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PRELIMINARY PALEOPALYNOLOGY OF THE KANGUK FORMATION (UPPER CRETACEOUS), REMUS CREEK, ELLESMERE ISLAND, CANADIAN ARCTIC ARCHIPELAGO: II. TERRESTRIAL PALYNOMORPHS

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ABSTRACT

A total of 78 terrestrial palynomorph taxa were identified from 39 samples collected at about one metre intervals from the Kanguk Formation (Upper Cretaceous) on Remus Creek, Ellesmere Island, Canadian Arctic Archipelago. The terrestrial palynomorphs constitute 49% of total palynomorphs and are found in a marine facies where dinocysts and acritarchs are abundant. However, in the upper part of the section the terrestrial taxa dominate over marine palynomorphs indicating regressive conditions. Miospores and gymnosperm and angiosperm pollen grains, throughout the section, are small and thin-walled with varying degrees of preservation. Taxodiaceae-Cupressaceae pollen are the most abundant with common ocurrences of smooth trilete miospores and the accessory presence of small tricolpate pollen. The majority of the terrestrial taxa of the Kanguk Formation can be assigned to a Late Cretaceous boreal realm. Their character, distribution and variations in relative percentages through the section imply initial transgressive conditions followed by regressive conditions in the upper half of the section.

The Kanguk terrestrial palynomorph assemblage suggests that the nearby continental areas were vegetated. The Taxodiaceae-Cupressaceae complex associated with terrestrial paralic environments was probably the dominant regional vegetation and, despite the high latitud, most likely, an open boreal forest compossed of gymnosperms was present in the area.

A small, but significant, fraction of the total of the terrestrial assemblages is considered to be reworked from Albian-Cenomanian sediments probably from the underlying Hassel Formation. Thus, reworked taxa document the existence of an unconformity between these formations.

Keywords: Late Cretaceous, Terrestrial palynomorphs, Kanguk Formation, Remus Creek, Ellesmere Island, Canadian Arctic Archipelago.

RESUMEN

Un total de 78 taxones de palinomorfos terrestres se identificaron mediante el estudio de 39 muestras recolectadas a intervalos de un metro de una sección de la Formación Kanguk (Cretácico Superior) en Remus Creek, Isla de Ellesmere, Archipiélago Ártico Canadiense. Los palinomorfos terrestres constituyen el 49% del total y aparecen en sedimentos marinos con abundancia de dinoquistes y acritarcos, si bien, en la parte superior de la sección los taxones terrestres dominan sobre los marinos, lo cual indica unas condiciones regresivas. En toda la sección las miosporas y el polen de gimnospermas y angiospermas tienen tendencia a ser pequeños y de pared fina, presentando varios grados de preservación. Lo más abundante es el polen del grupo de las Taxodiáceas-Cupresáceas, seguido de miosporas trilete lisas, y la presencia ocasional de pólenes tricolpados. La mayoría de los palinomorfos terrestres son propios de la Región boreal del Cretácico Superior. Su carácter, distribución y la variabilidad de porcentajes a lo largo de la sección indican que inicialmente las condiciones eran transgresivas seguidas de condiciones regresivas en la parte superior de la sección.

Los palinomorfos terrestres de la Formación Kanguk indican que las zonas continentales próximas al lugar de deposición se encontraban cubiertas por vegetación. La vegetación dominante pudiera estar asociada al complejo Taxodiaceae-Cupressaceae, y a pesar de la alta latitud geográfica, es muy posible que un bosque abierto compuesto de gimnospermas se encontrara presente en el área.

Por otra parte, una pequeña, pero importante, fracción del total de las asociaciones terrestres es considerada como retrabajada a partir de sedimentos de edad Albiense-Cenomaniense, probablemente de la infrayacente Formación Hassel. De este modo, los taxones retrabajados documentan la existencia de una disconformidad entre las dos formaciones.

Palabras clave: Palinomorfos terrestres, Cretácico Superior, Formación Kanguk, Remus Creeek, Isla de Ellesmere, Archipiélago Ártico Canadiense.

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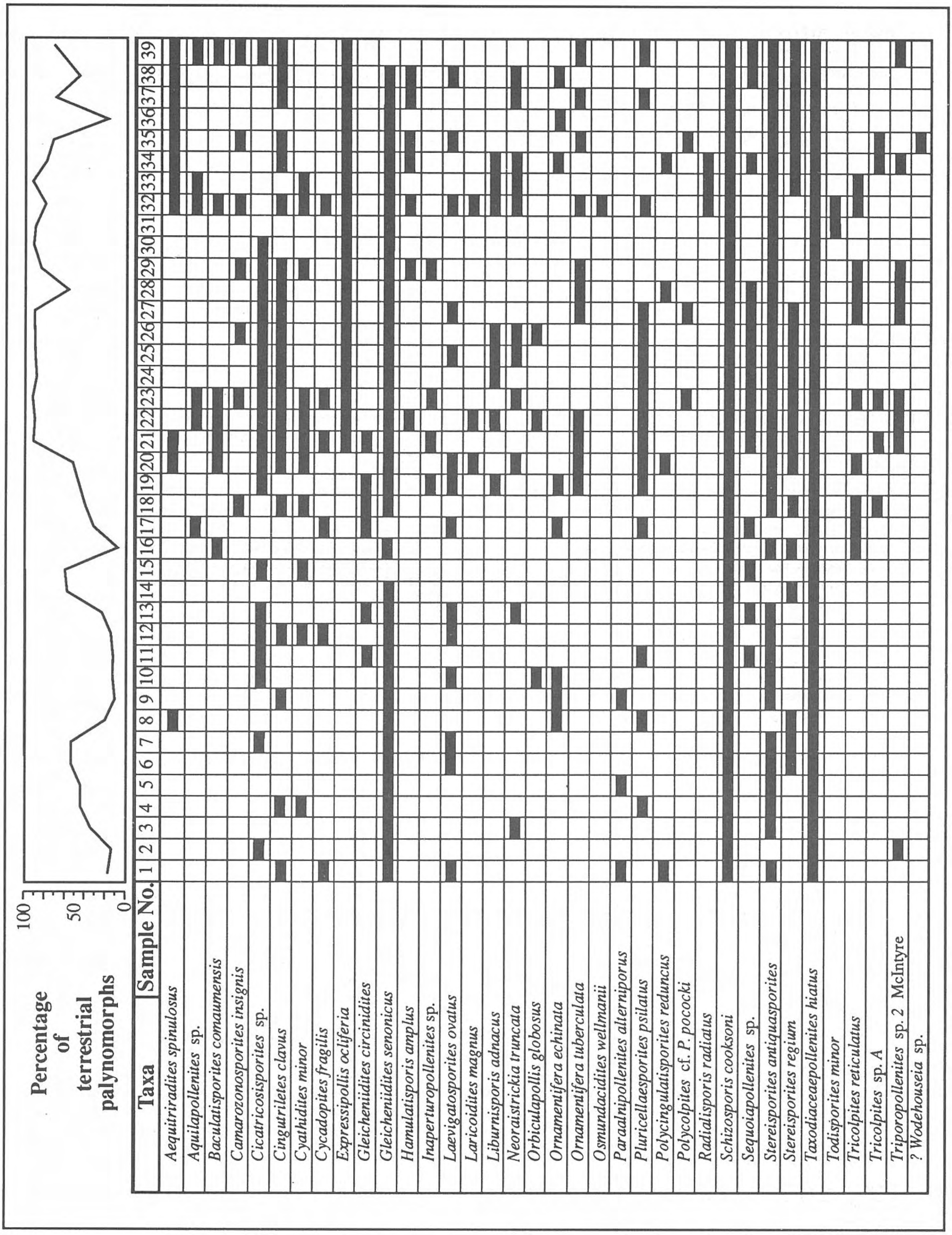

Figure 1. Kanguk Formation. Stratigraphic distribution of principal terrestrial palynomorph taxa from the Remus Creek section. Samples are spaced at one metre intervals and taxa arranged in alphabetical order.

MIOSPORES
Anteturma SPORITES
Turma Triletes
Subturma Azonotriletes
Infraturma Apiculati
H *Baculatisporites comaumensis* (Cookson, 1953) Potonié, 1956
Concavissimisporites cf. *C. variverrucatus* (Couper, 1958) Brenner, 1963
D *Concavissimisporites* sp. A
Liburnisporis adnacus Srivastava, 1972
Neoraistrickia sp. A
Neoraistrickia truncata (Cookson, 1953) Potonié, 1956
H *Osmundacidites wellmanii* Couper, 1953
Infraturma Laevigati
® *Concavisporites* sp.
Cyathidites concavus (Bolkhovitina, 1953) Dettmann, 1963
H *Cyathidites minos* Couper, 1953
DH® *Deltoidospora junctum* (Kara-Murza, 1956) Singh, 1964
Psilatriletes detortus (Weyland & Krieger, 1953) Potonié 1956
H *Stereisporites antiquasporites* (Wilson & Webster, 1946) Dettmann, 1963
H *Stereisporites regium* (Drozhastchich, 1961) Drugg, 1967
Todisporites minor Couper, 1958
Infraturma Murornati
Cicatricosisporites sp.
® *Foveosporites labiosus* Singh, 1971
Hamulatisporis amplus Stanley, 1965
Klukisporites sp.
H *Lycopodiacites* sp.
DH® *Lycopodiumsporites marginatus* Singh, 1964
® *Microreticulatisporites uniformis* Singh, 1964
Radialisporis radiatus (Krutzsch, 1959) Krutzsch, 1967
® *Retitriletes crassimacerius* (Hedlund, 1966) Burden & Hills, 1989
Subturma Zonotriletes
Infraturma Auriculati
® *Appendicisporites bifurcatus* Singh, 1964
® *Appendicisporites matesovae* (Bolkhovitina, 1961) Norris, 1967
H® *Appendicisporites* sp. *A*
H® *Trilobosporites* sp.
Infraturma Cingulati
Annulispora sp.
H *Cingulatisporites* sp.
D *Cingutriletes clavus* (Balme, 1957) Dettmann, 1963
Distaltriangulatisporites perplexus (Singh, 1964) Singh, 1971
Interulobites sp.
Murospora sp. *A*
® *Murospora truncata* Singh, 1971
Polycingulatisporites reduncus (Bolkhovitina, 1953) Playford & Dettmann, 1965
Polycingulatisporites sp. *A*
Turma Monoletes
Subturma Azonomonoletes
Infraturma Laevigatomonoleti
DH *Laevigatosporites ovatus* Wilson & Webster, 1946
Infraturma Sculptatomonoleti
® *Microfoveolatosporis* sp.

FUNGAL SPORES
H *Pluricellaesporites psilatus* Clarke, 1965

GYMNOSPERM POLLEN
Anteturma POLLENITES
Turma Saccites
Subturma Disaccites
Abiespollenites sp.
Pityosporites sp.
H *Podocarpidites* sp.
H *Vitreisporites* sp.
Turma Aletes
Subturma Azonaletes
Infraturma Psilonapiti
H *Inaperturopollenites* sp.
Laricoidites magnus (Potonié, 1931) Potonié, Thomson & Thiegart, 1950
Schizosporis cooksoni Pocock, 1962
® *Schizosporis parvus* Cookson & Dettmann, 1959
Schizosporis rugulatus Cookson & Dettmann, 1959
DH *Taxodiaceaepollenites hiatus* Kremp, 1949 *ex* Potonié, 1958
Infraturma Tuberini
Sequoiapollenites sp.

ANGIOSPERM POLLEN
Turma Plicates
Subturma Monocolpates (Monosulcites) and Zonocolpates
Infraturma Qualilaevigato and Microsculptati
Cycadopites fragilis Singh, 1964
Infraturma Sculpati
® *Liliacidites* sp.
Subturma Tricolpates
Fraxinoipollenites sp.
® *Retitricolpites vulgaris* Pierce, 1961
H *Retitricolpites* sp. *A*
Tricolpites reticulatus Cookson, 1947
H *Tricolpites* sp. *A*
Subturma Polycolpates
Polycolpites cf. *P. pococki* Srivastava, 1966
Polycolpites reticulatus Couper, 1960
Polycolpites sp *A*
Subinfraturma Pseudocingulati
Gleicheniidites circinidites (Cookson, 1953) Dettmann, 1963
DH *Gleicheniidites senonicus* Ross, 1949
Gleicheniidites umbonatus (Bolkhovitina, 1953) Bolkhovitina, 1968
H® *Sestrosporites pseudoalveolatus* (Couper, 1958)
Infraturma Tricrassati
H *Camarozonosporites insignis* Norris, 1967
Ornamentifera echinata (Bolkhovitina, 1953) Bolkhovitina, 1966
Ornamentifera tuberculata (Grigorjeva, 1961) Bolkhovitina, 1968
Turma Hilates
D *Aequitriradites spinulosus* (Cookson & Dettmann, 1958), Cookson & Dettmann, 1961
Aequitriradites sp. *A*
Turma Porines, Porates, Poroses
Subturma Triporines
Aquilapollenites sp.
?Cranwellia sp.
Expressipollis ocliferia Khlonova, 1961; emend. Bondarenko, 1965
Extratriporopollenites sp. 2 McIntyre, 1974
Orbiculapollis globosus (Khlonova, 1975) Khlonova, 1961
Triporopollenites sp. 2 McIntyre, 1974
Subturma Polyporines
Infraturma Stephanoporati
Paraalnipollenites alterniporus (Simpson, 1961), Srivastava, 1975
Infraturma Diplaperturati
?Wodehouseia sp.

Table 1. Terrestrial palynomorph taxa from the Kanguk Formation at Remus Creek. (®): reworked forms. (H): Taxa also described from the Hassel Fm. by Hopkins and Balkwill (1973), and (D): by Doerenkamp *et al.* (1976).

INTRODUCTION

This paper provides preliminary data on the terrestrial palynofloras from the Kanguk Formation on Remus Creek, Ellesmere Island. Núñez-Betelu and Hills (1992) provide detailed information about the geological framework of the area under study.

Study of the terrestrial palynomorph assemblages permit the establishment of variations in the conditions of deposition, and a broad reconstruction of the vegetation in the nearby continental areas which are the original source for these palynomorphs. Reworked palynomorphs, in the other hand, are applied to the stratigraphy of the section and combined with the lithology permit the evaluation of a sub-Kanguk uncorformity and the source area of these palynomorphs.

Studies by Balkwill and Hopkins (1976), Balkwill *et al.* (1982), Doerenkamp *et al.* (1976), Drugg (1967), Hopkins and Balkwill (1973), Norton and Hall (1969), Pierce (1961), Samoilovich (1967), Srivastava (1966, 1972), Stanley (1965), Sweet and McIntyre (1988), Tschudy (1973), Wiggins (1976), Williams and Brideaux (1975) and, Wilson (1978) provide basic background information on taxonomy and biostratigraphy required for this study.

Palynology: general remarks

Study area, collection of samples for palynological study and maceration techniques for the Remus Creek section (lat. 79° 56', long. 85° 09') of the Kanguk Formation have already been described (Núñez-Betelu and Hills, 1992).

In order to estimate the amount of continental influence, counts of 300 or more specimens per sample were made. The presence of rare to abundant miospores and pollen is taken to be indicative of varying continental influence on the marine Kanguk Formation. The distribution of the more common terrestrial taxa is presented in Fig. 1 and they are figured in Plates I-III. Taxa that are rare or sporadic in occurrence are only included in Table 1.

In the Remus Creek section of the Kanguk Formation terrestrial palynomorphs are small and thin-walled and hence more easily transported. Their overall quality of preservation and recovery is poor to good depending mainly on sample and specific taxa. Although preservation of terrestrial taxa commonly is not as good as for marine palynomorphs, within the section, the overall relatively good preservation is interpreted as a reflection of a low transport for these taxa. However, some taxa present slightly darker walls and/or pyrite pitting indicating a different thermal and diagenestic history. Taxa (Fig. 1), such as, *Taxodiaceaepollenites hiatus* (Pl. III, fig. 2) and *Schizosporis cooksoni* (Pl. II, fig. 10) are consistently well-preserved whereas *Trilobosporites* sp., and bisaccate pollen are consistently poorly preserved, darker coloured and occur sporadically in the section.

Furthermore, in some samples (i.e. No. 30 and 33) of the upper part of the section the associated organic residue consists of approximately equal amounts of cuticle, woody debris and poorly preserved palynomorphs. Marine palynomorphs are present in very low quantities and are even more poorly preserved than the terrestrial taxa.

PALYNOLOGICAL ANALYSIS OF THE TERRESTRIAL MICROFLORA

The Kanguk terrestrial microflora is fairly diverse and consists of 78 miospore and pollen taxa (Table 1) which have been assigned to artificial families of higher rank following Dettmann (1963) and Potonié (1956, 1958, 1960, 1966, 1970). Of these, 49 are miospores, 11 are gymnosperm pollen and 18 are angiosperm pollen. In this terrestrial flora wind-distributed pollen of the Taxodiaceae-Cupressaceae complex dominate, miospores of ferns and their allies are quite common and pollen grains of the angiosperms are relatively rare.

In the terrestrial assemblage the gymnosperm pollen comprises 60-75 %, miospores 15-25 % and angiosperm pollen 5-15 %. The gymnosperm pollen is dominated by Taxodiaceae-Cupressaceae pollen. The rest of the gymnosperm pollen are poorly preserved bisaccate grains, dark coloured and often "pyrite pitted". In the miospore component, smooth trilete miospores (Fig. 1), mainly *Stereisporites antiquasporites* (Pl. I, fig, 6), *S. regium* (Pl. I, fig. 7), *Gleicheniidites senonicus* (Pl. II, fig. 1) and *Cingutriletes clavus* (Pl. II, fig. 5), are dominant with accessory fungal spore taxa like *Pluricellaesporites psilatus* (Pl. II, fig. 11). The angiosperm fraction is composed of relatively small, nondescript, tricolpate pollen where *Expressipollis ocliferia* (Pl. III, fig. 12) is the most abundant (Fig. 1).

Based on the distribution of the palynomorphs the Remus Creek section can be subdivided into two approximately equally thick parts (Núñez-Betelu, 1991). Terrestrial palynomorph taxa are not restricted to any part of the section as are marine palynomorphs. Pollen and miospores are more abundant in the upper half of the section, but are common in the lower half also. Few taxa are consistently present throughout the entire sec-

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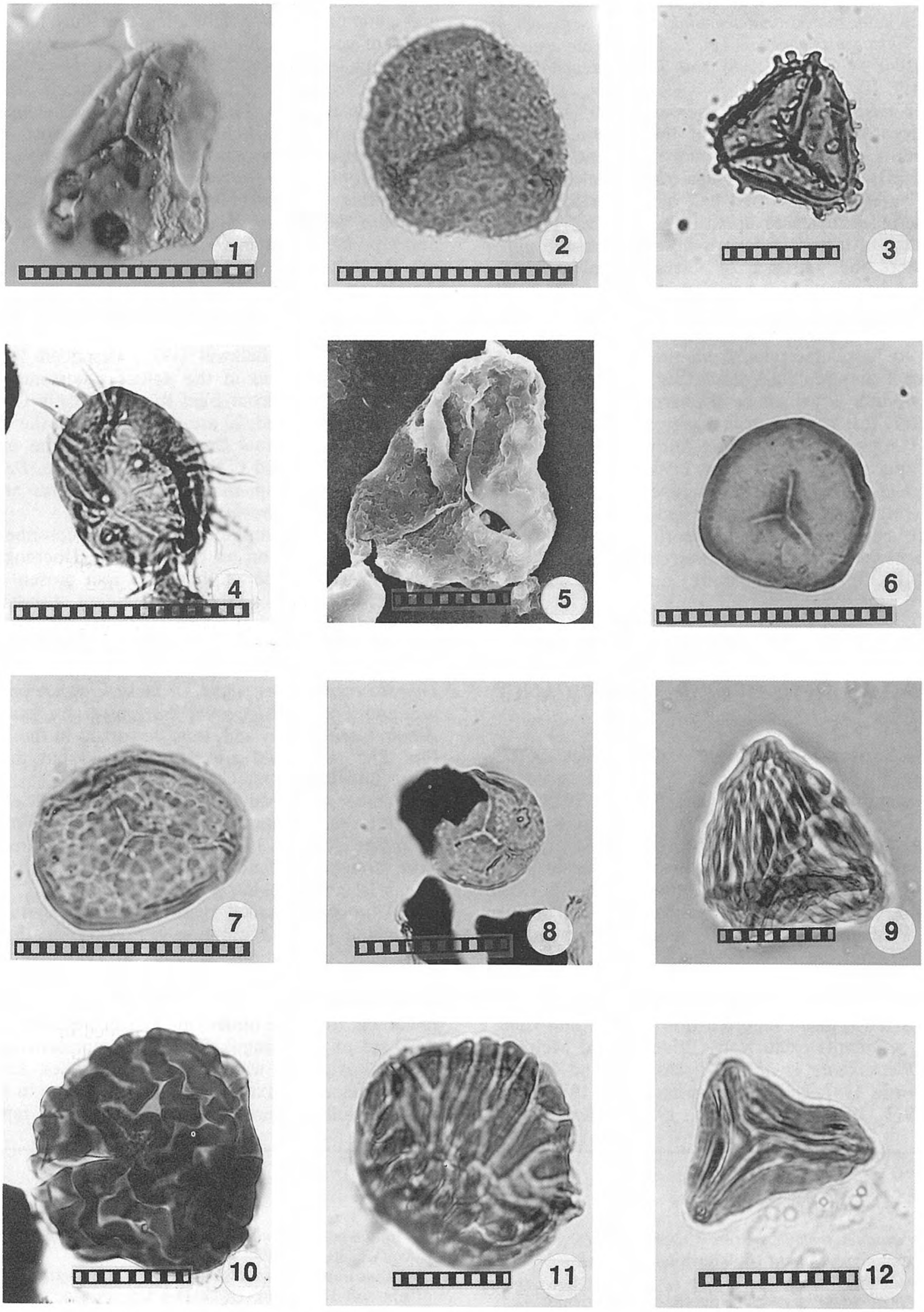
Plate I

1 *Osmundacidites wellmanii* Couper, UCG029-1b 2/5.
2 *Baculatisporites comaumensis* (Cookson) Potonié, UCG029-16a 1/5.
3 *Neoraistrickia truncata* (Cookson) Potonié, UCG029-34 1/5.
4 *Liburnisporis adnacus* Srivastava, UCG029-24 1/5.
5 *Cyathidites minor* Couper, UCG029-33 1/5, SEM.
6 *Stereisporites antiquasporites* (Wilson and Webster) Dettmann, UCG029-12 2/5.
7 *Stereisporites regium* (Drozhastchich) Drugg, UCG029-7 1/5.
8 *Todisporites minor* Couper, UCG029-32 1/3.
9 *Cicatricosisporites* sp., UCG029-30 1/5.
10 *Hamulatisporis amplus* Stanley, UCG029-32 1/5.
11 *Radialisporis radiatus* (Krutzsch) Krutzsch, UCG029-34 1/5.
12 *Gleicheniidites circinidites* (Cookson) Dettmann, UCG029-11a 2/5.

Plate I



Unless otherwise stated the pictures are from the light microscope. In the explanation of figures illustrated, the species name is followed by slide number in which the first part refers to the University collection number and the second to the sample number. Scale bar representes 30 μm.

tion (Fig. 1) but those that are, tend to occur in high numbers and include *Gleicheniidites senonicus* (Pl. II, fig. 1), *Schizosporis cooksoni* (Pl. II, fig. 10), *Stereisporites antiquasporites* (Pl. I, fig, 6) and *Taxodiaceaepollenites hiatus* (Pl. III, fig. 2).

The terrestrial elements are rare (5-10 %) and not very diagnostic at the base of the section, and the angiosperm pollen grains are rare or absent. The percentage of terrestrial taxa versus marine palynomorphs is very variable in this first half of the section and in some samples increases up to 80 %. This variability in percentage of terrestrial taxa is not found in the upper half where the presence of terrestrial palynomorphs (75-90 %) becomes well established. This part of the study is not finished yet and we continue to analyze it.

The miospores and pollen assemblages are in part similar to those described from the Ust-Yenisey Subprovince I and Middle-Yenisey Subprovince II of the Yenisey-Amur Province of Western Siberia (Samoilovich, 1967) that have been interpreted as belonging to a boreal complex. They also are fairly similar to Upper Cretaceous assemblages from Banks Island (Doerenkamp *et al.*, 1976) and Horton River, District of Mackenzie (McIntyre, 1974). *Expressipollis* and *Orbiculapollis* with a few occurences of poorly preserved *Aquilapollenites* and some other Triprojectacites pollen grains (Pl. III, fig. 8), for example, are common to all areas.

REWORKED TERRESTRIAL PALYNOMORPHS: THEIR SIGNIFICANCE

The Kanguk Formation generally overlies the deltaic Hassel Formation which is considered to be late Albian-Cenomanian (Hopkins and Balkwill, 1973; Wall, 1983). The contact between both formations is abrupt in the Remus Creek outcrop and Wall (1983) suggested the presence of an unconformity from the succession of Foraminifera encountered in the subsurface of Fosheim Peninsula. As the Kanguk is considered to be Turonian to late Campanian (Wall, 1983) there is a stratigraphic hiatus between the two formations. This is supported, in part, by the presence of reworked palynomorphs in the Kanguk Formation samples. These palynomorphs have previously been reported from Albian and Cenomanian sediments exclusively (Brideaux and McIntyre, 1975; Doerenkamp *et al.*, 1976; Hopkins and Balkwill, 1973; Norris, 1967; Paden Phillips and Felix, 1971; Singh, 1964, 1971, 1983; and Wingate, 1980). These palynomorphs typically have a, darker colour, pyrite pitting and poor preservation indicating that they have had a different geological history from the remaining taxa in the Kanguk Formation. These characteristics plus their known occurrence in older strata indicate that they have been recycled. These include the following terrestrial palynomorphs: *Appendicisporites bifurcatus, A. matesovae, Concavisporites* sp., *Deltoidospora junctum, Foveosporites labiosus, Liliacidites* sp., *Lycopodiumsporites marginatus, Microfoveolatisporis* sp., *Microreticulatisporis uniformis, Murospora truncata, Retitricolpites vulgaris* and *Sestrosporites pseudoalveolatus.* Some of these and other recicled taxa are present in the Hassel Formations including *Appendicisporites* sp. *A, Deltoidospora junctum, Lycopodiumsporites marginatus, Sestrosporites pseudoalveolatus,* and *Trilobosporites* sp.

Hopkins and Balkwill (1973) described terrestrial palynomorphs found in the deltaic sandstones of the Hassel Formation from Ellef Ringnes Island. Of the 38 genera they reported, 23 are also present in the Kanguk Formation on Remus Creek including some of those considered reworked (Table 1), for example, *Deltoidospora junctum, Lycopodiumsporites marginatus* and *Sestrosporites pseudoalveolatus.*

Terrestrial palynomorphs were also described from the Hassel Formation on Banks Island (Doerenkamp *et al.*, 1976) and some of them are also present in the Kanguk Formation (Table 1) including *Aequitriradites spinulosus, Cingutriletes clavus, Concavissimisporites* sp. *A, Deltoidospora junctum, Gleicheniidites senonicus, Laevigatosporites ovatus, Lycopodiumsporites marginatus* and *Taxodiaceaepollenites hiatus.* Of those, *Deltoidospora junctum* and *Lycopodiumsporites marginatus* are exclusively Albian-Cenomanian and, thus, reworked in the Kanguk Fm. The rest could also be reworked but they also range into the Upper Cretaceous.

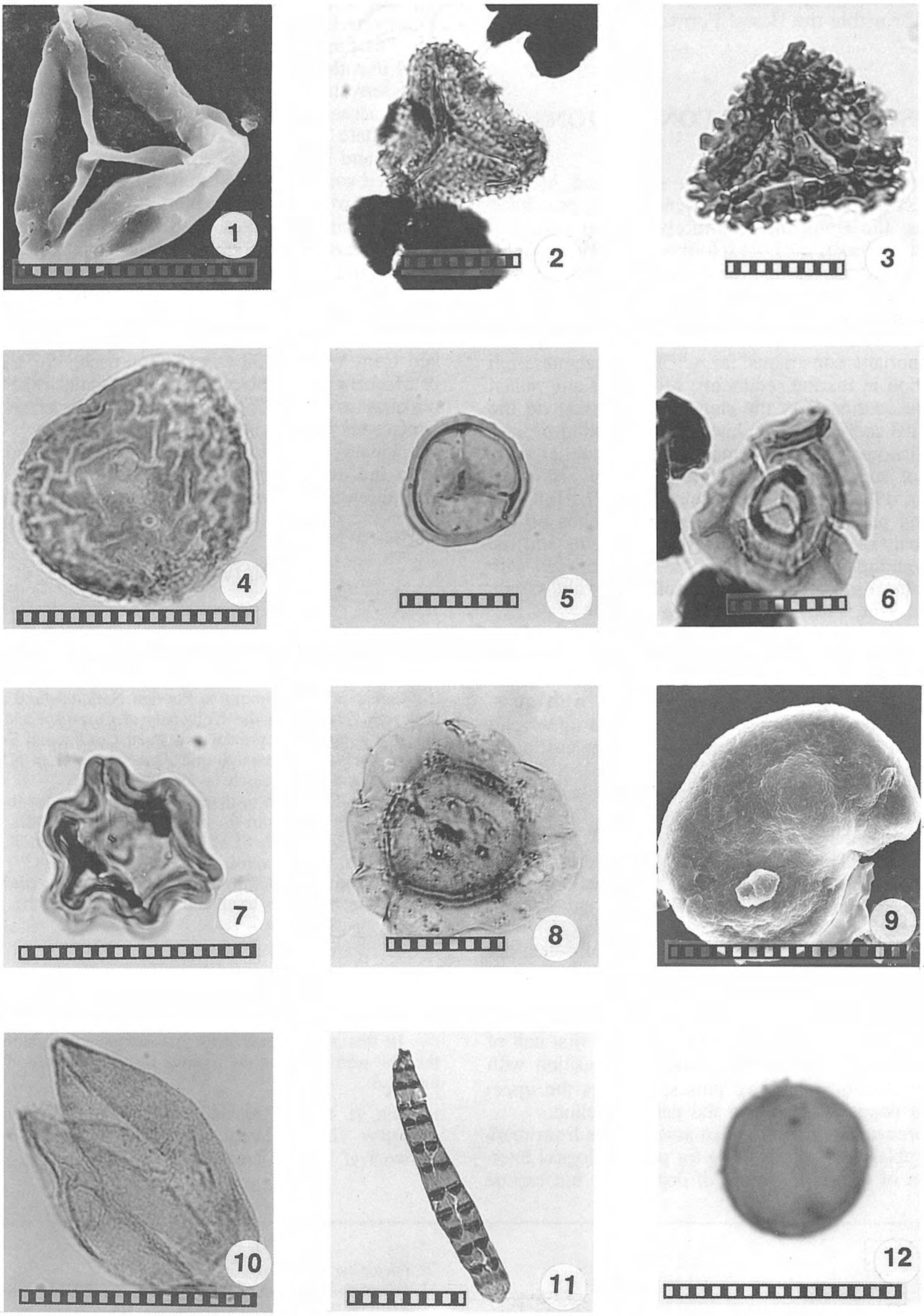
Three more studies also partially deal with the terrestrial palynomorph suites of the Hassel Formation from Ellef Ringnes Island (Balkwill and Hopkins, 1976), from Lougheed Island (Balkwill *et al.*, 1982) and from Banks Island (Hopkins *et al.* in Miall, 1979).

Although, detailed distribution of palynomorphs within the Hassel Formation is not known, the aforementioned publications allow us to infer that the presence of palynomorphs from Albian-Cenomanian sediments in the Kanguk Formation can be attributed to reworking from the underlying Hassel Formation. Thus, the base of the Kanguk Formation represents a transgressive event in which sediments eroded from the deltaic Hassel Formation supplied sediments to the former. To fully understand the degree of this reworking

Plate II

1 *Gleicheniidites senonicus* Ross, UCG029-12 1/5, SEM.
2 *Ornamentifera echinata* (Bolkhovitina) Bolhovitina, UCG029-19a 1/5.
3 *Ornamentifera tuberculata* (Grigorjeva) Bolkhovitina, UCG029-39 1/5.
4 *Camarozonosporites insignis* Norris, UCG029-39 1/5.
5 *Cingutriletes clavus* (Balme) Dettmann, UCG029-1b 5/5.
6 *Polycingulatisporites reduncus* (Bolkhovitina) Playford & Dettmann, UCG029-1a 2/5.
7 *Paraalnipollenites alterniporus* (Zaklinskaya) Hills and Wallace, UCG029-1b 2/5.
8 *Aequitriradites spinulosus* (Cookson and Dettmann) Cookson and Dettmann, UCG029-8 1/5.
9 *Laevigatosporites ovatus* Wilson and Webster, UCG029-1b 1/5, SEM.
10 *Schizosporis cooksoni* Pocock, UCG029-26 1/5.
11 *Pluricellaesporites psilatus* Clarke, UCG029-37 1/5.
12 *Inaperturopollenites* sp., UCG029-19a 1/5.

Plate II



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better control on the taxa present, their preservation and colour within the Hassel Formation must be determined.

DISCUSSION AND CONCLUSIONS

Terrestrial palynomorphs are distributed in sediments according to basic sedimentological principles, and thus, the abundance of miospores and pollen in sediment decreases offshore (Hoffmeister, 1954). Indeed, in a broad sense, further offshore there is a marked sorting among fossil miospores and pollen, with smaller forms being relatively more abundant than larger forms. However, sediment size and bottom morphology are also important constraints for territorial palynomorph distribution in marine sediments. Miospores and pollen are more abundant on the slope and rise than on the continental shelf and show higher concentration in sediment offshore from steam mouths than in other areas devoid of such continental contribution of sediments (Heusser, 1983; Heusser and Balsam, 1977). However, spore and pollen content of sediment depends on the productivity of vegetation in nearby continents and the relative abundance of reworked forms increases with distance from source continent as well (Groot and Groot, 1971; Heusser, 1983).

Based on terrestrial miospore assemblage composition and relative abundance, we conclude that the lower half of the Remus Creek section of the Kanguk Formation reflects changes in shoreline position, with transgresive and regressive episods, and that the upper part was deposited in a more stable, closer to paleoshoreline, setting.

At Remus Creek probable reworked palynomorphs constitute a small but significant fraction of the total of the assemblages suggesting a late Lower Cretaceous to early Cenomanian source. The Hassel Formation is proposed as the possible source, and, therefore, the reworked taxa indicate the existence of a sub-Kanguk Formation unconformity.

The facts that the *in situ* miospores and pollen are consistently small and thin-walled and their percentages and distribution are variable throughout the Kanguk Formation imply variations in distance from shoreline to the area of deposition. On that basis, the first half of the section reflects changes in shoreline position with transgressive and regressive pulses, whereas the upper part was deposited closer to the paleoshoreline.

Moreover, spore and pollen assemblages from marine assemblages are not suitable for paleoecological interpretation of the environment of deposition, but can be applied to reconstruction of the general paleoecological conditions in the nearby continental areas.

The Kanguk terrestrial palynomorph assemblage suggests that the dominant regional vegetation associated with terrestrial paralic environments was that of the Taxodiaceae-Cupressaceae complex as it was defined for the late Turonian Cardium Formation from Alberta (Sweet and McIntyre, 1988), however, sorting may have removed some taxa and, thus, the terrestrial palynological suite would not represent the entire flora of the nearby continental area. The terrestrial palynomorphs indicate that the continental areas were vegetated and, despite the high latitud, most likely, a boreal forest compossed almost exclusively of gymnosperms was present in the area.

This flora presents similarities with the ones described from Western Siberia (Samoilovich, 1967), District of Mackenzie (McIntyre, 1974) and Banks Island (Doerenkamp *et al.,* 1976), and corresponds to an Upper Cretaceous boreal complex.

Finally, probable reworked terrestrial palynomorphs from the underlying Hassel Formation would indicate the presence of a sub-Kanguk Formation unconformity.

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BIBLIOGRAPHY

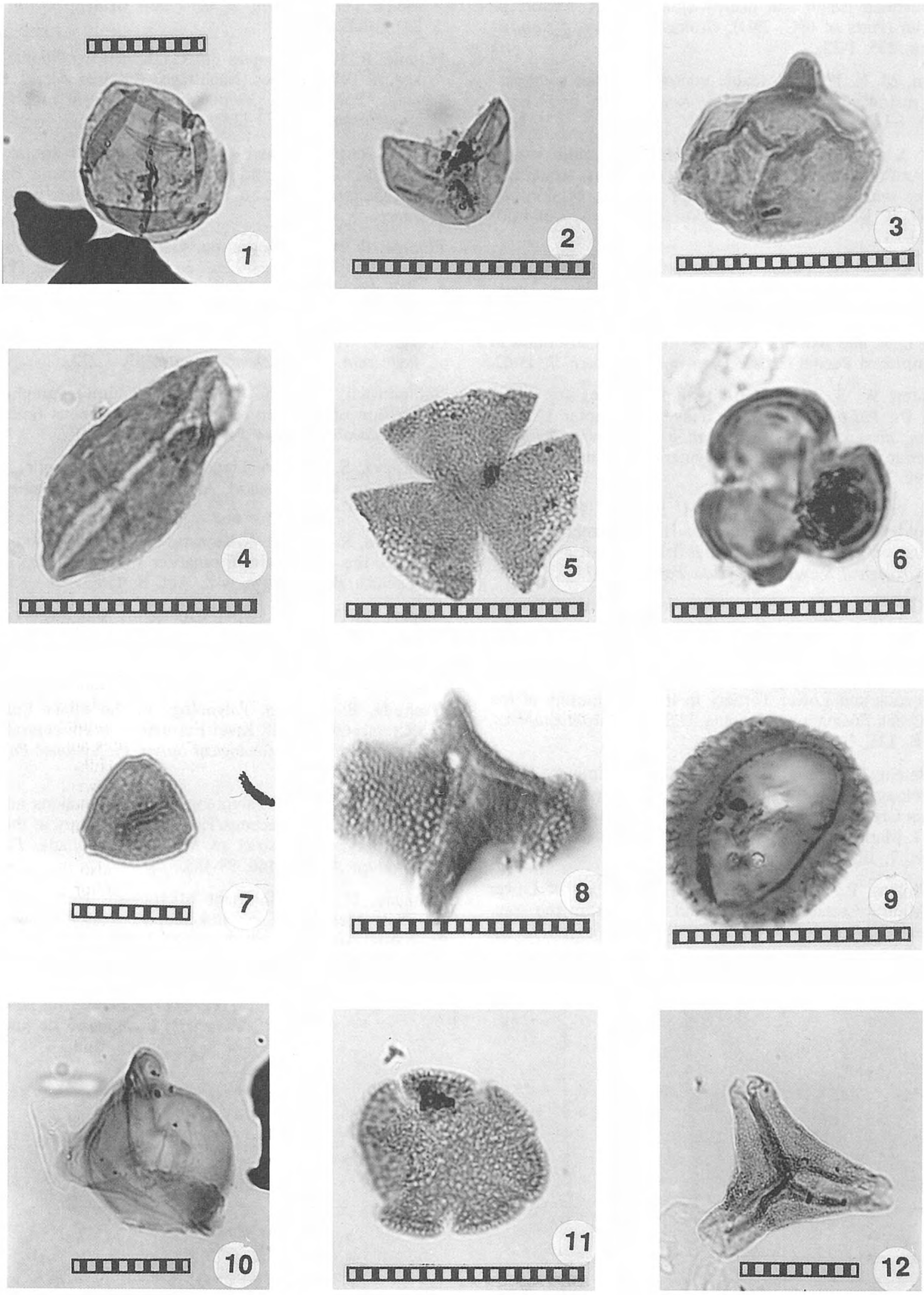
In this section only those publications not refered to in the first part of this study (Núñez-Betelu and Hills, 1992) are included.

Balkwill, H. R. and Hopkins. W. S. 1976. Cretaceous stratigraphy, Hoodoo Dome, Ellef Ringnes Island. *Geological Survey of Canada Paper,* **76-1B**, 329-334.

Plate III

1 *Laricoidites magnus* (Potonié) potonié, Thomson and Thiegart, UCG029-32 1/3.
2 *Taxodiaceaepollenites hiatus* Potonié, UCG029-34 1/5.
3 *Sequoiapollenites* sp., UCG029-24 1/5.
4 *Cycadopites fragilis* Singh, UCG029-17a 1/5.
5 *Tricolpites reticulatus* Cookson, UCG029-16a 1/5.
6 *Tricolpites* sp. *A,* UCG029-23 1/5.
7 *Triporopollenites* sp. 2 McIntyre, UCG029-34 1/5.
8 *Aquilapollenites* sp., UCG029-39a 1/5.
9 *?Wodehouseia* sp., UCG029-35 1/5, 94.1/35.5.
10 *Orbiculapollis globosus* (Khlonova) Khlonova, UCG029-26a 1/5.
11 *Polycolpites* cf. *P. pococki* Srivastava, UCG029-35 1/5.
12 *Expressipollis ocliferia* Khlonova, UCG029-34 1/5.

Plate III



Unless otherwise stated the pictures are from the light microscope. In the explanation of figures illustrated, the species name is followed by slide number in which the first part refers to the University collection number and the second to the sample number. Scale bar representes 30 μm.

Balkwill, H. R., Hopkins, W. S. and Wall, J. H. 1982. Geology of Lougheed Island and nearby small islands, District of Franklin (Parts of 69C, 79D). *Geological Survey of Canada Memoir,* **395**, 1-22.

Dettmann, M. E. 1963. Mesozoic microfloras from southeastern Australia. *Proceedings of the Royal Society of Victoria,* **77** (1), 1-138.

Groot, J. J. and Groot, C. R. 1971. Horizontal and vertical distribution of pollen and spores in Quaternary sequences. In: *The micropaleontology of oceans* (Eds. B. M. Funnell and W. R. Riedel) Cambridge University Press, Cambridge, 493-504.

Heusser, L. E. 1983. Pollen distribution in the bottom sediments of the western North Atlantic Ocean. *Marine Micropaleontology,* **8**, 77-88.

Heusser, L. E. and Balsam, W. L. 1977. Pollen distribution in the northeast Pacific Ocean. *Quaternary Research,* **7**, 45-62.

Hoffmeister, W. S. 1954. Microfossil prospecting for petroleum. In: *Paleopalynology.* (A. Traverse) Chapter 17: *Production, dispersal, and sedimentation of spores/pollen.* The Academic Division of Unwin Hyman Ltd., London, U.K., 397-398.

Hopkins, W. S. Jr. and Balkwill, H. R. 1973. Description, palynology and paleoecology of the Hassel Formation (Cretaceous) on eastern Ellef Ringnes Island, Distric of Franklin. *Geological Survey of Canada Paper,* **72-37**, 1-31.

Norris, G. 1967. Spores and pollen from Lower Colorado Group (Albian-Cenomanian) of central Alberta. *Paleontographica,* Abt. B. **120**, 72-115.

Norton, N. J., and Hall, J. W. 1969. Palynology of the Upper Cretaceous and Lower Tertiary in the type locality of the Hell Creek Formation, Montana, U.S.A. *Palaeontographica,* Abt. B, **125**, 1-64.

Núñez-Betelu, L. K. and Hills, L. V. 1992. Preliminary paleopalynology of the Kanguk Formation (Upper Cretaceous), Remus Creek, Ellesmere Island, Canadian Arctic Archipelago: I. Marine Palynomorphs. *Revista Española de Paleontología,* **7**, 185-196.

Paden Phillips, P., and Felix, C. J. 1971. A study of Lower and Middle Cretaceous spores and pollen from the southeastern United States. I Spores. *Pollen et Spores,* **13** (2), 279-348.

Pierce, R. L. 1961. Lower Upper Cretaceous plant microfossils from Minnesota. *Minnesota geological Survey Bulletin,* **42**, 1-86.

Potonié, R. 1956. Synopsis der Gattungen der Sporae dispersae, **I.** Teil: Sporites. *Beihefte zum Geologischen Jahrbuch,* **23**, 1-103.

Potonié, R. 1958. Synopsis der Gattungen der Sporae dispersae, II. Teil: Sporites (Nachträge), Saccites, Aletes, Praecolpates, Polyplicates, Monocolpates. *Beihefte zum Geologischen Jahrbuch,* **31**, 1-114.

Potonié, R. 1960. Synopsis der Gattungen der Sporae dispersae, III. Teil: Nachträge Sporites, Fortsetzung Pollenites mit Generalregister zu Teil I-III. *Beihefte zum Geologischen Jahrbuch,* **39**, 1-189.

Potonié, R. 1966. Synopsis der Gattungen der Sporae dispersae, IV. Teil: Nachträge zu allen Gruppen (Turmae). *Beihefte zum Geologischen Jahrbuch,* **72**, 1-244.

Potonié, R. 1970. Synopsis der Gattungen der Sporae dispersae, V. Teil: Nachträge zu allen Gruppen (Turmae). *Beihefte zum Geologischen Jahrbuch,* **87**, 1-222.

Samoilovich, S. R. 1967. Tentative botanico-geographical subdivision of northern Asia in Late Cretaceous time. *Review of Palaeobotany and Palynology,* **2**, 127-139.

Srivastava, S. K. 1966. Upper Cretaceous microflora (Maestrichtian) from Scollard, Alberta, Canada. *Pollen et Spores,* **8** (3), 497-552.

Srivastava, S. K. 1972. Systematic description of some spores from the Edmonton Formation (Maestrichtian), Alberta, Canada. *Palaeontographica,* Abt. B, **139**, 1-46.

Stanley, E. A. 1965. Upper Cretaceous and Paleocene plant microfossils and Paleocene dinoflagellates and hystrichosphaerids from northwestern South Dakota. *Bulletin of Canadian Petroleum Geology,* **17** (1), 47-66.

Tschudy, B. D. 1973. Palynology of the upper Campanian (Cretaceous) Judith River Formation, north central Montana. *United States Geological Survey Professional Paper,* **770**, 1-42,

Wilson, M. A. 1978. Palynology of three sections across the Uppers-most Cretaceous/Paleocene boundary in the Yukon Territory and District of Mackenzie, Canada. *Palaeontographica* Abt. B, **166**, 99-183.

Wingate, F. H. 1980. Plant Microfossils from the Denton Shale Member of the Bokchito Formation (Lower Cretaceous, Albian) in southern Oklahoma. *Oklahoma Geological Survey Bulletin,* **130**, 1-93.

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