Geological investigation of Cretaceous? strata beneath Cape Dyer Basalts (Paleocene), Baffin Island, District of Franklin

Project 740003

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Abstract

Mesozoic and Cenozoic strata on the coast of Baffin Island near Cape Dyer provide (1) information about the potential for offshore hydrocarbons and (2) evidence to constrain the timing of rifting of Baffin Bay. Questionable megafloral evidence in deltaic sand bodies suggests the assignment of outliers to the Paleocene. In contrast, palynology suggests an Albian age.

Résumé

Les couches mésozoïques et cénozoïques sur la côte de l'île de Baffin près du cap Dyer fournissent (1) des renseignements sur les possibilités de trouver des hydrocarbures au large de la côte et (2) des preuves permettant d'établir la chronologie de la formation de fossés d'effondrement dans la baie de Baffin. Des indices mégafloraux discutables trouvés dans des masses de sable deltaïque portent à croire que les avant-buttes dateraient du Paléocène. Par opposition, la palynologie semble indiquer un âge albien.

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Introduction

A rekindling of interest in Mesozoic and Cenozoic strata exposed along the coast of Baffin Island from Cape Dyer to Quqaluit Island was generated when, in 1976, scientists on the C.S.S. Hudson discovered hydrocarbon slicks from oil seeps off Scott Inlet (Loncarevic and Falconer, 1977). This discovery led to an increase in exploration on the Baffin Island shelf and subsequent discovery of additional slicks farther south in Buchan Gulf (Maclean and Falconer, 1979).

In the past, Mesozoic and Cenozoic outliers on southeastern Baffin Island contributed in a significant way to the ongoing debate over the timing of Baffin Bay rifting and seafloor spreading (Clarke and Upton, 1971). At present, the geological setting is explained by invoking one of two seafloor spreading models. The most widely accepted model is that of Clarke and Upton (1971), Keen et al. (1972, 1974), Srivastava (1978) and Jackson et al. (1979). According to this model, Baffin Bay formed as Paleogene seafloor spreading along the western arm of the Mid-Atlantic Ridge separated Labrador and Baffin Island from Greenland.

The opposing view stipulates that Baffin Island and Greenland did not drift apart to form Baffin Bay, but that continental crust is continuous from Baffin Island, across Baffin Bay and onto Greenland. This view states that Baffin Bay formed by foundering of continental blocks due to extensional forces which resulted in little new oceanic crust being produced (Grant, 1975, 1980; Umpelby, 1979; Kerr, 1980).

One of the cornerstones of these models is a presumed similarity of Baffin Island outliers with contemporaneous but much thicker outliers on western Greenland. To assess this similarity, a program to examine sections along the coast of Baffin Island for lithostratigraphy and biostratigraphy was undertaken.

Field Work

Sections of unconsolidated sand, shale, coaly shale and coal on Padloping, Durban and Quqaluit islands were measured and sampled for sedimentology and palynology (Fig. 58.1). Strata on these islands were found in small fault bounded basins on Precambrian basement. Sections were not well exposed; post-depositional faulting and soft-sediment deformation obscured many lateral relationships and cryogenic activity in the soft, unconsolidated sands distorted sedimentary structures. Where field relations could be determined with confidence, the sampling interval for detailed paleoenvironmental interpretations was very close (0.5 m or less). Preliminary observations are outlined for each of the islands.

Quqaluit Island

A northeasterly dipping section on the north side of the island at a location approximately equadistant between two projecting headlands was measured and sampled for sedimentology and palynology (Fig. 58.2). The lower contact with intensely weathered, friable and kaolinitic? Precambrian gneiss is scoured. Above this, is 52 m of cyclical coarsening upward shale and sandstone beds. Above 52 m, sandstones are uniformly thick bedded and fining upward cycles with tabular crossbeds, ironstone concretions, rip-up clasts and thin shale beds (Fig. 58.3). The top of the section at 115 m consists of interbedded sandstone and volcanic breccia beds.

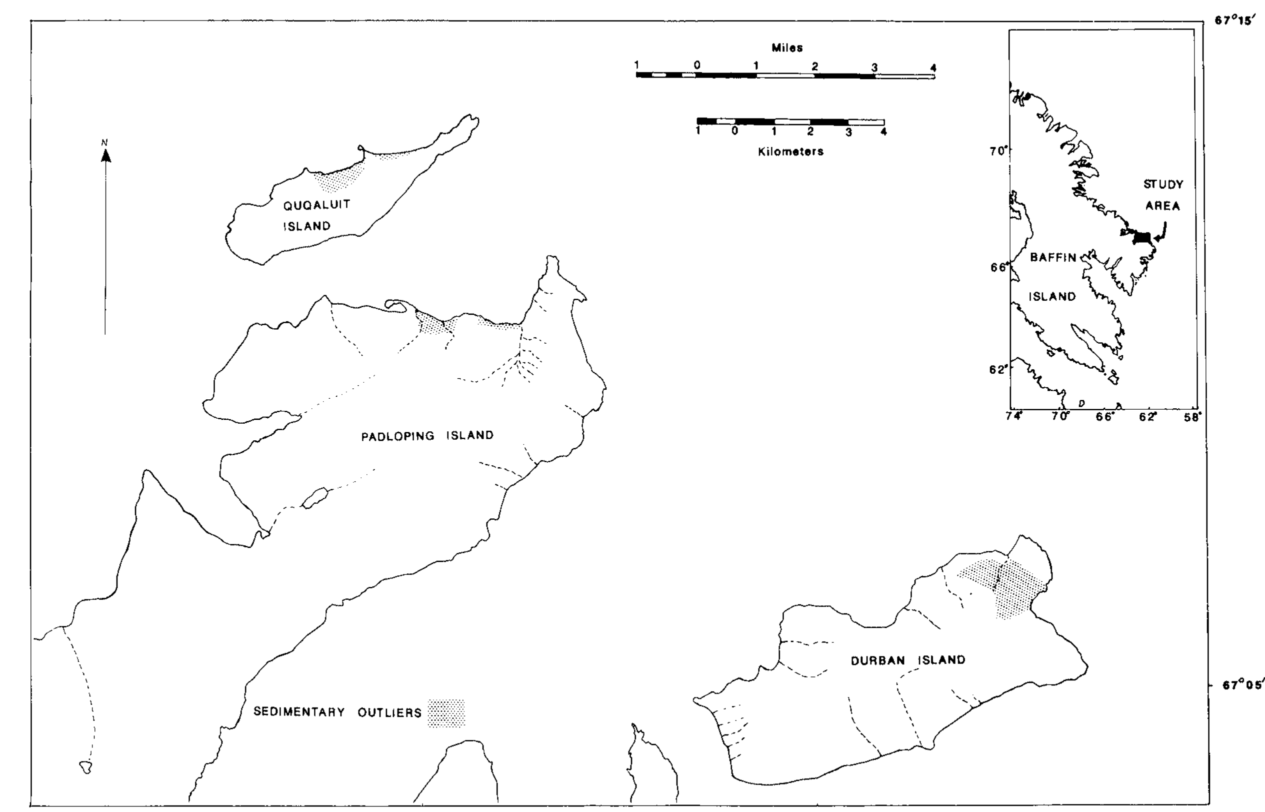

Figure 58.1. *Map of sedimentary outliers examined in this study.*

Padloping Island

The section at Padloping Island is a composite 180 m thick, derived from sections measured at two localities along the north coast of the island, east of a prominent sand spit (Fig. 58.2). Strata are deformed in a complex manner; a large Late or Post-glacial slump which dropped and rotated sediments and volcanics is superimposed on pre and post-depositional structures in this small basin (Fig. 58.4).

The lower contact with Precambrian gneiss is not directly observed. Periglacial debris consisting of intensely weathered gneiss occurs west of the outcropping strata; if projected onto the section, the Precambrian is approximately 40 m below the lowest sandstone outcrop.

The lower 30 m of measured section consists of coarsening upward trough crossbedded sandstones with thin shale lamina (Fig. 58.5). The interval from 30 to 70 m consists of thinly bedded sandstones containing concretions and shales containing Metasequoia needles. Above 70 m to the covered interval at 110 m the beds consist of shale with thin sandstones containing concretions.

The upper part of the section outcrops approximately 500 m farther east. Here, beds from 126 to 150 m consist of thinly stratified sandstone with concretions, coaly shale and coal. Above 150 m sandstone beds are thick bedded and fining upward cycles with trough cross stratification. The contact with overlying volcanics at 170 m is gradational; nevertheless, sandstone and shale beds are characterized by large mineralized logs on the contact with the volcanics.

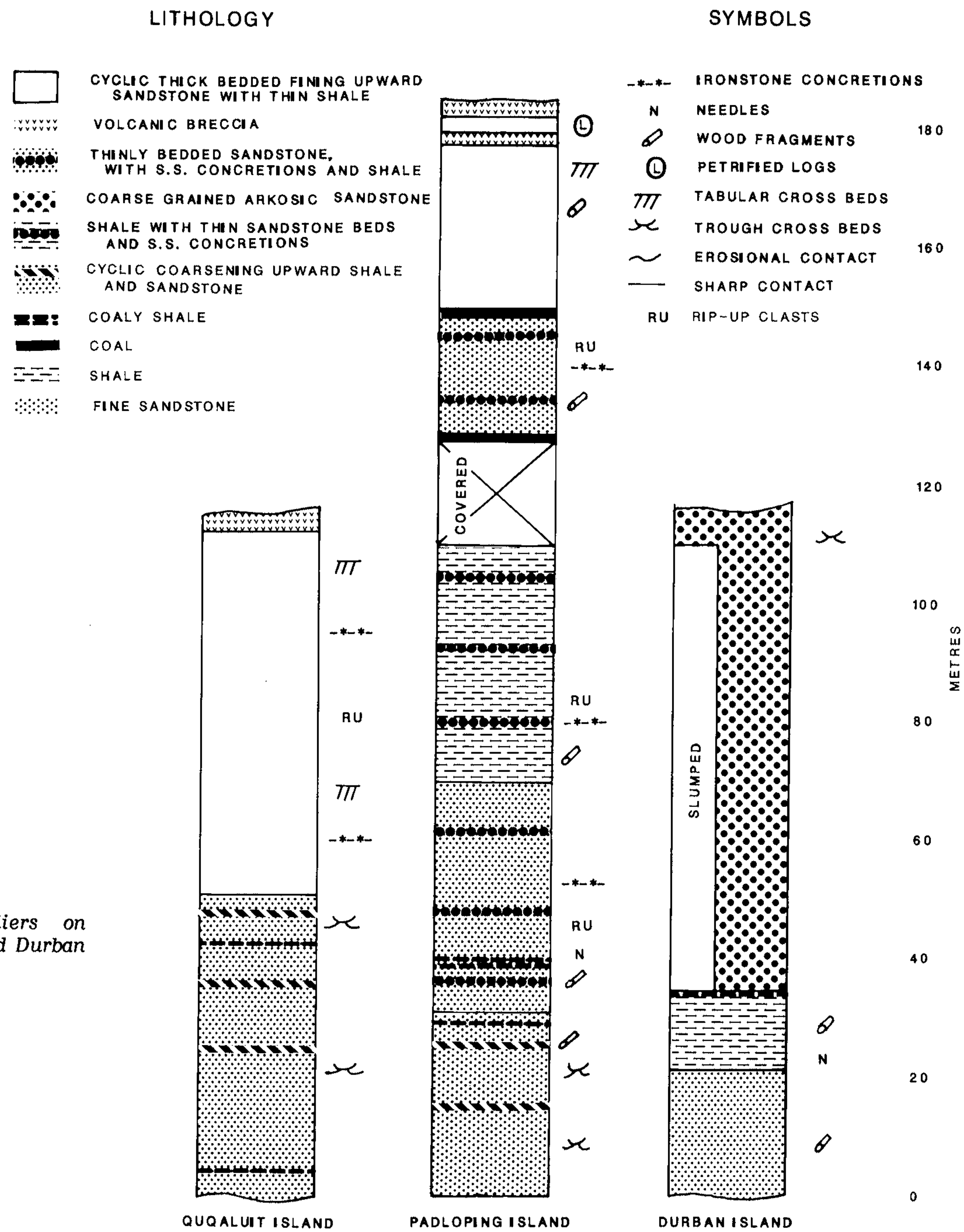

Figure 58.2

Stratigraphy of outliers on Quqaluit, Padloping and Durban islands.

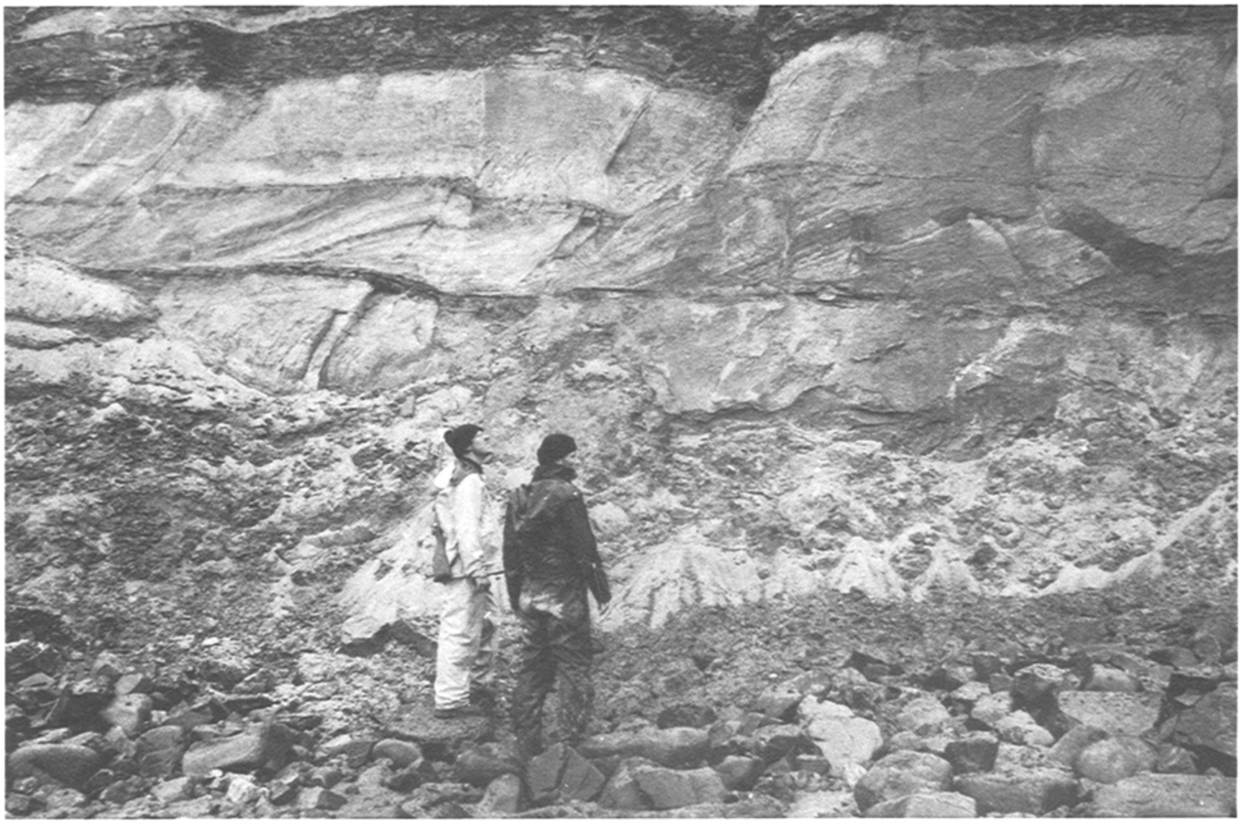

Figure 58.3. *Tabular crossbeds separated by thin shale partings.*

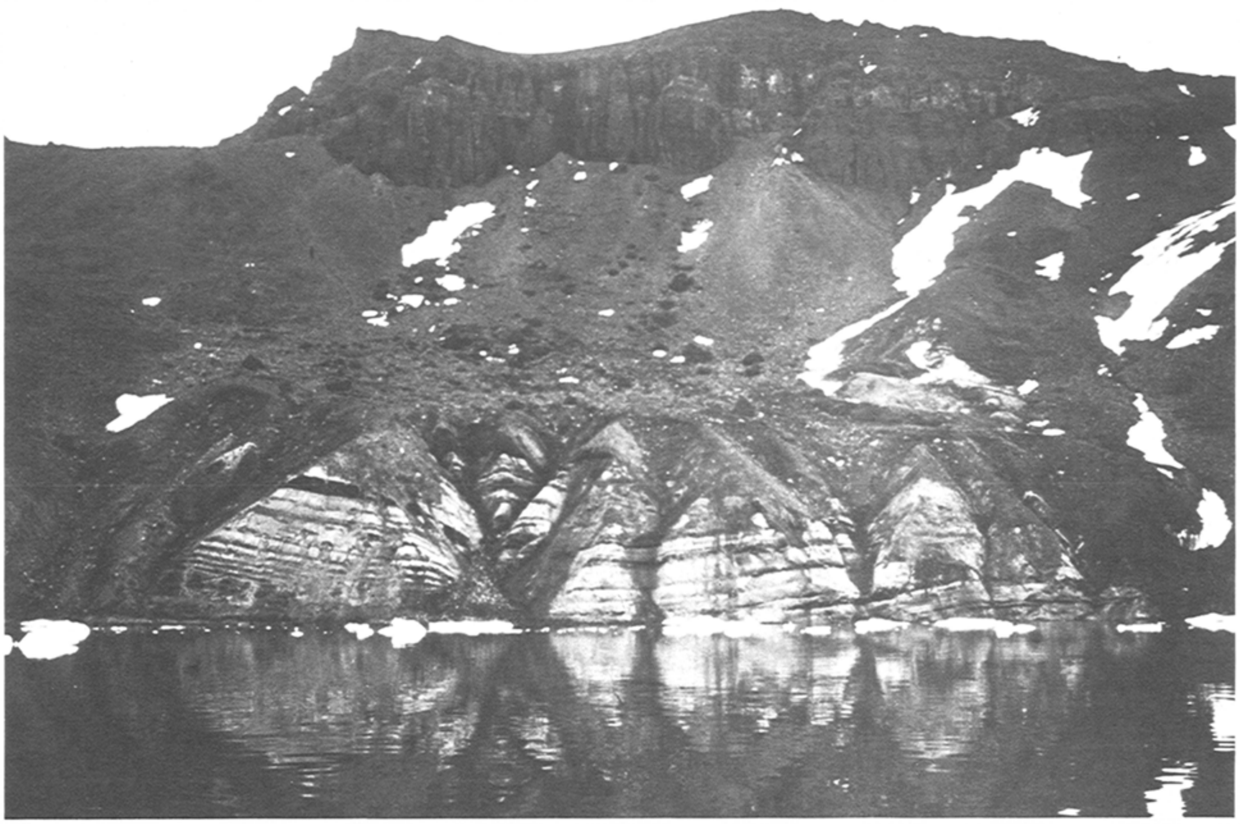

Figure 58.4. *Faulted, slumped and rotated strata of the lower part of the Padloping Island section.*

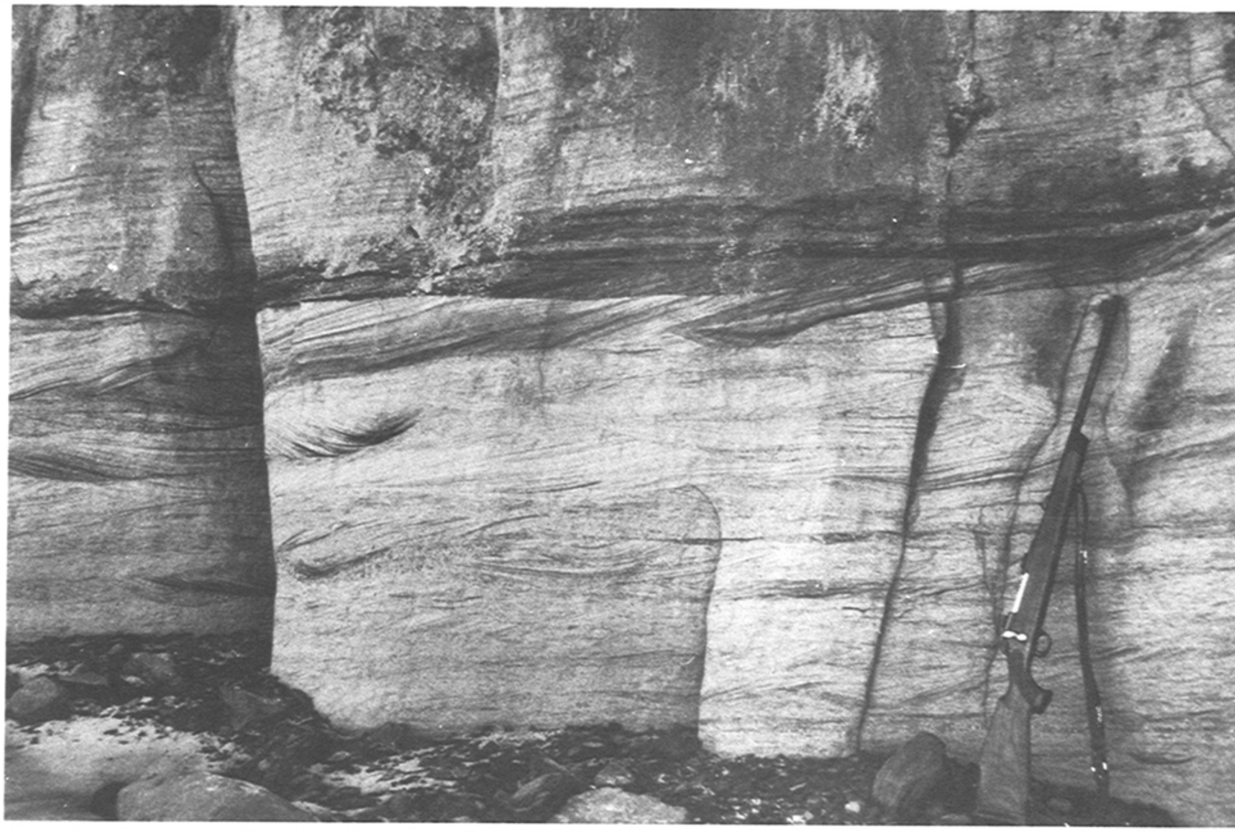

Figure 58.5. *Trough crossbedded sandstones at the top of a coarsening upward cycle.*

Durban Island

Strata on Durban Island occur in a small fault bounded basin on the northeast corner of the island. Here, 22 m of thick bedded, fine grained sandstone overlies weathered Precambrian gneiss. This is overlain by 10 m of shale capped with 2 m of coaly, micaceous shale. The interval from 37 through 115 m is slumped sandstone covered with blocks of lithified granular sandstone. From a nearby hillside it can be seen that beds are close to the surface and that most of the slumped debris is locally derived. Above 115 m is an outcrop of indurated, coarse grained, trough crossbedded sandstone. Clarke and Upton (1971) indicated that this sandstone is 250 m thick; from our fieldwork, we could not reach this conclusion. A nearby hillside covered with blocks of indurated sandstone may be an up-faulted repeat section.

Palynology

Eight samples (GSC collection numbers 18461-18468) collected in 1980 from unspecified localities on Quqaluit, Padloping and Durban islands during a reconnaissance survey by the Geological Survey of Canada have been analysed. Slides and residues are at the Atlantic Geoscience Centre, Dartmouth.

All samples contain abundant woody material with minor amounts of cuticle and resin. Palynomorph assemblages are dominated by **Alisporites bilateralis** Rouse, 1959, **Cedripites canadensis** Pocock, 1962, **Parvisaccites radiatus** Couper, 1958, **Podocarpidites multesimus** (Bolkhovitina) Pocock, 1962 and **P. canadensis** Pocock, 1962. Biostratigraphically useful species include **Appendicisporites matesovai** Bolkhovitina, 1968, **Cicatricosisporites auritus** Singh, 1971, **Clavifera** sp. cf. **C. rudis** Bolkhovitina, 1968, **Concavissimisporites parkinii** Pocock, 1962, **Densoisporites microrugulatus** Brenner, 1963, **Foveogleicheniidites confossus** (Hedlund) Burger, 1976, **Foveosporites canalis** Balme, 1957, **Impardecispora marylandensis** (Brenner) Venkatachala, Kar and Raza, 1968, **Retitricolpites promiscuus** Laing, 1975 and **Saxetia scurrandus** (Norris) Srivastava, 1975.

Discussion

The age and depositional environment of outliers exposed along the coast of Baffin Island near Cape Dyer is by no means clear. Floral remains described by McMillan (1910) and Bell (in Clarke and Upton, 1971) from Durban Island were compared with the west Greenland sequence and to infer a nonmarine deposit of Paleocene age. In contrast, Deutsch and Patzold (1984) have paleomagnetic evidence suggesting an age older than Paleocene for basalts overlying strata on Durban Island and MacLean and Williams (1983) have nonmarine strata with Albian affinities off the coast of Padloping Island. Farther north, Choi et al. (1984) have evidence to suggest Tertiary plants evolved in the Arctic during the Cretaceous and Burden and Holloway (in press) have reassigned Cretaceous-Paleogene? outliers at Scott Inlet to the Quaternary.

In our study of the strata beneath Cape Dyer Basalts we have evidence indicating a period of intense weathering of Precambrian gneisses prior to the onset of clastic sedimentation. Deposits overlying gneisses are believed to represent deltas and shallow shelf sands. Where observed, the contact with subaqueous breccia beds is gradational. Nevertheless, with abundant wood at the contact, one or more catastrophic eruptions must have marked the onset of volcanism. Palynomorphs recovered from samples analysed to date indicate a nonmarine deposit of Albian or Cenomanian age. This is consistent with the age and depositional environments assigned to Albian through

Campanian deposits found in Greenland (Henderson et al. 1981). However, we cannot rule out the possibility that older strata have been reworked into Paleocene deltas and shelf deposits.

Conclusion

Preliminary investigations on our part indicate that the sediments beneath the Cape Dyer basalts represent deltas and shelf deposits. Palynology indicates that the outliers are nonmarine Albian or Cenomanian deposits correlative with similar strata in Greenland. The abundance of woody material in palynomorph preparations suggests that these sediments may, with sufficient burial, be gas prone.

Acknowledgments

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