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CRETACEOUS AND TERTIARY STRATIGRAPHY AND PALEOGEOGRAPHY, NORTHERN INTERIOR PLAINS, DISTRICT OF MACKENZIE

C.J. YORATH
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Preface

Stratigraphic and paleogeographic studies of Cretaceous and Tertiary rocks of northwestern District of Mackenzie began in 1968 under Operation Norman and continued for several years as new subsurface data became available. This report combines surface and subsurface information on the stratigraphy, biostratigraphy and distribution of Cretaceous and Tertiary sequences and proposes regional correlations and paleogeographic reconstructions for this vast region.

Petroleum exploration in the area has been directed primarily at sub-Cretaceous targets. The descriptive and interpretive information in this report provides a basis for the design of exploration programs to test the Cretaceous sequences as potential petroleum reservoirs.

D.J. McLaren
Director General
Geological Survey of Canada

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CRETACEOUS AND TERTIARY STRATIGRAPHY AND PALEOGEOGRAPHY, NORTHERN INTERIOR PLAINS, DISTRICT OF MACKENZIE

Abstract

Sedimentary rocks ranging in age from Early Cretaceous to Late Tertiary were deposited in Anderson Basin, Peel Trough and Great Bear Basin and across intervening positive areas of Carnwath Platform, Keele Arch and Eskimo Lakes Arch. Deposition was initiated in the Neocomian (possibly Late Jurassic) in Anderson Basin. The main transgression onto the craton began in the Aptian with deposition of nonmarine sands on Carnwath Platform, marine mudstones in Anderson Basin, and marine sandstones in Peel Trough. Transgression continued into the Albian. The seas encroached onto Carnwath Platform and Keele Arch by expansion southward of Anderson Basin and eastward of Peel Trough, which resulted in the entire region, with the exception of Keele Arch, being submerged by Middle Albian time. Subsidence of Great Bear Basin primarily occurred in Middle Albian time. Peel Trough and Great Bear Basin continued to expand onto Keele Arch so that the two basins were linked across the southern part of the arch in the Late Albian and the arch was completely inundated by Turonian time. Anderson Basin to the north, conversely, was uplifted and eroded so that no record exists of Late Albian, Cenomanian, Turonian and probably most of Coniacian time. Deposition was re-initiated there during the Late Coniacian and continued into the Maastrichtian. Similarly, Great Bear Basin appears to have been uplifted and eroded in pre-Campanian time so that Upper Albian to Santonian rocks are missing. Conversely, Peel Trough appears to have received continuous deposition from Albian to Paleocene time. Sandstone wedges within the Peel Trough sequence were derived from the Cordillera to the south and west. Deposition changed from marine to nonmarine in Late Maastrichtian time. Nonmarine deposition continued into the Paleocene with deposition of coarse conglomerates. A new name, the Summit Creek Formation, is proposed for the conglomerate unit. Similarly, in western Great Bear Basin, deposition appears to have changed from marine to nonmarine in Late Maastrichtian time. In Anderson Basin, an unconformity separates Maastrichtian marine strata and nonmarine gravels and sands intepreted to be Late Miocene to Pliocene in age.

Résumé

Dans le bassin d'Anderson, le sillon de Peel et le bassin du Grand lac de l'Ours, et dans les zones positives intermédiaires de la plate-forme de Carnwath, de l'arche de Keele et l'arche des lacs des Esquimaux, se sont déposées des roches sédimentaires entre le début du Crétacé et la fin du Tertiaire (possiblement du Jurassique supérieur). La sédimentation a commencé dans le bassin d'Anderson pendant le Néocomien. La principale transgression sur le craton a commencé à l'Aptien par le dépôt de sables continentaux sur la plate-forme de Carnwath, de pélites marines dans le bassin d'Anderson et de grès marins dans le sillon de Peel. La transgression s'est poursuivie pendant l'Albien. La mer a progressé sur la plate-forme de Carnwath et l'arche de Keele, grâce à l'expansion vers le sud du bassin d'Anderson et vers l'est du sillon de Peel; ainsi, la région toute entière, à l'exception de l'arche de Keele, a été submergée dès l'Albien moyen. La subsidence du bassin du Grand lac de l'Ours s'est surtout produite pendant l'Albien moyen. Le sillon de Peel et le bassin du Grand lac de l'Ours ont continué à s'étendre sur l'arche de Keele, de sorte que les deux bassins se sont réunis dans la zone sud de l'arche à la fin de l'Albien et que l'arche elle-même a été complètement submergée au Turonien. Par contre, au nord, le bassin d'Anderson a été soulevé et érodé, de sorte qu'ont disparu les terrains de la fin de l'Albien, du Cénomanien, du Turonien et probablement la majeure partie des terrains du Coniacien. La sédimentation a repris au cours de la fin du Coniacien et s'est poursuivie pendant le Maestrichtien. De même, il semble que le bassin du Grand lac de l'Ours ait été soulevé et érodé avant le Campanien, de sorte qu'on ne trouve pas de terrains compris entre l'Albien supérieur et le Santonien. Par contre, il semble que dans le sillon de Peel, la sédimentation ait été continué de l'Albien au Paléocène. Les couches de grès, se terminant en biseau, qui appartiennent à la succession observée dans le sillon de Peel ont pour origine la Cordillère au sud et à l'ouest. La sédimentation est passée de marine à continentale à la fin du Maestrichtien. La sédimentation continentale s'est poursuivie pendant le Paléocène, avec le dépôt de conglomérats grossiers. On propose un nouveau nom, celui de formation de Summit Creek, pour l'unité conglomératique. De même, dans l'ouest du bassin du Grand lac de l'Ours, il semble que la sédimentation soit passée de marine à continentale à la fin du Maestrichtien. Dans le bassin d'Anderson, une discordance sépare les couches marines du Maestrichtien des graviers et sables d'origine continentale, que l'on considère comme s'étendant de la fin du Miocène au Pliocène.

CRETACEOUS AND TERTIARY STRATIGRAPHY AND PALEOGEOGRAPHY, NORTHERN INTERIOR PLAINS, DISTRICT OF MACKENZIE

INTRODUCTION

This report describes the Cretaceous and Tertiary stratigraphy and paleogeography of a large area in northwestern District of Mackenzie (Fig. 1). The area is bounded in the south by Latitude 64°N, in the north by the Beaufort Sea, in the west by Longitude 132°W and the Mackenzie Mountain front, and in the east by Longitude 120°W. The area covers approximately 360 000 square kilometres, of which about 60 per cent is underlain by Cretaceous and Tertiary strata.

Stratigraphic studies of the Cretaceous and Tertiary rocks were included as part of "Operation Norman", a regional helicopter-supported reconnaissance operation of the Geological Survey of Canada which co-ordinated stratigraphic studies and regional surface mapping. The operation was conducted under the general supervision of J.D. Aitken. Mapping and stratigraphic studies in 1968 were carried out by two parties, a southern party led by Aitken which concentrated its work in the Interior Plains south of 68°N and a northern party led by Yorath which completed mapping and stratigraphic studies in Anderson and Horton Plains north of 68°N. In 1969 Yorath participated as Cretaceous and Tertiary stratigrapher in a field party led by Aitken. Cretaceous and Tertiary studies that year were concentrated in the Peel Plateau, Peel Plain, and Mackenzie Plain regions adjacent to Mackenzie Mountains. Since 1969 short periods of field work have been undertaken in the study area by one author or the other when a logistical base was available through some other Geological Survey operation. Cook's involvement in mapping regional distributions of lithostratigraphic units led to extensive consultation between him and Yorath, both in the field and in the office and resulted in this collaborative report. The initial intent was to deal only with the stratigraphy of Mackenzie Valley, but it was finally decided to assess the entire operation area, and consequently to include description of strata with resultant inferences from Anderson and Horton Plains to the north and from Great Bear Plain to the east. The former area has been described in various papers by Yorath et al. (1969, 1975), Yorath and Balkwill (1969, 1970), and Balkwill and Yorath (1970, 1971). Information from Great Bear Plain consists essentially of subsurface data from a few wells, and descriptions of widely scattered outcrops made by J.D. Aitken and H.R. Balkwill (1971). Samples collected from those exposures have provided important paleontologic information. A few outcrops on the west side of Great Bear Plain and northeast of the McConnell Range have been visited by the writers.

This report is based primarily on studies of surface exposures. No detailed examination and description of subsurface samples has been undertaken, but the report, nonetheless, incorporates subsurface information from published and unpublished sources which are acknowledged at appropriate places in the text to follow. The report modifies stratigraphic relationships, nomenclature and areal distributions of rock units illustrated previously by Yorath (GSC Open File Report 336, 1976).

Acknowledgments

Many colleagues have been consulted during this study. Of these J.D. Aitken, H.R. Balkwill and O.L. Hughes deserve special mention. D.C. Pugh provided subsurface data on Cretaceous and older strata of the northwestern part of Peel Trough. G.K. Williams provided much information on the subsurface geology of Great Bear Basin and southeastern Peel Trough, and his discussions influenced many aspects of this report.

Much of the subsurface data in this report are derived from lithostratigraphic studies illustrated by strip logs provided by Canadian Stratigraphic Services Ltd. E.J. Tassonyi's (1969) excellent subsurface studies, conducted prior to Operation Norman, are cited throughout parts of this report.

Micropaleontological studies by T.P. Chamney, D.H. McNeil and J.H. Wall, macrofossil identification by J.A. Jeletzky and M.V.H. Wilson, and palynological studies of surface and subsurface collections by R.L. Cox, W.W. Brideaux, W.S. Hopkins, A.R. Sweet, and D.G. McGregor have been extremely useful.

Able assistance in the field was provided by student assistants, L.A. Love, A.J.M. Elliott, H. Lenstra, D. Turner and P.S. Graham.

Access

Commercial transport to the region is provided year-round by commercial air carrier to Norman Wells and Inuvik. Barge transport operates along Mackenzie River in the summer, and truck transport to Norman Wells is possible in some winters following freeze-up. An all-weather "Mackenzie Highway" is in various stages of construction.

The principal access for day to day geological work is by helicopter. Camp moves, remote gas caching and provisioning were carried out using a small fixed-wing aircraft. Boat or canoe traverses down some of the main rivers are possible.

History of exploration

The first to explore, occupy and establish an economy in the region were the native people. Aboriginal migrations via the Bering Land Bridge into northern mainland Canada may have begun earlier than 27 000 years ago if a controversial bone artifact, collected from stream deposits on Old Crow River in northern Yukon proves to have been fashioned from fresh material (Irving and Harington, 1973). In any event, archaeologists are generally agreed that man entered North America sometime between 25 000 and 35 000 years ago and that he used the Bering Land Bridge as his route of entry (Hopkins, 1967).

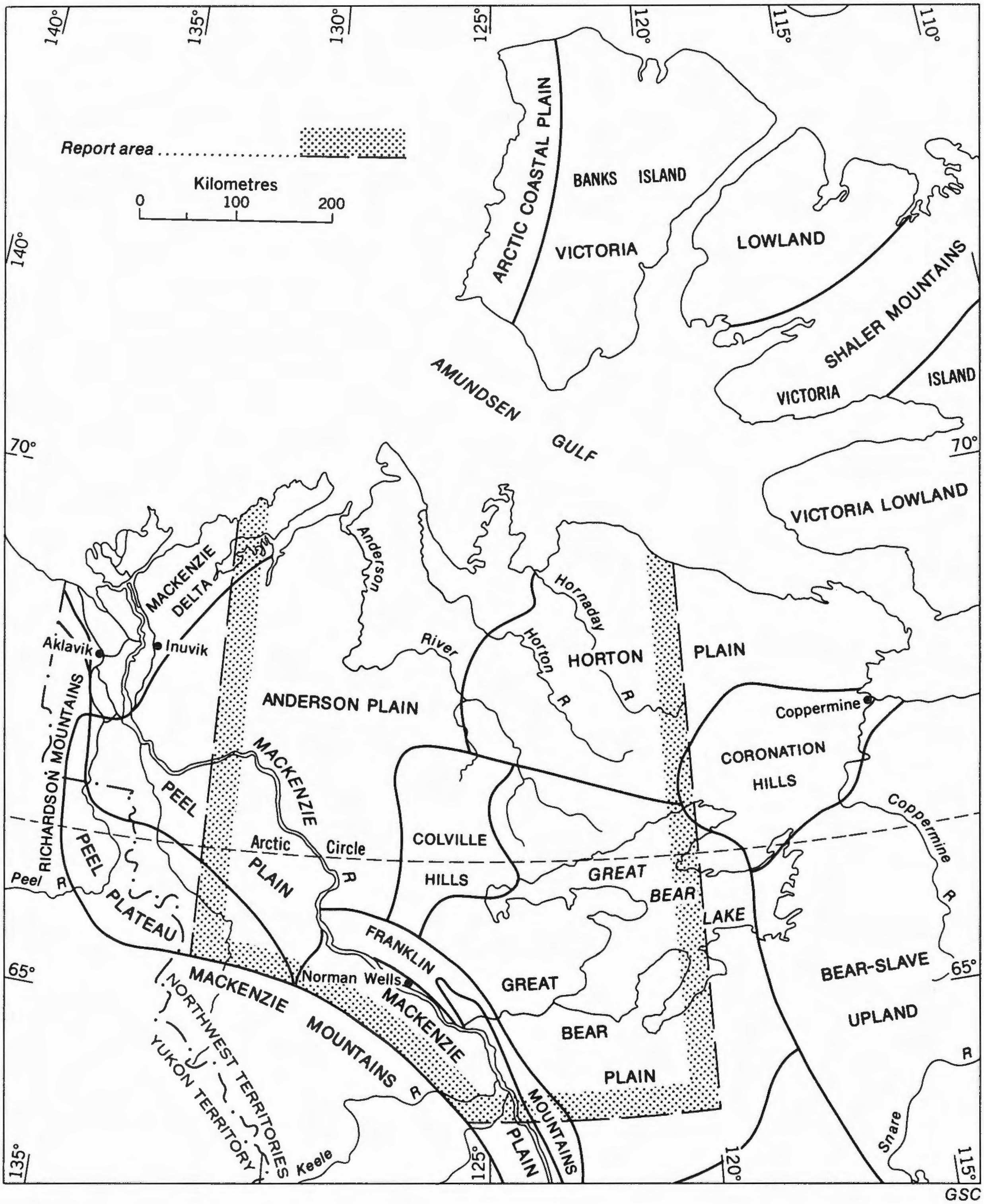


FIGURE 1. *Index map showing position of report area with respect to regional physiographic provinces (after Bostock, 1970).*

Once man was on the continent, however, further routes of migration were limited. Wisconsin ice covered much of the northern half of the land-mass except for a corridor extending up the valley of the Yukon River into the Mackenzie River valley and thence southward into the open plains of the southern part of the continent. The Mackenzie corridor was open between 28 000 and 20 000 years ago and then closed until about 13 000 years ago. During the open period, man must have spread quickly southward and then northward again, following the last and final retreat of the Laurentide ice sheets (Claiborne, 1973).

Practically nothing is known of the ethnography or distribution of the northern Indians until the time of the first white contact, following which the scientific and exploitive exploration of the District of Mackenzie began. From the time of establishment of the Hudson's Bay Company on the shore of Hudson Bay in 1670 to following its amalgamation with its competitor, the Northwest Company in 1822, much exploration of the Northwest Territories was accomplished by fur traders. Although Peter Pond, a Northwest Company trader, was aware that a major river drained into the Arctic Ocean from Great Slave Lake, it was not until 1789 that Alexander Mackenzie descended the river system from Lake Athabaska to the delta. Although he described physiography, wildlife and Indian people, Mackenzie made no geological observations on his northward journey. However, on the return trip, near the confluence of Great Bear River with the Mackenzie River, Mackenzie observed "several smokes along the shore" and "experienced a very sulphurous smell and at length discovered that the whole bank was on fire for a very considerable distance". He incorrectly concluded that "it proved to be a coal mine, to which the fire had communicated from an old Indian encampment". He observed "the beach was covered with coals" and his Indian guide gathered a number of pieces which his people used as a source of "black dye; it being the mineral, . . with which (they) render their quills black" (Mackenzie, 1801). The phenomenon which Mackenzie observed was a bocanne within the Tertiary succession, just southeast of the modern community of Fort Norman. This succession will be described later in this report.

The search for the Northwest Passage provided the impetus for two major expeditions into the Mackenzie District, each under the command of John Franklin. The first of these, in the years 1819 to 1822, concerned itself with geographical exploration from the mouth of the Coppermine River eastward to Kent Peninsula along the south shore of Coronation Gulf. Franklin's journal of this expedition (1823) describes a story of incredible hardship, including starvation, murder, cannibalism, heroism, and endurance since unrivaled.

The second overland expedition between 1825 and 1827 was less eventful than the first. The route to the Arctic Ocean followed that of Mackenzie some thirty-six years earlier, where at Point Separation the expedition split into two parties. The main party under Franklin's command explored the coastline to the west of Mackenzie Delta as far as Barter Island off the coast of Alaska. The other party, under the direction of John Richardson, examined the coast from the delta to the mouth of Coppermine River from whence they returned to join the main party at Fort Franklin on Great Bear Lake.

Richardson was the first to describe the spontaneous combustion phenomena along the Smoking Hills and the carbonates of Parry Peninsula (*see* Richardson, Appendix I in Franklin, 1828). These latter strata were later designated as Silurian in age by Richardson during his 1848 traverse of the Arctic Ocean Coast in search of the discovery ships which were under Franklin's command during the previous year and which, along with the members of the expedition, have never been found (Richardson, 1851).

In addition to his traverse of the Arctic Ocean Coast, Richardson (in Franklin, 1828) made many detailed notes of the physiography and geology of the shores of Great Bear Lake. He noted the considerable depth at many points in the lake, and speculated that its bottom was below sea-level, he described stratigraphic sections at Limestone Point on Dease Arm (Proterozoic - Hornby Bay Group; Cook and Aitken, 1971), he remarked on the character of the bedrock of Scented Grass Hills and Grizzly Bear Mountain (Cretaceous shales), he described the geology along Great Bear River, and in some detail gave an account of the mineralogy of the "primitive" crystalline rocks of the eastern shores of Great Bear Lake. On the initial total party voyage down the Great Bear and Mackenzie Rivers he described the geology and alluded to the use of salt in the region (Saline River Formation) by the Indians. He collected "impressions of ferns" and "impressions of the bark of a tree (lepidodendron) and some ammonites" along Great Bear River, probably from Tertiary and Cretaceous beds. He comprehensively described the stratigraphy and structure of Bear Rock and recognized the breccia that characterizes the Devonian Bear Rock Formation. Near the confluence of Great Bear and Mackenzie Rivers and at other localities in this vicinity, Richardson measured several sections of strata containing coal, and in detail described the character of these lignites, and associated beds of ash which characterize the Tertiary succession in the region. An example of his scientific curiosity and descriptive power is as follows: "The pipe-clay, when taken newly from the bed, is soft and plastic, has little grittiness, and when chewed for a little time, a somewhat unctuous but not unpleasant taste". To the authors' knowledge this is the only described attempt to introduce volcanic ash into western diet.

Along the Mackenzie River Richardson described black bituminous shales near the modern site of Norman Wells, the carbonate and clastic strata (Ramparts and Sans Sault Formations respectively) at East Mountain and the nature of the stratigraphy and structure at "The Ramparts". At this latter region he appears to have confused the geology with another locality because his description of "The Ramparts" is not in accordance with the known geology of the area. In his notes he makes the following statement:

"The few notes that the rapidity of our voyage permitted me to make, as to the direction of the strata, etc. were inserted in the book that was purloined by the Esquimaux at the mouth of the river".

Presumably this portion of Richardson's Appendix to Franklin's journal was written after the expedition had returned to England, and was in part based upon Franklin's notes and samples collected the previous summer when Franklin, Back and Kendall reconnoitered the river to its mouth in preparation for the main expedition the following year, during which Richardson lost his notes.

With the exception of the travels of the traders, little exploration occurred in the lower Mackenzie valley until 1848 when Richardson again descended the river to search for the lost Franklin expedition (Richardson, 1851). Little new information was added to that of his earlier voyage. In 1849 and 1850 Pullen and Hooper added cartographic information on the Mackenzie River and the Arctic Ocean coast between Richards Island and Cape Bathurst.

Between 1857 and 1866 Roderick Ross MacFarlane, in the employ of the Hudson's Bay Company, carried out extensive explorations and collecting expeditions in the Anderson River and Franklin Bay area. In 1861 he established Fort Anderson on the east bank of Anderson River some 56 km downstream from its confluence with the Carnwath River. The fort was abandoned due to lack of trade in 1866 (Mackay, 1963).

Further cartographic work was carried out between 1865 and 1872 by Emile Petitot over a wide area from Great Bear Lake to the Arctic coast. In addition, from 1889 to 1907 Count de Sainville, the French explorer, A.J. Stone, an American naturalist and A.H. Harrison produced maps of the lower Mackenzie region of variable value and precision (Mackay, 1963).

Exploratory work by the Federal Government of Canada was initiated by the Department of the Interior. The surveys of William Ogilvie provided the first precise maps of the lower Mackenzie region (Ogilvie, 1889). These maps were supplemented by the work of R.G. McConnell (1890). From 1899 to 1907 extensive geological surveys by members of the Geological Survey of Canada were undertaken by J.M. Bell, Charles Camsell and Joseph Keele (Hume, 1954).

The first record of petroleum exploitation in the Mackenzie region is contained in a letter written by W.L. Hardisty of the Hudson's Bay Company at Fort Simpson. It is dated February 28, 1872 and addressed to Mr. Gaudet at Fort Good Hope. In it Hardisty states: "I shall require 5 kegs of good clean tar from you, for Fort Simpson, and 1 keg for Peels River, to be sent down by the spring boat".

The tar was collected from the Rond Lake oil seep by Indians who scooped the thick oil into kegs with hand-hewn wooden paddles (de Mille, 1969).

In 1898 and 1899 a number of gold-seekers chose the Mackenzie River as their route to the Klondike. One man, Davidson, came upon the well known oil seep near Fort Norman and used the oil-impregnated shale as fuel (de Mille, *ibid.*).

Oil and gas seeps were well known by the traders along Mackenzie valley. Officers of the Geological Survey of Canada described a number of these (McConnell, 1890). In 1911 J.K. Cornwall, head of the Northern Trading and Transportation Company hired an Indian named Karkesee to search for, sample, and report on oil seepages in the region. A number of samples were collected and sent to Edmonton for analysis, the results of which encouraged the formation of a Calgary-based syndicate to explore for oil in the Mackenzie valley. The syndicate hired Dr. T.O. Bosworth to carry out the geological investigations. The report, resulting from his 1914 field work was exhaustive and included many recommendations to the syndicate encouraging them to form a company to carry out drilling in the region. The syndicate tried to interest several companies in the properties and during World War I the report and the land rights were sold to Imperial Oil Ltd. (de Mille, 1969).

In 1919, the Northwest Company (not the fur-trading company), a subsidiary of Imperial Oil Limited, began exploration and drilling in the Mackenzie River area, which led to the discovery, in 1920, of the Norman Wells field. The discovery provided stimulus to the Geological Survey of Canada and much work was undertaken in the Mackenzie drainage area, resulting in reports by Kindle and Bosworth (1921), Williams (1922, 1923) and Hume (1923, 1924).

During the next two decades following the initial discovery only about half a dozen wells were drilled in the Norman Wells field. The remoteness of the region, the Great Depression and the lack of favourable markets resulted in a loss of interest, and by 1940 only about 100 barrels of oil per day were being refined as aviation fuel for local use.

With the outbreak of World War II the fortunes of Norman Wells changed. In 1942, in recognition of the strategic importance of northern inland oil supplies, the Canadian and United States governments entered into an agreement under a project known as Canol (standing for Canadian oil), whereby additional exploratory and drilling activity was to be carried out in the Lower Mackenzie Valley. The geological work was directed by T.A. Link, chief geologist for Imperial Oil Ltd. Forty reports resulted which were submitted to the Canadian Government, and these were later summarized by Hume (1954).

Since the end of World War II, exploratory activity in the Mackenzie region has continued to the present at various paces. Petroleum companies have carried out extensive surface geological surveys and have submitted vast amounts of data in the form of reports to the Department of Indian and Northern Affairs. Geophysical exploration has been equally extensive.

To the time of writing more than 190 exploratory and development wells have been drilled in the report area. Of these 70 are development and field wells in the Norman Wells field. The field has an estimated 500 million barrels of oil in place with an estimated recoverable reserve of about 50 million barrels. Oil is produced at about 2750 barrels per day from 44 producing wells (J.D. Boggs, Department of Indian and Northern Affairs, pers. com., 1979).

PHYSIOGRAPHY

The report area has been described in terms of three main physiographic regions (Bostock, 1970) each of which encloses numerous divisions which more or less possess unique characteristics derived from underlying geological architecture and/or glacial processes.

That portion of the Cordilleran Region included within the study area comprises part of Mackenzie Mountains, Mackenzie Plain and Franklin Mountains. The Mackenzie Mountains, in the southwest part of the region, consist of uplifted Proterozoic and early to middle Paleozoic clastic and carbonate rocks, which attain elevations in excess of 1800 m. Mackenzie Plain is a flat valley, averaging 56 km in width containing the Mackenzie River. The valley is underlain mainly by Cretaceous and Tertiary strata and up to 45 m of glacial drift (Prest, 1970). Within Mackenzie Plain four uplifted areas of Devonian and older carbonates and clastics occur. The Imperial Hills (Lat. 65°27'N; Long. 128°30'W), structurally referred to as Imperial Anticline, comprise an arcuate belt of resistant rock that is parallel to the westward curvature of the Mackenzie Mountain front. To the southwest of these hills, Cretaceous strata are preserved in a narrow synclinal portion of Mackenzie Plain between the mountain front and Imperial Hills. To the north, between the hills and Franklin Mountains Cretaceous strata are essentially flat lying and, although broadly synclinal, the overlying topography is gently rolling. Another uplifted area within Mackenzie Plain is West Mountain (Lat. 65°38'N; Long. 128°50'W), a small anticline of Middle Devonian carbonate rocks, which constitutes the western limit of the Franklin Mountains. A third uplifted area within the Plain is

MacKay Range southwest of Fort Norman (Lat. 64°41'N; Long. 125°38'W). There early and middle Paleozoic carbonates form a narrow, northwesterly trending range that stands more than 300 m above the surrounding plain. Adjacent to and southwest of MacKay Range is a local plateau standing at elevations of 760 to 1070 m. It is underlain by essentially horizontal, moderately to poorly indurated, Tertiary sandstone, coal, tuff and conglomeratic beds. A fourth area of uplifted middle and lower Paleozoic rocks, the Gambill Hills (Lat. 65°33'N; Long. 126°13'W), extends in a northerly trending belt into Mackenzie Plain from the Mackenzie Mountains in the southwestern corner of the map-area (Map 1498A). These hills are more than 450 m higher than the average elevation of Mackenzie Plain but are somewhat lower than the adjacent uplands supported by Tertiary strata.

Towards the northwest, Mackenzie Plain merges with Peel Plain, a division of the Interior Plains Region.

The Franklin Mountains, within the report area, comprise a series of curvilinear, generally northwesterly and westerly trending asymmetric ranges upheld by early and middle Paleozoic carbonates, and separated by broad, mostly drift-filled valleys. The ranges trend generally northwesterly and then westerly to terminate at West Mountain near Mackenzie River. A unique feature of these ranges is that along their trends many reversals in topographic asymmetry occur. In the Norman Range, for example, Discovery Ridge is asymmetric with a steep northeast-facing scarp, yet northwestward along the range the asymmetry reverses abruptly to a steep southwest-facing scarp. The morphological reversals are directly related to reversals in structural geometry within the ranges which are formed by asymmetric anticlines or by steeply-dipping reverse faults.

Colville Hills extend northward from the Franklin Mountains and separate Anderson and Great Bear Plains. They too are formed by linear asymmetric ranges, but they are mostly anticlinal, trend mainly northerly and northeasterly, are more subdued and more widely separated than Franklin Mountain ranges. The ranges have elevations of up to 670 m and are locally more than 365 m above the surrounding plain (Bostock, 1970).

The Arctic Coastal Plain Region includes the Island Coastal Plain, Yukon Coastal Plain and Mackenzie Delta physiographic divisions (Bostock, *ibid.*). Only part of the latter division is included within the report area. The Mackenzie Delta is a composite delta comprising the modern active delta to the west of the report area, and the Pleistocene delta complex of Richards Island (west of the report area) and the Tuktoyaktuk Peninsula. Glacial, periglacial and permafrost features of the region include complex outwash deposits, thermokarst depressions, patterned ground, massive ground ice and pingos. For a full treatment of these and other features of the Mackenzie Delta the reader is referred to Mackay (1962, 1963, 1971), Mackay and Stager (1966), Stager (1956), Rampton (1971), Rampton and Mackay (1971) and Pihlainen et al. (1956).

The Interior Plains Region, comprising the greatest part of the report area, includes Anderson Plain, Horton Plain, Peel Plain, Peel Plateau, and Great Bear Plain physiographic divisions (Bostock, 1970).

Anderson Plain is a broad region extending from the Arctic coast to the Mackenzie River in the southwest. It comprises a gently undulating surface, underlain by essentially flat-lying Paleozoic and Mesozoic strata and glacial drift. The region is poorly drained and covered by numerous small lakes. The principal drainage is provided by the Anderson River drainage system which includes the Anderson, Carnwath and Andrew Rivers. Other entrenched streams include the Kugaluk and Iroquois Rivers. Klassen (in Yorath, et al., 1969) modified the informal subdivisions of the plain published by Mackay (1963).

In a number of places between Anderson and Horton Rivers small, tight disharmonic folds are locally impressed upon Upper Cretaceous rocks (Fig. 6). These folds are probably detached above highly ductile Lower Cretaceous bentonitic shales, and owing to a variation in trend of their axial planes, it is suggested that continental glaciation may have been the generator of these structures. Further information on these structures is provided in Yorath et al. (1975) and Gretener (1969).

Horton River Delta, on the west side of Franklin Bay, is one of the more prominent recent features of Anderson Plain. It resulted from a breach in the coastal cliffs which bound the Smoking Hills at the apex of a meander loop of Horton River. Mackay (1958) has estimated the time of the breakthrough at about the year 1800 and a future breakthrough is likely to occur at the apex of the larger meander loop immediately south of the present mouth of the river. For further details on the delta the reader is referred to Mackay (1958) and Yorath et al. (1975).

The most prominent effects of glaciation appear as extensive morainic belts, the most distinctive of which, named the Melville Hills, extends westward from Horton Plain, across the southern part of Parry Peninsula. The belt consists of kames, hummocky moraine and morainic ridges, and varies from 183 m to 335 m elevation with up to 60 m of local relief. On Parry Peninsula, a very low and flat plain underlain by lower Paleozoic flat-lying carbonate rocks, glacial grooves and drumlins are well developed.

Horton Plain (Bostock, 1970) is an elevated surface underlain by nearly flat-lying lower Paleozoic carbonates in the southwest (Horton Plateau - Klassen in Yorath et al., 1969) and deformed upper Proterozoic clastic and carbonate rocks in the Hornaday River area (Brock Upland - Klassen, *ibid.*).

Great Bear Plain is a very broad region of gently rolling topography that surrounds Great Bear Lake. For the most part it is underlain by poorly exposed Cretaceous strata but

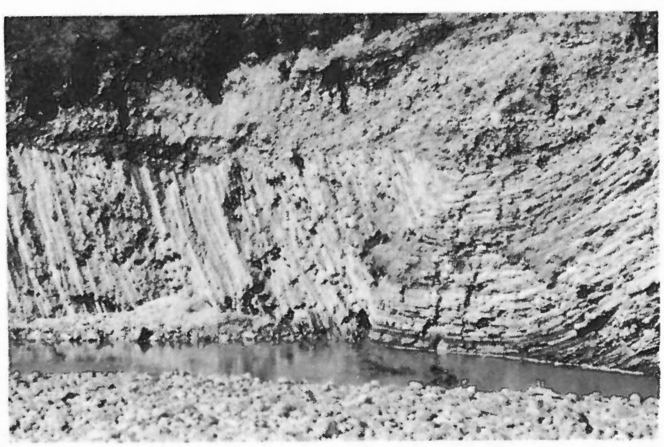


FIGURE 6. *Disharmonic fold in the Smoking Hills Formation, Anderson Basin. 69 14'N, 127 32.5'W.*

lower Paleozoic carbonates occur in the western part, north of Mahony Lake. The surface is mainly below 305 m elevation with the exception of Scented Grass Hills and Grizzly Bear Mountain, two elliptical plateaux with elevations of about 450 m that project as peninsulas into Great Bear Lake. North of the lake, hummocky moraine is widespread. Disharmonic folds in Upper Cretaceous shales have been noted at Etacho Point at the eastern end of Scented Grass Hills and on Grizzly Bear Mountain (Balkwill, 1971).

Great Bear Lake is the fourth largest lake in area on the North American continent and ranks ninth in the world (Johnson, 1966). Its total area is in excess of 3110 square kilometres. Its deepest known point occurs near Port Radium, east of the report area where a depth of 452 m has been measured, confirming Richardson's speculations (Franklin, 1828) that the bottom of the lake is below sea-level by an amount of 296 m. Within the report area, depths within Smith, Keith and McVicar Arms are in excess of 90 m.

Peel Plain, lying southwest of Mackenzie River, is the northern continuation of Mackenzie Plain. It is a lowland region in the south with elevations averaging 122 m above sea level; to the north the plain rises to elevations of about 457 m in the Grandview Hills west of Little Chicago on Mackenzie River. For the most part the plain is underlain by flat-lying Cretaceous strata but, adjacent to Mackenzie River, Devonian clastic and carbonate rocks occur at the surface. Extensive glacial drift covers much of the area and lowland areas below about 140 m are characterized by northwest trending lakes developed on ice-rich glaciolacustrine sediments (Hughes et al., 1973, p. 12, 15).

Peel Plateau, the southeastern portion of which is included within the report area, is an upland region lying to the southwest of Peel Plain and forms a sloping terrace to the Mackenzie Mountain front. Elevations up to 975 m occur. The plateau is an erosion surface cut into upturned and truncated Upper Cretaceous sandstones and older rocks, and mantled locally by a thin cover of drift. The Arctic Red River is deeply entrenched into the plateau.

Approximately two-thirds of the report area lies above the Arctic Circle (Lat. 66°30'N). The northern limit of trees passes through the northern part of the region as does the southern limit of continuous permafrost. The effects of permafrost on topography and land forms are marked throughout the area; these include patterned ground, ground ice, pingos, oriented lakes and various solifluction structures, and many other periglacial phenomena. River valleys such as the Mackenzie, Carcajou, Mountain, Ramparts, Anderson and Horton display active valley-wall slumping in many places due to the effects of the active layer above permafrost or enclosed ground ice.

REGIONAL GEOLOGICAL SETTING

The report area includes all or parts of the following structural provinces of Douglas et al. (1963): Arctic Coastal Plain, Anderson Plain, Horton Plain (introduced by Balkwill and Yorath, 1971), Coppermine Arch, Colville Uplift, Great Bear Plain, Mackenzie Plain, Franklin Mountains, Mackenzie Mountains, Peel Plain and Peel Plateau. These structural subdivisions of the Northern Interior Plains and Cordilleran orogen are useful in describing the area only in terms of broad continental proportions; however, they do not suffice to characterize the more detailed structural and stratigraphic relationships of the northwestern District of Mackenzie. In the following discussion a number of terms are introduced to describe specific tectonic elements that played important roles in the generation and distribution of Cretaceous and Tertiary strata in the report area.

Beneath the Cretaceous succession throughout most of the region, Paleozoic rocks as young as Middle Devonian can be characterized as comprising a shallow water carbonate shelf sequence, deposition of which was interrupted intermittently by uplift and erosion, with consequent development of regional unconformities. The sequence forms an overall westward thickening wedge within which each unit changes facies westward to basinal shale. The change takes place west of the report area for all but the Middle Devonian Ramparts Formation. The Hare Indian Formation, in part equivalent to the commonly reefoid Ramparts carbonates, comprises calcareous shales and limestones that extend well onto the platform to underlie the Cretaceous succession on Anderson River. Supra-Ramparts Canol Formation black shales of early Late Devonian age are exposed in a narrow, northward-trending linear belt from the southern border of the report area to near the mouth of Anderson River. The Upper Devonian Imperial Formation represents a fundamental change from carbonate shelf deposition to sandstone and shale flysch, probably derived from Ellesmerian movements in northern Yukon.

The Mississippian, Permian, Triassic and Jurassic systems are nowhere represented at the surface in the report area so far as is known. Non deposition or pre-Cretaceous erosion could equally account for their absence; however, it is noteworthy that each of these periods is represented in Cretaceous palynological suites from the area. This suggests that much of Cretaceous clastic deposition was derived from terrains to the northwest, west or southwest. Mississippian rocks have been reported in the subsurface adjacent to the western boundary of the report area (Amoco PCP A-1 Cranswick A-22-well history report), and D.C. Pugh (pers. com., 1978) has identified strata of this age in the Amoco PCP A-1 Cranswick A-22, and Can Del Mobil et al. N. Ramparts A-59 wells.

Figure 2 shows the interpreted pre-Cretaceous geology of the region. The map is based upon subsurface control from exploratory wells, and on surface control points established where Cretaceous rocks have been mapped in contact with underlying older strata. The latter control type is in part derived from interpretive mapping across extensive regions of Quaternary cover, and the map should be considered as a first approximation only.

Within the report-area, Cretaceous rocks generally truncate successively older strata from Upper Devonian in the west to Proterozoic on Coppermine Arch to the east. A prominent exception occurs in the south central part of the area where pre-Cretaceous erosion has cut down to as low as the Middle Cambrian along the crest of a northward-trending arch named the Keele Arch by Cook (1975). Truncation of successively younger strata away from the axis occurred on each side of the arch.

Principal tectonic elements

A number of uplifted terrains within and adjacent to the report area in Cretaceous time had varying affects on rates of deposition, facies and distribution of Cretaceous sediments. These include the Cordilleran orogen, Aklavik Arch Complex, Coppermine Arch, and Keele Arch. They confined Cretaceous deposition within the report area to three, more or less distinct sedimentary basins: the Anderson Basin in the north, Peel Trough to the southwest and Great

Bear Basin to the southeast (Fig. 3). The Beaufort-Mackenzie Basin, part of which occurs in the northwest corner of the report area, has been described in a number of publications (Yorath, 1973; Yorath and Norris, 1975; Young et al., 1976) and will be discussed here only insofar as it relates to Anderson Basin of this report.

Cordilleran Orogen

Probably the most important paleo-landmass, and yet the least well known with respect to Cretaceous sedimentation is the extensive uplift in the general area of the modern northern Cordillera. The Columbian Orogeny (Late Jurassic to early Late Cretaceous; Douglas et al., 1970) probably affected much of the Mackenzie Mountains, however, the clearest evidence for Columbian deformation in the northern Cordillera occurs in Selwyn Fold Belt (Gabrielse, 1967) to the southwest of the report area where Ellesmerian folds were refolded and intruded by discordant granitic rocks, of early Late Cretaceous age (Norris, 1973; Douglas et al., 1970). It is generally accepted that a landmass occupied the full length of the Canadian Cordillera throughout all of Cretaceous time (*see* Jeletzky, 1971, Figs. 9-20) and a number of facies relationships present in the report area are attributable to this landmass. Middle Albian marine sandstones (Sans Sault Formation) and Late Albian to Turonian marine sandstone (Trevor Formation) occurring near Sans Sault Rapids and in the southwest part of Peel Plateau respectively appear to be examples of sands derived from the area of the Cordillera as suggested by Eisbacher et al. (1974). If so they represent a late phase Columbian molasse. The geometry of distribution and the presence of reworked late Paleozoic palynomorphs in the Santonian to Middle Campanian Little Bear Formation also suggest a southwestern or western source within the Cordilleran orogen. Another younger and more local example of western derived rocks is a sandstone wedge of Campanian to Maastrichtian age (sandstone member of the East Fork Formation) in the region of Little Bear River and MacKay Range (*see* Figs. 5, and 35). These sandstones were derived from the southwest and they appear to pinch out into equivalent shales of the East Fork Formation to the east and north. A third response to activity within the orogen is represented by coarse conglomerates, fluvial sandstone, and coal of latest Maastrichtian to Early Tertiary age (Summit Creek Formation) (*see* Fig. 36). These deposits reflect Laramide tectonism and appear as an alluvial molasse apron adjacent to the Mackenzie Mountain front in the southernmost part of the report area.

The lack of coarse clastic facies related to Cordilleran source areas throughout most of the Cretaceous suggests that the Cordilleran shorelines were considerably to the southwest of the present Cretaceous erosional zero-edges which more or less follow the present Mackenzie Mountains front. Nonmarine Cretaceous rocks reported by Blusson (1971) in Sekwi Mountain map-area, about 160 km southwest of the present report area, provide a very crude limit to marine deposition at the time of their deposition. D.C. McGregor and W.S. Hopkins [GSC Loc. No. 7969 and 7970, Appendix 2(g)] suggested a Late Cretaceous age for those rocks.

Eskimo Lakes Arch

The Eskimo Lakes Arch (Young et al., 1976) is a component of the Aklavik Arch Complex (Yorath and Norris, 1975; Jeletzky, 1961), a northeast trending en échelon series of structural elements that extend, in Canada, from the Yukon-Alaska boundary to east of Mackenzie Delta. The component of the complex that cuts across the northwest corner of the report area in the subsurface has been named the Eskimo Lakes Arch by Young et al. (1976). The complex is an ancient feature which was tectonically active as early as the Proterozoic. For a discussion of pre-Cretaceous history the reader is referred to Norris (1974). Eskimo Lakes Arch existed as a positive element during the Early Cretaceous. During the Neocomian (possibly Late Jurassic) and again in the Aptian, sandstones were shed both to the northwest into the region of modern Mackenzie Delta and to the southeast into Anderson Basin (*see* Fig. 31 and Table 1). The arch became progressively submerged during Early and Middle Albian time and the entire region with the exception of Keele Arch became submerged and the site of shale deposition during the Middle Albian. The Aklavik Arch Complex remained subdued throughout the remainder of Cretaceous time but was uplifted and eroded prior to the deposition of Tertiary strata now exposed on the north flank of Campbell Uplift, another positive element of the complex (*see* Norris, 1974). During the Tertiary the complex was highly active. Extensive down-to-basin faulting on its northern flank permitted the development of thick Tertiary deltaic wedges of the Beaufort-Mackenzie Basin (Young et al., 1976).

On Kugaluk River, shales of the Aptian-Early Albian Langton Bay Formation onlap the flanks of a paleotopographically high area and are overstepped by shales of the Middle Albian Horton River Formation. Yorath et al. (1969) interpreted the relationship as due to a small independent arch which they named the Kugaluk Arch. The onlap relationships on Kugaluk River are herein considered to mark the southeastward flank of the larger Eskimo Lakes Arch, and pending further data the term "Kugaluk Arch" is abandoned. Whatever its configuration, it had little effect on facies patterns within the Lower Cretaceous rocks of the report area.

Coppermine Arch

Coppermine Arch is a broad tectonic feature that trends northwesterly across the northeast corner of the report area (Fig. 3). There is strong evidence for faulting and corresponding erosional truncation of Proterozoic units prior to deposition of the Lower Cambrian Old Fort Island Formation but it cannot be determined whether that deformation was localized along the arch or was part of a more regional uplift. Renewed uplift, prior to deposition of the Lower Devonian Bear Rock Formation apparently removed only the Mount Kindle Formation and part of the Franklin Mountain Formation and was probably related to pre-Devonian epeirogenic uplift and erosion over the entire region rather than to localized activity along the arch.

The first clear evidence of the Coppermine Arch as a localized tectonic element is found at the sub-Cretaceous unconformity. Within the broad framework of regional pre-Cretaceous epeirogeny, localized differential uplift occurred along the arch such that Cretaceous strata overlay Proterozoic rocks on the arch, yet Paleozoic rocks are found on both east and west flanks. A number of north-northwest trending steeply dipping faults may be related to pre-Cretaceous uplift, but unfortunately no Cretaceous rocks remain in the area of the faults and they cannot be dated more accurately than post-early-Ordovician (post-cherty unit of the Franklin Mountain Formation). A few small east-northeast trending faults are present and at least one of these (Balkwill and Yorath, 1971) offsets and therefore postdates Lower Cretaceous basal sandstone. Proterozoic and Cambrian quartzite and sandstone on Coppermine Arch probably have been a major source for Aptian to Albian(?) Gilmore Lake Member sandstones deposited in Anderson Basin

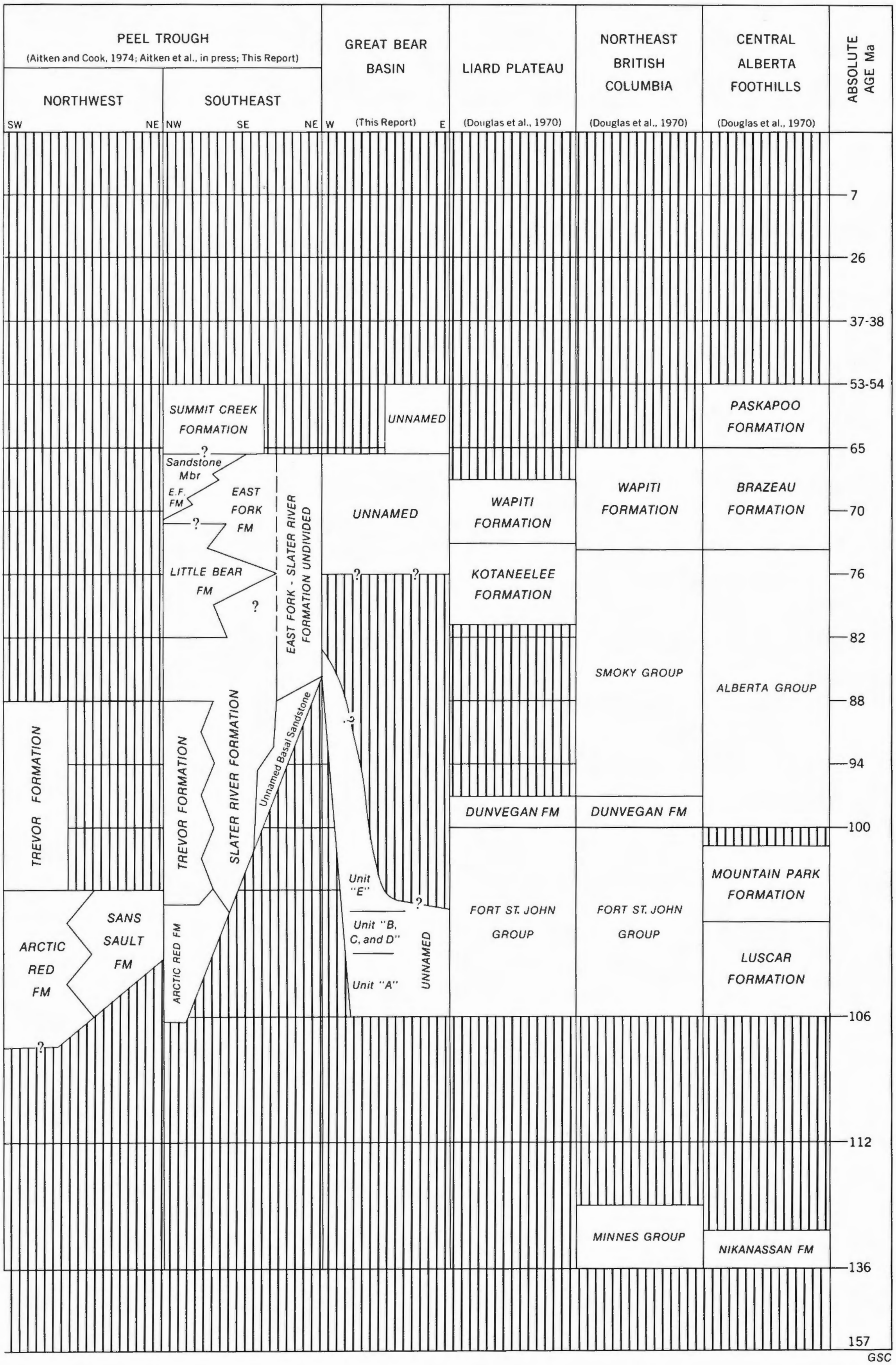
TABLE 1

Regional correlation chart

SYSTEM	SERIES	STAGE	SOUTHERN BANKS ISLAND (Plauchut and Jutard, 1976)	BEAUFORT-MACKENZIE BASIN (TUKTOYAKTUK PENINSULA) (Young et al., 1976)	ANDERSON BASIN (Yorath et al., 1975 and This Report) NW–SE
TERTIARY	UPPER TERTIARY	PLIOCENE		BEAUFORT FORMATION?	BEAUFORT FORMATION?
		MIOCENE			
	LOWER TERTIARY	OLIGOCENE		REINDEER FORMATION EQUIVALENT	
		EOCENE		REINDEER FORMATION EQUIVALENT	
		PALEOCENE		REINDEER FORMATION EQUIVALENT	
CRETACEOUS	UPPER CRETACEOUS	MAASTRICHTIAN		TENT ISLAND FM / MASON RIVER FM	MASON RIVER FORMATION
		CAMPANIAN	KANGUK FORMATION	TENT ISLAND FM / MASON RIVER FM; BOUNDARY CREEK FM / SMOKING HILLS FM	SMOKING HILLS FORMATION
		SANTONIAN	KANGUK FORMATION	BOUNDARY CREEK FM / SMOKING HILLS FM	SMOKING HILLS FORMATION
		CONIACIAN		BOUNDARY CREEK FM / SMOKING HILLS FM	
		TURONIAN			
		CENOMANIAN			
	LOWER CRETACEOUS	ALBIAN	HASSEL FM; CHRISTOPHER FORMATION	ARCTIC RED FM / HORTON RIVER FORMATION	HORTON RIVER FORMATION; LANGTON BAY FORMATION: Crossley Lakes Member
		APTIAN	ISACHSEN FORMATION	Upper Shale - Siltstone Division; Basal Sandstone and Conglomerate; HORTON RIVER FORMATION	LANGTON BAY FORMATION: Crossley Lakes Member; Gilmore Lake Member
		NEOCOMIAN (BAR, HAU, VAL, BER)	ISACHSEN FORMATION (BAR)	Upper Shale - Siltstone Division; Parsons Sandstone; HUSKY FM	?
JURASSIC	UPPER JURASSIC	TITHONIAN			LANGTON BAY FM: Gilmore Lake Member
		PORTLANDIAN			LANGTON BAY FM: Gilmore Lake Member
		KIMMERIDGIAN			LANGTON BAY FM: Gilmore Lake Member
		OXFORDIAN			LANGTON BAY FM: Gilmore Lake Member ?

GSC

TABLE 1 Continued



and on Carnwath Platform to the west and possibly in Great Bear Basin to the southwest. In Anderson Basin, clasts in basal Cretaceous sandstones (Gilmore Lake Member) markedly increase in size eastward toward the arch in agreement with the suggestion that the arch was a source area. Outliers of basal Cretaceous sandstone occurring on the arch have abundant stromatolitic chert clasts indicating fairly local derivation from the Lower Ordovician cherty unit of the Franklin Mountain Formation.

Keele Arch

Keele Arch occurs in the south central part of the report area. It may have existed as early as Middle and Late Cambrian, but was fully established as an important tectonic feature during regional pre-Devonian epeirogenic uplifts, at which time localized uplift resulted in deeper erosion along the arch (Cook, 1975). Similarly, greater uplift and erosion took place along the arch as an integral part of broad regional pre-Cretaceous epeirogenesis so that the general pattern of truncation of successively older units eastward by Cretaceous rocks (Fig. 2) is interrupted by Keele Arch. The differential uplift and resultant deeper erosion along the arch occurred prior to deposition of Cretaceous rocks as indicated by the interpreted paleogeology (Fig. 2). Deep erosion to Middle Cambrian strata in the southern part of the arch was largely accomplished in pre-Devonian time, so that pre-Cretaceous erosion need have removed little more than the Devonian formations.

Figure 31 shows the interpretation that the northern part of Keele Arch (northward to Lac des Bois) in Aptian time was covered by Gilmore Lake Member sands. This assumes that the Aptian sands were subsequently removed by erosion and then overstepped by Turonian mudstone and siltstone which occur at Lac des Bois. In any case the arch did not appear to have any appreciable influence on facies distribution during the Aptian. During the Early and Middle Albian the arch probably was emergent as a topographically low barrier between Peel Trough on the west and Great Bear Basin on the east. A chert-rich saprolite, remnants of which are preserved locally on the arch, probably developed during this time. In Late Albian to Turonian time (Fig. 33) the arch subsided and was the site of marine deposition. Surprisingly, it was not until then that there is clear evidence of the arch serving as a major sediment source area. Basal sandstones of the undivided Slater River-East Fork, and probably equivalent to the Slater River Formation have abundant chert clasts and pebbles which can be related to the saprolite, noted above, which developed due to deep chemical weathering of the cherty unit of the Franklin Mountain Formation on the northern part of the Arch. By the Turonian the arch probably was no longer an identifiable geomorphic feature (Fig. 33).

Carnwath Platform

Keele Arch broadens northward into a wide upland herein named the Carnwath Platform (Fig. 3). This broad area throughout the Early Cretaceous experienced subaerial erosion, nonmarine deposition and shallow marine inundation in that order. No sedimentary record for the Late Cretaceous exists on the platform. Cretaceous rocks occurring on the platform can readily be assigned to formations of Anderson Basin and are consequently discussed, in the stratigraphic section of this report, under the heading of Anderson Basin. The platform and its appendage, the Keele Arch, effectively divide the report area into the three principal basins, Anderson Basin to the northwest, Peel Trough to the southwest, and Great Bear Basin to the southeast (Fig. 3).

The platform during Aptian time was the site of deposition of the nonmarine Gilmore Lake Member of the Langton Bay Formation (*see* Fig. 31). In the western part of Carnwath Platform drainage channels cut into underlying Devonian rocks have been described by Cook and Aitken (1975). The channels can be grouped into those which drained southwesterly into Peel Trough and those that drained northwesterly into Anderson Basin. The platform was submerged during the Albian with resultant linkage of Anderson Basin and Peel Trough and deposition of marine siltstones, mudstones, and shales in the western part of the platform. No rocks of Albian age have been found in the region from Colville Lake to the Coppermine Arch, but the authors assume that a marine connection through that area in Middle Albian time linked Anderson Basin and Great Bear Basin (*see* Fig. 32); the latter appears to have been the site of rapid subsidence and deposition at that time.

From Late Albian through the remainder of the Cretaceous virtually no sedimentary record exists on the platform. If it was emergent no facies patterns are clearly relatable to it.

Anderson Basin

Anderson Basin was the site of the earliest Cretaceous deposition within the report area. It contains sandstones and equivalent open marine shales of Neocomian (possibly Late Jurassic) and Aptian age derived from Aklavik Arch on the northwest and from Carnwath Platform and Coppermine Arch to the south-southeast. Anderson Basin was a site of epicontinental marine deposition during Aptian to Middle Albian time, presumably receiving clastic debris derived primarily from the west, south and southeast. The area of the basin was emergent from Late Albian to Coniacian. During Late Coniacian marine transgression occurred southward across Anderson Basin. Eskimo Lakes Arch was not identifiable at that time. Deposition continued until the Early Maastrichtian.

Peel Trough

Peel Trough (Fig. 3), the southeastern extension of the feature described by Young et al. (1976, Fig. 8, p. 19) in east central Yukon is considered to have first subsided and received marine sediments during the Late Aptian. A basal nonmarine facies of Aptian age localized in channels of a paleo-drainage system, as on Carnwath Platform, would be anticipated but has not been documented. Nonmarine coal-bearing strata do occur in the Atlantic et al. Ontaratue K-4 well and in the Triad B.P. Arco C.C. Hume River A-53 well southwest of Fort Good Hope on the northeast side of Peel Trough. Coal-bearing strata which outcrop on Arctic Red River on the southwest side of Peel Trough are considered to be Aptian, but may be Mississippian in age. Peel Trough appears to be essentially part of the system of orogenic foredeeps extending southward along the length of the Cordillera. Its southern and western shoreline during most of the Albian probably was to the south in the area of the present Mackenzie Mountains because no clearly identifiable shoreline facies of that age are preserved today. In Late Albian time Peel Trough became linked to Great Bear Basin by a connection across the southern part of Keele Arch. The first recorded effect of the Cordilleran landmass to the southwest on Peel Trough sedimentation is represented by the Middle Albian Sans Sault Formation which contains abundant reworked late Paleozoic palynomorphs for which there is no eastern source.

In the portion of northwestern Peel Trough included in this report no rocks younger than the Turonian (uppermost Trevor Formation) are found, whereas in the southern part marine deposition continued into latest Cretaceous time, and, although a change from marine to nonmarine deposition occurred, sedimentation appears to have been continuous into the Paleocene. Late Cretaceous marine sandstones (Little Bear Formation and an unnamed sandstone member of the East Fork Formation) and Paleocene nonmarine conglomerates and sandstones (Summit Creek Formation) were derived from the Cordillera to the southwest.

Great Bear Basin

Great Bear Basin existed as a structural and at times depositional basin at various times during the Paleozoic and Mesozoic, essentially corresponding to periods of uplift along the adjacent Keele Arch. During the Early Albian and possibly earlier, mature quartz sands filled in existing topography with local relief of up to 59 m (G.K. Williams pers. com., 1977). Deposition at that time appears to have been essentially the same as on the broad Carnwath Platform to the north and northwest. In fact Carnwath Platform can be considered to have included the area of Great Bear Basin in Aptian and part of Albian time. The Cretaceous basin developed in the Middle Albian during and following which time rapid subsidence allowed the accumulation of up to 865 m of marine sandstone and shale. The adjacent Keele Arch apparently received no sediment during that period, but does not seem to have acted as an important source area, although the details of stratigraphic and sedimentational relationships between subsurface and surface sections have yet to be determined.

Great Bear Basin and Peel Trough appear to have been linked due to subsidence of the southern portion of Keele Arch, beginning in Late Albian time and continuing into the Paleocene. The occurrence of Maastrichtian and Paleocene rocks on both east and west sides of Great Bear Basin leads to the supposition that rocks of these ages were once deposited across the basin. They may be represented in part by an undated younger sequence identified tentatively by G.K. Williams (pers. com., 1978) in the subsurface in the central part of the basin.

STRATIGRAPHY

Introduction

The Cretaceous stratigraphy of the report area is discussed in terms of the three principal basins: Anderson Basin, Peel Trough and Great Bear Basin.

For the following discussion of stratigraphy and paleogeography, paleontological control for Peel Trough and Great Bear Basin is presented in Appendix II and keyed to the text. Locations of fossil collections are shown on the paleogeographic maps (Figs. 31 to 37). Biostratigraphic data for Anderson Basin have been presented previously in reports by Yorath et al. (1975), Brideaux and McIntyre (1975), Brideaux and Fisher (1976) and Doerenkamp et al. (1976) and are not included in Appendix II nor are their locations indicated on the paleogeographic maps. Only collections which have yielded ages specific to the time interval represented are shown. Collections of a general temporal category such as "Early Cretaceous" or "Cretaceous" are excluded. Additional published paleontological information is referred to in the text but is neither shown on the maps nor included in the appendix. Stratigraphic cross-sections (Figs. 4 and 5) show the locations of all GSC Locality Numbers from each well or section in Peel Trough and Great Bear Basin.

The discussion of stratigraphy in Anderson Basin will be comparatively brief owing to extensive published reports on the area that have described these strata in some detail (Yorath et al., 1969, 1975; Yorath and Balkwill, 1969, 1970; Balkwill and Yorath, 1970, 1971). The stratigraphic nomenclature introduced by Yorath et al. (1975) for the Franklin Bay and Malloch Hill map-areas (95 C and F) is herein applied to the entire Anderson Basin.

During the Early Cretaceous a nonmarine and subsequent marine connection between Anderson Basin and Peel Trough existed across Carnwath Platform. This resulted in thin, nonmarine sandstone and marine mudstone and siltstone deposits across the platform, which are today poorly and intermittently exposed. Although these deposits link Anderson Basin and Peel Trough they are readily assigned to the Langton Bay Formation of Anderson Basin and consequently will be treated under that heading. The boundary between Carnwath Platform and Peel Trough (Fig. 3) is chosen to be represented by the depositional limit of basal nonmarine sandstones (assigned to Gilmore Lake Member of Langton Bay Formation of Anderson Basin). The Mackenzie River for much of its course through that area more or less follows that limit.

Stratigraphic descriptions of Cretaceous units in Peel Trough have been published by Yorath (in Aitken and Cook, 1974) and Aitken et al. (in press) as well as by Cook and Aitken (1975). Nonetheless, stratigraphic relationships in this region are complex, and at the risk of repetition, discussion of Cretaceous stratigraphy and correlations is more extensive than for Anderson Basin.

Another Early Cretaceous connection across Carnwath Platform probably existed between Anderson and Great Bear Basin. Exposures on the eastern part of the platform are extremely rare, but those present are basal sandstones which also are assigned to the Gilmore Lake Member.

The Cretaceous stratigraphy of Great Bear Basin depends greatly upon subsurface information, particularly with regard to Lower Cretaceous strata. A significant problem exists in correlating surface and subsurface strata. Available paleontology indicates that subsurface strata in the central part of the basin are Middle Albian or older, whereas many outcrops on the flanks of the basin are Late Albian or younger. Accepting the paleontology as valid the authors advance a tectonic model which accommodates these ages. At the same time they recognize that future paleontologic studies may refine age assignments and substantially modify the model.

A discussion of stratigraphy of the Beaufort-Mackenzie Basin, the northeast corner of which occurs within the map-area, is excluded from this report. For a full treatment of this basin the reader is referred to Young et al. (1976).

Anderson Basin - Cretaceous stratigraphy

Introduction

The Cretaceous rocks of Anderson Basin consist of a series of sandstones and mudstones that comprise a gentle northwesterly dipping homocline extending from Carnwath Platform to beneath the Tertiary and Quaternary cover of Arctic Coastal Plain. From west to east they successively truncate older Paleozoic rocks and ultimately, on the western flank of Coppermine Arch, they are in contact with strata of Proterozoic age.

The principal exposures of Anderson Basin occur in the valleys of the Anderson, Horton, Hornaday, Brock and Kugaluk Rivers and their tributaries. Additional outcrops occur along the Smoking Hills escarpment facing Franklin Bay and in the numerous small uplands and plateaux east and northeast of Travaillant Lake. Numerous small exposures which occur on Carnwath Platform are included in the discussion of the Anderson Basin.

Lower Cretaceous - Darnley Bay Group

The Darnley Bay Group of Neocomian (possibly Late Jurassic) to Middle Albian age (Yorath et al., 1975) occurs within Anderson Basin and discontinuously across Carnwath Platform. The group is divided into two formations: the lower Langton Bay Formation, and the upper Horton River Formation. The former is further divided into two members: a lower nonmarine Gilmore Lake Member and an upper, marine Crossley Lakes Member. Those members comprise the discontinuous outcrops across Carnwath Platform. Lower Cretaceous rocks occurring in the core of a pingo about 10 km east of Horton Lake suggest the presence of this series beneath the extensive drift-covered region north of Great Bear Lake and consequently Aptian and Albian deposition is interpreted on Figures 31 and 32 as having extended through that region.

The Langton Bay Formation represents the basal unit of a transgressive epicontinental sequence, composed of nonmarine, fluvial sandstones, derived through erosion of adjacent highlands represented by Coppermine Arch and deposited mainly on Carnwath Platform. Onlapping marine siltstones and mudstones invaded the platform craton from the boreal sea to the north, and from Peel Trough to the southwest.

The Darnley Bay Group lies unconformably on Paleozoic strata and is overlain disconformably by rocks of the Upper Cretaceous Amundsen Gulf Group.

Langton Bay Formation - Gilmore Lake Member

Lithology and distribution. The Gilmore Lake Member of the Langton Bay Formation has its type section on Horton River near Gilmore Lake (Yorath et al., 1975). The member comprises nonmarine sandstones with minor coal and mudstone beds. It occurs in discontinuous exposures across Carnwath Platform, along the southeast flank of Anderson Basin from where it disappears northward into the subsurface and where it was penetrated by the Elf Horton River G-02 well on the northwest flank of Anderson Basin (*see* Fig. 31, and Table 1).

At the type section the Gilmore Lake Member consists of 67 m of nonmarine, fluvial sandstones with interbedded, thin, low grade coal seams near the base. There the unit overlies the Devonian Bear Rock Formation, large angular blocks of which are incorporated into the lowermost beds (Fig. 7). Sedimentary structures include large scale cross-bedding, scour and fill channels, convolute lamination, the geometry and relationships among which suggest a point bar origin for the section. Northward along Horton River and within the Hornaday River valley the Gilmore Lake Member becomes finer grained, argillaceous and intertongues laterally with the overlying dark grey mudstones and siltstones of the Crossley Lakes Member.

FIGURE 7. *Poorly indurated sandy mudstone, sandstone and coal of the Gilmore Lake member (type section) disconformably overlying limestone beds of the Devonian Bear Rock Formation. Note large limestone blocks in basal Gilmore Lake beds. 68°51'N, 125°24'W.*

Outcrops of the Gilmore Lake Member occur in the south, southeast, and eastern parts of Anderson Basin, and across the western part of Carnwath Platform (Fig. 8). It occurs in the subsurface of Anderson Basin and is 198 m thick in the Elf Horton River G-02 well (Yorath et al., 1975).

For reasons which will be discussed in another section, the lowermost 85 m of the subsurface section may be equivalent to the Neocomian "Parsons Lake sandstone", an informal name (Cote et al., 1975) for deltaic deposits of that age on the north flank of the Aklavik Arch Complex. On the other hand, Brideaux and Fisher (1976) raise the possibility that these lowermost Gilmore Lake beds are Late Jurassic.

Isolated outcrops of the Gilmore Lake Member occur on the west flank of Coppermine Arch southeast of Delesse Lake (Lat. 68°39'N; Long. 125°07'W). There the unit consists of white, fine- to coarse-grained conglomeratic sandstone and conglomerate resting on an erosion surface with pronounced local relief in the order of several metres. Conglomerate cobbles and pebbles consist of white and grey chert derived from the Lower Ordovician cherty unit of the Franklin Mountain Formation. The distribution of the conglomerate lenses within the channeled disconformity suggests a fluvial origin (Balkwill and Yorath, 1970).

To the northwest, the type section near Gilmore Lake has crossbedding azimuths averaging 315°, which, together with the decreasing clast size in that direction suggests that the Gilmore Lake Member was derived by streams which drained the highlands of the Coppermine Arch. Additional fluvial deposits, assumed to be equivalents of the Gilmore Lake Member occur in the valley of an unnamed stream (Lat. 69°22'N; Long. 120°12'W) northwest of Buchanan River on the northeast side of the arch (Balkwill and Yorath, 1971). Two isolated occurrences of the Gilmore Lake Member are preserved in small grabens along Hornaday River where they rest unconformably upon Proterozoic and Paleozoic rocks (Balkwill and Yorath, *ibid.*).

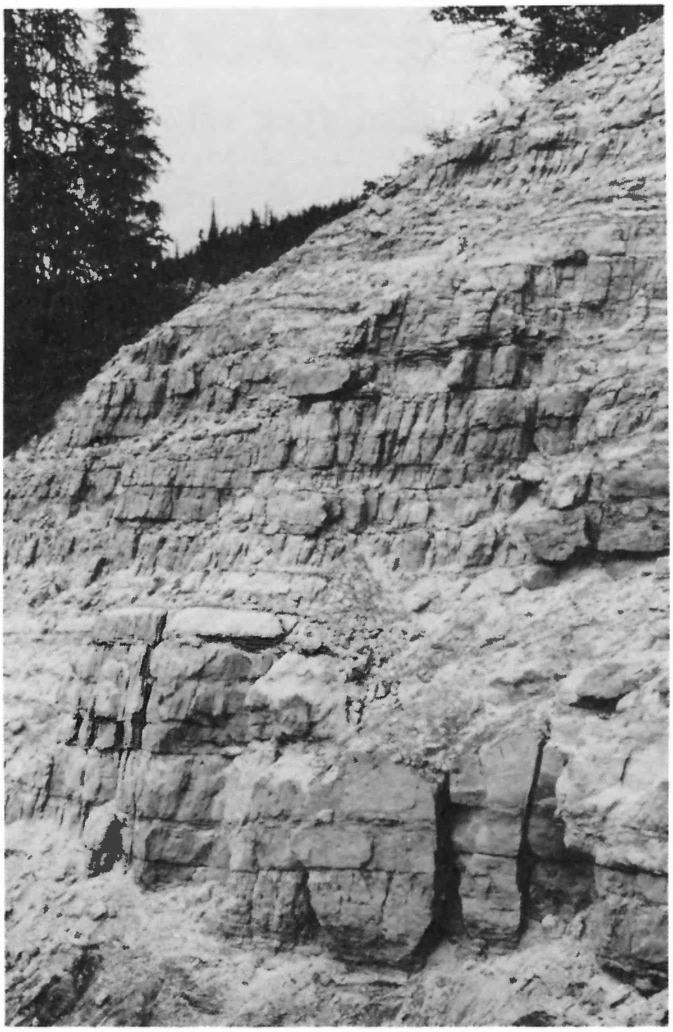


FIGURE 8. *Gilmore Lake member sandstone, Carnwath Platform. 67°37'N, 130 °03'W.*

Across the broad region of the Carnwath Platform the most common basal Cretaceous deposits consist of quartzose and locally oil-stained crossbedded sandstone herein identified as the Gilmore Lake Member. Poorly exposed, discontinuous basal quartz sandstones on the southwest side of Mackenzie River between the mouths of Ontaratue and Ramparts Rivers constitute the southwesternmost exposures of the Gilmore Lake Member. It is not known how far these sandstones extend into the subsurface of Peel Trough; however, they are interpreted to pass westerly into marine sandstones at the base of the Arctic Red Formation. Possible nonmarine equivalents underlying the Arctic Red are noted in the discussion of the Arctic Red Formation.

Grain sizes vary abruptly from fine to coarse and lenses of quartz and chert pebbles occur locally. The sandstone is commonly calcareous. Presumably due to leaching of the calcareous cement most exposures are friable and porous and many consist of unconsolidated white sand. A few exposures of unconsolidated brown fine sand interlaminated with dark grey to black carbonaceous clay were observed.

On Carnwath Platform Gilmore Lake sandstones occupy paleo-depressions with relief of up to 100 m on the sub-Cretaceous unconformity (*see* Fig. 31 and Cook and Aitken, 1975). For example, about 16 km northwest of Fort Good Hope on the west bank of Mackenzie River, oil-stained Gilmore Lake Member sandstone occupies a channel cut into the Ramparts Formation. In the Bluefish River and lower part of the Hare Indian River valleys, well-developed, crossbedded, fine-grained sandstones occur in broad paleotopographic valleys (Cook and Aitken, 1971, 1975). Apparently the modern drainage mimics in part an Early Cretaceous drainage system. In the Hare Indian River valley, well-developed planar cross-bedding indicates Early Cretaceous sediment transport directions averaging about 300 degrees.

Age and correlation. The Gilmore Lake Member at the type section on Horton River is Aptian in age (Yorath et al., 1975; Plauchut and Jutard, 1976; Doerenkamp et al., 1976; Brideaux and McIntyre, 1975). On Carnwath Platform age control is poor but available paleontology suggests an Aptian age [GSC Loc. No. C-10072, C-4314; Appendix II(a)] at least for the lower part. The possibility that the unit includes beds of Albian age cannot be excluded. Indeed, buff shales from about 32 km west of Canot Lake are considered nonmarine and most likely Lower or Middle Albian by W.S. Hopkins [GSC Loc. No. C-5542; Appendix II(b)].

The member is correlated, at least in part, with the basal glauconitic sandstone of the Arctic Red Formation of Peel Trough. Northward into Anderson Basin the Gilmore Lake Member changes facies to mudstone, sandstone, and siltstone of the Crossley Lakes Member and consequently correlates with the lower part of that member. Still farther north in Anderson Basin sandstones assigned to the Gilmore Lake Member again occur below the Crossley Lakes Member. In the Elf Horton River G-02 well, Brideaux identified many diagnostic dinoflagellate cysts which indicate an age for the Gilmore Lake Member ranging from Berriasian-Valanginian at the base to Aptian-Early(?) Albian at the top (Yorath et al., 1975). However, the Valanginian to Barremian stages are missing, (Brideaux and Fisher, 1976, p. 8) indicating a hiatus at a depth of 469 m in the well. The lowermost 85 m of beds assigned to the Gilmore Lake Member may be the temporal and lithological equivalents of the "Parsons Lake Sandstone" (Cote et al., 1975) of Berriasian-Valanginian age (Young et al., 1976) which occurs on the north flank of the Aklavik Arch Complex west of the report area. Conversely, these beds may be Late Jurassic (Brideaux and Fisher, 1976, p. 8).

Contact relationships. The Gilmore Lake Member rests unconformably on Devonian and older rocks, and as described above, tends to fill in paleotopographic relief of up to 100 m.

On Carnwath Platform it is overlain and locally overstepped by the Crossley Lakes Member. Northward into Anderson Basin the Gilmore Lake changes by lateral facies transition to the Crossley Lakes Member of the Langton Bay Formation.

Langton Bay Formation - Crossley Lakes Member

Lithology and distribution. The type section of the Crossley Lakes Member of the Langton Bay Formation is composite, comprising four partial sections, on Horton River in northeastern Anderson Basin (Yorath et al., 1975). The Crossley Lakes Member is widely but mostly poorly exposed throughout Anderson Basin, although it is not present along Eskimo Lakes Arch. The member is in part a lateral facies of the Gilmore Lake Member. Scattered rare outcrops of shale, mudstone, and siltstone overlying Gilmore Lake sands on Carnwath Platform are assigned to the Crossley Lakes Member, but it has not been possible to differentiate them on geological maps.

In the four sections which constitute the composite type section (between Latitudes 69°05'N and 69°13'N on Horton River) the lithology consists in the lowermost (southernmost) section of dark to medium grey blocky mudstone with intercalated beds of fine grained, argillaceous sandstone which passes upwards in the northerly sections into sandy siltstone and mudstone. Rusty-weathering silty carbonate concretions are common throughout and some of the sandstone beds are bituminous. Black, carbonized woody material and thin, low grade coaly lenses occur locally. Coquina beds composed of poorly preserved and broken pelecypods are present in the middle and upper parts of the member, as are well preserved tree trunks a few metres long. The top of the Crossley Lakes Member occurs at the base of a well developed and laterally persistent cone-in-cone carbonate concretionary bed which forms the base of the conformably overlying Horton River Formation. The thickness of the unit is difficult to estimate due to the widely separated exposures of the type section; however, a thickness of 299 m has been illustrated in Figure 10 of Yorath et al. (1975). In the Elf Horton River G-02 well the member is 122 m thick and has much the same lithology as the surface sections.

Downstream along Anderson River from its junction with Carnwath River several partial sections are exposed and have much the same lithology as on Horton River except that the sand and silt content is much less. An estimate of 152 to 183 m for the exposed thickness of the unit on Anderson River has been provided by Yorath et al. (1969). On Hornaday and Brock Rivers and their tributaries the member is locally well exposed downstream from outcrops of the underlying Gilmore Lake Member. To the west, on Kugaluk River, no part of the Langton Bay Formation occurs; however, to the south in the hills adjacent to Hyndman Lake, Crossley Lakes pelecypod bearing, concretionary mudstones cap less resistant Devonian Imperial Formation mudstones. Similar exposures occur overlying Devonian Hare Indian shales east of Andrew River.

On Carnwath Platform, strata of the Crossley Lakes Member overlie the Gilmore Lake Member in areas of paleotopographic depressions, whereas on paleotopographic uplands the Crossley Lakes oversteps the Gilmore Lake to rest unconformably on Devonian rocks. The Crossley Lakes Member, on Carnwath Platform, displays a variable lithology consisting of brownish grey concretionary shales, friable, white sandstone or siltstone interlaminated with dark grey shale and mudstone, and dark grey to black shale. Rare exposures are characterized by orange-weathering, silty and sandy limestone beds several centimetres thick which bear Albian pelecypods [C-10070; Appendix II(b)]. Poorly developed cone-in-cone structures occur locally and are reminiscent of those at the top of the Crossley Lakes Member on Horton River to the north. A few miles north of Little Chicago on Mackenzie River, pale grey, soft mudstone weathers to miniature badland topography (Fig. 9).

Age and correlation. Correlation of the Crossley Lakes Member is illustrated in Table 1. The member appears to be in part a lateral facies equivalent of the Gilmore Lake Member and therefore the lower part is considered Aptian in age. The upper part is Albian based on paleontologic control from Anderson Basin (Yorath et al., 1975) and on a few age determinations from Carnwath Platform [GSC Loc. No. C-2575, C-5439; Appendix II(b)]. The Crossley Lakes Member correlates with the lower part of the Arctic Red Formation and with at least part of the Sans Sault Formation, each of which occur in Peel Trough to the south.

FIGURE 9. *Crossley Lakes Member mudstone, Carnwath Platform. 67°21'N, 130°03'W.*

Contact relationships. The Langton Bay Formation has not been subdivided on the geological map due to the lack of continuity of exposure over most of Anderson Basin and Carnwath Platform. Important stratigraphic relationships are thus not illustrated nor are paleotopographic relationships between the two members and the pre-Cretaceous topography.

In the central part of Anderson Basin the marine Crossley Lakes Member is the basal Cretaceous unit unconformably overlying Paleozoic rocks; near the junction of Anderson, Wolverine, Andrew and Carnwath Rivers the member rests with gentle angular unconformity upon shales and mudstones of the Middle Devonian Hare Indian Formation (Yorath et al., 1969; Yorath and Balkwill, 1969). The member is flanked both to the north and south by partly correlative nonmarine sandstones of the Gilmore Lake Member (Fig. 31). The Crossley Lakes sea in Albian time expanded both to the north, and to the south across Carnwath Platform where the Crossley Lakes Member locally oversteps the Gilmore Lake to directly overlie Devonian rocks. Exposures are rare and poor and the nature of the contact is not known.

In Anderson Basin the Crossley Lakes Member is conformably overlain by the Horton River Formation. The member onlaps Eskimo Lakes Arch and is there overstepped by the Horton River Formation.

Horton River Formation

Lithology and distribution. The type section of the Horton River Formation is composite, comprising three sections located along lower Horton River between Latitudes 69°19'N (base) and 69°27'N (top) (Yorath et al., 1975).

The formation occurs entirely within Anderson Basin, conformably overlies the Langton Bay Formation, and comprises the upper unit of the Darnley Bay Group.

The Horton River Formation (Yorath et al., 1975) consists of a monotonous succession of black, plastic shale containing numerous intervals of rusty-brown weathering ironstone concretions. Iron content of the unit is variable and locally exposures exhibit a banded appearance with dark grey to black shale alternating with rusty-brown weathering beds. Thin silt laminae are localized at the base and top of the formation. The base of the formation is defined as the base of a laterally persistent cone-in-cone limestone concretionary bed, about 0.3 to 0.5 m thick, that occurs throughout Anderson Basin. A characteristic feature of the unit is its widespread tendency to slump. The shale is composed of swelling clays (montmorillonite), and bedrock at many localities is covered with soft sticky mud with numerous embedded concretions, in thick, slowly moving talus fans.

The thickness of the Horton River Formation is variable because of erosion at the disconformity below the overlying Smoking Hills Formation. Moreover, the sections that form the composite type section probably contain gaps and/or overlaps of intervals. An estimate of 152 to 183 m for the formation was given in Yorath et al. (1969). In the Elf Horton River G-02 well, a nearly complete succession of the formation is 235 m thick.

The formation is widely exposed throughout central Anderson Basin. Along Hornaday and Brock Rivers, on the west flank of Coppermine Arch the unit is estimated to be about 91 m thick. Along the Smoking Hills escarpment, the succession is poorly exposed due to active slumping. On Anderson River a composite total of 137 m of Horton River beds occurs in recessive slopes beneath the overlying Amundsen Gulf Group. On Kugaluk River, near its mouth, about 27 m of the formation is exposed beneath the disconformably overlying Smoking Hills Formation. About 1.6 km downstream from this locality, the Devonian Imperial Formation outcrops. Bedding is essentially horizontal and in the absence of any evidence of faults, Yorath et al. (1968) concluded that the Langton Bay Formation is missing due to non-deposition and that the Horton River Formation rests unconformably on the Imperial Formation. This onlap relationship is considered to mark the southeastern limit of Eskimo Lakes Arch (Fig. 32) discussed earlier in the chapter on tectonic elements. In the numerous stream valleys south of Kaglik Lake (Lat. 69°24'N; Long. 129°46'W), including that of Smoke River, the unit is well exposed and commonly overlain by the Smoking Hills Formation.

West of Horton River, about the site of the Elf Horton River G-02 well, a narrow, northwesterly trending inlier of Horton River beds is exposed in juxtaposition with red and yellow strata of the disconformably overlying Smoking Hills Formation. The inlier appears to be due to the presence of a fault on the southeast flank of the subsurface Aklavik Arch Complex (*see* Fig. 25 in Young et al., 1976), where the upthrown side of the fault elevates the Lower Cretaceous succession resulting in a small anticline.

Age and correlation. The Horton River Formation is Middle Albian in age on the basis of microspores and microplankton (Yorath et al., 1975; Brideaux and McIntyre, 1975). The formation appears to correlate with the upper parts of the Arctic Red Formation and the Sans Sault Formation (Table 1).

Contact relationships. The Horton River Formation conformably overlies the Crossley Lakes Member of the Langton Bay Formation everywhere except on Eskimo Lakes Arch where it appears to overstep the Crossley Lakes Member to rest directly and unconformably on the Devonian Imperial Formation.

The Horton River Formation is disconformably overlain by the Upper Cretaceous Smoking Hills Formation of the Amundsen Gulf Group.

Upper Cretaceous - Amundsen Gulf Group

The Amundsen Gulf Group of Late Coniacian to Maastrichtian age (McIntyre, 1974; Yorath et al., 1975) occurs entirely within Anderson Basin. The group is divided into two formations: a lower Smoking Hills Formation and an upper Mason River Formation. It rests disconformably upon the Darnley Bay Group and possesses unique physical and chemical properties which allow it to be easily distinguished from the underlying successions. Characteristic of outcrops of the group is the wide variety of vivid colours, particularly displayed by the Smoking Hills Formation. Hues of yellow, orange and red are common. The overlying Mason River Formation displays very pale greys which appear white in the sunshine from a distance. A further feature is the well developed badland topography eroded from the group on Anderson, and particularly Horton River.

Smoking Hills Formation

Lithology and distribution. The type section of the Smoking Hills Formation (Yorath et al., 1975) occurs on Horton River at Latitude 69°27.5'N where it disconformably overlies the Horton River Formation.

The formation is well exposed throughout north central and western Anderson Basin. On Anderson River, sections vary between 30 and 51 m thick and additional sections on Horton River measured between 30 and 46 m thick. The unit is recognizable but poorly exposed in the upland region west of lower Anderson River southwest of Kaglik Lake. At the mouth of Kugaluk River, 8 m of the formation are exposed overlying the Horton River Formation with sharp disconformable contact (Yorath and Balkwill, 1970). West of the mouth of Horton River, surrounding the site of the Elf Horton River G-02 well, poorly exposed outcrops enclose the northwesterly trending inlier of Horton River Formation beds. To the south between Horton and Anderson Rivers, scattered outliers of the unit are present as well as east of Horton River beneath the uplands adjacent to Smoking Hills escarpment.

At the type section the Smoking Hills Formation consists of 100 m of interbedded black to medium grey, soft but commonly fissile bituminous shale and white to dark yellow and orange-weathering, waxy to crumbly, very thin to thin bedded jarosite. Other constituents are: gypsum (including selenite), quartz, illite, kaolinite, montmorillonite and various aluminous clay minerals. At the base of the type section a few chert pebbles occur scattered throughout the lowermost beds. In other sections, the basal beds consist of a laterally discontinuous but locally well developed conglomerate of variable thickness. The conglomerate consists of pebbles of ironstone, chert, quartzite, carbonates and black angular shale chips, the latter derived from the underlying Horton River Formation. The matrix of the conglomerate is ferruginous, clay-cemented, coarse-grained sandstone. A well exposed occurrence of the basal conglomerate is located about 21 km downstream along Horton River from the type section.

The formation is burning locally at present and, where active combustion is taking place, the outcrops are called "bocannes" (*see* Fig. 10). Sir John Richardson (in Franklin, 1828) was the first to note this phenomenon along the Smoking Hills escarpment in 1826. The location of combustion changes frequently, possibly related to the rate of production of jarosite and hematite in an oxidizing

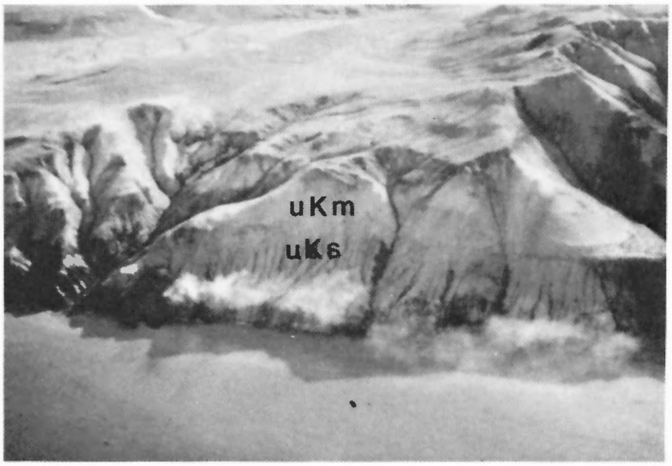


FIGURE 10. *Mason River Formation (uKm) conformably overlying Smoking Hills Formation (uKs), Smoking Hills, west side of Franklin Bay. Note bocanne.*

environment. A.E. Foscolos (pers. com., 1978) has provided the following chemical equation for the reaction based upon the minerals and salts detected by X-ray diffraction of samples of the unit collected on Anderson River:

$$(2Ca).clay + 2[(KAl_3(OH)_6(SO_4)_2)] + 10Fe_2S + 20(O_2) +$$

Bentonite — Alunite — Pyrite — Oxygen

$$48H_2O \longrightarrow K_2O\ 3Fe_2O_3.4SO_3.6H_2O +$$

Water — Jarosite

$$7Fe_2O_3 + 2(Al_2O_3SO_3.14H_2O) + (Al_2O_3SO_4.9H_2O) +$$

Hematite — Aluminum Sulphate Hydrate — Aluminite

$$(4H).clay + 2CaSO_4.2H_2O + 5H_2S$$

Acid clay — Gypsum — Hydrogen Sulphide

All minerals in the equation have been identified and presumably the reaction is aided by the bitumen in the black shales.

A particularly spectacular locality, where several parts of a continuous exposure have often been seen burning, is along the sea cliffs a few miles south of Fitton Point, north of the mouth of Horton River.

Where the formation is burning or has undergone combustion, the exposures are bright yellows, oranges and dark maroons to red. The red material is earthy hematite which is a product of the oxidation reaction. Large gypsum crystals are scattered about the dark scoriaceous appearing outcrops, and where they are actively burning, noxious fumes of hydrogen sulphide are produced. As a note of caution, well exposed outcrops along the Smoking Hills escarpment are dangerous to examine. Frequent spalling of Smoking Hills beds and slumping of the underlying Horton River shales can cause extremely hot material to fall on the unsuspecting observer.

The Smoking Hills Formation contains locally well preserved vertebrate remains. D.A. Russell (1967) of the National Museum has described species of Platecarpus ictericus, Dolichorgynchops osborni and Hesperornis regalis collected from the unit on Anderson River. Two of these are marine reptiles, the first a mosasaur and the second a plesiosaur suggesting open marine conditions of deposition. Hesperornis regalis is a large marine bird (Russell, *ibid.*).

Age and correlation. The Smoking Hills Formation is Coniacian to Campanian in age (McIntyre, 1974; Yorath et al., 1975). It correlates with the Little Bear Formation and in part with the East Fork Formation, both of Peel Trough (Table 1).

Contact relationships. The Smoking Hills Formation unconformably overlies the Horton River Formation. The hiatus represents Late Albian, Cenomanian, Turonian, and probably most of Coniacian time.

The Smoking Hills Formation is overlain with gradational but abrupt contact (Fig. 10) by the Mason River Formation, the uppermost Cretaceous unit in Anderson Basin.

Mason River Formation

Lithology and distribution. The type section of the Mason River Formation (Yorath et al., 1975) is composite and consists of two partial sections, the lower on Horton River at Latitude 69°28'N and the upper at Mackenzie Lake near the mouth of Horton River.

The Mason River is well exposed throughout the lower Horton and Anderson River valleys. It is 179 m thick in the former and estimated to be 137 m thick in the latter. West of Anderson River this poorly exposed formation caps the hills of the upland plateau. At the mouth of Anderson River, at Krekovic Landing a small inlier of the upper member is surrounded by Quaternary drift.

At the type section the Mason River Formation comprises three members. The lower member, 117 m thick, consists of pale grey-weathering, soft, blocky to moderately fissile shale of noticeably low density. In the lowermost 18 m thin beds of yellow jarosite are interbedded with the shale and in the upper 15 m jarosite occurs as thin laminae and lenses. Dark ferruginous carbonate concretions are present commonly in the middle part of the member. The middle member, about 30 m thick, consists of medium- to dark-grey and pale-grey shale with minor interbeds of jarosite. The unit appears banded with dark rusty-brown ferruginous shale at outcrops in valleys tributary to Anderson River. The uppermost member, 32 m thick, consists of medium to dark grey brown ferruginous shale that grades upward into pale grey sandy shale.

Throughout the formation shales have characteristically low densities. Their composition, determined through laboratory studies and thin section examination, consists of amorphous silica, illite, kaolinite, jarosite, montmorillonite and minor gypsum. The amorphous silica is represented by radiolarian spicules and tests.

A specimen of Cimoliasaurus sp. was collected and described by D.A. Russell (1967) from the Mason River Formation of Anderson River. This marine reptile, a plesiosaur, suggests open marine conditions of deposition.

Age and correlation. The Mason River Formation is Campanian to Maastrichtian in age (Yorath et al., 1975). It correlates with the East Fork Formation of Peel Trough and may correlate in part with the mostly older Little Bear Formation.

Contact relationships. The Mason River Formation overlies the Smoking Hills Formation with gradational but abrupt contact. Because it is lighter weathering and more recessive than the underlying Smoking Hills the contact between the two is distinctive (Fig. 10) and one of the more easily mapped Cretaceous contacts in the region.

The Mason Hills Formation is overlain disconformably by unconsolidated sands and gravels tentatively assigned to the Upper Tertiary Beaufort Formation. The contact was not observed.

Anderson Basin - Tertiary(?) stratigraphy

Beaufort Formation(?)

Lithology and distribution. Strata of presumed Tertiary age have been described by Yorath et al. (1969, 1975) and Yorath and Balkwill (1970) in Anderson Basin where they have been mapped between Anderson and Horton Rivers. In this region they have been described as possible equivalents of the Late Miocene to Early Pliocene Beaufort Formation of Banks Island (Hills, 1970). The unit consists of unconsolidated gravel and sand, the latter commonly showing low-angle foreset bedding with a wide range of inferred transport direction but generally indicating a northwesterly paleocurrent trend. The pebbles and cobbles are mainly quartzite, dolomite and black chert. Small wood fragments and some humic material are present in the sands. The unit has a uniform thickness of from 2.4 to 3.0 m and overlies the Mason River Formation between Horton and Anderson Rivers and locally the Smoking Hills Formation west of Horton River although at the latter locality the contact is not exposed. Its identificiation, in the absence of paleontological data, is based on the lithologic similarity of the Anderson Plain beds with the Beaufort Formation of Banks Island. Quaternary sediments described by Rampton (1972) for this region do not resemble the presumed Tertiary sediments either lithologically nor with regard to depositional style. The latter underlie a flat, featureless plain and crop out as benches of uniform height in the small dendritic stream valleys tributary to Anderson and Horton Rivers. The unit appears to have been deposited by a fluvial system that drained the uplifted area of Anderson Basin and as such appears similar in depositional style to the Beaufort Formation of Banks Island.

It should be noted that Plauchut and Jutard (1976, p. 368) deny the presence of Tertiary strata in Anderson Basin.

Anderson Basin - Unnamed Cretaceous(?) or Tertiary(?) rocks

Lithology and distribution. On the west flank of Maunoir Ridge (Lat. 67°09'N; Long. 125°05'W) south of Lac Maunoir a limonite-cemented conglomerate (Fig. 11) has been deposited against a scarp of lower Paleozoic Franklin Mountain Formation dolomite (Cook and Aitken, 1971). The scarp resulted from erosion of the anticline which forms Maunoir Ridge and thus the conglomerate post-dates the formation of the ridge. The deformation which formed Belot and Colville Ridges to the west post-dates Early Cretaceous sandstone of the Gilmore Lake Member (*see* Cook and Aitken, 1971). If Maunoir Ridge formed at the same time then the hematite-cemented conglomerate is also younger than Early Cretaceous. A single spore genus Gleicheniides from the conglomerate indicates a Jurassic or Cretaceous age to W.S. Hopkins [GSC Loc. No. C-4318; Appendix II(g)]. This, combined with the above structural consideration, requires that the conglomerate be Late Cretaceous in age.

FIGURE 11. *Unnamed Cretaceous or Tertiary limonite-cemented conglomerate, Maunoir Ridge. 67°18'N, 125°16'W.*

Nonetheless, these strata are unlike any other Cretaceous rocks in the region and the possibility that they are Tertiary with the Gleicheniides re-worked from older rocks cannot be eliminated.

Peel Trough

Introduction

Peel Trough, as preserved today, is an arcuate structural trough lying northeast of and parallel to the Mackenzie Mountain front (Fig 3). The trough is broad to the northwest and narrows to the southeast. Subsidence and deposition were initiated in the northwestern part of the basin with deposition of Aptian marine strata of the lower Arctic Red Formation. Continued subsidence into the Middle Albian is recorded by most of the Arctic Red Formation and the Sans Sault Formation. During Late Albian to Turonian time, Peel Trough expanded southeastward across the southern part of Keele Arch, as marked by shales of the Slater River Formation and unnamed basal conglomeratic sands. In the northwestern part of the basin during the same period sandstones of the Trevor Formation were being deposited. Deposition to the northwest appears to have terminated with the Trevor Formation although the possibility that younger rocks have been removed by erosion cannot be excluded. In the southeastern part of the basin deposition continued throughout the Late Cretaceous and into the Paleocene resulting in deposition of the Little Bear, East Fork and Summit Creek Formations.

Throughout the basin the quantity and quality of exposures varies widely. Sandstone successions are commonly well exposed whereas shale and mudstone sequences are largely covered. Facies changes are common and in part interpreted within the limits of available lithologic and paleontologic control.

In addition to the papers of Hume (1924, 1954), Tassonyi (1969), and the several unpublished Canol Project reports, some more recent reports describe the Cretaceous and Tertiary stratigraphy of parts of Peel Trough (Yorath, 1970; Yorath and Cook, 1972; Yorath in Aitken and Cook, 1974; Aitken et al., in press). These reports utilize the nomenclature proposed by Stewart (1945) for the southeastern part of the basin (Sans Sault, Slater River, Little Bear, and East Fork Formations), and that proposed by Mountjoy and Chamney (1969) for the northwestern part of the basin (Arctic Red and Trevor Formations). In this report some modifications in definition of the old nomenclature are introduced and one new name is added.

There are a number of problems relating to Cretaceous nomenclature in the area, not the least of which is due to the establishment of names by Canol geologists in 1942 who, under very difficult conditions, conducted stratigraphic studies in limited areas without the advantage of palynology, extensive exploratory drilling, and regional observations using helicopters. Until recently little has been published on the existence of Keele Arch (Cook, 1975), and its potential influence on sediment type and distribution has not been considered in published reports. Exploratory drilling by petroleum companies has permitted the understanding of regional stratigraphic relationships, and moreover, has penetrated complete and thick "basin center" sections of the formations whereas heretofore our knowledge of these units was derived almost exclusively from inadequately documented condensed sections at the basin margins.

Relationship of present to previous studies of Cretaceous rocks - Peel Trough

Canol Project geologists (J.M. Parker, A.W. Nauss, L.R. Laudon, F.A. McKinnon, E.J. Foley, V.B. Monnett, W.P. Hancock, G.D. Bath and C.R. Stelck) carried out stratigraphic studies of Cretaceous rocks in Peel Trough. Their several reports were summarized by Hume (1954) who used Stewart's (1945) nomenclature. Subsequently Tassonyi (1969) extended this nomenclature into the subsurface and relied greatly upon the Canol Reports for his correlations. The present report modifies the application of Stewart's nomenclature and introduces new stratigraphic units and terminology to account for recent biostratigraphic and lithostratigraphic information from both the surface and subsurface rocks. The following is therefore a brief statement describing previous studies as they pertain to terminology and related stratigraphic information.

Aitken, Cook and Yorath (in press) restricted the use of Sans Sault Formation to the region adjacent to Mackenzie River and between Fort Good Hope and a point about 26 km northwest of Norman Wells. Correspondingly they extended the use of the Arctic Red Formation eastward to include mountain front sections previously assigned (*see* Hume, 1954; Tassonyi, 1969) to the Sans Sault Formation, Sans Sault Group, Sperry shale, and Slater River Formation. The application of Sans Sault and Arctic Red Formations by Aitken, Cook and Yorath (in press) is followed in this report.

The Slater River Formation is excluded from the region northwest of Slater River. Strata previously identified as Slater River at Imperial River and Mountain River are designated as Arctic Red Formation, part of which is probably correlative with Slater River strata as used in this report (*see* Fig. 4). The Slater River is mainly the temporal equivalent of the Trevor Formation (Fig. 12), a unit not recognized by Canol geologists. At Imperial and Mountain Rivers, strata heretofore named Little Bear Formation (Hume, 1954; Tassonyi, 1969) are herein identified as Trevor Formation.

The Little Bear Formation does not occur in mountain front areas northwest of the Aquitaine Dodo Canyon K-03 well. It and the overlying East Fork Formation are used more or less as they were originally defined; however, as previously suggested, the Little Bear may in part be a facies equivalent of the East Fork Formation. The latter has been modified to include an unnamed sandstone member, a unit not recognized by Canol and later studies.

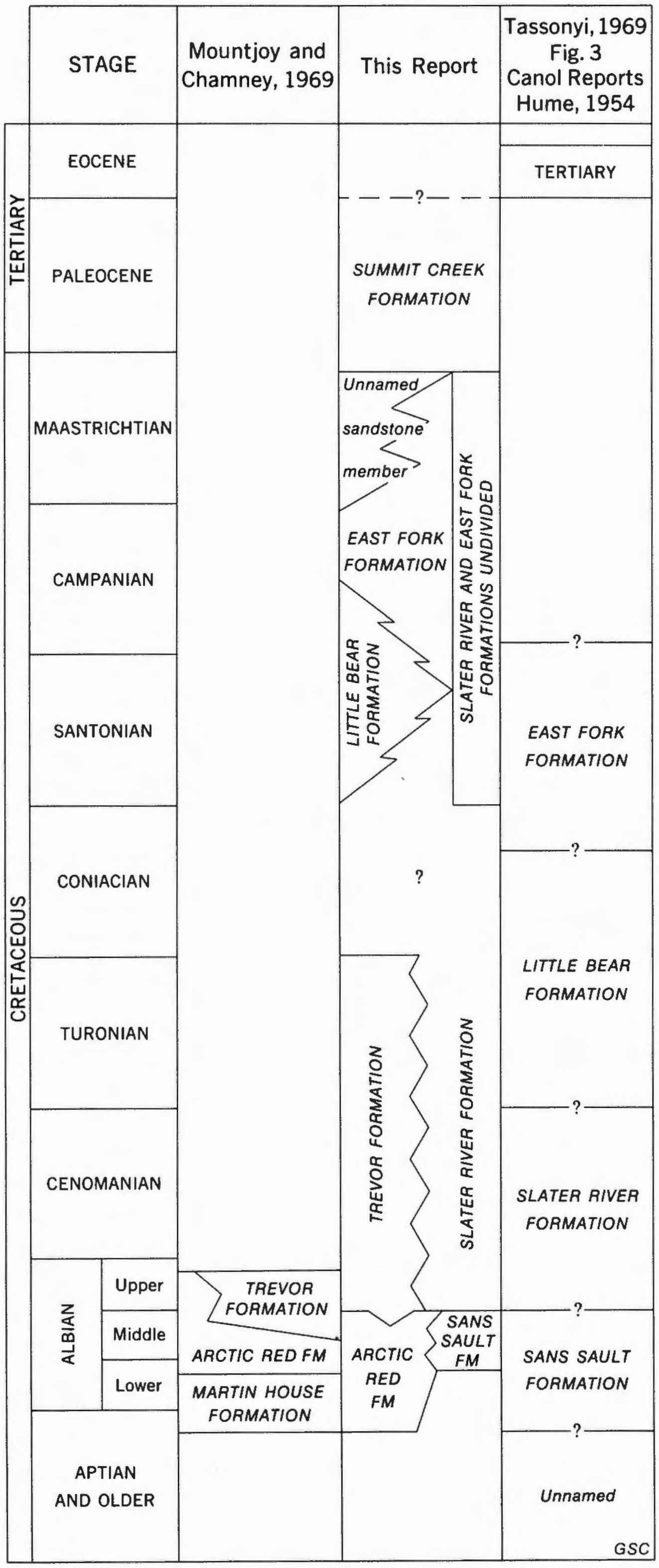
The work of E.J. Tassonyi (1969) is a carefully compiled compendium of what was then known of the Cretaceous stratigraphy of the area of Peel Trough. Although his report presents extensive subsurface information, he was limited to what had already been published on fossil collections and descriptions of surface outcrops of the region; modern collections and micropaleontological studies, particularly from the subsurface were unavailable to him. Consequently, with the regional information derived from Operation Norman and subsequent subsurface data the authors here modify some of what Tassonyi illustrated. For a full discussion of previous Cretaceous nomenclature and correlations, the reader is referred to Tassonyi (*ibid.*). Table 2 briefly summarizes previous work in the report area and adjacent region and relates these to conclusions presented in this report.

To some extent the identification and designation of a formation name to a particular sequence in Peel Trough is subjective, depending largely upon the relative proportion of arenites in the section. Paleontological control in some places lacks sufficient precision to clearly define the age limits of closely juxtaposed sequences. Moreover, facies changes, interpretable only in the subsurface, occur across relatively broad belts of poor exposure. For example, on the geological map the facies change between the Trevor Formation and the Slater River Formation has been drawn arbitrarily across Mackenzie Plain. The precise locus of the facies change is unknown as nowhere are the two formations observed in lateral continuity. Furthermore, several of the subsurface sequences have not been studied by the authors, reliance being placed upon descriptions by other workers, thus subjective continuity has suffered.

FIGURE 12. *Trevor Formation, Arctic Red River.*

TABLE 2

Correlation chart showing relationships of stratigraphic nomenclature of Peel Trough used in this report and that of earlier reports



Lithostratigraphic correlations of surface and subsurface sections, including paleontological control, more or less along the axis of the Peel Trough are shown in Figure 4. Surface, basin margin type-sections are illustrated adjacent to their nearest equivalent subsurface section in the southern half of the profile.

Stratigraphic descriptions of sections studied by Yorath in Peel Trough appear in Appendix I. The sections described occur on Hume, Slater, Little Bear and East Little Bear Rivers, at Sans Sault Rapids on Mackenzie River, and at MacKay Range and on an unnamed creek draining the uplands west of Tate Lake.

Peel Trough Cretaceous stratigraphy

Arctic Red Formation

Lithology and distribution. The Arctic Red Formation was proposed by Mountjoy and Chamney (1969) to describe a succession of mudstones and shales of Early Cretaceous (Albian) age that occur in the Snake and Peel Rivers region of the Peel Plateau, west of the study area. This name is herein used for a succession of concretionary and silty, recessive shales, mudstones and basal sandstone and conglomerate, that disconformably overlie strata of the Upper Devonian Imperial Formation between the Mackenzie Mountain front and the Mackenzie River.

Within the report-area the formation is thickest in the west, with a thickness of 1588 m in the Candel Texaco et al. Arctic Red F-47 well. It thins progressively southeastward apparently by depositional onlap. About 48 km southeast of Norman Wells both the Arctic Red and the overlying Trevor Formations are replaced to the southeast by the Slater River Formation. A large area, in the western part of the report-area, drained mainly by the Ontaratue River and extending north to the Mackenzie River is underlain by poorly exposed shale and minor sandstone that are assigned to the Arctic Red Formation. Between Norman Wells and Fort Good Hope the upper part of the Arctic Red changes facies northeastward to become the arenaceous Sans Sault Formation.

The most complete section of the Arctic Red Formation occurs along a small creek, tributary to Hume River (Lat. 65°24'N; Long. 129°57'W) (Appendix I). Other less complete sections occur along Mountain River on the north flank of Imperial Anticline (Lat. 65°26'N; Long. 129°11'W), and within the valley of Imperial River; each section is in contact with structurally concordant strata of the Devonian Imperial Formation.

Three subdivisions of the Arctic Red Formation are recognizable over most of its area of occurrence. A lowermost glauconitic sandstone unit is overlain by a middle fossiliferous concretionary mudstone unit which is overlain in turn by a silty concretionary mudstone unit.

On Hume River the Arctic Red Formation occurs in a section dipping 45° northward. The basal glauconitic sandstone is 12 m thick and consists of medium brown-weathering, generally medium bedded, fine grained, well sorted, argillaceous and glauconitic sandstone; sandy mudstone and minor shale-chip and chert pebble conglomerate occur near the base in discontinuous lenses. A prominent horizon of clay-ironstone concretions occurs in the middle of the unit. The sandstones are vertically burrowed, with minor tool marks, small scale flute casts and local convolute laminations. The middle fossiliferous concretionary mudstone unit is 592 m thick, and consists of dark grey to black, blocky and locally fissile concretionary mudstones. The concretions contain poorly to well preserved ammonites and in the lower part of the section display a "disk-and-ball" geometry which is common to concretionary shale outcrops in proximity to the basal glauconitic sandstone in adjacent areas (e.g. on Ontaratue River). In the uppermost 183 m of this unit, thin seams (0.7 to 2.5 cm) of pale-grey to pale-yellow bentonite are present in irregularly distributed intervals. Within this same part of the section the silt content of the mudstones increases, and near the top argillaceous siltstones are interbedded with nodular and rusty-weathering mudstones. The uppermost silty concretionary mudstone unit of the Arctic Red Formation at Hume River consists of approximately 625 m of poorly exposed, locally concretionary, interbedded dark grey and rusty-weathering mudstone, and medium-grey, commonly rusty-weathering, fine-grained, locally calcareous and argillaceous sandstone and siltstone. The few concretionary intervals lack well preserved fossils. In the Hume River area this part of the section mainly outcrops between the mouth of the small tributary creek and the southward flowing segment of Hume River, approximately 1.6 km to the west, where the gradationally overlying Trevor Formation is well exposed. The thickness of the upper part of this upper member was estimated from regional attitudes on air photographs.

On Mountain River the Arctic Red Formation is 616 m thick on the north flank of Imperial Anticline, and is moderately well exposed. The basal glauconitic sandstone unit overlies the Imperial Formation, and comprises 15 m of conglomerate and glauconitic sandstone (Fig. 13). The fossiliferous concretionary mudstone unit comprises 601 m of concretionary shale and mudstone. The uppermost silty concretionary mudstone unit of Hume River appears to be absent due to facies change to sandstones of the Trevor Formation.

Black, rusty-weathering, plastic shale is the most common lithology of the Mountain River section where "disk-and-ball" concretions occur close to the glauconitic basal sandstone, and where thin bentonite seams and siltstone laminae occur near the top. Only one ammonite, "Gastroplites" n. sp. A [GSC Loc. No. C-10032; Appendix II(b)] was collected immediately below the basal contact of the overlying Trevor Formation; however, a few poorly preserved ammonites were observed in broken concretions in the scree.

Additional partial exposures of the Arctic Red Formation occur widely throughout the region. On Arctic Red River, at Latitude 65°27'N, a thin basal sandstone and interbedded mudstone unit contains thin, low grade coal seams. These beds may be Mississippian because they occur southwest of the zero-edge of Mississippian strata (*see* Fig. 2) and because D.C. Pugh (pers. com., 1978) finds coal locally in Mississippian rocks in the subsurface. On the other hand, in the Atlantic et al. Ontaratue K-4 well, Pugh (pers. com., 1978) recorded from beneath the Arctic Red Formation coal-bearing shales dated by Ioannides as Early Cretaceous [C-15567; Appendix II(a)]. The coal-bearing beds at Arctic Red River probably represent similar locally developed nonmarine Early Cretaceous beds. That unit is succeeded by discontinuous outcrops of poorly exposed concretionary shale for about 11 km downstream. Incomplete exposures occur beneath the sandstones of the Trevor Formation within stream valleys tributary to Arctic Red, Cranswick and Ramparts Rivers. On the south flank of Imperial Anticline on Gayna River and other streams tributary to Mountain River, small outcrops of the lowermost part of the concretionary shale member and basal glauconitic sandstone member are exposed above the Imperial Formation. On Ontaratue River the basal glauconitic sandstone contains poorly preserved pelecypod bivalve impressions. The

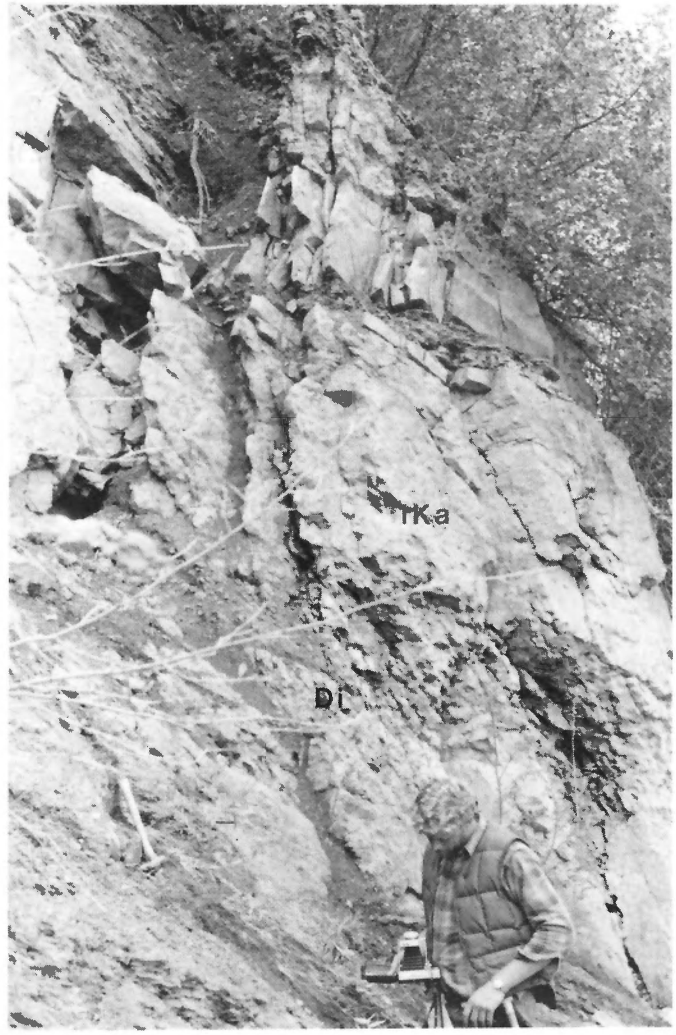


***FIGURE 13.** Contact of basal sandstone of Arctic Red Formation (1Ka) with Devonian Imperial Formation (Di), north limb of Imperial Anticline at Mountain River.*

sandstones are overlain by discontinuous outcrops of the fossiliferous concretionary mudstone unit which locally yield well preserved ammonites.

To the southeast along Imperial River, and on the southwest limb of Imperial Syncline, a poorly exposed succession, 902 m thick, of beds assigned herein to the Arctic Red Formation is exposed. The lowermost 46 m, designated as the basal glauconitic sandstone unit consists of a basal conglomerate composed of flat and rounded pebbles of chert, carbonates, quartzite and abundant dark grey-green Imperial Formation shales within a matrix of fine sandstone and mudstone, overlain by a succession of interbedded yellowish grey-weathering, massive to thin bedded, glauconitic, argillaceous burrowed sandstone and sandy mudstone. Towards the top of this interval are a few zones of black shale and interbedded sandstone. Downstream from the basal unit is a very poorly and intermittently exposed succession of the fossiliferous concretionary mudstone unit, approximately 518 m thick. Outcrops consist of soft, plastic concretionary shale and mudstone, largely covered and slumped. The uppermost silty concretionary mudstone unit, approximately 335 m thick, is somewhat better exposed and comprises interbedded rusty-brown-weathering, fine grained, dense, locally glauconitic sandstone and interbedded blocky and rusty-weathering locally concretionary and fossiliferous mudstone. The sandstones appear lenticular and commonly shale out downstream along the river. Where well exposed they commonly show well developed current ripples and low-angle cross-bedding.

In the axial area of Imperial Syncline the Arctic Red Formation is conformably but abruptly overlain by dense sandstone and mudstones of the Trevor Formation (Fig. 14).

The Arctic Red Formation has been penetrated in a number of exploratory wells in Peel Trough. In all of the wells the stratigraphy is more or less like that of surface sections and in some the three-fold division of the formation is recognizable.

The following list shows the thickness of the formation in metres and its components in the wells studied:

Well Name	Basal SS.	Foss. con. mudstone unit	Silty con. mudstone unit	Total
1. Arctic Red F-47	15	473	1113	1601
2. N. Ramparts A-59	15	744	515	1274
3. Cranswick A-22				76
4. Loonex No. 1				302
5. Loon Ck. No. 1				46
6. Dodo Canyon K-03		302	146	448
7. Hume River L-09				607
8. Mountain River A-23				376

The southernmost section of recognizable Arctic Red Formation appears in the Aquitaine Dodo Canyon K-03 well. Southeastward from there the formation probably changes facies to black shales of the lower part of the Slater River Formation.

Age and correlation. The age of the Arctic Red Formation, in the Upper Ramparts River (106 G) and Sans Sault Rapids (106 H) map-areas is Aptian to late Middle or early Late Albian (Aitken et al., in press). Fossil localities are shown on Figure 32 and fossil identifications are provided in Appendix II(b). At Imperial River, a solitary specimen of Beaudanticeras (Grantziceras) affine was collected approximately 613 m above the base of the formation (about 76 m above the base of the silty concretionary mudstone unit), indicating an age of late Early to early Middle Albian [GSC Loc. No. C-9145; Appendix II(b)]. One sample collected about 152 m above the base of the silty concretionary mudstone member (76 m above the Beaudanticeras collection) yielded a large number of Late Jurassic and Early Cretaceous (Hauterivian to Barremian) palynomorphs and dinoflagellates [GSC Loc. No. 33956; Appendix II(g)]. These taxa are considered to be contaminants from reworked older beds presumably located in the Cordilleran region, otherwise structural complications involving at least one substantial thrust fault, for which no other evidence has been observed, must be assumed for the regional interpretation of the geology. Other samples from the Arctic Red Formation yielded palynomorphs and dinoflagellates of an undifferentiated Hauterivian to Senonian age.

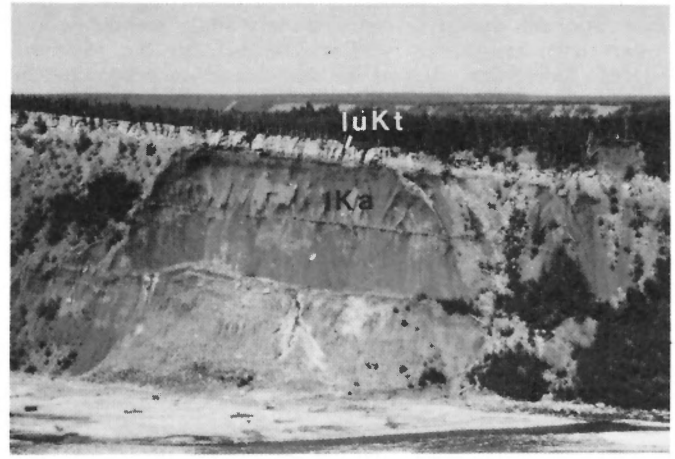


FIGURE 14. *Trevor Formation (luKE) overlying Arctic Red Formation (1Ka), Imperial River.*

In the Aquitaine Dodo Canyon K-03 well, three samples from depths of 488, 701 and 854 m yielded palynologic assemblages of an undifferentiated Albian age (GSC Loc. No. C-30268; Appendix II(b); Fig. 4).

The Arctic Red Formation correlates with the Langton Bay and Horton River Formations with which it probably was co-extensive; the Mackenzie River is selected arbitrarily as the boundary between the Crossley Lakes Member and the Arctic Red Formation. The upper part of the Arctic Red changes northeastward by facies transition to the Sans Sault Formation, a mudstone and sandstone succession. Because the transition zone migrated northeastward with time the interpreted trace of the zone (Map 1498A) at surface is farther to the northeast than it is in the subsurface. For the middle and upper units of the Arctic Red the facies change to Sans Sault Formation occurs near the locations of Hume River L-09, Mountain River H-23, Loonex No. 1, and Loon Creek No. 1 wells. Tassonyi (1969, Fig. 10) showed the pertinent section in each of these wells as Sans Sault Formation, whereas the authors assign these rocks to the Arctic Red Formation because the arenite content in each well is markedly subordinate to mudstone. However, the lowermost 97 m of the Cretaceous section in Loonex No. 1, and lowermost 116 m in Loon Creek No. 1 are assigned to the Sans Sault Formation on the basis of the sandstone content.

Rocks equivalent in part to the Arctic Red Formation occur in Great Bear Basin, however deposition in the two basins was independent due to the intervening Keele Arch.

The Arctic Red Formation of the report area encloses strata equivalent to the type section of the formation and the underlying Martin House Formation on Snake and Peel Rivers in eastern Yukon Territory. No fossils have been recovered from the basal glauconitic sandstone within the report area. It is, however, considered to be Late Aptian (*see* Aitken et al., in press), and correlative with the Glauconite Member of the Martin House Formation to which Mountjoy and Chamney (1969), have assigned an Aptian age. A single fossil collection from immediately above the glauconitic sandstone near Mountain River represents the earliest Albian zone [C-10035; Appendix II(b)]. The overlying fossiliferous concretionary and silty concretionary shale members of the report area are closely similar lithologically but temporally slightly older than units of the same name on Snake and Peel Rivers.

In eastern Yukon, Mountjoy and Chamney (*ibid.*) recognized two distinct facies belts within the Arctic Red Formation. Closest to the mountain front they identified a silty shale facies which they divided into three members, and a concretionary shale facies, northward removed from the mountain front which they subdivided into two members of the same names and lithology that are used for the upper two members of this report. The silty shale facies is not recognized in the report area and the writers assume that this facies loses definition eastward around the mountain front where it is replaced by the concretionary shale facies.

Contact relationships. The Arctic Red Formation unconformably overlies the Upper Devonian Imperial Formation over most of its area of occurrence. It intertongues with the Sans Sault Formation which it oversteps to the northeast.

The Arctic Red is overlain by sandstones of the Trevor Formation with which it intertongues. The nature of the contact will be more fully described under the heading of the Trevor Formation.

Sans Sault Formation

Lithology and distribution. The Sans Sault Formation was first named and described in an unpublished Canol report by Parker (1944). The name "Sans Sault group" was first published by Stewart (1945). The type section of the formation, adjacent to Sans Sault Rapids in Mackenzie River, is well exposed on the east bank close to the Middle Devonian Ramparts Formation, on the north flank of East Mountain anticline. The contact with the underlying Ramparts Formation is covered there but is well exposed a few miles to the north at Bat Hills (Fig. 15).

Aitken, Cook and Yorath (in press) restricted the Sans Sault Formation to the region adjacent to Mackenzie River between Fort Good Hope and a point about 26 km northwest of Norman Wells. That treatment is followed in this report. Well exposed partial sections occur in the Bat Hills (Lat. 65°46'N; Long. 128°43'W), on Donnelly River (Lat. 65°52'N; Long. 128°23'W), Maida Creek (Lat. 65°35'N; Long. 128°17'W) and on the west side of Mackenzie River immediately across from the type section. Poor exposures occur along the lower reaches of Carcajou River and in the upland between Chick Lake (Lat. 65°52'N; Long. 128°03'W) and Moon Lake (Lat. 65°38'N; Long. 127°30'W).

In the subsurface the Sans Sault Formation has been penetrated by a number of wells mainly on the west side of Mackenzie River. The maximum measured thickness of 698 m occurs in the Triad L-24 well. The formation thins southward, southwestward, and westward, due to the facies change with the Arctic Red Formation; older Sans Sault beds extend further southwest than younger beds. The formation also thins northeastward partly due to Quaternary erosion and partly due to depositional thinning onto Keele Arch.

At the type section (Appendix I), the lowest exposed beds of the Sans Sault Formation are separated by 12 m of covered interval from the highest exposed strata of the Ramparts Formation. The two formations are structurally concordant and dip towards the north at 68°. The exposed section is 442 m thick and is divisible into three informal members: a lower sandstone and mudstone unit, 69 m thick, a

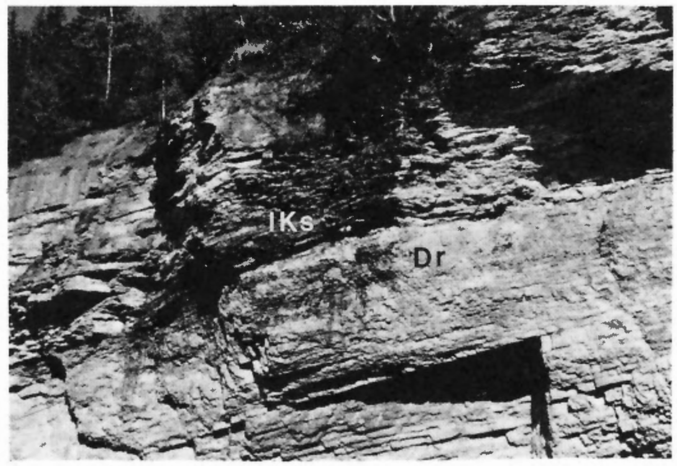


FIGURE 15. *Contact of Sans Sault Formation (1Ks) with Devonian Ramparts Formation (Dr), Batt Hills, Mackenzie River. 65°47'N, 128°47'W.*

middle concretionary mudstone and minor sandstone unit, 274 m thick, and an upper concretionary sandstone and mudstone unit, 99 m thick. A steep fault with small displacement, north side down, occurs at 336 m above the base of the section: the stratigraphic throw is believed to be small resulting in minor omission of section.

The lower sandstone and mudstone unit comprises light to medium brown-weathering, thin-bedded, relatively dense but friable, thinly laminated, calcareous sandstone interbedded with 15 to 60 cm thick intervals of dark grey, locally rusty-weathering, blocky, sandy mudstone. Ironstone concretions occur at the top of the unit.

Exposure of the middle concretionary mudstone and sandstone member is discontinuous due to covered intervals. Scattered outcrops of the lower and middle parts of the unit display rusty- and dark-weathering, blocky, calcareous mudstone and argillaceous siltstone interbedded with lesser amounts of light to medium brown-weathering, thin bedded, laminated, fine-grained sandstone. Toward the top of the unit, sandstone and siltstone gradually become dominant and more friable. Sedimentary structures in the sandstone units include low-angle crossbedding and rare burrows and trails.

The upper concretionary sandstone and mudstone unit as compared to the lower unit, is less calcareous, low-angle crossbedding is more conspicuous, and the many concretions contain well preserved pelecypods and ammonites of Early Albian age (GSC Loc. No. 84788 and 84792; Appendix II(b). The upper unit forms the rapids in Mackenzie River adjacent to the type section.

In the upper Donnelly River area, Foley (in Hume, 1954) reported 18 m of sandstone and conglomerate overlain by more than 90 m of dark grey, concretionary, bentonitic shale. Although these outcrops were not observed by the authors, they assume that the shale represents the middle mudstone unit of the Sans Sault Formation.

The following list shows those wells in which the formation has been examined, its thickness and underlying formation. The three-fold division of the formation, recognizable in the type section, has been established in most of the boreholes of the list by Tassonyi (1969).

1. Imperial Sans Sault #1
   Sans Sault Formation - thickness 428 m (Surface to 428 m)
   Underlying Unit: Ramparts Formation

2. Triad Carcajou L-24
   Sans Sault Formation - thickness 698 m (surface to 698 m)
   This thickness may include underlying Imperial Formation strata
   Underlying Unit: Imperial Formation

3. Triad BP Arco CC Hume River 0-62
   Sans Sault Formation - thickness 484 m (20 to 504 m)
   Underlying Unit: Ramparts Formation

4. Amoco Mountain River H-47
   Sans Sault Formation - thickness 69 m (?) (surface to 69 m)
   Underlying Unit: Imperial Formation. The uppermost 49 m assigned to the Imperial Formation are possibly Sans Sault Formation

5. Imperial Loonex #1
   Sans Sault Formation: 97 m (305 to 402 m)
   Overlying Unit: Arctic Red Formation
   Underlying Unit: Imperial Formation

6. Imperial Loon Creek #1
   Sans Sault Formation: 116 m (52 to 168 m)
   Overlying Unit: Arctic Red Formation
   Underlying Unit: Imperial Formation

7. Imperial Ray #1
   Sans Sault Formation: 110 m (482 to 592 m)
   Overlying Unit: Arctic Red Formation (357 m thick) in turn overlain by Trevor Formation
   Underlying Unit: Imperial Formation

8. Imperial Canol Mac #1
   Sans Sault Formation: 92 m (155 to 247 m)
   Overlying Unit: Arctic Red Formation (63 m thick) in turn overlain by surface deposits that may include Trevor Formation strata
   Underlying Unit: Imperial Formation.

In Imperial Loon Creek #1 the lowermost 21 m of the Sans Sault Formation was designated as "unnamed Cretaceous" by Tassonyi (1969, p. 122). His exclusion of this interval from the Sans Sault Formation was based upon the identification by T.P. Chamney of unnamed "spore cases" of assumed Barremian and Aptian age. These spore cases are of doubtful value as age indicators and the writers include the interval in the Sans Sault Formation, on the basis of appropriate lithology and in accordance with Stewart's (1945) definition of the formation which "includes all Lower Cretaceous Strata from the base upward to the first bentonite bed" (Arctic Red Formation of this report).

Age and correlation. Fifteen samples from the lower 396 m of the type section yielded early Middle Albian foraminifers and a poorly preserved microflora no older than Middle Albian in age [GSC Loc. Nos. C-9301 to C-9321; W.S. Hopkins, Jr. and D.H. McNeil, Appendix II(b)]. Macrofossils collected from the upper member [GSC Loc. Nos. 84788, 84792; Appendix II(b)] indicate an early Early Albian age. Although a fault was noted in the type section, which on the basis of the above data suggests thrust repetition placing older strata above younger beds, the authors believe that the biostratigraphic discrepancy reflects differences in precision and/or world standards between the two fossil groups rather than structural displacement. Macrofossils from outcrops of the formation at Donnelly River (GSC Loc. No. 84795) and Maida Creek (GSC Loc. No. C-10023) indicate a late Early to early Middle Albian age.

In their micropaleontological studies of the upper 146 m of the Imperial Loon Creek #1 well, McGill and Loranger (1961) established a general Albian age for this sequence which, in this report, includes most of the Sans Sault Formation and the thin overlying Arctic Red Formation. The core obtained between 116 and 119 m of this well was examined by T.P. Chamney who assigned a Middle Albian age for the interval on the basis of foraminifers (Tassonyi, 1969). As previously indicated, the lowermost 21 m of Cretaceous deposits in this well was excluded from the Sans Sault Formation by Tassonyi on the basis of recovered spore cases obtained from two cored intervals between 147, 150 and 157 to 162 m. The spore cases suggested an "? Aptian and/or Neocomian ?" age for the upper core and possibly a Barremian age for the lower core. This paleontological data is of questionable value and thus this interval has been included in the Sans Sault Formation by the present authors.

Considering all of the above data the Sans Sault can be interpreted to have a general early Middle Albian age (possibly some Early Albian strata occur). Future detailed biostratigraphic studies will doubtlessly modify this assignment. On this basis the Sans Sault Formation correlates with the Arctic Red Formation with which it intertongues to the south and west. It may also correlate with Middle Albian beds of the Trevor Formation situated on the north flank of Imperial Range. If so the Sans Sault could be interpreted as a distal facies of the Trevor Formation. Although attractive, this possibility is negated by present paleontologic control which indicates that the oldest Trevor beds are Late Middle Albian [C-10032; Appendix II(b)] whereas the youngest indicated age for the Sans Sault is Early Middle Albian [C-9321; Appendix II(b)]. On the other hand, in support of this model, late Paleozoic contaminant palynomorphs [C-9301-04, C-9306-10, C-9312-17, C-9319-21; Appendix II(g)] in the Sans Sault Formation demand that the Sans Sault sediments were derived from the region of the Cordillera.

If the Sans Sault Formation is not a distal facies of the Trevor Formation a Cordilleran source for the Sans Sault poses problems related to mechanisms of transport, because at their time of derivation and deposition an orogenic foredeep, the site of shale and mudstone accumulation (Arctic Red Formation) would have separated the source area of the Sans Sault sandstones from their region of accumulation adjacent to the western flank of Keele Arch.

The Sans Sault Formation correlates with the Crossley Lakes Member of the Langton Bay Formation and Horton River Formation of Anderson Basin. The Sans Sault is somewhat younger and probably lacks physical continuity with the Gilmore Lake Member of Carnwath Platform.

In Great Bear Basin rocks equivalent to the Sans Sault Formation are present in the subsurface. These consist of fine- to coarse-grained sandstones and mudstones (units A to E, Table 3) which D.H. McNeil identified as Lower to Middle Albian in age [*see* Fig. 5 and Appendix II(b)]. For further details the reader is referred to the section on Great Bear Basin.

Contact relationships. The Sans Sault Formation unconformably overlies Devonian units ranging from Middle Devonian Ramparts to Upper Devonian Imperial Formations. It is in part overlain by and in part a lateral facies of the Arctic Red Formation as discussed previously. Over most of its area of occurrence it is the youngest formation exposed.

Trevor Formation

Lithology and distribution. The Trevor Formation was established by Mountjoy and Chamney (1969) for a succession of sandstones that occur in the Snake and Peel Rivers area in east central Yukon. Aitken et al. (in press) described sandstones which they assigned to the Trevor Formation, in Upper Ramparts River and Sans Sault map areas.

In the report area the Trevor Formation is preserved in broad synclines in a belt that extends parallel to the Mackenzie Mountain front from the west boundary of the report-area to about 48 km south of Norman Wells. The greatest observed thickness of 1152 m was measured on Hume River. The original northward and southward extent of the formation is unknown because it has been removed by erosional truncation of the limbs of the broad synclines. Southeastward it changes facies to shales of the Slater River Formation.

The Trevor Formation consists of interbedded sandstone and mudstone. The best-exposed sections are on Hume River where the Trevor is 1152 m thick (Appendix I) and on Mountain River where it is 518 m thick. In the former area the formation rests upon the silty concretionary mudstone unit of the Arctic Red Formation but in the latter region the formation overlies the older fossiliferous concretionary mudstone unit; the absence of the younger unit is considered to be due to a change in facies and resultant replacement by the lower beds of the Trevor Formation.

Sandstones of the Trevor Formation are thin to commonly medium bedded, medium brown and grey weathering, flaggy, hard, dense, fine grained, laminated and rarely calcareous and glauconitic. Bedding planes commonly display interference ripple marks and small channels. Load casts are common; microcrossbedding is rare in the lower beds and more common towards the top. The sandstones are immature being composed of strained and unstrained quartz, rock fragments, tripolitic chert and feldspar. A frequent component of the more massive sandstone beds is conglomeratic ironstone lenses. These consist of rounded to subrounded pebbles of clay ironstone in a matrix of dense sandstone. The pebbles often appear to be floating as individuals or closely clustered in aggregates and most commonly occur above ripple marked bedding planes. The mudstone interbeds are blocky and sandy and weather recessively in dark grey to rusty colours. Bedding planes commonly display small wood fragments and small scale tool marks.

A section, 220 m thick, of concretionary, black, soft, plastic shale occurs 926 m above the base of the formation on Hume River. The shale is sparsely laminated with pale yellow weathering sulphurous bentonite seams. Overlying the shale are approximately 33 m of interbedded sandstone and mudstone beds. Above this, and separated from the upper sandstone and mudstone beds by a covered interval about 30 m thick are plateau-forming sandstones which are conspicuous on air photographs (Fig. 16) of the region from Hume River westward to Trevor Range in east central Yukon.

The plateau-forming units are the uppermost part of the Trevor Formation. Exposures of these sandstones consist of heaps of frost-riven blocks and flagstones, displayed as a succession of bands separated by covered intervals on the flanks of low-relief hills which form Peel Plateau. The number of bands varies from place to place; a maximum of six occurs at one locality west of Arctic Red River. The sandstone is light to medium grey weathering, hard, dense and fine grained in the lower bands to medium and locally coarse grained in the upper layers. It is compositionally immature, consisting of quartz, feldspar, rock fragments and substantial quantities of tripolitic chert that locally comprise more than 50 per cent of the rock.

On Mountain River the arenite aspect of the formation is subdued in comparison to the section at Hume River. The sandstone units are thinner bedded and fewer in number and the intervening mudstone units are largely covered to poorly exposed. At the base of the section the arenites comprise argillaceous siltstone with intercalated beds of dense calcareous fine grained sandstone. Towards the top of the formation the sandstones become coarser grained and locally conglomeratic. Ripple marks, small flute casts and vertical burrows are common. The uppermost observed sandstone unit contains thin coal laminae. Throughout the Mountain River section of the Trevor Formation, ironstone concretions are more common than at Hume River. A few of these concretions contain poorly preserved pelecypod valves.

At Imperial River the Trevor Formation occurs in the core of Imperial Syncline where the formation is 290 m thick. It rests with gradational but abrupt contact above the silty concretionary mudstone unit of the Arctic Red Formation (Fig. 14). The Trevor Formation at this locality is identified at the first occurrence of resistant medium bedded sandstone. From there towards the core of the syncline, outcrops are discontinuous as far as the axis of the syncline where the uppermost part of the formation is exposed as a horizontal succession, 111 m thick, of interbedded, medium to dark grey weathering, thin bedded, fine grained argillaceous sandstone and recessive dark grey and rusty weathering, blocky mudstone.

Additional partial exposures of the Trevor Formation occur along the lower courses of the Arctic Red (Fig. 12) and Ramparts Rivers and their tributaries that drain Peel Plateau. Toward the southeast from the Hume River area, sections of the formation become progressively less arenaceous, until ultimately in the subsurface section at Aquitaine Dodo Canyon K-03 siltstone and mudstone dominate the sequence with relatively minor sandstone contribution to the total sequence which is 378 m thick. In the Candel et al. Texaco Arctic Red River F-47 well which spudded in the plateau-forming sandstones the arenite component of the section, 610 m thick, is subordinate to mudstone. A similar relationship was reported by Mountjoy and Chamney (1969) in the Snake and Peel Rivers area where, northward from the type section the contribution of sandstone to the formation diminishes.

Age and correlation. The age of the Trevor Formation, throughout most of its area of occurrence is Late Albian to Late Turonian [GSC Loc. Nos. C-33953-55, C-10033-34, and 84800, 84798; Appendix II(c), and Aitken et al., in press]. In the Mountain River area, however, the silty concretionary mudstone unit of the Arctic Red Formation is replaced by sandstones of the Trevor Formation, which are middle Albian in age [GSC Loc. No. C-10032; Appendix II(b)]. These beds may correlate with the Sans Sault Formation as discussed previously. In Aquitaine Dodo Canyon K-03 an undifferentiated Albian age was obtained from the section identified as Trevor Formation [GSC Loc. No. C-30268; Appendix II(b); Fig. 4].

The Trevor Formation has no known correlatives in Anderson Basin. The entire area of Anderson Basin, Carnwath Platform, and the northern part of Keele Arch apparently was emergent during the period of deposition of the Trevor Formation (Late Albian to Turonian). The Trevor Formation correlates southeastward within Peel Trough with the Slater River Formation and eastward into Great Bear Basin with unnamed sandstones and shales (Figs. 4, 33).

FIGURE 16. *Vertical air photo showing topographic expression of "plateau sandstones" of the Trevor Formation, west of Arctic Red River.*

Contact relationships. The Trevor Formation overlies the Arctic Red Formation with gradational contact. Mountjoy and Chamney (1969) describe the base of the Trevor Formation at Trevor Range, west of the report area, as Middle Albian whereas its base throughout most of the report area is interpreted to be Late Albian in age. On the other hand, sandstone units in the Trevor vary in number from place to place and no single sandstone unit serves as the universal base of the formation. Details are uncertain, but reconnaissance mapping suggests that successively lower (i.e. older) sandstone units define the base of the formation in an easterly direction from the western boundary of the report area toward Hume River (*see* Aitken et al., in press). Further detailed studies are required to resolve the apparent conflict between lithostratigraphic and biostratigraphic data. In the paleogeography section of this report the authors further discuss these problems as they relate to provenance of the Trevor Formation.

The Trevor is a lateral facies of the Slater River Formation, but rocks of the transition zone from one to the other are nowhere exposed.

Over most of its area of occurrence the Trevor is the youngest formation preserved. An exception occurs to the southeast in the Dodo Canyon K-03 well where the Trevor Formation is interpreted to be overlain by the Little Bear Formation on the basis of a change in lithology and projected attitudes of the latter. The nature of the contact cannot be determined from well samples and it is nowhere exposed at surface. The contact may be unconformable because the youngest known age for rocks of the Trevor Formation is Turonian, whereas the oldest known age for rocks of the overlying Little Bear Formation is Santonian. Because no fossils representing the Coniacian Stage have been reported from this region the entire report area could have been one of non-deposition during the Coniacian. Alternatively the absence of Coniacian fossils from this region could be due to inadequate sampling of a poorly exposed interval.

Slater River Formation

Lithology and distribution. The Slater River Formation was first defined by Stewart (1945) who based his definition upon a description by Foley (1944), a Canol Project geologist. The type area of the formation is along Slater River (Lat. 64°58'N; Long. 126°14'W) where 61 m of the formation are exposed excluding the top and base (Appendix I). No type section has been designated. In the type area, and indeed at all other outcrop localities, the formation is so poorly exposed that it seems inappropriate to designate a type section at this time. A number of exploratory wells have penetrated complete sections, and the possibility of selecting a subsurface type section in the future, remains open.

In outcrop along Slater River the formation consists of black, plastic, soft, concretionary and bentonitic shale. The bentonite appears as thin beds up to 2 cm thick, which are medium brown weathering and are distributed irregularly throughout the section. Bedding planes display selenite rosettes and traces of bitumen as well as poorly preserved fish scales. Small Inoceramus prisms occur in the middle of the section.

Additional outcrops of the formation are widely scattered and poorly exposed; many are slumped. On Little Bear River and in the Grotto Creek area (Lat. 64°41'N; Long. 126°39'W) soft alum-bearing shales are exposed a short distance from underlying Devonian Imperial Formation strata.

The Slater River Formation is perhaps the least known stratigraphic unit of Peel Trough and yet one of the most extensive. Poor outcrops with very few fossils, similarity in lithology to other shale and mudstone units (Arctic Red and East Fork Formations) in the region and incompletely documented observations and collections by previous workers over 30 years ago have contributed to confusion regarding age, facies and contact relationships. Outcrop sections which have been examined by the present and previous authors occur at the Peel Trough margin as presently preserved. Towards the basin center a number of exploratory wells recently have penetrated thick Cretaceous sections including the Slater River Formation (Fig. 4 and 5). The Slater River has been tentatively identified in the following wells:

1. Mobil Slater River A-37
   Slater River Formation 162 m (0 to 162 m)
   Underlying Unit: Devonian Imperial Formation

   NOTE: In Aitken and Cook (1974) Yorath incorrectly included 165 m of Imperial Formation strata in the Slater River Formation.

2. Candel East Mackay B-45
   Slater River Formation: 250 m (966 to 1216 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Devonian Imperial Formation

3. Candel Little Bear I-70
   Slater River Formation: 403 m (1326 to 1729 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Devonian Imperial Formation

4. Candel Tate J-65
   Slater River Formation: 287 m (1463 to 1750 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Devonian Hare Indian or Canol Formation

5. Shell Keel River L-04
   Slater River Formation: 213 m (485 to 698 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Cambrian Mount Cap Formation

6. Candel Stewart B-30
   Slater River Formation: 265 m (1390 to 1655 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Devonian Hare Indian or Canol Formation

7. Decalta Keel South A-28
   Slater River Formation: 409 m (771 to 1180 m)
   Overlying Unit: Little Bear Formation
   Underlying Unit: Devonian Imperial Formation.

In each of these wells the Slater River Formation maintains a consistent lithology comprising dark grey to black, blocky, silty to sandy mudstone and minor siltstone and fine-grained sandstone. The arenite layers do not appear to be correlative from well to well. Inoceramus prisms commonly occur near the base of the sections as do glauconite and fish scales. Ironstone concretions are common throughout all sections of the formation. The basal beds, in contact with the underlying Paleozoic strata comprise mostly mudstone (B-45, B-30, A-28 wells) and siltstone (I-70, J-65 wells).

Age and correlation. The identification of these subsurface sections as belonging to the Slater River Formation is tenuous. Widely scattered and imperfectly documented surface sections have yielded fossils of mostly Late Albian to Turonian age (Tassonyi, 1969; Yorath in Aitken and Cook,

1974) which identifies the formation as being generally younger than the Arctic Red Formation and the temporal facies equivalent of the Trevor Formation. In a small area on the north shore of Mackenzie River, about 13 km west of Fort Norman, two shale outcrops are assigned to the Slater River Formation because they yielded palynological assemblages collectively of Late Albian to Turonian age [GSC Locs. Nos. C-30980-81; Appendix II(c)]. Problems arise in the subsurface where, from pre-Little Bear Formation strata, Campanian dinoflagellates have been collected from cuttings obtained from the Candel Tate J-65 well [GSC Loc. No. C-52553/4900 and /5400; Appendix II(e)]. On the other hand, pre-Little Bear Formation beds in the nearby Shell Keele River L-04 well are considered to be of Cenomanian-Turonian age (A.P. Audretsch, Shell Canada Ltd., pers. com., 1979). Lower Cretaceous spores and dinoflagellates from the same interval are considered by Audretsch to be reworked. Insofar as the latter well is located on the crest of the Keele Arch, corresponding arch-flank sections should contain older or broadly contemporaneous beds, because the Slater River Formation represents marine transgression over the arch. The Campanian dinoflagellates from pre-Little Bear Formation strata in the Candel Tate J-65 well probably are contaminants due to caving from Campanian Little Bear and/or East Fork strata above. Furthermore, in the Shell Keele River L-04 well, immediately above the 24 m thick unnamed basal sandstone is an interval of black, fissile, fish-scale-bearing shale, 20 m thick, which is closely similar to Slater River beds at the type area of that formation. For these reasons, and, because the overlying sandstone succession in the listed wells (Fig. 4) is clearly identifiable as the Little Bear Formation, the authors tentatively assign the underlying mudstones and siltstones to the general Late Albian to Turonian Slater River Formation and as such they are the lateral facies equivalent of the Trevor Formation. Clearly, however, much additional, careful work is needed to define the lithology, age, distribution and facies relationships of this formation.

Contact relationships. The Slater River Formation unconformably overlies Paleozoic rocks ranging in age from Cambrian Mount Cap Formation on the axis of Keele Arch to Upper Devonian Imperial Formation and Middle Devonian Hume Formation on the flanks of the arch. The Slater River and equivalent deposits represent marine transgression across the southern part of Keele Arch and apparently the first linking (within the limits of the report area) of Peel Trough and Great Bear Basin. On, and immediately adjacent to the arch, the Slater River overlies an unnamed chert-pebble conglomerate and chert sandstone which appears to replace the Slater River along the axis of the arch (*see* below and Figs. 5 and 33). Although mostly younger than the Arctic Red Formation the oldest beds of the Slater River Formation may be the age equivalent and thus the lateral extension of the youngest beds of the Arctic Red Formation (*see* Fig. 4). This possibility is strongly supported by one outcrop about 30 km southwest of MacKay Range, considered to be Slater River Formation, which yielded palynomorphs of Middle to (?) Late Albian age [GSC Loc. No. C-5539; Appendix II(b)]. The upper parts of the Slater River are a lateral facies of the Trevor Formation, but the nature of the transition zone is everywhere obscured by overburden.

The Slater River is overlain abruptly by sandstones of the Little Bear Formation. Present paleontologic control indicates that the youngest possible age for Slater River beds is Turonian, and that the oldest possible age for the overlying Little Bear Formation is Santonian. The possibility therefore exists that the Little Bear Formation is in unconformable contact with the Slater River. Conversely, such an unconformity would represent only the Coniacian stage, and it seems likely, considering the paucity of outcrops, that the absence of Coniacian faunas is due to inadequate sampling. The Little Bear Formation appears to wedge out northeastwards towards the crest of Keele Arch beyond which Slater River beds are overlain by East Fork strata. Subdivision of these supra-adjacent shale formations has not been made and in the absence of Little Bear Formation sandstone the entire succession is labelled "Slater River-East Fork Formation undivided" (*see* Map 1498A and Fig. 5).

Unnamed Basal Cretaceous Sandstones

Lithology and distribution. Unnamed, conglomeratic, medium- to coarse-grained chert-rich sandstones occur at the base of the Cretaceous sequence in six known localities more or less on the axis of Keele Arch. Surface exposures occur north of Kelly Lake and south of Mahony Lake. In the subsurface basal chert-rich conglomeratic sandstones occur in Aquitaine Brackett Lake C-21, Aquitaine Old Fort Point E-30, Candel Police Island L-66, and Shell Keele L-04 wells.

In the valley of a small creek flowing into the northeast side of the southern part of Kelly Lake (Lat. 65°26'N; Long. 126°04'W), medium-grained, friable, thick-bedded, locally crossbedded chert-rich sandstone, and thin chert conglomerate beds occur adjacent to the stream (Fig. 18). The unit is poorly exposed there but is probably less than 10 m thick. In places the sandstone overlies a 3 m thick interval of white weathering, laminated-chert breccia with a chalky matrix (Fig. 19a). In one outcrop cherty dolomite of the "cherty unit" of the Franklin Mountain Formation grades upward to the chalky matrix breccia. The breccia is clearly a saprolite developed by leaching of the underlying "cherty unit" of the Franklin Mountain Formation on the crest of the Keele Arch. Although it is a distinctive unit underlying the unnamed sandstones, the saprolite is described here because it is an obvious source for the abundant chert clasts in the overlying sandstone and conglomerate beds. It has been recognized in only one other locality, a creek bank west of Mahony Lake (Lat. 65°31'N; Long. 125°45'W) (Fig. 19b) where it is overlain by black shales of the undivided Slater River and East Fork Formations.

The unnamed chert-rich sandstone unit also outcrops in a small creek valley about 3 km from the southern end of Mahony Lake (Lat. 65°21'N; Long. 125°06'W). There, coarse friable angular chert, quartz, and carbonate grain sandstones lie with angular unconformity upon the Franklin Mountain Formation (Fig. 20). About 6 m of sandstones are exposed. In the subsurface this unit is 10 m thick in the Brackett Lake C-21 well, 119 m (?) thick in the Old Fort Point E-30 well, 40 m thick in the Police Island L-66 well, and 24 m thick in the Shell Keele River L-04 well. In the subsurface it is apparently more conglomeratic than in the surface exposures.

Age and correlation. From the northwest side of Kelly Lake, sandstones of the unnamed unit yielded palynomorphs which W.W. Brideaux considered to be probably Late Cretaceous in age [GSC Loc. No. C-37209; Appendix II(c)]. A sample from southeast of Mahony Lake yielded dinoflagellate cysts which indicate a Late Albian or Cenomanian age to Brideaux [GSC Loc. Nos. C-16887; Appendix II(c)]. Brideaux raised and rejected the possibility that these forms were reworked. This meager biostratigraphic data suggests that the sandstone is a facies equivalent of the Slater River Formation and Figure 5 is drawn with that interpretation. In the Police Island L-66 well the unnamed sandstone is overlain by about 161 m of shale and siltstone which is overlain in turn by the Little Bear Formation. The intervening shale and siltstone is here considered to be Slater River Formation.

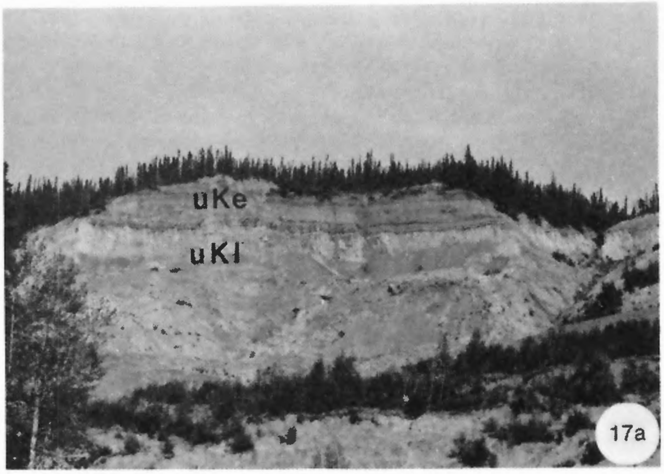


FIGURE 17a. Upper part of Little Bear Formation (uK1) type section, overlain by East Fork Formation (uKe), Little Bear River.

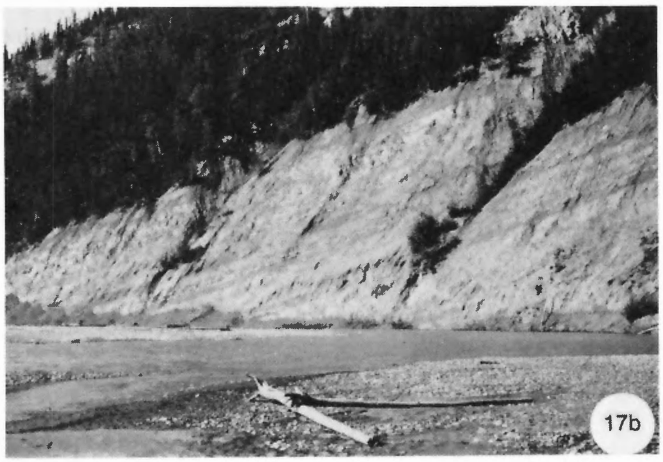


FIGURE 17b. Lower part of Little Bear Formation type section.

Contact relationships. The unnamed conglomeratic sandstone overlies Paleozoic rocks everywhere with the possible exception of the rare localities where it rests on the chert-breccia saprolite. The saprolite is undated and may have developed any time between the end of the Devonian and the end of the Middle Albian.

The occurrence of the basal sandstone south of Mahony Lake is noteworthy because the unconformity there is angular, with a discordance of about 15 degrees. The sandstone dips gently westward whereas the Franklin Mountain Formation dips gently eastward (Fig. 20). This is the only locality observed in the northern Franklin Mountains wherein localized pre-Cretaceous deformation and erosional truncation can be demonstrated. Rapid truncation in this vicinity is further recorded by the existence of Mount Kindle Formation (which normally overlies Franklin Mountain Formation) in outcrop a few hundred feet to the east of the Cretaceous-on-cherty-unit outcrop, and by the presence of Upper Devonian Canol Formation shales beneath the basal Cretaceous sandstone a few miles to the south in the Brackett Lake C-21 well. Elsewhere in the report area relationships at the base of the Cretaceous are consistent with a model of broad epeirogenic uplift and attendant regional truncation of Paleozoic formations (Fig. 2).

FIGURE 18. Unnamed basal conglomeratic sandstone north of Kelly Lake. 65°26'N, 126°04'W.

The upper contact of the unnamed sandstone is nowhere exposed. The writers envisage an abrupt but transitional contact to black shales of the East Fork Formation in the eastern part of Peel Trough and to the shales and siltstones of the Slater River Formation deeper in the basin, as represented by the L-66 well. The model presented is one of continuous shale deposition in the eastern part of Peel Trough from Slater River to East Fork time. Slater River can be differentiated from East Fork only in localities where the Little Bear Formation is present. Where the Little Bear is absent the entire interval is referred to as Slater River-East Fork undivided. An alternate model which is not favoured here, but which is suggested by the absence of Coniacian fossils, places an unconformity beneath the Little Bear-East Fork sequence such that the Little Bear would rest unconformably on the Slater River whereas the East Fork would rest unconformably on either the Slater River or the unnamed basal conglomeratic sandstones.

Little Bear Formation

Lithology and distribution. The name "Little Bear Formation" was first used by T.A. Link in an unpublished oil company report and subsequently by Canol Project geologists. It was given formal status by Stewart (1945).

The type section of the Little Bear Formation occurs on Little Bear River (Fig. 17) (Appendix I). The section is composite, comprising a lower sequence 135 m thick, and dipping 22° westerly at Latitude 64°37.7'N, and an upper interval, 93 m thick at Latitude 64°38.5'N. The two sections are estimated to be in stratigraphic continuity without significant overlap or gap. The contact with the presumed underlying Slater River Formation is not exposed. At the type section and downstream along Little Bear River the formation is overlain, locally with apparent disconformity, by shales of the East Fork Formation.

The Little Bear Formation occurs generally in the same area as the Slater River Formation in southeastern Peel Trough.

The Little Bear Formation is a unit of interbedded sandstone, siltstone and mudstone. The sandstones are characterized by the occurrence of dull white, tripolitic chert clasts which impart a strong resemblance to the "plateau-

FIGURE 19a. *Unnamed sandstones overlying chert-breccia saprolite, north of Kelly Lake. 65°26'N, 126°04'W.*

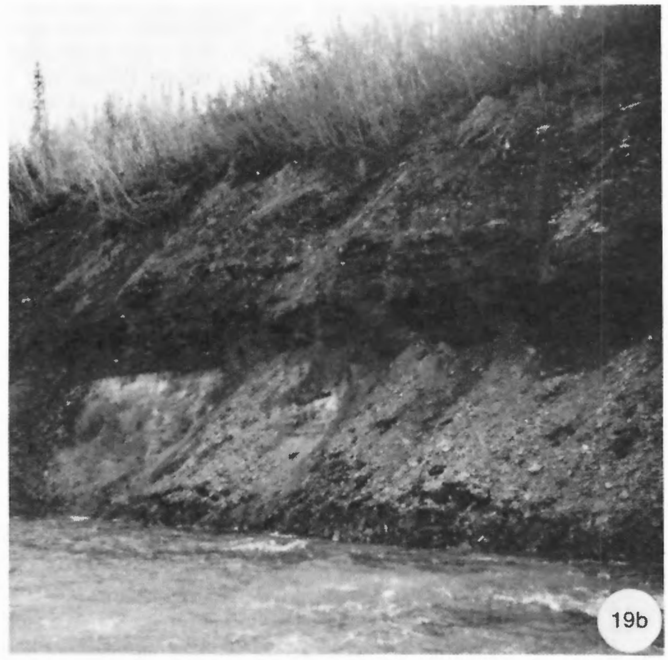


FIGURE 19b. *Undivided Slater River-East Fork shales overlying chert-breccia saprolite, west of Mahony Lake. 65°31'N, 125°45'W.*

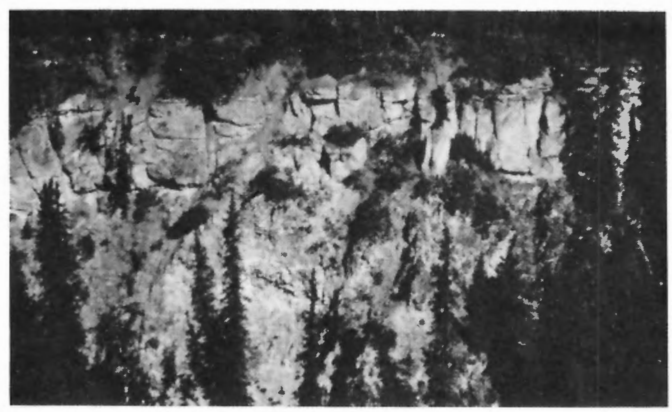


FIGURE 20. *Angular unconformity between gently west-dipping unnamed Cretaceous sandstones and gently east-dipping lower Paleozoic Franklin Mountain Formation, southeast of Mahony Lake. 65°21'N, 125°06'W.*

forming" sandstones of the Trevor Formation. The formation is thickest in the southwest and thins toward Keele Arch. It is interpreted to thin depositionally and to be replaced to the northeast and east by black shales of the East Fork Formation. At the composite type section the Little Bear Formation can be subdivided into three units. The lower sandstone unit, 135 m thick, consists of basal medium grey and mottled, rusty weathering mudstone with local ironstone concretions, that grade within a short distance upward to argillaceous siltstone and fine-grained chert-rich sandstone containing poorly preserved plant remains. Medium and thin-bedded sandstones become dominant upward and exhibit small-scale flame structures, oscillation ripple marks and raindrop imprints. A 7 cm seam of carbonized wood and low-grade coal occurs 35 m above the base. The section is capped by 40 m of fine-grained, well sorted, medium bedded to massive sandstone with local low-angle foreset bedding, load casts and thin, discontinuous dark chert pebble beds.

The middle unit constitutes the lower portion of the upper section and is 75 m thick. It consists of poorly exposed, rusty-brown and maroon-weathering mudstone that becomes increasingly silty and sandy upsection. The uppermost 15 m of the unit contains thin sandstone beds that are medium grey and grey-brown, fine-grained and argillaceous. The contact with the overlying unit appears to be locally erosional with visible relief of about 0.3 m.

The overlying upper sandstone unit, 18 m thick, is composed of fine grained, well sorted, massive, blocky, pale to medium grey weathering chert-rich sandstone. It contains a 30 cm thick bed of coal and carbonized wood. Interbedded medium-grey and rusty-brown and orange-weathering, blocky and nodular mudstone occurs throughout the unit. The contact of the upper unit with the overlying East Fork Formation appears to be erosional. Immediately beneath the contact a ferruginous, yellow weathering band that, according to X-ray analysis by A.E. Foscolos contains about 10 per cent kaolinite, may represent a regolith.

Additional exposures of the Little Bear Formation occur downstream from the type section on Little Bear River to its junction with East Little Bear River, on the northwest flank of MacKay Range, on Redstone River, Keele River and in small creek valleys between the latter two streams. Throughout much of this region outcrops are small, and consist predominantly of the sandstone facies; mudstones are rarely exposed. On the geological map the Little Bear Formation is shown to occur on the flanks of two, northward plunging folds which are traversed by Redstone River. Although sandstone "ribs" present in this area are recognizable on air photographs, their identification as Little Bear Formation as opposed to the younger sandstone member of the East Fork Formation is largely interpretive. The Little Bear Formation sandstones can be distinguished from those of the East Fork sandstone member by the presence of substantial quantities of white, tripolitic chert in the former, and, in the few outcrops examined in the region, this characteristic was found to be of value. Additionally, the drawing of structural cross-sections permitted the authors to make tentative correlations of "ribs" evident on the air photographs with rock units identified in the subsurface. The combination of these two criteria, unsupported by biostratigraphic information, is the basis of the geometry and rock unit distribution shown in the Redstone River area.

The geological map shows a different interpretation of the relationship of the Little Bear Formation to underlying units from that illustrated by Aitken and Cook (1974) in the Carcajou Canyon map-area (96D, GSC Map 1390A) where the Slater River Formation (Sans Sault-Slater River undivided) is shown to be absent east of the Gambill Fault, a thrust east of Little Bear River. This implied overstep of the Slater River Formation by the Little Bear Formation is negated by an age determination noted previously of Middle to (?) Late Albian made by W.W. Brideaux of a shale sample from an outcrop in the area [GSC Loc. No. C-5539; Appendix II(b)]. Accordingly, the geological map accompanying this report shows Slater River Formation in contact with Devonian strata in that area.

The Little Bear Formation is well represented in the subsurface of the southern part of Peel Trough. Figures 4 and 5 illustrate the thickness, correlation and general lithology of the formation in each of the following wells:

1. Aquitaine Dodo Canyon K-03
   Little Bear Formation: 82 m thick (0 to 82 m)
   Underlying Unit: Trevor Formation

2. Candel East Mackay B-45
   Little Bear Formation: 332 m thick (634 to 966 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

3. Candel Little Bear I-70
   Little Bear Formation: 482 m thick (844 to 1326 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

4. Candel Tate J-65
   Little Bear Formation: 323 m thick (1140 to 1463 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

5. Shell Keele River L-04
   Little Bear Formation: 281 m thick (204 to 485 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

6. Candel Stewart B-30
   Little Bear Formation: 308 m thick (1082 to 1390 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

7. Decalta Keele South A-28
   Little Bear Formation: 317 m thick (454 to 771 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation

8. Candel Police Island L-66
   Little Bear Formation: 61 m thick (691 to 752 m)
   Overlying Unit: East Fork Formation
   Underlying Unit: Slater River Formation.

In the Aquitaine Dodo Canyon K-03 well the uppermost 82 m have been assigned to the Little Bear Formation on the basis of mapped thicknesses, and its regional distribution within the Mackenzie Synclinorium. The unit comprises fine grained, well sorted clean to argillaceous glauconitic sandstone. Insofar as glauconite is a rare constituent of the Trevor Formation but common in the upper parts of Little Bear subsurface sections, its presence lends support to the assignment of that interval to the Little Bear Formation.

In the remaining wells shown in Figure 4 the lithology of the Little Bear Formation varies only in detail. Although the tripartite division evident at the type section is not particularly well displayed in the subsurface, the formation, nonetheless, can be traced with confidence longitudinally down the axis of southern Peel Trough (Fig. 4). The sections more or less comprise interbedded units of sandstones, siltstones and mudstones. The sandstones are generally fine grained, well sorted, medium to dark grey, cherty, feldspathic and commonly glauconitic at the top; rarely they are calcareous. The mudstones and siltstones are generally dark grey and concretionary. <u>Inoceramus</u> prisms occur locally. Low grade coals occur in the upper parts of the formation in East MacKay B-45, Little Bear I-70 and Tate J-65. The lowermost and uppermost sandstones of East MacKay B-45 and the uppermost sandstone in Keele South A-28 are coarse grained, very feldspathic and cherty. In the Imperial Redstone No. 1 well on Redstone River, the uppermost 162 m of section were assigned to the Sans Sault and Slater River Formation by E.J. Tassonyi (1969, Fig. 10). Although biostratigraphic support is lacking, the authors assign these strata to the Little Bear Formation. The section is particularly arenaceous, glauconitic and locally coarse grained. It is lithologically very similar to the Little Bear section in Decalta Keele South A-28.

Tracing the Little Bear Formation to the northeast across the basin is not as straight-forward. In the Police Island L-66 well 50 m of sandstones typical of the Little Bear are underlain by 161 m of shale and siltstone, which are underlain in turn by 40 m of conglomeratic, chert-rich sandstone, previously described as unnamed basal Cretaceous sandstone. If the basal chert conglomerate and sandstone and the overlying shale are excluded from the Little Bear then the Little Bear has thinned from 332 m in the East MacKay B-45 well to 50 m in the Police Island L-66 well.

Similarly, log-markers traceable from the Little Bear I-70 well to East MacKay B-45 well cannot be recognized in the Fort Norman K-14 well (G.K. Williams, pers. com., 1978) even though much of the section there is sandstone and siltstone typical of the Little Bear Formation. The Little Bear appears to change facies towards the northeast to black shales of the East Fork Formation; the location of the K-14 and L-66 wells being situated near the facies transition from Little Bear to East Fork Formation.

Age and correlation. Palynomorphs from the type section of the Little Bear Formation indicate a Santonian to Campanian, possibly Early Maastrichtian age [Brideaux, 1971; Yorath <u>in</u> Aitken and Cook, 1974; GSC Loc. No. C-23926-29; Appendix II(d)]. Derived Carboniferous spores, Triassic pollen, and Lower Cretaceous spores and dinoflagellates are common in these samples. Subsurface and surface age-control points are shown on Figure 34 and the corresponding data are in Appendix II(d).

In the Candel Fort Norman K-14 well, discussed above as being transitional lithostratigraphically to East Fork Formation, biostratigraphic material comprises a mixed assemblage of Early and Late Cretaceous pollen and dinoflagellates [GSC Loc. No. C-48826; Appendix II(g)]. The rocks there are probably Late Cretaceous in age with the older material having been redeposited as is the case in the Little Bear elsewhere. The alternative, that the rocks are Neocomian to Aptian in age but have been contaminated by down-hole caving of Campanian to Maastrichtian material, is discounted because it is inconsistent with the regional geology.

Based on the Santonian to Campanian age the Little Bear Formation correlates mainly with the Smoking Hills Formation and perhaps in part with the Mason River Formation of Anderson Basin. With the subsidence of Keele Arch it seems likely that Peel Trough and Great Bear Basin were linked, and that strata equivalent to the Little Bear were deposited in Great Bear Basin. No positive correlatives have been found, however, in Great Bear Basin.

Contact relationships. The contact of the Little Bear Formation with the underlying Slater River Formation is not exposed. The youngest dated material from the Slater River Formation is Turonian whereas the oldest known age for the Little Bear Formation is Santonian. The possibility therefore exists of an unconformity generally representing the Coniacian Stage, which is nowhere represented by the biostratigraphic material from the report area. Conversely the Coniacian may be unrepresented due to lack of sampling of a small interval. Such an unconformity occurs in Anderson Basin and is suspected in Great Bear Basin; both cases involve a greater time interval than the Coniacian.

The contact with the overlying East Fork Formation at the type section may be erosional. On the other hand, Little Bear sandstones thin northeastward and appear from well-logs to intertongue with the East Fork Formation (G.K. Williams, pers. com., 1978). The formation thus appears to be an eastward tapering wedge which is replaced by facies change to the east by East Fork Formation (*see* Fig. 5). That geometry implies a southwestern or western source which is confirmed by the presence of reworked Carboniferous, Permian, and Triassic spores and pollen, because the youngest possible source rocks to the east and northeast are Devonian (Fig. 2).

East Fork Formation

Lithology and distribution. The East Fork Formation was the term applied by T.A. Link in a private oil company report and later by Canol Project geologists for a very poorly exposed succession of black shales lying above Little Bear Formation sandstone in the vicinity of the junction of Little Bear and East Little Bear (East Fork of Little Bear) Rivers. Stewart (1945) designated that locality as the "type locality" where 259 m of East Fork strata were stated to be exposed. In 1969 approximately 76 m were exposed, the remainder being covered by drift, talus and trees. The poorly exposed and incomplete section at the "type locality" is such as to exclude it for a type section. Moreover, other exposures of the formation are no better than at the "type locality" nor do any exposed sections contain a sandstone member, which occurs at the top of the East Fork Formation in the subsurface. Although the term East Fork Formation will be retained in this report because of long standing usage, future subsurface studies of the thick and complete sections available for examination in well samples may result in redefinition of the unit, and definition of a type section.

The East Fork Formation occurs mainly in the Mackenzie River valley south of Fort Norman and mainly in the subsurface. At the type locality (Appendix I) the East Fork Formation is exposed above the uppermost interbedded sandstone and mudstone of the Little Bear Formation. The formation has a basal, laterally discontinuous, rusty-brown weathering conglomerate from 2 to 3 m thick. The conglomerate pebbles comprise black chert, quartzite and carbonate rocks, moderately well sorted and imbricated, and enclosed in a ferruginous mudstone matrix. The conglomerate is overlain by a monotonous succession of black, plastic, blocky weathering, soft shale approximately 76 m thick (exposed).

Exposures fairly typical of the formation (Fig. 21) occur on Keele River near its confluence with the Mackenzie River. On Redstone River sections of East Fork Formation shales are exposed on the northeast flank of a northward plunging anticline. The sections are small, discontinuous and lacking in paleontological information.

On the west flank of Bear Rock, where the Norman Range intersects Mackenzie River a few kilometres downstream from Fort Norman, several East Fork Formation outcrops of light grey, soft, blocky weathering shales are poorly exposed, either as slumps or steeply dipping beds near the river's edge. These outcrops are close to outcrops of the Hume Formation and the East Fork may overstep the Slater River and unnamed basal sandstone at this point.

The East Fork there is mapped as undivided Slater River and East Fork Formations because it cannot realistically be subdivided from older shales and mudstones which occur farther downstream.

East Fork Formation black shales occur in isolated outcrops a few miles southeast of Mahony Lake where they must overlie sandstones of the unnamed basal sandstone unit, and in an outlier exposed in a creek west of Mahony Lake. The unnamed basal sandstones were not seen there, and in one outcrop (Fig. 19b), the black shales of the East Fork directly overlie the chert-breccia saprolite described under the heading of the unnamed basal sandstones. Another outlier of

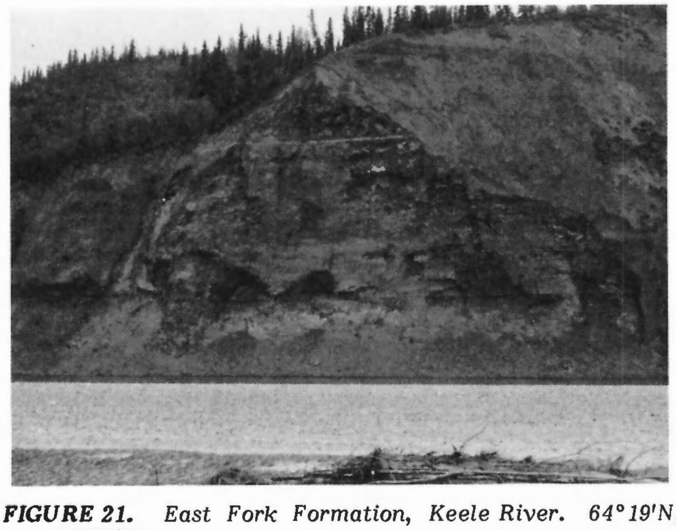


FIGURE 21. *East Fork Formation, Keele River. 64°19'N, 124°55'W.*

East Fork Formation can be inferred north of Kelly Lake because black shale cobbles occur in a creek bed upstream from outcrops of Little Bear Formation. The cobbles cannot have travelled far and indicate the close presence of East Fork bedrock even though no exposures were seen.

In the subsurface the shale succession of the East Fork Formation remains relatively uniform throughout the area. The succession consists predominantly of medium to dark grey, blocky mudstone and interbedded fine grained, argillaceous, medium-grey sandstone and siltstone. Ironstone concretions are common throughout many successions as are Inoceramus prisms. Bentonite occurs near the top and/or bottom of the shale member in several of the wells illustrated and coal is well developed at the base of the section in Candel Little Bear I-70.

The subsurface sandstone member of the East Fork Formation consists of interbedded light to medium grey and grey brown, fine to locally medium grained, poorly to moderately well sorted, argillaceous, locally calcareous, sandstone and medium grey, soft shale and mudstone. The sandstones are markedly cherty, feldspathic, and immature.

The following list shows those wells in which the East Fork Formation, including the sandstone member, is represented in the subsurface of southern Peel Trough (Figs. 4 and 5).

1. Candel East MacKay B-45
   East Fork Formation: 634 m thick (surface to 634 m)
   Sandstone Member: 192 m (surface to 192 m)
   Underlying Unit: Little Bear Formation

2. Candel Little Bear I-70
   East Fork Formation: 845 m thick (surface to 845 m)
   Sandstone Member: Not represented
   Underlying Unit: Little Bear Formation

3. Candel Tate J-65
   East Fork Formation: 1055 m thick (85 to 1140 m)
   Sandstone Member: 357 m thick (85 to 442 m)
   Overlying Unit: Tertiary Hills Formation
   Underlying Unit: Little Bear Formation

4. Shell Keele River L-04
   East Fork Formation: 58 m thick (146 to 204 m)
   Sandstone Member: Not represented
   Overlying Unit: Tertiary Hills Formation
   Underlying Unit: Little Bear Formation

5. Candel Stewart B-30
   East Fork Formation: 933 m thick (149 to 1082 m)
   Sandstone Member: 321 m thick (149 to 470 m)
   Overlying Unit: Tertiary Hills Formation
   Underlying Unit: Little Bear Formation

6. Decalta Keele South A-28
   East Fork Formation: 439 m thick (15 to 454 m)
   Sandstone Member: 290 m thick (15 to 305 m)
   Overlying Unit: Quaternary Drift
   Underlying Unit: Little Bear Formation

7. Candel Police Island L-66
   East Fork Formation: 413 m thick (277 to 690 m)
   Sandstone Member: Not represented
   Overlying Unit: Tertiary Hills Formation
   Underlying Unit: Little Bear Formation.

In the southern part of the area near Keele and Redstone Rivers sandstone units apparent on air photos as "ribs" occur stratigraphically higher than other sandstones assigned to the Little Bear Formation. These are considered to be the sandstone member of the East Fork Formation. In the subsurface to the east, north and west of MacKay Range these sandstones are replaced by shales so that the entire East Fork interval is represented by shale, a clear indication that the sandstones were derived from the southwest or west.

A problematical outcrop of sandstone (Fig. 22a) occurs adjacent to the east flank of MacKay Range (Appendix I). One hundred and forty seven metres of beds are exposed in an overturned section that dips at 80° towards the west. The base of the section is not exposed, the lowermost strata being separated by a covered interval from westward dipping strata of the Cambrian Saline River Formation. Likewise the top of the section is separated from the Summit Creek Formation by a covered interval.

The lowermost beds of this sandstone section consist of medium grey and mottled rusty brown weathering, thin bedded, blocky and rubbly weathering, moderately friable, fine grained, well sorted mature sandstone with thin interbeds and laminae of argillaceous siltstone and mudstone. Upwards the section becomes medium bedded and locally thick bedded and highly jointed. Ironstone in the form of nodules, concretions and beds is a common constituent throughout. Towards the top the sandstones become medium grained and locally coarse grained. A 2 m thick unit of black, carbonaceous woody shale occurs about 15 m below the top of the exposure. Throughout the section convolute laminations, in part highly contorted, burrows, wood casts and small load casts are common. The uppermost bedding surface displays well developed interference ripple marks (Fig. 22b).

FIGURE 22a. *Unnamed sandstone (overturned, top to right), east side MacKay Range. 64°36'N, 125°36'W.*

FIGURE 22b. *Interference ripples, unnamed sandstone section, east side MacKay Range.*

This section is problematical because due to its position relative to the overlying Summit Creek Formation it appears to be broadly homotaxial with the subsurface sandstone member of the East Fork Formation with which it is broadly similar in age; however, these two sandstones differ markedly in composition and maturity. Moreover, A.R. Sweet (pers. com., 1979) considers that the palynologic assemblage [C-8715; Appendix II(e)] from the problematical section has closer affinities to those from the Little Bear Formation [for example, C-8720; Appendix II(e)] than to those from the type section of the East Fork Formation [C-23930 to C-23940; Appendix II(d)].

Age and correlation. On the basis of palynology, the age of the East Fork Formation at the type locality is Middle Campanian to Early Maastrichtian [Yorath in Aitken and Cook, 1974; Appendix II(d) and (e)].

In the Candel Tate J-65 well palynological studies of samples from the base and top of the shale member yielded a Campanian age for the former and a Campanian, possibly Maastrichtian age for the latter [C-52553/3600 and C-52553/1600; Appendix II(e)]. Samples from the sandstone member in the same well yielded a Maastrichtian age [GSC Loc. No. C-52553/400, 700, and 1100; Appendix II(e)]. East Fork samples from near Bear Rock, from south of Mahony Lake, and from the cobbles previously noted from north of Kelly Lake have all been assigned Campanian to Maastrichtian ages by W.W. Brideaux [GSC Locs. Nos. C-30978-79, 82, 84, 85; Appendix II(e)]. The sandstone section on the east flank of MacKay Range, on the basis of palynology, is Campanian [GSC Loc. Nos. C-8715 and C-9285; Appendix II(e)].

The East Fork correlates generally with the Mason River Formation of Anderson Basin and possibly in part with the older Smoking Hills Formation (Table 1).

Correlative rocks apparently occur in the eastern part of Great Bear Basin. Outcrops near Great Bear Lake have been assigned a probable Late Campanian age by J.H. Wall [GSC Loc. Nos. C-4291 to C-4300, C-2566; Appendix II(e)] based on radiolaria.

Contact relationships. Stratigraphic relationships between the East Fork and the Little Bear Formation are not clear. On the one hand, at the type locality of the former, the basal conglomerate suggests that an unconformity separates the two formations, and at the type section of the Little Bear a similar relationship is suggested by the interpreted regolith and erosional contact with the East Fork Formation. Moreover, the base of the East Fork could be interpreted to cut down section northeastward across the Little Bear to overlie the older unnamed sandstones on the flank and crest of Keele Arch. On the other hand available palynological data do not support a hiatus between the East Fork and the Little Bear, and the disappearance northeastward of the Little Bear can readily be interpreted as depositional thinning of a westerly derived clastic wedge. The writers favour such an interpretation.

There also could be an unconformity at the base of the Little Bear and East Fork as a single stratigraphic package, on the basis of available paleontologic data. This would account for the apparent absence of Coniacian strata everywhere within the basin (between Little Bear and Slater River Formations) and the possible absence of Turonian, Coniacian, and Santonian strata on the flank and crest of Keele Arch (between the East Fork Formation and the unnamed basal conglomeratic sandstone). Nonetheless, paleontologic data are sparse, and the model favoured by the writers is one of more or less continuous deposition from Slater River to East Fork time, as portrayed in Figure 5. In that model the upper part of the Slater River, the Little Bear, and the East Fork, as they occur in the western part of the basin are all represented by the East Fork Formation black shales as they occur above the basal chert conglomeratic sands on the crest and flank of Keele Arch.

The contact with the overlying Summit Creek Formation is for the most part unexposed, but palynological data from a section north of Police Island on Mackenzie River indicate continuous sedimentation from Cretaceous into Tertiary time [GSC Loc. Nos. C-16889-92, Appendix II(f)].

Cretaceous sandstone compositions from Peel Trough

Figure 23 is a ternary plot of end-member compositions for each of the main sandstone units of Peel Trough. The plot is derived from X-ray analyses conducted by A.E. Foscolos and is based upon peak heights rather than rigorous quantitative measures. All peaks equal to or greater than 14Å were interpreted as chlorite but this needs confirmation by further study.

The end-members are SiO_2, feldspar-kaolinite and illite-chlorite. The SiO_2 end-member includes chert, the main distinguishing component among sandstones of otherwise similar composition. The outside limits of the scatter plots for each sandstone are connected; however, due to alternate possible choices of point connection, the shape of each has little significance.

The Trevor Formation is the broadest in compositional range extending from an SiO_2 component of 80 per cent to a low of 15 per cent. The contribution of feldspar-kaolinite is generally less than 40 per cent and the range contribution of illite-chlorite extends from 55 to 10 per cent. This compositional immaturity probably reflects the multiplicity of source rocks within the core zone of the Cordillera.

The Little Bear Formation is more restricted in its compositional range than the Trevor, however there is overlap in the SiO_2 end of the spectrum. The SiO_2 contribution varies from near 50 to 90 per cent, feldspar-kaolinite from 3 to 24 per cent, and illite-chlorite from 4 to 36 per cent. The silica component includes substantial quantities of tripolitic chert probably derived from the cherty dolomites of the Franklin Mountain Formation.

The Sans Sault Formation is even more restricted compositionally but is completely enclosed within the range of the Little Bear and Trevor Formations. Its principal distinguishing feature is its low chert content relative to the other two formations. Its silica content varies from 79 to 58 per cent, feldspar-kaolinite from 16 to 2 per cent and illite-chlorite from 29 to 12 per cent.

The Upper Cretaceous surface sandstone east of MacKay Range is the most restricted compositionally, however the number of analysed samples is comparatively few. Its compositional range clusters close to the SiO_2 apex and as such is readily distinguishable from the other arenites. Moreover, the chert contribution to the silica component is relatively small. The SiO_2 component varies from 100 to 86 per cent and the ratio of feldspar-kaolinite to illite-chlorite is uniform at 0.7.

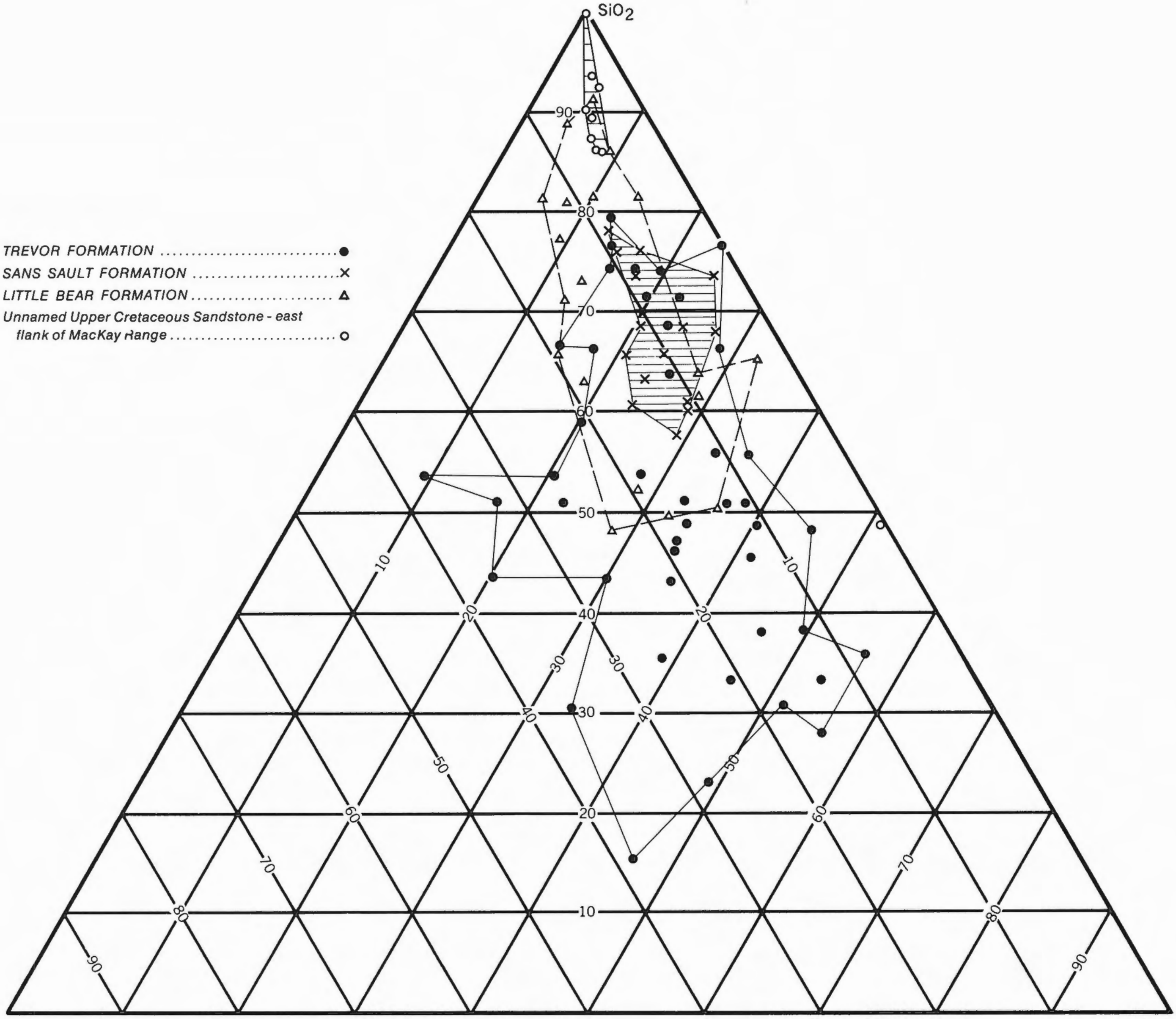


FIGURE 23. Ternary plot of Cretaceous sandstone compositions from Peel Trough determined by X-ray diffraction.

Peel Trough - Tertiary stratigraphy

Summit Creek Formation (new name)

Lithology and distribution. The name "Summit Creek Formation" is herein proposed for a Late Maastrichtian and Paleocene succession of conglomerate, sandstone, ash beds and low grade coals that occurs in the upland west of Tate Lake (Map 1498A) immediately adjacent to the Mackenzie Mountains front, on the east bank of Mackenzie River south of Fort Norman, along Brackett River, and in several isolated exposures on the east flank of MacKay Range and north of Keele River. Summit Creek strata have been penetrated in the Shell Keele River L-04, Candel Tate J-65, Candel Stewart B-30, and Candel Police Island L-66 wells.

Outcrops of this formation are easily differentiated from the underlying black shales and local sandstones of the East Fork Formation. The lowermost beds, nonetheless, are recessive over much of its area of occurrence as is the underlying East Fork Formation. The contact is rarely exposed and is consequently shown as assumed over most of its trace. The formation is best exposed in the upland west of Tate Lake and is named for Summit Creek which, with its tributaries, drains the southwest flank of the upland. Topographic expression is variable from resistant castellated cliffs of conglomerate in that upland to recessive poorly exposed sandstones and shales in the banks of creeks draining the lowlands of Mackenzie River Valley to the east.

The composite type section (Appendix I), approximately 295 m thick, is designated along an unnamed creek at the following localities listed in upward stratigraphic order:

1. Latitude 64°29'N; Longitude 125°33'W. Thickness 33.5 m.

2. Latitude 64°28'N; Longitude 125°34'W. Thickness 125.0 m.

3. Latitude 64°28'N; Longitude 125°40'W. Thickness 47.3 m.

4. Latitude 64°28'N; Longitude 125°41'W. Thickness 89.9 m.

The base of the formation at the type section is not exposed. A few kilometres to the northwest, the formation is in contact with the black shales and mudstones of the East Fork Formation and the contact appears conformable but sharp. South of the type section at Latitude 64°22'N and Longitude 125°25'W an additional 15 m of conglomerate and sandstone are exposed and presumably underlie the lowermost beds of the composite type section. On the basis of regional attitudes and elevations the Summit Creek Formation is estimated to be approximately 488 m thick.

In the lowermost section of the composite type section the Summit Creek Formation consists of massive, moderately well indurated, resistant, medium grey weathering, sandy conglomerate. Pebbles and cobbles consisting of black chert, black siliceous shale, limestone, dolomite, quartzite and minor sandstones are well rounded and vary in size between 1.25 to 16 cm with a modal size of 5 cm. The matrix consists of grey and brown ferruginous fine sandstone. The conglomerates are locally moderately well graded in units approximately 3 m thick. No imbrication was observed.

A covered interval of about 59 m, included as the basal portion of the supra-adjacent section, separates the well exposed conglomerates of the next unit. These conglomerates are massive, well indurated, resistant and appear as castellated cliffs and stacks resembling hoodoos (Fig. 24). The composition, size, sorting and grading of the conglomerates are much the same as in the underlying section. Throughout the section there are discrete beds of rusty-grey brown-weathering, fine- to medium-grained well sorted sandstones in sharp contact with enclosing conglomerates. The sandstone beds are commonly displayed as lenses that pass laterally into massive conglomerate. Upwards, the grading of the conglomerates becomes well defined and a crude imbrication is present. The components of the conglomerates include well rounded spherical to oblate pebbles of pale grey tuff. Dense, hard lenses of well-cemented conglomerate occur in the upper half of the section. Towards the top the sandstone lenses are cross-bedded with a wide range of easterly directed dip azimuths.

The uppermost 9 m of the second section consist of pale yellow to very pale grey-weathering, poorly indurated, soft, blocky tuff with a basal portion comprised of rusty, maroon shale and carbonized wood. The interval overlies the conglomerates with erosional contact. Within the tuffs are local horizons of low grade coal and carbonaceous shale (Fig. 25). At one locality between section 2 and 3 a small, lens-like body of white to light grey, dense, finely vessicular, glassy material occurs surrounded by baked, red, siliceous, laminated shale (Fig. 26). The core of the outcrop appears to be volcanic in origin and is composed largely of calcium feldspar laths and devitrified glass. This locality appears to be unique; no other exposures were observed.

Sections 3 and 4 are much like the lower sections except that thinly laminated sandstones are much more abundant and cross-bedding within them more common and

FIGURE 24a. *Hoodooed conglomerates in the Summit Creek Formation type section, near Stewart Lake. 64°23.5'N, 125°16'W.*

FIGURE 24b. *Close-up of conglomerate in Figure 24a.*

well developed. Basal contacts of sandstones with conglomerates are sharp whereas upper contacts can be sharp or gradational and locally appear intrusive into overlying conglomerate. Thin discontinuous low-grade coal seams are distributed throughout and are well developed at the base of an upper pale yellow and grey weathering tuff interval, about 24 m thick that underlies the topmost conglomerate of the Summit Creek section.

Throughout the sections thin claystone and shale horizons contain poorly preserved plant remains in the form of leaf impressions and stem material. Sections 2 and 4 yielded Paleocene pollen [GSC Loc. No. C-41896-97; Appendix II(f)].

The Summit Creek Formation is interpreted to represent a large alluvial fan derived from the uplift of Mackenzie Mountains. Additional small, poorly exposed outcrops of the formation occur as far as Mackenzie Range in small stream valleys draining the southwestern side of Mackenzie River valley. Small exposures occur on the east side of the southern end of MacKay Range where the

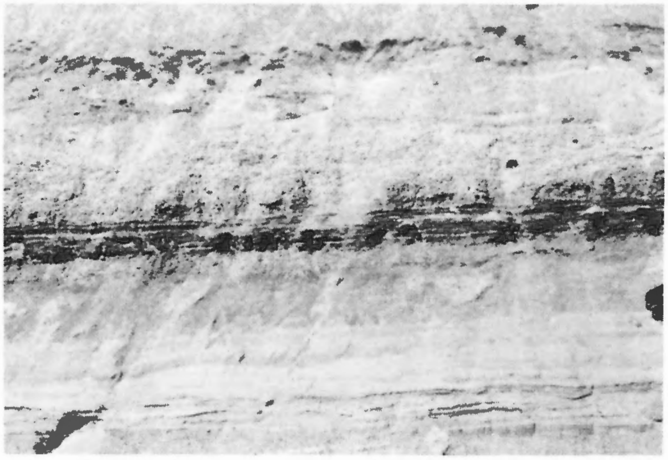


FIGURE 25. Coal seam enclosed by tuff, Summit Creek Formation type section. 64°28'N, 125°40'W.

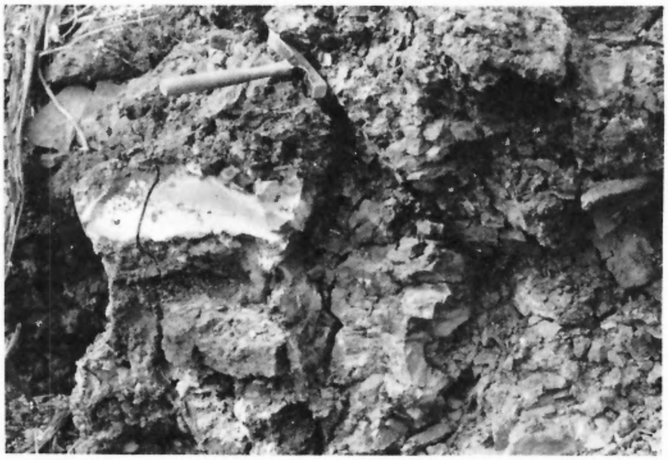


FIGURE 26. Welded vitric crystalline tuff enclosed by baked, red, siliceous laminated shale, Summit Creek Formation type section. 64°29'N, 125°33'W.

distinctive pale yellow weathering tuff beds are prominently displayed in tilted beds adjacent to the flanks of the range which, therefore, is post Paleocene in origin. Small exposures of conglomerate, ash, and coaly beds occur in the stream valley immediately east of MacKay Range and overlie the overturned unnamed Upper Cretaceous sandstone, although the contact is not exposed.

A section, southeast of Fort Norman, consists of approximately 64 m of Tertiary beds. Moderately well exposed, it is referred to the Summit Creek Formation and appears to represent the product of a fluvial system that developed in conjunction with the eastward encroaching alluvial fan. The section is composed of sandstone, conglomerate, mudstone, tuff, low grade coal and thin beds of conglomeratic fire clay, in decreasing order of abundance. Sedimentary structures, typical of point bar deposits are present, including well developed scours where cross-bedded sandstones infill channels cut into lenticular conglomerates, poorly preserved current ripples on bedding surfaces, tool marks, and convolute laminations that pass upward to thinly and evenly laminated massive sandstones. The low grade coals and woody beds are enclosed in argillaceous fine sandstones or mudstones. The composition of the conglomerates is much like that of the type section although pebbles are most commonly 3 cm or less in size and are predominantly black chert.

The fire clays noted above result from natural combustion of coaly horizons. Bocannes in that area were noted by Alexander Mackenzie (1801) and were reported by Richardson as early as 1827. In 1969 Yorath noted one bocanne 48 m above the base of the exposed section. The bocanne comprised a small outcrop where woody coal was issuing sulphurous smoke; scattered about the outcrop were chunks of yellow jarosite, coarse gypsum crystals and red fire clay.

In the subsurface poorly consolidated conglomerate composed of pebbles of black chert, carbonates and quartzite, and fine to medium sand were encountered in Candel Tate J-65 and Candel Stewart B-30. In the former well the section is 85 m thick and in the latter, 149 m thick. In Shell Keel River L-04, 146 m of Summit Creek Formation were encountered. The sequence there consists of sandy conglomerate, mudstone and thin coal seams. Traces of tuff occur in samples but most of this material was probably lost in the sample washing process. In the Candel Police Island L-66 well, 277 m of interbedded coarse pebbly sandstone, pale grey mudstone and coal are interpreted to represent Summit Creek Formation strata (Fig. 5). The sections in these wells are tentatively assigned to the Summit Creek Formation; however, one or more may contain beds of Quaternary age.

Age and correlation. Hume (1954) reported an Eocene age for plants collected from Tertiary beds in the Fort Norman area. More recent determinations have indicated an older, latest Maastrichtian and Paleocene age for the Summit Creek Formation. Localities from which age determinations have been made by the Geological Survey of Canada are Department of Public Works bore-hole No. 519 on the east side of Bear Rock [Paleocene, GSC Loc. No. C-39597; Appendix II(f)], sections 2 and 4 of the composite type section [Paleocene, GSC Loc. Nos. C-41896 and C-41897; Appendix II(f)], and an outcrop section on the north bank of Mackenzie River north of Police Island. Descriptions and samples of that section have been provided by B. Groeneweg and P. Monahan of Aquitaine Company of Canada (pers. com., 1972). The section described by them is 69 m thick and comprises sandstones, shales, coal and shaly coal with a basal conglomerate 8 m thick. Three samples from the upper 37 m yielded Maastrichtian ages [Wilson, 1978; C-16890 to C-16892; Appendix II(f)]. A fourth and uppermost sample yielded a Paleocene age [Wilson, 1978; C-16889; Appendix II(f)].

Bihl (unpubl., 1973) studied the palynology of Maastrichtian and Paleocene strata near Tate Lake. He considered a lower brown and grey siltstone unit to be East Fork Formation because it contained Maastrichtian palynomorphs. An upper unit of conglomerate, lignite, siltstone, volcanic ash and sandstone was assigned to the "Tate Lake Conglomerate". Based on a decrease in diversity of forms Bihl suggested that there had been a significant climatic change from tropical to less tropical conditions at the Cretaceous-Tertiary boundary, but he saw no significant break in sedimentation. Presumably both of his units fall in the Summit Creek Formation as used here.

Bihl reported reworked Mississippian and Albian forms from his conglomeratic unit.

No rocks equivalent to the Summit Creek Formation were deposited in Anderson Basin to the north. Maastrichtian and Paleocene rocks were deposited in the eastern part of Great Bear Basin. They are discussed later in this report.

Contact relationships. The lower part of the Summit Creek Formation is mainly recessive and the contact with the underlying East Fork Formation was rarely observed in outcrop. In the subsurface the contact seems to be abrupt, being a change over an interval of 6 m from black shales and thin sandstones of the East Fork Formation. In wells where the sandstone member of the East Fork occurs the change is abrupt from mudstone and fine-grained sandstone to conglomerate.

An unconformity might be expected to separate the nonmarine conglomerate and sandstone of the Summit Creek Formation from the underlying marine shales and sandstones of the East Fork Formation and, indeed, the East Fork in the Shell Keele River L-04 and Candel Police Island L-66 wells is abnormally thin, suggesting truncation. Conversely available paleontologic control requires that any such hiatus would represent a short interval, sometime in the Maastrichtian and suggests that continuous sedimentation proceeded from East Fork marine deposition to Summit Creek nonmarine deposition.

GREAT BEAR BASIN

Introduction

Of the three basins described, Great Bear Basin is the most stratigraphically and structurally complex, the largest and the least well known. It appears to have been emergent throughout much of Early Cretaceous time and to have begun subsiding in Early Albian time. Rapid subsidence took place in the Middle Albian possibly with the paleotopographically high Keele Arch defining the western limit of the basin. The arch progressively subsided resulting in the linkage of Great Bear Basin and Peel Trough in Late Albian time. Late Albian and Turonian rocks occur on the arch and on the flanks of Great Bear Basin, but have not been identified in the subsurface of Great Bear Basin.

Albian rocks appear to be truncated in the subsurface by a younger undated sequence. The unconformity is poorly defined and undated. If real it probably developed during some part of the Cenomanian to Coniacian interval in conjunction with development of the widespread hiatus representing that period in Anderson Basin. Turonian strata at Lac des Bois are considered part of the on-lap sequence initiated in the Albian. If so, development of the unconformity is further restricted to some part of latest Turonian to Coniacian time.

Little has been published on the Cretaceous and Tertiary rocks east of Franklin Mountains. Balkwill (1971) described Cretaceous rocks in the vicinity of the southern shores of Great Bear Lake and Cook and Aitken (1971) described those outcrops which occur along the north shore of the lake and in the region of the Colville Hills. Since Operation Norman a number of exploratory wells have penetrated substantial sections of Lower Cretaceous strata in the vicinity of Whitefish River. The authors are indebted to G.K. Williams and F.G. Young who provided subsurface information from this area.

On the geological map (Map 1498A), the large area east of Franklin Mountains is shown to be underlain by strata designated as "Cretaceous undivided". This is necessary for the following reasons:

1. Although Cretaceous strata in the subsurface can be subdivided into lithostratigraphic units which are largely recognized from well to well it has not been possible to correlate surface stratigraphic units with those of the subsurface.

2. Strata of widely differing ages (Albian to Paleocene) crop out along the shores of Great Bear Lake as small, poorly exposed and widely scattered exposures that cannot be correlated with the subsurface nor subdivided into significant mappable units at surface.

3. The region north of Great Bear Lake is presumed to be underlain by Cretaceous strata on the basis of only two outcrops. One of Upper Cretaceous shales occurs east of Good Hope Bay on the north shore of Smith Arm, and the other, of Lower Cretaceous shales, occurs in a pingo near Horton Lake.

The northern limit of Great Bear Basin is arbitrary, being chosen to approximate the locus of the height of land north of Great Bear Lake.

Cretaceous and Tertiary stratigraphy

Unnamed Albian to Turonian sequence

Lower and Middle Albian rocks of Great Bear Basin have been identified in the subsurface. In a few outcrops adjacent to the east flank of McConnell Range and the unnamed range to the north containing St. Charles Mountain, and in a single outcrop at MacIntosh Bay on Great Bear Lake, Middle and Upper Albian strata have been identified.

Several wells in the Whitefish River area south of Smith Arm penetrated substantial sections of Albian rocks, and a number of informal stratigraphic units ("A" to "E") can be recognized and correlated from well to well.

Table 3 is a list of the thicknesses of each of the informal units from ten wells examined in the area. The Sinclair Wolverine Creek D-61 well (Lat. 65°10'14"; Long. 124°12'52") is herein designated as the reference well for the Lower Cretaceous rocks of the basin.

In the reference well the total Cretaceous succession is 860 m thick and appears to be Early Cretaceous in age (Middle Albian and older), with the exception of the uppermost 40 m which G.K. Williams (pers. com., 1978) tentatively considers to be Late Cretaceous in age. The lower section is a sandstone, siltstone, sandy shale, and shale succession which can be divided into five lithologic units designated A to E in upwards stratigraphic order (Fig. 5), each of which is recognizable in other wells in the basin. The uppermost unit "E" comprises a number of shale and sandy shale units recognizable in the reference well but not individually identifiable in adjacent wells. This is partly because the floor of the basin rises to the south and to the east with the result that unit "E" is missing in many wells.

Surprisingly, surface exposures of Albian strata along the west flank of the southern part of the basin can be subdivided into only three units none of which can be recognized with confidence in the subsurface. The uppermost, moreover, has been dated as Late Albian to Cenomanian, ages which have nowhere been positively identified in the subsurface.

Basal sandstone, unit "A". The "A" unit comprising the lowermost 27 m of the Cretaceous section in the reference well unconformably overlies carbonates of the Bear Rock

TABLE 3

List of informal units and their thicknesses (in metres) in selected wells of Great Bear Basin. Tops based on information provided by G.K. Williams (pers. com., 1978)

Well		D-61	N-70	M-07	F-62	I-74	H-34	K-76	N-30	H-61	G-52
	drift	3	30	58	30	73	46	0	159	46	0
Younger Sequence	shale	25	81	0	154	155	104	209	0	0	0
	sandstone	12	11	10	trace	17	0	0	0	0	0
Lower and Middle Albian Sequence	E	430	213	141	0	369	303	220	164	94	0
	D	34	17	17	0	32	29	43	25	34	0
	C	246	205	158	258	235	198	192	265	260	26
	B	86	82	107	67	55	64	69	73	70	0
	A	27	15	5	24	24	20	79	0	0	0
Total (Lower Cretaceous)		823	532	428	349	715	614	603	527	458	26

Formation. It consists of poorly cemented, white, locally glauconitic sandstone that grades upward from medium to coarsely granular at the base to fine-grained at the top.

This basal unit is not known to occur south of Great Bear River. Abrupt thickness variations in this unit occur and are no doubt related to relief on the sub-Cretaceous unconformity. For example it is 79 m thick in the Sinclair Whitefish River K-76 well where it rests on Devonian Bear Rock Formation, whereas it is only 20 m thick in the ARCO West Whitefish River H-34 well about 6 km away where it rests on Devonian Hume Formation. This relationship was first indicated to the writers by G.K. Williams (pers. com., 1976). The obvious conclusion is that a pre-Cretaceous escarpment formed by erosion of the Hume Formation has been subsequently buried by the basal Cretaceous sands of unit "A".

Surface exposures of basal Cretaceous sandstone occur in the northwest part of Great Bear Basin between Smith Arm of Great Bear Lake and Lac des Bois. There, unconsolidated fine brown sand with interbeds of dark grey carbonaceous clay unconformably overlies the Ordovician-Silurian Mount Kindle Formation. Those sands appear to be older than Unit "A" but are considered to be co-extensive with it.

Age and correlation of unit "A". Foraminifera from unit "A" in the reference well (*see* Fig. 5 and Appendix IIb) and in Sinclair Whitefish River K-76 [GSC Loc. No. C-12218; Appendix II(b)] indicate an Early to Middle Albian age. On that basis it correlates with the Crossley Lakes Member of the Langton Bay Formation and probably part of the Horton River Formation in Anderson Basin and with some part of the Arctic Red and Sans Sault Formations in Peel Trough.

The unit also is very similar to and probably co-extensive with the Gilmore Lake Member of the Langton Bay Formation of Carnwath Platform. Both units are basal Cretaceous, mature, quartz sandstones, which fill pre-Cretaceous topographic relief. If they are co-extensive, as seems probable, they are parts of a regional time-transgressive basal sandstone unit, with transgression proceeding from northwest to southeast into the area subsequently to be occupied by Great Bear Basin. The area of Great Bear Basin was clearly part of Carnwath Platform prior to and during deposition of unit "A".

Although no Early Cretaceous sandstones occur along the axis of Keele Arch, Figure 31 is interpreted to show that basal Cretaceous sandstones were deposited across the northern part of the arch. If so, they were subsequently eroded away on the crest of the arch prior to deposition of Turonian shales and siltstones which appear to overlie Paleozoic rocks at Lac des Bois, and before deposition of Late Albian to Cenomanian chert-sandstones which overlie Paleozoic rocks near Kelly and Mahony Lakes.

Unit "B". The basal sandstones of unit "A" in the reference well are overlain by unit "B" comprising 86 m of interbedded fine grained, glauconitic sandstones, siltstones, mudstones and shale. The unit is capped by a 3 m thick interval of light grey, fine grained sandstone and minor coal fragments. Pyrite is common throughout the unit both as crystals and small spheres. F.G. Young noted several burrowed intervals in the middle and upper parts of the unit.

This interval occurs in all wells in the northern part of the basin and extends farther south than the basal sandstone of unit "A". It has been recognized south of Great Bear River by G.K. Williams (pers. com., 1978) in the SOBC CS Great Bear River N-30, SOBC CS St. Charles Creek H-61, Cdn. Res. Sig. Keller Lake P-14, and Cdn. Res. Sig. Keller Lake 0-13 wells, but not in the Shell Blackwater Lake G-52 well in the extreme southwestern part of the report area. Thickness varies from zero in that well to a maximum of 107 m in the BP et al. Russell M-07 well. It has not been observed in outcrop along the western flank of the basin and is known to be missing at Big Smith Creek where dark grey mudstone is virtually in contact with underlying Devonian Hume Formation. The absence of the unit in the G-52 well and at Big Smith Creek, suggests that it wedges to zero thickness toward the western side of the basin.

Age of unit "B". Unit B is Middle Albian, based on micropaleontology by D.H. McNeil of samples from the unit in the D-61 well [*see* Fig. 5 and Appendix II(b)].

Unit "C". The "C" unit gradationally overlies the "B" unit and is 246 m thick in the reference well. It is a monotonous succession of concretionary, dark grey shales and minor interbedded mudstone. Glauconite is common throughout the unit as is pyrite. Bioturbation structures were noted in the middle and upper parts of the unit by F.G. Young.

Unit "C" occurs throughout the basin. It is the only unit present in the Blackwater Lake G-52 well to the southwest, where 26 m of dark grey mudstone rest unconformably on Devonian carbonates assigned to the Hume Formation, and are overlain by Quaternary deposits. Traced eastward (*see* Fig. 5) it is the youngest Early Cretaceous unit recognized, in the Arco Lost Hill Lake F-62 well, although units "D" and "E" may occur in the interval unrepresented by samples (Fig. 5). In that well G.K. Williams (pers. com., 1978) tentatively identified a clean mature quartz sandstone at a depth of 184 m which he suspects represents the base of a younger sequence unconformable on unit "C". Middle to Upper Albian sandstone and carbonaceous clay occur at surface at MacIntosh Bay on the south side of Smith Arm of Great Bear Lake [GSC Loc. No. 2570A, Appendix II(c)]. The Albian sequence is either truncated or condensed on Grizzly Bear Mountain where it can be no thicker than a covered interval of 275 m which occurs between Upper Cretaceous rocks [GSC Loc. No. 6658, Appendix II(c)] and outcrops of Ordovician-Silurian Mount Kindle Formation mapped at the shoreline of Great Bear Lake by Balkwill (1971).

Westward, at the surface on Great Bear River, a covered recessive interval occurs between east dipping Devonian Hume Formation at the east base of St. Charles Mountain and gently east dipping sandstones and siltstones which form St. Charles Rapids. This recessive interval in a general way probably corresponds to the shales and mudstones of unit "C" in the subsurface, but a precise correlation cannot be made because subsurface markers above and below unit "C" cannot be identified at surface. Mudstones and siltstones of the recessive interval also are exposed farther south at St. Charles Creek (Fig. 27) and at Big Smith Creek.

Age of unit "C". Age determinations by T.P. Chamney (1971) of unit "C" in the Blackwater Lake G-52 well, and Sinclair Whitefish River K-76 well [GSC Loc. No. C-12213, Appendix II(b)] and by D.H. McNeil in the Sinclair Wolverine Creek D-61 well [*see* Fig. 5 and Appendix II(b)] all indicate a Middle Albian age.

From the surface recessive interval foraminifers identified by D.H. McNeil [GSC Loc. No. C-9270 and C-9277, Appendix II(b)] indicate a Middle Albian age.

FIGURE 27. *Unnamed Middle to Upper Albian mudstones and siltstones, west flank of Great Bear Basin. 64°49'N, 124°26'W.*

Unit "D". Unit "D", overlying unit "C", is a thin interval (33.5 m in D-61) of interbedded dark grey shale and grey quartz siltstone.

This unit is traceable to the east in the BP et al. Grey Goose N-70 and BP et al. Russell M-07 wells, but cannot be identified in Arco Lost Hill Lake F-62 (*see* Fig. 5). Its absence in F-62 may be due to facies change to shales and mudstones of unit "C", but more probably it is missing due to post-Albian erosion.

Unit "D" also is traceable to the south from D-61 and has been identified by G.K. Williams (pers. com., 1978) in the SOBC CS Great Bear River N-30 and the SOBC CS St. Charles Creek H-61 wells. South of H-61 it has probably been truncated by post-Albian erosion.

Age of unit "D". One sample from unit "D" [*see* Fig. 5 and Appendix II(b)] yielded Middle Albian foraminifers, identified by D.H. McNeil.

Unit "E". Unit "E" in D-61 is 430 m thick and comprises an alternating sequence of sandstone, shale and silty or sandy shale. The lowermost 28 m are dark grey shale, overlain by 146 m of light to medium grey, fine grained, argillaceous and glauconitic sandstone interbedded and interlaminated with brown argillaceous siltstones, greenish-grey and black shales and mudstones. In the middle of this interval, brown micritic limestone-containing gastropods and foraminifers is present. The lowermost 58 m of the interval is pervasively glauconitic and burrows and bioturbation structures are recorded. This sandy interval is overlain by 107 m of medium to dark grey concretionary mudstone and dark grey fish-scale bearing shale, capped by light brown sandy and silty limestone. Finally the uppermost interval of unit "E", 149 m thick, comprises a heterogeneous succession of fine grained, glauconitic sandstones, medium to dark grey, glauconitic mudstones and light brown, argillaceous, calcareous and concretionary siltstones. In the adjacent BP Grey Goose N-70 well, unit "E" mudstones and sandstones are markedly sideritic, however, glauconite is absent.

The various intervals of unit "E" described above are distinctive in the D-61 well but are not readily recognized in adjacent wells, partly perhaps due to facies changes within the unit but probably largely due to truncation of units by post-Albian erosion. Outcrops of sandstone, siltstone, mudstone and shale at St. Charles Rapids on Great Bear River and on St. Charles Creek and nearby creek valleys on the west flank of Great Bear Basin may correlate in a general way with unit "E", but could also correlate in part with unit "D".

Unit "E" in the D-61 well is overlain by 12 m of medium to coarse-grained quartz sandstone which G.K. Williams (pers. com., 1978) tentatively assigns to a younger unconformable sequence.

Age of unit "E". Foraminifers identified by D.H. McNeil [Fig. 5 and Appendix II(b)] and by T.P. Chamney [GSC Loc. No. C-12195; Appendix II(b)] indicate a Middle Albian age for unit "E". Because the uppermost collection is only 88 m from the top of the unit, it is assumed that the entire unit in the well is Middle Albian in age. Overlying the rapids-forming sandstones at St. Charles Rapids on Great Bear River are dark grey shales and mudstones which, to the south at St. Charles Creek and in a tributary to Big Smith Creek, have yielded palynomorphs of Late Albian and Late Albian to Cenomanian age [GSC Loc. Nos. C-9269, C-9276 and C-30983; Appendix II(c)] according to W.W. Brideaux. D.H. McNeil, on the basis of foraminifers, assigned a Late Albian age to samples C-9269 and C-30983 and a Middle to Late (?) Albian age to sample C-9276. These outcrops represent condensed basin margin sections which cannot be precisely correlated with subsurface basin-centre strata. Equivalents of Upper Albian to Turonian outcrops at the basin margin would be expected to occur in the basin centre but apparently have been removed by later erosion.

Unit "E" overlies unit "D" in many wells presumably with gradational contact. Both units can be traced eastward from D-61 to N-70 and M-07, but both are missing from F-62 (Fig. 5) probably due to erosional truncation as illustrated in Figure 5. The alternative that unit "C" in the F-62 well is a condensed sequence containing equivalents of units "D" and "E" cannot be eliminated.

The Turonian strata herein included in this transgressive sequence occur on the east flank of Keele Arch at Lac des Bois (Lat. 66°52.5'N; Long. 124°54.0'W). There dark grey and rusty brown weathering, locally oil saturated, fissile, bentonite-laminated, concretionary mudstones and siltstones occur close to Paleozoic rocks and are considered basal to the Cretaceous sequence in that area. The concretions are large (up to 2 m in diameter), oblate, laminated and contain well preserved fossil fish [Figs. 28 and 29; GSC Loc. No. C-76622; Appendix II(c)] and pelecypods dated by J.A. Jeletzky as Early Turonian in age [GSC Loc. No. 84342; Appendix II(c)].

Summary of Albian to Turonian sequence

The Albian sequence described above appears to be truncated and unconformably overlain by younger strata. The contact between the two sequences is nowhere exposed and the unconformity is inferred from widely scattered surface

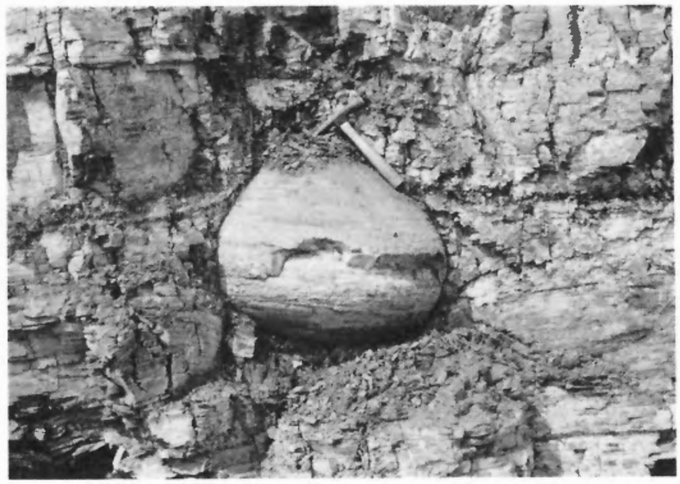


FIGURE 28. *Calcareous siltstone concretion enclosed by Turonian mudstone, northwestern Great Bear Basin, Lac des Bois. 66°52'N, 125°21'W.*

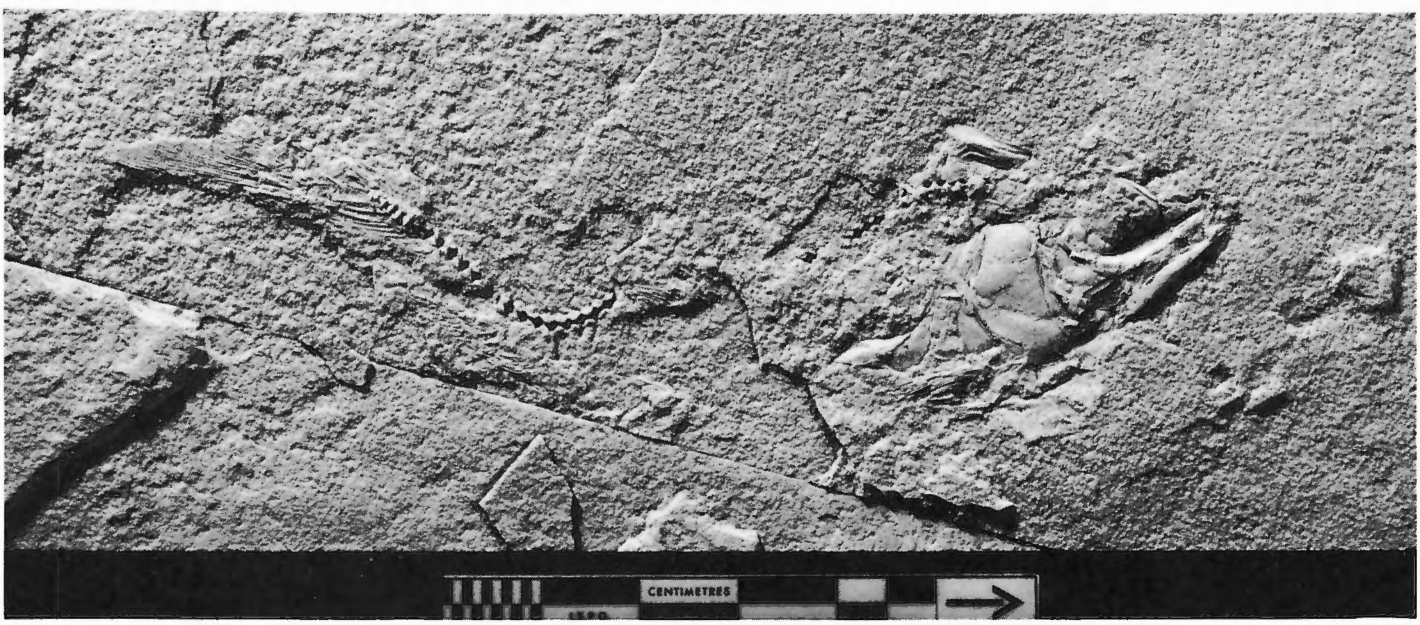


FIGURE 29. *Fish (Osmeroides sp.) skeleton from concretion similar to that shown in Figure 28.*

exposures and from tentative marker-picks made by G.K. Williams (pers. com., 1978) in the subsurface. The picture which emerges is one of an Albian basin that, as preserved, is asymmetric from west to east (western side steepest) and asymmetric longitudinally, from northwest to southeast, with a shallow plunge from the shallow southeastern end to the deep northwestern end. The basin described is what is preserved today after post-Early Turonian uplift and truncation. Facies patterns are not well enough understood within the basin to document or infer the initial (Middle Albian) basin geometry. The writers envisage a Middle Albian basin with its western shore more or less coinciding with the east flank of Keele Arch (*see* Fig. 32). Onlap resulted in a condensed section adjacent to the arch and overstepping by Upper Albian to Turonian strata onto the arch. Post-Turonian regression and erosion resulted in erosional truncation across Great Bear Basin and removal of Upper Albian to Turonian strata from the basin centre.

Younger sequence - Campanian to Maastrichtian

Scattered outcrops of Cretaceous rocks younger than Early Turonian occur in the southern part and on the east flank of Great Bear Basin. Balkwill (1971, p. 22) reported early Upper Cretaceous dark grey to black shales from an outcrop about 40 km northeast of the McConnell Range and about 68 km south of Fort Franklin [GSC Loc. No. C-6657; Appendix II(c)].

On the east side of Great Bear Basin widely scattered outcrops of post-Albian rocks occur. The oldest, dated as early Late Cretaceous [GSC Loc. No. C-6658; Appendix II(c)], occurs low on the west side of Grizzly Bear Mountain about 274 m higher than Ordovician-Silurian Mount Kindle Formation exposed at the shore of Great Bear Lake (*see* Balkwill, 1971, Map 5-1971).

Other outcrops which have been dated include grey and dark grey shales at Kokeragi Point at an elevation greater than 610 m [GSC Loc. No. C-2566; Appendix II(e)] and on the north side of Smith Arm between Good Hope Bay and Katseyedie River [C-4291 to C-4300; Appendix II(e)]. Radiolaria from these samples examined by J.H. Wall indicate a Late Cretaceous, probably Late Campanian age.

Still younger (Maastrichtian-Paleocene) rocks outcrop in the Great Bear Lake area. They will be discussed below under a separate heading. The younger subsurface sequence identified by G.K. Williams appears to truncate Albian strata. It consists of a basal mature quartz sandstone overlain by black carbonaceous shales with occasional oil staining in either shale or sandstone. The sandstone (maximum of 17 m in the I-74 well) cannot always be recognized with confidence in other wells. The truncating relationships seen by Williams are illustrated in Figure 5. Table 3 shows thicknesses identified by Williams in various wells as belonging to the younger sequence. Williams (pers. com., 1978) emphasizes that his markers are tentative and unsupported by paleontologic data.

Age and correlation. The younger sequence tentatively identified by Williams is undated in the subsurface. Dark grey shales at Kokeragi Point and north of Smith Arm are considered Late Campanian in age by J.H. Wall [GSC Loc. No. C-4291-300, C-2566; Appendix II(e)] and are assumed to pertain to the younger sequence. They thus correlate with the East Fork Formation of Peel Trough and the Mason River Formation of Anderson Basin. In fact, the lack of shoreline facies suggests that shales of this age may have been deposited over the entire report area rather than in separate northern and southern basins as shown in Figure 35.

Contact relationships. The markers tentatively picked by G.K. Williams (pers. com., 1978) indicate a cross-cutting unconformable younger sequence. Surface exposures are widely scattered and the contact is nowhere exposed.

Unnamed Maastrichtian to Paleocene strata

On the east side of Great Bear Basin three outcrops of nonmarine strata are known. At Kokeragi Point medium grey shale with a very thin (1 cm) coal seam occurs. To the northeast across Deerpass Bay a clearly continental deposit comprises at least 8 m of unconsolidated sand overlain by about 3 m of semi-resistant but friable clay cemented sandstone with root casts, overlain in turn by at least 1.5 m of coal. Balkwill (1971, p. 22) reported medium grey, silty, very bentonitic, blocky weathering mudstone with thin layers (less than 1 cm) of soft black lignite, at the northern end of Grizzly Bear Mountain (Fig. 30). The beds there are contorted and rotated. Balkwill (*ibid.*, p. 20) suggests the deformation was probably due to large-scale landsliding or ice thrusting (Fig. 30).

The lignite and contained angiosperm pollen identified by W.S. Hopkins [GSC Loc. No. C-4301; Appendix II(e)] indicate a nonmarine origin for those rocks, whereas dinoflagellates and acritarchs identified by R.L. Cox [GSC Loc. No. C-4301; Appendix II(e)] indicate a marine origin.

Age and correlation. Rocks from Kokeragi Point are latest Maastrichtian or Early Paleocene according to A.R. Sweet [GSC Loc. No. C-2567; Appendix II(f)]. Samples from the north side of Deerpass Bay are Tertiary, probably Paleocene, according to Sweet [GSC Loc. No. C-2568; Appendix II(f)]. Samples from the northern part of Grizzly Bear Mountain have been assigned an age of Upper Campanian-Middle Maastrichtian by W.S. Hopkins, and of probable Maastrichtian age by R.L. Cox [GSC Loc. No. C-4301; Appendix II(e)].

These Maastrichtian to Paleocene rocks have a similar age to the Summit Creek Formation of Peel Trough.

FIGURE 30. *Slumped or ice-thrusted unnamed Upper Cretaceous lignite and mudstone, Great Bear Basin, Grizzly Bear Mountain. 65°32'N, 120°54'W.*

Contact relationships. The outcrops at Kokeragi Point and the north side of Deerpass Bay occur at elevations between 150 and 305 m, considerably lower than Campanian rocks, also at Kokeragi Point [GSC Loc. No. C-2566; Appendix II(e)], at an elevation of about 600 m. This anomalous stratigraphic relationship has at least three possible explanations. Firstly, the low elevations of Maastrichtian-Paleocene strata may mark post-Campanian to pre-Late Maastrichtian erosional relief. Secondly, the younger rocks may have slumped to their present low-elevation positions. Thirdly, a synclinal axis of unknown orientation may occur to the east of locality C-2566. Of the three the first seems least likely because the exposure at Grizzly Bear Mountain indicates a transition from marine to nonmarine conditions, and assuming this is a regional relationship, erosional relief of 300 to 450 m is unlikely.

Cretaceous and Tertiary regional correlations

Table 1 illustrates the correlation of Cretaceous and Tertiary rocks within and adjacent to the study area.

The Lower Cretaceous rocks of Anderson Basin are correlated with the Christopher and Isachsen Formations of Banks Island, the Arctic Red and Sans Sault Formation of Peel Trough and the unnamed Lower and Middle Albian strata of eastern Great Bear Basin. To the south their equivalents occur within the lower part of the Fort St. John Group of the Liard Plateau and northeastern British Columbia and the Mountain Park and Luscar Formations of the central Alberta Foothills. They also are equivalent to the Mannville Group of southern Alberta.

The "Middle" Cretaceous (Upper Albian to Turonian) strata of Peel Trough have no equivalents in Anderson Basin, but do have in Great Bear Basin. To the south, correlative strata are represented by the upper Fort St. John Group of the Liard Plateau (Lepine, Sikanni, Sully and Dunvegan Formations), the same formations in northeast British Columbia in addition to the lower part of the Smoky Group (Kaskapau and Cardium Formation) and the lower part of the Alberta Group (Blackstone and Cardium Formations) in the central Alberta Foothills. In southern Alberta, equivalent strata are included in the lower part of the Colorado Group (Joli Fou and Viking Formations and the shale succession enclosing the fish-scale zone and second white specks).

The Upper Cretaceous strata of Anderson Basin are correlative with the Tent Island and Boundary Creek Formations of the Beaufort-Mackenzie Basin and in part with the Kanguk Formation of Banks Island. These strata have no equivalents in northwestern Peel Trough (of this report) and are broadly correlative with the Little Bear and East Fork Formations of the southeastern part of Peel Trough, and with unnamed strata of Great Bear Basin.

A section of probable Cretaceous strata unconformably overlies Devonian shales with pronounced erosional relief immediately south of the map-area, on Redstone River. The Cretaceous succession there comprises a lower shale unit about 30 m thick which to date has yielded neither macrofossils, foraminifers nor palynomorphs. The shales are overlain by prominent, resistant, coarse grained and conglomeratic sandstones which also are unfossiliferous. Stott (1960) examined these outcrops and suggested that because they appeared dissimilar to both the Fort St. John Group and Paleozoic rocks of the region, they may be of very early Cretaceous or Jurassic age. On the basis of the interpretations presented in the geological map (Map 1498A), which at the southern border of the area shows the surface rocks as belonging to the Slater River and Little Bear Formations enclosed within northwesterly trending folds across Redstone River, and which incorporates interpretations of subsurface sections, the authors suggest that the exposures on Redstone River immediately to the south of the report area can be assigned to the Slater River and Little Bear Formations.

To the south the Little Bear and East Fork Formations are correlated with the Kotaneelee and Wapiti Formations of Liard Plateau, the upper part of the Smoky Group (Puskwaskau Formation) and Wapiti Formations of northeastern British Columbia, and the upper part of the Alberta Group (Wapiabi Formation) and Brazeau Formation of the central Alberta Foothills. They are equivalent to a variety of rock units in Southern Alberta including the upper part of the Colorado Group, the Milk River, Pakowki, Belly River, Bearpaw, Blood Reserve, Eastend, Whitemud, Battle and Frenchman Formations.

The Tertiary rocks are present only locally in the report area. The Maastrichtian-Paleocene Summit Creek Formation is probably equivalent, at least in part to the Reindeer and uppermost parts of the Tent Island Formation and Moose Channel Formation (Wilson, 1978, p. 163) of the Beaufort-Mackenzie Basin. Along the Cordilleran front, equivalent rocks occur only in central and southern Alberta and are represented by the Paskapoo and Porcupine Hills Formations; the latter represented by a series of coalescing alluvial fans. Within the interior of the Cordillera, Eisbacher (1971) has described the Late Paleocene to Eocene Brothers Peak Formation as a series of alluvial fans which enclose sheets of silicic tuff.

The thin pebbly sands which outcrop along the top of the recessive cliffs of Horton River and its tributaries are tentatively identified as the Miocene-Pliocene Beaufort Formation and are correlated with that formation of Banks Island (Hills, 1970) and Mackenzie Delta (Young, 1978).

PALEOGEOGRAPHY

Introduction

The paleogeography of the region is discussed in terms of six paleogeographic lithofacies maps:

1. Neocomian to Aptian (Fig. 31)
2. Early and Middle Albian (Fig. 32)
3. Late Albian to Turonian (Fig. 33)
4. Coniacian to Campanian (Fig. 34)
5. Campanian to Maastrichtian (Fig. 35)
6. Maastrichtian to Tertiary (Fig. 36).

The time intervals chosen enclose the major lithofacies of the three basins; however, due to the great size of the region described some overlapping of specific lithofacies occurs across the boundaries of adjacent time intervals. The intervals represent those periods when specific lithofacies developed in response to activities in source areas and, for the most part, describe those conditions that remained constant during any one interval.

The paleogeographic maps are highly interpretive and represent the authors' "best guesses" for any given interval. The paucity of specific paleontological control, the lack of outcrop within broad areas such as north of Great Bear Lake and the lack of detailed sedimentological information (e.g. paleocurrent data) from surface and subsurface sections lends a highly speculative quality to the interpretations.

Pre-Cretaceous paleogeology

The pre-Cretaceous geology of the report area is illustrated in Figure 2. The youngest pre-Cretaceous rocks comprise Mississippian clastic rocks which have been reported to occur beneath the Arctic Red Formation in the Amoco PCP A-1 Cranswick A-22 well (well history report), Amoco PCP A-1 Cranswick A-22, and Can Del Mobil et al. N. Ramparts A-59, wells (D.C. Pugh, pers. com., 1978.). No Pennsylvanian, Permian, Triassic or Jurassic rocks are known to occur in the report area with the possible exception of Upper Jurassic rocks in the subsurface of Anderson Basin (Brideaux and Fisher, 1976, p. 8). As noted earlier in this report, many outcrop samples of Cretaceous rocks collected from the region contain palynological suites from each of these unrepresented systems. Approximately 100 black chert pebbles from Tertiary rocks were sectioned in anticipation of finding fossils; none were found. One or more of these systems may have been represented in the report area prior to a lengthy pre-Aptian period of erosion. Most of the reworked palynological components of Cretaceous rocks are marine dinoflagellates with those from the Mississippian and Jurassic systems being most abundant.

The pre-Cretaceous geology comprised middle and lower Paleozoic rocks and Precambrian strata that regionally were disposed in a westward dipping homoclinal succession the topographic expression of which was probably a simple plain with local relief of up to 200 m. The south-central part of the homocline was interrupted by the Keele Arch, a northward extending anticlinal culmination. To the northeast, the northwesterly oriented Coppermine Arch existed as a potential source for clastic rocks as did the northeasterly trending Aklavik Arch Complex in the northwestern corner of the area. The Keele Arch, although structurally clearly defined by Albian time was rarely a major source of clastic material and probably existed as a topographically positive but low-lying area with respect to the adjacent basins.

Neocomian to Aptian paleogeography and lithofacies (Fig. 31)

In the Neocomian most of the region remained an area of non-deposition, probably a broad, low-relief landmass. In the northwest, however, the Eskimo Lakes Arch of the Aklavik Arch Complex was actively shedding clastics which were deposited upon its northwestern and southeastern flanks. In the Beaufort-Mackenzie Basin these clastics are represented by a Neocomian deltaic complex, part of which is expressed by the gas-bearing "Parsons Sandstone" (Cote et al., 1975) beneath the modern Mackenzie Delta (Young et al., 1976). On the southeast side of the arch complex, similar sandstones developed within a nonmarine to intertidal environment during earliest Neocomian (possibly Late Jurassic) time. These sandstones, included in the Gilmore Lake Member of the Langton Bay Formation, occur only in the subsurface of northern Anderson Basin and were penetrated by the Elf Horton River G-02 well (Yorath et al., 1975).

In Aptian time (Fig. 31), nonmarine deposition commenced over a broad area extending from Coppermine Arch in the northeast, across southern Anderson Basin and Carnwath Platform at least to the eastern edge of the embryonic Peel Trough. To the northwest, on each flank of Aklavik Arch Complex, similar nonmarine sandstones were transported towards the adjacent basins. On the north side of the complex, braided streams deposited microconglomerates in topographic lows such as at Atkinson Point where they are oil-bearing (Young et al., 1976). On the southeast side of the complex upper Gilmore Lake Member nonmarine sandstones and coal reflect deltaic deposition within a shore line and intertidal environment that defined the northern margin of a marine embayment that extended southwestward from Franklin Bay and which separated nonmarine deposition to the north from fluvial accumulations to the south. Within the marine embayment the lower beds of the Crossley Lakes Member suggest shallow marine environments into which flowed streams draining the Coppermine Arch. The Gilmore Lake Member on the flanks of Coppermine Arch grades northwestwards from coarse conglomerates through point bar deposits to estuarine siltstones and mudstones in the area of the marine embayment.

Across the broad region of Carnwath Platform extending from Anderson River to Mackenzie River and southeastwards towards Great Bear Lake, nonmarine Gilmore Lake Member sandstones appear to have been predominantly deposited in paleotopographic lows created by pre-Cretaceous drainage patterns. North and east of the north bend of Mackenzie River a drainage divide appears to have separated streams flowing to the south and southwest into Peel Trough from those flowing northward towards the Crossley Lakes marine embayment. These sandstones represent fluvial deposits consisting of commonly cross-bedded, fine-grained, well sorted quartz arenites that probably were derived mainly through erosion of Precambrian and Cambrian quartzites on Coppermine Arch. On the east side of Keele Arch similar sandstones occur north of Great Bear Lake, and it is probable that Aptian sediments were deposited across the northern part of the arch and subsequently were eroded.

Peel Trough developed as a foredeep to the Cordilleran orogen. Subsidence began during the Aptian as marked by the Martin House Formation to the west of the report area (Mountjoy and Chamney, 1969), and the basal glauconitic sandstone of the Arctic Red Formation within the report area.

Early and Middle Albian paleogeography and lithofacies (Fig. 32)

In Early and Middle Albian time widespread marine transgression occurred throughout much of central North America (Jeletzky, 1971). The incursion of marine conditions onto the craton began with advances via the area of modern Mackenzie Delta and widespread expansion of the Crossley Lakes marine embayment. During this interval mudstones and shales of the upper Crossley Lakes Member and Horton River Formation were deposited in Anderson Basin. The rapidly deepening Peel Trough foredeep expanded southeastward so that the sea transgressed farther into the report area toward the east. This foredeep was filled with thick mudrocks and sandstones of the Arctic Red and Sans Sault Formations.

At this time Keele Arch became a distinct, two-sided arch extending northwards into the open marine Albian seas. Great Bear Basin rapidly foundered and received fine-grained sandstones and mudstone, the coarser components of which were probably derived from Keele Arch and the Cordillera to the southwest. On the west side of Keele Arch, a thick succession of shallow marine fine-grained sandstones and mudstones of the Sans Sault Formation developed and extended westwards into the deepening Peel Trough foredeep. These sandstones and mudstones, although situated "off-shore" from the Cordillera were nonetheless derived from the west or southwest. Facies relationships between the Sans Sault, Arctic Red and basal Trevor Formations are not clearly understood.

To the northeast the Coppermine Arch is shown on Figure 32 to have been covered by marine shale. There is little evidence for this interpretation except that on the western side of the arch Horton River Formation shales and mudstones contain no coarse components such as those of the underlying beds of the Gilmore Lake Member sandstones and conglomerates. This would suggest that marine conditions invaded the area of the arch which at that time had become subdued by the earlier erosion.

Late Albian to Turonian paleogeography and lithofacies (Fig. 33)

During Late Albian to Turonian time widespread marine regression occurred in Anderson and Beaufort-Mackenzie Basins. The regression affected a large region including much of the Arctic Archipelago.

Peel Trough, acting as a foredeep to the rising Columbian orogenic welt to the southwest and connected to the Boreal Sea via the Blow Trough (Young et al., 1976) continued to receive Arctic Red Formation mudstones and siltstones in earliest Late Albian time. Soon thereafter, strong orogenic activity in the core zone of the Cordillera resulted in rapid and thick accumulations of sandy sediments of the Trevor Formation in the northwestern end of the foredeep. These sediments in part possibly were delivered to the foredeep via the Peel Re-entrant to the west of the report area. Towards the southwest the sandy sediments become finer grained and ultimately pass into shales of the Slater River Formation. These shales continued to fill the basin, coeval with the Trevor sands to the northwest until at least the close of the Turonian. The possibility of more than one source region and delivery route for the Trevor Formation sandstones is suggested by stratigraphic relationships between the Trevor Formation and Arctic Red Formation in the region from Cranswick River to Mountain River. The conflicting lithostratigraphic and biostratigraphic data described earlier in this report suggest that the older Trevor Formation strata in the Snake-Peel Rivers region west of the report area (Mountjoy and Chamney, 1969) were deposited as a result of Middle Albian or earlier erosion within the adjacent Columbian Orogen to the southwest. On the other hand, the appearance of successively older Trevor sandstone strata in an easterly direction from Cranswick River (immediately adjacent to the western boundary of the report area) towards Hume River implies a source region within the Cordillera to the south and southeast. This latter interpretation is supported by the observation that the base of the Trevor Formation rests on older rocks of the Arctic Red Formation at Mountain River than at Hume River to the west and that the basal Trevor sandstones pass westerly into upper Arctic Red mudstones.

During this interval marine conditions extended across the southern portion of Keele Arch to connect Great Bear Basin and Peel Trough. The long period of pre-Late Albian exposure of the arch had permitted the development of chalky, chert breccia saprolites on the axis of the arch. Erosion of the saprolite provided chert clasts which became incorporated into the unnamed basal conglomeratic sandstones equivalent to the Slater River Formation, and which developed as an arcuate clastic fan. To the east, toward Great Bear Basin, it is assumed that the conglomeratic sandstone facies passed into an open marine shale facies, recorded in the Upper Albian to Cenomanian mudstones and siltstones of St. Charles Rapids and St. Charles Creek areas and the Lower Turonian fish-bearing concretionary mudstones at Lac des Bois.

Coniacian to Campanian paleogeography and lithofacies (Fig. 34)

Although the authors envisage essentially continuous deposition in southeastern Peel Trough from Late Albian-Turonian time (Slater River Formation) to Coniacian-Maastrichtian time (Little Bear and East Fork Formations), it must be acknowledged that no Coniacian age rocks have been identified anywhere in Peel Trough or Great Bear Basin, nor have they been reported in southern District of Mackenzie (Stott, 1960). In Figure 34 rocks of Coniacian age have been tentatively identified only in the area of northern Anderson Basin. Thus on purely biostratigraphic grounds a regional unconformity may exist, separating a Little Bear and East Fork sequence, above, from a Slater River sequence, below. Nonetheless the Coniacian, according to Jeletzky (1971), was a period of widespread transgression in the Canadian western interior and the Arctic Archipelago, and it is convenient to consider that the southeastern portion of Peel Trough remained negative throughout this period.

In the proposed model, shale deposition that was initiated in Late Albian time with development of the Slater River Formation was interrupted in the southwestern part of Peel Trough by the introduction of a southwestern derived sandstone wedge comprising the Little Bear Formation in Coniacian to Campanian time; however, shale deposition continued in the eastern part of Peel Trough and on the subsided Keele Arch, with the accumulation of the East Fork Formation. Great Bear Basin may have been emergent during some part of Coniacian to Campanian time but at least the eastern part was the site of shale deposition in the Late Campanian.

In northernmost Anderson Basin, which had been emergent since the Late Albian, marine transgression occurred in Late Coniacian time. Possible restricted marine circulation resulted in reducing conditions contributing to the development of pyritic shale which was subsequently oxidized at the surface to jarosite. Temperatures in the region were temperate enough to permit populations of marine reptiles and birds to flourish.

Campanian to Maastrichtian paleogeography and lithofacies (Fig. 35)

The age of the uppermost Little Bear and lowermost East Fork Formations is Middle Campanian and probably the temporal intervals represented in Figure 34 and 35 overlap. No lateral facies transition from sandstone to shale (Little Bear to East Fork) was observed in surface sections, but subsurface data (*see* Fig. 5) indicate such a relationship.

Following deposition of the Little Bear Formation sandstones in southwestern Peel Trough, open marine conditions occurred which allowed for the deposition of East Fork Formation mudstones, shales and sandstones within the broad basin that extended eastward to include unnamed shales near Great Bear Lake.

In Late Campanian and at least Early Maastrichtian time, sandstones derived from the Cordillera invaded the East Fork shale basin from the southwest. These shallow marine sandstones appear to pass northerly into open marine shales of the upper part of the East Fork Formation. These sandstones are possibly equivalent to the sandstones, coal and carbonaceous shales of the Wapiti Formation to the south (Stott, 1960).

To the north, in Anderson and Beaufort-Mackenzie Basins marine regression produced the offlapping radiolarian shales of the Mason River Formation. These beds also contain vertebrate remains suggesting continued temperate conditions in the region.

Maastrichtian to Pliocene paleogeography and lithofacies (Fig. 36)

Figure 36 is a paleogeographic map for the combined Late Maastrichtian to Paleocene and Miocene-Pliocene intervals. The former are shown in Peel Trough and the latter are illustrated in Anderson Basin.

Following the northward incursion of Campanian to Maastrichtian sands into the East Fork Formation shale basin, the sedimentary regime of southeastern Peel Trough changed significantly. Laramide uplift of the Mackenzie Mountains resulted in the development of syn-orogenic molasse in the form of a broad alluvial fan that prograded eastwards. Volcanism to the west, possibly as far removed as the St. Elias Mountains (Douglas et al., 1970, Figs. VIII-44 and 45) may have contributed ash which formed the well defined tuff layers within the fan complex.

The alluvial fan deposits were subsequently deformed by Laramide Orogeny. Summit Creek Formation strata are tilted on the east flank of the southern end of MacKay Range and are probably overturned adjacent to the section of unnamed Upper Cretaceous sandstones, also on the east flank of the range. In eastern Great Bear Basin, local nonmarine and transitional Maastrichtian-Paleocene exposures suggest a regional termination of marine conditions which had occupied the region throughout much of Cretaceous time.

Fluvial sediments, in Anderson Basin, possibly derived from Coppermine Arch, extended across the basin towards the northwest during the Late Miocene and Early Pliocene. These sediments were developed within a distributary stream complex which drained the gentle northwesterly dipping land surface that presently defines the surface of northern Anderson Basin. If these sediments are equivalents of the Beaufort Formation of Banks Island, the land surface thus extended across Amundsen Gulf.

ECONOMIC GEOLOGY

Hydrocarbons

Anderson Basin

Cretaceous and Tertiary rocks of Anderson Basin have low potential for production of hydrocarbons. Conglomerates at the base of the Smoking Hills Formation would be potential reservoir rocks, but are widely exposed, have gentle uniform dips toward the northwest and have been buried at most to about 300 m. Gilmore Lake Member sandstones are another potential reservoir, but they too are widely exposed and dip gently to the northwest. The Gilmore Lake has been buried to at least about 700 m, and possibly deeper - depending on the thickness of strata removed during development of the pre-Smoking Hills Formation hiatus. Permeability barriers or local structures in the subsurface of Anderson Basin would be required for favourable reservoir conditions. The Gilmore Lake occupies paleotopographic depressions on Carnwath Platform and if a similar situation exists in the subsurface of Anderson Basin the possibility of reservoir-forming stratigraphic pinch-outs would be greater.

Carnwath Platform

Oil-saturated sandstones and a number of oil and gas seeps (*see* Fig. 37) have been reported on Carnwath Platform (*see* Cook and Aitken, 1971, 1975). The sources of these seeps must be Paleozoic rocks in most if not all cases. A seep at Lac des Bois is known to be from Paleozoic rocks because local Cretaceous rocks are immature with respect to contained hydrocarbons (T.G. Powell, pers. com., 1978).

Peel Trough

The paleo-drainage system documented on Carnwath Platform by Cook and Aitken (1975) may extend to the southwest into the subsurface of Peel Trough, providing the possibility of porous channel-filling sands as a reservoir. If they exist they have been buried to about 2000 m, adequate for oil generation, but they are capped by glauconitic sandstones of the Arctic Red Formation. The fact that basal sandstones on Carnwath Platform are locally oil-bearing does not enhance the potential of any basal sandstone in Peel

FIGURE 37. *Oil seep at Rond Lake. 67°06'N, 125°26'W.*

Trough because there the thick Late Devonian Imperial Formation shales would preclude migration from the deeper stratigraphic levels which supplied the oil on Carnwath Platform. Any oil trapped in such sands would, therefore, have to be derived from source beds in the overlying Arctic Red Formation or the underlying Late Devonian Imperial Formation.

Southeastward in Peel Trough in the Candel Deckmg et al. E. Mackay B-45 well, oil has been discovered in the Upper Ordovician to Lower Silurian "cherty unit" of the Franklin Mountain Formation. A drill stem test yielded 1830' (560 m) of 20° API gravity oil and 530' (160 m) of salt water (unpubl. well history report, Indian and Northern Affairs). The oil is immature and the source was the Slater River Formation based on geochemical evidence (Geochem Laboratories and Agat Consultants, 1977). Potential exists for other outliers of "cherty unit" or other pre-Cretaceous porous and permeable rocks buried by Slater River Formation on or adjacent to Keele Arch.

With the Slater River as source beds, the unnamed basal conglomeratic sandstone which locally underlies the Slater River is prospective. However, since it is exposed up-dip, structural or permeability traps would be needed. Maximum burial was during the Paleocene to Eocene and consequently oil generation may have been broadly contemporaneous with Laramide deformation. Subsurface Laramide structures involving the unnamed sandstone would therefore be prospective.

Sandstones of the Little Bear Formation and the sandstone member of the East Fork Formation pinch out eastward into potential source beds of the Slater River and East Fork Formations. Unfortunately these units have little to no porosity and have low potential as reservoirs.

Great Bear Basin

In Great Bear Basin a number of sandstones occur but most are tight so far as is known. One notable exception is the basal sandstone, unit "A", which comprises a mature porous sandstone. Although almost certainly exposed up-dip to the northwest it pinches out up-dip to the south and probably to the east and west. It thickens and thins due to infilling of paleotopography, increasing the possibility of stratigraphic pinch-outs.

Little is known about the bedrock geology of a large area north of Smith Arm on Great Bear Lake and east of Lac des Bois because bedrock is obscured by thick Quaternary deposits. It seems probable, however, that basal porous sands of unit "A" extend northward into this area. Structures related to the Franklin Mountains or Colville Hills may exist in the subsurface of Great Bear Basin because steeply tilted beds occur as far east as Manitou Island in Keith Arm of Great Bear Lake (Balkwill, 1971). Because such structures tend to be discontinuous and can follow a variety of structural trends they could be missed by conventional cross-basin seismic surveys. Maximum burial of the basal sandstones appears to have been about 1000 m. Consequently, trapped hydrocarbons, if derived from Cretaceous rocks, would almost certainly be gas. On the other hand, Paleozoic oil, migrated from deeper levels, as on Carnwath Platform, could be trapped in the basal sandstone.

Coal

Coal beds occur in the Gilmore Lake Member of the Langton Bay Formation in Anderson Basin, and in the Summit Creek Formation in Peel Trough. Thin seams in the former have been used as a fuel source by trappers and by the mission at Paulatuk (Mackay, 1958), but deposits are not extensive. Potentially more significant deposits found near Fort Norman in the Summit Creek Formation have been explored by Manalta Coal. They are reported on briefly by Padgham et al. (1976).

Hematite

The local development of earthy hematite at the sites of modern or old bocannes within the Smoking Hills Formation appears to be related to surface decomposition and/or oxidation and is not expected to be extensive beneath the surface.

Bentonite

The black plastic shale of the Horton River Formation was analyzed and found to contain between 22 and 30 per cent chlorite and montmorillonite (A.E. Foscolos, pers. com., 1972). The montmorillonite appears to be of the low swelling type with a high exchange capacity, therefore it has doubtful use as a drilling fluid material. Other shales such as those of the Arctic Red, Slater River and East Fork Formations have not been analyzed but are expected to have little commercial value.

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APPENDIX 1

Descriptions of Tertiary and Cretaceous Formations in Peel Trough

SUMMIT CREEK FORMATION
(latest Maastrichtian to Paleocene)

The type section comprises four partial sections which are located adjacent to an unnamed stream which drains the eastern flank of the uplands west of Tate Lake and which flows into the northern end of Tate Lake. The sections do not contain significant overlap nor gaps, and, for the most part their enclosed strata are well exposed.

Station YB-69-024 Latitude 64°28'N; Longitude 125°41'W.

Unit	Lithology	Thickness metres	Height Above Base metres
7	Mostly covered. Talus comprises well sorted, unconsolidated chert, carbonate and quartzite pebbles and medium grained friable, light grey sandstone. A pale yellowish grey layer, 0.6 m thick (tuff ? as below) occurs 1.0 m above the base of the unit	19.8	295.7
6	Uppermost 20 m: Tuff, pale yellow and grey weathering, friable (dry) plastic (wet), thin bedded, locally containing rounded chert and quartzite pebbles. Lowermost 3.6 m: Lignite, black, fissile; carbonized wood; interbedded with dark grey, soft, sandy mudstone and siltstone	23.8	275.9
5	Interbedded sandstone and conglomerate. Conglomerate, medium grey, massive, poorly consolidated, poorly sorted, ungraded, composed of subrounded pebbles, cobbles and widely scattered boulders of black chert, siliceous shale, tuff, carbonate and quartzite in a matrix of grey, sandy clay and mudstone. Sandstone, medium grey weathering, well laminated, locally pebbly; laminae composed of dark grey mudstone and siltstone with poorly preserved plant impressions on bedding surfaces	30.0	252.1
4	Covered. Talus comprises pebbles and cobbles of poorly sorted black chert, carbonate and quartzite	10.6	222.1
3	Sandstone, medium grey weathering, medium bedded, friable, cross-laminated with thin mudstone laminae, composed of medium grained, well sorted, subrounded, frosted quartz, chert and carbonaceous grains; local thin lenses of chert and quartzite pebble conglomerate and rare, thin woody lignite beds. Laterally the unit passes into well developed thick crossbedded intervals, the foresets of which are truncated by deep scours enclosing poorly consolidated pebble conglomerate	5.7	211.5

The base of unit 3 of Station YB-69-024 overlies the top of unit 2 of Station YB-69-023, the latter located 1.0 km southeast of the former.

Station YB-69-023 Latitude 64°28'N; Longitude 125°40'W.

Unit	Lithology	Thickness metres	Height Above Base metres
2	Interbedded conglomerate and sandstone. Conglomerate, medium grey weathering, massive, poorly consolidated, fair to well sorted, composed of black chert, siliceous shale, carbonate and quartzite pebbles. The conglomerate beds and lenses vary from 0.5 to 2.0 m thick, each of which shows a slight fining upwards grading. Where lensed they vary from a few to several metres in length and commonly overlie deep scours into underlying sandstone. Sandstone, medium grey weathering, thin to medium bedded, friable to poorly consolidated, composed of medium grained, well sorted, subrounded frosted quartz, chert and carbonaceous grains with local thin pebble beds and "floating" pebbles	30.5	205.8
1	Interbedded tuff, mudstone and woody lignite. Tuff, pale yellow and mottled yellow and orange weathering, blocky, thin bedded, friable, composed of very fine to fine grained irregular fragments of amorphous, partly devitrified silicate of a general orthoclase composition. Mudstone, rusty maroon and dark grey weathering, blocky, containing abundant poorly preserved plant debris and carbonized wood; this material encloses low graded, woody, black, friable lignite beds from a few centimetres to 0.5 m thick	16.8	175.3

Note: Within this interval and approximately 2.5 km west of Station YB-69-023 is a small, lens-like body of white to light grey, dense, finely vessicular welded tuff or ignimbrite, enclosed by brick red, baked siliceous mudstone.

Station YB-69-022 Latitude 64°28'N; Longitude 125°34'W.

Unit	Lithology	Thickness metres	Height Above Base metres
7	Conglomerate, massive, mottled grey and rusty brown weathering, well indurated, resistant, molded into regular hoodoos, composed of graded units averaging 1.2 m thick within which cobbles (15 cm max. dimension) at the base rapidly fine upwards to well sorted pebbles (3 to 5 cm), clast composition comprises black chert and siliceous shale, tuff, quartzite and carbonate in decreasing order of abundance; numerous thin to medium beds of medium grey, fine to medium grained pebbly sandstone. Fossils, C-41896, Appendix II(f)	29.0	158.5
6	Covered, adjacent inaccessible cliffs show hoodooed conglomerates as above	3.6	129.5
5	Sandstone, medium grey weathering, well laminated and crossbedded, composed of medium grained, well sorted, subrounded, frosted quartz, chert and carbonate grains, poorly indurated and cemented; this unit passes laterally into resistant, well indurated conglomerate, its basal contact with unit 4 is sharp and the upper contact with unit 6 is gradational	1.0	125.9
4	Conglomerate, as above, graded units well developed in cycles 2.5 to 3.0 m thick, the basal cobbles are predominantly ovoid quartzite and carbonate and the intervening pebble intervals are mainly tuff and black chert, the unit is developed into resistant and irregular hoodoos, conglomerate matrix consists of ferrous, medium grained pebbly sandstone	22.3	124.9
3	Sandstone, rusty grey-brown weathering, thin bedded, well indurated, flaggy, composed of fine to medium grained, well sorted, subrounded frosted quartz, chert and carbonaceous grains, cemented by ferrous clay and mudstone; the unit passes laterally into cyclically graded conglomerate as above, upper and lower contacts with units 4 and 2 are sharp	1.0	102.6
2	Conglomerate, rusty maroon and grey brown weathering, massive, composed of poorly sorted pebbles and cobbles (2 to 15 cm) of black chert, siliceous black shale, quartzite, carbonate, ironstone and minor tuff in a dense groundmass of medium to coarse grained carbonaceous sandstone	9.0	101.6
1	Covered, loose talus composed of poorly sorted pebbles and cobbles as above, much loose sand	59.1	92.6

Unit	Lithology	Thickness metres	Height Above Base metres
Station YB-69-021 Latitude 64°29'N; Longitude 125°33'W.			
1	Conglomerate, medium grey weathering, some 0.5 to 2.0 m thick brown weathering intervals, massive, crudely graded, composed of generally poorly sorted pebbles and cobbles (2 to 15 cm) of black chert, carbonate and widely scattered speckled tuff and quartzite, graded units average 2.0 m thick, crude imbrication evident in lower parts of each graded unit, matrix composed of grey and brown, coarse grained, ferrous sandstone; throughout the conglomerate beds are thin (20 cm thick) layers of carbonaceous pebbly mudstone	33.5	33.5

Unnamed Upper Cretaceous Sandstone
(Campanian)

The sandstone unit is located on the east flank of Mackay Range at Latitude 64°36'N; Longitude 125°36'W. The section is overturned, dips at 80° towards the west and encloses 147 m of well exposed strata.

Unit	Lithology	Thickness metres	Height Above Base metres
11	Sandstone, dark brown weathering, medium bedded, jointed, with well developed interference ripple marks on bedding surfaces, composed of medium to fine grained, well sorted, angular to subrounded clear and frosted quartz and carbonaceous grains; minor maroon, fissile, thin bedded, sandy mudstone	15.8	146.9
10	Shale, black, highly carbonaceous, grey and yellow orange weathering, fissile, friable, contains thin (1 cm) lenses of carbonized wood. Fossils, C-8715; Appendix II(e)	2.4	131.1
9	Sandstone, light grey to white weathering, medium to thick bedded, composed of medium grained, well sorted, subangular to subrounded, frosted quartz and carbonaceous grains; the unit is jointed	16.5	128.7
8	Sandstone, dark brown and rusty brown weathering, massive, ripple laminated, friable, composed of medium to locally coarse grained and locally finely conglomeratic quartz and dark chert, the latter well rounded and locally "floating" in coarse grained ferrous sandstone	3.6	112.2
7	Sandstone, banded grey and dark brown, thin and medium bedded, very fissile and flaggy, friable, composed of fine to medium grained, subangular to subrounded clear quartz and finely disseminated carbonaceous material, ironstone concretionary beds are common throughout and become increasingly abundant upwards; minor intervals of interbedded, banded dark grey to black and brown sandy mudstone and fine grained argillaceous sandstone	36.6	108.6
6	Sandstone, generally medium yellow brown weathering, thin bedded at base grading to medium bedded at top, highly jointed with minor horizontal faults in lowermost 4.5 m, composed of fine to medium grained, fair sorted, frosted, subrounded quartz and disseminated carbonaceous material, moderately friable; minor 0.3 m intervals of dark grey sandy mudstone; ironstone concretions occur throughout and near the top of the unit, horizons of irregularly "clotted" ironstone occur in an interval about 1.5 m thick, top of unit capped by a 15 cm thick dark maroon concretionary bed; sedimentary structures include small load casts, sandstone pillows and rare ripple laminations	29.0	72.0
5	Sandstone and interbedded mudstone, banded brown, rusty maroon and grey weathering, very thin to thin bedded, flaggy, rubbly: sandstone composed of fine grained with some interlaminated medium to coarse grained quartz and chert, individual laminae well sorted; common thin beds of maroon ironstone and nodular ironstone; 4 cm thick layer of woody debris at base of unit	6.1	43.0
4	Sandstone, medium brown weathering, massive, pervasively jointed, friable, laminated with thin ferrous mudstone and siltstone laminae that are commonly intricately convoluted into flattened "S" curves	9.8	36.9
3	Sandstone, medium grey weathering, very thin bedded, friable, pervasively jointed, rubbly, composed of fine grained, angular, clear quartz and disseminated carbonaceous grains; some beds display fine grained sandstone "clots" bounded by convoluted sandy mudstone laminae; local spheroidal inclusions of dense ferruginous sandstone; minor widely disseminated wood fragments	15.5	27.1
2	Sandstone, medium brown weathering, thin to medium bedded, flaggy, friable, pervasively jointed with iron stain on joint surfaces, composed of fine grained, angular, clear quartz, disseminated carbonaceous grains; interbedded with thin bedded, flaggy, mottled grey and rusty brown weathering, argillaceous, fine grained sandstone and siltstone; the unit contains abundant wood casts and rare burrowed intervals	6.1	11.6
1	Sandstone, medium grey and mottled rusty brown weathering, very thin to thin bedded, argillaceous, very fine to fine grained, well sorted; bedding planes defined by thin laminae of argillaceous siltstone; some beds contain compressed irregular "clots" of argillaceous, medium grained sandstone; burrows and grazing marks common. Fossils, C-9285; Appendix II(e)	5.5	5.5

Base of member not exposed.

EAST FORK FORMATION

Shale Member
(Campanian and Maastrichtian)

The name "East Fork Formation" was introduced by T.A. Link in a private oil company report. The name was later adopted by R.M. Hart and other Canol Project geologists whose brief description of the "type section" (Tassonyi, 1969, p. 111) was the basis upon which Stewart (1945) formally recognized the name.

The "type section" (Tassonyi, 1969) or "type locality" (Stewart, 1945) occurs on East Little Bear (East Fork of Little Bear) River near its junction with Little Bear River. According to Hart (reported in Hume, 1954 and Tassonyi, 1969) 259 m of strata are exposed there. One of the authors (CJY) examined the locality in 1969 and found that only the basal 76 m remained exposed, the remainder being covered by talus and trees. This section and others in the region are inadequate for type section status and it is suggested that such sections should be designated from the subsurface of the region where a number of wells have penetrated complete basin-centre sequences. Insofar as this report does not include detailed descriptions of subsurface strata the authors feel that it is premature to assign a subsurface type section.

For the sake of completeness in this appendix, the following is a description of the East Fork Formation (shale member) near the junction of Little Bear and East Little Bear Rivers.

Station YB-69-032 Latitude 64°47'N; Longitude 126°02'W.

Unit	Lithology	Thickness metres	Height Above Base metres
2	Shale, dark grey to black, soft, plastic, uniform, locally slightly silty, recessive, forms sluggish soft talus fans; laterally across a small gully and at the equivalent topographic level, minor thin beds of coarse grained, pebbly sandstones and shale-chip conglomerate sandstones occur at the base of the unit. The uppermost 58.4 m of this unit are largely covered, isolated poor outcrops and talus concentrations show black, plastic shale. Fossils, C-23930-33, C-23935-36, C-23938-40; Appendix II(d)	74.2	76.0
1	Conglomerate, rusty maroon and medium grey weathering, poorly indurated, basal 45 cm composed of subrounded to round black chert and carbonate pebbles in a friable matrix of silty, coarse grained ferrous sandstone. Upper part of unit comprises well sorted fine pebble conglomerate. The two parts of the unit constitute one graded unit. Laterally, in poorly exposed recessive slope outcrops, the conglomerates are replaced by black shale as above with thin (5 to 15 cm) lignite seams	1.8	1.8

Base of unit 1 is in contact with sandstones of Little Bear Formation.

LITTLE BEAR FORMATION
(Santonian and Campanian)

The type section of the Little Bear Formation is composite, composed of two sections, each located on the east bank of Little Bear River. The formation name was used by T.A. Link in an unpublished oil company report and later adopted by Canol Project geologists. On the basis of the Canol Reports Stewart (1945) gave official recognition to the formation and designated the Little Bear River as the "type locality". In this report a formal type section is proposed, comprising the two partial sections whose geographic coordinates appear below. No significant overlap nor gap occurs between the two sections of the type section.

Station YB-69-026 Latitude 64°37'N; Longitude 126°18'W.

Unit	Lithology	Thickness metres	Height Above Base metres
5	East Fork Formation; shale, dark grey to black, soft, plastic, locally slightly silty	1.8	228.7
	Little Bear Formation		
4	Mudstone, medium grey, rusty brown and orange banded weathering, blocky, crumbly, common ironstone and ferrous shale nodules. The uppermost 0.3 m comprises a distinct yellow weathering band composed of 80% quartz and equal proportions of illite and kaolinite; its contact with unit 5 (East Fork Formation) is undulatory with local relief on the contact of 0.5 m	7.3	226.9
3	Upper 0.3 m siltstone, dark grey to black, very carbonaceous and argillaceous. Middle 0.6 m sandstone, medium grey weathering, medium bedded, blocky, friable composed of fine grained, well sorted, frosted quartz in an argillaceous siltstone matrix. Lower 0.3 m coal and carbonized wood	1.2	219.6
2	Sandstone, light to medium grey weathering, massive, blocky, jointed, composed of fine grained, well sorted, subrounded, frosted quartz, carbonaceous grains and white, tripolitic chert; local horizons are well laminated with black carbonaceous, gently convoluted laminae	9.1	218.4
1	Mudstones, rusty brown, maroon and dark grey banded weathering, blocky, interbedded with widely separated thin (2 to 5 cm) beds of medium grey, laminated, fine grained, argillaceous sandstone which become more numerous upwards. The contact with unit 2 appears disconformable with local relief on the contact surface of about 0.3 m	75.0	209.3

Station YB-69-025 Latitude 64°37'N; Longitude 126°18'W.

Unit	Lithology	Thickness metres	Height Above Base metres
7	Sandstone, light grey weathering,medium bedded to massive, some thin beds at the base, jointed, composed of very fine to fine grained, well sorted, angular to subrounded, clear and frosted quartz, dark and tripolitic chert and disseminated carbonaceous grains, upwards the unit becomes medium grained, well laminated with minor low angle cross-laminae; near the top of the unit some bedding surfaces display hemispherical (4 cm dia.) ferrous sandstone nodules, sandstone beds in this part are locally pebbly with widely distributed (0.5 cm) rounded chert grains	39.6	134.3
6	Covered, very recessive slope, talus composed of sandstone blocks from unit 7 and medium grey and maroon, friable mudstone	34.7	94.7
5	Sandstone, light to medium grey weathering, medium bedded, jointed, blocky, locally well laminated with thin, silty carbonaceous material, composed of fine grained, well sorted, angular, clear and frosted quartz, tripolitic chert and disseminated carbonaceous grains, mostly grain supported	9.5	60.0
4	Mudstone, dark rusty brown and maroon weathering, jointed, blocky and nodular weathering in upper part, grades to maroon weathering argillaceous siltstone at top. Fossils, C-23929; Appendix II(d)	5.5	50.5
3	Interbedded sandstone, mudstone and siltstone, sandstone dominant, mudstone and siltstone occurring as thin beds and laminae; sandstone, light to medium grey weathering, locally banded rusty brown and grey brown, thin to locally medium bedded, friable, blocky, composed of fine grained, well sorted, angular to subangular, clear quartz, tripolitic chert and carbonaceous grains, matrix of ferrous silty clay, commonly well laminated; sedimentary structures include sandstone pillows enclosing medium grained sandstone, symmetrical (oscillation) ripples, rain imprints and numerous grazing trails. Mudstone and siltstone, dark grey and rusty grey brown, soft, friable, occurs as thin interbeds and parting laminations. In middle of unit is a 2 cm thick seam of low grade coal and carbonized wood overlain by a 12 cm thick interval of iron encrusted, well sorted sandy pebble conglomerate. Fossils, C-23928; Appendix II(d)	21.0	45.0
2	Mudstone, rusty brown weathering, blocky, friable, jointed, grading to siltstone upwards, parting laminations of siltstone display irregular grazing trails and woody debris. Fossils, C-23927; Appendix II(d); C-8719-20; Appendix II(e)	9.7	24.0
1	Mudstone, medium grey and locally mottled rusty brown weathering, friable, blocky, coarsely micaceous, common lenses and small irregularly shaped masses of Fe clays, upwards the unit grades to argillaceous siltstone and ultimately to fine grained friable sandstone which contain irregularly shaped pockets of concentrated carbonaceous material. Fossils, C-23926; Appendix II(d)	14.3	14.3

Base of formation not exposed.

Unit	Lithology	Thickness metres	Height Above Base metres

SLATER RIVER FORMATION
(Late Albian ? to Turonian ?)

The type area of the Slater River Formation occurs along Slater River. Stewart (1945) first defined the formation based upon a description by Foley contained in a Canol Project report. One of the authors (CJY) examined the formation at the locality listed below and concluded that exposures in this area nor at other localities are sufficiently complete or well exposed for type section designation. It is suggested that such be obtained from the subsurface where several exploratory wells have penetrated complete sequences. The following description from the "type locality" is included in this appendix for completeness.

Station YB-69-012 Latitude 64°57'N; Longitude 126°15'W.

Unit	Lithology	Thickness metres	Height Above Base metres
1	Shale, black weathering soft, plastic fissile, platy weathering; regularly interbedded with thin (2 cm) beds of pale cream to medium brown weathering, fibrous bentonite; concretionary layers occur throughout the section; shale bedding planes commonly display selenite rosettes and in the middle of the section fish scales and *Inoceramus* fragments are common; minor fine grained argillaceous sandstone beds (1 cm) occur at the base	60.0	60.0
	Base of formation not exposed.		

SANS SAULT FORMATION
(Early and Middle Albian)

The Sans Sault Formation is synonymous with "Sans Sault Group" of Stewart (1945). The type section of the formation occurs at the west end of East Mountain along the eastern shore of Mackenzie River. Neither the top nor base of the formation is exposed.

Station YB-69-064 Latitude 65°42'N; Longitude 128°47'W.

Unit	Lithology	Thickness metres	Height Above Base metres
11	Sandstone, medium grey brown weathering, thick bedded, blocky weathering; the interval is mostly composed of talus blocks	45.7	441.8
10	Mudstone, rusty maroon weathering, blocky, moderately friable; well developed fossiliferous ironstone beds and ironstone concretionary intervals; minor medium grey, fine grained sandstone beds at the top. Fossils, C-9321, 84788, 84792; Appendix II(b)	18.3	396.1
9	Sandstone, medium grey brown weathering, medium to thick bedded, generally very argillaceous and matrix-supported but with some grain-supported lenses; finely interbedded with dark grey argillaceous siltstones. Fossils C-9319 and C-9320; Appendix II(b)	18.3	377.8
8	Sandstone, light to medium grey brown weathering, thin to medium bedded, hard, dense, composed of fine grained, well sorted, subrounded quartz, matrix-supported by calcareous siltstone and argillaceous material, commonly micro- cross-laminated with carbonaceous and argillaceous laminae; rare ironstone concretionary beds (8 to 12 cm) distributed unevenly throughout; sandstone beds separated by 2 cm to 1.5 m thick intervals of dark grey, blocky, argillaceous siltstone and mudstone. This unit and those above underlie the rapids adjacent to the type section. Fossils, C-9314-17; Appendix II(b)	25.9	359.5
	Fault		
7	Covered, talus consists of dark grey to black mudstone and large rusty maroon ironstone concretions	76.2	333.6
6	Interbedded sandstone, siltstone and mudstone; sandstone, medium brown weathering, locally rusty maroon mottled, thin to medium bedded; composed of matrix-supported, fine grained, well sorted quartz in calcareous cement and argillaceous matrix, commonly burrowed; mudstone and siltstone, medium to dark grey, friable, arranged in intervals from 0.5 to 2.0 m thick, common irregular grazing trails on bedding surfaces of siltstone; this unit is laterally replaced by fine grained sandstones as above. Fossils, C-9313; Appendix II(b)	22.8	257.4
5	Covered; small, widely scattered outcrops display dark maroon and dark grey weathering, friable mudstone and argillaceous siltstone with minor thin (1 cm) interbeds of calcareous sandstone	15.2	234.6
4	Interbedded sandstone and mudstone as above; sandstone, light to medium brown weathering, thin bedded, hard, dense, calcareous intermittently laminated with thin carbonaceous and calcareous siltstone laminae; mudstone, dark grey, very sandy, blocky, occurs as intervals from 0.3 to 1.0 m thick. Fossils, C-9310 and C-9312; Appendix II(b)	22.8	219.4
3	Covered; widely scattered outcrops comprise dark grey weathering, blocky, calcareous siltstone and mudstone	118.9	196.6
2	Interbedded sandstone, siltstone and mudstone; sandstone: light to medium grey and grey brown weathering, thin to medium bedded, hard, dense, calcareous, composed of fine grained, fair to well sorted quartz in an argillaceous and calcareous matrix, locally calcite-cemented but where calcite is leached, sandstone has weathered to loose unconsolidated sand, locally laminated with thin, wispy carbonaceous laminae; mudstone: dark grey and commonly rusty brown weathering, friable, blocky, locally very sandy, mudstone units vary in thickness from 2 cm to 0.8 m and are distributed evenly throughout; a prominent ironstone beds, 0.3 m thick occurs in the middle of the unit. The uppermost 30 cm of the unit is only intermittently exposed. Fossils, C-9303-04, C-9306-09; Appendix II(b)	64.9	77.7
1	Interbedded sandstone and mudstone as above, very calcareous, well laminated with thin carbonaceous siltstone laminae; rare concretionary intervals that laterally grade to ironstone beds. Fossils, C-9301, C-9302; Appendix II(b)	12.8	12.8
	Base not exposed		

The following comprises a description of the Trevor and Arctic Red Formations as they occur in the Hume River area. These sections are herein identified as the reference sections of these formations for northwestern District of Mackenzie.

TREVOR FORMATION
(Late Albian to Turonian)

"Plateau Forming Sandstones"

Several "ribs" of the "Plateau Forming Sandstones" are exposed on the flanks of low-relief hills south of "Yadek Lake" (Lat. 65°30.0'N; Long. 130°04.5'W). The exposures consist of rubbly blocks on pale grey weathering, lichen covered, medium grained, poorly sorted, hard, dense sandstone composed of frosted, subrounded quartz, dark and tripolitic chert and feldspar.

The lowermost "rib" is separated from the top of unit 33 below by about 30 m of covered interval across a horizontal distance of about 3 km.

Unit	Lithology	Thickness metres	Height Above Base metres
	Station YB-69-091 Latitude 65°26'N; Longitude 130°03'W.		
33	Sandstone, medium grey weathering, thick bedded to massive, dense, composed of fine grained, moderately well sorted, angular to subangular, grain-supported quartz, chert and feldspar; some thin carbonaceous laminae	15.2	1152.0
32	Mudstone, dark grey and rusty brown weathering, blocky, friable, laminated with thin, discontinuous, siltstone; minor sandstone as above at top	9.1	1136.8
31	Sandstone, medium grey brown weathering, thin to medium bedded, blocky, composed of well sorted, fine grained, matrix-supported, frosted, subrounded quartz, chert, feldspar and carbonaceous grains in soft mudstone matrix	9.1	1127.7
	Station YB-69-081 Latitude 65°25'N; Longitude 130°01'W.		
30	Covered, widely scattered outcrops display dark grey to black, soft, plastic shale as below; slopes on opposite side of Hume River (below unit 31 above) display soft, sticky talus fans	122.0	1118.6
29	Shale, black, soft, plastic, recessive, minor thin (0.5 cm) bentonite laminae, widely separated 0.3 m thick ironstone concretionary layers mainly in the lower part. This unit and unit 30 above occurs within the valley occupied by the easterly directed segment of Hume River prior to where it turns sharply southward	70.1	996.6
28	Sandstone, yellowish brown weathering, thin bedded, fine grained, well sorted well laminated with thin carbonaceous mudstone laminae; a thin, ironstone pebble layer occurs near the top of the unit; well preserved grazing trails, burrows and interference ripples at the top	16.8	926.5
27	Covered	21.3	909.7
26	Mudstone, dark grey weathering, local thin rusty brown weathering intervals, blocky, nodular weathering, minor fine grained sandstone interbeds at the base becoming more numerous towards the top, unit capped by a 7.6 m interval of medium brown weathering, thin bedded, fine grained, well sorted, dense, grain supported sandstone. Fossils, 84798; Appendix II(c)	47.3	888.4
25	Covered, scattered poor exposures display thinly interbedded dark grey mudstone and medium grey, fine grained sandstone	15.2	841.1
24	Interbedded sandstone and mudstone; sandstone, brownish grey weathering, thin to medium bedded, jointed, flaggy, composed of fine grained, well sorted, grain supported, slightly argillaceous, quartz and carbonaceous grains; mudstone, blocky, crumbly, very sandy. Sandstones are well laminated with thin carbonaceous laminae, locally showing climbing ripple structure; the uppermost sandstone contains thin chert pebble conglomerate streaks; the sandstones are disposed in three subunits averaging 3.0 m thick. Fossils, 84800; Appendix II(c)	54.9	825.9
23	Interbedded sandstone and mudstone as above; sandstones are generally thin bedded and disposed in four subunits with intervening mudstone intervals 8.0 to 10.0 m thick	35.0	771.0
22	Inaccessible. Opposite bank displays thinly interbedded mudstone and sandstone and minor thin ironstone concretionary intervals	70.1	736.0
21	Sandstone, grey brown weathering, thin bedded, flaggy, hard, dense, composed of fine grained, well sorted, matrix supported, quartz, carbonaceous and micaceous grains in mudstone matrix, local scour-and-fill structures near the top and minor thin nodular ironstone beds at base	27.4	665.9
20	Interbedded sandstone and mudstone as unit 23 above	34.1	638.5
19	Interbedded sandstone and mudstone as above; mudstone subunits very thin; sandstones display micro and macro crossbedding, ripple laminations occur in the uppermost sandstone; sandstones are mainly grain supported	8.5	604.4
18	Inaccessible. Opposite bank displays thinly interbedded mudstone and very thin bedded, dark grey weathering sandstone	88.4	595.9
17	Sandstone, dark brownish grey weathering, thin to medium bedded but with massive aspect, jointed, flaggy, composed of fine grained, well sorted, grain supported, frosted, subrounded quartz and widely disseminated tripolitic chert; sandstones are finely laminated with thin mudstone partings and black carbonaceous laminae	14.6	507.5
16	Inaccessible. Opposite bank displays thinly interbedded dark grey and rusty brown banded mudstone and thin bedded sandstone which increases in thickness and frequency upwards	32.0	492.9
15	Inaccessible. Opposite bank shows sandstone, dark brownish grey weathering, thin to medium bedded with a massive aspect, jointed, very resistant; minor thin mudstone interbeds	16.8	460.9
14	Inaccessible. Opposite bank shows dark grey weathering, blocky mudstone and thin; grey brown weathering, flaggy sandstone	51.8	444.1
13	Sandstone, medium brown weathering, thin bedded, flaggy, hard, dense, composed of fine grained, well sorted, quartz, carbonaceous grains and finely disseminated tripolitic chert in an argillaceous matrix; local interference ripples on bedding surfaces	3.0	392.3
12	Mudstone, dark grey and rusty maroon weathering, very sandy, blocky, crumbly, locally nodular, commonly with very low amplitude interference ripple marks on bedding surfaces; minor thin intervals of dark grey weathering, flaggy sandstone in upper part	45.7	389.3
11	Sandstone, rusty brown weathering, thin bedded, very resistant with thin sandy mudstone interbeds, rusty ironstone interbeds; sandstones composed of fine grained, well sorted, frosted, subangular to subrounded quartz and micaceous grains in an argillaceous matrix; sandstones developed into small pyritic nodules and small pillows, well laminated, hard and dense	4.0	343.6
10	Mudstone, dark grey and rusty maroon weathering, banded, very blocky, crumbly, grading to nodular weathering at top; numerous thin ironstone interbeds	30.2	339.6

Unit	Lithology	Thickness metres	Height Above Base metres
9	Sandstone, as above, common disseminated tripolitic chert, common "floating" ironstone nodules, and small egg-shaped ferrous sandstone nodules oriented perpendicular to bedding, rare ripple marks	3.7	309.4
8	Mudstone, dark grey, locally rusty brown weathering, nodular to blocky weathering, rare plant impressions on bedding surfaces; interbedded with dark grey brown weathering, very thin bedded, fine grained, well sorted sandstone	15.2	305.7
7	Sandstone, medium grey and grey brown weathering, thin to medium bedded, flaggy, with minor thin sandy mudstone interbeds, sandstone composed of fine grained, well sorted, subrounded, matrix supported quartz, carbonaceous and dark chert grains, finely disseminated tripolitic cherts and micaceous grains, well laminated with thin carbonaceous mudstone laminae, locally calcareous, rare ironstone conglomeratic streaks, common current ripples on bedding surfaces and rare sandstone pillows	9.1	290.5
6	Inaccessible. Opposite bank displays interbedded nodular, dark grey weathering mudstone and thin bedded, grey brown, flaggy weathering sandstone	108.2	281.4
5	Sandstone, as above, common nodular ironstone conglomeratic streaks	8.2	173.2
4	Inaccessible. Opposite bank shows poorly exposed thin bedded, grey brown sandstone and interbedded dark grey mudstone	33.5	165.0
3	Sandstone, as above, rare disseminated glauconite, common low amplitude current ripples with poorly preserved plant debris in ripple troughs	6.1	131.5
2	Interbedded sandstone and mudstone as above, very poorly exposed	96.9	125.4
1	Interbedded sandstone and mudstone; sandstone, brown and grey weathering, very thin to thin bedded becoming medium bedded upwards, hard, dense, well laminated with carbonaceous laminae, composed of fine grained, well sorted, matrix supported quartz in argillaceous matrix; mudstone, dark grey and rusty brown weathering, blocky, very sandy. The sandstone and mudstone intervals are regularly interbedded at the base, sandstones become dominant upwards and show undulatory contacts with mudstones, and rare ripple marks on bedding surfaces	28.5	28.5

Contact with silty concretionary mudstone member of Arctic Red Formation gradational. Contact chosen at the base of first unit where sandstone is dominant lithology.

ARCTIC RED FORMATION
(Early and Middle Albian)

The top of the Silty Concretionary Mudstone Member of the Arctic Red Formation is in gradational contact with the Trevor Formation as described above. The uppermost 387 m of this member are exposed in dip slopes along the eastward flowing segment of Hume River connecting the base of Station YB-69-081 (Trevor Formation) and the mouth of an unnamed creek flowing northwards into Hume River 1.6 km to the east. The dip of the Arctic Red Formation is 45°N, thus the exposures of the upper part of the Silty Concretionary Mudstone Member along the eastward flowing segment of Hume River are poor. The remainder of the member and the fossiliferous concretionary mudstone member are exposed in the unnamed creek valley.

Station YB-69-080 Latitude 65°24'N; Longitude 129°57'W.

Silty Concretionary Mudstone Member

Unit	Lithology	Thickness metres	Height Above Base metres
14	Interbedded mudstone and sandstone; mudstone, dark grey and rusty maroon weathering, crumbly, friable, highly jointed, enclosing numerous ironstone concretionary beds and isloated concretions; sandstone, grey brown weathering, very thin to thin bedded, laterally discontinuous, composed of fine grained well sorted quartz and carbonaceous grains in a silty and argillaceous matrix; downsection the sandstones grade to siltstones, become thinner and less frequent.	387.0	1230.8
13	Mostly covered; scattered outcrop display poorly exposed dark grey concretionary mudstone and siltstone. The top of this unit coincides with the mouth of the unnamed creek draining into the easterly flowing Hume River.	71.0	843.8
12	Interbedded mudstone, siltstone and sandstone, mudstone, dark grey weathering, crumbly, locally very sandy; sandstone and siltstone, medium grey weathering, very thin to thin bedded, finely laminated with thin gently convolute laminations, composed of very fine to fine grained and silt size quartz in an argillaceous and calcareous matrix.	4.9	772.8
11	Mostly covered. Widely separated poor outcrops show dark grey and rusty maroon weathering concretionary mudstone and thin, grey weathering locally calcareous siltstone; talus slopes commonly strewn with numerous irregular concretions	163.7	767.9

Fossiliferous Concretionary Mudstone Member

The contact between the Fossiliferous Concretionary Mudstone and Silty Concretionary Mudstone Members is poorly exposed. The contact appears gradational over a short distance of several metres.

Unit	Lithology	Thickness metres	Height Above Base metres
10	Mudstone, dark grey and rusty brown and maroon weathering, distinctly banded, nodular weathering, friable but commonly fissile; numerous ironstone concretionary beds and isolated ironstone concretions distributed evenly throughout, concretions are oblate to rounded and commonly contain fibrous calcite centres and rarely, poorly preserved ammonite remains	96.0	604.2
9	Mudstone, dark rusty maroon and grey weathering, fissile, interbedded with thin (1 to 2 cm) intervals of pale yellowish grey bentonite; common concretionary intervals comprising beds and isolated oblate concretions, some containing well preserved ammonites; local black weathering bentonitic shale and mudstone intervals, highly slumped. Fossils, C-10027, C-10029-30; Appendix II(b)	105.2	508.2
8	Mudstone, dark grey to black weathering, fissile, enclosing numerous nodular and cylindrical ironstone concretions up to 0.5 m long, numerous fossiliferous oblate concretions as above; 40 m above the base is a well developed cone-in-cone concretionary horizon 0.3 m thick. Fossils, C-10026; Appendix II(b)	109.1	403.0
7	Mostly covered. Scattered outcrops and talus display dark grey to black and locally rusty maroon weathering fissile concretionary mudstone; concretions are discoid	144.8	293.9

Unit	Lithology	Thickness metres	Height Above Base metres
6	Mudstone, dark grey to black, fissile, soft, plastic; one 0.2 cm thick concretionary bed in middle of unit, mudstone bedding planes display small linear tool marks and fine plant (?) debris. Fossils, C-10025; Appendix II(b)	3.0	149.1
5	Covered. Loose talus consists of blocky mudstone and widely scattered discoid concretions containing a central sphere enclosing poorly preserved ammonite material	39.6	146.1
4	Mudstone, dark grey to black weathering, fissile, and interbedded thin (1 to 2 cm) pale yellow bentonite beds; numerous fossiliferous disk-and-ball concretions bearing well preserved ammonites; well developed cone-in-cone concretionary bed at top of unit	19.8	106.5
3	Mudstone, as above but distinctly nodular weathering, rare bentonite as above; in middle of unit is a laterally persistent, 2 cm thick silty limestone bed	44.2	86.7
2	Covered. Talus comprises dark grey to black fissile mudstone grading to shale	30.5	42.5
1	Sandstone, medium brown weathering, generally medium bedded with some thick and very thin beds, fine grained, argillaceous at top, glauconitic, well laminated; minor interbedded sandy mudstone and minor streaks of shale-chip and black chert pebble conglomerate at base of unit; prominent 15 cm thick ironstone concretionary interval in middle of unit; sandstone bedding planes display perpendicular burrow holes filled with siltstone and mudstone, small irregular tool marks and small load casts; laminae are commonly convolute	12.0	12.0

Base of unit 1 above is in structurally conformable contact with the Upper Devonian Imperial Formation.

APPENDIX II

Report on Fossils

Appendix IIa

Aptian and Older Fossils

By W.W. BRIDEAUX

NOTE: Nomenclature of dinoflagellate species is that current in mid-1977 and has not been revised to reflect numerous changes proposed in Stover and Evitt (1978).

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Gilmore Lake Member	ELF Horton River G-02 well Depth 335-341 m 69°51'22.5"N, 127°15'56.25"W; NTS 97C	C-12520 1972

Age: *Senoniasphaera microreticulata* appears in sample C-12520. This species is restricted in outcrop to section CR12A-68, from 45-58.5 m (150-195 feet). (Brideaux and McIntyre, 1976). Local correlation with this section, and the interval in ELF Horton River G-02 well is thus likely in part. Other species present in the interval 335-469 m indicate a Middle Albian age for the enclosed rock.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Gilmore Lake Member Chevron Standard Ltd.	Seismic shot hole Depth 18 m 67°19'45"N, 129°32'45"W; NTS 106P	C-24106 1973

Age: Early Cretaceous, Neocomian-Aptian palynologic reconnaissance only, species list not provided.

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BY W.S. HOPKINS, JR.

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed poorly consolidated sand with carbonaceous layers D.G. Cook	Outcrop S.W. of Lac des Bois 66°24'N, 124°52 1/2'W; NTS 96K	C-4314 1969

Laevigatosporites sp.
Osmundacidites wellmanii Couper
Rouseisporites cf. *R. triangularis* Pocock
Gleicheniidites senonicus Ross
Cicatricosisporites australiensis (Cookson) Pontonié
Cicatricosisporites cf. *C. perforatus* (Baranov, Nemkova, Kondratiev) Singh
Cicatricosisporites sp.
Trilobosporites apiverrucatus Couper
Trilobosporites cf. *T. canadensis* Pocock
Murospora florida Pocock
Deltoidospora sp.
Sphagnum antiquasporites Wilson and Webster
Lycopodiumsporites austroclavatidites (Cookson) Pocock
Baculatisporites sp.
Cyathidites australis Couper
Verrucosisporites sp.
?*Cedrus* sp.
Pinus sp. *Haploxylon*-type
?*Keteleeria* sp.
Tsugaepollenites mesozoicus Couper
Taxodiaceae
?*Araucariacites* sp.
Podocarpus sp.
Classopollis classoides (Pflug) Pocock and Jansonius
Monosulcites sp.
Ephedra sp.
?*Quercus*-type

Age: Aptian

Comments: Sample C-4314 is most interesting in that it contains a relatively large flora, and for the most part the palynomorphs are well preserved. The most abundant elements of the flora appear to be the coniferalse, suggesting a wide-spread conifer forest in the area at the time of deposition. Most elements of the florule would be compatible with a Jurassic or Cretaceous age, but several more sharply delimit the age interpretation. *Rouseisporites* has been found in rocks ranging in age from Barremian to Early Aptian of Canada, *Cicatricosisporites perforatus* from Aptian to Turonian of Canada, and the USSR; and *Murospora florida* has been recorded from Neocomian to Aptian of both Australia and Canada.

The highly doubtful *Quercus*-type grain, if it is truly tricolpate, would suggest at least an Albian age. However, the identification is questionable at best, and consequently is disregarded in drawing an age conclusion.

Consideration of the overall flora, plus those which appear to have a more restricted stratigraphic range, leads me to consider this sample to be most probably Aptian in age.

Stratigraphy and Collector	Location, Flora, and Age	GSC Loc. No. and Report Year
Gilmore Lake Member D.G. Cook	Outcrop, east of Thunder River 67°37'N, 130°05'W	C-10072 1971

Gleicheniidites senonicus Ross
Cyathidites minor Couper
Cyathidites australis Couper
Densoisporites cf. *D. velatus* Weyland and Krieger
cf. *Hymenozonotriletes* sp.
Osmundacidites wellmanii Couper
Lycopodiumsporites cf. *L. austroclavatidites* (Cookson) Pocock
Lycopodiumsporites marginatus Singh
Deltoidospora junctum (Kara-Murza) Singh
Deltoidospora sp.
Sphagnum antiquasporites Wilson and Webster
cf. *Cicatricoisporites* sp.
Cingutriletes sp.
cf. *Murospora* sp.
?*Trilobosporites* sp.
Triletes spp.
Alisporites sp.
Podocarpidites sp.
assorted bisaccate pollen grains (conifers)
Spheripollenites sp.
Tsugaepollenites mesozoicus Couper
Tsugaepollenites sp.
Cycadopites sp.
Monosulcites sp.
cf. *Araucariacites* sp.

Age: Lower Cretaceous, probably Aptian.

Comments: This sample is undoubtedly Cretaceous in age. The lack of typical earliest Cretaceous spores as well as a lack of typical Late Cretaceous spores and pollen suggest a late Early Cretaceous age for these samples. I would consider Aptian as a reasonable interpretation. A complete lack of phytoplankton suggest these are continental sediments.

BY N.S. IOANNIDES

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed beds D.C. Pugh	Atlantic Ontaratue K-04 well 66°33'37.5"N, 130°46'10.3"W; NTS 106 O Depth 46-67 m (3 samples)	C-15567/160-220 1978

Three samples prepared from this interval yielded very similar microfloras. In addition to terrestrially derived Cretaceous palynomorphs, marine elements were represented in fair abundance. They included *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson, *Oligosphaeridium complex* (White) Davey and Williams, *O. pulcherrimum* (Deflandre and Cookson) Davey and Williams *Gardodinium eisenacki* Alberti, *Muderongia asymmetrica* Brideaux, *M. staurota* Sarjeant and *Cyclonephelium* sp. cf. *C. tabulatum* Davey and Verdier.

Reworked material was present comprising several specimens of the typical latest Devonian spore *Spelaeotriletes lepidophytus* (Kedo) Streel. The presence of this species indicates an age of Fa2d-Tn1b (Tn1a referred to as Strunian by some authors). *S. lepidophytus* was associated with *Auroraspora macra* Sullivan, and apparently younger forms (Mississippian) such as *Densosporites* cf. *intermedius* Butterworth and Williams and *Lycospora pellucida* types. These elements may have been derived from the Peel River area to the west. Rare, probably pre-*lepidophytus* spores (?Frasnian) were also observed.

The dinoflagellates recovered suggest an Early Albian (or Late Aptian) age.

As above — Depth 91-131 m (7 samples) — C-15567/300-430

A seemingly drastic qualitative change was documented at 91 m. Abundant Frasnian palynomorphs such as species of *Archaeoperisaccus*, *Hystricosporites*, *Ancyrospora*, *Calyptosporites velatus* (Eis.) Richardson and the megaspore species *Ocksisporites connatispinosus* Chi and Hills and *Lagenicula devonica* Chaloner, were seen (megaspores identified by A.R. Sweet). Accompanying members included *S. lepidophytus* and other Late Devonian and Mississippian forms in association with Early Cretaceous palynomorphs. The "Frasnian" complex was progressively reduced from 91 m down to 131 m.

The known occurrences of reworked Frasnian into Cretaceous outcrop samples in the Peel River region and north of Ontaratue river have led the writer to have the coal verification (hand-picked coal fragments ultrasonically treated). It contained among others, abundant bissaccate pollen *Classopollis*, *Cyathidites* and *Cerebropollenites mesozoicus* (Couper) Nilsson, an assemblage not typical of, but often found in Lower Cretaceous non-marine sediments. The absence of marine Cretaceous elements was expected because of the coaly nature of the lithology. Therefore the absence of Palaeozoic palynomorphs would probably suggest that this horizon is still within the Lower Cretaceous interval.

As above — Depth 134-171 m (4 samples) — C-15567/440-560

An influx of Frasnian spores, associated with sporadic Strunian or younger elements, occurred at 134 m and persisted down to 171 m. As above, among others, species of *Archaeoperisaccus*, *Hystricosporites*, *Ancyrospora*, *Lagenicula devonica*, *Ocksisporites connatispinosus* and *Calyptosporites velatus* dominated the assemblages. For the Cretaceous-Devonian boundary to be drawn with certainty further samples should be prepared down the section. At present, because of the rather abrupt reappearance of Frasnian elements at 134 m and their numerical persistence down to 171 m, a provisional Frasnian age is proposed for this interval.

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BY D.C. MCGREGOR

Stratigraphy and Collector	Locality, Flora, and Age	GSC Loc. No. and Report Year
Unnamed	From a pingo, 8 mi. east of Horton Lake. Field No. CD87a and CD87c; 67°30 1/3'N, 122°1/2'W; NTS 96O	5535 1960

Spores:
cf. *Aneimia dorsostriata* Bolkh.
Cicatricosisporites dorogensis Pot. and Gel.
Cyathidites sp.
Gleicheniidites senonicus Ross
Leiotriletes sp.
Lophotriletes sp. (cf. *Lygodium*)
Lygodioisporites sp.
cf. *Lycopodium subrotundatum* Kara-Mursa
cf. *Osmunda*
Trilobosporites apiverrucatus Couper

Pollen:
Abietineaepollenites sp.
Cycadopites sp.
Ephedripites sp.
Pinuspollenites sp. (*Pityosporites*)
cf. *Podocarpidites biformis* Rouse

Age: The identifications given above are based on sample CD87a, and all remarks here apply to that sample only. Sample CD87c yielded very few recognizable microfossils. Those that were seen suggest, however, that it is the same or nearly the same age as CD87a.

The age of the assemblage is Early Cretaceous. The abundance of schizaeceous types (*Cicatricosisporites*, *Lygodioisporites*, cf. *Aneimia*) indicates that the assemblage is post-Jurassic, and the absence of angiosperm pollen indicates that it probably is pre-Albian. *Trilobosporites apiverrucatus* is regarded by Couper (1958), as a key form for the Wealden.

The microfossils in CD87a are well preserved. There is no evidence whatever of mixing with older or younger forms than Lower Cretaceous ones. The possibility of secondary deposition of the microfossils appears to be eliminated.
Material has not been updated since 1960.

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Appendix IIb

Lower to Middle Albian Fossils

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, Palynologic Assemblage, and Age	GSC Loc. No. and Report Year
Slater River Formation J.D. Aitken	Outcrop 64°27 1/2'N, 126°18'W; NTS 96D	C-5539 1976

palynologic reconnaissance only, species lists not provided. Large population of dinoflagellates with good diversity.

Age: There are several new (to the writer) species in the assemblage, but it appears basically to be Albian (Middle to (?) Upper) without typical Cenomanian-Turonian forms, although many of the species present range into the Upper Cretaceous.

Stratigraphy and Collector	Locality, Palynologic Assemblage, and Age	GSC Loc. No. and Report Year
unnamed strata C.J. Yorath	Outcrop Big Smith Creek; 64°41'N, 124°23'W; NTS 96C	C-9277 1975

Tanyosphaeridium sp. AE of Brideaux
Oligosphaeridium complex (White) Davey and Williams
Chlamydophorella nyei Cookson and Eisenack
Dictyopyxidia sp.
derived Devonian spores

Age: Cretaceous, probably early Cretaceous. An absence of diagnostic species precludes further refinement of the age of this assemblage.

Stratigraphy and Collector	Locality, Palynologic Assemblage, and Age	GSC Loc. No. and Report Year
Arctic Red Formation	Aquitaine Dodo Canyon K-03 well Depth 488 m; 65°02'33"N, 126°46'14"W; NTS 96E	C-30268/1600 1975

Hystrichodinium voigtii (Alberti) Davey
Exochosphaeridium phragmites Davey, Downie, Sarjeant and Williams
Pterodinium sp. cf. *P. alatum* Eisenack
Microdinum opacum Brideaux
Chlamydophorella nyei Cookson and Eisenack
Spiniferites ramosus (Ehrenberg) Loeblich and Loeblich

Age: Early Cretaceous, probably Albian.

Stratigraphy and Collector	Locality, Palynologic Assemblage, and Age	GSC Loc. No. and Report Year
Arctic Red Formation	Aquitaine Dodo Canyon K-03 well Depth 701 m 65°02'33"N, 126°46'14"W; NTS 96E	C-30268/2300 1975

Odontochitina operculata (O. Wetzel) Deflandre and Cookson
Microdinium opacum Brideaux
Vitreisporites pallidus (Reissinger) Nilsson
caved Upper Cretaceous dinoflagellates (rare)

Age: Early Cretaceous, late Hauterivian to Albian.

Stratigraphy and Collector	Locality, Palynologic Assemblage, and Age	GSC Loc. No. and Report Year
Arctic Red Formation	Aquitaine Dodo Canyon K-03 well Depth 853 m 65°02'33"N, 126°46'14"W; NTS 96E	C-30268/2800 1975

Senoniasphaera microreticulata Brideaux and McIntyre
Cyclonephelium distinctum Deflandre and Cookson
Gonyaulacysta hyalodermopsis (Cookson and Eisenack) Sarjeant
Oligosphaeridium complex (White) Davey and Williams
Oligosphaeridium anthophorum (Cookson and Eisenack) Davey
Palaeoperidinium cretaceum (Pocock ex Davey) Lentin and Williams
Gardodinium trabeculosum Alberti
Aptea sp. cf. *A. polymorpha* Eisenack
Endoscrinium campanulum (Gocht) Vozzhennikova
Leptodinium cancellatum Brideaux and McIntyre
Odontochitina operculata (O. Wetzel) Deflandre and Cookson
Leptodinium delicatum (Davey) Davey
Appendicisporites sp.
Aequitriradites spinulosus (Cookson and Dettmann) Cookson and Dettmann

Age: Early Cretaceous, Albian (several species of this assemblage have been found previously only in the Horton River Formation of Middle Albian age).

BY T.P. CHAMNEY

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Crossley Lakes Member J.D. Aitken	Tchaneta River 67°15'N, 127°29'W; NTS 96M	C-2575 1970

Saccammina lathrami Tappan
Haplophragmoides spp.
Siphotextularia spp.
?*Trochamminoides* sp.
?*Verneuilinoides* sp.
megaspores

Age: Early Cretaceous (Early to Middle Albian). *Siphotextularia* spp., including *Siphotextularia rayi* Tappan, are the index markers for the silty zone of the Anderson Plains area.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Arctic Red Formation D.G. Cook	Outcrop Grandview Hills 66°59'N, 131°20'W; NTS 106J	C-5547 1970

Hippocrepina sp., few
Hyperammina sp., abundant
Jaculella sp., rare
Saccammina lathrami Tappan, few
S. sp., abundant
Ammodiscus sp., few
Glomospirella parammodiscus (McGill and Loranger), common
Glomospira cf. *G. eucalla* McGill and Loranger, few
G. cf. *G. obesa* McGill and Loranger, few
G. sp., abundant
Reophax sp., common
H. cf. *H. volubilis* Romanova, few
H. ex. gr. *H. spissus* Stelck and Wall, common
Haplophragmoides sp., very abundant
Ammobaculites cf. *A. fragmentarius* Cushman, few
Spiroplectinata bettenstaedti Grabert, very abundant
Gaudryina ex. gr. *G. canadensis* Cushman, few
Trochammina ex. gr. *T. canningensis* Tappan, abundant
Verneuilinoides sp., few

Age: Middle Albian.

Stratigrapy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Crossley Lakes Member D.G. Cook	Outcrop 67°21'N, 130°15'W; NTS 106O	C-10069 1973

?*Gaudryina* ex. gr. *G. nanushukensis* Tappan (rare)
plant roots (common)
?faecal pellets (common)

Age: Lower Cretaceous, Albian undifferentiated, biostratigraphic equivalent Sans Sault-Slater River Formations.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed unit "E"	Sinclair Wolverine Creek D-61 well Depth 128 m 65°10'14"N, 124°12'52"W; NTS 96F	C-12195 1971

Reophax aff. *troyeri* Tappan
Trochamminoides sp.
Ammobaculites fragmentarius Cushman
(?)*Textularia* sp.
(?)*Trochammina* sp.
Gaudryina nanushukensis Tappan
(?)radiolarian

Age: *Gaudryina nanushukensis* is a Middle Albian form.

Environment: The complexity of the agglutinated foraminifers indicates this is a marine assemblage which may have had an open marine access.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed unit "C"	Sinclair Whitefish River K-76 well Depth 506 m 65°35'32"N, 124°29'16"W; NTS 96F	C-12213 1971

Ammodiscus cf. *mangusi* Tappan
Reophax aff. *subfusiformis* Earland
Haplophragmoides spp.
Ammobaculites fragmentarius Cushman
(?)*Trochammina* sp.
Verneuilina sp.
Gaudryina sp. (short stubby)
G. sp.
(?)*Dorothia* sp.

Age: *Gaudryina* sp. (short stubby) is of Middle Albian age. The *Gaudryina* specimens are sharply tricarinate, indicative of older forms of the species and also indicative of Middle Albian.

Environment: The abundance and variety of both simple and complex agglutinated foraminifers suggests the sample was formed in a marine environment, probably near shore and close to a good food supply. The lack of bivalve prisms and wood fragments is surprising, but may be attributable to tidal current winnowing.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed unit "A"	As above Depth 772 m	C-12218 1971

Bathysiphon sp.
(?)*Hippocrepina* sp.
(?)*Miliammina* sp.
Haplophragmoides multiplus Stelck and Wall
Haplophragmoides aff. *H. platus* Loeblich
Haplophragmoides ex. gr. *gigas minor* Nauss
Textularia aff. *T. gravenori* Stelck and Wall
T. aff. *T. topagorukensis* Tappan
(?)*Trochammina* sp.
Gaudryina nanushukensis Tappan
(?)*Verneuilinoides* sp.

Age: *Gaudryina nanushukensis* is an Early Cretaceous, Albian form. The tenuated and rugged (dwarf) forms of *Gaudryina* and (?) *Hippocrepina* are more indicative of older forms (Early to early Middle Albian) of these two genera.

Environment: The dwarfed nature of the foraminifers and the large quantities of amorphous pyrite suggest this deposit formed under toxic conditions. At this time there does not appear to have been any freshening of the sea waters from fluviatile or deltaic sources as indicated by the presence of megaspores in the absence of wood fragments.

BY W.S. HOPKINS, JR.

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
Buff coloured shale containing wood fragments, Gilmore Lake Member? M.E. Ayling	West of Canot Lake 67°25'N, 129°13'W; NTS 106P	C-5542 1970

Deltoidospora sp.
Densoisporites sp
Gleichenndites sp
Murospora sp.
Sphagnum sp.
Lycopodium cf. *L. novomexicanum* Anderson
Lycopodium sp.
Acanthotriletes sp.
Laevigatosporites sp.
?*Klukisporites* sp.
Pinus - type
Tsugaepollenites sp.
Larix - type
Cupressaceae - Taxodiaceae types
Alnus sp.
cf. *Betula* sp.
Chenopodiaceae
Tetraporate, very small, unidentified

Age: See comments.

Comments: Preservation of the angiosperm pollen appears much better than that of the spores or gymnosperm pollen. This suggests contamination of the sample either from the over-lying Pleistocene or recent vegetation. If all the pollen and spores are indigenous to the sample we would be forced to conclude that we are dealing with a Pleistocene or Tertiary unit. However, if we conclude that the angiosperm pollen are contaminants, as seems likely, a Lower Cretaceous age is suggested.

The lack of small, simple tricolpate pollen grains characteristic of the Upper Albian suggest a pre-Late Albian age. Furthermore, the lack of more typical Lower Cretaceous spores would suggest a post-Aptian age. Therefore, and this is only a hunch, the indicated age is most likely Lower or Middle Albian.

A complete lack of phytoplankton suggests a continental origin for this unit.

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Type section of Sans Sault Formation Near Sans Sault Rapids 65°42'N, 128°47'W; NTS 106H	1978
	0-6 m from base	C-9301
	6 m - 13 m from base	C-9302
	12 m - 18 m from base	C-9303
	18 m - 24 m from base	C-9304
	30 m - 41 m from base	C-9306
	41 m - 49 m from base	C-9307
	49 m - 78 m from base	C-9308
	78 m from base	C-9309
	197 m - 209 m from base	C-9310
	213 m - 219 m from base	C-9312
	244 m - 258 m from base	C-9313
	334 m - 341 m from base	C-9314
	341 m - 347 m from base	C-9315
	347 m - 354 m from base	C-9316
	354 m - 360 m from base	C-9317
	360 m - 365 m from base	C-9319
	366 m - 375 m from base	C-9320
	378 m - 396 m from base	C-9321

These eighteen samples are highly carbonaceous, and contain only a very small, partially carbonized, and exceedingly poorly preserved microflora. Indeed, preservation so poor that identifications are difficult and in some cases highly uncertain. Because the contained palynomorphs are essentially the same in all samples, I have presented a composite microfloral listing rather than itemizing individual samples.

?*Sigmopollis*, *Cingulatisporites*, *Laevigatosporites*, *Cyathidites*, *Baculatisporites*, *Cicatricosisporites*, cf. *Apiculatisporis*, *Concavissimisporites*, *Deltoidospora*, ?*Osmundacidites*, *Verrucosisporites*, *Appendicisporites*, unidentified bisaccate conifer pollen, cf. *Podocarpidites*, *Inaperturopollenites*, *Cycadopites*, small psilate and microreticulate? tricolpate angiosperm pollen.

In addition to the above listing all samples contained a substantial number of reworked Carboniferous and ?Devonian palynomorphs.

This scabby assemblage is far from completely age diagnostic; however, good and abundant lower Cretaceous forms are absent, as are upper Cretaceous angiosperm pollen.

However, the rare presence of probable "primitive" angiosperm pollen would suggest an age no older than Middle Albian.

BY J.A. JELETZKY

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata Mobil Oil	North bank of Smith Creek 30 km from mouth NTS 96C	28878 1956/57

"Gastroplites" (a new unpublished genus) n. sp. aff. *cantianus* Spath 1937

Stratigraphy and Age: The identification of *Gastroplites* sp. indet. in the fossil lot 28878 previously proposed by the writer in the fossil report Km-7-1956/57 is outdated. It must be revised as follows. The ammonite fragment of the lot 28878 is not congeneric with *Gastroplites* McLearn 1931 as interpreted presently by the writer in a report submitted for publication in the GSC Paper series. It belongs instead to a new genus of the subfamily Gastroplitinae Wright 1952 described in GSC Paper 79-22 as *Pseudogastroplites* gen. nov. This new genus is not known to occur in the Canadian Western Interior Region proper (i.e. region south of the Lower Mackenzie Lowlands) to which the true *Gastroplites* is almost exclusively restricted. However, this new genus is widespread in the upper part of the Christopher Formation of the Canadian Arctic Archipelago. It also occurs in the European Arctic regions and in eastern England. The ammonite fragment of the lot 28878 is closely allied to *"Gastroplites" cantianus* Spath, from eastern England. Furthermore it is either conspecific with or very closely related to the representative of the above mentioned new genus occurring at the GSC loc. 40602 and 40606 in the upper part of the Christopher Formation on Banks Island. Of these localities the GSC loc. 40606 occurs about 64 m (210 feet) stratigraphically below its top. This Banks Island ammonite was identified as *Gastroplites* aff. *canadensis* by the writer (i.e. *in* Tozer and Thorsteinsson, GSC Mem. 330, 1962, p. 64 and *in* Jeletzky, GSC Paper 64-11, p. 90, Pl. Fig. 4). However, this identification was changed in the above mentioned, report by the writer. The lot 28878 is correlated accordingly with the upper part of the Christopher Formation on the Banks Island and the equivalent beds of the Upper shale member of the formation elsewhere. The beds which yielded the fossil lot 28878 appear to be equivalent either to the basal beds (i.e. *Pseudopulchellia pattoni* Subzone) of the generalized *Gastroplites* Zone or to the upper part of the Unnamed Zone F in the Canadian Western Interior Region (*see* Jeletzky, 1968, p. 18, 19, Table 1; 1971, p. 8, Fig. 2 and this Appendix in the discussion of the lot C-10032).

In terms of the international standard stages and European standard zones the lot 28878 is of the late, but not the latest, middle Albian age and apparently corresponds to the upper part of the *Euhoplites lautus* and *Hoplites dentatus* Zone. This lot is either approximately contemporary with or slightly younger than the lot C-10032 discussed below.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Measured section Sans Sault Rapids 379 m - 385 m from base 65°42'N, 128°47'W; NTS 106H *Pleuromya borealis* Warren	84788 1970

Age and Correlation: *Pleuromya borealis* Warren was described from the lower Albian to early middle Albian *Beudanticeras affine* Zone in Lower Mackenzie River area and is not known to occur anywhere else (Warren, 1947, loc. cit.). The lot 84788 is, therefore, Albian in age and represents some part of Sans Sault shale. Ordinarily, this dating and correlation would have to be treated as tentative only as pelecypods like *P. borealis* tend to be long-ranging and facies bound. However, the presence of *Sonneratia* (s. lato)? ex. aff. *kitchini* Spath in the same interval of the section (*see* under the lot 84792) dates the lot 84788 as of the early early Albian age.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	As above 385 m from base *Sonneratia* (s. lato)? ex aff. *kitchini* Spath *Pleuromya* sp. indet.	84792 1970

Age and Correlation: Early lower Albian. *Sonneratia*? cf. *kitchini* zone (*see* Jeletzky, 1968, p. 16). The *Sonneratia*? cf. *kitchini* zone was recently found to be the oldest Albian zone known in Canada. This early lower Albian zone appears to be equivalent to the lower part of European *Leymeriella tardefurcata* zone and the lower part of *Brewericeras* (*Leconteites*) *lecontei* zone of the Pacific Slope of North America (*see* Jeletzky, 1977, p. 110). So far as known, *Sonneratia*? cf. *kitchini* zone occurs near the base of Sans Sault Formation in Norman Wells area. Farther north it seems to be underlain by older lower Cretaceous (Aptian) rocks.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed C.J. Yorath	Outcrop south of St. Charles Creek 64°49'N, 124°26'W; NTS 96C *Pleuromya* cf. *borealis* Warren	84793

Age and Correlation: Possibly the same general Albian age as for the lot 84788 but this is a tentative suggestion only because of rather poor preservation of the only *Pleuromya* specimen available.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Outcrop Donnelly River 65°52'N, 128°23'W; NTS 106H *Beudanticeras (Grantziceras) affine* (Whiteaves)	84795 1970

Age and Correlation: Presumably of the late early or early mid-Albian age and either from the *Arcthoplites* spp. Zone in the sense of Jeletzky (1975, p. 241, 242, Fig. 3) or from the next younger Unnamed Zone F of Jeletzky (1968, p. 17, 18, Fig. 1). This dating is tentative because of the poor preservation of all ammonites contained in the lot 84795. It must be pointed out that the above dating and correlation is emended as compared with the original report provided in 1970. Since that time the writer (*see* Jeletzky, 1. cit.) came to realize that *Beudanticeras (Grantziceras) affine* and all other *Grantziceras* forms occurring in the Canadian Western Interior Region range considerably higher than do the *Arcthoplites* species occurring in the same region. These *Beudanticeras (Grantziceras)* were found to occur alone in the otherwise ammoniteless rocks of the Unnamed Zone F of Jeletzky (1968, p. 17, 18, Fig. 1) and to range up either all the way or almost all the way to the base of the *Pseudopulchellia pattoni* Subzone of the generalized *Gastroplites* Zone (Jeletzky, 1971, p. 8, Fig. 2). The upper lower Albian part of the *Arcthoplites* spp. and *Beudanticeras (Grantziceras) affine* Zone of Jeletzky (1968, p. 17, 18, Fig. 1) was therefore, segregated into a zone of its own and renamed *Arcthoplites* spp. Zone in order to stress the unsuitability of *Beudanticeras (Grantziceras) affine* and all allied *Beudanticeras (Grantziceras)* forms as its zonal indices. So restricted the *Arcthoplites* spp. Zone of the Canadian Western Interior region is correlative with the upper lower Albian *Brewericeras hulenense* and *Douvilleiceras* spp. Zone of the Pacific slope of Canada and the approximately equivalent *Douvilleiceras mammillatum* Zone (sensu Spath) of the European standard (*see* Jeletzky, 1975, p. 241, 242, Fig. 3; 1977, p. 110, Fig. 4 for further details). In the Lower Mackenzie Lowlands beds containing *Beudanticeras (Grantziceras)* ex gr. *affine-glabrum-multicostatum* have so far only been found in the Sans Sault Formation and its unnamed equivalents. The lot 84795 represents some part of this formation. It appears to represent a younger part of Sans Sault Formation than the lot 84792.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Crossley Lakes Member Horton River Formation C.J. Yorath	Outcrop 69°17'N, 123°39'W; NTS 97D *Panope*? *elongatissima* (McLearn) *Tancredia* cf. *T. yarwoodi* McLearn *Tancredia* cf. *T. stelcki* McLearn	88070 1974

Age and Correlation: Most likely derived from some part of the Albian shale-siltstone division of Jeletzky (1959, p. 18-20) and of an early to early middle Albian age. However, all pelecypods of lot 88070 are now known to be long-ranging and facies-bound types. Therefore, the lot could possibly be derived from the underlying Upper sandstone division and be of an Aptian age.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Horton River Formation T.P. Chamney	Outcrop Horton River 69°19'N, 126°50'W; NTS 97C ammonite fragment resembling *Arcthoplites (Freboldiceras) irenense* McLearn but not identifiable definitively even to the genus	C-257 1969

Age and Correlation: Possibly represents the late lower Albian *Arcthoplites* spp. Zone of the Canadian Western Interior standard sequence as re-defined in the discussion of the lot 84795 but cannot be dated definitively because of an extremely poor preservation of the only ammonite fragment available. The lot C-257 is at any rate of a general early to mid-Albian age because of the general affinities of its ammonite fragment.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Horton River Formation T.P. Chamney	Outcrop Horton River 69°27'30"N, 126°54'W; NTS 97C *Beudanticeras (Grantziceras)* cf. *glabrum* (Whiteaves) (immature specimen) serpulid worms, genus and species indet	C-258 1969

Age and Correlation: The same as for the lot 84795. The dating is just as tentative because of the poor preservation of the only specimen available.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata J.D. Aitken	Outcrop 67°01'N, 131°07'W; NTS 106O *Arcthoplites* cf. *belli* (McLearn) var. *Beudanticeras (Grantziceras) affine* (Whiteaves)	C-2019 1971

Age and Correlation: The same as for the lot C-257. However, the lot C-258 is dated unreservedly as the generic assignment of its *Arcthoplites* is definitive. Stratigraphic position of the lot C-2019 within Sans Sault Group remains obscure but it must be stratigraphically higher than the *Sonneratia*? ex aff. *kitchini* fauna collected by C.J. Yorath (GSC Loc. 84792).

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Horton River Formation H.R. Balkwill	Outcrop, Kugaluk River 12 m below top of Formation 69°04'N, 130°55'W; NTS 107D *Beudanticeras (Grantziceras) multicostatum* Imlay	C-3988 1970

Age and Correlation: The same as for the lot 84795 and C-258. The dating is provided without any reservations as the ammonites are well preserved.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Crossley Lakes Member H.R. Balkwill	100' above base of Cretaceous Tributary of Andrew River 67°44'N, 128°05'W; NTS 106P *Arctica* cf. *limpidiana* McLearn cf. *Psilomya* sp. indet. cf. *Tracia* sp. indet. (juven.) Pelecypods, genus and species indet.	C-5439 1970

Age and Correlation: *Arctica limpidiana* McLearn is a prominent member of the late lower Albian Clearwater fauna of the Lower Athabasca area in the Canadian Western, Interior region. This species was, furthermore, never reported outside of the Albian rocks in Canada or northern Alaska. A general Albian (late Lower Cretaceous) age is therefore suggested for the lot C-5439. It cannot be overstressed, however, that the genus *Arctica* is a long-ranging, facies-bound type which cannot be treated as a reliable index fossil.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Arctic Red Formation C.J. Yorath	Outcrop Imperial River 65°09'N, 127°50'W; NTS 96E *Beudanticeras (Grantziceras) affine* (Whiteaves)	C-9145 1971

Age and Correlation: The same as for the lot 84795, C-258, and C-3988. The dating is definitive as the ammonites of the lot C-9145 are well preserved.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Outcrop Maida Creek Directly across from Caracjou Ridge Fossils from lowest 12 m of 30 m exposure 65°36'N, 128°15'W; NTS 106H *Beudanticeras (Grantziceras)* cf. *affine* (Whiteaves) *Beudanticeras (Grantziceras)* cf. *glabrum* (Whiteaves) *Inoceramus* cf. *anglicus* Woods	C-10023 1972

Age and Correlation: The same as for the lot C-3988 and other lots of the group. The dating is, however, tentative because of a poor preservation of all ammonites available. The lot C-10023 is at any rate of an early to mid-Albian age because of the general affinities of its fauna.

Unnamed strata C.J. Yorath	Isolated exposure 8 m thick Ontaratue River 66°24'N, 131°02'W; NTS 106J *Beudanticeras (Grantziceras) affine* (Whiteaves) *Beudanticeras (Grantziceras)* n. sp. aff. *affine* (Whiteaves) indeterminate pelecypods (best specimens to Index Collection)	C-10024 1972

Age and Correlation: The same as for the lots C-10023, C-91414 and other lots of that group. The dating is definitive because of good preservation of most of the ammonites of the lot C-10024.

Arctic Red Formation C.J. Yorath	Measured section near Hume River 146-149 m above base of Cretaceous 65°24'N, 129°57'W; NTS 106H *Beudanticeras (Grantziceras)* cf. *affine* (Whiteaves)	C-10025 1972

Age and Correlation: The same as for the lots C-10023, C-10024, C-91414 and other lots of that group. The dating is tentative, however.

Arctic Red Formation C.J. Yorath	As above, 336 m above base of Cretaceous *Beudanticeras (Grantziceras)* cf. *affine* (Whiteaves)	C-10026 1972

Age and Correlation: The same as for the lots C-10023, C-10024 and C-10025 and other lots of that group. The dating is just as tentative as in the case of the lot C-10025.

Arctic Red Formation C.J. Yorath	As above, 410 m above base of Cretaceous *Beudanticeras (Grantziceras)* cf. *affine* (Whiteaves)	C-10027 1972

Age and Correlation: The same as for the lots C-9141, C-10023 and other lots of that group. The dating is just as tentative as in the case of the lot C-10025 and other lots containing poorly preserved specimens of *Beudanticeras (Grantziceras)*.

Arctic Red Formation C.J. Yorath	As above, 457 m above base of Cretaceous Although found in the scree, the specimen was located high above the creek immediately below outcrop and is considered to have been approximately in place. *Beudanticeras (Grantziceras) affine* (Whiteaves)	C-10029 1972

Age and Correlation: The same as for the lots 84795, C-3988, C-10024 and other lots of that group. The lot C-10029 is dated without reservations.

Arctic Red Formation C.J. Yorath	As above, 460 m above base of Cretaceous Although collected in the scree this specimen was found high above the creek and immediately below outcrop. *Cleoniceras (Grycia)* ex gr. *sablei* Imlay 1961	C-10030 1972

Age and Correlation: The *Cleoniceras (Grycia)* ex gr. *sablei* Imlay 1961 fauna of the lot C-10030 is new to the Western Interior region of Canada and can only be dated tentatively by comparison with the similar upper lower to middle Albian faunas of Northern Alaska (*see* Imlay , 1961, p. 46) and Spitzbergen (Nagy, 1970, pp. 21-23) containing closely related or (?) specifically identical *Cleoniceras (Grycia) sablei* and *C. (G.) wittingtoni*. These data suggest that *C. (G.)* ex gr. *sablei-whittingtoni* range through the *Arcthoplites* spp. Zone and Unnamed Zone F in the Western Interior region of Canada. In Arctic Canada these forms appear to range through the most part of the Christopher Formation (except for its uppermost part), some part of the Sans Sault Formation and some parts of its unnamed equivalents on Lower Mackenize Lowlands.

[1]This ammonite was described more recently as *Pseudopulchellia balkwilli* n. sp. (Jeletzky, 1980, p. 18, Pl. 8, Fig. 2).

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	Measured Section Mountain River 616 m above base of Cretaceous 65°28'N, 129°11'W; NTS 106H "*Gastroplites*" (new genus) n. sp. A	C-10032 1972

Age and Correlation: The "*Gastroplites*" (new genus) n. sp. A fauna was only found previously in the Canadian Arctic Archipelago where it was assigned tentatively to the generalized *Gastroplites* zone (Jeletzky, 1964, p. 90). In the Christopher Formation "*Gastroplites*": (new genus) n. sp. A is associated with other gastroplitid ammonites (Jeletzky, 1964, p. 90, 92; pl. XXXI, Figs. 3, 4, 5, 7; pl. XXXII, Fig. 4) some of which appear to be at least congeneric and possibly conspecific with *Pseudopulchellia pattoni* Imlay, 1960. [1]In northeastern British Columbia similar ammonites occur in the *Pseudopulchellia pattoni* Subzone [(in Hulcross Member of Commotion Formation which in turn comprises the basal part of generalized *Gastroplites* Zone (*see* Jeletzky, 1964, Table 1; 1968, p. 18-19)]. In Spitzbergen, finally, (Nagy, 1970, pp. 19, 53-54, pl. 9, Figs. 2-4, Text-figs. 3, 13) closely similar "*Gastroplites*" *subquadratus* Nagy and related forms occur in the upper part of the Middle Albian corresponding to the *Euhoplites lautus* and *Hoplites dentatus* (upper part) Zone of the British standard sequence. The lot C-10032 is therefore dated as of the late Middle Albian age in terms of the international standard stages and correlated with the basal beds (i.e. *Pseudopulchellia pattoni* Subzone) of the generalized *Gastroplites* Zone of the Western Interior region of Canada. In terms of the formational nomenclature of Stott (1968) the lot C-10032 appears to represent some part (?upper) of the Hulcross Member of the Commotion Formation. As already mentioned, the lot C-10032 is either approximately contemporary with or slightly older than the lot 28878 (*see* in its discussion for further details).

Arctic Red Formation C.J. Yorath	Isolated outcrop Mountain River area, specimens in situ at base of exposure 65°23'N, 129°07'W; NTS 106H *Cleoniceras (Cleoniceras)* ex aff. *C. (C.) antiquum* Casey 1966 (to Index Collection)	C-10035 1972

Age and Correlation: Early Lower Albian, probably *Leymeriella regularis* Subzone of the *Leymeriella tardefurcata* Zone of the European standard judging by the restriction of *Cleoniceras (Cleoniceras) antiquum* Casey (1966, p. 564) to this subzone in England. At any rate not younger than the basal beds of the *Douvilleceras mammillatum* Zone of the European standard. Primitive *Cleoniceras* s. str. of that type have not yet been found anywhere in Northern Canada or for that matter anywhere in North America. However, this fauna may be either slightly older or a faunal facies of the *Sonneratia*? cf. *kitchini* Zone found by the collector in the Sans Sault Formation at Sans Sault Rapids (*see* GSC Loc. 84792, this appendix). Like the lot 84792, the lot C-10035 apparently represents a level at or near the base of the Sans Sault Formation and at or near the base of the Cretaceous sequence in the Norman Well area. Farther north and northwest (i.e. in Upper Peel River area and in Eastern Richardson Mountains) equivalents of *Sonneratia*? cf. *kitchini* and (?) *Cleoniceras (Cleoniceras)* ex aff. *C. (C.) antiquum* beds are underlain by older Lower Cretaceous (Aptian) rocks. The same may be true of the Arctic Coastal Plain east of the Mackenzie Delta.

Arctic Red Formation C.J. Yorath	Outcrop 65°59'N, 130°39'W; NTS 106G *Arcthoplites* ex aff. *jachromensis* (Nikitin)	C-10036 1972

Age and Correlation: The same as for the lots C-257 and C-2019. The dating is definitive as for the lot C-2019. See in the discussion of the lot 84795 for the details of the presently adopted concept of *Arcthoplites* spp. Zone.

Crossley Lakes Member D.G. Cook	Outcrop 67°19'N, 130°03'W; NTS 106G *Tancredia kurupana* Imlay 1961 indeterminate pelecypods	C-10070 1972

Age and Correlation: *Tancredia kurupana* Imlay appears to be restricted to the Albian rocks in Northern Alaska (Imlay 1961) and Arctic Canada. General Albian age is suggested for the lot C-10070.

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BY D.H. MCNEIL

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Sans Sault Formation type section near Sans Sault Rapids 65°42'N, 128°47'W; NTS 106H	
	0-6 m above base of section *Bathysiphon* sp. *Ammobaculites fragmentarius* Cushman *Trochammina*(?) sp. *Gaudryina nanushukensis* Tappan	C-9301 1978
	6-13 m above base *Bathysiphon* sp.	C-9302 1978
	18-24 m above base *Saccammina alexanderi* (Loeblich and Tappan) *Reophax*(?) sp. *Ammobaculites fragmentarius* Cushman	C-9304 1978
	30-41 m above base *Bathysiphon* sp. *Haplophragmoides* sp. C of Stelck and Wall, 1956 *Gaudryina nanushukensis* Tappan	C-9306 1978
	49-78 m above base *Bathysiphon* sp. *Ammobaculites* cf. *A. janus* Stelck and Wall *A. fragmentarius* Cushman *Haplophragmoides* sp. *Trochammina*(?) sp. *Gaudryina nanushukensis* Tappan	C-9308 1978
	78 m above base *Saccammina alexanderi* (Loeblich and Tappan) *Haplophragmoides* sp. C of Stelck and Wall, 1956 *Ammobaculites fragmentarius* Cushman *Gaudryina nanushukensis* Tappan	C-9309 1978
	213-219 m above base *Haplophragmoides* sp. C of Stelck and Wall *Ammobaculites fragmentarius* Cushman *Flabellammina*(?) sp. *Gaudryina nanushukensis* Tappan	C-9312 1978
	244-258 m above base *Glomospirella*(?) sp. *Psamminopelta*(?) sp. *Ammobaculites fragmentarius* Cushman *Gaudryina nanushukensis* Tappan	C-9313 1978
	334-341 m above base *Bathysiphon*(?) sp. *Reophax*(?) sp. *Haplophragmoides*(?) sp.	C-9314 1978
	341-347 m above base *Saccammina alexanderi* (Loeblich and Tappan) *Haplophragmoides* sp. C of Stelck and Wall, 1956 *Haplophragmoides* sp. *Ammobaculites fragmentarius* Cushman *Gaudryina nanushukensis* Tappan	C-9315 1978
	347-354 m above base *Haplophragmoides* sp. C(?) of Stelck and Wall, 1956 *Ammobaculites fragmentarius* Cushman *Gaudryina nanushukensis* Tappan	C-9316 1978
	354-360 m above base *Bathysiphon* sp. *Saccammina alexanderi* (Loeblich and Tappan) *Hippocrepina barksdalei* (Tappan) *Haplophragmoides* sp. B of Stelck and Wall, 1956 *Ammobaculites fragmentarius* Cushman *Trochammina* sp. *Gaudryina nanushukensis* Tappan	C-9317 1978
	360-365 m above base *Bathysiphon* sp. *Psamminopelta*(?) sp. *Haplophragmoides* sp. C of Stelck and Wall, 1956 *Trochammina*(?) sp. *Gaudryina nanushukensis* Tappan	C-9319 1978
	366-375 m above base *Miliammina*(?) sp. *Haplophragmoides* sp. C of Stelck and Wall, 1956 *H.* sp. B of Stelck and Wall, 1956 *Ammobaculites* cf. *janus* Stelck and Wall *A. fragmentarius* Cushman *Trochammina* sp. *Eggerella* sp. B of Stelck and Wall, 1956 *Gaudryina nanushukensis* Tappan	C-9320 1978
	378-396 m above base *Bathysiphon* sp. *Saccammina alexanderi* (Loeblich and Tappan) *Haplophragmoides* sp. C of Stelck and Wall *H.* cf. *H. kirki* of Stelck and Wall *Ammobaculites* cf. *A. janus* Stelck and Wall *Gaudryina nanushukensis* Tappan	C-9321 1978

Age and Comments: The foraminifers studied from the Sans Sault Rapids area indicate an early Middle Albian age for the sampled section.

The microfauna compares closely with that known from the middle shale member of the Commotion Formation of northeastern British Columbia as described by Stelck *et al.*,(1956).

In terms of the foraminiferal zonal scheme for the prairie provinces (Caldwell *et al.*, 1978), the microfauna equates approximately to that of the agglutinated biofacies of the *Marginulinopsis collinsi-Verneuilinoides cummingensis* Subzone of the *Gaudryina nanushukensis* Zone. This Subzone, in turn, probably coincides with the *Arcthoplites (Lemuroceras) irenensis* and *A. (L.) mcconnelli* Subzones of the *Beudanticeras affine* Zone of the ammonite sequence of Jeletzky (1968, 1971).

The exclusively agglutinated microfauna recovered is indicative of a restricted, shallow-marine paleoenvironment. The sampled sequence appears to be conformable and a generalized increase in the species diversity from the bottom to the top of the section may be indicative of progressively deeper water and transgression.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Outcrop unnamed tributary of St. Charles Creek 64°49'N, 124°32'W; NTS 96C *Haplophragmoides* cf. *H.* sp. C of Stelck and Wall, 1956 *Ammobaculites* cf. *A. wenonhae* Tappan *Gaudryina nanushukensis* Tappan	C-9270 1978

Comments: Middle Albian. This assemblage compares with a slightly more diverse assemblage of agglutinated foraminifers from Middle Albian beds of the Commotion Formation in northeastern British Columbia. In the Western Interior *G. nanushukensis* is known from the Early and Middle Albian, but in the Arctic Slope of Alaska Tappan (1962) records it from the Late Albian Grandstand Formation.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	As above *Haplophragmoides* cf. *H.* sp. C of Stelck and Wall, 1956 *Ammobaculites* cf. *A. wenonahae* Tappan *Gaudryina nanushukensis* Tappan	C-9271 1978

Comments: Middle Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
	As above *Haplophragmoides* cf. *H.* sp. C of Stelck and Wall, 1956 *Ammobaculites* cf. *A. fragmentarius* Cushman *A.* cf. *A. wenonahae* Tappan *Gaudryina nanushukenis* Tappan	C-9272 1978

Comments: Middle Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
	Outcrop Unnamed tributary of St. Charles Creek 64°49'N, 124°26'W; NTS 96C *Haplophragmoides postis* Stelck and Wall *Ammobaculites* cf. *A. fragmentarius* Cushman *Gravellina chamneyi* Stelck *Arenobulimina*(?) sp.	C-9273 1978

Comments: Middle Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
	As above *Ammodiscus* sp. *Haplophragmoides postis* Stelck and Wall *Ammobaculites* cf. *A. fragmentarius* Cushman *Gaudryina nanushukensis* Tappan	C-9274 1978

Comments: Middle Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
	Outcrop Unnamed tributary to Big Smith Creek 64°44'N, 124°17'W; NTS 96C *Haplophragmoides postis* Stelck and Wall *Ammobaculites* cf. *A. fragmentarius* Cushman *Gaudryina nanushukensis* Tappan *G.* cf. *G. irenensis* Stelck and Wall	C-9276 1978

Comments: Middle Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
	Outcrop Big Smith Creek 64°41'N, 124°23'W; NTS 96C *Haplophragmoides postis* Stelck and Wall *Tritaxia athabascensis* Mellon and Wall	C-9277 1978

Comments: Middle Albian. *T. athabascensis* has been recorded previously from the Middle Albian Clearwater Shale of northwestern Alberta (Stelck *et al.*, 1956; Mellon and Wall, 1956).

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata	Sinclair Wolverine Creek D-61 Well 65°10'14"N, 124°12'52"W; NTS 96F	1978

Microfossil slides borrowed from Shell Canada Limited contain a fairly rich, well-preserved Albian microfauna consisting of both agglutinated and calcareous foraminifers. Many of the species are well-known from the boreal Albian of North America and their distributions are best documented from either the Arctic Slope of Alaska or the areas of northeastern British Columbia and northwestern Alberta.

The sampled section extends from 305 to 915 m in the well; samples from the upper 305 m were unobtainable. The section between 305 to 915 m shows a rich foraminiferal assemblage characteristic of the Middle Albian *Marginulinopsis collinsi-Verneuilinoides cummingensis* Subzone of the *Gaudryina nanushukensis* Zone (foraminiferal zonal scheme of the prairie provinces, after Caldwell *et al.*, 1978).

The two biofacies of the above Subzone are clearly demarked in the well. The sections 305 to 457 m and 854 to 863 m are marked by the agglutinated, *V. cummingensis* biofacies; the section between 457 and 854 m is marked by the mixed agglutinated and calcareous benthonic *M. collinsi* biofacies. Carbonate chips recovered from drill cuttings below 863 m presumably indicate contact with Paleozoic rock units.

Distribution of the agglutinated biofacies (*Gaudryina nanushukensis* Tappan included) probably extends through the upper part of the well, as Chamney (GSC Loc. No. C-12195, this Appendix) recorded a partly comparable assemblage from a sample at 128 m.

The significance of these two biofacies has been summarized by Caldwell *et al.*, (1978). They state that the geographic and stratigraphic distribution of the biofacies "suggests that the calcareous...biofacies is an expression of the offshore, open-sea environment of the transgressive boreal (Clearwater) sea, the agglutinated...biofacies an expression of the more restricted environmental conditions that prevailed during regression that sea and in the marginal-marine (possibly brackish-water) environments of the near-shore zone. The agglutinated biofacies commonly is associated with somewhat coarser-grained sediments".

The calcareous biofacies in the Wolverine Creek D-61 well shows an increase in the kinds and numbers of calcareous foraminifers from 854 m upwards to a zone of maximum abundance at 549 to 580 m. It follows from the paleo-environmental summary of Caldwell *et al.*, that the sequence in Wolverine Creek D-61 represents transgression from marginal-marine conditions (863-854 m), climaxing at 549 m, followed by regression and a progressive return to restricted, near-shore conditions of sedimentation (549-305 m).

Regionally, this fauna has been described from the Clearwater Formation in the Athabasca River district and in equivalent strata of northeastern British Columbia and northwestern Alberta (Mellon and Wall, 1956; Stelck *et al.*, 1956). Chamney (1978) has recorded the fauna from the Arctic Red Formation in the Yukon. And, in the Arctic Slope of Alaska, as comparable assemblage has been recorded from the upper Torok Formation by Tappan (1962) and by Bergquist (1966).

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BY J.H. WALL

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed G.K. Williams	SOBC CS St. Charles H-61 well Core from 418-430 m depth 64°50'24"N, 123°56'26"W; NTS 96B *Bathysiphon* sp. *Ammodiscus rotalarius* Loeblich and Tappan *Glomospira* sp. *Glomospirella scaphoidea* (McGill and Loranger) *Miliammina* sp. *Haplophragmoides gigas minor* Nauss *H.* sp. *Ammobaculites humei* Nauss *A.* sp., trochospiral coil - one specimen *Siphotextularia*(?) sp. cf. *S.* (?) *rayi* Tappan *Gaudryina nanushukensis* Tappan *G. tailleuri* (Tappan) *Serovaina loetterlei* (Tappan) - one specimen *Gavelinella* sp. - one poorly preserved specimen	C-57101 1976

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed G.K. Williams	As above Core from 430-440 m depth *Ammodiscus* sp. of Stelck and Wall, 1956 (pl. 2, Figs. 31, 32) *Glomospira* sp. *Glomospirella scaphoidea* (McGill and Loranger) *Miliammina subelliptica* Mellon and Wall - one specimen *Haplophragmoides gigas minor* Nauss *H.* sp. *Ammobaculites humei* Nauss *Gaudryina nanushukensis* Tappan *G. tailleuri* (Tappan) *G.* sp. *Serovaina loetterlei* (Tappan) - one specimen *Conorboides* sp. - one specimen	C-57102 1976

Comments: The above microfauna is known from the Loon River Formation of northern Alberta and the Sans Sault Group of the lower Mackenzie River area as well as from equivalent beds in northern Alaska, the Yukon and the Canadian Arctic Archipelago. The microfauna is dated early to middle Albian because of its association with certain key ammonites.

The assemblage from this well is dominated by agglutinated forms as only the last two species listed in both samples are calcareous and these are rare. The environment was thought to have been relatively shallow marine, probably within the inner part of the neritic zone.

Appendix IIc

Late Albian to Turonian Fossils

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Outcrop St. Charles Creek 64°57'N, 124°26'W; NTS 96C *Cyclonephelium compactum* Deflandre and Cookson *Cyclonephelium eisenackii* Davey *Cribroperidinium intricatum* Davey *Apteodinium reticulatum* Singh *Gonyaulacysta? tenuiceras* (Eisenack) Sarjeant *Exochosphaeridium striolatum* (Deflandre) Davey *Batioladinium jaegeri* (Alberti) Brideaux *Imbatodinium* sp. AE of Brideaux and McIntyre *Palaeoperidinium cretaceum* (Pocock ex Davey) Lentin and Williams *Leptodinium modicum* Brideaux and McIntyre *Chlamydophorella nyei* Cookson and Sisenack *Dictyopyxidia imperfecta* Brideaux and McIntyre *Luxadinium* sp. *Microdinium opacum* Brideaux *Spiniferites ramosus* (Ehrenberg) Mantell *Cleistosphaeridium aciculare* Davey *Polysphaeridium laminaspinosum* Davey and Williams *Cirratriradites teter* Norris *Lycopodiumsporites marginatus* Singh microforam linings derived Jurassic dinoflagellates	C-9269 1975

Age: Early Cretaceous, late Albian. Although many of these species occur also in Cenomanian rocks, no typical elements of Cenomanian dinoflagellate assemblages occur. Furthermore, some of the species recorded are not known to range into Cenomanian rocks.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Outcrop Tributary to Big Smith Creek 64°44'N, 124°17'W; NTS 96C *Stereisporites antiquasporites* (Wilson and Webster) Dettmann *Camarozonosporites* sp. bisaccate pollen *Palaeoperidinium eurypylum* (Manum and Cookson) Evitt *Microdinium opacum* Brideaux *Palaeoperidinium cretaceum* (Pocock ex Davey) Lentin and Williams *Leptodinium delicatum* (Davey) Davey *Palaeoperidinium* sp. AE of Brideaux *Oligosphaeridium pulcherrimum* (Deflandre and Cookson) Davey and Williams *Cleistosphaeridium aranéosum* Brideaux *Pterospermopsis helios* Sarjeant *Leiofusa jurassica* Eisenack (?)*Cauca parva* Davey *Luxadinium propatulum* Brideaux and McIntyre *Chlamydophorella nyei* Cookson and Eisenack *Odontochitina operculata* (Wetzel) Deflandre and Cookson *Cleistosphaeridium polypes* subsp. *clavulum* Davey *Veryhachium* spp. *Polysphaeridium* sp.	C-9276 1975

Age: Cretaceous, Late Albian to Cenomanian.

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
Unnamed sandstone B. Groeneweg and P. Monahan, Aquitaine Company of Canada	Outcrop near the southern tip of Mahony Lake 65°21'N, 125°06'W; NTS 96F *Luxadinium propatulum* Brideaux and McIntyre cf. *Spinidinium vestitum* Brideaux *Ovoidinium verrucosum* (Cookson and Eisenack) Davey *Hexagonifera*? sp. internal capsule with type 3I acheopyle (dinoflagellate cyst)	C-16887 1972

Age: Late Albian or Cenomanian.

Comments: If the material in lot C-16887 is *in situ*, then it appears that the material was deposited in a marine evnironment and is of Late Albian-Cenomanian age. There seems to be no evidence that this material is reworked into younger strata; the only organic material consists of the dinoflagellate cysts and cominuted organic debris of indeterminate origin. Hence the possibility that the cysts were reworked into a younger, barren lithology is discounted despite a (palynologically) unpromising lithology.

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
Slater River or East Fork Formation D.G. Cook	Outcrop, east bank, Mackenzie River about 13 km downstream from Fort Norman 64°56'N, 125°50'20"W; NTS 96C bisaccate pollen plant fragments (cuticle; tracheids) various trilete spores *Laevigatosporites ovatus* Wilson and Webster *Verrutricolpites* sp. *Chatangiella magna* (Davey) Lentin and Williams *Isabelidinium glomeratum* (Davey) Lentin and Williams *Ovoidinium verrucosum* (Cookson and Hughes) Davey *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Luxadinium propatulum* Brideaux and McIntyre various dinoflagate species, unidentified derived Paleozoic spores derived Triassic bisaccate pollen derived Jurassic dinoflagellates	C-30980 1974

Age: Late Albian-Cenomanian.

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
Slater River or East Fork Formation D.G. Cook	East bank, Mackenzie River, about 11 km downstream from Fort Norman 64°55'40"N, 125°48'20"W; NTS 96C *Cyclonephelium distinctum* Deflandre and Cookson *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Odontochitina costata* Alberti *Cleistosphaeridium polypes* subsp. *polypes* Davey *Chatangiella magna* (Davey) Lentin and Williams *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Tubulospina oblongata* Davey *Dorocysta litotes* Davey *Dorocysta* n. sp. *Hystrichosphaeridium cooksonae* Singh *Caligodinium aceras* (Cookson and Eisenack) Lentin and Williams *Spiniferites cingulatus* (O. Wetzel) Sarjeant *Cleistosphaeridium armatum* (Deflandre) Davey *Endoscrinium campanulum* (Gocht) Vozzhennikova *Subtilisphaeva pirnaensis* (Alberti) Jain and Millepied *Pterodinium aliferum* Eisenack *Chlamydophorella nyei* Cookson and Eisenack *Hexagonifera chlamydata* Cookson and Eisenack	C-30981 1974

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
	Oligosphaeridium pulcherrimum (Deflandre and Cookson) Davey and Williams *Trithyrodinium suspectum* (Manum and Cookson) Davey *Canningia ringnesii* Manum and Cookson *Fromea amphora* Cookson and Eisenack Retitricolpites sp. ("vulgaris" of Pierce) *Wallodinium anglicum* (Cookson and Hughes) Lentin and Williams acanthomorph acritarchs *Microdinium veligerum* (Deflandre) Davey *Microdinium crinitum* Davey *Tigrisporites scurrandus* Norris various trilete spores *Vitreisporites pallidus* (Reissinger) Balme bisaccate pollen grains derived Triassic bisaccate pollen	

Age: Cenomanian-Turonian.

Unnamed strata D.G. Cook	North bank, Great Bear River above St. Charles Rapids about 9 km east of Mount St. Charles 65°01'50"N, 124°30'15"W; NTS 96F *Oligosphaeridium totum* Brideaux subsp. *totum* *Cribroperidinium intricatum* Davey *Dinopterygium cladoides* Deflandre *Palaeoperidinium cretaceum* (Pocock ex Davey) Lentin and Williams *Oligosphaeridium anthophorum* (Cookson and Eisenack) Eisenack and Kjellström *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Luxadinium propatulum* Brideaux and McIntyre *Hystrichosphaeridium cooksonae* Singh *Silicisphaera ferox* (Deflandre) Davey and Verdier *Cyclonephelium distinctum* Deflandre and Cookson *Cyclonephelium* sp. cf. *C. clathromarginatum* Cookson and Eisenack *Cyclonephelium compactum* Deflandre and Cookson *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Batioladinium jaegeri* (Alberti) Brideaux *Oligosphaeridium complex* (White) Davey and Williams *Fromea amphora* Cookson and Eisenack *Trichodinium castaneum* (Deflandre) Clarke and Verdier *Endoscrinium campanulum* (Gocht) Vozzhennikova *Odontochitina costata* Alberti *Palaeostomocystis fragilis* Cookson and Eisenack *Carpodinium granulatum* Cookson and Eisenack *Batioladinium longicornutum* (Alberti) Brideaux *Cribroperidinium orthoceras* (Eisenack) Davey *Oligosphaeridium pulcherrimum* (Deflandre and Cookson) Davey and Williams bisaccate pollen various trilete spores derived Paleozoic spores derived Permian pollen	C-30983 1974

Age: Late Albian - Cenomanian

Stratigraphy and Collector	Locality	GSC Loc. No. and Report Year
Trevor Formation	Texaco Arctic Red F-47 well Candel *et al.*, Depth 0-18 m 65°36'25"N, 130°53'53"W;	C-33952/0-60 1975
	As above, 98-122 m	C-33952/320-400
	As above, 128-152 m	C-33952/420-500
	As above, 155-182 m	C-33952/510-600
	As above, 186-244 m	C-33952/610-800
	As above, 274 m	C-33952/900

Comments: All residues contained an abundance of fine, comminuted kerogen and relatively sparse concentrations of plant microfossils.

The age of the samples in the interval between 0 m and 122 m is Cenomanian based on the occurrence of tricolpate angiosperm pollen, a few rare dinoflagellate species and *Sequoiapollenites*. The samples in the interval between 128 m and 244 m are of a general Late Albian-Cenomanian age. The relatively impoverished assemblage does not permit a further refinement. The age of the sample at 274 m is questionable. The pollen and spore assemblage permits only the assignment of a general Early Cretaceous age. The character of the residue, however, shows no change from the other five samples and the sample is possibly of an age similar to that at 186-244 m.

Stratigraphy and Collector	Locality	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	Measured section 30-69 m above base of section 65°11'N, 127°42'W; NTS 96E amorphous kerogen plant fragments bisaccate pollen derived Jurassic dinoflagellates derived Carboniferous spores *Distaltriangulisporites perplexus* (Singh) Singh *Palaeostomocystis fragilis* Cookson and Eisenack *Sequoiapollenites* sp. *Tricolpites* sp. (= *Tricolpites* sp. C of Thusu) various trilete spores	C-33953 1975

Age: Late Albian or Cenomanian.

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	As above *Appendicisporites potomacensis* Brenner *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Odontochitina costata* Alberti *Cleistophaeridium aciculare* Davey *Subtilisphaera* sp. *Xiphophoridium* sp. *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Trichodinium castaneum* (Deflandre) Clarke and Verdier *Litosphaeridium siphoniphorum* (Cookson and Eisenack) Davey and Williams *Hystrichosphaeridium stellatum* Maier *Hystrichosphaeridium difficile* Manum and Cookson *Cribroperidinium orthoceras* (Eisenack) Davey *Hystrichophaeridium arundum* Eisenack and Cookson *Hystrichophaeridium cooksonae* Singh *Florentinia* sp. *Pterodinium aliferum* Eisenack *Cribroperidinium intricatum* Davey *Leptodinium modicum* Brideaux and McIntyre acanthomorph acritarchs various trilete spores *Deflandrea* sp. *Canningia* sp. derived Jurassic dinoflagellates	C-33954 1975

Age: Late Albian or Cenomanian.

Trevor Formation C.J. Yorath	Outcrop 65°12'N, 127°40'W; NTS 96E derived Jurassic dinoflagellates *Luxadinium propatulum* Brideaux and McIntyre *Endoscrinium campanulum* (Gocht) Vozzhennikova *Cribroperidinium intricatum* Davey *Fromea amphora* Cookson and Eisenack *Caligodinium aceras* (Cookson and Eisenack) Lentin and Williams *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Cyclonephelium eisenackii* Davey *Batioladinium jaegeri* (Alberti) Brideaux *Cleistosphaeridium aciculare* Davey *Oligosphaeridium complex* (White) Davey and Williams *Odontochitina* sp. of Singh (in litt.) (with extremely short post-cingular horn)	C-33955

Age: Late Albian-Cenomanian.

Unnamed basal sandstone D.G. Cook	Outcrop 14 km north of Kelly Lake 65°26'28"N, 126°05'00"W; NTS 96E abundant organic debris *Alisporites* sp. (2)* *Deflandrea* sp. (1) dinoflagellates unidentified (2) *Palaeohystrichophora infusorioides* Deflandre (1)	C-37209 1975

Age: Cretaceous, probably Late Cretaceous. The age determination is given with caution considering the small number of palynomorphs. (* indicates number of specimens recorded).

BY W.S. HOPKINS, JR.

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed strata H.R. Balkwill	Outcrop Black Water Lake Sheet 64°33'N, 123°27'W; NTS 96B	C-6657 1970

Osmundacidites wellmanii Couper
Sphagnum antiquasporites Wilson and Webster
Laevigatosporites sp.
Baculatisporites comaumensis (Cookson) Potonié
Hamulatisporis cf. *H. hamulatis* Krutzsch
Apiculatisporis sp.
Cyathidites sp.
Gleicheniidites senonicus Ross
Lycopodium spp.
Deltoidospora sp.
cf. *Laricoidites* sp.
cf. *Araucariacites* sp.
Taxodium sp.
cf. *Glyptostrobus* sp.
Tsugaepollenites mesozoicus Couper
Podocarpidites sp.
Alisporites sp.
cf. *Cedrus* sp.
Vitreisporites pallidus (Reissinger) Nilsson
Salix-type
Tricolpites sp.

Age: Early - Upper Cretaceous.

Comments: Lots C-6657 and C-6658 are completely lacking in any characteristic Lower Cretaceous palynomorphs. Moreover, they are also lacking elements characteristic of the Late Upper Cretaceous. A few "primitive" angiosperm pollen species are present which indicate a post-Albian age (at least in this latitude). On the basis of the absence of significant angiosperm pollen from Cenomanian deposits of Northern Alaska and abundant angiosperm pollen in Cenomanian deposits of the northeastern United States, I would suggest an age for these rocks of Cenomanian or Turonian. This conclusion is also supported by the rare presence of *Vitreisporites* which became extinct about that time. Both *Hamulatisporis* and *Rugubivesiculites* would also suggest a Cenomanian or possibly Turonian age.

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed strata H.R. Balkwill	Outcrop Grizzly Bear Mountain 65°21'N, 121°17'W; NTS 96H	C-6658 1970

Lycopodiumsporites cf. *L. marginatus* Singh
Osmundacidites wellmanii Couper
Baculatisporites comaumensis (Cookson) Potonié
Verrucosisporites sp.
cf. *Laricoidites* sp.
Tsugaepollenites mesozoicus Couper
Taxodium sp.
Cupressaceae - Taxodiaceae
cf. *Araucariacites* sp.
cf. *Glyptostrobus* sp.
Alisporites sp.
cf. *Rugubivesiculites reductus* Pierce
miscellaneous bisaccate conifer pollen
Vitreisporites pallidus (Reissinger) Nilsson
cf. Liliaceae
Salix-type
Tricolpites sp.
Tricolporopollenites sp.

Age: Early - Late Cretaceous.

Comments: Lots C-6657 and C-6658 are completely lacking in any characteristic Lower Cretaceous palynomorphs. Moreover, they are also lacking elements characteristic of the Late Upper Cretaceous. A few "primitive" angiosperm pollen species are present which indicate post-Albian age (at least in this latitude). On the basis of the absence of significant angiosperm pollen from Cenomanian deposits of Northern Alaska, and abundant angiosperm pollen in Cenomanian deposits of the northeastern United States, I would suggest an age for these rocks of Cenomanian or Turonian. This conclusion is also supported by the rare presence of *Vitreisporites* which became extinct about this time. Both *Hamulatisporis* and *Rugubiversiculites* would also suggest a Cenomanian or possibly Turonian age.

BY J.A. JELETZKY

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Little Bear Formation Mobil Oil	North bank of Redstone River 6 miles from mouth Norman-Wrigley Sheet, NTS 96C	28647 1957

Inoceramus ex aff. *percostatus* Müller? (a new species?)
Pecten cf. *silentiensis* McLearn
Pleuromya sp. indet.
Arctica? sp. indet.

Age and Correlation: Lot No. 28647 contains a peculiar *Inoceramus*, probaly representing a new species. Although it cannot be compared closely with any of the *Inoceramus* species known to the writer, its evolutionary grade is that of the early Upper Cretaceous *Inoceramus* species. The closest analogy of this *Inoceramus* occur in the Upper Turonian to Lower Coniacian rocks of North America and Europe; these include *Inoceramus percostatus* Müller, *Inoceramus gilberti* White and *Inoceramus flaccidus* White.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata D. Bardack	Lac des Bois, on the W side of the lake, on a peninsula which projects into the lake. In concretions which have weathered out of a cliff which reaches 12 m in height. Most concretions came from the lower levels of this cliff 66°52'N, 125°22'W; NTS 96K	84342 1969

Scaphites delicatulus Warren
Inoceramus labiatus Schlotheim
Otoscaphites cf. *seabeensis* Cobban and Gryc
Borissiakoceras cf. *ashurkoffae* Cobban and Gryc
Inoceramus ex aff. *lamarcki* Parkinsen
a generically indeterminate (new genus?) kelaenid squid (order Teuthida Naef, 1916, family Kelaenidae Jeletzky, 1966 nov. nomen).
Indeterminate pelecypods

Age and Correlation: The well preserved and diagnostic fossils of the lot GSC loc. 84342 permit its unreserved early Turonian, *Watinoceras* and *Inoceramus labiatus* Zone, (*see* Jeletzky, 1968, p. 27-28) dating. The lot GSC 84342 can furthermore be placed in the upper part (subzone) of the interregional *Watinoceras* and *Inoceramus labiatus* Zone characterized by *Watinoceras reesidei* and *Inoceramus labiatus* (Jeletzky, loc. cit., p. 28; W.A. Cobban and G. Gryc, 1961, p. 178). This subzone is known to occur in the middle part of the Slater River Formation (about 1,100 feet above base according to C.R. Stelck, pers. comm.) of the Mackenzie River valley (Hume, 1954, p. 47, 51; Warren, 1947, p. 118, 119). The lot GSC loc. 84342 is, therefore, undoubtedly correlative with this part of the Slater River Formation.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	Measured section West Hume River, 837-885 m 65°25'N, 130°01'W; NTS 106G	84798 1970

Inoceramus lamarcki Parkinson var. *interruptus* Schmidt
Inoceramus sp. indet.

Age and Correlation: Some part of the broad *Prionocyclus* and *Inoceramus lamarcki* Zone of the Canadian Western Interior region (Jeletzky, 1968, p. 29) and of middle to upper Turonian age in terms of international standard stages.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	As above, 810 m above base	84800 1970

Inoceramus labiatus (Schlotheim) var.
Inoceramus labiatus (Schlotheim) var. *latus* Sowerby
Inoceramus cf. *amudariensis* Arkhangelsky

Age and Correlation: Early Turonian, Zone of *Watinoceras* and *Inoceramus labiatus* Schlotheim (*see* Jeletzky, 1968, p. 27-28). *I.* cf. *amudariensis* Arkhangelsky is suggestive of the upper part of the zone. The beds from which lot 84800 was obtained represent the littoral (sandstone) facies of that part of Slater River shale (i.e. Bear Rock locality) from which *Scaphites delicatulus* fauna was obtained by Dr. C.R. Stelck (*see* Warren, 1947, pp. 118-123, pls. 29-30). It is also approximately contemporary with beds that have yielded *Scaphites delicatulus* fauna at Lac des Bois (84342, this appendix). The littoral (sandstone-grit) facies of *Watinoceras* and *Inoceramus labiatus* Zone is also known in Upper Pine River area (Tuskoola sandstone member). The occurrence of lot 84800 closely beneath lot 84798 suggests that the Little Bear Formation (Trevor Formation of this report) laterally replaces Slater River shale to the west.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Trevor Formation C.J. Yorath	Measured section Mountain River 1083 m above base of the Cretaceous 65°28'N, 129°11'W; NTS	C-10033 1972

Inoceramus cf. *dunveganensis* McLearn s. lato

Age and Correlation: The lot C-10033 contains a fauna that is new for the area. The poorly preserve *Inoceramus* of this lot is comparable with *I. dunveganensis* McLearn, an earliest Upper Cretaceous (Cenomanian) index fossil of more southern areas of the Western Interior Region of Canada (*see* Jeletzky, 1968, p. 24-25). This suggests a considerably younger age of the lot C-10033 as compared with lots C-10023-32 inclusive and its correlation with the *Inoceramus dunveganensis* Zone of the Dunvegan (= Fort Nelson) Formation or with the equivalent beds (*Inoceramus athabascensis* beds) of the basal Labiche Formation. *Inoceramus dunveganensis* McLearn was

Stratigraphy and Collection	Locality, Fauna and Age	GSC Loc. No. and Report Year
	recently found in the Ninuluk Formation of Northern Alaska (Jones and Gryc, 1960, p. 159, pls. 15-18, 20-21, Text-fig. 31). Closely related and contemporary *Inoceramus crippsi* Mantell have been found in the Upper Cretaceous shale division of northeastern Richardson Mountain (Jeletzky, 1959, p. 21-22). It should be pointed out that the preservation of the two fragmentary specimens available is insufficient to rule out their reference to the late Lower Albian (= *Neogastroplites* Zone; *see* Jeletzky, 1968, pp. 19-20) ?*Posidonomya* ex gr. *nahwisi* McLearn which is probably an *Inoceramus*. However, the Cenomanian age of lot C-10033 appears to be much more likely.	
C.J. Yorath	As above 1084 m above base of Cretaceous *Inoceramus* cf. *dunveganensis* McLearn	C-10034 1972

Age and Correlation: The same as for the lot C-10033 and with the same reservation concerning the rather remote possibility of the late Albian (*Neogastroplites* Zone) age.

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BY D.H. MCNEIL

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Outcrop St. Charles Creek 65°57'N, 124°26'W; NTS 96C *Miliammina*(?) sp. *Psamminopelta bowsheri* Tappan *Haplophragmoides postis* Stelck and Wall *H. spissum* Stelck and Wall *H.* cf. *H.* sp. C of Stelck and Wall, 1956 *Textularia* cf. *T. topagorukensis* *Trochammina umiatensis* Tappan *Gravellina chamneyi* Stelck	C-9269 1978

Comments: Late Albian. Elements of this assemblage are known from Middle and Late Albian beds in both the Western Interior and the Arctic Slope of Alaska. Its general composition compares closely with that of the Late Albian *Miliammina manitobensis* Zone of the prairie provinces, and the occurrence of *G. chamneyi* substantiates a Late Albian age.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Unnamed tributary to Big Smith Creek 64°44'N, 124°17'W; NTS 96C *Haplophragmoides postis* Stelck and Wall *Ammobaculites* cf. *A. fragmentarius* Cushman *Gaudryina nanushukensis* Tappan *G.* cf. *G. irenensis* Stelck and Wall	C-9276

Comments: Middle to Late(?) Albian.

Stratigraphy and Collector	Locality, Foraminifers and Age	GSC Loc. No. and Report Year
Unnamed strata D.G. Cook	Outcrop St. Charles Rapids 65°01'15"N, 124°30'15"W; NTS 96F *Reophax* cf. *R. troyeri* Tappan *Psamminopelta bowsheri* Tappan *Haplophragmoides* sp. *Ammobaculites* cf. *A. fragmentarius* Cushman *Trochammina* cf. *T. umiatensis* Tappan (poorly preserved) *Gravellina* cf. *G. chamneyi* Stelck (poorly preserved)	C-30983 1978

Age: Late Albian.

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BY J.H. WALL

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed J.D. Aitken	Mackintosh Bay, Smith Arm, Great Bear Lake 66°09'N, 123°15'W; NTS 96J Foraminifera: *Ammodiscus kiowensis* Loeblich and Tappan *Miliammina* sp. - one distorted specimen *Haplophragmoides gigas minor* Nauss *H.* sp. *Ammobaculites* sp. *Textularia* sp. *Gravellina chamneyi* Stelck	C-2570A 1977

Age: Early Cretaceous, middle to late Albian.

BY MARK V.H. WILSON (UNIVERSITY OF ALBERTA)

Stratigraphy and Collector	Locality, description and age	GSC Loc. No. and Report Year
Unnamed strata C.J. Yorath	Lac des Bois, on west side of lake 66°52'N, 125°22'W; NTS 96K The fossil fish from Lac des Bois, in my opinion, represents a species, probably undescribed, of the genus *Osmeroides* Agassiz (*see* Forey, 1973 for the most recent revision and discussion of this genus)	C-76622 1978

Age: The known geological range is Late Albian to Coniacian. The genus is known mostly from European deposits.

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Appendix IId

Coniacian to Campanian Fossils

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
Little Bear Formation C.J. Yorath	Outcrop Little Bear River 64°34'N, 126°19'W; NTS 96D *Spinidinium* sp. *Chatangiella* sp. cf. *spectabilis* (Alberti) Lentin and Williams *Chatangiella* spp. various unidentified dinoflagellates *Baltisphaeridium* spp. *Veryhachium reductum* forma *trispinoides* (de Jekhowsky) de Jekhowsky various trilete spores *Inaperturopollenites dubius* (Potonié) Thoms. and Pflug. *Gleicheniidites senonicus* Ross sensu Skarby *Aquilapollenites trialatus* Rouse *Aquilapollenites* sp. cf. *A. decorus* Srivastava	C-8721 1971
Age: Late Cretaceous, Campanian.		
Little Bear Formation C.J. Yorath	Type section of Little Bear Formation 14 m above base Little Bear River 64°37'N, 126°18'W; NTS 96D Derived Carboniferous spores and Upper Permian-Lower Triassic bisaccate pollen *Trichodinium castaneum* (Deflandre) Clarke and Verdier *Isabelidinium cooksoniae* (Alberti) Lentin and Williams *Chatangiella granulifera* (Manum) Lentin and Williams *Chatangiella spectabilis* (Alberti) Lentin and Williams ?*Chatangiella scheii* (Manum) Lentin and Williams *Chatangiella* spp. *Heterosphaeridium conjunctum* Cookson and Eisenack *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Cleistosphaeridium huguoniotii* (Valensi) Davey *Odontochitina operculata* (Deflandre) Deflandre and Cookson Various trilete spores	C-23926 1973
Age: Santonian.		
Little Bear Formation C.J. Yorath	As above, 14-24 m above base Derived Carboniferous spores and Triassic bisaccate pollen *Chatangiella* sp. aff. *C. scheii* (Manum) Lentin and Williams *Alterbia balmei* (Cookson and Eisenack) Lentin and Williams *Trichodinium castaneum* (Deflandre) Clarke and Verdier *Exochosphaeridium* sp. aff. *E. striolatum* (Deflandre) Davey Cf. Forma P of Evitt *Ovoidinium* sp. cf. *O. verrucosum* (Cookson and Hughes) Davey *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Cleistosphaeridium huguoniotii* (Valensi) Davey *Spinidinium* sp. cf. *S. densispinatum* Stanley dinoflagellate cysts unidentified	C-23927 1973
Age: Santonian.		
Little Bear Formation C.J. Yorath	As above, 24-48 m above base Derived Carboniferous spores, Triassic bisaccate pollen and Lower Cretaceous dinoflagellates Cf. Forma P. of Evitt *Areoligera*? sp. *Coronifera* sp. *Alterbia acuminata* (Cookson and Eisenack) Lentin and Williams *Exochosphaeridium* sp. aff. *E. striolatum* (Deflandre) Davey *Cyclonephelium distinctum* Cookson and Eisenack *Spinidinium* sp. cf. *S. densispinatum* Stanley *Oligosphaeridium complex* (White) Davey and Williams dinoflagellate cysts unidentified various trilete spores	C-23928 1973
Age: Santonian.		
Little Bear Formation C.J. Yorath	As above, 48-53 m above base Derived Carboniferous spores and Triassic bisaccate pollen various trilete spores *Vitreisporites pallidus* (Reissinger) Balme *Exochosphaeridium* sp. aff. *E. striolatum* (Deflandre) Davey *Trichodinium castaneum* (Deflandre) Clarke and Verdier *Chatangiella spectabilis* (Alberti) Lentin and Williams *Chatangiella* spp. dinoflagellate crysts unidentified	C-23929 1973
Age: Santonian.		
East Fork Formation C.J. Yorath	Measured section, 3-6 m above base East Fork, Little Bear River 64°47'N, 126°02'W; NTS 96D Derived Carboniferous spores and Lower Cretaceous dinoflagellates *Retitriletes* sp. *Osmundacidites* sp. *Aquilapollenites* sp. *Aquilapollenites* sp. cf. *A. sentus* Srivastava	C-23930 1973
Age: Post-Santonian, probably Campanian.		
East Fork Formation C.J. Yorath	As above, 6-9 m above base various trilete spores *Scollardia steevesi* Srivastava *Aquilapollenites* sp. cf. *A. sentus* Srivastava	C-23931 1973
Age: Post-Santonian, probably Campanian.		
East Fork Formation C.J. Yorath	As above, 16-18 m above base Derived Carboniferous spores Triassic bisaccate pollen, and Lower Cretaceous spores and dinoflagellates various trilete spores *Taxodiaceaepollenites* sp. *Aquilapollenites* spp. *Balmeisporites (Styx)* sp. H. of Gunther and Hills *Alterbia acuminata* (Cookson and Eisenack) Lentin and Williams *Isabelidinium cooksonae* (Alberti) Lentin and Williams *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *S. cingulatus* (Wetzel)	C-23932 1973
Age: Early or middle Campanian.		
East Fork Formation C.J. Yorath	As above, 21-24 m above base Derived Carboniferous spores, Triassic bisaccate pollen and Lower Cretaceous dinoflagellates various trilete spores *Aquilapollenites* sp. cf. *A. sentus* Srivastava *Aquilapollenites* sp. cf. *A. polaris* Funkhouser *Balmeisporites (Styx)* sp. ex gr. *rarus-longirimosus* *Alterbia acuminata* (Cookson and Eisenack) Lentin and Williams	C-23933 1973
Age: Early or middle Campanian.		
East Fork Formation C.J. Yorath	As above, 34-37 m above base Derived Devono-Mississippian spores *Balmeisporites (Styx)* sp. *Aquilapollenites aucellatus* Srivastava	C-23935 1973
Age: Post-Santonian, probably Campanian.		

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
East Fork Formation C.J. Yorath	As above, 40-43 m above base Derived Carboniferous spores various trilete spores *Bacutriletes* sp. cf. *B. tylotus* Harris (of Gunther and Hills) *Cranwellia rumseyensis* Srivastava	C-23936 1973

Age: Lower or Middle Campanian.

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
East Fork Formation C.J. Yorath	As above, 25-27 m above base Derived Devono-Carboniferous spores and Lower Cretaceous dinoflagellates various trilete spores *Aquilapollenites* sp. cf. *A. polaris* Funkhouser *Pterodinium* spp. *Diconodinium* sp. *Tanyosphaeridium* sp. *Hystrichospheridium stellatum* Maier *Alterbia acuminata* (Cookson and Eisenack) Lentin and Williams *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich	C-23938 1973

Age: Post-Santonian, Campanian.

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
East Fork Formation C.J. Yorath	As above, 30-34 m above base Derived Devono-Carboniferous spores and Triassic bisaccate pollen *Diconodinium* sp. *Leptodinium delicatum* (Davey) Sarjeant *Cyclonephelium distinctum* Cookson and Eisenack *Cleistosphaeridium* sp. *Alterbia balmeii* (Cookson and Eisenack) Lentin and Williams *Isabelidinium cooksonae* (Alberti) Lentin and Williams various unidentified dinoflagellate cysts *Aquilapollenites* spp.	C-23939 1973

Age: Post-Santonian, probably Campanian.

Stratigraphy and Collector	Locality, Assemblage and Age	GSC Loc. No. and Report Year
East Fork Formation C.J. Yorath	As above, 33-34 m above base Derived Devono-Carboniferous spores *Odontochitina operculata* (Deflandre) Deflandre and Cookson *Chatangiella* spp. *Oligosphaeridium* spp. *Aquilapollenites* sp. cf. *A. polaris* Funkhouser *Aquilapollenites* spp. various trilete spores	C-23940 1973

Age: Post-Santonian, Campanian.

BY J.A. JELETZKY

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
East Fork Formation C.J. Yorath	Outcrop Keele River 64°19'N, 124°55'W; NTS 96C *Scaphites* (*Clioscaphites* or? *Desmoscaphites*) sp. indet. *Inoceramus* cf. *steenstrupi* de Loriol *Inoceramus* cf. *patootensis* de Loriol	84794 1970

Age and Correlation: Lot 84794 can represent any of the following Santonian to lower Campanian fossil zones of the Canadian Western Interior Region: 1. *Scaphites* (*Clioscaphites*) *vermiformis*; 2. *Scaphites* (*Clioscaphites*) *montanensis*; 3. *Scaphites* (*Desmoscaphites*) spp.; and 4. *Scaphites* (*Hoploscaphites*) *hippocrepis* (*see* Jeletzky, 1968, pp. 38-45). The beds from which it was collected are equivalent to the middle or upper part of the Wapiabi Formation of the the Foothills Belt or to some part of Kotaneelee Formation of the Liard River area. The East Fork Formation of Lower Mackenzie area is traditionally correlated with Kotaneelee and Wapiabi Formation (Stott, 1960, p. 18) and the lot 84794 should represent some part of the East Fork Formation.

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Appendix IIe

Campanian to Maastrichtian Fossils

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Unnamed surface sandstone unit C.J. Yorath	Unnamed sandstone unit 129-131 m above base East side of McKay Range 64°36'N, 125°36'W: NTS 96C *Aquilapollenites trialatus trialatus* Rouse *Aquilapollenites trialatus variabilis* Tschudy and Leopold *Aquilapollenites trialatus* Rouse ?n. subsp. *Kurtzipites* sp. of McIntyre *Extratriporopollenites* sp. 1 of McIntyre *Extratriporopollenites* sp. 2 of McIntyre *Azonia fabacea* Samoilovich *Polycolpites pocockii* Srivastava triporate/triatriate pollen unidentified *Cingulatisporites dakotaensis* Stanley *Hamulatisporis amplus* Stanley *Radialisporis radialis* (Krutzsch) Krutzsch alete pollen species unidentified (n. gen.?) Bisaccate pollen *Cicatricosisporites* sp. *Radialisporis* sp. *Vitreisporites pallidus* (Reissinger) Nilsson	C-8715 1975

Age: Late Cretaceous, late Senonian, late Campanian. The dominance of the pollen assemblage by *Aquilapollenites trialatus* together with pollen species ranging into the Maastrichtian suggests a late Campanian age for this sample.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Little Bear Formation C.J. Yorath	Measured section, 16-23 m above base Little Bear River southwest of Fort Norman 64°34'N, 126°19'W; NTS 96D *Cingulatisporites radiatus* Stanley *Stereisporites* spp. *Cingutriletes* spp. *Hamulatisporis amplus* Stanley *Gleicheniidites senonicus* Ross sensu Skarby *Osmundacidites* spp. *Abietineaepollenites* sp. *Inaperturopollenites hiatus* (Pot.) Thoms. and Pflug *Psilatricolpites* sp. *Retitricolpites* sp. *Marcellopites tolmanensis* Srivastava *Aquilapollenites* sp. cf. *A. dentatus* B.D. Tschudy *Aquilapollenites* sp. cf. *A. stelckii* Srivastava *Aquilapollenites trialatus* Rouse *Spiniferites* sp.* *Baltisphaeridium* sp.* various trilete apiculate spores (*microplankton)	C-8719 1971

Age: Late Senonian, Campanian, to ?Early Maastrichtian.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Little Bear Formation C.J. Yorath	As above, 23-25 m above base *Cingulatisporites radiatus* Stanley *Cingutriletes* spp. *Stereisporites* spp. *Cicatricosisporites* spp. *Hamulatisporis amplus* Stanley *Lycopodiumsporites* sp. cf. *L. papillaesporites* (Rouse) Srivastava *Deltoidospova* sp. *Gleicheniidites senonicus* Ross sensu Skarby *Zlivisporis* sp. cf. *Z. blanensis* Pacltova *Osmundacidites wellmannii* Couper *Laevigatosporites ovatus* Wilson and Webster *Polypodiisporites* sp. cf. *P. favus* (Potonié) Potonié *Inaperturopollenites hiatus* (Pot.) Thoms. and Pflug *Liliacidites* sp. various trilete apiculate spores *Marcellopites tolmanensis* Srivastava *Tetracolpites* sp. *Retitricolporites* sp. *Triporopollenites* sp. *Extratriporopollenites* sp.	C-8720 1971

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year

Triatriopollenites costatus Norton
Aquilapollenites trialatus Rouse
Aquilapollenites sp. cf. *A. oblatus* Srivastava
"Mancicorpus" sp.
Aquilapollenites clarireticulatus (Samoilovich) B.D. Tschudy
Tenua? sp.*

Age: Late Senonian, Campanian to ?Early Maastrichtian.

Comments: The pollen and spore assemblages recovered from samples C-8719 and C-8720 of the Little Bear Formation comprise both long ranging species and those with more restricted ranges. Some of the species with published ranges restricted to the Maastrichtian have been described only from the Edmonton Formation (Srivastava, 1970) and their basal ranges have not been determined. Certain other species, however, have been widely reported and possess ranges restricted to the Campanian. Because these ranges might possibly be extended into the Early Maastrichtian by more detailed work in the District of Mackenzie, and because of the presences of a variety of forms known to occur in the Maastrichtian, the possibility that the ages of (C-8719) and (C-8720) might be as young as Early Maastrichtian cannot be ruled out.

The assemblage of angiosperm pollen form C-8719 and C-8720 includes abundant specimens of the genus *Aquilapollenites* Rouse. Reports in the literature of Aptian-Albian and pre-Late Santonian occurrences of this genus have never been substantiated. A very few specimens have been recorded from the Late Santonian of Alaska. The abundance of specimens and the species diversity of the *Aquilapollenites* assemblage under discussion rules out any possibility of a Late Santonian age assignment.

Aquilapollenites trialatus Rouse has been reported only from deposits of Campanian age in the Rocky Mountain region of Canada and the United States (Tschudy and Leopold, 1970). The presence of this species in abundance C-8719 and C-8720 therefore supports strongly the assignment of a Campanian age. Other species of *Aquilapollenites* cited in the report have been recorded from the Maastrichtian. This age assignment is not contradicted by the absence of species of the pollen genus, *Wodehouseia* Stanley, especially those species with published ranges restricted to the Maastrichtian.

For similar reasons, the age of the sample taken from a 69.8 m (229 ft) thick sequence (C-8721) below the Little Bear River Formation, is considered to be of Campanian age. This sample also contains several species of the cavate dinoflagellate cyst, *Chatangiella* Lentin and Williams, notably one very similar to *C. spectabilis* (Alberti) Lentin and Williams, a species recorded from the Late Senonian of Germany.

In formulating the discussion, it should be noted that several assumptions have been made. Firstly, ranges of species of *Aquilapollenites* compiled from the Rocky Mountain region, are assumed to hold for areas north of that region in the District of Mackenzie. Secondly, the absence of certain species of *Wodehouseia* is due to biostratigraphic and not paleoecologic control.

The proposal of a Campanian-?Early Maastrichtian age for the Little Bear Formation is in conflict with several other sources. A Late Albian age is suggested in *Geology and Economic Minerals of Canada* (5th Ed., Chart III). Evidence presented here indicates that this determination must be revised. Jeletzky (1971, p. 58) reports an occurrence, brought to his attention by C.R. Stelck, of "a 2-foot long Santonian *Inoceramus* ex gr. *cardissoides-pinniformis*..." which was "presumed to have been collected from the East Fork shale...". It is suggested from this evidence that the age of the East Fork Formation, which overlies the Little Bear Formation (Hume, 1954, pp. 48-51) could be Santonian. Because the evidence for this is based on a specimen not found *in situ* and because of the evidence cited herein, the age of the East Fork Formation must be at least Campanian or younger. This resolves a situation which would have seen Santonian rocks resting on rocks of Campanian or younger age.

Unnamed surface sandstone unit
C.J. Yorath — Unnamed sandstone unit, 0-5 m above base, East side of McKay Range, 64°36'N, 125°35'W; NTS 96C — C-9285, 1975

Chatangiella ditissima (McIntyre) Lentin and Williams
Spinidinium clavum Harland
Chatangiella granulifera (Manum) Lentin and Williams
Membranosphaera maastrichtia Samoilovich ex Norris and Sarjeant
Tricolpites sp. 9 of McIntyre
Aquilapollenites sp.
Triporate pollen unidentified
Gleicheniidites senonicus Ross sensu Skarby
derived Devonian spores
derived Carboniferous spores and pollen
derived Jurassic dinoflagellates
Vitreisporites pallidus (Reissinger) Nilsson

Age: Late Cretaceous, late Senonian, Campanian.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
East Fork Formation D.G. Cook	East bank, Mackenzie River, about 8 km downstream from Fort Norman 64°55'N, 125°44'30 W; NTS 96C	C-30978 1974

Chatangiella biapertura (McIntyre) Lentin and Williams
deflandreoid cyst body (Type 1)
palaeoperidinioid cryst body (Type A3I3Pa)
Surculosphaeridium longifurcatum (Firtion) Davey, *et al.*
Palaeohystrichophora infusorioides Deflandre
Isabelidinium amphiata (McIntyre) Lentin and Williams
Odontochitina costata Alberti
Spiniferites ramosus (Ehrenberg) Loeblich and Loeblich
Canningia ringnesii Manum and Cookson
Cleistosphaeridium ancoriferum (Cookson and Eisenack) Davey

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year

Diconodinium arcticum Manum and Cookson
Odontochitina operculata (O. Wetzel) Deflandre and Cookson
Wallodinium anglicum (Cookson and Hughes) Lentin and Williams
Palambages sp.
Hystrichosphaeridium sp.
Laciniadinium sp.
Membranosphaera maastrichtia Samoilovich ex Norris and Sarjeant

Age: Late Campanian to Early Maastrichtian (=Divisions H2 and lower part of H3 of McIntyre, 1974).

East Fork Formation D.G. Cook	Outcrop, east bank, Mackenzie River, about 14 km downstream from Fort Norman 64°56'N, 125°52'20"W; NTS 96C	C-30979 1974

Palaeoperidinium sp.
Silicisphaera ferox (Deflandre) Davey and Verdier
Batioladinium jaegeri (Alberti) Brideaux
Diconodinium arcticum Manum and Cookson
Spiniferites ramosus (Ehrenberg) Loeblich and Loeblich
Palaeostomocystis fragilis Cookson and Eisenack
Membranosphaera maastrichtia Samoilovich ex Norris and Sarjeant
Tricolpites sp.
Tricolpites sp. 1 of McIntyre, 1974
Gleicheniidites senonicus Ross sensu Skarby
Gillinia hymenophora Cookson and Eisenack
Horologinella(?) sp.
Spongiodinium? sp.
various dinoflagellate cysts, unidentified
derived Paleozoic spores

Age: Late Cretaceous, Campanian - (?)early Maastrichtian

East Fork Formation D.G. Cook	East bank, Mackenzie River, about 8 km downstream from Fort Norman District of Mackenzie 64°55'10"N, 125°45'00"W; NTS 96C	C-30982 1974

Isabelidinium amphiata (McIntyre) Lentin and Williams
Chatangiella ditissima (McIntyre) Lentin and Williams
Deflandrea sp. 2 of McIntyre
Ceratiopsis sp. cf. *C. diebeli* (Alberti) Lentin and Williams
Chatangiella biapertura (McIntyre) Lentin and Williams
Chatangiella decorosa (McIntyre) Lentin and Williams
Trithyrodinium suspectum (Manum and Cookson) Davey
Diconodinium sp.
Microdinium ornatum Cookson and Eisenack
Wallodinium anglicum (Cookson and Hughes) Lentin and Williams
Diconodinium arcticum Manum and Cookson
Membranosphaera maastrichtia Samoilovich ex Norris and Sarjeant
various dinoflagellate cysts, unidentified

Age: Late Campanian to Early Maastrichtian (=Division H3 of McIntyre, 1974).

East Fork Formation D.G. Cook	About 3 km south-southeast of southeastern extremity of Mahoney Lake on unnamed stream flowing into Brackett Lake; District of Mackenzie 65°20'40"N, 125°06'20"W; NTS 96F	C-30984 1974

deflandreoid cyst body (Type I)
deflandreoid? cyst body (Type I)
laciniadinioid cyst body (Type 3I3Pa)
trithyrodinioid cyst body (Type 3I)
Palaeohystrichophora infusorioides Deflandre

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
	Palaeotetradinium silicorum Deflandre *Palaeostromocystis laevigata* Drugg *Deflandrea* spp. (n. spp.) *Leptodinium delicatum* (Davey) Sarjeant** *Odontochitina costata* Alberti *Canningia ringnesii* Manum and Cookson *Deflandrea minor* Alberti *Hystrichosphaeridium cooksonae* Singh** *Hystrichosphaeridium difficile* Manum and Cookson *Wallodinium anglicum* (Cookson and Hughes) Lentin and Williams *Chatangiella granulifera* (Manum) Lentin and Williams *?Chatangiella biapertura* (McIntyre) Lentin and Williams *Palambages* spp. *Tenua* sp. *Fromea amphora* Cookson and Eisenack *Diconodinium articum* Manum and Cookson *Microdinium ornatum* Cookson and Eisenack *Dorocysta* n. sp. *Membranosphaera maastrichtia* Samoilovich ex Norris and Sarjeant *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich	

Note: ** Indicates species possibly derived from older Cretaceous rocks)

Age: Late Campanian-Early Maastrichtian (=H2 and H3 Divisions of McIntyre, 1974).

East Fork Formation D.G. Cook	Shale cobbles from bed of unnamed stream flowing into Kelly Lake about 4½ km north of Kelly Lake 65°27'N, 126°05'W; NTS 96E *Palambages* sp. *Isabelidinium amphiata* (McIntyre) Lentin and Williams *Cleistosphaeridium aciculare* Davey *Ginginodinium* sp. cf. *G. ornatum* (Felix and Burbridge) Lentin and Williams *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Isabelidinium cooksonae* (Alberti) Lentin and Williams *Palaeohystrichophora infusorioides* Deflandre *Wallodinium anglicum* (Cookson and Hughes) Lentin and Williams *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Spiniferites porosus* (Manum and Cookson) Harland *Odontochitina costata* Alberti	C-30985 1974

BY R.L. COX

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed volcanic shale H.R. Balkwill	Outcrop Grizzly Bear Mountain 65°32'N, 120°54'W; NTS 96H *Pterospermopsis* sp. *Cymatiosphaera* sp. *Baltisphaeridium* sp. *Deflandrea* sp. *Trithyrodinium* sp. *Microdinium* spp. *Wallodinium* sp. *Oligosphaeridium* sp. *Palambages* sp.	C-4301 1970

Age: Late Cretaceous.

Unnamed, sheared, bentonitic shale H.R. Balkwill	As above *Deflandrea diebelii* Alberti, 1961 *Deflandrea* sp. *Spinidinium* sp. *Hystrichosphaeridium* sp. *Scriniodinium* cf. *S. eurypylum* Manum and Cookson, 1964 *Scriniodinium* sp. *Microdinium* sp. *Gonyaulacysta* sp. *Cannosphaeropsis* sp. *Odontochitina* sp. *Spiniferites* sp. *Svalbardella* sp. *Aptea* sp. *Palaeoperidinium basilium* Drugg, 1967	C-4301 1970

Age: Late Campanian - Danian.

Comments: Both samples are from the same outcrop. Together they indicate an age no older than Late Campanian and no younger than Danian. A Maastrichtian age is strongly suggested. The two samples examined are of marine origin.

Stratigraphy and Collector	Locality, Microfossil Assemblage and Age	GSC Loc. No. and Report Year
	Canningia minor Cookson and Hughes *Chatangiella magna* (Davey) Lentin and Williams *Hystrichosphaeridium* sp. cf. *H. cooksonae* Singh *Canningia ringnesii* Manum and Cookson *Alterbia acuminata* Cookson and Eisenack *Chatangiella spectabilis* (Alberti) Lentin and Williams *Membranosphaera maastrichtia* Samoilovich ex Norris and Sarjeant	

Age: Late Campanian-Early Maastrichtian (= Divisions H2 and H3 of McIntyre, 1974).

Subsurface sandstone member	Candel Decking *et al.*, Tate J-65 well 64°24'39"N, 125°26'48"W; NTS 96C Depth 122 m	C-52553/400 1975
Subsurface sandstone member	As above Depth 213 m	C-52553/700 1975
Subsurface sandstone member	As above Depth 335 m	C-52553/1100 1975
Shale Member	As above Depth 488 m	C-52553/1600 1975
Shale Member	As above Depth 1097 m	C-52553/3600 1975
Little Bear Formation	As above Depth 1158 m	C-52553/3800 1975
Little Bear Formation	As above Depth 1250 m	C-52553/4100 1975
Slater River Formation	As above Depth 1493 m	C-52553/4900 1975
Slater River Formation	As above Depth 1646 m	C-52553/5400 1975

Comments: The three samples at the 122 m, 213 m and 335 m depth in the well are of *Maastrichtian age* and are dominated by angiosperm pollen. A few dinoflagellate species occur also. A coastal environment of deposition is suggested.

The sample at 488 m depth in the well yields the first influx of dinoflagellate species and indicates a change to marine conditions of deposition. The age of the sample is *Campanian, possibly Maastrichtian*.

The five samples taken between the depths of 1097 m and 1646 m in the well are considered to be *Campanian* in age. Domination of the assemblages by dinoflagellate cysts continues, suggesting a shallow marine sedimentary environment. The residue of the sample at 1646 m contains few palynomorphs, mainly dinoflagellates and a few deltoid trilete spores.

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BY W.S. HOPKINS, JR.

Stratigraphy and collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed volcanic shale H.R. Balkwill	Outcrop Grizzly Bear Mountain 65°32'N, 120°54'W; NTS 96H *Lycopodium* sp. *Araucariacites* sp. *Pinus* sp. *Podocarpus* sp. Cupressaceae (*Juniperus*?) *Alnus* sp. *Salix* sp. *Populus* sp. Ericaceae	C-4301 1976

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
	Compositae Gramineae Cyperaceae *Chenopodium* sp. *Ephedra* sp. *Quercus*-type	

Age: See "Comments".

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed Lignite H.R. Balkwill	As above Circular fungal spore *Lycopodium* spp. *Laevigatosporites* spp. Polypodiaceae-Dennstaedtiaceae, forms 1 and 2 (after Martin and Rouse) *Osmunda* sp. *Deltoidospora* sp. *Cyathidites* sp. *Sphagnum* spp. *Microreticulatisporites* sp. ?*Potamogeton* sp. ?*Typha* sp. Gramineae *Populus* sp. *Salix* sp. *Alnus* sp. Tricolpate, psilate Tricolporate, psilate Monocolpate *Pinus* sp. *haploxylon*-type *Taxodium-Metasequoia* sp.	C-4301 1976

Age: See "Comments".

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed sheared, bentonitic shale H.R. Balkwill	As above *Aquilapollenites* *Triprojectus magnus* Apparently reworked: a few Upper Cretaceous-Paleocene forms plus numerous Devonian and Mississippian spores. Also several tricolpate and triporate (*Corylus*?) pollen grains	C-4301 1976

Age: See "Comments".

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed shale interbedded with lignite H.R. Balkwill	As above *Laevigatosporites* sp. Polypodiaceae-Dennstaedtiaceae, forms 1, 2 and 3 (after Martin and Rouse) Reticulate monolete spores (probably from family Polypodiaceae) *Lycopodium* spp. *Schizaea* sp. ?*Schizosporis* sp. *Liliacidites* sp. Cupressaceae (*Juniperus*?) Taxaceae (*Taxus*?) *Taxodium-Metasequioa* sp. ?*Tsuga* sp. *Podocarpus* sp. Gramineae ?*Typha* sp. *Salix* sp. ?*Corylus* sp. ?*Betula* sp. *Alnus* sp. *Quercus*-type	C-4301 1976

Comments: Because these four samples represent interbedded lithologies at the same location they are discussed here as a group. Considerable age confusion exists in these samples because of the range in age of the various forms encountered.

The volcanic shale contains numberous "modern looking" pollen grains including representatives of the Compositae which do not make their appearance in the pollen record until the Miocene. Modern looking grass and sedge pollen is also abundant. Also pollen of the more temperate angiosperms, a characteristic component of most Tertiary microfloras, is completely lacking. My first inclination was to consider this Miocene, Pliocene or even Pleistocene.

The other three samples tend to refute this however, in that several Maastrichtian-Paleocene forms (*Aquilapollenites, Schizaea, Schizosporis,* and *Araucariacites*) are also present. In addition the sheared bentonitic shale contains a moderately abundant Devonian and Mississippian flora as well as Upper Cretaceous-Paleocene pollen and spores. In short, taken as a group, the samples are characterized by palynomorphs indicative of Devonian-Mississippian, Upper Senonian-Paleocene and Miocene-Pliocene-Pleistocene.

H. Balkwill, the collector, feels that a Miocene to Pleistocene age for the deposits is incompatible with the geology of the area. Furthermore, the lignite simply does not look that young. Also, in the sheared bentonitic shale lithology I found *Aquilapollenites* and a species of *Triprojectus magnus*, the latter being apparently restricted to Upper Campanian-Middle Maastrichtian rocks. This would be compatable with the rest of the microflora, therefore I feel an age of Upper Campanian-Middle Maastrichtian is most likely for this rock unit.

BY J.H. WALL

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata J.D. Aitken	Outcrop Kokeragi Point, Deerpass Bay, Great Bear Lake 65°46'N, 122°23'W; NTS 96G Radiolaria *Melitosphaera (Melitosphaera)* sp. ?*Cenosphaera (Cenosphaera)* sp. *Spongodiscus (Spongodiscus)* spp. *Spongaster* or *Crucella* sp. *Dictyomitra multicostata* Zittel	C-2566 1977

Age: Late Cretaceous, probably late Campanian, but possibly younger. Assemblage is very similar to that in 68MQ113 at 0-1 m (C-4291), described elsewhere in this report. The form identified as *Spongaster* or *Crucella* in this sample is basically the same as the *Spongasteriscus* in C-4291, except for the presence of a patagium which is only incipiently developed in the latter.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	Measured section, 0-1 m from base North shore Smith Arm, Great Bear Lake 66°28'N, 123°40'W; NTS 96J Radiolaria *Melitosphaera (Melitosphaera)* sp. ?*Cenosphaera (Cenosphaera)* sp. *Spongurus (Spongurantha)* sp. A of Bergquist, 1966 *Spongodiscus (Spongodiscus)* sp. *Spongasteriscus (Spongasteriscinus)* sp. *Dictyomitra multicostata* Zittel	C-4291 1977

Age: Late Cretaceous, probably late Campanian, but possibly younger.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 6 m from base Radiolaria *Melitosphaera (Melitosphaera)* sp. ?*Cenosphaera (Cenosphaera)* sp. *Spongurus (Spongurantha)* sp. A of Bergquist, 1966 *Spongodiscus (Spongodiscus)* sp.	C-4292 1977

Age: As for previous sample.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 11 m from base Radiolaria ?*Cenosphaera (Cenosphaera)* sp. indeterminate spongodiscids	C-4293 1977

Age: Assumed same as for previous samples.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 17 m from base Radiolaria (sparse) *Melitosphaera (Melitosphaera)* sp. ?*Cenosphaera (Cenosphaera)* sp. *Spongodiscus (Spongodiscus)* sp.	C-4294 1977

Age: Assumed same as for previous samples.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 21 m from base Radiolaria *Melitosphaera (Melitosphaera)* spp. *Spongodiscus (Spongodiscus)* sp. cf. *S. (S.) renillaeformis* Campbell and Clark *S. (S.)* sp. *Sethocyrtis* sp. of Wall, 1975 *Dictyomitra (Dictyomitrella)* sp. one specimen	C-4295 1977

Age: Late Cretaceous, probably late Campanian, but possibly younger.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 26 m from base Radiolaria *Spongodiscus (Spongodiscus)* sp.	C-4296 1977

Age: Assumed same as for previous samples.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 29 m from base Radiolaria ?*Cenosphaera (Cenosphaera)* sp. *Spongodiscus (Spongodiscus)* sp. cf. *S. (S.) renillaeformis* Campbell and Clark *S. (S.)* spp. *Sethocyrtis* sp. of Wall, 1975 ?*Dictyomitra (Dictyomitrella)* sp. of Wall, 1975	C-4297 1977

Age: Late Cretaceous, probably late Campanian, but possibly younger.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 35 m from base Radiolaria *Melitosphaera* (*Melitosphaera*) spp. ?*Cenosphaera* (*Cenosphaera*) sp. *Spongurus* (*Spongurantha*) sp. A of Bergquist, 1966 *Spongodiscus* (*Spongodiscus*) sp. cf. *S.* (*S.*) *renillaeformis* Campbell and Clark *S.* (*S.*) sp. *Sethocyrtis* sp. of Wall, 1975 ?*Dictyomitra* (*Dictyomitrella*) sp. of Wall, 1975	C-4298 1977

Age: As for previous sample.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 40 m from base Radiolaria *Melitosphaera* spp. *Spongodiscus* (*Spongodiscus*) sp. cf. *S.* (*S.*) *renillaeformis* Campbell and Clark *S.* (*S.*) sp. *Dictyocephalus macrostoma* Rust(?) - one specimen ?*Dictyomitra* (*Dictyomitrella*) sp. of Wall, 1975	C-4299 1977

Age: As for previous sample.

Stratigraphy and Collector	Locality, Fauna and Age	GSC Loc. No. and Report Year
Unnamed strata R.W. Macqueen	As above, 43 m from base Radiolaria *Spongodiscus* (*Spongodiscus*) spp.	C-4300 1977

Age: Late Cretaceous, as for previous sample.

Comments: The interpretation of a probably late Campanian age and possibly younger is based on general similarity of the radiolarian assemblages to those from:

(1) The lower part of the Sentinel Hill Member and the upper part of the Barrow Trail Member of the Schrader Bluff Formation of northern Alaska, considered middle Senonian by Bergquist (1966).

(2) An unnamed shale unit in the Buffalo Head Hills of north-central Alberta, considered to be most probably Campanian in age by Wall and Singh (1975).

(3) The Bearpaw Formation of southern Alberta which is of late Campanian age.

(4) Various spot samples of the Kanguk and Eureka Sound Formations in the Arctic Islands of probable Campanian to Maastrichtian age.

The radiolarian-bearing samples are all devoid of foraminifers, possibly indicating deposition in a moderately deep, offshore environment. An alternative explanation is that foraminifers, which would suggest shallower water conditions, may have been part of the original assemblage but have been subsequently destroyed through post-depositional leaching. Large numbers of radiolarians are sometimes present along with foraminifers in the Bearpaw Formation of southern Alberta, where the environment is considered to have been relatively shallow within the shelf zone.

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Chamney, T.P.
1969: Micropaleontology report on 21 lots of samples from Smith Arm and Keith Arm, Great Bear Lake, District of Mackenzie, collected by R.W. Macqueen for Operation Norman mapping, study requested by D.G. Cook; Geol. Surv. Can., Internal Service Report No. Mes. 1, TPC, 1969.

1969b: Preliminary report on 11 lots of Cretaceous samples collected by Dr. J.D. Aitken on Operation Norman, Great Bear Lake area, District of Mackenzie in 1968 and requested for age and correlation by Dr. D.G. Cook, November 1969; Geol. Surv. Can., Internal Service Report No. Mes. 2, TPC, 1969.

Sweet, A.R.
1976: Report on megaspore and miospore content of 1 sample from Tuitatui Lake (65°48'N, 122°09'W) as requested by D.G. Cook; Geol. Surv. Can., Internal Service Report No. AS-1976-4.

Wall, J.H.
1975: Diatoms and radiolarians from the Cretaceous of Alberta - a preliminary report *in* Caldwell, W.G.E., ed., "The Cretaceous System in the Western Interior of North America - Selected Aspects"; Geol. Assoc. Can., Spec. Paper 13, p. 391-410.

Wall, J.H. and Singh, C.
1975: A Late Cretaceous microfossil assemblage from the Buffalo Head Hills, north-central Alberta; Can. J. Earth Sci., v. 12, no. 7, p. 1157-1174.

Appendix IIf

Maastrichtian to Tertiary Fossils

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, palynologic Assemblage and Age	GSC Loc. No. and Report Year
Summit Creek Formation B. Groeneweg and P. Monahan, Aquitaine Company of Canada Ltd.	Near the top of a 37 m thick section north of Police Island, 19 km east of Fort Norman, upstream on the Mackenzie River 64°53'N, 125°13'W; NTS 96C Various trilete spores (common) various bisaccate grains (dominant) *Sequoiapollenites* sp. *Taxodiaceaepollenites hiatus* (Pot.) Thoms. and Pflug *Corylus* sp. *Alnipollenites* sp. *Betulaceoipollenites* spp.	C-16889 1972

Age: Cenozoic, Tertiary, Paleocene, possibly early Paleocene.

Stratigraphy and Collector	Locality, palynologic Assemblage and Age	GSC Loc. No. and Report Year
Summit Creek Formation B. Groeneweg and P. Monahan, Aquitaine Company of Canada Ltd.	As above, intermediate position in section, but higher than C-16891 Derived Carboniferous spores Derived Upper Permian-Lower Triassic bisaccate grains (rare) Derived Lower Cretaceous dinoflagellate cysts various trilete spores various bisaccate grains *Azolla* sp. *Wodehouseia spinata* Stanley *Aquilapollenites* spp. *Paraalnipollenites confusus* (Zaklinskaya) Hills and Wallace *Cranwellia* sp. *Tricolporites* sp.	C-16890 1972

Age: Mesozoic, Cretaceous, Late Cretaceous, Maastrichtian, probably late Maastrichtian.

Stratigraphy and Collector	Locality, palynologic Assemblage and Age	GSC Loc. No. and Report Year
Summit Creek Formation B. Groeneweg and P. Monahan, Aquitaine Company of Canada Ltd.	As above, intermediate position in section, but below C-16890 Derived Lower Cretaceous dinoflagellate cysts (common) Derived Carboniferous spores (common) Derived Upper Permian-Lower Triassic bisaccate pollen grains (rare) various trilete spores various bisaccate grains *Aquilapollenites* spp. *Wodehouseia spinata* Stanley *Cranwellia edmontonensis* Srivastava *Paraalnipollenites confusus* (Zaklinskaya) Hills and Wallace *Triporopollenites* sp. AA *Tricolporites* sp.	C-16891 1972

Age: Mesozoic, Cretaceous, Late Cretaceous Maastrichtian, probably Late Maastrichtian.

Stratigraphy and Collector	Locality, palynologic Assemblage and Age	GSC Loc. No. and Report Year
Summit Creek Formation B. Groeneweg and P. Monahan, Aquitaine Company of Canada Ltd.	As above, bottom sample *Podocarpidites* spp. *Pinuspollenites* spp. *Alisporites grandis* (Cookson) Dettmann abundant plant cuticle and tracheids various trilete spores *Laevigatosporites ovatus* Wilson and Webster *Polypodiisporites* spp. *Paraalnipollenites confusus* (Zaklinskaya) Hills and Wallace *Triporopollenites* sp. AA	C-16892 1972

Age: Mesozoic, Cretaceous, Late Cretaceous, probably Maastrichtian.

Comments on North Police Island Samples:

The disappearance of the several angiosperm pollen species between Samples C-16889 and C-16890 of this 37 m section, and the appearance in Samples C-16890 and C-16891 of a variety of Late Cretaceous species, suggests that the section contains the Maastrichtian-Paleocene contact. It is of interest to note that *Triporopollenites* sp. AA. and *Paraalnipollenites confusus* (= *Betulaceoipollenites* sp. AA.) of other reports, occur in these Maastrichtian rocks, and occur also in strata of probably Maastrichtian age of the Moose Channel Formation.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year

Derived material is common in Sample C-16890 and abundant in Sample C-16891. The derived material indicates that strata of Carboniferous, Late Permian-Early Triassic and Early Cretaceous age, were exposed during the time of deposition of this material. The absence of *in situ* dinoflagellates, abundance of trilete spores and the derived material, indicate that the environment of deposition was probably continental.

Sample C-16892 is dominantly comprised of coal. This is reflected in the dominance of pteridophyte spores (both trilete and monolete) and the abundant conifer pollen and lack of exotic angiosperm forms (e.g. *Cranwellia*, *Wodehouseia*). The small diversity of the assemblage is typical of this type of autochthonous sedimentary environment (non-marine, probable swamp).

Summit Creek Formation — Department of Public Works Borehole, NW of Fort Norman, 64°55'50"N, 125°37'30"W; NTS 96C — C-39597, 1975

Laevigatosporites ovatus Wilson and Webster
Sigmopollis hispidus Hedlund
Tricolpites mutabilis Leffingwell
Liliacidites vareigatus Couper
Sequoiapollenites paleocenicus Stanley
Tricolpites hians Stanley sensu Elsik
Wodehouseia spinata Stanley
Retitricolporopollenites sp.
Aquilapollenites spp.
Extratriporopollenites spp.
Betulaceoipollenites sp.
Retitricolpites spp.
Phyllocladidites sp.
Cranwellia sp.
Striatopollis sp.
Radialisporis sp.
Ulmipollenites sp.
Verrutricolpites sp.
Granatriporites sp.
Zlivisporis sp.
Spiniferites sp.*
Hystrichokolpoma sp.*
Deflandrea sp.*
Apectodinium homomorphum * (Deflandre and Cookson) Lentin and Williams
derived Cretaceous dinoflagellates
derived Cretaceous spores
derived Paleozoic spores
(*) dinoflagellate species

Age: Tertiary, late Paleocene to (?) middle Eocene.

Summit Creek Formation, C.J. Yorath — Measured section, 135 m from base of Summit Creek Formation, 64°29'N; 125°33'W; NTS 97C — C-41896, 1975

Polycingulatisporites reduncus (Bolkovitina) (Playford and Dettmann)
Stereisporites antiquasporites (Wilson and Webster) Dettmann
Tricolpites mutabilis Leffingwell
Corylus sp.
Betulaceoipollenites sp.
tricolpate/tricolporate pollen unidentified

Age: Tertiary, probably Paleocene.

Summit Creek Formation, C.J. Yorath — Measured section, 250 m from base of Summit Creek Formation, 64°28'N; 125°40'W; NTS 97C — C-41897, 1975

abundant plant material (cuticle and woody cell fragments)
pinaceous pollen
Paraalnipollenites sp.
Deltoidospora sp.
Taxodiaceaepollenites sp.
Laevigatosporites ovatus Wilson and Webster
Triporopollenites sp.
Podocarpidites sp.

Age: Tertiary, probably Paleocene. This type of residue, dominated by taxodiaceous pollen and abundant plant material, is quite distinctive, and may reflect a period of relatively recent natural oxidation.

BY A.R. SWEET

Stratigraphy and Collector	Locality, Megaspores and Age	GSC Loc. No. and Report Year

Unnamed strata, J.D. Aitken — Outcrop near Kokeragi Point, 65°48'N, 122°09'W; NTS 96G — C-2567, 1976

Balmeisporites canadensis Srivastava and Binda emend. Bergad 1973
Azolla schopfii Dijkstra 1961
Azolla velus (Dijkstra) Hall 1969
seed cases (*Spermatites* spp.)

Miospores
For the miospore preparation the sample was split into a coal and a clastic fraction.
The coal fraction yielded only:
Taxodiaceous pollen (abundant)
Laevigatosporites spp. (common)
Bisaccate pollen (common)
Deltoidospora sp. (scarce)
Osmundacidites sp. (rare)
Sphagnum sp. (rare)
Kurtzipites sp. (rare)

The clastic fraction yielded, in addition to the above:
Aquilapollenites magnus Mchedlishvilli 1961
A. quadricretaceus Chlonova 1961
A. attenuatus Funkhouser 1961
A. trialatus Rouse 1957
Mancicorpus senonicus Mchedlishvilli 1961
Wodehouseia spinata Stanley 1961
Cupanieidites speciosus Stanley 1965
Trialapollis scabratus Stanley 1965
Ulmipollenites verrucatus Norton and Hall 1969
Proteacidites sp.
?Paraalnipollenites sp.
Cingulatisporites dakotaensis Stanley 1965
Miscellaneous tricolpate, tricolporate and triporate forms.

Age: *Azolla schopfii* is known from the Paleocene of Europe, mid-western United States, Saskatchewan, and Alberta. *Azolla barbata* Sneed 1969 can be demonstrated to have evolved directly into *A. schopfii* during uppermost Maastrichtian time such that the Paleocene specimens belonging to this complex can be identified as classical *A. schopfii* (unpublished data). In the lower Paleocene *A. schopfii* is commonly found in assocation with *A. velus* whereas higher in the Paleocene, if it occurs, it is in association with *A. stanleyi* Jain and Hall, 1969. *Balmeisporites canadensis* is known only from the Maastrichtian of west-central North America.

Of the species of miospores present *Aquilapollenites trialatus* is restricted to the Campanian, in both Alaska and mid-continental North America; *A. attenuatus* and *Mancicorpus senonicus* range from Campanian to Maastrichtian; *Aquilapollenites quadricretaceus* from Maastrichtian to Danian (lower Paleocene) in the USSR although in Saskatchewan it is restricted to the Maastrichtian; *A. magnus* and *Wodehouseia spinata* from Maastrichtian to Paleocene; and *Cingulatisporites dakotaensis* and *Paraalinipollenites* from uppermost Maastrichtian to Paleocene.

The presence of several species known only from Maastrichtian or younger strata excludes a Campanian age. Hence *Aquilapollenites trialatus* may indicate a reworked Campanian component in this assemblage. The other species present with a Campanian to Maastrichtian age range might also be part of this component. As no miospores definitive of a Paleocene age occur, to explain the concurrent occurrence of the Maastrichtian species *Balmeisporites canadensis* and *Azolla schopfii* a very uppermost Maastrichtian age for this sample appears most probable (i.e. a time at which *Azolla schopfii* has evolved but residual elements of a Maastrichtian flora are still present). In Saskatchewan this time interval has been recognized and the contained flora arbitrarly labeled Maastrichtian-transition.

An alternate explanation, based on the lack of any species definitive of Maastrichtian in the coal fraction, would be to interpret the entire Upper Cretaceous component of the assemblage in the clastic fraction as reworked and consider the age of the sample to be Early Paleocene based on the occurrence of *Azolla schopfii*. Unfortunately without additional samples from stratigraphically higher and lower horizons this possibility cannot be tested. Hence, as the first alternative is compatible with the observed species it is favored at this time.

Unnamed strata, J.D. Aitken — Outcrop, north side of Deerpass Bay, 65°57'N, 121°53'W; NTS 96H — C-2568, 1977

The sample bag bearing this number contains a mixture of fine coaly material, pieces of carbonized wood and a few small pieces of coaly shale (missed on the initial examination of the sample). After 4 separate attempts to recover miospores from the fine coaly material it was concluded that the sample was barren of palynomorphs with the exception of rare bisaccate pollen grains. However on reexamination of the sample pieces of coaly shale were identified (about 1% of total sample). The following assemblage was recovered from the coaly shale:

Paraalnipollenites alterniporus (Simpson) Srivastava 1975 (common)
Ulmipollenites sp. (rugulate, scarce)
Ulmipollenites sp. (4 to 6 pores, scarce)
Pterocarya sp. (rare)
Carya sp. (rare)
Hazaria sheopiarii Srivastava 1971
Ericaceae pollen (common)
Laevigatosporites sp. (scarce)
Taxodiaceaous pollen (scarce)
Bisaccate pollen (rare)
Miscellaneous triporate pollen

Age: Based on the combined presence of *Paraalnipollenites*, *Ulmipollenites*, *Pterocarya* and *Hazaria sheopiarii* and *Carya*, and the absence of any Maastrichtian elements, the sample is concluded to be post Cretaceous in age. As the *Pterocarya* and *Carya* are of a 'primitive' aspect and other forms characteristic of the Eocene such as *Tilia* are absent a Paleocene age is favoured for the sample.

Stratigraphy and Collector	Locality, Palynomorphs and Age	GSC Loc. No. and Report Year
Tertiary coal R.W. Lake Arctic Railway Study	West bank of Mackenzie River south of Police Island 64°45'N, 125°07'W; NTS 96C *Alnipollenites verus* Potonié 1931 *Paraalnipollenites confusus* (Zaklinskaia) Hills and Wallace 1969 *Maceopolipollenites amplus* Leffingwell 1969	C-29068 1973

Age: Paleocene.

Stratigraphy and Collector	Locality, Palynomorphs and Age	GSC Loc. No. and Report Year
Tertiary coal R.W. Lake Arctic Railway Study	As above *Alnipollenites verus* Potonié 1931 *Paraalnipollenites confusus* (Zaklinskaia) Hills and Wallace 1969 *Insulapollenites rugulatus* Leffingwell 1966 *Erdtmanipollis procumbentiformis* (Samoilovitch) Krutzsch 1966	C-29069 1973

Age: Paleocene.

Stratigraphy and Collector	Locality, Palynomorphs and Age	GSC Loc. No. and Report Year
Tertiary coal R.W. Lake Arctic Railway Study	As above *Alnipollenites verus* Potonié 1931 *Paraalnipollenites confusus* (Zaklinskaia) Hills and Wallace 1969 *Insulapollenites rugulatus* Leffingwell 1966 *Erdtmanipollis procumbentiformis* (Samoilovitch) Krutzsch 1966	C-29070 1973

Age: Paleocene.

Comments: Because of the presence of *Insulapollenites rugulatus*, coal samples C-29069 and C-29070 can probably be considered age equivalent to the upper coals in the Estevan area of Saskatchewan and to Leffingwell's (1970) Assemblage C which was described from the upper part of the Fort Union Formation in Wyoming.

REFERENCE

Leffingwell,
1970: Palynology of the Lance (Late Cretaceous) and Fort Union (Paleocene) Formation of the type Lance area, Wyoming: Geol. Soc. Am. Spec. Paper 127, p. 1-64.

Appendix IIg

Miscellaneous Fossil Report

BY W.W. BRIDEAUX

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Arctic Red Formation C.J. Yorath	Outcrop, Imperial River 65°07'N, 127°44'W; NTS 96E bisaccate pollen derived Triassic pollen derived Devonian spores derived Carboniferous spores *Psaligonyaulax dualis* Brideaux and Fisher* *Pareodinia borealis* Brideaux and Fisher* *Scriniodinium crystallinum* Deflandre* *Gonyaulacysta jurassica* (Deflandre) Dodekova* *Pareodinia capillosa* Brideaux and Fisher* *Pterodinium* sp. *Gonyaulacysta* sp. *Cribroperidinium orthoceras* (Eisenack) Davey *Spiniferites cingulatus* (O. Wetzel) Sarjeant *Sirmiodinium grossii* Alberti** *Pareodinia* n. sp. *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Palaeostomocystis triquetra* Brideaux** *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Dictyopyxidia imperfecta* Brideaux and McIntyre "*Kalyptea monoceras*" Cookson and Eisenack *Oligosphaeridium complex* (White) Davey and Williams *Appendicisporites potomacensis* Brenner *Plicatella abaca* (Burger) Norris** *Cicatricosiporites* sp. cf. *C. angicanalis* Burger** *Cicatricosisporites potomacensis* Brenner *Cicatricosisporites rotundus* Brenner *Cicatricosisporites* sp. cf. *C. cuneiformis* Pocock various trilete spores *Callialasporites* spp. *Alisporites grandis* (Balme) Dettmann [*derived Jurassic (U. Oxfordian-U. Tithonian) dinoflagellates]	C-33956 1975

Age: Early Cretaceous, possibly Hauterivian to Barremian, but most probably as young as Albian.

NOTE: The writers, Yorath and Cook, consider taxa marked (**) to be reworked from older beds; otherwise a substantial fault, for which no other evidence has been observed, must be interpreted in the section. W.W. Brideaux (pers. comm., 1978) concurs that this is the most logical interpretation, barring contamination.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Little Bear Formation?	Candel Fort Norman K-14 well 61 m depth 64°53'42"N, 125°18'08"W; NTS 96C *Oligosphaeridium anthophorum* (Cookson and Eisenack) Davey *Oligosphaeridium complex* (White) Davey and Williams *Coronifera oceanica* Cookson and Eisenack *Palaeoperidinium cretaceum* (Pocock ex Davey) Lentin and Williams *Aptea eisenackii* (Davey) Davey *Cyclonephelium compactum* Deflandre and Cookson *Cribroperidinium intricatum* Davey *Canningia minor* Cookson and Hughes *Fromea amphora* Cookson and Eisenack *Cleistosphaeridium araneosum* Brideaux *Cleistosphaeridium multispinosum* (Singh) Brideaux *Senoniasphaera microreticulata* Brideaux and McIntyre *Gonyaulacysta obesa* Brideaux *Baltisphaeridium admixtum* Brideaux *Odontochitina operculata* (O. Wetzel) Deflandre and Cookson *Scriniodinium rostratum* Brideaux and McIntyre *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Exochosphaeridium phragmites* Davey, Downie, Sarjeant and Williams *Hystrichosphaeridium cooksonae* Singh *Luxadinium propatulum* Brideaux and McIntyre *Endoscrinium campanula* (Gocht) Vozzhennikova derived Devonian spores caved Upper Cretaceous pollen caved Upper Cretaceous dinoflagellates various trilete spores	C-48826/200 1975

Age: Early Cretaceous, Middle to? Late Albian.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
	As above Depth 152 m *Cranwellia* sp. *Tricolporites* sp. *Aquilapollenites* sp. *Diconodinium* sp.	C-48826/500 1975

Age: The age of the assemblage, which is interpreted as caved, is Campanian-Maastrichtian. This sample apparently yielded no indigenous material.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
	As above Depth 274 m *Oligosphaeridium asterigerum* (Gocht) Davey and Williams *Senoniasphaera microreticulata* Brideaux and McIntyre caved Upper Cretaceous pollen	C-48826/900 1975

Age: Early Cretaceous, probably Albian, but possibly as old as Barremian.

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
	As above, Depth 427 m	C-48826/1400 1975

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
	Palaeoperidinium cretaceum (Pocock ex Davey) Lentin and Williams *Cribroperidinium* sp. *Oligosphaeridium pulcherrimum* (Deflandre and Cookson) Davey and Williams *Caligodinium aceras* (Manum and Cookson) Lentin and Williams derived Carboniferous spores caved Upper Cretaceous dinoflagellates caved Upper Cretaceous pollen	

Age: Early Cretaceous, Hauterivian to Albian.

	As above Depth 671 m	C-48826/2200 1975
	Pseudoceratium retusum (Brideaux) *Caligodinium aceras* (Manum and Cookson) Lentin and Williams *Cyclonephelium distinctum* Deflandre and Cookson *Exochosphaeridium phragmites* Davey, Downie, Sarjeant and Williams *Cyclonephelium* sp. cf. *C. vannophorum* Davey *Spiniferites ramosus* (Ehrenberg) Loeblich and Loeblich *Palaeostomocystis fragilis* Cookson and Eisenack caved Upper Cretaceous dinoflagellates caved Upper Cretaceous pollen	

Age: Early Cretaceous, Barremian to Albian.

Comments: The sample at 61 m depth in the well yields a diverse middle to ?late Albian assemblage of dinoflagellates. Other samples at 274 m, 427 m and 671 m yield less diverse assemblages of Early Cretaceous age. All of the samples yield Upper Cretaceous pollen and several contain assemblages of Upper Cretaceous dinoflagellates, particularly the sample at 671 m depth in the well. One sample, at 152 m depth in the well, contains only Upper Cretaceous pollen. These Upper Cretaceous assemblages are interpreted as being caved material. The presence of this caved assemblage indicates the presence, at some interval above 61 m depth in the well, of strata of Campanian to Maastrichtian age.

BY W.S. HOPKINS, JR.

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year
Unnamed liminite cemented conglomerate D.G. Cook	Maunoir Ridge 67°08'N, 125°06'W;	C-4318 1969
	Gleicheniidites cf. *G. senonicus* Ross *Pinus* sp. *haploxylon*-type	

Age: Probably Mesozoic.

Comments: Assuming that the *Gleicheniidites spores* are indigenous to the rock, they would suggest an age of Jurassic or Cretaceous for the samples.

		GSC Plant Loc. No. and Report Year
Unnamed strata S.L. Blusson	Northeast Sekwi Map-area NTS 105P 13 km north of June Lake, at peak 7548	7969 1971, 1977
	Septate fungal spores *Triletes* sp. cf. *Gleicheniidites* sp. ?*Sphagnumsporites* sp. ?Bisaccate pollen grain ?*Tricolpites* sp.	

Age: Cretaceous, See "comments".

Unnamed strata S.L. Blusson	Same locality as sample above but 37 m higher in section	7970 1971, 1977
	Septate fungal spores cf. *Gleicheniidites* sp. ?Bisaccate pollen grain *Monocolpites* sp.	

Age: Cretaceous, See "comments".

Comment #1: This report should be read in conjunction with that of D.C. McGregor, (this appendix).

It was originally suggested by the collector that these rocks were Devonian in age. McGregor felt they were more probably Cretaceous on the basis of poorly preserved megafossil plant compressions and on several spore types. Samples and slides were sent to me; whereupon I re-macerated the material. Little can be added to what McGregor has already said, i.e. on the basis of the plant megafossils and on the very rare and poorly preserved palynomorphs, the rock is no older than Cretaceous.

I will add that the septate fungal spores and the very doubtfully identified tricolpate grain, suggest an Upper Cretaceous age.

Stratigraphy and Collector	Locality, Flora and Age	GSC Loc. No. and Report Year

Comment #2: Because the above results were inconclusive the residues were reprocessed in 1977 using more sophisticated techniques.

Unfortunately the carbonization level of the kerogen is comparatively high, and the palynomorphs are nearly unrecognizable. However, on the second reprocessing we found a probable proteaceous grain which would tend to confirm the Upper Cretaceous age previously assigned. In fact, the samples would appear to be Upper Cretaceous but with the information available I cannot be more specific.

BY D.C. MCGREGOR

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Plant Loc. No. and Report Year
Unnamed strata S.L. Blusson	Northeast Sekwi Map-area, (NTS 105P) 13 km north of June Lake at peak 7548	7969 1969

Remarks: Spores are present in this sample, and sufficiently well preserved to show that the age is not Devonian, but is probably Cretaceous. Megafossil plant compressions suggestive of *Cladophlebis* and *Athrotaxites* support this age assignment (*see also* W.S. Hopkins, elsewhere, this appendix).

Unnamed strata S.L. Blusson	As above, 37 m above G.S.C. Loc. No. 7969	7970 1969

Remarks: There are few palynomorphs in this sample, and they are rather highly carbonized. However, they are sufficient to indicate that the sample is not Devonian and is probably no older than Early Cretaceous. *Cicatricosisporites* sp., ?*Gleicheniidites* sp., and septate fungal spores are present.

I suggest Late Cretaceous age, but only tentatively (*see also* W.S. Hopkins, elsewhere, this appendix).

BY S.A. PICKERING

Stratigraphy and Collector	Locality, Palynologic Assemblage and Age	GSC Loc. No. and Report Year
Sans Sault Formation C.J. Yorath	Type section of Sans Sault Formation near Sans Sault Rapids 65°42'N, 128°47'W; NTS 106H	1978
	0-6 m above base	C-9301
	6-13 m above base	C-9302
	13-18 m above base	C-9303
	18-24 m above base	C-9304
	30-41 m above base	C-9306
	41-49 m above base	C-9307
	49-78 m above base	C-9308
	78 m above base	C-9309
	197-209 m above base	C-9310
	213-219 m above base	C-9312
	244-258 m above base	C-9313
	334-341 m above base	C-9314
	341-347 m above base	C-9315
	347-354 m above base	C-9316
	354-360 m above base	C-9317
	360-365 m above base	C-9319
	366-375 m above base	C-9320
	378-396 m above base	C-9321

Comments: This is a report on reworked fossil material present in 18 field samples. Cretaceous palynomorphs from the same samples have been reported by W.S. Hopkins [*see* appendix 2(b)].

These eighteen samples contained a substantial number of reworked palynomorphs, exhibiting poor preservation and high carbonization characteristics. Because the contained palynomorphs are essentially the same in all samples, I have presented a composite microfloral listing rather than itemizing individual samples.

Vittatina, Protohaploxypinus, Lueckisporites, Florinites, Triquitrites, Tripartites, Raistricka

Following is a summary range chart showing minimum ranges of these palynomorphs, which are identified to the generic level:

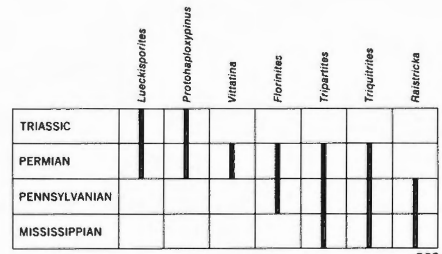

Figure 1. Summary Range Chart

From the above assemblage it is reasonable to conclude that reworked Carboniferous, Permian and Triassic(?) palynomorphs are present in the 18 samples. The Triassic is questionable as only fossil grains ranging into the Triassic were present, while those usually found restricted to the Triassic were not present.