; Playford, p. 544, pl. 104, figs. 7-8.

1987 *Appendicisporites problematicus* (Burger) Singh; Langille, p. 61-62, pl. 2, fig. 6.

1989 *Appendicisporites problematicus* (Burger) Singh; Burden and Hills, p. 20-1, pl. , figs. 5-6.

Age and Distribution: This taxon occurs in Berriasian and Valanginian strata of the Netherlands (Burger, 1966); Berriasian to Albian strata of Alberta (Singh, 1971), Aptian to upper Albian strata of southeast Baffin Island (Langille, 1987), and upper Albian or lower Cenomanian strata, Moose River Basin, northwest Ontario (Zippi and Bajc, 1990).

Remarks: One specimen was recovered from subzone R of the Bylot Island Formation, near Cape Hay.

Genus *Camarozonosporites* Pant ex Potonié emend.
Klaus 1960

Type Species *Camarozonosporites* *cretaceous* (Weyland and Kreiger) Potonié 1956.

Camarozonosporites *ambigens* (Fradkina) Playford, 1971
Figure 14.

Synonymy:

1967 *Camarozonosporites* *insignis* Norris, p. 96-97, pl. 1, figs. 12-16.

1971 *Camarozonosporites* *insignis* Norris; Singh, p. 111, pl. 15, figs. 8-13.

1971 *Camarozonosporites* *ambigens* (Fradkina) Playford, p. 546, pl. 104, figs. 22,23.

1974 *Lycopodiacidites* *canaliculatus* Singh; Hopkins, p. 11, pl. 2, fig. 17.

1975 *Camarozonosporites* *ambigens* (Fradkina) Playford; Brideaux and McIntyre, p. 15, pl.2, fig. 25.

1980 *Camarozonosporites* *ambigens* (Fradkina) Playford; Wingate, p. 10, pl. 1, fig. 10.

1989 *Camarozonosporites* *ambigens* (Fradkina) Playford;

Sparkes, p. 52-53, pl.2, fig. 8.

Age and Distribution: This taxon is reported from Albian and Cenomanian strata of Alberta (Singh, 1971), mid to upper Albian strata of Oklahoma (Wingate, 1980), Campanian and Maastrichtian at Eclipse Trough (Sparkes, 1989) and Albian to Senonian strata of Yakutsk, U.S.S.R. (Fradkina; in Playford, 1971).

Remarks: The interradial crassitudes of *Camarozonosporites* distinguish it from *Hamulatisporis* Krutzsch emend. Srivastava, 1972 (Farabee and Canright, 1986) which has no such features.

This species is rare in the Bylot Island and Sermilik Formations.

Genus *Hamulatisporis* Krutzsch emend. Srivastava, 1972

Type Species: *Hamulatisporis hamulatis* Krutzsch, 1959.

Hamulatisporis hamulatis Krutzsch, 1959

Figure 15.

Synonymy:

1965 *Hamulatisporis hamulatis* Krutzsch; Stanley, p. 242, pl.

29, figs. 7,8.

1969 Hamulatisporis hamulatis Krutzsch; Oltz, p. 119, pl. 39, fig. 19.

1969 Hamulatisporis hamulatis Krutzsch; Norton and Hall, p. 1, pl. 1, fig. 6.

1971 Hamulatisporis hamulatis Krutzsch; Felix and Burbridge, p. 11, pl. 1, fig. 14.

1973 Hamulatisporis hamulatis Krutzsch; Stone, p. 68, pl. 11, fig. 61.

1978 Hamulatisporis hamulatis Krutzsch; Wilson, p. 114, pl. 3, figs. 3,4.

1986 Hamulatisporis hamulatis Krutzsch; Farabee and Canright, p. 19-20, pl. 4, fig. 3.

Age and Distribution: H. hamulatis occurs in the Maastrichtian and Paleocene Hell Creek and Fort Union Formations of South Dakota (Stanley, 1965); Maastrichtian strata in Montana (Oltz, 1969); Maastrichtian in the Yukon and District of Mackenzie, N.W.T. (Wilson, 1978) and the Maastrichtian Lance Formation, Wyoming (Farabee and Canright, 1986). Wilson (1978) notes that the species ranges from Campanian to Paleocene in North America and Eocene in Europe.

Remarks: H. amplus Stanley has a size range of 50-83 µm; H. hamulatis is smaller at 24-35 µm (Stanley, 1965; Farabee and

Canright, 1986). Wilson (1978) suggests, however, that the species have no morphological differences apart from size and the two taxa may be artificial divisions of gradational end members. Specimens in this study range from 27-(40)-56 µm.

H. hamulatis is rare but present in all strata.

Genus *Gleicheniidites* Ross 1949 ex Delcourt and Sprumont emend. Dettmann, 1963

Type Species: *Gleicheniidites senonicus* Ross, 1949.

Gleicheniidites senonicus Ross, 1949

Figure 16.

Synonymy:

1958 *Gleicheniidites senonicus* Ross; Couper, p. 138, pl. 19, figs. 1-15.

1966 *Gleicheniidites senonicus* Ross; Burger, p. 239, pl. 3, fig. 5.

1971 *Gleicheniidites senonicus* Ross; Singh, p. 97, pl. 14, fig. 1.

1973 *Gleicheniidites senonicus* Ross; Hopkins and Balkwill, p. 14, pl. 1, fig. 23.

1974 *Gleicheniidites senonicus* Ross; McIntyre, pl. 14, figs. 4,5.

1989 *Gleicheniidites senonicus* Ross; Burden and Hills, pl. 4, fig. 11.

1989 Gleicheniidites senonicus Ross; Sparkes, p. 55-56, pl. 2, fig. 11.

Age and Distribution: G. senonicus is a cosmopolitan Jurassic and Cretaceous species.

Remarks: It is present in almost every sample (1-34 specimens per sample) and most abundant in the Bylot Island and Sermilik Formations.

Gleicheniidites sp. cf. circinidites (Cookson)

Dettmann, 1963

Figure 17.

Synonymy:

1964 Gleicheniidites sp. cf. G. circinidites (Cookson) Dettmann; Singh, p. 39, pl. 8, figs. 10, 11.

1971 Gleicheniidites sp. cf. G. circinidites (Cookson) Dettmann; Singh, p. 97, pl. 14, figs. 2,3.

1977 Gleicheniidites circinidites (Cookson); Dörhöfer and Norris, pl. 2, fig. 24.

1989 Gleicheniidites sp. cf. G. circinidites (Cookson) Dettmann; Burden and Hills, pl. 4, fig. 12.

1989 Gleicheniidites sp. cf. G. circinidites (Cookson)

Dettmann; Sparkes, p. 56, pl. 2, fig. 12.

Age and Distribution: This is a cosmopolitan taxon ranging from the late Jurassic to early Cretaceous (Singh, 1971).

Remarks: There are 2-10 specimens per sample in subzone R of the Bylot Island Formation and isolated occurrences in the other formations.

Genus *Ornamentifera* Bolkhovitina, 1966

Type Species: *Ornamentifera* *echinata* (Bolkhovitina) Bolkhovitina, 1966.

Ornamentifera *baculata* Singh, 1971

Figure 18.

Synonymy:

1971 *Ornamentifera* *baculata* Singh, p. 100, pl. 14, figs. 4,5.

1975 *Ornamentifera* *baculata* Singh; Brideaux and McIntyre. p. 15. pl. 2, fig. 29.

1989 *Ornamentifera* *baculata* Singh; Sparkes, p. 57, pl. 2, fig. 14.

Age and Distribution: This species is reported from mid to upper Albian Peace River area strata in Alberta (Singh, 1971), Aptian to Albian of the Horton River area, District of Mackenzie, N.W.T., (Brideaux and McIntyre, 1975) and upper

Albian strata, Moose River Basin, Northwestern Ontario (Zippi and Bajc, 1990).

Remarks: It is rare (1-2 specimens/slide) but present in all strata as a recycled component. Probable reworked specimens were found in basal strata of the Bylot Island Formation in Eclipse Trough (Sparkes, 1989).

Genus *Tappanispora* Srivastava, 1972

Type Species: *Tappanispora loeblichii* Srivastava, 1972.

Tappanispora reticulata (Singh) Srivastava, 1975

Figure 19.

Synonymy:

1971 *Tappanispora reticulatus* Singh, p. 139, pl. 18, figs. 17,18.

1975 *Tappanispora reticulata* (Singh) Srivastava, p. 64, pl. 29, figs. 7-9

1981 *Tappanispora reticulata* (Singh) Srivastava; Srivastava, pl. 8, figs. 9,10.

1987 *Tappanispora reticulata* (Singh) Srivastava; Langille, p. 72, pl. 3, fig. 8.

1989 *Tappanispora reticulata* (Singh) Srivastava; Burden and Hills, p. 24, pl. 4, figs. 14-16.

1989 *Tappanispora reticulata* (Singh) Srivastava; Sparkes, p. 58, pl. 2, fig. 15.

Age and Distribution: This species occurs in middle Albian strata of Alberta (Singh, 1971), upper Barremian to mid Albian of Western Canada (Burden and Hills, 1989), mid Albian to lower Cenomanian of Colorado and Nebraska, U.S.A. (Pannella in Srivastava, 1975), Aptian to upper Albian of southeast Baffin Island (Langille, 1987).

Remarks: This species has a finer sculpture than T. scurrandus Norris or T. loeblichii Srivastava (Srivastava, 1972b). Only 3 specimens were found, all in subzone R of the Bylot Island Formation near Cape Hay.

Genus Lycopodiacidites Couper emend. Potonié, 1956

Type Species: Lycopodiacidites bullerensis Couper, 1953.

Lycopodiacidites canaliculatus Singh, 1971

Figure 20.

Synonymy:

1971 Lycopodiacidites canaliculatus Singh, p. 38, pl. 1, fig. 15.

1987 Lycopodiacidites canaliculatus Singh; Langille, p. 66, pl. 2, fig. 13.

1989 Lycopodiacidites canaliculatus Singh; Sparkes, p. 58-59, pl. 2, fig. 16.

Age and Distribution: The species has been reported from middle and upper Albian strata of the Peace River area, Alberta (Singh, 1971) and Aptian to upper Albian strata of southeast Baffin Island (Langille, 1987).

Remarks: *L. canaliculatus* is rare in the Bylot Island and Sermilik Formations.

Genus *Cicatricosisporites* Pflug and Thomson, 1953

Type Species *Cicatricosisporites dorogensis* Potonié and Gelletich, 1933.

Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann, 1963

Figure 21.

Synonymy:

1963 *Cicatricosisporites pseudotripartitus* (Bolkhovitina) Dettmann, p. 55-56, pl. 10, figs 1-5.

1971 *Cicatricosisporites pseudotripartitus* (Bolkhovitina) Dettmann; Singh, p. 77-78, pl. 9, figs. 12-15.

1971 Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann; Hopkins, p. 115, pl. 20, fig. 18.

1971 Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann; Paden-Philips and Felix, p. 292-294, pl. 2, fig. 1.

1974 Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann; Hopkins, p. 15, pl. 3, figs. 35,36.

1989 Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann; Burden and Hills, pl. 6, figs. 1-4.

Age and Distribution: C. pseudotripartitus is cosmopolitan in Albian and Cenomanian strata. Dettmann (1963) reports it in Cenomanian strata of Yakutsk and W. Siberia and Albian of S.E. Australia. Specimens have also been recorded in Albian strata of Peace River area, Alberta (Singh, 1971), Cenomanian in Mississippi (Paden-Philips and Felix, 1971) and the ?Upper Valanginian to Aptian Isachsen Formation of Melville Island, District of Franklin, N.W.T. (Hopkins, 1971).

Remarks: It is very rare and present only in subzone R of the Bylot Island Formation near Cape Hay.

Cicatricosisporites *australiensis* (Cookson) Potonié, 1956

Figure 22.

Synonymy:

1963 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Dettmann, p. 53, pl. 9, figs. 10-16.

1964 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Balme, pl. 7, fig. 4.

1967 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Norris, p. 92, pl. 11, fig. 14.

1971 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Singh, p. 69, pl. 7, figs. 12-15.

1974 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Hopkins. p. 15, pl. 3, fig. 32.

1975 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Brideaux and McIntyre, p. 15, pl. 1, fig. 37.

1987 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Langille, pl. 3, fig. 1.

1989 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Sparkes, p. 60-61, pl. 2, fig. 18.

1989 *Cicatricosisporites* *australiensis* (Cookson) Potonié; Burden and Hills, pl. 5, fig. 4,5.

Age and Distribution: Cosmopolitan; Late Jurassic and Cretaceous (Burden, 1982).

Remarks: There are 1-3 specimens/sample in subzone R of the Bylot Island Formation near Cape Hay and scattered occurrences as high as the Aktineq Formation.

Cicatricosisporites subrotundus Brenner, 1963.

Figure 23.

Synonymy:

1963 Cicatricosisporites subrotundus Brenner, p. 51, pl. 10, figs. 1,2.

1967 Cicatricosisporites subrotundus Brenner; Norris. p. 93, pl. 11, figs. 23-26.

1971 Cicatricosisporites subrotundus Brenner; Singh, p. 79-80, pl. 10, fig. 4,5.

1989 Cicatricosisporites subrotundus Brenner; Burden and Hills, pl. 6, figs. 11,12.

Age and Distribution: This species occurs in the upper Albian of the Potomac Group in Maryland, U.S.A. (Brenner, 1963), Albian of Central Alberta (Norris, 1967), middle and upper Albian, N.W. Alberta (Singh, 1971), and Aptian and Albian of western Canada (Burden, 1982).

Remarks: A single reworked specimen was found in the Sermilik Formation.

Genus Radialisporis Krutzsch, 1967.

Type Species: Radialisporis radiatus (Krutzsch) Krutzsch, 1967.

Radialisporis radiatus (Krutzsch) Krutzsch, 1967

Figure 24.

Synonymy:

1965 Anemia radiatus (Krutzsch) Stanley, p. 258, pl. 3, figs. 6,7.

1972 Radialisporis radiatus (Krutzsch) Krutzsch; Rouse and Srivastava, p. 1177, pl. 5, figs. 54,55.

1972a Radialisporis radiatus (Krutzsch) Krutzsch; Srivastava, p. 29, pl. 24, figs. 8-1, pl. 25, figs. 1,2.

1974 Radialisporis radiatus (Krutzsch) Krutzsch; McIntyre, p. 36, pl. 14, figs. 15,16.

1989 Radialisporis radiatus (Krutzsch) Krutzsch; Sparkes, p. 62, pl. 3, fig. 2.

Age and Distribution: The taxon has a late Campanian to Paleocene range. It is reported from the Maastrichtian of the

Edmonton Formation, Alberta (Srivastava, 1972a), Paleocene of the Bonnet Plume Formation, Yukon Territory (Rouse and Srivastava, 1972), upper Campanian to mid Maastrichtian at Horton River, N.W.T. (McIntyre, 1974) and upper Campanian to upper Maastrichtian in Bylot Island and Sermilik strata in Eclipse Trough, Bylot Island (Sparkes, 1989).

Remarks: This species appears sporadically in Bylot Island and Sermilik strata (1-5 specimens/sample when present).

Genus *Klukisporites* Couper, 1958

Type Species: *Klukisporites* *variegatus* Couper, 1958.

Klukisporites *pseudoreticulatus* Couper, 1958

Figure 25.

Synonymy:

1958 *Klukisporites* *pseudoreticulatus* Couper, p. 138, pl. 19, figs. 8-10, figs. 8-10.

1964 *Dictyotriletes* *pseudoreticulatus* (Couper) Pocock; Singh, p. 64, pl. 7, figs. 12,13.

1971 *Klukisporites* *pseudoreticulatus* Couper; Singh, p. 96, pl. 13, figs. 12-15.

1975 *Klukisporites* *pseudoreticulatus* Couper; Brideaux and McIntyre, p. 15, pl. 1, fig. 28.

in prep. Klukisporites pseudoreticulatus Couper; Burden and Langille, pl. 2, fig. 2.

Age and Range: This taxon is found in Upper Jurassic to lower Cenomanian strata in Western North America and England (Singh, 1971). Burden and Langille (in prep.) report it from the upper Albian or Cenomanian Quqaluit Formation.

Remarks: This species is rare in the Bylot Island Formation; a single specimen occurs in one sample in the Sermilik Formation.

Genus Retitriletes (van der Hammen, 1956 ex Pierce, 1961) emend. Döring, Krutzsch, Mai and Schultz, 1963

Type Species: Retitriletes globosus Pierce, 1961.

Remarks: Retitriletes species are difficult to identify and tend to be long ranging; they are not differentiated on the range chart.

Retitriletes austroclavatidites (Cookson) Döring, Krutzsch, Mai and Schultz, 1963

Figure 26.

Synonymy:

1966 Lycopodiumsporites austroclavatidites Cookson; Burger, p. 247, pl. 15, fig. 2.

1971 Lycopodiumsporites austroclavatidites (Cookson) Potonié; Singh, p. 40, pl. 2, fig. 1.

1971 Lycopodiumsporites austroclavatidites (Cookson) Potonié; Playford, p. 537, pl. 103, fig. 2.

1972a Retitriletes austroclavatidites (Cookson) Krutzsch; Srivastava, p. 30, pl. 25, figs. 5-9, pl. 26, figs. 1-3.

1974 Lycopodiumsporites austroclavatidites (Cookson) Potonié; Hopkins, p. 30, pl. 2, fig. 14.

1975 Lycopodiumsporites austroclavatidites (Cookson) Potonié; Brideaux and McIntyre, p. 56, pl. 1, fig. 21.

1977 Lycopodiumsporites austroclavatidites (Cookson) Potonié; Dörhöfer and Norris, pl. 1, fig. 24.

1981 Retitriletes austroclavatidites (Cookson) Döring et al.; Srivastava, p. 19, pl. 7, figs. 10, 11.

1989 Retitriletes austroclavatidites (Cookson) Döring et al.; Burden and Hills, pl. 6, fig. 31,32.

Age and Distribution: Singh (1971) reports this species is cosmopolitan and ranges from the Jurassic to Cretaceous.

Remarks: A few specimens occurred in most of the samples.

Retitriletes reticulumsporites (Rouse, 1959) Burden and Hills, 1989

Figure 27.

Synonymy:

1963 Lycopodiumsporites reticulumsporites (Rouse) Dettmann, p. 45, pl. 7, figs. 4-7.

1971 Lycopodiumsporites reticulumsporites (Rouse) Dettmann; Singh, p. 43-44, pl. 3, fig. 1-2.

1972a Retitriletes reticulisporites (Rouse) Krutzsch; Srivastava, p. 2, pl. 27, fig. 5.

1989 Retitriletes reticulumsporites (Rouse) Burden and Hills, p. 71, pl. 7, figs. 4-5.

Age and Distribution: Cosmopolitan. Bathonian to Albian (Burden and Hills (1989).

Remarks: Specimens are rare but found in all formations at Maud Bight.

Genus Stoverisporites Burger, 1976

Type Species: Stoverisporites lunaris (Cookson and Dettmann) Burger, 1976.

Stoverisporites lunaris (Cookson and Dettmann) Burger, 1976

Figure 28.

1971 Kuylisporites lunaris Cookson and Dettmann; Singh, p. 108, pl. 14, figs. 10,11.

1975 Kuylisporites lunaris Cookson and Dettmann; Brideaux and McIntyre, p. 14, pl. 1, fig. 16.

1980 Kuylisporites lunaris Cookson and Dettmann; Wingate, p. 22, pl. 9, fig. 1.

1983 Kuylisporites lunaris Cookson and Dettmann; Rao et al., pl. 1, fig. 14.

1984 Stoverisporites lunaris (Cookson and Dettmann) Burger; Burden, fig. 12 h.

1989 Stoverisporites lunaris (Cookson and Dettmann) Burger; Burden and Hills, p. 19, pl. 7, figs. 15-18.

Age and Range: Upper Barremian to upper Albian in western Canada (Singh, 1971, and Burden and Hills, 1989), Aptian-Albian rocks at Horton River, N.W.T. (Brideaux and McIntyre, 1975); Lower Cretaceous of S.E. Australia (Dettmann, 1963) and Lower Cretaceous, Gangapur Beds, Pranhita-Godavari Basin, India (Rao *et al.*, 1983).

Remarks: One specimen was present in subzone R of the Bylot Island Formation near Cape Hay.

Genus *Biretisporites* Delcourt and Sprumont emend. Delcourt, Dettmann and Hughes, 1963

Type Species: *Biretisporites potoniaei* Delcourt and Sprumont, 1955.

Biretisporites potoniaei Delcourt and Sprumont, 1955

Figure 29.

Synonymy:

1963 *Biretisporites* cf. *B. potoniaei* Delcourt and Sprumont; Dettmann, p. 26, pl. 2, figs. 1,2.

1971 *Biretisporites potoniaei* Delcourt and Sprumont; Singh, p. 49, pl. 3, figs. 15, 16.

1980 *Biretisporites potoniaei* Delcourt and Sprumont; Wingate, p. 14, pl. , fig. 5.

1987 *Biretisporites potoniaei* Delcourt and Sprumont; Langille, p. 74, pl. 3, fig. 15.

1989 *Biretisporites potoniaei* Delcourt and Sprumont; Burden and Hills, pl. 7, figs. 35,36.

Age and Range: Lower Cretaceous in Western Canada, Belgium and France (Singh, 1971), lower Cretaceous in S.E. Australia (Dettmann, 1963), Albian of Oklahoma (Wingate, 1980).

Remarks: Biretisporites potoniaei is a rare component in all formations at Maud Bight.

Genus Todisporites Couper, 1958

Type Species: Todisporites major Couper, 1958.

Todisporites minor Couper, 1958

Figure 30.

1958 Todisporites minor Couper, p. 135, pl. 16, fig. 9.

1964 Todisporites minor Couper; Singh, p. 45-46, pl. 1, fig. 22.

1971 Todisporites minor Couper; Singh, p. 50-51, pl. 4, fig. 2.

1980 Todisporites minor Couper; Wingate, p. 14, pl. 3, fig. 8.

1989 Todisporites minor Couper; Burden and Hills, p. 29, pl. 8, fig. 2.

Age and Distribution: Bajocian of England (Couper, 1958); Jurassic to lower Cretaceous (Pocock, 1962) of Western

Canada; and Albian and Cenomanian of Oklahoma (Hedlund in Singh, 1971; Wingate, 1980).

Remarks: Specimens are very rare but found in all strata at Maud Bight.

Genus Stereisporites Pflug, 1953

Type Species: Stereisporites stereoides (Potonié and Venitz) Pflug, 1953.

Stereisporites antiquasporites (Wilson and Webster) Dettmann, 1963

Figure 31.

Synonymy:

1963 Stereisporites antiquasporites (Wilson and Webster) Dettmann, p. 25, pl. 1, figs. 20,21.

1965 Sphagnum antiquasporites (Wilson and Webster) Stanley, p. 236, pl. 27, figs. 1-5.

1971 Stereisporites antiquasporites (Wilson and Webster) Dettmann; Singh, p. 33-34, pl. 1, figs. 4-5.

1974 Stereisporites antiquasporites (Wilson and Webster) Dettmann; McIntyre, pl. 14, fig. 1.

1975 Stereisporites antiquasporites (Wilson and Webster)

Dettmann; Brideaux and McIntyre, p. 14, pl. 1, fig. 6.

1982 Stereisporites antiquasporites (Wilson and Webster) Dettmann; Jarzen, pl. 1, fig. 2.

1987 Stereisporites antiquasporites (Wilson and Webster) Dettmann; Langille, p. 75, pl. 3, fig. 15.

Age and Distribution: Cosmopolitan. Jurassic to Tertiary (Singh, 1971).

Remarks: This is a common species (usually 4-10 specimens/sample and as high as 50 specimens/sample) in all strata at Maud Bight.

Stereisporites regium (Drozhastchich) Drugg, 1967

Figure 32.

Synonymy:

1965 Sphagnum regium Drozhastchich; Stanley, p. 238, pl. 27, figs. 12-17.

1967 Stereisporites regium (Drozhastchich) Drugg, p. 37, pl. 6, fig. 20.

1974 Stereisporites regium (Drozhastchich) Drugg;

McIntyre, p. 36, pl. 14, figs. 2,3.

1978 _Stereisporites regium_ (Drozhastchich) Drugg; Wilson, p. 109, pl. 1, fig. 4.

1989 _Stereisporites regium_ (Drozhastchich) Drugg; Sparkes, p. 66-67, pl. 3, fig. 6.

Age and Distribution: Maastrichtian at Horton River, N.W.T. (McIntyre, 1974), Maastrichtian and Paleocene strata of Western Siberia and Paleocene of South Dakota (Stanley, 1965).

Remarks: _Stereisporites regium_ is infrequent (1-7 specimens/sample where present) and is present in the Bylot Island to Aktineq strata.

Genus _Cingulatisporites_ Pflug emend. Potonié, 1956

Type Species: _Cingulatisporites levispeciosus_ Pflug, 1956.

Cingulatisporites dakotaensis Stanley, 1965

Figure 33.

Synonymy:

1965 _Cingulatisporites dakotaensis_ Stanley, p. 243, pl. 30, figs. 1-8.

1969 _Cingulatisporites dakotaensis_ Stanley; Norton and

Hall, p. 15, pl. 2, fig. 6.

1969 Cingulatisporites dakotaensis Stanley; Oltz, p. 120, pl. 39, fig. 22.

1973 Cingulatisporites dakotaensis Stanley; Stone, p. 66, pl. 10, fig. 56.

1975 Cingulatisporites dakotaensis Stanley; Norris et al., p. 349, pl. 3, fig. 2.

1986 Cingulatisporites dakotaensis Stanley; Farabee and Canright, p. 15, pl. 2, fig. 1.

1989 Cingulatisporites dakotaensis Stanley; Sparkes, p. 67-68, pl. 3, fig. 7.

Age and Distribution: This species occurs in the upper Campanian Almond Formation of Wyoming (Stone, 1973); Maastrichtian Fort Union Formation of South Dakota (Stanley, 1965); Maastrichtian Lance Formation, Wyoming (Farabee and Canright, 1986), and Paleocene; Tullock Member of the Fort Union Group, Montana (Oltz, 1969). Sparkes (1989) reports it from the upper Campanian and Maastrichtian in the Eclipse Trough.

Remarks: Cingulatisporites dakotaensis is rare (1-4 specimens/sample) in the Bylot Island and Sermilik Formations and very rare in the Navy Board and Aktineq Formations. It is one of the few late Cretaceous terrestrial palynomorphs recovered from subzone R in the Bylot Island Formation.

Genus *Deltoidospora* Miner, 1935

Type Species: *Deltoidospora hallii* Miner, 1935.

Deltoidospora hallii Miner, 1935

Figure 34.

1964 *Deltoidospora hallii* Miner; Singh, p. 80, pl. 9, figs. 13,14.

1971 *Deltoidospora hallii* Miner; Singh, p. 118, pl. 16, fig. 8.

1980 *Deltoidospora hallii* Miner; Wingate, p. 25, pl. 9, fig. 14.

1989 *Deltoidospora hallii* Miner; Sparkes, p. 68-69, pl. 3, fig. 8.

1989 *Deltoidospora hallii* Miner; Burden and Hills, p. 30, pl. 8, fig. 4.

Age and Distribution: It is widespread in the Jurassic and Cretaceous of North America (Singh, 1971).

Remarks: This species is common in all strata at Maud Bight and Cape Hay (6-15 specimens/sample).

Deltoidospora diaphana Wilson and Webster, 1946.

Figure 35.

Synonymy:

1971 *Deltoidospora diaphana* Wilson and Webster; Singh, p. 119, pl. 16, fig. 9.

1973 *Deltoidospora diaphana* Wilson and Webster; Stone, p.64, pl. 10, fig,. 52.

1989 *Deltoidospora diaphana* Wilson and Webster; Burden and Hills, p. 30, pl. 8, fig. 5.

Age and Distribution: Late Jurassic to Tertiary of North America (Singh, 1971).

Remarks: It is very rare but present in all strata.

Deltoidospora psilostoma Rouse, 1959

Figure 36.

Synonymy:

1964 *Deltoidospora psilostoma* Rouse; Singh, p. 80-81, pl. 9, fig. 15.

1971 *Deltoidospora psilostoma* Rouse; Singh, p. 120, pl.

16, fig. 12.

1974 *Deltoidospora psilostoma* Rouse; Hopkins, p. 18, pl. 4, fig. 48.

1989 *Deltoidospora psilostoma* Rouse; Burden and Hills, p. 30. pl. 8, figs. 6-7.

Age and Distribution: *D. psilostoma* is common in the upper Jurassic to upper Cretaceous of Western Canada (Singh, 1971). It also occurs in the Albian of the Amund and Ellef Ringnes Islands, N.W.T. (Hopkins, 1974).

Remarks: This species is rare (1-2 specimens/sample) in the Hassel, Bylot Island and Sermilik Formations. Scattered specimens occur in the Navy Board Formation.

Genus *Cyathidites* Couper, 1953

Type Species: *Cyathidites australis* Couper, 1953.

Cyathidites australis Couper, 1953

Figure 37.

Synonymy:

1964 *Cyathidites australis* Couper; Singh, p. 70-71, pl. 8, fig. 12.

1971 *Cyathidites australis* Couper; Singh, p. 101, pl.

14, fig. 8.

1974 Cyathidites australis Couper; Hopkins, p. 12, pl. 2, fig. 19.

1989 Cyathidites australis Couper; Burden and Hills, p. 30, pl. 8, fig. 14.

Age and Distribution: Cosmopolitan. Jurassic and Cretaceous (Singh, 1971).

Remarks: It is rare but present in all strata at Maud Bight and Cape Hay.

Cyathidites minor Couper, 1953

Figure 38.

Synonymy:

1958 Cyathidites minor Couper; Couper, p. 139, pl. 20, figs. 9,10.

1963 Cyathidites minor Couper; Dettmann, p. 22, pl. 1, figs. 4,5.

1964 Cyathidites minor Couper; Singh, p. 71, pl. 8, fig. 13.

1965 Cyathidites minor Couper; McGregor, pl. 7, figs. 3,4.

1967 Cyathidites minor Couper; Srivastava, pl. 1, fig. M.

1971 Cyathidites minor Couper; Singh, p. 101, pl. 14, fig. 9.

1973 Cyathidites minor Couper; B.D. Tschudy, p. 6, pl. 1, fig. 1.

1974 Cyathidites minor Couper; McIntyre, pl. 14, fig. 8.

1975 Cyathidites minor Couper; Brideaux and McIntyre, p. 14, pl. 1, fig. 3.

1989 Cyathidites minor Couper; Burden and Hills, p. 30, pl. 8, fig. 15.

Age and Distribution: Cosmopolitan. Jurassic to Cretaceous (Singh, 1971). It is abundant in Eclipse Trough strata (Sparkes, 1989).

Remarks: C. minor is common in all strata (typically 7-15 specimens/sample).

Genus Gemmatriletes Pierce, 1961

Type Species: Gemmatriletes morulus PIerce, 1961.

Gemmatriletes clavatus Brenner, 1968

Figure 39.

Synonymy:

1968 *Gemmatriletes clavatus* Brenner, p. 353, pl. 1, fig.7.

1983 *Gemmatriletes clavatus* Brenner; Singh, p. 30, pl. 1, figs. 2,3.

1988 *Gemmatriletes clavatus* Brenner; Sweet and McIntyre, fig. 6, Number 11.

1989 *Gemmatriletes clavatus* Brenner; Sparkes, p. 71-72, pl. 3, fig. 11.

Age and Distribution: This species occurs in Albian to Cenomanian strata in N.E. Peru (Brenner, 1968), Cenomanian strata of Alberta (Singh, 1983), upper Turonian in the Foothills of the Rockies, Alberta (Sweet and McIntyre, 1988). Sparkes (1989) reports a single specimen from the Bylot Island Formation in Eclipse Trough.

Remarks: *G. clavatus* is rare but occurs in all the formations.

Genus *Osmundacites* Couper, 1953

Type Species: *Osmundacites wellmanii* Couper, 1953.

Osmundacites wellmanii Couper, 1953

Figure 40.

Synonymy:

1958 Osmundacites wellmanii Couper; Couper, p. 134, pl. 16, figs. 4,5.

1963 Osmundacites wellmanii Couper; Dettmann, p. 32, pl., figs. 19-21.

1964 Osmundacites wellmanii Couper; Singh, p. 44, pl. 1, fig. 20.

1965 Osmundacites wellmanii Couper; McGregor, pl. 2, fig. 12.

1966 Osmundacites wellmanii Couper; Burger, p. 251, pl. 20, fig. 3.

1967 Osmundacites wellmanii Couper; Norris, p. 88, pl. 10, fig. 14.

1971 Osmundacites wellmanii Couper; Singh, p. 50, pl. 4, fig. 1.

1972a Osmundacites wellmanii Couper; Srivastava, p. 27, pl. 23, figs. 1-3.

1974 Osmundacites wellmanii Couper; McIntyre, p. 36, pl. 14, figs. 10,11.

1974 Osmundacites wellmanii Couper; Hopkins, p. 13, pl. 2, fig. 24.

1989 Osmundacites wellmanii Couper; Burden and Hills, p. 31, pl. 8, figs. 19,20.

Age and Distribution: Cosmopolitan. Jurassic and Cretaceous (Singh, 1971).

Remarks: It is present in all formations (5-12 specimens/sample).

Genus *Baculatisporites* Thomson and Pflug, 1953

Type Species: *Baculatisporites* *primarius* (Wolff) Thomson and Pflug, 1953.

Baculatisporites *comaumensis* (Cookson) Potonié, 1956

Figure 41.

Synonymy:

1963 *Baculatisporites* *comaumensis* (Cookson) Potonié; Dettmann, p. 35, pl. 3, figs. 22,23.

1965 *Baculatisporites* *comaumensis* (Cookson) Potonié; McGregor, pl. 7, fig. 10.

1971 *Baculatisporites* *comaumensis* (Cookson) Potonié; Hopkins, pl. 20, figs. 10, 11.

1971 *Baculatisporites* *comaumensis* (Cookson) Potonié; Singh, p. 48, pl. 3, fig. 14.

1974 *Baculatisporites* *comaumensis* (Cookson) Potonié; McIntyre, p. 6, pl. 14, fig. 9.

1975 Baculatisporites comaumensis (Cookson) Potonié; Brideaux and McIntyre, p. 36, pl. 14, fig. 9.

1980 Baculatisporites comaumensis (Cookson) Potonié; Bebout, pl. 1, fig. 10.

1983 Baculatisporites comaumensis (Cookson) Potonié; Truswell, p. 141, pl. 1, figs. 3,4.

1989 Baculatisporites comaumensis (Cookson) Potonié; Burden and Hills, p. 31, pl. 8, figs. 21, 22.

Age and Distribution: Cosmopolitan. Early Cretaceous (Dettmann, 1963; Singh, 1971; Truswell; 1983); Oligocene to Miocene in core from Baltimore Canyon, Atlantic outer continental shelf (Bebout, 1980).

Remarks: This species is rare (1-3 specimens/sample) but present in all strata.

Genus Echinatisporis Krutzsch, 1959

Type Species: Echinatisporis longechinus Krutzsch, 1959.

Echinatisporis varispinosus, (Pocock) Srivastava, 1975

Figure 42.

Synonymy:

1962 Acanthotriletes varispinosus, Pocock, p. 6, pl. 1, figs. 18-20.

1964 Acanthotriletes varispinosus, Pocock; Singh, p. 43, pl. 1, fig. 17,18.

1971 Acanthotriletes varispinosus, Pocock; Singh, p.45, pl. 3, fig. 8.

1975 Echinatisporis varispinosus, (Pocock) Srivastava, p. 39, pl. 17, figs. 8-14, pl. 18, figs. 1-4.

1986 Echinatisporis varispinosus, (Pocock) Srivastava; Farabee and Canright. p. 17, pl. 2, figs. 9,10.

Age and Distribution: This species occurs in the Aptian-Maastrichtian of Western Canada (Srivastava, 1975); Maastrichtian in the Lance Formation of Wyoming (Farabee and Canright, 1986); and Maastrichtian strata in Eclipse Trough (Waterfield, 1989).

Remarks: Echinatisporis varispinosus is very rare and only occurs in the Bylot Island and Sermilik Formations (1-4 specimens/sample).

Genus Impardecispora Venkatachala et al., 1968

Type Species: Impardecispora apiverrucata (Couper) Venkatachala et al., 1968.

Impardecispora humilis (Delcourt and Sprumont) Burden and Hills, 1989

Figure 43.

Synonymy:

1963 *Trilobosporites humilis* Delcourt and Sprumont; Brenner, p. 71, pl. 23, figs. 3,4.

1971 *Trilobosporites humilis* Delcourt and Sprumont; Singh, p. 143, pl. 19, figs. 10-14.

1980 *Trilobosporites humilis* Delcourt and Sprumont; Wingate, p. 21, pl. 8, fig. 6,7.

1989 *Impardecispora humilis* (Delcourt and Sprumont) Burden and Hills, p. 75, pl. 11, figs. 8,9.

Age and Distribution: Barremian to Albian, North America (Burden and Hills, 1989).

Remarks: This species is very rare; several specimens were found in subzone R of the Bylot Island Formation near Cape Hay.

Monolete Spores

Genus Laevigatosporites Ibrahim emend. Schopf, Wilson and Bentall, 1944.

Type Species: Laevigatosporites vulgaris (Ibrahim) Ibrahim, 1933.

Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug, 1953

Figure 44.

Synonymy:

1965 Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; Stanley, p. 252, pl. 32, figs. 1-3.

1972c Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; Srivastava, p. 232, pl. 5, figs. 9,10.

1975 Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; Srivastava, p. 50-51, pl. 25, fig. 5.

1978 Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; Wilson, p. 117-118, pl. 4, figs. 7,8.

1981 Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; Srivastava, p. 8, pl. 7, fig. 4.

Age and Range: Cosmopolitan. Mesozoic to Tertiary (Srivastava, 1975).

Remarks: Wilson (1978) states that the distinction of L. ovatus and L. gracilis from L. hardti is irrelevant and arbitrary, since all three have common form and the former two have size ranges fitting within that of L. hardti (20-70 µm.). L. hardti ranged between 24-65 µm. in this study. In Eclipse Trough Sparkes (1989) distinguished two distinct end members; L. sp. cf. ovatus (24-28 µm.) and L. hardti (30-70 µm.), while Waterfield (1989), noting morphological gradation, retained only the L. hardti classification.

This species was among the most common in the study area; it was present in every sample (17-30 specimens/sample and up to 66 specimens in one sample).

Genus Hazaria Srivastava, 1971

Type Species: Hazaria sheoparii Srivastava, 1971.

Hazaria sheoparii Srivastava, 1971

Figure 45.

Synonymy:

1971 Hazaria sheoparii Srivastava, p. 258, pl. 2, figs. 1-4.

1972 Hazaria sheoparii Srivastava; Rouse and Srivastava, p. 1172, pl. 2, figs. 15,16.

1974 Hazaria sheoparii Srivastava; McIntyre, p. 37, pl.

14, figs. 26,27.

1986 *Hazaria sheoparii* Srivastava; Jerzykiewicz and Sweet, p. 164, pl. 1, fig.

1990 *Hazaria sheoparii* Srivastava; Eberth *et al.*, pl. 1, fig. 3.

Age and Distribution: This species is present in upper Campanian to Maastrichtian strata at Horton River, N.W.T. (McIntyre, 1974); Campanian to Paleocene strata in the Banks Island region (Doerenkamp *et al.*, 1976); mid to upper Campanian, Judith River Formation, Saskatchewan (Eberth *et al.*, 1990); upper Campanian to upper Maastrichtian in Eclipse Trough, Bylot Island (Sparkes, 1989); Maastrichtian in the Edmonton Formation, Alberta (Srivastava, 1971); the Bonnet Plume Formation (Maastrichtian) of the Yukon Territory (Rouse and Srivastava, 1972); the Coalspur Formation (Maastrichtian to Paleocene) of the Alberta Foothills (Jerzykiewicz and Sweet, 1986).

Remarks: *Hazaria sheoparii* is rare (1-4 specimens/sample) in all strata.

Genus *Cicatricosisporites*

Pflug and Thomson, 1953 ex. Krutzsch, 1959

Type Species: *Cicatricososporites* *eocenicus* (Selling) Jansonius and Hills, 1976.

Cicatricososporites *eocenicus* (Selling) Jansonius and Hills, 1976

Figure 46.

Synonymy:

1964 *Schizaeoisporites* *eocenicus* (Selling) Potonié; Singh, p. 62-63, pl. 7, fig. 8,9.

1969 *Schizaeoisporites* *eocenicus* (Selling) Potonié; Vagvolgyi and Hills, p. 161, pl. 3, fig. 16.

1969 *Schizaeoisporites* *eocenicus* (Selling) Potonié; Oltz, p. 125, pl. 40, fig. 4.

1976 *Cicatricososporites* *eocenicus* (Selling) Jansonius and Hills, cards 468-469.

1980 *Schizaeoisporites* *eocenicus* (Selling) Potonié; Wingate, p. 20, pl. 8, figs. 1-3.

1989 *Cicatricososporites* *eocenicus* (Selling) Jansonius and Hills; Burden and Hills, p. 35, pl. 12, fig. 8.

Age and Distribution: This species occurs in the lower Cretaceous of Western Canada and the Eocene of Germany (Singh, 1964). Wingate (1980) reports it from the Albian Bokchito Formation of southern Oklahoma.

Remarks: One specimen was found in the uppermost strata of the Sermilik Formation.

Hilate Spores

Genus Aequitriradites Delcourt and Sprumont, 1955, emend. Cookson and Dettmann, 1961

Type Species: Aequitriradites dubius Delcourt and Sprumont, 1955.

Aequitriradites sp. cf. spinulosus

Figure 47.

Synonymy:

1963 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Dettmann, p. 93-94, pl. 22, fig. 7-13.

1964 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Singh, p. 88-89, pl. 11, fig. 12,13.

1971 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Singh, p. 34-35, pl. 1, fig. 6.

1971 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Playford, pl. 106, fig. 7.

1980 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Wingate, p. 8, pl. 1, fig.2.

1989 Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann; Burden and Hills, p. 37, pl. 13, figs. 8,9.

Age and Distribution: Lower Cretaceous of S.E. Australia (Dettmann, 1963); Lower Cretaceous to Danian of U.S.S.R. (Bolkhovitina in Singh, 1971); mid to upper Albian of the Swan River Group of Saskatchewan and Manitoba (Playford, 1971); Albian of the Peace River area, Alberta (Singh, 1971); Albian of southern Oklahoma (Wingate, 1980).

Remarks: The ornament on the distal face of A. spinulosus consists of fine spinules of variable size while the proximal face is smooth to finely scabrate (Singh, 1964). The sculpture in specimens studied appears to be finer than those found at Peace River (Singh, 1971) or in Oklahoma (Wingate, 1980).

It is a very rare species; a maximum of 1 specimen/sample is found in the Bylot Island and lower Sermilik strata.

Inaperturate Pollen

Genus Inaperturopollenites Pflug, 1952, ex Thomson and Pflug emend. Potonié, 1958

Type Species: Inaperturopollenites dubius (Potonié and Venitz) Thomson and Pflug, 1953.

Inaperturopollenites sp.

Figure 48.

Synonymy:

1968 Inaperturopollenites sp.; Ting, p. 596, pl. 7, fig. 12,14.

1971 Inaperturopollenites sp.; Singh, p. 150, pl. 21, fig. 1.

1973 Inaperturopollenites sp.; Hopkins and Balkwill, p. 20, pl. 2, fig. 45.

1974 Inaperturopollenites sp.; Hopkins, p. 23, pl. 6, fig. 70.

1989 Inaperturopollenites sp.; Burden and Hills, p. 40, pl. 14, fig. 17.

in prep. Inaperturopollenites sp.; Burden and Langille, pl. 3, fig. 9.

Age and Distribution: *Inaperturopollenites* is cosmopolitan and ranges from the Mesozoic to Cenozoic.

Remarks: This species is present in all strata.

Genus *Taxodiaceaepollenites* Kremp, 1949 ex Potonié, 1958

Type Species: *Taxodiaceaepollenites* *hiatus* Potonié ex Potonié, 1958.

Taxodiaceaepollenites *hiatus* (Potonié) Kremp, 1949

Figure 49.

Synonymy:

1965 *Thuja* ? *hiatus* (Potonié) Stanley, p. 273, pl. 38, figs. 1-3.

1967 *Taxodiaceaepollenites* *hiatus* (Potonié) Kremp; Srivastava, pl. 2, fig. C.

1971 *Taxodiaceaepollenites* *hiatus* (Potonié) Kremp; Singh, p. 158, pl. 22, fig. 7.

1975 *Taxodiaceaepollenites* *hiatus* (Potonié) Kremp; Brideaux and McIntyre, p. 17, pl. 4, fig. 19.

1980 *Taxodiaceaepollenites* *hiatus* (Potonié) Kremp; Wingate, p. 37, pl. 13, fig. 15.

1986 _Taxodiaceaepollenites hiatus_ (Potonié) Kremp; Farabee and Canright, p. 35, pl. 10, fig. 2.

1989 _Taxodiaceaepollenites hiatus_ (Potonié) Kremp; Burden and Hills, p. 40, pl. 14, fig. 18.

Age and Distribution: Cosmopolitan. Cretaceous to Tertiary (Farabee and Canright, 1986).

Remarks: _T. hiatus_ is abundant; the number of specimens/sample increases through the stratigraphic column; 5-8 specimens/sample in subzone R of the Bylot Island Formation, 7-20 specimens/sample in rest of the Bylot Island and Sermilik Formations and 16-74 specimens/sample in the Navy Board and Aktineq Formations.

Taxodiaceaepollenites vacuipites (Wodehouse) Wingate, 1980

Figure 50.

Synonymy:

1933 _Glyptostrobus vacuipites_ Wodehouse; p. 494.

1980 _Taxodiaceaepollenites vacuipites_ (Wodehouse) Wingate; p. 37, pl. 13, fig. 16.

1989 _Taxodiaceaepollenites vacuipites_ (Wodehouse)

Wingate; Sparkes, p. 78-79, pl. 3, fig. 18.

Age and Distribution: Albian of Bokchito Formation, southern Oklahoma (Wingate, 1980); upper Campanian to Maastrichtian of Bylot Island and Sermilik Formations, Bylot Island (Sparkes, 1989).

Remarks: Wingate (1980) defined _T. vacuipites_ as being morphologically similar to _Glyptostrobus vacuipites_ from the Eocene Green River Shale of Colorado and Utah (described by Wodehouse in Wingate 1980). He kept it in the form-genus _Taxodiaceaepollenites_ because there was no evidence to support linking it to the modern genus. _T. vacuipites_ is larger than _T. hiatus_ and has folds in the exine parallel to the dehiscence (Wingate, 1980).

It is very rare (1-3 specimens/sample) but present in all strata at Maud Bight and Cape Hay.

Genus _Araucariacites_ Cookson, 1947 ex Couper 1953

Type Species: _Araucariacites australis_ Cookson, 1947.

Araucariacites australis Cookson, 1947

Figure 51.

Synonymy:

1958 _Araucariacites australis_ Couper, p. 151, pl. 27, figs. 3-5.

1963 Araucariacites australis Cookson; Dettmann, p. 105-106, pl. 26, fig. 15.

1971 Araucariacites australis Cookson; Singh, p. 156, pl. 22, fig.4

1974 Araucariacites australis Cookson; Hopkins, p. 22, pl. 5, fig. 66.

1975 Araucariacites australis Cookson; Brideaux and McIntyre, p. 17, pl. 4, fig. 15.

1980 Araucariacites australis Cookson; Wingate, p. 37, pl. 13, fig. 14.

1989 Araucariacites australis Cookson; Burden and Hills, p. 40, pl. 14, fig. 19.

Age and Distribution: Cosmopolitan. Jurassic to Tertiary (Singh, 1971).

Remarks: This species is very rare (1-3 specimens/sample) but present in all strata.

Genus Sequioapollenites Thiergart, 1938

Type Species: Sequioapollenites polyformosus Thiergart, 1938.

Sequioapollenites paleocenicus Stanley, 1965

Figure 52.

Synonymy:

1965 _Sequioapollenites_ _paleocenicus_ Stanley,p. 283, pl. 38, figs. 8-11.

1971 _Sequioapollenites_ _paleocenicus_ Stanley; Srivastava, p. 241, pl. 8, fig.2.

1989 _Sequioapollenites_ _paleocenicus_ Stanley; Waterfield, p. 126, pl. 4, fig. 16.

1990 _Sequioapollenites_ _paleocenicus_ Stanley; Burden and Langille, pl. 3, fig. 10.

Age and Distribution: Mid Campanian of southern Alberta (Jarzen, 1982); mid to upper Campanian, Judith River Formation, Saskatchewan (Eberth _et_ _al._, 1990); Paleocene of South Dakota (Stanley, 1965); Paleocene of Naheola Formation, Alabama (Srivastava, 1971); Paleocene of S.E. Baffin Island (Burden and Langille, 1990); Maastrichtian? to Paleocene strata of Eclipse Trough, Bylot Island (Waterfield, 1989).

Remarks: This rare species occurs in the uppermost Sermilik, Navy Board and Aktineq Formations (1-4 specimens/sample).

The pollen is found in association with the _Metasequoia_ needles in the Maud Bight Member of the Aktineq Formation. _Metasequoia_ is found in floras of late Cretaceous and

Tertiary age (Tidwell, 1975).

Monosaccate Pollen

Genus Cerebropollenites Nilsson, 1958

Type Species: Cerebropollenites mesozoicus (Couper) Nilsson, 1958.

Cerebropollenites mesozoicus (Couper) Nilsson, 1958

Figure 53.

Synonymy:

1966 Cerebropollenites mesozoicus (Couper) Nilsson; Burger, p. 261, pl. 27, fig. 4, pl, 28, fig. 1.

1971 Cerebropollenites mesozoicus (Couper) Nilsson; Singh, p. 172, pl. 25, fig. 7.

1975 Cerebropollenites mesozoicus (Couper) Nilsson; Brideaux and McIntyre, p. 16, pl. 3, fig. 35, 36.

1977 Cerebropollenites mesozoicus (Couper) Nilsson; Dörhöfer and Norris, p. 88, pl. 1, fig. 3.

1980 Cerebropollenites mesozoicus (Couper) Nilsson; Wingate, p. 40, pl. 15, fig. 5.

1989 Cerebropollenites mesozoicus (Couper) Nilsson;

Burden and Hills, p. 41-42, pl. 15, figs. 12-14.

Age and Distribution: Cosmopolitan. Jurassic and Cretaceous (Singh, 1971).

Remarks: This species is very rare and found only in subzone R of the Bylot Island Formation near Cape Hay.

Bisaccate Pollen

Genus Podocarpidites Cookson, 1947, ex Couper 1953

Note: specimens identifiable only to Genus Podocarpidites were grouped as Podocarpidites sp. on the range chart.

Type Species: Podocarpidites ellipticus Cookson, 1947.

Podocarpidites ellipticus Cookson, 1947

Figure 54.

Synonymy:

1962 Podocarpidites cf. P. ellipticus Cookson; Pocock, p. 65, pl. 10, figs. 153-156.

1964 *Podocarpidites* sp. cf. *ellipticus* Cookson; Singh, p. 115-116, pl. 15, fig. 11.

1971 *Podocarpidites* sp. cf. *ellipticus* Cookson; Singh, p. 162, pl. 22, fig. 13.

1981 *Podocarpidites* *ellipticus* Cookson; Srivastava, p. 8, pl. 10, fig. 1.

1989 *Podocarpidites* sp. cf. *ellipticus* Cookson; Burden and Hills, p. 43, pl. 16, fig. 14.

Age and Distribution: Cosmopolitan. Jurassic and Cretaceous (Singh, 1971; Burden and Hills, 1989).

Remarks: Srivastava (1975) considers *P. multesimus*, *P. ellipticus* and *P. biformis* to be conspecific, with *P. ellipticus* being senior synonym, because of similar morphologies and overlapping size ranges. More recently, Burden and Hills (1989) keep the species separate, presumably not noting any morphological gradation. Two distinct species were identified in this study; *P. ellipticus* and *P. multesimus*.

P. ellipticus is very rare but occurs in all formations.

Podocarpidites multesimus (Bolkhovitina) Pocock, 1962

Figure 55.

Synonymy:

1964 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; Singh, p. 116, pl. 15, figs. 12,13.

1971 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; Singh, p. 166, pl. 24, fig. .

1973 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; B.D. Tschudy, p. 16, pl. 7, figs. 1,2.

1975 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; Brideaux and McIntyre, p. 16, pl 4, figs. 3,4.

1980 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; Wingate, p. 38, pl. 14, fig. 7,8.

1989 _Podocarpidites multesimus_ (Bolkhovitina) Pocock; Burden and Hills, p. 43, pl. 16, fig. 14.

Age and Distribution: Cosmopolitan. Jurassic and Cretaceous (Singh, 1971). Sparkes (1989) reports _P. multesimus_ is rare in Bylot Island and Sermilik strata at Eclipse Trough.

Remarks: This species is rare but present in all strata (1-5 specimens/samples).

Genus *Pityosporites* Seward emend. Manum, 1960

Type Species: *Pityosporites* *antarcticus* Seward, 1914.

Note: Specimens identifiable to genus are classified as *Pityosporites* sp. in the range chart.

Pityosporites *alatipollenites* (Rouse) Singh, 1964

Figure 56.

Synonymy:

1964 *Pityosporites* *alatipollenites* (Rouse) Singh, p. 123, pl. 16, fig. 10.

1971 *Pityosporites* *alatipollenites* (Rouse) Singh; Singh, p. 173, pl. 25, fig. 9.

1973 *Pityosporites* *alatipollenites* (Rouse) Singh; B.D.Tschudy, p. 15, pl. 6, fig. 1.

1989 *Pityosporites* *alatipollenites* (Rouse) Singh; Burden and Hills, p. 43, pl. 16, fig. 15.

Age and Distribution: Upper Jurassic to upper Cretaceous of

Western Canada (Singh, 1971); upper Campanian in the Judith River Formation of Montana (B.D. Tschudy, 1973); Albian of S.E. Baffin Island (Langille, 1987); upper Campanian and Maastrichtian (Bylot Island and Sermilik Formations) in Eclipse Trough, Bylot Island (Sparkes, 1989 and Waterfield, 1989).

Remarks: It is very rare but present in all strata.

Pityosporites constrictus Singh, 1964

Figure 57.

Synonymy:

1964 *Pityosporites constrictus* Singh, p. 122, pl. 16, figs. 8,9.

1966 *Pityosporites constrictus* Singh; Srivastava, p. 524, pl. 6, fig. 2.

1967 *Pityosporites constrictus* Singh; Srivastava, p. 140, pl. 2, fig. M.

1971 *Pityosporites constrictus* Singh; Singh, p. 174, pl. 25, fig. 10.

1973 *Pityosporites* sp. cf. *P. constrictus* Singh; B. D. Tschudy, p. 15, pl. 5, fig. 9.

1980 *Pinuspollenites constrictus* (Singh) Wingate, p. 40, pl. 15, figs. 6,7.

1989 Pityosporites constrictus Singh; Burden and Hills, p. 43, pl. 16, 17.

Age and Distribution: Lower Cretaceous of Western Canada (Burden and Hills, 1989); Albian strata in Oklahoma (Wingate, 1980); upper Campanian of the Judith River Formation in Montana (B.D. Tschudy, 1973); upper Campanian and Maastrichtian strata (Bylot Island and Sermilik Formations) in Eclipse Trough (Sparkes, 1989 and Waterfield, 1989).

Remarks: It is rare and occurs in the Bylot Island, Sermilik and Navy Board Formations.

Pityosporites elongatus (Norton) Norton and Hall, 1969

Figure 59.

Synonymy:

1969 Pityosporites elongatus (Norton) Norton and Hall, p. 27, pl. 4, fig. 1.

1973 Pityosporites elongatus var. elongatus (Norton) B. D. Tschudy, p. 15, pl. 6, fig. 2-4.

1989 Pityosporites elongatus (Norton) Norton and Hall;

Waterfield, p. 114, pl. 4, fig. 4

Age and Distribution: Upper Cretaceous and Paleocene of Hell Creek Formation, Montana (Norton and Hall, 1969), upper Campanian of the Judith River Formation, Montana (B.D. Tschudy, 1973); Maastrichtian and Paleocene strata of Eclipse Trough strata (Waterfield, 1989).

Remarks: It is present in all formations (1-27 specimens/sample).

Pityosporites deweyensis (Ting) n. comb.

Figure 62.

Synonymy:

1968 Pinus deweyensis Ting, p. 574-576, pl. 2, figs. 7,8

Age and Distribution: Eocene and Oligocene strata in Idaho (Ting, 1968).

Remarks: Keeping with the practice of using fossil instead of modern nomenclature for fossil species, these are included in genus Pityosporites.

P. deweyensis is infrequent in the Navy Board and Aktineq Formations (1-10 specimens/sample). The range of this species is extended into the Paleocene based in its occurrence in the Navy Board and Aktineq Formations.

Genus *Abiespollenites* Thiergart, 1937 emend. Potonié, 1958

Type Species: *Abiespollenites absolutus* Thiergart, 1937.

Abiespollenites sp.

Figure 58.

Synonymy:

1971 *Abiespollenites* sp.; Singh, p. 168, pl. 24, fig. 8.

1989 *Abiespollenites* sp.; Burden and Hills, p. 43, pl. 17, fig. 1.

Age and Distribution: Cosmopolitan. Cretaceous and Tertiary.

Remarks: Specimens fit Singh's description (1971). *Abiespollenites* sp. is rare (1-6 specimens/sample) but occurs in all formations.

Genus *Alisporites* Daugherty emend. Jansonius, 1971

Type Species: <u>Alisporites</u> <u>opii</u> Daugherty, 1941.

<u>Alisporites</u> <u>bilateralis</u> Rouse, 1959

Figure 61.

Synonymy:

1962 <u>Alisporites</u> <u>thomasii</u> (Couper) Pocock, p. 62, pl. 14, fig. 143.

1964 <u>Alisporites</u> <u>thomasii</u> (Couper) Pocock; Singh, p. 109, pl. 14, figs. 11,12.

1965 <u>Alisporites</u> <u>thomasii</u> (Couper) Pocock; McGregor, p. 24, pl. 7, fig. 39.

1966 <u>Alisporites</u> <u>thomasii</u> (Couper) Pocock; Burger, p. 259, pl 35, fig. 2.

1971 <u>Alisporites</u> <u>bilateralis</u> Rouse; Singh, p. 169, pl. 24, fig. 9.

1973 <u>Alisporites</u> <u>thomasii</u> (Couper) Pocock; B. D. Tschudy

1974 <u>Alisporites</u> <u>bilateralis</u> Rouse; McIntyre, pl. 14, fig. 38.

1975 <u>Alisporites</u> <u>bilateralis</u> Rouse; Brideaux and McIntyre, p. 16, pl. 3, fig. 32.

1976 <u>Alisporites</u> <u>bilateralis</u> Rouse; Scott, p. 592, pl. 9, fig. 5.

1989 <u>Alisporites</u> <u>bilateralis</u> Rouse; Burden and Hills, p. 44, pl. 17, fig. 4,5.

Age and Distribution: Cosmopolitan. Upper Jurassic to Cenomanian (Singh, 1971 and B. D. Tschudy, 1973).

Remarks: This species is found in all strata (4-10 specimens/sample and 25 specimens in one case).

<u>Alisporites</u> <u>grandis</u> (Cookson) Dettmann, 1963

Figure 60.

Synonymy:

1957 <u>Alisporites</u> <u>rotundus</u> Rouse, p. 371, pl. 1, figs. 15,16.

1962 <u>Alisporites</u> <u>rotundus</u> Rouse; Pocock, p. 61-62, pl. 9, figs. 140-141.

1964 <u>Alisporites</u> <u>rotundus</u> Rouse; Singh, p. 110, pl. 14, figs. 13,14; pl. 15, figs. 1,2.

1966 <u>Alisporites</u> <u>grandis</u> (Cookson) Dettmann; Srivastava, p. 524, pl. 6, figs. 4,5,7 and 10.

1971 <u>Alisporites</u> <u>grandis</u> (Cookson) Dettmann; Singh, p. 170, pl. 25, figs. 1,2.

1973 <u>Alisporites</u> <u>grandis</u> (Cookson) Dettmann; B.D. Tschudy, p. 14, pl. 5, figs. 2,.

1980 <u>Alisporites</u> <u>grandis</u> (Cookson) Dettmann; Wingate, p.

39, pl. 15, fig. 1.

1989 _Alisporites_ _grandis_ (Cookson) Dettmann; Burden and Hills, p. 44, pl. 17, fig. 3.

Age and Distribution: Cosmopolitan. Upper Jurassic to Tertiary (Wilson, 1978).

Remarks: Rare; (2-4 specimens/sample).

Genus _Vitreisporites_ Leschik, 1955

Type Species: _Vitreisporites_ _signatus_ Leschik, 1955.

Vitreisporites _pallidus_ (Reissinger) Nilsson, 1958

Figure 63.

Synonymy:

1958 _Caytonipollenites_ _pallidus_ (Reissinger) Couper, p. 150, pl. 26, figs. 7,8.

1964 _Vitreisporites_ _pallidus_ (Reissinger) Nilsson; Singh, p. 102, pl. 14, fig. 1.

1971 _Vitreisporites_ _pallidus_ (Reissinger) Nilsson; Singh, p. 154, pl. 22, fig. 1.

1973 _Vitreisporites_ _pallidus_ (Reissinger) Nilsson; Hopkins and Balkwill, p. 16, pl. 2, fig. 34.

1973 _Vitreisporites_ _pallidus_ (Reissinger) Nilsson;

Stone, p. 78, pl. 15, fig. 84.

1974 *Vitreisporites pallidus* (Reissinger) Nilsson; Hopkins, p. 21, pl. 5, figs. 5,6.

1978 *Vitreisporites pallidus* (Reissinger) Nilsson; Wilson, p. 124,125, pl. 5, figs. 13,14.

Age and Distribution: This species is cosmopolitan and has a Jurassic to Cretaceous range.

Remarks: *V. pallidus* is very rare and occurs in the Bylot Island Formation.

Genus *Cedripites* Wodehouse, 1933

Type Species: *Cedripites eocenicus* Wodehouse, 1933.

Cedripites canadensis Pocock, 1962

Figure 64.

Synonymy:

1962 *Cedripites canadensis* Pocock, 63, pl. 10, fig. 49, 50.

1964 *Cedripites canadensis* Pocock; Singh, p. 112, pl. 15, fig. 6.

1967 *Cedripites canadensis* Pocock; Norris, p. 102, pl. 15, figs. 149, 150.

1971 Cedripites canadensis Pocock; Singh, p. 171, pl. 25, figs. 4,5.

1975 Cedripites canadensis Pocock; Brideaux and McIntyre, p. 16, pl. 3, fig. 37.

1989 Cedripites canadensis Pocock; Burden and Hills, p. 45, pl. 17, figs. 11,12.

Age and Distribution: Barremian to Albian of Western Canada (Burden, 1982). It is the most common bisaccate taxon in upper Campanian and Maastrichtian strata (Bylot Island and Sermilik Formations) at Eclipse Trough (Sparkes, 1989).

Remarks: It is common (5-19 specimens/sample).

Genus Pristinuspollenites B.D. Tschudy, 1973

Type Species: Pristinuspollenites microsaccus B.D. Tschudy, 1973.

Pristinuspollenites microsaccus B.D. Tschudy, 1973

Figure 65.

Synonymy:

1962 Alisporites sp. cf. microsaccus (Couper) Pocock, p. 61, pl. 9, figs. 138,139.

1965 ?Pteruchisporites microsaccus Couper; McGregor, pl. 7, fig. 31.

1973 Pristinuspollenites microsaccus (Couper) B.D. Tschudy, p. 17-18, pl. 7, figs. 4-6.

1987 Pristinuspollenites microsaccus (Couper) B.D. Tschudy; Langille, p. 94-95, pl. 5, fig. 14.

1989 Pristinuspollenites microsaccus (Couper) B.D. Tschudy; Burden and Hills, p. 45, pl. 17, figs. 14, 15.

Age and Distribution: Upper Jurassic and Cretaceous worldwide (Burden, 1982).

Remarks: It is very rare and occurs only in the Bylot Island and Sermilik Formations.

Monosulcate Pollen

Genus Clavatipollenites Couper, 1958

Type Species: Clavatipollenites hughesii Couper, 1958.

Clavatipollenites hughesii Couper, 1958

Figure 66.

Synonymy:

1958 Clavatipollenites hughesii Couper, p. 159-160, pl. 31, figs. 19-22.

1967 Clavatipollenites hughesii Couper; Norris, p. 106, pl.16, fig. 20.

1971 Clavatipollenites hughesii Couper; Singh, p. 181, pl. 27, figs. 1-3.

1975 Clavatipollenites hughesii Couper; Brideaux and McIntyre, p. 17, pl. 4, fig. 30.

1977 cf. Clavatipollenites hughesii Couper; Doyle and Robbins, pl. 1, figs. 1-3, 20,21; pl. 3, figs. 1,2.

1989 Clavatipollenites hughesii Couper; Burden and Hills, p. 79, pl. 19, fig. 1,2.

Age and Distribution: Barremian-Aptian, England (Couper, 1958); Albian, Peace River area, Alberta (Singh, 1971); Barremian? to Cenomanian strata, Atlantic Coastal Plain (Doyle and Robbins, 1977); Albian, Horton River area, N.W.T. (Brideaux and McIntyre, 1975); Albian?-Cenomanian, lower Colorado Group, Central Alberta (Norris, 1967).

Remarks: C. hughesii has a size range 18-(20)-29 by 15-(18)-20 µm (Couper, 1958); specimens in this study were 26x19 µm.

C. hughesii is very rare and found only in the Sermilik Formation.

Genus Liliipollis Krutzsch, 1970

Type Species: Liliipollis liliioides Krutzsch, 1970.

Liliipollis sp. 1

Figure 67.

Synonymy:

1986 Liliipollis sp. Farabee and Canright, p. 53, pl. 19, figs. 6,7.

1989 Liliipollis sp. 1? Sparkes, p. 88-89, pl. 4, fig. 12.

Age and Distribution: It occurs in the upper Campanian and Maastrichtian Bylot Island and Sermilik Formations of Eclipse Trough (Sparkes, 1989) and Maastrichtian of the Lance Formation, Wyoming (Farabee and Canright, 1986).

Remarks: Liliipollis sp. of Farabee and Canright (1986) consists of a monosulcate, fusiform grain with a sulcus that extends the entire length of grain. The exine is two layered and the nexine appears thin with the sexine being baculate with baculae arranged in a crotonoid reticulum pattern. Grains in their study were 30x18 µm. Sparkes' (1989) specimens are morphologically similar but somewhat larger; 38 (42) 44 x 22 (24) 25) µm. There was a single specimen found in the upper strata of the Sermilik Formation. It is 33µm in length and 20 µm in width.

The specimen in this study resembles those described by

Farabee and Canright (1986). Grains studied by Sparkes extend the size range of this species to 30-44 x 18-25 µm.

Genus _Liliacidites_ Couper, 1953

Type Species: _Liliacidites kaitangataensis_ Couper, 1953.

Liliacidites leei Anderson, 1960

Figure 68.

Synonymy:

1973 _Liliacidites leei_ Anderson; Stone, p. 83, pl. 17, fig. 96.

1986 _Liliacidites leei_ Anderson; Farabee and Canright, p. 52, pl. 19, figs. 1,2.

Age and Distribution: Campanian, Almond Formation (Stone, 1973); Maastrichtian, Lance Formation, Wyoming (Farabee and Canright, 1986); upper Cretaceous to lower Paleocene strata, San Juan Basin, New Mexico (Anderson _in_ Farabee and Canright, 1986).

Remarks: It is very rare with 1-3 specimens/sample recovered from the Bylot Island, Sermilik and Aktineq Formations.

Genus Cycadopites Wodehouse, 1933, ex Wilson and Webster, 1946.

Type Species: Cycadopites follicularis Wilson and Webster, 1946.

Cycadopites follicularis Wilson and Webster, 1946

Figure 69.

Synonymy:

1964 Cycadopites fragilis Singh, p. 103, pl. 14, fig. 2.

1965 Cycadopites follicularis Wilson and Webster; McGregor, p. 26, pl. 8, fig. 24.

1966 Cycadopites follicularis Wilson and Webster; Srivastava, p. 518, pl. 5, figs. 5-7.

1973 Cycadopites follicularis Wilson and Webster; Stone, p. 76, pl. 15, fig. 78.

1978 Cycadopites follicularis Wilson and Webster; Wilson, p. 129, pl. 7, fig. 4.

1980 Gingkocycadophytus nitidus (Balme) de Jersey; Wingate , p. 36, pl. 13, fig. 12.

1980 Cycadopites follicularis Wilson and Webster; Bebout, pl. 2, fig. 5.

1983 Cycadopites follicularis Wilson and Webster; Fensome, p. 553, pl. 21, figs. 4,6.

1987 Cycadopites follicularis Wilson and Webster; Langille, p. 96, pl. 6, fig. 1.

Age and Range: Cosmopolitan. Late Paleozoic to Cenozoic (Fensome, 1983).

Remarks: Entylissa Balme differs from Cycadopites by having a sulcus which widens and merges with the outline of the body at the end of the grain, also, Entylissa has a granulate to scabrate sculpture while Cycadopites is psilate (Singh, 1971). Fensome (1983) states that Cycadopites has a variable morphology, being elongate to subspheroidal, and has sculpture ranging from psilate to scabrate or granulate. He stated that Gingkocycadophytus (Balme) de Jersey (Entylissa) and Cycadopites were just gradational end members and therefore the senior synonym (Cycadopites) should stand. While some sculptural and morphological variation did occur, the two taxa appear to be separate entities in the Maud Bight strata and are reported as such.

C. follicularis is common in all strata, with 5-15 specimens in most samples and as high as 23 specimens in one sample.

Genus Entylissa Naumova, 1939, ex Ishchenko, 1952

Type Species: Entylissa caperatus (Luber) Potonié and Kremp, 1954.

Entylissa nitidus Balme, 1957

Figure 70.

Synonymy:

1962 *Gingkocycadophytus nitidus* (Balme) de Jersey, p. 12, pl. 5, figs. 1-3.

1963 *Gingkocycadophytus nitidus* (Balme) de Jersey; Dettmann, p. 104, pl. 26, figs. 8,9.

1971 *Gingkocycadophytus nitidus* (Balme) de Jersey; Singh, p. 155, pl. 22, fig. 3.

1980 *Cycadopites* sp.; Wingate, p. 36, pl. 13, fig. 11.

1989 *Entylissa nitidus* Balme; Burden and Hills, p. 340, pl. 30, figs. 4,5.

Age and Distribution: Cosmopolitan. Triassic to Cretaceous (Singh, 1971).

Remarks: This species is rare, but found in all strata (1-4 specimens/sample).

Tricolpate Pollen

Genus *Tricolpites* Cookson ex Couper 1953 emend.

Potonié 1960

Type Species: Tricolpites reticulatus Cookson, 1947.

Tricolpites hians Stanley, 1965

Figure 71.

Synonymy:

1965 Tricolpites hians Stanley, p. 321, pl. 47, figs. 24-27.

1968b Tricolpopollenites hians (Stanley) Elsik, p. 622, pl. 24, figs. 11-14.

1978 Tricolpites hians Stanley; Wilson, pl. 9, figs. 5,6.

1984 Tricolpites hians Stanley; Gaponoff, p. 6, pl. 4, figs. 12-14.

1986 Tricolpites hians Stanley; Farabee and Canright, p. 66, pl. 22, figs. 16-20.

Age and Distribution: Campanian to Paleocene in the Yukon Territory (Wilson, 1978); Maastrichtian in Lance Formation, Wyoming (Farabee and Canright, 1986); Paleocene in South Dakota and Texas (Stanley, 1965; Elsik, 1968b); upper Paleocene Silverado Formation, California (Gaponoff, 1984). Maastrichtian and Paleocene strata in Eclipse Trough (Waterfield, 1989).

Remarks: It is a rare component (1-5 specimens/sample) present in all but the R subzone of the Bylot Island Formation.

Tricolpites parvus Stanley, 1965

Figure 72.

Synonymy:

1965 Tricolpites parvus Stanley, p. 322, pl. 47, figs. 28-31.

1968b Tricolpites hians Stanley; Elsik, p. 622-623, pl. 23, figs. 13-19.

1971 Tricolpites parvus Stanley; Singh, p. 210-211, pl. 32, figs. 12-17.

1972c Tricolpites parvus Stanley; Srivastava, pl. 25, figs. 5-18.

1973 Tricolpites parvus Stanley; Chmura, p. 111, pl. 23, fig. 1.

1986 Tricolpites parvus Stanley; Farabee and Canright, p. 68-69, pl. 24, figs. 2,3.

Age and Distribution: This species occurs in the Albian of the Peace River area, Alberta (Singh, 1971); Campanian to Maastrichtian, San Joaquin Valley, California (Chmura, 1973);

Maastrichtian of the Lance Formation, Wyoming (Farabee and Canright, 1986); Paleocene of South Dakota,Texas and Alabama (Stanley, 1965; Elsik, 1968b; Srivastava, 1972c).

Remarks: _T. parvus_ is a rare component (1-6 specimens/sample) present in all but the R subzone of the Bylot Island Formation.

Genus _Rousea_ Srivastava, 1969

Type Species: _Rousea subtillis_ Srivastava, 1969.

Rousea georgensis ? (Brenner) Dettmann, 1973

Figure 73.

Synonymy:

1967 _Retitricolpites georgensis_ Brenner; Norris, p. 108, pl. 18, figs. 1-4.

1968 _Retitricolpites georgensis_ Brenner; Hedlund and Norris, p. 145, pl. 6, figs. 1,3.

1971 _Retitricolpites georgensis_ Brenner; Singh, p. 200, pl. 30, figs. 1-6.

1971 _Retitricolpites georgensis_ Brenner; Playford, p. 561, pl. 107, figs. 11,12.

1973 _Retitricolpites georgensis_ Brenner; Burger, p. 7, pl. 3, figs. 2-4.

1975 Retitricolpites georgensis Brenner; Brideax and McIntyre, p. 17, pl. 4, figs. 31,32.

1975 Rousea georgensis (Brenner), Dettmann; Srivastava, p. 92, pl. 43, figs. 10,11.

1980 Tricolpites sp. cf. Retitricolpites georgensis Brenner; Wingate, p. 45, pl. 17, figs. 3,4.

1981 Rousea georgensis (Brenner), Dettmann; Srivastava, p. 27, pl. 11, fig. 3.

1988 Rousea georgensis (Brenner), Dettmann; Sweet and McIntyre, p. 506, fig. 7, No. 15,16.

Age and Distribution: Albian of Peace River area, Alberta (Singh, 1971); Albian of the Swan River Group, Saskatchewan and Manitoba (Playford, 1971); Albian of Horton River area, District of Mackenzie, N.W.T. (Brideaux and McIntyre, 1975); upper Turonian, Alberta Foothills (Sweet and McIntyre, 1988). Sparkes (1989) reports R. georgensis from upper Campanian and Maastrichtian strata (Bylot Island and Sermilik Formations) in Eclipse Trough.

Remarks: It is very rare; single specimens were found in the Bylot Island and Sermilik Formations. The orientation of the specimens is not ideal for absolute identification.

Genus *Striatopollis* Krutzsch, 1959

Type Species: *Striatopollis sarstedtensis* Krutzsch, 1959.

Striatopollis tectatus Leffingwell, 1971

Figure 74.

Synonymy:

1986 *Striatopollis tectatus* Leffingwell; Farabee and Canright, p. 64, pl. 22, figs. 5,6.

Age and Distribution: *S. tectatus* is reported from the Maastrichtian Lance Formation, Wyoming (Farabee and Canright, 1986).

Remarks: *Striatopollis* is distinct from *Simpsonipollis* Srivastava and *Aesculidites* Elsik in lacking pores (*Simpsonipollis*) and circumpolar sculpturing or colporae (*Aesculidites*). This species is very rare (1-4 specimens/sample) and restricted to the Navy Board and Aktineq Formations.

Genus *Fraxinoipollenites* Potonié ex Potonié, 1960

Type Species: *Fraxinoipollenites pudicus* (Potonié) Potonié, 1960.

Fraxinoipollenites variabilis Stanley, 1965

Figure 75.

Synonymy:

1965 Fraxinoipollenites variabilis Stanley, p. 306, pl. 45, figs. 29-35.

1971 Fraxinoipollenites variabilis Stanley; Leffingwell, p. 45, pl. 8, figs. 8-10.

1972 Fraxinoipollenites variabilis Stanley; Rouse and Srivastava, p. 1178, figs. 71-73.

1973 Fraxinoipollenites variabilis Stanley; Stone, p. 88, pl. 18, figs. 116, 117.

1975 Fraxinoipollenites variabilis Stanley; Srivastava, p. 88, pl. 42, figs. 3-5.

1981 Fraxinoipollenites variabilis Stanley; Srivastava, pl. 10, figs. 9,10.

1986 Fraxinoipollenites variabilis Stanley; Farabee and Canright, p. 49, pl. 18, fig. 1.

Age and Distribution: This species is reported from the upper Campanian Almond Formation, Wyoming (Stone, 1973); Maastrichtian, Lance Formation, Wyoming (Farabee and Canright, 1986); Paleocene, Fort Union Formation, South Dakota and Wyoming (Stanley 1965; Leffingwell, 1971) and Paleocene strata of the Bonnet Plume Formation, Yukon (Rouse and Srivastava, 1972). Sparkes (1989) reports it from the upper Campanian to Maastrichtian Bylot Island Formation in Eclipse Trough.

Remarks: F. variabilis is very rare (1-3 specimens/sample) and is found only in the Sermilik, Navy Board and Aktineq Formations.

Syncolpate Pollen

Genus Porosipollis Krutzsch, 1969

Type Species: Porosipollis porosus Krutzsch (Mchedlishvili) 1969.

Porosipollis porosus Krutzsch (Mchedlishvili) 1969.

Figure 76.

Synonymy:

1969 Porosipollis porosus Krutzsch, p. 407, pl. 1, figs. 10-14.

1974 Syncolpites porosus Mchedlishvili; McIntyre, p. 51, pl. 21, figs. 4,5.

1976 Syncolpites porosus Mchedlishvili; Doerenkamp et al., p. 407, pl. 2, figs. 1,2.

1989 Porosipollis porosus Krutzsch; Sweet et al., p. 94, pl. 1, fig. 29.

1989 Porosipollis porosus Krutzsch; Sparkes, p. 98-99, pl. 5, fig. 7.

Age and Distribution: Senonian and Paleocene of Siberia (Krutzsch, 1969); upper Campanian to mid Maastrichtian strata, Horton River, (McIntyre, 1974); lower to mid Maastrichtian strata, Kanguk Formation, Banks Island, N.W.T. (Doerenkamp *et al.*, 1976); and mid or upper Maastrichtian strata, Police Island, Mackenzie River, N.W.T. (Sweet *et al.*, 1989). Sparkes (1989) reports it from the Bylot Island and Sermilik Formations in Eclipse Trough.

Remarks: Sweet *et al.* (1989) define a *P. porosus* zone of mid or late Maastrichtian age at their Police Island section. This species is generally very rare but occurs in the Bylot Island, Sermilik and Aktineq Formations. Sample PB-113 from the Sermilik Formation contains 126 specimens. This anomaly is probably explained by the fact that the bed sampled is an ancient debris flow consisting of mud supported pebble size clasts and coaly fragments. Alternately a flower within the sample might yield a dominantly monospecific assemblage.

Tricolporate Pollen

Genus *Tricolporites* Cookson, 1947

Type Species *Tricolporites prolata* Cookson, 1947.

Tricolporites sp. 1

Figure 77.

Remarks: Specimens are tricolporate, prolate, 21x16 µm (equatorial view) in size and scabrate. The colpi are narrow slits extending the full length of the grain. There are protruding annuli surrounding pores which are about 4 µm in diameter. Exine is psilate and under 1 µm thick. The protruding annuli distinguish it from *Tricolporites.* sp. 2.

It is very rare (1-2 specimens/sample) and restricted to the Navy Board and Aktineq Formations.

Tricolporites sp. 2

Figure 78.

Remarks: Specimens are tricolporate and spindle shaped with the colpi extending the full length of the grain. Measurements of the specimens in equatorial view are 25-30 by

10-14 µm. The exine is 1-1.3 µm thick and psilate, although it often contains minute depressions (see photographed specimen).

This species is very rare (1-3 specimens/sample) and restricted to the Navy Board and Aktineq Formations.

Genus *Cranwellia* Srivastava emend. Srivastava, 1969

Type Species: *Cranwellia striata* (Couper) Srivastava, 1966.

Cranwellia striata (Couper) Srivastava, 1966

Figure 79.

Synonymy:

1966 *Cranwellia striata* (Couper) Srivastava, p. 537-538, pl. 11, figs. 1,4.

1970 *Cranwellia striata* (Couper) Srivastava; Takahashi, pl. 29, fig. 1a,1b.

1973 *Cranwellia striata* (Couper) Srivastava; Evitt, pl. 1, fig. 25.

1973 *Cranwellia striata* (Couper) Srivastava; Chmura, p. 132-133, pl. 28, figs. 3,4.

1974 *Cranwellia* sp., McIntyre, pl. 21, fig. 9,10.

1981 *Cranwellia striata* (Couper) Srivastava; Chlonova, pl. 2, fig. 5.

1986 *Cranwellia striata* (Couper) Srivastava; Farabee and

Canright, p. 44-45, pl. 16, figs. 3-11.

1988 *Cranwellia striata* (Couper) Srivastava; Fredericksen *et al.*, pl. 2, figs. 19,20.

Age and Distribution: Campanian to Maastrichtian strata, Western San Joaquin Valley, California (Chmura, 1973); Senonian strata, Siberia (Chlonova, 1981); Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1966); Maastrichtian, Japan (Takahashi, 1970); Maastrichtian, Lance Formation, Wyoming (Farabee and Canright, 1986) and Maastrichtian, North Slope, Alaska (Fredericksen *et al.*, 1988).

Remarks: This species is very rare with 1-4 specimens/sample in upper Sermilik strata and one specimen in the Navy Board Formation.

Cranwellia rumseyensis Srivastava, 1966

Figure 80.

Synonymy:

1966 *Cranwellia rumseyensis* Srivastava, p. 58, pl. 11, figs. 3,7.

1972 *Cranwellia rumseyensis* Srivastava; Rouse and

Srivastava, fig. 27.

1973 _Cranwellia_ _rumseyensis_ Srivastava; Stone, p. 88, pl. 18, figs. 118-119.

1978 _Cranwellia_ _rumseyensis_ Srivastava; Wilson, 135, pl. 8, figs. 7,12.

1986 _Cranwellia_ _rumseyensis_ Srivastava; Jerzykiewicz and Sweet, p. 1370, pl. 3, fig. 6.

1986 _Cranwellia_ _rumseyensis_ Srivastava; Sweet, p. 1379, pl. 1, fig. 10.

1990 _Cranwellia_ _rumseyensis_ Srivastava; Eberth _et_ _al._, pl. 1, fig. 12.

Age and Distribution: Upper Campanian, Almond Formation, Montana (Stone, 1973); upper Campanian to Maastrichtian, Fish River area, Yukon Territory (Wilson, 1978); Maastrichtian, Bonnet Plume Formation, Yukon Territory (Rouse and Srivastava, 1972); Maastrichtian, Alberta Foothills (Jerzykiewicz and Sweet, 1986).

Remarks: Three specimens were found in the Sermilik Formation.

Triporate Pollen

Genus Carpinipites Srivastava, 1966

Type Species: Carpinipites ancipites (Wodehouse) Srivastava, 1966.

Carpinipites ancipites (Wodehouse) Srivastava, 1966

Figure 81.

Synonymy:

1933 Carpinus ancipites Wodehouse, p. 510, fig. 42.

1966 Carpinus ancipites Wodehouse; Martin and Rouse, p. 197, pl. 8, figs. 74-76.

1967 Carpinipites ancipites (Wodehouse) Srivastava; Srivastava, p. 141, pl. 2, fig. R.

1971 Carpinipites ancipites (Wodehouse) Srivastava; Rouse et al., p. 236, pl. 8, figs. 12,15.

1978 Carpinipites ancipites (Wodehouse) Srivastava; Wilson, p. 142, pl. 10, fig. 2.

Age and Distribution: This species occurs in the upper Campanian to Maastrichtian, Lebo Formation, Yukon Territory (Wilson, 1978); upper Campanian to Paleocene (Bylot Island, Sermilik, Pond Inlet and Aktineq Formations) Eclipse Trough strata (Sparkes, 1989; Waterfield, 1989); Eocene, Burrard

Formation, Vancouver, B.C. (Rouse _et_ _al._, 1971).

Remarks: Wodehouse (1933) reports `_Carpinus_' is distinct in having "pores very slightly or not at all protruding, exine surrounding pores scarcely or not at all thickened." This species is infrequent and occurs in the Sermilik and Aktineq Formations (1-12 specimens/sample).

Genus _Caryapollenites_ Raatz ex Potonié 1960

emend. Krutzsch 1961

Type Species: _Caryapollenites_ _simplex_ Potonié and Venitz, 1934.

Caryapollenites sp. cf. _inelegans_

Figure 82.

Synonymy:

1978 _Caryapollenites_ _inelegans_ Nichols and Ott, p. 105-106, pl. 2, figs. 8,9.

1983 _Caryapollenites_ sp. cf. _inelegans_ Nichols and Ott; Wingate, p. 118, pl. 5, fig. 20.

1987 _Caryapollenites_ _inelegans_ Nichols and Ott; Pocknall, pl. 1, fig. 7.

1989 _Caryapollenites_ sp. 1; Waterfield, p.136, pl. 5, fig. 10.

Age and Distribution: _C._ _inelegans_ is reported from the Paleocene in the Wind River Basin, Wyoming (Nichols and Ott, 1978); upper Paleocene strata, central and southern Alberta (Demchuk, 1990) and Eocene Elko Formation, Nevada (Wingate, 1983). Waterfield (1989) recovered a single specimen resembling _C._ _inelegans_ from lower Paleocene strata in Eclipse Trough.

Remarks: According to Nichols and Ott (1978) _C._ _inelegans_ has a size range of 26-(31)-34 µm, while specimens assigned to _C._ sp. cf. _inelegans_ by Wingate (1983) had a range of 18-23 µm. Specimens in this study had a range of 21-27 µm. This species is rare in the Navy Board and Aktineq Formations (1-4 specimens/sample).

Genus _Paraalnipollenites_ Hills and Wallace, 1969

Type Species: _Paraalnipollenites_ _alterniporus_ (Simpson) Srivastava, 1975.

Paraalnipollenites _alterniporus_ (Simpson)

Srivastava, 1975

Figure 83.

Synonymy:

1967 Triatriopollenites confusus Zaklinskaia; Bratzeva, p. 123, pl. 1, fig. F.

1969 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace, p. 141, pl. 17, figs. 1-8.

1972 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Rouse and Srivastava, p. 1177, fig. 59.

1974 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; McIntyre, p. 53, pl. 22, fig. 14.

1977 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Rouse, p. 51, pl. 1, fig. 2.

1978 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Wilson, p. 144, pl. 10, fig. 25.

1983 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Wingate, p. 118, pl. 5, fig. 18.

1984 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Gaponoff, p. 98, pl. 7, figs. 10-11.

1986 Paraalnipollenites alterniporus (Simpson) Srivastava; Jerzykiewicz and Sweet, p. 1371, pl. 4, fig. 1.

1988 Paraalnipollenites confusus (Zaklinskaia) Hills and Wallace; Frederiksen et al., p. 521, pl. 1, figs. 8,9.

1989 Paraalnipollenites alterniporus (Simpson) Srivastava; Sweet et al., p. 98, pl. 2, fig. 10.

1989 <u>Paraalnipollenites</u> <u>alterniporus</u> (Simpson) Srivastava; McIntyre, p. 195, pl. 2, fig. 5.

Age and Distribution: <u>P.</u> <u>alterniporus</u> occurs in the Maastrichtian to Paleocene Eureka Sound Formation, Bathurst Island, N.W.T. (Hills and Wallace, 1969); upper Maastrichtian strata, Horton River, N.W.T. (McIntyre, 1974); Maastrichtian, Yukon Territory (Wilson, 1978); (upper Maastrichtian to Paleocene) Coalspur Formation, central Alberta (Jerzykiewicz and Sweet, 1986); mid Maastrichtian strata, Alaska's North Slope (Fredericksen <u>et</u> <u>al.</u>, 1988); upper Maastrichtian to Paleocene strata, Police Island, District of Mackenzie, N.W.T. (Sweet <u>et</u> <u>al.</u>, 1989); lower Paleocene, Bonnet Plume Formation, northeastern Yukon (Rouse and Srivastava, 1972); lower to mid Paleocene, Eureka Sound Formation, Ellesmere Island (Rouse, 1977); Paleocene, Silverado Formation, California (Gaponoff, 1984); Paleocene, Eureka Sound Group, Somerset Island, N.W.T. (McIntyre, 1989); and the Eocene Elko Formation of Nevada (Wingate, 1983). This species is rare in Eclipse Trough strata (Sparkes, 1989; Waterfield, 1989).

Remarks: Gaponoff (1984) noted this species has form variability ranging from the classic Normapolles with arci forming pseudopores to a form almost resembling

Trivestibulopollenites Pflug *in* Thomson and Pflug. This species is infrequent in Sermilik and common in Navy Board and Aktineq strata (4-16 specimens/sample).

Genus *Triatriopollenites* Pflug, 1953

Type Species: *Triatriopollenites rurensis* Pflug and Thomson, 1953.

Triatriopollenites rurensis Pflug and Thomson, 1953

Figure 84.

Synonymy:

1978 *Triatriopollenites rurensis* Pflug and Thomson; Schumacker-Lambry, pl. 13, figs. 4,8.

19891989 *Triatriopollenites rurensis* Pflug and Thomson; Sparkes, p. 106-107, pl. 5, fig. 16.

Age and Distribution: This species occurs in German Danian to Eocene strata (Thomson and Pflug *in* Jansonius and Hills, 1976); Paleocene strata of Belgium (Schumacker-Lambry, 1978) and the upper Campanian to Maastrichtian Bylot Island Formation, Eclipse Trough (Sparkes, 1989).

Remarks: Isolated specimens of *T. rurensis* occur in the Bylot

Island and Sermilik Formations but it becomes common (7-22 specimens/sample) in the Navy Board and Aktineq Formations.

Triatriopollenites costatus Norton, 1969

Figure 85.

Synonymy:

1969 Triatriopollenites costatus Norton in Norton and Hall, p. 40-41, pl. 5, fig. 19.

1973 Triatriopollenites costatus Norton; B.D. Tschudy, p. 31, pl. 11, figs. 4,5.

1975 Triatriopollenites costatus Norton; Jarzen and Norris, pl. 2, fig. 3.

1990 Triatriopollenites costatus Norton; Eberth et al., pl.1, figs. 20, 26.

Age and Distribution: Early Campanian, eastern Alberta (Jarzen and Norris, 1975); mid to upper Campanian Judith River Formation, Saskatchewan (Eberth et al., 1990); upper Campanian, Judith River Formation, Montana (B.D. Tschudy, 1973) and Maastrichtian to Paleocene, Hell Creek, Tullock and Lebo Formations, Montana (Norton and Hall, 1969).

Remarks: A single specimen was found in the upper strata of the Sermilik Formation.

Triatriopollenites sp.1

Figure 86.

Description: Grains are sub-spherical with protruding, annulate, isopolar, atriate germinals and average 24 µm in diameter (5 specimens measured). The exine is thin (1 µm) and psilate but thickens around the germinal (2.5 µm). The pore-canal index is approximately 0.14.

Remarks: The protruding germinal distinguishes it from *T. rurensis* and *T. costatus*. It resembles most *Triatriopollenites* sp. 1 (pl. 13, figs. 6,7) of Schumacker-Lambry (1978) which was recovered from Paleocene Belgian strata. This very rare species was only recovered from the Bylot Island Formation (1-2 specimens/sample).

Genus *Trivestibulopollenites* Pflug *in* Thomson and Pflug, 1953

Type Species *Trivestibulopollenites betuloides* Pflug *in* Thomson and Pflug, 1953.

Figure 87.

Synonymy:

1968 <u>Trivestibulopollenites</u> <u>betuloides</u> Pflug, <u>in</u> Thomson and Pflug; Nakoman, p. 538, pl. 4, figs. 27-30.

1978 <u>Betulaceoipollenites</u> sp., Christopher, p. 8, pl. 2, fig. 5.

1980 <u>Trivestibulopollenites</u> cf. <u>T.</u> <u>betuloides</u> Pflug <u>in</u> Thomson and Pflug; Bebout, pl. 5, fig. 7.

1986 Betulaceae-Myricaceae pollen, Jerzykiewicz and Sweet, p. 1370, pl. 3, fig. 3.

1986 <u>Trivestibulopollenites</u> <u>betuloides</u> Pflug, <u>in</u> Thomson and Pflug; Norris, p. 40, pl. 10, figs. 38-42.

in prep. <u>Trivestibulopollenites</u> <u>betuloides</u> Pflug, <u>in</u> Thomson and Pflug; Burden and Langille, pl. 4, fig. 10.

Age and Distribution: Maastrichtian, South Carolina (Christopher, 1978); upper Maastrichtian and Paleocene, central Alberta (Jerzykiewicz and Sweet, 1986); lower to mid Paleocene, Cape Searle Formation, Southeastern Baffin Island (Burden and Langille, in prep.); upper Oligocene and Pliocene, Mackenzie Delta, N.W.T. (Norris, 1986); upper Miocene, Turkey (Nakoman, 1968).

Remarks: Pflug (in Jansonius and Hills, 1976) describes T. betuloides as " 18-28 μm; amb subcircular to convexly triangular; labrum not very prominent; annulus and endannulus may be weakly developed; vestibulum small... exine smooth, up to 2 μm thick." It ranged from 19-(24)-27 μm in this study.

This species is rare in the Sermilik but becomes common in the Navy Board and Aktineq Formations (5-19 and in one case 28 specimens/sample).

Genus Momipites Frederiksen and Christopher, 1978

Type Species: Momipites coryloides Wodehouse, 1933.

Momipites wyomingensis Nichols and Ott, 1978

Figure 88.

Synonymy:

1978 Momipites wyomingensis Nichols and Ott, p. 100, pl. 1, figs. 1-4.

1986 Momipites wyomingensis Nichols and Ott; Farabee and Canright, p. 55, pl. 19, fig. 15.

1987 Momipites wyomingensis Nichols and Ott; Pocknall, pl. 1, fig. 3.

1989 Momipites wyomingensis Nichols and Ott; McIntyre, p. 195, pl. 1, fig. 3.

1989 Momipites wyomingensis Nichols and Ott; Sparkes, p.

105-106, pl. 5, fig. 15.

Age and Distribution: This species occurs in the Maastrichtian Lance Formation, Wyoming (Farabee and Canright, 1986); Paleocene, Fort Union Formation, Wind River Basin, Wyoming (Nicholls and Ott, 1978); and the upper Paleocene Eureka Sound Group, Somerset Island, N.W.T. (McIntyre, 1989). Sparkes (1989) reports it from the Sermilik Formation in Eclipse Trough (upper Campanian-upper Maastrichtian). Demchuk defined a lower Paleocene _M. wyomingensis_ zone for strata in central and south-central Alberta based on the first appearance of the taxon, which also occurred in late Paleocene strata.

Remarks: According to Nichols and Ott (1978), _M. wyomingensis_ is distinct from other _Momipites_ species; it has the simplest morphology, with a convex form and no exinal structures near its pores. They report a size range of 19-(24)-27 µm while Farabee and Canright (1986) report a smaller variance; 23-25.5 µm. In this study grains varied from 20-(24)-27 µm.

It is very rare and occurs only in the Navy Board and Aktineq Formations.

Genus _Triporopollenites_ Pflug and Thomson _in_ Pflug and Thomson, 1953

Type Species: Triporopollenites coryloides Pflug in Thomson and Pflug, 1953.

Triporopollenites mullensis (Simpson) Rouse and Srivastava, 1972

Figure 89.

Synonymy:

1972 Triporopollenites mullensis (Simpson) Rouse and Srivastava, fig. 61.

1988 Triporopollenites mullensis (Simpson) Rouse and Srivastava; Fredericksen et al., pl. 1, fig. 2.

1989 Triporopollenites mullensis (Simpson) Rouse and Srivastava; Dietrich et al., pl. 3, fig. 5.

1989 Triporopollenites mullensis (Simpson) Rouse and Srivastava; McIntyre, pl. 2, fig. 11.

Age and Distribution: Mid Maastrichtian to Paleocene, Colville River region, Alaska (Fredericksen et al., 1988); Paleocene, Bonnet Plume Formation, Northeastern Yukon (Rouse and Srivastava, 1972); Paleocene, Fish River and Aklak sequences, Beaufort Sea (Dietrich et al., 1989); upper Paleocene, Somerset Island, N.W.T. (McIntyre, 1989)

Remarks: It is rare in the Sermilik Formation and infrequent in the Navy Board and Aktineq Formations (averaging 5-15 specimens/sample and 27 specimens in one sample.

Genus *Complexiopollis* Krutzsch, 1959 emend. R.H. Tschudy, 1973.

Type Species: *Complexiopollis* *praeatumescens* Krutzsch, 1959

Complexiopollis sp.

Figure 90.

Age and Distribution: This genus ranges from the Cenomanian to Eocene (R.H. Tschudy, 1973).

Remarks: One specimen (21 µm in size) was found in the Navy Board FOrmation. It is partially obscured, limiting precise identification but its concavely triangular amb, elongate, structurally complex germinals and multilayered walls are characteristic of the genus *Complexiopollis* (Jansonius and Hills, 1976).

Genus *Pseudoplicapollis* Krutzsch, 1967

Type Species: *Pseudoplicapollis* *palaeocaenicus* Krutzsch, 1967.

Pseudoplicapollis *serenus* Tschudy, 1975

Figure 91.

Synonymy:

1975 *Pseudoplicapollis serenus* Tschudy, p. 22, pl. 13, figs. 8-12, text fig. 21.

1976 Pollen Type NC-2 Wolfe, p. 12, pl. 1, fig. 14.

1981 *Pseudoplicapollis serenus* Tschudy; Azema *et al.*, p. 267, pl. 6, fig. 9.

Age and Distribution: Santonian or Campanian strata near Vendée, France (Azema *et al.*, 1981); lower to upper Campanian strata, Middle Atlantic States, U.S.A. (Wolfe, 1976); and uppermost Campanian, Coffee Sand, Tennessee (R.H. Tschudy, 1975).

Remarks: Tschudy (1975) gives *P. serenus* a size range of 13.5-19 µm; the specimen in this study is 21 µm but is otherwise morphologically similar. A single specimen occurred in the Bylot Island Formation.

Genus *Trudopollis* Pflug emend. Krutzsch, 1967

Type Species: *Trudopollis pertrudens* (Pflug) Pflug, 1953.

Genus *Trudopollis conrector* Pflug, 1953

Figure 92.

Synonymy:

1961 *Trudopollis conrector* Pflug; Groot *et al.*, p. 137, pl. 26, fig. 52.

1981 *Trudopollis conrector* Pflug; Pacltova, p. 205, pl. 17, figs. 2, 2b, 2c.

1981 *Trudopollis conrector* Pflug; Mikhelis, p. 229, pl. 13, figs. 5-10.

1989 *Trudopollis conrector* Pflug; Sparkes, p. 108-109, pl 5, fig. 18.

Age and Distribution: Santonian, Magothy Formation, Eastern U.S.A. (Groot *et al.*, 1961); Santonian, Bohemian Massif, Eastern Europe (Pacltova, 1981); Campanian to Paleocene, Sea of Azov (Mikhelis, 1981). Sparkes (1989) reports this species from the Bylot Island Formation (late Campanian to late Maastrichtian), Eclipse Trough.

Remarks: Several specimens were recovered from the Bylot Island Formation.

Trudopollis ex. gr. *arector*

Figure 93.

Synonymy:

1981 Trudopollis ex. gr. arector Mikhelis, pl. 12, figs. 24-33.

Age and Distribution: It is reported from Campanian to Paleocene strata in the Sea of Azov area, Russia.

Remarks: Specimens recovered in this study resembled T. ex. gr. arector of Mikhelis (1981).

It is very rare; 2 specimens were found in the uppermost strata of the Sermilik Formation.

Genus Extratriporopollenites Pflug emend. Skarby, 1968

Type Species: Extratriporopollenites fractus Pflug, 1953.

Extratriporopollenites sp. 2 of McIntyre, 1974

Figure 94.

Synonymy:

1974 Extratriporopollenites sp. 2 McIntyre (pars) p. 52, pl. 2, figs. 3,4 only.

1989 Extratriporopollenites sp. 2 of McIntyre; Sparkes, p. 111-112, pl. 6, fig. 3.

Age and Distribution: Early to mid Maastrichtian, Horton River, N.W.T. (McIntyre, 1974); upper Campanian to upper

Maastrichtian (Bylot Island and Sermilik Formations), Eclipse Trough, Bylot Island (Sparkes, 1989).

Remarks: It is very rare; several specimens were recovered from the Sermilik, Navy Board and Aktineq Formations.

Normapolles sp. 1

Figure 95.

Remarks: The single specimen recovered is a large (56 µm in diameter) triporate grain with a convex triangular form and protruding pores. The simple pore openings are 17 µm in diameter while the exine around the pores is faintly striate parallel to the pore opening. The exine thins towards the germinals and reaches a maximum thickness of approximately 1.5 µm. The grain is torn and corroded likely contributing to the pitted appearance of the exine. It superficially resembles *Jussiaea champlainensis* Traverse (pl. 1, figs. 13,14 of Doerenkamp *et al.*, 1976) and *Corsinipollenites* sp. (card 613 Jansonius and Hills, 1976 and pl. 6, figs. 21-23 and pl. 7, figs. 1-3, Wilkinson and Boulter, 1980) but lacks their pore structure which consists of a complex annular thickening of the endexine enveloped by ectexine which appears to almost separate the pore structure from the body.

A single specimen was found in the Sermilik Formation.

Stephanoporate Pollen

Genus Polyvestibulopollenites Pflug, 1953

Type Species: Polyvestibulopollenites verus (Potonié) Thomson and Pflug, 1953.

Polyvestibulopollenites verus (Potonié) Thomson and Pflug, 1953.

Figure 96.

Synonymy:

1966 Alnipollenites quadrapollenites (Rouse) Srivastava, p. 50, pl. 7, fig. 3.

1967 Alnipollenites quadrapollenites (Rouse) Srivastava; Srivastava, p. 141, pl. 2, fig. 5.

1968 Polyvestibulopollenites verus (Potonié) Thomson and Pflug; Nakoman, pl. 5, figs. 3-5.

1968b Alnus verus Martin and Rouse; Elsik, p. 606, pl. 17, figs. 1-3.

1969 Alnus verus (Potonié) Martin and Rouse: Hopkins, p. 1118, pl. 7, figs. 76-83.

1969 Alnipollenites verus Potonié; Norton and Hall, p. 42, pl. 5, fig. 26.

1969 Alnipollenites verus Potonié; Oltz, p. 140, pl. 41, fig. 98.

1971 Alnipollenites verus Potonié; Felix and Burbridge, p. 15, pl. 3, fig. 25.

1973 Alnipollenites quadrapollenites (Rouse) Srivastava; Stone, p. 97, pl. 20, fig. 147.

1978 Polyvestibulopollenites verus (Potonié) Thomson and Pflug; Wilson, p. 145-146, pl. 11, figs. 9,10.

1980 Polyvestibulopollenites sp. Wilkinson and Boulter, p. 66, pl.10, figs. 30-36, pl. 11, figs. 1-13.

1983 Alnipollenites verus Potonié; Wingate, p. 122, pl. 6, figs. 20,21.

1984 Polyvestibulopollenites verus (Potonié) Thomson and Pflug; Gaponoff, p. 99, pl. 6, fig. 10.

1986 Polyvestibulopollenites verus (Potonié); Thomson and Pflug, Norris, p. 41, pl. 11, fig. 3,4.

1987 Alnipollenites verus Potonié; Pocknall, pl. 1, fig. 18.

Age and Distribution: Upper Campanian, Almond Formation, Wyoming (Stone, 1973); Campanian to Paleocene, Fish River area, Yukon Territory (Wilson, 1978); Maastrichtian, Hell Creek Formation, Montana (Norton and Hall, 1969); Cenozoic, Mackenzie Delta region (Norris, 1986); Paleocene, Texas (Elsik, 1968b); Eocene, Elko Formation, Nevada (Wingate, 1983); Paleocene, Silverado Formation, California (Gaponoff, 1984); Eocene, Kitsilano Formation, B.C. (Hopkins, 1969); and the Oligocene of the Western British Isles (Wilkinson and Boulter, 1980).

Remarks: This species has 4-6 pores and curved arci running between them (Wilson, 1986). Specimens with 5 pores were most common in this study.

P. verus is present in one sample from the Sermilik Formation and is rare in the Navy Board and Aktineq Formations (1-7 specimens/sample).

Genus *Ulmoideipites* Anderson, 1960

Type Species: *Ulmoideipites krempi* Anderson, 1960.

Ulmoideipites krempi Anderson, 1960

Figure 97.

Synonymy:

1986 *Ulmoideipites krempi* Anderson; Jerzykiewicz and Sweet, pl. 4, fig. 29.

1988 *Ulmipollenites krempi* Anderson; Fredericksen *et al.*, pl. 1, fig. 12.

Age and Distribution: This species is reported from mid

Maastrichtian and Paleocene strata of the Colville River region, North Slope, Alaska (Fredericksen _et al._, 1988) and Paleocene strata from the central Alberta Foothills (Jerzykiewicz and Sweet, 1986).

Remarks: Srivastava (1969a) considers _Ulmoideipites_ to be the junior synonym of _Ulmipollenites_ Wolff. Sweet (1986) retains both names stating that _Ulmipollenites_ has an undulate or rugulate sculpture while _Ulmoideipites_ originally defined by Anderson is verrucate. This species is rare (1-7 specimens/sample) and present in Navy Board and Aktineq strata.

Genus _Polyatriopollenites_ Pflug, 1953

Type Species: _Polyatriopollenites_ _stellatus_ (Potonié) Pflug, 1953.

Polyatriopollenites _stellatus_ (Potonié) Pflug, 1953.

Figure 98.

Synonymy:

1966 _Pterocarya_ _stellatus_ (Potonié) Martin and Rouse, p. 196, pl.8, figs. 79, 80.

1968 Polyporopollenites stellatus (Potonié and Venitz) Thomson and Pflug; Nakoman, p. 539, pl. 5, figs. 10-12.

1969 Pterocaryapollenites stellatus (Potonié) Thiergart; Norton and Hall, p. 42, pl. 5, fig. 25.

1969 Pterocarya stellatus (Potonié) Martin and Rouse; Hopkins, p. 1121, pl. 8, figs. 122-124.

1972 Pterocarya stellatus (Potonié) Martin and Rouse; Rouse and Srivastava, fig. 66.

1980 Polyatriopollenites sp. Wilkinson and Boulter, p. 66, pl. 11, figs. 14-16.

1983 Polyatriopollenites stellatus (Potonié) Pflug; Wingate, p. 12, pl. 6, figs 25,26.

1986 Polyatriopollenites stellatus (Potonié) Pflug; Norris, p. 41-42, pl. 11, figs. 5-7.

Age and Distribution: Maastrichtian to Paleocene, Atkinson Well, Tuktoyaktuk Peninsula, N.W.T. (Wilson, 1978); Eocene, Elko Formation, Nevada (Wingate, 1983); Eocene, Kitsilano Formation, B.C. (Hopkins, 1969); Oligocene, Queen Charlotte Islands, B.C. (Martin and Rouse, 1966); Oligocene, Western British Isles (Wilkinson and Boulter, 1980); upper Miocene, Turkey (Nakoman, 1968).

Remarks: P. stellatus is very rare (1-2 specimens/sample) in the Navy Board and Aktineq Formations and two specimens occur in the uppermost strata of the Bylot Island Formation.

Genus Beaupreaidites Cookson, 1950

Type Species: Beaupreaidites elegansiformis Cookson, 1950.

Beaupreaidites angulatus (Samoilovitch) Srivastava, 1969.

Figure 99.

Synonymy:

1969c Beaupreaidites angulatus (Samoilovitch) Srivastava, p. 157-1574, pl. 1, figs. 3-5

1972 Beaupreaidites sp. Rouse and Srivastava, fig. 40.

Age and Distribution: Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1969c); Maastrichtian, Bonnet Plume Formation, Northeastern Yukon (Rouse and Srivastava, 1972).

Remarks: Beaupreaidites is characterized by Srivastava (1969c) as being grains with "three colpoid apertures, angulaperturate, apertures vestibulate, amb triangular with blunt to rounded angles and ± rounded sides, shape oblate; sexine fine to coarsely reticulate, retipilate or verrucate, thinner in apertural areas." Srivastava reports B. angulatus has a size range of 50-80 μm while Samoilovitch and

Mtchedlishvili (*in* Srivastava, 1969c) describe specimens ranging from 49.1 to 61.7 µm. Specimens recovered from Maud Bight ranged from 48-56 µm in diameter. *Beaupreaidites* sp. in Rouse and Srivastava (1972) resembles this species.

This species occurs in one sample from upper Sermilik strata (7 specimens).

Beaupreaidites mollis (Samoilovitch) Srivastava, 1969

Figure 100.

Synonymy:

1967 *Proteacidites mollis* Samoilovitch; Drugg, p. 57-58, pl. 8, fig. 37.

1969c *Beaupreaidites mollis* (Samoilovitch) Srivastava, p. 1573.

Age and Distribution: Upper (?) Maastrichtian of Western Siberia (Samoilovitch and Mtchedlishvili *in* Drugg, 1967); Maastrichtian to Danian, Upper Moreno Formation, Escarpado Canyon, California (Drugg, 1967).

Remarks: *Proteacidites thalmanii* Anderson is similar but differs primarily by having notched pores and coarser reticulation than *B. mollis* (Drugg, 1967). Martin (1973) feels that this taxon cannot be correctly assigned to either

Beaupreaidites or Proteacidites due to more complex pore structures, but since it hasn't been officially emended, the most recent version (B. mollis) is retained. The single specimen of B. mollis in this study was 25 μm in size; Drugg (1967) reports a range of 22-(28)-32 μm.

The grain was found in the Navy Board Formation.

Beaupreaidites sp. 1

Figure 101.

Description: The single specimen recovered is triaperturate, colpoid and has germinals that taper from 12 μm to 8 μm at the apertures. The colpi are short and are restricted to the apertural area. The grain has a convex triangular form and is 50 μm in diameter. The exine thickens from 1 μm in the inter-germinal areas to 2 μm at the germinal. The sculpture of the grain is tegillate-baculate though it becomes granulose around the apertures.

This specimen is distinguished from B. angulatus which has a much finer vermiculate ornamentation. B. occulatus (Samoilovitch) Srivastava has a straight-sided triangular amb whereas B. sp. 1 has a convex triangular amb (Srivastava, 1969c). It most resembles B. libitus Srivastava except that instead of a verrucate sculpture that fines towards the aperture (Srivastava, 1969c) there is a sharp transition to granulose sculpture in the apertural zones.

Remarks: A single specimen was recovered from upper strata of the Sermilik Formation.

Pollen Tetrad

Genus Ericaceoipollenites (Potonié) ex Potonié, 1960

Type Species: Ericaceoipollenites roboreus (Potonié) Potonié, 1951 ex Potonié, 1960.

Ericaceoipollenites rallus Stanley, 1965

Figure 102.

Synonymy:

1965 Ericaceoipollenites rallus Stanley, p. 296, pl. 44, figs. 15-18.

1973 Ericaceoipollenites rallus Stanley; Stone, p. 90, pl. 18, fig. 122.

1978 Ericaceoipollenites rallus Stanley; Wilson, p. 136, pl. 9, figs. 2,3.

1989 Ericaceae McIntyre, pl. 1, fig. 8.

Age and Distribution: Upper Campanian Almond Formation, Wyoming (Stone, 1973); Maastrichtian to Paleocene in the Atkinson Well, Tuktoyaktuk Peninsula, N.W.T. (Wilson, 1978); Paleocene, South Dakota (Stanley, 1965); and upper Paleocene, Eureka Sound Group, Somerset Island, N.W.T. (McIntyre, 1989).

Remarks: E. rallus is very rare in the Sermilik Formation but becomes common (3-18 specimens/sample) in the Navy Board and Aktineq Formations.

Binigeminate Pollen

Genus Azonia Samoilovitch, 1961

Type Species: Azonia recta (Bolkhovitina) Samoilovitch, 1961.

Remarks: Azonia differs from Wodehouseia and Singularia in that it "lacks the interpreted columella and tectum layer equivalents of the ektexine (characteristic of the genera Wodehouseia and Singularia), lacks the carinate flange formed by these layers in Wodehouseia, and lacks the granules and/or spines restricted to these ektexine layers in Wodehouseia and Singularia" (Wiggins, 1976).

Azonia cribrata Wiggins, 1976

Figure 103.

Synonymy:

1976 Azonia cribrata Wiggins, pl. 61-62, pl. 1, figs. 21,22.

1988 Azonia cribrata Wiggins; Fredericksen et al., pl. 2, fig. 1.

Age and Distribution: Upper Campanian to basal Maastrichtian? strata of the Alaskan North Slope (Wiggins, 1976); mid Maastrichtian, Colville River, region, Alaska (Fredericksen et al., 1988)

Remarks: This species was very rare; specimens were only found in the Bylot Island Formation.

Azonia jacutense (Samoilovitch) Wiggins, 1976

Figure 104.

1969b Wodehouseia jacutense (Samoilovitch) Samoilovitch;

Srivastava, p. 1309, pl. 1, figs. 8,9.

1974 _Wodehouseia_ _jacutense_ (Samoilovitch) Samoilovitch; McIntyre, pl. 15, figs. 13,19.

1976 _Wodehouseia_ _jacutense_ (Samoilovitch) Samoilovitch; Doerenkamp _et_ _al._, pl. 3, figs. 15,16.

1976 _Azonia_ _jacutense_ (Samoilovitch) Wiggins; p. 62, fig. 70.

Age and Distribution: This species has been recorded from Campanian-Maastrichtian strata, Banks Island, N.W.T. (Doerenkamp _et_ _al._, 1976); Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1969b); lower Maastrichtian strata, Horton River N.W.T. (McIntyre, 1974); and from Maastrichtian to Danian strata of Siberia (Samoilovitch and Mtchedlishvili, 1961). It hasn't been recorded in post Maastrichtian sediments in North America.

Remarks: Srivastava (1969b) notes that _Wodehouseia_ _jacutense_ from the Edmonton Formation has a much narrower flange than Russian specimens. Wiggins (1976) reassigned this species to the genus _Azonia_ because it lacked typical _Wodehouseia_ features. A single specimen was recovered from lower strata of the Sermilik Formation.

Genus _Wodehouseia_ Stanley, 1961

Type Species: *Wodehouseia spinata* Stanley, 1961.

Wodehouseia spinata Stanley, 1961

Figure 105.

Synonymy:

1965 *Wodehouseia spinata* Stanley; Stanley, p. 324.

1966 *Wodehouseia spinata* Stanley; Srivastava, p. 548, pl. 11, figs. 8,11,13.

1967 *Wodehouseia spinata* Stanley; Srivastava, p. 143, pl. 3, fig. Q.

1969b *Wodehouseia spinata* Stanley; Srivastava, p. 1309, pl. 1, figs. 3-5.

1969 *Wodehouseia spinata* Stanley; Norton and Hall, p. 58, pl. 8, fig. 3.

1969 *Wodehouseia spinata* Stanley; Oltz, p. 159, pl. 42, fig. 179.

1970 *Wodehouseia spinata* Stanley; Leffingwell *et al.*, pl. 7, fig. 1-7.

1970 *Wodehouseia spinata* Stanley; Srivastava, pl. 3, fig. 9.

1972 *Wodehouseia spinata* Stanley; Rouse and Srivastava, fig. 52.

1973 *Wodehouseia spinata* Stanley; Evitt, p. 35, pl. 1, fig. 24.

1974 *Wodehouseia spinata* Stanley; McIntyre, pl. 15, fig.

18.

1976 Wodehouseia spinata Stanley; Wiggins, p. 62, pl. 3, figs. 1-4.

1978 Wodehouseia spinata Stanley; Srivastava, pl. 7, fig. 13.

1978 Wodehouseia spinata Stanley; Wilson, p. 148, pl. 11, fig. 16.

1981 Wodehouseia spinata Stanley; Chlonova, pl. 2, fig. 11.

1983 Wodehouseia spinata Stanley; Zhou and Wang, pl. 3, fig. 12.

1986 Wodehouseia spinata Stanley; Jerzykiewicz and Sweet, p. 1370-1372, pl. 4, fig. 31.

1989 Wodehouseia spinata Stanley; Sweet et al., pl. 1, fig. 21.

Age and Distribution: Maastrichtian, Hell Creek Formation, Montana (Norton and Hall, 1969); Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1970); Maastrichtian, Bonnet Plume Formation, Yukon Territory (Rouse and Srivastava, 1972); mid Maastrichtian, North Slope, Alaska (Fredericksen et al., 1988); upper Maastrichtian, North Slope, Alaska (Wiggins, 1976); Maastrichtian, Rudong Region, northern Jiangsu, China (Zhou and Wang, 1983); Maastrichtian to

Paleocene, Police Island, Mackenzie River, N.W.T. and Maastrichtian to Paleocene of U.S.S.R (Wilson, 1978); Maastrichtian (Kemp Clay) and Danian (recycled? component in Kincaid Formation) strata of Texas (Evitt, 1973).

Remarks: Though rarely occurring in the lower Paleocene strata this species is typically used as a upper Maastrichtian indicator. Seven specimens were recovered from the Sermilik Formation.

Wodehouseia gracile (Samoilovitch) Pokrovaskaya, 1966

Figure 106.

Synonymy:

1967 Wodehouseia gracile (Samoilovitch) Samoilovitch, p. 12, pl. 2, fig. 6.

1969b Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Srivastava, p. 1309, pl. 1, figs. 6,7.

1970 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Srivastava, pl. 2, fig. 11.

1974 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; McIntyre, pl. 15, figs. 15,16.

1976 Wodehouseia gracile (Samoilovitch) Pokrovaskaya;

Doerenkamp et al., pl. 3, figs. 18,19.

1976 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Wiggins, p. 65, pl. 3, figs. 3,4.

1981 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Takahashi, tables 1,2.

1982 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Takahashi and Shimono, p. 89, pl. 11, figs. 4-14.

1988 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Fredericksen et al., pl. 2, fig. 2.

1989 Wodehouseia gracile (Samoilovitch) Pokrovaskaya; Sweet et al., p. 95, pl. 1, fig. 20.

Age and Distribution: Sweet et al. (1989) defined the W. gracile/Aquilapollenites parallelus Zone in the Brackett Coal Basin, N.W.T. as being mid? Maastrichtian in age. This species also occurs in uppermost Campanian to mid Maastrichtian strata of Horton River, N.W.T. (McIntyre, 1974); Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1970); Maastrichtian of the Kanguk Formation, Banks Island, N.W.T. (Doerenkamp et al., 1976); upper Maastrichtian, Alaskan North Slope (Wiggins, 1976); Maastrichtian of Hida, Japan and Yenisey and Western Siberian Lowlands, U.S.S.R. (Takahashi, 1981); Maastrichtian of the Miyadani-gawa Formation, Japan (Takahashi and Shimono, 1982); and mid(?) Maastrichtian strata, Police Island, N.W.T. (Sweet *et al.*, 1989). It has also been reported from the Maastrichtian to Danian strata of Siberia (Samoilovitch and Mtchedlishvili *in* Srivastava, 1969b). Sparkes (1989) reports it from the Sermilik and Bylot Island Formations in the Eclipse Trough.

Remarks: A single specimen was found in the Bylot Island Formation.

Wodehouseia quadrispina Wiggins, 1976

Figure 107.

Synonymy:

1976 *Wodehouseia quadrispina* Wiggins, p. 63, pl. 2, figs. 7-12.

1988 *Wodehouseia quadrispina* Wiggins, Fredericksen *et al.*, pl. 2, fig. 3.

Age and Distribution: Mid Maastrichtian, North Slope, Alaska (Fredericksen *et al.*, 1988); upper Maastrichtian, North Slope, Alaska (Wiggins, 1976).

Remarks: Wiggins (1976) notes that while *W. quadrispina* has only 4 equatorial spines it otherwise has a close similarity and affinity to the many spined *Wodehouseia spinata*. A single specimen was found in upper Sermilik strata.

Genus _Singularia_ Samoilovitch, 1961

Type Species: _Singularia_ _aculeata_ Samoilovitch, 1961.

Singularia _aculeata_ Samoilovitch, 1961

Figure 108.

Synonymy:

1974 _Singularia_ _aculeata_ Samoilovitch; McIntyre,

1976 _Singularia_ _aculeata_ Samoilovitch; Wiggins, p. 68, 74.

Age and Distribution: Upper Campanian to Maastrichtian, Horton River area, N.W.T. (McIntyre, 1974); upper Maastrichtian, Alaska (Wiggins, 1976); Maastrichtian-Paleocene?, West Siberian Lowland (Samoilovitch and Mtchedlishvili _in_ Wiggins, 1976).

Remarks: Two specimens were found in the Sermilik Formation.

Triprojectate Pollen

Genus Mancicorpus Mtchedlishvili emend. Srivastava, 1968

Type Species: Mancicorpus anchoriforme Mtchedlishvili, 1961.

Mancicorpus trapeziforme Mtchedlishvili, 1961

Figure 109.

Synonymy:

1974 Mancicorpus trapeziforme Mtchedlishvili; McIntyre, p. 49, pl. 20, figs. 5,6.

1976 Mancicorpus trapeziforme Mtchedlishvili; Doerenkamp et al., p. 409, pl. 3, fig. 2.

1989 Mancicorpus trapeziforme Mtchedlishvili; Sparkes, p. 120-121, pl. 6, fig. 11.

Age and Distribution: Uppermost Campanian to Maastrichtian of Horton River area, N.W.T. (McIntyre, 1974); Maastrichtian of Banks Island, N.W.T. (Doerenkamp et al., 1976). Sparkes (1989) reports one specimen from the Sermilik Formation in Eclipse Trough.

Remarks: Two specimens were found in a sample from upper Sermilik strata.

Genus Aquilapollenites (Rouse) Funkhouser, 1961

Type Species: Aquilapollenites quadrilobus Rouse, 1957.

Aquilapollenites augustus Srivastava, 1969

Figure 110.

Synonymy:

1969b Aquilapollenites augustus Srivastava, p. 137, pl. 3, figs. 18-21.

1978 Aquilapollenites augustus Srivastava; Srivastava, pl. 7, fig. 3.

1986 Aquilapollenites augustus Srivastava; Farabee and Canright, p. 39, pl. 11, figs. 3-8.

1986 Aquilapollenites augustus Srivastava; Jerzykiewicz and Sweet, p. 1370, pl. 2, fig. 2.

Age and Distribution: Maastrichtian, Edmonton Formation, Alberta (Srivastava, 1969b); Maastrichtian, lower Lance Formation, Wyoming (Farabee and Canright, 1986); Maastrichtian, Upper Hakobuchi Group, Hokkaido, Japan (Srivastava, 1978); Maastrichtian, Alberta Foothills (Jerzykiewicz and Sweet, 1986).

Remarks: A single specimen was recovered from the Aktineq Formation; it is thought to be recycled.

Aquilapollenites sp. cf. *immiser*

Figure 111.

Synonymy:

1986 *Aquilapollenites immiser* Jerzykiewicz and Sweet, p. 1378, pl. 1, figs. 6-9.

Age and Distribution: *A. immiser* is reported from uppermost Maastrichtian and lowest Paleocene strata, Alberta Foothills (Jerzykiewicz and Sweet, 1986).

Remarks: This specimen has a similar morphology to *A. immiser* described by Jerzykiewicz and Sweet (1986) but is larger; the measured distance from radial extremity to the opposite side of the grain is 30 µm compared to 23 µm in their study.

A single specimen was found in the Maud Bight Member of the Aktineq Formation.

Aquilapollenites reticulatus (Mtchedlishvili) Tschudy and Leopold, 1971

Figure 112.

Synonymy:

1961 Aquilapollenites reticulatus Stanley, p. 348-349, pl. 8, figs. 12.

1965 Aquilapollenites reticulatus Stanley; Stanley, p. 315, pl. 49, figs. 10-14.

1969 Aquilapollenites reticulatus Stanley; Norton and Hall, p. 56, pl. 6, fig. 6.

1969 Aquilapollenites reticulatus Stanley; Oltz, p. 155, pl. 42, fig. 160.

1971 Aquilapollenites reticulatus (Mtchedlishvili) Tschudy and Leopold; Evitt, p. 35, pl. 2, figs. 9,19.

1973 Aquilapollenites reticulatus (Mtchedlishvili) Tschudy and Leopold; B.D. Tschudy, pl. 27, pl. 9, fig. 25.

1973 Aquilapollenites reticulatus Stanley; Stone, p. 91, pl. 19, fig. 127.

1973 Aquilapollenites reticulatus Stanley; Chmura, p. 140, pl. 31, figs. 1-5.

1978 Aquilapollenites reticulatus Stanley; Wilson, p. 132, pl. 8, figs. 2,3.

1986 Aquilapollenites reticulatus (Mtchedlishvili) Tschudy and Leopold; Farabee and Canright, p. 42, pl. 15, figs. 1-6.

1986 Aquilapollenites reticulatus (Mtchedlishvili) Tschudy and Leopold; Jerzykiewicz and Sweet, p.

1370, pl. 2, fig. 11.

1988 _Aquilapollenites_ _reticulatus_ (Mtchedlishvili) Tschudy and Leopold; Fredericksen _et_ _al._, pl. 2, fig. 8.

Age and Distribution: Upper Campanian, Judith River Formation, Montana (B.D. Tschudy, 1973); Campanian to Maastrichtian, San Joaquin Valley, California (Chmura, 1973); Maastrichtian, South Dakota (Stanley, 1965); Maastrichtian, Hell Creek Formation, Montana (Norton and Hall, 1969); Maastrichtian, lower Lance Formation, Wyoming (Farabee and Canright, 1986); mid Maastrichtian, Colville River area, Alaska (Fredericksen _et_ _al._, 1988); Maastrichtian and possibly lower Paleocene, Yukon and District of Mackenzie, N.W.T. (Wilson, 1978); Maastrichtian and lower Paleocene, Ravenscrag and Frenchman Formations, Saskatchewan (Sweet, 1978b); Maastrichtian and Paleocene, Alberta Foothills (Jerzykiewicz and Sweet, 1986); Danian (possibly reworked) of Texas (Evitt, 1971).

Remarks: This taxon is very rare and occurs only in the Bylot Island Formation.

Aquilapollenites _trialatus_ Rouse, 1957

Figure 113.

Synonymy:

1969 Aquilapollenites trialatus Rouse; B.D. Tschudy, p. 7, pl. 4, figs. 1-5.

1970 Aquilapollenites trialatus Rouse; Srivastava and Rouse, p. 371, pl. 2, figs. 14-15.

1973 Aquilapollenites trialatus Rouse; B.D. Tschudy, p. 27, pl. 9, figs. 22-24.

1973 Aquilapollenites trialatus Rouse; Jarzen and Norris, pl. 2, fig. 5.

1975 Aquilapollenites trialatus Rouse; Wall and Singh, p. 1168, pl. 5, fig. 1.

1977 Aquilapollenites trialatus Rouse; Jarzen, fig. 5, No. 2, 7.

1978 Aquilapollenites trialatus Rouse var. trialatus Tschudy and Leopold, 1971; Wilson, p. 133, pl. 8, fig. 5.

1978 Aquilapollenites trialatus Rouse; Srivastava, pl. 6, fig. 2.

1982 Aquilapollenites trialatus Rouse; Jarzen, pl. 1, fig. 14.

1988 Aquilapollenites trialatus Rouse; Traverse, fig. 13.11 b.

1989 Aquilapollenites trialatus Rouse; Sweet et al., pl.

1, fig. 10.

Age and Distribution: Sweet *et al.* (1989) defined the *A. trialatus* Zone in the Brackett Coal Basin, N.W.T., as being late Campanian. This species is also reported from the upper Cretaceous, Colville River, Alaska (B.D. Tschudy, 1969); upper Cretaceous, Tyung region, Yakutsk Province, U.S.S.R. (Bolkhovitina *in* Srivastava and Rouse, 1970); upper Campanian, Horseshoe Canyon Formation, southern Alberta (Awai-Thorne *in* Wall and Singh, 1975); upper Campanian, Oldman Formation, southern Alberta (Rouse *in* Wall and Singh, 1975); Campanian, Buffalo Head Hills, North-Central Alberta (Wall and Singh, 1975); upper Campanian, Judith River Formation, Montana (B.D. Tschudy, 1973); Campanian, Alberta (Jarzen, 1977 and 1982); Maastrichtian, Atkinson Well, Tuktoyaktuk Peninsula, N.W.T. (Wilson, 1978) and Maastrichtian, Colorado (Traverse, 1988).

Remarks: *A. trialatus* is very rare (1-2 specimens/sample) and occurs only in the Bylot Island Formation.

FUNGAL REMAINS

Remarks: All abundance values for species in this section, except for Pesavis, are qualitative, not quantitative.

Monocellate Fungal Spores

Genus Monoporisporites Van der Hammen 1954 emend. Sheffy and Dilcher, 1971.

Type Species: Monoporisporites minutus Van der Hammen, 1954.

Monoporisporites singularis Sheffy and Dilcher, 1971

Figure 114.

Synonymy:

1971 Monoporisporites singularis Sheffy and Dilcher, p. 40, pl. 1, fig. 22; pl. 15, fig. 22.

1986 Monoporisporites singularis Sheffy and Dilcher; Norris, p. 19, pl. 1, figs. 6-8.

Age and Distribution: The genus occurs in Maastrichtian to Recent strata (Elsik, 1981). M. singularis is reported from the Eocene of Tennessee (Sheffy and Dilcher, 1971); Oligocene, Mackenzie Delta area (Norris, 1986).

Remarks: Specimens of M. singularis are spherical, psilate, have a single pore and average 15 μm in diameter. M. singularis is very rare in Bylot Island and Sermilik Formations and uncommon in the Navy Board and Aktineq Formations.

Dicellate Fungal Spores

Genus Dicellaesporites Elsik, 1968 emend.

Type Species: Dicellaesporites popovii Elsik, 1968.

Dicellaesporites popovii Elsik, 1968

Figure 115.

Synonymy:

1968a Dicellaesporites popovii Elsik, p. 269, pl. 2, fig. 9.

1976 Dicellaesporites popovii Elsik; Jansonius and Hills, card 773.

1981 Dicellaesporites popovii Elsik; Elsik, p. 65.

1986 Dicellaesporites popovii Elsik; Norris, p. 21, pl. 2, figs. 1,2.

Age and Distribution: This species occurs in the Paleocene of the Rockdale Lignite, Texas (Elsik, 1968a); Elsik (1981) later extends its range from Paleocene to mid Eocene. Norris

(1986) reports it from the Eocene to Oligocene (Richards and Kugmallit Formations) of the Mackenzie Delta area, N.W.T.

Remarks: Elsik (1981) describes D. popovii as being psilate, monoporate, aseptate or with one septum, typically oval in shape, one chamber may be a bit larger than the other and the pore is located off the apex.

This species occurs rarely in the upper strata of the Sermilik Formation and more often in the Navy Board and Aktineq Formations.

Multicellate Fungal Spores

Genus Reduviasporonites Wilson, 1962 emend. Elsik, 1981

Type Species: Reduviasporonites catenulatus Wilson, 1962 emend.

Elsik, 1981.

Reduviasporonites sp. 1

Figure 116.

Synonymy:

1976 Reduviasporonites sp., Jansonius and Hills, card 2343.

1981 Reduviasporonites sp., Elsik, pp. 153.

1986 Reduviasporites sp. cf. R. catenulatus Wilson, p. 23, pl. 2, figs. 40,41,43.

Age and Distribution: Elsik (1981) reports that Reduviasporonites occurs in upper Permian and upper Paleocene to Recent strata.

Remarks: Specimens consisted of a uniseriate chains of oval cells 8-18 µm by 5-10 µm which are attached by their long axes, they may or may not be branching. Cells are thin walled, psilate and often irregularly folded or torn.

Specimens were very rare in the Navy Board and Aktineq Formations.

Genus Brachysporisporites Lange and Smith, 1971

Type Species: Brachysporisporites pyriformis Lange and Smith, 1971.

Brachysporisporites cotalis (Elsik and Jansonius) Norris.

Figure 117.

Synonymy:

1974 Granatisporites cotalis Elsik and Jansonius, p.

954, fig. 13.

1986 Brachysporisporites cotalis (Elsik and Jansonius) Norris, p. 24, pl. 2, figs. 45-47.

1989 Brachysporites sp. Dietrich et al., pl. 3, figs. 19, 21.

Age and Distribution: Paleogene, Mackenzie Delta region (Elsik and Jansonius, 1974): Eocene, Mackenzie Delta (Norris, 1986).

Remarks: Elsik and Jansonius (1974) describe this species as consisting of 3-4 cells, having a pistilliform shape, widest in middle and concave in its upper portions, and a terminal porate cell. The holotype is 24x14 µm.

This species is rare in the Aktineq and Navy Board and very rare in the Sermilik Formation.

Genus Diporicellasporites Elsik, 1968

Type Species: Diporicellasporites stacyi Elsik, 1968.

Diporicellasporites sp. cf. stacyi

Figure 118.

Synonymy:

1968a Diporicellasporites stacyi Elsik, p. 279, pl. 3, fig. 10-11.

Age and Distribution: Paleocene, Rockdale Lignite, Texas (Elsik, 1968a).

Remarks: *D. stacyi* is described by Elsik (1968a) as being a "tetracellate, psilate, diporate fungal spore 11 to 13 µm wide and 23 to 31 µm long" with the septae being twice as thick as the 0.5 µm wall and with the inner surface being granular to punctate. The specimen in this study resembles *D. stacyi* but is larger; 41x15 µm.

A single specimen was found in the Maud Bight Member, Aktineq Formation.

Diporicellasporites reticulatus Elsik and Dilcher, 1974

Figure 119.

Synonymy:

1974 *Diporicellasporites reticulatus* Elsik and Dilcher, p. 72, pl. 27, figs. 44-45.

Age and Distribution: mid Eocene, Lawrence clay pit, western Tennessee (Elsik and Dilcher, 1974).

Remarks: This fungal spore is elongate, diporate with the pores at the ends, has 5-10 septa which may be split, is asymmetric about the long axis, and ranges from 55-60 µm in length and 8-18 μm in width (Elsik and Dilcher, 1974).

It is infrequent in the Navy Board and Aktineq Formations and very rare in all other strata.

<u>Diporicellasporites</u> sp. 1.

Figure 120.

Description: Diporate, multicellular fungal spore with 8-10 septa. The septa often are split and there is a slight constriction of the amb at the septa. The walls are ≈0.5 μm thick and psilate. The spore is straight to slightly curved about the long axis. The dimensions of <u>D.</u> sp. 1 are 35-48x7-8 μm.

Remarks: It is rare and occurs in the Sermilik, Navy Board and Aktineq Formations.

Genus <u>Striasporonites</u> nom. nud. Elsik, 1981

Type Species: <u>Striasporonites</u> <u>neogenicus</u> nom. nud. Elsik, 1981.

<u>Striasporonites</u> sp. 1

Figure 121.

Synonymy:

1981 <u>Striasporonites</u> Elsik, p. 88.

Age and Distribution: Striasporonites ranges from the Maastrichtian? and late Paleocene to Recent.

Remarks: Elsik (1981) describes Striasporonites as a "diporate, monoseptate fungal spore of variable shape, subspherical to elliptical; with symmetrical or asymmetrical amb, indented or not at the median or near median septum." The pores are located on the apices and may or may not be annulate and protruding. They have a pore chamber; typically of the raised collar type or with subsidiary basal septa. The exinal sculpture varies from longitudinal heavy ribs or costae to very fine striae. Occasionally the specimens have ornamental elements at low to high angles to the long axis of the spore.

The single specimen recovered is 40x18 µm, longitudinally striate, constricted at the central septum, the pores are apical and annulate and otherwise fits Elsik's diagnosis of Striasporonites.

The specimen was found in the Sermilik Formation.

Genus Polyadosporites Van der Hammen 1954 emend. Elsik 1981

Type Species: Polyadosporites suescae Van der Hammen 1954.

Polyadosporites suescae Van der Hammen 1954

Figure 122.

Synonymy:

19761976 *Polyadosporites suescae* Van der Hammen; Jansonius and Hills, card 2074.

Age and Distribution: Maastrichtian, Columbia (Van der Hammen *in* Jansonius and Hills, 1976). The genus has a Maastrichtian to Recent range (Elsik, 1981).

Remarks: *P. suescae* is described by Van der Hammen (*in* Jansonius and Hills, 1976) as fungal spores composed of multiple psilate grains or cells that are "united along several axes or in a more or less regular manner," and are 40-55 µm in diameter.

P. suescae is very rare and occurs only in the Sermilik, Navy Board and Aktineq Formations.

Genus *Staphlosporonites* Sheffy and Dilcher, 1971

Type Species: *Staphlosporonites conoideus* Sheffy and Dilcher, 1971.

Staphlosporonites delumbus Norris, 1986

Figure 123.

Synonymy:

1986 Staphlosporonites delumbus Norris, p. 26, pl. 3, figs. 17-20.

Age and Distribution: Eocene to Oligocene, Kugmallit and Richards Formations, Mackenzie Delta region, N.W.T. (Norris, 1986).

Remarks: S. delumbus consists of a multicellular cone which increases from uni- to tri-serial polygonal cells. Specimens resemble those described by Norris (1986).

S. delumbus is very rare the Sermilik, Navy Board and Aktineq Formations.

Genus Pesavis Elsik and Jansonius 1974

Type Species: Pesavis tagluensis Elsik and Jansonius, 1974.

Pesavis tagluensis Elsik and Jansonius, 1974

Figure 125.

Synonymy:

1974 Pesavis tagluensis Elsik and Jansonius, p. 956, pl. 1, figs. 5-9, 11 only.

1976 *Pesavis tagluensis* Elsik and Jansonius; Jansonius, p. 131, pl. 1, fig. 1.

1976 *Pesavis tagluensis* Elsik and Jansonius; Elsik, fig. 2v.

1977 *Pesavis tagluensis* Elsik and Jansonius; Rouse, pl. 2, fig. 49.

1986 *Pesavis tagluensis* Elsik and Jansonius; Norris, p. 27, pl. 3, figs. 24,25.

1988 *Pesavis* sp. cf. *tagluensis* Elsik and Jansonius; Fredericksen *et al.*, pl. 1, fig. 1.

1988 *Pesavis tagluensis* Elsik and Jansonius; Kalgutkar and Sweet, p. 123, pl. 6.2, figs. 6-12.

1989 *Pesavis tagluensis* Elsik and Jansonius; Dietrich *et al.*, pl. 3, fig. 22.

1989 *Pesavis tagluensis* Elsik and Jansonius; Ediger and Alisan, pl. 6, figs. 1-3.

Age and Distribution: Paleocene to Eocene of Washington, British Columbia, Alaska and the Mackenzie Delta, N.W.T. (Elsik and Jansonius, 1974); Paleocene, Colville River region, Alaska (Fredericksen *et al.*, 1988); mid Paleocene to upper Eocene strata in the Arctic (Rouse, 1977); Paleocene to Eocene, Mackenzie Delta area, N.W.T. (Norris, 1986) and upper Eocene to upper Oligocene, Northern Thrace Basin, Turkey (Ediger and Alisan, 1989).

Remarks: The original diagnosis of _P. tagluensis_ by Elsik and Jansonius (1974) was that of a "multicellular fungal fruiting body consisting of a stalked central cell and two lateral arms consisting of some (5-8) cells each. Lateral arms ... curved, closely appressed. Two planes of symmetry present. Cells of the primary structure ... have secondary septate hyphae-like filaments." Noting that _P. tagluensis_ is morphologically variable, Kalgutkar and Sweet (1988) refined the original definition to include two end members; _P. tagluensis_ and _P. parva_ Kalgutkar and Sweet. _P. tagluensis_ typically has a diameter of 30 µm or greater and 5-8 lateral arm cells while _P. parva_ is 21-31 µm in size and only has 2-5 lateral arm cells (Kalgutkar and Sweet, 1986). Specimens of _P. tagluensis_ in this study ranged from 31 to 40 µm.

P. pesavis is very rare and present only in the Navy Board and Aktineq Formations.

Pesavis parva Kalgutkar and Sweet, 1988

Figure 124.

Synonymy:

1974 _Pesavis tagluensis_ Elsik and Jansonius (pars), p. 955, pl. 1, fig. 10 only.

1976 "_Pesavis parva_" Jansonius, p. 13, pl. 1, fig. 2.

1978a Pesavis sp. Sweet, p. 6, pl. 6.2, fig. 15.

1986 Pesavis sp. in Jerzykiewicz and Sweet, p. 1365, pl. 1, fig. 7.

1988 Pesavis parva Kalgutkar and Sweet, p. 123, pl. 6.1, figs. 6-12.

Age and Distribution: Maastrichtian, Alberta Foothills (Jerzykiewicz and Sweet, 1986); Maastrichtian to lower Paleocene in western and northern Canada (Kalgutkar and Sweet, 1988) and Paleocene of S.E. Baffin Island (Burden and Langille, 1990). Sparkes (1989) reports two specimens of P. parva from the uppermost strata of the Bylot Island Formation, Eclipse Trough.

Remarks: P. parva ranged from 19 to 29 µm in this study. This species is rare (1-4 specimens/sample) but occurs in the Navy Board, Aktineq and several samples from the Sermilik Formation.

Mycelial Hyphae

Fungal Hyphae Type C of Norris, 1986

Figure 127.

Synonymy:

1981 Genus Septohyphaeites Elsik, p. 164.

1986 Fungal Hyphae Type C, Norris, p. 27-28, pl. 4, figs. 9,10.

Age and Distribution: Elsik (1981) gives a range of Maastrichtian to Recent for the genus Septohyphaeites. Norris's (1986) Type C hyphae occur in Eocene and Oligocene strata, Mackenzie Delta area.

Remarks: These hyphae are the same as Type C hyphae described by Norris (1986); "hyphae 3-6 µm wide, more or less constant width... cells 15-100 µm long. Hyphal wall levigate, approximately 0.25 µm thick. Septa 0.5-1.0 µm wide with a minute pore that is scarcely visible. Lateral branches inserted at right angles to main axis of cell."

Type 1 hyphae were the most common form of fungal remains in the study area, often composing the majority of the fungal material.

Fungal Hyphae Type E of Norris, 1986

Figure 126.

Synonymy:

1986 Fungal Hyphae Type E, Norris, p. 28, pl 4, figs. 15,16.

Age and Distribution: Late Oligocene, Kugmallit Formation, Mackenzie Delta area (Norris, 1986).

Remarks: Specimens recovered are the same as Fungal Hyphae Type E (Norris, 1986); " Hyphae 4-6 µm wide, parallel sides straight or sinuous, with slight constriction at locus of septal insertion. Cells 12-30 µm long; hyphal wall levigate (and) very thin. Septa of same width as hyphal wall, usually strongly dentate; minute septal pore... balloon shaped (branching) cells... constricted at point of insertion."

It is very rare in the Navy Board and Aktineq Formations.

Fungal Fruiting Bodies

Genus *Plochmopeltinites* Cookson 1947 emend. Selkirk, 1975

Type Species: *Plochmopeltinites masonii* Cookson, 1947.

Plochmopeltinites masonii Cookson, 1947

Figure 128.

Synonymy:

1986 Plochmopeltinites masonii Cookson; Norris, p. 8, pl. 5, figs. 1-3.

Age and Distribution: Eocene to mid Oligocene, Mackenzie Delta area, N.W.T. (Norris, 1986).

Remarks: Genus Plochmopeltinites is distinct from other Microthyriales in having a flattened pycnidia, nearly circular form consisting of radiating intertwining strands of elongate cells, a thickened collar of cells surrounding the ostiole and ragged edges due to thinning of pycnidia (Elsik, 1981).

P. masonii is very rare and occurs only in the Maud Bight Member of the Aktineq Formation.

Genus Phragomthyrites Edwards, 1922

Type Species: Phragmothyrites eocaenicus Edwards, 1922.

Phragmothyrites sp.

Figure 129.

Synonymy:

1976 Phragmothyrites Jansonius and Hills, card 1987.

1981 *Phragmothyrites* sp. Elsik, p. 180.

Age and Distribution: The genus ranges from the Albian to Recent (Elsik, 1981).

Remarks: The type species was first reported as occurring on coniferous (*Podocarpus*?) leaves in lower Eocene strata, Mull, Scotland (Edwards *in* Jansonius and Hills, 1976). It is radiate, has a variable margin (usually smooth), non-ostiolate and the centre cells are not modified in any way (Elsik, 1981). It differs from *Callimothallus* Dilcher in having aporate cells.

Specimens are rare and occur in the Navy Board and Aktineq Formations.

Genus *Callimothallus* Dilcher, 1965

Type Species: *Callimothallus* *pertusus* Dilcher, 1965.

Callimothallus *pertusus* Dilcher, 1965

Figure 130.

Synonymy:

1965 *Callimothallus* *pertusus* Dilcher, p. 13-16, pl. 5, figs. 37-42; pl. 6, figs. 4-46;pl. 7, figs. 47-55.

1976 *Callimothallus* *pertusus* Dilcher; Jansonius, pl. 1, fig. 22.

1976 _Callimothallus pertusus_ Dilcher; Jansonius and Hills, card 356.

1986 _Callimothallus pertusus_ Dilcher; Norris, p. 30, pl. 6, figs. 4,6-9.

Age and Distribution: Paleocene Lasqueti Island strata and Chuckanut Formation, Southwestern British Columbia (Rouse _et al._, 1990); Paleogene, Mackenzie Delta region, N.W.T. (Jansonius, 1976); lower Eocene, Wilcox Formation, Lawrence clay pit, western Tennessee (Dilcher, 1965); mid Eocene (_Pesavis_ zone) Richards Formation, Mackenzie Delta, N.W.T. (Norris, 1986).

Remarks: This species of epiphyllous fungi was first noted by Dilcher (1965) on cuticular preparations of leaves. _Callimothallus pertusus_ as diagnosed by Dilcher (1965); "no free hyphae; stroma round, radiate, astomate, no central dehiscence, individual cells may possess single pore." Specimens in his study had a range of 30-250 μm.

C. pertusus is present in most samples from the Navy Board and Aktineq Formations, and possible corroded specimens were recovered from the Sermilik Formation.

Genus *Microthallites* Dilcher, 1965

Type Species: *Microthallites lutosus* Dilcher, 1965.

Microthallites lutosus Dilcher, 1965

Figure 131.

Synonymy:

1965 *Microthallites lutosus* Dilcher, p. 16, pl. 10, figs. 83-85.

1976 *Microthallites lutosus* Dilcher, Jansonius and Hills, card 1665.

1981 *Microthallites* sp., Elsik, p. 177.

1989 *Microthallites* sp., Ediger and Alisan, p. 157, pl. 7, figs. 4-6.

Age and Distribution: Lower Eocene, Wilcox Formation, western Tennessee (Dilcher, 1965); upper Eocene to upper Oligocene Northern Thrace Basin, Turkey (Ediger and Alisan, 1989). Elsik (1981) reports an early Eocene to early Pliocene range for the genus.

Remarks: Specimens of *M. lutosus* have pycnidia which radiate dichotomizing rows of rectangular cells, circular ambs, irregular margins, more or less fimbriate and range from 25-40 µm in diameter (Dilcher, 1965; Elsik, 1981). Specimens reported from Turkey (Ediger and Alisan, 1989) ranged from

30-70 µm. Dilcher further notes that _Microthallites_ is distinguished from _Microthyriacites_ by having a central thick walled cell. Except in one uncertain case hyphae were not found in association with specimens of _M. lutosus_ (Dilcher, 1965). A cluster of five specimens (Plate 7, figure 123) from this study, however, are all attached by strands of fungal hyphae which pass through the centre of each specimen. Specimens were 25-(30)-35 µm in diameter.

M. lutosus was found in several samples from the Aktineq Formation.

MARINE MICROPLANKTON

Remarks: This is not a marine algal study but two biostratigraphically important species are discussed.

Proximate Dinoflagellates

Genus _Ceratiopsis_ Vozzhenikova emend. Bujak, Downie, Eaton and Williams, 1980

Type Species: _Ceratiopsis leptoderma_ Vozzhennikova, 1963

Ceratiopsis diebelii (Alberti) Vozzhennikova, 1967.

Figure 132.

Synonymy:

1967 _Deflandrea diebelii_ sp. cf. _D. diebelii_; Drugg, p. 16, pl. 2, fig. 6.

1974 _Deflandrea diebelii_ Alberti; McIntyre, p. 17, pl. 4, figs. 4,5.

1975 _Deflandrea diebelii_ Alberti; McIntyre, p. 67, pl. 4, figs. 1,2.

1976 _Deflandrea diebelii_ Alberti; Doerenkamp _et al._, pl. 4, fig. 7.

1977 _Deflandrea diebelii_ Alberti; Williams and Bujak, p. 46, pl. 5, fig. 1.

1978 _Deflandrea diebelii_ Alberti; Wilson, p. 151, pl. 11, fig. 15.

1980 _Deflandrea diebelii_ Alberti; May, p. 75, pl. 8, fig. 16.

1980 _Deflandrea diebelii_ Alberti; Croxton, p. 25, pl. 4, fig. 6; p. 27, pl. 5, fig. 6.

1985 _Ceratiopsis diebelii_ (Alberti) Vozzhennikova; Williams and Bujak, p. 870, fig. 23, No. 17.

1986 _Deflandrea diebelii_ Alberti; Ioannides, p. 19, pl. 11, figs. 6,7,10 and 11.

1988 _Ceratiopsis diebelii_ (Alberti) Vozzhennikova; Shaozhi and Norris, p. 78, pl. 9, fig. 6.

Age and Distribution: Maastrichtian, Horton River (McIntyre, 1974;1975); Maastrichtian, Banks Island region (Doerenkamp *et al*., 1976) and Maastrichtian, offshore eastern Canada (Bujak and Williams, 1978). Sparkes (1989) and Waterfield (1989) report it from the upper Campanian to upper Maastrichtian Bylot Island and Sermilik Formations in Eclipse Trough.

Remarks: Specimens were recovered from subzone R beds of the Bylot Island Formation at Cape Hay and the Bylot Island and Sermilik Formations at Maud Bight.

Genus *Paleoperidinium* Delfandre emend. Sarjeant, 1967

Type Species: *Paleoperidinium pyrophorum* (Ehrenburg) Sarjeant, 1967.

Paleoperidinium kozlowskii (Gorka) Davey, 1970

Figure 133.

Synonymy:

1974 *Lejeunia kozlowskii* Gorka; McIntyre, p. 17, pl. 4, figs. 2,3.

1975 *Lejeunia kozlowskii* Gorka; McIntyre, p. 68, pl. 4, figs. 3,4.

1976 *Lejeunia kozlowskii* Gorka; Doerenkamp *et al.*, p.

411, pl. 4, fig. 8.

1989 Paleoperidinium kozlowskii (Gorka) Davey, p. 127-128, pl. 6, fig. 18.

Age and Distribution: P. koslowskii occurs in upper Campanian to lower Maastrichtian Horton River area strata (McIntyre 1974;1975); upper Campanian to lower Maastrichtian strata, Banks Island and vicinity (Doerenkamp et al., 1976) and upper Campanian to mid Maastrichtian Sermilik Formation, Eclipse Trough (Sparkes, 1989).

Remarks: It is rare and only occurred in the Bylot Island Formation.

CHAPTER 4 BIOSTRATIGRAPHY

4.1 INTRODUCTION

Palynological analyses allow biostratigraphic division of Cretaceous and Tertiary strata from North Bylot Trough into four informally established palynological assemblage zones and one subzone in accordance with guidelines set in the North American Stratigraphic Code (NACSN, 1983) and the International Stratigraphic Guide (Hedburg, 1976).

These zones are the *Azonia cribrata* - *Aquilapollenites trialatus* (AA) zone, the *Porosipollenites porosus* - *Wodehouseia spinata* (PW) zone and the *Paraalnipollenites alterniporus* - *Pesavis parva* (PP) zone. Within the AA zone, subzone R is defined where assemblages contain 85% or more recycled palynomorphs.

Each zone is named after a selected pair of index species. Index species do not have to be present in every sample nor do they have to be restricted to the particular zone they are defining (Hedburg, 1976); this allows for a certain degree of interpretation when marking boundaries. The boundaries are marked as occurring between the uppermost sample of the lower zone and the lowermost sample of the upper zone. Significant taxa in the zones are listed in

Figure 4.1 with their known ranges based on available literature. Longer ranging taxa are recorded on the range chart only (Appendix C).

Species relevant to each assemblage zone are listed under the following subheadings: species (biostratigraphic or long ranging taxa) restricted to the biozone, species common in the zone but overlapping with other zones (biostratigraphic or long ranging), first occurrences and biostratigraphically important taxa which are present in multiple zones.

4.2.1 *AZONIA CRIBRATA* - *AQUILAPOLLENITES TRIALATUS* (AA) ZONE

Species restricted to this zone include *Pseudoplicapollis serenus* Tschudy, *Trudopollis conrector* Pflug, *Azonia cribrata* Wiggins, *Wodehouseia gracile* Samoilovitch) Pokrovskaya, *Aquilapollenites reticulatus* (Mtchedlishvili) Tschudy and Leopold and *Aquilapollenites trialatus* Rouse.

Species first appearing in this zone but not restricted to it include *Densoisporites velatus* (Weyland and Krieger) Krasnova, *Radialisporis radiatus* (Krutzsch) Krutzsch, *Echinatisporis varispinosus* (Pocock) Srivastava, *Hazaria* sheoparii Srivastava, Liliacidites leei Anderson, Porosipollis porosus Krutzsch, Triatriopollenites rurensis Pflug and Thomson, Monoporisporites singularis Sheffy and Dilcher, Ceratiopsis diebelli (Alberti) Vozzhennikova and Paleoperidinium kozlowski (Gorka) Davey.

Distribution

The stratotype for the AA Zone is from sections 14 and 15 (composite section B in Appendix A) including samples PB-101 to PB-104 of the Bylot Island Formation. The 55 metres of strata included in sections 14 and 15 (composite section B) are herein designated as the parastratoype for the biozone.

Age

The AA Zone is late Campanian to mid Maastrichtian in age. The sparse terrestrial assemblage contains a number of biostratigraphically significant species. These include Radialisporis radiatus (Krutzsch) Krutzsch (late Campanian to Paleocene), Echinatisporis varispinosus (Pocock) Srivastava (Aptian to Maastrichtian), Hazaria sheoparii Srivastava (late Campanian to Paleocene), Liliacidites leei Anderson (upper Campanian-Maastrichtian), Porosipollis porosus Krutzsch (late Campanian to late Maastrichtian), Triatriopollenites rurensis

Pflug and Thomson (Maastrichtian to Eocene), _Pseudoplicapollis serenus_ Tschudy (Santonian to Campanian), _Azonia cribrata_ Wiggins (upper Campanian to mid Maastrichtian), _Wodehouseia gracile_ Samoilovitch) Pokrovskaya (late Campanian to Maastrichtian), _Aquilapollenites reticulatus_ (Mtchedlishvili) Tschudy and Leopold (upper Campanian to lowest Paleocene), _Aquilapollenites trialatus_ Rouse (upper Campanian to Maastrichtian) and _Monoporisporites singularis_ Sheffy and Dilcher (Maastrichtian to Recent).

Of these species _Aquilapollenites trialatus_ Rouse is at its peak in the upper Campanian; Sweet _et al._ (1989) defined an (upper Campanian) _A. trialatus_ Zone in the Brackett Coal Basin, N.W.T.. _Aquilapollenites trialatus_ does extend into the early Maastrichtian in that basin (Sweet _et al._, 1989). This species is also dominantly reported from Campanian strata in Western Canada and the U.S.A. (B.D. Tschudy, 1973; Jarzen 1977 and 1982). _Pseudoplicapollis serenus_ Tschudy ranges no higher than the Campanian suggesting that lower strata in this zone are at least upper Campanian in age.

There is a notable absence of late Maastrichtian and younger triporate pollen such as _Paraalnipollenites alterniporus_ (Simpson) Srivastava and _Triporopollenites betuloides_ Pflug, and _Carpinipites ancipites_ (Wodehouse)

Srivastava. Azonia cribrata Wiggins ranges no higher than mid Maastrichtian on the North Slope of Alaska (Fredericksen et al., 1988). Wodehouseia gracile (Samoilovitch) Pokrovskaya, found in the upper strata of the biozone suggests an upper age of mid Maastrichtian. It is known to range from very late Campanian to late Maastrichtian (McIntyre, 1974; Wiggins, 1976). Sweet et al. (1989) defined a Wodehouseia gracile/Aquilapollenites parallelus Zone in the Brackett Coal Basin that is mid? Maastrichtian in age. The gradational contact with strata above the AA Zone (and the corresponding mid to late Maastrichtian age of the PW Zone) also restrict this zone to a mid Maastrichtian age.

The ranges of taxa in this zone suggest a late Campanian to mid Maastrichtian age. The AA Zone is in part equivalent McIntyre's (1974) microfloral zone H3 of Section CR 16B N-68 of Horton River (late Campanian to Maastrichtian). The late Campanian Brackett Coal Basin Aquilapollenites trialatus Zone of Sweet et al. (1989) is also characterized by occurrence Azonia parva Wiggins, A. recta (Bolkhovitina) Samoilovitch, Aquilapollenites insignis Mtchedlishvili and A. turbidus Tschudy. It is also equivalent to the Banks Island (late Campanian to mid Maastrichtian) Expressipollis, *Orbiculapollis*, *Deflandrea* *biapertura* (CVI) zone of Doerenkamp *et al.* (1976).

4.2.2 Subzone R

Important species restricted to this subzone include, *Cicatricosisporites pseudotripartitus* (Bolkhovitina) Dettmann, *Appendicisporites bifurcatus* Singh, *Appendicisporites* sp. cf. *Anemia macrorhiza* (Maljavkina) Bolkhovitina, *Appendicisporites problematicus* (Burger) Singh, *Stoverisporites lunaris* (Cookson and Dettmann) Burger and *Tappanispora reticulata* (Singh) Srivastava. Those species characteristic of the zone but not restricted to it include *Lycopodiacidites canaliculatus* Singh, *Klukisporites pseudoreticulatus* Couper, *Cingutriletes* sp. 1, *Aequitriradites spinulosus* (Cookson and Dettmann) Cookson and Dettmann and *Cerebropollenites mesozoicus* (Couper) Nilsson.

Biostratigraphically important species include *Ceriatopsis diebelli* (Alberti) Vozzhennikova and *Paleoperidinium kozlowski* (Gorka) Davey.

Distribution

The R subzone includes all Bylot Island Formation samples from Cape Hay and also sample PB-65 from Maud Bight. The presence late Cretaceous marine palynomorphs determine the recycled nature of the assemblages .

Age

Pollen in subzone R is recycled from mid or late Albian strata. The sparse terrestrial palynomorph assemblage does contain a number of biostratigraphically significant species. These include Cicatricosisporites pseudotripartitus (Bolkhovitina) Dettmann (upper Valanginian? to Cenomanian), Appendicisporites problematicus (Burger) Singh (Berriasian to late Albian or early Cenomanian), Appendicisporites bifurcatus Singh (Barremian to Cenomanian), Appendicisporites sp. cf. Anemia macrorhiza (Maljavkina) Bolkhovitina (mid to late Albian), Stoverisporites lunaris (Cookson and Dettmann) Burger (late Barremian to late Albian), Tappanispora reticulata (Singh) Srivastava (late Barremian to late Albian), Lycopodiacidites canaliculatus Singh (mid to late Albian), Klukisporites pseudoreticulatus Couper (late Jurassic to early Cenomanian) and Cingutriletes sp. 1 (Neocomanian? to late Albian or Cenomanian).

A number of species listed do not range beyond the late Albian including _Stoverisporites_ _lunaris_ (Cookson and Dettmann) Burger and _Tappanispora_ _reticulata_ (Singh) Srivastava. The occurrence of _Lycopodiacidites_ _canaliculatus_ Singh restricts the age of the source strata to mid or late Albian. _Cingutriletes_ sp. 1 notably has also been reported in strata from Southern Baffin Island and ranges up into the late Albian or Cenomanian (Burden and Langille, in press).

The source assemblage of subzone R is probably equivalent to the Aptian to Cenomanian? _Gemmatriletes_ _clavatus_ - _Cicatricosisporites_ _potomacensis_ Zone (GC Zone) of the Quqaluit Formation, S.E. Baffin Island (Burden and Langille, _in_ _press_), the mid to late Albian microfloral assemblage from Peace River Formation, Alberta (Singh, 1971), mid Albian assemblage in the Crossley Lakes Member (Langton Bay Formation), along the Horton River, N.W.T. (Brideaux and McIntyre, 1975), and the mid to late Albian assemblage from the Denton Shale Member of the Bokchito Formation in Southern Oklahoma (Wingate, 1980). It also has much in common with the mid to late Albian Christopher Formation assemblage of Ellef and Amund Ringnes Islands, N.W.T. (Hopkins, 1974).

The R subzone belongs within the AA Zone because of the presence of the dinoflagellate species _Ceriatopsis_ _diebelli_

(Alberti) Vozzhennikova and *Lejeunia kozlowski* (Gorka) Davey; whose mutual occurrence are excellent indicators for Maastrichtian strata (McIntyre 1974 and 1975; Doerenkamp *et al.*, 1976 and Bujak and Williams, 1978). Biozone AA contains these species plus other taxa indicative of a late Campanian to mid Maastrichtian age such as *Radialisporis radiatus* (Krutzsch) Krutzsch and *Porosipollis porosus* Krutzsch.

4.3 *POROSIPOLLIS POROSUS* - *WODEHOUSEIA SPINATA* (PW) ZONE

Species restricted to this zone include *Cicatricososporites eocenicus* (Selling) Jansonius and Hills, *Liliipollis* sp. 1, *Monosulcites* sp. 1, *Cranwellia striata* (Couper) Srivastava, *Cranwellia rumseyensis* Srivastava, *Triatriopollenites costatus* Norton, *Trudopollis* ex. gr. *arector*, Normapolles sp. 1, *Beaupreaidites angulatus* (Samoilovitch) Srivastava, *B. mollis* (Samoilovitch) Srivastava, *B.* sp. 1, *Azonia jacutense* (Samoilovitch) Samoilovitch, *Wodehouseia spinata* Stanley, *Wodehouseia quadrispina* Wiggins, *Singularia aculeata* Samoilovitch, *Mancicorpus trapeziforme* Mtchedlishvili and *Striasporonites* sp.1

Species first appearing but not restricted to this zone include Sequioapollenites paleocenicus Stanley, Fraxinoipollenites variabilis Stanley, Carpinipites ancipites (Wodehouse) Srivastava, Paraalnipollenites alterniporus (Zaklinskaia) Hills and Wallace, Trivestibulopollenites betuloides Pflug, Triporopollenites mullensis (Simpson) Rouse and Srivastava, Extratriporopollenites sp.2 of McIntyre, Ericaceoipollenites rallus Stanley, Dicellaesporites popovii Elsik, Brachysporites cotalis (Elsik and Jansonius) Norris and Pesavis parva Kalgutkar and Sweet.

Species characteristic of this zone but not restricted to it include Porosipollis porosus Krutzsch and Hazaria sheoparii Srivastava.

Distribution

The stratotype for the PW Zone is section 15 and 16 (composite section B of Appendix A) of the Sermilik Formation including samples PB-107, PB-113 and PB-117. The 200 metres of strata included in these sections (composite section B) are designated as the parastratotype for the PW Zone.

Age

The PW zone is mid to late Maastrichtian in age. Biostratigraphically significant species include Hazaria sheoparii Srivastava (upper Campanian to Paleocene), Liliipollis sp. 1 (upper Campanian to Maastrichtian), Porosipollis porosus Krutzsch (late Campanian to late Maastrichtian), Cranwellia striata (Couper) Srivastava (Maastrichtian), Cranwellia rumseyensis Srivastava (upper Campanian to Maastrichtian), Triatriopollenites costatus Norton (Campanian to Paleocene), Sequioapollenites paleocenicus Stanley (mid Campanian to Paleocene), Fraxinoipollenites variabilis Stanley (late Campanian to Paleocene), Carpinipites ancipites (Wodehouse) Srivastava (late Campanian to Eocene), Paraalnipollenites alterniporus (Zaklinskaia) Hills and Wallace (late Maastrichtian to Eocene), Trivestibulopollenites betuloides Pflug (Maastrichtian to Miocene), Triporopollenites mullensis (Simpson) Rouse and Srivastava (mid Maastrichtian to late Paleocene), Trudopollis conrector Pflug (Santonian to Maastrichtian), Extratriporopollenites sp.2 of McIntyre (late Campanian to late Maastrichtian), Polyvestibulopollenites trinus (Stanley) Norris (Maastrichtian to Miocene), Beaupreaidites angulatus (Samoilovitch) Srivastava (Maastrichtian), B. mollis (Samoilovitch) Srivastava (upper

Maastrichtian to Danian), Ericaceoipollenites rallus Stanley (upper Campanian to Paleocene), Azonia jacutense (Samoilovitch) Samoilovitch (Campanian to Maastrichtian in North America), Wodehouseia spinata Stanley (Maastrichtian to lower Paleocene), Wodehouseia quadrispina Wiggins (mid to upper Maastrichtian), Singularia aculeata Samoilovitch (late Campanian to Paleocene) and Mancicorpus trapeziforme Mtchedlishvili (late Campanian to Maastrichtian), Striasporonites sp.1 (Maastrichtian? to Recent), Dicellaesporites popovii Elsik (Paleocene to Oligocene) and Pesavis parva Kalgutkar and Sweet (late Maastrichtian to Paleocene).

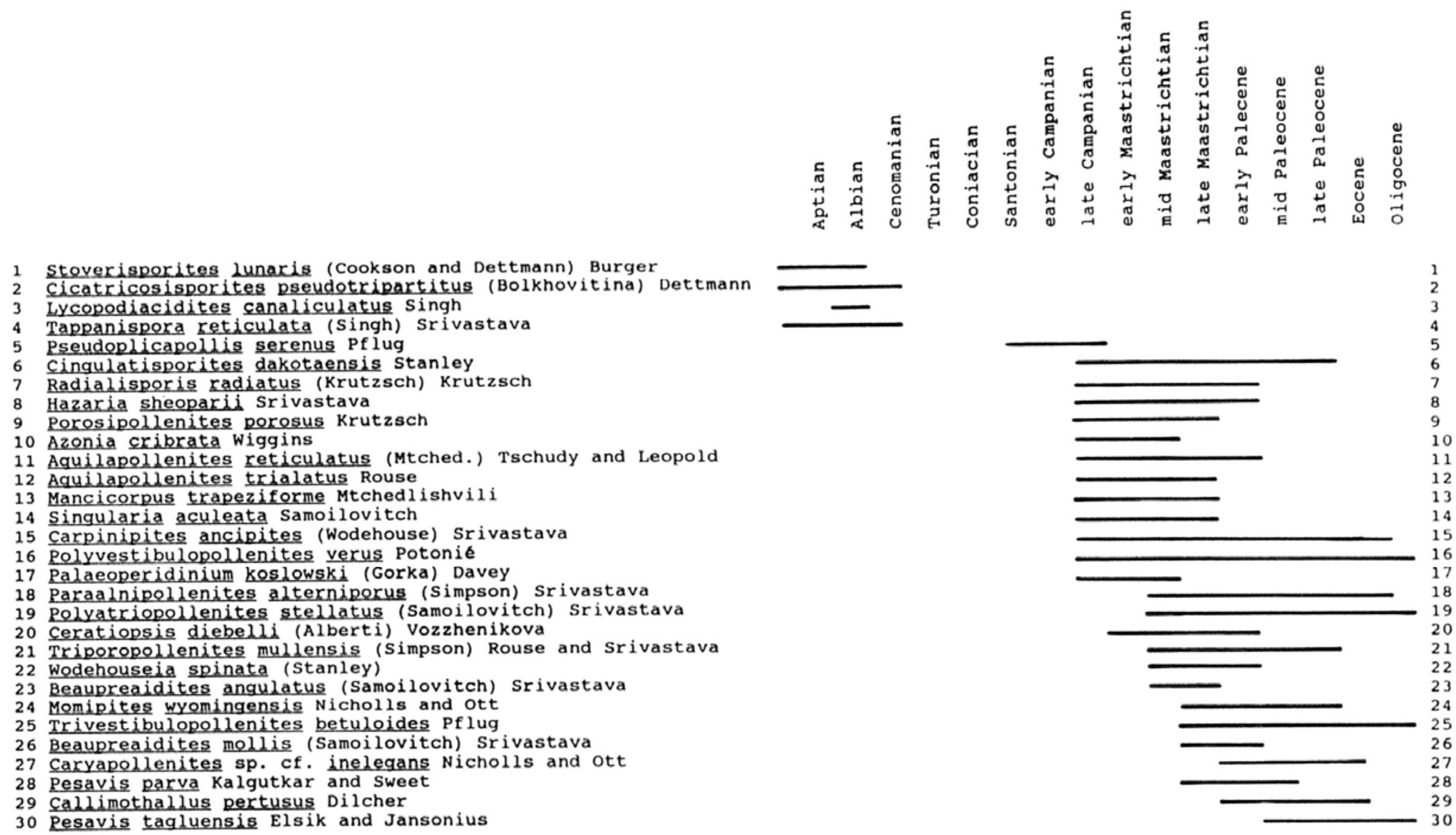

Table 4.1 Range chart of selected taxa.

The abundance of Porosipollis porosus Krutzsch in the PW assemblage suggests a mid or late Maastrichtian age. This species is restricted to late Campanian to mid Maastrichtian strata at Horton River, N.W.T. (McIntyre, 1974) and early to mid Maastrichtian strata at Banks Island (Doerenkamp et al., 1976). Sweet et al. (1989) define a mid or late Maastrichtian P. porosus Zone based on its first and last occurrences. P. porosus in this study ranges slightly lower than the zone it defines.

Cranwellia rumseyensis Srivastava is most common in the mid Maastrichtian strata of the Police Island Section (Sweet et al., 1989). Wodehouseia spinata Stanley is the most common binigeminate pollen in latest Cretaceous strata in North America. Wiggins (1976) describes it as abundant in upper Maastrichtian strata of Alaska's North Slope, although occasionally occurring in the lowest Paleocene. McIntyre (1974) and Wilson (1978) report it from Maastrichtian strata at Horton River and Police Island (Mackenzie River) respectively. Wodehouseia quadrispina Wiggins is restricted to mid and upper Maastrichtian strata (Wiggins, 1976). Sweet et al. (1989) report this taxon from the latest Maastrichtian Myrtipites scabratus/Aquilapollenites conatus var. collaris zone in the Brackett Coal Basin.

Several species first occurring in the PW zone including Paraalnipollenites alterniporus (Zaklinskaia) Hills and Wallace and Pesavis parva Kalgutkar and Sweet first appear in the late Maastrichtian (McIntyre, 1974; Kalgutkar and Sweet, 1988). This allows assignment of a mid to late Maastrichtian age for the PW zone.

The PW zone is in part equivalent to the Singularia aculeata - Pesavis parva (SP) zone in Eclipse Trough which is early late Maastrichtian (Sparkes, 1989). It also correlative with mid to late Maastrichtian microfloral division H3 of Section CR 17A N-68, Horton River (McIntyre, 1974), the late Maastrichtian "Deflandrea" diebelli, Palaeoperidinium pyrophorum (CVII) zone of Banks Island (Doerenkamp et al., 1976) and the mid or late Maastrichtian Porosipollis porosus and latest Maastrichtian Myrtipites scabratus/Aquilapollenites conatus var. collaris zones of the Police Island Section, Mackenzie River, Brackett Coal Basin, N.W.T. (Sweet et al., 1989). The mid Maastrichtian assemblage in the Colville River region, North Slope, Alaska (Fredericksen et al., 1988), also resembles the PW zone.

4.4 *PARAALNIPOLLENITES ALTERNIPORUS* - *PESAVIS PARVA* (PP) ZONE

Species restricted to this zone include *Striatopollis tectatus* Leffingwell, *Tricolporites* sp. 1, *Tricolporites* sp. 2, *Ulmoideipites krempi* Anderson, *Momipites wyomingensis* Nichols and Ott, *Caryapollenites* sp. cf. *inelegans* Nicholls and Ott, *Complexiopollis* sp., *Aquilapollenites augustus* Srivastava, *Aquilapollenites* sp. cf. *immiser*, *Reduviasporonites* sp. 1, *Diporicellasporites* sp. 1, *Diporicellasporites* sp. cf. *stacyi*, *Staphlosporonites delumbus* Norris, *Pesavis tagluensis* Elsik and Jansonius, fungal hyphae type F, *Phragmothyrites* sp., *Callimothallus pertusus* Dilcher, *Plochmopeltinites masonii* Cookson and *Microthallites lutosus* Dilcher.

Those becoming more common in the PP Zone include *Sequioapollenites paleocenicus* Stanley, *Carpinipites ancipites* (Wodehouse) Srivastava, *Paraalnipollenites alterniporus* (Zaklinskaia) Hills and Wallace, *Trivestibulopollenites betuloides* Pflug, *Triporopollenites mullensis* (Simpson) Rouse and Srivastava, *Polyvestibulpollenites verus* Potonié, *Ericaceoipollenites rallus* Stanley, *Monoporisporites singularis* Sheffy and

Dilcher, Dicellaesporites popovii Elsik, Brachysporites cotalis (Elsik and Jansonius) Norris, Diporicellasporites reticulatus Elsik and Dilcher, Fungal Hyphae Type C and Pesavis parva Kalgutkar and Sweet. A significant species continuing into the zone is Hazaria sheoparii Srivastava.

Distribution

The PP Zone lies within the Navy Board and Aktineq Formations. The stratotype for the PP Zone includes PB-4, PB-9, PB-12, PB-16, PB-62 and PB-64 of sections 1 and 4 (in composite section C of Appendix A). The parastratotype of the zone includes the 200 to 340 metre interval in composite section C (Appendix A).

Age

Based on rich terrestrial assemblages the PP Zone is early to mid Paleocene in age. Biostratigraphically important species include Hazaria sheoparii Srivastava (late Campanian to Paleocene), Sequioapollenites paleocenicus Stanley (mid Campanian to Paleocene), Carpinipites ancipites (Wodehouse) Srivastava (late Campanian to Eocene), Polyvestibulpollenites verus Potonié (late Campanian to Oligocene), Ericaceoipollenites rallus Stanley (late Campanian to late

Paleocene), Ulmoideipites krempi Anderson, Beaupreaidites mollis (Samoilovitch) Srivastava (late Maastrichtian to Danian), Pesavis parva Kalgutkar and Sweet (Maastrichtian to early Paleocene), Striatopollis tectatus Leffingwell (Maastrichtian), Momipites wyomingensis Nichols and Ott (Maastrichtian to late Paleocene), Polyatriopollenites stellatus (Samoilovitch) Srivastava (Maastrichtian to upper Miocene), Paraalnipollenites alterniporus (Zaklinskaia) Hills and Wallace (late Maastrichtian to Eocene), Trivestibulopollenites betuloides Pflug (Maastrichtian to Miocene), Triporopollenites mullensis (Simpson) Rouse and Srivastava (mid Maastrichtian to late Paleocene), Caryapollenites sp. cf. inelegans (Paleocene to Eocene), Pesavis tagluensis Elsik and Jansonius (early Paleocene to Oligocene), Dicellaesporites popovii Elsik (Paleocene to Oligocene), Diporicellasporites reticulatus Elsik and Dilcher (mid Eocene) and Callimothallus pertusus Dilcher (Paleocene to mid Eocene).

Of these species Paraalnipollenites alterniporus occurs in older strata but becomes abundant in this zone. The Paraalnipollenites alterniporus zone of the Police Island Section (Sweet et al., 1989) is defined as an increase in the abundance of this species (combined with a lack of distinctive upper Cretaceous taxa) and is thought to be earliest Paleocene in age. According to McIntyre (1989) the coexistence of abundant _P. alterniporus_ and _Triporopollenites mullensis_ (Simpson) Rouse and Srivastava is an indicator of Paleocene strata at Somerset Island. Associated occurrences of _Momipites_ and _Caryapollenites_ with these species is also typical of the Paleocene. A number of other species typical of the Paleocene also become abundant in the PP zone including _Carpinipites ancipites_ (Wodehouse) Srivastava _Trivestibulopollenites betuloides_ Pflug, _Polyvestibulpollenites verus_ Potonié, _Ericaceoipollenites rallus_ Stanley, and _Sequioapollenites paleocenicus_ Stanley. On Banks Island, N.W.T., frequent occurrence of _Triporopollenites mullensis_ (Simpson) Rouse and Srivastava, _Alnipollenites_ (_Polyvestibulopollenites_) sp., _Ericaceoipollenites_ sp., _Ulmipollenites_ sp. and predominant _Taxodiaceaepollenites hiatus_/_Sequioapollenites_ sp., _Laevigatosporites ovatus_ (_L. hardtii_ in this study) and _Stereisporites antiquasporites_, are characteristic of the Paleocene TIa zone (Doerenkamp _et al._, 1976). The disappearance of _Hazaria sheoparii_ delimits the end of the TIa zone on Banks Island (Doerenkamp _et al._, 1976). _H._

sheoparii occurs in Navy Board and Aktineq strata in this study.

Pesavis parva Kalgutkar and Sweet and Pesavis tagluensis Elsik and Jansonius are excellent index fossils; P. parva ranges from late Maastrichtian to early Paleocene and P. tagluensis from early Paleocene to Oligocene (Kalgutkar and Sweet, 1988). Overlapping occurrence of the two species, as at Maud Bight is indicative of lower to mid Paleocene strata. Callimothallus pertusus Dilcher occurs in Paleocene to mid Eocene strata (Rouse et al., 1990; Norris, 1986) and Dicellaesporites popovii Elsik occurring in Paleocene to Oligocene strata (Elsik, 1981; Norris, 1986) may turn out to be good Paleogene indicators in the Canadian Arctic.

Diporicellasporites reticulatus Elsik and Dilcher, Staphlosporonites delumbus Norris, Plochmopeltinites masonii Cookson and Microthallites lutosus Dilcher have never been reported in strata older than Eocene; the range of these species is herein extended into the Paleocene. This is supported by the presence of early to mid Paleocene palynomorphs and absence of late Paleocene or younger palynomorphs such Pistillipollenites mcgregorii (Rouse) Elsik. The macroflora present in strata within this zone are of probable early to middle Paleocene age (Basinger, personal communication, 1988) supporting the microfloral diagnosis.

Correlative biozones include the very similar Paleocene TIa zone, Banks Island (Doerenkamp *et al.*, 1976), the lowest Paleocene *Paraalnipollenites alterniporus* zone of the Police Island Section, Mackenzie River, N.W.T. (Sweet *et al.*, 1989) and the lower Paleocene *Trivestibulopollenites betuloides* - *Pesavis parva* Zone (TP Zone) of the Cape Searle Formation, S.E. Baffin Island (Burden and Langille, *in press*). Equivalent Arctic assemblages include pollen from lower Paleocene strata, Colville River, North slope, Alaska (Fredericksen *et al.*, 1988). The PP zone also resembles somewhat the lower Paleocene assemblage in the Fort Union Formation, South Dakota (Stanley, 1965).

CHAPTER 5 BASIN AND REGIONAL HISTORY

5.1 BASIN HISTORY

The Cretaceous and Tertiary geological history of the North Bylot Trough is established from lithological and facies analysis of the strata, structural relationships and palynology. The basin depositional and tectonic history was divided into three phases by Benham and Burden (1990). Hassel strata deposited during Phase 1 (mid to late Albian) are part of a series of sheet sandstones that formed along the continental margin from Labrador to Jones Sound in the lower Cretaceous due to crustal sag (Smith *et al.*, 1989). The Hassel in Eclipse Trough is described by Miall *et al.* (1980) as having a fluviatile setting; this is based on presence of coal beds and a lack of glauconite and marine fossils. Kerr (1980) also postulated that a sheet of fluviatile sediment was deposited on the low lying craton prior to formation of Lancaster Aulacogen and opening of Baffin Bay. The presence of marine trace fossils in Hassel strata at Eclipse Trough suggest depositional conditions in the Lancaster Sound region may have been at least partly marine during Hassel time. Most of the Hassel strata in North Bylot Trough has been removed;

it only preserved in isolated down-faulted blocks and topographic lows.

Phase 2 includes the deposition of the Bylot Island and Sermilik Formations after a 25-30 million year hiatus. Recycled terrestrial palynomorphs in the Bylot Island and Sermilik Formations suggest that Hassel strata in the North Bylot Trough were reworked into these younger deposits. The Bylot Island beds were laid down during a marine transgression. The bioturbated grey mudstone of the Bylot Island Formation (late Campanian-mid Maastrichtian) was mainly deposited on a shallow marine shelf. These strata grade up into marine foreshore and beach deposits of glauconitic arenites of the (mid to late Maastrichtian) Sermilik Formation. The uppermost Sermilik Formation contains interbedded gravel megaripples, coaly sandstones, mudstones and a debris flow deposit from a shoreline marsh.

The Bylot Island Formation resembles equivalent mudstones in Eclipse Trough. In contrast the Maud Bight outcrops of the Sermilik Formation have different depositional settings from those in Eclipse Trough. According to Sparkes (1989) the Sermilik Formation at Eclipse Trough was deposited in submarine fan and braid delta complexes as compared to foreshore and beaches in North Bylot Trough. Both sedimentary packages, however, do show a similar coarsening up trend. The change from depositionally and compositionally equivalent strata is a result of increasing isolation of the two basins as the uplifting Byam Martin Mountains separated North Bylot Trough and Eclipse Trough (Benham and Burden, 1990). This increased tectonism probably marks the onset of rifting in Lancaster Sound and North Baffin Bay. The sea floor spreading in the Labrador Sea which began in the Campanian (S.P. Srivastava, 1978) was preceded by a period of rifting (Henderson et al., 1980) that extended into Baffin Bay. The presence of Aptian to early Cenomanian nonmarine sediments in southeast Baffin Island half-grabens (Burden and Langille, 1990), the Nûgssuaq Embayment in western Greenland (Schiener, 1977) and Hassel strata in North Bylot Trough support minor rifting well before opening of Baffin Bay and considerably more rifting by the Maastrichtian (Table 5.1). The existence of 200+ metres of regressive Phase 2 strata suggests that sea level fall in conjunction with tectonic activity affected basin fill at this time. An angular unconformity marks the end of Phase 2 in North Bylot Trough.

Phase 3 contains rocks deposited during a episode of increased tectonism in the lower to middle Paleocene. Continuing uplift of the Byam Martin Mountains resulted in an increasing depositional gradient; braided stream, flood plain and/or lacustrine? strata (Navy Board Formation) are overlain by a 200+ metre wedge of alluvial conglomerate and meandering stream deposited strata (Maud Bight Member and Aktineq sandstone). Increased tectonic activity is reflected in part by the deposition and deformation of the Navy Board and Atkineq Formations. The folding and faulting in these rocks correlate with the main rifting and volcanism in Baffin Bay (S.P. Srivastava, 1978; Peirce, 1982; S.P. Srivastava and Tapscott, 1986). Based largely on seismic studies, Beh (1975) suggested the main rifting in Lancaster Aulacogen occurred during the middle Eocene. Kerr (1980), tying in Eclipse Trough strata to rocks in the aulacogen, stated that rifting began in the latest Cretaceous and had ended by the Miocene/Pliocene. Tectonism in the southern end of North Bylot Trough actually ended in the middle Paleocene after the boulder beds of the Maud Bight Member were deposited. North Bylot Trough likely separated from Lancaster Aulacogen about this time when North Baffin Fault formed 10 kilometres offshore (Benham and Burden, 1990).

Exposures of Cretaceous and Tertiary strata at North Bylot Trough are restricted to the margin of the basin whereas Eclipse Trough strata are exposed over a larger area.

This results in North Bylot Trough being dominated by proximal depositional facies, such as the boulder beds of the Maud Bight Member. Similar strata are located along the rim of Eclipse Trough but are a minor component. In spite of this, strata in North Bylot Trough are equivalent to those in Eclipse Trough (Table 5.1). Pronounced angular unconformities at Maud Bight can all be found in Eclipse Trough though they may be more subdued. All Maud Bight strata are near the North Bylot Trough margins and therefore more subject to folding and faulting through the basin's history than Eclipse Trough. Tectonic activity in Lancaster Aulacogen and vicinity is reflected more strongly in the smaller North Bylot Trough.

One notable difference between Eclipse Trough and North

Table 5.1 Regional stratigraphic correlation

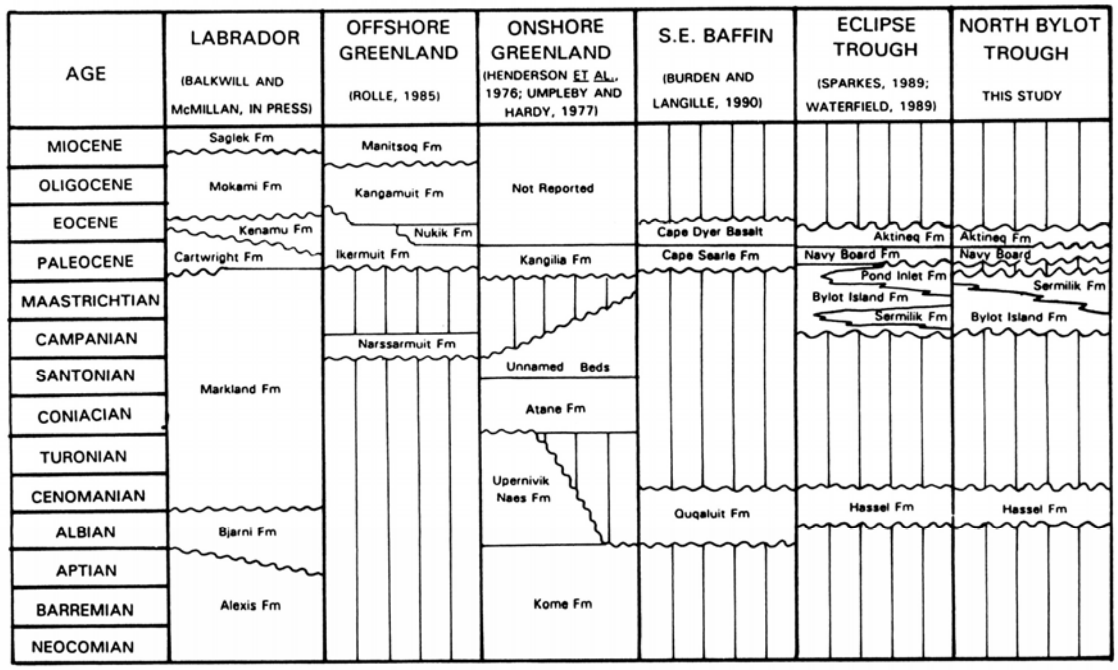

Table 5.1 Regional stratigraphic correlat

Bylot Trough is the presence of an two regressive sedimentary packages in Eclipse Trough. Sparkes (1989) recognizes in Eclipse Trough a late Campanian-early Maastrichtian regressive event resulting in the Sermilik Formation braid delta and submarine fan complex. Waterfield (1989) notes a second regressive deposit; the lower Paleocene Pond Inlet Formation which overlies the Bylot Island Formation. Basin fill in Eclipse Trough is thought to be complexly related to regional tectonism and sea level rise and fall (Sparkes, 1989; Waterfield, 1989). Biostratigraphic control is poor in the Pond Inlet Formation and Burden (1991, pers. comm.) feels the strata may be upper Maastrichtian. If this is true, it calls into question the assignment of the Sermilik Formation to the single mid to upper Maastrichtian regressive package at North Bylot Trough. Assuming for a moment that the package at Maud Bight is equivalent to the Pond Inlet Formation, deposition of the sandstone would have begun earlier in Eclipse Trough than at North Bylot Trough. If Pond Inlet Formation was deposited at Maud Bight it may have been removed prior to deposition of the Navy Board and Aktineq Formation. Lancaster Sound may contain strata equivalent to the Pond Inlet Formation.

5.2 PETROLEUM GEOLOGY

Petroleum exploration in the eastern Arctic is limited by weather conditions, sea ice, high exploration costs and environmental concerns. Because of this, no wells have been drilled in the vicinity of Bylot Island, however several been drilled off southern Baffin Island and southwest Greenland. Numerous seismic studies have been done in Lancaster Sound and nearby in Baffin Bay; Smith *et al.* (1989) estimate 60,000 line-kilometres of seismic data have been recorded by various government surveys and petroleum companies. Seismic studies have delineated over 30 structural traps, these possibly containing up to 10 billion barrels of oil (Smith *et al.*, 1989). The best structural traps are upthrown and tilted fault blocks (formed during initial rifting) which are draped with Tertiary sediments, but others include anticlinal structures formed by transcurrent faulting and possibly evaporite diapirs (Smith *et al.*, 1989). Harper and Woodcock (*in* Smith *et al.*, 1989) also note onlapping, subunconformity truncation and depositional edges in Lancaster Sound as potential stratigraphic traps.

Oil seeps and petroliferous strata off the eastern coast of Baffin Island (Scott Inlet, Buchan Gulf and Home Bay) are described in several studies (Levy, 1978; MacLean and Falconer, 1979; MacLean and Williams, 1983). MacLean et al. (1981) report marine organic rich mudstone of Campanian age in samples recovered from the Baffin shelf in Buchan Gulf and Home Bay as possible source rocks for the seeps. The equivalent strata in North Bylot Trough are the marine mudstones of the Bylot Island Formation. These contain abundant marine palynomorphs and may be good source rocks in Lancaster Sound. Marine organic material tends to generate oil rich hydrocarbons while terrestrial organic debris yields gas rich hydrocarbons. Through the use of sequence stratigraphy two unnamed transgressive marine sequences and a possible lacustrine deposit have been identified as potential source beds in Lancaster Sound (Smith et al., 1989). Other strata in North Bylot Trough with potential as source rocks are the shales of the Navy Board and Aktineq Formations. Palynological preparations of shales in the Navy Board and Aktineq are rich in terrestrial palynomorphs, leaf cuticle and wood fragments; hand samples often contain abundant in woody debris. A sample collected for geochemical analysis (McWhae, 1981) from a "Tertiary" outcrop at Maud Bight (either Navy Board Formation or Aktineq sandstone) contained 1.8% total organic carbon (T.O.C.); the dominant organic type was thermally immature amorphous matter. Mature amorphous organic matter generates oil rich hydrocarbons.

Palynomorph exine colouration as an indicator of relative geothermal maturity is known as a thermal alteration index (T.A.I.). The T.A.I. of specimens recovered from upper Cretaceous and Tertiary strata in this study were (on a scale of 1-5) 1 to 1+ which is immature. Recycled lower Cretaceous palynomorphs from the Cape Hay strata of the Bylot Island Formation were immature to marginally mature (2- to 2+). Upper Cretaceous and Tertiary strata in North Bylot Trough were never buried deeper than a few hundred metres; similar rocks buried in Lancaster Sound would probably generate hydrocarbons.

Potential reservoir rocks in North Bylot Trough exist in the Hassel, Sermilik and Aktineq Formations. The Hassel Formation in the North Bylot Trough consists of porous clean arenites, limited to isolated pods and down-faulted blocks. A thicker and more continuous sequence likely exists in Lancaster Sound where it rests unconformably on Palaeozoic carbonates and Archean migmatites. It is overlain and potentially sealed by the Bylot Island mudstones. The

Sermilik Formation at Maud Bight consists almost entirely of very porous medium to coarse grained quartz arenite up to 200 metres thick. These beds likely extend into Lancaster Sound and show excellent reservoir potential. The Sermilik Formation is overlain by the shales of the Navy Board Formation creating a subunconformity truncation with the best trapping potential in the North Bylot Trough. The conglomerates and channel sands of what is likely Aktineq sandstone show fair to excellent porosity (22% porosity and 72 md permeability in one sample according to McWhae (1981)). It should be noted, however, that the Tertiary sandstones in North Bylot Trough tend to be clay-rich and pore space may be clogged during diagenesis.

Potential source and reservoir rocks are present in North Bylot Trough but unfortunately they are immature. Sufficient burial of equivalent strata in Lancaster Sound would generate hydrocarbons in the region. Numerous structural and stratigraphic traps in Lancaster Sound have been defined by seismic studies. Similar basins around the world including the Anadarko Basin in Southeastern United States, Viking graben in the North Sea and Gulf of Suez (Kerr, 1980) have yielded large amounts of hydrocarbons and may provide analogues for exploration in Lancaster Sound

CHAPTER 6 CONCLUSIONS

The Cretaceous and Tertiary depositional and tectonic history of North Bylot Trough consists of three phases. During the first phase sheet sands of the fluvial Hassel Formation were deposited across low-lying craton during the late Albian. Onset of rifting in Lancaster Sound and Baffin Bay is marked by the deposition of regressive Phase 2 strata. The shallow marine late Campanian to mid Maastrichtian Bylot Island Formation is conformably and gradationally overlain by foreshore and beach sandstones of the mid to late Maastrichtian Sermilik Formation. Increased tectonism in Phase 3 is reflected by the presence of a thick alluvial wedge with the coarsest material restricted to the basin margin. The early to mid Paleocene flood plain of the Navy Board Formation is conformably to unconformably overlain by thick alluvial fan (Maud Bight Member of the Aktineq Formation) and meandering stream sediments (Aktineq sandstone). Strata in North Bylot and Eclipse Trough are equivalent and differ only in that proximal depositional environments rather than distal are represented in North Bylot Trough. Basin fill, as in Eclipse Trough (Sparkes, 1989; Waterfield, 1989), is controlled by local tectonism (formation of Lancaster Aulacogen) and global changes in sea level.

Based on terrestrial palynomorphs three biozones and one subzone were defined for strata at Maud Bight. The *Aquilapollenites trialatus*-*Azonia cribrata* (AA) zone ranges from upper Campanian to mid Maastrichtian. Subzone R within the AA zone consists dominantly of recycled palynomorphs typical of the mid to late Albian strata and presumably from the Hassel Formation. The other biozones are the mid to upper Maastrichtian *Porosipollenites porosus*-*Wodehouseia spinata* (PW) zone and the lower to mid Paleocene *Paraalnipollenites alterniporus*-*Pesavis parva* (PP) zone.

North Bylot Trough contains the only onshore expression of the stratigraphic sequence within Lancaster Sound and allows some tentative evaluations of offshore hydrocarbon potential. Organic matter from North Bylot Trough was found to be thermally immature to marginally mature. With sufficient burial in Lancaster Sound, the organic-rich marine Bylot Island Formation and terrestrial Navy Board and Aktineq Formations would generate hydrocarbons. Porous sandstones of the Hassel and Sermilik are potential reservoirs in Lancaster Sound; the Tertiary sandstones and conglomerates of the Navy Board and Aktineq Formations are clay-rich and may have limited porosity. Seismic studies have defined numerous structural and stratigraphic traps within Lancaster Aulacogen. Similar basins in the North Sea and Gulf of Suez have yielded large amounts of hydrocarbons and may provide analogous exploration models for Lancaster Sound.

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PLATES

Specimens 1 and 2 were identified by J. Basinger, University of Saskatchewan. Except for figures 1-5 on plate 1, specimens were photographed in interference contrast. Palynological specimen figures list species name, palynology processing number with slide number in brackets, field sample number, microscopic coordinates and magnification.

PLATE 1

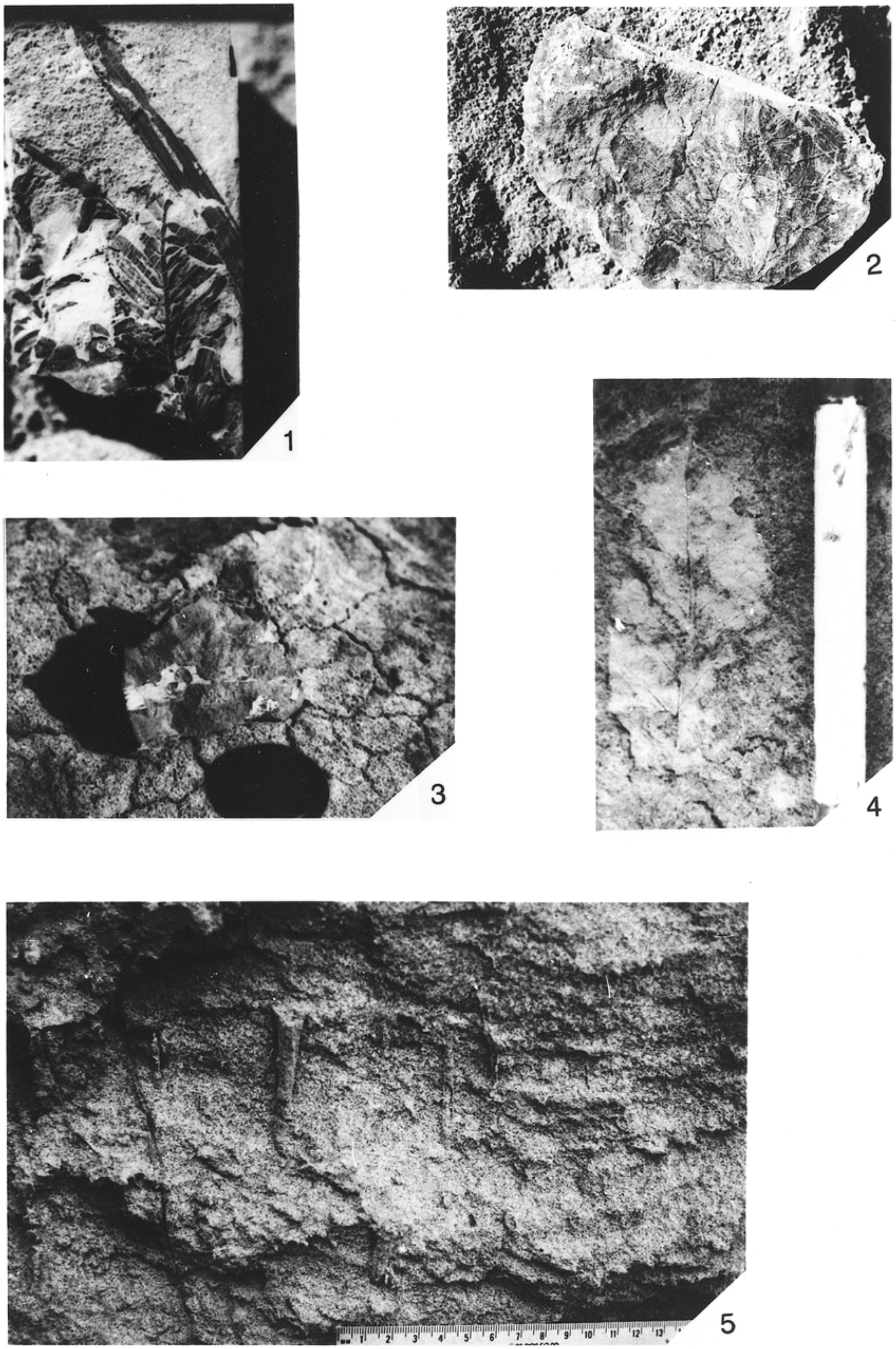
Figure 1. Equisetum sp. and leaf of Metasequoia occidentalis (Newberry) Chaney; PB-74, Maud Bight Member.

Figure 2. Trochodendroides arctica (Heer) Berry; PB-74, Maud Bight Member.

Figure 3. Alnus sp.; PB-145, Navy Board Formation.

Figure 4. Teredo bored permineralized wood; PB-37, Sermilik Formation.

Figure 5. Skolithos; Section 4, Sermilik Formation. Ruler is 15 cm. long.



PL 1

PLATE 2

Figure 6. Cingutriletes pococki (Burger) Burden and Hills; 89052 (2), PB-65, 81.7x7.5, 1060x.

Figure 7. Cingutriletes sp. 1 90004 (1), PB-127, 90.8x14.5, 1060x.

Figure 8. Densoisporites velatus (Weyland and Krieger) Krasnova; 89067 (2), PB-104, 87.4x2, 1060x.

Figure 9. Antulsporites distaverrucosus (Brenner) Archangelsky and Gamerro; 89052 (2), PB-65, 93x9, 660x.

Figure 10. Appendicisporites bifurcatus Singh; 90002 (1), PB-124, 95.7x9.3, 850x.

Figure 11. A. sp. cf. Anemia macrorhyza (Maljavkina) Bolkhovitina; 90002 (1), PB-124, 99.1x11, 1060x.

Figure 12. A. matesovae (Bolkhovitina) Norris; 89052 (1), PB-65, 105.6x10, 660x.

Figure 13. A. problematicus (Burger) Singh; 90002 (1), PB-124, 93.8x17.1, 1060x.

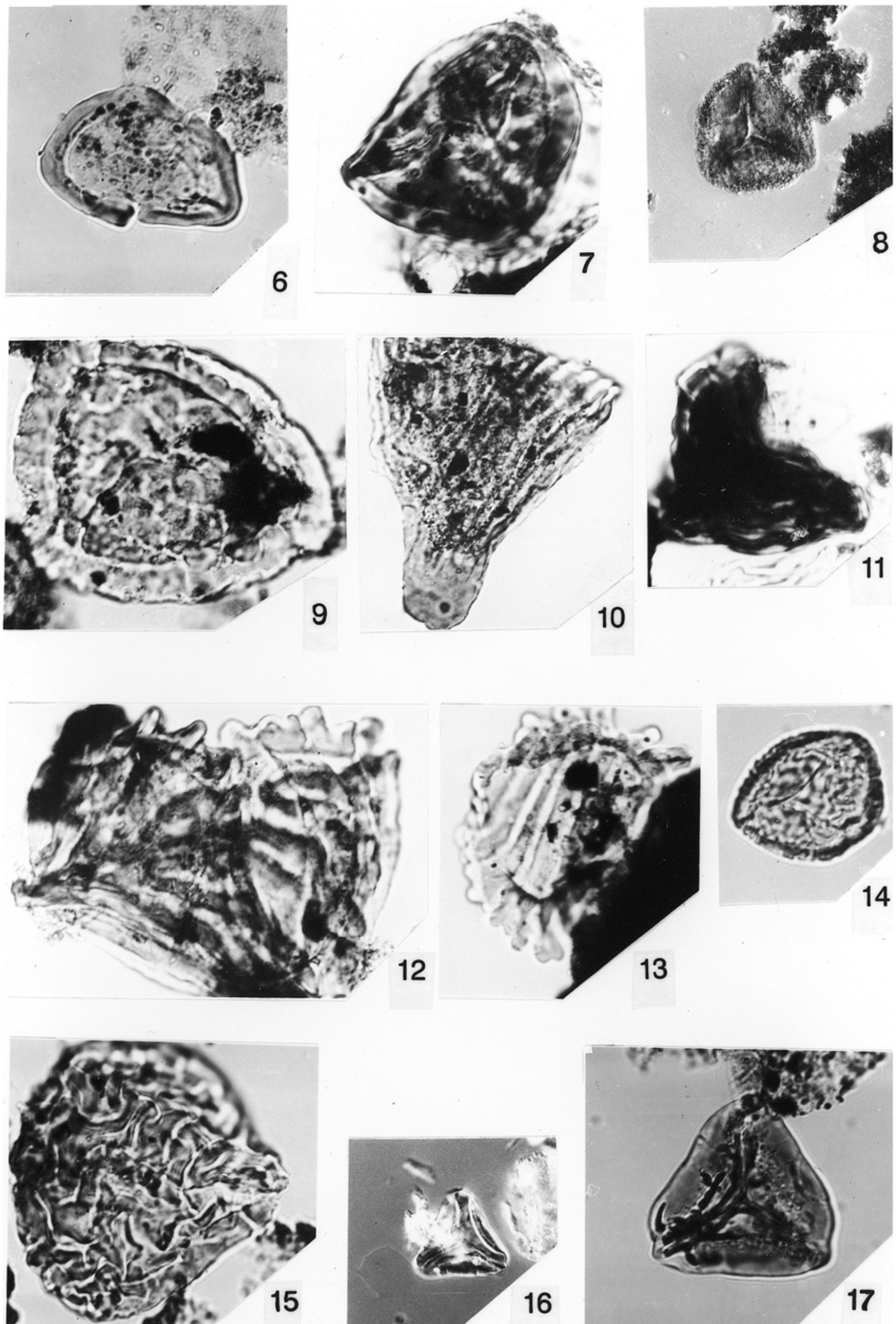
Figure 14. Camarozonosporites ambigens (Fradkina) Playford; 89068 (1), PB-107, 74x5.6, 1060x.

Figure 15. Hamulatisporis hamulatis Krutzsch; 89045 (1), PB-35, 90.5x13.3, 1060x.

Figure 16. Gleicheniidites senonicus Ross; 89052 (1), PB-65, 104.2x7.5, 660x.

Figure 17. G. sp. cf. circinidites (Cookson) Dettmann; 90002 (1), PB-124, 81.9x10, 1060x.

Figure 18. O. baculata Singh; 90002 (1), PB-124, 87.8x6, 1060x.



PL 2

PLATE 3

Figure 19. Tappanispora reticulata (Singh) Srivastava; 90003 (1), PB-125, 83.3x14, 1060x.

Figure 20. Lycopodiacidites canaliculatus Singh; 89052 (1), PB-65, 84.8x7.3, 1060x.

Figure 21. Cicatricosisporites pseudotripartitus (Bolhovitina) Dettmann; 90002 (1), PB-124, 79x9.2, 1060x.

Figure 22. C. australiensis (Cookson) Potonié; 90004 (1) PB-127, 94.8x6.5, 1060x.

Figure 23. C. subrotundus Brenner; 89071 (1), PB-117, 87x12.3, 1300x.

Figure 24. Radialisporis radiatus (Krutzsch) Krutzsch; 89071 (1) PB-117, 1060x.

Figure 25. Klukisporites pseudoreticulatus Couper; 89052 (1), PB-65, 83.8x19.5, 660x.

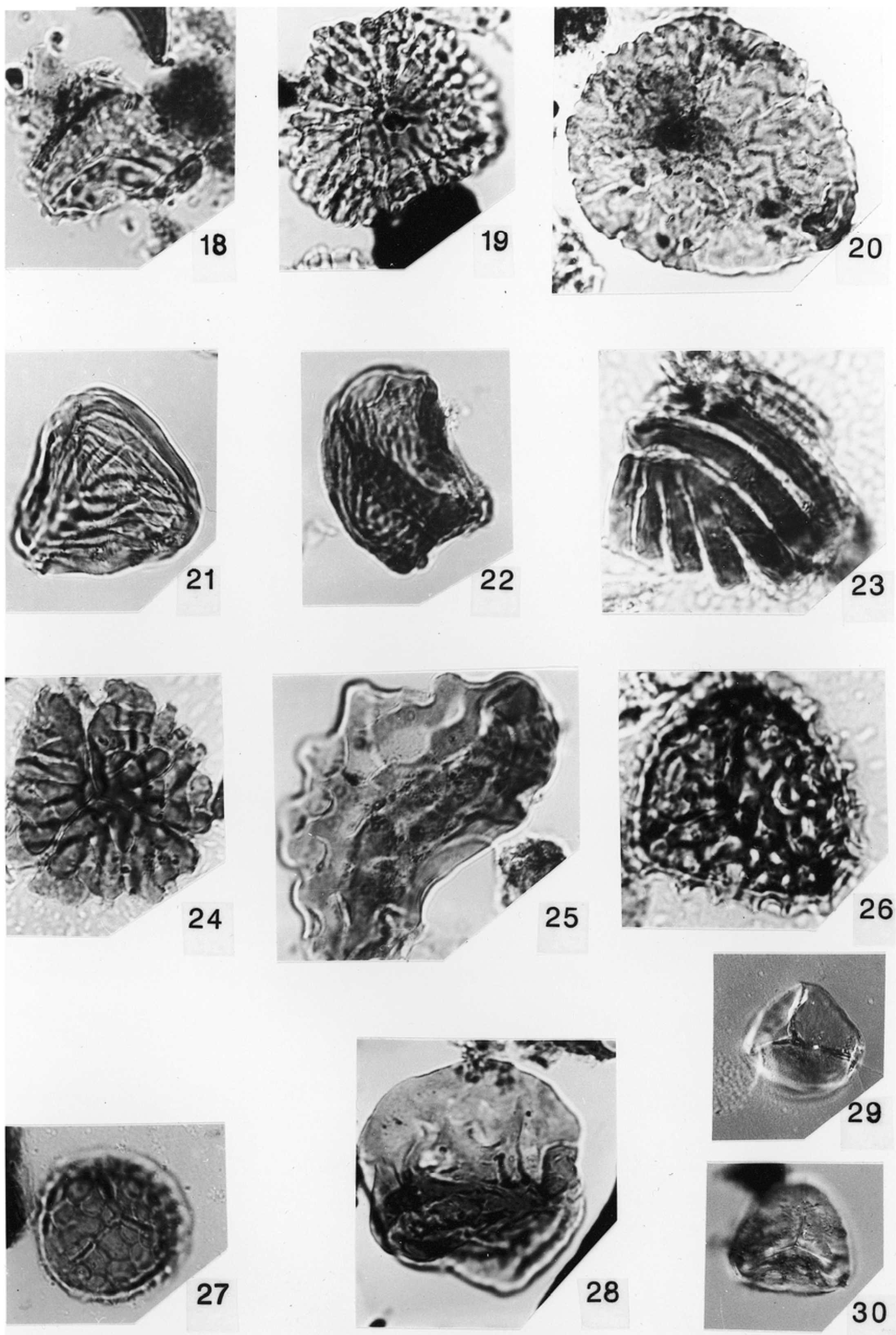
Figure 26. Retitriletes austroclavitides (Cookson) Krutzsch; 89071 (1), PB-117, 94.8x9.2, 1600x.

Figure 27. R. reticulumsporites (Rouse) Burden and Hills; 89071 (1), PB-117, 101.4x10, 1060x.

Figure 28. Stoverisporites lunaris (Cookson and Dettmann) Burger; 90003 (1), PB-125, 94.3x14.8, 660x.

Figure 29. Biretisporites potoniaei Delcourt and Sprumont; 89070 (1), PB-113, 103.0x9.2, 660x.

Figure 30. Todisporites minor Couper; 90002 (1), PB-124, 86.6x9, 660x.



PL 3

PLATE 4

Figure 31. Stereisporites antiquasporites (Wilson and Webster) Dettmann; 89046 (1), PB-40, 78.5x9, 1060x.

Figure 32. S. regium (Drozhastchich) Drugg; 89047 (1), PB-41, 85.4x12.2, 1060x.

Figure 33. Cingulatisporites dakotaensis Stanley; 89068 (1), PB-107, 90.1x10, 1060x.

Figure 34. Deltoidospora halli Miner; 89068 (1), PB-107, 101.6x10.3, 1060x.

Figure 35. D. diaphana Wilson and Webster; 89018 (2), PB-91, 102.7x15.1, 660x.

Figure 36. D. psilostoma Rouse; 90002 (1), PB-124, 98.5x12.3, 660x.

Figure 37. Cyathidites australis Couper; 90007 (1), PB-136, 99.3x8, 660x.

Figure 38. C. minor Couper; 89068 (1), PB-107, 99.3x8, 1060x.

Figure 39. Gemmatriletes clavatus Brenner; 90007 (1) PB-136, 79.3x7.5, 660x.

Figure 40. Osmundacities wellmanii Couper; 89071 (3), PB-117, 90.5x5.2, 660x.

Figure 41. Baculatisporites comaumensis (Cookson) Potonié; 90071 (1), PB-117, 90.5x5.2, 1060x.

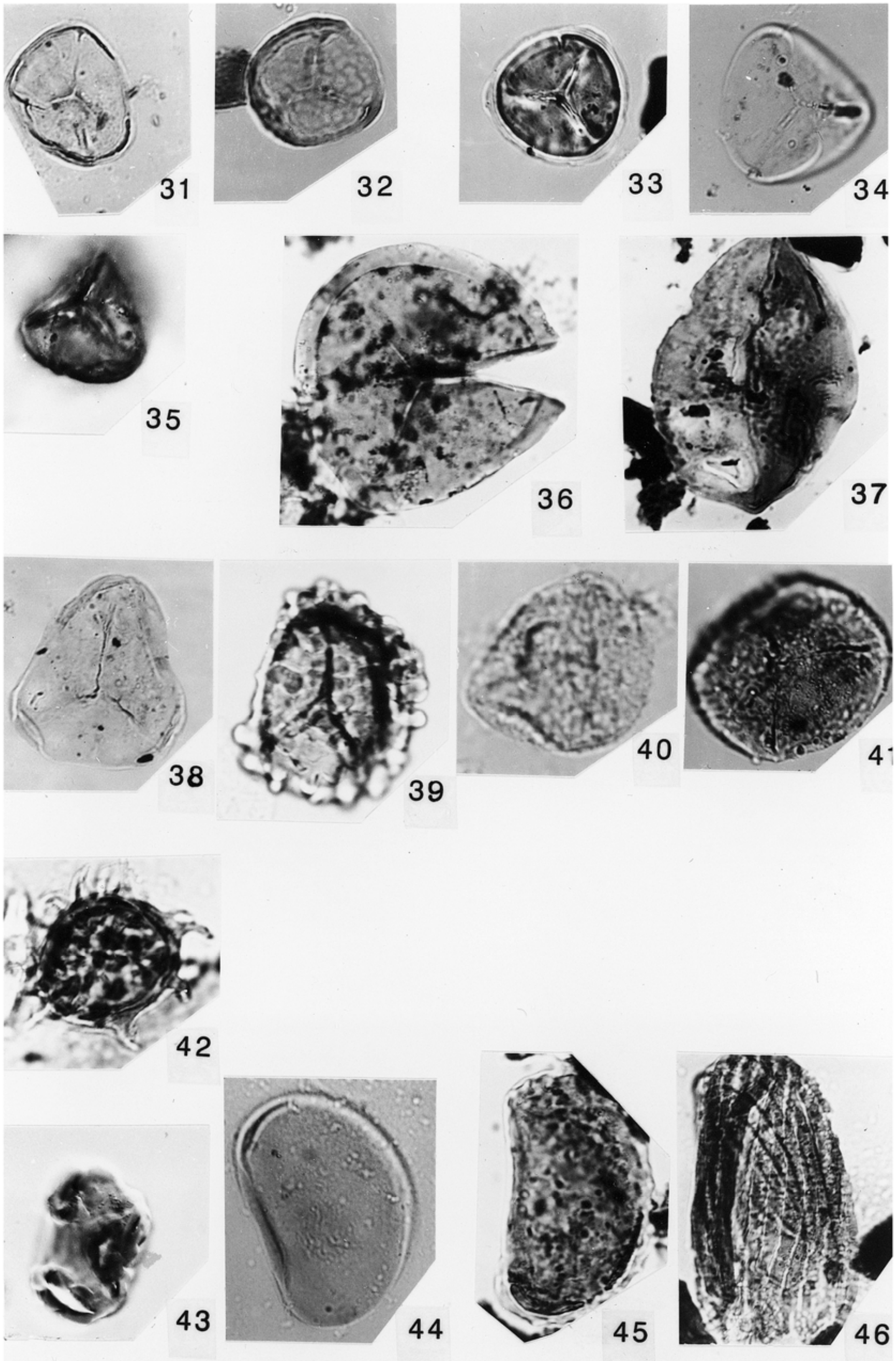
Figure 42. Echinatisporites varispinosus Pocock; 89071 (1), PB-117, 79.7x13, 1060x.

Figure 43. Impardecispora humilis (Delcourt and Sprumont) Burden and Hills; 90002 (1), PB-124, 92.3x10.0, 660x.

Figure 44. Laevigatosporites haardti (Potonié and Venitz) Thomson and Pflug; 89071 (1), PB-117, 99.3x8.2, 1060x.

Figure 45. Hazaria sheoparii Srivastava; 89057 (1), PB-42, 88x10.9, 1060x.

Figure 46. Cicatricososporites eocenicus (Selling) Jansonius and Hills; 89071 (1), PB-117, 90.9x9.2, 850x.



PL 4

PLATE 5

Figure 47. Aequitriradites spinulosus? (Cookson and Dettmann) Cookson and Dettmann; 90003 (1), PB-125, 79.5x10.5, 1060x.

Figure 48. Inaperturopollenites sp.; 89020 (1), PB-1, 76.2x8.3, 1060x.

Figure 49. Taxodiaceaepollenites hiatus (Potonié) Kremp; 89072 (1), PB-120, 81.7x5.4, 1060x.

Figure 50. T. vacuipites (Wodehouse) Wingate; 89071 (1) PB-120, 81.7x5.4, 1060x.

Figure 51. Araucariacites australis Cookson; 89071 (1), Pb-117, 84.2x8.3, 850x.

Figure 52. Sequoiapollenites paleocenicus Stanley; 89072 (1) PB-120, 97x9, 1060x.

Figure 53. Cerebropollenites mesozoicus (Couper) Nilsson; 90005 (1) PB-128, 76.9x12.6, 1060x.

Figure 54. Podocarpidites ellipticus Cookson; 90008 (1) PB-138, 94.2x13, 660x.

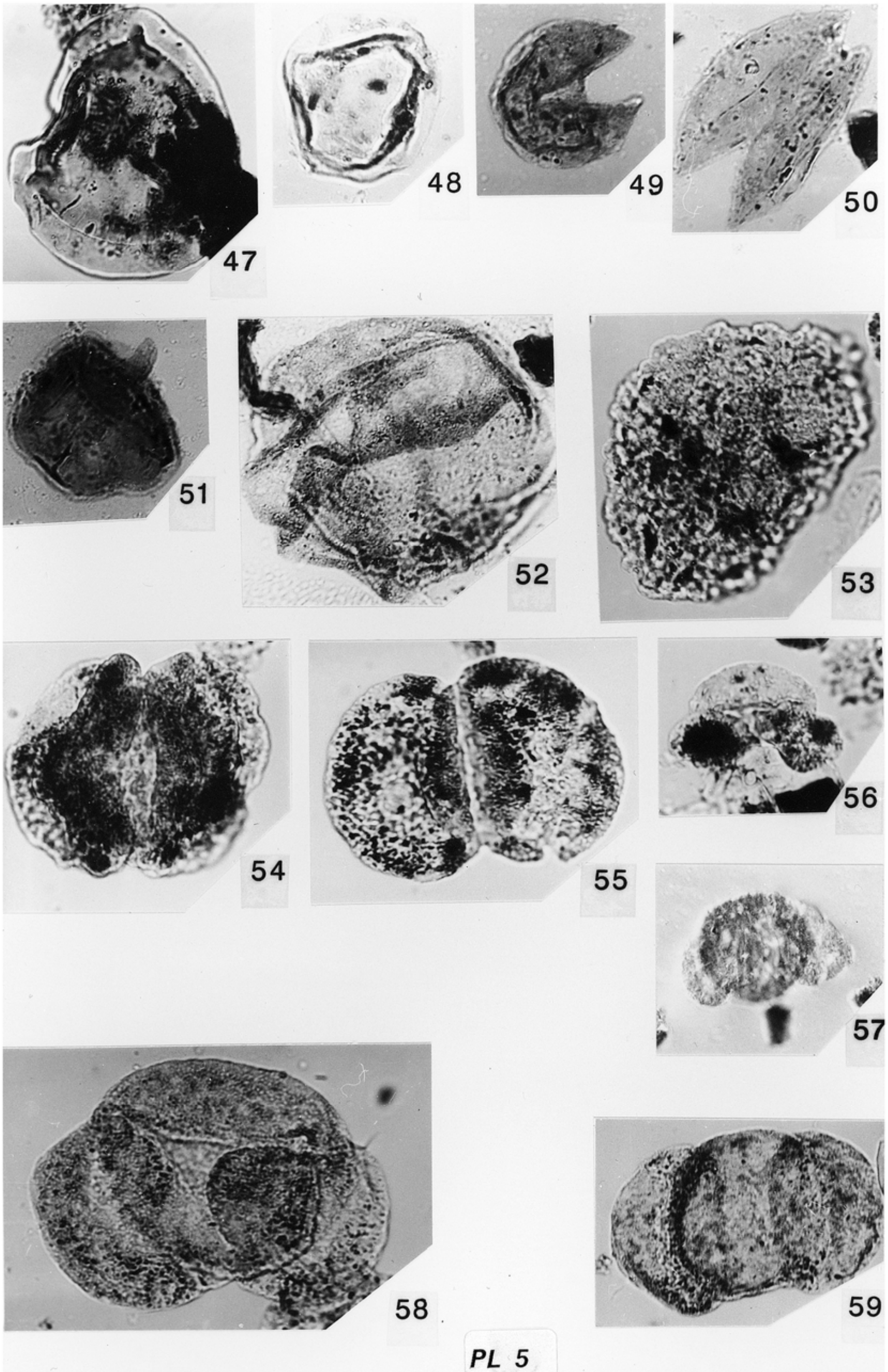
Figure 55. P. multesimus (Bolkhovitina) Pocock; 90008 (2) PB-138, 105.8x10, 660x.

Figure 56. Pityosporites alatipollenites (Rouse) Singh; 90002 (1) PB-124 (1), 93.5x12.2, 660x.

Figure 57. P. constrictus Singh; 89067 (2), PB-104, 73.9x6.1, 660x.

Figure 58. Abiespollenites sp.; 90008 (2), PB-138, 97.1x9.3, 660x.

Figure 59. Pityosporites elongatus (Norton) Norton and Hall; 89024 (1), PB-16, 85.1x17.2, 430x.



PL 5

PLATE 6

Figure 60. Alisporites grandis (Cookson) Dettmann; 90008 (1), PB-18, 95.4x9, 660x.

Figure 61. A. bilateralis Rouse; 89057 (2), PB-42, 80.6x10.3, 660x.

Figure 62. Pityosporites deweyensis (Ting) n. comb.; 90008 (1), PB-138, 95.4x7.8, 660x.

Figure 63. Vitreisporites pallidus (Reissinger) Nilsson; 90002 (1), PB-124, 104.4x12.1, 660x.

Figure 64. Cedripites canadensis Pocock; 89071 (1), PB-117, 87.7x5.9, 660x.

Figure 65. Pristinuspollenites microsaccus (Couper) B.D. Tschudy; 89057 (2), PB-42, 87.7x59, 1060x.

Figure 66. Clavatipollenites hughesii Couper; 89071 (1), PB-117, 82.9x9.5, 1060x.

Figure 67. Liliipollis sp. 1; 89046 (1), PB-40, 90x12, 1060x.

Figure 68. Liliacidites leei Anderson; 89060 (1), PB-90, 78x10, 1060x.

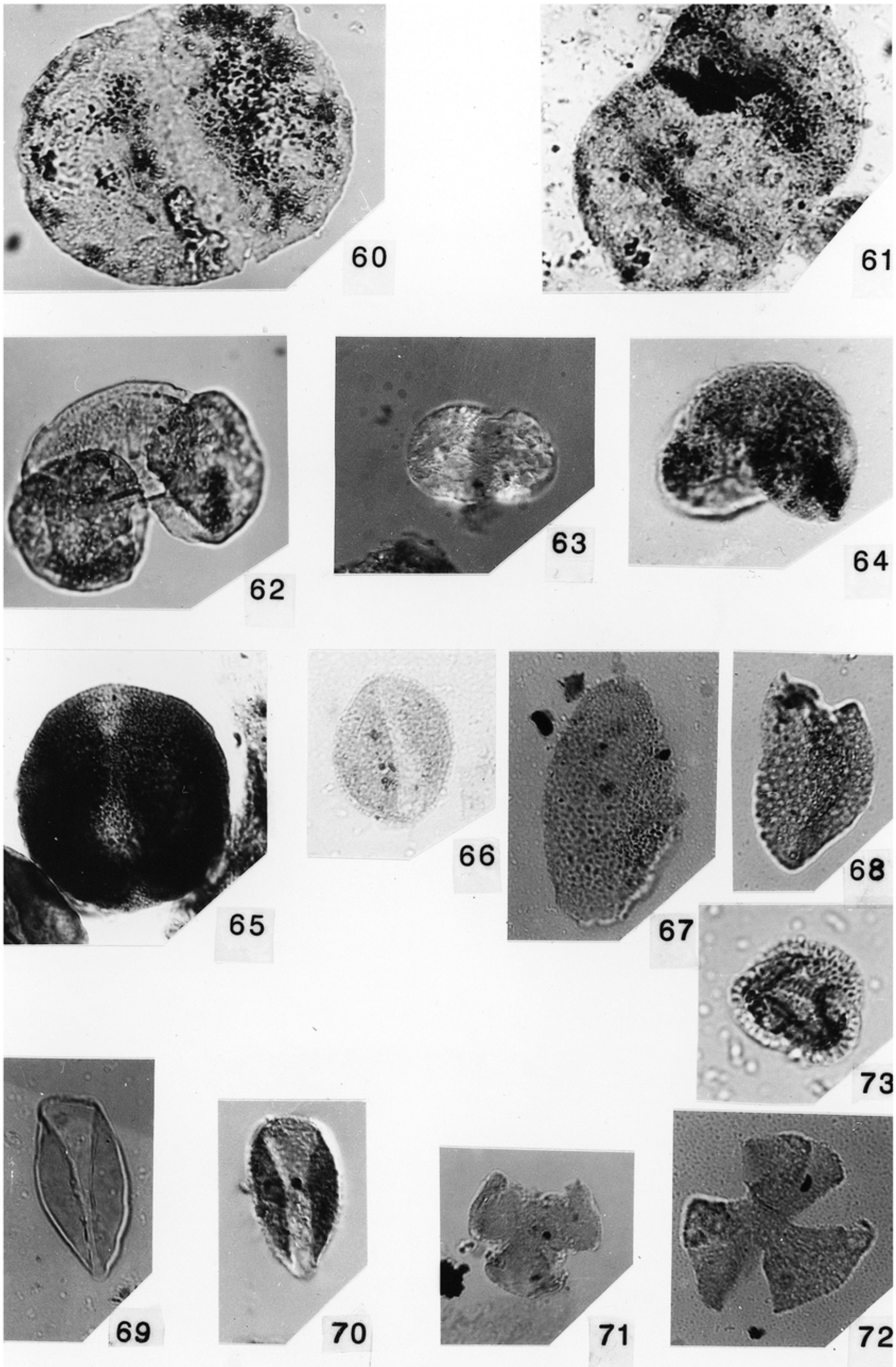
Figure 69. Cycadopites follicularis Wilson and Webster; 89071 (1), PB-117, 76.4x9, 1060x.

Figure 70. Entylissa nitidus Balme; 89071 (1), PB-117, 77.8x9.3, 660x.

Figure 71. Tricolpites hians Stanley; 89064 (2), PB-101, 92.3x12.5, 1060x.

Figure 72. T. parvus Stanley; 89046 (1), PB-40, 76.2x14.5, 1060x.

Figure 73. Rousea georgensis (Brenner) Dettmann; 89064 (1), PB-101, 85.1x7, 1060x.



PL 6

PLATE 7

Figure 74. Striatopollis tectatus Leffingwell; 89014 (1), PB-54, 92x9, 1060x.

Figure 75. Fraxinoipollenites variabilis Stanley; 89070 (1), PB-113, 89x9.9, 660x.

Figure 76. Porosipollis porosus Krutzsch; 89070 (1), PB-113, 87.3x4.5, 660x.

Figure 77. Tricolporites sp. 1; 89020 (1), PB-1, 82.3x9.5, 1060x.

Figure 78. T. sp. 2; 89062 (1), PB-94, 93.2x10.1, 1060x.

Figure 79. Cranwellia striata (Couper) Srivastava; 89070 (1), PB-11, 94.6x17, 660x.

Figure 80. C. rumseyensis Srivastava; 90015 (1), PB-151, 86.3x5.6, 1060x.

Figure 81. Carpinipites ancipites (Wodehouse) Srivastava; 90060 (1), PB-90, 96.8x4.4, 1300x.

Figure 82. Caryapollenites sp. cf. inelegans Nichols and Ott; 89072 (1), PB-120, 82.3x6.9, 1060x.

Figure 83. Paraalnipollenites alterniporus (Zaklinskaia) Hills and Wallace; 89062 (1), PB-94, 1300x.

Figure 84. Triatriopollenites rurensis Pflug and Thomson; 89062 (1), PB-94, 72.8x10.1, 1300x.

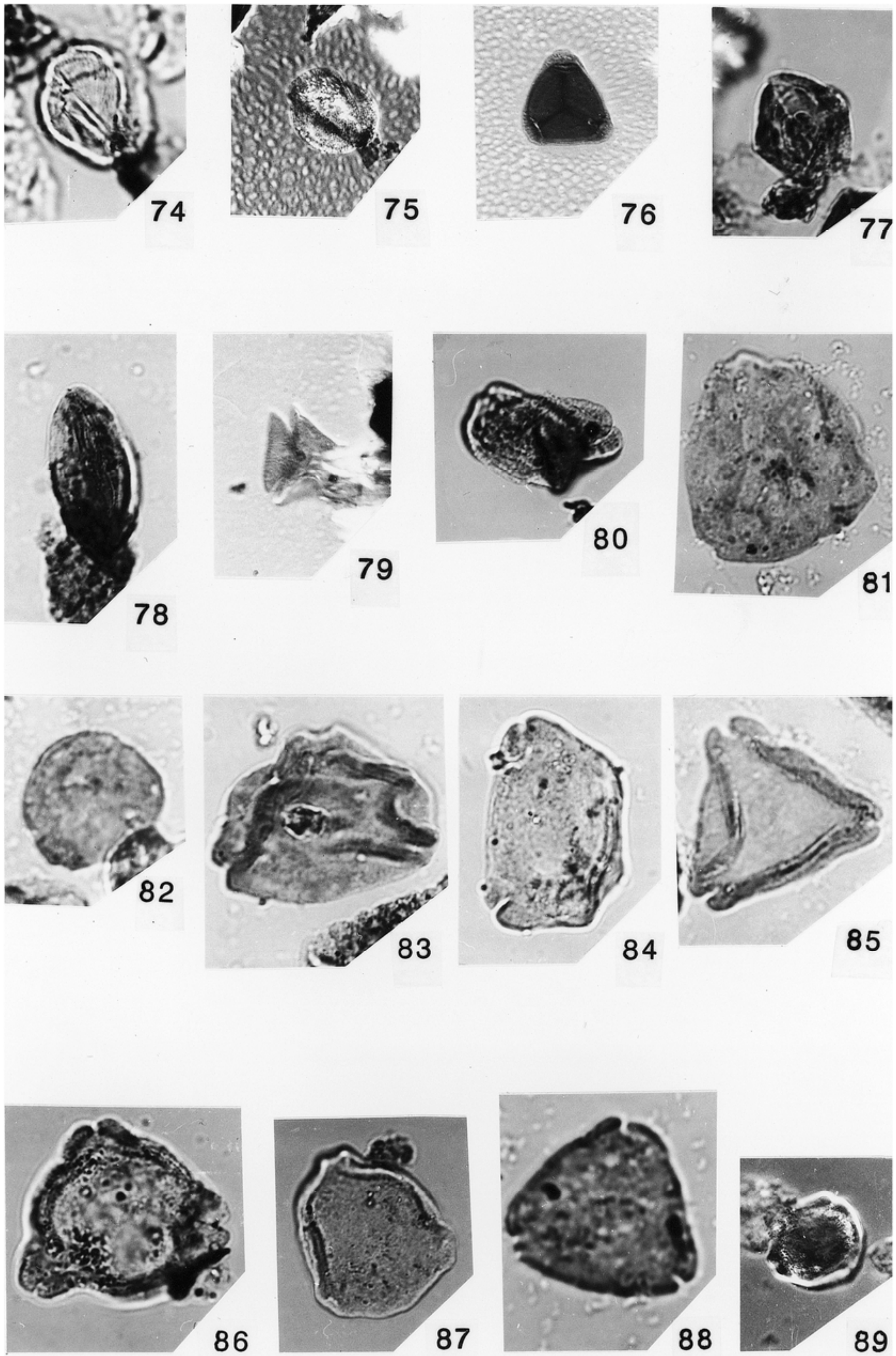
Figure 85. T. costatus Norton; 89071 (1), PB-117, 87.5x6.3, 1300x.

Figure 86. T. sp. 1; 89026 (1), PB-25, 76.8x7.0, 1300x.

Figure 87. Trivestibulopollenites betuloides Pflug; 90010 (1), PB-141, 8.2x11.5, 1060x.

Figure 88. Momipites wyomingensis Nichols and Ott; 89061 (1), PB-92, 90.6x12.2, 1300x.

Figure 89. Triporopollenites mullensis (Simpson) Rouse and Srivastava; 89068 (1), PB-107, 74.2x10.9, 660x.



PL 7

PLATE 8

Figure 90. Complexiopollis sp.; 89012 (1), PB-49, 83.x6.8, 1300x.

Figure 91. Pseudoplicapollis serenus Tschudy; 89026 (1), PB-25, 76.2x8.5, 1060x.

Figure 92. Trudopollis conrector Pflug; 89066 (1), PB-103, 89.3x8.6, 1300x.

Figure 93 T. ex. gr. arector Mikhelis; 89071 (1), PB-117, 83.8x14.6, 1300x.

Figure 94. Extratriporopollenites sp. 2 of McIntyre; 89071 (1), PB-117, 83.4x14.5, 1060x.

Figure 95. Normapolles sp. 1; 89068 (1); PB-107, 88.5x11.5, 660x.

Figure 96. Polyvestibulopollenites verus (Potonié) Thomson and Pflug; 89062 (1), PB-94, 83.6x15.3, 1300x.

Figure 97. Ulmoideipites krempi Anderson; 89072 (1), PB-120, 97.9x9, 1060x.

Figure 98. Polyatriopollenites stellatus (Potonié) Pflug; 89061 (1), PB-92, 86.3x12.1, 1060x.

Figure 99. B. angulatus (Samoilovitch) Srivastava; 89071 (1), PB-117, 85.7x9.5, 1060x.

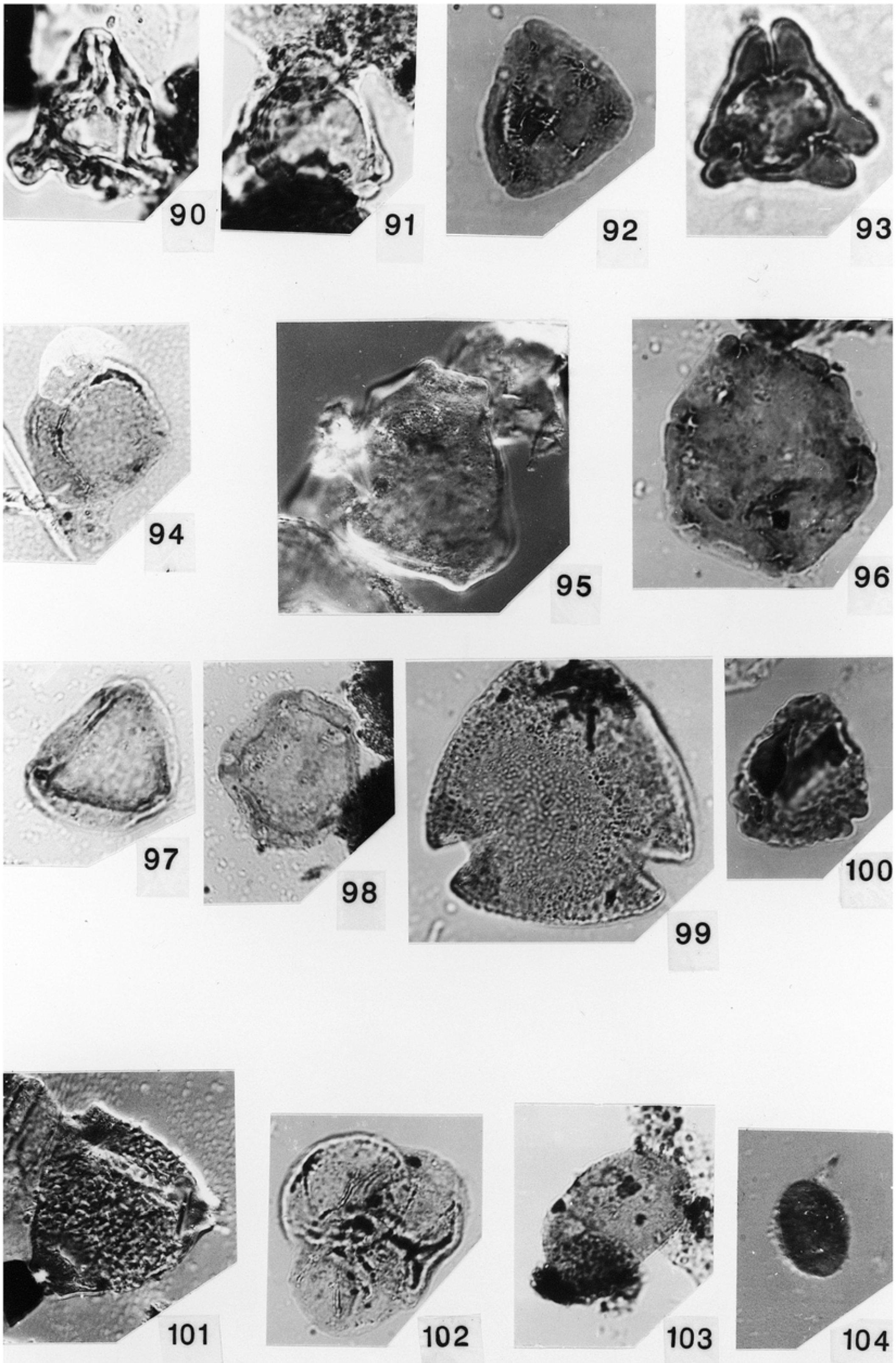
Figure 100. B. mollis (Samoilovitch) Srivastava; 90013 (1), PB-149, 89.9x13, 1060x.

Figure 101. B. sp. 1; 89071 (1), PB-117, 97.4x12.3, 660x.

Figure 102. Ericaceoipollenites rallus Stanley; 90008 (1), PB-138, 92.3x8, 1060x.

Figure 103. Azonia cribrata Wiggins; 89070 (1), PB-113, 93.2x9, 1060x.

Figure 104. A. jacutense Wiggins; 89067 (2), PB-104, 95.3x1.3, 660x.



PL 8

PLATE 9

Figure 105. Wodehouseia spinata Stanley; 89071 (1), PB-117, 78.7x12.8, 1060x.

Figure 106. W. gracile (Samoilovitch) Pokrovaskaya; 89066 (1), PB-103, 77.8x6, 1060x.

Figure 107. W. quadrispina Wiggins; 89071 (1), PB-124, 90.6x8.8, 1060x.

Figure 108. Singularia aculeata Samoilovitch; 89071 (1), PB-117, 83.9x17.5, 660x.

Figure 109. Mancicorpus trapeziforme Mtchedlishvili; 89071 (1), PB-117, 75.6x9.1, 1060x.

Figure 110. Aquilapollenites augustus Srivastava; 90007 (1), PB-136, 95.2x10.1, 1060x.

Figure 111. A. sp. cf. immiser Jerzykiewicz and Sweet; 89021 (1), PB-9, 92.9x4, 1060x.

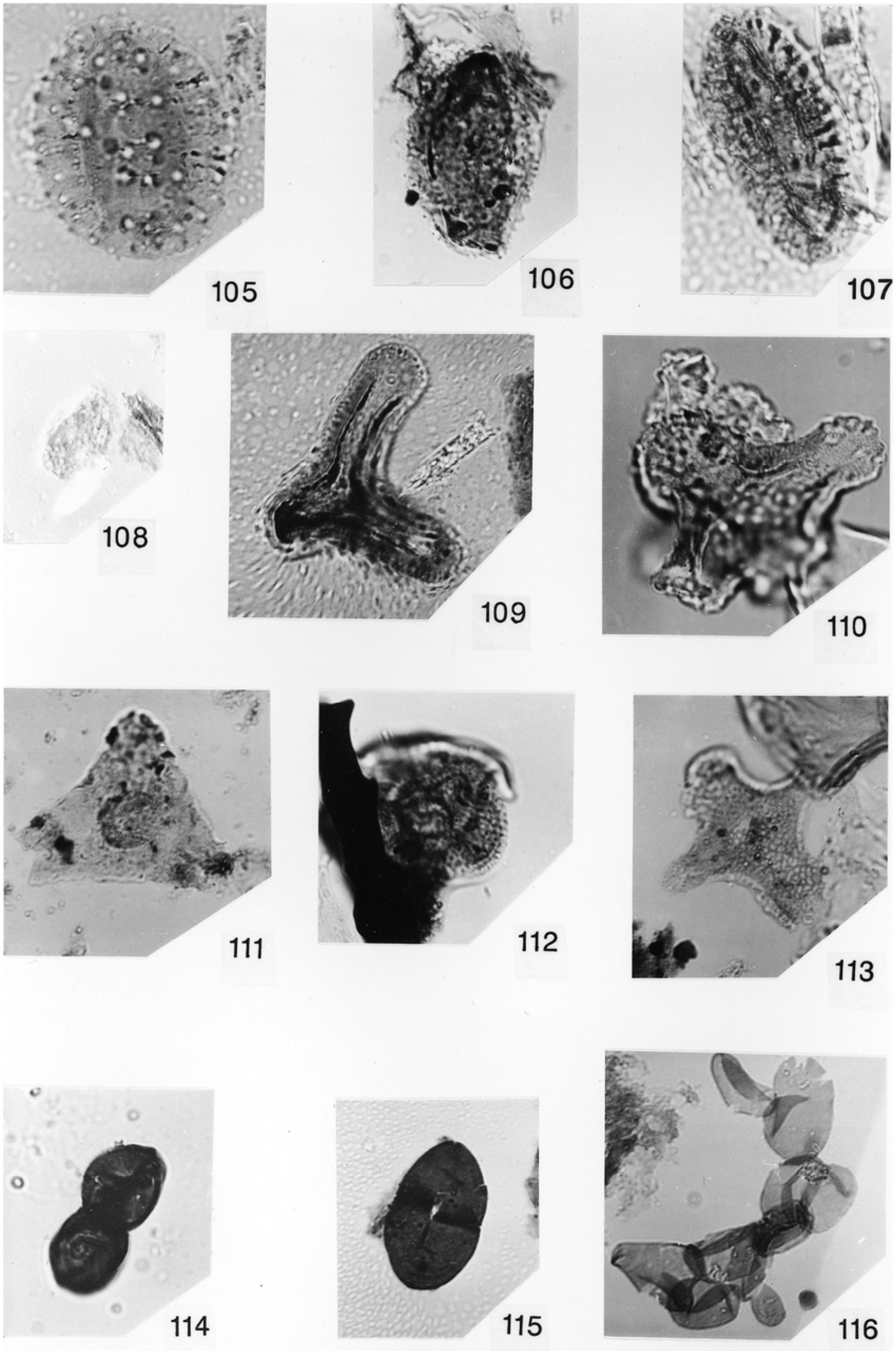
Figure 112. A. reticulatus Stanley, 89067 (1), PB-104, 99.2x11.5, 1060x.

Figure 113. A. trialatus Rouse, 89066 (1), PB-103, 86.3x11, 1060x.

Figure 114. Monoporisporites singularis Sheffy and Dilcher; 90010 (1), PB-141, 95.6x11.4, 1060x.

Figure 115. Dicellaesporites popovii Elsik; 89071 (1), PB-117, 95.8x8.2, 660x.

Figure 116. Reduviasporonites sp. 1; 90010 (1), PB-141, 82.6x10, 1060x.



PL 9

PLATE 10

Figure 117. Brachysporisporites cotalis (Elsik and Jansonius) Norris; 90010 (1), PB-141, 90.2x11, 1060x.

Figure 118. Diporicellasporites sp. cf. stacyi Elsik; 88124 (1), PB-71, 84.4x3.3, 1060x.

Figure 119. D. reticulatus Elsik and Dilcher; 90007 (1), PB-136, 94.5x10.8, 660x.

Figure 120. D. sp. 1; 89071 (1), PB-117, 81.1x9.2, 660x.

Figure 121. Striasporonites sp. 1; 89047 (1), PB-41, 78.5x13, 1060x.

Figure 122. Polyadosporites suescae Van der Hammen; 90010 (1), PB-141, 84.3x10, 1060x.

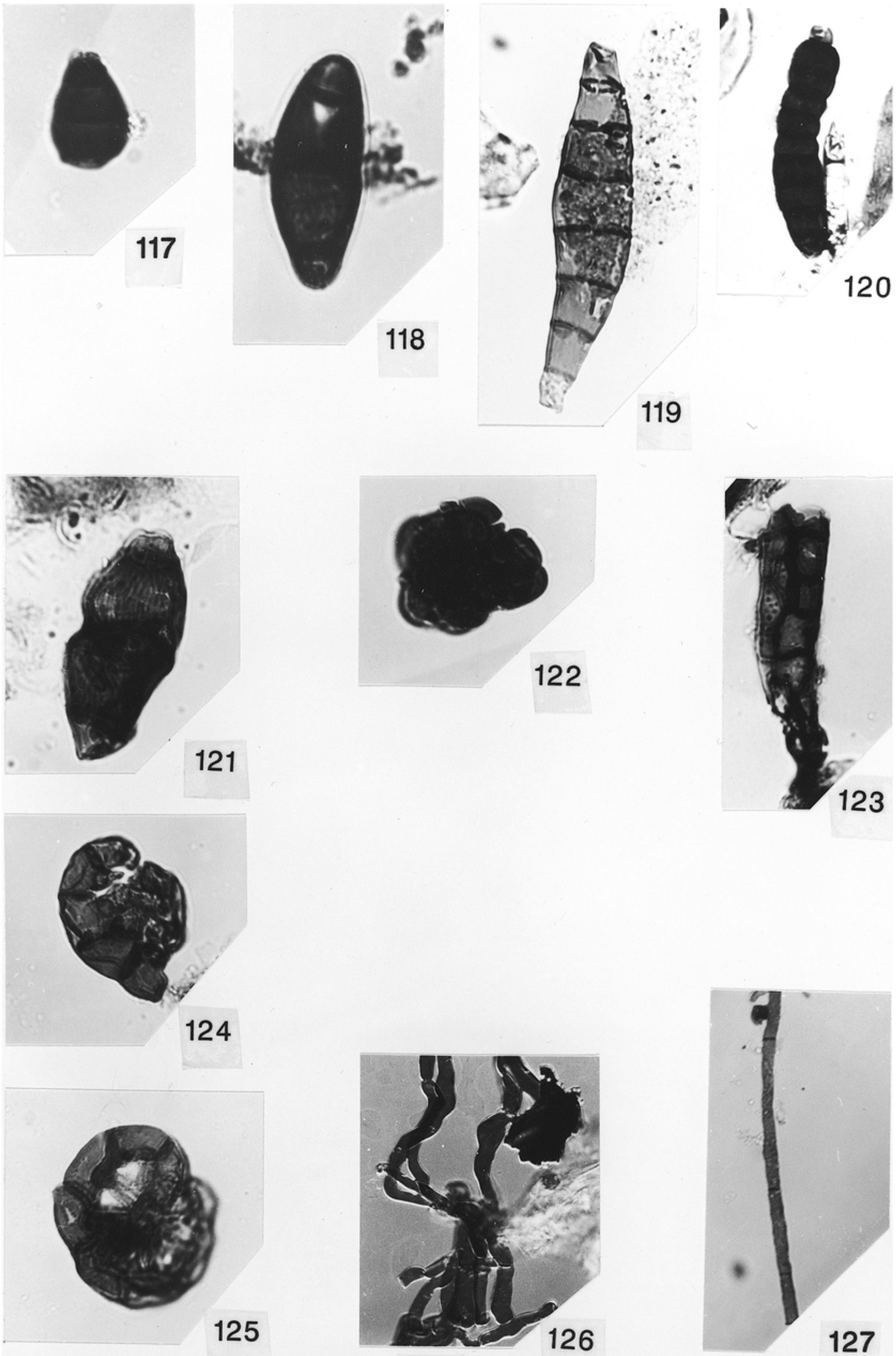
Figure 123. Staphlosporonites delumbus Norris; 89046 (1), PB-40, 81.8x4.5, 660x.

Figure 124. Pesavis parva Kalgutkar and Sweet; 89007 (1), PB-4, 86.6x4.6, 1060x.

Figure 125. P. tagluensis Elsik and Jansonius; 89062 (1), PB-94, 71.9x10, 1060x.

Figure 126. Fungal hyphae type F; 90010 (1), PB-141, 85.1x15.8, 660x.

Figure 127. Fungal hyphae type C; 90009 (1), PB-140, 94.3x11.1, 660x.



PL 10

PLATE 11

Figure 128. Plochmopeltinites masonii Cookson; 90010 (1), PB-141, 94.6x6.8, 430x.

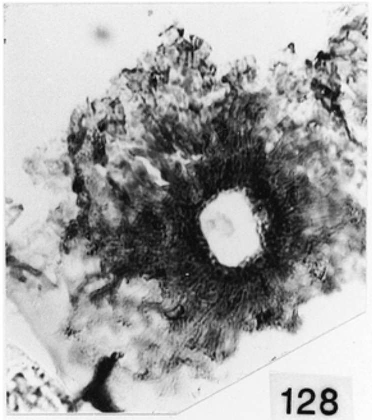
Figure 129. Phragmothyrites sp.; 88124 (1), PB-71, 100.5x7, 850x.

Figure 130. Callimothallus pertusus Dilcher; 90008 (1), PB-138, 90.9x12, 430x.

Figure 131. Microthallites lutosus Dilcher; 90010 (1), PB-141, 90.6x11.6, 430x.

Figure 132. Ceratiopsis diebelli (Alberti) Vozzhennikova; 90005 (1), PB-128, 91.7x6.2, 660x.

Figure 133. Paleoperidinium koslowski (Gorka) Davey; 90004 (3), PB-127, 93.2x8.4, 430x.



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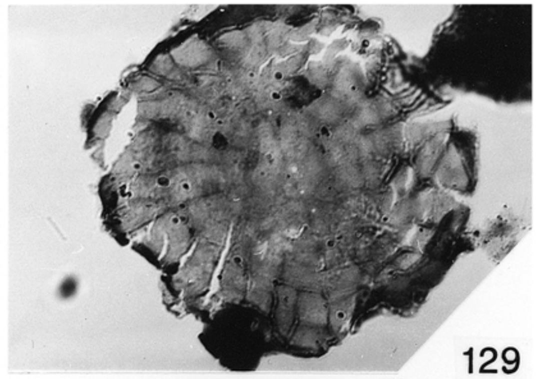

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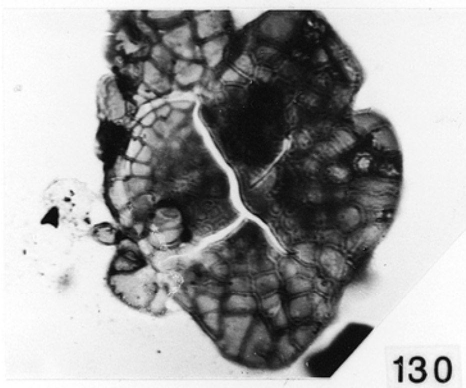

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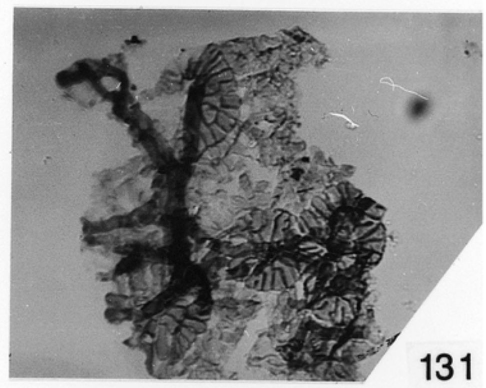

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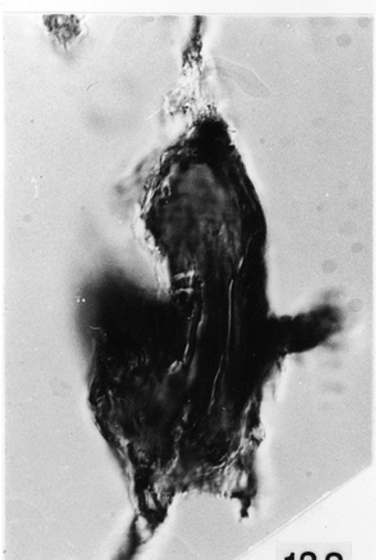

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PL 11

Cretaceous and Tertiary strata of North Bylot Trough at Maud Bight on Lancaster Sound are divided into five formations representing three tectonic phases based on lithology and palynology. In detail, late Albian Hassel Formation fluvial quartz arenites were deposited at Maud Bight prior to rifting in Baffin Bay and Lancaster Sound (Phase 1). Late Campanian-mid Maastrichtian shelf mudstones (Bylot Island Formation) and mid to late Maastrichtian (Sermilik Formation) nearshore and beach deposited quartz arenites reflect uplift of the Byam Martin Mountains and separation from Eclipse Trough (Phase 2). Lower to middle Paleocene shale and thinly bedded sandstone (Navy Board Formation), lithic greywacke and over 200 metres of conglomerate (Aktineq Formation including the newly defined Maud Bight Member) are equivalent to strata in Eclipse Trough. The Navy Board Formation consists of braided stream, flood plain and lacustrine deposits. These strata are overlain by meandering stream deposits (Aktineq sandstone) and alluvial fan strata (Maud Bight Member). This tectonically deformed coarsening up sequence indicates renewed activity corresponding with the

opening of Baffin Bay to the east and the Lancaster Aulacogen to the north (Phase 3).

Based on spores, pollen and fungal remains three terrestrial palynomorph assemblage zones and one subzone containing components of both the Aquilapollenites and Normapolles Provinces are defined for the North Bylot Trough strata: Azonia cribrata-Aquilapollenites trialatus (AA) Zone, Porosipollenites porosus-Wodehouseia spinata (PW) Zone and the Paraalnipollenites alterniporus-Pesavis parva (PP) Zone. Subzone R lies within the AA Zone and consists of >85% recycled palynomorphs typical of mid to late Albian assemblages such as Cicatricosisporites, Tappanispora and Klukisporites. The AA Zone is late Campanian to mid Maastrichtian and is characterized by Azonia, Aquilapollenites, Trudopollis, Ceratiopsis and Lejeunia. Characteristic genera of the mid to late Maastrichtian PW Zone include Porosipollenites, Aquilapollenites, Beaupreaidites, Singularia and Wodehouseia. The PP Zone is early to mid Paleocene and is characterized by Paraalnipollenites, Trivestibulopollenites, Momipites, Triporopollenites, Caryapollenites and Pesavis.

Organic matter recovered from strata at Maud Bight is thermally immature but with sufficient burial in offshore Lancaster Aulacogen would generate liquid and gas hydrocarbons. Stratigraphic relationships in North Bylot Trough, when applied with geophysical data in Lancaster Sound should allow for delineation of a series of stratigraphic and structural traps.

KEY WORDS: Sedimentology, Palynology, Lancaster Sound, Bylot Island, Hydrocarbons, Cretaceous, Tertiary, Rifting.

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DEDICATION

This thesis is dedicated

to the memory of

Peter Edward Benham,

my dad;

who inspired me with a wonder

for nature

from tales of his adventures

as a young adult.

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LEGEND FOR COMPOSITE SECTIONS

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RU	RIP UP CLASTS
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	CONGLOMERATE
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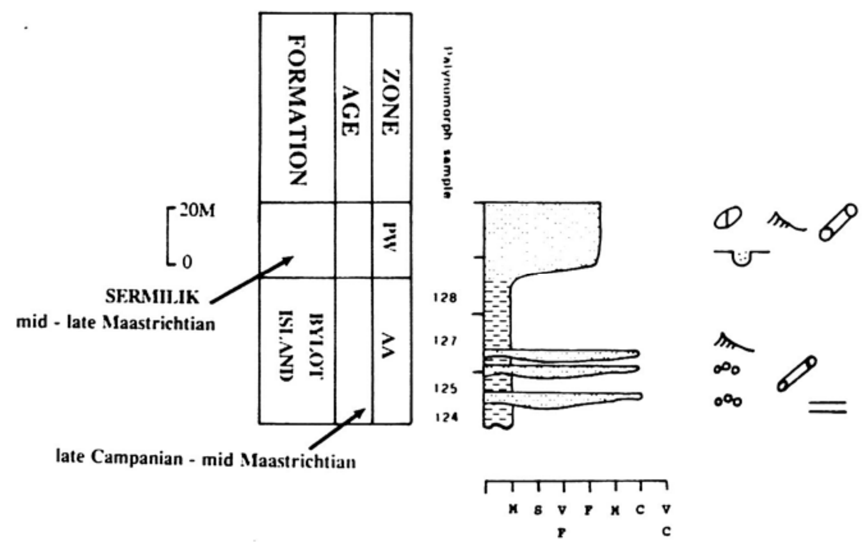
	SILTSTONE
	MUDSTONE / SHALE

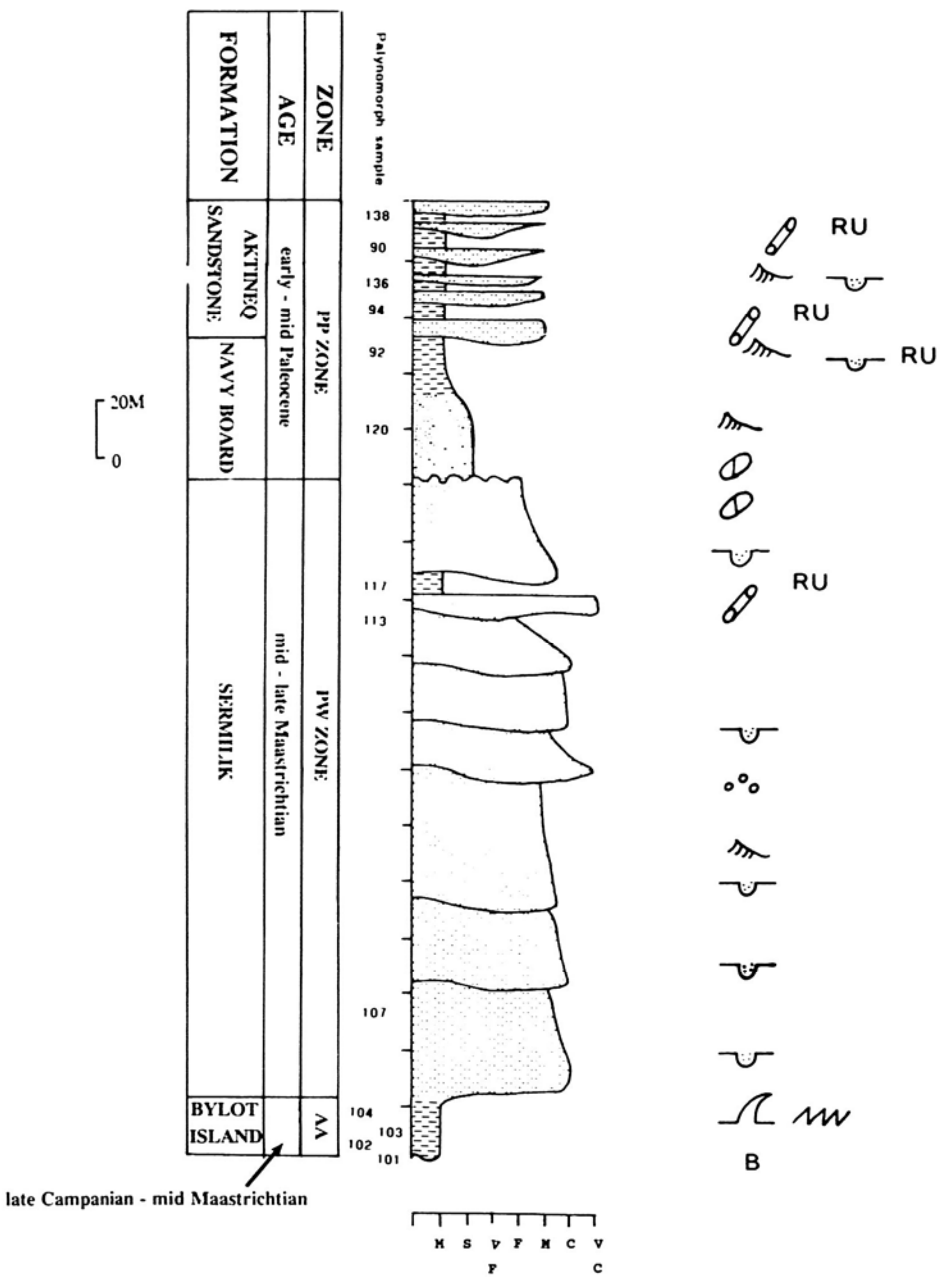
The composite sections are based on the measured stratigraphic sections in Appendix B. The stratigraphic sections used to generate the composite sections are as follows: A-19; B-11, 12, 14, 15, 16, 18 and 26; C-1, 3 and 4 and D-2, 5, 6, 30, 31 and 32. For reference see Appendix map B1.

COMPOSITE SECTION A



Note: The horizontal bar in the composite sections is a grain size indicator; m=mudstone or shale; s=siltstone; vf, f, m, c and vc respectively represent very fine, fine, medium, coarse and very coarse grained sandstone; p=pebble conglomerate and b=boulder conglomerate.

COMPOSITE SECTION B



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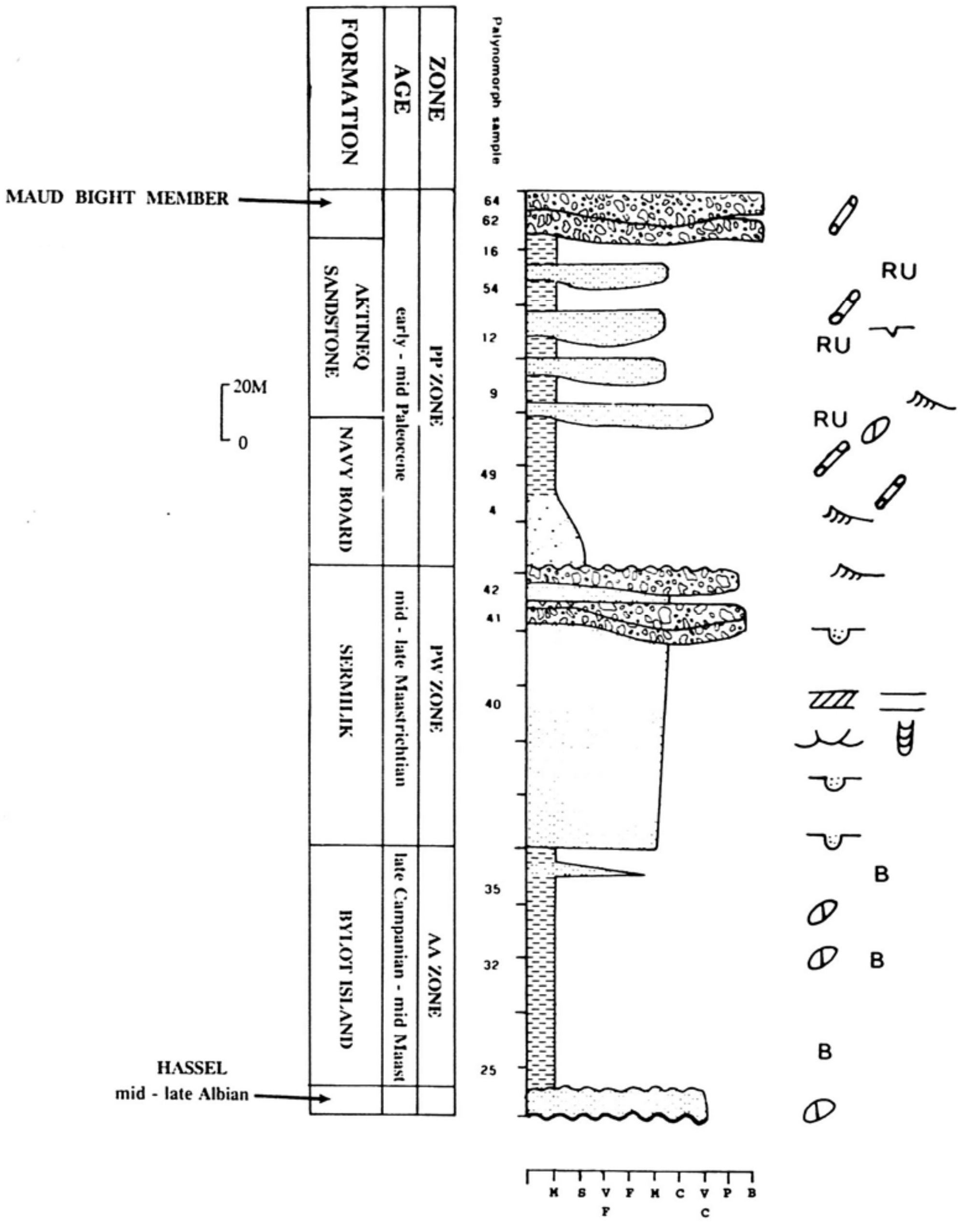
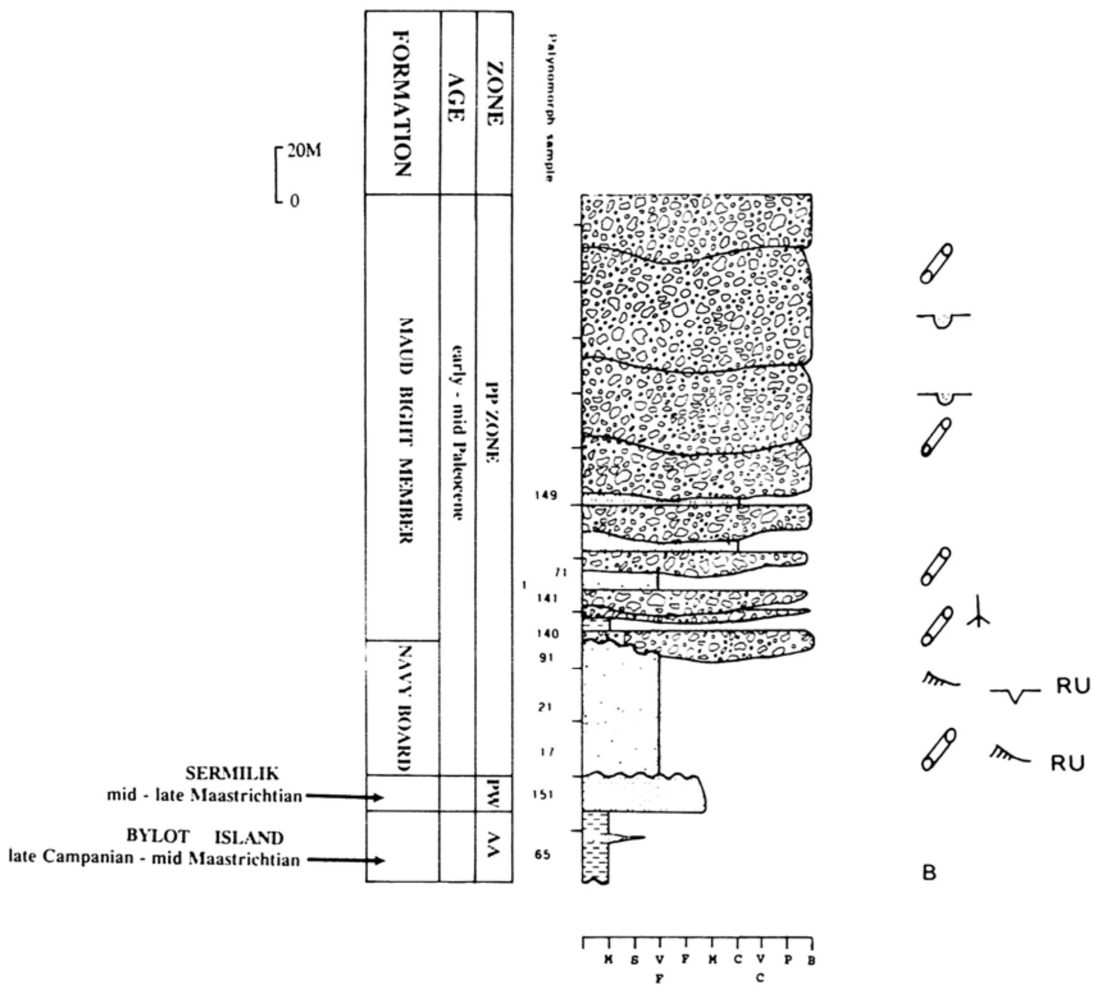
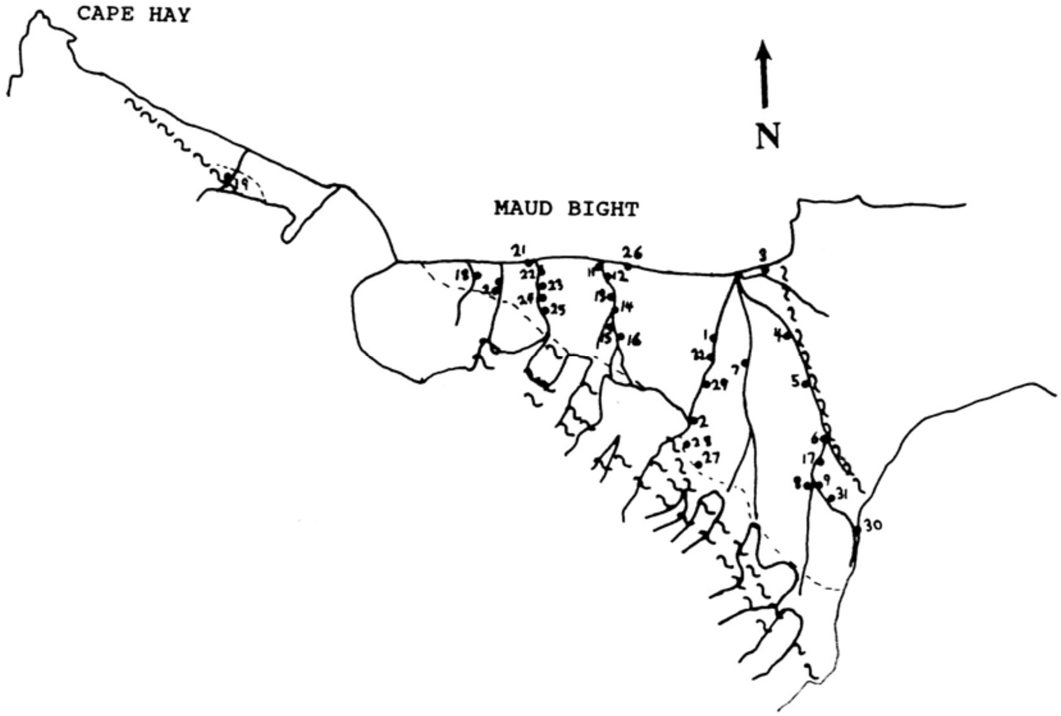


COMPOSITE SECTION D



APPENDIX B.1

LOCATION AND GENERAL DESCRIPTION OF
SAMPLES AND STRATIGRAPHIC SECTIONS
FOR ALL FIELD STATIONS



B.1 General map of field stations in North Bylot Trough. For more precise locations see general descriptions in this appendix. Composite sections represent the typical stratigraphic column in each of the following four areas: A=Cape Hay; B=western Maud Bight; C=northeastern Maud Bight and D=southeastern corner of North Bylot Trough.

GENERAL DESCRIPTIONS
FOR ALL FIELD STATIONS

Note: Each section and site is marked on Appendix Map B1. All sections are also located with respect to UTM coordinates on Energy, Mines and Resources 1:50000 topographic maps: Cape Liverpool (Map 38C/11) and Cape Hay (Map 38C/12). Both maps are located within UTM grid zone 17X. Because most sections were measured on flat-lying or shallowly dipping strata, their base and top occur within the same UTM coordinates. Two coordinates are given (base and top respectively) in cases where strata is inclined more steeply.

Section 1

Location: Section measured along a prominent cliff on the west side of unnamed glacial stream draining into Maud Bight (see Figure 2.9): map 38C/12, UTM grid 612690.

Unit/ Formation	Description	Height Above Base (m)
5 Akt. sst.	**Sandstone**: buff weathering homogeneous to trough cross-bedded, common angular RUC's 2-100 cm long, very coarse grained with subangular to subrounded polymictic boulders 10-110 cm long, with moderate woody debris; in fining up cycles 3-5.5 m thick separated by scour surfaces; interbedded with occasional lenticular RUC filled beds.	94.5
4 Akt. sst.	**Sandstone**: buff weathering, grey on fresh surfaces, laminated and rippled, fine to medium grained; fining up into grey **siltstone** and black **shale**, rich in woody debris; interbedded with **shale** and **siltstone**; mud-cracked, rippled; beds under 30 cm in fining-upward cycles associated with overall coarsening and thickening-upward cycles.	66.5

Unit/Formation	Description	Height Above Base (m)
3 Akt. sst.	**Sandstone**; buff weathering, light grey-green on fresh surfaces, varying from homogeneous to laminated, planar cross-bedded,	52.5

Unit/Formation	Description	Height Above Base (m)
	rippled and/or contorted beds with abundant angular shale RUC's 1-50 cm long, fine to coarse grained, occasional calcite concretions and moderately rounded polymictic cobbles 2-12 cm long; interbedded by black **shale** or erosively over-lain by the next sandstone bed; in fining-upward cycles from 2-8 m thick.	
2 Navy Board	**Shale**; black weathering; inter-bedded with minor **sandstone**; buff weathering, rippled, fine to medium grained, lenticular bedded (1-4 cm thick and up to 2 m long); unbioturbated.	26.5
1 Navy Board?	**Sandstone**; poorly exposed, light grey weathering, massive, coarse grained.	3.0

Section 2

Location: Section measured along a prominent cliff on the east bank of a glacially fed stream draining into Maud Bight: map 38C/12, UTM grid 602655.

Unit/Formation	Description	Height Above

Unit/ Formation	Description	Height Above Base (m)
4 M.B.M.	**Conglomerate**: massive, boulder-supported, composed of subrounded granite, gneiss and quartz arenite clasts up to 60 cm in diameter, poorly cemented with calcite.	65.0
3 Navy Board	**Sandstone**: light grey weathering, rippled with abundant RUC's; interbedded with dark grey **siltstone** and black **shale**; laminated with common woody debris; the sandstone varies from 5 to 25 cm and the finer strata from 2 to 20 cm thick forming fining-upward cycles nested in overall coarsening and thickening-upward cycles ranging from 2 to 5 m thick.	51.8
2 Navy Board	**Sandstone**, **siltstone** and **shale** similar to unit 1 but variably contorted, folded and/or broken into elongate clasts.	25.0
1 Navy Board	**Sandstone**: light grey weathering, rippled, commonly contains RUC's; interbedded with grey **siltstone** and black **shale**; laminated, rippled and containing leaf fragments; the sandstone varies from 4-20 cm thick and the finer strata from 2 to 20 cm thick forming fining-upward cycles nested in overall coarsening and thickening-upward cycles from 2 to 5 m thick.	24.0

Section 3

Location: Section measured along the sea cliffs on the eastern margin of Maud Bight: map 38C/11, UTM grid 643726 to 638723.

Unit/ Formation	Description	Height Above Base (m)
28 Akt. sst.	**Sandstone**: buff weathering, massive or rippled, planar cross-bedded, horizontally laminated, containing RUC's, minor woody debris, slight bioturbation, fine to very coarse grained with calcite concretions; interbedded with laminated grey **siltstone** and black **shale**, rich in woody debris; in fining-upward cycles up to 4 m thick, separated by scours.	345.0
27	**Siltstone**: grey weathering,	291.0

Unit/ Formation	Description	Height Above Base (m)
Navy Board	minor bioturbation, abundant woody debris including logs; interbedded with grey-brown **shale**; beds in fining-upward cycles (up to 40 cm thick).	
26	Covered interval.	261.0
25 Navy Board	**Siltstone**: grey weathering, occasionally bioturbated, common woody debris; interbedded with grey **shale** and occasional lenticular **sandstone** stringers; beds up to 40 cm thick in fining-upward cycles.	253.0
24	Obscured interval; buff weath-	249.0

Navy Board	ering **sandstone** and grey **siltstone** occasionally visible.	
23 Navy Board	**Siltstone**: grey weathering, minor bioturbation, abundant woody debris; interbedded with grey-brown **shale**; beds in fining-upward cycles (up to 40 cm thick).	232.0
22 Navy Board	**Sandstone**: brown weathering, laminated or rippled, burrows and woody debris common, medium grained with muddy matrix; interbedded with brown **siltstone**; in fining-upward cycles 2-3 m thick.	227.0
21 Sermilik	**Shale**: black weathering, bio-turbated, rich in woody debris; interbedded with buff weathering, rippled and laminated, fine grained **sandstone** and clast-supported cobble **conglomerate**; clasts 2-22 cm long; bedding variable from 40 cm to 2 m thick with coarser strata separated by scours.	220.0
20 Sermilik	**Conglomerate**: buff weathering, megarippled, cobble supported, composed of well rounded, granite, gneiss and quartz arenite cobbles	215.5

Unit/ Formation	Description	Height Above Base (m)
	3-15 cm in diameter, matrix consists of quartz arenite.	
19 Sermilik	**Sandstone**: white to buff weathering, coarse to very coarse grained quartz arenite with pebbly stringers; interbedded with **conglomerate**; gravel supported, composed of well rounded quartz arenite and granite clasts 3-15 cm	210.8

	in diameter; fining-upward into wavy bedded **siltstone** and **shale**; rich in woody debris; beds are 2 to 4 m thick and separated by scour surfaces.	
18 Sermilik	**Sandstone**: green-white weathering, low angle planar cross-bedded, herringbone cross-bedded and trough cross-bedded, with stringers of pebbles and heavy minerals, medium to coarse grained with abundant glauconite, varying from unconsolidated to poorly cemented by siderite, fining up cycles 10-50 cm thick separated by scour surfaces with quartz arenite pebble lag.	204
17 Sermilik	**Sandstone**: buff to greenish-white weathering, massive with occasional siderite cemented scour surfaces containing quartz arenite pebble lag.	199.0
16 Sermilik	**Sandstone**: black weathering, coaly, massive bed with a high mud content.	174.8
15 Sermilik	**Sandstone**: buff to greenish-white weathering, massive with occasional siderite cemented scour surfaces containing quartz arenite pebble lag, scours vary from 1 to 6 m apart, medium to coarse grained with abundant glauconite.	174.3

Unit/ Formation	Description	Height Above Base (m)
14 Sermilik	**Conglomerate**: rusty reddish weathering, matrix supported, well rounded buff weathering quartz	140.5

	arenite cobbles 2-15 cm long, matrix consists of medium to coarse grained **sandstone**, bed fines-upward.	
13 Sermilik	**Sandstone**: buff weathering, massive, medium to very coarse grained, contains quartz arenite pebbles; fining up to homogeneous brown **siltstone.**	138.5
12 Sermilik	**Sandstone**: buff to greenish weathering, massive, fine grained with calcite concretions (up to 10 cm) and Teredolites bored wood.	132.5
11 Bylot Island?	Obscured interval: probably entirely **mudstone**.	130.0
10 Bylot Island	**Mudstone**: black weathering, with bands of yellow jarositic clays, intensely bioturbated (including Chondrites), unconsolidated; inter-bedded with minor brown and grey weathering **siltstone** and fine grained **sandstone**; the coarser beds are scour based, rippled or hummocky cross-stratified, contain RUC's, fine-upwards and are only bioturb-ated at their top.	122.0
9 Bylot Island	**Mudstone**: grey to black weathering, intensely bioturbated, with calcite concretions up to 75 cm in diameter (contain well preserved Chondrites traces); interbedded with brown and grey weathering **siltstone** and fine grained **sandstone**; layer boundaries indistinct due to intense bioturbation, sulfurous odour.	97.0

Unit/ Formation	Description	Height Above Base (m)
8 Bylot Island	**Mudstone**: poorly exposed, similar to adjacent outcrops.	65.0
7 Bylot Island	**Mudstone**: dark brown to grey or black weathering with bands of yellow jarositic clays, intensely bioturbated (<u>Chondrites</u>), unconsolidated sulfurous odour.	49.0
6 Bylot Island	Covered interval: appears to consist of black **mudstone**.	44.0
5 Helikian Victor Bay Formation	**Dolomite**: breccia with boulder size clasts including stromatolite fragments; intensely fractured.	42.0
Fault		40.0
4 Hassel	**Sandstone**: white weathering, with yellow banding, massive, medium to coarse grained, small greenish pyritic concretions, little clay content, moderately consolidated.	40.0
3 Hassel	**Regolith**: greenish **claystone** with increasing sand content upward, rare **dolomite** clasts near base.	36.6
2 Helikian Victor Bay Formation and Hassel regolith	**Dolomite**: breccia with boulder size clasts including stromatolite fragments; intensely fractured and infilled with clay rich **sandstone**; greenish weathering, poorly consolidated.	35.0
Fault		33.0
1	**Mudstone**: dark brown to grey or	33.0

Bylot Island	black weathering with bands of yellow jarositic clays, intensely bioturbated (<u>Chondrites</u> and others), sulfurous odour.	

Section 4

Location: Section measured on the east bank of a glacial stream draining into Maud Bight: map 38C/11, UTM grid 655684.

Unit/ Formation	Description	Height Above Base (m)
8 M.B.M.	**Conglomerate**: massive with well rounded clasts composed dominantly of foliated granite, augen gneiss and Adams Sound quartz arenite, 15-70 cm in diameter, beds 50 cm to 4 m thick; interbedded with **sandstone**: green weathering, lithic, massive, coarse grained, logs common, beds up to 60 cm thick; separated by scour surfaces.	80.0
7 M.B.M.	**Sandstone**: brown to grey weathering, rippled, rich in woody debris, fine to medium grained; interbedded with **siltstone**: grey weathering, laminated; beds under 15 cm thick, in fining-upward cycles, moderately cemented.	75.0
6 M.B.M.	**Conglomerate**: grey-green weathering with a rusty iron oxide stain, massive, unimodal, clast supported with well rounded boulders of foliated granite, augen gneiss and Adams Sound sandstone, clasts 10-50 cm in diameter, occasional logs, matrix consists of green	64.0

	weathering lithic, coarse grained **sandstone**, with separate garnet grains; moderately cemented with calcite.	
5 Sermilik	**Sandstone**: greenish-white weathering, massive, with occasional Skolithos, medium to coarse grained with quartz arenite pebbles, glauconitic, varies from poorly consolidated to moderately cemented.	57.0

Unit/ Formation	Description	Height Above Base (m)
4 Bylot Island	Obscured section: consisting of black **mudstone** and platy brown fine grained **sandstone**, sulfurous odour.	38.0
3 Bylot Island	**Mudstone**: black weathering, with yellow jarositic clay streaks, intensely bioturbated, sulfurous, unconsolidated.	18.0
2 Bylot Island	Obscured section: consisting of black weathering **mudstone.**	11.0
1 Bylot Island	**Mudstone**: black weathering, with yellow jarositic clay streaks, intensely bioturbated, sulfurous, unconsolidated.	3.3

Section 5

Location: Section measured on the west bank of a glacial stream draining into Maud Bight. It is located 1.4 km south of Section 4: map 38C/11, UTM grid 654670.

Unit/ Formation	Description	Height Above Base (m)
3 M.B.M.	**Conglomerate**: massive, clast supported, moderately rounded boulders 20-65 cm in diameter; **sandstone** matrix: green weathering, coarse grained; outcrop highly weathered.	25.0
2 Bylot Island	**Mudstone**: black weathering, highly bioturbated, poorly consolidated.	19.5

Unit/ Formation	Description	Height Above Base (m)
1 Helikian carbonates	**Dolomite**: buff weathering, laminated, stromatolitic, with salt crystal casts; thickly bedded with thin black **shale** interbeds; well cemented.	2.0

Section 6 Type Section for the Maud Bight Member

Location: Section measured along a prominent cliff on the west bank of glacial stream draining into Maud Bight. It is located approximately 1.2 km south of Section 5: map 38C/11, UTM grid 658658.

Unit/ Formation	Description	Height Above Base (m)
11 M.B.M	**Conglomerate**: Thickly bedded to massive, clast supported; composed of subrounded quartz arenite, granite and gneiss boulders 15-70 cm in diameter, logs common, some iron oxide coated beds, matrix consists of green weathering coarse grained **sandstone**, moderately cemented with calcite.	194.0
10 M.B.M.	**Conglomerate**: Thickly bedded, clast supported, composed of sub-rounded granite, gneiss and quartz arenite boulders 15-50 cm in diameter, with abundant RUC's and logs; occasionally interbedded with **sandstone**: green weathering, massive or laminated with laminae often draped over boulders, coarse grained; in fining-upward cycles, separated by scour surfaces, some iron oxide coated beds, strata moderately cemented with calcite.	75.0

Unit/ Formation	Description	Height Above Base (m)
9 M.B.M.	**Sandstone**: grey-green weathering, massive, lithic, medium grained with abundant woody debris; inter-bedded with pebbly **conglomerate** lenses, minor black **shale** and grey **siltstone**; rippled, occasionally burrowed, containing abundant well preserved low diversity leaf assemblage; strata in fining	58.2

	upward cycles separated by siltstone and shale beds.	
8 M.B.M.	**Conglomerate**: thickly bedded, clast supported, composed of subrounded quartz arenite, gneiss and granite cobbles 3-30 cm in diameter, abundant logs, matrix consists of coarse grained **sandstone**; beds are 2-4 m thick in fining-upward cycles separated by scours, poorly cemented with calcite.	43.0
7 Sermilik	**Sandstone**: greenish-white weathering, massive, contains occasional subhorizontal burrows, medium to coarse grained, glauconitic quartz arenite, moderately consolidated.	36.7
6 Sermilik?	Covered interval: loose debris consists dominantly of quartz grains.	28.0
5 Bylot Island	**Mudstone**: brown-black weathering with yellowish streaks, mottled, intensely bioturbated; interbedded with thin silty stringers, sulfurous odour, poorly consolidated.	26.0
4 Bylot Island	**Sandstone**: buff to white weathering, rippled, bioturbated, coarse to very coarse grained, fining-upward, moderately cemented.	10.5

Unit/ Formation	Description	Height Above Base (m)
3 Bylot	**Mudstone**: brown-black weathering with yellowish streaks, mottled,	9.0

Island	intensely bioturbated; interbedded with thin silty stringers, sulfurous odour, poorly consolidated.	
2 Bylot Island	**Regolith**: consisting of black to rusty red weathering **mudstone** containing subrounded black chert, quartz arenite and dolomite pebbles 1-3 cm long, moderately cemented with calcite.	2.4
1 Helikian carbonates	**Dolomite**: buff weathering, laminated, stromatolitic, with salt crystal casts; thickly bedded with thin black **shale** interbeds; well cemented.	2.0

Site 7 **Spot Check**

Location: Brief observations made of outcrop on the west bank of a glacial stream draining into Maud Bight: map 38C/12, UTM grid 626680.

Description: Approximately 17 m of **sandstone**: greenish white weathering, massive, occasionally rippled, coarse to very coarse grained, glauconitic quartz arenite with minor magnetite, poorly consolidated.

Section 8

Location: Section measured along the east bank of an unnamed glacial stream draining into Maud Bight: map 38C/11, UTM grid 658617.

Unit/ Formation	Description	Height Above Base (m)
3 Navy Board	**Sandstone**: grey-green weathering, rippled, laminated, containing RUC's, occasionally burrowed, medium to fine grained, lithic	29.0

Unit/ Formation	Description	Height Above Base (m)
	composition; interbedded with laminated grey **siltstone** and black **shale** (shale more common than in Unit 1); in fining-upward cycles 5-40 cm thick, some separated by scour surfaces, woody debris abundant, poorly to moderately cemented with calcite.	
2 Navy Board	**Sandstone**: contorted, overturned or ripped into twisted, elongate clasts within a single bed; strata otherwise same as Unit 1.	3.7
1 Navy Board	**Sandstone**: grey-green weathering, rippled, laminated, containing RUC's (1-20 cm long), occasionally burrowed, medium to fine grained, lithic composition; interbedded with laminated grey **siltstone** and black **shale**; in fining-upward cycles 5-40 cm thick, some separated by scour surfaces, woody debris abundant, poorly to moderately cemented with calcite.	3.0

Site 9 Spot Check

Location: View northward down into canyon cut by unnamed glacial stream draining into Maud Bight: map 38C/11, UTM grid 566618.

Description: Approximately 50 m of thinly bedded **grey-green** weathering **sandstone**, **siltstone** and **shale** (same as Unit 1, Section 8); overlain by greater than 40 m of boulder **conglomerate** (same as Unit 6, Section 5).

Site 10 Spot Check

Location: Outcrop at the foot of Byam Martin Mountains immediately east of unnamed glacier (southeast of outcropping Cretaceous/Tertiary strata in North Bylot Trough): map 38C/11, UTM grid 749603.

Description: Precambrian Arctic Bay Formation; highly indurated shale and siltstone.

Section 11

Location: Section measured along west bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 555720. Sections 11 to 16 were measured along this stream.

Unit/ Formation	Description	Height Above Base (m)
2 Akt. sst.	**Sandstone**: green to buff weathering, rippled, laminated to massive, with RUC's, medium to fine grained; interbedded with **shale**: black to grey-black weathering, with abundant woody debris, containing lenticular beds of **sandstone**: buff weathering, rippled, up to 4 cm thick; in fining-upward cycles with sandstone 30-150 cm thick and shale 30-400 cm thick, separated by scour surfaces, shale more abundant than in Unit 1.	39.0
1 Akt. sst.	**Sandstone**: green to buff weathering, rippled, laminated to massive, with RUC's up to 50 cm long, occasionally burrowed, lithic, medium to coarse grained, moderately cemented, contains calcite concretions; interbedded with grey **siltstone** and black **shale**:	10.0

laminated, abundant woody debris; beds 40 cm to 5 m thick, in fining-upward cycles, separated by fluted or curving scour surfaces.

Section 12

Location: Section measured along east bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 558717.

Unit/ Formation	Description	Height Above Base (m)
4 Akt. sst.	**Sandstone**: buff weathering, rippled, laminated to massive with small RUC's, minor woody debris; interbedded with **siltstone**: brown weathering, laminated; beds 1.5-3.0 m thick, in fining-upward cycles, separated by scour surfaces; well cemented.	25.0
3 Akt. sst.	**Sandstone**: green to buff weathering, rippled, laminated, rich in woody debris; interbedded with buff, grey or black weathering, laminated **siltstone** and **shale**; beds under 20 cm thick, in fining-upward cycles; occasional very well cemented calcitic bands.	20.0
2 Akt. sst.	**Sandstone**: buff weathering, rippled, laminated to massive with small RUC's, minor woody debris; interbedded with **siltstone**: brown weathering, laminated; beds 1.5-3.0 m thick, in fining-upward cycles, separated by scour surfaces; well cemented.	25.0

Unit/ Formation	Description	Height Above Base (m)
1 Navy Board	**Shale**: black weathering, with plant debris; interbedded with minor lenticular beds of **sandstone**: buff weathering, rippled, fine grained, in beds up to 4 cm thick.	11.0

Section 13

Location: Section measured along west bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 563709.

Unit/ Formation	Description	Height Above Base (m)
1 Navy Board	**Shale**: black weathering, moderately bioturbated to mottled; interbedded with **siltstone** and fine grained **sandstone**: brown weathering, laminated, rippled; in lenticular beds (under 4 cm); coarser strata well cemented with carbonate.	25.0

Section 14

Location: Section measured along east bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 566702.

Unit/ Formation	Description	Height Above Base (m)
1 Bylot Island	**Sandstone**: grey weathering, intensely bioturbated, fine grained to silty; indistinctly interbedded with grey **shale** and **siltstone**; uncemented except for occasional spherical calcite concretions 1-2 m in diameter containing Chondrites and various sub-vertical trace fossils, slight coarsening upward through section.	31.9

Section 15

Location: Section measured along west bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 565699 to 565697.

Unit/ Formation	Description	Height Above Base (m)
8 Sermilik	**Sandstone**: greenish-white to yellow-white weathering, massive	150.0

Unit/ Formation	Description	Height Above Base (m)
	to rarely rippled, laminated, unbioturbated, glauconite present, medium to very coarse grained and pebbly, rich in well rounded quartz clasts up to 2 cm long, pebbles mainly occur on base of 3-8 m thick beds in fining-upward cycles, separated by scour surfaces.	

7 Sermilik	**Sandstone**: greenish-white weathering, rippled, laminated, with soft sediment deformation, unbioturbated, glauconite present, fine to very coarse grained and pebbly, rich in well rounded granitic and quartz clasts up to 2 cm long, pebbles mainly occur on base of beds up to 2 m thick, in fining-upward cycles, separated by scour surfaces.	90.5
6 Sermilik	**Sandstone**: greenish-white to yellow-white weathering, massive to rarely rippled and laminated, unbioturbated, glauconite present, fine to coarse grained, glauconite abundant in bands; interbedded with rare black **shale**; in fining-upward cycles 2-5 m thick separated by scours; poorly cemented with siderite marking scour surfaces.	84.0
5	Covered interval.	31.0
4 Sermilik	**Sandstone**: white weathering, rippled and possible HCS, occasional flame structures and other soft sediment deformation, rare vertical burrows, medium to coarse grained; interbedded with muddy **sandstone** and **siltstone**; in fining-upward cycles 10-100 cm thick, separated by scour surfaces, overall coarsening-upward trend.	27.3
3	Covered interval.	23.0

Unit/ Formation	Description	Height Above Base (m)
2	**Sandstone**: white weathering,	20.0

Sermilik	occasional flame structures and other soft sediment deformation, rare vertical burrows, fine to medium grained; interbedded with muddy **sandstone** and **siltstone**; in fining-upward cycles 10-100 cm thick, separated by scour surfaces, overall coarsening-upward trend.	
1 Bylot Island	**Shale**: black weathering, intensely bioturbated; with minor **siltstone** wisps; coarsening-upward to medium grey mottled **siltstone**.	15.0

Section 16

Location: Section measured along east bank of unnamed glacial stream draining into Maud Bight: map 38C/12, UTM grid 567697 to 567695.

Unit/ Formation	Description	Height Above Base (m)
4 Sermilik	**Sandstone**: white weathering, massive with red, green and black **shale** RUC's, medium to very coarse grained with pebbly stringers, quartz arenite clasts are well rounded and 1-3 cm in diameter; interbedded with **mudstone** containing coaly fragments; in coarsening-upward cycles from 2 to 5 m thick; locally cemented with siderite.	81.5
3 Sermilik	**Sandstone**: white weathering, massive, fine grained, poorly cemented.	61.0
2 Sermilik	**Mudstone**: dark grey weathering massive, with abundant black and green shale fragments, coal, quartz arenite pebbles up to 7 cm	54.3

Unit/ Formation	Description	Height Above Base (m)
	in diameter; matrix supported debris flow.	
1 Sermilik	**Sandstone**: greenish-white weathering, massive to laminated and rippled, fine to very coarse grained, with pebble stringers, finer strata contains rare buff and green **shale** RUC's; in fining-upward cycles 1-10 m thick, separated by scour surfaces, poorly cemented.	50.0

Site 17

Location: Outcrop mapped on the west bank of unnamed glacial stream draining into Maud Bight, between the confluences of the two main tributaries: 400 m south of one and 1.5 km south of the other: map 38C/11, UTM grid 661638.

Description: Outcrop greenish white weathering, massive, poorly cemented, medium to coarse grained **sandstone**.

Section 18

Location: The section was measured on the east canyon wall of an unnamed glacial stream draining into Maud Bight. It is the first major stream immediately east of a major glacial extending to the sea between Cape Hay and Maud Bight: Map 38C/12, UTM grid 502713.

Unit/ Formation	Description	Height Above Base (m)
4 Maud Bight	**Conglomerate**: polymodal, clast supported, composed of angular to sub-angular migmatite boulders 5-100 cm in diameter, moderately cemented with calcite.	~40.0

Unit/ Formation	Description	Height Above Base (m)
3 Navy Board	**Shale**: black weathering, unbio-turbated, contains occasional angular migmatite clasts near base.	22.0
2 Navy Board	**Regolith**: brown, yellow and black weathering boulder breccia with coarse **sandstone** and **clay** matrix; interbedded with black weathering **shale** in upper few metres; highly weathered.	10.0
1	**Migmatite**: highly fractured, highly weathered.	2.0

Section 19

Location: Section measured along both banks of a minor glacial stream flowing on a plateau above sea cliffs composed of Precambrian carbonates approximately 10 km southeast of Cape Hay: map 38C/12, UTM grid 392752 to 392750.

Unit/ Formation	Description	Height Above Base (m)

9 Sermilik	**Sandstone**: white weathering, occasionally laminated, rippled, rare subhorizontal burrows, with bedding parallel calcite nodules, abundant woody debris, fine to coarse grained, with occasional well rounded quartz arenite pebbles up to 2 cm in diameter; in fining-upward cycles 1.5 to 4 m thick, separated by scoured surfaces; poorly cemented.	84.0
8 Bylot Island	**Mudstone**: black weathering with abundant plant debris; interbedded with **sandstone**: greyish yellow weathering, fine to medium grained; in fining-upward cycles up to 60 cm thick, overall coarsening and thickening upwards.	54.0

Unit/ Formation	Description	Height Above Base (m)
7 Bylot Island	**Mudstone**: black weathering, moderately bioturbated, occasional woody debris; interbedded with thin stringers of grey weathering **siltstone**.	51.0
6	Partially obscured outcrop; cover is black **mudstone.**	40.0
5 Bylot Island	**Sandstone**: grey-green weathering, laminated, rippled, with abundant fine woody debris, fine to very coarse grained with pebbles up to 2 cm in diameter at the base of the bed; in fining-upward cycles 2-2.5 m thick, separated by scour surfaces; moderately cemented with quartz.	30.2
4 Bylot	**Mudstone**: green-black weathering with abundant fine plant debris; inter-	19.0

Island	bedded with **sandstone**: yellow weathering, fine grained, rippled bands <1 cm thick; moderately consolidated.	
3 Bylot Island	**Sandstone**: grey weathering, massive, with pyrite nodules, abundant woody debris, medium to coarse grained, in fining-upward cycles 1.5 m thick, with scour surface on base; moderately cemented.	7.0
2 Bylot Island	**Mudstone**: green-black weathering, moderately consolidated.	6.4
1	**Regolith**: **limestone breccia** (from the underlying Helikian Society Cliffs Formation) resting in grey, green and rusty brown **mudstone**.	5.0

Site 20

Location: The outcrop was observed on both banks of the next major glacial stream 1.3 km immediately east of Section 18: map 38C/12, UTM grid 502713.

Description: Approximately 8 m of **conglomerate** composed of angular to subangular quartz arenite boulders with a quartzose **sandstone** matrix overlain by black weathering **shale**.

Section 21

Location: Section measured on the Maud Bight shoreline, along the sea cliffs, 300 m west of the mouth of a glacial stream. This stream is the third glacial stream east of the major glacier resting on the western shore of Maud Bight: map 38C/12, UTM grid 528721.

Unit/ Formation	Description	Height Above Base (m)
2 Navy Board	Obscured outcrop; apparently all black **shale**.	30.0
1 Navy Board	**Shale**: black weathering, friable, with lenticular beds and wisps of brown weathering **siltstone**.	11.0

Section 22

Location: Section measured approximately 300 m from the mouth, on the east bank of the third stream east of the major glacier resting on the western shore of Maud Bight: map 38C/12, UTM grid 531718. Sections 22 to 25 were measured along this stream.

Unit/ Formation	Description	Height Above Base (m)
1 Navy Board	**Shale**: black weathering, unbioturbated; interbedded with rare **siltstone**: brown weathering, rippled, flaggy; with <u>Metasequoia</u> needles and occasional logs.	16.2

Site 23

Location: Outcrop observed approximately 500 m upstream of Section 22, on the east bank: map 38C/12, UTM grid 531713.

Description: Approximately 15 m of black **shale**, overlain by 8-10 m thick bed of calcite cemented boulder **conglomerate** which scours into the shale.

Site 24

Location: Outcrop observed approximately 800 m upstream of Section 22, on the east bank. The gully narrows at this point: map 38C/12, UTM grid 532704.

Description: Several meters of rusty migmatite **breccia** are overlain by interbedded **conglomerate** and **sandstone**; fining to pebbly **sandstone**. This is overlain by several meters of black weathering **shale** and then by 10 m of boulder **conglomerate**.

Site 25

Location: Approximately 550 m upstream of Section 22, on the east bank: map 38C/12, UTM grid 531699.

Description: Outcrop consists of several meters of **breccia**: composed of ultramafic and migmatitic clasts 2-20 cm in diameter; cemented with calcite.

Section 26

Location: Section measured on the Maud Bight shoreline along the sea cliffs approximately 600 m east of the mouth of a major glacial stream: map 38C/12, UTM grid 566722.

Unit/ Formation	Description	Height Above Base (m)
6 Akt. sst.	**Shale**: black weathering, unbioturbated; with lenticular interbeds of **sandstone**: grey weathering, rippled and fine	35.2

Unit/ Formation	Description	Height Above Base (m)
	grained.	
5 Akt. sst.	**Sandstone**: grey to green weathering, laminated, rippled, with occasional RUC's up to 10 cm long, fine to medium grained; interbedded with **siltstone** and **shale**: grey to black weathering, mud-cracked, common plant debris; in fining-upward cycles up to 3.5 m thick, separated by scour surfaces; poorly cemented with calcite.	28.5
4 Akt. sst.	**Shale**: black weathering, unbioturbated; with lenticular 3-10 cm thick interbeds of **sandstone**: grey weathering, rippled and fine grained.	21.0
3 Akt. sst.	**Sandstone**: grey to green weathering, massive to laminated and rippled, with occasional RUC's at the base of the bed, fine to medium grained; interbedded with **siltstone** and **shale**: grey to black weathering, laminated, mud-cracked, common fine plant debris; in fining-upward cycles up to 1.5 m thick, separated by scour surfaces; containing bedding parallel concretions otherwise poorly cemented with calcite.	13.0
2 Akt. sst.	**Shale**: black weathering, unbioturbated; interbedded with fine grained **sandstone** and **siltstone**: grey weathering, laminated, rippled; in fining-upward cycles up to 30 cm thick, separated by scour surfaces.	4.0
1 Akt. sst.	**Sandstone**: grey weathering, massive, fining upwards to black	1.5

weathering **shale** over 1.5 m.

Site 27

Location: Outcrop observed on hillside and north bank of a glacial stream draining into Maud Bight. It is approximately 2.1 km south of Section 2: map 38C/12, UTM grid 604631.

Description: Massive clast supported **conglomerate** composed of angular to subangular granite, Adams Sound quartz arenite and potassium feldspar augen gneiss boulders commonly up to 80 cm in diameter but occasionally up to 1.6 m; numerous coaly fragments occur on the slope; moderately cemented with calcite.

Site 28

Location: Outcrop observed on hillside and north bank of a glacial stream draining into Maud Bight. It is approximately 1.3 km south of Section 2: map 38C/12, UTM grid 599640.

Description: Outcrop consists of thinly bedded rippled **sandstone** and laminated **shale** in fining-upward cycles up to 5 cm thick; channelized **sandstone**: laminated with RUC's, coarse grained, up to 1 m thick, scour based; and interbedded coarse grained **sandstone** and **conglomerate** with subangular to subrounded cobbles of quartz arenite and feldspar augen gneiss up to 20 cm in diameter; all overlain by massive boulder **conglomerate**; woody debris abundant throughout area.

Site 29

Location: Outcrop observed on the east bank of a glacial stream draining into Maud Bight. It is approximately 2.3 km north of Section 2: map 38C/12, UTM grid 608676.

Description: Outcrop composed of **conglomerate**: massive, clast supported, clasts are subangular to subrounded and average 25-60 cm in diameter but occasionally reach 210 cm; poorly cemented with calcite.

Section 30

Location: Section measured on the west bank of a glacial stream. To the immediate east is a glacial moraine and very large glacier and 100 m to the south a Helikian dike is exposed: map 38C/11, UTM grid 676596.

Unit/ Formation	Description	Height Above Base (m)
6 Maud Bight	**Conglomerate**: thickly bedded, clast supported, composed of subrounded granite and quartz arenite clasts 30-70 cm in diameter; occasionally inter-bedded with **sandstone**: green weathering, massive, medium grained; beds separated by scours.	49.5
5 Maud Bight	**Shale**: black, green and red weathering, with oxidized bands, may be sheared by faulting.	43.0
4 Maud Bight	**Sandstone**: buff weathering, abundant woody debris; interbedded with **shale**: light grey weathering; in fining-upward cycles 3-10 cm thick; and single **conglomerate** bed: clast supported, composed of subrounded gneiss and granite boulders 30-70 cm in diameter, with very coarse grained **sandstone** matrix; interbedded with **sandstone**: buff weathering, massive, variable amounts of RUC's 10-100 cm long, abundant woody debris, fine to medium grained; also interbedded	33.0

Unit/ Formation	Description	Height Above Base (m)
	with light grey to black **shale**; in fining-upward cycles up to 3.5 m thick, separated by scour surfaces.	
3 Maud Bight	**Conglomerate**: buff weathering, well sorted, clast supported, composed of well rounded gneiss and granite boulders 30-70 cm in diameter, with very coarse grained sandstone matrix; interbedded with **sandstone**: buff weathering, massive or rich in RUC's 10-100 cm long, with abundant woody debris; in fining-upward cycles up to 3.5 m thick, separated by scour surfaces, poorly cemented.	24.0
2 Navy Board	Thin interbeds of orange weathering **sandstone**, buff weathering **siltstone** and grey to green	16.0

Unit/ Formation	Description	Height Above Base (m)
	weathering **shale**; in fining-upward cycles up to 5 cm thick; bedding varying from undisturbed to contorted and incorporated in debris flows up to 1 m thick.	
1 Navy Board	**Sandstone**: green weathering, with RUC's of grey **shale** from 50-70 cm long, abundant woody debris; in beds up to 1 m thick, separated by scour surfaces; most of unit moderately sheared and faulted.	8.0

Section 31

Location: Section measured along the east canyon wall of a glacial stream draining into Maud Bight approximately 400 m northwest of where the stream's course shifts from westerly to northwesterly flow: map 38C/11, UTM grid 664615.

Unit/ Formation	Description	Height Above Base (m)
3 Maud Bight	**Conglomerate**: moderately sorted, clast supported, composed of sub-rounded granite, gneiss and quartz arenite cobbles 20-50 cm in diameter; interbedded with **sandstone**: buff to green weathering, massive with occasional RUC's up to 5 cm long, fine to coarse grained, containing abundant woody debris; in fining-upward cycles 1.5-8 m thick, separated by scour surfaces.	54.0
2 Maud Bight	**Conglomerate**: well sorted, clast supported, composed of subrounded granite, gneiss and quartz arenite cobbles 10-25 cm in diameter; inter-bedded with **sandstone**: buff to green weathering, massive, with abundant logs and fine plant debris, occasional RUC's, medium to very coarse grained and pebbly, with silty lenses; in fining-upward cycles 1-2.2 m thick, separated by scour surfaces.	33.0
1 Navy Board	**Sandstone**: green weathering, rippled, laminated, with abundant fine plant debris, fine grained; interbedded with **siltstone**: grey weathering, laminated; in fining-upward cycles 5-20 cm thick.	21.7

Site 32

Location: Outcrop observed on the west bank of a glacial stream, approximately 800 m south of Section 1: map 38C/12, UTM grid 610682.

Description: 5 m thick outcrop of **sandstone**: grey to white weathering, laminated with rare RUC's, medium to coarse grained with pebbly stringers, pebbles composed of quartz arenite; in beds up to 30 cm thick, separated by scour surfaces. This is overlain by up to 4 m of **Conglomerate**: moderately sorted, clast supported, composed of subangular migmatite, foliated granite, augen gneiss, quartz arenite and amphibolite boulders up to 2 m (but averaging 30-60 cm) in diameter; interbedded with **sandstone**: buff weathering, medium to coarse grained; in fining-upward cycles up to 2 m thick separated by scour surfaces.

APPENDIX B.2
SAMPLE LOCATION

Note: Sample position in stratigraphic column is given for measured sections only, not spot checks. Pal=palynomorph, Sed=sediment. All samples, thin sections and palynological slides and data are archived at Memorial University of Newfoundland and may be accessed by contacting Dr. E.T. Burden of Dept. of Earth Sciences.

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
1	32	***	Pal
2	32	***	Sed
3	1	1.5	Sed
4	1	3.8	Pal
5	1	14.4	Pal
6	1	18.5	Pal
7	1	26.0	Pal
8	1	27.5	Sed
9	1	34.6	Pal
10	1	47.8	Pal
11	1	57.0	Pal
12	1	66.0	Pal
13	1	75.0	Sed
14	1	78.7	Pal
15	1	85.8	Sed
16	1	91.0	Pal
17	2	1.0	Pal
18	2	2.0	Sed
19	2	10.5	Pal
20	2	11.0	Sed
21	2	20.5	Pal
22	2	30.5	Pal
23	3	3.0	Pal
24	3	6.0	Pal
25	3	18.0	Pal
26	3	27.0	Pal
27	3	34.6	Pal

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
28	3	39.0	Sed
29	3	44.5	Pal
30	3	65.6	Pal
31	3	76.0	Pal
32	3	86.0	Pal
33	3	96.0	Pal
34	3	106.0	Pal
35	3	116.0	Pal
36	3	130.5	Sed
37	3	132.5	Bored Wood
38	3	138.0	Pal
39	3	160.0	Sed
40	3	174.6	Pal
41	3	206.3	Pal
42	3	215.8	Pal
43	3	204.5	Sed
44	3	139.0	Sed
45	3	218.0	Sed
46	3	228.0	Pal
47	3	205.6	Sed
47B	3	208.0	Sed
48	3	253.0	Pal
49	3	266.0	Sed/Pal
50	3	279.0	Pal
51	3	288.5	Pal
52	3	300.2	Pal
52B	3	284.0	Log Cast

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
53	3	312.5	Pal
54	3	323.5	Pal
55	3	334.0	Pal
56	3	344.0	Pal
57	4	1.0	Pal
58	4	12.0	Pal
59	4	47.0	Sed
60	4	60.8	Sed
61	4	64.5	Sed
62	4	65.5	Pal
63	4	77.0	Sed
64	4	74.4	Sed/Pal
65	5	3.5	Pal
66	5	14.0	Pal
67	6	3.5	Pal
68	6	15.0	Pal
69	6	25.0	Pal
70	6	35.0	Pal
71	6	43.0	Pal
72	6	50.0	Sed
73	6	55.0	Pal
74	6	58.0	Leaves
75	6	65.5	Pal
76	6	82.5	Sed
77	6	58.0	Pal
78	7	***	Sed
79	8	1.0	Pal

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
80	8	9.5	Pal
81	8	19.0	Pal
82	8	25.7	Sed
83	8	28.5	Pal
84	10	***	Pal
85	10	***	Pal
86	10	***	Sed
87	11	4.5	Pal
88	11	5.7	Sed
89	11	19.0	Pal
90	11	32.0	Pal
91	2	46.2	Pal
92	12	11.0	Pal
93	12	15.6	Sed
94	12	18.4	Pal
95	12	20.2	Sed
96	13	2.6	Pal/Sed
97	13	14.5	Pal
98	14	20.0	Sed
99	14	9.0	Pal
100	14	18.0	Pal
101	14	28.0	Pal
102	15	4.0	Pal
103	15	14.5	Pal
104	15	24.9	Pal
105	15	38.6	Sed
106	15	37.5	Sed

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
107	15	52.0	Pal
108	15	89.0	Sed
109	15	115.0	Sed
110	15	144.0	Sed
111	16	43.2	Pal
112	16	47.0	Sed
113	16	51.5	Pal
114	16	51.0	Coal
115	16	58.0	Sed
116	16	61.0	Pal
117	16	63.5	Pal
118	16	80.0	Sed
119	17	***	Sed
120	18	11.0	Pal
121	18	21.0	Pal
122	18	~26.0	Sed
123	19	7.0	Sed
124	19	10.0	Pal
125	19	18.3	Pal
126	19	28.0	Sed
127	19	41.0	Pal
128	19	50.0	Pal
129	19	79.3	Sed
130	21	0.5	Pal
131	21	10.0	Pal
132	22	1.5	Pal
133	22	14.0	Pal

SAMPLE #	SECTION #	POSITION(m)	SAMPLE TYPE
134	25	***	Sed
135	26	0.8	Sed
136	26	2.5	Pal
137	26	14.0	Pal
138	26	29.3	Pal
139	28	***	Sed
140	30	15.0	Pal
141	30	21.0	Pal
142A	30	29.6	Sed
142B	30	42.4	Pal
143	dike nr 30	***	Sed
144	31	***	Pal
145	31	0.5	Leaf
146	31	1.5	Sed
147	31	14.0	Pal
148	31	31.8	Pal
149	31	45.0	Pal
150	31	28.4	Pal
151	32	***	Pal
152	32	***	Sed
153	3	216.0	Pal
154	3	218.0	Pal
155	3	226.0	Pal

APPENDIX C
POINT COUNT DATA

36 samples from Maud Bight and near Cape Hay were thin sectioned and stained for petrological study. The staining process allowed plagioclase feldspars and orthoclase feldspars to be easily distinguished. A number of samples were poorly consolidated to weakly cemented and were impregnated with epoxy before thin sectioning. 500 points were counted on each thin section unless grain size or thin section condition restricted counting to 250 points. Major constituents in a point count of 500 will be accurate to +/- 4.5% of the actual volume 95% of the time (Van der Plas and Tobi, 1965). Sandstone samples with a clay matrix under 15% were classified according to McBride (1963) and over 15% matrix according to Folk (1980). These systems are purely descriptive and allow classification based on the major components; quartz (monocrystalline and polycrystalline), (orthoclase and plagioclase) feldspar and lithic fragments. Other components include hornblende, mica, opaque minerals, glauconite, tourmaline, garnet, organics and pyroxene. Clay content and cement type were also noted. A significant proportion of the opaque minerals are magnetite as over half of the total opaque heavy minerals in tested unconsolidated samples proved magnetic.

Point Count Results for the
Hassel, Bylot Island and Sermilik Formations

Sp	Qm	Qp	K	Pl	Li	Lm	Ls	Op	Bi	Gl	Hb	Mis
27	26	3	11	7	40	5	5	2	2	-	-	G
28	88	5	<1	2	-	-	2	2	<1	-	-	-
98	55	-	29	2	-	-	-	6	3	5	-	-
123	93	<1	-	-	-	-	3	3	-	-	-	Z
126	85	-	1	-	-	-	13	1	-	<1	-	-
36	40	-	16	17	5	-	-	<1	-	4	14	-
44	91	3	2	1	-	-	1	1	1	-	-	-
45	41	13	15	17	3	2	-	3	4	-	4	-
47A	74	3	2	<1	-	-	-	18	-	-	-	T
47B	80	5	9	1	2	-	-	3	-	-	-	T
59	77	3	10	1	2	-	2	3	1	-	<1	-
70	81	2	3	<1	-	-	<1	<1	-	13	-	-
78	95	2	-	1	-	-	-	-	-	2	-	-
105	85	<1	7	1	-	-	-	2	1	3	-	T,P
108	90	2	1	2	2	<1	-	1	<1	-	-	T,G
115	87	8	-	<1	-	-	-	4	-	-	-	T

Sp	Qm	Qp	K	Pl	Li	Lm	Ls	Op	Bi	Gl	Hb	Mis
118	57	27	4	2	-	3	7	-	-	-	-	-
129	71	1	13	-	3	-	-	6	-	7	-	-
152	37	<1	18	<1	-	29	6	2	3	-	4	T,G
155	36	<1	5	-	40	16	1	1	-	-	-	G

Abbreviations represent; Sp=Sample number; Qm=Monocrystalline quartz; Qp=Polycrystalline quartz; K=Potassium feldspar; Pl=Plagioclase feldspar; Lm=Metamorphic lithic clast; Li=Igneous lithic clast; Ls=Sedimentary lithic clast; Op=Opaque; Bi=Biotite; Gl=Glauconite; Hb=Hornblende; Mis=Miscellaneous grains; included in this column are T=Tourmaline; Z=Zircon; G=Garnet; O=organics and P=Pyroxene.

Point Count Results for Navy Board and Aktineq Formations

Sp	Qm	Qp	K	Pl	Li	Lm	Ls	Op	Bi	Gl	Hb	Mis
18	11	8	13	10	28	16	9	1	<1	-	-	-
72	29	<1	3	<1	14	49	2	<1	1	-	1	-
82	34	-	43	6	-	-	-	4	5	-	5	O
139	50	-	19	2	-	12	5	5	-	-	5	G,Z
142	37	-	23	6	-	18	7	3	5	-	2	G,P
8	22	-	20	10	28	10	-	2	2	-	1	G
15	38	<1	24	18	-	-	-	3	4	-	<1	G
61	16	12	5	-	59	-	-	2	-	-	<1	-
88	24	<1	15	11	30	10	-	3	4	-	-	T
95	24	2	50	4	17	-	-	2	2	-	-	G,T
135	37	4	17	<1	33	-	<1	2	4	-	<1	Z
2	15	12	12	4	15	29	-	1	5	-	<1	GPT
60	27	<1	20	8	23	-	-	4	3	4	-	G

Sp	Qm	Qp	K	Pl	Li	Lm	Ls	Op	Bi	Gl	Hb	Mis
63	31	14	7	3	12	18	10	<1	2	-	-	GPO
122	9	7	12	2	-	62	-	<1	-	-	-	-
134	12	2	11	1	-	70	-	1	1	-	-	GPT

Abbreviations represent; Sp=Sample number; Qm=Monocrystalline quartz; Qp=Polycrystalline quartz; K=Potassium feldspar; Pl=Plagioclase feldspar; Lm=Metamorphic lithic clast; Li=Igneous lithic clast; Ls=Sedimentary lithic clast; Op=Opaque; Bi=Biotite; Gl=Glauconite; Hb=Hornblende; Mis=Miscellaneous grains; included in this column are T=Tourmaline; Z=Zircon; G=Garnet; O=Organics and P=Pyroxene.

QFL Percent, Matrix and Cement in samples from the Navy Board and Aktineq Formations

Sp#	Formation	Q	F	L	Clay	Cement
18	Navy Board	23	23	54	-	-
72	Navy Board	30	3	67	Y	-
82	Navy Board	41	59	0	Y	-
139	Navy Board	57	24	19	-	-
142	Navy Board	41	32	27	Y	-
8	Akt. sst.	24	33	42	-	-
15	Akt. sst.	40	43	17	Y	-
61	Akt. sst.	21	18	61	Y	-

Sp#	Formation	Q	F	L	Clay	Cement
18	Navy Board	23	23	54	-	-
88	Akt. sst.	27	29	44	-	-
95	Akt. sst.	26	56	18	Y	-
135	Akt. sst.	45	23	36	Y	Qtz
2	M.B.M.	31	18	51	Y	Calc
60	M.B.M.	32	37	31	Y	-
63	M.B.M.	48	11	42	Y	Calc
122	M.B.M.	17	15	67	Y	Calc
134	M.B.M.	15	12	73	Y	Calc

Abbreviations represent; Sp#=Sample number; Q=Quartz; F=Feldspar; L=lithic clast; Qtz=Quartz cement; Calc=Calcite cement; Hem=Hematite cement

QFL Percent, Matrix and Cement in samples from the Hassel Bylot Island and Sermilik Formations

Sp#	Formation	Q	F	L	Clay	Cement
27	Hassel	29	19	52	Y	-
28	Hassel	95	3	2	-	-
98	Bylot Island	65	35	0	Y	Calc
123	Bylot Island	97	0	3	Y	Qtz

Sp#	Formation	Q	F	L	Clay	Cement
27	Hassel	29	19	52	Y	-
126	Bylot Island	87	1	13	-	Calc
36	Sermilik	51	43	7	Y	-
44	Sermilik	94	5	1	Y	-
45	Sermilik	58	36	6	Y	-
47A	Sermilik	97	3	0	Y	-
47B	Sermilik	88	10	2	Y	-
59	Sermilik	84	12	4	Y	-
70	Sermilik	96	4	0	-	-
78	Sermilik	99	1	0	-	Hem
105	Sermilik	92	8	0	-	Hem
108	Sermilik	95	3	2	Y	Hem
115	Sermilik	100	0	0	-	-
118	Sermilik	84	6	10	-	Hem
129	Sermilik	82	14	4	Y	-
152	Sermilik	41	19	40	Y	Hem
155	Sermilik	37	5	58	-	Calc

Abbreviations represent; Sp#=Sample number; Q=Quartz; F=Feldspar; L=lithic clast; Qtz=Quartz cement; Calc=Calcite cement; Hem=Hematite cement

APPENDIX E
SUMMARY OF ORGANIC REMAINS FROM PALYNOLOGICAL COUNTS

S=sample number; **L**=Lycopodium spike recorded during count; **D**=Number of Dinoflagellates; **B**=Unclassified bisaccates; **I**=Indeterminate grains including pollen and spores; **F**=Fungal remains.

The samples referred to are located on the composite stratigraphic sections in Appendix A, on the measured stratigraphic sections in Appendix B.1 and the Palynomorph Range Chart in Appendix D.

The Palynomorph Range Chart in Appendix D was generated through the Checklist Programme. It is a graphical representation of species abundances out of a total count of 200 grains in each sample.

Formation	S	L	D	B	I	F
Bylot Is.	25	140	>200	59	29	59
Bylot Is.	32	72	>200	64	60	28
Bylot Is.	35	108	>200	63	39	79
Bylot Is.	65	146	>200	78	74	0
Bylot Is.	101	243	>200	60	59	21
Bylot Is.	102	51	>200	43	25	27
Bylot Is.	103	32	>200	17	72	2
Bylot Is.	104	100	>200	21	24	5
Bylot Is.	124	65	>200	51	43	1
Bylot Is.	125	170	>200	67	80	1
Bylot Is.	127	101	>200	100	76	0
Bylot Is.	128	153	>200	99	27	4
Sermilik	40	42	>200	117	51	76
Sermilik	41	27	99	80	43	40
Sermilik	42	85	>200	64	60	28
Sermilik	107	130	>200	98	39	10
Sermilik	113	94	0	17	43	15

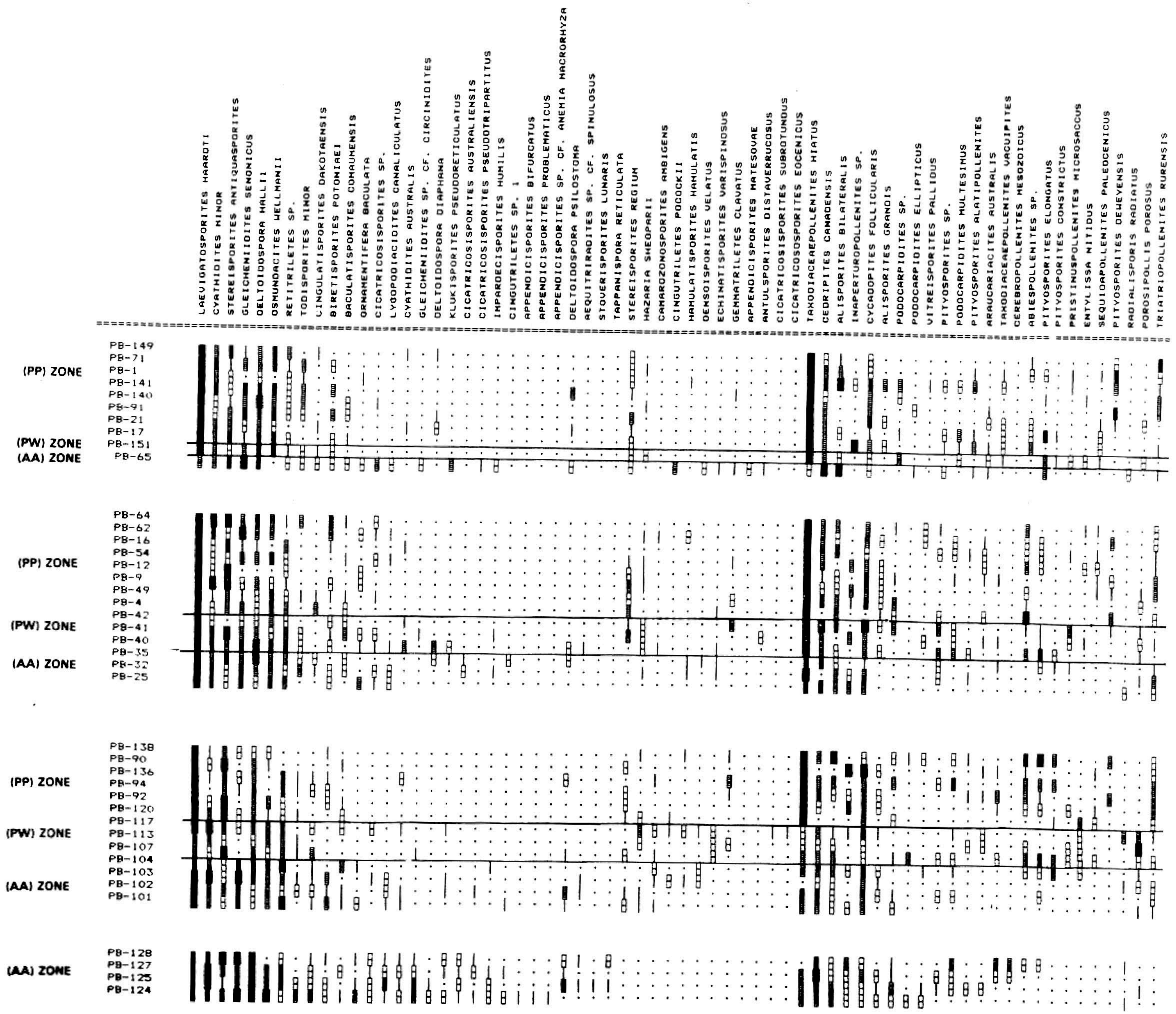
Formation	S	L	D	B	I	F
Sermilik	117	7	0	26	48	47
Sermilik	151	28	>200	71	63	74
Navy Bd.	4	12	0	62	24	54
Navy Bd.	17	3	1	35	49	35
Navy Bd.	21	17	5	42	74	74
Navy Bd.	49	11	2	29	50	53
Navy Bd.	91	13	6	21	66	71
Navy Bd.	92	24	2	11	46	26
Navy Bd.	120	10	0	13	29	2
Navy Bd.	140	22	0	29	56	303
Akt. sst.	12	14	0	22	54	71
Akt. sst.	16	32	0	52	52	76
Akt. sst.	54	14	1	30	53	78
Akt. sst.	94	108	4	26	46	21
Akt. sst.	136	52	0	52	88	200
Akt. sst.	138	25	0	20	29	29
M.B.M.	1	68	0	101	102	59
M.B.M.	62	18	>200	49	73	32
M.B.M.	64	7	21	26	46	174
M.B.M.	71	161	0	49	63	104
M.B.M.	141	0	0	23	78	206
M.B.M.	149	24	0	24	100	38

RANGE CHART OF GRAPHIC ABUNDANCES BY MANUAL ORDERING

Key to Symbols

= Very Rare (1 Count)
= Rare (2-4 Counts)
= Few (5-9 Counts)
= Common (10-14 Counts)
= Abundant (15+ Counts)
? = Questionably Present
. = Not Present
X = Present, Not Quantified

APPENDIX I
RANGE CHA



APPENDIX D
RANGE CHART FOR NORTH BYLOT TROUGH