UPPERMOST ALBIAN-CAMPANIAN PALYNOLOGICAL BIOSTRATIGRAPHY OF AXEL HEIBERG AND ELLESMERE ISLANDS (CANADIAN ARCTIC)

L. Koldo Núñez-Betelu, R.A. MacRae, and L.V. Hills, Department of Geology and Geophysics, University of Calgary, Calgary, Alberta, Canada, T2N 1N4
G.K. Muecke, Department of Earth Sciences, Dalhousie University, Halifax, Nova Scotia, Canada, B3H 3J5

ABSTRACT

The uppermost Albian to Campanian stratigraphy of the northeastern Sverdrup Basin includes the Bastion Ridge, Strand Fiord, and Kanguk Formations. The Bastion Ridge Formation and the overlying and intertonguing volcanic Strand Fiord Formation are restricted to Axel Heiberg Island, where they conformably to unconformably overlie the Hassel Formation and are unconformably overlain by the Kanguk Formation. On Ellesmere Island, the Kanguk Formation directly and unconformably overlies the Hassel Formation. On western Axel Heiberg Island, the Kanguk Formation is conformably overlain by the Eureka Sound Group; however, locally on Ellesmere Island a major unconformity separates the Kanguk Formation and the Eureka Sound Group.

The palynomorph assemblage from the Bastion Ridge and Strand Fiord Formations is dominated by terrestrial taxa with a low diversity of marine dinocysts that are dominated by morphologically variable *Nyktericysta*. In both formations, the age of the assemblage is Late Albian. The depositional setting for the Bastion Ridge Formation was a stressed marine, nearshore environment, probably a shallow restricted basin. The majority of the Strand Fiord Formation sediments are marine, but a freshwater or terrestrial paleoenvironment is possible for some.

The Kanguk Formation contains a rich marine and terrestrial palynomorph assemblage. The marine assemblage tends to dominate in the lower part, and terrestrial taxa dominate in the upper part. The base of the formation contains abundant reworked Albian taxa that originated from the underlying Hassel, Bastion Ridge, and/or Strand Fiord Formations. The age difference between these latter units (Late Albian) and the Kanguk Formation (Late Turonian-Early Campanian) indicates the presence of a Cenomanian to middle Turonian unconformity.

INTRODUCTION

This study (1) adds to the insufficiently known stratigraphy of the uppermost Lower and Upper Cretaceous of the northeastern Sverdrup Basin (Fig.1), (2) provides information on the latest stages of development of the Sverdrup Basin, and (3) gives insight into events in the nearby Canada Basin. Major characteristics of this interval have been previously defined and summarized by Ricketts et al. (1985), Embry and Osadetz (1988), Embry and Dixon (1990), and Embry (1991). The stratigraphic interval containing the Bastion Ridge, Strand Fiord, and Kanguk Formations (Fig.2) represents approximately 20 million years and includes a major hiatus. These three units are sandwiched between the Albian Hassel Formation and the Upper Cretaceous-Tertiary Eureka Sound Group and represent variations in depositional environments in the Sverdrup Basin. Historically, the stratigraphy has been based mostly on lithological and sedimentological characteristics with sparse

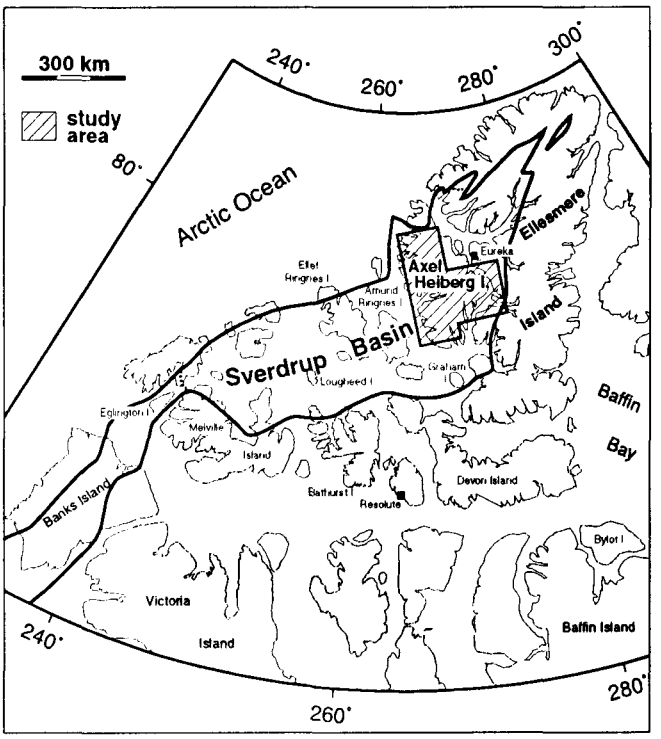

Fig.1. Study area within the Sverdrup Basin, Canadian Arctic Archipelago.

paleontological data because of the paucity of macrofossils. Organic microfossils are numerous and well-preserved in these formations; but the few published micropaleontological analyses of this stratigraphic interval are mainly in the western Sverdrup Basin (e.g., Hopkins and Balkwill, 1973; Doerenkamp et al., 1976). For more detailed summaries, refer to Núñez-Betelu (1991), MacRae (1992), and Núñez-Betelu and Hills (1992a, b).

Detailed palynological analysis was undertaken to establish the Late Albian to Early Campanian history of Axel Heiberg and Ellesmere Islands. Age-diagnostic dinocysts, acritarchs, miospores, and pollen were used to date the stratigraphic units and document the presence of unconformities within the sequence.

REGIONAL STRATIGRAPHY

The Bastion Ridge Formation and the overlying and intertonguing Strand Fiord Formation are restricted to western and southern Axel Heiberg Island. The Kanguk Formation is present throughout the entire study area (Fig.1). All occur in the Carboniferous to Tertiary Sverdrup Basin of the Canadian Arctic Archipelago, and the Kanguk Formation extends into other areas of the Arctic Archipelago.

The Hassel Formation (Heywood, 1957) is composed mainly of sandstone. In most areas of the Sverdrup Basin the Hassel Formation can be subdivided into two units; a

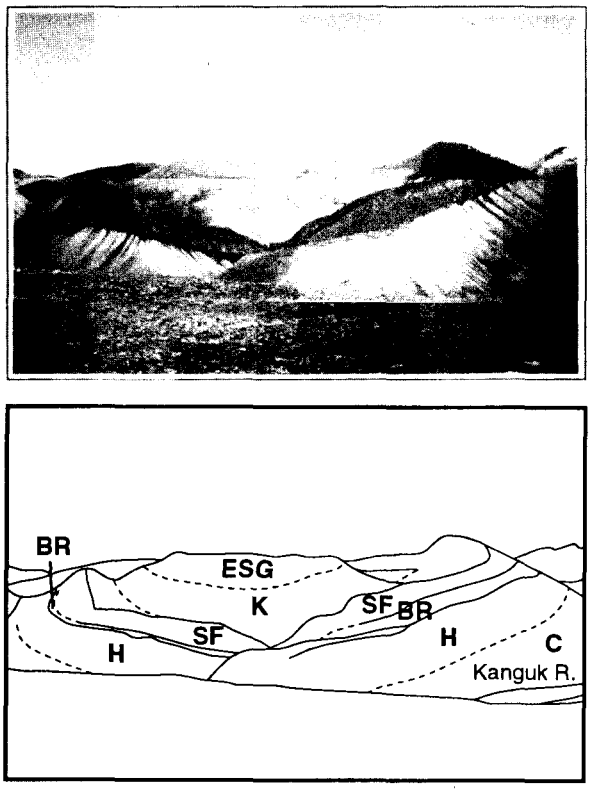

Fig.2. View looking north to Bastion Ridge across the Kanguk River, Kanguk Peninsula, western Axel Heiberg Island. This view shows Albian-Maastrichtian stratigraphic units including the Christopher (C), Hassel (H), Bastion Ridge (BR), Strand Fiord (SF), and Kanguk (K) Formations and the Eureka Sound Group (ESG).

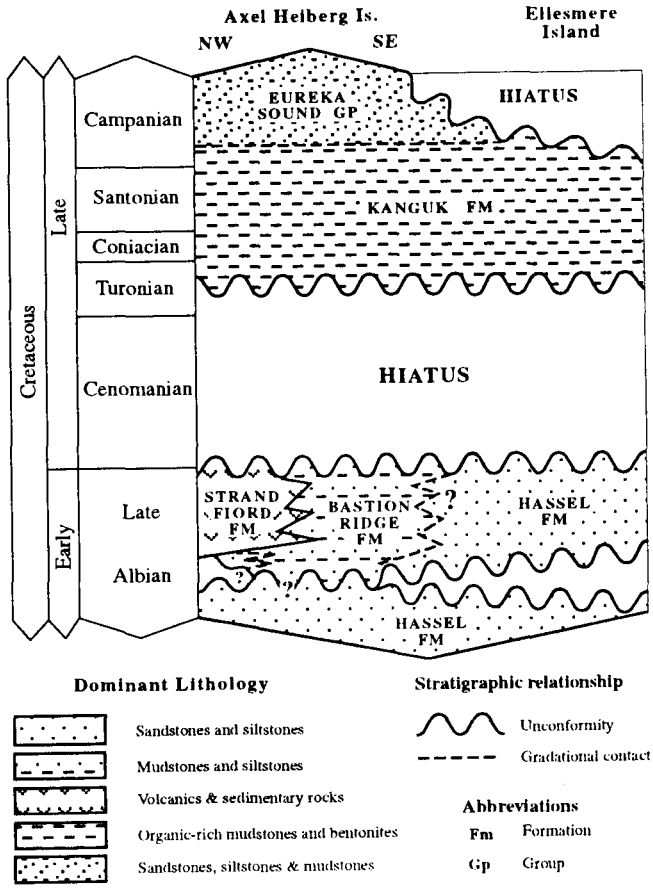

Fig.3. Time-stratigraphic relationships within the Upper Albian to Lower Campanian interval. A minor unconformity may be present between the Hassel and Bastion Ridge Formations in areas where the Strand Fiord Formation is present. In other areas, where the Strand Fiord Formation is not present, sedimentological evidence supports the presence of this unconformity. Sandstones intertonguing with the Bastion Ridge Formation could either represent lateral equivalents of the formation or could unconformably rest on the Hassel Formation. The hiatus defined on top of the Kanguk Formation and lower part of the Eureka Sound Group extends into the Paleocene.

lower, fine- to medium-grained marine sandstone unit, and an upper, fluvial to marginal marine unit consisting of interbedded fine- to coarse-grained sandstone, siltstone, mudstone, and minor coal (Embry, 1991). In most of the Sverdrup Basin this formation (Fig.3) is overlain by dark, marine mudstones of the Kanguk Formation (Souther, 1963; Núñez-Betelu and Hills, 1992a). The Hassel beds contain rare marine macrofossils (Fricker, 1963; Plauchut 1971). On the basis of terrestrial palynomorphs Hopkins and Balkwill (1973) considered the Hassel Formation to be latest Albian and/or Early Cenomanian in age.

On western and southern Axel Heiberg Island (Fig.4), the Hassel Formation is overlain by a thin mudstone-dominated unit--the Bastion Ridge Formation (Fricker, 1963; MacRae, 1992). In the south, an unconformity separates the two formations, as evidenced by the presence of a sideritic sandstone with plant macrofossils and an undulose contact. Locally on western Axel Heiberg Island, the Bastion Ridge Formation underlies and interfingers with the volcanic Strand Fiord Formation (Fig.3), and its mudstones contain pyroclastic ejecta in its upper part (Ricketts et al., 1985; Embry and Osadetz, 1988; MacRae, 1992). Where the Strand Fiord volcanics are absent, the Bastion Ridge Formation is directly overlain by the Kanguk Formation. On southern Axel Heiberg Island the Bastion Ridge Formation is capped by a sandstone unit that is bioturbated at its base. Prominent paleosol horizons are present at the top of the Bastion Ridge Formation at this locality, indicating that it is separated from the overlying Kanguk Formation by an unconformity.

The Strand Fiord Formation overlies and interfingers the Bastion Ridge Formation in most areas, but on northwestern Axel Heiberg Island the Strand Fiord Formation directly overlies the Hassel Formation (Fischer, 1985; Ricketts et al., 1985). The Strand Fiord Formation is composed mainly of basaltic volcanics and ranges from 40 to almost 800 m thick (Ricketts et al., 1985; MacRae, 1992). Carbonaceous mudstones and siltstones, usually less than 5 m thick, occur sporadically within the volcanics. Based on palynological data, the Strand Fiord Formation is Late Albian in age (MacRae, 1992).

Unconformably overlying either the Hassel, Bastion Ridge, or Strand Fiord Formations are the organic rich beds of the Kanguk Formation (Fig.3), which are conformably to unconformably overlain by the Eureka Sound Group (Souther, 1963; Miall, 1979; Ricketts,

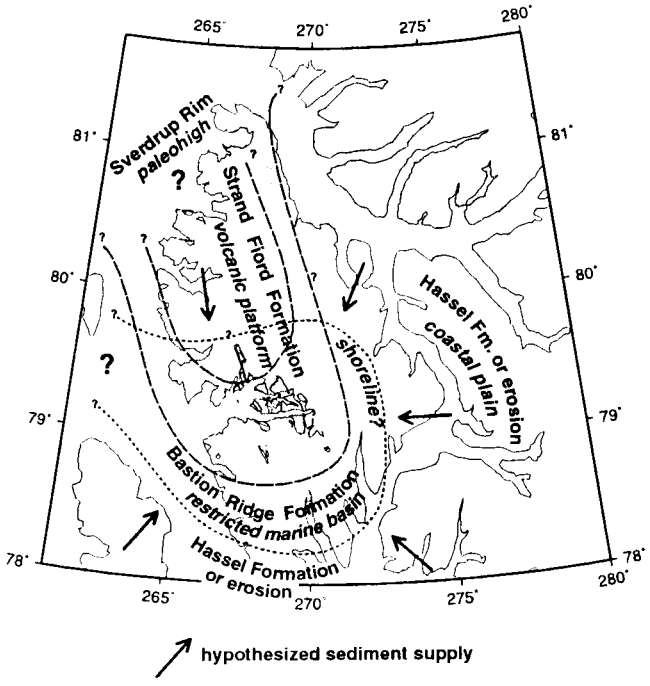

Fig.4. Paleogeographical distribution of the Bastion Ridge and Strand Fiord Formations. The Strand Fiord Formation prograded and intertongued with the Bastion Ridge Formation. This approximates the surface on which the Kanguk Formation was deposited after a time of nondeposition and erosion.

1986, 1991). Organic-rich mudstones with rare to abundant interbeds of centimeter to meter-thick bentonites and silty mudstones constitute the main lithology of this formation. Based on foraminifers (Wall, 1983) and palynology (Núñez-Betelu, 1991; Núñez-Betelu and Hills, 1992a,b), the Kanguk Formation is Late Turonian to Early Campanian in age. The contact between the Kanguk Formation and the Eureka Sound Group is transitional and conformable on western and southern Axel Heiberg Island and northeast of Eureka (Remus Creek, Ellesmere Island); on central and western Ellesmere Island, Eureka Sound strata unconformably rest on the Kanguk Formation.

PALYNOLOGICAL ANALYSIS

This study is based on measurement and sample collection of 13 sections of the Bastion Ridge and Strand Fiord Formations and of 14 sections of the Kanguk Formation. Details pertaining to sample collection, palynological processing, and data collection are summarized in Núñez-Betelu, 1991; MacRae, 1992; and Núñez-Betelu and Hills 1992a,b. A total of 174 palynomorph taxa from the Bastion Ridge and Strand Fiord Formations and 181 taxa from the Kanguk Formation were identified. The palynomorph assemblages include dinocysts, acritarchs, miospores, megaspores, fungal spores, and pollen. Reworked palynomorphs are common, especially in the lower parts of the formations; and their preservation is sometimes similar to that of *in situ* taxa.

I. Bastion Ridge and Strand Fiord Formations

Palynomorphs are well-preserved throughout the Bastion Ridge Formation and sporadically preserved in relatively thin (usually less than 5 m) sediment intervals within the dominantly volcanic Strand Fiord Formation. Preservation quality within the Strand Fiord Formation is in part controlled by thermal effects from the surrounding volcanic flows.

One hundred and seventy-four species are recognized: 86 miospore, fungal spore, and pollen; 70 dinocyst; and 18 acritarch species. Palynomorph assemblages from both formations are dominated by terrestrial palynomorphs, with aquatic palynomorphs (dinocysts and acritarchs) usually less than 5 percent and rarely reaching 10 percent of the total assemblage. Aquatic palynomorphs are present throughout the Bastion Ridge Formation and most of the Strand Fiord Formation. Paleosols, rooted horizons, plant macrofossils, and terrestrial palynomorph assemblages in parts of the Strand Fiord Formation indicate that it was, in part, deposited in a terrestrial environment.

The terrrestrial palynomorphs include diverse bisaccate and taxodiaceous pollen, fern, and moss spores; megaspores; and uncommon angiosperm pollen (mainly small reticulate, monocolpate, and tricolpate forms). The terrestrial palynomorph distribution is fairly homogeneous throughout the two Formations; but the presence of *Liliacidites dividuus*, ?*Nyssapollenites* sp., *Rugubivesiculites rugosus*, and *R. peroreticulatus* support a Late Albian age for the two formations. The aquatic palynomorphs show a general reduction in diversity through the Bastion Ridge Formation and into the Strand Fiord Formation due to increasing dominance by species of *Nyktericysta* (Pl.I, Figs.1,2). Five species of *Nyktericysta* are present, including three probable new species and two displaying vertical morphoclines (MacRae, 1992; MacRae, 1993). Other age-diagnostic dinocysts include *Catastomocystis spinosa*, *Chichaouadinium vestitum* (Pl.I, Fig.5), *Litosphaeridium arundum*, *L. siphonophorum* subsp. *glabrum*, *Luxadinium primulum*, *L. propatulum*, and *Hapsocysta* ? *benteae* (Nøhr-Hansen, 1983; Pl.I, Fig.6). This assemblage compares closely with Late Albian assemblages from western Canada described by Singh (1971, 1983), Leckie and Singh (1991), and Bloch et al. (1993). The acritarchs *Limbicysta* (Pl.I, Fig.3) and *Wuoria* (Pl.I, Fig.4) are common as in certain southern hemisphere assemblages (Marshall, 1989).

Reworked palynomorphs include *Acanthaulax* sp. 2 of Johnson and Hills, 1973, *Gochteodinia villosa*, *Gonyaulacysta jurassica* subsp. *jurassica* var. *longicornuta*, *Muderongia australis*, *M. tetracantha*, *Nannoceratopsis gracilis*, *Sirmiodinium grossii*, and *Tubotuberella apatela* (Pl.I, Fig.7). These marine palynomorphs are typical of the Late Jurassic to Valanginian Deer Bay (Davies, 1983) and Middle to Late Jurassic Savik Formations (Johnson and Hills, 1973).

II. Kanguk Formation

The Kanguk Formation contains abundant and well-preserved marine and terrestrial palynomorph assemblages that include 103 dinocyst and acritarch species and 78 miospore, pollen, and fungal spore taxa. Dinocysts are

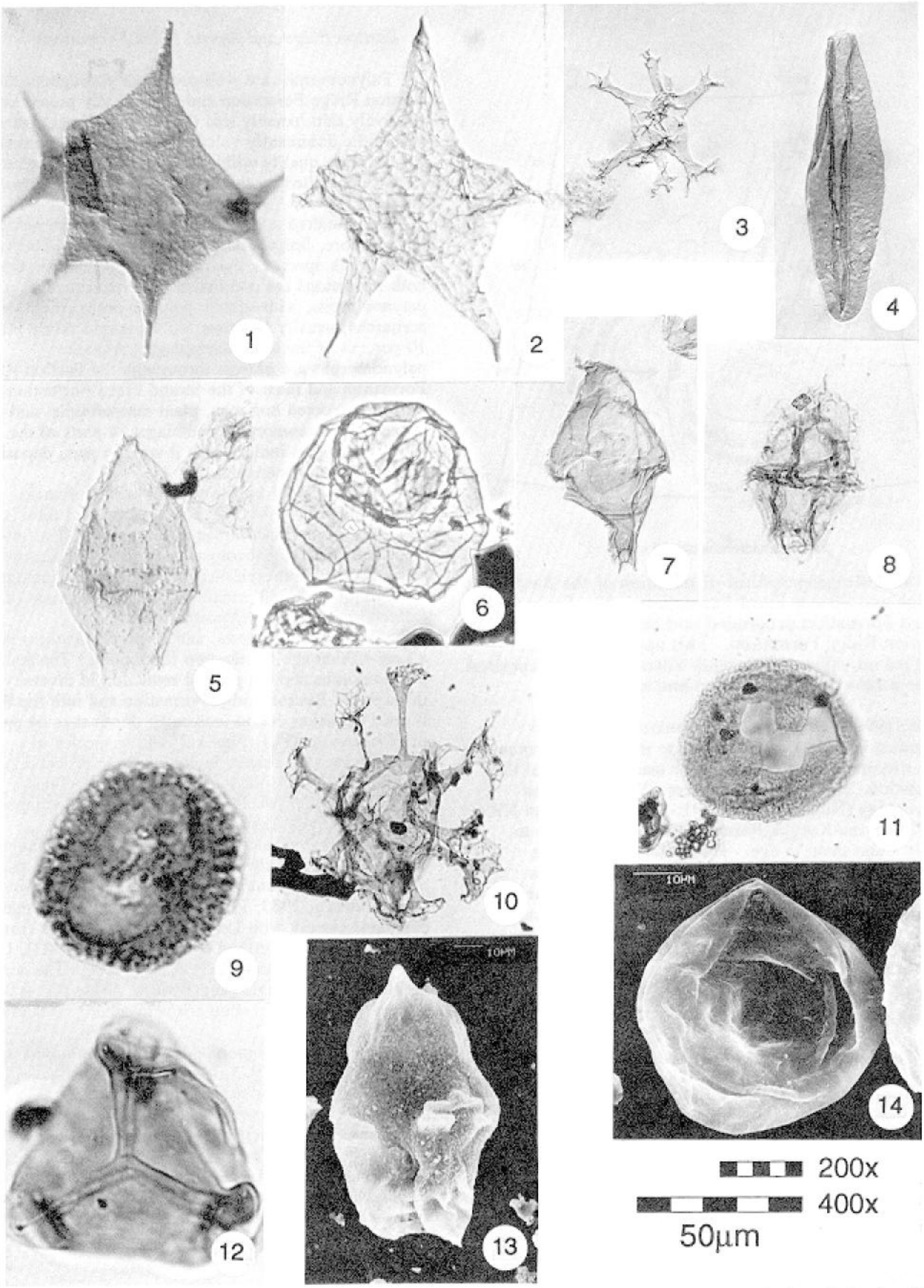

Plate I. Upper Albian-Lower Campanian palynomorph taxa. The upper part of the plate shows marine palynomorphs from the Bastion Ridge and Strand Fiord Formations (Figs.1-7); the lower part shows palynomorphs recovered from the Kanguk Formation (Figs.8-14). (1) *Nyktericysta davisii* (x400); (2) *Nyktericysta* sp. A (x400); (3) *Limbicysta* sp. A (x200); (4) *Wuoria* sp. (x200); (5) *Chichaouadinium vestitum* (x400); (6) *Hapsocysta ? henteae* (Nøhr-Hansen, 1993) (x400); (7) *Tubotuberella apatela* (x200); (8) *Gonyaulacysta cassidata* (x200); (9) *Azonia* sp. (x400); (10) *Oligosphaeridium pulcherrimum* (x200); (11) *Trithyrodinium suspectum* (x200); (12) *Deltoidospora juncta* (x400); (13) *Chatangiella granulifera* (SEM); (14) *Isabelidinium? globosum* (SEM).

abundant in the lower part of the formation, whereas spores and pollen are dominant in the upper part.

The most age-diagnostic dinocyst taxon is *Isabelidinium ? globosum* (Pl.I, Fig.14), which occurs in the lowermost part of the formation. This species is considered to be age-representative of the Turonian from the Arctic (McIntyre, pers. commun., 1991). Typical Upper Cretaceous forms such as *Chatangiella ditissima*, *C. granulifera* (Pl.I, Fig.13), *C. verrucosa*, *Chlamydophorella discreta*, *C. nyei*, *Cleistosphaeridium ? multispinosum*, *Kiokansium polypes*, *Oligosphaeridium pulcherrimum* (Pl.I, Fig.10), *Palaeohystrichophora infusorioides*, and *Trithyrodinium suspectum* (Pl.I, Fig.11) are common. Chorate cysts, the most abundant type, are present throughout the formation.

Terrestrial palynomorphs are abundant in the upper part of the formation (Núñez-Betelu and Hills, 1992b). The most common taxa are *Gleicheniidites senonicus*, *Schizosporis cooksoniae*, *Stereisporites antiquasporites*, and *Taxodiaceaepollenites hiatus*. Dinocysts are present in lower numbers in the upper part of the formation and do not include any middle Campanian diagnostic forms, but the presence of pollen taxa such as *Azonia* (Pl.I, Fig.9) and *Aquilapollenites* types indicates a most likely Early Campanian age for the top of the formation.

Reworked marine and terrestrial taxa are present in the Kanguk samples. Characteristic Albian to Cenomanian reworked palynomorphs, such as *Cassiculosphaeridia reticulata, Deltoidospora juncta* (Pl.I, Fig.9), *Gonyaulacysta cassidata* (Pl.I, Fig.8), *Lycopodiumsporites marginatus*, and *Sestrosporites pseudoalveolatus* have been reported previously from the Hassel Formation (Hopkins and Balkwill, 1973; Doerenkamp et al., 1976), which indicates that the Hassel Formation was--at least locally--being eroded during deposition of the Kanguk Formation.

DISCUSSION AND CONCLUSIONS

Correlations within the Hassel, Bastion Ridge, Strand Fiord, and Kanguk Formations and the base of the Eureka Sound Group are poorly known. An early interpretation suggested that the Bastion Ridge and Strand Fiord Formations were lateral equivalents of the basal Kanguk Formation (Fricker, 1963; Thorsteinsson and Tozer, 1970). However, Ricketts et al. (1985), Embry and Osadetz (1988), and MacRae (1992) indicate that the Bastion Ridge Formation is time-equivalent to the Strand Fiord Formation in some areas, and that both may be time-equivalent to the upper Hassel Formation. It also is possible that the Bastion Ridge and Strand Fiord Formations represent, elsewhere in the Sverdup Basin, a time of nondeposition or erosion between the Hassel and Kanguk Formations.

The gap in age, determined by palynology, between the Bastion Ridge and Strand Fiord Formations (Late Albian) and the overlying Kanguk Formation (Late Turonian) spans the Cenomanian and represents an extensive unconformity over the entire study area. Outside the area of Bastion Ridge and Strand Fiord Formations deposition, this unconformity occurs between the Hassel and Kanguk Formations. The unconformity at the top of the Strand Fiord Formation is marked by alteration of volcanic flows and extensive boulder conglomerates of uncertain age (Ricketts et al., 1985; MacRae, 1992).

ACKNOWLEDGMENTS

The authors wish to acknowledge the logistic support of the Polar Continental Shelf Project. Financial support was provided by the University of Calgary (Thesis Research Grants) to L. K. Núñez-Betelu and R. A. MacRae. Further economic assistance was provided by Fedirchuk McCullough and Associates, Geological Society of America, American Association of Petroleum Geologists, and Northern Scientific Training Program (Department of Indian and Northern Affairs, Government of Canada) and Natural Sciences and Engineering Research Council Grants in Aid of Research to Dr. L. V. Hills and Dr. G. K. Muecke. Dr. A. F. Embry and D. J. McIntyre, both from the Geological Survey of Canada, kindly reviewed the manuscript. Dr. A. Embry also supplied some samples from the Hassel, Bastion Ridge, Strand Fiord, and Kanguk Formations. We want to warmly thank Ms. L. Bloom and Ms. B. Rhoades, who efficiently processed the samples. Some maps in this report were produced with the aid of the freely distributable GMT-System (Wessel and Smith, 1991).

REFERENCES

Bloch, J., Schroder-Adams, C., Leckie, D.A., McIntyre, D. J., Craig, J. and Stanland, M., 1993. Revised stratigraphy of the lower Colorado Group (Albian to Turonian), Western Canada. Bulletin of Canadian Petroleum Geology, 41(3): 325-348.

Davies, E.H., 1983. The dinoflagellate Opel-zonation of the Jurassic-Lower Cretaceous sequence in the Sverdrup Basin, Arctic Canada. Geological Survey of Canada, Bulletin 359, 59 pp.

Doerenkamp, A., Jardine, S. and Moureau, P., 1976. Cretaceous and Tertiary palynomorph assemblages from Banks Island and adjacent areas (N.W.T.). Bulletin of Canadian Petroleum Geology, 24(3): 372-417.

Embry, A.F., 1991. Mesozoic history of the Arctic Islands, Chapter 14. In: H.P. Trettin (Editor), Geology of the Innuitian Orogen and Arctic Platform of Canada and Greenland. Geological Survey of Canada, Geology of Canada, no. 3, and Geological Society of America, The Geology of North America, v. E, pp. 369-433.

Embry, A.F. and Dixon, J., 1990. The breakup unconformity of the Amerasia Basin, Arctic Ocean: Evidence from Arctic Canada. Geological Society of America Bulletin, 102: 1526-1534.

Embry, A.F., and Osadetz, K.G., 1988. Stratigraphy and tectonic significance of Cretaceous volcanism in the Queen Elizabeth Islands, Canadian Arctic Archipelago. Canadian Journal of Earth Sciences, 25 (8): 1209-1219.

Fischer, B.F.G., 1985. The geology of the area surrounding Bunde and Bukken Fiords, northwestern Axel Heiberg Island, Canadian Arctic Archipelago. M.Sc. Thesis, The University of Calgary, 114 pp.

Fricker, P.E., 1963. Geology of the Expedition area, western central Axel Heiberg Island, Canadian Arctic archipelago. Axel Heiberg Island Research Reports, McGill University, Montreal, Geology, No. 1, 156 pp.

Heywood, W.W., 1957. Isachsen area, Ellef Ringnes Island, District of Franklin, Northwest Territories. Geological Survey of Canada, Paper 56-8.

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

Johnson, C.D. and Hills, L.V., 1973. Microplankton zones of the Savik Formation (Jurassic), Axel Heiberg and Ellesmere Islands, District of Franklin. Bulletin of Canadian Petroleum Geology, 21(2): 178-218.

Leckie, D.A. and Singh, C., 1991. Estuarine deposits of the Albian Paddy Member (Peace River Formation) and lowermost Shaftesbury Formation, Alberta, Canada. Journal of Sedimentary Petrology, 61(5): 825-849.

MacRae, R.A., 1992. Palynology of the Bastion Ridge and Strand Fiord Formations, western Axel Heiberg Island, Canadian Arctic Islands, N.W.T.: Implications for stratigraphy, age, paleoenvironment, and *Nyktericysta* taxonomy. M.Sc. Thesis. The University of Calgary, 347 pp.

MacRae, R.A. and Hills, L.V., 1993. Species succession and morphoclines of the fossil dinoflagellate *Nyktericysta*: a measure of increasing paleoenvironmental stress and proximity to shoreline? Program and Abstracts, Geological Association of Canada/Mineralogical Association of Canada, Joint Annual Meeting, Edmonton, Canada, p. 65.

Marshall, N.G., 1989. An unusual assemblage of algal cysts from the Late Cretaceous of the Gippsland Basin, southeastern Australia. Palynology, 13: 21-56.

Miall, A.D., 1979. Mesozoic and Tertiary geology of Banks Island, Arctic Canada. The history of an unstable craton margin. Geological Survey of Canada, Memoir 387, pp. 1-235.

Nøhr-Hansen, H., 1993. Dinoflagellate cyst stratigraphy of the Barremian to Albian, Lower Cretaceous, North-East Greenland. Grønlands Geologiske Undersøgelse, Bulletin 166, pp.1-171.

Núñez-Betelu, L.K., 1991. Palynology of the Kanguk Formation (Late Cretaceous), Remus Creek, Ellesmere Island, Canadian Arctic Archipelago. M.Sc. Thesis. The University of Calgary, 270 pp.

Núñez-Betelu, L.K. and Hills, L.V., 1992a. Preliminary paleopalynology of the Kanguk Formation (Upper Cretaceous), Remus Creek, Canadian Arctic Archipelago: I. Marine Palynomorphs. Revista Espanola de Paleontologia, 7(2): 185-196.

Núñez-Betelu, L.K. and Hills, L.V., 1992b. Preliminary paleopalynology of the Kanguk Formation (Upper Cretaceous), Remus Creek, Canadian Arctic Archipelago: II. Terrestrial Palynomorphs. Revista Espanola de Paleontologia, 7(2): 197-206.

Plauchut, B.P., 1971. Geology of the Sverdrup Basin. Bulletin of Canadian Petroleum Geology, 19 (3): 659-679.

Ricketts, B.D., 1986. New Formations in the Eureka Sound Group, Canadian Arctic Islands. Geological Survey of Canada, Paper 86-1B, pp. 363-374.

Ricketts, B.D., 1991. Delta evolution in the Eureka Sound Group, Western Axel Heiberg Island: the transition from wave-dominated to fluvial-dominated deltas. Geological Survey of Canada, Bulletin 402, pp. 1-72.

Ricketts, B.D., Osadetz, K.G. and Embry, A.F., 1985. Volcanic style in the Strand Fiord Formation (Upper Cretaceous), Axel Heiberg Island, Canadian Arctic archipelago. Polar Research, 3: 107-122.

Singh, C., 1971. Lower Cretaceous microfloras of the Peace River Area, northwestern Alberta. Research Council of Alberta, Bulletin 28, 542 pp.

Singh, C., 1983. Cenomanian microfloras of the Peace River Area, northwestern Alberta. Research Council of Alberta, Bulletin 44, 322 pp.

Souther, J.G., 1963. Geological traverse across Axel Heiberg Island from Buchanan Lake to Strand Fiord. In: Y.O. Fortier, R.G. Blackadar, B.F. Glenister, H.R. Greiner, D.J. McLaren, N.J. McMillan, A.W. Norris, E.F. Roots, J.G. Souther, R. Thorsteinsson, and E.T. Tozer (Editors), Geology of the North-Central Part of the Arctic Archipelago, Northwest Territories (Operation Franklin). Geological Survey of Canada, Memoir 320, pp. 426-448.

Thorsteinsson, R. and Tozer, E.T., 1970. Geology of the Arctic Archipelago. In: R.J.W. Douglas (Editor), Geology and Economic Minerals of Canada. Geological Survey of Canada, Economic Geological Report No. 1, pp. 548-590.

Wall, J.H., 1983. Jurassic and Cretaceous foraminiferal biostratigraphy in the eastern Sverdrup Basin, Canadian Arctic Archipelago. Bulletin of Canadian Petroleum Geology, 31(4): 246-281.

Wessel, P. and Smith, W.H.F., 1991. Free software helps maps and display data. EOS Transactions of the AGU, v. 72, no. 441, pp. 445-446.