Preliminary results of palynological studies of the Permian and lowermost Triassic sediments, Sabine Peninsula, Melville Island, Canadian Arctic Archipelago

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Abstract

Well preserved palynomorphs have been found in samples from the uppermost part of the Canyon Fiord Formation (Lower Permian?); the Belcher Channel (Lower Permian), Sabine Bay (Lower Permian), and Assistance (Lower Permian) formations; "Unit A" (Lower or Upper Permian); and the Trold Fiord (Upper Permian) and lower Bjorne (Lower Triassic) formations. Pollen and spores occur in all formations, and acritarchs in all except the Canyon Fiord and Bjorne. In general terms, the Permian assemblages contain abundant, striate disaccate pollen (**Protohaploxypinus** spp.), polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.), and trilete spores. Monosaccate pollen (**Cordaitina** spp.) occurs occasionally. The Lower Triassic assemblages contain abundant striate disaccate pollen (**Protohaploxypinus** spp. and **Taeniaesporites** spp.), non-striate disaccate pollen (**Falcisporites** sp. and **Klausipollenites** spp.), colpate pollen (**Gnetaceaepollenites** spp.), and trilete spores (**Kraeuselisporites** spp. and **Lundbladispora** spp.). Present also is the cyst-like microfossil **Tympanicysta stoschiana.** The assemblages are unlike those of Gondwana and Cathaysia. They appear to be more similar to those described from the northeast European part of Russia than those of Western Europe.

The Thermal Alteration indices of the palynomorphs are low (2- to 2+ on a five point scale), suggesting suitable conditions for the generation of liquid hydrocarbons.

Résumé

Des palynomorphes bien conservés ont été trouvés dans des échantillons provenant de la partie supérieure de la formation de Canyon Fiord (Permien inférieur?); des formations de Belcher Channel, de Sabina Bay et d'Assistance, toutes du Permien inférieur; de l'"unité A" (Permien inférieur ou supérieur); de la formation de Trold Fiord (Permien supérieur) et de la partie inférieure de la formation de Bjorne (Trias inférieur). Toutes ces formations contiennent du pollen et toutes, sauf celle de Canyon Fiord et de Bjorne, contiennent des acritarches. En général, les assemblages permiens contiennent une quantité abondante de pollens bi-ailé strié (espèces de **Protohaploxypinus**), de pollen polyplicaturé (espèces de **Vittatina** et de **Weylandites**) et des spores trilètes. On trouve du pollen à ballonet (espèces de **Cordaitina**) par endroits. Les assemblages du Trias récent contiennent d'abondantes quantités de pollen bi-ailé strié (espèce de **Protohaploxypinus** et de **Taeniaesporites**), de pollen bi-ailé non strié (espèce de **Falcisporites** et espèces de **Klausipollenites**), de pollen à sillons (espèces de **Gnetaceaepollenites**) et de spores trilètes (espèces de **Kraeuselisporites** et de **Lundbladispora**), ainsi qu'un microfossile en forme de kyste, **Tympanicysta stoschiana.** Ces assemblages sont différents de ceux de Gondwana et de Cathaysia; ils ressemblent plus à ceux qui proviennent de la partie nord-est européenne de la Russie qu'à ceux de l'Europe occidentale.

Les palynomorphes ont de faibles indices d'altération thermique (de 2- à 2+ sur une échelle de cinq points), ce qui porte à croire que les conditions favorisaient la formation d'hydrocarbures liquides.

Introduction

During the summer of 1984, seventy-four samples were collected from Permian and lower Triassic formations in the Tingmisut Lake and Hiccles Creek areas in the southeast part of the Sabine Peninsula of Melville Island (Fig. 28.1, 28.2). Units sampled include the uppermost part of the Canyon Fiord Formation; the Belcher Channel, Sabine Bay, and Assistance formations; "Unit A"; and the Trold Fiord and lower Bjorne formations (Fig. 28.3). Preservation of palynomorphs is generally good; damage by the growth of pyrite crystals on pollen and spore exines is slight, and the Thermal Alteration indices are low (2- to 2+ on the five point scale of Hunt, 1979). Identifications made are mainly at the generic level, reflecting the large number of undescribed species present, and the fact that further taxonomic study is necessary.

In the following section, the stratigraphy in the Tingmisut Lake area is summarized (in ascending order) and a general description given of the palynological assemblages (Fig. 28.4).

Stratigraphy and palynological assemblages

Canyon Fiord Formation

The lowest beds of the formation, according to Tozer and Thorsteinsson (1964), consist of light grey to white, quartzose, medium grained sandstone, with some grains of black chert and much carbonate cement. A Middle Pennsylvanian brachiopod fauna was collected by Tozer and Thorsteinsson from this unit. The overlying beds consist of reddish brown, interbedded sandstone and conglomerate, overlain by red shale containing grey limestone concretions up to 0.08 m in diameter. The total thickness approaches 600 m.

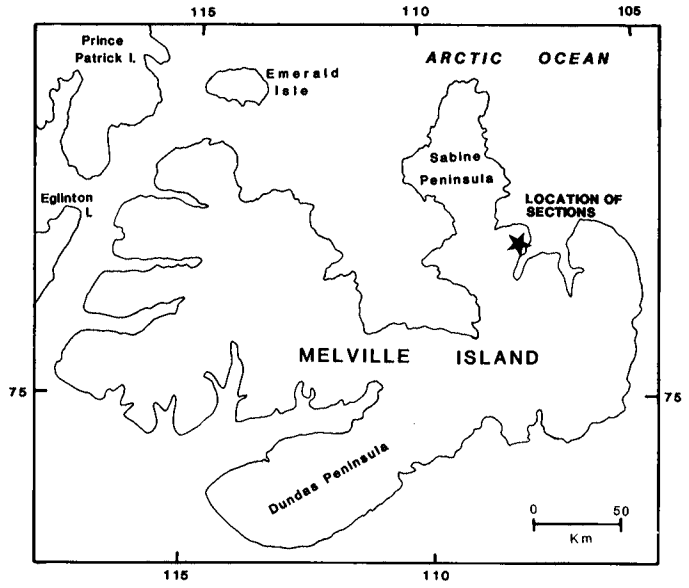
No macrofaunal data are available from the middle and upper part of the formation. In the Canyon Fiord area of Ellesmere Island, Thorsteinsson (1974), reported that the oldest fossils (mainly fusulinaceans) were of Bashkirian age and the youngest were probably Sakmarian, although an Asselian age could not be ruled out.

In the investigation of this formation during the summer of 1984, only the middle and upper parts were studied. Most of the formation, with its dominantly red-brown colour, is not suitable for palynological analysis; however, in the uppermost part, about 10 m below the base of the Belcher Channel Formation, approximately 8 m of alternating grey, grey-khaki and purplish shale occur. Samples from this unit yielded poor to fairly well preserved assemblages of pollen and spores.

Striate disaccate pollen (**Protohaploxypinus** spp.) and polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.) are common, with rare, monosaccate pollen (**Cordaitina** sp.) and occasional trilete spores (**Leiotriletes** sp., **Lophotriletes** sp., **Punctatisporites** sp., and **Raistrickia** sp).

The age of this material is uncertain, but the abundance of polyplicate grains and striate disaccate grains indicates that it may be Early Permian (Asselian or Sakmarian).

The organic matter consists mainly of small to medium sized (approx. 30-50 μm) coaly fragments, along with some woody and exinous fragments. The abundance of land derived pollen and spores, along with the lack of any marine palynomorphs, suggests a nonmarine environment of deposition for the interval sampled. The fact that the coaly fragments are small to medium sized may be the result of transportation, possibly in a fluviatile regime, prior to deposition. The fine grained grey sediments at the top of the formation are poorly exposed, but the colour change can be traced along strike for several hundred metres, suggesting that the beds are laterally extensive, and that they may represent deposition in a lacustrine environment.



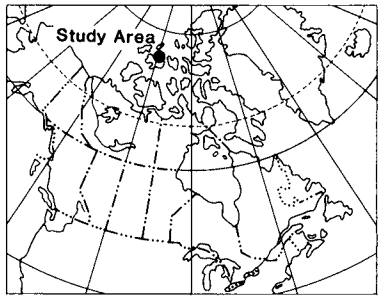


Figure 28.1. *Location of study area.*

The spores and pollen are light yellow-brown to medium brown suggesting a Thermal Alteration Index of 2+.

Belcher Channel Formation

The original description by Tozer and Thorsteinsson (1964, p. 102), included beds, now assigned to the Belcher Channel Formation, in the lower Sabine Bay Formation. They pointed out (p. 229) that further work on Ellesmere and Axel Heiberg islands would probably necessitate revision of the stratigraphy and that the upper, essentially nonmarine part should be included in the Sabine Bay Formation, whereas the lower, marine part correlated with the Belcher Channel Formation of the northeastern Arctic islands. The lithology of the Belcher Channel Formation at the sample locality is essentially a quartzose, bioclastic limestone, within which is a calcareous, quartzose sandstone at least 20 m thick. The total thickness is in the order of 90 m. In the limestone units occur brachiopods, bryozoans and fusulinids, which, according to Tozer and Thorsteinsson (1964), indicate an Early Permian age. In other parts of the Sverdrup basin, the formation has a possible age range from latest Carboniferous (Gzhelian) to earliest Artinskian, (Nassichuk and Wilde, 1977, Textfigure 4), but Nassichuk (1965), pointed out that in the southern part of Sabine Peninsula only the uppermost part of

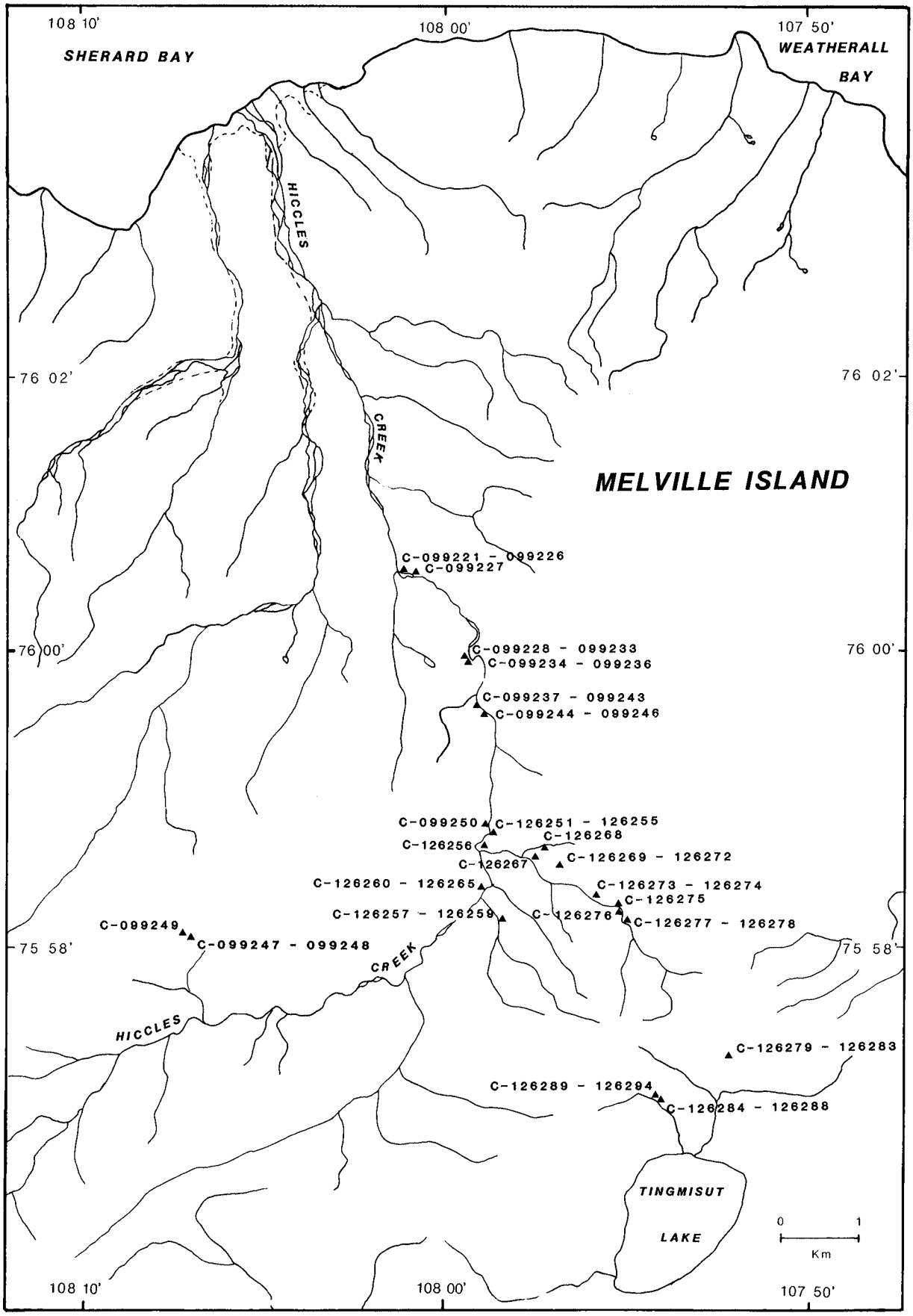


Figure 28.2. *Sample localities.*

the formation may be represented. Fusulinids collected by Nassichuk from near the top of the formation were identified by Thorsteinsson as **Parafusulina** sp., and an early Artinskian age was suggested (Nassichuk, 1970).

Within the limestone units occur very thin, argillaceous intercalations that were sampled for palynomorphs. These intercalations contain assemblages with striate disaccate pollen (**Protohaploxypinus** spp. and **Striatoabieites** sp.), polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.), and a variety of trilete spores (**Apiculatisporis** sp., **Calamospora** sp., **Cyclogranisporites** sp., **Dictyotriletes** sp., **Kraeuselisporites** spp., **Leiotriletes** sp., **Lophotriletes** sp., and **Raistrickia** sp.). Monosaccate pollen is rare, but includes **Cordaitina** sp. and **Florinites luberae** Samoilovich 1961. Acritarchs (**Micrhystridium** spp.) occur occasionally, and scolecodonts are rare.

The organic matter consists of a high proportion (approx. 50%) of finely dispersed organic debris along with approximately equal proportions of small to medium sized, coaly, woody and exinous material. The occurrence of this type of organic matter, and the fact that land derived pollen and spores are abundant and acritarchs occur occasionally, suggest a high energy, shallow marine environment of deposition.

The colour of the spores is yellow-brown to dark orange, indicating a Thermal Alteration Index of 2.

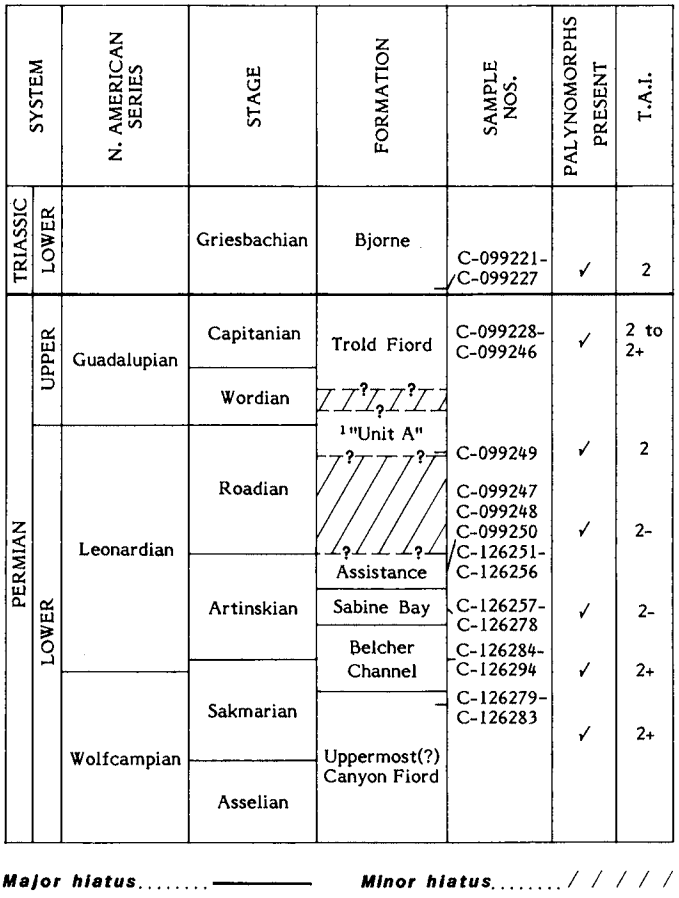


Figure 28.3. *Correlation table indicating the approximate ages of beds sampled in the Tingmisut Lake area, Sabine Peninsula, Melville Island.* [1]*"Unit A" used in the sense of Nassichuk (1965).* √*Indicates palynomorphs present.*

Sabine Bay Formation

This formation consists mainly of medium grained, generally grey to buff, cross-bedded, quartzose sandstone. It contains occasional, thin beds of carbonaceous mudstone and coal (0.05 m); varicoloured chert pebbles are commonly present. Exposure of the formation, especially the lower part, is generally poor and discontinuous in the Hiccles Creek area. Near the presumed base occurs a bed with large (0.80 m), calcareous, nodular concretions that contain occasional brachiopods and trace fossils (**Zoophycus**? sp.); the latter were observed also near the top of the formation. The Sabine Bay Formation may be divided into a lower unit, which is so unindurated that sections may be dug easily with a shovel, and an upper part, which is well indurated, and forms prominent cliffs. According to Nassichuk (1965), the total maximum thickness is approximately 120 m.

The age of the formation is uncertain but, near the base, Nassichuk (1970), recorded **Sverdrupites** sp., and suggested an Artinskian age.

The thin, argillaceous, carbonaceous beds yielded very well preserved pollen and spores and occasional acritarchs. The assemblages contain a variety of taxa, including striate disaccate pollen (**Protohaploxypinus** spp., **Striatopodocarpites** spp., and **Hamiapollenites** sp.), and non-striate disaccate pollen (**Alisporites** spp., **Pityosporites** spp., **Sulcatisporites** spp., and **Triadispora** spp.), polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.), trilete spores (**Apiculatisporis** spp., **Calamospora** spp., **Cyclogranisporites** spp., **Densoisporites** spp., **Foveosporites** spp., **Kraeuselisporites** spp., **Leiotriletes** spp., **Lophotriletes** spp., **Neoraistrickia** spp., **Nevesisporites** sp., **Punctatisporites** spp., **Raistrickia** spp., and **Verrucosisporites** sp.), and the monolete spore **Speciosporites** sp. Acritarch genera include **Micrhystridium** and **Veryhachium.** Also present are reworked Late Devonian specimens including **Ancyrospora** sp. and **Cyrtospora cristifer** (Luber) Van der Zwan 1979, along with **Pustulatisporites** sp. and **Retusotriletes** sp., which may also be of Late Devonian age.

The organic matter consists of abundant (50-80%) medium to large sized (approx. 50-170 µm) coaly fragments along with some woody and exinous fragments. Finely dispersed organic matter is rare. The medium to large size of the coaly fragments, the abundance of land derived pollen and spores, and the presence of occasional acritarchs, indicate a fairly low energy, marine environment of deposition such as a delta front.

The pollen and spores are yellow-orange in colour and the Thermal Alteration Index is estimated to be 2-.

Assistance Formation

The Assistance Formation is recognized in the sense of Nassichuk (1965), rather than that of Tozer and Thorsteinsson (1964). It consists of grey sandstone, ironstone concretionary bands and grey mudstone. The total thickness is in the order of 30 m.

Exposure is extremely poor due to the recessive nature of the beds and a cover of solifluction debris. In the Hiccles Creek area, Nassichuk (1965) recorded typical Assistance ammonoids. In the type section of the Assistance Formation (Grinnell Peninsula, Devon Island), the ammonoid fauna indicates a probable Late Artinskian age (Nassichuk, 1970).

Samples collected from the rare exposures yielded well preserved, diverse assemblages of pollen and spores. Acritarchs are common and occasional scolecodonts occur.

SYSTEM	FORMATION	ASSEMBLAGE CHARACTERISTICS
TRIASSIC	Lower Bjorne	*Taeniaesporites noviaulensis, Protohaploxypinus* spp., *Striatoabieites richteri, Falcisporites zapfei, Klausipollenites staplinii, Gnetaceaepollenites steevesi, Kraeuselisporites* sp., *Lundbladispora obsoleta, Lundbladispora* sp., *Proprisporites pocockii, Tympanicysta stoschiana.*
UPPER PERMIAN	Trold Fiord	*Protohaploxypinus* spp., *Striatoabieites* spp., *Abiespollenites* sp., *Alisporites* sp., *Limitisporites* sp., *Sulcatisporites* sp., *Triadispora* sp., *Vitreisporites* sp., *Vittatina* spp., *Weylandites* spp., *Cordaitina* sp., *Florinites luberae, Apiculatisporis* spp., *Cyclogranisporites* spp., *Diatomozonotriletes* sp., *Kraeuselisporites* spp., *Lophotriletes* sp., *Neoraistrickia* sp., *Nevesisporites* sp., *Micrhystridium* spp., *Veryhachium* spp.
-?-?-?-	"Unit A"	Aletes(?) common. *Vittatina* spp., *Weylandites* spp., *Florinites luberae, Sulcatisporites* sp., *Apiculatisporis* sp., *Calamospora* sp., *Cyclogranisporites* sp., *Diatomozonotriletes* sp., *Kraeuselisporites* sp., *Leiotriletes* sp., *Punctatisporites* spp., *Micrhystridium* spp., *Veryhachium* spp.
LOWER PERMIAN	Assistance	*Protohaploxypinus* spp., *Striatoabieites* spp., *Abiespollenites* sp., *Triadispora* sp., *Pityosporites* sp., *Vittatina* spp., *Weylandites* sp., *Florinites luberae, Apiculatisporis* sp., *Diatomozonotriletes* sp., *Kraeuselisporites* spp., *Lophotriletes* sp., *Neoraistrickia* spp., *Nevesisporites* sp., *Punctatisporites* sp., *Raistrickia* sp., *Verrucosisporites* sp., *Micrhystridium* spp., *Veryhachium* spp.
	Sabine Bay	*Protohaploxypinus* spp., *Striatopodocarpites* spp., *Hamiapollenites* sp., *Alisporites* spp., *Pityosporites* spp., *Sulcatisporites* spp., *Triadispora* spp., *Vittatina* spp., *Weylandites* spp., *Apiculatisporis* spp., *Calamospora* spp., *Cyclogranisporites* spp., *Densoisporites* spp., *Foveosporites* spp., *Kraeuselisporites* spp., *Leiotriletes* spp., *Lophotriletes* spp., *Neoraistrickia* spp., *Nevesisporites* sp., *Punctatisporites* spp., *Raistrickia* spp., *Verrucosisporites* sp., *Speciosporites* sp., *Micrhystridium* spp., *Veryhachium* spp.
	Belcher Channel	*Protohaploxypinus* spp., *Hamiapollenites?* sp., *Striatoabieites* sp., *Vittatina* spp., *Weylandites* spp., *Apiculatisporis* sp., *Calamospora* sp., *Cyclogranisporites* sp., *Dictyotriletes* sp., *Kraeuselisporites* spp., *Leiotriletes* sp., *Lophotriletes* sp., *Raistrickia* sp., *Cordaitina* sp., *Florinites luberae, Micrhystridium* spp.
	Uppermost Canyon Fiord	*Protohaploxypinus* spp., *Hamiapollenites?* sp., *Striatoabieites* sp., *Vittatina* spp., *Weylandites* spp., *Cordaitina* sp., *Striomonosaccites* sp., *Leiotriletes* sp., *Lophotriletes* sp., *Punctatisporites* sp., *Raistrickia* sp.

Figure 28.4. *Summary of palynomorph assemblages.*

The assemblages contain striate disaccate pollen (**Protohaploxypinus** spp. and **Striatoabieites** spp.) and non-striate disaccate pollen (**Abiespollenites** sp., **Triadispora** sp., and **Pityosporites** sp.), polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.), monosaccate pollen **Florinites luberae** Samoilovich, 1961, and a variety of trilete spores (**Apiculatisporis** sp., **Diatomozonotriletes** sp., **Kraeuselisporites** sp., **Lophotriletes** sp., **Neoraistrickia** spp., **Nevesisporites** sp., **Punctatisporites** sp., **Raistrickia** sp., and **Verrucosisporites** sp.). Acritarch genera include **Micrhystridium** and **Veryhachium**. Scolecodonts occur rarely. Present are some specimens of spores which are possibly derived from the Late Devonian or, more rarely, the Lower Carboniferous (e.g. **Densosporites rarispinosus** Playford 1963).

The organic content consists largely of abundant, medium to large sized (approx. 50-170 µm) coaly and woody fragments (75%) but there is a significant amount of exinous and finely dispersed debris. This type of organic matter, along with the presence of abundant land derived pollen and spores, acritarchs and scolecodonts, suggests a nearshore marine environment of deposition, with the presence of abundant nutrients.

The colour of the spores is yellow-orange, indicating a Thermal Alteration Index of 2-.

"Unit A"

"Unit A", recognized by Nassichuk (1965), consists mainly of bioclastic limestone and is about 90 m thick. He suggested that the upper and lower contacts are disconformable. This conclusion was based mainly on litho-stratigraphic criteria, as the abundant fauna of brachiopods and bryozoans has yet to be studied; a late Early or early Late Permian age was tentatively suggested, based mainly on the relative stratigraphic position of the unit.

Argillaceous intercalations suitable for palynological samples are rare in "Unit A", but one sample, from approximately 5 m above the base, was found to contain fairly well preserved palynomorphs. These consisted of

abundant alete grains of uncertain affinity. Polyplicate pollen was common (**Vittatina** spp. and **Weylandites** spp.); present also was monosaccate pollen (**Florinites luberae**), non-striate disaccate pollen (**Sulcatisporites** sp.), and trilete spores (**Apiculatisporis** sp., **Diatomozonotriletes** sp., **Kraeuselisporites** sp., **Leiotriletes** sp., and **Punctatisporites** sp.). In addition, the acritarchs **Micrhystridium** spp. and **Veryhachium** spp. occur. Occasional reworked spores occur, including **Cyrtospora cristifer** (Luber) Van der Zwan 1979; these were probably derived from Late Devonian rocks.

The organic matter consists of small, medium and large sized (approx. 30-170 µm) coaly and woody fragments (approx. 50%), and finely dispersed organic debris with a small amount of exinous material. The variety of size ranges of the coaly and woody material, the abundance of land derived pollen and spores, and the presence of acritarchs, indicate a high energy, nearshore marine environment of deposition.

The colour of the spores is yellow to orange, suggesting a Thermal Alteration Index of 2- to 2.

Trold Fiord Formation

The Trold Fiord Formation consists of green, glauconitic sandstone, black chert and minor limestone bands. Occasional, thin, grey mudstone intercalations occur, and these were sampled for palynomorphs. Exposure of the formation is incomplete; approximately 65 m of actual outcrop were measured, although the formation as a whole is much thicker. Nassichuk, who referred to this formation as "Unit B" in 1965, estimated its thickness to be in the vicinity of 230 m; Thorsteinsson (1974, p. 66) later assigned "Unit B" to the Trold Fiord Formation. The formation contains an abundant fauna of brachiopods, but present in addition are bryozoans, pelecypods, gastropods, and rare cephalopods. Well preserved trace fossils (**Zoophycus**? sp.) are common.

Macrofaunal data concerning the age of the Trold Fiord Formation on Melville Island are limited, but brachiopods collected by Nassichuk and studied by R.E. Grant indicate a Guadalupian age (Thorsteinsson, 1974). No evidence of any Dzulfian or Changhsingian rocks has yet been found in this area, suggesting that a significant hiatus is present between the Permian and Triassic.

Palynomorphs found in the Trold Fiord Formation include pollen and spores, acritarchs and occasional scolecodonts. Present are striate disaccate pollen (**Protohaploxypinus** spp. and **Striatoabieites** spp.) and non-striate disaccate pollen (**Abiespollenites** sp., **Alisporites** sp., **Limitisporites** sp., **Sulcatisporites** sp., **Triadispora** sp., and **Vitreisporites** sp.), polyplicate pollen (**Vittatina** spp. and **Weylandites** spp.), and occasional monosaccate pollen (**Cordaitina** sp. and **Florinites luberae** Samoilovich 1961). There is a variety of trilete spores, including **Apiculatisporis** spp., **Cyclogranisporites** spp., **Diatomozonotriletes** sp., **Kraeuselisporites** spp., **Lophotriletes** sp., **Neoraistrickia** spp., and **Nevesisporites** sp. Acritarchs include **Micrhystridium** spp. and **Veryhachium** spp. Scolecodonts occur rarely. In addition, a number of reworked species occur, including **Cornispora varicornuta** Staplin and Jansonius in Staplin, 1961, of Late Devonian (Famennian) age, and **Densosporites** sp. and **Murospora** sp. of Early Carboniferous age.

The organic matter consists mainly of finely dispersed organic debris, which sometimes occurs in coagulated lumps; small to medium sized (approx. 30-50 µm) woody and coaly fragments and exinous material constitute the remainder. The presence of abundant, finely dispersed organic matter, occurring in association with land derived pollen and spores, acritarchs and scolecodonts, suggests deposition in a high energy, nearshore marine environment, with abundant nutrients.

The colour of the spores is pale yellow-brown, suggesting a Thermal Alteration Index of 2.

Bjorne Formation

The Bjorne Formation was named by Tozer (1961; and in Fortier et al., 1963), and has its type section on the Bjorne Peninsula, southern Ellesmere Island. It is mainly composed of sandstone, and is a basin margin equivalent of the mid-basin, marine Blind Fiord Formation. The oldest beds of the Blind Fiord Formation are regarded as representing the base of the Triassic (Tozer, 1967), and the oldest beds of the Bjorne Formation are approximately synchronous (Tozer, personal communication in Thorsteinsson, 1974, p. 73).

In the Hiccles Creek section there are approximately 15 m of crossbedded, fine grained, buff sandstone with occasional thin, grey, shaly intercalations. Trace fossils occur on some bedding planes near the base of the section.

The contact with the underlying Trold Fiord Formation is not exposed at this locality, and, therefore, it is not certain that these beds represent the oldest part of the formation.

Well preserved palynomorphs occur in samples taken from the grey shale beds, and include pollen, spores and the cyst-like microfossil **Tympanicysta stoschiana** Balme 1980. The assemblage contains striate disaccate pollen [**Taeniaesporites noviaulensis** Leschik 1956, **Protohaploxypinus** spp., and **Striatoabieites richteri** (Klaus) Hart 1965], non-striate disaccate pollen [**Falcisporites zapfei** (Potonié and Klaus) Leschik 1956 and **Klausipollenites staplinii** Jansonius 1962], plicate pollen (**Gnetaceaepollenites steevesi** Jansonius 1962), and trilete spores (**Kraeuselisporites** sp., **Lundbladispora obsoleta** Balme 1970, **Lundbladispora** sp., and **Proprisporites pocockii** Jansonius 1962). Reworked spores include **Cyrtospora cristifer** (Luber) Van der Zwan 1979 and **Hystricosporites**? sp.; these are probably of Late Devonian age.

The organic matter consists mainly of small, medium and large sized (approx. 30-170 µm) coaly and woody fragments, with the remainder comprising exinous material. The facts that only land derived pollen and spores were found, and that there is considerable variety in the size of the coaly and woody fragments, suggest deposition in a continental (fluviatile?) environment.

The spores are yellow-brown and the Thermal Alteration Index is estimated as 2.

Conclusions

It is difficult to reliably compare the Permian Melville Island assemblages with those from other parts of Canada, because although illustrations have been given in publications by Barss (1967) and Bamber and Barss (1969), the only material accompanied by systematic descriptions is that of Jansonius (1962). The latter described assemblages from the Belloy Formation of the Peace River area of Western Canada, and suggested a Leonardian-Guadalupian age. The presence of striate disaccate pollen and polyplicate pollen is documented, but in general the assemblages lack variety, and reliable comparisons are difficult. **Vittatina striata** Jansonius, which is common in the Belloy Formation, occurs in all of the Permian formations of Melville Island.

In East Greenland, Balme (1980), recorded assemblages that contain abundant specimens of **Vittatina** spp. and which he suggested may be younger than Guadalupian. In contrast to the Upper Permian assemblages of Melville Island, the Greenland material has low diversity and trilete spores are rare.

The assemblages from the Bjorne Formation are similar to those recorded by Jansonius (1962), from rocks of probable Griesbachian age from the Toad-Grayling Formation of the Peace River area of Western Canada, and by Fisher (1979), from his palynofloral zone 1 of Griesbachian age from the Canadian Arctic Archipelago. Also, there are many similarities to the **Protohaploxypinus** – Association of East Greenland described by Balme (1980), and assigned to the Griesbachian.

At the specific level, the Melville Island Permian assemblages are unlike those of Gondwana and Cathaysia. Neither are they like those from Western Europe. They have a number of features in common with assemblages described from the northeast European part of Russia by Varyukhina (1971), and Molin and Koloda (1972); for example, there are many qualitative similarities and, quantitatively, species of **Vittatina** and striate disaccate pollen are abundant and trilete spores common at both localities. According to Meyen (1982), the northeast European part of Russia contains Angaran and sub-Angaran plants; this area is marginal to the Angara paleofloristic province and is termed the Pechora province. A detailed comparision of the Canadian with the Russian material will probably enable relatively precise biostratigraphic correlations to be made. At present, insufficient work has been carried out on the marine fauna of the Melville sections to provide detailed biostratigraphic control; it is hoped that the study of conodont and foraminifera samples, collected by A.C. Higgins and P.H. von Bitter, simultaneously with the study of palynology samples from the Belcher Channel to Trold Fiord formations, will partially remedy this situation.

The environment of deposition deduced for the Permian formations in the southwestern part of the Sabine Peninsula is, with the exception of the uppermost part of the Canyon Fiord Formation, nearshore marine. The uppermost part of the Canyon Fiord Formation is possibly lacustrine. No marine palynomorphs were found in the Triassic Bjorne Formation and a continental (fluviatile?) environment is suggested.

The Thermal Alteration indices in the study area are low and vary from 2- to 2+. The variation appears to be more the result of lithological differences than depth of burial. For example, the Thermal Alteration Index is only 2- in the Sabine Bay and Assistance formations, which consist mainly of sandstone and mudstone respectively, but 2 to 2+ in the overlying Trold Fiord Formation, which consists mainly of glauconitic sandstone, black chert and minor limestone bands. These levels of maturation suggest that conditions may have been suitable for the generation of liquid hydrocarbons.

The occurrence of reworked Upper Devonian spores in the Permian and Lower Triassic rocks is not surprising in view of the abundance of Upper Devonian rocks present on Melville Island. The presence of occasional Lower Carboniferous spores in the Assistance and Trold Fiord formations is more problematical, as no Lower Carboniferous rocks are known from this part of the Arctic Archipelago; there is a hiatus between the Upper Devonian (Famennian) and the Upper Carboniferous (Moscovian). The Thermal Alteration indices of both the Upper Devonian and Lower Carboniferous material is 2+ (spores are light brown), indicating that the sediments from which they were derived had not been subjected to any great depth of burial.

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