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FOREWORD

The goal of the Geo-mapping for Energy and Minerals (GEM) program was to improve the foundation for sustainable economic development in the North. The Program provides modern public geoscience that will set the stage for long-term decision making related to responsible land-use and resource development. Geoscience knowledge produced by GEM supports evidence-based exploration for new energy and mineral resources and enables northern communities to make informed decisions about their land, economy and society. Building upon the success of its first five-years, GEM was renewed until 2020 to continue producing new, publically available, regional-scale geoscience knowledge in Canada's North.

PROJECT SUMMARY

The GEM-2 Western Arctic Margins project was focused on improving the understanding of bedrock geology and geological history along the western extents of the Canadian Arctic Archipelago (Fig. 1). Research will provide a regional geological framework based on correlation of onshore stratigraphy into offshore areas using new data acquired by UNCLOS and industry seismic surveys, and will integrate recent mapping projects on Ellef Ringnes, northwest Victoria, northern Axel Heiberg, and Ellesmere islands (Evenchick and Embry, 2012a, b; Dewing et al., 2015; Williamson, 2016).

The scientific questions of the GEM-2 Western Arctic Project were designed to improve the understanding of the timing and mechanisms of the opening of the Canada Basin and Arctic Ocean and implications of this event on Canadian natural resources. The main scientific questions were:

• What is the stratigraphic and structural history of the margins of the Arctic Ocean?

• What is the structural and stratigraphic architecture of the Canada Basin and how does it compare to the onshore margins?

• How did the opening of the Arctic Ocean control deposition of source rocks, depth and timing of burial, and timing of uplift across the region?

The Banks Island activity of the GEM-2 Western Arctic Project had two field seasons led by field party chief Dr. I. Rod Smith in 2015 and 2016. The primary objective of the field campaigns were to refine the bedrock geological mapping compilation of Miall (1979) using radiometric dating, quantitative biostratigraphy, and seismic records that were unavailable in the 1970s when mapping was conducted. As reported here, new sample suites were obtained for paleontological, primarily palynological, analyses to refine age control and paleoenvironment. Other project activities include reconciliation of seismic images that show abundant faulting with surface mapping that shows relatively few faults; analysis of kinematic indicators from areas of surface faulting and folding; and analysis of new sample suites for geochemical and geochronological studies to reconcile bedrock ages that are in apparent conflict with age of units elsewhere in the region, and analysis of bedrock samples for mineral indicators. Additional details of these research activities are published in Smith et al. (2016) and Piepjohn et al. (2018).

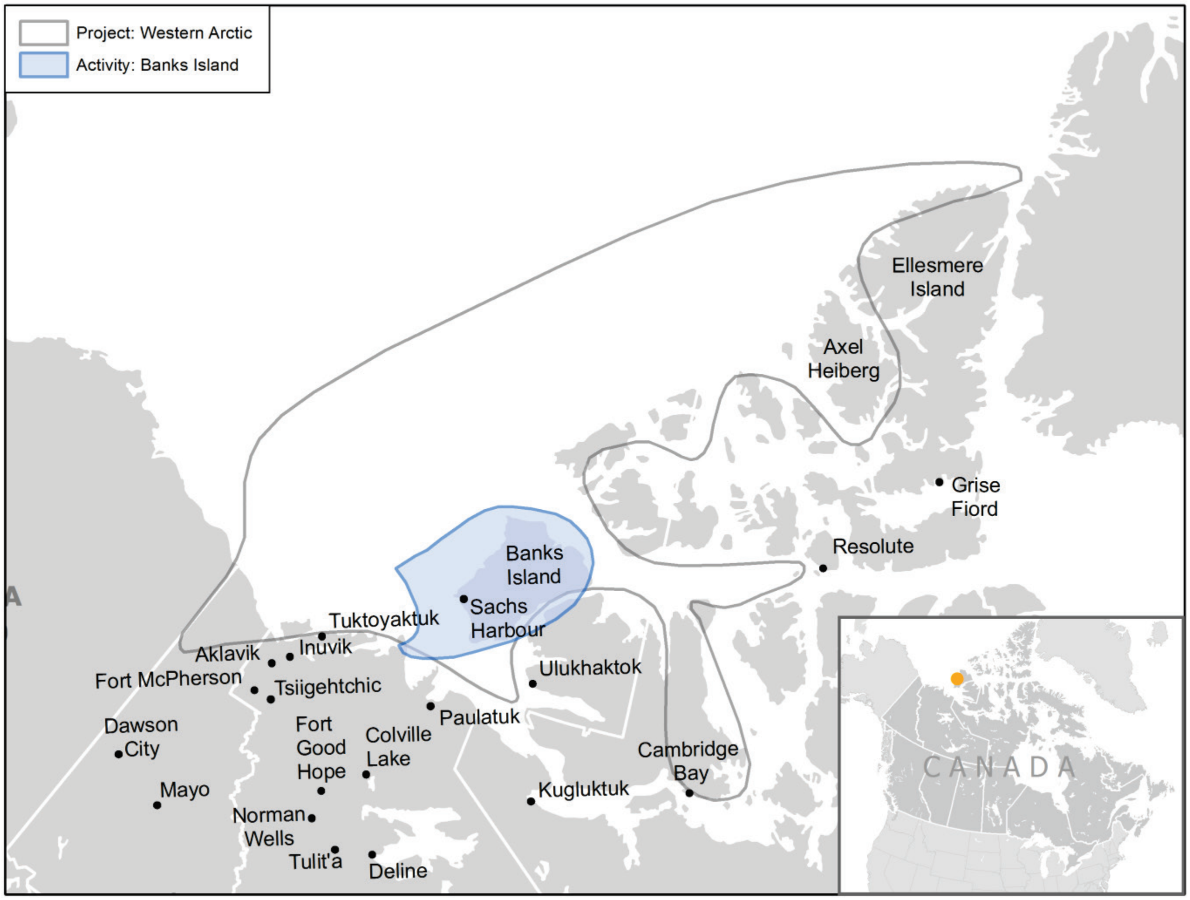

Figure 1: Basemap showing the geographic area of the GEM 2 Western Arctic Margins project (grey line) and the geographic location of the Banks Island activity (blue).

INTRODUCTION

This report provides palynologically-based age and paleoenvironment interpretations for samples submitted by GSC Research Scientists J.M. Galloway, K. Dewing, and I.R. Smith, and K. Piepjohn (BGR) in support of the Geo-mapping for Energy and Minerals Program (GEM-2), Western Arctic Project, from various locations on Banks Island.

Mesozoic and Cenozoic strata were targeted at the following locations on Banks Island: Nelson Head, Thomsen River, Able River, Antler Cove, Cape Vessey Hamilton, and various inland localities in the NE part of Banks Island. Strata in these localities were mapped previously as belonging to the Lower to Upper Cretaceous Isachsen, Christopher, Hassel, and Kanguk formations and the Cenozoic Eureka Sound Group by Miall (1979) (Fig. 2).

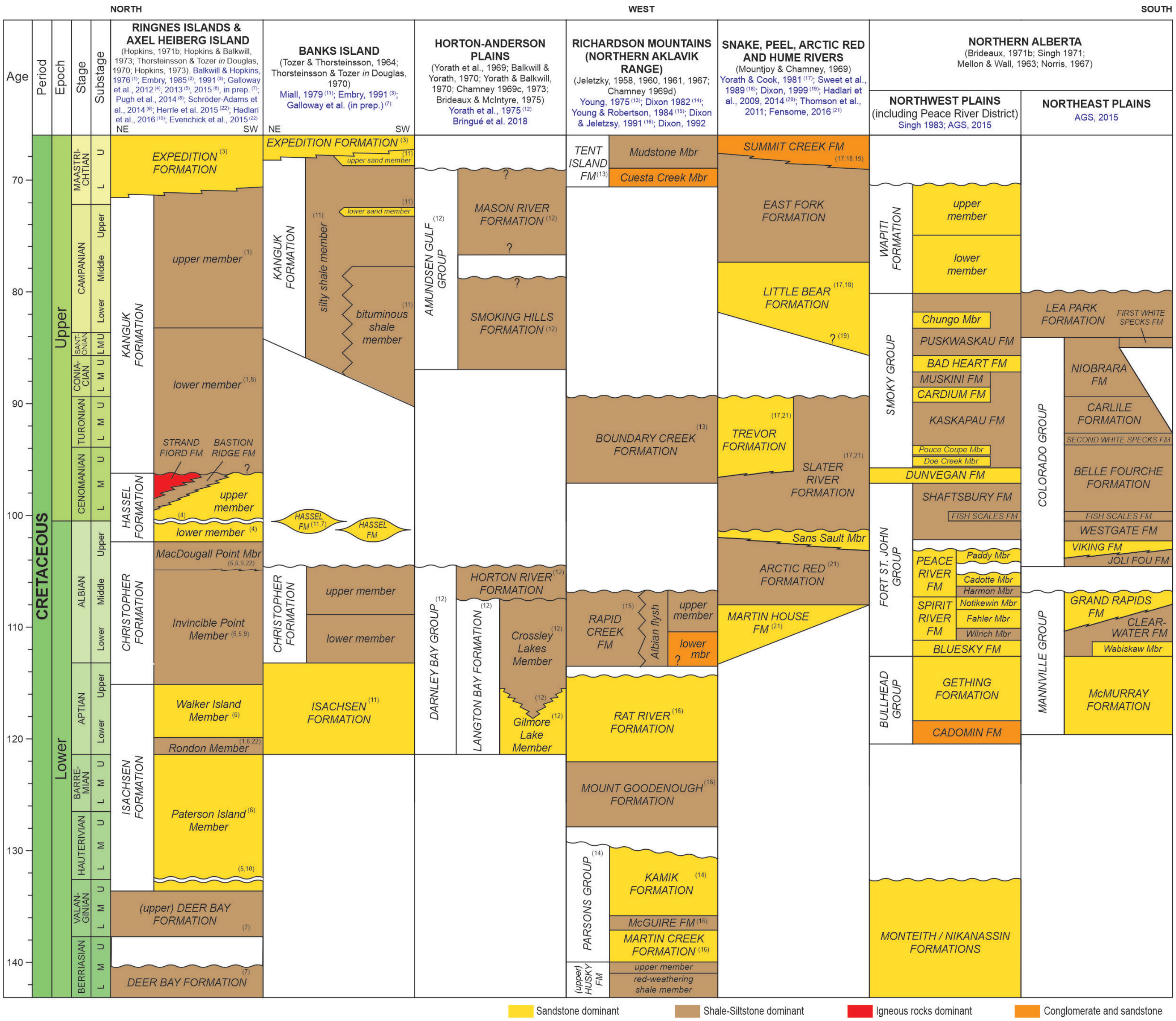

Figure 2: Lithostratigraphic column comparison of Arctic and sub-Arctic regions in Canada modified after Bringué et al. (2018) to be in accordance with the Geological Time Scale v 2020. See Bringué et al. (2018) for full list of references. The time scale is based on the Geological Time Scale v 2020, the Cretaceous System (Gale et al., 2020). For detailed summaries see references listed in the columns. Figure provided by M. Bringué, September, 2020.

METHODS

In July 2016, field operations were staged out of temporary base camps at Nelson Head on southeast Banks Island and Polar Bear Cabin on north-central Banks Island. One hundred and thirty-four samples of organic-rich mudrock from lithostratigraphic units of interest were sampled for palynological analyses (Table 1). Small trenches were dug to sample fresh material. Poorly consolidated material were collected in Ziploc bags. Samples were transported to the Geological Survey of Canada for curation in permanent collections.

Table 1: List of samples collected and herein analyzed for palynology from Banks Island in 2016. See Figure 3 for lithostratigraphic sections of samples where applicable. Full sample metadata available in Geological Survey of Canada's Sample Management System (SMS) database. See Appendix A for taxonomic authority of taxa mentioned in Table 1.

GSC Curation Number	Sample code	Meterage	Location	Station	Lithostratigraphic unit	Age interpretation based on terrestrial palynology	Notes
C-604570	16-GTA-F2	8m	Nelson Head (measured section)	16-DTA-07	Isachsen Formation	Early Cretaceous	Consistent with Isachsen Formation palynoflora
C-604573	16-GTA-F5	24.5m	Nelson Head (measured section)	16-DTA-07	Isachsen Formation	Early Cretaceous	Consistent with Isachsen Formation palynoflora
C-604583	16-GTA-F15	69.5m	Nelson Head (measured section)	16-DTA-07	Isachsen Formation		Effectively barren
C-604585	16-GTA-T2	3m	Thomsen River (measured section)	16-DTA-10	Christopher Formation	Indeterminate	Abundant dinocysts
C-604602	16-GTA-T20	n/a	Thomsen River (measured section)	16-DTA-10	uppermost? Christopher Formation	Late Albian	Scarce angiosperm pollen accords with assignment of this sample to the upper Christopher Formation
C-604607	16-GTA-06	n/a	Thomsen River (grab sample)	16-DTA-12	Christopher Formation	Albian	The occurrence of rare pollen from *Sciadopityspollenites* pollen provides some evidence for an Albian age. Scare dinocysts.
C-604612	16-GTA-G5	n/a	Glendonite bluffs (measured section)	16-DTA-13	unknown	Early Cretaceous	Rare *Caryapollenites* pollen is probably contamination; there are no other Cenozoic indicators. Dinocysts are scare
C-604618	16-GTA-14	5m	Baker Creek (measured section)	16-DTA-15	uppermost? Isachsen Formation	Early Cretaceous	The assemblage suggests an Early Cretaceous age with the exception of rare angiosperm pollen assigned to *Clavatipollenites*?, that is suggestive of a late Albian or younger age. This occurrence could be contamination. Dinocysts are scare.
C-604625	16-GTA-21	19.5	Baker Creek (measured section)	16-DTA-15	Christopher Formation	Early Cretaceous	Absence of angiosperm pollen precludes a more precise age determination. Dinocysts are rare.

C-604632	16-GTA-27	3m	Able River (measured section)	16-DTA-18	lowermost? Kanguk Formation	Late Cretaceous	Rare *Fraxinoipollenites* and *Retitricolpites* pollen are consistent with a Late Cretaceous age. Dinocysts are abundant.
C-604640	16-GTA-38	16m	Able River (measured section)	16-DTA-18	Kanguk Formation	Indeterminate	Algal dominated assemblage with few terrestrial palynomorphs.
C-604649	16-GTA-47	4.45m	Antler Cove (measured section)	16-DTA-19	Hassel Formation	Late Early Cretaceous	The occurrence of rare *Appendicisporites* spores points to a late Early Cretaceous age. Abundant dinocysts.
C-604652	16-GTA-50	8.4m	Antler Cove (measured section)	16-DTA-19	Kanguk Formation	Indeterminate	Absence of angiosperm pollen is unexpected in Kanguk Formation. Abundant dinocysts.
C-604668	16-GTA-70	1.3m	Not named (measured section)	16-DTA-21	unknown	Early Cretaceous	Absence of angiosperm pollen suggests an Early Cretaceous age. Rare dinocysts.
C-604669	16-GTA-71	2.10-2.15m	Not named (measured section)	16-DTA-21	unknown	Early Cretaceous	Rare Liliacidites suggests a late Albian or early Cenomanian age. Rare dinocysts.
C-604670	16-GTA-72	3.15m	Not named (measured section)	16-DTA-21	unknown	Early Cretaceous	Absence of angiosperm pollen suggests an Early Cretaceous age. Rare dinocysts.
C-604701	16-GTA-94	n/a	Cape Vessey Hamilton (grab sample)	16-DTA-27	Isachsen Formation	Indeterminate	Effectively barren of palynomorphs.
C-604707	16-GTA-100	n/a	Cape Vessey Hamilton (grab sample)	16-DTA-27	Isachsen Formation	Indeterminate	Abundant bisaccate pollen. Barren of dinocysts and algae.
C-604712	16-GTA-103	n/a	Eastern Banks Island (grab sample)	No station	unknown	Early Cretaceous	Absence of angiosperm pollen suggests an age no younger than middle or late Albian. Reworked Paleozoic palynomorphs are present. Rare dinocysts.
C-604713	16-GTA-104	n/a	Eastern Banks Island (grab sample)	No station	unknown	Early Cretaceous	Absence of angiosperm pollen suggests an age no younger than middle or late Albian. Rare dinocysts.
C-604718	16-GTA-108	n/a	Eastern Banks Island (grab sample)	No station	unknown	Indeterminate	Abundant bisaccate pollen. Barren of dinocysts and algae.

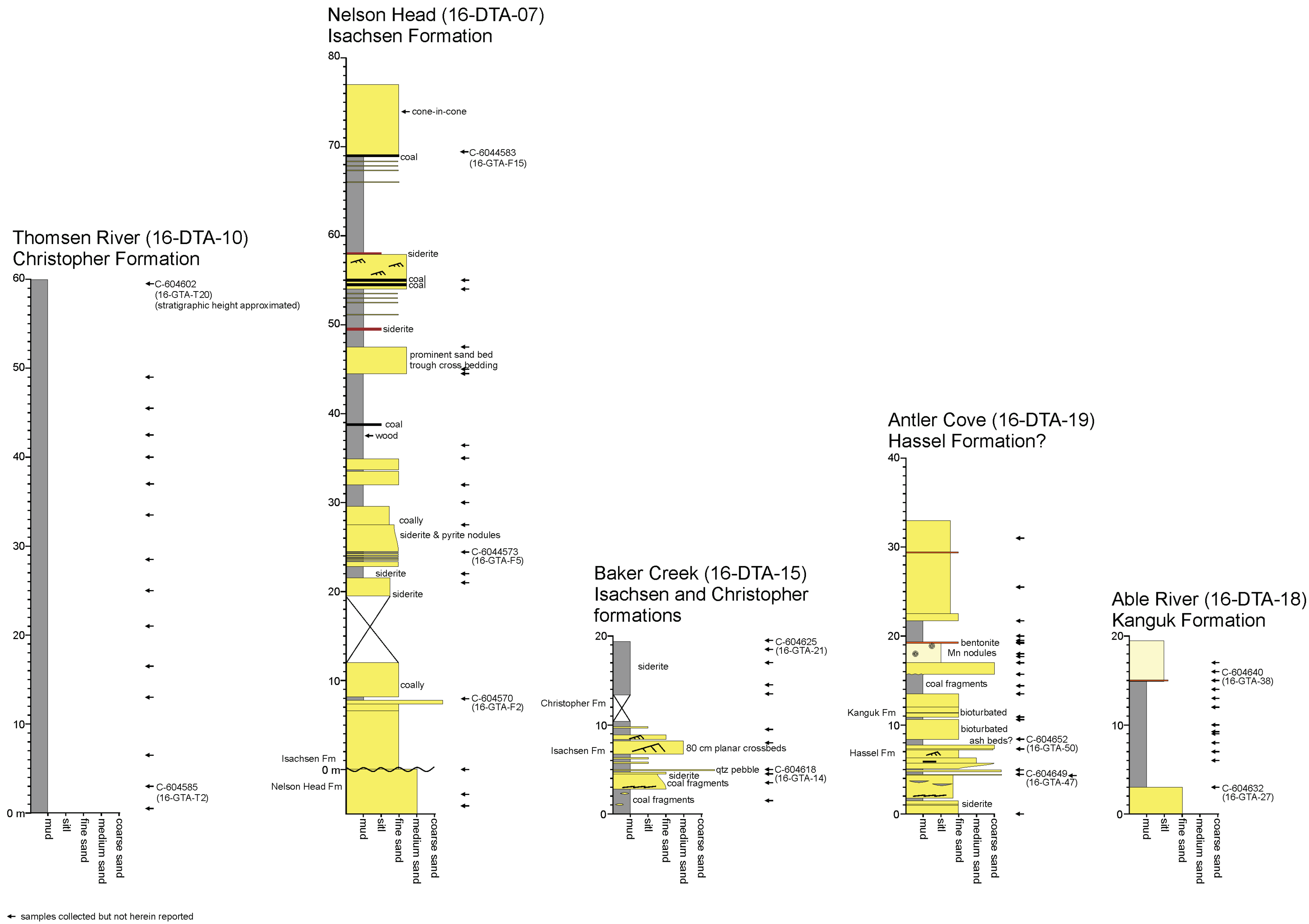
Thomsen River (16-DTA-10)
Christopher Formation
C-604602
(16-GTA-T20)
(stratigraphic height approximated)
C-604585
(16-GTA-T2)
Nelson Head (16-DTA-07)
Isachsen Formation
cone-in-cone
coal
C-6044583
(16-GTA-F15)
siderite
coal
coal
siderite
prominent sand bed
trough cross bedding
coal
wood
coally
siderite & pyrite nodules
C-6044573
(16-GTA-F5)
siderite
siderite
coally
C-604570
(16-GTA-F2)
Isachsen Fm
Nelson Head Fm
Baker Creek (16-DTA-15)
Isachsen and Christopher
formations
C-604625
(16-GTA-21)
siderite
Christopher Fm
Isachsen Fm
80 cm planar crossbeds
qtz pebble
C-604618
(16-GTA-14)
siderite
coal fragments
coal fragments
Antler Cove (16-DTA-19)
Hassel Formation?
bentonite
Mn nodules
coal fragments
Kanguk Fm
bioturbated
bioturbated
ash beds?
C-604652
(16-GTA-50)
Hassel Fm
C-604649
(16-GTA-47)
siderite
Able River (16-DTA-18)
Kanguk Formation
C-604640
(16-GTA-38)
C-604632
(16-GTA-27)
mud
silt
fine sand
medium sand
coarse sand
samples collected but not herein reported

Figure 3: Lithostratigraphy of selected measured sections. Arrows denote samples taken for palynology and other analyses. C-numbers and 16-GTA-sample numbers denote samples analyzed for palynology and reported on herein.

Palynological preparation and microscopy

Samples were prepared for palynology at the Geological Survey of Canada, Calgary Palynological Laboratory following standard procedures (Traverse, 2007). Briefly, samples were subjected to hot treatments of hydrochloric and hydrofluoric acids, oxidation with Schulze's solution, sieved, and stained with safranin O. Permanent mounts were made in liquid bioplastic. All materials are stored in the permanent collections of the Geological Survey of Canada. Refer to the Geological Survey of Canada's Canada Sample Management System (SMS) database for further information on samples.

Microscopy was conducted by J.M. Galloway using an Olympus BX61 transmitted light microscope at 400x and 1000x magnification under oil immersion. The botanical authority of identified taxa are provided at the end of this report in Appendix 1.

RESULTS

Sample Identification: Geological Survey of Canada Curation Number (C-number), sample collector number (16-GTA- for Galloway; 16-SUV for Smith, 16-DTA for Dewing), and the Palynology Laboratory at the Geological Survey of Canada Preparation Number (P-number). Legend: Rare (R) = 1-2, scarce (S) = 3-5, common (C) = 6-9, abundant (A) = +10. This format follows standard reporting for GSC Paleontology Palynology reports. The number of specimens encountered is not relative abundance, or per transect, but rather the number of specimens encountered during a subjective overview of the slide by the analyst. Thermal Alteration Index (TAI) was determined on preparations prior to oxidation (kerogen mounts) and is after Pearson (1984). England Finder coordinates are provided for biostratigraphically important specimens.

Nelson Head, Station 16-DTA-07

The objectives of fieldwork on southeastern Banks Island at Nelson Head were to look for kimberlite indicator minerals, kinematic indicators near faults in the vicinity of the Nelson Head graben, to examine the extent of the Upper Cretaceous Kanguk Formation and sample tuffs within it, and, relevant to this report, to measure and sample a section of the Lower Cretaceous Isachsen Formation for palynology-based age control (Smith et al., 2016).

The Isachsen Formation was deposited in marine, deltaic, and fluvial environments during the development of the adjacent Amerasia Basin (Embry and Dixon, 1990; Tullius et al., 2014; Hadlari et al., 2016) and contains the break-up unconformity and post-rift deposits of the Jurassic-Cretaceous rift succession of the Sverdrup Basin (Hadlari et al., 2016). The Isachsen Formation extends south of the Sverdrup Basin and is found on Banks Island and in the adjacent offshore. Deposition of the lowermost part of the Isachsen Formation in the Sverdrup Basin is contemporaneous with the first main pulse of the High Arctic Large Igneous Province (HALIP) at ca. 122 Ma (Dockman et al., 2018). Study of the Isachsen Formation on Banks Island will provide insight into the timing of the development of the Amerasia Basin and the Arctic Ocean, and the likely diachronous deposition of this unit on Banks Island. The Isachsen Formation is also of interest from a natural resource perspective. It may contain KIMs that can be repeatedly reworked and thus confound the interpretation of KIM transport and location of kimberlite source.

At Nelson Head, the basal beds of the Isachsen Formation examined herein unconformably overlies Proterozoic Nelson Head Formation (Miall, 1979; Rainbird et al., 1994) and consist of interbedded fine sand, mudstone and coal. The age of basal Isachsen Formation strata at Nelson Head are not known. Samples were collected from this locality to determine if the Isachsen Formation on southern Banks Island has a contemporaneous history to Isachsen Formation strata of the Sverdrup Basin where a sub-Hauterivian unconformity is interpreted as the break-up unconformity (Galloway et al., 2015; Hadlari et al., 2016).

At the Nelson Head locality, station 16-DTA-07, twelve samples of organic-rich rocks from a 77 m section were sampled for palynology to assess the age of the rocks and to confirm their assignment to the Isachsen Formation. Three samples were analyzed for palynology and herein reported: C-604570, C-604573 and C-604583.

C-604570, 16-GTA-F2; 8m

Sample C-604570 was collected from organic-rich mudrock immediately overlying conglomerate mapped as Isachsen Formation. The Thermal Alteration Index is 1.

P5372-2B (unsieved)

Pollen

Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (C)
Cupressaceae-Taxaceae (S)
Cycadopites follicularis (R)
Laricoidites magnus (R
Perinopollenites elatoides (S)
Podocarpidites (R)
Vitreisporites pallidus (R)

Spores

Baculatisporites comaumensis (R)
Cicatricosisporites cf. *C. potomacensis* (R)
Deltoidospora psilostoma (A)
Dictyophyllidites harisii (R)
Gleicheniidites senonicus (C)
Laevigatosporites ovatus (R)
Todisporities major (R)

Non-pollen palynomorphs

None

C-604573, 16-GTA-F5; 24.5m

The sample was collected from a siltstone layer with minor sand overlying a fine-grained sandstone succession. Overlying is a fining upward succession into interbeds of fine sand and siltstone that contain siderite concretions, pyrite nodules, and coalified and permineralized wood. The succession also contains wood that appears to be barely altered. The Thermal Alteration Index is 2.

P5372-5B (unsieved)
Pollen
Araucariacites australis (R)
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cycadopites follicularis (R)
Laricoidites magnus (R)
Perinopollenites elatoides (C)
Spores
Baculatisporites comaumensis (R)
Cicatricosisporites annulatus (R)
Concavissimisporites variverrucatus (R)
Deltoidospora hallei (A)
Deltoidospora juncta (R)
Gleicheniidites senonicus (A)
Laevigatosporites ovatus (S)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (R)
Stereisporites antiquasporites (R)
Non-pollen palynomorphs
Nil

C-604583, 16-GTA-F15; 69.5m

This sample was collected from a thin organic-rich horizon within a sandstone dominant succession. Near the top of the 77 m measured section, at 73.5 m, cone-in-cone features were noted in scree associated with the very fine sandstone that occurs at the top of the measured exposure. The preparation has a high abundance of refractory organic matter and a low abundance of palynomorphs. The TAI is 3.

P5372-12B (unsieved)
Pollen
Nil
Spores
Deltoidospora hallei (S)
Stereisporites antiquasporites (S)
Gleicheniidites senonicus (R)
Non-pollen palynomorphs
Nil

Comments on samples collected at station 16-DTA-07 at Nelson Head

Only two of the three preparations from samples from this section were productive for palynomorphs (C-604570 and C-604573). The preparations of these two samples contain abundant undifferentiated bisaccate pollen. *Perinopollenites elatoides* pollen is common in C-604573. Other common constituents include *Cerebropollenites mesozoicus* pollen (common in C-604570 and scarce in C-604583). The assemblages preserved in preparations of the two productive samples from Nelson Head can be considered representative of the *Cerebropollenites* Province of the northern hemisphere (Herngreen et al., 1996) and are generally similar to an assemblage described from Isachsen Formation on Ellef Ringnes Island in the central Sverdrup Basin (Galloway et al., 2015). Long-ranging pollen and spore types that characterize the *Cerebropollenites* Province (e.g., *Gleicheniidites, Cicatricosisporites*, *Araucariacites, Inaperturopollenites, Perinopollenites, Classopollis*, and *Cerebropollenites mesozoicus*) are unhelpful in providing a more precise age than Early Cretaceous based on known age ranges of these taxa alone. Many taxa found in the province are common to Late Jurassic floras (Herngreen et al., 1996), with the addition of certain taxa (e.g., *Aequitriradites, Cicatricosisporites* and *Ruffordiaspora, Trilobosporites*, and *Foveosporites subtriangularis*) that are indicative of a Cretaceous age (Venkatachala and Kar, 1970; Hopkins, 1971; Bose and Banerji, 1984; Taugourdeau-Lantz, 1988).

Thomsen River, Stations 16-DTA-10, 16-DTA-12, and 16-DTA-13

Several outcropping sections were visited in the vicinity of Thomsen River to observe the successions mapped as Christopher Formation by Miall (1979). These units were sampled to confirm their assignment to the Christopher Formation and for comparison of microfossil assemblages to those preserved in the Christopher Formation of the Sverdrup Basin.

Samples were collected from three localities in the vicinity of Thomsen River.

Station 16-DTA-10

The first locality is station 16-DTA-10 at an outcropping of black organic-rich mudrock along the north side of a river that flows west into the Thomsen River. The thickness of the continuous measured section of this outcrop was 59 m. The succession contained numerous poorly preserved ammonites, siderite concretions, and possible ash horizons. This exposure is mapped by Miall (1979) as part of the Christopher Formation. In the Sverdrup Basin (Axel Heiberg Island) the Christopher Formation spans from late Aptian to the late Albian in age (Schröder-Adams et al., 2014; Herrle et al., 2015). From station 16-DTA-10, 16 samples of organic-rich bedrock were collected for palynology and two are herein analyzed for palynology to confirm assignment to the Christopher Formation.

C-604585, 16-GTA-T2; 3m

Sample C-604585 was collected 3 m above the base of the exposed section (contact with underlying lithostratigraphic unit not exposed). The Thermal Alteration Index is 1.

P5372-13B (unsieved)

Pollen

Bisaccate pollen undifferentiated (A)

Cerebropollenites mesozoicus (R)

Cupressaceae-Taxaceae (S)
Cycadopites follicularis (R)
Laricoidites magnus (R)
Spores
Baculatisporites comaumensis (S)
Cicatricosisporites (R)
Deltoidospora hallei (R)
Gleicheniidites senonicus (R)
Leptolepidites verrucatus (R)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (S)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (A)
Veryhachium (R)

P5372-13E (-20 µm)
Barren of angiosperm pollen

C-604602, 16-GTA-T20, no meterage

Sample C-604602 was collected from a succession of mudstone and siltstone interbedded with fine sand at the same outcropping exposure as sample C-604585, from near the top of the exposure. Here, bedding was not discernible and the material was unlithified. The sample was collected from the gradational contact of mudstone to overlying sandstones, potentially of the Hassel Formation. The Hassel Formation is a quartz sandstone-dominated unit with interbedded siltstone and mudstone distributed widely across the Sverdrup Basin of the Canadian Arctic Archipelago. Due to the nature of the outcrop at this exposure at Thomsen River, the contact between the putative Christopher and Hassel formations was not precisely discernable. The Thermal Alteration Index is 1.

P5372-27B (unsieved)
Pollen
Bisaccate pollen undifferentiated (C)
Cupressaceae-Taxaceae (C)
Cerebropollenites mesozoicus (S)
Retitricolpites or *Liliacidites* (S)
Spores
Baculatisporites comaumensis (S)
Camarozonosporites insignis (R)
Cingutriletes clavus (R)
Deltoidospora hallei (S)
Gleicheniidites senonicus (C)
Ornamentifera (R)
Osmundacidites wellmannii (S)
Plicifera dicarpoides (R)
Retitriletes austroclavatidites (R)
Stereisporites antiquasporites (R)

Undulatisporites undulapolus (R)
Non-pollen palynomorphs
Acritarch undifferentiated (R)
Dinoflagellate cyst undifferentiated (R)

Comments on samples collected at Station 16-DTA-10 from Thomsen River

In the sample collected from near the base of the exposure, C-604585, an abundance of dinoflagellate cysts (undifferentiated) and poorly preserved ammonites in the geological section confirms deposition in a marine environment. A marine depositional environment is consistent with this unit being assigned to the Christopher Formation. In both samples, angiosperm pollen is absent. See Galloway et al. (2012) for a full discussion on the low abundance and diversity of angiosperm pollen in the Canadian Arctic relative to lower latitude and other high latitude areas. An absence of angiosperm pollen from preparations of samples C-604585 and C-604602 is therefore not useful for authenticating this unit as Christopher Formation or not. While the earliest angiosperm pollen (tricolpate) in the Sverdrup Basin are documented in the (probable mid to upper) Christopher Formation (Hopkins, 1974), the abundance of these pollen types remain low well into Cenomanian-aged strata (Galloway et al., 2012). Plauchut and Jutard (1976) reported "very rare" tricolpate angiosperm pollen from the late Albian?-Cenomanian-aged Hassel Formation exposed at Castel Bay, northern Banks Island but report an absence of angiosperm pollen from samples collected from Hassel Formation to the immediate south of the Castel Bay locality (in the vicinity of sample C-26392 in Miall, 1979).

Station 16-DTA-12

Samples were also collected from a locality (station 16-DTA-12) on the south side of the valley from station 16-DTA-10 at Thomsen River. Two samples were collected from station 16-DTA-12 for palynology (C-604606 and C-604607). Sample C-604607 was collected from an isolated outcropping of black mudstone. The small exposure contained stellate nodules interpreted in the field to be glendonites, fossilized wood, a shell hash bed, and various isolated fossils. The mudstone sample C-604607 was collected for palynology at the same horizon as a glendonite occurrence. Based on the presence of glendonites, wood, close proximity to a succession mapped as Christopher Formation, it was interpreted in the field that this outcrop was an exposure of Christopher Formation. The sample C-604607 was collected for palynology to confirm this.

C-604607, 16-GTA-06

The Thermal Alteration Index is 1.

P5372-29B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cupressaceae-Taxaceae (S)
Cycadopites follicularis (S)
Laricoidites magnus (R)
Perinopollenites elatoides (S)
Sciadopityspollenites (R)
Spores

Baculatisporites comaumensis (R)
Deltoidospora hallei (A)
Deltoidospora psilostoma (R)
Gleicheniidites senonicus (S)
Leptolepidites verrucatus (R)
Lycopodiumsporites cf. *L. crassimacerius* (R)
Microreticulatisporites uniformis (R)
Retitriletes austroclavatidites (R)
Ruffordiaspora australiensis (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (S)

Comments on samples collected from 16-DTA-12 at Thomsen River

The occurrence of rare pollen from *Sciadopityspollenites* provides some evidence for an Albian age. An abundance of this pollen taxon, however, has been used to argue a Cenomanian age for the Hassel Formation (Galloway et al., 2012), although this pollen type is long-ranging. The unit appeared to have been deposited in a marine setting in the field based on lithology and the occurrence of glendonites and the shell hash bed that contained pelecypods. It is therefore unexpected that the preparation contained only scarce dinoflagellate cysts. The scarcity of dinoflagellate cysts could be a product of poor preservation.

Station 16-DTA-13

An isolated outcropping (14 m measured) of sandstone with rare interbeds of organic-rich mudstone was found at station 16-DTA-13 (Figs. 4, 5). The sandstone contains planar cross-bedding, small scale ripple beds, shell hash beds, and massive white sandstone units. The succession also contains abundant stellate nodules assumed in the field to be glendonites preserved in the sandstone as well as permineralized wood and wood fragments. This succession, was informally referred to by the field party as “glendonite bluffs”. Stellate nodules were sampled at 5.8 m above the base of the exposure. Five samples were collected from this locality for palynology, and a preparation from C-604612 is herein analyzed. This sample was collected from the top of the sandstone unit in the organic-rich material that is directly overlain by the sand unit containing stellate nodules.

Figure 4: Photograph of stellates nodule at station 16-DTA-13. The prominent nodule in the left of the photograph is approximately 6 cm in diameter. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-400.

Figure 5: Photograph of the outcropping at station 16-DTA-13 showing stellate nodules in poorly lithified sandstone. Ice axe is 80 cm in length. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-401.

Sample C-604612, 16-GTA-G5

The TAI is 1.

P5372-30B (unsieved)

Pollen

Araucariacites australis? (R)
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cupressaceae-Taxaceae (A)
Cycadopites follicularis (S)
Laricoidites magnus (R)
Podocarpidites (R)
Triporate pollen, possibly *Caryapollenites* (R)

Spores

Deltoidospora hallei (S)
Gleicheniidites senonicus (S)
Neoraistrickia truncata (R)
Osmundacidites wellmannii (R)
Todisporities major (R)

Undulatisporites undulapolus (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (S)
Veryhachium (R)

P5372-30E (-20 µm)
Barren of angiosperm pollen

Comments on sample C-604612 collected from station 16-DTA-13 from Thomsen River

The presence of rare *Caryapollenites* pollen could be contamination, as there are no other occurrences of angiosperm pollen, including in the -20 µm fraction. The assemblage contains no age-diagnostic taxa and can be considered a typical Early Cretaceous assemblage (e.g., Galloway et al., 2015). This accords with mapping of the locality as Isachsen Formation by Miall (1979). If the unit is indeed Isachsen Formation, this will be the first report, to the best of the authors knowledge, of stellate nodules in this unit. Rogov and Zakharov (2010) summarize glendonite occurrences in Upper Jurassic to Lower Cretaceous strata and highlight that they occur in almost every stage of the Lower Cretaceous, including the Hauterivian (e.g., western Siberia; Potapova, 2006). They re-interpret documentation of 'Valanginian' glendonites from Svalbard (Price and Nunn, 2010) to be upper Hauterivian in age based on their collections.

Baker Creek, Station 16-DTA-15

Nineteen and a half metres of outcrop were measured, described and sampled at 16-DTA-15. The lithology of the outcrop is generally fining upward from a basal very fine sand to mudrock. A horizon of sub-rounded pebbles up to 3 cm at their largest dimension occur at 5 m in the section. Ten samples of organic-rich material was collected from the section for biostratigraphic age control. It was interpreted in the field that the contact between the Isachsen Formation and overlying Christopher Formation likely occurred between 10 and 13 m. Two of the 10 samples collected were analyzed and reported herein for palynology. These samples are C-604618 and C-604625.

C-604618, 16-GTA-14; 5m

The TAI is 1 to 1+.

P5372-35B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (C)
Classopollis classoides (A)
Clavatipollenites (R)
Cupressaceae-Taxaceae (A)
Cycadopites follicularis (R)
Ephedripites (R)
Laricoidites magnus (C)
Perinopollenites elatoides (R)
Vitreisporites pallidus (R)

Spores
Acanthotriletes varispinosus (R)
Baculatisporites comaumensis (R)
Biretisporites potoniaei (R)
Cicatricosisporites cf. *C. auritus* (R)
Cicatricosisporites hughesii (R)
Contignisporites (R)
Cyathidites australis (R)
Cyathidites minor (R)
Deltoidospora hallei (A)
Gleicheniidites senonicus (C)
Granulatisporites (S)
Leptolepidites verrucatus (R)
Lycopodiumsporites (R)
Lycopodiumsporites expansus (R)
Osmundacidites wellmannii (C)
Retitriletes austroclavatidites (R)
Ruffordiaspora australiensis (S)
Stereisporites antiquasporites (R)
Trilobosporites apiverrucatus (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (S)
Oligosphaeridium anthroporum-type (R)
Pterospermella (R)

P5372-35E (-20 µm)
Pollen
Angiosperm pollen?
Spores
Nil
Non-pollen palynomorphs
Nil

C-604625, 16-GTA-21; 19.5m
The TAI is 2.

P5372-42B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (A)
Classopollis classoides (R)
Cupressaceae-Taxaceae (A)
Cycadopites follicularis (S)
Laricoidites magnus (R)
Perinopollenites elatoides (R)
Podocarpidites (R)

Spores
Biretisporites potoniaei (R)
Cyathidites australis (R)
Deltoidospora hallei (S)
Densoisporites (R)
Densoisporites microrugulatus (R)
Foraminisporis wonthaggiensis (R)
Foveosporites (R)
Gleicheniidites senonicus (C)
Granulatisporites (R)
Leptolepidites verrucatus (S)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (R)
Retitriletes austroclavatidites (S)
Ruffordiaspora australiensis (R)
Stereisporites antiquasporites (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated, possibly *Oligosphaeridium* (R)
Pediastrum (R)

Comments on samples collected from station 16-DTA-15 at Baker Creek

Preparations of samples C-604618 and C-604625 contain well preserved and diverse palynomorphs. *Clavatipollenites* first appears in the Barremian-lower Aptian of the Great Artesian Basin of Australia (Burger, 1993). However, this taxon is not documented to occur in age-equivalent strata of the Christopher Formation from the Canadian Arctic (Hopkins, 1974). This single specimen could be contamination. Hopkins (1974) analyzed spores and pollen from basal seismic shothole samples from Ellef Ringnes and Amund Ringnes islands and northwestern Melville Island. He documents the first occurrence of angiosperm pollen in the upper part of the Christopher Formation that he interprets to be mid to late Albian in age. The taxa he describes are *Tricolpites* sp. A and *Tricolpites* sp. B. These are tricolpate pollen from early dicotyledenous angiosperms in Arctic Canada. If the Christopher Formation material sampled in C-604618 and C-604625 were from the lower or even middle part of the formation, the absence of angiosperm pollen accords with the previous work of Hopkins (1974). The presence of rare *Pediastrum* in sample C-604625 is an unusual finding as it suggests a lacustrine (freshwater) environment or transport from such an environment into a marine setting.

Able River, Station 16-DTA-18

A locality near Able River, station 16-DTA-18, was visited to measure and sample an outcrop of Kanguk Formation. At this location, 17 m of outcrop was measured. The lower 3 m are composed of very fine sand, putatively of the Hassel Formation. From 3 to 15 m the lithology consists of black to grey mudrock with numerous thin tuff layers, interpreted as the basal bituminous unit of the Kanguk Formation. At 8 m a ~10 cm thick unit is highly weathered and contains bivalves. A prominent white bentonite bed, ~50 cm thick, occurs at 15 m. This is overlain by light grey silty shale to the top of the outcrop. Fourteen samples of mudrock were collected for palynology. The outcrop at this locality was clearly folded (see Fig. 7 of Piepjohn et al., 2018). Age dating of this outcrop may improve the understanding of the timing of deformation that produced the fold. Two samples (C-604634 and C-604640) from locality 16-DTA-18 were analyzed for palynology and reported herein.

C-604632, 16-GTA-27; 3m

The TAI is 0.

P5372-46B (unsieved)

Pollen

Bisaccate pollen undifferentiated (S)
Cupressaceae-Taxaceae (A)
Fraxinoipollenites (R)
Perinopollenites elatoides (S)
Retitricolpites (R)
R. vulgaris (R)

Spores

Baculatisporites comaumensis (R)
Biretiesporites potoniaei (R)
Cingulate spore cf. *Cingutriletes* (R)
Deltoidospora hallei (R)
Lycopodiumsporites (R)

Non-pollen palynomorphs

Dinoflagellate cyst undifferentiated (A)
Cymatiosphaera (R)
Leiosphaeridia (A)
Pterospermella (A)

C-604640, 16-GTA-38; 16m

The TAI is 0.

Algal dominated preparation in P5372-53B (unsieved) with few to no terrestrial palynomorphs.

Comments on samples collected from station 16-DTA-18 at Able River

Sample C-604632 has a very low TAI but the preparation is also highly oxidized. This sample contains a diversity of pollen with affinities to coniferous trees as well as rare angiosperm pollen. *Retitricolpites* pollen is documented in the Hassel Formation of late Albian to Cenomanian age in the Sverdrup Basin (Núñez-Betelu et al., 1994; Galloway et al., 2012). Doerenkamp et al. (1976) and Plauchut and Jutard (1976) reported "very rare" tricolpate angiosperm pollen from Hassel Formation (Albian) at Castel Bay, northern Banks Island. The oldest known occurrence of *Fraxinoipollenites* pollen is documented in Alberta from Maastrichtian-aged Scollard Localities 1, 2, & 18 (= Scollard Localities 1, 2, &18, collection on the high banks of the Red Deer River, about 5 miles west of Scollard hamlet (Edmonton)) (Srivastava, 1966). Payenberg et al. (2002) report this genus in Sanotian to early Campanian-aged rocks of the Milk River Formation of southern Alberta and in early Campanian-aged rocks of the Eagle Formation in Montana. Questionable *?Fraxinoipollenites* pollen occurs in upper Albian rocks of the Great Artesian Basin of Australia (Burger, 1993). *Fraxinoipollenites* (as *F. staplini*) is documented by Núnez-Betelu and Hills (1994) at sections at Glacier Fiord and Bay Fiord. These sections are interpreted as including the Hassel, Bastion Ridge, and Kanguk formations and lowermost Eureka Sound Group, but their palynological sample numbers do not correspond with meterages of sample numbers listed in their Open File, so it is not possible to precisely say which unit the samples containing *Fraxinoipollenites* pollen came from. The Hassel Formation at the Glacier Fiord locality is late Albian in age (Schröder-Adams et al., 2014). In the Bonnet Plume Formation of the Yukon, an assemblage containing *Fraxinoipollenites* (*F. variabilis*) along with other angiosperm pollen, is considered to be Paleocene in age by Rouse and Srivastava (2011). Abundant dinoflagellate cysts in sample C-604632 suggest a marine depositional setting.

Antler Cove, Station 16-DTA-19

Locality 16-DTA-19 (74-MLA-44 of Miall) was visited to examine what had been mapped as Hassel Formation and Kanguk Formation. A 30.1 m section was measured, described, and sampled (Fig. 6). The contact of Kanguk Formation with underlying Hassel Formation was exposed. The lithology of the basal unit is lithified very fine sandstone that weathers dark grey to reddish from 0 to 7.3 m (presumably Hassel Formation). Mottled sandstone is present from 7.3 to 10.6 m. From 10.6 m upward (Kanguk Formation) the strata consists of mudrock with notable spheroidal manganese? concretions at 18 m and 19.2 m. A possible tuff layer occurs at 19.3 m. A thin ash bed occurred at 29.4 m. Above this level, siltstone to very fine sandstone beds occur. Seventeen samples were collected for palynology. Two samples (C-604649 and C-604652) was analyzed for palynology.

Figure 6: Photo of Kanguk Formation outcrop at station 16-DTA-19. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-402.

C-604649, 16-GTA-47; 4.45m
The TAI was not measured

P5372-61B (unsieved)
Pollen
Bisaccate pollen undifferentiated (S)

Cupressaceae-Taxaceae (C)
Spores
Appendicisporites (R)
Baculatisporites comaumensis (R)
Cicatricosisporites (R)
Cingutriletes distaverrucatus (C)
Deltoidospora hallei (R)
Dictyophyllidites harisii (R)
Distaltriangularisporites perplexus (S)
Gleicheniidites senonicus (S)
Neoraistrickia truncata (R)
Osmundacidites wellmannii (R)
Stereisporites antiquasporites (R)
Non-pollen palynomorphs
Algal cyst undifferentiated (R)
Dinoflagellate cyst undifferentiated (A)
Oligosphaeridium (R)

C-604652, 16-GTA-50; 8.4m
The TAI is 0 in this exceptionally well preserved preparation.

P5372-64B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cupressaceae-Taxaceae (A)
Laricoidites magnus (R)
Sciadopityspollenites (R)
Spores
Acanthotriletes varispinosus (R)
Baculatisporites comaumensis (C)
Cicatricosisporites (R)
Cingutriletes clavus (R)
Deltoidospora hallei (S)
Foveosporites (R)
Gleicheniidites senonicus (A)
Laevigatosporites ovatus (S)
Leptolepidites verrucatus (R)
Lycopodiumsporites (R)
Lycopodiumsporites canaliculatus (R)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (S)
Retitriletes austroclavatidites (R)
Ruffordiaspora australiensis (R)
Non-pollen palynomorphs
Cavate dinoflagellate cyst (R)

Dinoflagellate cyst undifferentiated (A)

Comments on samples from station 16-DTA-19 at Antler Cove

The palynoassemblage preserved in preparations from samples C-604649 and C-604652 do not seem to accord with identification of these strata as belonging to the Kanguk Formation (cf. Núñez-Betelu and Hills, 1994). In Upper Cretaceous strata of the Sverdrup Basin and Horton River area of the Northwest Territories, a diversity of angiosperm pollen and dinocysts are reported (McIntyre, 1974; Núñez-Betelu and Hills, 1994). The absence of angiosperm pollen in preparations of samples C-604649 and C-604652 alone would suggest that the strata sampled belong to the Christopher Formation where a paucity of angiosperm pollen occur (Galloway et al., 2012). However, the abundance of dinocysts in the samples accords with a Kanguk Formation assignment. Dinocyst identification and evaluation of palynomorphs in the <20 µm fraction of the preparation will be the focus of future study to confirm the age of strata sampled at station 16-DTA-19.

Northern coast of Banks Island, Station 16-DTA-21

A sample was collected for palynology from the northern coast of Banks Island at station 16-DTA-21. This locality is at a section mapped as Tertiary and containing abundant stellate nodules in the outcrop and scree. Miall (1979) collected pelecypods from this locality that were not age diagnostic as reported by Jeletzky in Miall (sample C-26195). Abundant bivalves are preserved in the scree at the base of the section at the coastline. A 3.90 m section was measured and samples for palynological analyses and stellate nodules, interpreted by visual observation in the field to be glendonite, were collected (Figs. 7, 8). The small exposure begins with buff quartzite (0-1.20 m) overlain by siltstone with sandstone interbeds (1.20-1.80 m). From 1.80 m to 2.10 m a thick sandstone with cross-beds and planar bedding containing stellate nodules is present. From 2.10 m to 2.15 m an organic rich mudstone occurs and was sampled for palynology (C-604669; 16-GTA-71). From 2.15 to 2.20 a layer of white sand occurs overlain by a mudstone interval interbedded with sand. From 2.30-2.70 m a bed of fine sand with interbeds of mudstone and with stellate nodules occurs. Overlying this is mottled sand, interbedded with mudstone between 2.90-2.95, mottled sandstone from 2.95-3.15 m, black mud from 3.15-3.20, yellow sand topped with stellate nodules from 3.20-3.40 m. An *Ophiomorpha*? burrow occurs at 3.30 m. Mudstone intebedded with sand from 3.40-3.50 m and sandstone with mud drapes from 3.50-3.60 m. Near the top of the succession at 3.60 m stellate nodules occur in mudstone. From 3.60 m to the top of the exposure at 3.90 m mottled mudstone with sandstone containing stellate nodules occurs. Samples C-604673 (2.50 m), C-604672 (3.80 m), C-604671 (3.40 m), C-604670 (31.50 m) are samples for palynology (Table 1) that also contain stellate nodules collected at the same horizon. This locality was mapped by Miall (1979) as Tertiary. At the immediate coast down from the aforementioned outcrop, stellate nodules in sandstone scree and pelecypods occur (Figs.9, 10).

Figure 7: Photo of the outcrop at station 16-DTA-21. Increments on Jacob's staff are 10 cm. Photograph by J.M. Galloway. NRCan photo NRCan Photo Database Number 2020-403.

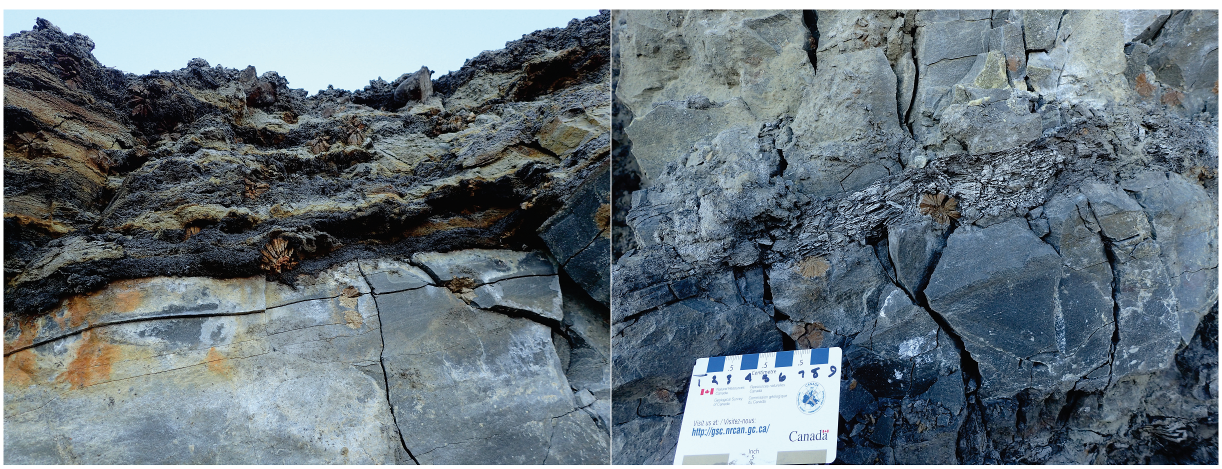

Figure 8: Top Right, photo of stellate nodules in poorly lithified sandstone at station 16-DTA-21. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-404. Top Left, photo of stellate nodules in poorly lithified sandstone at station 16-DTA-21. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-405. Bottom, photo of stellate nodule in poorly lithified sandstone at station 16-DTA-21. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-406.

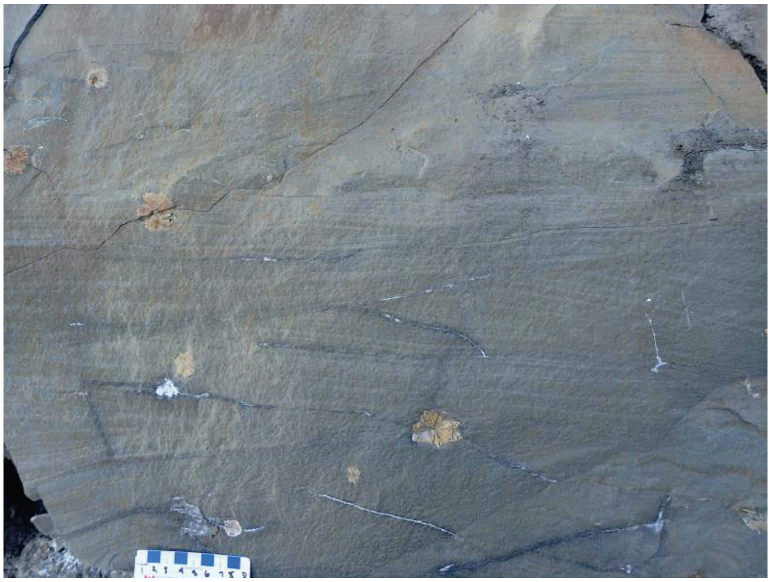

Figure 9: Stellate nodules in lithified sandstone scree at station 16-DTA-21. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-407.

Figure 10: Pelecypods in lithified sandstone scree at station 16-DTA-21. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-408.

The following samples from 16-DTA-21 were analyzed for palynology.

C-604668, 16-GTA-70; 1.3m

The TAI is 1+ to 2 and the preparation contains abundant lignite and inertinite.

P5372-77B (unsieved)

Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (R)
Cupressaceae-Taxaceae (S)
Cycadopites follicularis (S)
Perinopollenites elatoides (R)
Sciadopityspollenites (C)
Spores
Baculatisporites comaumensis (R)
Biretisporites potoniaei (R)
Cyathidites australis (R)
Deltoidospora hallei (S)
Dictyophyllidites harisii (S)
Gleicheniidites senonicus (S)
Osmundacidites wellmannii (R)
Retitriletes austroclavatidites (R)
Spore undifferentiated (R)
Stereisporites antiquasporites (S)
Verrucate cingulate spore (S)
Non-pollen palynomorphs
Oligosphaeridium complex-type (R)

P5372-77E (-20 µm)
Barren of angiosperms

C-604669, 16-GTA-71; 2.10-2.15m
The TAI is 1 to 2+ and the preparation contains abundant refractory organic matter.

P5372-78B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cycadopites follicularis (C)
Cupressaceae-Taxaceae (A)
Liliacidites (R)
Sciadopityspollenites (S)
Spores
Baculatisporites comaumensis (R)
Cyathidites australis (R)
Deltoidospora hallei (A)
Gleicheniidites senonicus (S)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (R)
Stereisporites antiquasporites (S)
Non-pollen palynomorphs
Acritarch undifferentiated (R)

Dinoflagellate cyst undifferentiated (R)
Veryhachium (R)

P5372-78E (-20 µm)
Barren of angiosperms
Pollen
Classopollis classoides (R)
Spores
Nil
Non-pollen palynomorphs
Nil

C-604670, 16-GTA-72; 3.15m
The TAI is 1.

P5372-79B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (A)
Classopollis classoides (R)
Cupressaceae-Taxaceae (S)
Cycadopites follicularis (C)
Dictyophyllidites harisii (S)
Laricoidites magnus (S)
Sciadopityspollenites (R)
Spores
Baculatisporites comaumensis (S)
Biretisporites potoniaei (R)
Cicatricosisporites (R)
Cingutriletes clavus (R)
Cyathidites australis (R)
Deltoidospora hallei (C)
Gleicheniidites senonicus (S)
Laevigatosporites ovatus (R)
Leptolepidites verrucatus (R)
Microreticulatisporites uniformis (R)
Osmundacidites wellmannii (C)
Retitriletes austroclavatidites (R)
Stereisporites antiquasporites (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (R)
Oligosphaeridium complex-type (S)

Comments on samples collected at station 16-DTA-21
Based on the absence of angiosperm pollen the material sampled is probably older than mid to late Albian (Hopkins, 1974; Galloway et al., 2012). The palynoassemblage is typical for Lower

Cretaceous strata in the Sverdrup Basin (Galloway et al., 2013, 2015). This agrees with observations from Cape Crozier where a similar pelecypod-bearing sandstone overlies dark grey shale with stellate nodules, mapped by Miall as Christopher Formation.

Cape Vessey Hamilton, Station 16-DTA-27

An outcrop of Isachsen Formation was visited near Cape Vessey Hamilton at station 16-DTA-27. The Isachsen Formation at this locality outcrops as a mostly massive, poorly lithified white sandstone (Fig. 11). Two samples (C-604701 and C-604707) were collected for palynology from the most organic-rich units. Sample C-604701 was collected from a coarse sand above the lower conglomerate. Sample C-604707 was collected from a coal bed about 1-3 cm thick and containing coalified wood/plant remains that occurs above the second conglomerate in a cyclic white planar cross bedded sand unit with isolated discontinuous mud clasts and coal. The sand is generally unlithified although some areas are partially lithified. This creates the castellated exposures at the top. Preparations of these two samples are analyzed and reported on herein. Thin coal beds occur in the overall white poorly lithified sandstone and these were also sampled but not yet analyzed for palynology.

Figure 11: Poorly lithified sandstone of the Isachsen Formation at station 16-DTA-27. Photograph by J.M. Galloway. NRCan Photo Database Number 2020-409.

C-604701, 16-GTA-94

The TAI is 1+ and the preparation contains a very low abundance of pollen and spores.

P5372-84B (unsieved)

Pollen

Classopollis classoides (R)

Spores
Gleicheniidites senonicus (R)
Cyathidites australis (R)
Deltoidospora hallei (R)
Non-pollen palynomorphs
Nil

C-604707, 16-GTA-100

The TAI is 1 and the preparation contains a very low abundance of palynomorphs

P5372-86B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Classopollis classoides (R)
Spores
Cyathidites minor (R)
Deltoidospora hallei (S)
Dictyophyllidites harisii (R)
Ruffordiaspora australiensis (R)
Trilete spore undifferentiated (R)
Non-pollen palynomorphs
Nil

Comments on samples collected from station 16-DTA-17 at Cape Vessey Hamilton

The recovery of palynomorphs in the two preparations is insufficient to determine the age of the strata.

Tertiary strata interior of east-central Banks Island, no station names

During fieldwork in 2015, several outliers of Neogene Beaufort Formation (*sensu lato*) were identified along eastern Banks Island (Smith, 2015). These occur as upland fluvial terraces, mantled by 2-8 m of heavily oxidized, brightly orange-stained rounded pebble-gravel, containing abundant quartzite, chert (black and grey, with minor red and green), sandstone and other local lithologies (including rare granitic material). One such occurrence in a large valley within interior northeastern Banks Island includes a series of incised fluvial terraces overlying poorly lithified, grey siltstone. Outcrops of sulphur-stained black shale with thin coal beds (<0.1 m thick) outcrop along the valley walls (Smith, 2015; Fig. 6, site 17). The area is mapped by Miall (1979) as upper Devonian Melville Island Group (pre-Mercy Bay Member) with numerous (unmapped) scattered outliers of Christopher Formation.

Thirteen grab samples were collected from the shale and coal strata in order to establish biostratigraphic age control on both these strata and the overlying presumed Beaufort Formation strata.

C-604712, 16-GTA-103

The TAI is 1.

P5372-87B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cupressaceae-Taxaceae (C)
Cycadopites follicularis (R)
Inaperturopollenites (R)
Podocarpidites (R)
Sciadopityspollenites (R)
Taenite bisaccate pollen with TAI 1 to 1+
Spores
Aequitriradites (R)
Appendicisporites (R)
Baculatisporites comaumensis (S)
Cicatricosisporites (R)
Cicatricosisporites hughesii (R)
Cyathidites minor
Deltoidospora hallei (R)
Densoisporites (R)
Gleicheniidites senonicus (C)
Retitriletes antiquasporites (R)
Reworked spores (Paleozoic) TAI of 3 to 3+ (A)
Reworked spores (Paleozoic) TAI of 4 (S)
Stereisporites antiquasporites (S)
Verrucate cingulate spore (S)
Undifferentiated cingulate spore (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (R)
Oligosphaeridium complex-type (R)

P5372-87E (-20 µm)
Barren of angiosperms
Pollen
Classopollis classoides (R)

C-604713, 16-GTA-104
The TAI is 0 to 1.

P5372-88B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A)
Cerebropollenites mesozoicus (S)
Cupressaceae-Taxaceae (S)
Cycadopites follicularis (S)
Dictyophyllidites harisii (R)

Laricoidites magnus (R)
Perinopollenites elatoides (R)
Spores
Cyathidites minor (R)
Deltoidospora hallei (R)
Laevigatosporites ovatus (R)
Leptolepidites verrucatus (R)
Non-pollen palynomorphs
Dinoflagellate cyst undifferentiated (R)
Fungal spore (R)

C-604718, 16-GTA-108

Low abundance of palynomorphs. TAI not measured.

P5372-92B (unsieved)
Pollen
Bisaccate pollen undifferentiated (A
Spores
Deltoidospora hallei (A)
Leptolepidites verrucatus (R)
Stereisporites antiquasporites (A)
Non-pollen palynomorphs
Nil

Comments on preparations of samples C-604712, C-604713, and C-604718

The TAI in the preparations of C-604712 and C-604713 are low, between 0 and 1. The preparations, including the -20 µm fraction of C-604712, are devoid of angiosperm pollen. This absence suggests that the strata are older than late Albian (Galloway et al., 2012). The pollen and spore assemblage is typical for that of the Early Cretaceous (Galloway et al., 2015). The addition of *Appendicisporites* to the assemblage in sample C-604712 suggests that the strata are Cretaceous in age, and not Late Jurassic. No comments can be made about the age of sample C-604718 due to insufficient palynomorphs in the preparation. The results are suggestive of outliers of Lower Cretaceous strata on eastern Banks Island.

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APPENDIX A

Taxonomic authority and references for taxa mentioned in this study. See also Table 1.

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Undifferentiated dinoflagellate cysts (dinocysts)